Magnetic and Transistorized Digital Modules

pb Packard Bell Computer

The TF2 Dual Flip-Flop Module holds two identical and independent Eccles-Jordan flip-flop circuits. The transistors are operated either at cut-off or at saturation. The TF2 is designed primarily for use in counting applications. For this purpose a toggle input is provided which changes the state of the flip-flop each time a suitable positive step is applied. Each side of a TF2 flip-flop can accept inputs from a diode gate or another flip-flop while only one of the two sides can accept an auxiliary input from an IC4 Input Circuit.

SPECIFICATIONS

INPUT

(To set, reset or toggle inputs directly or through diode gates and to auxiliary inputs through IC4, IC2 input circuits)

A positive step with the following characteristics:

Minimum amplitude	8 volts
Maximum rise time	1 microsecond
Maximum repetition rate	200 kilocycles

OUTPUT

Voltage $\begin{cases} \text{"One"} \\ \text{"Zero"} \end{cases}$ —9 to —12 volts / 0 to —0.25 volt

Maximum rise time $\begin{cases} \text{No load} & 0.25 \text{ microsecond} \\ \text{Full load} & 1.0 \text{ microsecond} \end{cases}$

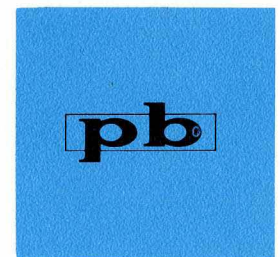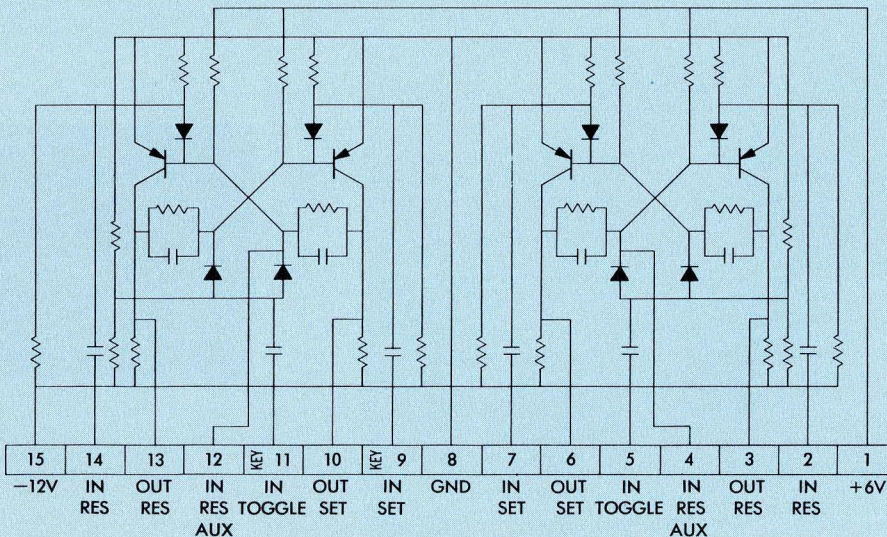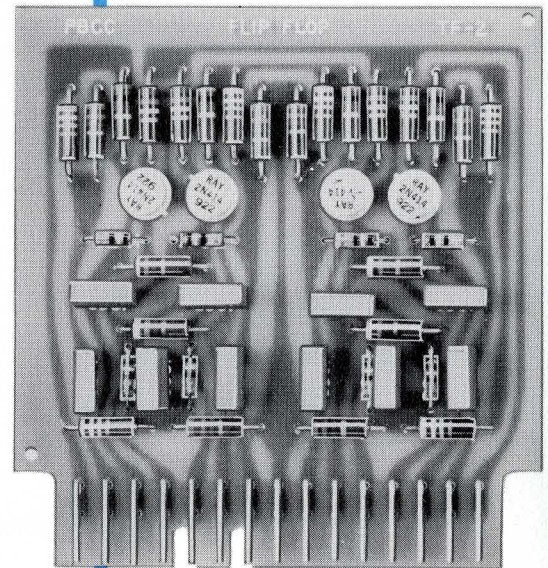Maximum load per output as a flip-flop:

Clocked or d.c. diode gates	10
Unclocked diode gates operating input circuits	8
NOR inputs	30

Maximum load per output as a toggle:

Clocked or d.c. diode gates	10
Unclocked diode gates operating input circuits	6
NOR inputs	30

POWER REQUIREMENTS FOR ENTIRE MODULE

—12 volts	30 milliamperes
+6 volts	0.9 milliampere

15	14	13	12	KEY	11	10	KEY	9	8	7	6	5	4	3	2	1
—12V	IN RES	OUT RES	IN RES AUX		IN TOGGLE	OUT SET		IN SET	GND	IN SET	OUT SET	IN TOGGLE	IN RES AUX	OUT RES	IN RES	+6V

TF3 Dual Flip-Flop

The TF3 Dual Flip-Flop Module holds two identical and independent Eccles-Jordan flip-flop circuits. The transistors are operated either at cut-off or at saturation. Each side of a TF3 flip-flop has two inputs: one which will accept inputs from a diode gate or another flip-flop, and an auxiliary which will accept inputs from an IC4 Input Circuit.

SPECIFICATIONS

INPUT (To set, reset inputs directly or through diode gates, and to auxiliary inputs through IC4, IC2 Input Circuits)

A positive step with the following characteristics:

Minimum amplitude	8 volts
Maximum rise time	1 microsecond
Maximum repetition rate	200 kilocycles

OUTPUT

Voltage	"One"	—9 to —12 volts
	"Zero"	0 to —0.25 volt
Maximum rise time	No load	0.25 microsecond
	Full load	1.0 microsecond

Maximum load per output:

Clocked or d.c. diode gates	10
Unclocked diode gates operating input circuits	8
NOR inputs	30

POWER REQUIREMENTS FOR ENTIRE MODULE

—12 volts	30 milliamperes
+6 volts	0.9 milliampere

15	14	13	12	KEY 11	10	9	8	7	6	5	4	KEY 3	2	1
—12V	IN RES	OUT RES	IN RES AUX	IN SET AUX	OUT SET	IN SET	GND	IN SET	OUT SET	IN SET AUX	IN RES AUX	OUT RES	IN RES	+6V

The TI3 Amplifier-Inverter Module holds six identical and independent single-stage preloaded amplifier circuits. In addition to providing the logical operation of negation, the TI3 serves to amplify the outputs of flip-flops and diode gates.

SPECIFICATIONS

INPUT

Voltage { "One" . . . . −9 to −12 volts
{ "Zero" . . . . 0 to −1 volt

Maximum rise time . . . . 1.0 microsecond
Maximum fall time . . . . 2.0 microseconds
Maximum repetition rate . . . . . . 200 kilocycles

OUTPUT

Voltage { "One" . . . . −9 to −12 volts
{ "Zero" . . . . 0 to −0.25 volt

Maximum rise time { No load . . . 0.25 microsecond
{ Full load . . . 1.0 microsecond

Maximum load per output . . . . . 10 diode gates or 30 NOR inputs

(When a TI3 inverter is operated from a diode gate the "One" input drops to −7.5 volts and the maximum load becomes 7 gates.)

POWER REQUIREMENTS FOR ENTIRE MODULE

−12 volts . . . . volts { 51 milliamperes with all units at "Zero"
{ 13 milliamperes with all units at "One"

+6 volts . . . . 2.4 milliamperes

15	14	13	12	KEY 11	10	9	KEY 8	7	6	5	4	3	2	1
−12V	IN	OUT	IN	OUT	IN	OUT	GND	IN	OUT	IN	OUT	IN	OUT	+6V
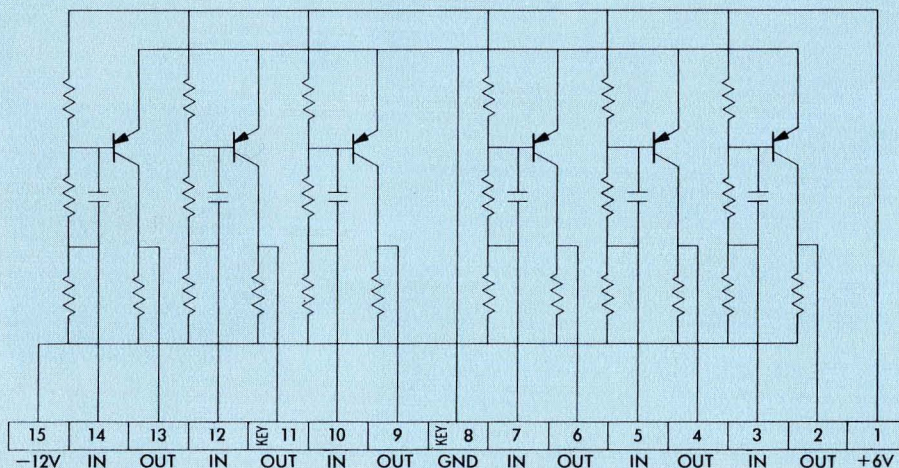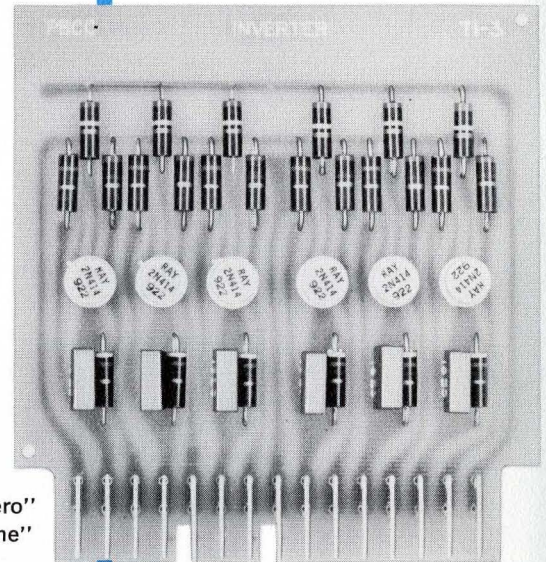
The EF1 Emitter-Follower Module holds six identical and independent amplifier circuits. In conjunction with Diode Gate Modules, the EF1 provides for the construction of d.c. OR and AND-OR gates. EF1 outputs, then, may be employed as inputs to other gates so as to provide multilevel gating. The EF1 also can be used to provide a low impedance output for driving long lines and similar devices.

SPECIFICATIONS

INPUT (Directly or through a d.c. diode gate)

Voltage
- "One" . . . . —9 to —12 volts
- "Zero" . . . . 0 to —0.25 volt

Maximum rise time . . . . 1 microsecond

OUTPUT

Voltage
- "One" . . . . —8 to —12 volts
- "Zero" . . . . +0.25 to —0.25 volt

Maximum rise time . . . . 1.5 microseconds

Maximum load per output:
- Clocked or d.c. diode gates 2
- NOR inputs 6

Additional load capability of directly operated emitter-follower:
- Maximum capacity . . . . 1000 micromicrofarads
- Minimum resistance to ground . . . . . . 500 ohms

POWER REQUIREMENTS FOR ENTIRE MODULE

—12 volts
- 90 milliamperes with all units at "One"
- 30 milliamperes with all units at "Zero"

+6 volts
- 90 milliamperes with all units at "One"
- 30 milliamperes with all units at "Zero"

15	14	13	12	11	10	KEY 9	KEY 8	7	6	5	4	3	2	1
—12V	IN	OUT	IN	OUT	IN	OUT		IN	OUT	IN	OUT	IN	OUT	+6V

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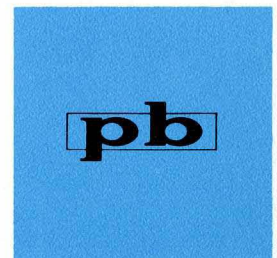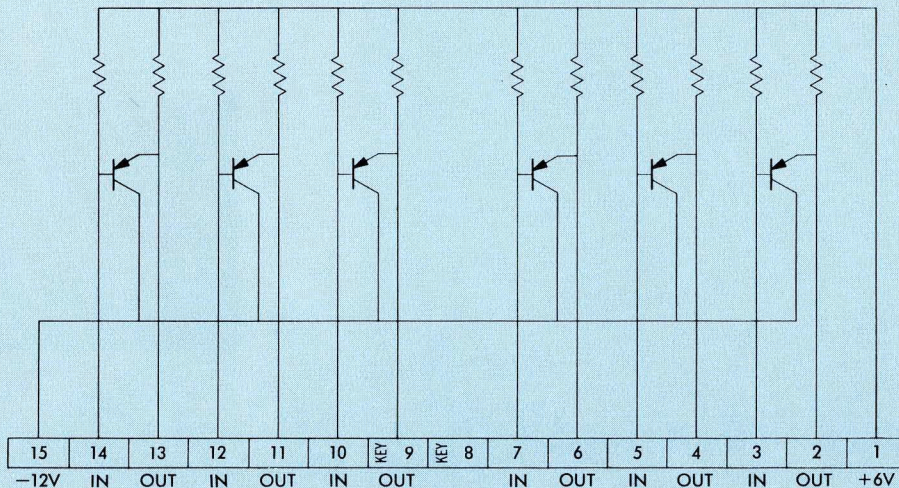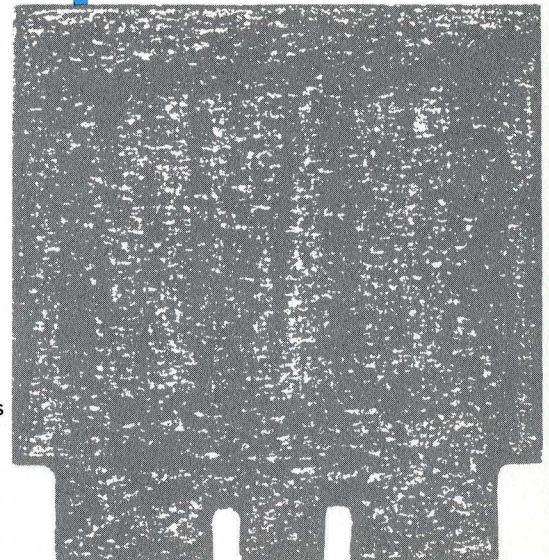
The DC1 Decade Counter Module holds four standard flip-flop circuits gated to count from zero through nine in the 8-4-2-1 binary coded decimal code. A reset input is provided and both collectors of each flip-flop are available at the connector. The true output of the most significant bit also serves as a carry signal to subsequent decimal stages. A preset value can be entered from external switches. In an alternate configuration of the DC1, one base and one collector of each flip-flop are made available.

