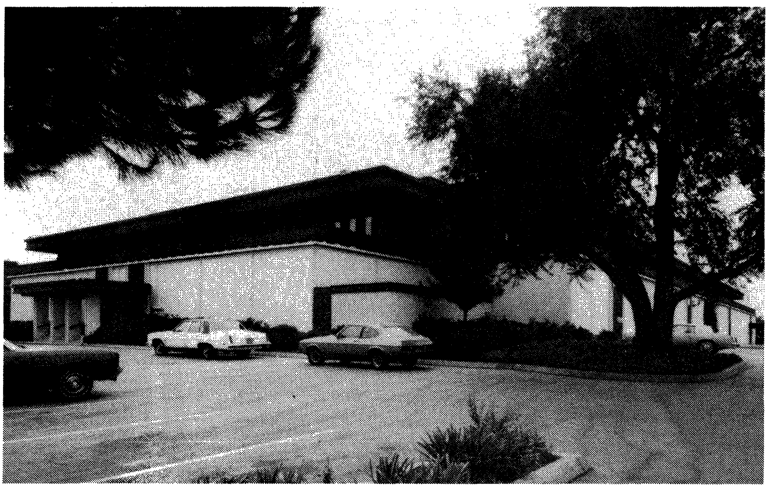
OPTOELECTRONICS CATALOG 1982

Litronix A Siemens Company

Litronix A Siemens Company

OPTOELECTRONICS CATALOG 1982

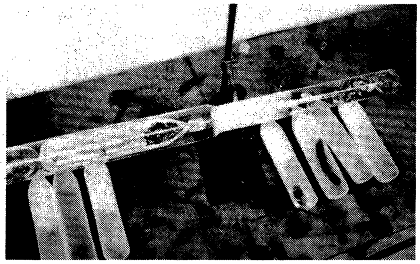
Litronix, Inc., 19000 Homestead Road, Cupertino, California 95014 • Telephone (408) 257-7910 / TWX 910-338-0022



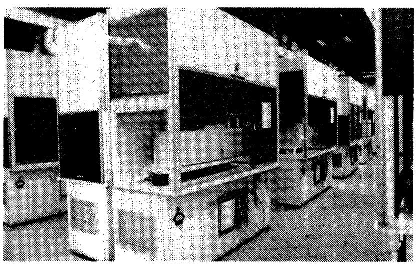
Headquartered in Cupertino, California, Litronix designs, manufactures and markets optoelectronic components and related products worldwide.

PRODUCTION PROFILE

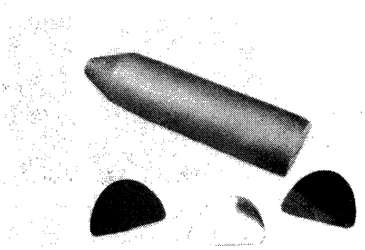
LED PRODUCTION



LED (light emitting diode) production, at the Cupertino facility, begins with ultra pure gallium and arsenic contained within a quartz boat (ampoule).

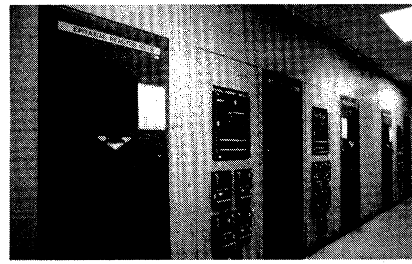


Ampoules are processed through a furnace.

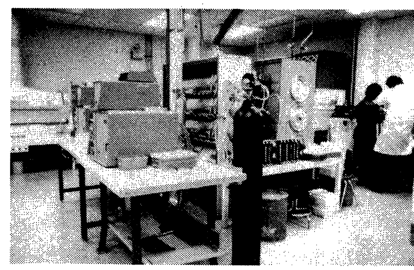


The resulting GaAs (gallium arsenide) ingot is sawed into wafers.

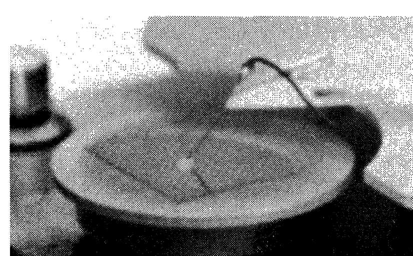
Wafers are lapped and polished to a mirror finish.



Polished wafers are put through EPI (epitaxial) reactors for vapor-phase epitaxial growth. The thin EPI layer is doped with phosphine to form a GaAsP (gallium arsenide phosphide) layer.

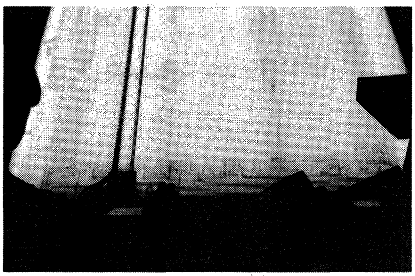


Next, the material passes through the photo masking and diffusion area. Patterns are etched through a masking silicon-nitride layer. Then a thin layer of zinc is diffused into the material through the mask patterns and front and backside metals are evaporated on the wafer for electrical contact.

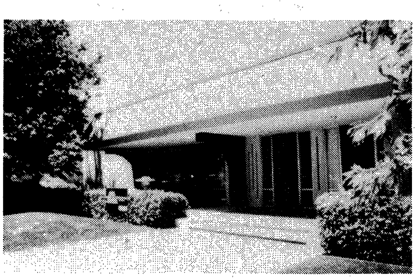


Finished wafers are shipped to one of Litronix' offshore production plants for scribing and breaking into individual LED chips (sometimes known as die) for assembly into finished products.

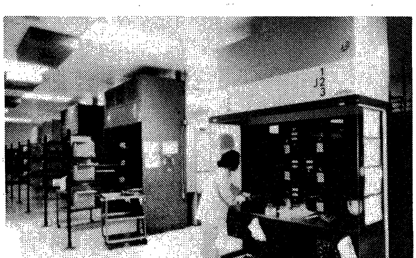
INTEGRATED CIRCUIT PRODUCTION



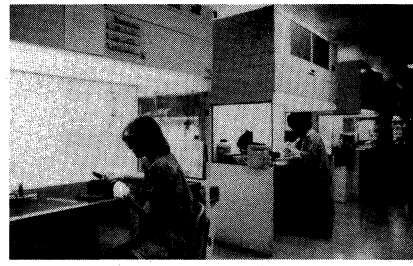
CMOS, NMOS and PMOS LSI (large scale integration) circuits and bi-polar circuits are designed for a wide variety of applications.



Litronix produces silicon integrated circuits at a wafer fabrication facility located in Sunnyvale, California.



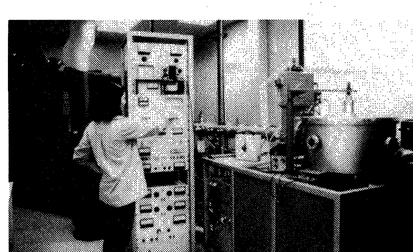
Oxidation of silicon wafers in a furnace.



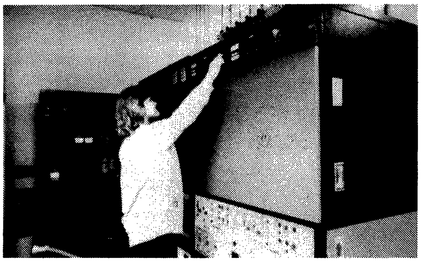
Diffusion: (thermally adding dopant).

Masking for circuit patterns, typically 8 masks per wafer.

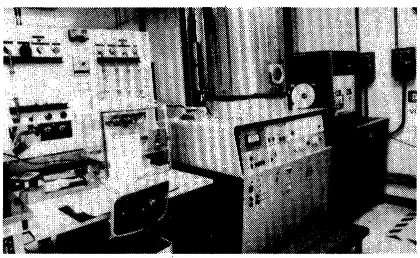
Aligning, developing and etching to reproduce the circuit pattern in the oxide mask.



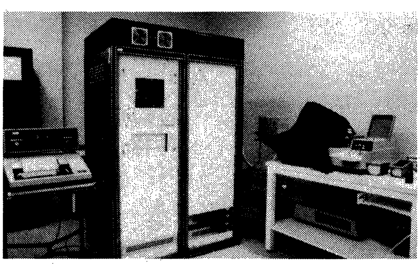
Implanting with dopant atoms in ION implanter (alternate process to thermal diffusion).



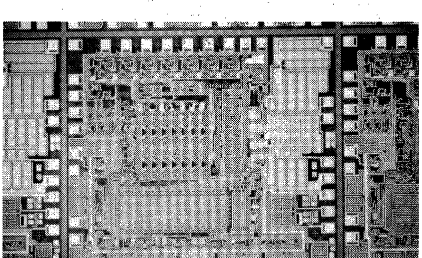
Polysilicon deposition (for silicon gate processing).



Aluminum deposition to form electrical inter-connect patterns.

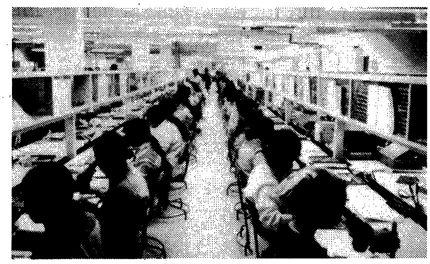


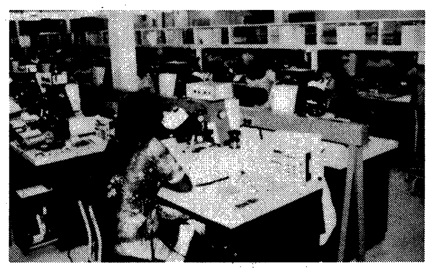
Finished wafers are tested on Litronix designed and built micro processor controlled automatic testers.



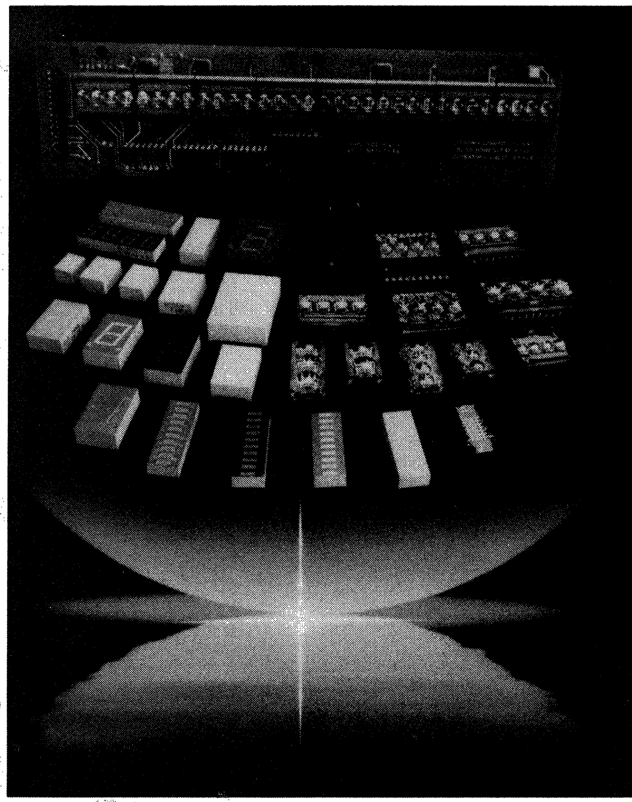
A typical LSI timekeeping circuit.

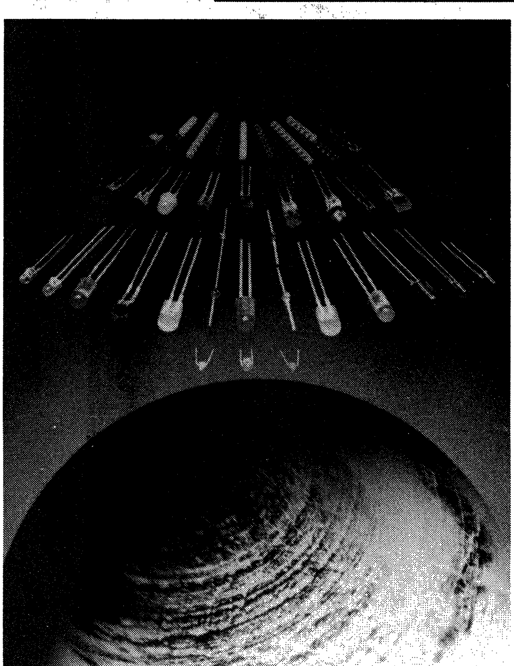
MANUFACTURING





Litronix Penang, Malaysia plant.





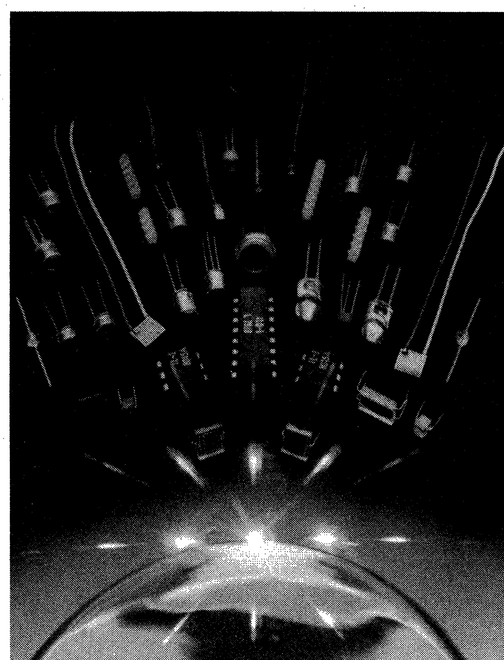


TABLE OF CONTENTS

ALPHANUMERIC INDEX

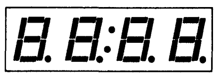
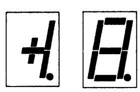
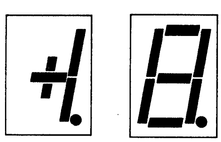
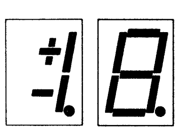
ALPHANUMERIC INDEX (con't)

* Not recommended for new design—phasing out.

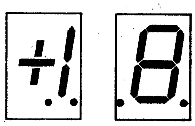
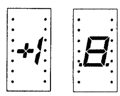
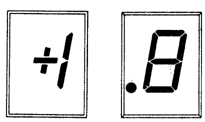
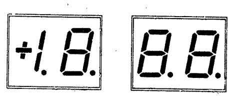
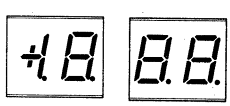
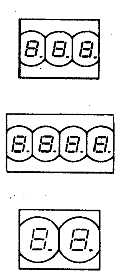
ALPHANUMERIC INDEX (con't)

* Not recommended for new design—phasing out.

LED NUMERIC DISPLAYS

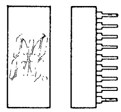
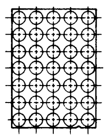
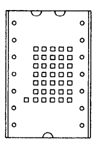
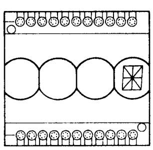
Package Type	Package Outline	Part Number	Character Height	Description	Polarity	Color	Luminous Intensity per segment Typ I_V	I_F(mA)	PAGE
Compact Single Digit Encapsulated (Filled Reflector)		HD1075R	7 mm .28"	7 seg. D.P. right	C.A.	Red	800μcd	20	19
		HD1077R		7 seg. D.P. right	C.C.				
		HD1075O		7 seg. D.P. right	C.A.	Hi. Eff. Red	1000μcd	15	
		HD1077O		7 seg. D.P. right	C.C.				
		HD1075Y		7 seg. D.P. right	C.A.	Yellow	900μcd	15	
		HD1077Y		7 seg. D.P. right	C.C.				
		HD1075G		7 seg. D.P. right	C.A.	Green	1000μcd	15	
		HD1077G		7 seg. D.P. right	C.C.				
Compact Four Digit Encapsulated (Filled Reflector)		DL-4770	7 mm .28"	7 seg. D.P. right	C.C.	Red	180μcd	10	23
		DLO-4770		7 seg. D.P. right	C.C.	Hi. Eff. Red	400μcd	10	
Compact Single Digit Encapsulated (Filled Reflector)		HD1105R	10mm .39"	7 seg. D.P. right	C.A.	Red	1000μcd	25	27
		HD1106R		±1 overflow					
		HD1107R		7 seg. D.P. right	C.C.				
		HD1108R		±1 overflow					
		HD1105O		7 seg. D.P. right	C.A.	Hi. Eff. Red	1000μcd	15	
		HD1106O		±1 overflow					
		HD1107O		7 seg. D.P. right	C.C.				
		HD1108O		±1 overflow					
		HD1105Y		7 seg. D.P. right	C.A.	Yellow	900μcd	15	
		HD1106Y		±1 overflow					
		HD1107Y		7 seg. D.P. right	C.C.				
		HD1108Y		±1 overflow					
		HD1105G		7 seg. D.P. right	C.A.	Green	1000μcd	15	
		HD1106G		±1 overflow					
		HD1107G		7 seg. D.P. right	C.C.				
		HD1108G		±1 overflow					
Single Digit Encapsulated (Filled Reflector)		DL-7750S	11mm .43"	7 seg. D.P. left	C.A.	Red	400μcd	20	31
		DL-7751S		7 seg. D.P. right					
		DL-7756S		±1 overflow	UNIV.				
		DL-7760S		7 seg. D.P. right	C.C.				
		DLO-7650S		7 seg. D.P. left	C.A.	Hi. Eff. Red	1720μcd	20	
		DLO-7651S		7 seg. D.P. right					
		DLO-7653S		7 seg. D.P. right	C.C.				
		DLO-7656S		±1 overflow	UNIV.				
		DLY-7660S		7 seg. D.P. left	C.A.	Yellow	1500μcd	20	
		DLY-7661S		7 seg. D.P. right					
		DLY-7663S		7 seg. D.P. right	C.C.				
		DLY-7666S		±1 overflow	UNIV.				
		DLG-7670S		7 seg. D.P. left	C.A.	Green	640μcd	20	
		DLG-7671S		7 seg. D.P. right					
		DLG-7673S		7 seg. D.P. right	C.C.				
		DLG-7676S		±1 overflow	UNIV.				
Single Digit Encapsulated (Filled Reflector)		HD1131R	13.5 .53"	7 seg. D.P. right	C.A.	Red	1400μcd	35	35
		HD1132R		±1 overflow					
		HD1133R		7 seg. D.P. right	C.C.				
		HD1134R		±1 overflow					
		HD1131O		7 seg. D.P. right	C.A.	Hi. Eff. Red	1400μcd	20	
		HD1132O		±1 overflow					
		HD1133O		7 seg. D.P. right	C.C.				
		HD1134O		±1 overflow					
		HD1131Y		7 seg. D.P. right	C.A.	Yellow	1300μcd	20	
		HD1132Y		±1 overflow					
		HD1133Y		7 seg. D.P. right	C.C.				
		HD1134Y		±1 overflow					
		HD1131G		7 seg. D.P. right	C.A.	Green	1400μcd	20	
		HD1132G		±1 overflow					
		HD1133G		7 seg. D.P. right	C.C.				
		HD1134G		±1 overflow					

LED NUMERIC DISPLAYS

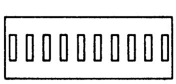
Package Type	Package Outline	Part Number	Character Height	Description	Polarity	Color	Luminous Intensity per segment Typ I_V	I_F(mA)	Page
Single Digit Encapsulated (Filled Reflector)		DL-3400	20mm .8"	7 seg. D.P. left	C.A.	Red	900μcd	20	39
		DL-3401		7 seg. D.P. left					
		DL-3403		7 seg. D.P. left	C.C.				
		DL-3405		7 seg. D.P. left					
		DL-3406		±1 overflow	UNIV.				
		DLO-3900	20mm .8"	7 seg. D.P. left	C.A.	Hi. Eff. Red	2000μcd	20	
		DLO-3901		7 seg. D.P. left					
		DLO-3903		7 seg. D.P. left	C.C.				
		DLO-3905		7 seg. D.P. left					
		DLO-3906		±1 overflow	UNIV.				
Single Digit Light Pipe		*DL-701	7.6mm .3"	±1 overflow	C.A.	Red	300μcd	10	41
		*DL-702		7 seg. D.P. left	C.C.				43
		*DL-704		7 seg. D.P. right					
		*DL-707		7 seg. D.P. left	C.A.				41
		*DL-707R		7 seg. D.P. right					
		*DL-746	16mm .63"	±1 overflow	C.A.	Red	700μcd	20	45
		*DL-747		7 seg. D.P. left					
		*DL-749		±1 overflow	C.C.				
		*DL-750		7 seg. D.P. left					
Two Digit Light Pipe		*DL-721	13mm .51"	±1 overflow	C.A.	Red	400μcd	20	49
		*DL-722			C.C.				
		*DL-727		7 seg. D.P. right	C.A.				
		*DL-728			C.C.				
Two Digit Air Reflector		*DL-524	12.7mm .50"	±1 overflow	C.C.	Red	400μcd	20	51
		*DL-527		7 seg. D.P. right	C.A.				
		*DL-528			C.C.				
		*DLO-524		±1 overflow	C.C.	Hi. Eff. Red	1200μcd	20	
		*DLO-527		7 seg. D.P. right	C.A.				
		*DLO-528			C.C.				
Multi Digit Magnified Monolithic		DL-330M	2.8mm .11"	7 seg. 3 Digit	C.C. MULTIPLEX	Red	1500μcd	5	53
		DL-340M		7 seg. 4 Digit					
		DL-430M	3.8mm .15"	7 seg. 3 Digit					
		DL-440M		7 seg. 2 Digit					

*NOT RECOMMENDED FOR NEW DESIGN—PHASING OUT

LED ALPHANUMERIC DISPLAYS

Package Type	Package Outline	Part Number	Character Height	Description	Polarity	Color	Luminous Intensity per segment Typ I_V	I_F(mA)	Page
Single Char. Encapsulated (Filled Reflector)		HD14101R	10mm	14 seg. D.P. right	C.A.	Red	850µcd	25	55
		HD14101G	.39"	14 seg. D.P. right		Green	1000µcd	15	
		DL-5735	17.5mm .69"	5 x 7 dot matrix	MULT.	Red	200µcd	20	61
Single Char. Hybrid		DL-57	9mm .35"	5 x 7 dot matrix	MULT.	Red	400µcd	10	57
4 Char. Magnified Monolithic		DL-416	4mm .16"	16 seg., 4 digit	MULT.	Red	200µcd	5	59

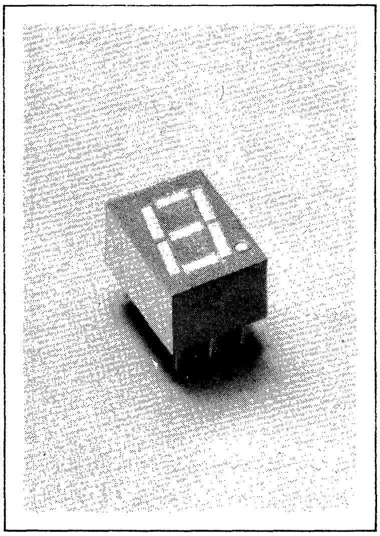
LED BAR GRAPH DISPLAYS

10 Element Encapsulated (Filled Reflector) Linear Display		RBG-1000	3.8mm .15"	10 element bar graph	Separately addressable anode and Cathode	Red	500µcd	20	63
		OBG-1000				Hi. Eff. Red	2500µcd	20	
		YBG-1000				Yellow	2000µcd	20	
		GBG-1000				Green	2000µcd	20	

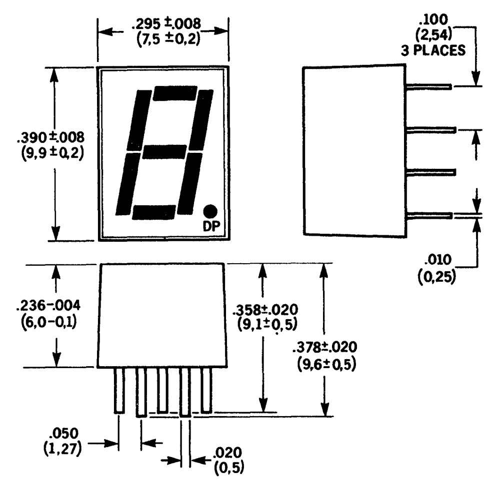
litronix
A Siemens Company

HD 1075 R, HD 1077 R
RED
HD 1075 O, HD 1077 O
HIGH EFFICIENCY RED
HD 1075 Y, HD 1077 Y
YELLOW
HD 1075 G, HD 1077 G
GREEN

0.28 INCH (7 mm) SEVEN SEGMENT NUMERIC DISPLAY



Package Dimension in inches (mm)



FEATURES

- Rugged Encapsulated Package
- 0.28 Inch (7 mm) Digit Height
- Choice of Colors
- Common Anode or Common Cathode
- Wide Viewing
- Intensity Coded for Display Uniformity

DESCRIPTION

The 0.28 inch (7 mm) Digit Height Series of HD1075/1077 Seven Segment Displays offers the choice of common anode or common cathode with right hand decimal point.

These displays have good viewing and can be used in electronic instruments, point-of-sale systems, clocks, and other general industrial and consumer applications. All displays have a light grey face.

Contrast enhancement filters are recommended for use with all displays.

Specifications are subject to change without notice.

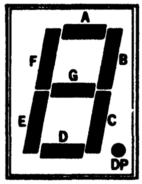
Product	Color	Description
HD1075 R	Red	Common Anode Right Decimal
HD1077 R	Red	Common Cathode Right Decimal
HD1075 O	High Efficiency Red	Common Anode Right Decimal
HD1077 O	High Efficiency Red	Common Cathode Right Decimal
HD1075 Y	Yellow	Common Anode Right Decimal
HD1077 Y	Yellow	Common Cathode Right Decimal
HD1075 G	Green	Common Anode Right Decimal
HD1077 G	Green	Common Cathode Right Decimal

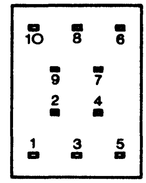
MAXIMUM RATINGS

Power Dissipation (Per Segment)	40 mW
Operating Temperature	–35° to +85°C
Storage Temperature	–40° to +85°C
D.C. Forward Current per segment	
HD1075 R, HD1077 R	20 mA
HD1075 O, HD1077 O, HD1075 G, HD1077 G, HD1075 Y, HD1077 Y	15 mA
Peak Forward Current ($t \leqslant 10\,\mu s$)	
HD1075 R, HD1077 R	400 mA
HD1075 O, HD1077 O, HD1075 G, HD1077 G, HD1075 Y, HD1077 Y	150 mA
Reverse Voltage	6 V
Thermal Resistance (Junction to Air)	170 K/W
Soldering Temperature (Less than 5 sec @ min distance of 2 mm)	230°C

Optoelectronic Characteristics @ 25°C

Parameter	Min	Typ	Max	Units	Conditions
Luminous Intensity (Per Segment)					
HD1075 R, HD1077 R	120	350		μcd	I_F = 10 mA
		800		μcd	I_F = 20 mA
HD1075 O, HD1077 O	90	260		μcd	I_F = 5 mA
		1000		μcd	I_F = 15 mA
HD1075 Y, HD1077 Y	90	200		μcd	I_F = 5 mA
		900		μcd	I_F = 15 mA
HD1075 G, HD1077 G	120	260		μcd	I_F = 5 mA
		1000		μcd	I_F = 15 mA
Forward Voltage					
HD1075 R, HD1077 R		1.6	2.0	V	I_F = 10 mA
HD1075 O, HD1077 O, HD1075 G, HD1077 G		1.9	2.4		I_F = 5 mA
HD1075 Y, HD1077 Y		1.9	2.4	V	I_F = 5 mA
Reverse Current		0.01	10	μA	V_R = 6V
Peak Emission Wavelength					
HD1075 R, HD1077 R		665		nm	
HD1075 O, HD1077 O		645		nm	
HD1075 G, HD1077 G		560		nm	
HD1075 Y, HD1077 Y		590		nm	
Rise Time/Fall Time					
HD1075 R, HD1077 R		5		ns	
HD1075 O, HD1077 O, HD1075 Y, HD1077 Y		100		ns	
HD1075 G, HD1077 G		50		ns	
Capacitance					
HD1075 R, HD1077 R		40		pf	$V_R = 0_V$ f = 1MHz
HD1075 O, HD1077 O		12		pf	$V_R = 0_V$ f = 1MHz
HD1075 G, HD1077 G		45		pf	$V_R = 0_V$ f = 1MHz
HD1075 Y, HD1077 Y		10		pf	$V_R = 0_V$ f = 1MHz





TOP VIEW

HD1075

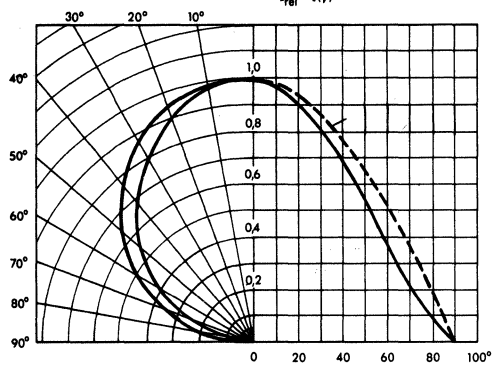
PIN	FUNCTION
1	CATHODE SEGMENT E
2	CATHODE SEGMENT D
3	COMMON ANODE
4	CATHODE SEGMENT C
5	CATHODE DECIMAL POINT
6	CATHODE SEGMENT B
7	CATHODE SEGMENT A
8	COMMON ANODE
9	CATHODE SEGMENT G
10	CATHODE SEGMENT F

HD1077

PIN	FUNCTION
1	ANODE SEGMENT E
2	ANODE SEGMENT D
3	COMMON CATHODE
4	ANODE SEGMENT C
5	ANODE DECIMAL POINT
6	ANODE SEGMENT B
7	ANODE SEGMENT A
8	COMMON CATHODE
9	ANODE SEGMENT G
10	ANODE SEGMENT F

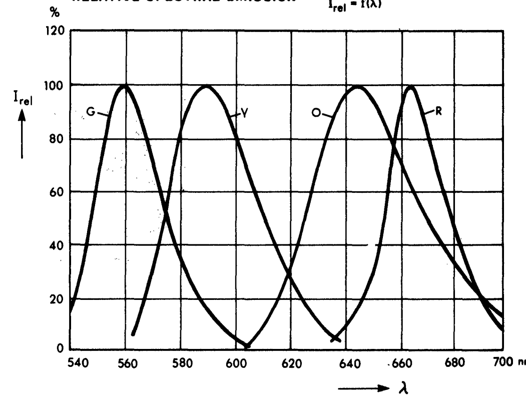
RADIATION CHARACTERISTICS

$I_{rel} = f(\gamma)$



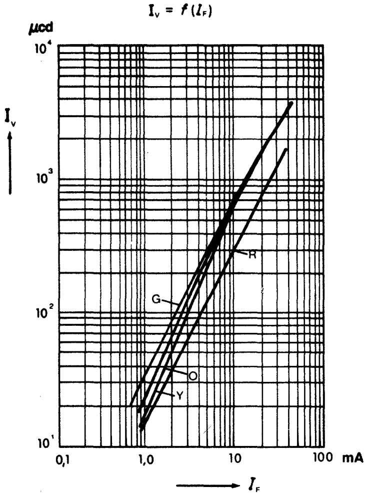
RELATIVE SPECTRAL EMISSION

$I_{rel} = f(\lambda)$



LUMINOUS INTENSITY

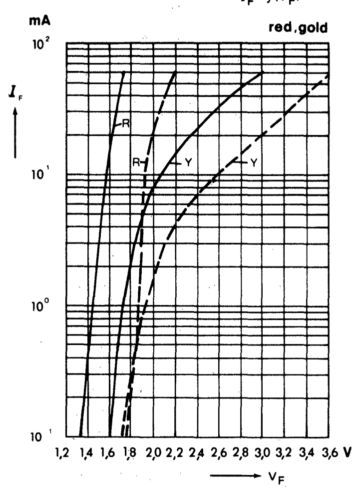
$I_v = f(I_F)$



FORWARD VOLTAGE

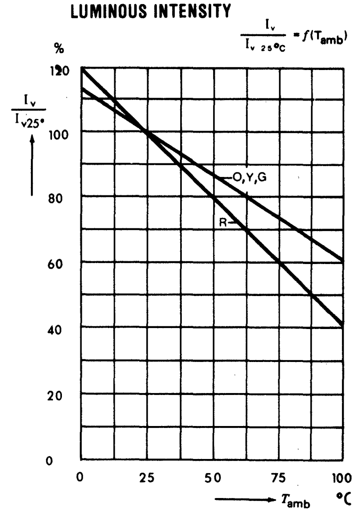
$I_F = f(V_F)$

red, gold



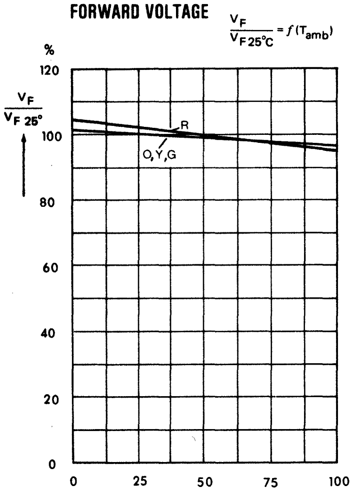
LUMINOUS INTENSITY

$\frac{I_v}{I_{v\,25°C}} = f(T_{amb})$



FORWARD VOLTAGE

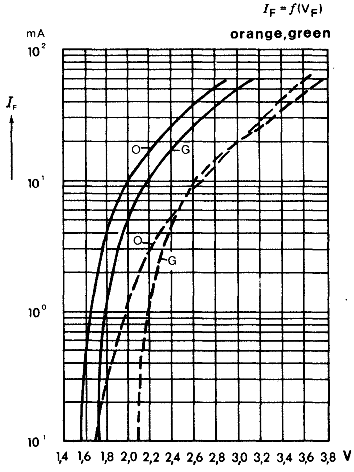
$\frac{V_F}{V_{F\,25°C}} = f(T_{amb})$



FORWARD VOLTAGE

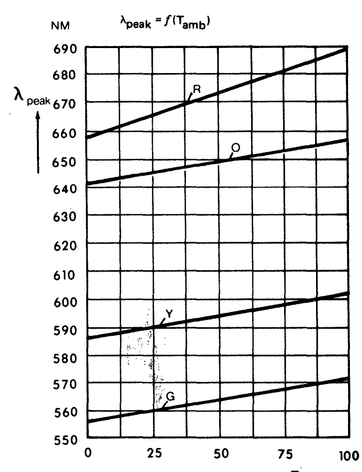
$I_F = f(V_F)$

orange, green



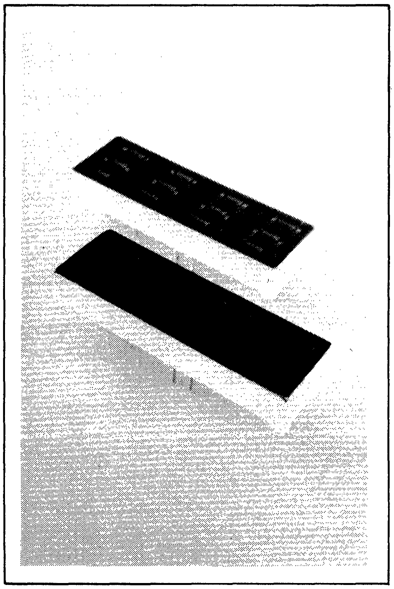
WAVELENGTH AT PEAK EMISSION

$\lambda_{peak} = f(T_{amb})$

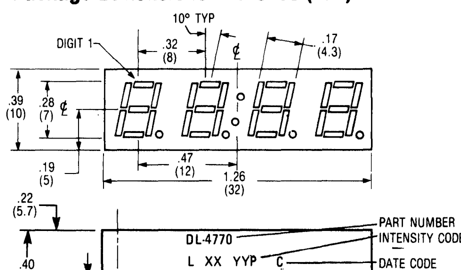


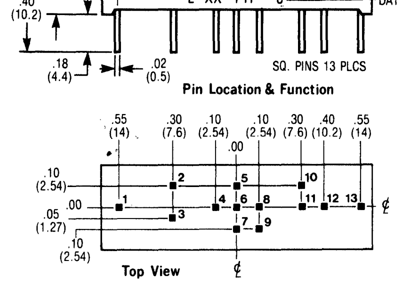
litronix
A Siemens Company

DL-4770
RED
DLO-4770
HIGH EFFICIENCY RED
7-SEGMENT 4-DIGIT DISPLAY



Package Dimensions in Inches (mm)





Pin	Function
1	Digit 1 Cathode
2	Segment B Anode
3	Segment C Anode
4	Digit 2 and Lower Colon Cathode
5	Segment A Anode
6	Segment D Anode
7	Decimal Point Anode
8	Digit 3 and Upper Colon Cathode
9	Colon Anode
10	Segment F Anode
11	Segment E Anode
12	Segment G Anode
13	Digit 4 Cathode

FEATURES

- **0.28 Inch (7 mm) Digit Height**
- **Rugged Encapsulated Package**
- **Filled Reflector Construction**
- **End Stackable Module**
- **Intensity Coded for Display Uniformity**
- **Right Hand Decimal**
- **Colon Included for Clock Applications**

DESCRIPTION

The DL-DLO-4770 is a 0.28 inch (7 mm) four-digit display in a 0.39 x 1.26 inch (10 mm x 32 mm) package. The units are end stackable and offer a colon for time-keeping and other operations. The DL/DLO-4770 is designed to serve a wide variety of industrial and consumer applications requiring medium-sized digits in a very small package.

Maximum Ratings @ 25°C

Power Dissipation (package)	820 mW
Derate Linearly from 25°C	−13.7 mW/°C
Storage Temperature	−20°C to +85°C
Operating Temperature	−20°C to +85°C
Continuous Forward Current	
DL-4770 (per segment)	30 mA
DL-4770 (all segments lit)	12 mA/seg
DLO-4770 (per segment)	25 mA
DLO-4770 (all segments lit)	10 mA/seg
Peak Inverse Voltage	
DL-4770	3 V
DLO-4770	3 V

Opto-Electronic Characteristics Per Segment (@ 25°C)

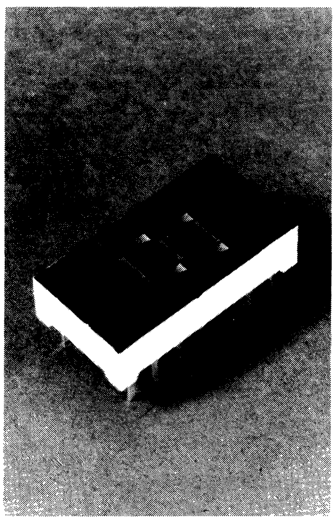
Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity/Segment (Digit Average)					
DL	.08	.18		mcd	$I_F = 10$ mA
DLO	.25	.40		mcd	$I_F = 10$ mA
Forward Voltage					
DL			2.0	V	$I_F = 20$ mA
DLO			2.8	V	$I_F = 20$ mA
Reverse Current					
DL			100	μA	$V_R = 3$ V
DLO			100	μA	$V_R = 3$ V
Peak Emission Wavelength					
DL		660		nm	
DLO		630		nm	

Specifications subject to change without notice.

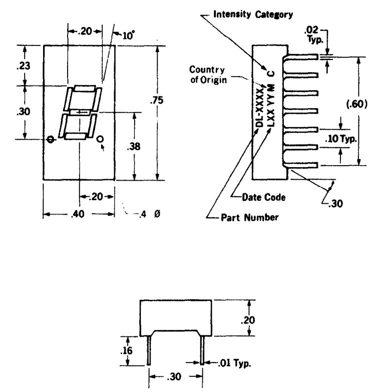
litronix
A Siemens Company

DL-7730 Series
RED
DLO-7610 Series
HIGH EFFICIENCY RED
0.3 INCH SEVEN SEGMENT NUMERIC DISPLAY

PRELIMINARY



Physical Dimensions (inches)



FEATURES

- **Rugged Encapsulated Package**
- **Filled Reflector Construction**
- **Choice of Red or High Efficiency Red**
- **Choice of Common Anode (Left or Right D.P.) Common Cathode**
- **Sharp Clear 0.3 inch (7.62 mm) Character**
- **Wide Viewing Angle**
- **Good "Off" Segment Contrast**
- **Intensity Coded for Display Uniformity**
- **Standard 0.3 inch Dual-Inline-Package Leads on 0.1 centers**

DESCRIPTION

The DL-7730 and DL0-7610 Series are 0.3 inch (7.62 mm) Red and High Efficiency Red LED displays. Both series offer a choice of either common anode or common cathode versions, right or left decimal point as well as a polarity and overflow indicator.

These displays were designed for viewing distances of up to 10 feet and can be used in instruments, point-of-sale systems, clocks, and other general industrial and consumer applications.

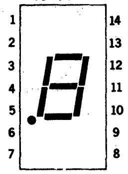
The DL-7734 and DLO-7614 are pin for pin compatible with the DL-304 and DL-704.

These displays are painted to match the appearance of an unlit segment in order to maximize contrast enhancement. Contrast enhancement filters are recommended for use with all displays.

Part Number	Color	Description	
DLO-7610	High Efficiency Red	Common Anode Left Hand Decimal	(14 pin pkg)
DLO-7611	High Efficiency Red	Common Anode Right Hand Decimal	(14 pin pkg)
DLO-7613	High Efficiency Red	Common Cathode Right Hand Decimal	(10 pin pkg)
DLO-7614	High Efficiency Red	Common Cathode Right Hand Decimal	(14 pin pkg)
DL-7730	Standard Red	Common Anode Left Hand Decimal	(14 pin pkg)
DL-7731	Standard Red	Common Anode Right Hand Decimal	(14 pin pkg)
DL-7734	Standard Red	Common Cathode Right Hand Decimal	(14 pin pkg)
DL-7740	Standard Red	Common Cathode Right Hand Decimal	(10 pin pkg)

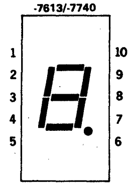
Specifications subject to change without notice.

-7610/-7730



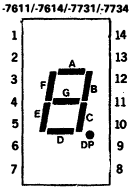
TOP VIEW

-7613/-7740



TOP VIEW

-7611/-7614/-7731/-7734



TOP VIEW

DL-7730 and DLO-7610 Series

	FUNCTION				
PIN	-7610 -7730	-7611 -7731	PIN	-7613 -7740	-7614 -7734
1	CATHODE A	CATHODE A	1	CATHODE	ANODE F
2	CATHODE F	CATHODE F	2	ANODE F	ANODE G
3	ANODE	ANODE	3	ANODE G	NO PIN
4	NO PIN	NO PIN	4	ANODE E	CATHODE
5	NO PIN	NO PIN	5	ANODE D	NO PIN
6	CATHODE DP	NO CONN.	6	CATHODE	ANODE E
7	CATHODE E	CATHODE E	7	ANODE DP	ANODE D
8	CATHODE D	CATHODE D	8	ANODE C	ANODE C
9	NO CONN.	CATHODE DP	9	ANODE B	ANODE DP
10	CATHODE C	CATHODE C	10	ANODE A	NO PIN
11	CATHODE G	CATHODE G	11		NO PIN
12	NO PIN	NO PIN	12		CATHODE
13	CATHODE B	CATHODE B	13		ANODE B
14	ANODE	ANODE	14		ANODE A

MAXIMUM RATINGS

	Standard Red	High Efficiency Red
Power Dissipation per Segment or D.P. @ 25°C	42 mW	50 mW
Derating Factor from 50°C	.43 mA/°C	.4 mA/°C
Storage Temperature	−20° to +85°C	
Operating Temperature	−20° to +85°C	
Peak Forward Current per Segment or D.P.	150 mA	60 mA
Continuous Forward Current per Segment or D.P.	25 mA	20 mA
Peak Inverse Voltage per Segment or D.P.	6.0 V	
Lead Soldering Temperature (1/16 inch below seating plane)	260°C for 3 Seconds	

ELECTRICAL/OPTICAL CHARACTERISTICS AT T_A = 25° C

STANDARD RED DL-7730/7731/7734/7736/7740

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment (Digit Average)	I_v	I_{peak} = 100 mA 10% Duty Cycle		200		μcd
	I_v	I_f = 20 mA	100	350		
Peak Wavelength	λ peak			655		nm
Forward Voltage/Segment or D.P.	V_f	I_f = 20 mA		1.6	2.0	V
Reverse Current/Segment or D.P.	I_R	V_R = 6 V		10	100	μA
Response Time	t_r, t_f			10		ns
Temperature Coefficient of V_f/Segment or D.P.	$\Delta V_f/°C$			−2.0		mV/°C

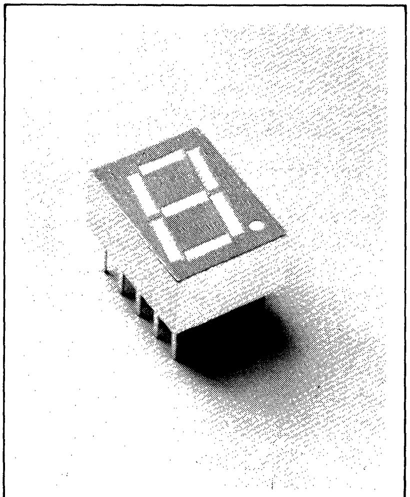
HIGH EFFICIENCY RED DLO-7610/7611/7613/7614/7616

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment (Digit Average)	I_v	5 mA D.C.	70	250		μcd
		20 mA D.C.		1430		
		60 mA Pk: 1 of 6 Duty Factor		810		
Peak Wavelength	λ peak			635		nm
Forward Voltage/Segment or D.P.	V_f	I_f = 5 mA		1.7		V
		I_f = 20 mA		2.0	2.5	
		I_f = 60 mA		2.8		
Reverse Current/Segment or D.P.	I_R	V_R = 6 V		10		μA
Response Time	t_r, t_f			90		ns
Temperature Coefficient of V_f/Segment or D.P.	$\Delta V_f/°C$			−2.0		mV/°C

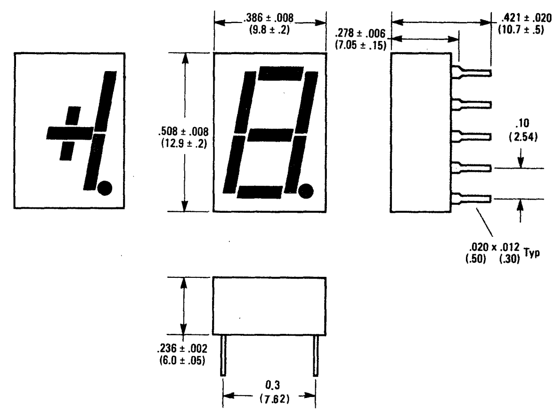
litronix
A Siemens Company

HD 1105R, HD 1106R, HD 1107R, HD 1108R
RED
HD 1105O, HD 1106O, HD 1107O, HD 1108O
HIGH EFFICIENDY RED
HD 1105Y, HD 1106Y, HD 1107Y, HD 1108Y
YELLOW
HD 1105G, HD 1106G, HD 1107G, HD 1108G
GREEN

0.39 INCH (10 mm) SEVEN SEGMENT NUMERIC DISPLAY



Package Dimensions in Inches (mm)



FEATURES

- Rugged Encapsulated Package
- Large 0.39 Inch (10 mm) Digit Height
- Choice of Colors
- Common Anode or Common Cathode
- Wide Viewing
- Intensity Coded for Display Uniformity
- ±1 Polarity Overflow

DESCRIPTION

The 0.39 inch (10 mm) Digit Height Series of HD1105/1107 Seven Segment Displays offers the choice of common anode or common cathode with right hand decimal point.

The HD1106/1108 overflow displays also offer the choice of common anode or common cathode versions with right hand decimal point.

These displays were designed for viewing distances of up to 10 feet and can be used in electronic instruments, point-of-sale systems, clocks, and other general industrial and consumer applications. All displays have a light grey face.

Contrast enhancement filtered are recommended for use with all displays.

Specifications subject to change without notice.

MAXIMUM RATINGS

Power Dissipation Per Segment (T_{amb} = 45°C) . . . . 50 mW
Operating Temperature . . . . -35° to +85°C
Storage Temperature . . . . -40° to +85°C
D.C. Forward Current Per Segment (T_{amb} = 45°C)
HD1105R, HD1106R, HD1107R, HD1108R . . . . 25 mA
HD1105O, HD1106O, HD1107O, HD1108O . . . . 17.5 mA
HD1105G, HD1106G, HD1107G, HD1108G . . . . 17.5 mA
HD1105Y, HD1106Y, HD1107Y, HD1108Y . . . . 17.5 mA
Peak Forward Current ($t \leqslant 10\ \mu s$, T_{amb} =45°C)
HD1105R, HD1106R, HD1107R, HD1108R . . . . 400 mA
HD1105O, HD1106O, HD1107O, HD1108O . . . . 150 mA
HD1105G, HD1106G, HD1107G, HD1108G . . . . 150 mA
HD1105Y, HD1106Y, HD1107Y, HD1108Y . . . . 150 mA
Reverse Voltage . . . . 6 V
Thermal Resistance (Junction to Air)
HD1105/HD1107 series . . . . 135 K/W
HD1106/HD1108 series . . . . 185 K/W
Soldering Temperature (Less than 5 sec @ min distance of 2 mm) . . . . 230°C

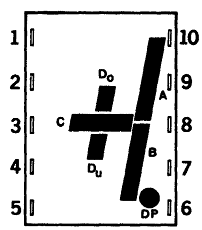
Optoelectronic Characteristics @ 25°C

Parameter	Min	Typ	Max	Units	Conditions
Luminous Intensity (Per Segment)					
HD1105R, HD1106R, HD1107R, HD1108R	120	350		μcd	I_F = 10 mA
		1000		μcd	I_F = 25 mA
HD1105O, HD1106O, HD1107O, HD1108O	90	260		μcd	I_F = 5 mA
		1000		μcd	I_F = 15 mA
HD1105G, HD1106G, HD1107G, HD1108G	120	260		μcd	I_F = 5 mA
		1000		μcd	I_F = 15 mA
HD1105Y, HD1106Y, HD1107Y, HD1108Y	90	200		μcd	I_F = 5 mA
		900		μcd	I_F = 15 mA
Forward Voltage					
HD1105R, HD1106R, HD1107R, HD1108R		1.6	2.0	V	I_F = 10 mA
HD1105O, HD1106O, HD1107O, HD1108O		1.9	2.4	V	I_F = 5 mA
HD1105G, HD1106G, HD1107G, HD1108G		1.9	2.4	V	I_F = 5 mA
HD1105Y, HD1106Y, HD1107Y, HD1108Y		1.9	2.4	V	I_F = 5 mA
Reverse Current		0.01	10	μA	V_R = 6 V
Peak Emission Wavelength					
HD1105R, HD1106R, HD1107R, HD1108R		665		nm	
HD1105O, HD1106O, HD1107O, HD1108O		645		nm	
HD1105G, HD1106G, HD1107G, HD1108G		560		nm	
HD1105Y, HD1106Y, HD1107Y, HD1108Y		590		nm	
Rise Time/Fall Time					
HD1105R, HD1106R, HD1107R, HD1108R		5		ns	
HD1105O, HD1106O, HD1107O, HD1108O		100		ns	
HD1105G, HD1106G, HD1107G, HD1108G		50		ns	
HD1105Y, HD1106Y, HD1107Y, HD1108Y		100		ns	
Capacitance					
HD1105R, HD1106R, HD1107R, HD1108R		40		pf	$V_R = 0_V$ f = 1MHz
HD1105O, HD1106O, HD1107O, HD1108O		12		pf	$V_R = 0_V$ f = 1MHz
HD1105G, HD1106G, HD1107G, HD1108G		45		pf	$V_R = 0_V$ f = 1MHz
HD1105Y, HD1106Y, HD1107Y, HD1108Y		10		pf	$V_R = 0_V$ f = 1MHz

Specifications subject to change without notice.

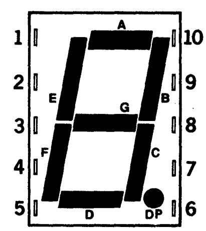
Product	Color	Description
HD1105R	Red	Common Anode Right Decimal
HD1106R	Red	Common Anode ±1 Right Decimal
HD1107R	Red	Common Cathode Right Decimal
HD1108R	Red	Common Cathode ±1 Right Decimal
HD1105O	High Efficiency Red	Common Anode Right Decimal
HD1106O	High Efficiency Red	Common Anode ±1 Right Decimal
HD1107O	High Efficiency Red	Common Cathode Right Decimal
HD1108O	High Efficiency Red	Common Cathode ±1 Right Decimal
HD1105G	Green	Common Anode Right Decimal
HD1106G	Green	Common Anode ±1 Right Decimal
HD1107G	Green	Common Cathode Right Decimal
HD1108G	Green	Common Cathode ±1 Right Decimal
HD1105Y	Yellow	Common Anode Right Decimal
HD1106Y	Yellow	Common Anode ±1 Right Decimal
HD1107Y	Yellow	Common Cathode Right Decimal
HD1108Y	Yellow	Common Cathode ±1 Right Decimal

HD 1106/1108



Top View

HD 1105/1107



Top View

HD 1106 R, HD 1106 O, HD 1106 G, HD 1106 Y

1	Cathode D_O
2	Anode D_O
3	Cathode C
4	Cathode D_u
5	Anode C,D_u
6	Cathode DP
7	Cathode B
8	Anode A,B,DP
9	Cathode A
10	Anode A,B,DP

HD 1105 R, HD 1105 O, HD 1105 G, HD 1105 Y

1	Cathode G
2	Cathode F
3	Common Anode
4	Cathode E
5	Cathode D
6	Cathode DP
7	Cathode C
8	Common Anode
9	Cathode B
10	Cathode A

HD 1108 R, HD 1108 O, HD 1108 G, HD 1108 Y

1	Anode D_O
2	Cathode D_O
3	Anode C
4	Anode D_u
5	Cathode C,D_u
6	Anode DP
7	Anode B
8	Cathode A,B,DP
9	Anode A
10	Cathode A,B,DP

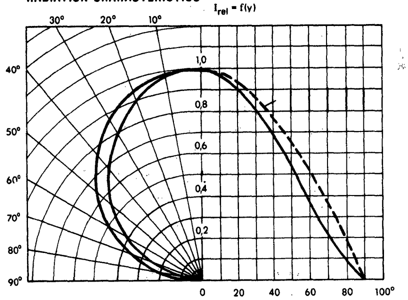
HD 1107 R, HD 1107 O, HD 1107 G, HD 1107 Y

1	Anode G
2	Anode F
3	Common Cathode
4	Anode E
5	Anode D
6	Cathode DP
7	Cathode C
8	Common Cathode
9	Anode B
10	Anode A

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

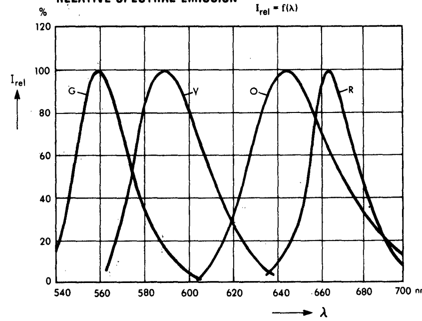
RADIATION CHARACTERISTICS

$I_{rel} = f(\gamma)$



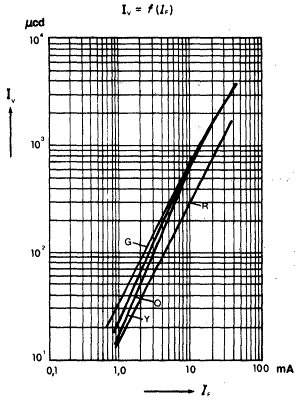
RELATIVE SPECTRAL EMISSION

$I_{rel} = f(\lambda)$



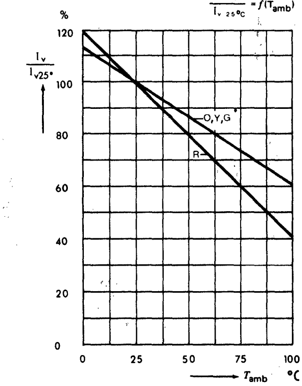
LUMINOUS INTENSITY

$I_v = f(I_F)$



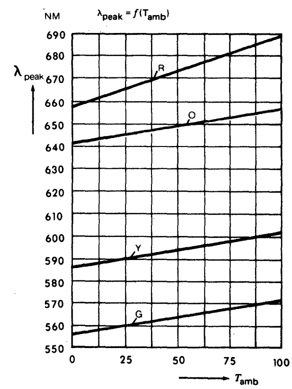
LUMINOUS INTENSITY

$\frac{I_v}{I_{v\,25°C}} = f(T_{amb})$



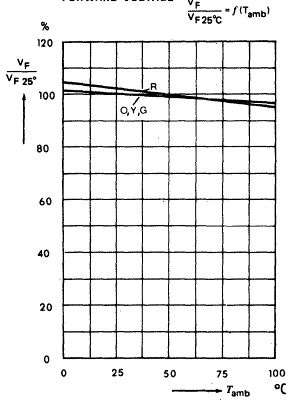
WAVELENGTH AT PEAK EMISSION

$\lambda_{peak} = f(T_{amb})$



FORWARD VOLTAGE

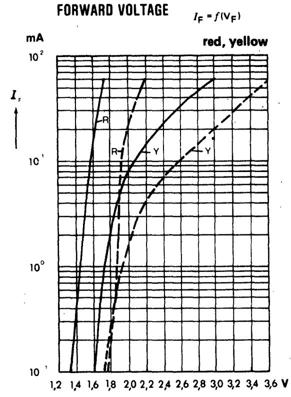
$\frac{V_F}{V_{F\,25°C}} = f(T_{amb})$



FORWARD VOLTAGE

$I_F = f(V_F)$

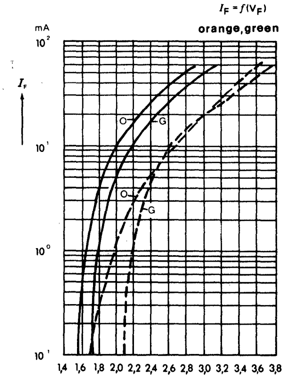
red, yellow



FORWARD VOLTAGE

$I_F = f(V_F)$

orange, green

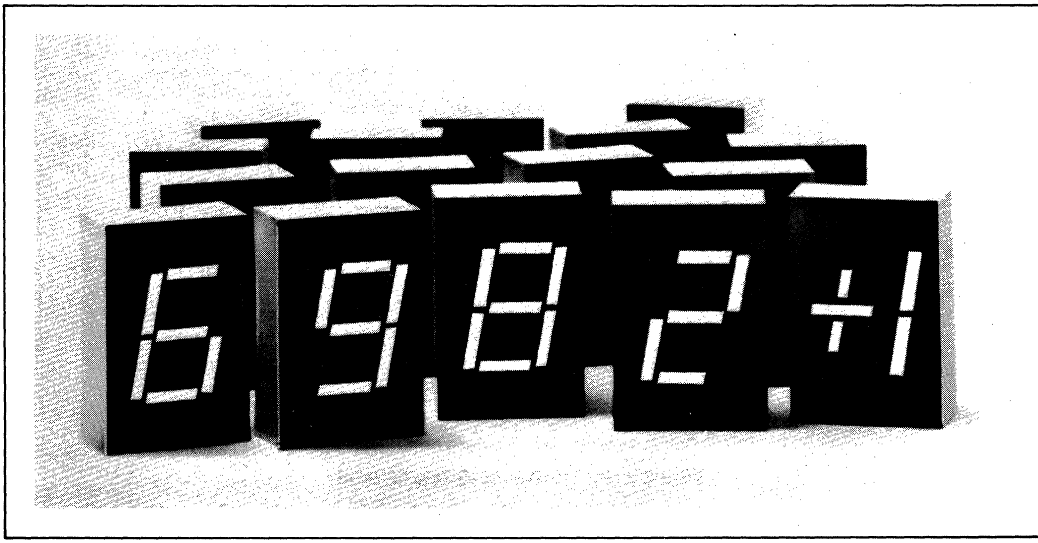


litronix
A Siemens Company

DL-7750S SERIES RED
DLO-7650S SERIES HIGH EFFICIENCY RED
DLY-7660S SERIES YELLOW
DLG-7670S SERIES GREEN

0.43 INCH SEVEN SEGMENT NUMERIC DISPLAY

PRELIMINARY



FEATURES

- **Rugged Encapsulated (Filled Reflector Construction)**
- **Choice of Colors (Including High Intensity Red) as well as Common Anode (D. P. Left & Right), Common Cathode and Universal Polarity Overflow**
- **Sharp, Clear .43 Inch Character for Viewing up to 20 Feet**
- **Intensity Coded for Matching Uniformity**
- **Standard 14 Pin, .3 Inch Pin Spacing, Dual-In-Line Package**

DESCRIPTION

The DL-7750S, -7650S, -7660S, -7670S series are large 0.43 inch (10.92 mm) Red; Hi-efficiency Red, Yellow, and Green seven segment displays. These displays are designed for use in instruments, point-of-sale systems, clocks, and other general industrial & consumer applications.

Part Number	Color	Description
DL-7750 S	Standard Red	C.A. 7 Segment, D.P. Left
DL-7751 S	"	C.A. 7 Segment, D.P. Right
DL-7756 S	"	Univ. ±1 Polarity Overflow
DL-7760 S	"	C.C. 7 Segment, D.P. Right
DLO-7650 S	High Efficiency Red	C.A. 7 Segment, D.P. Left
DLO-7651 S	"	C.A. 7 Segment, D.P. Right
DLO-7653 S	"	C.C. 7 Segment, D.P. Right
DLO-7656 S	"	Univ. ±1 Polarity Overflow
DLY-7660 S	Yellow	C.A. 7 Segment, D.P. Left
DLY-7661 S	"	C.A. 7 Segment D.P. Right
DLY-7663 S	"	C.C. 7 Segment, D.P. Right
DLY-7666 S	"	Univ. ±1 Polarity Overflow
DLG-7670 S	Green	C.A. 7 Segment, D.P. Left
DLG-7671 S	"	C.A. 7 Segment, D.P. Right
DLG-7673 S	"	C.C. 7 Segment, D.P. Right
DLG-7676 S	"	Univ. ±1 Polarity Overflow

ELECTRICAL/OPTICAL CHARACTERISTICS AT $T_A = 25°C$

STANDARD RED DL-7750S/7751S/7756S/7760S

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment	I_V	$I_f = 10$ mA	120	350		μcd
	I_V	$I_f = 25$ mA		1000		μcd
Peak Wavelength	λpeak			665		nm
Dominant Wavelength	λd			645		nm
Forward Voltage/Segment or D.P.	V_f	$I_f = 10$ mA		1.6	2.0	V
Reverse Current/Segment or D.P.	I_R	$V_R = 6V$		0.01	10	μA
Rise and Fall Time	t_r, t_f			5		ns

HIGH EFFICIENCY RED DLO-7650S/7651S/7653S/7656S

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment	I_V	$I_f = 5$ mA	90	260		μcd
		$I_f = 15$ mA		1000		μcd
Peak Wavelength	λpeak			645		nm
Dominant Wavelength	λd			638		nm
Forward Voltage/Segment or D.P.	V_f	$I_f = 5$ mA		1.9	2.4	V
Reverse Current/Segment or D.P.	I_R	$V_R = 6V$		0.01	10	μA
Rise and Fall Time	t_r, t_f			100		ns

YELLOW DLY-7660S/7661S/7663S/7666S

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment	I_V	$I_f = 5$ mA	90	200		μcd
		$I_f = 15$ mA		900		μcd
Peak Wavelength	λpeak			590		nm
Dominant Wavelength	λd			592		nm
Forward Voltage/Segment or D.P.	V_f	$I_f = 5$ mA		1.9	2.4	V
Reverse Current/Segment or D.P.	I_R	$V_R = 6V$		0.01	10	μA
Rise and Fall Time	t_r, t_f			100		ns

GREEN DLG-7670S/7671S/7673S/7676S

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminious Intensity/Segment	I_V	$I_f = 5$ mA D.C.	120	260		μcd
		$I_f = 15$ mA D.C.		1000		μcd
Peak Wavelength	λpeak			560		nm
Dominant Wavelength	λd			561		nm
Forward Voltage/Segment or D.P.	V_f	$I_f = 5$ mA		1.9	2.4	V
Reverse Current/Segment or D.P.	I_R	$V_R = 6V$		0.01	10	μA
Rise and Fall Time	t_r, t_f			50		ns

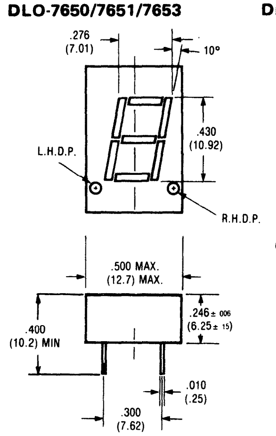
Specifications subject to change without notice.

Maximum Ratings

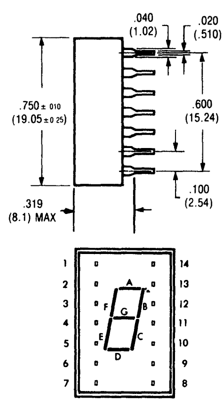
	Standard Red	All Others
Power Dissipation per Segment or D.P. @ 25°C	50 mW	
Storage Temperature	−40 to +85°C	
Operating Temperature	−35 to +85°C	
Peak Forward Current per Segment or D.P. ($t \leq 10\mu sec$)	400 mA	150 mA
Continuous Forward Current per Segment or D.P.	25 mA	17.5 mA
Peak Inverse Voltage per Segment or D.P.	6.0 V	
Lead Soldering Temperature	230°C for 3 seconds	

Package Dimensions in Inches (mm)

DL-7750/7751/7760
DLO-7650/7651/7653

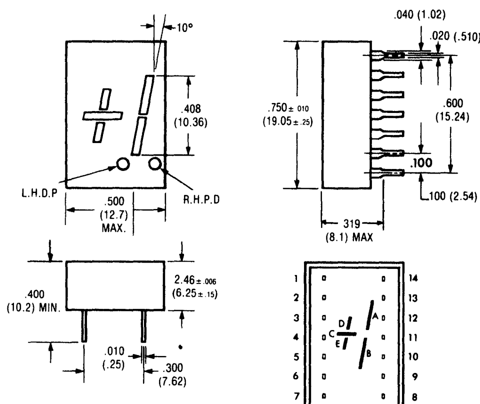


DLG-7670/7671/7673
DLY-7660/7661/7663



TOP VIEW

DL-7756/DLG-7676/DLO-7656/DLY-7666



All untoleranced dimensions are for reference only.

TOP VIEW

DLO-7650/DLY-7660 / DLG-7670/DL-7750

Pin	Function
1	Cathode -a
2	Cathode -f
3	Anode
4	No Pin
5	No Pin
6	Cathode -d.p.
7	Cathode -e
8	Cathode -d
9	No Conn.
10	Cathode -c
11	Cathode -g
12	No Pin
13	Cathode -b
14	Anode

DLO-7651/DLY-7661 / DLG-7671/DL-7751

Pin	Function
1	Cathode -a
2	Cathode -f
3	Anode
4	No Pin
5	No Pin
6	No Conn.
7	Cathode -e
8	Cathode -d
9	Cathode -d.p.
10	Cathode -c
11	Cathode -g
12	No Pin
13	Cathode -b
14	Anode

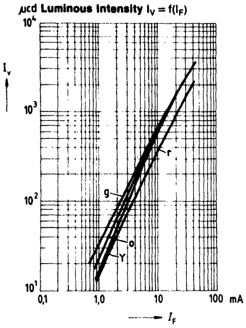
DLO-7653/DLY-7663 / DLG-7673/DL-7760

Pin	Function
1	Anode -a
2	Anode -f
3	Cathode
4	No Pin
5	No Pin
6	No Conn.
7	Anode -e
8	Anode -d
9	Anode -d.p.
10	Anode -c
11	Anode -g
12	No Pin
13	Anode -b
14	Cathode

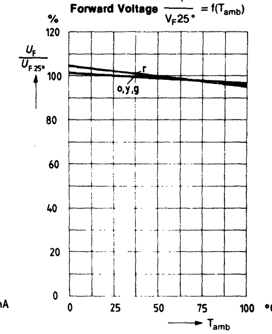
DL-7756/DLG-7676/DLO-7656/DLY-7666

Pin	Function	Pin	Function
1	Cathode -d	8	Anode -d.p.
2	Anode -d	9	Cathode -d.p.
3	No Pin	10	Cathode -b
4	Cathode -c	11	Cathode -a
5	Cathode -e	12	No Pin
6	Anode -e	13	Anode -a
7	Anode -c	14	Anode -b

μcd **Luminous Intensity** $I_V = f(I_F)$

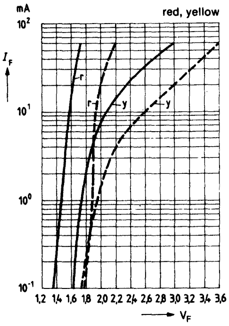


Forward Voltage $\frac{V_F}{V_F 25°} = f(T_{amb})$



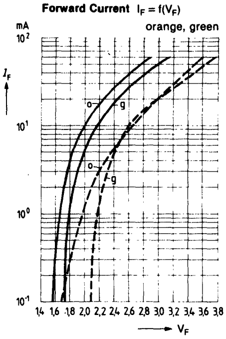
Forward Current $I_F = f(V_F)$

red, yellow



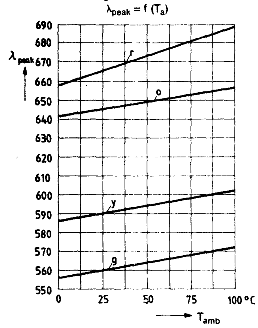
Forward Current $I_F = f(V_F)$

orange, green

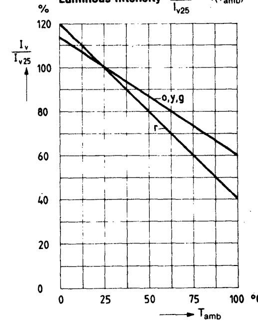


Wavelength at Peak Emission

$\lambda_{peak} = f(T_a)$

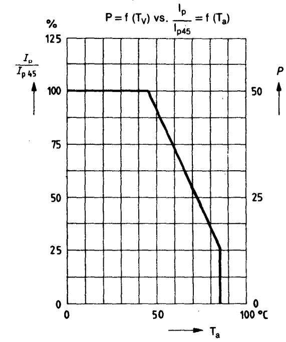


Luminous Intensity $\frac{I_V}{I_{V25}} = f(T_{amb})$

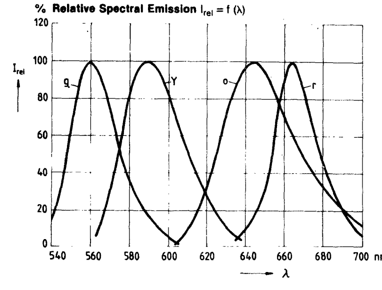


Power Dissipation and Pulse Current

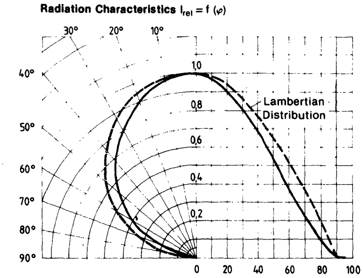
$P = f(T_V)$ vs. $\frac{I_p}{I_{p45}} = f(T_a)$



% **Relative Spectral Emission** $I_{rel} = f(\lambda)$



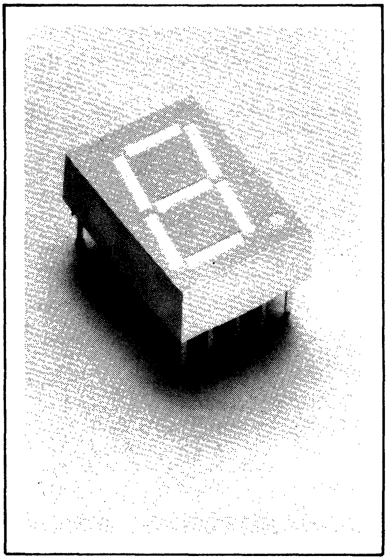
Radiation Characteristics $I_{rel} = f(\varphi)$



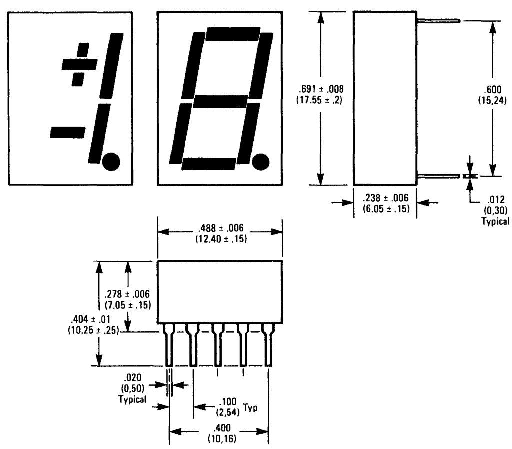
litronix
A Siemens Company

HD 1131 R, HD 1132 R, HD 1133 R, HD 1134 R
RED
HD 1131 O, HD 1132 O, HD 1133 O, HD 1134 O
HIGH EFFICIENCY RED
HD 1131 Y, HD 1132 Y, HD 1133 Y, HD 1134 Y
YELLOW
HD 1131 G, HD 1132 G, HD 1133 G, HD 1134 G
GREEN

0.53 (13.5 mm) SEVEN SEGMENT NUMERIC DISPLAY



Package Dimensions in Inches (mm)



FEATURES

- **Rugged Encapsulated Package**
- **Large 0.53 Inch (13.5 mm) Digit Height**
- **Choice of Colors**
- **Common Anode or Common Cathode**
- **Wide Viewing**
- **Intensity Coded for Display Uniformity**
- **±1 Polarity Overflow**
- **Pin for Pin Compatibility with DL500/DL507, FND500/FND507, MAN6680/MAN6660, TIL322/TIL321**

DESCRIPTION

The 0.53 inch (13.5 mm) Digit Height Series of HD1131/1133 Seven Segment Displays offers the choice of common anode or common cathode versions with right hand decimal point.

The HD1132/1134 overflow displays also offer the choice of common anode or common cathode versions with right hand decimal point.

These displays were designed for viewing distances of up to 20 feet and can be used in electronic instruments, point-of-sale systems, clocks, and other general industrial and consumer applications. All displays have a light grey face.

Contrast enhancement filters are recommended for use with all displays.

Specifications subject to change without notice.

MAXIMUM RATINGS

Power Dissipation Per Segment (T_{amb} = 45°C)	60 mW
Operating Temperature	−35° to +85°C
Storage Temperature	−40° to +85°C
D.C. Forward Current Per Segment (T_{amb} = 45°C)	
HD1131R, HD1132R, HD1133R, HD1134R	35 mA
HD1131O, HD1132O, HD1133O, HD1134O	20 mA
HD1131G, HD1132G, HD1133G, HD1134G	20 mA
HD1131Y, HD1132Y, HD1133Y, HD1134Y	20 mA
Peak Forward Current ($t \leqslant 10\,\mu s$, T_{amb} = 45°C)	
HD1131R, HD1132R, HD1133R, HD1134R	400 mA
HD1131O, HD1132O, HD1133O, HD1134O	150 mA
HD1131G, HD1132G, HD1133G, HD1134G	150 mA
HD1131Y, HD1132Y, HD1133Y, HD1134Y	150 mA
Reverse Voltage	6 V
Thermal Resistance (Junction to Air)	
HD1131/HD1133 series	115 K/W
HD1132/HD1134 series	155 K/W
Soldering Temperature (Less than 5 sec @ min distance of 2 mm)	230°C

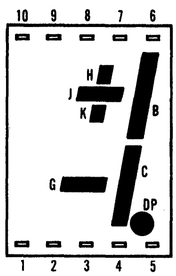
Optoelectronic Characteristics @ 25°C

Parameter	Min	Typ	Max	Units	Conditions
Luminous Intensity (Per Segment)					
HD1131R, HD1132R, HD1133R, HD1134R	120	300		μcd	I_F = 10 mA
		1400		μcd	I_F = 35 mA
HD1131O, HD1132O, HD1133O, HD1134O	90	260		μcd	I_F = 5 mA
		1400		μcd	I_F = 20 mA
HD1131G, HD1132G, HD1133G, HD1134G	120	260		μcd	I_F = 5 mA
		1400		μcd	I_F = 20 mA
HD1131Y, HD1132Y, HD1133Y, HD1134Y	90	200		μcd	I_F = 5 mA
		1300		μcd	I_F = 20 mA
Forward Voltage					
HD1131R, HD1132R, HD1133R, HD1134R		1.6	2.0	V	I_F = 10 mA
HD1131O, HD1132O, HD1133O, HD1134O		1.9	2.4	V	I_F = 5 mA
HD1131G, HD1132G, HD1133G, HD1134G		1.9	2.4	V	I_F = 5 mA
HD1131Y, HD1132Y, HD1133Y, HD1134Y		1.9	2.4	V	I_F = 5 mA
Reverse Current		0.01	10	μA	V_R = 6 V
Peak Emission Wavelength					
HD1131R, HD1132R, HD1133R, HD1134R		665		nm	
HD1131O, HD1132O, HD1133O, HD1134O		645		nm	
HD1131G, HD1132G, HD1133G, HD1134G		560		nm	
HD1131Y, HD1132Y, HD1133Y, HD1134Y		590		nm	
Rise Time/Fall Time					
HD1131R, HD1132R, HD1133R, HD1134R		5		ns	
HD1131O, HD1132O, HD1133O, HD1134O		100		ns	
HD1131G, HD1132G, HD1133G, HD1134G		50		ns	
HD1131Y, HD1132Y, HD1133Y, HD1134Y		100		ns	
Capacitance					
HD1131R, HD1132R, HD1133R, HD1134R		40		pf	$V_R = 0_V$ f = 1MHz
HD1131O, HD1132O, HD1133O, HD1134O		12		pf	$V_R = 0_V$ f = 1MHz
HD1131G, HD1132G, HD1133G, HD1134G		45		pf	$V_R = 0_V$ f = 1MHz
HD1131Y, HD1132Y, HD1133Y, HD1134Y		10		pf	$V_R = 0_V$ f = 1MHz

Specifications subject to change without notice.

Product	Color	Description
HD1131R	Red	Common Anode Right Decimal
HD1132R	Red	Common Anode ±1 Right Decimal
HD1133R	Red	Common Cathode Right Decimal
HD1134R	Red	Common Cathode ±1 Right Decimal
HD1131O	High Efficiency Red	Common Anode Right Decimal
HD1132O	High Efficiency Red	Common Anode ±1 Right Decimal
HD1133O	High Efficiency Red	Common Cathode Right Decimal
HD1134O	High Efficiency Red	Common Cathode ±1 Right Decimal
HD1131G	Green	Common Anode Right Decimal
HD1132G	Green	Common Anode ±1 Right Decimal
HD1133G	Green	Common Cathode Right Decimal
HD1134G	Green	Common Cathode ±1 Right Decimal
HD1131Y	Yellow	Common Anode Right Decimal
HD1132Y	Yellow	Common Anode ±1 Right Decimal
HD1133Y	Yellow	Common Cathode Right Decimal
HD1134Y	Yellow	Common Cathode ±1 Right Decimal

HD 1132/1134



TOP VIEW

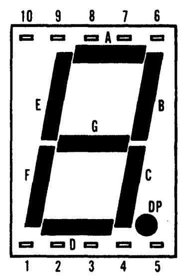
HD1132R
HD1132O
HD1132G
HD1132Y

1 Cathode G
2 No Connection
3 Common Anode
4 Cathode C
5 Cathode DP
6 Cathode B
7 No Connection
8 Common Anode
9 Cathode HJK
10 No Connection

HD1134R
HD1134O
HD1134G
HD1134Y

1 Anode G
2 No Connection
3 Common Cathode
4 Anode C
5 Anode DP
6 Anode B
7 No Connection
8 Common Cathode
9 Anode HJK
10 No Connection

HD 1131/1133



TOP VIEW

HD1131 R
HD1131 O
HD1131 G
HD1131 Y

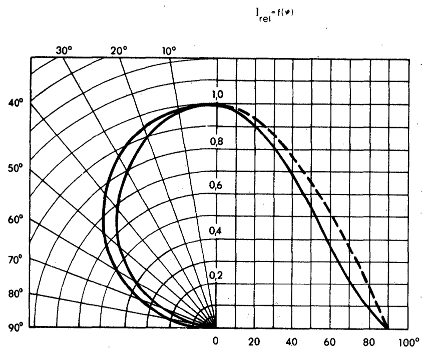
1 Cathode E
2 Cathode D
3 Common Anode
4 Cathode C
5 Cathode DP
6 Cathode B
7 Cathode A
8 Common Anode
9 Cathode F
10 Cathode G

HD1133 R
HD1133 O
HD1133 G
HD1133 Y

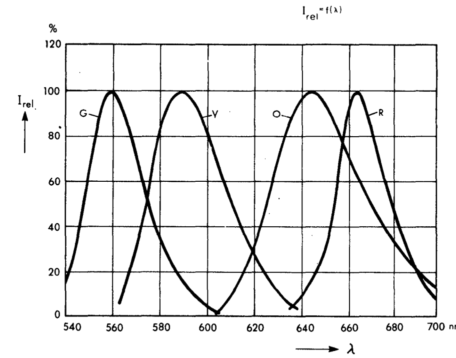
1 Anode E
2 Anode D
3 Common Cathode
4 Anode C
5 Anode DP
6 Cathode B
7 Cathode A
8 Common Cathode
9 Anode F
10 Anode G

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

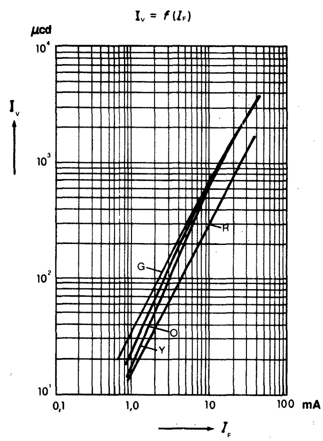
RADIATION CHARACTERISTICS



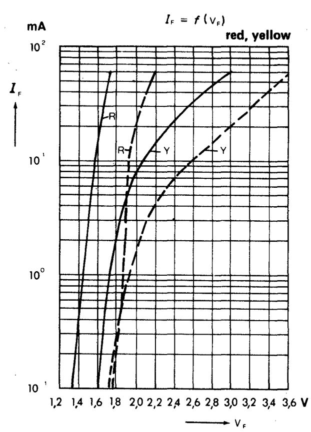
RELATIVE SPECTRAL EMISSION



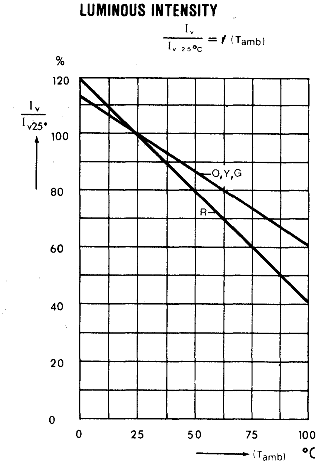
LUMINOUS INTENSITY



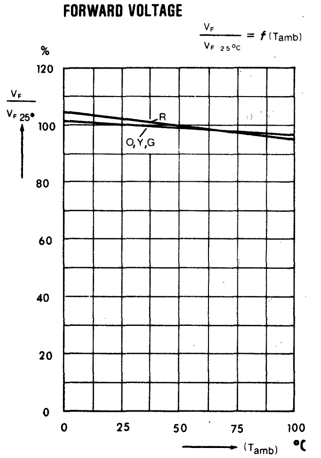
FORWARD VOLTAGE



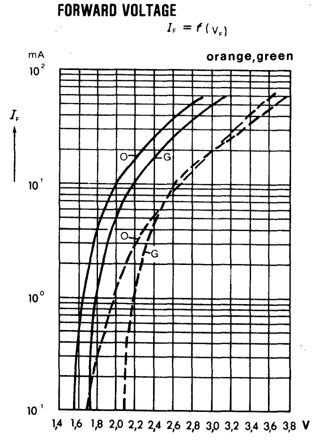
LUMINOUS INTENSITY



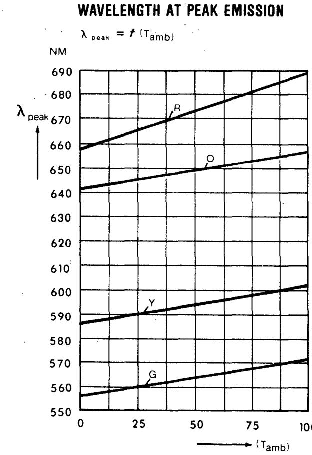
FORWARD VOLTAGE



FORWARD VOLTAGE



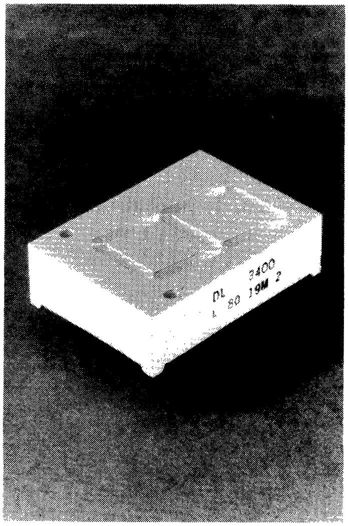
WAVELENGTH AT PEAK EMISSION



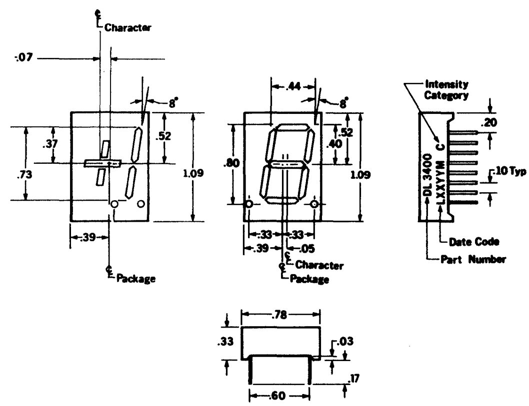
litronix
A Siemens Company

DL-3400 SERIES
RED

DLO-3900 SERIES
HIGH EFFICIENCY RED
0.8 INCH SEVEN SEGMENT NUMERIC DISPLAY



Package Dimensions in Inches



Specifications subject to change without notice.

FEATURES
- Rugged Encapsulated Package
- Filled Reflector Construction
- Very Large 0.8 inch (20 mm) Digit Height
- Choice of: Common Anode or Common Cathode
  Left or Right Decimal Point
  Universal Polarity Overflow
- Wide Viewing Angle
- Good "Off" Segment Contrast
- Intensity Coded for Display Uniformity
- Standard 0.6 inch Dual-In-Line Package with Leads on 0.1 inch Centers

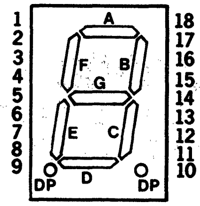
Part Number	Description	
DL-3400	Common Anode	Left Hand Decimal
DL-3401	Common Anode	Right Hand Decimal
DL-3403	Common Cathode	Right Hand Decimal
DL-3405	Common Cathode	Left Hand Decimal
DL-3406	Universal Overflow ±1	Right Hand Decimal
DLO-3900	Common Anode	Left Hand Decimal
DLO-3901	Common Anode	Right Hand Decimal
DLO-3903	Common Cathode	Right Hand Decimal
DLO-3905	Common Cathode	Left Hand Decimal
DLO-3906	Universal Overflow ±1	Right Hand Decimal

DESCRIPTION

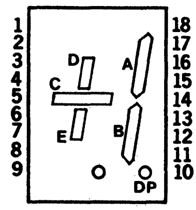
The DL-3400 Series, Red, and DLO-3900 Series, High Efficiency Red, are very large 0.8 inch (20 mm) LED seven segment displays. The series offers the choice of either common anode or common cathode versions, left or right decimal point, as well as a polarity and overflow indicator.

These displays were designed for viewing distances of up to 30 feet and can be used in electronic instruments, point-of-sale systems, clocks, and other general industrial and consumer applications.

These displays are painted to match the appearance of an unlit segment in order to maximize contrast enhancement. Contrast enhancement filters are recommended for use with all displays.



TOP VIEW



TOP VIEW

	FUNCTION					
PIN	-3900 -3400	-3901 -3401	-3903 -3403	-3905 -3405	-3906 -3406	PIN
1	NO PIN	NO PIN	NO PIN	NO PIN	NO PIN	1
2	CATHODE A	CATHODE A	ANODE A	ANODE A	CATHODE A	2
3	CATHODE F	CATHODE F	ANODE F	ANODE F	ANODE D	3
4	ANODE	ANODE	CATHODE	CATHODE	CATHODE D	4
5	CATHODE E	CATHODE E	ANODE E	ANODE E	CATHODE C	5
6	ANODE	ANODE	CATHODE	CATHODE	CATHODE E	6
7	CATHODE DP	NO CONN.	NO CONN.	ANODE DP	ANODE E	7
8	NO PIN	NO PIN	NO PIN	NO PIN	CATHODE DP	8
9	NO PIN	NO PIN	NO PIN	NO PIN	NO PIN	9
10	NO PIN	CATHODE DP	ANODE DP	NO PIN	ANODE DP	10
11	CATHODE D	CATHODE D	ANODE D	ANODE D	CATHODE DP	11
12	ANODE	ANODE	CATHODE	CATHODE	CATHODE B	12
13	CATHODE C	CATHODE C	ANODE C	ANODE C	ANODE B	13
14	CATHODE G	CATHODE G	ANODE G	ANODE G	ANODE C	14
15	CATHODE B	CATHODE B	ANODE B	ANODE B	ANODE A	15
16	NO PIN	NO PIN	NO PIN	NO PIN	NO PIN	16
17	ANODE	ANODE	CATHODE	CATHODE	CATHODE A	17
18	NO PIN	NO PIN	NO PIN	NO PIN	NO PIN	18

MAXIMUM RATINGS

	DL-3400 Series	DLO-3900 Series
Power Dissipation per Segment on D_P ($T_A = 50\,°C$)	100mW	85mW
Operating Temperature	−20 °C to +85 °C	−20 °C to +85 °C
Storage Temperature	−20 °C to +85 °C	−20 °C to +85 °C
Peak Forward Current per Segment or D_P ($T_A = 50\,°C$, Pulse Width < 1.2ms)	200mA	120mA
DC Forward Current per Segment or D_P	50mA	30mA
Derating Factor from 50 °C	1mA/°C	.6mA/°C
Reverse Voltage per Segment or D_P	6.0V	6.0V
Lead Soldering Tempeature (1/16 inch Below Seating Place)	260 °C for 3 sec.	260 °C for 3 sec.

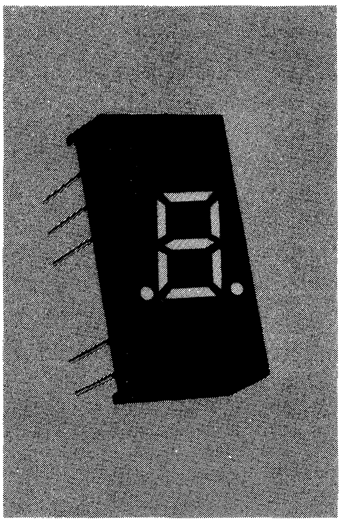
OPTO-ELECTRICAL CHARACTERISTICS @ $T_A = 25\,°C$

Parameter	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment (Digit Average)					
DL-3400 Series	$I_F = 20mA$	500	900		μcd
DLO-3900 Series	$I_F = 20mA$	650	2000		μcd
Forward Voltage					
DL-3400 Series	$I_F = 20mA$		1.6	2.0	V
DLO-3900 Series	$I_F = 20mA$		2.2	2.8	V
Reverse Current					
DL-3400 Series	$V_R = 5V$		10	100	μA
DLO-3900 Series	$V_R = 6V$		10	100	μA
Dominant Wavelength					
DL-3400 Series	λd		640		nm
DLO-3900 Series	λd		625		nm
Rise and Fall Time			10		ns
Temperature Coefficient of Forward Voltage	$I_F = 20mA$		−1.5		mV/°C

litronix
A Siemens Company

DL-707, DL-707R, DL-701

RED 0.3 INCH SEVEN SEGMENT COMMON ANODE NUMERIC DISPLAYS



PHASING OUT—NOT FOR NEW DESIGN

FEATURES
- Left or right hand decimal
- Easy to read 0.3" character
- Light pipe construction
- IC power supply compatible
- Intensity color coded for display uniformity
- Standard 14 pin dual-in-line package

DESCRIPTION

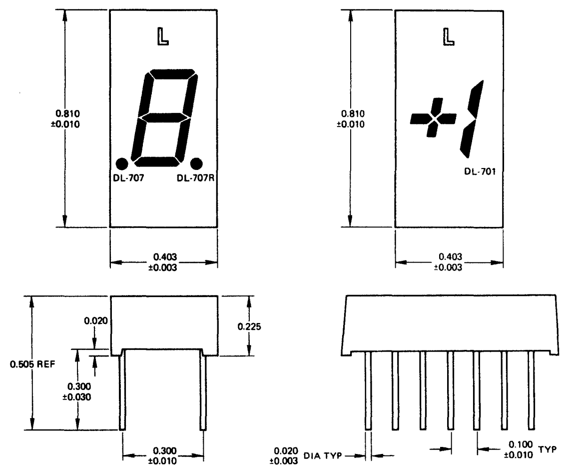
The DL-707, DL707R, and DL-701 are 0.3 inch high red numeric LED display digits designed for viewing distances up to 10 feet. The light pipe construction insures a broad stroke width allowing comfortable viewing for extended periods of time. A black plastic cap surrounding the bar segments provides good contrast.

The DL-707, DL-707R, and DL-701 are pin for pin replacements for the DL-10/MAN-1 series of displays. Internal power dissipation is reduced over the earlier devices by the use of a single GaAsP diode per segment.

The DL-707 has a left hand decimal point and is designed for use in instruments, panel meters and general industrial applications. The DL-701 is a polarity and overflow display for use with the DL-707. The DL-707R has a right hand decimal point for use in table top calculators and point of sale display systems.

Package Dimensions in Inches

DL-707 Left Hand D.P.
DL-707R Right Hand D.P.
DL-701 Overflow, Polarity Function



Maximum Ratings

Power Dissipation @25°C Ambient .... 480 mW
Derating Factor from 25°C .... −8.0 mW/°C
Storage & Operating Temperatuare .... −20°C to +85°C
Continous Forward Current Total .... 240 mA
Per Segment or Decimal .... 30 mA
Peak Inverse Voltage
Per Segment or Decimal .... 3.0 V

Opto-Electronic Characteristics (@25°C)

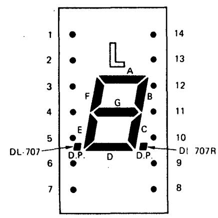
Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity/ Segment (Digit Analog)	55	300		μcd	$I_F = 10$ mA
Emission Peak Wavelength		650		nm	
Line Half Width		40		nm	
Forward Voltage		1.7	2	V	$I_F = 20$ mA
Forward Voltage (DL-701±)		3.4	4	V	$I_F = 20$ mA
Reverse Leakage		0.1	100	μA	$V_R = 3.0$ V
Forward Voltage Temperature Coefficient		−1.8 mV/°C			

Specifications subject to change without notice.

PIN CONFIGURATIONS

DL-707, DL-707R

(TOP VIEW)

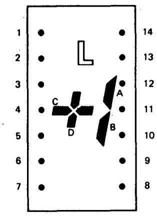


PIN	FUNCTION
1	CATHODE A
2	CATHODE F
3	COMMON ANODE
4	OMITTED
5	OMITTED
6	DECIMAL POINT CATHODE
7	CATHODE E
8	CATHODE D
*9	COMMON ANODE
10	CATHODE C
11	CATHODE G
12	OMITTED
13	CATHODE B
14	COMMON ANODE

*DL-707 Only — DL-707R Pin Omitted

DL-701

(TOP VIEW)

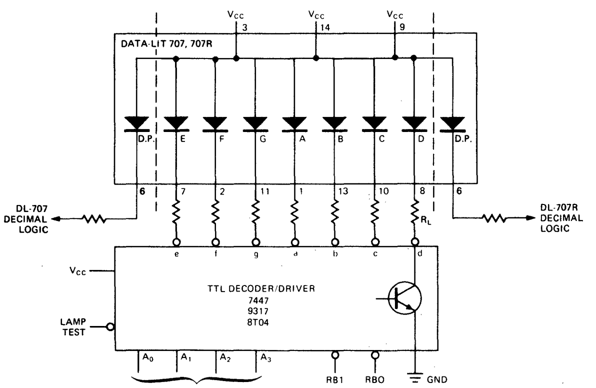


PIN	FUNCTION
1	ANODE-COMMON C,D
2	OMITTED
3	OMITTED
4	OMITTED
5	OMITTED
6	OMITTED
7	CATHODE D
8	CATHODE C
9	OMITTED
10	CATHODE B
11	CATHODE A
12	OMITTED
13	OMITTED
14	ANODE-COMMON A,B

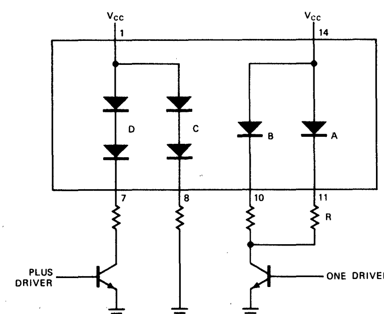
Jumper Pins 1 and 14 on
Circuit Board for Common Anode

TYPICAL DRIVE CIRCUITRY

DL-707, DL-707R



DL-701



TYPICAL OPTOELECTRONIC CHARACTERISTICS

FIGURE 1. LUMINOUS INTENSITY VS TEMPERATURE

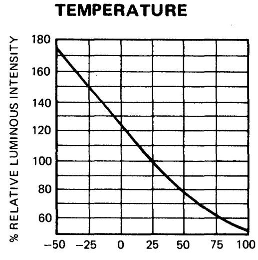
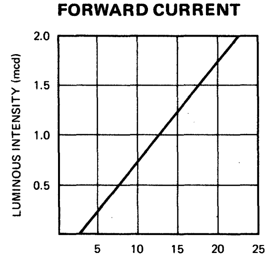


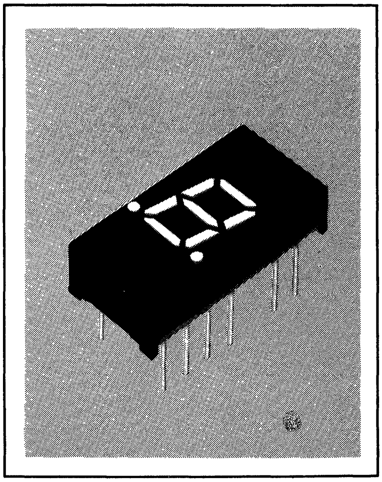
FIGURE 2. LUMINOUS INTENSITY VS FORWARD CURRENT



litronix
A Siemens Company

DL-702, DL-704

0.3-INCH SEVEN-SEGMENT COMMON CATHODE RED NUMERIC DISPLAY



PHASING OUT—NOT FOR NEW DESIGN

FEATURES

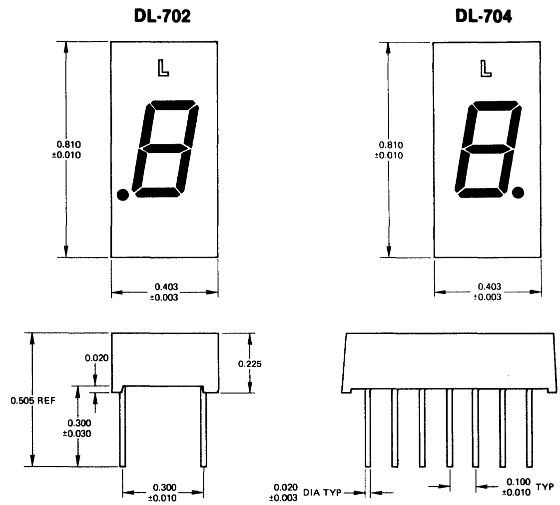
- Left or Right Hand Decimal
- Common Cathode
- Easy to Read 0.3″ Character
- Light Pipe Construction
- IC Power Supply Compatible
- Intensity Color Coded for Display Uniformity
- Standard 14-Pin Dual-In-Line Package

DESCRIPTION

The DL-702/DL-704 is a 0.3 inch high, red numeric LED display digit designed for viewing distances up to 10 feet. The light pipe construction insures a broad stroke width allowing comfortable viewing for extended periods of time. A black plastic cap surrounding the bar segments provides good contrast.

The DL-702/DL-704 is optimized for operation at 10 mA/segment DC, but may be used successfully at 5 mA/ segment, average, when pulsed under narrow duty cycle conditions. It is therefore ideal for use in table top calculators and point of sale terminals.

Package Dimensions in Inches



Maximum Ratings

Power Dissipation @ 25°C Ambient	480 mW
Derating Factor from 25°C	8.0 mW/°C
Storage and Operating Temperature	−20°C to +85°C
Continuous Forward Current Total	240 mA
Per Segment or Decimal	30 mA
Peak Inverse Voltage	
Per Segment or Decimal	3.0 V

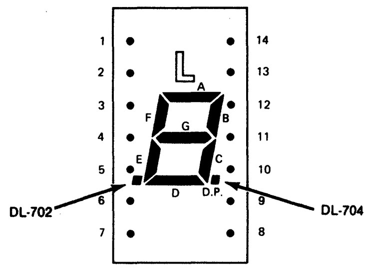
Optoelectronic Characteristics (@ 25°C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity/Segment (Digit Average)	55	300		μcd	$I_F = 10$ mA
Emission Peak Wave Length		655		nm	
Line Half Width		40		nm	
Forward Voltage		1.7	2.0	V	$I_F = 20$ mA
Reverse Leakage		0.1	100	μA	$V_R = 3.0$ V
Forward Voltage Temperature Coefficient			−1.8 mV/°C		

Specifications subject to change without notice.

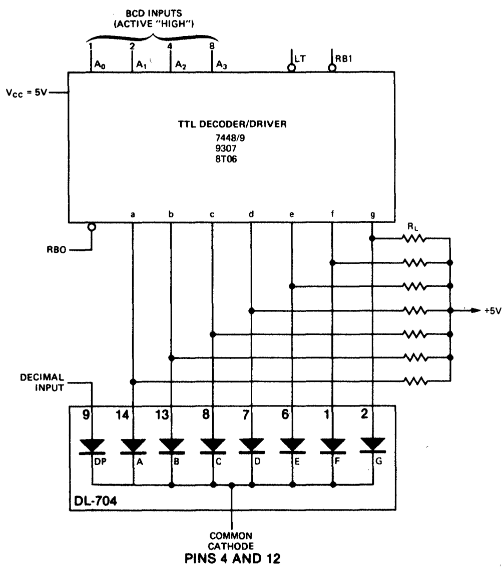
PIN CONFIGURATION

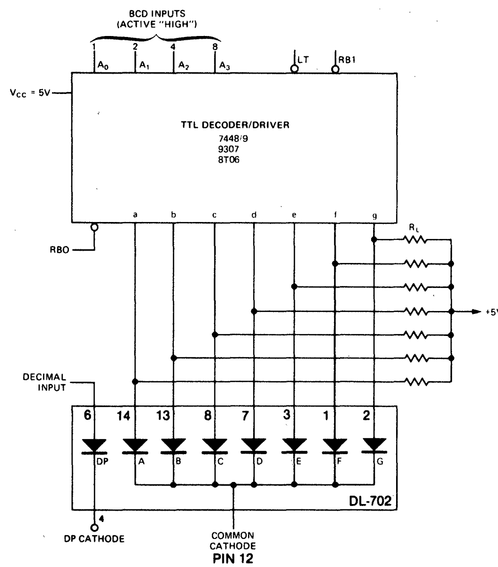
(TOP VIEW)



PIN	DL-704 FUNCTION	PIN	DL-702 FUNCTION
1	ANODE F	1	ANODE F
2	ANODE G	2	ANODE G
3	OMITTED	3	ANODE E
4	COMMON CATHODE	4	D.P. CATHODE
5	OMITTED	5	OMITTED
6	ANODE E	6	D.P. ANODE
7	ANODE D	7	ANODE D
8	ANODE C	8	ANODE C
9	D.P. ANODE	9	OMITTED
10	OMITTED	10	OMITTED
11	OMITTED	11	OMITTED
12	COMMON CATHODE	12	COMMON CATHODE EXCEPT DECIMAL
13	ANODE B	13	ANODE B
14	ANODE A	14	ANODE A

TYPICAL DRIVE CIRCUITRY





TYPICAL OPTO-ELECTRONIC CHARACTERISTICS

FIGURE 1. LUMINOUS INTENSITY VS TEMPERATURE

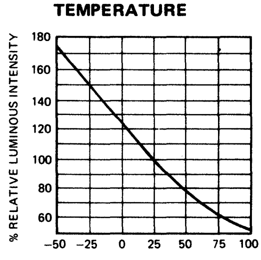
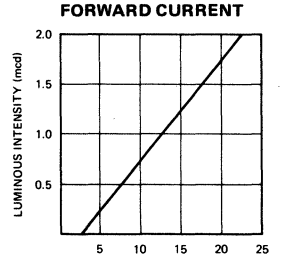
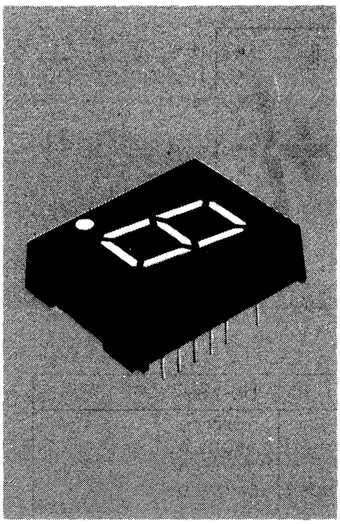


FIGURE 2. LUMINOUS INTENSITY VS FORWARD CURRENT



litronix
A Siemens Company

DL-746, DL-747 DL-749 AND DL-750
RED 0.6-INCH SEVEN-SEGMENT NUMERIC DISPLAY



PHASING OUT—NOT FOR NEW DESIGN

FEATURES

- Large character height (0.6") for distance viewing — up to 25 feet
- High light output — typ 5.0 mcd @ 20 mA
- Light pipe construction
- IC power supply compatible
- Intensity color coded for display uniformity

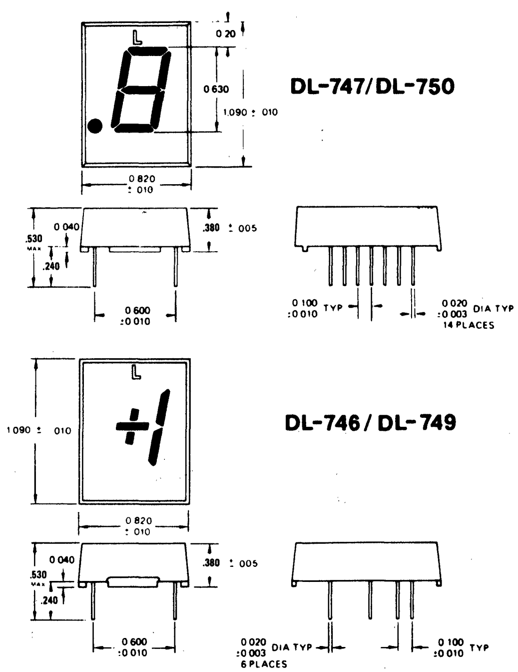
DESCRIPTION

The DL-747 and DL-750 are 0.6 inch high red numeric LED display digits designed for viewing distances up to 25 feet. The light pipe construction insures a broad stroke width allowing comfortable viewing for extended periods of time. A black plastic cap surrounding the bar segments provides good contrast.

Both units have a left hand decimal point and are designed for use in instruments, panel meters, general industrial and consumer applications.

The DL-746 and DL-749 are companion displays providing the overflow/polarity functions.

Package Dimensions in Inches



Maximum Ratings

Power Dissipation @ 25°C Ambient .... 960 mW
Derating Factor from 25°C .... 16 mW/°C
Storage & Operating Temperature .... −20 to +85°C
Continuous Forward Current Total .... 240 mA
Per Segment or Decimal .... 30 mA
Peak Inverse Voltage Per Segment .... 6.0 V

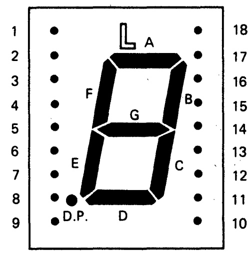
Opto-Electronic Characteristics (@25°C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity/Segment (Digit Average)	.28	.70		mcd	$I_F = 20$ mA
Emission Peak Wavelength		650		nm	
Spectral Line Half-Width		40		nm	
Forward Voltage (segment)		3.4	4.0	V	$I_F = 20$ mA
(decimal)		1.6	2.0	V	$I_F = 20$ mA
Forward Voltage Coefficient		−1.5		mV/°C	
Reverse Leakage (segment)			100	μA	$V_R = 6.0$ V
(decimal)			100	μA	$V_R = 3.0$ V

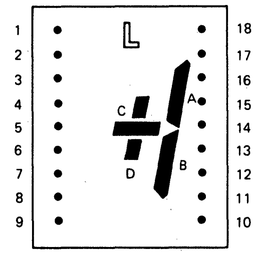
Specifications subject to change without notice.

PIN CONFIGURATIONS

DL-747, DL-750



DL-746, DL-749



Pin Function

PIN	DL-747	DL-746	DL-750	DL-749
1	OMITTED	OMITTED	OMITTED	OMITTED
2	CATHODE A	CATHODE D	ANODE A	ANODE D
3	CATHODE F	OMITTED	ANODE F	OMITTED
4	COMMON ANODE	OMITTED	COMMON CATHODE	OMITTED
5	CATHODE E	OMITTED	ANODE E	OMITTED
6	COMMON ANODE	OMITTED	COMMON CATHODE	OMITTED
7	D.P. CATHODE	OMITTED	D.P. ANODE	OMITTED
8	OMITTED	COMMON ANODE C, D	OMITTED	COMMON CATHODE C, D
9	OMITTED	OMITTED	OMITTED	OMITTED
10	OMITTED	OMITTED	OMITTED	OMITTED
11	CATHODE D	CATHODE B	ANODE D	ANODE B
12	COMMON ANODE	OMITTED	COMMON CATHODE	OMITTED
13	CATHODE C	OMITTED	ANODE C	OMITTED
14	CATHODE G	COMMON ANODE A, B	ANODE G	COMMON CATHODE A, B
15	CATHODE B	OMITTED	ANODE B	OMITTED
16	OMITTED	CATHODE A	OMITTED	ANODE A
17	COMMON ANODE	CATHODE C	COMMON CATHODE	ANODE C
18	OMITTED	OMITTED	OMITTED	OMITTED

TYPICAL OPTOELECTRONIC CHARACTERISTICS

FIGURE 1. LUMINOUS INTENSITY VS TEMPERATURE

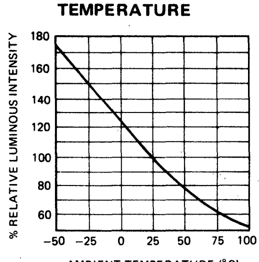
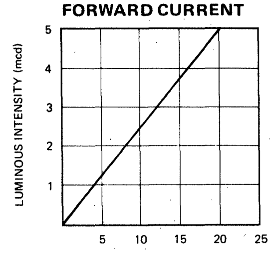
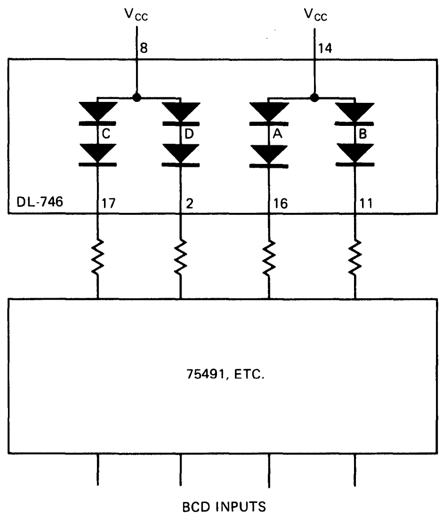
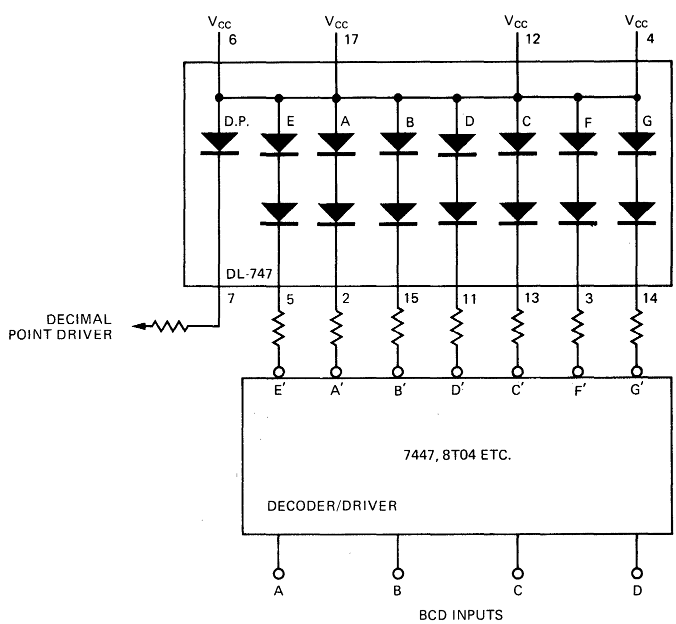
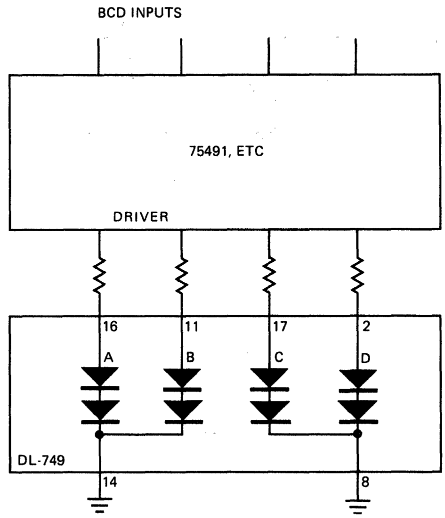


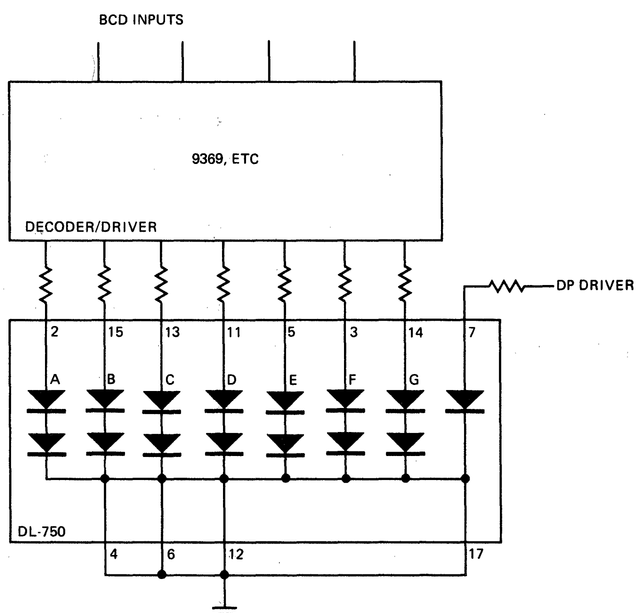
FIGURE 2. LUMINOUS INTENSITY VS FORWARD CURRENT




VCC
VCC
8
14
C
D
A
B
DL-746
17
2
16
11
75491, ETC.
BCD INPUTS


VCC
6
VCC
17
VCC
12
VCC
4
D.P.
E
A
B
D
C
F
G
DL-747
7
5
2
15
11
13
3
14
DECIMAL
POINT DRIVER
E'
A'
B'
D'
C'
F'
G'
7447, 8T04 ETC.
DECODER/DRIVER
A
B
C
D
BCD INPUTS

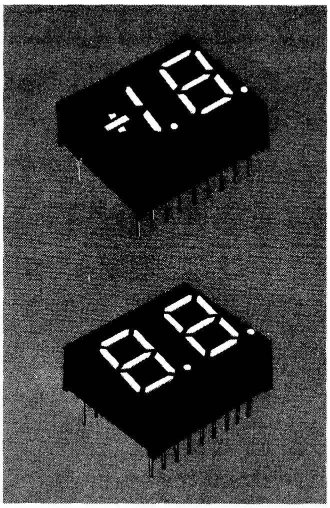

BCD INPUTS
75491, ETC
DRIVER
16
11
17
2
A
B
C
D
DL-749
14
8


BCD INPUTS
9369, ETC
DECODER/DRIVER
DP DRIVER
2
15
13
11
5
3
14
7
A
B
C
D
E
F
G
DL-750
4
6
12
17

litronix
A Siemens Company

DL-721, DL-727
DL-722, DL-728

RED 0.5-INCH SEVEN-SEGMENT TWO-DIGIT DISPLAYS

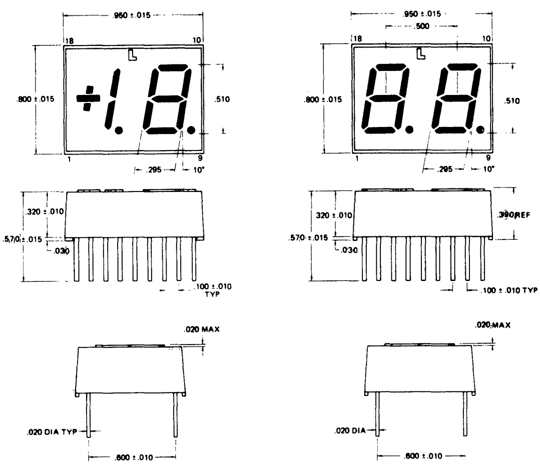


PHASING OUT—NOT FOR NEW DESIGN

Package Dimensions in Inches

DL-721
DL-722

DL-727
DL-728



FEATURES
- **Large, Easy-to-Read 0.5″ Digits**
- **End Stackable on 0.5″ Digit Centers**
- **Common Anode (DL-721, DL-727)**
- **Common Cathode (DL-722, DL-728)**
- **Standard DIP Pin Spacing**
- **Low Cost, Light-Pipe Construction**
- **IC Power Supply Compatible**

DESCRIPTION
The DL-721, DL-727, DL-722 and DL-728 are multi-digit 0.5 inch high red numeric LED displays, designed for use in instrumentation, point-of-sales systems, clocks, TV tuners — wherever large, easy-to-read digits are required.

The DL-721 and DL-722 contain a ±1 polarity and overflow indicator together with a seven-segment digit. The DL-727 and DL-728 contain two seven-segement digits.

The DL-721 and DL-727 are common anode devices. The DL-722 and DL-728 are common cathode devices. All digits have a right-hand decimal.

Maximum Ratings
Power Dissipation @ 25 °C Ambient .... 450 mW/digit, 900 mW/pkg
Derating Factor from 25 °C .... −7.5 mW/°C/digit, −15 mW/°C/pkg
Storage and Operating Temperature .... −20 °C to +85 °C
Continuous Forward Current
  Per Digit .... 225 mA
  Per Segment or Decimal .... 30 mA
Peak Inverse Voltage
  Per Segment or Decimal .... 3.0 V

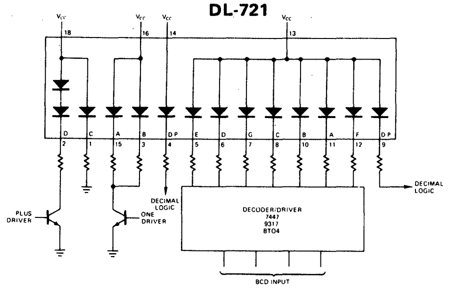
Optoelectronic Characteristics (@ 25 °C)

Parameter	Min	Typ	Max	Unit	Test Condition
Emission Peak Wave Length		650		nm	
Line Half Width		40		nm	
Forward Voltage Seg.		1.7	2.0	V	$I_F = 20$ mA
Forward Voltage Dec.		1.7	2.0	V	$I_F = 20$ mA
Pulsed Segment		1.8		V	$I_F = 50$ mA
Pulsed Decimal		1.8		V	$I_F = 50$ mA
Reverse Leakage		0.1	100	μA	$V_R = 3$ V
Temperature Coefficient at Forward Voltage		1.8		mV/°C	$I_F = 5$ to 50 mA
Luminous Intensity/Segment (Digit Average)	.14	.4		mcd	$I_F = 20$ mA

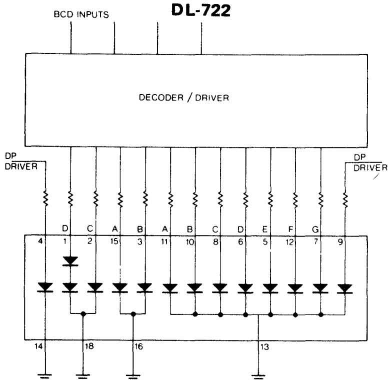
Specifications subject to change without notice.

TYPICAL DRIVE CIRCUITRY

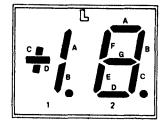
DL-721



DL-722

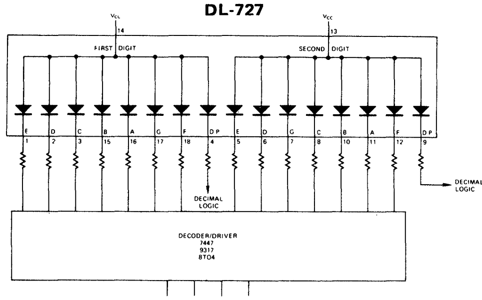


DL-721
DL-722

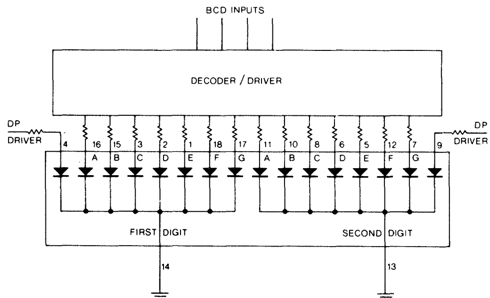


DL-721 PIN	FUNCTION	DL-722 PIN	FUNCTION
1	CATHODE C (NO. 1)	1	ANODE D #1
2	CATHODE D (NO. 1)	2	ANODE C #1
3	CATHODE B (NO. 1)	3	ANODE B #1
4	D. P. CATHODE (NO. 1)	4	D.P. ANODE #1
5	CATHODE E (NO. 2)	5	ANODE E #2
6	CATHODE D (NO. 2)	6	ANODE D #2
7	CATHODE G (NO. 2)	7	ANODE G #2
8	CATHODE C (NO. 2)	8	ANODE C #2
9	D. P. CATHODE (NO. 2)	9	D.P. ANODE #2
10	CATHODE B (NO. 2)	10	ANODE B #2
11	CATHODE A (NO. 2)	11	ANODE A #2
12	CATHODE F (NO. 2)	12	ANODE F #2
13	ANODE DIGIT (NO. 2)	13	COMMON CATHODE #2
14	ANODE D. P. (NO. 1)	14	D.P. CATHODE #1
15	CATHODE A (NO. 1)	15	ANODE A #1
16	ANODE NO. 1 A AND B	16	COMMON CATHODE A&B #1
17	N. C.	17	N.C.
18	ANODE NO. 1 C AND D	18	COMMON CATHODE C&D #1

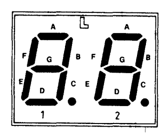
DL-727



DL-728



DL-727
DL-728



DL-727 PIN	FUNCTION	DL-728 PIN	FUNCTION
1	E CATHODE (NO. 1)	1	E ANODE NO. 1
2	D CATHODE (NO. 1)	2	D ANODE NO. 1
3	C CATHODE (NO. 1)	3	C ANODE NO. 1
4	D. P. CATHODE (NO. 1)	4	D.P. ANODE NO. 1
5	E CATHODE (NO. 2)	5	E ANODE NO. 2
6	D CATHODE (NO. 2)	6	D ANODE NO. 2
7	G CATHODE (NO. 2)	7	G ANODE NO. 2
8	C CATHODE (NO. 2)	8	C ANODE NO. 2
9	D. P. CATHODE (NO. 2)	9	D.P. ANODE NO. 2
10	B CATHODE (NO. 2)	10	B ANODE NO. 2
11	A CATHODE (NO. 2)	11	A ANODE NO. 2
12	F CATHODE (NO. 2)	12	F ANODE NO. 2
13	NO. 2 ANODE	13	COMMON CATHODE NO. 2
14	NO. 1 ANODE	14	COMMON CATHODE NO. 1
15	B CATHODE (NO. 1)	15	B ANODE NO. 1
16	A CATHODE (NO. 1)	16	A ANODE NO. 1
17	G CATHODE (NO. 1)	17	G ANODE NO. 1
18	F CATHODE (NO. 1)	18	F ANODE NO. 1

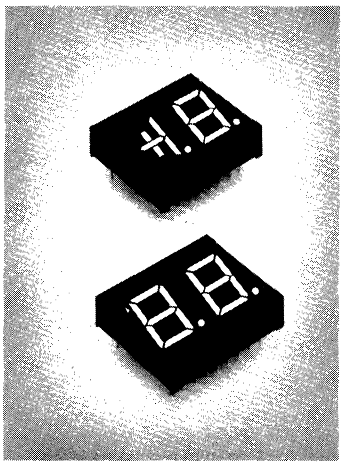
litronix
A Siemens Company

DL-524, DL-527, DL-528
RED

DLO-524, DLO-527, DLO-528
HIGH EFFICIENCY RED

0.5 INCH SEVEN SEGMENT MULTI-DIGIT DISPLAYS

OBSOLETE — OUT OF PRODUCTION



OBSOLETE—NOT FOR NEW DESIGN

FEATURES

- State of the Art Reflector Technology
- Large High Contrast Displays
- Common Anode and Common Cathode
- End Stackable on 0.5" Digit Centers
- Right Hand Decimal
- Intensity Coded for Display Uniformity

DESCRIPTION

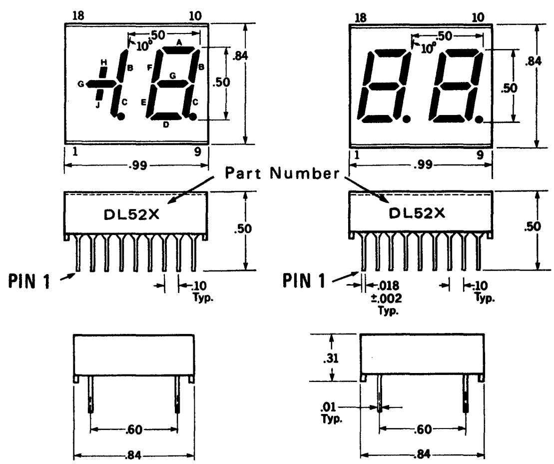
These displays are two digit arrays that can be used as a single unit for TV channel indicators, CB radios and other systems requiring just two digits. They also can be stacked in groups of 4, 6, 8 to be used in a wide range of consumer and industrial applications.

The 0.5 inch character height affords good viewing at distances up to 20 feet.

The -524 contains a ± 1 polarity overflow indicator together with a seven segment digit. The -527, and -528 Series contain two full seven segment digits. All units have a right hand decimal.

Package Dimensions in Inches

DL-524 DL-527 DL-528

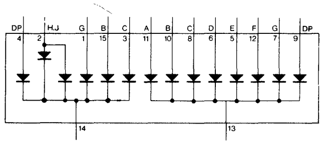


Part Number	Color	Description
DL-524	Red	Common Cathode with ±1
DLO-524	High Efficiency Red	Common Cathode with ±1
DL-527	Red	Common Anode Dual Digit
DLO-527	High Efficiency Red	Common Anode Dual Digit
DL-528	Red	Common Cathode Dual Digit
DLO-528	High Efficiency Red	Common Cathode Dual Digit

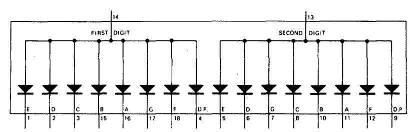
Specifications are subject to change without notice.

Pin	-524 Series Function	-527 Series Function	-528 Series Function	Pin
1	G Anode #1	E Cathode #1	E Anode #1	1
2	H & J Anode #1	D Cathode #1	D Anode #1	2
3	C Anode #1	C Cathode #1	C Anode #1	3
4	DP Anode #1	DP Cathode #1	DP Anode #1	4
5	E Anode #2	E Cathode #2	E Anode #2	5
6	D Anode #2	D Cathode #2	D Anode #2	6
7	G Anode #2	G Cathode #2	G Anode #2	7
8	C Anode #2	C Cathode #2	C Anode #2	8
9	DP Anode #2	DP Cathode #2	DP Anode #2	9
10	B Anode #2	B Cathode #2	B Anode #2	10
11	A Anode #2	A Cathode #2	A Anode #2	11
12	F Anode #2	F Cathode #2	F Anode #2	12
13	Common Cathode #2	Common Anode #2	Common Cathode #2	13
14	Common Cathode #1	Common Anode #1	Common Cathode #1	14
15	B Anode #1	B Cathode #1	B Anode #1	15
16	No Pin	A Cathode #1	A Anode #1	16
17	No Pin	G Cathode #1	G Anode #1	17
18	No Pin	F Cathode #1	F Anode #1	18

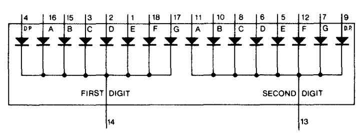
-524
Series



-527
Series



-528
Series



INTERNAL SCHEMATICS

Maximum Ratings

Forward Current Per Segment @ 25°C
- DL-Series .... 30 mA
- DLO-Series .... 25 mA

Forward Current per Digit .... 225 mA
Operating Temperature .... −20 to +85°C
Storage Temperature .... −20 to +85°C
Peak Inverse Voltage .... 3 V
Power Dissipation @ 25°C .... 450 mW/digit
Derating Factor from 25°C .... 7.5 mW/°C/digit

Opto-Electronic Characteristics Per Digit (@ 25°C)

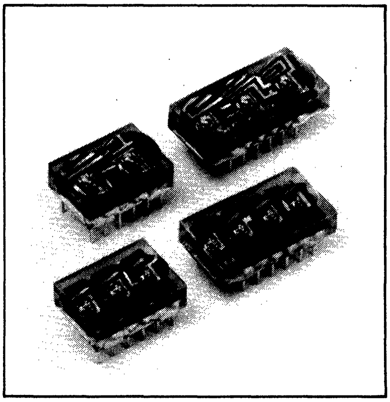
Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity/Segment (Digit Average)					
DL-Series	.14	.4		mcd	$I_F = 20$ mA
DLO-Series	.21	1.2		mcd	$I_F = 20$ mA
Forward Voltage Per Segment					
DL-Series		1.7	2.0	V	$I_F = 20$ mA
DLO-Series		2.2	2.8	V	$I_F = 20$ mA
Reverse Leakage		0.1	100	μA	$V_R = 3$ V
Emission Peak Wavelength					
DL-Series		650		nm	
DLO-Series		630		nm	

Specifications subject to change without notice.

litronix
A Siemens Company

DL-330M
.11 INCH 3 DIGIT
DL-340M
.11 INCH 4 DIGIT
DL-430M
.15 INCH 3 DIGIT
DL-440M
.15 INCH 2 DIGIT

RED 7 SEGMENT MAGNIFIED MONOLITHIC NUMERIC DISPLAY



FEATURES

- **Rugged Encapsulated Package**
- **Integrated Magnifier Lens**
- **Monolithic Construction for Maximum Brightness at Minimum Power**
- **Common Cathode for Simplicity of Multiplexing**
- **Standard Dual-In-Line Package**
- **Categorized for Brightness Uniformity**

DESCRIPTION

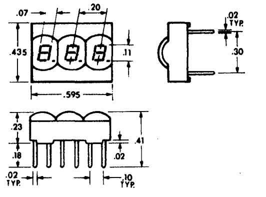
The DL-330M/340M and DL-430M/440M are red numeric LED displays. Low cost is achieved through minimum use of monolithic GaAsP material and magnification to full height using a simple integrated lens construction. A red plexiglass or circularly polarized filter is recommended to enhance visibility and to eliminate glare from the surface of the package.

These displays are designed for multiplex operation, the desired digit being displayed by selecting the appropriate cathode. A right hand decimal point is provided.

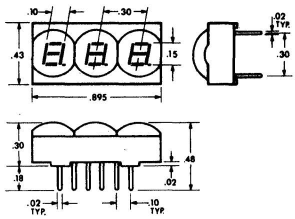
All devices are optimized for low power portable battery operated equipment using MOS and CMOS integrated logic circuits such as DMM's and digital thermometers.

Package Dimensions in Inches

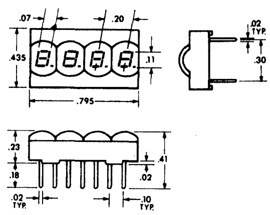
DL-330M



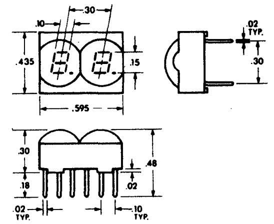
DL-430M



DL-340M



DL-440M



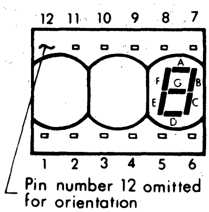
Maximum Ratings (at 25 °C)

Power Dissipation/Digit .... 80 mW
Derating Factor from 25 °C/Digit .... 1.8 mW/ °C
Storage and Operating Temperature ...... −20 °C to +70 °C
Continuous Forward Current
Per Segment and Decimal .... 20 mA
Per Digit Total .... 40 mA
Peak Inverse Voltage
Per Segment and Decimal .... 3 V

Opto-Electronic Characteristics (at 25 °C)

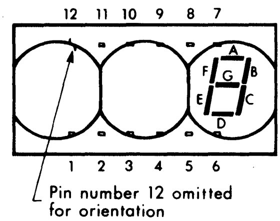
Parameter	Min	Max	Unit	Test Condition
Luminance	1.5		mcd	$I_F=5$ mA
Emission Peak Wavelength	650		nm	
Line Half-Width	40		nm	
Forward Voltage	1.7	2.0		$I_F=20$ mA
Dynamic Resistance	7		Ω	$I_F=10$ mA
Capacitance	50		pF	V=0, f=1 MHz
Reverse Leakage		100	μA	$V_R=3.0$ V

Specifications subject to change without notice.



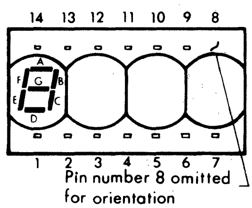
DL-330M

Pin	Function
1	Cathode D1
2	Anode E
3	Anode D
4	Cathode D2
5	Anode C
6	Anode DP
7	Cathode D3
8	Anode B
9	Anode G
10	Anode A
11	Anode F
12	No Pin



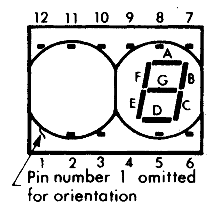
DL-430M

Pin	Function
1	Cathode D1
2	Anode E
3	Anode D
4	Cathode D2
5	Anode C
6	Anode DP
7	Cathode D3
8	Anode B
9	Anode G
10	Anode A
11	Anode F
12	No Pin



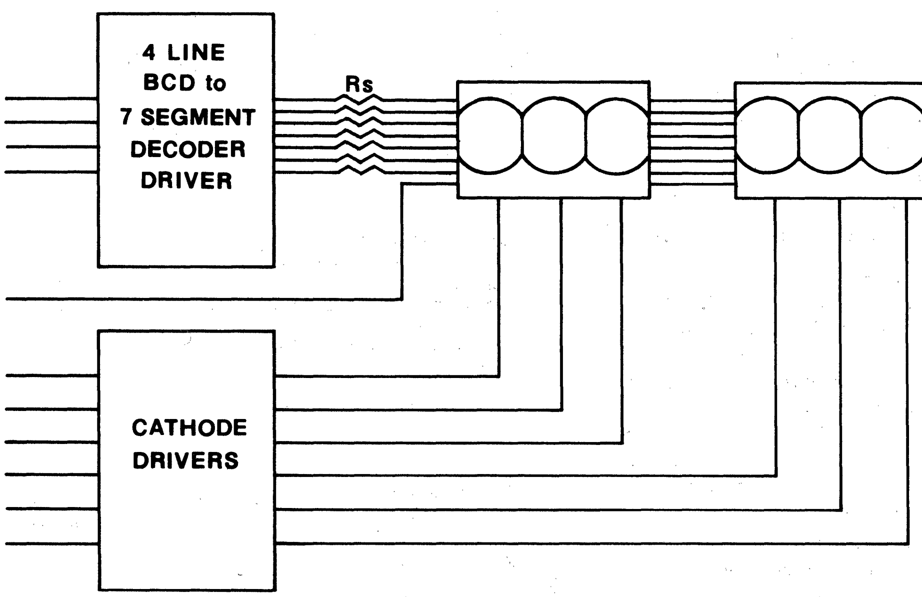
DL-340M

Pin	Function
1	No Connection
2	Anode E
3	Anode D
4	Anode C
5	Anode DP
6	Anode G
7	Cathode 4
8	No Pin
9	Anode B
10	Cathode 3
11	Anode F
12	Cathode 2
13	Anode A
14	Cathode 1



DL-440M

Pin	Function
1	No Pin
2	Anode E
3	Anode D
4	No Pin
5	Anode C
6	Anode DP
7	Cathode D2
8	Anode B
9	Anode G
10	Anode A
11	Anode F
12	Cathode D1

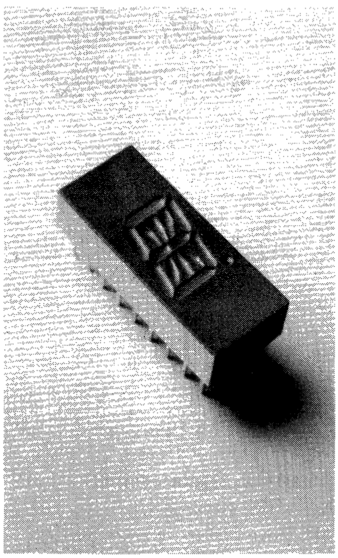


BLOCK DIAGRAM FOR TYPICAL DISPLAY DRIVE CIRCUITRY

litronix
A Siemens Company

HD 14101R
RED
HD 14101G
GREEN

.039 INCH (10 mm) 14-SEGMENT ALPHANUMERIC DISPLAY



FEATURES

- **14-Segment Alphanumeric Display**
- **Rugged Encapsulated Package**
- **0.39 Inch (10 mm) Character Height**
- **Available in Red, HD 14101R, and Green, HD 14101G**
- **Decimal Point Right**
- **Common Anode**
- **Up to 15 Feet Viewing Distance**

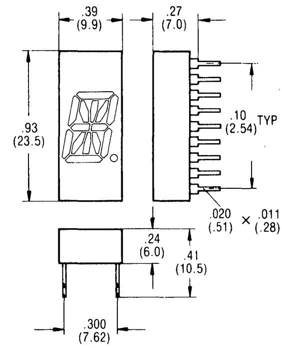
DESCRIPTION

The 0.39 inch (10 mm) digit height series of HD 14101R Red and HD 14101G Green, 14-segment display is offered in common anode with right hand decimal.

These displays have good wide angle viewing and can be read up to 15 feet away. Applications would include consumer or industrial products and equipment that require large size alphanumeric capability.

The displays have a light grey face. Contrast enhancement filters are recommended.

Package Dimensions in Inches (mm)



Maximum Ratings

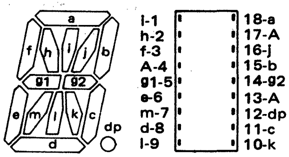
Power Dissipation Per Segment	45 mW
Operating Temperature	−35 to +85 °C
Storage Temperature	−40 to +85 °C
DC Forward Current Per Segment	
HD 14101R	25 mA
HD 14101G	17.5 mA
Peak Forward Current ($t \leq 10\ \mu s$)	
HD 14101R	400 mA
HD 14101G	150 mA
Reverse Voltage	6 V
Thermal Resistance	80 K/W

Opto-Electronic Characteristics (@25 °C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity Per Segment					
HD 14101R	120	300		μcd	$I_F = 10$ mA
		850		μcd	$I_F = 25$ mA
HD 14101G	120	260			$I_F = 5$ mA
		1,000			$I_F = 15$ mA
Forward Voltage					
HD 14101R		1.6	2.0	V	$I_F = 10$ mA
HD 14101G		1.9	2.4	V	$I_F = 5$ mA
Reverse Current		0.01	10	μA	$V_R = 6$ V
Peak Emission Wavelength					
HD 14101R		665		nm	
HD 14101G		560		nm	
Rise Time/Fall Time					
HD 14101R		5		ns	
HD 14101G		50		ns	
Capacitance					
HD 14101R		40		pF	$V_R = 0$ V, f = 1 MHz
HD 14101G		45		pF	$V_R = 0$ V, f = 1 MHz

Specifications subject to change without notice.

CONDENSER PLATE ATTACHMENT

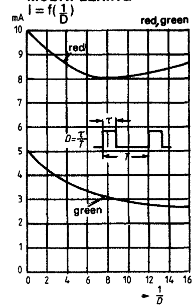


A = COMMON ANODE

TOP VIEW

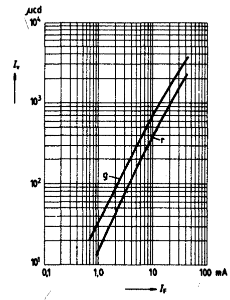
CURRENT FOR CONSTANT LIGHT OUTPUT I_V FOR MULTIPLEXING

$I = f(\frac{1}{D})$



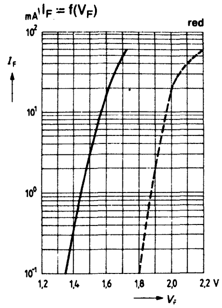
LUMINOUS INTENSITY

$I_v = f(I_F)$



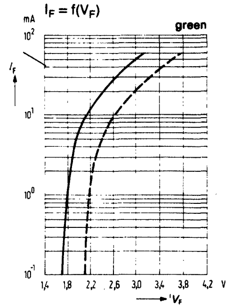
FORWARD CURRENT

$I_F = f(V_F)$



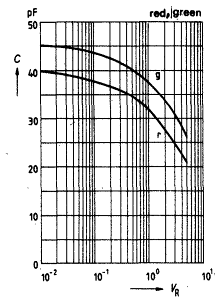
FORWARD CURRENT

$I_F = f(V_F)$



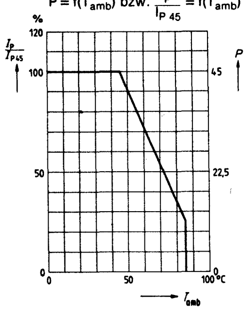
CAPACITANCE

$C = f(V_R)$



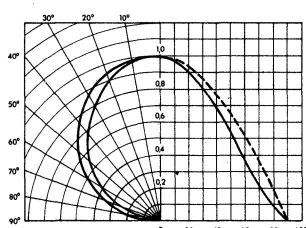
POWER DISSIPATION AND PEAK CURRENT PER SEGMENT

$P = f(T_{amb})$ bzw. $\frac{I_P}{I_{P\,45}} = f(T_{amb})$



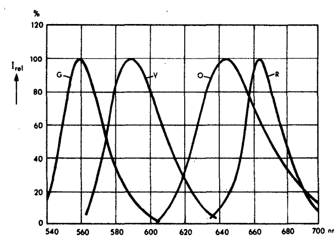
RADIATION CHARACTERISTICS

$I_F = f(y)$



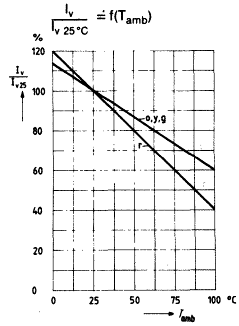
RELATIVE SPECTRAL EMISSION

$I_{rel} = f(\lambda)$



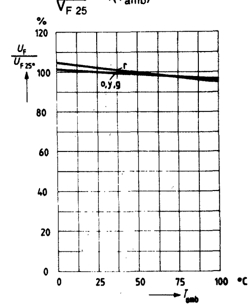
LUMINOUS INTENSITY

$\frac{I_v}{I_{v\,25\,°C}} = f(T_{amb})$



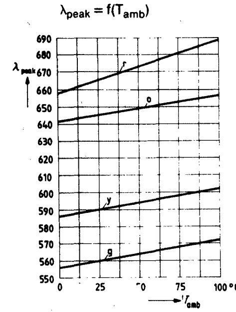
FORWARD VOLTAGE

$\frac{V_F}{V_{F\,25}} = f(T_{amb})$



WAVELENGTH AT PEAK EMISSION

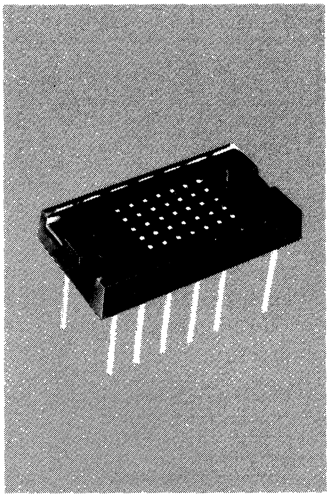
$\lambda_{peak} = f(T_{amb})$



litronix
A Siemens Company

DL-57

RED 5 x 7 DOT MATRIX ALPHANUMERIC DISPLAY



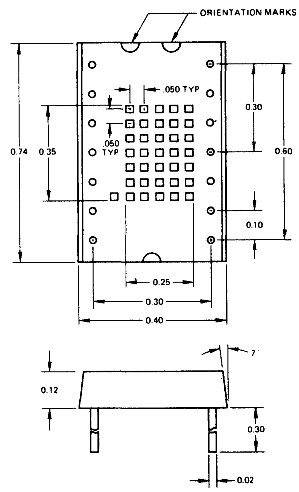
FEATURES

- Displays All 64 ASCII Characters
- Solid State Reliability — Impervious to Vibration
- IC Compatible
- Small Size
- Standard 14 Pin Dual-In-Line Package

DESCRIPTION

The DL-57 is a 5x7 dot matrix array Gallium Arsenide Phosphide light emitting diode alpha numeric display. It is particularly well suited for use in keyboard verifiers, film annotation, computer peripheral equipment and other applications requiring the readout of alphabetical characters as well as numeric digits.

Package Dimensions in Inches



DUAL, IN-LINE CONFIGURATION

Maximum Ratings (@25 °C)

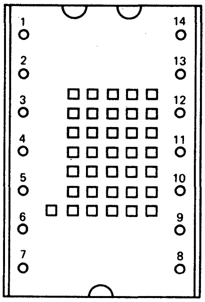
Power Dissipation @ 25 °C Ambient	750 mW
Derating Factor from 25 °C	−10 mW/°C
Storage Temperature	−20 °C to +100 °C
Operating Temperature	0 °C to +75 °C
Continuous Forward Current (Each Diode)	20 mA 200 mA Total
Peak Inverse Voltage	3.0 V

Opto-Electronic Characteristics (@ 25 °C)

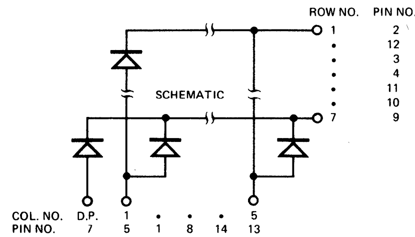
Parameter (Each Diode)	Min	Typ	Max	Unit	Test Condition
Luminous Intensity	.25	.40		mcd	$I_F = 10$ mA
Emission Peak Wave Length		650		nm	
Line Half Width		40		nm	
Forward Voltage		1.7	20	V	$I_F = 20$ mA
Reverse Leakage			100	μA	$V_R = 3$ V

Specifications subject to change without notice.

PIN CONFIGURATIONS



PIN	ROW-COLUMN	BIAS
1	COLUMN 2,	+
2	ROW 1,	–
3	ROW 3,	–
4	ROW 4,	–
5	COLUMN 1,	+
6	N.C.	
7	D.P.	+
8	COLUMN 3,	+
9	ROW 7,	–
10	ROW 6,	–
11	ROW 5,	–
12	ROW 2,	–
13	COLUMN 5,	+
14	COLUMN 4,	+



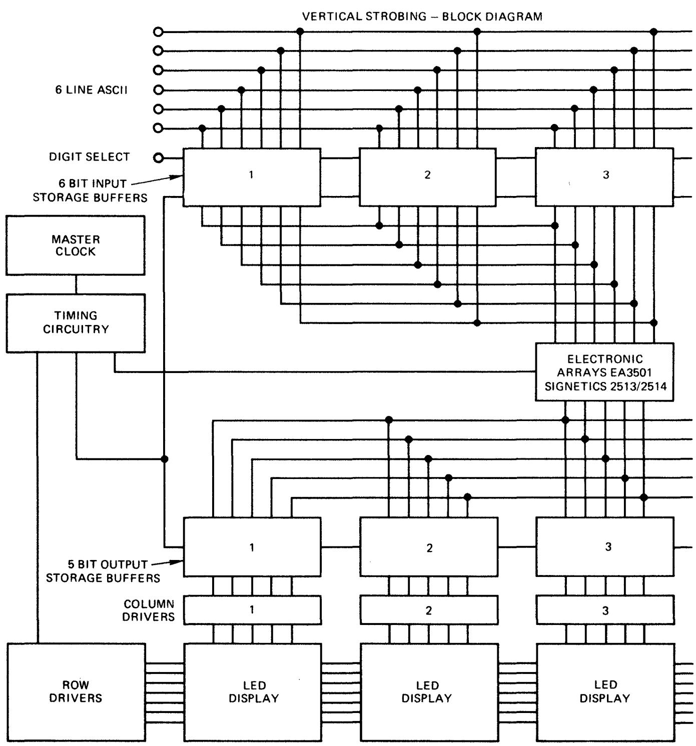
THE 64 ASCII CHARACTERS

0 1 2 3 4 5 6 7 8 9

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

@ - $ & ! # * , . + – / ; = ? : " % ' \ [ ] > < ( ) ^

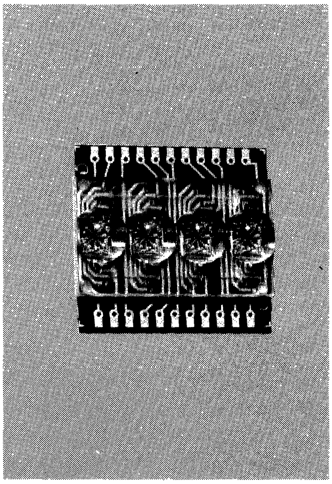
TYPICAL VERTICAL SCAN DISPLAY SYSTEM



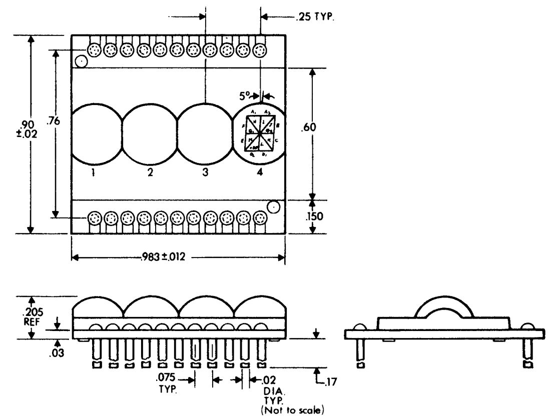
litronix
A Siemens Company

DL-416

4-CHARACTER 16-SEGMENT RED ALPHANUMERIC DISPLAY



Package Dimensions in Inches



FEATURES

- 16 Segment Starburst
- Full Alphanumeric Display Capability
- End-Stackable Module
- High Contrast, Magnified Monolithic Display
- Low Cost Construction

DESCRIPTION

The DL-416 is a 4 character 16 segment alpha/numeric display. The individual 4 character units are end-stackable. The magnified character is slanted 5 degrees and is 160 mils high. Designed for use in hand-held and mobile equipment. The DL-416 provides a high contrast, daylite viewable display readable at distances up to 5 ft.

Maximum Ratings

Continuous Forward Current	
@ 25 °C	15 mA/seg
All Segments On	5 mA/seg average
Power Dissipation @ 25 °C	170 mW/character
Derating from 25 °C	3.8 mW/ °C/character
Reverse Voltage	3 V
Operating Storage Temp.	−20 °C to 70 °C
Maximum Peak Current	200 mA

Electro Optical Characteristics

Optical

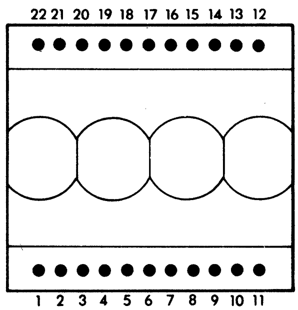
	Typical
Luminous Intensity	.2 mcd/seg, Min. @ 5 mA/seg
Spectral Peak Wavelength	650 nm Typ.
Spectral Line Half-Width	40 nm Typ.
Viewing Angle	±20° Min.
Digit Size	160 mils

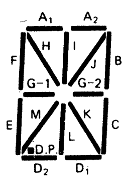
Electrical

Forward Voltage	1.65 Typ. @ $I_F = 10$ mA
Reverse Current	100 μA Typ. @ $V_R = 3$ V

Specifications subject to change without notice.

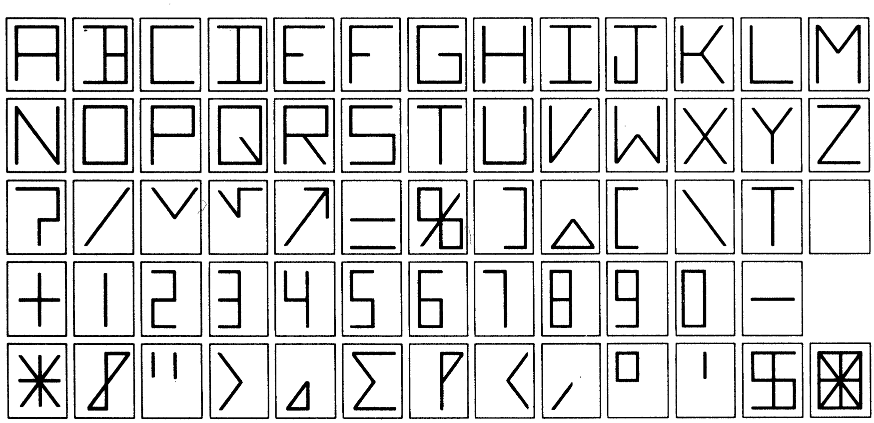
PIN CONFIGURATION





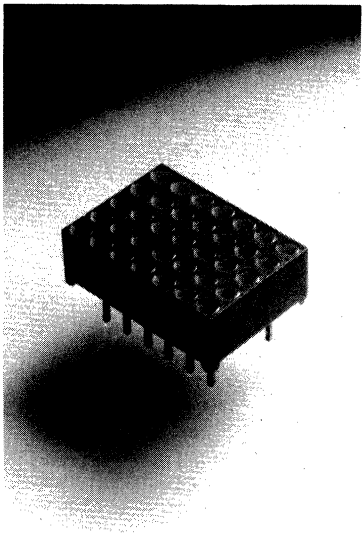
PIN	FUNCTION
1	G_1 Anode
2	Decimal Point Anode
3	Common Cathode Digit 1
4	D_2 Anode
5	L Anode
6	Common Cathode Digit 3
7	E Anode
8	M Anode
9	K Anode
10	Common Cathode Digit 4
11	D_1 Anode
12	J Anode
13	NC
14	G_2 Anode
15	A_2 Anode
16	I Anode
17	Common Cathode Digit 2
18	B Anode
19	A_1 Anode
20	C Anode
21	H Anode
22	F Anode

TYPICAL DISPLAY PATTERNS



DL-5735

0.68" (17.27 mm) RED, 5x7 ALPHANUMERIC DISPLAY



FEATURES

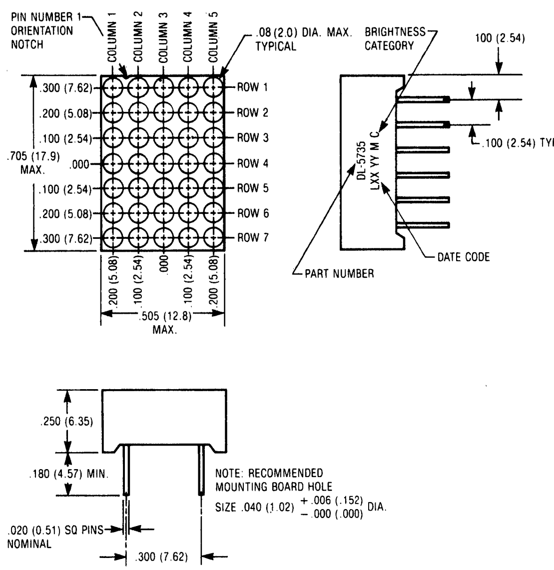
- **5x7 Matrix Array with Row-column Select**
- **End & Side Stackable**
- **Rugged Encapsulation (Filled Reflector Construction)**
- **Compatible with ASCII and EBCDIC Format**
- **Standard 12 pin, 0.3" pin spacing, Dual-Inline-Package**
- **Good "OFF" Segment Contrast Grey face with clear segments.**

DESCRIPTION

The DL5735 is a 5x7 dot matrix gallium arsenide phosphide light emitting diode alphanumeric display.

