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AN/GSQ-174
FREQUENCY CONTROL SET

VOLUME I
OPERATION AND MAINTENANCE MANUAL

VOLUME II
ILLUSTRATED PARTS BREAKDOWN

DECEMBER 1973
(SUPERSEDES MARCH 1971)

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AN/GSQ-174

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INTRODUCTION

Volume I of this manual contains the information necessary to operate and maintain the AN/GSQ-174 Frequency Control Set, manufactured by AUSTRON, Inc., Austin, Texas, U. S. A. The AN/GSQ-174 system is comprised of three subsystems, including the R-1776/GSQ-174 Loran Receiver, O-1632/GSQ-174 RF Oscillator; and CV-2929/GSQ-174 Frequency Multiplier. Information on each subsystem is presented in this manual in the following order

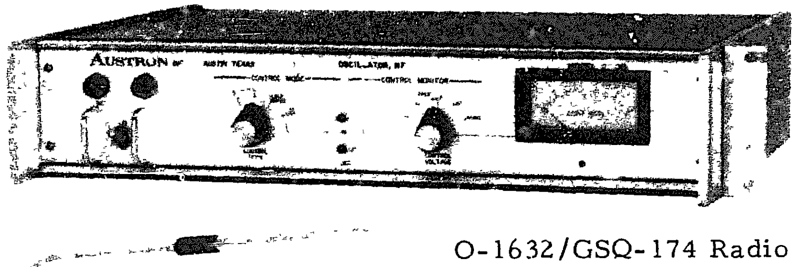
1. CV-2929/GSQ-174
2. R-1776/GSQ-174
3. O-1632/GSQ-174
4. AS-2739/GSQ-174

Likewise, volume I of this manual contains information on physical description, installation and preliminary adjustment, operating procedures, and calibration and alignment procedures. Information is presented as applicable and separate for each subsystem. Schematics, logic diagrams, and other drawings support the text. The manual is suitable for all personnel operating and maintaining the AN/GSQ-174 system.

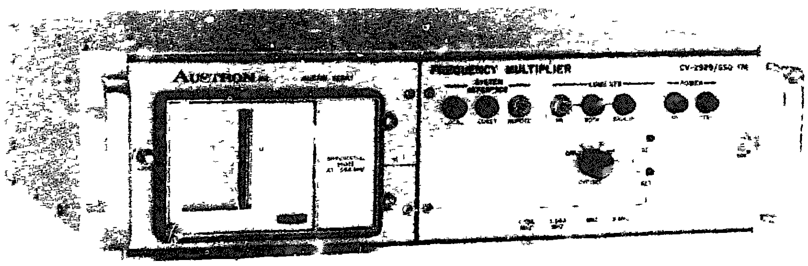
Volume II of this manual contains the illustrated parts breakdown of the AN/GSQ-174 system, by complete subsystem, for location, identification, adjustment, or repair of any item in an equipment.

Related Publications. The following publications and documents supplement this manual in the use and maintenance of the AN/GSQ-174 system.

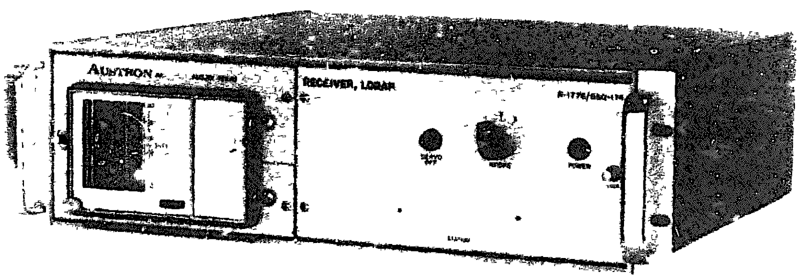
1. (PROVISIONING LISTINGS)	Supporting documentation for consumer use for determination of quantitative requirements and sources to maintain and support the AN/GSQ-174 system.



O-1632/GSQ-174 Radio Frequency Oscillator



CV-2929/GSQ-174 Frequency Multiplier



R-1776/GSQ-174 Loran Receiver with AS-2739/GSQ-174 Antenna

Figure 1-1. AN/GSQ-174 1.536/1. 544 MHz Phaselocked Synthesizer System

SECTION I

1.0 GENERAL DESCRIPTION

1.1 SCOPE OF SECTION

1.2 This section introduces the AN/GSQ-174 Frequency Control Set manufactured by AUSTRON, Inc The section describes three components, the CV-2929/GSQ-174 Frequency Multiplier, the R-1776/GSQ-174 Loran Receiver, and the O-1632/GSQ-174 RF Oscillator. Provided are descriptions of the purpose and physical characteristics of each component in the system.

1.3 PURPOSE OF THE AN/GSQ-174 SYSTEM

1.4 The AN/GSQ-174 Frequency Control Set is designed to provide a high resolution frequency measurement and intercomparison system utilization of Loran-C transmission. Linked to user instrumentation, the AN/GSQ-174 enables high precision traceable frequency calibration by Loran-C over the Eastern two-thirds of the United States, most of Europe, Japan, and much of the Central and Western Pacific. Eventually, broader world wide Loran-C coverage will make the AN/GSQ-174 universally acceptable in frequency calibration and time distribution. The system generates a 1.536/1.544 MHz signal with normal accuracy and stability of 1 microsecond. The system is closely phaselocked to an external 1.536 or 1.544 MHz reference, should the Loran-C reference become unavailable. If both the Loran-C signal and 1.536 or 1.544 MHz reference disappear, the system will hold and coast at a frequency set by servo memory action. The artificial frequency closely approximates the last monitored Loran-C or reference signal.

1.5 DESCRIPTION OF SYSTEM

1.6 The AN/GSQ-174 consists of four intercoupled instrument packages. These are the CV-2929/GSQ-174 Frequency Multiplier (hereafter called CV-2929), which provides all system and electronic interfacing between the R- 1776/GSQ-174 Loran Receiver (hereafter called R-1776), and the primary and backup O-1632/GSQ-174 RF Oscillator (hereafter called 0- 1632) (Figure 1-1).

1.7 CV-2929/GSQ-174 FREQUENCY MULTIPLIER The CV-2929 consists of a combiner system to supply a 1 MHz reference signal to a R-1776 Loran-C tracking receiver, an automatic reference switch to supply a phaselock reference to two O-1632 RF Oscillators, and two frequency synthesizers to convert 1 536 and 1 544 MHz to 1 000 MHz, and vice versa Synthesizer phase stability is 50 nanoseconds equivalent

1.8 COMBINER SYSTEM The Combiner System in the CV-2929 supplies standard frequency derived from primary and backup O-1632 RF Oscillators in normal operation Should one 0-1632 fail, automatic detection and switching circuits change to the remaining operative RF Oscillator without signal dropout

1.9 SYSTEM REFERENCE LOGIC This subsystem ensures that the 1 536/1 544 MHz system output is slaved to the best available reference Sensing and logic circuitry is provided to establish the system phase reference as

a) Loran-C groundwave, whenever available
b) Line 1 536/l. 544 MHz, when Loran-C reference is not available

When both reference signals disappear, a logic signal is provided to each RF Oscillator to lock its frequency control servo for “coast” mode of operation

1.10 PHASE COMPARATOR 4 comparator and phase difference recorder permanently records AN/GSQ-174 system 1 536/1 544

MHz phase. The recorder is a thirty day, lnkless type which is calibrated for 1 cycle full scale of 1 536 or 1 544 MHz phase difference.

1.11 R-1776/SSQ-174 LORAN RECEIVER. The R-1776 Loran Receiver is a solid-state, low frequency receiver designed to track Loran-C signals for frequency calibration and control When used to monitor the Loran-C groundwave, R-1776 frequency measurements are accurate to several parts in 10^{12}, with one-day averaging Key features are

a) All electronic phase tracking servo system
b) Twenty-nanosecond servo resolution.
c) 0.1 microvolt RF sensitivity
d) Protection of vital power, tuning, and tracking controls from accidental operation.
e) Extensive use of integrated circuits
f) Complete coverage of all Loran-C repetition rates.
g) Provision for standby battery.
h) Internal chart recorder

NOTE: Refer to Paragraph 1. 18 for additional specifications

1.12 0-1632/GSQ-174 RF OSCILLATOR The O-1632 RF Oscillator consists of an oscillator servo-control lockup system, and high precision, electrcnic-control component oscillator The oscillator unit is mounted within the chassis frame of the 0-1632 The all digital memory control system and high-stability rate generator lock the voltage-tuned frequency standard to the reference input. Manual frequency slewing of frequency standard aids rapid acquisition; decade slewing rate control is ganged to CONTROL FREQUENCY display range switch for coarse and fine slewing Panel meter and range switches indicate frequency control voltage; range switch selects among four decades of sensitivity

NOTE: Refer to Paragraph 1 21 for additional specifications.

1.13 AN/GSQ-174 SYSTEM SPECIFICATIONS

1.14 The physical and electrical specifications of the AN/GSQ-174 system are listed by component in the following paragraphs.

1.15 CV-2929

1.16 PHYSICAL SPECIFICATIONS

Height	5 1/2 inches
Width	19 inches
Depth	17 1/2 inches
Weight	40 pounds max
Mounting	Standard 19 inch rack

1.17 ELECTRICAL SPECIFICATIONS

Voltage	115/230 volts AC + 15%, line or 22-32 volts DC, 1 amp, standby
Frequency	48 to 420 Hz
Ground	Negative

1.18 R-1776

1.19 PHYSICAL SPECIFICATIONS

Height	5 1/2 inches
Width	19 inches
Depth	17 1/2 inches
Weight	40 pounds max

PHYSICAL SPECIFICATIONS (continued)

Mounting	Standard 19 inch rack
For AS-2739 Antenna	
Height	3 l/2 feet
Weight	Less than ten pounds
Mounting	Standard four-inch pipe flange

1.20 ELECTRICAL SPECIFICATIONS

Voltage	110/220 volts AC line, or 22-32 volts DC, 0.7 amp standby
Frequency	50-400 Hz
Antenna	AS-2739/GSQ-174 loop
RF Sensitivity	0.1 microvolts into 50Ω at tracking point
RF Bandwidth	35 kHz nominal in tracking channel; 5 kHz nominal in acquisition channel
RF Gain Control	0 to 20 dB, in 10 dB steps, plus 0 to 10 dB in 1 dB steps.
For AS-2739 Antenna	
Equivalent Height	0.5 CM nominal @ 100 kHz (50 ohm termination)
3 dB Bandwidth	100 kHz (50-150 kHz) nominal
Delay	Phase Delay, 0.0 microseconds nominal Envelope Delay, 2 microseconds nominal
Cable	Designed for 50 ohm cable (100 feet of RG-58/AU supplied)

1.21 O-1632

1.22 PHYSICAL SPECIFICATIONS

Height	3 l/2 inches
Width	17 inches
Depth	12 inches
Weight	20 pounds max.
Mounting	Standard 19 inch rack

PHYSICAL SPECIFICATIONS (continued)

1.23 ELECTRICAL SPECIFICATIONS

Voltage	115/230 volts AC + 15% line; or 22-32 volts DC, 0.8 amp, standby
Frequency	48 to 420 Hz
Reference Input.	
Level	1 to 10 volts peak-to-peak
Impedance	680 ohms
Frequency	1 MHz + 10^{-7}
Connector	BNC (rear panel)
Standard Output, 1 MHz	
Level	5 volts peak-to-peak
Shape	40% duty cycle pulses
Rise/Fall Time	Less than 20 nanoseconds
Impedance	50 ohms
Frequency	5 MHz (locked to Reference Input)
Quantity	Two
Connector	BNC (rear panel)
Time Constants	
Third Loop	200,000 seconds
Second Loop	50,000 seconds
First Loop	5,000, 250 or 5 seconds selected by front panel switch
Temperature	o° c to 50° c

SECTION II

2.0 INSTALLATION

2.1 SCOPE OF SECTION

2.2 This section describes the steps required to prepare the AN/GSQ-174 Frequency Control Set for operation or reshipment. **Installation** data is presented separately for each of the three components making up an AN/GSQ-174 system. Included for the three components, CV-2929, R-1776 and O-1632 instruments are data on unpacking, inspection, fundamental electronic requirements and shipping.

2.3 AN/GSQ-174 INSTALLATION

2.4 The AN/GSQ-174 system consists of three intercoupled instrument packages. Each requires a set-up and turn-on procedure independent of the other two. The installation procedures in this section describe the proper coupling of each instrument package in the system.

2.5 UNPACKING AND INSPECTION. Unpack the equipment and accessories carefully Thoroughly examine each instrument package for damage that may have occurred during shipment Check each unit for proper operation prior to final rack installation, according to operational checkout procedures.

2.6 INITIAL INSPECTION. Immediately report any equipment damage to the carrier making delivery and to.

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Austin, Texas 78758

Inspect internal components and circuit boards by removing the appropriate covering panels. Examine exterior and interior parts carefully.

2.7 CIRCUIT BOARDS. Exercise care when removing and installing circuit boards to ensure that connector contacts are not damaged. The recommended installation procedure is to slide the board carefully along the guide until it meets resistance to movement, then mate the contacts with a gentle, steady push.

2.8 ACCESSORIES. Each instrument package contains accessories necessary for installation. Check the accessory list against the delivered items. Notify the carrier and AUSTRON, Inc. of any shortages.

2.9 POWER SUPPLY. The AN/GSQ-174 system power supply must meet the requirements of each individual system component. Power not meeting these requirements may result in faulty operation, damage to the system, or both.

2.10 PREPARATION FOR RESHIPMENT

2.11 Check to see that all mounted components are in place and securely tightened. All printed circuit cards should be tightly inserted in their respective connectors.

2.12 For shipping, enclose each instrument package in a suitable water and vapor-proof transparent plastic bag. Projections, sharp edges, or other features which might tear or puncture the plastic bags should be padded with cushioning material Heat seal or tape the plastic bag to ensure a moisture-proof closure. When sealing the bag, keep the trapped air volume to a practical minimum.

2.13 The shipment container should be a rigid box of sufficient strength to protect the equipment from damage.

2.14 CV-2929 FREQUENCY MULTIPLIER, INSTALLATION

2.15 Unpack and examine the equipment and accessories carefully. Prepare the installation site in advance. Refer to Paragraphs 2.3 through 2.9 for more information on basic installation. Review the manual thoroughly before attempting installation.

2.16 INTERCONNECTIONS. All signal Interface interconnections between the CV-2929, primary and backup O-1632 units, the R-1776 Loran Receiver, and the user's system are shown in Figure 4-1. Interconnections should be made with RG-58/U cable terminated with BNC connectors

2.17 CIRCUIT BOARDS. There are 7 printed circuit boards (including the power supply) in the CV-2929. At Installation, inspect each for secure seating and correct positron. Use care when removing and installing each printed circuit board

2.18 STANDARD ACCESSORIES. The following standard accessories should be received with the CV-2929 Frequency Multiplier:

a) Three-wire 115 volts AC power cord.
b) Two extender cards.
c) Set of spare fuses and pilot lamps.
d) Connector for standby DC power.
e) Tuning wand.

2.19 POWER CONNECTIONS Connect 115 volt or 230 volt power, 50-60 Hz, to the CV-2929, using the AC power cable supplied. Select the proper line voltage on the line voltage switch mounted on the power supply module, behind the left front panel. If no-break primary AC power is not available at the installation site, provide 24 volt standby power to the unit in the form of two lantern batteries, or automotive storage batteries. Connect standby power negative to terminal B and positive to terminal A of the rear panel standby power connector.

STANDBY POWER CONNECTION

Terminal A	Positive (+)
Terminal B	Negative (-)
Terminal C	No Connection

2.20 R-1776 LORAN RECEIVER, INSTALLATION

2.21 Unpack and examine the equipment and accessories carefully. Prepare the installation site in advance. Refer to Paragraphs 2.3 through 2.9 for more information on basic installation. Review the manual thoroughly before attempting installation.

2.22 CIRCUIT BOARDS. There are 9 printed circuit boards (excluding the power supply) in the R-1776. At installation, inspect each for secure seating and correct position. Use care when removing and installing each printed circuit board.

2.23 STANDARD ACCESSORIES. The following standard accessories should be received with the R-1776 Loran Receiver:

a) Three-wire 115 volt AC power cord.

b) 3-foot square loop antenna (AS-2739/GSQ-174).

c) 100 feet of RG58/AU antenna cable.

d) Two extender cards.

e) Set of spare fuses and pilot lamps.

f) Connector for standby DC power.

2.24 POWER CONNECTIONS. The R-1776 may be mounted in a standard 19 inch rack with brackets provided, or located on a bench. The R-1776 operates on 20 watts of 115 or 230 volts AC, 48-420 Hz, single phase. Before connecting the power cable to the source, open the left hand access door and verify that the voltage slide switch on the front panel of the Power Supply is in the appropriate position for the voltage to be used. To guard against line power failure, connect auxiliary DC power at the rear panel connector labelled DC STANDBY. When a 22-32 volt, 0.7 amp, DC source is connected, unit operation will be uninterrupted by line power failure when STANDBY switch on POWER SUPPLY is in the ON position. Negative side is connected to chassis.

STANDBY POWER CONNECTION

Terminal A	Positive (+)
Terminal B	Negative (-)
Terminal C	No connection

2.25 ANTENNA. Normal mounting of the antenna is to a horizontal surface by means of a standard four-inch pipe flange, supplied with the loop. Connect the AS -2739 loop antenna to rear panel coaxial connector labeled ANTENNA. Mount the antenna on a rooftop or in a clear area away from sources of interference. On e hundred feet of 50-ohm coaxial cable (RG 58/AU) with BNC connectors installed is supplied with the receiver. Arrow on base of loop antenna should be oriented toward the station. If an antenna 0ther than an AUSTRON loop is to be used, its effective height should not exceed 1 cm at 100 kHz, to prevent overloading the receiver. Because the internal noise of the receiver is appreciable less than the atmospheric noise from even this small antenna, increasing the effective capture area of an antenna will not improve the signal-to-noise ratio but will increase the probability of amplifier limiting from strong interference.

2.26 FREQUENCY STANDARD. Connect a frequency source of 1 MHz to the rear panel connector labeled FREQ STD INPUT. The frequency standard should have an amplitude between 1.0 and 10.0 volts peak-to-peak and a frequency stability of 1 x 10^{-7} or better Standard source is from the CV-2929 Frequency Multiplier.

2.27 ANCILLARY EQUIPMENT. To complete the installation of the R-1776, connect a laboratory oscilloscope the rear pane1 VERTICAL, Z-AXIS and TRIGGER outputs. The oscilloscope should have a vertical sensitivity at least as great as 50 millivolts per division and a sweep rate greater than 50 microseconds per division External recorders, if used for the amplitude strobe detector, should be the adjustable gain potentiometric type with 1.0 to 10.0 volt full scale capabilities. The phase recorder may be either a 5-volt full scale or a 1 milliampere current meter.

2.28 O-1632 RF OSCILLATOR, INSTALLATION

2.29 Unpack and examine the equipment and accessories carefully. Prepare the installation site in advance. Refer to Paragraph 2.3 through 2 9 for more information on basic installation. Review the manual thoroughly before attempting installation.

2.30 CIRCUIT BOARDS There are 14 printed circuit boards in the 0-1632 At installation, inspect each for secure seating and correct position. Use care when removing and installing each printed circuit board.

2.31 STANDARD ACCESSORIES The following standard accessories should be received with the O-1632 RF Oscillator:

a) Three-wire 115 volts AC power cord

b) Connector for standby DC power.

c) One extender card

d) Set of spare fuses and pilot lamps

e) One tuning wand

2.32 POWER CONNECTIONS. The 0-1632 may be mounted in a standard 19 inch rack with brackets provided, or located on a bench. The unit operates on 25 watts of 115 or 230 volts AC, 48-420 Hz, single phase Before connecting the power cable to the source, verify that the voltage slide switch on the rear panel is in the appropriate position for the voltage to be used. To guard against line power failure, connect auxiliary DC power at the rear panel connector labelled DC STBY When a 22-32 volt, 0 8 amp, DC source is connected, unit operation will be uninterrupted by line power failure. All functions of the equipment will operate normally from DC power source only.

STANDBY POWER CONNECTION

Terminal A	Positive (+)
Terminal B	Negative (-)
Terminal C	No connection

SECTION I I I

3.0 OPERATING INSTRUCTIONS

3.1 SCOPE OF SECTION

3.2 This section provides instructions for operating the AN/GSQ-174 Frequency Control Set Operating instructions are provided for each component of the AN/GSQ-174 system Included are general descriptions of set-up, check out, alignment, and operating instructions for the CV-2929 Frequency Multiplier, the R-1776 Loran Receiver, and the O-1632 RF Oscillator A functional description of operating controls and indicators is included.

3.3 OPERATING THE AN/GSQ-174 SYSTEM

3.4 Effective operation of the AN/GSQ-174 system requires thorough familiarity with the operating controls and indicators Before attempting to operate any system component, study the operating controls, functions, and procedures presented in the following paragraphs. Use the manual as a quick reference prior to executing an unfamiliar procedure.

3.5 SYSTEM READINESS. Operation of the system requires correct installation and application of power sources The following procedures assume a proper installation has been made.

3.6 CV-2929 FREQUENCY MULTIPLIER

3.7 SET-UP AND TURN-ON. Apply power to the CV-2929 by setting the AC and STANDBY POWER switches to ON Activate the remainder of the AN/GSQ-174 system according to applicable procedures. in normal operation, no alignment, adjustment, or control action is required for the CV-2929 Combiner and system reference status are indicated by front panel indicator lamps

3.8 LORAN-C REFERENCE In normal operation, Loran- C reference is fixed in the CV-2929 combiner system, thus preventing loss of signal by the R-1776 Loran Receiver

3.9 CONTROLS, INDICATORS, AND CONNECTORS, CV-2929

3.10 Figures 3-1 and 3-2 show the controls, indicators, and connectors on the front and rear panels of the CV-2929 Frequency Multiplier Specific references and function descriptions are provided in the following paragraphs

3.11 FRONT PANEL, CV-2929

REFERENCE	NAME	FUNCTION
1	SYSTEM REFERENCE-LOCAL lamp	Green lamp on indicates normal operation and Loran-C groundwave is present and serving as system phase reference
	SYSTEM REFERENCE-COAST lamp	Red lamp on indicates loss or absence of Loran-C local reference and 1 536/1 544 MHz line remote reference, frequency standards are coasting.
3	SYSTEM REFERENCE-REMOTE lamp	White lamp on indicates absence of Loran-C groundwave, and line 1 536/1 544 MHz is serving as system phase reference
4	COMBINER-PRI lamp	White lamp on indicates backup standard signal is not present, and system is operating on primary standard alone
5	COMBINER-BOTH lamp	Green lamp on indicates normal system operation and all I MHz-related signals and 1 536/1 544

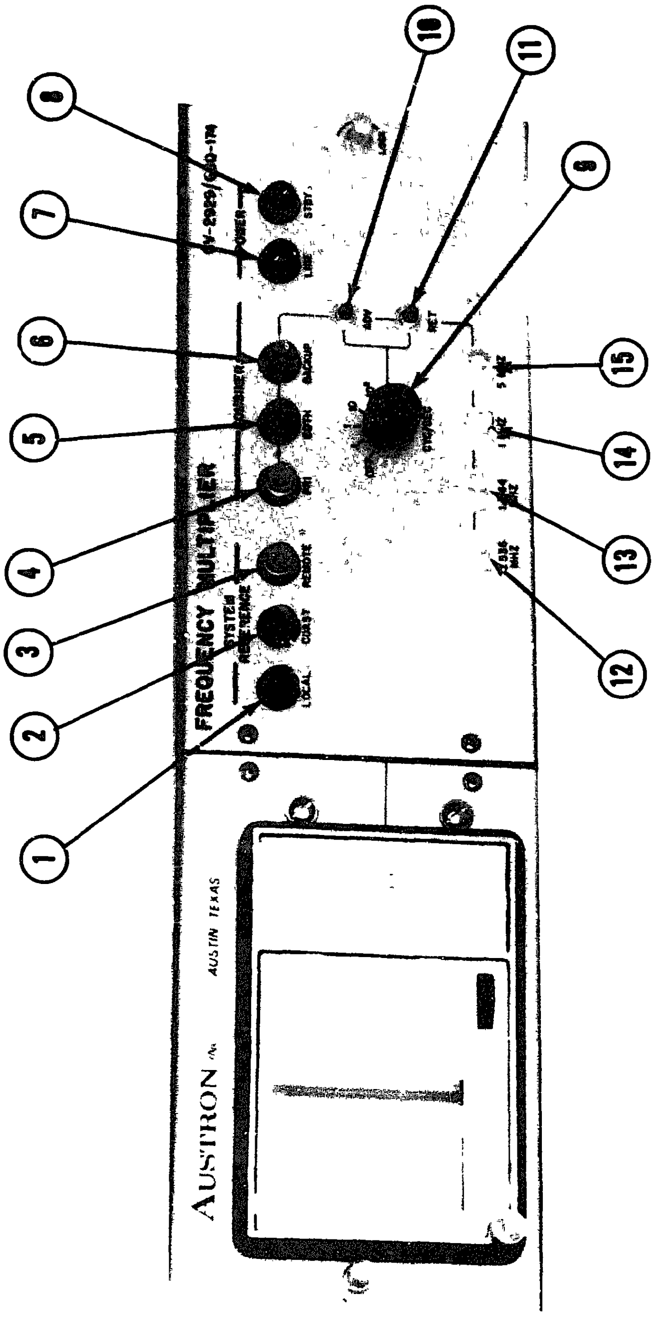


Figure 3-1. CV-2929 Front Panel Controls, Indicators and Connectors

FRONT PANEL, CV-2929 (Continued)

REFERENCE	NAME	FUNCTION
		MHz- related signal phases are derived from averaging of primary and backup standards
6	COMBINER-BACKUP lamp	Red lamp on indicates missing primary standard signal; system is operating on output of backup standard alone.
7	POWER-LINE lamp	Green lamp on indicates normal operation on AC power.
8	POWER-STAY lamp	Red lamp on indicates operation in standby DC power supply
9	CYC/ SEC switch	Five position switch selects slewing rate of electronic servo
10	ADV pushbutton	Depression of the ADV pushbutton advances the electronic servo at the rate set on the CYC/SEC switch
11	RET pushbutton	Depression of the RET pushbutton retards the electronic servo at the rate set on the CYC/SEC switch
12	1 536 MHz	1 volt RMS sine wave into 50 ohms
13	1 544 MHz	1 volt RMS sine wave into 50 ohms
14	1 MHz	1 volt RMS sine wave into 50 ohms
15	5 MHz	1 volt RMS sine wave into 50 ohms

3.12 REAR PANEL, CV-2929

REFERENCE	NAME	FUNCTION
1	DIFF PHASE OUT	Current proportional to front panel meter reading Full scale represents 1 cycle at 1 536 or 1 544 MHz

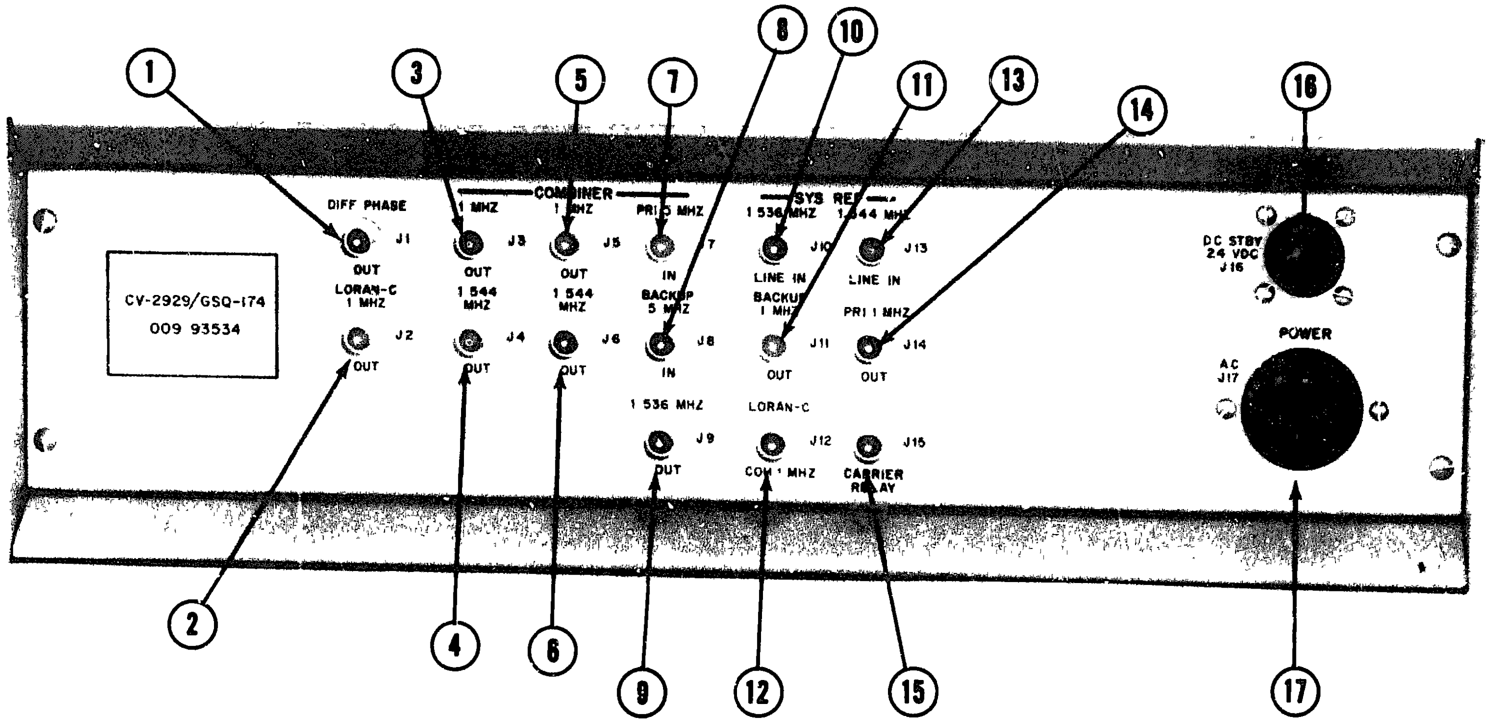


Figure 3-2. CV-2929 Rear Panel Controls, Indicators, and Connectors

REAR PANEL, CV-2929 (Continued)

REFERENCE	NAME	FUNCTION
2	LORAN-C 1 MHz OUT	1 volt RMS sine wave into 50 ohms
3	COMBINER- 1 MHz OUT	1 volt RMS sine wave into 50 ohms Same as front panel
4	COMBINER- 1 544 MHz OUT	1 volt RMS sine wave into 50 ohms. Same as front panel
5	COMBINER- 1 MHz OUT	1 volt RMS sine wave into 50 ohms To R-1776 FREQ STD input
6	COMBINER-l 544 MHz OUT	1 volt RMS sine wave into 50 ohms Same as front panel
7	COMBINER-PRI 5 MHz IN	0 5 to 5 volts RMS sine or square wave into 600 ohms from primary O-1631
8	COMBINER-BACKUP 5 MHz IN	0.5 to 5 volts RMS sine or square wave into 600 ohms from backup 0-1632.
9	COMBINER-l 536 MHz OUT	1 volt RMS sine wave into 50 ohms Same as front panel
10	SYS REF-1.536 MHz LINE IN	0.5 to 5 volts RMS sine or square wave into 600 ohms
11	SYS REF-BACKUP 1 MHz OUT	1 volt RMS sine wave into 50 ohms. To backup O-1632.
12	SYS REF-LORAN-C COH 1 MHz	0.5 to 5 volts RMS sine or square wave into 600 ohms From R- 1776
13	SYS REF 1 544 MHz LINE IN	0.5 to 5 volts RMS sine or square wave into 600 ohms.
14	SYS REF-PRI 1 MHz OUT	1 volt RMS sine wave into 50 ohms. To primary O-1632
15	SYS REF-CARRIER RELAY	From R-1776 +20 volts indicates loss of LORAN-C signal Ground indicates signal present

REAR PANEL, CV-2929 (Continued)

REFERENCE	NAME	FUNCTION
16	DC STBY	DC standby power input.
17	POWER	AC line power input.

3.13 R-1776 LORAN RECEIVER

3.14 SET-UP AND TURN-ON. The R-1776 requires more steps in the set-up, turn-on. and operating procedure than other system components: Before operation specific steps must be followed to ensure correct power supply and internal control settings Internal controls require close attention to ensure continuous monitoring of a selected Loran-C station These controls are mounted on printed circuit boards The power supply panel and the internal controls or the PCB's are easily accessible behind the front panel doors. (Refer to Figure 3-3.)

3.15 POWER SUPPLY. Open the front panel door and check the following conditions.

1. Fuses	Standard 3AG for standby power protection, B+, and AC line.
2. 115/230	Slide switch set to proper transformer connection for selected A C operating voltage.
3. AC-ON	AC power switch set to ON.
4 DC STBY-ON	DC standby power switch set to ON.

3.16 INTERNAL CONTROLS. Printed circuit boards A5, A6, A7, A8, and A10 require attention to internal control settings prior to operation of the R-1776 Settings are as follows:

PCB No A5	$10^4 \mu sec/10^3 \mu sec/10^2 \mu sec$ -- Three decade rotary switches select desired Loran- C repetition period in 100 microsecond incre-

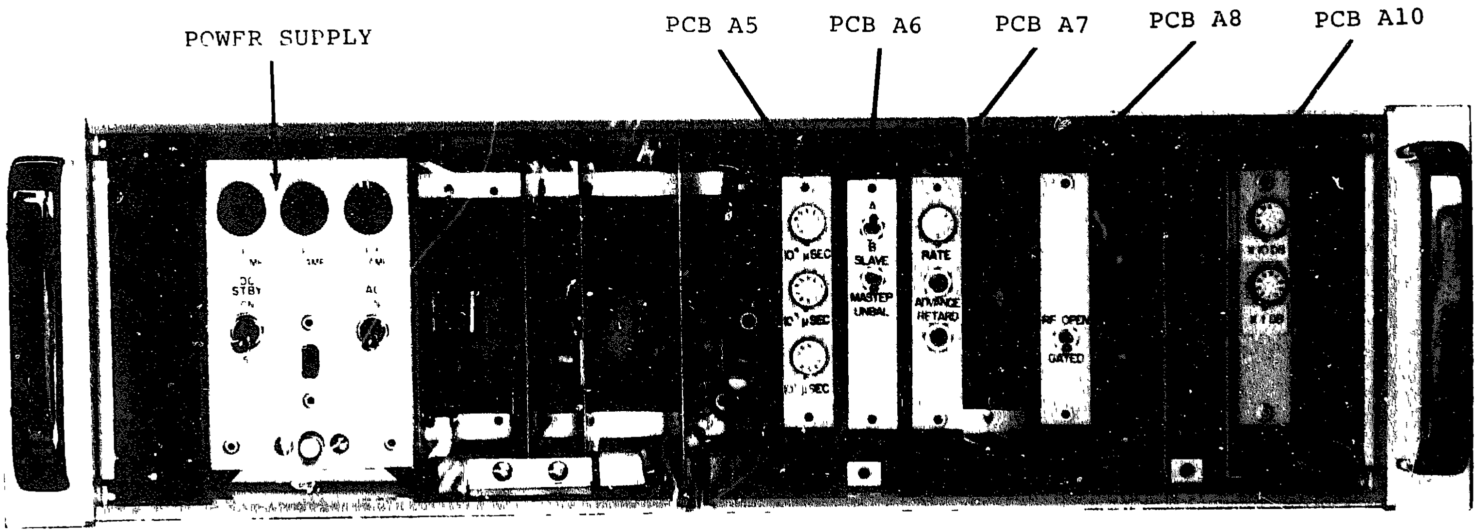


Figure 3-3. R-1776 Internal Controls

INTERNAL CONTROLS (Continued)

	ments from 20,000 to 109,000 microseconds.
PCB No A6	A/B -- Toggle switch selects sequence of phase code group in Frame Changing switch setting effectively moves coding one repetition period
	SLAVE/MASTER -- Toggle switch selects phase code for master or slave transmitter.
PCB No A7	RATE -- Rotary switch selects rate at which electronic phase shifter is slewed when ADVANCE or RETARD button is depressed Fast rate (F) is 10,000 microseconds/second. Slow rate (S) is one microsecond/second
	ADVANCE -- Pushbutton switch advances electronic phase shifter while button is depressed.
	RETARD -- Pushbutton switch retards electronic phase shifter while button is depressed
PCB No. A8	RF OPEN/GATED -- Toggle switch selects phase decoding for phase tracking or opens phase decoding switch for acquisition
PCB No. A10	XlODB/XlDB -- Rotary switches adjust RF gain. Switches read db of attenuation Maximum gain is 0 db, minimum gain is 99 db.

3.17 CONTROLS, INDICATORS, AND CONNECTORS, R-1776

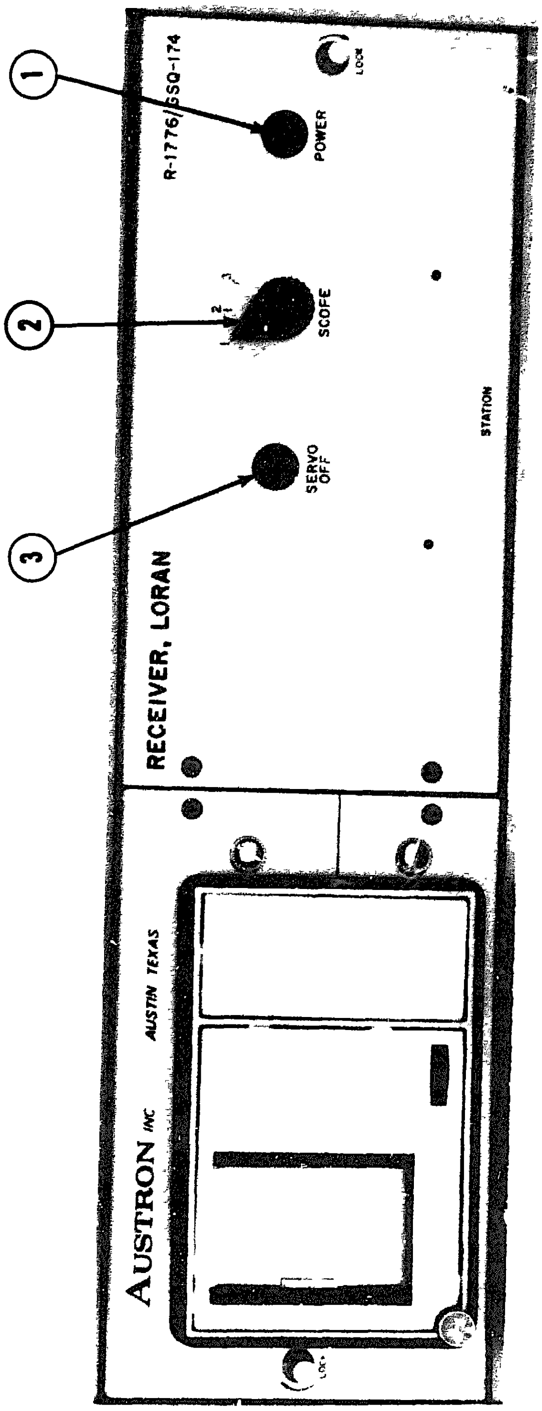


Figure 3-4. R-1776 Front Panel Controls, Indicators and Connectors

3.18 Figures 3-4 and 3-5 show the controls, indicates, and connectors on the front, rear, and interior panels of the R-1776 Loran Receiver Specific references and function descriptions are provided in the following paragraphs

NOTE: Internal controls are described in Paragraphs 3.15 and 3.16.

3.19 FRONT PANEL, R-1776.

REFERENCE	NAME	FUNCTION
1	POWER lamp	Indicator lamp is on when receiver is operating on AC power.
2	SCOPE mode switch	Rotary switch selects one of three scope outputs at corresponding connectors: Z-AXIS, TRIG, and VERT See Table below:

SCOPE Mode Switch Settings

Position	Z-Axis	Vertical	Trigger
1	Eight 150 usec pulses during window	5 KHz BW View RF	1 ms before RF window
2	Eight 150 usec pulses during window	5 KHz BW View RF	Eight 5 ms pulses at Scan window
3	1 usec Phase Strobe	Tracking RF (35 KHz SW)	Eight 5 ms pulses at Scan window

REFERENCE	NAME	FUNCTION
	SERVO OFF lamp	Indicator lamp is off when receiver is tracking the Loran-C signal

3.20 REAR PANEL, R-1776

REFERENCE	NAME	FUNCTION
1	SCOPE - VERT/TRIG Z-AXIS	Connectors providing corresponding signals.
2	INCREASE	Potentiometer sets full scale current for 10 usec phase output.
3	ZERO	Pushbutton switch sets outputs at connector of linear phase comparators, and amplitude strobe to zero when depressed
4	FULL SCALE	Pushbutton switch sets linear phase comparator outputs to full scale when depressed
5	POWER - DC STBY 22-32VDC	Connector for 22-32 volts DC, 0.7 amps, input.
6	POWER - AC	Connector for 115/230 + 15% volts AC, 48-420 Hz input.
7	10 uSEC	Connector for 10 usec phase comparator output for external chart recorder Adjacent locking control for setting full scale current.
8	FREQ STD INPUT	Connector for 1 MHz signal from the CV-2929; 1-10 volts peak-to-peak input level
9	PHASE SHIFTED - 1 MHz	Output of phase shifted standard oscillator to provide 1 MHz signal corrected to received Loran-C signal, 3 volts peak- to-peak.
10	GRP	Connector for 8 millisecond pulse coincident with first phase gate (5 volts peak- to-peak).
11	CARRIER "RELAY"	Connector provides signal from

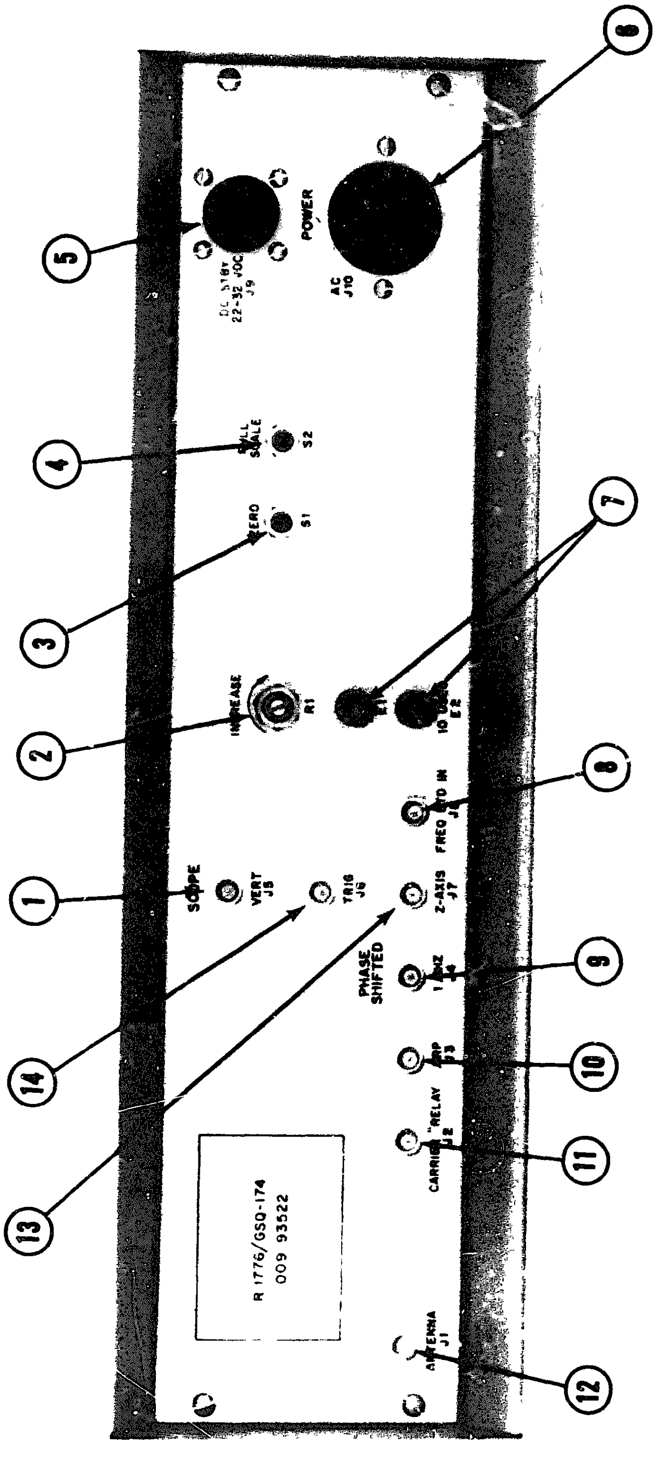


Figure 3-5. R-1776 Rear Panel Controls, Indicators and Connectors

REAR PANEL, R-1776 (Continued)

REFERENCE	NAME	FUNCTION
		servo lock lamp (+20 volts for signal, zero volts for no signal).
12	ANTENNA	Connector for whip or loop antenna input signal Impedance is 50 ohms
13	Z-AXIS	Trigger output for oscilloscope Z-axis
14	TRIG	Output to oscilloscope external trigger

3.21 STEP-BY-STEP OPERATING INSTRUCTIONS, R- R-1776

3.22 The following are detailed instructions for operating the R-1776 Loran Receiver The instructions Include steps for turning the unit on, control settings in sequence for various stages of signal acquisition and tracking, and helpful hints for easy operation of the R-1776.

