Raytheon Company
Semiconductor Division

Raytheon

Product Selection Guide

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DESC SMD Drawings

SMD#	38510 BASIC	RAYTHEON P/N	COMPETITOR'S QPL STATUS						
			PMI	SIG.	LTC	AMD	HARRIS	MICRO PWR.	TI
PROM									
7902401JA		R29633DM/883B							
82008013A		R29671LM/883B		X		X			
8200801JA		R29671DM/883B		X		X			
8200801LA		R29671SM/883B							
82008043A		R29671ALM/883B							
8200804JA		R29671ADM/883B							
8200804LA		R29671ASM/883B							
LINEAR									
7700801CA	11201	LM139D/883B	X	X					
7705001CA		XR2211D/883B							
7705401CA		RM4194DC/883B							
7704301CA	11005	LM124D/883B		X					X
8203601GA	13501	OP07AT/883B	X					X	
8203601PA	13501	OP07AD/883B					X	X	
8203602GA	13502	OP07T/883B	X					X	
8203602PA	13502	OP07D/883B					X	X	
8551401GA		REF02AT/883B	X		X				
8551401PA		REF02AD/883B	X		X				
5962-8687901EA		RM3182S/883B					X		
5962-8958101GA		REF01AT/883B							
5962-8958101PA		REF01AD/883B							
5962-8958102GA		REF01T/883B							
5962-8958102PA		REF01D/883B							
5962-8773801GA		OP77BT/883B	X		X				
5962-8773801PA		OP77BD/883B	X		X				
5962-8773802GA		OP77AT/883B	X		X				
5962-8773802PA		OP77AD/883B	X		X				
5962-8853701GA		OP37AT/883B	X		X			X	
5962-8853701PA		OP37AD/883B	X		X			X	
5962-8853702GA		OP37BT/883B	X					X	
5962-8853702PA		OP37BD/883B	X					X	
5962-8853703GA		OP37CT/883B	X		X			X	
5962-8853703PA		OP37CD/883B			X			X	

Raytheon QPL Approval Status Per M38510 Per QPL-38510-79 Dated November 1989

M38510 P/N	RAYTHEON P/N	RAYTHEON QPL STATUS	COMPETITOR'S QPL STATUS					
			NAT.	PMI	SIG.	LTC	MOT.	SGS
10101BCA	MM0741 DCA	I	I					
10101BCC	MM0741 DCC	I						
10101BGA	MM0741 TEA	I	I	I				
10101BGC	MM0741 TEC	I						
10101BPA	MM0741 DEA	I	I					
10101BPC	MM0741 DEC	I						
10102BAC	MM0747 CJC	I						
10102BCA	MM0747 DCA	I	I					
10102BCC	MM0747 DCC	I						
10102BIA	MM0747 TFA	I	I					
10102BIC	MM0747 TFC	I	I					
10103BCA	MM0101ADCA	I	I			I		
10103BCC	MM0101ADCC	I						
10103BGA	MM0101ATEA	I	I			I		I
10103BGC	MM0101ATEC	I				I		
10103BHC	MM0101ACQC	I	I (BHA)			I (BHA)		
10103BPA	MM0101ADEA	I	I					
10103BPC	MM0101ADEC	I						
10104BGC	MM0108ATEC	I		I		I		
10104BGA	MM0108ATEA	I	I	I		I		
10104BPC	MM0108ADEC	I		I (BPB)				
10104BPA	MM0108ADEA	I	I	I		I		
10105BEA	MM2101ADMA	I	I		I			I
10105BEC	MM2101ADMC	I	I					
10106BEC	MM2108ADMC	I	I (BEC)	I (BEB)				
10106BEA	MM2108ADMA	I	I	I		I		
10304BCC	MM0111 DFC	I		I (BCB)				
10304BCA	MM0111 DFA	I	I	I				
10304BGA	MM0111 TEA	I	I	I				I
10304BGC	MM0111 TEC	I						
10304BHC	MM0111 CQC	I	I (BHA)					
10304BPA	MM0111 DEA	I	I	I				
10304BPC	MM0111 DEC	I		I (BPB)				
10305BEA	MM2111 DMA	I	I					
10305BEC	MM2111 DMC	I						
11001BCA	MM0148 DCA	I	I					
11001BCC	MM0148 DCC	I						
11003BCA	MM4156 DCA	I						
11003BCC	MM4156 DCC	I						
11004BCA	MM4136 DCA	I	I	I				
11004BCC	MM4136 DCC	I		I (BCB)				
11005BCA	MM0124 DCA	I	I		I			
11005BCC	MM0124 DCC	I						
11201BAC	MM0139 CJC	I						
11201BCA	MM0139 DCA	I	I	I	I		I	
11201BCC	MM0139 DCC	I		I (BCB)				
11301BEA	MM4818 DMA	I		I				
11301BEC	MM4818 DMC	I		I (BEB)				
11302BEA	MM4818ADMA	I		I				
11302BEC	MM4818ADMC	I		I (BEB)				
13101BGA	MM5534ATEA	I						
13101BGC	MM5534ATEC	I						
13101BPA	MM5534ADEA	I						
13101BPC	MM5534ADEC	I						
13102BPC	MM5532ADHC	I						
13102BPA	MM5532ADHA	I						
13501BPA	MM4807ADEA	I		I		I		
13501BPC	MM4807ADEC	I		I (BPB)				
13501BGA	MM4807ATEA	I		I		I		
13501BGC	MM4807ATEC	I		I		I		
13502BPA	MM4807 DEA	I		I		I		
13502BPC	MM4807 DEC	I		I (BPB)				
13502BGA	MM4807 TEA	I		I		I		
13502BGC	MM4807 TEC	I		I		I		
20902BVA	JR29651DQ	I			I			
20902BVC*	JR29651MQ	I						
20904BJA	JR29631DR	I			I			
20904BJC*	JR29631MR	I						
21002BJA	JR29681DR	I			I			
21002BJC*	JR29681MR	I						

* "C" Finish: Consult factory — lead finish being discontinued

Ordering Information

Raytheon Series

RM 4077 A L /883B

Temperature Range
RM = Military -55°C to +125°C
RV = Industrial -25°C to +85°C
RC = Commercial 0°C to +70°C

Basic Part Type
Four digits max

Electrical Grade
See data sheet

Package Type

High Reliability Processing
(Optional)

*Temperature range may be extended to -35°C or -40°C for specific device types

LT-Series & DAC-Series

DAC - 6012 A M D /883B

Prefix: DAC = D/A Converter
LT = Industry Type (2nd Source)

Basic Part Type
Four digits max

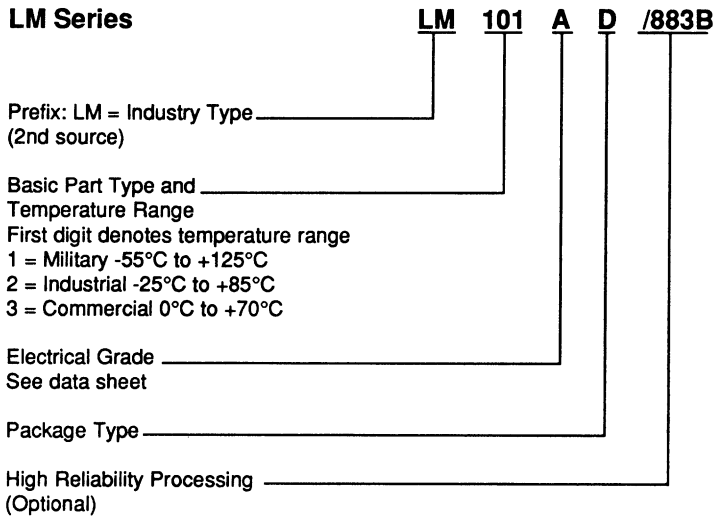
Electrical Grade
See data sheet

Temperature Range
M = Military -55°C to +125°C
C = Commercial 0°C to +70°C

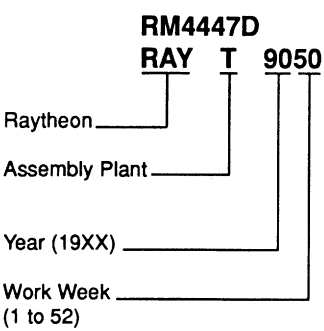
Package Type

High Reliability Processing
(Optional)

LM Series



Branding Codes



Package Codes

CH	Waffle-Packed Dice
CW	Chip in Wafer Form
D	Ceramic Dual In-Line Package (DIP)
H	Metal Can (epoxy die attach)
K	9-Lead Metal Can Power Package
L	Ceramic Leadless Chip Carrier (LCC)
M	Small Outline Package (SOIC)
N	Plastic DIP
S	Sidebraze Ceramic DIP
T	Metal Can (eutectic die attach)

Refer to the individual data sheet or to the Packaging Information for outline dimensions.

See page 2-2 for PROM ordering information.

Section 1

Cross References

General Cross References

INDUSTRY TYPE	RAYTHEON DIRECT REPLACEMENT	RAYTHEON FUNCTIONAL REPLACEMENT
ADVFC32		RC4153
ADOP07	OP-07	
ADOP27	OP-27	
ADOP37	OP-37	
ADREF01	REF-01	
ADREF02	REF-02	
AD101	LM101	
AD558		DAC-4888
AD581		REF-01
AD586		REF-02
AD647		RC4207
AD654		RC4152
AD707		RC4077
AD708		RC4277
AD741	RC741	
AD767		DAC-4881
AM686		RC4805
CA124	LM124	
CA324	LM324	
CA139	LM139	
CA339	LM339	
CA741	RC741	
CS3842		RC4190
CMP-04		LM139
CMP-05		RC4805
DAC-08	DAC-08	
DAC-10	DAC-10	
DAC-80		DAC-4881
DAC-100		DAC-10
DAC0800	DAC-08	
DAC0801	DAC-08	
DAC1208		DAC-4881
DAC1230		DAC-4881
DAC8222		DAC-4881
HA-OP27	OP-07	
HA-OP27	OP-27	
HA-OP37	OP-37	
HA-3182	RM3182	

INDUSTRY TYPE	RAYTHEON DIRECT REPLACEMENT	RAYTHEON FUNCTIONAL REPLACEMENT
HA-4741	RC4741	
HA-5147		OP-47
HSOP07	OP-07	
HSOP27	OP-27	
HSOP37	OP-37	
ICL7660		RC4391
ICL7680		RC4190
ICL8013		RC4200
LH2101	LH2101	
LH2108	LH2108	
LH2111	LH2111	
LM101	LM101	
LM111	LM111	
LM108	LM108	
LM124	LM124	
LM148	LM148	
LM324	LM324	
LM331		RC4152
LM348	LM348	
LM368-5.0		REF-02
LM368-10		REF-01
LM369		REF-01
LM607		RC4077
LM741	RC741	
LM833	RC5532	
LM1458		RC4558
LM1851	LM1851	
LM1851		RC4145
LM2900	LM2900	
LM2901		LM339
LM2902		LM324
LM3900	LM3900	
LP165	LP165	
LP365	LP365	
LT-1001	LT-1001	
LT-1019		REF-01
LT-1019		REF-02
LT-1024		RC4207
LT-1028		OP-37
LT-1054		RC4391

General Cross References (Continued)

INDUSTRY TYPE	RAYTHEON DIRECT REPLACEMENT	RAYTHEON FUNCTIONAL REPLACEMENT
LT-1070		RC4190
LT-1084		RC4292
MAX400		RC4077
MAX630	RC4193	
MAX630		RC4190
MAX634	RC4391	
MC1741	RC741	
MC1747	RC747	
MC3403	RC3403	
MC4558	RC4558	
MC4741	RC4741	
MPREF01	REF-01	
MPREF02	REF-02	
MPOP07	OP-07	
MPOP27	OP-27	
MPOP37	OP-37	
MP108	LM108	
NE5532	RC5532	
NE5534	RC5534	
OPA27		OP-27
OPA37		OP-37
OP-02		RC741
OP-04		RC747
OP-07	OP-07	
OP-14		RC4558
OP-27	OP-27	
OP-37	OP-37	
OP-77	OP-77	
OP-200		RC4207, RC4277
OP-207		RC4207
OP-227		RC4227
OP-270		RC4227
PM-108	LM108	
PM-139	LM139	
PM-148	LM148	
PM-339	LM339	
PM-348	LM348	
PM-741	RC741	
PM-747	RC747	
RC4136	RC4136	
RC4151	RC4151	
RC4152	RC4152	
RC4558	RC4558	
RC4559	RC4559	
REF-01	REF-01	
REF-02	REF-02	
REF-05		REF-02
REF-10		REF-01
SE5534		RC5534
SG101	LM101	
SG124	LM124	
SG741	RC741	
SI-9100		RC4292
SSM-2134		RC5534
TA7504	RC741	
TA75339	LM339	
TL494		RC4190
TL496		RC4190
TL497		RC4190
TL510		RC4805
TSC9400		RC4151
TSC9401		RC4151
TSC9402		RC4151
UC1842		RC4292
VFC-32		RC4153
XR-2207	RM2207	
XR-2208		RC4200
XR-2211	RM2211	
XR-3403	RC3403	
XR-4136	RC4136	
XR-4194	RC4194	
XR-4195	RC4195	
XR-5532	RC5532	
XR-5534	RC5534	
µA101	LM101	
µA108	LM108	
µA111	LM111	
µA124	LM124	
µA139	LM139	
µA148	LM148	
µA324	LM324	
µA339	LM339	
µA348	LM348	
µA741	RC741	
µA747	RC747	