SPECIFICATIONS

INPUT (Count and Reset)

A positive step with the following characteristics:

Minimum amplitude	8 volts
Maximum rise time	1 microsecond
Maximum count rate	200 kilocycles

OUTPUT

Voltage $\begin{cases} \text{"One"} \\ \text{"Zero"} \end{cases}$

"One"	—9 to —12 volts
"Zero"	0 to —0.25 volt

Maximum rise time $\begin{cases} \text{No load} \\ \text{Full load} \end{cases}$

No load	0.25 microsecond
Full load	1.0 microsecond

Maximum load per output:

Clocked or d.c. diode gates	8
Unclocked diode gates	5
NOR inputs	24

POWER REQUIREMENTS FOR ENTIRE MODULE

—12 volts	62 milliamperes
+6 volts	1.8 milliamperes
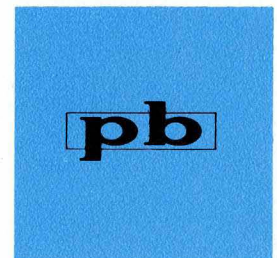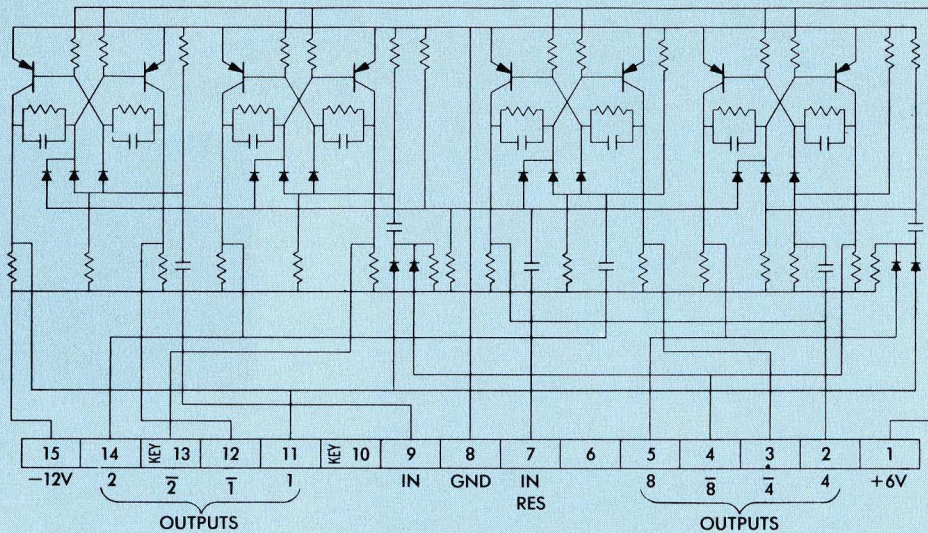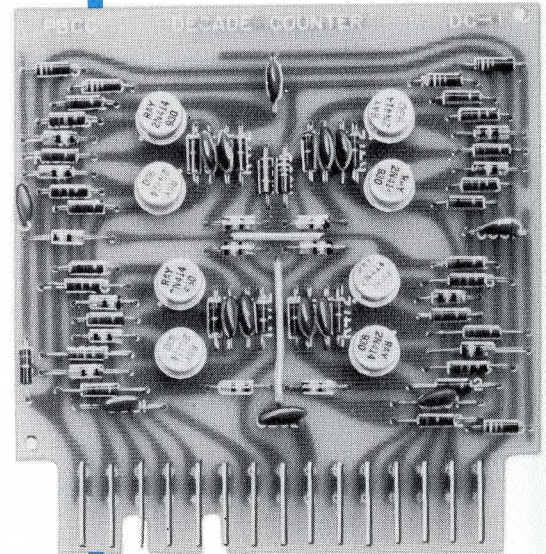
The BC1 Binary Counter Module holds four flip-flop circuits which count from zero through fifteen in pure binary. A reset input is provided and both collectors of each flip-flop are available at the connector. The true output of the most significant bit also serves as a carry signal to subsequent stages. A preset value can be entered from external switches. In an alternate configuration of the BC1, one base and one collector of each flip-flop are made available.

SPECIFICATIONS

INPUT (Count and Reset)

A positive step with the following characteristics:

Minimum amplitude	8 volts
Maximum rise time	1 microsecond
Maximum count rate	200 kilocycles

OUTPUT

Voltage	"One"	—9 to —12 volts
	"Zero"	0 to —0.25 volt
Maximum rise time	No load	0.25 microsecond
	Full load	1.0 microsecond

Maximum load per output:

Clocked or d.c. diode gates	10
Unclocked diode gates	5
NOR inputs	30

POWER REQUIREMENTS FOR ENTIRE MODULE

—12 volts	58 milliamperes
+6 volts	1.8 milliamperes

15	14	KEY 13	12	11	10	9	8	KEY 7	6	5	4	3	2	1
—12V	2	$\bar{2}$	$\bar{1}$	1		IN	GND	RES IN		8	$\bar{8}$	$\bar{4}$	4	+6V

OUTPUTS   OUTPUTS

pb
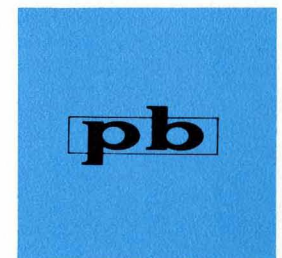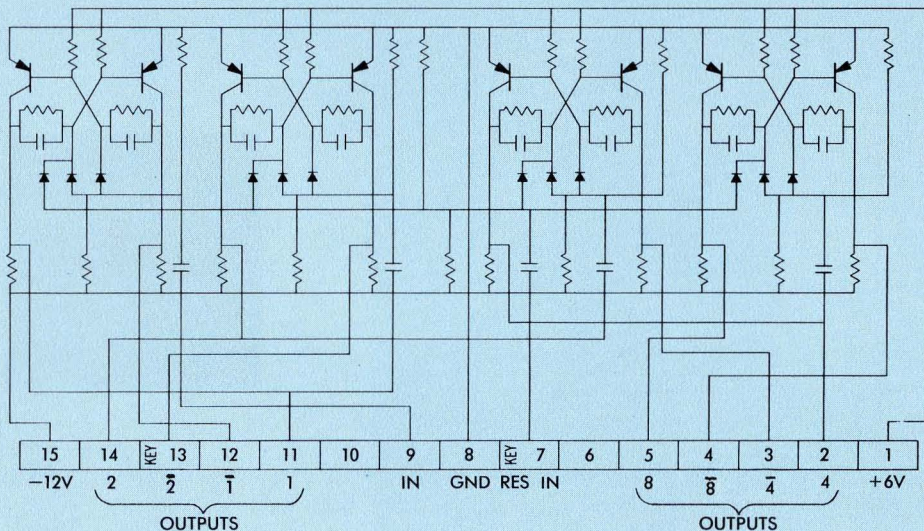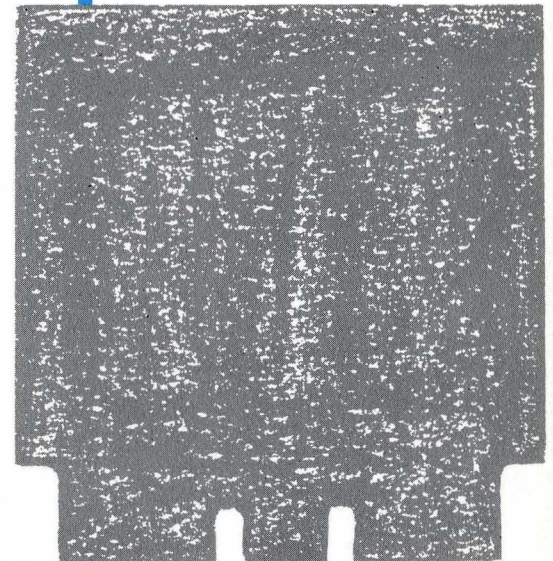
The TD2 Relay or Lamp Driver Module consists of four independent and identical power amplifier circuits that can each provide sufficient current to energize the coil of a d.c. relay or to light an incandescent lamp. An input emitter-follower is included in each amplifier in order to minimize the input power requirements. Diodes are provided to protect the power transistors from inductive surges.
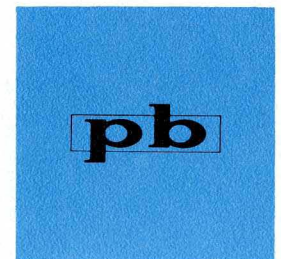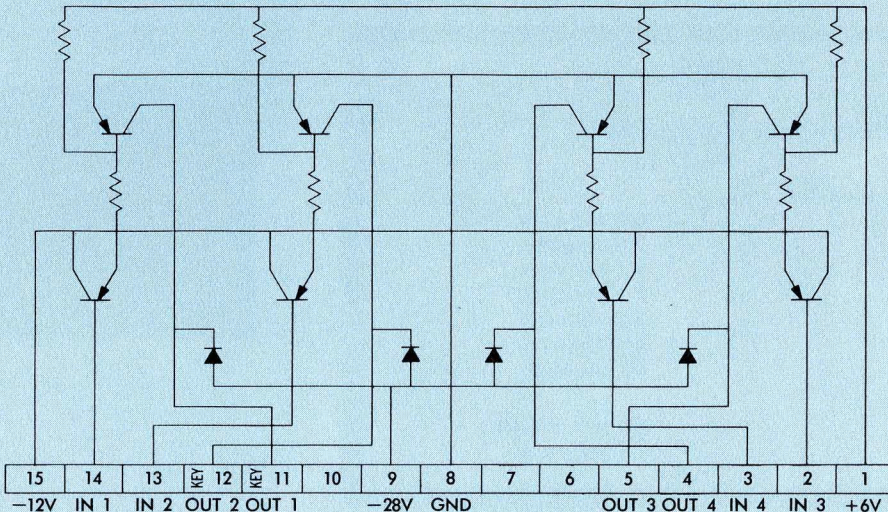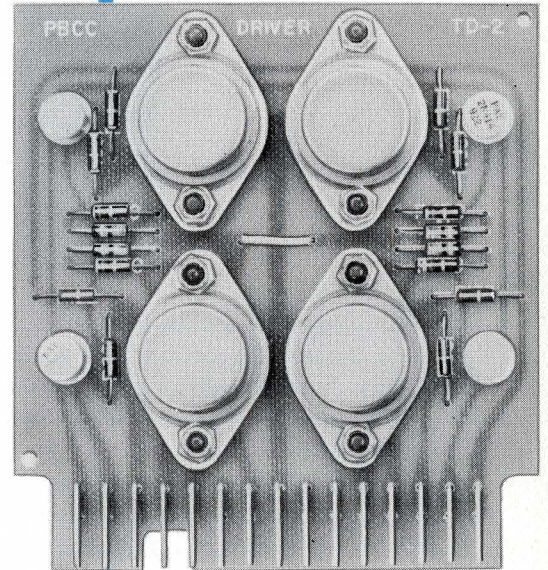
SPECIFICATIONS

INPUT

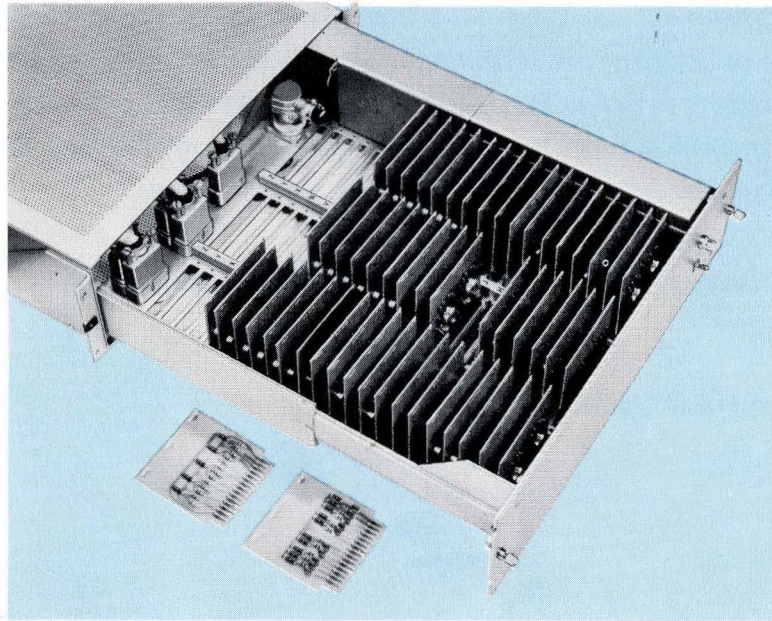|	
Turn-on voltage	—8 to —12 volts
Turn-off voltage	0 to —1 volt
Maximum repetition rate	2 kilocycles

OUTPUT

Maximum voltage	28 volts d.c.
Maximum load current per output	350 milliamperes
Maximum power per output	10 watts

POWER REQUIREMENTS FOR ENTIRE MODULE

—12 volts	{ 60 milliamperes, with all units ON
	{ 15 milliamperes, with all units OFF
+6 volts	20 milliamperes

15	14	13	KEY 12	KEY 11	10	9	8	7	6	5	4	3	2	1
—12V	IN 1	IN 2	OUT 2	OUT 1		—28V	GND			OUT 3	OUT 4	IN 4	IN 3	+6V

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The Mounting Case for the Packard Bell Computer Corporation Digital Modules holds 72 cards and, if required, an internal Power Supply. This facilitates the construction of small digital systems economically and with a minimum of special design.

The Mounting Case requires 5¼ inches of a standard relay rack. Space is provided for input and output connectors, and plastic channels serve to hold and protect inter-row wiring. Top and bottom dust covers are apertured to permit vertical cooling.

Up to 60 Amperex 6977 indicators can be mounted on the front panel. These are low power devices that require very small signals and so represent no additional load on the drive circuits.

The Power Supply is completely Solid State and is mounted with two screws. It will power both the Packard Bell Computer Corporation's Medium Frequency and High Frequency Transistorized Modules. An additional tandem supply is required for the Magnetic Modules or —28V may be supplied externally. Both the +6V and the —12V supplies have controls which permit voltage variations that are adequate for the marginal checking of the digital modules. Supply voltages to power the indicators are included.

The MC72 is normally supplied without module connectors.

Blank Circuit Cards, with connectors, and Card Extenders are also available.

SPECIFICATIONS

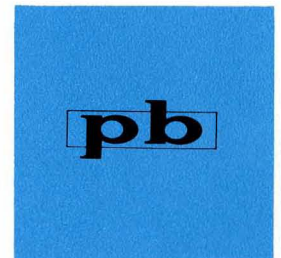**INPUT**

105 to 125 volts, 50 to 60 cycle single phase a.c. power

OUTPUT

Regulated voltages for plug-in modules:

+6 volts d.c.	0.5 amperes
—12 volts d.c.	1.5 amperes
Load regulation	±1 per cent
Line regulation	±1 per cent
Ripple	0.8 per cent peak to peak
Efficiency	55 per cent

Unregulated power for indicators:

+50 volts d.c.	80 milliamperes
1 volt a.c.	1.8 amperes

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TO3 Dual One-Shot Multivibrator

The TO3 Dual One-Shot Multivibrator Module holds two identical and independent circuits that functionally can also serve as triggered blocking oscillators. A potentiometer in each circuit provides a fine adjustment over a 3 to 1 range. The coarse range is determined by a capacitor on the board that may operate in conjunction with an external capacitor for which connections are provided. This procedure maintains the absolute interchangeability of all modules with identical keying.