3.22 1 The R-1776 receiver requires a stable 1 MHz reference input in order to acquire and track a Loran-C signal The 1 MHz reference is normally derived from the outputs of the O-1632 RF Oscillators The 0-1632 RF Oscillators in turn rely upon the R-1776 Receiver output to control their output frequency Therefore, during the initial start-up the alternate turn-on procedure must be used (see Paragraph 3 32) After the O-1632 RF Oscillators have been turned on using the alternate procedure, then the normal R-1776 turn-on procedure can be used.

3.23 R-1776 TURN-ON -- STEP-BY-STEP PROCEDURE After installing the R-1776 according to Section II, verify that the power supply voltage slide switch IS in the appropriate position for voltage to be used

STEP	PROCEDURE
1	Turn AC Power Supply switch ON Line indicator lamp should come on
2	Set Pulse Repetition Period (PCB No A5) to period in usec of Loran-C chain desired
3	Set Slew Rate (PCB No A7) RATE to F (fast)

R-1776 TURN-ON -- STEP-BY-STEP PROCEDURE (Continued)

STEP	PROCEDURE
Text	Set RF OPEN/GATED switch (PCB NO. A8) to OPEN.
Text	Set RF ATTENUATOR (PCB No. A10) to about 20 dB.
Text	Set SCOPE mode (Front Panel) to 1.
Text	Set oscilloscope controls Vertical -- About 1 volt/div. Trigger -- + slope, + level, DC or AC Sweep Speed -- 10 mlllisec/div.

3.24 SCOPE ADJUSTMENT. (See Figure 3-8.) Adjust the scope intensity so that eight bright pulses appear on the left side of the scope display between one and nine milliseconds after the start of the sweep. Another group of eight bright pulses will appear one repetition period later on the right side of the scope display. The vertical signal appears as random impulse noise with the signals from the selected Loran-C chain appearing as a stationary sequence of eight or nine pulses. Groups of pulses moving across the scope are from Loran-C chains of different repetition periods. Stations are identifiable by pulse repetition rate, For better viewing, the RF Attenuator (PCB No. A10) may be adjusted so that the amplitude of the group of eight or nine pulses from the desired station is at about 2 volts peak-to-peak. This amplitude setting will remain the same for all modes.

3.25 The ADVANCE or RETARD pushbuttons (PCB No. A7) will slew the electronic servo causing the groups of eight or nine pulses to move left or right on the scope display. Slew the eight pulses from the desired Loran-C station to match the eight Intensified spots at the start of the sweep. The slew rate is selected by the RATE switch. The slow (S) rate is 1 microsecond per second. The rate is increased in decade steps to the fast (F) rate of 10,000 microseconds per second.

NOTE: Sweep speed should be increased to one millisecond/div before making final adjustments. The Loran-C signals are "fixed" in time. The ADVANCE and RETARD pushbuttons move the scope trigger in a direction with respect to the Loran-C signals Because the scope is triggered from phase shifted signals, the Loran-C signals will appear to move in the opposite direction to the button labels.

3.26 Reposition the receiver and oscilloscope controls as follows:

SCOPE Mode Switch	2
RF OPEN/GATED	RF GATED
Scope Sweep Speed	20 usec/dlv

These settings superimpose the pulses so that the carrier within the pulse envelope may be observed

3.27 Using the ADVANCE or RETARD pushbuttons (PCB No A7) slew the beginning of the pulse envelope to the beginning of the intensified area on the scope. It may be necessary to readjust scope intensity for proper contrast This slewing adjustment is not critical The slow rise of the pulse makes it impossible to determine when it starts One of the first few cycles of the carrier is now placed in the tracking gate

3.28 Position the SLAVE/MASTER and A/B switches (PCB No A6) so that the pulse carrier is decoded Figure 3-9 shows correct and incorrect phase decoding If the pulse carrier will not decode in any combination of SLAVE/MASTER and A/B switch positions, either the station is not transmitting eight pulses or the eight pulses are not centered in the eight intensified areas on the scope display. To determine which is the case, repeat the steps beginning at Paragraph 3.23.

3.29 Set the SCOPE mode switch to position 3. Pulse may be slewed to place tracking point intensified spot (Figure 3-9) on positive slope of third cycle of pulse. Make fine slewing adjustment to place intensified spot at a zero crossing of pulse. SERVO OFF lamp should be off indicating that receiver is tracking the signal.

3.30 CHANGING TRACKING POINTS. To change the tracking point, press either the ADVANCE or RETARD button (PCB No. A7) depending on which way the tracking point is to be moved. Advance or retard the tracking point an integral number of cycles Because the 100 KHz Loran-C carrier has a period of 10 microseconds, one cycle of the carrier equals one cycle of meter deflection Therefore, when the recorder needle passes the initial reading a number of times equal to the number of cycles the tracking point is to be shifted, and stops on the initial reading, the tracking point has been shifted the desired integral number of cycles

3.31 To verify that the tracking servo is operating properly, note the reading on the chart recorder. Slew the tracking point about one microsecond. If the servo is operating properly, the needle will slowly return to the initial reading.

3.32 R-1776 TURN-ON -- ALTERNATE PROCEDURE. This procedure must be used for the initial turn-on (see Paragraph 3.22. 1).

STEP	PROCEDURE
1	Connect the system as shown in Figure 4-1.
2	Turn the 0-1632 RF Oscillators on for at least two hours for warm-up.
3	Disconnect the 1 MHz REFERENCE in and the 5 MHz STANDARD out from the BACK-UP O-1632 RF Oscillator.

R-1776 TURN-ON -- ALTERNATE PROCEDURE (Continued)

STEP	PROCEDURE
4	Slew the AGING indicator to zero and the FREQ Xl indicator to mid-scale on the PRIMARY O-1632 RF Oscillator. Follow the R-1776 Receiver turn-on instructions given in Paragraphs 3.23 through 3.31.

NOTE: If the Loran-C signal drifts and the receiver will not track, slew the FREQ Xl indicator on the PRIMARY 0-1632 RF Oscillator until the drift ceases (Refer to paragraph 3.37)

STEP	PROCEDURE
6	After the receiver has locked on and is tracking the Loran signal, place the CONTROL MODE switch of the PRIMARY O-1632 in the LOCK SERVO position
7	Follow steps 1 through 7 of Paragraph 3.42 to turn-on the BACK-UP 0-1632 RF Oscillator except use the PHASE SHIFTED 1 MHz from the R-1776 Receiver for the scope trigger input
8	Place the Control Mode switch of the PRIMARY 0-1632 RF Oscillator to the LOCK SERVO position

R-1776 TURN-ON - - ALTERNATE PROCEDURE (Continued)

STEP	PROCEDURE
9	Connect the 1 MHz REFERENCE in and the 5 MHz STANDARD out from the BACK-UP O-1632 RF Oscillator to the CV-2929 Frequency Multiplier
10	Disconnect the PRIMARY O-1632 RF Oscillator 5 MHz STANDARD out and 1 MHz REFERENCE in from the CV-2929 Frequency Multiplier.
11	Repeat steps 3 through 9 above except substitute the BACK-UP O-1632 for the PRIMARY O-1632 RF Oscillator.
12	Go to ACQUISITION Procedure (Paragraph 3.43).

3.33 0-1632 RF OSCILLATOR

3.34 SET-UP AND TURN-ON. The O-1632 requires only basic set-up and turn-on procedures. Verify that the proper AC power supply voltage has been selected and set the ON switch to ON. The most critical step is the requirement to wait two hours for the 5 MHz crystal oscillator to stabilize. Activate the remainder of the AN/GSQ-174 system according to applicable procedure

3.35 CONTROLS, INDICATORS, AND CONNECTORS, 0-1632

3.36 Figures 3.6 and 3.7 show the controls, indicators, and connectors on the front and rear panels of the O-1632 RF Oscillator. Specific references and function descriptions are provided in the following paragraphs

3.37 FRONT PANEL, 0-1632.

REFERENCE	NAME	FUNCTION
1	**ON Switch**	**Toggle switch turns AC and DC power on or off**
2	**LINE Lamp**	**Indicator lamp is on when unit is operating on AC power.**
3	**STBY Lamp**	**Indicator lamp is on when unit is operating on DC power.**
4	**CONTROL MODE Switch**	**Rotary switch selects one of five operating mode s.**

CONTROL MODES

LOOP TIME CONSTANT (SEC)

	First	Second	Third
T1	5	**50,000**	**200,000**
T2	**250**	**50,000**	**200,000**
T3	**5,000**	**50,000**	**200,000**
LOCK **SERVO**	**Locked**	**Locked**	**Locked**
SET CONTROL	**Locked**		

*** Manually controlled by INC and DEC switches.**

REFERENCE	NAME	FUNCTION
	INC	Increases **DC** output of second or third loop which, increases output frequency when depressed and the **CONTROL MODE** switch is in **SET CONTROL.**
6	**DEC**	Decreases **DC** output of second or third loop which decreases output frequency when depressed and the **CONTROL MODE** switch is in **SET CONTROL.**
7	CONTROL VOLTAGE Switch	Rotary switch selects meter range. (For calibration see paragraph 5.21)
8	**METER**	**Monitors oscillator control voltage and control loop outputs, according to the setting of the front panel** switches.

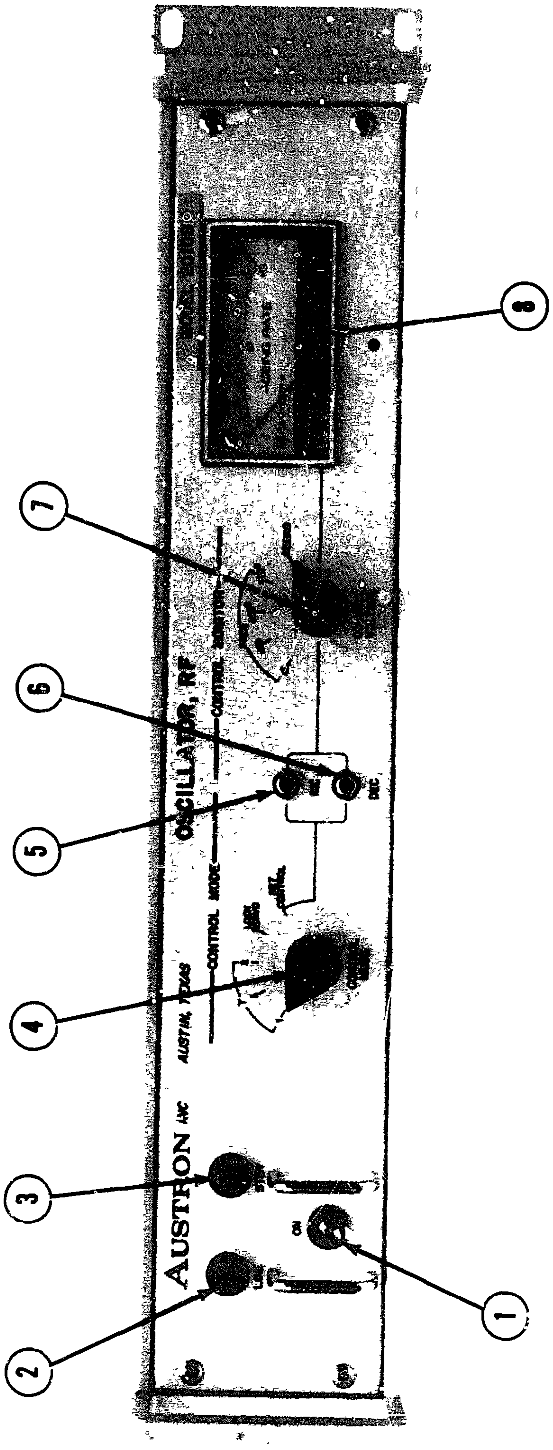


Figure 3-6. O-1632 Front Panel Controls, Indicators and Connectors

3.38 REAR PANEL, 0-1632.

REFERENCE	NAME	FUNCTION
1	CONTROL MONITOR	Connector provides a DC voltage proportional to front panel meter reading. Range is from 0 to 5 volts DC, 10 K impedance. 0.5 to 10 volts peak-to-peak 1 MHz reference signal.
2	CONTROL VOLTAGE - 1	Connector provides a DC voltage proportional to oscillator control voltage. Range is from 0 to 5 volts DC, 10 K impedance.
3	REF IN - 1 MHz	Connector provides input for 1 MHz
4	STD OUT - 5 MHz	Connector provides 5 volts peak-to-peak square wave, 50-ohm impedance signal from 5 MHz crystal oscillator.
5	STD OUT - 1 MHz	Connector provides 5 volts peak-to-peak, 40% duty cycle pulses, 50-ohm impedance signal from 5 MHz crystal oscillator
6	5V REG-2A	3AG-2 amp fuse protects 5-volt power supply
7	AC-2A	3AG-2 amp fuse protects AC power
8	DC STBY	Connector provides input for DC standby power 22 to 32 volts DC at 0 8 amps
9	115/230	Slide switch selects proper transformer connections for 115 or 230 volts AC operation
10	AC POWER	Connector provides input for AC power 115 or 230 volts + 15%, 48-420 Hz

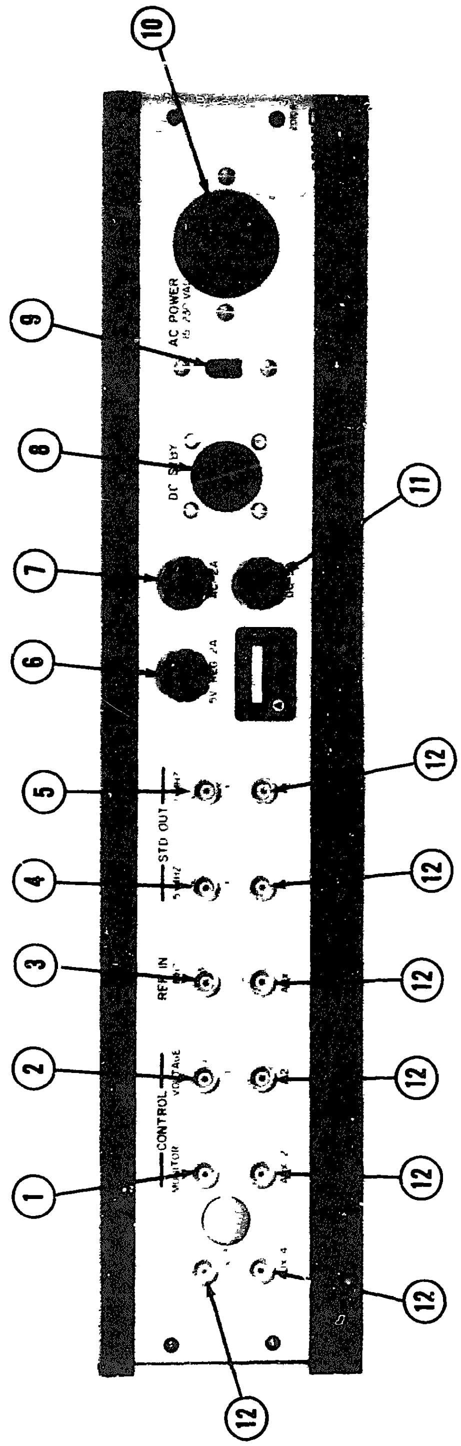


Figure 3-7. O-1632 Rear Panel Controls Indicators and Connectors

REAR PANEL, 0-1632 (Continued)

REFERENCE	NAME	FUNCTION
11	DC-5A	3AG-2 amp fuse protects DC power
12	AUX 1, 2, 3, 4 and CONTROL VOLTAGE-2	No connection

3.39 STEP-BY-STEP OPERATING INSTRUCTIONS, 0-1632

3.40 The following are basic instructions for operating the O-1632 RF Oscillator as part of the AN/GSQ-174 system The instructions Include steps for turning on the unit, setting servo loops, acquisition, and basic information on operating restrictions

3.41 0-1632 TURN-ON STEP-BY-STEP PROCEDURE After installing the 0-1632 according the Section II, verify that the power supply slide switch is in the appropriate position for voltage to be used.

STEP	PROCEDURE
1	Verify proper AC power setting (115 or 230 volts)
2	Set ON switch to ON. The LINE and STBY indicator lamps should come on Wait two hours after turn-on for 5 MHz crystal oscillator to stabilize

3.42 SET SERVO LOOPS PROCEDURE Following the two hour wait after turn-on (Paragraph 3.41), servo loops can be set.

STEP	PROCEDURE
1	Ensure that the 1 MHz REFERENCE input is disconnected
2	Trigger an oscilloscope from a 1 MHz frequency standard (normally the CV-2929 output)

SET SERVO LOOPS PROCEDURE (Continued)

STEP	PROCEDURE
3	Connect the VERTICAL input of the oscilloscope to the 1 MHz STANDARD out.
4	Set the AGING meter indication to zero by utilizing the SET CONTROL position of the CONTROL MODE switch and the INCREASE and DECREASE pushbutton switches.
5	Set the FREQUENCY X1 meter indication to midscale using the controls as in step 4.
6	Set the CONTROL MODE switch to the LOCK SERVO position.
7	Observe the oscilloscope display. If the 1 MHz STANDARD output frequency waveform drifts less than 0 1 microsecond in a one hundred second time period (frequency difference of less than 10^{-9} between the trigger input and the 1 MHz STANDARD output) then no adjustment is necessary If the drift is greater than 0 1 microsecond in one hundred seconds, then adjust the trimmer capacitor in the MODEL 1155 oscillator through the access hole in the rear panel until the drift is within the above stated limit
8	Go to ACQUISITION PROCEDURE (Paragraph 3 43)

3.43 ACQUISITION PROCEDURE.

STEP	PROCEDURE
1	Set CONTROL MODEL to T1.
2	Set CONTROL VOLTAGE to AGING.

NOTE The three servo loops will have reached equilibrium when the METER reading stabilizes. The third loop time constant is 200,000 seconds or approximately two and one-third days. Therefore, wait about four and one-half days or at least two times as long as the third loop time constant for the reading to stabilize. During this time, the 1 MHz and 5 MHz OUTPUTS will be locked to the 1 MHz REF IN signal and may be used as if the loops have reached equilibrium. If the 1 MHz REF IN signal is removed before the loops reach equilibrium, the 1 MHz and 5 MHz OUTPUTS will take up the frequency and aging rate set by the servo loops.

3.44 POST ACQUISITION PROCEDURE.

STEP	PROCEDURE
1	Set CONTROL VOLTAGE to desired position to monitor frequency or aging control voltage.
2	Record METER readings at regular intervals

POST ACQUISITION PROCEDURE (Continued)

STEP	PROCEDURE
3	Set CONTROL MODE to Tl, T_2, or T3, providing restrictions in Paragraphs 3.46 and 3.47 are not exceeded

NOTE: After a long interval of time, the X1 meter reading may approach full scale or zero. If so, repeat Paragraphs 3.42 and 3.43.

3.45 OPEN LOOP OPERATION PROCEDURE If a 1 MHz REF signal is not available, follow these steps:

STEP	PROCEDURE
1	Set CONTROL MODE to SET CONTROL.
2	Set CONTROL VOLTAGE to AGING
3	Depress INC or DEC pushbutton switches until METER indicates zero aging rate at midscale
4	Set CONTROL VOLTAGE to Xl, x10, $x10^2$, or $X10^3$
5	Depress INC or DEC pushbutton switches to change 5 or 1 MHz OUT frequency
6	Set CONTROL MODE to LOCK SERVO

OPEN LOOP OPERATION PROCEDURE (Continued)

STEP	PROCEDURE

NOTE: When in LOCK SERVO position, the three loops are locked and will not respond to the INC or DEC switches or the 1 MHz REFERENCE INPUT The 5 MHz crystal oscillator aging rate will be corrected by the rate locked in the third loop

STEP	PROCEDURE
7	**After some time interval, measure output frequency and compute aging rate** (Refer to Appendix B)

NOTE: Before proceeding to next steps, refer to calibration data

STEP	PROCEDURE
8	**Set CONTROL MODE to SET CONTROL**
9	**Set CONTROL VOLTAGE to AGING**
10	**Depress INC or DEC pushbutton switches to correct aging rate by computed amount**
11	**Set CONTROL VOLTAGE to X1 (1.4** parks in 10^{-7}), x10 (1.4 parts in ***10*** -8, x10 2 **(1.4** parts in 1O-^{9}), or X10 ^{3} (1.4 parts in 10^{-10})

OPEN LOOP OPERATION PROCEDURE (Continued)

STEP	PROCEDURE
12	Depress INC or DEC pushbutton switches to correct frequency by the computed amount.
13	Readjust oscillator as required.

3.46 OPERATING RESTRICTIONS. The 1 MHz, REF IN signal cannot change phase more than about 0.5 microsecond during the time constant selected by the CONTROL MODE switch If the phase change is larger, then the three loops will lose lock If the unit loses lock, a shorter time constant must be selected or the 1 MHz REF IN phase change is reduced.

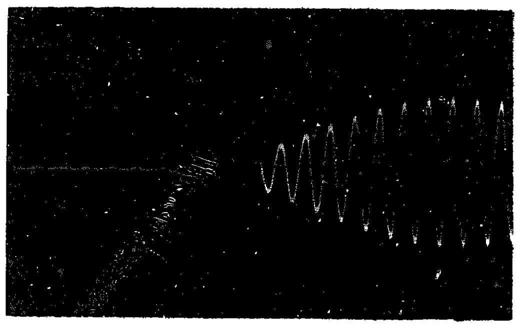
3.47 The 5 MHz crystal oscillator aging rate cannot exceed 1.5×10^{-9} or the third loop will lose lock.

Mode = 1
Sweep Speed = 10 M Sec/Div
RF Open
Vertical = Approx. 1 Volt/Div

Mode = 1
Sweep Speed = 1 M Sec/Div
RF Open
Vertical = Approx. 1 Volt/Div

Figure 3-8. Oscilloscope Display for Loran-C Signal Acquisition

Mode = 2
RF Gated
Incorrect Decoding
Sweep Speed = 20 μSec/Div
Vertical = Approx. 1 Volt/Div



Mode = 2
RF Gated
Correct Decoding
Sweep Speed = 20 μSec/Div
Vertical = Approx. 1 Volt/Div

Mode = 3
RF Gated
Correct Decoding

Intensified Spot
-- Tracking Point
Sweep Speed = 20 μSec/Div
Vertical = Approx. 1 Volt/Div

Figure 3-9. Phase Decoding Waveforms

SECTION IV

4.0 PRINCIPLES OF OPERATION

4.1 SCOPE OF SECTION

4.2 This section provides a general description of the overall operation of the AN/GSQ-174 Frequency Control Set, and a detailed analysis of circuits in each of its components, CV-2929, O-1632, and R-1776. This information is supported by block diagrams and references to schematic diagrams as required.

4.3 FUNCTIONAL DESCRIPTION

4.4 The AN/GSQ-174 consists of three separate components. The CV-2929 Frequency Multiplier; the R-1776 Loran Receiver, and the O-3632 RF Oscillator. Each component is made up of unique operating sections, Including independent power supplies for each. Refer to Figure 4-1 for functional block diagram of the AN/GSQ-174 system. Functional descriptions, schematics and block diagrams follow in this section for each separate component.

4.5 THE AN/GSQ-174 SYSTEM. In the complete configuration, containing proper hookup of the CV-2929, R-1776, and O-1632, the AN/GSQ-174 system performs several Loran-C functions. The Loran Receiver (R-1776), supported by an interface unit (CV-2929) and a disciplined frequency standard (O-1632), performs the following functions

a) Receives and decodes Loran-C signals for all Pulse Repetition Rates.
b) Phase tracks the decoded signals.
c) Produces phase corrected pulses at selected Pulse Repetition Rates.

d) Provides a phase corrected 1 MHz reference signal.

e) Provides an output for indicating and recording phase difference between the received carrier and external frequency standard.

f) Identifies the tracking position within the Loran-C pulse envelope

4.6 AN/GSQ-174 SYSTEM COMPONENTS

4.7 CV-2929 FREQUENCY MULTIPLIER. The CV-2929 acts as a standard frequency combiner, standard frequency reference logic and distribution unit, and frequency synthesizer. Figure 4-2 shows the functional components of the system. Figure 4-3 shows operation of 1 536/1. 544 MHz and 1 000 MHz synthesizers in greater detail In furnishing these functions, the CV-2929 provides all necessary system and electronic Interfacing between the R-1776 Loran Receiver, and primary and backup O-1632 RF Oscillator, to form the AN/GSQ-174 Frequency Control Set

4.8 COMBINER SYSTEM A combiner system within the CV-2929 supplies standard frequency derived from both primary and backup disciplined frequency standards to the 1. 536/1 544 MHz synthesizer in normal operation. If one of the two standards should fall, switch-over to the remaining operative standard will occur automatically, without dropout of the standard frequency signal. As shown in Figure 4-2 the combiner consists primarily of a mixer that obtains the sum frequency (and phase) of primary and backup signals, and a divide-by-two circuit that reduces the 10 MHz sum frequency back to 5 MHz. By virtue of this method of operation, the 5 MHz signal exhibits the average of the phases of the two input signals. Phase stability of the synthesizers is better than 50 nano - seconds equivalent.

4.9 SYSTEM REFERENCE LOGIC The System Reference Logic subsystem of Figure 4-2 ensures that the 1 536/1 544 MHz system is slaved to the best available reference The rule of operation of the system establishes the system phase reference as

a) Loran-C groundwave, whenever available, or
b) Line 1.536/1.544 MHz, when Loran-C reference is not available;
c) No reference signal is provided when both Loran-C and 1.536/1 544 MHz line signals are absent, so that CV-2929 units automatically switch over to the "coast" mode of operation. System reference indicator lamps on the CV-2929 front panel indicate status of the reference.

4.10 R-1776 LORAN RECEIVER. (Refer to Figure 4-4, Block Diagram) In the R-1776, the received RF signal is amplified, filtered, and then phase detected. The phase strobe samples each Loran-C pulse for one microsecond. If the average signal during the one-microsecond sample is not zero, the electronic phase shifter will shift the phase or time of the phase gate until the average signal is zero. Thus, if the phase gate is late, the phase error signal will cause the electronic phase shifted to advance the phase gate. In this way, the phase gate will remain "locked" to any desired cycle of the Loran-C pulse. The linear phase comparator provides an output proportional to the relative time difference between the frequency standard and the received Loran-C pulse.

4.11 PHASE DECODING. (Refer to Figure 4-5 and 4-6, Block Diagrams.) The RF signal from the antenna is amplified and inverted so that in-phase and out-of-phase RF is available to the Phase Decoding Switch. The Phase Decoding Switch, controlled by a phase code generator, switches in-phase and out-of-phase RF during the time the RF is gated and is grounded at all other times to provide a no signal reference for the phase strobe. The decoded RF is then filtered, amplified, and supplied to two strobe detectors and the scope. The phase strobe samples a one-microsecond segment and produces a phase error signal proportional to the displacement of the center of the strobe with respect to the zero crossing of the RF signal. The Amplitude Strobe is also one-microsecond wide but IS displaced one-fourth cycle from the Phase Strobe. The output of the Amplitude Strobe is monitored by a threshold circuit which locks the tracking servo when the RF signal disappears. The RF signal is supplied to an accessory scope in the tracking bandwidth or in a narrow bandwidth (5 KHz; for viewing.

4.12 PULSE REPETITION RATE A one megahertz signal is supplied to the Frequency Standard Input where it in multiplied by ten and shaped. The resulting normalized 10 MHz signal is supplied to an electronic phase shifter and a reference divider. The first Phase Shifter is controlled by the Phase Error output to servo the location of Phase and Amplitude Strobes The phase-shifted 10 MHz signal is divided to 100 KHz and compared in a Linear Phase Comparator to a 100 KHz signal from the reference standard, producing a 10 microsecond record output. The phase shifted 10 KHz signal provides a reference for the Preset Counter. The period for 10 KHz is 100 microseconds and is in the “building block” of all Loran-C PRR.

4.13 The output of the Preset Counter is the Loran-C Pulse Repetition Rate (PRR) and is supplied to the Strobe and Phase Code Generator. The output also furnishes a Scope Trigger The Strobe and Phase Code Generator produces decoding signals for the Phase Decoding Switch and gate signals for the Amplitude and Phase Strobes. The Strobe and Phase Code Generator also produces a Z-axis signal to intensify the auxiliary scope

4.14 O-1632 RF OSCILLATOR. The O-1632 is a high stability crystal oscillator controlled by an all-electronic third order servo loop Figure 4-7 is a functional block diagram. The 0-1632 provides a disciplined frequency standard for use in the AN/GSQ-174 system

4.15 CRYSTAL OSCILLATOR. The 5 MHz output of the crystal oscillator is phase shifted and then buffered to produce the 5 MHz standard output. A divider (÷5) and buffer amplifier produce the 1 MHz standard output. The A-PHASE SHIFTER, controlled by the A-PHASE

DETECTOR, keeps the 5 and 1 MHz standard output signals phase-locked to the 1 MHz reference

4.16 B AND D DIVIDERS The outputs of B-DIVIDER and D-DIVIDER are phase detected and then filtered to produce the control voltage for the 5 MHz crystal oscillator If the 5 MHz crystal oscillator's frequency is not five times the 1 MHz reference frequency, the A-PHASE SHIFTER will operate to keep the standard output phase locked to the 1 MHz reference The phase shift across A-PHASE SHIFTER appears between the output of B and D-DIVIDERS, changing the 5 MHz crystal oscillator control voltage The control voltage is changed until the 5 MHz crystal oscillator's frequency is five times the 1 MHz reference frequency

4.17 D-PHASE SHIFTER. The outputs of B and C-Dividers are compared and used to gate step commands to the D-PHASE SHIFTER. The step commands change the phase between the B and D-Divider outputs, causing the control voltage to change After the servo loops have reached equilibrium, the step commands gated to D-PHASE SHIFTER will cause the control voltage to change at the rate necessary to correct for the 5 MHz crystal oscillator's aging rate

4.18 C-PHASE SHIFTER. The C-PHASE SHIFTER is used to manually change the aging rate correction The D-PHASE SHIFTER is also used to manually change the control voltage

4.19 C-PHASE DETECTOR The C-PHASE DETECTOR is switched between B, C, and D-Dividers to monitor the control voltage and aging rate correction

4.20 AN/GSQ-174 CIRCUIT DESCRIPTIONS

4.21 The following paragraphs are descriptions of the circuits making up each separate component of the AN/GSQ-174 system Circuit descriptions are presented with the R-1776 first, followed by the 0-1632, and CV-2929 Schematics representing each circuit appear in Section VI Circuits **referred to in Section I V text are outlined on the schematic dia-**

grams by broken lines and labelled with titles corresponding to those in text Gene rally, signals are traced from left to right on the schematics.

4.22 R-1776 LORAN RECEIVER CIRCUITS

4.23 RF AMPLIFIER (PCB No. A10, Figure 6-10) The RF amplifier circuits amplify, decode, filter, and attenuate Loran-C signals received from the antenna Figure 4-8 is a block diagram of the RF Amplifier The single-ended RF signal from the antenna is coupled through transformer T1 to balanced Differential Amplifier A. The signal is amplified and applied to switching transistors Q7 and Q8 through amplifier outputs RF 0° and RF 180°, respectively The outputs at RF 180° and RF 0° have identical pulse shapes but with 180° phase differences between respective 100 KHz carriers. Analog switching transistors Q7, Q8, and Q9 together with the switch driver compose a three-position, single pole switch Analog switching transistor Q7 couples Loran-C pulses having 0° carrier phase angle from RF 0° to Buffer A. Analog switching transistor Q8 couples the phase-shifted 180° phase angle Loran-C pulses from RF 180° to Buffer A All properly decoded pulses, therefore, arrive at Buffer A with 0° carrier phase angle If the Receiver phase code sequence does not match the Loran-C phase code sequence, the pulses will not decode properly, resulting in some pulses arriving at Buffer A with 180° phase angle In this case, the Receiver will not track the Loran- C signal Between windows, analog switching transistor Q9 blocks interference from other signals and provides a no-signal reference for the Phase and Amplitude Strobe Detectors. The output of Buffer A is filtered at the RF Filter, buffered at Buffer B, and attenuated at the RF attenuator before coupling to RF Amplifier A on the Phase Strobe, PCB No A9.

4.24 DIFFERENTIAL AMPLIFIER A Transistors Q1 through Q6 compose a differential amplifier which amplifies and inverts the RF signal received from the antenna. Two amplifier outputs are provided at RF 0° and RF 180° for phase decoding Variable resistor R7 provides adjustment for equal amplitude at the outputs Variable capacitor C3 provides adjustment for 180° phase difference at the outputs.

4.25 PHASE DECODING SWITCH. Field effect transistors Q7 and Q8, when switched on and off in the proper sequence, decode the Loran-C phase code. Only one of the two FET's conducts at any time If the Receiver is tracking the Loran-C signal properly, Q7 conducts when the Loran-C pulse phase code is 0°, and Q8 conducts when the Loran-C pulse phase code is 180° Between groups of Loran-C pulses (between widows), FET Q9 conducts, assuring that no signal arrives at the input of Buffer A, and Q7 and Q8 do not conduct.

4.26 SWITCH DRIVERS Transistor Q10 amplifies and inverts the eight millisecond RF gate pulse for switching FET Q9 off while the group of Loran- C pulses is being received Transistor Q11 amplifies and inverts the phase code signal for switching FET Q7 on and off at the proper time Transistor Q12 and resistors R17 and R14 provide a "NOR" gate for switching FET Q8 on when FET's Q9 and Q7 are not conducting.

4.27 BUFFER A. FET Q13 and transistor Q14 provide a unity gain buffer amplifier for matching the high impedance of the Phase Decoding Switch to the low impedance of the RF filter.

4.28 RF FILTER The RF Filter has a 100 KHz center frequency, 35 KHz bandwidth, and three poles.

4.29 BUFFER B. Transistor Q15 is an emitter follower which provides isolation between the RF Filter and the RF attenuator

4.30 RF ATTENUATOR Switch S2 and resistors R28 through R36 compose a 1 db per step attenuator Switch S3 and resistors R37 through R52 compose a 10 db per step attenuator.

4.31 POWER SUPPLY FILTER Resistors R56 and R65 and capacitors C13 and C14 filter the zero and +20 volt inputs to the analog circuits Signal ground is at +10 volts Logic ground is at zero volts

4.32 PHASE STROBE. (PCB No. A9, Figure 6-9) The Phase Strobe circuits amplify and limit the RF signal received from PCB No. A10, RF Amplifier and detect the phase error between the Loran-C pulse and the Phase Gate. Figure 4-5 is a block diagram of the Phase Strobe. Amplifiers A and B amplify the RF output received at pin 22F from the RF Amplifier, providing inputs for both the Phase and Amplitude Strobes. The Limiter symmetrically limits the gain of Amplifier B for large signals.

4.33 Assume that the Receiver is properly tracking the Loran-C signal. The eight Loran-C pulses are sampled during the 8000 microsecond window. Stray noise signals are sampled between RF windows to establish a no-signal reference. Switch 42 samples the RF signal for five microseconds every 1000 microseconds. When Q2 is not sampling, Q1 shunts the signal to signal common. Capacitor C5 stores the average of the Loran-C pulse during the five microsecond phase gate pulse. When the phase gate is centered on a zero crossing for one cycle of the Loran-C pulse, the voltage across C5 is zero thus indicating no phase error between the phase gate average and Loran-C pulse. When the phase gate is not centered, the amplitude and polarity of the voltage across C5 is proportional to the phase error. Note, waveforms A for C5 voltage conditions are shown on Figure 6.9 Schematic. During the RF windows, when transistor Q4 is conducting, the voltage across C5 is integrated and stored through operational amplifier U1 onto signal capacitor C8. Between RF windows, when transistor Q5 is conducting, stray voltage C5 is stored through operational amplifier U1 onto reference capacitor C11 as a reference voltage. The output from Q4 and Q5 is filtered and buffered, then coupled to the Threshold Detector. The threshold monostable multivibrator triggers when the difference between the signal and reference exceeds the threshold. Note, waveforms C for threshold conditions are shown on Figure 6-9 Schematic. The multivibrator turns on Q4 and Q5, clearing the Hold Circuit. (See waveforms B on Figure 6-9 Schematic.) The multivibrator output pulse also causes the digital phase shifter to advance or retard the phase gate pulse by 0.1 microsecond. The process of sampling and holding the phase error until the threshold detector triggers is repeated until the phase error is less than 0.1 microsecond. The output of the buffer is also demodulated and amplified to produce a DC voltage proportional to the difference between reference and signal voltages. The amplifier output controls a delay generator which provides smoothing between the 0.1 microsecond phase steps of the digital phase shifter.

4.34 AMPLIFIER A. A differential amplifier composed of transistors Q32, Q33, and Q34 amplifies the voltage difference between the bases of transistors Q32 (RF in) and Q33 (feedback signal), providing drive for transistor Q34. Resistors R75 and R76 determine the gain of the amplifier at 100 kHz. Capacitor C26 provides high frequency rolloff and capacitor C27 provides low frequency rolloff.

4.35 AMPLIFIER B. An operational amplifier, composed of transistors Q35 through Q39 amplifies the output of Amplifier A received at the base of Q35 and provides an output to the Junction of resistors R87 and R88. Resistors R78, R109, R91 and R92 determine the gain of the amplifier at 100 kHz. Capacitors C33 and C35 provide high frequency rolloff and capacitors Cl2 and C36 provide low frequency rolloff.

4.36 LIMITER. Diodes CR3 through CR8 comprise a symmetrical limiting feedback network for Amplifier B. The limiter does not affect the amplifier when small signals are encountered. For large positive signals CR6, VR1, CR7, CR4 and resistor R93 limit the amplifier output. For large negative signals CR8, VRl, CR5, CR3 and R93 limit the amplifier output.

4.37 PHASE STROBE DRIVER. Transistor Q20 amplifies and inverts the phase gate pulses received at pin 7F, Providing drive to Q2. Transistors Q21 and Q22 amplify the phase gate pulses, providing drive to Ql.

4.38 PHASE STROBE. Switch Q2 samples the RF signal received at pin 9F for five microseconds during each 1000 microseconds of the RF windows. Capacitor C5 stores the average of the five microseconds sample. Between phase gates when Q2 is not sampling, switch Q1 shunts the signal to signal common.

4.39 BUFFER A. Transistors Q3, Q8, Q46 and Q47 act as an amplifier and buffer between the output of the Phase Strobe and Hold Circuit. Note that Q3 and Q47 are selected field-effect transistors. If any repair is made to this buffer circuitry consult the IPB for location and exact replacement information for these field-effect transistors. Likewise, R23 is a selected resistor and may require readjusting upon repair of the buffer A circuitry.

4.40 HOLD CIRCUIT. An integrator and storage circuit is formed by Q47, Q48 and operational amplifier U1. The phase error signals from the Phase Strobe are integrated and stored in the Hold Circuit. During the RF windows, the integrated phase error signal is stored on capacitor C8. Between RF windows, a no-signal reference is stored on capacitor C11. A phase change between the receiver phase gate pulse and the Loran-C signal appears as a voltage difference between C8 and C11. Note that Q48 and Q49 are selected field-effect transistors. If their replacement is required consult the IPB for location and exact replacement Information.

4.41 SWITCH STAGE, During the RF windows, switch Q4 conducts, storing the output of U1 onto capacitor C8. Between RF windows, switch Q5, conducts, storing the output of U1 onto capacitor C11. Variable resistor R14 is used to balance the operational amplifier U1.

4.42 BUFFER B. Transistors Q50 and 051 form a buffer circuit. DC feedback, coupled through the source follow&r transistor Q50 and a filter consisting of resistor R13 and capacitor C41, as fed back into the input of the Hold Circuit to stabilize the reference voltage on C11.

4.43 SWITCH DRIVER, Transistor Q24 and Q26 amplifies and inverts the RF window signal received at pin 4F. Transistor Q24 provides drive to Q4 and Q7 during the RF window. Transistor Q27 inverts once again the RF window thus providing drive for Q5 and Q6 between RF windows. Transistors Q23 and Q25 shunt the base drive at Q24 and Q27 permitting both switches Q4 and Q5 to conduct to clear the Hold Circuit.

4.44 FILTER. A filter, consisting of resistor R10 and capacitor C15, filters the output signal of the Hold Circuit during the RF windows when analog switch Q7 conducts. Another filter, consisting of R10 and capacitor C14, filters the no-signal reference between windows when Q6 conducts.

4.45 BUFFER C. A unit gain buffer amplifier, composed of transistors Q45 and Q9, matches the high impedance of the Filter to the low impedance of the Threshold Detector and Demodulator

4.46 THRESHOLD DETECTOR. Capacitor C16 and resistor R24 differentiate the phase error signal received from the Buffer, producing positive and negative pulses. A monostable multivibrator, consisting of transistors Q10 and Q11, triggers when a negative-going pulse at the base of Q10 is large enough to turn off Q11. When Q11 turns off, Q12 turns off. Positive feedback, coupled through capacitor C18 to the base Q11, assures that Q12 remains off for approximately 0.1 second. Capacitor C19 and resistor R35 differentiate the rise in collector voltage from Q12, turning on transistor Q13 for approximately five microseconds. The collector output from Q13 drives the Digital Phase Shifter on PCB No. A4, Standard Input, through pin 3F. The 0.1 second pulse from the collector of Q12 clears the Hold Circuit and the Demodulator.

4.47 DEMODULATOR DRIVER. Transistor Q29 amplifies and inverts the demodulator reference, providing drive to analog switch Q14. Transistor Q31 amplifies the demodulator reference, providing drive to analog switch Q15. Transistors Q28 and Q30 shunt the base drives to Q29 and Q31, clearing the Demodulator.

4.48 DEMODULATOR. Analog switches Q14 and Q15 demodulate the signal and reference voltage difference received from the Buffer. The difference voltage appears between capacitors C20 and C21.

4.49 DC AMPLIFIER. A differential amplifier composed of transistors Q16 and Q17 amplifies the phase error signal received from C20 and C21. Common mode feedback from transistor Q18 stabilizes the average collector voltage of Q16 and Q17 at approximately five volts DC. Transistor Q19 amplifies and inverts the collector signal of Q17. The output of the DC amplifier controls the delay in the delay multivibrator on PCB No. A4, Standard Input, which provides smoothing between the 0.1 microsecond steps of the Digital Phase Shifter on PCB No. A4, Standard Input.

4.50 POWER SUPPLY FILTERS. Capacitors Cl, C2, C24, and C25 filter the power supply inputs. Signal ground for the analog circuits is +lO volts. Logic ground for the switching circuits base Strobe Driver, Switch Driver, and Demodulator Driver) 1 zero volts.

4.51 AMPLITUDE STROBE. (PCB No. A8, Figure 6-8) The Amplitude Strobe circuits sample and average the Loran-C signal at the time the amplitude gate occurs. Figure 4-6 is a block diagram of the Amplitude Strobe. The amplitude strobe output is a DC voltage proportional to the average amplitude of the Loran-C pulse. When the receiver is tracking a signal, the eight Loran-C pulses are sampled during the 8000 microseconds RF window, Stray noise signals are sampled between RF windows to establish a no-signal reference. Buffer A buffers the RF input, then couples the signal to switches Q2 and Q3. Q3 samples the signal for one microsecond every 1000 microseconds. When Q3 is not sampling, Q2 shunts the signal to signal common. Capacitor C3 stores the average of the Loran-C pulse during the one microsecond amplitude strobe pulse. During the RF window, when transistor Q5 is conducting, the voltage across C3 is integrated and stored through operational amplifier U1 onto signal capacitor C4. Between RF windows, when transistor Q6 is conducting, stray voltages across C3 are stored through operational amplifier U1 onto reference capacitor C7 as a reference voltage. The output from Q5 and Q6 is filtered and buffered, demodulated and amplified, producing a DC voltage proportional to the average Loran-C pulse amplitude at the time the one microsecond amplitude strobe gate occurs. Note, typical waveforms for amplitude strobe are shown on Figure 6-8 Schematic.