Precision Operational Amplifier Cross Reference

ANALOG DEV.	RAYTHEON	PACKAGE
AD OP-07AH	*OP-07AT	TO-99
AD OP-07AH/883	*OP-07AT/883B	TO-99
AD OP-07CN	*OP-07CN	PLASTIC
AD OP-07CR	*OP-07CM	SO-8
AD OP-07Q/883	*OP-07D/883B	CERAMIC
AD OP-07DN	*OP-07DN	PLASTIC
AD OP-07EN	*OP-07EN	PLASTIC
AD OP-07H	*OP-07T	TO-99
AD OP-07H/883	*OP-07T/883B	TO-99
AD OP-07Q	*OP-07D	CERAMIC
AD OP-07AQ	*OP-07AD	CERAMIC
AD OP-07AQ/883B	*OP-07AD/883B	CERAMIC
AD OP-27AH	OP-27AT	TO-99
AD OP-27AH/883	OP-27AT/883B	TO-99
AD OP-27AQ	OP-27AD	CERAMIC
AD OP-27AQ/883	OP-27AD/883B	CERAMIC
AD OP-27BH	OP-27BT	TO-99
AD OP-27BH/883	OP-27BT/883B	TO-99
AD OP-27BQ	OP-27BD	CERAMIC
AD OP-27BQ/883	OP-27BD/883B	CERAMIC
AD OP-27CH	OP-27CT	TO-99
AD OP-27CH/883	OP-27CT/883B	TO-99
AD OP-27CQ	OP-27CD	CERAMIC
AD OP-27CQ/883	OP-27CD/883B	CERAMIC
AD OP-27EN	OP-27EN	PLASTIC
AD OP-27FN	OP-27FN	PLASTIC
AD OP-27GN	OP-27GN	PLASTIC
AD OP-37AE	OP-37AL	LCC
AD OP-37AE/883	OP-37AL/883B	LCC
AD OP-37AH	OP-37AT	TO-99
AD OP-37AH/883	OP-37AT/883B	TO-99
AD OP-37AQ	OP-37AD	CERAMIC
AD OP-37AQ/883	OP-37AD/883B	CERAMIC
AD OP-37BH	OP-37BT	TO-99
AD OP-37BH/883	OP-37BT/883B	TO-99
AD OP-37BQ	OP-37BD	CERAMIC
AD OP-37BQ/883	OP-37BD/883B	CERAMIC
AD OP-37CH	OP-37CT	TO-99
AD OP-37CH/883	OP-37CT/883B	TO-99
AD OP-37CQ	OP-37CD	CERAMIC
AD OP-37CQ/883	OP-37CD/883B	CERAMIC
AD OP-37EN	OP-37EN	PLASTIC
AD OP-37FN	OP-37FN	PLASTIC
AD OP-37GN	OP-37GN	PLASTIC
AD707AQ	*RC4077FD	CERAMIC
AD707CH	*RM4077AT	TO-99
AD707CH/883	*RM4077AT/883B	TO-99
AD707CQ	*RM4077AD	CERAMIC
AD707CQ/883	*RM4077AD/883B	CERAMIC
AD707JN	*RC4077FN	PLASTIC
AD707JR	*RC4077FM	SO-8
AD707KN	*RC4077EN	PLASTIC
AD707KR	*RC4077EM	SO-8
AD707SH	*RC4077AT	TO-99
AD707SH/883B	*RC4077AT/883B	TO-99
AD707SQ	*RC4077AD	CERAMIC
AD707SQ/883	*RC4077AD/883B	CERAMIC
AD707TH	*RC4077AT	TO-99
AD707TH/883B	*RC4077AT/883B	TO-99
AD707TQ	*RC4077AD	CERAMIC
AD707TQ/883	*RC4077AD/883B	CERAMIC

BURR BROWN	RAYTHEON	PACKAGE
OPA27AJ/883	*OP-27AT/883B	TO-99
OPA27BJ/883	*OP-27BT/883B	TO-99
OPA27CJ	*OP-27CT/883B	TO-99
OPA27AJ	*OP-27AT	TO-99
OPA27AZ	*OP-27AD	CERAMIC
OPA27BJ	*OP-27BT	TO-99
OPA27BZ	*OP-27BD	CERAMIC
OPA27CJ	*OP-27CT	TO-99
OPA27CZ	*OP-27CD	CERAMIC
OPA27EP	*OP-27EN	PLASTIC
OPA27FP	*OP-27FN	PLASTIC
OPA27GP	*OP-27GN	PLASTIC
OPA27GU	*OP-27GM	SO-8
OPA27GZ	*OP-27GD	CERAMIC
OPA27AZ/883	*OP-27AD/883B	CERAMIC
OPA27BZ/883	*OP-27BD/883B	CERAMIC
OPA27CZ/883	*OP-27CD/883B	CERAMIC
OPA37AJ	*OP-37AT	TO-99
OPA37AJ/883	*OP-37AT/883B	TO-99
OPA37AZ	*OP-37AD	CERAMIC
OPA37AZ/883	*OP-37AD/883B	CERAMIC
OPA37BJ	*OP-37BT	TO-99
OPA37BJ/883	*OP-37BT/883B	TO-99
OPA37BZ	*OP-37BD	CERAMIC
OPA37BZ/883	*OP37-BD/883B	CERAMIC
OPA37CJ	*OP-37CT	TO-99
OPA37CJ/883	*OP-37CT/883B	TO-99
OPA37CJ/883	*OP-37CD/883B	CERAMIC
OPA37CZ	*OP-37CD	CERAMIC
OPA37EP	*OP-37EN	PLASTIC
OPA37FP	*OP-37FN	PLASTIC
OPA37GP	*OP-37GN	PLASTIC
OPA37GU	*OP-27GM	SO-8

* Denotes functionally equivalent types.

Precision Operational Amplifier Cross Reference (Continued)

LTC	RAYTHEON	PACKAGE
OP-07AH	OP-07AT	TO-99
OP-07AH/883B	OP-07AT/883B	TO-99
OP-07AJ8	OP-07AD	CERAMIC
OP-07AJ8/883B	OP-07AD/883B	CERAMIC
OP-07CN8	OP-07CN	PLASTIC
OP-07CS8	OP-07CM	SO-8
OP-07EN8	OP-07EN	PLASTIC
OP-07H	OP-07T	TO-99
OP-07H/883B	OP-07T/883B	TO-99
OP-07J8	OP-07D	CERAMIC
OP-07J8/883B	OP-07D/883B	CERAMIC
OP-27AH	OP-27AT	TO-99
OP-27AH/883B	OP-27AT/883B	TO-99
OP-27AJ8	OP-27AD	CERAMIC
OP-27AJ8/883B	OP-27AD/883B	CERAMIC
OP-27CH	OP-27CT	TO-99
OP-27CH/883B	OP-27CT/883B	TO-99
OP-27CJ8	OP-27CD	CERAMIC
OP-27CJ8/883B	OP-27CD/883B	CERAMIC
OP-27EN8	OP-27EN	PLASTIC
OP-27GN8	OP-27GN	PLASTIC
OP-37AH	OP-37AT	TO-99
OP-37AH/883B	OP-37AT/883B	TO-99
OP-37AJ8	OP-37AD	CERAMIC
OP-37AJ8/883B	OP-37AD/883B	CERAMIC
OP-37CH	OP-37CT	TO-99
OP-37CH/883B	OP-37CT/883B	TO-99
OP-37CJ8	OP-37CD	CERAMIC
OP-37CJ8/883B	OP-37CD/883B	CERAMIC
OP-37EN8	OP-37EN	PLASTIC
OP-37GN8	OP-37GN	PLASTIC

LTC	RAYTHEON	PACKAGE
LM108AH	LM108AT	TO-99
LM108AH/883B	LM108AT/883B	TO-99
LM108AJ8/883B	LM108AD/883B	CERAMIC
LM108H	LM108T	TO-99
LM108H/883B	LM108T/883B	TO-99
LM108J8/883B	LM108D/883B	CERAMIC
LT1001ACH	LT-1001ACT	TO-99
LT1001ACN8	LT-1001ACN	PLASTIC
LT1001AMH/883B	LT-1001AMT/883B	TO-99
LT1001AMJ8	LT-1001AMD	CERAMIC
LT1001AMJ8/883	LT-1001AMD/883B	CERAMIC
LT1001CH	LT-1001CT	TO-99
LT1001CN8	LT-1001CN	PLASTIC
LT1001CS8	LT-1001CM	SO-8
LT1001MH	LT-1001MT	TO-99
LT1001MH/883B	LT-1001MT/883B	TO-99
LT1001MJ8	LT-1001MD	CERAMIC
LT1001MJ8/883B	LT-1001MD/883B	CERAMIC
OP-227EN	*RC4227FN	PLASTIC
OP-227GN	*RC4227GN	PLASTIC
OP-227AJ	*RM4227BD	CERAMIC
OP-227AJ/883B	*RM4227BD/883B	CERAMIC

*Denotes functionally equivalent types.
NOTE: LTC OP-227 contains two die in a 14-pin package.
Raytheon's 4227 is a monolithic IC in an 8-pin package.

Precision Operational Amplifier Cross Reference (Continued)

PMI	RAYTHEON	PACKAGE
OP07AJ	OP-07AT	TO-99
OP07AJ/883	OP-07AT/883B	TO-99
OP07AZ	OP-07AD	CERAMIC
OP07AZ/883	OP-07AD/883B	CERAMIC
OP07CP	OP-07CN	PLASTIC
OP07CS	OP-07CM	SO-8
OP07DP	OP-07DN	PLASTIC
OP07DS	OP-07DM	SO-8
OP07EP	OP-07EN	PLASTIC
OP07J	OP-07T	TO-99
OP07J/883	OP-07T/883B	TO-99
OP07RC/883	OP-07L/883B	LCC
OP07Z	OP-07D	CERAMIC
OP07Z/883	OP-07D/883B	CERAMIC
OP27AJ	OP-27AT	TO-99
OP27AJ/883	OP-27AT/883B	TO-99
OP27AZ	OP-27AD	CERAMIC
OP27AZ/883	OP-27AD/883B	CERAMIC
OP27BJ	OP-27BT	TO-99
OP27BJ/883	OP-27BT/883B	TO-99
OP27BRC/883	OP-27BL/883B	LCC
OP27BZ	OP-27BD	CERAMIC
OP27BZ/883	OP-27BD/883B	CERAMIC
OP27CJ	OP-27CT	TO-99
OP27CJ/883	OP-27CT/883B	TO-99
OP27CZ	OP-27CD	CERAMIC
OP27CZ/883	OP-27CD/883B	CERAMIC
OP27EP	OP-27EN	PLASTIC
OP27FP	OP-27FN	PLASTIC
OP27FS	OP-27FM	SO-8
OP27GS	OP-27GM	SO-8
OP27GP	OP-27GN	PLASTIC
OP37AJ	OP-37AT	TO-99
OP37AJ/883	OP-37AT/883B	TO-99
OP37AZ	OP-37AD	CERAMIC
OP37AZ/883	OP-37AD/883B	CERAMIC
OP37BJ	OP-37BT	TO-99
OP37BJ/883	OP-37BT/883B	TO-99
OP37BRC/883	OP-37BL/883B	LCC
OP37BZ	OP-37BD	CERAMIC
OP37BZ/883	OP-37BD/883B	CERAMIC
OP37CJ	OP-37CT	TO-99
OP37CJ/883	OP-37CT/883B	TO-99
OP37CZ	OP-37CD	CERAMIC
OP37CZ/883	OP-37CD/883B	CERAMIC
OP37EP	OP-37EN	PLASTIC
OP37FP	OP-37FN	PLASTIC

PMI	RAYTHEON	PACKAGE
OP77AJ	OP-77AT	TO-99
OP77AJ/883	OP-77AT/883B	TO-99
OP77AZ	OP-77AD	CERAMIC
OP77AZ/883	OP-77AD/883B	CERAMIC
OP77BJ	OP-77BT	TO-99
OP77BJ/883	OP-77BT/883B	TO-99
OP77BRC/883	OP-77BL/883B	LCC
OP77BZ	OP-77BD	CERAMIC
OP77BZ/883	OP-77BD/883B	CERAMIC
OP77EP	OP-77EN	PLASTIC
OP77FP	OP-77FN	PLASTIC
OP77FS	OP-77FM	SO-8
OP77GP	OP-77GN	PLASTIC
OP77GS	OP-77GM	SO-8
PM108AZ	LM108AD	CERAMIC
PM108AZ/883	LM108AD/883B	CERAMIC
PM108AJ	LM108AT	TO-99
PM108AJ/883	LM108AT/883B	TO-99
PM108ARC	LM108AL	LCC
PM108ARC/883	LM108AL/883B	LCC
PM108DZ	LM108D	CERAMIC
PM108DZ/883	LM108D/883B	CERAMIC
PM108J	LM108T	TO-99
PM108J/883	LM108T/883B	TO-99
PM2108AQ	LH2108AD	CERAMIC
PM2108AQ/883	LH2108AD/883B	CERAMIC
PM2108Q	LH2108D	CERAMIC
PM2108Q/883	LH2108D/883B	CERAMIC
OP207AY/883	*RM4207BD/883B	CERAMIC
OP207AY	*RM4207BD	CERAMIC
OP227AY	*RM4227BD	CERAMIC
OP227AY/883	*RM4227BD/883B	CERAMIC
OP227BY/883	*RM4227BD/883B	CERAMIC
OP227GY	*RC4227GN	PLASTIC

* Denotes functionally equivalent types.
NOTE: PMI's OP207/227 contains two die in a 14-pin package. Raytheon's 4207/4227 is a monolithic IC in an 8-pin package.

General Purpose Operational Amplifier Cross Reference

Raytheon	PMI	FSC	AMD	Motorola	National	RCA	Signetics	T.I.
LH2101A			LH2101A		LH2101A		LH2101A	
LH2111			LH2111		LH2111			
LM101A		µA101A	LM101A	LM101A	LM101A	CA101A	LM101A	
LM111		µA111	LM111	LM111	LM111	CA111	LM111	
LM124		µA124	LM124	LM124	LM124	CA124	LM124	LM124
LM139	PM139	µA139	LM139	LM139	LM139	CA139	LM139	LM139
LM148	PM148	µA148	LM148		LM148		LM148	
LM301A		µA301A	LM301A	LM301A	LM301A	CA301A	LM301A	LM301A
LM324		µA324	LM324	LM324	LM324	CA324	LM324	LM324
LM339	PM339	µA339	LM339	LM339	LM339	CA339	LM339	LM339
LM348		µA348	LM348		LM348		LM348	LM348
LM2900		µA2900			LM2900			
LM3900		µA3900			LM3900			LM3900
RC3403A		µA3403		MC3403				MC3403
RC4136	OP-09	µA4136						RC4136
RC4156		µA148*		MC4741	LM348*			LM348*
RC4157		µA148/ 348*		MC4741*	LM348*			LM348*
RC4558		µA4558		MC4558				RC4558
RC4559		µA4558*		MC4558*				RC4559
RC4741N				MC3-4741-5				
RM4741D				MC1-4741-2				
RC5532							NE5532	NE5532
RC5532A							NE5532A	NE5532A
RC5534							NE5534	NE5534
RC5534A							NE5534A	NE5534A
RC741	OP-02	µA741		MC1741	LM741	CA741	CA741	
RC747	OP-04	µA747		MC1747	LM747	CA747	CA747	
RC747S	OP-04	µA747			LM747			

*Functional Equivalent

Data Conversion Cross Reference

Raythen	PMI	AMD	Motorola	NSC	Devices	Analog Power	Micro-Datel
DAC-08AD	DAC-08AQ	AMDAC-08AQ	MC1408L8	DAC-08AQ	AD-1508-9D	MP-7523*	DAC-IC8BC*
DAC-08D	DAC-08Q	AMDAC-08Q		DAC-08Q	AD-1508-9D	MP-7523*	DAC-IC8BC*
DAC-08ED	DAC-08EQ	AMDAC-08EQ		DAC-08EQ	AD-1408-8D	MP-7523*	DAC-IC8UP*
DAC-08EN	DAC-08EP	AMDAC-08EN		DAC-08EP			DAC-IC8UP*
DAC-08CN	DAC-08CP	AMDAC-08CN	MC1408P6	DAC-08CP			DAC-IC8UP*
DAC-10BD	DAC-10BX			DAC-1020 LD*	AD7520/30/33*	MP-7520/30/33*	DAC- HF10BMM*
DAC-10CD	DAC-10CX			DAC-1021/22LD8*	AD7520/30/33*	MP-7520/30/33*	DAC- HF10BMM*
DAC-10FD	DAC-10FX			DAC-1020 LCN*	AD7520/30/33*	MP-7520 30/33*	DAC- HF10BMC*
DAC-10GD	DAC-10GX			DAC-1021/22LCN*	AD7520/30/33*	MP-7520/30/33*	DAC-HF10BMC*