SPECIFICATIONS

INPUT

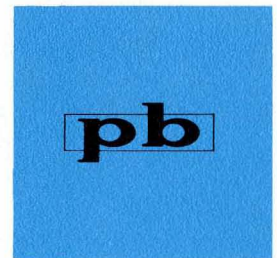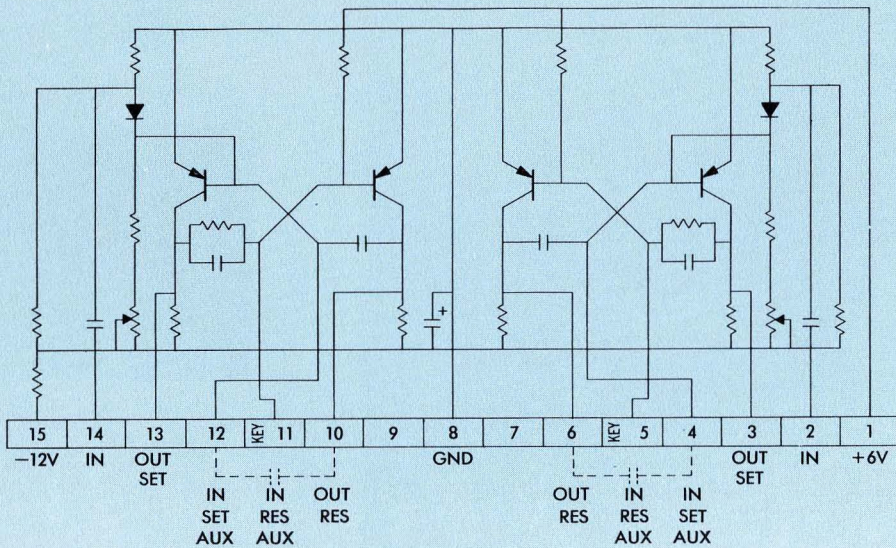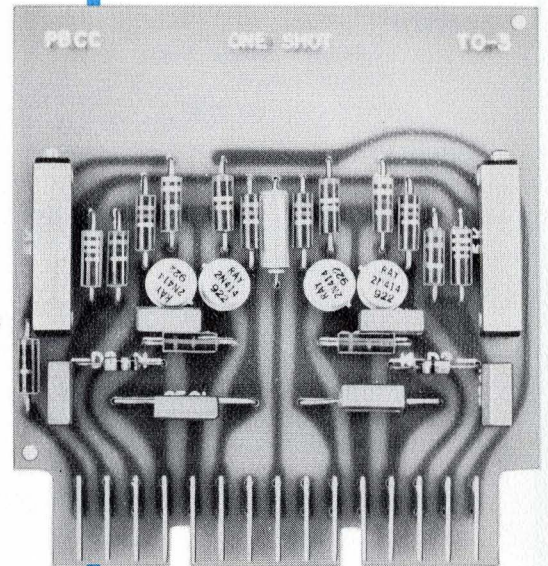A positive step with the following characteristics:

Minimum amplitude	8 volts
Maximum rise time	1 microsecond

OUTPUT

Voltage	"One"	—10 to —12 volts
	"Zero"	0 to —0.25 volt
Maximum rise time		0.5 microsecond

Maximum load per output:

Diode gates	4
NOR inputs	12
Delay range (no external capacity)	1—3 microseconds

Approximate external capacity to increase delay range:

10—30 microseconds	0.005 microfarad
0.1—0.3 millisecond	0.05 microfarad
1—3 milliseconds	0.5 microfarad
10—30 milliseconds	5.0 microfarads
0.1—0.3 second	50 microfarads

POWER REQUIREMENTS FOR ENTIRE MODULE

—12 volts	51 milliamperes
+6 volts	0.8 milliampere

15	14	13	12	KEY	11	10	9	8	7	6	KEY	5	4	3	2	1
—12V	IN	OUT SET						GND						OUT SET	IN	+6V
			IN SET AUX		IN RES AUX	OUT RES				OUT RES		IN RES AUX	IN SET AUX			

ST1 Dual Schmitt Trigger

The ST1 Dual Schmitt Trigger Module holds two identical and independent trigger circuits that are designed to provide reshaping of degenerated waveforms and sensing of d.c. levels. In order to permit heavier loading, an output amplifier is included in each circuit.
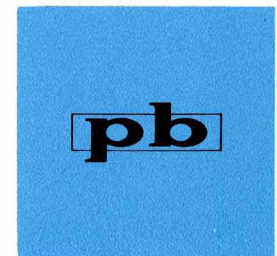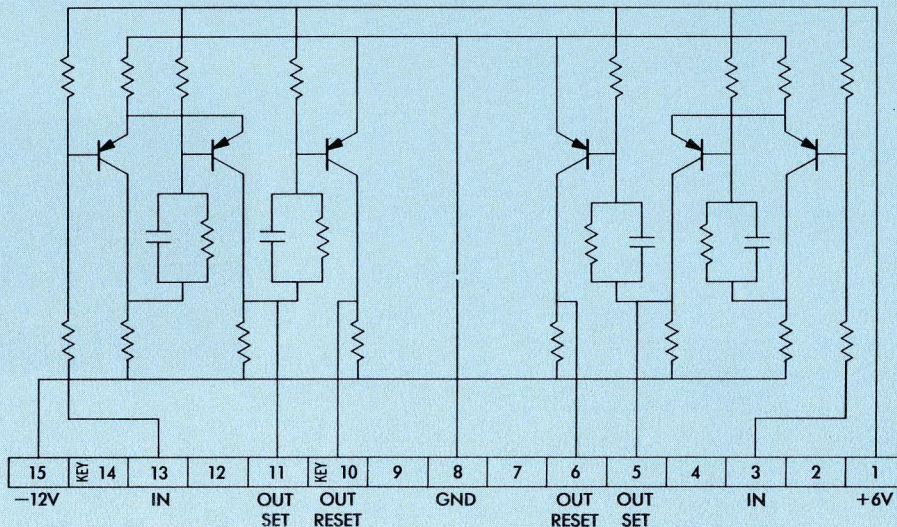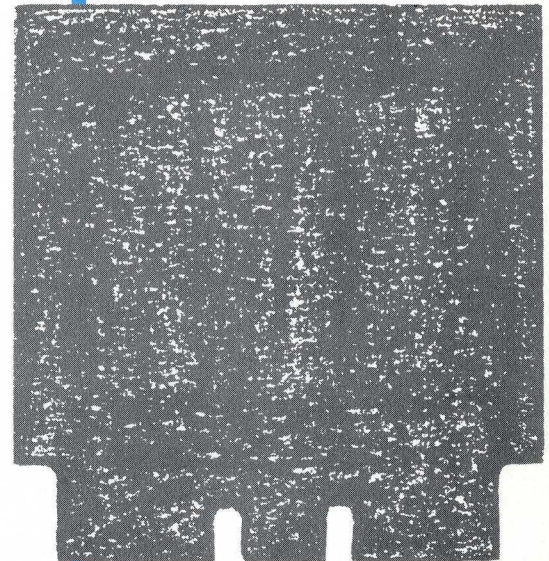
SPECIFICATIONS

INPUT

Maximum voltage range	± 20 volts
Threshold level	-3.5 to -4.5 volts
Maximum frequency	200 kilocycles

OUTPUT

Voltage "One"		-9 to -12 volts
"Zero"	Set Outputs (Pins 11 and 5)	-0.8 to -1.5 volts
	Reset Outputs (Pins 10 and 6)	0 to -0.25 volt
Maximum rise time		1 microsecond

Maximum load per Set Output:

Diode Gates	3
NOR inputs	9

Maximum load per Reset Output:

Diode Gates	10
NOR inputs	30

POWER REQUIREMENTS FOR ENTIRE MODULE

-12 volts	30 milliamperes
$+6$ volts	2.2 milliamperes

15	KEY 14	13	12	11	KEY 10	9	8	7	6	5	4	3	2	1
−12V		IN		OUT SET	OUT RESET		GND		OUT RESET	OUT SET		IN		+6V

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The HF3 Clock Generator and Multivibrator Module consists of a self-starting astable multivibrator circuit and a two-stage amplifier. The multivibrator frequency is nominally set at 100 kilocycles. Contacts are provided for an external capacitor if a lower frequency is required.

SPECIFICATIONS

OUTPUT

Voltage { "One"	. . . .	−10 to −12 volts
"Zero"	. . . .	0 to −0.25 volt
Maximum load	. . . .	30 diode gates
Maximum rise time { No load	. . . .	0.1 microsecond
Full load	. . . .	0.8 microsecond
Maximum repetition rate	. . . .	200 kilocycles
Standard repetition rate	. . . .	100 kilocycles

Approximate value of external capacitors to reduce repetition rate:

10 kilocycles	. . . .	0.005 microfarad
1 kilocycle	. . . .	0.05 microfarad
100 cycles	. . . .	0.5 microfarad
10 cycles	. . . .	5.0 microfarads
1 cycle	. . . .	50.0 microfarads

POWER REQUIREMENTS

−12 volts	. . . .	37 milliamperes
+6 volts	. . . .	0.8 milliampere

15	14	13	12	KEY 11	KEY 10	9	8	7	6	5	4	3	2	1
−12V							GND		INV OUT		OUT			+6V
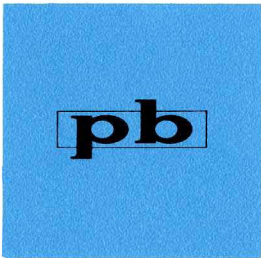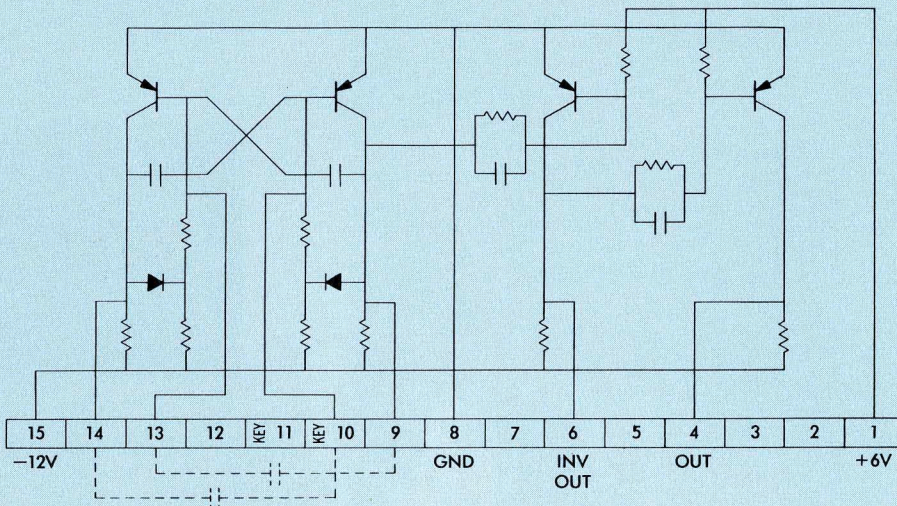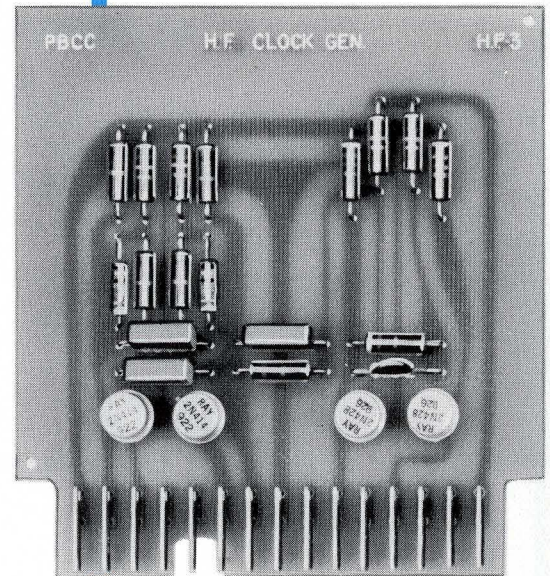
The NE1 Dual NOR Module holds two independent and identical NOR circuits. Each NOR circuit has five inputs preloaded to present a more natural load for PNP transistor flip-flops and amplifiers. The NOR circuit can be operated by the TF2 or TF3 flip-flop, by the TI3 amplifier, as well as by other NOR elements. In turn, the NOR element can drive diode gates as well as other NOR modules. The NE1 is particularly applicable in the construction of large decoding matrices.

SPECIFICATIONS

INPUT

Voltage
- "One" . . . . —8 to —12 volts
- "Zero" . . . . 0 to —0.25 volt

Unused inputs must be connected to ground

OUTPUT

Voltage
- "One" . . . . —8 to —12 volts
- "Zero" . . . . 0 to —0.25 volt

Maximum inherent switching time . . . . 10 microseconds

Maximum load per output:
- NOR elements 9
- Clocked or d.c. diode gates 3

POWER REQUIREMENTS FOR ENTIRE MODULE
- —12 volts . . . . 9 milliamperes
- +6 volts . . . . 0.15 milliampere

15	14	13	12	11	KEY 10	9	KEY 8	7	6	5	4	3	2	1
—12V	OUT	IN	IN	IN	IN	IN	GND	IN	IN	IN	IN	IN	OUT	+6V
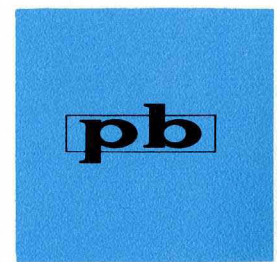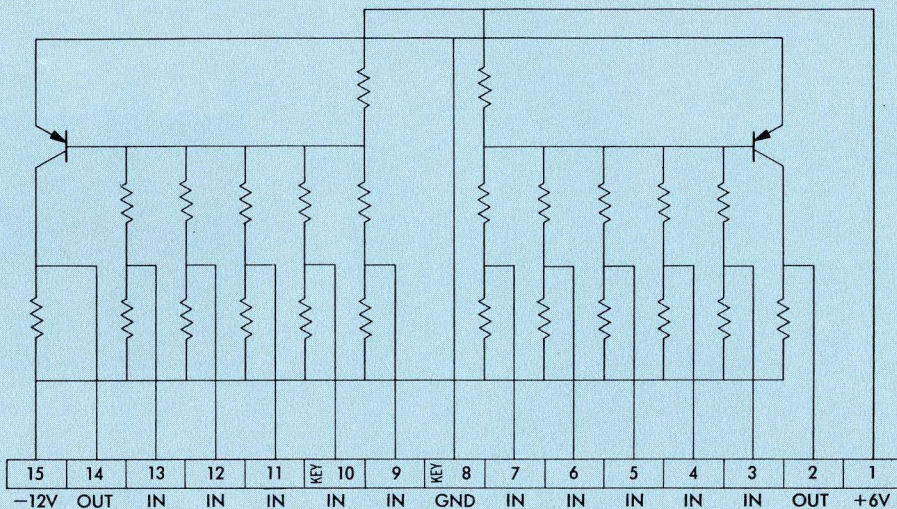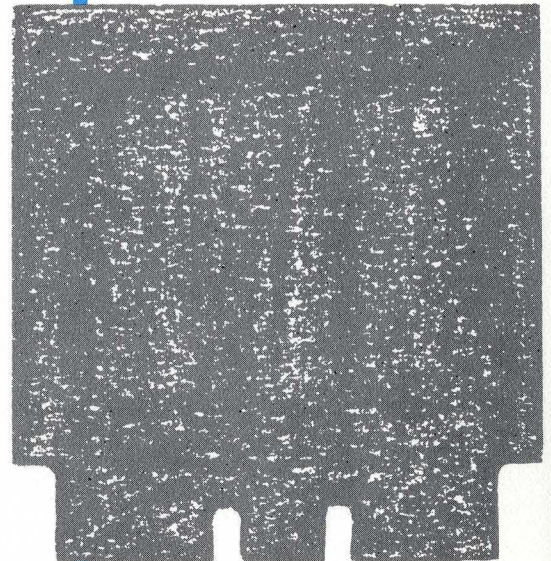
The CD3 Clock Driver Module is a multi-output amplifier which accepts a single input signal from a suitable clock source, shapes it, and provides a high power output. The input signal can be provided by an HF3, a TI3 or any other source fulfilling the input requirements. The CD3 is designed to drive up to 400 gates.
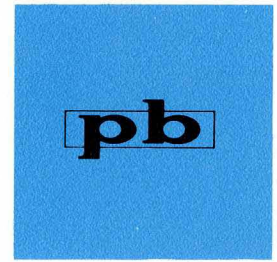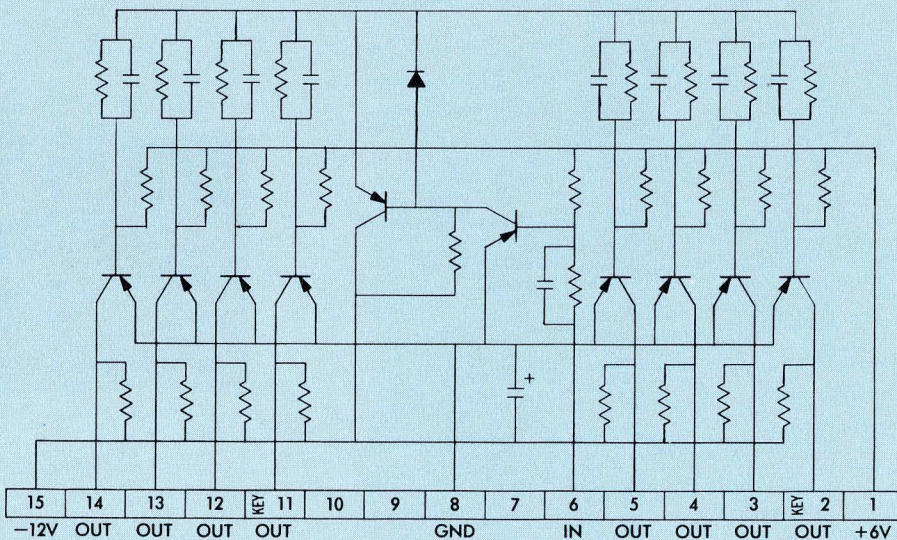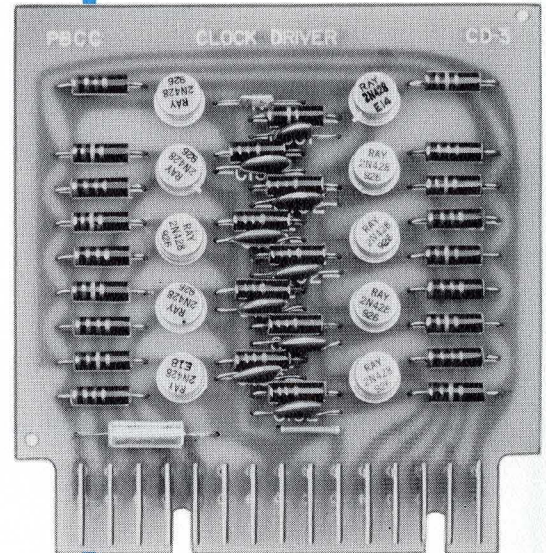
SPECIFICATIONS