4.52 BUFFER A. Emitter follower transistor Ql isolates the amplitude strobe from the RF Amplifier

4.53 AMPLITUDE STROBE DRIVER. Transistor Q26 amplifies and inverts the amplitude strobe gate pulses received at pin 6F, providing drive to Q3. Transistors Q27 and Q28 amplify the amplitude strobe gate pulses, providing drive to Q2.

4.54 AMPLITUDE STROBE. Switch Q3 samples the RF signal, received from Buffer A, for one-microsecond each 1000 microseconds of the RF window. Capacitor C3 stores the average of the one-microsecond sample. Between signal gates when Q3 is not sampling, switch Q2 shunts the signal to signal common

4.55 BUFFER B. Transistors Q37, Q38, Q39 and Q29 act as an amplifier and buffer between the output of the amplitude strobe and the hold circuit. **Note** that Q37 and Q29 are selected field-effect transistors. If any repair is made to this buffer circuitry consult the IPB for location and exact replacement information for these field-effect transistors. Likewise, R71 is a selected resistor and may require readjusting upon repair of the buffer B circuitry

4.56 HOLD CIRCUIT. An integrator and storage circuit is formed by Q4, Q11 and operational amplifier U1. The amplitude signals from the amplitude strobe are integrated and stored in the hold circuit. During the RF window, the integrated amplitude signal is stored on capacitor C4. Between RF windows, a no-signal reference is stored on capacitor C7. As the amplitude strobe occurs, the amplitude of the received Loran-C signal is sampled and stored in the hold circuit as a voltage difference between C4 and C7. Note that Q4 and Q11 are selected field-effect transistors. If their replacement is required consult the IPB for location and exact replacement information.

4.57 SWITCH STAGE. During the RF window, switch Q5 conducts, storing the output of U1 onto capacitor C4. Between RF windows, switch Q6 conducts, storing the output of U1 onto capacitor C7. Variable resistor R19 is used to balance the operational amplifier U1.

4.58 BUFFER C. Transistors Q40 and Q41 form a buffer circuit. DC feedback, coupled through the source follower transistor Q40 and filter consisting of resistor R74 and capacitor C12, is fed back into the input of the hold circuit to stabilize the reference voltage on C7.

4.59 SWITCH DRIVER. Transistors Q30 and Q31 amplifies and inverts the RF window signal received at pin 3F. Transistor Q30 provides drive for Q5 and Q7 during the RF window. Transistor Q33 inverts once again the RF window signal thus providing drive for Q6 and Q8 between RF windows. Transistors Q44 and Q32 short the base drive at Q30 and Q33 permitting both switches Q5 and Q6 to conduct when a zero set is received at pin 2F. This allows the hold circuit to be cleared.

4.60 FILTER. A filter, consisting of resistors R13 and R25 and capacitor C27, filters the output signal at the Hold Circuit during the RF window when analog switch Q7 conducts. Another filter, consisting of resistors R15 and R25 and capacitor C14, filters the no-signal reference between windows, when analog switch Q8 conducts.

4.61 BUFFER D. A unity gain buffer amplifier, consisting of transistors Q9 and Q10, matches the high impedance of the filter to the low impedance of the Demodulator.

4.62 DEMODULATOR. Analog switches Q12 and Q13 demodulate the output of Buffer B, producing a DC voltage across capacitor Cl6 proportional to the difference between the Loran-C signal and the no-signal reference

4.63 DEMODULATOR DRIVER. Transistor Q34 amplifies and inverts the RF window. Transistors Q35 and Q36 further amplify the RF window.

4.64 DC AMPLIFIER, A differential amplifier, composed of transistors Q14 through Q17, amplifies the Demodulator output. Emitter follower transistors Ql8 and Q19 provide low output impedance Variable resistor R36 provides amplifier balance for zero output with no input signal.

4.65 THRESHOLD DETECTOR. When the amplitude output at pin 19F is more positive than the base voltage at transistor Q21, Q21 conducts. When Q21 conducts, transistor Q24 conducts, turning off SERVO OFF lamp driver transistor Q25.

4.66 POWER SUPPLY FILTER Resistor R80 and capacitors C22 and C23 filter the DC power inputs.

4.67 SERVO CONTROL. (PCR No A7, Figure 6-7) The Servo Control circuits generate Phase Step and Direction commands to the phase shifter on the Standard Input board (PCB No A4), as well as a Servo Off command to the Phase Strobe (PCB No. A9). Logic circuits on this board drive the external oscilloscope Trigger and Z-axis outputs. A jumper is provided for the selection of positive going or negative going logic output pulses. Depression of the Advance or Retard switches will slew the output of the phase shifter on the Standard Input board at a rate selected on the Rate switch. In addition, buffers are supplied on this board for the Scope Trigger and Phase Shifted 1 MHz Outputs.

4.68 TRIGGER LOGIC. Controlled by the front panel Scope switch, the Trigger Logic circuit produces a single pulse on millisecond before the 1 window (Mode 1) or eight 0 5 millisecond pulses during the RF window (Modes 2 and 3). The Mode 2 Trigger input is delayed somewhat with respect to the Mode 3 Trigger input by circuits on the Output Buffer board (PCB No. A2) to compensate for the signal delay through the narrow bandwidth acquisition filter on the Viewing Filter board (PCB No. A3) when the front panel Scope switch is in the Mode 2 position.

4.69 INVERTER C. Invert C shifts the output of the Trigger Logic circuit 180° to produce positive-going pulses at the Scope Trigger output.

4.70 TRIGGER OUTPUT BUFFER. Phase splitter transistor Q5, pull-up transistor Q6, and pull-down transistor Q7 form a buffer with a constant 50 ohm output impedance for the Scope Trigger output.

4.71 L-AXIS LOGIC Controlled by the front panel Scope switch, the Z-axis Logic circuit generates eight 150 microsecond pulses during the RF window (Modes 1 and 2) or eight 1.0 microsecond pulses coincident with the Phase Gate input during the RF window (Mode 3). To compensate for signal delay through the acquisition filter on the Viewing Filter board (PCB No. A3), the Modes 1 and 2 Z-axis input is delayed somewhat with respect to the Phase Gate input by circuits on the Output buffers board (PCB No. A2). A jumper is provided for the selection of positive or negative Z-axis logic output pulses.

4.72 INVERTER A. Integrated circuit U51A inverts the Scope Switch B input, keeping the outputs of NAND gates U551C and U61A high during Mode 3. This prevents the Mode 2 Trigger input from affecting NAND gate U/1A during Mode 3; it also keeps the Models 1 and 2 Trigger input from affecting NAND gate U61B during Mode 3.

4.73 PHASE STROBE SERVO LOCK The Phase Strobe Servo Lock circuit disables the Threshold Detector on the Phase Strobe (PCS No. A9) whenever the Loran-C signal drops below an acceptable tracking level. On the first Phase Threshold input pulse (indicating a phase change between the Antenna and Frequency Standard input to the receiver) after the Amplitude Threshold has changed from zero volts to +5 volts (indicating a low Loran-C signal level), the Q output of flip-flop U31A goes high, turning transistor Q3 on and disabling the Threshold Detector on the Phase Strobe board. When the Amplitude Threshold input changes back from +5 volts to zero volts (indicating an acceptable Loran-C signal level), flip-flop U31A is immediately preset, turning Q3 off and enabling the Phase Strobe Threshold Detector.

4.74 PHASE STEP. The Phase Step circuit provides a clock input to the Phase Strobe Servo Lock circuit (to disable the Phase Strobe after the Amplitude Strobe has detected a low average signal level) and a step input to the Phase Shifter Control Logic circuit (to step the phase shifter on the Standard Input board). With no difference in phase between the rear panel Antenna and Frequency Standard inputs, the Phase Threshold input at pin 4F will be at +5 volts, transistor Q3 will be turned off (keeping its collector at +5 volts), and the output of NAND gate U21D will be low. When the Phase Strobe (PCB No 49) detects a phase difference between the Antenna and Frequency Standard inputs, a narrow negative pulse will appear at pin 4F, causing the output of the NAND gate to go high, which will turn Q2 on. Q2 will remain on (keeping the NAND gate output high) until C3 has discharged through R6. This positive feedback arrangement inverts and lengthens the Phase Threshold input.

4.75 SWITCH BUFFER. Capacitor Cl and resistor R4 differentiate the output of the rate switch and transistor Q1 inverts the differentiated output to provide narrow positive-going clock pulses to the Phase Shifter Control Logic and Rate/Step Slewing Logic circuits.

4.76 SLEWING LOGIC. The Rate/Step Slewing Logic circuit determines the direction and amount by which the phase shifter on the Standard Input board (PCB No. A4) can be slewed. Depression of the Advance pushbutton clears flip-flop U111B, causing the Direction output at pin 19F co go low, which in turn causes the phase shifter on the standard input board to shorten its division ratio by one cycle of 10 MHz each time it receives a step command during this period. Depression of the Retard pushbutton presets flip-flop U111B and causes the Direction output to go high, which forces the phase shifter on the Standard Input board to lengthen its division ratio by one cycle of 10 MHz each time it receives a step command.

4.77 Depression of the Advance or Retard switch causes the output of NAND gate U101C to go high. This high gets inverted by integra ted circuit U101D and inverter again by U93A. As the output of inverter U93A goes high, the output of the Switch Buffer is gated through NAND gates U71B and U83A to provide a step input to the phase shifter on the Standard Input board. The output of the Switch Buffer continues to step the phase shifter until the Advance or Retard pushbutton is released. The available slewing rates are 10,000 (F), 1,000; 100, 10, and i (S) microsecond per second.

4.78 PHASE SHIFTER CONTROL LOGIC. The Phase Shifter Control Logic circuits gate inputs from the Switch Buffer, Inverters B and D, Rate/Step Slewing Logic, and Phase Step circuits to the step and direction inputs of the phase shifter on the Standard Input Board.

4.79 INVERTER B. Inverting the Demodulator Reference input, integrated circuit U73B disables NAND gate U83C during the RF window.

4.80 POWER SUPPLY FILTER. Capacitor C8 filters the +5 volt power supply input.

4.81 PHASE CODE. (PCB No. AS, Figure 6-6) The Phase Code circuits produce both slave and master (and A and B) phase codes, Modes 1 and 3 Trigger, RF Window, and Demodulator Reference outputs.

4.82 SCAN WINDOW GENERATOR. Flip-flop U13A synchronizes the GRP 1 kHz output from the GRP Divider (PCB No. A5) to the GRP 2 kHz signal. Flip-flop U13B synchronizes the 1kHz Q output from flip-flop U13A to the GRP 10 kHz signal. The resulting 1 kHz outputs at of Q U13A and at Q of U13B differ in phase by 50 microseconds. The Scan 1 kHz output at Q of flip-flop U13B is used in circuits on the GRP Divider board to derive the Amplitude Strobe. The 1 kHz output at Q of flip-flop U13A is inverted twice by NAND gates U23C and U23D and combined with the Demodulator Reference signal in NAND gate U33D to produce the Mode 3 Trigger output. The Strobe Window B input is not used in R-1776 receiver.

4.83 RF WINDOW/TRIGGER LOGIC. Integrated circuits U73A, U73B, U83B and U93B gate the GRP 1 kHz, GRP 100 Hz B, and Tens GRP inputs to produce the Mode 1 Trigger output, a signal with a period equal to the GRP and a 1 millisecond positive duty cycle. NAND gate U73C and flip-flop U93A gate the Tens GRP,

GRP 100 Hz B, and Mode 1 Trigger signals to produce the Demodulator Reference output. NAND gate U33D combines one of the 1 kHz outputs of the Scan Window Generator with the Demodulator Reference signal to produce the Mode 3 Trigger output. NAND gate U73B combines the Q output of flip-flop U93A with the RF Open/Gated input to produce the RF Window B output.

4.84 RF WINDOW DRIVER. Transistor Q2 inverts the Demodulator Reference signal to produce the RF Window A output.

4.85 PHASE CODE LOGIC. The Phase Code Logic circuit gates the GRP 200 Hz, GRP 500 Hz and RF Open/Gated inputs together with an output from the RF Window/Trigger Logic circuit to produce the Phase Code output, which is used to decode the output of Differential Amplifier A on the RF Amplifier board (PCB No. A10). Switches are provided for the selection of Master or Slave codes, as well as Pulse Repetition Period A or B.

4.86 PHASE CODE INVERTER. Integrated circuit U81D inverts the output of the Phase Code Logic Circuit to produce the correct polarity input for the switch drivers on the RF Amplifier board.

4.87 POWER SUPPLY FILTER. Capacitor Cl filters the +5 volts power supply input.

4.88 GRP DIVIDER. (PCB No. A5, Figure 6-5) The GRP Divider circuits produce the GRP, Amplitude Strobe and Phase Gate signals, as well as several fixed frequencies synchronized to the GRP.

4.89 DIVIDER A. Integrated circuits U43 and U33 divide the Phase Shifted 1 MHz input down to 10 kHz, producing the GRP 100 kHz and GRP 10 kHz outputs, as well as several intermediate frequencies used to derive the Amplitude Strobe and Phase Gate outputs. The GRP Sync input is grounded.

4.90 DIVIDER B. Integrated circuits U23, U51B and U13 divide the 10 kHz output from Divider A down to 100 Hz, producing tenths, units, and tens inputs to Gate A, as well as the GRP 2 kHz, GRP 1 kHz, GRP 500 Hz, GRP 200 Hz, GRP 100 Hz A and GRP 100 Hz B outputs.

4.91 INVERTER A. Integrated circuit U71A inverts the GRP 2 kHz output from divider U23 to provide a clock input to flip-flop U51B.

4.92 GATE A. Integrated circuit U113A gates the tens output of Divider B with the tens count output of the Ring Counter. Integrated circuit U113C gates the units output of Divider B with the units count output of the Ring Counter. Integrated circuit U113B gates the tenths output of Divider B with the tenths count output of the Ring Counter. NAND gate U123B combines the outputs of gates U113A, Ul13C and U113B to provide an input count for Divider C.

4.93 RING COUNTER. Integrated circuits U103A, U93B, U93A and U83D are connected to form a ring counter. In its initial state, the Q output of flip-flop U93A (tens count) is high, the Q output of flip-flop U93B (units count) is low, and the Q output of flip-flop U103A (tenths count) is low. This allows the GRP 100 Hz B output from Divider B to begin loading Divider C. When the count in Divider B matches the setting of the tens of milliseconds GRP switch, the output of NAND gate U133D goes low, forcing the output of NAND gate U123C to go high, which resets Divider B and Divider C to zero and advances the Ring Counter by one count. Now the units count output (Q of U93B) goes high, while the tens and tenths count outputs are low. This allows the GRP 1 kHz output from Divider B to begin loading Divider C. When the count in Divider C matches the setting on the units of milliseconds GRP switch, the output of NAND gate U133C goes low, resetting Divider B and Divider C to zero and advancing the Ring

Counter by one count. Now the tenths count output (Q of U103A) of the Ring Counter goes high while the other outputs are low, allowing the 10 kHz output from Divider A to begin loading Divider C When the count in Divider C matches the setting on the tenths of milliseconds GRP switch, the output of NAND gate U133A goes low, resetting Dividers B and C to zero and returning the Ring Counter to its original state, where the cycle begins again.

4.94 GATL B. Integrated circuit U133D gates the output of the tens of milliseconds GRP switch with the tens count output of the Ring Counter. Integrated circuit U133C gates the output of the units of milliseconds GRP switch with the units count output of the Ring Counter. Integrated circuit U133A gates the output of the tenths of milliseconds GRP switch with the tenths count output of the Ring Counter. NAND gate U123C combines the outputs of gates U133A, U133C and U133D to provide a reset signal to the GRP Reset Control Circuit.

4.95 INVERTER E. Integrated circuit U133B inverts the Gate B output to provide the correct polarity input for the GRP Reset Control circuit.

4.96 GRP RESET CONTROL. On the first Phase Shifted 1 MHz input pulse after receiving a reset command from Inverter E, flip-flop U111B changes state, resetting Dividers B and C to zero, advancing the Ring Counter by one count, and consequently removing the reset command from Inverter E. On the first Phase Shifted 1 MHz input pulse after the reset command from Inverter E has been removed, flip-flop U111B returns to its original state and the count begins again.

4.97 DIVIDER C. Flip-flops U91B, U101A, U101B and U111A store the tens, units and tenths of milliseconds counts supplied by Gate A.

4.98 DECODER. NAND gates U121A, U121B, U12lC, U121D, U123A and U83C decode the Divider C outputs.

4.99 INVERTER B. Integrated circuit U71B inverts the GRP Sync input, which is not used in the R-1776 receiver.

4.100 INVERTER C. Integrated circuit U53A inverts the B output of divider U43

4.101 INVERTER D. Integrated circuit U71C inverts the GRP 100 kHz output of divider U43

4.102 AMPLITUDE LOGIC. The Amplitude Logic circuit gates the outputs of Divider A with the Balance input from the Phase Code board (PCB No. A6) to produce the Amplitude Strobe output.

4.103 PHASE STROBE LOGIC. Flip-flop U61B is clocked with the complement of the GRP 1 kHz output and cleared with the output of Inverter C, producing a 1 kHz positive-going Q output pulse 1 microsecond wide, synchronized to both the GRP and the Phase shifted 1 MHz input. This 1 kHz pulse is gated with the Balance input by integrated circuit U11A to produce a frame-balanced Phase Gate output.

4.104 GRP OUTPUT LOGIC. Flip-flop U51A synchronizes the Demodulator Reference input to the phase gate output from flip-flop U61B.

4.105 GRP OUTPUT BUFFER. Phase splitter transistor Q3, pull-up transistor Q4, and pull-down transistor Q5 form a buffer with a constant 50 ohm output impedance for the GRP output

4.106 +5 VOLT FILTER. Capacitor C5 filters the +5 volt power supply input

4.107 STANDARD INPUT. (PCB No. A4, Figure 6-4) The Standard Input circuitry multiplies the 1 MHz frequency standard input to 10 MHz, then divides the 10 MHz signal back down to 1 MHz, phase shifting the output by varying the division ratio. In addition, a flip-flop phase comparator is provided which produces a 100 kHz output with a duty cycle proportional to the difference in phase between the rear panel Antenna and Frequency Standard inputs.

4.108 WAVESHAPER The waveshaper circuit squares and amplifies the 1 MHz frequency standard input, producing a zero to +5 volts square wave clock input for the 1 MHz Phase Comparator A circuit.

4.109 1 MHz PHASE COMPARATOR A. Flip-Flop U83B compares the i MHz frequency standard input with a 1 MHz square wave derived from the 10 MHz Voltage Controlled Oscillator. The output of the phase comparator is a 1 MHz square wave with a fifty percent nominal duty cycle (over a long period of time) If the output of the VCO increases in frequency slightly, the 1 MHz feedback signal at the D input to flip-flop U83B will advance slightly with respect to the frequency standard input, causing the duty cycle of the output of the flip-flop to change. The resulting change in average voltage at the output of the phase comparator will cause the VCO to decrease in frequency, thus locking the VCO output to the 1 MHz frequency standard input.

4.110 10 MHz VOLTAGE CONTROLLED OSCILLATOR. As the average voltage at the output of the 1 MHz Phase Comparator A increases (indicating the VCO has increased in frequency), the reverse voltage across varicap CR1 decreases, which Increases the capacity of the varicap and decreases the frequency of oscillation of the VCO The output of the oscillator is a 10 MHz square wave, locked to the 1 MHz frequency standard input.

4.111 DIVIDER A. Integrated circuit U51 divides the 10 MHz output of the VCO to a 1 MHz square wave for feedback to the 1 MHz Phase Comparator A circuit. Integrated circuit U41 divides the 1 MHz output of US1 to a 100 kHz reference input for the 100 kHz Phase Comparator.

4.112 100 kHz PHASE COMPARATOR. Flip-flop U21A is blocked by a 100 kHz reference signal from Divider A and cleared by a 100 kHz phase shifted signal from the GRP Divider board (PCB NO. AS). The duty cycle of the resulting recorder output is proportional to the phase difference between the clock and clear inputs. Depression of the Zero pushbutton on the rear panel causes the Q output of the flip-flop to go high. Depression of the Full Scale pushbutton causes the Q output to go low. Transistor Q9, resistors R23 and R24, and NAND gate U11B form a differentiating circuit which produces narrow negative-going pulses coincident with the leading edges of the output from NAND gate U11A.

4.113 PHASE SHIFTER A The Phase Shifter A circuit forms a variable ratio divider which has the capability of dividing its input frequency by 4, 5 or 6. The phase shifter normally divides the 10 MHz output of the VCO by 5, producing a 2 MHz output signal. Upon command from the Servo Control board (PCB No. A7), the phase shifter will shorten its output period by one cycle of 10 MHz (division by four, advancing the 2 MHz output by 0.1 microsecond) or lengthen its output period by one cycle of 10 MHz (division by 51A, retarding the output 0.1 microsecond). A low direction input, accompanied by a step pulse, causes the output of the phase shifter to advance in phase. A high direction input, along with a step pulse, retards the phase of the output.

4.114 DIVIDER C. Flip-flop U13A divides the 2 MHz output of the Phase Shifter A circuit down to a 1 MHz clock input for the 1 MHz Phase Comparator B circuit.

4.115 1 MHz PHASE COMPARATOR B. Flip-flop U83A is clocked by a phase shifted 1 MHz input from Divider C and cleared by a 1 MH7 signal derived from the 2 MHz Locked Oscillator. Transistor Q15, resistors R37 and R38 and NAND gate U63B form a differentiating circuit which produces narrow negative-going pulses coincident with the leading edges of the 1 MHz square wave output of Divider D. The output of the phase comparator is a 1 MHz square wave with a fifty percent nominal duty cycle, the 2 MHz Locked Oscillator increases in frequency slightly, the 1 MHz feedback signal at the clear input of flip-flop U83A will advance in phase slightly with respect to the 1 MHz output of Divider C, causing the positive duty cycle of the Q output to increase. This increase in average voltage at the output of the phase comparator will force the 2 MHz Locked Oscillator to decrease in frequency, thus locking the oscillator to the phase shifted 1 MHz input from Divider C.

4.116 2 MHz LOCKED OSCILLATOR. Transistors Q13 and Ql6 form a free-running multivibrator oscillator circuit. The amount of DC voltage supplied to the RC time constant portion of the multivibrator will control its operating frequency. The voltage controlled by variable resistor R27, as seen across C11, sets the normal frequency of the oscillator. If the 2 MHz Locked Oscillator tries to increase in frequency, an increase in duty cycle will result in the output of the 1 MHz Phase Comparator B. The increase in duty cycle causes Q10 to conduct for an increased period of time thus reducing the DC voltage across capacitor Cll. The decrease in voltage across Cl1 will result in a decrease in frequency thus completing the control loop for the 2 MHz Locked Oscillator. An input from pin 2C provides a smoothing signal from the Phase Strobe (PCB No. A9) to the 2 MHz Locked Oscillator. The amount of smoothing is set by variable resistor R2 and again appears as a voltage change across Cl1 and into the 2 MHz Locked Oscillator circuitry Transistors Qll and Q12 ensures proper starting of the oscillator circuit when power is first applied.

4.117 DIVIDER D. Flip-flop U53B divides the output of the 2 MHz Locked Oscillator to 1 MHz.

4.118 +20 VOLTS FILTER. Resistors R40 and R41, and capacitors C15, C17 and C18 filter the +20 volts power supply input.

4.119 +5 VOLTS FILTER. Resistor R42 and capacitors C16 and C19 filter the +5 volts power supply input.

4.120 VIEWING FILTER. (PCB No. A3, Figure 4-3) The Viewing Filter circuits amplify and filter the RF output from Amplifier B on the Phase Strobe (PCB No. A9).

4.121 VIEWING FILTER. Transistor Q1 inverts and amplifies the RF input. The acquisition filter has a 5 kHz bandwidth centered about 100 kHz. Transistor Q2 buffers the filter output. Variable resistor R7 controls the gain of the stage.

4.122 TRACKING AMP. Transistors Q3 and Q4 form an emitter-coupled amplifier. Variable resistor R14 controls the gain of the stage.

4.123 +20 VOLTS FILTER. Resistor R11 and capacitor C11 filter the +20 volts power supply input.

4.124 OUTPUT BUFFERS. (PCB No. A2, Figure 6-2) The Output Buffers circuitry buffers the Z-axis oscilloscope output, delays the Modes 1 and 2 Z-axis and Mode 2 Trigger pulses to compensate for the RF signal delay through the narrow bandwidth viewing filter, and buffers the 10 microsecond phase **comparator** output for the front panel and external chart recorders.

4.125 Z-AXIS BUFFER. Transistors Q1 and Q2 amplify and invert the Z-axis output from pin 12F of the Servo Control board (PCB No. A7).

4.126 10 MICROSECOND BUFFER. Transistors Q6, Q7 and Q8 amplify and clamp to ground and the +5 volts bus the 10 kHz variable duty cycle output from pin 6C on the Standard Input board (PCB No. A4). Two filters (R20 and C7 and R17, R18 and C8) produce DC outputs proportional to the relative phase difference between the rear panel Frequency Standard Input and the Loran-C signal. One filter, composed of R20 and C7, provides a rear panel Frequency Standard Input and the Loran-C signal. One filter, composed of R20 and C7, provides a rear panel output suitable for driving an external chart recorder. The other filter, composed of R17, R18 and C8, provides an input for the front panel chart recorder. Variable resistor R18 adjusts current to meter movement thus allowing for variations in meter movement sensitivity and provides therefore, a full scale reading adjustment.

4.127 Z-AXIS DELAY. Transistors Q12, Q15, Q9, Q10 and Q11 delay the GRP 1 kHz input to produce the Modes 1 and 2 **Z-axis** output. Capacitor Q11 and resistor R27 differentiate the output of a one-shot (Q9 and Q10) to produce 5 millisecond pulses at the collector of Q11. Variable resistor R24 controls the delay time.

4.128 TRIGGER DELAY. Transistors Q16 and Q17 amplify the Mode 3 Triggcr input. Transistor Q18 delays the amplified pulses and transistor Q19 drives the input of a one-shot composed of transistors Q20 and Q21. Transistor Q22 inverts and buffers the one-shot output, producing the Mode 2 Trigger output. Variable resistor R41 controls the trigger delay.

4.129 POWER SUPPLY FILTERS Capacitors C18 and C19 filter the +5 volts power supply Inputs.

4.130 POWER SUPPLY ASSEMBLY (PCB No. A1A1 and PCB No. A142, Figure 6-l) The Power Supply Assembly circuits convert an unregulated AC line input to regulated +20, +10 and +5 volts outputs Provision is made for automatic switchover to a DC standby input in the event of primary AC line failure.

4.131 AC POWER SUPPLY. The AL ine input is stepped down by transformer T1 and converted to a +35 volts unregulated DC supply by a bridge rectifier composed of diodes CR2, CR3, CR4 and CR5. Capacitor Cl filters the unregulated supply.

4.132 DC POWER SUPPLY. Standby holdoff diode CR1 is kept reverse biased by the +35 volts unregulated DC supply as long as AC line power is present. (The Standby Power input can vary between +22 and +32 volts DC.) Upon loss of the primary AC line, diode CR1 becomes forward biased as soon as the +35 volts unregulated supply drops below the Standby Power input voltage. Switchover from AC line to DC standby power will not affect the tracking functions of the receiver, chart drive power to the recorder, however, will be lost. Upon the return of AC line power, the chart drive motor on the recorder will begin running again and the receiver will continue tracking on the same cycle as before the power loss.

4.133 +20 V DC REGULATOR. When power is first applied to the receiver, the regulated +10 and +20 volts supply outputs will be at zero volts. As the voltage across capacitor Cl begins to rise, capacitor C2 will begin to charge through resistors R13 and R14 toward the unregulated supply. When the firing potential of transistor Q5 is reached, the unijunction will turn on, discharging capacitor C2 and producing a positive pulse at Ease 1. As the voltage across zener diode VR1 begins to rise, transistor Q2 turns on, providing base drive for transistor Q3. As transistor Q3 begins to conduct, transistor A11Q1 also turns on, and the +20 volts regulated supply begins to rise. As the +20 volts line rises, Q6 turns on and disables the starting circuit. Eventually, enough current is drawn through diode VR1 to push it into its zener region (5.1 volts) and enough current is drawn through resistors R3 and R4 to turn Q1 on. When the output of the regulator rises above +20 volts, the collector current of transistor Q2 decreases, reducing the collector current of transistor Q3, and decreasing the base drive to transistor A11Q1, thereby, dropping the output back to +20 volts. When the regulated output drops below +20 volts, the error is sensed by the differential amplifier and the collector currents of transistors Q2, Q3 and A11Q1 increase, returning the output to +20 volts. Variable resistor R4 provides output voltage adjustment.

4.134 +10 V DC REGULATOR. The difference between the +10 volts supply and half of the +20 volts supply is sensed by a differential amplifier, composed of transistors Q7 and Q8. The output of the amplifier drives shunt regulator transistor Q9.

4.135 +5 VDC REGULATOR. Transistors Q10 through Q15 form a switching mode regulator. A +5 volts reference is derived from the +20 volts regulated supply by a voltage divider, consisting of resistors R26 and R39. A differential amplifier, composed of transistors Q14 and Q15, amplifies the error between the reference voltage-and the regulated +5 volts output. The collector currents of transistors Q14 and Q15 control the duty cycle of a free-running multivibrator (Q10 and Q11). Transistor Q12 provides base drive for transistor Q13. When transistor Q13 is turned on, the voltage at the input of the filter, consisting of Inductor L1 and capacitor C8, is the unregulated supply voltage. When transistor Q13 is turned off, diode CR11 clamps the voltage at the input of the filter to ground. If the output of the filter rises above +5 volts, the differential amplifier (414 and Q15) senses the error and decreases the positive duty cycle of the input to the filter, thus dropping the filter output back to +5 volts. If the output of the filter drops below +5 volts, the differential amplifier increases the positive duty cycle of the input to the filter, which raises the output back to +5 volts. If a malfunction in the regulator causes the output voltage to **rise** beyond the normal operating limits, zener diode VR2 will clamp the output at +6.8 volts.

4.136 O-1632 RF OSCILLATOR CIRCUITS

4.137 +20 VOLT AND +5 VOLT REGULATOR. (PCB No. Al, Figure 6-12) The error (voltage difference) between the reference zener diode VR1 and variable resistor R18 is amplified by a differential amplifier, composed of transistors Q8 and Q9, then by transistor Q1. Q1 drives the series regulator transistor Q2 When the regulated output at pins 10F and 10C increases above +20 volts, the collector current of Q8 decreases, reducing the collector current of Q1 and decreasing the drive to Q4, thus decreasing the output to +20 volts. Transistor Q7 acts as a current source for VR1 and the base input of Q8 and provides isolation from the +35 volts unregulated supply.

4.138 Transistors Q3, Q4, Q5 and Q6 form a switching mode regulator. A +5 volt DC reference is derived from a voltage divider composed of R12 and R13. The emitter voltage of Q6 controls the nominal duty cycle of an oscillator formed by Q3, Q4 and Q5. When Q4 is conducting, the voltage at the input of the filter, consisting of inductor L1 and Capacitor C4, is the unregulated supply voltage. When Q4 is not conducting, diode CR3 clamps the voltage at the input of the filter to ground. When the regulated output at pins 20C and 20F increases above +5 volts, Q5 stays on for a shorter length of time, which decreases the length of time Q3 and Q4 are turned on, **thus** shortening the positive duty cycle of the waveform at the emitter of Q4. As the average voltage at the input of the filter decreases, the output of the regulator returns to +5 volts.

4.139 +10 VOLT REGULATOR. (PCB So A2, Figure 6-13) The circuits on PCB No. A2 contain a line input rectifier, AC power lamp control, DC standby lamp control and +10 volts power supply regulator. Diodes CR4, CR5, CR6 and CR7 form a bridge rectifier which converts the AC line input to approximately +32 volts unregulated DC output at pin 6F. As long as the line input is present, current will flow through R5 to the AC power lamp. The positive DC standby input (nominally +24 volts) is connected to pin 5F. When the AC line input is present, the unregulated output at pin 61 will normally be more positive than the **DC** standby input, keeping the standby hold-off diode (CR1 on PCB No A1) turned off and diodes CR1 and CR2 (on this board) turned on. The voltage drop across R2 keeps CR3 and Q1 turned off In the absence of the AC line input, the unregulated voltage at the output of the bridge will drop until the standby hold-off diode on PCB No. A1 conducts. At the same time, the voltage across R2 will drop until CR3 conducts, turning on Q1 and lighting :he standby lamp.

4.140 Transistors Q2, Q3 and Q4 form the +10 volt power supply regulator. Q2 and Q3 are a differential amplifier which compares the regulated +10 volt output at pin 9F to a +10 volt reference voltage derived from the regulated +20 volt input at pin 10F by a voltage divider formed by R6 and R7. Transistor Q4 is a parallel regulator. If the output at pin 9F goes positive with respect to the reference voltage, the voltage at the collector of Q2 will also go positive, causing Q4 to conduct harder and dropping the output voltage back to its normal level.

4.141 DIFFERENTIATOR. (PCB No. A3, Figure 6-14) **PCB No.** A3 contains four transistor-integrated circuit differentiatirs. The circuit containing transistor Q1 and integrated circult U1D is typical, Under normal conditions the input at pin 8C will be zero volts, which will keep Q1 turned off and provide inputs of +5 volts and zero volts at pins 9 and 10, respectively, of the integrated circuit. When the input at pin 8C goes positive, Q1 will turn on and (after a short length of time determined by the speed with which Q1 switches) the collector of Q1 will approach zero volts. During the period between the time the input at pin 8C goes positive and the time at which Q1 turns on, a narrow negative pulse with fast rise and fall times suitable for driving clock inputs on integrated circuits is produced at pin 13C.

4.142 PHASE COMPARATOR. (PCB No. A4, Figure 6-15) The square wave input at pin 19C is inverted by integrated circuit U1A and differentiated by transistor Q1 and integrated circuit U1D before being applied to the clear input of a J-K flip-flop (integrated circuit U2A). The outputs of the flip-flop at pins 12 and 13 are two complementary, variable duty cycle square waves. The duty cycles of the square waves are proportional to the relative phase difference between the inputs at pins 17C and 19C. The Q output is inverted by transistor Q3 and filtered by resistor R17 and capacitor C5 to produce a DC output at pin 7C suitable for driving an external recorder. Pin 7C is connected to the CONTROL VOLTAGE Jack on the rear panel. The Q output of integrated circuit U2A is inverted by transistor Q2 and used to drive the gate input of field-effect switch Q7. Transistor Q7, zener diode VR1, and resistors R8, R9, R10, and R11 form a precision switching network which, in conjunction with a low-pass filter (C2, C3, C4, R12, R13 and R14), provides the control voltage input for the crystal oscillator.

4.143 Transistor Q4 and integrated circuits U1B, U1C and U2B form a phase comparator similar to the one described above The Q output of integrated circuit U2B is inverted by transistor Q5 and filtered by resistor R24 and capacitor C7 to produce a DC output at pin 11F which is used to drive the front panel meter. R25 limits the current at the output and is used to calibrate the meter. The Q output of integrated circuit U2B is also inverted by transistor Q6 and filtered by resistor R29 and capacitor C9 to produce a CC output at pin 18F suitable for driving an external recorder. Pin 18F is connected to the CONTROL MONITOR Jack on the rear panel.

4.144 DIVIDER 1. (PCB No. A5, Figure 6-16) PCB No. A5 contains eight SN7490N integrated circuit dividers arranged in two separate sections. Integrated circuits U1 through U6 are arranged in series to provide a total division ratio of 50.000.

Integrated Circuit U1 is connected as an N/5 divider. Integrated circuits U2 through U6 are connected as N/10 dividers. Intermediate division rates are brought out on pins 17F, 16F, 15F, 19F, 8F and 7F. Integrated circuits U7 and U8 are connected in series to provide an N/5 output (2F) and an N/100 output (1F).

4.145 DIVIDER 2. (PCB No. A6, Figure 6-17) PCB No. A6 contains eight SN7490N integrated circuit dividers arranged in four separate sections. Integrated circuits U1 through U4 are arranged to provide a total division ratio of 5,000. Intermediate division ratio signals are brought out on pins 18F, 16F, 6F, 15F and 13F. Integrated circuit U5 divides the input at pin 8F by ten. Integrated circuit U6 divides the input at pin 4F by ten. Integrated circuits U7 and U8 are connected to divide the input pin 1F by 100.

4.146 DIVIDER 3. (PCB No. A7, Figure 6-18) Eight SN7490N integrated circuits are connected in series to divide the input frequency at pin 14F by 100,000,000. All eight SN7490N's are connected as N/10 dividers with final output on pin 8F intermediate division ratio signals are brought on pins 19F and 11F.

4.147 SERVO CONTROL. (PCB No. A8, Figure 6-19) A differentiating circuit, formed by transistor Q2 and integrated circuit U1B, produces narrow negative-going pulses at the trailing edges of the square wave input at pin 19C. The output of the differentiator is connected to the step input of one section of a dual phase shifter (PCB No. A9). The 10 MHz signal present at pin 16C is gated with 5 kHz signals (derived from the 10 kHz inputs at pins 2C and 6C) to produce the aging correction output at pin 14C. The 5 MHz signals are also brought out on pins 2F and 7F.

4.148 DUAL PHASE SHIFTPP (PCB No. A9 and PCB No. A12, Figures 6-20 and 6-23) The circuits on PCB No. A9 and PCB No. A14 each contain two separate variable ratio dividers. Each divider normally divides the clock input (pins 14F and 2F) outputs are provided at pins 12C and 2C. N/10 output at pins 11C and 1C. A direction input is provided 6C) to control the abnormal division ratio (either step inputs are provided (pins 17F, 18F, 3F and 4F) when abnormal division will occur.

4.149 For example, if a negative going occurs while the direction input is a logical 1 (+5 output of the variable ratio divider will divide the quency by 6. If a negative going step input occurs direction input is a logical zero (zero volts), the the variable ratio divider will divide the input from If no step inputs occur, the divider will produce a one fifth of the input frequency, regardless of the direction input.

4.150 A lock input (pins 16F and 1F) is If the lock input is a logical zero, then the step have no effect on the divider.

4.151 5 MHz VCO. (PCB No. A10, Figure and 0/50 inputs at pins 1C and 12C are inverted and transistors Q5 and Q9, and summed in an amplifier from transistors Q6 and Q7 (Q8 provides a constant colle for Q6 and Q7). The output of the amplifier is fil and applied to the inverting input of operational a The output of the operational amplifier is averaged pass filter (R27 and C16) and applied across varica control the frequency of the 5 MHz oscillator. The tive excursion of the waveform at the output of the (collector of Q3) is clamped at five volts by a dic PCB No. A13.

4.152 DIGITAL INTEGRATOR. (PCB No. All The 5 MHz output of the crystal oscillator is conve

C l, resistors R3 and R4 and transistor Q1, then are U4D. A differentiating circuit formed by integrated circuit U2A produces narrow negative filing edges of the square wave present at pin 10 cuit U4D. Integrated circuits U2B and U1B and a second differentiator which produces narrow it the leading edges of the square wave present integrated circuit U4D. These two signals are com- es U1A, U1C and U1D to produce 10MHz outputs at 19C. R4 is adjusted to compensate for the ted circuit U2B. The 1 MHz input at pin 8C is gate U4C to produce a clock input to phase shifter 1 MHz input at pin 8C is also divided by 100 recuits US and U6 and gated with a 10 kHz signal the 100 kHz input at pin 1F) to produce step outs to phase shifter B at pins 14C and 12C.

4.153 PHASE DETECTOR. (PCB No. A13, Figure 6-24) the positive excursion of the input at pin 7C collector of Q3 on PCB No. A10) to +5 volts. This out of the 5 MHz VCO to a logic level suitable for J7400N-type integrated circuits. Integrated cir- the input and provides a 5 MHz output at pin 1C. it U6 is an SN7490N connected as an N/5 divider, outputs at pins 8 and 11. The 1 MHz output at ated circuit U6 is applied to a transistor-inte- ifferentiator (Q1 and integrated circuit U4D) arrow negative-going pulses at pin 8. The 1 MHz ate U4D is applied to the clear input of inte- 5A, a D-type flip-flop (SN7474N). A 1 MHz input the clock input of integrated circuit USA.

4.154 This arrangement produces a 1 MHz variable duty cycle square wave output at pin 3C. The duty cycle of the square wave is proportional to the relative phase difference between the clock and clear inputs to integrated circuit U5A. If the clear input advances in phase with respect to the clock input, the positive duty cycle of the output will decrease. The buffered 1 MHz reference input at pin 19C is inverted by integrated circuit U1A and applied to the input of a transistor-integrated circuit differentiator composed of Q2 and integrated circuit U1D. The negative-going pulses at the output of NAND gate U1D are gated with the 1 MHz output at pin 8 of integrated circuit U6 to produce a variable duty cycle 1 MHz output at pin 18C (used to control the rate of the unijunction oscillator on PCB No. A14) and a direction output for a variable ratio divider at pin 14C.

4.155 INPUT/OUTPUT BUFFERS. (PCB No. A14, Figure 6-25) The circuits on PCB No. A14 contain an input buffer and detector, a unijunction oscillator and two output buffers. Transistors Q1, Q2, Q3 and Q4 amplify and square the 1 MHz frequency standard input, producing a five volts peak-to-peak output at pin 1C. As long as the 1 MHz frequency standard input to the unit is present, C2, R11, R12 and CR1 differentiate the square wave at the collector of Q4, producing positive spikes at a 1 MHz rate at the base of Q5 to keep Q5 turned on and C3 discharged. When the 1 MHz frequency standard input is absent, C3 is allowed to charge through R13 toward the positive five volts supply, turning Q6 on. The output at pin 1F will be a logic 1 (+5 volts) when the frequency standard input is present and a logic zero (zero volts) when the frequency standard input is absent.

4.156 Transistor Q8 acts as a variable resistance in the charge path of C4. A variable duty cycle 1 MHz square wave at the base of Q7 controls the length of time Q8 is turned on and thus the output frequency of the unijunction Q9. Transistors Q11 and Q10 **amplify** and square the output pulses produced at pin 13C. Transistors Q12, Q13 and Q14 form a buffer amplifier designed to produce a 1 MHz square wave output at a constant fifty ohm impedance. Transistors Q15, Q16 and Q17 form a similar buffer for the 5 MHz rear panel outputs.

4.157 CV-2929 FREQUENCY MULTIPLIER

4.158 POWER SUPPLY ASSEMBLY. (PCB No. A1A1 and PCB No. A1A Figure 6-27) The Power Supply Assembly circuits convert an unregulated AC line input to regulated +20, +10 and +5 volt outputs. Provision is made for automatic switchover to a DC standby input in the event of primary AC line failure.

4.159 AC POWER SUPPLY, The AC line input is stepped down by transformer T1 and converted to a +35 volts unregulated DC supply by a bridge rectifier composed of diodes CR2, CR3, CR4 and CR5. Capacitor Cl filters the unregulated supply.

4.160 DC POWER SUPPLY. Standby holdoff diode CR1 is held in reverse bias by the +35 volts unregulated DC supply as long as AC line power is present. (The Standby Power input can vary between +22 and +32 volts DC.) Upon loss of the primary AC line, diode CR1 becomes forward biased when the +35 volts unregulated supply drops below the Standby Power input voltage. Switchover from AC line to DC standby power does not affect the logic functions of the Frequency Multiplier; chart drive power to the recorder, however, will be lost. Upon the return of AC line power, the chart drive motor on the recorder will begin running again.

4.161 As long as AC line power is present, the voltage at the cathode of diode CR1 is more positive than the voltage at the DC Standby input, which keeps diodes CR7 and CR8 turned on, and diode CR9 and transistor Q16 turned off. When AC line power is lost, the voltage at the cathode of diode CR1 drops below the DC Standby input. This drops the voltage at the cathode of diode CR8 and turns on diode CR9 and transistor Q16, which supplies current to illuminate the Standby lamp. Upon resumption of AC line power, the circuit returns to its original state.