*Functional Equivalent

Special Functions Cross Reference

Raytheon	Teledyne	Analog Devices	EXAR	Motorola	Datel	Burr Brown
RC4151	4780*	AD451*	XR4151		VFQ-1C*	VFC-32KF*
RC4152	4781*	AD452*	XR4151*		VFQ-2C*	VFC-42BP*
RC4153	4782*	AD537*			VFQ-3C*	VFC-52BP*
RC4200/A		AD539*		MC1494*		4202K* & 4205K*
RM2207			XR2207			
RM2211			XR2211			
RC4444				MC3416		

*Functional Equivalent

Voltage Regulator and Voltage Reference Cross Reference

Raytheon	EXAR	Maxim	T.I.	Analog Devices	Motorola	NSC
REF-01	REF-01		MP-5501	AD581*	MC1504AU10*	LH0070-0*
REF-01A	REF-01A		MP-5501A	AD581*		LH0070-1*
REF-01C	REF-01C		MP-5501C	AD581*	MC1404U10*	LH0070-2*
REF-01D	REF-01D		MP-5501D	AD581*	MC1404U10*	
REF-01E	REF-01E		MP-5501E	AD581*		
REF-01H	REF-01H		MP-5501H	AD581*	MC1404AU10*	
REF-02	REF-02		MP-5502		MC1504AU5*	LM136-5.0*
REF-02A	REF-02A		MP-5502A			LM136A-5.0*
REF-02C	REF-02C		MP-5502C		MC1404U5*	LM336-5.0*
REF-02D	REF-02D		MP-5502D		MC1404U5*	LM336-5.0*
REF-02E	REF-02E		MP-5502E			LM336A-5.0*
REF-02H	REF-02H		MP-5502H		MC1404AU5*	
RC4190		MAX630*				
RC4193		MAX630*				
RC4391		MAX634*				
RC4194	XR4194CN					
RC4195	XR4195CP				MC1468/ MC1568*	LM325/326*

*Functional Equivalent

Section 2

Standard Linear

Precision Op Amps

Input Offset Voltage Selection Table by Package Type (+25°C limits, in microvolts)

Part Type	Plastic DIP (N)	SOIC (M)	Ceramic DIP (D)	Leadless Chip Carrier (L)	Metal Can TO-99 (T)
RC4077	±10	±25	±10	±10	±10
RC4207*	±75		±75		
RC4227*	±75		±75		
RC4277*	±30		±30		±25
OP-07	±75	±75	±25	±25	±25
OP-27	±25	±25	±25	±25	±25
OP-37	±25	±25	±25	±25	±25
OP-47	±25	±25	±25	±25	±25
OP-77	±25	±60	±25	±25	±25
LT1001	±25	±25	±15	±15	±15
LM108			±500	±500	±500
LH2108*			±500	±500	±500

*Dual

Precision Operational Amplifiers

Type	Description	Electrical Characteristics (min/max except*)						
		V_{os} (μV)	TCV_{os} (μV/°C)	I_{os} (nA)	I_B (nA)	CMRR (dB)	Gain (V/μV)	I_{SY} (mA)
RC4077A	Ultra Low V_{os}	10	0.3	1.5	±2.0	120	5	1.67
RC4077E		25	0.3	1.5	±2.0	120	5	1.67
RC4077F		60	0.6	2.8	±2.8	116	2	1.67
RM4077A		10	0.3	1.5	±1.5	120	5	1.67
RM4077B		15	0.1	1.5	±2.0	120	5	1.67
RC4207F	Dual Low Noise	75	1.3	5	±5	100	0.4	6.67
RC4207G		150	0.7*	10	±10	94	0.25	8.0
RM4207B		75	1.3	5	±5	100	0.4	6.67
RC4227F	Dual Low Noise	75	1.3	10	±15	104	0.5	6.67
RC4227G		150	0.4*	15	±25	100	0.4	8.0
RM4227B		75	1.3	10	±15	104	0.5	6.67
RC4277E	Dual Low V_{os}	30	0.3	0.3	±3.0	120	2.0	5.5
RC4277F		75	1.0	5.0	±5.0	110	2.0	5.5
RV4277E		30	0.3	3.0	±3.0	120	2.0	5.5
RV4277F		75	1.0	5.0	±5.0	110	2.0	5.5
RM4277A		30	0.3	3.0	±3.0	120	2.0	5.5
LH2108A	Low Noise	500	5.0	0.2	±2.0	96	.04	0.4
LH2108		2000	15	0.2	±2.0	85	.025	0.4
LM108A		500	5.0	0.2	±2.0	96	.04	0.4
LM108		2000	15	0.2	±2.0	85	.025	0.4
LT1001AM	Ultra Low V_{os}	15	0.6	2.0	±2.0	114	0.45	2.5
LT1001AC		25	0.6	2.0	±2.0	114	0.45	2.5
LT1001C		60	1.0	3.8	±4.0	110	0.4	2.67
LT1001M		60	1.0	3.8	±4.0	110	0.4	2.67
OP-07A	Low V_{os}	25	0.6	2.0	±2.0	110	0.3	4.0
OP-07		75	1.3	2.8	±3.0	110	0.2	4.0
OP-07E		75	1.3	3.8	±4.0	106	0.2	4.0
OP-07C		150	1.8	6.0	±7.0	100	0.12	5.0
OP-07D		150	2.5	6.0	±12.0	94	0.12	5.0
OP-27A	Ultra Low Noise	25	0.6	35	±40	114	1.0	4.67
OP-27B		60	1.3	50	±55	106	1.0	4.67
OP-27C		100	1.8	75	±80	100	0.7	5.67
OP-27E		25	0.6	35	±40	114	1.0	4.67
OP-27F		60	1.3	50	±55	106	1.0	4.67
OP-27G		100	1.8	75	±80	100	0.7	5.67
OP-37A	Decompensated	25	0.6	35	±40	114	1.0	4.67
OP-37B	(ac stable with	60	1.3	50	±55	106	1.0	4.67
OP-37C	$AV_{CL} \geq 5$)	100	1.8	75	±80	100	0.7	5.67
OP-37E		25	0.6	35	±40	114	1.0	4.67
OP-37F		60	1.3	50	±55	106	1.0	4.67
OP-37G		100	1.8	75	±80	100	0.7	5.67
OP-47A	Decompensated	25	0.6	35	±40	114	1.0	4.67
OP-47B	(ac stable with	60	1.3	50	±55	106	1.0	4.67
OP-47C	$AV_{CL} \geq 400$)	100	1.8	75	±80	100	0.7	5.67
OP-47E		25	0.6	35	±40	114	1.0	4.67
OP-47F		60	1.3	50	±55	106	1.0	4.67
OP-47G		100	1.8	75	±80	100	0.7	5.67
OP-77A	Low V_{os}	25	0.3	1.5	±2.0	120	5.0	2.0
OP-77B		60	0.6	2.8	±2.8	116	2.0	2.0
OP-77E		25	0.3	1.5	±2.0	120	5.0	2.0
OP-77F		60	0.6	2.8	±2.8	116	2.0	2.0
OP-77G		100	1.2	2.8	±2.8	116	2.0	2.0

Slew (V/μS)	GBW* (mHz)	1 KHz Noise** (nV/√Hz)	Packages M SOIC	D CDIP	N PDIP	T TO-99	L LCC	Temperature Range -55°C to +125°C	-25°C to +85°C	0°C to +70°C	Mil-Std 883/B Availability
0.3	0.8	18			X				X		
0.3	0.8	18	X	X	X	X			X	X	
0.3	0.8	20	X	X	X	X			X	X	
0.3	0.8	18		X		X	X	X			X
0.3	0.8	18		X		X	X	X			X
0.3	1.5	10.3*		X	X					X	
0.3	1.5	10.3*		X	X					X	
0.3	1.5	10.3*		X				X			X
2.7	8.0	3.8*		X	X					X	
2.7	8.0	3.8*		X	X					X	
2.7	8.0	3.8*		X				X			X
0.3	1.5	10.3*			X					X	
0.3	1.5	10.3*			X					X	
0.3	1.5	10.3*		X					X		
0.3	1.5	10.3*		X					X		
0.3	1.5	10.3*		X				X			X
.05	1.0	30		X				X			X
.05	1.0	30		X				X			X
.05	1.0	30		X		X	X	X			X
.05	1.0	30				X	X	X			X
0.3	0.8	18		X		X	X	X			X
0.3	0.8	18	X	X	X	X					
0.3	0.8	18	X	X	X	X					
0.3	0.8	18		X		X					
0.3	0.5	18		X		X	X	X			X
0.3	0.5	18		X		X	X	X			X
0.3	0.5	18	X	X	X	X				X	
0.3	0.5	20	X	X	X	X				X	
0.3	0.5	20	X	X	X	X				X	
2.8	8.0	5.5		X		X	X	X			X
2.8	8.0	5.5		X		X	X	X			X
2.8	8.0	8.0		X		X	X	X			X
2.8	8.0	5.5	X	X	X	X			X	X	
2.8	8.0	5.5	X	X	X	X			X	X	
2.8	8.0	8.0	X	X	X	X			X	X	
17	63	5.5		X		X	X	X			X
17	63	5.5		X		X	X	X			X
17	63	8.0		X		X	X	X			X
17	63	5.5	X	X	X	X			X		
17	63	5.5	X	X	X	X			X		
17	63	8.0	X	X	X	X			X		
50	70	5.5		X		X	X	X			X
50	70	5.5		X		X	X	X		X	X
50	70	8.0		X		X	X	X		X	X
50	70	5.5	X	X	X	X			X		
50	70	5.5	X	X	X	X			X	X	
50	70	8.0	X	X	X	X			X	X	
0.3	0.6	18		X		X	X	X			X
0.3	0.6	18		X		X	X	X			X
0.3	0.6	18		X	X	X			X		
0.3	0.5	20	X	X	X	X			X		
0.3	0.6	20	X		X					X	

**10Hz

Audio and General Purpose Operational Amplifiers

Single Operational Amplifiers

Type	Description	Maximum Input Specifications @25°C: Offset Voltage (mV)	Offset Current (nA)	Bias Current (nA)	Typ.[1] Unity Gain BW (MHz)	Typ. Slew Rate (V/µS)	Temp[2] Range	Available Packages: D	L	M	N	T
LM101A	General Purpose with Im-	2.0	10	75	1.0	0.5	M	X				X
LM301A	proved Input Characteristics	7.5	50	250	1.0	0.5	C				X	
RC741	General Purpose, Internal Comp	6.0	200	500	1.0	0.5	C	X			X	X
RC5534	High Performance, Low Noise	4.0	300	1500	10	13	C				X	
RM5534		2.0	200	800	10	13	M	X				X
RC5534A[3]		4.0	300	1500	10	13	C				X	
RM5534A[3]		2.0	200	800	10	13	M	X				X

1. Gain bandwidth product for 5534/A series and closed loop bandwidth for OP series.
2. Operating Temperature Range: M = -55°C to +125°C; C = 0°C to +70°C.
3. RM/RC5534A guarantees maximum input noise specification.

Dual Operational Amplifiers

Type	Description	Maximum Input Specifications @25°C: Offset Voltage (mV)	Offset Current (nA)	Bias Current (nA)	Typ.[1] Unity Gain BW (MHz)	Typ. Slew Rate (V/µS)	Temp[2] Range	Available Packages: D	L	M	N	T
LH2101A	High Performance	2	10	75		0.5		X				
RC747	Dual 741	6	200	500	1	0.5	C				X	
RM747		5	200	500	1	0.5	M	X				X
RC4558	Wideband 741	6	200	500	3	1	C			X	X	
RM4558		5	200	500	3	1	M	X				X
RC4559	High Performance	6	100	250	4 (3)	2 (1,5)	C			X	X	
RM4559		5	100	250	4 (3)	2 (1,5)	M	X				X
RC5532	High Performance,	4	150	800	10	8	C				X	
RM5532	Low Noise	2	100	400	10	8	M	X				X
RC5532A[3]		4	150	800	10	8	C				X	
RM5532A[3]		2	100	400	10	8	M	X				X

1. Gain bandwidth product for 5532A series.
2. Operating Temperature Range: M = -55°C to +125°C; C = 0°C to +70°C.
3. RM/RC5532A guarantees maximum input noise specification.

( ) Denotes guaranteed specifications.

Package Codes:
D = Ceramic DIP
L = Leadless Chip Carrier
M = Plastic SOIC
N = Plastic DIP
T = Metal Can (TO-99)

Quad Operational Amplifiers

Type	Description	Maximum Input Specifications @25°C			Typ.[1] Unity Gain BW (MHz)	Typ. Slew Rate (V/μS)	Temp[1] Range	Available Packages				
		Offset Voltage (mV)	Offset Current (nA)	Bias Current (nA)				D	L	M	N	T
RM4741	741 General Purpose	3	30	200	3.5	1.6	M	X				
RC4741		5	50	300	3.5	1.6	C				X	
LM124	Single Supply	5	30	150	1	—	M	X				
LM148	Low Power 741	5	25	100	1	0.5	M	X				
LM324	Single Supply	7	50	250	1	—	C				X	
LM348	Low Power 741	6	50	200	1	0.5	C				X	
LM3900	Current Mode, Single Supply	—	—	200	2.5	+.5/-20	C				X	
RC3403A	Ground Sensing	6	50	500	1	1.2	C				X	
RC4136	741 General Purpose	6	200	500	3	1	C			X	X	
RM4136		4	150	400	3	1.5	M	X				
RC4156	High Performance	5	50	300	3.5 (2.8)	1.6 (1.3)	C			X	X	
RM4156		3	30	200	3.5 (2.8)	1.6 (1.3)	M	X				
RC4157	High Speed, Decompensated	5	50	300	19 (15)	8 (6.5)	C				X	
RM4157		3	30	200	19 (15)	8 (6.5)	M	X				

Notes:
1. Operating Temperature Range: M = -55°C to +125°C; C = 0°C to +70°C.
( ) Denotes guaranteed specification.

