Ron Nott

COLLINS

instruction book

Collins Radio Company

Collins Radio Co.
Dallas, Texas 75207

54N-1
FM Frequency Monitor

BROADCAST EQUIPMENT GUARANTEE

The equipment described herein is sold under the following guarantee:

a. Except as set forth in paragraph b. of this section, Collins agrees with Buyer to repair or replace, without charge, any properly maintained equipment, parts or accessories which are defective as to design, materials, or workmanship and which are returned in accordance with Collins instructions by Buyer to Collins factory, transportation prepaid, provided:

   1. Notice of a claimed defect in the design, materials or workmanship of the equipment manufactured by Collins is given by Buyer to Collins within five (5) years from date of delivery, with exception of rotating machinery such as blowers, motors, and fans whereby notice must be given by Buyer to Collins within two (2) years from date of delivery.
   2. Notice of a claimed defect in the design, materials or workmanship of the following described Collins manufactured equipment is given by Buyer to Collins within two (2) years from the date of delivery:

20V-3	26U-2	81M	172G-2	216C-2	313T-4	642A-2	820F-1	830D-1	830F-2A
26J-1	42E-7	144A-1	212H-1	313T-1	356H-1	786M-1	A830-2	830E-1	830H-1A
26U-1	42E-8	172G-1	212Z-1	313T-3	564A-1	820E-1	830B-1	830F-1	830N-1A

b. The above guarantee does not extend to other equipment, accessories, tubes, lamps, fuses, and tape heads manufactured by others which are subject to only adjustment as Collins may obtain from the supplier thereof.

c. Collins further guarantees that any radio transmitter described herein will deliver full radio frequency power output at the antenna lead when connected to a suitable load, but such guarantee shall not be construed as a guarantee of any definite coverage or range of said apparatus.

d. The guarantee of this section is void if:

   1. The equipment malfunctions or becomes defective as a result of alterations or repairs by others than Collins or its authorized service center, or
   2. The equipment is exposed to environmental conditions more severe than specified by Collins in equipment manuals.

e. NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR INTENDED PURPOSE, SHALL BE APPLICABLE TO ANY EQUIPMENT SOLD HEREUNDER.

f. THE FOREGOING SHALL CONSTITUTE THE BUYER'S SOLE RIGHT AND REMEDY UNDER THE AGREEMENTS IN THESE SECTIONS. IN NO EVENT SHALL COLLINS HAVE ANY LIABILITY FOR CONSEQUENTIAL DAMAGES, OR FOR LOSS, DAMAGE OR EXPENSE DIRECTLY OR INDIRECTLY ARISING FROM THE USE OF THE PRODUCTS, OR ANY INABILITY TO USE THEM EITHER SEPARATELY OR IN COMBINATION WITH OTHER EQUIPMENT OR MATERIALS, OR FROM ANY OTHER CAUSE.

g. The guarantees of this section and limitations thereon will also accrue to the benefit of any purchaser of Buyer's F.C.C. license, provided:

   1. Notice of the sale of the F.C.C. license is given by Buyer to Collins in writing within thirty (30) days after the consummation of said sale; and
   2. No greater rights are granted to the purchaser of Buyer's F.C.C. license than are granted herein to Buyer.

How to Return Material or Equipment If, for any reason, you should wish to return material or equipment, whether under the guarantee or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. If the item is thought to be defective, such notice must give full information as to nature of defect and identification (including part number if possible) of part considered defective. (With respect to tubes we suggest that your adjustments can be speeded up if you give notice of defect directly to the tube manufacturer.) Upon receipt of such notice, Collins will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods or failure to provide full particulars may cause unnecessary delay in the handling of your returned merchandise.

ADDRESS:

Collins Radio Company
Customer Returned Goods, 412-023
1225 North Alma Road
Richardson, Texas 75080

INFORMATION NEEDED:

(A) Type number, name and serial number of equipment
(B) Date of delivery of equipment
(C) Date placed in service
(D) Number of hours of service
(E) Nature of trouble
(F) Cause of trouble if known
(G) Part number (9 or 10 digit number) and name of part thought to be causing trouble
(H) Item or symbol number of same obtained from parts list or schematic
(I) Collins number (and name) of unit subassemblies involved in trouble
(J) Remarks

How to Order Replacement Parts When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable. To enable us to give you better replacement service, please be sure to give us complete information.

ADDRESS:

Collins Radio Company
Service Parts, 412-024
1225 North Alma Road
Richardson, Texas 75080

INFORMATION NEEDED:

(A) Quantity required
(B) Collins part number (9 or 10 digit number) and description
(C) Item or symbol number obtained from parts list or schematic
(D) Collins type number, name and serial number of principal equipment
(E) Unit subassembly number (where applicable)

1 December 1967

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1 April 1968

instruction book

54N-1
FM Frequency Monitor

For low 19 KHz add resistor
on preset board p 7.32/38

Collins Radio Company | Dallas, Texas

table of contents

table of contents (cont)

list of illustrations

list of tables

glossary

AND:	A coincidence circuit that provides a prescribed output when all of several possible input conditions are met.
FLIP-FLOP:	A bistable multivibrator.
GATE:	A circuit operating as a switch to pass or block a signal.
NAND:	An AND circuit that provides phase inversion.
NOR:	An OR circuit that provides phase inversion.
OR:	A circuit that provides a prescribed output with one or more of several possible input conditions.
TOGGLE:	Change of state. Reverse the outputs of a flip-flop.
TRUTH TABLE:	Shows output conditions of a logic circuit element for all combinations of input conditions.

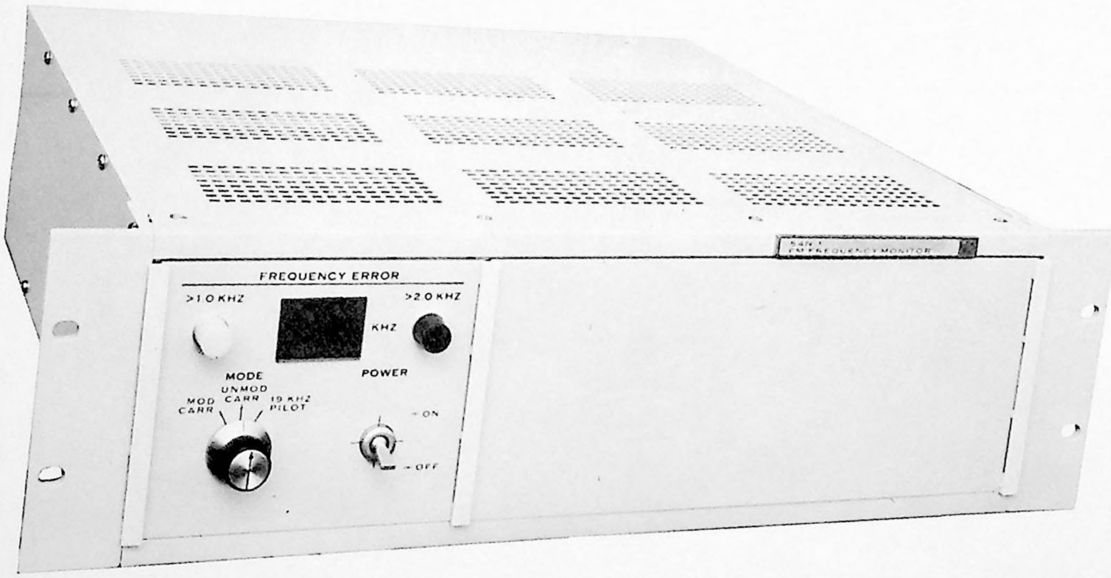


Figure 1-1. 54N-1 FM Frequency Monitor.

section 1
general description

1.1 PURPOSE OF INSTRUCTION BOOK

This instruction book contains information for the installation, adjustment, operation, and maintenance of the 54N-1 FM Frequency Monitor. Instructions for all available optional equipment are included.

1.2 PURPOSE OF EQUIPMENT

The 54N-1 FM Frequency Monitor (figure 1-1) is a solid-state digital counter for remote, unattended monitoring of an FM broadcast transmitter carrier and, as an option, multiplex pilot carrier frequency drift. Frequency error is displayed, up to ±2.0 kHz, in 1-kHz increments, and local alarm indicators for errors greater than 1.0 kHz and 2.0 kHz are provided on the front panel. In addition, the frequency error in digital form, polarity of error, and contact closures for operation of remote indicators, alarms, or interlocks (to initiate transmitter shutdown), are provided on the monitor rear panel.

1.3 PHYSICAL DESCRIPTION

The monitor is assembled in a metal case 5-1/4 inches high, 19 inches wide, and 14 inches deep, and weighs approximately 20 pounds. The monitor is of modular construction consisting of six fiberglass etched circuit cards, and a control and indicator module (with a power supply) that are removable from the front. The monitor contains a shield to prevent rf interference and emission. The rf input, pilot carrier input, 1-MHz output (to check frequency standard operation), and remote readout connections are located on the rear panel.

1.4 FUNCTIONAL DESCRIPTION

The frequency monitor determines frequency error by converting the transmitter carrier to a pulse train and using the pulse train to clock a binary counter from a preset number to zero during a precise 1- or 10-second time period. During the 1-second readout time, the count in the binary counter is read, decoded, and applied to the monitor display and, if applicable, to the alarm circuits. The frequency error display is updated at the end of each count period and is displayed during the next sample period.

See figure 1-2. During monitor installation and setup, a binary number corresponding to the transmitter carrier frequency (divided by 100) is physically wired on the preset card. The preset card provides the binary counter with the binary number to start the counting. The 1- or 10-second sample time, 1-second off-time, and six timing pulses (P1 through P6) are derived by dividing the 3-MHz oscillator output. The rf transmitter carrier, containing from 0 to 100 percent frequency modulation (75-kHz frequency deviation) is applied to the rf circuit where it is divided by 100 and shaped into a square wave. The shaped signal is applied to the count-gate matrix, but is not passed until the 1- or 10-second SAMPLE signal, from the divider network, is applied to the count-gate matrix. Prior to a count period, the binary counter is set at P1 time and preset to the transmitter frequency at P2 time. The decade counter is cleared at P1 time to ensure that the decade counter starts from zero and not an ambiguous number left from the previous count period. During a 10-second sample time, the rf pulse train (divided by 100 in the rf circuit) is applied to the decade counter, where it is then divided by 10 and applied through the binary counter gate to the binary counter. The pulses, applied to the binary counter, cause the binary counter to count backwards from the transmitter carrier frequency (divided by 100) towards zero. During the 1-second off-time (after the count period), the number in the binary counter is analyzed by the detector and storage circuits. The count remaining in the decade counter is examined by the round-off circuit, and if it is five or higher, adds another pulse to the binary counter, decreasing the count by one. If the binary counter counted more transmitter carrier frequency pulses than the assigned frequency, the detector and storage circuits add a pulse to the binary counter again to decrease the count by one. This pulse is added because the binary counter transition through zero requires an extra pulse from the rf input pulse train. The detector and storage circuits apply the count from the binary counter to the code converter and the alarm and inhibit circuits, and apply the polarity sign to the display circuits. The code converter decodes the binary input and applies a decimal equivalent to the display circuits. The code converter also applies the digital signals to the rear terminal connectors and the optional digital-to-analog converter. The inhibit circuit prevents the first error greater than 2.0 kHz from energizing the greater-than-2.0-kHz alarm relay. A TRANSIENT INHIBIT PULSE applied to the inhibit circuit also prevents the greater-than-2.0-kHz alarm circuit from operating if a momentary power loss or fluctuation interrupts the frequency count. If the transmitter rf carrier is lost or turned off, a SIGNAL PRESENCE signal inhibits both alarm circuits. The greater-than-1.0-kHz alarm is not inhibited for the first error count, and the first error greater than 1.0 kHz energizes the alarm.

Operation in the 1-second sample mode is similar to the 10-second mode with the following differences. The counting period is 1 second. The rf pulse train, applied to the count-gate matrix, bypasses the decade counter and is applied directly to the binary counter gate and then to the binary counter. The round-off circuit is not used in the 1-second mode, but accuracy is not reduced because the carrier must be unmodulated for the 1-second sample time.

Operation in the 19 KHZ PILOT mode is an option provided by Preset 3 or 4 Card. When operating in the 19 KHZ PILOT mode, monitor operation is similar to the 10-second mode with the following exceptions: the 19-kHz rf input is applied to a shaper on the preset card where it is amplified, limited, and formed into a 19-kHz pulse train, applied to the count-gate matrix and bypasses the decade counter.

The MODE switch supplies a constant 19-kHz OPERATE signal to the rf circuit to enable the signal presence circuit, to the preset card to disable the transmitter frequency preset, to the count-gate matrix to disable the 10-second count gate, and to the round-off circuit. The SIGNAL PRESENCE signal provides a logic 0 signal that enables the preset card, 19-kHz preset circuit, and the 19-kHz count gate. The MODE switch also enables the transient inhibit circuit, which inhibits the greater-than-2.0-kHz alarm. The 19-kHz pulse train is sampled for 10 seconds, and the binary counter counts backwards from 190,000. The visual error readout in this mode is -2 to +2 Hz in 0.1-Hz increments. The greater-than-1.0-kHz alarm indicator actually means greater than 1.0 Hz, and the greater-than-2.0-kHz alarm indicator will not operate.

1.5 CUSTOMER OPTIONS

The following equipment options are available to tailor the monitor to customer requirements and provide checkout.

a. Preset 1 Card (CPN 770-7893-001). This card is supplied in monitor CPN 758-5742-002, and is used to set only the transmitter carrier frequency into the binary counter.
b. Preset 2 Card (CPN 770-7899-001). This card is supplied in monitor CPN 758-5742-003, and is used to set the transmitter carrier frequency into the binary counter, and to provide digital-to-analog conversion for a remote analog frequency meter.
c. Preset 3 Card (CPN 774-6745-001). This card is supplied in monitor CPN 758-5742-004, and is used to set the transmitter carrier and pilot carrier frequencies into the binary counter, to provide a 19-kHz pilot carrier amplifier-shaper, and to provide digital-to-analog conversion for a remote analog frequency meter.
d. Preset 4 Card (CPN 781-1468-001). This card is provided in monitor CPN 758-5742-005, and is used to set the transmitter and pilot carrier frequencies into the binary counter, and to provide a 19-kHz pilot carrier amplifier-shaper. NO REMOTE.
e. 82U-1 Remote Analog Meter Panel (CPN 777-1390-001). The analog meter is a frequency meter mounted on a standard 19-inch rack panel and provides visual remote-frequency indications when using a monitor with Preset 2 or 3 Card installed.
f. 782B-1 Self-Check Card (CPN 777-1439-001). The self-check card is prewired to 1 MHz and contains a switch wired to preset errors of -1.6, -.8, -.0, +.8, and +1.6 into the binary counter. This card provides a functional check by comparing the preset error to the monitor 1-MHz reference output. #1080
g. Extender Card (CPN 781-5248-001). The extender card is used to provide access to monitor circuit card components for checkout.
h. RF Extender Cable (CPN 781-5252-001). The rf cable is used, when the rf circuit card is on the extender card, to connect the monitor rf input to the rf circuit card input connector.

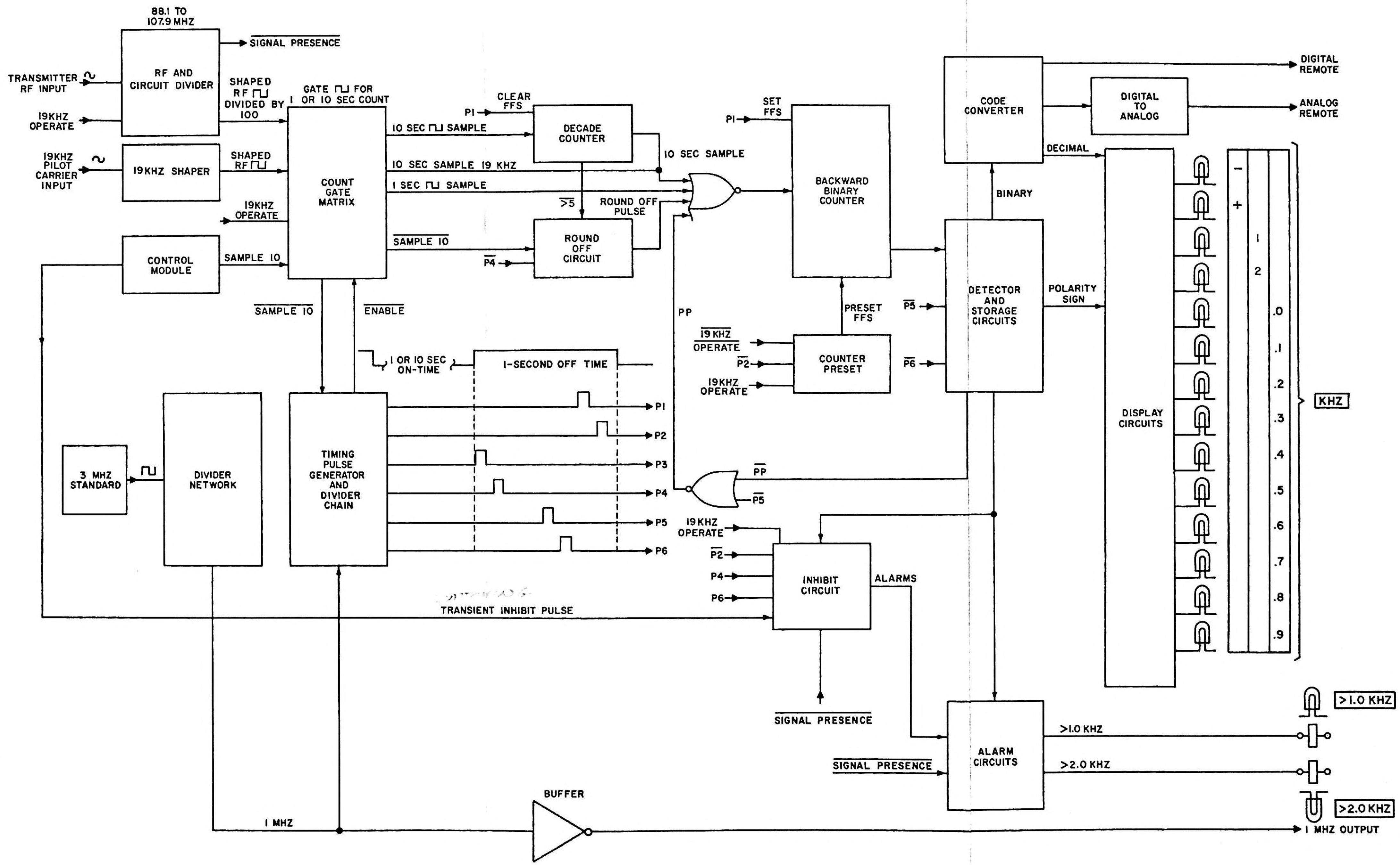


Figure 1-2. Functional Block Diagram.

1.6 TECHNICAL CHARACTERISTICS

Frequency Range:
- Carrier
  - 88 to 108 MHz
- Pilot Carrier
  - 19 kHz
- Minimum Channel Spacing
  - 100 kHz

RF Carrier Signal Input:
- Voltage Level
  - 3 to 9 vrms
- Frequency Modulation
  - 0 to 100% max (100% modulation is defined as 75-kHz frequency deviation)
- Modulation Frequency
  - 30 Hz to 75 kHz

19-kHz Carrier Signal:
- Input Impedance
  - Greater than 15K
- Voltage Level
  - 0.05 to 0.3 vrms

Frequency Standard:
- Stability
  - 0.5 parts per 10^6 from -25° to 55°C
- Aging
  - 1 part per 10^6 per year

Error Display:
- Carrier
  - -2.0 to +2.0 kHz. Inhibited above ±2.0 kHz
- 19 kHz
  - -2.0 to +2.0 Hz. Inhibited above ±2.0 Hz

Carrier Alarm Presentation:
- Visual alarm and contact closure when error exceeds +1.0 kHz
- Visual alarm and contact closure, inhibited from transient activation, when error exceeds ±2.0 kHz for two consecutive samples

19-kHz Alarm Presentation:
- Visual alarm and contact closure when error exceeds ±1.0 Hz
- No visual alarm or contact closure when error exceeds ±2.0 Hz

Accuracy of Readout:
- 10-Second Sample Mode
  - Modulated carrier ±200 Hz
- 1-Second Sample Mode
  - Unmodulated carrier ±200 Hz
- 19-kHz Mode
  - ±0.1 Hz

Resolution of Readout:
- Carrier
  - 100 Hz
- 19 kHz
  - 0.1 Hz

Ambient Temperature Range:
- -25° (-10°F) to +55°C (+131°F)

Ambient Humidity Range:
- 0 to 95%

Altitude Range:
- Up to 10,000 feet above msl

Shock and Vibration Conditions:
- Normal handling and shipping

Power Source:
- 117 vac ±10%, single phase, 50/60 Hz

Type of Service:
- Continuous

Alarm Relay Contact Rating:
- At 24 vdc - 2 amperes resistive, 1 ampere inductive
- At 115 vrms - 1 ampere resistive, 0.5 ampere inductive

External Readout Characteristics:
- Typically 3ma at 1 vdc

section 2
installation and adjustment

2.1 UNPACKING AND INSPECTING THE EQUIPMENT

Remove all packing material and carefully lift the unit from the package. Check the equipment against the packing slips. Visually inspect the units for damaged or missing components. Check for proper operation of controls. Any claims for damage should be filed promptly with the transportation agency. If such claims are to be filed, all packing material must be retained.

2.2 INSTALLATION

2.2.1 Mounting

Position the monitor in a standard 19-inch rack, or cabinet, and secure.

2.2.2 Connections

Prior to connecting monitor primary power and external input and outputs, set POWER switch to OFF.

2.2.2.1 Alarm and Digital Readout Connections

Connect the desired digital readouts and alarms to terminal block on back of monitor (figure 2-1) as listed in table 2-1. Refer to paragraph 1.7 for alarm relay contact rating and external readout signal characteristics.

2.2.2.2 Remote Analog Frequency Meter Connection

If the remote-analog-frequency-meter option was purchased, verify that the monitor contains a Preset 2 Card (CPN 770-7899-001) or a Preset 3 Card (CPN 774-6745-001) in slot A6. Loop resistance of the connecting line to the remote meter must not exceed 15K. Connect remote meter pin 1 to monitor terminal 19. Connect remote meter pin 2 to monitor terminal 20. Remove shorting spring from meter terminals. Retain shorting spring for future use. Replace shorting spring on meter terminals before disconnection from monitor. To calibrate meter, refer to paragraph 2.2.3.

2.2.2.3 RF Cable, 19-kHz, and Primary Power Connection

Connect the monitor power cord to a 115-vac, 50/60-Hz source.

Note

> The monitor will not operate properly if the rf inputs are not within the following limits.

Obtain the rf transmitter output signal from a point in the transmitter where the carrier signal is 3 to 9 vrms. Connect a 50-ohm coaxial cable between the monitor rf input connector and the transmitter. Obtain the 19-KHZ PILOT carrier signal from a point in the transmitter where the signal is 0.05 to 0.3 vrms. Connect the cable between monitor terminal 17 (19-kHz input) and terminal 18 (19-kHz ground) and the transmitter.

2.2.2.4 Preset Card Wiring

The monitor contains one of four types of preset cards in slot A6. Regardless of the type of preset card in the monitor, the card must be wired to correspond to the broadcast transmitter frequency that it will monitor. To wire a preset card, two 15-inch lengths of pliable #24 bus wire are required. The jumper wires are connected to the terminals by two or three tight wraps around each terminal. The column on the extreme left of table 2-2 lists transmitter frequency and the 18 columns progressing to the right on the table correspond to preset card terminals 1 through 18. Connect a jumper wire to preset card pin 19 and each terminal represented by a 0 in table 2-2, columns 1 through 18. Connect a jumper wire to preset card GRD terminal and each terminal represented by a 1 in table 2-2, columns 1 through 18.

Table 2-1. Alarm and Digital Readout Connections.

SIGNAL NOMENCLATURE	TERMINAL NO.
Alarms	
> 1.0-kHz Contact Closure (greater than 1.0 kHz)	
Normally closed contacts	12 and 13
Normally open contacts	11 and 12
> 2.0-kHz Contact Closure (greater than 2.0 kHz)	
Normally closed contacts	15 and 16
Normally open contacts	14 and 15
Readout Signals	
NEGATIVE POLARITY (negative frequency error)	1
POSITIVE POLARITY (positive frequency error)	2
2^0 (binary 1)	3
2^1 (binary 2)	4
2^2 (binary 4)	5
2^3 (binary 8)	7
2^4 (binary 16)	6
ENABLE (10-second or 1-second)	8
SAMPLE 10	9
19-kHz operate	10

2.2.3 Remote Analog Meter Calibration

If the remote analog meter option was purchased and the meter is connected, calibrate meter as follows:

a. Remove logic 2 card and logic 4 card from locations A4 and A8.
b. Place preset card on extender card in location A6.
c. Using jumper wire, connect collector of Q9 to GRD terminal on preset card.
d. Set POWER switch to ON.
e. Using adjustment located on remote meter panel, adjust remote meter reading to 18. The polarity depends on the signal stored in A1A5A53 when the logic 2 card is removed.
f. Set POWER switch to OFF.
g. Remove jumper wire from Q9 and GRD terminal.
h. Remove extender card and place preset card back in card cage.

2.2.4 Installation Checks

Note

The following procedure does not check calibration of the monitor frequency standard. Refer to calibration procedure for oscillator adjustment.

If a self-check card has been purchased, check monitor operation after installation per the following procedure.

a. Remove preset card from location A6, insert self-check card in location A6, and remove rf card from location A1.
b. Connect jumper wire from logic 1, TP1, to logic 2, TP5.
c. Set POWER switch to ON and MODE switch to UNMOD CARR.
d. Rotate self-check card frequency error switch through each of the five positions and observe error display indications of -1.6, -.8, -.0, +.8, and +1.6.
e. Set MODE switch to MOD CARR and repeat step d.

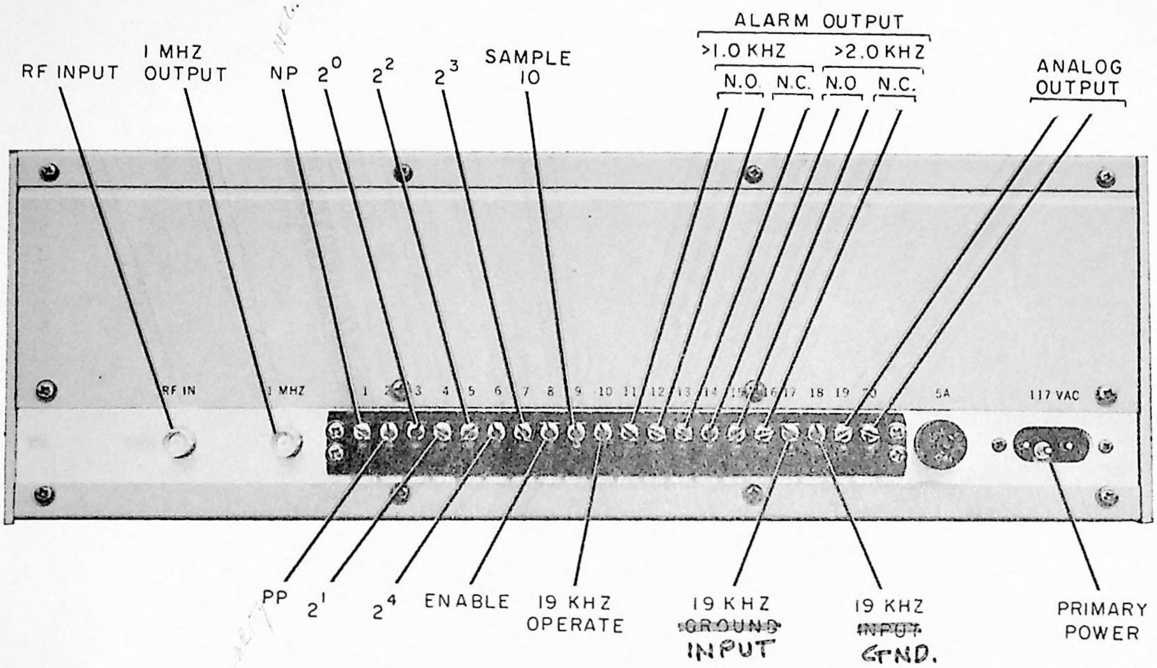


Figure 2-1. Rear Panel Connections.