4.162 +20V DC REGULATOR. When power is first applied to the receive?, the regulated +10 and +20 volt supply outputs will be at zero volts. As the voltage across capacitor Cl begins to rise, capacitor C2 will begin to charge through resistors R13 and R14 toward the unregulated supply. When the firing potential of transistor Q5 is reached, the unijunction will turn on, discharging capacitor C2 and producing a positive pulse at Base 1. As the voltage across zener diode VR1 begins to rise, transistor Q2 turns on, providing base drive for transistor Q3. As transistor Q3 begins to conduct, transistor A7Q1 also turns on, and the +20 volts regulated supply begins to rise. As the +20 volts line rises, Q6 turns on and disables the starting circuit. Eventually, enough current is drawn through diode VR1 to push it into its zener region (5.1 volts) and enough current is drawn through resistors R3 and R4 to turn on Q1. When the output of the regulator rises above +20 volts, the collector current of transistor Q2 decreases. This reduces the collector current of transistor Q3, and decreases the base drive to transistor A7Q1, thereby dropping the output back to +20 volts. When the regulated output drops below +20 volts, the error is sensed by the differential amplifier. If this happens, the collector currents of transistors Q2, Q3 and A7Q1 increase, returning the output to +20 volts. Variable resistor R4 provides output voltage adjustment.

4.163 +10 V DC REGULATOR. The difference between the +10 volts supply and half of the +20 volts supply is sensed by a differential amplifier, composed of transistors Q7 and Q8. The output of the amplifier drives shunt regulator transistor **Q9,**

4.164 +5 V DC REGULATOR. Transistors Q10 through Q15 form a switching mode regulator. A +5 volts reference is derived from the +20 volts regulated supply by a voltage divider, consisting of resistors R26 and R39. A differential amplifier, composed of transistors Q14 and Q15, amplifies the error between the reference voltage and the regulated +5 volts output. The collector currents of transistors Q14 and Q15 control the duty cycle of a free-running multivibrator (Q10 and Q11). Transistor Q12 provides base drive for transistor Q13. When transistor Q13 is turned on, the voltage at the input of the filter, (consisting of inductor L1 and capacitor C8) is the unregulated supply voltage. When transistor Q13 is turned off, diode CR11 clamps the voltage at the input of the filter to ground. If the output of the filter rises above +5 volts, the differential amplifier (Q14 and Q15) senses the error and decreases the positive duty cycle of the input to the filter, thus dropping the filter output back to +5 volts. If the output of the filter drops below +5 volts, the differential amplifier increases the positive duty cycle of the input to the filter, which raises the output back to +5 volts. If a malfunction in the regulator causes the output voltage to rise beyond the normal operating limits, zener diode VR2 will clamp the output at +6.8 volts until fuse F2 is blown.

4.165 SYSTEM REFERENCE LOGIC. (PCB No. A2, Figure 6-28) The System Reference Logic circuits (1) buffer and monitor the condition of the Carrier Relay, Coherent 1 MHz and 1.536/1.544 MHz Line inputs, (2) detect the phase difference between the Remote Reference input and the 1.544 MHz or 1.536 MHz output, and (3) buffer the 1 MHz, 1.536 MHz, 1,544 MHz and 5 MHz outputs.

4.166 CARRIER RELAY INPUT BUFFER. Transistors Q1, Q2 and Q3 buffer the Carrier Relay input. A positive feedback loop (transistor Q1 and resistors R2 and R3) provides feedback for positive switching. Transistor Q4 converts the buffer output to TTL switching levels and integrated circuit U1B inverts and further shapes the output.

4.167 LOCAL LAMP DRIVER. When the Carrier Relay input goes high (indicating the Model R-1776 receiver is tracking a Loran-C signal), the output of the Carrier Relay Input Buffer will go high, turning on transistors Q9, which supplies current to the Local lamp. Integrating capacitor C3 reduces the switching speed of transistor Q9 to help. prevent crosstalk between the Local lamp wire and other wires in the cable bundle running from the Interconnect board and the front panel.

4.168 REMOTE REFERENCE WAVESHAPER. The Remote Reference Waveshaper circuit amplifies and squares the Remote Reference input, producing a square wave going from zero to +5 volts at the collector of transistor Q8. Transistor Q7 and resistors R15 and R16 introduce positive feedback for switching.

4.169 REMOTE REFERENCE DETECTOR. Capacitor C2 and resistor R19 differentiate the output of the Remote Reference Waveshaper. Diode CR3 shorts the negative spikes to ground, insuring that the base of transistor Q10 is never more than one diode potential below ground. The differentiated signal turns transistor Q10 on at the Remote Reference rate, keeping capacitor C4 discharged and transistor Q11 turned off. If the Remote Reference input is lost, transistor Q10 turns off and stays off, allowing capacitor C4 to charge toward the positive supply, which turns transistor Q11 on. As long as the Remote Reference input is present, the Remote Reference Detector output will be +5 volts. When the Remote Reference input disappears, the Detector output will be zero volts.

4.170 REMOTE/COAST LOGIC. If the output of the Carrier Relay Input Buffer goes low (indicating that the R-1776 receiver is not tracking a Loran signal) while the Remote Reference Detector is indicating the presence of a Remote Reference input, the output of inverter U2A will go high, turning on transistor Q12, which supplies current to the Remote lamp. (At the same time, the low output from the Carrier Relay input Buffer will turn off transistor Q9, which supplies current to the Local lamp.) If the Remote Reference Input is lost while the receiver is not tracking a Loran signal, the output of inverter U2A will go low, turning off the Remote lamp. This also causes the output of inverter U2D to go high, turning on transistor Q13, which supplies current to the Coast lamp. At the same time, the Lock A output will go low, disabling NAND gate U6A on the 1 MHz Synthesizer board (PCB No. A3) and removing the 1 MHz inputs to the Model O-1632 RF Oscillators. If the Remote Reference input is lost while the receiver is tracking a Loran signal, the Local lamp will remain on, the Remote and Coast lamps will remain off, the Lock A output will remain high, and the 1 MHz inputs will continue to be supplied to the RF Oscillators.

4.171 REMOTE LAMP DRIVER. When the output of inverter U2A goes high (indicating the R-1776 receiver is not tracking a Loran signal), transistor Q12 is turned on, lighting the Remote lamp.

4.172 COAST LAMP DRIVER. When the output of inverter U2D goes high (indicating the loss of the Remote Reference input while the receiver is not tracking a signal), transistor Q13 is turned on, lighting the Coast lamp.

4.173 1 MHz INPUT BUFFER. The 1 MHz Input Buffer differentiates the 1 MHz Receiver input, producing narrow 1 MHz positive-going pulses at the collector of transistor Q15. This 1 MHz Receiver output resets divider U5 on the 1 MHz Synthesizer board (PCB No. A3), synchronizing the 1 MHz inputs to the O-1632 RF Oscillators with the 1 MHz output of the R-1776 Loran Receiver.

4.174 PHASE COMPARATOR. The Phase Comparator circuit produces a square wave output with a duty cycle proportional to the difference in phase between the Phase Detector A input (the Remote Reference signal) and the Phase Detector B input. Phase Detector B input can be either 1.536 MHz or 1.544 MHz from the 1.536/1.544 MHz Synthesizer, depending on the setting of switch S1 on the 1 MHz Synthesizer board. Resistor R30, capacitor C10 and integrated circuits U4C and U4D differentiate the Phase Detector A input. With a zero volt input at pin 7C, pin 12 of NAND gate U4C will b low and pin 13 of NAND gate U4C will go high and (after a short length of time determined by the speed with which inverter U4D switches and the length of time by which resistor R30 and capacitor C10 delay the output of the inverter) pin 13 of NAND gate U4C Will go low. During the period between the time pin 12 of the NAND gate goes high and pin 13 goes low, a narrow negative pulse with fast rise and fall times is produced at the output of gate U4C. A similar circuit differentiates the Phase Detector B input.

4.175 The outputs of the differentiators are applied to the inputs of a flip-flop composed of NAND gates U3C and U3D. The output of the flip-flop is a square wave (either 1.536 MHz or 1.544 MHz, depending on the frequency of the inputs) with a duty cycle proportional to the difference in phase between the Phase Detector A and Phase Detector B inputs.

4.176 RECORDER DRIVER. The Recorder Driver circuit filters the output of the Phase Comparator, producing a DC input for the front panel chart recorder. Common base amplifier Q16 isolates the output of the Phase Comparator from the filter. Variable resistor R77 provides a full scale adjustment for the recorder.

4.177 PHASE DIFFERENCE OUTPUT BUFFER. Inverter U3A inverts and buffers the output of the Phase Comparator, providing a Phase Difference B output for the rear panel.

4.178 1.544 MHz OUTPUT BUFFER. Transistor Q17, Q18, and Q19 invert and amplify the 1.544 MHz square wave input from the 1.536/1.544 MHz Synthesizer (PCB No. A6). Inductors L1, L2 and L3 and capacitors C19 through C24 filter the square wave, producing three sine wave outputs. Capacitors C46, C47 and C48 are selected for maximum output signal amplitude.

4.179 1 MHz OUTPUT BUFFER. Similar to the 1.544 MHz Output Buffer, this circuit converts the 1 MHz square wave input from the phase Shifter (PCB No. AS) to three sine wave outputs. Like the 1.544 MHz output buffer circuitry, capacitors C49, C50 and C51 are selected for maximum output signal amplitude.

4.180 5 MHz OUTPUT BUFFER. Again similar to the 1.544 MHz Output Buffer, this circuit converts the 5 MHz square wave input from the 5 MHz Amplitude Detectors (PCB No. A4) to a sine wave output. Similarly, capacitor C52 is selected for maximum output signal amplitude.

4.181 1.536 MHz OUTPUT BUFFER. Like the other output buffers, this circuit converts the 1.536 MHz square wave input from the 1.536/1.544 MHz Synthesizer (PCB No. A6) to two sine wave outputs. Likewise, capacitors C53 and C54 are selected for maximum output signal amplitude.

4.182 POWER SUPPLY FILTERS. Capacitors C39 through C45 filter the +20, +10 and +5 volts power supply inputs.

4.183 1 MHz SYNTHESIZER, (PCB No. A3, Figure 6-29) The 1 MHz Synthesizer circuits derive 1 MHz square wave outputs (which serve as reference inputs to the O-1632 RF Oscillators) from the Remote Reference input. A synchronizing circuit locks the 1 MHz outputs to the Phase Shifted 1 MHz output of the R-1776 Loran Receiver.

4.184 INVERTER. Integrated circuit U1C inverts and squares the leading and trailing edges of the Remote Reference input from the System Reference Logic board (PCB No. AZ).

4.185 DIVIDER A. The Divider A circuit divides the Remote Reference input by 192 (if switch S1 is in the 1.536 MHz position) or 193 (if the switch is in the 1.544 MHz position) to produce an 8 kHz output. Integrated circuits U4A, U4B, U4C and transistor Q1 reset the divider after the count of 192 or 193 has been reached.

4.186 PHASE COMPARATOR. The Phase Comparator circuit uses an 8 kHz gating pulse (divided down from the 10 MHz output of the Voltage Controlled Oscillator) to sample the leading edge of the 8 kHz output from Divider A. During the first half of the positive duty cycle of the 8 kHz gating pulse from Divider B, Q2 is turned on, allowing capacitor Cl to begin to discharge through diode CR2 and resistor R5. During the last half of the positive duty cycle of the 8 kHz gating pulse, transistor Q3 is turned off, allowing capacitor Cl to begin to charge through diode CR1 and resistor R4. If the Remote Reference input advances in phase (or if the VCO decreases in frequency), the leading edge of the 8 kHz output from Divider A will no longer be centered within the positive duty cycle of the 8 kHz gating pulse from Divider B. Transistor Q2 will then remain on for a shorter period of time than normal and transistor Q3 will remain off for a longer period of time than normal This allow capacitor Cl to discharge for shorter periods of time and charge for longer periods, increasing the average voltage at the input of the Buffer circuit. An increase of average voltage eventually forces the VCO to increase in frequency until the leading edge of the 8 kHz output from Divider A is again centered within the positive duty cycle of the 8 kHz gating pulse from Divider B.

4.187 BUFFER. Transistors Q4 and Q9 form a unity gain buffer amplifier which isolates the output of the Phase Comparator from the input to the Voltage Controlled Oscillator.

4.188 VOLTAGE CONTROLLED OSCILLATOR. As the average voltage at the output of the Buffer increases, the reverse voltage across varicap CR3 increases. This action decreases the capacity of the varicap and increases the frequency of the VCO. The input to the oscillator is normally held at +8 volts DC, while the output is a 10 MHz square wave. Variable capacitor C3 initially sets the nominal frequency of the oscillator to 10 MHz.

4.189 DIVIDER B. The Divider B circuit divides the 10 MHz output of the VCO by 1250 to produce an 8 kHz gating pulse. This gating pulse is used in the Phase Comparator circuit to sample the leading edge of the 8 kHz output from Divider A. Inverter U6C and flip-flop U11A convert the square wave output of divider U10 to a narrow positive pulse.

4.190 SYNCHRONIZER. Reset by a buffered 1 MHz signal from the R-1776 receiver, integrated circuit U5 divides the 10 MHz output of the VCO down to 1 MHz. When the receiver is not tracking a Loran signal, the Carrier Relay input goes low. This keeps the 1 MHz receiver signal from resetting the divider. If the Remote Reference input is lost while the receiver is not tracking a Loran signal, the Lock A input goes low, thus disabling NAND gate U6A and disconnecting the 1 MHz reference inputs from the O-1632 RF Oscillators.

4.191 1 MHz OUTPUT BUFFERS. Inverters U6B and U6D buffer the 1 MHz reference outputs to the RF Oscillators.

4.192 POWER SUPPLY FILTERS. Resistor R24 and capacitors C11 through C23 filter the +20 an-l +5 volts power supply inputs.

4.193 5 MHz AMPLITUDE DETECTORS. (PCB No. A4, Figure 6-30) The 5 MHz Amplitude Detectors circuits buffer, mix and monitor the condition of the 5 MHz Primary and Backup inputs. In addition, a unijunction oscillator generates step commands to the Phase Shifter (PCB No. A5).

4.194 PRIMARY BUFFER A. Transistors Q3, Q4, Q5 and Q6 amplify and square the 5 MHz Primary input. The signal at the collector of transistor Q6 turns on transistor Q7 at a 5 MHz rate, keeping capacitor C5 discharged and holding the output of Primary Buffer A at zero volts. If the Primary 5 MHz input is lost, transistor Q7 turns off and stays off, allowing capacitor C5 to charge through resistor R15 to the +5 volts supply.

4.195 PRIMARY 5 MHz DETECTOR. If the 5 MHz Primary input signal is lost, the input to the Primary 5 MHz Detector will go high, forcing the output of inverter U2A to go low. A low output from inverter U2A forces the output of NAND gate U2B to go high, and the two high inputs to NAND gate U2D produce a zero volts Primary 5 MHz DC output. When the 5 MHz Primary input returns, the input to the Primary 5 MHz Detector will go low, forcing the output of inverter U2A *to* go high. The *two* high inputs to NAND gate U2C produce a low output, which turns off transistor Q8 and allows capacitor C6 *to* charge through resistor R18 toward the +20 volts supply. When the voltage across capacitor C6 reaches the firing potential of the unijunction, transistor Q30 turns on, discharging capacitor C6 through resistor R21 and the base-emitter junction of transistor Q9. The resulting low signal at the collector of transistor Q9 returns the 5 MHz Primary DC output *to* its normal high state. As the 5 MHz Primary DC output goes high, the two high inputs to NAND gate U2B produce a low output, which forces the output of NAND gate U2C to go high, turning on transistor Q8 and returning the circuit to its original state

4.196 PRIMARY BUFFER B. Transistors Q1, Q2 and Q3 amplify and square the 5 MHz input, producing inputs for the Mixer and the Phase Shifter board (PCB NO. A5).

4.197 BACKUP BUFFER A. Transistors Q17, Q18 and 019 amplify and square the 5 MHz Backup input.

4.198 MIXER. Inverters U1A and U1B and transistors Q14 and Q15 form a switch driver which alternately turns on transistors Q31 and Q32 at the 5 MHz primary rate. Two 5 MHz Backup signals, 180° out of phase with each other, are taken from the secondary of transformer T1 and switched by transistors Q31 and Q32 to the base of emitter follower Q13. The buffered mixer output is fed from the emitter of transistor Q13 through a filter composed of inductor L1 and capacitors C7 and C8. The filter is tuned to the 10 MHz component of the mixer output. Transistor Q10 buffers the output of the filter, while transistors Q11 and Q12 and inverter U1D amplify and square the 10 MHz output.

4.199 BACKUP BUFFER B. Transistors Q23, Q24, Q25 and Q26 amplify and square the 5 MHz Backup input. The signal at the collector of transistor Q16 turns on transistor Q27 at a 5 MHz rate, keeping capacitor C21 discharged and holding the output of Backup Buffer B at zero volts. If the 5 MHz Backup input is lost, transistor Q27 turns off and stays off, allowing capacitor C21 to charge through resistor R52 to the +5 volts supply.

4.200 BACKUP 5 MHz DETECTOR. The Backup 5 MHz Detector circuit is identical to the Primary 5 MHz Detector. If the 5 MHz Backup input is lost, the normally high 5 MHz Backup DC output will change to zero volts.

4.201 SLEWING RATE OSCILLATOR. Transistors Q33, Q21 and Q22 and integrated circuits U4C and U4F form a unijunction oscillator which produces a step input for the Phase Shifter board (PCB No. ***A5).*** The frequency of the oscillator is controlled by timing resistors and capacitors mounted on the front panel Combiner Cycles/ Second switch. Transistors Q21 and Q22 and inverters U4F and U4C form a positive feedback loop which sharpens the leading and trailing edges of the step output pulse.

4.202 POWER SUPPLY FILTERS. Resistors R66 and R67 and capacitors C16, C17, C18 and C23 through C28 filter the +20, +10 and +5 volts power supply inputs.

4.203 PHASE SHIFTER. (PCB No. A5, Figure 6-31) The Phase Shifter circuits synthesize a 10 MHz signal from the output of the Mixer on the 5 MHz Amplitude Detectors board. In the event of failure of either the 5 MHz Primary or Backup input lines, the input of the synthesizer is switched from the output of the Mixer to the remaining 5 MHz line. The synthesized 10 MHz signal is divided and phase shifted to produce 5 MHz and 1 MHz outputs.

4.204 PRIMARY/BACKUP LOGIC. If both the 5 MHz Primary and Backup inputs from the RF Oscillators are present, the DC inputs to the Primary/Backup Logic circuit are high. The two high inputs to NAND gate U1C produce a low output, which forces the outputs of NAND gates U1B, U2D and U3B to go high. The high outputs of gates U1B and U2D are inverted by integrated circuits U1A and U2B. The low outputs of inverters U1A and U2B disable NAND gates U4B and U2A, disconnecting the 5 MHz Primary and Backup AC signals from the input to the Phase Detector/Amplifier. The low output from NAND gate U1C is also inverted by integrated circuit U1D to enable gate U5B (which connects the 5 MHz output of Divider A to the input of the Phase Detector/Amplifier) and to turn on transistor Q2 (which supplies current to the Both lamp on the front panel).

4.205 If the 5 MHz Primary input is lost, the 5 MHz Primary DC input goes low, forcing the outputs of NAND gates U1C and U2D to go high. These high outputs are inverted by integrated circuits U1D and U2B, disabling NAND gates U5B and U2A and keeping the Primary and Both Lamp Drivers turned off. The two high inputs to NAND gate U1B produce a low output, which is inverted by integrated circuit U1A to enable gate U4B (which connects the 5 MHz

Backup AC signal to the input of the Phase Detector/Amplifier) and to turn on transistor Q3 (which supplies current to the Backup lamp on the front panel).

4.206 If the 5 MHz Backup input is lost, the 5 MHz Backup DC input goes low, forcing the outputs of NAND gates U1C and U1B to go high. These high outputs are inverted by integrated circuits U1D and U1A, disabling NAND gates U5B and U4B and keeping the Backup and Both Lamp Drivers turned off. The two high inputs to NAND gate U2D produce a low output, which is inverted by integrated circuit U2B to enable gate U2A (which connects the 5 MHz Primary AC signal to the input of the Phase Detector/Amplifier) and to turn on transistor Q1 (which supplies current to the Primary lamp on the front panel).

4.207 If both the 5 MHz Primary and Backup signals are lost, the DC inputs at pins 6C and 7C go low, forcing the outputs of NAND gates U1C, U2D and U2B to go high. These high outputs are inverted by integrated circuits U1D, U2B and U1A disabling NAND gates U2A, U5B and U4B and keeping all of the front panel Combiner lamps off. The three high inputs to NAND gate U3B produce a low Lock B output which disables gates U1A and U1B on the 1.536/1.544 MHz Synthesizer board (PCB No. A6).

4.208 PRIMARY LAMP DRIVER. When the output of inverter U2B goes high (indicating a loss of the 5 MHz Backup signal from the 0-1632 RF Oscillator), transistor Q1 is turned on, lighting the Primary lamp. Capacitor Cl slows down the switching speed of transistor Q1 to help prevent crosstalk.

4.209 BOTH LAMP DRIVER. When the output of inverter U1D is high (indicating the presence of both the 5 MHz Primary and Backup signals from the 0-1632 RF Oscillators), transistor Q2, is turned on, lighting the Both lamp. Capacitor C2 slows down the switching speed of transistor Q3.

4.210 BACKUP LAMP DRIVER. When the output of inverter U1A is high (indicating loss of the 5 MHz Primary signal from the 0-1632 RF Oscillator), transistor Q3 is turned on, lighting the Backup lamp. Capacitor C3 slows down the switching speed of transistor Q3.

4.211 DIVIDER A. Integrated circuit U6 divides the 10 MHz output of the Mixer on the 5 MHz Amplitude Detectors board (PCB No. A4) down to 5 MHz.

4.212 5 MHz GATES. When both the 5 MHz Primary and Backup signals from the RF Oscillators are present, low outputs from inverters U2B and U1A disable NAND gates U2A and U4B, and a high output from inverter U1D enables gate U5B (which connects the 5 MHz output from Divider A to the input of the Phase Detector/Amplifier). If the 5 MHz Primary signal from the RF Oscillator is lost, gates U2A and USE are disabled with low inputs, while a high input to pin 5 of gate U4B connects the 5 MHz Backup AC signal to the input of the Phase Detector/Amplifier. If the 5 MHz Backup signal is lost, gates U5B and U4B are disabled with low inputs, while a high input to pin 2 of gate U2A connects the 5 MHz Primary AC signal to the input of the Phase Detector/Amplifier. NAND gate U3A combines the outputs of gates U2A, U4B and U5B.

4.213 PHASE DETECTOR/AMPLIFIER. Integrated circuit U7 compares the phase of the output signal from the 5 MHz Gates (pin 1, Reference Input) with the phase of the output signal from the Voltage Controlled Oscillator (pin 3, Variable Input), producing a DC output at pin 8 proportional to the difference in phase between the two signals. External components R11, R12, R13, R14, C22, C23 and Q4 and an internal Darlington amplifier form an active filter for the outputs of an integrated circuit charge pump (pins 5 and 10).

4.214 VOLTAGE CONTROLLED OSCILLATOR. Controlled by the DC output of the Phase Detector/Amplifier, integrated circuit U8 produces a 5 MHz output locked to the phase of the output of the 5 MHz Gates. Capacitor C24 sets the nominal frequency of the oscillator to 5 MHz. Integrated circuit U8 will continue to oscillate at 5 MHz (although slightly shifted in phase) for a short period of time if the output from the 5 MHz Gates is lost.

4.215 DOUBLER. Exclusive - OR gates U16A and U16B and flip-flop U17A form a frequency doubler, which produces a 10 MHz output. Gated by the Q output of flip-flop U17A, exclusive-OR gate U16B, which is gated by the Q output of flip-flop U17A, produce negative-going pulses at the leading and trailing edges of the 5 MHz input.

4.216 INVERTER. Integrated circuit U15D inverts the 10 MHz, output of the Doubler.

4.217 DIVIDER B. Integrated circuit U9 divides the 10 MHz output of the Inverter down to 1 MHz.

4.218 1 MHz OUTPUT BUFFER. Inverter U11C and resistors R18 and R19 buffer the 1 MHz output of Divider B.

4.219 PHASE SHIFTER. The Phase Shifter circuit normally divides the 10 MHz output of the Inverter down to 5 MHz. If a Step input pulse (pin 16C) is received while the Advance pushbutton is depressed, the Phase Shifter shortens the period of its output by one cycle (0.1 microsecond) of the 10 MHz input. If a Step command is received while the Retard pushbutton is depressed the Phase Shifter lengthens the period of its output by one cycle of the 10 MHz input. If a Step command is received while both the Advance and Retard pushbuttons are depressed, the output of the Phase Shifter will be retarded.

4.220 Under normal conditions (when neither the Advance nor Retard pushbuttons are depressed), the two high inputs to NAND gate U4A produce a low output, which disables **gate U5A,** disconnecting the Step command from the clock input of flip-flop U10B. With the clock input disconnected, the Q output of flip-flop U10B will remain in either a high or low state. It the Q output is low, gates U11A, U11D, U11B, U13C and U13B will force both the Q output of flip-flop U12B and the Q output of flip-flop U12A to go low. The two low inputs to exclusive-OR gate U13A will produce a low output, which will disable NAND gates U3C and USC, allowing flip-flop U10A to divide the 10 MHz output from the Inverter down to 5 MHz. If the 6 output of flip-flop U10B is in a high state during this period, gates U11A, U11D, U11B, U13C and U13B will force both the Q output of flip-flop U12B and the Q output of flip-flop U12A to go high. The two high inputs to exclusive-OR gate U13A will produce a low output, again disabling gates U3C and USC and allowing flip-flop U10A to divide the 10 MHz input by 2.

4.221 If the Advance pushbutton is depressed, the low input to NAND gate U4A forces its output to go high This enables gate USA, allowing Step command pulses to clock flip-flop U10B (provided the front panel Combiner Cycles/Second switch is not in the Off position). During this period, each Step Input pulse changes the output state of flip-flop U10B. Each time the output of the flip-flop changes, there is a short period of **time** when the Q output of flip-flop U12B and the Q output of flip-flop U12A are neither both high nor both low. The two unlike inputs to exclusive-CR gate U13A produce a high output which gets synchronized with the 10 MHz input by NAND gate U3C to clear flip-flop U10A, advancing the 5 MHz output by 0.1 microsecond.

4.222 If the Retard pushbutton is depressed, the low input at p-n 14C disables gate U3C and forces inverter U4D to enable gate U5C. This also allows the Step command pulse to be gated through to the clock input of flip-flop U10B. Each time the Q output of flip-flop changes, there is a short period of time when the Q output of flip-flop U12B and the Q output of flip-flop U12A are neither both high nor both low. The two unlike inputs to exclusive-OR gate U13A produce a high output which gets synchronized with the 10 MHz input by NAND gate U5C to preset flip-flop U10A, retarding the 5 MHz output by 0.1 microsecond.

4.223. DIVIDER C. Integrated circuit U14 divides the 5 MHz output of the Phase Shifter down to 1 MHz.

4.224 POWER SUPPLY FILTER. Capacitors C4 through C21 filter the +5 volts power supply input.

4.225 1.536/1.544 MHz SYNTHESIZER. (PCB No. A6, Figure 6-32) The 1.536/1.544 MHz Synthesizer circuits derive 1.536 MHz and 1.544 MHz square wave outputs from the 1 MHz output of the Phase Shifter board. Gating circuits disable the outputs in the event of loss of both the 5 MHz Primary and Backup inputs to the CV-2929

4.226 INVERTER Integrated circuit U1D inverts the 1 MHz output of the Phase Shifter board.

4.227 DIVIDER A. The Divider A circuit divides the 1 MHz output of the Inverter by 125 to produce an 8 kHz gating pulse which is used in the Phase Comparator A and B circuits to sample the trailing edges of the 8 kHz outputs of Dividers C and E.

U1C and flip-flop USA convert the output of divider U4 to a narrow positive pulse.

4.228 PHASE COMPARATOR A. The Phase Comparator A circuit uses the 8 kHz gating pulse from Divider A to sample the trailing edge of an 8 kHz square wave output from Divider C (which is derived from the output of Voltage Controlled Oscillator A). During the first half of the positive duty cycle of the 8 kHz gating pulse from Divider A, transistor Q1 is turned off, allowing capacitor C3 to begin to charge through resistor R2 and diode CR1, During the last half of the positive duty cycle of the 8 kHz gating pulse from Divider A, transistor Q2 is turned on, allowing capacitor C3 to begin to discharge through diode CR2 and resistor R5. If the 1 MHz input advances in phase (or if the VCO decreases in frequency), the trailing edge of the 8 kHz output from Divider C will no longer be centered within the positive duty cycle of the 8 kHz gating pulse from Divider A. Transistor Q1 will then remain off for a longer period of time than normal. This allows capacitor C3 to charge for longer periods, increasing the average voltage at the input of Buffer A This eventually forces Voltage Controlled Oscillator A to increase in frequency until the trailing edge of the 8 kHz output from Divider C is once again centered within the positive duty cycle of the 8 kHz gating pulse from Divider A.

4.229 BUFFER A. Transistors Q3 and Q4 form a unity gain buffer amplifier which Isolates the output of Phase Comparator A from the input to **Voltage** Controlled Oscillator A.

4.230 VOLTAGE CONTROLLED OSCILLATOR A. As the average voltage at the output of Buffer A increases, the reverse voltage across "varicap" CR3 increases. This decreases the capacity of the "varicap" and increases the frequency of the VCO. The input to the oscillator is normally held at +8 volts DC, while the output is a 12.332 MHz square wave. Variable capacitor C6 initially ***sets*** the nominal frequency of the oscillator to 12,352 MHz.

4.231 DIVIDER B. Integrated circuits U7, U8 and U9 divide the 12.352 MHz output of Voltage Controlled Oscillator A down to 1.544 MHz to supply inputs for Divider C and the 1.544 MHz Gate.

4.232 DIVIDER C. The Divider C circuit divides the 1.544 MHz output from Divider B by 193 to produce an 8 kHz input for Phase Comparator A. Integrated circuits U12A, U12B, U12C and transistor Q9 reset the divider after the count of 193 has been reacted.

4.233 1.544 MHz GATE. If both the 5 MHz Primary and Backup inputs to the Model CV-2929 are lost, the Lock B input goes low, which disables NAND gate U1A and remove: the 1.544 MHz signal from pins 15F and 16F.

4.234 PHASE COMPARATOR B. The Chase **Comparator** B circuit uses the 8 MHz gating pulse from Divider 4 to sample the trailing edge of an 8 kHz square wave output from Divider E (which is derived from the output of Voltage Controlled Oscillator B). During the first half of the positive duty cycle of the 8 kHz gating pulse from Divider A, transistor Q11 is turned on, allowing capacitor C13 to begin to discharge through diode CR5 and resistor R29. During the last half of the positive duty cycle of the 8 kHz gating pulse from Divider A, transistor Q12 is turned on, allowing capacitor C13 to discharge through diode CR6 and resistor R32. If the 1 MHz input advances in phase (or if the VCO decreases in frequency), the trailing edge of the 8 kHz output from Divider E is no longer centered within the positive duty cycle of the 8 kHz gating pulse from Divider A. Transistor Q11 then remains off for a longer period of time than normal and transistor Q12 remains on for a shorter period of time than normal. This allows capacitor C13 to charge for longer periods of time and discharge for shorter periods, increasing the average voltage at the input of Buffer B. This increase in average voltage eventually forces Voltage Controlled Oscillator B to increase in frequency until the trailing edge of the 8 kHz output from Divider E is again centered within the positive duty cycle of the 8 kHz gating pulse from Divider A.

4.235 BUFFER B. Transistor Q13 and Q14 form a unity gain buffer amplifier which isolates the output of Phase Comparator B from the input to Voltage Controlled Oscillator B.

4.236 VOLTAGE CONTROLLED OSCILLATOR B. As the average voltage at the output of Buffer B increases, the reverse voltage across varicap CR7 increases. This decreases the capacity of the varicap and increases the frequency of the VCO. The input to the oscillator is normally held at +8 volts DC, while the output is a 12.288 MHz square wave. Variable capacitor C16 initially sets the nominal frequency of the oscillator to 12.288 MHz.

4.237 DIVIDER D. Integrated circuits U13, U14 and U15 divide the 12.288 MHz output of Voltage Controlled Oscillator B down to 1.536 MHz to supply inputs for Divider E and the 1.536 MHz Gate.

4.238 DIVIDER E. The Divider E circuit divides the 1.536 MHz output of Divider D by 192 to produce an 8 kHz **input** for Phase Comparator B. Integrated circuits U18B, U18C, U18D and transistor Q10 reset the divider after the count of 192 has been reached.

4.239 1.536 MHz GATE. If both the 5 MHz Primary and Backup inputs to the CV-2929 are lost, the Lock B input goes low, which disables NAND gate U19A and removes the 1.536 MHz signals from pins 4F and SF.

SECTION V

5.0 MAINTENANCE

5.1 SCOPE OF SECTION

5.2 This section provides a list of the test equipment required to calibrate and troubleshoot the AN/GSQ-174 system, system alignment procedures, and malfunction and probable cause tables for each unit.

5.3 TEST EQUIPMENT REQUIRED

5.4 The following pieces of test equipment are required to calibrate and troubleshoot the AN/GSQ-174 system:

a) Tektronix 545 B Oscilloscope (or equivalent).
b) Simpson 260 Volt-ohm Meter (or equivalent).
c) Data Technology DT-120 Digital Oscillator (or any synthesizer capable of producing a 100 kHz sine wave output locked to the system frequency standard).
d) Hewlett-Packard HP355C Attenuator (or equivalent).
e) Hewlett-Packard HP355D Attenuator (or equivalent).

5.5 SYSTEM CALIBRATION

5.6 The AN/GSQ-174 system callbration procedure is divided into three parts. (1) R-1776 Loran Receiver Calibration, (2) 0-1632 RF Oscillator Calibration and (3) CV-2929 Frequency Multiplier Calibration. The operator should become familiar with the operating instructions in Section III and the principles of operation in Section IV before attempting to align the AN/GSQ-174 system.

NOTE: Equipment may contain mainframe (mother board) wiring or interconnects not in use for the AN/GSQ-174 configuration.

5.7 R-1776 LORAN RECEIVER CALIBRATION. Calibration of the receiver should be performed at a time of day when the signal-to noise ratio is high. To locate the components described in the following paragraphs refer to the schematic of the printed circuit board concerned (Section IV). Calibration of the receiver boards should be performed in the following order

a) Power Supply Assembly (PCB No. Al).
b) Standard Input - 10 MHz VCO (PCB No. A4).
c) Standard Input - 2 MHz VCO (PCB No. A4)
d) Amplitude Strobe (PCB No. A8).
e) Phase Strobe (PCB No. A9).
f) Viewing Filter (PCB No. A3).
g) Output Buffers (PCB No. A2).
h) Standard Input - Smoothing (PCB No. A4).
i) RF Amplifier (PCB No. A10).

5.8 POWER SUPPLY ASSEMBLY. (PCB No. Al, Figure 6-1) Adjustment requires removal of Power Supply Assembly from chassis.

STEP	PROCEDURE
1	Set AC and DC Standby switches to OFF.
2	Disconnect AC line and DC standby input power cables.
3	Remove Power Supply Assembly from chassis.
CAUTION	Power supply section must be supported if equipment is rack mounted.
4	Reconnect Power Supply Assembly to chassis with two extender boards.
5	Connect negative lead of voltmeter to negative terminal of Cl. Connect positive lead of voltmeter to positive terminal of C8.
6	Reconnect AC line power cable.
7	Set AC switch to ON.
8	Adjust R4 for voltmeter reading of 4.9 + 0.1 volts.

5.9 STANDARD INPUT - 10 MHz VCO. (PCB No. A4, Figure 6-4) Adjustment requires removal of PCB No. A4 from chassis.

STEP	PROCEDURE
1	Set power supply assembly AC and DC Standby switches to OFF.
2	Remove PCB No. A4 from chassis and mount on an extender board.
3	Connect 1 MHz signal from system frequency standard to rear panel Frequency Standard Input (J8).
4	Disconnect antenna.
5	Set power supply assembly AC switch to ON.
6	Set oscilloscope controls as follows: Triggering Mode — Auto Triggering Slope — Int + Stability — Preset Time/Cm — 1 millisecond Volts/Cm — 0 1 Vertical Coupling — AC
7	Ground X10 attenuator scope probe tip Using scope vertical position control, shift trace to center graticule.
8	Reset the following scope controls: Triggering Mode — AC Stability — Full CW Triggering Level — Full CW
9	Unground probe tip and connect to pin 9 of flip-flop U83B on PCB No. A4.
10	Adjust C6 to produce symmetrical vertical deflection of the "free-Funning trace about the center graticule. Number of centimeters of peak de-

STANDARD INPUT - 10 MHz VCO (Continued)

STEP	PROCEDURE
	flection above center graticule should equal number of centimeters of peak deflection below center graticule.

5.10 STANDARD INPUT - 2 MHz VCO. (PCB No. A4, Figure 6-4) Adjustment requires removal of PCB No. A4 from chassis.

STEP	PROCEDURE
1	Set power supply assembly AC and DC Standby switches to OFF.
2	Remove PCB No. A4 from chassis and mount on an extender board.
3	Connect 1 MHz signal from system frequency standard to rear panel Frequency Standard Input (J8).
4	Disconnect antenna.
5	Set power supply assembly AC switch to ON.
6	Connect oscilloscope X10 attenuator probe to pin 6 of flip-flop U83A on PCB No. A4. Adjust scope controls to produce a stable trace.
7	Adjust R27 to give a 1 MHz square wave with a 50 percent duty cycle at pin 6 of flip-flop U83A. (PCB No, A9 may be removed if oscillo-scope display IS unstable.)

5.11 AMPLITUDE STROBE (PCB No. A8, Figure 6-8) Adjustment requires removal of PCB No. A8 from chassis Procedures are as follows:

STEP	PROCEDURE
1	Set power supply assembly AC and DC Standby switches to OFF
2	Remove PCB No A8 from chassis and mount on an extender board.
3	Connect 1 MHz signal from system frequency standard to Frequency Standard Input (J8)
4	Connect negative voltmeter lead to emitter of Q18
5	Connect positive voltmeter lead to pm 14F
6	Set Power supply assembly switch to ON
7	While depressing rear panel Zero pushbutton (S1), adjust R35 for zero reading on voltmeter
8	Release Zero pushbutton and adjust R19 for zero reading on voltmeter (allowing sufficient time for reading to stabilize).

5.12 PHASE STROBE (PCB No A9, Figure 6-9) Adjustment requires removal of PCB No. A9 from chassis.

STEP	PROCEDURE
1	Set power supply assembly AC and DC Standby switches to OFF
2	Remove PCB No. A9 from chassis and mount on an extender board.
3	Connect antenna to Antenna input (J 1) and connect 1 MHz signal from system frequency standard to rear

PHASE STROBE (Continued)

STEP	PROCEDURE
	panel Frequency Standard Input (J8).
4	Connect positive voltmeter lead to pin 1F on PCB No. A9 and negative lead to pin 6F.
5	Set power supply assembly AC switch to ON
6	Acquire and track a Loran-C signal
7	Disconnect antenna and adjust R14 on PCB No A9 for a steady voltmeter reading If R14 is adjusted incorrectly, voltmeter reading will slowly change about one volt, then rapidly return to original reading This adjustment must be made while Servo Off lamp is off. If lamp comes on, reconnect antenna and wait for lamp to turn off again, then repeat steps 6 and 7.

5.13 VIEWING FILTER. (PCB No A3, Figure 6-3) Adjustment requires removal of top cover from chassis or removal of Rustrak Recorder Panel.

STEP	PROCEDURE
1	Set power supply assembly AC and DC Standby switches to OFF
2	Remove top cover from chassis.
3	Connect antenna to Antenna input (J1) and connect 1 MHz signal from system frequency standard to rear panel Frequency Standard Input (J8)
4	Set power supply assembly AC switch

VIEWING FILTER (Continued)

STEP	PROCEDURE
	to ON
5	Acquire and track a Loran-C signal
6	Adjust R7 on PCB No A3 for an AC voltage gain of five between pin 9F and pm 17F.
7	Adjust R14 for an AC voltage gain of five between pm 9F and pin 19F

5.14 OUTPUT BUFFERS (PCB No. A2, Figure 6-2) Adjustment requires removal of top cover from chassis or removal of Rustrak Recorder Panel

STEP	PROCEDURE
1	Set power supply assembly AC and DC Standby switches to OFF
2	Remove top cover from chassis
3	Connect antenna to Antenna input (J1) and connect 1 MHz signal from system frequency standard to rear panel Frequency Standard input (J8).
4	Set power supply assembly AC switch to ON
5	Acquire and track a Loran-C signal
6	Adjust R41 on PCB No A2 so that the leading edge of the Loran-C pulse stays in the same location on the oscilloscope display when the front panel Scope switch (S3) is changed from position 2 to position 3
7	Adjust R24 so that the leading edge of the intensified area in Scope switch position 2 occurs at the same location

OUTPUT BUFFERS (Continued)

STEP	PROCEDURE
	on the oscilloscope display as the leading edge of the intensified spot in Scope switch position 3.
8	While depressing the rear panel Zero pushbutton (S1), position the chart recorder needle at the bottom of the chart with the recorder zero adjust screw

NOTE: Zero adjust screw is located behind panel on right side of Rustrak Recorder

	While depressing the rear panel Full Scale pushbutton (S2), adjust R18 on PCB No A2 to position the chart recorder needle at the top of the chart

5.15 STANDARD INPUT - SMOOTHING (PCB No. A4, Figure 6-4) Adjustment requires removal of PCB No A4 from chassis.

STEP	PROCEDURE
1	Set power supply assembly AC and DC Standby switches to OFF
2	Remove PCB No A4 from chassis and mount on an extender board
3	Connect antenna to Antenna input (J 1) and connect 1 MHz signal from system frequency standard to rear

STANDARD INPUT SMOOTHING (Continued)

STEP	PROCEDURE
	panel Frequency Standard input.
4	Set power supply assembly AC switch to ON.
5	Acquire and track a Loran-C signal.
6	Using the manual slewing controls on the front of PCB No. A7, advance the receiver tracking point 1 5 microseconds and wait for the Phase strobe to return the tracking point to its original position. Note the phase trace on the chart recorder.
	Again using the manual slewing controls, retard the tracking point 1 5 microseconds and wait for the Phase Strobe to return the tracking point to its original position.
	Compare the relative smoothness of the phase traces obtained in steps 6 and 7 Adjust R2 on PCB No. A4 until steps 6 and 7 can be performed with equally smooth phase trace returns from the advance and retard directions.

5.16 RF AMPLIFIER (PCB No A10, Figure 6-10) Adjustment requires removal of top cover from chassis

STEP	PROCEDURE
1	Set power supply assembly AC and DC Standby switches to OFF.
2	Remove top cover from chassis.

RF AMPLIFIER (Continued)

STEP	PROCEDURE
3	Connect 1 MHz signal from system frequency standard to rear panel Frequency Standard input (J8) of the receiver and to the reference input of a synthesizer which is capable of generating a 100 KHz sine wave output locked to the reference input.

NOTE: See Paragraph 5.4.c

	Connect the output of the synthesizer to the Antenna input (J 1) of the receiver. Turn synthesizer on
4	Set RF Open/Gated switch on PCB No. A8 to Gated position. Remove PCB No A8 from chassis and short the base of Q24 to ground with a removable clip lead. (The easiest place to attach the clip lead is at the contacts of the RF Open/Gated switch.)
5	Mount PCB No A8 on an extender board and reconnect to chassis
6	Connect voltmeter negative lead pin 14F on PCB No A8 Connect positive lead to emitter of Q18.
7	Set RF Attenuator switches on PCB No. A10 to 30 db
8	Set front panel Scope switch (S3) to

RF AMPLIFIER (Continued)

STEP	PROCEDURE
	position 3.
9	Connect oscilloscope to rear panel Vertical, Trigger, and Z-axis outputs
10	Set power supply assembly AC switch to ON.
11	Adjust scope controls for a stable display.
12	Adjust synthesizer output amplitude to produce a 3 volts peak-to-peak deflection at receiver Vertical output.
13	Using manual slewing controls on the front of PCB No. A7, slew tracking point marker intensified spot to a zero crossing.
14	Adjust C3 on PCB No. A 10 to produce a zero voltmeter reading (allow sufficient time for circuit to stabilize).
15	Again using manual slewing controls, slew tracking point marker to either one of the nearest peaks.
16	Adjust R7 on PCB No. A10 to produce a zero voltmeter reading (allow sufficient time for circuit to stabilize).
17	Slew tracking point marker back to the original zero crossing and recheck step 14 If necessary, repeat steps 14, 15, and 16

5.17 0-1632 RF OSCILLATOR CALIBRATION. The following are step-by-step procedures for calibrating the 0-1632 RF Oscillator. To locate the components described in the following paragraphs, refer to the schematic of the printed circuit board concerned (Section IV).