Comparators

Type	Description	Maximum Input Specifications @25°C			Voltage Gain (V/mV typ)	Max Sat. Voltage	Output Leakage Current (nA typ)	Available Packages				
		Offset Voltage (mV)	Bias Current (nA)	Offset Current (nA)				D	L	M	N	T
LH2111	Dual Precision Voltage	3.0	100	10	200	1.5V	0.2	X				
LM111	Low Input Current	3.0	100	10	200	1.5V	0.2	X	X			X
LM139	Quad Single Supply	5.0	100	25	200	0.40	0.1	X	X			
LM339	Quad Single Supply	5.0	250	50	200	0.40	0.1			X	X	
LP165	Programmable	3.0	50	20	500	0.40	2	X			X	
RC4805	Precision High Speed	0.6	1800	150	10	0.40	—				X	X
RM4085		0.6	1800	150	20	0.40	—	X				X
RM4805A		0.25	1200	80	20	0.40	—	X				X
RC4805E		0.25	1200	80	10	0.40	—				X	X

Voltage References

Device	Nominal Voltage Out	Typical Tempco (ppm/°C)	Temp. Range	Typical ΔV_{OUT} Over Temp. (%)	Typical Line Reg. (%/Volt)	Typical Load Reg. (%/mA)	Typical Load Current (mA)	Input Voltage Range (Voltage)
REF-01A	10.00	3.0	Mil	.06	.006	.005	15	12 to 40
REF-01	10.00	10.0	Mil	.18	.006	.006	15	12 to 40
REF-01C	10.00	20.0	Comm	.14	.009	.006	15	12 to 40
REF-01D	10.00	70.00	Comm	.49	.012	.009	15	12 to 40
REF-01E	10.00	3.0	Comm	.02	.006	.005	15	12 to 40
REF-01H	10.00	10.00	Comm	.07	.006	.006	15	12 to 40
REF-02A	5.00	3.0	Mil	.06	.006	.005	15	7 to 40
REF-02	5.00	10.00	Mil	.18	.006	.006	15	7 to 40
REF-02C	5.00	20.00	Comm	.14	.009	.006	15	7 to 40
REF-02D	5.00	70.00	Comm	.49	.012	.009	15	7 to 40
REF-02E	5.00	3.00	Comm	.02	.006	.005	15	7 to 40
REF-02H	5.00	10.00	Comm	.07	.006	.006	15	7 to 40

Other Standard Linear Products From Raytheon

D/A Converters

DAC-08	8-Bit Current Output
DAC-10	10-Bit Current Output
DAC-4881	12-Bit Complete
DAC-4888	8-Bit Complete
DAC-8565	12-Bit Complete

V/F Converters

RC4151	Basic 100 kHz
RC4152	Low-Drift 100 kHz
RC4153	Precision 250 kHz

Voltage Regulators

RC4190	Low Power Switcher
RC4191/92/93	Low Power Switcher
RC4194	Dual Tracking Linear
RC4195	Dual Tracking Linear
RC4292	Negative Input
RC4391	Inverting Switcher

Ground Fault Interrupters

LM1851	Industry Alternative Source
RC4143/4144	Standard GFI
RC4145	Low Power GFI

Special Functions

RC4200	Analog Multiplier
RC4444	Cross-Point Array
RC4447	Pin-Diode Driver
RM3182	ARINC Bus Driver
RM2207	Voltage Controlled Oscillator
RM2211	FSK Demodulator

Section 3
Bipolar PROMs

R29000 Series Standard PROMs and Power-Switched SPROMs

Features/Benefits

- Devices are available in both the commercial (0°C to +75°C) and military (-55°C to +125°C) temperature range
- Standard PROMs are offered in power-switched SPROM versions
- Typically, 75% power savings achieved on deselected SPROMs
- Reliable nichrome fuses
- Three-state outputs
- Devices programmed on standard PROM programmers
- Device pinouts comply with JEDEC standards
- Available in surface mount and through-hole packaging
- 32K and 64K PROMs/SPROMs are offered in 24-pin, 0.3" wide DIPs
- High immunity or resistance to high levels of constant or burst radiation

Applications

- Microprogram control store
- Microprocessor program store
- Programmable logic
- Custom look-up tables
- Security encoding/decoding
- Code converter
- Character generator
- Use in redundant systems

Description

Raytheon's R29000 Series of Bipolar Field Programmable Read-Only Memories include both standard and power-switched versions. Chip select inputs provide logic flexibility and ease of memory expansion decoding.

All Raytheon R29000 Series PROMs and SPROMs are manufactured with nichrome fuses and low power Schottky technology. The devices are shipped with all bits in the HIGH (logical ONE) state. To achieve a LOW state in a given bit location, the nichrome link is fused open by passing a short, high current pulse through the link.

Standard PROMs are enabled when $\overline{CS}$ is low and CS is high. Power-switched SPROMs are enabled when $\overline{PS}$ is low and PS is high. Refer to individual block diagrams for device enabling schemes.

PROM Selection Guide

Device Type	Size	Organization	Enable*	Outputs	Raytheon		θ JC °C/W	ICC Power Supply Current	ICCD Power Down Supply Current
					Raytheon Package Designator	Mil-M-38510 Appendix C Case Outline			
R29621/1A	4K	512 x 8	$\overline{CS}$	TS	D	D-8	<11	155 mA	
R29623/3A	4K	512 x 8	$\overline{PS}$	TS	D	D-8	<11		45 mA
R29631/1A	8K	1024 x 8	$\overline{CS}^1$, $\overline{CS}^2$ CS^3, CS^4	TS	D L F	D-3 C-4 F-6	<11 <10 <10	170 mA	
R29633/3A	8K	1024 x 8	$\overline{PS}^1$, $\overline{PS}^2$ PS^3, PS^4	TS	D L F	D-3 C-4 F-6	<11 <10 <10		45 mA
R29651/1A	8K	2048 x 4	$\overline{CS}$	TS	D	D-6	<1	170 mA	
R29653/3A	8K	2048 x 4	$\overline{PS}$	TS	D	D-6	<11		45 mA
R29681/1A	16K	2048 x 8	$\overline{CS}^1$ CS^2, CS^3	TS	S D L	D-9** D-3 C-4	<11 <11 <10	180 mA	
R29683/3A	16K	2048 x 8	$\overline{PS}^1$ PS^2, PS^3	TS	S D L	D-9** D-3 C-4	<11 <11 <10		50 mA
R29671/1A	32K	4096 x 8	$\overline{CS}^1$, CS^2	TS	S D L	D-9** D-3 C-4	<11 <11 <10	195 mA	
R29673	32K	4096 x 8	$\overline{PS}^1$, PS^2	TS	S D L	D-9** D-3 C-4	<11 <11 <10		55 mA
R29791	64K	8196 x 8	$\overline{CS}$	TS	S D	D-9** D-3	<11 <11	190 mA	
R29793	64K	8196 x 8	$\overline{PS}$	TS	S D	D-9** D-3	<11 <11		50 mA

* $\overline{CS}$ = Chip enable for PROM $\overline{PS}$ = Chip enable for SPROM ** Contact factory regarding flat pack packages

JAN Ordering Information

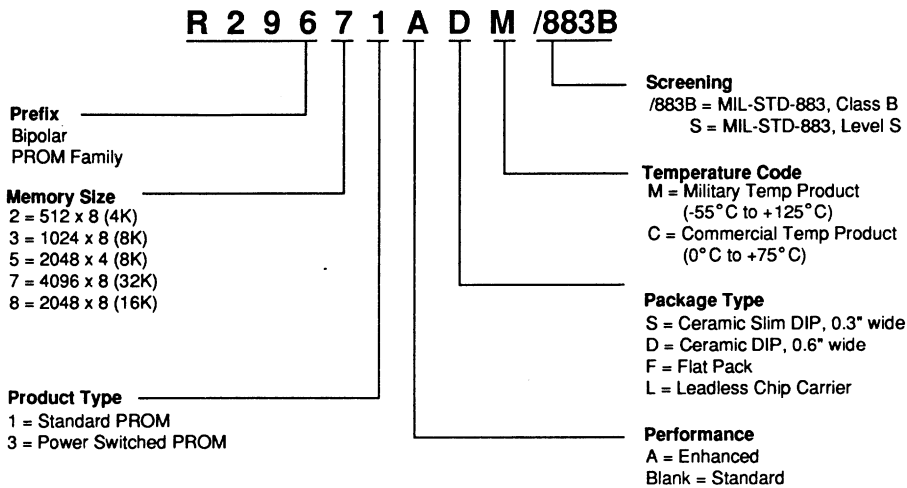
Mil-M-38510 Slash Sheet

Part Number	Raytheon Part Number
Mil-M-38510/20902BVA	R29651DM (2K x 4, 18-pin ceramic 0.3" DIP)
Mil-M-38510/20904BJA	R29631DM (1K x 8, 24-pin ceramic 0.6" DIP)
Mil-M-38510/21002BJA	R29681DM (2K x 8, 24-pin ceramic 0.6" DIP)

Standard Military Drawing (DESC Print) Ordering Information

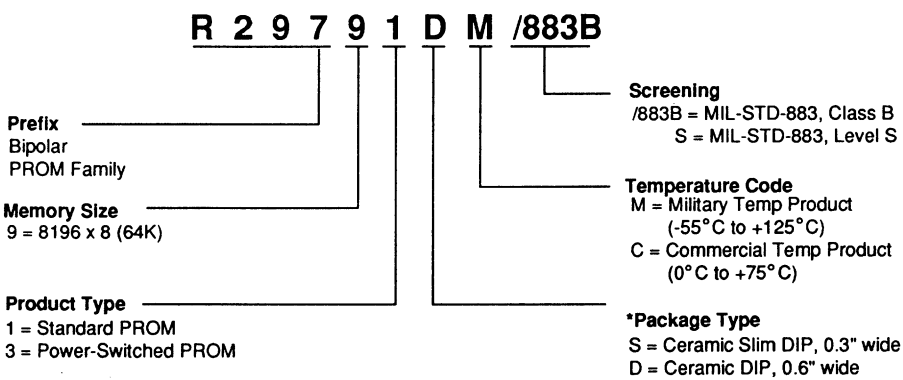
SMD Part Number	Raytheon Part Number
7902401JA	R29633DM/883B (Power-switched, 1K x 8, 24-pin ceramic 0.6" DIP)
8200801JA	R29671DM/883B (4K x 8, 24-pin ceramic 0.6" DIP)
8200801LC	R29671SM/883B (4K x 8, 24-pin ceramic 0.3" DIP)
82008013A	R29671LM/883B (4K x 8, 28-terminal leadless chip carrier)
8200804JA	R29671ADM/883B (4K x 8, 24-pin ceramic 0.6" DIP)
8200804LC	R29671ASM/883B (4K x 8, 24-pin ceramic 0.3" DIP)
82008043A	R29671ALM/883B (4K x 8, 28-terminal leadless chip carrier)

Standard Product Ordering Information



Country of Origin Designator - Prefixes Date Code
O = U.S.A
T = Mexico

65-4058



Country of Origin Designator - Prefixes Date Code
O = U.S.A.
T = Mexico

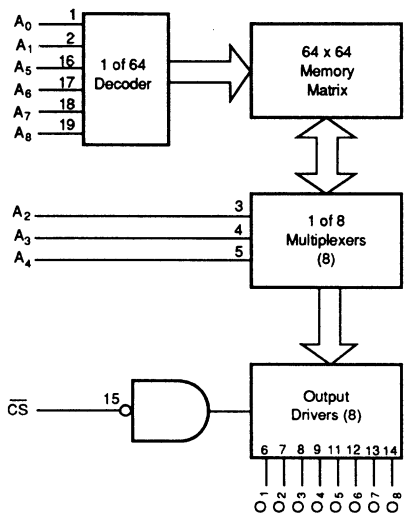
*Contact factory regarding flat pack package.

65-4058A

512 x 8 R29621/R29621A (PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outline
D	D-8

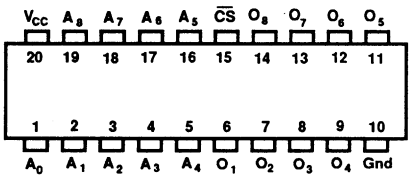
Block Diagram



65-0112

Pin-Out Information

Dual In-Line Package



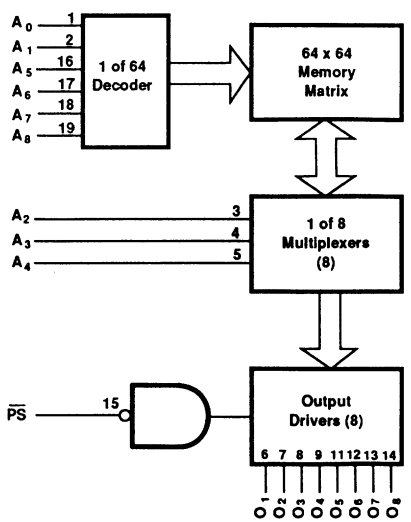
Pin 15 is also the programming pin (pp)

65-1314

512 x 8 R29623/R29623A (Power-Switched PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outline
D	D-8

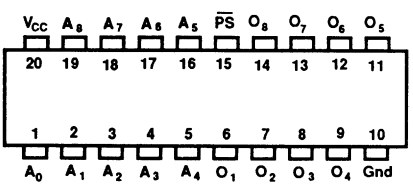
Block Diagram



65-0113

Pin Out Information

Dual In-Line Package



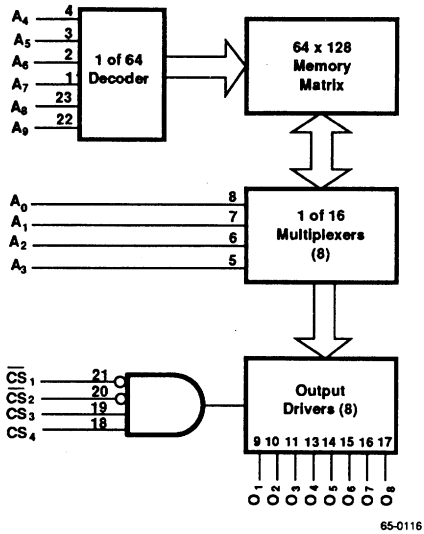
Pin 15 is also the programming pin (pp)

65-1316

1024 x 8 R29631/R29631A (PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outlines
D	D-3
L	C-4
F	F-6

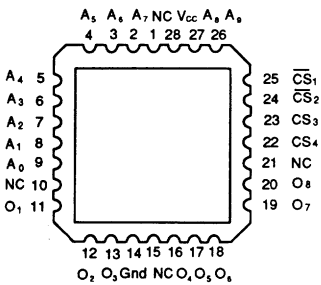
Block Diagram



65-0116

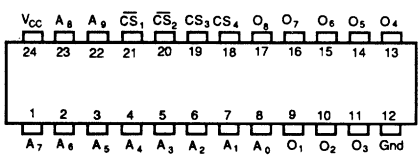
Pin Out Information

Leadless Chip Carrier (28-Terminal)



Pin 24 is also the programming pin (pp)

Dual-In-Line Package

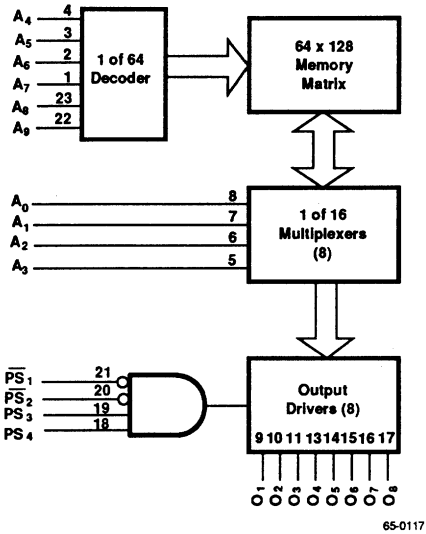


Pin 20 is also the programming pin (pp) 65-4069

1024 x 8 R29633/R29633A (Power-Switched PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outlines
D	D-3
L	C-4
F	F-6

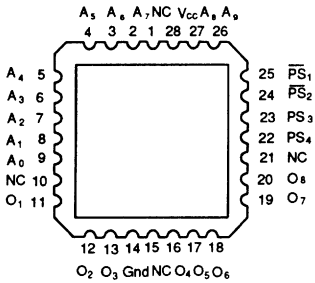
Block Diagram



65-0117

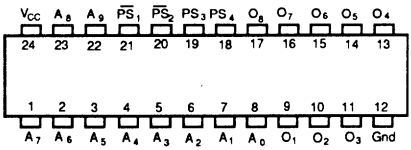
Pin Out Information

Leadless Chip Carrier (28-Terminal)



Pin 24 is also the programming pin (pp)