Compatible with ASCII and EBCDIC formats, the DL5735 is well suited for use in keyboard verifiers, computer peripheral equipment, other applications requiring an alphanumeric display, and stackable both horizontally and vertically to generate large alphanumeric or even graphic displays.

Package Dimensions in Inches (mm)



Maximum Ratings @ 25°C

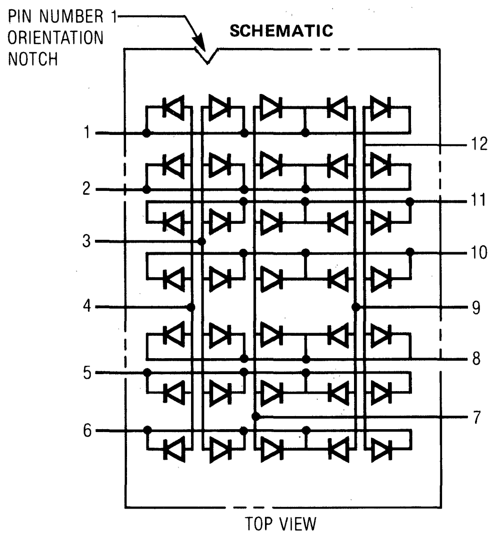
Power Dissipation/Package	750 mW
Derate Linearly from 25°C	11.5 mW/°C
Storage Temperature	−20 to +70°C
Operating Temperature	−20 to +70°C
Continuous Forward Current Per Segment	20 mA
Pulse Peak Current/Segment 20% Duty Cycle	100 mA
Reverse Voltage	3V
Solder Temperature 1/16 below seating plane for 5 seconds	260°C

Opto-Electronics Characteristics @ 25°C

Parameter	Min	Typ	Max	Unit	Test Conditions
Luminous Intensity Per DOT Digit Average	100	200		μcd	$I_F = 20$ mA
Forward Voltage		1.7	2.0	V	$I_F = 20$ mA
Reverse Current			100	μA	$V_R = 3$ V
Peak Emission Wavelength		650		nm	
Spectral Line Half-Width		40		nm	
Capacitance		115		pf	V = 0

Specifications subject to change without notice.

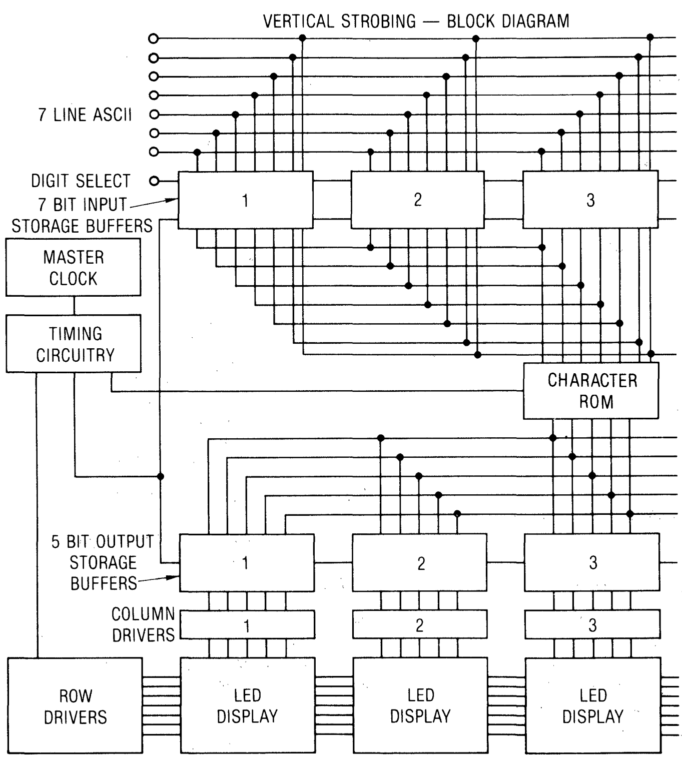
PIN CONFIGURATIONS



PIN FUNCTION

PIN	FUNCTION
1	ROW 1 CATHODE
2	ROW 2 CATHODE
3	COLUMN 2 ANODE
4	COLUMN 1 ANODE
5	ROW 6 CATHODE
6	ROW 7 CATHODE
7	COLUMN 3 ANODE
8	ROW 5 CATHODE
9	COLUMN 4 ANODE
10	ROW 4 CATHODE
11	ROW 3 CATHODE
12	COLUMN 5 ANODE

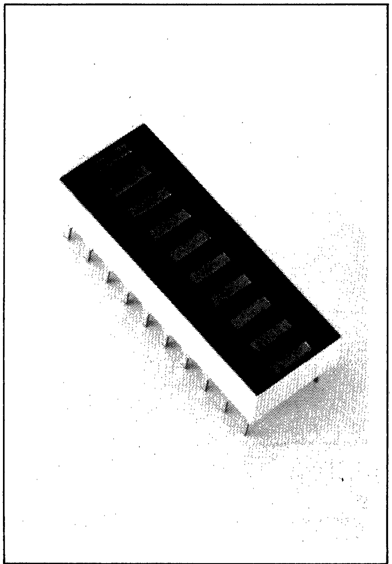
TYPICAL VERTICAL SCAN DISPLAY SYSTEM



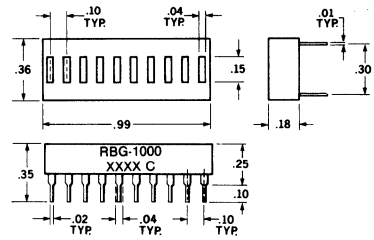
litronix
A Siemens Company

RBG-1000
RED
OBG-1000
HIGH EFFICIENCY RED
YBG-1000
YELLOW
GBG-1000
GREEN

10 ELEMENT LINEAR DISPLAY



Package Dimensions in Inches



Maximum Ratings

Storage Temperature	−20° to +85°C
Operating Temperature	20° to +85°C
Power Dissipation @25°C	450 mW
Derating Factor from 25°C	7.5 mW/°C
Continous Forward Current	
RBG-1000 per display	200 mA
per element	20 mA
OBG-1000 YBG-1000 GBG-1000 per display	156 mA
per element	20 mA
Peak Inverse Voltage per Element	3 V

Opto-Electronic Characteristics (@25°C)

Parameter	Typ	Max	Unit	Test Condition
Luminous Intensity/ Element (Display Average)				
RBG-1000	.5		mcd	$I_F = 20$ mA/ Segment
OBG-1000	2.5		mcd	$I_F = 20$ mA/ Segment
YBG-1000	2.0		mcd	$I_F = 20$ mA/ Segment
GBG-1000	2.0		mcd	$I_F = 20$ mA/ Segment
Forward Voltage				
RBG-1000	1.7	2.0	V	$I_F = 20$ mA
OBG-1000	2.2	2.8	V	$I_F = 20$ mA
YBG-1000	2.4	3.0	V	$I_F = 20$ mA
GBG-1000	2.4	3.0	V	$I_F = 20$ mA
Reverse Leakage	0.1	100	μA	$V_R = 3$ V
Emission Peak Wavelength				
RBG-1000	660		nm	
OBG-1000	630		nm	
YBG-1000	585		nm	
GBG-1000	565		nm	

Specifications subject to change without notice.

FEATURES

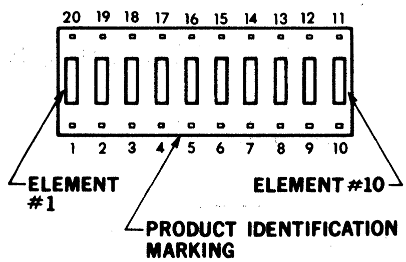
- 10 Element Display
- End Stackable Module
- Individual Addressable Anode and Cathode
- Intensity Coded for Display Uniformity
- Rugged Encapsulation
- Choice of Colors

DESCRIPTION

The Red RBG-1000, Hi-efficiency Red OBG-1000, Yellow YBG-1000, and Green GBG-1000 are 10 individual element linear bar displays. They are contained in a 1 inch long, 20 pin dual-in-line package that can be end stacked as bar-graph displays of various lengths. Applications include: bar graph, solid-state meter movement, position indicator, etc.

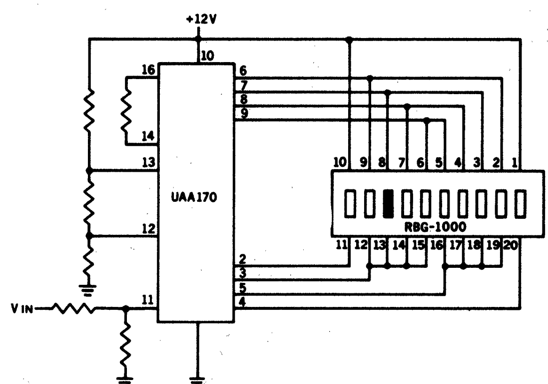
RBG-1000, OBG-1000, YBG-1000 AND GBG-1000

TOP VIEW



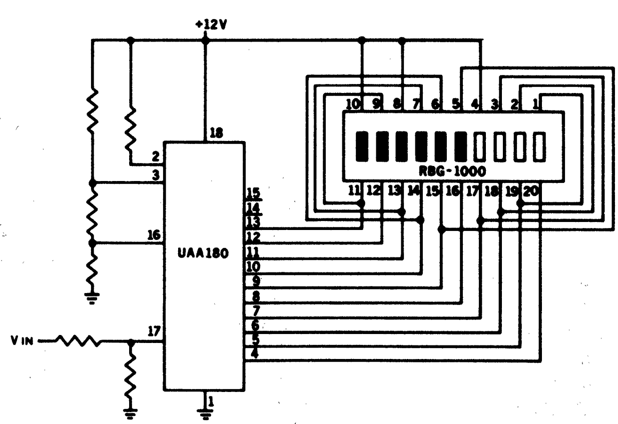
PIN	FUNCTION	PIN	FUNCTION
1	ANODE 1	11	CATHODE 10
2	ANODE 2	12	CATHODE 9
3	ANODE 3	13	CATHODE 8
4	ANODE 4	14	CATHODE 7
5	ANODE 5	15	CATHODE 6
6	ANODE 6	16	CATHODE 5
7	ANODE 7	17	CATHODE 4
8	ANODE 8	18	CATHODE 3
9	ANODE 9	19	CATHODE 2
10	ANODE 10	20	CATHODE 1

TYPICAL APPLICATIONS



LIGHT SPOT DISPLAY

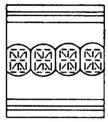
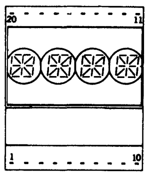
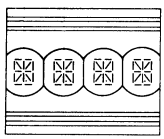
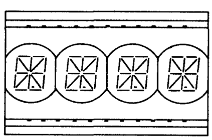
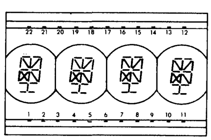
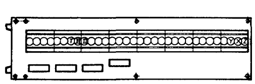
LINEAR DISPLAY DRIVERS
Siemens UAA170
Siemens UAA180
National LM3914
National LM3915
Sharp IR2406



LIGHT BAND DISPLAY

No endorsement or warranty of other manufacturer's products is intended by Litronix

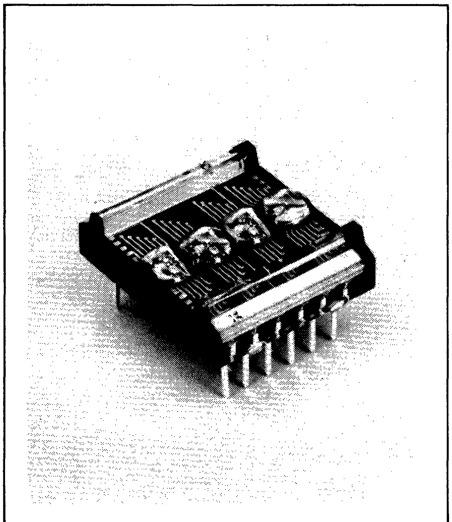
LED Intelligent Displays™

Package Type	Package Outline	Part Number	Character Height	Description	Page
4 Char. Module Encapsulated		DL-1414	.112"	17 segment, 4 character display with built in CMOS ASCII decoder, multiplexer, memory and driver	67
4 Char. Module		DL-1416	.160"	16 segment, 4 character display with built in CMOS ASCII decoder, multiplexer, memory and driver	71
4 Char. Module Encapsulated		DL-2416	.160"	17 segment, 4 character display with built in CMOS ASCII decoder, multiplexer, memory and driver	75
4 Char. Module Encapsulated		DL-3416	.225"	17 segment, 4 character display with built in CMOS ASCII decoder, multiplexer, memory and driver	79
4 Char. Module Encapsulated		DL-3422	upper case lower case	22 segment, 4 character display, upper and lower case letters with built in CMOS ASCII decoder, multiplexer, memory and driver	83
16 & 32 Char. Assembly		IDA-2416-16	.160"	16 character assembly containing four DL-2416 displays	87
		IDA-2416-32		32 character assembly containing eight DL-2416 displays	

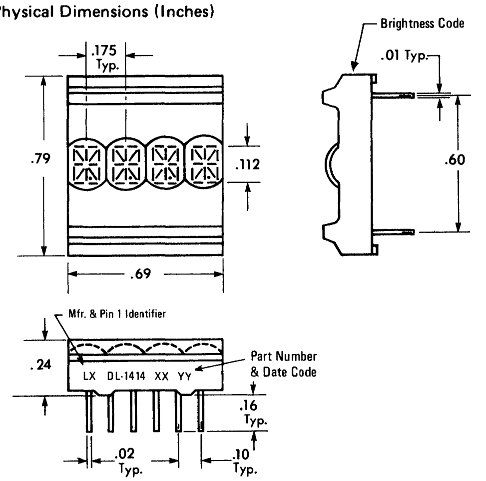
litronix
A Siemens Company

DL-1414

.112″ RED, 4-DIGIT 17-SEGMENT ALPHANUMERIC Intelligent Display™ WITH MEMORY/DECODER/DRIVER



Physical Dimensions (Inches)



Tolerance ± .01 Unless Otherwise Noted

FEATURES

- **112 Mil High, Magnified Monolithic Char.**
- **Wide Viewing Angle, ±40°**
- **Close Vertical Row Spacing, .800 Inches**
- **Rugged Solid Plastic Encapsulated Package**
- **Fast Access Time, 450 nSEC**
- **Compact Size For Hand Held Equipment**
- **Built-In Memory**
- **Built-In Character Generator**
- **Built-In Multiplex and LED Drive Circuitry**
- **Direct Access To Each Digit Independently and Asynchronously**
- **TTL Compatible, 5 Volt Power**
- **17th Segment For Improved Punctuation Marks**
- **Low Power Consumption, Typically 10 mA per character**
- **Intensity Coded For Display Uniformity**
- **End-Stackable, 4-Character Package**

DESCRIPTION

The DL1414 is a four digit display module having 16 bar segments plus a decimal segment and a built-in CMOS integrated circuit.

The integrated circuit contains memory, ASCII character generator, and LED multiplexing and drive circuitry. Inputs are TTL compatible. A single 5-volt power supply is required. Data entry is asynchronous and random access. A display system can be built using any number of DL1414's since each character in any DL1414 can be addressed independently and will continue to display the character last written until it is replaced by another.

LOADING DATA

Loading data into the DL1414 is straightforward. The desired data code (D_0–D_6) and digit address (A_0, A_1) is presented in parallel and held stable during a write cycle. Data entry may be asynchronous and in random order. (Digit 0 is defined as right hand digit with $A_1 = A_0 = 0 =$ low).

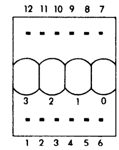
System interconnection is also straightforward. The least significant two address bits (A_0, A_1) are normally connected to the like named inputs of all DL1414's in the system. Data lines are connected to all DL1414's directly and in parallel. Multiple DL1414 systems usually use an external one-of-N decoder chip. The "write" pulse is connected to the CE of the decoder. A 3-to-8 line decoder multiplexer (74138) or a 4-to-16 line decoder/multiplexer (74154) are possible choices. All higher-order address bits (above A_1) become inputs to the decoder.

Specifications Subject To Change Without Notice

Pin	Function
1	D5 Data Input
2	D4 Data Input
3	$\overline{WR}$ Write
4	A1 Digit Select
5	AØ Digit Select
6	V_{CC}

Pin	Function
7	Gnd
8	DØ Data Input (LSB)
9	D1 Data Input
10	D2 Data Input
11	D3 Data Input
12	D6 Data Input (MSB)

TOP VIEW



Product Identification
Markings on Front Surface

OPTO-ELECTRONIC CHARACTERISTICS @ 25°C

MAXIMUM RATINGS

Voltage, Any Pin
Respect to GND . . . . -.5 to +6 VDC
Operating Temperature . . . . . -20°C to 65°C
Storage Temperature . . . . -20°C to 70°C
Relative Humidity (non condensing) @ 65°C, 85%

OPTICAL CHARACTERISTICS (TYPICAL)

Luminous Intensity per digit/8 segments @ 5V . . . . . 0.5 mcd
Off Axis Viewing Angle (Note 1) . . . . ±40°
Digit Size . . . . 112 mils
Spectral Peak Wavelength . . . . 660 nm

DC CHARACTERISTICS

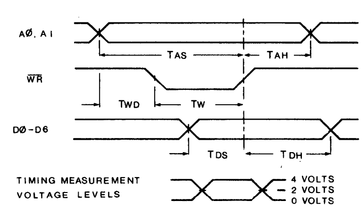
Parameter	-20°C Typ	+25°C (Note 6)	+65°C Typ	Conditions
I_{CC} 4 Digits on (10 seg/Digit)	100 mA	90 mA Max	70 mA	V_{CC} = 5.0 V
I_{CC} Blank		2.7 mA Max		V_{IN} = 0 V_{CC} = 5.0 V $\overline{WR}$ = 5.0 V
I_{IL}	180 μA	160 μA Max	100 μA	V_{IN} = .8 V V_{CC} = 5.0 V
V_{IL}		.8 V Max		V_{CC} = 4.5 V
V_{IH} (Note 4)		2.7 V Min 3.3 V Min		V_{CC} = 4.5 V V_{CC} = 5.5 V

AC CHARACTERISTICS
MINIMUM TIMING PARAMETERS @ 4.5 V (nanoseconds)

Parameter	-20°C Typ	25°C Min	+65°C Typ
T_{AS}	300	400	500
T_{WD}	50	75	125
T_W	250	325	375
T_{DS}	200	250	300
T_{DH}	50	50	100
T_{AH}	50	50	100

TIMING CHARACTERISTICS

WRITE CYCLE WAVEFORMS



Note 1: "Off Axis Viewing Angle" is here defined as: "the minimum angle in any direction from the normal to the display surface at which any part of any segment in the display is not visible".

Note 2: This display contains a CMOS integrated circuit. Normal CMOS handling precautions should be taken to avoid damage due to high static voltages or electric fields.

Note 3: Unused inputs must be tied to an appropriate logic voltage level (either V+ or V-).

Note 4: $V_{cc} \geqslant V_{IH} \geqslant 0.6\ V_{cc}$.

Note 5: **Warning** — Do not use solvents containing alcohol.

Note 6: V_{cc} = +5.0 VDC ±10%

CHARACTER SET

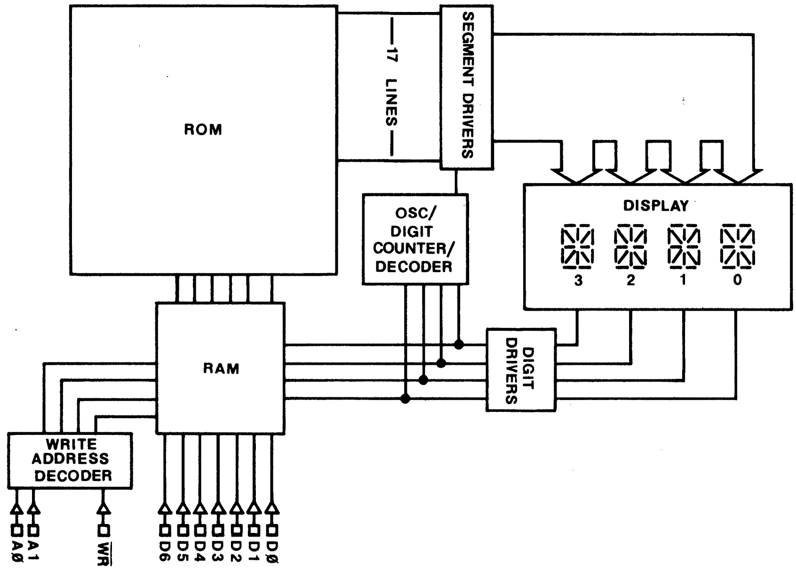
D6	D5	D4	D3	D0: L D1: L D2: L	D0: H D1: L D2: L	D0: L D1: H D2: L	D0: H D1: H D2: L	D0: L D1: L D2: H	D0: H D1: L D2: H	D0: L D1: H D2: H	D0: H D1: H D2: H
L	H	L	L		!	"	#	$	%	&	'
L	H	L	H	(	)	*	+	,	-	.	/
L	H	H	L	0	1	2	3	4	5	6	7
L	H	H	H	8	9	:	;	<	=	>	?
H	L	L	L	@	A	B	C	D	E	F	G
H	L	L	H	H	I	J	K	L	M	N	O
H	L	H	L	P	Q	R	S	T	U	V	W
H	L	H	H	X	Y	Z	[	\	]	^	_

All Other Input Codes Display "Blank"

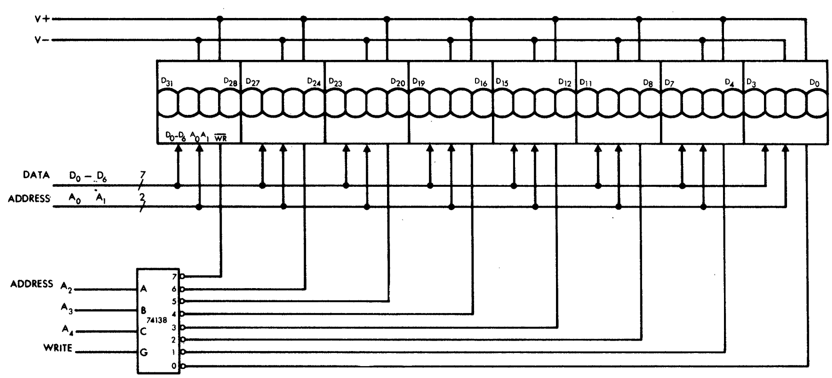
LOADING DATA STATE TABLE

$\overline{WR}$	A1	A0	D6	D5	D4	D3	D2	D1	D0	DIGIT 3	DIGIT 2	DIGIT 1	DIGIT 0
H		PREVIOUSLY LOADED DISPLAY								G	R	E	Y
L	L	L	H	L	L	L	H	L	H	G	R	E	E
L	L	H	H	L	H	L	H	L	H	G	R	U	E
L	H	L	H	L	L	H	H	L	L	G	L	U	E
L	H	H	H	L	L	L	L	H	L	B	L	U	E
L	L	H	H	L	L	L	H	L	H	B	L	E	E
L	L	L	H	L	H	L	H	H	H	B	L	E	W
L	X	X	SEE CHARACTER CODE							SEE CHARACTER SET			

X = DON'T CARE



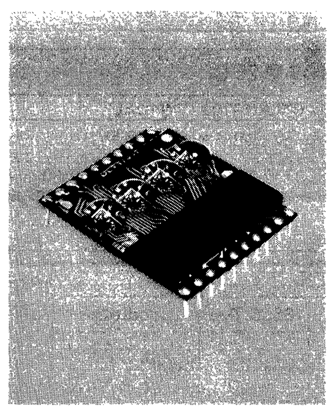
DL-1414 Block Diagram



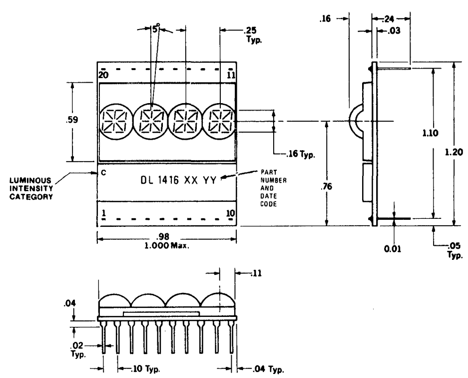
TYPICAL INTERCONNECTION
FOR 32 DIGITS

litronix
A Siemens Company

DL-1416
.160″ RED, 4-DIGIT 16-SEGMENT ALPHANUMERIC Intelligent Display™ WITH MEMORY/DECODER/DRIVER



Dimensions in inches



TOLERANCE ±.01 UNLESS OTHERWISE NOTED

FEATURES

- **End-stackable, 4-Character Package**
- **High Contrast, 160 mil High, Magnified Monolithic Characters**
- **64-Character ASCII Format**
- **Built-in Memory, Decoder, Multiplexer and Drivers**
- **Direct Access to Each Digit Independently and Asynchronously**
- **5 Volt Logic, TTL Compatible**
- **5 Volt Power Supply Only**
- **Independent Cursor Function**
- **Intensity Coded For Display Uniformity**

DESCRIPTION

The DL-1416 Intelligent Display is a four-digit LED display module having a 16-segment font and an on-board CMOS integrated circuit driver.

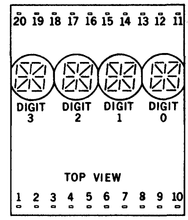
The CMOS chip includes memory for four digits and cursor, 64 ASCII character generator ROM, and segment/digit drivers with associated multiplexing circuitry. Inputs are TTL compatible as is the power supply requirement. Data entry is asynchronous and random access. A display system can be built using any number of DL-1416s since each digit of each DL-1416 can be addressed independently. Each digit will continue to display the character last "written" until replaced by another.

A cursor is defined as all segments of a digit position to be lit. The cursor is *not* a character, however, and upon removal leaves the previously displayed character unchanged. Normally, the cursor would be loaded and unloaded (flash) under software control. This can be used as a pointer in a line of DL-1416 displays or a "lamp test" function is realized by simply storing a cursor in all four digit positions of a display.

System interconnection is very straight forward. The least significant two address bits (A_0, A_1) are connected to the like inputs of all DL-1416s in a system. In small systems having 16 digits (4-DL-1416s), the enable ($\overline{CE}$) inputs of the four devices could simply be used directly to select each DL-1416. In larger displays, the $\overline{CE}$ inputs would come from A 1-of-N decoder integrated circuit. In this case, address lines $A_2 \ldots A_n$ would go to the decoder inputs. Data lines (D_0-D_6) would be connected to all DL-1416s directly and in parallel. The cursor ($\overline{CU}$) and write ($\overline{W}$) lines would also be connected directly directly and in parallel. The display will then behave as a "write-only memory."

Specifications subject to change without notice.

Pin		Function	Pin		Function
1	D5	Data Input	11	A1	Digit Select
2	D4	Data Input	12	Unused	
3	DØ	Data Input	13	Unused	
4	D1	Data Input	14	Unused	
5	D2	Data Input	15	Unused	
6	D3	Data Input	16	Unused	
7	$\overline{CE}$	Chip Enable	17	Unused	
8	$\overline{W}$	Write	18	V+	
9	$\overline{CU}$	Cursor Input	19	V–	
10	AØ	Digit Select	20	D6	Data Input



OPTO-ELECTRONIC CHARACTERISTICS @ 25°C

MAXIMUM RATINGS	
Voltage, Any Pin Respect to GND (V-)	–0.5 to Vcc +0.5 VDC
Operating Temperature	–20 to +65°C
Storage Temperautre	–20 to +70°C
Relative Humidity (non condensing) @ 65°C	85%

OPTICAL CHARACTERISTICS (TYPICAL)	
Luminous Intensity per digit/8 segments @ 5V,	0.5 mcd
Viewing Angle	±20°
Digit Size	160 mils
Spectral Peak Wavelength	660 nm

DC CHARACTERISTICS

Parameter	–20°C Typ	+25°C[4]	+65°C Typ	Conditions
I_{CC} 4 digits on (10 seg/digit)		75 mA max[1]		V_{CC} = 5.0 V
I_{CC} Cursor[2]		100 mA max[1]		V_{CC} = 5.0 V
I_{CC} Blank	5.0 mA	5 mA max	2.0 mA	V_{IN} = 0 V_{CC} = 5.0 V $\overline{WR}$ = 5.0 V
I_{IL}	20 μA	160 μA max	10 μA	V_{IN} = .8 V V_{CC} = 5.0 V
V_{IL}		.8 V Max		V_{CC} = 4.5 V
V_{IH}[3]		2.7 V Min		V_{CC} = 4.5 V
		3.3 V Min		V_{CC} = 5.5 V

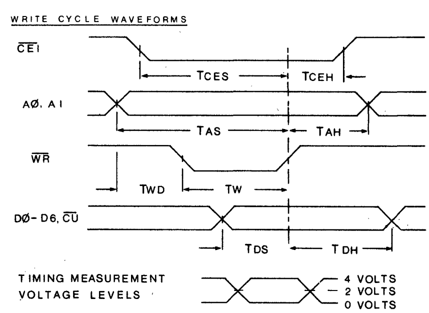
1. Measured at 5 seconds.
2. 60 sec. max. duration.
3. $V_{CC} \geq V_{IH} \geq 0.6\ V_{CC}$
4. V_{cc} = +5.0 VDC ±10%

AC CHARACTERISTICS @ 25°C

MINIMUM TIMING PARAMETERS @ 4.5 V (nanoseconds)

T_{AS}	1000
T_{WD}	500
T_W	500
T_{DS}	1000
T_{DH}	400
T_{AH}	400
T_{CEH}	400
T_{CES}	1000

TIMING CHARACTERISTICS



Note 1: This display contains a CMOS integrated circuit. Normal CMOS handling precautions should be taken to avoid damage due to high static voltages or electric fields.
Note 2: Unused inputs must be tied to an appropriate logic voltage level (eigher V+ or V–).
Note 3: **Warning** — Do not use solvents containing alcohol.

LOADING DATA

The chip enable ($\overline{CE}$) held low and cursor ($\overline{CU}$) held high will enable data loading. The desired data code (D_0-D_6) and selected digit address (A_0-A_1) should be held stable while write ($\overline{W}$) is low for storing new data. The timing parameters in the AC characteristics table are minimum and should be observed. There are no maximum timing requirements. Data entry may be asynchronous and in random order. All undefined data codes (see character set) loaded as data will display a blank.

Digit 0 is defined as the right hand digit with $A_1 = A_0 = 0 =$ low.

LOADING CURSOR

The chip enable ($\overline{CE}$) and Cursor ($\overline{CU}$) are held low. A write (W) signal will now load a cursor into any digit position for which the respective first four data lines (D_0, D_1, D_2, D_3) individually or together are held high. If previously stored, the cursors can only be removed if their respective data lines are held low while $\overline{CE}$, $\overline{CU}$ are low and write ($\overline{W}$) occurs.

The cursor ($\overline{CU}$) should *not* be hardwired high (off). During the power-up of DL-1416s the cursor memory will be in a random state. Therefore, it is recommended for the processor-based system to initialize or write out possible cursors during the system initializing portion of the software.

The cursor display will be over ridden by a blank from an undefined code in that digit position.

TYPICAL LOADING DATA STATE TABLE

			ADDRESS		DATA INPUT							DIGIT	DIGIT	DIGIT	DIGIT
$\overline{CE}$	$\overline{CU}$	$\overline{W}$	A_1	A_0	D6	D5	D4	D3	D2	D1	D0	3	2	1	0
H	X	X	X	X	X	X	X	X	X	X	X	NO CHANGE	NO CHANGE	NO CHANGE	NO CHANGE
L	H	L	L	L	H	L	L	L	L	L	H	NO CHANGE	NO CHANGE	NO CHANGE	A
L	H	L	L	H	H	L	L	L	L	H	L	NO CHANGE	NO CHANGE	B	A
L	H	L	H	L	H	L	L	L	L	H	H	NO CHANGE	C	B	A
L	H	L	H	H	H	L	L	L	H	L	L	D	C	B	A
L	H	L	L	L	H	L	L	L	H	L	H	D	C	B	E
L	H	L	H	L	H	L	L	H	L	H	H	D	K	B	E
L	H	L	–	–	–	–	–	–	–	–	–	SEE CHARACTER SET			

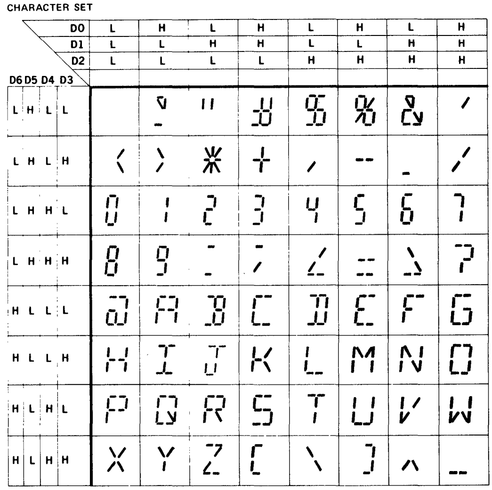
X = DON'T CARE

TYPICAL LOADING CURSOR STATE TABLE

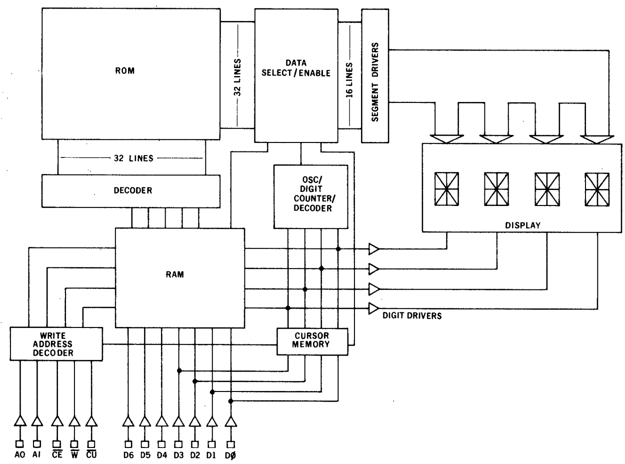
			ADDRESS		DATA INPUT							DIGIT	DIGIT	DIGIT	DIGIT
$\overline{CE}$	$\overline{CU}$	$\overline{W}$	A_1	A_0	D6	D5	D4	D3	D2	D1	D0	3	2	1	0
H	X	X	X	X	X	X	X	X	X	X	X	D	K	B	E
L	L	L	X	X	X	X	X	L	L	L	H	D	K	B	⧆
L	L	L	X	X	X	X	X	L	L	L	L	D	K	B	E
L	L	L	X	X	X	X	X	L	L	H	L	D	K	⧆	E
L	L	L	X	X	X	X	X	L	H	L	L	D	⧆	B	E
L	L	L	X	X	X	X	X	H	L	L	L	⧆	K	B	E
L	L	L	X	X	X	X	X	H	H	H	H	⧆	⧆	⧆	⧆
L	L	L	X	X	X	X	X	L	L	L	L	D	K	B	E

X = DON'T CARE

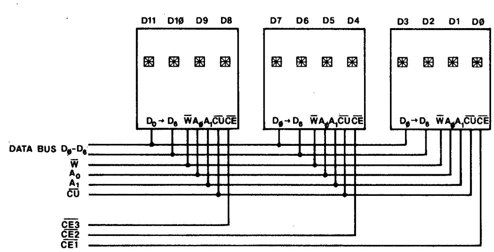
CHARACTER SET



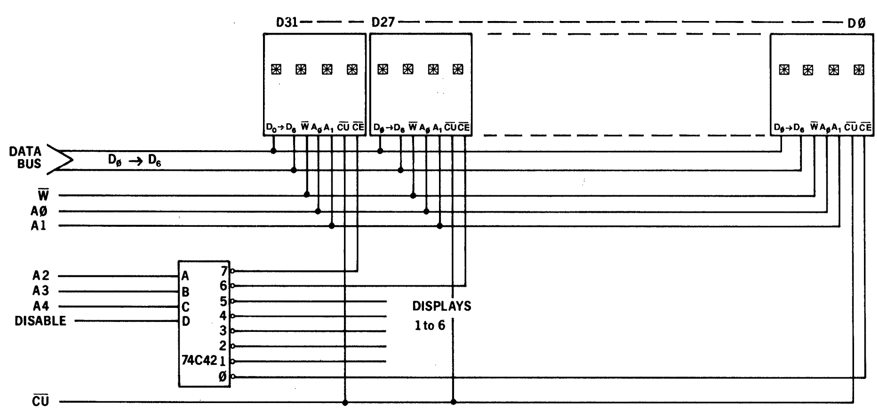
NOTE: All undefined data codes that are loaded or occur on power-up will cause a blank display state.



INTERNAL SCHEMATIC



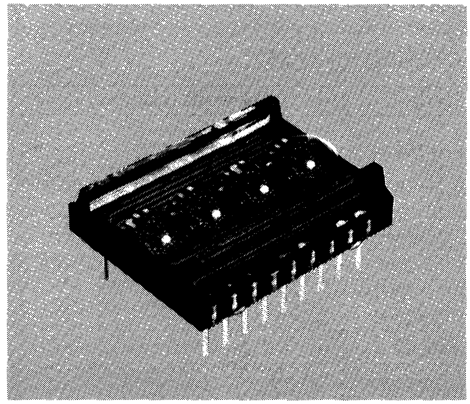
Typical interconnect
for small systems. 12digits

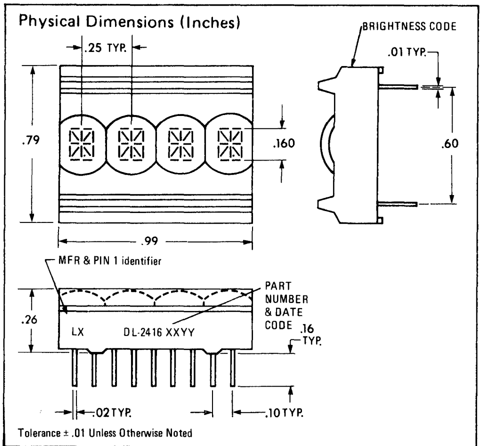


Typical schematic
for 32 digit systems

litronix
A Siemens Company

DL-2416, DL-2416 H
.160″ RED, 4-DIGIT 16-SEGMENT PLUS DECIMAL ALPHANUMERIC Intelligent Display™ WITH MEMORY/DECODER/DRIVER





FEATURES

- 160 Mil High, Magnified Monolithic Char.
- Wide Viewing Angle ± 50°
- Close Vertical Row Spacing, .800 Inches
- Rugged Solid Plastic Encapsulated Package
- Fast Access Time
  DL-2416 500 nSEC
  DL-2416H 300 nSEC
- Full Size Display for Stationary Equipment
- Built-in Memory
- Built-in Character Generator
- Built-in Multiplex and LED Drive Circuitry
- Direct Access to Each Digit Independently & Asynchronously
- TTL Compatible, 5 Volt Power
- Independent Cursor Function
- 17th Segment for Improved Punctuation Marks
- Memory Clear Function
- Display Blank Function
- End-Stackable, 4-Character Package
- Intensity Coded for Display Uniformity

DESCRIPTION

The DL 2416 is a four digit display module having 16 segments plus decimal and a built-in CMOS integrated circuit.

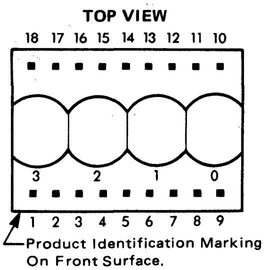
The integrated circuit contains memory, ASCII ROM decoder, multiplexing circuitry, and drivers. Data entry is asychronous and can be random. A display system can be built using any number of DL 2416's since each digit of any DL 2416 can be addressed independently and will continue to display the character last stored until replaced by another.
System interconnection is very straightforward. The least significant two address bits (A_0, A_1) are normally connected to the like named inputs of all DL 2416's in the system. With two chip enables ($\overline{CE1}$, and $\overline{CE2}$) four DL 2416's (16 characters) can easily be interconnected without a decoder.

Alternatively, one-of-n decoder IC's can be used to extend the address for large displays.

Data lines are connected to all DL 2416's directly and in parallel, as is the write line ($\overline{WR}$). The display will then behave as a write-only memory.

The cursor function causes all segments of a digit position to illuminate. The cursor is *not* a character, however, and upon removal the previously displayed character will reappear.

Specifications are subject to change without notice.



Pin	Function	Pin	Function
1	$\overline{CE1}$ Chip Enable	10	Gnd
2	$\overline{CE2}$ Chip Enable	11	DØ Data Input
3	$\overline{CLR}$ Clear	12	D1 Data Input
4	CUE Cursor Enable	13	D2 Data Input
5	$\overline{CU}$ Cursor Select	14	D3 Data Input
6	$\overline{WR}$ Write	15	D6 Data Input
7	A1 Digit Select	16	D5 Data Input
8	AØ Digit Select	17	D4 Data Input
9	V_{CC}	18	$\overline{BL}$ Display Blank

OPTO-ELECTRONIC CHARACTERISTICS @ 25°C

MAXIMUM RATINGS

Voltage, Any Pin
Respect to GND . . . . -.5 to 6.0 VDC
Operating Temperature . . . . . . -20° to 65°C
Storage Temperature . . . . -20° to 70°C
Relative Humidity
(non condensing) @ 65°C 85%

OPTICAL CHARACTERISTICS (TYPICAL)

Luminous Intensity per digit/8 segments . . 0.5 mcd
Off Axis Viewing Angle (Note 1) . . . . ±50°
Digit Size . . . . 160 mils
Spectral Peak Wavelength . . . . 660 nm

DC CHARACTERISTICS
DL-2416 AND DL-2416 H

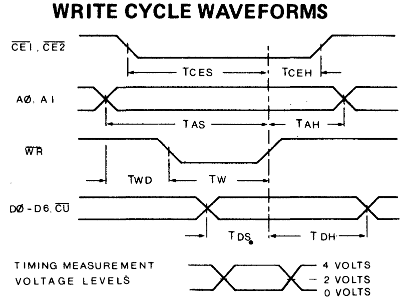
Parameter	-20°C Typ	+25°C[4]	+65°C Typ	Conditions
I_{CC} 4 digits on (10 seg/digit)	135 mA	125 mA max[1]	100 mA	V_{CC} = 5.0 V
I_{CC} Cursor[2]	160 mA	140 mA max[1]	120 mA	V_{CC} = 5.0 V
I_{CC} Blank		3.7 mA max		V_{IN} = 0 V_{CC} = 5.0 V $\overline{WR}$ = 5.0 V
I_{IL}	200 μA	160 μA max	100 μA	V_{IN} = .8 V V_{CC} = 5.0 V
V_{IL}		.8 V max		V_{CC} = 4.5 V
V_{IH}[3]		2.7 V min		V_{CC} = 4.5 V
		3.3 V min		V_{CC} = 5.5 V

1. Measured at 5 sec.
2. 60 sec max duration.
3. $V_{CC} \geqslant V_{IH} \geqslant 0.6\ V_{CC}$.
4. V_{cc} = +5.0 VDC ±10%

AC CHARACTERISTICS
Timing Parameters @ 4.5 V (nanoseconds)

Parameter	-20°C Typ		+25°C Min		+65°C Typ	
	DL-2416	DL-2416 H	DL-2416	DL-2416 H	DL-2416	DL-2416 H
T_{AS}	300	200	450	250	600	400
T_{WD}	50	50	150	50	175	75
T_W	250	150	300	200	425	325
T_{DS}	150	100	250	150	350	250
T_{DH}	50	50	50	50	100	100
T_{AH}	50	50	50	50	100	100
T_{CEH}	50	50	50	50	100	100
T_{CES}	300	150	450	250	600	400
T_{CLR}			15 milliseconds			
			access time			
			500 ns	300 ns		

TIMING CHARACTERISTICS
WRITE CYCLE WAVEFORMS



Note 1: "Off Axis Viewing Angle" is here defined as: "the minimum angle in any direction from the normal to the display surface at which any part of any segment in the display is not visible".

Note 2: This display contains a CMOS integrated circuit. Normal CMOS handling precautions should be taken to avoid damage due to high static voltages or electric fields.

Note 3: Unused inputs must be tied to an appropriate logic voltage level (either V+ or V–).

Note 4: **Warning** — Do not use solvents containing alcohol.

LOADING DATA

Setting the chip enables ($\overline{CE1}$, $\overline{CE2}$) to their true state will enable data loading. The desired data code (D0-D6) and digit address (A_0, A_1) must be held stable during the write cycle for storing new data.

Data entry may be asynchronous and random. (Digit 0 is defined as right hand digit with $A_1 = A_0 = 0$.)

Clearing of the entire internal four-digit memory can be accomplished by holding the clear ($\overline{CLR}$) low for one complete display multiplex cycle, 15 mS minimum. Loading an illegal data code will display a blank.

LOADING CURSOR

Setting the chip enables ($\overline{CE1}$, $\overline{CE2}$) and cursor select ($\overline{CU}$) to their true state will enable cursor loading. A write ($\overline{WR}$) pulse will now store or remove a cursor into the digit location addressed by A_0, A_1; as defined in data entry. A cursor will be stored if D0 = 1; and will be removed if D0 = 0. Cursor will not be cleared by the CLR signal. The cursor ($\overline{CU}$) pulse width should not be less than the write ($\overline{WR}$) pulse or erroneous data may appear in the display.

For those users not requiring the cursor, the cursor enable signal (CUE) may be tied low to disable display of the cursor function. A flashing cursor can be realized by simply pulsing CUE. If cursor has been loaded to any or all positions in the display, then CUE will control whether the cursor(s) or the characters appear. CUE does not affect the contents of cursor memory.

DISPLAY BLANKING

Blanking the display may be accomplished by loading a blank or space into each digit of the display or by using the ($\overline{BL}$) display blank input.

Setting the ($\overline{BL}$) input low does not affect the contents of either data or cursor memory. A flashing display can be realized by pulsing ($\overline{BL}$).

TYPICAL LOADING DATA STATE TABLE

CONTROL							ADDRESS		DATA							DISPLAY DIGIT			
$\overline{BL}$	$\overline{CE1}$	$\overline{CE2}$	CUE	$\overline{CU}$	$\overline{WR}$	$\overline{CLR}$	A1	A0	D6	D5	D4	D3	D2	D1	D0	3	2	1	0
H	X	X	L	X	H	H	PREVIOUSLY LOADED DISPLAY									G	R	E	Y
H	H	X	L	X	X	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	X	H	L	X	X	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	L	L	L	H	L	H	L	L	H	L	L	L	H	L	H	G	R	E	E
H	L	L	L	H	L	H	L	H	H	L	H	L	H	L	H	G	R	U	E
H	L	L	L	H	L	H	H	L	H	L	L	H	H	L	L	G	L	U	E
H	L	L	L	H	L	H	H	H	H	L	L	L	L	H	L	B	L	U	E
L	X	X	X	X	H	H	X	X	BLANK DISPLAY										
H	L	L	L	H	L	H	H	H	H	L	L	L	H	H	H	G	L	U	E
H	X	X	L	X	H	L	X	X	CLEARS CHARACTER DISPLAYS										
H	L	L	L	H	L	H	X	X	SEE CHARACTER CODE							SEE CHARACTER SET			

X = DON'T CARE

LOADING CURSOR STATE TABLE

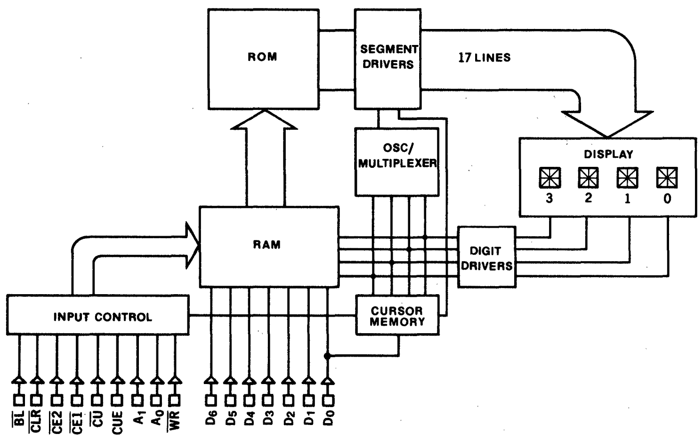
CONTROL							ADDRESS		DATA							DISPLAY DIGIT			
$\overline{BL}$	$\overline{CE1}$	$\overline{CE2}$	CUE	$\overline{CU}$	$\overline{WR}$	$\overline{CLR}$	A1	A0	D6	D5	D4	D3	D2	D1	D0	3	2	1	0
H	X	X	L	X	H	H	PREVIOUSLY LOADED DISPLAY									B	E	A	R
H	X	X	H	X	H	H	DISPLAY PREVIOUSLY STORED CURSORS									B	E	A	R
H	L	L	H	L	L	H	L	L	X	X	X	X	X	X	H	B	E	A	⊠
H	L	L	H	L	L	H	L	H	X	X	X	X	X	X	H	B	E	⊠	⊠
H	L	L	H	L	L	H	H	L	X	X	X	X	X	X	H	B	⊠	⊠	⊠
H	L	L	H	L	L	H	H	H	X	X	X	X	X	X	H	⊠	⊠	⊠	⊠
H	L	L	H	L	L	H	H	L	X	X	X	X	X	X	L	⊠	E	⊠	⊠
H	X	X	L	X	H	H	DISABLE CURSOR DISPLAY									B	E	A	R
H	L	L	L	L	L	H	H	H	X	X	X	X	X	X	L	B	E	A	R
H	X	X	H	X	H	H	DISPLAY STORED CURSOR									B	E	⊠	⊠

X = DON'T CARE

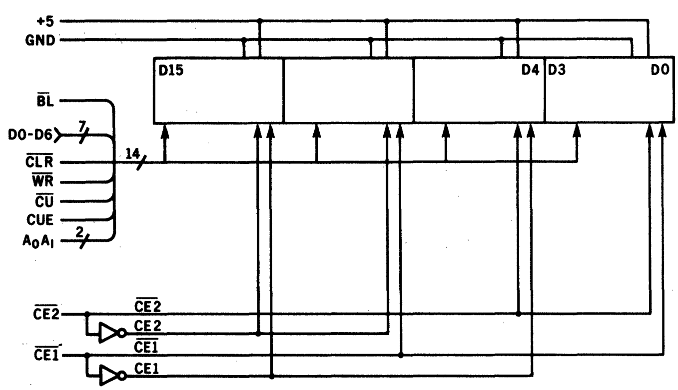
CHARACTER SET

				0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
			D0	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
			D1	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H	H
			D2	L	L	L	L	H	H	H	H	L	L	L	L	H	H	H	H
			D3	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H
D6	D5	D4	HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
L	H	L	2		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
L	H	H	3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
H	L	L	4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
H	L	H	5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_

All other input codes display "blank"



Internal Block Diagram

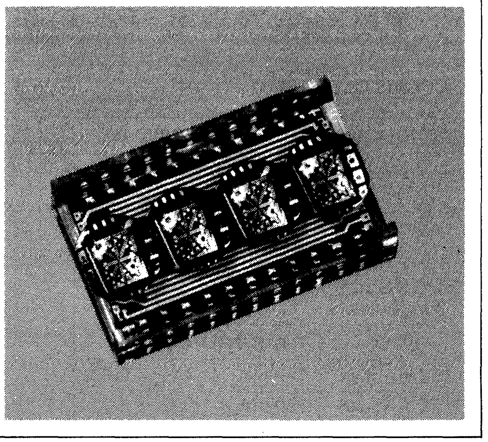


Typical Schematic for 16 Digit System

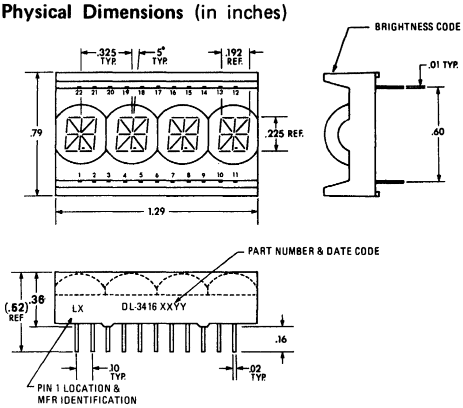
litronix
A Siemens Company

DL-3416, DL-3416 H
.225″ RED, 4-DIGIT 16-SEGMENT PLUS DECIMAL ALPHANUMERIC Intelligent Display™ WITH MEMORY/DECODER/DRIVER

PRELIMINARY



Physical Dimensions (in inches)



Tolerance ± .01 Unless Otherwise Noted

FEATURES

- 225 Mil High, Magnified Monolithic Char.
- Wide Viewing Angle ±40°
- Close Vertical Row Spacing, 0.8 Inches
- Rugged Solid Plastic Encapsulated Package
- Fast Access Time
  DL-3416 500 nSEC
  DL-3416H 300 nSEC
- Full Size Display for Stationary Equipment
- Built-in Memory
- Built-in Character Generator
- Built-in Multiplex and LED Drive Circuitry
- Each Digit Independently Addressed
- TTL Compatible, 5 Volt Power
- Independent Cursor Function
- 17th Segment for Improved Punctuation Marks
- Memory Clear Function
- Display Blank Function
- End Stackable, 4-Character Package
- Intensity Coded for Display Uniformity

DESCRIPTION

The DL 3416 is a four digit display module having 16 segments plus decimal and a built-in CMOS integrated circuit.

The integrated circuit contains memory, ASCII ROM decoder, multiplexing circuitry, and drivers. Data entry is asynchronous and can be random. A display system can be built using any number of DL 3416's since each digit of any DL 3416 can be addressed independently and will continue to display the character last stored until replaced by another.

System interconnection is very straightforward. The least significant two address bits (A_0, A_1) are normally connected to the like named inputs of all DL 3416's in the system. With four chip enables four DL 3416's (16 characters) can easily be interconnected without a decoder.

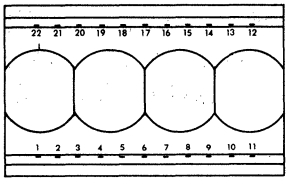
Alternatively, one-of-n decoder IC's can be used to extend the address for large displays.

Data lines are connected to all DL 3416's directly and in parallel, as in the write line ($\overline{WR}$). The display will then behave as a write-only memory.

The cursor function causes all segments of a digit position to illuminate. The cursor is *not* a character, however, and upon removal the previously displayed character will reappear.

Specification subject to change without notice.

TOP VIEW



Product Identification
Marking on Front Surface

Pin	Function	Pin	Function
1	CE1 Chip Enable	12	Gnd
2	$\overline{CE2}$ Chip Enable	13	N/C
3	$\overline{CE3}$ Chip Enable	14	$\overline{BL}$ Blanking
4	$\overline{CE4}$ Chip Enable	15	N/C
5	$\overline{CLR}$ Clear	16	D0 Data Input
6	VCC	17	D1 Data Input
7	A0 Digit Select	18	D2 Data Input
8	A1 Digit Select	19	D3 Data Input
9	$\overline{WR}$ Write	20	D4 Data Input
10	$\overline{CU}$ Cursor Select	21	D5 Data Input
11	CUE Cursor Enables	22	D6 Data Input

OPTO-ELECTRONIC CHARACTERISTICS @ 25°C

MAXIMUM RATINGS	
Voltage, any pin respect to GND	−.5 to 6.0 VDC
Operating Temperature	−20° to +65°C
Storage Temperature	−20° to +70°C
Relative Humidity (non condensing) @ 65°C	85%

OPTICAL CHARACTERISTICS (TYPICAL)	
Luminous Intensity 8 segments/digit @ 5 V, 5 mcd	
Off Axis Viewing Angle (Note 1)	±40°
Digit Size	225 mils
Spectral Peak Wavelength	660 nm

DC CHARACTERISTICS
DL-3416 AND DL-3416H

Parameter	−20°C Typ	+25°C[4]	+65°C Typ	Conditions
I_{CC} 4 digits on (10 seg/digit)	190 mA	150 mA max[1]	120 mA	V_{CC} = 5.0 V
I_{CC} Cursor[2]	225 mA	175 mA max[1]	150 mA	V_{CC} = 5.0 V
I_{CC} Blank		19 mA max		V_{IN} = 0 V_{CC} = 5.0 V $\overline{WR}$ = 5.0 V
I_{IL}	225 μA	160 μA max	150 μA	V_{IN} = .8 V V_{CC} = 5.0 V
V_{IL}		.8 V max		V_{CC} = 4.5 V
V_{IH}[3]		2.7 V min		V_{CC} = 4.5 V
		3.3 V min		V_{CC} = 5.5 V

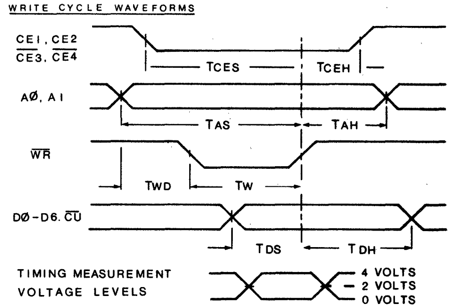
1. Measured at 5 sec.
2. 60 sec max duration.
3. $V_{CC} \geqslant V_{IH} \geqslant 0.6\ V_{CC}$.
4. V_{cc} = +5.0 VDC ±10%

AC CHARACTERISTICS
Timing Parameters @ 4.5 V (nanoseconds)

Parameter	−20°C Typ		+25°C Min		+65°C Typ	
	DL-3416	DL-3416H	DL-3416	DL-3416H	DL-3416	DL-3416H
T_{AS}	300	200	450	250	600	400
T_{WD}	50	50	150	50	175	75
T_W	250	150	300	200	425	325
T_{DS}	150	100	250	150	350	250
T_{DH}	50	50	50	50	100	100
T_{AH}	50	50	50	50	100	100
T_{CEH}	50	50	50	50	100	100
T_{CES}	300	150	450	250	600	400
T_{CLR}			15 milliseconds			
			access time			
			500 ns	300 ns		

TIMING CHARACTERISTICS

WRITE CYCLE WAVEFORMS



Note 1: "Off Axis Viewing Angle" is here defined as: "the minimum angle in any direction from the normal to the display surface at which any part of any segment in the display is not visible".

Note 2: This display contains a CMOS integrated circuit. Normal CMOS handling precautions should be taken to avoid damage due to high static voltages or electric fields.

Note 3: Unused inputs must be tied to an appropriate logic voltage level (either V+ or V−).

Note 4: **Warning** — Do not use solvents containing alcohol.

LOADING DATA

Setting the chip enables (CE1, CE2, $\overline{CE3}$, $\overline{CE4}$) to their true state will enable data loading. The desired data code (D0-D6) and digit address (A_0, A_1) should be held stable during the write cycle for storing new data.

Data entry may be asynchronous and random. (Digit 0 is defined as right hand digit with $A_1 = A_0 = 0$.)

Clearing of the entire internal four-digit memory can be accomplished by holding the clear ($\overline{CLR}$) low for one complete display multiplex cycle, 15 mS minimum.

LOADING CURSOR

Setting the chip enables (CE1, CE2, $\overline{CE3}$, $\overline{CE4}$) and cursor select ($\overline{CU}$) to their true state will enable cursor loading. A write ($\overline{WR}$) pulse will now store or remove a cursor into the digit location addressed by A_0, A_1; as defined in data entry. A cursor will be stored if D0 = 1; and will be removed if D0 = 0. Cursor will not be cleared by the $\overline{CLR}$ signal. The cursor ($\overline{CU}$) pulse width should not be less than the write pulse ($\overline{WR}$) width or erroneous data may appear in the display.

For those users not requiring the cursor, the cursor enable signal (CUE) may be tied low to disable display of the cursor function. A flashing cursor can be realized by simply pulsing CUE. If cursor has been loaded to any or all positions in the display, then CUE will control whether the cursor(s) or the characters appear. CUE does not affect the contents of cursor memory.

DISPLAY BLANKING

Blanking the display may be accomplished by loading a blank or space into each digit of the display or by using the ($\overline{BL}$) display blank input.

Setting the ($\overline{BL}$) input low does not affect the contents of either data or cursor memory. A flashing display can be realized by pulsing ($\overline{BL}$).

TYPICAL LOADING DATA STATE TABLE

$\overline{BL}$	CE1	CE2	$\overline{CE3}$	$\overline{CE4}$	CUE	$\overline{CU}$	$\overline{WR}$	$\overline{CLR}$	A1	A0	D6	D5	D4	D3	D2	D1	D0	DIGIT 3	2	1	0
H	X	X	X	X	L	X	H	H	PREVIOUSLY LOADED DISPLAY									G	R	E	Y
H	L	X	X	X	L	X	X	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	X	L	X	X	L	X	X	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	X	X	H	X	L	X	X	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	X	X	X	H	L	X	X	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	X	X	X	X	L	X	H	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	H	H	L	L	L	H	L	H	L	L	H	L	L	L	H	L	H	G	R	E	E
H	H	H	L	L	L	H	L	H	L	H	H	L	H	L	H	L	H	G	R	U	E
H	H	H	L	L	L	H	L	H	H	L	H	L	L	H	H	L	L	G	L	U	E
H	H	H	L	L	L	H	L	H	H	H	H	L	L	L	L	H	L	B	L	U	E
L	X	X	X	X	X	X	H	H	X	X	BLANK DISPLAY										
H	H	H	L	L	L	H	L	H	H	H	H	L	L	L	H	H	H	G	L	U	E
H	X	X	X	X	L	X	X	L	CLEARS CHARACTER DISPLAY												
H	H	H	L	L	L	H	L	H	X	X	SEE CHARACTER CODE							SEE CHARACTER SET			

X = DON'T CARE

LOADING CURSOR STATE TABLE

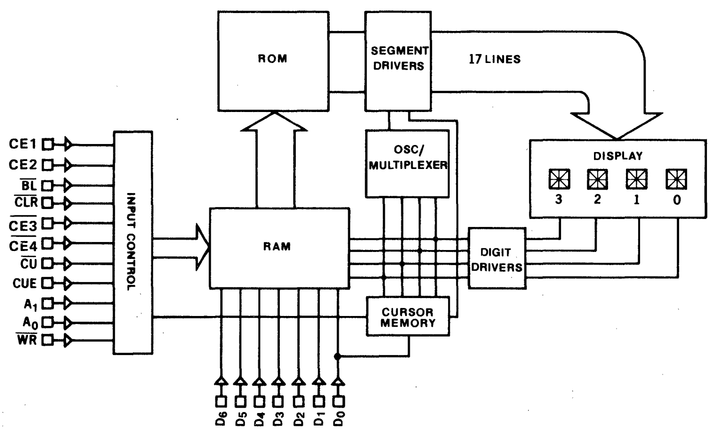
$\overline{BL}$	CE1	CE2	$\overline{CE3}$	$\overline{CE4}$	CUE	$\overline{CU}$	$\overline{WR}$	$\overline{CLR}$	A1	A0	D6	D5	D4	D3	D2	D1	D0	DIGIT 3	2	1	0
H	X	X	X	X	L	X	H	H	PREVIOUSLY LOADED DISPLAY									B	E	A	R
H	X	X	X	X	H	X	H	H	DISPLAY PREVIOUSLY STORED CURSORS									B	E	A	R
H	H	H	L	L	H	L	L	H	L	L	X	X	X	X	X	X	H	B	E	A	⊠
H	H	H	L	L	H	L	L	H	L	H	X	X	X	X	X	X	H	B	E	⊠	⊠
H	H	H	L	L	H	L	L	H	H	L	X	X	X	X	X	X	H	B	⊠	⊠	⊠
H	H	H	L	L	H	L	L	H	H	H	X	X	X	X	X	X	H	⊠	⊠	⊠	⊠
H	H	H	L	L	H	L	L	H	H	L	X	X	X	X	X	X	L	⊠	E	⊠	⊠
H	X	X	X	X	L	X	H	H	DISABLE CURSOR DISPLAY									B	E	A	R
H	H	H	L	L	L	L	L	H	H	H	X	X	X	X	X	X	L	B	E	A	R
H	X	X	X	X	H	X	H	H	DISPLAY STORED CURSORS									B	E	⊠	⊠

X = DON'T CARE

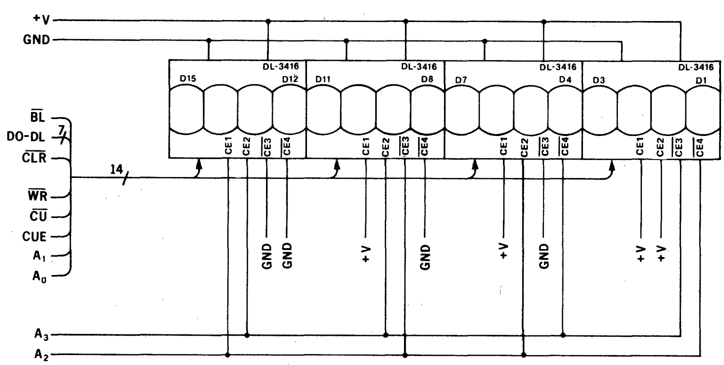
CHARACTER SET

D6	D5	D4																	
			D0	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
			D1	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H	H
			D2	L	L	L	L	H	H	H	H	L	L	L	L	H	H	H	H
			D3	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H
D6	D5	D4	HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
L	H	L	2		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
L	H	H	3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
H	L	L	4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
H	L	H	5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_

ALL OTHER CODES DISPLAY BLANK



Internal Block Diagram



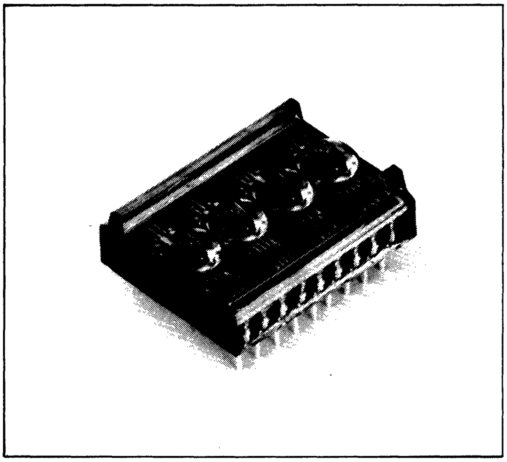
Typical Schematic for 16 Digits

DL-3422

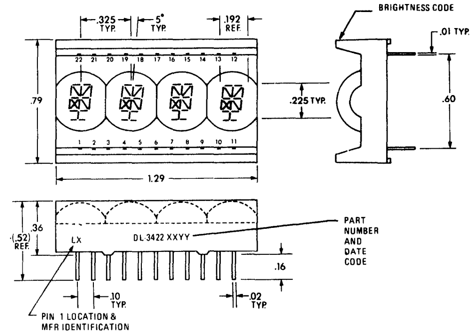
litronix
A Siemens Company

.170"/.100" (Nom.) UPPER AND LOWER CASE 4-DIGIT 22-SEGMENT ALPHANUMERIC Intelligent Display™ WITH MEMORY/DECODER/DRIVER

PRELIMINARY



Physical Dimensions (in inches)



Tolerance ± .01 unless otherwise noted

FEATURES

- 170 Mil/100 Mil (Nom.) Upper & Lower Case Letters
- Wide Viewing Angle ± 50°
- Close Vertical Row Spacing, .800 Inches
- Rugged Solid Plastic Encapsulated Package
- Fast Access Time, 500 nSEC
- Full Size Display for Stationary Equipment
- Built-in Memory
- Built-in Character Generator
- Built-in Multiplex and LED Drive Circuitry
- Direct Access to Each Digit Independently & Asynchronously
- TTL Compatible, 5 Volt Power
- Independent Cursor Function
- 22 Segment for 96 Character ASCII Format Upper & Lower Case Letters
- Memory Clear Function
- Display Blank Function

DESCRIPTION

The DL 3422 is a four digit display module having 22 segments and a built-in CMOS integrated circuit.

The integrated circuit contains memory, ASCII ROM decoder, multiplexing circuitry, and drivers. Data entry is asynchronous and can be random. A display system can be built using any number of DL 3422's since each digit of any DL 3422 can be addressed independently and will continue to display the character last stored until replaced by another.

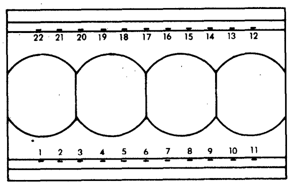
System interconnection is very straightforward. The least significant two address bits (A_0, A_1) are normally connected to the like named inputs of all DL 3422's in the system. With two chip enables (CE1, and $\overline{CE2}$) four DL 3422's (16 characters) can easily be interconnected without a decoder.

Alternatively, one-of-n decoder 1C's can be used to extend the address for large displays.

Data lines are connected to all DL 3422's directly and in parallel, as is the write line ($\overline{WR}$). The display will then behave as a write-only memory.

The cursor function causes all segments of a digit position to illuminate. The cursor is *not* a character, however, and upon removal the previously displayed character will reappear.

Specification subject to change without notice.



Pin	Function	Pin	Function
1	CE1 Chip Enable	12	Gnd
2	N/C	13	N/C
3	$\overline{CE2}$ Chip Enable	14	$\overline{BL}$ Blanking
4	N/C	15	N/C
5	$\overline{CLR}$ Clear	16	D0 Data Input
6	VCC	17	D1 Data Input
7	A0 Digit Select	18	D2 Data Input
8	$\overline{A1}$ Digit Select	19	D3 Data Input
9	$\overline{WR}$ Write	20	D4 Data Input
10	$\overline{CU}$ Cursor Select	21	D5 Data Input
11	CUE Cursor Enable	22	D6 Data Input

OPTO-ELECTRONIC CHARACTERISTICS @ 25°C

MAXIMUM RATINGS	
Voltage, any pin respect to GND . .	−.5 to 6.0 VDC
Operating Temperature	−20° to +65°C
Storage Temperature	−20° to +70°C
Relative Humidity (non condensing) @ 65°C	85%

OPTICAL CHARACTERISTICS	
Luminous Intensity 8 Segments @ 5 V . . .	5 mcd
Off Axis Viewing Angle (Note 1)	±50°
Digit Size	160 mils
Spectral Peak Wavelength	660 nm

DC CHARACTERISTICS

Parameter	−20°C Typ	+25°C[4]	+65°C Typ	Conditions
I_{CC} 4 digits on (10 seg/digit)	135 mA	125 mA max[1]	100 mA	V_{CC} = 5.0 V
I_{CC} 4 digits or Cursor[2]	160 mA	140 mA max[1]	120 mA	V_{CC} = 5.0 V
I_{CC} Blank		3.7 mA max		V_{IN} = 0 V_{CC} = 5.0 V $\overline{WR}$ = 5.0 V
I_{IL}	200 μA	160 μA max	100 μA	V_{IN} = .8 V V_{CC} = 5.0 V
V_{IL}		.8 V max		V_{CC} = 4.5 V
V_{IH}[3]		2.7 V min		V_{CC} = 4.5 V
		3.3 V min		V_{CC} = 5.5 V

1. Measured at 5 sec.
2. 60 sec max duration.
3. $V_{CC} \geqslant V_{IH} \geqslant 0.6\ V_{CC}$.
4. V_{cc} = +5.0 VDC ±10%

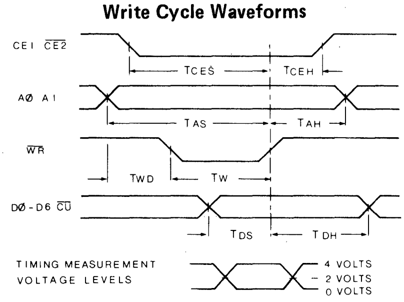
AC CHARACTERISTICS

Timing Parameter @ 4.5 V (nanoseconds)

	−20°C Typ	+25°C Min	+65°C Typ
T_{AS}	300	450	600
T_{WD}	50	150	175
T_W	250	300	425
T_{DS}	150	250	350
T_{DH}	50	50	100
T_{AH}	50	50	100
T_{CEH}	50	50	100
T_{CES}	300	450	600
T_{CLR}		15 milliseconds	

TIMING CHARACTERISTICS

Write Cycle Waveforms



Note 1: "Off Axis Viewing Angle" is here defined as: "the minimum angle in any direction from the normal to the display surface at which any part of the segment in the display is not visible".

Note 2: This display contains a CMOS integrated circuit. Normal CMOS handling precautions should be taken to avoid damage due to high static voltages or electric fields.

Note 3: Unused inputs must be tied to an appropriate logic voltage level (either V+ or V−).

Note 4: **Warning** — Do not use solvents containing alcohol.

LOADING DATA

Setting the chip enables (CE1, $\overline{CE2}$) to their true state will enable data loading. The desired data code (D0-D6) and digit address (A_0, A_1) should be held stable during the write cycle for storing new data.

Data entry may be asynchronous and random. (Digit 0 is defined as right hand digit with $A_1 = A_0 = 0$.)

Clearing of the entire internal four-digit memory can be accomplished by holding the clear ($\overline{CLR}$) low for one complete display multiplex cycle, 15 mS minimum.

LOADING CURSOR

Setting the chip enables (CE1, $\overline{CE2}$) and cursor select ($\overline{CU}$) to their true state will enable cursor loading. A write ($\overline{WR}$) pulse will now store or remove a cursor into the digit location addressed by A_0, A_1; as defined in data entry. A cursor will be stored if DO = 1; and will be removed if DO = 0. Cursor will not be cleared by the $\overline{CLR}$ signal.

For those users not requiring the cursor, the cursor enable signal (CUE) may be tied low to disable display of the cursor function. A flashing cursor can be realized by simply pulsing CUE. If cursor has been loaded to any or all positions in the display, then CUE will control whether the cursor(s) or the characters appear. CUE does not affect the contents of cursor memory.

DISPLAY BLANKING

Blanking the display may be accomplished by loading a blank or space into each digit of the display or by using the ($\overline{BL}$) display blank input.

Setting the ($\overline{BL}$) input low does not affect the contents of either data or cursor memory. A flashing display can be realized by pulsing ($\overline{BL}$).

TYPICAL LOADING DATA STATE TABLE

$\overline{BL}$	CE1	$\overline{CE2}$	CUE	$\overline{CU}$	$\overline{WR}$	$\overline{CLR}$	A1	A0	D6	D5	D4	D3	D2	D1	D0	DIGIT 3	2	1	0
H	X	X	L	X	H	H	PREVIOUSLY LOADED DISPLAY									G	R	E	Y
H	L	X	L	X	X	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	X	X	L	X	X	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	X	H	L	X	X	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	X	X	L	X	X	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	X	X	L	X	H	H	X	X	X	X	X	X	X	X	X	G	R	E	Y
H	H	L	L	H	L	H	L	L	H	L	L	L	H	L	H	G	R	E	E
H	H	L	L	H	L	H	L	H	H	L	H	L	H	L	H	G	R	U	E
H	H	L	L	H	L	H	H	L	H	L	L	H	H	L	L	G	L	U	E
H	H	L	L	H	L	H	H	H	H	L	L	L	L	H	L	B	L	U	E
O	X	X	X	X	H	H	BLANK DISPLAY												
H	H	L	L	H	L	H	H	H	H	L	L	L	H	H	H	G	L	U	E
H	X	X	L	X	X	L	CLEARS CHARACTER DISPLAY												
H	H	L	L	H	L	H	X	X	SEE CHARACTER CODE							SEE CHARACTER SET			

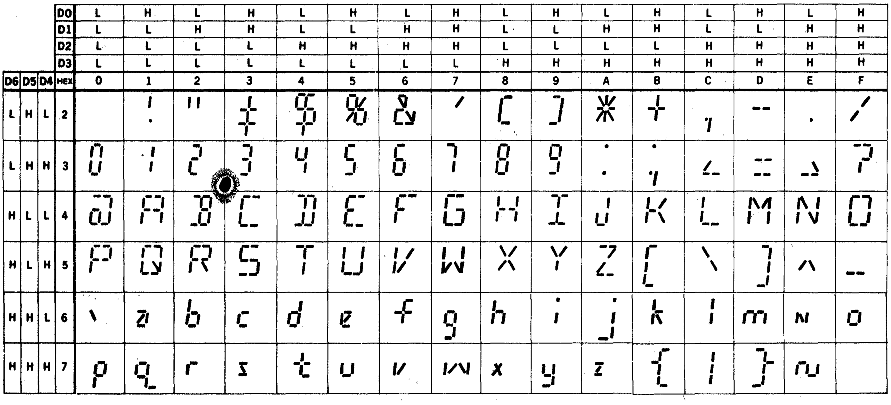
X = DON'T CARE

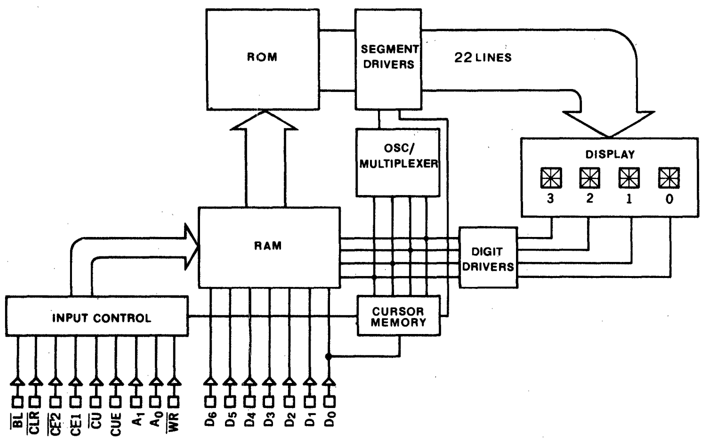
LOADING CURSOR STATE TABLE

$\overline{BL}$	CE1	$\overline{CE2}$	CUE	$\overline{CU}$	$\overline{WR}$	$\overline{CLR}$	A1	A0	D6	D5	D4	D3	D2	D1	D0	DIGIT 3	2	1	0
H	X	X	L	X	H	H	PREVIOUSLY LOADED DISPLAY									B	E	A	R
H	X	X	H	X	H	H	DISPLAY PREVIOUSLY STORED CURSORS									B	E	A	R
H	H	L	H	L	L	H	L	L	X	X	X	X	X	X	H	B	E	A	▩
H	H	L	H	L	L	H	L	H	X	X	X	X	X	X	H	B	E	▩	▩
H	H	L	H	L	L	H	H	L	X	X	X	X	X	X	H	B	▩	▩	▩
H	H	L	H	L	L	H	H	H	X	X	X	X	X	X	H	▩	▩	▩	▩
H	H	L	H	L	L	H	H	L	X	X	X	X	X	X	L	▩	E	▩	▩
H	X	X	L	X	H	H	DISABLE CURSOR DISPLAY									B	E	A	R
H	H	L	L	L	L	H	H	H	X	X	X	X	X	X	L	B	E	A	R
H	X	X	H	X	H	H	DISPLAY STORED CURSORS									B	E	▩	▩

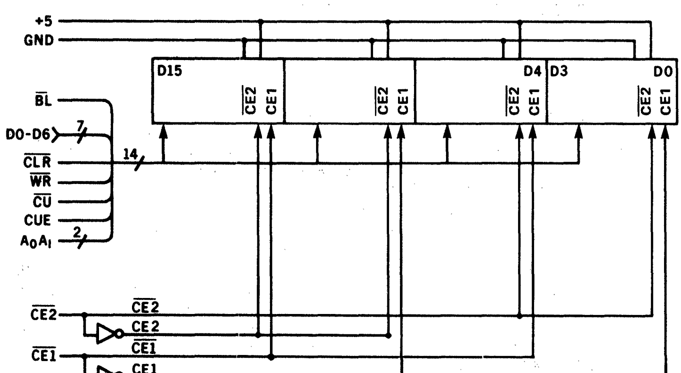
X = DON'T CARE

CHARACTER SET





Internal Block Diagram



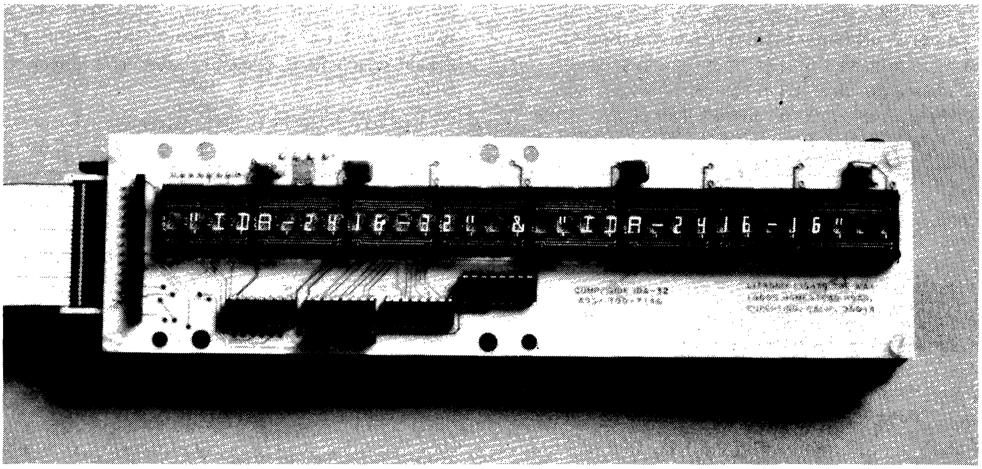
Typical Schematic for 16 Digit System

litronix
A Siemens Company

IDA-2416 Series

DL-2416 Intelligent Display™ ASSEMBLY

PRELIMINARY



FEATURES

- Complete Alphanumeric Display Assembly Utilizing the DL-2416
  - Built-in Multiplex and LED Drive Circuitry
  - Built-in Memory
  - Built-in Character Generator
- Displays 64 Character ASCII Set
- Direct Access to Each Digit Independently
- Display Blank Function
- Memory Clear Function
- Cursor Function
- Choice of 16 or 32 Character Display Length (Other lengths optional)
- Single 5.0 Volt Power Supply
- TTL Compatible
- Easily Interfaced to a Microprocessor
- Tri-State or Open-Collector Input Circuitry
- Schmitt Trigger Inputs on Control Lines

The IDA-2416 Series Assembly is an extension of the very easy-to-use DL-2416 Intelligent Display™. This product provides the designer with circuitry for display maintenance. It also minimizes interaction and interface normally required between the user's system and a multiplexed alphanumeric display.

The assembly consists of DL-2416's in a single row together with decoder and interface buffers on a single printed circuit board. Each DL-2416 provides its own memory, ASCII ROM character decoder, multiplexing circuitry, and drivers for its four 17-segment LED's.

Intelligent Display Assemblies can be used for applications such as data terminals, controllers, instruments, and other products which require an easy to use alphanumeric display.

Part Number	Description
IDA-2416-16	Single Line 16 Character Alphanumeric Display Utilizing the DL-2416
IDA-2416-32	Single Line 32 Character Alphanumeric Display Utilizing the DL-2416
IDA-2416-XX-YY	Single Line Alphanumeric Display Utilizing the DL-2416 Display XX — indicates number of characters (groups of four) from 16 to 40 YY — options or specials versions (consult factory for more information)

System Overview

The Intelligent Display Assembly offers the designer a choice of either 16 or 32 alphanumeric characters (the IDA-2416-16 and IDA-2416-32, respectively), and operates from just a +5-V supply. Based on the previously introduced Litronix DL-2416 four-character intelligent display, the IDA-2416 adds all the support logic required for direct connection to most microprocessor buses. The system interface takes place through a 26-pin connector, which has available on it the data and address lines as well as the control signals needed. Two additional connectors are included on the IDA-2416 – one of them is used for the power and ground connections, and the other is used to implement display enable selection.

System Power Requirements

Operating from a single +5-V power supply, the IDA-2416-16 requires a typical operating current of 450 mA with eight of the segments lit on each character. For the 32 character display, the current increases to 850 mA, typical. For the worst-case condition with all segments lit, the 16 character display draws 650 mA and the 32 character display requires 1250 mA. With the display blanked, the board circuitry draws about 70 mA.

Display Interface

The display interface available on the 26-pin connector consists of seven data lines (D0 to D6), five address lines (A0 to A4), four display-enable lines ($\overline{\text{DE1}}$ to $\overline{\text{DE4}}$), several unused pins, and various control signals. All address, data, and control lines have either pull-up or pull-down 1K ohm resistors.

$\overline{\text{BL}}$ (Blanking, active low): When this line is pulled low, it causes the entire IDA display to go blank without affecting the contents of the display memory on the DL-2416s. $\overline{\text{BL}}$ is active regardless of address or display enable lines. A flashing display can be realized by pulsing this line.

$\overline{\text{WR}}$ (Write, active low): To store a character in the display memory, this line must be pulsed low for a minimum of 200 ns. See timing diagram for timing & relationships to other signals. The $\overline{\text{WR}}$ input drives a schmitt-trigger.

CUE (Cursor Enable, active high): When high, this line permits the cursor to be displayed, and when brought low, it disables the cursor function without affecting the stored value. CUE is active regardless of address or display enable lines. A flashing cursor can be created by pulsing the CUE line low.

$\overline{\text{CU}}$ (Cursor Select, active low): The cursor function (character with all segments lit) is loaded by selecting the digit address and holding $\overline{\text{CU}}$ true. A "1" on D0 writes the cursor. A "0" on D0 removes the cursor. The change occurs during the next write pulse per the timing diagram.

$\overline{\text{CLR}}$ (Clear, active low): When held low for one display multiplex cycle (see DL-2416 data sheet for more information) of 15 ms, this line will cause all stored characters in the display, except for the cursor, to be cleared. $\overline{\text{CLR}}$ is active regardless of address or display enable lines. The $\overline{\text{CLR}}$ input drives a schmitt-trigger.

$\overline{\text{DE1}}$ to $\overline{\text{DE4}}$ (Display Enable, active low): There are four jumper selectable lines, any one of which can be selected to provide one of four board addresses that can be used when multiple IDAs are built into a system. When low, this line enables the selected display to permit data loading. The display enable input drives a schmitt-trigger.

Address lines A0 to A4 are set up so that the right-most character is the lowest address. The left-most character is the highest address. Data lines are set up so that D0 is the least significant bit and D6 is the most significant bit.

Using the Display Interface

Through the use of memory-mapped I/O techniques, the IDA can be treated almost like a memory location – supply the data, address and proper control signals and the characters appear, with each character location independently addressable. The basic signal flow sequence to load a character would start with the address lines going to the desired address while the $\overline{\text{CLR}}$ and $\overline{\text{BL}}$ lines are high to permit the data to be loaded in and displayed. After the address has stabilized, the data can change to the desired values (including the cursor). After the data have stabilized, the $\overline{\text{WR}}$ pulse is started, and must remain low for at least 200 ns. Signals must be held stable for 75 ns, minimum, after the rising edge of the $\overline{\text{WR}}$ pulse to ensure correct loading, while the addresses must be stable for 650 ns preceding the same rising edge of the $\overline{\text{WR}}$ pulse. See the timing diagram for a pictorial explanation.

Enable Selection

For board enable (the $\overline{\text{DE1}}$ through $\overline{\text{DE4}}$ lines) the user can choose any one of the four enable signals he has provided on the cable. This signal will be used to provide a master enable to each IDA. All that need be done is to insert the shorting plug in the appropriate position on the pins provided. This allows the user to make the system display the same information on two or more different IDAs or display different information on each of up to four groups of IDA's.

IDA-2416 Series

Maximum Ratings

V_{CC}	6.0 V
Voltage applied to any input	-0.5 to V_{CC} +0.5 VDC
Operating Temperature	-20 to +65°C
Storage Temperature	-20 to +70°C
Relative Humidity (non condensing) @ 65°C	85%

Optoelectronic Characteristics @ 25°C

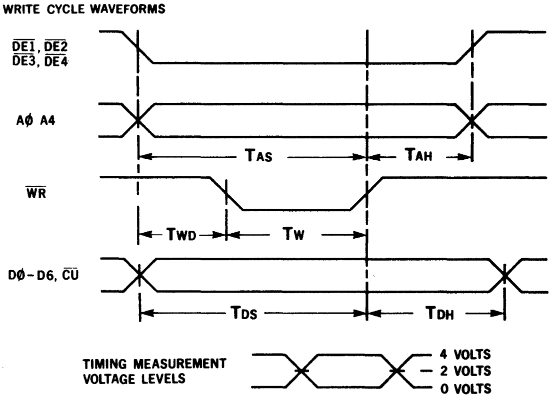
Parameter	Symbol	Min	Typ	Max	Units	Test Conditions
Supply Current/Digit	I_{CC}		25		mA	V_{CC} = 5.0 V (8 Segments/Digit)
Total (IDA-2416-16)	I_{CC}			650	mA	V_{CC} = 5.0 V (All Segments/Digit)
Total (IDA-2416-32)	I_{CC}			1250	mA	V_{CC} = 5.0 V (All Segments/Digit)
Supply Voltage	V_{CC}	4.75	5.00	5.25	V	
Input Voltage — High (All inputs)	V_{IH}	2			V	V_{CC} = 5.0 V ± .25 V
Input Voltage — Low (All inputs)	V_{IL}			0.8	V	V_{CC} = 5
Input Current — High (All inputs)	I_{IH}			40	μA	V_{CC} = 5.5 V, V_I = 2.4 V
Input Current — Low (All inputs)	I_{IL}			2.2	mA	V_{CC} = 5.5 V, V_I = 0.4 V
Luminous Intensity Average Per Digit	I_V		0.5		mcd	V_{CC} = 5.0 V (8 Segments/Digit)
Peak Wavelength	λ_{peak}		660		nm	
Viewing Angle			±45		Deg	Vertical & Horizontal From Normal To Display Plane

Switching Characteristics @ 5 V

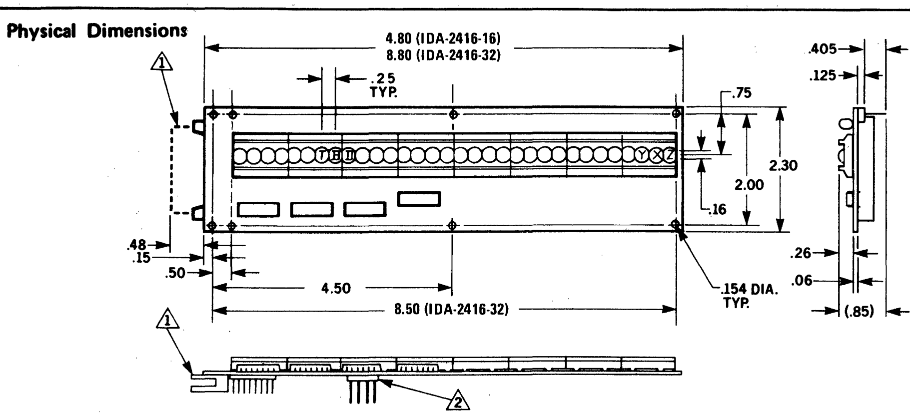
Parameter @ 25°C	Symbol	Min	Units
Write Pulse	T_W	200	nS
Address/DE Setup Time	T_{AS}	650	nS
Data Setup Time	T_{DS}	650	nS
Write Setup	T_{WD}	200	nS
Data Hold Time	T_{DH}	75	nS
Address/DE Hold Time	T_{AH}	75	nS
Clear Time	T_{CLR}	15	mS

TIMING CHARACTERISTICS

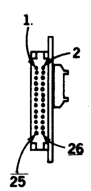
WRITE CYCLE WAVEFORMS



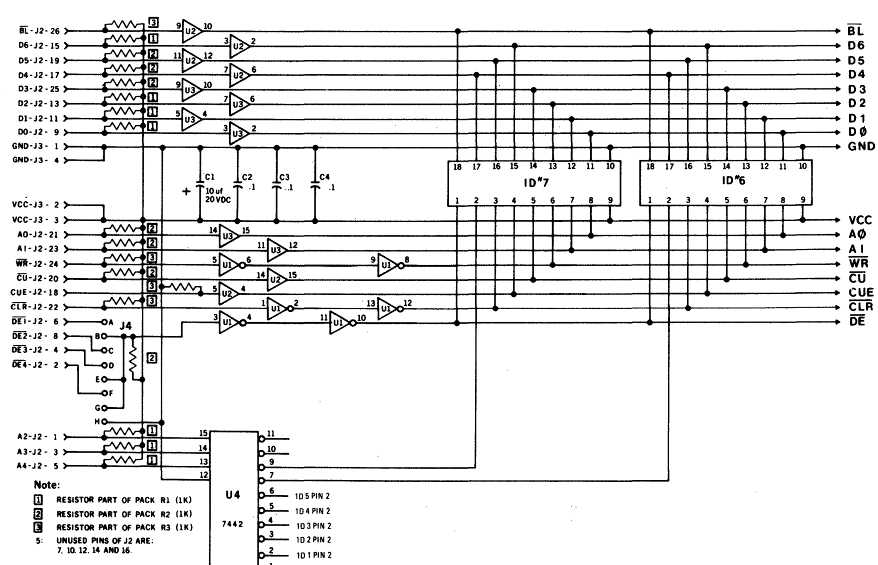
Physical Dimensions



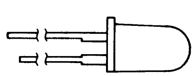
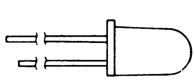
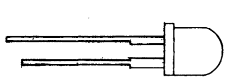
RECOMMENDED MATING CONNECTOR			
Connector	**Function**	**Type**	**Suggested Mfg.**
△1 J2	Control/Data	26-Pin Ribbon	BERG P/N 65496-013
△2 J3	Power	Molex	AMP P/N 87066-4



PIN	FUNCTION	PIN	FUNCTION
J2-1	A2 ADDRESS LINE	J2-14	NO CONNECTION
J2-2	$\overline{\text{DE4}}$ DISPLAY ENABLE	J2-15	D6 DATA LINE
J2-3	A3 ADDRESS LINE	J2-16	NO CONNECTION
J2-4	$\overline{\text{DE3}}$ DISPLAY ENABLE	J2-17	D4 DATA LINE
J2-5	A4 ADDRESS LINE	J2-18	CUE CURSOR ENABLE
J2-6	$\overline{\text{DE1}}$ DISPLAY ENABLE	J2-19	D5 DATA LINE
J2-7	NO CONNECTION	J2-20	$\overline{\text{CU}}$ CURSOR SELECT
J2-8	$\overline{\text{DE2}}$ DISPLAY ENABLE	J2-21	AØ ADDRESS LINE
J2-9	DØ DATA LINE	J2-22	$\overline{\text{CLR}}$ CLEAR
J2-10	NO CONNECTION	J2-23	A1 ADDRESS LINE
J2-11	D1 DATA LINE	J2-24	$\overline{\text{WR}}$ WRITE
J2-12	NO CONNECTION	J2-25	D3 DATA LINE
J2-13	D2 DATA LINE	J2-26	$\overline{\text{BL}}$ BLANKING
J3-1	GND	J3-3	VCC
J3-2	VCC	J3-4	GND



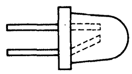
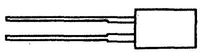
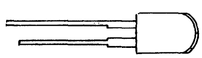
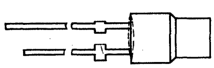
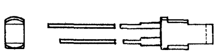
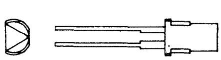
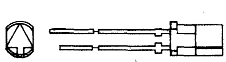
LED LAMPS

Package Type and Spacing	Package Outline	Color	Part Number	Lens	Viewing Half Angle	Luminous Intensity (mcd)	Luminous Intensity (mA)	Max Fwd Current (mA)	Page
T1¾ 5mm (12.2mm Top of Lens to standoff) Min. ½" Leads		Red	LD50A	Red Diffused	±12°	>1.0	20	100	97
			LD50-1			2.0-4.0			
			LD50-2			>3.2			
		High Efficiency Red	LD52C	Red Diffused		15-30	10	60	99
			LD52CA			9.0-18			
			•CQV51F			10-20	20		
			•CQV51G			16-32			
			•CQV51H			25-50			
			•CQV51J			>40			
		Yellow	LD56C	Yellow Clear		10-20	10		101
			LD56CA			6.0-12			
			•CQV53F			10-20	20		
			•CQV53G			16-32			
			•CQV53H			25-50			
			•CQV53J			>40			
		Green	LD57C	Green Clear		20-40	10		103
			LD57CA			12-24			
			•CQV55G			16-32	20		
			•CQV55H			24-50			
			•CQV55J			40-80			
			•CQV55K			>63			
T1¾ 5mm (11.6mm Top of Lens to standoff) Min. ½" Leads		Red	LD41A	Red Diffused	±35°	>.3		100	97
			LD41-1			1.0-2.4			
			LD41-2			>2.0			
			•CQV20-3			1.0-2.0			
			•CQV20-4			>1.6			
		High Efficiency Red	LD52-1			1.2-2.4	10	60	99
			LD52-2			>2.0			
			•CQV21-4			1.6-3.2	20		
			•CQV21-5			2.5-5.0			
			•CQV21-6			>4.0			
		Yellow	LD56A	Yellow Diffused		>.6	10		101
			LD56-1			1.0-2.0			
			LD56-2			>1.6			
			•CQV23-4			1.6-3.2	20		
			•CQV23-5			2.5-5.0			
			•CQV23-6			>4.0			
		Green	LD57A	Green Diffused		>.6			103
			LD57-1			2.0-4.0			
			LD57-2			>3.2			
			•CQV25-3			1.0-2.0			
			•CQV25-4			1.6-3.2			
			•CQV25-5			2.5-5.0			
			•CQV25-6			>4.0			
T1¾ 5mm 1" Leads		Red	RL-2000	Red Diffused	±35°	>1.6	20	100	105
			RL-4403			>.8			
			RL-4850			.8 Typ.			
			RL-5054-1		±10°	>1.0	10		109
			RL-5054-2			>2.0			
		Orange	*OL-30-3	Orange Diffused	±250°	>3.0	20	50	111
			*OL-30-4			>6.0			
T1¾ 5mm 1" leads No Standoffs		Red	RL-5053-1	Red Diffused	±35°	1.0-2.0	20	100	107
			RL-5053-2			1.6-3.2			
			RL-5053-3			>2.5			
			RL-5053A			>0.3			
		Yellow	YL-4550	Yellow Diffused	±35°	>1.0	10	60	113
			YL-4850			1.6 Typ.			
		Green	GL-4850	Green Diffused		1.0 Typ.	20		115
			GL-4950			>1.0			
T1¾ 5mm Low Profile Min. ½" Leads		High Efficiency Red	CQX23-1	Red Diffused	±70°	1.8-3.6	20	60	119
			CQX23-2			>2.8			
		Yellow	CQX33-1	Yellow Diffused		1.8-3.6			
			CQX33-2			>2.8			
		Green	CQX13-1	White Diffused		1.8-3.6			
			CQX13-2			>2.8			

• NEW TYPES TO BE PHASED IN

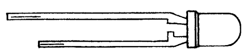
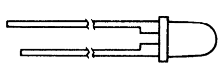
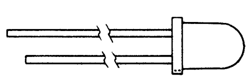
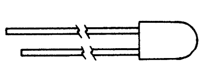
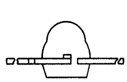
*NOT RECOMMENDED FOR NEW DESIGN – PHASING OUT

LED LAMPS

Package Type and Spacing	Package Outline	Color	Part Number	Lens	Viewing Half Angle	Luminous Intensity (mcd)	(mA)	Max Fwd Current (mA)	Page
4mm Low Profile No Standoffs		Red	*RL-2	Red Diffused	±30°	1.2 Typ		100	117
5mm Rec-tangular		High Efficiency Red	CQV36-3	Red Diffused	±50°	1.0-2.0	20	60	123
			CQV36-4			1.6-3.2			
			CQV36-5			>2.5			
		Yellow	CQV38-3	Yellow Diffused		1.0-2.0			
			CQV38-4			1.6-3.2			
			CQV38-5			>2.5			
		Green	CQV39-3	Green Diffused		1.0-2.0			
			CQV39-4			1.6-3.2			
			CQV39-5			>2.5			
5mm Rounded Rec-tangular		Red	LD80A	Red Diffused		>.6		100	127
			LD80-1			1.0-2.0			
			LD80-2			>1.6			
		High Efficiency Red	LD82A			>.6		60	
			LD82-1			1.0-2.0			
			LD82-2			>1.6			
		Yellow	LD86A	Yellow Diffused		>.6			
			LD86-1			1.0-2.0			
			LD86-2			>1.6			
		Green	LD87A	Green Diffused		>.6			
			LD87-1			1.0-2.0			
			LD87-2			>1.6			
5mm Cylin-drical		High Efficiency Red	CQV56-2	Red Diffused		.63-1.25			131
			CQV56-3			1.0-2.0			
			CQV56-4			>1.6			
		Yellow	CQV58-2	Yellow Diffused		.63-1.25			
			CQV58-3			1.0-2.0			
			CQV58-4			>1.6			
		Green	CQV59-2	Green Diffused		.63-1.25			
			CQV59-3			1.0-2.0			
			CQV59-4			>1.6			
Square		High Efficiency Red	CQV16-2	Red Diffused		.63-1.25			135
			CQV16-3			1.0-2.0			
			CQV16-4			>1.6			
		Yellow	CQV18-2	Yellow Diffused		.63-1.25			
			CQV18-3			1.0-2.0			
			CQV18-4			>1.6			
		Green	CQV19-2	Green Diffused		.63-1.25			
			CQV19-3			1.0-2.0			
			CQV19-4			>1.6			
Tri-angular		High Efficiency Red	CQV26-2	Red Diffused		.63-1.25			139
			CQV26-3			1.0-2.0			
			CQV26-4			>1.6			
		Yellow	CQV28-2	Yellow Diffused		.63-1.25			
			CQV28-3			1.0-2.0			
			CQV28-4			>1.6			
		Green	CQV29-2	Green Diffused		.63-1.25			
			CQV29-3			1.0-2.0			
			CQV29-4			>1.6			
Arrow		High Efficiency Red	LD602-2	Red Diffused		.63-1.25			143
			LD602-3			1.0-2.0			
			LD602-4			>1.6			
		Yellow	LD606-2	Yellow Diffused		.63-1.25			
			LD606-3			1.0-2.0			
			LD606-4			>1.6			
		Green	LD607-2	Green Diffused		.63-1.25			
			LD607-3			1.0-2.0			
			LD607-4			>1.6			

*NOT RECOMMENDED FOR NEW DESIGN—PHASING OUT

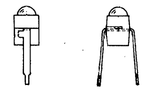
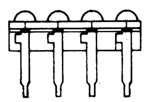
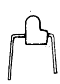
LED LAMPS

Package Type and Spacing	Package Outline	Color	Part Number	Lens	Viewing Half Angle	Luminous Intensity (mcd)	Luminous Intensity (mA)	Max Fwd Current (mA)	Page
T1 3mm ½" min Leads 90 MIL Lead Spacing		Red	LD30A	Red Diffused	±35°	>0.3	20	100	147
			LD30-1			1.0-2.4			
			LD30-2			2.0-4.0			
			LD30-3			>3.2			
			•CQV10-3			1.0-2.0			
			•CQV10-4			>1.6			
			LD30C	Glass Clear	±25°	>1.0			
			•CQV30A			1.0-2.0			
			•CQV30B			1.6-3.2			
			•CQV30C			>2.5			
		High Efficiency Red	LD32-1	Red Diffused	±35°	1.2-2.4	10	60	149
			LD32-2			>2.0			
			•CQV11-4			1.6-3.2	20		
			•CQV11-5			2.5-5.0			
			•CQV11-6			>4.0			
			LD32C	Red Clear	±25°	>2.5	10		
			•CQV31D			4.0-8.0	20		
			•CQV31E			>6.3			
		Yellow	LD36A	Yellow Diffused	±35°	>.6	10		151
			LD36-1			1.0-2.0			
			LD36-2			>1.6			
			•CQV13-4			1.6-3.2	20		
			•CQV13-5			2.5-5.0			
			•CQV13-6			>4.0			
			LD36C	Yellow Clear	±25°	>2.0	10		
			•CQV33D			4.0-8.0	20		
			•CQV33E			>6.3			
		Green	LD37A	Green Diffused	±35°	>0.5			153
			LD37-1			2.0-4.0			
			LD37-2			>3.2			
			•CQV15-3			1.0-2.0			
			•CQV15-4			1.6-3.2			
			•CQV15-5			2.5-5.0			
			•CQV15-6			>4.0			
			LD37C	Glass Clear	±25°	>4.0			
			•CQV35D			4.0-8.0			
			•CQV35E			>6.3			
T1 3mm 1" Leads 100 MIL Lead Spacing		Red	RL-4480	Red Diffused	±35°	>0.3		40	155
			RL-4480-1			>1.0			
			RL-4480-2			>2.0			
			RL-4480-5			0.8 Typ.			
T1 3mm 1" Leads 50 MIL Lead Spacing		Red	RL-209A	Red Diffused		0.5	20	40	157
			RL-209-1			1.0			
			RL-209-2			>2.0			
			RL-4484			0.8 Typ.			
T1 3mm 1" Leads 50 MIL Lead Spacing No Standoff		Orange	*OL-31-2	Orange Diffused		>1.5			159
			*OL-31-4			>4.0			
		Yellow	YL-212	Yellow Diffused		>1.0	10		161
			YL-4484			1.6 Typ.			
		Green	GL-211	Green Diffused		>0.8	20		163
			GL-4484			1.0 Typ.			
T1 3mm 1" Leads 75 MIL Lead Spacing Flangeless		Red	*RL-T1	Red Diffused		>0.3	20	40	165
Miniature Axial Lead		Red	RL-50	Water clear		>0.3	20	40	167
			RL-50-01	Red Diffused		>0.3			
			RL-54			0.8 Typ			169
Miniature Axial Lead High Dome Lens			RL-55			>2.0	20	40	170
			RL-55-5			>0.8			
		Yellow	YL-56	Yellow Diffused		2.0 Typ			172
		Green	GL-56	Green Dif.		1.0 Typ			

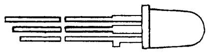
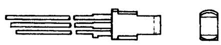
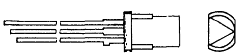
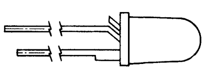
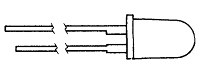
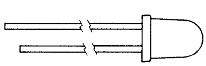
•NEW TYPES TO BE PHASED IN

*NOT RECOMMENDED FOR NEW DESIGN – PHASING OUT

LED LAMPS

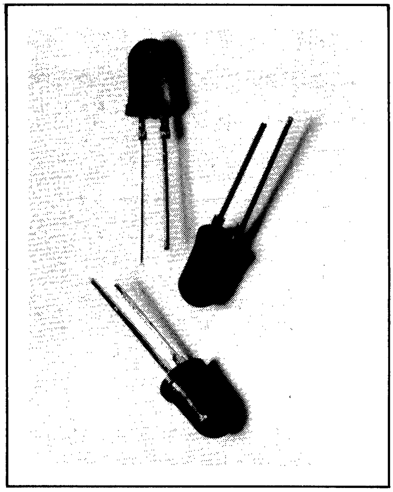
Package Type and Spacing	Package Outline	Color	Part Number	Lens	Viewing Half Angle	Luminous Intensity		Max Fwd Current	Page
						(mcd)	(mA)	(mA)	
Miniature Radial Lead 100 MIL Lead Spacing		Red	LD461	White Diffused	±50°	>0.6	20	35	173
		Green	LD471	Green Diffused		>0.6		25	175
		Yellow	LD481	Yellow Diffused		>0.6			177
2 Diode Array		Red	LD462	White Diffused	±50°	>0.6	20	35	173
3			LD463			>0.6			
4			LD464			>0.6			
5			LD465			>0.6			
6			LD466			>0.6			
7			LD467			>0.6			
8			LD468			>0.6			
9			LD469			>0.6			
10			LD460			>0.6			
2 Diode Array		Green	LD472	Green Diffused		>0.6		25	175
3			LD473			>0.6			
4			LD474			>0.6			
5			LD475			>0.6			
6			LD476			>0.6			
7			LD477			>0.6			
8			LD478			>0.6			
9			LD479			>0.6			
10			LD470			>0.6			
2 Diode Array		Yellow	LD482	Yellow Diffused		>0.6		25	177
3			LD483			>0.6			
4			LD484			>0.6			
5			LD485			>0.6			
6			LD486			>0.6			
7			LD487			>0.6			
8			LD488			>0.6			
9			LD489			>0.6			
10			LD480			>0.6			
Sub Miniature 1mm		High Efficiency Red	LD121	Red Diffused	±30°	0.63	10	25	179
		Yellow	LD161	Yellow Diffused		0.63			
		Green	LD171	White Diffused		0.63			

INTEGRATED CIRCUITS LED LAMPS

Package Type and Spacing	Package Outline	Color	Part Number	Lens	Viewing Half Angle	Luminous Intensity (mcd)	Luminous Intensity (mA)	Max Fwd Current (mA)	Page
T1¾ Bicolor		Red and Green	LD100-3s	colorless	±50°	1.0-2.0	20	60	193
			LD100-3t			1.0-2.0			
			LD100-4s			1.6-3.2			
			LD100-4t			1.6-3.2			
			LD100-5s			>2.5			
			LD100-5t			>2.5			
Rectangle Bicolor		Red and Green	LD110-2s	colorless	±50°	0.63-1.25	20	60	195
			LD110-2t			0.63-1.25			
			LD110-3s			1.0-2.0			
			LD110-3t			1.0-2.0			
			LD110-4s			>1.6			
			LD110-4t			>1.6			
Square Bicolor		Red and Green	LD111-2s	colorless	±50°	0.63-1.25	20	60	197
			LD111-2t			0.63-1.25			
			LD111-3s			1.0-2.0			
			LD111-3t			1.0-2.0			
			LD111-4s			>1.6			
			LD111-4t			>1.6			
Triangle Bicolor		Red and Green	LD112-2s	colorless	±50°	0.63-1.25	20	60	199
			LD112-2t			0.63-1.25			
			LD112-3s			1.0-2.0			
			LD112-3t			1.0-2.0			
			LD112-4s			>1.6			
			LD112-4t			>1.6			
T1¾ Flashing Lamp		Red	FRL-2000	Red Diffused	±35°	>0.8	V_F=5V	35 V_F=5V	183
			FRL-4403			>0.5			185
T1¾ Current Regulated		Red	RLC200	Red Diffused	±35°	>0.8	V_F=6V	24 V_F= 12.5V	187
			RLC201			>0.4		14 V_F=16V	189
T1 Current Regulated		Red	RLC210	Red Diffused	±50°	>0.1	V_F=6V	14 V_F=11V	191

litronix
A Siemens Company

CQV 20 (LD 41) SERIES
LD 50 SERIES
RED T 1¾ LED LAMP



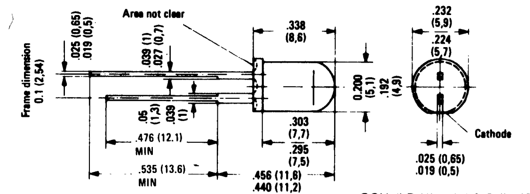
FEATURES

- Moderately Wide Viewing Angle ±35° CQV 20 (LD 41) Series
- Narrow Viewing Angle ±12° LD 50 Series
- T 1¾ Package Size
- ½" Minimum Lead Length
- Front Panel Mounting
  Snap-in Mounting Clips Available
  Clip/Collar #004-9002 Black
  #004-9003 Clear
- I/C Compatible

DESCRIPTION

The CQV 20 (LD 41) and LD 50 Series are standard red gallium arsenide phosphide LED solid-state lamps. They both have red diffused plastic lenses. The CQV 20 (LD 41) offers a wider viewing angle which is suitable for front panel indicator applications. The LD 50 Series has a narrow viewing angle of ±12° and is intended for head on viewing or back lit legends where high brightness of the CQV 21/51 Series (see CQV 21/51 Series Data Sheet) is not required.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

CQV (LD41) - (11.6-0.4) .457
LD50 - (12.4-0.4) .488

Maximum Ratings

Reverse voltage	V_R	5	V
Forward current	I_F	100	mA
Surge current (t≤1 μs)	i_{FS}	2.0	A
Storage temperature	T_{stor}	−55 to +100	°C
Junction temperature	T_j	100	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	200	mW
Thermal resistance			
Junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

Wavelength at peak emission	λ_{peak}	665 ±15	nm
Dominant wavelength	λ_{dom}	645	nm
Half angle			
(limits for 50% of luminous intensity I_v)			
CQV 20 (LD 41)	φ	35	degree
LD 50	φ	12	degree
Forward voltage (I_F = 20 mA)	V_F	1.6 (≤ 2.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤ 10)	μA
Rise time	t_r	5	ns
Fall time	t_f	5	ns
Capacitance (V_R = 0 V)	C_0	40	pF

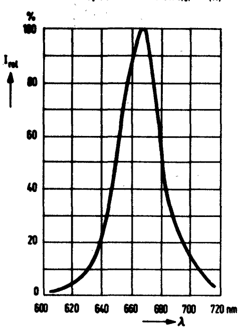
Luminous Intensity

Type	Min	Max	Unit	Test Condition
(LD 41A)	0.3	–	mcd	20 mA
CQV 20-3	1.0	2.0	mcd	20 mA
(LD 41-1)	1.0	2.4	mcd	20 mA
CQV 20-4	1.6	–	mcd	20 mA
(LD 41-2)	2.0		mcd	20 mA
LD 50A	1.0	–	mcd	20 mA
LD 50-1	2.0	4.0	mcd	20 mA
LD 50-2	3.2	–	mcd	20 mA

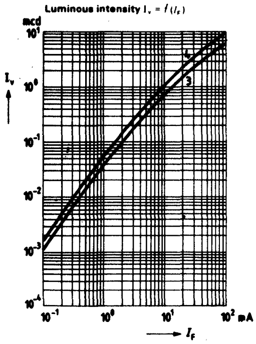
*CQV designations are preferred types for new designs and conform to new international classification standards. LD equivalents may continue to be delivered during transition period.

Specifications are subject to change without notice.

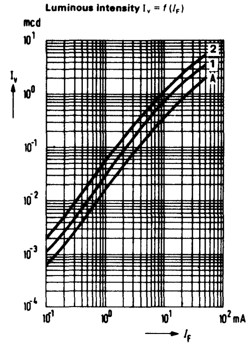
Relative spectral emission $I_{rel} = f(\lambda)$



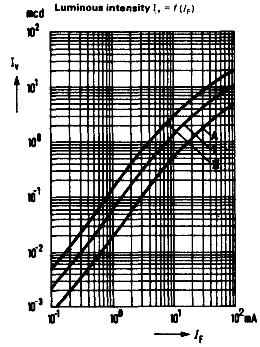
CQV 20
Luminous intensity $I_v = f(I_F)$



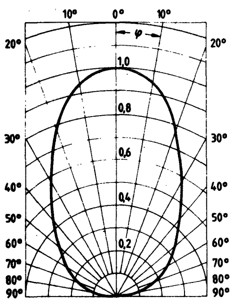
LD 41
Luminous intensity $I_v = f(I_F)$



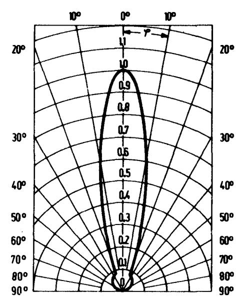
LD 50
Luminous intensity $I_v = f(I_F)$



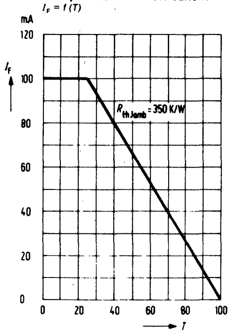
CQV 20 (LD 41)
Radiation characteristic $I_{rel} = f(\varphi)$



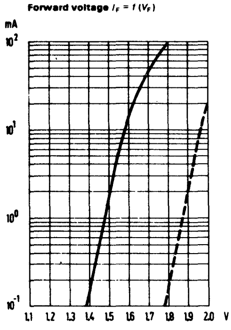
LD 50
Radiation characteristic $I_{rel} = f(\varphi)$



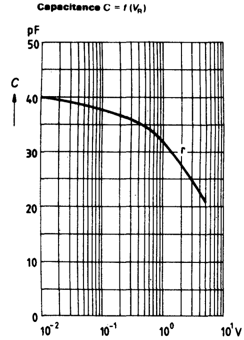
Max. permissible forward current
$I_F = f(T)$



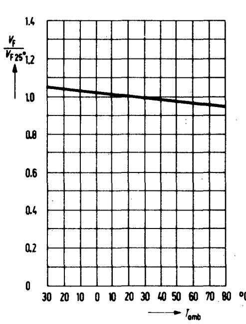
Forward voltage $I_F = f(V_F)$



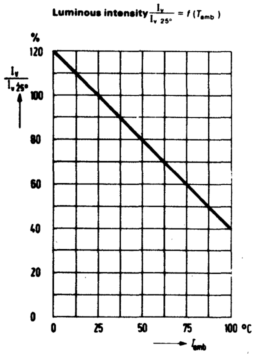
Capacitance $C = f(V_R)$



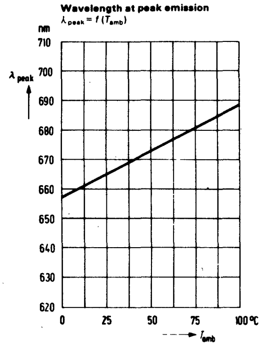
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



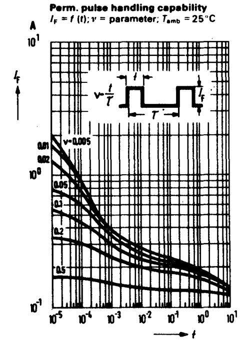
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



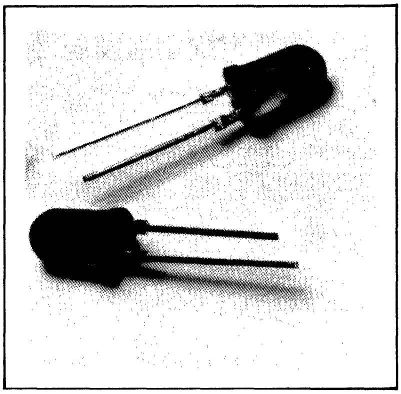
Perm. pulse handling capability
$I_F = f(t)$; v = parameter; $T_{amb} = 25°C$



litronix
A Siemens Company

CQV 21 (LD52-1/-2) SERIES
CQV 51 (LD52C/CA) SERIES

HIGH EFFICIENCY RED
T 1¾ LED LAMP



FEATURES

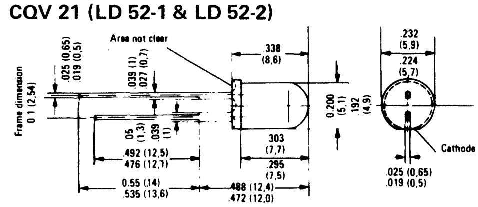
- High Light Output
- Red Diffused Lens
  Wide Viewing Angle ±35°
  CQV 21 (LD 52-1, LD 52-2)
- Red Clear Lens
  High On Axis Intensity ±12°
  CQV 51 (LD 52C, LD 52CA)
- T 1¾ Package Size
- ½" Minimum Lead Length
- Front Panel Mounting
  Snap-in Mounting Clips Available
  Clip/Collar #004-9002 Black
  #004-9003 Clear
- I/C Compatible

DESCRIPTION

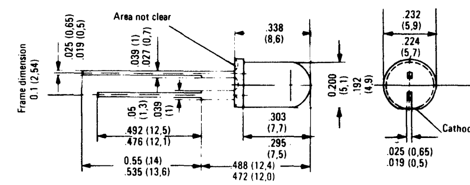
The CQV 21/51 Series is a premium high efficiency light emitting diode lamp fabricated with TSN (transparent substrate nitrogen) technology. The CQV 21 Series has a red diffused plastic lens which provides a large full flooded front radiating area and wide angle viewing. This makes it ideal for front panel installation. The CQV 51 Series has a red clear lens and narrow viewing angle for the concentration of intense brightness in a head-on position. This is particularly desirable for legend back lighting applications.

Package Dimensions in Inches (mm)

CQV 21 (LD 52-1 & LD 52-2)



CQV 51 (LD 52C & LD 52CA)



Maximum Ratings

Reverse voltage	V_R	5.0	V
Forward current	I_F	60	mA
Surge current ($t \leq 1$ μs)	i_{FS}	1.0	A
Storage temperature	T_{stor}	−55 to 100	°C
Junction temperature	T_j	100	°C
Power dissipation	P_{tot}	200	mW
Thermal resistance junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

Wavelength at peak emission	λ_{peak}	645 ±15	nm
Half angle (limits for 50% of luminous intensity I_v)			
CQV 21 (LD 52-1, LD 52-2)	φ	35	degree
CQV 51 (LD 52C, LD 52CA)	φ	12	degree
Forward voltage (I_F = 20 mA)	V_F	2.4 (≦ 3.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≦ 10)	μA
Rise time	t_r	100	ns
Fall time	t_f	100	ns
Capacitance (V_R = 0 V)	C_0	12	pF

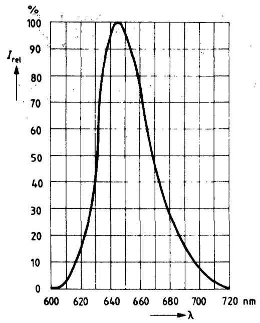
Luminous Intensity

Type	Min	Max	Unit	Test Condition
CQV 21-4	1.6	3.2	mcd	20 mA
CQV 21-5	2.5	5.0	mcd	20 mA
(LD 52-1)	1.2	2.4	mcd	10 mA
CQV 21-6	4.0	–	mcd	20 mA
(LD 52-2)	2.0	–	mcd	10 mA
CQV 51F	10.0	20.0	mcd	20 mA
CQV 51G	16.0	32.0	mcd	20 mA
(LD 52CA)	9.0	18.0	mcd	10 mA
CQV 51H	25.0	50.0	mcd	20 mA
(LD 52C)	15.0	–	mcd	10 mA
CQV 51J	40.0	–	mcd	20 mA

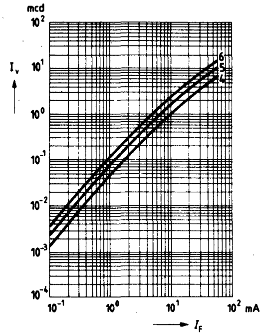
*CQV designations are preferred types for new designs and conform to new international classification standards. LD 52 equivalents may continue to be delivered during transition period.

Specifications are subject to change without notice.

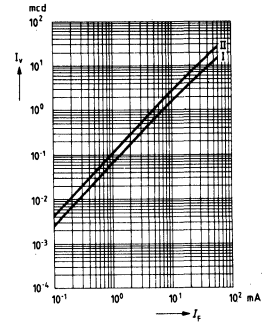
Relative spectral emission $I_{rel} = f(\lambda)$



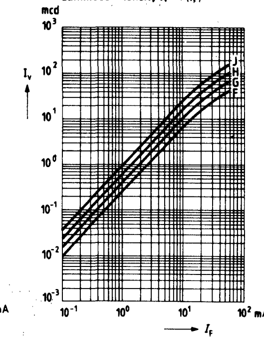
CQV 21
Luminous intensity $I_v = f(I_F)$



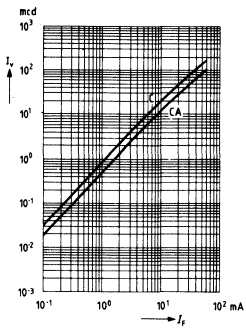
(LD 52-1/-2)
Luminous intensity $I_v = f(I_F)$



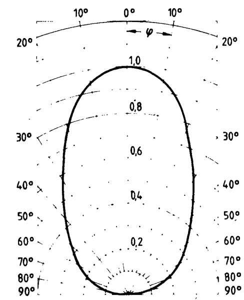
CQV 51
Luminous intensity $I_v = f(I_F)$



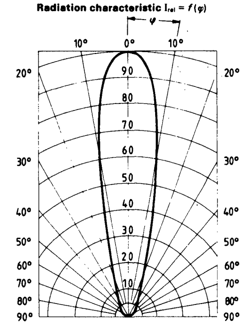
LD 52C/CA
Luminous intensity $I_v = f(I_F)$



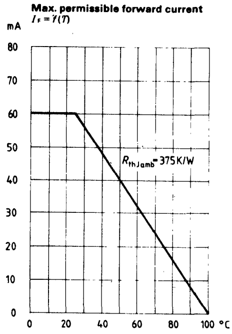
CQV 21, LD 52
Radiation characteristic $I_{rel} = f(\varphi)$
$I_{rel} = f(\varphi)$



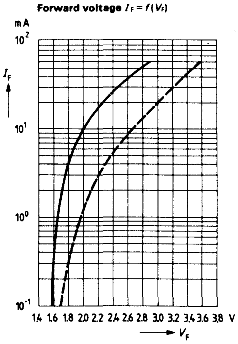
CQV 51 (LD 52C/CA)
Radiation characteristic $I_{rel} = f(\varphi)$



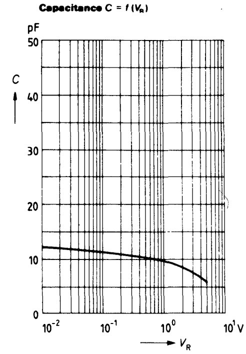
Max. permissible forward current
$I_F = f(T)$



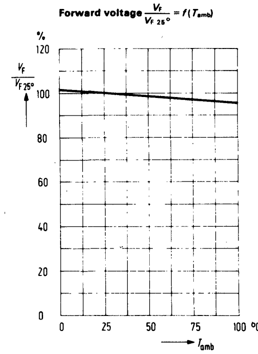
Forward voltage $I_F = f(V_F)$



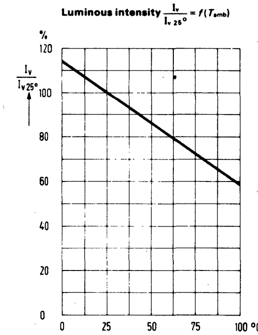
Capacitance $C = f(V_R)$



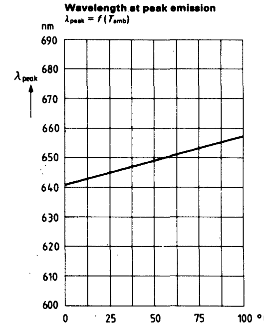
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



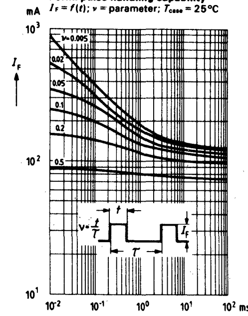
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

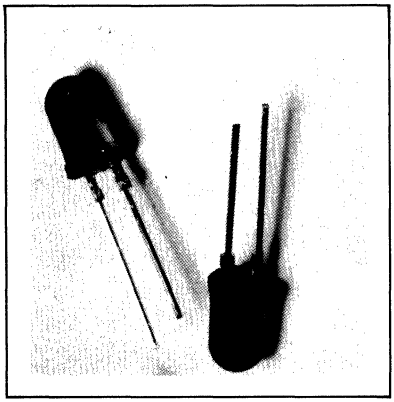


Perm. pulse handling capability
$I_F = f(t)$; v = parameter; $T_{case} = 25°C$



litronix
A Siemens Company

CQV 23 (LD 56A/-1/-2) SERIES
CQV 53 (LD 56C/CA) SERIES
YELLOW T 1¾ LED LAMP



FEATURES

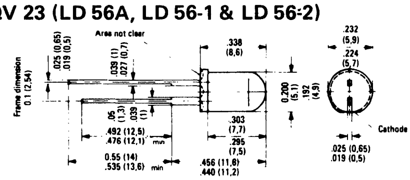
- **High Light Output**
- **Yellow Diffused Lens**
  Wide Viewing Angle ±35°
  CQV 23 (LD 56A, LD 56-1 & LD 56-2)
- **Yellow Clear Lens**
  High On Axis Intensity ±12°
  CQV 53 (LD 56C & LD 56CA)
- **T-1¾ Package Size**
- **½" Minimum Lead Length**
- **Front Panel Mounting**
  Snap-in Mounting Clips Available
  Clip/Collar #004-9002 Black
  #004-9003 Clear
- **I/C Compatible**

DESCRIPTION

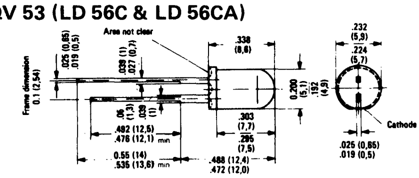
The CQV 23/53 Series is a premium high efficiency light emitting diode lamp fabricated with TSN (transparent substrate nitrogen) technology. The CQV 23 Series has a yellow diffused plastic lens which provides a large full flooded front radiating area and wide angle viewing. This makes it ideal for front panel installation. The CQV 53 Series has a yellow clear lens and narrow viewing angle for the concentration of intense brightness in a head-on position. This is particularly desirable for legend back lighting applications.

Package Dimensions

CQV 23 (LD 56A, LD 56-1 & LD 56-2)



CQV 53 (LD 56C & LD 56CA)



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	5.0	V
Forward current	I_F	60	mA
Surge current ($t \leq 1\,\mu s$)	i_{FS}	1.0	A
Storage temperature	T_{stor}	−55 to 100	°C
Junction temperature	T_j	100	°C
Power dissipation	P_{tot}	200	mW
Thermal resistance junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

Wavelength at peak emission	λ_{peak}	590 ±10	nm
Half angle (limits for 50% of luminous intensity I_V)			
CQV 23 (LD 56A/-1/-2)	φ	35	degree
CQV 53 (LD 56C/CA)	φ	12	degree
Forward voltage (I_F = 20 mA)	V_F	2.4 (≤ 3.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤ 10)	μA
Rise time	t_r	100	ns
Fall time	t_f	100	ns
Capacitance (V_R = 0 V)	C_O	10	pF

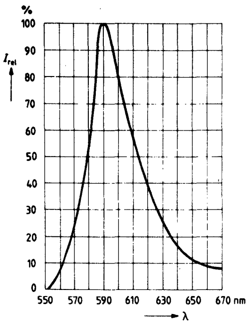
Luminous Intensity

Type	Min	Max	Unit	Test Condition
(LD 56A)	.6	–	mcd	10 mA
CQV 23-4	1.6	3.2	mcd	20 mA
(LD 56-1)	1.0	2.0	mcd	10 mA
CQV 23-5	2.5	5.0	mcd	20 mA
(LD 56-2)	1.6	–	mcd	10 mA
CQV 23-6	4.0	–	mcd	20 mA
CQV 53F	10.0	20.0	mcd	20 mA
CQV 53G	16.0	32.0	mcd	20 mA
(LD 56CA)	6.0	12.0	mcd	10 mA
CQV 53H	25.0	50.0	mcd	20 mA
(LD 56C)	10.0	–	mcd	10 mA
CQV 53J	40.0	–	mcd	20 mA

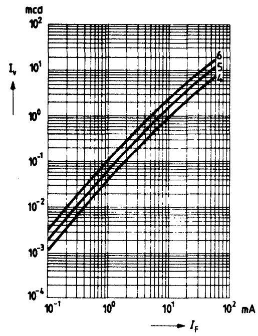
*CQV designations are preferred types for new designs and conform to new international classification standards. LD equivalents may continue to be delivered during transition period.

Specifications are subject to change without notice.

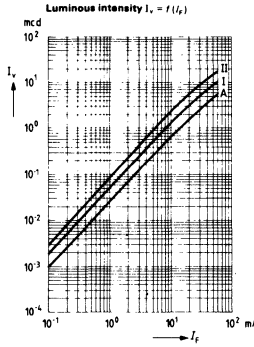
Relative spectral emission $I_{rel} = f(\lambda)$



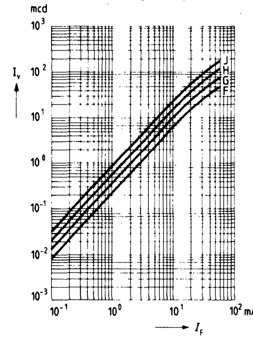
CQV 23
Luminous intensity $I_v = f(I_F)$



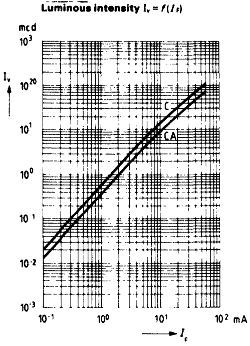
LD 56 A/-1/-2
Luminous intensity $I_v = f(I_F)$



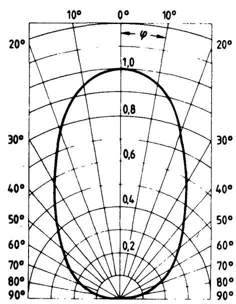
CQV 53
Luminous intensity $I_v = f(I_F)$



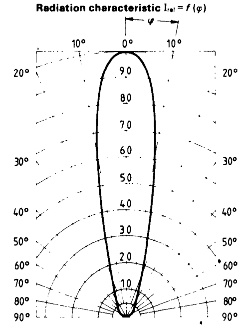
LD 56C/CA
Luminous intensity $I_v = f(I_F)$



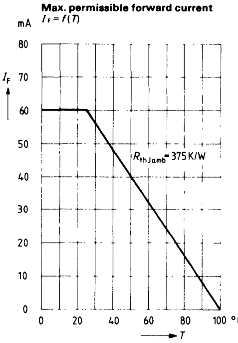
CQV 23, LD 56 A/-1/-2
Radiation characteristic
$I_{rel} = f(\varphi)$



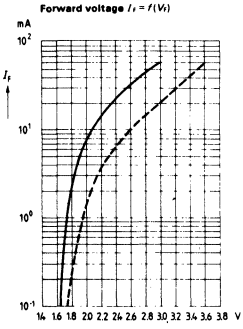
CQV 53 (LD 56C/CA)
Radiation characteristic $I_{rel} = f(\varphi)$



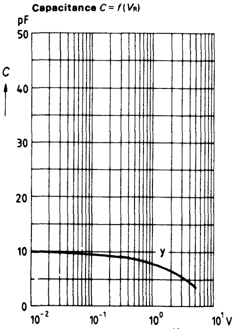
Max. permissible forward current
$I_F = f(T)$



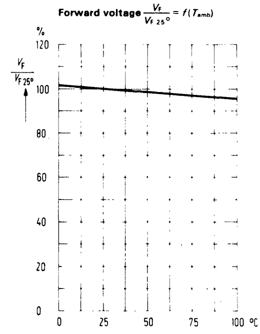
Forward voltage $I_F = f(V_F)$



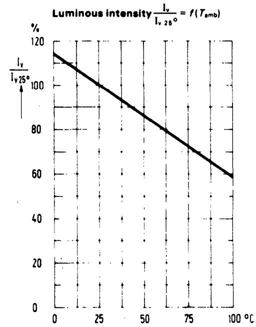
Capacitance $C = f(V_R)$



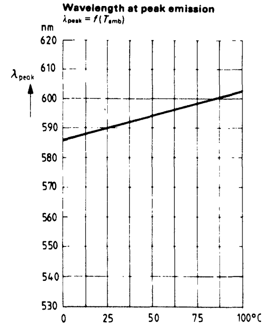
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



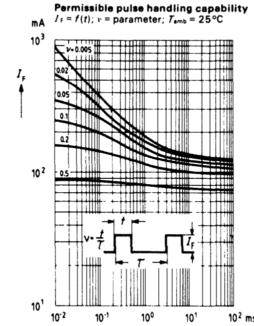
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

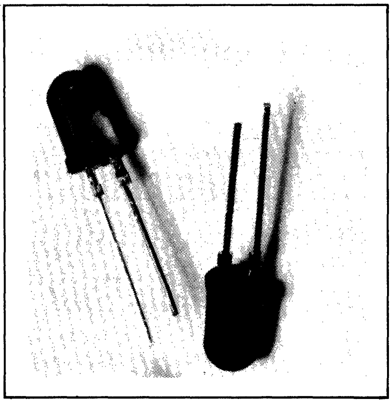


Permissible pulse handling capability
$I_F = f(t)$; v = parameter; T_{amb} = 25 °C



litronix
A Siemens Company

CQV 25 (LD 57A/-1/-2) SERIES
CQV 55 (LD 57C/CA) SERIES
GREEN T 1¾ LED LAMP



FEATURES

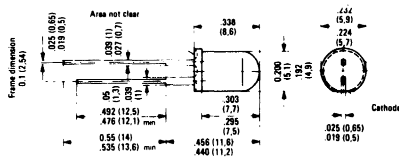
- **Extremely High Light Output**
  CQV 55 (LD 57C & LD 57CA)
- **Green Diffused Lens**
  Moderately Wide Viewing Angle ±35°
  CQV 25 (LD 57A, LD 57-1 & LD 57-2)
- **Green Clear Lens**
  High On Axis Intensity ±12°
  CQV 55 (LD 57C & LD 57CA)
- **T-1¾ Package Size**
- **½" Minimum Lead Length**
- **Front Panel Mounting**
  Snap-in Mounting Clips Available
  Clip/Collar #004-9002 Black
  #004-9003 Clear
- **I/C Compatible**

DESCRIPTION

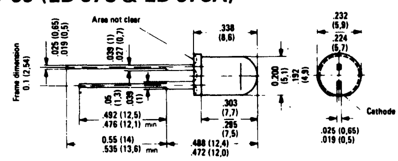
The CQV 25/55 Series are green gallium phosphide LED solid state lamps. The CQV 25 has a green diffused plastic lens which emits green light with a moderately wide viewing angle, suitable for front panel indicator applications. The CQV 55 has a glass clear plastic lens which emits a yellowish green light. Its narrow viewing angle and extremely intense light output make it particularly desirable for back lighting applications.

Package Dimensions in Inches (mm)

CQV 25 (LD 57A/-1/-2)



CQV 55 (LD 57C & LD 57CA)



Maximum Ratings

Reverse voltage	V_R	5	V
Forward current	I_F	60	mA
Surge current ($t \leq 10\ \mu s$)	i_{FS}	1	A
Storage temperature	T_{stor}	−55 to +100	°C
Junction temperature	T_j	100	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	200	mW
Thermal resistance Junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

Wavelength at peak emission	λ_{peak}	560 ± 15	nm
Dominant wavelength	λ_{dom}	561	nm
Half angle (limits for 50% of luminous intensity I_v)			
CQV 25 (LD 57A/-1/-2)	φ	35	degree
CQV 55 (LD 57C/CA)	φ	12	degree
Forward voltage (I_F = 20 mA)	V_F	2.4 (≤ 3.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤ 10)	µA
Rise time	t_r	50	ns
Fall time	t_f	50	ns
Capacitance (V_R = 0 V)	C_0	45	pF

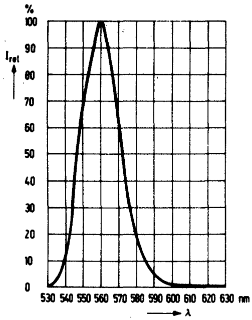
Luminous Intensity

Type	Min	Max	Unit	Test Condition
(LD 57A)	.6	–	mcd	20 mA
CQV 25-3	1.0	2.0	mcd	20 mA
CQV 25-4	1.6	3.2	mcd	20 mA
(LD 57-1)	2.0	4.0	mcd	20 mA
CQV 25-5	2.5	5.0	mcd	20 mA
(LD 57-2)	3.2	–	mcd	20 mA
CQV 25-6	4.0	–	mcd	20 mA
CQV 55G	16.0	32.0	mcd	20 mA
(LD 57CA)	12.0	24.0	mcd	10 mA
CQV 55H	25.0	50.0	mcd	20 mA
(LD 57C)	20.0	–	mcd	10 mA
CQV 55J	40.0	80.0	mcd	20 mA
CQV 55K	63.0	–	mcd	20 mA

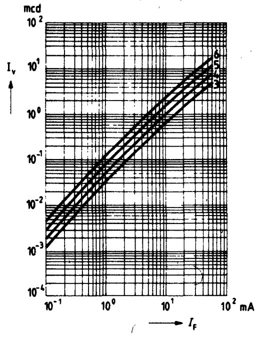
Specifications are subject to change without notice.

***CQV designations are preferred types for new designs and conform to new international classification standards. LD equivalents may continue to be delivered during transition period.**

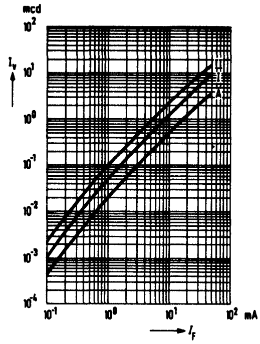
Relative spectral emission $I_{rel} = f(\lambda)$



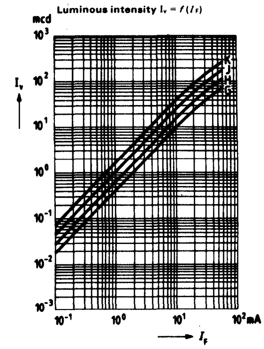
CQV 25
Luminous intensity $I_v = f(I_F)$



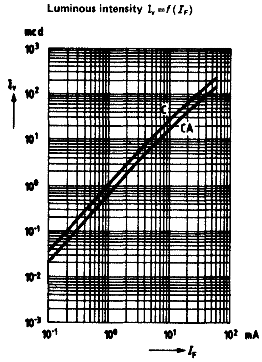
Luminous intensity $I_v = f(I_F)$



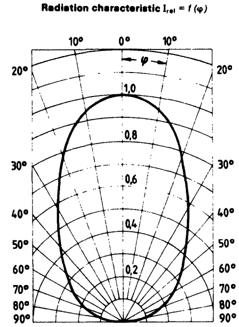
CQV 55
Luminous intensity $I_v = f(I_F)$



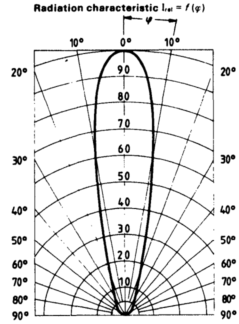
Luminous intensity $I_v = f(I_F)$



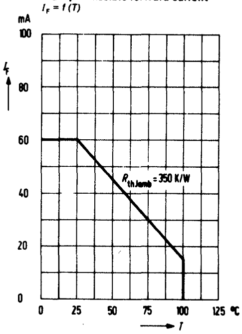
CQV 25 (LD 57A/-1/-2)
Radiation characteristic $I_{rel} = f(\varphi)$



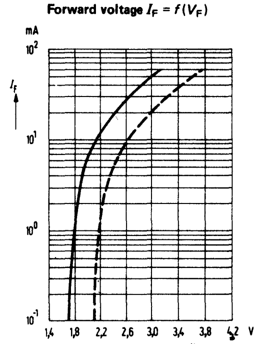
CQV 55 (LD 57C/CA)
Radiation characteristic $I_{rel} = f(\varphi)$



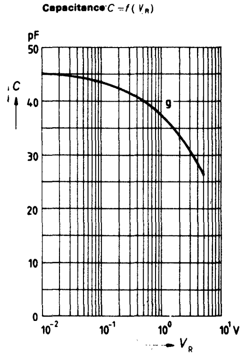
Max. permissible forward current
$I_F = f(T)$



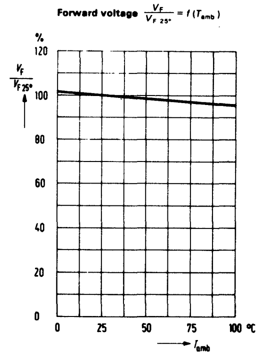
Forward voltage $I_F = f(V_F)$



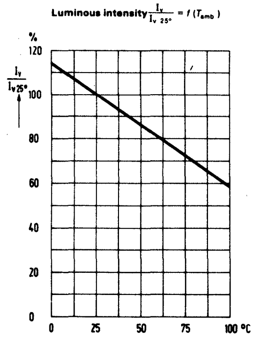
Capacitance $C = f(V_R)$



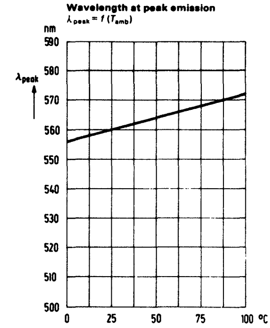
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



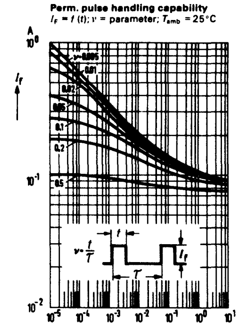
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



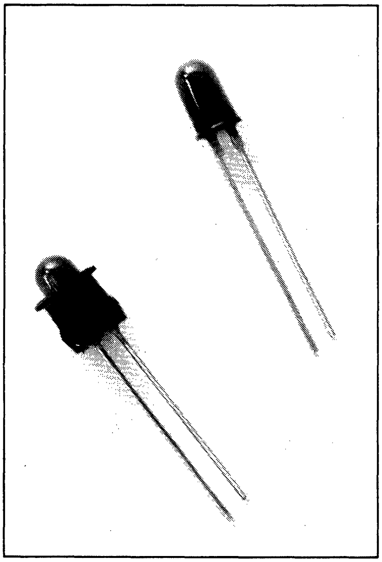
Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; T_{amb} = 25°C



litronix
A Siemens Company

RL-2000
RL-4403
RL-4850

RED T1¾ LED LAMP



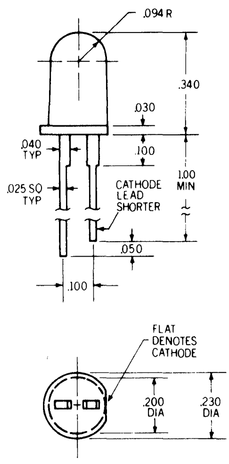
FEATURES

- Choice of Brightness Ranges
- Front Panel Mounting
- Large Full Flood Radiating Area
- IC Compatible
- Snap-in Mounting Clip

DESCRIPTION

The RL-2000, RL-4403 and RL-4850 are high brightness gallium arsenide phosphide solid-state lamps with a red diffused plastic lens which provides a large full flooded front radiating area and wide angle viewing. These devices are easily soldered directly into a PC board or mounted in a panel with a snap-in mounting clip.

Package Dimensions in Inches



BOTTOM VIEW

Maximum Ratings

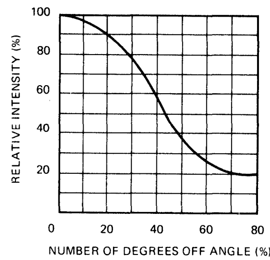
Power Dissipation @ 25 °C .... 100 mW
Derate Linearly from 25 °C .... −2.67 mW/°C
Continuous Forward Current .... 50 mA
Storage and Operating Temperature .... −55 °C to +100 °C
Lead Soldering Temperature
(1/16 in. from case) .... 5 sec @ 260 °C
Peak Inverse Voltage .... 3.0 V

Opto-Electronic Characteristics (@ 25 °C)

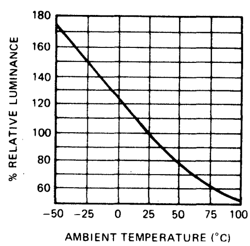
Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity					
RL-2000	1.6	2.5		mcd	$I_F = 20$ mA
RL-4403	0.8	1.2		mcd	$I_F = 20$ mA
RL-4850		0.8		mcd	$I_F = 20$ mA
Emission Peak Wave Length		650		nm	
Spectral Line Half-Width		40		nm	
Forward Voltage		1.6	2.0	V	$I_F = 20$ mA
Reverse Leakage		0.1	100	μA	$V_R = 3.0$ V
Temperature Coefficient of Forward Voltage		−1.8		mV/°C	$I_F = 5$ to 50 mA

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

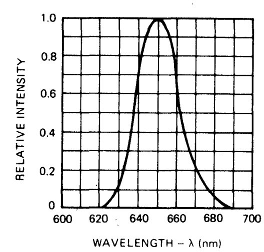
RELATIVE LUMINOUS INTENSITY VS ANGLE



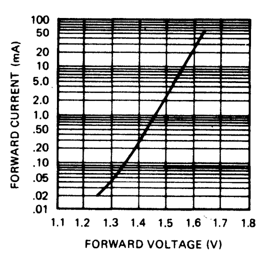
LUMINOUS INTENSITY VS AMBIENT TEMPERATURE



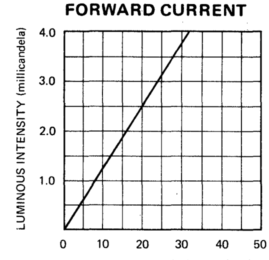
SPECTRAL DISTRIBUTION



FORWARD CURRENT VS FORWARD VOLTAGE



LUMINOUS INTENSITY VS FORWARD CURRENT



Mounting Information

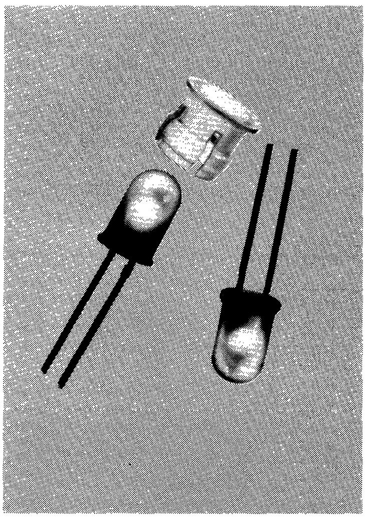
The clip mounts in a .250" dia. hole and fits up to .125" panel thickness. A plastic collar is provided which fits over the back of the clip to lock the LED securely against the panel.

BLACK CLIP AND COLLAR: 004-9002
CLEAR CLIP AND COLLAR: 004-9003

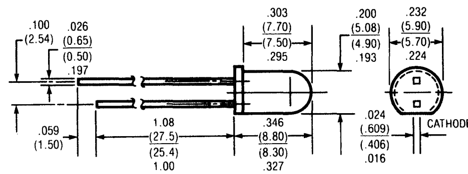
litronix
A Siemens Company

RL-5053 SERIES

RED, T1¾, LED LAMP



Package Dimensions in Inches (mm)



Maximum Ratings

Power Dissipation @ 25°C 200mW
Derate Linearly from 25°C . . . . -2.67 mW/°C
Continuous Forward Current . . . . 100 mA
Recurrent Peak Forward Current
(1 μsec pulse @ .1% duty cycle) . . . . 5 A
Storage & Operating Temperature . . . . -55 to +100°C
Lead Soldering Temperature
(1/16 in. from case) . . . . 5 sec @ 260°C
Peak Inverse Voltage . . . . 5.0 V

Opto-Electronic Characteristics (at 25°C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity.				mcd	I_F=20 mA
RL-5053-A.	0.3				
RL-5053-1	1.0		2.0		
RL-5053-2.	1.6		3.2		
RL-5053-3	2.5				
Emission Peak Wavelength .		650	665	nm	
Spectral Line Half-Width. .		40		nm	
Half Angle		35		degree	
Forward Voltage.		1.6	2.0	V	I_F=20 mA
Reverse Leakage.		.01	10	μA	V_R= 5.0 V

Specifications subject to change without notice.

FEATURES

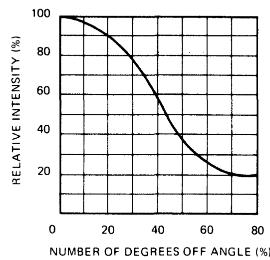
- 1 Inch Leads — No Standoffs
- Large Full Flood Radiating Area
- Four Brightness Groups
- IC Compatible
- Snap-in Mounting Clip available for easy panel mounting. Black P/N 004-9002
  Clear P/N 004-9003

DESCRIPTION

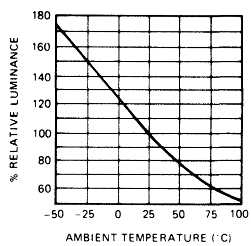
The RL-5053 series is a Gallium Arsenide Phosphide solid state lamp with a red diffused plastic lens which provides a large full flooded front radiating area and wide angle viewing. These devices are easily soldered directly into a PC board or mounted in a panel with a snap-in mounting clip.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

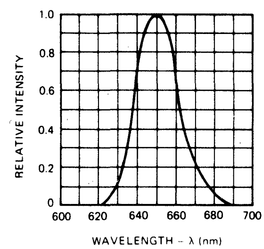
RELATIVE LUMINOUS INTENSITY VS ANGLE



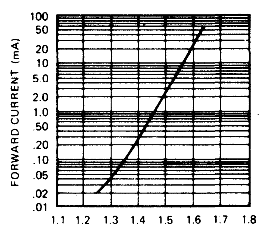
LUMINOUS INTENSITY VS AMBIENT TEMPERATURE



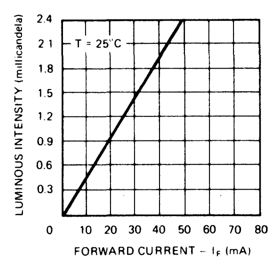
SPECTRAL DISTRIBUTION



FORWARD CURRENT VS FORWARD VOLTAGE



LUMINOUS INTENSITY VS FORWARD CURRENT



Mounting Information

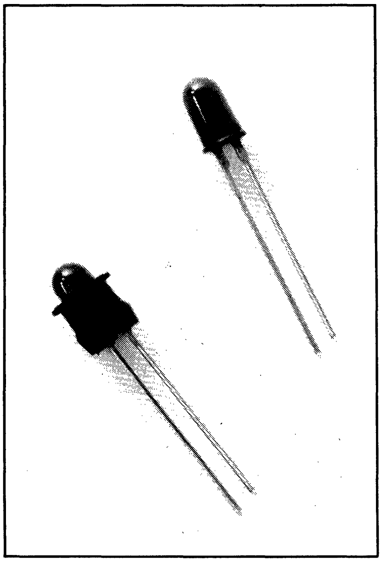
The clip mounts in a .250" dia. hole and fits up to .125" panel thickness. A plastic collar is provided which fits over the back of the clip to lock the LED securely against the panel.