5.18 +20 VOLT AND +5 VOLT REGULATOR. (PCB No. Al, Figure 6-12) Adjustment requires removal of the top cover from chassis

STEP	PROCEDURE
1	Set AC switch to OFF.
2	Remove top cover.
3	Set AC switch to ON.
4	Connect negative voltmeter lead to ground (pins 21 and 22) and positive lead to +5 volts output (pm 20).
5	Adjust R18 for voltmeter reading of +4 9 + 0.1 volts

5.19 5 MHz VCO. (PCB No A10, Figure 6-21) Adjustment requires removal of the top cover from chassis.

STEP	PROCEDURE
1	Set AC switch to OFF
2	Remove top cover
3	Remove PCB No. A10 from chassis and mount on an extender board
4	Set AC switch to ON.
5	Walt two hours for 5 MHz crystal oscillator to stabilize
6	Connect oscilloscope X 10 attenuator probe to pin 1C of PCB No A10 and verify that signal at this point has approximately 50 percent cycle
7	Connect scope probe to pin 6 of integrated circuit U1 on PCB No A10 and adjust C4 until voltage at pin 6 is +8 volts

5.20 DIGITAL INTEGRATOR. (PCB No. All, Figure 6-22) Adjustment requires removal of top cover.

STEP	PROCEDURE
1	Set AC switch to OFF.
2	Remove top cover.
3	Set AC switch to ON.
4	Wait two hours for 5 MHz crystal oscillator to stabilize
5	Connect oscilloscope X10 attenuator probe to pin 17C of PCB No. All and verify that 10 MHz positive-going pulses are present
	Repeat step 5 at pins 18C and 19C.
	Reconnect scope probe to pin 17C and adjust R4 until spacing between pulses is equal.

5.21 PHASE COMPARATOR. (PCB No. A4, Figure 6-15) Adjustment requires removal of top cover.

STEP	PROCEDURE
1	Set AC switch to OFF.
2	Remove top cover
3	Set AC switch to ON.
4	Set front panel Control Mode switch to Set Control position.
5	Set front panel Control Voltage switch to Aging position.
6	Depress Increase pushbutton until indicator on front panel meter reaches maximum positive reading and recycles
	Adjust R25 on PCB No. A4 until re-cycle point occurs at +5 on meter scale.

5.22 CV-2929 FREQUENCY MULTIPLIER CALIBRATION. The following are step-by-step procedures for calibrating the CV-2923 Frequency Multiplier. To locate the components described in the following paragraphs, refer to the schematic of the printed circuit board concerned (Section IV). Calibration of the Frequency Multiplier boards should be performed in the order indicated below:

a) Power Supply Assembly (PCB No. Al).
b) 5 MHz Amplitude Detectors (PCB No. A4).
c) 1.536/1.544 MHz Synthesizer (PCB No. A6).
d) 1 MHz Synthesizer (PCB No. A3).
e) System Reference Logic (PCB No. A2).

5.23 POWER SUPPLY ASSEMBLY. (PCB No. Al, Figure 6-27) Adjustment requires removal of Power Supply Assembly from chassis.

STEP	PROCEDURE
1	Set AC and DC Standby switches to OFF.
2	Disconnect AC line and DC standby input power cables.
3	Remove power supply assembly from chassis.

CAUTION: Power supply section must be supported if equipment is rack mounted.

STEP	PROCEDURE
4	Reconnect power supply assembly to chassis with two extender boards.
5	Connect negative lead of voltmeter to negative terminal of Cl.
6	Reconnect AC line power cable.
7	Set AC switch to ON.
8	Adjust R4 for voltmeter reading of 4.9 + 0.1 volts.

5.24 5 MHz AMPLITUDE DETECTORS. (PCB No. A4, Figure 6-30) Adjustment requires removal of PCB No. A4 from chassis. Steps and procedures are on the following pages.

5 MHz AMPLITUDE DETECTORS (Continued)

STEP	PROCEDURE
1	Set power supply assembly AC and DC Standby switches to OFF.
2	Remove PCB No. A4 from chassis and mount on an extender board
3	Connect primary and backup 5 MHz inputs to rear panel.
4	Connect oscilloscope X10 attenuator probe to emitter of Q10.
5	Set power supply assembly AC switch to ON.
6	Adjust C8 for maximum amplitude 10 MHz signal at emitter of Q10.

5.25 1. 536/1 544 MHz SYNTHESIZER. (PCB No. A6, Figure 6-32) Adjustment requires removal of PCB No A6 from chassis.

STEP	PROCEDURE
1	Set power supply assembly AC and DC Standby switches to OFF
2	Remove PCB No. A6 from chassis and mount on an extender board.
3	Connect primary or backup 5 MHz input to rear panel
4	Connect oscilloscope X10 attenuator probe to collector of Q4.
5	Set power supply assembly AC switch to ON
6	Adjust C6 for +8 volts DC at collector of Q4.
7	Connect scope probe to collector of Q14
8	Adjust C16 for +8 volts DC at collector of Q14.

5.26 1 MHz SYNTHESIZER (PCB No. A3, Figure 6-29)
Adjustment requires removal of PCB No A3 from chassis.

STEP	PROCEDURE
1	Set power supply assembly AC and DC Standby switches to OFF.
2	Remove PCB No A3 from chassis and mount on an extender board.
3	Connect remote reference input to rear panel
4	Set 1. 536/l 544 MHz switch on PCB No A3 to appropriate position for remote reference frequency being used
5	Connect oscilloscope X10 attenuator probe to collector of Q4.
6	Set power supply assembly AC switch to ON
7	Adjust C3 for +8 volts DC at collector of Q4

5.27 SYSTEM REFERENCE LOGIC (PCB No. A2, Figure 6-28) Adjustment does not require removal of PCB No. A2 from, chassis

STEP	PROCEDURE
1	Connect remote reference and primary or backup 5 MHz inputs to rear panel.
2	Set power supply assembly AC switch to ON.
3	Manually slew the combiner output until the front panel chart recorder needle reaches the bottom of the chart and recycles
4	Repeat step 3, turning recorder zero adjust screw until recycle point

SYSTEM REFERENCE LOGIC (Continued)

STEP	PROCEDURE
	occurs at zero chart reading.
5	Manually slew the combiner output until the front panel chart recorder needle reaches the top of the chart and recycles.
6	Repeat step 5, adjusting R77 on PCB No. A? until recycle point occurs at full scale chart reading.

5.28 MALFUNCTION AND PROBABLE CAUSE TABLES

5.29 The operator should become familiar with the operating instructions in Section I I I and the principles of operation in Section IV before attempting to troubleshoot the AN/GSQ-174 system Malfunction and probable cause tables are presented for each component of the system.

Table 5-1 Malfunctions and Probable Causes, R-1776

Symptom	Probable Cause
1. Receiver functions do not appear to operate.	a) Fuses blown, b) Incorrect supply voltages, c) Power supply failure
2. Oscilloscope does not trigger.	a) Oscilloscope trigger controls set incorrectly, b) Trigger circuit failed.
3. No intensified area on oscilloscope display.	a) Oscilloscope controls set incorrectly, b) Z-axis circuit failed.
4 Unable to distinguish Loran- C signal on oscilloscope display.	a) Antenna positioned incorrectly, b) Antenna shielded by large metal Object. c) RF AMPLIFIER or VIEWING FILTER circuits failed, d) Signal burled in noise or local interference,

Table 5-1 Malfunctions and Probable Causes, R-1776 (Continued)

Symptom	Probable Cause
	e) Open or shorted antenna cable
5. No output amplitude.	a) AMPLITUDE STROBE circuits failed
6. Receiver does not phase track Loran--C pulse	a) Frequency standard offset too large for tracking time constant,
	b) PHASE STROBE circuits failed,
	c) PHASE SHIFTER circuits failed
7. No 10usec or 100usec phase record output	a) OUTPUT BUFFER circuits failed,
	b) Phase comparator circuits failed
8. Drifting of Loran-C pulses on o s oscilloscope display	a) Frequency standard off frequency,
	b) Incorrect Group Repetition Rate selected,
	c) Frequency standard input circuit failed,
	d) GRP circuit failed.
9. Difficulty in locking on to Loran-C signal.	a) Incorrect operating procedure.

Table 5-2 Malfunctions and Probable Causes, 0-1632

Symptom	Probable Cause
1. No outputs. Power lamps off.	a) Fuses blown,
	b) Power supply failure.
2. AC power lamp off, DC standby lamp on when AC power input is present.	a) AC fuse blown.
3. Unit does not automatically switch to DC standby power upon loss of AC line power	a) DC standby fuse blown.
	b) DC standby input cable disconnected,
	c) CR1 open on PCB No. Al.
4. No 1 MHz outputs.	a) Failure of 1 MHz output buffer on PCB No. A14.
5. No 5 MHz outputs.	a) Failure of 5 MHz output buffer on PCB No. A14.

Table 5-2 Malfunctions and Probable Causes, 0-1632 (Continued)

Symptom	Probable Cause
6. Depression of INC and DEC pushbuttons has no effect on outputs.	a) Failure of servo control circuit on PCB No. A8, b) Failure of unijunction oscillator on PCB No. A14.

Table 5-3 Malfunctions and Probable Causes, CV-2929

Symptom	Probable Cause
1 No outputs. Power lamps off.	a) Fuses blown, b) Power supply failure, c) Power supply assembly incorrectly seated.
2. AC power lamp off, DC standby lamp on when AC power input is present.	a) AC fuse blown.
3. Unit does not automatically switch to DC standby power upon loss of AC line power.	a) DC standby fuse blown, b) DC standby input cable disconnected, c) DC standby switch on power supply assembly set to OFF, d) CR1 open on PCB No. A1P2.
4. 1.536 MHz output is present No 1. 544 MHz output.	a) Failure of 1.544 MHz output buffer on PCB No. A2, b) Failure of 1.544 MHz synthesizer on PCB No. A6.
5. 1.544 MHz output is present. No 1.536 MHz output.	a) Failure of 1.536 MHz output buffer on PCB No. A2, b) Failure of 1.536 MHz synthesizer on PCB No. A6.
6. No 5 MHz, 1.536 MHz and 1.544 MHz outputs. Chart recorder indicates either full scale or zero. All Inputs present.	a) Failure of Mixer on PCB No. A4, b) Failure of Divider A, 5 MHz Gates, Phase Detector/Amplifier, VCO, Doubler, Inverter, Phase Shifter, or Divider C on PCB No. A5.
7. No 1 MHz outputs. All inputs present.	a) Failure of 1 MHz output buffer on PCB No. A2,

Table 5-3 Malfunctions and Probable Causes, CV-2929 (Continued)

Symptom	Probable Cause
	b) Failure of 1 MHz synthesizer on PCB No. A3.
8. No 5 MHz output. All other inputs and outputs present.	a) Failure of 5 MHz output buffer on PCB No. A2.

APPENDIX A

LORAN-C RADIO NAVIGATION

INTRODUCTION

Loran-C is a pulse-type, hyperbolic system of radio navigation similar to the standard Loran-A All stations transmit at 100 KHz. The low frequency of 100 KHz was chosen for propagation stability and for low attenuation of the groundwave with distance. Thus, highly stable, long-range transmission is possible. These characteristics make transmissions ideally suited for a long range time and frequency distribution system as well as a navigation system.

SYSTEM DESCRIPTION

The Loran-C system contains many networks of stations, called chains, all of which broadcast at 100 KHz. Each chain transmits on a unique Pulse Repetition Rate (PRR) by which it can be distinguished from its neighbors. Period of the PRR is always a multiple of 100 microseconds in length. Table A-1 shows the basic and specific Pulse Repetition Periods.

A chain consists of a master station and two or more slave stations separated in distance from one another by several hundred miles. All stations within a chain transmit a group of pulses at the same frequency and PRR but not simultaneously. Each slave is delayed a controlled amount (called coding delay) so that the master is always received first. The delay between pulse groups is large enough so that no two groups overlap within receiving distance from the station.

Figure A-l shows a series of pulse groups from a hypothetical chain consisting of one master and two slaves. Phase coding for all three stations is indicated. Codes are changed between Pulse Repetition Periods A and B.

Within each group of eight pulses from master or slave stations, the phase

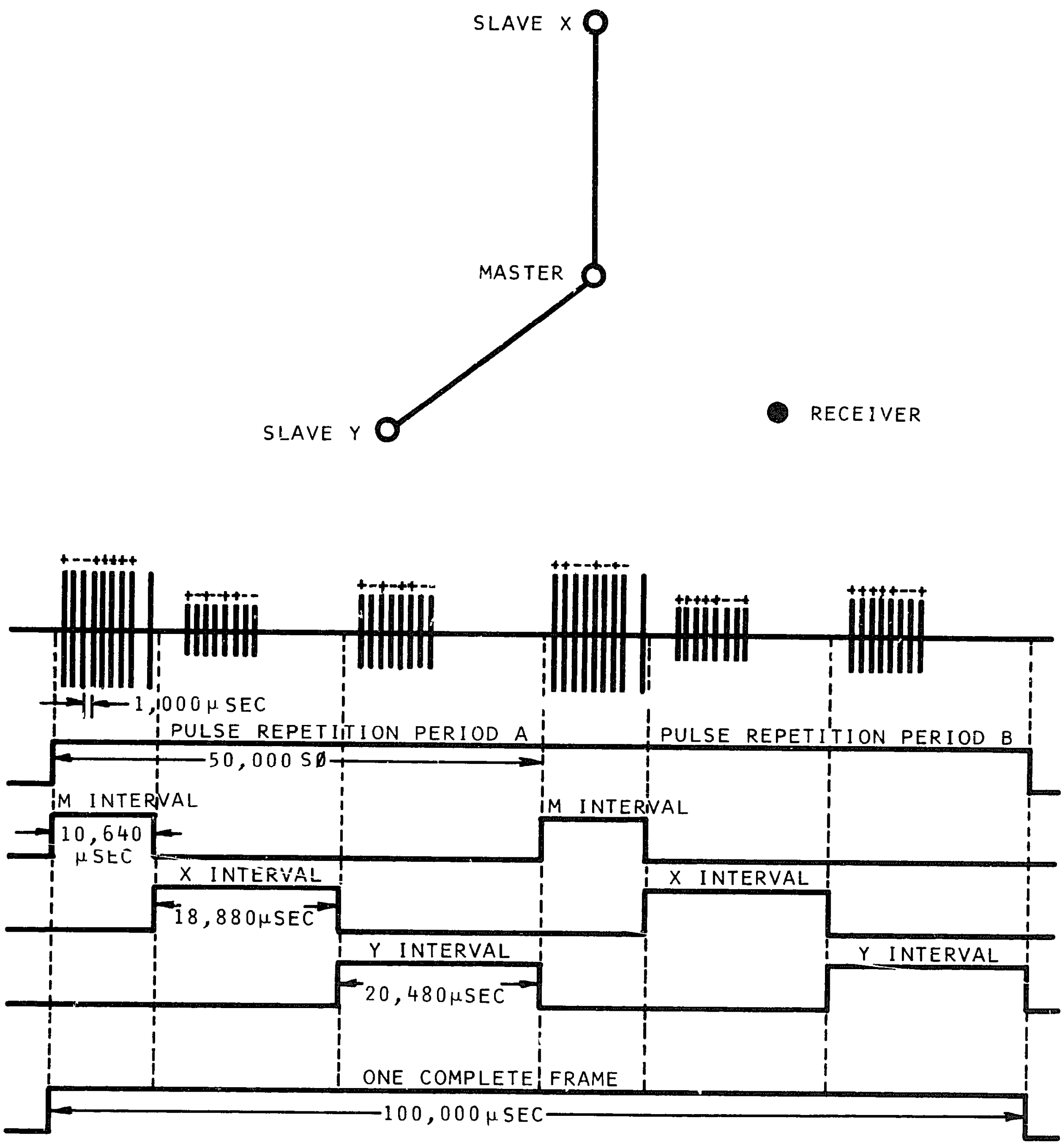


Figure A-1 Pulse Groups Within a Loran-C Chain

of the RF carrier is changed systematically from pulse-to-pulse. The phase of each pulse in a group is defined according to a prescribed code so that it is either in phase (t) or 180° out of phase (-) with respect to a stable 100 KHz reference signal. The phase code used at a master station is different from the phase code used at a slave, but all slave stations use the same code and all masters use the same code.

TABLE A-1

PULSE REPETITION PERIODS

Specific PRP	BASIC PRP (Microseconds)					
	SS	SL	SH	S	L	H
0	100,000	80,000	60,000	50,000	40,000	30,000
1	99,900	79,900	59,900	49,900	39,900	29,900
2	99,800	79,800	59,800	49,800	39,800	29,800
3	99,700	79,700	59,700	49,700	39,700	29,700
4	99,600	79,600	59,600	49,600	39,600	29,600
5	99,500	79,500	59,500	49,500	39,500	29,500
6	99,400	79,400	59,400	49,400	39,400	29,400
7	99,300	79,300	59,300	49,300	39,300	29,300

When radio waves are transmitted, a portion of the waves travel out from the antenna parallel to the surface of the earth. This is known as the groundwave. Another portion of the radio waves travel upward and outward These encounter the monosphere and are bounced back to earth These reflections from the monosphere are known as skywaves. Unlike the skywave, the groundwave amplitude and phase are not Influenced by factors that depend on the time of day.

De spite its stability, the groundwave is not useful at an unlimited range from the transmitter The attenuation of the groundwave Increases rapidly at ranges beyond 1000 nautical miles, so that the groundwave signal finally becomes burled in noise and interference. Further, the delay from arrival of the groundwave to arrival of the skywave (large at short ranges) finally diminishes to the point of allowing contamination of the much smaller groundwave by the skywave. These factors establish the groundwave range at about 2000 nautical miles. Within groundwave range of the station, the highly stable groundwave pulse may be used for precise timing and frequency calibration. The groundwave is stable to within tens of nanoseconds and is unaffected by diurnal shifts and other ionospheric disturbances which plague skywave reception and CW systems

PHASE CODING

The phase coding lends itself to a very useful purpose: eliminating CW interference by phase code balance

Figure A-2 shows a typical Loran-C pulse. Pulse configuration will vary from transmitter to transmitter, depending on transmitter type, antenna loading conditions, and other factors However, only the first few cycles of the pulse are most likely to be free of skywave contamination. For frequency calibration, it is necessary to track at a point within the first three cycles, to avoid skywave contamination.

Slave transmissions are delayed by the coding delay However, the master station transmission is used to synchronize the slaves and the coding delay time is measured from the arrival of the master station transmission. The actual time of transmission of the slave pulse is the propagation delay between master and slave plus the coding delay. The sum of these two delays is called the emission delay.

Table A-2 shows characteristics of existing Loran-C chains.

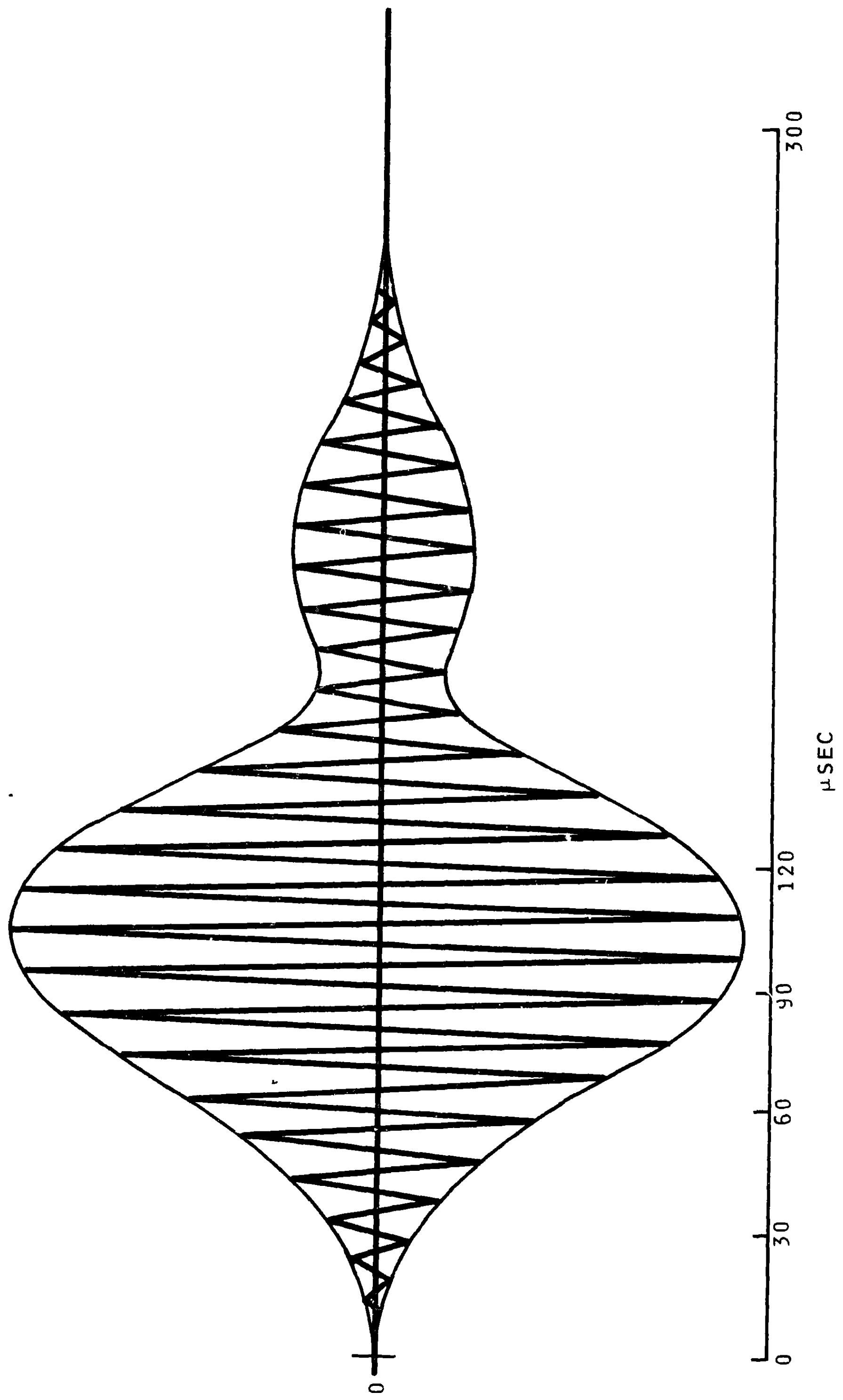


Figure A-2. Individual Loran-C Pulses

TABLE A-2

STATION LIST

Station and Location				Baseline (BC) µs	Baseline (BC) Nautical Miles	Coding Delay (CD) µs	Emission Delay (1) (BC + CD) µs
Norwegian Sea Loran-C Chain -- Rate: SL3			Repetition Rate: 79, 700 µs				
Ejde, Faeroe Islands	(M)	62°17'57"N	07°04'15"W	0000000	0.0	000000	00000000
Sylt, Germany	(W)	54°48'29"N	08°17'41"E	4, 065.2	657.5	26, 000	30, 065.2
BØ, Norway	(X)	68°38'05"N	14°27'54"E	4, 048.1	654.7	11, 000	15, 048.1
Sandur, Iceland	(Y)	64°54'31"N	23°55'08"W	2, 944.7	476.3	46, 000	48, 944.7
Jan Mayen	(Z)	70°54'56"N	08°43'59"W	3, 217.0	520.3	60, 000	63, 217.0
North Atlantic Loran-C Chain -- Rate: SL7			Repetition Rate: 79, 300 µs				
Angissoq, Greenland	(M)	59°59'21"N	45°10'19"W	0000000	0.0	000000	00000000
Sandur, Iceland	(W)	64°54'31"N	23°55'08"W	4, 068.1	658.0	11, 000	15, 068.1
Ejde, Faeroe Islands	(X)	62°17'57"N	07°04'15"W	6, 803.8	1100.4	21, 000	27, 803.8
Cape Race, Newfoundland	(Z)	46°46'32"N	53°10'29"W	5, 212.8	843.1	43, 000	48, 212.8
Mediterranean Sea Loran-C Chain -- Rate: SL1			Repetition Rate: 79, 900 µs				
Catanzaro, Italy	(M)	38°52'20"N	16°43'09"E	0000000	0.0	000000	00000000
Wadi, Mitrathin, Libya	(X)	30°35'49"N	18°24'11"E	3, 107.6	502.6	11, 000	14, 107.6
Karga Burnu, Turkey	(Y)	40°58'20"N	27°52'05"E	3, 273.3	529.4	29, 000	32, 273.3
Estartit, Spain	(Z)	42°03'36"N	03°12'20"E	3, 999.7	646.9	47, 000	50, 999.7

TABLE A-2

STATION LIST (Continued)

Station and Location				Baseline (BC) µs	Baseline (BC) Nautical Miles	Coding Delay (CD) µs	Emission Delay (1) (BC + CD) µs
Vietnam Loran-C Chain		-- Rate:	S3	Repetition Rate:	49,700 µs		
Sattahip, Thailand	(M)	12°37'05"N	100°57'38"E	0000000	0.0	000000	00000000
Lampang, Thailand	(X)	18°19'31"N	99°22'50"E	2,182 9	353.1	11,000	13,182.9
Con Son Island, Vietnam	(Y)	08°43'18"N	106°37'59"E	2,522 1	407.9	27,000	29,522.1
Northwest Pacific Loran-C Chain		-- Rate:	SS3	Repetition Rate:	99,700 µs		
Iwo Jima	(M)	24°48'04"N	141°19'29"E	0000000	0.0	000000	00000000
Marcus Island	(W)	24°17'08"N	153°58'51"E	4,283.9	692.8	11,000	15,283.9
Hokkaido, Japan	(X)	42°44'33"N	143°43'05"E	6,684 7	1081.1	30,000	36,684.7
Gesashi, Okinawa	(Y)	26°36'21"N	128°08'54"E	4,463.3	721 9	55,000	59,463.3
Yap	(Z)	09°32'46"N	138°09'55"E	5,746.8	929.4	75,000	80,746.8
Alaskan Loran-C Chain		-- Rate:	SL2	Repetition Rate:	79,800 µs		
St Paul, Pribiloff Island	(M)	57°09'11"N	170°14'57"W	0000000	0.0	000000	00000000
Sitkinak Is, Alaska	(X)	56°32'21"N	154°07'43"W	3,284.4	531 2	11,000	14,284.4
Attu Is, Aleutian Islands	(Y)	52°49'47"N	173°10'55"E	3,875 3	626.8	28,000	31,875.3
Pt Clarence, Alaska	(Z)	65°14'41"N	166°53'11"W	3,069.1	496 4	50,000	53,069.1

TABLE A-2

STATION LIST (Concluded)

Station and Location				Baseline (BC) µs	Baseline (BC) Nautical Miles	Coding Delay (CD) µs	Emission Delay (1) (BC + CD) µs
Hawaiian Loran-C Chain		-- Rate:	S1	Repetition Rate:	49,900 µs		
Johnston (Sand) Island	(M)	16°44'44"N	169°30'32"W	0000000	0.0	000000	00000000
Upolo Point, Hawaii	(X)	20°14'50"N	155°53'09"W	4,972 4	804.2	11,000	15,972.4
Kure Island	(Y)	28°23'41"N	178°17'30"W	5,253 0	849.6	30,000	35,253.0
East Coast Loran-C Chain		-- Rate:	SS7	Repetition Rate:	99,300 µs		
Cape Fear, N. Caroline	(M)	34°03'46"N	77°54'46"W	0000000	0.0	000000	00000000
Jupiter Inlet, Florida	(W)	27°01'59"N	80°06'53"W	2,695 5	436 0	11,000	13,695.5
Cape Race, Newfoundland	(X)	46°46'32"N	53°10'29"W	8,389 6	1356.8	28,000	36,389.6
Nantucket Is, Mass.	(Y)	41°15'12"N	69°58'39"W	3,451.3	572 8	49,000	52,541 3
Dana, Indiana	(Z)	39°51'08"N	87°29'11"W	3,560.7	575 9	65,000	68,560.7
Wildwood, New Jersey	(T)	38°56'58"N	74°52'01"W	2,026 2	327 7	82,000	84,026 2

NOTES:

1) Relative to master station.

2) M denotes Master Station; W, X, Y, Z denote Slave Stations; T denotes Test Station

3) All baselines are assumed to be seawater pathes, i e , not corrected for overland propagation conditions.

4) Mercury Datum has been used for all computations.

APPENDIX B

AN/GSQ-174 SPECIAL APPLICATIONS

FREQUENCY MEASUREMENT AND CALIBRATION

Using the R-1776 Receiver of the AN/GSQ-174 system to measure the frequency of a local frequency standard is accomplished in two simple steps

First, prepare a phase tracking record using the signal radiated by a synchronized Loran-C transmitter The record should cover a period appropriate to the desired measurement accuracy. For example, in most locations a groundwave phase record extending over 24 hours is adequate for relative frequency determinations having a probable error of one or two parts in 10^{12} Groundwave signals within the first three cycles of the pulse should be tracked, as indicated by the CYC readout, and verified by obtaining a tracking record that is free of phase disturbances at sunrise and sunset

Second, reduce data provided by the record show frequency difference or offset The basic expression that is used for this purpose is

$$\frac{\Delta f}{f} = \frac{t_2 - t_1}{\Delta T}, \text{ where } \frac{\Delta f}{f} \text{ is the fractional frequency offset}$$

existing between the local standard and the Loran-C carrier, as received, and t_1 and t_2 are initial and final phase or time differences, respectively, obtained from the record over the averaging time interval AT

For example, a record of this type is shown in Figure B-1 Here, we see that the relative phase between the standard at Austin, Texas, and the Cape Fear Loran- C signal stood at t1 = 3 45 seconds at noon of September 26; at the following noon (86,400 seconds later) the relative time had diminished to (5 9- 20) microseconds.

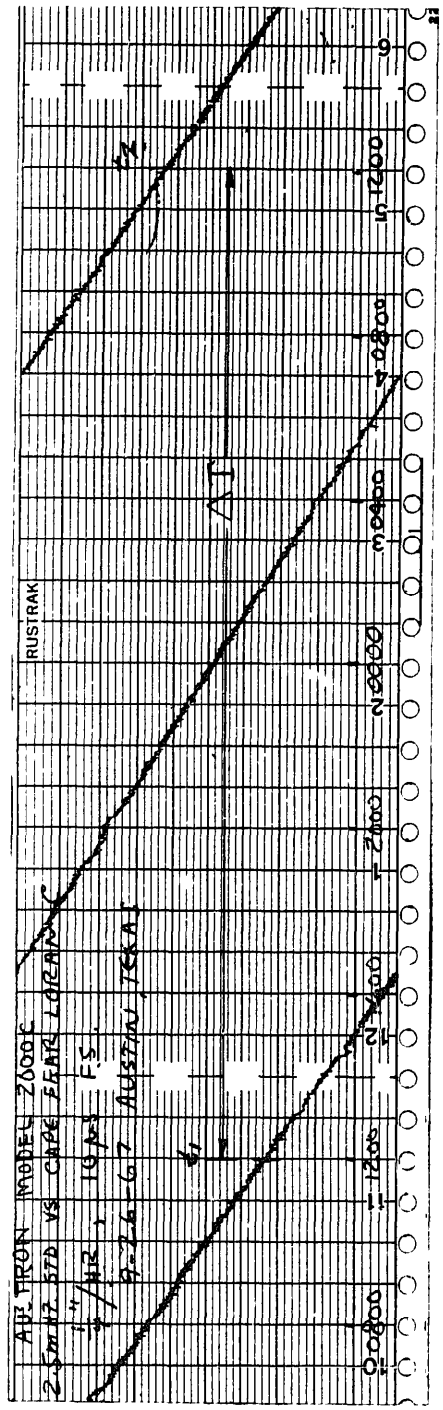


FIGURE B-1. PHASE TRACKING RECORD

NOTE: In the example, (-20) is added to allow for the fact that the ten microseconds full scale record recycled twice between the two phase readings. Thus, the apparent average frequency difference existing between the two standards for the indicated twenty- four period was

$$\frac{\Delta f}{f} \approx \frac{(5\ 9-20)-3.45}{86,000}\ \frac{\mu sec}{sec} = \frac{-17\ 55 \times 10^{-6}}{8.64 \times 10^{4}} \approx -2\ 03 \times 10^{-10}$$

This example illustrates the method used for computing exact values of frequency offset. A chart that facilitates quick estimates of this quantity is given in Figure B-2.

Probable Error * Under normal laboratory conditions, cycle phase tracking stability and resolution of the R-1776 are approximately 50 nanoseconds. Further, the phase stability of the groundwave propagation path is normally a few tens of nanoseconds, even at relatively great ranges Therefore, at most locations, the limitation on the accuracy of frequency offset measurements that are made using the R-1776 is normally imposed by natural and man-made interference

Referring to Figure B-2, it is clear that near noon, peak deviation of the phase record produced by noise and interference were smaller than 100 nanoseconds Under the assumptions that the phase noise distribution is Gaussian, and that 100 nanoseconds deviation is characteristically not

* Reference Data for Radio Engineers; fourth edition; International Telephone and Telegraph Company; p.989.

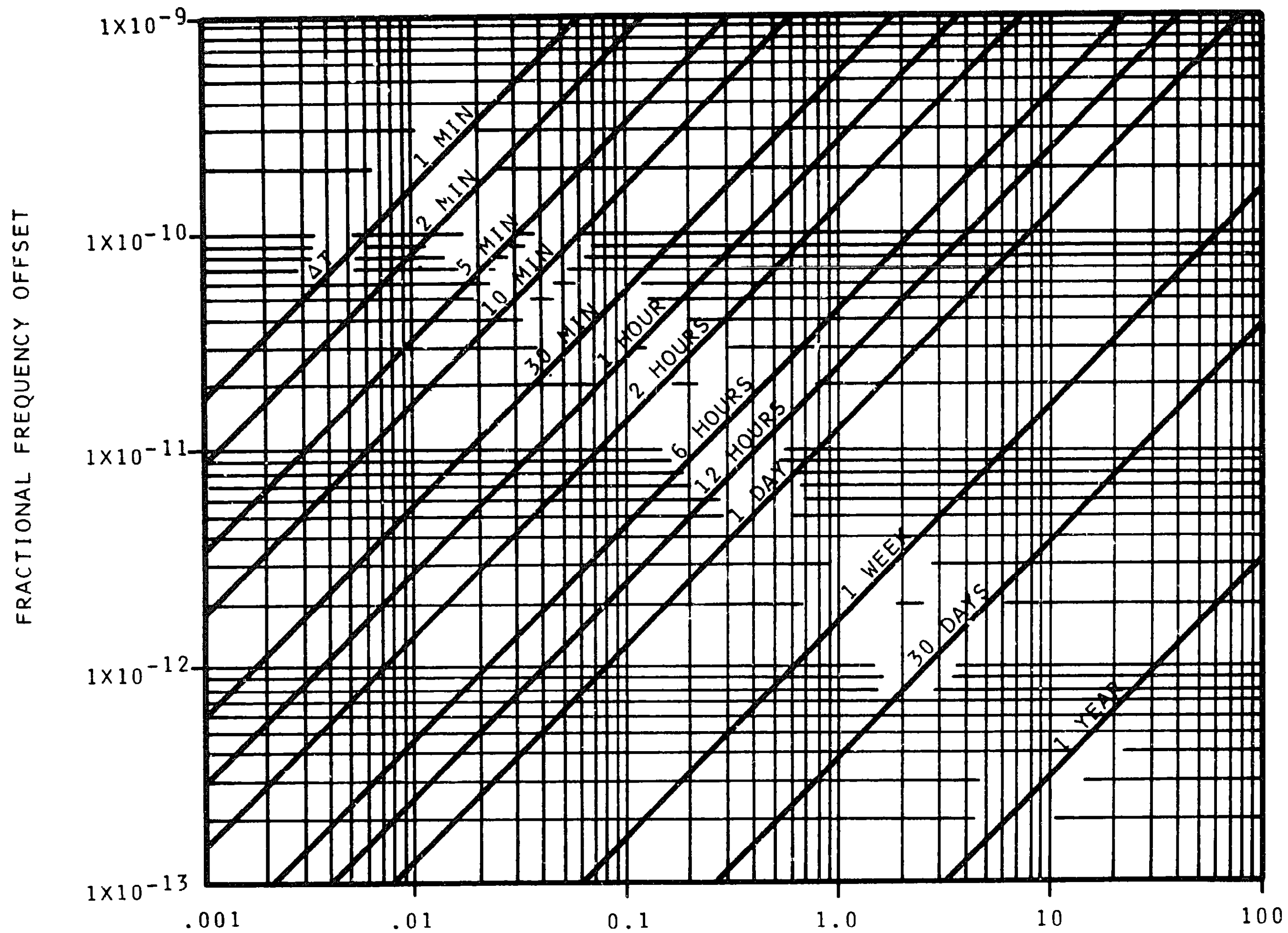


Figure B-2. Chart Fractional Frequency Offset Versus T_2 - T_1 Microseconds

exceeded more than 5% of the time, a standard deviation (a) of roughly 50 nanoseconds is Indicated The corresponding probable error, or error that is exceeded 50% of the time in this type of measurement, is .67σ, or 34 nanoseconds

Determination of a frequency offset requires two such time measurements; assuming that their errors are statistically independent, the resulting probable error in $t_2 - t_1$ is 34 nanoseconds x 2 = 048 seconds. Thus, the probable error due to noise and interference does not appear to exceed

$$\frac{.048 \times 10^{-6}}{86,400} \ \frac{sec}{sec} \approx .55 \times 10^{-12} \text{ in this example}$$

In Figure B-l, it is apparent that the nighttime phase noise was somewhat greater If we take 300 nanoseconds peak as a conservative estimate of the 2σ deviation, the corresponding probable error is 1 7 x 10^{-12}, for nighttime readings.

Traceability. Frequency offset measurements that are made by following the routine that is outlined above are traceable to the National standards of frequency and time, when use is made of signals from synchronized Loran-C transmitters At the time of writing, stations of the East Coast chain, the Central Pacific chain, the Norwegian Sea chain, the Northwest Pacific chain, and the Mediterranean chain are fully stabilized under the guidance of United States Naval Observatory (USNO).

Substantiation of Data. The Loran-C groundwave, unlike less stable VLF or LF transmissions that are employed for frequency calibration, has no characteristic phase signature such as the diurnal phase shift of the skywave at VLF, or the WWVB type of periodic phase offset and return. In the absence of the built-m phase disturbances, substantiation of the Loran-C phase record may easily be accomplished in several ways.

a) A signal envelope record showing the position of tracking point may be made on a second chart channel. Use of a slow signal strobe scan rate will prevent use of an exorbitant amount of chart paper for this purpose.

b) A concurrent record of signal amplitude may be made; however, this is not as definite and clear an evidence of tracking as the recycling envelope trace suggested in a)

c) The tests that are listed for verifying tracking in the operating instructions may be performed. The results may be entered on the phase difference or amplitude records as notes in support of phase record validity.

APPENDIX C

(Facsimile)

UNSO TIME SERVICES NOTICES

U S. NAVAL OBSERVATORY
WASHINGTON, D C. 20390

12 December 1963

TIME SERVICE NOTICE NO 12
LORAN-C

1. This Notice provides information on the availability of Loran-C navigational pulses for time synchronization and frequency calibration.

2. Loran-C is a pulsed, radio navigational system operated by the U S Coast Guard which utilizes groundwave propagation. Experiments indicate that groundwave propagation may be used to synchronize clocks to about 1 microsecond and to measure time intervals to about 0.1 microsecond.

3. The U S. East Coast Loran-C chain consists of a master station at Carolina Beach, North Carolina, near Cape Fear, and two other stations, at Nantucket, Massachusetts, and Jupiter Inlet, Florida. The pulses emitted from Nantucket and Jupiter are delayed with respect to the Cape Fear pulses by fixed amounts held constant to about 0.1 microsecond. Any of the three stations may be used to obtain precise time and frequency.

4. The pulses are locked to the carrier wave, whose frequency is 100 kc/s Atomic and quartz-crystal oscillators are used to provide high stability in time and frequency for the East Coast chain

5. The time of emission of the Loran-C pulses from Cape Fear is controlled by the U. S. Naval Observatory so as to be closely synchronized with the Naval Observatory Master Clock and with Naval Communications System time signal transmissions. Steering is accomplished by adjusting the frequency of the control oscillator.

6. It is planned to provide precise time from transmissions of other Loran-C chains in the future, such as the North Atlantic, Mediterranean, Alaskan, and Hawaiian chains. The chains will by synchronized with Cape Fear as this becomes practicable. Studies on the utilization of Loran- C for precise timing are being carried out cooperatively by the U. S. Coast Guard, the National Bureau of Standards, the Naval Research Laboratory, and the Naval Observatory.

Additional information on the use of Loran-C for timing will be provided from time to time.

T. S. BASKETT
Captain, U. S. Navy
Superintendent

AN/GSQ-174

U. S. NAVAL OBSERVATORY
WASHINGTON, D. C 20390

(Facsimile)

TIME SERVICE LETTER 19 October 1967

Supplement to Dally Phase Values No. 4

Subject: Instructions for use of "Phase Values" Bulletins and Teletype Messages.

I. Description

1. The weekly U S. Naval Observatory publication "Dally Relative Phase Values" and the dally "Phase Values" teletype message are distributed to assist those who employ VLF phase tracking techniques and Loran-C transmissions for synchronization purposes.

2. The Phase Values published provide the time link between the U. S. Naval Observatory Master Clock and selected VLF and Loran-C transmitters. They are a measure, in microseconds, of the daylight path phase delays of the carrier frequencies of VLF transmitting stations and of the time difference between the Loran-C "Time Reference Pulses" and the USN0 Master Clock. All VLF phase values reported are for the paths between the transmitting antennas of the VLF transmitters and the receiving antennas of the U. S. Naval Observatory monitoring and reference stations. All phase values reported are relative to the U. S. Naval Observatory Master Clock and increasing phase readings, from day to day, indicate that the transmitter " clock" is falling behind in respect to the U. S. Naval Observatory Master Clock.

3. For the time being, reported phase values of VLF transmissions are relative measurements only and Loran- C Phase Values are absolute measurements

4. All phase values are given in microseconds

5. The sense (sign convention) used for reporting the phase delays has been chosen such that night shifts are positive excursions; i.e., during the diurnal shift, the magnitude of the VLF phase delay will Increase. This

convention is the same as the sense of readings obtained if a received VLF carrier frequency is displayed on an oscilloscope triggered by a local clock. To avoid confusion and errors; all recording instruments should be labelled to indicate the direction of increasing phase readings

II Loran-C

1. The East Coast and Hawaiian Loran-C chains of the U. S. Coast Guard are controlled by the U. S. Naval Observatory in phase and are maintained at all times to within +25 us to the USN0 Master Clock. Phase values published by the USN0 permit a user to increase his precision of timing obtained by monitoring any of these stations to about one microsecond relative to the USN0 Master Clock.

2. The phase values published by the USNO, for the Loran-C transmissions of the East Coast and Hawaiian Chains, represent the time difference, in microseconds, between the USN0 Master Clock and the beginning of the emitted Loran-C reference pulses. This is a change from previous practice since the propagation delay between the Loran Station and the USN0 monitor station will not now be included in the Loran- C phase values as reported

3. The repetition rate of the East Coast Loran-C transmissions is presently 100,000 us and the beginning of the pulse which is preceded by a one pulse per second (1PPS) is the reference point from which phase measurements, relative to the USN0 Master Clock, are published. (The 1PPS is transmitted two milliseconds ahead of that reference pulse.)

4. The repetition rate of the Hawaiian Chain is presently 59,600 us and the beginning of the first pulse of one of the groups is emitted at a particular second on the UTC time scale That pulse is synchronized to the USN0 Master Clock. Ephemeris tables are published and distributed by the USNO, upon request, and give the time of emission on the UTC time scale of the beginning of that reference pulse. As above, time of emission measurements published by the USN0 give the time correction between this

reference pulse and the USN0 Master Clock

USN0 time of emission value = (USN0 Master Clock -- Loran-C Clock) (4)

III. Summary

The U. S. Naval Observatory controls the phase and the emission time of the transmitted pulses of the East Coast and Hawaiian Loran-C Chains of the U. S. Coast Guard and of the U. S. Navy VLF stations (including Omega) in order to maintain these transmissions closely synchronized to the USN0 Master Clock. Tracking of these stations is, therefore, desirable and recommended, in principle, for all tracking operations in the coordinated UT system (UTC)

AN/GSQ-174

FREQUENCY CONTROL SET

VOLUME II

ILLUSTRATED PARTS BREAKDOWN

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CHAPTER 1.

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CHAPTER 1

GROUP ASSEMBLY PARTS LIST

Section I. INTRODUCTION

1-1. GENERAL.