Dual In-Line Package



Pin 20 is also the programming pin (pp)

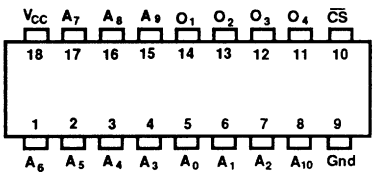
65-4071

2048 x 4 R29651/R29651A (PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outlines
D	D-6

Pin Out Information

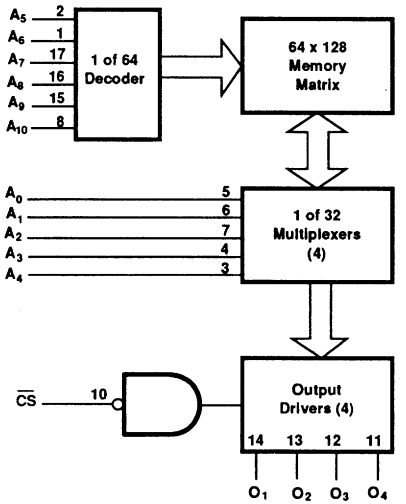
Dual In-Line Package



Pin 10 is also the programming pin (pp)

65-1324

Block Diagram



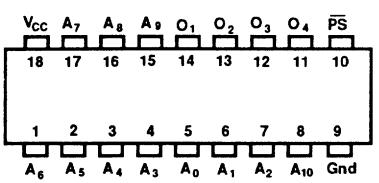
65-0122

2048 x 4 R29653/R29653A (Power-Switched PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outline
D	D-6

Pin Out Information

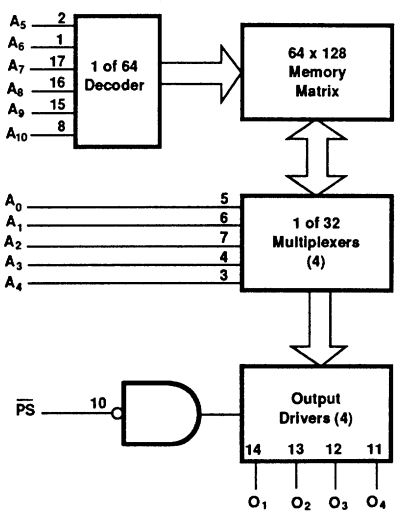
Dual In-Line Package



Pin 10 is also the programming pin (pp)

65-1326

Block Diagram



65-0123

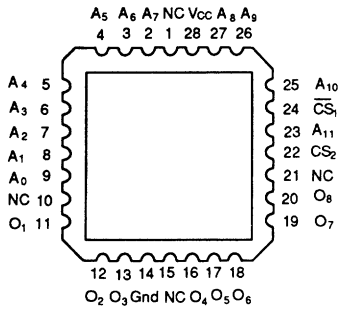
4096 x 8 R29671/R29671A (PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outlines
S	D-9
D	D-3
L	C-4

Contact factory for flat pack package.

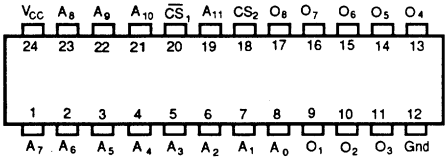
Pin Out Information

Leadless Chip Carrier (28-Terminal)



Pin 24 is also the programming pin (pp)

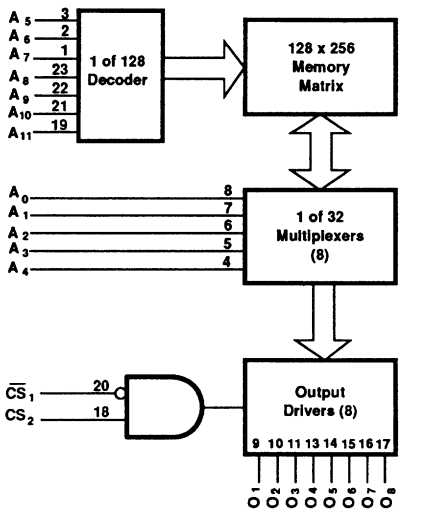
Dual-In-Line Package
Available in 0.3" and 0.6" Wide Packages



Pin 20 is also the programming pin (pp)

65-4062

Block Diagram



65-0126

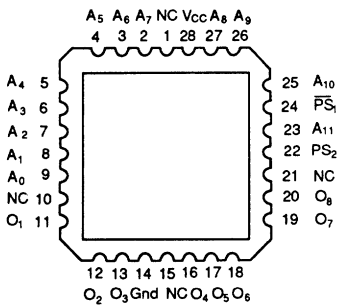
4096 x 8 R29673 (Power-Switched PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outlines
S	D-9
D	D-3
L	C-4

Contact factory for flat pack package.

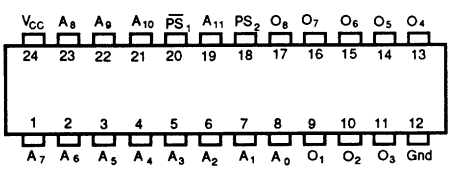
Pin Out Information

Leadless Chip Carrier (28-Terminal)



Pin 24 is also the programming pin (pp)

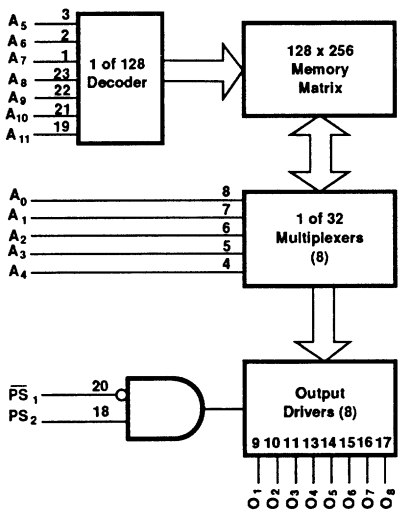
Dual-In-Line Package
Available in 0.3" and 0.6" Wide Packages



Pin 20 is also the programming pin (pp)

65-4072

Block Diagram



65-0127

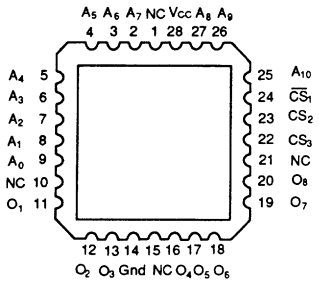
2048 x 8 R29681/R29681A (PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outlines
S	D-9
D	D-3
L	C-4

Contact factory for flat pack package.

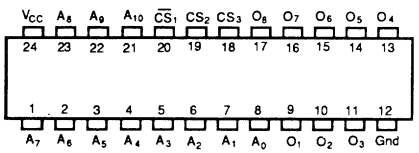
Pin Out Information

Leadless Chip Carrier (28-Terminal)



Pin 24 is also the programming pin (pp)

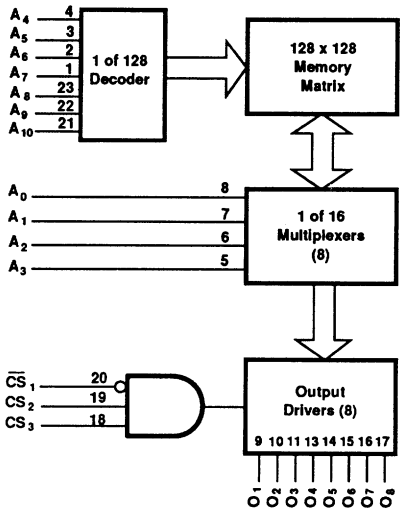
Dual-In-Line Package
Available In 0.3" and 0.6" Wide Packages



Pin 20 is also the programming pin (pp)

65-4073

Block Diagram



65-0128

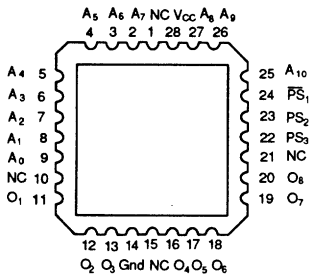
2048 x 8 R29683/R29683A (Power-Switched PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outlines
S	D-9
D	D-3
L	C-4

Contact factory for flat pack package.

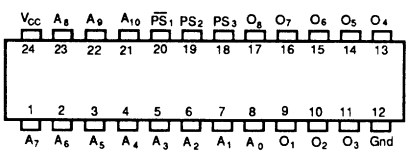
Pin Out Information

Leadless Chip Carrier (28-Terminal)



Pin 24 is also the programming pin (pp)

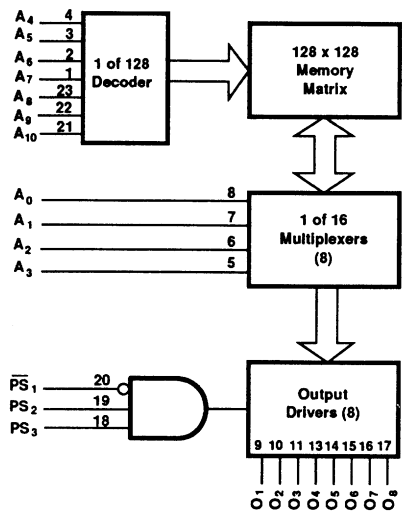
Dual-In-Line Package
Available in 0.3" and 0.6" Wide Packages



Pin 20 is also the programming pin (pp)

65-4074

Block Diagram



65-0129

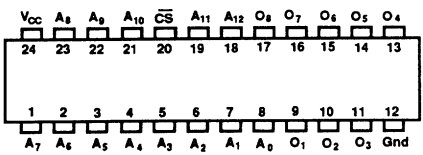
8196 x 8 R29791 (PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outline
S	D-9
D	D-3

Contact factory for flat pack package.

Pin-Out Information

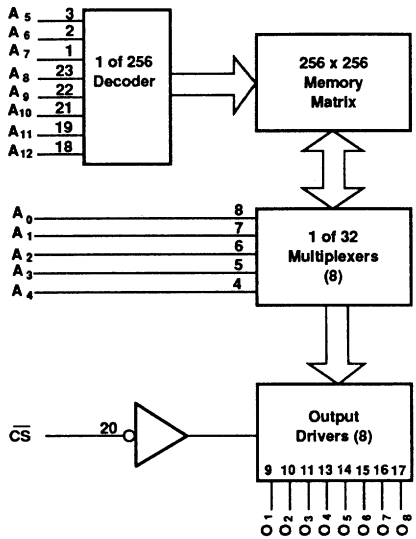
Dual-In-Line Package
Available in 0.3" and 0.6" Wide Packages



Pin 20 is also the programming pin (pp)

65-4062A

Block Diagram



65-0126A

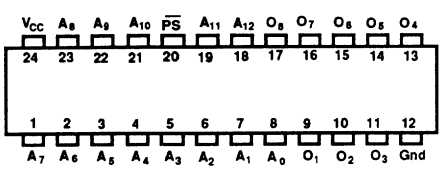
8196 x 8 R29793 (Power-Switched PROMs)

Raytheon Package Designator	Conforms to Mil-M-38510, Appendix C Case Outline
S	D-9
D	D-3

Contact factory for flat pack packages.

Pin Out Information

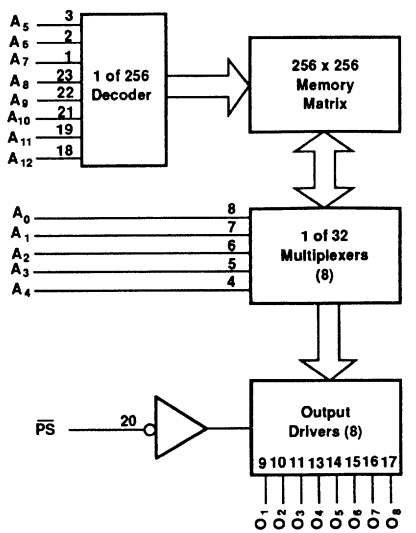
Dual-In-Line Package
Available in 0.3" and 0.6" Wide Packages



Pin 20 is also the programming pin (pp)

65-4072A

Block Diagram



65-0127A

Section 4

Application Specific Integrated Circuits

Raytheon's application specific products include low power ECL configurable gate arrays, custom devices, standard cells, ISL digital bipolar arrays, semicustom arrays and custom linear ICs.

ECL

ECL Gate Array Family
High Density, Low Power

- CGA70E18 — 12,800 gates
  CGA40E12 — 7,750 gates
  CGA1ME12 — 4,600 gates plus 1,280 bits RAM

Note: The number of gates here indicates the maximum number of equivalent two input OR gates that can be placed in the array. A 4 to 1 multiplexer contains 8 equivalent gates.

- I/O counts:
  CGA70E18 — 176
  CGA40E12 — 120
  CGA1ME12 — 120
- I/O interface options:
  TTL — 8 mA IOL
  ECL — 10 KH or 100K
  ETL — Combines ECL and TTL I/Os
- 300 pS typical gate delay
- 300 µW typical gate power
- Speed power product of 0.09 pJ is the lowest for any ECL array
- Toggle frequency of 1.2 GHz typical
- Commercial and military temperature ranges
- Macrocell drive options to optimize performance over a wide range of fanouts
- Valid, Mentor and Daisy workstation libraries supported
- Contiguous row topology for efficient layout
- Fully integrated CAD environment with a proven design methodology
- Packaged in 232 or 149 PGA
- 5 to 6W typical chip power dissipation for 70E18; 3 to 4W typical chip power dissipation for 40E12

Description

Raytheon's ECL gate array family combines exceptional performance with design flexibility using Raytheon's comprehensive CAD system. The high speed, low power performance is derived from the efficient design and unique BIT1 ECL process. The process, based on 2-micron lithography and polysilicon self-aligning techniques, produces a transistor size that results in power dissipation one-tenth that of conventional ECL gates at comparable propagation delays.

Raytheon's contiguous row topology allows the greatest possible compaction of macrocells and macrofunctions. The very high density of the array is the result of utilizing ultra-small 14 μm^2 bipolar transistors and 4 µm metal pitch interconnects. Full utilization of the array is achieved through the ability to route over unused component sites and the placement flexibility afforded by the contiguous row topology. Implementation of the customer design requires four personalization masks: contact, first metal, via, and second metal.

Customers can choose from ECL (10 KH, 100K, or 10K military), TTL, and ETL interface options. A 232 pin PGA with cavity down construction is offered for the 70E18 which reduces the junction

to case thermal resistance to less than 0.5°C/W. A similar 149 PGA is offered for the 40E12 and 1ME12 arrays. An extensive library of array core macrocells is available with low, medium, high, and wire-OR drive options.

Raytheon's proven and fully integrated set of CAD design tools produce error-free designs while minimizing circuit turnaround time. Raytheon engineering workstations and remote access to the CGA design system provide complete verification and flexibility for customer design development.

Junction Operating Temperature Range

$-25°C \leq TJ \leq 150°C$

Array Organization

As opposed to fixed position cell-based ECL gate arrays, Raytheon uses a "contiguous row" approach by which transistors and resistors are aligned side by side in adjacent rows rather than in grouped blocks or cells. The result is improved placement flexibility by offering a much greater number of Minimum Addressable Placement Sites (MAPS). Macrocells and macrofunctions may be placed directly next to each other to optimize performance or incrementally stretched by MAPS to enhance routability. Bias cells (reference voltage generators) are situated at opposite ends of each row. Each I/O cell has its own individual bias cell to enable operation over a military temperature range. Interconnect metal lines are allowed to run over inactive or unused component sites. Separating the rows are routing channels which accommodate first metal interconnect lines. Second metal is routed in a vertical preferred direction over the entire core. I/Os are situated around the die edge with dedi-cated supply and ground pins interlaced. The array topology for CGA70E18 is shown in Figure 1.