INPUT

Voltage { "One"	. . . .	—8 to —12 volts
"Zero"	. . . .	0 to —1 volt
Maximum rise time	. . . .	1 microsecond
Maximum repetition rate	. . . .	200 kilocycles

OUTPUT

Voltage { "One"	. . . .	—10 to —12 volts
"Zero"	. . . .	0 to —0.25 volt
Maximum load per output	. . . .	50 diode gates
Maximum rise time { No load	. . . .	0.1 microsecond
Full load	. . . .	1 microsecond

POWER REQUIREMENTS FOR ENTIRE MODULE

—12 volts	. . . .	100 milliamperes
		(Average for 50% duty factor)
+6 volts	. . . .	3 milliamperes

15	14	13	12	KEY 11	10	9	8	7	6	5	4	3	KEY 2	1
—12V	OUT	OUT	OUT	OUT			GND		IN	OUT	OUT	OUT	OUT	+6V

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CS1 Dual Clock Shaper

The CS1 Dual Clock Shaper Module holds two identical and independent amplifiers which provide shaping and power amplification for clock signals. The input signal can be provided by an HF3, a TI3, or any other source fulfilling the input requirements. The CS1 is designed to drive up to 30 gates from each amplifier.

SPECIFICATIONS

INPUT

Voltage { "One"	. . . .	—8 to —12 volts
"Zero"	. . . .	0 to —1 volt
Maximum rise time	. . . .	1 microsecond
Maximum repetition rate	. . . .	200 kilocycles

OUTPUT

Voltage { "One"	. . . .	—10 to —12 volts
"Zero"	. . . .	0 to —0.25 volt
Maximum load per output	. . . .	30 diode gates
Maximum rise time { No load	. . . .	0.1 microsecond
Full load	. . . .	0.8 microsecond

POWER REQUIREMENTS FOR ENTIRE MODULE

—12 volts	. . . .	50 milliamperes
+6 volts	. . . .	1.6 milliamperes

15	KEY 14	13	12	11	10	9	8	KEY 7	6	5	4	3	2	1
—12V		OUT		INV OUT		IN	GND	IN		INV OUT		OUT		+6V

pb
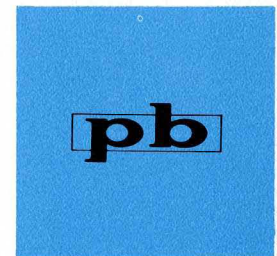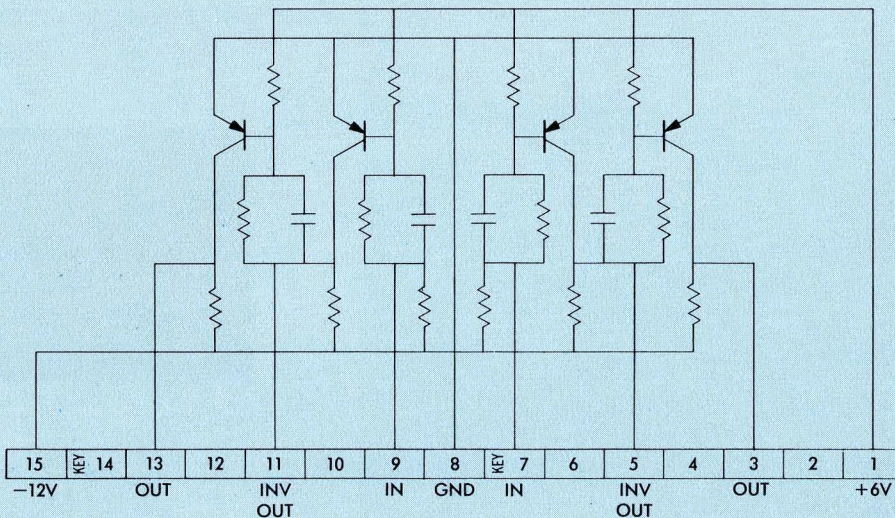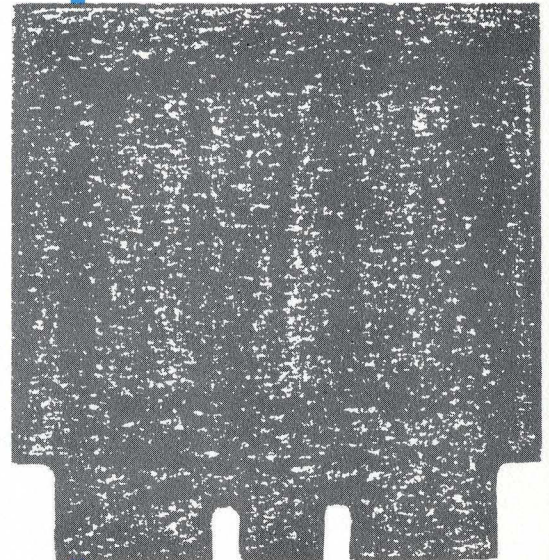
The DG3 Diode Gate Module consists of five AND gates, each with two or three diodes. The gates are independent, except for one common input applied to one diode in each gate. Each AND gate may drive a flip-flop input circuit, an inverter, or an emitter-follower.

In conjunction with an emitter-follower, the DG3 may be operated as a d.c. AND-OR gate. The common input now becomes the output of the multilevel gate, and is connected to the emitter-follower. Additional terms may be connected to each AND gate from a DG4 Module.
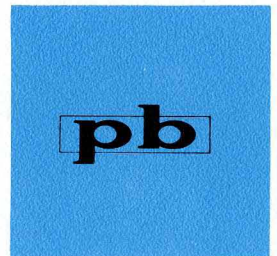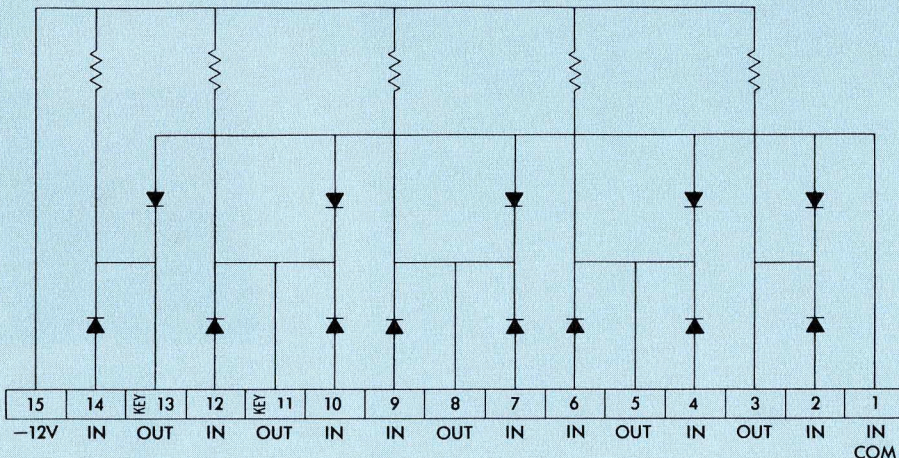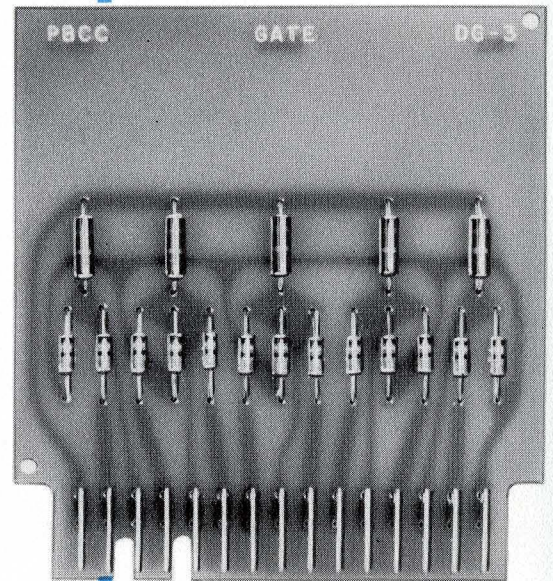
SPECIFICATIONS

INPUT

Voltage
- "One" . . . . — 9 to —12 volts
- "Zero" . . . . 0 to —0.25 volt

Clock or Trigger:
- Minimum dwell at either level . . . . 2 microseconds
- Maximum rise time . . . . 1 microsecond
- Maximum repetition rate . . . . 200 kilocycles

POWER REQUIREMENTS

—12 volts . . . . 10 milliamperes

15	14	KEY 13	12	KEY 11	10	9	8	7	6	5	4	3	2	1
—12V	IN	OUT	IN	OUT	IN	IN	OUT	IN	IN	OUT	IN	OUT	IN	IN COM

The DG4 Diode Gate Module consists of three independent AND gates, two of which are detached from their resistors to allow their combination with other AND gates in a DG3 or DG4 Module requiring additional terms or inputs. AND gates with almost any number of terms may thus be formed. Each DG4 AND gate may operate a flip-flop input circuit, an inverter or an emitter-follower.
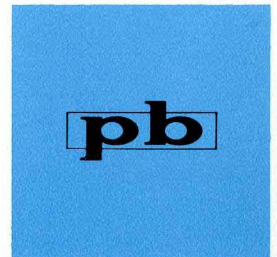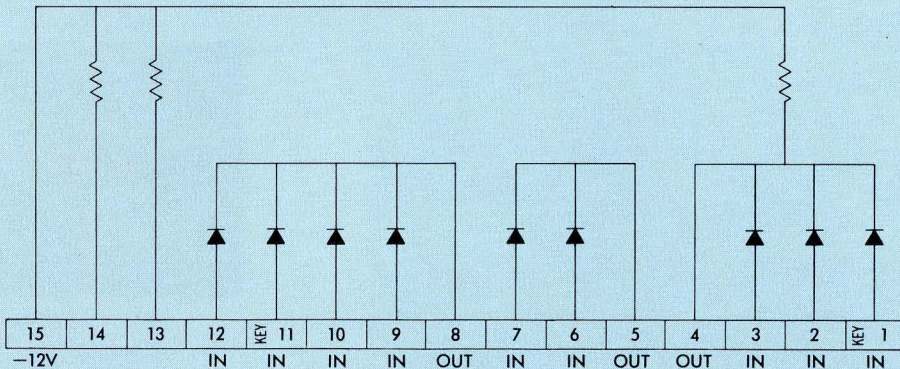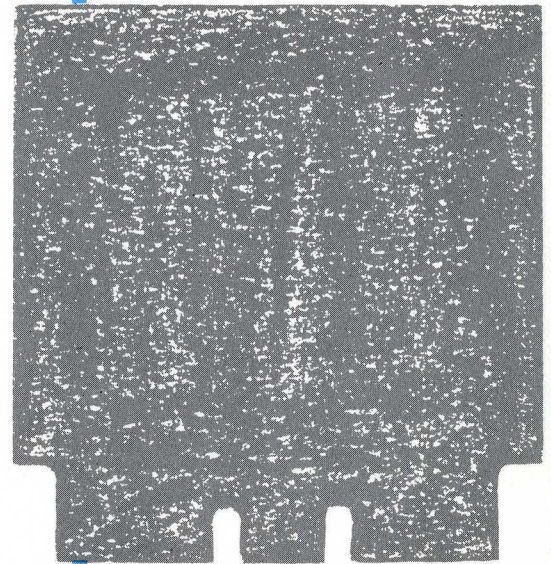
SPECIFICATIONS

INPUT

Voltage { "One" . . . . —9 to —12 volts
         { "Zero" . . . . 0 to —0.25 volt

Clock or Trigger:

Minimum dwell at either level . . . . 2 microseconds
Maximum rise time . . . . 1 microsecond
Maximum repetition rate . . . . 200 kilocycles