Table 2-2. Preset Card Wiring Table.

TRANSMITTER FREQUENCY (MHz)	PRESET CARD TERMINAL NUMBER																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
88.1	1	0	1	1	0	1	0	0	0	1	1	1	0	1	0	1	1	0
88.3	1	1	1	0	0	1	0	0	1	1	1	1	0	1	0	1	1	0
88.5	1	0	0	0	0	1	0	0	0	0	0	0	1	1	0	1	1	0
88.7	1	1	0	1	1	0	0	0	1	0	0	0	1	1	0	1	1	0
88.9	1	0	1	0	1	0	0	0	0	1	0	0	1	1	0	1	1	0
89.1	1	1	1	1	0	0	0	0	1	1	0	0	1	1	0	1	1	0
89.3	1	0	0	1	0	0	0	0	0	0	1	0	1	1	0	1	1	0
89.5	1	1	0	0	0	0	0	0	1	0	1	0	1	1	0	1	1	0
89.7	1	0	1	1	1	1	1	1	1	0	1	0	1	1	0	1	1	0
89.9	1	1	1	0	1	1	1	1	0	1	1	0	1	1	0	1	1	0
90.1	1	0	0	0	1	1	1	1	1	1	1	0	1	1	0	1	1	0

Table 2-2. Preset Card Wiring Table (Cont).

TRANSMITTER FREQUENCY (MHz)	PRESET CARD TERMINAL NUMBER																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
90.3	1	1	0	1	0	1	1	1	0	0	0	1	1	1	0	1	1	0
90.5	1	0	1	0	0	1	1	1	1	0	0	1	1	1	0	1	1	0
90.7	1	1	1	1	1	0	1	1	0	1	0	1	1	1	0	1	1	0
90.9	1	0	0	1	1	0	1	1	1	1	0	1	1	1	0	1	1	0
91.1	1	1	0	0	1	0	1	1	0	0	1	1	1	1	0	1	1	0
91.3	1	0	1	1	0	0	1	1	1	0	1	1	1	1	0	1	1	0
91.5	1	1	1	0	0	0	1	1	0	1	1	1	1	1	0	1	1	0
91.7	1	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	1	0
91.9	1	1	0	1	1	1	0	1	0	0	0	0	0	0	1	1	1	0
92.1	1	0	1	0	1	1	0	1	1	0	0	0	0	0	1	1	1	0
92.3	1	1	1	1	0	1	0	1	0	1	0	0	0	0	1	1	1	0
92.5	1	0	0	1	0	1	0	1	1	1	0	0	0	0	1	1	1	0
92.7	1	1	0	0	0	1	0	1	0	0	1	0	0	0	1	1	1	0
92.9	1	0	1	1	1	0	0	1	1	0	1	0	0	0	1	1	1	0
93.1	1	1	1	0	1	0	0	1	0	1	1	0	0	0	1	1	1	0
93.3	1	0	0	0	1	0	0	1	1	1	1	0	0	0	1	1	1	0
93.5	1	1	0	1	0	0	0	1	0	0	0	1	0	0	1	1	1	0
93.7	1	0	1	0	0	0	0	1	1	0	0	1	0	0	1	1	1	0
93.9	1	1	1	1	1	1	1	0	0	1	0	1	0	0	1	1	1	0
94.1	1	0	0	1	1	1	1	0	1	1	0	1	0	0	1	1	1	0
94.3	1	1	0	0	1	1	1	0	0	0	1	1	0	0	1	1	1	0
94.5	1	0	1	1	0	1	1	0	1	0	1	1	0	0	1	1	1	0
94.7	1	1	1	0	0	1	1	0	0	1	1	1	0	0	1	1	1	0
94.9	1	0	0	0	0	1	1	0	1	1	1	1	0	0	1	1	1	0
95.1	1	1	0	1	1	0	1	0	0	0	0	0	1	0	1	1	1	0

Table 2-2. Preset Card Wiring Table (Cont).

TRANSMITTER FREQUENCY (MHz)	PRESET CARD TERMINAL NUMBER																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
95.3	1	0	1	0	1	0	1	0	1	0	0	0	1	0	1	1	1	0
95.5	1	1	1	1	0	0	1	0	0	1	0	0	1	0	1	1	1	0
95.7	1	0	0	1	0	0	1	0	1	1	0	0	1	0	1	1	1	0
95.9	1	1	0	0	0	0	1	0	0	0	1	0	1	0	1	1	1	0
96.1	1	0	1	1	1	1	0	0	1	0	1	0	1	0	1	1	1	0
96.3	1	1	1	0	1	1	0	0	0	1	1	0	1	0	1	1	1	0
96.5	1	0	0	0	1	1	0	0	1	1	1	0	1	0	1	1	1	0
96.7	1	1	0	1	0	1	0	0	0	0	0	1	1	0	1	1	1	0
96.9	1	0	1	0	0	1	0	0	1	0	0	1	1	0	1	1	1	0
97.1	1	1	1	1	1	0	0	0	0	1	0	1	1	0	1	1	1	0
97.3	1	0	0	1	1	0	0	0	1	1	0	1	1	0	1	1	1	0
97.5	1	1	0	0	1	0	0	0	0	0	1	1	1	0	1	1	1	0
97.7	1	0	1	1	0	0	0	0	1	0	1	1	1	0	1	1	1	0
97.9	1	1	1	0	0	0	0	0	0	1	1	1	1	0	1	1	1	0
98.1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	1	1	1	0
98.3	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0
98.5	1	0	1	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0
98.7	1	1	1	1	0	1	1	1	1	0	0	0	0	1	1	1	1	0
98.9	1	0	0	1	0	1	1	1	0	1	0	0	0	1	1	1	1	0
99.1	1	1	0	0	0	1	1	1	1	1	0	0	0	1	1	1	1	0
99.3	1	0	1	1	1	0	1	1	0	0	1	0	0	1	1	1	1	0
99.5	1	1	1	0	1	0	1	1	1	0	1	0	0	1	1	1	1	0
99.7	1	0	0	0	1	0	1	1	0	1	1	0	0	1	1	1	1	0
99.9	1	1	0	1	0	0	1	1	1	1	1	0	0	1	1	1	1	0
100.1	1	0	1	0	0	0	1	1	0	0	0	1	0	1	1	1	1	0

Table 2-2. Preset Card Wiring Table (Cont).

TRANSMITTER FREQUENCY (MHz)	PRESET CARD TERMINAL NUMBER																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
100.3	1	1	1	1	1	1	0	1	1	0	0	1	0	1	1	1	1	0
100.5	1	0	0	1	1	1	0	1	0	1	0	1	0	1	1	1	1	0
100.7	1	1	0	0	1	1	0	1	1	1	0	1	0	1	1	1	1	0
100.9	1	0	1	1	0	1	0	1	0	0	1	1	0	1	1	1	1	0
101.1	1	1	1	0	0	1	0	1	1	0	1	1	0	1	1	1	1	0
101.3	1	0	0	0	0	1	0	1	0	1	1	1	0	1	1	1	1	0
101.5	1	1	0	1	1	0	0	1	1	1	1	1	0	1	1	1	1	0
101.7	1	0	1	0	1	0	0	1	0	0	0	0	1	1	1	1	1	0
101.9	1	1	1	1	0	0	0	1	1	0	0	0	1	1	1	1	1	0
102.1	1	0	0	1	0	0	0	1	0	1	0	0	1	1	1	1	1	0
102.3	1	1	0	0	0	0	0	1	1	1	0	0	1	1	1	1	1	0
102.5	1	0	1	1	1	1	1	0	0	0	1	0	1	1	1	1	1	0
102.7	1	1	1	0	1	1	1	0	1	0	1	0	1	1	1	1	1	0
102.9	1	0	0	0	1	1	1	0	0	1	1	0	1	1	1	1	1	0
103.1	1	1	0	1	0	1	1	0	1	1	1	0	1	1	1	1	1	0
103.3	1	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	1	0
103.5	1	1	1	1	1	0	1	0	1	0	0	1	1	1	1	1	1	0
103.7	1	0	0	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0
103.9	1	1	0	0	1	0	1	0	1	1	0	1	1	1	1	1	1	0
104.1	1	0	1	1	0	0	1	0	0	0	1	1	1	1	1	1	1	0
104.3	1	1	1	0	0	0	1	0	1	0	1	1	1	1	1	1	1	0
104.5	1	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	0

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

19 to 0
GRD TO 1

Table 2-2. Preset Card Wiring Table (Cont).

TRANSMITTER FREQUENCY (MHz)	PRESET CARD TERMINAL NUMBER																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
104.7	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	0
104.9	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1
105.1	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1
105.3	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1
105.5	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1
105.7	1	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1
105.9	1	1	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	1
106.1	1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1
106.3	1	1	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	1
106.5	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
106.7	1	1	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	1
106.9	1	0	0	1	1	1	1	1	1	0	0	1	0	0	0	0	0	1
107.1	1	1	0	0	1	1	1	1	0	1	0	1	0	0	0	0	0	1
107.3	1	0	1	1	0	1	1	1	1	1	0	1	0	0	0	0	0	1
107.5	1	1	1	0	0	1	1	1	0	0	1	1	0	0	0	0	0	1
107.7	1	0	0	0	0	1	1	1	1	0	1	1	0	0	0	0	0	1
107.9	1	1	0	1	1	0	1	1	0	1	1	1	0	0	0	0	0	1

section 3
operation

3.1 PANEL CONTROLS AND INDICATORS

This section locates, illustrates, and describes the function of each front panel control. Refer to figure 3-1 and table 3-1.

3.2 OPERATING INSTRUCTIONS

To operate monitor, set POWER switch to ON. There is no delay or warmup time required; however, disregard the first one or two error displays to allow the counting circuits to stabilize. Set MODE switch to MOD CARR. This is the normal mode of operation for the monitor when the transmitter signal is modulated. The error readout is updated every 11 seconds. The UNMOD CARR mode of operation, with a 2-second update time, is usually used when adjusting transmitter frequency. The 19-KHZ PILOT mode of operation, with an 11-second update time, is used to check multiplex pilot-carrier frequency drift. When switching the monitor mode of operation, disregard the first one or two error displays to allow the counting circuits to stabilize. The greater-than-2.0-kHz alarm is protected from transient operation when switching monitor mode of operation or when turning power on.

Note

Do not use the MODE switch 19-KHZ PILOT position if there is no 19-kHz input. If the monitor MODE switch is inadvertently set to the 19-KHZ PILOT position without a 19-kHz pilot carrier present, the greater-than-1.0-kHz alarm indicator will light; however, the error display and greater-than-2.0-kHz alarm will be inhibited.

3.3 TRANSMITTER FREQUENCY ADJUSTMENT

If the transmitter frequency drifts, the transmitter frequency may be adjusted.

3.3.1 Unmodulated Carrier Adjustment

a. Set MODE switch to UNMOD CARR position for 2-second update time.
b. Observe display and adjust transmitter frequency until display indicates zero frequency error.

3.3.2 Modulated Carrier Adjustment

a. Set MODE switch to MOD CARR position for 11-second update time.
b. Observe display and adjust transmitter frequency until display indicates zero frequency error.

3.4 19-kHz PILOT CARRIER ADJUSTMENT

Adjust the pilot carrier by setting the MODE switch to 19-KHZ PILOT and adjusting pilot carrier frequency until monitor display indicates zero frequency error.

Table 3-1. Controls and Indicators.

NAME	PANEL MARKING	FUNCTION
Power switch	POWER ON OFF	Turns monitor on and off.
Mode switch	MODE	
	MOD CARR	Selects 10-second sample mode.
	UN MOD CARR	Selects 1-second sample mode.
	19 KHZ PILOT	Selects 10-second sample mode for 19-kHz pilot carrier.
Frequency-error-greater-than-1-kHz indicator lamp	FREQUENCY ERROR >1.0 kHz	Indicates frequency error of more than 1 kHz in MOD or UMOD CARR position, or more than 1 Hz in 19 KHZ PILOT position.
Frequency-error-greater-than-2-kHz indicator lamp	FREQUENCY ERROR > 2.0 kHz	Indicates frequency error of more than 2 kHz in MOD or UMOD CARR position, but does not operate in the 19 KHZ PILOT position.
Frequency-error readout screen	FREQUENCY ERROR KHZ	Displays frequency error from 0 to ±2.0 kHz in MOD or UNMOD CARR position, or 0 to ±2.0 Hz in 19 KHZ PILOT position.

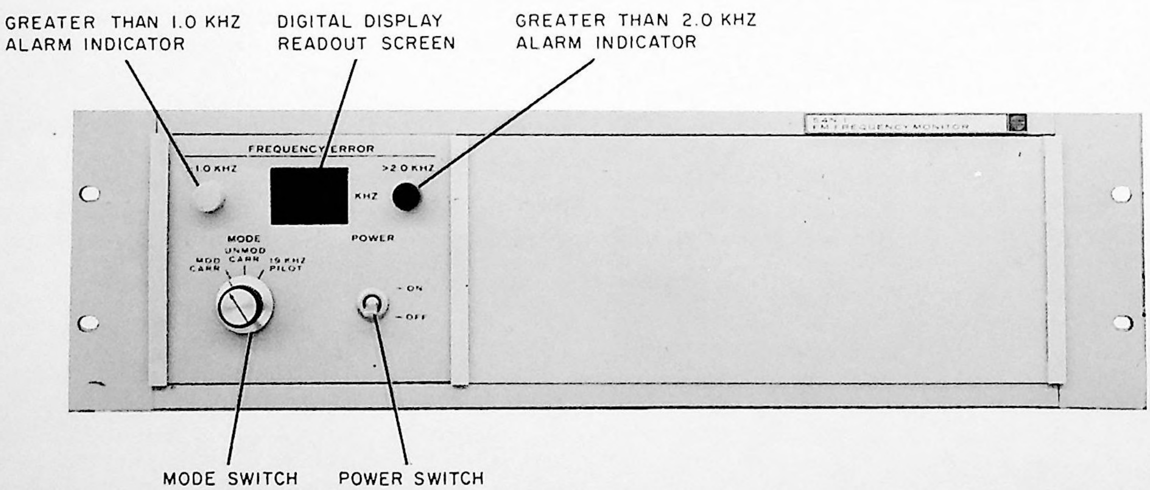


Figure 3-1. Panel Controls and Indicators.

section 4
principles of operation

4.1 GENERAL

The 54N-1 FM Frequency Monitor uses integrated circuits to perform the digital counting, decoding, readout, and gate functions.

The frequency monitor uses positive logic; that is, a logic 1 always more positive than a logic 0. The logic states are represented by the following voltages:

Logic 1: nominally 1.0 vdc
Logic 0: nominally 0.3 vdc

4.2 INTEGRATED CIRCUITS

The following paragraphs present a general description of the integrated circuits used in the frequency monitor.

4.2.1 Fairchild 923 JK Flip-Flop

The Fairchild Micrologic 923JK flip-flops are used as storage elements, counters, and dividers. Refer to figure 4-1 for schematic diagram, logic symbol, and truth table. The JK flip-flops differ from ordinary flip-flops in that no ambiguous output state can result from simultaneous logic 1 inputs. There are only two output conditions: pin 7 is logic 1 while pin 5 is logic 0, and pin 7 is logic 0 while pin 5 is logic 1. The flip-flop changes state on the negative transition of a clock pulse (at pin 2), or a logic 1 applied at pin 6. Simultaneous logic 0 signals on the SET (pin 1) and CLEAR (pin 3) inputs allow the output at pins 5 and 7 to toggle (reverse) when the clock pulse is applied. With logic 1 inputs on the SET and CLEAR pins, the output at pins 5 and 7 will not change with the clock input. A logic 1 on pin 1 and logic 0 on pin 3 changes the output at pin 7 to logic 1, and pin 5 to logic 0 at the next clock pulse. A logic 0 on pin 1 and logic 1 applied to pin 6 presets the output at pin 7 to logic 0 regardless of the clock input or the logic levels on pins 1 and 3.

4.2.2 Dual 2-Input NOR Gate

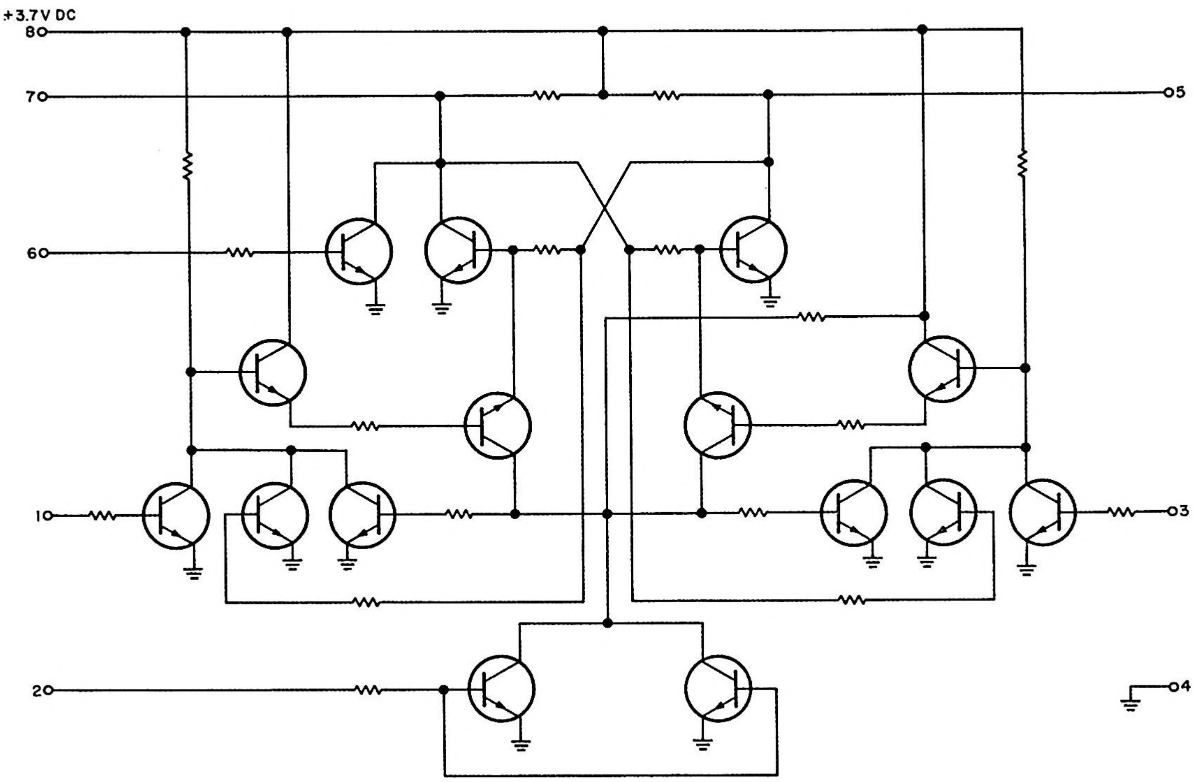
The Fairchild Micrologic 914 is a dual 2-input NOR gate. When any one or more inputs to a NOR gate is a logic 1, the output is a logic 0. Refer to figure 4-2 for schematic, logic symbols, and truth tables. Each NOR gate may be used separately as a 2-input gate, or the output pins (6 and 7) may be tied together to form a 4-input gate. In the gate function operation, assume a logic-1 input at pin 2 and a square-wave input at pin 1. The output at pin 7 remains at a logic 0, because of the logic-1 input at pin 2, and blocks the square-wave input at pin 1. When the input at pin 2 changes to logic 0, the square wave at pin 1 is passed by the gate. Any input pins not used are tied to ground (logic 0). The dual 2-input gate is also used as a set/reset flip-flop by external crosscoupling (pin 6 to pin 2 and pin 7 to pin 3). (The control pulses are applied to pins 1 and 5.)

4.2.3 Buffer Element

The Fairchild Micrologic 900 Buffer is an inverting driver capable of supplying 16 ma at 0.9 vdc. Refer to figure 4-2 for schematic, logic symbol, and truth table. The buffer is used as a line driver to increase fanout, as a buffer to provide isolation, or as an inverting amplifier. Fanout refers to the number of integrated circuits that a device can drive. A logic 1 at pin 3 produces a logic 0 output at pin 5, and a logic 0 at pin 3 produces a logic 1 output at pin 5.

4.2.4 Sylvania JK Flip-Flop

The Sylvania SF53 and SF253 are AND input JK flip-flops used as frequency dividers in the rf section. Refer to figures 4-3 and 4-4 for schematics and truth tables. The JK flip-flops differ from ordinary flip-flips in that no ambiguous output state can result from simultaneous logic 1 or logic 0 inputs on the J and K inputs. Simultaneous logic 1 signals allow the flip-flop to toggle with the clock input, and simultaneous logic 0



TRUTH TABLE

SET PIN 1	CLEAR PIN 3	OUTPUT PIN 7
1	1	X^n
1	0	1
0	1	0
0	0	$\overline{X^n}$

X IS THE OUTPUT STATE AT TIME n_1

1 = HIGH
0 = LOW

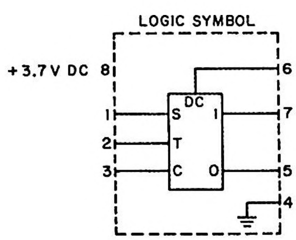


Figure 4-1. Fairchild 923 JK Flip-Flop Schematic.

inputs inhibit toggling. Information is applied to the J and/or K terminals while the clock is at logic 0. This new information is ANDed with the present state of the flip-flop and stored in the depletion region of a diode when the clock changes to logic 1. When the clock returns to logic 0, the stored information is ANDed with the inverted clock, causing the cross-coupled NAND gates to set. Asynchronous SET, PRESET, and RESET inputs are used for setting the flip-flop independently of the clock. Unused J and/or K inputs may be tied to Vcc (2.0 to 5.0 vdc) or to the clock. Unused SET and/or PRESET inputs may be tied to Vcc (2.0 to 5.0 vdc) or to the $\overline{Q}$ output. The unused RESET input may be tied to Vcc (2.0 to 5.0 vdc) or to the Q output.

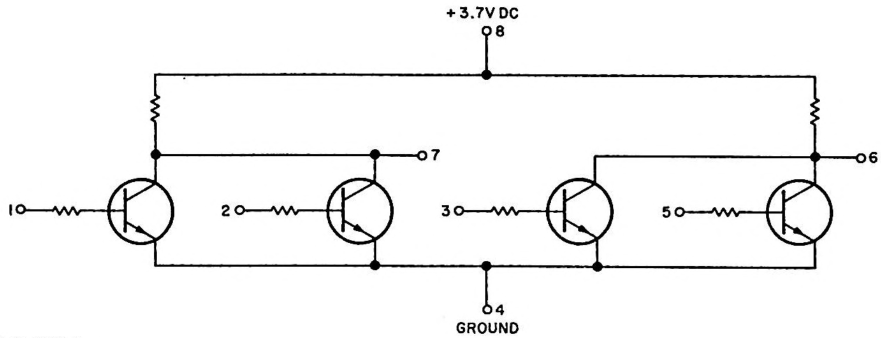
4.3 MONITOR PRINCIPLES OF OPERATION

The following paragraphs are keyed to the functional diagram in figure 7-1. When they are preset, the signals (figure 7-1) with a bar across the top are logic 0 and the signals without a bar are logic 1.