BLACK CLIP AND COLLAR: 004-9002
CLEAR CLIP AND COLLAR: 004-9003

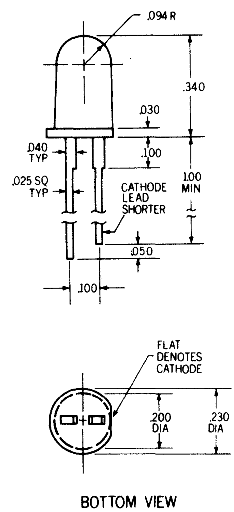
litronix
A Siemens Company

RL-5054-1
RL-5054-2

RED T1¾ LED LAMP



Package Dimensions in Inches



FEATURES

- **RL-5054-1 — 1 mcd Min at $I_F = 10$ mA**
- **RL-5054-2 — 2 mcd Min at $I_F = 10$ mA**
- **High Intensity Spot Light for Back Lighting a Transparent Panel**
- **Illuminates a ¼" Diameter Circle**
- **One Inch Leads**
- **IC Compatible**
- **Versatile Mounting on P.C. Board**
- **Snap In Mounting Clip for Panel Mounting**
- **Replacement for MV5054-1/MV5054-2**

DESCRIPTION

The RL-5054-1/RL-5054-2 is a very bright Gallium Arsenide Phosphide solid state lamp in a red epoxy package that is designed to illuminate a 1/4" circle. Its high intensity narrow on axis beam is ideal for back lighting applications. It is not recommended for general purpose front panel installation where the wide angle RL-4403 is particularly well suited.

Maximum Ratings

Power Dissipation @ 25°C Ambient . . . . 200 mW
Derate Linearly from 25°C . . . . −2.67 mW/°C
Continuous Forward Current . . . . 100 mA
Storage and Operating Temperature . . . . −55°C to +100°C
Lead Soldering Temperature
(1/16 in. from case) . . . . 5 sec @ 260°C
Peak Inverse Voltage 3V

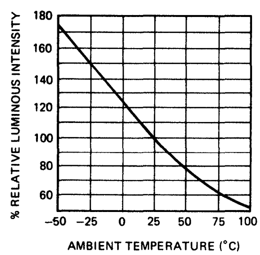
Opto-Electronic Characteristics (at 25°C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity					
RL-5054-1	1	2		mcd	$I_F = 10$ mA
RL-5054-2	2	2.5		mcd	$I_F = 10$ mA
Emission Peak Wavelength		650		nm	
Spectral Line Half-Width		40		nm	
Forward Voltage		1.6	2.0	V	$I_F = 20$ mA
Reverse Leakage		0.1	10	μA	$V_R = 3V$
Capacitance		35		pF	V = 0
Rise and Fall Time		50		ns	50Ω System
Viewing Angle (Total)		24		deg.	Between 50% Intensity Points
Illumination (Circle Dia.)		.250		in.	Measured From End of Lens

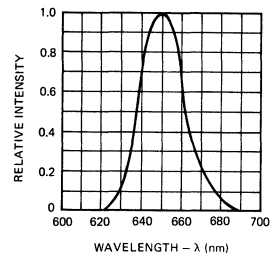
Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

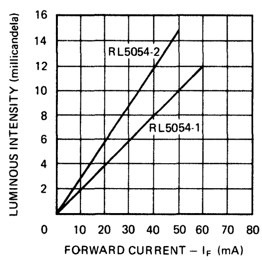
LUMINOUS INTENSITY VS AMBIENT TEMPERATURE



SPECTRAL DISTRIBUTION



LUMINOUS INTENSITY VS FORWARD CURRENT



Mounting Information

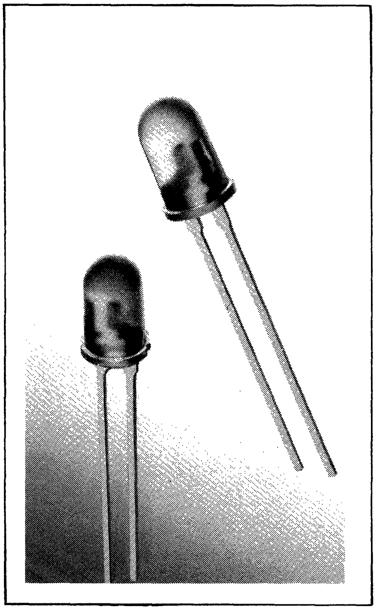
The clip mounts in a .250″ dia. hole and fits up to .125″ panel thickness. A plastic collar is provided which fits over the back of the clip to lock the LED securely against the panel.

BLACK CLIP AND COLLAR: 004-9002
CLEAR CLIP AND COLLAR: 004-9003

litronix
A Siemens Company

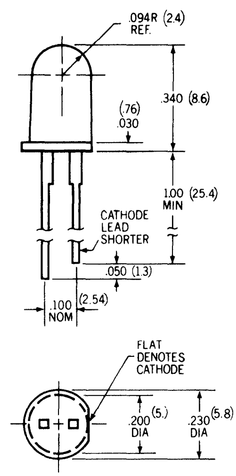
OL-30 SERIES

ORANGE T1¾ LED LAMP



PHASING OUT—NOT FOR NEW DESIGN

Package Dimensions in Inches (mm)



FEATURES

- T1¾ Package Size
- IC Compatible
- Wide viewing angle
- Low power consumption
- Mounting clips available

DESCRIPTION

The OL-30, a T1¾ lamp, is a high brightness orange TSN (Transparent Substrate Nitrogen) technology, solid state lamp which emits light in the orange region with good off-angle viewing.

The lamp is in a lightly diffused orange case.

Maximum Ratings

Power Dissipation	125mW
Derate Linearity from 25°C	1.6 mW/°C
Continuous Forward Current	50 mA
Operating Temperature	-55° to +100°C
Storage Temperature	-55° to +100°C
Peak Inverse Voltage	3.0V
Lead Soldering Temperature (1/16 inch from case)	5 sec @ 260°C

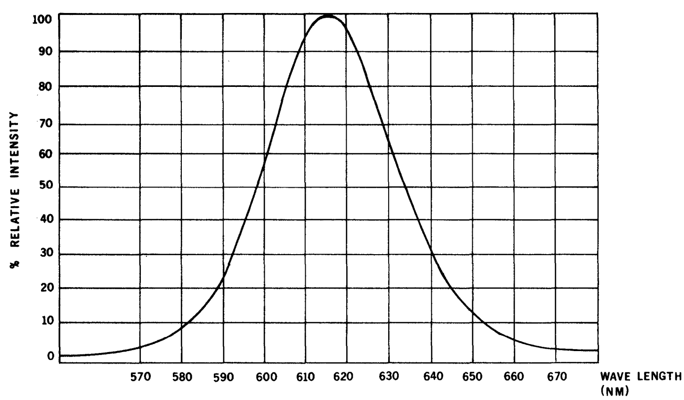
Opto-Electronic Characteristics @ 25°C

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity					
OL 30-3	3.0	5.0		mcd	I_F = 20mA
OL 30-6	6.0	10.0		mcd	I_F = 20mA
Forward Voltage		1.8	2.7	V	I_F = 20mA
Reverse Current		0.1	100	μA	V_R = 3V
Peak Emission Wavelength		615		nm	
Viewing Angle		25		degrees	

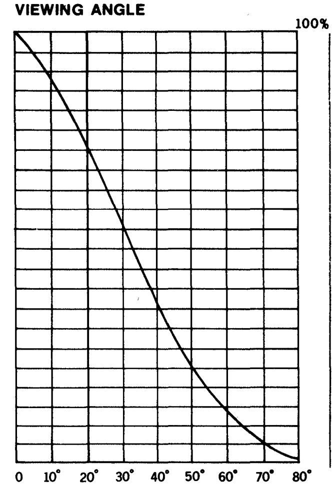
Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTICS CURVES

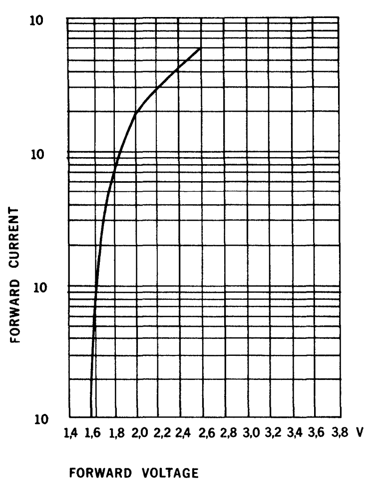
SPECTRAL DISTRIBUTION



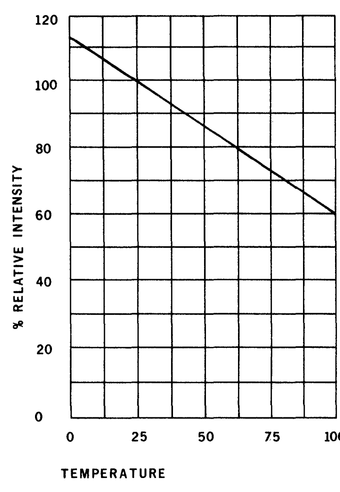
LUMINOUS INTENSITY VS VIEWING ANGLE



FORWARD CURRENT VS FORWARD VOLTAGE



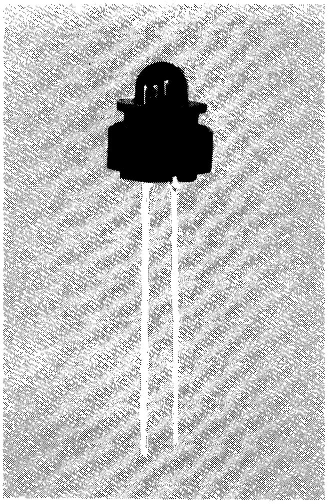
LUMINOUS INTENSITY VS AMBIENT TEMPERATURE



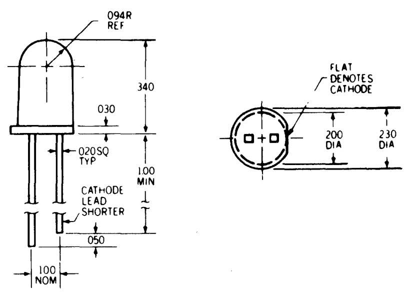
litronix
A Siemens Company

YL-4850
YL-4550

YELLOW T1¾ LED LAMPS



Package Dimensions in Inches



FEATURES

- T1¾ Package Size
- 1 Inch Leads
- Both Types Can Be Front Panel Mounted
- Snap In Mounting Clips Available
- IC Compatible

DESCRIPTION

Both types are TSN (Transparent Substrate Nitrogen) LED lamps with yellow diffused lens. The YL-4850 is a low price commercial grade device. The YL-4550 is a higher brightness lamp.

Maximum Ratings

Power Dissipation @25 °C .... 120 mW
Derate Linearly from 25 °C .... −1.6 mW/°C
Storage & Operating Temperatuare ...... −55 °C to +100 °C
Lead Soldering Temperature
(1/16 in. from case) .... 5 sec @ 260 °C
Peak Inverse Voltage .... 3.0 V/5.0 V
Continuous Forward Current .... 30 mA

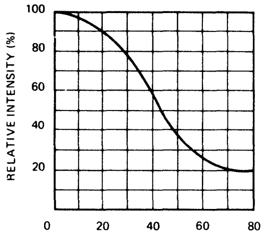
Opto-Electronic Characteristics (@25 °C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity					
YL-4850	.05	2.0		mcd	$I_F = 20$ mA
YL-4550	1.0	1.8		mcd	$I_F = 10$ mA
Emission Peak Wavelength		585		nm	
Spectral Line Half-Width		35		nm	
Forward Voltage		2.4	3.5	V	$I_F = 20$ mA
Reverse Leakage					
YL-4850		0.1	100	μA	$V_R = 3.0$ V
YL-4550		0.1	100	μA	$V_R = 5.0$ V

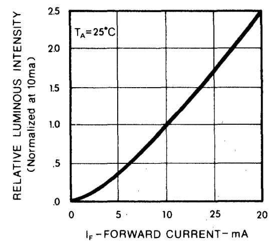
Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

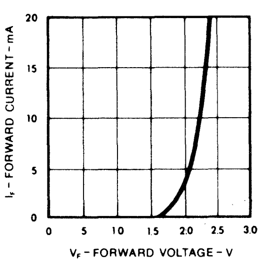
RELATIVE LUMINOUS INTENSITY VS ANGLE



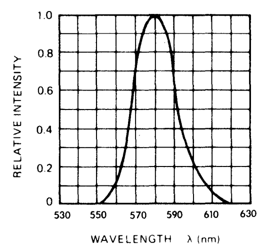
RELATIVE LUMINOUS INTENSITY VS FORWARD CURRENT

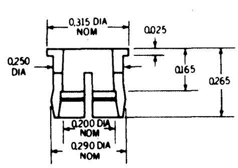


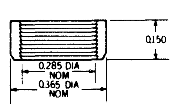
FORWARD CURRENT VS FORWARD VOLTAGE



SPECTRAL DISTRIBUTION







Mounting Information: YL-4850 and YL-4550

The clip mounts in a .250"dia. hole and fits upt to .125"panel thickness. A plastic collar is provided which fits over the back of the clip to lock the LED securely against the panel.

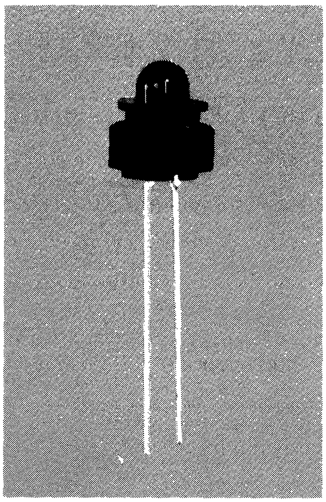
BLACK CLIP AND COLLAR: 004-9002

CLEAR CLIP AND COLLAR : 004-9003

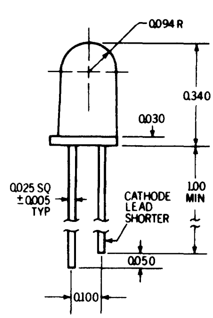
litronix
A Siemens Company

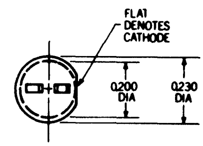
GL-4850
GL-4950

GREEN T1 ¾ LED LAMP



Package Dimensions in Inches





See other side for clip dimensions.

FEATURES

- T1 ¾ —Package Size
- 1 Inch Leads
- Both Types Can Be Front Panel Mounted
- Snap In Mounting Clips Available
- IC Compatible

DESCRIPTION

Both types are green gallium phosphide solid state lamps with green diffused lens. The GL-4850 is a low price commercial grade device. The GL-4950 is a higher brightness lamp with minimum light output specified.

Maximum Ratings

Power Dissipation @25 °C .... 120 mW
Derate Linearly from 25 °C .... −2.2 mW/ °C
Storage & Operating Temperature .... −40 °C to +80 °C
Lead Soldering Temperature
(1/16 in. from case) .... 5 sec @260 °C
Peak Inverse Voltage .... 3.0 V/5.0 V
Continuous Forward Current .... 30 mA

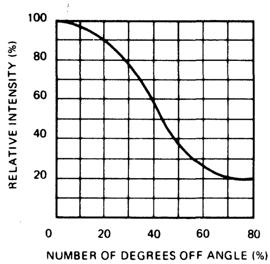
Opto-Electronic Characteristics (@25 °C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity					
GL-4850		1.0		mcd	$I_F = 20$ mA
GL-4950	1.0	1.8		mcd	$I_F = 20$ mA
Emission Peak Wavelength		565		nm	
Spectral Line Half-Width		35		nm	
Forward Voltage		2.2	3.0	V	$I_F = 20$ mA
Reverse Leakage					
GL-4850		0.1	100	μA	$V_R = 3.0$ V
GL-4950			100	μA	$V_R = 5.0$ V

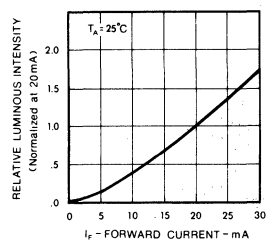
Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES.

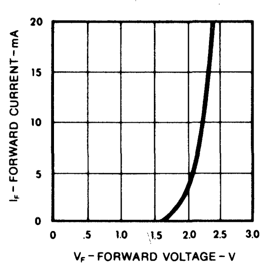
RELATIVE LUMINOUS INTENSITY VS ANGLE



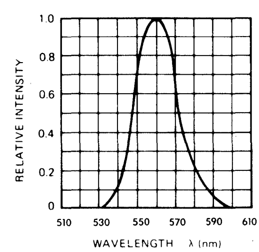
RELATIVE LUMINOUS INTENSITY VS FORWARD CURRENT

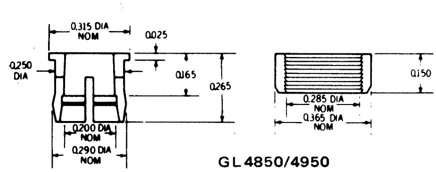


FORWARD CURRENT VS FORWARD VOLTAGE



SPECTRAL DISTRIBUTION





GL4850/4950

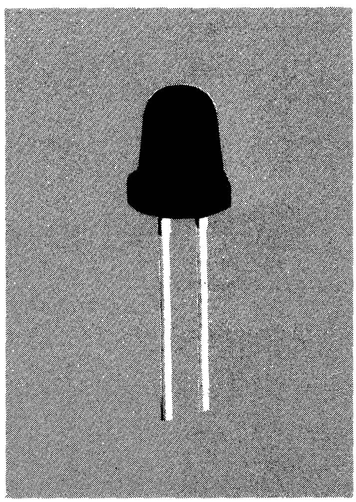
Mounting Information: GL-4850 and GL-4950

The clip mounts in a .250" dia. hole and fits up to .125" panel thickness. A plastic collar is provided which fits over the back of the clip to lock the LED securely against the panel.

BLACK CLIP AND COLLAR: 004-9002
CLEAR CLIP AND COLLAR: 004-9003

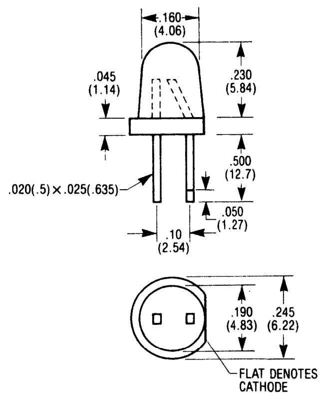
RL-2

RED LOW PROFILE LED LAMP



PHASING OUT—NOT FOR NEW DESIGN

Package Dimensions In Inches (mm)



Maximum Ratings

Power Dissipation @ 25°C . . . . 200 mW
Derate Linearly from 25°C . . . . −2.67 mW/°C
Continuous Forward Current . . . . 100 mA
Recurrent Peak Forward Current
(1 μsec pulse @ .05% duty cycle) . . . . 3.0 A
Storage and Operating Temperature . . . . . . −55 to +100°C
Lead Soldering Temperature
(1/16 in. from case) . . . . 5 sec @ 260°C
Peak Inverse Voltage . . . . 3.0 V

Opto-Electronic Characteristics (at 25°C)

Parameter	Typ	Max	Unit	Test Conditions
Luminous Intensity . .	1.5		mcd	I_F = 50 mA
	.3		mcd	I_F = 10 mA
Emission Peak Wavelength.	650		nm	
Spectral Line Half-Width	40		nm	
Light Transition Times	1		ns	
Forward Voltage	1.65	2.0	V	I_F = 50 mA
	1.58		V	I_F = 10 mA
Reverse Leakage	0.1	10	μA	V_R = 3.0 V
Capacitance	115		pF	V = 0
Temperature Coefficient of Forward Voltage	−1.8		mV/°C	I_F = 5 to 50 mA

Specifications subject to change without notice.

FEATURES

- **Red Diffused Lens**
- **Front Panel Mounting Clip Available**
- **Large Radiating Area**
- **Low Power Consumption**
- **IC Compatible**
- **Economical Molded Plastic Package**
- **½ Inch Leads**

DESCRIPTION

The Red-Lit 2 is a gallium arsenide phosphide light-emitting diode packaged in a red-diffusive molded lens. The large radiating area presents an ideal visual display for indicating functions.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. RELATIVE LUMINOUS INTENSITY VS ANGLE

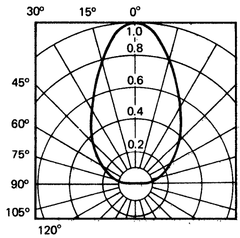


FIGURE 2. LUMINOUS INTENSITY VS AMBIENT TEMPERATURE

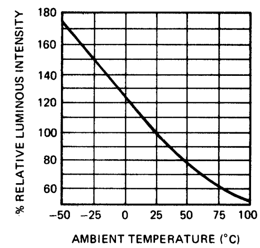


FIGURE 3. SPECTRAL DISTRIBUTION

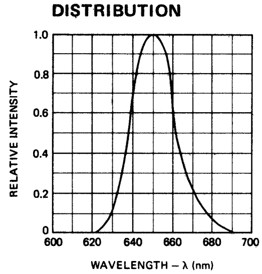


FIGURE 4. FORWARD CURRENT VS FORWARD VOLTAGE

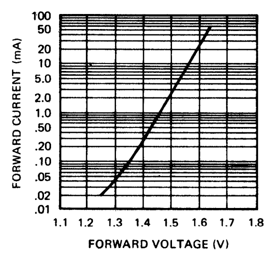
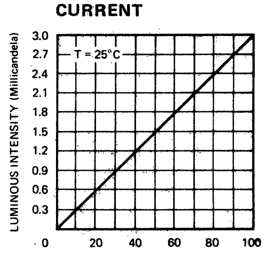


FIGURE 5. LUMINOUS INTENSITY VS FORWARD CURRENT



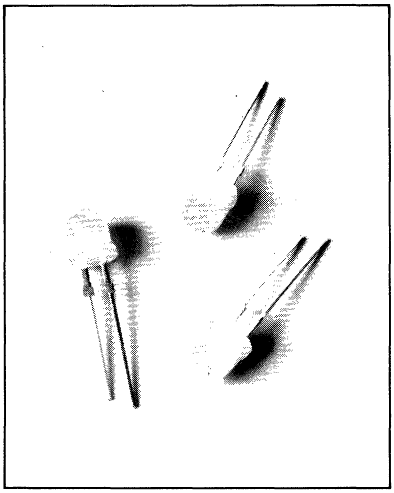
Mounting Information

The clip mounts in a .265″ dia. hole and fits a 0.062″ or 0.125″ panel thickness.

For other panel thicknesses, a plastic collar is available which fits over the back of the clip to lock the LED securely against the panel.

litronix
A Siemens Company

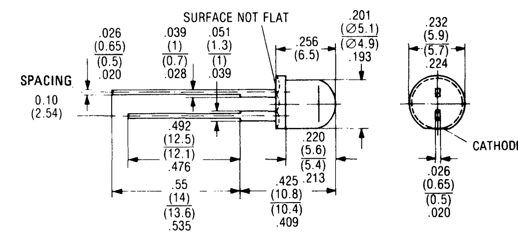
GREEN CQX 13
RED CQX 23
YELLOW CQX 33
T 1¾ LOW PROFILE LED LAMP



FEATURES
- **White Diffused Lens, CQX-13**
- **Red Diffused Lens, CQX-23**
- **Yellow Diffused Lens, CQX-33**
- **Very Wide Viewing Angle ±70°**
- **Modified T 1¾ Low Profile Package**
- **½″ Minimum Lead Length**
- **I/C Compatible**

DESCRIPTION
The CQX 13 is a gallium phosphide light emitting diode solid state lamp. It has a white diffused plastic lens which emits a yellowish green light. The CQX 23, Red Diffused Lens, and CQX 33, Yellow Diffused Lens, are fabricated with TSN (Transparent Substrate Nitrogen) technology. Their unusually wide viewing angle of ±70° is of particular value as an indicator where good lateral visibility is required.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse Voltage (V_R)	5 V
Forward Current (I_F)	60 mA
Surge Current (I_{FS}), $t \leq 10\ \mu s$	1 A
Storage Temperature (T_{stor})	−55 to +100 °C
Junction Temperature (T_j)	100 °C
Power Dissipation (P_{tot}), $T_{amb} = 25$ °C	200 mW
Thermal Resistance Junction-to-Air (T_{thJamb})	375 K/W

Characteristics ($T_{amb} = 25$ °C)

		CQX-13	CQX-23	CQX-33	
Wavelength at Peak Emission	λ_{peak}	560±15	645±15	590±10	nm
Dominant Wavelength	λ_{dom}	561	638	592	nm
Half Angle (Limits for 50% of Luminous Intensity), I_v	φ	70	70	70	Deg.
Forward Voltage ($I_F = 20$ mA)	V_F		2.4 (≤3.0)		V
Reverse Current ($V_R = 5$ V)	I_R		0.01 (≤10)		μA
Luminous Intensity ($I_F = 20$ mA)	I_v	≥1.8	≥1.8	≥1.8	mcd
Rise Time	t_r	50	100	100	ns
Fall Time	t_f	50	100	100	ns
Capacitance ($V_R = 0$ V, f = 1 MHz	C_O	45	12	10	pF

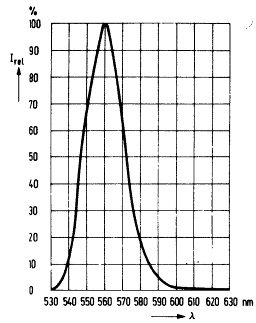
Luminous Intensity

Type	Min	Max	Unit	Test Condition
CQX 13-1	1.8	3.6	mcd	20 mA
CQX 13-2	2.8	—	mcd	20 mA
CQX 23-1	1.8	3.6	mcd	20 mA
CQX 23-2	2.8	—	mcd	20 mA
CQX 33-1	1.8	3.6	mcd	20 mA
CQX 33-2	2.8	—	mcd	20 mA

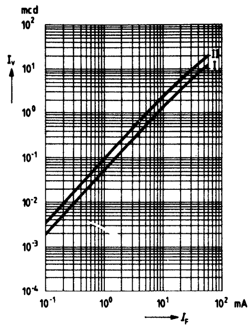
Specifications are subject to change without notice.

CQX 13

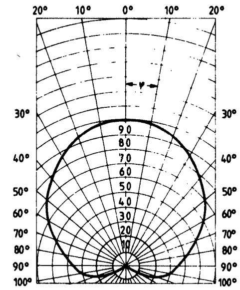
Relative spectral emission $I_{rel} = f(\lambda)$



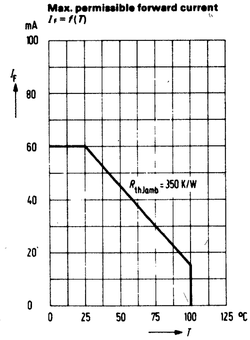
Luminous intensity $I_v = f(I_F)$



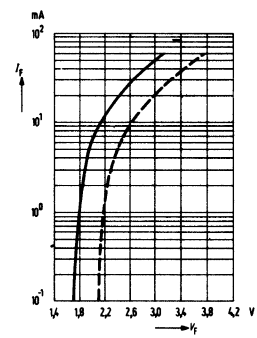
Radiation characteristic $I_{rel} = f(\varphi)$



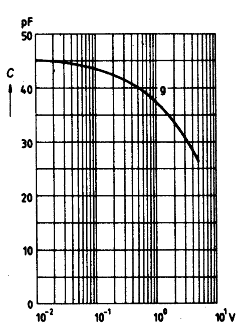
Max. permissible forward current
$I_F = f(T)$



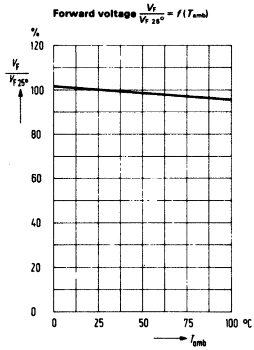
Forward voltage $I_F = f(V_F)$



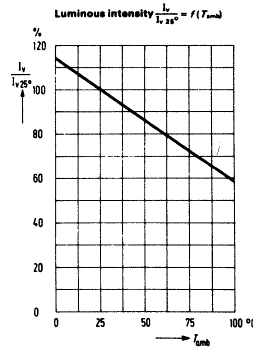
Capacitance $C = f(V_R)$



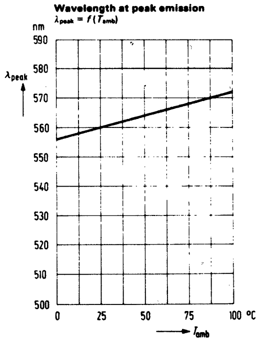
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



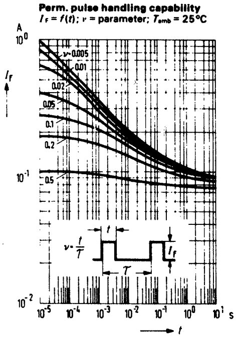
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

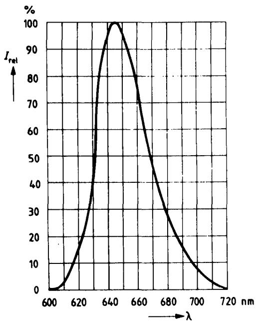


Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; T_{amb} = 25°C

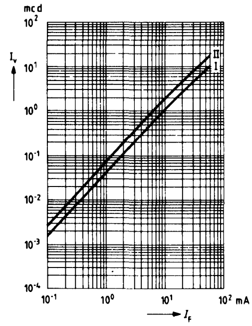


CQX 23

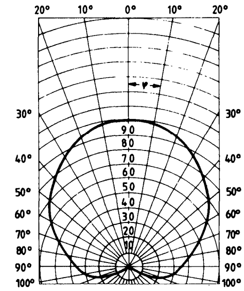
Relative spectral emission $I_{rel} = f(\lambda)$



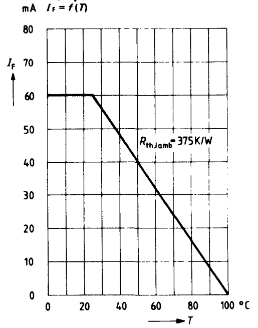
Luminous intensity $I_v = f(I_F)$



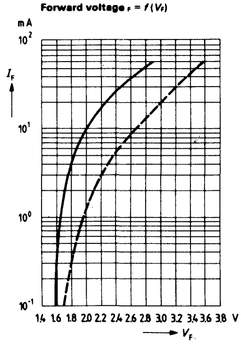
Radiation characteristic $I_{rel} = f(\varphi)$



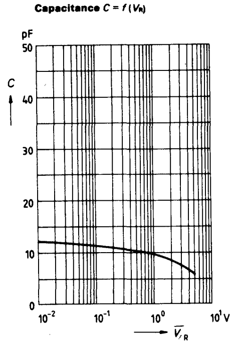
Max. permissible forward current
$I_F = f(T)$



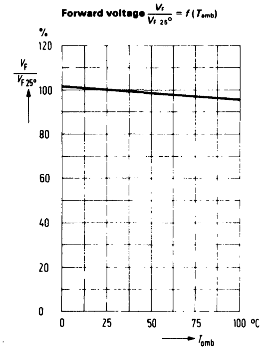
Forward voltage $I_F = f(V_F)$



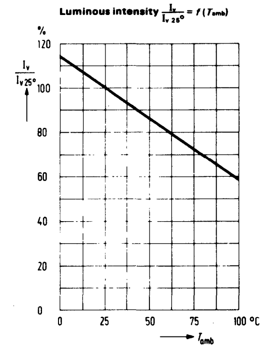
Capacitance $C = f(V_R)$



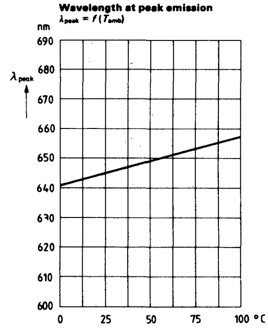
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



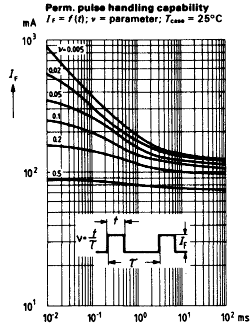
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

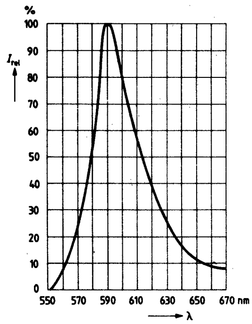


Perm. pulse handling capability
$I_F = f(t)$; v = parameter; T_{case} = 25°C

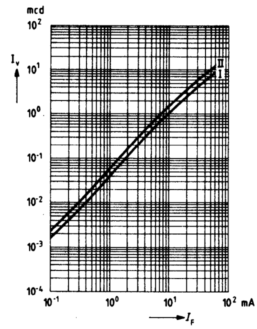


CQX 33

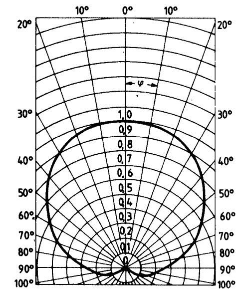
Relative spectral emission $I_{rel} = f(\lambda)$



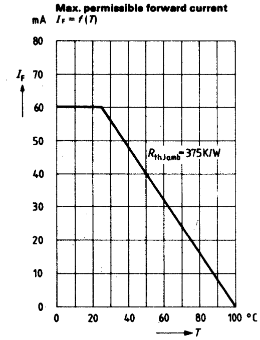
Luminous intensity $I_v = f(I_F)$



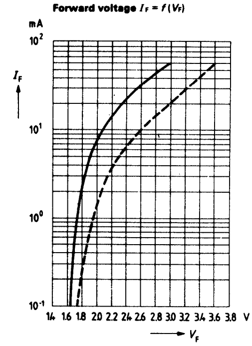
Radiation characteristic $I_{rel} = f(\varphi)$



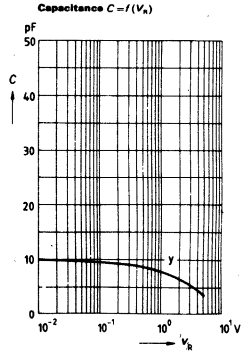
Max. permissible forward current $I_F = f(T)$



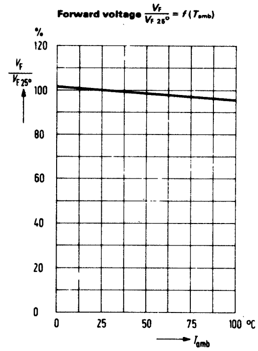
Forward voltage $I_F = f(V_F)$



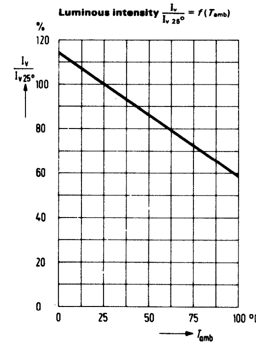
Capacitance $C = f(V_R)$



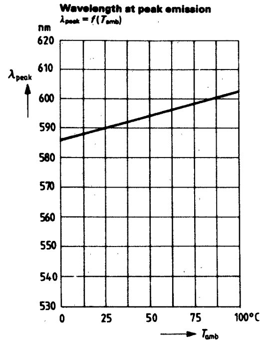
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



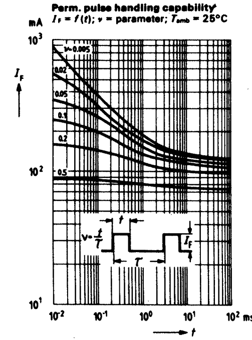
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



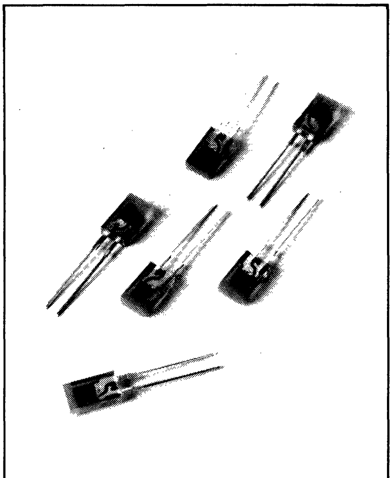
Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



Perm. pulse handling capability
$I_F = f(t)$; v = parameter; T_{amb} = 25°C



HIGH EFFICIENCY RED CQV 36 SERIES
YELLOW CQV 38 SERIES
GREEN CQV 39 SERIES
RECTANGULAR LED LAMP



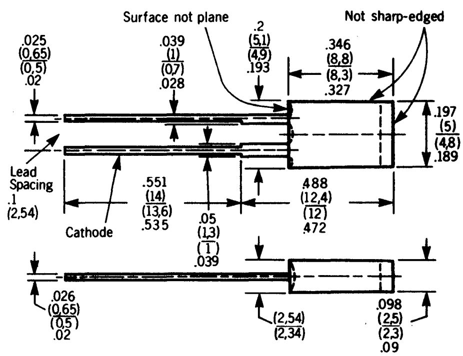
FEATURES

- Red Diffused Lens – CQV 36
  Yellow Diffused Lens – CQV 38
  Green Diffused Lens – CQV 39
- T 1¾ Size Rectangular Shape
- Minimum Lead Length ½"
- 1/10" Lead Spacing
- I/C Compatible

DESCRIPTION

The CQV 36 and CQV 38 Series are light emitting diode lamps fabricated with TSN (transparent substrate nitrogen) technology. The CQV 39 is a gallium phosphide LED lamp. All three series have a diffused lens which forms an evenly dispersed rectangular head-on light. They can be used singly as indicators or stacked together to form arrays.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	5	V
Forward current	I_F	60	mA
Surge current ($t \leq 10$ s)	i_{FS}	1	A
Storage temperature	T_s	–55 to +100	°C
Junction temperature	T_j	100	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	200	mW
Thermal resistance junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

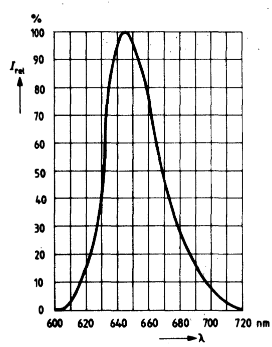
		CQV 36	CQV 38	CQV 39	
Wave length of emitted light	λ_{peak}	645 ± 15	590 ± 10	560 ± 15	nm
Dominant wave length	λ_{dom}	638	592	561	nm
Aperture cone (half angle) (Limits for 50% of luminous intensity I_V) shielded against lateral emission of light	φ	50	50	50	degrees
Forward voltage (I_F = 20 mA)	V_F		2.4 (≤3.0)		V
Reverse current (V_R = 5 V)	I_R		0.01 (≤ 10)		µA
Luminous intensity (I_F = 20 mA)	I_V	≦1.0	≦1.0	≦1.0	mcd
Rise time	t_r	100	100	50	ns
Fall time	t_f	100	100	50	ns
Capacitance (V_R = 0 V)	C_o	12	10	45	pF

Luminous Intensity

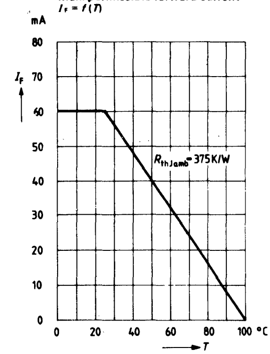
Type	Min	Typ	Unit	Test Condition
CQV 36-3	1.0	2.0	mcd	20 mA
CQV 36-4	1.6	3.2	mcd	20 mA
CQV 36-5	2.5	–	mcd	20 mA
CQV 38-3	1.0	2.0	mcd	20 mA
CQV 38-4	1.6	3.2	mcd	20 mA
CQV 38-5	2.5	–	mcd	20 mA
CQV 39-3	1.0	2.0	mcd	20 mA
CQV 39-4	1.6	3.2	mcd	20 mA
CQV 39-5	2.5	–	mcd	20 mA

Specifications are subject to change without notice.

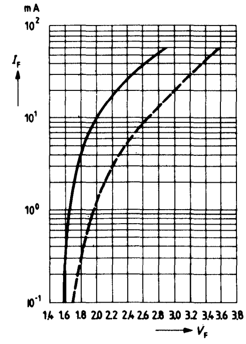
Relative spectral emission $I_{rel} = f(\lambda)$



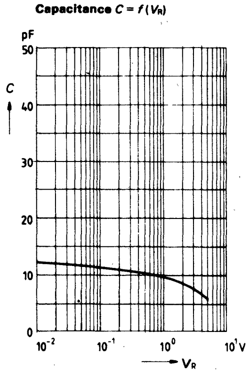
Max. permissible forward current
$I_F = f(T)$



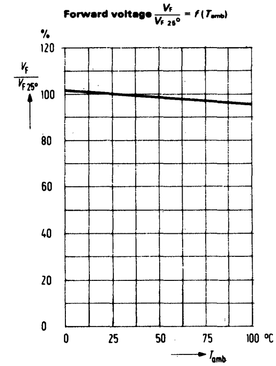
Forward voltage $I_F = f(V_F)$



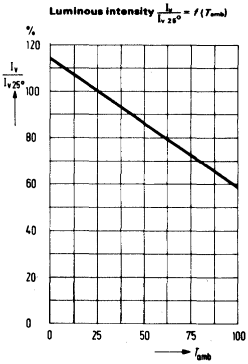
Capacitance $C = f(V_R)$



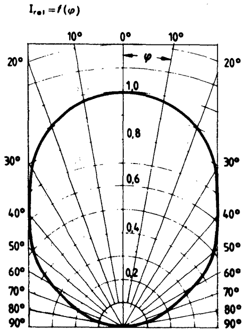
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



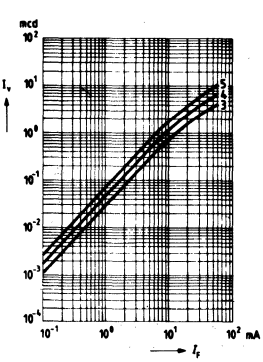
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



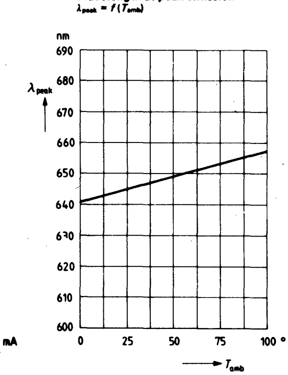
Radiation characteristic $I_{rel} = f(\varphi)$
$I_{rel} = f(\varphi)$



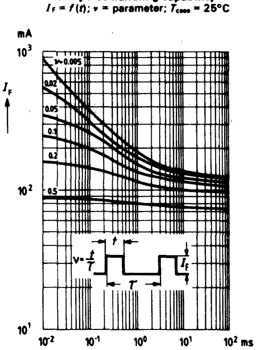
Luminous intensity $I_v = f(I_F)$



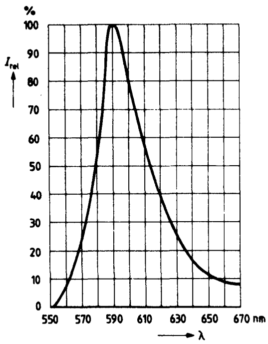
Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



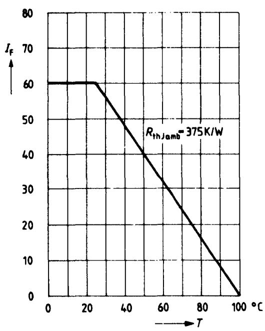
Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; T_{case} = 25°C



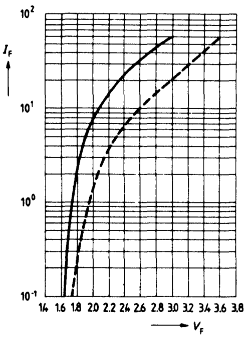
Relative spectral emission $I_{rel} = f(\lambda)$



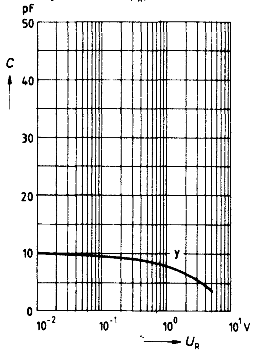
Max. permissible forward current $I_F = f(T)$



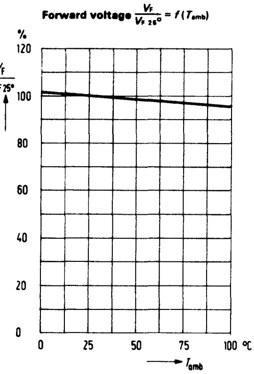
Forward voltage $I_F = f(V_F)$



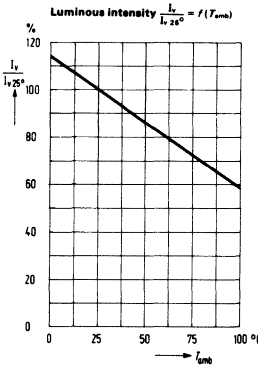
Capacitance $C = f(V_R)$



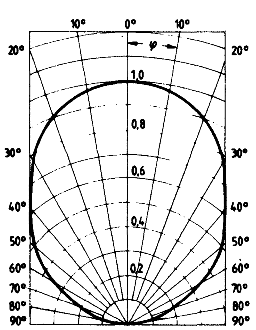
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



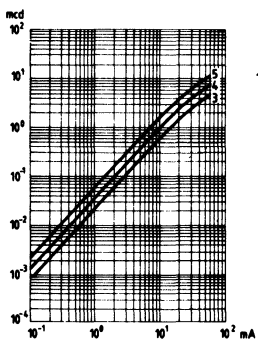
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



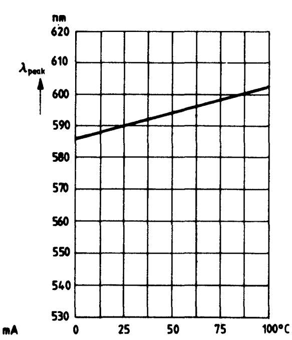
Radiation characteristic
$I_{rel} = f(\varphi)$



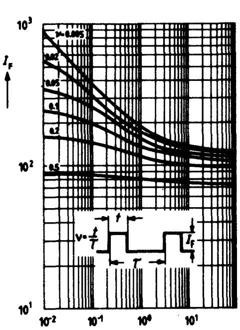
Luminous intensity
$I_v = f(I_F)$



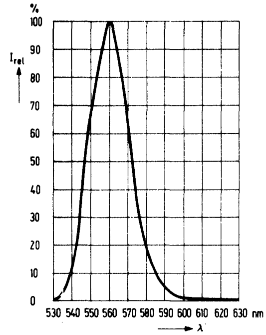
Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



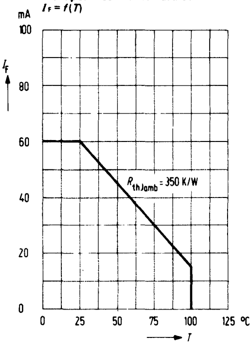
Perm. pulse handling capability
mA $I_F = f(t)$; v = parameter; T_{amb} = 25°C



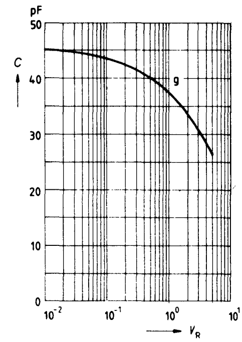
Relative spectral emission $I_{rel} = f(\lambda)$



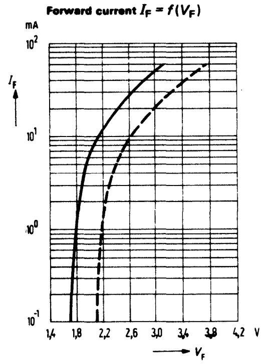
Max. permissible forward current
$I_F = f(T)$



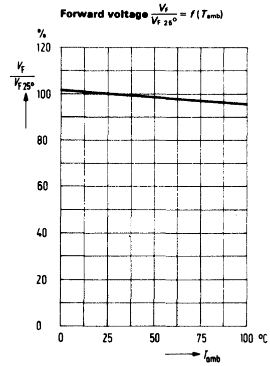
Capacitance $C = f(V_R)$



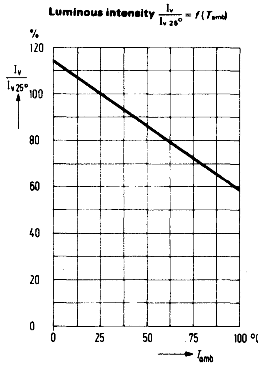
Forward current $I_F = f(V_F)$



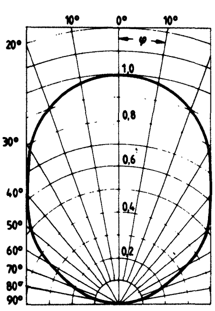
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



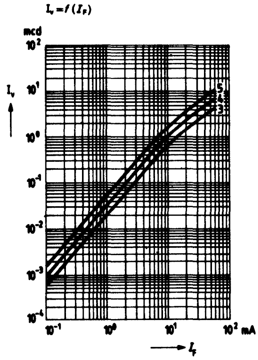
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



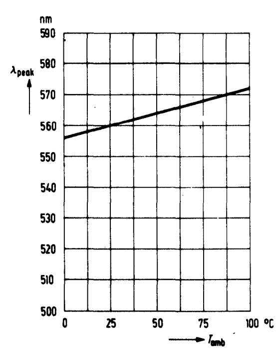
Radiation characteristic $I_{rel} = f(\varphi)$
$I_{rel} = f(\varphi)$



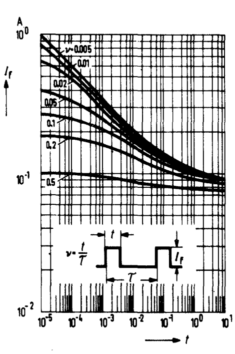
Luminous intensity
$I_v = f(I_F)$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

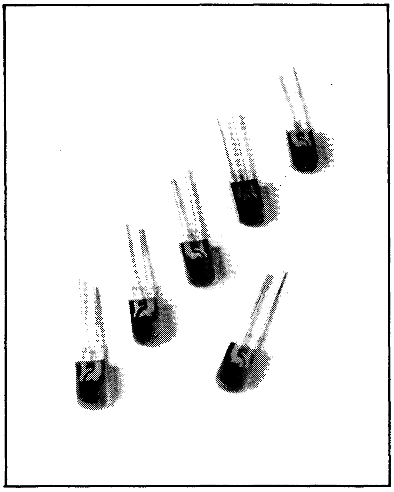


Perm. pulse handling capability
$I_F = f(t)$; v = parameter; T_{amb} = 25 °C

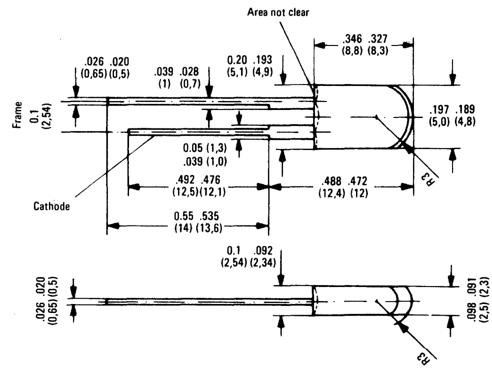


litronix
A Siemens Company

STANDARD RED LD 80 SERIES
HIGH EFFICIENCY RED LD 82 SERIES
YELLOW LD 86 SERIES
GREEN LD 87 SERIES
ROUNDED RECTANGULAR LED LAMP



Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

		LD 80	LD 82 LD 86 LD 87	
Reverse voltage	V_R	5	5	V
Forward current	I_F	100	60	mA
Surge current ($t \leqq 10$ s)	i_{FS}	2	1	A
Storage temperature	T_s	–55 to +100		°C
Junction temperature	T_j	100	100	°C
Power Dissipation (T_{amb} = 25°C)	P_{tot}	200	200	mW
Thermal resistance junction to air	R_{thJamb}	375	375	K/W

Characteristics (T_{amb} = 25°C)

		LD 80	LD 82	LD 86	LD 87	
Wave length of emitted light	λ_{peak}	665 ±15	645 ±15	590 ±10	560 ±15	nm
Aperture cone (half angle) (Limits for 50% of luminous intensity I_V) shielded against lateral emission of light	φ	50	50	50	50	degrees
Forward voltage (I_F = 20 mA)	V_F	1.6 (≦2.0)	2.4 (≦ 3.0)			V
Reverse current (V_R = 5 V)		.01 (≦10)				µA
Rise time	t_r	5	100	100	50	ns
Fall time	t_f	5	100	100	50	ns
Capacitance (V_R = 0 V)	C_o	40	12	10	45	pF

Luminous Intensity

Type	Min	Typ	Unit	Test Condition
LD 80A	.6	–	mcd	20 mA
LD 80-1	1.0	2.0	mcd	20 mA
LD 80-2	1.6	–	mcd	20 mA
LD 82A	.6	–	mcd	20 mA
LD 82-1	1.0	2.0	mcd	20 mA
LD 82-2	1.6	–	mcd	20 mA
LD 86A	.6	–	mcd	20 mA
LD 86-1	1.0	2.0	mcd	20 mA
LD 86-2	1.6	–	mcd	20 mA
LD 87A	.6	–	mcd	20 mA
LD 87-1	1.0	2.0	mcd	20 mA
LD 87-2	1.6	–	mcd	20 mA

Specifications are subject to change without notice.

FEATURES

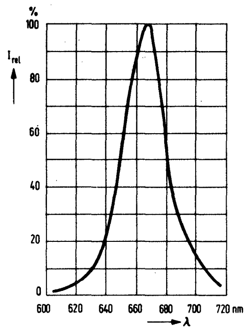
- **Red Diffused Lens — LD 80 & LD 82**
  Yellow Diffused Lens — LD 86
  Green Diffused Lens — LD 87
- **Rounded End Rectangular Shape**
- **Minimum Lead Length ½"**
- **1/10" Lead Spacing**
- **I/C Compatible**

DESCRIPTION

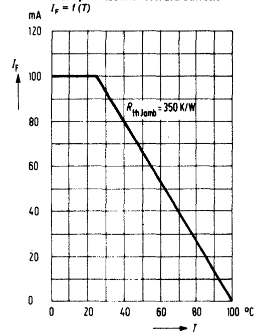
The LD 80 is a standard red gallium arsenide phosphide light emitting diode lamp. The LD 82 and LD 86 Series are fabricated with TSN (transparent substrate nitrogen) technology. The LD 87 is a gallium phosphide LED lamp. All four series have a diffused lens which forms an evenly dispersed rectangular head-on light. They can be used singly as indicators or stacked together to form arrays.

LD 80

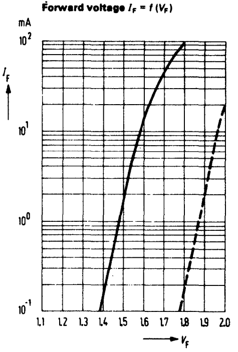
Relative spectral emission $I_{rel} = f(\lambda)$



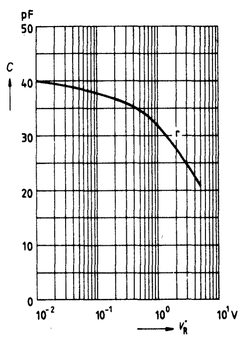
Max. permissible forward current $I_F = f(T)$



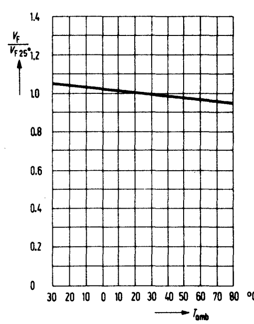
Forward voltage $I_F = f(V_F)$



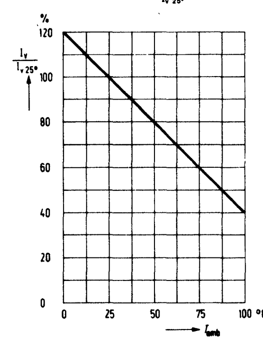
Capacitance $C = f(V_R)$



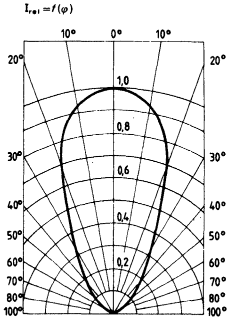
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



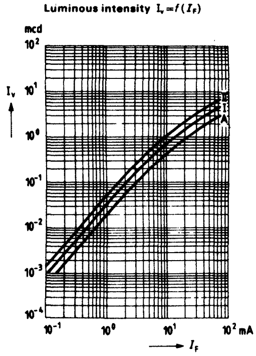
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



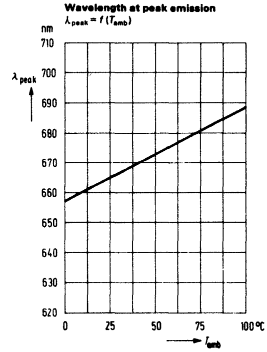
Radiation characteristic
$I_{rel} = f(\varphi)$



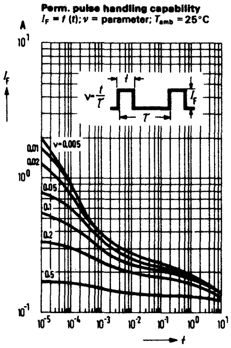
Luminous intensity $I_v = f(I_F)$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

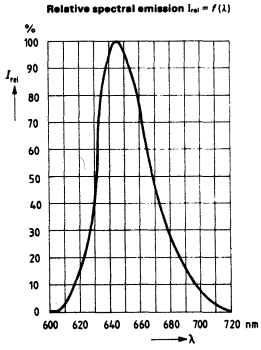


Perm. pulse handling capability
$I_F = f(t)$; v = parameter; T_{amb} = 25 °C

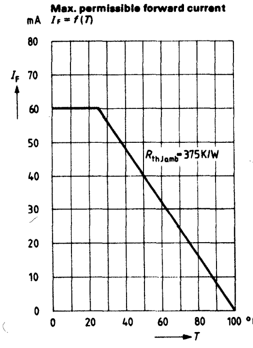


LD 82

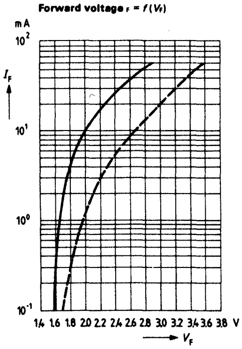
Relative spectral emission $I_{rel} = f(\lambda)$



Max. permissible forward current $I_F = f(T)$

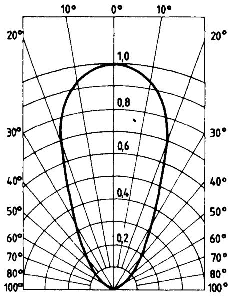


Forward voltage $I_F = f(V_F)$

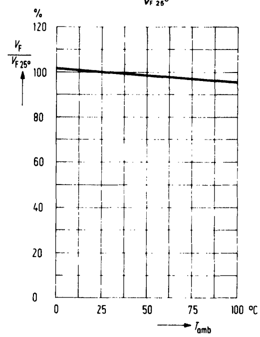


LD 82 (continued)

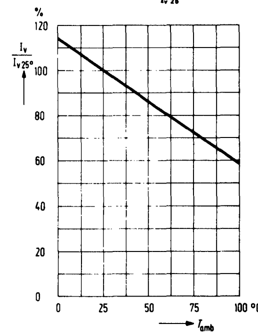
Radiation characteristic $I_{rel} = f(\varphi)$



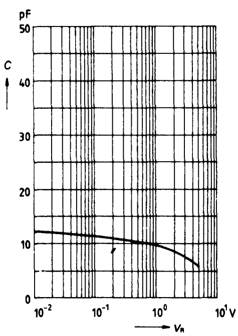
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



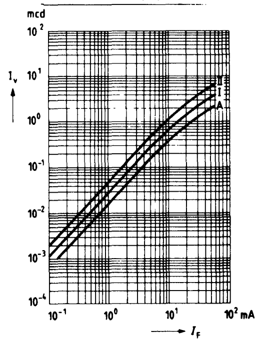
Luminous intensity $\frac{I_V}{I_{V\,25°}} = f(T_{amb})$



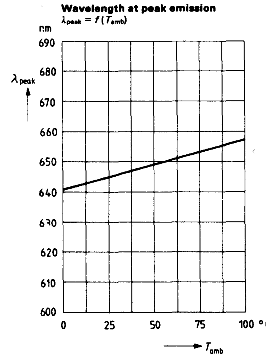
Capacitance $C = f(V_R)$



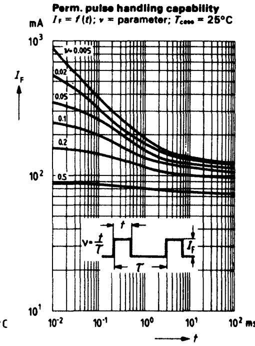
Luminous intensity $I_v = f(I_F)$



Wavelength at peak emission $\lambda_{peak} = f(T_{amb})$

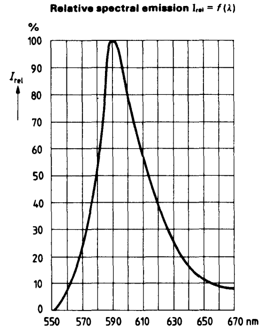


Perm. pulse handling capability $I_F = f(t)$; v = parameter; $T_{case} = 25°C$

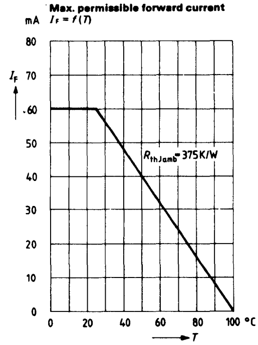


LD 86

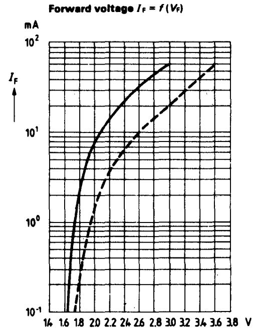
Relative spectral emission $I_{rel} = f(\lambda)$



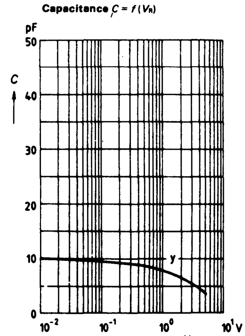
Max. permissible forward current $I_F = f(T)$



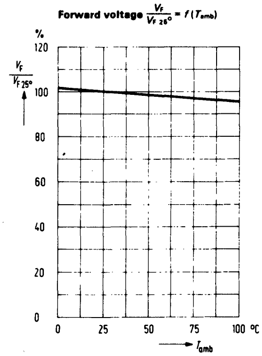
Forward voltage $I_F = f(V_F)$



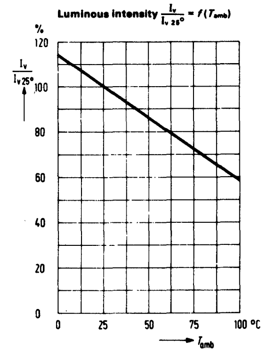
Capacitance $C = f(V_R)$



Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$

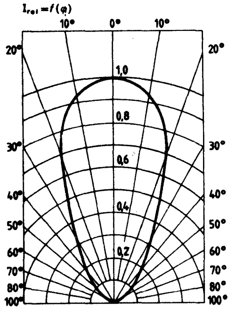


Luminous intensity $\frac{I_V}{I_{V\,25°}} = f(T_{amb})$

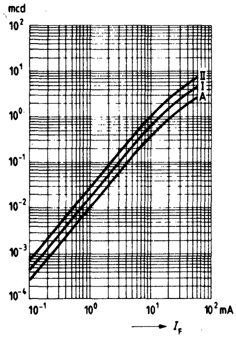


LD 86 (continued)

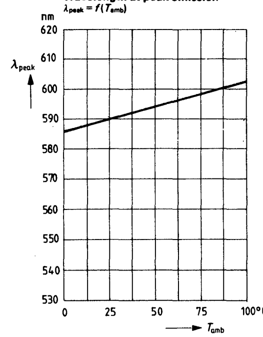
Radiation characteristic $I_{rel} = f(\varphi)$



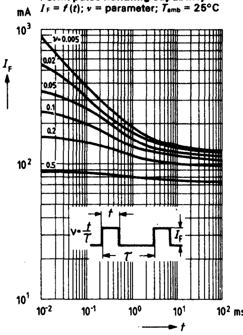
Luminous intensity $I_v = f(I_F)$



Wavelength at peak emission $\lambda_{peak} = f(T_{amb})$

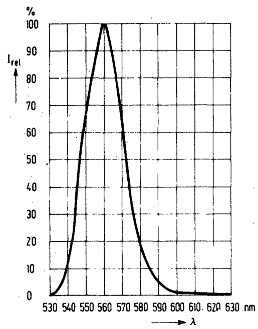


Perm. pulse handling capability $I_F = f(t)$; v = parameter; T_{amb} = 25°C

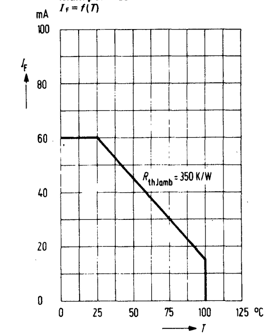


LD 87

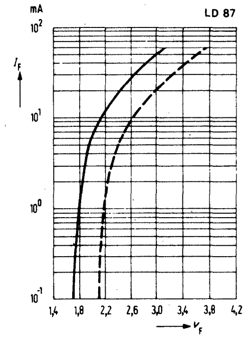
Relative spectral emission $I_{rel} = f(\lambda)$



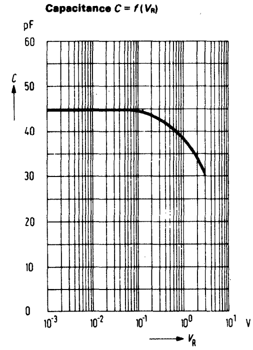
Max. permissible forward current $I_F = f(T)$



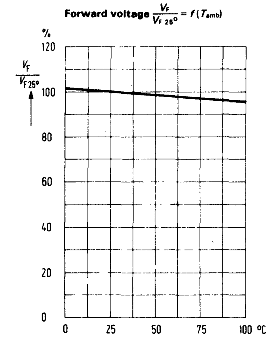
Forward current $I_F = f(V_F)$



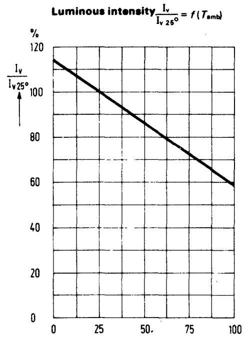
Capacitance $C = f(V_R)$



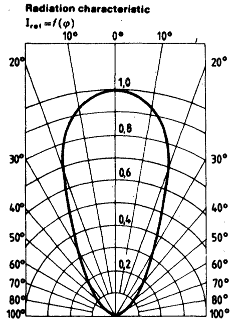
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



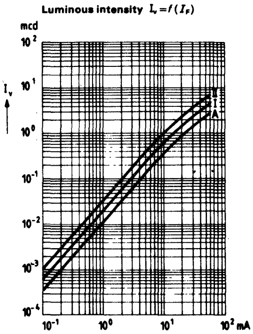
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



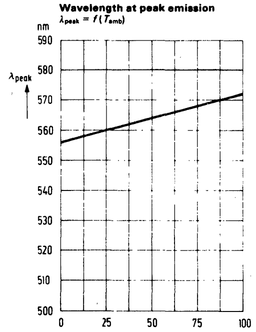
Radiation characteristic $I_{rel} = f(\varphi)$



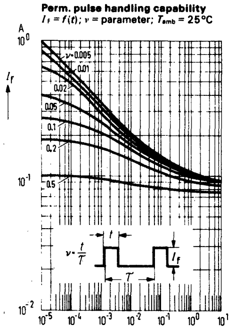
Luminous intensity $I_v = f(I_F)$



Wavelength at peak emission $\lambda_{peak} = f(T_{amb})$

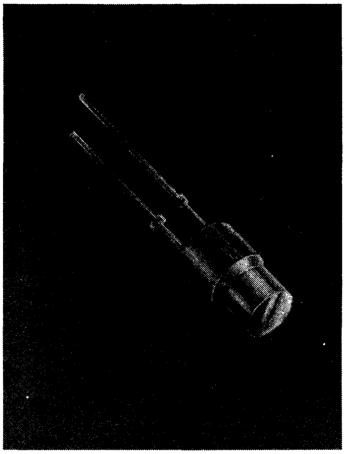


Perm. pulse handling capability $I_F = f(t)$; v = parameter; T_{amb} = 25°C



litronix
A Siemens Company

HIGH EFFICIENCY RED CQV 56 SERIES
YELLOW CQV 58 SERIES
GREEN CQV 59 SERIES
CYLINDRICAL LED LAMP
PRELIMINARY



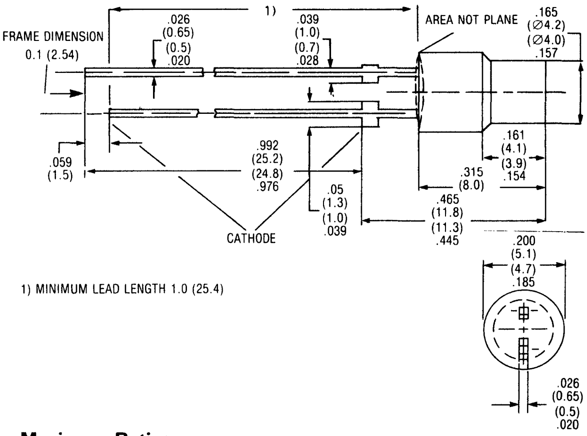
FEATURES

- **Red Diffused Lens, CQV 56**
  Yellow Diffused Lens, CQV 58
  Green Diffused Lens, CQV 59
- **Cylindrical Shape**
- **Minimum Lead Length 1″**
- **1/10″ Lead Spacing**
- **I/C Compatible**

DESCRIPTION

The CQV 56 and CQV 58 are light emitting diode lamps fabricated with TSN (transparent substrate nitrogen) technology. The CQV 59 is a gallium phosphate LED lamp. All three series have a diffused lens which forms an evenly dispersed circular head on light.

Package Dimensions in Inches (mm)



1) MINIMUM LEAD LENGTH 1.0 (25.4)

Maximum Ratings

Reverse voltage	V_R	5	V
Forward current	I_F	60	mA
Surge current ($t \leqq 10\ \mu s$)	i_{FS}	1	A
Storage temperature	T_s	−55 to +100	°C
Junction temperature	T_j	100	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	200	mW
Thermal resistance junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

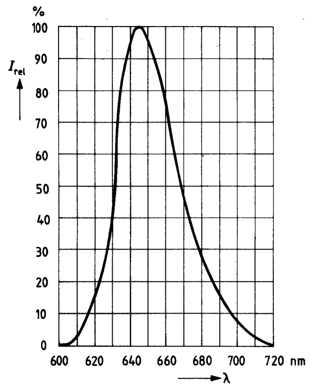
		CQV 56	CQV 58	CQV 59	
Wave length of emitted light	λ_{peak}	645±15	590±10	560±15	nm
Dominant wave length	λ_{dom}	638	592	561	nm
Aperture cone (half angle) (Limits for 50% of luminous intensity I_v) shielded against lateral emission of light	φ	50	50	50	degrees
Forward voltage (I_F = 20 mA)	V_F		2.4 ($\leqq$ 3.0)		V
Reverse current (V_R = 5 V)	I_R		0.01 ($\leqq$ 10)		μA
Luminous intensity (I_F = 20 mA)	i_v	$\geqq$ 0.63	$\geqq$ 0.63	$\geqq$ 0.63	mcd
Rise time	t_r	100	100	50	ns
Fall time	t_f	100	100	50	ns
Capacitance (V_R = 0 V)	C_o	12	10	45	pF

Luminous Intensity

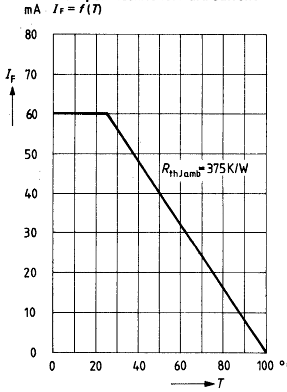
Type	Min	Max	Unit	Test Condition
CQV 56-2	.63	1.25	mcd	20 mA
CQV 56-3	1.0	2.0	mcd	20 mA
CQV 56-4	1.6	—	mcd	20 mA
CQV 58-2	.63	1.25	mcd	20 mA
CQV 58-3	1.0	2.0	mcd	20 mA
CQV 58-4	1.6	—	mcd	20 mA
CQV 59-2	.63	1.25	mcd	20 mA
CQV 59-3	1.0	2.0	mcd	20 mA
CQV 59-4	1.6	—	mcd	20 mA

Specifications subject to change without notice.

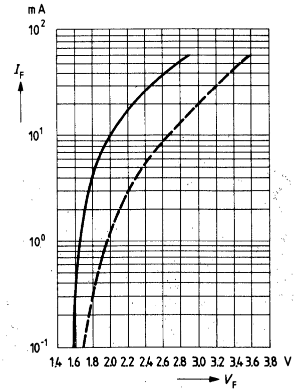
Relative spectral emission $I_{rel} = f(\lambda)$



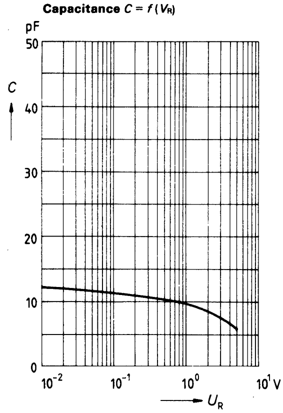
Max. permissible forward current $I_F = f(T)$



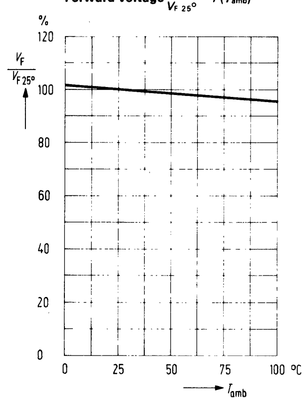
Forward voltage $I_F = f(V_F)$



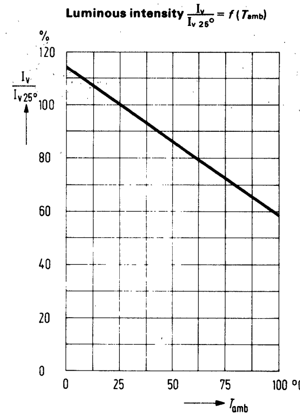
Capacitance $C = f(V_R)$



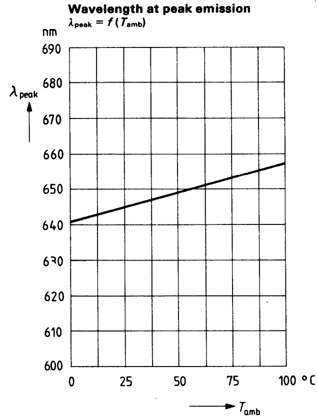
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



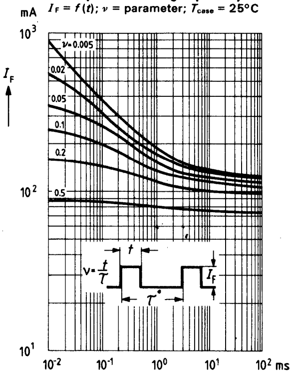
Luminous intensity $\frac{I_V}{I_{V\,25°}} = f(T_{amb})$



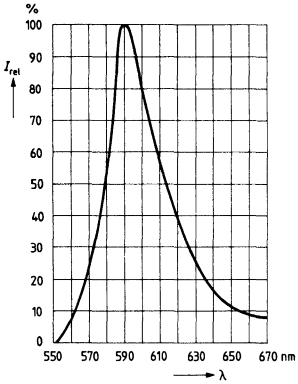
Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



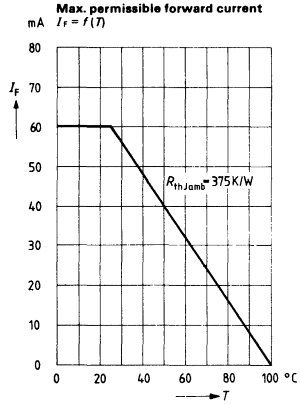
Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; T_{case} = 25°C



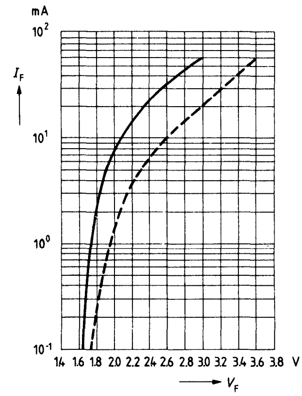
Relative spectral emission $I_{rel} = f(\lambda)$



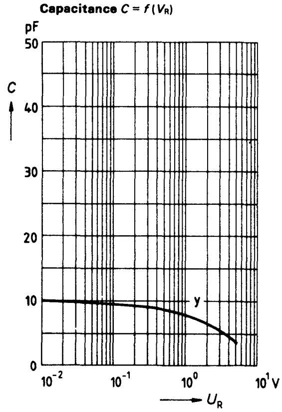
Max. permissible forward current



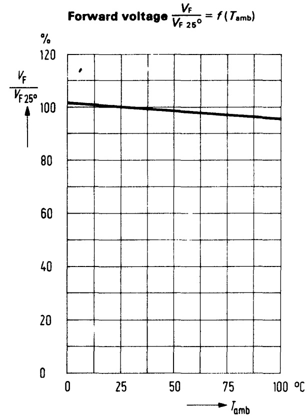
Forward voltage $I_F = f(V_F)$



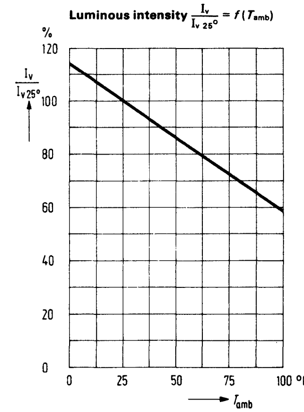
Capacitance $C = f(V_R)$



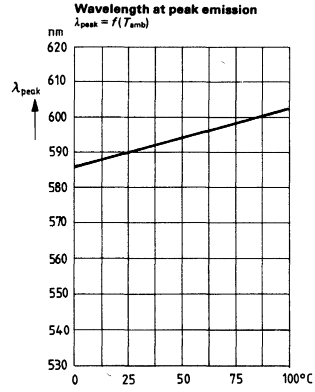
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



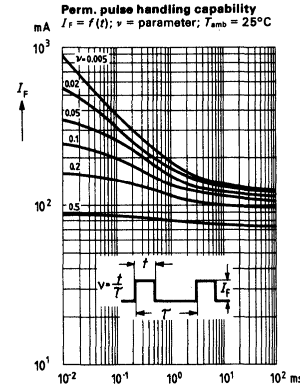
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



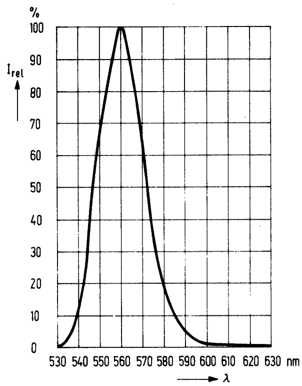
Wavelength at peak emission



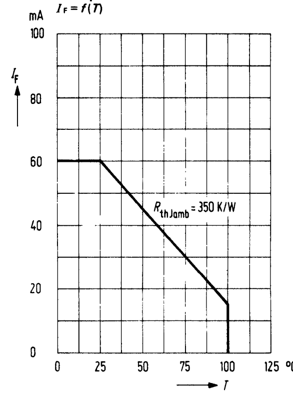
Perm. pulse handling capability



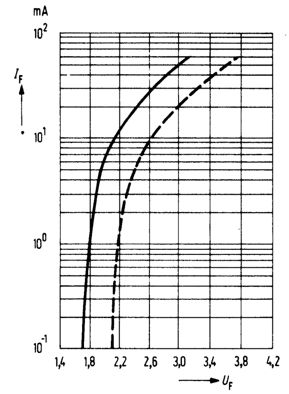
Relative spectral emission $I_{rel} = f(\lambda)$



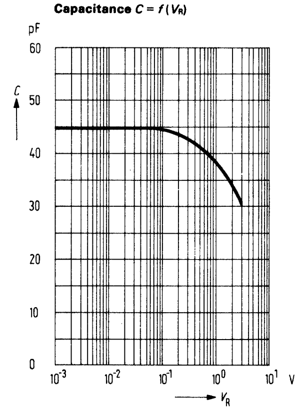
Max. permissible forward current
$I_F = f(T)$



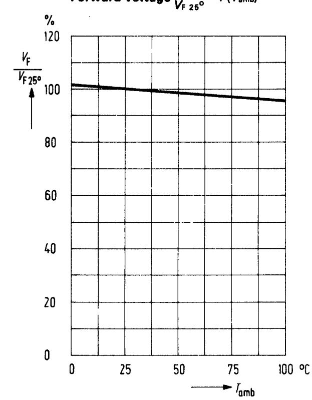
Forward voltage $I_F = f(V_F)$



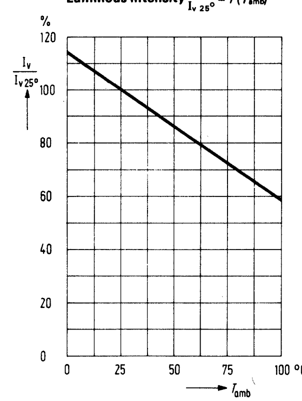
Capacitance $C = f(V_R)$



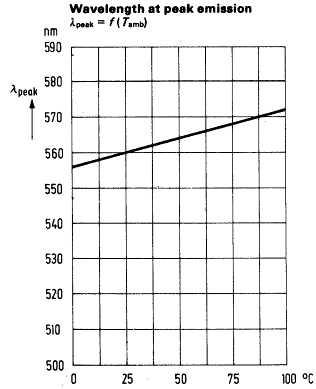
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



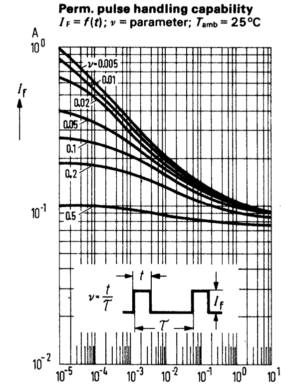
Luminous intensity $\frac{I_V}{I_{V\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

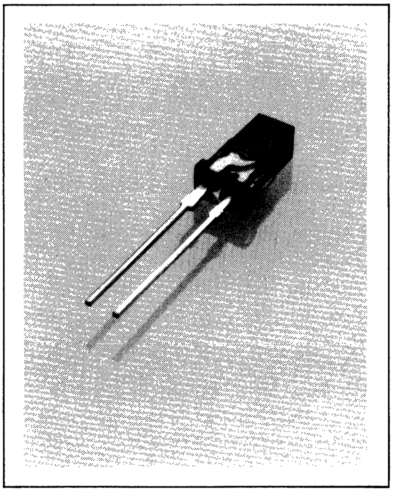


Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; $T_{amb} = 25°C$



litronix
A Siemens Company

HIGH EFFICIENCY RED CQV 16
YELLOW CQV 18
GREEN CQV 19
SQUARE LED LAMP



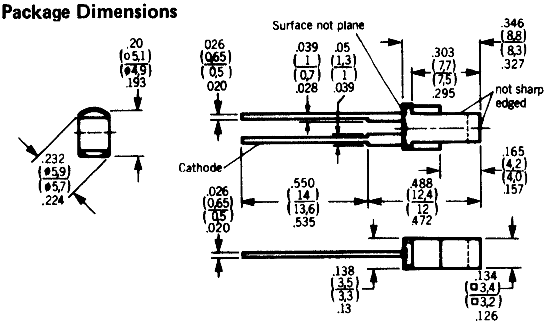
FEATURES

- Red Diffused Lens, CQV 16
  Yellow Diffused Lens, CQV 18
  Green Diffused Lens, CQV 19
- Square Shape
- Minimum Lead Length ½″
- 1/10″ Lead Spacing
- I/C Compatible

DESCRIPTION

The CQV 16 and CQV 18 are light emitting diode lamps fabricated with TSN (transparent substrate nitrogen) technology. The CQV 19 is a gallium phosphide LED lamp. All three series have a diffused lens which forms an evenly dispersed rectangular head on light.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	5	V
Forward current	I_F	60	mA
Surge current ($t \leqq 10\ \mu s$)	i_{FS}	1	A
Storage temperature	T_s	−55 to +100	°C
Junction temperature	T_j	100	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	200	mW
Thermal resistance junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

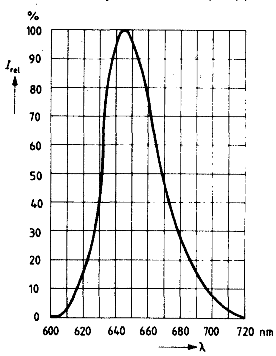
		CQV 16	CQV 18	CQV 19	
Wave length of emitted light	λ_{peak}	645±15	590±10	560±15	nm
Dominant wave length	λ_{dom}	638	592	561	nm
Aperture cone (half angle) (Limits for 50% of luminous intensity I_v) shielded against lateral emission of light	φ	50	50	50	degrees
Forward voltage (I_F = 20 mA)	V_F		2.4 (≦ 3.0)		V
Reverse current (V_R = 5 V)	I_R		0.01 (≦ 10)		μA
Luminous intensity (I_F = 20 mA)	i_v	≧ 0.63	≧ 0.63	≧ 0.63	mcd
Rise time	t_r	100	100	50	ns
Fall time	t_f	100	100	50	ns
Capacitance (V_R = 0 V)	C_o	12	10	45	pF

Luminous Intensity

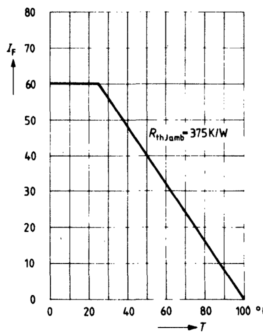
Type	Min	Max	Unit	Test Condition
CQV 16-2	.63	1.25	mcd	20 mA
CQV 16-3	1.0	2.0	mcd	20 mA
CQV 16-4	1.6	—	mcd	20 mA
CQV 18-2	.63	1.25	mcd	20 mA
CQV 18-3	1.0	2.0	mcd	20 mA
CQV 18-4	1.6	—	mcd	20 mA
CQV 19-2	.63	1.25	mcd	20 mA
CQV 19-3	1.0	2.0	mcd	20 mA
CQV 19-4	1.6	—	mcd	20 mA

Specifications are subject to change without notice.

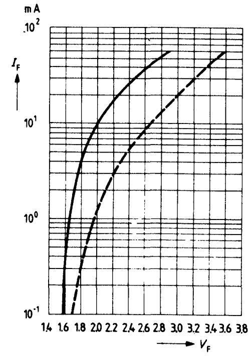
Relative spectral emission $I_{rel} = f(\lambda)$



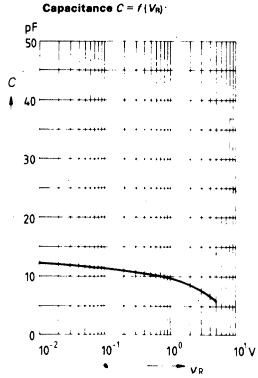
Max. permissible forward current $I_F = f(T)$



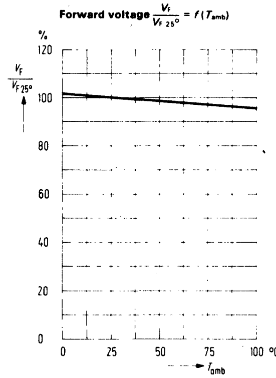
Forward voltage $I_F = f(V_F)$



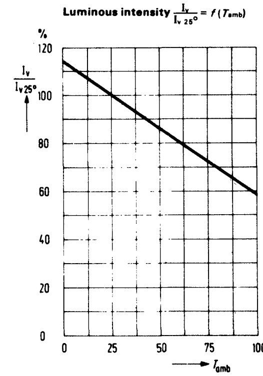
Capacitance $C = f(V_R)$



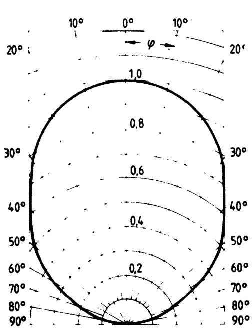
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



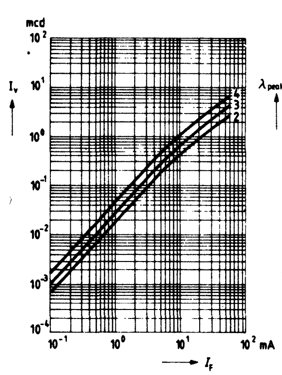
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



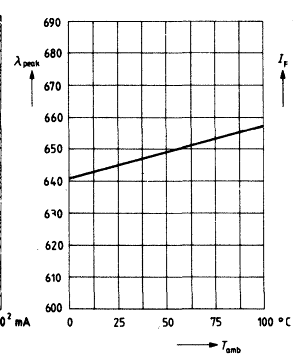
Radiation characteristic
$I_{rel} = f(\varphi)$



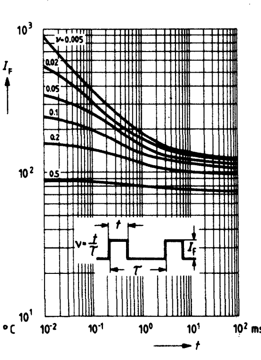
Luminous intensity $I_v = f(I_F)$



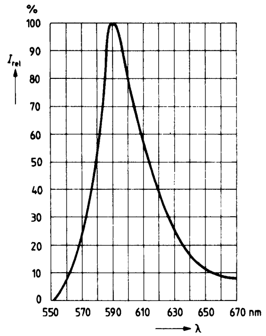
Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



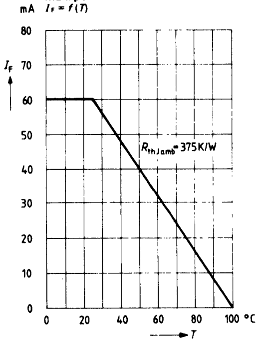
Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; T_{case} = 25°C



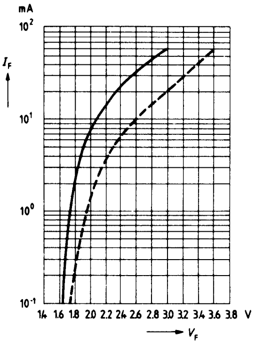
Relative spectral emission $I_{rel} = f(\lambda)$



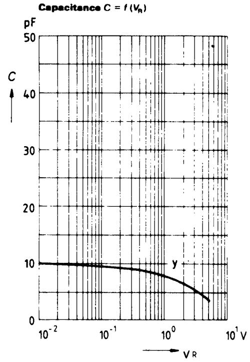
Max. permissible forward current $I_F = f(T)$



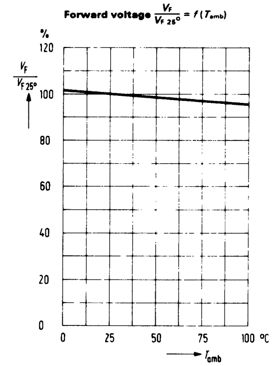
Forward voltage $I_F = f(V_F)$



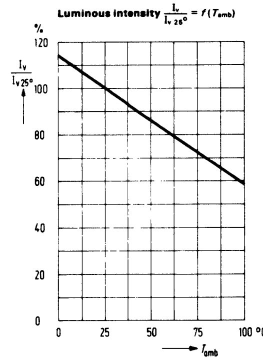
Capacitance $C = f(V_R)$



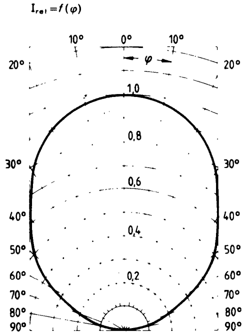
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



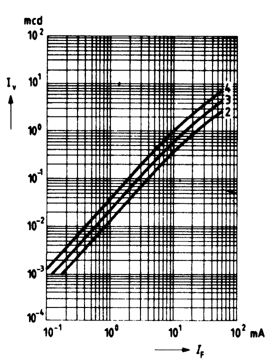
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



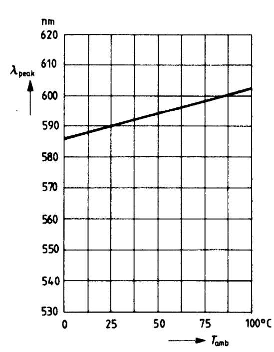
Radiation characteristic
$I_{rel} = f(\varphi)$



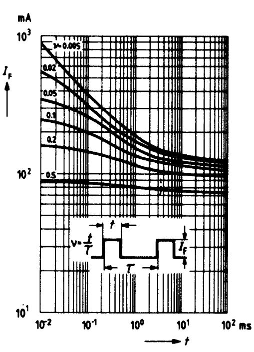
Luminous intensity $I_v = f(I_F)$



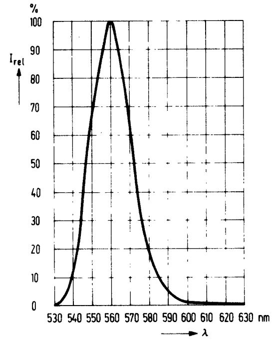
Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



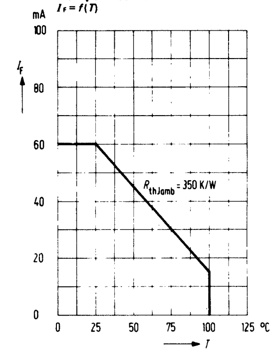
Perm. pulse handling capability
$I_F = f(t)$; v = parameter; T_{amb} = 25°C



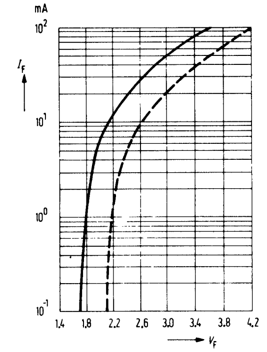
Relative spectral emission $I_{rel} = f(\lambda)$



Max. permissible forward current
$I_F = f(T)$

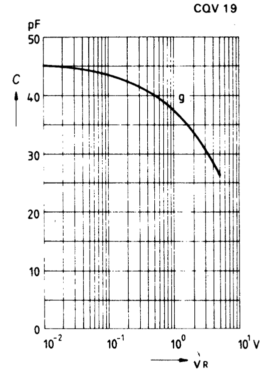


Forward voltage $I_F = f(V_F)$

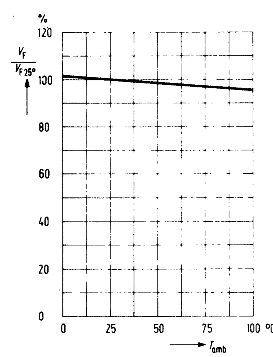


Capacitance $C = f(V_R)$

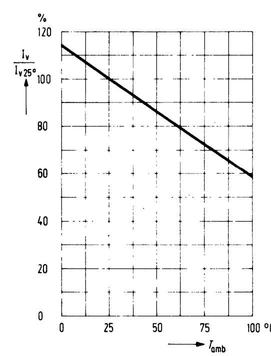
CQV 19



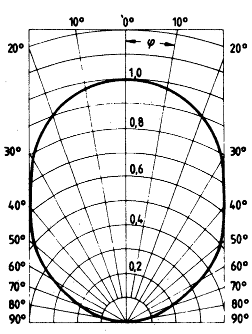
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



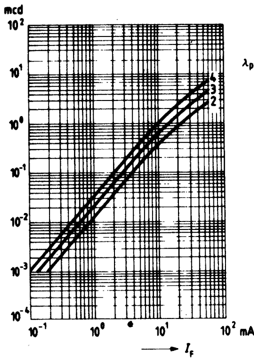
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



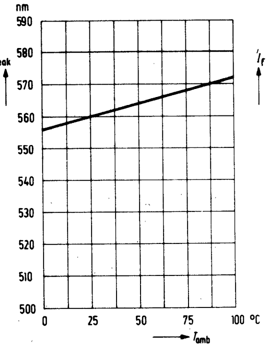
Radiation characteristic
$I_{rel} = f(\varphi)$



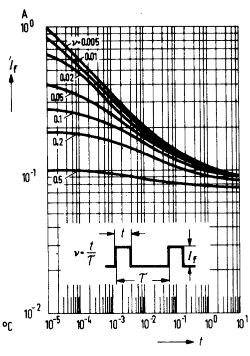
Luminous intensity
$I_v = f(I_F)$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

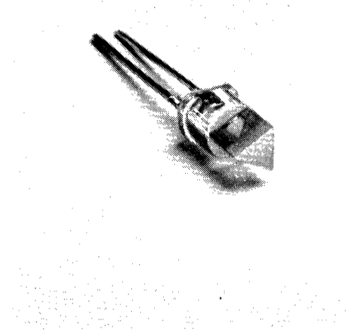


Perm. pulse handling capability
$I_F = f(t)$; v = parameter; T_{amb} = 25°C



litronix
A Siemens Company

HIGH EFFICENCY RED CQV 26 SERIES
YELLOW CQV 28 SERIES
GREEN CQV 29 SERIES
TRIANGULAR LED LAMP



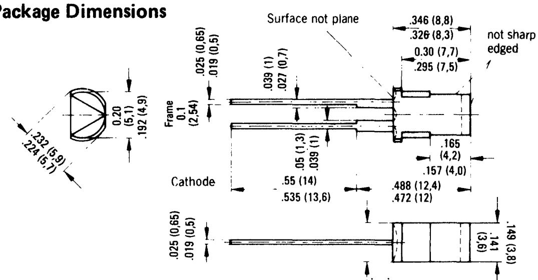
FEATURES

- **Red Diffused Lens, CQV 26**
  Yellow Diffused Lens, CQV 28
  Green Diffused Lens, CQV 29
- **Triangular Shape**
- **Minimum Lead Length ½"**
- **1/10" Lead Spacing**
- **I/C Compatible**

DESCRIPTION

The CQV 26 and CQV 28 are light emitting diode lamps fabricated with TSN (transparent substrate nitrogen) technology. The CQV 29 is a gallium phosphide LED lamp. All three series have a diffused lens which forms an evenly dispersed triangular head on light.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	5	V
Forward current	I_F	60	mA
Surge current ($t \leqq 10\ \mu s$)	i_{FS}	1	A
Storage temperature	T_s	−55 to +100	°C
Junction temperature	T_j	100	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	200	mW
Thermal resistance junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

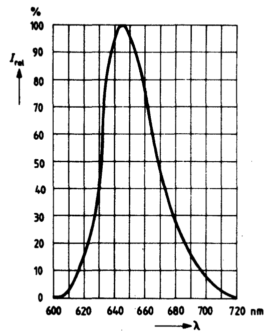
		CQV 26	CQV 28	CQV 29	
Wave length of emitted light	λ_{peak}	645±15	590±10	560±15	nm
Dominant wave length	λ_{dom}	638	592	561	nm
Aperture cone (half angle) (Limits for 50% of luminous intensity I_v) shielded against lateral emission of light	φ	50	50	50	degrees
Forward voltage (I_F = 20 mA)	V_F		2.4 (≦3.0)		V
Reverse current (V_R = 5 V)	I_R		0.01 (≦ 10)		µA
Luminous intensity (I_F = 20 mA)	i_v	≧ 0.63	≧ 0.63	≧ 0.63	mcd
Rise time	t_r	100	100	50	ns
Fall time	t_f	100	100	50	ns
Capacitance (V_R = 0 V)	C_o	12	10	45	pF

Luminous Intensity

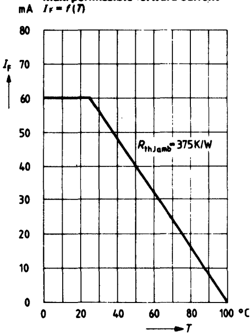
Type	Min	Max	Unit	Test Condition
CQV 26-2	.63	1.25	mcd	20 mA
CQV 26-3	1.0	2.0	mcd	20 mA
CQV 26-4	1.6	–	mcd	20 mA
CQV 28-2	.63	1.25	mcd	20 mA
CQV 28-3	1.0	2.0	mcd	20 mA
CQV 28-4	1.6	–	mcd	20 mA
CQV 29-2	.63	1.25	mcd	20 mA
CQV 29-3	1.0	2.0	mcd	20 mA
CQV 29-4	1.6	–	mcd	20 mA

Specifications are subject to change without notice.

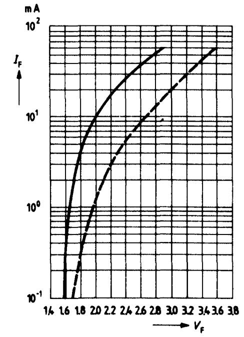
Relative spectral emission $I_{rel} = f(\lambda)$



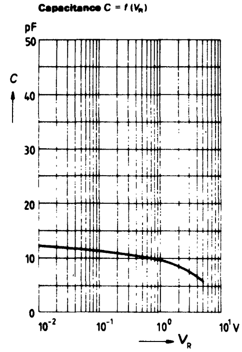
Max. permissible forward current $I_F = f(T)$



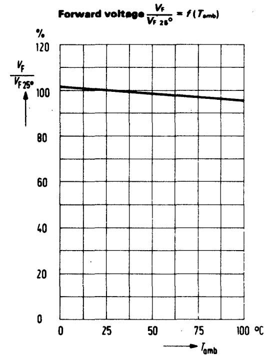
Forward voltage $I_F = f(V_F)$



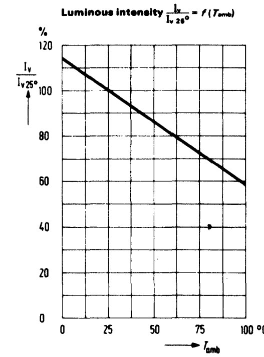
Capacitance $C = f(V_R)$



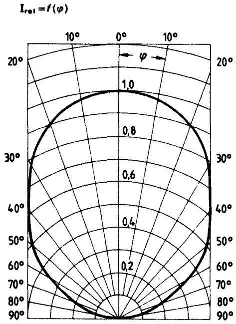
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



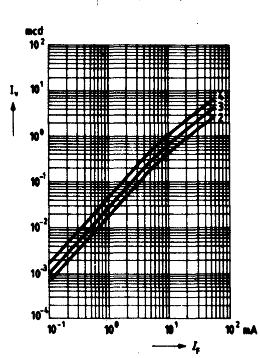
Luminous intensity $\frac{I_V}{I_{V\,25°}} = f(T_{amb})$



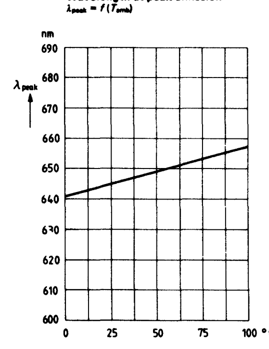
Radiation characteristic
$I_{rel} = f(\varphi)$



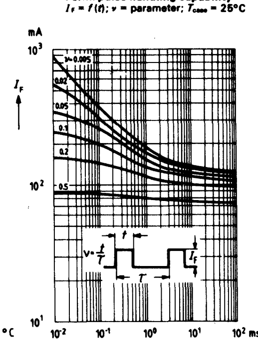
Luminous intensity $I_V = f(I_F)$



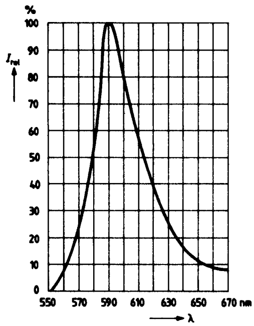
Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



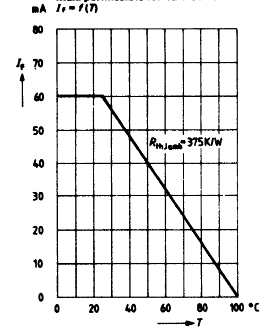
Perm. pulse handling capability
$I_F = f(t)$; v = parameter; T_{case} = 25°C



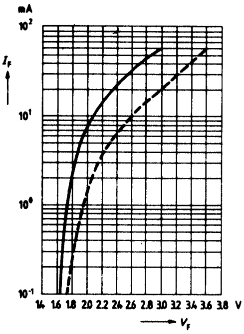
Relative spectral emission $I_{rel} = f(\lambda)$



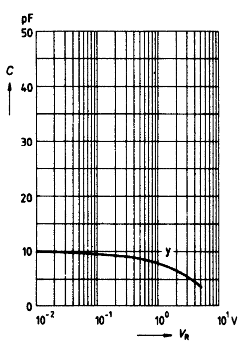
Max. permissible forward current
$I_F = f(T)$



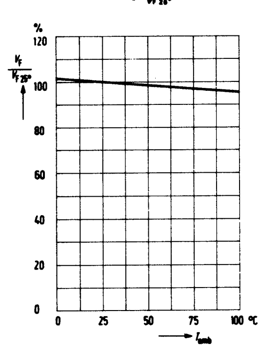
Forward voltage $I_F = f(V_F)$



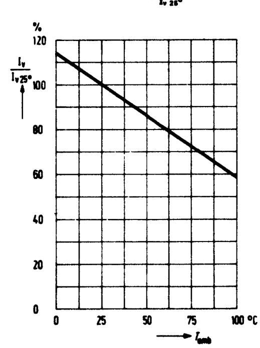
Capacitance $C = f(V_R)$



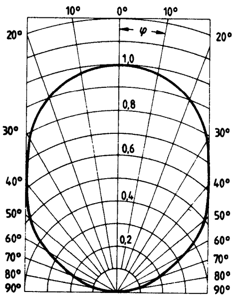
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



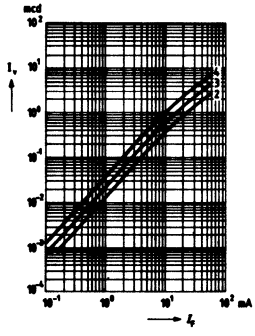
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



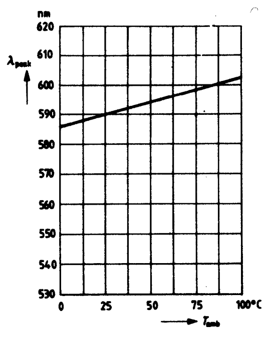
Radiation characteristic
$I_{rel} = f(\varphi)$



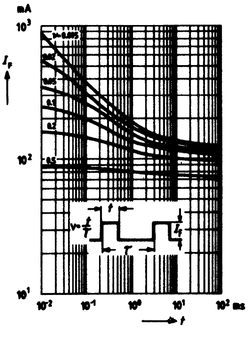
Luminous intensity $I_v = f(I_F)$



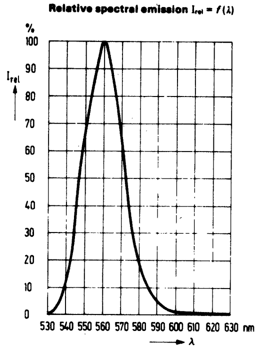
Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



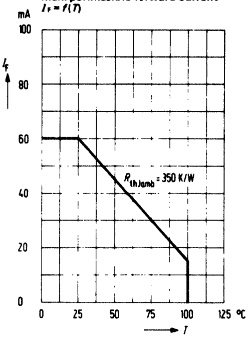
Perm. pulse handling capability
$I_F = f(t)$; v = parameter; T_{amb} = 25°C



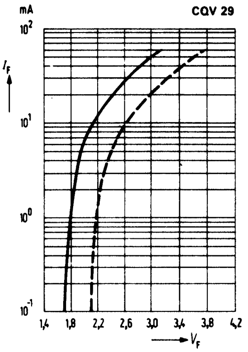
Relative spectral emission $I_{rel} = f(\lambda)$



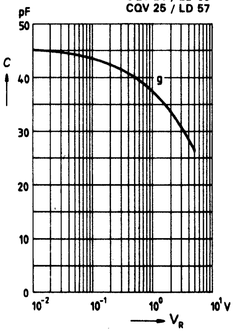
Max. permissible forward current $I_F = f(T)$



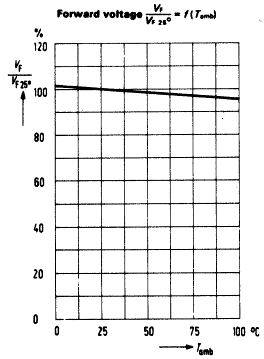
Forward voltage $I_F = f(V_F)$



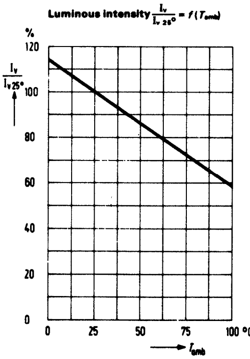
Capacitance $C = f(V_R)$
CQV 24 / LD 55
CQV 25 / LD 57



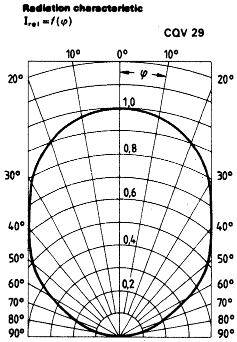
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



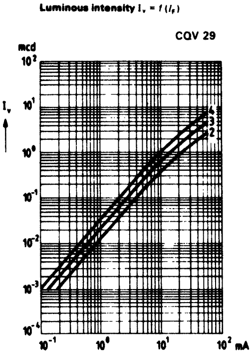
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



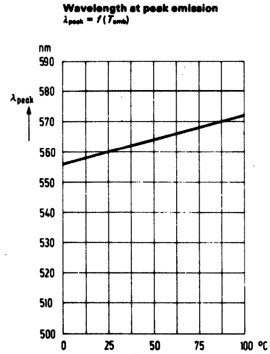
Radiation characteristic
$I_{rel} = f(\varphi)$



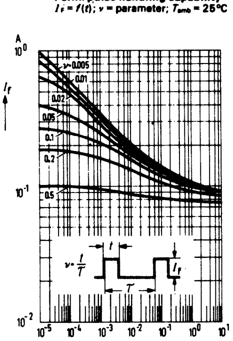
Luminous intensity $I_v = f(I_F)$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; T_{amb} = 25°C



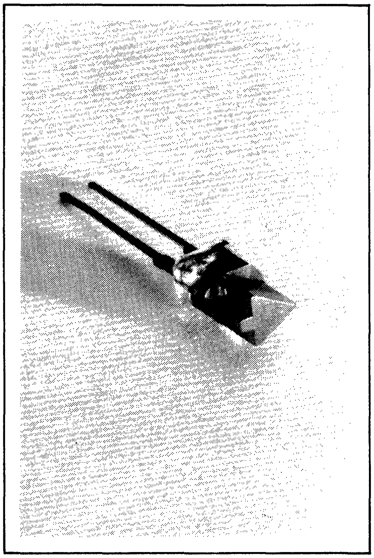
litronix
A Siemens Company

LD 602 SERIES
HIGH EFFICIENCY RED

LD 606 SERIES
YELLOW

LD 607 SERIES
GREEN

ARROW LED LAMP
PRELIMINARY



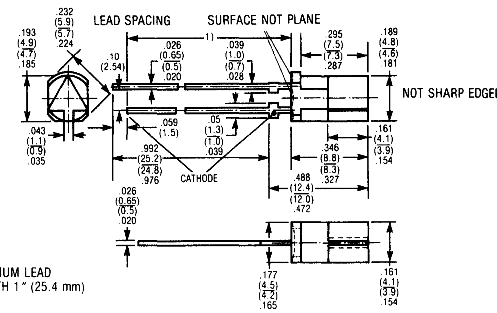
FEATURES

- **Arrow Shape**
- **Red Diffused Lens, LD 602**
  Yellow Diffused Lens, LD 606
  Green Diffused Lens, LD 607
- **Minimum Lead Length 1″ (25.4 mm)**
- **1/10″ (2.54 mm) Lead Spacing**

DESCRIPTION

The LD 602 and LD 606 are light emitting diode lamps fabricated with TSN (Transparent Substrate Nitrogen) technology. The LD 607 is a gallium phosphide LED lamp. These lamps have a diffused lens in the shape of an arrow.

Package Dimensions in Inches (mm)



1) MINIMUM LEAD LENGTH 1″ (25.4 mm)

Maximum Ratings

Reverse Voltage (V_R) .... 5 V
Forward Current (I_F) .... 60 mA
Surge Current (i_{FS}, $t \le 10\ \mu s$) .... 1 A
Storage Temperature (T_s) .... −55 °C to +100 °C
Junction Temperature (T_j) .... 100 °C
Power Dissipation (P_{tot}), $T_{amb} = 25\ °C$ .... 200 mW
Thermal Resistance Junction to Air (R_{thJamb}) .... 375 K/W

Opto-Electronic Characteristics ($T_{amb} = 25\ °C$)

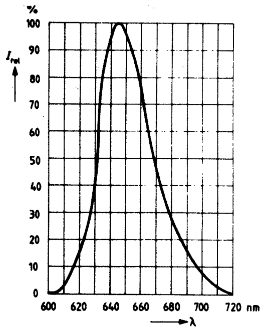
Parameter	Symbol	LD 602	LD 606	LD 607	Unit
Wave Length of Emitted Light	(λ_{peak})	645±15	590±10	560±15	nm
Dominant Wave Length	(λ_{dom})	638	592	561	nm
Aperture Cone (Half Angle) (Limits for 50% of luminous Intensity I_V) Shielded Against Lateral Emission of Light	φ	50	50	50	degrees
Forward Voltage ($I_F = 20$ mA)	V_F		2.4 (≤3.0)		V
Reverse Current ($V_R = 5$ V)	I_R		0.01 (≤10)		μA
Luminous Intensity ($I_F = 20$ mA)	I_V	≥0.63	≥0.63	≥0.63	mcd
Rise Time	t_r	100	100	50	ns
Fall Time	t_f	100	100	50	ns
Capacitance ($V_R = 0$ V)	C_o	12	10	45	pF

Luminous Intensity

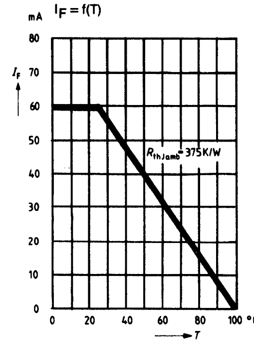
Type	Min	Max	Unit	Test Condition
LD 602-2	.63	1.25	mcd	20 mA
LD 602-3	1.0	2.0	mcd	20 mA
LD 602-4	1.6	–	mcd	20 mA
LD 606-2	.63	1.25	mcd	20 mA
LD 606-3	1.0	2.0	mcd	20 mA
LD 606-4	1.6	–	mcd	20 mA
LD 607-2	.63	1.25	mcd	20 mA
LD 607-3	1.0	2.0	mcd	20 mA
LD 607-4	1.6	–	mcd	20 mA

Specifications subject to change without notice.

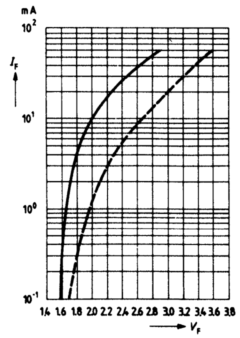
RELATIVE SPECTRAL EMISSION $I_{rel} = f(\lambda)$



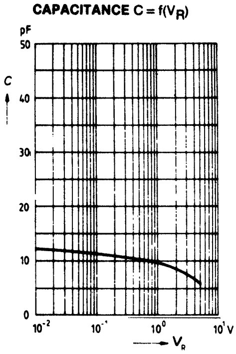
MAXIMUM PERMISSIBLE FORWARD CURRENT
$I_F = f(T)$



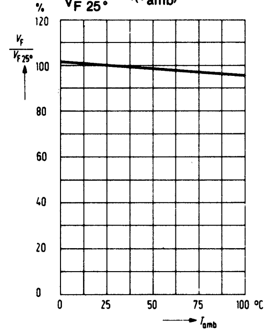
FORWARD VOLTAGE
$I_F = f(V_F)$



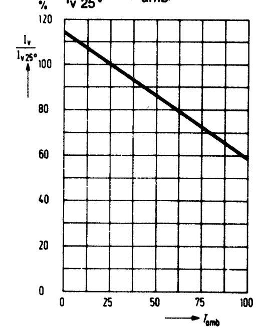
CAPACITANCE $C = f(V_R)$



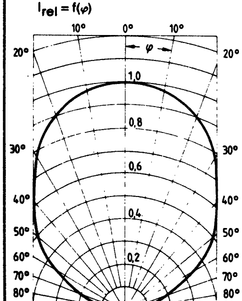
FORWARD VOLTAGE
$\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



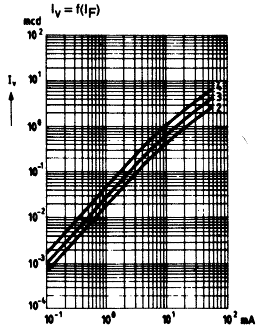
LUMINOUS INTENSITY
$\frac{I_V}{I_{V\,25°}} = f(T_{amb})$



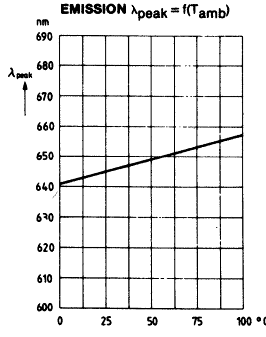
RADIATION CHARACTERISTICS
$I_{rel} = f(\varphi)$



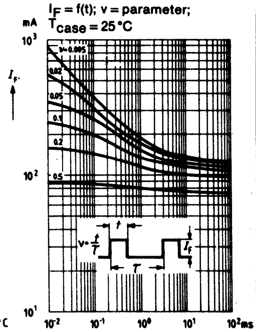
LUMINOUS INTENSITY
$I_V = f(I_F)$



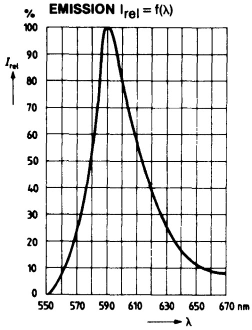
WAVELENGTH AT PEAK EMISSION $\lambda_{peak} = f(T_{amb})$



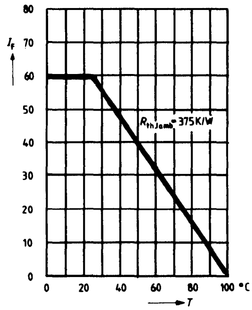
PERM. PULSE HANDLING CAPABILITY
$I_F = f(t)$; v = parameter;
$T_{case} = 25\,°C$



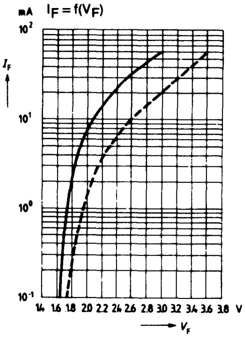
RELATIVE SPECTRAL EMISSION $I_{rel} = f(\lambda)$



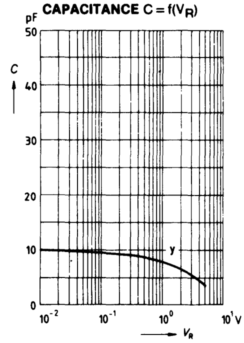
MAXIMUM PERMISSIBLE FORWARD CURRENT $I_F = f(T)$



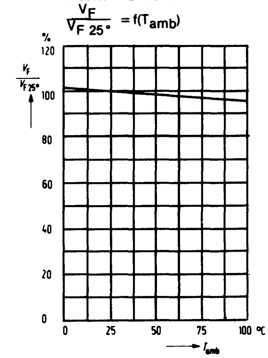
FORWARD VOLTAGE $I_F = f(V_F)$



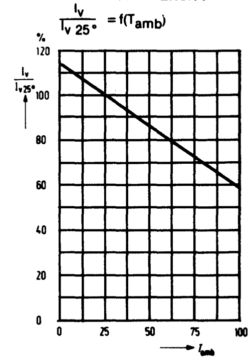
CAPACITANCE $C = f(V_R)$



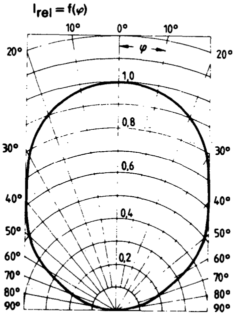
FORWARD VOLTAGE $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



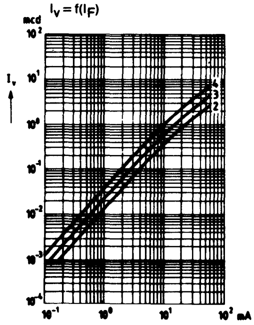
LUMINOUS INTENSITY $\frac{I_V}{I_{V\,25°}} = f(T_{amb})$



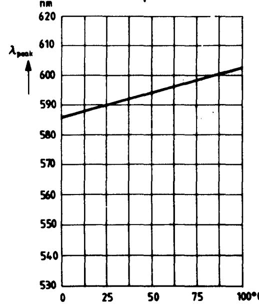
RADIATION CHARACTERISTICS $I_{rel} = f(\varphi)$



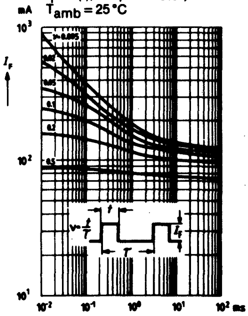
LUMINOUS INTENSITY $I_V = f(I_F)$



WAVELENGTH AT PEAK EMISSION $\lambda_{peak} = f(T_{amb})$

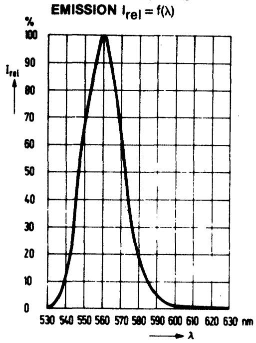


PERM. PULSE HANDLING CAPABILITY
$I_F = f(t)$; v = parameter; $T_{amb} = 25\,°C$

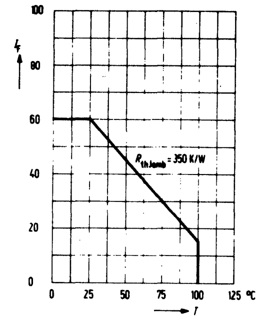


LD 607

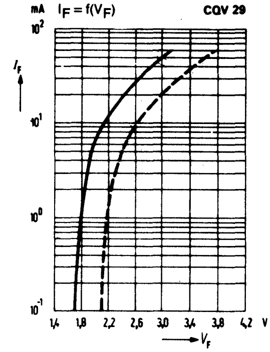
RELATIVE SPECTRAL EMISSION $I_{rel} = f(\lambda)$



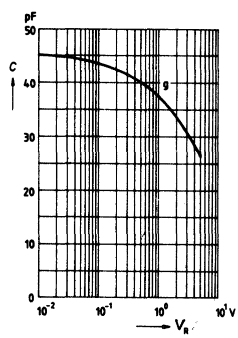
MAXIMUM PERMISSIBLE FORWARD CURRENT $I_F = f(T)$



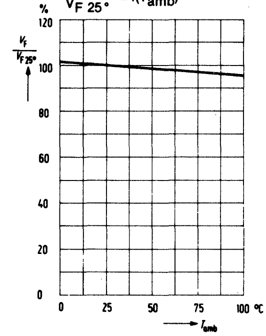
FORWARD VOLTAGE $I_F = f(V_F)$ **CQV 29**



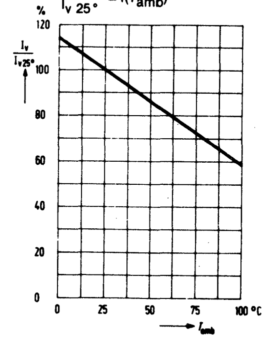
CAPACITANCE $C = f(V_R)$



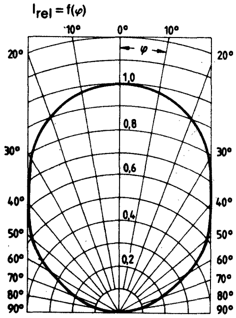
FORWARD VOLTAGE $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



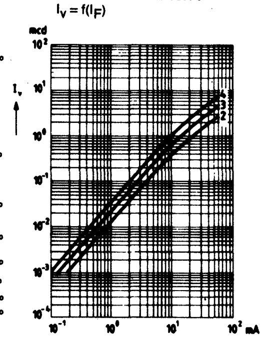
LUMINOUS INTENSITY $\frac{I_V}{I_{V\,25°}} = f(T_{amb})$



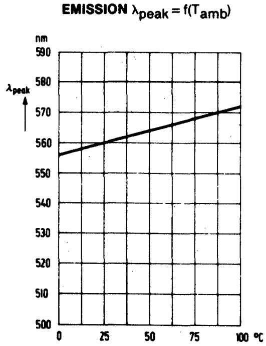
RADIATION CHARACTERISTICS $I_{rel} = f(\varphi)$



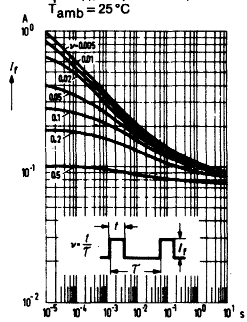
LUMINOUS INTENSITY $I_V = f(I_F)$



WAVELENGTH AT PEAK EMISSION $\lambda_{peak} = f(T_{amb})$

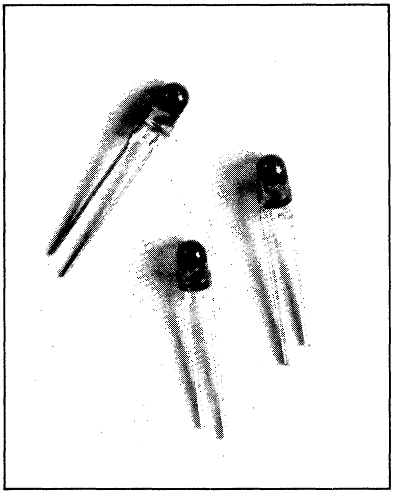


PERM. PULSE HANDLING CAPABILITY $I_F = f(t)$; v = parameter; $T_{amb} = 25\,°C$



litronix
A Siemens Company

CQV 10 (LD 30A/-1/-2/-3) SERIES
CQV 30 (LD 30C) SERIES
RED T 1 LED LAMP



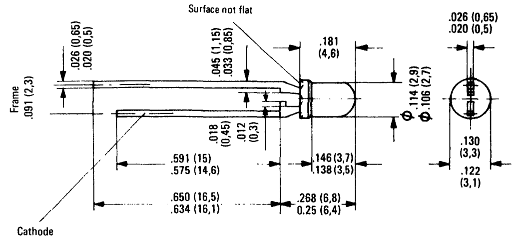
FEATURES

- **Red Diffused Lens**
  Wide Viewing Angle ±35°
  CQV 10 (LD 30A/-1/-2/-3)
- **Glass Clear Lens**
  Moderate Viewing Angle ±25°
  CQV 30 (LD 30C)
- **T-1 Size**
- **½" Minimum Lead Length**
- **Front Panel Mounting**
  Snap-in Mounting Clips Available
  Clip/Collar #004-9016 Clear
  #004-9015 Black
- **I/C Compatible**

DESCRIPTION

The CQV 10/30 Series are standard red gallium arsenide phosphide LED solid state lamps. The CQV 10 Series has a red diffused plastic lens and offers a wide viewing angle of ±35°. The CQV 30 has a glass clear plastic lens and somewhat narrower viewing angle of ±25°. These lamps can be mounted in front panel applications with clips or used as back panel indicators.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse voltage	V_R	5	V
Forward current	I_F	100	mA
Surge current ($t \leq 1\ \mu s$)	i_{FS}	2.0	A
Storage temperature	T_{stor}	−55 to +100	°C
Junction temperature	T_j	100	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	200	mW
Thermal resistance			
Junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

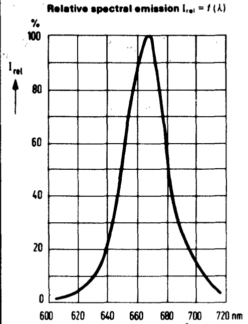
Wavelength at peak emission	λ_{peak}	665 ±15	nm
Half angle			
(limits for 50% of luminous intensity I_v)			
CQV 10 (LD 30A/-1/-2/-3)	φ	35	degree
CQV 30 (LD 30C)	φ	25	degree
Forward voltage (I_F = 20 mA)	V_F	1.6 (≤ 2.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤ 10)	µA
Rise time	t_r	5	ns
Fall time	t_f	5	ns
Capacitance (V_R = 0 V)	C_0	40	pF

Luminous Intensity

Type	Min	Max	Unit	Test Condition
(LD 30A)	.3	–	mcd	20 mA
CQV 10-3	1.0	2.0	mcd	20 mA
(LD 30-1)	1.0	2.4	mcd	20 mA
CQV 10-4	1.6	3.2	mcd	20 mA
(LD 30-2)	2.0	–	mcd	20 mA
(LD 30-3)	3.2	–	mcd	20 mA
CQV 30A	1.0	2.0	mcd	20 mA
(LD 30C)	1.0	–	mcd	20 mA
CQV 30B	1.6	3.2	mcd	20 mA
CQV 30C	2.5	–	mcd	20 mA

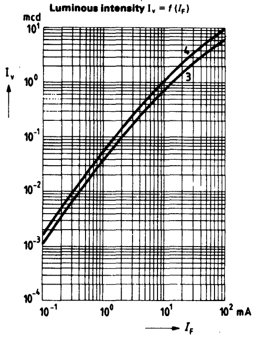
*CQV designations are preferred types for new designs and conform to new international classification standards. LD equivalents may continue to be delivered during transition period.
Specifications are subject to change without notice.

Relative spectral emission $I_{rel} = f(\lambda)$



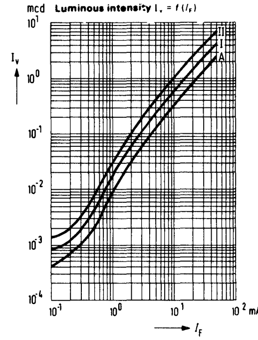
CQV 10

Luminous intensity $I_v = f(I_F)$



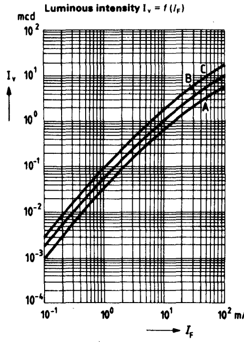
LD 30A/-1/-2

Luminous intensity $I_v = f(I_F)$



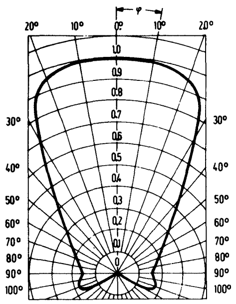
CQV 30 (LD 30C)

Luminous intensity $I_v = f(I_F)$



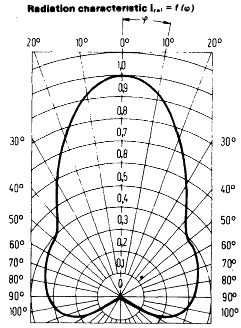
CQV 10 (LD 30)

Radiation characteristic $I_{rel} = f(\varphi)$

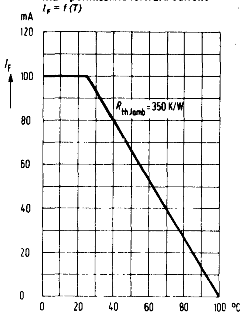


CQV 30 (LD 30C)

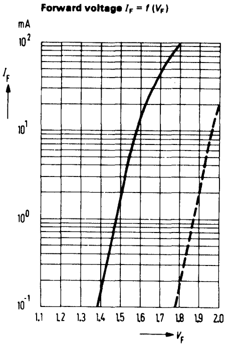
Radiation characteristic $I_{rel} = f(\varphi)$



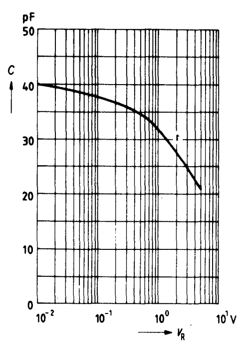
Max. permissible forward current
$I_F = f(T)$



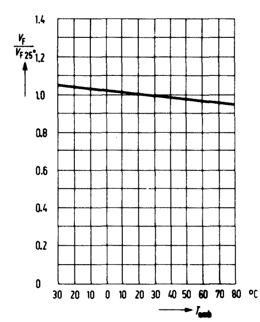
Forward voltage $I_F = f(V_F)$



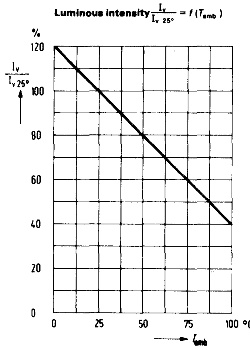
Capacitance $C = f(V_R)$



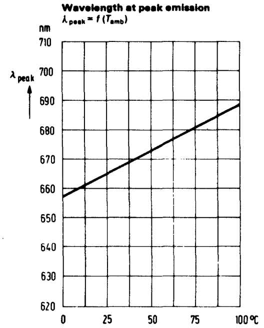
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



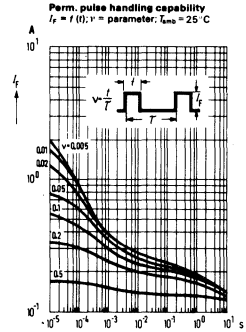
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

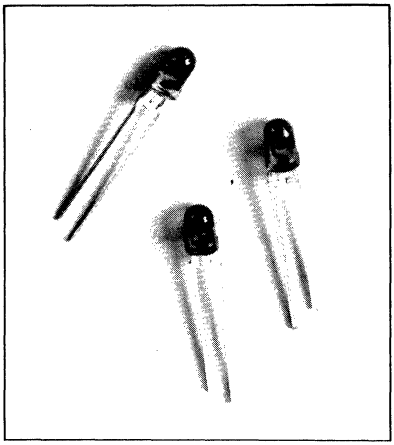


Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; T_{amb} = 25 °C



litronix
A Siemens Company

CQV 11 (LD 32-1/-2) SERIES
CQV 31 (LD 32 C) SERIES
HIGH EFFICIENCY RED T1 LED LAMP



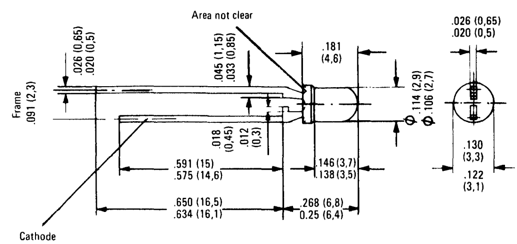
FEATURES

- **High Light Output at 10 mA**
- **Red Diffused Lens**
  Wide Viewing Angle ±35°
  CQV 11 (LD 32-1 & LD 32-2)
- **Red Clear Lens**
  Moderately Wide Viewing Angle ±25°
  CQV 31 (LD 32C)
- **T-1 Size**
- **½" Minimum Lead Length**
- **Front Panel Mounting**
  Snap-in Mounting Clips Available
  Clip/Collar #004-9016 Clear
  #004-9015 Black
- **I/C Compatible**

DESCRIPTION

The CQV 11/31 Series is a premium high efficiency light emitting diode lamp fabricated with TSN (transparent substrate nitrogen) technology. The CQV 11 Series has a red diffused plastic lens which emits a full flooded intense light. The CQV 31 has a red clear lens and a somewhat narrower viewing angle but higher light output. These lamps can be mounted in front panel indicator applications or may be used for legend back lighting.

Package Dimensions in Inches (mm)



Clip #004-9016 Black
#004-9015 Clear

Maximum Ratings

Reverse voltage	V_R	5.0	V
Forward current	I_F	60	mA
Surge current ($t \leq 1$ µs)	i_{FS}	1.0	A
Storage temperature	T_{stor}	−55 to 100	°C
Junction temperature	T_j	100	°C
Power dissipation	P_{tot}	200	mW
Thermal resistance junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

Wavelength at peak emission	λ_{peak}	645	nm
Half angle (limits for 50% of luminous intensity I_v)			
CQV 11 (LD 32-1/-2)	φ	35	degree
CQV 31 (LD 32C)		25	degree
Forward voltage (I_F = 20 mA)	V_F	2.4 (≦ 3.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≦ 10)	µA
Rise time	t_r	100	ns
Fall time	t_f	100	ns
Capacitance (V_R = 0 V)	C_0	12	pF

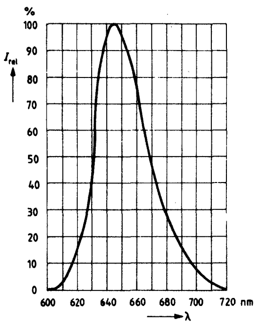
Luminous Intensity

Type	Min	Max	Unit	Test Condition
CQV 11-4	1.6	3.2	mcd	20 mA
(LD 32-1)	1.2	2.4	mcd	10 mA
CQV 11-5	2.5	5.0	mcd	20 mA
(LD 32-2)	2.0	–	mcd	10 mA
CQV 11-6	4.0	–	mcd	20 mA
CQV 31D	4.0	8.0	mcd	20 mA
(LD 32C)	2.5	–	mcd	10 mA
CQV 31E	6.3	–	mcd	20 mA

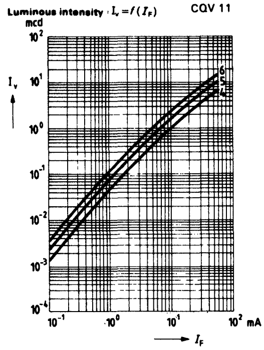
*CQV designations are preferred types for new designs and conform to new international classification standards. LD equivalents may continue to be delivered during transition period.

Specifications are subject to change without notice.

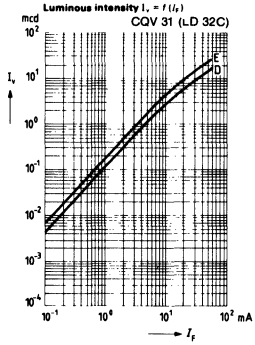
Relative spectral emission $I_{rel} = f(\lambda)$



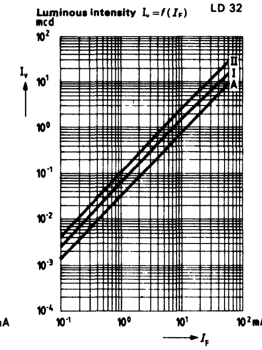
Luminous intensity $I_v = f(I_F)$ CQV 11



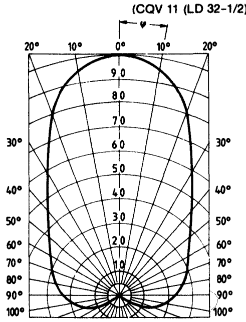
Luminous intensity $I_v = f(I_F)$ CQV 31 (LD 32C)



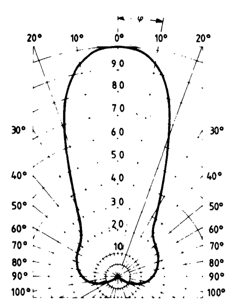
Luminous intensity $I_v = f(I_F)$ LD 32



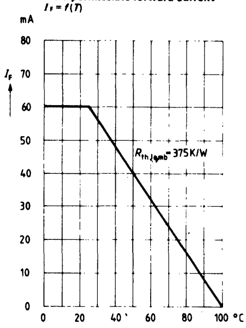
Radiation characteristic $I_{rel} = f(\varphi)$ (CQV 11 (LD 32-1/2)



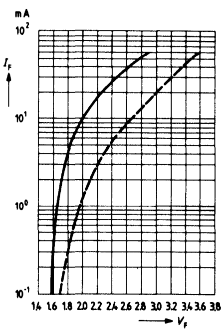
Radiation characteristic $I_{rel} = f(\varphi)$ CQV 31 (LD 32C)



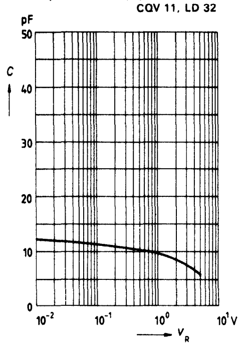
Max. permissible forward current $I_F = f(T)$



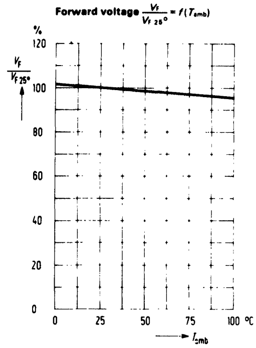
Forward voltage $I_F = f(V_F)$



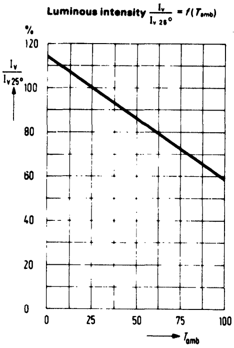
Capacitance $C = f(V_R)$ CQV 11, LD 32



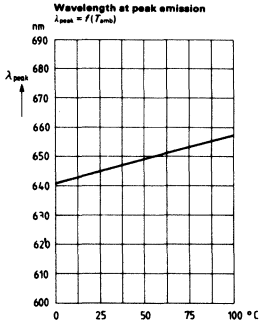
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



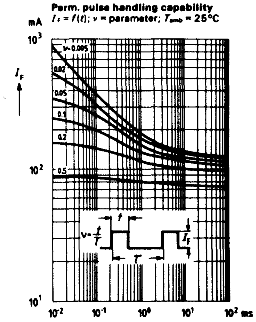
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission $\lambda_{peak} = f(T_{amb})$

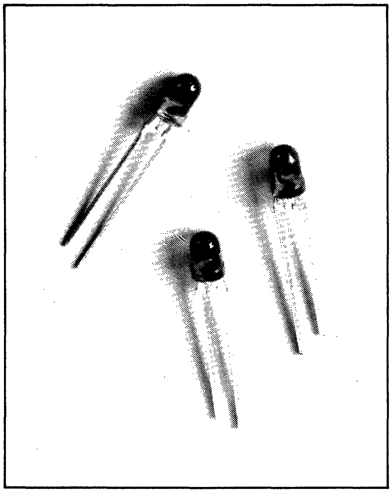


Perm. pulse handling capability $I_F = f(t)$; v = parameter; $T_{amb} = 25\,°C$



litronix
A Siemens Company

CQV 13 (LD 36A/-1/-2) SERIES
CQV 33 (LD 36C) SERIES
YELLOW T 1 LED LAMP



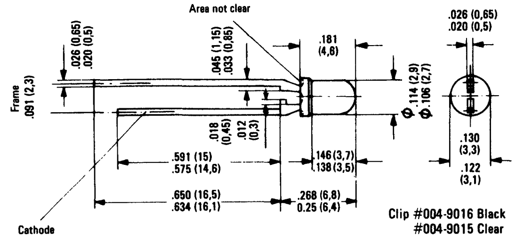
FEATURES

- **Yellow Diffused Lens Wide Viewing Angle ±35° CQV 13 (LD 36A/-1/-2)**
- **Clear Yellow Lens Moderately Wide Viewing Angle ±25° CQV 33 (LD 36C)**
- **T 1 Size**
- **½" Minimum Lead Length**
- **Front Panel Mounting Snap-in Mounting Clips Available Clip/Collar #004-9015 Clear #004-9016 Black**
- **I/C Compatible**

DESCRIPTION

The CQV 13/33 Series is a high efficiency light emitting diode lamp fabricated with TSN (transparent substrate nitrogen) technology. The yellow diffused plastic lens provides wide viewing angle for front panel applications.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	5.0	V
Forward current	I_F	60	mA
Surge current ($t \leq 1$ µs)	i_{FS}	1.0	A
Storage temperature	T_{stor}	−55 to 100	°C
Junction temperature	T_j	100	°C
Power dissipation	P_{tot}	200	mW
Thermal resistance junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

Wavelength at peak emission	λ_{peak}	590	nm
Half angle (limits for 50% of luminous intensity I_V)			
CQV 13 (LD 36A/-1/-2)	φ	35	degree
CQV 33 (LD 36C)	φ	25	degree
Forward voltage (I_F = 20 mA)	V_F	2.4 (≤ 3.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤ 10)	µA
Rise time	t_r	100	ns
Fall time	t_f	100	ns
Capacitance (V_R = 0 V)	C_0	10	pF

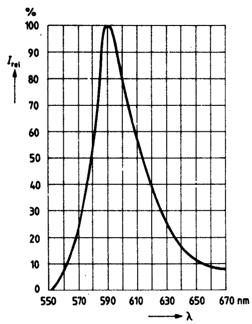
Luminous Intensity

Type	Min	Max	Unit	Test Condition
(LD 36A)	.6	–	mcd	10 mA
CQV 13-4	1.6	3.2	mcd	20 mA
(LD 36-1)	1.0	2.0	mcd	10 mA
CQV 13-5	2.5	5.0	mcd	20 mA
(LD 36-2)	1.6		mcd	10 mA
CQV 13-6	4.0	–	mcd	20 mA
(LD 36C)	2.0	–	mcd	10 mA
CQV 33D	4.0	8.0	mcd	20 mA
CQV 33E	6.3	–	mcd	20 mA

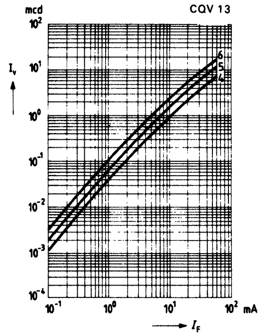
*CQV designations are preferred types for new designs and conform to new international classification standards. LD equivalents may continue to be delivered during transition period.

Specifications are subject to change without notice.

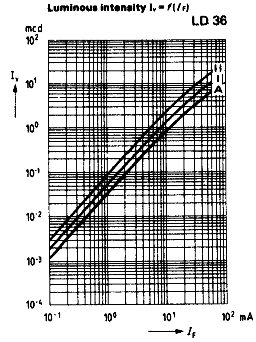
Relative spectral emission $I_{rel} = f(\lambda)$



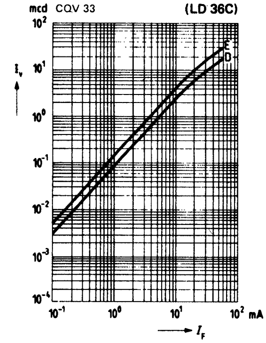
Luminous intensity $I_v = f(I_F)$



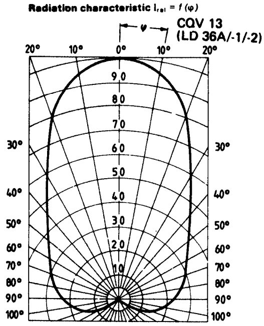
Luminous intensity $I_v = f(I_F)$



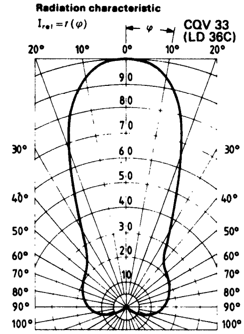
Luminous intensity $I_v = f(I_F)$



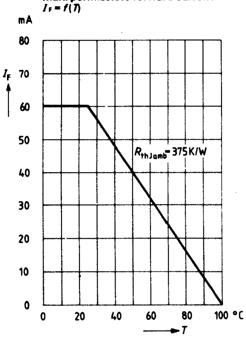
Radiation characteristic $I_{rel} = f(\varphi)$



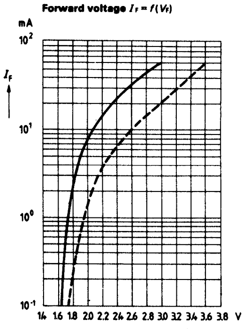
Radiation characteristic $I_{rel} = f(\varphi)$



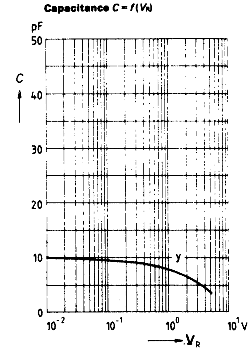
Max. permissible forward current $I_F = f(T)$



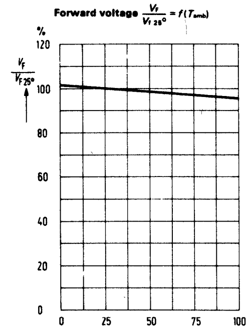
Forward voltage $I_F = f(V_F)$



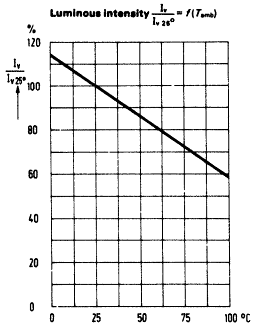
Capacitance $C = f(V_R)$



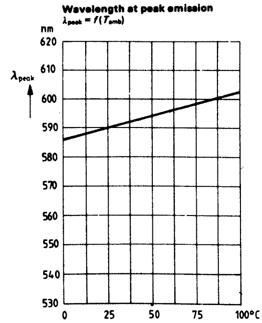
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



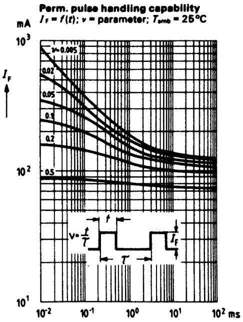
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission $\lambda_{peak} = f(T_{amb})$

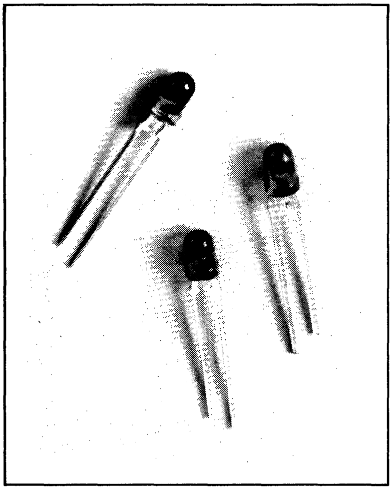


Perm. pulse handling capability $I_F = f(t)$; v = parameter; T_{amb} = 25°C



litronix
A Siemens Company

CQV 15 (LD 37A/-1/-2) SERIES
CQV 35 (LD 37C) SERIES
GREEN T 1 LED LAMP



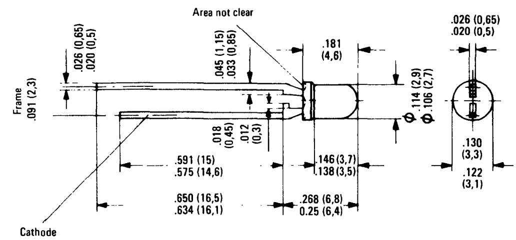
FEATURES

- **Green Diffused Lens**
  Wide Viewing Angle ±35°
  CQV 15 (LD 37A, LD 37-1 & LD 37-2)
- **Glass Clear Lens**
  Moderately Wide Viewing Angle ±25°
  CQV 35 (LD 37C)
- **T-1 Package Size**
- **½" Minimum Lead Length**
- **Front Panel Mounting**
  Snap-in Mounting Clips Available
  Clip/Collar #004-9015 Clear
  #004-9016 Black
- **I/C Compatible**

DESCRIPTION

The CQV 15/35 Series are green gallium phosphide LED solid state lamps. The CQV 15 Series has a green diffused plastic lens which emits a green light with a wide viewing angle. The CQV 35 has a glass clear plastic lens which emits a yellowish green light with a somewhat narrower viewing angle. These lamps are intended for mounting in front panel applications.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	5	V
Forward current	I_F	60	mA
Surge current ($t \leq 1\,\mu s$)	i_{FS}	1	A
Storage temperature	T_{stor}	−55 to +100	°C
Junction temperature	T_j	100	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	200	mW
Thermal resistance Junction to air	R_{thJamb}	375	K/W

Characteristics (T_{amb} = 25°C)

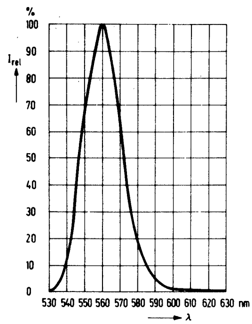
Wavelength at peak emission	λ_{peak}	560 ± 15	nm
Half angle (limits for 50% of luminous intensity I_v)			
CQV 15 (LD 37A/-1/-2)	φ	35	degree
CQV 35 (LD 37C)	φ	25	degree
Forward voltage (I_F = 20 mA)	V_F	2.4 (≤ 3.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤ 10)	µA
Rise time	t_r	50	ns
Fall time	t_f	50	ns
Capacitance (V_R = 0 V)	C_0	45	pF

Luminous Intensity

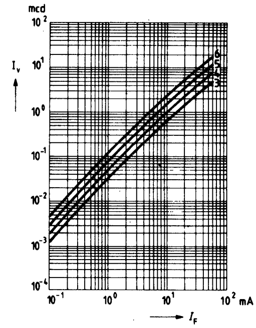
Type	Min	Max	Unit	Test Condition
(LD 37A)	0.5	–	mcd	20 mA
CQV 15-3	1.0	2.0	mcd	20 mA
CQV 15-4	1.6	3.2	mcd	20 mA
(LD 37-1)	2.0	4.0	mcd	20 mA
CQV 15-5	2.5	5.0	mcd	20 mA
(LD 37-2)	3.2	–	mcd	20 mA
CQV 15-6	4.0	–	mcd	20 mA
CQV 35D	4.0	8.0	mcd	20 mA
(LD 37C)	4.0	–	mcd	20 mA
CQV 35E	6.3	–	mcd	20 mA

*CQV designations are preferred types for new designs and conform to new international classification standards. LD equivalents may continue to be delivered during transition period.
Specifications are subject to change without notice.

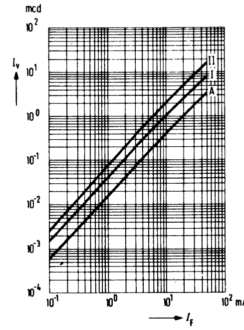
CQV 15
Luminous intensity $I_v = f(I_F)$



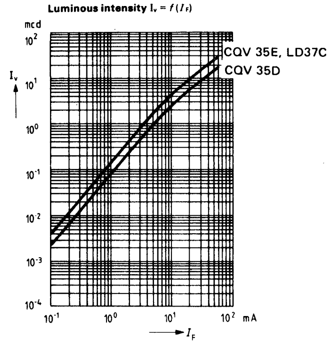
CQV 15
Luminous intensity $I_v = f(I_F)$



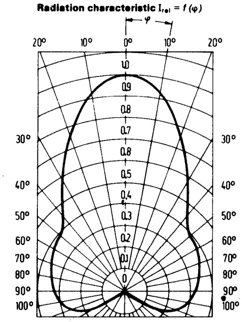
(LD 37A/-1/-2)
Luminous intensity $I_v = f(I_F)$



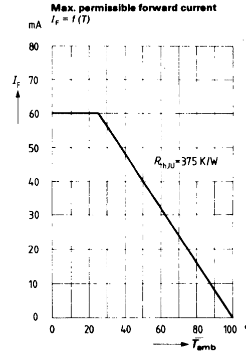
CQV 35 (LD 37C)
Luminous intensity $I_v = f(I_F)$



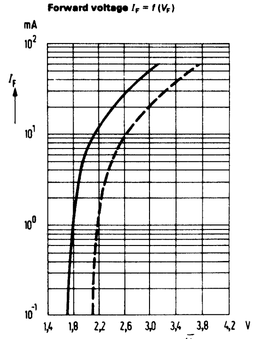
Radiation characteristic $I_{rel} = f(\varphi)$



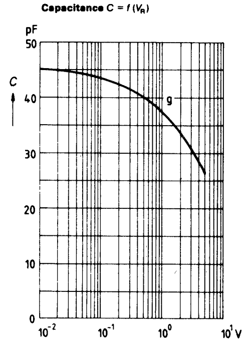
Max. permissible forward current $I_F = f(T)$



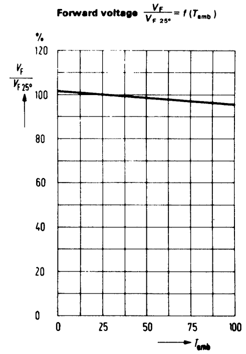
Forward voltage $I_F = f(V_F)$



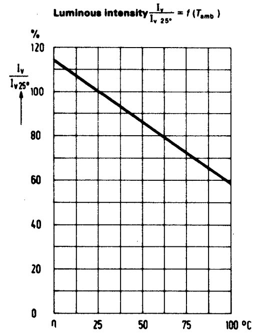
Capacitance $C = f(V_R)$



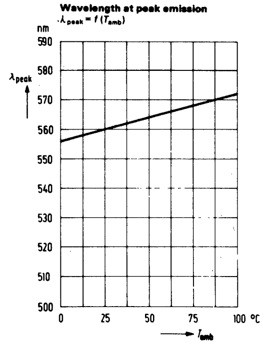
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



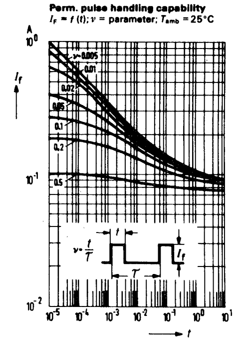
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



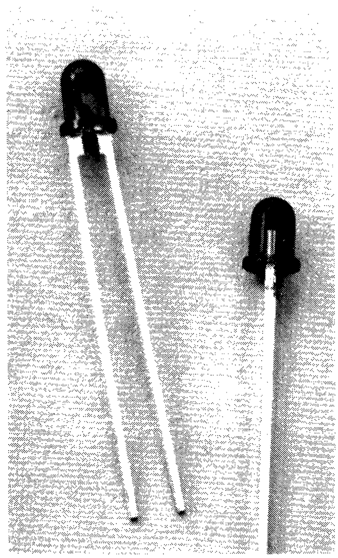
Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; $T_{amb} = 25°C$



litronix
A Siemens Company

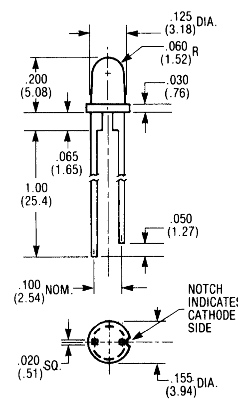
RL-4480 SERIES

RED T1 LED LAMP



Package Dimensions in Inches (mm)

RL-4480



FEATURES

- Choice of Brightness Ranges
- Miniature Size (T1 Lamp)
- .100 Lead Spacing with Standoffs,
- IC Compatible
- Economical Molded Plastic Package
- Mounting Clip Available

DESCRIPTION

The RL-4480 is a gallium arsenide phosphide red diffused lamp intended for high volume usage in array and indicator light applications requiring long life at low cost.