Development Overview

Macrocell libraries are provided for the user's own in-house engineering workstations. Alternatively, Raytheon's CAD tools are available for option development at the Mountain View Design Center (see Figure 2). Front-end development can be executed entirely by the customer, by Raytheon or as a combined effort. Raytheon provides a comprehensive design manual and offers a design tutorial covering all aspects of ECL design technology. The actual array development starts with entering a schematic on the selected workstation. The workstation software provides for schematic capture, simulation (delays based on statistical modelling of metal lengths as a function of fan out), design rule checking and circuit statistics. The resulting design data base links to Cadence's Verilog, Veritime and Verifault if desired. Once approved, the design moves on to layout which is done on Cadence's Gate Ensemble while in parallel to this effort the test program is being developed.

Final simulation of the design based the actual layout of the circuit can be done in either the workstation or the Verilog environment. Once the layout is approved, a pattern generation tape is generated from which the required masks are created. During 1990, Raytheon is planning to add logic synthesis to its tool suite to enable faster, better optimized logic design. The wafers are processed in state-of-the-art fabrication facilities. Customer-preferred pinouts can be accommodated.

Array Performance

Maximum gate array performance is achieved when a hierarchical netlist is created during schematic capture, Raytheon's ac fanout design rules are followed for each drive type, and the circuit layout is optimized to reduce metal lengths of timing critical paths.

A hierarchical netlist can be implemented by function or by a bit-slice approach. The main advantages of a hierarchical netlist are clarity of documentation and layout flexibility. One layout flexibility example is the performance window

Product Outline

Device Number	Gate Complexity[1]	Number of MAPS	Max Pads[2]	I/Os	Dedicated Inputs	Max I/Os[2]	Interfaces
CGA70E18	12800	7696	252	128	48	176	TTL/ECL/ETL

Notes:
1. Gate count based on the 4:1 mux method
2. The difference between the maximum number of pads and I/Os is the number of dedicated V_{CC1},GND, or V_{EE} pads.

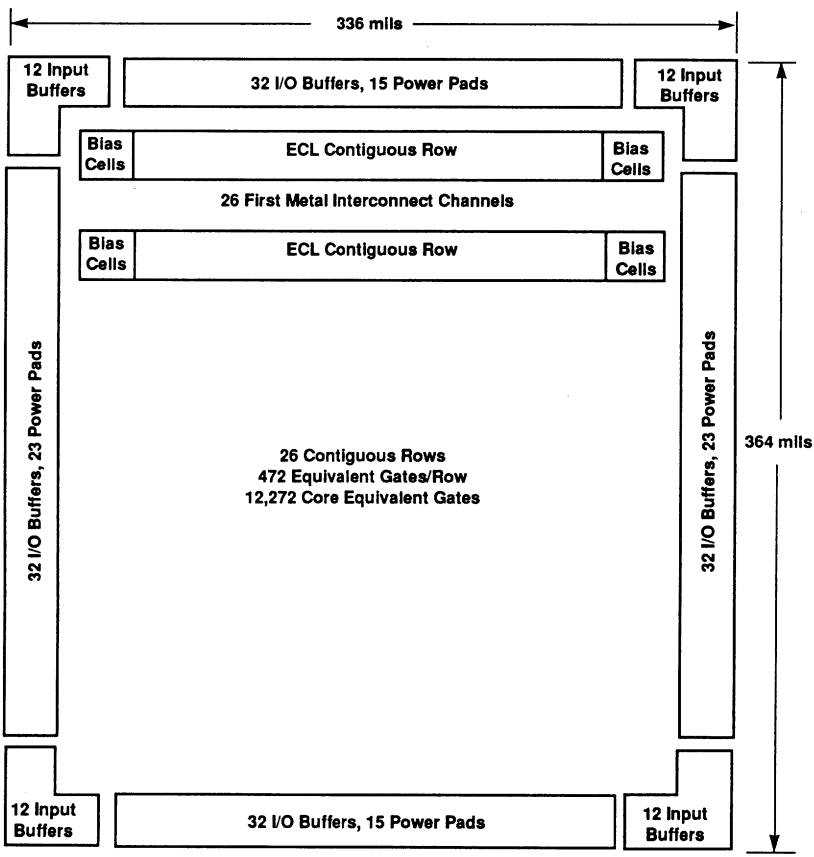


Figure 1. CGA70E18 Topology

65-3276

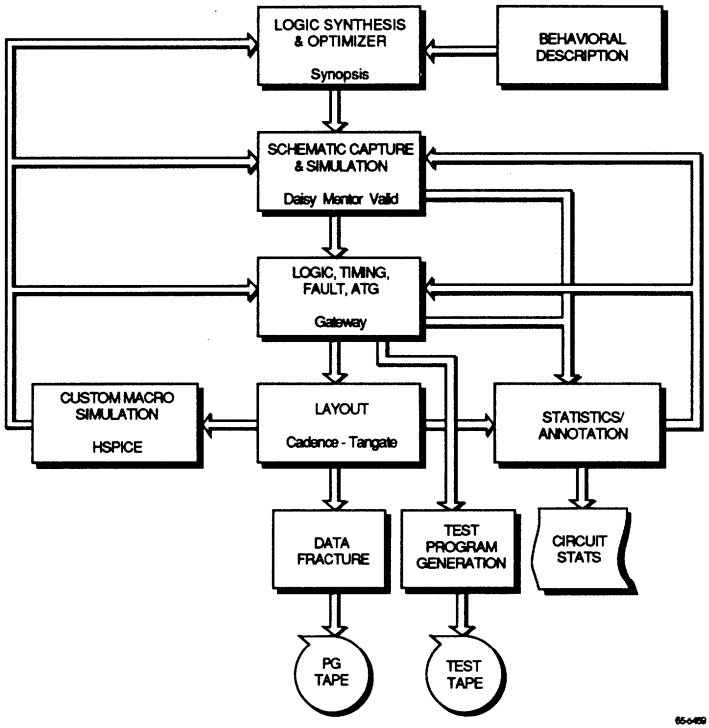


Figure 2. Gate Array Design Tools

control of a bus operation. Each bit slice of a bus can be duplicated by a macrofunction in a netlist. During layout, that macrofunction can be "hardened" into a fixed geometric pattern. Each bit slice is then configured on the array using the "hardened" macrofunction.

The recommended critical path fanout (loads) of each macrocell output type follows:

- Input buffer (high drive) = 16
- Low drive macrocell = 4
- Medium drive macrocell = 8
- High drive macrocell = 16
- Wire-OR (high drive) macrocell = 16

The low, medium, high, and wire-OR drive non-critical path fanout limits are 50, 80, 150 and 150 respectively. A functional block or bit-slice floorplan, which follows the netlist structure, is created before layout. Emphasis is placed on optimizing the timing relationships between blocks and I/Os. Interactive placement and routing is used to implement the floorplan in layout. All layout and logic design rules are followed by the CAD system during the interactive layout phase. A critical path can be controlled such that the metal interconnects between macrocells are minimized. Two macrocells placed next to each other on a row is the optimum case resulting in near zero additional metal delay. Macrocells placed on adjacent rows can be positioned to minimize the metal interconnect length to 5 mils.

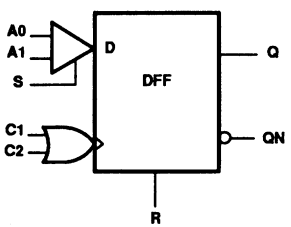
The design manual contains simulation instructions and macrocell performance information. Figure 2 depicts the typical information that is provided for all macrocells.

Macrocell Performance

Each macrocell in the library has four drive options: low drive, medium drive, high drive and wire-OR drive. Figure 3 shows the information provided for each macrocell.

The propagation delays shown are typical for a fanout of 1. Best case/worst case delays are a function of temperature, supply voltage and process derating multipliers. A general estimate can be obtained by multiplying these typical values by 0.7 and 1.3 respectively for the commercial temperature range of 0 to 70°C, with a supply voltage of -5.2V ±5%.

DFF40 Scan-Type DFF With Reset



Truth Table

S	D
0	A0
1	A1

R	D	C	Q
L	L	L→H	L
L	H	L→H	H
L	X	L	-
L	X	H	-
H	X	X	L

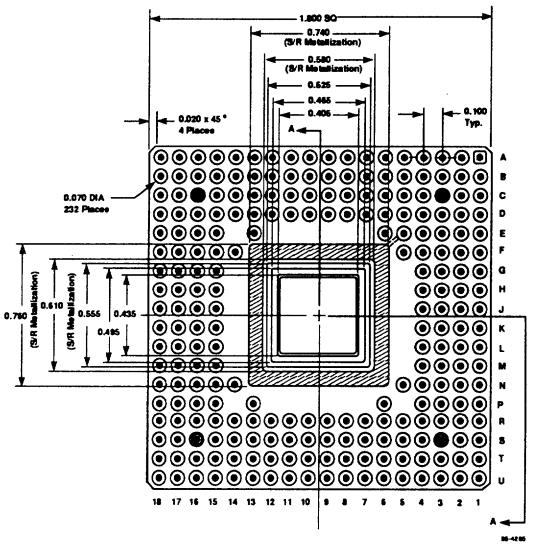
65-3930

Input Loading (1,1,1,1,1, 2)

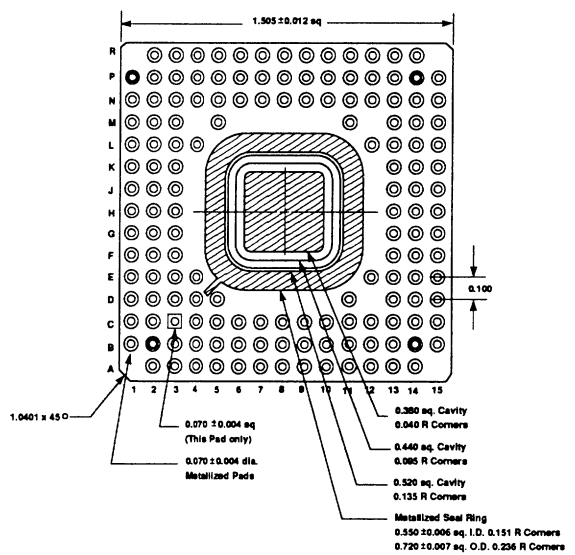
Parameter		Low DFF40L	Macrocell Medium DFF40	Drive Option High DFF40H	Wire-OR DFF40W	Units
tpd (C1, C2 to Q)	LH	640	720	870	870	pS
	HL	720	760	830	830	pS
tpd (C1, C2 to QN)	LH	660	750	900	900	pS
	HL	740	790	860	860	pS
tpd (R to Q)	HL	880	940	1040	1040	pS
tpd (R to QN)	LH	870	960	1060	1060	pS
tsu (min)		500	500	500	500	pS
thd (min)		300	300	300	300	pS
Ckl Pulse (min)		800	800	800	800	pS
Power		4.52	5.34	6.98	3.62	mW
Utilization		8	9	10	10	MAPS

Figure 3. Macrocell Data

232 PGA Package Case — Bottom View



149 PGA Package Case — Bottom View



Linear

Semicustom and Full Custom Linear ICs

- Full-custom bipolar and JFET ICs
- Semicustom bipolar and JFET linear arrays

Services Offered

- Photo mask layout
- Wafer fabrication
- Package assembly
- Testing — wafer and package
- Reliability screening — commercial and military
- Technical aid

Introduction

Analog semicustom and full custom services offered include both IC manufacturing and engineering support. Raytheon's goal is to provide the customer with the simplest design procedures and most convenient method of converting a circuit design into semicustom format. The RLA/RFA series of devices allows a design method that is simple to use and similar to the methods used to design a medium complexity PC card. It also allows the use of a true semicustom method of manufacture, with prefabricated wafers held in storage until a final metal mask step is performed.

The RLA ICs come in four sizes: 4, 8, 12 and 16 macrocells per IC. The RFA comes in one size: 12 macrocells per IC. Some information on the twelve-macrocell devices, the RLA120 and the RFA120, is given in this brochure. For more complete information on all five types, refer to the following publications:

- *RLA Series Linear Array Design Manual*
  — Covers RLA40, RLA80, RLA120 and RLA160 bipolar linear arrays
- *RFA120 Linear FET Array Product Specifications*
  — 12 macrocells (8 of which are JFETs)
- *RLA/RFA Linear Array Applications Manual*

RLA Device Features

General

- Dual-layer metal for ease of interconnect routing and maximum array utilization
- Binarily weighted thin-film resistors having superior performance and ease of use
- Bipolar transistors arranged as:
  - User-configurable gain cells of 10 transistors each
  - Small NPN transistors
  - Small PNP transistors
  - 200 mA NPN transistors
- Wide supply voltage range — 2V to 32V (±1V to ±16V)
- Available in LCC, PLCC and other packages (see Packaging Options, page 11)
- Die sizes:
  - 98 mils x 89 mils (RLA40)
  - 135 mils x 95 mils (RLA80)
  - 148 mils x 119 mils (RLA120)
  - 189 mils x 123 mils (RLA160)

Components

- Resistors:
  - ±10% absolute resistor tolerance (max)
  - ±1% resistor matching (identical values)
  - ±200 ppm/°C absolute resistor tempco
  - ±5 ppm/°C resistor tempco tracking
- With macro gain cell in op amp configuration:
  - Slew rates to 5 V/µS (2 V/µS in unity gain)
  - 1 mV input offset voltage (5 mV max)
  - 25 nA input bias current
  - 1 nA input offset current
  - 80 dB dc voltage gain into 10 kΩ load
- With macro gain cell in comparator configuration:
  - Propagation delay to 300 nS
  - 1 mV input offset voltage (5 mV max)
  - 1 mA output sink current (min)
- Transistors:
  - Breakdown voltage: 32V
  - 400 MHz NPN F_T
  - 4 MHz PNP F_T
  - NPN H_{FE} = 100 (min)
  - PNP H_{FE} = 30 (min)

IC Processing

Wafers are manufactured using Raytheon's standard bipolar planar process at Raytheon's own Mountain View, California site. This process, which has been well characterized, is used to make many commercial and military IC products. The use of this process has two advantages: it allows building military grade parts and it allows any semicustom design to be easily converted to a full custom design. This provides a trouble-free transition from low volume to high volume production, with low-cost, semicustom devices turned around quickly and full custom devices arriving later.