4.3.1 Frequency Divider Network

The 3-MHz crystal oscillator output applied to the shaper is formed into a square wave and applied

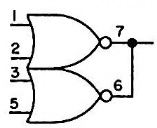
FAIRCHILD MICROLOGIC 914 DUAL TWO INPUT NOR GATE



TRUTH TABLE
PINS 6 AND 7 CONNECTED

INPUT PINS				OUTPUT PINS
1	2	3	5	6 OR 7
1	1	1	1	0
1	1	1	0	0
1	1	0	1	0
1	1	0	0	0
1	0	1	1	0
1	0	1	0	0
1	0	0	1	0
1	0	0	0	0
0	1	1	1	0
0	1	1	0	0
0	1	0	1	0
0	1	0	0	0
0	0	1	1	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	1

LOGIC SYMBOL



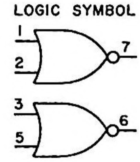
1 = HIGH
0 = LOW

TRUTH TABLE
PINS 6 AND 7
NOT CONNECTED

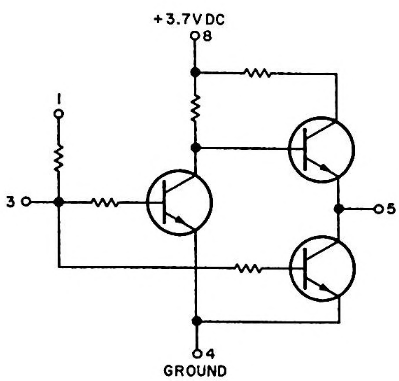
INPUT PINS		OUTPUT PINS
1	2	7
0	0	1
1	0	0
1	1	0
0	1	0

INPUT PINS		OUTPUT PINS
3	5	6
0	0	1
1	0	0
1	1	0
0	1	0

LOGIC SYMBOL



FAIRCHILD MICROLOGIC 900 BUFFER



TRUTH TABLE

INPUT PIN 3	OUTPUT PIN 5
0	1
1	0

1 = HIGH
0 = LOW

LOGIC SYMBOL

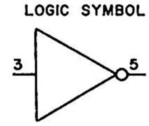
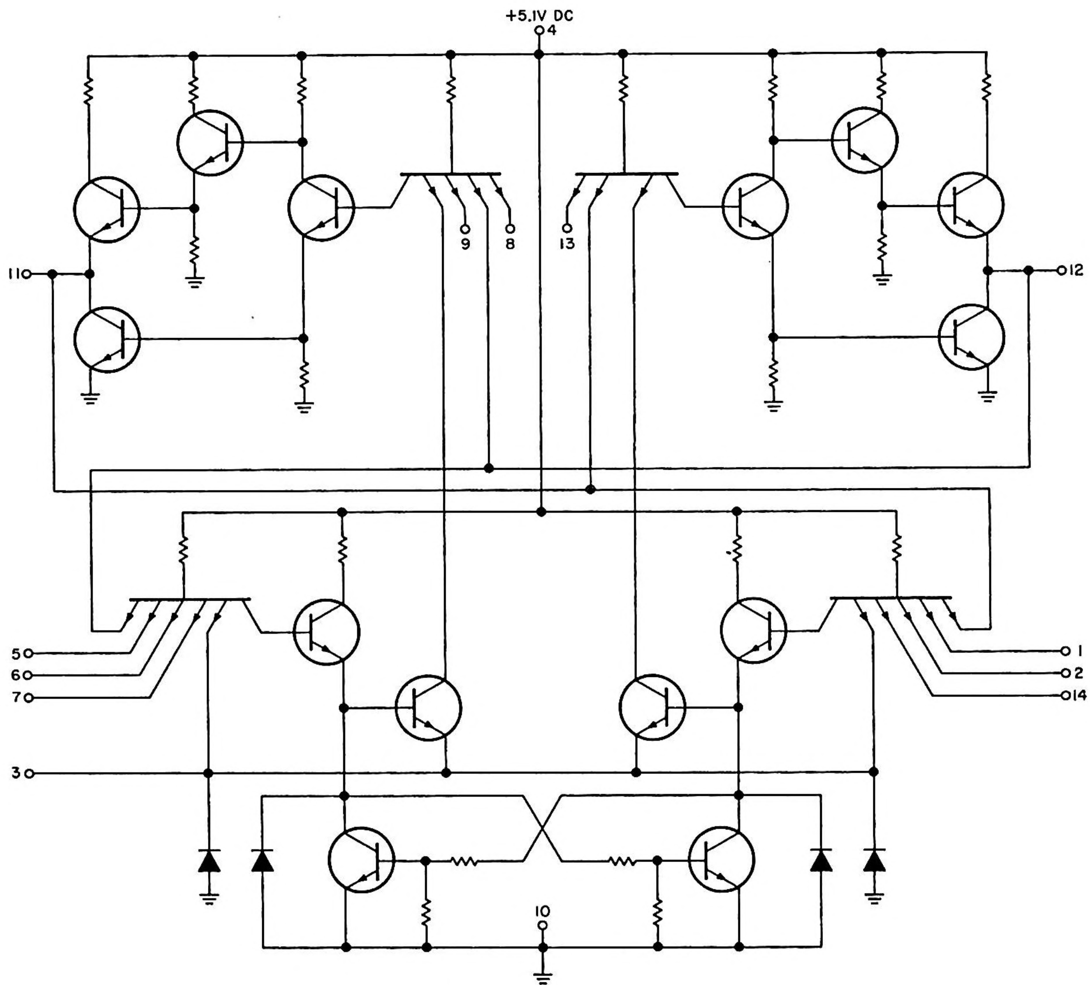
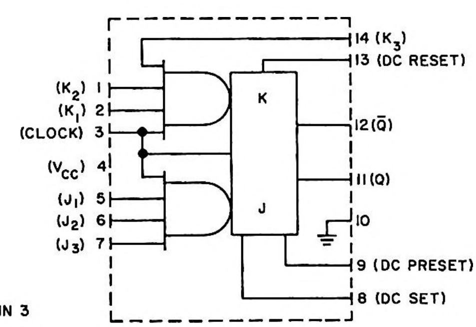


Figure 4-2. Fairchild 914 Dual 2-Input Gate and 900 Buffer Schematic.



TRUTH TABLE

J	K	Q_n	$Q_n + 1$
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0



Q_n = OUTPUT AT PIN 11 PRIOR TO CLOCK PULSE AT PIN 3

$Q_n + 1$ = OUTPUT AT PIN 11 AFTER A CLOCK PULSE AT PIN 3

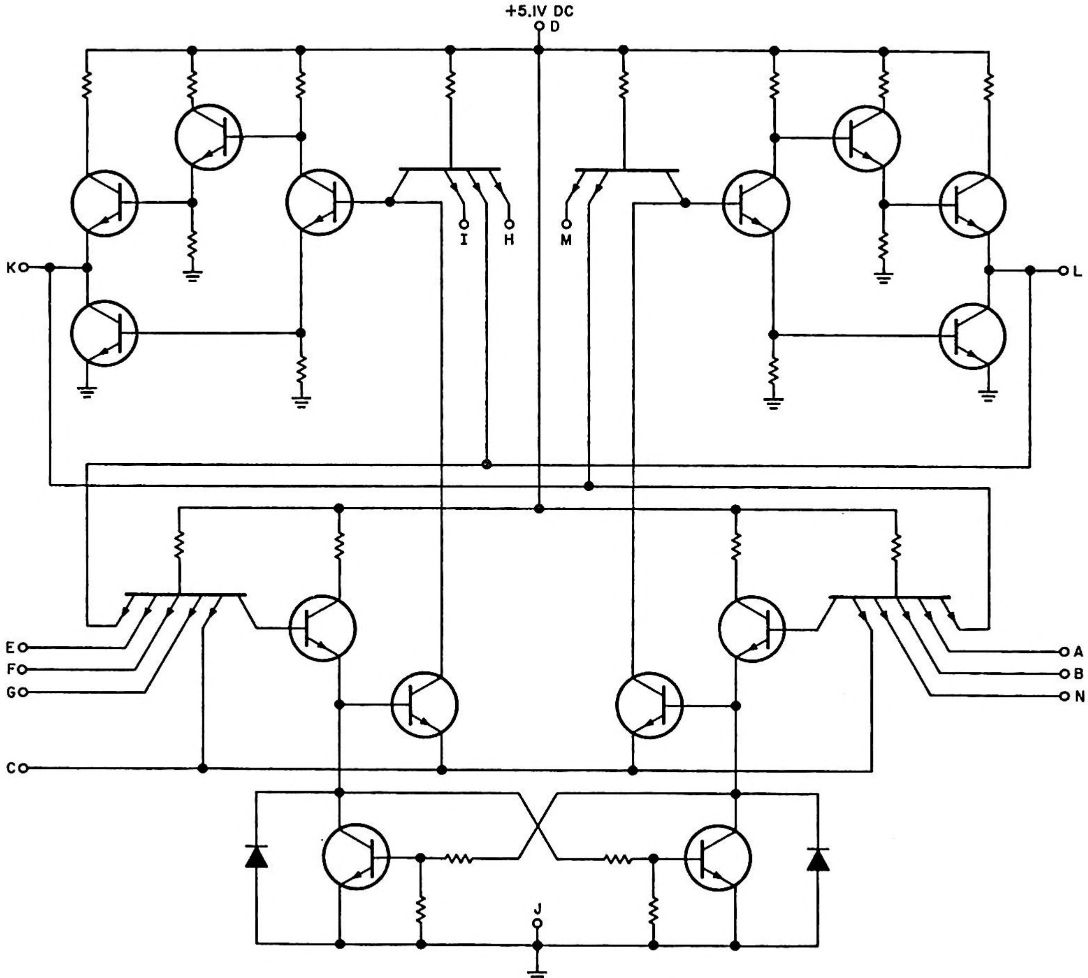
$J = J_1 \cdot J_2 \cdot J_3$

$K = K_1 \cdot K_2 \cdot K_3$

1 = HIGH

0 = LOW

Figure 4-3. Sylvania SF253 JK Flip-Flop Schematic.



TRUTH TABLE

J	K	Q_n	$Q_n + 1$
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

Q_n = OUTPUT AT PIN K PRIOR TO CLOCK PULSE AT PIN C

$Q_n + 1$ = OUTPUT AT PIN K AFTER A CLOCK PULSE AT PIN C

$J = J_1 \cdot J_2 \cdot J_3$

$K = K_1 \cdot K_2 \cdot K_3$

1 = HIGH

0 = LOW

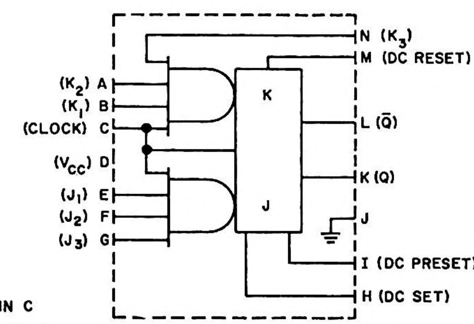


Figure 4-4. Sylvania SF53 JK Flip-Flop Schematic.

to a divide-by-3 flip-flop network (figure 7-1) that produces two 1-MHz outputs. One output, from the divide-by-3 network, is fed to a buffer and then to an rf connector on the rear panel. The other 1-MHz output is applied to a divide-by-4 flip-flop network. The resulting 250-kHz signal is divided twice by 25 to obtain first a 10-kHz signal, then a 400-Hz signal. The 400-Hz signal is applied to a divide-by-50 flip-flop network to obtain an 8-Hz signal that is applied to a divide-by-8 network. The divide-by-8 network provides 4-, 2-, and 1-Hz output signals to the timing pulse generator logic. The 1-Hz signal is also applied to a divide-by-2-or-11 network that provides a 1- or 10-second sample time with a 1-second readout time.

4.3.2 Timing Pulse Generator

The 8-, 4-, 2-, and 1-Hz signals, derived from the divider network (figure 7-1), are used to establish the 1-second and 10-second sample, readout, and timing pulses required for the sampling and processing operation.

One output of the 1-Hz signal is divided by 2 or 11, depending on the MODE switch position, to produce a sample time of 1 (UNMOD CARR) or 10 (MOD CARR) seconds with a 1-second off-time for sample-count processing and display updating. The SAMPLE signal is applied to a count-gate matrix to control the rf-input sample time.

A second 1-Hz signal, from the divide-by-8 network, is combined with 4-, 2-, and 1-Hz signals to generate timing pulses that perform sequential operations during the 1-second off-time. Refer to figure 5-2. These pulses, spaced over the 1-second off-time, are 80 ms in duration, with 45 ms between pulses. The pulses are identified as P1, (P1), $\overline{\text{P2}}$, P3, P4, $\overline{\text{P4}}$, $\overline{\text{P5}}$, P6, and $\overline{\text{P6}}$ and are discussed in the following paragraphs as they are used.

4.3.3 RF Circuit

The rf input frequency (figure 7-7) (from the transmitter) is divided by 2 in the first parametric divider and, due to losses in the first divider, amplified by Q1 and Q2. The signal is again divided by 2 in the second parametric divider and, due to losses in the second divider, amplified by Q3 and shaped by Q4. Transistor Q4 provides the square-wave output required by the first integrated circuit divide-by-5 network. The output of the first divide-by-5 network is applied to the second divide-by-5 network. The signal, now divided by 100, is applied to transistor Q5, which conditions the divided rf pulse train to the monitor logic 1 and logic 0 levels.

The signal presence circuit prevents the monitor from activating an alarm when there is no transmitter rf input. An output signal from flip-flop A1 is applied to a voltage doubler consisting of diodes CR1 and CR2 and capacitors C14 and C15. This causes transistor Q6 to conduct and provide the logic 0 $\overline{\text{SIGNAL PRESENCE}}$ signal that is applied to the alarm and display circuits. Loss of the rf input shuts off transistor Q6 and provides a logic 1 that inhibits the alarm and display circuits. When the MODE switch is in the 19 KHZ PILOT position, a logic 1 is applied to the base of transistor Q6 through resistor R21 to supply a constant logic 0 $\overline{\text{SIGNAL PRESENCE}}$ signal. This prevents the loss of the signal presence signal, if the rf input is not present while monitoring the pilot carrier frequency.

4.3.4 Count-Gate Matrix

The count-gate matrix (figure 7-1) directs the SHAPED RF input through the 1-second or 10-second gates as selected by the MODE switch position.

The MODE switch MOD CARR position applies a logic 1 to the count-gate matrix that disables the 1-second gate A1A4A2. The logic 1 applied to A1A4A1 causes a logic 0 output that enables the round-off circuit and the 10-second gate A1A4A13, and causes the divide-by-2-or-11 circuit to supply an 11-second period (containing a logic 0 sample time of 10 seconds and a logic 1 read time of 1 second) to the count-gate matrix rf gates A1A4A3, A2, and A7. The decade counter output gate A1A4A13 is disabled during readout time by set/reset flip-flop A1A4A8. The MODE switch UNMOD CARR position applies a logic 0 to the count-gate matrix that enables the 1-second gate A1A4A2. The logic 0 applied to A1A4A1 causes a logic 1 output that disables the round-off circuit and decade counter output gate A1A4A13, and causes the divide-by-2 or-11 circuit to supply a 2-second period (containing a logic 0 sample time for 1 second and a logic 1 read time for 1 second) to the count-gate matrix rf gates A1A4A2, A3, and A7.

4.3.5 Decade Counter

The decade counter (figure 7-1) is a ring counter that produces one output pulse for every 10 input pulses. The decade counter receives the rf pulse train from the count-gate matrix and applies the divided-by-10 output (from pin 7 of A1A4A25) to the output gate A1A4A13. Sampling the input pulses for 10 seconds and dividing by 10 permits frequency count round-off that reduces count-gate ambiguity. At the end of the sample period, the decade counter output is inhibited by a P3 pulse. During the readout time, the count remaining in the decade counter is examined by the round-off circuit; it if is five or more, another count is added to the binary counter. A count of five or more is logic 0 at A1A4A25 pin 5. The decade counter is cleared (logic 0 at pins 7 and logic 1 at pins 5) prior to each sample period by a logic 1 on pins 6 at P1 time.

4.3.6 Round-Off Circuit

The round-off circuit (figure 7-1) rounds off the frequency count to the nearest whole cycle when the monitor is operating in the 10-second sample mode. The round-off circuit is enabled by a logic 0 from A1A4A1, a logic 0 from the MODE switch, and a logic 0 (five or greater count) from the decade counter A1A4A25 pin 5. With the three ENABLE signals present during readout time, a logic 0 (from the timing pulse generator) at P4 time adds one count to the binary counter. The round-off circuit is disabled when the MODE switch is set to the UNMOD CARR position by a logic 1 from A1A4A1. In the 19 KHZ PILOT mode, a logic 1 applied from the MODE switch disables the round-off circuit.

4.3.7 Binary Counter Gate

The binary counter gate (figure 7-1) is a 4-input NOR gate that supplies the binary counter with all count pulses. The four inputs are: 1- or 10-second rf count pulses, the round-off pulse, and the positive polarity pulse. To add a count to the binary counter, a logic 1 pulse is applied to the input, providing a logic 0 output pulse to the binary counter.

4.3.8 Binary Counter Preset

To count from a maximum of 1.08 MHz (the rf carrier is divided by 100 in the rf circuit) 21 flip-flops are required and 18 flip-flops are wired for preset (figure 7-1). The three lowest order flip-flops are always set to zero at P1 time by a logic 1 and are not wired to the preset card A1A6. The preset card is wired (by the customer) to the binary equivalent of the transmitter frequency that it will monitor. Preset occurs at P2 time when a logic 0 is applied to A1A6 pin 19. This applies a logic 1 to pin 6 of all binary counter flip-flops that are connected to A1A6 terminal 19. For 19-kHz operation, refer to paragraph 4.3.15.

4.3.9 Binary Counter

The binary counter (figure 7-1) counts backward from a binary number that represents the transmitter frequency during a precise time period. Prior to a sample period, the binary counter flip-flops are set at P1 time by a logic 1 pulse, and preset at P2 time to the binary number representing the transmitter frequency. During a sample period, each pulse from the binary counter gate decreases the number in the binary counter by one. At the end of a sample period, all flip-flops will be set to zero if the transmitter frequency is correct. A negative error results if the counter does not reach zero, and a positive error results if the counter passes zero. The error count and polarity of error are examined by the detector and storage circuits.

4.3.10 Detector and Storage Circuits

The detector and storage circuits (figure 7-1) analyze the states of all 21 flip-flops in the binary counter to determine polarity and magnitude of frequency error, and store the information for display during the next sample period. The polarity detector consists of two 16-input NOR circuits with the outputs applied to polarity storage flip-flops A1A5A52 and 53 and the greater-than-10 and greater-than-20 error detectors. Pins 5 of the last 16 flip-flops in the binary counter are connected to one 16-input NOR gate. Pins 7 are connected to the other 16-input NOR gate. When there is a negative frequency error, the 16 flip-flop outputs from all pins 5 are logic 1 and the outputs at all pins 7 are logic 0. For a negative frequency error the following conditions exist: a logic 0 input to A1A5A52 pin 3 and a logic 1 input to A52 pin 1, a logic 1 input to A1A5A53 pin 3 and a logic 0 input to A53 pin 1. At P6 time flip-flops A52 and A53 are updated by a $\overline{P6}$ pulse. This provides a logic 1 from A1A5A54 pin 7 to transistor A1A9A2 Q9 lighting the negative-error display lamp, and a logic 0 from A1A5A51 pin 6 to transistor A1A9A2 Q4 inhibiting the positive-error display lamp. When there is a positive frequency error, the outputs of the binary counter flip-flops are reversed (pins 5 logic 0 and pins 7 logic 1), the storage circuit outputs are reversed, the positive-error lamp lights and the negative-error lamp is inhibited.

If the logic levels on pin 5 of the last 16 binary counter flip-flops are not the same, the frequency error is 3.2-kHz or greater, and the outputs of both 16-input NOR gates are logic 0. The logic 0 outputs are inverted to logic 1 through A1A5A26 and are applied to the greater-than-1.0-and-2.0-kHz error detectors A1A5A31 and A36. The error detectors provide a logic 1 from A1A5A41 to the greater-than-1.0-and-2.0-kHz alarm storage flip-flops A1A8A9 and A10.

The error signals for display (from the first five binary counter flip-flops) are applied to the display storage circuits. The error signals are also examined by NOR gates A1A4A16, 17, 18, and 19, which are part of the greater-than-10-and-20-Hz error detectors. The display error signals are loaded directly into the storage flip-flops by a logic 0 applied to the storage circuit NOR gates at P5 time. The output signals from the storage flip-flops are partially combined, buffered, and applied to the binary-to-decimal decode circuit.

For all positive errors, an additional pulse is added to the binary counter. This pulse is required because the counter transition through zero requires an extra pulse from the rf input pulse train. This pulse is added by clocking the binary counter at P5 time with logic 0 signals $\overline{P5}$ and $\overline{PP}$, and storing the new number in the storage flip-flops during P5 time. The stored binary number, for positive frequency errors, is inverted for proper decoding in the code converter. This is accomplished by toggling the display storage flip-flops at P6 time with logic 0 signals $\overline{P6}$ and $\overline{PP}$.

4.3.11 Decode Circuit

The decode circuit (figure 7-1) receives binary error signals from the storage circuits, decodes the signals, and lights the decimal equivalent lamp. Assume logic 0 on A1A8 input pins 5, 10, 12, and 14, and logic 1 on A1A8 input pins 1, 2, 3, 4, 6, 15, and 18. The four logic 0 signals only enable 4-input gate A1A8A36. The resulting logic 1 output of A1A8A36 is inverted twice by A38. The logic 1 output from A1A8A38 pin 6 enables transistor A1A9A2 Q7 that lights the .5 (hundreds) lamp.

4.3.12 External Readout Signals

The external readout signals (figure 7-1) are digital and, as an option, analog. The binary digital signals are obtained directly from the storage circuits on A1A4 pins 9, 24, 26, 25, and 33 and applied to A1A10 logic for conditioning. The digital readout signals are: SAMPLE 10, ENABLE, 2^0, 2^1, 2^2, 2^3, 2^4, POSITIVE POLARITY, NEGATIVE POLARITY, and 19-KHZ OPERATE.

The analog output is derived by applying the digital signals to the analog output converter. The analog output signal is determined by the transistor that is enabled and the current flow through the collector resistor. If more than one transistor is enabled, the collector currents are added, which results in a larger analog meter indication. The polarity of error is controlled by a NEGATIVE POLARITY STORED ($\overline{NPS}$) signal that is logic 0 when frequency error is negative. When the frequency error is positive, the NPS signal changes to a logic 1 enabling transistor A1A6Q2, which energizes relay A1A6 K1. This changes the analog meter movement to indicate a positive-error signal. The analog output is inhibited during display update time by a logic 1 signal to transistor A1A6 Q3 that cuts off transistor Q1. If the error is greater than 2.0 kHz, the greater-than-2.0-kHz alarm signal enables transistor A1A6 Q10, which disables transistor Q1 and pegs the remote meter.

4.3.13 Alarm Circuits

The alarm circuits (figure 7-1) receive the greater-than-1.0-and-2.0-kHz error signals (refer to paragraph 4.3.10) from the greater-than-1.0-and-2.0-kHz error detectors and at P6 time, stores them in storage flip-flops A1A8A9 and A10. A logic 0 from flip-flop A1A5A9 pin 5, and a logic 0 SIGNAL PRESENCE signal from the rf circuit, produce a logic 1 from A1A8A14 pin 6 that enables transistor A1A9A2 Q5, which energizes relay A1A9A2 K1. A1A9A2 K1 relay contacts 6 and 7 light the greater-than-1.0-kHz alarm indicator, and contacts 9 and 10 close the greater-than-1.0-kHz external/remote alarm circuit. A logic 1 from flip-flop A1A8A9 pin 5 inhibits the greater-than-1.0-kHz alarm relay by providing a logic 0 from A1A8A14 pin 6.

LAMP INHIBIT during display update is provided by a logic 1 signal at P4 time to A1A8A15 pin 3, which sets the output of A1A8A15 pin 7 to logic 1. This produces a logic 1 from A1A8A34 pin 5 that inhibits all readout signals. At P6 time, the set/reset flip-flop A1A8A15 is reset by a logic 1 applied to A1A8A15 pin 2. The output at A1A8A15 pin 7 changes to logic 0 and provides a logic 0 at A1A8A34 pin 5 that enables all readout gates.

With an error of less than 2.0 kHz, the output of flip-flop A1A8A10 pin 5 is a logic 1 that inhibits the greater-than-2.0-kHz alarm signal from A1A8A14 pin 7, presets flip-flops A1A8A29 and A30 pins 5 through A1A8A19 and A24 to logic 1, and provides a logic 1 through A1A8A20 and A24 to pin 2 of flip-flop A1A8A29. With the first error count greater than 2.0 kHz, the output at pin 5 of flip-flop A1A8A10 changes, at P6 time, to logic 0. This enables one input of A1A8A14, removes the logic 1 preset at pins 6 of flip-flops A1A8A29 and A30, and applies logic 0 to A1A8A20 pin 1. At P2 time, a logic 0 applied to A1A8A20 pin 2 clocks flip-flop A1A8A29. With the second greater-than-2.0-kHz count, the output of flip-flop A1A8A10 pin 5 remains logic 0, and the logic 0 P2 pulse clocks flip-flop A1A8A29, which then clocks flip-flop A1A8A30. With the third greater-than-2.0-kHz count, the output of flip-flop A1A8A10 pin 5 remains logic 0, and the logic 0 P2 pulse clocks flip-flop A1A8A29. This provides two logic 0 outputs from flip-flops A1A8A29 and A30 to A25 pins 3 and 5. The logic 1 output from A1A8A25 pin 6 disables the flip-flop input gate A1A8A20, and provides a logic 1 output (greater-than-2.0-kHz alarm) from A1A8A14 pin 7 that enables transistor A1A9A2Q24, which energizes relay A1A9A2K2. A1A9A2 K2 relay contacts 6 and 7 light the greater-than-2.0-kHz alarm indicator, and contacts 9 and 10 close the greater-than-2.0-kHz external/remote alarm/interlock circuit.

If a logic 1 SIGNAL PRESENCE and/or a TRANSIENT INHIBIT signal is applied to A1A8A19, the inhibit flip-flops preset to the zero state and remain in this state until the signal is removed. The greater-than-2.0-kHz logic 1 signal from A1A8A10 pin 7 provides a LAMP INHIBIT signal that inhibits all display circuits for errors over 2.0 kHz.

4.3.14 Power Supply

The power supply (figure 7-8) provides regulated and filtered 3.7 vdc, 20 vdc and 5.1 vdc for monitor transistor circuits, and unregulated 5.5 vdc for indicator and alarm display circuits.

The 20-vdc power supply is a full-wave rectifier consisting of diodes CR10 and CR11 and capacitor C7. The voltage output is regulated at 20 vdc by VR12. The 5.5-vdc power supply is a full-wave rectifier consisting of diodes CR8 and CR9 and capacitor C6. The 5.1-vdc power supply is a full-wave rectifier consisting of diodes CR4 and CR5 and capacitor C3, with the voltage regulated at 5.1 vdc by VR3. The 3.7-vdc power supply is a full-wave rectifier with a series regulator. The rectifier consists of diodes CR6 and CR7 and capacitors C4 and C5; the series regulator consists of transistors Q3 and Q4, which are controlled by transistors Q1 and Q2. If the series regulator fails, VR2 limits the voltage to 5.1 volts to protect the integrated circuits.

4.3.15 19-kHz Pilot Operation

Monitor operation in the 19-KHZ PILOT mode (figure 7-1) is similar to the MOD CARR mode. Only the differences in operation are explained in the following paragraphs. The visual display in this mode of operation is ±2 in 0.1-Hz increments.

The MODE switch 19-KHZ PILOT position supplies two constant logic 1 levels that control monitor gate functions. A logic 1 from MODE switch S1 pin 7 applied to the count-gate matrix enables the 10-second sample mode of operation. The second logic 1 level from MODE switch S1 pin 1, applied to A1A9A2 CR6 and R19, performs the following gate switching: disables the round-off circuit and the decade counter output gate A1A4A13, disables the transmitter frequency preset gate A1A6A14, enables the 19-kHz gate A1A4A7 after inversion to a logic 0 from A1A4A6 pin 7, and enables the 19-kHz preset gate A1A6A7. The logic 1 19-KHZ OPERATE signal applied to transistor A1A9A2 Q19 disables Q17, and applies a constant logic 1 TRANSIENT INHIBIT PULSE to the greater-than-2.0-kHz inhibit circuit. This prevents transmitter alarm/interlock operation if the pilot carrier frequency is out of tolerance. The logic 1 19-KHZ OPERATE signal applied to the rf circuit disables the signal presence circuit (refer to paragraph 4.3.3).

The 19-kHz pilot carrier is applied to a shaper circuit consisting of A1A6 Q11 and Q12 that amplifies the carrier, and applies the carrier to a clamping and limiting circuit, consisting of diode A1A6 CR4 and transistor A1A6 Q13.

The 19-kHz pulse train is applied to the 19-kHz gate A1A4A7, and is gated to the binary counter gate during the 10-second sample time. Logic circuits on the preset card preset the binary equivalent of 190,000 Hz into the binary counter by a logic 0 at P2 time.

4.3.16 782B-1 Self-Check Card

The self-check card (figure 7-9) checks the monitor counting circuits by presetting an error count in the binary counter and counting a 1-MHz reference signal. At P2 time, the self-check card presets the binary counter to 999,984; 999,992; 1,000,000; 1,000,008; or 1,000,016, depending on the error switch position. The 1-MHz reference, jumpered between logic 1 card A1A2 TP1 and logic 2 card A1A4 TP5, clocks the binary counter. When the monitor is operating properly, the resulting error readouts will be -1.6, -.8, -.0, +.8, or +1.6 KHZ, depending on the error switch position.

5.1 PREVENTVE MAINTENANCE

There is no preventive maintenance required for the monitor.

5.2 CORRECTIVE MAINTENANCE

Monitor corrective maintenance is limited to calibration and lamp replacement, unless a circuit card fails. Refer to paragraph 5.4 for monitor calibration data. Refer to paragraph 5.5 for indicator lamp replacement data. Refer to paragraph 5.6 for general trouble analysis procedures.

Caution

The monitor POWER switch must be set to OFF prior to removing or installing any circuit card or component.