Maximum Ratings

Power Dissipation @ 25°C Ambient . . . . 80 mW
Derate Linearly From 25°C . . . . -1.1 mW/°C
Storage and Operating Temperature . . . . -55° to 100°C
Continuous Forward Current . . . . 40 mA
Peak Inverse Voltage 3.0V

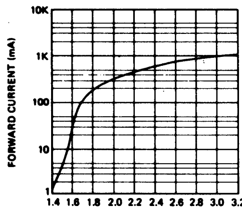
Opto-Electronic Characteristics (@25°C)

Parameter	Min	Typ	Max	Unit	Test Condition
Reverse Current		100		μA	−3.0 V
Forward Voltage		1.6	2.0	V	$I_F = 20$ mA
Luminous Intensity					
RL-4480	0.3	0.8		mcd	$I_F = 20$ mA
RL-4480-1	1.0	1.5		mcd	$I_F = 20$ mA
RL-4480-2	2.0	2.5		mcd	$I_F = 20$ mA
RL-4480-5		0.5		mcd	$I_F = 20$ mA
Emission Peak Wavelength		650		nm	

Specifications subject to change without notice.

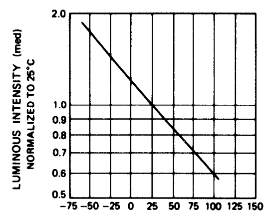
TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. FORWARD CHARACTERISTICS



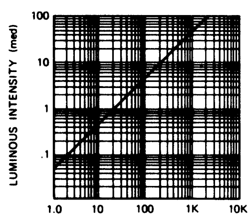
FORWARD CURRENT vs FORWARD VOLTAGE

FIGURE 2. LUMINANCE vs T_J



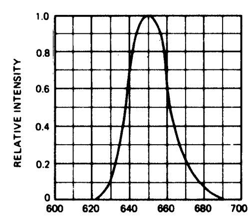
T_j, JUNCTION TEMPERATURE (°C)

FIGURE 3. LUMINANCE vs FORWARD CURRENT



I_F mA (pulsed)

FIGURE 4. SPECTRAL DISTRIBUTION



λ, WAVELENGTH (nm)

The effect of junction heating is not reflected in figure 3 as pulse width and duty cycle were limited to prevent heating effects. However, junction heating can cause reduction in luminance as evidenced in figure 2. To estimate output level, average junction temperature may be calculated from

$$T_{J(AV)} = T_A + \theta_{JA} V_F I_F D$$

Where D is the duty cycle of the applied current I_F, θ_{JA} = 350°C/W (max). This calculation should be limited to pulse durations of less than 10 ms to avoid errors caused by high peak junction temperature.

Clip Mounting Information

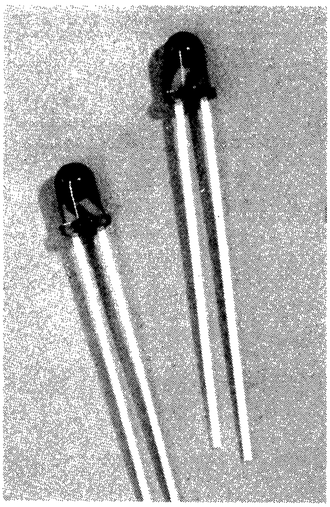
The clip mounts in a .203" dia. hole and fits a .062" panel thickness.

BLACK CLIP: 004-9011

litronix
A Siemens Company

RL-209 SERIES
RL-4484

RED T1 LED LAMPS

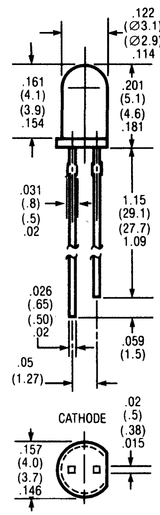


FEATURES
- Miniature T1 Size
- One Inch Leads
- 50 Mil Lead Spacing
- Brightness Categories, RL-209
- Low Power Consumption
- IC Compatible
- Economical Molded Plastic Package
- Mounting Clip Available

DESCRIPTION

The Red-Lit 209 series is intended for high volume usage in array and indicator light applications requiring long life at low cost. This series offers brightness categories for easy selection and assembly.

Package Dimensions in Inches (mm)



NOTE: Lead spacing on the RL-209 and RL-4484 was formerly 75 mils. If wider lead spacing on a T1 size lamp is required, refer to RL-4480 with 100 mil lead spacing.

Maximum Ratings

Power Dissipation @ 25°C Ambient	80 mW
Derate Linearly From 25°C	−1.1 mW/°C
Storage and Operating Temperature	−55°C to 100°C
Continuous Forward Current	40 mA
Peak Inverse Voltage	3.0V

Opto-Electronic Characteristics (@25°C)

Parameter	Min	Typ	Max	Unit	Test Condition
Reverse Current		100		nA	$V_R = 3.0$ V
Forward Voltage		1.6	2.0	V	$I_F = 20$ mA
Luminous Intensity					
RL-4484		0.8		mcd	$I_F = 20$ mA
RL-209A	0.5	0.8		mcd	$I_F = 20$ mA
RL-209-1	1.0	1.5	2.0	mcd	$I_F = 20$ mA
RL-209-2	2.0	2.4		mcd	$I_F = 20$ mA
Emission Peak Wavelength		650		nm	

Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. FORWARD CHARACTERISTICS

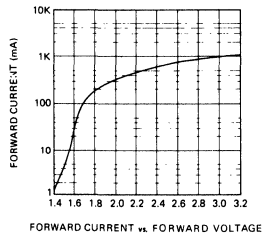


FIGURE 2. LUMINANCE vs T_J

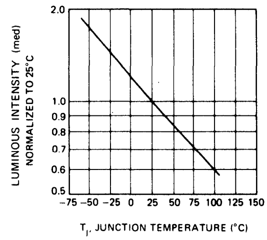


FIGURE 3. LUMINANCE vs FORWARD CURRENT

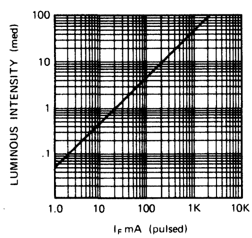
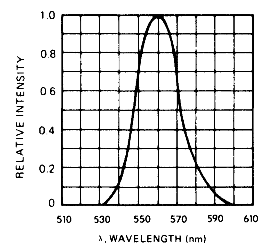


FIGURE 4. SPECTRAL DISTRIBUTION



The effect of junction heating is not reflected in figure 3 as pulse width and duty cycle were limited to prevent heating effects. However, junction heating can cause reduction in luminance as evidenced in figure 2. To estimate output level, average junction temperature may be calculated from

$$T_{J(AV)} = T_A + \theta_{JA} V_F I_F D$$

Where D is the duty cycle of the applied current I_F, $\theta_{JA} = 350°C/W$ (max). This calculation should be limited to pulse durations of less than 10 ms to avoid errors caused by high peak junction temperature.

Clip Mounting Information

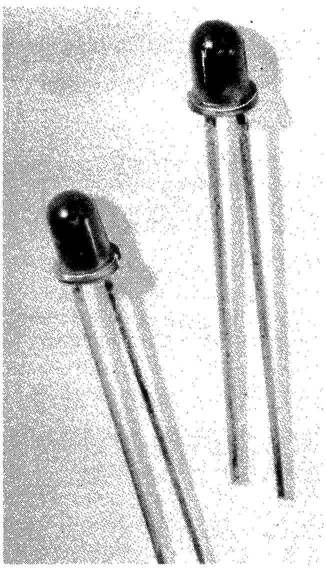
The clip mounts in a .203" dia. hole and fits a .062" panel thickness.

BLACK CLIP: 004-9011

litronix
A Siemens Company

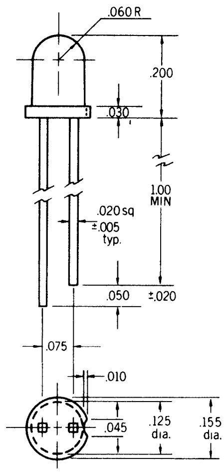
OL-31 SERIES

ORANGE T1 LED LAMP



PHASING OUT — NOT FOR NEW DESIGN

Package Dimensions in Inches



FEATURES

- T1 Package Size
- IC Compatible
- Wide viewing angle
- Low power consumption
- Mounting clips available

DESCRIPTION

The OL-31, a T1 lamp, is a high brightness orange TSN (Transparent Substrate Nitrogen) technology, solid state lamp which emits light in the orange region with good off-angle viewing.

The lamp is in a lightly diffused orange case.

Maximum Ratings

Power Dissipation	100mW
Derate Linearity from 25°C	1.3 mW/°C
Continuous Forward Current	40 mA
Operating Temperature	-55° to +100°C
Storage Temperature	-55° to +100°C
Peak Inverse Voltage	3.0V
Lead Soldering Temperature (1/16 inch from case)	5 sec @ 260°C

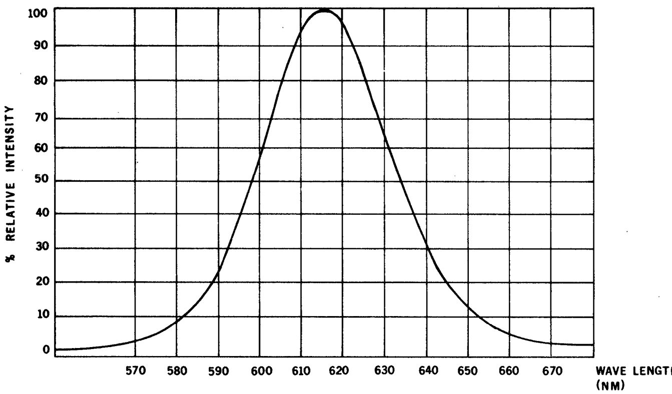
Opto-Electronic Characteristics @ 25°C

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity					
OL 31-2	1.5	3.0		mcd	I_F = 20mA
OL 31-4	4.0	6.0		mcd	I_F = 20mA
Forward Voltage		1.8	2.7	V	I_F = 20mA
Reverse Current		0.1	100	μA	V_R = 3V
Peak Emission Wavelength		615		nm	
Viewing Angle		35		degrees	

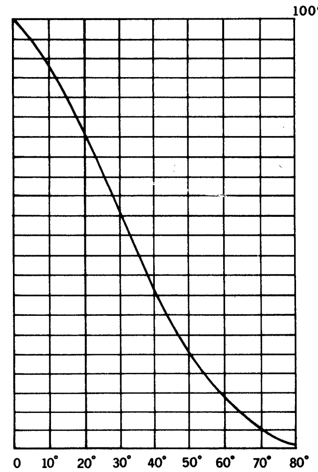
Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTICS CURVES

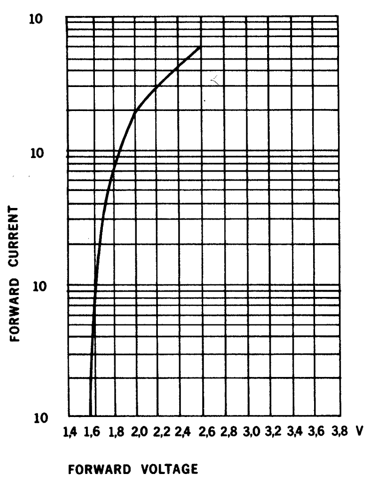
SPECTRAL DISTRIBUTION



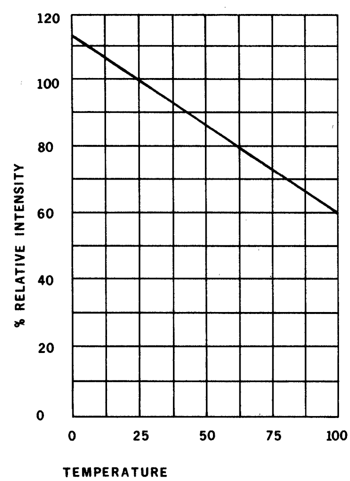
LUMINOUS INTENSITY VS VIEWING ANGLE



FORWARD CURRENT VS FORWARD VOLTAGE



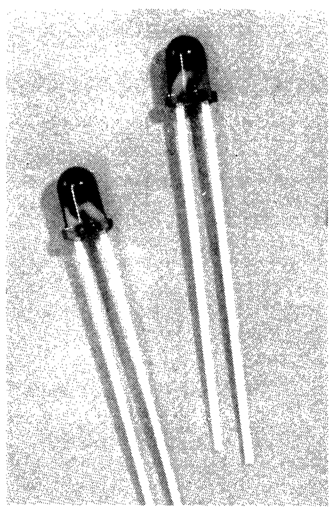
LUMINOUS INTENSITY VS AMBIENT TEMPERATURE



litronix
A Siemens Company

YL-212
YL-4484

YELLOW T1 LED LAMPS

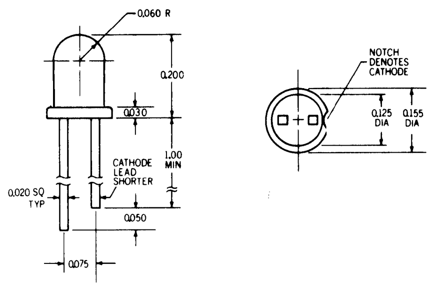


FEATURES
- T1 Package Size
- 1 Inch Leads
- Both Types Can Be Front Panel Mounted
- Snap In Mounting Clips Available
- IC Compatible

DESCRIPTION

Both types are TSN (Transparent Substrate Nitrogen) LED lamps with yellow diffused lens. The YL-4484 is a low price commercial grade device. The YL-212 is a higher brightness lamp with minimum light output specified.

Package Dimensions in Inches



Maximum Ratings

Power Dissipation @25 °C	120 mW
Derate Linearly from 25 °C	−1.6 mW/ °C
Storage & Operating Temperatuare	−55 °C to +100 °C
Lead Soldering Temperature (1/16 in. from case)	5 sec @ 260 °C
Peak Inverse Voltage	5.0 V/3.0 V
Continuous Forward Current	30 mA

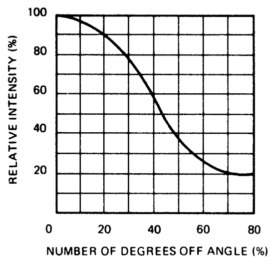
Opto-Electronic Characteristics (@25 °C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity					
YL-4484	.05	2.0		mcd	$I_F = 20$ mA
YL-212	1.0	1.8		mcd	$I_F = 10$ mA
Emission Peak Wavelength		585		nm	
Spectral Line Half-Width		35		nm	
Forward Voltage		2.4	3.5	V	$I_F = 20$ mA
Reverse Leakage					
YL-4484		0.1	100	μA	$V_R = 3.0$ V
YL-212		0.1	100	μA	$V_R = 5.0$ V

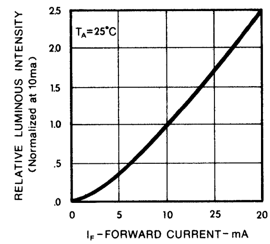
Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

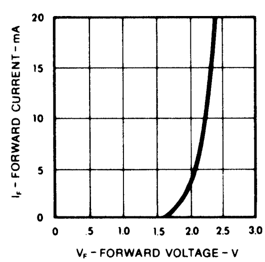
RELATIVE LUMINOUS INTENSITY VS ANGLE



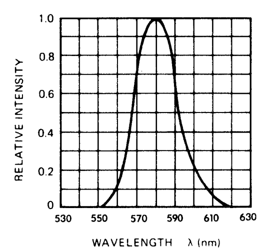
RELATIVE LUMINOUS INTENSITY VS FORWARD CURRENT

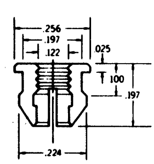


FORWARD CURRENT VS FORWARD VOLTAGE



SPECTRAL DISTRIBUTION





Mounting Information; YL-212 and YL-4484

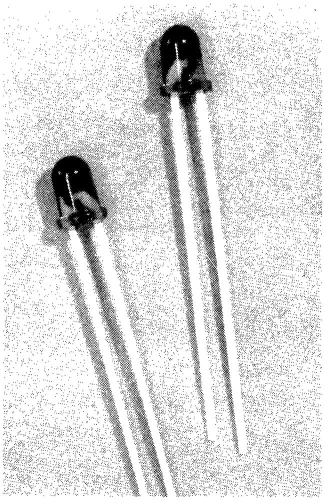
The clip mounts in a .203" dia. hole and fits a .062" panel thickness.

BLACK CLIP: 004-9011

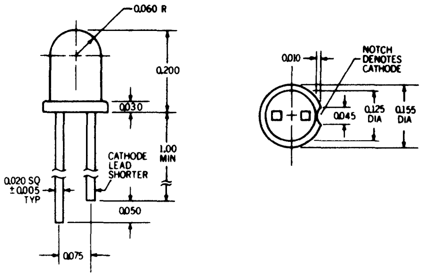
litronix
A Siemens Company

GL-211
GL-4484

GREEN T1 LED LAMP



Package Dimensions in Inches



See other side for clip dimensions.

FEATURES

- T1 Package Size
- 1 Inch Leads
- Both Types Can Be Front Panel Mounted
- Snap In Mounting Clips Available
- IC Compatible

DESCRIPTION

Both types are green gallium phosphide solid state lamps with green diffused lens. The GL-4484 is a low price commercial grade device. The GL-211 is a higher brightness lamp with minimum light output specified.

Maximum Ratings

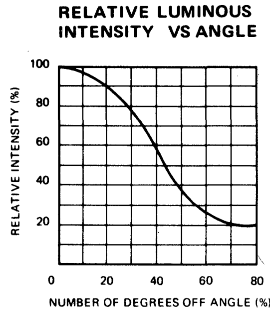
Power Dissipation @25 °C .... 120 mW
Derate Linearly from 25 °C .... −2.2 mW/°C
Storage & Operating Temperature .... -55° C to 100° C
Lead Soldering Temperature
(1/16 in. from case) .... 5 sec @260 °C
Peak Inverse Voltage .... 3.0 V
Continuous Forward Current .... 30 mA

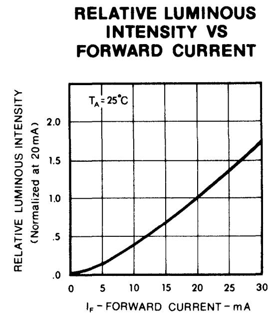
Opto-Electronic Characteristics (@25 °C)

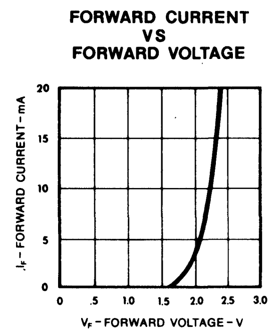
Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity					
GL-4484		1.0		mcd	$I_F = 20$ mA
GL-211	0.8	1.5		mcd	$I_F = 10$ mA
Emission Peak Wavelength		565		nm	
Spectral Line Half-Width		35		nm	
Forward Voltage		2.2	3.0	V	$I_F = 20$ mA
Reverse Leakage		0.1	100	μA	$V_R = 3.0$ V
			100	μA	$V_R = 5.0$ V

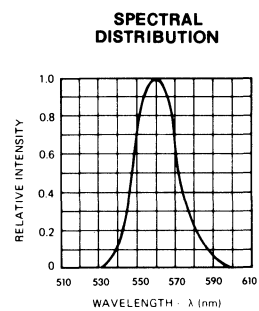
Specifications subject to change without notice.

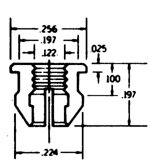
TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES.











Mounting Information: GL-211 and GL-4484

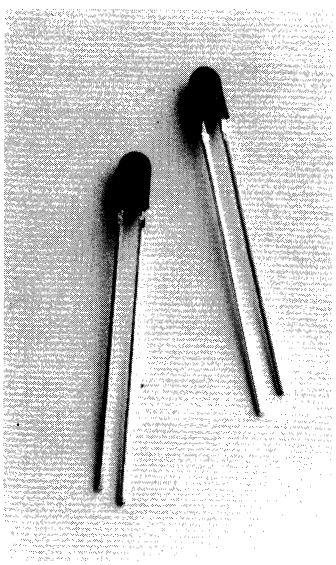
The clip mounts in a .203" dia. hole and fits a .062" panel thickness.

BLACK CLIP: 004-9011

litronix
A Siemens Company

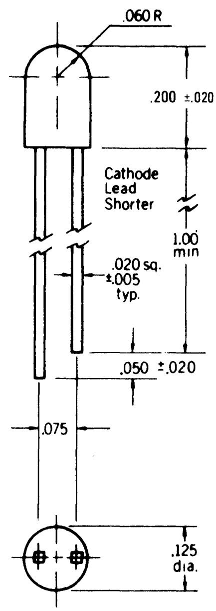
RL-T1

RED LED LAMP



PHASING OUT — NOT FOR NEW DESIGN

Package Dimensions in Inches



FEATURES

- **Miniature Size (T-1 Lamp)**
- **1 Inch Leads**
- **75 Mil Lead Spacing, No Standoffs, No Flange**
- **Low Power Consumption**
- **IC Compatible**
- **Economical Molded Plastic Package**

DESCRIPTION

The RL-T1 is intended for high volume usage in array and indicator light applications requiring a small flangeless lamp at low cost.

Maximum Ratings

Power Dissipation @25 °C Ambient .... 80 mW
Derate Linearly from 25 °C .... −1.1 mW/°C
Storage and Operating Temperature .... −55 to +100 °C
Continuous Forward Current .... 40 mA
Peak Inverse Voltage .... 3.0 V

Opto-Electronic Characteristics (@25 °C)

Parameter	Min	Typ	Max	Unit	Test Condition
Reverse Current		100		nA	−3.0 V
Forward Voltage		1.6	2.0	V	I_F = 20 mA
Luminous Intensity	0.3	0.8		mcd	I_F = 20 mA
Emission Peak Wavelength		650		nm	

Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. FORWARD CHARACTERISTICS

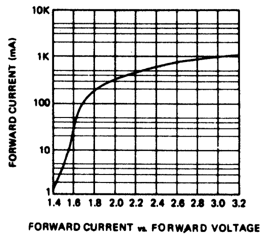


FIGURE 2. LUMINANCE vs T_J

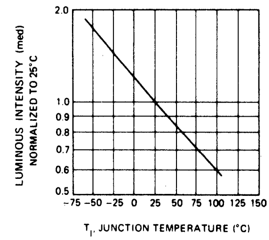


FIGURE 3. LUMINANCE vs FORWARD CURRENT

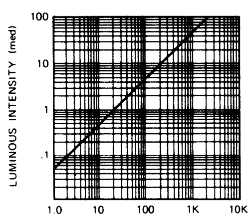
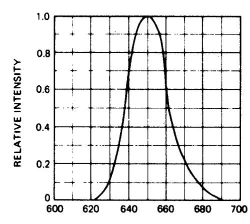


FIGURE 4. SPECTRAL DISTRIBUTION



The effect of junction heating is not reflected in figure 3 as pulse width and duty cycle were limited to prevent heating effects. However, junction heating can cause reduction in luminance as evidenced in figure 2. To estimate output level, average junction temperature may be calculated from

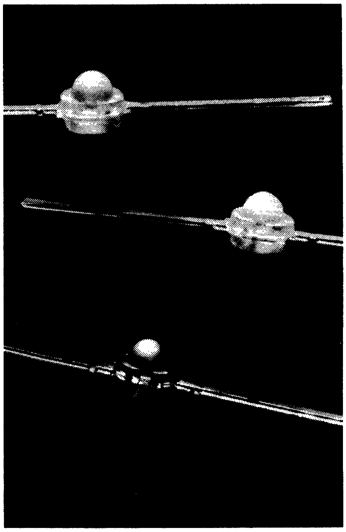
$$T_{J(AV)} = T_A + \theta_{JA} V_F I_F D$$

Where D is the duty cycle of the applied current I_F, $\theta_{JA} = 350°C/W$ (max). This calculation should be limited to pulse durations of less than 10 ms to avoid errors caused by high peak junction temperature.

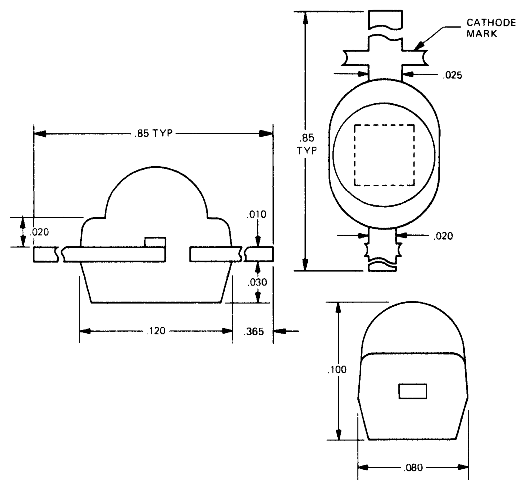
litronix
A Siemens Company

RL-50

RED MINIATURE AXIAL LEAD LED LAMP



Package Dimensions in Inches



FEATURES

- **High Luminance — Typically 0.8 mcd**
- **Optimum Packaging Design for Maximum Strength at Minimum Linear Spacing**
- **Operates from 5 V IC Logic Supply**
- **Small Size**
- **High Reliability**

DESCRIPTION

The RL-50 is intended for high volume usage in array and indicator light applications. Major advantages of this device are high luminance at lower currents, long life and low cost.

Note:
RL-50 Water Clear Lens
RL-50-01 Red Diffused Lens
RL-50-02 Red Clear Lens

Maximum Ratings

Power Dissipation @ 25°C Ambient	80 mW
Derate Linearly From 25°C	–1.1 mW/°C
Storage and Operating Temp Range	–55 to 100°C
Continuous Forward Current	40 mA
Peak Inverse Voltage	3.0 V

Opto-Electronic Characteristics (@ 25°C)

Parameter	Min	Typ	Max	Unit	Test Condition
Reverse Current		100		μA	–3.0 V
Forward Voltage		1.6	2.0	V	I_F = 20 mA
Luminous Intensity	0.3	0.8		mcd	I_F = 20 mA
Light Rise and Fall Time		1.0		ns	

Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. FORWARD CHARACTERISTICS

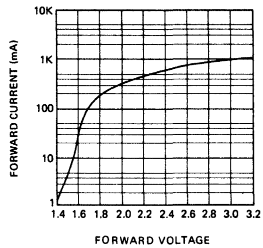


FIGURE 2. LUMINANCE VS T_J

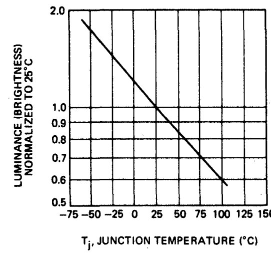
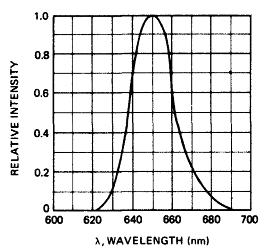


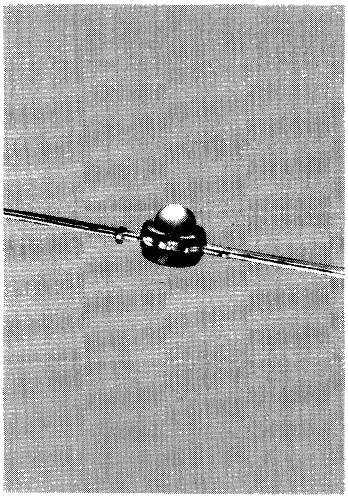
FIGURE 3. SPECTRAL DISTRIBUTION



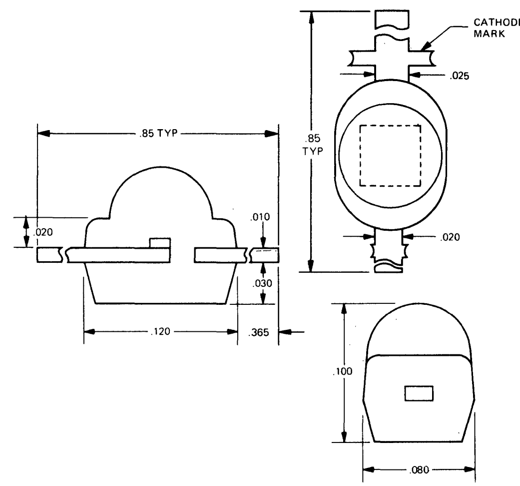
litronix
A Siemens Company

RL-54

RED MINIATURE AXIAL LEAD LED LAMP



Package Dimensions in Inches



FEATURES

- Low Cost
- Optimum Packaging Design For Maximum Strength at Minimum Linear Spacing
- Operates From 5V IC Logic Supply
- Small Size
- High Reliability
- Red Diffused Lens

DESCRIPTION

The Red-Lit 54 is intended for high volume usage in array and indicator light applications. Major advantages of this device are high luminance at lower currents, long life and low cost.

Maximum Ratings

Power Dissipation @25 °C Ambient................. 80 mW
Derate Linearly from 25 °C .... −1.1 mW/ °C
Storage & Operating Temp. Range .... -40° C to +80° C
Continous Forward Current .... 40 mA
Peak Inverse Voltage .... 3.0 V

Opto-Electronic Characteristics (@25 °C)

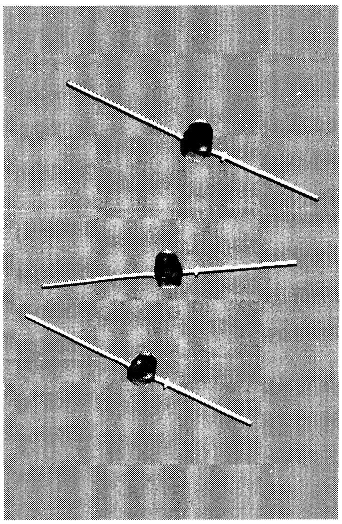
Parameter	Min	Typ	Max	Test Conditions
Reverse Current		100		μA@ -3.0 V
Forward Voltage		1.6	2.0	V@I_F = 20 mA
Brightness	0.05	0.8		mcd@I_F = 20 mA
Light Rise and Fall Time		1.0		ns

Specifications subject to change without notice.

litronix
A Siemens Company

RL-55
RL-55-5

RED MINIATURE AXIAL LEAD LED LAMP



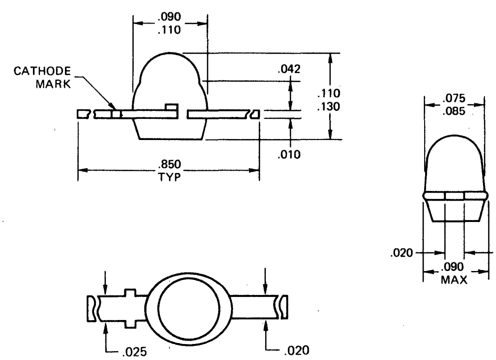
FEATURES

- **2 Gate Load Bright Light — .4 mcd at 3 mA**
- **High on Axis Intensity — 3 mcd at 20 mA**
- **Optimum Packaging Design for Maximum Strength at Minimum Linear Spacing**
- **Operates from 5 V IC Logic Supply**
- **Miniature Axial Lead**
- **High Reliability**
- **RL-55-5 — Low Cost Version**

DESCRIPTION

The RL-55 is a Gallium Arsenide Phosphide LED lamp that has high on axis intensity at low current (3 mA), long life and low cost. It uses a dark red diffused lens and provides a full .080" flooded light with good contrast. When operated at high current (20 mA) the RL-55 has a very high on axis intensity of 3 mcd. Applications include mounting on P.C. boards at low current as diagnostic and circuit status indicators. Function and low voltage indicator on battery powered equipment such as calculators, watches and portable DVM's and in the higher current mode as a back light.

Package Dimensions in Inches



Maximum Ratings

Power Dissipation @ 25°C Ambient . . . . 80 mW
Derate Linearly From 25°C . . . . −1.1 mW/°C
Storage and Operating Temperature . . . . −55°C to +100°C
Continuous Forward Current . . . . 40 mA
Lead Solder Time @ 260°C (1/16" from case) . . . . 5 sec
Peak Inverse Voltage 3V
Peak Forward Current
(1μs pulse, 0.1% duty cycle) . . . . 400 mA

Opto-Electronic Characteristics (@25°C)

Parameter	Min	Typ	Max	Unit	Test Condition
Reverse Current			10	μA	$V_R = 3$ V
Forward Voltage		1.6	2.0	V	$I_F = 20$ mA
Luminous Intensity					
RL-55	2	3		mcd	$I_F = 20$ mA
RL-55-5	0.8	1.5		mcd	$I_F = 20$ mA
Capacitance		20		pF	V = 0
Light Rise and Fall Time		1.0		ns	
Peak Emission Wavelength		650		nm	
Spectral Line Half-Width		40		nm	

Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES RL-55

(25°C Free Air Temperature Unless Otherwise Specified)

FIGURE 1. RADIATED POWER

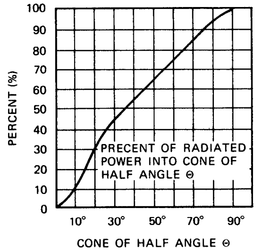


FIGURE 2. RADIATION INTENSITY VS. ANGLE

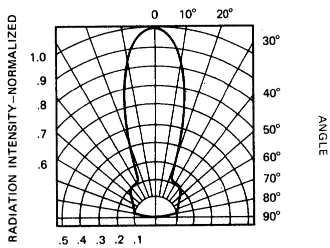
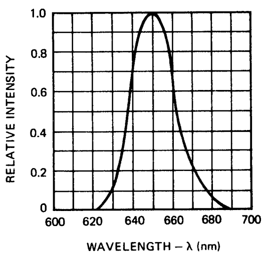
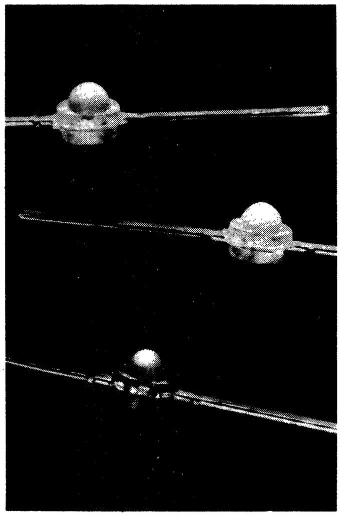


FIGURE 3. SPECTRAL DISTRIBUTION



litronix
A Siemens Company

YL-56
YELLOW
GL-56
GREEN
MINIATURE AXIAL LEAD LED LAMP



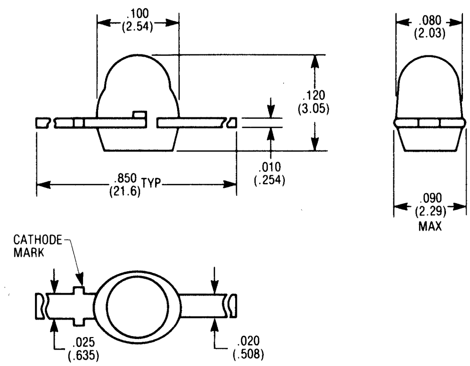
FEATURES

- **High on Axis Intensity**
- **Optimum Packaging Design for Maximum Strength at Minimum Linear Spacing**
- **Operates from 5 V IC Logic Supply**
- **Miniature Axial Lead**
- **High Reliability**

DESCRIPTION

The GL-56/YL-56 are Gallium Phosphide LED lamps that have high on axis intensity, long life and low cost. They use diffused lenses and provide a full 0.080" flooded light with good contrast. When operated at high current (20 mA) they have high on axis intensity. Applications include mounting on P.C. boards at low current as diagnostic and circuit status indicators.

Package Dimensions in Inches (mm)



Maximum Ratings

Power Dissipation @ 25°C Ambient	80 mW
Derate Linearly From 25°C	−1.1 mW/°C
Storage and Operating Temperature	−55°C to +100°C
Continuous Forward Current	22 mA
Lead Solder Time @ 260°C (1/16" from case)	5 sec
Peak Inverse Voltage	3V
Peak Forward Current (1μs pulse, 0.1% duty cycle)	250 mA

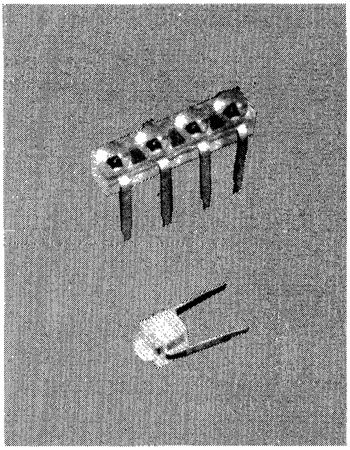
Opto-Electronic Characteristics (@ 25°C)

Parameter	Min	Typ	Max	Units	Test Condition
Luminous Intensity					
YL-56	.05	2.0		mcd	$I_F = 20$ mA
GL-56	.05	1.0		mcd	$I_F = 20$ mA
Forward Voltage					
YL-56		2.4	3.5	V	$I_F = 20$ mA
GL-56		2.2	3.5	V	$I_F = 20$ mA
Reverse Current		0.15		μA	$V_R = 3$ V
Peak Emission Wavelength					
YL-56		585		nm	
GL-56		565		nm	

Specifications subject to change without notice.

litronix
A Siemens Company

LD 460 SERIES
RED MINIATURE LED SINGLE LAMP AND ARRAYS



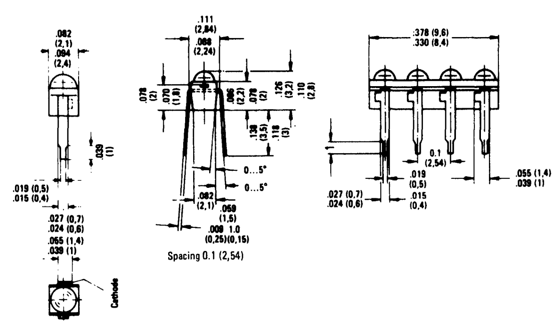
FEATURES

- **White Diffused Lens, Emits Red Light**
- **Miniature Size**
- **Selection of 2 thru 10 Diode Arrays As Well As A Single Device**
- **1/10" Lead Spacing**
- **End Stackable to Arrays of Any Length**
- **I/C Compatible**

DESCRIPTION

The LD 460 Series are red gallium arsenide phosphide LED solid state lamps. They have a white diffused plastic encapsulation formed as a lens where the light is emitted. The single lamps may be used individually in such applications as behind the panel troubleshooting locators or stacked together or along with their counterpart arrays to form lines or other patterns. The arrays can be end stacked to form position indicators of any length for such applications as meters and scales.

Package Dimensions in Inches (mm)



Maximum Ratings (Individual Diode)

Reverse voltage	V_R	5	V
Forward current	I_F	35	mA
Surge current ($t \leq 10\ \mu s$)	i_{FS}	1.0	A
Storage temperature	T_{stor}	−30 to +80	°C
Junction temperature	T_j	80	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	85	mW
Thermal resistance			
Junction to air	R_{thJamb}	750	K/W
Junction to solder pin	R_{thJL}	650	K/W

Characteristics (T_{amb} = 25°C)

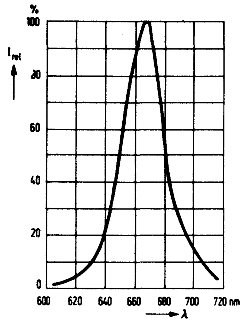
Wavelength at peak emission	λ_{peak}	665 ± 15	nm
Dominant wavelength	λ_{dom}	645	nm
Half angle (limits for 50% of luminous intensity I_v)	φ	50	degree
Forward voltage (I_F = 20 mA)	V_F	1.6 ($\leq$ 2.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 ($\leq$ 10)	μA
Rise time	t_r	5	ns
Fall time	t_f	5	ns
Capacitance (V_R = 0 V)	C_O	40	pF

Luminous Intensity

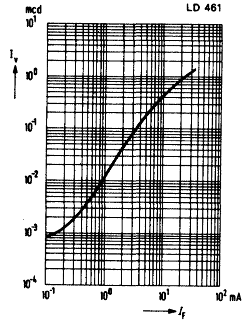
Type	Number of LEDs	Min	Unit	Test Condition
LD 461	1	.6	mcd	20 mA
LD 462	2	.6	mcd	20 mA
LD 463	3	.6	mcd	20 mA
LD 464	4	.6	mcd	20 mA
LD 465	5	.6	mcd	20 mA
LD 466	6	.6	mcd	20 mA
LD 467	7	.6	mcd	20 mA
LD 468	8	.6	mcd	20 mA
LD 469	9	.6	mcd	20 mA
LD 460	10	.6	mcd	20 mA

Specifications are subject to change without notice.

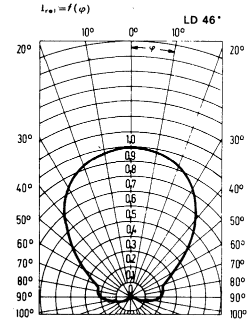
Relative spectral emission $I_{rel} = f(\lambda)$



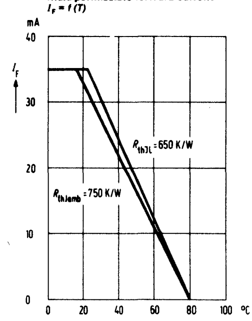
Luminous intensity $I_v = f(I_F)$



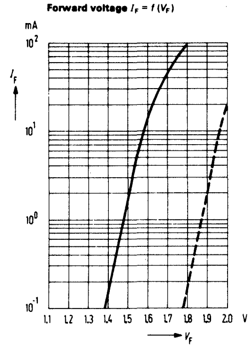
Radiation characteristic
$I_{rel} = f(\varphi)$



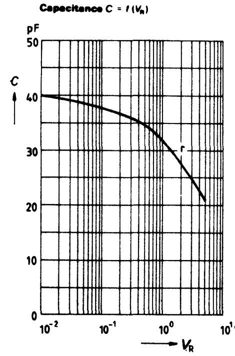
Max. permissible forward current
$I_F = f(T)$



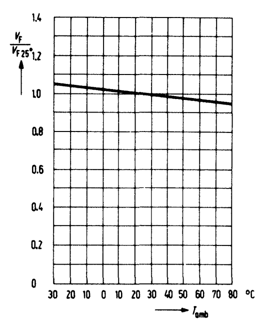
Forward voltage $I_F = f(V_F)$



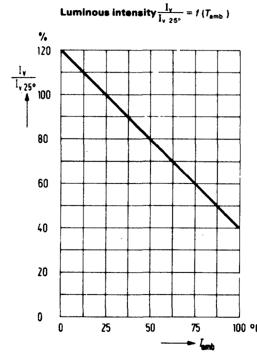
Capacitance $C = f(V_R)$



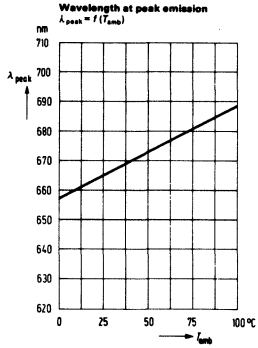
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



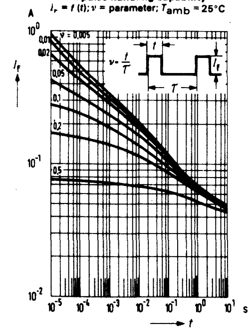
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

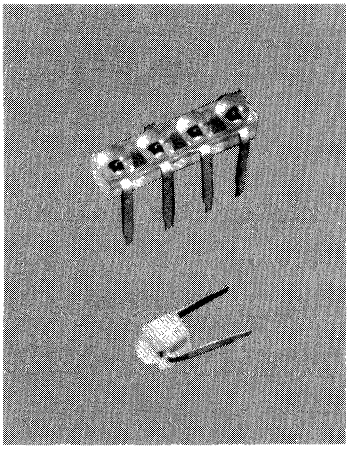


Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; T_{amb} = 25°C



litronix
A Siemens Company

LD 470 SERIES
GREEN MINIATURE LED SINGLE LAMP AND ARRAYS



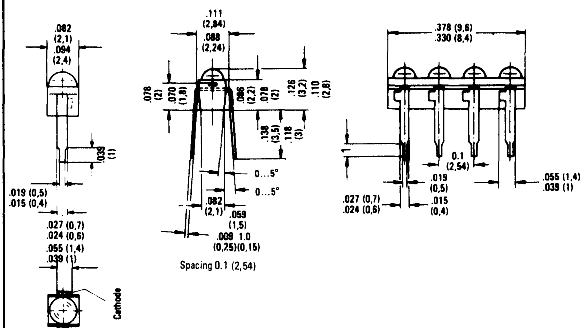
FEATURES

- **Green Diffused Lens**
- **Miniature Size**
- **Selection of 2 thru 10 Diode Arrays As Well As A Single Device**
- **1/10" Lead Spacing**
- **End Stackable to Arrays of Any Length**
- **I/C Compatible**

DESCRIPTION

The LD 470 Series are green gallium phosphide LED solid state lamps. They have a green diffused plastic encapsulation formed as a lens where the light is emitted. The single lamps or arrays may be used individually or stacked together to form lines of any lengths. Typical applications are position indicators such as meters and scales.

Package Dimensions in Inches (mm)



Maximum Ratings (Individual Diode)

Reverse voltage	V_R	5	V
Forward current	I_F	25	mA
Surge current ($t \leq 10\ \mu s$)	i_{FS}	0.5	A
Storage temperature	T_{stor}	-30 to +80	°C
Junction temperature	T_j	80	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	85	mW
Thermal resistance			
Junction to air	R_{thJamb}	750	K/W
Junction to solder pin	R_{thJL}	650	K/W

Characteristics (T_{amb} = 25°C)

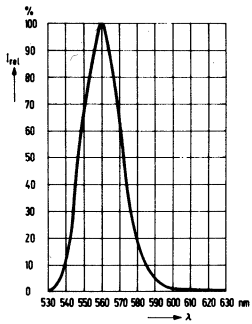
Wavelength at peak emission	λ_{peak}	560 ± 15	nm
Dominant wavelength	λ_{dom}	561	nm
(limits for 50% of luminous intensity I_v)	φ	50	degree
Forward voltage (I_F = 20 mA)	V_F	2.4 (≤ 3.0)	V
Reverse current (V_R = 3 V)	I_R	0.1 (≤ 10)	µA
Capacitance (V_R = 0 V)	C_O	45	pF
Rise time	t_r	50	ns
Fall time	t_f	50	ns

Luminous Intensity

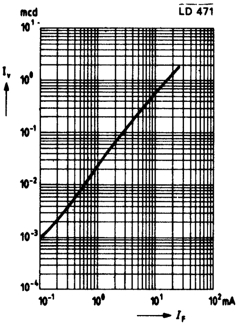
Type	Number of LEDs	Min.	Unit	Test Condition
LD 471	1	.6	mcd	20 mA
LD 472	2	.6	mcd	20 mA
LD 473	3	.6	mcd	20 mA
LD 474	4	.6	mcd	20 mA
LD 475	5	.6	mcd	20 mA
LD 476	6	.6	mcd	20 mA
LD 477	7	.6	mcd	20 mA
LD 478	8	.6	mcd	20 mA
LD 479	9	.6	mcd	20 mA
LD 470	10	.6	mcd	20 mA

Specifications are subject to change without notice.

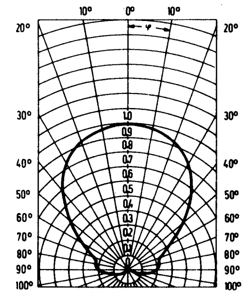
Relative spectral emission $I_{rel} = f(\lambda)$



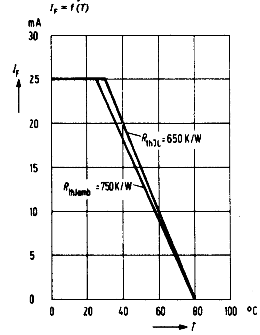
Luminous intensity $I_v = f(I_F)$



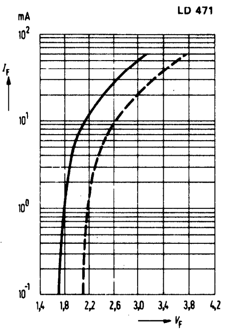
Radiation characteristic $I_{rel} = f(\varphi)$



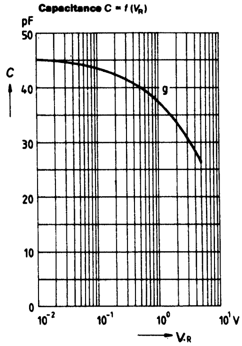
Max. permissible forward current
$I_F = f(T)$



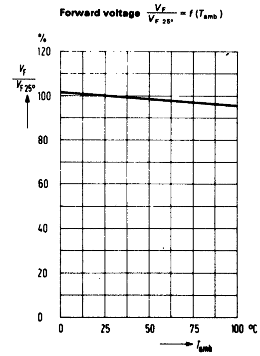
Forward current $I_F = f(V_F)$



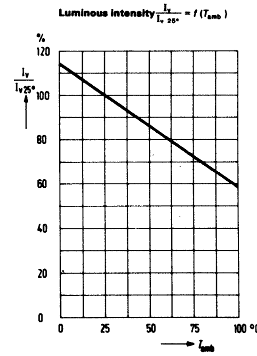
Capacitance $C = f(V_R)$



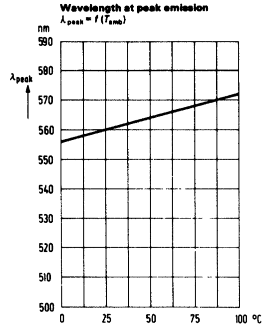
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



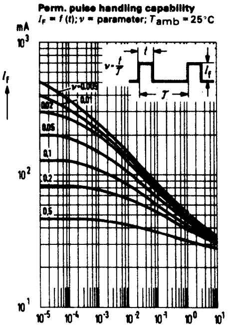
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

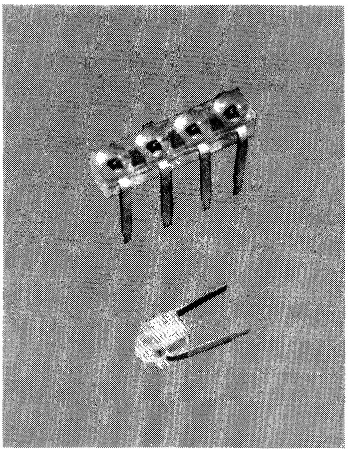


Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; T_{amb} = 25°C



litronix
A Siemens Company

LD 480 SERIES
YELLOW LIGHT EMITTING DIODE SINGLE LAMP AND ARRAYS



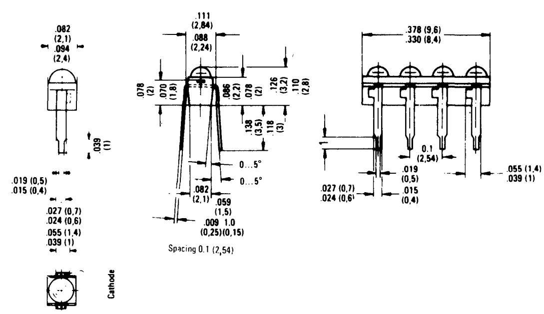
FEATURES

- Yellow Diffused Lens
- Miniature Size
- Selection of 2 Through 10 Diode Arrays as well as Single Device
- 1/10" Lead Spacing
- End Stackable to Arrays of Any Length
- I/C Compatible

DESCRIPTION

The LD 480 series are yellow gallium phosphide LED solid state lamps. They have a yellow diffused plastic encapsulation formed to a lens where the light is emitted. The single lamps or arrays may be used individually or stacked together to form lines of any lengths. Typical applications are position indicators such as meters and scales.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse voltage	V_R	5	V
Forward current	I_F	25	mA
Surge current ($t \leq 10\ \mu s$)	i_{FS}	0.5	A
Storage temperature	T_{stor}	−30 to +80	°C
Junction temperature	T_j	80	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation ($T_L = 25°C$)	P_{tot}	85	mW
Thermal resistance			
Junction to air	R_{thJamb}	750	K/W
Junction to solder pin	R_{thJL}	650	K/W

Characteristics ($T_{amb} = 25°C$)

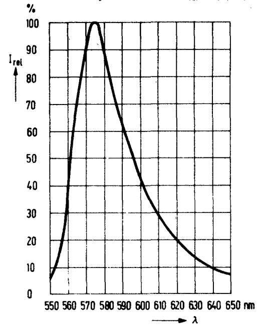
Wavelength at peak emission	λ_{peak}	575 ± 15	nm
Dominant wavelength	λ_{dom}	573	nm
Half angle (limits for 50% of luminous intensity I_v)	φ	50	degree
Forward voltage ($I_F = 20$ mA)	V_F	2.4 (≤ 3.0)	V
Reverse current ($V_R = 3$ V)	I_R	0.1 (≤ 10)	μA
Capacitance ($V_R = 0$ V)	C_O	45	pF
Rise time	t_r	50	ns
Fall time	t_f	50	ns

Luminous Intensity

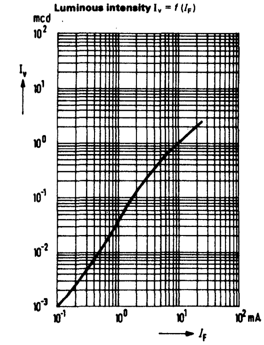
Type	Number of LEDs	Min.	Unit	Test Condition
LD 481	1	.6	mcd	20
LD 482	2	.6	mcd	20
LD 483	3	.6	mcd	20
LD 484	4	.6	mcd	20
LD 485	5	.6	mcd	20
LD 486	6	.6	mcd	20
LD 487	7	.6	mcd	20
LD 488	8	.6	mcd	20
LD 489	9	.6	mcd	20
LD 480	10	.6	mcd	20

Specifications are subject to change without notice.

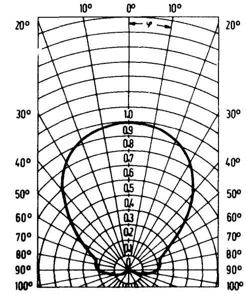
Relative spectral emission $I_{rel} = f(\lambda)$



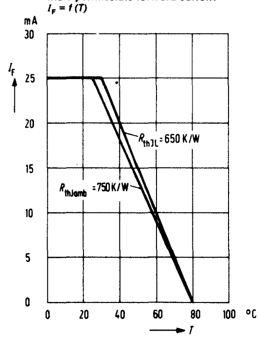
Luminous intensity $I_v = f(I_F)$



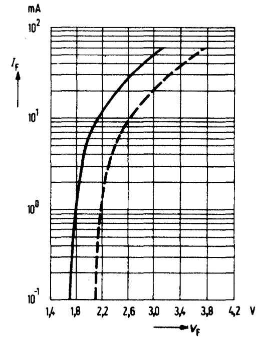
Radiation characteristic $I_{rel} = f(\varphi)$



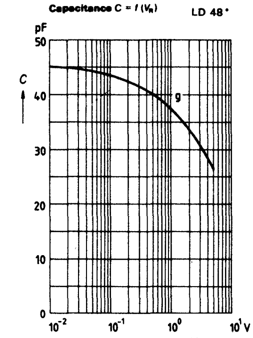
Max. permissible forward current
$I_F = f(T)$



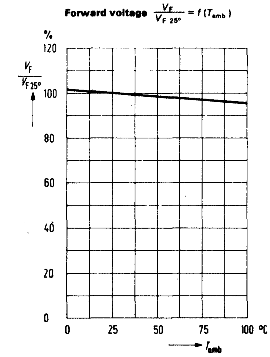
Forward voltage $I_F = f(V_F)$



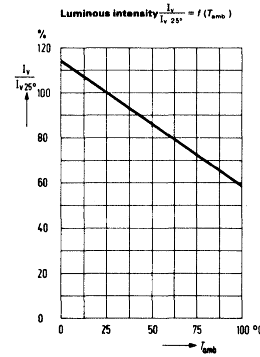
Capacitance $C = f(V_R)$ **LD 48***



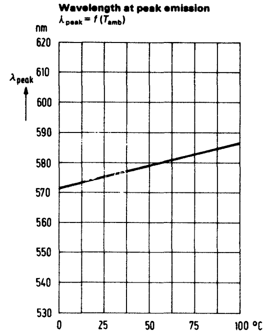
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



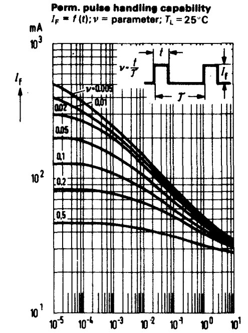
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$

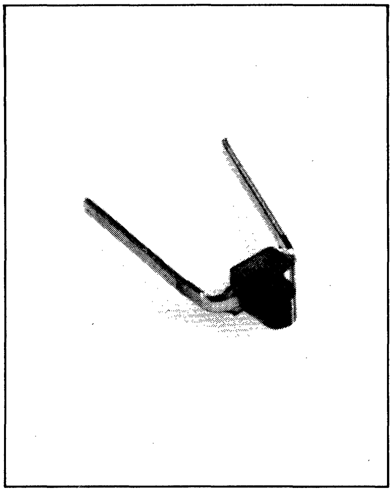


Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; $T_L = 25\,°C$



litronix
A Siemens Company

RED LD 121
YELLOW LD 161
GREEN LD 171
SUB MINIATURE LED LAMP



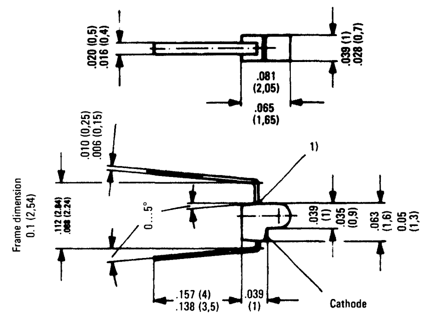
FEATURES

- Red Clear Lens — LD 121
  Yellow Clear Lens — LD 161
  Glass Clear Lens — LD 171
- Sub Miniature Size (1mm/.039" Thick)
  Smallest LED Lamp Available
- I/C Compatible

DESCRIPTION

The LD 121 and LD 161 are light emitting diode lamps fabricated with TSN (transparent substrate nitrogen) technology. The LD 171 is a gallium phosphide LED lamp. The extremely small size of these lamps make them suitable for use within tight space confinement or applications requiring very close spacing of several LED lamps.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	5	V
Forward current	I_F	15	mA
Surge current ($t \leqq 1\ \mu s$)	i_{FS}	350	A
Storage temperature	T_{stor}	−40 to +80	°C
Junction temperature	T_j	80	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	35	mW
Thermal resistance junction to air	R_{thJamb}	1500	K/W

Characteristics (T_{amb} = 25°C)

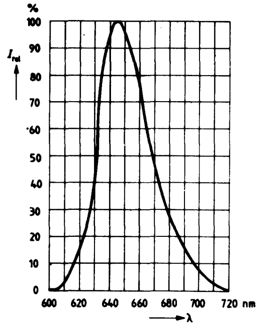
		LD 121	LD 161	LD 171	
Wavelength at peak emission	λ_{peak}	645 ± 15	590 ± 10	560 ± 15	nm
Forward voltage (I_F = 20 mA)	V_F		2.4 (≦3.0)		V
Reverse current (V_R = 5 V)	I_R		.01 (≦10)		µA
Rise time, Fall time	$t_r\ t_f$	100	100	50	ns
Capacitance (V_R = 0 V)	C_o	12	10	45	pF
Aperture cone (half angle) (Limits for 50% of luminous intensity)	φ	30	30	30	degree

Luminous Intensity

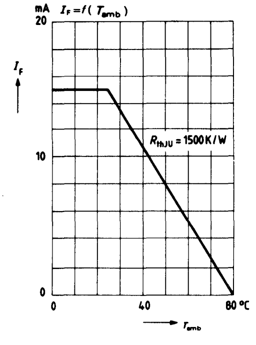
Type	Min	Unit	Test Condition
LD 121	.63	mcd	10 mA
LD 161	.63	mcd	10 mA
LD 171	.63	mcd	10 mA

Specifications are subject to change without notice.

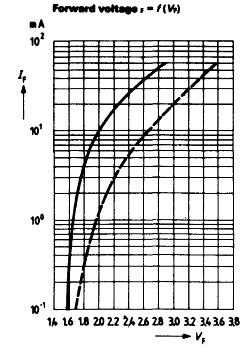
Relative spectral emission $I_{rel} = f(\lambda)$



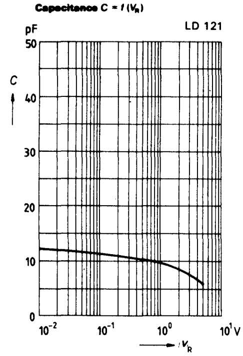
Max. permissible forward current $I_F = f(T_{amb})$



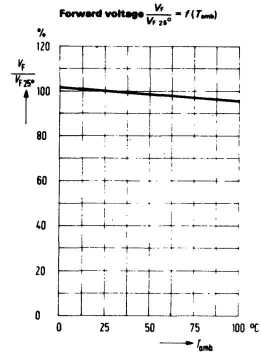
Forward voltage $I_F = f(V_F)$



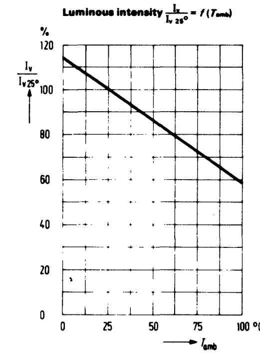
Capacitance $C = f(V_R)$



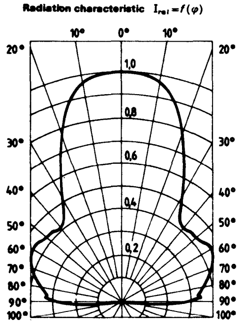
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



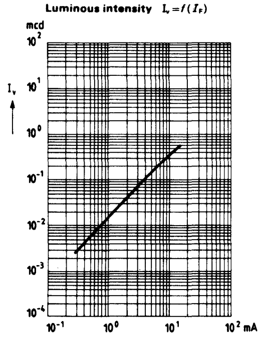
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



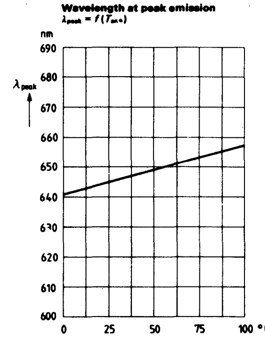
Radiation characteristic $I_{rel} = f(\varphi)$



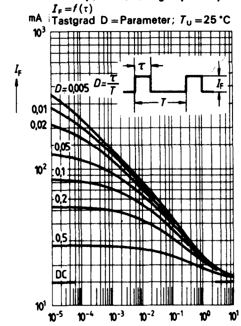
Luminous intensity $I_v = f(I_F)$



Wavelength at peak emission $\lambda_{peak} = f(T_{amb})$

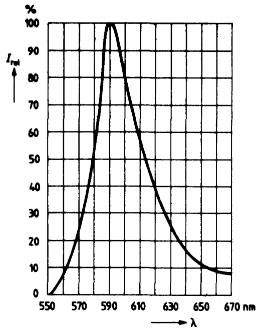


Perm. pulse handling capability
$I_F = f(\tau)$
Tastgrad D = Parameter; T_U = 25 °C

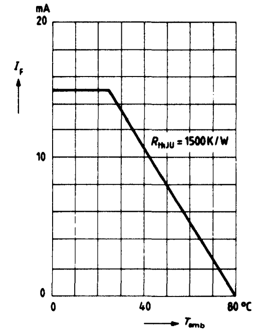


LD161

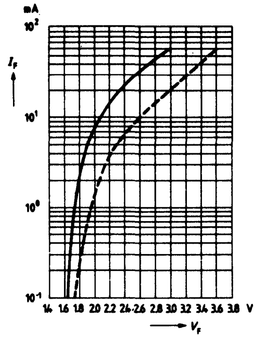
Relative spectral emission $I_{rel} = f(\lambda)$



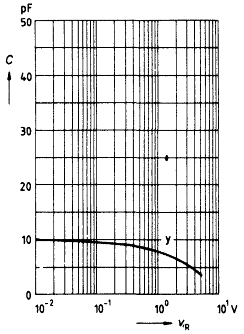
Max. permissible forward current
$I_F = f(T_{amb})$



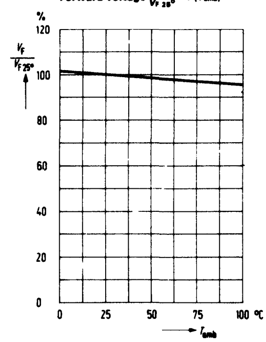
Forward voltage $I_F = f(V_F)$



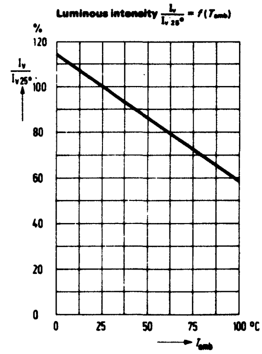
Capacitance $C = f(V_R)$



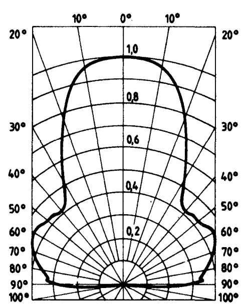
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



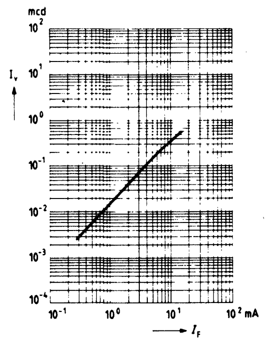
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



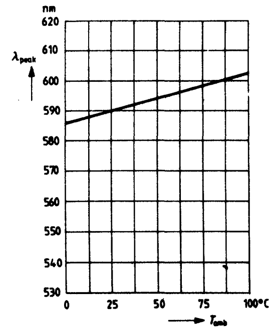
Radiation characteristic
$I_{rel} = f(\varphi)$



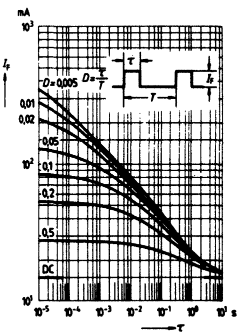
Luminous intensity $I_v = f(I_F)$



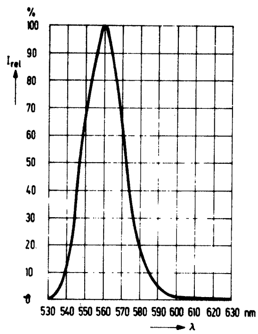
Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



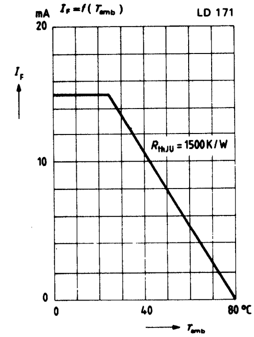
Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; T_{amb} = 25°C



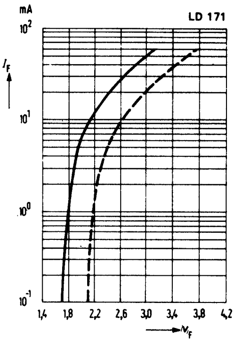
Relative spectral emission $I_{rel} = f(\lambda)$



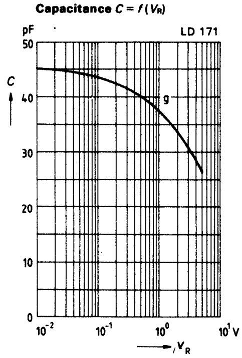
Max. permissible forward current $I_F = f(T_{amb})$



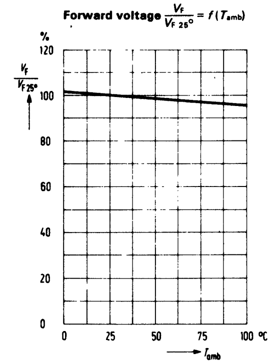
Forward voltage $I_F = f(V_F)$



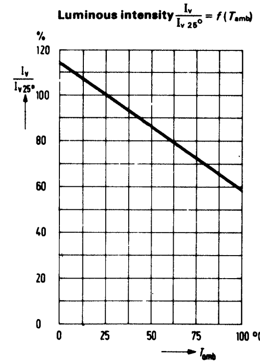
Capacitance $C = f(V_R)$



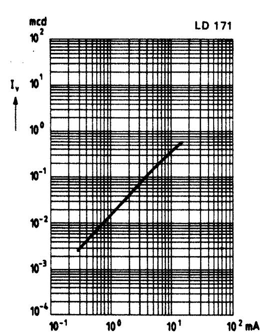
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



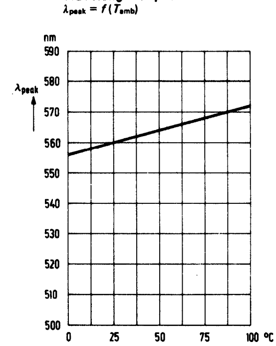
Luminous intensity $\frac{I_v}{I_{v\,25°}} = f(T_{amb})$



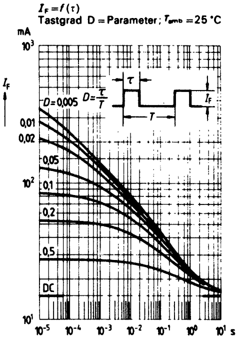
Luminous intensity $I_v = f(I_F)$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



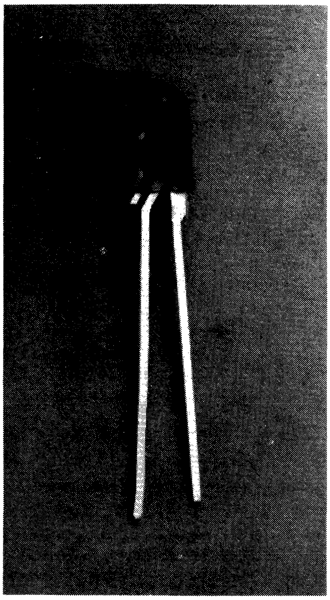
Perm. pulse handling capability
$I_F = f(\tau)$
Tastgrad D = Parameter; T_{amb} = 25 °C



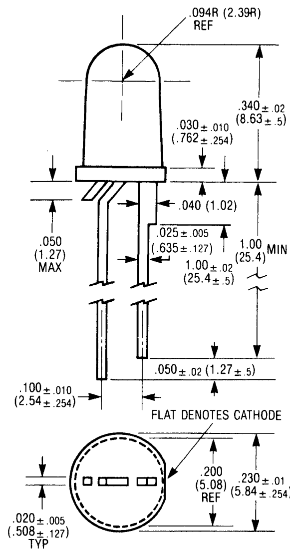
litronix
A Siemens Company

FRL-2000

RED T1¾ FLASHING LED LAMP



Physical Dimensions in Inches (mm)



FEATURES

- **Built-in IC Chip, Flashes Lamp On and Off to Attract Attention**
- **Pulse Rate — 2.5 Hz**
- **T1¾ Size**
- **Large Full Flood Radiating Area**
- **1.2 mcd @ $V_F = 5$ V**
- **IC Compatible**

DESCRIPTION

The FRL-2000 is a gallium arsenide phosphide solid state lamp with a red diffused plastic lens. The built-in IC flashes the lamp on/off and can be driven directlly by standard TTL and CMOS circuits, eliminating the need for external switching circuitry.

Maximum Ratings

Operating Temperature	0 to 70 °C
Storage Temperature	−20 to +100 °C
Lead Soldering Temperature (1/16 in. from case)	5 sec @ 260 °C
Operating Voltage	7 V
Peak Inverse Voltage	0.4 V

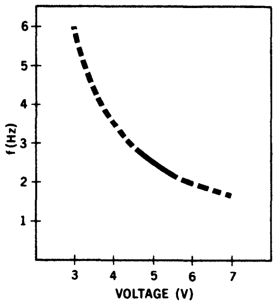
Opto-Electronic Characteristics (@ 25 °C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous Intensity	0.8	1.2		mcd	$V_F = 5$ V
Emission Peak Wavelength		650		nm	
Spectral Line Half-Width		40		nm	
Operating Voltage	4.75	5.0	5.25	V	
Peak Current (50% Duty Cycle)		20	35	mA	$V_F = 5$ V
Pulse Rate	1.5	2.5	4.5	Hz	$V_F = 5$ V
Pulse Rate (0 °C to 70 °C)	1.0		5.8	Hz	$V_F = 5$ V

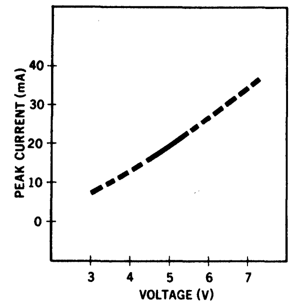
Specifications subject to change without notice.

TYPICAL OPERATING CHARACTERISTICS

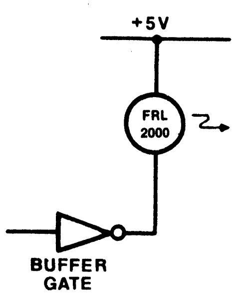
FREQUENCY VS VOLTAGE



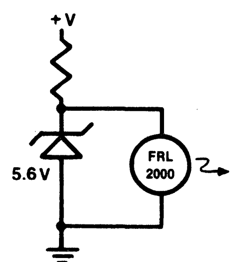
CURRENT VS VOLTAGE



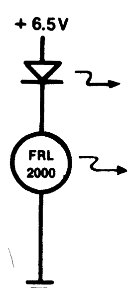
TYPICAL APPLICATIONS



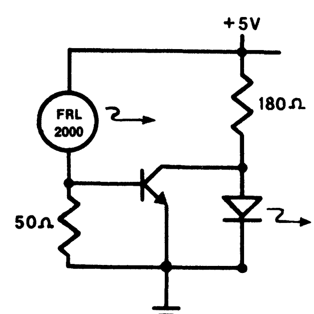
DRIVEN BY TTL OR
MOS BUFFER GATE



FOR OPERATION
AT GREATER
THAN 5 VOLTS



TYPICAL CIRCUIT
TWO LEDs
FLASHING TOGETHER

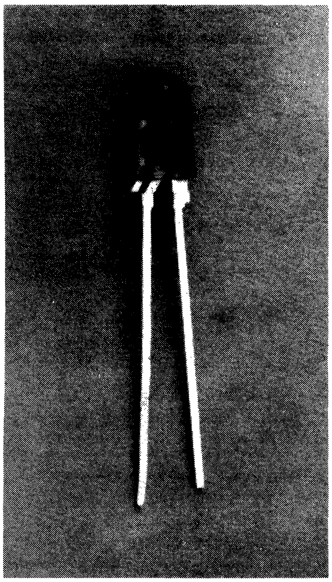


TYPICAL CIRCUIT
TWO LEDs
FLASHING ALTERNATELY

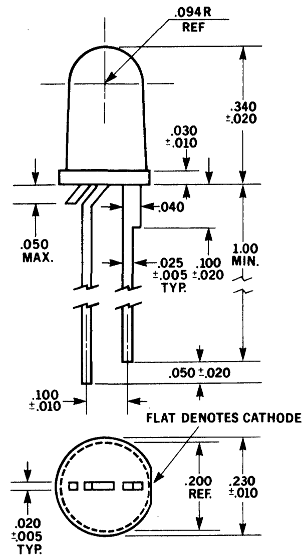
litronix
A Siemens Company

FRL-4403

RED FLASHING LED LAMP



Package Dimensions in Inches



FEATURES

- **Built-in IC chip, flashes lamp on and off to attract attention.**
- **Pulse rate — 2.5 Hz**
- **TI ¾ size**
- **1-Inch Leads**
- **Large full flood radiating area**
- **0.5 mcd @ V_F = 5V**
- **IC compatible**

DESCRIPTION

The FRL-4403 is a gallium arsenide phosphide solid state lamp with a red diffused plastic lens. The built-in IC flashes the lamp on/off and can be driven directly by standard TTL and CMOS circuits, eliminating the need for external switching circuitry.

Maximum Ratings

Operating Temperature	0°C to 70°C
Storage Temperature	−20°C to +85°C
Lead Soldering Temperature (1/16 inch from case)	5 sec @ 260°C
Operating Voltage	7V
Peak Inverse Voltage	0.4V

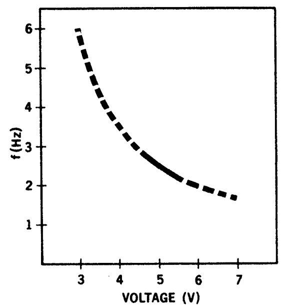
Opto-Electronic Characteristics (@ 25°C)

Parameter	Min	Typ	Max	Unit	Test Conditions
Luminous Intensity	0.5	1.2		mcd	V_F = 5V
Emission Peak Wavelength		650		nm	
Spectral Line Half-Width		40		nm	
Operating Voltage	4.75	5.0	5.25	V	
Peak Current (50% duty cycle)		20	3	mA	V_F = 5V
Pulse Rate	1.5	2.5	4.5	Hz	V_F = 5V
Pulse Rate (0° C to 70° C)	1.0	—	5.8	Hz	V_F = 5V

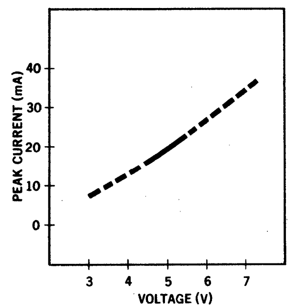
Specifications subject to change without notice

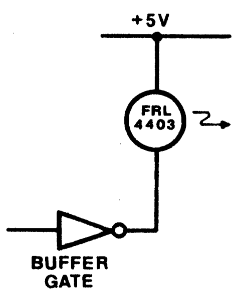
TYPICAL OPERATING CHARACTERISTICS FRL-4403

FREQUENCY VS VOLTAGE

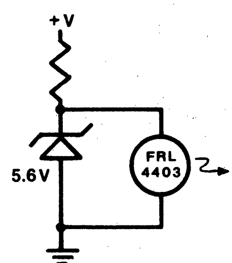


CURRENT VS VOLTAGE

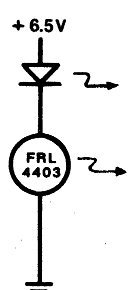




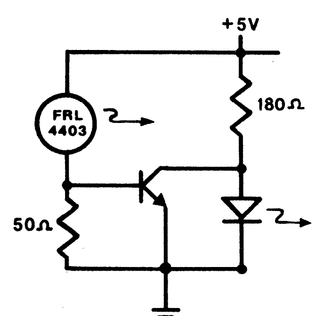
DRIVEN BY TTL OR MOS BUFFER GATE



FOR OPERATION AT GREATER THAN 5 VOLTS



TYPICAL CIRCUIT TWO LED's FLASHING TOGETHER

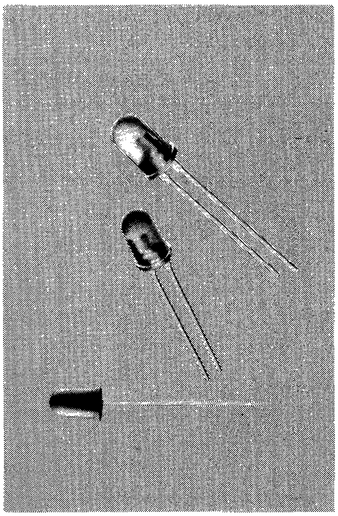


TYPICAL CIRCUIT TWO LED's FLASHING ALTERNATELY

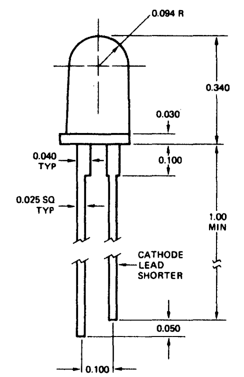
litronix
A Siemens Company

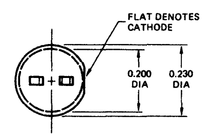
RLC-200

RED T1¾ CURRENT REGULATED LED LAMP



Package Dimensions in Inches





BOTTOM VIEW

FEATURES

- T1¾ Size
- 1 Inch Leads
- Constant Intensity from 4.5 V to 12.5 V
- 20 mA typical forward current
- 1.2 mcd typical at $V_F = 6.0$ V
- No resistor needed to operate up to 12.5 V
- Front panel mounting
- Large full flood radiating area
- IC compatible
- Snap in mounting clip available
- Red diffused lens

DESCRIPTION

The RLC 200 is a high brightness Gallium Arsenide Phosphide solid state lamp containing a current regulating integrated circuit that provides a constant intensity over a wide voltage range. The unit has a large full flooded front radiating area for wide angle viewing and can be easily soldered directly to a PC board or mounted in a panel with a snap in mounting clip.

Maximum Ratings

Power dissipation @ 25°C 300mW
Derate voltage linearly from 25°C. . . . . –0.125V/°C
Forward voltage @ 25°C 12.5V
Storage and operating temperature . . . . –55 to +100°C
Lead soldering temperature (1/16 inch from case). . 5 sec. @ 260°C
Peak inverse voltage 3.0V

Optoelectronic Characteristics (at 25°C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous intensity	0.8	1.2		mcd	$V_F = 6V$
Forward current	14	20	24	mA	$V_F = 12.5V$
Emission peak wavelength		650		nm	
Spectral line half width		40		nm	
Reverse leakage		0.1	100	μA	$V_R = 3.0V$

Specifications subject to change without notice.

FIGURE 1. RELATIVE LUMINOUS INTENSITY VS. ANGLE

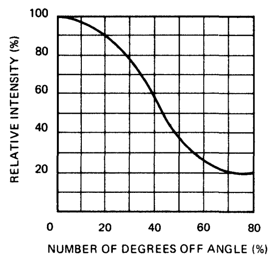


FIGURE 2. SPECTRAL DISTRIBUTION

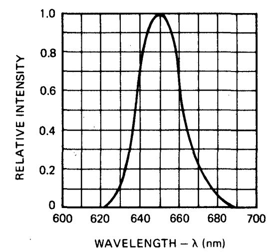


FIGURE 3. FORWARD CURRENT VS. FORWARD VOLTAGE

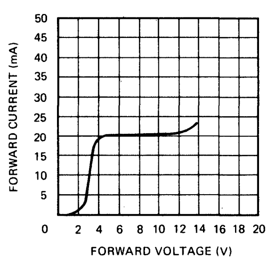
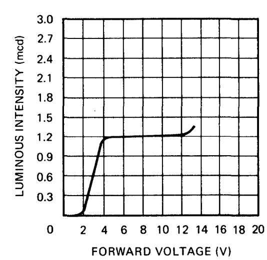


FIGURE 4. LUMINOUS INTENSITY VS. FORWARD VOLTAGE



Mounting Information

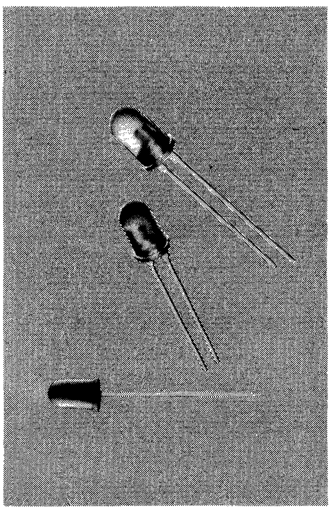
The clip mounts in a .250" dia. hole and fits up to a .125" panel thickness. A plastic collar is provided which fits over the back of the clip to lock the LED securely against the panel.

BLACK CLIP AND COLLAR: 004-9002
CLEAR CLIP AND COLLAR: 004-9003

litronix
A Siemens Company

RLC-201

RED T1¾ CURRENT REGULATED LED LAMP



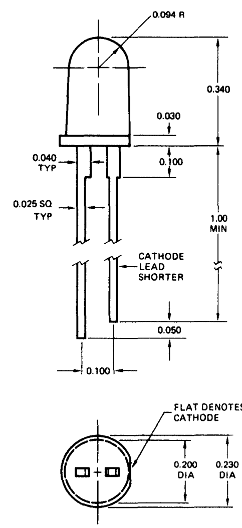
FEATURES

- T1¾ size
- 1 inch leads
- Constant intensity from 4.5 V to 16 V
- 10 mA typical forward current
- 0.7 mcd typical at $V_F = 6.0$ V
- No resistor needed to operate up to 16 V
- Front panel mounting
- Large full flood radiating area
- IC compatible
- Snap in mounting clip available
- Red diffused lens

DESCRIPTION

The RLC 201 is a high brightness Gallium Arsenide Phosphide solid state lamp containing a current regulating integrated circuit that provides a constant intensity over a wide voltage range. The unit has a large full flooded front radiating area for wide angle viewing and can be easily soldered directly to a PC board or mounted in a panel with a snap in mounting clip.

Package Dimensions in Inches



BOTTOM VIEW

Maximum Ratings

Power dissipation @ 25°C 300mW
Derate voltage linearly from 50°C. . . . . −0.25V/°C
Forward voltage @ 25°C 16V
Storage and operating temperature . . . . −55 to +100°C
Lead soldering temperature (1/16 inch from case). . 5 sec. @ 260°C
Peak inverse voltage 3.0V

Optoelectronic Characteristics (at 25°C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous intensity	0.4	0.7		mcd	$V_F = 6V$
Forward current	7	10	14	mA	$V_F = 16V$
Emission peak wavelength		650		nm	
Spectral line half width		40		nm	
Reverse leakage		0.1	100	µA	$V_R = 3.0V$

Specifications are subject to change without notice.

TYPICAL OPTOELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. RELATIVE LUMINOUS INTENSITY VS. ANGEL

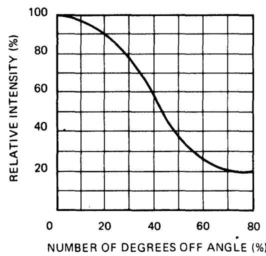


FIGURE 2. SPECTRAL DISTRIBUTION

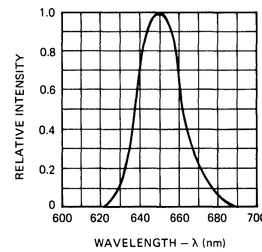


FIGURE 3. FORWARD CURRENT VS. FORWARD VOLTAGE

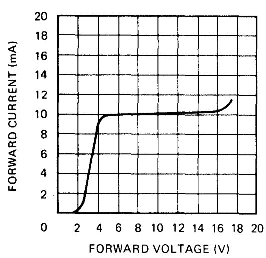
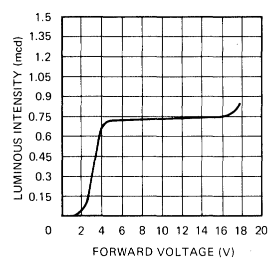


FIGURE 4. LUMINOUS INTENSITY VS. FORWARD VOLTAGE



Mounting Information

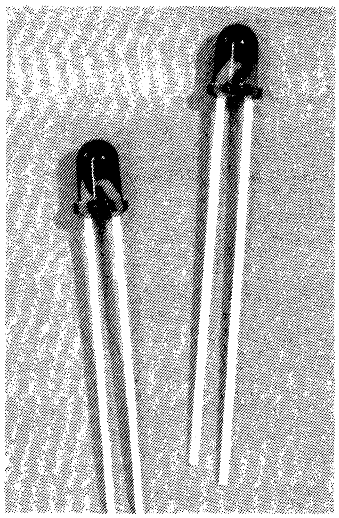
The clip mounts in a .250" dia. hole and fits up to a .125" panel thickness. A plastic collar is provided which fits over the back of the clip to lock the LED securely against the panel.

BLACK CLIP AND COLLAR: 004-9002
CLEAR CLIP AND COLLAR: 004-9003

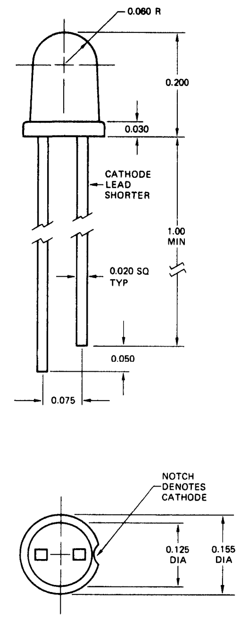
litronix
A Siemens Company

RLC-210

RED T1 CURRENT REGULATED LED LAMP



Package Dimensions in Inches



FEATURES

- T1 Size
- 1 Inch Leads
- Constant Intensity from 4.5 V to 11 V
- 10 mA Typical Forward Current
- No Resistor Needed to Operate Up to 11 V
- Miniature Size (T1 Lamp)
- Low Power Consumption
- IC Compatible
- Snap In Mounting Clip Available
- Red Diffused Lens

DESCRIPTION

The RLC 210 is a Gallium Arsenide Phosphide solid state lamp containing a current regulating integrated circuit that provides a constant intensity over a wide voltage range.

Maximum Ratings

Power dissipation @ 25°C 160mW
Derate voltage linearly from 25°C. . . . . −0.1V/°C
Forward voltage @ 25°C 11V
Storage and operating temperature . . . . −55 to +100°C
Peak inverse voltage 3.0V

Optoelectronic Characteristics (at 25°C)

Parameter	Min	Typ	Max	Unit	Test Condition
Luminous intensity	0.1	0.6		mcd	$V_F = 6V$
Forward current	7	10	14	mA	$V_F = 11V$
Emission peak wavelength		650		nm	
Spectral line half width		40		nm	
Reverse leakage		0.1	10	µA	$V_R = 3.0V$

Specifications subject to change without notice.

TYPICAL OPTOELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. FORWARD CURRENT VS. FORWARD VOLTAGE

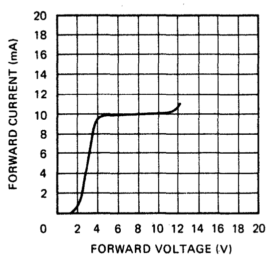


FIGURE 2. LUMINOUS INTENSITY VS. FORWARD VOLTAGE

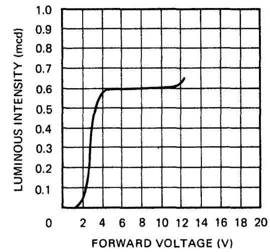
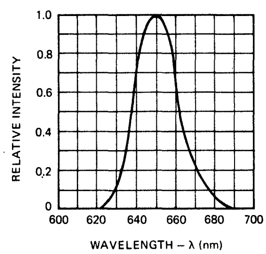


FIGURE 3. SPECTRAL DISTRIBUTION



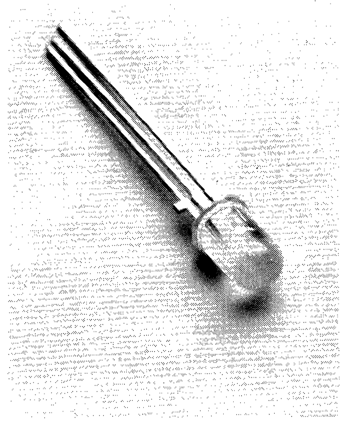
Clip Mounting Information

The clip mounts in a .203" dia. hole and fits a .062" panel thickness.
BLACK CLIP: 004–9011

litronix
A Siemens Company

LD 100

TWO-COLOR, RED AND GREEN T1¾ LED LAMP PRELIMINARY



FEATURES

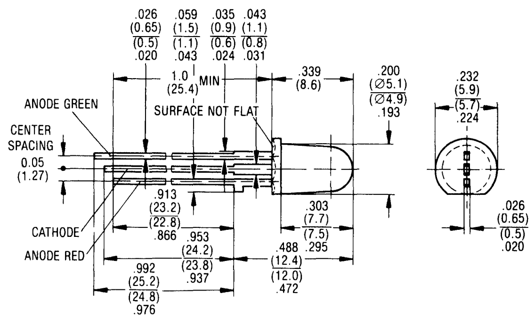
- **T1¾ Package Size**
- **Colorless Lens**
- **Two-Color Operation, Red and Green**
- **Three Leads, One of Which Is Common Cathode**
- **Minimum Lead Length 1″**
- **.05″ Lead Spacing**

DESCRIPTION

The LD-100 has a colorless, round 5 mm case with diffuser layer. Two chips (GaP-green and TSN-red) allow use as optical indicator with two functions.

Because of its very low current consumption and hence low inherent heating as well as high vibration resistance and long service life, this LED is suitable for applications where signal lamps are not or only inadequately useful. Moreover, the LED can be driven by TTL ICs.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse Voltage (V_R)	5 V
Forward Current* (I_F)	60 mA
Surge Current* (i_{FS}), $t \leq 10\ \mu s$	1 A
Storage Temperature (T_{stg})	−55 to +100 °C
Junction Temperature (T_j)	100 °C
Power Dissipation (P_{tot}) $T_{amb} = 25\ °C$	200 mW
Thermal Resistance (R_{thJA}) Junction-to-Air	375 K/W

Characteristics ($T_{amb} = 25\ °C$)

Parameter	Symbol	TSN-red	GaP-green	Unit
Wavelength of the Emitted Light	λ_{peak}	645 ± 15	560 ± 15	nm
Dominant Wavelength	λ_{dom}	638	561	nm
Half Angle (Limits for 50% of Luminous Intensity I_v)	φ	50		degrees
Forward Voltage ($I_F = 20$ mA)	V_F	2.4 (≤3.0)		V
Reverse Current ($V_R = 5$ V)	I_R	0.01 (≤10)		μA
Luminous Intensity ($I_F = 20$ mA)	I_v	≥0.63		mcd
Rise Time	t_r	100	50	ns
Fall Time	t_f	100	50	ns
Capacitance ($V_R = 0$ V, f = 1 MHz)	C_O	12	45	pF

Luminous Intensity

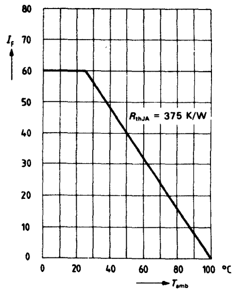
Part Number	Min	Max	Unit	**Matching Factor	Test Condition
LD-100-3s	1.0	2.0	mcd	<2	20 mA
LD-100-3t	1.0	2.0	mcd	<4	20 mA
LD-100-4s	1.6	3.2	mcd	<2	20 mA
LD-100-4t	1.6	3.2	mcd	<4	20 mA
LD-100-5s	2.5	—	mcd	<2	20 mA
LD-100-5t	2.5	—	mcd	<4	20 mA

*The ratings indicated for the forward current I_F or the surge current i_{FS}, respectively, are maximum ratings of the component. If both chips are operated simultaneously, the sum of the forward current ratings is not allowed to exceed the indicated maximum value.

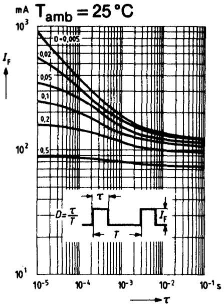
** $\frac{I_{v\,max}}{I_{v\,min}}$ is the ratio of intensity of both chips to each other and determines the luminous intensity factor (s or t).

Specifications subject to change without notice.

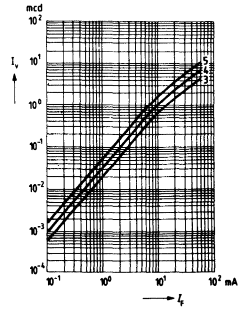
MAX. PERMISSIBLE FORWARD CURRENT
$I_F = f(T_{amb})$



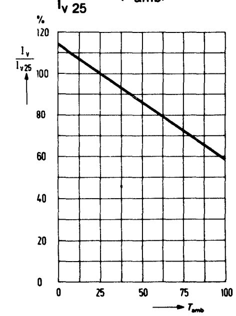
PERM. PULSE HANDLING CAPABILITY $I_F = f(t)$
Duty Cycle D = Parameter; $T_{amb} = 25\,°C$



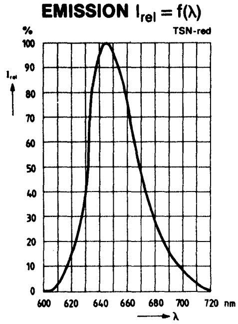
LUMINOUS INTENSITY
$I_v = f(I_F)$



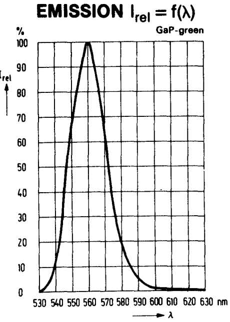
LUMINOUS INTENSITY
$\frac{I_v}{I_{v\,25}} = f(T_{amb})$



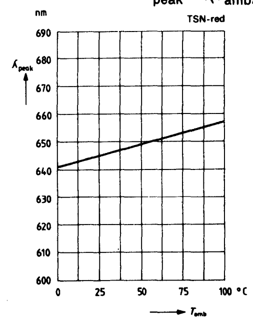
RELATIVE SPECTRAL EMISSION $I_{rel} = f(\lambda)$



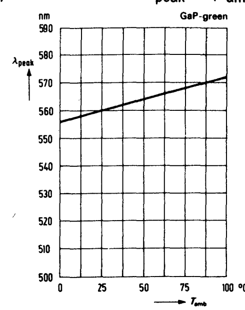
RELATIVE SPECTRAL EMISSION $I_{rel} = f(\lambda)$



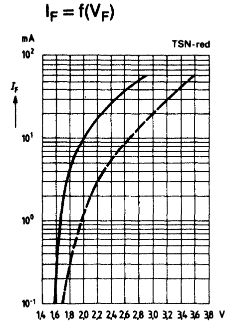
WAVELENGTH OF PEAK EMISSION $\lambda_{peak} = f(T_{amb})$



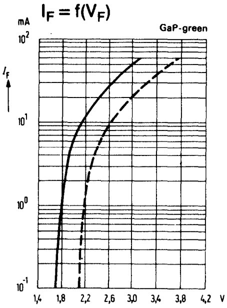
WAVELENGTH OF PEAK EMISSION $\lambda_{peak} = f(T_{amb})$



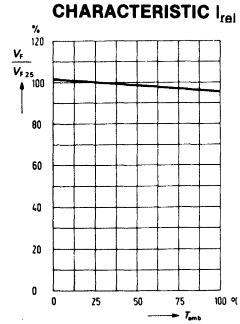
FORWARD CURRENT
$I_F = f(V_F)$



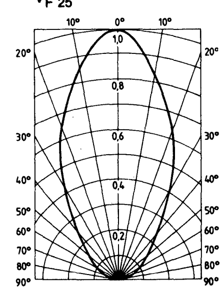
FORWARD CURRENT
$I_F = f(V_F)$



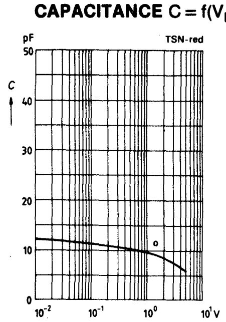
RADIATION CHARACTERISTIC $I_{rel} = f(\varphi)$



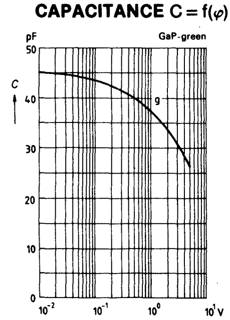
FORWARD VOLTAGE
$\frac{V_F}{V_{F\,25}} = f(T_{amb})$



CAPACITANCE $C = f(V_R)$

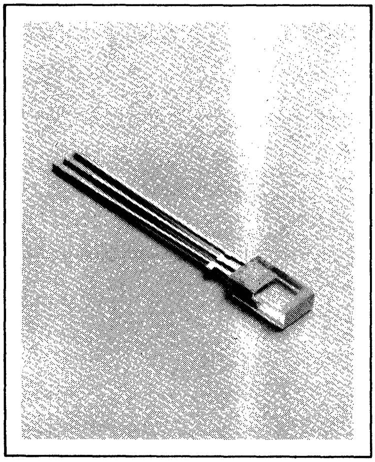


CAPACITANCE $C = f(\varphi)$



LD-110

TWO-COLOR RED AND GREEN RECTANGULAR LED LAMP PRELIMINARY



FEATURES

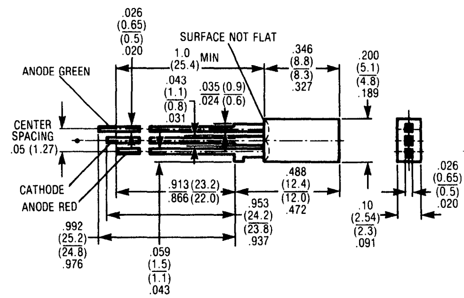
- **Rectangular Shape**
- **Colorless Lens**
- **Two-Color Operation, Red and Green**
- **Three Leads, One of Which Is Common Cathode**
- **Minimum Lead Length 1″**
- **.05″ Lead Spacing**

DESCRIPTION

The LD 110 has a colorless case with rectangular, luminous area and diffuser layer. Two chips (GaP-green and TSN-red) enable the use as optical indicator with two functions.

Because of its very low current consumption and hence low inherent heating as well as high vibration resistance and long service life, this LED is suitable for applications where signal lamps are not or only inadequately useful. Moreover, the LED can be driven by TTL ICs.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse Voltage (V_R)	5 V
Forward Current* (I_F)	60 mA
Surge Current (i_{FS}), $t \leq 10\ \mu s$*	1 A
Storage Temperature (T_{stg})	−55 to +100 °C
Junction Temperature (T_j)	100 °C
Power Dissipation (P_{tot}), $T_{amb} = 25$ °C	200 mW
Thermal Resistance Junction-Air (R_{thJA})	375 K/W

*The ratings indicated for the forward current I_F or the surge current i_{FS}, respectively, are maximum ratings of the component. If both chips are operated simultaneously, the sum of the forward current ratings is not allowed to exceed the indicated maximum value.

Characteristics ($T_{amb} = 25$ °C)

Parameter	Symbol	TSN-red	GaP-green	Unit
Wavelength of the Emitted Light	λ_{peak}	645 ± 15	560 ± 15	nm
Dominant Wavelength	λ_{dom}	638	561	nm
Aperture Cone (Half Angle) (Limits for 50% of Luminous Intensity I_v) Lateral Emission of Light Screened	φ	50		degrees
Forward Voltage ($I_F = 20$ mA)	V_F	2.4 (≤3.0)		V
Reverse Current ($V_R = 5$ V)	I_R	0.01 (≤10)		μA
Luminous Intensity ($I_F = 20$ mA)	I_v	≥0.63		mcd
Rise Time	t_r	100	50	ns
Fall Time	t_f	100	50	ns
Capacitance ($V_R = 0$ V, f = 1 MHz	C_O	12	45	pF

Luminous Intensity

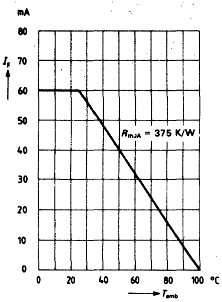
Type	Min	Max	Unit	Matching Factor**	Test Condition
LD 110-2s	.63	1.25	mcd	<2	20 mA
LD 110-2t	.63	1.25	mcd	<4	20 mA
LD 110-3s	1.0	2.0	mcd	<2	20 mA
LD 110-3t	1.0	2.0	mcd	<4	20 mA
LD 110-4s	1.6	—	mcd	<2	20 mA
LD 110-4t	1.6	—	mcd	<4	20 mA

*The ratings indicated for the forward current I_F or the surge current i_{FS}, respectively, are maximum ratings of the component. If both chips are operated simultaneously, the sum of the forward current ratings is not allowed to exceed the indicated maximum value.

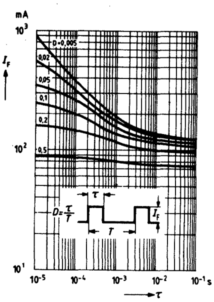
**$\frac{I_v max}{I_v min}$ is the ratio of intensity of both chips to each other and determines the luminous intensity factor (s or t).

Specifications subject to change without notice.

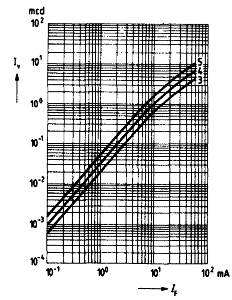
Max. permissible forward current
$I_F = f(T_{amb})$



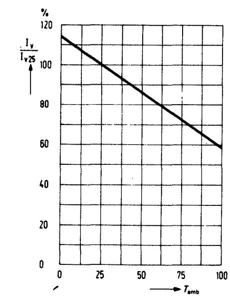
Perm. pulse handling capability
$I_F = f(\tau)$
Duty cycle D = parameter; T_{amb} = 25°C



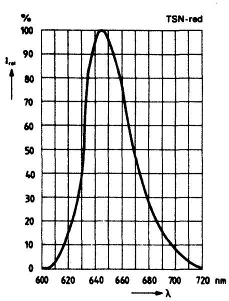
Luminous intensity $I_v = f(I_F)$



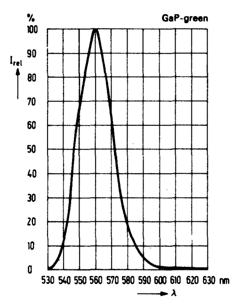
Luminous intensity $\frac{I_v}{I_{v25}} = f(T_{amb})$



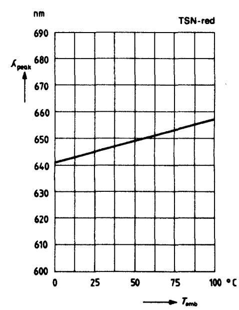
Relative spectral emission $I_{rel} = f(\lambda)$



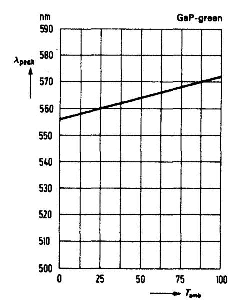
Relative spectral emission $I_{rel} = f(\lambda)$



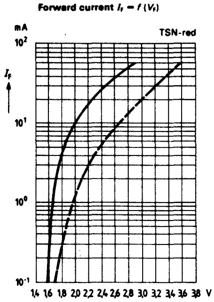
Wavelength of peak emission
$\lambda_{peak} = f(T_{amb})$



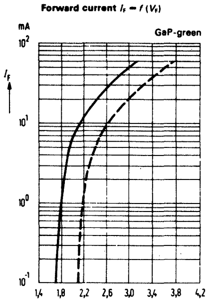
Wavelength of peak emission
$\lambda_{peak} = f(T_{amb})$



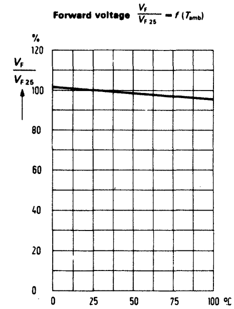
Forward current $I_F = f(V_F)$



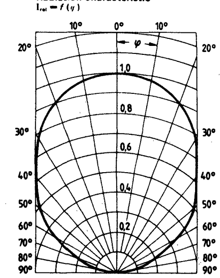
Forward current $I_F = f(V_F)$



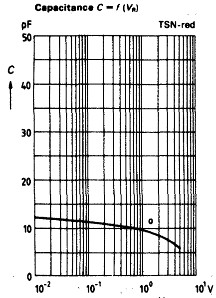
Forward voltage $\frac{V_F}{V_{F25}} = f(T_{amb})$



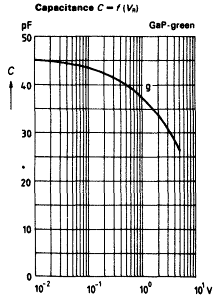
Radiation characteristic
$I_{rel} = f(\varphi)$



Capacitance $C = f(V_R)$



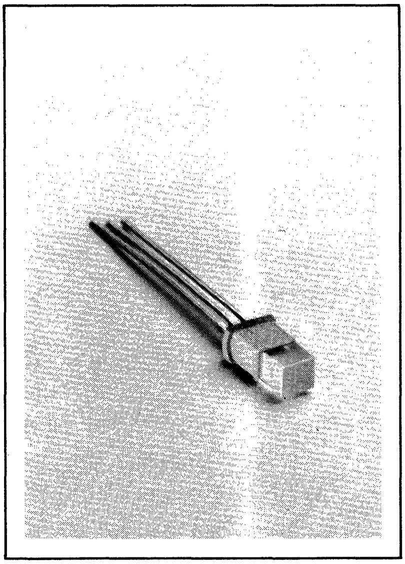
Capacitance $C = f(V_R)$



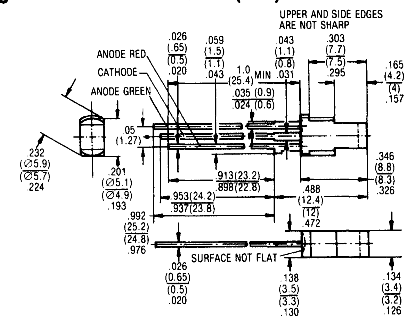
litronix
A Siemens Company

LD-111

TWO COLOR RED AND GREEN SQUARE LED LAMP PRELIMINARY



Package Dimensions in Inches (mm)



FEATURES

- **Square Shape**
- **Colorless Lens**
- **Two Color Operation, Red and Green**
- **Three Leads, One of Which Is Common Cathode**
- **Minimum Lead Length 1″**
- **.05″ Lead Spacing**

DESCRIPTION

The LD-111 has a colorless case with square, luminous area and diffuser layer. Two chips (GaP-green and TSN-red) allow use as optical indicator with two functions.

Because of its very low current consumption and hence low inherent heating as well as high vibration resistance and long service life, this LED is suitable for applications where signal lamps are not or only inadequately useful. Moreover, the LED can be driven by TTL ICs.

Maximum Ratings

Reverse Voltage (V_R) .... 5 V
Forward Current* (I_F) .... 60 mA
Surge Current (i_{FS}), $t \leq 10\ \mu s$* .... 1 A
Storage Temperature (T_{stg}) .... −55 to +100 °C
Junction Temperature (T_j) .... 100 °C
Power Dissipation (P_{tot}), $T_{amb} = 25\ °C$ .... 200 mW
Thermal Resistance Junction-Air (R_{thJA}) .... 375 K/W

* The ratings indicated for the forward current I_F or the surge current i_{FS} respectively, are maximum ratings of the component. If both chips are operated simultaneously, the sum of the forward current ratings is not allowed to exceed the indicated maximum value.

Characteristics ($T_{amb} = 25\ °C$)

Parameter	Symbol	TSN-red	GaP-green	Unit
Wavelength of the Emitted Light	λ_{peak}	645 ± 15	560 ± 15	nm
Dominant Wavelength	λ_{dom}	638	561	nm
Aperture Cone (Half Angle) (Limits for 50% of Luminous Intensity I_v) Lateral Emission of Light Screened	φ	50		degrees
Forward Voltage ($I_F = 20$ mA)	V_F	2.4 (≤3.0)		V
Reverse Current ($V_R = 5$ V)	I_R	0.01 (≤10)		μA
Luminous Intensity ($I_F = 20$ mA)	I_v	≥0.63		mcd
Rise Time	t_r	100	50	ns
Fall Time	t_f	100	50	ns
Capacitance ($V_R = 0$ V, f = 1 MHz)	C_O	12	45	pF

Luminous Intensity

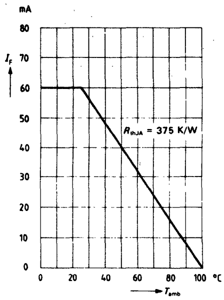
Type	Min	Max	Unit	Matching Factor**	Test Condition
LD-111-2s	.63	1.25	mcd	<2	20 mA
LD-111-2t	.63	1.25	mcd	<4	20 mA
LD-111-3s	1.0	2.0	mcd	<2	20 mA
LD-111-3t	1.0	2.0	mcd	<4	20 mA
LD-111-4s	1.6	—	mcd	<2	20 mA
LD-111-4t	1.6	—	mcd	<4	20 mA

*The ratings indicated for the forward current I_F or the surge current i_{FS}, respectively, are maximum ratings of the component. If both chips are operated simultaneously, the sum of the forward current ratings is not allowed to exceed the indicated maximum value.

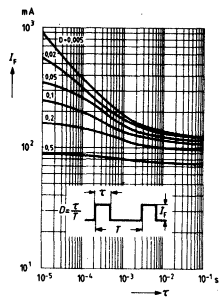
**$\frac{I_v max}{I_v min}$ is the ratio of intensity of both chips to each other and determines the luminous intensity factor (s or t).

Specifications subject to change without notice.

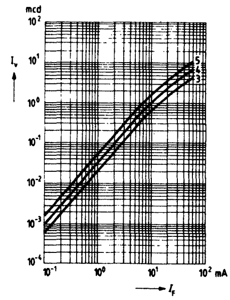
Max. permissible forward current
$I_F = f(T_{amb})$



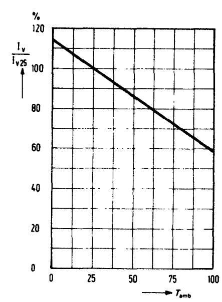
Perm. pulse handling capability
$I_F = f(\tau)$
Duty cycle D = parameter; T_{amb} = 25°C



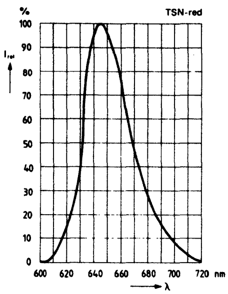
Luminous intensity $I_v = f(I_F)$



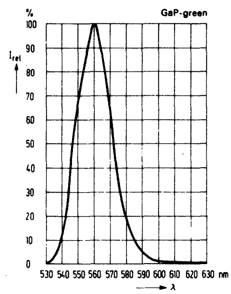
Luminous intensity $\frac{I_v}{I_{v25}} = f(T_{amb})$



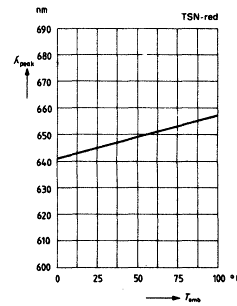
Relative spectral emission $I_{rel} = f(\lambda)$



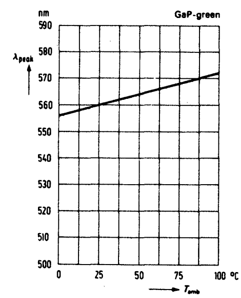
Relative spectral emission $I_{rel} = f(\lambda)$



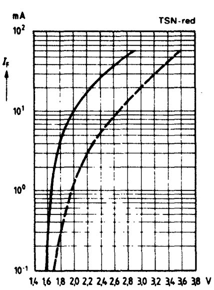
Wavelength of peak emission
$\lambda_{peak} = f(T_{amb})$



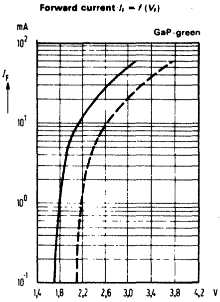
Wavelength of peak emission
$\lambda_{peak} = f(T_{amb})$



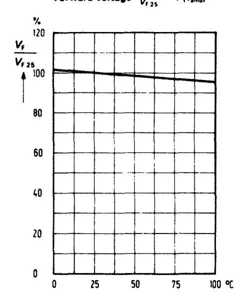
Forward current $I_F = f(V_F)$



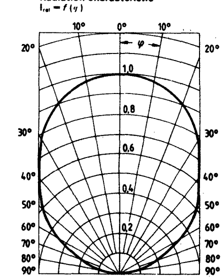
Forward current $I_F = f(V_F)$



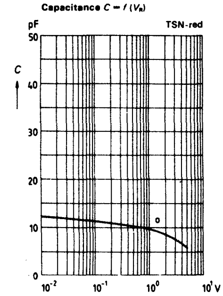
Forward voltage $\frac{V_F}{V_{F25}} = f(T_{amb})$



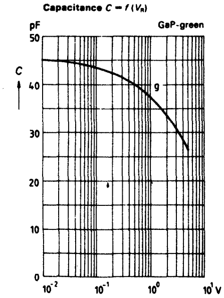
Radiation characteristic
$I_{rel} = f(\varphi)$



Capacitance $C = f(V_R)$



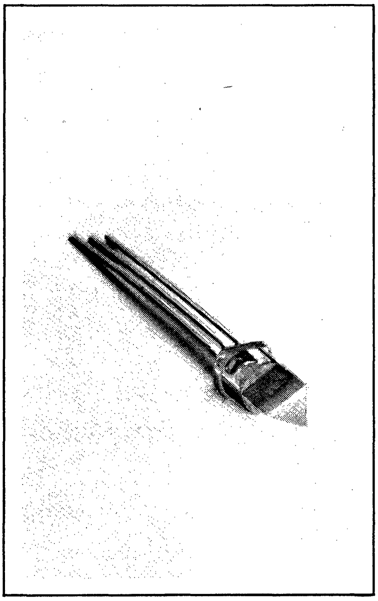
Capacitance $C = f(V_R)$



litronix
A Siemens Company

LD-112

TWO-COLOR RED AND GREEN TRIANGULAR LED LAMP



FEATURES

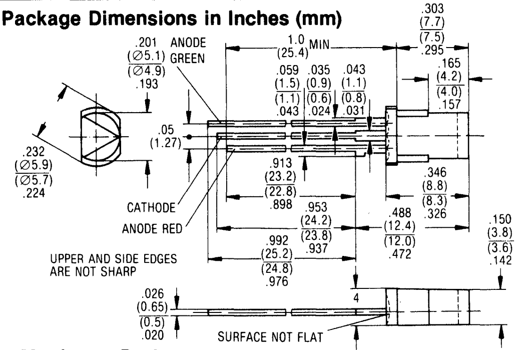
- Triangular Shape
- Colorless Lens
- Two-Color Operation, Red and Green
- Three Leads, One of Which Is Common Cathode
- Minimum Lead Length 1″
- .05″ Lead Spacing

DESCRIPTION

The LD-112 has a colorless case with triangular, luminous area and diffuser layer. Two chips (GaP-green and TSN-red) allow use as optical indicator with two functions.

Because of its very low current consumption and hence low inherent heating as well as high vibration resistance and long service life, this LED is suitable for applications where signal lamps are not or only inadequately useful. Moreover, the LED can be driven by TTL ICs.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse Voltage (V_R)	5 V
Forward Current* (I_F)	60 mA
Surge Current (i_{FS}), $t \leq 10\ \mu s$*	1A
Storage Temperature (T_{stg})	−55 to +100 °C
Junction Temperature (T_j)	100 °C
Power Dissipation (P_{tot}), $T_{amb} = 25\,°C$	200 mW
Thermal Resistance Junction-Air (R_{thJA})	375 K/W

Characteristics ($T_{amb} = 25\,°C$)

Parameter	Symbol	TSN-red	GaP-green	Unit
Wavelength of the Emitted Light	λ_{peak}	645 ± 15	560 ± 15	nm
Dominant Wavelength	λ_{dom}	638	561	nm
Aperture Cone (Half Angle) (Limits for 50% of Luminous Intensity I_V) Lateral Emission of Light Screened	φ	50		degrees
Forward Voltage ($I_F = 20$ mA)	V_F	2.4 (≤3.0)		V
Reverse Current ($V_R = 5$ V)	I_R	0.01 (≤10)		µA
Luminous Intensity ($I_F = 20$ mA)	I_V	≥0.63		mcd
Rise Time	t_r	100	50	ns
Fall Time	t_f	100	50	ns
Capacitance ($V_R = 0$ V, f = 1 MHz)	C_O	12	45	pF

Luminous Intensity

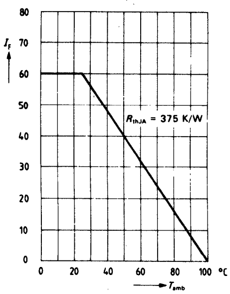
Type	Min	Max	Unit	Matching Factor**	Test Condition
LD 112-2s	.63	1.25	mcd	<2	20 mA
LD 112-2t	.63	1.25	mcd	<4	20 mA
LD 112-3s	1.0	2.0	mcd	<2	20 mA
LD 112-3t	1.0	2.0	mcd	<4	20 mA
LD 112-4s	1.6	—	mcd	<2	20 mA
LD 112-4t	1.6	—	mcd	<4	20 mA

* The ratings indicated for the forward current I_F or the surge current i_{FS} respectively, are maximum ratings of the component. If both chips are operated simultaneously, the sum of the forward current ratings is not allowed to exceed the indicated maximum value.

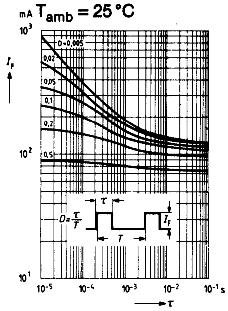
** $\frac{I_V\ max}{I_V\ min}$ is the ratio of intensity of both chips to each other and determines the luminous intensity factor (s or t).

Specifications subject to change without notice.

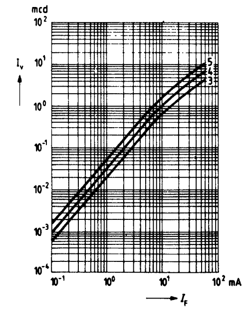
MAXIMUM PERMISSIBLE FORWARD CURRENT
$I_F = f(T_{amb})$



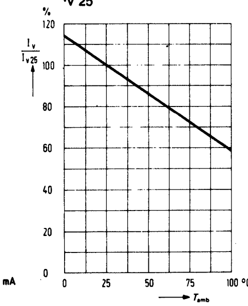
PERMANENT PULSE HANDING CAPABILITY $I_F = f(\tau)$
Duty Cycle D = Parameter;
$T_{amb} = 25\,°C$



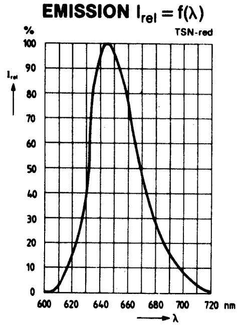
LUMINOUS INTENSITY
$I_v = f(I_F)$



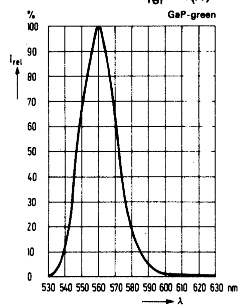
LUMINOUS INTENSITY
$\frac{I_v}{I_{v\,25}} = f(T_{amb})$



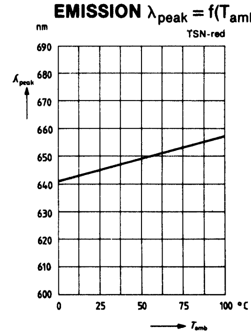
RELATIVE SPECTRAL EMISSION $I_{rel} = f(\lambda)$



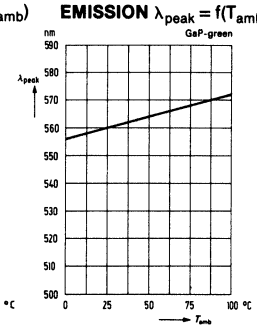
RELATIVE SPECTRAL EMISSION $I_{rel} = f(\lambda)$



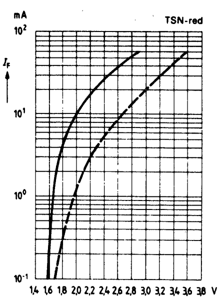
WAVELENGTH OF PEAK EMISSION $\lambda_{peak} = f(T_{amb})$



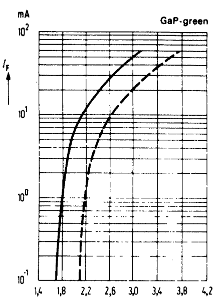
WAVELENGTH OF PEAK EMISSION $\lambda_{peak} = f(T_{amb})$



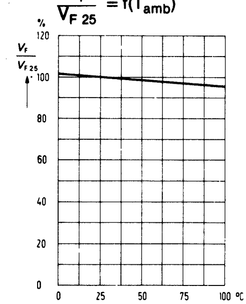
FORWARD CURRENT
$I_F = f(V_F)$



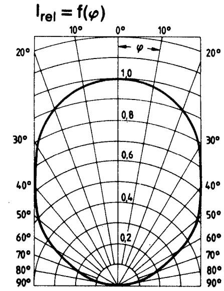
FORWARD CURRENT
$I_F = f(V_F)$



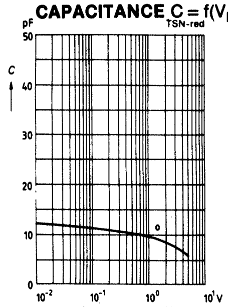
FORWARD VOLTAGE
$\frac{V_F}{V_{F\,25}} = f(T_{amb})$



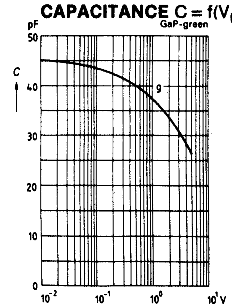
RADIATION CHARACTERISTICS
$I_{rel} = f(\varphi)$



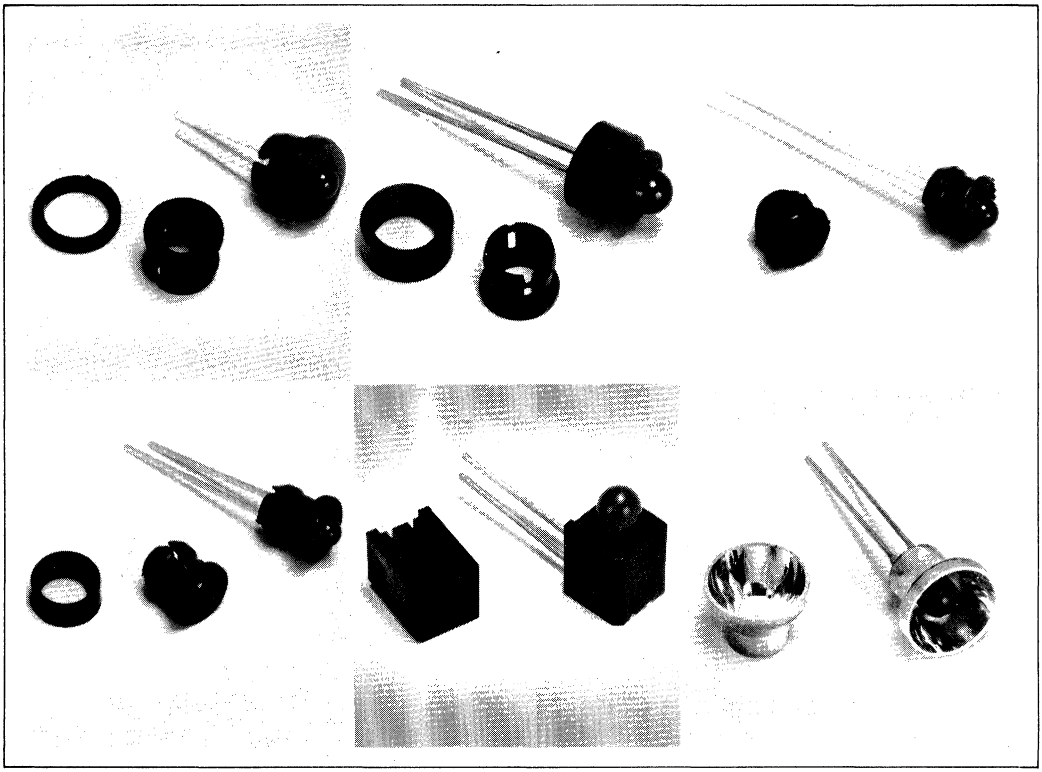
CAPACITANCE $C = f(V_R)$



CAPACITANCE $C = f(V_R)$

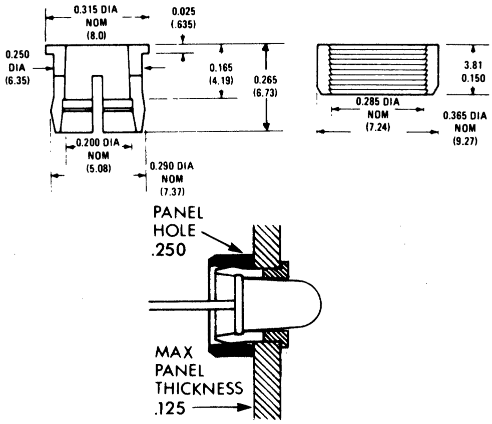


Accessories

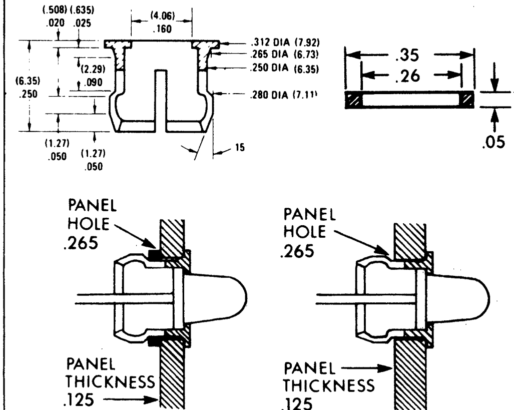


Part Number	Description	Color	Features
004-9002	Mounting Clip & Collar for T-1¾ LED's	Black	Fits GL-4850, 4950; LD-41, 50, 52, 56, 57; OL-30; RL-20, 21, 2000, 4403, 4850, 5054, RLC-200, 201; YL-4550, 4850
004-9003		Clear	
004-9004	Mounting Clip & Collar for Low Profile LED's	Black	Fits RL-2 Series
004-9005		Clear	
004-9011	Mounting Clip for T-1 LED's	Black	Fits GL-211, 4484; OL-31; RL-209, 4480, 4484; RLC-210, 410; YL-212, 4484
004-9015	Mounting Clip & Collar for T-1 LED's	Clear	Fits LD-30, 32, 36, 37 Series
004-9016		Black	
004-9019	Right Angle Mounting Part	Black	Designed to allow right angle mounting of lamps to PC Boards and other surfaces
004-9020	Reflector	Polished	This highly polished reflector greatly increases lighted area and enhances overall brightness of low profile and T-1¾ LED's

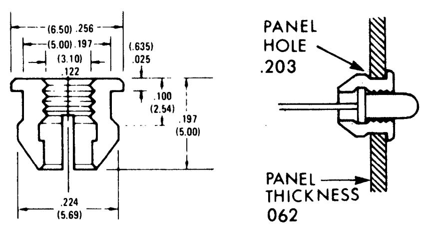
004-9002
004-9003



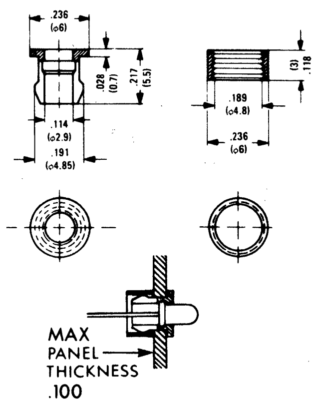
004-9004
004-9005



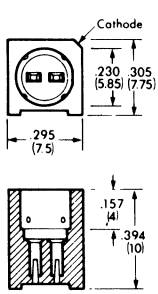
004-9011



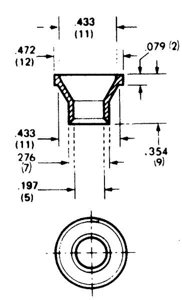
004-9015
004-9016



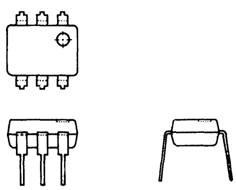
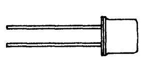
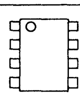
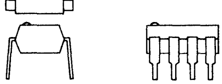
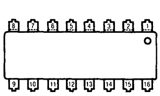
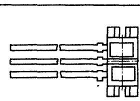
004-9019 Right Angle Mounting Part



004-9020 Reflector

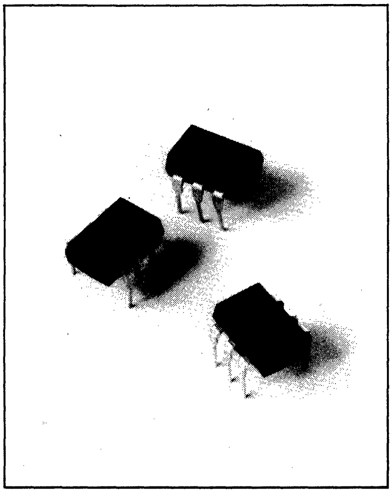


OPTO-COUPLERS

Package and Type	Package Outline	Part Number	Current Transfer Ratio (%) I_F=10mA	Isolation Breakdown Voltage	BV_{CEO}	Page
6 PIN DIP Single Channel Photo-transistor Output		CNY17-1	40-80	4400	70	205
		CNY17-2	63-125			
		CNY17-3	100-200			
		CNY17-4	160-320			
		IL-1	20	2500	30	209
		IL-5	50			213
		IL-12	10	1000	20	215
		IL-74	12.5	1500		217
		IL-201	75-150	5000	30	221
		IL-202	125-250			
		IL-203	225-450			
		IL-501	20	5000	30	223
		IL-505	50			
		IL-512	10		20	
		SFH600-0	40-80	2800	70	225
		SFH600-1	63-125			
		SFH600-2	100-200			
		SFH600-3	160-320			
		SFH601-1	40-80	5300		229
		SFH601-2	63-125			
		SFH601-3	100-200			
		SFH601-4	160-320			
		4N25	20	2500	30	233
		4N26		1500		
		4N27	10			
		4N28		500		
		4N35	100	3550		235
		4N36		2500		
		4N37		1500		
6 PIN DIP Single Channel Photo-transistor Darlington Output		ILA-30	100	1500	30	237
		ILA-55			55	
		ILCA-2-30		2500	30	239
		ILCA-2-55			55	
		IL-530		5000	30	241
		IL-555			55	
		4N32	500	2500	30	236
		4N33	500	1500		
6 PIN DIP AC INPUT		H11AA1	20	1500	30	243
6 PIN DIP Bidirectional INPUT		IL-250	50	5000		245
TO-72 Metal Case Single Channel		CNY18-2	16-32	500	32	247
		CNY18-3	25-50			
		CNY18-4	40-80			
		CNY18-5	63-125			
8 PIN DIP Single Channel High Speed		IL-100	75 Propogation Delay Time (ns)	2500	–	249
		IL-101	200	1500		253
8 PIN DIP Two Channel		ILCT-6	20	1500	30	255
		ILD-1	20	2500		209
		ILD-74	12.5	1500	20	217
		ILD-506	20	5000	30	258
16 PIN DIP Four Channel		ILQ-1	20	2500	30	209
		ILQ-74	12.5	1500	20	217
Miniature 3 Lead Plastic Package		SFH900	Reflective Sensor. IR emitter and phototransistor collector in side by side configuration.			261

litronix
A Siemens Company

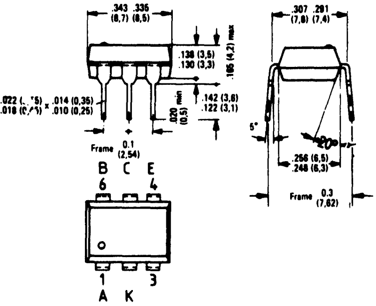
CNY 17 SERIES
SINGLE CHANNEL PHOTOTRANSISTOR OPTO-ISOLATOR

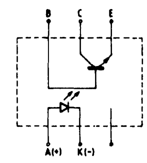


FEATURES
- 4400 Volt Breakdown Voltage
- High Current Transfer Ratio, 4 Groups
  CNY 17-1, 40 to 80%
  CNY 17-2, 63 to 125%
  CNY 17-3, 100 to 200%
  CNY 17-4, 160 to 320%
- Long Term Stability
- Industry Standard Dual-in-Line

DESCRIPTION
The CNY 17 is an optically coupled pair employing a gallium arsenide infrared LED and a silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. The CNY 17 can be used to replace relays and transformers in many digital interface applications, as well as analog applications such as CRT modulation.

Package Dimensions in Inches (mm)





1. Anode
2. Cathode
3. Not Connected
4. Emitter
5. Collector
6. Base

Maximum Ratings

Emitter (GaAs infrared emitting diode)			
Reverse voltage	V_R	6	V
Forward current	I_F	60	mA
Surge current ($t \leq 10\ \mu s$)	i_{FS}	1.5	A
Power dissipation	P_{tot}	100	mW
Detector (Si phototransistor)			
Collector-emitter reverse voltage	V_{CEO}	70	V
Emitter-base reverse voltage	V_{EBO}	7	V
Collector current	I_C	50	mA
Collector current (t<1 ms)	I_{CSM}	100	mA
Power dissipation	P_{tot}	150	mW
Coupler			
Storage temperature	T_{stor}	−40 to +150	°C
Operating temperature	T_{amb}	−40 to +100	°C
Junction temperature	T_j	100	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	260	°C
Isolation voltage (between emitter and detector referred to standard climate 23/50 DIN 50014;	V_{is}	4400	V
leakage path, DIN 57883, 6.80		8.2 MIN.	mm
air path, VDE 0883, 6.80		7.6 MIN.	mm

Tracking resistance: Group III (KC ≥ 600 in accordance with VDE 110 § 6, table 3 and DIN 53 480/VDE 0330, part 1.

Isolation voltage @ V_{is} = 500 V	R_{is}	10^{11}	Ω

Characteristics (T_{amb} = 25°C)

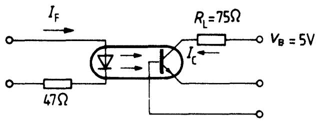
Emitter (GaAs infrared emitting diode)			
Forward voltage (I_F = 60 mA)	V_F	1.25 (≤ 1.65)	V
Breakdown voltage (I_R = 100 μA)	V_{BR}	30 (≥ 6)	V
Reverse current (V_R = 3 V)	I_R	0.01 (≤ 10)	μA
Capacitance (V_R = 0 V; f = 1 MHz)	C_O	40	pF
Thermal Resistance	R_{thJamb}	750	K/W
Detector (Si phototransistor)			
Capacitance (V_{CE} = 0 V; f = 1 MHz)	C_{CE}	6.8	pF
	C_{CB}	8.5	pF
	C_{EB}	11	pF
Thermal Resistance	R_{thJamb}	500	K/W
Coupler			
Collector-emitter saturation voltage (I_F = 10 mA; I_C = 2.5 mA)	V_{CEsat}	.25 (≤ .4)	V
Coupling capacitance	C_K	.30	pF

The couplers are grouped in accordance with their current ratio $\frac{I_C}{I_F}$ at I_E = 10 mA and V_{CE} = 5 V and marked by Roman numerals.

Specifications subject to change.

Group		CNY 17-1	CNY 17-2	CNY 17-3	CNY 17-4	
$\frac{I_C}{I_F}$		40 to 80	63 to 125	100 to 200	160 to 320	%
Collector-emitter leakage current (V_{CE} = 10 V)	I_{CEO}	2 (≤ 50)	2 (≤ 50)	5 (≤ 100)	5 (≤ 100)	nA

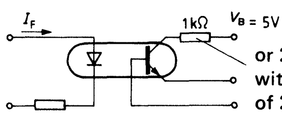
Linear operation (without saturation)



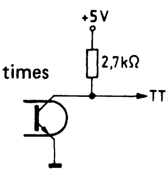
Load resistance	R_L	75	Ω
Delay time	t_d	3,0 (≦5,6)	µs
Rise time	t_r	2,0 (≦4,0)	µs
Storage time	t_s	2,3 (≦4,1)	µs
Fall time	t_f	2,0 (≦3,5)	µs
Cut-off frequency	f_g	250	kHz

I_F = 10 mA
V_B = 5 V
T_{amb} = 25°C

Switching operation (with saturation)

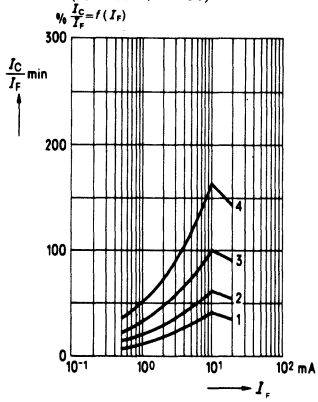


TTL level observed
but no TTL switching times

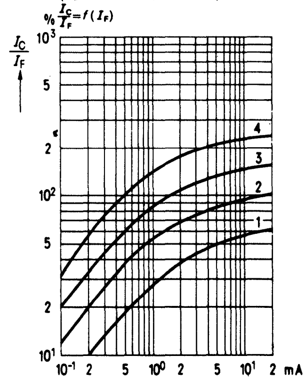


Group		1 I_F=20 mA	2 and 3 I_F=10 mA	4 I_F=5 mA	
Delay time	t_d	3,0 (≦5,5)	4,2 (≦8,0)	6,0 (≦10,5)	µs
Rise time	t_r	2,0 (≦4,0)	3,0 (≦6,0)	4,6 (≦8,0)	µs
Storage time	t_s	18 (≦34)	23 (≦39)	25 (≦43)	µs
Fall time	t_f	11 (≦20)	14 (≦24)	15 (≦26)	µs
	$V_{CE\,sat}$		0,25 (≦0,4)		V

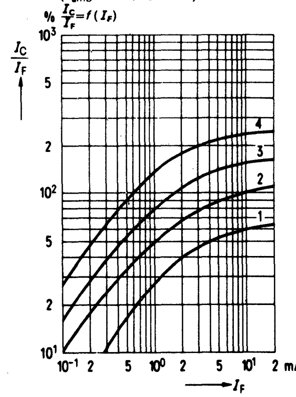
Minimum current transfer ratio as a function of diode current
(T_{amb} =25 °C, V_{CE} =5 V)
% $\frac{I_C}{I_F}=f(I_F)$



Current transfer ratio as a function of diode current
(T_{amb} = −25 °C, V_{CE} =5 V)
% $\frac{I_C}{I_F}=f(I_F)$

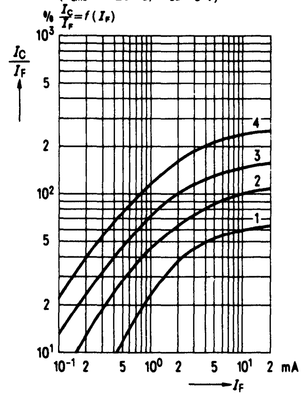


Current transfer ratio as a function of diode current
(T_{amb} =0 °C; V_{CE} =5 V)
% $\frac{I_C}{I_F}=f(I_F)$



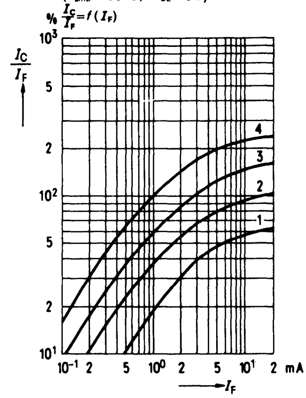
Current transfer ratio as a function of diode current

($T_{amb} = -25$ °C, $V_{CE} = 5$ V)



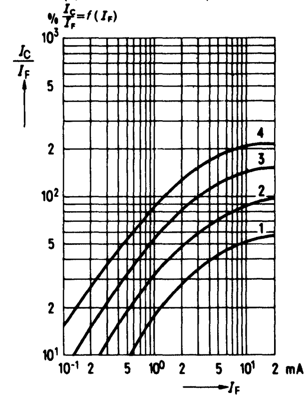
Current transfer ratio as a function of diode current

($T_{amb} = 50$ °C; $V_{CE} = 5$ V)



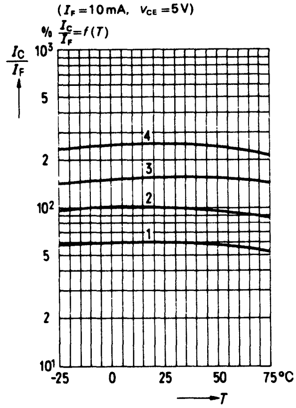
Current transfer ratio as a function of diode current

($T_{amb} = 75$ °C; $V_{CE} = 5$ V)



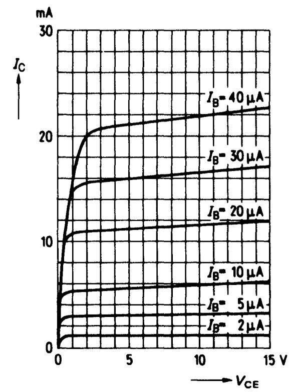
Current transfer ratio as a function of temperature

($I_F = 10$ mA, $V_{CE} = 5$ V)



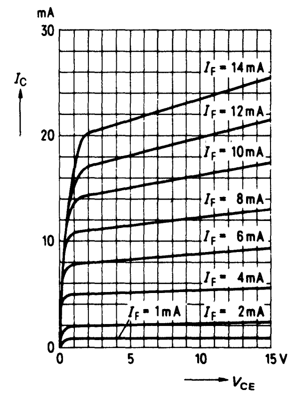
Transistor characteristics

(Current gain B=550)
($T_{amb} = 25$ °C; $I_F = 0$)
$I_C = f(V_{CE})$



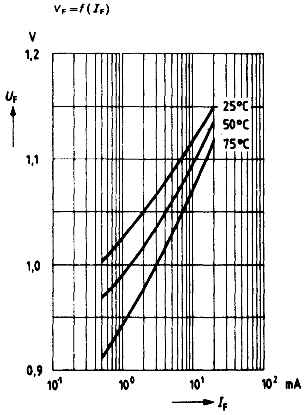
Output characteristics

($T_{amb} = 25$ °C)
$I_C = f(V_{CE})$



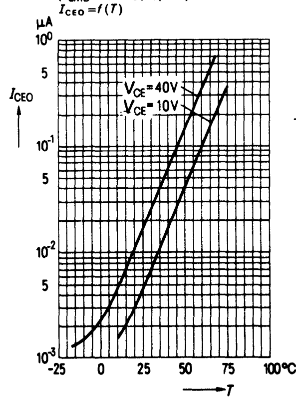
Forward voltage

$V_F = f(I_F)$



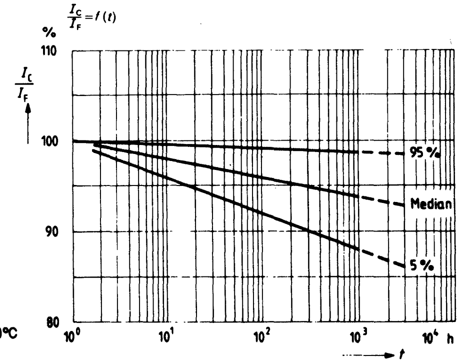
Collector-emitter off-state current

($T_{amb} = 25$ °C; $I_F = 0$)
$I_{CEO} = f(T)$



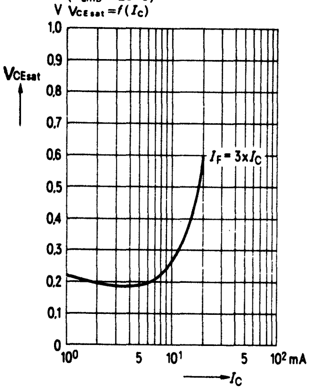
Variation of current transfer ratio as a function of load time

$\frac{I_C}{I_F} = f(t)$



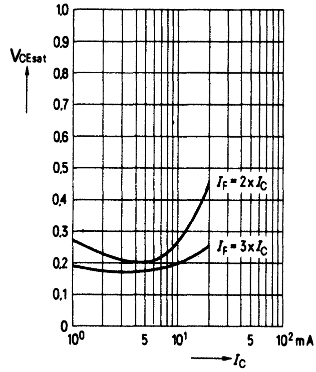
Saturation voltage as a function of collector current and modulation depth for CNY17-1

(T_{amb} = 25 °C)
V $V_{CEsat} = f(I_C)$



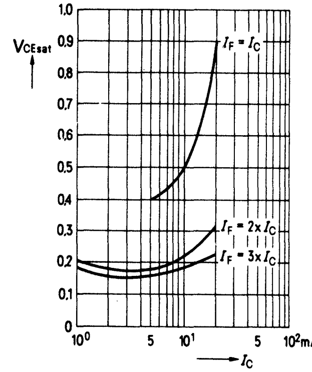
Handling same except for CNY17-2

(T_{amb} = 25 °C)
V $V_{CEsat} = f(I_C)$



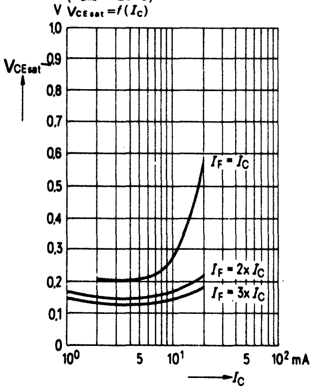
CNY17-3

(T_{amb} = 25 °C)
V $V_{CEsat} = f(I_C)$



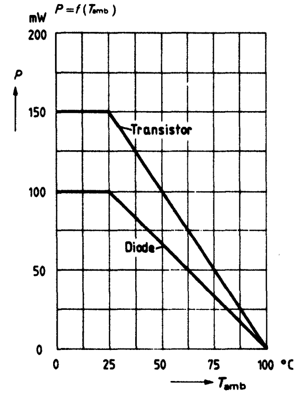
CNY17-4

(T_{amb} = 25 °C)
V $V_{CEsat} = f(I_C)$



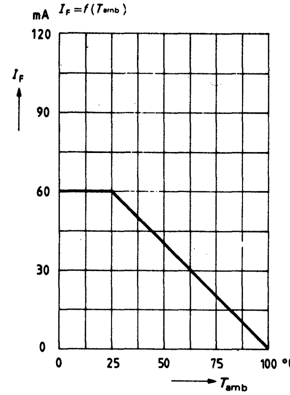
Permissible loss transistor and diode

$P = f(T_{amb})$



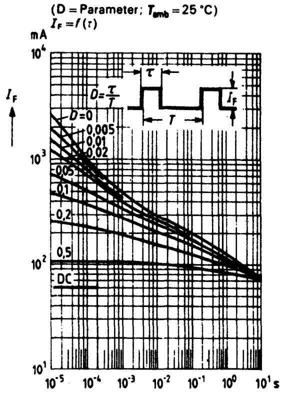
Permissible loss diode

$I_F = f(T_{amb})$



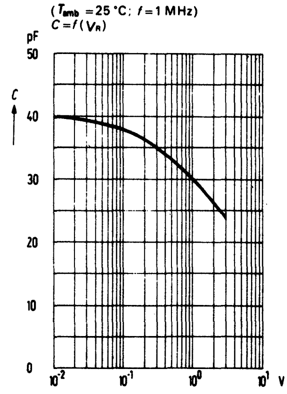
Permissible pulse load

(D = Parameter; T_{amb} = 25 °C)
$I_F = f(\tau)$



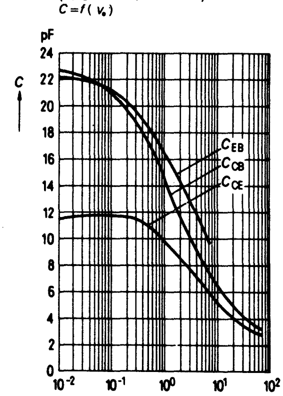
Diode capacitance

(T_{amb} = 25 °C; f = 1 MHz)
$C = f(V_R)$



Transistor capacitances

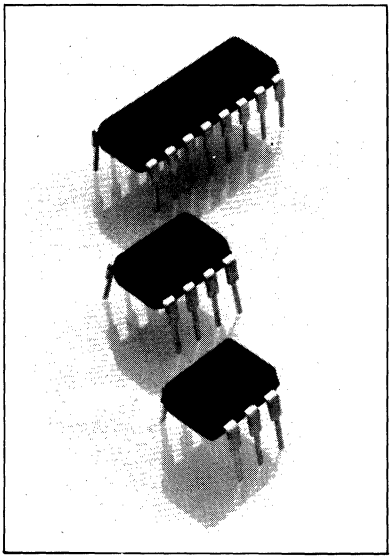
(T_{amb} = 25 °C; f = 1 MHz)
$C = f(V_o)$



litronix
A Siemens Company

IL-1 SINGLE CHANNEL ILD-1 DUAL CHANNEL ILQ-1 QUAD CHANNEL

PHOTOTRANSISTOR OPTO-ISOLATOR



FEATURES

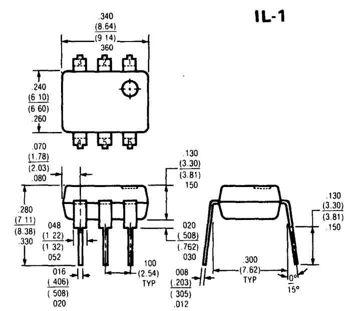
- 7400 Series T^2L Compatible
- 2500 Volt Breakdown Voltage
- 0.5 pF Coupling Capacitance
- Industry Standard Dual-In-Line Package
- Single Channel, Dual, and Quad Configurations
- Underwriters Lab Approval #E52744

DESCRIPTION

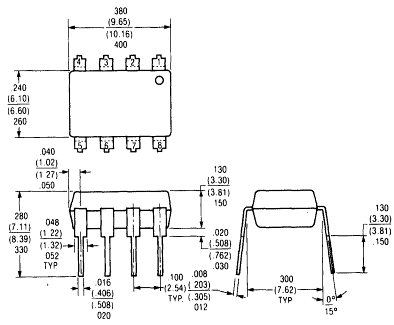
IL-1 is an optically coupled pair employing a Gallium Arsenide infrared LED and a silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. The IL-1 is especially designed for driving medium-speed logic, where it may be used to eliminate troublesome ground loop and noise problems. It can also be used to replace relays and transformers in many digital interface applications, as well as analog applications such as CRT modulation. The ILD-1 offers two isolated channels in a single DIP package while the ILQ-1 provides four isolated channels per package.

Package Dimensions in Inches (mm)

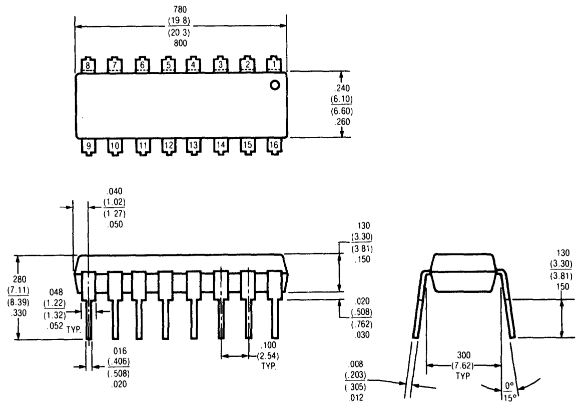
IL-1



ILD-1



ILQ-1



Specifications subject to change without notice.