RLA/RFA Series Comparison Chart

	RLA 40	RLA 80	RLA 120	RLA 160	RFA 120
FET macrocells	0	0	0	0	8
Complete macrocells	4	8	4	7	4
Partial macrocells	0	0	8	8	0
NPNS transistors	37	46	39	43	71
NPNM transistors	4	0	0	0	4
NPNL transistors	0	3	4	4	0
PNPS transistors	17	19	16	10	29
Resistor (1.25K to 150K)	66	93	196	240	262
1.25K	8	14	24	30	0
2.5K	12	14	24	30	18
4.0K	0	0	10	6	0
5.0K	8	14	24	30	24
10K	16	20	48	60	70
20K	8	6	24	30	44
25K	2	0	10	10	0
30K	0	0	0	0	24
40K	4	7	12	15	8
50K	0	6	0	0	8
100K	4	6	8	12	18
125K	0	0	0	1	0
150K	4	6	12	16	18
50Ω	0	0	0	0	18
600Ω	0	0	0	0	12

RFA120 Linear FET Macrocell Array

General Features

- 71 Small NPN transistors
- 29 Small PNP transistors
- 4 100 mA NPN transistors
- 262 Thin-film resistors (2.5 kΩ to 150 kΩ)
- ±10% resistor tolerance
- ±1% resistor matching
- 200 ppm/°C resistor tempco
- 399 crossunders (.05 Ω resistance)
- SPICE models available for all component and macrocell functions
- Die size: 190 mils x 136 mils

FET Macrocell Features

- 8 FET macro gain cells, containing 32 P-channel FET transistors
- User configurable to FET input op amps, analog switches, multiplexers
- 200 pA input bias current
- 100 pA input offset current
- 5 mV input offset voltage
- Slew rates to 15 V/nS

Bipolar Macrocell Features

- 4 ground sensing input macro gain cells (same as Raytheon RLA)
- 1 mV input offset voltage
- Low I_{CC} of 100 μA when configured as a 324 op amp
- Design information available in RLA support literature

Description

The RFA120 Linear Array is a monolithic semicustom IC consisting of configurable FET-input and bipolar-input operational amplifier macrocells which are placed alongside uncommitted thin-film resistor networks and auxiliary bipolar transistors. It is unique among linear arrays in that it provides JFET transistors for use in both op amp and switching applications.

The RFA IC is organized in a tile-like array of FET gain blocks and bipolar gain blocks (macrocells). There are committed connections between some of the transistors. These hard-wired connections result in two characteristics: they free up surface area for customer specific interconnection routing and help provide for pre-designed high performance analog functions.

Aluminum crossunders are also available to simplify metallization routing and provide printed-circuit board-like versatility.

The basics of semicustom IC design are covered in the *RLA Series Linear Array Design Manual;* these notes cover design procedures and components that are specific to the FET devices found on RFA ICs. This description, when used in conjunction with the *RLA Design Manual* and the *RLA/RFA Linear Array Applications Manual*, will provide the necessary information for completing an RFA design.

Technical Support

Customers may request pre-design assistance in partitioning a particular circuit. Help in planning a cost-effective and manufacturable allocation of circuit functions to the IC will be provided free of charge.

Close design consultation with technical staff members and applications engineers is standard. The design effort culminates in a joint Design Review Meeting where all aspects of the design are set down in detail. The agenda at the meeting includes, at minimum, the following topics:

- Application — Review of requirements and specifications.
- Pin-out and I/O count — Inter-lead capacitance and effect on signal coupling, bond wire resistance, test probe points.
- Breadboard simulation — Review of collected data.
- SPICE simulation — Review of collected data.
- Process variation sensitivity — Calculations on effect of variations in matching, beta, resistor value. Manufacturing yields and costs.
- Die size reduction — Combining component functions, common-pocketing.
- Layout — Thermal gradients, noise, metal routing and resistances, matching, substrate currents, and possible inversion areas.
- External components — Recommended types, effect of pin-out on PC board placement, effect of value tolerance on circuit performance.
- System performance — Potential lock-up modes, effects of IC on system performance, feedback stability, power-up and power-down conditions.
- Testing — Functional vs. parametric tests, dc testing to predict ac and temperature drift parameters, translating specifications into software.
- Reliability — Expected operating lifetime, Mil-Std processing review (if applicable), hermeticity and environmental issues, breakdown voltages, electromigration.
- Packaging — Protoype vs. final production packages, thermal resistance calculations, assembly shift.
- Milestone schedule for further development — Maskmaking, assembly, test, etc.

Design Tools/Support

- RLA design kit
  - 180-page design manual
  - 90-page applications manual
  - IBM PC compatible CAD software
  - Kit parts
  - 200X plots
- Design support
  - Two ASCII SPICE libraries
  - SPICE simulation for PC, Mentor, Valid and VAX
  - Schematic capture for OrCAD, Mentor and Valid
  - GDS2 symbolic and physical data base

SPICE Libraries

- Standard and Monte Carlo Versions
- Major attributes are temperature dependent
- 10 macro level macrocell subcircuit models
  - 3 amplifiers
  - 4 comparators
  - 2 voltage references
  - 1 analog switch
- 10 transistor level macrocell subcircuit models
  - 5 amplifiers
  - 4 comparators
  - 1 analog switch
- 8 transistor subcircuit models
  - 4 NPN
  - 2 NPN
  - 2 zener diodes
- 5 transistor SPICE models
  - 3 NPN
  - 2 PNP
- 11 resistor models
  - 1.25K to 150K
- 4 miscellaneous passive element models

RLAModel Diskette

- Contains 17 files
  - Two SPICE libraries
  - Shell program for PSPICE
  - OrCAD/SDT symbolic library
  - Full screen ASCII
  - Example SPICE and OrCAD circuits and schematics
  - Installation and document printing instructions
  - Full documentation of all features

Reliability Screening

The quality and reliability activity at Raytheon is a continuous process. Established programs include the Mil-Std-883 program, which monitors quality. In addition to the 883 program military flow, Raytheon will be able to provide the RLA80, 120, 160 and the RFA120 to full Mil-M-38510:

RLA80	Mil-M-38510/70601
RLA120	Mil-M-38510/70602
RLA160	Mil-M-38510/70603
RFA120	Mil-M0-38510/70801

This test flow is the most rigorous offered for the RLA series of devices. These tests may or may not be performed, depending on the level of screening required by the customer. Absolute minimum screening would consist of a visual inspection plus wafer sort testing for unpackaged dice. For commercial packaged devices, a +25°V test of the assembled parts must also be performed. Various combinations of the other tests may be specified. Special tests other than those listed are also available; include the requirements when asking for a budget quotation. To receive a budget quotation, supply a block diagram of the proposed IC along with a tentative test specification to Raytheon.

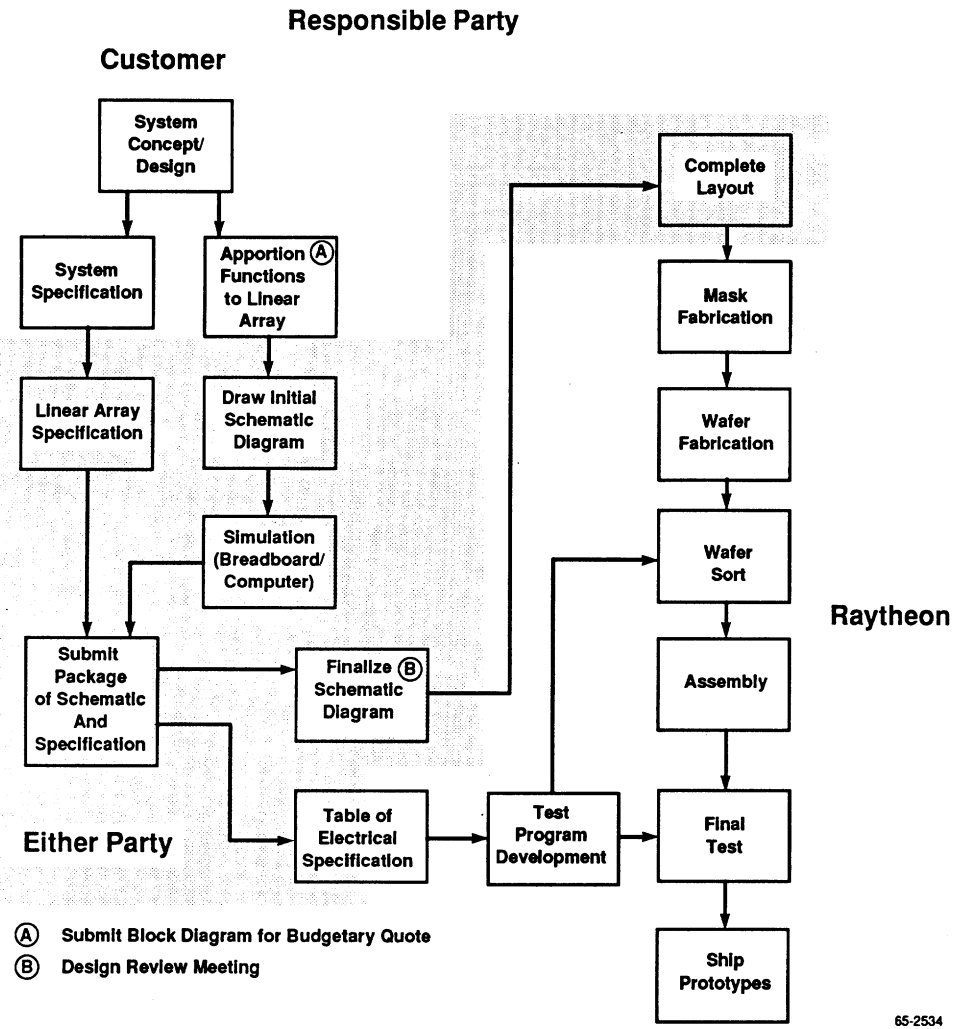
For more information consult Raytheon's *RLA Series Linear Array Design Manual*, or contact your Raytheon sales representative.

IC Development

The following flowchart provides the most often used method of developing an RLA/RFA series semicustom IC.

The circuit design is performed by the customer after consulting Raytheon's *RLA Linear Array Design Manual* and *Linear Array Applications Manual* and combining circuits therein with textbook and "cookbook" circuits to form an application specific design. Raytheon's engineering staff will provide asistance with data, advice, and schematics to solve particular sub-circuit problems.

Simulation is also usually performed by the customer, by building a breadboard made from macrocell bulding blocks and transistor kit parts. Computer simulation is optional; SPICE models for transistors, op amp macro models and comparator macro models are available in the *RLA Linear Array Design Manual.*


Responsible Party
Customer
System Concept/ Design
System Specification
Apportion (A) Functions to Linear Array
Linear Array Specification
Draw Initial Schematic Diagram
Simulation (Breadboard/ Computer)
Submit Package of Schematic And Specification
Finalize (B) Schematic Diagram
Either Party
Table of Electrical Specification
Test Program Development
Complete Layout
Mask Fabrication
Wafer Fabrication
Wafer Sort
Assembly
Final Test
Ship Prototypes
Raytheon
(A) Submit Block Diagram for Budgetary Quote
(B) Design Review Meeting
65-2534

Packaging Options

Package Code	Description	Fits ICs					θja
		RLA40	RLA80	RLA120	RLA160	RFA120	
DICE	100% Tested Dice in Waffle Packs	N/A	N/A	N/A	N/A		N/A
CB	Ceramic 44-Lead Flat Pack			X	X	X	60°C/W
DH-8	Ceramic 8-Lead DIP	X	X				120°C/W
DF-14	Ceramic 14-Lead DIP	X	X				100°C/W
DL-16	Ceramic 16-Lead DIP	X	X	X	X		80°C/W
DQ-18	Ceramic 18-Lead DIP	X	X	X	X		75°C/W
DS-20	Ceramic 20-Lead DIP	X	X	X	X		70°C/W
DJ-24	Ceramic 24-Lead DIP (.3" wide)		X	X	X		70°C/W
LS-20	Hermetic 20-Pad LCC (.35" square)	X					85°C/W
LD-28	Hermetic 28-Pad LCC (.45" square)	X	X	X	X	X	75°C/W
LB-44	Hermetic 44-Pad LCC (.65" square)		X	X	X	X	65°C/W
MC-14	Side Braze 14-Lead DIP (.3" wide)	X	X	X			80°C/W
ML-16	Side Braze 16-Lead DIP (.3" wide)	X	X	X	X		70°C/W
M3-20	Side Braze 20-Lead DIP (.3" wide)	X	X				65°C/W
MY-24	Side Braze 24-Lead DIP (.3" wide)				X	X	60°C/W
M6-28	Side Braze 28-Lead DIP (.3" wide)	X	X	X	X	X	60°C/W
MV-28	Side Braze 28-Lead DIP (.6" wide)		X	X	X	X	50°C/W
M5-40	Side Braze 40-Lead DIP (.6" wide)		X	X	X	X	45°C/W
KN-8	Plastic 8-Lead DIP	X	X				100°C/W
KD-14	Plastic 14-Lead DIP	X	X				90°C/W
KM-16	Plastic 16-Lead DIP	X	X				85°C/W
PF-20	Plastic 20-Lead DIP	X	X	X		X	65°C/W
PE-24	Plastic 24-Lead DIP	X	X	X	X	X	55°C/W
QA-28	Plastic 28-Lead Chip Carrier	X	X	X	X	X	65°C/W
QB-44	Plastic 44-Lead Chip Carrier	X	X	X	X	X	55°C/W
NC-24	Plastic 24-Lead Small Outline	X	X	X	X	X	110°C/W
PJ-40	Plastic 40-Lead DIP	X	X	X	X	X	50°C/W

Section 5

Small Signal Transistors (Hermetic Seal)

Part No.	Package	Description	Commercial	JAN	JAN TX	JAN TXV
2N0328A	TO39	PNP Chopper	X	X		
2N0328B	TO39	PNP Chopper	X			
2N0329A	TO39	PNP Chopper	X	X		
2N0329B	TO39	PNP Chopper	X			
2N0497	TO39	NPN General Purpose Amplifier		X		
2N0498	TO39	NPN General Purpose Amplifier		X		
2N0656	TO39	NPN General Purpose Amplifier	X	X		
2N0657	TO39	NPN General Purpose Amplifier	X	X		
2N0696	TO39	NPN General Purpose Amplifier	X	X		
2N0697	TO39	NPN General Purpose Amplifier	X	X		
2N0699	TO39	NPN General Purpose Amplifier	X			
2N0706	TO18	NPN Ultra High Speed Switch	X	X		
2N0706A	TO18	NPN Ultra High Speed Switch	X			
2N0708	TO18	NPN Ultra High Speed Switch	X			
2N0717	TO18	NPN General Purpose Amplifier	X			
2N0718	TO18	NPN General Purpose Amplifier	X			
2N0718A	TO18	NPN General Purpose Amplifier	X	X	X	X
2N0720A	TO18	NPN General Purpose Amplifier	X	X	X	
2N0744	TO18	NPN Ultra High Speed Switch	X	X		
2N0744A	TO18	NPN Ultra High Speed Switch	X			
2N0757A	TO18	NPN Low Noise, Hi Gain Amplifier	X	X		
2N0759A	TO18	NPN Low Noise, Hi Gain Amplifier	X	X		
2N0760A	TO18	NPN Low Noise, Hi Gain Amplifier		X		
2N0910	TO18	NPN General Purpose Amplifier	X	X	X	
290911	TO18	NPN General Purpose Amplifier	X	X	X	
2N0912	TO18	NPN General Purpose Amplifier		X	X	
2N0916	TO18	NPN Radio Frequency Amplifier	X	X		
2N0917	TO72	NPN UHF Amplifier	X			
2N0917A	TO72	NPN UHF Amplifier	X			
2N0918	TO72	NPN UHF Amplifier	X	X	X	X
2N0929	TO18	NPN Low Noise, High Gain Amp	X		X	
2N0930	TO18	NPN Low Noise, High Gain Amp	X	X	X	
2N0930A	TO18	NPN Low Noise, High Gain Amp	X			
2N0930B	TO18	NPN Low Noise, High Gain Amp	X			
2N0956	TO18	NPN General Purpose Amplifier	X			
2N0997	TO18	NPN Darlington Amplifier	X			
2N0998	TO72	NPN Darlington Amplifier	X			
2N0999	TO72	NPN Darlington Amplifier	X			
2N1131	TO39	PNP General Purpose Amplifier	X	X		
2N1132	TO39	PNP General Purpose Amplifier	X	X		
2N1613	TO39	NPN Med Current Gen Purpose Amp	X	X	X	X
2N1711	TO39	NPN General Purpose Amplifier	X	X	X	
2N1711B	TO39	NPN General Purpose Amplifier	X			
2N1890	TO39	NPN General Purpose Amplifier	X	X	X	
2N1893	TO39	NPN General Purpose Amplifier	X	X	X	
2N2060	TO77	NPN Differential Amplifier	X	X	X	X
2N2102	TO39	NPN General Purpose Amplifier	X			
2N2102A	TO39	NPN General Purpose Amplifier	X			
2N2102B	TO39	NPN General Purpose Amplifier	X			
2N2192B	TO39	NPN General Purpose Amplifier	X			