5.3 SPARE PARTS

Spare parts may be ordered from the following address:

Collins Radio Company
Service Parts, 412-024
1225 North Alma Road
Richardson, Texas 75080

5.4 CALIBRATION

Adjust the 3-MHz oscillator standard as follows:

a. Tune a communication receiver to WWV test frequency of 5, 10, 15, or 20 MHz.
b. Connect a coaxial cable to the monitor 1-MHz output jack A2P2.
c. Position the coaxial cable close to the communication receiver antenna terminal.
d. Observe S-meter on receiver, or listen for the beat note caused by the difference in frequency between the harmonic of the 1-MHz monitor standard and the WWV carrier frequency. For example: If the 1-MHz monitor standard frequency is 0.2-Hz high and the 10-MHz WWV is tuned in, the beat note is 0.2 times 10 or 2 Hz. If the 20-MHz WWV carrier is tuned in, the beat note is 0.2 times 20 or 4 Hz.
e. Adjust the monitor 3-MHz oscillator until the 1-MHz standard beat note is less than 1/2 Hz. This adjusts the monitor to within 0.1-Hz error when using the 5-MHz WWV carrier reference. The 1-MHz standard frequency can be adjusted closer when using the higher WWV carrier frequencies.

5.5 INDICATOR LAMP REPLACEMENT

5.5.1 Alarm Indicator Lamp Replacement

Remove alarm indicator cover and replace lamp.

5.5.2 Readout Assembly Lamp Replacement

The lamps are mounted on two removable readout modules housed in the readout assembly. When the readout assembly (figure 5-1) in the control module is viewed from the back, the hundreds indicators are in the left-hand readout module, and the thousands, positive, and negative indicators are in the right-hand readout module. Each readout module is numbered with lamp and terminal designations. Determine which readout module to remove and which lamp to replace the table 5-1 before starting the replacement procedure. Replace indicator lamps as follows:

a. Remove two screws from readout module and carefully pull it straight back from readout assembly.
b. Replace lamp.
c. Replace readout module.

5.6 TROUBLE ANALYSIS

Circuit malfunctions can be isolated to a circuit card by using an oscilloscope and circuit card test points. Indicator lamp failures can be isolated by lamp substitution.

Use the functional diagram, figure 7-1, as an aid in localizing faults. Test points on the ends of the cards are accessible with the cards plugged into the monitor. The card extender provides access to components on individual cards.

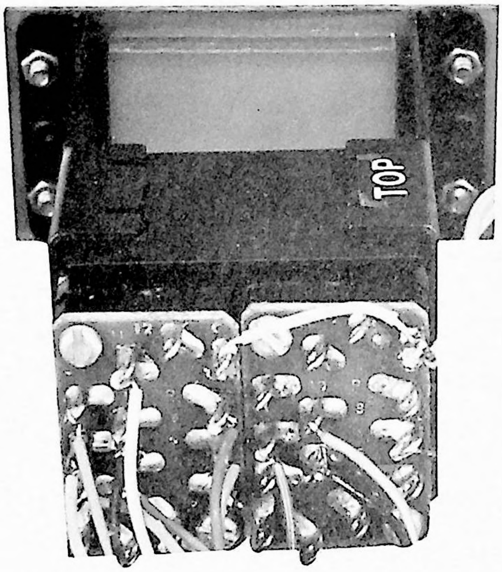


Figure 5-1. Readout Assembly Rear View.

Circuit card test-point indications are listed in table 5-2. The signals are either logic 1 or logic 0. The amplitude of a logic 1 is typically 1 vdc and the amplitude of a logic 0 is 0.3 vdc or less. These voltages are typical and will vary, but a logic 1 should never be below 0.85 vdc or a logic 0 be above 0.46 vdc. If the specified indication is not obtained at a test point, refer to the schematics in section 7 to isolate the malfunction. Some indications in table 5-2 will be a different frequency for each monitor; however, the relationship given in the table will remain constant. To obtain total time between P time pulses, add 1-second or 10-second sample time as indicated by the MODE switch position (UNMOD CARR position is 1-second sample, MOD CARR position is 10-second sample, and 19 KHZ PILOT position is 10-second sample). The amplitudes of waveforms in table 5-2 and figure 5-2 are logic 1 or logic 0.

The following paragraphs present possible malfunction indications and general procedures to follow for malfunction isolation. If required, detailed troubleshooting is performed by using an oscilloscope, extender card, and by referring to the detailed schematics in section 7.

Caution

When making repairs on the circuit cards, do not use a soldering iron rated at more than 40 watts. Do not jar or strike a card to remove excess solder.

5.6.1 Error Display and Warning Indicators Not Lighted

a. Check rf cable input at rear of monitor for rf input (refer to paragraph 2.2.5 for parameters).
b. Check 19-kHz pilot carrier input at rear of monitor.
c. Check 1/2 amp fuse at rear of monitor.
d. Check 5 amp fuse in power supply module.
e. Check SHAPED RF and SIGNAL PRESENCE signals logic 2 card A1A4 (table 5-2).
f. Check power supply voltages (figure 7-8).

5.6.2 Greater-Than-2.0-kHz Alarm Lighted and Greater-Than-1.0-kHz Alarm Not Lighted

a. Check greater-than-1.0-kHz indicator lamp.
b. Check greater-than-1.0-kHz contact closure at terminals on rear of monitor terminal block pins 11 and 12.
c. Check greater-than-1.0-kHz STORED signal on logic 4 card A1A8 (table 5-2).

5.6.3 Greater-Than-2.0-kHz Alarm Lighted With Some Error Display

Check lamp inhibit circuit on logic 4 card A1A8 (figure 7-6).

5.6.4 Greater-Than-1.0-kHz Alarm Lighted With Error Display of 1.0 kHz or Less

a. Check logic levels in decoding circuit on logic 4 card A1A8 (figure 7-6).
b. Check lamp in thousands digit readout.

5.6.5 Error Display With No Polarity Indication

a. Check polarity signal on logic 4 card A1A8 (figure 7-6).
b. Check polarity lamps in readout assembly.

Table 5-1. Lamp-Number-to-Character-Display Conversion Chart.

HUNDREDS INDICATORS		THOUSANDS, POSITIVE, AND NEGATIVE INDICATORS	
LEFT READOUT MODULE		RIGHT READOUT MODULE	
LAMP NO. TERMINAL	CHARACTER DISPLAY	LAMP NO. TERMINAL	CHARACTER DISPLAY
2	.1	5	+
3	.2	6	-
4	.3	7	1
5	.4	8	2
6	.5		
7	.6		
8	.7		
9	.8		
10	.9		
11	.0		

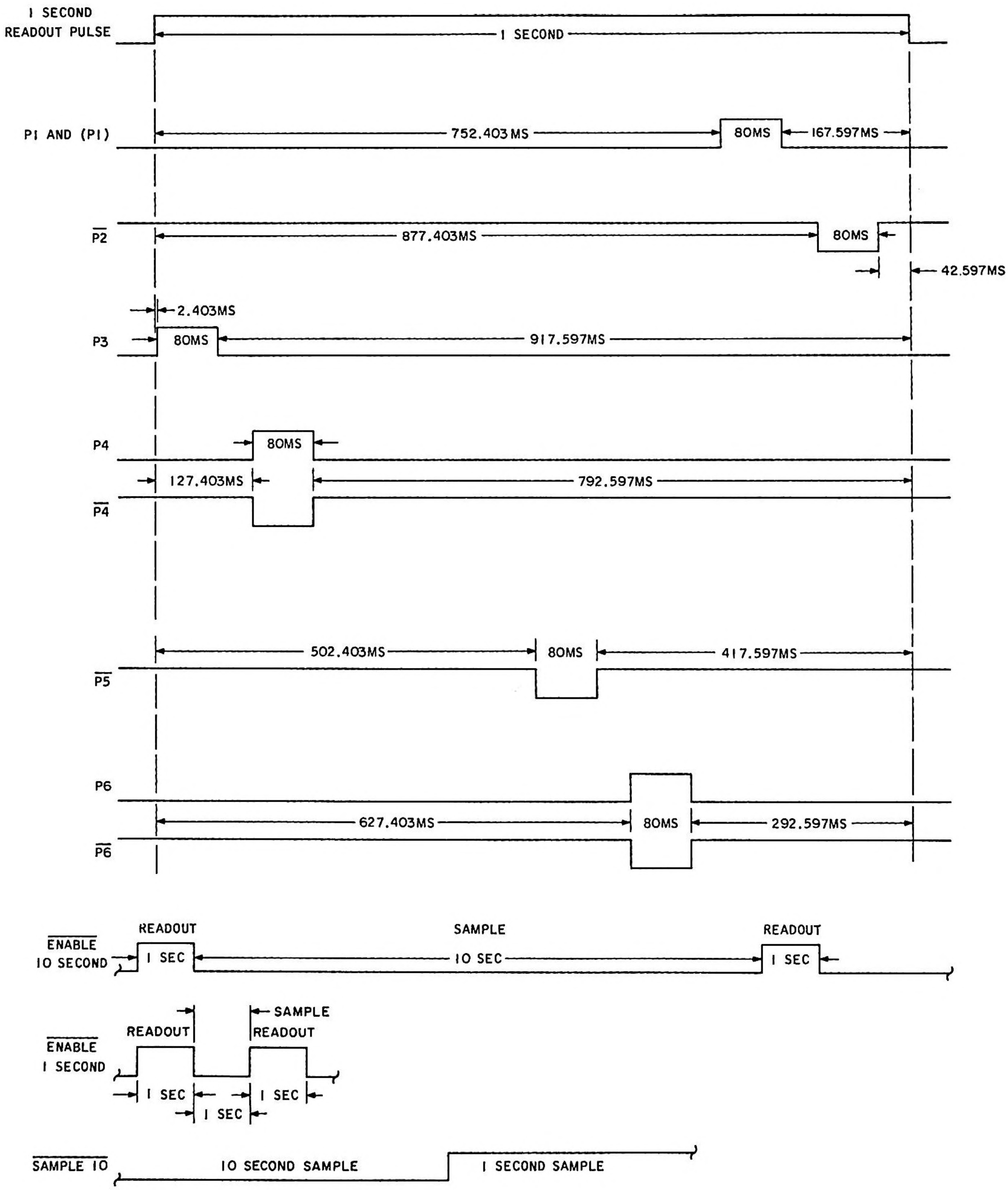


Figure 5-2. Control and Timing Pulse Waveforms.

Table 5-2. Test Point Indications.

CIRCUIT CARD	TEST POINT	INDICATION
RF card A1A1	TP1	$\overline{\text{SP}}$ ($\overline{\text{SIGNAL PRESENCE}}$), logic 0 with rf carrier present or 19-kHz operating mode.
	TP2	Shaped and divided by 100 rf output
	TP3	SHAPED RF signal divided by 20.
	TP4	SHAPED RF signal divided by 4
	TP5	Ground
Logic 1 A1A2	TP1	1-MHz square wave
	TP2	8-Hz square wave
	TP3	$\overline{\text{P6}}$ timing pulse (figure 5-2)
	TP4	$\overline{\text{ENABLE}}$ (figure 5-2)
	TP5	1-Hz square wave
	TP6	Ground
Logic 2 A1A4	TP1	P3 timing pulse (figure 5-2)
	TP2	881,000 to 1,079,000 pulses in 1 second or 10 seconds, dependent on MODE selector switch position, or 190,000 pulses in 10 seconds in 19 KHZ PILOT position
	TP3	$\overline{\text{P5}}$ timing pulse (figure 5-2)
	TP4	$\overline{\text{SAMPLE 10}}$ (figure 5-2)
	TP5	SHAPED RF, divided by 100, 881 kHz to 1079 kHz, depending upon transmitter frequency
	TP6	Ground
Logic 3 A1A5	TP1	881,000 to 1,079,000 pulses (1- or 10-second time span) divided by 8, or 190,000 pulses in 10 seconds divided by 8
	TP2	P1 timing pulse (figure 5-2)
	TP3	Logic 1 when POSITIVE POLARITY is stored
	TP4	Logic 1 when NEGATIVE POLARITY is stored
	TP5	(P1) timing pulse (figure 5-2) occurs at the same time as P1
	TP6	Ground
Logic 4 A1A8	TP1	>+10 STORED, logic 1 when error is greater than 1.0 kHz (or 1.0 Hz for 19 KHZ PILOT)
	TP2	$\overline{\text{>±20 STORED}}$, logic 0 when error is greater than 2.0 kHz (or 2.0 Hz for 19 KHZ PILOT)
	TP3	P6 timing pulse (figure 5-2)
	TP4	$\overline{\text{SIGNAL PRESENCE}}$, logic 0 when rf signal is present, or MODE switch is in 19 KHZ PILOT position
	TP5	Not used
	TP6	Ground

section 6
parts list

6.1 GENERAL

This section contains a list of all replaceable electrical, electronic, and critical mechanical parts for the 54N-1 FM Frequency Monitor (758-5742-XXX).

The manufacturers' codes appearing in the MFR CODE column of the parts list are listed in numerical order at the end of the parts list. The code list provides the manufacturer's name and address as shown in the Federal Supply Code for Manufacturers' Handbook H4-1. Manufacturers not listed in Handbook H4-1 are assigned a 5-letter code and appear first in the code list.

6.2 LIST OF EQUIPMENT

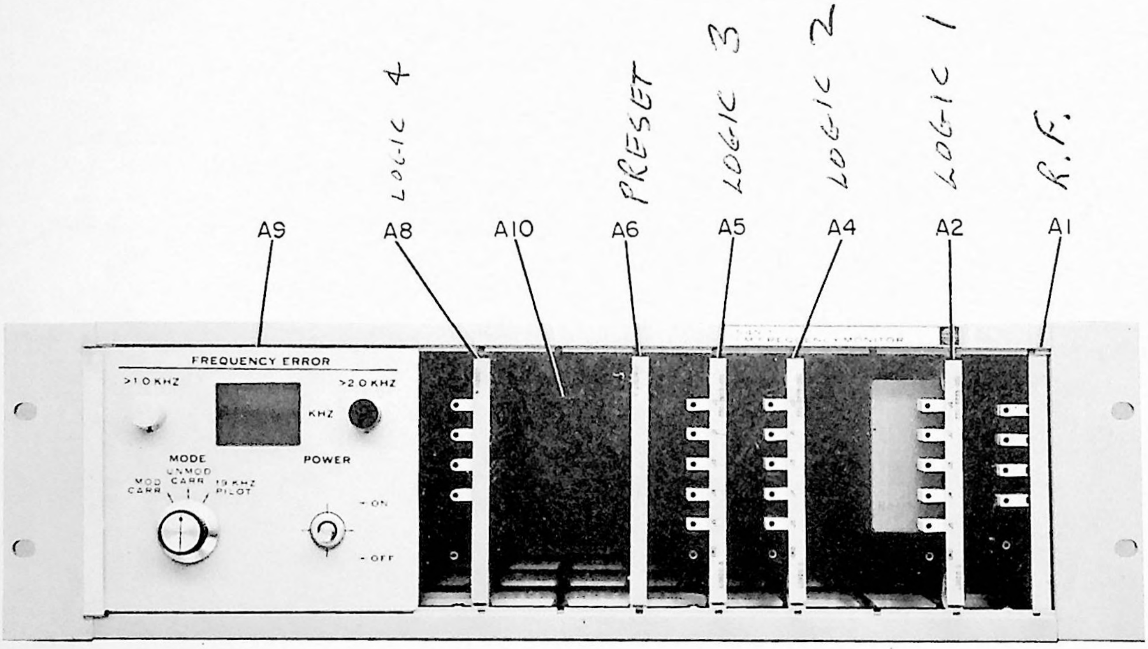


Figure 6-1. 54N-1 FM Frequency Monitor.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	FM FREQUENCY MONITOR 54N-1			758-5742-001
	FM FREQUENCY MONITOR 54N-1			758-5742-002
	FM FREQUENCY MONITOR 54N-1			758-5742-003
	FM FREQUENCY MONITOR 54N-1			758-5742-004
	FM FREQUENCY MONITOR 54N-1			758-5742-005
A1	FMRF CARD SEE BREAKDOWN ON PAGE 6-4			781-1305-001
A2	LOGIC 1 CARD SEE BREAKDOWN ON PAGE 6-8			781-5225-001
A3	NOT USED			
A4	LOGIC 2 CARD SEE BREAKDOWN ON PAGE 6-11			770-7779-001
A5	LOGIC 3 CARD SEE BREAKDOWN ON PAGE 6-14			770-7823-001
A6	PRESET 1 CARD -USED ON 758-5742-C02 ONLY- SEE BREAKDOWN ON PAGE 6-16			770-7893-001
	PRESET 2 CARD -USED ON 758-5742-C03 ONLY- SEE BREAKDOWN ON PAGE 6-18			770-7899-001
	PRESET 3 CARD -USED ON 758-5742-C04 ONLY- SEE BREAKDOWN ON PAGE 6-21			774-6745-001
	PRESET 4 CARD -USED ON 758-5742-C05 ONLY- SEE BREAKDOWN ON PAGE 6-24			781-1468-001
A7	NOT USED			
A8	LOGIC 4 CARD SEE BREAKDOWN ON PAGE 6-25			770-7858-001
A9	FM CONTROL MODULE SEE BREAKDOWN ON PAGE 6-27			776-1919-001
A10	BACKPLANE BOARD WITH CONNECTOR ASSEMBLY SEE BREAKDOWN ON PAGE 6-35			776-1847-001

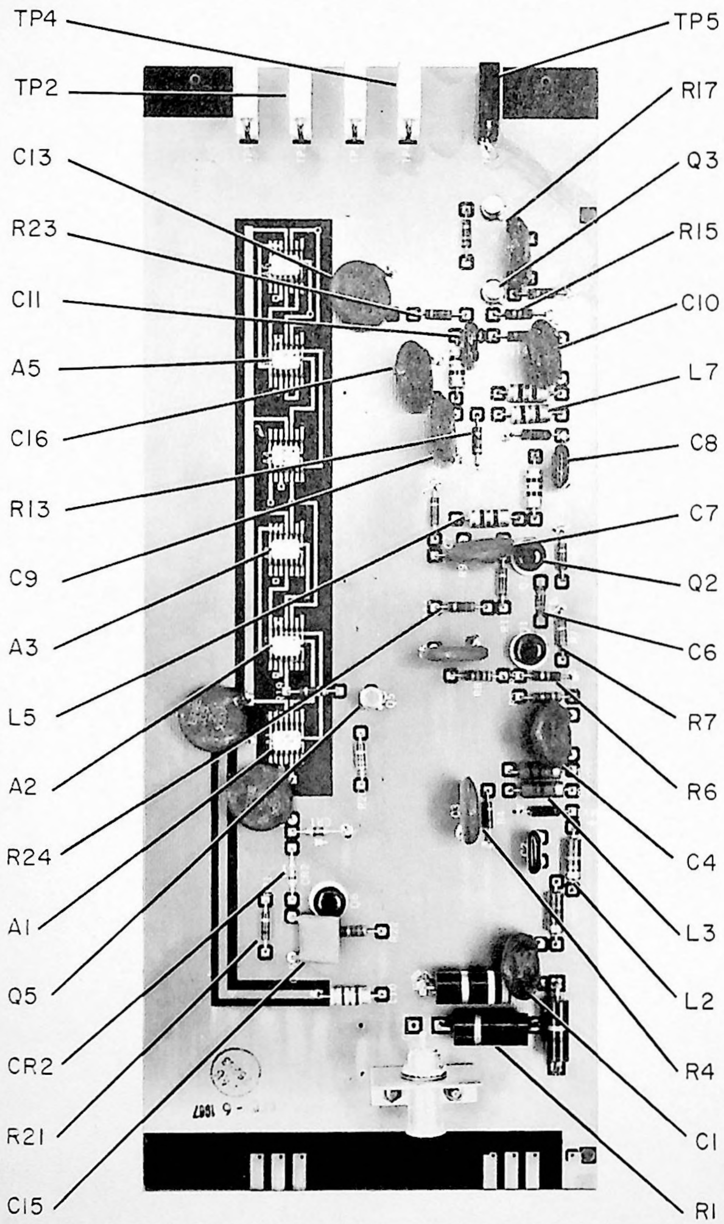


Figure 6-2. FMRF Card A1 (Sheet 1 of 2).

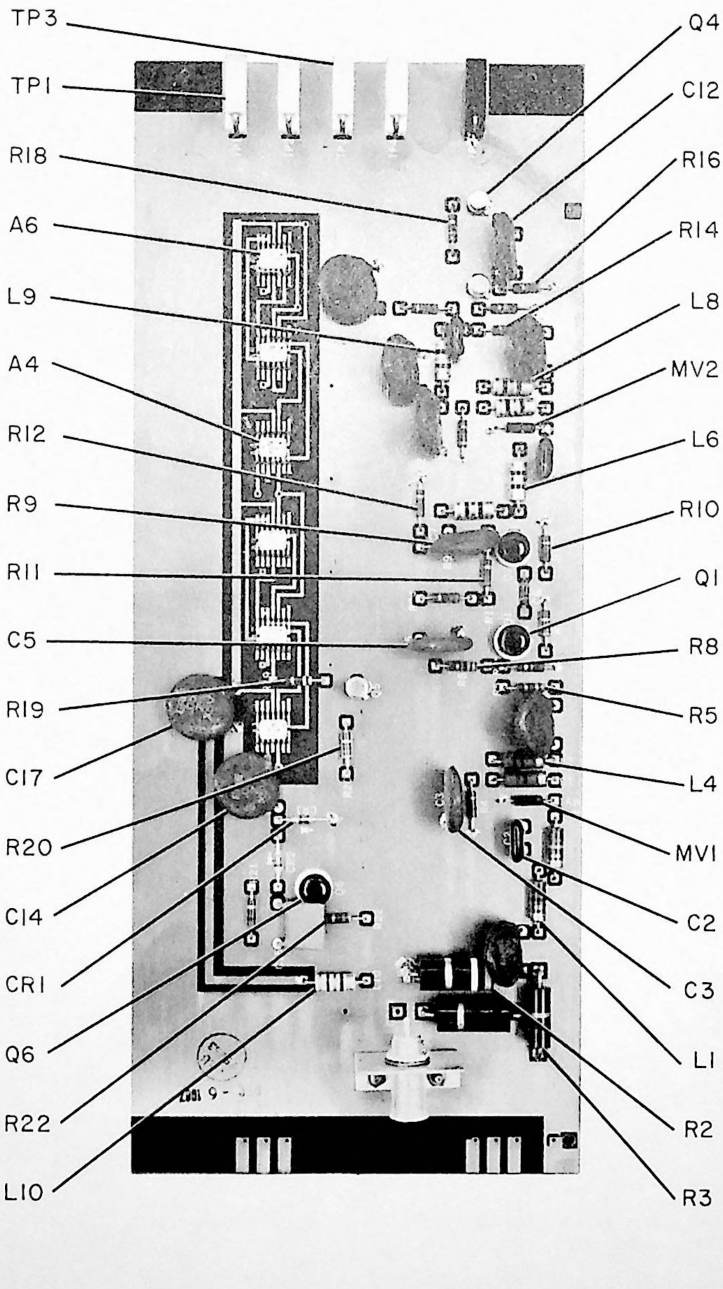


Figure 6-2. FMRF Card A1 (Sheet 2 of 2).

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
R8	RESISTOR, FXD, COMPOSITION 33K OHMS, 10% TOL, 1/4 WATT	RC07GF333K	81349	745-0803-000
R9	RESISTOR, FXD, COMPOSITION 560 OHMS, 10% TOL, 1/4 WATT	RC07GF561K	81349	745-0740-000
R10	RESISTOR, FXD, COMPOSITION 150 OHMS, 10% TOL, 1/4 WATT	RC07GF151K	81349	745-0719-000
R11	RESISTOR, FXD, COMPOSITION 6.8K OHMS, 10% TOL, 1/4 WATT	RC07GF682K	81349	745-0779-000
R12	RESISTOR, FXD, COMPOSITION 1K OHMS, 10% TOL, 1/4 WATT	RC07GF102K	81349	745-0749-000
R13	RESISTOR, FXD, COMPOSITION 47 OHMS, 10% TOL, 1/4 WATT	RC07GF470K	81349	745-0701-000
R14	RESISTOR, FXD, COMPOSITION 270 OHMS, 10% TOL, 1/4 WATT	RC07GF271K	81349	745-0728-000
R15	RESISTOR, FXD, COMPOSITION 22K OHMS, 10% TOL, 1/4 WATT	RC07GF223K	81349	745-0797-000
R16	SAME AS R7			
R17	RESISTOR, FXD, COMPOSITION 2.2K OHMS, 10% TOL, 1/4 WATT	RC07GF222K	81349	745-0761-000
R18	SAME AS R5			
R19	RESISTOR, FXD, COMPOSITION 3.9K OHMS, 10% TOL, 1/4 WATT	RC07GF392K	81349	745-0770-000
R20	SAME AS R7			
R21	SAME AS R12			
R22	SAME AS R7			
R23	SAME AS R11			
R24	SAME AS R11			
TP1	JACK, TIP WHITE	4877-125-9	17117	360-0434-100
TP2	SAME AS TP1			
TP3	SAME AS TP1			
TP4	SAME AS TP1			
TP5	JACK, TIP BLACK	4877-125-0	17117	360-0434-010

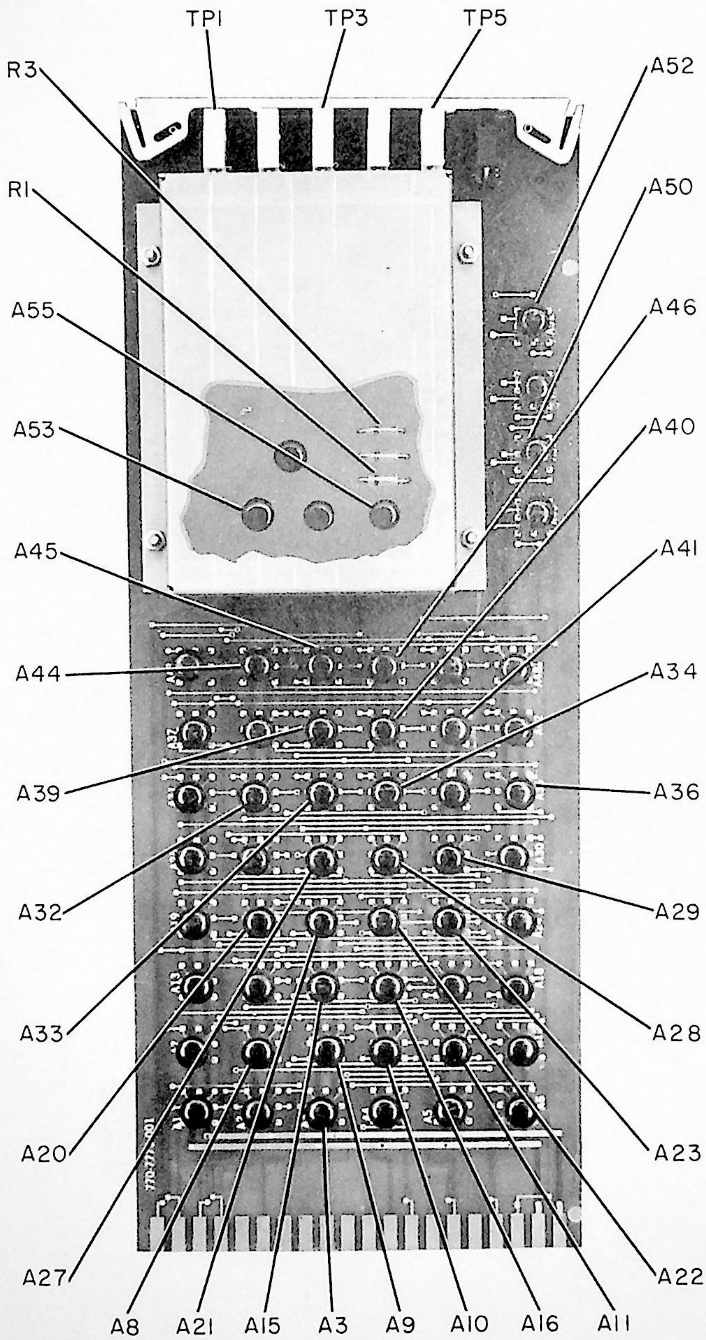


Figure 6-3. Logic 1 Card A2 (Sheet 1 of 2).