MAXIMUM RATINGS

Gallium Arsenide LED (each channel)

Power Dissipation @ 25°C

IL-1	200 mW
ILD-1	150 mW
ILQ-1	150 mW

Derate Linearly from 25°C

IL-1	2.6 mW/°C
ILD-1	1.33 mW/°C
ILQ-1	1.33 mW/°C

Continuous Forward Current

IL-1	100 mA
ILD-1	100 mA
ILQ-1	100 mA

Detector Silicon Phototransistor (each channel)

Power Dissipation @ 25°C

IL-1	200 mW
ILD-1	150 mW
ILQ-1	150 mW

Derate Linearly from 25°C

IL-1	2.6 mW/°C
ILD-1	2.0 mW/°C
ILQ-1	2.0 mW/°C

Collector-Emitter Breakdown Voltage	30 V
Emitter-Collector Breakdown Voltage	7 V
Collector-Base Breakdown Voltage (IL-1)	70 V

Package

Total Package Dissipation at 25°C Ambient (LED Plus Detector)

IL-1	250 mW
ILD-1	400 mW
ILQ-1	500 mW

Derate Linearly from 25°C

IL-1	3.3 mW/°C
ILD-1	5.33 mW/°C
ILQ-1	6.67 mW/°C

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Lead Soldering Time @ 260°C	10 sec

ELECTRICAL CHARACTERISTICS PER CHANNEL (at 25°C Ambient)

Parameter	Min	Typ	Max	Units	Test Conditions
Gallium Arsenide LED					
Forward Voltage		1.3	1.5	V	$I_F = 60$ mA
Reverse Current		0.1	10	μA	$V_R = 3.0$ V
Capacitance		100		pF	$V_R = 0$
Phototransistor Detector					
BV_{CEO}	30	50		V	$I_C = 1$ mA
I_{CEO}		5.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$
Collector-Emitter Capacitance		2.0		pF	$V_{CE} = 0$
BV_{ECO}	7	10		V	$I_E = 100\ \mu$A
Coupled Characteristics					
DC Current Transfer Ratio	0.2	0.35			$I_F = 10$ mA, $V_{CE} = 10$ V
V_{SAT}		0.25	0.5	V	$I_C = 1.6$ mA, $I_F = 16$ mA
Capacitance, Input to Output		0.5		pF	
Breakdown Voltage	2500			V	D.C.
Resistance, Input to Output		100		GΩ	
Propagation Delay					
$t_{D\ ON}$		6.0		μs	$R_L = 2.4$KΩ, $V_{CE} = 5$ V
$t_{D\ OFF}$		25		μs	$I_F = 16$ mA

TYPICAL OPTOELECTRONIC CHARACTERISTIC CURVES FOR EACH CHANNEL

FIGURE 1. RELATIVE OUTPUT VS TEMPERATURE

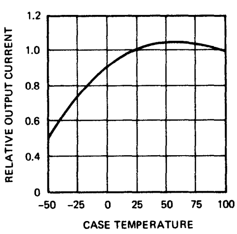


FIGURE 2. DARK CURRENT VS TEMPERATURE

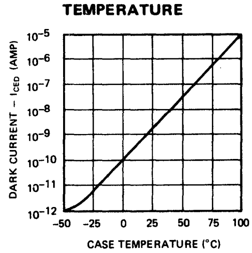


FIGURE 3. TRANSFER CHARACTERISTICS

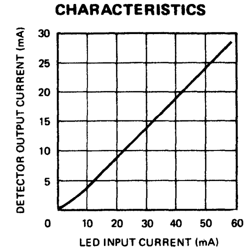


FIGURE 4. DETECTOR OUTPUT CHARACTERISTICS

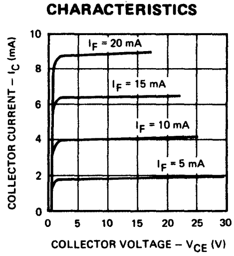
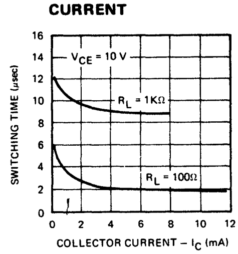


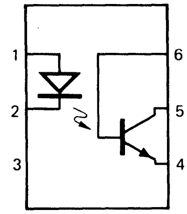
FIGURE 5. SWITCHING TIME VS COLLECTOR CURRENT



PIN CONFIGURATIONS

IL-1

(TOP VIEW)

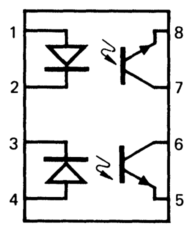


LED CHIP ON PIN 2
PT CHIP ON PIN 5

PIN NO.	FUNCTION
1	ANODE
2	CATHODE
3	NC
4	EMITTER
5	COLLECTOR
6	BASE

ILD-1

(TOP VIEW)

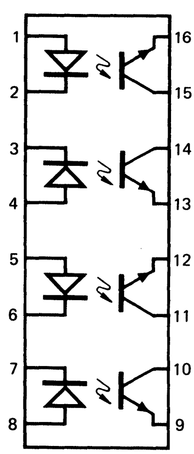


LED CHIPS ON PINS 2 AND 3
PT CHIPS ON PINS 6 AND 7

PIN NO.	FUNCTION
1	ANODE
2	CATHODE
3	CATHODE
4	ANODE
5	EMITTER
6	COLLECTOR
7	COLLECTOR
8	EMITTER

ILQ-1

(TOP VIEW)



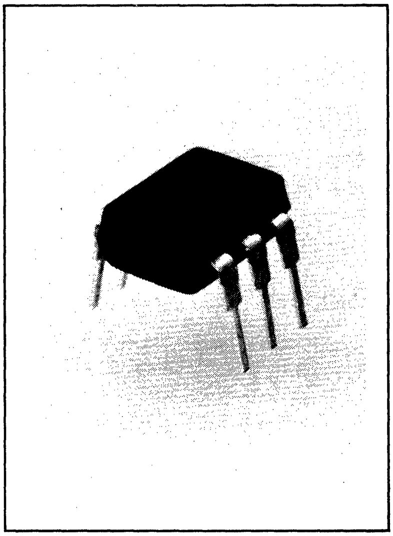
LED CHIPS ON PINS 2, 3, 6, 7
PT CHIPS ON PINS 10, 11, 14, 15

PIN NO.	FUNCTION
1	ANODE
2	CATHODE
3	CATHODE
4	ANODE
5	ANODE
6	CATHODE
7	CATHODE
8	ANODE
9	EMITTER
10	COLLECTOR
11	COLLECTOR
12	EMITTER
13	EMITTER
14	COLLECTOR
15	COLLECTOR
16	EMITTER

litronix
A Siemens Company

IL-5

PHOTOTRANSISTOR OPTO-ISOLATOR



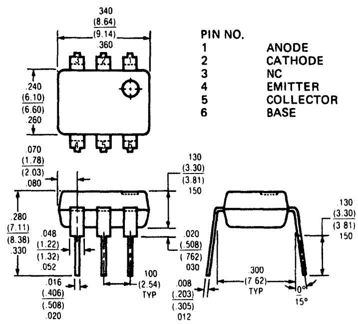
FEATURES

- 2500 Volt Breakdown Voltage
- 70% Typical Transfer Ratio
- Industry Standard Dual-In-Line
- 0.5 pF Coupling Capacitance
- Underwriters Lab Approval #E52744

DESCRIPTION

IL-5 is an optically coupled pair employing a Gallium Arsenide infrared LED and a silicon NPN phototransistor. Signal information, inlcuding a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. The IL-5 can be used to replace relays and transformers in many digital interface applications, as well as analog applications such as CRT modulation.

Package Dimensions in Inches (mm)



Maximum Ratings

Gallium Arsenide LED

Power Dissipation @ 25°C	200 mW
Derate Linearly from 25°C	2.6 mW/°C
Continuous Forward Current	100 mA
Peak Inverse Voltage	3.0 V

Detector (Silicon Phototransistor)

Power Dissipation @ 25°C	200 mW
Derate Linearly From 25°C	2.6 mW/°C
Collector-Emitter Breakdown Voltage (BV_{CEO})	30 V
Emitter-Collector Breakdown Voltage (BV_{ECO})	7 V
Collector-Base Breakdown Voltage (BV_{CBO})	70 V

Package

Total Package Dissipation at 25°C Ambient (LED Plus Detector)	250 mW
Derate Linearly From 25°C	3.3 mW/°C
Storage Temperature	−55 to +150°C
Operating Temperature	−55 to +100°C
Lead Soldering Time @ 260°C	10 sec

Electrical Characteristics (at 25°C Ambient)

Parameter	Min	Typ	Max	Unit	Test Condition
Gallium Arsenide LED					
Forward Voltage		1.3	1.5	V	I_F = 60 mA
Reverse Current		.1	10	μA	V_R = 3.0 V
Capacitance		100		pF	V_R = 0
Phototransistor Detector					
H_{FE}		450			V_{CE} = 5.0 V, I_C = 100 μA
BV_{CEO}	30	50		V	I_C = 1 mA
BV_{ECO}	7	10		V	I_E = 100 μA
I_{CEO} (dark)		5	50	nA	V_{CE} = 10 V, I_F = 0
Collector-Emitter Capacitance		2		pF	V_{CE} = 0
Coupled Characteristics					
DC Current Transfer	0.5	0.70			I_F = 10 mA, V_{CE} = 10V
Collector-Emitter Saturation Voltage $V_{CE(sat)}$		0.25	0.5V		I_F = 16 mA, I_C = 1.6 mA
Capacitance, Input to Output		.5		pF	
Breakdown Voltage	2,500			V	D.C.
Resistance, Input to Output		100		GΩ	
Output Rise and Fall Times		2		μs	I_F = 10 mA, V_{CE} = 10 V

Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. RELATIVE OUTPUT VS TEMPERATURE

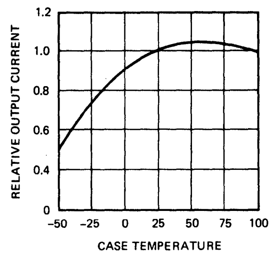


FIGURE 2. DARK CURRENT VS TEMPERATURE

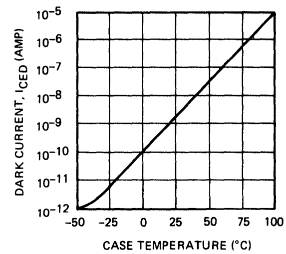


FIGURE 3. TRANSFER CHARACTERISTICS

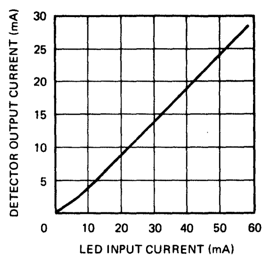


FIGURE 4. DETECTOR OUTPUT CHARACTERISTICS

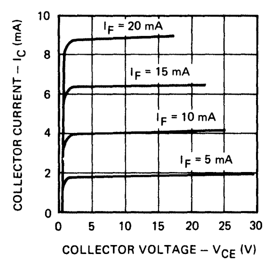
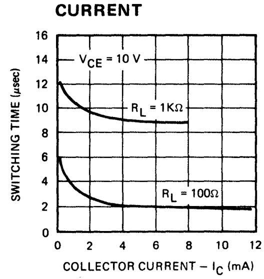


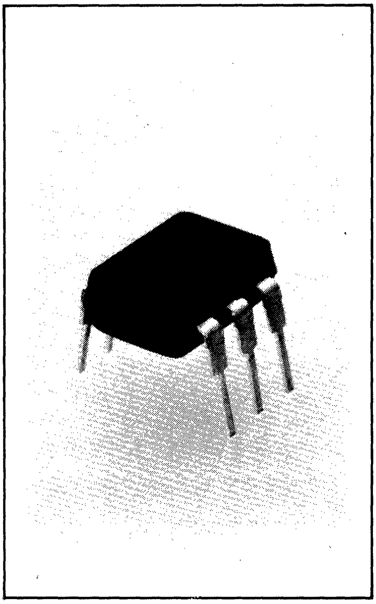
FIGURE 5. SWITCHING TIME VS COLLECTOR CURRENT



litronix
A Siemens Company

IL-12

PHOTOTRANSISTOR OPTO-ISOLATOR



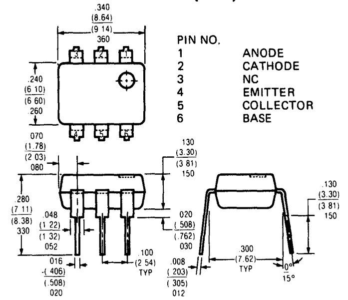
FEATURES

- **1000 Volt Breakdown Voltage**
- **10% Minimum Current Transfer Ratio**
- **2 pF max. Coupling Capacitance**
- **Standard Dual-In-Line Package**
- **Replacement For TIL-112**
- **Underwriters Lab Approval #E52744**

DESCRIPTION

IL-12 is an optically coupled pair employing a Gallium Arsenide infrared LED and a silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. The IL-12 can be used to replace relays and transformers in many digital interface applications, as well as analog applications such as CRT modulation.

Package Dimensions in Inches (mm)



Maximum Ratings

Gallium Arsenide LED	
Power Dissipation @ 25°C	200 mW
Derate Linearly from 25°C	2.6 mW/°C
Continuous Forward Current	100 mA
Peak Inverse Voltage	3.0V
Detector (Silicon Phototransistor)	
Power Dissipation at 25°C	200 mW
Derate Linearly from 25°C	2.6 mW/°C
Collector-Emitter Breakdown Voltage (BV_{CEO})	30V
Emitter-Collector Breakdown Voltage (BV_{ECO})	7V
Collector-Base Breakdown Voltage (BV_{CBO})	70 V
Package	
Total Package Dissipation at 25°C Ambient (LED Plus Detector)	250 mW
Derate Linearly From 25°C	3.3 mW/°C
Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Lead Soldering Time @ 260°C	10 sec

Electrical Characteristics (at 25°C Ambient)

Parameter	Min	Typ	Max	Unit	Test Condition
Gallium Arsenide LED					
Forward Voltage			1.5	V	I_F = 10 mA
Reverse Current			100μA		V_R = 3.0V
Capacitance		100		pF	V_R = 0
Phototransistor Detector					
H_{FE}	50				V_{CE} = 5.0V, I_C = 100 μA
BV_{CEO}	20	60		V	I_C = 1 mA
BV_{ECO}	4	10		V	I_E = 100 μA
I_{CEO} (dark)		5	250	nA	V_{CE} = 5V
Collector-Emitter Capacitance		2		pF	V_{CE} = 0
Output Rise and Fall Times		2		μs	I_F = 10 mA, V_{CE} = 10V
Coupled Characteristics					
DC Current Transfer Ratio	.10	.20			I_F = 10 mA, V_{CE} = 5V, R_L = 100 Ω
V_{CE} (SAT)		0.3	0.5	V	I_C = 2 mA, I_F = 50 mA
Capacitance, Input to Output			2	pF	
Breakdown Voltage	1000			V	D.C.
Resistance Input to Output		100		GΩ	

Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. RELATIVE OUTPUT VS TEMPERATURE

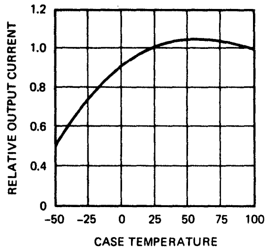


FIGURE 2. DARK CURRENT VS TEMPERATURE

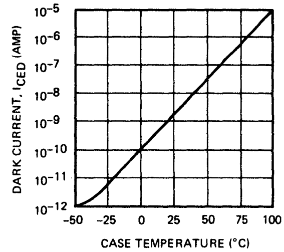


FIGURE 3. TRANSFER CHARACTERISTICS

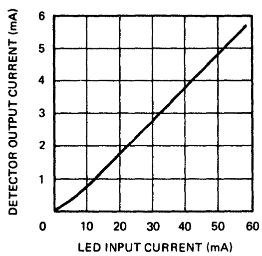


FIGURE 4. DETECTOR OUTPUT CHARACTER'STICS

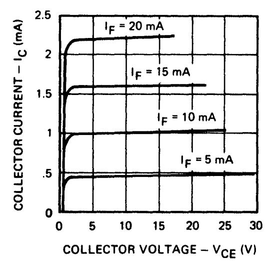
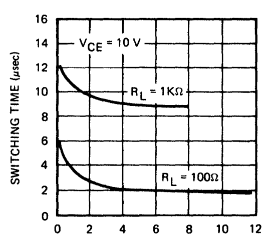
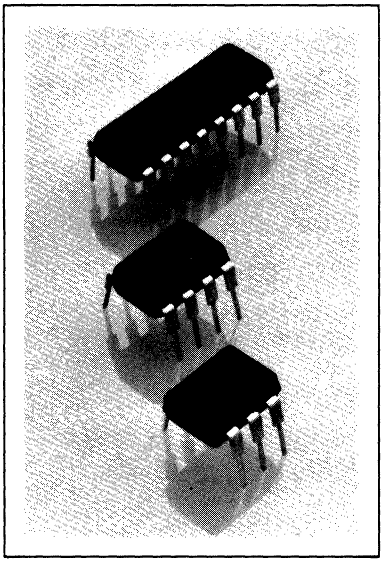


FIGURE 5. SWITCHING TIME VS COLLECTOR CURRENT



litronix
A Siemens Company

IL-74 SINGLE CHANNEL
ILD-74 DUAL CHANNEL
ILQ-74 QUAD CHANNEL
PHOTOTRANSISTOR OPTO-ISOLATOR



FEATURES

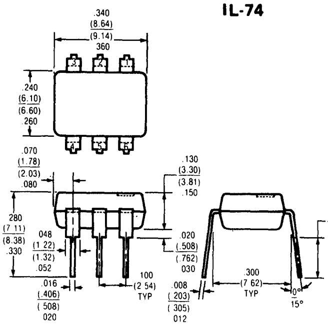
- 7400 series T^2L compatible
- 1500 volt breakdown voltage
- 35% typical transfer ratio
- 0.5 pF coupling capacitance
- Industry standard dual-in-line package
- Single channel, dual, and quad configurations
- Underwriters Lab Approval #E52744

DESCRIPTION

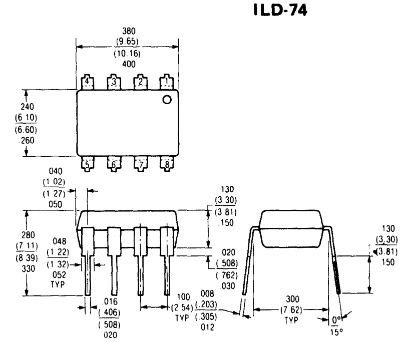
IL-74 is an optically coupled pair employing a Gallium Arsenide infrared LED and a silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. The IL-74 is especially designed for driving medium-speed logic, where it may be used to eliminate troublesome ground loop and noise problems. It can also be used to replace relays and transformers in many digital interface applications, as well as analog applications such as CRT modulation. The ILD-74 offers two isolated channels in a single DIP package while the ILQ-74 provides four isolated channels per package.

Package Dimensions in Inches (mm)

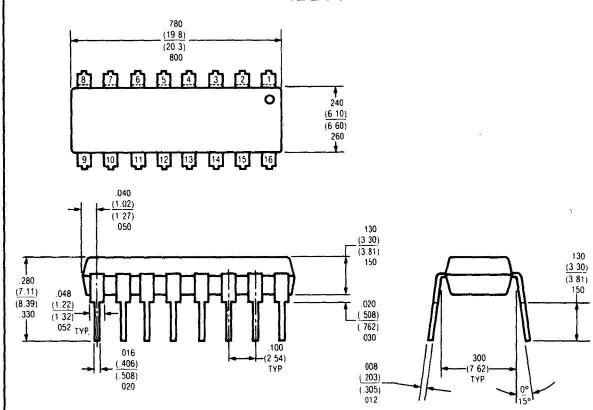
IL-74



ILD-74



ILQ-74



Specifications subject to change without notice.

MAXIMUM RATINGS

Gallium Arsenide LED (each channel)

Power Dissipation @ 25°C	150 mW
Derate Linearly from 25°C	1.33 mW/°C
Continuous Forward Current	100 mA
Peak Inverse Voltage	3.0V

Detector-Silicon Phototransistor (each channel)

Power Dissipation @ 25°C	150 mW
Derate Linearly from 25°C	2.0 mW/°C
Collector-Emitter Breakdown Voltage (BV_{CEO})	20V

Package

Total Package Dissipation at 25°C Ambient (LED Plus Detector)

IL-74	200 mW
ILD-74	400 mW
ILQ-74	500 mW

Derate Linearly From 25°C

IL-74	3.3 mW/°C
ILD-74	5.33 mW/°C
ILQ-74	6.67 mW/°C
Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Lead Soldering Time @ 260°C	10 sec

ELECTRICAL CHARACTERISTICS PER CHANNEL (at 25°C Ambient)

Parameter	Min	Typ	Max	Units	Test Conditions
Gallium Arsenide LED					
Forward Voltage		1.3		V	$I_F = 100$ mA
Reverse Current		0.1		μA	$V_R = 3.0V$
Capacitance		100		pF	$V_R = 0$
Phototransistor Detector					
BV_{CEO}	20	50		V	$I_C = 1$ mA
I_{CEO}		5.0	500	nA	$V_{CE} = 5V, I_F = 0$
Collector-Emitter Capacitance		2.0		pF	$V_{CE} = 0$
Coupled Characteristics					
DC Current Transfer Ratio	0.125	0.35			$I_F = 16$ mA, $V_{CE} = 5V$
V_{SAT}		0.3	0.5	V	$I_C = 2$ mA, $I_F = 16$ mA
Capacitance, Input to Output		0.5		pF	
Breakdown Voltage	1500			VDC	
Resistance, Input to Output		100		GΩ	
Propagation Delay					
$t_{D\,ON}$		6.0		μs	$R_L = 2.4K\Omega, V_{CE} = 5V$
$t_{D\,OFF}$		25		μs	$I_F = 16$ mA

Specifications subject to change without notice.

TYPICAL OPTOELECTRONIC CHARACTERISTIC CURVES FOR EACH CHANNEL

FIGURE 1. RELATIVE OUTPUT VS TEMPERATURE

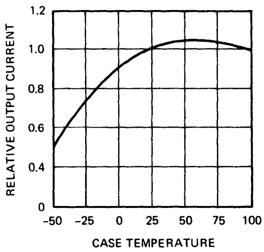


FIGURE 2. DARK CURRENT VS TEMPERATURE

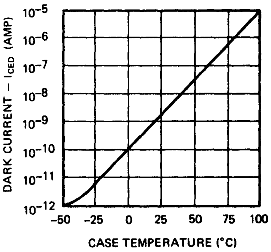


FIGURE 3. TRANSFER CHARACTERISTICS

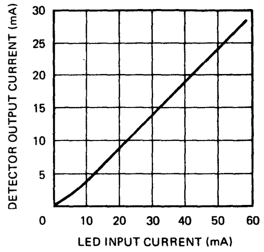


FIGURE 4. DETECTOR OUTPUT CHARACTERISTICS

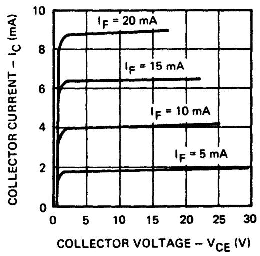
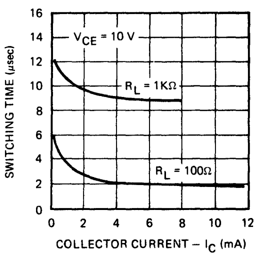


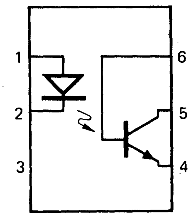
FIGURE 5. SWITCHING TIME VS COLLECTOR CURRENT



PIN CONFIGURATIONS

IL-74

(TOP VIEW)

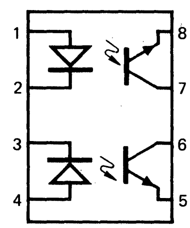


LED CHIP ON PIN 2
PT CHIP ON PIN 5

PIN NO.	FUNCTION
1	ANODE
2	CATHODE
3	NC
4	EMITTER
5	COLLECTOR
6	BASE

ILD-74

(TOP VIEW)

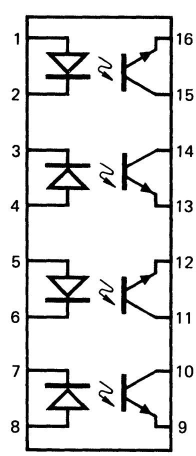


LED CHIPS ON PINS 2 AND 3
PT CHIPS ON PINS 6 AND 7

PIN NO.	FUNCTION
1	ANODE
2	CATHODE
3	CATHODE
4	ANODE
5	EMITTER
6	COLLECTOR
7	COLLECTOR
8	EMITTER

ILQ-74

(TOP VIEW)



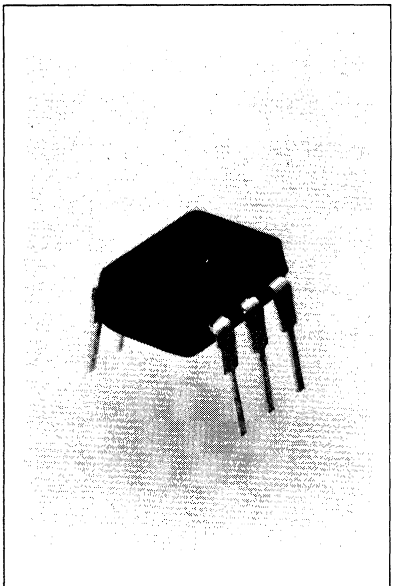
LED CHIPS ON PINS 2, 3, 6, 7
PT CHIPS ON PINS 10, 11, 14, 15

PIN NO.	FUNCTION
1	ANODE
2	CATHODE
3	CATHODE
4	ANODE
5	ANODE
6	CATHODE
7	CATHODE
8	ANODE
9	EMITTER
10	COLLECTOR
11	COLLECTOR
12	EMITTER
13	EMITTER
14	COLLECTOR
15	COLLECTOR
16	EMITTER

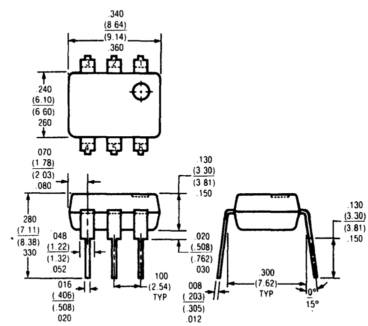
litronix
A Siemens Company

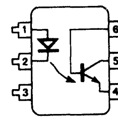
IL-201, IL-202, IL-203

PHOTOTRANSISTOR OPTO-ISOLATOR



Package Dimensions in Inches (mm)





PIN NO.
1 ANODE
2 CATHODE
3 N/C
4 EMITTER
5 COLLECTOR
6 BASE

Maximum Ratings

Gallium Arsenide LED
- Power Dissipation @ 25°C . . . . 200 mW
- Derate Linearly from 25°C . . . . 2.6 mW/°C
- Continuous Forward Current . . . . 100 mA
- Peak Inverse Voltage . . . . 6.0 V

Detector (Silicon Phototransistor)
- Power Dissipation @ 25°C . . . . 200 mW
- Derate Linearly From 25°C . . . . 2.6 mW/°C
- Collector-Emitter Breakdown Voltage (BV_{CEO}) . . . . 30 V
- Emitter-Collector Breakdown Voltage (BV_{ECO}) . . . . 7 V
- Collector-Base Breakdown Voltage (BV_{CBO}) . . . . 70 V

Package
- Total Package Dissipation at 25°C Ambient (LED Plus Detector) . . . . 250 mW
- Derate Linearly From 25°C . . . . 3.3 mW/°C
- Storage Temperature . . . . −55 to +150°C
- Operating Temperature. . . . . −55 to +100°C
- Lead Soldering Time @ 260°C. . . . . 10 sec

Electrical Characteristics (0°C – 70°C unless otherwise specified)

Parameter	Min	Typ	Max	Unit	Test Condition
Gallium Arsenide LED					
Forward Voltage V_F		1.2	1.5	V	I_F = 20 mA
Forward Voltage V_F		1.0	1.2	V	I_F = 1 mA
Reverse Current I_R		0.01	10	µA	V_R = 6 V, T_A = 25°C
Breakdo· Voltage V_R	6	20		V	I_R = 10 µA
Phototransistor Detector					
H_{FE}	100	200			V_{CE} = 5V, I_C = 100 µA
BV_{CEO}	30	50		V	I_C = 1 mA
BV_{ECO}	7	10		V	I_C = 100 µA
BV_{CBO}	70	90		V	I_C = 100 µA
I_{CEO}		5	50	NA	V_{CE} = 10 V, T_A = 25°C
Coupled Characteristics					
Base Current Transfer Ratio (BTR)	0.15			%	I_F = 10 mA, V_{CE} = 10 V
$V_{CE\ (sat)}$			0.4	V	I_F = 10 mA, I_C = 2 mA
DC Current Transfer Ratio (CTR)					
IL-201	75	100	150	%	I_F = 10 mA
IL-202	125	200	250	%	V_{CE} = 10 V
IL-203	225	300	450	%	
DC Current Transfer Ratio (CTR)					
IL-201	10			%	I_F = 1 mA
IL-202	30			%	V_{CE} = 10 V
IL-203	50			%	
Input to Output Isolation Voltage	5000			V	D.C.

Specifications subject to change without notice.

FEATURES

- **5000 Volt Breakdown Voltage**
- **High Current-Transfer-Ratio (75%–450%)**
- **Long Term Stability**
- **Industry Standard Dual-In-Line**
- **1 mA Current-Transfer-Ratio Guarantee**
- **Underwriters Lab Approval #E52744**

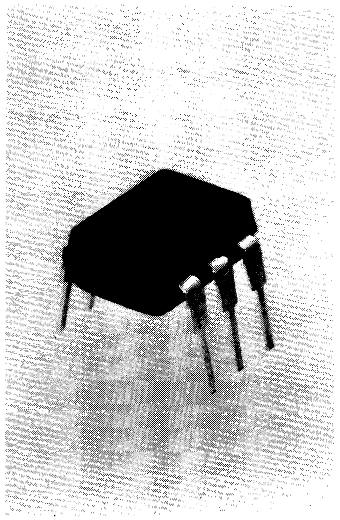
DESCRIPTION

IL-201, IL-202, IL-203 are optically coupled pairs employing a Gallium Arsenide infrared LED and a silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. The IL-201, IL-202, IL-203 can be used to replace relays and transformers in many digital interface applications, as well as analog applications such as CRT modulation.

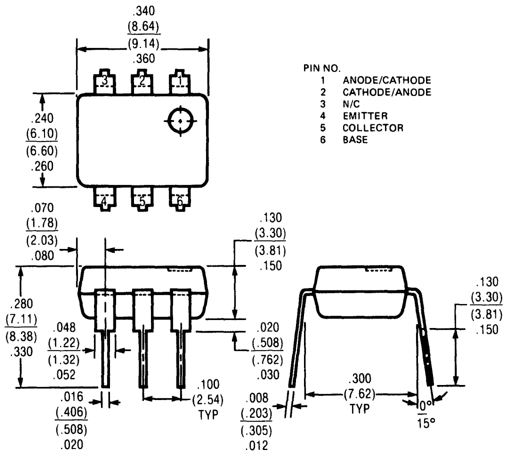
litronix
A Siemens Company

IL-501, IL-505, IL-512

PHOTOTRANSISTOR OPTO-ISOLATOR



Package Dimensions in Inches (mm)



FEATURES

- **5000 Volt Breakdown Voltage**
- **IL-501 — 35% Typical CTR**
- **IL-505 — 70% Typical CTR**
- **IL-512 — 20% Typical CTR**
- **Standard Dual-In-Line Package**
- **Underwriters Lab Approval #E52744**

DESCRIPTION

The IL-501/505/512 is an optically coupled pair employing a gallium arsenide infrared LED and a silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. They can be used to replace relays and transformers in many digital interface applications, as well as analog applications such as CRT modulation.

Maximum Ratings

Gallium Arsenide LED

- Power Dissipation @ 25 °C .... 200 mW
- Derate Linearly from 25 °C .... 2.6 mW/ °C
- Continuous Forward Current .... 100 mA
- Peak Inverse Voltage .... 3.0 V

Detector (Silicon Phototransistor)

- Power Dissipation @ 25 °C .... 200 mW
- Derate Linearly from 25 °C .... 2.6 mW/ °C
- Collector-Emitter Breakdown Voltage (BV_{CEO}) .... 30 V
- Emitter-Collector Breakdown Voltage (BV_{ECO}) .... 7 V
- Collector-Base Breakdown Voltage (BV_{CBO}) .... 70 V

Package

- Total Package Dissipation @ 25 °C Ambient (LED Plus Detector) .... 250 mW
- Derate Linearly from 25 °C .... 3.3 mW/ °C
- Storage Temperature .... −55 to +150 °C
- Operating Temperature .... −55 to +100 °C
- Lead Soldering Time @ 260 °C .... 10 sec

Specifications subject to change without notice.

Electrical Characteristics (@ 25 °C Ambient)

Parameter	Min	Typ	Max	Unit	Test Condition
Gallium Arsenide LED					
Forward Voltage					
IL-501/505	—	1.3	1.5	V	$I_F = 60$ mA
IL-512	—	1.2	1.5	V	$I_F = 10$ mA
Reverse Current					
IL-501/505	—	0.1	10	μA	$V_R = 3.0$ V
IL-512	—	1.0	100	μA	$V_R = 3.0$ V
Capacitance	—	100	—	pF	$V_R = 0$ V
Phototransistor Detector					
HFE					
IL-501/505	—	450	—	—	$I_C = 100$ μA
IL-512	50	—	—	—	$V_{CE} = 5.0$ V
BV_{CEO}					
IL-501/505	30	50	—	V	$I_C = 1$ mA
IL-512	20	60	—	V	$I_C = 1$ mA
BV_{ECO}					
IL-501/505	7	10	—	V	$I_E = 100$ μA
IL-512	4	10	—	V	$I_E = 100$ μA
I_{CEO} (Dark)					
IL-501/505	—	5	50	nA	$V_{CE} = 10$ V
IL-512	—	50	250	nA	$V_{CE} = 5$ V
Capacitance					
Collector-Emitter	—	2	—	pF	$V_{CE} = 0$ V
Output Rise and Fall Times	—	2	—	μs	$I_F = 10$ mA, $V_{CE} = 10$ V
Coupled Characteristics					
Collector-Emitter Saturation					
Voltage $V_{CE(sat)}$					
IL-501/505	—	0.3	0.5	V	$I_F = 16$ mA, $I_C = 1.6$ mA
IL-512	—	0.3	0.5	V	$I_F = 50$ mA, $I_C = 2$ μA
DC Current Transfer Ratio					
IL-501	0.2	0.35	—	—	$I_F = 10$ mA, $V_{CE} = 10$ V
IL-505	0.5	0.70	—	—	$I_F = 10$ mA, $V_{CE} = 10$ V
IL-512	0.1	0.2	—	—	$I_F = 10$ mA, $V_{CE} = 5$ V
Breakdown Voltage	5000	7000	—	VDC	t = 1 Min
Resistance, Input-to-Output	—	10^{12}	—	Ω	$V_{1-0} = 500$ V
Capacitance, Input-to-Output	—	0.5	—	pF	

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. RELATIVE OUTPUT VS TEMPERATURE

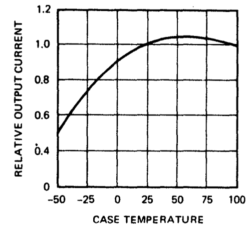


FIGURE 2. DARK CURRENT VS TEMPERATURE

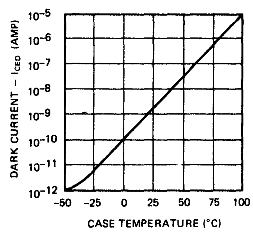


FIGURE 3. TRANSFER CHARACTERISTICS

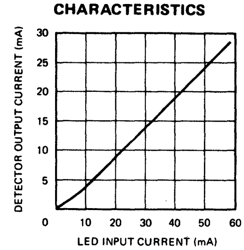


FIGURE 4. DETECTOR OUTPUT CHARACTERISTICS

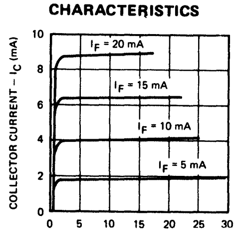
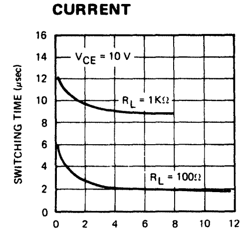


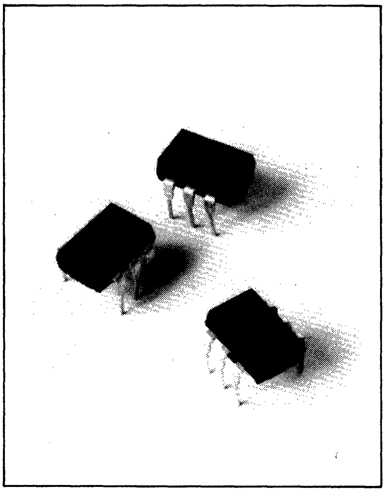
FIGURE 5. SWITCHING TIME VS COLLECTOR CURRENT



litronix
A Siemens Company

SFH 600 SERIES

SINGLE CHANNEL PHOTOTRANSISTOR OPTO-ISOLATOR



FEATURES

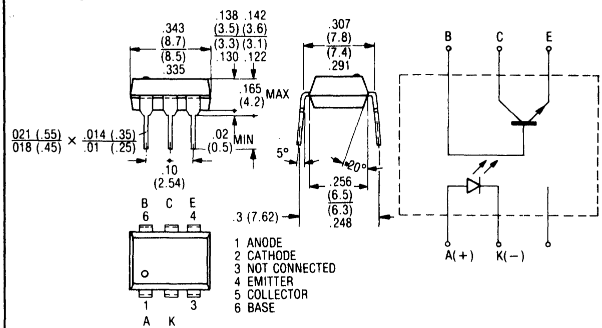
- **High Quality Premium Device**
- **Long Term Stability**
- **High Current Transfer Ratio, 4 Groups**
  SFH 600-0, 40 to 80%
  SFH 600-1, 63 to 125%
  SFH 600-2, 100 to 200%
  SFH 600-3, 160 to 320%
- **2800 Volt Isolation (1 Minute)**
- **Storage Temperature −55 to +150°C**
- **VCE SAT 0.25 (<0.4) Volt $I_F = 10$ mA, $I_C = 2.5$ mA**

DESCRIPTION

The optoelectronic coupler SFH 600 comprises a GaAs LED as the emitter which is optically coupled with a silicon planar phototransistor as the detector. The component is located in a plastic plug-in case 20 AB DIN 41866.

The coupler allows to transfer signals between two electrically isolated circuits. The potential difference between the circuits to be coupled is not allowed to exceed the maximum permissable insulating voltage.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse Voltage (V_R)	6 V
Forward Current (I_F)	60 mA
Surge Current (I_{FS}), $t_p = 10\ \mu s$	1.5 A
Power Dissipation (P_{tot})	100 mW
Detector (Silicon Phototransistor)	
Collector-Emitter Voltage (C_{CEO})	70 V
Emitter-Base Reverse Voltage (V_{EBO})	7 V
Collector Current (I_C)	50 mA
Collector Current (I_{CS}), t = 1 ms	100 mA
Power Dissipation (P_{tot})	150 mW
Coupler	
Storage Temperature (T_{stor})	−55 to +150°C
Ambient Temperature (T_{amb})	−55 to +100°C
Junction Temperature (T_j)	100°C
Soldering Temperature (T_L), 1 Min.	260°C
Isolation Test Voltage (1 Min.) (V_{is}) (between emitter and detector referred to standard climate 23/50 DIN 50014)	2800 V−
Tracking Resistance	Min. 8.2 mm
Air Path	Min. 7.6 mm

Tracking Resistance
Group III (KC = >600) in accordance with VDE0110 § 6
Table 3 and DIN 53480/VDE0303, Part 1
As to nominal isolation voltage DIN57883 or VDC0883 applies.

Isolation Voltage (R_{is}) at $V_{is} = 500$ V	$10^{11}\ \Omega$

Climatic Conditions
DIN 40040, Humidity Class F

Flammability
DIN57471 or VDE0471, Part 2, of April 1975 or MIL-202E, Method 11A

Characteristics ($T_{amb} = 25$ °C)

Emitter (GaAs LED)	
Forward Voltage (V_F), $I_F = 60$ mA	1.25 (≤1.65) V
Breakdown Voltage (V_{BR}), $I_R = 100\ \mu A$	30 (≥6) V
Reverse Current (I_R), $V_R = 3$ V	0.01 (≤10) μA
Capacitance (C_O), $V_R = 0V$, f = 1 MHz	40 pF
Thermal Resistance ($R_{th\ Jamb}$)	750 K/W
Detector (Silicon Phototransistor)	
Capacitance, ($V_{CE} = 5$ V, f = 1 MHz)	
C_{CE}	5.2 pF
C_{CB}	6.5 pF
C_{EB}	9.5 pF
Thermal Resistance ($R_{th\ Jamb}$)	500 K/W

Specifications subject to change without notice.

Characteristics (Continued)

Coupler

Collector-Emitter Saturation Voltage ($V_{CE\ sat}$)

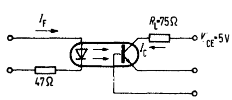
$I_f = 10$ mA. $I_C = 2.5$ mA) .... 0.25 (≤0.4) V

Coupling Capacitance (C_K) .... 0.55 pF

The couplers are grouped in accordance with their current ratio $\frac{I_C}{I_F}$ at $I_F = 10$ mA and $V_{CE} = 5$ V and marked by Roman numerals.

Group	0	1	2	3	
$\frac{I_C}{I_F}$	40-80	63-125	100-200	160-320	%
Collector-Emitter Leakage Current ($V_{CE} = 10$ V) I_{CEO}	2 (≤35)	2 (≤35)	2 (≤35)	5 (≤70)	nA

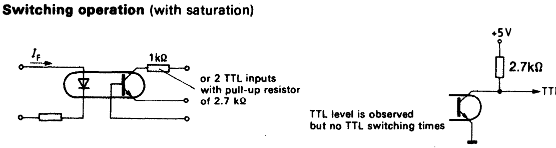
Linear operation (without saturation)



Load Resistance (R_L)	75	Ω
Delay Time (t_d)	3.2 (<4.6)	μs
Rise Time (t_r)	2 (≤3)	μs
Storage Time (t_s)	3.0 (<4.0)	μs
Fall Time (t_f)	2.5 (≤3.3)	μs
Cut-off Frequency (f_g)	250	kHz

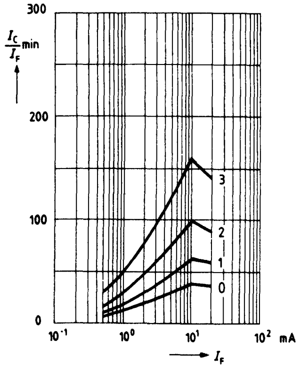
I_F = 10 mA
V_{CE} = 5 V
T_{amb} = 25°C

Switching operation (with saturation)

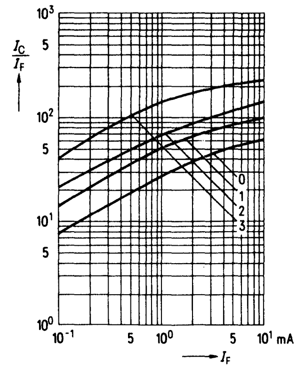


Group	**0**	**1 and 2**	**3**	
	$I_F = 20$ mA	**$I_F = 10$ mA**	**$I_F = 5$ mA**	
Switch-On Time (t_{ein})	3.7 (≤5.8)	4.5 (≤6.2)	5.8 (≤8.0)	μs
Rise Time (t_r)	2.5 (≤4.0)	3 (≤4.2)	4 (≤5.5)	μs
Switch-Off Time (t_{aus})	19 (≤25)	21 (≤27)	24 (≤31)	μs
Fall Time (f_f)	11 (≤14)	12 (≤15)	14 (≤18)	μs
$V_{CE\ sat}$	0.25 (≤0.4)			V

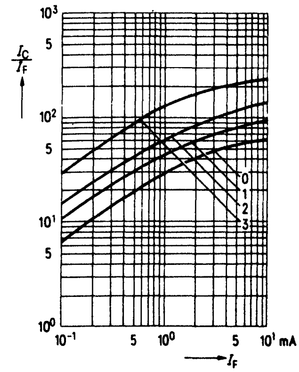
Minimum current transfer ratio as a function of diode current (T_{amb} = 25°C, V_{CE} = 5 V) $\frac{I_C}{I_F} = f(I_F)$



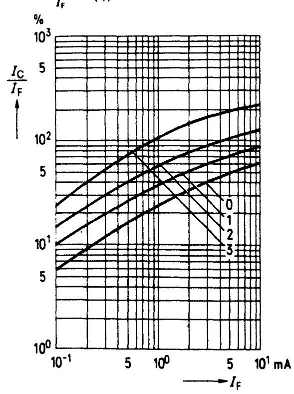
Current transfer ratio as a function of diode current (T_{amb} = −25°C) $\frac{I_C}{I_F} = f(I_F)$ V_{CE} = 5 V



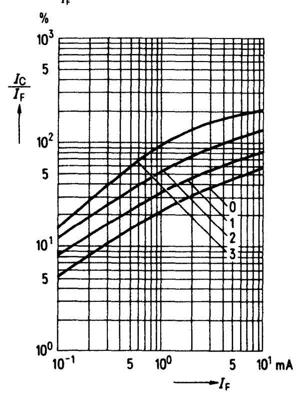
Current transfer ratio as a function of diode current (T_{amb} = 0°C) $\frac{I_C}{I_F} = f(I_F)$ V_{CE} = 5 V



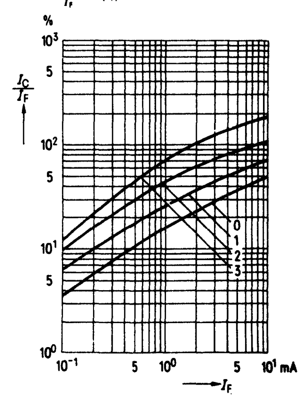
Current transfer ratio as a function of diode current (T_{amb} = 25°C) $\frac{I_C}{I_F} = f(I_F)$ V_{CE} = 5 V



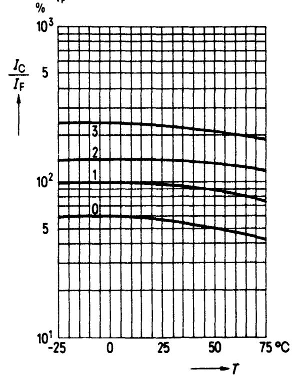
Current transfer ratio as a function of diode current (T_{amb} = 50°C) $\frac{I_C}{I_F} = f(I_F)$ V_{CE} = 5 V



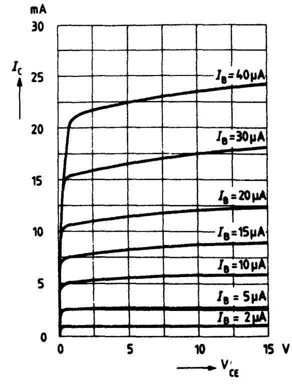
Current transfer ratio as a function of diode current (T_{amb} = 75°C) $\frac{I_C}{I_F} = f(I_F)$ V_{CE} = 5 V

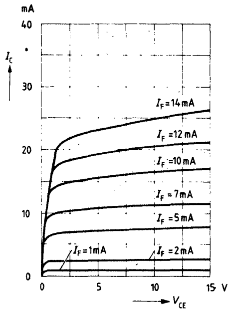


Current transfer ratio as a function of temperature $\frac{I_C}{I_F} = f(T)$ (I_F = 10 mA, V_{CE} = 5 V)

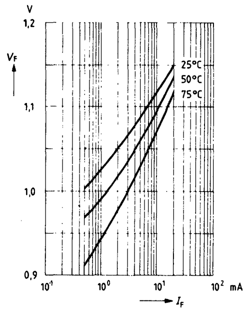


Transistor characteristics (B = 550) $I_C = f(V_{CE})$ (T_{amb} = 25 °C, I_F = 0) **Group 2 & 3**

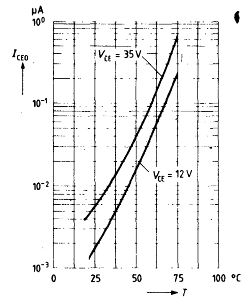




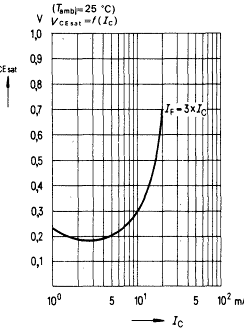
Output characteristics $I_C = f(V_{ce})$
(T_{amb} = 25 °C) Group 2 & 3



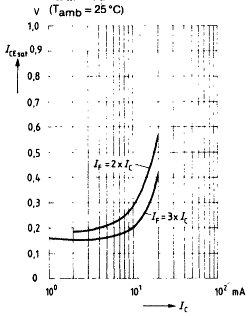
Forward voltage $V_F = f(I_F)$



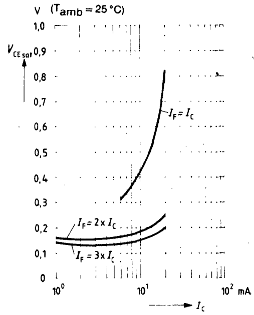
Collector-emitter off-state current
$I_{CEO} = f(V, T)$
(T_{amb} = 25 °C, I_F = 0)



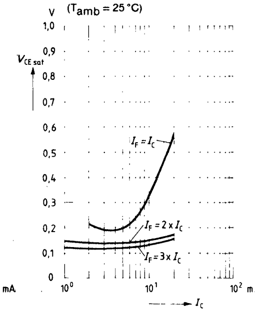
Saturation voltage as a function of collector current and modulation depth for SFH 600-0
(T_{amb} = 25 °C)
$V_{CEsat} = f(I_C)$



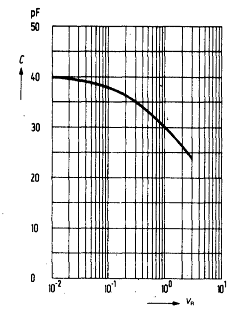
Saruration voltage as a function of collector current and modulation depth for SFH 600-I
$V_{CE\,sat} = f(I_c)$
(T_{amb} = 25 °C)



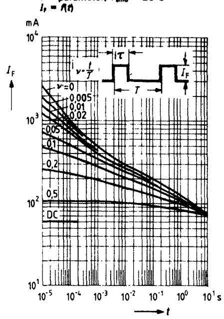
Saturation voltage as a function of collector current and modulation depth for SFH 600-2
$V_{CE\,sat} = f(I_c)$
(T_{amb} = 25 °C)



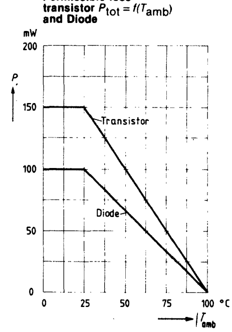
Saturation voltage as a function of collector current and modulation depth for SFH 600-3
$V_{CE\,sat} = f(I_c)$
(T_{amb} = 25 °C)



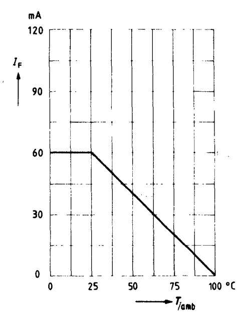
Diode capacitance $C = f(V_R)$
(T_{amb} = 25 °C, f = 1 MHz)



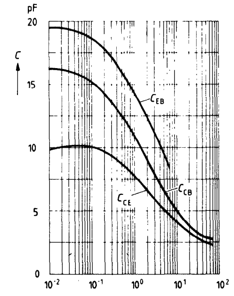
Permissible pulse load
v = parameter, T_{amb} = 25°C
$I_F = f(t)$



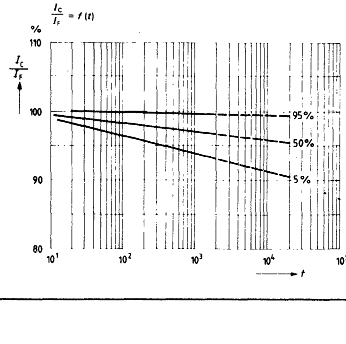
Permissible loss transistor $P_{tot} = f(T_{amb})$ and Diode



Permissible loss diode $P_{tot} = f(T_{amb})$



Transistor capacitances $C = f(V_o)$
(T_{amb} = 25 °C; f = 1 MHz)



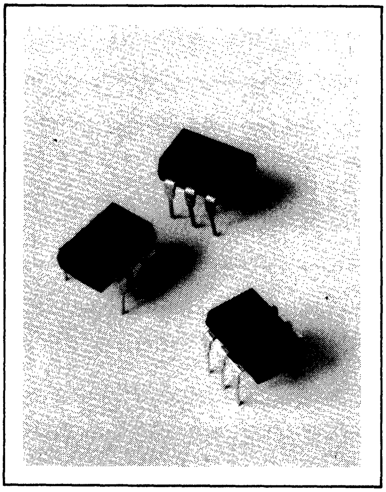
Variation of current transfer ratio as a function of load time
$\frac{I_C}{I_F} = f(t)$

V_{CE} = 5 V
R_L = 1kΩ
T_{amb} = 60°C
I_F = 30 mA = measurement current
R_{thJamb} = 750 K/W
Propability S = 60%

litronix
A Siemens Company

SFH 601 SERIES

SINGLE CHANNEL PHOTOTRANSISTOR OPTO-ISOLATOR



FEATURES

- **Highest Quality Premium Device**
- **Built to Conform to VDE Requirements**
- **Long Term Stability**
- **High Current Transfer Ratios, 4 Groups**
  SFH 601-1, 40 to 80%
  SFH 601-2, 63 to 125%
  SFH 601-3, 100 to 200%
  SFH 601-4, 160 to 320%
- **5300 Volt Isolation (1 Minute)**
- **Storage Temperature −40° to +150°C**
- **V_{CEsat} 0.25 (<0.4) Volt**
  I_F = 10 mA, I_C = 2.5 mA

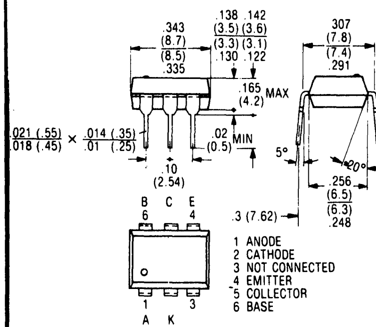
DESCRIPTION

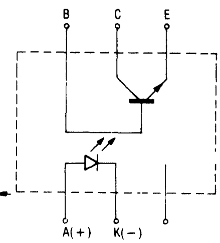
The optoelectronic coupler SFH 601 comprises a GaAs LED as the emitter which is optically coupled with a silicon planar phototransistor as the detector. The component is located in a plastic plug-in case 20 AB DIN 41866.

The coupler allows to transfer signals between two electrically isolated circuits. The potential difference between the circuits to be coupled is not allowed to exceed the maximum permissible insulating voltage.

VDE test symbol will be applied for.

Package Dimensions in Inches (mm)





Maximum Ratings

Reverse Voltage (V_R)	6 V
Forward Current (I_F)	60 mA
Surge Current (I_{FS}), t_p = 10 μs	1.5 A
Power Dissipation (P_{tot})	100 mW
Detector (Silicon Phototransistor)	
Collector-Emitter Voltage (V_{CEO})	70 V
Emitter-Base Reverse Voltage (V_{EBO})	7 V
Collector Current (I_C)	50 mA
Collector Current (I_{CS}), t = 1 ms	100 mA
Power Dissipation (P_{tot})	150 mW
Coupler	
Storage Temperature (T_{stor})	−40 to +150 °C
Ambient Temperature (T_{amb})	−40 to +100 °C
Junction Temperature (T_j)	100 °C
Soldering Temperature (T_L), 10 s Max.	260 °C
Isolation Test Voltage (V_{is}), 1 Min. (between emitter and detector referred to standard climate 23/50 DIN 50014)	5300 V–
Tracking Resistance	Min. 8.2 mm
Air Path	Min. 7.6 mm
Tracking Resistance	
Group III (KC = >600) in accordance with VDE 0110 § 6 Table 3 and DIN 53480/VDE 0303, Part 1.	
As to nominal isolation voltage DIN 57883 or VDE 0883 applies.	
Isolation Voltage (R_{is}), @ V_{is} = 500 V	10^{11} Ω
Climatic Conditions	
DIN 40040, humidity Class F	
Flammability	
DIN 57471 or VDE 0471, Part 2, of April 1975 or MIL202E, Method 11 A	

Characteristics (T_{amb} = 25 °C)

Emitter (GaAs LED)	
Forward Voltage (V_F), I_F = 60 mA	1.25 (≤1.65) V
Breakdown Voltage (V_{BR}), I_R = 100 μA	30 (≥6) V
Reverse Current (I_R), V_R = 3 V	0.01 (≤10) μA
Capacitance (C_O) (V_R = 0 V; f = 1 MHz)	40 pF
Thermal Resistance (R_{thJamb})	750 K/W
Detector (Silicon Phototransistor)	
Capacitance (V_{CE} = 5 V; f = 1 MHz)	
C_{CE}	6.8 pF
C_{CB}	8.5 pF
C_{EB}	11 pF
Thermal Resistance (R_{thJamb})	500 K/W

Specifications subject to change without notice.

Characteristics (Continued)

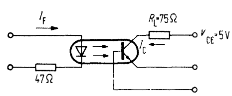
Coupler

Collector-Emitter Saturation Voltage (V_{CEsat})
($I_F = 10$ mA, $I_C = 2.5$ mA) .... 0.25 (<0.4) V
Coupling Capacitance (C_K) .... 0.30 pF

The couplers are grouped in accordance with their current ratio $\frac{I_C}{I_F}$ at $I_F = 10$ mA and $V_{CE} = 5$ V and marked by numbers.

Group	1	2	3	4	
$\frac{I_C}{I_F}$	40-80	63-125	100-200	160-320	%
Collector-Emitter Leakage Current ($V_C = 10$ V), I_{CEO}	2 (<50)	2 (<50)	5 (<100)	5 (<100)	nA

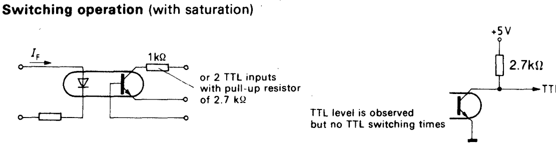
Linear operation (without saturation)



Load Resistance (R_L)	75	Ω
Delay Time (t_d)	3.0 (≤5.6)	μs
Rise Time (t_r)	2.0 (≤4.0)	μs
Storage Time (t_s)	2.3 (≤4.1)	μs
Fall Time (t_f)	2.0 (≤3.5)	μs
Cut-off Frequency (f_g)	250	kHz

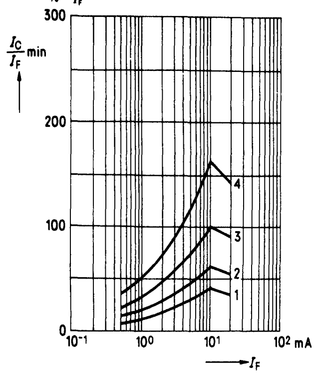
I_F = 10 mA
V_{CE} = 5 V
T_{amb} = 25°C

Switching operation (with saturation)

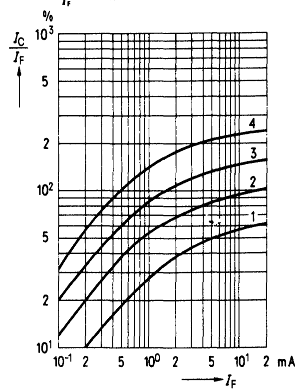


Group	1	2 and 3	4	
	$I_F = 20$ mA	**$I_F = 10$ mA**	**$I_F = 5$ mA**	
Switch-On Time (t_{ein})	3.0 (≤5.5)	4.2 (≤8.0)	6.0 (≤10.5)	μs
Rise Time (t_r)	2.0 (≤4.0)	3.0 (≤6.0)	4.6 (≤8.0)	μs
Switch-Off Time (t_{off})	18 (≤34)	23 (≤39)	25 (≤43)	μs
Fall Time (t_f)	11 (≤20)	14 (≤24)	15 (≤26)	μs
$V_{CE\ sat}$		0.25 (≤0.4)		V

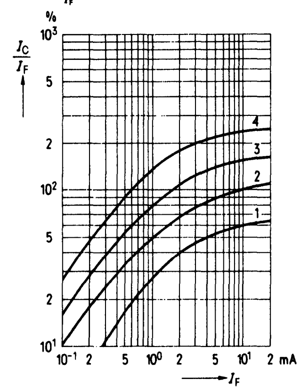
Minimum current transfer ratio as a function of diode current
(T_{amb} = 25°C, V_{CE} = 5 V)
$\frac{I_C}{I_F} = f(I_F)$



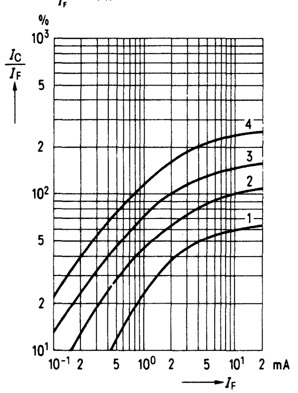
Current transfer ratio as a function of diode current (T_{amb} = −25°C)
$\frac{I_C}{I_F} = f(I_F)$ V_{CE} = 5 V



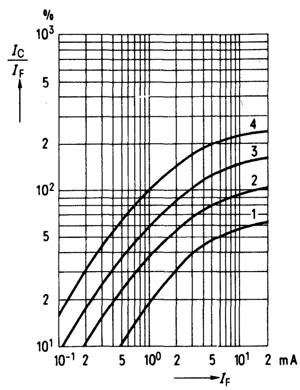
Current transfer ratio as a function of diode current (T_{amb} = 0°C)
$\frac{I_C}{I_F} = f(I_F)$ V_{CE} = 5 V



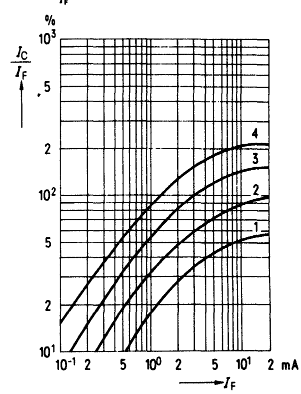
Current transfer ratio as a function of diode current (T_{amb} = 25°C)
$\frac{I_C}{I_F} = f(I_F)$ V_{CE} = 5 V



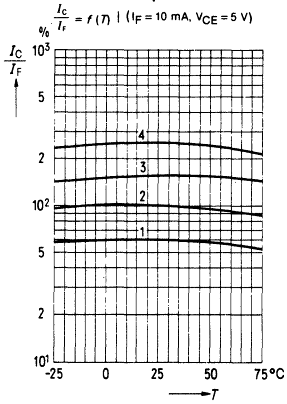
Current transfer ratio as a function of diode current (T_{amb} = 50°C)
$\frac{I_C}{I_F} = f(I_F)$ V_{CE} = 5 V



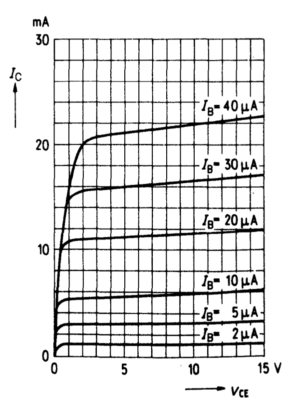
Current transfer ratio as a function of diode current (T_{amb} = 75°C)
$\frac{I_C}{I_F} = f(I_F)$ V_{CE} = 5 V



Current transfer ratio as a function of temperature
$\frac{I_C}{I_F} = f(T)$ | (I_F = 10 mA, V_{CE} = 5 V)

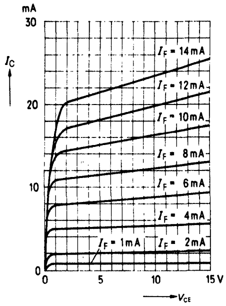


Transistor characteristics (B = 550)
$I_C = f(V_{CE})$ (T_{amb} = 25 °C, I_F = 0)

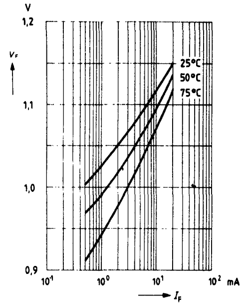


Output characteristics $I_C = f(V_{CE})$

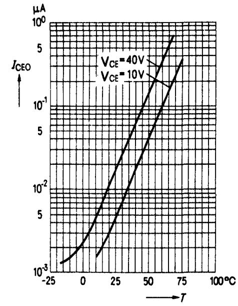
($T_{amb} = 25\,°C$)



Forward voltage $V_F = f(I_F)$



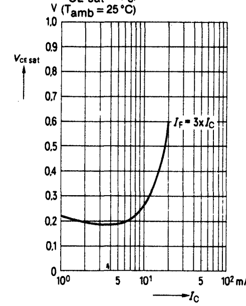
Collector-emitter off-state current $I_{CEO} = f(V, T)$ ($T_{amb} = 25\,°C$, $I_F = 0$)



Saturation voltage as a function of collector current and modulation depth for SFH 601-1

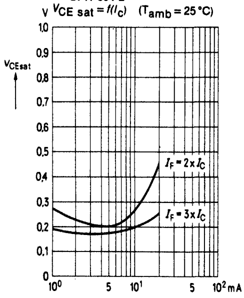
$V_{CE\,sat} = f(I_C)$

V ($T_{amb} = 25\,°C$)



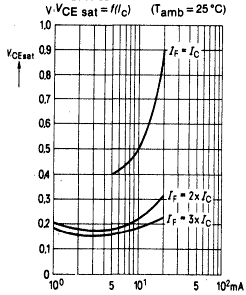
Saruration voltage as a function of collector current and modulation depth for SFH 601-2

V $V_{CE\,sat} = f(I_C)$ ($T_{amb} = 25\,°C$)



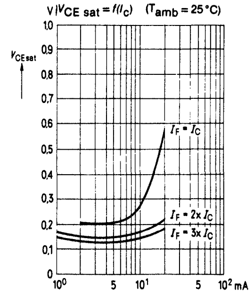
Saturation voltage as a function of collector current and modulation depth for SFH 601-3

V $V_{CE\,sat} = f(I_C)$ ($T_{amb} = 25\,°C$)



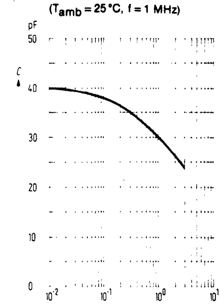
Saturation voltage as a function of collector current and modulation depth for SFH 601-4

V $V_{CE\,sat} = f(I_C)$ ($T_{amb} = 25\,°C$)

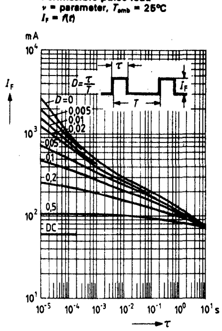


Diode capacitance $C = f(V_R)$

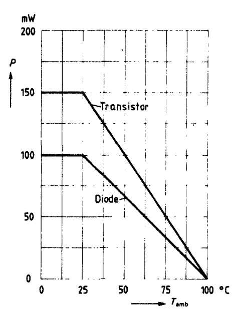
($T_{amb} = 25\,°C$, f = 1 MHz)



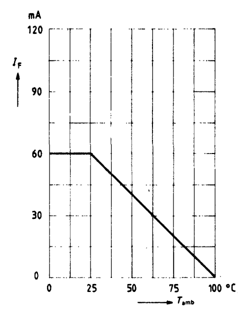
Permissible pulse load
v = parameter, T_{amb} = 25°C
$I_F = f(t)$



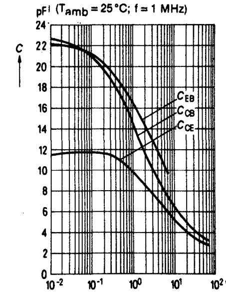
Permissible loss transistor $P_{tot} = f(T_{amb})$



Permissible loss diode $P_{tot} = f(T_{amb})$

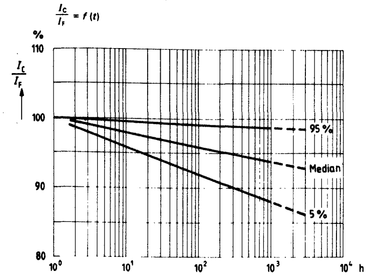


Transistor capacitances $C = f(V_0)$



Variation of current transfer ratio as a function of load time

$\frac{I_C}{I_F} = f(t)$

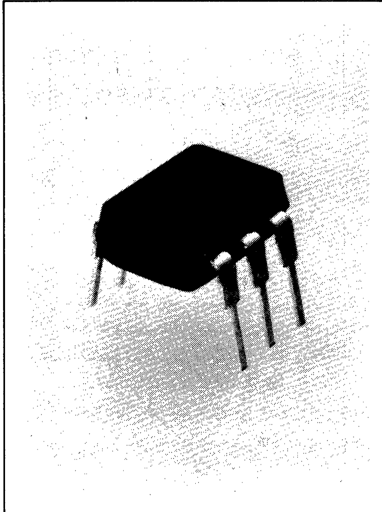


V_{CE} = 5 V
R_L = 1kΩ
T_{amb} = 60°C
I_F = 30 mA = measurement current
R_{thJamb} = 750 K/W
Propability S = 60%

litronix
A Siemens Company

4N25, 4N26, 4N27, 4N28

PHOTOTRANSISTOR OPTO-ISOLATORS



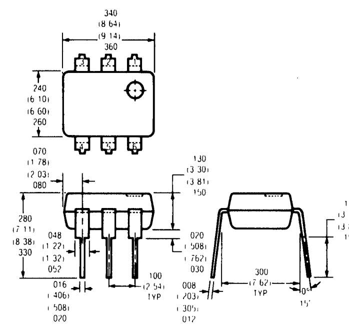
FEATURES

- **2500 Volt Breakdown Voltage**
- **High DC Current Transfer Ratio**
- **I/O Compatible with Integrated Circuits**
- **0.5pF Coupling Capacitance**
- **Underwriter Lab Approval #E52744**

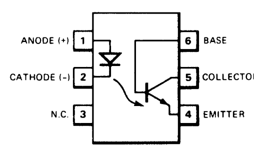
DESCRIPTION

The LITRONIX 4N25, 4N26, 4N27, and 4N28 series are optically coupled pairs, each consisting of a Gallium Arsenide infrared LED and a silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. They can be used to replace relays and transformers in many digital interface applications. They have excellent frequency response when used in analog applications.

Package Dimensions in Inches (mm)



CONNECTION DIAGRAM DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Absolute Maximum Ratings:

Gallium Arsenide LED:
- *Power Dissipation @ 25°C 150mW
- *Derate Linearly from 25°C . . . . 2.0 mW/°C
- *Continuous Forward Current 80mA
- *Forward Current Peak (1μs pulse, 300 pps) . . . . . 3.0 A
- *Peak Inverse Voltage 3.0V

Detector (Silicon Photo-Transistor)
- *Power Dissipation @ 25°C 150mW
- *Derate Linearly from 25°C . . . . 2.0mW/°C
- *Collector-Emitter Breakdown Voltage (BV_{CEO}) . . . 30V
- *Emitter-Collector Breakdown Voltage (BV_{CBO}) . . 7.0 V
- *Collector-Base Breakdown Voltage 70V

Package
- *Total Package Dissipation @ 25°C Ambient (equal power in each element) 250mW
- *Derate Linearly from 25°C . . . . 3.3mW/°C
- *Storage Temperature . . . . –55°C to +150°C
- *Operating Temperature . . . . –55°C to +100°C
- *Lead Soldering Time @ 260°C . . . . 10 sec.

*indicates JEDEC registered values

Specifications subject to change without notice.

ELECTRICAL CHARACTERISTICS

PARAMETERS (at 25° Ambient)

Parameter	Min	Typ	Max	Unit	Test Condition
Gallium Arsenide LED					
*Forward Voltage . .		1.3	1.5	V	I_F=50mA
*Reverse Current . .		0.1	100	μA	V_R=3.0V
Capacitance.		100		pF	V_R=0
Photo-transistor Detector					
H_{FE}		150			V_{CE}=5.0V
*BV_{CEO}	30			V	I_C=1mA
*BV_{ECO}	7			V	I_E=100μA
*BV_{CBO}	70			V	I_C=100μA
*I_{CEO} (dark)					
4N25,					
4N26, 4N27. . . .		5	50	nA	V_{CE}=10V
4N28.		10	100	nA	(base open)
*I_{CBO} (I_F=0)		2	20	nA	V_{CB}=10V (emitter open)
Collector-Emitter Capacitance . . .		2		pF	V_{CE}=0
Coupled Characteristics					
*DC Current Transfer Ratio					
4N25,					
4N26	0.2	0.5			I_F=10mA V_{CE}=10V
4N27, 4N28 . .	0.1	0.3			I_F=10mA V_{CE}=10V
Capacitance, Input to Output.		0.5		pF	
*Breakdown Voltage					
4N25.	2500			V	Peak
4N26, 4N27. . . .	1500			V	Peak
4N28.	500			V	Peak
*Resistance, Input to Output.	100			GΩ	
Rise and Fall Times		2		μs	I_F=10mA V_{CE}=10V
*Collector-Emitter Saturation Voltage			0.5	V	I_F=50mA I_C=2.0mA

*indicates JEDEC registered values

TYPICAL CURVES

FIGURE 1. RELATIVE OUTPUT VS TEMPERATURE

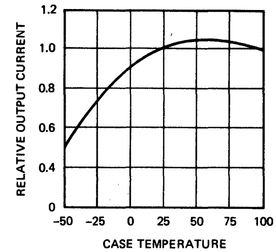


FIGURE 2. DARK CURRENT VS TEMPERATURE

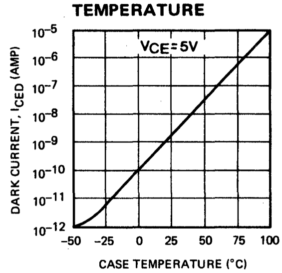


FIGURE 3. TRANSFER CHARACTERISTICS

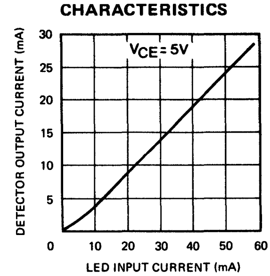
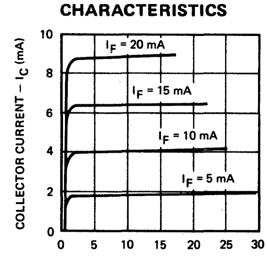
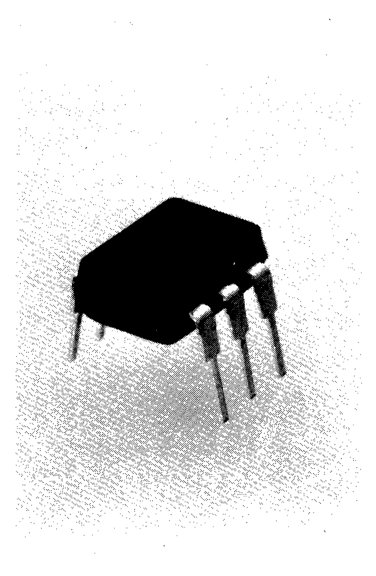


FIGURE 4. DETECTOR OUTPUT CHARACTERISTICS

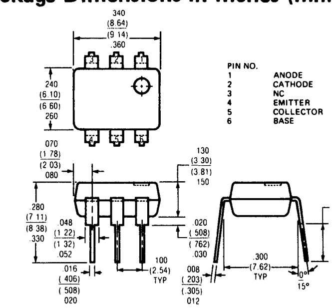


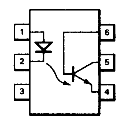
litronix
A Siemens Company

4N35, 4N36, 4N37
PHOTOTRANSISTOR OPTO-ISOLATOR



Package Dimensions in Inches (mm)





Maximum Ratings

Gallium Arsenide LED	
Power Dissipation @ 25°C	100 mW
Derate Linearly from 25°C	1.33 mW/°C
Continuous Forward Current	60 mA
Peak Inverse Voltage	6.0 V
Detector (Silicon Phototransistor)	
Power Dissipation @ 25°C	300 mW
Derate Linearly from 25°C	4.0 mW/°C
Collector-Emitter Breakdown Voltage (BV_{CEO})	30 V
Emitter-Collector Breakdown Voltage (BV_{ECO})	7 V
Collector-Base Breakdown Voltage (BV_{CBO})	70 V
Package	
Storage Temperature*	-55 to +150°C
Operating Temperature	-55 to +100°C
Lead Soldering Time @ 260°C	10 sec
Relative Humidity @ 85°C*	85%

Electrical Characteristics (at 25°C Ambient)

Parameter	Min	Typ	Max	Unit	Test Condition
Gallium Arsenide LED					
Forward Voltage*		1.3	1.5	V	I_F = 10 mA
Reverse Current*		.1	10	μA	V_R = 6.0 V
Capacitance			100	pF	V_R = 0 f = 1 MHz
Phototransistor Detector					
H_{FE}	100	150			V_{CE} = 5.0 V, I_C = 100 μA
BV_{CEO}*	30			V	I_C = 1 mA
BV_{CEO}*	7			V	I_E = 100 μA
I_{CEO} (dark)		5	50	nA	V_{CE} = 10 V, I_F = 0
I_{CEO} (dark)*			500	μA	V_{CE} = 30 V, I_F = 0, T_A = 100°C
BV_{CBO}*	70			V	I_C = 100 μA
Collector-Emitter Capacitance		2		pF	V_{CE} = 0
Coupled Characteristics					
DC Current Transfer Ratio*	100			%	I_F = 10mA, T_A = 25°C, V_{CE} = 10 V
DC Current Transfer Ratio*	40			%	I_F = 10 mA, V_{CE} = 10 V, T_A = 55° to 100°C
Capacitance, Input to Output*			2.5	pF	f = 1.0 MHz
Resistance, Input to Output*		10^{11}		Ω	V_{IO} = 500 V
T_{on} T_{off}			10	μs	I_C = 2 mA, R_L = 100 Ω, V_{CC} = 10 V
Collector-Emitter Saturation Voltage $V_{CE(sat)}$*			0.3	V	I_F = 10 mA, I_C = 0.5 mA
Input to Output Isolation Current (Pulse Width = 8 m. sec)*					
4N35			100	μA	V_{IO} = 3550 V
4N36			100	μA	V_{IO} = 2500 V
4N37			100	μA	V_{IO} = 1500 V

*Indicates JEDEC Registered Data
Specifications subject to change without notice.

FEATURES

- **1500 to 3500 Volt Breakdown Voltage**
- **High Current-Transfer-Ratio (100% Min)**
- **Industry Standard Dual-In-Line**
- **0.5 pF Coupling Capacitance**
- **Underwriters Lab Approval #E52744**

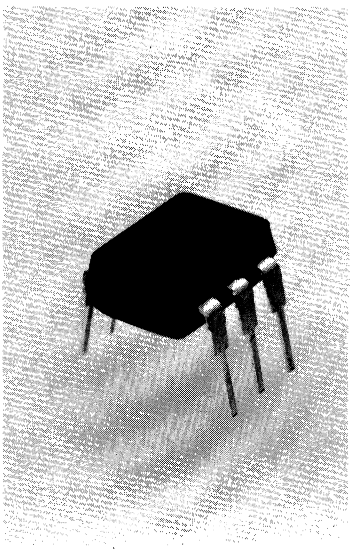
DESCRIPTION

4N35, 4N36, 4N37 are optically coupled pairs employing a Gallium Arsenide infrared LED and a silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. The 4N35, 4N36, 4N37 can be used to replace relays and transformers in many digital interface applications, as well as analog applications such as CRT modulation.

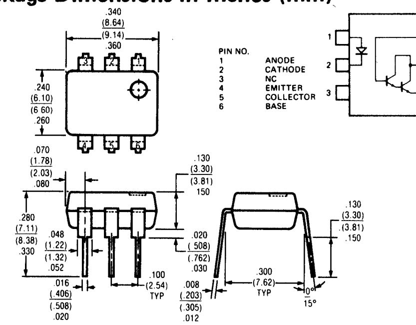
litronix
A Siemens Company

4N32, 4N33

PHOTO DARLINGTON OPTO-ISOLATOR



Package Dimensions in Inches (mm)



Maximum Ratings

Gallium Arsenide LED (Drive Circuit)
- Power Dissipation at 25°C . . . . . 150 mW
- Derate Linearly From 55°C . . . . . 2 mW/°C
- Continuous Forward Current . . . . . 80 mA
- Peak Reverse Voltage . . . . . 3 V

Photodarlington Sensor (Load Circuit)
- Power Dissipation at 25°C Ambient . . . . . 150 mW
- Derate Linearly From 25°C . . . . . 2.0 mW/°C
- Collector (load) Current . . . . . 125 mA
- Collector-Emitter Breakdown Voltage (BV_{CEO}) . . . . . 30 V
- Collector-Base Breakdown Voltage (BV_{CBO}) . . . . . 50 V
- Emitter-Base Breakdown Voltage (BV_{EBO}) . . . . . 8 V
- Emitter-Collector Breakdown Voltage (BV_{ECO}) . . . . . 5 V

Package
- Total Dissipation at 25°C . . . . . 250 mW
- Derate Linearly From 25°C* . . . . . 3.3 mW/°C
- Storage Temperature* . . . . . -55°C to +150°C
- Operating Temperature . . . . . -55°C to +100°C
- Lead Soldering Time at 260°C . . . . . 10 sec

Electrical Characteristics (at 25°C Ambient)

Parameter	Min	Typ	Max	Unit	Test Condition
GaAs Emitter					
Forward Voltage*		1.25	1.5	V	I_F = 50 mA
Reverse Current*		0.01	100	μA	V_R = 3.0 V
Capacitance		100		pF	V_R = 0
Sensor					
H_{FE}		13K			V_{CE} = 5 V, I_C = 0.5mA
BV_{CEO}*	30			V	I_C = 100μA, I_F = 0
BV_{CBO}*	50			V	I_C = 100μA, I_F = 0
BV_{EBO}*	8			V	I_C = 100μA, I_F = 0
BV_{ECO}*	5			V	I_E = 100μA
I_{CEO}*		1.0	100	nA	V_{CE} = 10 V, I_F = 0
Coupled Characteristics					
Current Transfer Ratio*	500			%	I_F = 10mA, V_{CE} = 10 V
$V_{CE(SAT)}$			1.0	V	I_C = 2 mA, I_F = 8 mA
Isolation Resistance*		10^{11}		ohm	V_{IO} = 500 V
Isolation Capacitance		1.5		pf	
Turn-on Time			5	μs	V_{CC} = 10 V, I_C = 50 mA
Turn-off Time			120	μs	I_F = 200 mA, R_L = 180 Ω, Pulse Width = 8ms
Input to Output Current*					
4N32			100	μA	V_{IO} = 2500 V
4N33			100	μA	V_{IO} = 1500 V

*Indicates JEDEC Registered Data

Specifications subject to change without notice.

FEATURES

- 1500 or 2500 Volt Isolation Voltage
- 500% CTR
- High Isolation Resistance (10^{11} Ω Typical)
- Low Coupling Capacitance
- Standard Plastic Dip Package
- Underwriters Lab Approval #E52744

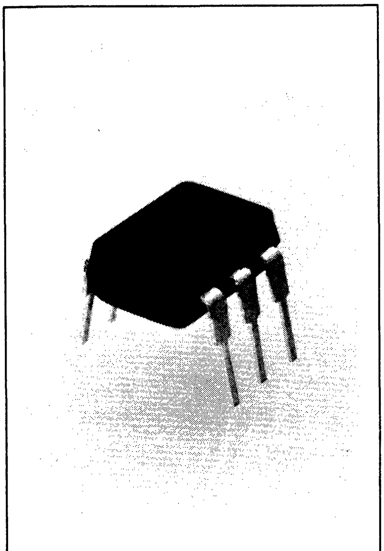
DESCRIPTION

The 4N32 and 4N33 are optically coupled isolators employing a gallium arsenide infrared emitter and a silicon photo darlington sensor. Switching can be accomplished while maintaining a high degrees of isolation between driving and load circuits. They can be used to replace reed and mercury relays with advantages of long life, high speed switching and elimination of magnetic fields.

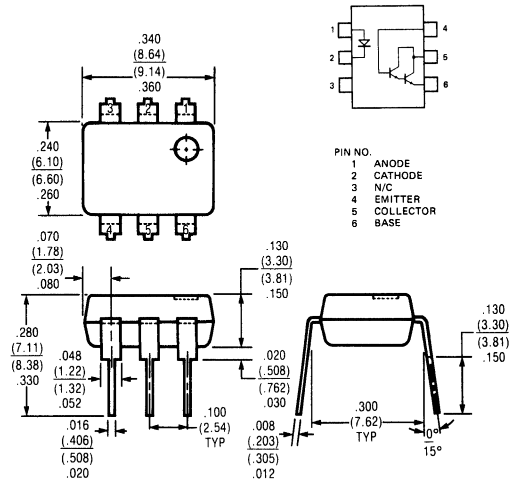
litronix
A Siemens Company

ILA-30, ILA-55

PHOTO DARLINGTON OPTO-ISOLATORS



Package Dimensions in Inches (mm)



FEATURES

- **1500 Volt Isolation Voltage**
- **100 mA Load Current Rating**
- **Fast Turn On Time — 10μs**
- **Fast Turn Off Time — 35μs**
- **Solid State Reliability**
- **Standard Plastic DIP Package**
- **Underwriter Lab Approval #E52744**

DESCRIPTION

The ILA-30 and ILA-55 are optically coupled isolators employing a gallium arsenide infrared emitter and a silicon photo darlington sensor. Switching can be accomplished while maintaining a high degree of isolation between driving and load circuits. They can be used to replace reed and mercury relays with advantages of long life, high speed switching and elimination of magnetic fields.

Maximum Ratings

	ILA-30	ILA-55
Gallium Arsenide LED (Drive Circuit)		
Power Dissipation at 25°C	90 mW	
Derate Linearly From 55°C	1.2 mW/°C	
Continuous Forward Current	60 mA	
Peak Reverse Voltage	3V	
Photodarlington Sensor (Load Circuit)	ILA-30	ILA-55
Power Dissipation at 25°C Ambient	210 mW	210 mW
Derate Linearly From 25°C	2.8 mW/°C	2.8 mW/°C
Collector (load) Current	100 mA	100 mA
Collector-Emitter Breakdown Voltage (BV_{CEO})	30V	55V
Collector-Base Breakdown Voltage (BV_{CBO})	30V	55V
Emitter-Base Breakdown Voltage (BV_{EBO})	8V	8V
Package		
Total Dissipation at 25°C	250 mW	
Derate Linearly From 25°C	3.3 mW/°C	
Storage Temperature	−55°C to +150°C	
Operating Temperature	−55°C to +100°C	
Lead Soldering Time at 260°C	10 sec	

Specifications subject to change without notice.

Opto-Electrical Characteristics (at 25° Ambient)

Parameter	Min	Typ	Max	Unit	Test Condition
GaAs Emitter					
Forward Voltage		1.25	1.5	V	I_F = 60mA
Reverse Current		0.01	10	μA	V_R = 3.0V
Capacitance		50		pF	V_R = 0
Sensor					
H_{fe}		13K			V_{CE} = 5V
					I_C = 0.5mA
BV_{CEO}	30/55			V	I_C = 100μA
					I_F = 0
BV_{CBO}	30/55			V	I_C = 10μA
					I_F = 0
BV_{EBO}	8			V	IE = 1μA
					I_F = 0
I_{CEO}		0.01	1.0	μA	V_{CE} = 5V
					I_F = 0
Capacitance					
Collector-Emitter		3.4		pF	V_{CE} = 10V
Collector-Base		10		pF	V_{CB} = 10V
Emitter-Base		10		pF	V_{EB} = 0.5V
Coupled Characteristics					
Current Transfer Ratio .	100			%	I_F = 10mA
					V_{CE} = 5V
$V_{CE(SAT)}$			1.0	V	I_C = 60mA
Rise Time		10		μs	V_{CE} = 13.5V
Fall Time		35		μs	I_F = 50mA
					R_L = 100Ω
Isolation Voltage	1500			V	
Isolation Resistance . . .		10^{11}		ohm	
Isolation Capacitance . .		0.5		pf	

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. GaAs EMITTER: FORWARD CURRENT – VOLTAGE CHARACTERISTICS

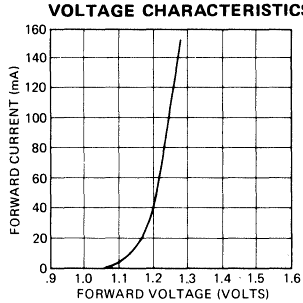


FIGURE 2. DARLINGTON TRANSISTOR OUTPUT CURRENT VS VOLTAGE

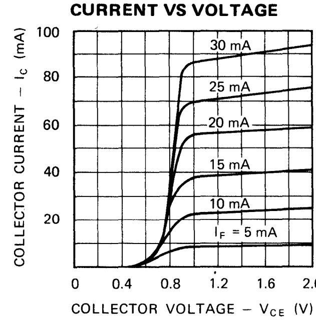


FIGURE 3. DARLINGTON TRANSISTOR CURRENT VS VOLTAGE

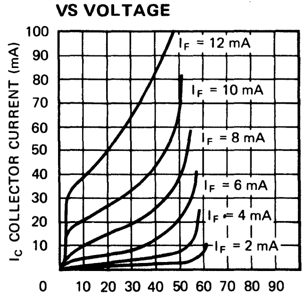
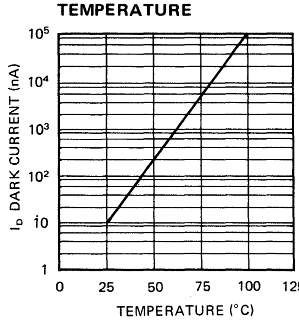


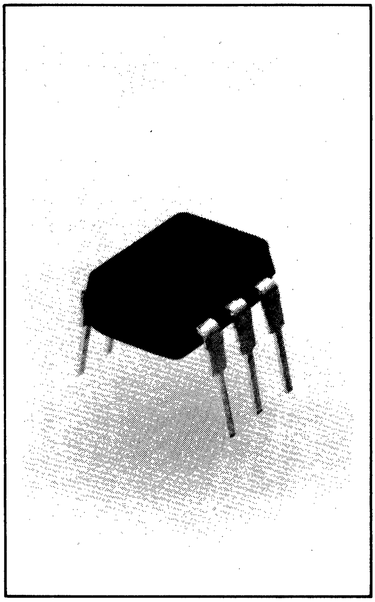
FIGURE 4. DARK CURRENT VS TEMPERATURE



litronix
A Siemens Company

ILCA2-30
ILCA2-55

PHOTO DARLINGTON OPTO-ISOLATORS



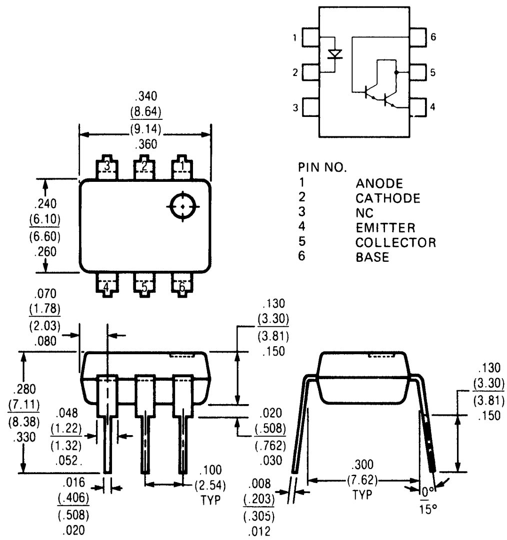
FEATURES

- 2500 Volt Isolation Voltage
- Equivalent to MCA2-30/MCA2-55
- 125 mA Load Current Rating
- Fast Turn On Time — 10μs
- Fast Turn Off Time — 35μs
- Solid State Reliability
- Standard Plastic DIP Package
- Underwriter Lab Approval #E52744

DESCRIPTION

The ILCA2-30 and ILCA2-55 are optically coupled isolators employing a gallium arsenide infrared emitter and a silicon photo darlington sensor. Switching can be accomplished while maintaining a high degree of isolation between driving and load circuits. They can be used to replace reed and mercury relays with advantages of long life, high speed switching and elimination of magnetic fields.

Package Dimensions in Inches (mm)



Maximum Ratings

Gallium Arsenide LED (Drive Circuit)		
Power Dissipation at 25°C	90 mW	
Derate Linearly From 55°C	1.2 mW/°C	
Continuous Forward Current	60 mA	
Peak Reverse Voltage	3V	
Photodarlington Sensor (Load Circuit)	ILCA2-30	ILCA2-55
Power Dissipation at 25°C Ambient	210 mW	210 mW
Derate Linearly From 25°C	2.8 mW/°C	2.8 mW/°C
Collector (load) Current	125 mA	125 mA
Collector-Emitter Breakdown Voltage (BV_{CEO})	30V	55V
Collector-Base Breakdown Voltage (BV_{CBO})	30V	55V
Emitter-Base Breakdown Voltage (BV_{EBO})	8V	8V
Package		
Total Dissipation at 25°C	250 mW	
Derate Linearly From 25°C	3.3 mW/°C	
Storage Temperature	–55°C to +150°C	
Operating Temperature	–55°C to +100°C	
Lead Soldering Time at 260°C	10 sec	

Specifications subject to change without notice.

Electrical Characteristics (at 25° Ambient)					
Parameter	Min	Typ	Max	Unit	Test Condition
GaAs Emitter					
Forward Voltage		1.25	1.5	V	I_F = 20mA
Reverse Current		0.01	10	μA	V_R = 3.0V
Capacitance		50		pF	V_R = 0
Sensor					
H_{fe}		13K			V_{CE} = 5V, I_C = 0.5mA
BV_{CEO}	30/55			V	I_C = 100μA, I_F = 0
BV_{CBO}	30/55			V	I_C = 10μA, I_F = 0
BV_{EBO}	8			V	IE = 1μA, I_F = 0
I_{CEO}		1.0	100	nA	V_{CE} = 10V, I_F = 0
Capacitance					
Collector-Emitter		3.4		pF	V_{CE} = 10V
Collector-Base		10		pF	V_{CB} = 10V
Emitter-Base		10		pF	V_{EB} = 0.5V
Coupled Characteristics					
Current Transfer Ratio .	100	400		%	I_F = 10mA, V_{CE} = 5V
$V_{CE(SAT)}$		0.9	1.0	V	I_C = 50mA, I_F = 50mA
Rise Time		10		μs	V_{CE} = 13.5V
Fall Time		35		μs	I_F = 50mA, R_L = 100Ω
Isolation Voltage	2500			V	
Isolation Resistance . . .		10^{11}		ohm	
Isolation Capacitance . .		0.5		pf	

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. GaAs EMITTER: FORWARD CURRENT – VOLTAGE CHARACTERISTICS

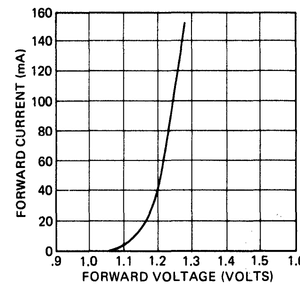


FIGURE 2. DARLINGTON TRANSISTOR OUTPUT CURRENT VS VOLTAGE

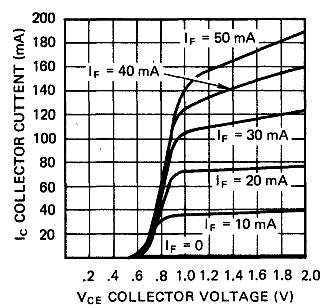


FIGURE 3. DARLINGTON TRANSISTOR CURRENT VS VOLTAGE

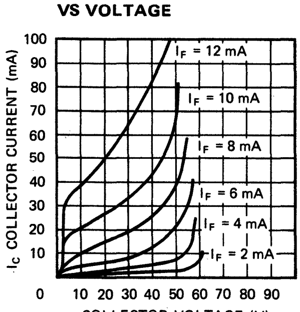
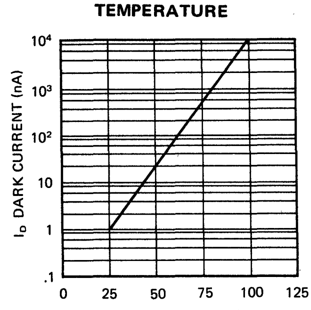


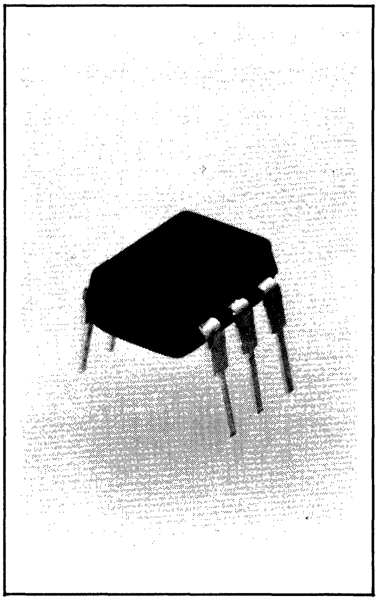
FIGURE 4. DARK CURRENT VS TEMPERATURE



litronix
A Siemens Company

IL-530
IL-555

PHOTO DARLINGTON OPTO-ISOLATOR



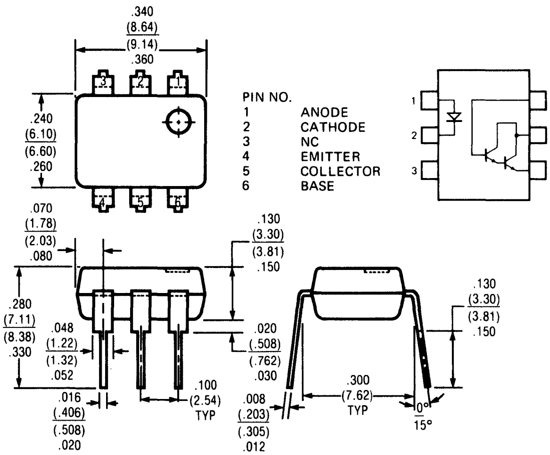
FEATURES

- **5000 V Isolation Voltage**
- **125 mA Load Current Rating**
- **Fast Turn On Time — 10 μs**
- **Fast Turn Off Time — 35 μs**
- **Solid State Reliability**
- **Standard Plastic DIP Package**
- **Underwriters Lab Approval #52744**

DESCRIPTION

The IL-530 and IL-550 are optically coupled isolators employing a gallium arsenide infrared emitter and a silicon photo darlington sensor. Switching can be accomplished while maintaining a high degree of isolation between driving and load circuits. They can be used to replace reed and mercury relays with advantages of long life, high speed switching and elimination of magnetic fields.

Package Dimensions in Inches (mm)



Maximum Ratings

Gallium Arsenide LED (Drive Circuit)	
Power Dissipation @ 25°C	90 mW
Derate Linearly from 55°C	1.2 mW/°C
Continuous Forward Current	60 mA
Peak Reverse Voltage	3 V
Photo Darlington Sensor (Load Circuit)	
Power Dissipation @ 25°C	
IL-530	210 mW
IL-555	210 mW
Derate Linearly from 25°C	
IL-530	2.8 mW/°C
IL-555	2.8 mW/°C
Collector (Load) Current	
IL-530	125 mA
IL-555	125 mA
Collector-Emitter Breakdown Voltage (BV_{CEO})	
IL-530	30 V
IL-555	55 V
Collector-Base Breakdown Voltage (BV_{CBO})	
IL-530	30 V
IL-555	55 V
Emitter-Base Breakdown Voltage (BV_{EBO})	
IL-530	8 V
IL-555	8 V
Package	
Total Dissipation @ 25°C	250 mW
Derate Linearly from 25°C	3.3 mW/°C
Storage Temperature	−55 to +150°C
Operating Temperature	−50 to +100°C
Lead soldering Time @ 260°C	10 sec

Specifications subject to change without notice.

Electrical Characteristics (@ 25 °C Ambient)

Parameter	Min	Typ	Max	Unit	Test Condition
GaAs Emitter					
Forward Voltage		1.25	1.5	V	$I_F = 20$ mA
Reverse Current		0.01	10	μA	$V_R = 3.0$ V
Capacitance		50		pF	$V_R = 0$
Sensor					
H_{fe}		13K			$V_{CE} = 5$ V, $I_C = 0.5$ mA
BV_{CEO}					
IL-530	30			V	$I_C = 100\ \mu$A
IL-555	55			V	$I_C = 100\ \mu$A
BV_{CBO}					
IL-530	30			V	$I_C = 10\ \mu$A
IL-555	55			V	$I_C = 10\ \mu$A
BV_{EBO}	8			V	$I_E = 1\ \mu$A
I_{CEO}		1.0	100	nA	$V_{CE} = 10$ V
Capacitance					
Collector-Emitter		3.4		pf	$V_{CE} = 10$ V
Collector-Base		10		pF	$V_{CB} = 10$ V
Emitter-Base		10		pF	$V_{EB} = 0.5$ V
Coupled Characteristics					
Current Transfer Ratio	100	400		%	$I_F = 10$ mA, $V_{CE} = 5$ V
$V_{CE(SAT)}$		0.9	1.0	V	$I_C = 50$ mA, $I_F = 50$ mA
Rise Time		10		μs	$V_{CE} = 13.5$ V
Fall Time		35		μs	$I_F = 50$ mA, $R_L = 100\ \Omega$
Isolation Voltage	5000	7000		VDC	t = 1 Minute
Isolation Resistance		10^{12}		Ω	
Isolation Capacitance		0.5		pF	

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

FIGURE 1. GaAs EMITTER: FORWARD CURRENT – VOLTAGE CHARACTERISTICS

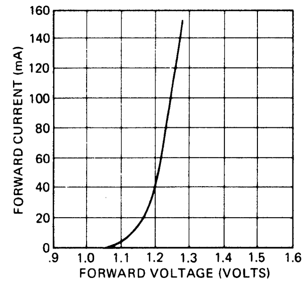


FIGURE 2. DARLINGTON TRANSISTOR OUTPUT CURRENT VS VOLTAGE

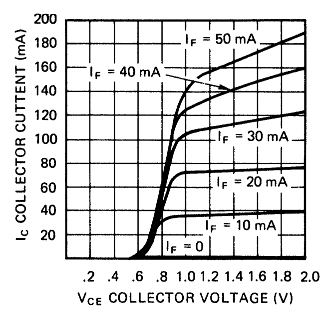


FIGURE 3. DARLINGTON TRANSISTOR CURRENT VS VOLTAGE

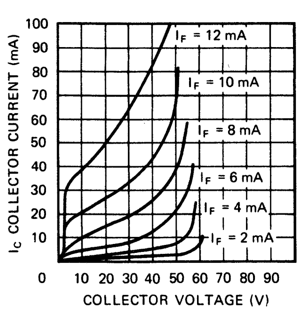
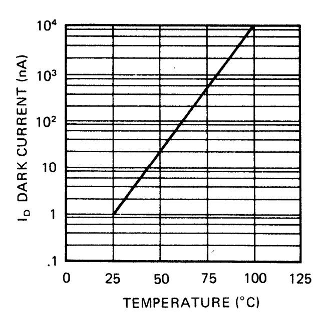


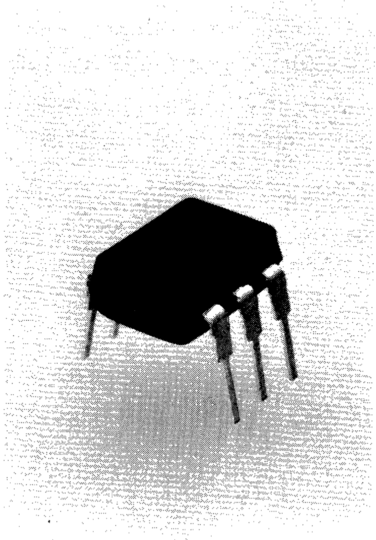
FIGURE 4. DARK CURRENT VS TEMPERATURE



litronix
A Siemens Company

H11AA1

AC INPUT OPTO-ISOLATOR



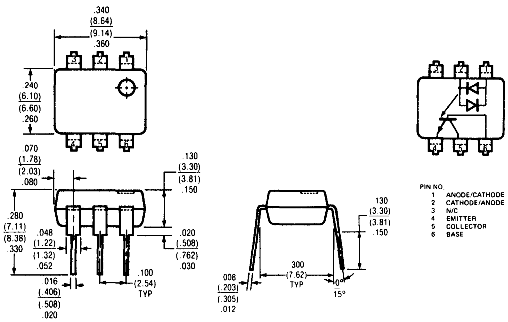
FEATURES

- **1500 Volt Isolation Voltage**
- **AC or Polarity Insensitive Input**
- **High Current Transfer Ratio (20% min.)**
- **Built-in Reverse Polarity Input Protection**
- **I/O compatible with integrated circuits**
- **Underwriters Lab Approval #E52744**

DESCRIPTION

The H11AA1 is a direct electrical and mechanical replacement of the General Electric series. This bi-directional input optoisolator consists of two gallium arsenide infrared emitting diodes connected in inverse parallel coupled to a silicon NPN phototransistor in a 6 pin dual in-line plastic package.

Package Dimensions in Inches (mm)



Maximum Ratings

Gallium Arsenide LED

Power Dissipation @ 25°C	100 mW
Derate Linearly from 25°C	1.33 mW/°C
Continuous Forward Current (RMS)	60 mA

Detector (Silicon Phototransistor)

Power Dissipation @ 25°C	300 mW
Derate Linearly From 25°C	4.0 mW/°C
Collector-Emitter Breakdown Voltage (BV_{CEO})	30 V
Emitter-Base Breakdown Voltage (BV_{EBO})	5 V
Collector-Base Breakdown Voltage (BV_{CBO})	70 V

Package

Storage Temperature	-55 to +150°C
Operating Temperature	-55 to +100°C
Lead Soldering Time @ 260°C	10.0 sec

Electrical Characteristics (25°C unless otherwise specified)

Parameter	Min	Typ	Max	Unit	Test Condition
Gallium Arsenide LED					
Forward Voltage V_F	–	1.2	1.5	V	$I_F = \pm 10$ mA
Phototransistor Detector					
BV_{CEO}	30	50	–	V	$I_C = 10$ mA
BV_{EBO}	5	9	–	V	$I_E = 100\ \mu A$
BV_{CBO}	70	90	–	V	$I_C = 100\ \mu A$
I_{CEO}	–	5	100	nA	$V_{CE} = 10$ V
Coupled Characteristics					
$V_{CE(set)}$	–	0.2	0.4	V	$I_F = \pm 10$ mA, $I_C = 0.5$ mA
DC Current Transfer Ratio CTR	20	80	–	%	$I_F = \pm 10$ mA, $V_{CE} = 10$ V
Symmetry $\frac{\text{CTR @ + 10 mA}}{\text{CTR @ – 10 mA}}$	0.33	1.0	3.0	–	
Input to Output Isolation Voltage	1500	4000	–	V	D.C.

Specifications subject to change without notice.

TYPICAL OPTO-ISOLATOR CHARACTERISTIC CURVES

FIGURE 1. INPUT CHARACTERISTICS

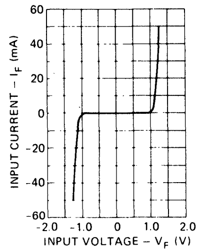


FIGURE 2. TRANSFER CHARACTERISTICS

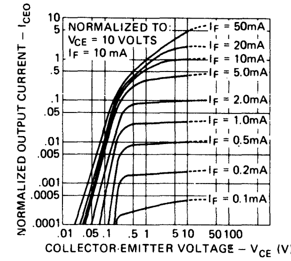


FIGURE 3. OUTPUT VS. INPUT CURRENT

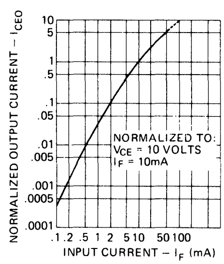


FIGURE 4. OUTPUT CHARACTERISTICS

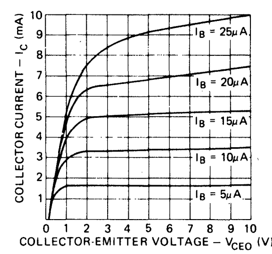


FIGURE 5. DARK CURRENT VS. TEMPERATURE

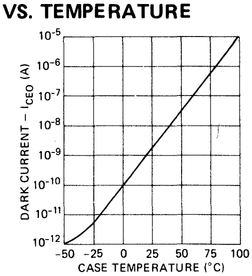
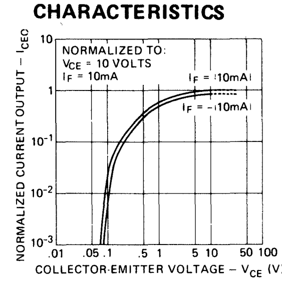


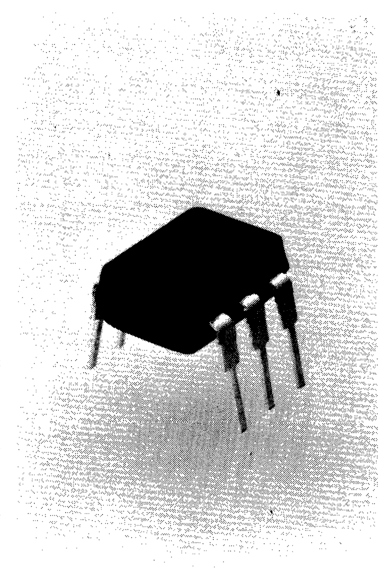
FIGURE 6. SYMMETRY CHARACTERISTICS



litronix
A Siemens Company

IL-250

BIDIRECTIONAL INPUT OPTO-ISOLATOR



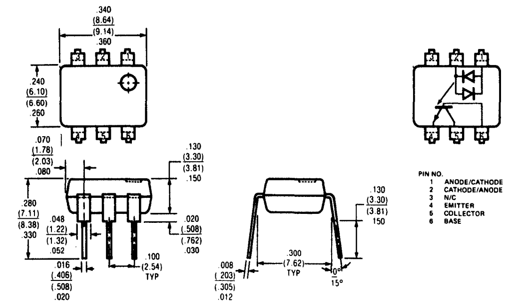
FEATURES

- AC or Polarity Insensitive Input
- 5000 Volt Breakdown Voltage
- High Current-Transfer-Ratio (>50% min.)
- Industry Standard Dual-In-Line
- Built-in Reverse Polarity Input Protection
- Underwriters Lab Approval #E52744

DESCRIPTION

The IL250 is a bidirectional input opto-isolator. It consists of two gallium arsenide infrared emitting diodes coupled to a silicon NPN phototransistor in a 6 pin dual in-line plastic package.

Package Dimensions in Inches (mm)



Maximum Ratings

Gallium Arsenide LED
- Power Dissipation @ 25°C . . . . . 200 mW
- Derate Linearly from 25°C . . . . . 2.6 mW/°C
- Continuous Forward Current . . . . . 100 mA
- Peak Inverse Voltage . . . . . 3.0 V

Detector (Silicon Phototransistor)
- Power Dissipation @ 25°C . . . . . 200 mW
- Derate Linearly From 25°C . . . . . 2.6 mW/°C
- Collector-Emitter Breakdown Voltage (BV_{CEO}) . . . . . 30 V
- Emitter-Base Breakdown Voltage (BV_{ECO}) . . . . . 5 V
- Collector-Base Breakdown Voltage (BV_{CBO}) . . . . . 70 V

Package
- Total Package Dissipation at 25°C Ambient (LED Plus Detector) . . . . . 250 mW
- Derate Linearly From 25°C . . . . . 3.3 mW/°C
- Storage Temperature . . . . . -55 to +150°C
- Operating Temperature . . . . . -55 to +100°C
- Lead Soldering Time @ 260°C . . . . . 10 sec

Electrical Characteristics (25°C unless otherwise specified)

Parameter	Min	Typ.	Max	Unit	Test Condition
Gallium Arsenide LED					
Forward Voltage V_F		1.2	1.5	V	$I_F = \pm 10$ mA
Phototransistor Detector					
H_{FE}	100	200			$V_{CE} = 5V$, $I_C = 100\ \mu A$
BV_{CEO}	30	50		V	$I_C = 1$ mA
BV_{ECO}	7	10		V	$I_C = 100\ \mu A$
BV_{CBO}	70	90		V	$I_C = 10\ \mu A$
I_{CEO}		5	50	nA	$V_{CE} = 10$ V
Coupled Characteristics					
$V_{CE(set)}$			0.4	V	$I_F = \pm 16$ mA, $I_C = 2$ mA
DC Current Transfer Ratio (CTR)	50	150		%	$I_F = \pm 10$ mA, $V_{CE} = 10$ V
Symmetry $\frac{CTR\ @\ +10\ mA}{CTR\ @\ -10\ mA}$	0.33	1.0	3.0		
Input to Output Isolation Voltage	5000			V	D.C.

TYPICAL OPTO-ISOLATOR CHARACTERISTIC CURVES

FIGURE 1. INPUT CHARACTERISTICS

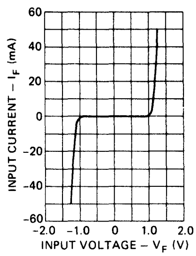


FIGURE 2. TRANSFER CHARACTERISTICS

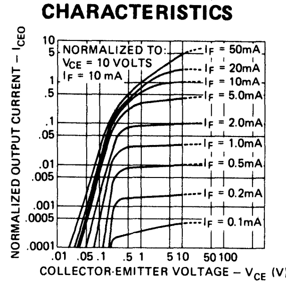


FIGURE 3. OUTPUT VS. INPUT CURRENT

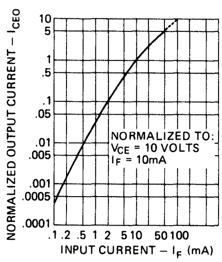


FIGURE 4. OUTPUT CHARACTERISTICS

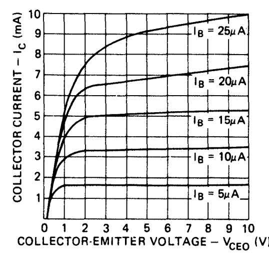


FIGURE 5. DARK CURRENT VS. TEMPERATURE

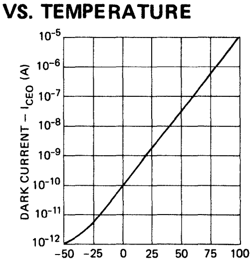
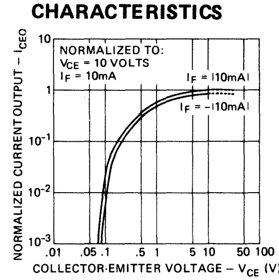


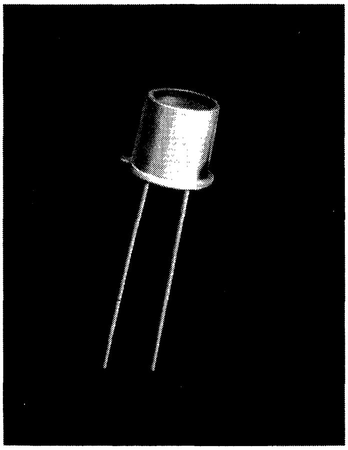
FIGURE 6. SYMMETRY CHARACTERISTICS



litronix
A Siemens Company

CNY 18 SERIES

SINGLE CHANNEL PHOTOTRANSISTOR OPTO-ISOLATOR



FEATURES

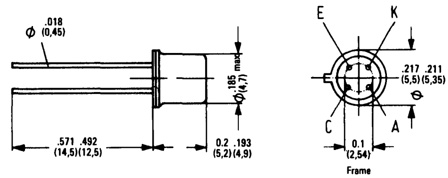
- TO-72 Metal Case Package
- Current Transfer Ratio, 4 Groups
  CNY 18-2, 16 to 32%
  CNY 18-3, 25 to 50%
  CNY 18-4, 40 to 80%
  CNY 18-5, 63 to 125%

DESCRIPTION

The optically coupled isolator CNY 18 uses as emitter a GaAs infrared emitting diode which is optically coupled with a silicon planar phototransistor acting as detector. The component is incorporated in an 18 A DIN 41876 (TO-72) case. The collector of the phototransistor is electrically connected to the metal case.

The coupling device is suitable for signal transmission between two electrically separated circuits. The potential difference between the circuits to be coupled is not allowed to exceed the maximum permissible insulating voltage.

Package Dimensions in Inches (mm)



C connected to case

Maximum Ratings

Emitter (GaAs infrared emitting diode)			
Reverse voltage	V_R	3	V
Forward current	I_F	60	mA
Surge current ($t \leq 10\ \mu s$)	i_{FS}	1.5	A
Power dissipation	P_{tot}	100	mW
Detector (Si phototransistor)			
Collector-emitter reverse voltage	V_{CEO}	32	V
Collector current	I_C	100	mA
Power dissipation	P_{tot}	150	mW
Coupler			
Storage temperature	T_{stor}	−55 to +125	°C
Operating temperature	T_{amb}	−55 to +100	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
isolation voltage (between emitter and detector referred to standard climate 23/50 DIN 50014; leakage path 0.35 mm min; air path 0.35 mm min)	V_{is}	500	V

Tracking resistance: Group III (KC ≥ 600) in accordance with VDE 110 § 6, table 3 and DIN 53 480/ VDE 0330, part 1.

DIN standard specification and/or VDE instructions under consideration; as to the nominal Isolation voltage VDE decision 69 or VDE 0110 and 0160 applies.

Characteristics (T_{amb} = 25°C)

Emitter (GaAs infrared emitting diode)			
Forward voltage (I_F = 60 mA)	V_F	1.25 (≤1.7)	V
Breakdown voltage (I_R = 100 µA)	V_{BR}	30 (≥4)	V
Reverse current (V_R = 3 V)	I_R	0.01 (≤10)	µA
Capacitance (V_R = 0 V; f = 1 MHz)	C_O	50	pF
Detector (Si phototransistor)			
Collector-emitter leakage current (V_{CE} = 10 V)	I_{CEO}	2 (≤100)	nA
Collector-emitter capacitance (V_{CE} = 0 V; f = 1 MHz)	C_{CE}	10	pF
Coupler			
Collector-emitter saturation voltage (I_F = 10 mA; I_C = 1 mA)	V_{CEsat}	0.1 (≤0.2)	V

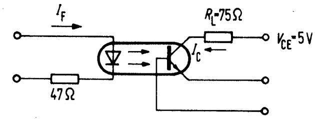
Coupling capacitances (f = 1 MHz)

Infrared emitting diode		Phototransistor			
Anode-cathode short-circuited	▶	Emitter-collector. short-circuited	C_K	1.4	pF
Anode-cathode short-circuited	▶	Collector (emitter conn. to frame)	C_K	1.1	pF
Anode-cathode short-circuited	▶	Emitter (collector conn. to frame)	C_K	0.1	pF

The couplers are grouped in accordance with their current ratio $\frac{I_C}{I_F}$ at I_F = 10 mA and V_{CE} = 5 V.

Group	CNY 18-2	CNY 18-3	CNY 18-4	CNY 18-5	
$\frac{I_C}{I_F}$	16 to 32	25 to 50	40 to 80	63 to 125	%

Specifications are subject to change without notice.

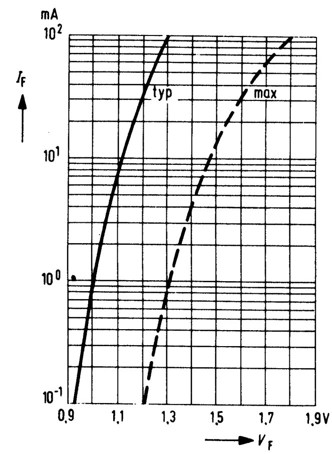


$I_F = 10$ mA
$V_{CE} = 5$ V
$T_{amb} = 25$ °C

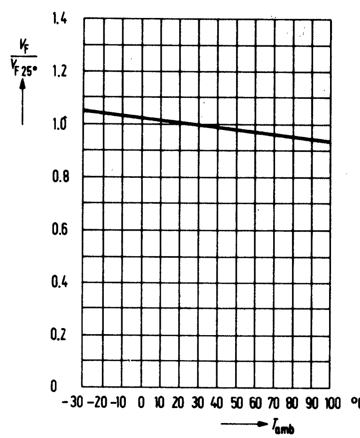
Switching Times

Load Resistance (R_L)	75 Ω
Delay Time (t_d)	3.2 (≤4.6) µs
Rise Time (t_r)	2 (≤3) µs
Storage Time (t_s)	3.0 (≤4.0) µs
Fall Time (t_f)	2.5 (≤3.3) µs
Cut Off Frequency (f_g)	250 kHz

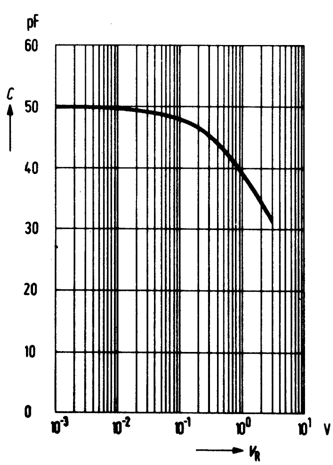
Forward voltage $I_F = f(V_F)$



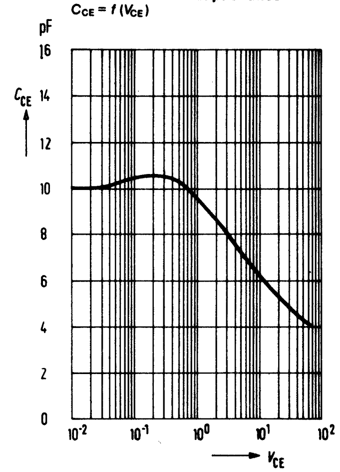
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



Capacitance $C = f(V_R)$



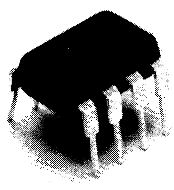
Collector-emitter capacitance
$C_{CE} = f(V_{CE})$



litronix
A Siemens Company

IL-100

VERY HIGH SPEED THREE STATE OPTO-ISOLATOR



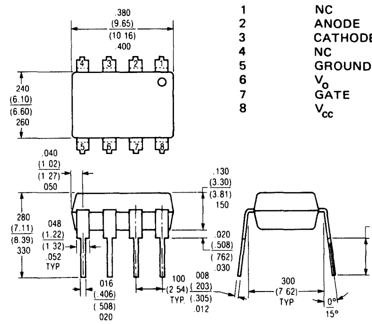
FEATURES

- **Very High Speed — 65 n-sec typ. prop. delay**
- **Faraday Shielded Photodetector for Improved Common Mode Rejection**
- **DTL/TTL Compatible -5V supply**
- **Three State Output Logic for Multiplexing**
- **Built-in Schmitt Trigger to Avoid Oscillation**
- **Underwriters Lab Approval #E52744**

DESCRIPTION

IL-100 is an optically coupled pair employing a Gallium Arsenide Phosphide LED and a silicon monolithic integrated circuit including a photodetector. High speed digital information can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. The IL-100 can be used to replace pulse transformers in many digital interface applications. A built-in Schmitt Trigger provides hysteresis to reduce the possibility of oscillation.

Package Dimensions (inches/mm)



PIN NO.	
1	NC
2	ANODE
3	CATHODE
4	NC
5	GROUND
6	V_o
7	GATE
8	V_{cc}

Recommended Operating Conditions

	Min.	Nom.	Max.	Units
Logical (1) Input Current - I_{in} (1)	0		10	mA
Supply Voltage - V_{cc}	4.5	5.0	5.5	V
Fan-Out - N (TTL Load)			10	–
Operating Temperature Range - T_A	0	25	70	°C

Absolute Maximum Ratings

Storage Temperature .... −55°C to +125°C
Operating Temperature .... 0°C to +70°C
Lead Solder Temperature .... 260°C for 10 Sec.
Input Diode
  Forward DC Current .... 10 mA
  Reverse Voltage 5V
Output - IC
  Supply Voltage - V_{CC} 7V
  Enable Input Voltage - V_E 5.5V
  (Not to exceed V_{CC} by more than 500 mV)
  Output Collector Current - IC .... 100 mA
  Output Collector Power Dissipation .... 100 mW
  Output Collector Voltage - V_{OUT} 7V
Isolation Voltage (Input-Output) 2500V

Electrical Characteristics
Over Recommended Temperature (T_A = 0°C – 70°C)

Parameter	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
I_{in} (1): Logic (1) Input Current to Ensure Logic (0) Output	5			mA		1.2	–
I_{in} (0): Logic (0) Input Current to Ensure Logic (1) Output			250	μA		1.2	–
V_G (1): Logic (1) Gate Voltage	2.0			V		–	–
V_G (0): Logic (0) Gate Voltage			.8	V		–	–
I_{out} (off)	−100μA		+100μA		V_{CC} = 5.5V, V_o = 1.5V, V_G = 0V, I_{in} = 0, 10mA	–	–

Specifications subject to change without notice.

Electrical Characteristics (Continued)
Over Recommended Temperature (T_A = 0°C – 70°C)

Parameter	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
V_{out} (0): Logic (0) Output Voltage		.35	.6	V	V_{CC} = 5.5V, V_G = 2.4V I_{in} = 5 mA, I_{out} (Sinking) = 16 mA	–	–
I_G (0): Logic (0) Gate Current		−1.6	−2.0	mA	V_{CC} = 5.5V, V_G = 0.5V	–	–
I_G (1): Logic (1) Gate Current		0		mA	V_{CC} = 5.5V, V_G = 2.4V	–	–
I_{CC} (1): Logic (1) Supply Current		18	22	mA	V_{CC} = 5.5V, V_G = 0.5V, I_{in} = 0	–	–
I_{CC} (0): Logic (0) Supply Current		18	22	mA	V_{CC} = 5.5V, V_G = 0.5V, I_{in} = 10 mA	–	–
I_{CC}		13	16		V_{CC} = 5.5, V_G = 2.4V, I_{in} = 0	–	–
I_{CC}		17	21		V_{CC} = 5.5, V_G = 2.4V, I_{in} = 10 mA		

Switching Characteristics at T_A = 25°, V_{CC} = 5V

Parameter	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
t_{pd}(1): Propagation Delay Time to Logical (1) Level		65	75	ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5 mA	–	1
t_{pd}(0): Propagation Delay Time to Logical (0) Level		65	75	ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5 mA	–	2
t_R-t_F: Output Rise-Fall Time (10-90%)		15		ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5 mA	–	–
t_G(1): Propagation Delay Time of Gate from V_G(1) to V_G(0)		15		ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5 mA, V_G(1) = 2V, V_G(0) = 0.5V	–	3
t_G(0): Propagation Delay Time of Gate from V_G(0) to V_G(1)		15		ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5 mA, V_G(1) = 2V, V_G(0) = 0.5V	–	4

Electrical Characteristics—Input-Output at T_A = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Insulation Voltage (Input-Output)	BV_{I-O}	2500			V		–	5
Resistance (Input-Output)	R_{I-O}	10^{12}			Ω	V_{I-O} = 500V	–	5
Capacitance (Input-Output)	C_{I-O}		0.5	0.8	pF	f = 1MHz	–	5
Common Mode Rejection Voltage to Logical (0) Level	CMRV (1)		60		VAC p-p	f = 10MHz R_L = 350Ω, V_{out}(min.)= 2V, I_{in} = 0 mA	–	6
Common Mode Rejection Voltage to Logical (1) Level	CMRV (0)		60		VAC p-p	f = 10MHz R_L = 350Ω, V_{out}(max.)= 0.6V, I_{in} = 7.5 mA	–	6
Current Transfer Ratio	CTR		1000		%	I_{in} = 5.0 mA, V_{CC} = 5V, R_L = 100Ω	–	7

Electrical Characteristics—Input Diode at T_A = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Forward Voltage	V_F	1.2	1.5	1.75	V	I_{in} = 10 mA	1	8
Reverse Breakdown Voltage	V_{BR}	5			V	I_R = 10μA	–	–
Capacitance	C_{in}		25		pF	V = 0, f = 1MHz	–	–

Operating Procedures and Definitions

Logic Convention. The IL-100 is defined in terms of positive logic.

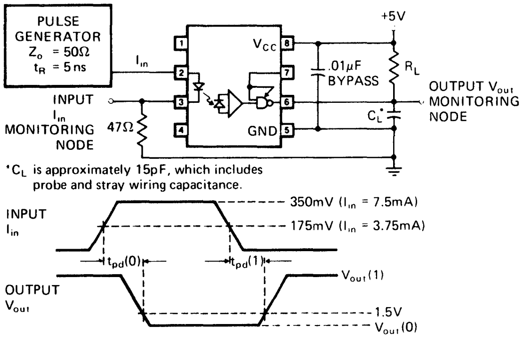
Bypassing. A ceramic capacitor (.01μF min.) should be connected from pin 8 to pin 5. Its purpose is to stabilize the operation of the switching amplifier. Failure to provide the bypassing may impair the switching properties.

Polarities. All voltages are referenced to network ground (pin 5). Current flowing toward a terminal is considered positive.

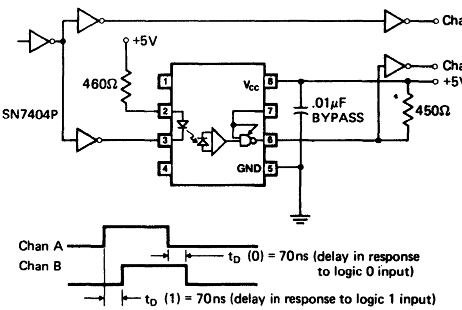
Gate Input. No external pull-up required for a logic (1).

NOTES:

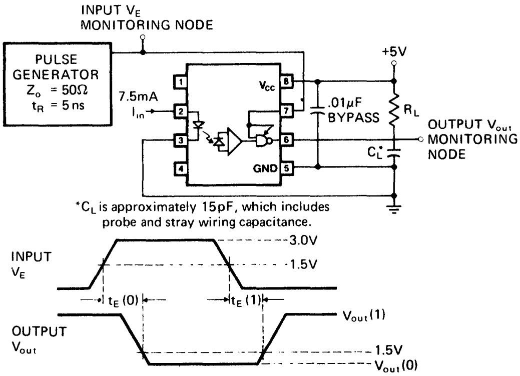
1. The t_{pd}(1) propagation delay is measured from the 3.75 mA point on the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
2. The t_{pd}(0) propagation delay is measured from the 3.75 mA point on the input pulse to the 1.5V point on the leading edge of the output pulse.
3. The t_G(1) gate propagation delay is measured from the 1.5V point of the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
4. The t_G(0) gate propagation delay is measured from the 1.5V point on the input pulse to the 1.5V point on the leading edge of the output pulse. The input diode is DC biased to 10 mA [I_{in}(1)].
5. Pins 2 and 3 shorted together, and pins 5, 6, 7, and 8 shorted together.
6. CMRV (1) is the maximum tolerable common mode voltage to assure that the output will remain in a logic (1) state (V_{out} > 2.0V). CMRV (0) is the maximum tolerable common mode voltage to assure that the output will remain in a logic (0) state (V_{out} < 0.6V).
7. DC Current Transfer Ratio is defined as the ratio of the output collector current to the forward bias input current times 100%.
8. At 10 mA V_F decreases with increasing temperature at the rate of 1.6mV/°C.



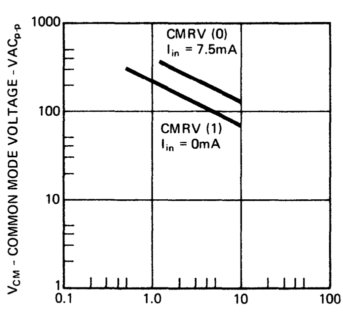
Test Circuit for $t_{pd}(0)$ and $t_{pd}(1)$.

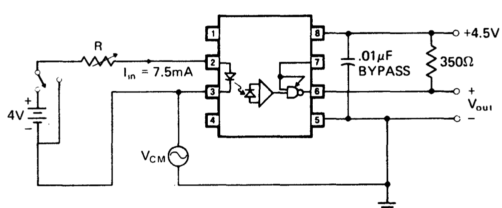


Response Delay Between TTL Gates.

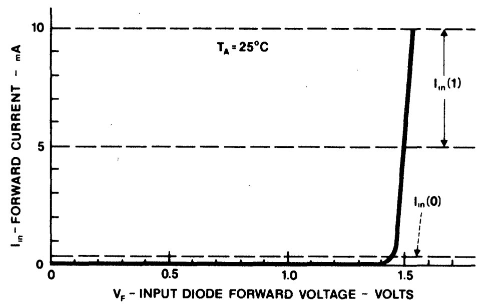


Test Circuit for t_E (0) and t_E (1).





Typical Common Mode Rejection Characteristics/Circuit



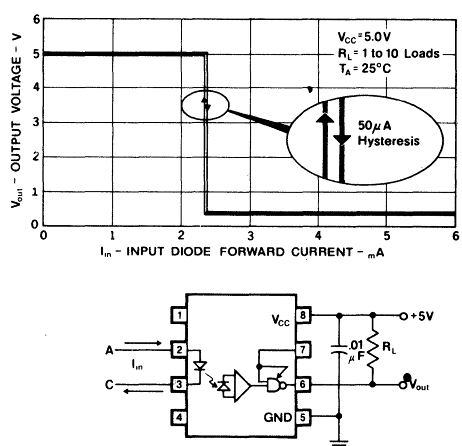
Input Diode Forward Characteristic

Figure 1

TRUTH TABLE (Positive Logic)

Input*	Enable	Output
1	1	0
0	1	1
1	0	off
0	0	off

*See definition of terms for logic state.



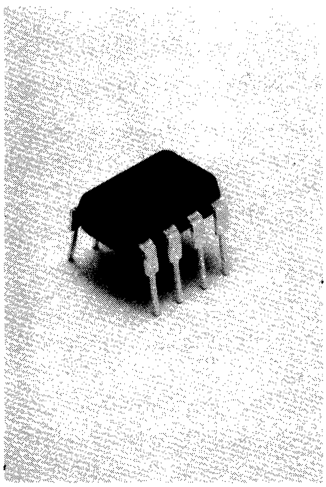
Input-Output Characteristics

Figure 2

litronix
A Siemens Company

IL-101

HIGH SPEED THREE STATE OPTO-ISOLATOR



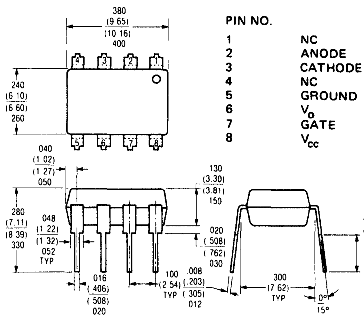
FEATURES

- **High Speed — 100 n-sec typ. prop. delay**
- **Faraday Shielded Photodetector for Improved Common Mode Rejection**
- **DTL/TTL Compatible -5V supply**
- **Three State Output Logic for Multiplexing**
- **Built-in Schmitt Trigger to Avoid Oscillation**
- **Underwriters Lab Approval #E52744**

DESCRIPTION

IL-101 is an optically coupled pair employing a Gallium Arsenide Phosphide LED and a silicon monolithic integrated circuit including a photodetector. High speed digital information can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. The IL-101 can be used to replace pulse transformers in many digital interface applications. A built-in Schmitt Trigger provides hysteresis to reduce the possibility of oscillation.

Package Dimensions (inches/mm)



Absolute Maximum Ratings

Storage Temperature	−55°C to +125°C
Operating Temperature	0°C to +70°C
Lead Solder Temperature	260°C for 10 Sec.
Input Diode	
Forward DC Current	10 mA
Reverse Voltage	5V
Output - IC	
Supply Voltage - V_{CC}	7V
Enable Input Voltage - V_E	5.5V
	(Not to exceed V_{CC} by more than 500 mV)
Output Collector Current - IC	100 mA
Output Collector Power Dissipation	100 mW
Output Collector Voltage - V_{OUT}	7V
Isolation Voltage (Input-Output) - DC	1500V

Electrical Characteristics
Over Recommended Temperature (T_A = 0°C – 70°C)

Parameter	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
I_{in} (1): Logic (1) Input Current to Ensure Logic (0) Output	5			mA		1	–
I_{in} (0): Logic (0) Input Current to Ensure Logic (1) Output			250	μA		1	–
V_G (1): Logic (1) Gate Voltage	2.0			V		–	–
V_G (0): Logic (0) Gate Voltage			.8	V		–	–
V_{out} (0): Logic (0) Output Voltage		.35	.6	V	V_{CC} = 5.5V, V_G = 2.4V, I_{in} = 5 mA, I_{out} (Sinking) = 16 mA	–	–
I_{CC}		18	22	mA	V_{CC} = 5.5V V_G = 0.5V I_{in} = 0.10 mA		

Specifications subject to change without notice.

Switching Characteristics at T_A = 25°, V_{CC} = 5V

Parameter	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
$t_{pd}(1)$: Propagation Delay Time to Logical (1) Level		100	200	ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5 mA	1	1
$t_{pd}(0)$: Propagation Delay Time to Logical (0) Level		100	200	ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5 mA	1	2
t_R-t_F: Output Rise-Fall Time (10-90%)		15		ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5 mA	–	–

Electrical Characteristics—Input-Output at T_A = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Insulation Voltage (Input-Output)	$BV_{I\text{-}O}$	1500			V		–	3
Resistance (Input-Output)	$R_{I\text{-}O}$	10^{12}			Ω	$V_{I\text{-}O}$ = 500V	–	3
Capacitance (Input-Output)	$C_{I\text{-}O}$		0.5	0.8	pF	f = 1MHz	–	3

Electrical Characteristics—Input Diode at T_A = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Forward Voltage	V_F	1.2	1.5	1.75	V	I_{in} = 10 mA	–	4
Reverse Breakdown Voltage	V_{BR}	5			V	I_R = 10μA	–	–
Capacitance	C_{in}		10		pF	V = 0, f = 1MHz	–	–

Operating Procedures and Definitions

Logic Convention. The IL-101 is defined in terms of positive logic.

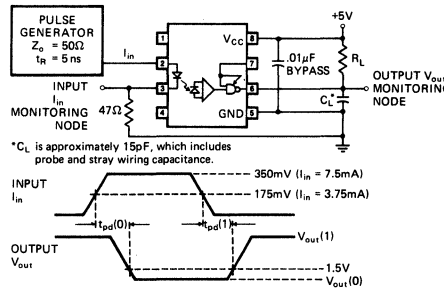
Bypassing. A ceramic capacitor (.01μF min.) should be connected from pin 8 to pin 5. Its purpose is to stabilize the operation of the switching amplifier. Failure to provide the bypassing may impair the switching properties.

Polarities. All voltages are referenced to network ground (pin 5). Current flowing toward a terminal is considered positive.

Gate Input. No external pull-up required for a logic (1).

NOTES:

1. The $t_{pd}(1)$ propagation delay is measured from the 3.75 mA point on the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
2. The $t_{pd}(0)$ propagation delay is measured from the 3.75 mA point on the input pulse to the 1.5V point on the leading edge of the output pulse.
3. Pins 2 and 3 shorted together, and pins 5, 6, 7, and 8 shorted together.
4. At 10 mA V_F decreases with increasing temperature at the rate of 1.6mV/°C.



Test Circuit for $t_{pd}(0)$ and $t_{pd}(1)$.

Fig. 1

TRUTH TABLE (Positive Logic)

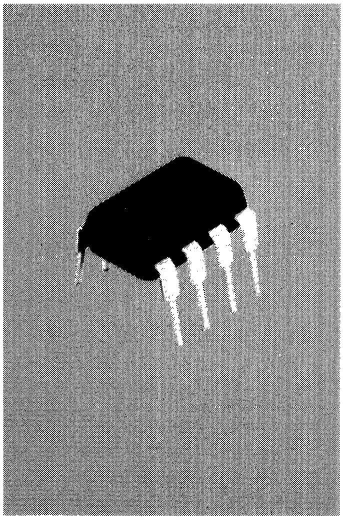
Input*	Enable	Output
1	1	0
0	1	1
1	0	off
0	0	off

*See definition of terms for logic state.

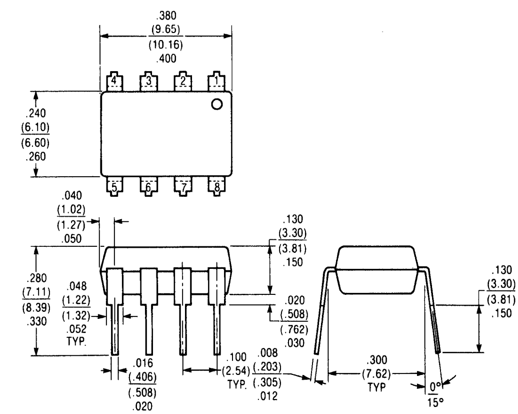
litronix
A Siemens Company

IL-CT6

DUAL PHOTOTRANSISTOR OPTO-ISOLATOR



Package Dimensions in Inches (mm)



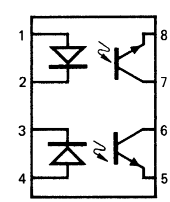
FEATURES

- **Two Isolated Channels Per Package**
- **1500V Isolation**
- **50% Typical Current Transfer Ratio**
- **1 nA Typical Leakage Current**
- **Direct Replacement For MCT6**
- **Underwriter Lab Approval #E52744**

DESCRIPTION

The IL-CT6 is a two channel opto isolator for high density applications. Each channel consists of an optically coupled pair employing a Gallium Arsenide infrared LED and a silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. The IL-CT6 is especially designed for driving medium-speed logic, where it may be used to eliminate troublesome ground loop and noise problems. It can also be used to replace relays and transformers in many digital interface applications, as well as analog applications such as CRT modulation.

Pin Configuration



LED CHIPS ON PINS 2 AND 3
PT CHIPS ON PINS 6 AND 7

PIN NO.	FUNCTION
1	ANODE
2	CATHODE
3	CATHODE
4	ANODE
5	EMITTER
6	COLLECTOR
7	COLLECTOR
8	EMITTER

MAXIMUM RATINGS

Maximum Temperatures	
Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Lead Temperature (Soldering, 10 seconds)	260°C
Input Diode (each channel)	
Rated Forward Current, DC	60 mA
Peak Forward Current (1μs pulse, 300 pps)	3 A
Power Dissipation at 25°C Ambient	100 mW
Derate Linearly From 25°C	1.3 mW/°C
Output Transistor (each channel)	
Power Dissipation @ 25°C Ambient	150 mW
Derate Linearly From 25°C	2 mW/°C
Collector Current	30 mA
Coupled	
Input to Output Breakdown Voltage	1500 Volts DC
Total Package Power Dissipation @ 25°C Ambient	400 mW
Derate Linearly From 25°C	5.33 mW/°C

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

Parameter	Min	Typ	Max	Units	Test Conditions
Input Diode					
Rated Forward Voltage		1.25	1.50	V	I_F = 20 mA
Reverse Voltage	3.0	5.0		V	I_R = 10 μA
Reverse Current		0.001	10	μA	V_R = 3.0 V
Junction Capacitance		100		pF	V_F = 0V
Output Transistor					
Breakdown Voltage,					
Collector to Emitter	30	65		V	I_C = 1.0 mA
Emitter to Collector	7.0	10		V	I_C = 100 μA
Leakage Current, Collector to Emitter		1.0	100	nA	V_{CE} = 10V
Capacitance Collector to Emitter		8.0		pF	V_{CE} = 0V
Coupled					
DC Current Transfer Ratio (I_C/I_F)	20	50		%	V_{CE} = 10 V, I_F = 10 mA
Saturation Voltage — Collector to Emitter			0.40	V	I_C = 2.0 mA, I_F = 16 mA
Isolation Voltage	1500	2500		VDC	t = 1 Minute
Isolation Resistance		10^{11}		Ω	V_{I-O} = 500 V
Isolation Capacitance		0.5		pF	f = 1.0 MHz
Breakdown Voltage — Channel-to-Channel		1500		V	Relative Humidity = 40%
Capacitance Between Channels		0.4		pF	f = 1.0 MHz
Bandwidth		150		KHz	I_C = 2.0 mA, V_{CC} = 10V R_L = 100 Ω
Switching Times, Output Transistor					
Non-Saturated Rise Time, Fall Time		2.4		μs	I_C = 2.0 mA, V_{CE} = 10V R_L = 100 Ω
Non-Saturated Rise Time, Fall Time		15		μs	I_C = 2.0 mA, V_{CE} = 10V R_L = 1.0 KΩ
Saturated Turn-On Time (From 5.0 V to 0.8 V)		5.0		μs	R_L = 2.0 kΩ, I_F = 15 mA
Saturated Turn-Off Time (From Saturation to 2.0V)		25		μs	R_L = 2.0 KΩ, I_F = 15 mA

Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES FOR EACH CHANNEL

FIGURE 1. I-V CURVE OF PHOTOTRANSISTOR

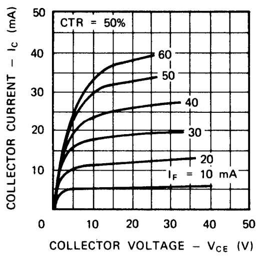


FIGURE 2. I-V CURVE IN SATURATION

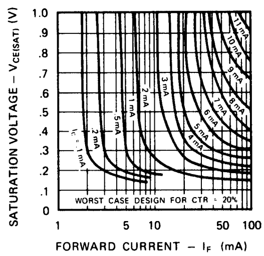


FIGURE 3. CTR VS FORWARD CURRENT

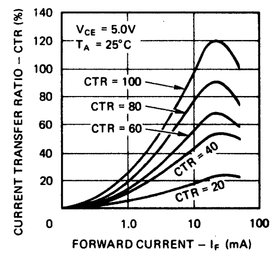


FIGURE 4. CURRENT TRANSFER RATIO VS TEMPERATURE

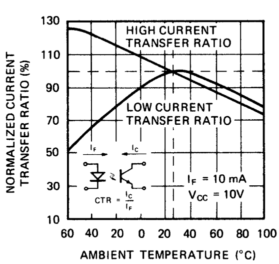


FIGURE 5. I-V CURVE OF LED VS TEMPERATURE

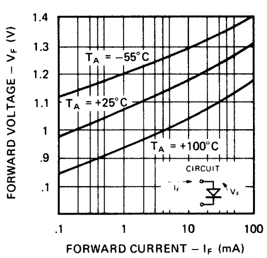


FIGURE 6. LEAKAGE CURRENT VS TEMPERATURE VS COLLECTOR VOLTAGE

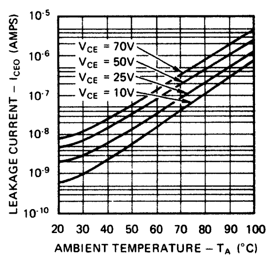
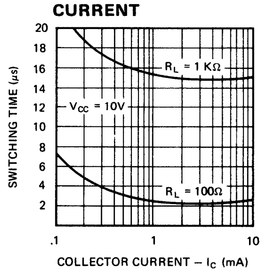
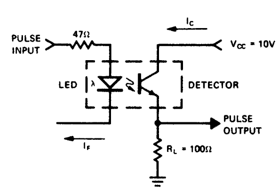


FIGURE 7. SWITCHING TIME VS COLLECTOR CURRENT

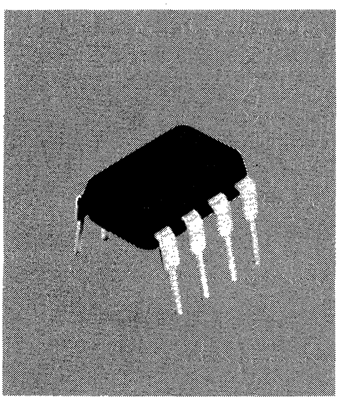




CIRCUIT USED TO OBTAIN SWITCHING TIME VS COLLECTOR CURRENT PLOT

ILD-506

DUAL PHOTOTRANSISTOR OPTO-ISOLATOR



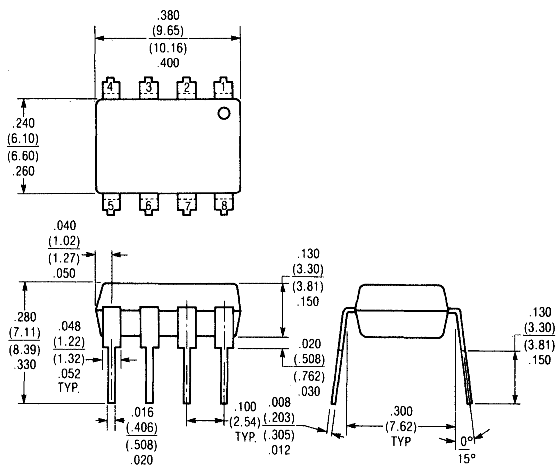
FEATURES

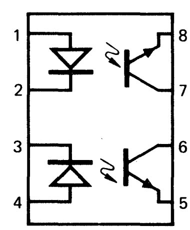
- **Two Isolated Channels Per Package**
- **5000 V Isolation**
- **50% Typical Current Transfer Ratio**
- **1 nA Typical Leakage Current**
- **Replacement for MCT6**
- **Underwriters Lab Approval #E52744**

DESCRIPTION

The IL-506 is a two-channel opto-isolator for high density applications. Each channel consists of an optically coupled pair employing a gallium arsenide infared LED and a silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output. The IL-506 is especially designed for driving medium-speed logic, where it may be used to eliminate troublesome ground loop and noise problems. It can also be used to replace relays and transformers in many digital interface applications, as well as analog applications such as CRT modulation.

Package Dimensions in Inches (mm)





LED CHIPS ON PINS 2 AND 3
PT CHIPS ON PINS 6 AND 7

PIN NO.	FUNCTION
1	ANODE
2	CATHODE
3	CATHODE
4	ANODE
5	EMITTER
6	COLLECTOR
7	COLLECTOR
8	EMITTER

Specifications subject to change without notice.

Maximum Ratings

Maximum Temperatures

Storage Temperature	−55 °C to +150 °C
Operating Temperature	−55 °C to +100 °C
Lead Temperature (Soldering, 10 seconds)	260 °C

Input Diode (Each Channel)

Rated Forward Current, DC	60 mA
Peak Forward Current (1 μs pulse, 300 pps)	3 A
Power Dissipation @ 25 °C Ambient	100 mW
Derate Linearly from 25 °C	1.3 mW/ °C

Output Transistor (Each Channel)

Power Dissipation @ 25 °C Ambient	150 mW
Derate Linearly from 25 °C	2 mW/ °C
Collector Current	30 mA

Coupled

Input-to-Output Breakdown Voltage	5000 VDC
Total Package Power Dissipation @ 25 °C Ambient	400 mW
Derate Linearly from 25 °C	5.33 mW/ °C

Electro-Optical Characteristics (@ 25 °C Free Air Temperature Unless Otherwise Specified)

Parameter	Min	Typ	Max	Units	Test Conditions
Input Diode					
Rated Forward Voltage		1.25	1.50	V	$I_F = 20$ mA
Reverse Voltage	3.0	5.0		V	$I_R = 10$ μA
Reverse Current		0.001	10	μA	$V_R = 3.0$ V
Junction Capacitance		100		pF	$V_F = 0$ V
Output Transistor					
Breakdown Voltage,					
Collector-to-Emitter	30	50		V	$I_C = 1.0$ mA
Emitter-to-Collector	7.0	10		V	$I_E = 100$ μA
Leakage Current,					
Collector-to-Emitter		1.0	100	nA	$V_{CE} = 10$ V
Capacitance,					
Collector-to-Emitter		8.0		pF	$V_{CE} = 0$ V
Coupled					
DC Current Transfer Ratio (I_C/I_F)	20	50		%	$V_{CE} = 10$ V, $I_F = 10$ mA
Saturation Voltage —					
Collector-to-Emitter		0.25	0.40	V	$I_C = 2.0$ mA, $I_F = 16$ mA
Isolation Voltage	5000	7000		VDC	t = 1 Minute
Isolation Resistance		10^{12}		Ω	$V_{I\text{-}O} = 500$ V
Isolation Capacitance		0.5		pF	f = 1.0 MHz
Breakdown Voltage —					
Channel-to-Channel		2500		VDC	t = 1 Minute
Capacitance Between Channels		0.4		pF	f = 1.0 MHz
Bandwidth		150		kHz	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100$ Ω
Switching Times, Output Transistor					
Non-Saturated Rise Time, Fall Time		2.4		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100$ Ω
Non-Saturated Rise Time, Fall Time		15		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 1.0$ kΩ
Saturated Turn-On Time (From 5.0 V to 0.8 V)		5.0		μs	$R_L = 2.0$ kΩ, $I_F = 15$ mA
Saturated Turn-Off Time (From Saturation to 2.0 V)		25		μs	$R_L = 2.0$ kΩ, $I_F = 15$ mA

Specifications subject to change without notice.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES FOR EACH CHANNEL

FIGURE 1. I-V CURVE OF PHOTOTRANSISTOR

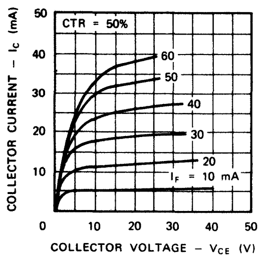


FIGURE 2. I-V CURVE IN SATURATION

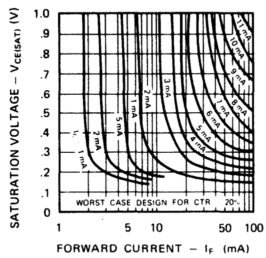


FIGURE 3. CTR VS FORWARD CURRENT

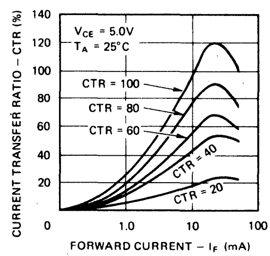


FIGURE 4. CURRENT TRANSFER RATIO VS TEMPERATURE

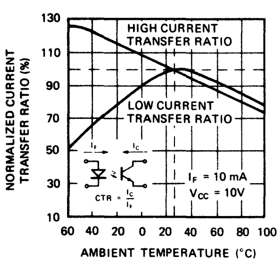


FIGURE 5. I-V CURVE OF LED VS TEMPERATURE

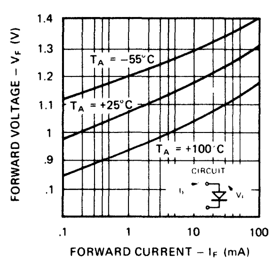


FIGURE 6. LEAKAGE CURRENT VS TEMPERATURE VS COLLECTOR VOLTAGE

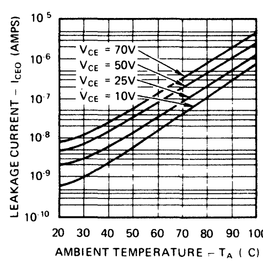
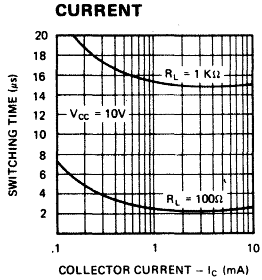
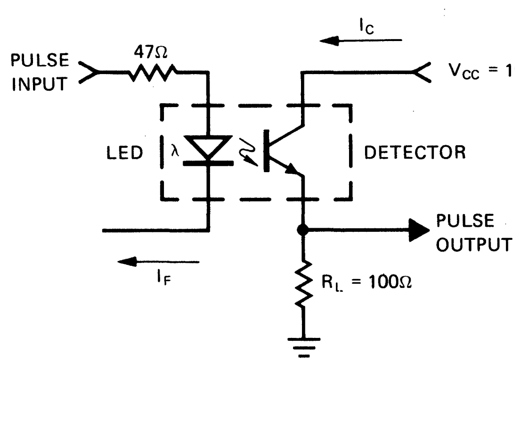


FIGURE 7. SWITCHING TIME VS COLLECTOR CURRENT



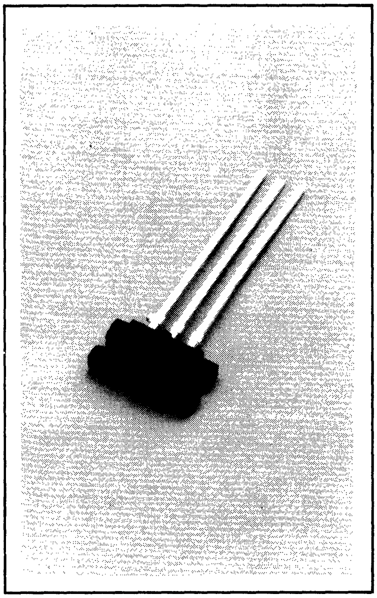
CIRCUIT USED TO OBTAIN SWITCHING TIME VS COLLECTOR CURRENT PLOT



litronix
A Siemens Company

SFH 900

MINIATURE LIGHT REFLECTION EMITTER/SENSOR PRELIMINARY



FEATURES

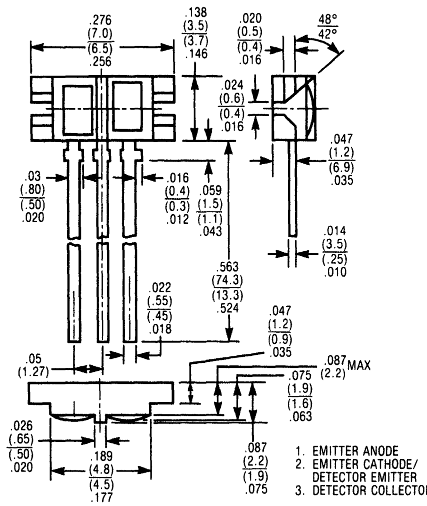
- **IR Emitter and NPN Phototransistor Detector**
- **High Sensitivity**
- **Designed for Short Distances Up to 5 mm**

DESCRIPTION

The SFH 900 is a reflex light barrier for short distances, operating in the infrared range, which includes a GaAs IRED as transmitter and an NPN phototransistor with a high photosensitivity as receiver. Both components are manufactured in modern strip-line technique and are mounted side-by-side in a plastic package. A daylight filter screens against undesired light effects.