1-2. This Illustrated Parts Breakdown lists, illustrates, and describes assemblies, subassemblies, and detailed parts for the equipment making up the AN/GSQ-174 Frequency Control Set, manufactured by Austron, Inc.

1-3. The purpose of this Illustrated Parts Breakdown is for identification and requisitioning of parts.

1-4. This Illustrated Parts Breakdown is divided into three chapters covering the Group Assembly Parts List, the Numerical Index and the Reference Designation Index. Chapter 1, the Group Assembly Parts List, is further divided into five sections covering the introduction, the overall Frequency Control Set, the O-1632/GSQ-174 Radio Frequency Oscillator, the CV-2929/GSQ-174 Frequency Multiplier, and the R-1776/GSQ-174 Loran Receiver, as follows:

a. CHAPTER 1. GROUP ASSEMBLY PARTS LIST.

(1) Section I. INTRODUCTION. An overall introduction to this Illustrated Parts Breakdown is provided in Section I, while the three major assemblies of the AN/GSQ-174 are each covered in a separate section of the Group Assembly Parts List.

(2) Section II. AN/GSQ-174 Frequency Control Set. Main subassemblies of the AN/GSQ-174 Frequency Control Set are illustrated,listed and identified in this section.

(3) Section III. O-1632/GSQ-174 Radio Frequency Oscillator. All replaceable parts and assemblies required for maintenance of the O-1632/GSQ-174 are illustrated, listed and identified in this section.

(4) Section IV. CV-2929/GSQ-174 Frequency Multiplier. All replaceable parts and assemblies required for maintenance of the CV-2929/GSQ-174 are illustrated, listed and identified in this section.

(5) Section V. R-1776/GSQ-174 Loran Receiver. All replaceable parts and assemblies required for maintenance of the R-1776/GSQ-174 are illustrated, listed and identified in this section.

b. CHAPTER 2. NUMERICAL INDEX. This chapter is a complete alphabetical-numerical index of all parts listed in Chapter 1, and provides a cross reference to the figure and index number which illustrates and identifies each part.

C. CHAPTER 3. REFERENCE DESIGNATION INDEX. This chapter provides a complete listing of all electronic parts by their reference designations, arranged in alphabetical-numerical order. The Reference Designation Index also provides a cross reference to the part numbers and the figure and index numbers in Chapters 1 and 2.

1-5. EXPLANATION OF CHAPTER 1 - GROUP ASSEMBLY PARTS LIST.

1-6. GENERAL. Chapter 1, Group Assembly Parts List, consists of a breakdown of the complete unit into subassemblies and detailed parts. Each assembly is listed in its order of disassembly and is followed immediately by its component parts, properly indented below it, to show their relationship to the assembly. Attaching parts are listed immediately following the parts they attach. Items which are made from raw stock, such as cut lengths of wire, solder, varnish, lacing cord, tubing, etc., are not included in the Group Assembly Parts List.

1-7. FIGURE AND INDEX NUMBER COLUMN. The numbers in this column are made up of three parts, separated by dashes. The first number is the section number of the Group Assembly Parts List covering that specific main assembly. The second group of numbers refer to the figure in which the part is illustrated. The last group of numbers, assigned in sequence in the Group Assembly Parts List, correspond with the index numbers on the illustration.

1-8. PART NUMBER COLUMN. Part numbers listed are either Austron Inc. part numbers, AN (Army-Navy) standard part numbers, or part numbers of vendors other than Austron Inc. If the part has an AN part number, that number is listed. If a part is purchased from a vendor other than Austron Inc,, the vendor's part number is listed. Commercial hardware items available from normal commercial sources and having no definitive part numbers are listed as COML. Assemblies that are not identified by a part number have the expression NO NUMBER listed. All other part numbers listed are Austron Inc. part numbers. Part numbers are used exclusively to identify parts. Part numbers for parts kits, when provided, will be placed last in the listing of the unit to which they apply.

1-9. DESCRIPTION COLUMN. In this column each assembly, its attaching parts, and components of the assembly, properly indented to show their relationship to the assembly, is listed. All abbreviations used in the DESCRIPTION column are in accordance with MIL-STD-12B. If a part is purchased from a vendor other than Austron Inc., a Federal Manufacturers Code Number from Cataloging Handbook H4-1 or H4-2 will be shown in parentheses following the description of the item. For convenience, applicable manufacturer's code numbers are listed as follows:

01121 Allen-Bradley Co., 1201 South 2nd Street, Milwaukee, Wisconsin 53212

01281 TRW Semiconductors, Inc., 14520 Aviation Blvd., Lawndale, California 90260

01295 Texas Instruments, Inc., Semiconductor-Components Div., P.O. Box 5012, Dallas, Texas 75222

02111 Spectrol Electronics Corp., 17070 East Gale Avenue, City of Industry, California 91744

02114 Ferroxcube Corp. of America, Mt. Marion Road, Saugerties, New York 12477

02660 Amphenol-Borg Electronics Corp., 2801 South 25 Avenue, Broadview, Illinois 60153

02735 RCA, Electronic Components and Devices, 415 South Fifth Street, Harrison, New Jersey 07029

04009 Arrow-Hart and Hegeman Electric Co., 103 Hawthorn, Hartford, Connecticut 06105

04222 HI-Q Div of Aerovox Corp., Air Base Myrtle Beach, South Carolina

04713 Motorola Semiconductor Products, Inc., 5005 East McDowell, Phoenix, Arizona 85008

05137 Decker Corporation, 45 Monument Road, Bala-Cynwyd, Pennsylvania, 19004

05820 Wakefield Engineering Inc., 139 Foundry St., Wakefield, Massachusetts 01880

07047 The Milton Ross Co., 511 Second Street Pike, Southampton, Pennsylvania, 18966

07115 Corning Glass Works, Electronic Products Div., 1950 Mast, Corning, New York 14830

07263 Fairchild Camera & Instrument Corp., Semiconductor Division, 423 National, Mountain View, California 94040

07688 Joint Electron Device Engineering Council, Washington, D.C.

09134 Texas Capacitor Company, 7830 Westglen Dr., P.O. BOX 36275, Houston, Texas 77042

10054 Marson Corp., 130 Crescent Ave., Chelsea, Massachusetts 02150

18736 Voltronics Corp., 296 Route #10, Hanover, New Jersey, 07936

24453 General Electric Distributing Corp., Bridgeport, Connecticut

24672 Austron, Inc,, 10214 North Interregional Hwy., Austin, Texas 78753

24675 Supreme Engineering, 1926 Placentia Ave., Bldg. 5 & 7, Costa Mesa, California 92627

27191 Cutler-Hammer, Inc., 4201 N. 27th Street, Milwaukee, Wisconsin 53216

37942 P. R. Mallory and Company, Inc., 3029 Washington St., Indianapolis, Indiana 46206

56289 Sprague Electric Co., Marshall St., North Adams, Massachusetts 01247

65092 Weston Instruments, Inc., Weston-Newark, 614 Frelinghuysen Ave., Newark, New Jersey 07114

71400 Bussman Manufacturing Division, McGraw-Edison Company University at Jefferson, St. Louis, Missouri 63107

71590 Centralab Division of Globe-Union, Inc., P.O. Box 591, Milwaukee, Wisconsin 53201

71729 Crescent Box Corp., Erie Ave-E, Philadelphia, Pennsylvania 19134

71785 Cinch Manufacturing Company, 1026 South Homan Avenue, Chicago, Illinois 60624

72136 Electra Motive Mfg. Co. Inc., The South Park and John Sts., Willimantic, Connecticut, 06226

72619 Dialight Corp,, 60 Stewart Ave., Brooklyn, New York 11237

72653 G C Electronics Co.,, 400 South Wyman, Rockford, Illinois 61101

72982 Erie Technological Products Inc., 644 w. 12th St., Erie, Pennsylvania 16512

73734 Federal Screw Products, Inc., 3917 N, Kenzie Ave., Chicago, Illinois 60618

74306 Piezo Crystal Co., 265 E. Promfret St., Carlisle, Pennsylvania 17013

74868 Amphenol RF Div of Amphenol-Borg Electronics Corp., Danbury, Connecticut 06810

75915 Littelfuse, Inc., 800 East Northwest Highway, Des Plaines, Illinois 60016

80112 GC Electronics Co., 3225 Exposition Place, Los Angeles, California 90018

80183 Sprague Products Co., 87 Marshall, North Adams, Massachusetts 01247

80294 Bourns Laboratories, Inc., 1200 Columbia Avenue, Riverside, California 92507

81073 Grayhill, Inc. 545 Hillgrove, La Grange, Illinois 60525

81349 Military Specifications Promulgated By Standardization Div., Directorate of Logistic Services, DSA

82389 Switchcraft, Inc., 5555 North Elstron Avenue, Chicago, Illinois 60630

83330 Smith, Herman P., Inc., 812 Snediker, Brooklyn, New York 11207

83389 Taylor Dynamometer and Machine Co., 6411 River Parkway, Milwaukee, Wisconsin 53213

84171 Arco Electronics, Inc., Community Drive, Great Neck, New York 11021

90201 Mallory P. R. and Co., Inc., Detroit Michigan

93352 Sylvania Electric Products Inc., Semiconductor Products Division, 100 Sylvan Rd., Woburn, Massachusetts 01801

94144 Raytheon Co., 465 Centre St., Quincy, Mass. 02169

95146 Alco Electronic Products, Inc., 3 Wolcott Ave., Lawrence, Massachusetts 01843

96853 Rustrak Instrument Co., Inc., Municipal Airport 130 Silver, Manchester, New Hampshire, 03103

99800 Delevan Electronics Corp., 270 Quaker Rd., East Aurora, New York 14052

1-10. UNITS PER ASSEMBLY COLUMN. Quantities specified in this column are the total number of each part required per assembly, or subassembly, and are not necessarily the total number used in the complete equipment. The letters AR denote that the selection of a part or parts would be made as required. REF refers to an assembly which is completely assembled on a preceding illustration.

1-11. USABLE ON CODE. Parts variations within the groups of equipments are indicated by a letter symbol immediately following the units per assembly in the USABLE ON CODE column In cases where this column has been left blank, parts listed apply to all equipment covered by this book.

1-12. EXPLANATION OF CHAPTER 2 - NUMERICAL INDEX.

1-13. GENERAL. Chapter 2, Numerical Index, is compiled in accordance with the numerical part number filing system described below:

a. Part number numerical arrangement starts in the lefthand position and continues from left to right, one position at a time, until all part numbers are arranged in sequence.

b. The order of precedence in beginning the part number arrangement on the extreme left-hand (first) position is as follows:

Letters A through Z
Numerals 0 through 9

NOTE: Alphabetical O's shall be considered numerical zeros.

C. The order of precedence in continuing the part number arrangement in the second and succeeding positions of the part number, from left to right, is as follows:

Space (blank column)
Diagonal (slant)
Point (period)
Dash (-)
Letters A through Z
Numerals 0 through 9

NOTE: Alphabetical O's shall be considered numerical zeros. Spaces, diagonals, and decimal points, if used in old part numbers, shall take precedence over letters and numerals as indicated above.

1-14. PART NUMBER COLUMN. This column contains the part numbers of all parts that comprise the articles covered by this Illustrated Parts Breakdown, including superseded parts which have continued application. However, the parts of this equipment which have been listed only as complete assemblies in the Group Assembly Parts List are not included.

1-15. FIGURE AND INDEX NUMBER COLUMN. The numbers shown in the Group Assembly Parts List are listed in this column and explained in paragraph 1-7. This column contains the figure and index number for all parts listed. For Government Standard Parts and Contractor Standard Parts, only the first figure and index number that occurs is listed. When an assembly or part has not been assigned an index number in the Group Assembly Parts List, only the figure number appears. The part number is not repeated when more than one figure and index number is shown for the same part.

1-16. SOURCE AND MAINTAINABILITY/ REPAIR CODE COLUMNS. These columns list the coding, as assigned by the procuring department. When such codes have not been assigned, these columns are left blank.

1-17. EXPLANATION OF CHAPTER 3 - REFERENCE DESIGNATION INDEX.

1-18. GENERAL. This chapter lists all reference designation symbols which have been assigned in accordance with USAS Y32.16-1968 for all electronic parts of this equipment.

1-19. REFERENCE DESIGNATION COLUMN. Assigned reference designation symbols are arranged in alphabetical-numerical sequence. Listed are all reference designation symbols shown on schematic diagrams and contained in the operating, service, or overhaul manuals for this equipment. Assigned prefixes are found in paragraph 1-22.

1-20. FIGURE AND INDEX NUMBER COLUMN. This column contains the Group Assembly Parts List figure and index numbers assigned to reference designation items.

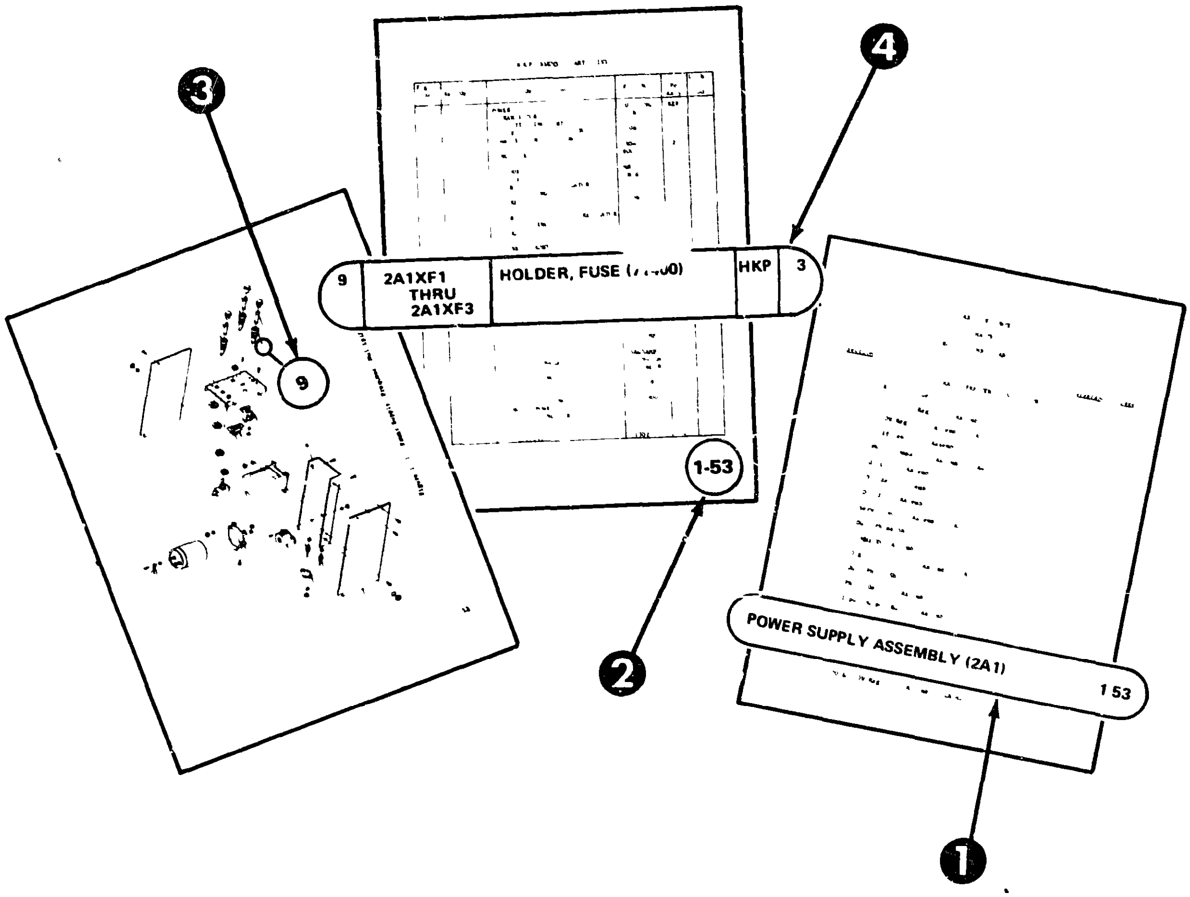
1-21. PART NUMBER COLUMN. The part numbers listed are those assigned reference designation symbols

1-22. REFERENCE DESIGNATION PREFIXES. The following prefixes have been assigned in this manual:

PREFIX	UNIT
1	O-1632/GSQ-174 Radio Frequency Oscillator PCB
1A1	+20 & +5V Regulator PCB
1A2	+10V Regulator PCB
1A3	Differentiator PCB
1A4	Phase Comparator PCB
1A5	Divider 1 PCB
1A6	Divider 2 PCB
1A7	Divider 3 PCB
1A8	Servo Control PCB
1A9	Dual Phase Shifter PCB
1A10	5 MHz VCO PCB
1A11	Digital Integrator PCB
1A12	Dual Phase Shifter PCB
1A13	Phase Detector PCB
1A14	Input/Output Buffers PCB
1A15	Chassis Assembly
2	CV-2929/GSQ-174 Frequency Multiplier
2A1	Power Supply Assembly
2A1A1	+5V Regulator PCB
2A1A2	+20 & +10V Regulator PCB
2A2	System Reference Logic PCB
2A3	1 MHz Synthesizer PCB
2A4	5 MHz Amplitude Detector PCB
2A5	Phase Shifter PCB
2A6	1.544/1.536 MHz Synthesizer PCB
2A7	Chassis Assembly
2A7A1	Rustrack Recorder
3	R-1776/GSQ-174 Loran Receiver
3A1	Power Supply Assembly
3A1A1	+5V Regulator PCB
3A1A2	+20 & +10V Regulator PCB
3A2	Output Buffers PCB
3A3	Viewing Filter PCB
3A4	Standard Input PCB
3A5	GRP Divider PCB
3A6	Phase Code PCB
3A7	Servo Control PCB
3A8	Amplitude Strobe PCB
3A9	Phase Strobe PCB
3A10	RF Amplifier PCB
3A11	Chassis Assembly
3A11A1	Rustrack Recorder
4	AS-2739/GSQ-174 Antenna

HOW TO USE THIS ILLUSTRATED PARTS BREAKDOWN

SHEET 1 OF 2



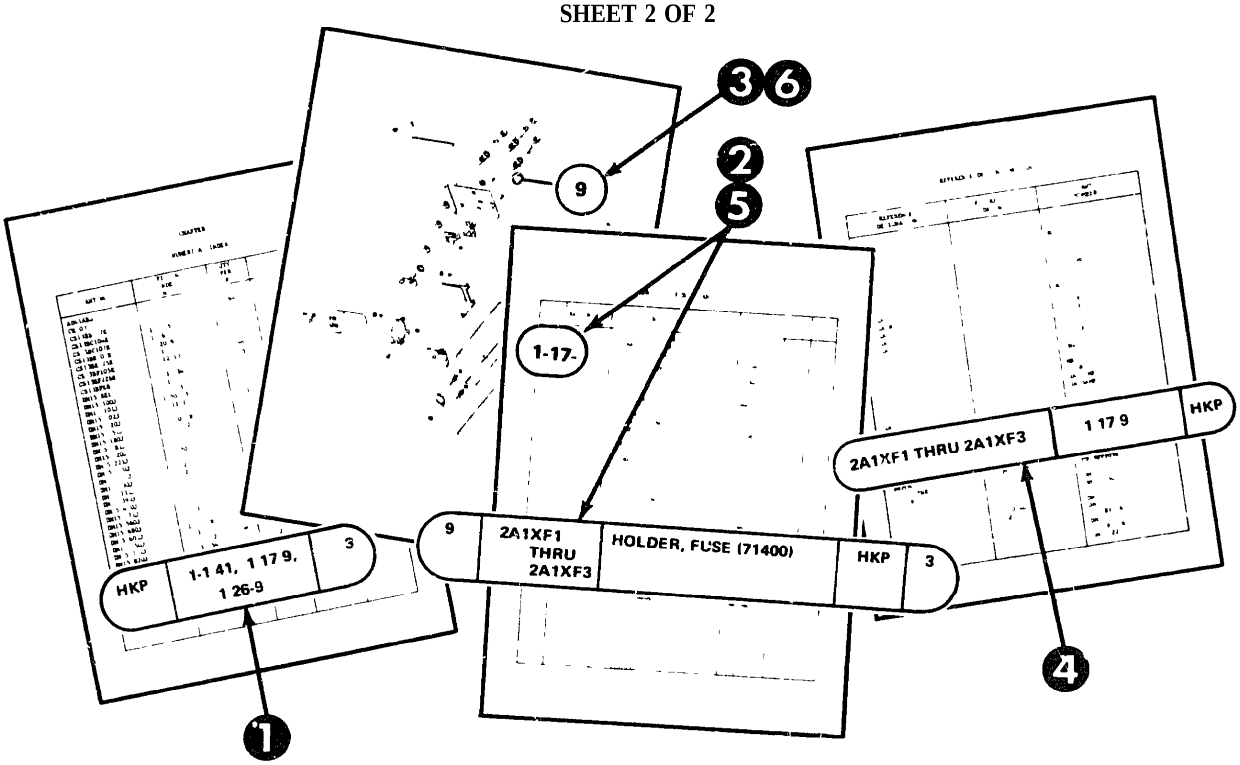
WHEN THE PART NUMBER IS NOT KNOWN

(1) Turn to the Table of Contents and find the page number for the Major Assembly, or System, in which the part is used.

(2) Turn to the page determined in step (1).

(3) Locate the part and its index number on the illustration.

(4) Refer to the same index number on the Group Assembly Parts List page to determine specific information regarding the part.



WHEN THE PART NUMBER OR REFERENCE DESIGNATION IS KNOWN

(1) When the part number is known, refer to the Numerical Index to find the part number. Note the figure and index number assigned to the part number.

(2) Turn to the figure indicated and locate the index number referenced in the Numerical Index.

(3) If a pictorial representation of the part, or its location, is desired, refer to the same index number on the accompanying illustration.

(4) When the reference designation is known, refer to the Reference Designation Index to locate the reference designation symbol. Note the figure and index number, and the part number.

(5) Turn to the figure indicated and locate the index number referenced in the Reference Designation Index.

(6) If a pictorial representation of the part, or its location, is desired, refer to the same index number on the accompanying illustration.

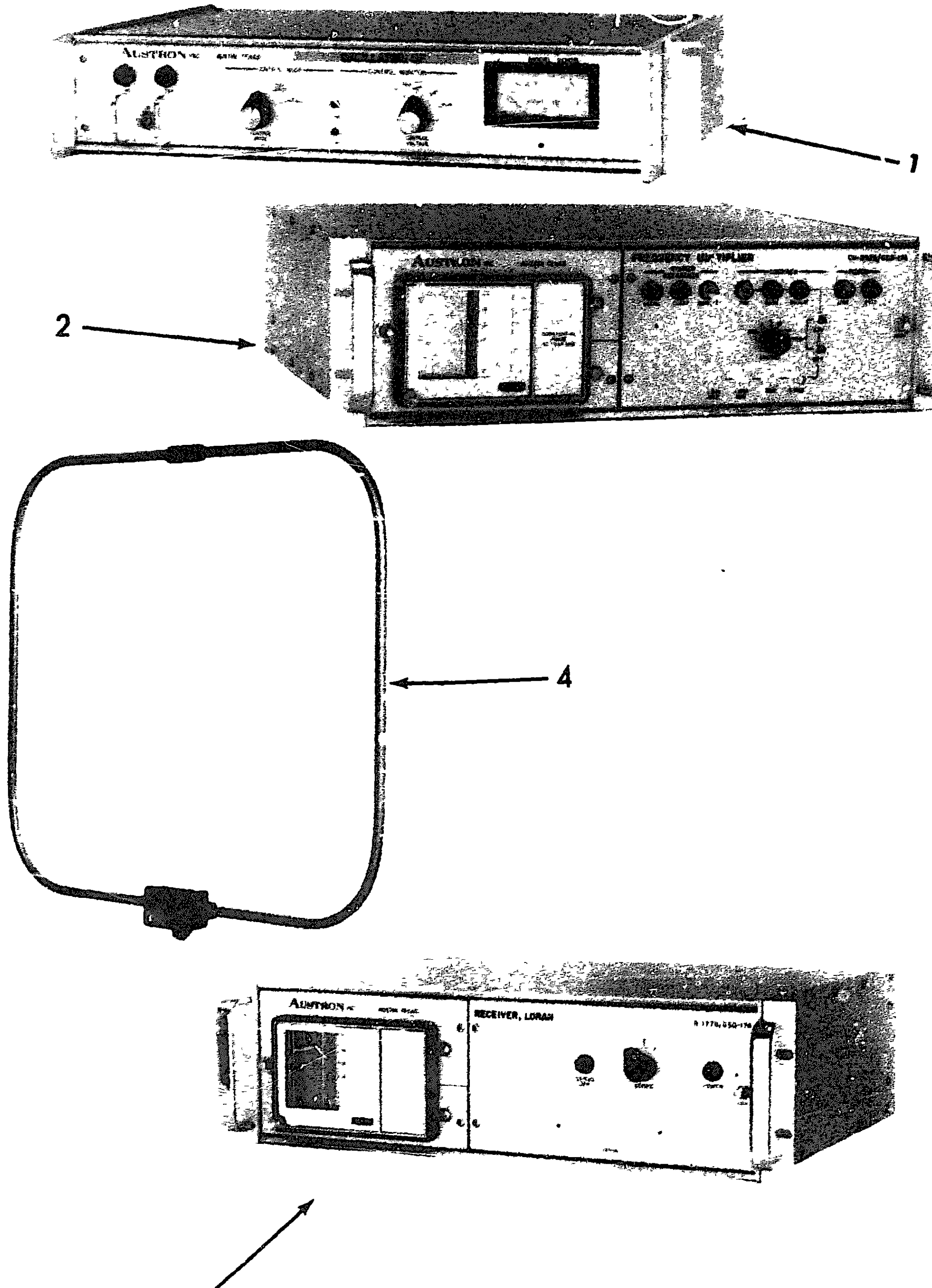
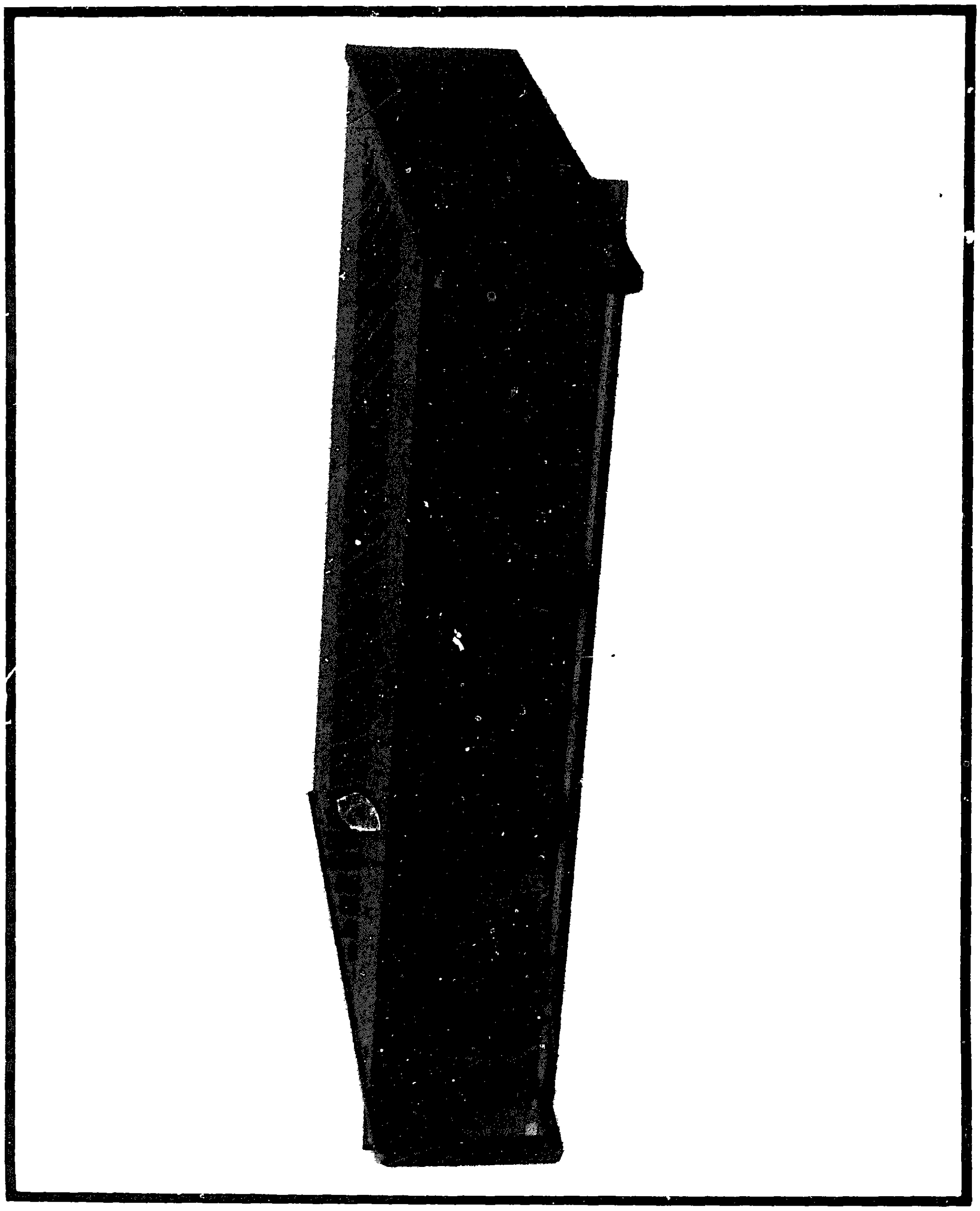


Figure 1-1. Frequency **Control Set, AN/GSQ-174**

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-1		FREQUENCY CONTROL SET, AN/GSQ-174			
-1	1	. OSCILLATOR, RADIO FREQUENCY, 0-1632/GSQ-174 (AUSTRON PART NO. MOD. 2010B) SEE FIGURE 1-2 FOR BREAKDOWN. .	30493634		
-2	2	. FREQUENCY MULTIPLIER, CV-2929/GSQ-174 (AUSTRON PART NO. MOD. 6014) SEE FIGURE 1-17 FOR BREAKDOWN. .	30493531		
-3	3	. RECEIVER, LORAN, R-1776/ GSQ-174 (AUSTRON PART NO. MOD. 2004) SEE FIGURE 1-26 FOR BREAKDOWN	30493409		
-4	4	. ANTENNA, AS-2739/GSQ-174 (AUSTRON PART NO. MOD. 2021L-01)	32192613		



Section II. 0-1632/GSQ-174 Radio Frequency Oscillator

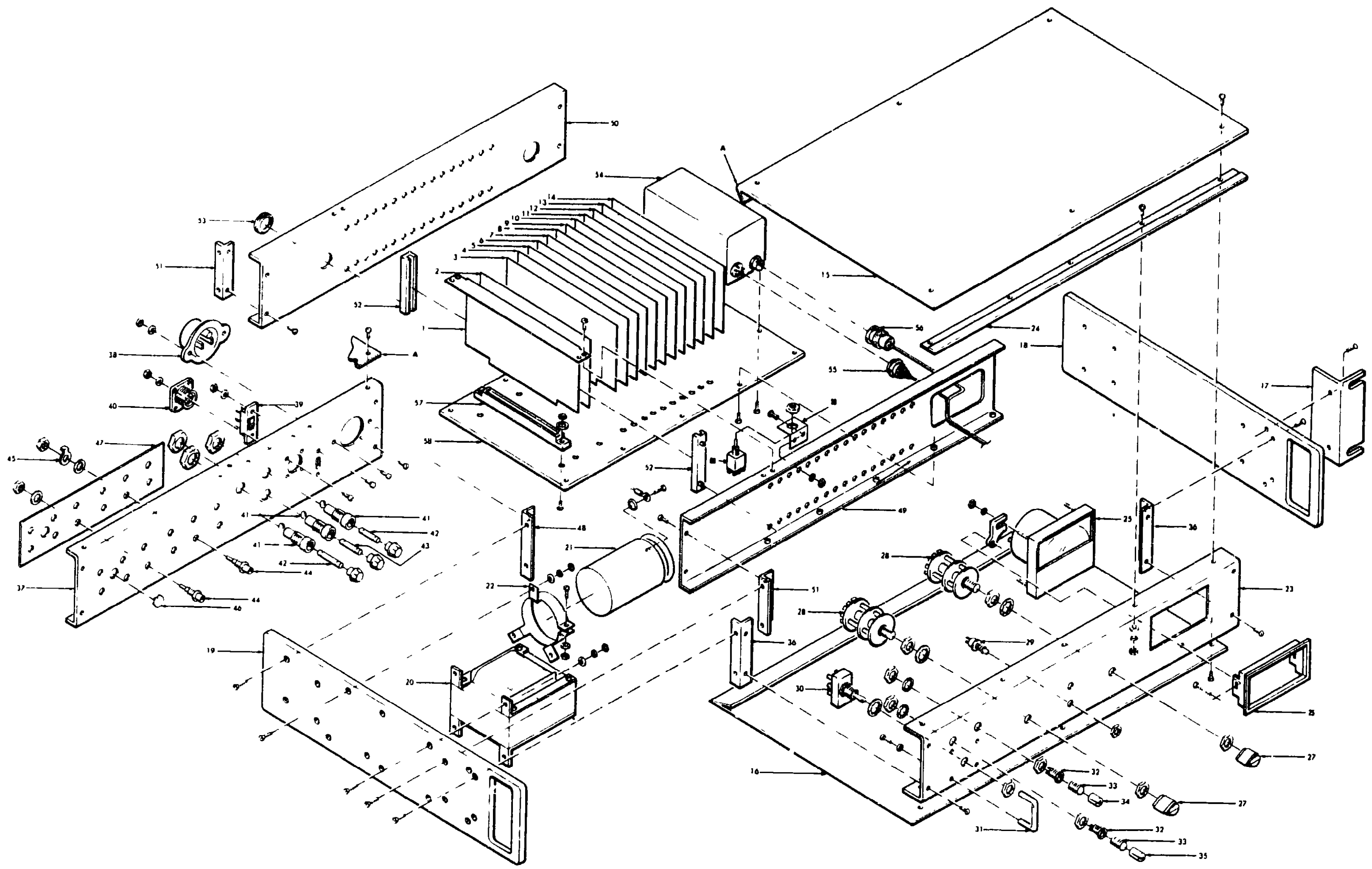


Figure 1-2. Radio Frequency Oscillator O-1632/GSQ-174

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
·2	1	OSCILLATOR, RADIO FREQUENCY 0-1632/GSQ-174	30493634	REF	
-1	1A1	. PCB ASSY, +20 & +5V REGUL (ASSY's 1A1 THRU 1A14 ACCESSIBLE WHEN CHASSIS COVER REMOVED)	10392258	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 4-40x1/4 IN (7	17042	4	
		- - - - - - - - - * - - - - -			
-2	1A2	. PCB ASSY, +10V REGULATOR	10392260	1	
-3	1A3	. PCB ASSY, DIFFERENTIATOR	10392248	1	
-4	1A4	. PCB ASSY, PHASE COMPARATOI	10392213	1	
-5	1A5	. PCB ASSY, DIVIDER 1 . . .	103922081	1	
-6	1A6	. PCB ASSY, DIVIDER 2 . . .	103922082	1	
-7	1A7	. PCB ASSY, DIVIDER 3 . . .	103922083	1	
-8	1A8	. PCB ASSY, SERVO CONTROL .	10392216	1	
-9	1A9	. PCB ASSY, DUAL PHASE SHIF	10392172	1	
-10	1A10	. PCB ASSY, 5 MHZ VCO . . .	10392245	1	
-11	1A11	. PCB ASSY, DIGITAL INTEGRA	10392237	1	
-12	1A12	. PCB ASSY, DUAL PHASE SHIF	10392172	1	
-13	1A13	. PCB ASSY, PHASE DETECTOR .	10392219	1	
-14	1A14	. PCB ASSY, INPUT/OUTPUT BUFFERS	10392243	1	
	1A15	. CHASSIS ASSY	11493647	1	
-15		. . COVER, TOP	00793645	1	
-16		. . COVER, BOTTOM	00793645	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x1/4 IN (73734).	17042	6	
		. . SCREW, PH, 4-40x1/2 IN (73734).	17046	6	
		- - - - - - - - - * - - - - -			
-17		. . BRACKET	00493936	2	
		(ATTACHING PARTS)			
		. . SCREW, FH, 6-32x3/8 IN (96906).	MS35249-35	4	
		- - - - - - - - - * - - - - -			
-18		. . PANEL, SIDE, RIGHT . . .	009939371	1	
		(ATTACHING PARTS)			
		. . SCREW, FH, 4-40x3/8 IN (96906)	MS35249-22	8	
		- - - - - - - --- * - - - - -			
-19		. . PANEL, SIDE, LEFT	009939372	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-2		(ATTACHING PARTS)			
		. . SCREW, FH, 4-40x3/8 IN (96906)	MS35249-22	8	
		- - - - - - - - * - - - - - - -			
-20	1A15T1	. . TRANSFORMER	75192036	1	
		(ATTACHING PARTS)			
		. . SCREW, FH, 6-32x1/2 IN (96906)	MS35249-37	4	
		. . WASHER, FLAT, NO. 6 (73734)	1404	4	
		. . WASHER, SPLIT LOCK, NO. 6 (73734)	1358	4	
		. . NUT, HEX, 6-32x5/16 IN (73734)	8005	4	
		- - - - - - - - - * - - - - - - -			
-21	1A15C1	. . CAPACITOR (56289)	36D842G040 BB2A	1	
		(ATTACHING PARTS)			
-22		. . CLAMP, CAPACITOR MTG (37942	VR8	1	
		. . SCREW, FH, 6-32x1/2 IN (96906)	MS35249 37	3	
		. . WASHER, FLAT, NO. 6 (73734)	1404	3	
		. . WASHER, SPLIT LOCK, NO. 6 (73734)	1358	3	
		. . NUT, HEX, 6-32x5/16 IN (73734)	8005	3	
		- - - - - - - - - * - - - - - - -			
-23		. . PANEL, FRONT	00992083	1	
-24		. . BAR, EXTRUSION.	00193646	2	
		(ATTACHING PARTS)			
		. . SCREW, FH, 4-40x5/16 IN (96906)	MS35249-21	4	
		. . WASHER, FLAT, NO. 4 (73734)	1402	4	
		. . WASHER, SPLIT LOCK, NO. 4 (73734)	1355	4	
		. . NUT, HEX, 4-40x1/4 IN (73734)	8003	4	
		- - - - - - - - - * - - - - - - -			
-25	1A15M1	. . METER and BEZEL, 0-500 DC UA (24672)	5570000005	1	
-26		. .DELETED			
		- - - - - - - - - * - - - - - - -			
-27		. . KNOB, SWITCH (49956) . . .	7052G	2	
-28	1A15S1,4	. . SWITCH, ROTARY (71590) . .	PA2011	2	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
2-29	1A15S2,3	. . SWITCH, PUSHBUTTON (81073) .	30-1	2	
-30	1A15S5	. . SWITCH, TOGGLE (27191) . . .	7565K6	1	
-31		. . HANDLE, SWITCH GUARD (71279	1220-1-02	2	
-32	1A15XDS1,2	. . HOLDER, LAMP (72619)	359-8430-09-502	2	
-33	1A15DS1,2	. . LAMP (24453)	327	2	
-34		. . LENS, RED (72619)	162-0931	1	
-35		. . LENS, GREEN (72619)	162-0932	1	
-36		. . BRACKET, ANGLE	00491559	2	
		(ATTACHING PARTS)			
		. . SCREW, TRUSS HD, PHIL, 6-32 x1/4 IN (73734). . . .	23443	4	
		- - - - - - - - * - - - - - - -			
-37		. . PANEL, REAR	00992095	1	
-38	1A15J34	. . CONNECTOR, RECEPTACLE (74868).	160-5N	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x1/4 IN (73734).	17042	2	
		. . WASHER, SPLIT LOCK, NO. 4	1355	2	
		. . NUT, HEX, 4-40x1/4 IN (73734).	8003	2	
		- - - - - - - - * - - - - - - -			
-39	1A15S6	. . SWITCH, DPDT (82389)	46256LFR	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x1/4 IN (73734).	17042	2	
		. . WASHER, SPLIT LOCK, NO. 4	1355	2	
		. . NUT, HEX, 4-40x1/4 IN (73734).	8003	2	
		- - - - - - - - * - - - - - - -			
-40	1A15J33	. . CONNECTOR, RECEPTACLE (74868).	MS3102A-14S-2P	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x1/4 IN (73734).	17042	4	
		. . WASHER, SPLIT LOCK, NO. 4 (73734).	1355	4	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-2		. . NUT, HEX, 4-40x 1/4 IN (73734).	8003	4	
		- - - - - - - - - * - - - - - - - -			
-41	1A15XF1,2, 3	. . HOLDER, FUSE (71400)	HKP	3	
-42	1A15F1,2	. . FUSE, 2A (75915)	312002	2	
-43	1A15F3	. . FUSE, 5A (75915)	312005	1	
-44	1A15J19 THRU 30	. . CONNECTOR, BNC (74868) . . .	UG625/U	12	
-45		. . LUG, TERMINAL (83330) . . .	1497	6	
-46		. . PLUG, HOLE (83330).	653	1	
-47		. . PLATE, GROUND	01093661	1	
-48		. . BRACKET, ANGLE . . . . (ATTACHING PARTS)	00491561	2	
		. . SCREW, PH, 4-40x1/4 IN (73734)	17042	4	
		- - - - - - - - - * - - - - - - - -			
-49		. . PANEL, GUIDE RAIL, FRONT (ATTACHING PARTS)	00992128	1	
		. . SCREW, PH, 6-32x1/4 IN (73734)	17062	5	
		- - - - - - - - - * - - - - - - - -			
-50		. . PANEL, GUIDE RAIL, REAR . . (ATTACHING PARTS)	00992129	1	
		. . SCREW, PH, 6-32x1/4 IN (73734)	17062	5	
		- - - - - - - - - * - - - - - - - -			
-51		. . BRACKET, ANGLE . . . . (ATTACHING PARTS)	00492126	4	
		. . SCREW, PH 4-40x1/4 IN (73734)	17042	8	
		- - - - - - - - - * - - - - - - - -			
-52		. . GUIDE, PCB (24672). . . .	5060010001	28 28	
-53		. . GROMMET, 1/2 IN ID (80112) .	1043	1	
-54		. . OSCILLATOR (24672) . . . . (ATTACHING PARTS)	30294320	1	
		. . SCREW, PH, 6-32x1/4 IN (73734)	17062	2	
		- - - - - - - - - * - - - - - - - -			
-55	1A15P1	. . CONNECTOR, PLUG (71785) . .	9EM	1	
-56	1A15P2	. . CONNECTOR, PLUG (02660) . .	UG88/U	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-2-57	1A15J1 THRU 14	. . CONNECTOR, RECEPTACLE, PCB (71785)	50-44-B-10	14	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x1/2 IN (73734)	17046	28	
		. . WASHER, INT LOCK, NO. 4 . .	1302	28	
		. . NUT, HEX, 4-40x1/4 IN (73734)	8003	28	
		- - - - - - - - - * - - - - - - -			
-58		. . PCB, CHASSIS BASE	00392271	1	
-59	1A15	. . BRACKET, SWITCH (24672)	00494162	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x3/8 IN (73734)	17064	2	
		. . LOCKWASHER, INT. TOOTH No. 6 (73734)	1304	2	
		. . NUT, HEX, 6-32x5/16IN (73734)	8005	2	
		-------------*-----------			
-60	1A15S7	. . SWITCH, TOGGLE 3PDT (95146)	MST 305D	1	
		. . LABEL, SWITCH (24672) .	12294160	1	