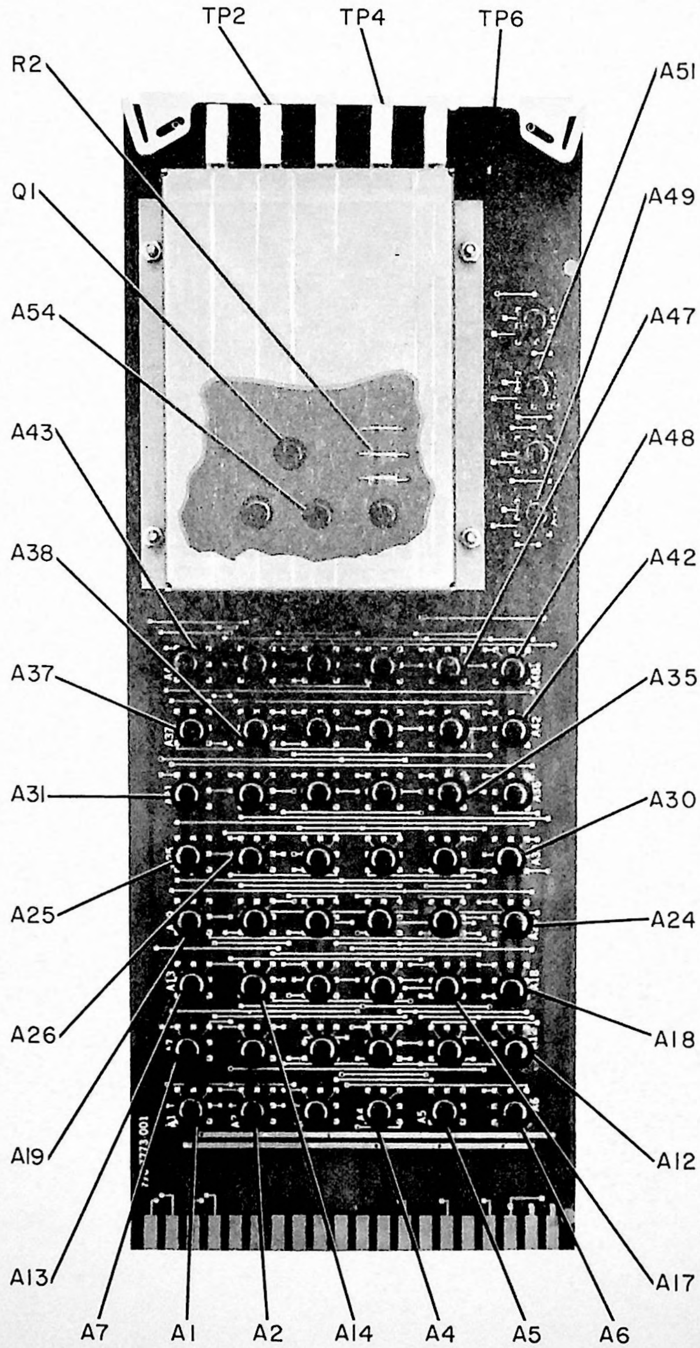


Figure 6-3. Logic 1 Card A2 (Sheet 2 of 2).

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	LOGIC 1 CARD A2			781-5225-001
A1	INTEGRATED CIRCUIT	SL3977	07263	351-7121-010
A2	SAME AS A1			
A3	SAME AS A1			
A4	INTEGRATED CIRCUIT	SL3978	07263	351-7121-020
A5	INTEGRATED CIRCUIT	SL3979	07263	351-7121-030
A6	SAME AS A5			
A7	SAME AS A5			
A8	SAME AS A5			
A9 THROUGH A12	SAME AS A4			
A13	SAME AS A5			
A14	SAME AS A4			
A15 THROUGH A18	SAME AS A1			
A19 THROUGH A23	SAME AS A4			
A24	SAME AS A1			
A25	SAME AS A1			
A26	SAME AS A1			
A27 THROUGH A30	SAME AS A4			
A31 THROUGH A36	SAME AS A1			
A37	SAME AS A4			
A38	SAME AS A4			
A39 THROUGH A43	SAME AS A1			
A44	SAME AS A4			
A45 THROUGH A49	SAME AS A1			
A50	SAME AS A4			
A51	SAME AS A1			
A52	SAME AS A1			
A53	SAME AS A5			
A54	SAME AS A1			
A55	SAME AS A1			
Q1	TRANSISTOR	2N3567	07688	352-0629-010
R1	RESISTOR, FXD, COMPOSITION 680 OHMS, 10% TOL, 1/4 WATT	RC07GF681K	81349	745-0743-000
R2	RESISTOR, FXD, COMPOSITION 10K OHMS, 10% TOL, 1/4 WATT	RC07GF103K	81349	745-0785-000
R3	RESISTOR, FXD, COMPOSITION 2200 OHMS, 10% TOL, 1/4 WATT	RC07GF222K	81349	745-0761-000
TP1	JACK, TIP WHITE	4877-125-9	17117	360-0434-100
TP2 THROUGH TP5	SAME AS TP1			
TP6	JACK, TIP BLACK	4877-125-0	17117	360-0434-010

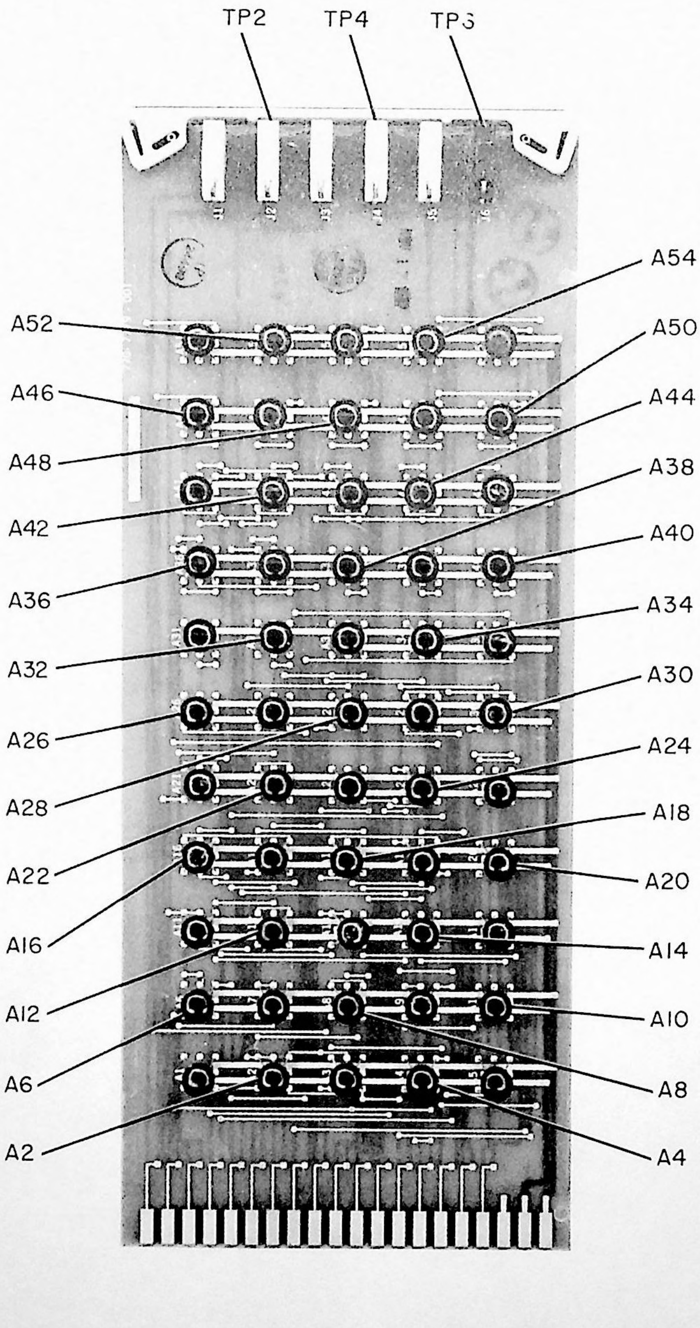


Figure 6-4. Logic 2 Card A4 (Sheet 1 of 2).

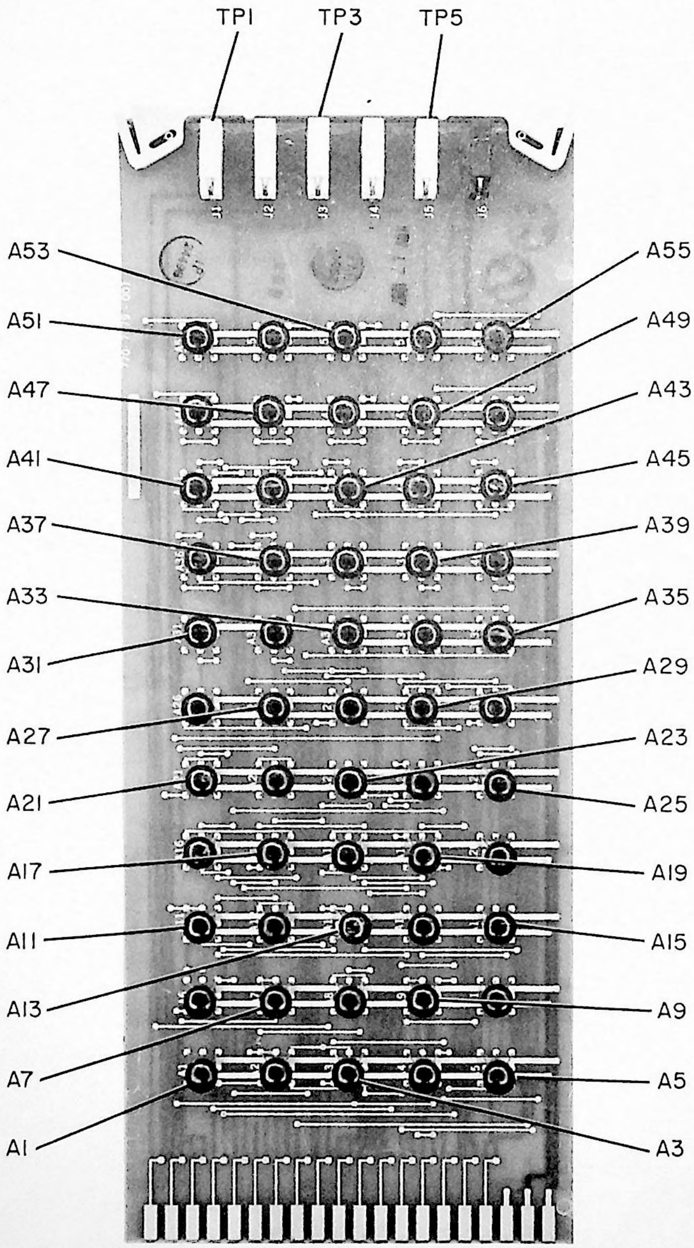


Figure 6-4. Logic 2 Card A4 (Sheet 2 of 2).

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	LOGIC 2 CARD A4			770-7779-001
A1	INTEGRATED CIRCUIT	SL3979	07263	351-7121-030
A2	INTEGRATED CIRCUIT	SL3978	07263	351-7121-020
A3	SAME AS A2			
A4	SAME AS A1			
A5	INTEGRATED CIRCUIT	SL3977	07263	351-7121-010
A6 THROUGH A9	SAME AS A2			
A10	SAME AS A5			
A11 THROUGH A14	SAME AS A2			
A15	SAME AS A5			
A16 THROUGH A19	SAME AS A2			
A20	SAME AS A5			
A21	SAME AS A2			
A22	SAME AS A2			
A23	SAME AS A1			
A24	SAME AS A2			
A25	SAME AS A5			
A26 THROUGH A30	SAME AS A2			
A31	SAME AS A1			
A32	SAME AS A1			
A33	SAME AS A2			
A34	SAME AS A2			
A35	SAME AS A2			
A36	SAME AS A5			
A37	SAME AS A5			
A38	SAME AS A1			
A39	SAME AS A1			
A40	SAME AS A1			
A41	SAME AS A2			
A42	SAME AS A2			
A43	SAME AS A5			
A44	SAME AS A5			
A45	SAME AS A5			
A46 THROUGH A55	SAME AS A1			
TP1	JACK, TIP WHITE	4877-125-9	17117	360-0434-100
TP2 THROUGH TP5	SAME AS TP1			
TP6	JACK, TIP BLACK	4877-125-0	17117	360-0434-010

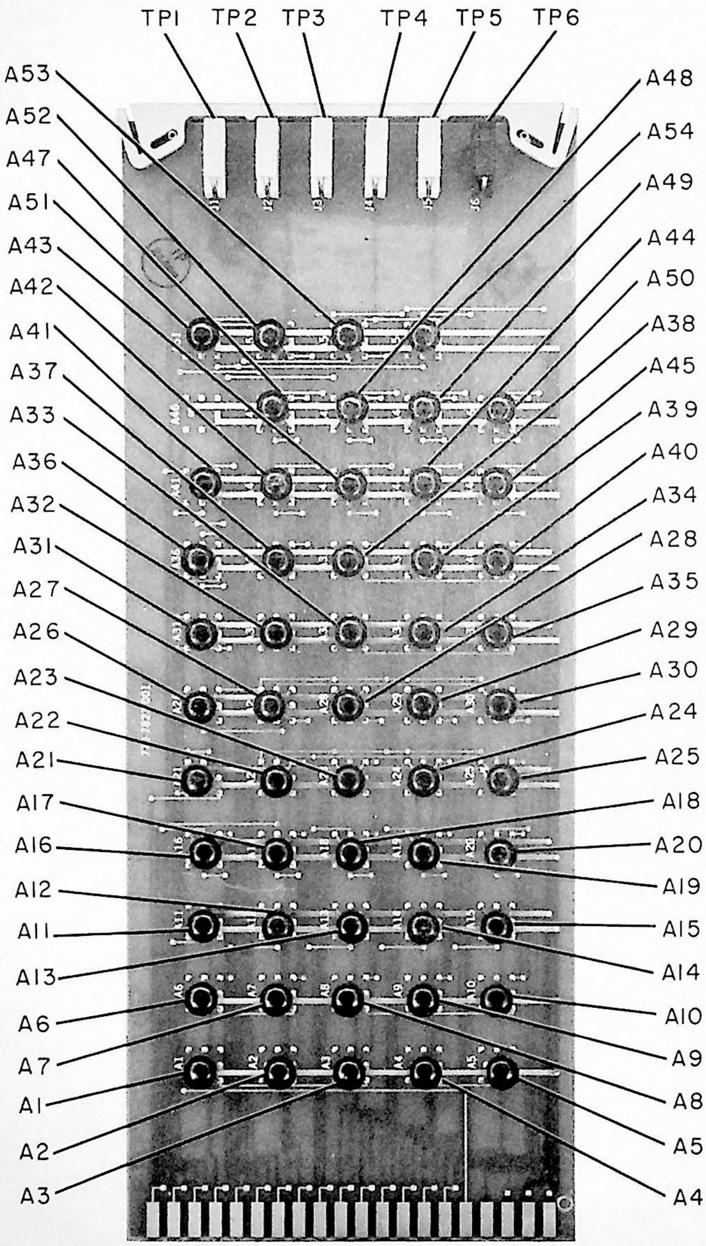


Figure 6-5. Logic 3 Card A5.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	LOGIC 3 CARD A5			770-7823-001
A1	INTEGRATED CIRCUIT	SL3979	07263	351-7121-030
A2 THROUGH A10	SAME AS A1			
A11	INTEGRATED CIRCUIT	SL3977	07263	351-7121-010
A12 THROUGH A20	SAME AS A11			
A21	INTEGRATED CIRCUIT	SL3978	07263	351-7121-020
A22 THROUGH A31	SAME AS A21			
A32 THROUGH A35	SAME AS A1			
A36	SAME AS A21			
A37 THROUGH A40	SAME AS A1			
A41	SAME AS A21			
A42 THROUGH A45	SAME AS A11			
A46	NOT USED			
A47 THROUGH A50	SAME AS A11			
A51	SAME AS A21			
A52	SAME AS A11			
A53	SAME AS A11			
A54	SAME AS A21			
TP1	JACK, TIP WHITE	4877-125-9	17117	360-0434-100
TP2 THROUGH TP5	SAME AS TP1			
TP6	JACK, TIP BLACK	4877-125-0	17117	360-0434-010

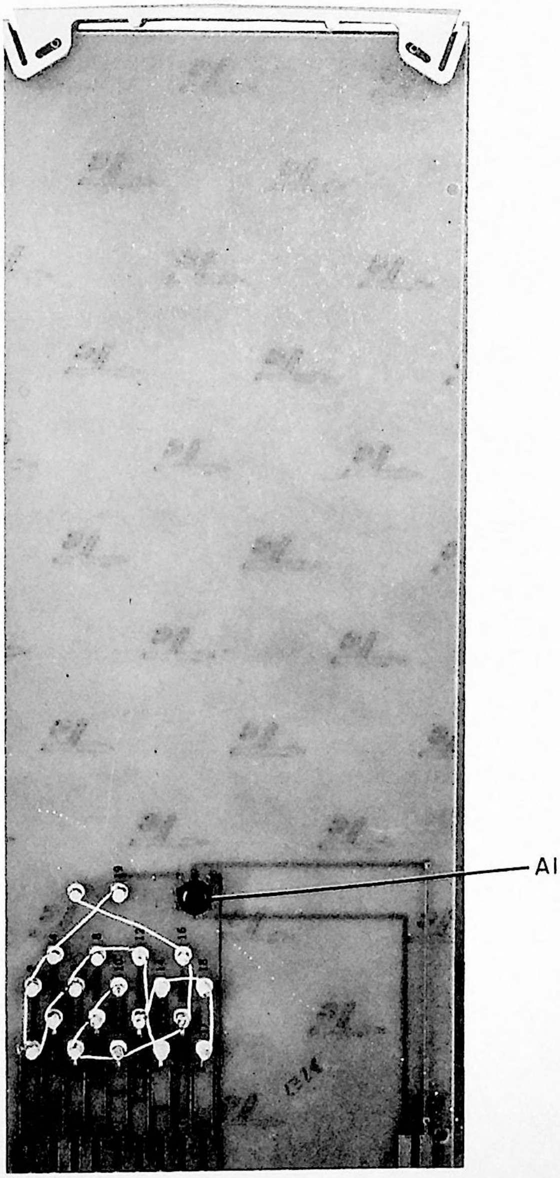


Figure 6-6. Preset 1 Card A6-1.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	PRESET 1 CARD A6			770-7893-001
A1	INTEGRATED CIRCUIT	SL3979	07263	351-7121-010

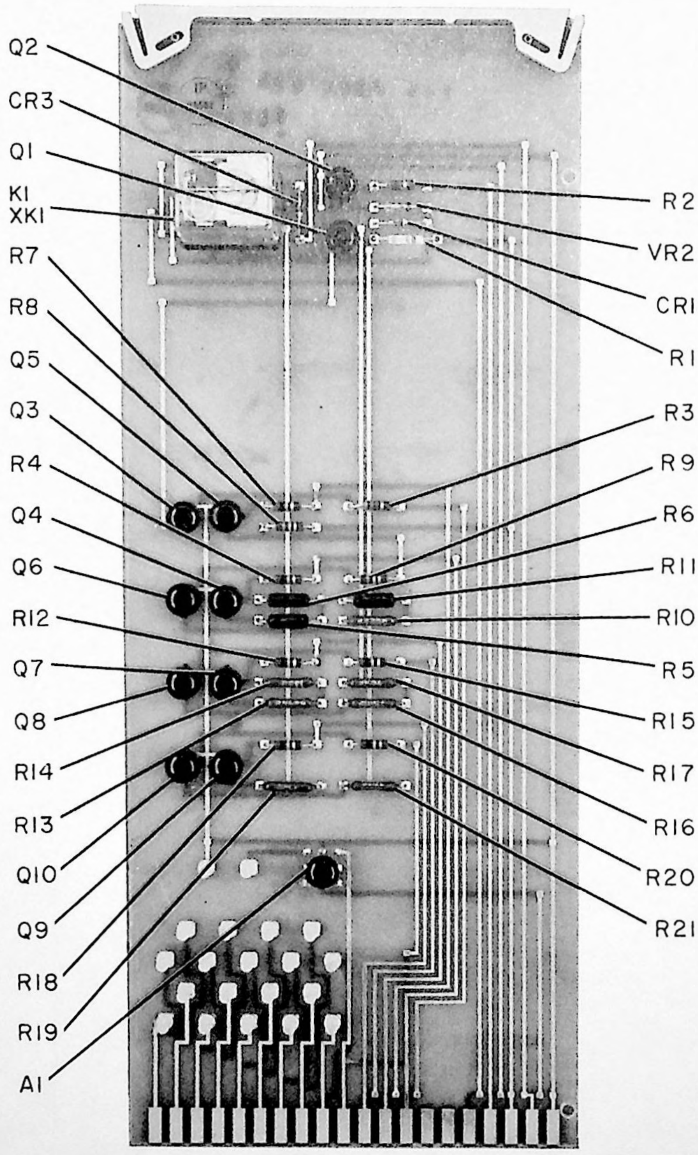


Figure 6-7. Preset 2 Card A6.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	PRESET 2 CARD A6			770-7899-001
A1	INTEGRATED CIRCUIT	SL3979	07263	351-7121-030
CR1	SEMICONDUCTOR DEVICE, DIODE	1N914	07688	353-2906-000
CR2	NOT USED			
CR3	SAME AS CR1			
K1	RELAY, ARMATURE 2C CONTACT ARRANGEMENT	T154-2C6VDC, 52 OHMS	70309	970-2227-000
Q1	TRANSISTOR	2N3567	07688	352-0629-010
Q2 THROUGH Q10	SAME AS Q1			
R1	RESISTOR, FXD, COMPOSITION 1200 OHMS, 10% TOL, 1/4 WATT	RC07GF122K	81349	745-0752-000
R2	RESISTOR, FXD, COMPOSITION 100 OHMS, 10% TOL, 1/4 WATT	RC07GF101K	81349	745-0713-000
R3	RESISTOR, FXD, COMPOSITION 330 OHMS, 10% TOL, 1/4 WATT	RC07GF331K	81349	745-0731-000
R4	RESISTOR, FXD, COMPOSITION 10K OHMS, 10% TOL, 1/4 WATT	RC07GF103K	81349	745-0785-000
R5	RESISTOR, FXD, FILM 110K OHMS, 1% TOL, 1/4 WATT	RN60D1103F	81349	705-6694-000
R6	RESISTOR, FXD, FILM 10K OHMS, 1% TOL, 1/4 WATT	RN60D1002F	81349	705-6644-000
R7	SAME AS R4			
R8	RESISTOR, FXD, COMPOSITION 56K OHMS, 10% TOL, 1/4 WATT	RC07GF563K	81349	745-0812-000
R9	SAME AS R8			
R10	RESISTOR, FXD, FILM 56.2K OHMS, 1% TOL, 1/4 WATT	RN60D5622F	81349	705-6680-000
R11	RESISTOR, FXD, FILM 3830 OHMS, 1% TOL, 1/4 WATT	RN60D3831F	81349	705-6624-000
R12	SAME AS R4			
R13	RESISTOR, FXD, FILM 28.7K OHMS, 1% TOL, 1/4 WATT	RN60D2872F	81349	705-6666-000
R14	RESISTOR, FXD, FILM, 1330 OHMS, 1% TOL, 1/4 WATT	RN60D1331F	81349	705-6602-000
R15	SAME AS R4			
R16	RESISTOR, FXD, FILM 7500 OHMS, 1% TOL, 1/4 WATT	RN60D7501F	81349	705-6638-000
R17	SAME AS R16			
R18	SAME AS R4			
R19	SAME AS R16			
R20	SAME AS R4			
R21	RESISTOR, FXD, FILM 14.7K OHMS, 1% TOL, 1/4 WATT	RN60D1472F	81349	705-6652-000
VR1	NOT USED			
VR2	SEMICONDUCTOR DEVICE, DIODE	1N748	07688	353-2703-000
XK1	SOCKET, RELAY 10 CONTACTS	30055-1	02288	220-1475-000