POWER REQUIREMENTS

—12 volts . . . . 6 milliamperes

| 15	14	13	12	KEY	11	10	9	8	7	6	5	4	3	2	KEY	1
—12V			IN		IN	IN	IN	OUT	IN	IN	OUT	OUT	IN	IN		IN

pb

The IC4 Input Circuit Module contains nine
a.c. coupled trigger circuits, identical to those
used in the TF2, TF3, TO3, etc. The nine
input circuits are connected together in four
groups of two and three each, to form a.c.
OR gates. These groups are applied either
singly or in combination to the auxiliary input
of a TF2 or TF3 flip-flop, to provide alternate
trigger sources. The IC4 may be operated
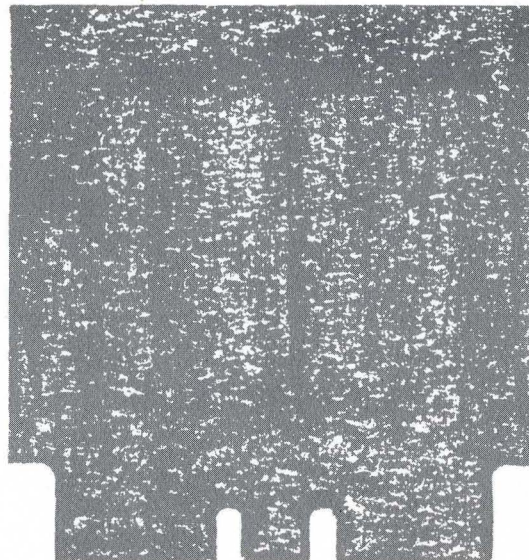from DG3 or DG4 diode AND gates to form
an a.c. AND-OR gate.
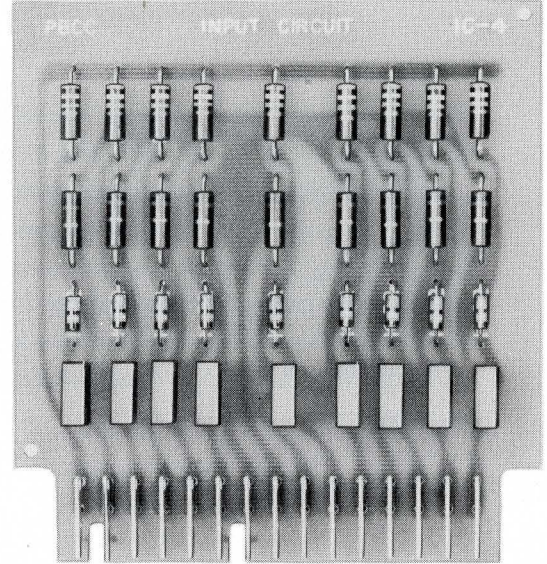
POWER REQUIREMENTS

—12 volts . . . . 3 milliamperes
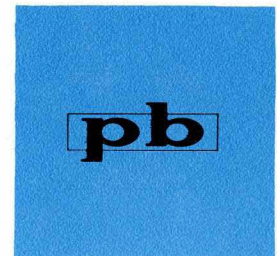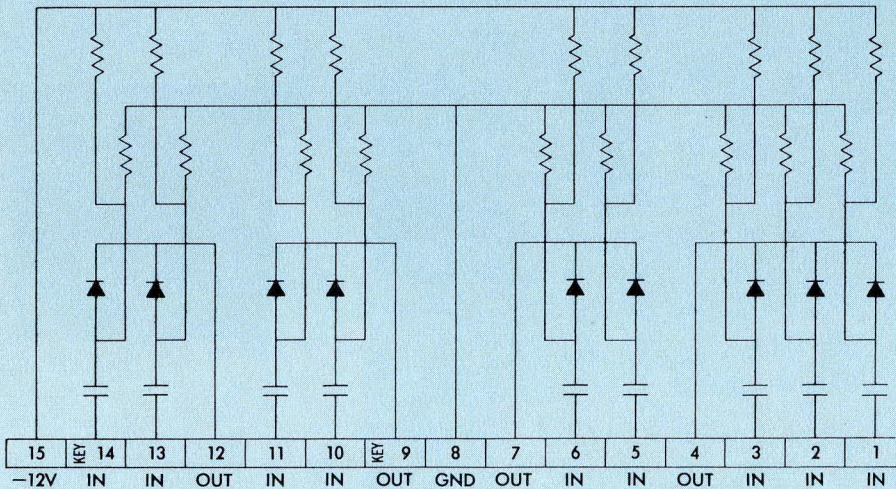
The IC2 Input Circuit Module consists of four toggle trigger circuits identical to those used in the TF2. Instead of being operated at a fixed bias, however, contacts are available for controlling the bias of each pair of trigger circuits, thus gating the toggle trigger inputs. The IC2 is designed primarily for use with the TF3 Flip-Flop Module to form bidirectional counters.

POWER REQUIREMENTS

−12 volts . . . . 0.7 milliamperes
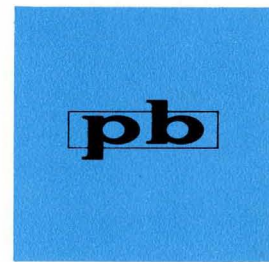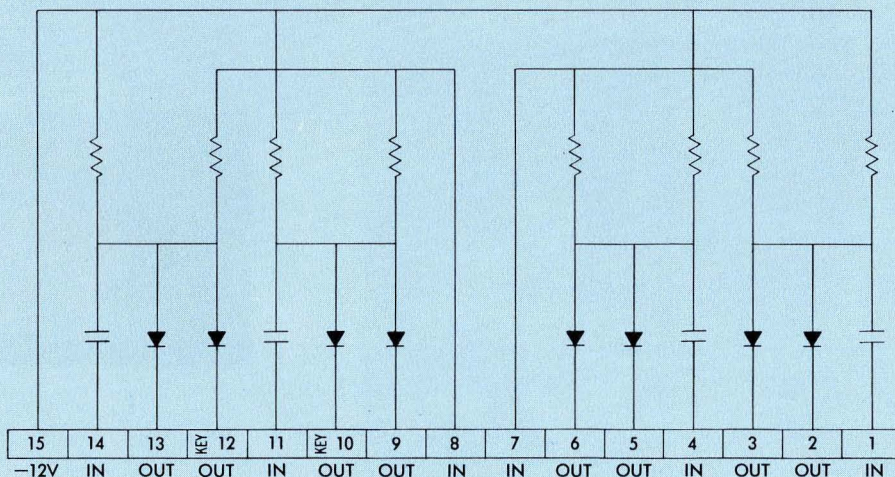
15	14	13	KEY 12	11	KEY 10	9	8	7	6	5	4	3	2	1
−12V	IN	OUT	OUT	IN	OUT	OUT	IN	IN	OUT	OUT	IN	OUT	OUT	IN

pb
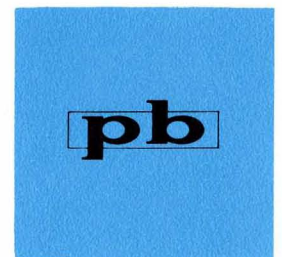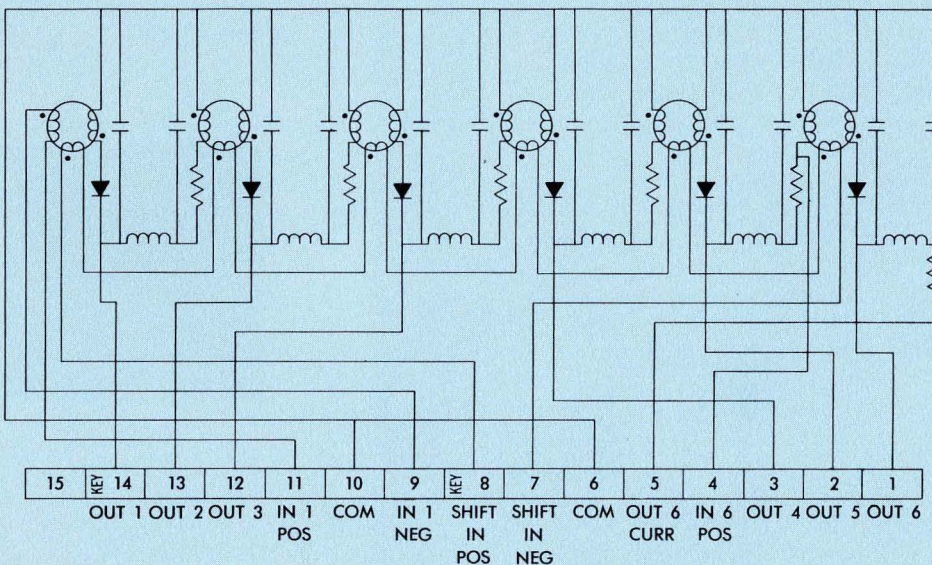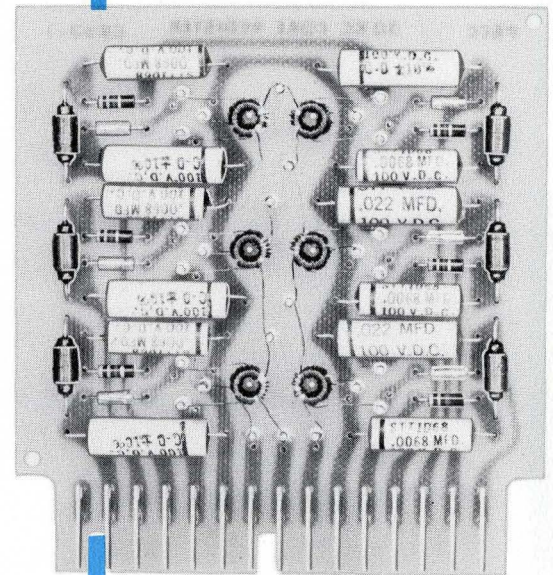
The CR50-1 Magnetic Core Register Module holds six stages of a 50 kilocycle magnetic core shift register. Input information is entered serially while the output can be either six parallel signals or a single serial signal. For system flexibility, the input and output can be referenced at different d.c. levels. Core modules can also be provided which will accept parallel inputs and produce a serial output.

SPECIFICATIONS

Shift frequency	0—50 kilocycles
Recommended shift pulse:	
Rise time	1.0 microsecond
Fall time	1.0 microsecond
Duration (at half amplitude)	3.5 microseconds
Amplitude	1.3 amperes
Voltage drop	0.55 volt per stage for a "one" signal
Operating range at 1.3 ampere drive	1.5—9.0 microseconds
Minimum operating current	0.75 ampere
Power consumption (per stage)	0.065 watt for repetitive switching at 50 kilocycles

OUTPUT

Amplitude	8 volts
"One" to "zero" ratio	8:1
Minimum load impedance	5 kilohms

SIGNAL INPUT   10 milliamperes for 10 microseconds

15	KEY 14	13	12	11	10	9	KEY 8	7	6	5	4	3	2	1
		OUT 1	OUT 2	OUT 3	IN 1 POS	COM	IN 1 NEG	SHIFT IN POS	SHIFT IN NEG	COM	OUT 6	IN 6 CURR	POS	OUT 4 OUT 5 OUT 6

The MCD1 Low Frequency Core Driver Module provides shift pulses for the CR50-1 Magnetic Core Register. The MCD1 consists of a one-shot multivibrator, a two stage amplifier, and a power output stage capable of driving 50 core stages. A clear input is provided to permit resetting of the register. For high power applications a heat sink is available.

SPECIFICATIONS

INPUT (Trigger and Clear)

A positive step with the following characteristics:

Minimum amplitude	8 volts
Minimum rise time	1 microsecond
Maximum Trigger repetition rate	50 kilocycles
Minimum Clear duration	16 microseconds

OUTPUT

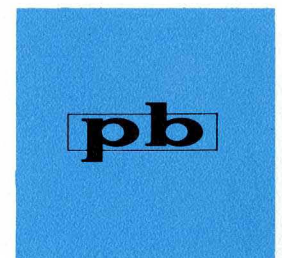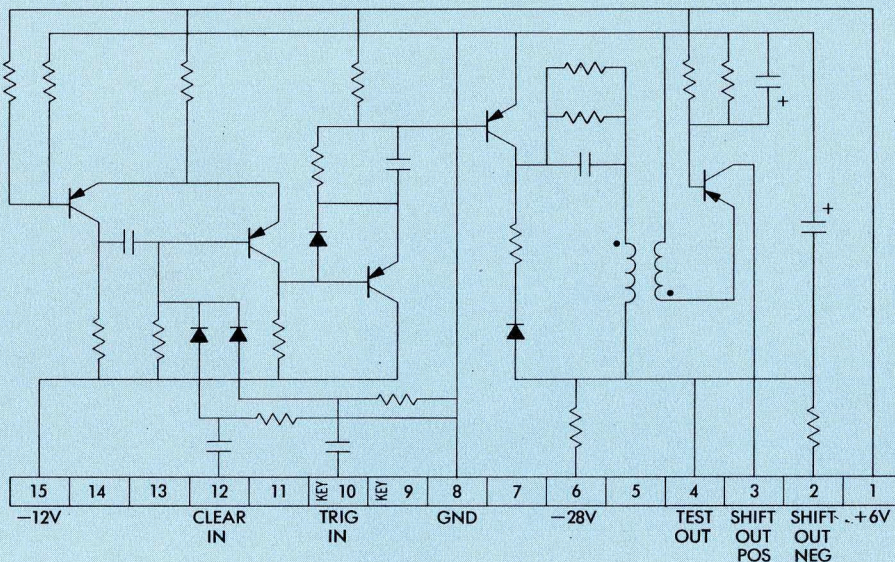Current pulse with the following characteristics:

Amplitude	1.3 ampere
Rise time	1.0 microsecond
Fall time	1.0 microsecond
Duration (at half amplitude)	3.5 microseconds
Output voltage	0 to 27 volts dependent on load

Power rating of output transistor at 45°C:

No heat sink	1.0 watt
With heat sink	8.0 watts

POWER REQUIREMENTS

+6 volts	30 milliamperes
—12 volts	18 milliamperes
—28 volts	Current dependent on duty factor

15	14	13	12	11	KEY 10	KEY 9	8	7	6	5	4	3	2	1
—12V			CLEAR IN		TRIG IN		GND		—28V		TEST OUT	SHIFT OUT POS	SHIFT OUT NEG	+6V
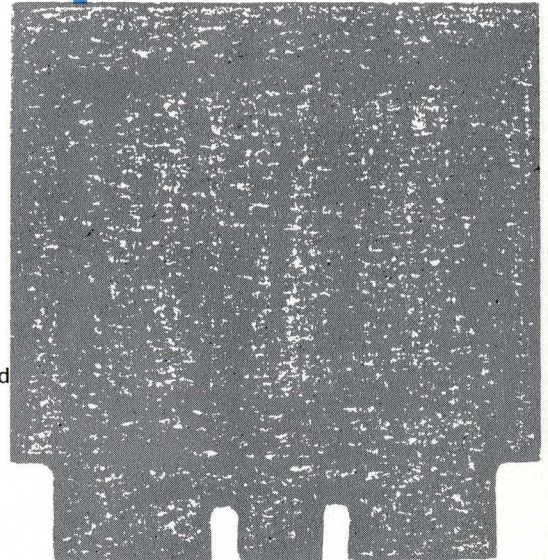
TF4 Dual Flip-Flop

The TF4 Dual Flip-Flop Module holds two identical and independent Eccles-Jordan flip-flop circuits capable of switching up to 3 million times per second. The transistors are operated either at cut-off or at saturation. Each side of a TF4 flip-flop has two inputs, one which will accept signals from a diode gate or another flip-flop, and an auxiliary which will accept signals from an IC5 Input Circuit.

SPECIFICATIONS

INPUT (To set or reset inputs directly or through diode gates and to auxiliary inputs through IC5 Input Circuits)

A positive step with the following characteristics:

Minimum amplitude	7 volts
Maximum rise time	0.06 microsecond
Maximum repetition rate	3 megacycles

OUTPUT

Voltage	"One"	−7 to −10 volts
	"Zero"	0 to −0.3 volt
Maximum rise time	No load	0.04 microsecond
	Full load	0.06 microsecond

Maximum load per output:

(a) Number of clocked or d.c. gates 7
(b) Wiring capacity . . . . 50 micromicrofarads

Note. When driving TI4 Amplifier-Inverter, the output of the flip-flop should be preloaded with 5.6 kilohms to −12 volts.