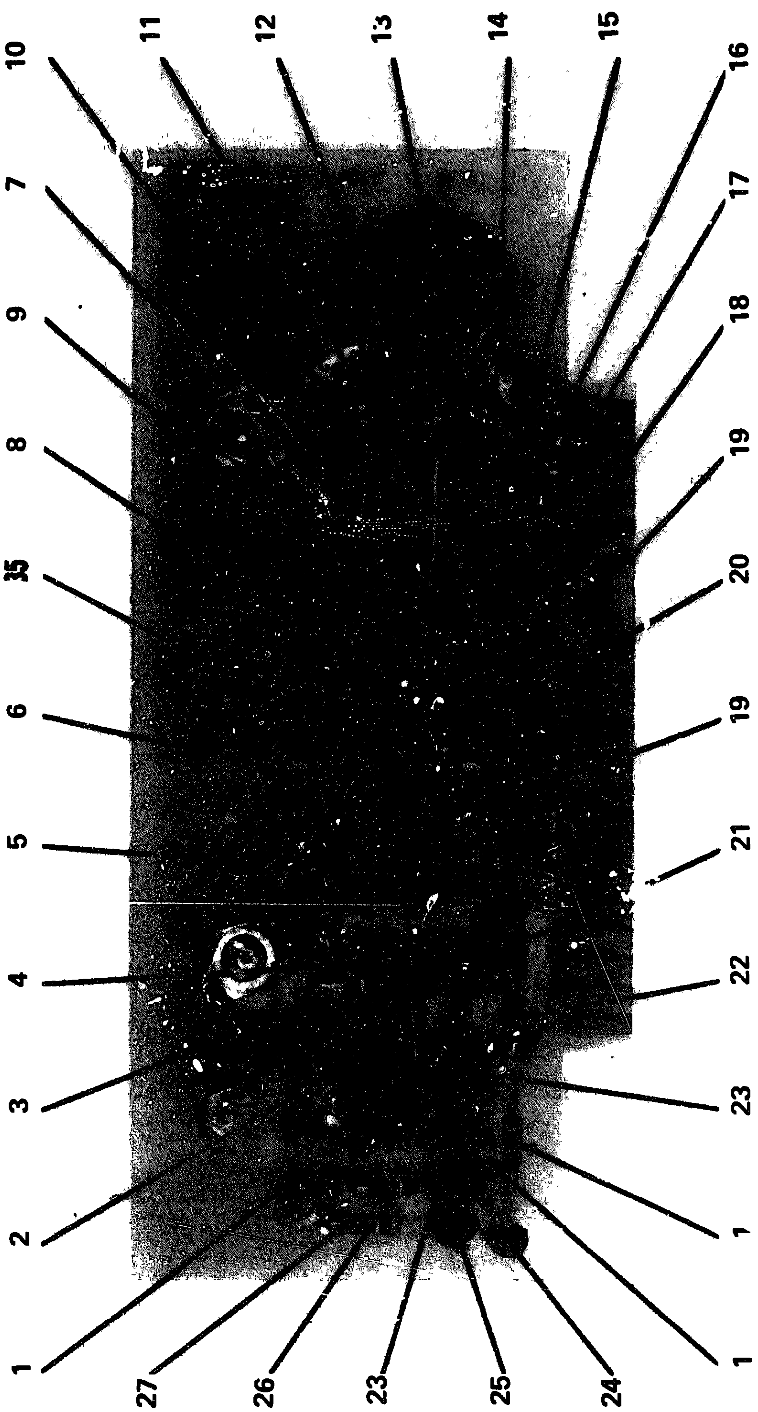


Figure 1-3, +20 & +5 V Regulator Assembly (Sheet 1 of 2)

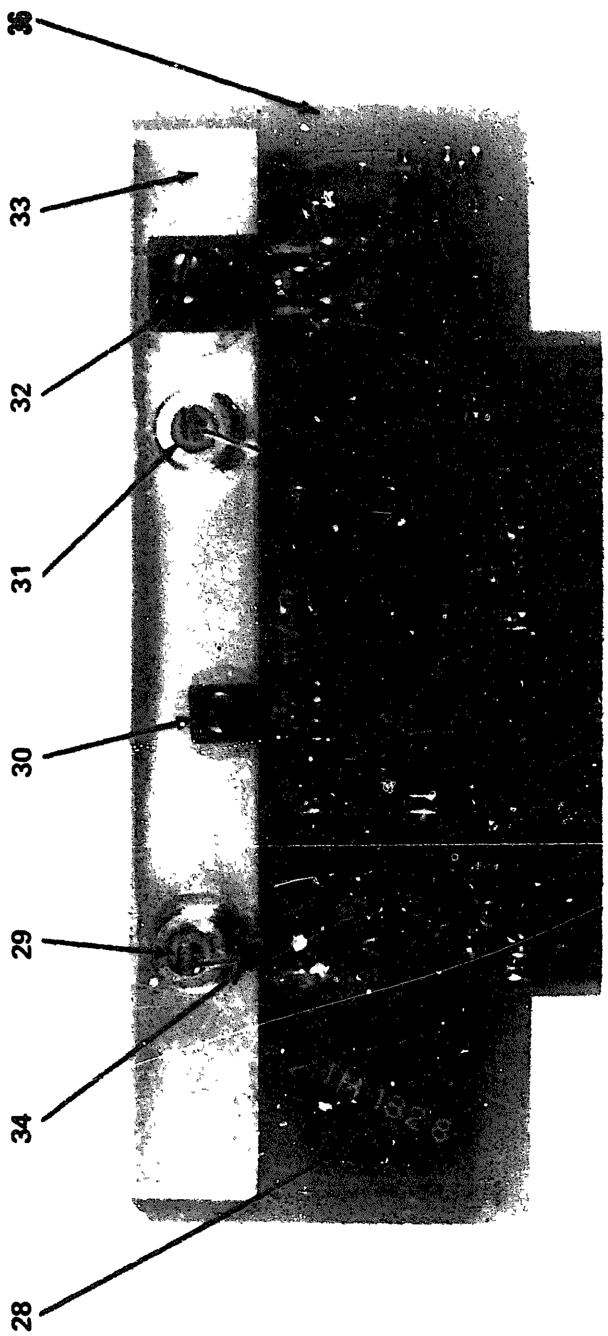


Figure 1-3. +20 & +5V Regulator Assembly (Sheet 2 of 2)

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-3	1A1	+20 & +5V REGULATOR ASSY. . . .	10392258	REF	
-1	1A1R4,R14, R15	. RESISTOR, 1/4W, 10%, 1K (81349)	RC07GF102K	3	
-2	1A1R16	. RESISTOR, 1/4W, 10%, 5.6K (81349)	RC07GF562K	1	
-3	1A1R1	. RESISTOR, 1/4W, 10%, 560 OHM (81349)	RC07GF561K	1	
-4	1A1R19	. RESISTOR, 1/8W, 1%, 2.37K (81349)	RN55D2371F	1	
-5	1A1R18	. RESISTOR, 1/4W, 10%, 100 OHM (80294)	3067P 1-101	1	
-6	1A1R6	. RESISTOR, 1/4W, 10%, 680 OHM (81349)	RC07GF681K	1	
-7	1A1Q6	. TRANSISTOR (04713)	2N3906	1	
-8	1A1R7	. RESISTOR, 1/4W, 10%, 3.3K (81349)	RC07GF332K	1	
-9	1A1Q5	. TRANSISTOR (04713).	2N3904	1	
-10	1A1C2	. CAPACITOR, 22 UF, 35 VDC (56289)	CS13BF226K	1	
-11	1A1C4	. CAPACITOR, 330 UF, 6 VDC (56289)	CS13BB337K	1	
-12	1A1R5	. RESISTOR, 1/4W, 10%, 33K (81349).	RC07GF333K	1	
-13	1A1R10	. RESISTOR, 1/4W 10%, 100 OHM (81349).	RC07GF101K	1	
-14	1A1CR3	. DIODE (01295)	1N662	1	
-15	1A1R12	. RESISTOR, 1/8W, 1%, 2.15K (81349)	RN55D2151F	1	
-16	1A1R11	. RESISTOR, 1/4W, 10%, 470 OHM (81349).	RC07GF471K	1	
-17	1A1R13	. RESISTOR, 1/8W, 1%, 6.34K (81349)	RN55D6341F	1	
-18	1A1R9	. RESISTOR, 1/4W, 10%, 47 OHM (81349)	RC07GF470K	1	
-19	1A1C1,C3	. CAPACITOR, .01 UF, 200 VDC (56289).	192P10392	2	
-20	1A1R8	. RESISTOR, 1/4W, 10%, 10 OHM (81349).	RC07GF100K	1	
-21	1A1R17	. RESISTOR, 1/8W, 1%, 825 OHM (81349)	NSSD8250F	1	
-22	1A1VR1	. DIODE ZENER (04713)	1N4733	1	
-23	1A1Q8,Q9	. TRANSISTOR (01295).	2N3704	2	
-24	1A1Q7	. TRANSISTOR (04713).	2N5555	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-3-25	1A1Q1	. TRANSISTOR (01295)	2N3702	1	
-26	1A1R3	. RESISTOR, 1/4W, 10%, 56 OHM (81349)	RCO7GF560K	1	
-27	1A1R2	. RESISTOR, 1/4W, 10%, 12K (81349).	RC07GF123K	1	
-28	1A1L1	. CHOKE (24765).	TM1828	1	
-29	1A1CR4	. DIODE (04713).	1N3879	1	
-30	1A1Q4	. TRANSISTOR (04713)	2N5192	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 4-40x3/8 IN (73734)	17044	1	
		. WASHER, INT LOCK, NO. 4 (73734)	1302	1	
		. NUT, HEX, 4-40x1/4 IN (73734).	8003	1	
		- - - - - - - - - * - - - - - - - -			
-31	1A1CR1	. DIODE (04713).	MR1125	1	
-32	1A1Q2	. TRANSISTOR (04713)	MJ3055	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 6-32x1/2 IN (73734)	17066	1	
		. WASHER, INT LOCK, NO. 6 (73734).	1304	1	
		. NUT, HEX, 6-32x5/16 IN (73734)	8005	1	
		- - - - - - - - - * - - - - - - - -			
-33		. BRACKET, HEAT SINK	00492217	1	
-34		. BEAD, FERRITE (02114).	5659065/3B	2	
-35	1A1Q3	. TRANSISTOR (01295).	2N2907	1	
-36		.PCB, +20 & +5V REGULATOR.	00392257	1	

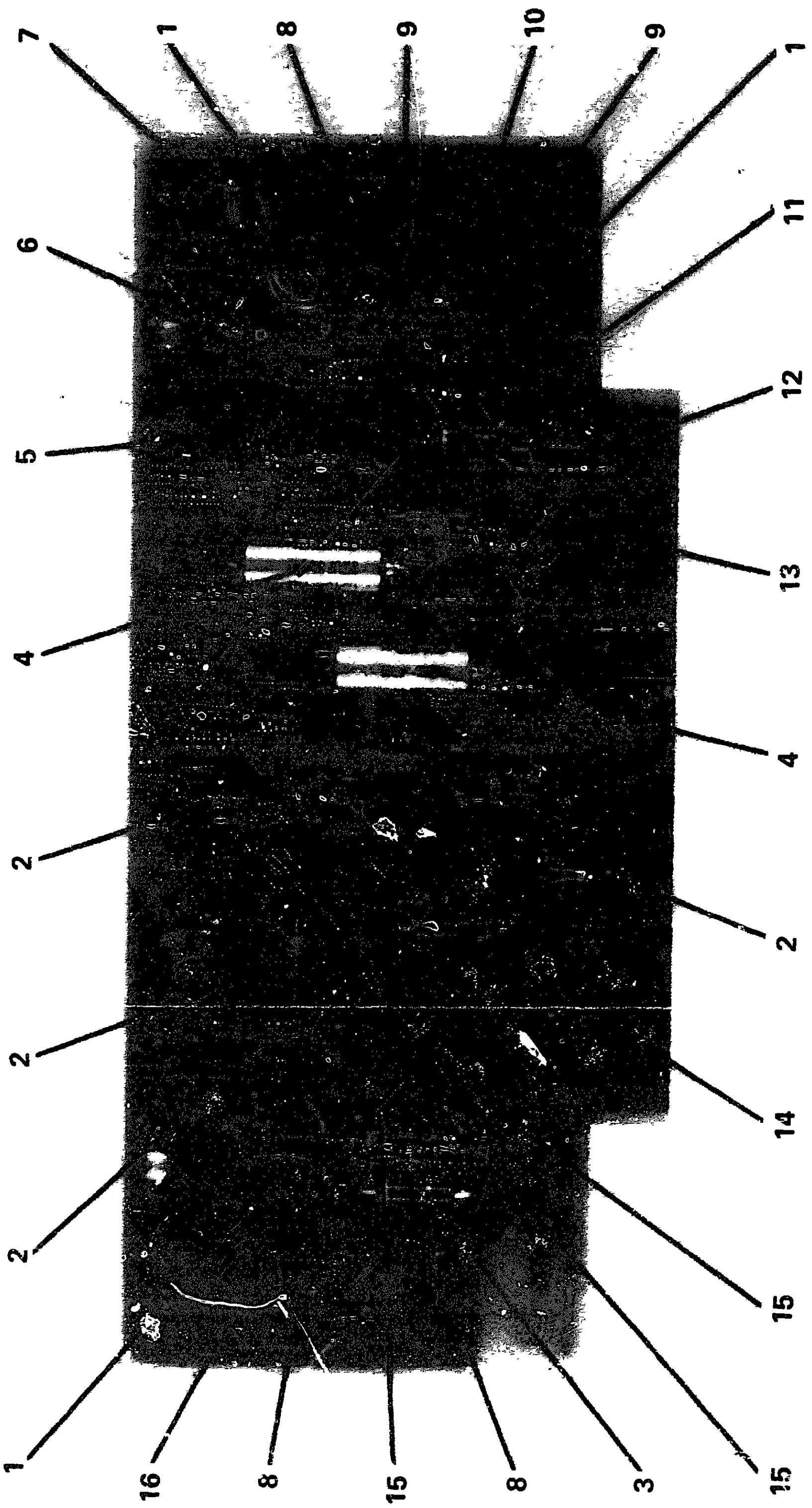


Figure 1-4. 10V Regulator Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-4	1A2	+10V REGULATOR ASSY.	10392260	REF	
-1	1A2Q1,2,3	. TRANSISTOR (04713)	2N3906	3	
-2	1A2CR4,5, 6,7	. DIODE (04713).	1N4002	4	
-3	1A2R3	RESISTOR, 1/2W, 10%, 470 OHM (81349)	RC20GF471K	1	
-4	1A2C1,3	. CAPACITOR, 22 UF, 35 VDC, 10% (56289).	CS13BF226K	2	
-5	1A2R12	. RESISTOR, 1/4W, 10%, 100 OHM (81349).	RC07GF101K	1	
-6	1A2R8	. RESISTOR, 1/4W, 10%, 5.6K (81349).	RC07GF562K	1	
-7	1A2Q4	. TRANSISTOR (02735)	2N2270	1	
-8	1A2R1,2,9	. RESISTOR, 1/4W, 10%, 12K (81349).	RC07GF123K	3	
-9	1A2R6,7	. RESISTOR, 1/4W, 1%, 4.64K . . (81349).	RN55D4641F	2	
-10	1A2C2	. CAPACITOR, .022 UF, 200 VDC, 10% (56289)	192P22392	1	
-11	1A2R10	. RESISTOR, 1/4W, 10%, 560 OHM (81349).	RC07GF561K	1	
-12	1A2R11	. RESISTOR, 1/4W, 10%, 1K (81349).	RC07GF102K	1	
-13	1A2R13	. RESISTOR, 1/4W, 10%, 4.7K (81349).	RC07GF472K	1	
-14	1A2R5	. RESISTOR, 1/2W, 10%, 150 OHM (81349).	RC20GF151K	1	
-15	1A2CR1,2,3	. DIODE (01295).	1N914	3	
-16		. PCB, +10V REGULATOR.	00392259	1	

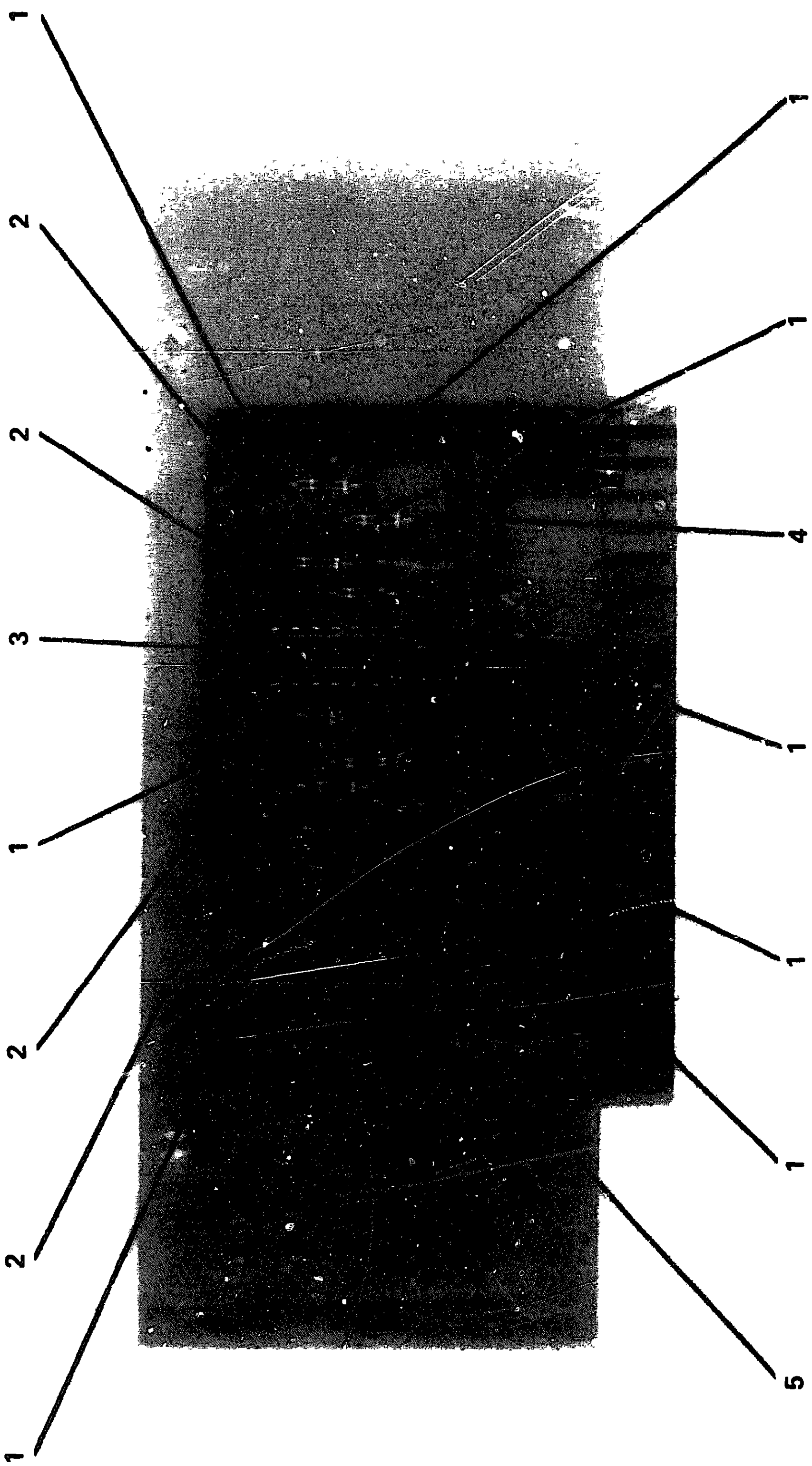


Figure 1-5. Differentiator Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-5	1A3	DIFFERENTIATOR ASSY.	10392248	REF	
-1	1A3R1 THRU 1A3R8	. RESISTOR, 1/4W, 10%, 4.7K (81349).	RC07GF472K	8	
-2	1A3Q1 THRU 1A3Q4	. TRANSISTOR (07263)	2N3646	4	
-3	1A3U1	. INTEGRATED CIRCUIT (01295) . .	SN7400N	1	
-4	1A3C1	. CAPACITOR, .022 UF, 200 VDC, 10% (56289).	192P22392	1	
-5		. PCB, DIFFERENTIATOR.	00392247	1	

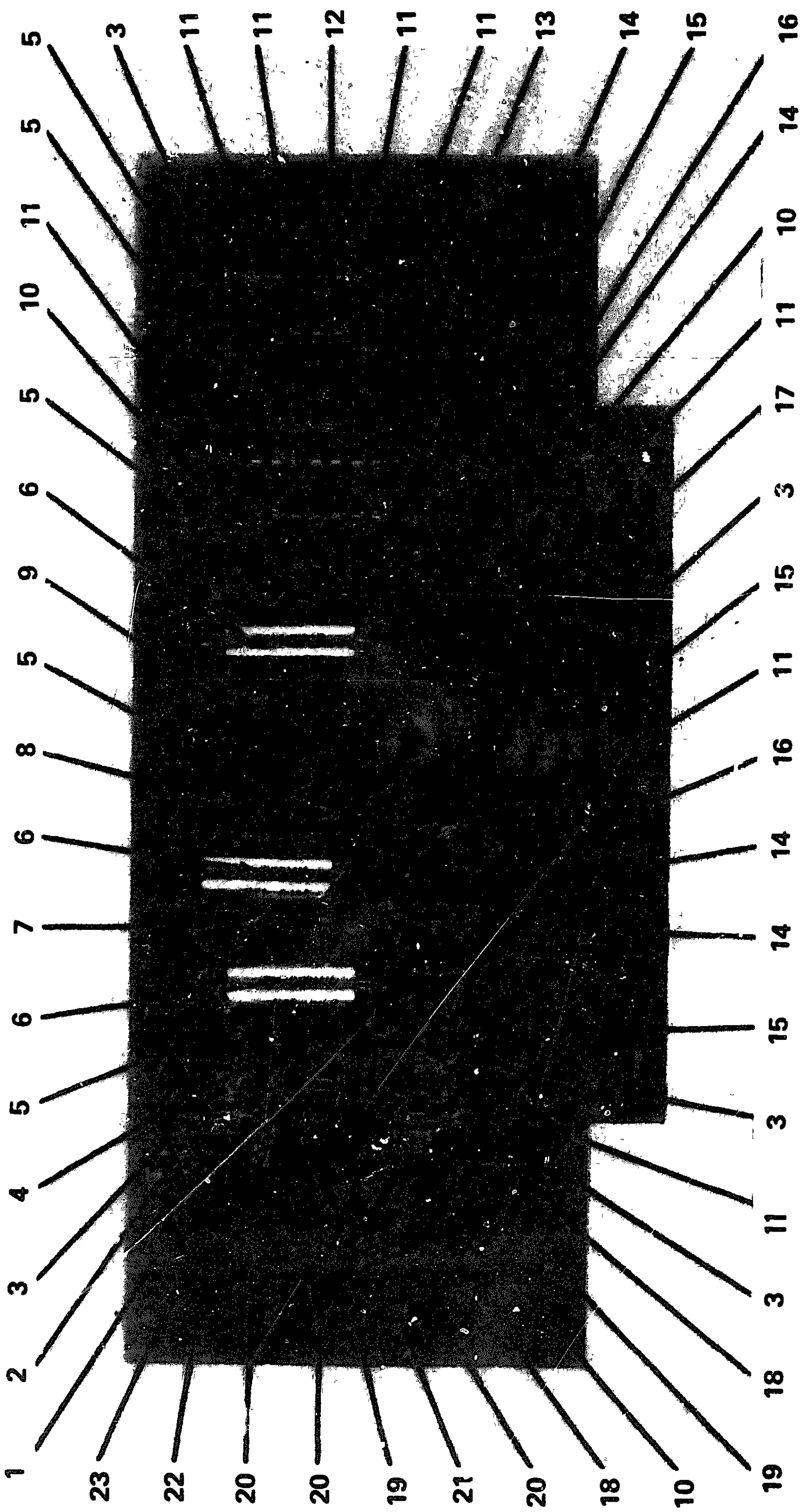


Figure 1-6. Phase Comparator Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-6	1A4	PHASE COMPARATOR ASSY	10392213	REF	
-1	1A4Q7	. TRANSISTOR (04713).	2N5555	1	
-2	1A4VR1	. DIODE, ZENER (04713).	1N821	1	
-3	1A4R5,6,14, 17,29	. RESISTOR, 1/4W, 10%, 10K (81349)	RC07GF103K	5	
-4	1A4R8	. RESISTOR, 1/8W, 1%, 2.21K (81349)	RN55D2211	1	
-5	1A4Q1,2,4, 5,6	. TRANSISTOR (80131)	2N3646	5	
-6	1A4C5,7,9	. CAPACITOR, 22 UF, 35 VDC, 10% (56289)	CS13BF226K	3	
-7	1A4Q3	. TRANSISTOR (01295).	2N3704	1	
-8	1A4R23	. RESISTOR, 1/4W, 10%, 2.2K (81349)	RC07GF222K	1	
-9	1A4R25	. RESISTOR, 1/2W, 5%, 5K (80294)	1067P1-502	1	
-10	1A4C1,6,8	. CAPACITOR, 22 PF, 500 VDC, 5% (72136)	DM15-220J	3	
-11	1A4R1,2,4, 15,19,20, 22,27	. RESISTOR, 1/4W, 10%, 4.7K (81349)	RC07GF472K	8	
-12	1A4U1	. INTEGRATED CIRCUIT (01295). .	SN7400N	1	
-13	1A4U2	. INTEGRATED CIRCUIT (01295).	SN7473N	1	
-14	1A4R16, 18, 28, 30	. RESISTOR, 1/4W, 10%, 470 OHM (81349)	RC07GF471K	4	
-15	1A4R3,21, 26	. RESISTOR, 1/4W, 10%, 1K (81349)	RC07GF102K	3	
-16	1A4C10,11	. CAPACITOR, .022 UF, 200 VDC, 10% (56289)	192P22392	2	
-17	1A4R24	. RESISTOR, 1/4W, 10%, 33K (81349).	RC07GF333K	1	
-18	1A4R10,11	. RESISTOR, 1/8W, 1%, 287K (81349)	RN55D2873F	2	
-19	1A4R12,13	. RESISTOR, 1/4W, 10%, 100K (81349)	RC07GF104K	2	
-20	1A4C2,3,4	. CAPACITOR .22 UF 200 VDC, 5% (09134).	31-224C	3	
-21	1A4R9	. RESISTOR, 1/8W, 1%, 76.8K (81349)	RN55D7682F	1	
-22	1A4R7	. RESISTOR, 1/4W, 10%, 22K (81349)	RC07GF223K	1	
-23		. PCB, PHASE COMPARATOR	00392212	1	

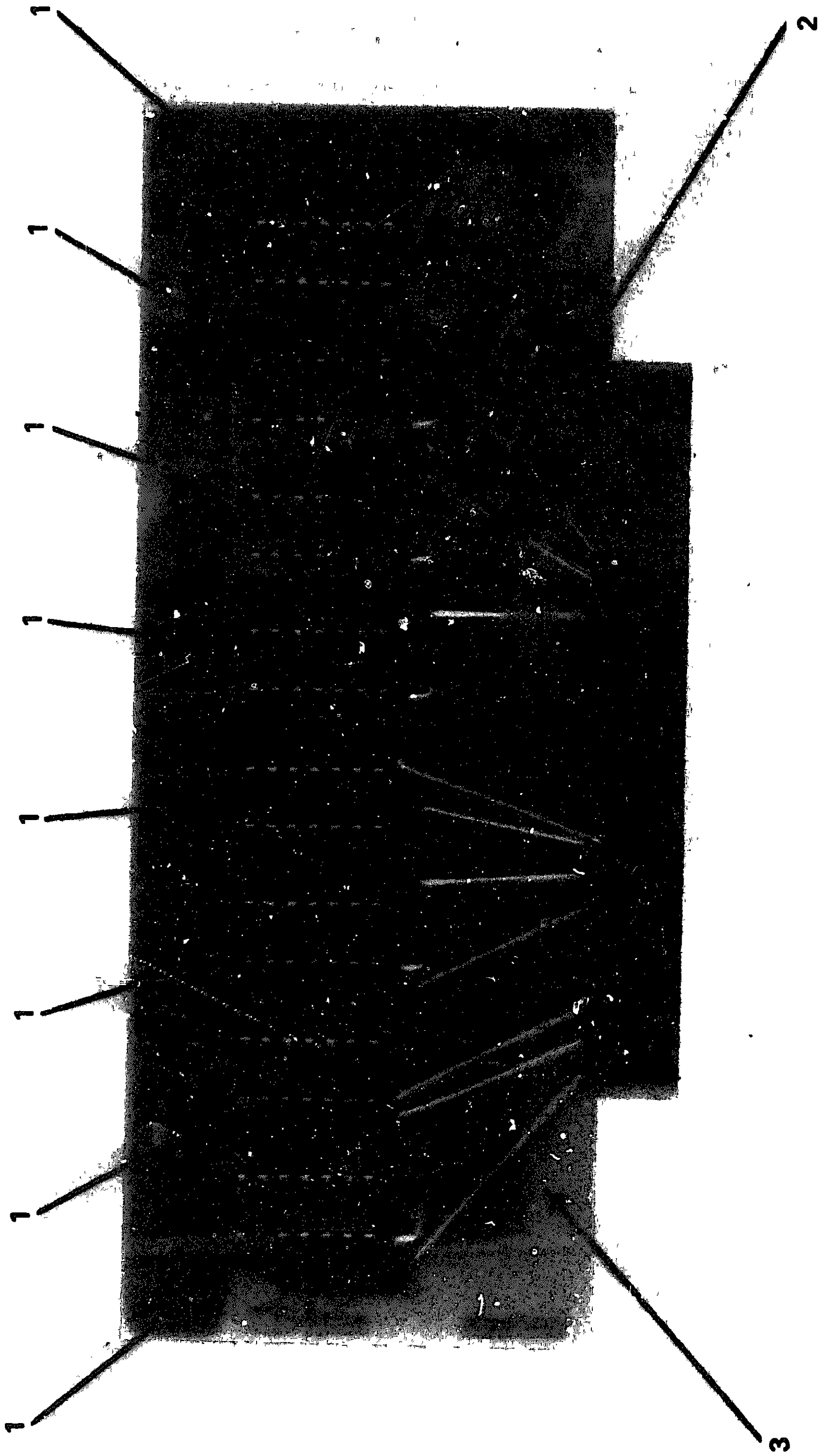


Figure 1-7. Divider 1 Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-7	1A5	DIVIDER 1 ASSY.	103922081	REF	
-1	1A5U1 THRU 1A5U8	. INTEGRATED CIRCUIT (01295). .	SN7490N	8	
-2	1A5C1	. CAPACITOR, .022 UF, 200 VDC, 10% (56289)	192P22392	1	
-3		. PCB, DIVIDER.	00392207	1	

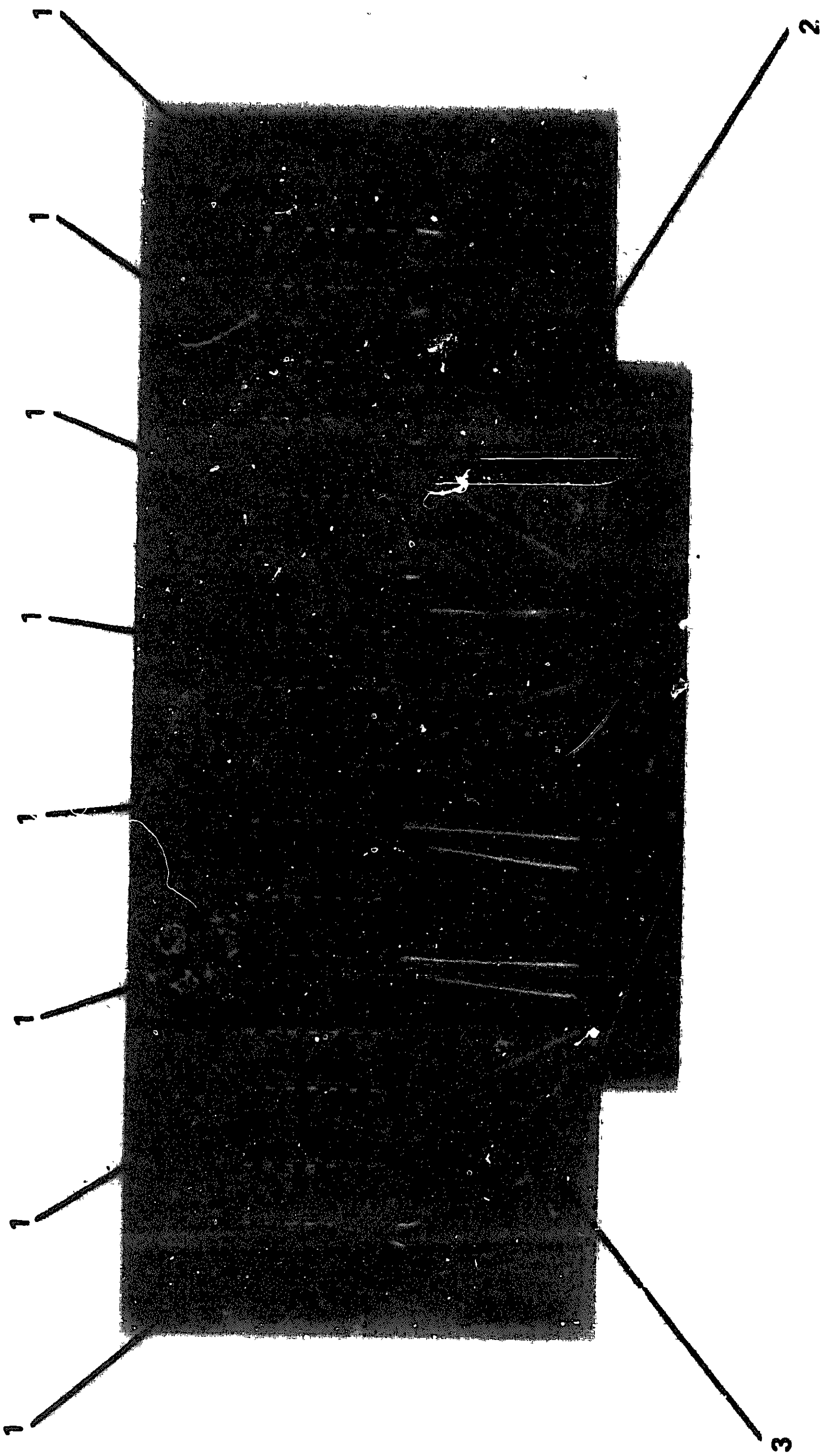


Figure 1-8. Divider 2 Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-8	1A6	DIVIDER 2 ASSY.	103922082	REF	
-1	1A6U1 THRU 1A6U8	. INTEGRATED CIRCUIT (01295). .	SN7490N	8	
-2	1AC1	. CAPACITOR, .022 UF, 200 VDC, 10% (56289)	192P22392	1	
-3		. PCB, DIVIDER.	00392207	1	

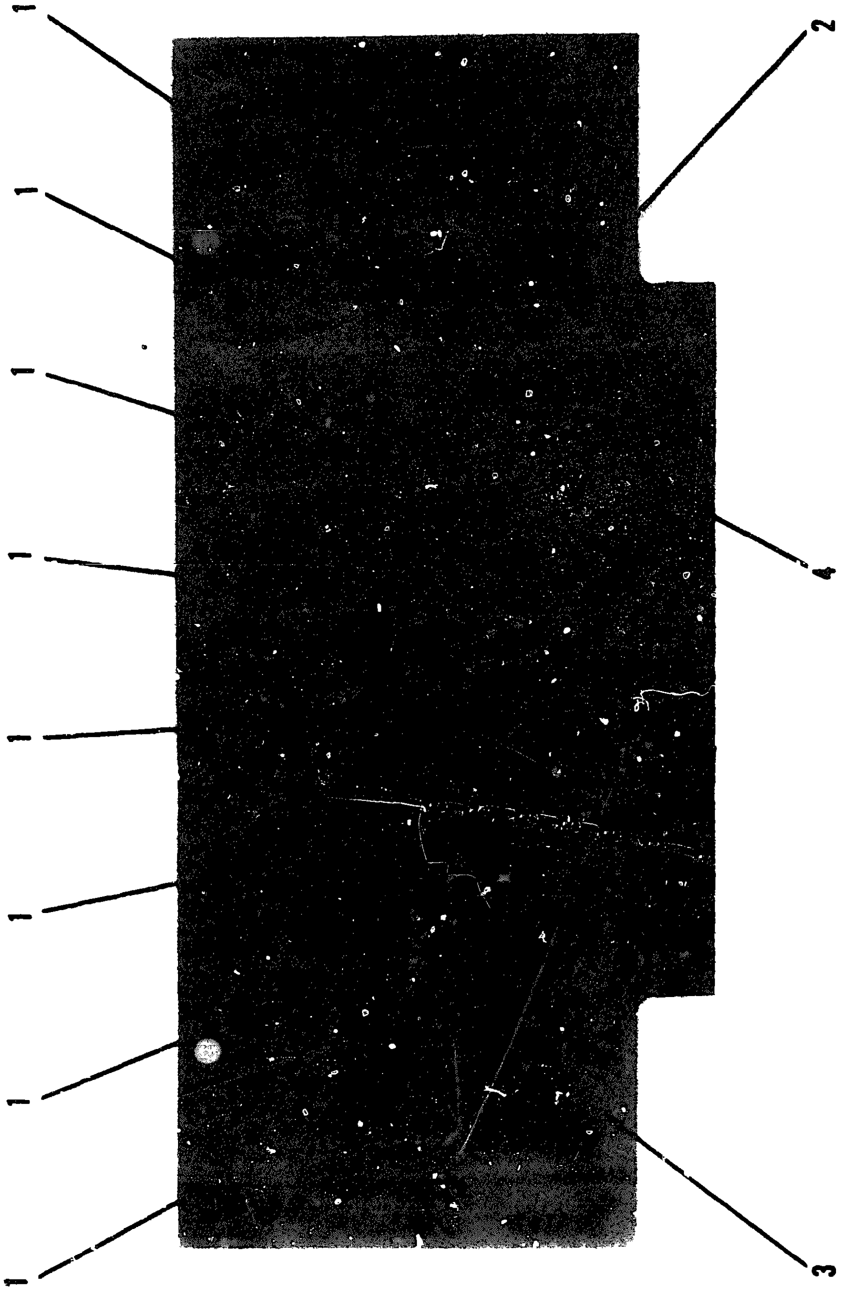


Figure 1-9. Divider 3 Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-9	1A7	DIVIDER 3 ASSY.	103922083	REF	
-1	1A7U1 THRU 1A7U8	. INTEGRATED CIRCUIT (01295). .	SN7490N	8	
-2	1A7C1	. CAPACITOR, .022 UF, 200 VDC, 10% (56289)	192P22392	1	
-3		. PCB, DIVIDER.	10392207	1	
-4	1A7R1	. RESISTOR, 1/4W, 10%, 2.2K (81349).	RC07GF222	1	

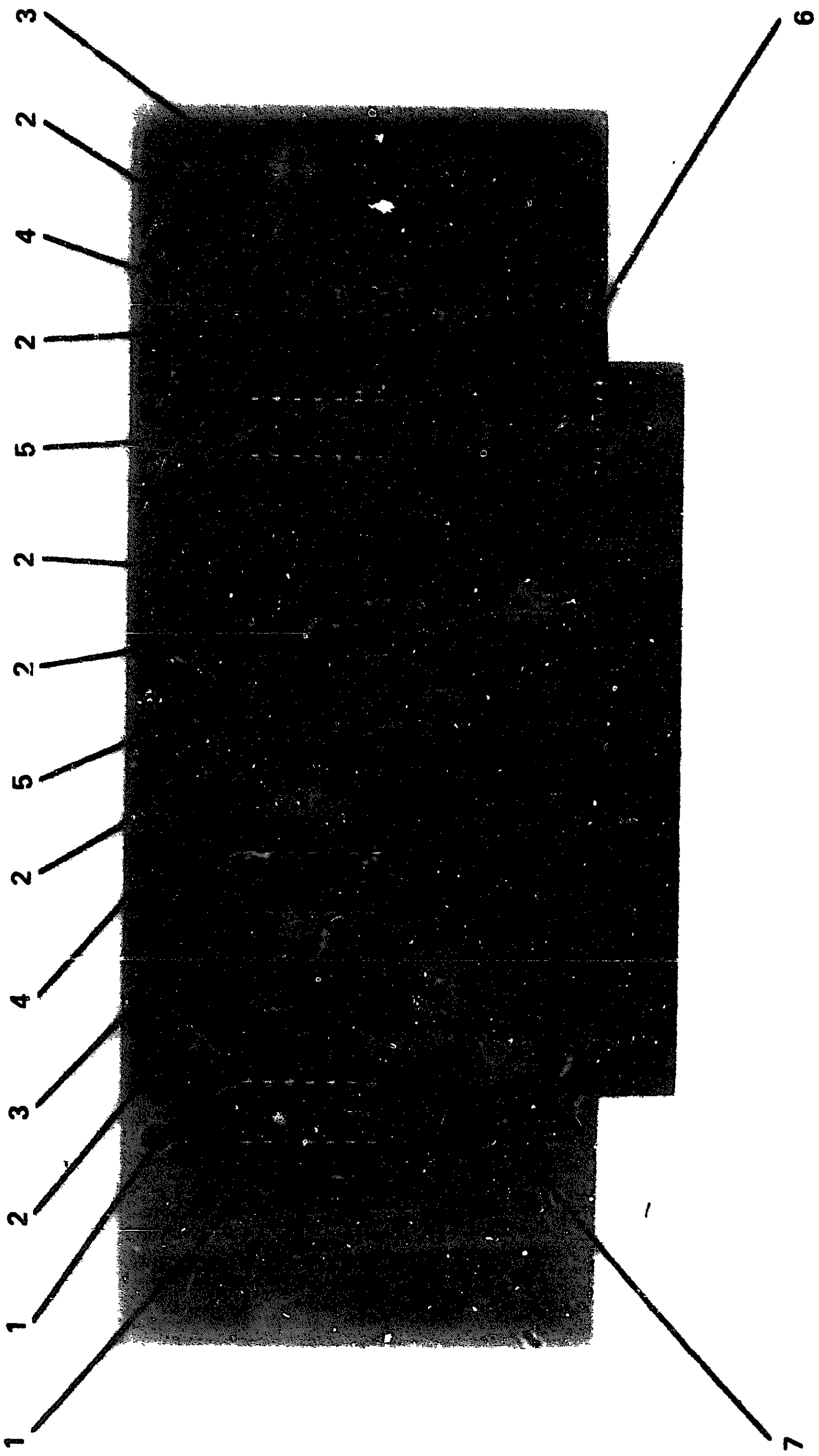


Figure 1-10. Servo Control Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-10	1A8	. SERVO CONTROL ASSY.	10392216	REF	
-1	1A8U3,4	. INTEGRATED CIRCUIT (01295). .	SN7474N	2	
-2	1A8R1,2,4, 5,7,8	RESISTOR, 1/4W, 10%, 4.7K (81349)	RC07GF472K	6	
-3	1A8R3,6	RESISTOR, 1/4W, 10%. 1K (81349)	RC07GF102K	2	
-4	1A8Q1,2	. TRANSISTOR (07263).	2N3646	2	
-5	1A8U1,2	. INTEGRATED CIRCUIT (01295).	SN7400N	2	
-6	1A8C1	. CAPACITOR, .022 UF, 200 VDC, 10% (56289)	192P22392	1	
-7		. PCB, SERVO CONTROL	00392215	1	