ILLUSTRATION NOT AVAILABLE·
TO BE SUPPLIED AT LATER DATE

Figure 6-8. Preset 3 Card A6.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	PRESET 3 CARD A6			774-6745-001
A1	INTEGRATED CIRCUIT	SL3978	07263	351-7121-020
A2 THROUGH A5	SAME AS A1			
A6	INTEGRATED CIRCUIT	SL3979	07263	351-7121-020
A7 THROUGH A12	SAME AS A1			
A13	SAME AS A6			
A14	SAME AS A1			
C1	CAPACITOR, FXD, CERAMIC 1 UF, PLUS 80% MINUS 20%, 25 VDCW	5C13A	56289	913-3810-000
C2	SAME AS C1			
C3	SAME AS C1			
C4	CAPACITOR, FXD, MICA 270 UUF, 5% TOL, 500 VDCW	CM05F271J03	81349	912-2846-000
CR1	SEMICONDUCTOR DEVICE, DIODE	1N914	07688	353-2906-000
CR2	NOT USED			
CR3	SAME AS CR1			
CR4	SAME AS CR1			
K1	RELAY, ARMATURE 2C CONTACT ARRANGEMENT	TP154CC6	70309	970-2451-230
Q1	TRANSISTOR	2N3567	07688	352-0629-010
Q2 THROUGH Q10	SAME AS Q1			
Q11	TRANSISTOR	2N4250	07263	352-0773-030
Q12	TRANSISTOR	2N3565	07688	352-0638-010
Q13	SAME AS Q12			
R1	RESISTOR, FXD, COMPOSITION 1200 OHMS, 10% TOL, 1/4 WATT	RC07GF122K	81349	745-0752-000
R2	RESISTOR, FXD, COMPOSITION 110 OHMS, 10% TOL, 1/4 WATT	RC07GF101K	81349	745-0713-000
R3	RESISTOR, FXD, COMPOSITION 330 OHMS, 10% TOL, 1/4 WATT	RC07GF331K	81349	745-0731-000
R4	RESISTOR, FXD, COMPOSITION 10K OHMS, 10% TOL, 1/4 WATT	RC07GF103K	81349	745-0785-000
R5	RESISTOR, FXD, FILM 110K OHMS, 1% TOL, 1/4 WATT	RN60D1103F	81349	705-6694-000
R6	RESISTOR, FXD, FILM 10K OHMS, 1% TOL, 1/4 WATT	RN60D1002F	81349	705-6644-000
R7	SAME AS R4			
R8	RESISTOR, FXD, COMPOSITION 56K OHMS, 10% TOL, 1/4 WATT	RC07GF563K	81349	745-0812-000
R9	SAME AS R8			
R10	RESISTOR, FXD, FILM 56.2K OHMS, 1% TOL, 1/4 WATT	RN60D5622F	81349	705-6680-000
R11	RESISTOR, FXD, FILM 3830 OHMS, 1% TOL, 1/4 WATT	RN60D3831F	81349	705-6624-000
R12	SAME AS R4			
R13	RESISTOR, FXD, FILM 28.7K OHMS, 1% TOL, 1/4 WATT	RN60D2872F	81349	705-6666-000
R14	RESISTOR, FXD, FILM 1330 OHMS, 1% TOL, 1/4 WATT	RN60D1331F	81349	705-6602-000
R15	SAME AS R4			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
R16	RESISTOR, FXD, FILM 7500 OHMS, 1% TOL, 1/4 WATT	RN60D7501F	81349	705-6638-000
R17	SAME AS R16			
R18	SAME AS R4			
R19	SAME AS R16			
R20	SAME AS R4			
R21	RESISTOR, FXD, FILM 14.7K OHMS, 1% TOL, 1/4 WATT	RN60D1472F	81349	705-6652-000
R22	RESISTOR, FXD, COMPOSITION 100K OHMS, 10% TOL, 1/4 WATT	RC07GF104K	81349	745-0821-000
R23	RESISTOR, FXD, COMPOSITION 1K OHMS, 10% TOL, 1/4 WATT	RC07GF102K	81349	745-0749-000
R24	RESISTOR, FXD, COMPOSITION 47K OHMS, 10% TOL, 1/4 WATT	RC07GF473K	81349	745-0809-000
R25	RESISTOR, FXD, COMPOSITION 1500 OHMS, 10% TOL, 1/4 WATT	RC07GF152K	81349	745-0755-000
R26	SAME AS R3			
R27	RESISTOR, FXD, COMPOSITION 330K OHMS, 10% TOL, 1/4 WATT	RC07GF334K	81349	745-0839-000
VR1	NOT USED			
VR2	SEMICONDUCTOR DEVICE, DIODE	1N748	07688	353-2703-000
XK1	SOCKET, RELAY 10 CONTACTS	3055-1	02288	220-1475-000

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Figure 6-9. Preset 4 Card A6.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	PRESET 4 CARD A6			781-1468-001
A1	INTEGRATED CIRCUIT	SL3978	07263	351-7121-020
A2 THROUGH A5	SAME AS A1			
A6	INTEGRATED CIRCUIT	SL3979	07263	351-7121-030
A7 THROUGH A12	SAME AS A1			
A13	SAME AS A6			
A14	SAME AS A1			
C1	CAPACITOR, FXD, CERAMIC 1 UF, PLUS 80% MINUS 20%, 25 VDCW	5C13A	56289	913-3810-000
C2	SAME AS C1			
C3	SAME AS C1			
C4	CAPACITOR, FXD, MICA 270 UUF, 5% TOL, 5CO VDCW	CM05F271J03	81349	912-2846-000
CR1	NOT USED			
CR2	NOT USED			
CR3	NOT USED			
CR4	SEMICONDUCTOR DEVICE, DIODE	1N914	07688	353-2906-000
Q1 THROUGH Q10	NOT USED			
Q11	TRANSISTOR	2N4250	07263	352-0773-030
Q12	TRANSISTOR	2N3565	07688	352-0638-010
Q13	TRANSISTOR	2N3567	07688	352-0629-010
R1 THROUGH R21	NOT USED			
R22	RESISTOR, FXD, COMPOSITION 100K OHMS, 10% TOL, 1/4 WATT	RC07GF104K	81349	745-0821-000
R23	RESISTOR, FXD, COMPOSITION 1K OHMS, 10% TOL, 1/4 WATT	RC07GF102K	81349	747-0749-000
R24	RESISTOR, FXD, COMPOSITION 47K OHMS, 40% TOL, 1/4 WATT	RC07GF473K	81349	745-0809-000
R25	RESISTOR, FXD, COMPOSITION 1500 OHMS, 10% TOL, 1/4 WATT	RC07GF152K	81349	745-0755-000
R26	RESISTOR, FXD, COMPOSITION 680 OHMS, 10% TOL, 1/4 WATT	RC07GF681K	81349	745-0743-000
R27	RESISTOR, FXD, COMPOSITION 330K OHMS, 10% TOL, 1/4 WATT	RC07GF334K	81349	745-0839-000

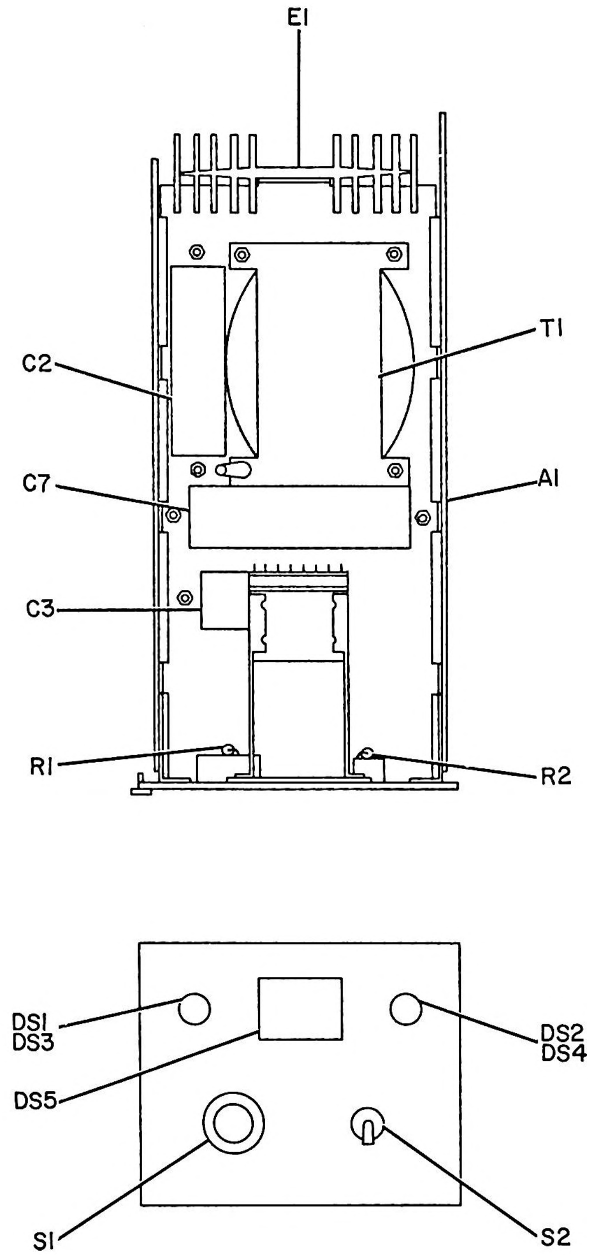


Figure 6-10. Logic 4 Card A8.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	LOGIC 4 CARD A8			770-7858-001
A1	INTEGRATED CIRCUIT	SL3978	07263	351-7121-020
A2 THROUGH A8	SAME AS A1			
A9	INTEGRATED CIRCUIT	SL3977	07263	351-7121-010
A10	SAME AS A9			
A11 THROUGH A28	SAME AS A1			
A29	SAME AS A9			
A30	SAME AS A9			
A31	SAME AS A1			
A32	SAME AS A1			
A33	SAME AS A1			
A34	INTEGRATED CIRCUIT	SL3979	07263	351-7121-030
A35 THROUGH A38	SAME AS A1			
A39	NOT USED			
A40	NOT USED			
A41	SAME AS A1			
A42	SAME AS A1			
A43	SAME AS A1			
A44	NOT USED			
A45	NOT USED			
A46	SAME AS A1			
A47	SAME AS A1			
A48	SAME AS A1			
A49	NOT USED			
A50	NOT USED			
A51	SAME AS A1			
A52	SAME AS A1			
A53	SAME AS A1			
A54	NOT USED			
A55	NOT USED			
A56	SAME AS A1			
A57	SAME AS A1			
A58	SAME AS A1			
TP1	JACK, TIP WHITE	4877-125-9	17117	360-0434-100
TP2	SAME AS TP1			
TP3	SAME AS TP1			
TP4	SAME AS TP1			
TP5	NOT USED			
TP6	JACK, TIP BLACK	4877-125-0	17117	360-0434-010

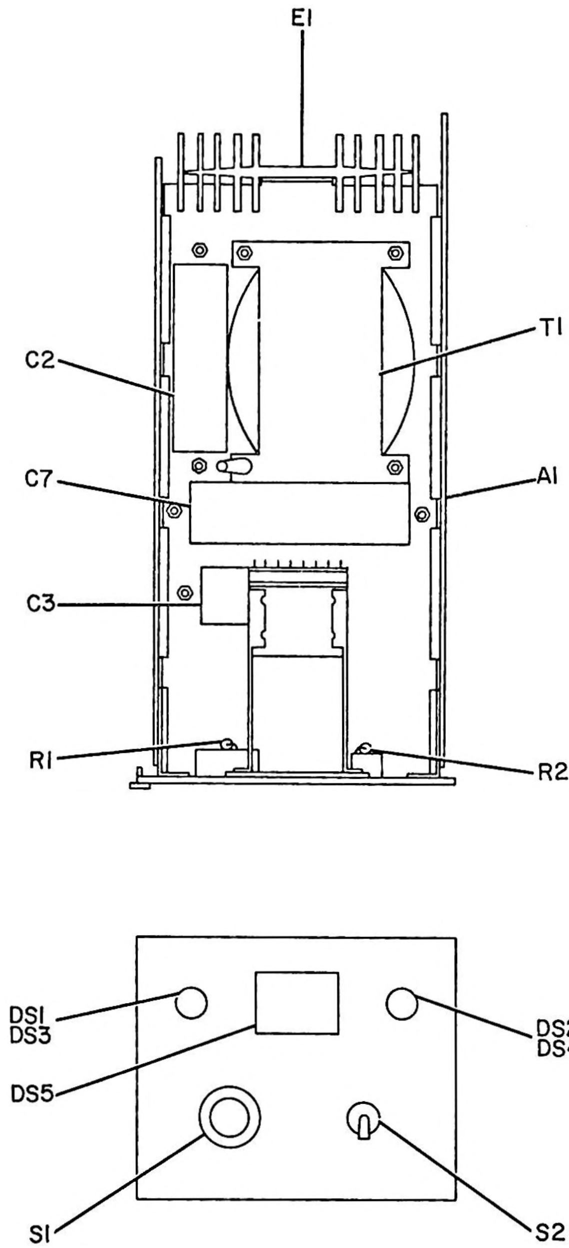
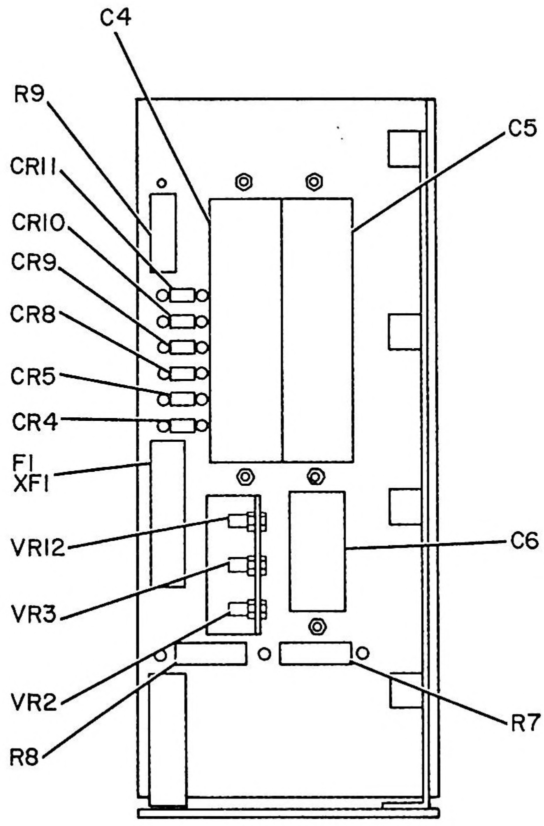


Figure 6-11. FM Control Module A9 (Sheet 1 of 2).



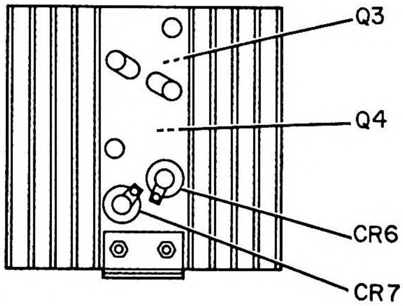


Figure 6-11. FM Control Module A9 (Sheet 2 of 2).

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	FM CONTROL MODULE A9			776-1919-001
A1	LAMPDRIVER BOARD SEE BREAKDOWN ON PAGE 6-31			774-7116-001
C1	NOT USED			
C2	CAPACITOR, FXD, ELECTROLYTIC 2000 UF, PLUS 100% MINUS 10%, 6 VDCW			183-1311-000
C3	CAPACATOR, FXD, ELECTROLYTIC 2500 UF, PLUS 100% MINUS 10%, 15 VDCW	MA20-42463	37942	183-2308-000
C4	CAPACITOR, FXD, ELECTROLYTIC 2900 UF, PLUS 75% MINUS 10%, 10 VDCW	60D298G010FT4	56289	183-1282-160
C5	SAME AS C4			
C6	CAPACITOR, FXD, ELECTROLYTIC 500 UF, PLUS 100% MINUS 10%, 12 VDCW	D33645	56289	183-1785-000
C7	CAPACITOR, FXD, ELECTROLYTIC 2300 UF, PLUS 75% MINUS 10%, 40 VDCW	601D238G040JT4	56289	183-1282-050
CR1	NOT USED			
CR2	NOT USED			
CR3	NOT USED			
CR4	SEMICONDUCTOR DEVICE, DIODE	2A100	13327	353-6453-010
CR5	SAME AS CR4			
CR6	SEMICONDUCTOR DEVICE; DIODE	1N1200	07688	353-1721-000
CR7	SAME AS CR6			
CR8 THROUGH CR11	SAME AS CR4			
DS1	LIGHT, INDICATOR AMBER	183-9730-1473	72619	262-2559-000
DS2	LIGHT, INDICATOR RED	183-9730-1471	72619	262-2557-000
DS3	LAMP, INCANDESCENT 0.2 AMPS, 6 VOLTS	MS25237-328	96906	262-0023-000
DS4	SAME AS DS3			
DS5	INDICATOR, DIGITAL DISPLAY 115 MA, 5 VOLTS	600328A	00303	262-2244-010
E1	HEATSINK			776-1852-001
F1	FUSE, CARTRIDGE 5 AMPS CURRENT RATING	MTH250-5	71400	264-0726-000
Q1	NOT USED			
Q2	NOT USED			
Q3	TRANSISTOR	2N3767	07688	352-0689-020
Q4	TRANSISTOR	2N3055	07688	352-0583-010
R1	RESISTOR, FXD, COMPOSITION 56K OHMS, 10% TOL, 1/4 WATT	RC07GF563K	81349	745-0812-000
R2	SAME AS R1			
R3 THROUGH R6	NOT USED			
R7	RESISTOR, FXD, WIRE WOUND 5.1 OHMS, 5% TOL, 6.5 WATTS	RWG7U5R1H	81349	747-5414-000
R8	RESISTOR, FXD, WIRE WOUND 8.2 OHMS, 5% TOL, 6.5 WATTS	RW67V8R2H	81349	747-5418-000
R9	RESISTOR, FXD, WIRE WOUND 62 OHMS, 5% TOL, 6.5 WATTS	RW67V620H	81349	747-5495-000
S1	SWITCH, WAFER, ROTARY 1 SECTION, 21 POLE, 3 POSITION	235166K1	76854	259-1908-000
S2	SWITCH, TOGGLE SPST CONTACT ARRANGEMENT	83050CA	95691	266-5329-000
T1	TRANSFORMER, POWER, STEP DOWN, OPEN FRAME	950-1697-200	83003	662-0324-010

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
VR1	NOT USED			
VR2	SEMICONDUCTOR DEVICE, DIODE	1N3996A	07688	353-6232-000
VR3	SAME AS VR2			
VR4 THROUGH VR11	NOT USED			
VR12	SEMICONDUCTOR DEVICE, DIODE	1N2984B	07688	353-1365-000
XF1	FUSEHOLDER 20 AMPS CURRENT RATING	3938	71400	265-1037-000

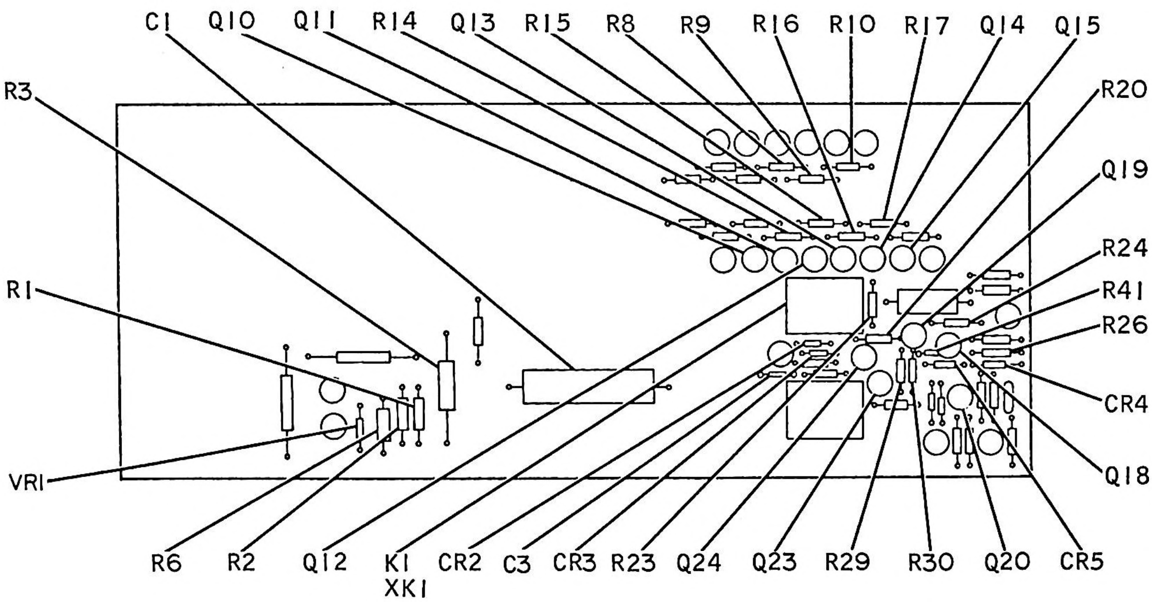


Figure 6-12. Lampdriver Board A9A1 (Sheet 1 of 2).

A2 ?

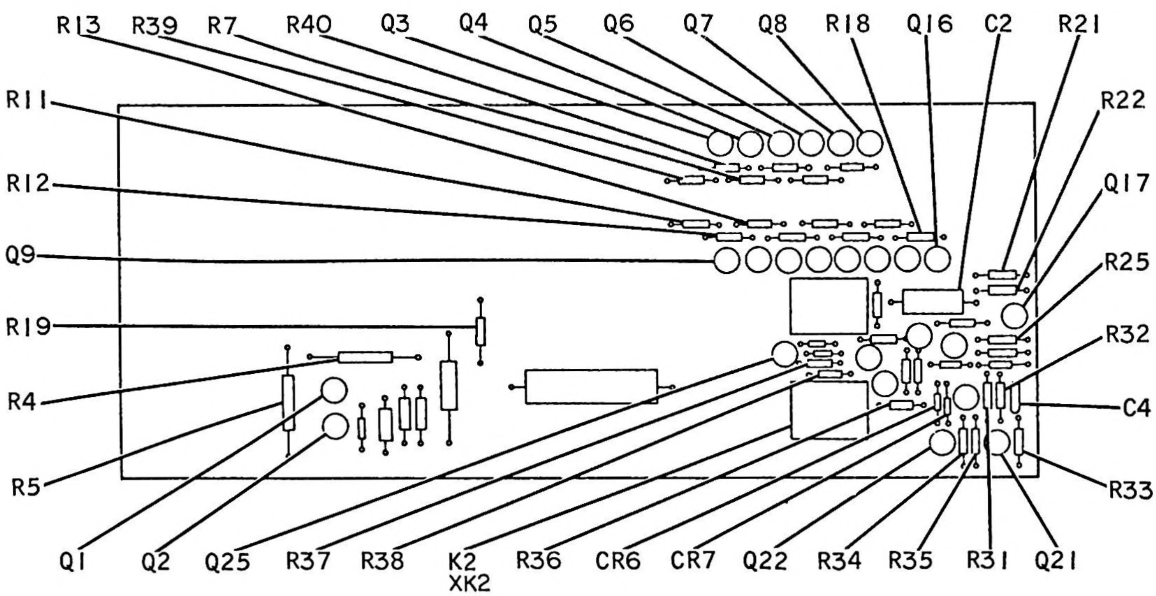


Figure 6-12. Lampdriver Board A9A1 (Sheet 2 of 2).

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	LAMPDRIVER BOARD A9A1			774-7116-001
C1	CAPACITOR, FXD, ELECTROLYTIC 300 UF, PLUS 75% MINUS 10%, 6 VDCW	30D36266	56289	183-1189-000
C2	CAPACITOR, FXD, ELECTROLYTIC 40 UF, PLUS 20% MINUS 15%, 30 VDCW	109D406C2030F2	56289	184-7781-000
C3	CAPACITOR, FXD, CERAMIC 0.33 UF, 20% TOL, 25 VDCW	5C7A	56289	913-3806-000
C4	SAME AS C3			
CR1	NOT USED			
CR2	SEMICONDUCTOR DEVICE, DIODE	1N914	07688	353-2906-000
CR3 THROUGH CR7	SAME AS CR2			
K1	RELAY, ARMATURE 2C CONTACT ARRANGEMENT	TP154CC6	70309	970-2451-230
K2	SAME AS K1			
Q1	TRANSISTOR	2N3569	07688	352-0629-030
Q2	SAME AS Q1			
Q3	TRANSISTOR	2N3567	07688	352-0629-010
Q4	TRANSISTOR	2N3569	07688	352-0629-030
Q5 THROUGH Q8	SAME AS Q3			
Q9	SAME AS Q4			
Q10 THROUGH Q25	SAME AS Q3			
R1	RESISTOR, FXD, COMPOSITION 2200 OHMS, 10% TOL, 1/2 WATT	RC20GF222K	81349	745-1366-000
R2	SAME AS R1			
R3	RESISTOR, FXD, COMPOSITION 680 OHMS, 10% TOL, 1 WATT	RC32GF681K	81349	745-3345-000
R4	RESISTOR, FXD, FILM 536 OHMS, 1% TOL, 1/2 WATT	RN65D5360F	81349	705-7083-000
R5	RESISTOR, FXD, FILM 1470 OHMS, 1% TOL, 1/2 WATT	RN65D1471F	81349	705-7104-000
R6	RESISTOR, FXD, COMPOSITION 330 OHMS, 10% TOL, 1/2 WATT	RC20GF331K	81349	745-1331-000
R7	RESISTOR, FXD, COMPOSITION 220 OHMS, 10% TOL, 1/4 WATT	RC07GF221K	81349	745-0725-000
R8 THROUGH R18	SAME AS R7			
R19	RESISTOR, FXD, COMPOSITION 680 OHMS, 10% TOL, 1/4 WATT	RC07GF681K	81349	745-0743-000
R20	SAME AS R19			
R21	SAME AS R19			
R22	RESISTOR, FXD, COMPOSITION 1K OHMS, 10% TOL, 1/4 WATT	RC07GF102K	81349	745-0749-000
R23	SAME AS R19			
R24	SAME AS R22			
R25	SAME AS R19			
R26	RESISTOR, FXD, COMPOSITION 3900 OHMS, 10% TOL, 1/4 WATT	RC07GF392K	81349	745-0770-000
R27	NOT USED			
R28	NOT USED			
R29	SAME AS R19			
R30	SAME AS R26			
R31	SAME AS R19			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
R32	SAME AS R26			
R33	RESISTOR, FXD, COMPOSITION 560 OHMS, 10% TOL, 1/4 WATT	RC07GF561K	81349	745-0740-000
R34	RESISTOR, FXD, COMPOSITION 2200 OHMS, 10% TOL, 1/4 WATT	RC07GF222K	81349	745-0761-000
R35	SAME AS R33			
R36	SAME AS R22			
R37 THROUGH R40	SAME AS R7			
R41	SAME AS R26			
VR1	SEMICONDUCTOR DEVICE, DIODE	1N751A	07688	353-2710-000
XK1	SOCKET, RELAY 10 CONTACTS	3055-1	02288	220-1475-000
XK2	SAME AS XK1			

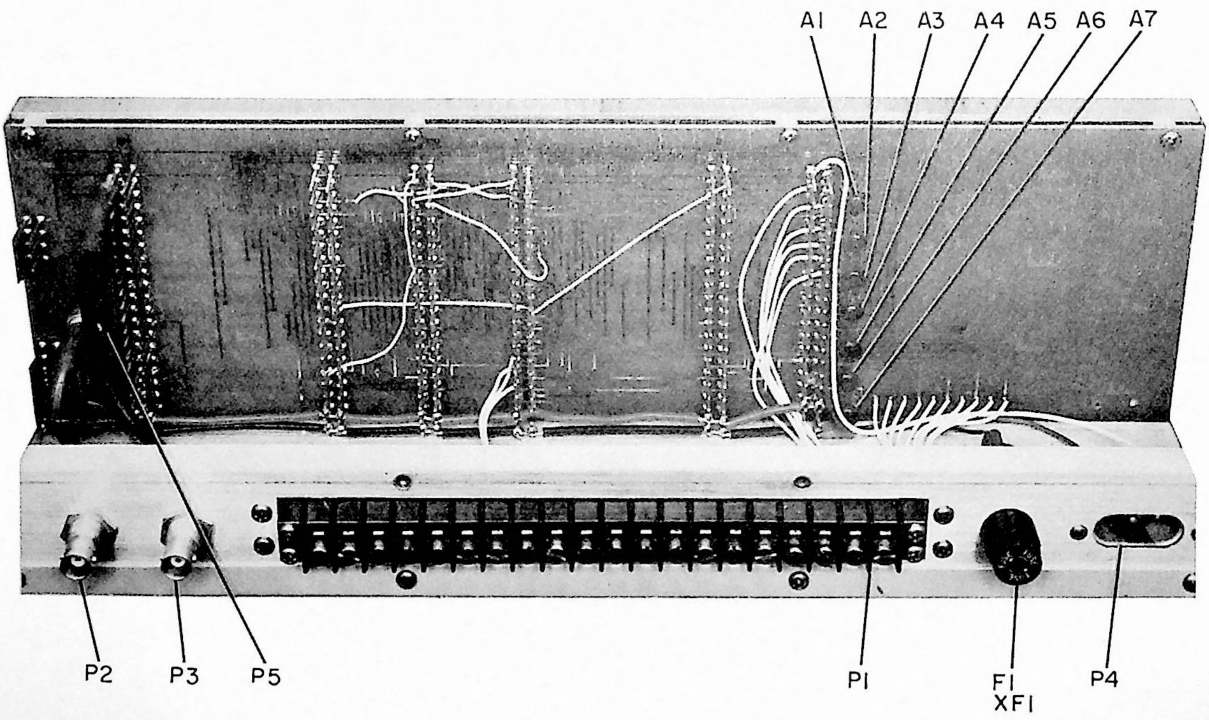


Figure 6-13. Backplane Board With Connector Assembly A10.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	BACKPLANE BOARD WITH CONNECTOR ASSEMBLY A10			776-1847-001
A1	INTEGRATED CIRCUIT	SL3978	07263	351-7121-020
A2 THROUGH A7	SAME AS A1			
F1	FUSE CARTRIDGE 1/2 AMP CURRENT RATING	F02B250V1AS	81349	264-4260-000
P1	BOARD, TERMINAL 20 TERMINAL	607A3000-20	75382	367-1852-200
P2	CONNECTOR, ELECTRICAL 1 CONTACT	UG625BU	80058	357-9670-000
P3	SAME AS P2			
P4	CONNECTOR, ELECTRICAL 3 CONTACTS	1065-1	87930	368-0207-010
P5	CONNECTOR, ELECTRICAL 1 CONTACT	UG1050A	80058	357-9211-000
XF1	FUSEHOLDER 30 AMPS CURRENT RATING	HKPH	71400	265-1171-000