The miniature reflex light barrier is designed for applications in industrial and entertainment electronics, e.g., as position reporting device and end position switch, for speed monitoring or in general, as a feeler element in various types of motion transmitters.

Package Dimensions in Inches (mm)



1. EMITTER ANODE
2. EMITTER CATHODE/ DETECTOR EMITTER
3. DETECTOR COLLECTOR

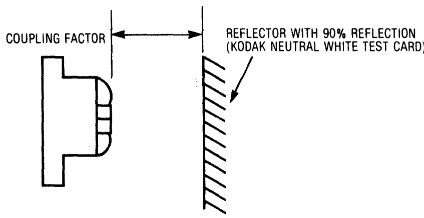
Maximum Ratings

Emitter (GaAs Infrared Diode)	
Reverse Voltage (V_R)	6 V
Forward Current (I_F)	60 mA
Surge Current (i_{FS}), t = 10 µs	1.5 A
Power Dissipation (P_{tot}), T_{amb} = 40 °C	100 mW
Detector (Silicon Phototransistor)	
Collector-Emitter Voltage (V_{CEO})	30 V
Emitter-Base Voltage (V_{EBO})	7 V
Collector Current (J_{CE})	10 mA
Power Dissipation (P_{tot})	100 mW
Package	
Storage Temperature (T_{stor})	−40 to +100 °C
Operating Temperature (T_{amb})	−40 to +100 °C
Junction Temperature (T_j)	100 °C
Soldering Temperature (T_S)	
2 mm From Case Bottom, t<3s	260 °C
Power Dissipation	150 mW

Characteristics (T_{amb} = 25 °C)

Emitter (GaAs Infrared Diode)	
Forward Voltage (V_F), I_F = 60 mA	1.25 (<1.65) V
Breakdown Voltage (V_{BR})	30 (>6) V
Reverse Current (I_R), V_R = 3 V	.01 (<10) µA
Capacitance (C_O)	
(V_R = 0 V; f = 1 MHz)	40 pF
Thermal Resistance (R_{thJL})	450 K/W
Detector (Silicon Phototransistor)	
Capacitance (V_{CE} = 5 V; f = 1 MHz)	
C_{CE}	11 pF
C_{CB}	15 pF
C_{EB}	16 pF
Thermal Resistance (R_{thJL})	750 K/W
Package	
Collector-Emitter Leakage Current (I_{CEO})	
(V_{CE} = 10 V)	20 (<200) nA
Photo Current (I_p)	
(V_{CE} = 5 V; E_E = 0.5 mW/cm²)	<3 mA

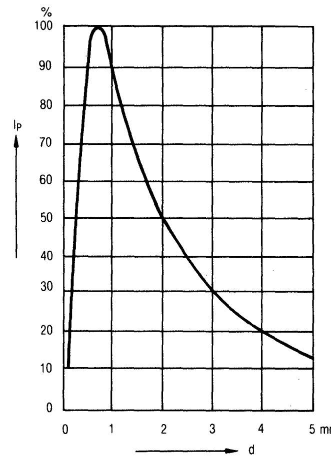
Specifications subject to change without notice.



$I_F = 10$ mA; $d = t_{mm}$; $V_{CE} = 5$ V $I_{CE} > 0.5$ mA

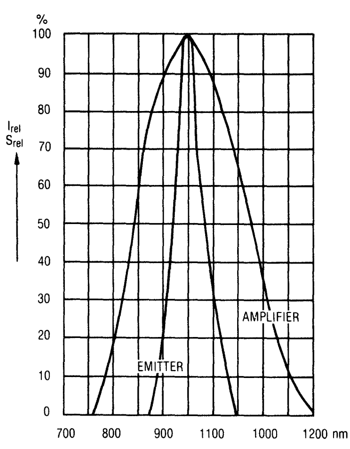
RELATIVE SPECTRAL EMISSION OF EMITTER AND DETECTOR

I_{rel}; $S_{rel} = f(\lambda)$



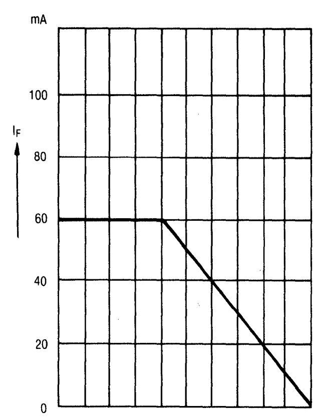
MAXIMUM PERMISSIBLE FORWARD CURRENT

$I_F = f(T)$

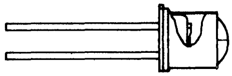
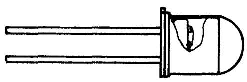
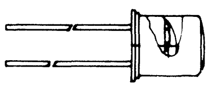
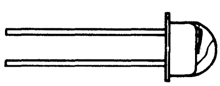
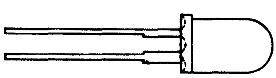
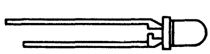


PHOTOCURRENT INDEPENDENT ON SPACING OF MEDIUMS

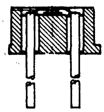
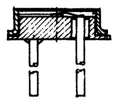
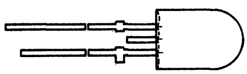
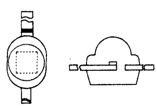
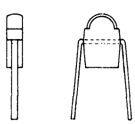
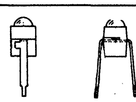
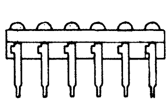
$I_P = f(d)$



INFRARED EMITTERS

Package Type	Package Outline	Part Number	Half Angle	Radiant Intensity I_e(mW/sr) Typ	@ (mA)	Page
TO-18 Dome Glass Lens		CQY17-4	15°	10-20		265
		CQY17-5		15-30		
		SFH401-1		6.3-12.5		267
		SFH401-2		10-20		
		SFH401-3		16-32		
TO-18 Round Glass Lens		CQY77-1	6°	8-16		269
		CQY77-2		12.5-25		
		CQY77-3		20-40		
		SFH400-1		12.5-25		271
		SFH400-2		20-40		
		SFH400-3		32-64		
TO-18 Flat Glass Lens		CQY78-1	40°	1.0-2.0	100	273
		CQY78-2		1.6-3.2		
		CQY78-3		2.5-5.0		
		SFH402-1		1.6-3.2		275
		SFH402-2		2.5-5.0		
		SFH402-3		4.0-8.0		
Modified TO-18 Glass Lens		LD242-1	60°	2.5-5.0		281
		LD242-2		4.0-8.0		
		LD242-3		6.3-12.5		
T1¾ 5mm Plastic		LD271	25°	10-15	100	277
		LD271H		>16		
		LD271A		>7		
T1 3mm Plastic		SFH409	30°	>5	100	279

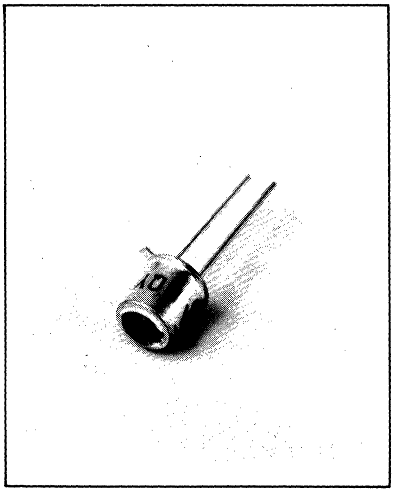
INFRARED EMITTERS

Package Type	Package Outline	Part Number	Half Angle	Radiant Intensity I_e(mW/sr) Typ	@ (mA)	Page
TO-46 Flat Plastic Package		SFH404	60°	output rad. power approx. 100μW	80	283
TO-46		SFH407-1		0.4-0.8	100	285
		SFH407-2		.63-1.25		
		SFH407-3		1.0-2.0		
Oval Plastic Package		LD273	25°	30	100	287
Miniature Axial Lead		IRL-60	25°	Total external radiated power >400mW	50	289
Miniature Radial Lead 1mm Pkg. Width		SFH405-1	16°	1.0-2.0	50	291
		SFH405-2		1.6-3.2		
		SFH405-3		2.5-5.0		
		SFH405-4		4.0-8.0		
Miniature Radial Lead 2mm Pkg. Width		LD261-4	30°	2.0-4.0		293
		LD261-5		3.2-6.3		
		LD261-6		5.0-10		
2 Diode Array		LD262	30°	2.5-8.0	50	
3		LD263				
4		LD264				
5		LD265				
6		LD266				
7		LD267				
8		LD268				
9		LD269				
10		LD260				

litronix
A Siemens Company

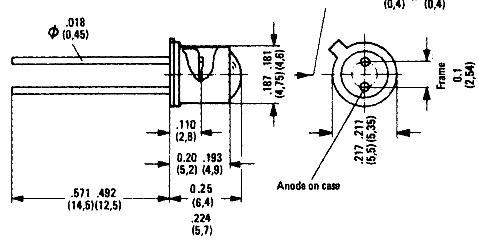
CQY 17 SERIES

INFRARED EMITTER



Specify SFH 401 for New Designs

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse voltage	V_R	4	V
Forward current	I_F	100	mA
Surge current ($t \leq 10\ \mu s$)	i_{FS}	2000	mA
Junction temperature	T_j	100	°C
Storage temperature	T_{stor}	−55 to +100	°C
Power dissipation (T_{case} = 65°C)	P_{tot}	180	mW
Thermal resistance			
Junction to air	R_{thJamb}	500	K/W
Junction to case	$R_{thJcase}$	180	K/W

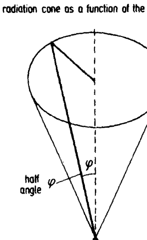
Characteristics (T_{amb} = 25°C)

Wavelength at peak emission at I_{max}	λ_{peak}	950	nm
Spectral bandwidth at 50% from I_{max}	$\Delta\lambda$	±20	nm
Switching times (I_e from 10% to 90%; I_F = 100 mA)	$t_r; t_f$	1	µs
Capacitance at V_R = 0 V	C_0	50	pF
Forward voltage (I_F = 100 mA)	V_F	1.35 (≤ 1.7)	V
Breakdown voltage (I_R = 100 µA)	V_{BR}	30 (≥ 4)	V
Reverse current (V_R = 3 V)	I_R	0.01 (≤ 10)	µA
Temperature coefficient of I_e or Φ_e	TC	−0.55	%/K
Temperature coefficient of V_F	TC	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC	0.3	nm/K
Half angle	φ	15	degrees

Radiant Power

Type	Group	Min	Typ	Max	Unit	Test Condition
CQY 17-4	Φ_e @ φ = 15°	1.1		2.8	mW	100 mA
	Φ_e (Total)		4		mW	100 mA
CQY 17-5	Φ_e @ φ = 15°	1.8		4.5	mW	100 mA
	Φ_e (Total)		6.3		mW	100 mA

radiation cone as a function of the half angle φ



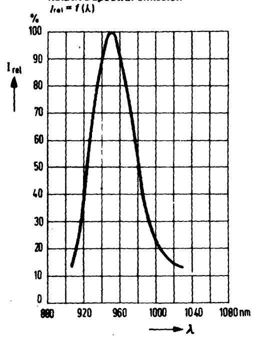
FEATURES

- Premium Hi-Rel Device
- Long Term Stability
- TO-18 Size Hermetic Package
- Dome Glass Lens
- Narrow Beam, 15°
- High Power, Up to 6.3 mW Typical

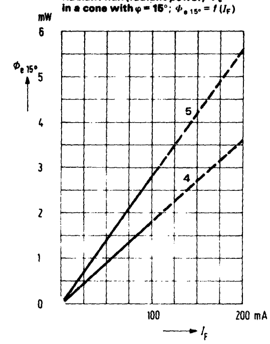
DESCRIPTION

The GaAs infrared emitting diode CQY 17 is designed to emit radiation at a wavelength in the near infrared. The radiation emitted is excited by current flowing in forward direction and can be modulated. The case 18A 2 DIN 41876 (similar to TO 18) is closed by a glass lens. The cathode terminal is marked by the adjacent projection on the rim of the case bottom. The anode is electrically connected to the case. From I_F = 100 mA heat sinks have to be used.

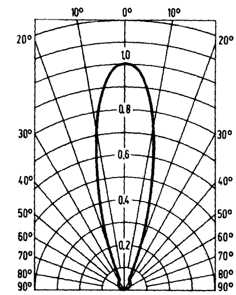
Relative spectral emission
$I_{rel} = f(\lambda)$



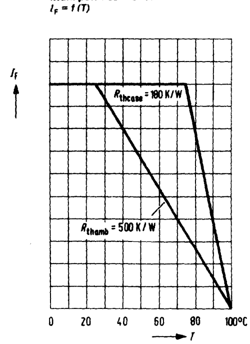
Radiant flux (radiant power) Φ_e **in a cone with** $\varphi = 15°$; $\Phi_{e\,15°} = f(I_F)$



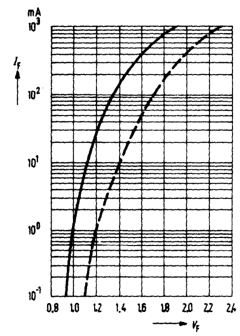
Radiation characteristic $I_{rel} = f(\varphi)$



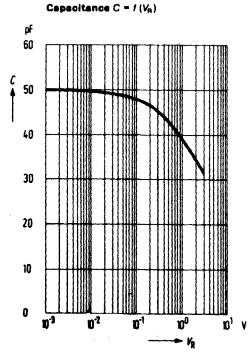
Max. permissible forward current
$I_F = f(T)$



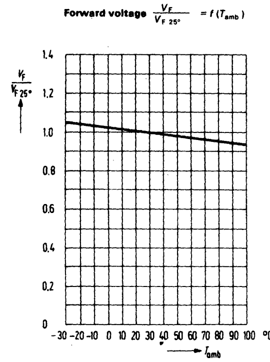
Forward voltage $I_F = f(V_F)$



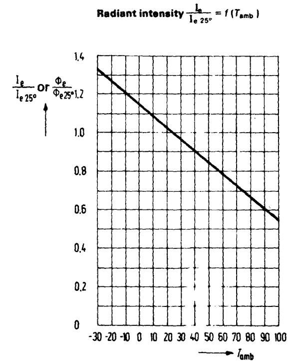
Capacitance $C = f(V_R)$



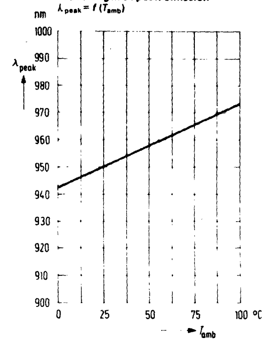
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



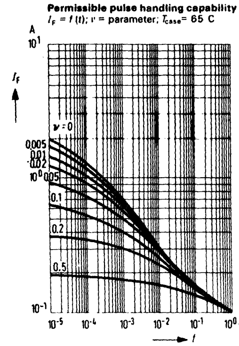
Radiant intensity $\frac{I_e}{I_{e\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



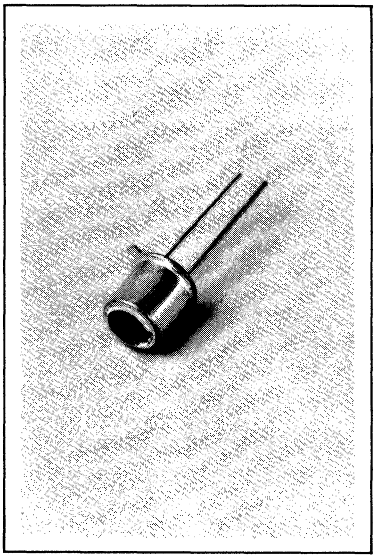
Permissible pulse handling capability
$I_F = f(t)$; ν = parameter; T_{case} = 65 C



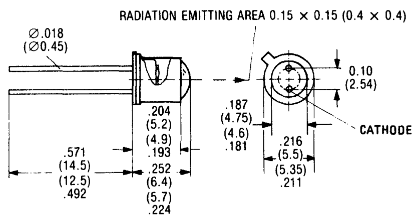
litronix
A Siemens Company

SFH 401 SERIES

INFRARED EMITTER



Package Dimensions in Inches (mm)



Maximum Ratings

Reverse Voltage (V_R)	4 V
Forward Current (I_F)	300 mA
Surge Current (i_{FS}), $\tau \leq 1\ \mu s$	5 A
Junction Temperature (T_j)	100 °C
Storage Temperature Range (T_s)	−55 to +100 °C
Power Dissipation (P_{tot})	470 mW
Thermal Resistance	
Junction-to-Air (R_{thJamb})	450 K/W
Junction-to-Case (R_{thJG})	160 K/W

FEATURES

- **TO-18 Hermetic Package**
- **Dome Glass Lens**
- **Narrow Beam, 15°**
- **Three High Power Intensity Ranges**
  SFH 401-1, 6.3 to 12.5 mW
  SFH 401-2, 10 to 20 mW
  SFH 401-3, 16 to 32 mW

DESCRIPTION

The SFH 401 GaAs infrared emitting diode is designed to emit radiation at a wavelength in the near infrared. The radiation emitted is excited by current flowing in forward direction and can be modulated. The case 18A 2 DIN41876 (similar to TO-18) is closed by a glass lens. The anode terminal is marked by the adjacent projection on the rim of the case bottom. The cathode is electrically connected to the case. From $I_F = 100$ mA heat sinks have to be used.

Characteristics ($T_{amb} = 25\,°C$)

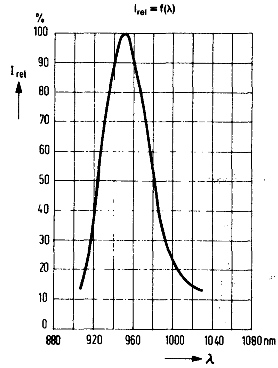
Wavelength at Peak Emission (@ I_{max}), λ_{peak}	950 nm
Spectral Bandwidth (@ 50% of I_{max}), $\Delta\lambda$	±20 nm
Half-Angle (Limits for 50% of Radiant Intensity (I_e), φ	15 Degrees
Switching Times (I_e from 10% to 90%; $I_F = 100$ mA), t_r;t_f	1 μs
Capacitance ($V_R = 0$ V), C_O	40 pF
Forward Voltage (V_F)	
($I_F = 100$ mA)	1.35 (≤1.7) V
($I_F = 1$ A)	1.9 (≤2.3) V
Breakdown Voltage ($I_R = 100\ \mu A$, V_{BR}	30 (≥4) V
Reverse Current ($V_R = 3$ V), I_R	0.01 (≤10) μA
Temperature Coefficient of (I_e or Φ_e), TC	−0.55 %/K
Temperature Coefficient of (V_F), TC	−1.5 mV/K
Temperature Coefficient of (λ_{peak}), TC	0.3 nm/K

The diodes are grouped according to their radiant intensity I_e at $I_F = 100$ mA in axial direction.

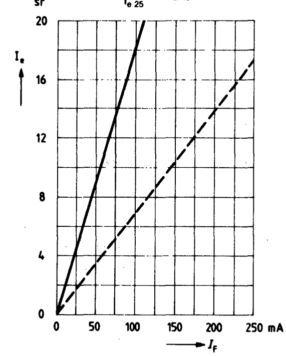
Group	I	II	III	
Radiant Intensity I_e	6.3 to 12.5	10 to 20	16 to 32	mW/sr
Φ_e (Total) typ.	2.5	4	10	mW

Specifications subject to change without notice.

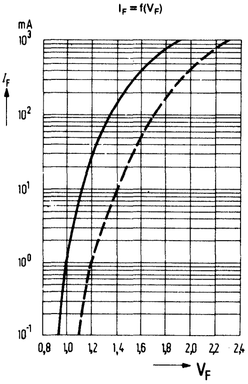
RELATIVE SPECTRAL EMISSION
$I_{rel} = f(\lambda)$



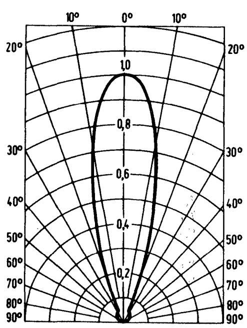
RADIANT INTENSITY
$\frac{I_e}{I_{e\,25}} = f(T_{amb})$



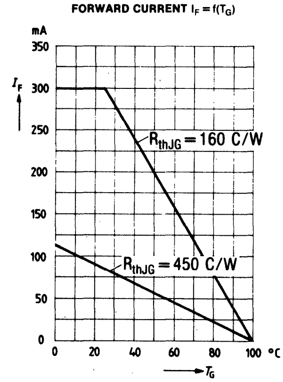
FORWARD CURRENT
$I_F = f(V_F)$



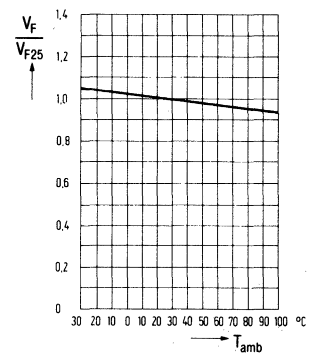
RADIATION CHARACTERISTICS
$I_{rel} = f(\varphi)$



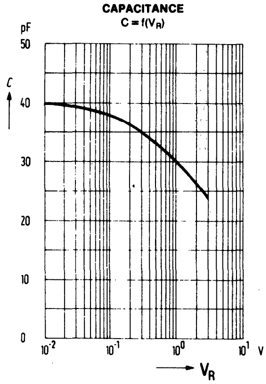
MAXIMUM PERMISSIBLE
FORWARD CURRENT $I_F = f(T_G)$



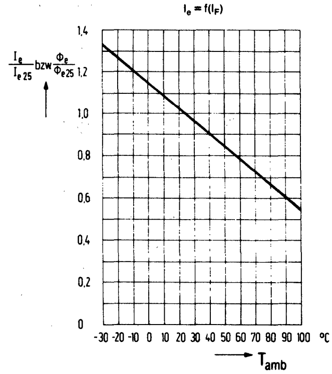
FORWARD VOLTAGE
$\frac{V_F}{V_{F\,25}} = f(T_{amb})$



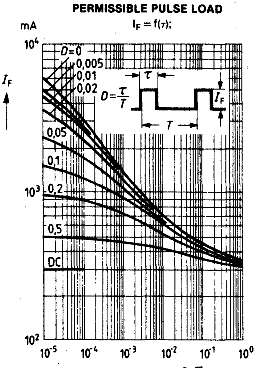
CAPACITANCE
$C = f(V_R)$



RADIANT INTENSITY
$I_e = f(I_F)$



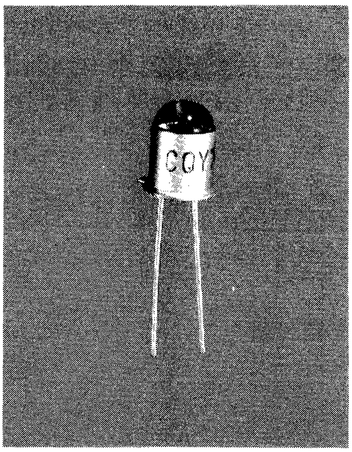
PERMISSIBLE PULSE LOAD
$I_F = f(\tau)$;



litronix
A Siemens Company

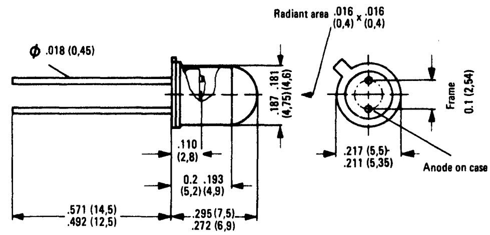
CQY 77 SERIES

INFRARED EMITTER



Specify SFH 400 for New Designs

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse voltage	V_R	4	V
Forward current	I_F	230	mA
Surge current ($t \leq 10\ \mu s$)	i_{FS}	4	A
Junction temperature	T_j	100	°C
Storage temperature	T_{stor}	−55 to +100	°C
Power dissipation (T_{case} = 40°C)	P_{tot}	350	mW
Thermal resistance			
Junction to air	R_{thJamb}	500	K/W
Junction to case	$R_{thJcase}$	180	K/W

Characteristics (T_{amb} = 25°C)

Wavelength at peak emission at I_{max}	λ_{peak}	950	nm
Spectral bandwidth at 50% of I_{max}	$\Delta\lambda$	±20	nm
Half angle			
(limits for 50% of radiant intensity I_e)	φ	6	degree
Switching times			
(I_e from 10% to 90%; I_F = 100 mA)	t_r; t_f	1	µs
Capacitance (V_R = 0 V)	C_O	40	pF
Forward voltage (I_F = 100 mA)	V_F	1.35 (≤ 1.7)	V
Breakdown voltage (I_R = 100 µA)	V_{BR}	30 (≥ 4)	V
Reverse current (V_R = 3 V)	I_R	0.01 (≤ 10)	µA
Temperature coefficient of I_e or ϕ_e	TC	−0.55	%/K
Temperature coefficient of V_F	TC	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC	0.3	nm/K

Radiant Intensity & Power

Type	Group	Min	Typ	Max	Unit	Test Condition
CQY 77-1	Intensity I_e	8		16	mW/sr	100 mA
	Φ_e (Total)		2.5		mW	100 mA
CQY 77-2	Intensity I_e	12.5		25	mW/sr	100 mA
	Φ_e (Total)		4.0		mW	100 mA
CQY 77-3	Intensity I_e	20		40	mW/sr	100 mA
	Φ_e (Total)		6.3		mW	100 mA

Specifications are subject to change without notice.

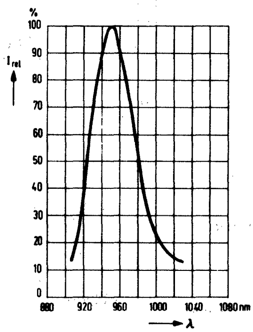
FEATURES

- Premium Hi-Rel Device
- TO-18 Size Hermetic Package
- Long Term Stability
- Round Glass Lens
- Very Narrow Beam, 6°
- High Power, Up to 6.3 mW Typical
- Very High Intensity, Up to 40 mW/sr

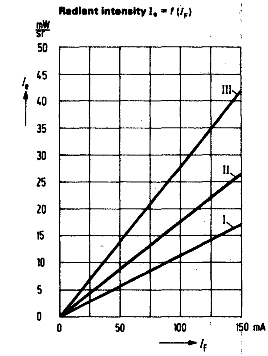
DESCRIPTION

The GaAs infrared emitting diode CQY 77 emits radiation at a wavelength in the near infrared range. The radiation emitted is excited by current flowing in forward direction and can be modulated. The case 18 A 2 DIN 41876 (similar to TO 18) is closed by a glass lens. The cathode terminal is marked by the adjacent projection on the rim of the case bottom. The anode is electrically connected to the case. From I_F = 100 mA heat sinks have to be used.

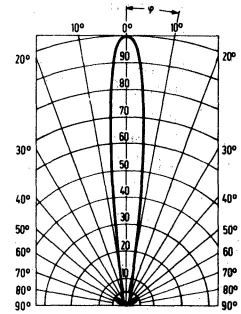
Relative spectral emission $I_{rel} = f(\lambda)$



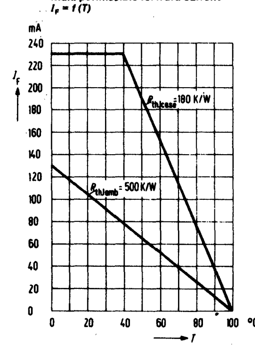
Radiant intensity $I_e = f(I_F)$



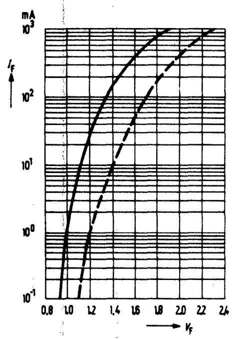
Radiation characteristic $I_{rel} = f(\varphi)$



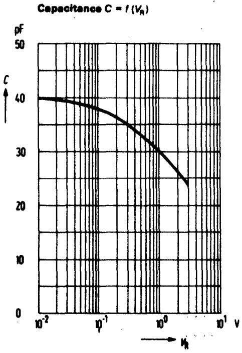
Max. permissible forward current
$I_F = f(T)$



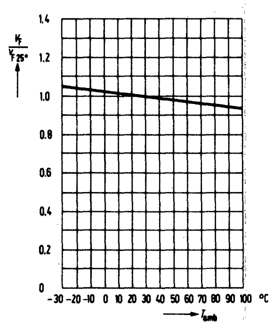
Forward voltage $I_F = f(V_F)$



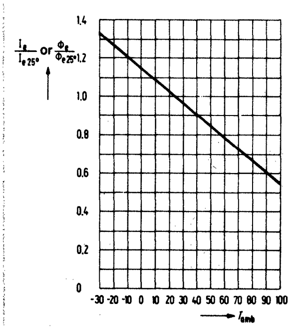
Capacitance $C = f(V_R)$



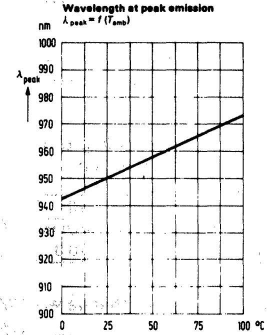
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



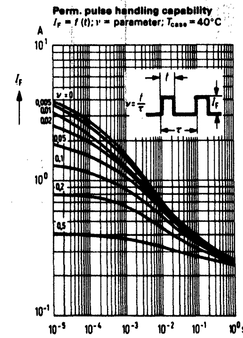
Radiant intensity $\frac{I_e}{I_{e\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



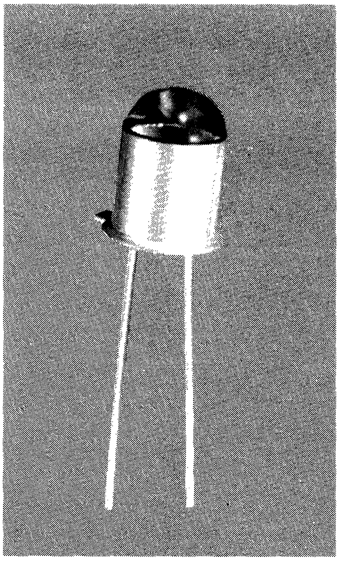
Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; T_{case} = 40°C



litronix
A Siemens Company

SFH 400 SERIES

INFRARED EMITTER



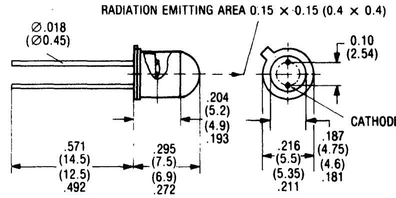
FEATURES

- **TO-18 Hermetic Package**
- **Round Glass Lens**
- **Very Narrow Beam, 6°**
- **Three Very High Power Intensity Ranges**
  SFH 400-1, 12.5 to 25 mW
  SFH 400-2, 20 to 40 mW
  SFH 400-3, 32 to 64 mW

DESCRIPTION

The SFH-400 GaAs infrared emitting diode emits radiation at a wavelength in the near infrared range. The radiation emitted is excited by current flowing in forward direction and can be modulated. The case 18 A 2 DIN 41876 (similar to TO-18) is closed by a glass lens. The anode terminal is marked by the adjacent projection on the rim of the case bottom. The cathode is electrically connected to the case. From $I_F = 100$ mA heat sinks have to be used.

Physical Dimensions in Inches (mm)



Maximum Ratings

Reverse Voltage (V_R)	4 V
Forward Current (I_F)	300 mA
Surge Current (i_{FS}), $\tau \leq 1\ \mu s$	5 A
Junction Temperature (T_j)	100 °C
Storage Temperature (T_s)	−55 to +100 °C
Power Dissipation (P_{tot}), $T_G = 25$ °C	470 mW
Thermal Resistance:	
Junction to Air (R_{thJamb})	450 K/W
Junction to Case (R_{thJG})	160 K/W

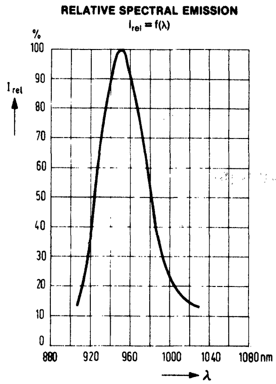
Characteristics ($T_{amb} = 25$ °C)

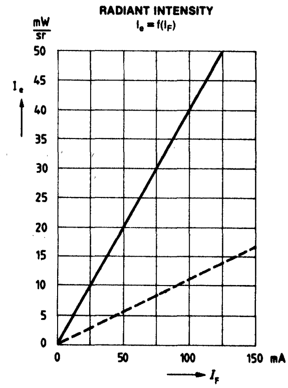
Wavelength at Peak Emission (λ_{peak}), at I_{max}	950 ± 15 nm
Spectral Bandwidth at 50% ($\Delta\lambda$), of I_{max}	± 20 nm
Half Angle (Limits for 50% of Radiant Intensity I_e), (φ)	6 Degrees
Switching Times (I_e from 10% to 90%; $I_F = 1000$ mA), (t_r;t_f)	1 μs
Capacitance (C_O), $V_R = 0$ V	40 pF
Forward Voltage (V_F)	
$I_F = 100$ mA	1.35 (≤1.7) V
$I_F = 1$ A	1.9 (≤2.3) V
Breakdown Voltage (V_{BR}), $I_R = 100\mu A$	30 (≥4) V
Reverse Current (I_R)	
$V_R = 3$ V	0.01 (≤10) μA
Temperature Coefficient of I_e or Φ_e (TC)	−0.55 %/K
Temperature Coefficient of V_F (TC)	−1.5 mV/K
Temperature Coefficient of λ_{peak} (TC)	0.3 nm/K

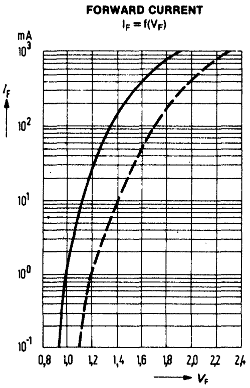
The diodes are grouped according to their radiant intensity I_e = at $I_F = 100$ mA in axial direction.

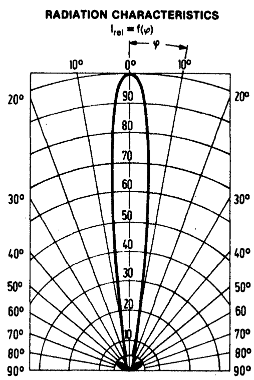
Group	I	II	III	
Radiant Intensity I_e	12.5 to 25	20 to 40	32 to 64	mW/sr
Φ_e (Total) typ.	4	6.3	10	mW

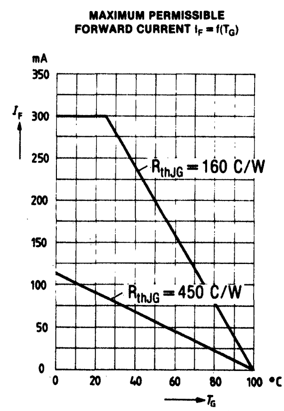
Specifications subject to change without notice.

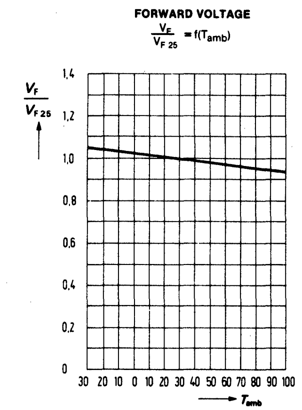

RELATIVE SPECTRAL EMISSION
$I_{rel} = f(\lambda)$
%
I_{rel}
880 920 960 1000 1040 1080 nm
λ

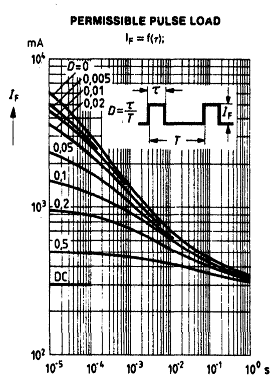

RADIANT INTENSITY
$I_e = f(I_F)$
mW/sr
I_e
0 50 100 150 mA
I_F

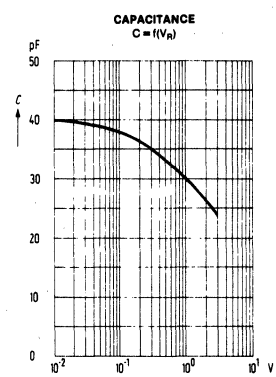

FORWARD CURRENT
$I_F = f(V_F)$
mA
I_F
0,8 1,0 1,2 1,4 1,6 1,8 2,0 2,2 2,4 V
V_F

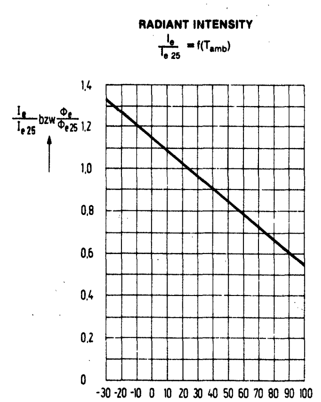

RADIATION CHARACTERISTICS
$I_{rel} = f(\varphi)$
φ


MAXIMUM PERMISSIBLE
FORWARD CURRENT $I_F = f(T_G)$
mA
I_F
$R_{thJG} = 160$ C/W
$R_{thJG} = 450$ C/W
0 20 40 60 80 100 °C
T_G


FORWARD VOLTAGE
$\frac{V_F}{V_{F\,25}} = f(T_{amb})$
$\frac{V_F}{V_{F\,25}}$
30 20 10 0 10 20 30 40 50 60 70 80 90 100 °C
T_{amb}

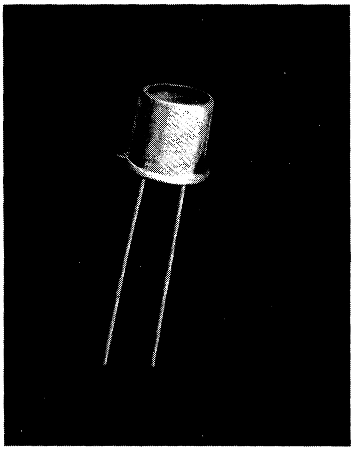

PERMISSIBLE PULSE LOAD
$I_F = f(\tau)$;
mA
I_F
D=0
0,005
0,01
0,02
0,05
0,1
0,2
0,5
DC
$D = \frac{\tau}{T}$
10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} s
τ


CAPACITANCE
$C = f(V_R)$
pF
C
10^{-2} 10^{-1} 10^{0} 10^{1} V
V_R


RADIANT INTENSITY
$\frac{I_e}{I_{e\,25}} = f(T_{amb})$
$\frac{I_e}{I_{e\,25}}$ bzw $\frac{\Phi_e}{\Phi_{e\,25}}$
-30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 °C
T_{amb}

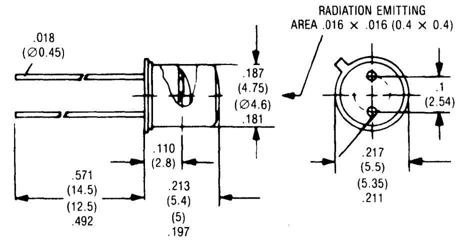
litronix
A Siemens Company

CQY 78 SERIES
INFRARED EMITTING DIODE



Specify SFH 402 for New Designs

Package Dimensions in Inches (mm)



FEATURES

- Premium Hi-Rel Device
- TO-18 Size Hermetic Package
- Long Term Stability
- Flat Glass Lens
- Wide Beam, 40°
- High Power, Up to 6.3 mW Typical

DESCRIPTION

The GaAs infrared emitting diode CQY 78 is designed to emit radiation at a wavelength in the near infrared range. The radiation emitted is excited by current flowing in forward direction and can be modulated. The case similar to TO 18, is equipped with a flat light window. The cathode is marked by the adjacent projection on the rim of the case bottom. The anode is electrically connected to the case. From I_F = 100 mA heat sinks have to be used.

Maximum Ratings

Reverse voltage	V_R	4	V
Forward current	I_F	230	mA
Surge current ($t \leq 10\,\mu s$)	i_{FS}	4	A
Junction temperature	T_j	100	°C
Storage temperature	T_{stor}	−55 to +100	°C
Power dissipation (T_{case} = 40°C)	P_{tot}	350	mW
Thermal resistance			
Junction to air	R_{thJamb}	500	K/W
Junction to case	$R_{thJcase}$	180	K/W

Characteristics (T_{amb} = 25°C)

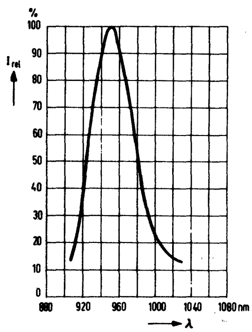
Wavelength at peak emission at I_{max}	λ_{peak}	950	nm
Spectral bandwidth at 50% of I_{max}	$\Delta\lambda$	±20	nm
Half angle (limits for 50% of radiant intensity I_e)	φ	40	degree
Switching times (I_e from 10% to 90%; I_F = 100 mA)	t_r; t_f	1	µs
Capacitance (V_R = 0 V)	C_O	40	pF
Forward voltage (I_F = 100 mA)	V_F	1.35 (≤ 1.7)	V
Breakdown voltage (I_R = 100 µA)	V_{BR}	30 (≥ 4)	V
Reverse current (V_R = 3 V)	I_R	0.01 (≤ 10)	µA
Temperature coefficient of I_e or Φ_e	TC	−0.55	%/K
Temperature coefficient of V_F	TC	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC	0.3	nm/K

Radiant Intensity & Power

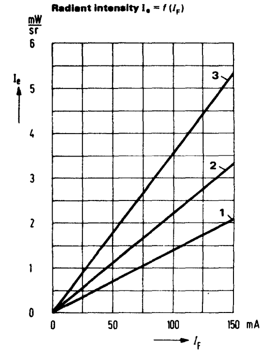
Type	Group	Min	Typ	Max	Unit	Test Condition
CQY 78-1	Intensity I_e	1.0		2.0	mW/sr	100 mA
	Φ_e (Total)		2.5		mW	100 mA
CQY 78-2	Intensity I_e	1.6		3.2	mW/sr	100 mA
	Φ_e (Total)		4.0		mW	100 mA
CQY 78-3	Intensity I_e	2.5		5.0	mW/sr	100 mA
	Φ_e (Total)		6.3		mW	100 mA

Specifications are subject to change without notice.

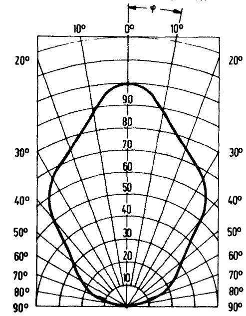
Relative spectral emission $I_{rel} = f(\lambda)$



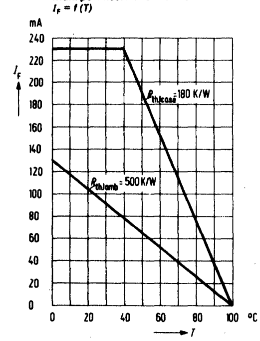
Radiant intensity $I_e = f(I_F)$



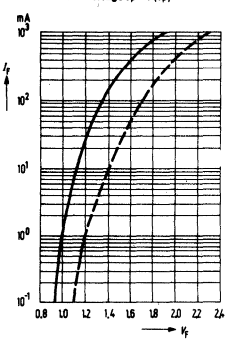
Radiation characteristic $I_{rel} = f(\varphi)$



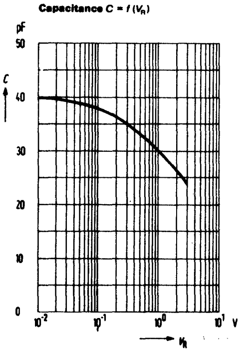
Max. permissible forward current
$I_F = f(T)$



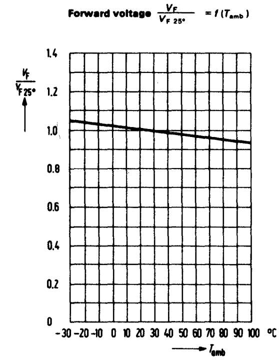
Forward voltage $I_F = f(V_F)$



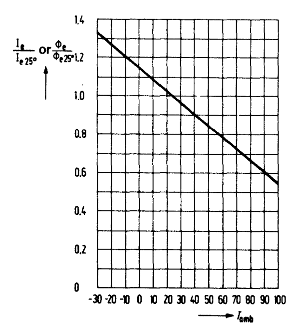
Capacitance $C = f(V_R)$



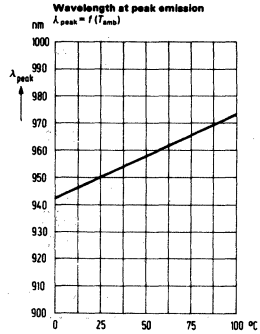
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



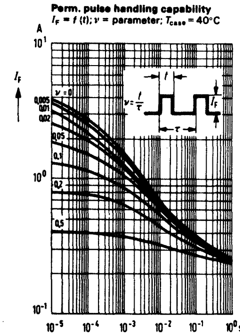
Radiant intensity $\frac{I_e}{I_{e\,25°}} = f(T_{amb})$



Wavelength at peak emission
$\lambda_{peak} = f(T_{amb})$



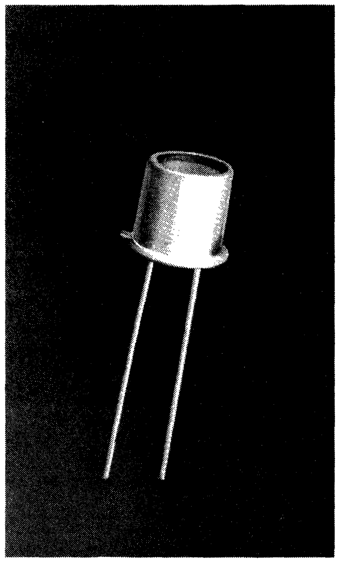
Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; $T_{case} = 40°C$



litronix
A Siemens Company

SFH 402 SERIES

INFRARED EMITTER



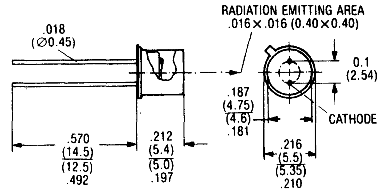
FEATURES

- **TO-18 Hermetic Package**
- **Flat Glass Lens**
- **Wide Beam, 40°**
- **Three Intensity Ranges**
  SFH 402-1, 1.6 to 3.2 mW
  SFH 402-2, 2.5 to 5.0 mW
  SFH 402-3, 4.0 to 8.0 mW

DESCRIPTION

The SFH 402 GaAs infrared emitting diode is designed to emit radiation at a wavelength in the near infrared range. The radiation emitted is excited by current flowing in forward direction and can be moduled. The case similar to TO-18 is equipped with a flat light window. The anode is marked by the adjacent projection on the rim of the case bottom. The cathode is electrically connected to the case. From $I_F = 100$ mA heat sinks have to be used.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse Voltage (V_R) .... 4 V
Forward Current (I_F) .... 300 mA
Surge Current (i_{FS}), $\tau \leq 1\,\mu s$ .... 5 A
Junction Temperature (T_j) .... 100 °C
Storage Temperature T_s) .... −55 to +100 °C
Power Dissipation (P_{tot})
($T_{amb} = 25$ °C) .... 470 mW
Thermal Resistance
Junction-to-Air (R_{thJamb}) .... 450 C/W
Junction-to-Case (R_{thJG}) .... 160 C/W

Characteristics ($T_{amb} = 25$ °C)

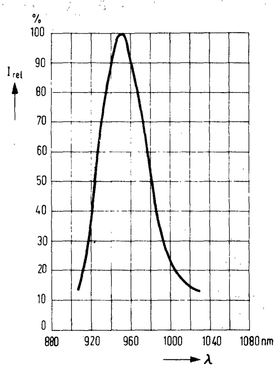
Wavelength at Peak Emission (@ I_{max}), λ_{peak} .... 950 nm
Spectral Bandwidth (@ 50% of I_{max}), $\Delta\lambda$ .... ±20 nm
Half-Angle (Limits for 50%
of Radiant Intensity I_e), φ .... 40 Degrees
Switching Times (I_e from 10% to 90%;
$I_F = 100$ mA), t_r; t_f .... 1 μs
Capacitance ($V_R = 0$ V), C_O .... 40 pF
Forward Voltage (V_F)
($I_F = 100$ mA) .... 1.35 (≤1.7) V
($I_F = 1$ A) .... 1.9 (≤2.3) V
Breakdown Voltage ($I_R = 100\,\mu A$), V_{BR} .... 30 (≥4) V
Reverse Current ($V_R = 3$ V), I_R .... 0.01 (≤10) μA
Temperature Coefficient of (I_e or Φ_e), TC .... −0.55 %/K
Temperature Coefficient of (V_F), TC .... −1.5 mV/K
Temperature Coefficient of (λ_{peak}), TC .... 0.3 nm/K

The diodes are grouped according to their radiant intensity I_e at $I_f = 100$ mA in axial direction.

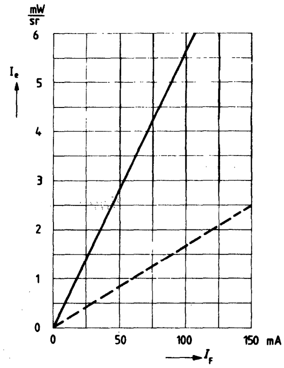
Group	I	II	III	
Radiant Intensity I_e	1.6 to 3.2	2.5 to 5	4 to 8	mW/sr
Φ_e (Total) typ.	4	6.3	10	mW

Specifications subject to change without notice.

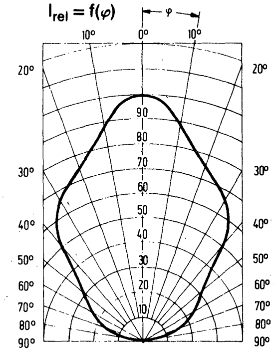
RELATIVE SPECTRAL EMISSION $I_{rel} = f(\lambda)$



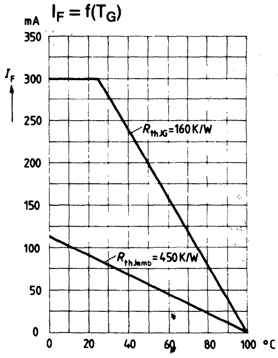
RADIANT INTENSITY $I_e = f(I_F)$



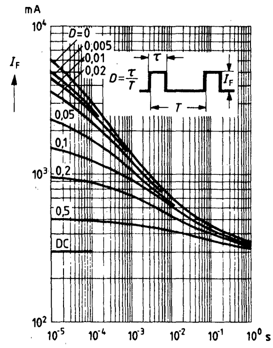
RADIATION CHARACTERISTICS $I_{rel} = f(\varphi)$



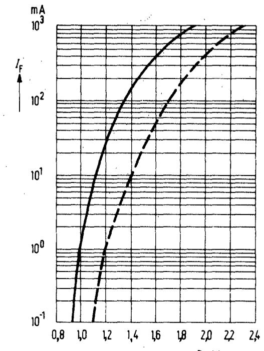
MAXIMUM PERMISSIBLE FORWARD CURENT $I_F = f(T_G)$



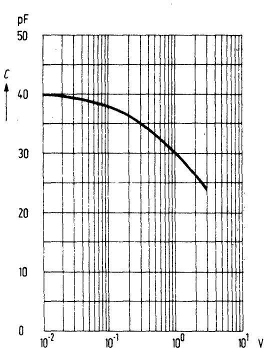
PERMISSIBLE PULSE LOAD $I_F = f(\tau)$



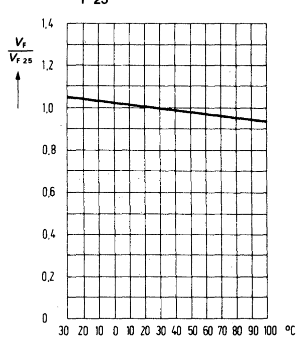
FORWARD CURRENT $I_F = f(V_F)$



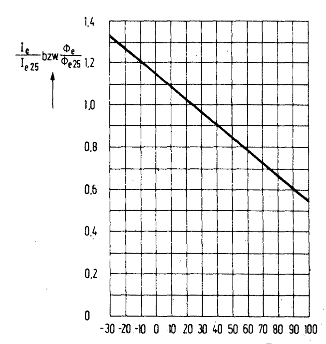
CAPACITANCE $C = f(V_R)$



FORWARD VOLTAGE $\frac{V_F}{V_{F\,25}} = f(T_{amb})$

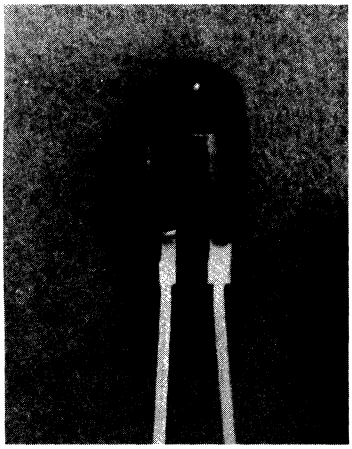


RADIANT INTENSITY $\frac{I_e}{I_{e\,25}} = f(T_{amb})$



litronix
A Siemens Company

LD 271 SERIES
INFRARED EMITTING DIODE



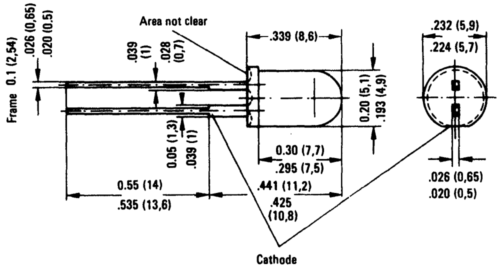
FEATURES

- Low Cost
- T-1¾ Package
- Lightly Diffused Gray Plastic Lens
- Long Term Stability,
- Medium Wide Beam, 25°
- Very High Power, 16 mW Typical
- High Intensity, 16 mW/sr

DESCRIPTION

The GaAs infrared emitting diode LD 271 is designed to emit radiation at a wavelength in the near infrared range. The radiation emitted is excited by current flowing in forward direction and can be modulated. LD 271 is enclosed in a dark plastic package of 5 mm diameter. It is preferably provided for IR remote control of color TV receivers.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

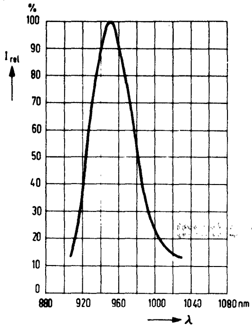
Reverse voltage	V_R	4	V
Forward current	I_F	130	mA
Surge current ($t \leq 10$ µs)	i_{FS}	2.5	A
Junction temperature	T_j	100	°C
Storage temperature	T_{stor}	−55 to + 100	°C
Power dissipation (T_{case} = 40°C)	P_{tot}	210	mW
Thermal resistance Junction to air	R_{thJamb}	350	K/W

Characteristics (T_{amb} = 25°C)

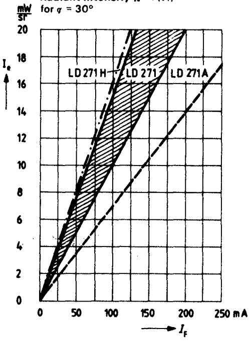
Wavelength of radiation at I_{max}	λ_{peak}	950	nm
Spectral bandwidth at 50% of I_{max}	$\Delta\lambda$	±20	nm
Radiant intensity in axial direction I_F = 100 mA for half angle φ = 30°			
LD271	I_e	15 (≥ 10)	mW/sr
LD271H		≥ 16	
LD271A		≥ 7	
Radiant flux ϕ_e (I_F = 100 mA) total (typ.)	ϕ_e	16	mW
Half angle (limits for 50% of radiant intensity I_e)	φ	25	degree
Switching times (Φ_e from 10% to 90%; I_F = 100 mA)	$t_r; t_f$	1	µs
Capacitance at V_R = 0 V	C_0	40	pF
Forward voltage (I_F = 100 mA)	V_F	1.35 (≤ 1.7)	V
Breakdown voltage (I_R = 100 µA)	V_{BR}	30 (≥ 4)	V
Reverse current (V_R = 3 V)	I_R	0.01 (≤ 10)	µA
Temperature coefficient of I_e or Φ_e	TC	−0.55	%/K
Temperature coefficient of V_F	TC	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC	+0.3	nm/K
Half-life of radiant intensity			

Specifications are subject to change without notice.

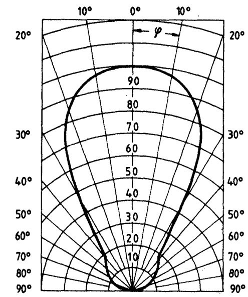
Relative spectral emission $I_{rel} = f(\lambda)$



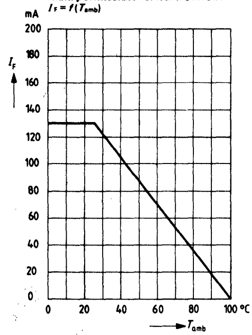
Radiant intensity $I_e = f(I_F)$ for $\varphi = 30°$



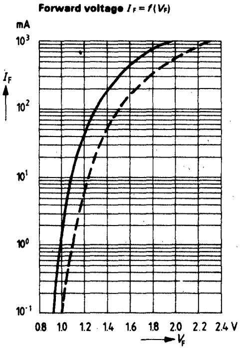
Radiation characteristic $I_{rel} = f(\varphi)$



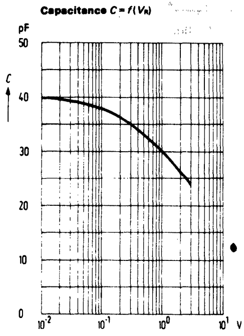
Max. permissible forward current $I_F = f(T_{amb})$



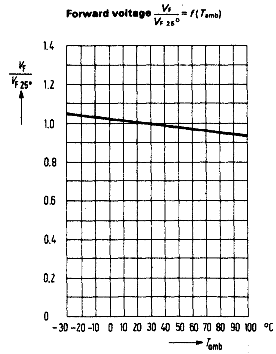
Forward voltage $I_F = f(V_F)$



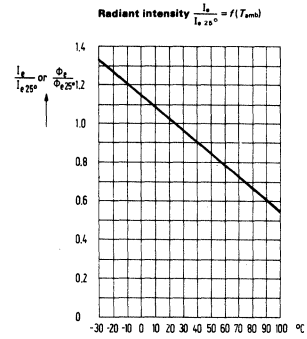
Capacitance $C = f(V_R)$



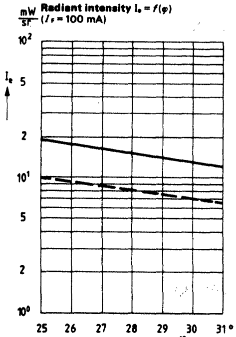
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



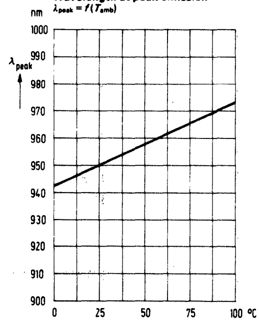
Radiant intensity $\frac{I_e}{I_{e\,25°}} = f(T_{amb})$



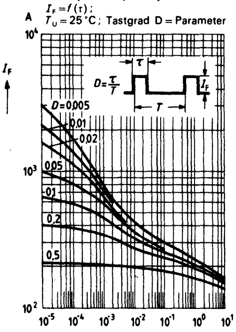
Radiant intensity $I_e = f(\varphi)$ (I_F = 100 mA)



Wavelength at peak emission $\lambda_{peak} = f(T_{amb})$



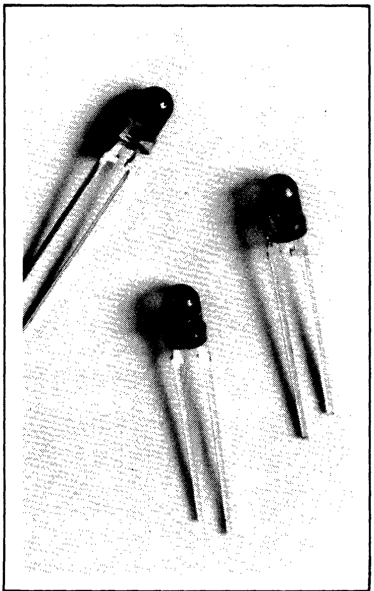
Perm. pulse capability $I_F = f(\tau)$; T_U = 25 °C; Tastgrad D = Parameter



litronix
A Siemens Company

SFH-409

INFRARED EMITTER ADVANCED INFORMATION



FEATURES

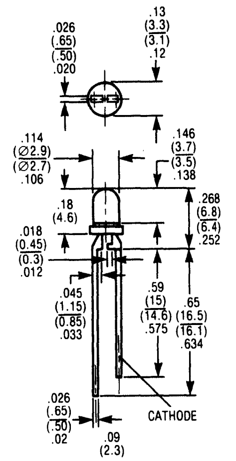
- 3 mm (T1) Size Package
- 1/10″ (2.3 mm) Lead Spacing
- Low Cost
- Matches with SFH-309 Phototransmitter

DESCRIPTION

The new infrared emitting diode (GaAs-IRED) SFH-409 is available as a low cost component in the usual 3 mm plastic case.

This component was conceived for preferred use in simple IR light barriers and for remote control applications in entertainment electronics and the toy industry.

Package Dimensions in Inches (mm)



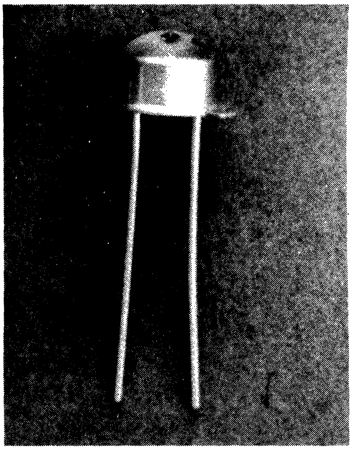
Characteristics

Radiant Intensity in the Axial Direction ($I_F = 100$ mA)	I_e	7(≥5) mW/sr
Aperture Cone (Half-Angle)	φ	30 Degrees
Wavelength at Peak Emission	λ_{peak}	950 nm
Forward Voltage ($I_F = 100$ mA)	V_F	1.35 (≤1.7) V

Specifications subject to change without notice.

litronix
A Siemens Company

LD 242 SERIES
INFRARED EMITTING DIODE



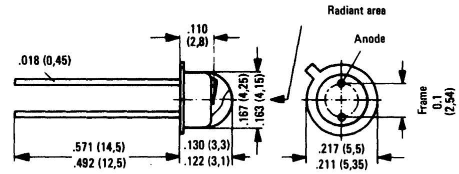
FEATURES

- Modified TO-18 Size Metal Case
- Rounded Plastic Lens
- Long Term Stability
- Very Wide Beam, 60°
- Very High Power, 16 mW Typical
- High Intensity, 12.5 mW/sr

DESCRIPTION

The GaAs infrared emitting diode LD 242 is designed to emit radiation at a wavelength in the near infrared range. The radiation emitted is excited by current flowing in forward direction and can be modulated. The plastic cover permits wide-angle radiation. The anode terminal is marked by the adjacent projection on the rim of the case bottom. The cathode is electrically connected to the case. The LD 242 is particularly suitable for use as emitter for IR sound transmission in radio and TV sets.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse voltage	V_R	4	V
Forward current	I_F	300	mA
Surge current ($t \leq 1\ \mu s$)	i_{FS}	5	A
Junction temperature	T_j	100	°C
Storage temperature	T_{stor}	−60 to + 100	°C
Power dissipation	P_{tot}	470	mW
Thermal resistance			
Junction to air	R_{thJamb}	450	K/W
Junction to case	$R_{thJcase}$	135	K/W

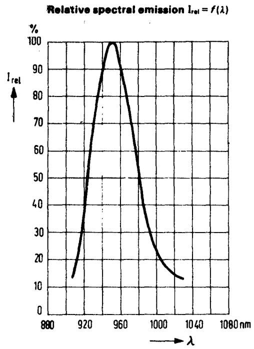
Characteristics (T_{amb} = 25°C)

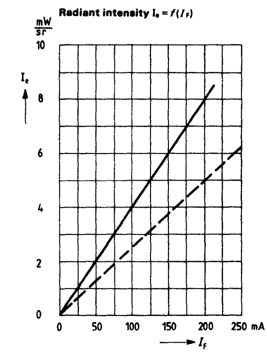
Wavelength at peak emission at I_{max}	λ_{peak}	950	nm
Spectral bandwidth at 50% of I_{max}	$\Delta\lambda$	±20	nm
Half angle (limits for 50% of radiant intensity I_e)	φ	60	degree
Switching times (I_e from 10% to 90%; I_F = 100 mA)	$t_r; t_f$	1	µs
Capacitance at V_R = 0 V	C_0	40	pF
Forward voltage (I_F = 100 mA)	V_F	1.35 (≤1.7)	V
Forward voltage (I_F = 1 A)	V_F	1.9 (≤2.3)	V
Breakdown voltage (I_R = 100 µA)	V_{BR}	30 (≥4)	V
Reverse current (V_R = 3 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC	−0.55	%/K
Temperature coefficient of V_F	TC	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC	0.3	nm/K

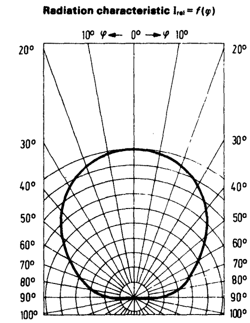
Radiant Intensity & Power

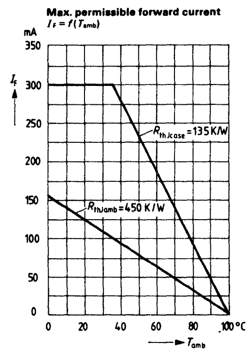
Type	Group	Min	Typ	Max	Unit	Test Condition
LD 242-1	Intensity I_e	2.5		5.0	mW/sr	100 mA
	Φ_e (Total)		6		mW	100 mA
LD 242-2	Intensity I_e	4.0		8.0	mW/sr	100 mA
	Φ_e (Total)		10		mW	100 mA
LD 242-3	Intensity I_e	6.3		12.5	mW/sr	100 mA
	Φ_e (Total)		16		mW	100 mA

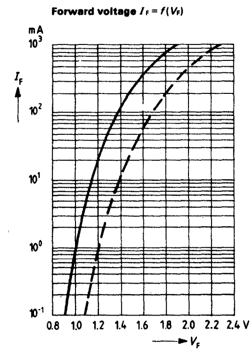
Specifications are subject to change without notice.

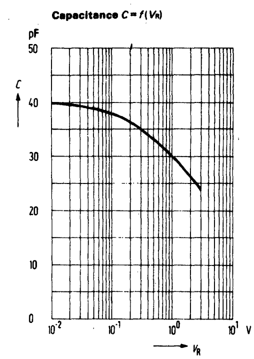

Relative spectral emission $I_{rel} = f(\lambda)$
%
I_{rel}
100
90
80
70
60
50
40
30
20
10
0
880 920 960 1000 1040 1080 nm
λ

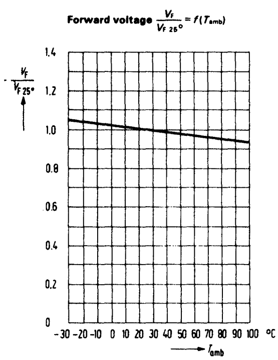

Radiant intensity $I_e = f(I_F)$
mW/sr
I_e
10
8
6
4
2
0
0 50 100 150 200 250 mA
I_F

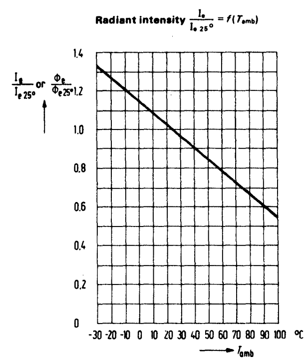

Radiation characteristic $I_{rel} = f(\varphi)$
10° φ ← 0° → φ 10°
20°
30°
40°
50°
60°
70°
80°
90°
100°

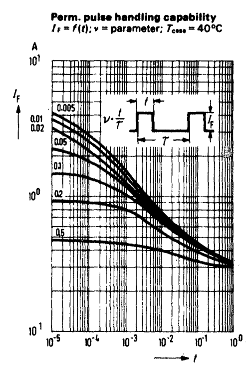

Max. permissible forward current
$I_F = f(T_{amb})$
mA
I_F
350
300
250
200
150
100
50
0
$R_{thJcase} = 135$ K/W
$R_{thJamb} = 450$ K/W
0 20 40 60 80 100 °C
T_{amb}

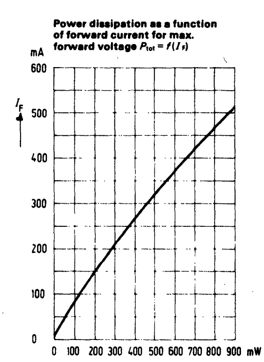

Forward voltage $I_F = f(V_F)$
mA
I_F
10^3
10^2
10^1
10^0
10^{-1}
0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 V
V_F


Capacitance $C = f(V_R)$
pF
C
50
40
30
20
10
0
10^{-2} 10^{-1} 10^0 10^1 V
V_R


Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$
$\frac{V_F}{V_{F\,25°}}$
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
-30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 °C
T_{amb}


Radiant intensity $\frac{I_e}{I_{e\,25°}} = f(T_{amb})$
$\frac{I_e}{I_{e\,25°}}$ or $\frac{\Phi_e}{\Phi_{e\,25°}}$
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
-30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 °C
T_{amb}

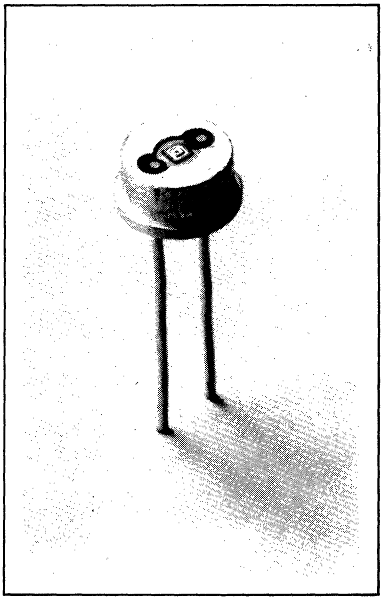

Perm. pulse handling capability
$I_F = f(t)$; ν = parameter; $T_{case} = 40$°C
A
I_F
10^1
10^0
10^{-1}
0.005
0.01
0.02
0.05
0.1
0.2
0.5
$\nu = \frac{t}{T}$
t
T
I_F
10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^0 s
t


Power dissipation as a function
of forward current for max.
forward voltage $P_{tot} = f(I_F)$
mA
I_F
600
500
400
300
200
100
0
0 100 200 300 400 500 600 700 800 900 mW
P_{tot}

litronix
A Siemens Company

SFH 404

INFRARED EMITTER



FEATURES

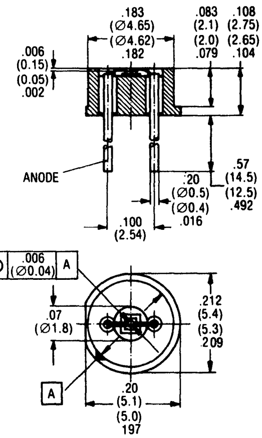
- **Similar to TO-46 Package**
- **Flat Plastic Coating**
- **1/10″ (2.54 mm) Lead Spacing**
- **Burrus Type GaAlAs Emitter**
- **For Fiber Optics Communications Up to 40 MBit/s**
- **Output Radiant Power, 100 μW**

DESCRIPTION

The SFH-404 is a GaAlAs infrared emitting diode of the burrus type. It is designed for applications in fiber optics communications to 40 MBit/s and lengths of several kilometers.

The diode is mounted centrally in a copper case for high performance without additional light pipe connectors. The case allows direct contact with projected light pipe spot face (∅ >2 mm). Anode and cathode are isolated from the case.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse Voltage (V_R)	2 V
Forward Current when incorporated in plug for fiber-optic systems(I_F)	180 mA
Forward Current (I_F)	180 mA
Surge Current (i_{FS}), t<10μs	300 mA
Storage Temperature (T_s)	-40 to +80°C
Junction Temperature (T_j)	80°C
Thermal Resistance	
Junction-to-Air (R_{thJamb})	500 C/LW
Junction-to-Air ($R_{thJcase}$) When Inserted in LWL Socket	170 C/W

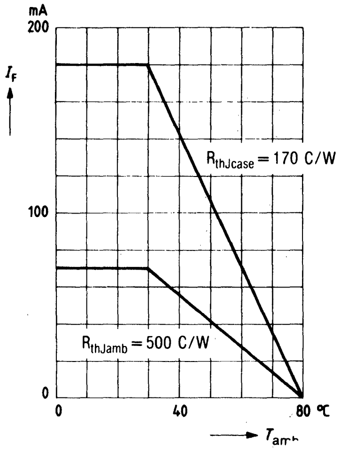
Characteristics (T_{amb}=25°C)

Wavelength at Peak Emission (λ_{peak})	830 ±20 nm
Spectral Bandwidth ($\Delta\lambda$)	40 nm
Radiant Intensity (I_e)	1.5 mW/sr
Coupled-in radiant power (at I_F=100 mA)	
in a gradient profile fiber, core diameter 63 μm, NA =0.22 (ϕ_{in})	>40 μW
in a stepped profile fiber, core diameter 200 μm, NA=0.22 (ϕ_{in})	>300 μW
in a stepped profile fiber, core diameter 200 μm, NA=0.4 (ϕ_{in})	>700 μW
Capacitance (C_O)	370pF
Rise Time (t_r)	15 ns
Fall Time (t_f)	15 ns
Bandwidth (B)	40 MHz
Forward Voltage (V_F)	
I_F=5 mA	1.35 (1.65) V
I_F=50 mA	1.50 (1.80) V
I_F=100 mA	1.65 (1.95) V

Specifications subject to change without notice.

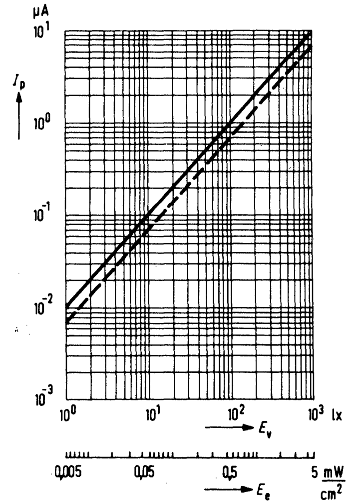
MAXIMUM PERMISSIBLE FORWARD CURRENT

$I_F = f(T_{amb})$



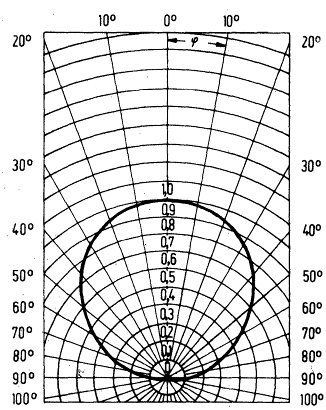
PHOTOCURRENT

$I_P = f(E_v)$



RADIATION CHARACTERISTICS

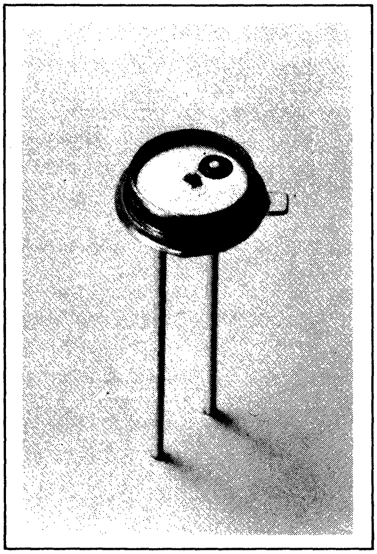
$I_P = f(\varphi)$



litronix
A Siemens Company

SFH 407 SERIES

INFRARED EMITTER



FEATURES

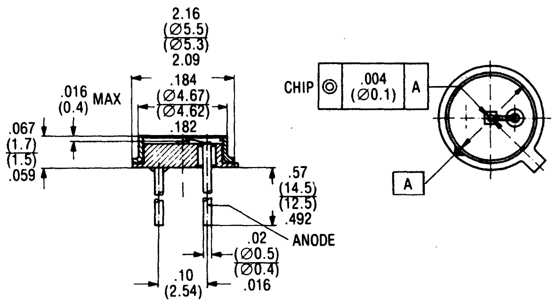
- TO-46 Package
- Flat Epoxy Coating
- 1/10" (2.54 mm) Lead Spacing
- For Fiber Optic Communications Up to 5 MBit/s
- Three Intensity Ranges
  SFH 407-1, .4 to .8 mW
  SFH 407-2, .63 to 1.25 mW
  SFH 407-3, 1.0 to 2.0 mW

DESCRIPTION

The SFH 407 GaAs diode emits radiation in the near infrared range. The radiation emitted is excited by current flowing in the forward direction and can be modulated. This diode is particularly noted for its high radiation ability.

The SFH 407 is mounted in a TO-46 case with collar casing and is encapsulated with epoxy. It is designed for applications in fiber optics communications up to 5 MBit/s.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse Voltage (V_R) .... 2 V
Forward Current (I_F) .... 50 mA
Forward Current When Mounted in LWL Socket (I_F), ($T_{amb} \leq 25\,°C$) .... 100 mA
Surge Current (I_{FS}), $\tau \leq 100\ \mu s$ .... 200 A
Storage Temperature Range (T_s) .... −40 to +80 °C
Junction Temperature (T_j) .... 80 °C
Thermal Resistance:
Junction-to-Air (R_{thJamb}) .... 750 K/W
Junction-to-Air When Inserted in LWL Socket (R_{thJamb}) .... 400 K/W
Junction-to-Case (R_{thJG}) .... 225 K/W

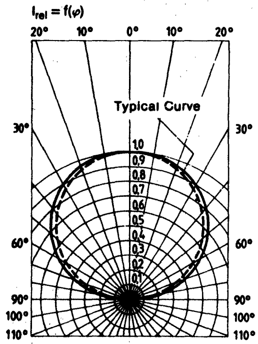
Characteristics ($T_{amb} = 25\,°C$)

Wavelength at Peak Emission, λ_{peak} .... 900 ± 20 nm
Spectral Bandwidth, $\Delta\lambda$ .... 40 nm
Half-Life Radiant Intensity in Gradient Profile Fiber with Core Diameter 63μm and NA = 0.2 (I_e = 1 mW/sr), Φ_{in} .... 2 μW
Rise Time (10% to 90%/I_F = 100 mA), t_r .... 50 ns
Fall Time (90% to 10%/I_F = 100 mA), t_f .... 40 ns
Bandwidth, B .... 7 MHz
Forward Voltage (I_F = 30 mA), U_F .... 1.22 (≤1.6) V
Reverse Current (V_R = 2 V), I_R .... 0.01 (≤10) μA
Capacitance (V_R = 0 V), C_O .... 35 pF

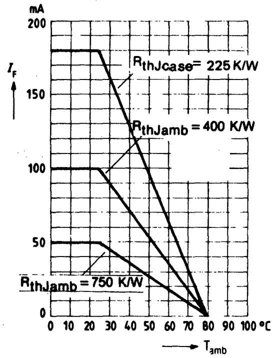
Group	I	II	III	
Radiant Intensity, I_e	0.4 to 0.8	0.63 to 1.25	1.0 to 2.0	mW/sr
Radiant Flux (Radiant Power) (Total) Typ., Φ_e	1.9	3.0	4.7	mW
Gradiant Profile Fiber Optic Cable with Cord Diameter = 63 μm and NA = 0.2 (Total) Typ., Φ_{in}	1.1	1.8	2.8	μW

Specifications subject to change without notice.

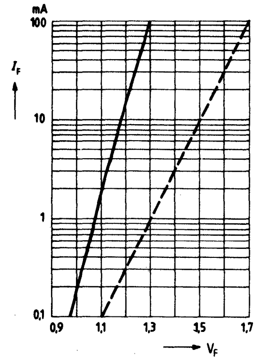
RADIATION CHARACTERISTICS



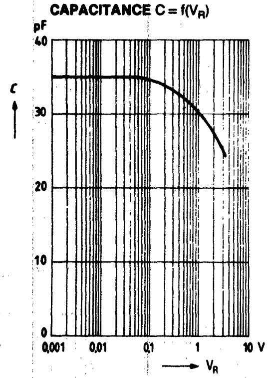
MAXIMUM PERMISSIBLE FORWARD CURRENT



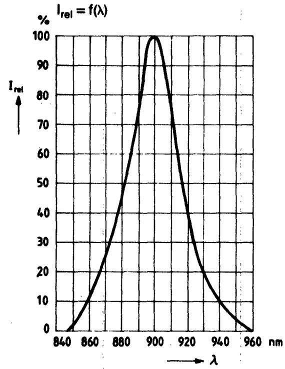
FORWARD CURRENT $I_F = f(V_F)$



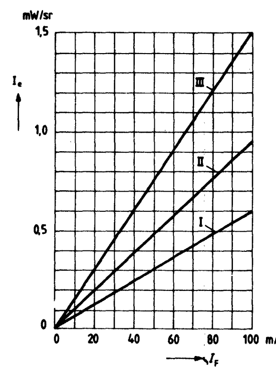
CAPACITANCE $C = f(V_R)$



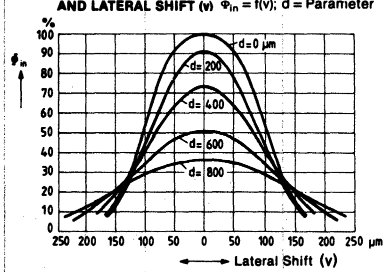
RELATIVE SPECTRAL EMISSION



RADIANT INTENSITY $I_e = f(I_F)$



RELATIVE COMBINED RADIATED POWER INDEPENDENT FROM SPACING (d) AND LATERAL SHIFT (v) $\Phi_{in} = f(v)$; d = Parameter



litronix
A Siemens Company

LD 273

TWOCHIP INFRARED EMITTING DIODES
ADVANCE INFORMATION

FEATURES

- **High Radiant Intensity**
- **Radiation in Axial Direction**

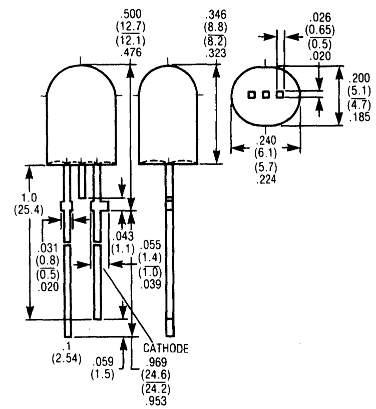
DESCRIPTION

Twofold GaAs-IREDs (two chips switched in series) with a high radiant intensity of 30 mW/sr at a forward current of I_F of 100 mA were developed under the designation LD 273.

Radiation occurs in the axial direction.

These IREDs in oval plastic case enable the construction of powerful infrared remote control systems with increased range, or reduce the number of required single IREDs respectively.

Package Dimensions in Inches (mm)



Characteristics

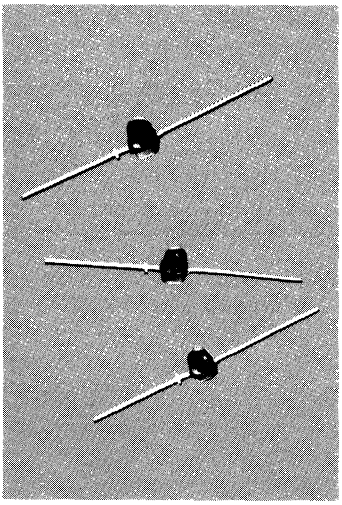
Radiant Intensity in the Axial Direction ($I_F = 100$ mA)	I_e	30 mW/sr
Aperture Cone (Half Angle)	φ	25 Degrees
Wavelength at Peak Emission	λ_{peak}	950 nm
Forward Voltage ($I_F = 100$ mA)	V_F	2.8 ($\leq$3.5) V
Breakdown Voltage, Typical ($I_R = 100\ \mu$A)	V_{BR}	30 V

Specifications subject to change without notice.

litronix
A Siemens Company

IRL-60

INFRARED EMITTER



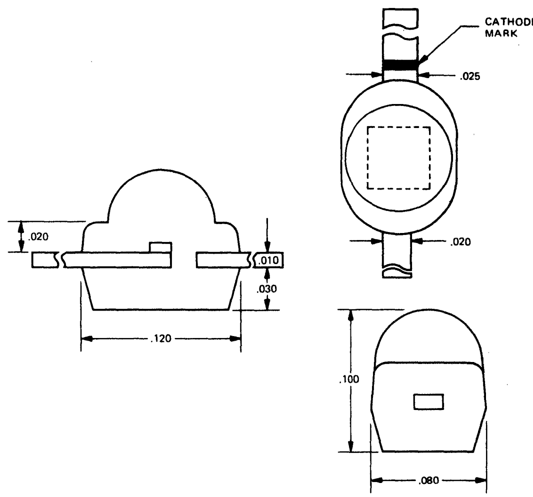
FEATURES

- Spectrally matched to Silicon Sensors
- Maximum package strength consistent with mounting on .087" centers
- Optical Encoding source
- Positioning and counting source
- Solid State reliability

DESCRIPTION

The IRL-60 is a gallium arsenide infrared emitting diode. On forward bias, it emits a spectrally narrow intense band of radiation peaking at 900 nm (the peak sensitivity point of silicon detectors). The packaging of this unit permits close-spacing in linear arrays. Its low cost and volume producibility opens new areas of use anywhere an infrared source is desirable.

DIMENSIONS (in inches, Nominal)



Maximum Ratings

Power Dissipation, 25°C	75 mW
Derate Linearly from 25°C	1.0 mW/°C
Storage and Operating Temperature	−55 + 100°C
Reverse Voltage	3.0 V
DC forward current	50 mA
Lead solder time @ 260°C (Note 1)	10 sec

Opto-Electronic Characteristics

Parameter	Min	Typ	Max	Units	Test Conditions
Total External Radiated Power	400	550		μW	$I_F = 50$ mA
Forward Voltage		1.3	1.5	V	$I_F = 50$ mA
Reverse Current		.15	10	μA	$I_F = 3.0$ V
Radiation Rise and Fall		1.0		n sec	
Capacitance		80		pF	V=0
Peak Emission Wave Length		900		nm	
Spectral Line Half-Width		40		nm	

NOTE:
1) The leads were immersed in 260° molten solder to a distance 1/16" from the body of the device per MIL-S-750.

TYPICAL OPTO-ELECTRONIC CHARACTERISTIC CURVES

Figure 1 — Radiant Intensity vs. Angle

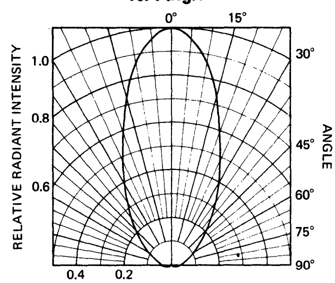


Figure 2 — Output Power vs. Input Current

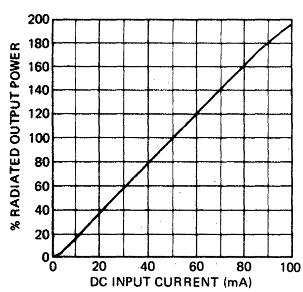
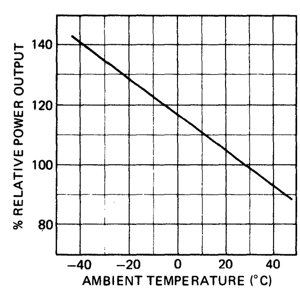


Figure 3 — % Relative Power Output vs. Ambient Temperature

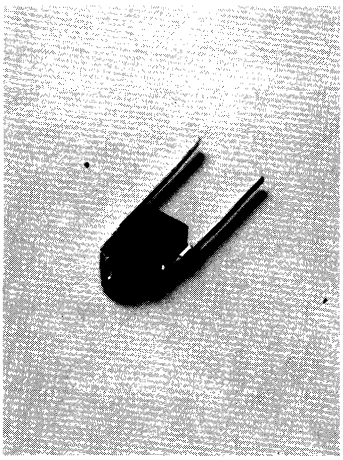


litronix

A Siemens Company

SFH 405 SERIES

INFRARED EMITTER



FEATURES

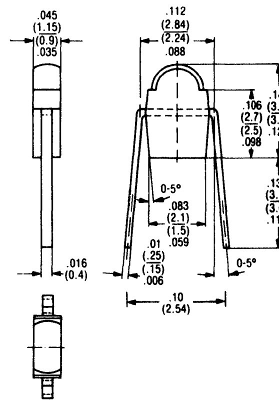
- **Miniature Plastic Package**
- **1/10″ (10 mm) Lead Spacing**
- **Emitter for SFH-305 Phototransistor Detector**
- **Designed for Maximum Spacing of 10 mm Between Emitter and Detector**
- **Four Radiant Intensity Groups**

DESCRIPTION

The SFH 405 is a GaAs infrared diode which emits radiation at a wavelength in the near infrared. The radiation emitted is excited by current flowing in the forward direction.

The case is transparent plastic with a lens shaped light output. The plastic is slightly smoke colored in order to differentiate between phototransistors of the same type (SFH 305). The terminals are solder pins in 1/10″ (2.54 mm) lead spacing. The infrared emitting diodes are grouped according to radiation intensity. SFH 405 is suitable for use as emitter with the phototransistor SFH 305 to effect miniature light barriers with close spacing between sender and receiver up to 10 mm maximum. The cathode is marked with a colored dot.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse Voltage (V_R) .... 4 V
Forward Current (I_F) .... 40 mA
Surge Current (i_{FS}), $t \leq 10\ \mu s$ .... 1.5 A
Junction Temperature (T_j) .... 80 °C
Storage Temperature (T_s) .... −40 to +80 °C
Soldering Temperature in a 2 mm case. (T_L)
($t \leq 3$ s) .... 230 °C
Power Dissipation (P_{tot})
($T_{amb} = 25$ °C) .... 65 mW
Thermal Resistance
Junction-to-Air (R_{thJamb}) .... 950 C/W
Junction-to-Case (R_{thJL}) .... 850 C/W

Characteristics ($T_{amb} = 25$ °C)

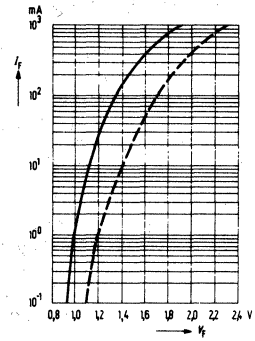
Wavelength at Peak Emission at I_{max}, λ_{peak} .... 950 nm
Spectral Bandwidth at 50% of I_{max}, $\Delta\lambda$ .... ±20 nm
Switching Times (I_e from 10% to 90%;
$I_F = 50$ mA), t_r; t_f .... 1 μs
Capacitance ($V_R = 0$ V), C_O .... 60 pF
Forward Voltage ($I_F = 50$ mA), V_F .... 1.25 (≤1.6) V
Breakdown Voltage ($I_R = 100\ \mu A$), V_{BR} .... 30 (≥4) V
Reverse Current ($V_R = 3$ V), I_R .... 0.01 (≤10) μA
Temperature Coefficient of I_e or Φ_e, TC .... −0.55%/K
Temperature Coefficient of V_F, TC .... −1.5 mV/K
Temperature Coefficient of λ_{peak}, TC .... 0.3 nm/K
Half Angle, φ .... 16 Degrees

Group	SFH 405-1	SFH 405-2	SFH 405-3	SFH 405-4	
Radiant Intensity I_e	1.0 to 2.0	1.6 to 3.2	2.5 to 5.0	4.0 to 8.0	mW/sr
Φ_e (Total) typ.	1.6	2.5	4	6.3	mW

Specifications subject to change without notice.

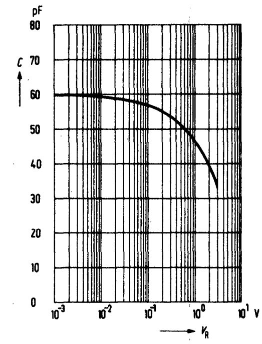
FORWARD CURRENT

$I_F = f(V_F)$



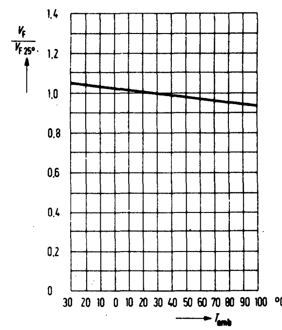
CAPACITANCE

$C = f(V_R)$



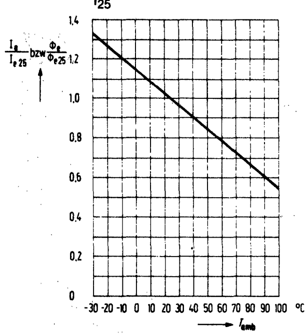
FORWARD VOLTAGE

$\frac{V_F}{V_{F25}} = (T_{amb})$



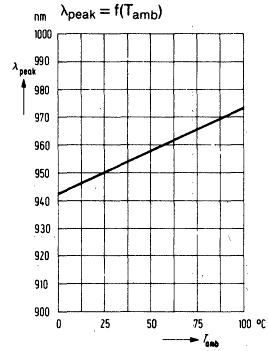
RADIANT INTENSITY

$\frac{I_e}{I_{25}} = f(T_{amb})$



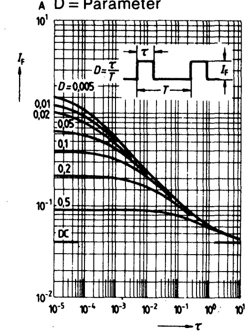
WAVELENGTH AT PEAK EMISSION

$\lambda_{peak} = f(T_{amb})$

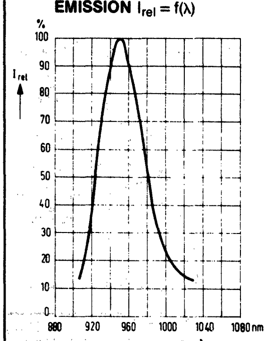


PERMISSIBLE PULSE LOAD

$I_F = f(\tau)$; $T_{amb} = 25\,°C$;
Duty Cycle
D = Parameter

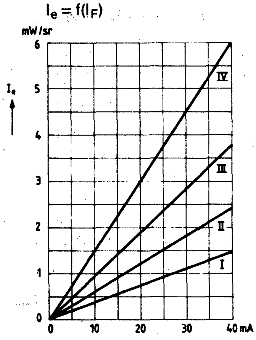


RELATIVE SPECTRAL EMISSION $I_{rel} = f(\lambda)$



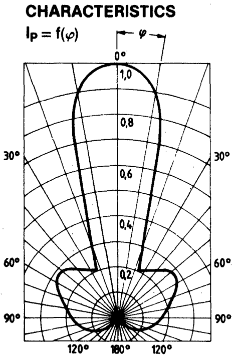
RADIANT INTENSITY

$I_e = f(I_F)$



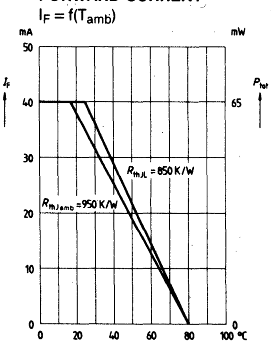
RADIATION CHARACTERISTICS

$I_p = f(\varphi)$



MAXIMUM PERMISSIBLE FORWARD CURRENT

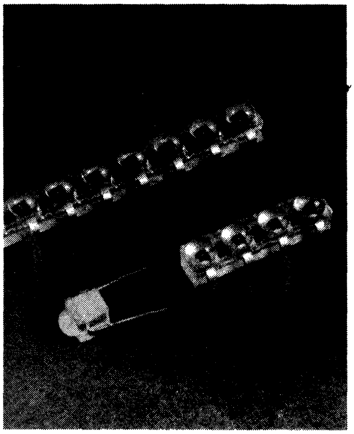
$I_F = f(T_{amb})$



litronix
A Siemens Company

LD 261 SERIES

INFRARED EMITTING DIODE SINGLE AND ARRAYS



FEATURES

- Low Cost
- Miniature Size
- Available As Single Unit, LD 261 and Arrays—
  Two Diodes, LD 262
  Three Diodes, LD 263
  Four Diodes, LD 264
  Five Diodes, LD 265
  Six Diodes, LD 266
  Seven Diodes, LD 267
  Eight Diodes, LD 268
  Nine Diodes, LD 269
  Ten Diodes, LD 260
- Medium Wide Beam, 30°
- High Power, 8 mW Typical
- High Intensity, 10 mW/sr

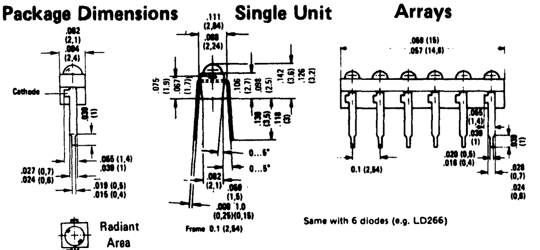
DESCRIPTION

The GaAs infrared emitting diode LD 261 is designed to emit radiation at a wavelength in the near infrared range. The radiation emitted is excited by current flowing in the forward direction.

The case out of glass-clear plastic material provides lens-shaped light output. The plastic is slightly orange colored in order to make the diodes different from the same type phototransistors (BPX 81). The terminals are solder pins in 2.54 mm (1/10") lead spacing. The infrared emitting diodes are grouped according to their radiant intensity. To identify the group the cathode terminal is marked by a colored dot.

The LD 261 in conjunction with the BPX 81 phototransistor is suitable for use in light barriers when emitter and detector are spaced approximately 10 mm apart. Mounting on PC boards as well as incorporation in thickfilm circuits can easily be performed. Thus, even complex scanning systems can be realized. Like the phototransistor series BPX 80 to BPX 89, the LD 261 infrared emitting diodes are also available in arrays up to 10 units comprising LD 260 to LD 269.

Package Dimensions — Single Unit — Arrays



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	4	V
Forward current	I_F	50	mA
Surge current ($t \leq 10\ \mu s$)	i_{FS}	1.5	A
Junction temperature	T_j	80	°C
Storage temperature	T_{stor}	−40 to +80	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation (T_L = 25°C)	P_{tot}	85	mW
Thermal resistance			
Junction to air	R_{thJamb}	750	K/W
Junction to solder pin	R_{thJL}	650	K/W

Characteristics (T_{amb} = 25°C)

Wavelength at peak emission at I_{max}	λ_{peak}	950	nm
Spectral bandwidth at 50% of I_{max}	$\Delta\lambda$	±20	nm
Switching times (I_e from 10% to 90%; I_F = 50 mA)	t_r; t_f	1	µs
Capacitance at V_R = 0 V	C_0	60	pF
Forward voltage (I_F = 50 mA)	V_F	1.25 (≤ 1.6)	V
Breakdown voltage (I_R = 100 µA)	V_{BR}	30 (≥ 4)	V
Reverse current (V_R = 3 V)	I_R	0.01 (≤ 10)	µA
Temperature coefficient of I_e or Φ_e	TC	−0.55	%/K
Temperature coefficient of V_F	TC	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC	0.3	nm/K
Half angle	φ	30	degree

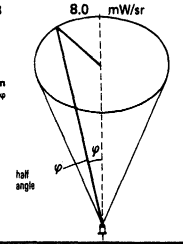
The diodes are grouped according to their radiant intensity I_e at I_f = 50 mA in axial direction.

Radiant Intensity & Power

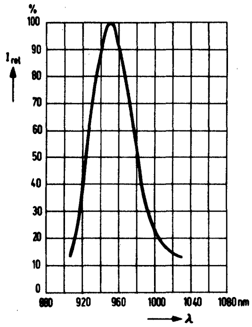
Type	Color Code (Cathode)	Group	Min	Typ	Max	Unit	Test Condition
LD 261-4	Yellow	Intensity I_e*	2.0		4.0	mW/sr	50 mA
		Φ_e (Total)		3.2		mW	50 mA
LD 261-5	Green	Intensity I_e*	3.2		6.3	mW/sr	50 mA
		Φ_e (Total)		5		mW	50 mA
LD 261-6	Blue	Intensity I_e*	5.0		10	mW/sr	50 mA
		Φ_e (Total)		8		mW	50 mA
LD 262 thru LD 260		I_e	.32		2.5	mW/sr	50 mA
LD 262A thru LD 260A		I_e	2.5		5.0	mW/sr	50 mA
LD 262B thru LD 260B		I_e	3.15		6.3	mW/sr	50 mA
LD 262C thru LD 260C		I_e	4.8		8.0	mW/sr	50 mA

*Radiant flux (radiant power) Φ_e in a cone with a half angle φ of 30°

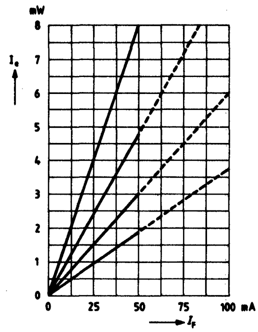
Cone of radiation as a function of the half-angle φ



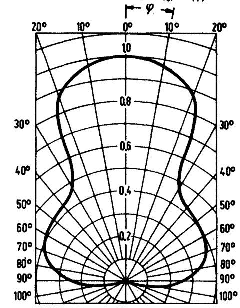
Specifications are subject to change without notice.



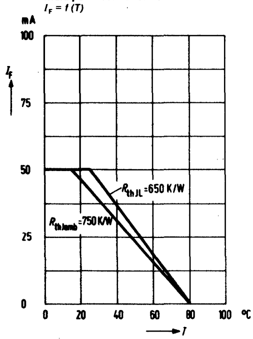
Relative spectral emission $I_{rel} = f(\lambda)$



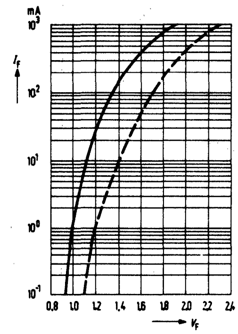
Radiant intensity $I_e = f(I_F)$



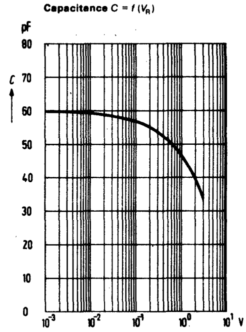
Radiation characteristic $I_{rel} = f(\varphi)$



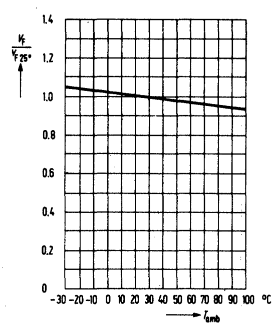
Max. permissible forward current $I_F = f(T)$



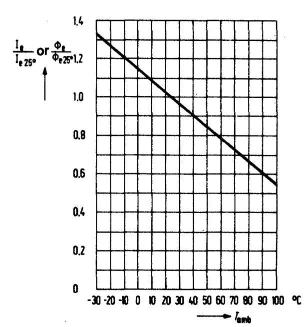
Forward voltage $I_F = f(V_F)$



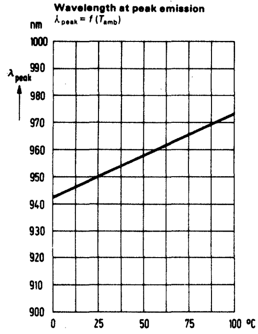
Capacitance $C = f(V_R)$



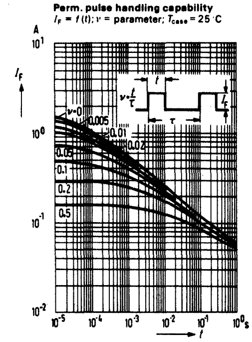
Forward voltage $\frac{V_F}{V_{F\,25°}} = f(T_{amb})$



Radiant intensity $\frac{I_e}{I_{e\,25°}} = f(T_{amb})$

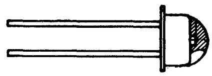
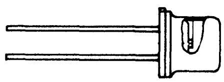
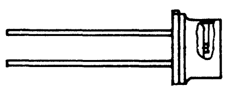
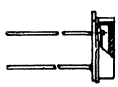
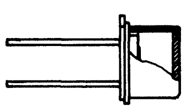


Wavelength at peak emission $\lambda_{peak} = f(T_{amb})$

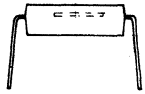
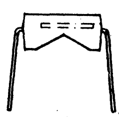
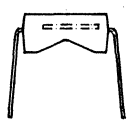
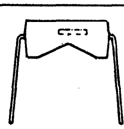
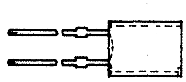
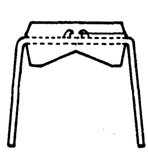


Perm. pulse handling capability $I_F = f(t)$; ν = parameter; $T_{case} = 25\,°C$

PHOTODIODES

Package Type	Package Outline	Part Number	Half Angle	Dark Current $[V_R]$ E-0 I_R (mA)	Sensitivity s (nA/lx) Typical	Page
TO-18 Round Plastic Lens		BPX63	75°	5 pA (<20) [1V]	10	297
TO-18 Flat Glass Lens		BPX65	30°	1(<5) [20V]	10	299
		BPX66		.15(<0.3) [1V]	9	301
TO-18 Flat Glass Lens		SFH202	60°	1(<5) [20V]	10	303
Similar to TO-5 Flat Glass Lens		BPX60	50°	7(<300) [10V]	50	305
		BPX61		2(<30) [10V]	70	307
Similar to TO-5 Flat Glass Lens		SFH203	50°	7(<50) [10V]	7.5	309

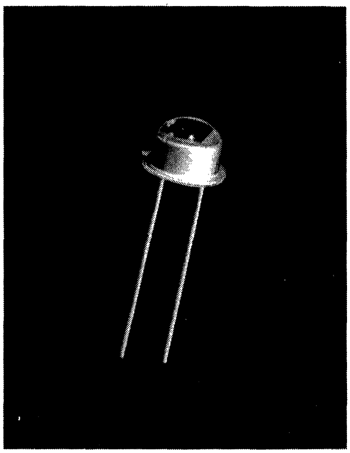
PHOTODIODES

Package Type	Package Outline	Part Number	Half Angle	Dark Current [V_R] E-0 I_R (mA)	Sensitivity s (nA:lx) Typical	Page
Plastic, Colorless, Solder Tabs		BPX48	60°	100(<200) [10V]	32	311
Plastic, *Black		BP104	60°	2(<30) [10V]	$40\mu A \frac{cm^2}{mW}$	313
Plastic, Colorless Solder Tabs		BPW33		20pa(<100) [1V]	50	315
		BPW34		2(<30) [10V]	70	317
		BPX91B		7(<300) [10V]	50	319
Plastic, Colorless, Solder Tabs		BPX90	60°	5(<200) [10V]	40	321
		BPX93		0.5(<50) [10V]	8	323
		BPW32		5pA(<20) [1V]	10	325
		SFH100		0.4(<10) [7V]	175	327
		SFH200		20 pA [3V]	20	329
Plastic, Colorless, Solder Tabs		BPX92	60°	1(<100) [10V]	7	331
Plastic, *Black, Solder Tabs		SFH205	70°	2(<30) [10V]	$50\mu A \frac{cm^2}{mW}$	333
		SFH206	60°			335
Plastic, Colorless		SFH206K			70	337
Miniature 6 Lead Four Quadrant		SFH204		0.01(<2) [10V]	11	339

*Transparent to I.R. Transmission

litronix
A Siemens Company

BPX 63
PHOTODIODE



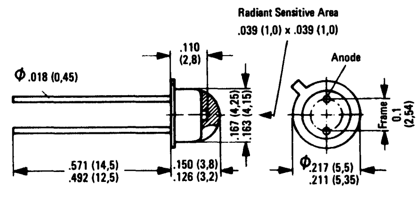
FEATURES

- Silicon Planar Photodiode
- Modified TO-18 Package
- Metal Case and Plastic Lens
- Very Low Dark Current, 5 pA

DESCRIPTION

The BPX 63 is a planar silicon photodiode, mounted on a TO-18 base plate and covered with transparent plastic material. The BPX 63 has been developed as a detector for low illuminances and is intended for use as a sensor for exposure meters and automatic exposure meters. The component is outstanding for low dark currents and—when used as a voltaic cell—for a high open circuit voltage at low illuminances. The cathode of the BPX 63 is electrically connected to the case.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	7	V
Storage temperature range	T_{stor}	− 55 to + 90	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	200	mW

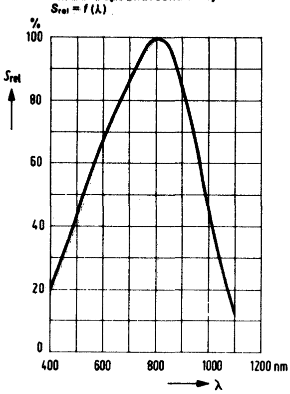
Characteristics (T_{amb} = 25°C)

Spectral sensitivity [1]	S	10 (≥ 8)	nA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	800	nm
Quantum yield (Electrons per photon) (λ = 800 nm)	η	0.73	$\frac{\text{Electrons}}{\text{Photon}}$
Spectral sensitivity (λ = 800 nm)	S	0.47	A/W
Forward voltage [2] (E = 0; I_F = 1 pA; T_{amb} = 50°C)	V_F	1 (≥ 0.5)	mV
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	t_r; t_f	1.3	µs
(R_L = 1 kΩ; V_R = 5 V; λ = 950 nm)	t_r; t_f	1.0	µs
Capacitance (V_R = 0 V)	C_0	120	pF
(V_R = 3 V)	C_3	50	pF
Dark current (V_R = 1 V; E = 0)	I_R	5 (≤ 20)	pA
Temperature coefficient of I_K	TC	0.1	%/K
Radiant sensitive area	A	1	mm^2
Noise equivalent power (V_R = 1 V)	NEP	2.7×10^{-15}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 1 V)	D^*	3.7×10^{13}	$\frac{cm\sqrt{Hz}}{W}$

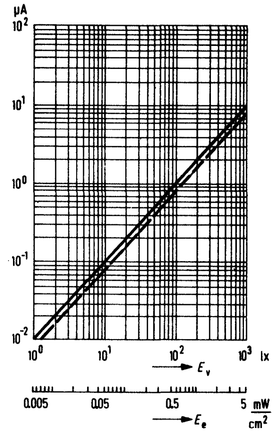
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a colour temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).
2) V_F is a measure for the lower spectral sensitivity when the photodiode is used in exposure meters.

Specifications are subject to change without notice.

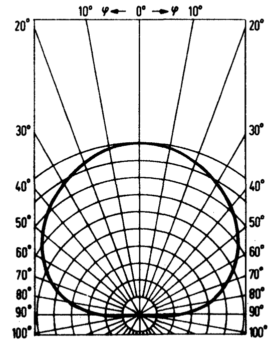
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



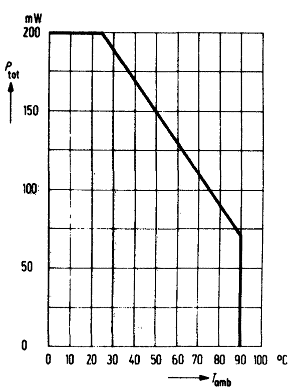
Photocurrent $I_P = f(E_v)$



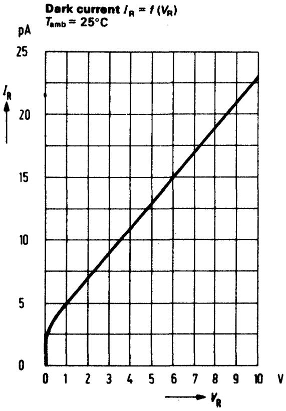
Directional characteristic $I_P = f(\varphi)$



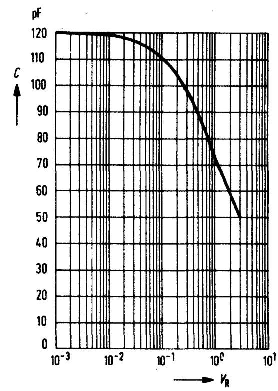
Power dissipation $P_{tot} = f(T_{amb})$



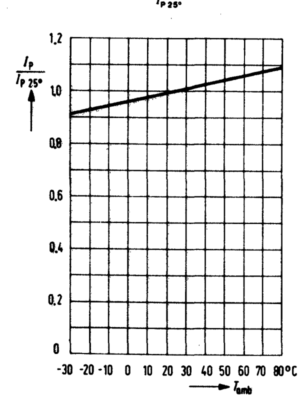
Dark current $I_R = f(V_R)$
$T_{amb} = 25°C$



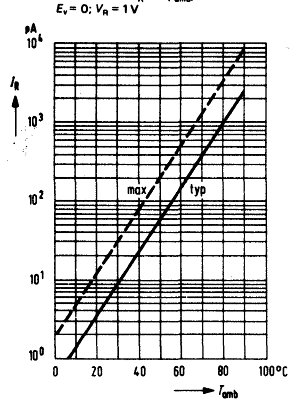
Capacitance $C = f(V_R)$



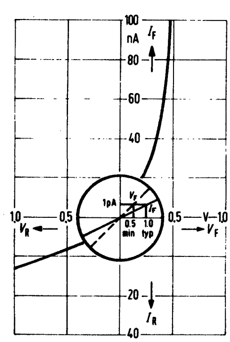
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



Dark current $I_R = f(T_{amb})$
$E_v = 0$; $V_R = 1$ V

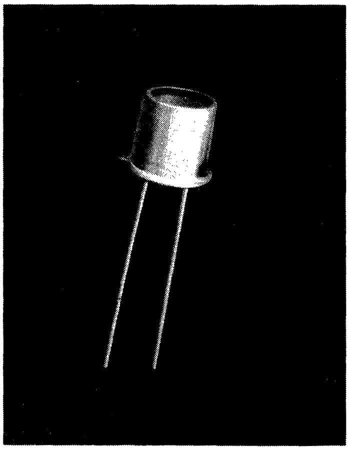


Zero cross over $S_0 = \frac{V_F}{I_F}$



litronix
A Siemens Company

BPX 65
PIN PHOTODIODE



FEATURES

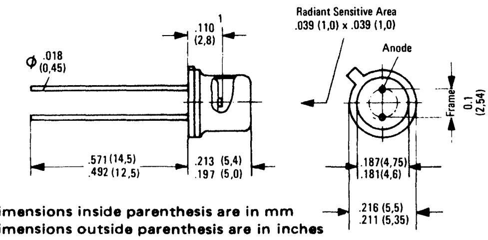
- **Silicon Planar Pin Photodiode**
- **Premium Hi-Rel Device**
- **TO-18 Size Package**
- **Flat Glass Lens**
- **High Speed, 1 ns**
- **Low Dark Current, 1 nA**

DESCRIPTION

The BPX 65 is a planar silicon PIN photodiode in a case 18 A 2 DIN 41876 (sim. to TO-18) with a flat window. The cathode is electrically connected to the case. The flat window has no influence on the beam path of optical lens systems. Because of its high cut-off frequency this diode is particularly suitable for use as optical sensor of high modulation bandwidth.

The PIN photodiode is outstanding for low junction capacitance and short switching times.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	50	V
Junction temperature	T_j	125	°C
Storage temperature range	T_{stor}	− 55 to + 125	°C
Power dissipation	P_{tot}	250	mW

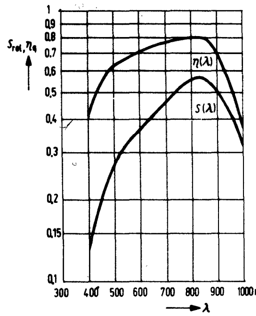
Characteristics (T_{amb} = 25°C)

Radiant sensitive area	A	1	mm^2
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)		0.80	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S	0.55	A/W
Rise time of the photo current (load resistance R_L = 50 Ω; V_R = 20 V; λ = 900 nm)	t_r	0.5 (≤ 1)	ns
Capacitance (V_R = 0 V)	C_0	15	pF
(V_R = 1 V)	C_1	12	pF
(V_R = 20 V)	C_{20}	3.5	pF
Cut off-frequency (load resistance R_L = 50 Ω; V_R = 20 V; λ = 900 nm)	f_g	500	MHz
Dark current (V_R = 20 V; E = 0)	I_R	1 (≤ 5)	nA
Spectral sensitivity [1] V_R = 20 V	S	10 (≥ 7)	nA/lx
Noise equivalent power (V_R = 20 V)	NEP	3.3×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 20 V)	D^*	3.1×10^{12}	$\frac{cm\sqrt{Hz}}{W}$
Temperature coefficient for I_P	TC	0.2	%/K

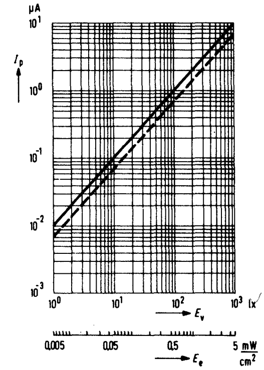
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

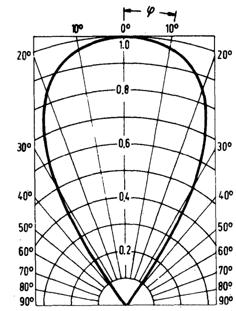
Spectral sensitivity $S_{rel} = f(\lambda)$ in A/W and quantum yield $\eta = f(\lambda)$ in electrons per photon



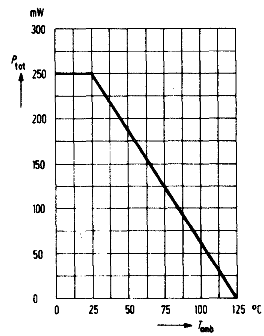
Photocurrent $I_P = f(E_v)$



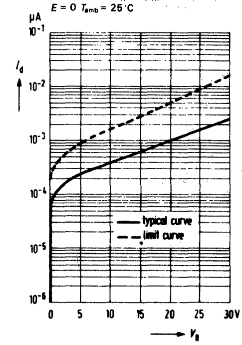
Directional characteristic $I_P = f(\varphi)$



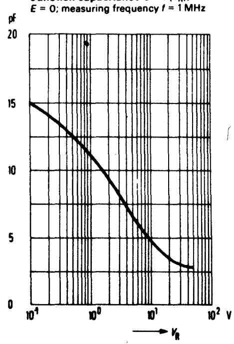
Power dissipation $P_{tot} = f(T_{amb})$



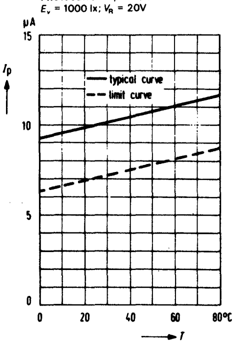
Dark current $I_R = f(V_R)$
$E = 0$ $T_{amb} = 25\,°C$



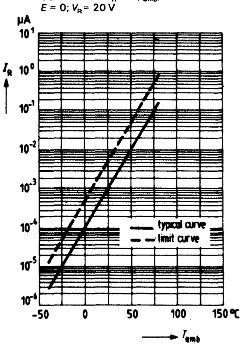
Junction capacitance $C = f(V_R)$;
$E = 0$; measuring frequency $f = 1$ MHz



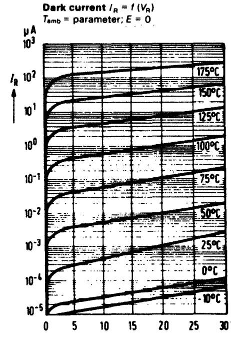
Photocurrent $I_P = f(T)$
$E_v = 1000$ lx; $V_R = 20$V



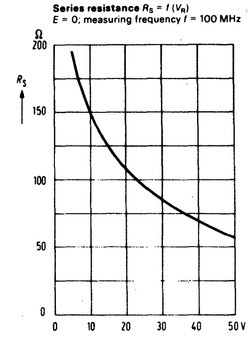
Dark current $I_R = f(T_{amb})$
$E = 0$; $V_R = 20$ V



Dark current $I_R = f(V_R)$
T_{amb} = parameter; $E = 0$



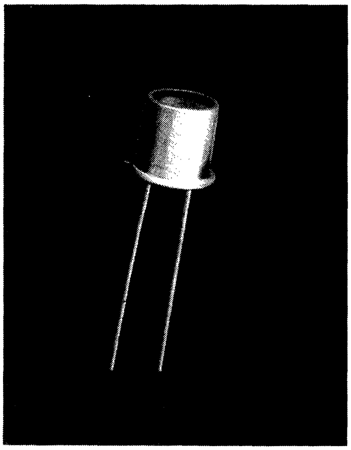
Series resistance $R_S = f(V_R)$
$E = 0$; measuring frequency $f = 100$ MHz



litronix
A Siemens Company

BPX 66

PIN PHOTODIODE



FEATURES

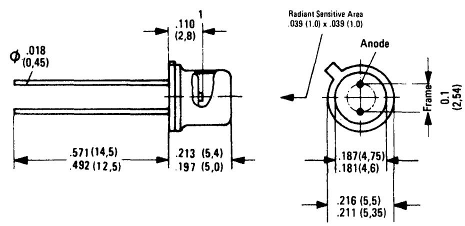
- **Silicon Planar Pin Photodiode**
- **Premium Hi-Rel Device**
- **TO-18 Size Package**
- **Flat Glass Lens**
- **High Speed, 0.5 ns**
- **Low Dark Current, 0.15 nA**

DESCRIPTION

The BPX 66 is a planar silicon PIN photodiode in a case 18 A 2 DIN 41876 (sim. to TO-18) with a flat window and extremely low dark current. The cathode is electrically connected to the case. The flat window has no influence on the beam path of optical lens systems. Because of its high cut-off frequency, this diode is particularly suitable for use as optical sensor of high modulation bandwidth.

The PIN photodiode is outstanding for low junction capacitance and short switching times.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	50	V
Junction temperature	T_j	125	°C
Storage temperature range	T_{stor}	− 55 to + 125	°C
Power dissipation	P_{tot}	250	mW

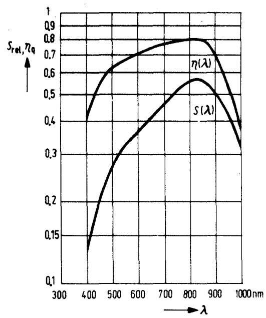
Characteristics (T_{amb} = 25°C)

Radiant sensitive area	A	1	mm^2
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.80	$\frac{\text{Electrons}}{\text{Photon}}$
Spectral sensitivity (λ = 850 nm)	S	0.55	A/W
Rise time of the photocurrent (load resistance $R_L = 50\,\Omega$; V_R = 20 V; λ = 900 nm)	t_r	0.5 (≤ 1)	ns
Capacitance (V_R = 0 V)	C_0	15	pF
(V_R = 1 V)	C_1	12	pF
(V_R = 20 V)	C_{20}	3.5	pF
Cut-off-frequency (load resistance $R_L = 50\,\Omega$; V_R = 20 V; λ = 900 nm)	f_g	500	MHz
Dark current (V_R = 1 V; E = 0)	I_R	0.15 (≤ 0.3)	nA
Spectral sensitivity [1] (V_R = 1 V)	S	9 (≥ 5)	nA/lx
Noise equivalent power (V_R = 1 V)	NEP	1.3×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 1 V)	D^*	6.4×10^{12}	$\frac{cm\sqrt{Hz}}{W}$
Temperature coefficient for I_P	TC	0.2	%/K

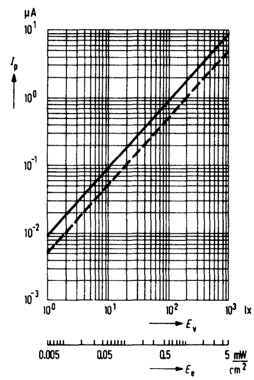
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a colour temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

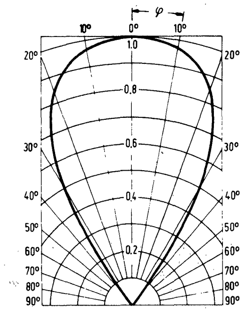
Spectral sensitivity $S_{rel} = f(\lambda)$ in A/W and quantum yield $\eta = f(\lambda)$ in electrons per photon



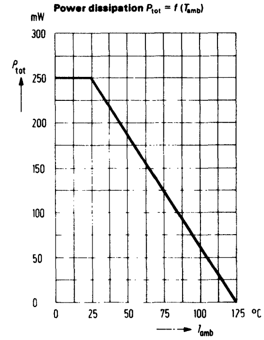
Photocurrent $I_P = f(E_v)$



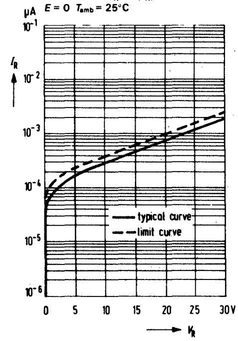
Directional characteristic $I_P = f(\varphi)$



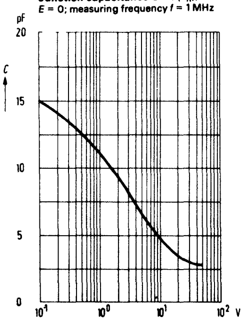
Power dissipation $P_{tot} = f(T_{amb})$



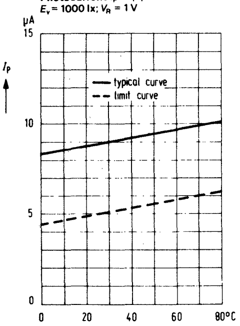
Dark current $I_R = f(V_R)$
$E = 0$ $T_{amb} = 25°C$



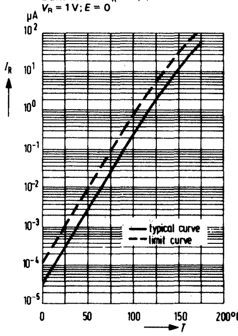
Junction capacitance $C = f(V_R)$;
$E = 0$; measuring frequency $f = 1$ MHz



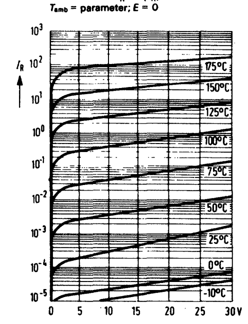
Photocurrent $I_P = f(T)$
$E_v = 1000$ lx; $V_R = 1$ V



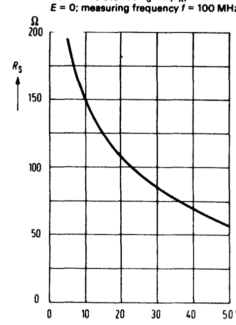
Dark current $I_R = f(T)$
$V_R = 1$ V; $E = 0$



Dark current $I_R = f(V_R)$
T_{amb} = parameter; $E = 0$



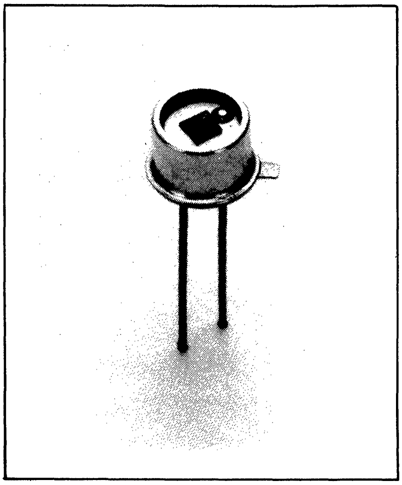
Series resistance $R_S = f(V_R)$
$E = 0$; measuring frequency $f = 100$ MHz



litronix
A Siemens Company

SFH 202

PIN PHOTO DIODE



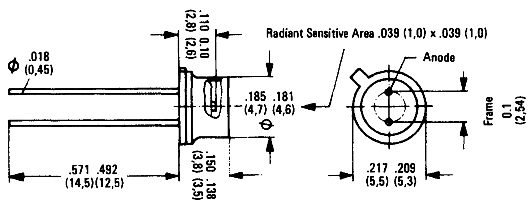
FEATURES

- TO-18 Hermetic Package
- Flat Glass Lens
- For Fiber Optic Communications
  tg = 500 MHz, tr = 0.5 ns

DESCRIPTION

SFH 202 is a planar silicon PIN-photo diode in case 18A2 DIN 41876 (similar to TO18) with flat glass lens. The cathode is electrically connected with the case. The PIN diode is a receiver with high limiting frequency that distinguishes itself through limited reverse current capacity and short switching time. Through the flat lens the diode is especially suitable for use with fiber optic cables, up to 560 Mbits/s.

Package Dimensions in Inches (mm)



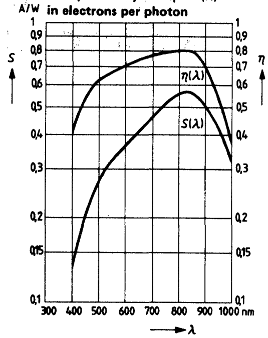
Maximum Ratings

Reverse voltage	V_R	50	V
Junction temperature	T_j	80	°C
Storage temperature range	T_s	−40...+80	°C

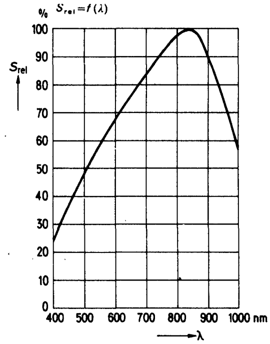
Characteristics (T_{amb} = 25°C)

Radiant sensitive area	A	1	mm²
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon)(λ = 850 nm)	η	0.80	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	A/W
Rise time of the photocurrent (R_L = 50Ω; V_R = 20 V; λ = 900 nm)	t_r	0.5 (≤ 1)	ns
Capacitance (V_R = 0 V)	C_0	15	pF
(V_R = 1 V)	C_1	12	pF
(V_R = 20 V)	C_{20}	3.5	pF
Cut-off frequency (R_L = 50Ω; V_R = 20 V; λ = 900 nm)	f_g	500	MHz
Dark current (V_R = 20 V; E = 0)	I_R	1 (≤ 5)	nA
Spectral sensitivity (V_R = 20 V)	S	10 (≥ 7)	nA/lx
Noise equivalent power (V_R = 20 V)	NEP	3.3×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 20 V)	D^*	3.1×10^{12}	$\frac{cm\sqrt{Hz}}{W}$
Temperature coefficient for I_P	TK	0.2	%/K

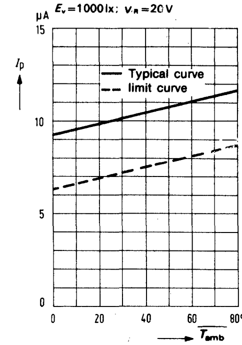
Specifications are subject to change without notice.



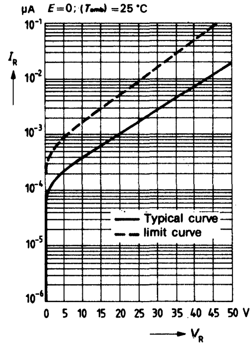
Spectral sensitivity $S = f(\lambda)$ and quantum yield $\eta = f(\lambda)$ in electrons per photon



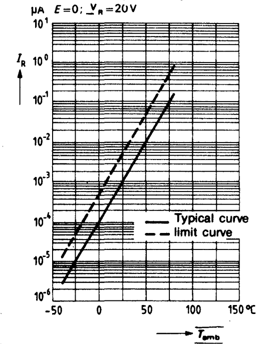
Relative spectral sensitivity $S_{rel} = f(\lambda)$



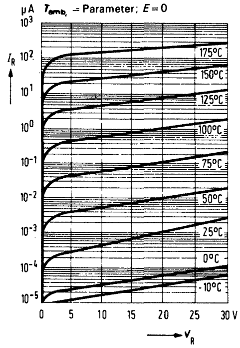
Photocurrent $I_P = f(T_{amb})$; $E_v = 1000$ lx; $V_R = 20$ V



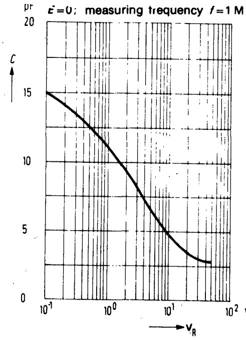
Forward current $I_R = f(V_R)$; $E = 0$; $(T_{amb}) = 25$ °C



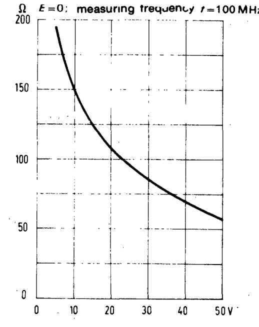
Dark current $I_P = f(T_{amb})$; $E = 0$; $V_R = 20$ V



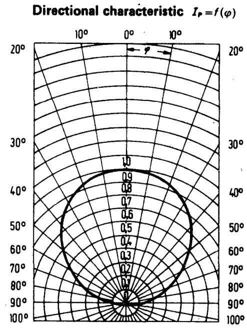
Dark current $I_R = f(V_R)$; T_{amb} = Parameter; $E = 0$



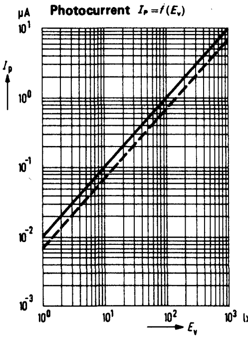
Junction capacitance $C = f(V_R)$; $E = 0$; measuring frequency $f = 1$ MHz



Series resistance $R_S = f(V_R)$; $E = 0$; measuring frequency $f = 100$ MHz



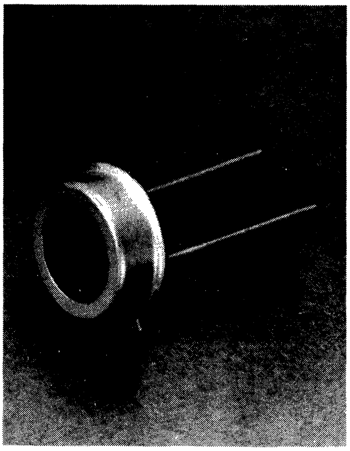
Directional characteristic $I_P = f(\varphi)$



Photocurrent $I_P = f(E_v)$

litronix
A Siemens Company

BPX 60
PHOTODIODE



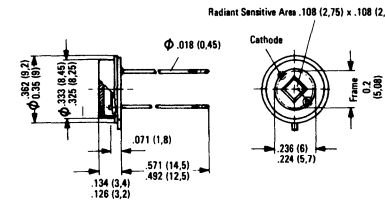
FEATURES

- Silicon Planar Photodiode
- Premium Hi-Rel Device
- Modified TO-5 Hermetic Case
- Flat Glass Lens
- Large Photo Sensitive Area

DESCRIPTION

The BPX 60 is a planar silicon photodiode. The large area photosensitive system is suitable for cell as well as diode operation at a very low reverse current level. The hermetically sealed case—a TO-5 modification with flat glass window—allows application at extreme operating conditions. The signal/noise ratio is particularly favorable even at low illuminances. The open circuit voltage at low illuminances is higher than with comparable mesa photovoltaic cells.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	32	V
Operating and storage temperature range	T_{stor}	− 40 to + 125	°C
Junction temperature	T_j	100	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation	P_{tot}	325	mW
Thermal resistance	$R_{th\ Jamb}$	300	K/W
	$R_{th\ Jcase}$	80	K/W

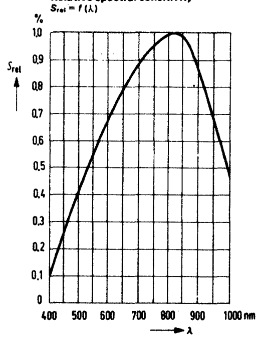
Characteristics (T_{amb} = 25°C)

Spectral sensitivity [1]	S	50 (≥ 35)	nA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.73	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S	0.50	A/W
Open circuit voltage (E_v = 100 lx) [1]	V_L	360 (≥ 270)	mV
(E_v = 1000 lx) [1]	V_L	460	mV
Short circuit current (E_v = 100 lx) [1]	I_K	5 (≥ 3.5)	µA
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	t_r; t_f	2.5	µs
(R_L = 1 kΩ; V_R = 10 V; λ = 950 nm)	t_r; t_f	1.0	µs
Temperature coefficient of V_L	TC	− 2.6	mV/K
Temperature coefficient of I_K	TC	0.2	%/K
Junction capacitance			
(V_R = 0 V; f = 1 MHz; E = 0)	C_0	750	pF
(V_R = 10 V; f = 1 MHz; E = 0)	C_{10}	220	pF
Radiant sensitive area	A	7.6	mm²
Dark current (V_R = 10 V; T_{amb} = 25°C; E = 0)	I_R	7 (≤ 300)	nA

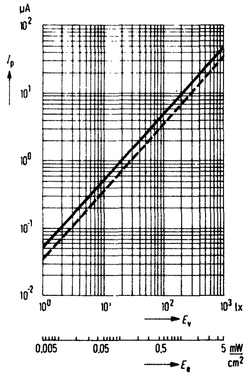
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a colour temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

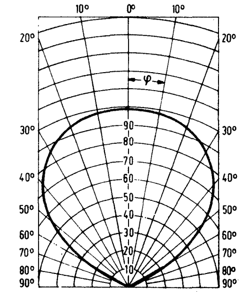
Relative spectral sensitivity $S_{rel} = f(\lambda)$



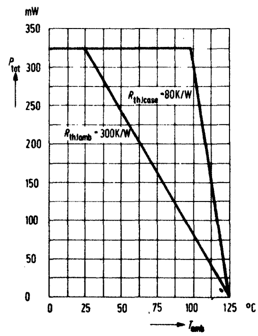
Photocurrent $I_P = f(E_v)$



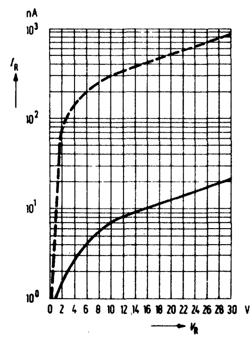
Directional characteristic $I_K = f(\varphi)$



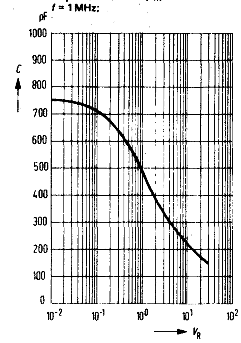
Power dissipation $P_{tot} = f(T_{amb})$



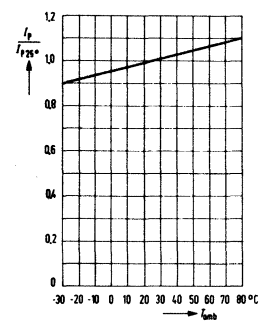
Dark current $I_R = f(V_R)$



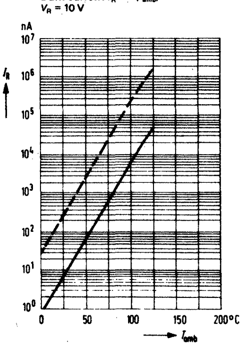
Capacitance $C = f(V_R)$
f = 1 MHz;



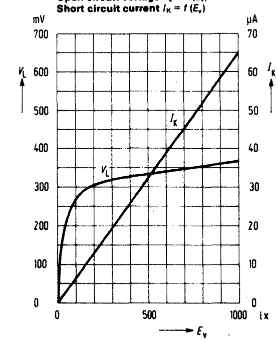
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



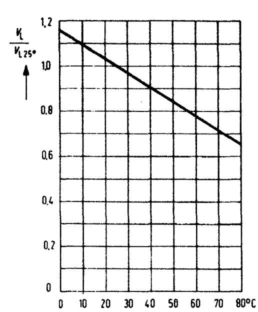
Dark current $I_R = f(T_{amb})$
V_R = 10 V



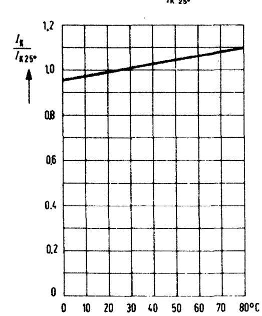
Open circuit voltage $V_L = f(E_v)$
Short circuit current $I_K = f(E_v)$



Open circuit voltage $\frac{V_L}{V_{L\,25°}} = f(T_{amb})$

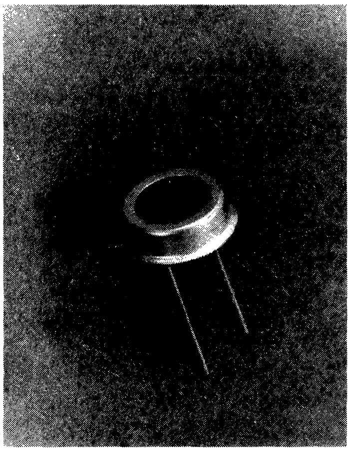


Short circuit current $\frac{I_K}{I_{K\,25°}} = f(T_{amb})$



litronix
A Siemens Company

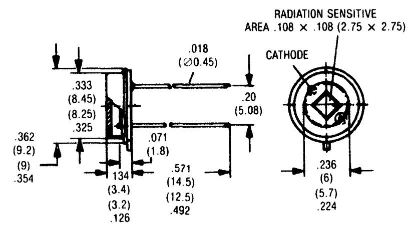
BPX 61
PIN PHOTODIODE



FEATURES
- Silicon Planar Pin Photodiode
- Premium Hi-Rel Device
- Modified TO-5 Hermetic Case
- Flat Glass Lens
- Large Photo Sensitive Area
- Low Dark Current, 2 nA
- Short Switching Time, 50 ns

DESCRIPTION
The BPX 61 is a planar silicon photodiode with low reverse current. Its low capacitance permits use up to 10 MHz. The large area photosensitive system is suitable for cell as well as diode operation at a very low reverse current level. The hermetically sealed case—a TO-5 modification with flat glass window—allows application at extreme operating conditions. The signal/noise ratio is particularly favorable even at low illuminances. The open circuit voltage at low illuminances is higher than with comparable mesa photovoltaic cells. The PIN photodiode is outstanding for low junction capacitance, high cut-off frequency and short switching times.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse voltage	V_R	32	V
Operating and storage temperature range	T_{stor}	−40 to +100	°C
Junction temperature	T_j	100	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	325	mW
Thermal resistance	$R_{th\,Jamb}$	300	K/W
	$R_{th\,Jcase}$	80	K/W

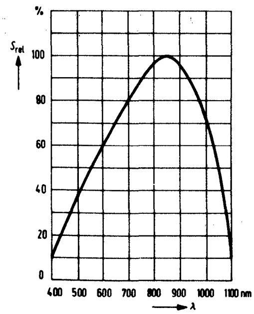
Characteristics (T_{amb} = 25°C)

Spectral sensitivity 1) (V_R = 5 V)	S	70 (≥ 50)	nA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.88	Electrons/Photon
Spectral sensitivity (λ = 850 nm)	S	0.60	A/W
Open circuit voltage (E_v = 100 lx) 1)	V_L	285	mV
(E_v = 1000 lx) 1)	V_L	365	mV
Short circuit current (E_v = 100 lx) 1)	I_K	6.5	µA
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	$t_r; t_f$	125	ns
(R_L = 1 kΩ; V_R = 10 V; λ = 950 nm)	$t_r; t_f$	50	ns
Temperature coefficient of V_L	TC	− 2.6	mV/K
Temperature coefficient of I_K	TC	0.2	%/K
Capacitance			
(V_R = 0 V; f = 1 MHz; E = 0)	C_0	72	pF
(V_R = 3 V; f = 1 MHz; E = 0)	C_3	25 (≤ 40)	pF
Radiant sensitive area	A	7.6	mm²
Dark current (V_R = 10 V; T_{amb} = 25°C; E = 0)	I_R	2 (≤ 30)	nA
Noise equivalent power (V_R = 10 V)	NEP	4.2×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 10 V)	D^*	6.6×10^{12}	$\frac{cm\sqrt{Hz}}{W}$

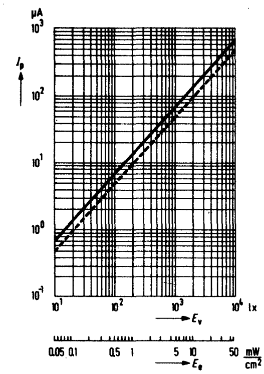
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

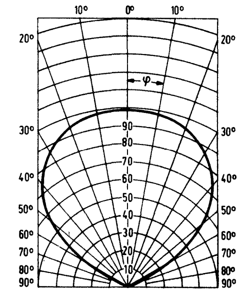
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



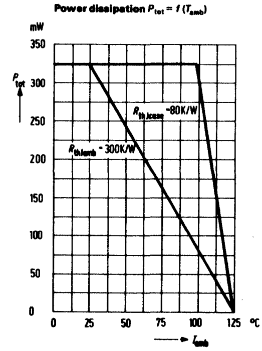
Photocurrent $I_P = f(E_v)$



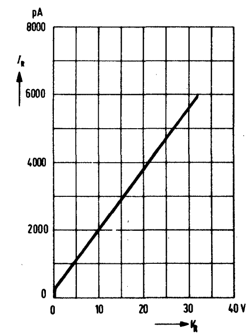
Directional characteristic $I_K = f(\varphi)$



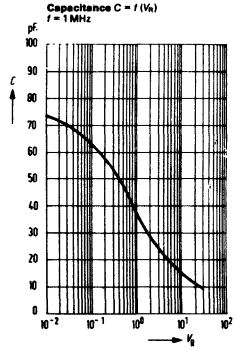
Power dissipation $P_{tot} = f(T_{amb})$



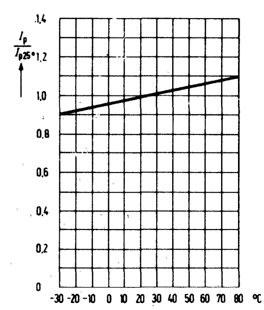
Dark current $I_R = f(V_R)$



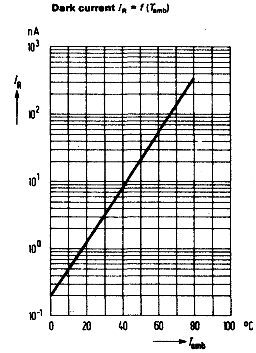
Capacitance $C = f(V_R)$
f = 1 MHz



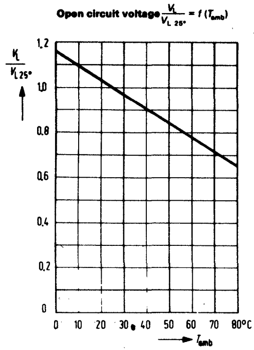
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



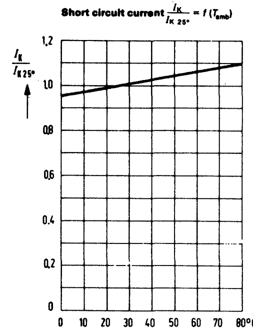
Dark current $I_R = f(T_{amb})$



Open circuit voltage $\frac{V_L}{V_{L\,25°}} = f(T_{amb})$

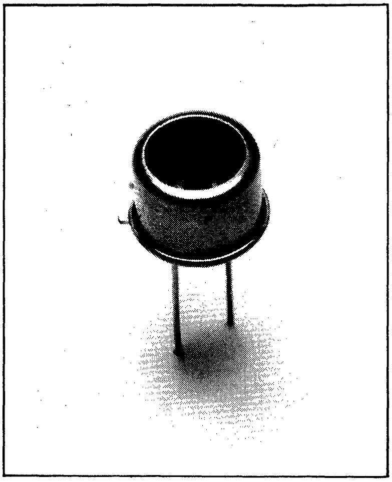


Short circuit current $\frac{I_K}{I_{K\,25°}} = f(T_{amb})$



litronix
A Siemens Company

SFH 203
SILICON PHOTODIODE



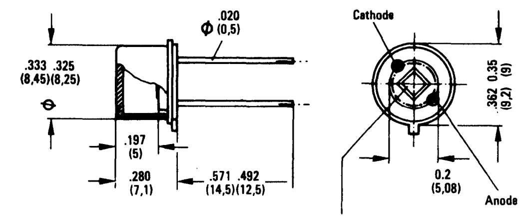
FEATURES

- TO-5 Hermetic Package
- Flat Glass Lens
- BG 38 Filter for Adaptable Sensitivity

DESCRIPTION

SFH 203 is a silicon planar photodiode. The large area photo sensitive system is suitable for cell as well as diode operation at very slow reverse voltage level. The hermetic modified TO-5 package is supplied with a flat glass lens that allows operation under extreme conditions. The filtered glass window (Schott & Gen) adapts the system to a sensitive aperture. The SFH 203 is therefore, especially applicable for daylight as well as being suitable for artificial lighting of high color temperature for photography and color analysis.

Package Dimensions



Radiant Sensitive Area .118 (3,0) x .118 (3,0)

Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	32	V
Operating and storage temperature range	T_s	−40...+100	°C
Junction temperature	T_j	100	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_L	230	°C
Power dissipation	P_{tot}	325	mW
Thermal resistance	$R_{th\ Jamb}$	300	K/W
	$R_{th\ Jcase}$	80	K/W

(T_{amb} = 25°C)

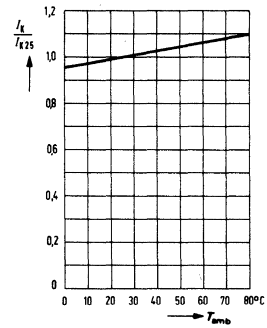
Characteristics

Spectral sensitivity[1]	S	7.5 (≥ 5)	nA/lx
Wavelength of the max. sensitivity	$\lambda_{S\ max}$	555	nm
Spectral sensitivity (λ = 555 nm)	S_λ	0.21	A/W
Open circuit voltage			
(E_v = 100 lx)[1]	V_L	244	mV
(E_v = 1000 lx)[1]	V_L	380	mV
Short circuit current (E_v = 100 lx)[1]	I_K	0.70	µA
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V)	t_r; t_f	2.5	µs
(R_L = 1 kΩ; V_R = 10 V)	t_r; t_f	1.0	µs
Temperature coefficient of V_L	TK	−0.6	%/K
Temperature coefficient of I_K	TK	0.2	%/K
Capacitance			
(V_R = 0 V; f = 1 MHz; E = 0)	C_0	900	pF
(V_R = 3 V; f = 1 MHz; E = 0)	C_3	770	pF
Radiant sensitive area	A	7.6	mm²
Dark current (V_R = 10 V; E = 0)	I_R	7 (≤ 50)	nA

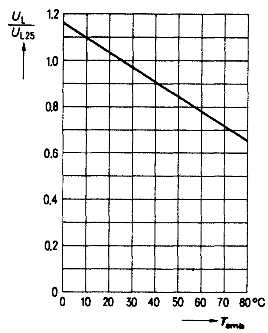
[1]The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

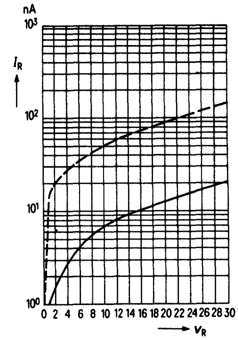
Short circuit current $\frac{I_K}{I_{K\,25}} = f(V_U)$



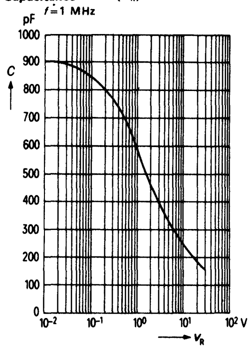
Open circuit voltage $\frac{V_L}{V_{L\,25}} = f(T_{amb})$



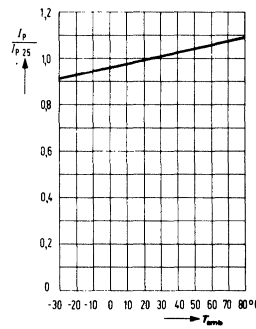
Dark current $I_R = f(V_R)$



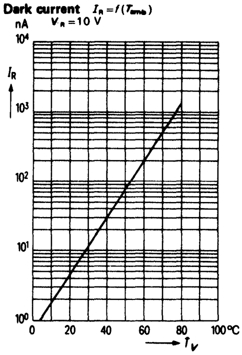
Capacitance $C = f(V_R)$
$f = 1$ MHz



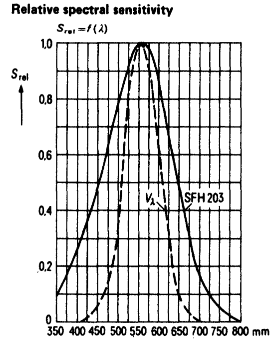
Photocurrent $\frac{I_P}{I_{P\,25}} = f(T_{amb})$



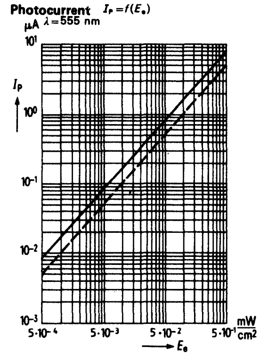
Dark current $I_R = f(T_{amb})$
$V_R = 10$ V



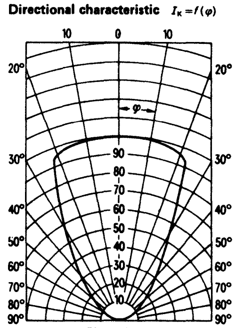
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



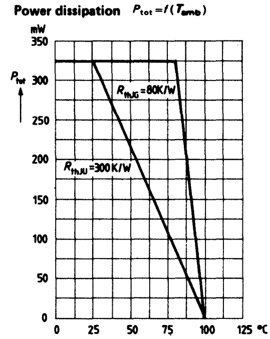
Photocurrent $I_P = f(E_e)$
$\lambda = 555$ nm



Directional characteristic $I_K = f(\varphi)$



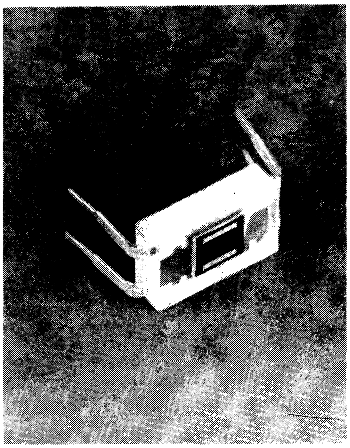
Power dissipation $P_{tot} = f(T_{amb})$



litronix
A Siemens Company

BPX 48

DIFFERENTIAL PHOTODIODE



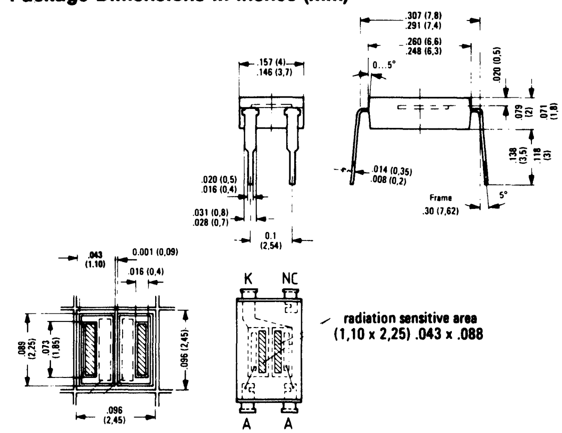
FEATURES

- **Differential Photodiode**
- **Plastic Encapsulated, Strip Line Technique**
- **Tightly Spaced Diodes For Precise Positional Indication**

DESCRIPTION

The differential photodiode BPX 48 is designed for special industrial electronic applications, such as follow-up control, edge control, path and angle scanning, respectively. The individual diodes are spaced 50 μm apart, thus resulting in a highly precise positional indication. The rise and fall times of the photocurrent are so short that control systems with small down times can be built up. The silicon planar method ensures a low dark current level, low noise and thus very favorable signal relationships.