POWER REQUIREMENTS FOR ENTIRE MODULE

−12 volts	24 milliamperes
+6 volts	0.4 milliampere

15	14	13	12	11	10	9	8	7	6	5	4	3	KEY 2	KEY 1
−12V	IN RES	OUT RES	IN RES AUX	IN SET AUX	OUT SET	IN SET	GND	IN SET	OUT SET	IN SET AUX	IN RES AUX	OUT RES	IN RES	+6V
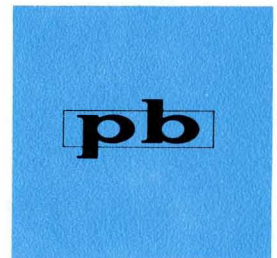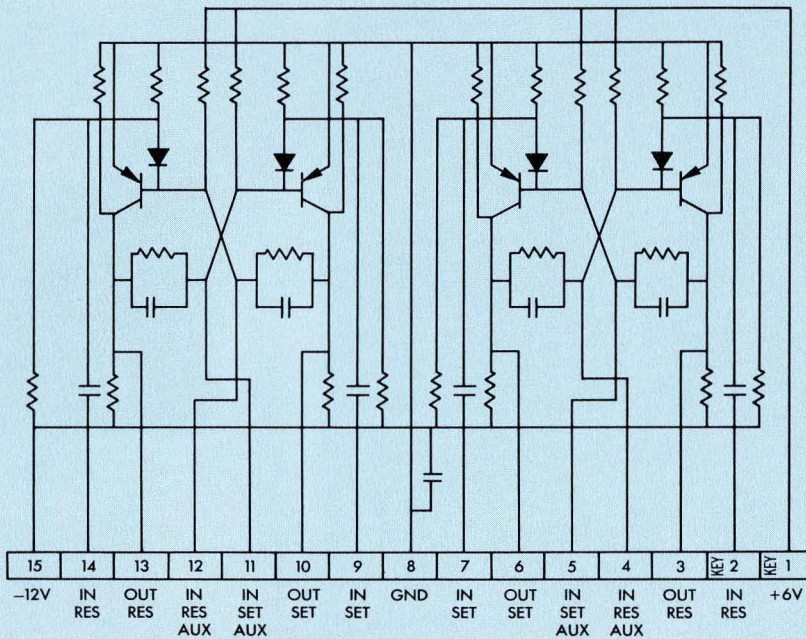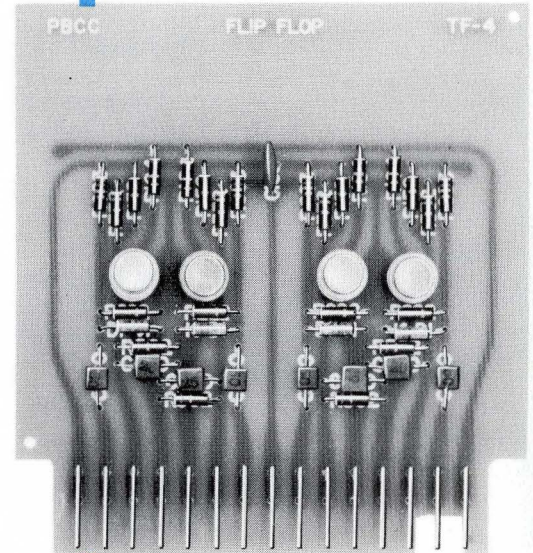
The AG1 Adder Gate Module contains all the gates required for a 3 megacycle serial adder. The "Sum" output is buffered by an emitter follower, and an amplifier is used to provide the "Inverted Sum." The AG1 contains carry gates, so that a full serial adder can be constructed by merely adding a "carry" flip-flop (half a TF4 module). The "Sum Gating Input" permits ON-OFF control of the adder.
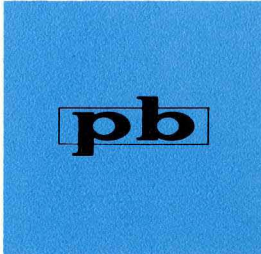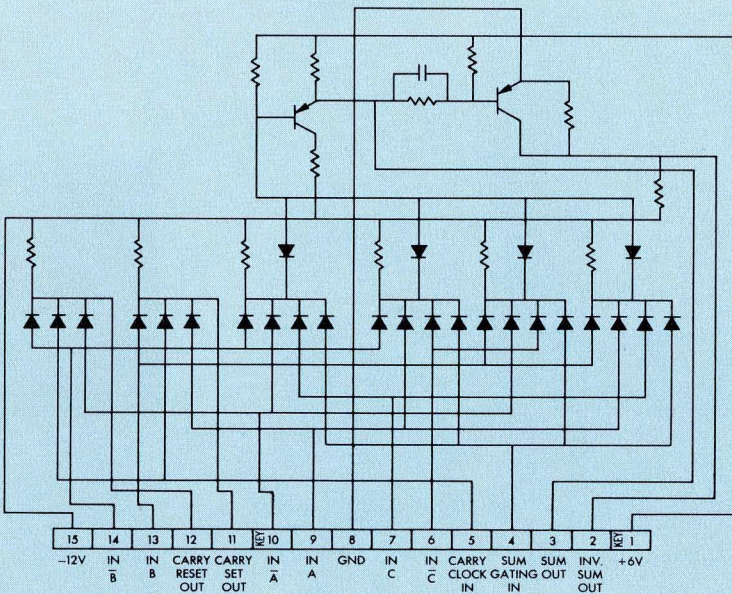
SPECIFICATIONS

INPUT
A, $\bar{A}$, B, $\bar{B}$, C, $\bar{C}$ . . . . Outputs from TF4 flip-flops
Clock . . . . Output from CD4 clock driver

OUTPUT
Sum:	Same as EF2 operated from diode AND-OR gate
Inverted Sum:	Same as TI4
Carry set and reset:	Same as DG6

POWER REQUIREMENTS
−12 volts . . . . 28 milliamperes
+6 volts . . . . 13 milliamperes

15	14	13	12	11	KEY 10	9	8	7	6	5	4	3	2	KEY 1
−12V	IN $\bar{B}$	IN B	CARRY RESET OUT	CARRY SET OUT	IN $\bar{A}$	IN A	GND	IN C	IN $\bar{C}$	CARRY CLOCK IN	SUM GATING IN	SUM OUT	INV. SUM OUT	+6V
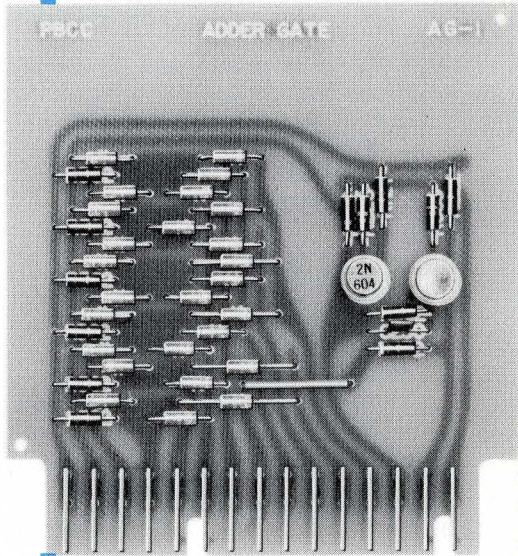
The TI4 Amplifier-Inverter Module holds six identical and independent single-stage amplifier circuits capable of operating at pulse rates up to 3 megacycles. In addition to providing the logical operation of negation, the TI4 serves to amplify the outputs of flip-flops, emitter-followers, and diode AND gates.

SPECIFICATIONS

INPUT

Voltage
- "One" . . . . −7 to −12 volts
- "Zero" . . . . +1 to −1 volt

Maximum rise time . . . . 0.10 microsecond
Maximum fall time . . . . 0.20 microsecond
Maximum pulse rate . . . . 3 megacycles

OUTPUT

Voltage
- "One" . . . . −7 to −10 volts
- "Zero" . . . . 0 to −0.3 volt

Maximum rise time
- No load . . . . . . 0.02 microsecond
- Full load . . . . . . 0.04 microsecond

Maximum load per output:
(a) Number of clocked or d.c. diode gates . . 7
(b) Wiring capacity . . . . 75 micromicrofarads

Note 1.   When TI4 is operated from a diode AND gate the "One" input drops to −6 volts and the maximum load becomes 5 gates. Preloading the input of the TI4 with 10 kilohms to −12 volts provides full input voltage and allows full loading.

Note 2.   When one TI4 inverter is operated from another, its input should be preloaded with 5.6 kilohms to −12 volts.

POWER REQUIREMENTS FOR ENTIRE MODULE
- −12 volts
  - 33 milliamperes with all units at "One"
  - 11 milliamperes with all units at "Zero"
- +6 volts   1 milliampere

15	14	13	12	11	KEY 10	9	8	7	6	5	4	3	KEY 2	1
−12V	IN	OUT	IN	OUT	IN	OUT	GND	IN	OUT	IN	OUT	IN	OUT	+6V
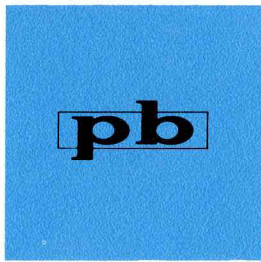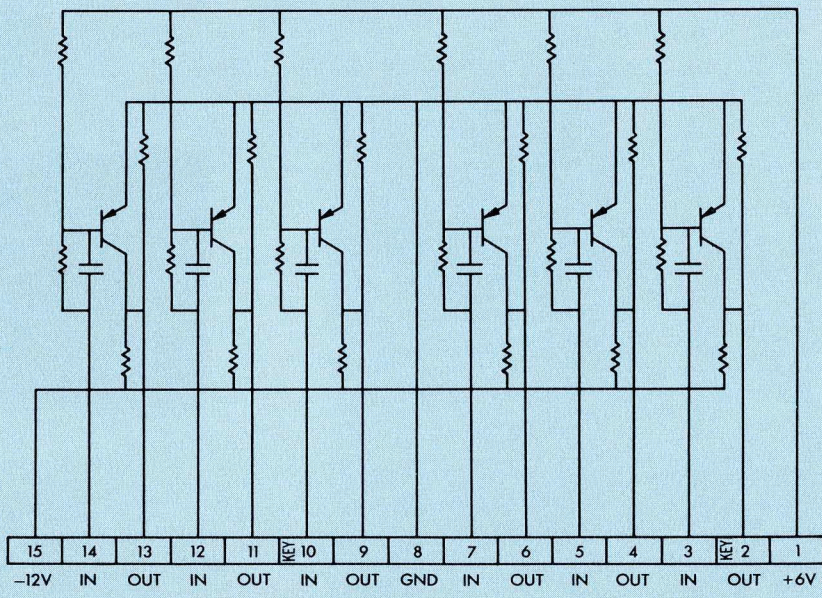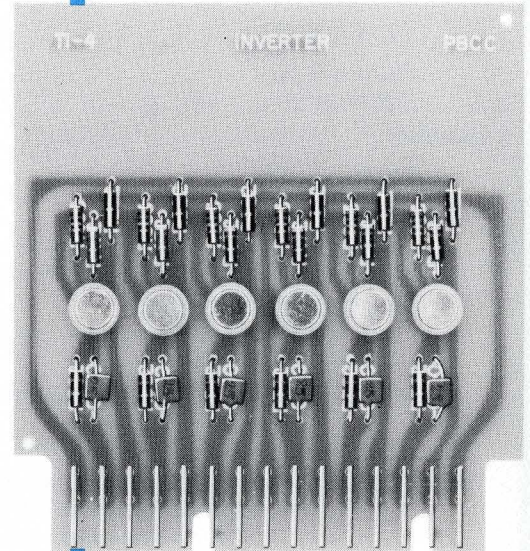
The EF2 Emitter-Follower Module holds six identical and independent amplifier circuits capable of operating at pulse rates up to 3 megacycles. In conjunction with Diode Gate Modules, the EF2 provides for the construction of d.c. AND-OR gates. EF2 outputs, then, may be employed as inputs to other gates so as to provide multilevel gating. The emitter-follower output is also suitable for driving a TI4 Amplifier Inverter.

When operated directly from a TF4 Flip-Flop or TI4 Amplifier-Inverter, the EF2 provides a low impedance output for driving long lines or other substantial capacitive and resistive loads. Under these conditions, the EF2 absorbs any current supplied by the load, while the inverter or flip-flop supplies the current required by the load. Any part of the flip-flop or inverter load may be transferred to the output of the emitter follower.

SPECIFICATIONS

INPUT (Directly or through a d.c. diode gate)

Voltage
- "One" . . . . —7 to —12 volts
- "Zero" . . . . 0 to —0.3 volt

Maximum rise time . . . . 0.08 microsecond

Maximum pulse rate . . . . 3 megacycles

OUTPUT

Voltage
- "One" . . . . —6.8 to —12 volts
- "Zero" . . . . +0.2 to —0.3 volt

Maximum rise time:
- Operated through d.c. AND-OR gate . . . 0.2 microsecond
- Operated directly or through d.c. AND gate   Equal to input rise time

Maximum load per output:
- (a) Number of clocked or d.c. diode gates   2
- (b) Wiring capacity . . . . 50 micromicrofarads

Additional load capability of directly operated emitter follower:
- (a) Maximum capacity . . . . 150 micromicrofarads
- (b) Minimum resistance to ground . . . 750 ohms

POWER REQUIREMENTS FOR ENTIRE MODULE

—12 volts
- 80 milliamperes with all units at "One"
- 30 milliamperes with all units at "Zero"

+6 volts
- 85 milliamperes with all units at "One"
- 32 milliamperes with all units at "Zero"

15	14	13	12	11	10	KEY 9	8	7	6	5	4	3	KEY 2	1
—12V	IN	OUT	IN	OUT	IN	OUT		IN	OUT	IN	OUT	IN	OUT	+6V
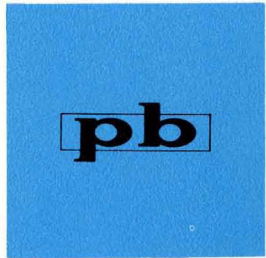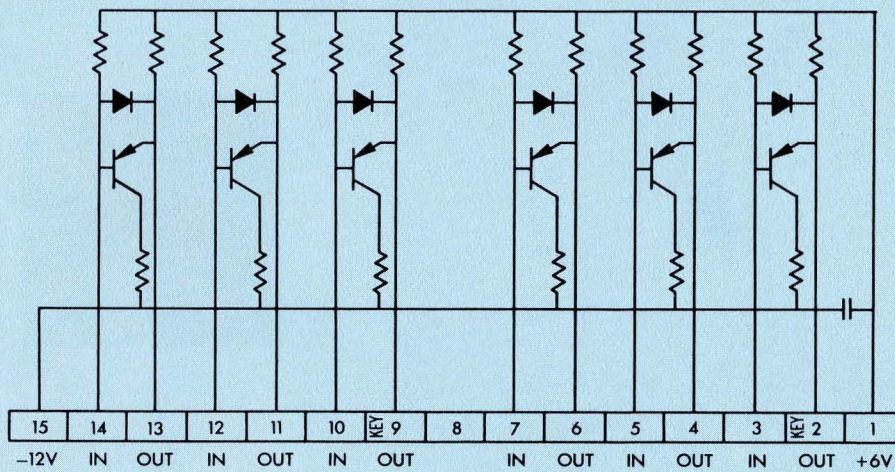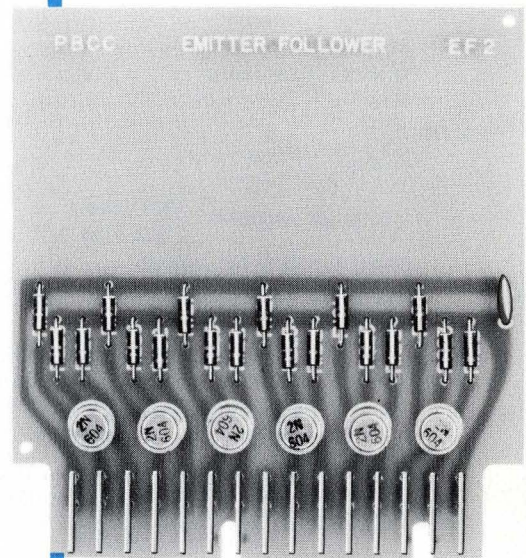
The CD4 Clock Driver Module is a multi-output amplifier which accepts a single input signal from a suitable clock source, shapes it, and provides a high power output. The input signal can be provided by an XCG1, TF4, TI4 or any other source fulfilling the input requirements. The CD4 is designed to drive up to 80 gates.