ILLUSTRATION NOT AVAILABLE
TO BE SUPPLIED AT LATER DATE

Figure 6-14. Optional Equipment.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	OPTIONAL EQUIPMENT			
A1	782B-1 SELF-CHECK CARD SEE BREAKDOWN ON PAGE 6-40C			777-1439-001
A2	EXTENDER CARD			781-1488-001
A3	EXTENDER CABLE			781-5252-001
A4	82U REMOTE READOUT METER -USED WITH 758-5742-003 AND 758-5742-004 ONLY- NO PARTS LIST AVAILABLE AT THIS TIME			777-1390-001

ILLUSTRATION NOT AVAILABLE
TO BE SUPPLIED AT LATER DATE

Figure 6-15. 782B-1 Self-Check Card.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	782B-1 SELF-CHECK CARD			777-1439-001
A1	INTEGRATED CIRCUIT	SL3979	07263	351-7121-030
S1	SWITCH, ROTARY 2 SECTIONS, 4 POLES, 5 POSITIONS	237966K2	76854	259-2204-000

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	MANUFACTURERS CODES			
CODE	MANUFACTURER			
00303	SHELLEY ASSOCIATES INC EL SEGUNDO, CALIFORNIA			
01939	SPRAGUE ELECTRIC CO OF WISCONSIN GRAFTON, WISCONSIN			
02288	ALLIED CONTROL CO, INC PLANTSVILLE, CONNECTICUT			
04713	MOTOROLA SEMICONDUCTOR PRODUCTS, INC PHOENIX, ARIZONA			
07263	FAIRCHILD CAMERA AND INSTRUMENT CORP, SEMICONDUCTOR DIVISION MOUNTAIN VIEW, CALIFORNIA			
07688	JOINT ELECTRON DEVICE ENGINEERING COUNCIL WASHINGTON DC			
12615	U S TERMINALS INC CINCINNATI, OHIO			
13327	SOLITRON DEVICES INC TAPPAN, NEW YORK			
17117	ELECTRONIC MOULDING CORP PAWTUCKET, RHODE ISLAND			
37942	P R MALLORY AND CO, INC INDIANAPOLIS, INDIANA			
56289	SPRAGUE ELECTRIC CO NORTH ADAMS, MASSACHUSETTS			
70309	ALLIED CONTROL CO, INC NEW YORK, NEW YORK			
71400	BUSSMAN MFG DIVISION OF MC GRAW-EDISON CO ST LOUIS, MISSOURI			
72619	DIALIGHT CORP BROOKLYN, NEW YORK			
75382	KULKA ELECTRIC CORP MT VERNON, NEW YORK			
76854	OAK MANUFACTURING CO CRYSTAL LAKE, ILLINOIS			
80058	JOINT ELECTRONIC TYPE DESIGNATION SYSTEM			
81349	MILITARY SPECIFICATIONS			
83003	VARO INC GARLAND, TEXAS			
87930	TOWER MANUFACTURING CORP PROVIDENCE, RHODE ISLAND			
93332	SYLVANIA ELECTRIC PRODUCTS INC, SEMICONDUCTOR PRODUCTS DIVISION WOBURN, MASSACHUSETTS			
95104	COLLINS RADIO CO DALLAS, TEXAS			
95691	ARROW-HART AND HEGEMAN ELECTRIC CO LOS ANGELES, CALIFORNIA			
96906	MILITARY SPECIFICATIONS			

section 7
illustrations

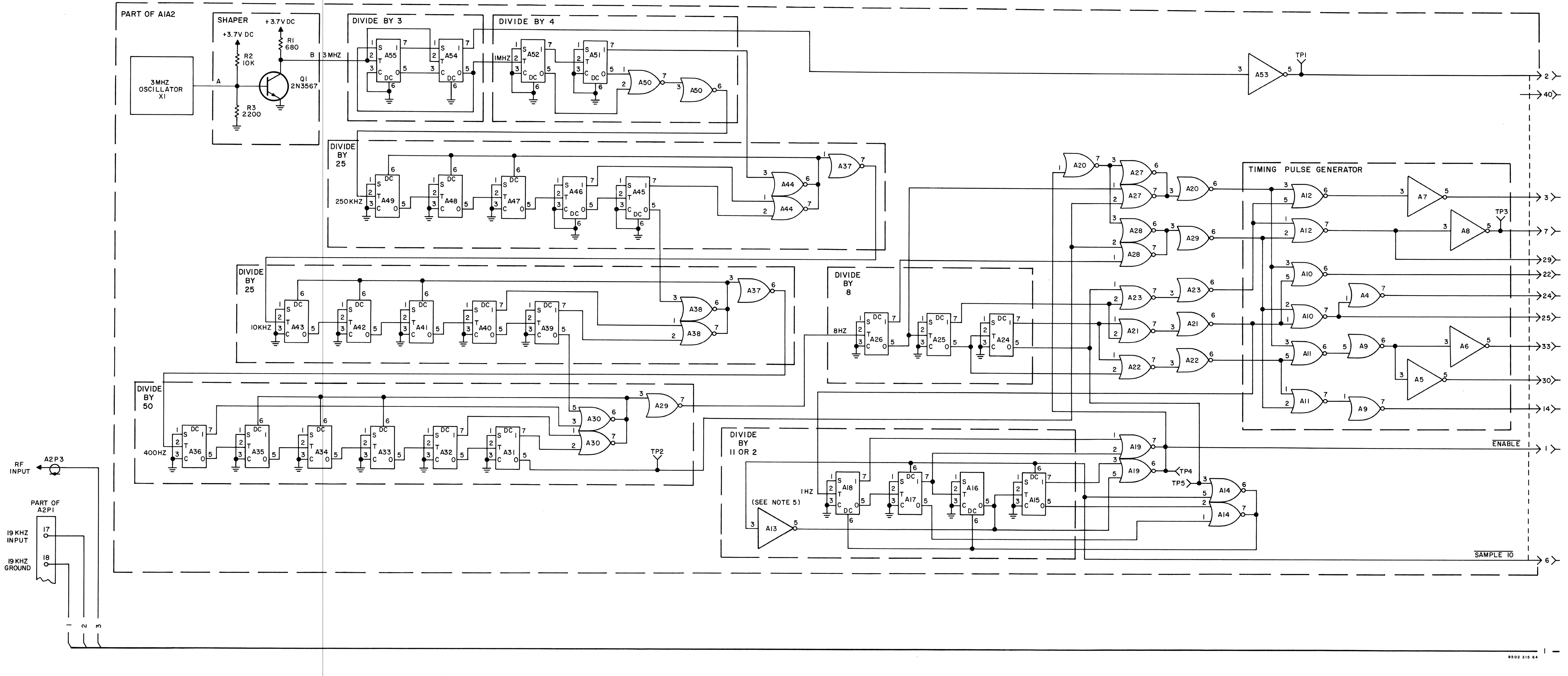


Figure 7-1. Functional Diagram (Sheet 1 of 6).

Figure 7-1. Functional Diagram (Sheet 2 of 6).

Figure 7-1. Functional Diagram (Sheet 3 of 6).

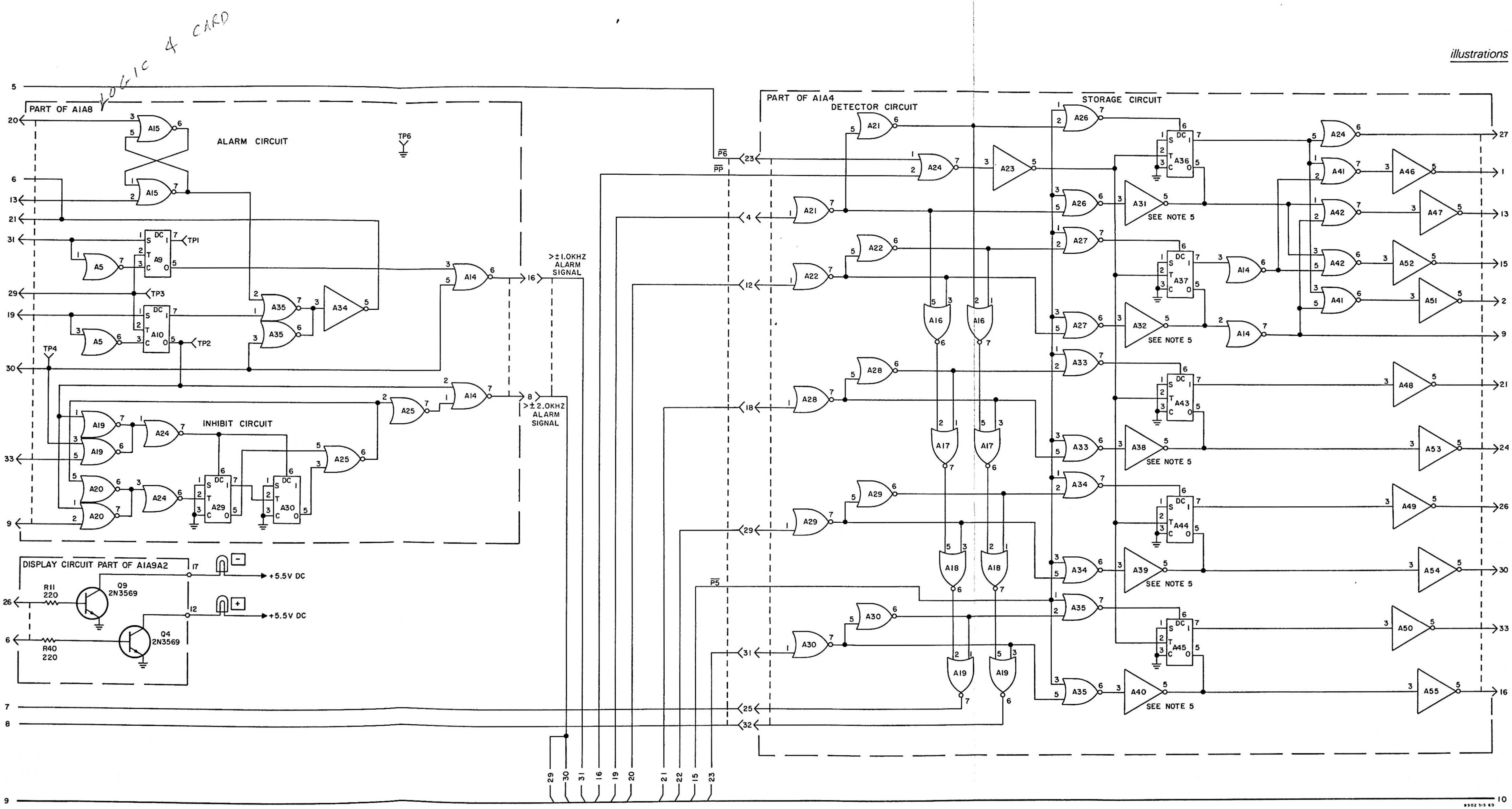


Figure 7-1. Functional Diagram (Sheet 4 of 6).

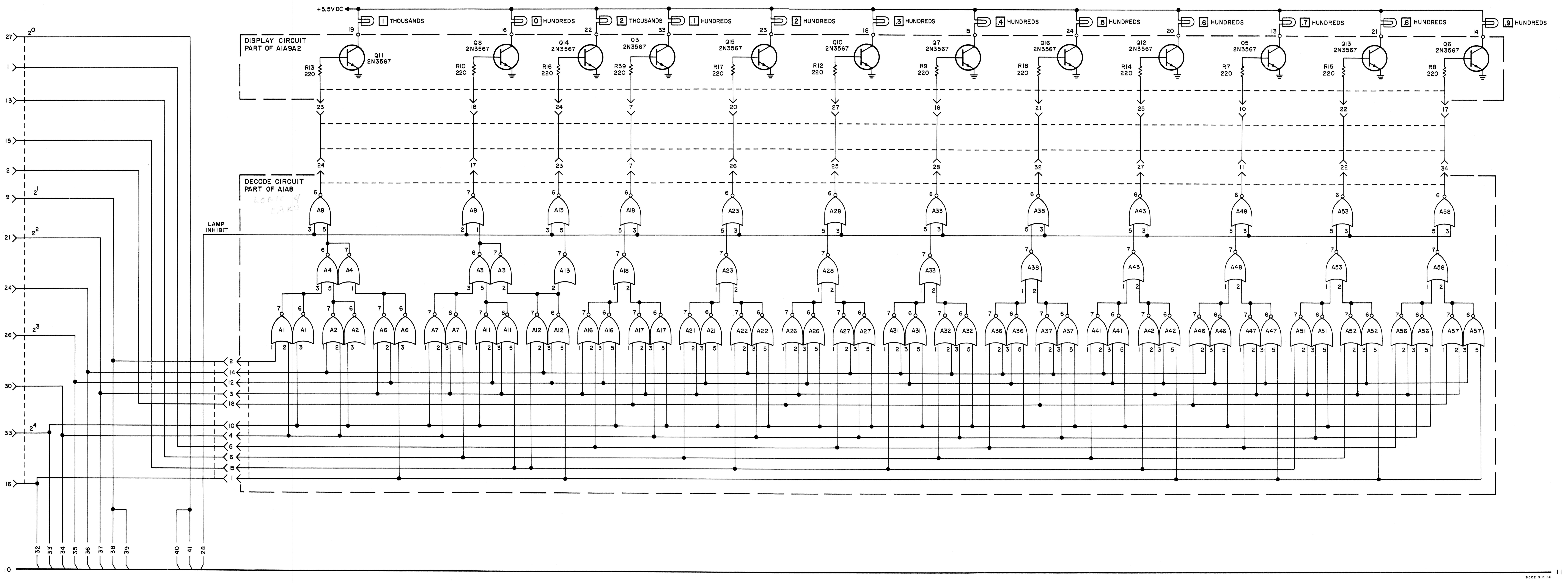
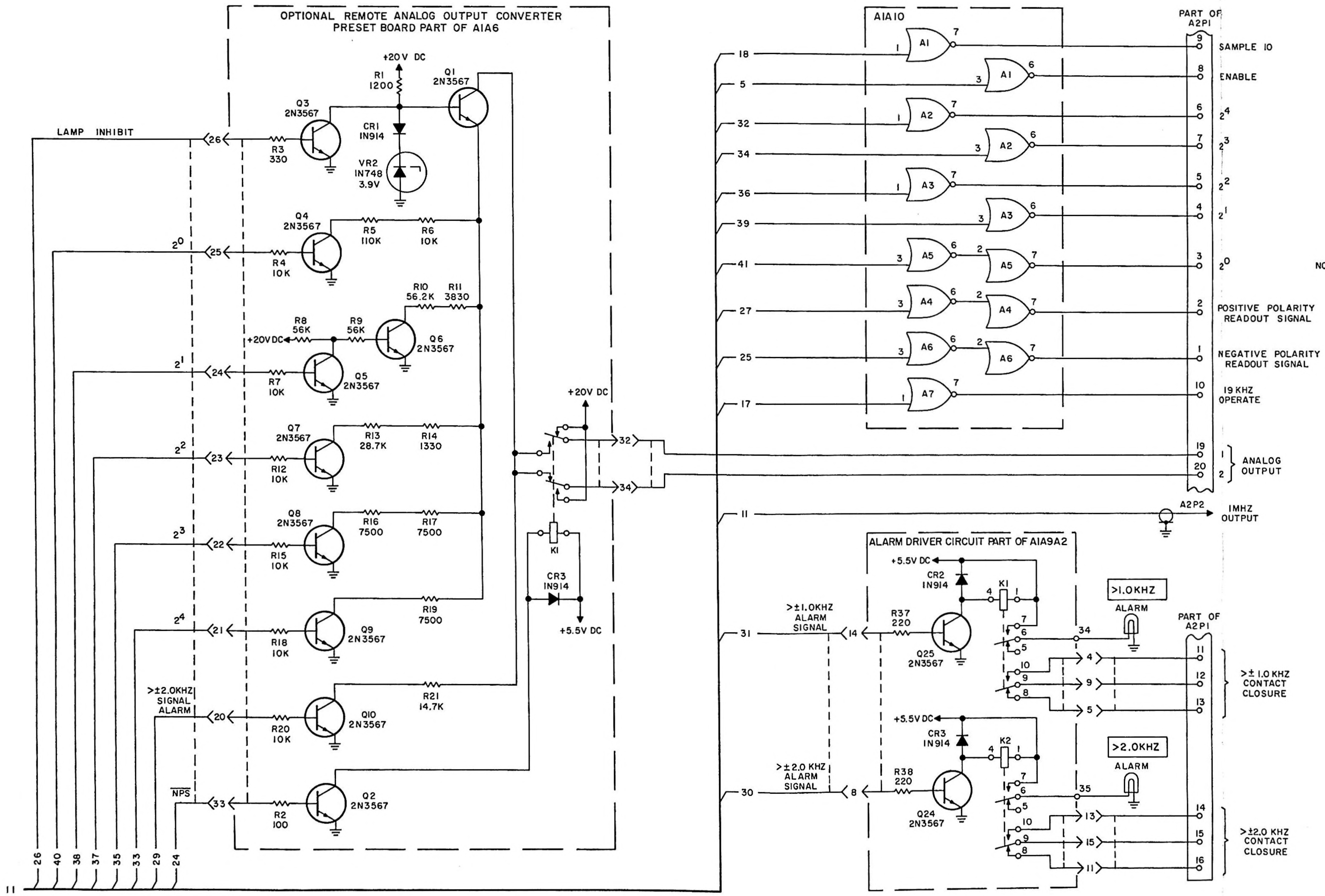


Figure 7-1. Functional Diagram (Sheet 5 of 6).



NOTES:

1. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS
   ALL CAPACITANCE VALUES ARE IN MICROMICRFARADS
2. ALL FLIP-FLOP SYMBOLS REPRESENT FAIRCHILD MICROLOGIC 923 JK FLIP-FLOPS
3. ALL NOR GATE SYMBOLS REPRESENT FAIRCHILD MICROLOGIC 914 DUAL TWO INPUT GATES
4. ALL INVERTER SYMBOLS REPRESENT FAIRCHILD MICROLOGIC 900 BUFFERS
5. + 3.7 V DC IS NOT CONNECTED TO THE FOLLOWING MICROLOGIC:
   A1A2: A13
   A1A4: A31, A32, A38, A39 AND A40
   A1A5: A1 THRU A10, A22, A23, A24, A27, A28, A29, A32 A33, A34, A35, A37, A38, A39 AND A40
   +3.7V DC IS CONNECTED TO UNITS A25 AND A30
6. PRESET CARD A1A6 SHOWN WIRED FOR 103.5 MHZ

Figure 7-1. Functional Diagram (Sheet 6 of 6).

POWER WIRING		
FROM	TO	FUNCTION
A1A9-39	A1A10A1-4	GRD
A1A9-39	A1A10A2-4	GRD
A1A9-39	A1A10A3-4	GRD
A1A9-39	A1A10A4-4	GRD
A1A9-39	A1A10A5-4	GRD
A1A9-39	A1A10A6-4	GRD
A1A9-39	A1A10A7-4	GRD
A1A9-39	A1A9-40	GRD
A1A9-40	A1A8-39	GRD
A1A8-39	A1A8-40	GRD
A1A8-40	A1A6-39	GRD
A1A6-39	A1A6-40	GRD
A1A6-40	A1A5-39	GRD
A1A5-39	A1A5-40	GRD
A1A5-40	A1A4-39	GRD
A1A4-39	A1A4-40	GRD
A1A4-40	A1A2-39	GRD
A1A2-39	A1A2-40	GRD
A1A2-40	A1A1-39	GRD
A1A1-39	A1A1-40	GRD
A1A9-33	A1A10A1-8	+3.7V DC
A1A9-33	A1A10A2-8	+3.7V DC
A1A9-33	A1A10A3-8	+3.7V DC
A1A9-33	A1A10A4-8	+3.7V DC
A1A9-33	A1A10A5-8	+3.7V DC
A1A9-33	A1A10A6-8	+3.7V DC
A1A9-33	A1A10A7-8	+3.7V DC
A1A9-35	A1A9-36	+3.7V DC
A1A9-36	A1A8-37	+3.7V DC
A1A8-37	A1A8-38	+3.7V DC
A1A8-38	A1A6-38	+3.7V DC
A1A6-38	A1A5-37	+3.7V DC
A1A5-37	A1A5-38	+3.7V DC
A1A5-38	A1A4-37	+3.7V DC
A1A4-37	A1A4-38	+3.7V DC
A1A4-38	A1A2-37	+3.7V DC
A1A2-37	A1A2-38	+3.7V DC
A1A2-38	A1A1-33	+3.7V DC
A1A9-30	A1A6-35	+20V DC
A1A6-35	A1A6-36	+20V DC
A1A6-36	A1A2-35	+20V DC
A1A2-35	A1A2-36	+20V DC
A1A2-36	A1A1-35	+20V DC
A1A9-29	A1A6-37	+5.5V DC
A1A9-32	A1A9-31	+5.1V DC
A1A9-31	A1A1-31	+5.1V DC

Figure 7-2. Interconnecting Wiring Diagram.

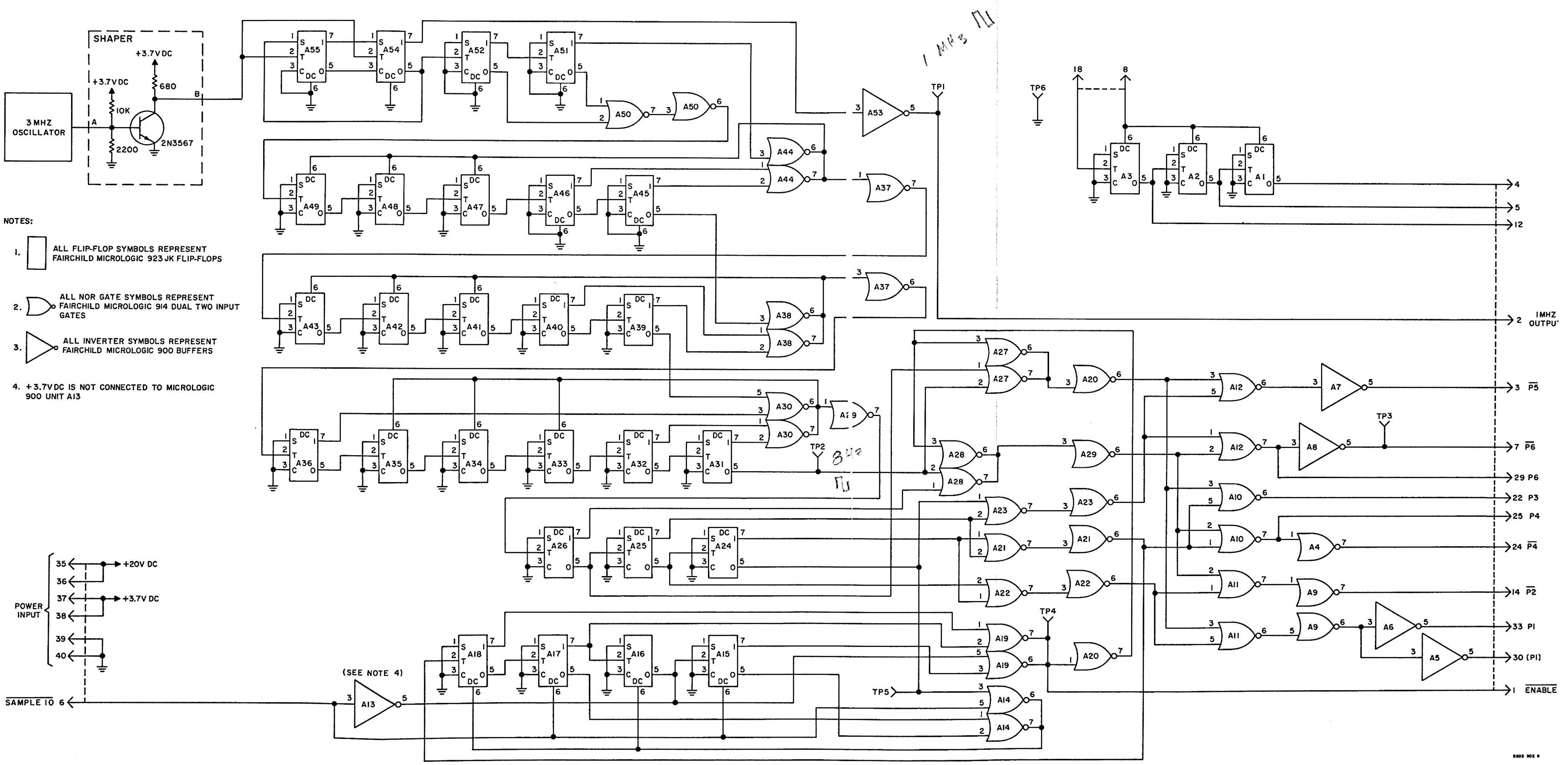
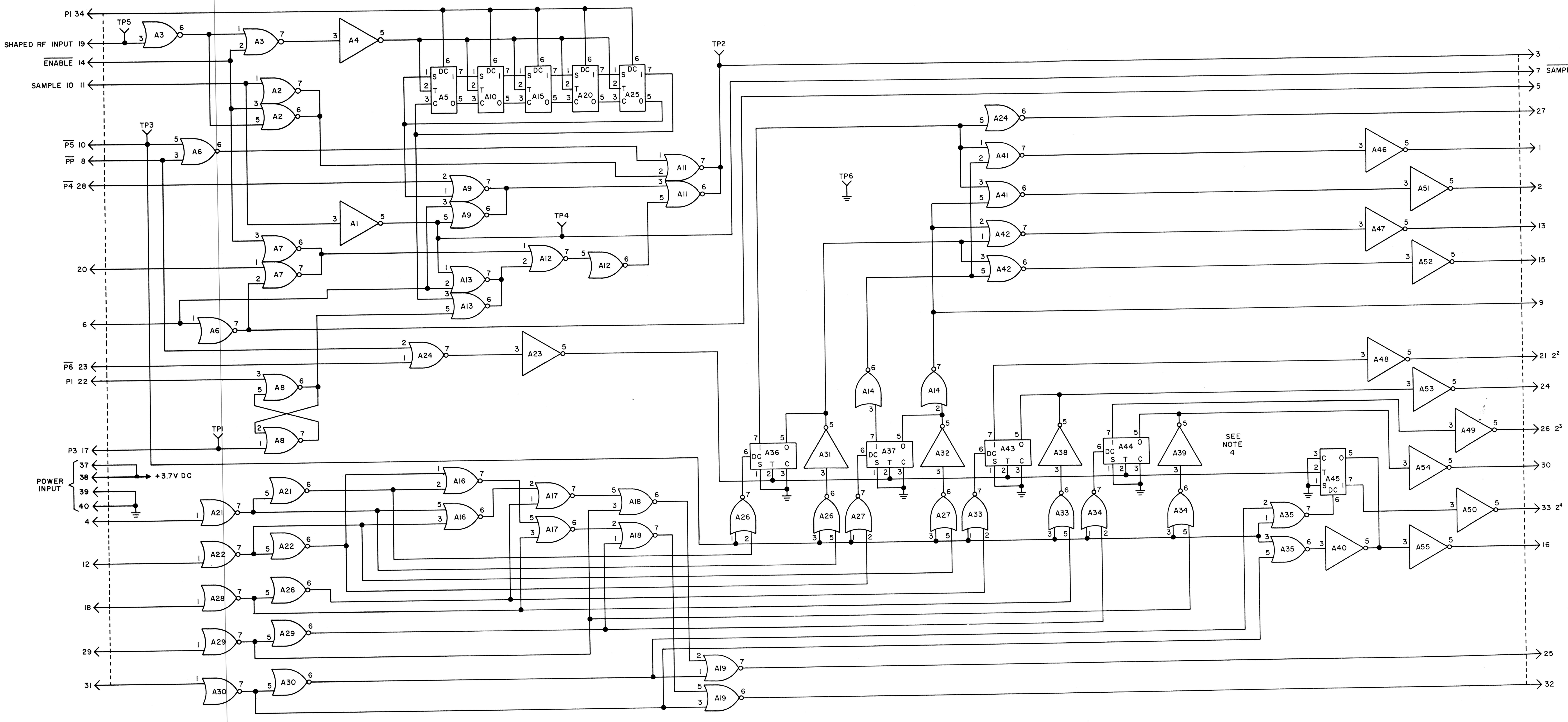


Figure 7-3.   Logic 1 Card A1A2 Schematic.