Part No.	Package	Description	Commercial	JAN	JAN TX	JAN TXV
2N2194	TO39	NPN General Purpose Amplifier	X			
2N2194A	TO39	NPN General Purpose Amplifier	X			
2N2194B	TO39	NPN General Purpose Amplifier	X			
2N2218	TO39	NPN Med Current Gen Purpose Amp		X	X	X
2N2218A	TO39	NPN Med Current Gen Purpose Amp		X	X	X
2N2219	TO39	NPN Med Current Gen Purpose Amp	X	X	X	X
2N2219A	TO39	NPN Med Current Gen Purpose Amp	X	X	X	X
2N2221	TO18	NPN Med Current Gen Purpose Amp		X	X	X
2N2221A	TO18	NPN Med Current Gen Purpose Amp	X	X	X	X
2N2222	TO18	NPN Med Current Gen Purpose Amp	X	X	X	X
2N2222A	TO18	NPN Med Current Gen Purpose Amp	X	X	X	X
2N2223	TO77	NPN Differential Amplifier	X			
2N2223A	TO77	NPN Differential Amplifier	X			
2N2243	TO39	NPN General Purpose Amplifier	X			
2N2243A	TO39	NPN General Purpose Amplifier	X			
2N2270	TO39	NPN General Purpose Amplifier	X			
2N2280	TO18	PNP Chopper	X			
2N2369	TO18	NPN Ultra High Speed Switch	X			
2N2369A	TO18	NPN Ultra High Speed Switch	X	X	X	X
2N2405	TO39	NPN General Purpose Amplifier	X			
2N2480	TO77	NPN Differential Amplifier	X			
2N2481	TO18	NPN Ultra High Speed Switch		X	X	
2N2483	TO18	NPN Low Level Low Noise Hi Gain Amp	X			
2N2484	TO18	NPN Low Level Low Noise Hi Gain Amp	X	X	X	X
2N2604	TO46	PNP Low Level Low Noise Hi Gain Amp		X	X	X
2N2605	TO46	PNP Low Level Low Noise Hi Gain Amp		X	X	X
2N2708	TO72	NPN Ultra High Frequency	X			
2N2725	TO72	NPN Darlington Amplifier	X			
2N2904	TO39	PNP Med Current Gen Purpose Amp	X	X	X	X
2N2904A	TO39	PNP Med Current Gen Purpose Amp	X	X	X	X
2N2905	TO39	PNP Med Current Gen Purpose Amp	X	X	X	X
2N2905A	TO39	PNP Med Current Gen Purpose Amp	X	X	X	X
2N2906	TO18	PNP Med Current Gen Purpose Amp	X	X	X	X
2N2906A	TO18	PNP Med Current Gen Purpose Amp	X	X	X	X
2N2907	TO18	PNP Med Current Gen Purpose Amp	X	X	X	X
2N2907A	TO18	PNP Med Current Gen Purpose Amp	X	X	X	X
2N2913	TO77	NPN Low Noise Hi Gain Differential Amp	X			
2N2914	TO77	NPN Low Noise Hi Gain Differential Amp	X			
2N2915	TO77	NPN Low Noise Hi Gain Differential Amp	X			
2N2915A	TO77	NPN Low Noise Hi Gain Differential Amp	X			
2N2916	TO77	NPN Low Noise Hi Gain Differential Amp	X			
2N2916A	TO77	NPN Low Noise Hi Gain Differential Amp	X			
2N2917	TO77	NPN Low Noise Hi Gain Differential Amp	X			
2N2918	TO77	NPN Low Noise Hi Gain Differential Amp	X			
2N2919	TO77	NPN Low Noise Hi Gain Differential Amp	X	X	X	X
2N2919A	TO77	NPN Low Noise Hi Gain Differential Amp	X			
2N2920	TO77	NPN Low Noise Hi Gain Differential Amp	X	X	X	X
2N2920A	TO77	NPN Low Noise Hi Gain Differential Amp	X			
2N2945	TO46	PNP Chopper	X			
2N2945A	TO46	PNP Chopper	X	X	X	X

Part No.	Package	Description	Commercial	JAN	JAN TX	JAN TXV
2N2946	TO46	PNP Chopper	X			
2N2946A	TO46	PNP Chooper	X	X	X	X
2N2972	TO71	NPN Low Noise, Hi Gain Differential Amp	X			
2N2973	TO71	NPN Low Noise, Hi Gain Differential Amp	X			
2N2976	TO71	NPN Low Noise, Hi Gain Differential Amp	X			
2N2979	TO71	NPN Low Noise, Hi Gain Differential Amp	X			
2N3019	TO39	NPN General Purpose Amplifier	X	X	X	X
2N3020	TO39	NPN General Purpose Amplifier	X			
2N3036	TO39	NPN General Purpose Amplifier	X			
2N3044	TO39	NPN Low Noise, Hi Gain Differential Amp	X			
2N3053	TO39	NPN General Purpose Amplifier	X			
2N3057	TO46	NPN General Purpose Amplifier	X			
2N3057A	TO46	NPN General Purpose Amplifier	X	X	X	X
2N3117	TO18	NPN Low Level, Low Noise, Hi Gain Amp	X			
2N3244	TO39	PNP Hi Current, Hi Switch Core Drive	X			
2N3250	TO18	PNP Low Level Gen Purpose Amp & Switch	X			
2N3250A	TO18	PNP Low Level Gen Purpose Amp & Switch	X	X	X	X
2N3251	TO18	PNP Low Level Gen Purpose Amp & Switch	X			
2N3251A	TO18	PNP Low Level Gen Purpose Amp & Switch	X	X	X	X
2N3347	TO77	PNP Low Noise, Hi Gain Differential Amp	X			
2N3423	TO72	PNP Low Noise, Hi Gain Differential Amp	X			
2N3424	TO72	PNP Low Noise, Hi Gain Differential Amp	X			
2N3467	TO39	PNP Core Driver	X	X	X	X
2N3468	TO39	PNP Core Driver	X	X	X	X
2N3485A	TO46	PNP Med Current Gen Purpose Amplifier	X	X	X	
2N3486A	TO46	PNP Med Current Gen Purpose Amplifier	X	X	X	
2N3498	TO39	NPN Hi Voltage General Purpose Amplifier		X	X	X
2N3499	TO39	NPN Hi Voltage General Purpose Amp		X	X	X
2N3500	TO39	NPN Hi Voltage General Purpose Amp		X	X	X
2N3501	TO39	NPN Hi Voltage General Purpose Amp	X	X	X	X
2N3634	TO39	PNP Hi Voltage General Purpose Amp	X	X	X	X
2N3635	TO39	PNP Hi Voltage General Purpose Amp	X	X	X	X
2N3636	TO39	PNP Hi Voltage General Purpose Amp	X	X	X	X
2N3637	TO39	PNP Hi Voltage General Purpose Amp	X	X	X	X
2N3700	TO18	NPN General Purpose Amplifier	X	X	X	X
2N3722	TO39	NPN Hi Cur., Hi Speed Switch Core Driver	X			
2N3724	TO39	NPN Hi Cur., Hi Speed Switch Core Driver	X			
2N3724A	TO39	NPN Hi Cur., Hi Speed Switch Core Driver	X			
2N3725	TO39	NPN Hi Cur., Hi Speed Switch Core Driver	X			
2N3725A	TO39	NPN Hi Cur., Hi Speed Switch Core Driver	X			
2N3734	TO39	NPN Hi Cur., Hi Speed Switch Core Driver	X			
2N3735	TO39	NPN Hi Cur., Hi Speed Switch Core Driver	X	X	X	X
2N3736	TO46	NPN Hi Cur., Hi Speed Switch Core Driver	X			
2N3737	TO46	NPN Hi Cur., Hi Speed Switch Core Driver	X	X	X	X
2N3762	TO39	PNP Hi Cur., Hi Speed Switch Core Driver	X	X	X	X
2N3763	TO39	PNP Hi Cur., Hi Speed Switch Core Driver	X	X	X	X
2N3764	TO46	PNP Hi Cur., Hi Speed Switch Core Driver	X			
2N3765	TO46	PNP Hi Cur., Hi Speed Switch Core Driver	X			
2N3799	TO18	PNP Low Level, Low Noise, Hi Gain Amp	X			
2N3805	TO71	PNP Low Noise, Hi Gain Differential Amp	X			

Part No.	Package	Description	Commercial	JAN	JAN TX	JAN TXV
2N3809	TO78	PNP Low Noise, Hi Gain Differential Amp	X			
2N3810	TO78	PNP Low Noise, Hi Gain Differential Amp	X	X	X	X
2N3811	TO78	PNP Low Noise, Hi Gain Differential Amp	X	X	X	X
2N3830	TO39	NPN Hi Cur., Hi Speed Switch Core Driver	X			
2N3838	TO89	NPN/PNP Complementary Dual	X	X	X	X
2N3866	TO39	NPN RF Amplifier	X	X	X	X
2N3866A	TO39	NPN RF Amplifier	X	X	X	X
2N3910	TO46	PNP Chopper	X			
2N3922	TO39	NPN Hi Cur., Hi Speed Switch Core Driver	X			
2N4029	TO18	PNP General Purpose Amplifier	X			
2N4032	TO39	PNP General Purpose Amplifier	X			
2N4033	TO39	PNP General Purpose Amplifier	X	X	X	X
2N4036	TO39	PNP Med Current Gen Purpose Amplifier	X			
2N4037	TO39	PNP Med Current Gen Purpose Amplifier	X			
2N4047	TO39	NPN Hi Cur., Hi Speed Switch Core Driver	X			
2N4209	TO18	PNP Ultra High Speed Switch	X			
2N4260	TO72	PNP Ultra High Frequency Amplifier	X			
2N4261	TO72	PNP Ultra High Frequency Amplifier	X	X	X	X
2N4449	TO46	NPN Ultra High Speed Switch	X	X	X	
2N4854	TO78	NPN/PNP Complementary Dual	X	X	X	X
2N4855	TO78	NPN/PNP Complementary Dual	X			
2N4937	TO78	PNP Low Noise, Hi Gain Differential Amp	X			
2N5022	TO39	PNP Hi Cur., Hi Speed Switch Core Driver	X			
2N5023	TO39	PNP Hi Cur., Hi Speed Switch Core Driver	X			
2N5109	TO39	NPN RF Amplifier	X	X	X	X
2N5793	TO78	Dual NPN Med Current Gen Purpose Amp	X	X	X	X
2N5794	TO78	Dual NPN Med Current Gen Purpose Amp	X	X	X	X
2N5795	TO78	Dual NPN Med Current Gen Purpose Amp	X	X	X	X
2N5796	TO78	Dual NPN Med Current Gen Purpose Amp	X	X	X	X
SP0918F	TO89	Dual NPN Ultra Hi Frequency Amplifier	X			
SP0918QD	TO116	Quad NPN Ultra Hi Frequency Amplifier	X			
SP0918QF	TO86	Quad NPN Ultra Hi Frequency Amplifier	X			
SP2219AF	TO89	Dual NPN Med Cur. Gen Purpose Amp	X			
SP2219AQD	TO116	Quad NPN Med Cur. Gen Purpose Amp	X			
SP2219AQF	TO86	Quad NPN Med Cur. Gen Purpose Amp	X			
SP2222AF	TO89	Dual NPN Med Cur. Gen Purpose Amp	X			
SP2222AQD	TO116	Quad NPN Med Cur. Gen Purpose Amp	X			
SP2222AQF	TO86	Quad NPN Med Cur. Gen Purpose Amp	X	X	X	X
SP2369AF	TO89	Dual NPN Ultra Hi Speed Switch	X			
SP2369AQD	TO116	Quad NPN Ultra Hi Speed Switch	X			
SP2369AQF	TO86	Quad NPN Ultra Hi Speed Switch	X			
SP2484F	TO89	Dual NPN Low Noise, Hi Gain Amplifier	X			
SP2484QD	TO116	Quad NPN Low Noise, Hi Gain Amplifier	X			
SP2484QF	TO86	Quad NPN Low Noise, Hi Gain Amplifier	X			
SP2605F	TO89	Dual PNP Low Noise, Hi Gain Amplifier	X			
SP2605QD	TO116	Quad PNP Low Noise, Hi Gain Amplifier	X			
SP2605QF	TO86	Quad PNP Low Noise, Hi Gain Amplifier	X			
SP2905AF	TO89	Dual PNP Med Cur. Gen Purpose Amp	X			
SP2905AQD	TO116	Quad PNP Med Cur. Gen Purpose Amp	X			

Part No.	Package	Description	Commercial	JAN	JAN TX	JAN TXV
SP2905AQF	TO86	Quad PNP Med Cur. Gen Purpose Amp	X			
SP2907AF	TO89	Dual PNP Med Cur. Gen Purpose Amp	X			
SP2907AQD	TO116	Quad PNP Med Cur. Gen Purpose Amp	X			
SP2907AQF	TO86	Quad PNP Med Cur. Gen Purpose Amp	X	X	X	X
SP3019F	TO89	Dual NPN Gen Purpose Amplifier	X			
SP3019QD	TO116	Quad NPN Gen Purpose Amplifier	X			
SP3019QF	TO86	Quad NPN General Purpose Amplifier	X			
SP3467F	TO89	Dual PNP Hi Current, Hi Speed Switch	X			
SP3467QD	TO116	Quad PNP Hi Current Hi Speed Switch	X			
SP3467QF	TO86	Quad PNP Hi Current Hi Speed Switch	X			
SP3724F	TO89	Dual NPN Hi Current, Hi Speed Switch	X			
SP3724QD	TO116	Quad NPN Hi Current, Hi Speed Switch	X			
SP3724QF	TO86	Quad NPN Hi Current, Hi Speed Switch	X			
SP3725F	TO89	Dual NPN Hi Current, Hi Speed Switch	X			
SP3725QD	TO116	Quad NPN Hi Current, Hi Speed Switch	X			
SP3725QF	TO86	Quad NPN Hi Current, Hi Speed Switch	X			

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