SPECIFICATIONS

INPUT

Voltage
- "One" . . . . −7 to −12 volts
- "Zero" . . . . +1.0 to −1.0 volt

Maximum rise time . . . . 0.1 microsecond
Maximum repetition rate . . . . 3 megacycles

OUTPUT

Voltage
- "One" . . . . −7 to −10 volts
- "Zero" . . . . 0 to −0.3 volt

Maximum load per output:
- (a) Number of gates 16
- (b) Flip-flops triggered 8
- (c) Wiring capacity . . . . 75 micromicrofarads

Maximum rise time
- No load . . . . . 0.02 microsecond
- Full load . . . . . 0.04 microsecond

POWER REQUIREMENTS FOR ENTIRE MODULE

−12 volts . . . . 65 milliamperes (at 50% duty factor)

+6 volts . . . . 10 milliamperes
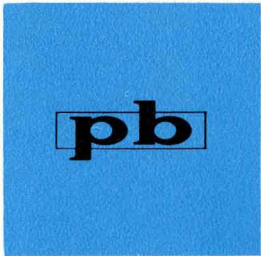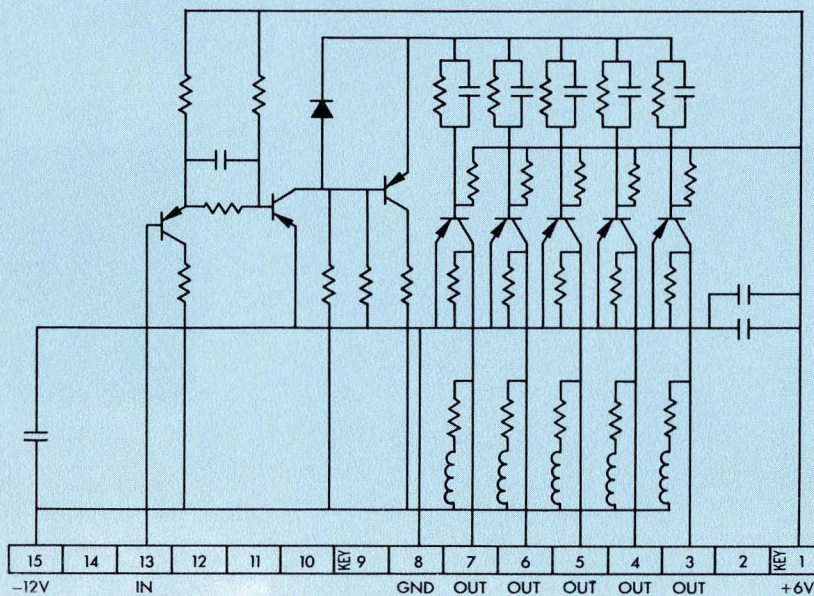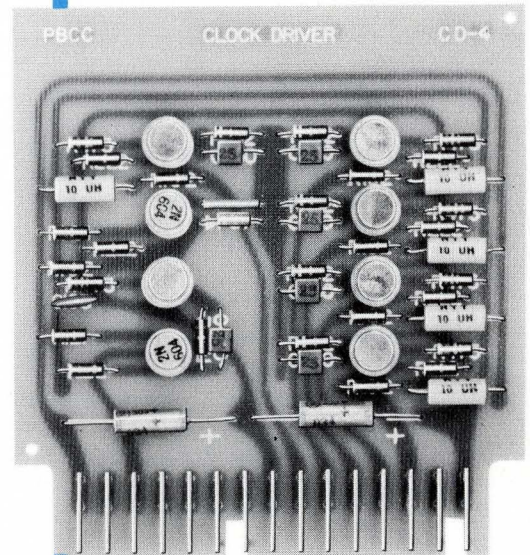
The XCG1 Clock Generator Module consists of a crystal controlled oscillator and shaping amplifier. The output is a pulse train suitable for operating up to 10 CD4 clock drivers. The standard frequency is 3 megacycles. (Other frequencies between 1 and 3 megacycles can be made to order.) The duty factor is adjustable over the the range 0.42 to 0.58.

SPECIFICATIONS

OUTPUT

Voltage	"One"	−8 to −11 volts
	"Zero"	0 to +0.5 volt

Maximum load:
- (a) Number of CD4 clock drivers 10
- (b) Wiring capacity . . . . 150 micromicrofarads

Maximum rise time	No load	0.025 microsecond
	Full load	0.05 microsecond
Maximum fall time	No load	0.04 microsecond
	Full load	0.08 microsecond
Repetition rate		3 megacycles ±0.01%

POWER REQUIREMENTS FOR ENTIRE MODULE

−12 volts	No load	20 milliamperes
	Full load	40 milliamperes
−6 volts	No load	12 milliamperes
	Full load	30 milliamperes

15	14	13	12	11	10	9	KEY 8	7	6	5	4	3	2	KEY 1
−12V							GND			AUX OUT		OUT		+6V

pb
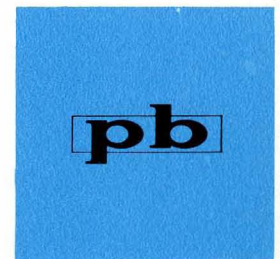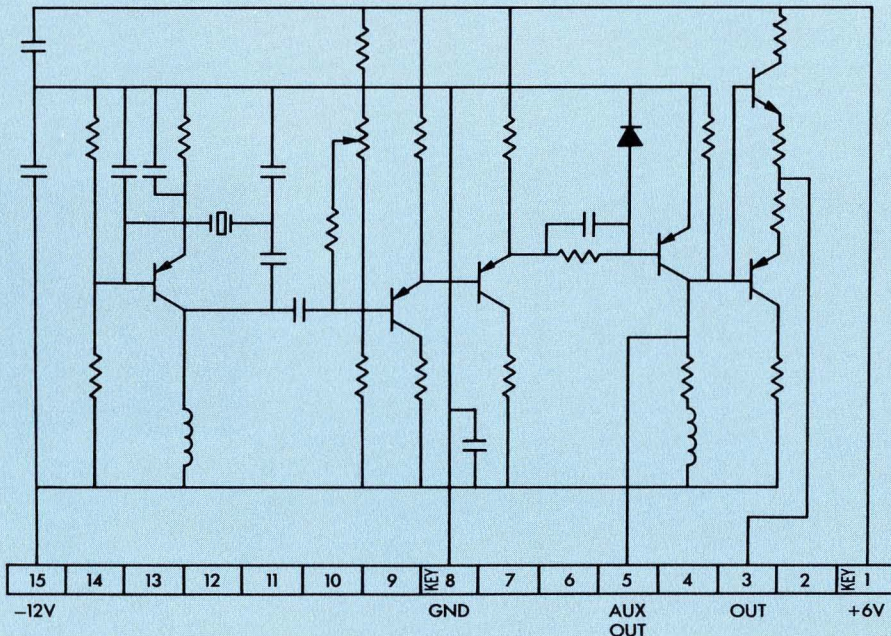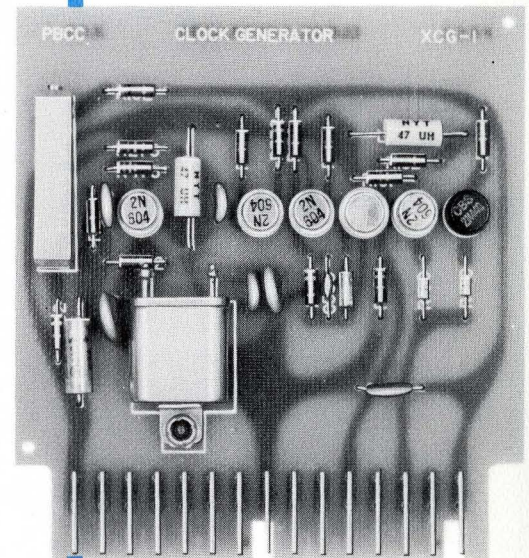
The DG5 Diode Gate Module consists of five 3 megacycle AND Gates, each with two or three diodes. The gates are independent, except for one common input applied to one diode in each gate. Each AND gate may drive a flip-flop input circuit (TF4 or IC5), an EF2, a CD4 or a TI4 (preloaded).

In conjunction with an EF2 emitter follower, the DG5 may be operated as a d.c. AND-OR gate. The common input now becomes the output of the multilevel gate and is connected to the emitter follower. Additional terms may be connected to each AND gate from a DG6 module.

The DG5 should be placed as close to its load as possible in order to minimize output wiring capacity.

SPECIFICATIONS

INPUT

Voltage $\begin{cases} \text{"One"} \\ \text{"Zero"} \end{cases}$

"One"	—7 to —12 volts
"Zero"	0 to —0.3 volt

Clock or Trigger:
Maximum rise time . . . . 0.06 microsecond
Maximum repetition rate . . . . 3 megacycles

POWER REQUIREMENTS
—12 volts . . . . 10 milliamperes

15	14	13	12	11	10	9	8	7	6	5	4	KEY 3	KEY 2	1
—12V	IN	OUT	IN	OUT	IN	IN	OUT	IN	IN	OUT	IN		OUT	IN	IN COM

DG6 Diode Gate

The DG6 Diode Gate Module consists of three independent 3 megacycle AND gates, two of which are detached from their resistors to allow their combination with other AND gates in a DG5 or DG6 module requiring additional terms or inputs. AND gates with any desired number of terms may thus be formed. Each DG6 AND gate may operate a flip-flop input circuit (TF4 or IC5), an EF2, a CD4 or a TI4 (pre-loaded).

SPECIFICATIONS

INPUT

Voltage   "One" . . . . —7 to —12 volts
          "Zero" . . . . 0 to —0.3 volt
Clock or Trigger:
Maximum rise time . . . . 0.06 microsecond
Maximum repetition rate . . . . 3 megacycles

POWER REQUIREMENTS
—12 volts . . . . 6 milliamperes

15	14	13	12	11	10	9	8	7	6	5	KEY 4	3	KEY 2	1
—12V			IN	IN	IN	IN	OUT	IN	IN	OUT	OUT	IN	IN	IN
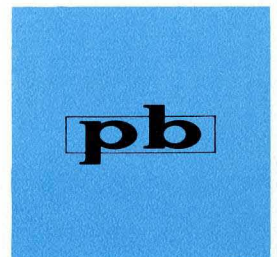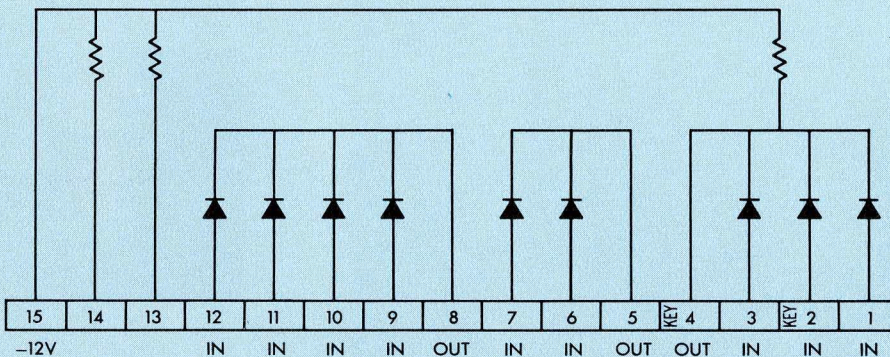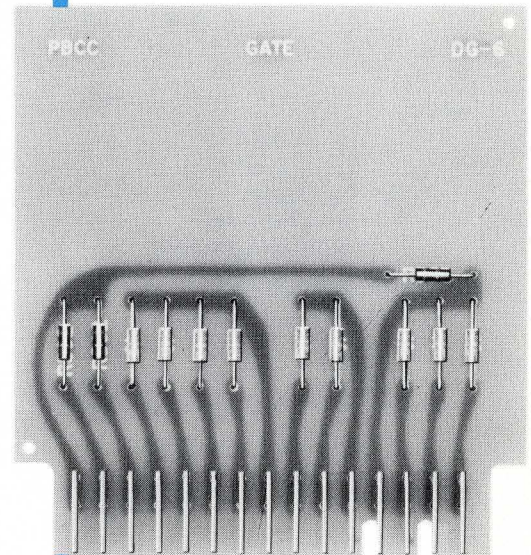
The IC5 Input Circuit Module contains eight a.c. coupled trigger circuits identical to those used in the TF4. Six of the input circuits are connected together in three groups of two each to form a.c. OR gates. One IC5 output is applied to an auxiliary input of a TF4 flip-flop in order to provide alternate trigger sources. The IC5 may be operated from DG5 or DG6 diode AND gates to form an a.c. AND-OR gate. The IC5 module should be adjacent to the TF4 modules it operates in order to minimize wiring capacity.
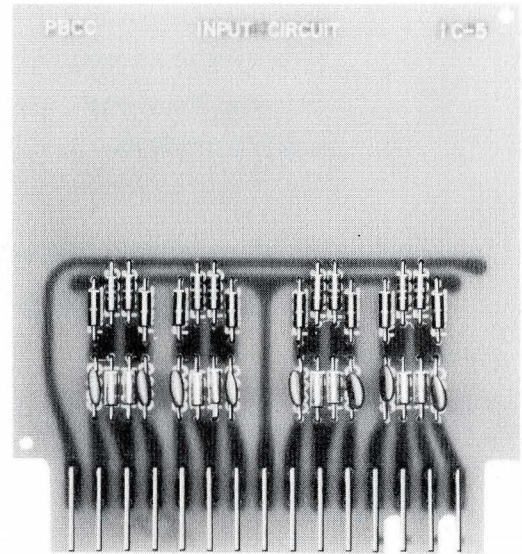
POWER REQUIREMENTS

−12 volts . . . . 1.5 milliamperes

15	14	13	12	11	10	9	8	7	6	5	4	KEY 3	2	KEY 1
−12V	IN	OUT	IN	IN	OUT	IN	GND	IN	OUT	IN	IN	OUT	OUT	IN
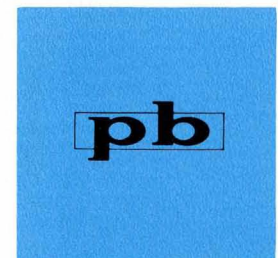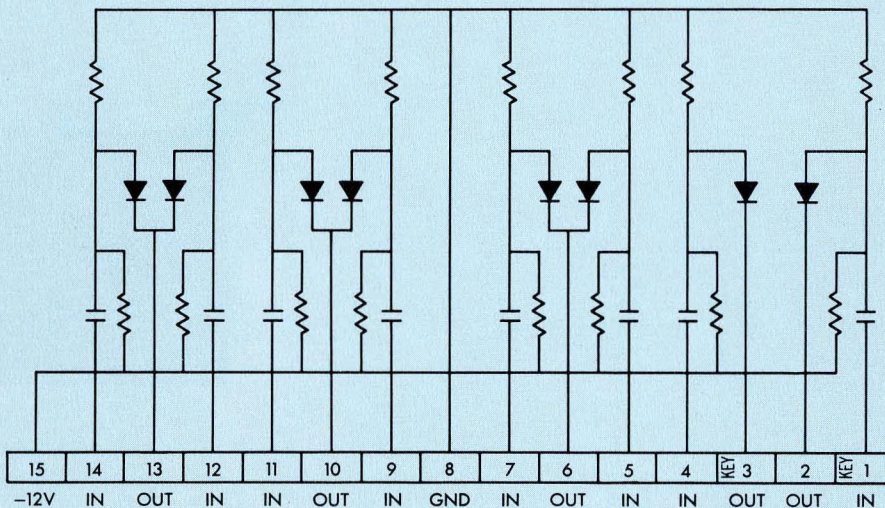
The OD1 Output Driver Module holds six identical and independent amplifier circuits capable of operating at pulse rates up to 3 megacycles. The OD1 is used to provide a low impedance output for driving long lines or other substantial capacitive and resistive loads.