Package Dimensions in Inches (mm)



radiation sensitive area

Maximum Ratings

Reverse voltage	V_R	10	V
Junction temperature	T_j	125	°C
Storage temperature range	T_{stor}	− 40 to + 80	°C
Power dissipation	P_{tot}	50	mW

Characteristics (T_{amb} = 25°C)

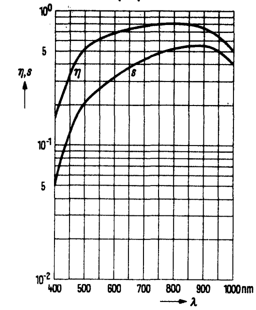
(the data refers to a photodiode system)

Spectral sensitivity [1]	S	32 (≥ 15)	nA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.80	Electrons/Photon
Spectral sensitivity (λ = 850 nm)	S	0.55	A/W
Rise and fall time of the photo current from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V)	t_r; t_f	≤ 500	ns
(R_L = 1 kΩ; V_R = 10 V)	t_r; t_f	≤ 150	ns
Cut-off frequency measured with a load resistance (R_L = 1 kΩ; V_R = 10 V)	f_g	3	MHZ
Capacitance			
(V_R = 0 V)	C_0	40	pF
(V_R = 10 V)	C_{10}	10	pF
Radiant sensitive area	A	2 x 2.47	mm2
Dark current (V_R = 10 V; E = 0)	I_R	100 (≤ 200)	nA

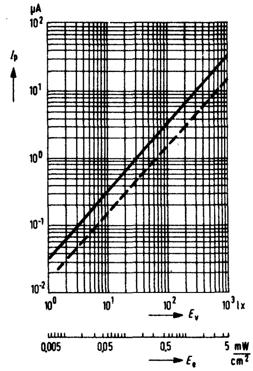
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

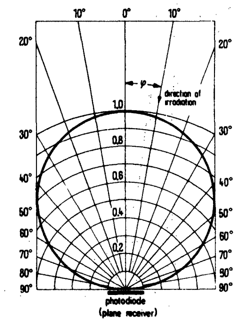
Spectral sensitivity $S = f(\lambda)$ in A/W and quantum yield $\eta = f(\lambda)$ in electrons per photon



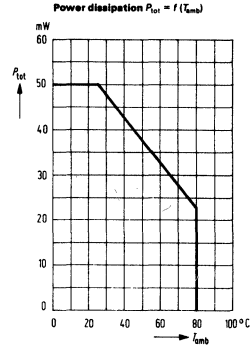
Photocurrent $I_P = f(E_v)$



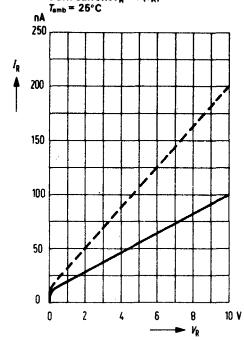
Directional characteristic $I_P = f(\varphi)$



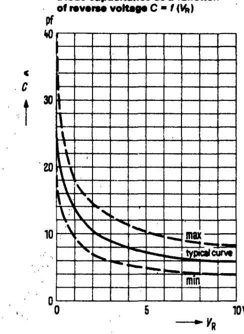
Power dissipation $P_{tot} = f(T_{amb})$



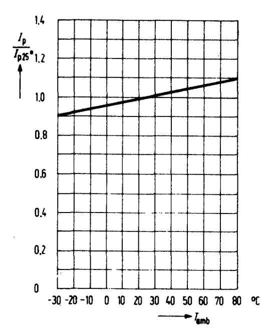
Dark current $I_R = f(V_R)$
T_{amb} = 25°C



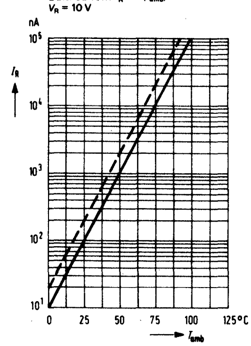
Diode capacitance as a function of reverse voltage $C = f(V_R)$



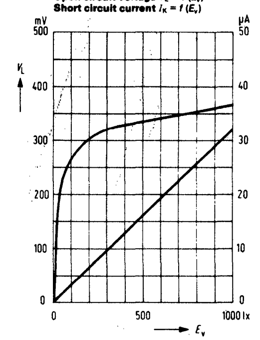
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



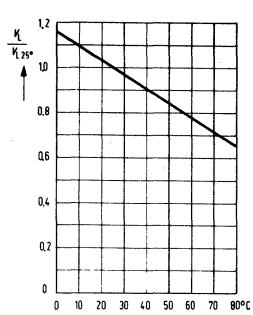
Dark current $I_R = f(T_{amb})$
V_R = 10 V



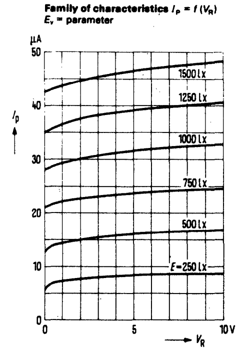
Open circuit voltage $V_L = f(E_v)$
Short circuit current $I_K = f(E_v)$



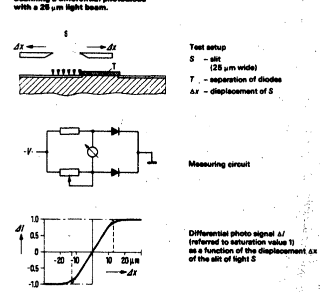
Open circuit voltage $V_L = f(T_{amb})$



Family of characteristics $I_P = f(V_R)$
E_v = parameter

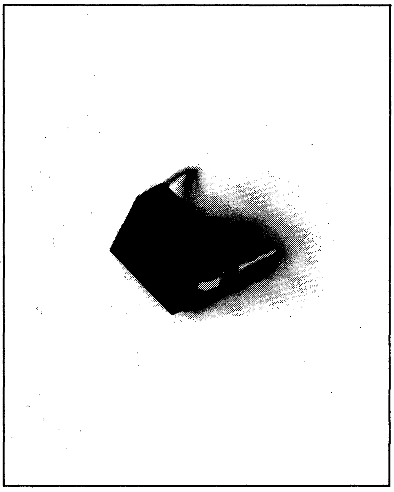


Scanning a differential photodiode with a 25 µm light beam.



litronix
A Siemens Company

BP 104
PIN PHOTODIODE



FEATURES

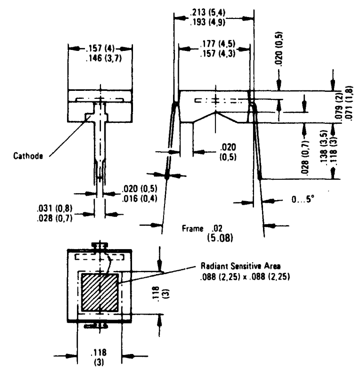
- **Silicon Planar Pin Photodiode**
- **IR Transparent Filter Plastic Package**
- **2/10" Lead Spacing**
- **High Speed, 10 ns**

DESCRIPTION

BP 104 is a silicon planar PIN photodiode, encapsulated in a plastic package, which simultaneously serves as filter and is transparent to IR radiation. Its terminals are soldering tabs spaced 5.08 mm (2/10") apart. Due to its design the diode can easily be mounted, even on PC boards. The flat back of the epoxy resin case makes rigid fixing of the component feasible. Arrays can be realized by multiple arrangements. This universal photodetector is suitable for diode as well as voltaic cell operation. The signal/noise ratio is particularly favorable, even at low illuminances.

The PIN photodiode is outstanding for its low junction capacitance, high maximum frequency, and fast switching times. It is particularly suitable for IR sound transmission. The cathode is marked by a blue dot.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

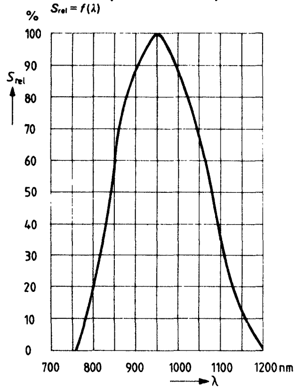
Reverse voltage	V_R	20	V
Operating and storage temperature range	T_{stor}	−40 to +80	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	150	mW

Characteristics (T_{amb} = 25°C)

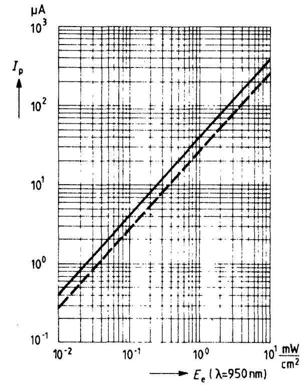
Spectral sensitivity (V_R = 5 V) (λ = 950 nm)	S	40 ($\geq$ 25)	$\mu A \cdot \frac{cm^2}{mW}$
Wavelength of max. spectral sensitivity	$\lambda_{s\,max}$	950	nm
Quantum yield (Electrons per photon) (λ = 950 nm)	η	0.92	$\frac{Electrons}{Photon}$
Spectral sensitivity (λ = 950 nm, V_R = 5 V)	S	0.71	A/W
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	$t_r; t_f$	125	ns
(R_L = 1 kΩ; V_R = 10 V; λ = 950 nm)	$t_r; t_f$	10	ns
Temperature coefficient for I_K or I_P	TC	0.18	%/K
Capacitance			
(V_R = 0 V; f = 1 MHz; E = 0)	C_0	48	pF
(V_R = 3 V; f = 1 MHz, E = 0)	C_3	17	pF
Radiant sensitive area	A	5.06	mm^2
Dark current (V_R = 10 V)	I_R	2 ($\leq$ 30)	nA
Noise equivalent power (V_R = 10 V)	NEP	4.2×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit	D^*	5.4×10^{12}	$\frac{cm\sqrt{Hz}}{W}$

Specifications are subject to change without notice.

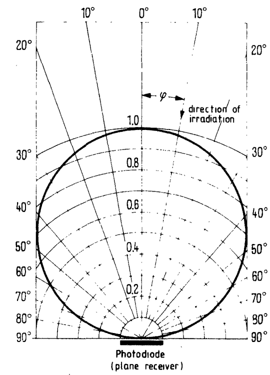
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



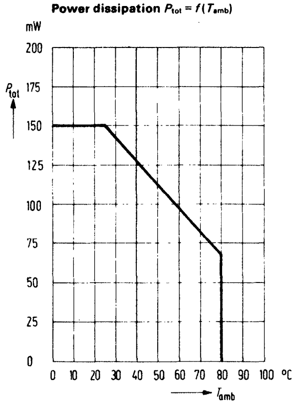
Photocurrent $I_P = f(E_e)$



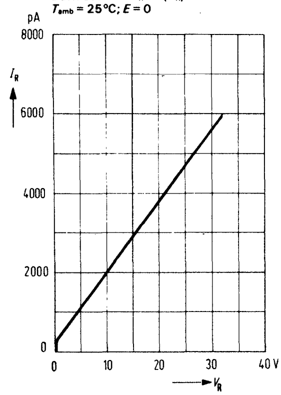
Directional characteristic $S_{rel} = f(\varphi)$



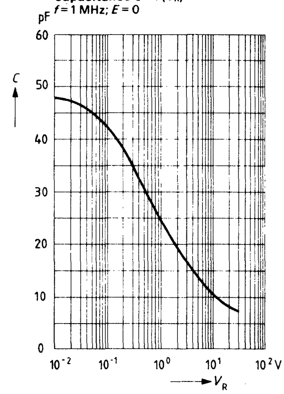
Power dissipation $P_{tot} = f(T_{amb})$



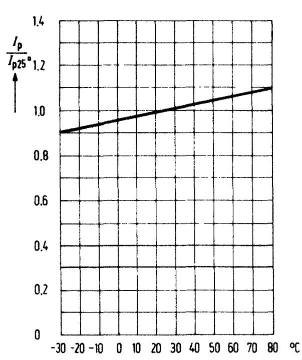
Dark current $I_R = f(V_R)$
$T_{amb} = 25°C$; $E = 0$



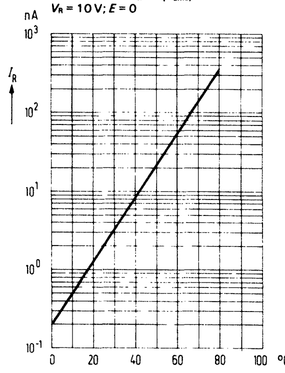
Capacitance $C = f(V_R)$
$f = 1$ MHz; $E = 0$



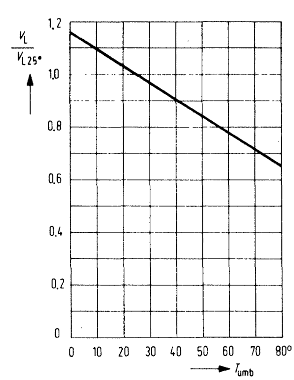
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



Dark current $I_R = f(T_{amb})$
$V_R = 10$ V; $E = 0$

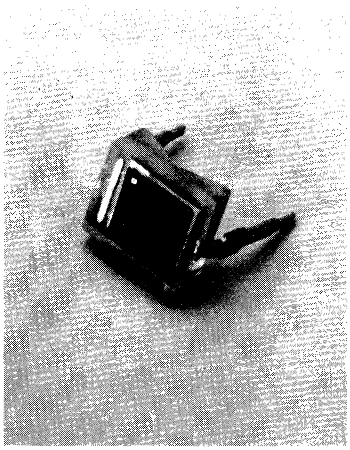


Open circuit voltage $\frac{V_L}{V_{L\,25°}} = f(T_{amb})$



litronix
A Siemens Company

BPW 33
PHOTODIODE



FEATURES

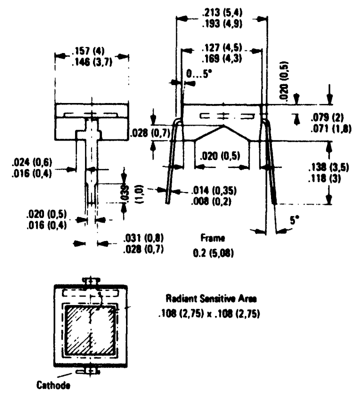
- Silicon Planar Photodiode
- Transparent Plastic Package
- 2/10" Lead Spacing
- Very Low Dark Current, 20 pA
- High Sensitivity, 50 nA/lx

DESCRIPTION

The BPW 33 is a large area silicon planar photodiode, which is incorporated in a transparent plastic package. Its terminals are soldering tabs, arranged in 5.08 mm (2/10") lead spacing. Because of its design the diodes can also very easily be assembled on PC boards. The flat back of the epoxy resin case makes rigid fixing of the component feasible.

The BPW 33 has been developed as a detector for low illuminances and is intended for use as a sensor in exposure meters and automatic exposure timers. The component is outstanding for high open circuit voltage at low illuminances. The cathode is marked by an orange dot.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	7	V
Storage temperature range	T_{stor}	– 40 to + 80	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	150	mW

Characteristics (T_{amb} = 25°C)

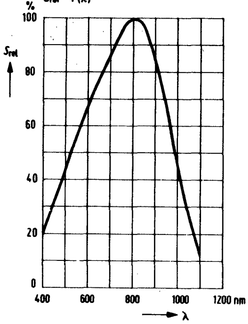
Spectral sensitivity [1]	S	50 (≥ 35)	nA/lx
Zero cross over [2] (E_v = 0; T_{amb} = 50°C)	S_0	≥ 0.05	mV/pA
Radiant sensitive area	A	7.6	mm2
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	800	nm
Quantum yield (Electrons per photon) (λ = 800 nm)	η	0.73	$\frac{\text{Electrons}}{\text{Photon}}$
Spectral sensitivity (λ = 800 nm)	S	0.47	A/W
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value (R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	t_r; t_f	2.5	µs
(R_L = 1 kΩ; V_R = 5 V; λ = 950 nm)	t_r; t_f	1.0	µs
Capacitance (V_R = 0 V; E = 0)	C_0	750	pF
(V_R = 3 V; E = 0)	C_3	330	pF
Dark current (V_R = 1 V; E = 0)	I_R	20 (≤ 100)	pA
Temperature coefficient of I_K	TC	0.2	%/K
Noise equivalent power (V_R = 1 V)	NEP	5.3×10^{-15}	$\frac{W}{\sqrt{Hz}}$
Detection limit	D^*	5.2×10^{13}	$\frac{cm\sqrt{Hz}}{W}$

1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a colour temperature of 2856 K (standard light A in accordance with DIN 5040 and IEC publ. 306-1).

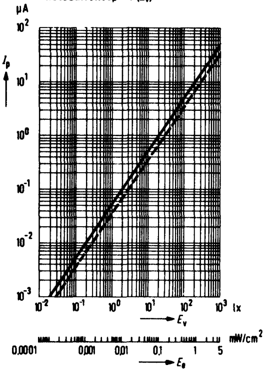
2) S_0 is a measure for the lower spectral sensitivity when the photodiode is used in exposure meters. The zero cross over S_0 is defined in the diagram.

Specifications are subject to change without notice.

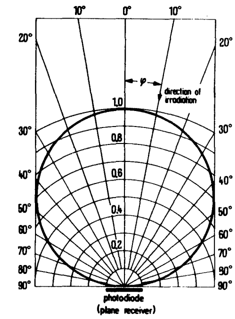
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



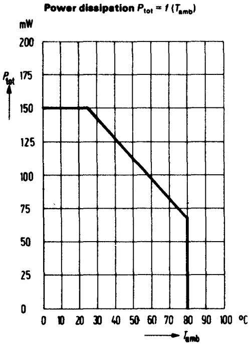
Photocurrent $I_P = f(E_v)$



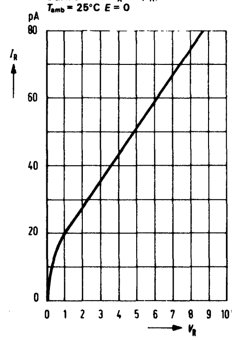
Directional characteristic $I_K = f(\varphi)$



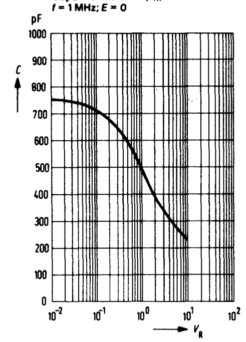
Power dissipation $P_{tot} = f(T_{amb})$



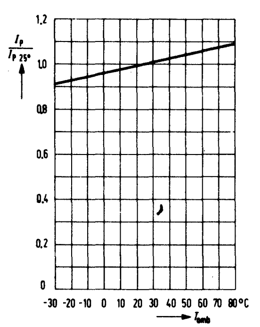
Dark current $I_R = f(V_R)$
$T_{amb} = 25°C$ $E = 0$



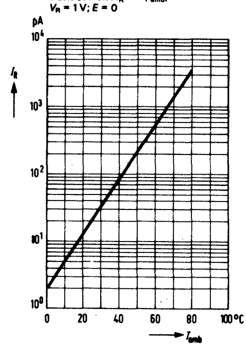
Capacitance $C = f(V_R)$
$f = 1$ MHz; $E = 0$



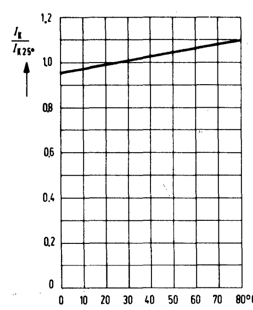
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



Dark current $I_R = f(T_{amb})$
$V_R = 1$ V; $E = 0$



Short circuit current $I_K = f(T_{amb})$



Open circuit voltage $V_L = f(T_{amb})$

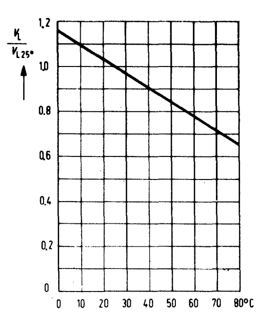
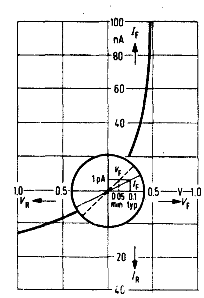
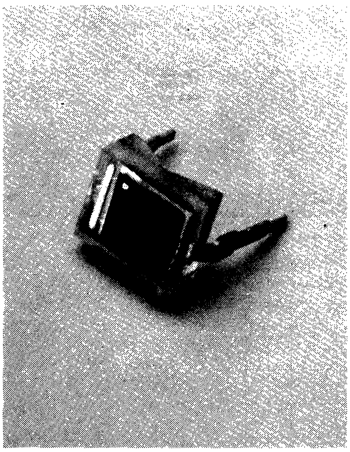


Diagram of the zero cross over S_0



litronix
A Siemens Company

BPW 34
PIN PHOTODIODE

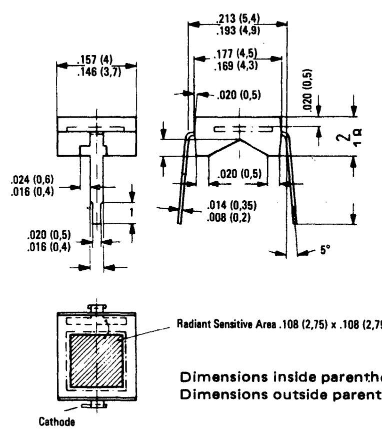


FEATURES
- **Silicon Planar Pin Photodiode**
- **Transparent Plastic Package**
- **2/10″ Lead Spacing**
- **Low Junction Capacitance, ≤ 40 pF**
- **Short Switching Time, 50 ns**
- **High Sensitivity, 70 nA/lx**

DESCRIPTION
The BPW 34 is a silicon planar PIN photodiode, which is incorporated in a transparent plastic package. Its terminals are soldering tabs arranged in 5.08 mm (2/10″) lead spacing. Due to its design the diode can also very easily be assembled on PC boards. The flat back of the epoxy resin case makes rigid fixing of the component feasible.

Arrays can be realized by multiple arrangements. This versatile photodetector can be used as a diode as well as a voltaic cell. The signal/noise ratio is particularly favorable, even at low illuminances. The open circuit voltage at low illuminances is higher than with comparable mesa photovoltaic cells. The PIN photodiode is outstanding for low junction capacitance, high cut-off frequency and short switching times. The photodiode is particularly suitable for IR sound transmission. The cathode is marked by a blue dot.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	32	V
Operating and storage temperature range	T_{stor}	− 40 to + 80	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \le 3$ s)	T_s	230	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	150	mW

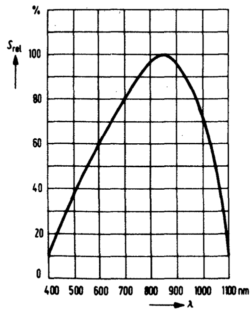
Characteristics (T_{amb} = 25°C)

Spectral sensitivity 1) (V_R = 5 V)	S	70 (≥ 50)	nA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.88	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S	0.60	A/W
Open circuit voltage (E_v = 100 lx) 1)	V_L	285	mV
Open circuit voltage (E_v = 1000 lx) 1)	V_L	365	mV
Short circuit current (E_v = 100 lx) 1)	I_K	6.5	µA
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	t_r; t_f	125	ns
(R_L = 1 kΩ; V_R = 10 V; λ = 950 nm)	t_r; t_f	50	ns
Temperature coefficient of V_L	TC	− 2.6	mV/K
Temperature coefficient of I_K or I_P	TC	0.18	%/K
Capacitance (V_R = 0 V; f = 1 MHz; E = 0)	C_0	72	pF
(V_R = 3 V; f = 1 MHz; E = 0)	C_3	25 (≤ 40)	pF
Radiant sensitive area	A	7.6	mm^2
Dark current (V_R = 10 V)	I_R	2 (≤ 30)	nA
Noise equivalent power (V_R = 10 V)	NEP	4.2×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit	D^*	6.6×10^{12}	$\frac{cm\sqrt{Hz}}{W}$

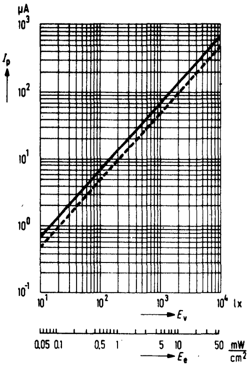
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5030 and IEC publ. 306-1).

Specifications are subject to change without notice.

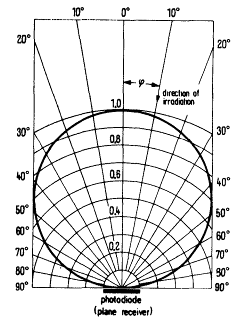
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



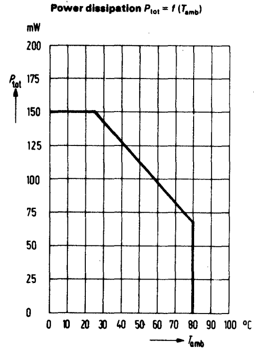
Photocurrent $I_P = f(E_v)$



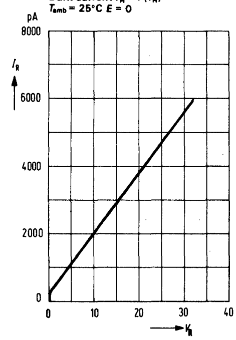
Directional characteristic $S_{rel} = f(\varphi)$



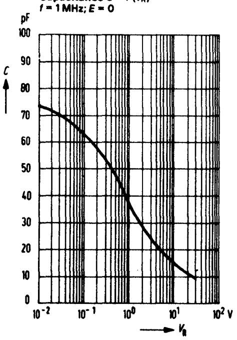
Power dissipation $P_{tot} = f(T_{amb})$



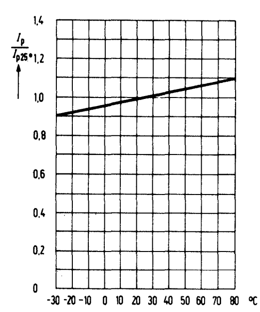
Dark current $I_R = f(V_R)$
$T_{amb} = 25°C$ $E = 0$



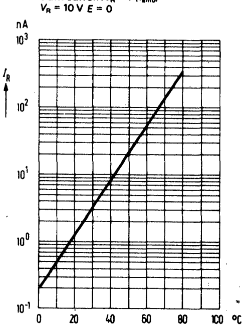
Capacitance $C = f(V_R)$
$f = 1$ MHz; $E = 0$



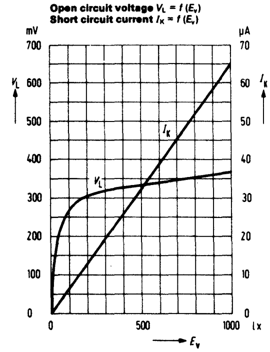
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



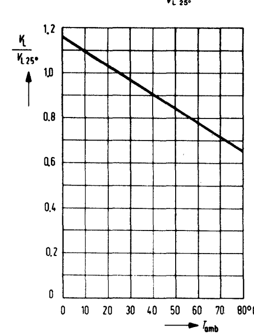
Dark current $I_R = f(T_{amb})$
$V_R = 10$ V $E = 0$



Open circuit voltage $V_L = f(E_v)$
Short circuit current $I_K = f(E_v)$



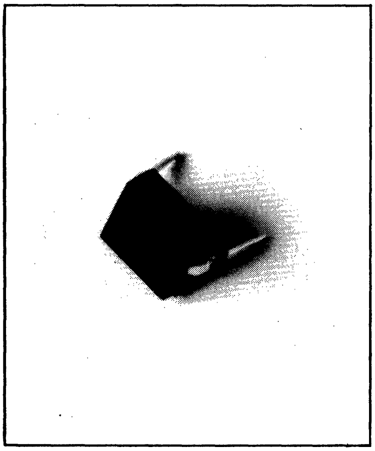
Open circuit voltage $\frac{V_L}{V_{L\,25°}} = f(T_{amb})$



litronix
A Siemens Company

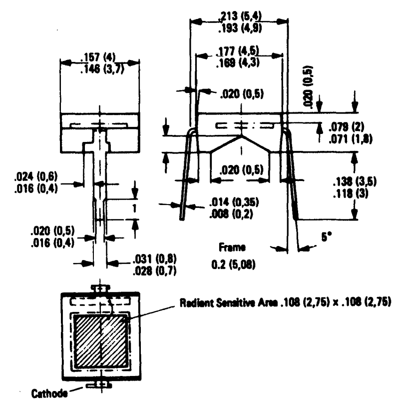
BPX 91B

PHOTODIODE



Supercedes BPX 91

Package Dimensions in Inches (mm)



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

FEATURES

- **Transparent Plastic Package**
- **2/10″ (5.08 mm) Lead Spacing**
- **High Blue Sensitivity, 400 mm = 30% Srel**

DESCRIPTION

The BPX 91B is a planar silicon photodiode, which is incorporated in a transparent plastic package. Its terminals are soldering tabs arranged in 2/10″ (5.08 mm) lead spacing. Due to its design, the diode can also very easily be assembled on PC boards. The flat back of the epoxy resin case makes rigid fixing of the component feasible. Arrays can be realized by multiple arrangements. The increased blue sensitivity with short wavelength makes the BPX 91B particularly suitable for application with high blue light source.

This versatile photodetector is suitable for diode as well as voltaic cell operation. The signal/noise ratio is particularly favorable, even at low illuminances. The open circuit voltage at low illuminances is higher than with comparable mesa photovoltaic cells. The cathode is marked by a tab on the solder lead.

Maximum Ratings

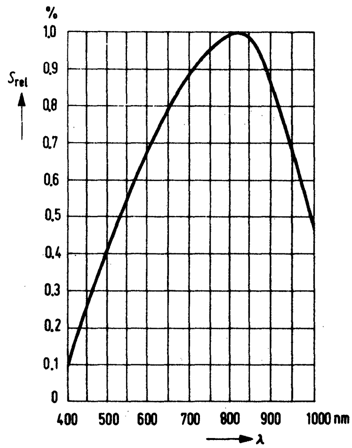
Reverse Voltage (V_R)	10 V
Operating and Storage Temperature Range (T_s)	−40 to +80 °C
Soldering Temperature in a 2 mm Distance from the Case Bottom (T_L), $t \leq 3$ s	230 °C
Power Dissipation (P_{tot}), $T_{amb} = 25$ °C	150 mW

Characteristics ($T_{amb} = 25$ °C)

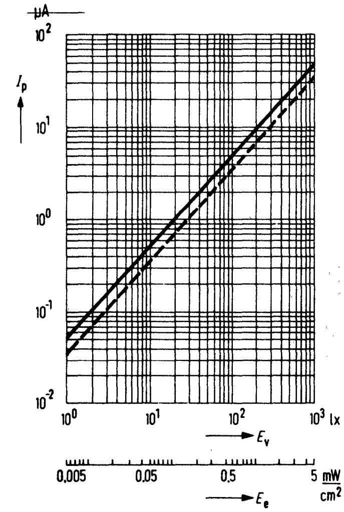
Photo Spectral Sensitivity (S)	50 (≥35) nA/lx
Wavelength of the Max. Sensitivity ($\lambda_{S\,max}$)	850 nm
Quantum Yield (η)	0.73 Electrons / Photon
Spectral Sensitivity (S_λ), $\lambda = 850$ nm	0.47 A/W
Open Circuit Voltage (V_L)	
$E_v = 100$ lx	360 (≥270) mV
$E_v = 1000$ lx	460 mV
Short Circuit Current (I_K)	
$E_v = 100$ lx	5 (≥3.5) µA
Rise and Fall Time of the Photo Current (t_r;t_f)	
$R_L = 1$ kΩ; $V_R = 0$ V; $\lambda = 950$ nm	2.5 µs
$R_L = 1$ kΩ; $V_R = 10$ V; $\lambda = 950$ nm	1.0 µs
Temperature Coefficient of (V_L), TC	−2.6 mV/K
Temperature Coefficient of (I_K), TC	0.2 %/K
Capacitance	
$V_R = 0$ V; f = 1 MHz; E = 0 (C_0)	750 pF
$V_R = 10$ V; f = 1 MHz; E = 0 (C_{10})	220 pF
Radiant Sensitive Area (A)	7.6 mm^2
Dark Current (I_R)	
$V_R = 10$ V: E = 0	7 (≤300) nA

Specifications subject to change without notice.

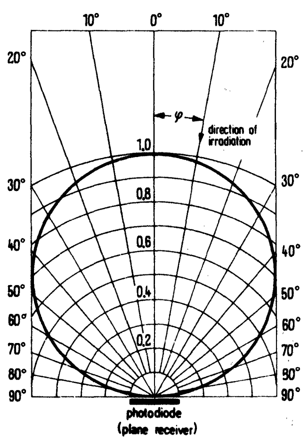
RELATIVE SPECTRAL SENSITIVITY
$S_{rel} = f(\lambda)$



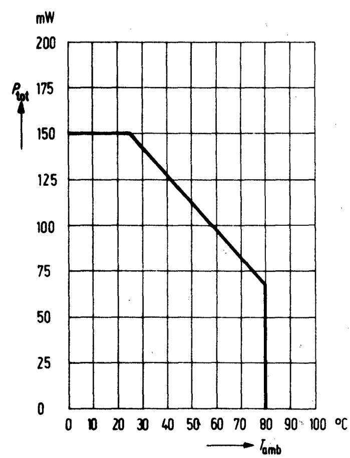
PHOTOCURRENT $I_P = f(E_v)$



DIRECTIONAL CHARACTERISTIC
$I_K = f(\varphi)$

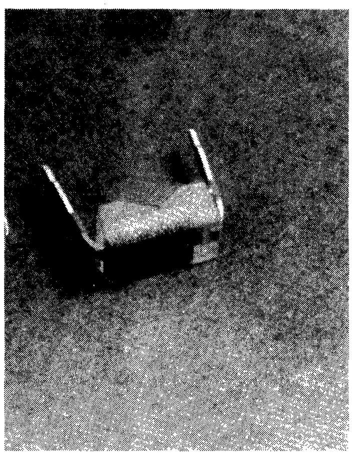


POWER DISSIPATION
$P_{tot} = f(T_{amb})$



litronix
A Siemens Company

BPX 90
PHOTODIODE



FEATURES

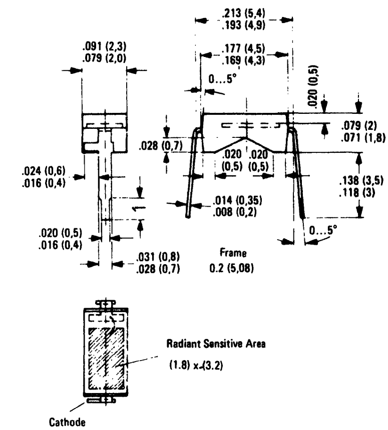
- Silicon Planar Photodiode
- Transparent Plastic Package
- 2/10" Lead Spacing
- High Sensitivity, 40 nA/lx

DESCRIPTION

The BPX 90 is a planar silicon photodiode, which is incorporated in a transparent plastic package. Its terminals are soldering tabs arranged in 5.08 mm (2/10") lead spacing. Due to its design the diode can also very easily be assembled on PC boards. The flat back of the epoxy resin case makes rigid fixing of the component feasible. Arrays can be realized by multiple arrangements.

This versatile photodetector is suitable for diode as well as voltaic cell operation. The signal/noise ratio is particularly favorable, even at low illuminances. The open circuit voltage at low illuminances is higher than with comparable mesa photovoltaic cells.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	32	V
Operating and storage temperature range	T_{stor}	− 40 to + 80	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation	P_{tot}	100	mW

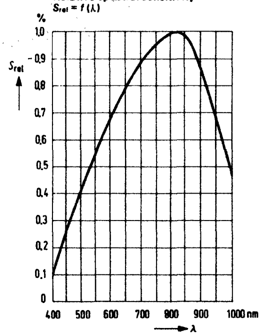
Characteristics (T_{amb} = 25°C)

Spectral sensitivity [1]	S	40 (≥ 25)	nA/lx
Wavelength of max. spectral sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.73	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S	0.50	A/W
Open circuit voltage (E_v = 100 lx) [1]	V_L	360 (≥ 270)	mV
(E_v = 1000 lx) [1]	V_L	460	mV
Short circuit current (E_v = 100 lx) [1]	I_K	4 (≥ 2.5)	µA
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	t_r; t_f	1.1	µs
(R_L = 1 kΩ; V_R = 10 V; λ = 950 nm)	t_r; t_f	0.8	µs
Temperature coefficient for V_L	TC	− 2.6	mV/K
Temperature coefficient for I_K	TC	0.2	%/K
Capacitance			
(V_R = 0 V; f = 1 MHz; E = 0)	C_0	500	pF
(V_R = 10 V; f = 1 MHz; E = 0)	C_{10}	170	pF
Radiant sensitive area	A	5.0	mm^2
Dark current (V_R = 10 V; E = 0)	I_R	5 (≤ 200)	nA

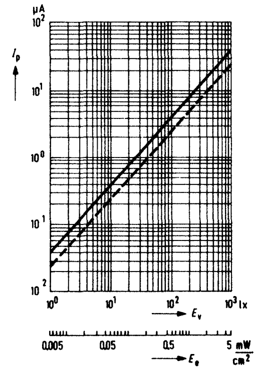
1) The illuminance indicated refers to unfiltered radiation of a tungsten-filament lamp at a color temperature of 2856 K. (Standard light A in accordance with DIN 5033 and IEC publ. 306-1.)

Specifications are subject to change without notice.

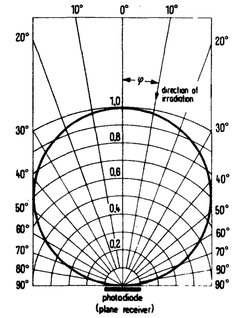
Relative spectral sensitivity $S_{rel} = f(\lambda)$



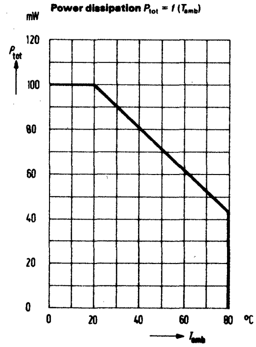
Photocurrent $I_P = f(E_v)$



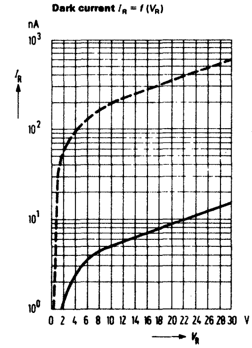
Directional characteristic $I_K = f(\varphi)$



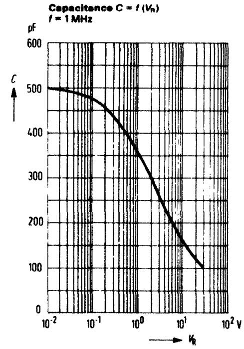
Power dissipation $P_{tot} = f(T_{amb})$



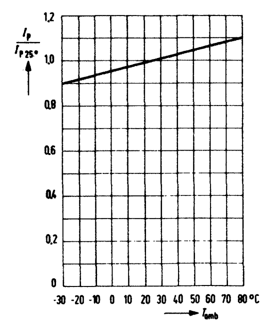
Dark current $I_R = f(V_R)$



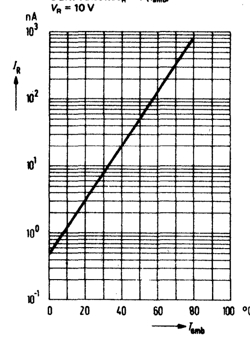
Capacitance $C = f(V_R)$
$f = 1$ **MHz**



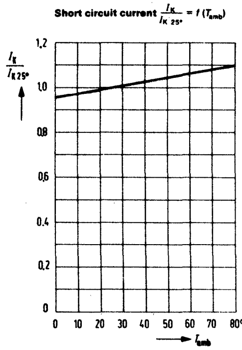
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



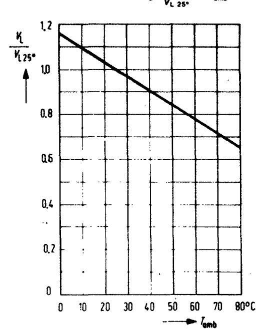
Dark current $I_R = f(T_{amb})$
$V_R = 10$ **V**



Short circuit current $\frac{I_K}{I_{K\,25°}} = f(T_{amb})$

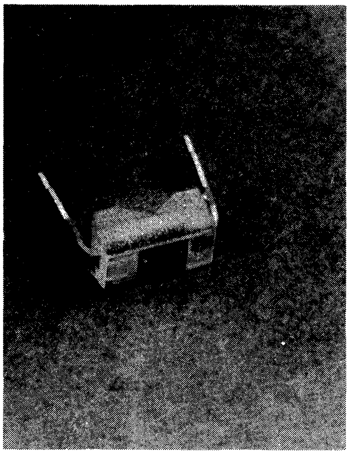


Open circuit voltage $\frac{V_L}{V_{L\,25°}} = f(T_{amb})$



litronix
A Siemens Company

BPX 93
PHOTODIODE



FEATURES

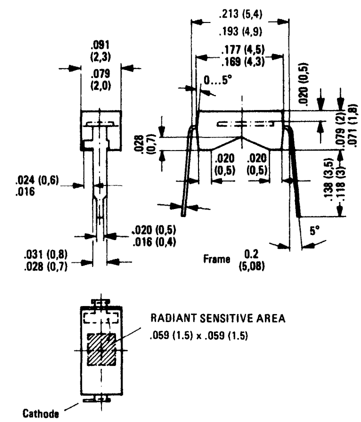
- Silicon Planar Photodiode
- Transparent Plastic Package
- 2/10" Lead Spacing
- Low Dark Current, 0.5 nA

DESCRIPTION

The BPX 93 is a planar silicon photodiode, which is incorporated in a transparent plastic package. Its terminals are soldering tabs arranged in 5.08 mm (2/10") lead spacing. Due to its design the diode can also very easily be assembled on PC boards. The flat back of the epoxy resin case makes rigid fixing of the component feasible. Arrays can be realized by multiple arrangements.

This versatile photodetector is suitable for diode as well as voltaic cell operation. The signal/noise ratio is particularly favorable, even at low illuminances. The open circuit voltage at low illuminances is higher than with comparable mesa photovoltaic cells. The cathode is marked by a white dot.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	32	V
Operating and storage temperature	T_{stor}	−55 to +80	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	75	mW

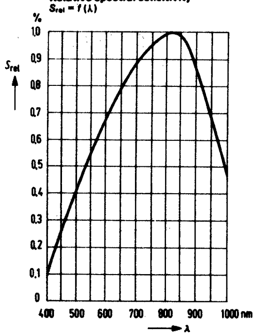
Characteristics (T_{amb} = 25°C)

Spectral sensitivity [1]	S	8 (≥ 5)	nA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.73	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S	0.50	A/W
Open circuit voltage			
(E_v = 100 lx) [1]	V_L	360 (≥ 270)	mV
(E_v = 1000 lx) [1]	V_L	460	mV
Short circuit current (E_v = 100 lx) [1]	I_K	0.8 (≥ 0.5)	µA
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V)	t_r; t_f	1.1	µs
(R_L = 1 kΩ; V_R = 10 V)	t_r; t_f	0.8	µs
Temperature coefficient of V_L	TC	−2	mV/K
Temperature coefficient of I_K	TC	0.1	%/K
Capacitance			
(V_R = 0 V; f = 1 MHz; E = 0)	C_0	120	pF
(V_R = 10 V; f = 1 MHz; E = 0)	C_{10}	40	pF
Radiant sensitive area	A	1	mm^2
Dark current (V_R = 10 V; E = 0)	I_R	0.5 (≤ 50)	nA

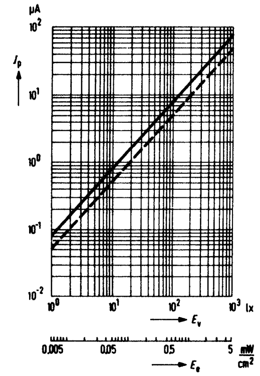
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a colour temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

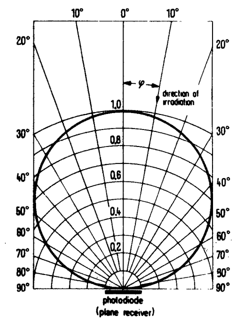
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



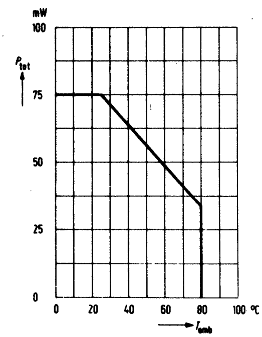
Photocurrent $I_P = f(E_v)$



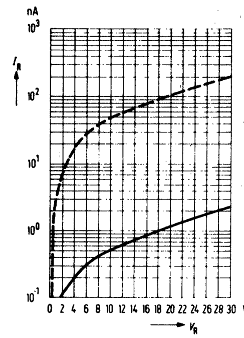
Directional characteristic $I_K = f(\varphi)$



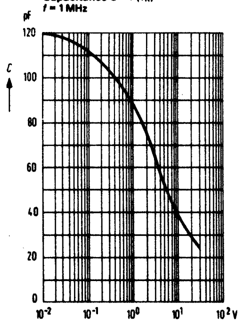
Power dissipation $P_{tot} = f(T_{amb})$



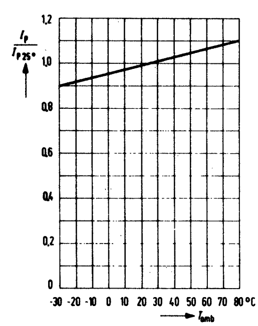
Dark current $I_R = f(V_R)$



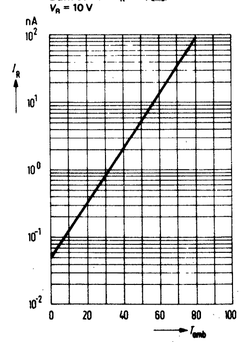
Capacitance $C = f(V_R)$
$f = 1$ **MHz**



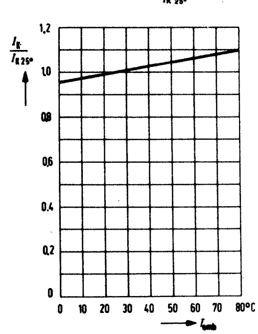
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



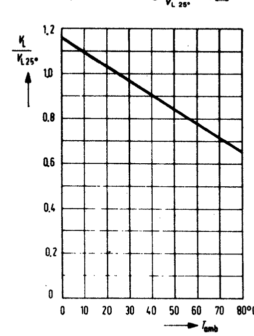
Dark current $I_R = f(T_{amb})$
$V_R = 10$ V



Short circuit current $\frac{I_K}{I_{K\,25°}} = f(T_{amb})$

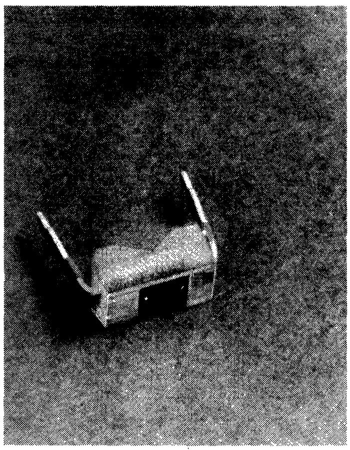


Open circuit voltage $\frac{V_L}{V_{L\,25°}} = f(T_{amb})$



litronix
A Siemens Company

BPW 32
PHOTODIODE



FEATURES

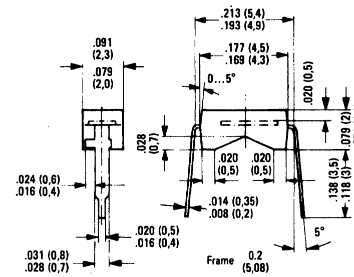
- Silicon Planar Photodiode
- Transparent Plastic Package
- 2/10" Lead Spacing
- Very Low Dark Current, 5 pA

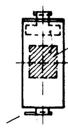
DESCRIPTION

The BPW 32 is a silicon planar photodiode, which is incorporated in a transparent plastic package. Its terminals are soldering tabs, arranged in 5.08 mm (2/10") lead spacing. Because of this design, the diodes can also very easily be assembled on PC boards. The flat back of the epoxy resin case makes rigid fixing of the component feasible.

The BPW 32 has been developed as a detector for low illuminances and is intended for use as a sensor in exposure meters and automatic exposure timers. The component is outstanding for low dark currents and—when used as a voltaic cell—for a high open circuit voltage at low illuminances. The cathode is marked by an orange dot.

Package Dimensions





Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	7	V
Storage temperature range	T_{stor}	− 55 to + 80	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	100	mW

Characteristics (T_{amb} = 25°C)

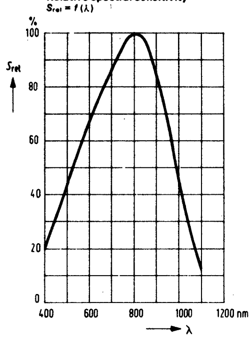
Spectral sensitivity [1]	S	10 (≥ 7)	nA/lx
Zero cross over [2] (E_e = 0 lx; T = 50°C)	S_O	≥ 0.5	mV/pA
Radiant sensitive area	A	1	mm²
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	800	nm
Quantum yield (Electrons per photon) (λ = 800 nm)	η	0.73	Electrons/Photon
Spectral sensitivity (λ = 800 nm)	S	0.47	A/W
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	t_r; t_f	1.3	µs
(R_L = 1 kΩ; V_R = 5 V; λ = 950 nm)	t_r; t_f	1.0	µs
Capacitance (V_R = 0 V; E = 0)	C_O	120	pF
(V_R = 3 V; E = 0)	C_3	50	pF
Dark current (V_R = 1 V; E = 0)	I_R	5 (≤ 20)	pA
Temperature coefficient of I_K	TC	0.2	%/K
Noise equivalent power (V_R = 1 V)	NEP	2.1×10^{-15}	$\frac{W}{\sqrt{Hz}}$
Detection limit	D^*	4.8×10^{13}	$\frac{cm\sqrt{Hz}}{W}$

1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306 1).

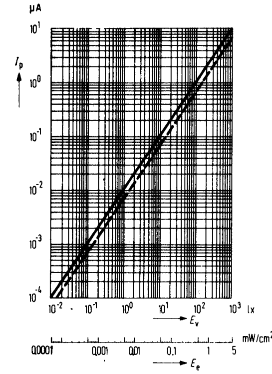
2) S_O is a measure for the lower spectral sensitivity when the photodiode is used in exposure meters. The zero cross over S_O is defined in the diagram.

Specifications are subject to change without notice.

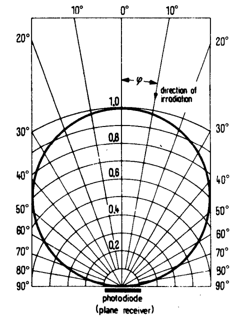
Relative spectral sensitivity $S_{rel} = f(\lambda)$



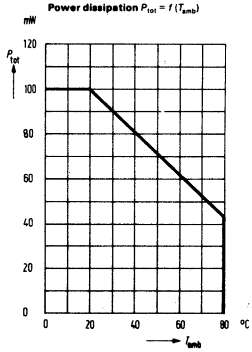
Photocurrent $I_P = f(E_v)$



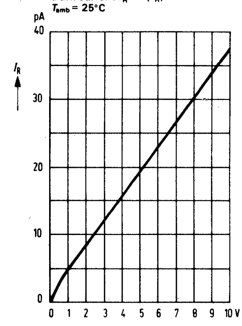
Directional characteristic $I_K = f(\varphi)$



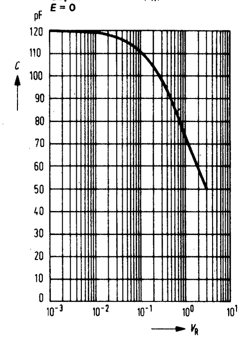
Power dissipation $P_{tot} = f(T_{amb})$



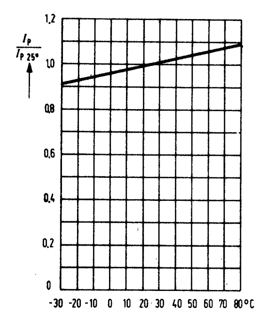
Dark current $I_R = f(V_R)$
$T_{amb} = 25°C$



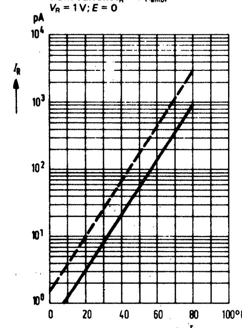
Capacitance $C = f(V_R)$
$E = 0$



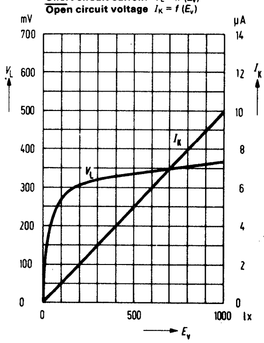
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



Dark current $I_R = f(T_{amb})$
$V_R = 1\,V; E = 0$



Short circuit current $V_L = f(E_v)$
Open circuit voltage $I_K = f(E_v)$



Open circuit voltage $\frac{V_L}{V_{L\,25°}} = f(T_{amb})$

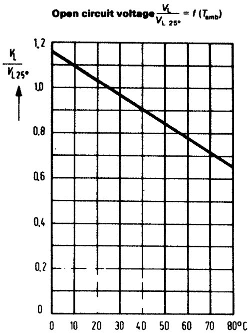
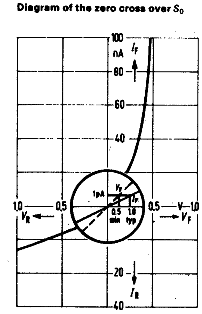
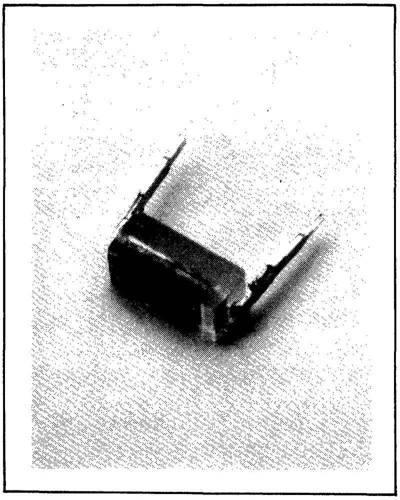


Diagram of the zero cross over S_0



litronix
A Siemens Company

SFH 100
PHOTODIODE



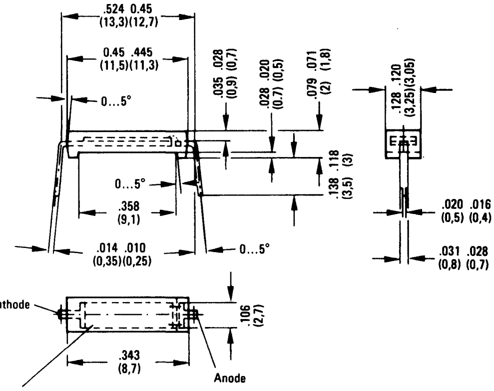
FEATURES

- **Transparent Plastic Package**
- **12.7 mm Lead Spacing**
- **Low Reverse Voltage, 0.1 V**

DESCRIPTION

The SFH100 silicon planar photodiode is supplied for universal applications. It is especially suitable for operation with small reverse voltage (approx. 0.1 V) for the detection of very limited illumination. The increased blue sensitivity of the diode lightens application with luminous source, which has a short wave emission spectrum. The component is built in a transparent plastic package and contains solder tab leads spaced at 12.7 mm.

Package Dimensions in Inches (mm)



Radiant Sensitive Area .343 (8,7) x .106 (2,7)

Maximum Ratings

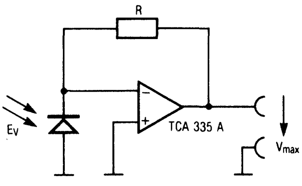
Reverse voltage	V_R	7	V
Operating and storage temperature range	T_s	-40...+80	°C
Soldering temperature in a 2mm distance from the case bottom ($t \leq 3$ s)	T_L	230	°C
Power dissipation	P_{tot}	100	mW

Characteristics (T_{amb} = 25°C)

Spectral sensitivity[1]	S	175 (≥ 150)	nA/lx
Wavelength of max. spectral sensitivity	$\lambda_{S\,max}$	800	nm
Quantum yield (Electrons per photon)(λ = 850 nm)	η	0.88	Electrons Photon
Spectral sensitivity (λ = 850 nm)	S_λ	0.5	A/W
Open circuit voltage (E_v = 100 lx)[1]	V_L	370	mV
(E_v = 1000 lx)[1]	V_L	430	mV
Short circuit current (E_v = 100 lx)[1]	I_K	175	µA
Rise time of the photocurrent	t_r	1.2	µs
Temperature coefficient for V_L	TC	-0.6	%/K
Temperature coefficient for I_K	TC	0.2	%/K
Capacitance (V_R = 0 V; E = 0)	C_0	1000	pF
Radiant sensitive area	A	23.5	mm²
Dark current (V_R = 10 V; E = 0)	I_R	0.4 (≤ 10)	nA

[1]The illuminance indicated refers to unfiltered radiation of a tungsten-filament lamp at a color temperature of 2856K. (Standard light A in accordance with DIN 5033 and IEC publ. 306-1.)

Switching Applications



$R = \frac{V_{max}}{I_{K\,max}}$

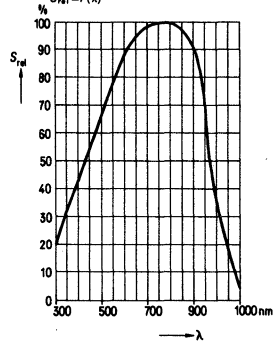
$I_K = E_{V\,max} \times 175$
($E_{V\,max}$ in Lux – $I_{V\,max}$ in nA)

A type with small input current should be used as operational amplifier.

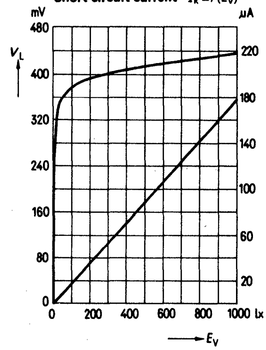
Specifications subject to change without notice.

Relative spectral sensitivity

$S_{rel} = f(\lambda)$

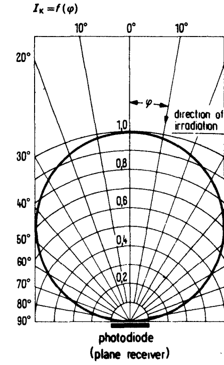


Open circuit voltage $V_L = f(E_V)$
Short circuit current $I_K = f(E_V)$



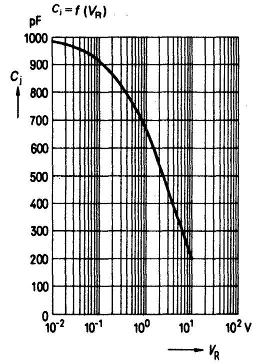
Directional characteristic

$I_K = f(\varphi)$

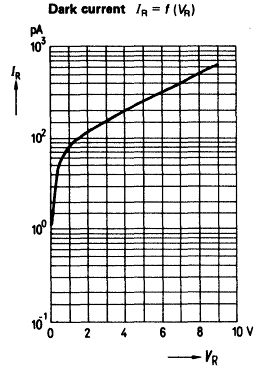


Collector-base capacitance

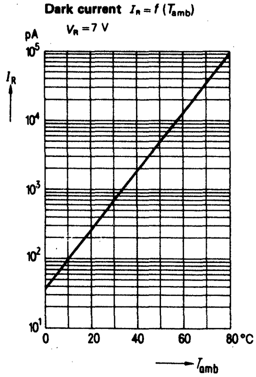
$C_j = f(V_R)$



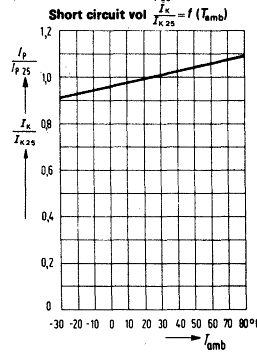
Dark current $I_R = f(V_R)$



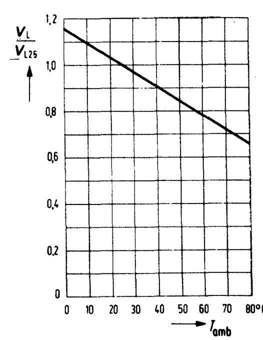
Dark current $I_R = f(T_{amb})$



Photocurrent $\frac{I_P}{I_{P\,25}} = f(T_{amb})$
Short circuit vol $\frac{I_K}{I_{K\,25}} = f(T_{amb})$



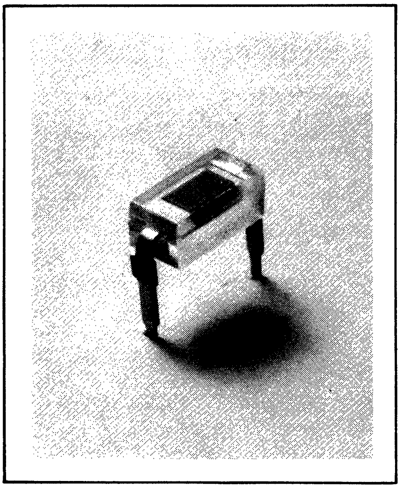
Open circuit voltage $\frac{V_L}{V_{L\,25°}} = f(T_{amb})$



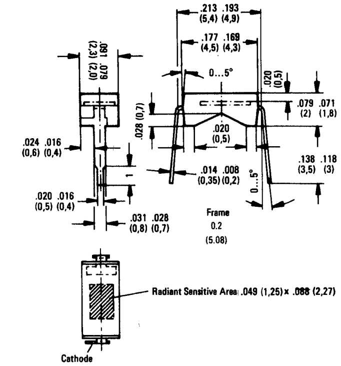
litronix
A Siemens Company

SFH 200

PHOTODIODE



Package Dimensions in Inches (mm)



FEATURES

- **Transparent Plastic Case**
- **5.08 mm (2/10") Lead Spacing**
- **Very Large Zero Crossover, 1 mV/pA**

DESCRIPTION

SFH 200 is a planar silicon photodiode incorporated in a transparent plastic package. Its terminals are solder tabs arranged in 5.08 mm (2/10 inch) lead spacing. The diode can also very easily be mounted on PC boards. The SFH 200 is developed for low luminescence as receiver for such applications as exposure meters. The photo component distinguishes itself by large zero point divisions and by high open circuit voltage with low luminescence.

Type Characterization: notch with blue point. The cathode is marked by a tab on solder lead.

Temperature

Operating and storage temp. range	T_{stor}	−55...+80	°C
Soldering temperature in a 2 mm distance from the case botton (t < 3s)		230	°C

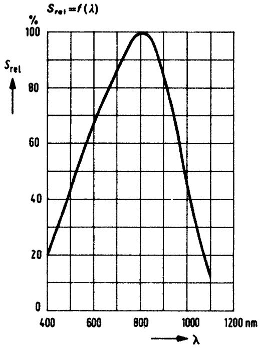
Characteristics (T_{amb} = 25°C)

Spectral sensitivity[1]	S	20 (≥ 14)	nA/lx
Zero cross over	S_0	≥ 1	mV/pA
Forward Current (E_e = 0 lx; T_{amb} = 25°C; V_F = 50 mV)	I_F	20	pA
Radiant sensitive area	A	2.8	mm²
Wavelength of max. spectral sensitivity	$\lambda_{S\,max}$	800	nm
Quantum yield (Electrons per photon) (λ = 800 nm)	η	0.73	Electrons Photon
Spectral sensitivity (λ = 800 nm)	S_λ	0.47	A/W
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	t_r; t_f	1.3	μs
(R_L = 1 kΩ; V_R = 5 V; λ = 950 nm)	t_r; t_f	1.0	μs
Capacitance			
(V_R = 0 V; E = 0)	C_0	240	pF
(V_R = 3 V; E = 0)	C_3	100	pF
Temperature coefficient for I_K	TK	0.2	%/K
Dark current (V_R = 3 V; E = 0)	I_R	20	pA

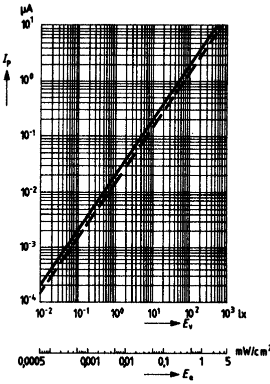
[1] The illuminance indicated refers to unfiltered radiation of a tungsten-filament lamp at a color temperature of 2856 K. (Standard light A in accordance with DIN 5033 and IEC publ. 306-1.)

Specifications are subject to change without notice.

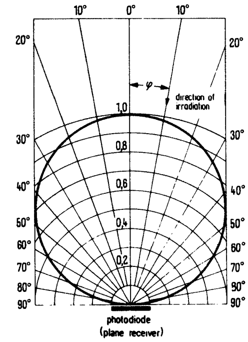
Relative spectral sensitivity $S_{rel} = f(\lambda)$



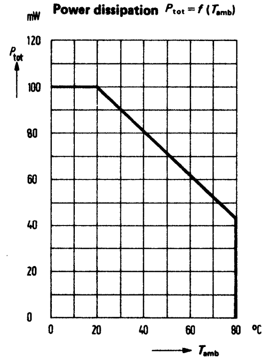
Photocurrent $I_P = f(E_v)$



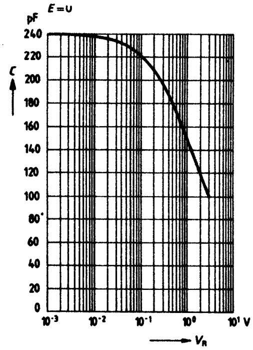
Directional characteristic $I_K = f(\varphi)$



Power dissipation $P_{tot} = f(T_{amb})$



Capacitance $C = f(V_R)$
$E = 0$



Photocurrent $\frac{I_P}{I_{P\,25}} = f(T_{amb})$

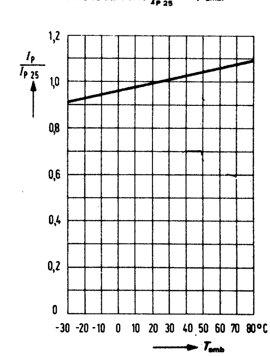
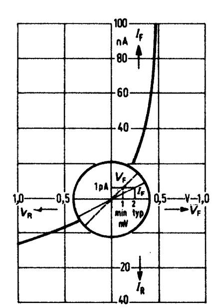


Diagram of zero crossover S_0

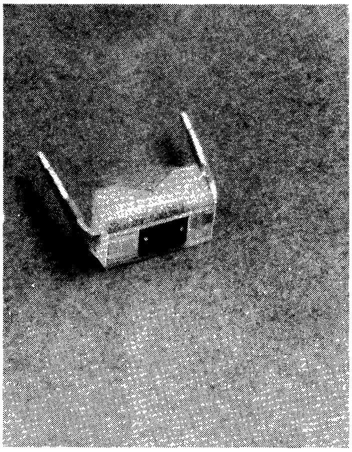


litronix

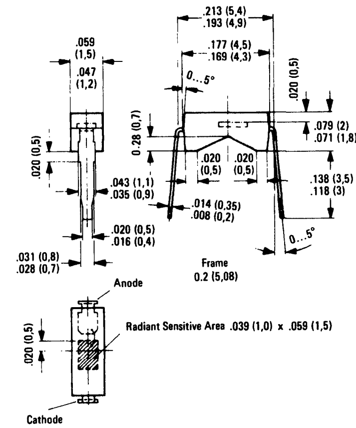
A Siemens Company

BPX 92

PHOTODIODE



Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions inside parenthesis are in inches

FEATURES

- Silicon Planar Photodiode
- Transparent Plastic Package
- 2/10" Lead Spacing
- Low Dark Current, 1 nA

DESCRIPTION

The BPX 92 is a planar silicon photodiode, which is incorporated in a transparent plastic package. Its terminals are soldering tabs arranged in 5.08 mm (2/10") lead spacing. Due to its design the diode can also very easily be assembled on PC boards. The flat back of the epoxy resin case makes rigid fixing of the component feasible. Arrays can be realized by multiple arrangements.

This versatile photodetector is suitable for diode as well as voltaic cell operation. The signal/noise ratio is particularly favorable, even at low illuminances. The open circuit voltage at low illuminances is higher than with comparable mesa photovoltaic cells.

Maximum Ratings

Reverse voltage	V_R	32	V
Operating and storage temperature	T_{stor}	− 55 to + 80	°C
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	50	mW

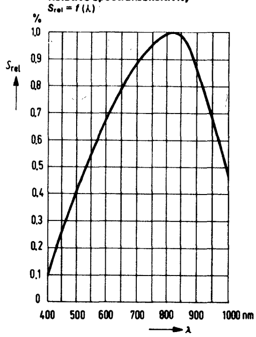
Characteristics (T_{amb} = 25°C)

Spectral sensitivity [1]	S	7 (≥ 4)	nA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.73	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S	0.50	A/W
Short circuit current			
(E_v = 100 lx) [1]	V_L	325 (≥ 240)	mV
(E_v = 1000 lx) [1]	V_L	410	mV
Open circuit voltage (E_v = 100 lx) [1]	I_K	0.7 (≥ 0.4)	µA
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1Ω; V_R = 0 V; λ = 950 nm)	$t_r; t_f$	1.1	µs
(R_L = 1Ω; V_R = 10 V; λ = 950 nm)	$t_r; t_f$	0.8	µs
Temperature coefficient of V_L	TC	− 2.6	mV/K
Temperature coefficient of I_K	TC	0.2	%/K
Capacitance			
(V_R = 0 V; f = 1 MHz; E = 0)	C_0	90	pF
(V_R = 10 V; f = 1 MHz; E = 0)	C_{10}	23	pF
Radiant sensitive area	A	1.5	mm²
Dark current (V_R = 10 V; E = 0)	I_R	1 (≤ 100)	nA

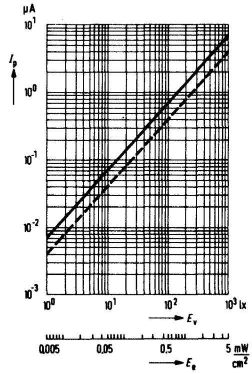
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a colour temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

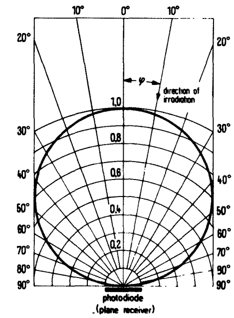
Relative spectral sensitivity $S_{rel} = f(\lambda)$



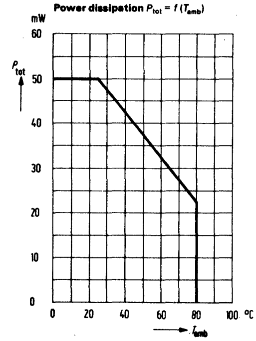
Photocurrent $I_P = f(E_v)$



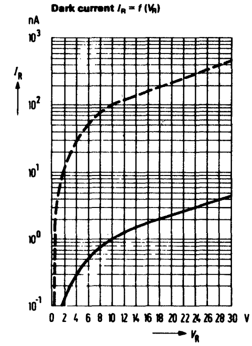
Directional characteristic $I_K = f(\varphi)$



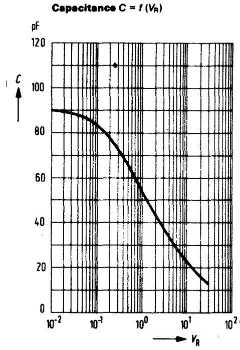
Power dissipation $P_{tot} = f(T_{amb})$



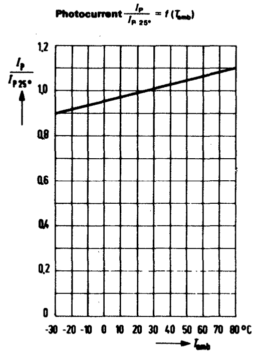
Dark current $I_R = f(V_R)$



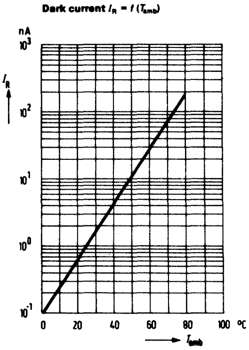
Capacitance $C = f(V_R)$



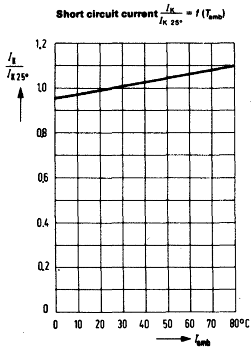
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



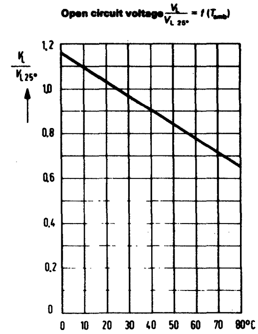
Dark current $I_R = f(T_{amb})$



Short circuit current $\frac{I_K}{I_{K\,25°}} = f(T_{amb})$



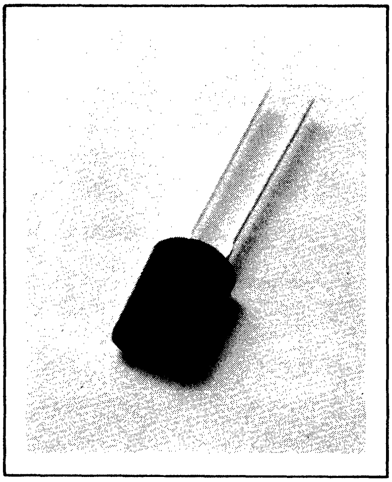
Open circuit voltage $\frac{V_L}{V_{L\,25°}} = f(T_{amb})$



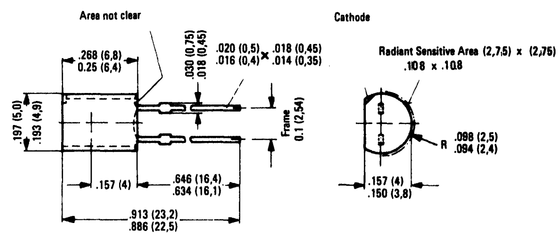
litronix
A Siemens Company

SFH 205

PIN PHOTODIODE



Package Dimensions in Inches (mm)



Maximum Ratings

Reverse voltage	V_R	20	V
Operating and storage temperature range	T_s	−40...+80	°C
Soldering temperature in a 1 mm distance from the case bottom ($t \leq 3$ s)	T_L	230	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	150	mW

FEATURES

- **Black Plastic Encapsulated Package**
- **2.54 mm (1/10") Lead Spacing**
- **Built in Day Light Filter**
- **Suitable for IR Sound Transmission**

DESCRIPTION

The SFH 205 is a silicon planar PIN photodiode, which is incorporated in a plastic package which simultaneously serves as filter and is also transparent for infrared emission. Its terminals are soldering tabs arranged in 2.54 mm (1/10") lead spacing. Due to its design, the diode can vertically be assembled on PC boards. Arrays can be realized by multiple arrangements. This versatile photodetector can be used as a diode as well as a voltaic cell. The signal/noise ratio is particularly favorable, even at low illuminances.

The PIN photodiode is outstanding for low junction capacitance, high cut-off frequency and short switching times. The photodiode is particularly suitable for IR sound transmission and remote control. The cathode is marked by stamping at the case edge.

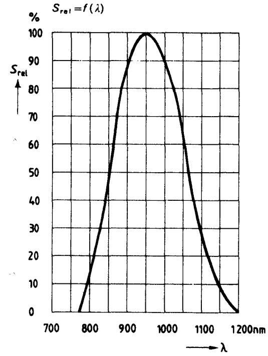
Characteristics (T_{amb} = 25°C)

Spectral sensitivity[1] (V_R = 5 V)	S	50 (≥ 30)	$\frac{\mu A \cdot cm^2}{mW}$
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	950	nm
Quantum yield (Electrons per Photon) (λ = 950 nm)	η	0.74	Electrons / Photon
Spectral sensitivity (λ = 950 nm)	S_λ	0.57	A/W
Open circuit voltage			
(E_e = 0.5 mW/cm², λ = 950 nm)	V_L	327	mV
(E_e = 0.05 mW/cm², λ = 950 nm)	V_L	248	mV
Short circuit current (E_e = 0.05 mW/cm², λ = 950 nm)	I_K	2	μA
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	t_r; t_f	125	ns
(R_L = 1 kΩ; V_R = 10 V; λ = 950 nm)	t_r; t_f	50	ns
Temperature coefficient of V_L	TK	−2.6	mV/K
Temperature coefficient of I_K or I_P	TK	0.18	%/K
Capacitance (V_R = 0 V; f = 1 MHz; E = 0)	C_0	72	pF
Radiant sensitive area	A	7.6	mm²
Dark current (V_R = 10 V)	I_R	2 (≤ 30)	nA
Noise equivalent power (V_R = 10 V)	NEP	4.4×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit	D^*	6.3×10^{12}	$\frac{cm\sqrt{Hz}}{W}$

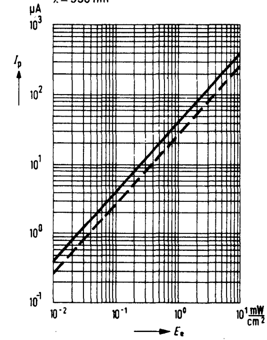
[1]The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5030 and IEC publ. 306-1).

Specifications are subject to change without notice.

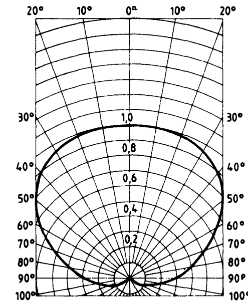
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



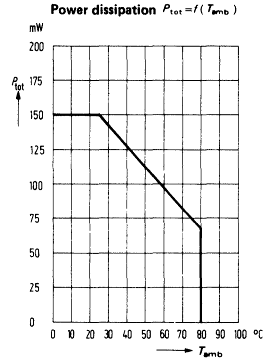
Photocurrent $I_P = f(E_e)$
$\lambda = 950$ nm



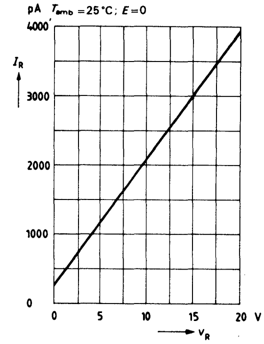
Directional characteristic
$S_{rel} = f(\varphi)$



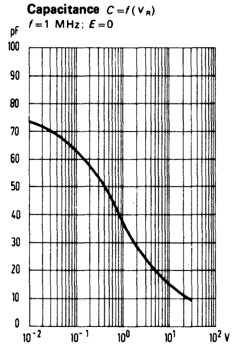
Power dissipation $P_{tot} = f(T_{amb})$



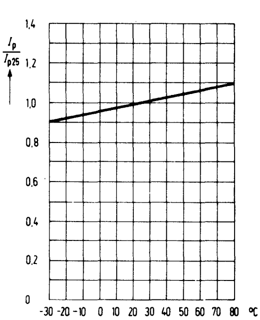
Dark current $I_R = f(V_R)$
pA $T_{amb} = 25$ °C; $E = 0$



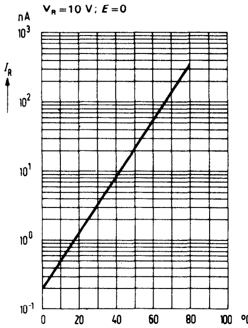
Capacitance $C = f(V_R)$
$f = 1$ MHz; $E = 0$



Photocurrent $\frac{I_P}{I_{P25}} = f(T_{amb})$

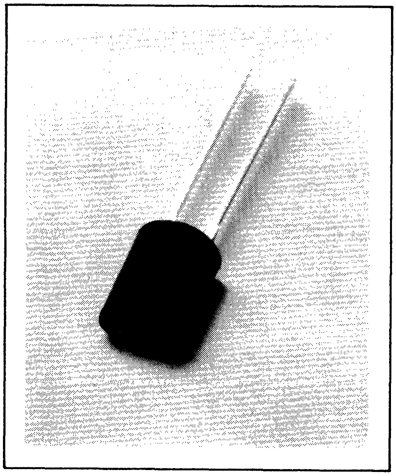


Dark current $I_R = f(T_{amb})$
$V_R = 10$ V; $E = 0$



litronix
A Siemens Company

SFH 206
PIN PHOTODIODE



FEATURES

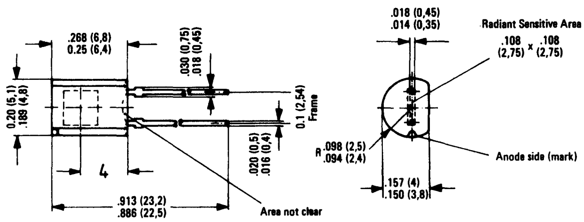
- Black Plastic Package
- 2.54 mm (1/10") Lead Spacing
- Built in Daylight Filter

DESCRIPTION

The SFH 206 is a silicon planar PIN photodiode which is incorporated in a black plastic package that serves as a filter for infrared radiation. Its terminals are solder tabs arranged in 2.54 mm (1/10") spacing. Due to its design the diode can vertically be assembled on PC boards. Arrays can be realized by multiple arrangements. This versatile photodetector can be used as a diode as well as a voltaic cell. The signal/noise ratio is particularly favorable, even at low illuminances.

The PIN photodiode is outstanding for low junction capacitance, high cut off frequency and short switching times. It is particularly suitable for IR sound transmission and remote control. The anode is marked by stamping at the case edge.

Package Dimensions in Inches (mm)



Maximum Ratings

Reverse voltage	V_R	20	V
Operating and storage temperature range	T_s	-40...+80	°C
Soldering temperature in a 1 mm distance from the case bottom ($t \leq 3$ s)	T_L	230	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	150	mW

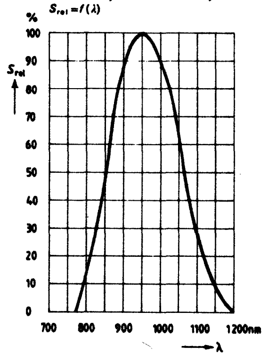
Characteristics

Spectral sensitivity[1] (V_R = 5 V)	S	50 (≥ 32)	$\frac{\mu A \cdot cm^2}{mW}$
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	950	nm
Quantum yield (Electrons per Photon)(λ = 950 nm)	η	0.74	$\frac{Electrons}{Photon}$
Spectral sensitivity (λ = 950 nm)	S_λ	0.57	A/W
Open circuit voltage			
(E_e = 0.5 mW/cm², λ = 950 nm)	V_L	327	mV
(E_e = 0.05 mW/cm², λ = 950 nm)	V_L	248	mV
Short circuit current (E_e = 0.05 mW/cm², λ = 950 nm)	I_K	2	µA
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	t_r; t_f	125	ns
(R_L = 1 kΩ; V_R = 10 V; λ = 950 nm)	t_r; t_f	50	ns
Temperature coefficient of V_L	TK	-2.6	mV/K
Temperature coefficient of I_K or I_P	TK	0.18	%/K
Capacitance (V_R = 0 V; f = 1 MHz; E = 0)	C_0	72	pF
Radiant sensitive area	A	7.6	mm²
Dark current (V_R = 10 V)	I_R	2 (≤ 30)	nA
Noise equivalent power (V_R = 10 V)	NEP	4.9×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit	D^*	5.6×10^{12}	$\frac{cm\sqrt{Hz}}{W}$

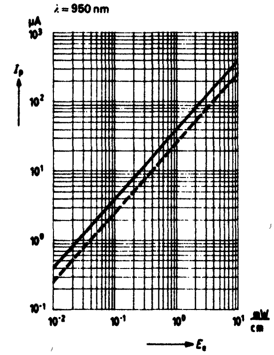
[1] The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

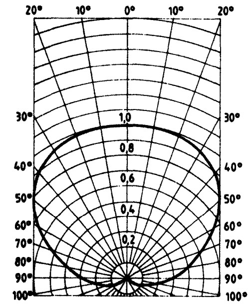
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



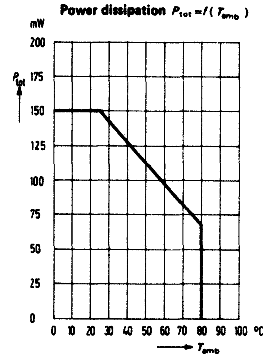
Photocurrent $I_P = f(E_e)$
$\lambda = 950$ nm



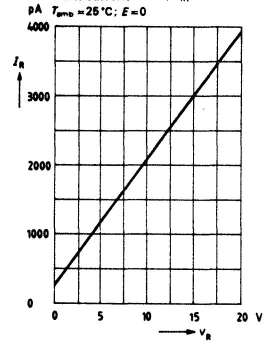
Directional characteristic $S_{rel} = f(\varphi)$



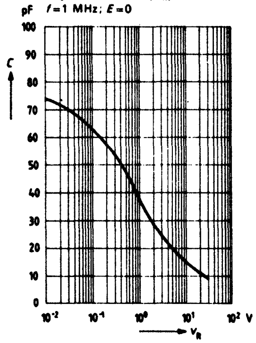
Power dissipation $P_{tot} = f(T_{amb})$



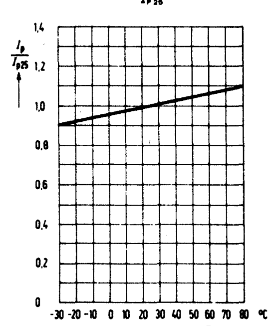
Dark current $I_R = f(V_R)$
pA $T_{amb} = 25$ °C; $E = 0$



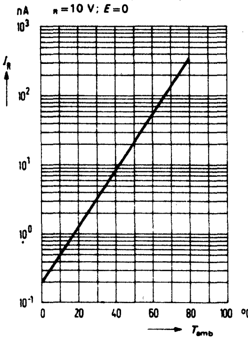
Capacitance $C = f(V_R)$
pF $f = 1$ MHz; $E = 0$



Photocurrent $\frac{I_P}{I_{P25}} = f(T_{amb})$



Dark current $I_R = f(T_{amb})$
nA $_R = 10$ V; $E = 0$

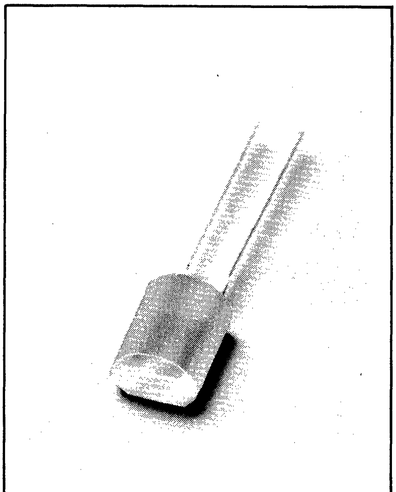


litronix

A Siemens Company

SFH 206K

PIN PHOTO DIODE



FEATURES

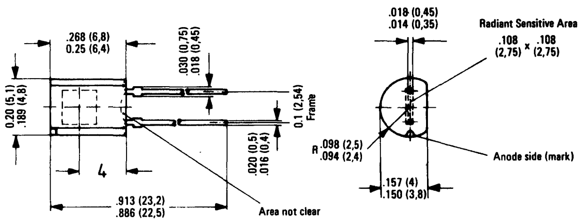
- **Colorless Plastic Package**
- **2.54 mm (1/10") Lead Spacing**
- **Suitable for IR Sound Transmission**

DESCRIPTION

The SFH 206K is a silicon planar PIN photodiode which is incorporated in a colorless plastic package. Its terminals are solder tabs arranged in 2.54 mm (1/10") spacing. Due to its design the diode can vertically be assembled on PC boards. Arrays can be realized by multiple arrangements. This versatile photodetector can be used as a diode as well as a voltaic cell. The signal/noise ratio is particularly favorable, even at low illuminances.

The PIN photodiode is outstanding for low junction capacitance, high cut off frequency and short switching times. It is particularly suitable for IR sound transmission and remote control. The anode is marked by stamping at the case edge.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	20	V
Operating and storage temperature range	T_s	−40...+80	°C
Soldering temperature in a 1 mm distance from the case bottom ($t \leq 3$ s)	T_L	260	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	150	mW

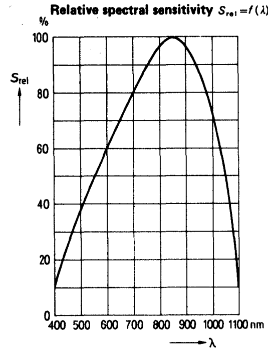
Characteristics (T_{amb} = 25°C)

Spectral sensitivity[1]	S	70 (≥ 50)	nA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.88	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S_λ	0.60	A/W
Open circuit voltage			
(E_v = 100 lx)[1]	V_L	285	mV
(E_v = 1000 lx)[1]	V_L	365	mV
Short circuit current (E_v = 100 lx)[1]	I_K	6.5	μA
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 0 V; λ = 950 nm)	t_r; t_f	125	ns
(R_L = 1 kΩ; V_R = 10 V; λ = 950 nm)	t_r; t_f	50	ns
Temperature coefficient of V_L	TK	−2.6	mV/K
Temperature coefficient of I_K or I_P	TK	0.18	%/K
Capacitance (V_R = 0 V; f = 1 MHz; E = 0)	C_0	72	pF
Radiant sensitive area	A	7.6	mm^2
Dark current (V_R = 10 V)	I_R	2 (≤ 30)	nA
Noise equivalent power (V_R = 10 V)	NEP	4.2×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit	D^*	6.6×10^{12}	$\frac{cm\sqrt{Hz}}{W}$

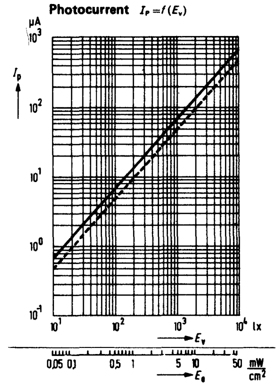
[1]The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5030 and IEC publ. 306-1).

Specifications are subject to change without notice.

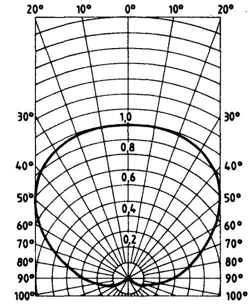
Relative spectral sensitivity $S_{rel} = f(\lambda)$



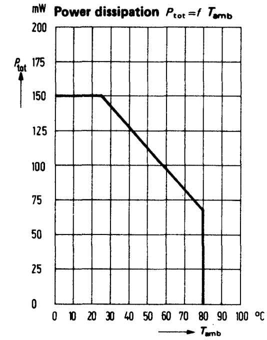
Photocurrent $I_P = f(E_v)$



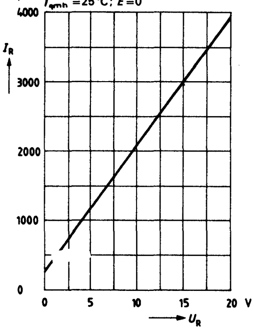
Directional characteristic $S_{rel} = f(\varphi)$



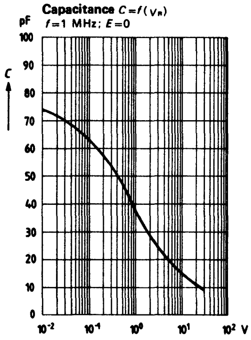
Power dissipation $P_{tot} = f\ T_{amb}$



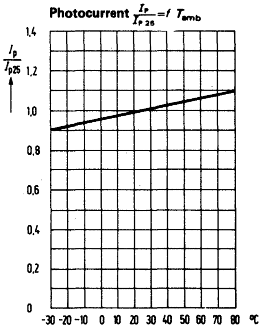
Dark current $I_R = f(V_R)$
$T_{amb} = 25\,°C$; $E = 0$



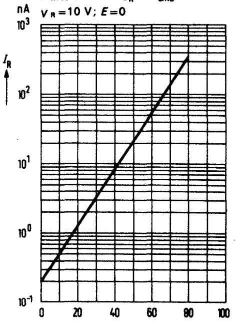
Capacitance $C = f(V_R)$
$f = 1$ MHz; $E = 0$



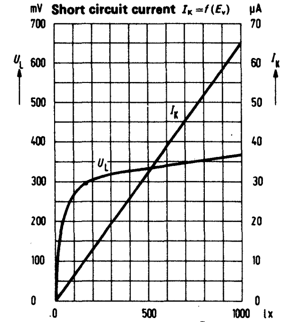
Photocurrent $\frac{I_P}{I_{P25}} = f\ T_{amb}$



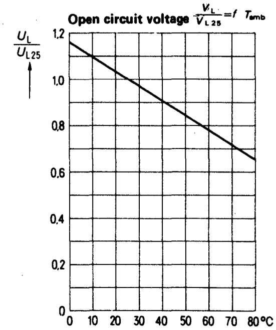
Dark current $I_R = f\ T_{amb}$
$V_R = 10$ V; $E = 0$



Open circuit voltage $V_L = f(E_v)$
Short circuit current $I_K = f(E_v)$



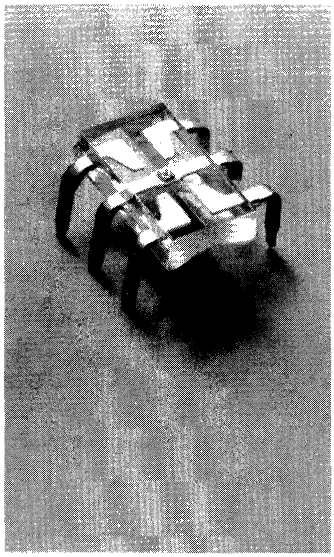
Open circuit voltage $\frac{V_L}{V_{L25}} = f\ T_{amb}$



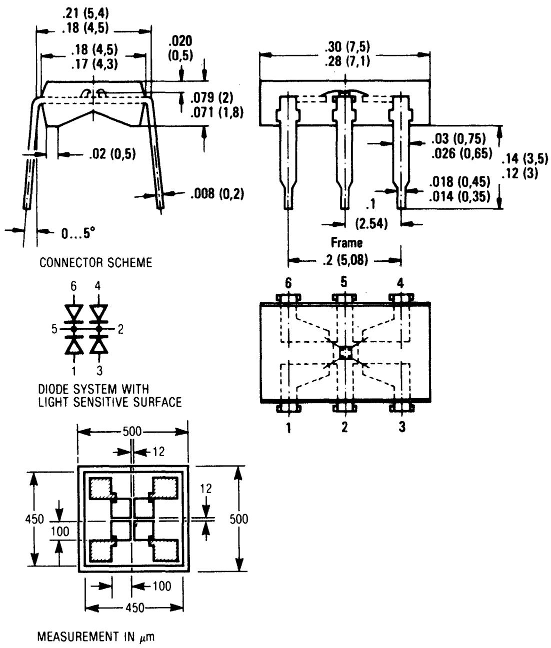
litronix
A Siemens Company

SFH 204

SILICON FOUR QUADRANT PHOTODIODE



Package Dimensions in Inches (mm)



FEATURES

- **Miniature size**
- **Four quadrant active sections**
- **Close spacing of contacts, 12 μm**
- **Can determine if and by how much a light source has deviated**

DESCRIPTION

The SFH 204 silicon planar miniature four quadrant photodiode has application in edge drive, positioning, and path and corner scanning control devices. The active units are spaced at only 12 μm apart from individual contacts. It is therefore possible to get exact positioning with high definition.

Maximum Ratings

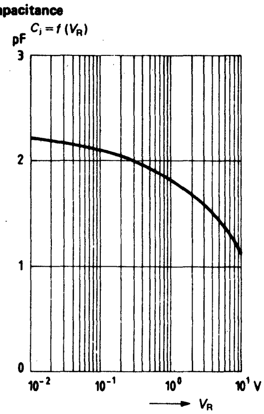
Reverse voltage	V_R	12	V
Junction temperature	T_j	80	°C
Soldering temperature in a 2mm distance from the case bottom ($t \leqslant 3$ s)	T_s	-20...+80	°C
Power dissipation	P_{tot}	40	mW

Characteristics (T_{amb} = 25°C)

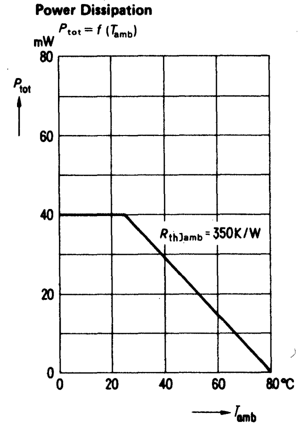
Wavelength of the max. sensitivity	$\lambda_{s\,max}$	850	nm
Spectral sensitivity	S	0.11 (≥0.08)	nA/lx
Spectral sensitivity (λ = 850 nm)	S_λ	> 0.35	A/W
Dark current (V_R = 10 V; T_{amb} = 25°C; E = 0)	I_R	0.01 (≤ 2)	nA
Junction capacitance			
(V_R = 0V; f = 1 MHz; E = 0)	C_0	2.5	pF
(V_R = 10 V; f = 1 MHz; E = 0)	C_{10}	1.5	pF
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1kΩ; V_R = 0 V; λ = 950 nm)	$t_r; t_f$	2	μs
(R_L = 1kΩ; V_R = 10 V; λ = 950 nm)	$t_r; t_f$	4	μs
Radiant sensitive area	A	4 x 0.01	mm²
Distance between radiant sensitive areas, breadth of the cross-shaped geometry		12 (≥ 10)	μm
Maximum deviation of the spectral sensitivity of the four systems from the mean	ΔS	< 20	%

Specifications subject to change without notice.

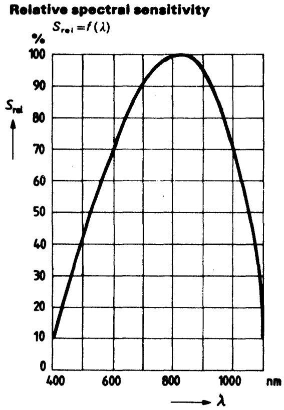
Capacitance



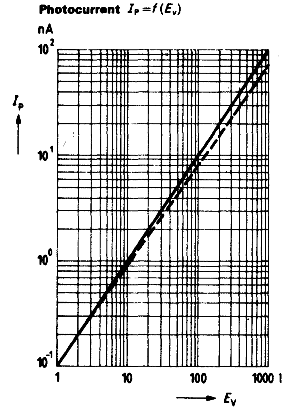
Power Dissipation



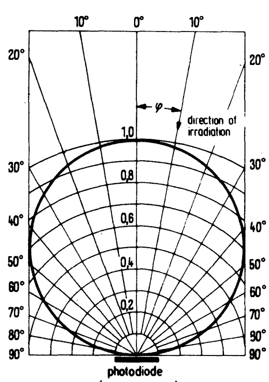
Relative spectral sensitivity



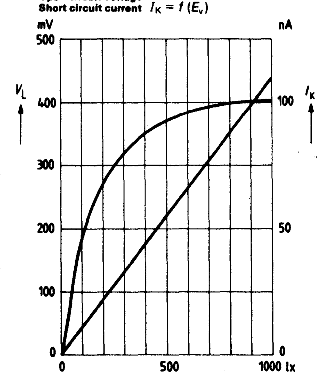
Photocurrent $I_P = f(E_v)$



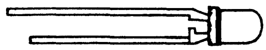
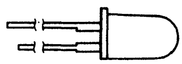
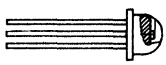
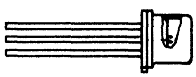
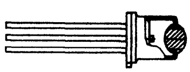
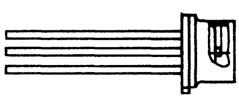
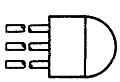
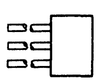
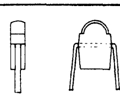
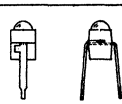
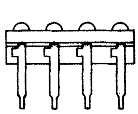
Directional characteristic $I_K = f(\varphi)$



Open circuit voltage $V_L = f(E_v)$
Short circuit current $I_K = f(E_v)$



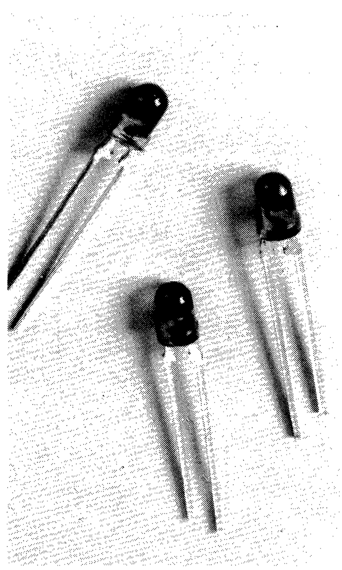
PHOTOTRANSISTORS

Package Type	Package Outline	Part Number	Acceptance Half Angle	Photo Current V_{CE}=5V E_V=1000lx (mA)	Collector Emittor Voltage V_{CEO} (V)	Page
T1 3mm Plastic		SFH309		1.0	35	342
T1¾ 5mm Plastic		BP103B-1	16°	1.6-3.2	35	343
		BP103B-2		2.5-5.0		
		BP103B-3		4.0-8.0		
		BP103B-4		6.3-12.6		
Similar to TO-18 Plastic		BP103-1	60°	.16-.32	50	345
		BP103-2		.25-0.5		
		BP103-3		0.4-0.8		
		BP103-4		.63-1.25		
TO-18 Flat Glass Lens		BPX38-1	40°	0.4-0.8	50	351
		BPX38-2		.63-1.25		
		BPX38-3		1.0-2.0		
		BPX38-4		1.6-3.2		
TO-18 Round Glass Lens		BPX43-1	20°	1.6-3.2	50	353
		BPX43-2		2.5-5.0		
		BPX43-3		4.0-8.0		
		BPX43-4		6.3-12.5		
		BPY62-1	8°	1.25-2.5	32	355
		BPY62-2		2.0-4.0		
		BPY62-3		3.2-6.3		
TO-18 Flat Glass Lens		SFH500	60°	0.7	15	357
Similar to TO-18 Round Epoxy Lens		LPT100	30°	>0.2	30	347
		LPT100A		1.0-3.0		
		LPT100B		1.3-2.6		
Similar to TO-18 Flat Epoxy Lens		LPT110	50°	>0.2		
		LPT110A		0.6-1.8		
		LPT110B		0.8-1.6		
Miniature 1mm		SFH305-2	16°	1.0-2.0	32	361
		SFH305-3		1.6-3.2		
Miniature Plastic		BPX81-1	18°	.63-1.25	32	359
		BPX81-2		1.0-2.0		
		BPX81-3		1.6-3.2		
		BPX81-4		2.5-5.0		
2 Diode Array		BPX82	18°	.32-1.0	32	359
3		BPX83				
4		BPX84				
5		BPX85				
6		BPX86				
7		BPX87				
8		BPX88				
9		BPX89				
10		BPX80				

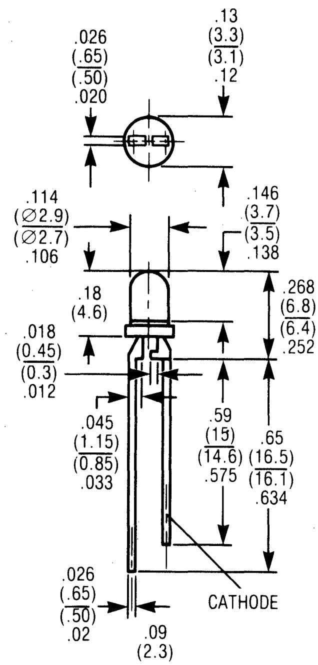
litronix
A Siemens Company

SFH-309

T1 SILICON PHOTOTRANSISTOR ADVANCED INFORMATION



Package Dimensions in Inches (mm)



FEATURES

- **3 mm (T1) Size Package**
- **.09 Inch (2.3 mm) Lead Spacing**
- **Low Cost**
- **Matches with SFH-409 Infrared Emitter**

DESCRIPTION

The new silicon NPN phototransistor SFH-309 is a low cost component in the normal 3 mm plastic case.

This component was designed for preferential use in simple IR light barriers and for remote control applications in entertainment electronics and toy industry.

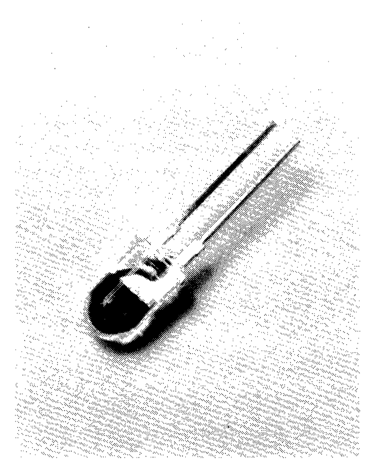
Characteristics (@25 °C)

Photo Current (V_{CE} = 5 V; E_v = 1000 lx)	I_P	1 mA
Collector-Emitter Leakage Current (V_{CE} = 30 V; E = 0)	I_{CEO}	5 (≤100) nA
Wavelength of the Maximum Sensitivity	$\lambda_{S_{max}}$	850 nm
Switching Time	t_r, t_f	5 (≤10) µs
Maximum Collector-Emitter Voltage	V_{CEO}	35 V

Specifications subject to change without notice.

litronix
A Siemens Company

BP 103B SERIES
PHOTOTRANSISTOR



FEATURES

- **Silicon NPN Epitaxial Phototransistor**
- **Low Cost**
- **T 1¾ Package**
- **Clear Plastic Lens**
- **Narrow Acceptance Angle 16°**
- **Very High Gain, Up to 56 mA**

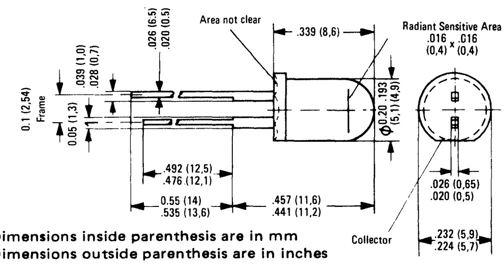
DESCRIPTION

BP103B is an epitaxial NPN silicon phototransistor of high sensitivity. It is enclosed in a tubular 5 mm all-plastic package.

The base terminal is not contacted, control is performed by the incident light. The collector is characterized by a flattening on the package base.

The phototransistor is mainly intended for standard applications and for use in automatic electronic flashes. Due to the tubular plastic shape, it can easily be mounted into holes and performed plastic sleeves; e.g. LED mounting assemblies.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Collector-emitter voltage	V_{CEO}	35	V
Emitter-Collector voltage	V_{EBO}	7	V
Collector current	I_C	100	mA
Collector peak current ($t \leq 10$ µs)	I_{CM}	200	mA
Junction temperature	T_j	125	°C
Storage temperature	T_{stor}	−55 to 80	°C
Max. permissible soldering temperature ($t \leq 5$ s)	T_s	260	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	210	mW
Thermal resistance Collector junction to air	R_{thJamb}	350	K/W

Characteristics (T_{amb} = 25°C)

Collector-emitter leakage current (V_{CE} = 30 V; E = 0)	I_{CEO}	5 (≤ 100)	nA
Range of spectral sensitivity (S = 0.1 S_{max})	λ	440 to 1070	nm
Wavelength of the max. sensitivity	$\lambda_{s\ max}$	850	nm
Collector base – Photodiode (E_v = 1000 lx; V_{CE} = 5 V)	I_{PCB}	10.8	µA
(E_e = 0.5 mW/cm²; λ = 950 nm; V_{CE} = 5 V)	I_{PCB}	2.7	µA
Radiant sensitive area	A	0.12	mm²
Rise time to 90% of the final value Fall time to 10% of the initial value (R_L = 1 kΩ)[1]	$t_r; t_f$	5 (≤ 10)	µs
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0)	C_{CE}	11	pF
Acceptance half angle	φ	16	degrees

Grouping is done at E_v = 1000 lx.

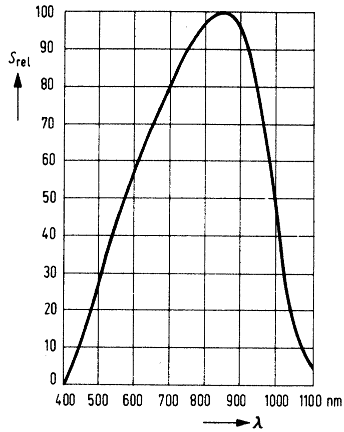
Group	BP103B-1	BP103B-2	BP103B-3	BP103B-4	
Photocurrent I_P (V_{CE} = 5 V; E_v = 1000 lx)	1.6 to 3.2	2.5 to 5.0	4.0 to 8.0	6.3 to 12.6	mA
Photocurrent approx. I_P (V_{CE} = 5 V; E_e = 20 mW/cm²)	7 to 14	11 to 22	18 to 36	28 to 56	mA

The illuminances refer to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC 306–1). Irradiance E_e measured with HP radiant flux meter 8334A with option 013.

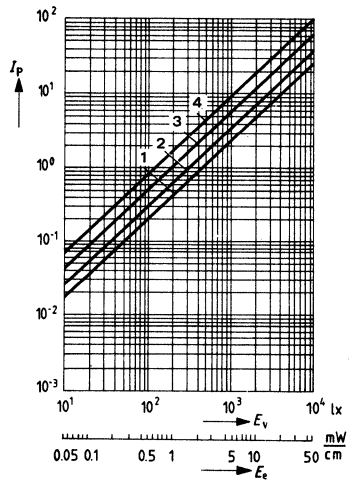
[1] measured with LED λ = 950 nm

Specifications are subject to change without notice.

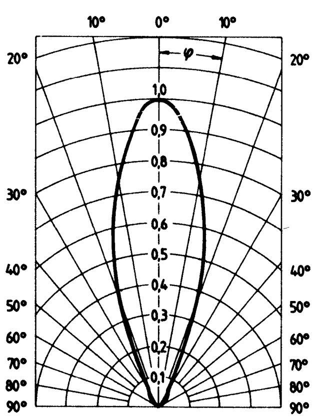
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



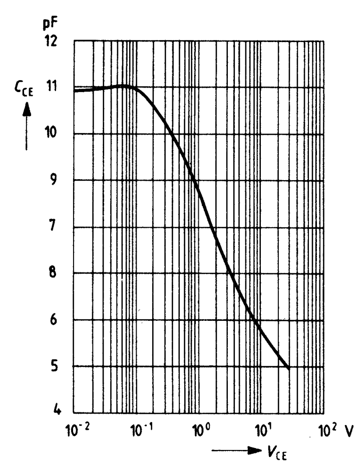
Photocurrent as a function of
E_v **or** E_e; $I_P = f(E_v)$



Directional characteristic $I_P = f(\varphi)$



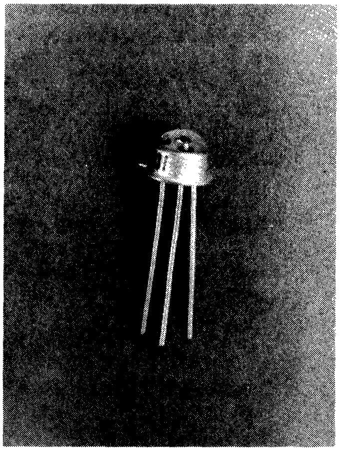
Collector-emitter capacitance
$C_{CE} = f(V_{CE})$



litronix
A Siemens Company

BP-103 SERIES

SILICON PHOTOTRANSISTOR



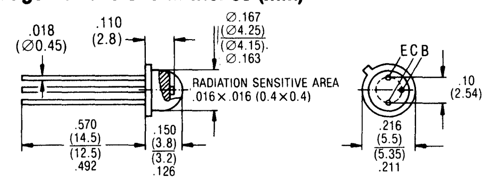
FEATURES

- **Silicon NPN Epitaxial Phototransistor**
- **Modified TO-18 Package**
- **Clear Plastic Lens**
- **Wide Acceptance Angle, 60°**
- **Four Sensitivity Ranges**

DESCRIPTIONS

The BP-103 is an epitaxial NPN silicon planar phototransistor, mounted on a base plate similar to 18 A 3 DIN 41876 (TO-18) with glass-clear plastic encapsulation. The plastic cover provides a wide angle for the incident light. This angle can also be reduced by mounting a diaphragm. The emitter terminal is marked by a small projection on the case bottom. The collector is electrically connected to the metallic case parts. The phototransistor is particularly suitable for use in automatic electronic flashes with base integrating circuit and self-excited (high-frequency) breakdown voltage generators (see circuit diagram) and in high Q electronic instructional toys used in filament lamp light and daylight, as well as in combination with GaAs infrared emitting diodes in small light barriers.

Package Dimensions in Inches (mm)



Maximum Ratings

Collector-Emitter Voltage (V_{CEO})	50 V
Emitter-Base Voltage (V_{EBO})	7 V
Collector Current (I_C)	100 mA
Collector Peak Voltage (I_{CM}), $t \leq 10\ \mu s$	200 mA
Junction Temperature (T_j)	125 °C
Storage Temperature (T_{stor})	−55 to +80 °C
Maximum Permissible Soldering Temperature (T_s), $t \leq 5$ s	260 °C
Power Dissipation (P_{tot}), $T_{amb} = 25$ °C	300 mW
Thermal Resistance Collector Junction-To-Air (R_{thJamb})	500 K/W
Collector Junction-To-Case ($R_{thJcase}$)	200 K/W

Characteristics ($T_{amb} = 25$ °C)

Collector-Emitter Leakage Current (I_{CEO}) ($V_{CE} = 30$ V; E = 0)	5 (≤100) nA
Range of Spectral Photosensitivity (λ)(S = 0.1 S_{max})	440 to 1070 nm
Wavelength of the Max. Sensitivity ($\lambda_{S\ max}$)	850 nm
Typical Spectral Sensitivity of the Collector Base Photodiode (I_{PCB})	
$E_v = 1000$ lx; $V_{CE} = 5$ V	2.1 μA
$E_e = 0.5$ mW/cm^2; λ = 950 nm; $V_{CE} = 5$ V	0.55 μA
Radiant Sensitive Area (A)	0.12 mm^2
Rise Time to 90% of the Final Value / Fall Time to 10% of the Initial Value (t_r, t_f) ($R_L = 1$ kΩ)[1]	5 (≤10) μs
Capacitance (C_{CE}), $V_{CE} = 0$ V; f = 1 MHz; E = 0	9 pF
(C_{CB}), $V_{CB} = 0$ V; f = 1 MHz; E = 0	13 pF
(C_{EB}), $V_{EB} = 0$ V; f = 1 MHz; E = 0	21 pF
Half-Angle (φ)	60 Degrees

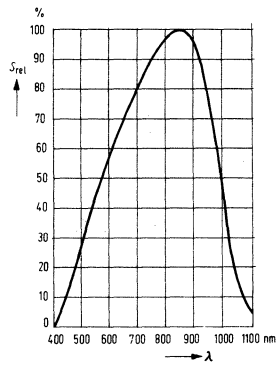
Group		BP 103-1	BP 103-2	BP 103-3	BP 103-4	
Photocurrent ($V_{CE} = 5$ V; $E_v = 1000$ lx)	I_P	160 to 320	250 to 500	400 to 800	630 to 1250	μA
Photocurrent ($V_{CE} = 5$ V; $E_e = 20$ mW/cm^2)	I_P	0.7 to 1.4	1.1 to 2.2	1.8 to 3.6	2.8 to 5.6	mA
Current Gain ($E_v = 1000$ lx; $V_{CE} = 5$ V)	$\frac{I_{PCE}^{(1)}}{I_{PCB}}$	180	280	450	710	
Collector-Emitter/ Saturation Voltage ($I_C = 0.1$ mA; $I_B = 1$ μA; E = 0)	V_{CEsat}	200	170	160	160	mV
($I_C = 2.5$ mA; $I_B = 25$ μA; E = 0)	V_{CEsat}	190	160	150	150	mV

The illuminances refer to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856K. (Standard light A in accordance with DIN 5033 and IEC 306-11). Irradiance E_e measured with HP radiant flux meter 8334A with option 013.

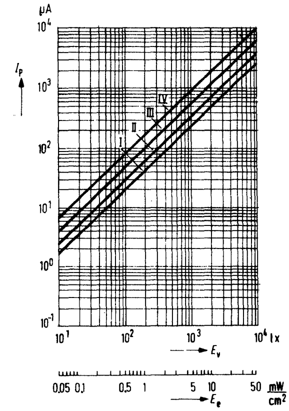
1. Measured with LED λ = 950 nm. (1) I_{PCE} = Photocurrent of transistors; I_{PCB} = Photocurrent of Collector-Basis-Diode.

Specifications subject to change without notice.

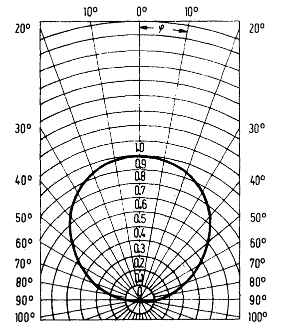
Relative Spectral Sensitivity
$S_{rel} = f(\lambda)$



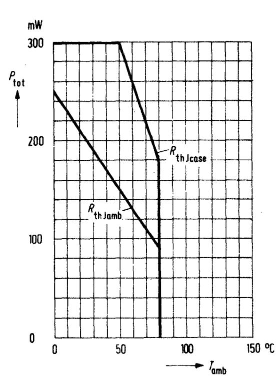
Photocurrent as a Function of E_v or E_e; $I_p = f(E_v)$



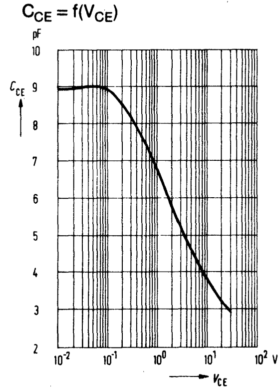
Directional Characteristic $I_P = f(\varphi)$



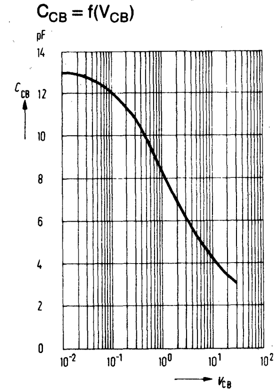
Power Dissipation $P_{tot} = f(T_{amb})$



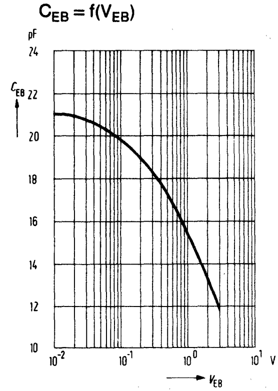
Collector-Emitter Capacitance
$C_{CE} = f(V_{CE})$



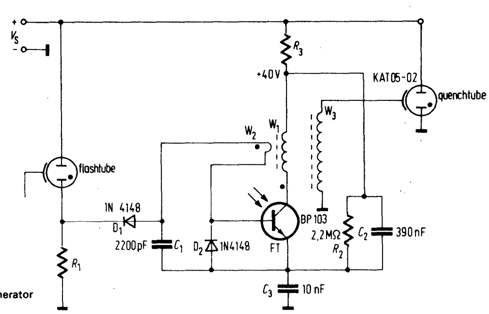
Collector-Base Capacitance
$C_{CB} = f(V_{CB})$



Emitter-Base Capacitance
$C_{EB} = f(V_{EB})$



Application Example

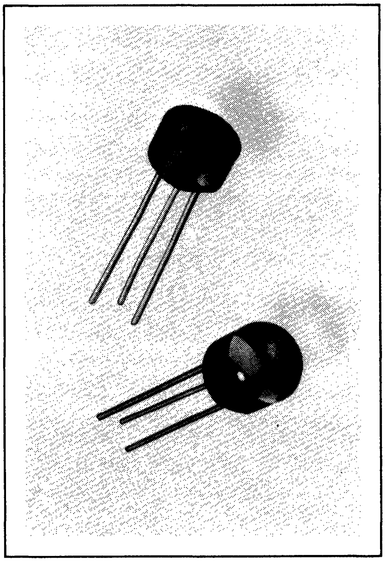


Breakdown voltage-generator
for measuring circuit
W_1 : 4 turns 0.15 Ø CuLS
W_2 : 1 turns 0.25 Ø CuL
W_3 : 140 turn 0.15 Ø CuLS
Interior space of the coil
with SIFERRIT cylindrical core,
material M 25,
inner coil diameter: 11 mm

litronix
A Siemens Company

LPT-100/110 SERIES

PHOTOTRANSISTOR



FEATURES

- Collector Dark Current 0.25 nA Typ
- Responsivity
  0.6μA/mW/cm² Min (Tungsten)
  1.8μA/mW/cm² Min (GaAs)
- Photo Current
  0.2 mA Min (Tungsten)
  0.6 mA Min (GaAs)
- Rise and Fall Time 2.8μs Typ

APPLICATIONS

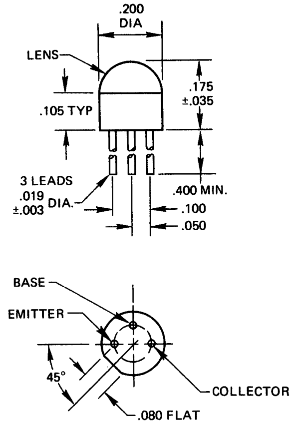
- Position Detector
- Intrusion Alarm Sensor
- Optical Tachometer

BENEFITS

- Flexible Circuit Design
  Base Lead Availability
  Large Range of Sensitivities
- Greater Power Dissipation — Ceramic Case
- Reliable — Exceptionally Stable Characteristics

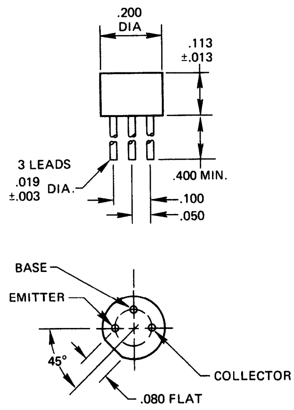
Package Dimensions (in inches)

LPT100/LPT100A/LPT100B



NOTE: ALL LEADS ELECTRICALLY ISOLATED FROM CASE

LPT110/LPT110A/LPT110B



NOTE 1: ALL LEADS ELECTRICALLY ISOLATED FROM CASE.
NOTE 2: FLATNESS VARIATION OF TOP OF CUP IS ±.015.
NOTE 3: PHOTOSENSITIVE AREA IS WITHIN A .030 DIAMETER CIRCLE WITH CENTER OF CIRCLE COINCIDENT WITH THE CENTER OF PACKAGE.

Specifications are subject to change without notice.

MAXIMUM RATINGS

Maximum Temperatures/Humidity
- Storage Temperature . . . . −55°C to +100°C
- Operating Junction Temperature . . . . −55°C to +85°C
- Relative Humidity at Temperature . . . . 98% at +65°C

Maximum Power Dissipation (Notes 1 and 2)
- Total Dissipation at +25°C Case Temperature . . . . 200 mW
- Total Dissipation at +25°C Ambient Temperature . . . . 100 mW

Maximum Voltages (Note 5)
- BV_{CBO} Collector to Base Voltage 50V
- LV_{CEO} Collector to Emitter Sustaining Voltage 30V

Maximum Current
- I_C Collector Current . . . . 100 mA

OPTO-ELECTRICAL CHARACTERISTICS (25°)

Symbols	Parameter	LPT-100/A/B Min	LPT-100/A/B Typ	LPT-100/A/B Max	LPT-110/A/B Min	LPT-110/A/B Typ	LPT-110/A/B Max	Units	Test Conditions
I_{CBO}	Collector Dark Current		0.25	25		0.25	25	nA	V_{CB} = 10V (Note 5)
I_{CBO} (65°C)	Collector Dark Current		0.025	0.5		0.025	0.5	μA	V_{CB} = 10V (Note 5)
I_{CEO}	Collector Dark Current		2.0	100		2.0	100	nA	V_{CE} = 5.0V (Note 5)
R_{CB}	Responsivity (Tungsten)	0.6	1.6		0.6	1.0		μA/mW/cm²	V_{CB} = 10V (Notes 3 and 8)
R_{CB}	Responsivity (GaAs)	1.8	4.8		1.8	3.0		μA/mW/cm²	V_{CB} = 10V (Notes 4 and 8)
$I_{CE(L)}$	Photo Current (Tungsten)								
	LPT-100 and LPT-110	0.2	1.4		0.2	0.88		mA	V_{CE} = 5.0V
	"A" Only	1.0		3.0	0.6		1.8	mA	H = 5.0 mW/cm²
	"B" Only	1.3		2.6	0.8		1.6	mA	(Notes 3 and 7)
$I_{CE(L)}$	Photo Current (GaAs)	0.6	4.2		0.6	2.7		mA	V_{CE} = 5.0V H = 5.0 mW/cm² (Notes 4 and 7)
t_r, t_f	Light Current Rise Time		2.8			2.8		μs	(Note 6)
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage		0.16			0.16		V	I_C = 500μA H = 20 mW/cm²
BV_{CBO}	Collector to Base Breakdown Voltage	50	120		50	120		V	I_C = 100μA (Note 5)
LV_{CEO}	Collector to Emitter Sustaining Voltage	30	50		30	50		V	I_C = 1.0 mA (Note 5)
BV_{ECO}	Emitter to Collector Breakdown		7.0			7.0		V	I_{EC} = 100μA (Note 5)

Note 1: These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

Note 2: These ratings give a maximum junction temperature of +85°C and junction to case thermal resistance of +300°C/W (derating factor of 3.33 mW/°C) and a junction to ambient thermal resistance of +600°C/W (derating factor of 1.67 mW/°C).

Note 3: Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854°K.

Note 4: These are values obtained at noted irradiance as emitted from a GaAs source at 0.9μ.

Note 5: Measured with radiation flux intensity of less than 0.1μW/cm² over the spectrum from 100 to 1500 nm.

Note 6: Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: I_{CE} = 4.0 mA, V_{CE} = 5.0V, R_L = 100 Ohms, GaAs Source.

Note 7: No electrical connection to base lead.

Note 8: No electrical connection to emitter lead.

TYPICAL OPTO-ELECTRONIC CHARACTERISTICS

FIGURE 1. PHOTO CURRENT CHARACTERISTICS

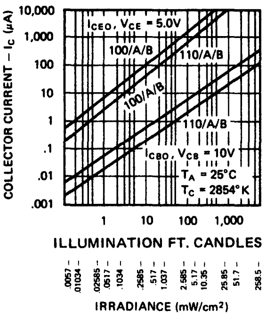


FIGURE 2. COLLECTOR CURRENT VS COLLECTOR VOLTAGE

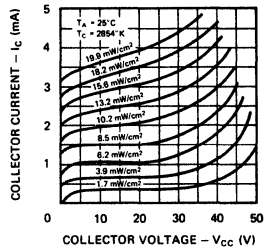


FIGURE 3. COLLECTOR BASE CHARACTERISTICS

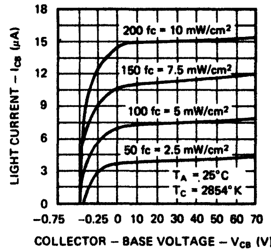


FIGURE 4. ANGULAR RESPONSE

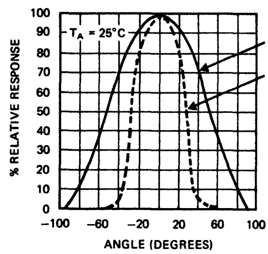


FIGURE 5. COLLECTOR DARK CURRENT VS TEMPERATURE

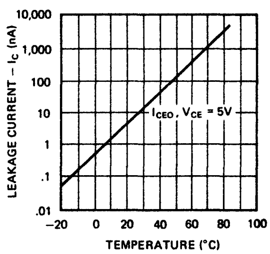


FIGURE 6. SPECTRAL CHARACTERISTICS

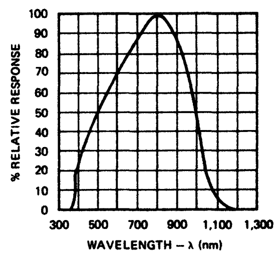


FIGURE 7. RISE AND FALL TIME VS COLLECTOR CURRENT (SHOWN IN FIGURE 10)

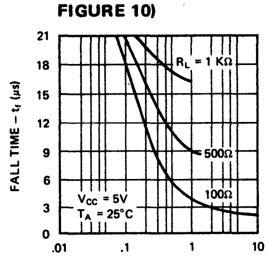


FIGURE 8. TURN-OFF DELAY TIMES FOR CURRENT (SHOWN IN FIGURE 11)

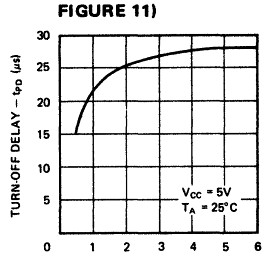
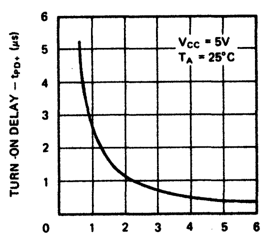


FIGURE 9. TURN-ON DELAY TIMES FOR CIRCUIT (SHOWN IN FIGURE 11)



TYPICAL OPTO-ELECTRONIC CHARACTERISTICS (CONT.)

FIGURE 10. SWITCHING CIRCUIT FOR RISE AND FALL TIMES

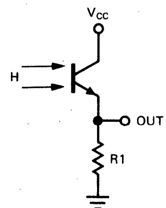
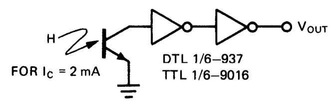
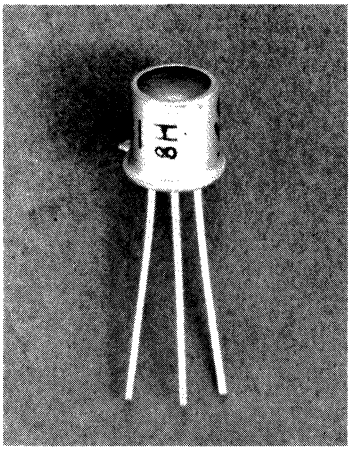


FIGURE 11. CIRCUIT FOR TURN-ON AND TURN-OFF DATA



litronix
A Siemens Company

BPX 38 SERIES
PHOTOTRANSISTOR



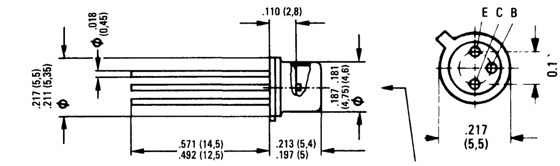
FEATURES

- **Silicon NPN Epitaxial Planar Phototransistor**
- **Premium Hi-Rel Device**
- **TO-18 Size Hermetic Package**
- **Flat Glass Lens**
- **Wide Acceptance Angle, 40°**
- **Moderate Gain, Up to 14 mA**
- **Four Sensitivity Ranges**

DESCRIPTION

The BPX 38 is a silicon NPN epitaxial planar phototransistor in an 18 A 3 DIN 41876 (TO 18) case with flat window and high radiant sensitivity for front irradiation. The flat window has no influence on the light paths. It is, therefore, particularly suitable for industrial applications, where lens systems are used. The collector terminal is electrically connected to the case.

Package Dimensions



Radiant Sensitive Area .034 (0,86) x .034 (0,86)

Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Collector-emitter voltage	V_{CEO}	50	V
Emitter-base voltage	V_{EBO}	7	V
Collector current	I_C	50	mA
Junction temperature	T_j	175	°C
Storage temperature	T_{stor}	−55 to +125	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	330	mW
Max. permissible soldering temperature (t≤ 5 s)	T_s	260	°C
Thermal resistance			
Collector junction to air	R_{thJamb}	≤ 450	K/W
Collector junction to case	$R_{thJcase}$	≤ 150	K/W

Characteristics (T_{amb} = 25°C)

Range of spectral sensitivity ($S = 0.1\,S_{max}$)	λ	450 to 1080	nm
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	870	nm
Collector-base – photodiode (E_v = 1000 lx; V_{CE} = 5 V)	I_{PCB}	4.8	μA
(E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CE} = 5 V)	I_{PCB}	1.2	μA
Radiant sensitive area	A	0.65	mm^2
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0)	C_{CE}	23	pF
(V_{CB} = 0 V; f = 1 MHz; E = 0)	C_{CB}	41	pF
(V_{EB} = 0 V; f = 1 MHz; E = 0)	C_{EB}	47	pF
Acceptance half angle	φ	40	degree
Grouping is done at E_v = 1000 lx.			

Group		BPX 38-1	BPX 38-2	BPX 38-3	BPX 38-4	
Photocurrent (V_{CE} = 5 V; E_v = 1000 lx)	I_P	0.4 to 0.8	0.63 to 1.25	1.0 to 2.0	1.6 to 3.2	mA
Photocurrent approx. (V_{CE} = 5 V; E_e = 20 mW/cm^2)	I_P	1.6 to 3.2	2.5 to 5.0	4.5 to 9.0	7.0 to 14.0	mA
Rise time from 10% to 90% of the final value; Fall time from 90% to 10% of the initial value (I_C = 1 mA; V_{CE} = 5 V; R_L = 1 kΩ)[1]	t_r; t_f	5	6	8	12	μs
Collector-emitter saturation voltage (I_C = 2 mA; I_B = 50 μA; E = 0)	V_{CEsat}	175	175	160	140	mV
Power gain (E_v = 1000 lx; V_{CE} = 5 V)	$I_{P(CE)}$[2)] / $I_{P(CE)}$	100	160	250	400	
Collector-emitter leakage current (V_{CEO} = 25 V; E = 0)	I_{CEO}	5 (≤ 200)	8 (≤ 200)	12 (≤ 500)	20 (≤ 500)	nA

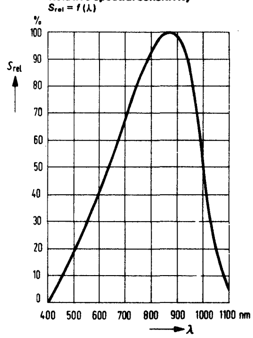
The illuminances refer to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K. (standard light A in accordance with DIN 5033 and IEC 306-1). Irradiance E_e measured with HP radiant flux meter 8334A with option 013.

1) measured with LED λ = 950 nm

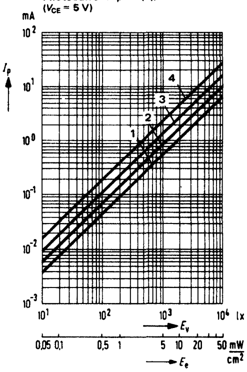
2) $I_{P(CE)}$ = Photocurrent of the phototransistor
$I_{P(CB)}$ = Photocurrent of the collector-base photodiode

Specifications are subject to change without notice.

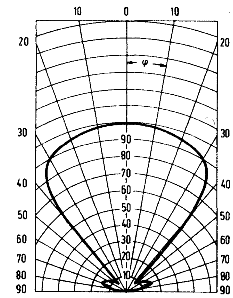
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



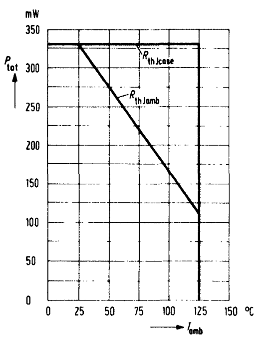
Photocurrent $I_P = f(E_v)$
$(V_{CE} = 5\ V)$



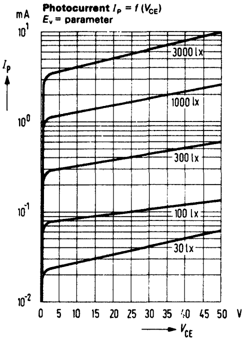
Directional characteristic $I_P = f(\varphi)$



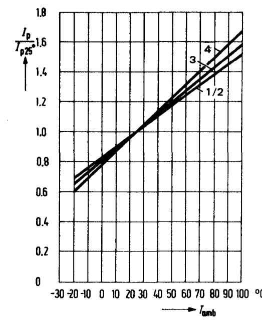
Power dissipation $P_{tot} = f(T_{amb})$



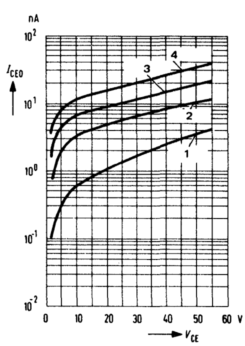
Photocurrent $I_P = f(V_{CE})$
E_v = parameter



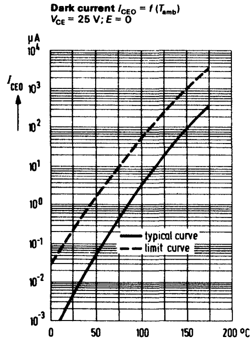
Photocurrent $\frac{I_P}{I_{P\ 25°}} = f(T_{amb})$



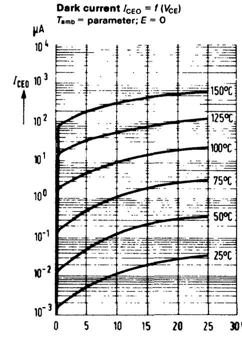
Dark current $I_{CEO} = f(V_{CE})$



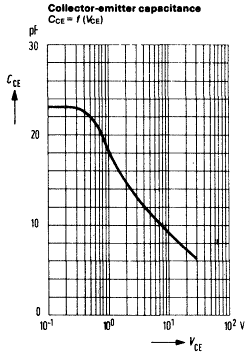
Dark current $I_{CEO} = f(T_{amb})$
$V_{CE} = 25\ V$; $E = 0$



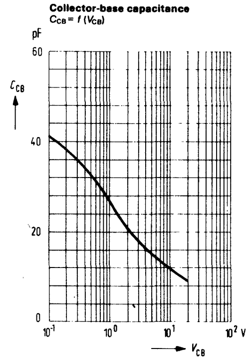
Dark current $I_{CEO} = f(V_{CE})$
T_{amb} = parameter; $E = 0$



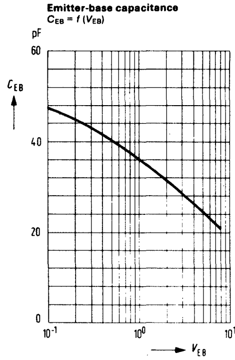
Collector-emitter capacitance
$C_{CE} = f(V_{CE})$



Collector-base capacitance
$C_{CB} = f(V_{CB})$

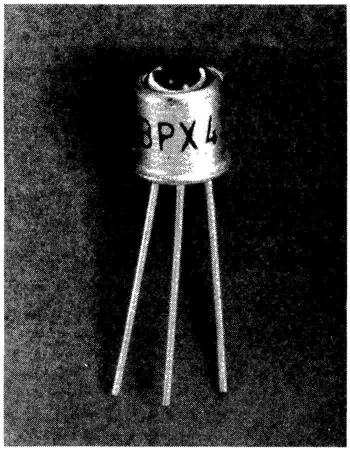


Emitter-base capacitance
$C_{EB} = f(V_{EB})$



litronix
A Siemens Company

BPX 43 SERIES
PHOTOTRANSISTOR



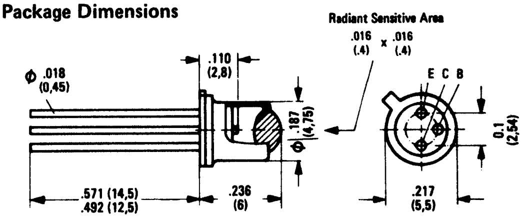
FEATURES

- **Silicon NPN Epitaxial Planar Phototransistor**
- **Premium Hi-Rel Device**
- **TO-18 Size Hermetic Package**
- **Rounded Glass Lens**
- **Narrow Acceptance Angle, 20°**
- **Very High Gain, Up to 70 mA**
- **Four Sensitivity Ranges**

DESCRIPTION

The BPX 43 is a silicon NPN epitaxial planar phototransistor in an 18 A 3 DIN 41876 (TO 18) case with lens-shaped window for front irradiation. The special transistor system in connection with the lens shaped window provides the transistor with a particularly high spectral sensitivity. It is therefore suitable for industrial applications at low illuminances. The collector terminal is electrically connected to the case.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Collector-emitter voltage	V_{CEO}	50	V
Emitter-base voltage	V_{EBO}	7	V
Collector current	I_C	100	mA
Junction temperature	T_j	175	°C
Storage temperature	T_{stor}	− 55 to + 125	°C
Power dissipation (T_{amb} = 25 °C)	P_{tot}	330	mW
Max. permissible soldering temperature ($t \leq$ 5 s)	T_s	260	°C
Thermal resistance			
Collector junction to air	$R_{thJ\,amb}$	≤ 450	K/W
Collector junction to case	$R_{thJ\,case}$	≤ 150	K/W

Characteristics (T_{amb} = 25°C)

Range of spectral sensitivity ($S = 0.1\,S_{max}$)	λ	450 to 1080	nm
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	870	nm
Collector base – photodiode			
(E_v = 1000 lx; V_{CE} = 5 V)	I_{PCB}	25	μA
(E_e = 0.5 mW/cm²; λ = 950 nm; V_{CE} = 5 V)	I_{PCB}	7.1	μA
Radiant sensitive area	A	0.65	mm²
Capacitance			
(V_{CE} = 0 V; f = 1 MHz; E = 0)	C_{CE}	23	pF
(V_{CB} = 0 V; f = 1 MHz; E = 0)	C_{CB}	41	pF
(V_{EB} = 0 V; f = 1 MHz; E = 0)	C_{EB}	47	pF
Acceptance Half Angle	φ	20	Degrees

Grouping is done at E_v = 1000 lx.

Group	BPX 43-1	BPX 43-2	BPX 43-3	BPX 43-4	
Photocurrent I_P (V_{CE} = 5 V; E_v = 1000 lx)	1.6 to 3.2	2.5 to 5.0	4.0 to 8.0	6.3 to 12.5	mA
Photocurrent approx. I_P (V_{CE} = 5 V; E_e = 20 mW/cm²)	9 to 18	14 to 28	22 to 45	35 to 70	mA
Rise time from 10% to 90% of the final value; Fall time from 90% to 10% of the initial value (I_C = 1 mA; V_{CE} = 5 V; R_L = 1 kΩ[1]) t_r; t_f	5	6	8	12	μs
Collector-emitter saturation voltage (I_C = 2 mA; I_B = 50 μA; E = 0) V_{CEsat}	175	175	160	140	mV
Power gain $\frac{I_{P(CE)}}{I_{P(CB)}}$[2] ($E_v$ = 1000 lx; V_{CE} = 5 V)	85	135	215	345	
Collector-emitter leakage current (V_{CEO} = 25 V; E = 0) I_{CEO}	5 (≤ 200)	8 (≤ 200)	12 (≤ 500)	20 (≤ 500)	nA

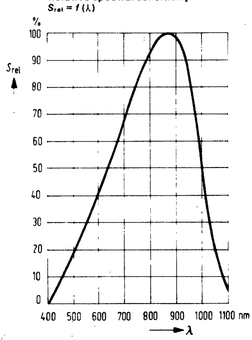
The illuminances refer to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K. (standard light A in accordance with DIN 5033 and IEC 306-1). Irradiance E_e measured with HP radiant flux meter 8334A with option 013.

[1] measured with LED λ = 950 nm

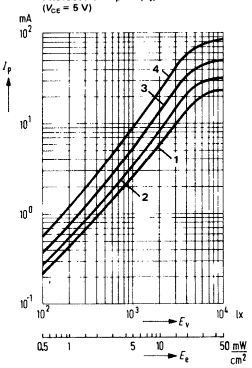
[2] $I_{P(CE)}$ = Photocurrent of the phototransistor
$I_{P(CB)}$ = Photocurrent of the collector-base photodiode

Specifications are subject to change without notice.

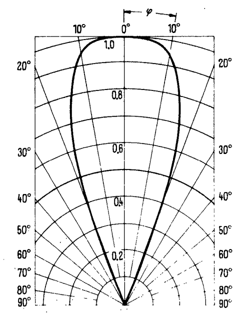
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



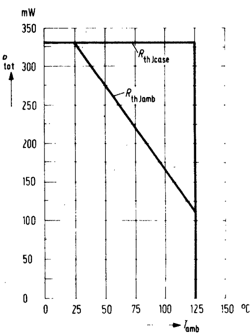
Photocurrent $I_P = f(E_v)$
(V_{CE} = 5 V)



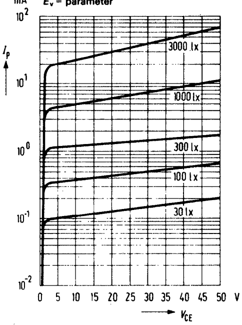
Directional characteristic $I_P = f(\varphi)$



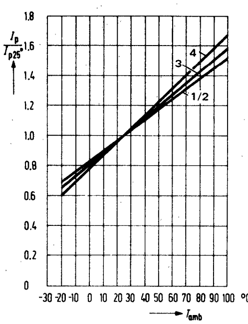
Power dissipation $P_{tot} = f(T_{amb})$



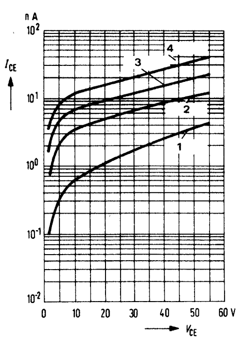
Photocurrent $I_P = f(V_{CE})$
E_v = parameter



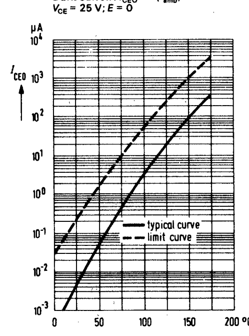
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



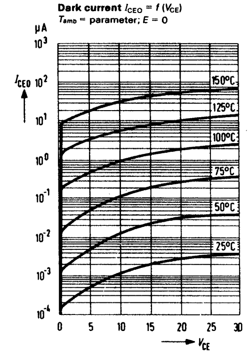
Dark current $I_{CEO} = f(V_{CE})$



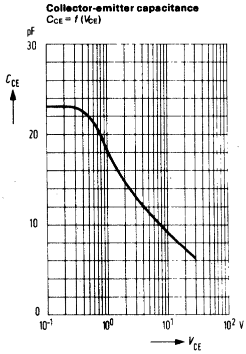
Dark current $I_{CEO} = f(T_{amb})$
V_{CE} = 25 V; E = 0



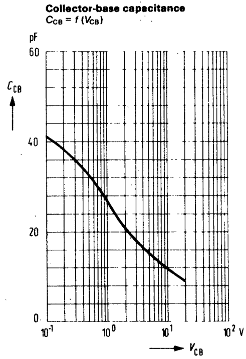
Dark current $I_{CEO} = f(V_{CE})$
T_{amb} = parameter; E = 0



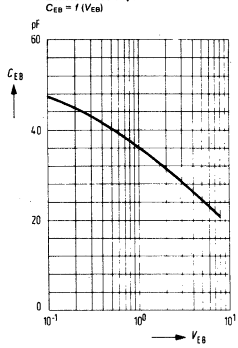
Collector-emitter capacitance
$C_{CE} = f(V_{CE})$



Collector-base capacitance
$C_{CB} = f(V_{CB})$

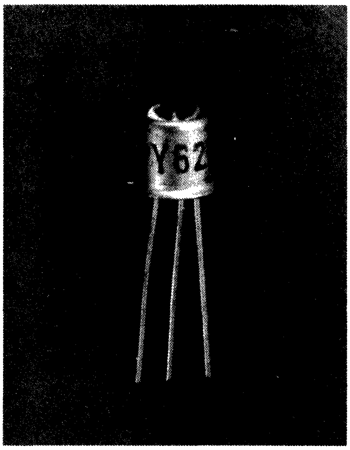


Emitter-base capacitance
$C_{EB} = f(V_{EB})$



litronix
A Siemens Company

BPY 62 SERIES
PHOTOTRANSISTOR



FEATURES

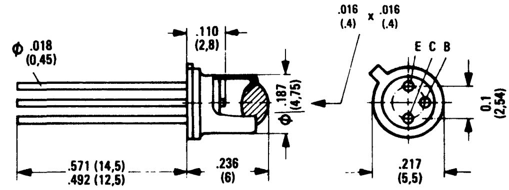
- Silicon NPN Epitaxial Planar Phototransistor
- Premium Hi-Rel Device
- TO-18 Size Hermetic Package
- Rounded Glass Lens
- Very Narrow Acceptance Angle, 8°
- High Gain, Up to 28 mA

DESCRIPTION

The BPY 62 is a silicon NPN epitaxial phototransistor in an 18 A 3 DIN 41876 (TO 18) case with a light window for front irradiation. The base connection is brought out and the emitter is marked by a small projection on the case bottom. The collector is electrically connected to the case.

The phototransistor BPY 62 is suitable for versatile applications in connection with filament lamp light mainly where particularly sensitive photoelectric detectors are required.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Collector-emitter voltage	V_{CEO}	32	V
Emitter-base voltage	V_{EBO}	5	V
Collector current	I_C	100	mA
Junction temperature	T_j	125	°C
Storage temperature	T_{stor}	−55 to +125	°C
Power dissipation (T_{amb} = 75°C)	P_{tot}	300	mW
Thermal resistance			
Collector junction to air	R_{thJamb}	500	K/W
Collector junction to case	$R_{thJcase}$	200	K/W

Characteristics (T_{amb} = 25°C)

Collector-emitter leakage current (V_{CE} = 25 V; E = 0)	I_{CEO}	5 (≤ 100)	nA
Collector-emitter saturation voltage (I_C = 1 mA; E_v = 1000 lx)	V_{CEsat}	0.3	V
Range of spectral sensitivity ($S > 0.1\,S_{max}$)	λ	430 to 1060	nm
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	800	nm
Collector-base – photodiode			
(E_v = 1000 lx; U_{CE} = 5 V)	I_{PCB}	17	µA
(E_e = 0.5 mW/cm²; λ = 950 nm; V_{CE} = 5 V)	I_{PCB}	3.5	µA
Rise time from 10% up to 90% of I_P Fall time from 90% up to 10% of I_P (R_L = 1 kΩ)[1]	$t_r; t_f$	5	µs
Radiant sensitive area	A	0.12	mm²
Capacitance			
(V_{CE} = 0 V; f = 1 MHz; E = 0)	C_{CE}	6	pF
(V_{CB} = 0 V; f = 1 MHz; E = 0)	C_{CB}	10	pF
(V_{EB} = 0 V; f = 1 MHz; E = 0)	C_{EB}	12	pF
Acceptance half angle	φ	8	degrees

Grouping is done at E_v = 1000 lx.

Group		BPY 62-1	BPY 62-2	BPY 62-3	
Photocurrent (V_{CE} = 5 V; E_v = 1000 lx;)[1]	I_P	1.25 to 2.5	2.0 to 4.0	3.2 to 6.3	mA
(V_{CE} = 5 V; E_e = 20 mW/cm²	approx. I_P	5.0 to 10.0	9.0 to 18.0	14.0 to 28.0	mA
Power gain (E_v = 1000 lx; V_{CE} = 5 V)	$\frac{I_{P(CE)}}{I_{P(CB)}}$[2]	355	560	900	

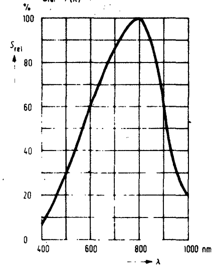
The illuminances refer to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K. (standard light A in accordance with DIN 5033 and IEC 306-1). Irradiance E_e measured with HP radiant flux meter 8334A with option 013.

[1]) measured with LED λ = 950 nm

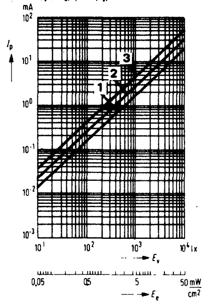
[2]) $I_{p\,(CE)}$ = Photocurrent of the phototransistor
$I_{p\,(CB)}$ = Photocurrent of the collector-base photodiode

Specifications are subject to change without notice.