NOTES:

1. ALL FLIP-FLOP SYMBOLS REPRESENT FAIRCHILD MICROLOGIC 923JK FLIP-FLOPS
2. ALL NOR GATE SYMBOLS REPRESENT FAIRCHILD MICROLOGIC 914 DUAL TWO INPUT GATES
3. ALL INVERTER SYMBOLS REPRESENT FAIRCHILD MICROLOGIC 900 BUFFERS
4. +3.7V DC IS NOT CONNECTED TO MICROLOGIC 900 UNITS A31, A32, A38, A39 AND A40

Figure 7-4. Logic 2 Card A1A4 Schematic.

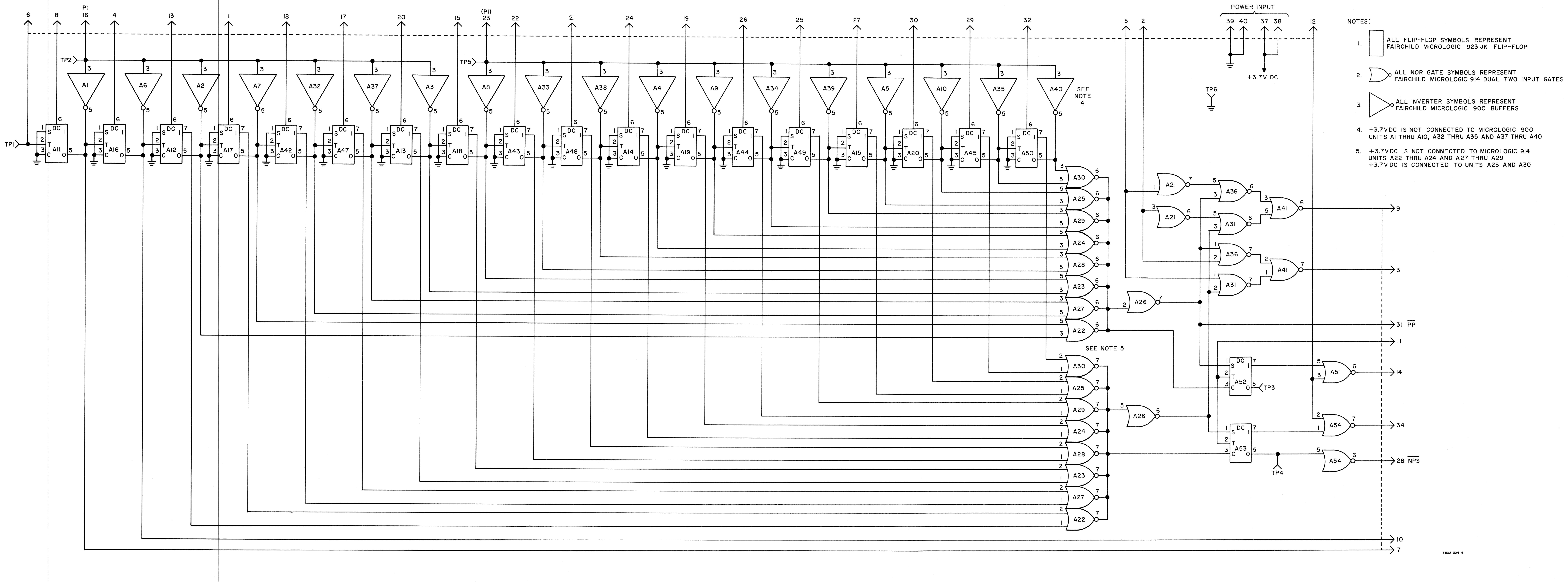
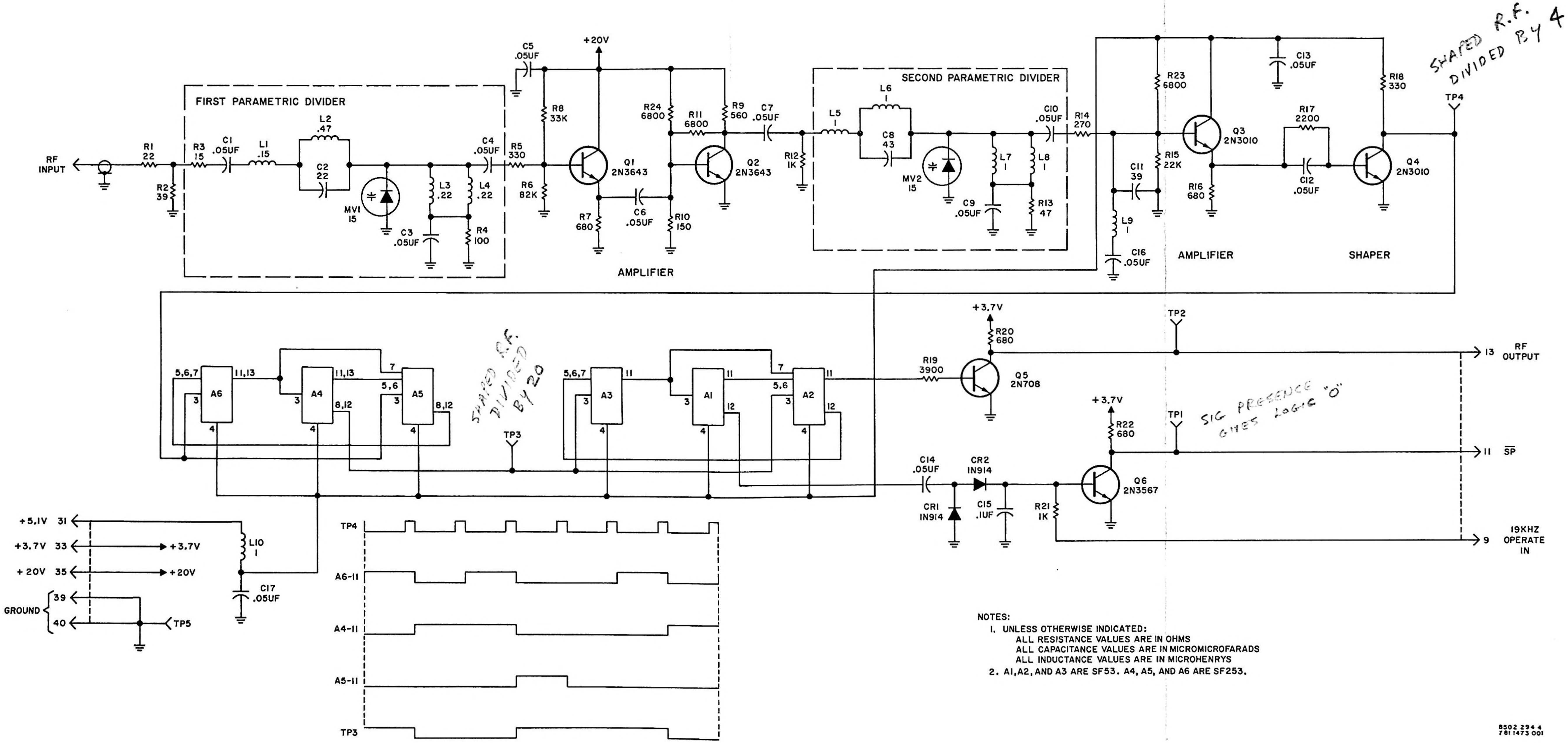


Figure 7-5. Logic 3 Card A1A5 Schematic.

Figure 7-6. Logic 4 Card A1A8 Schematic.



NOTES:
1. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS
   ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS
   ALL INDUCTANCE VALUES ARE IN MICROHENRYS
2. A1, A2, AND A3 ARE SF53. A4, A5, AND A6 ARE SF253.

Figure 7-7. RF Card A1A1 Schematic.

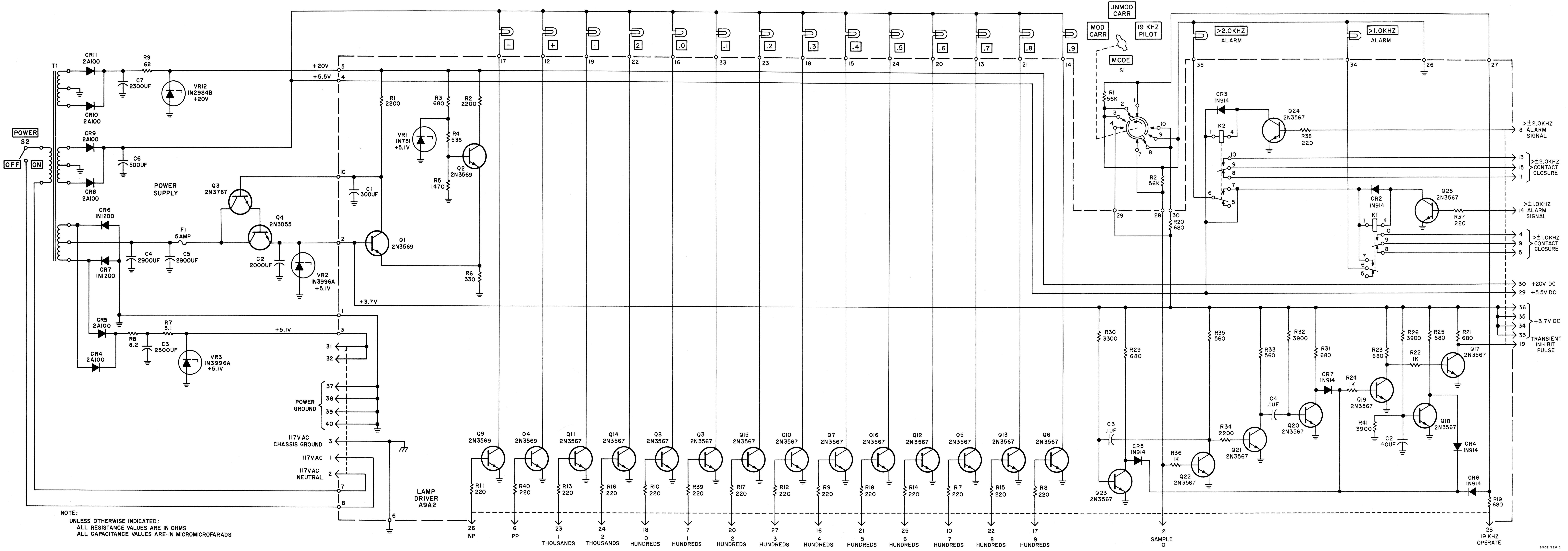


Figure 7-8. Control Module Schematic.

A9

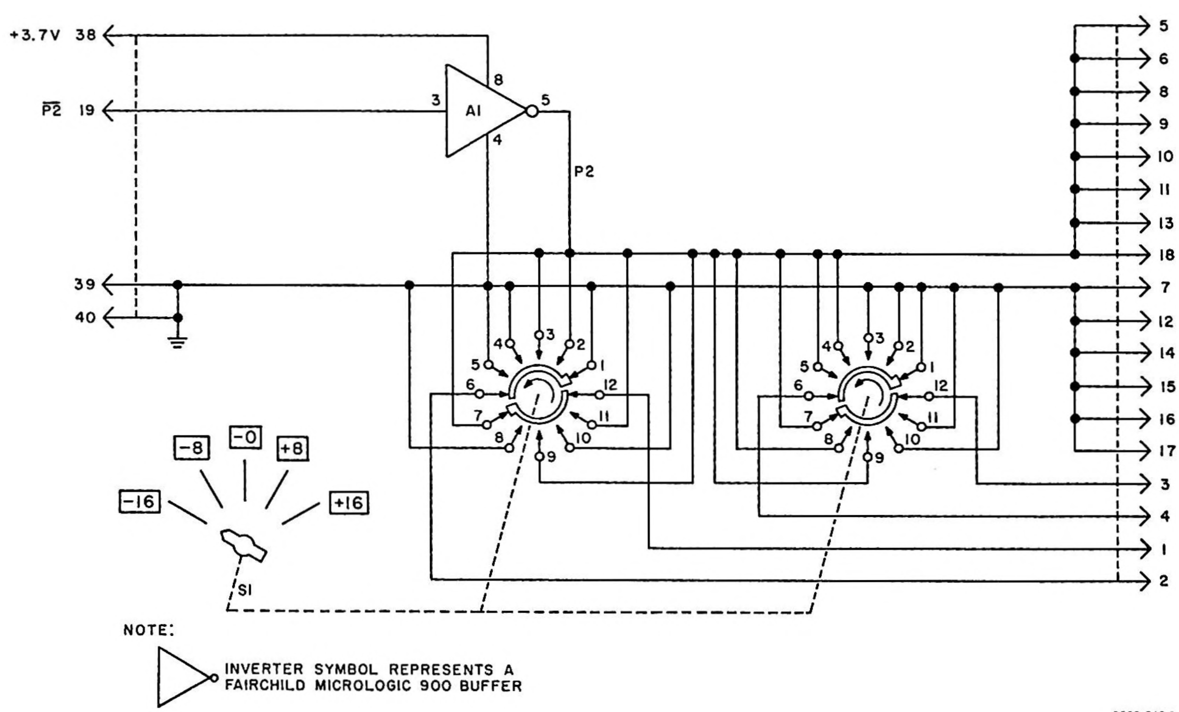


Figure 7-9. Self-Check Card Schematic.

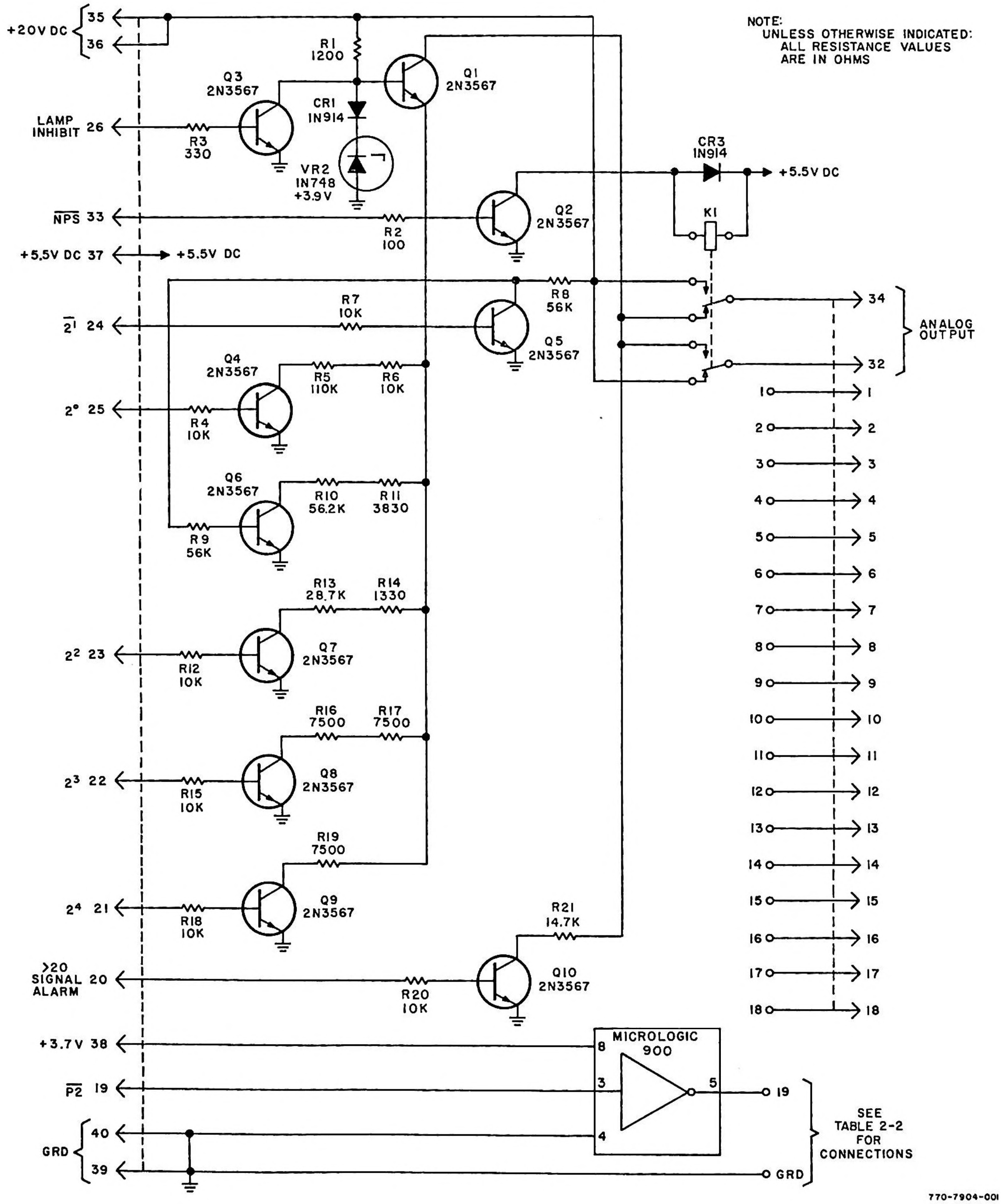


Figure 7-11. Preset 2 Card A1A6 Schematic.

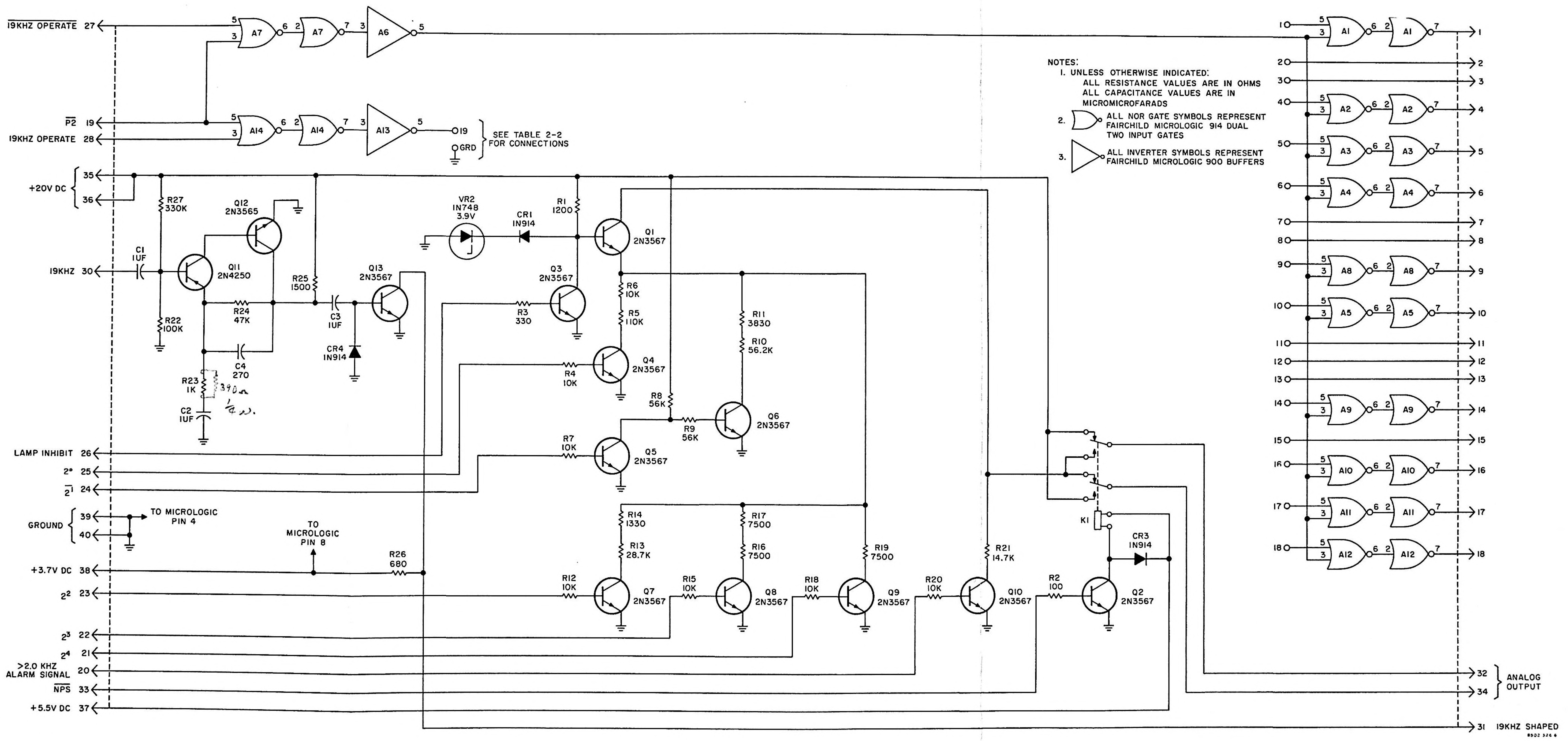
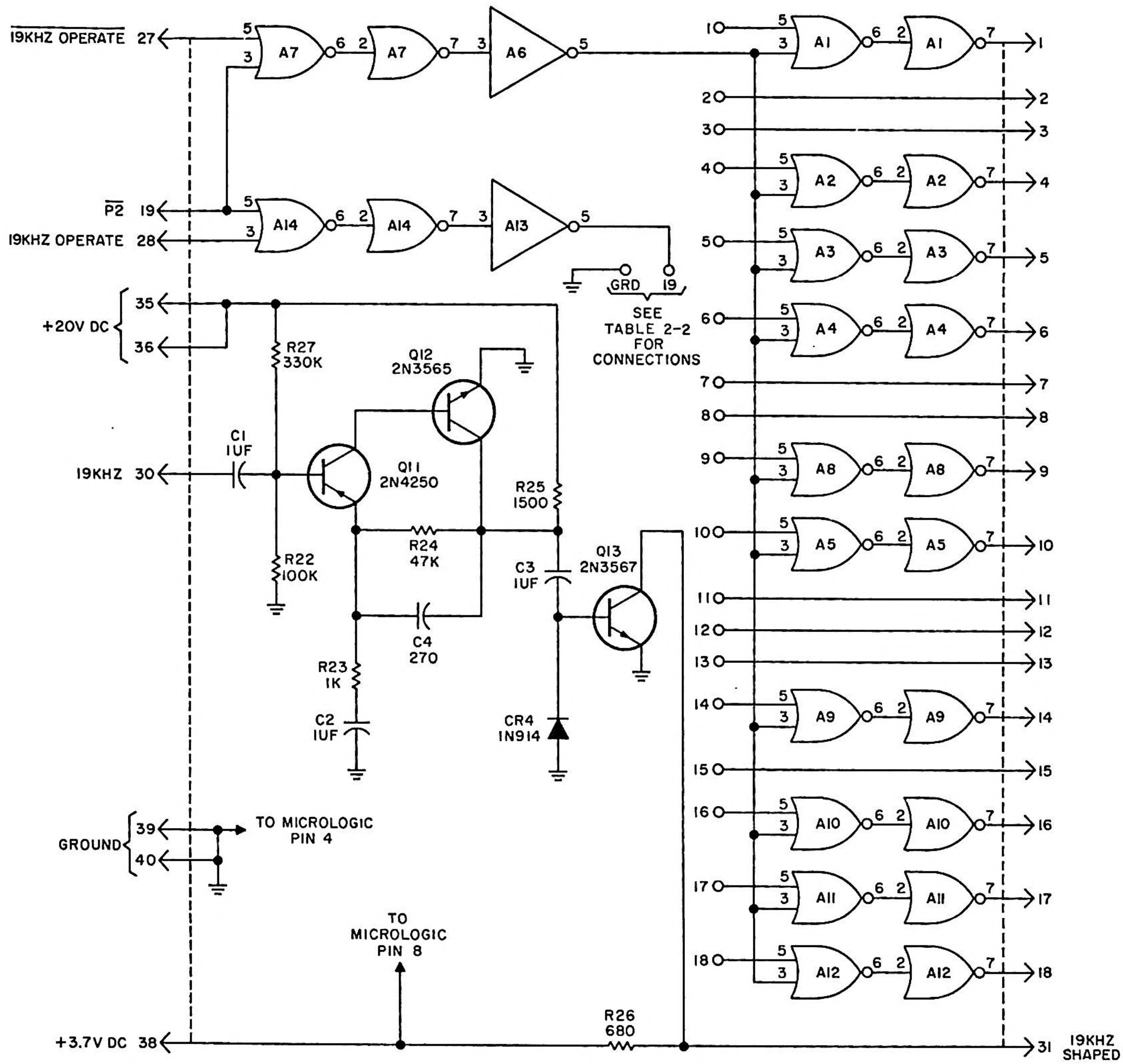


Figure 7-12. Preset 3 Card A1A6 Schematic.



NOTES:
1. UNLESS OTHERWISE INDICATED:
ALL RESISTANCE VALUES ARE IN OHMS
ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS

2. ALL NOR GATE SYMBOLS REPRESENT FAIRCHILD MICROLOGIC 914 DUAL TWO INPUT GATES

3. ALL INVERTER SYMBOLS REPRESENT FAIRCHILD MICROLOGIC 900 BUFFERS

8802 340 4

Figure 7-13. Preset 4 Card A1A6 Schematic.

COLLINS