SPECIFICATIONS

INPUT

Voltage
- "One" . . . . −7 to −12 volts
- "Zero" . . . . 0 to −0.3 volt

Maximum rise time . . . . 0.08 microsecond

Maximum pulse rate . . . . 3 megacycles

OUTPUT

Voltage
- "One" . . . . −6.8 to −12 volts
- "Zero" . . . . +1 to −0.3 volt

Maximum rise time . . . . 0.12 microsecond

Maximum load per output:

(a) Number of d.c. diode gates 4

(b) Number of d.c. or clocked diode gates . . . 3

(c) Resistance to ground . . . . 500 ohms

(d) Capacity to ground . . . . 400 micromicrofarads

POWER REQUIREMENTS FOR ENTIRE MODULE

−12 volts
- No load . . . . 1 milliampere
- Maximum capacitive load at maximum frequency . . . . 80 milliamperes

+6 volts
- No load . . . . 1 milliampere
- Maximum capacitive load at maximum frequency . . . . 80 milliamperes

15	14	13	12	11	10	9	8	7	KEY 6	5	4	3	2	KEY 1
−12V	IN	OUT	IN	OUT	IN	OUT		OUT		IN	OUT	IN	OUT	IN	+6V
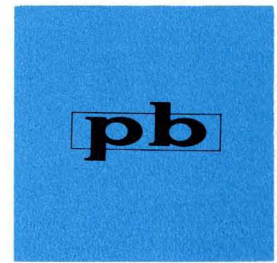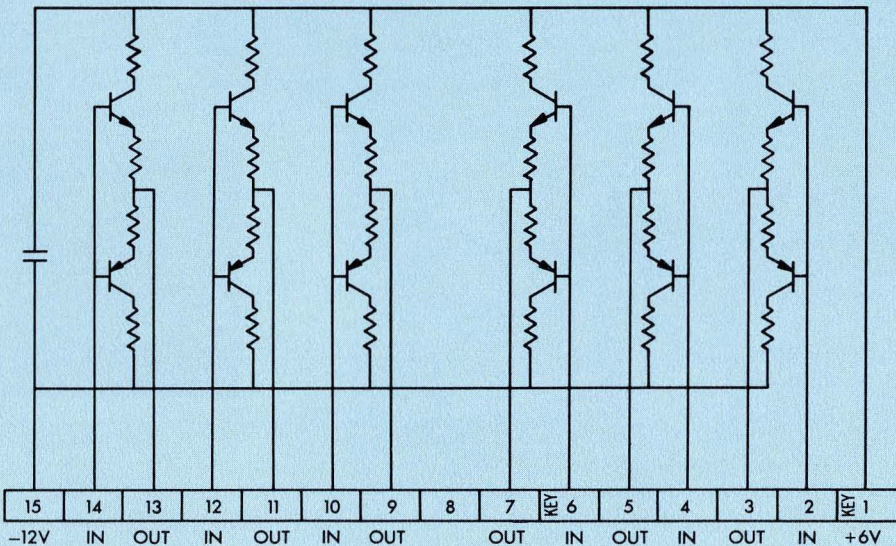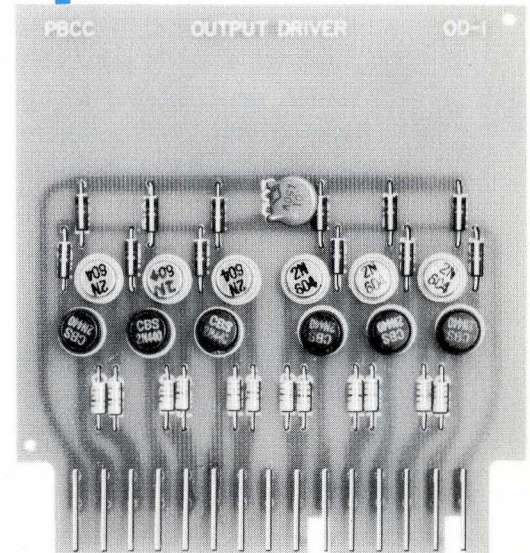
CR100-1 Magnetic Core Register

The CR100-1 Magnetic Core Register Module holds six stages of a 100 kilocycle magnetic core shift register. Input information is entered serially while the output can be either six parallel signals or a single serial signal. For system flexibility, the input and output can be referenced at different DC levels. An alternate version (CR100-2) will accept parallel inputs and produce a serial output.

SPECIFICATIONS

Shift frequency.	0 - 100 **kilocycles**
Recommended shift pulse:	
Rise time	0.5 microsecond
Fall time	0.5 microsecond
Duration (at half amplitude)	1.8 microseconds
Amplitude.	1.0 ampere
Voltage drop	0.5 volt per stage for a "one" signal
Operating range at 1.0 ampere drive. . .	0.9 - 4.5 microseconds
Minimum operating current	0.55 ampere
Power consumption (per stage)	0.045 watt for repetitive switching at 100 kilocycles

OUTPUT

Amplitude.	6.5 volts
"One" to "Zero" ratio	10:1
Minimum load impedance.	7 kilohms

SIGNAL INPUT	10 milliamperes for 5 microseconds

MCD2 Magnetic Core Driver

The MCD2 Medium Frequency Core Driver Module provides shift pulses for the CR100 Series Magnetic Core Registers. The MCD2 consists of a one-shot multivibrator and a power output stage capable of driving 54 core stages. A clear input is provided to permit resetting of the register. For high power applications, a heat sink should be specified when ordering.

SPECIFICATIONS

INPUT (Trigger and Clear)

A positive step with the following characteristics:

Minimum amplitude	8 volts
Minimum rise time	1 microsecond
Maximum Trigger repetition rate	100 kilocycles
Minimum Clear duration	8 microseconds

OUTPUT

Current pulse with the following characteristics:

Amplitude	1.0 ampere
Rise time	0.5 microsecond
Fall time	0.5 microsecond
Duration (at half amplitude)	1.8 microseconds
Output voltage	0 to 27 volts dependent on load

Power rating of output transistor at 45° C.:

No heat sink	1.0 watt
With heat sink	8.0 watts

POWER REQUIREMENTS

+ 6 volts	20 milliamperes
- 12 volts	30 milliamperes
- 28 volts	Current dependent on duty factor

(SEE REVERSE SIDE)

MS-1

MAGNETIC CORE DRIVER POWER SUPPLY

The MS-1 is a 28-volt supply that mounts in standard Packard Bell Computer Corporation module cases such as the MC72. Connections to the supply are made through a standard 15-pin Elco Connector and eight module spaces are required. The MS-1 will power three Magnetic Core Drivers (MCD) at maximum shifting frequencies and a proportionately larger number at lower frequencies. When the number of drivers exceeds nine, external filter capacitance may be required to average-out the load current.

The following chart indicates typical configurations:

	Frequency	Maximum Number of Drivers	Maximum Number of core stages
MCD-1	50 KC	3	48
	10 KC	15	240
MCD-2	100 KC	3	48
	25 KC	12	192
	5 KC	60	960

SPECIFICATIONS

Input

    105 to 125 volts, 50 to 60 cycle single-phase AC power

Output

Voltage:	28 volts DC
Current:	1.0 ampere
Load Regulation:	±1% maximum
Line Regulation:	±1% maximum
Ripple:	0.1% (peak-to-peak)

        PRICE: $200

        TERMS: Net 30 days
                           FOB Los Angeles

MOUNTING CASES and POWER SUPPLY

MC 72A

The MC 72A Mounting Case is identical to the MC 72 with the exception that tilt-up slides are employed. This permits easy access to the inter-module wiring without removing the case from a relay rack.

PRICE OF MC 72A

With Power Supply $680.00
Without Power Supply $315.00

MC 250

The MC 250 Mounting Case is a rack-mounted case that holds 250 digital modules. It consists of a cast aluminum spine to which are connected two vertical hinged frames, each of which holds 125 modules. Slides permit the entire assembly to be removed from the rack in which it is mounted and opened, as a book, to provide access to wiring side of the frames. The spine has provision for mounting input/output connectors, while a front panel can hold indicators and control switches. The dimensions of the MC 250 are: 19" wide, 31-1/2" high and 25-1/4" deep. It may be mounted in a 28" deep relay rack with vertical support in the rear.

A power supply, the PS 7, is available for operation with the MC 250. It employs magnetic regulation exclusively and has circuit breakers on all voltages for overload protection. The dimensions of an MC 250 with a PS 7 are: 19" wide, 33-1/4" high and 25-1/4" deep.

PS 7 SPECIFICATIONS

INPUT

105 to 125 VAC, 60 cycles

OUTPUT

Regulated
+ 6 volts DC . . . . 2 amperes
- 12 volts DC . . . . 8 amperes

Unregulated
+ 50 volts DC . . . . 0.15 amperes
1 volt AC . . . . 6 amperes

PRICE OF MC 250

With PS 7 Power Supply $2300.00
Without PS 7 Power Supply $1200.00

SR1 SHIFT REGISTER

The SR1 Shift Register Module contains three flip-flop circuits and interconnecting diode gates forming a complete shift register. Any number of these modules may be cascaded directly to form a long register. Both serial and parallel input and output has been provided. Parallel input is effected by means of a common reset line and individual set lines. The set lines may be driven from standard diode AND gates, if desired. Both the "Set" and "Reset" outputs of each stage are available at the connector, except for the "Reset 2" output. Where required, this signal may be generated from the "Set 2" output by means of a TI3 inverter stage.

SPECIFICATIONS

INPUT (To set, reset inputs directly or through diode gates)
A positive step with the following characteristics:

Minimum amplitude	8 volts
Maximum rise time	1 microsecond
Maximum repetition rate	200 kilocycles

OUTPUT

Voltage
"One"	-9 to -12 volts
"Zero"	0 to -0.25 volt

Maximum rise time
No load . . .	0.25 microsecond
Full load . .	1.0 microsecond

Maximum load per output:
Clocked or DC diode gates	9
Unclocked diode gates operating input circuits	7
NOR inputs	27

POWER REQUIREMENTS FOR ENTIRE MODULE

-12 volts	55 milliamperes
+ 6 volts	1.4 milliamperes

PRICE $75.00

CIRCUIT CARD HANDLE

An etched circuit card handle made of high impact cycolac plastic that easily spring-locks on the top edge of the card. This simply-designed accessory installs or removes digital module cards. Valuable for laboratory work and for production or field maintenance.

FEATURES

1. REDUCES LIKELIHOOD OF BOARD BREAKAGE AND SOCKET DAMAGE
2. CARDS CAN BE STACKED AS CLOSE AS 1/2"
3. ALLOWS FULL USE OF BOARD FOR CIRCUIT
4. FINGER TIP RELEASE ACTION
5. POSITIVE GRIPPING - WILL NOT SLIP

pb **Packard Bell Computer**

DIGITAL MODULES PRICE LIST   1 July 1960

200 KC Transistorized Digital Modules

		Unit Price
TF2	Dual Flip-Flop (2 circuits)	$ 45.00
TF3	Dual Flip-Flop (2 circuits)	45.00
TI3	Amplifier Inverter (6 circuits)	45.00
EF1	Emitter Follower (6 circuits)	45.00
DC1	Decade Counter	75.00
BC1	Binary Counter	75.00
TD2	Relay or Lamp Driver (4 circuits)	75.00
TO3	Dual One-Shot (2 circuits)	65.00
ST1	Dual Schmitt Trigger (2 circuits)	45.00
HF3	Clock Generator and Multivibrator	65.00
CD3	Clock Driver (8 circuits)	120.00
CS1	Dual Clock Shaper (2 circuits)	65.00
NE1	Dual NOR (2 circuits)	35.00
DG3	Diode Gate	30.00
DG4	Diode Gate	30.00
IC2	Input Gate	30.00
IC4	Input Gate	35.00

Magnetic Modules

CR50-1	Magnetic Core Register 50 KC (6 stages)	75.00
MCD1	Magnetic Core Driver 50 KC	90.00
CR100-1	Magnetic Core Register 100 KC (6 stages)	90.00
MCD2	Magnetic Core Driver 100 KC	90.00
MS1	Magnetic Core Driver Power Supply (28 volt)	200.00

*3 Megacycle Transistorized Digital Modules

			Corresponding 200 KC Type
TF4	Dual Flip-Flop (2 circuits)	100.00	TF3
TI4	Amplifier Inverter (6 circuits)	125.00	TI3
EF2	Emitter Follower (6 circuits)	90.00	EF1
CD4	Clock Driver (5 circuits)	175.00	CD3
DG5	Diode Gate	40.00	DG3
DG6	Diode Gate	40.00	DG4
IC5	Input Gate	40.00	IC4
XCG1	Crystal Clock Generator (similar to HF3 but with crystal)	175.00	---
OD1	Output Driver (6 Low-Impedance Driver Circuits)	175.00	---
AG1	Adder Gate (a complete Adder Gate with output amplifier)	90.00	---

Mounting Case, Power Supply, and Accessories

BB1	Blank Circuit Board with connector	10.00
	Extender Board	40.00
	Circuit Card Handle	20.00
MC72	Mounting Case:	
	With Power Supply	650.00
	Without Power Supply	285.00
	17 Indicators mounted in MC72 case	110.00
	60 Indicators mounted in MC72 case	250.00

PRICES: FOB our plant, Los Angeles, California
Prices are subject to change without notice.

TERMS: Net Cash, 30 Days

Quantity Discount: 5% on each purchase order over $10,000

All module prices include an ELCO 15-pin connector.
*All 3 Megacycle Modules are compatible with 200 KC and Magnetic Modules.