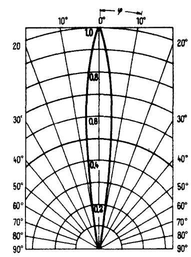
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



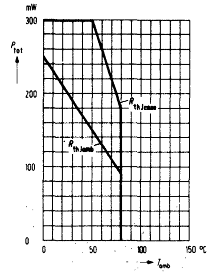
Photocurrent as a function of
E_v or E_e; $I_P = f(E_v)$



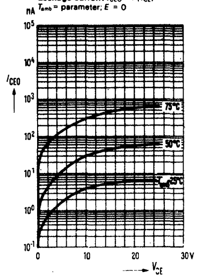
Directional characteristic $I_P = f(\varphi)$



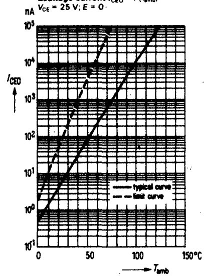
Power dissipation $P_{tot} = f(T_{amb})$
R_{th} = parameter



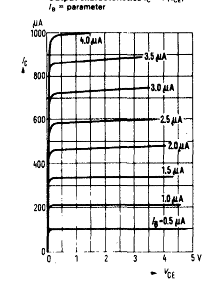
Leakage current $I_{CEO} = f(V_{CE})$
T_{amb} = parameter; $E = 0$



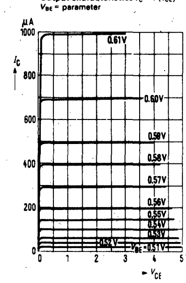
Leakage current $I_{CEO} = f(T_{amb})$
$V_{CE} = 25$ V; $E = 0$



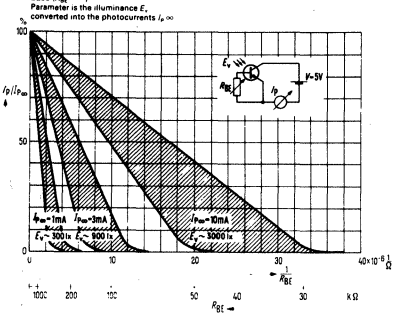
Output characteristics $I_C = f(V_{CE})$
I_B = parameter



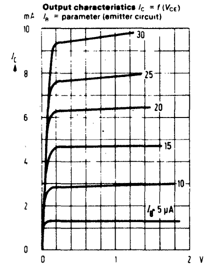
Output characteristics $I_C = f(V_{CE})$
V_{BE} = parameter



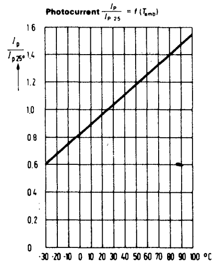
Photocurrent $I_P = f(R_{BE})$ **referred to photocurrent** $I_{P\infty}$ **during operation with open base** ($R_{BE} = \infty$)
Parameter is the illuminance E_v converted into the photocurrents $I_{P\infty}$



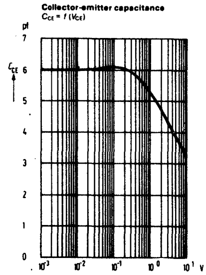
Output characteristics $I_C = f(V_{CE})$
I_B = parameter (emitter circuit)



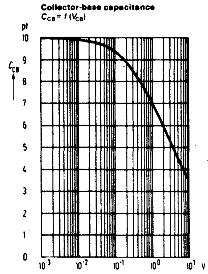
Photocurrent $\frac{I_P}{I_{P25}} = f(T_{amb})$



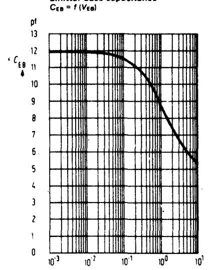
Collector-emitter capacitance
$C_{CE} = f(V_{CE})$



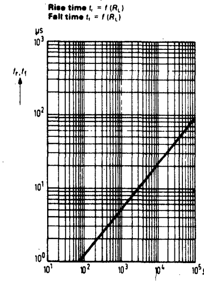
Collector-base capacitance
$C_{CB} = f(V_{CB})$



Emitter-base capacitance
$C_{EB} = f(V_{EB})$

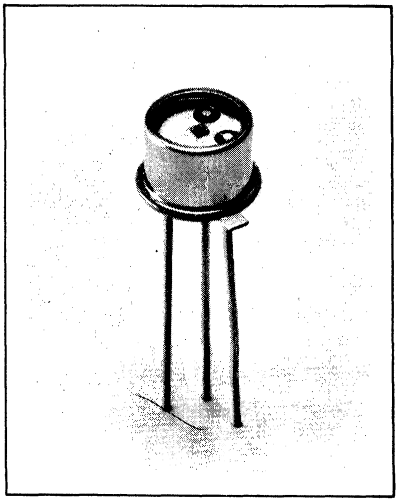


Rise time $t_r = f(R_L)$
Fall time $t_f = f(R_L)$



litronix
A Siemens Company

SFH 500
PHOTO TRANSISTOR



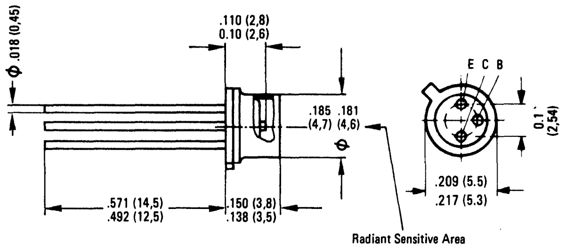
FEATURES

- TO-18 Package
- Flat Glass Lens
- Fast Speed, 2 MHz

DESCRIPTION

SFH 500 is a fast NPN silicon planar photodetector with a frequency to 2 MHz and a wide range of modulation from 10^2 to 10^4 LUX. The 1 X 1 mm chip is mounted in a TO-18 package with flat glass lens window. The photodetector is especially suitable for light wave conductor application through the small cap body (up to 2 Mbits/s). Also suitable for industrial electronics and in camera applications where a wider sensitivity range is necessary. The case is electrically connected to the collector.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Collector-emitter voltage	V_{CEO}	15	V
Emitter-base voltage	V_{EBO}	7	V
Collector current	I_C	20	mA
Junction temperature	T_j	100	°C
Storage temperature	T_s	-55...+100	°C
Max. soldering temperature ($t \leq 5$ s)	T_L	260	°C
Power dissipation ($T_{amb} = 25°C$)	P_{tot}	100	mW
Thermal resistance			
Collector junction to air	R_{thJamb}	600	K/W
Collector junction to case	$R_{thJcase}$	250	K/W

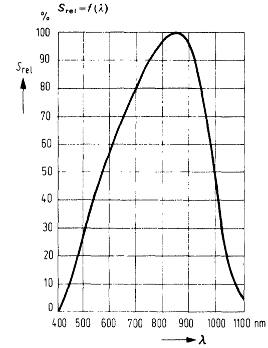
($T_{amb} = 25°C$)

Photocurrent			
($V_{CE} = 5$ V; $E_v = 1000$ lx)[1]	I_p	700 ($\geq$ 450)	µA
($V_{CE} = 5$ V; $E_e = 0.5$ mW/cm²)[2]	I_p	185	µA
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	825	nm
Quantum yield (Electrons per photon) ($\lambda = 850$ nm)	η	0.84	Electrons Photon
Spectral sensitivity ($\lambda = 850$ nm)	S_λ	0.56	A/W
Collector-emitter leakage current ($V_{CE} = 30$ V; $E = 0$)	I_{CEO}	1 ($\leq$ 10)	nA
Collector-emitter saturation voltage ($I_C = 500$ µA; $I_B = 25$ µA; $E = 0$)	V_{CEsat}	0.8 ($\leq$ 1.2)	V
Range of spectral sensitivity ($S = 0.1\ S_{max}$)	λ	420...1100	nm
Typ. spectral sensitivity of the collector base photodiode	S	1.17	nA/lx
Radiant sensitive area	A	0.14	mm²
Rise and fall time of the photocurrent			
Rise time to 90% of the final value			
Fall time to 10% of the initial value ($R_L = 1$ kΩ)[1]	t_r; t_f	0.25	µs
Capacitance			
($V_{CE} = 5$ V; $f = 1$ MHz; $E = 0$)	C_{CE}	2.7	pF
($V_{CB} = 5$ V; $f = 1$ MHz; $E = 0$)	C_{CB}	5.6	pF
Cut-off frequency ($R_L = 50$ Ω; $V = 12$ V; $I = 5$ mA)	f_g	2	MHz
Current gain ($V_{CE} = 5$ V; $I_C = 0.1$ mA)	B	600	–

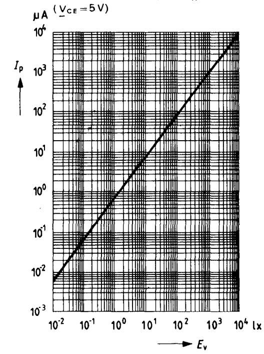
[1] measured with LED $\lambda = 950$ nm)
[2] $I_{p\,(CE)}$ = Photocurrent of the phototransistor
$I_{p\,(CB)}$ = Photocurrent of the collector-base photodiode

Specifications are subject to change without notice.

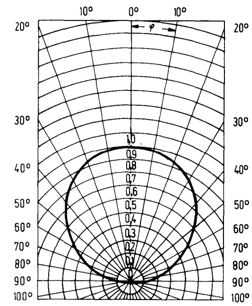
Relative spectral emission $S_{rel} = f(\lambda)$



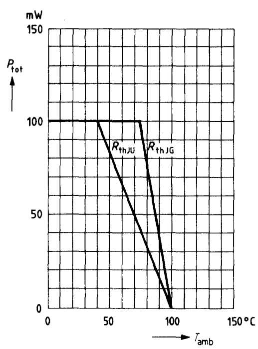
Photocurrent $I_P = f(E_v)$ ($V_{CE} = 5$ V)



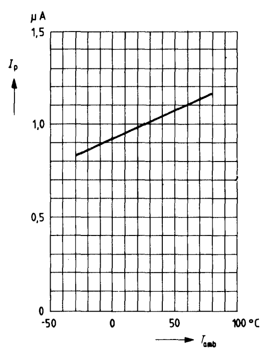
Directional characteristic $I_P = f(\varphi)$



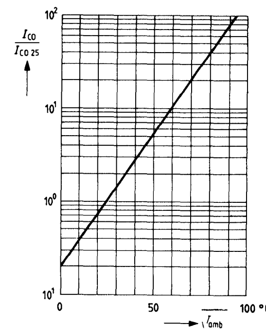
Power dissipation $P_{tot} = f(T_{amb})$



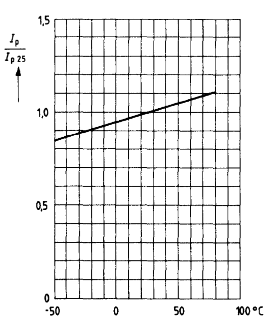
Photocurrent $I_P = f(T_{amb})$



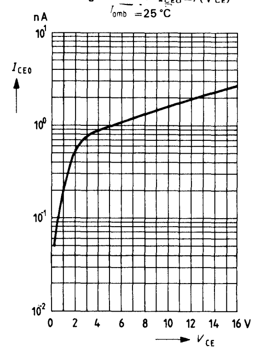
Leakage current $\frac{I_{CO}}{I_{CO25}} = f(T_{amb})$



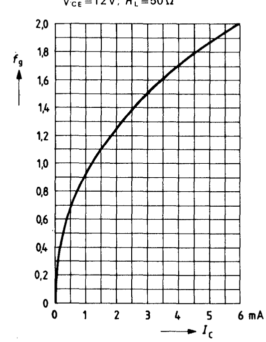
Photocurrent $\frac{I_P}{I_{P25}} = f(T_{amb})$



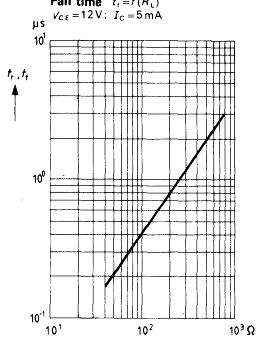
Leakage current $I_{CEO} = f(V_{CE})$
$T_{amb} = 25$ °C



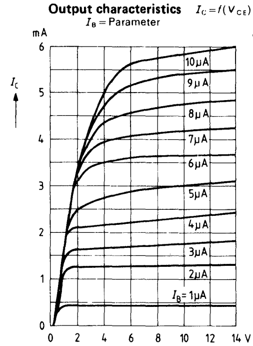
Cutoff frequency $f_g = f(I_C)$
$V_{CE} = 12$ V; $R_L = 50\ \Omega$



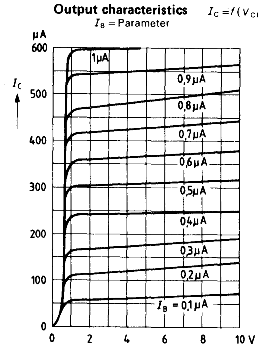
Rise time $t_r = f(R_L)$
Fall time $t_f = f(R_L)$
$V_{CE} = 12$ V; $I_C = 5$ mA



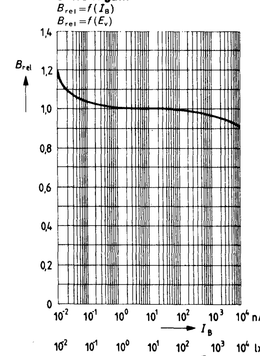
Output characteristics $I_C = f(V_{CE})$
I_B = Parameter



Output characteristics $I_C = f(V_{CE})$
I_B = Parameter

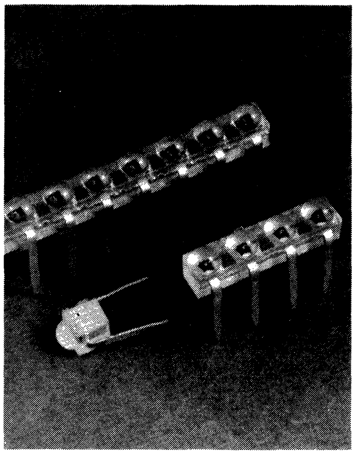


Current gain
$B_{rel} = f(I_B)$
$B_{rel} = f(E_v)$



litronix
A Siemens Company

BPX 81 SERIES
PHOTOTRANSISTOR SINGLE AND ARRAYS



FEATURES

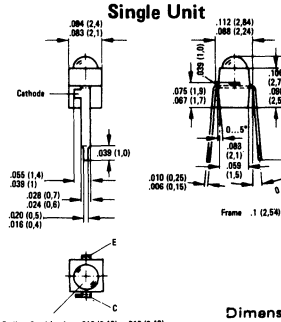
- **Silicon NPN Planar Phototransistor**
- **Low Cost**
- **Miniature Size**
- **Available As Single Unit, BPX 81 and Arrays—**
  Two Chip, BPX 82
  Three Chip, BPX 83
  Four Chip, BPX 84
  Five Chip, BPX 85
  Six Chip, BPX 86
  Seven Chip, BPX 87
  Eight Chip, BPX 88
  Nine Chip, BPX 89
  Ten Chip, BPX 80
- **Narrow Acceptance Angle, 18°**
- **High Gain, Up to 5 mA**

DESCRIPTION

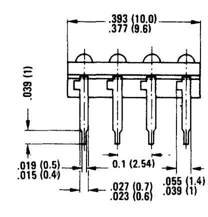
The types BPX 80 to BPX 89 are plastic encapsulated phototransistor arrays consisting of an arrangement of max. 10 silicon NPN epitaxial planar phototransistors. The individual photoelectric detectors are spaced apart according to the standard lead spacing of 2.54 mm (1/10"). A small angle of the lens-shaped light window avoids optical "cross modulation" from the adjacent system. The collector terminals are marked by small projections arranged at the sides of the solder pins. The phototransistor is suitable for versatile applications in conjunction with filament lamps and infrared light. The BPX 81 can be mounted on PC boards and is also provided for use as detector of the light emitting diode LD 261 (same type as BPX 81) in miniature light barriers.

Package Dimensions

Single Unit



Arrays



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Collector-emitter voltage	V_{CE}	32	V
Junction temperature	T_j	90	°C
Collector current	I_C	50	mA
Storage temperature	T_{stor}	– 40 to + 80	°C
Power dissipation	P_{tot}	100	mW
Soldering temperature in a 2 mm distance from the case bottom ($t \leq 3$ s)	T_s	230	°C
Thermal resistance			
Collector junction to air	R_{thJamb}	750	K/W
Collector junction to solder pin	R_{thJL}	650	K/W

Characteristics (T_{amb} = 25°C)

Collector-base – photodiode			
(E_v = 1000 lx; V_{CE} = 5 VO	I_{PCB}	7.1	μA
(E_e = 0.5 mW/cm²; λ = 950 nm; V_{CE} = 5 V)	I_{PCB}	1.5	μA
(V_{CE} = 5 V)			
Collector-emitter leakage current (V_{CE} = 25 V; E = 0)	I_{CEO}	25 (≤ 200)	nA
Collector emitter saturation voltage (I_C = 0.25 mA; E_v = 1000 lx)	V_{CEsat}	0.2	V
Range of spectral sensitivity ($S \geq 0.1\,S_{max}$)	λ	440 to 1070	nm
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Rise time from 10% up to 90% of the final value Fall time from 90% up to 10% of the initial value (R_L = 1 kΩ)[1])	t_r; t_f	5 (≤ 10)	μs
Radiant sensitive area	A	0.17	mm²
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0)	C_{CE}	6	pF
Acceptance half angle	φ	18	degree

Grouping is done at E_v = 1000 lx.

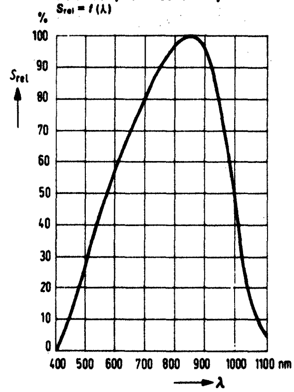
Group	BPX 81-1	BPX 81-2	BPX 81-3	BPX 81-4	BPX 82to 80	
Photocurrent I_P (V_{CE} = 5 V; E_v = 1000 lx)	0.63 to 1.25	1.0 to 2.0	1.6 to 3.2	2.5 to 5.0	.63 to 5.0	mA
Photocurrent ' approx. I_P (V_{CE} = 5 V; E_e = .5 mW/cm²)	.16 to .32	.25 to .50	.40 to .80	.63 to 1.25	.25 to 1.25 20 mW/cm²	mA
Colour code	brown	red	orange	yellow		

Upon request these groups are available.		E_v = 1000 lx	E_e = 0.5 mW/cm²
BPX 82A thru BPX 80A	I_P	1.25 to 2.5	.32 to .63
BPX 82B thru BPX 80B	I_P	1.6 to 3.2	.40 to .80
BPX 82C thru BPX 80C	I_P	2.0 to 4.0	.50 to 1.00

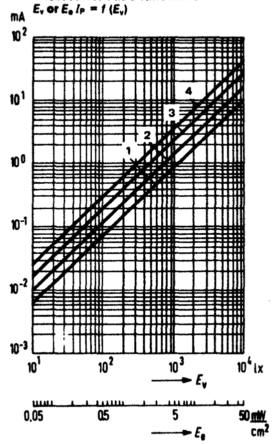
The illuminances refer to unfiltered radiation of a tungsten filament lamp at a colour temperature of 2856 K. (standard light A in accordance with DIN 5033 and IEC 306-1). Irradiance E_e measured with HP radiant flux meter 8334A with option 013.

Specifications are subject to change without notice.

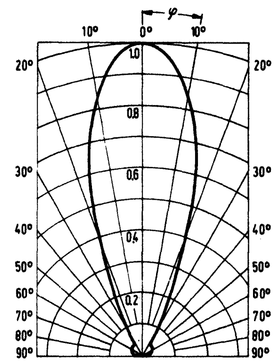
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



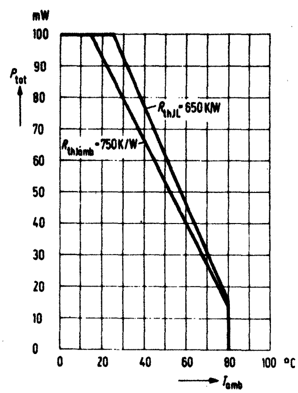
Photocurrent as a function of
E_v **or** E_e $I_P = f(E_v)$



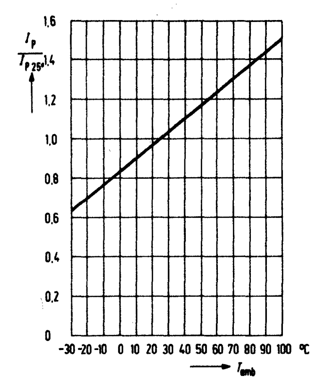
Directional characteristic $I_P = f(\varphi)$



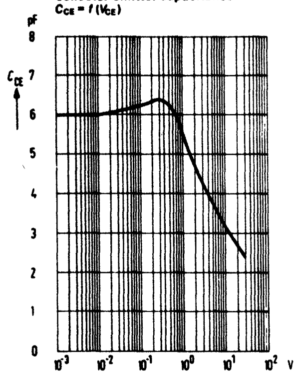
Power dissipation $P_{tot} = f(T_{amb})$



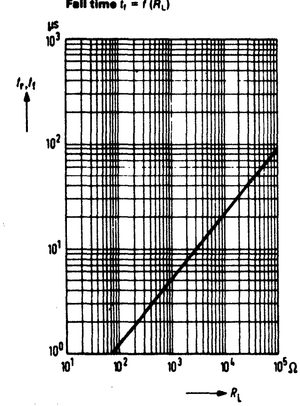
Photocurrent $\frac{I_P}{I_{P\,25°}} = f(T_{amb})$



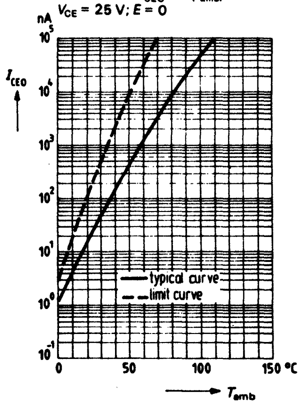
Collector-emitter capacitance
$C_{CE} = f(V_{CE})$



Rise time $t_r = f(R_L)$
Fall time $t_f = f(R_L)$

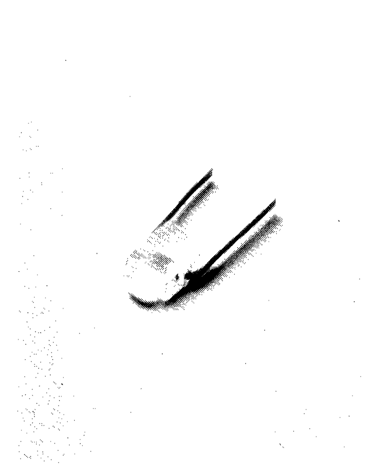


Dark current $I_{CEO} = f(T_{amb})$
V_{CE} = 25 V; E = 0



SFH 305 SERIES

PHOTOTRANSISTOR



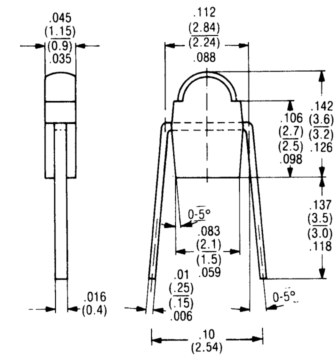
FEATURES

- **Miniature Plastic Package**
- **2.5 mm (1/10") Lead Spacing**
- **Detector for SFH 405 Infrared Emitter**
- **Designed for Maximum Spacing of 10 mm Between Emitter & Detector**

DESCRIPTION

The SFH 305 is a NPN silicon planar photo transistor in clear plastic encapsulation with solder PIN terminals. The connectors in the form of solder tabls are spaced 2.54 mm (1/10 inch). The photo transistors are grouped according to photo sensitivity. The SFH 305 is suitable for use as detector for the infrared diode SFH 405 to effect miniature light barriers with close spacing between sender and receiver up to 10 mm maximum. Also, the SFH 305 is suitable for application with glow-lamp light, i.e. daylight. The collector is marked with a colored dot.

Package Dimensions in Inches (mm)



Maximum Ratings

Collector-emitter voltage	V_{CEO}	32	V
Junction temperature	T_j	90	°C
Collector current	I_C	50	mA
Storage temperature	T_S	-40...+80	°C
Power dissipation (T_{amb} = 25°C)	P_{tot}	75	mW
Max. soldering temperature ($t \leq 5$ s)	T_L	230	°C
Thermal resistance			
Collector junction to air	R_{thJamb}	950	K/W
Collector junction to case	R_{thJL}	850	K/W

Characteristics (T_{amb} = 25°C)

Collector-emitter leakage current (V_{CE} = 30 V; E = 0)	I_{CEO}	3 ($\leq$ 20)	nA
Collector-emitter saturation voltage (I_C = 500 μA; I_B = 25 μA; E = 0)	V_{CEsat}	0.2	V
Range of spectral sensitivity (S = 0.1 S_{max})	λ	440...1070	nm
Wavelength of the max. sensitivity	$\lambda_{S\ max}$	850	nm
Radiant sensitive area			
Rise time to 90% of the final value Fall time to 10% of the initial value (R_L = 1 kΩ)[1]	t_r; t_f	5 ($\leq$ 10)	μs
Radiant sensitive area	A	0.17	mm²
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0)	C_{CE}	8	pF
Half Angle	φ	16	Degrees

[1] measured with LED λ = 950 nm

Group	I2)	SFH 305-2	SFH 305-3	IV2)	
Photocurrent I_P (V_{CE}=5 V; E_v=1000 lx)		1.0 to 2.0	1.6 to 3.2		mA
Photocurrent1) I_P (V_{CE}=5 V; E_e= 0.5 mW/cm²)		0.25 to 0.5	0.4 to 0.8		mA

The illuminances refer to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K. (Standard light A in accordance with DIN 5033 and IEC 306-1).

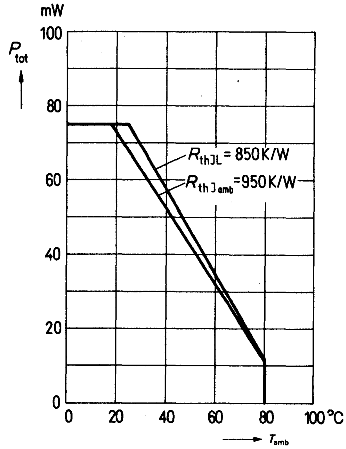
Irradiance E_e measured with HP radiant flux meter 8334A with option 013.

1) Measured with LED λ=950 nm.

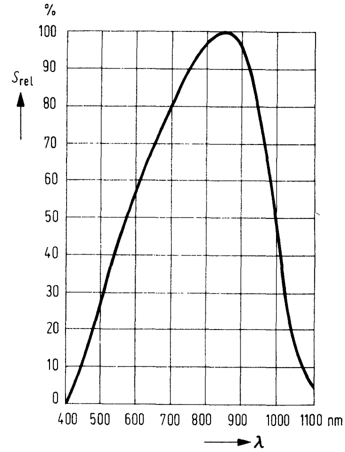
2) In preparation.

Specifications are subject to change without notice.

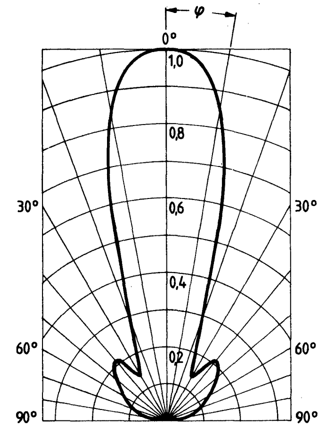
Power dissipation $P_{tot} = f(T_{amb})$



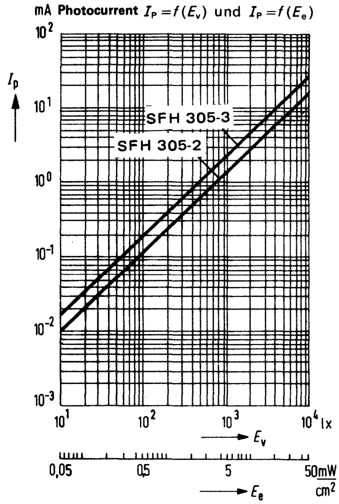
Relative spectral sensitivity $S_{rel} = f(\lambda)$



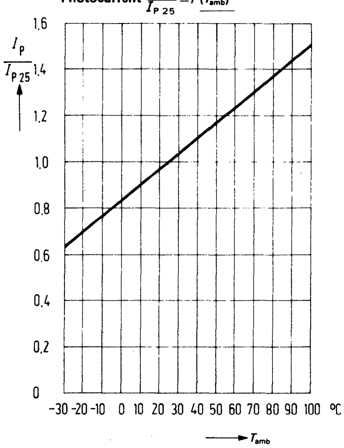
Directional characteristic $I_P = f(\varphi)$



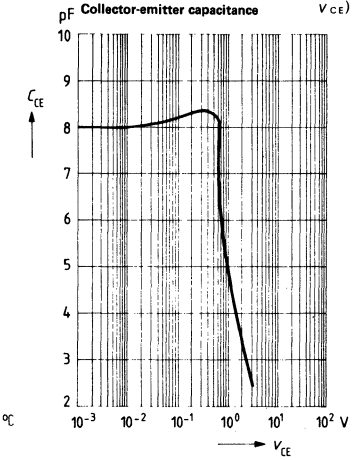
Photocurrent $I_P = f(E_v)$ und $I_P = f(E_e)$



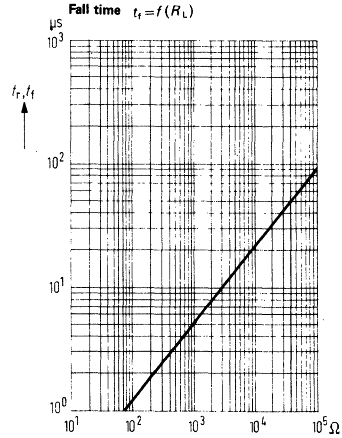
Photocurrent $\frac{I_P}{I_{P25}} = f(T_{amb})$



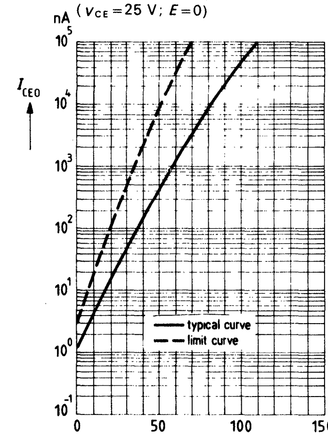
Collector-emitter capacitance (V_{CE})



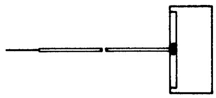
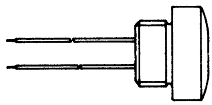
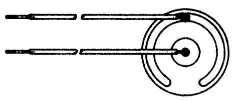
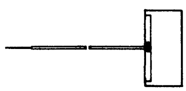
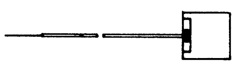
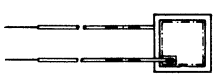
Rise time $t_r = f(R_L)$
Fall time $t_f = f(R_L)$



Leakage current $I_{CEO} = f(T_{amb})$
$(V_{CE} = 25\ V;\ E = 0)$

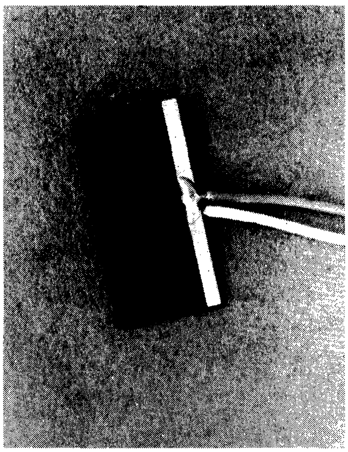


PHOTOVOLTAIC CELLS

Package Type	Package Outline	Part Number	Half Angle	Sensitivity s (nA/lx) Typical	Dark Current V_R=IV; E=0 I_R (μA)	Page
Chip with Leads		BPY47P	60°	1400	25	365
Chip with Leads Encapsulated		TP60	60°	1000	25	367
Chip with Leads		TP61	60°	1000	25	
Chip with Leads		BPY48P	60°	500	10	369
Chip with Leads		BPY64P	60°	250	4	371
Chip with Leads		BPX79	60°	135	0.3(<50)	373
Chip with Leads		BP100P	60°	25	3(<10)	375
		BPY11P-4		47-63	1(<10)	377
		BPY11P-5		56-75		
		BPY11P-6		>71		

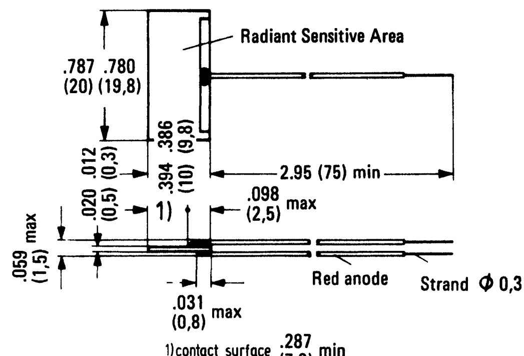
litronix
A Siemens Company

BPY 47P
PHOTOVOLTAIC CELL



Supercedes BPY 47

Package Dimensions in Inches (mm)



FEATURES

- **Silicon Photovoltaic Cell**
- **Medium Radiation Sensitive Surface**
- **Very High Sensitivity, .9 μA**

DESCRIPTION

The photovoltaic cell BPY 47P is suitable for general applications in control and drive circuits. It can be used as detector for filament lamps or daylight.

For mounting instructions see photovoltaic cell application note.

Maximum Ratings

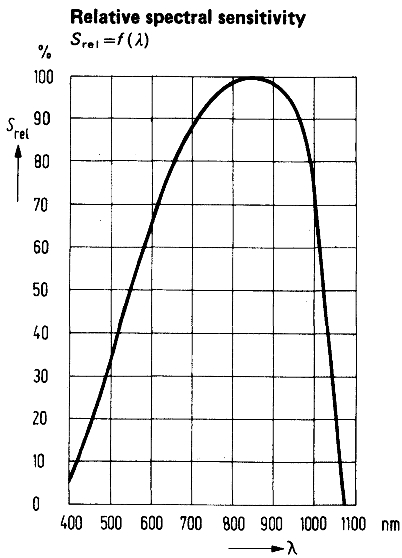
Reverse voltage	V_R	1	V
Temperature range	T_{amb}	−55 to +100	°C

Characteristics (T_{amb} = 25°C)

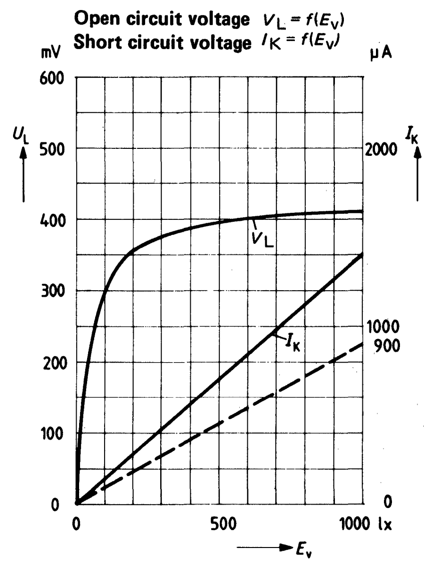
Spectral sensitivity [1] (Short circuit current I_K)	S	1.4 (≥ 0.9)	μA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.80	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S	0.55	A/W
Open circuit voltage (E_v = 10 000 lx) [1]	V_L	≧ 450	mV
Open circuit voltage (E_v = 1000 lx) [1]	V_L	410 (≧ 280)	mV
Open circuit voltage (E_v = 100 lx) [1]	V_L	300 (≧ 150)	mV
Short circuit current (E_v = 10 000 lx) [1]	I_K	13	mA
Radiant sensitive area	A	1.8	cm²
Temperature coefficient of V_L (see diagram)	TC	− 2.6	mV/K
Temperature coefficient of I_K (see diagram)	TC	0.2	%/K
Capacitance (V_R = 0 V; E = 0)	C_0	16	nF
Dark current (V_R = 1 V; E = 0)	I_R	25	μA
Dark current (V_R = 1 V; T_{amb} = 50°C; E = 0)	I_R	70	μA

1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

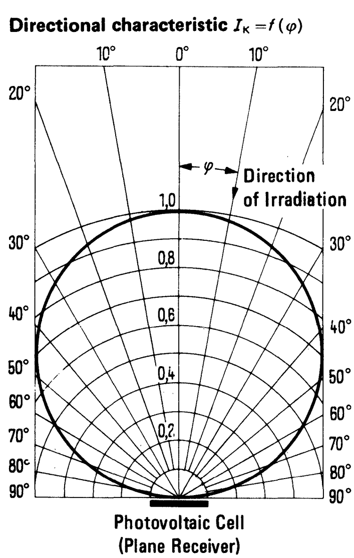
Specifications are subject to change without notice.



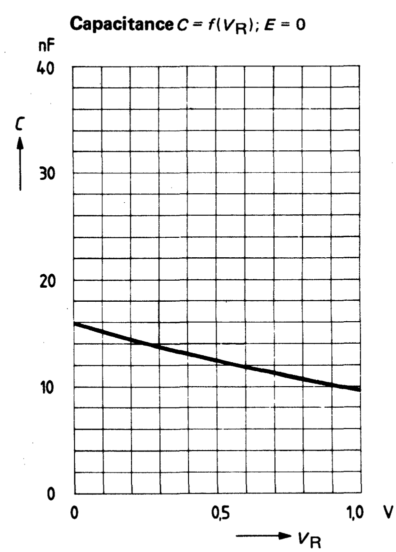
Relative spectral sensitivity
$S_{rel} = f(\lambda)$
%
100
90
80
70
60
50
40
30
20
10
0
S_{rel}
400 500 600 700 800 900 1000 1100 nm
λ



Open circuit voltage $V_L = f(E_V)$
Short circuit voltage $I_K = f(E_V)$
mV
600
500
400
300
200
100
0
U_L
μA
2000
1000
900
0
I_K
V_L
I_K
0 500 1000 lx
E_v



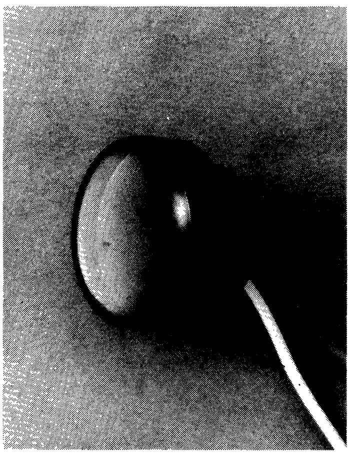
Directional characteristic $I_K = f(\varphi)$
10° 0° 10°
20° 20°
φ
Direction
of Irradiation
1,0
30° 30°
0,8
40° 40°
0,6
50° 50°
0,4
60° 60°
70° 70°
0,2
80° 80°
90° 90°
Photovoltaic Cell
(Plane Receiver)



Capacitance $C = f(V_R)$; $E = 0$
nF
40
30
20
10
0
C
0 0,5 1,0 V
V_R

litronix
A Siemens Company

TP 60, TP 61
SILICON PHOTOVOLTAIC CELLS



FEATURES

- **Silicon Photovoltaic Cell**
- **Stud Package, TP 60**
- **Wide Temperature Range, -55° to +100°, TP 61**
- **Very High Sensitivity, .7 μA/lx Min**

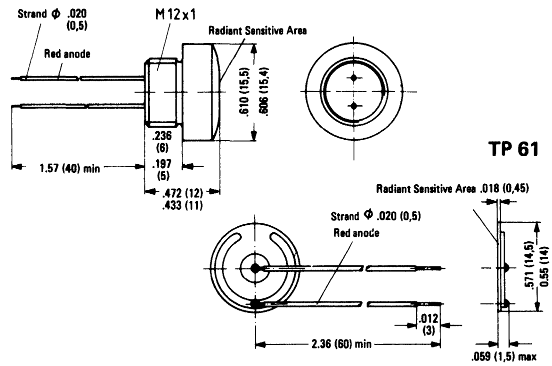
DESCRIPTION

The silicon photovoltaic cells TP 60 and TP 61 are suitable for use in drive and control circuits. Featuring the same electrical characteristics, they differ only in design. The anode (positive pole of the cell) is marked by a red lead.

For mounting instructions see photovoltaic cell application note.

Package Dimensions

TP 60



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

		TP 60	TP 61	
Operating and storage temperature range	T_{amb}	– 25 to + 75	– 55 to + 100	°C
Reverse voltage [1]	V_R	1.0	1.0	V

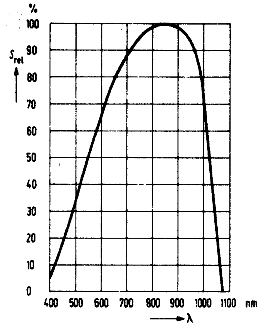
Characteristics (T_{amb} = 25°C)

Spectral sensitivity [1] (Short circuit current I_K)	S	1 (≥ 0.7)	μA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.80	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S	0.55	A/W
Open circuit voltage (E_v = 10 000 lx) [1]	V_L	≥ 440	mV
(E_v = 1000 lx) [1]	V_L	410 (≥ 270)	mV
(E_v = 100 lx) [1]	V_L	300 (≥ 140)	mV
Short circuit current (E_v = 10 000 lx) [1]	I_K	≥ 7	mA
(E_v = 1000 lx) [1]	I_K	≥ 0.7	mA
Infrared response limit	λ_g	1.100	nm
Radiant sensitive area	A	1.5	cm2
Tolerance of the radiant sensitive area	A tol	± 0.1	cm2
Temperature coefficient of V_L (see diagram)	TC	– 2.6	mV/K
Temperature coefficient of I_K (see diagram)	TC	0.12	%/K
Capacitance (V_R = 0 V; E = 0)	C_0	16	nF
Dark current (V_R = 1 V; E = 0)	I_R	25	μA
Dark current (V_R = 1 V; T_{amb} = 50°C; E = 0)	I_R	65	μA

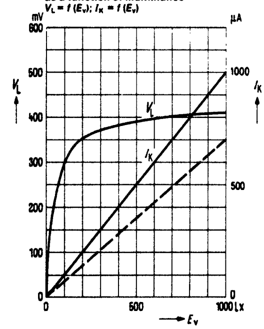
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

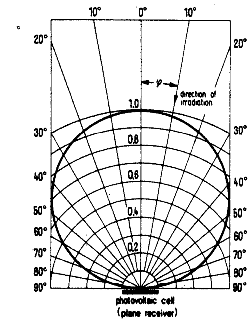
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



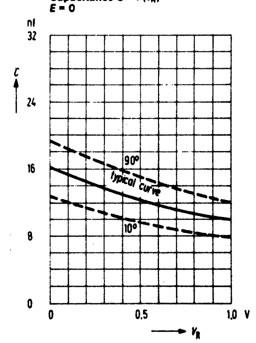
Open circuit voltage and short circuit current as a function of illuminance
$V_L = f(E_v)$; $I_K = f(E_v)$



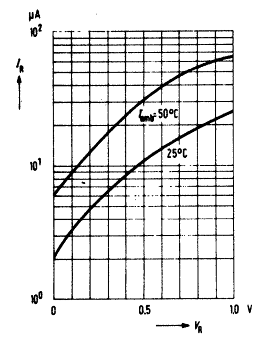
Directional characteristic $I_K = f(\varphi)$



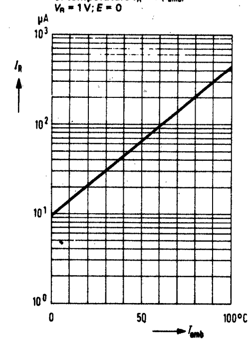
Capacitance $C = f(V_R)$
$E = 0$



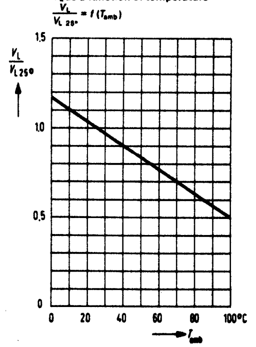
Dark current $I_R = f(V_R)$
T_{amb} = parameter; $E = 0$



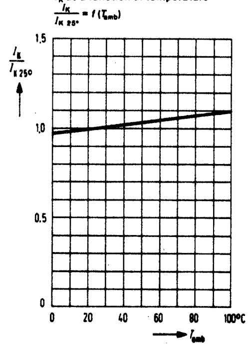
Dark current as a function of temperature $I_R = f(T_{amb})$
$V_R = 1\,V$; $E = 0$



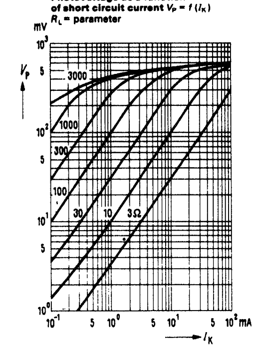
V_L **as a function of temperature**
$\frac{V_L}{V_{L\,25°}} = f(T_{amb})$



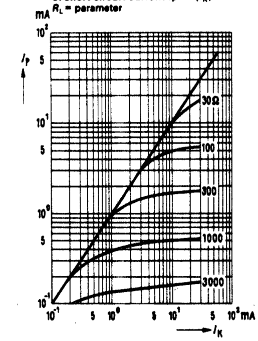
I_K **as a function of temperature**
$\frac{I_K}{I_{K\,25°}} = f(T_{amb})$



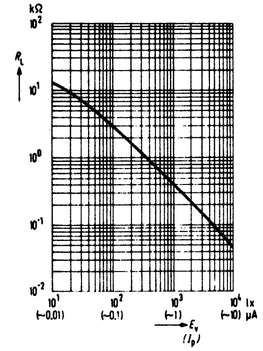
Photovoltage as a function of short circuit current $V_P = f(I_K)$
R_L = parameter



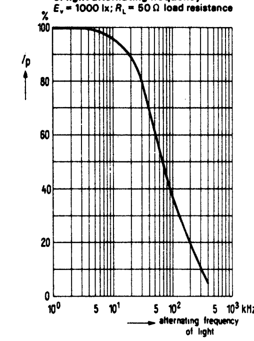
Photocurrent as a function of short circuit current $I_P = f(I_K)$
R_L = parameter



Optimum matching resistance
$R_L = f(E_v)$; $R_L = f(I_K)$

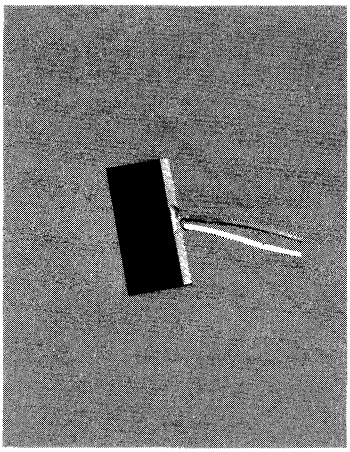


Average photocurrent as a function of light alternating frequency
$E_v = 1000$ lx; $R_L = 50\,\Omega$ load resistance



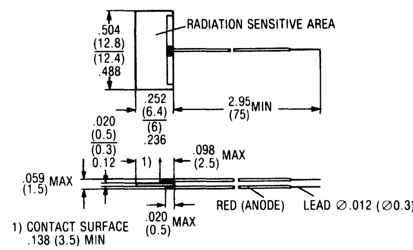
litronix
A Siemens Company

BPY 48P
PHOTOVOLTAIC CELL



Supersedes BPY 48

Package Dimensions in Inches (mm)



FEATURES

- Silicon Photovoltaic Cell
- Large Radiation Sensitive Surface
- High Sensitivity, .3 μA Min

DESCRIPTION

The photovoltaic cell BPY 48P is suitable for general applications in control and drive circuits. It can be used as detector for filament lamps or daylight.

For mounting instructions see photovoltaic cell application note.

Maximum Ratings

Reverse voltage	V_R	1	V
Temperature range	T_{amb}	− 55 to + 100	°C

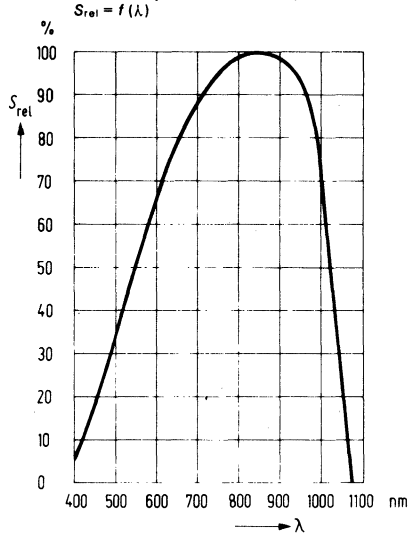
Characteristics (T_{amb} = 25°C)

Spectral sensitivity 1) (Short circuit current I_K)	S	0.5 (≥ 0.35)	µA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.80	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S	0.55	A/W
Open circuit voltage (E_v = 10 000 lx) 1)	V_L	≥ 450	mV
(E_v = 1000 lx) 1)	V_L	410 (≥ 280)	mV
(E_v = 100 lx) 1)	V_L	300 (≥ 150)	mV
Short circuit current (E_v = 10 000 lx) 1)	I_K	4.3	mA
Radiant sensitive area	A	0.67	cm²
Temperature coefficient of V_L (see diagram)	TC	−2.6	mV/K
Temperature coefficient of I_K (see diagram)	TC	0.2	%/K
Capacitance (V_R = 0 V; E = 0)	C_0	6	nF
Dark current (V_R = 1 V; E = 0)	I_R	10	µA
Dark current (V_R = 1 V; T_{amb} = 50°C; E = 0)	I_R	25	µA

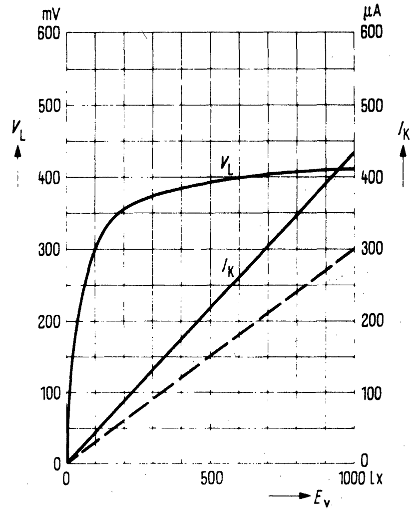
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a color temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

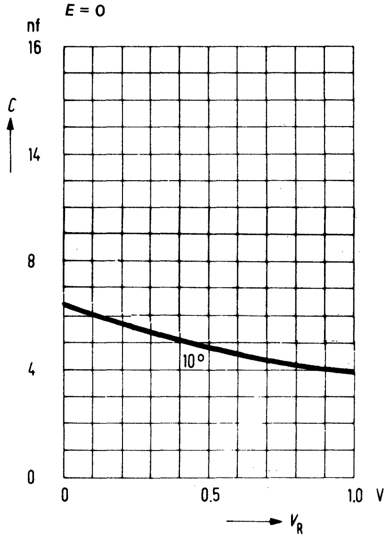
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



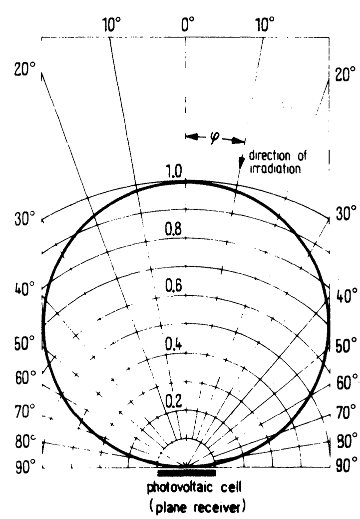
Open circuit voltage $V_L = f(E_v)$
Short circuit current $I_K = f(E_v)$



Capacitance $C = f(V_R)$
$E = 0$

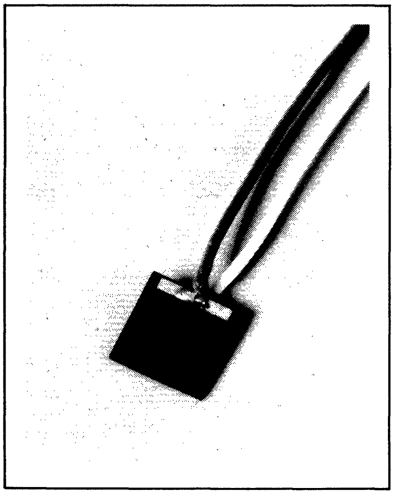


Directional characteristic $I_K = f(\varphi)$



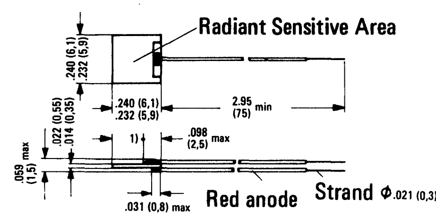
litronix
A Siemens Company

BPY 64P
PHOTOVOLTAIC CELL



Supercedes BPY 64

Package Dimensions in Inches (mm)



1) CONTACT SURFACE
.138 (3.5) MIN.

Maximum Ratings

Reverse voltage 1)	V_R	1	V
Temperature range	T_{amb}	− 55 to + 100	°C

FEATURES

- **Silicon Photovoltaic Cell**
- **Medium Size Radiation Sensitive Surface**
- **High Sensitivity, .16 μA Min**

DESCRIPTION

The BPY 64P is suitable for versatile applications in control and drive circuits. It can be used, like all silicon photovoltaic cells, as detector for light of filament lamps or daylight.

For mounting instructions see photovoltaic cell application note.

Characteristics (T_{amb} = 25°C)

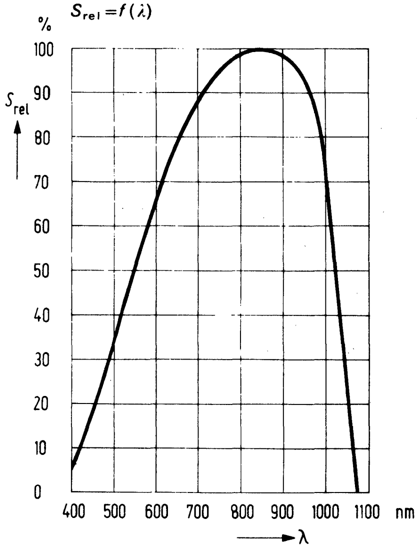
Spectral sensitivity 1) (Short circuit current I_K)	S	0.25 (⩾ 0.18)	μA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.80	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S	0.55	A/W
Open circuit voltage (E_v = 10 000 lx) 1)	V_L	≥ 450	mV
(E_v = 1000 lx) 1)	V_L	410 (≥ 280)	mV
(E_v = 100 lx) 1)	V_L	300 (≥ 150)	mV
Radiant sensitive area	A	approx. 0.32	cm²
Temperature coefficient of V_L (see diagram)	TC	− 2.6	mV/K
Temperature coefficient of I_K (see diagram)	TC	0.2	%/K
Capacitance (V_R = 0 V; E = 0)	C_0	3	nF
Dark current (V_R = 1 V; E = 0)	I_R	4	μA
Dark current (V_R = 1 V; T_{amb} = 50°C; E = 0)	I_R	10	μA

1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a colour temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

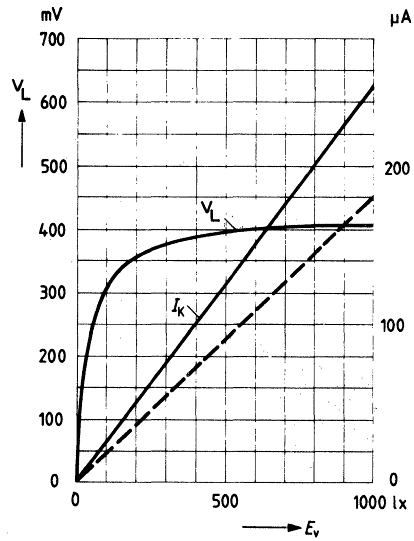
Specifications are subject to change without notice.

Relative spectral sensitivity

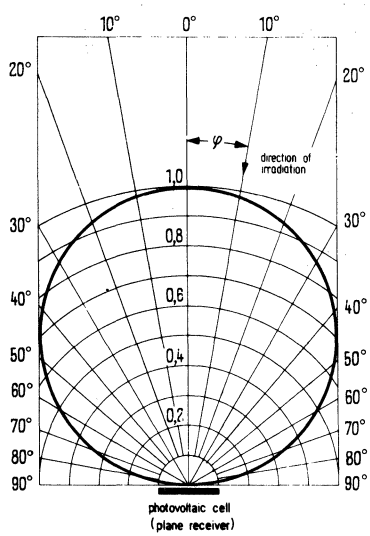
$S_{rel} = f(\lambda)$



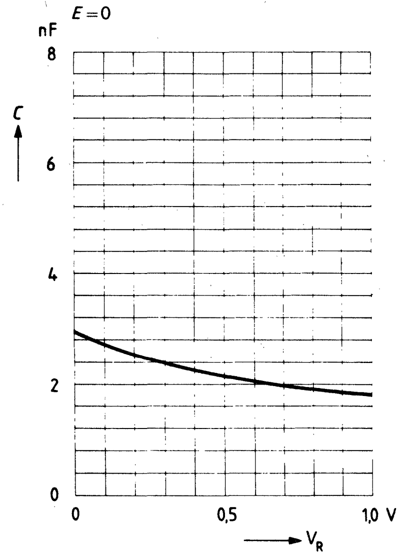
Open circuit voltage $V_L = f(E_v)$
Short circuit voltage $I_K = f(E_v)$



Directional characteristic $I_K = f(\varphi)$

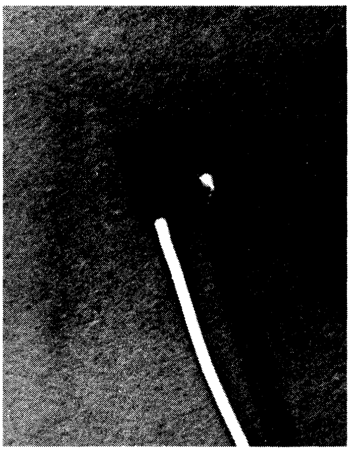


Capacitance $C = f(V_R)$;
$E = 0$



litronix
A Siemens Company

BPX 79
PHOTOVOLTAIC CELL



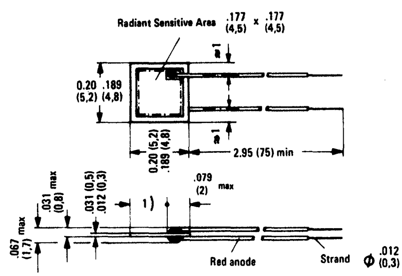
FEATURES

- Silicon Planar Photovoltaic Cell
- Medium Size Radiation Sensitive Surface
- High Sensitivity, 1 μA/lx

DESCRIPTION

The BPX 79 is a silicon planar photovoltaic cell. The increased sensitivity with shorter wavelengths makes it particularly suitable for applications with light sources having a high share of value. The planar method ensures a low reverse current level and low noise. The photovoltaic cell is nitride-passivated and has an anti-reflection coating for a wavelength of λ = 450 nm.

Package Dimensions



Dimensions inside parenthesis are in mm
Dimensions outside parenthesis are in inches

Maximum Ratings

Reverse voltage	V_R	1	V
Storage temperature and operating temperature	T_{amb}	− 55 to + 100	°C

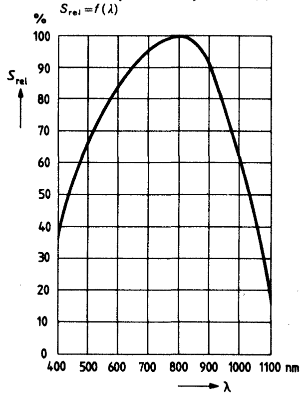
Characteristics (T_{amb} = 25°C)

Spectral sensitivity [1]	S	135 (≥ 100)	nA/lx
Open circuit voltage (E_v = 100 lx) [1]	V_L	320 (≥ 220)	mV
Open circuit voltage (E_v = 1000 lx) [1]	V_L	410 (≥ 310)	mV
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	800	nm
Quantum yield (Electrons per photon) (λ = 800 nm)	η	0.73	Electrons/Photon
Spectral sensitivity (λ = 800 nm)	S	0.47	A/W
Rise and fall time of the photocurrent from 10% to 90% and from 90% to 10% of the final value			
(R_L = 1 kΩ; V_R = 1 V; λ = 950 nm)	t_r; t_f	6	µs
(R_L = 1kΩ; V_R = 0 V; λ = 950 nm)	t_r; t_f	10	µs
Capacitances			
(V_R = 0 V)	C_0	2500	pF
(V_R = 1 V)	C_1	1800	pF
Radiant sensitive area	A	20	mm²
Dark current (V_R = 1 V; E = 0)	I_R	0.3 (≤ 50)	µA
Temperature coefficient of V_L	TC	− 2.6	mV/K
Temperature coefficient of I_K	TC	0.2	%/K

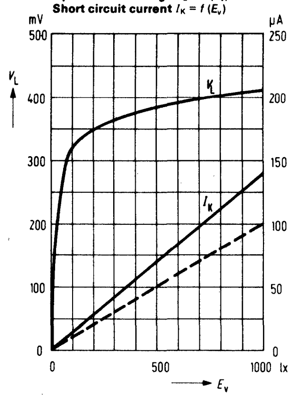
1) The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a colour temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications are subject to change without notice.

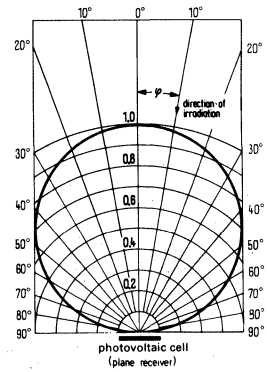
Relative spektrale Empfindlichkeit
$S_{rel} = f(\lambda)$



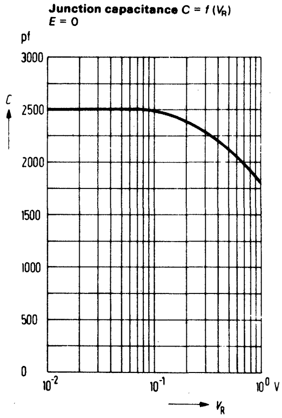
Open circuit voltage $V_L = f(E_v)$
Short circuit current $I_K = f(E_v)$



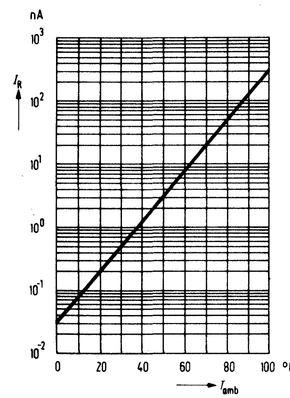
Directional characteristic $I_K = f(\varphi)$



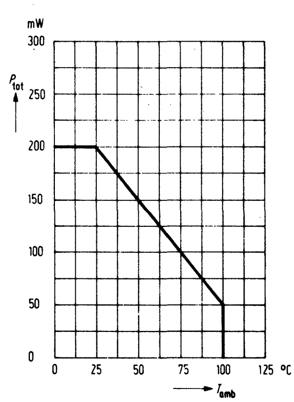
Junction capacitance $C = f(V_R)$
$E = 0$



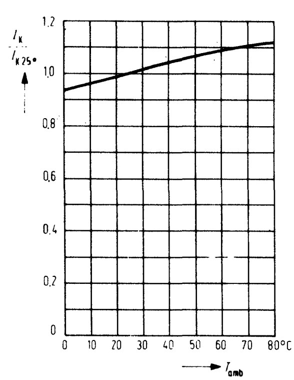
Dark current $I_R = f(T_{amb})$



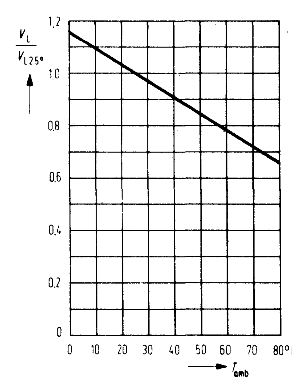
Power dissipation $P_{tot} = f(T_{amb})$



Short circuit current $\frac{I_K}{I_{K\,25°}} = f(T_{amb})$



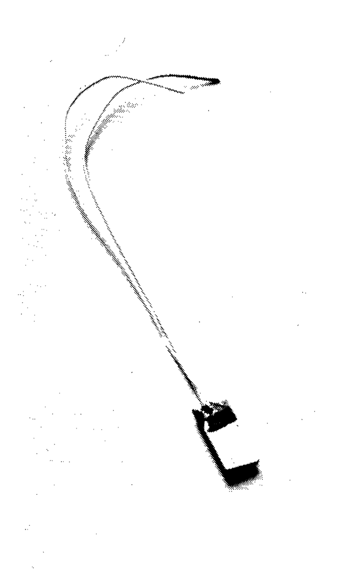
Open circuit voltage $\frac{V_L}{V_{L\,25°}} = f(T_{amb})$



litronix
A Siemens Company

BP-100P

SILICON PHOTOVOLTAIC CELL



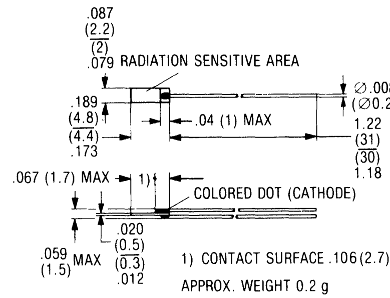
FEATURES

- **Miniature Size, Uncased**
- **May Be Tightly Stacked for Efficient Scanning**

DESCRIPTION

The silicon planar photovoltaic cell BP-100P is suitable for use in control and drive circuits. Its rapid response, small dimensions and high permissible operating temperature make versatile application feasible. Since this cell is not encased, the assembly of highly efficient scanning systems could be realized. For this purpose the cells may be cemented closely together on suitable mounting assemblies. The photo-insensitive side of the element is marked by a yellow dot.

Package Dimensions in Inches (mm)



1) CONTACT SURFACE .106(2.7) MIN

APPROX. WEIGHT 0.2 g

Maximum Ratings

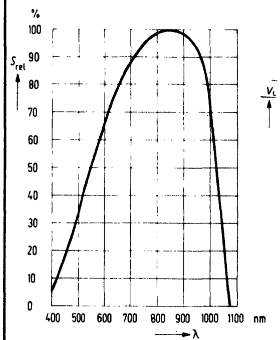
Ambient Temperature (T_{amb})	−55 to +100 °C
Reverse Voltage (V_R)	1 V

Characteristics (T_{amb} = 25 °C)

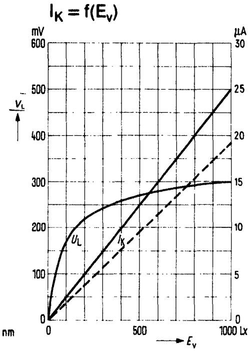
Photo Spectral Sensitivity (S) (Short Circuit Current)	25 (≥19) nA/lx
Wavelength of the Max. Sensitivity ($\lambda_{S\ max}$)	850 nm
Quantum Yield (η), i = 850 nm (Electrons per Photon)	.080
Spectral Photosensitivity ($S\lambda$), λ = 850 nm	0.55 A/W
Open Circuit Current (V_L)	
E_v = 100 lx	170 (≥120) mV
E_v = 1000 lx	300 (≥200) mV
Short Circuit Current (I_K)	
E_v = 1000 lx	25 μA
Rise Time for 60% of I_K (t_r)	4 μs
Temperature Coefficient (T_K) For Open Circuit Current	−2.6 mV/K
Temperature Coefficient (T_K) For Short Circuit Current	0.12 %/K
Capacitance (C_O), V_R = 0 V; E = 0	1000 pF
Radiant Sensitive Area (A)	7 mm^2
Dark Current (I_R)	
V_R = 1 V; E = 0	3 (≤10) μA
V_R = 1 V; T_{amb} = 50 °C; E = 0)	7 μA

Specifications subject to change without notice.

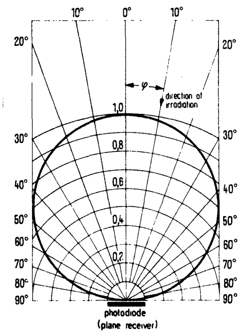
RELATIVE SPECTRAL SENSITIVITY
$S_{rel} = f(\lambda)$



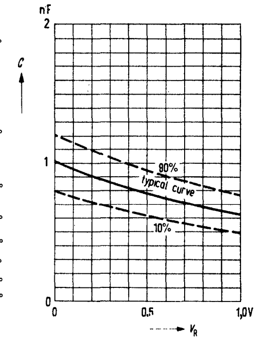
OPEN CIRCUIT VOLTAGE
$V_L = f(E_v)$
SHORT CIRCUIT CURRENT
$I_K = f(E_v)$



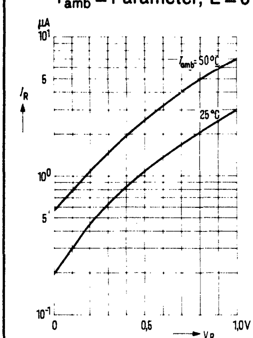
DIRECTIONAL CHARACTERISTIC
$I_K = f(\varphi)$



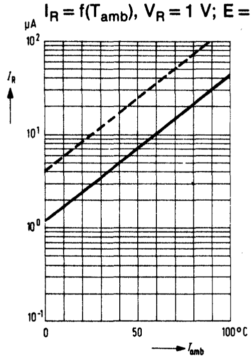
JUNCTION CAPACITANCE
$C = f(V_R)$; $E = 0$



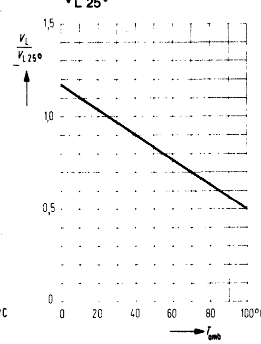
DARK CURRENT
$I_R = f(V_R)$
T_{amb} = Parameter; $E = 0$



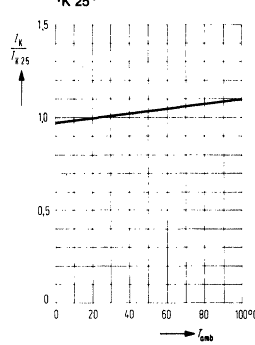
DARK CURRENT AS A FUNCTION OF TEMPERATURE
$I_R = f(T_{amb})$, $V_R = 1$ V; $E = 0$



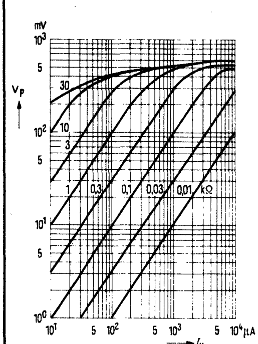
V_L AS A FUNCTION OF TEMPERATURE
$\frac{V_L}{V_{L\,25°}} = f(T_{amb})$



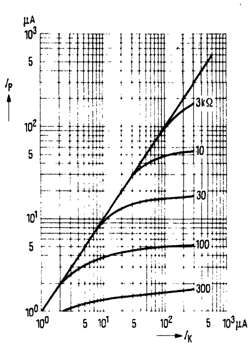
I_K AS A FUNCTION OF TEMPERATURE
$\frac{I_K}{I_{K\,25°}} = f(T_{amb})$



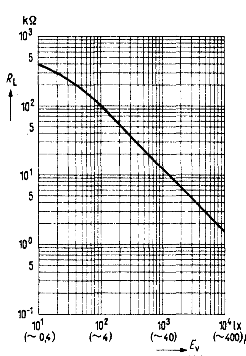
PHOTOVOLTAGE
$V_P = f(I_K)$;
R_L = Parameter



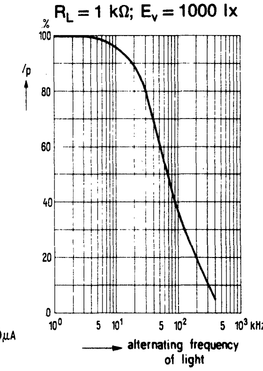
PHOTOCURRENT
$I_P = f(I_K)$
R_L = Parameter



OPTIMUM MATCHING RESISTANCE
$R_L = f(E_v)$; $R_L = f(I_K)$

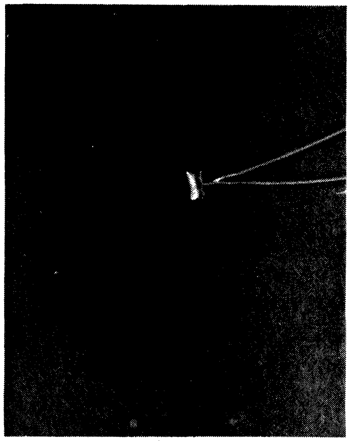


AVERAGE PHOTOCURRENT AS A FUNCTION OF LIGHT ALTERNATING FREQUENCY
$R_L = 1$ kΩ; $E_v = 1000$ lx



BPY 11 P SERIES

SILICON PHOTOVOLTAIC CELL



FEATURES

- **Small Package**
- **May Be Stacked Tightly Together**
- **Choice of 3 Sensitivity Groups**
- **Fast Response Time**

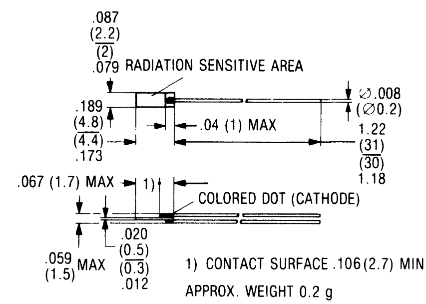
DESCRIPTION

BPY 11 P is a photovoltaic cell, fabricated with planar technology.

The silicon protovoltaic cell is suitable for use in control and drive circuits, for light pulse scanning, and for quantitative light measurements. Its rapid response, small dimensions, and high permissible operating temperature make universal application feasible.

Since this cell is not encased, the assembly of high efficient scanning systems can be realized. For this purpose the cells may be cemented closely together on suitable mounting assemblies. The photo-insensitive side of the element is marked by colored dots.

Package Dimensions in Inches (mm)



1) CONTACT SURFACE .106(2.7) MIN

APPROX. WEIGHT 0.2 g

Maximum Ratings

Ambient temperature	T_{amb}	−55 to 100	°C
Reverse voltage (positive pole to cathode)	V_R	1	V

Characteristics (T_{amb} = 25°C)

Spectral sensitivity[1]	S	50 (≧28)	nA/lx
Wavelength of the max. sensitivity	$\lambda_{S\,max}$	850	nm
Quantum yield (Electrons per photon) (λ = 850 nm)	η	0.80	Electrons / Photon
Spectral sensitivity (λ = 850 nm)	S	0.55	A/W
Open circuit voltage (E_v = 100 lx)[1]	V_L	310 (≧180)	mV
Open circuit voltage (E_v = 1000 lx)[1]	V_L	410 (≧260)	mV
Short circuit current (E_v = 1000 lx)[1]	I_K	50	µA
Rise time (for 60% of I_K)	t_r	4	µs
Cut-off frequency (load resistance R_L = 1 kΩ)	f_g	55	kHz
Temperature coefficient of V_L (see diagram)	TC	−2.6	mV/K
Temperature coefficient of I_K (see diagram)	TC	0.12	%/K
Capacitance (V_R = 0 V; E = 0)	C_0	0.8	nF
Radiant sensitive area	A	7	mm²
Dark current (V_R = 1 V; E = 0)	I_R	1 (≦10)	µA
Dark current (V_R = 1 V; T_{amb} = 50°C; E = 0)	I_R	2.5	µA

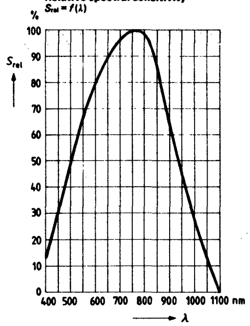
Spectral Sensitivity Groups

Type	Short circuit current I_K (µA) E_v = 100 lx[1]	Color code
BPY 11P-4	4.7 to 6.3	yellow
BPY 11P-5	5.6 to 7.5	green
BPY 11P-6	≧7.1	blue

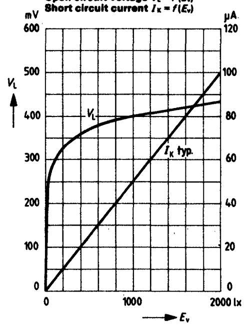
[1] The illuminance indicated refers to unfiltered radiation of a tungsten filament lamp at a colour temperature of 2856 K (standard light A in accordance with DIN 5033 and IEC publ. 306-1).

Specifications subject to change without notice.

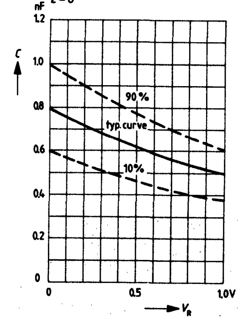
Relative spectral sensitivity
$S_{rel} = f(\lambda)$



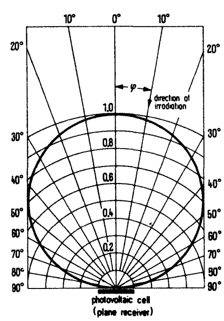
Open circuit voltage $V_L = f(E_v)$
Short circuit current $I_K = f(E_v)$



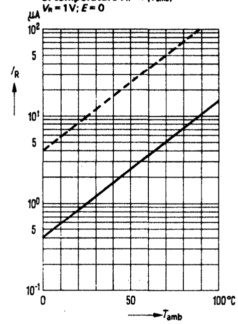
Junction capacitance $C = f(V_R)$
$E = 0$



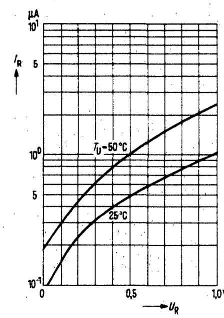
Directional characteristic $I_K = f(\varphi)$



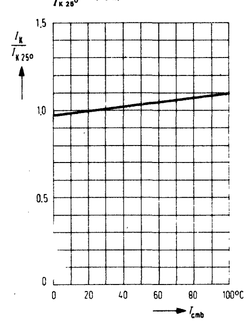
Dark current as a function of temperature $I_R = f(T_{amb})$
$V_R = 1$ V; $E = 0$



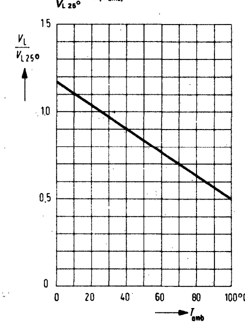
Dark current $I_R = f(V_R)$
T_U = Parameter; $E = 0$



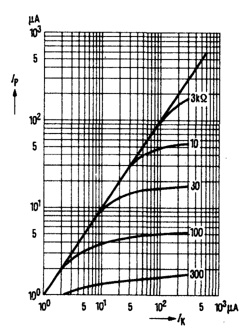
I_K as a function of temperature
$\frac{I_K}{I_{K\,25°}} = f(T_{amb})$



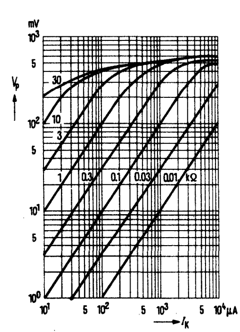
V_L as a function of temperature
$\frac{V_L}{V_{L\,25°}} = f(T_{amb})$



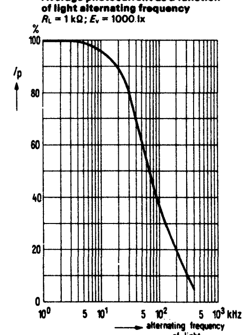
Photocurrent $I_P = f(I_K)$; R_L = parameter



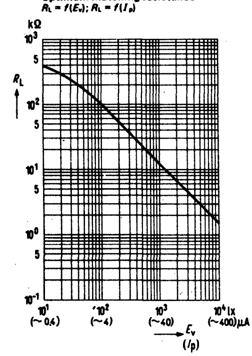
Photovoltage $V_P = f(I_K)$; R_L = parameter



Average photocurrent as a function of light alternating frequency
$R_L = 1$ kΩ; $E_v = 1000$ lx



Optimum matching resistance
$R_L = f(E_v)$; $R_L = f(I_P)$



litronix
A Siemens Company

Appnote 1

LED'S & PHOTOMETRY

by George Smith

The observed spectrum of electromagnetic radiations, extends from a few Hz, to beyond 10^{24} Hz, covering some 80 octaves. The narrow channel from 430 THz to 750 THz would be entirely negligible, except for the fact that more information is communicated to human beings, in this channel, than is obtained from the rest of the spectrum. This radiation has a wavelength ranging from 400nm to 700nm, and is detectable by the sensory mechanisms of the human eye. Radiation observable by the human eye is commonly called light.

Measurements of the physical properties of light and light sources, can be described in the same terms as any other form of electromagnetic energy. Such measurements are commonly called Radiometric Measurements.

Measurements of the psychophysical attributes of the electromagnetic radiation we call light, are made in terms of units, other than these radiometric units. Those attributes which relate to the luminosity (sometimes called visibility) of light and light sources, are called photometric quantities, and the measurement of these aspects is the subject of Photometry.

The electronics engineer who is starting to apply light emitting diodes and other opto-electronic devices to perform useful tasks, will find the subject of photometry to be a confused mass of strange units, confusing names for photometric quantities, and general disagreement as to what the important requirements are for his application.

The photometric quantities are related to the corresponding radiometric quantities by the C.I.E. Standard Luminosity Function (Fig. 1), which we may colloquially refer to as the standard eyeball. We can think of the luminosity function, as the transfer function of a filter which approximates the behavior of the average human eye under good lighting conditions.

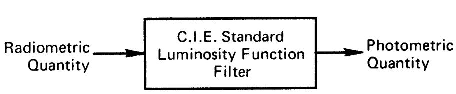


Figure 1. Relationship between radiometric units and photometric units.

The eye responds to the rate at which radiant energy falls on the retina, i.e., on the radiant flux density expressed as Watts/m^2. The corresponding photometric quantity is Lumens/m^2. The standard luminosity function is then, a plot of Lumens/Watt as a function of wavelength.

The function has a maximum value of 680 Lumens/Watt at 555nm and the ½ power points occur at 510nm and 610nm (Fig. 2).

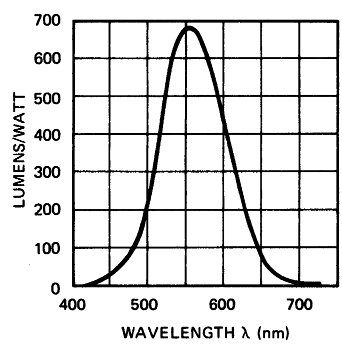


Figure 2. CIE standard photopic luminosity function.

The LUMEN is the unit of LUMINOUS FLUX and corresponds to the watt as the unit of radiant flux.

Thus the total luminous flux emitted by a light source in all directions is measured in lumens, and can be traced back to the power consumed by the source to obtain an efficiency number.

Since it is generally not practical to collect all the flux from a light source, and direct it in some desired direction, it is desirable to know how the flux is distributed spatially about the source. If we treat the source as a point (far field measurement), we can divide the space around the source into elements of solid angle (dω), and inquire as to the luminous flux (dF) contained in each element of solid angle ($\frac{df}{d\omega}$). The resulting quantity is Lumens/Steradian and is called LUMINOUS INTENSITY (I), (Fig. 3). The unit of Luminous intensity is called the CANDELA, sometimes loosely called the candle, or candle power.

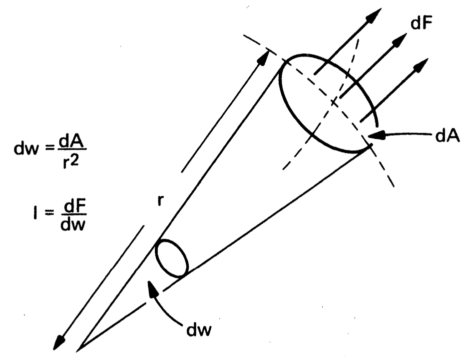


Figure 3. Solid angles and luminous intensity.

Since the space surrounding a point contains 4 π steradians, it is apparent that an isotropic radiator of one candela intensity, emits a total luminous flux of 4 π Lumens.

No real light source is isotropic, so it is quite common to show a plot of Luminous intensity versus angle off the axis (Fig. 4). If the source has no axis of symmetry, a more complex diagram is required.

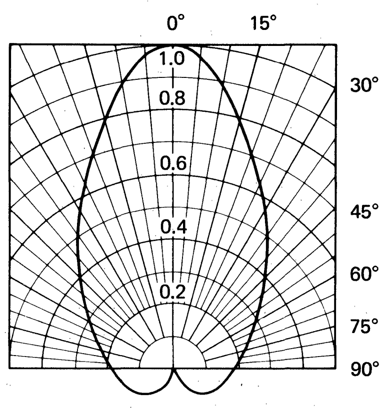


Figure 4. Spatial distribution pattern.

For an extended radiating surface, (such as an LED chip), each element of area contributes to the luminous intensity of the source, in any given direction. The luminous intensity contribution in the given direction, divided by the projected area of the surface element in that direction, is called the LUMINANCE (B) of the source (in that direction), (Fig. 5). The quantity is sometimes called photometric brightness, or simply brightness. The use of the term brightness on its own, should be discouraged, as this involves various subjective properties such as texture, color, sparkle, apparent size, etc. that have psychological implications.

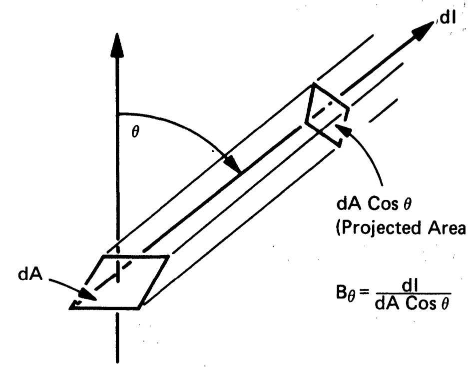


Figure 5. Definition of luminance.

The fundamental quantitative standard of the photometric system of units is the standard of luminance.

The luminance of a black body radiator at the temperature of freezing platinum (2043.8°K) is 60 candela per square centimeter. [A blackbody radiator is a perfect absorber of all electromagnetic energy incident on it. In thermal equilibrium at a given temperature, it emits radiation, spectrally distributed according to Plancks Formula

$$(W_\lambda = \frac{c_1 \lambda^{-5}}{\exp(\frac{c_2}{\lambda}) - 1})]$$

The units of Luminance in present use are an engineering nightmare.

1 candela/cm^2 is called a *Stilb*
1/π candela/cm^2 is called a *Lambert*
1 candela/m^2 is called a *Nit*
1/π candela/m^2 is called an *Apostilb*
1/π candela/ft^2 is called a *foot-Lambert*

The foot Lambert is the most commonly used unit in this country.

Of particular interest is a source whose angular distribution pattern is a circle (Fig. 6). For such a source we have $I_\theta = I_0 \cos\theta$, the luminance of such a source in a given direction θ, is then given by

$$B_\theta = \frac{d\,I_\theta}{d\,A \cos\theta} = \frac{d\,I_o \cos\theta}{d\,A \cos\theta} = \frac{d\,I_o}{dA}$$

The luminance is seen to be the same in all directions. Such a source is called a LAMBERTIAN SOURCE. It can be shown that a perfectly diffusing surface behaves in this fashion. The formula governing a diffusing surface $I_\theta = I_0 \cos\theta$ is called Lambert's Cosine Law.

It can be shown that a flat LED chip is a very good approximation to a Lambertian Source.

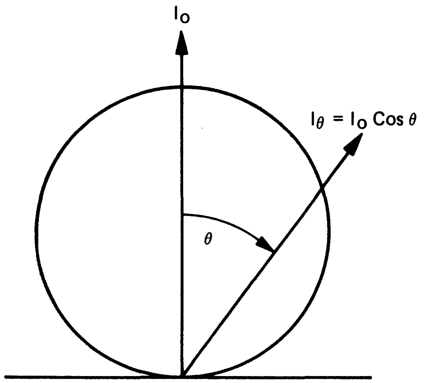


Figure 6. Lambertian radiation pattern.

If we now take a surface element (dA) and determine the intensity contribution in each direction we can determine the total flux (dF) emitted by the surface element. The resultant ratio ($\frac{dF}{dA}$) Lumens/m^2 is called the LUMINOUS EMITTANCE (L). For a flat surface we may calculate L from

$$L = 2\pi \int_{o}^{\pi/2} B(\theta)\, S_{IN}\, \theta \, \mathrm{Cos}\, \theta \, d\,\theta$$

The corresponding radiant emittance in watts/m^2 is of considerable interest for GaAs infrared LED's where total output power is an important parameter.

The total luminous flux emitted by a light source can then be calculated from $F_{total} = \int LdA$.

These photometric quantities are sufficient to describe the properties of light sources such as light emitting diodes.

When light falls on a receiving surface, it is either partially reflected in the case of a purely passive surface, or partly converted into some other form of energy by what we may describe as an active surface (such as a phototransistor or photomultiplier cathode). In either case we are interested in how much flux falls on each element of the surface; Lumens/m^2 in the case of a passive surface which we wish to illuminate, or the eye; and Watts/m^2 in the case of other active surfaces. The quantity Lumens/m^2 in this case is called the ILLUMINANCE sometimes loosely referred to as the illumination. The unit of illuminance is the LUX also referred to as the metercandle. Another commonly used unit of illuminance, in this country is the FOOT CANDLE, equal to one lumen per square foot. One lumen per square cm is called a PHOT.

Many of these photometric quantities and units are in common use in the field of illumination engineering, with the English units being most common in this country. It should be apparent to the reader that a mixed system of units is involved in common usage.

APPLICATION TO LIGHT EMITTING DIODES

The above description of photometric quantities should indicate to the reader that there are many ways in which the photometric properties of LED's can be stated. There is no general agreement among LED makers and users, as to the best way to specify LED performance, and this has lead to much confusion and misunderstanding.

Many factors must be taken into account when evaluating LED specifications for a particular application, and electronic engineers will need to develop a knowledge of these factors to put LED's to effective use in new designs.

Presently available light emitting diodes are made from the so-called III-V compound semiconductors, with Gallium Arsenide Phosphide and Gallium Phosphide being the major materials. Gallium Aluminum Arsenide is also used but is less common. Gallium Arsenide is commonly included in this group, but it should be remembered that GaAs emits only infra-red radiation around 900nm, which is not visible to the eye, and is thus not properly called light. All specifications of GaAs emitters must be in radiametric units.

GaP emits green light between 520 and 570nm peaking 550nm very close to the peak eye sensitivity. It also can emit red light between 630 and 790nm peaking at 690nm.

$GaAs_{(1-x)}P_x$ emits light over a broad orange red range depending on the percentage of GaP in the material (x). For x in the 0.4 region, red light between 640 and 700nm peaking at 660nm, is obtained. For x = 0.5, amber light peaking around 610nm is obtained.

$Ga_{(1-x)}Al_xA_s$ as presently available, emits red light between 650 and 700nm peaking at 670nm.

The efficiency of these materials is very dependent on the emitted wavelength, with drastic fall off in efficiency as the wavelength gets shorter. Fortunately the standard eyeball filter, favors the shorter wavelength (down to 555nm) and gives some measure of compensation. Some typical efficiencies reported by device makers, and the resulting overall luminous efficiency (Lumens/electrical watt) are as follows:

GaP.red .72% @ 20Lum/Watt =
.14 Lum/Watt overall (Opcoa)
$GaAs_{.6}P_{.4}$red .3% @ 50Lum/Watt =
.15 Lum/Watt overall (Litronix)
GaAlAs red .06% @ 40Lum/Watt =
.024 Lum/Watt overall (Mitsubishi)
GaP green .006% @ 675Lum/Watt =
.04 Lum/Watt overall (Monsanto)
$GaAs_{.5}P_{.5}$amber .0044% @ 340Lum/Watt –
.015 Lum/Watt overall (Monsanto)

For simple status indicator applications, front panel lamps and similar applications, several factors must be taken into account:

(1) Color. Generally the designer has Henry Ford's color choice; various similar shades of red. Amber and green are available in small quantity, because of availability of suitable raw material.

(2) Apparent source size. Various combinations of chip size and optical systems are available so that apparent source sizes from about 5 mils to about 300 mils diameter are available as standard products. Other things being equal, a larger source size is more visible.

(3) Angular distribution. GaAsP diode chips are nearly Lambertian, but GaP are nearly isotropic. With suitable optical design, the angular distribution pattern can be changed from very broad to quite narrow. By placing the chip at the focus of the lens system a narrow high intensity beam is obtained. The off axis visibility is drastically reduced. By using diffusing lens materials, a large area source with good off axis visibility is obtained. In this case the luminance is reduced.

(4) Luminous intensity. This will govern the visibility under optimum background contrast conditions, when viewed at normal distances. 1 millicandela is typical for red lamps of either GaAsP or GaP at normal operating conditions.

(5) Luminance. When it is not possible to provide a dark contrasting background, or when the source is viewed at very close distances, the luminance becomes important. Values from 100 ft-L to 5000 ft-L are typical.

These factors are all related to the design of the device and the user should understand the trade offs. High luminance values in excess of 10,000 ft-L are easily obtained by running very high current densities in the LED chip, but this can lead to shortened life if carried too far.

For a given drive current the luminous intensity of two different chips will be similar, while the luminance will be inversely proportional to the active area of the chip.

If the designer can use filter screens or circularly polarizing filters in front of the light source, excellent protection from background illumination can be obtained. In this case a diffusive lens giving a large apparent source with lower luminance, is more visible than a high luminance point source.

When a LED is used with an optical system to activate a remote sensor such as a cadmium sulphide or cadmium selenide cell (red light), or a GaAs IR emitter is used with a silicon photo detector, the performance requirements are somewhat different. It can be shown that for a given optical arrangement the irradiance of the detector determines the detected signal and this is proportional to the radiance of the source, which is comparable to the luminance (brightness) of the source. The intensity of the source will not be a factor unless the detector active area is larger than the incident beam.

When average power consumption must be minimized but good visibility is required, or detection at a considerable distance is required, pulsed operation can be used. With GaAs and GaAsP emitters using low duty cycle short pulses, very high peak intensity levels can be reached permitting communication over considerable distances. This technique is not useful with GaP diodes since they do not exhibit a linear relationship between optical output and instantaneous forward current, becoming saturated at moderate current levels. GaP also has a 50% higher rate of fall off in light output with temperature increase, than GaAsP which further inhibits high power applications.

The use of LED's to give a "Heads Up" projected display, such as for an automobile speedometer readout, or aircraft cockpit application, places severe requirements on the display luminance. For easy visibility, the projected image must be sufficiently contrasted with the ambient illumination. This requires very high luminance values for the LED's together with the use of photochromic windshields and probably polarizing screens.

The foregoing is a necessarily simplified, description of a very complex subject. The reader should avail himself of the standard textbook literature on these subjects.

References:

R. Kingslake, *Applied Optics & Optical Engineering*
Committee on Colorimetry of the O.S.A., *The Science of Color.*
Warren J. Smith, *Modern Optical Engineering.*

litronix
A Siemens Company

Appnote 2

APPLICATIONS OF OPTO-ISOLATORS

by George Smith

The Litronix Iso-Lit 1 is the first in a family of Opto-isolators. These products are also called photon coupled isolators, photo-couplers, photo-coupled pairs and optically coupled pairs. All of the characteristics of the Iso-Lit 1 are electrical: it has no external optical properties. Hence opto-isolators are not OPTO-ELECTRONIC DEVICES; they are in fact one of the simplest of all ELECTRO-OPTICAL SYSTEMS.

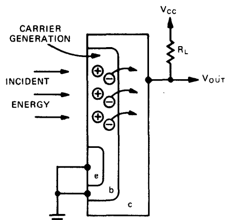
The Iso-Lit 1 consists of a Gallium Arsenide infrared emitting diode, and a silicon phototransistor mounted together in a DIP package.

When forward current (I_F) is passed through the Gallium Arsenide diode, it emits infrared radiation peaking at about 900nm wavelength. This radiant energy is transmitted through an optical coupling medium and falls on the surface of the NPN phototransistor.

Photo-transistors are designed to have large base areas; and hence a large base-collector junction area; and a small emitter area. Some fraction of the photons that strike the base area cause the formation of electron-hole pairs in the base region. This fraction is called the QUANTUM EFFICIENCY of the photodetector.

If we ground the base and emitter, and apply a positive voltage to the collector of the photo-transistor, the device operates as a photo diode.

The high field across the collector base junction quickly draws the electrons across into the collector region. The holes drift towards the base terminal attracting electrons from the terminal.

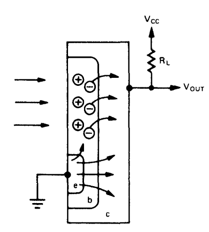


Thus a current flows from collector to base, causing a voltage drop across the load resistance (R_L).

The high junction capacitance, C_{cb}, results in an output circuit time constant R_LC_{cb}, with a corresponding output voltage rise time.

The output current in this configuration is quite small and hence this connection is not normally used.

The commonest circuit configuration is to leave the base connection open. With this connection, the holes generated in the base region cause the base potential to rise, forward biasing the base-emitter junction. Electrons are then injected into the base from the emitter, to try to neutralize the excess holes. Because of the close proximity of the collector junction, the probability of an electron recombining with a hole is small and most of the injected electrons are immediately swept into the collector region. As a result, the total collector current is much higher than the photo-generated current, and is in fact β times as great.



The total collector current is then several hundred times greater than for the previous connection.

This gain comes with a penalty of much slower operation. Any drop in collector voltage is coupled to the base via the collector-base capacitance tending to turn off the injected current. The only current available to charge this junction capacitance is the original photo-current. Thus, the rate of change of the output voltage is the same for both the diode and transistor connections. In the latter case, the voltage swing is β times as great, so the total rise time is β times as great as for the diode connection. Thus the effective output time constant is βR_LC_{cb}.

For the Iso-Lit 1 this results in a typical 2 μs rise time for 100Ω load.

The ratio of the output current from the photo-transistor (I_C or I_E), to the input current in the Gallium Arsenide diode, is called the Current Transfer Ratio (CTR). For the Iso-Lit 1 CTR is specified at 20% minimum with 35% being typical at I_F = 10 mA.* Thus for 10 mA input current the minimum output current is 2 mA. Other important parameters are V_F typically 1.3V at 100 mA I_F.

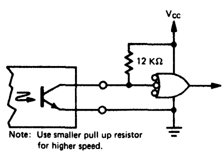
*NOTE: CTR values of 50% and higher are available from the factory.

DIGITAL INTERFACES

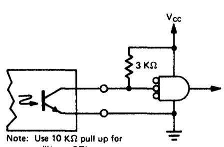
Output Sensing Circuits

The output of the photo-transistor can directly drive the input of standard logic circuits such as the 930 DTL and 7400 TTL families. The worst case input current for the 74 series gate is –1.6 mA for V_{IN} = 0.4 Volts. This can be easily supplied by the Iso-Lit 1, with 10 mA input to the infrared diode.

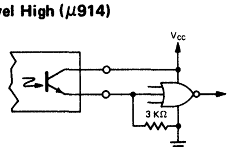
DTL or TTL Active Level Low (930 or 7400)



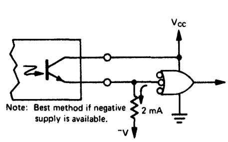
RTL Active Level Low (μ914)

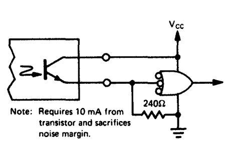


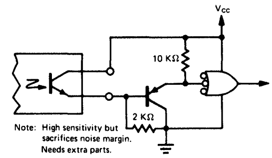
RTL Active Level High (μ914)

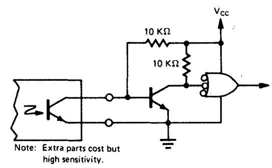


It is more difficult to operate into DTL and TTL gates in the active level high configuration. Some possible methods are as follows;

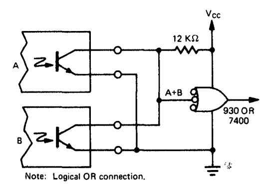


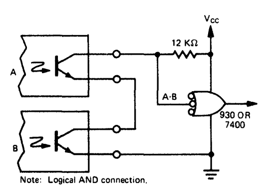






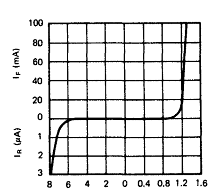
Obviously, several Iso-Lit output transistors can be connected to perform logical functions.





Input Driving Circuits

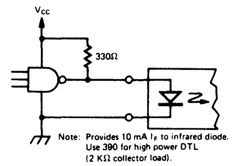
The input side of the Iso-Lit 1 has a diode characteristic as shown.



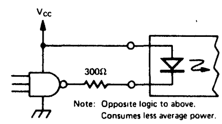
The forward current must be controlled to provide the desired operating condition.

The input can be conveniently driven by integrated circuit logic elements in a number of different ways.

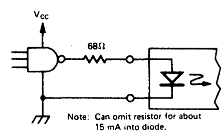
DTL Active Level High (930 Series)



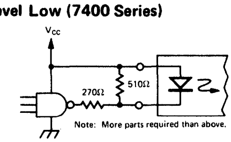
DTL Active Level Low (930 Series)

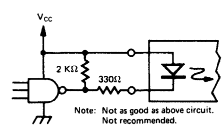


TTL Active Level High (7400 Series)



TTL Active Level Low (7400 Series)





There are obviously many other ways to drive the device with logic signals, but the commonest needs can be met with the above circuits. All provide 10 mA into the LED giving 2 mA minimum out of the photo-transistor. The 1 Volt diode knee and its high capacitance (typically 100 pF), provides good noise immunity. The rise time and propagation delay can be reduced by biasing the diode on to perhaps 1 mA forward current, but the noise performance will be worse.

All previous configurations show medium speed digital interfaces. These circuits have various advantages over other ways of doing the task.

(1) They can replace relays and reed relays, giving much faster switching speeds, no contact bounce, better reliability, and usually better electrical isolation except for special configurations. However relays have high current capability, higher output voltage, lower on resistance and offset voltage and higher off resistance.

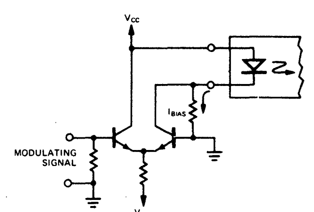
(2) They can replace pulse transformers in many floating applications. Opto-isolators can transmit DC signal components and low frequency AC, whereas pulse transformers couple only the high frequency components, and a latch is required to restore the DC information. Pulse transformers have faster rise time than photo-transistor opto-isolators.

(3) Integrated circuit line drivers and receivers are used to transmit digital information over long lines in the presence of common mode noise. The maximum common mode noise voltage permissible is usually in the 30 Volt range. There are many practical situations where common mode noise voltages of several hundred Volts can be be induced in long lines. For these applications opto-isolators provide protection against several thousand Volts.

LINEAR APPLICATIONS

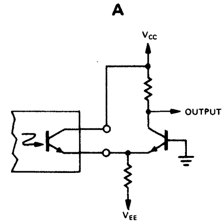
The curve of input current versus output current for the Iso-Lit 1 is somewhat non-linear, because of the variation of β with current for the photo-transistor, and the variation of infrared radiation out versus forward current in the GaAs diode. The useful range of input current is about 1 mA to 100 mA, but higher currents may be used for short duty cycles.

For linear applications the LED must be forward biased to some suitable current (usually 5 mA to 20 mA). Modulating signals can then be impressed on this DC bias. A differential amplifier is a good way to accomplish this.

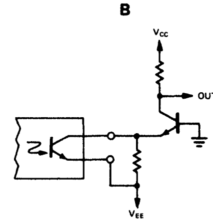


Sensing in linear applications can be done in several ways depending on the requirements. For high frequency performance, the photo-transistor should be operated into a low impedance input current amplifier. The simplest such scheme is a grounded base amplifier.

A

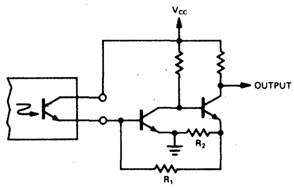


B



The circuit will work equally well either way, with a phase inversion between the two. Obviously a PNP transistor would work as well.

A feedback amplifier could also be used to get a low impedance input.



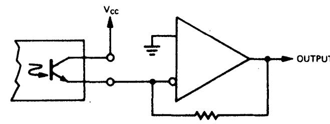
The current gain is $\left(1 + \frac{R_1}{R_2}\right)$.

The input impedance is approximately

$$\left(\frac{R_1}{1 + \frac{V_{CC} - 2V_{BE}}{.026}}\right)$$

For example if $R_1 = 900\Omega$, $R_2 = 100\Omega$, $V_{CC} = 5V$; we would have a current gain of 10 and an input impedance of about 6.3Ω. This would give a considerable speed improvement over a 100Ω load.

A high speed operational amplifier could be used to give excellent performance.



Note that in all cases the output can be taken from either the collector, or the emitter of the photo-transistor depending on the polarity desired. The operating speed is the same in either case.

CONCLUSION

This appnote covers the most commonly used ways of applying photo-transistor opto-isolators. The design engineer will see many ways to expand on these circuits to achieve his end goals. The devices are extremely versatile, and can provide better solutions to many systems problems than other competing components. Special designs are possible to optimize certain parameters such as coupling capacitance, or transfer ratio, and the engineer can expect to see a variety of these products in the future.

SUMMARY OF PROPERTIES OF SIGNAL COUPLING DEVICES

Device	Advantages	Disadvantages
Opto-Isolator	Economical. Solid state reliability. Medium to high speed signal transmission. DC & low frequency transmission. High voltage isolation. High isolation impedance. Small size DIP Package. No contact bounce Low power operation.	Finite ON Resistance Finite OFF Resistance. Limited ON state current. Limited OFF state voltage. Low transmission efficiency. (Low CTR)
Relays	High power capability. Low ON resistance. DC transmission. High voltage isolation.	High cost. High power consumption. Unreliable. Very slow operation. Physically large.
Pulse Transformers	High speed signal transmission. Moderate size. Good transmission efficiency.	No DC or low frequency transmission. Expensive for high isolation impedance or voltage.
Differential line Drivers and Receivers	Solid state reliability. Small size DIP package. High speed transmission. DC transmission. Low cost.	Very low breakdown Voltage. Low isolation impedance.

litronix
A Siemens Company

Appnote 3

MULTIPLEXING LED DISPLAYS

by George Smith

In digital displays, such as would be used in a D.V.M. or counter of conventional design, all digits are operated in parallel, with a separate decoder-driver for each digit operated from data generally stored in a quad latch.

In many cases, a reduction in cost can be effected by operating the display in a time division multiplexed mode. The question of cost effectiveness depends on the particular application. As a general rule, the greater the number of digits in the display, the more advantageous the multiplex system becomes from the cost standpoint. Because of the great variety of situations possible, it is difficult to say at what number of digits the change should be made. In some circumstances, non-multiplexed operation of less than 8 digits is more economical. On the other hand, there are circumstances under which multiplexing is used for three and four digit displays at a cost saving. This application note attempts to show some of the many ways of multiplexing digits, and it is left to the designer to decide whether his own system application would be lower in cost if he used a multiplex scheme.

The properties of light emitting diodes (LED) make them particularly suitable for multiplexed operation, and hence it is the preferred method to use, if a scheme can be designed which is cost competitive with non-multiplexed operation.

Throughout this paper, it will be generally assumed that we are talking of a system using TTL type logic families, with MSI functions being used where applicable. In most production situations this will be the most economical approach. There will be some cases where discrete gates and flip-flops may yield a lower cost. There are also cases where a single MOS chip contains all the necessary logic functions, and only interface driver circuits are required.

The seven segment numeric displays with a common anode connection made by Litronix provide compatibility with the most widely available decoder-drivers, which are active level low outputs. The commonest devices are SN7447, 8T04, 9317 and similar. Any of these is suitable for driving the Litronix DL-707 type display. For common cathode displays such as the Litronix DL-34M, SN7448, 8T06 and 9307 decoders can be used, and anode drivers become cathode drivers.

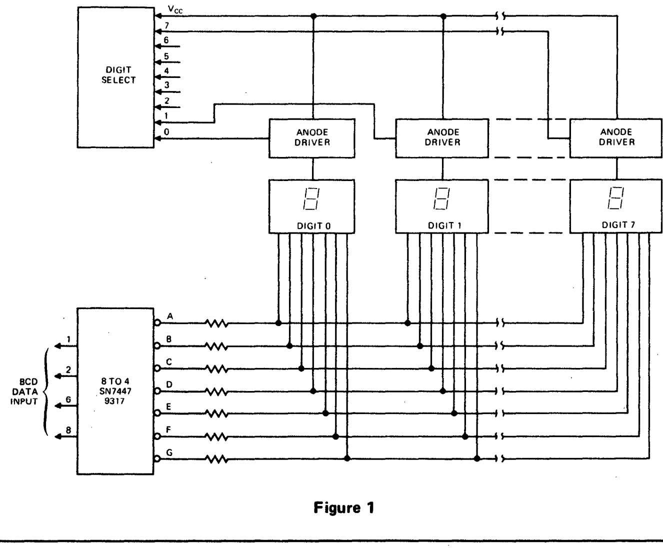


Figure 1

In a multiplex system, the corresponding cathodes of each digit are bussed together, and driven from one seven segment decoder-driver, via the usual current limiting resistors. The display data is presented serially by digit, to the decoder-driver, together with an enable signal to the appropriate digit anode Figure 1.

Each digit anode is driven by a switch, capable of passing the full current of all segments. The simplest switch would be a PNP high current switch or amplifier transistor, such as a core driver type.

In operation, the anode switches are activated one at a time, in the desired sequence, while the appropriate digital data is presented at the input to the decoder-driver. The amount of circuitry required in Figure 1 is much less than that used in the non-multiplexed scheme. The question of overall economy is dependent on the amount of circuitry required to sequence the anodes and present the data at the decoder input. Let us consider some typical situations.

CASE 1:

An 8-digit counter-timer display, with the data stored in multiple latch circuits. This is the most common situation present in a counter-timer of conventional design. A quad latch (SN7475) is used to store each digit, and this data is periodically updated. To scan this data, a 4 pole 8 position switch is required (SN74151). To select the appropriate digit, an octal counter (SN7493) and a 1 of 8 decoder (SN7442) are required. The complete circuit is as in Figure 2.

The total package count is about the same for this arrangement, as for non-multiplexed operation, but most of the packages are lower cost than the seven segment decoder. The scheme shown is a 20% cost reduction over non-multiplexed operation, based on O.E.M. prices for the components. For less than eight digits, it would be difficult to compete with non-multiplexed operation using this scheme.

CASE 2:

Multiplexing becomes more attractive, when the data is stored in a shift register, rather than in latches. In this case the data is circulated around the register, at some suitable rate, and is sequentially presented at the input of the seven-segment decoder-driver. The anode drive can be obtained from a counter and decoder as in Figure 2, or from a parallel output shift register – Figure 3.

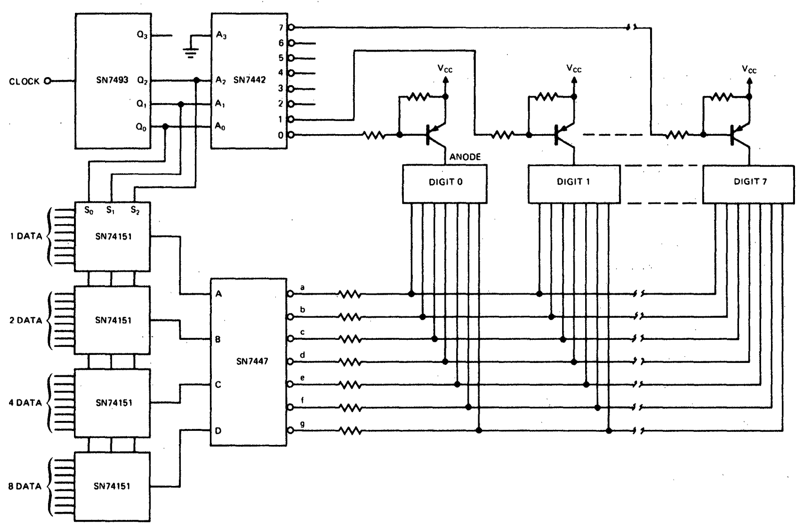


Figure 2

This circuit, which can be expanded to any number of digits, circulates a single zero, and thus can directly drive the PNP anode switches. Systems using recirculating memories generally require this digit timing circuitry for other reasons, so it is generally available in the system already.

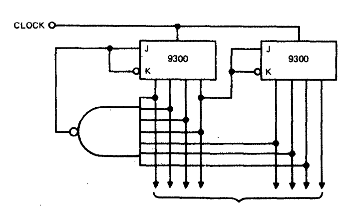


Figure 3

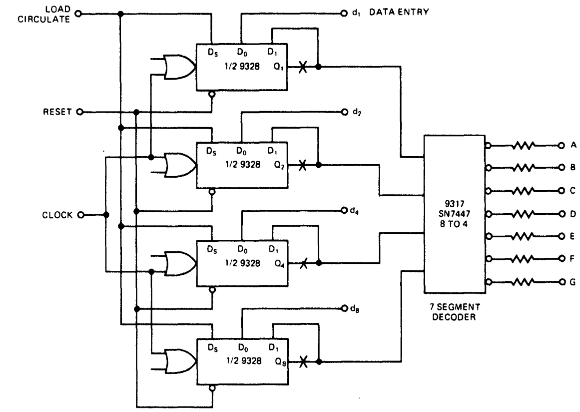


Figure 4

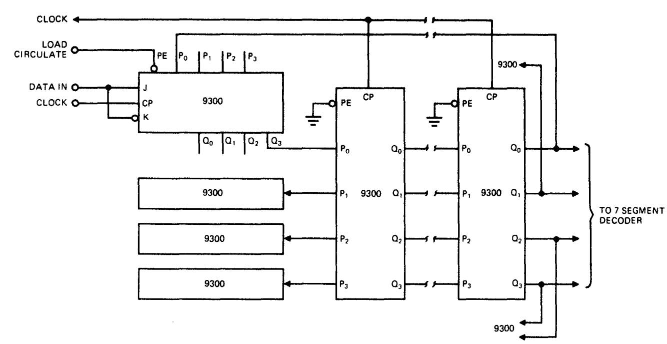


Figure 5

For displays of 8 digits; a very common number in counter-timer instruments, the 9328 dual 8 bit shift register makes a very good circulating shift register. Two packages are required to store and circulate 8 digits – Figure 4.

The scheme can be extended to more digits by adding a 4 bit parallel shift register such as the 9300, for each extra digit; the extra shift bits are inserted at the points marked X in Figure 4. The same circuit can be used for less than 8 digits, if a 12-1/2% duty cycle is satisfactory. For less than 8 digits, where maximum available duty cycle must be maintained, the scheme shown in Figure 5 can be used.

The preceding schemes demonstrate that systems containing recirculating data are very effectively coupled to multiplexed LED displays. Many multi-digit systems such as calculating machines use L.S.I. MOS circuits to provide their logic, and these naturally lend themselves to recirculating data. It is now practical to use custom L.S.I. to provide the logic functions of a D.V.M. or a counter-timer type of instrument, employing multiplexed LED displays, at a significant cost savings over conventional instrument designs.

Apart from the strictly logical problems involved in a multiplexed display, the designer must choose suitable operating conditions for the LED's. Peak forward current, current pulse width, duty cycle and repetition rate, are all factors which the designer must determine.

The luminous intensity, or the luminance of GaAsP LED's, is essentially proportional to forward current over a wide range, but certain phenomena modify this condition. At low currents, the presence of non-radiative recombination processes, results in less light output than the linear relationship would predict. This effect is noticeable in the region below about 5 mA per segment (for 1/4 inch characters). The result is that noticeable difference in luminance from segment to segment can occur at low currents. At high currents, the power dissipation in the chip causes substantial temperature rise, and this reduces the efficiency of the chip. As a result the light output versus forward current curve falls below the straight

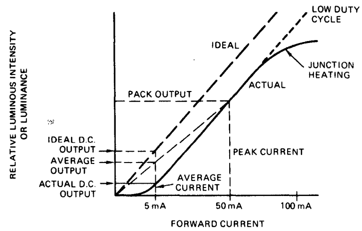


Figure 6

line, at high currents (Figure 6). It should be emphasized that this latter effect is entirely due to self heating. If the power dissipation is limited, by running short pulses at low duty cycle, the output follows the straight line up to very high current densities. Whereas 100 A/cm^2 may be used in DC operation, as much as 10^4 A/cm^2 can be used under pulsed conditions, with a proportionate increase in peak intensity. (If this did not occur, GaAsP lasers could not be built.) Gallium Phosphide, however, has an inherent saturation mechanism that causes a drastic reduction in efficiency at high current densities even if the junction temperature remains constant. This effect is due to competing non-radiative recombination mechanisms at high current density.

As a first approximation the brightness of a pulsed LED will be similar to that when operated at a DC forward current equal to the average pulsed current. For example, for 40 mA peak current at 25% duty cycle, the brightness will be similar to DC operation at 10 mA. The actual brightness comparison will depend on the actual pulsing conditions. Under most legitimate conditions the brightness will be greater for pulsed operation.

Figure 6 shows how the actual light output at 5 mA DC is substantially less than expected from the ideal curve, because of the "foot" on the curve at low currents. Operation at 50 mA peak current and 10% duty cycle yields a high peak output as shown, and an integrated average output that is much closer to the ideal value. It should be obvious that variations in the "foot" from segment to segment cause a significant variation in light output at a low DC current, but a much smaller variation in the average output when operated in a pulsed mode. As well as an increase in luminance, or luminous intensity due to pulsing, there is an increase in brightness because of the behavior of the eye. The eye does not behave as an integrating photometer, but as a partially integrating and partially peak reading photometer. As a result, the eye perceives a brightness that is somewhere between the peak and the average brightness.

The net result is that a low duty cycle high intensity pulse of light looks brighter than a DC signal equal to the average of the pulsed signal. The practical benefit of multiplexed operation then, is an improvement in display visibility for a given average power consumption besides the lower cost. The brightness variation from segment to segment and digit to digit is also reduced by time-sharing. The gain in brightness over DC operation can be as much as a factor of 5 at low duty cycles of 1 or 2 percent, and peak currents of 50 to 100 mA.

A number of factors must be taken into account when deciding on the design of a multiplexed display. Besides the optical output, thermal considerations are very important.

Most 1/4" size LED numerics are rated at 30 mA DC max per segment. Under pulsed operation, higher currents can be used provided several thermal considerations are taken into account.

(1) The average power dissipation must not exceed the maximum rated power.

(2) The power pulse width must be short enough to prevent the junction from overheating during the pulse. This implies that the pulse width must get shorter as the amplitude increases.

Present experience indicates that for pulses of 10 μs, the amplitude should be limited to 100 mA max. Shorter pulses of higher amplitude may be used but the circuit problems become severe if the pulse width is very short. As more information on thermal parameters of the devices becomes available, more specific design rules can be given to assist the designer.

litronix
A Siemens Company

Appnote 4

DRIVING HIGH-LEVEL LOADS WITH ISO-LIT™ OPTO-ISOLATORS

by David M. Barton

Frequently a load to be driven by an Iso-Lit requires more current, voltage, or both, than an Iso-Lit can provide at its output.

Available Iso-Lit output current, of course, is found by multiplying input (LED section) current by the "CTR" or current - transfer-ratio. For worst-case design, the minimum specified value would be used. The minimum CTR of the Litronix Iso-Lit 1, 12 and 16 are 0.2, 0.02 and 0.06 respectively. Temperature derating is not usually necessary over the 0 to +60 degree Celcius range because the LED light output and transistor beta have approximately compensating coefficients.

Multiplying the minimum CTR by 0.9 would ensure a safe design over this temperature range. Over a wide range, more margin would be required.

The LED source current is limited by its rated power dissipation. Table I shows maximum allowable I_F vs maximum ambient temperature.

Values for Table I are based on a 1.33 mW/°C derate from the 100 mW at 25°C power rating.

Table I

MAXIMUM TEMPERATURE	I_F MAXIMUM
40°C	65 mA
60°C	48 mA
80°C	25 mA

Obviously, one can increase the available output current then by either choosing a higher CTR-rated Iso-Lit, by providing more current, or both. Table II shows the minimum available output current of each device assuming 60°C derating (from Table I) and a 10 percent margin for temperature effects.

Table II

ISO-LIT	I_{CE}(MIN) mA
1	8.6
12	0.86
16	2.5

If the Iso-Lit is being operated from logic with 5 volt V_{CC}, and 0.2 volt V_{CE} saturation is assumed for the driving transistor, a 75 ohm R_{IF} resistor will provide the 48 mA. The forward voltage of the IR-emitting LED is about 1.2 volts. Figures 1A and 1B show two such drive circuits.

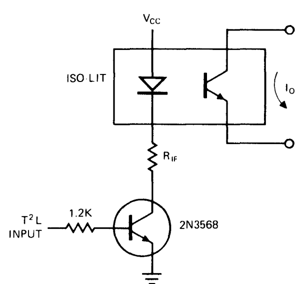


Figure 1A. NPN Driver

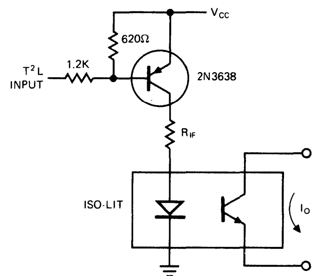


Figure 1B. PNP Driver

A "buffer-gate," such as the SN7440 or Signetics 8855, provides a very good alternative to discrete transistor drivers. Figure 2 shows how this is done. Note that the gate is used in the "current-sinking" rather than the "current-sourcing" mode. In other words, conventional current flows *into* the buffer-gate to turn on the LED. This makes use of the fact that a T^2L gate will sink more current than it will source. The SN7440 is specified to drive thirty 1.6 mA loads or 48 mA. Changing R_{IF} from 75 to 68 ohms adjusts for the higher saturation voltage of the monolithic device.

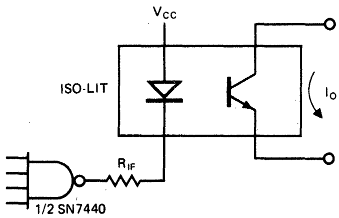


Figure 2. Buffer-Gate Drive

MORE CURRENT

For load currents greater than 8.6 mA, a current amplifier is required. Figures 3A and 3B show two simple one-transistor current amplifier circuits.

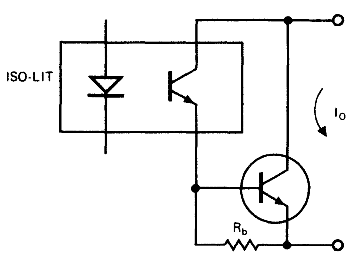


Figure 3A. NPN Current Booster

Since the transistor in the Iso-Lit is treated as a two-terminal device, no operational difference exists between the NPN and the PNP circuits. R_b provides a return path for I_{CBO} of the output transistor. Its value is: R_b = 400 mV/I_{CBO}(T) where I_{CBO}(T) is found for the highest *junction* temperature expected.

Assume that leakage currents double every ten degrees. Use the maximum dissipated power, the specified maximum junction-to-ambient thermal resistance,

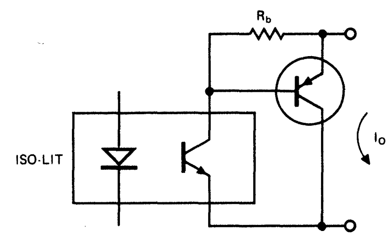


Figure 3B. PNP Current Booster

and the maximum design ambient temperature in conjunction with the specified maximum 25 degree I_{CBO} to calculate I_{CBO}(T).

As an example, suppose a 2N3568 is used to provide a 100 mA load current. Also assume a maximum steady-state transistor power dissipation of 100 mW and a 60°C maximum ambient. The transistor junction-to-ambient thermal resistance is 333°C/watt, so a maximum junction temperature of 60 + 33 or 93°C is expected. This is about 7 decades above 25°C. Therefore, I_{CBO}(T) = I_{CBO}(max) x 27 = 50 nA x 128 = 6.5 µA. A safe value for R_b is 400 mV/6.5 µA = 62 kilohms.

Working backwards, maximum base current under load will be I_O/h_{FE}(min) = 100 mA/100 = 1 mA. Current in R_b is V_{BE}/R_b = 600 mV/60k = 10 µA, which is negligible. Table II shows that an Iso-Lit 16 could provide more than enough base current for the transistor but an Iso-Lit 12 could not. Less than the maximum allowable drive could be provided to the Iso-Lit 16, since only 1 mA is required. A 20 mA drive provided by a 180 ohm resistor would suffice. An Iso-Lit 1 with 9 mA drive would also work.

If the load requires more current than can be obtained with the highest beta transistor available, then more than one transistor must be used in cascade. For example, suppose 3 amperes load current and 10 watt dissipation are needed. A Motorola MJE3055 might be used for the output transistor, driven by a MJE205 as shown in Figure 4. Using a 5°/watt heat sink and the rated MJE3055 junction-to-case thermal resistance of 1.4°/watt, we find that junction temperature rise is 6.4 x 10, or 64°. Therefore maximum junction temperature is 124°C. This is 10 decades above 25°C making $I_{CBO}(T) = 2^{10} I_{CBO}(max) = 10^3 I_{CBO}(max)$.

I_{CBO}(max) at 30 volts or less is not given, but I_{CEO} is. Using (for safety) a value of 20 for the minimum low-current h_{FE} of the device, I_{CBO} could be as large as

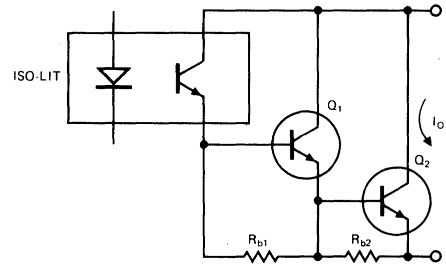


Figure 4. Two-NPN Current Booster

$I_{CEO}/20 = 35\ \mu A$. Then $I_{CBO}(T)$ is 35 mA and $R_{b2} = 400\ mV/35\ mA = 11$ ohms. For I_b use I_o/h_{FE}(min @ 4A) = 3A/20 = 150 mA. $I_{Rb2} = 600$ mV/10 ohms = 60 mA, so $I_{e(Q1)} = 210$ mA.

Maximum Power in Q_1 will be about 1/14 the power in Q_2 since its current is lower by that ratio and the two collector-to-emitter voltages are nearly the same. This means Q_1 must dissipate 700 mW.

Assuming a small "flag" heat sink having 50°/watt thermal resistance, we find the junction at about 95°C. The 150°C case temperature I_{CBO} rating for this device is 2 mA, so one can work backwards and assume about 1/30 of this value, or 70 μA. On the other hand, the 25° rated I_{CBO} is 100 μA. Choosing the larger of these contradictory specifications, $R_{b1} = 400\ mV/0.1\ mA = 4k \approx 3.9k$. Q_1 base current is $I_{E(Q1)}/h_{FE(Q1\text{-}min)} = 210\ mA/50^* = 4.2$ mA. Total current is $I_{b(Q1)} + I_{Rb1} = 4.2 + 0.24 = 4.5$ mA. Table II shows that an Iso-Lit 1 could be used here.

MORE LOAD VOLTAGES

All of the current-gain circuits shown so far have one common feature: load voltage is limited by the 30 volt rating of the Iso-Lit, not by the voltage or power rating of the transistor(s). Figure 5A shows a method of overcoming this limitation. This circuit will stand off BV_{CEO} of Q_1. The voltage rating of the phototransistor is irrelevant since its maximum collector-emitter voltage is the base-emitter voltage of Q_1 (about 0.7 volts).

Unlike the "Darlington" configurations shown previously, this circuit operates "normally-ON." When no current flows in the LED the phototransistor, being OFF, allows R_2 current to flow into the base of Q_1, turning Q_1 ON. When the Iso-Lit is energized, its phototransistor "shorts out" the R_2 current turning Q_1 OFF.

*Minimum h_{FE} is obtained using the specification at I_{CE} = 2A and the "Normalized DC Current Gain" graph given in the Motorola "Semiconductor Data Book," 5th Edition, pp. 7 – 232, 3.

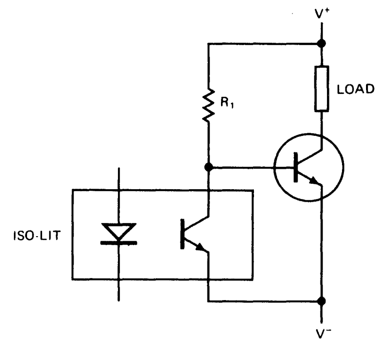


Figure 5A. NPN HV Booster

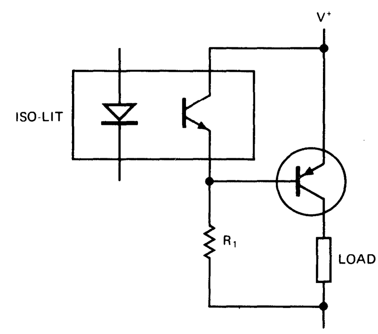


Figure 5B. PNP HV Booster

The value of R_1 depends only on the load-supply voltage $V^+ - V^-$, and the *maximum* required Q_1 base current. This is derived from the minimum beta of Q_1 at minimum temperature and the load current. The required current-drive capability is the same as I_{R1}, since I_{R1} changes negligibly when the circuit goes between its "ON" and "OFF" states.

In some applications either more current gain will be required than one transistor can provide or the power dissipated in R_1 will be objectionable. In these cases, simply use the Darlington high-voltage booster shown in Figure 6A.

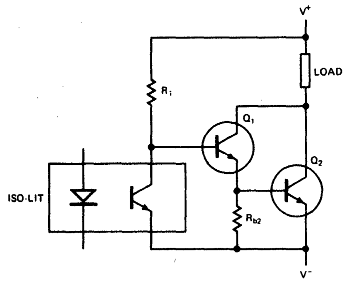


Figure 6A. NPN Darlington HV Booster

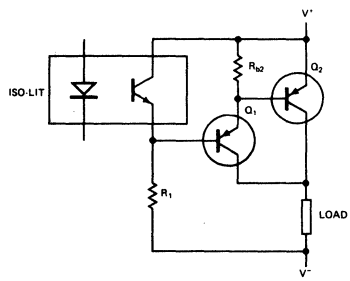


Figure 6B. PNP Darlington HV Booster

If more than one load is being driven and their negative terminals must be in common, use the PNP circuit, Figure 6B. Otherwise, the NPN is better because the transistors cost less. Of course performance characteristics of the NPN and PNP versions are identical if the device parameters are also the same.

APPLICATIONS

Iso-Lit isolated circuits are useful wherever ground loop problems exist in systems, or where dc voltage level translations are needed. In many systems so-called interpose relays are used between a logic circuit section (which may be a mini-computer) and the devices being controlled. Sometimes *two levels* of interpose relays are used in cascade either because of the load power level or because of extreme difficulties with EMI. Iso-Lits, aided by booster circuits such as those described, can replace many of the relays in these systems.

The reed relays, typically used as the first level of interpose and mounted on the interface logic cards in the electronic part of the system, are almost always replaceable by Iso-Lits since their load is just the coil of a larger relay. This relay may have a coil power of 1/2 to 5 watts and operate on 12, 24 or 48 volts dc.

Assuming worst-case design techniques are carefully followed, system reliability should improve in proportion to the number of relays replaced.

litronix
A Siemens Company

Appnote 5

MORE SPEED FROM ISO-LIT™ OPTICAL ISOLATORS

by David M. Barton

Figure 1 shows a typical circuit employing an Iso-Lit to transmit logic signals between electrically isolated parts of a system. In the circuit shown, the Iso-Lit must "sink" the current from one T^2L load plus a pull-up resistor. This load is roughly equivalent to a 4 kΩ resistor to V_{CC}. The resistor in series with the LED half of the Iso-Lit must supply the worst-case load current divided by the "current transfer ratio" or CTR of the Iso-Lit. If an Iso-Lit 1 is used, having a min CTR of 0.2, and 30 percent variation in the load is allowed, 8.1 mA is required. This is supplied by the 430Ω resistor.

The maximum repetition rate at which this circuit will operate is only about 3 kHz. The severe speed limitation is due entirely to the characteristics of the photo-transistor half of the Iso-Lit. This device has a large base-collector junction area and a very thick base region in order to make it sensitive to light. C_{ob} is typically 25 pF. This capacitance is, in the circuit of Figure 1, effectively multiplied by a large factor due to the "Miller effect." Also, because the base region volume is large, so is base storage time.

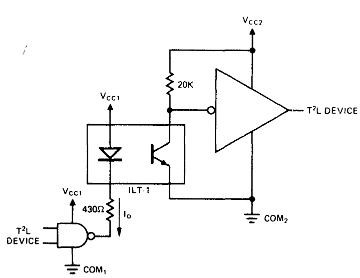


Figure 1

A very simple method of reducing both of these effects is to add a resistor between the base and emitter as shown in Figure 2. This resistor helps by reducing the time constant due to C_{ob} and by removing stored charge from the base region faster than recombination can. When a base-emitter resistor is used, of course, the required LED drive is increased since much of the photo-current generated in the base-collector junction is now deliberately "dumped."

Using this method does not usually result in a large power supply current drain since *average* repetition rate is low in most applications.

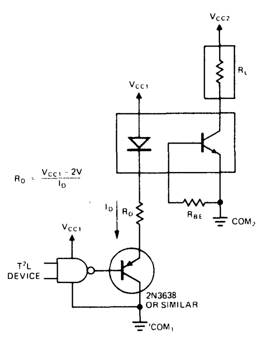


Figure 2

As drive is increased and R_{BE} reduced, turn-on time and turn-off time both decrease. The total amount of charge stored can also be reduced by decreasing the LED drive pulse duration. Also, as higher drive levels are used, the load resistance, R_L can be reduced to further enhance the speed of the circuit. These parameters are related to each other such that all should be changed together for best results.

One important generalization can be made concerning their interdependence. The LED drive pulse duration, T_{in}, output fall time, t_f, output rise time, t_r and propagation delay, t_p, should occur in a 1.5:1:1:1 ratio, approximately. If this relationship does not occur, the circuit will not operate at as high a repetition rate as it could at the same drive level. T_{out} equals T_{in} at low currents but stretches out at high currents.

Figure 3 is a graph relating the important parameters for a typical Iso-Lit 1 whose CTR is 0.25. The optimum values of T_{in}, R_{BE} and R_L are shown versus LED pulse current as are the resultant output pulse width and maximum full-swing frequency. Rise, fall and propagation time can be read as 2/3 of T_{in}.

Figure 3 shows that increasing drive to 200 mA and using optimum R_{BE} and R_L will increase the maximum repetition rate from 3 kHz to 500 kHz, a 167:1 improvement.

Lower grade isolators will behave similarly if the LED drive level is scaled appropriately to allow for a lower CTR.

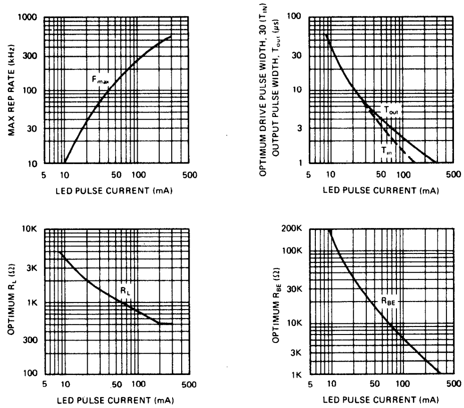


Figure 3. Parameters vs LED Pulse Current

Another method of increasing speed is to operate the photo-transistor as a photo-diode. In this method, bias voltage is supplied between the collector and base terminal, the emitter being unused. Operation to at least 10 MHz is possible this way, but the price is the need for external amplification. Figure 4 is a graph

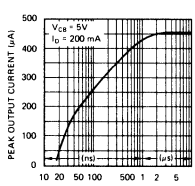


Figure 4. Diode Mode Output Current vs Drive Pulse Duration

showing peak output current versus drive pulse duration for 200 mA peak drive current.

Since output current is small, some type of wide-bandwidth amplifier must be employed in order to drive T^2L loads.

One simple solution for intermediate speed operation is the use of a low-power T^2L inverter (1/6 74L04). The collector of the photo-transistor is connected to its input along with a 100K pullup resistor. The base is connected to system output-side common. This inverter will in turn drive one 7400 series device.

Another device which will provide a good interface is an integrated comparator amplifier. The photo-transistor collector goes to V_{CC}. Its base has a 200Ω load resistor to ground and goes to one input of the comparator. Also, a resistor goes from this node to the minus supply. This resistor is chosen to supply 50 µA. The other comparator input is grounded. The voltage at the comparator input will switch from −10 mV to +10 mV or more when the diode turns on and the output will drive the T^2L loads.

Of course discrete-component amplifiers could be used and may be best in some applications.

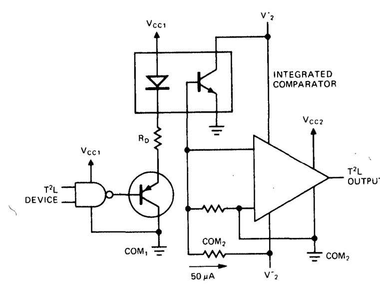


Figure 5

CONCLUSIONS

For operation to 500 kHz, the addition of a base-emitter resistor and a high-current driver is probably the best method of increasing Iso-Lit speed. Above 500 kHz one must revert to photodiode mode and use an external amplifier to drive most loads, particularly T^2L.

litronix
A Siemens Company

Appnote 6

OPERATING LED'S ON AC POWER

by David M. Barton

Introduction

Frequently it is desirable to operate LEDs on AC power rather than DC. Typically, the power source is 120 VRMS 60 Hz. The most obvious method is to rectify this power with a series diode and use a resistor to limit LED current as shown in Figure 1.

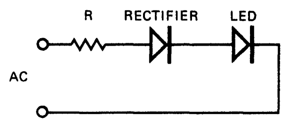


FIGURE 1. The Power Resistor Method

This method, though sound, results in very high power dissipation in the resistor since the LED operates on only 1.6 volts.

The Method

Figure 2 shows a better method. Here a capacitor is used to control LED current and a shunt silicon diode provides rectification.

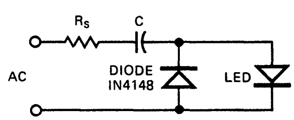


FIGURE 2.

Since, for current in either direction, voltage drop across the LED or rectifier is a negligible part of the supply voltage, current in the capacitor is almost exactly equal to the AC supply voltage divided by the reactance of the capacitor. Average capacitor current is then

1. $I_C\ (AV) = .9 \times VRMS/X_C$

   and average half-cycle LED or rectifier current is

2. $I_{LED\ (AV)} = 1/2\ I_D\ (AV) = .45\ VRMS/X_C$

   or, for 120 VRMS, 60 Hz operation,

3. $I_{LED\ (AV)} = 20\ mA \times C\mu F$

   or $C\mu F = \dfrac{I_{LED\ (AV)}}{20\ mA}$

Figure 3 shows the value of the series capacitor needed for a range of average LED currents assuming 60 Hz, 120 volt power.

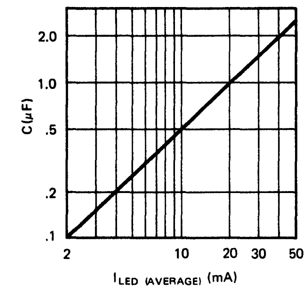


FIGURE 3. Series Capacitor Value vs Average LED Current for 120 VRMS 60 Hz.

A resistor is necessary in series with the capacitor to limit turn-on transient currents. A value of 100 ohms will be adequate in most cases.

The current in the LED, of course, flows almost exactly in quadrature with the line voltage. For this reason, power dissipation is low, being limited to the expected LED and rectifier power loss, the loss in series resistor and to losses in the capacitor. The latter term will be extremely low if high quality capacitors are used. Although power consumption of a circuit may not be of much significance in terms of the cost of the power, it certainly can be important to reduce heat generation within an enclosure.

If more than one LED is to be operated from the same source, simply put the LEDs in series in the same circuit, as shown in Figure 4. For small numbers of LEDs the current will be, for practical purposes, the same as for one.

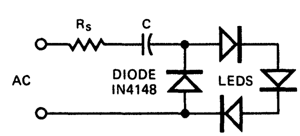


FIGURE 4.

Conclusion

Cost of the series capacitor (mylar) will be similar to the cost of a series power resistor. The shunt diode, a IN4148 or similar, will cost about two cents; much less than a series rectifier which must have a several hundred volt PIV rating.

So, the capacitor method is both lower in cost and lower in heat generation and power consumption than the resistor method.

litronix
A Siemens Company

Appnote 9A

APPLYING THE DL-1416 Intelligent Display™

by Dave Takagishi

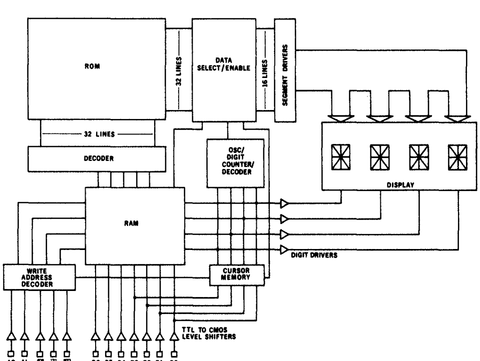
This application note is intended to serve as design and application guide for users of the DL-1416 Alphanumeric Display. The information presented covers: device electrical description and operation, considerations for general circuit designs, multi-digit display systems and interfacing to the 6800, Z80, and 8080 microprocessors.

The DL-1416 was designed to provide an easy-to-use alphanumeric display for the 64 character ASCII systems. Only twelve interconnect pins plus power and ground are needed to drive a single four digit display. The overall package is designed to allow end stacking of the DL-1416 to form any desired character length display.

ELECTRICAL DESCRIPTION

The on-board electronics of the DL-1416 eliminates all the traditional difficulties of using displays—segment decoding, driving, and multiplexing. The DL-1416 has gone further and provided internal memory for the four digits. This approach allows the user to address one of four digits, load the desired data asynchronously to the multiplex rate and continue.

Figure 1 is a block diagram of the circuitry in the DL-1416. The unit consists of a display and a single integrated circuit chip. The display is four 16-segment alphanumeric monolithic LED die magnified to a height of 160 mils. The IC chip contains the 16 segment drivers, 4 digit drivers, 64-character ROM, four-word 7-bit RAM, internal oscillator for multiplexing, multiplex counter/decoder, cursor RAM, write address decoder, and level shifters for the inputs.



INTERNAL SCHEMATIC
FIGURE 1

The inputs to the DL-1416 are:

$\overline{CE}$ CHIP ENABLE (active low)
This determines which device in an array will actually execute the loading of data. When the chip enable is in the high state, all inputs are inhibited.

A_0, A_1 DIGIT ADDRESS
The address to the DL-1416 determines the digit in which the data will be written. Address order is right-to-left for positive-true address.

D_0 - D_6 DATA LINES
The seven data input lines are designed to accept the 64 ASCII code set. See Table 1 for character set.

$\overline{W}$ WRITE (active low)
Data to be written into the DL-1416 must be present before the leading edge of write. The data and address must be stable until after the trailing edge.

$\overline{CU}$ CURSOR (active low)
When the $\overline{CU}$ is held low, the DL-1416 enables the user to write or remove a cursor in any digit position. The cursor function lights all 16 segments in the selected digits without erasing the data. After the cursor is removed, the digit will again display the previously written character.

V+ POSITIVE SUPPLY
TTL compatible + 5 volts

V− NEGATIVE SUPPLY
Ground

CHARACTER SET

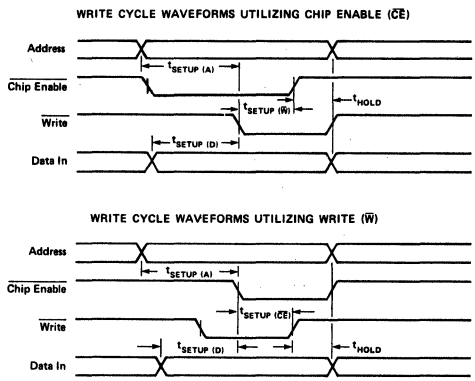
D6	D5	D4	D3 \ D0	L	H	L	H	L	H	L	H
			D1	L	L	H	H	L	L	H	H
			D2	L	L	L	L	H	H	H	H
L	H	L	L		!	"	#	$	%	&	'
L	H	L	H	(	)	*	+	,	-	.	/
L	H	H	L	0	1	2	3	4	5	6	7
L	H	H	H	8	9	:	;	<	=	>	?
H	L	L	L	@	A	B	C	D	E	F	G
H	L	L	H	H	I	J	K	L	M	N	O
H	L	H	L	P	Q	R	S	T	U	V	W
H	L	H	H	X	Y	Z	[	\	]	^	_

Note: All undefined codes will display a blank.

TABLE 1

OPERATION

Loading data into the DL-1416 is similar to writing into a RAM. The data and address must be present before the leading edge of the write signal ($\overline{W}$) and must be present until after the trailing edge. The waveforms of Figure 2 demonstrate the relationship of the signals required to generate a write cycle utilizing chip enable ($\overline{CE}$) and write ($\overline{W}$) (Check data sheet for minimum values).
As can be seen from the waveforms, $\overline{CE}$ and $\overline{W}$ are interchangeable. The true internal "write" function is formed by the "and-of-the-nots".



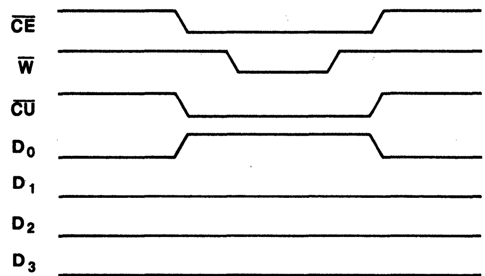
ADDRESS TABLE
FIGURE 2

Multiplexed display systems sequentially read and display data from a memory device. In *synchronous* systems, control circuitry must compare the location of data to be read and displayed to the location of new data to be stored, i.e. synchronize, before a write can be done. This can be slow if there are many memory locations. It can also be cumbersome.

Data entry of the DL-1416 is *asynchronous* and data may be stored in random order. Each digit will continue to display the character last "written" until replaced by another.

The cursor function causes all 16 segments of a digit to light. The cursor can indicate the position in the display of the next character to be entered. The cursor *is not* a character but overrides display of the stored character. Upon removal of the cursor, the display will again show the character stored in memory.

The cursor can be written into any digit position by enabling chip enable ($\overline{CE}$), cursor ($\overline{CU}$), the positional data, and a write ($\overline{W}$) signal. The position of the cursor will be dependent on which of the first four data lines (D_0, D_1, D_2, D_3) are held high. A high on data line D_0 will place a cursor display in the right-most digit and respectively a high on data line D_3 will place a cursor display in the left-most digit. The cursor can be loaded into, or erased from more than one position simultaneously by simply holding more than one data line high during the cursor write cycle.



CURSOR WRITE CYCLE
FIGURE 3

The cursor will remain displayed after the cursor ($\overline{CU}$) and write ($\overline{W}$) signals have been removed. The wave forms in Figure 3 show a cursor being placed in Digit 0 and erased from Digit 1, Digit 2, and Digit 3 simultaneously.

Hardwiring the cursor (CU) line high is not recommended. This internal cursor memory will be randomly loaded on power-up and all positions must be cleared before a cursor-free display is ensured.

GENERAL CIRCUIT DESIGN CONSIDERATIONS

Using positive-true address logic, address order is from right to left. For left to right address order, use the "ones-complement" or simple inversion of the addresses.

For systems with only a 6 bit ASCII code format, data line D_6 cannot be left open. Data D_6 must be the complement of data line D_5. If an illegal code is loaded into the DL-1416, it will display a blank in the digit accessed.

A "display test" function can be realized by simply storing a cursor in all digits simultaneously. This is done by holding D_0, D_1, D_2 and D_3 high and $\overline{CU}$ low during a cursor write cycle. The same operation, with the data lines low will end "display test".

Because of the random state of the cursor RAM after power up, it is necessary to clear it initially to assure that all the cursors are off.

When using DL-1416's on a separate display board having more than two feet of cable length, it may be necessary to buffer all DL-1416 inputs. This is most easily achieved with hex-non-inverting buffers such as 74365 IC's. The object is to prevent transient current in the DL-1416 protection diodes. The buffers should be located on the display board near the DL-1416's. Local power supply bypass capacitors are also needed in many cases. These should be 6 or 10 volt tantalum type having 10μF or greater capacitance. Low internal resistance is important to eliminate voltage transients due to the current steps which result from the internal multiplexing of the DL-1416.

If small wire cables are used, it is good engineering practice to calculate the wire resistance of the ground plus the +5 volt wires. More than 0.1 volt drop (at 25mA per digit worst case) should be avoided, since this loss is in addition to any inaccuracies or load regulation limitations of the power supply.
limitations of the power supply.

GENERAL INTERFACE

The most general and straight-forward interface approach would be to use the parallel I/O device of a microprocessor. This interface scheme can be completely software dependent. One eight bit output port can handle the seven input data bits and the cursor. Another eight bit output port can contain the address and chip enable information with one bit reserved for the write signal.

An 8080 system shown in Figure 4 illustrates a 16 character display using a 8255 programmable peripheral interface I/O device with a 7442 one-of-ten decoder added for ease of programming. The following program will display a simple 16 character message using the parallel I/O interface.

```
INIT:    MVI A, 80H;      control data mode 0
         OUT CONTROL;     load control register
CUSR:    MVI A, 00H;      clear cursor data
         OUT PORTA;       load data port
         MVI B, OFH;      set counter
CUSR1:   MOV A, B
         CALL DSPWT;      write subroutine
         DCR B;           decrement counter
         JNZ CUSR1;       16 characters
DISP:    LXI H, TABLE;    set table
DISP1:   MOV A, M
         OUT PORTA;       load data output
         MOV A, B
         CALL DSPWT;      load address & write
         INX H;           increment table address
         INR B;           increment counter
         MVI A, 10H;      set # of digits
         CMP B
         JNZ DISP1;       16 characters
         HLT;             end of program
DSPWT:   ORI 80H;         set write bit off
         OUT PORTB;       load address
         ANI 7FH;         set write bit on
         OUT PORTB;       load write
         ORI 80H;         set write bit off
         OUT PORTB;       load write
         RET
TABLE:   DB               OC3H
         DB               OC9H
         DB               OD4H
         DB               OD3H
         DB               OC1H
         DB               OD4H
         DB               OCEH
         DB               OC1H
         DB               OC6H
         DB               OAOH
         DB               OD3H
         DB               OD4H
         DB               OC8H
         DB               OC7H
         DB               OC9H
         DB               OCCH
```

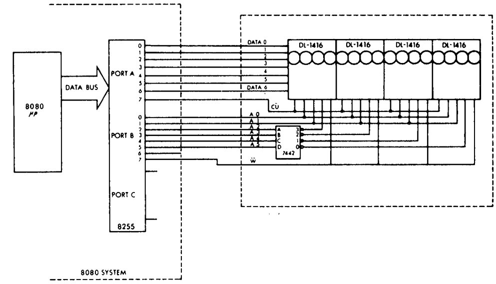


FIGURE 4

I/O OR MEMORY MAPPED ADDRESSING

Some designers may wish to avoid the additional cost of a parallel I/O device in their system. Structuring the addressing architecture for the DL-1416 to look like a set of output devices (I/O mapped) or RAM's, ROM's (memory mapped) is ideal. However, the set-up and hold times of the DL-1416 are too slow for some present µP's running at maximum speed.

To operate at maximum clock rates, the processor must be made to pause for the required display write cycle interval.

DL 1416/8080 INTERFACE

Microprocessors like the 8080 and Z80 have the ability to generate "wait states" for use with relatively slow memories. Figure 5 shows a circuit which utilizes "wait states" to interface the DL-1416 display to an 8080 system with a T cycle = 500 nS.

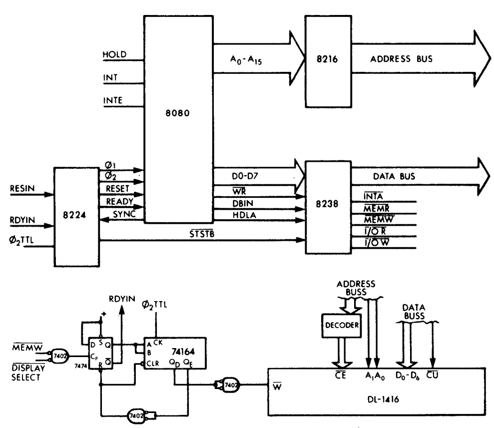


FIGURE 5

The signal $\overline{MEMW}$ • $\overline{DISPLAY\ SELECT}$ defines a DL-1416 display write cycle and initiates the RDYIN signal. $\overline{MEMW}$ alone would generate wait states for all write cycles and would slow down total computation. The shift register, 74164, is useful for generating a DL-1416 write signal which meets the setup times for different processor clock rates. The timing diagram, Figure 6, illustrates the relationship between write, wait, and DL-1416 write.

*Note: System controller 8238 required for an early MEMW signal.

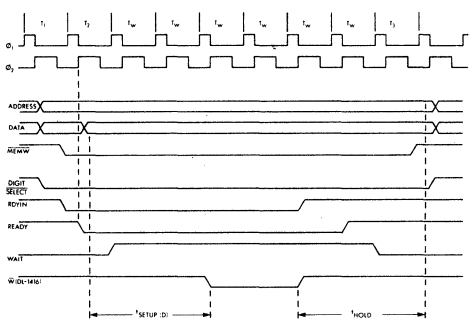


FIGURE 6

DL-1416/Z80 INTERFACE

The organization of the Z80 is very similar to the 8080 processor. Both processors utilize wait states for slow memory and, as can be seen in Figure 7, the interface can be identical to the 8080 System. For T cycle = 500 nS, only signal names are different.

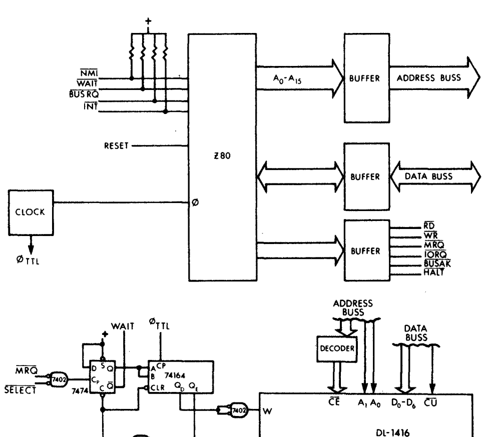


FIGURE 7

DL-1416/6800 Interface

For processors such as the 6800 that do not have wait state capability, clock pulse stretching techniques can be used. Microprocessor clocks such as the Motorola MC6871B have the ability to hold either Ø1 or Ø2. Figure 8 uses the same interface techniques as for the 8080 and Z80. The signal $\overline{H2}$ extends the Ø2 clock. All address and data lines will remain valid until $\overline{H2}$ is released. $\overline{H2}$ was taken from the output of the first stage of the shift register in this case to synchronize with Ø2; otherwise a narrow Ø1 may result.

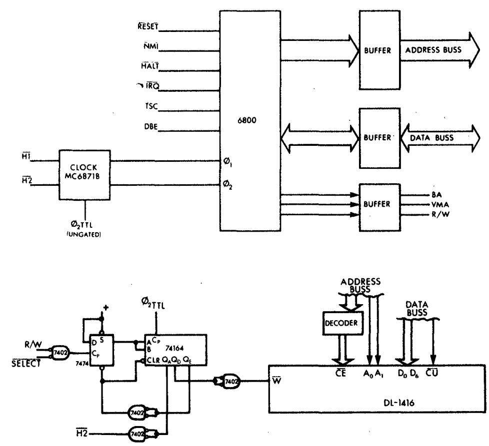
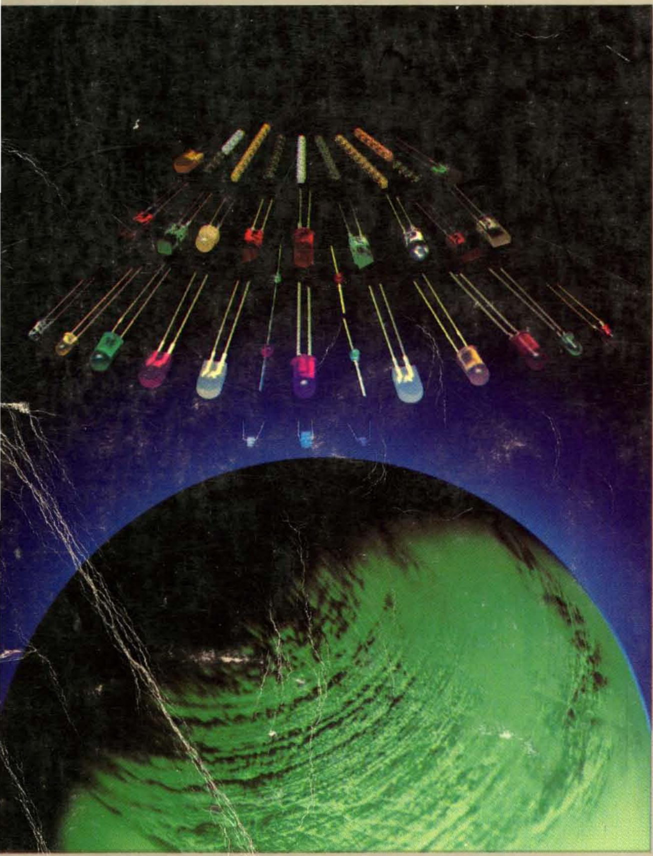


FIGURE 8

CONCLUSION

The interface schemes shown demonstrate the general simplicity of DL-1416 use with microprocessors. The differences among the examples are in providing proper write signals. Because of the setup and hold times of the DL-1416, many microprocessor systems will require some type of interface circuitry for compatibility. The techniques used in these examples were chosen for their versatility in accepting a wide range of clock rates. The user will undoubtedly invent other schemes to optimize his particular system to its requirements.

This application note is not intended to imply specific endorsement or warranty of other manufacturer's products by Litronix.



Litronix A Siemens Company

Litronix, Inc., 19000 Homestead Road, Cupertino, California 95014 • Telephone (408) 257-7910 / TWX 910-338-0022