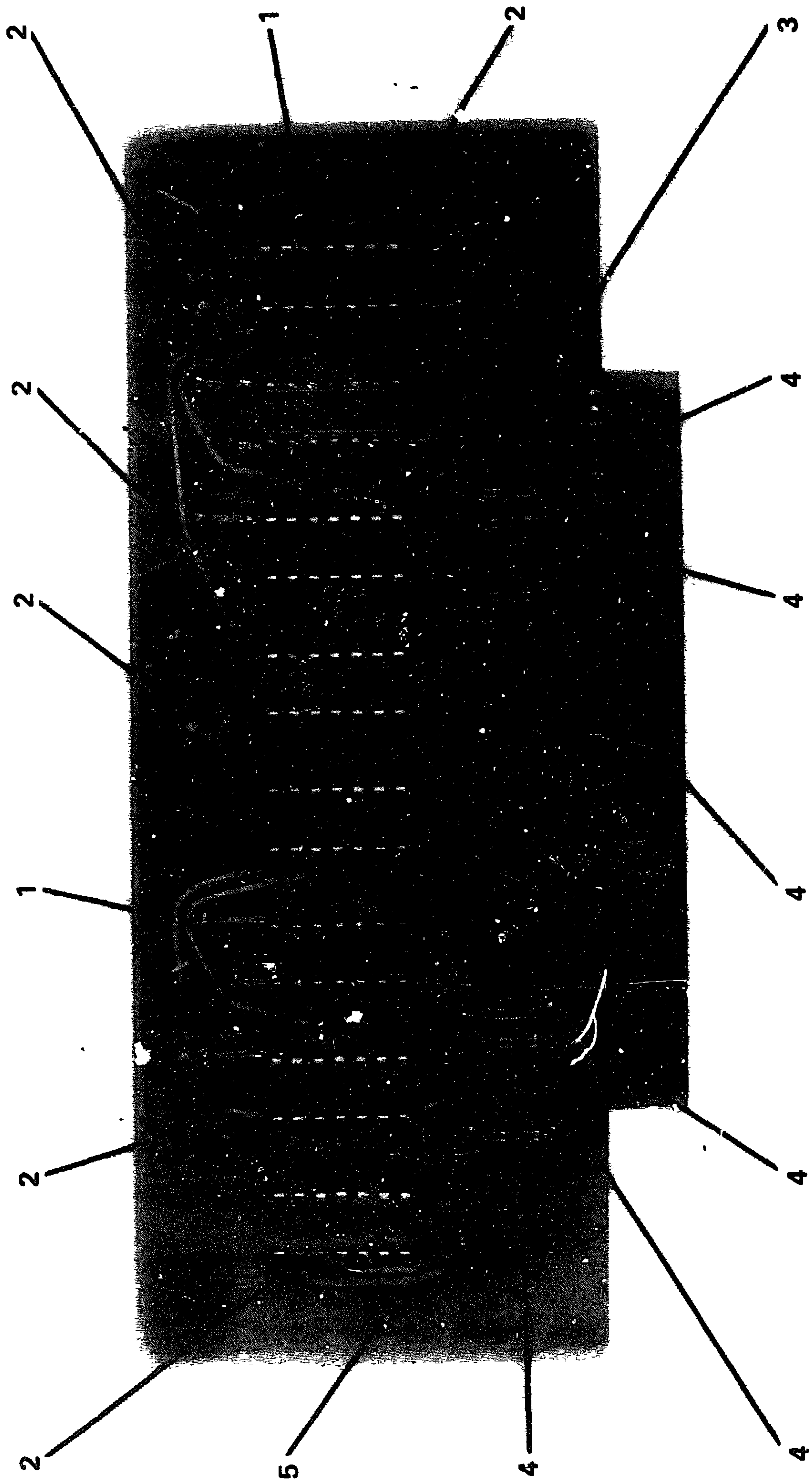


Figure 1-11. Dual Phase Shifter

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Desig.	Description	Part No.	Units Per Assy.	Usable On Code
1-11-	1A9	DUAL PHASE SHIFTER	10392172	REF	
-1	1A9U2,6	. INTEGRATED CIRCUIT (01295) . .	SN7400N	2	
-2	1A9U1,3,4, 5,7,8	. INTEGRATED CIRCUIT (01295) . .	SN7474N	6	
-3	1A9C1	. CAPACITOR, .022 UF, 200 VDC, 10% (56289).	192P22392	1	
-4	1A9R1 THRU 1A9R6	. RESISTOR, 1/4W, 10%, 4.7K (81349).	RC07GF472K	6	
-5		. PCB, DUAL PHASE SHIFTER. . . .	00392171	1	

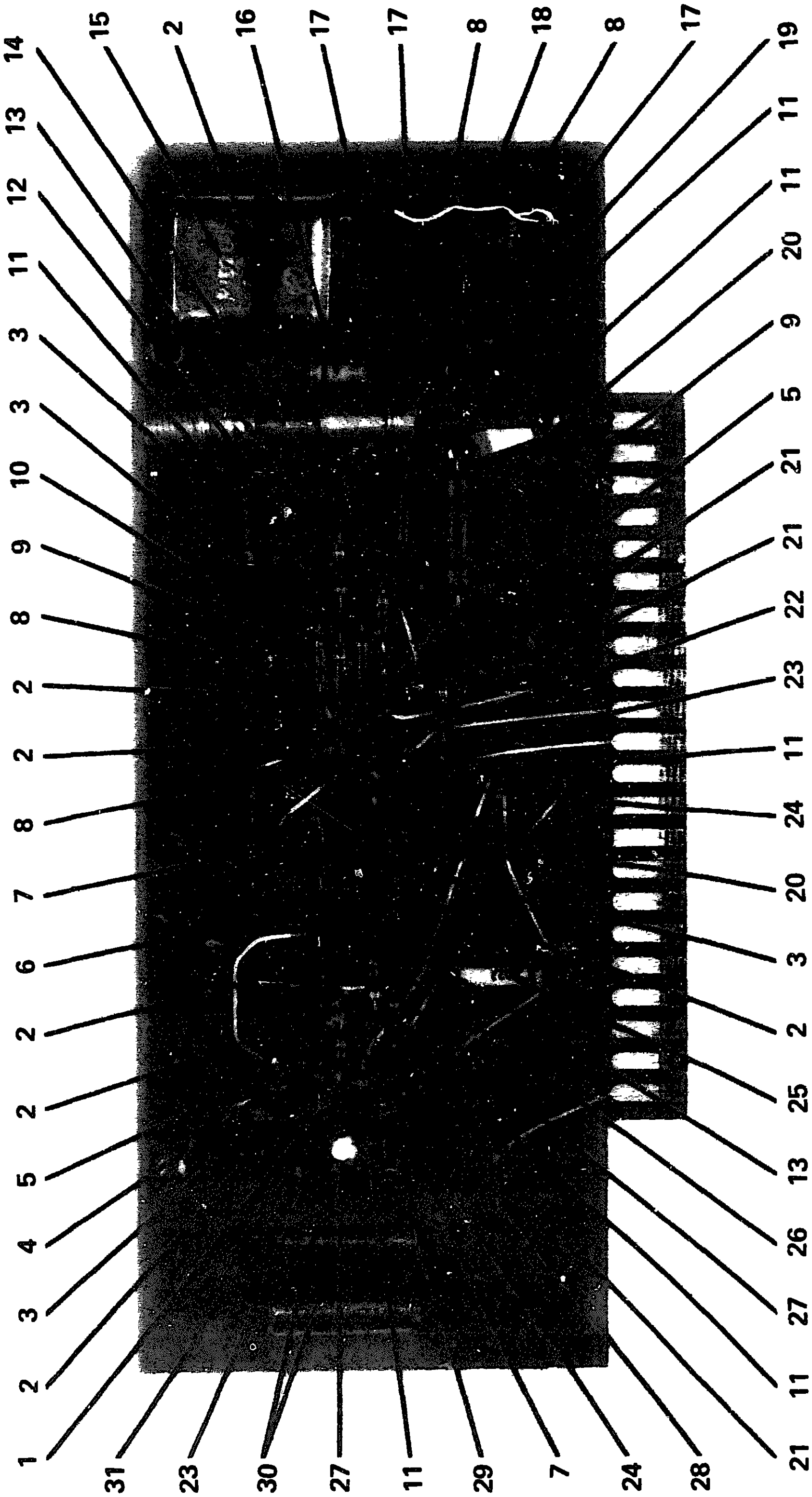


Figure 1-12. 5MHz VCO Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-12	1A10	5 MHZ VCO ASSY	10392245	REF	
-1	1A10R17	. RESISTOR, 1/8W, 1%, 6.04K (81349).	RN55D6041F	1	
-2	1A10Q1,Q3, Q4,Q5, Q6,Q7, Q9	. TRANSISTOR (80131).	2N3646	7	
-3	1A10R6,R9, R13,R18	. RESISTOR, 1/4W, 10%, 22K (81349).	RC07GF223K	4	
-4	1A10R23	. RESISTOR, 1/8W, 1%, 10K (81349).	RN55D1002F	1	
-5	1A10Q2,Q8	. TRANSISTOR (04713)	2N3906	2	
-6	1A10R21	. RESISTOR, 1/8W, 1%, 2.151K (81349).	RN55D 2151F	1	
-7	1A10R20, R22	. RESISTOR, 1/8W, 1%, 1K (81349)	RN55D1001F	2	
-8	1A10C7,C8, C9,C16	. CAPACITOR, .01 UF, 100 VDC (56289)	TGS10	4	
-9	1A10R3,R8	. RESISTOR, 1/4W, 10%, 10K (81349).	RC07GF103K	2	
-10	1A10C6	. CAPACITOR, 330 PF, 500 VDC, 5% (84171).	DM15-331J	1	
-11	1A10R2,R4, R10,R15, R24,R27	. RESISTOR, 1/4W, 10%, 1K (81349).	RC07GF102K	6	
-12	1A10R1	. RESISTOR 1/4W, 10% 47 OHM (81349).	RC07GF470K	1	
-13	1A10C5,C12	. CAPACITOR, 1000 PF, 100 VDC, 5% (72136)	DM15-102J	2	
-14	1A10C4	. CAPACITOR, VARIABLE (72982). .	525-000	1	
-15	1A10Y1	CRYSTAL 5MHz (74306)	4051122	1	
-16	1A10L1	. COIL, CHOKE, 33-68UH, 10%, SELECTED (99800) SEE NOTE 1	1025-SEL	1	
-17	1A10C1,C2, C3	. CAPACITOR, SELECTED, (84171) SEE NOTE 2	DM15-SEL	3	
-18	1A10CR1	. DIODE, EPICAP, (04713)	MV1638	1	
-19	1A10R28	RESISTOR 1/4W, 10% 100K (81349).	RC07GF104K	1	
-20	1A10C17, C18	CAPACITOR, 022 UF, 200 VDC, 10% (56289).	192P22392	2	
-21	1A10R7,R26, R5	RESISTOR, 1/4W, 10%, 100 OHM (81349)	RCO7GF101K	3	
-22	1A10L2	. COIL, CHOKE, 10%, 100 UH (99800).	1025-68	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-12-23	1A10R11, R16	RESISTOR, 1/4W, 10%, 4.7K (81349)	RC07GF472K	2	
-24	1A10C10, C11	. CAPACITOR, 22 PF, 500 VDC, 5% (72136)	DM15-220J	2	
-25	1A10C13	. CAPACITOR, .0022 UF, 200 VDC, 10% (56289)	192P2292	1	
-26	1A10R14 .	RESISTOR, 1/8W, 1%, 30.1K (81349)	RN55D3012F	1	
-27	1A10R12, R19	. RESISTOR, 1/4W, 10%, 47K (81349)	RC07GF473K	2	
-28	1A10U1	INTEGRATED CIRCUIT (07263)	U9T7741393	1	
-29	1A10R25	. RESISTOR, 1/4W, 10%, 220K (81349)	RC07GF224K	1	
-30	1A10C14, C15	CAPACITOR, 22 UF, 35 VDC, 10% (56289)	CS13BF226K	2	
-31		PCB, 5 MHZ VCO	00392244	1	
		NOTE 1: SELECT ONE OF THE FOLLOWING:			
-16	1A10L1	. COIL, CHOKE, 10%			
		33UH (99800)	1025-56		
		39UH (99800)	1025-58		
		47UH (99800)	1025-60		
		NOTE 2: SELECT ONE OF THE FOLLOWING:			
-17A	1A10C1	. CAPACITOR, 5%, 500 VDC (72136)			
		22 PF	DM15-220J		
		27 PF	DM15-270J		
		33 PF	DM15-330J		
		39 PF	DM15-390J		
-17B	1A10C2	. CAPACITOR, 5%, 500 VDC (84171)			
		330 PF	DM15-331J		
		390 PF	DM15-391J		
		470 PF	DM15-471J		
-17C	1A10C3	. CAPACITOR, 5%, 500 VDC (84171)			
		470 PF	DM15-471J		
		561 PF	DM15-561J		
		681 PF	DM15-681J		

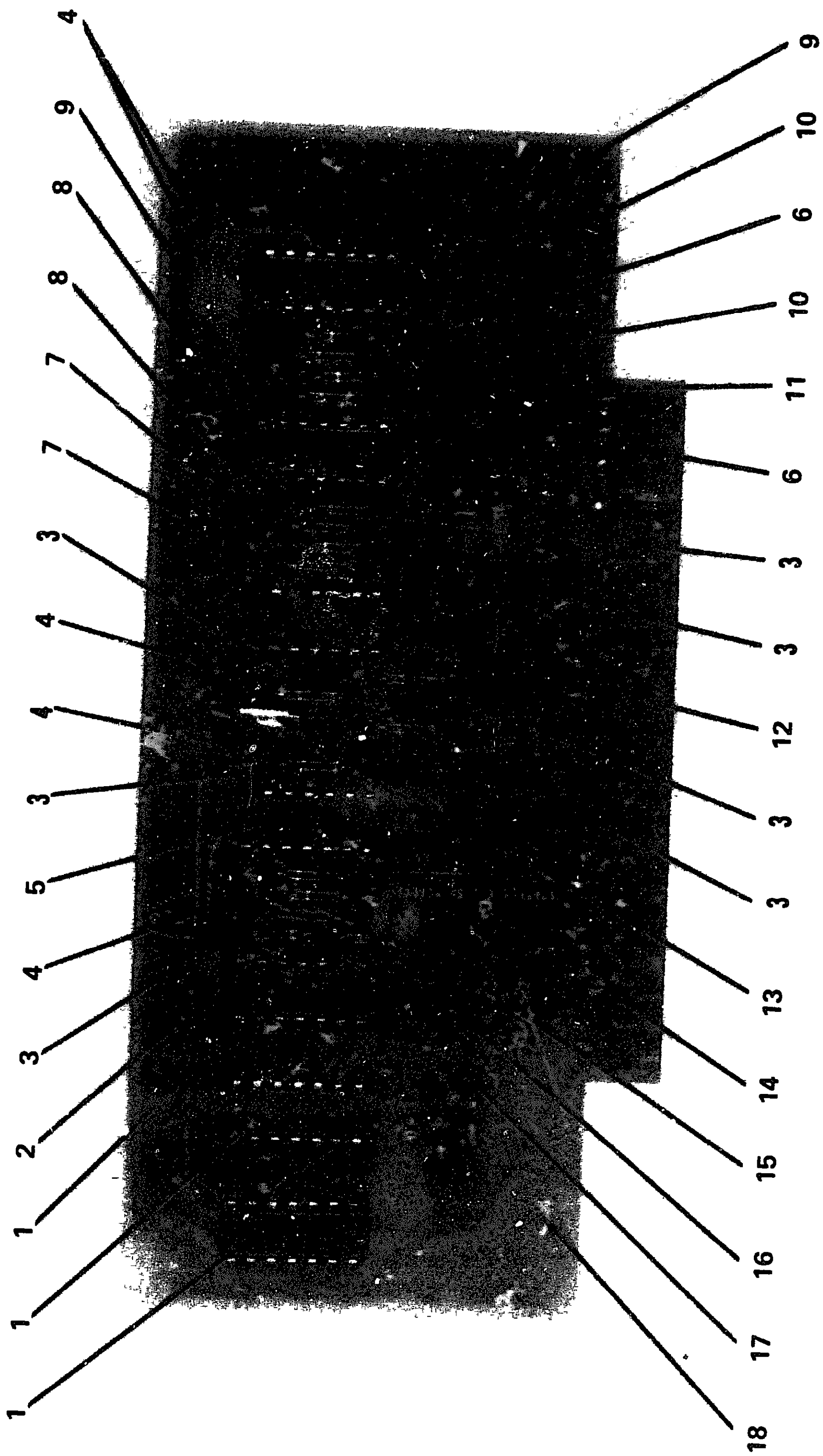


Figure 1-13. Digital Integrator Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref. Design	DESCRIPTION	Part No.	Units Per Assy.	Usable on Code
1-13	1A11	DIGITAL INTEGRATOR ASSY . . .	10392237	REF	
-1	1A11U5,6,7	. INTEGRATED CIRCUIT (01295)	SN7490N	3	
-2	1A11R1	. RESISTOR, 1/4W, 10%, 47 OHM (81349)	RC07GF470K	1	
-3	1A11R3,11 13,14, 15,16, 17	. RESISTOR, 1/4W, 10%, 4.7K (81349)	RC07GF472K	7	
-4	1A11Q1,2, 3,6,7	. TRANSISTOR (80131).	2N3646	5	
-5	1A11U4	. INTEGRATED CIRCUIT (01295)	SN7402N	1	
-6	1A11R6,8	. RESISTOR, 1/4W, 10%, 10K (81349)	RC07GF103K	2	
-7	1A11Q4,5	. TRANSISTOR (01295).	2N3704	2	
-8	1A11R10,12	. RESISTOR, 1/4W, 10%, 22K (81349)	RC07GF223K	2	
-9	1A11U1,2	. INTEGRATED CIRCUIT (01295).	SN74H00N	2	
-10	1A11R7,9	. RESISTOR, 1/4W, 10%, 680 OHM (81349)	RC07GF681K	2	
-11	1A11C3	. CAPACITOR, .022 UF, 200 VDC, 10% (56289)	192P22392	1	
-12	1A11U3	. INTEGRATED CIRCUIT (01295).	SN7474N	1	
-13	1A11C2	. CAPACITOR, 1 UF, 35 VDC, 10% (56289)	CS13BF105K	1	
-14	1A11R4	. RESISTOR, 1/2W, 5%, 5K, (80294)	3067P1-502	1	
-15	1A11R5	. RESISTOR, 1/4W, 10%, 1K (81349)	RC07GF102K	1	
-16	1A11R2	. RESISTOR, 1/4W, 10%, 470 OHM (81349)	RC07GF471K	1	
-17	1A11C1	. CAPACITOR, .01 UF, 100 VDC (56289)	TG-S10	1	
-18		. PCB, DIGITAL INTEGRATOR	00392236	1	

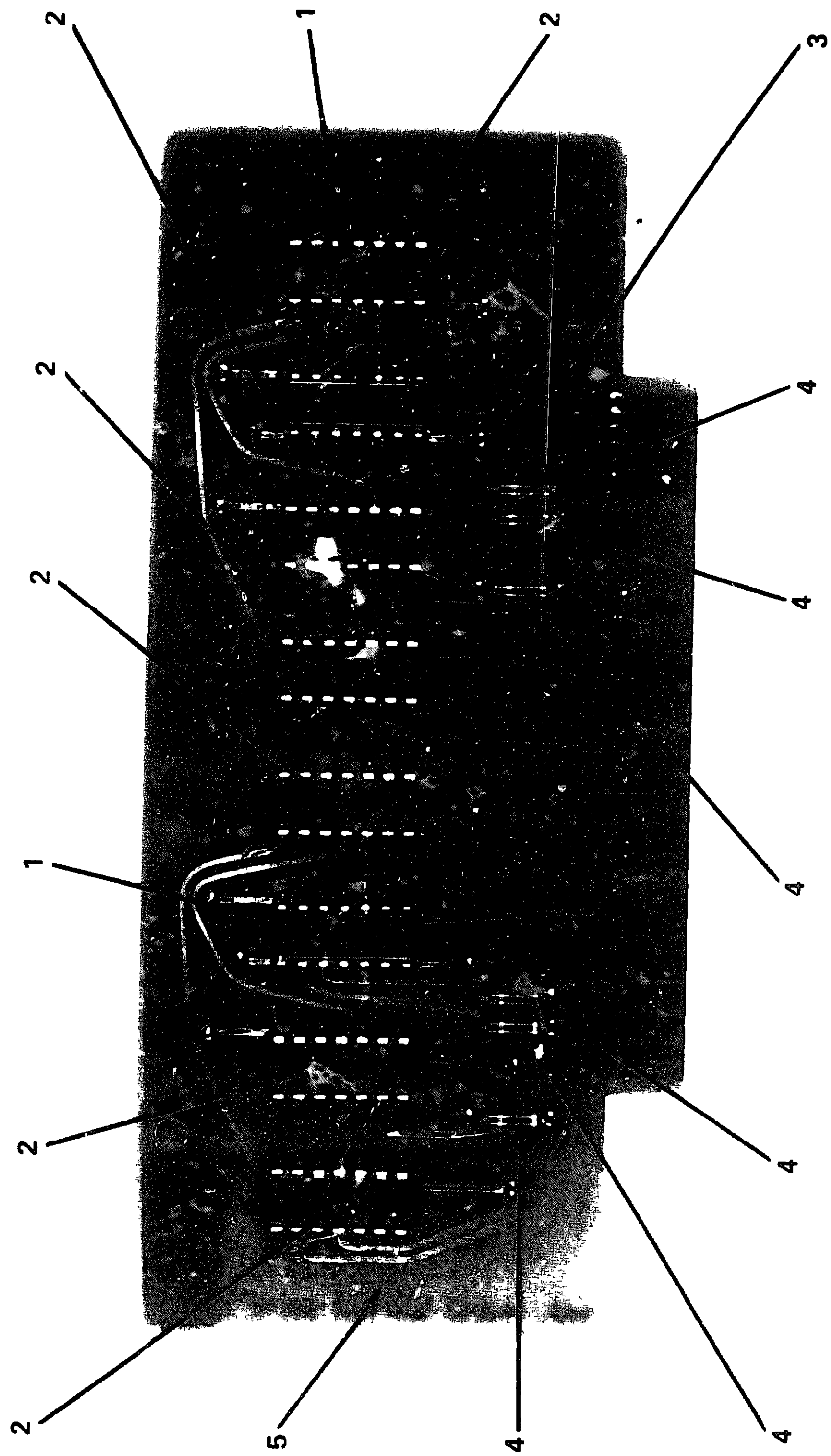


Figure 1-14. Dual Phase Shifter

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usabl On Code
1-14-	1A12	DUAL PHASE SHIFTER	10392172	REF	
-1	1A12U2,6	. INTEGRATED CIRCUIT (01295) .	SN7400N	2	
-2	1A12U1,3, 4,5,7,8	. INTEGRATED CIRCUIT (01295) .	SN7474N	6	
-3	1A12C1	. CAPACITOR, .022 UF, 200 VDC, 10% (56289).	192P22392	1	
-4	1A12R1 THRU 1A12R6	. RESISTOR, 1/4W, 10%, 4.7K (81349).	RC07GF472K	6	
-5		. PCB, DUAL PHASE SHIFTER. . .	30392171	1	

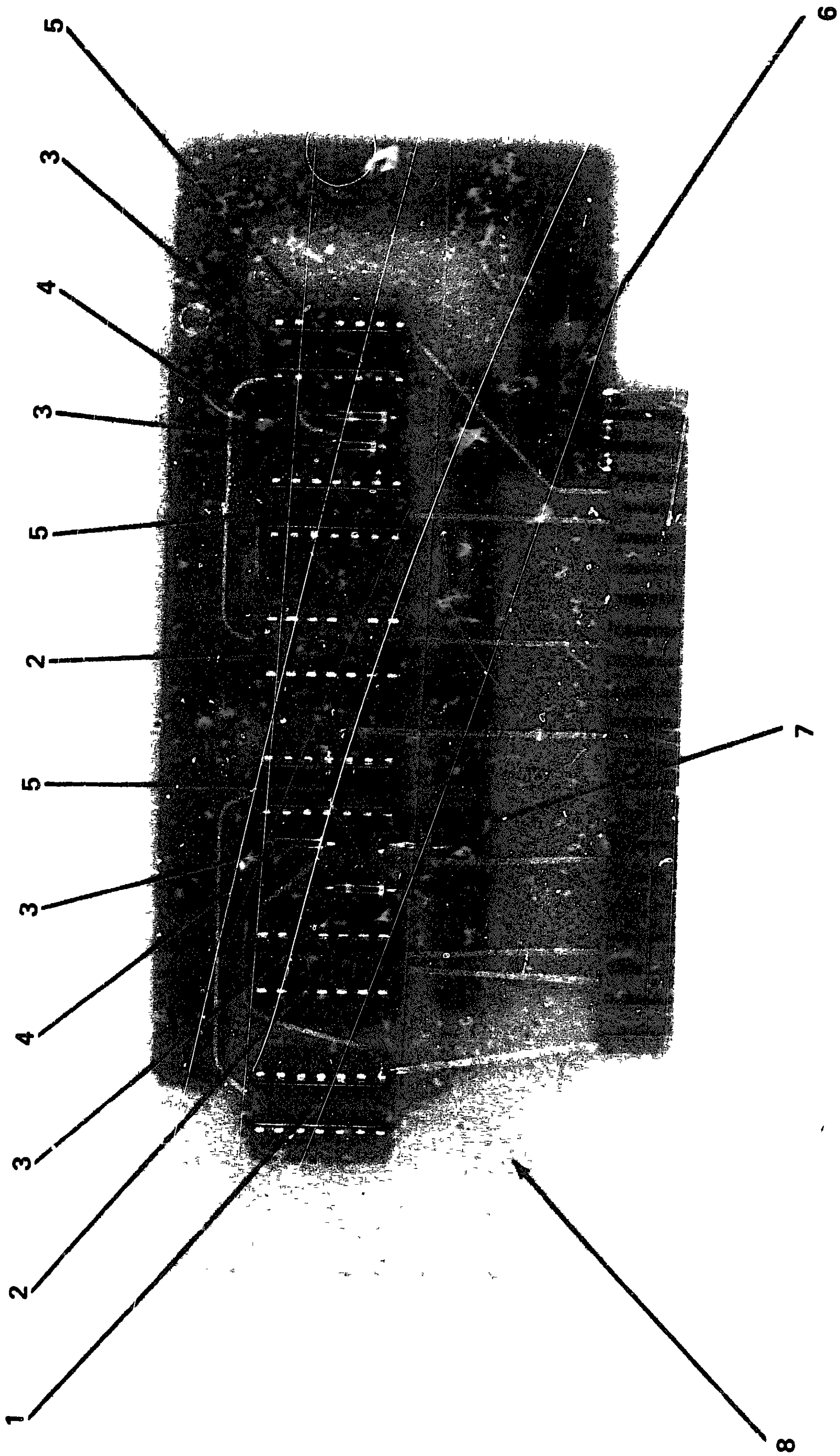


Figure 1-15. Phase Detector Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-15-	1A13	PHASE DETECTOR ASSY	120392219	REF	
-1	1A13U6	. INTEGRATED CIRCUIT (01295). .	SN7490N	1	
-2	1A13U3,5	. INTEGRATED CIRCUIT (01295). .	SN7474N	2	
-3	1A13R1 THRU 1A13R4	. RESISTOR, 1/4W, 10%, 4.7K (81349)	RC07GF472K	4	
-4	1A13Q1,2	. TRANSISTOR (80131)	2N3646	2	
-5	1A13U1,2,4	. INTEGRATED CIRCUIT (01295). .	SN7400N	3	
-6	1A13C1	. CAPACITOR, .022 UF, 200 VDC, 10% (56289)	192P22392	1	
-7	1A13CR1	. DIODE (80131)	1N662	1	
-8		. PCB, PHASE DETECTOR.	00392218	1	

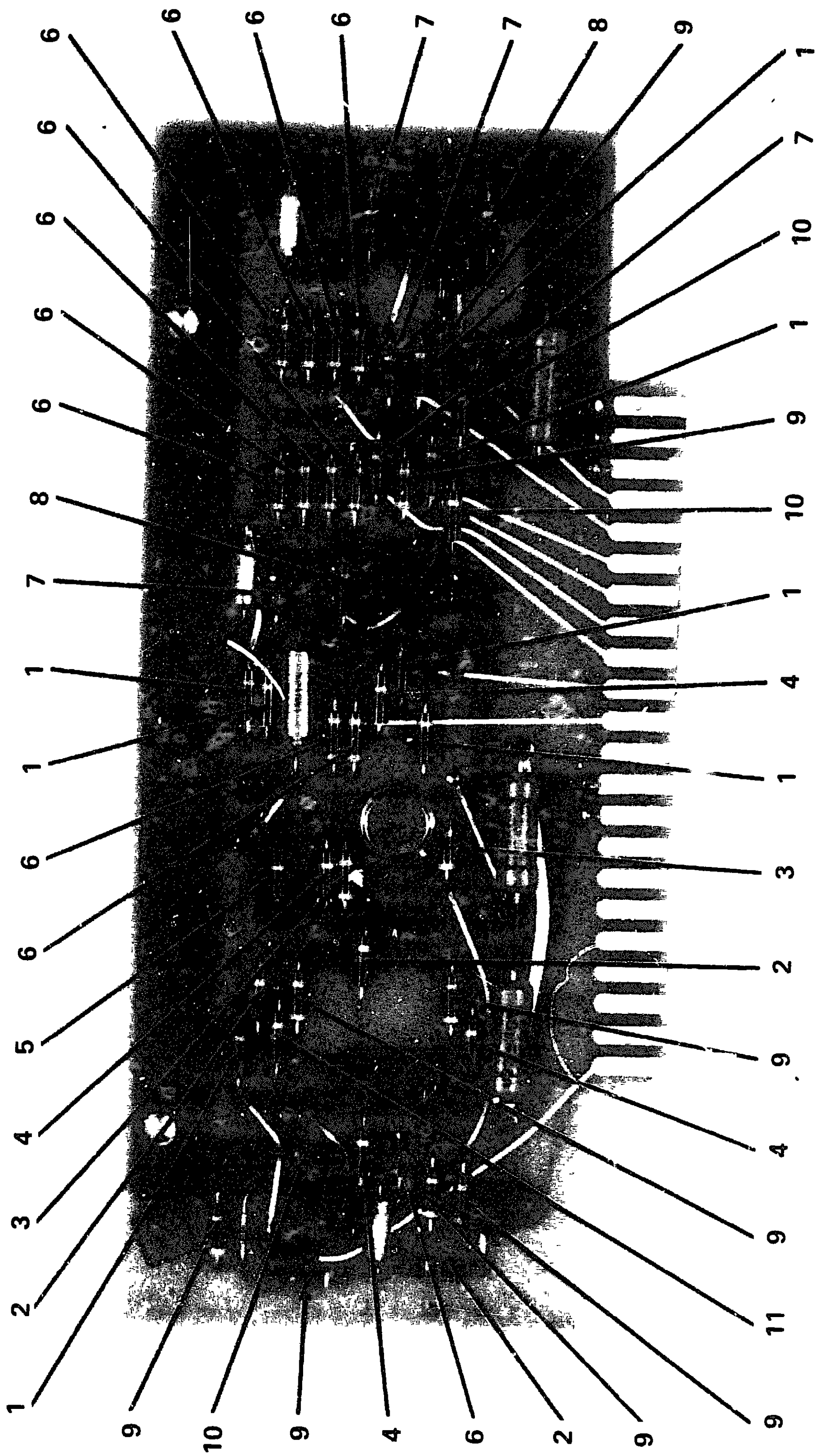


Figure 1-16. Input/Output Buffers Assembly (Sheet 1 of 2)

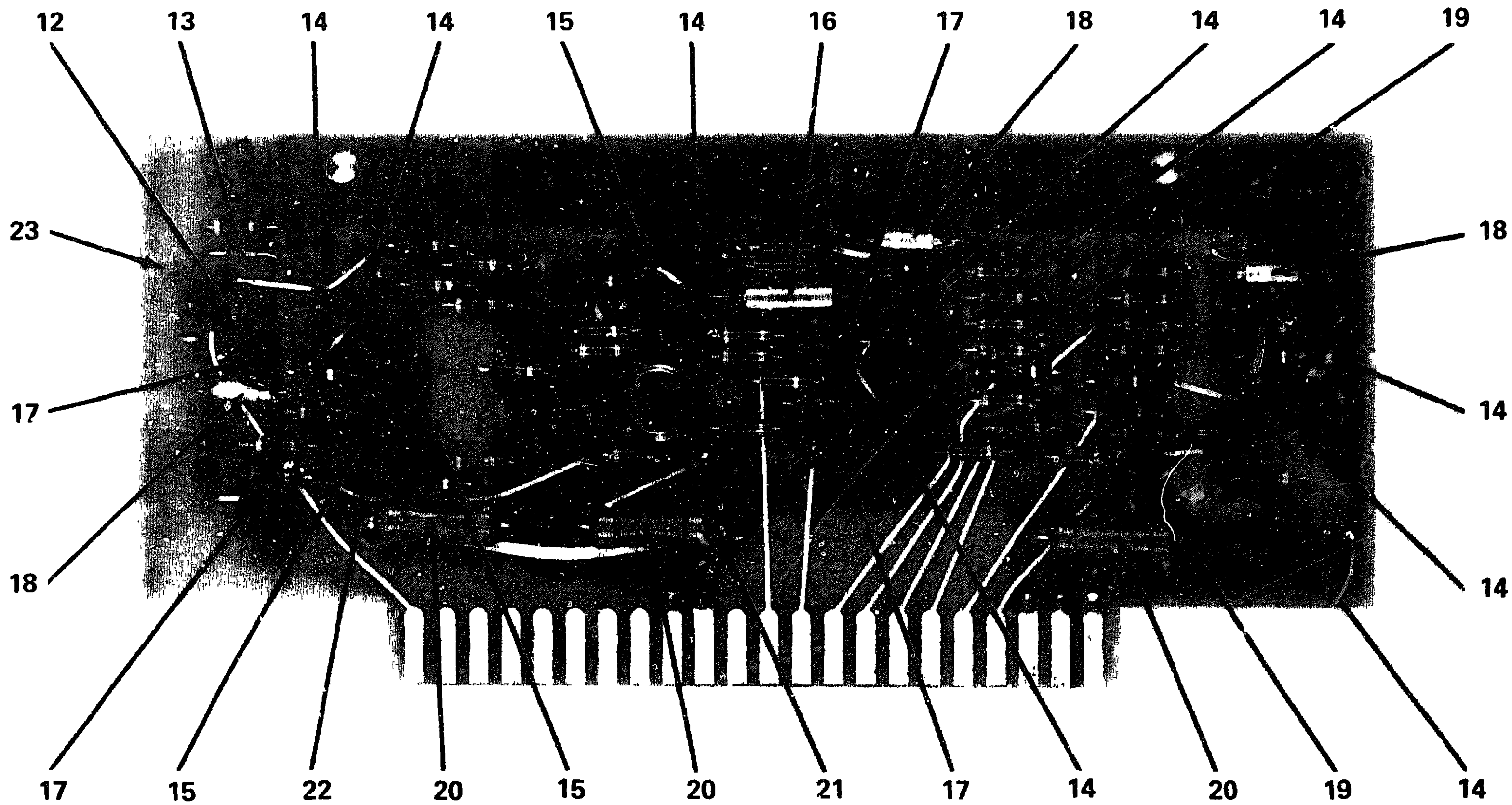


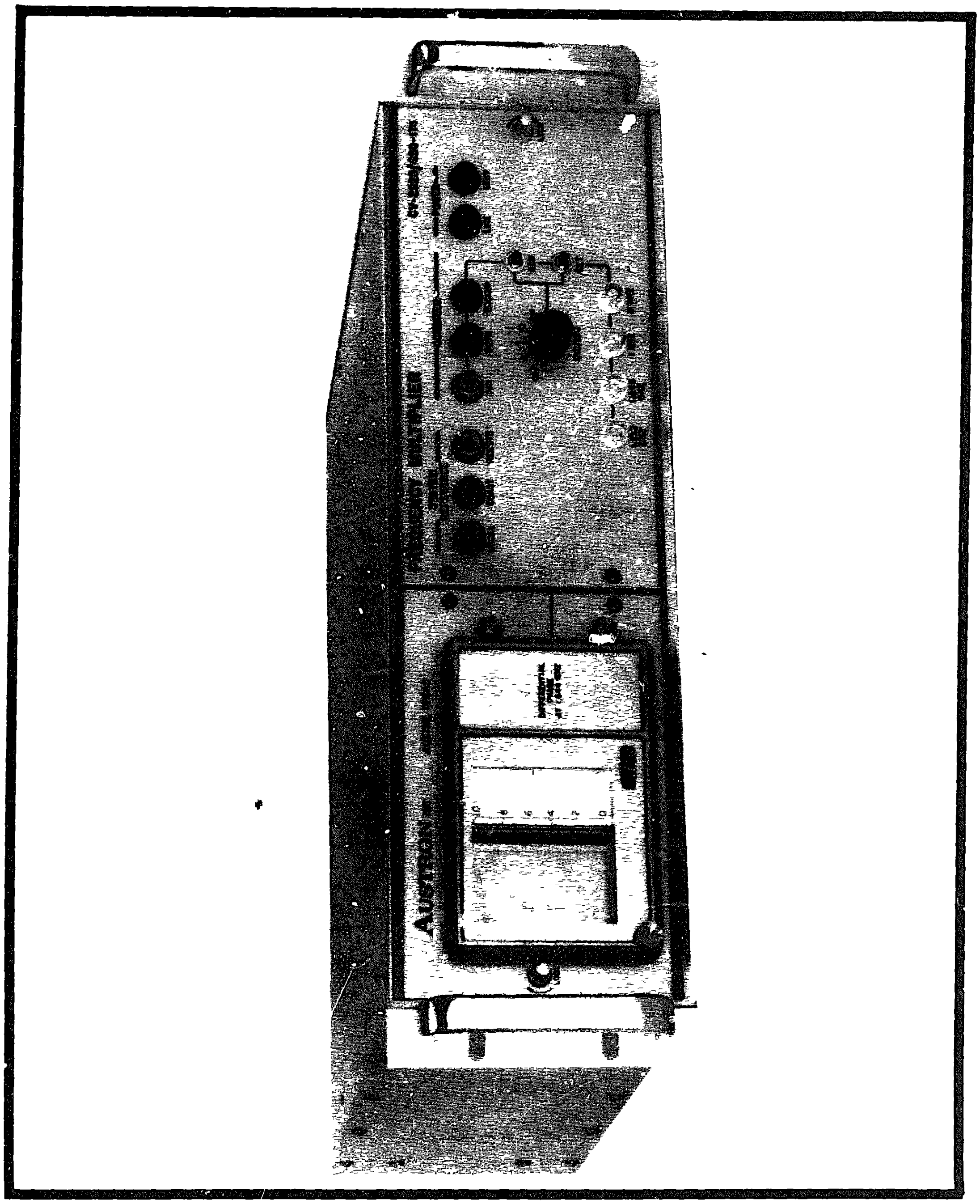
Figure 1-16. Input/Output Buffers Assembly (Sheet 2 of 2)

GROUP ASSEMBLY P-ARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-16					
	1A14	INPUT/OUTPUT BUFFERS ASSY. . .	10392243	REF	
-1	1A14R10, R16,R18, R22,R23, R27,R37	. RESISTOR, 1/4W, 10%, 1K (81349).	RC07GF102K	7	
-2	1A14R3,R9, R14	. RESISTOR, 1/4W, 10%, 10K (81349).	RC07GF103E	3	
-3	1A14R20, R24	. RESISTOR, 1/4W, 10%, 470 OHM (81349)	RC07GF471K	2	
-4	1A14R1,R6, R17,R25	. RESISTOR, 1/4W, 10%, 680 OHM (81349).	RC07GF'681K	4	
-5	1A14R19	. RESISTOR, 1/4W, 10%, 680 OHM (81349)	RCO7GF6831K	1	
-6	1A14R4,R21, R26,R33, R34,R35, R36,R43, R44,R45, R46	. RESISTOR, 1/4W, 10%, 47 OHM (81349).	RC07GF470K	11	
-7	1A14R31, R32, R41, R42	. RESISTOR, 1/4W, 10%, 560 OHM (81349).	RC07CF561K	4	
-8	1A14R30, R40	RESISTOR, 1/4W, 10%, 150 OHM (81349).	RC07GF151K	2	
-9	1A14R2,R7 R11,R12, R13,R15, R28,R38	. RESISTOR, 1/4W, 10%, 4.7K (81349).	RC07GF472K	8	
-10	1A14R5, R29,R39	. RESISTOR, 1/4W 10%, 1.5K (81349)	RC07GF152K	3	
-11	1A14R8	. RESISTOR, 1/4W, 10%, 100K (81349)	RC07GF104K	1	
-12	1A14C2	. CAPACITOR, .01 UF, 100 VDC (56289)	TG-S10	1	
-13	1A14CR1	. DIODE (01295).	IN91.4	1	
-14	1A14Q3,Q4. Q7, Q12, Q13,Q14, Q15,Q16, Q17	. TRANSISTOR (80131)	2N3646	9	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-16-15	1A14Q1,Q2, Q8	. TRANSISTOR (04713)	2N3906	3	
-16	1A14C4	. CAPACITOR, 2.2 UF, 20 VDC, 10% (80131).	CS13BE225K	1	
-17	1A14Q5,Q6, Q10,Q11	. TRANSISTOR (01295)	2N3704	4	
-18	1A14C3,C6, C8	. CAPACITOR, 1 UF, 35 VDC, 10% (56289)	CS13BF105E	3	
-19	1A14C5,C7	. CAPACITOR, 22 PF, 500 VDC, 5% (72136).	DM15-220J	2	
-20	1A14C9, C10,C11	. CAPACITOR, .022 UF, 200 VDC, 10% (56289)	192P22392	3	
-21	1A14Q9	. TRANSISTOR (01295)	2N1671B	1	
-22	1A14C1	. CAPACITOR, 1000 PF, 100 VDC, 5% (72136)	DM15-102J	1	
-23		. PCB, INPUT/OUTPUT BUFFERS . .	00392242	1	



Section III. CV-2929/GSQ-174 Frequency Multiplier

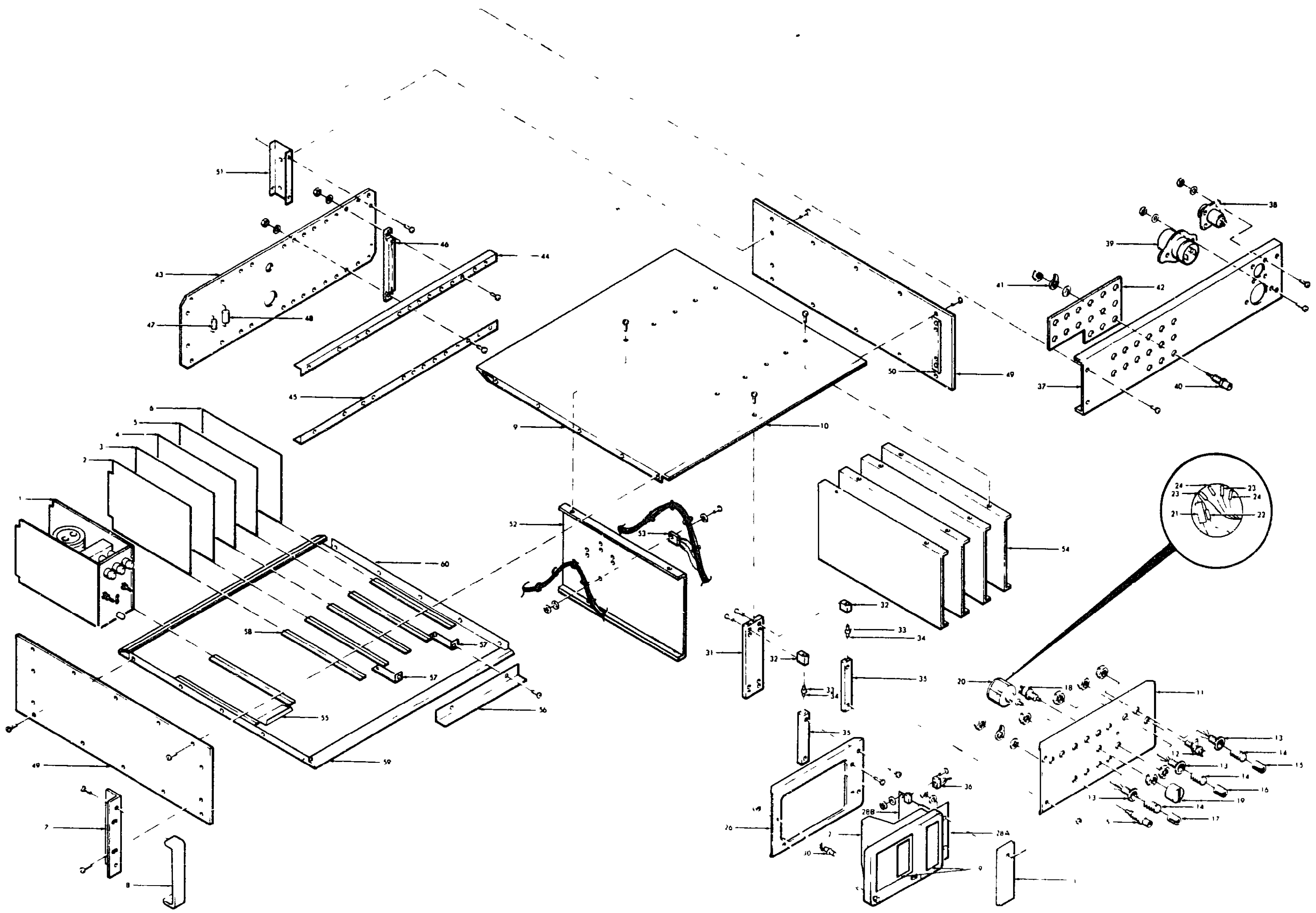


Figure 1-17. Frequency Multiplier CV-2929/GSQ-174.

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-17-	2	FREQUENCY MULTIPLIER, CV-2929/ GSQ-174	30493531	REF	
-1	2A1	. POWER SUPPLY ASSY ASSY'S 2A1 THRU 2A6 (ACCESSIBLE WHEN CHASSIS COVER IS REMOVED) .	20392396	1	
-2	2A2	. PCB ASSY, REFERENCE LOGIC . .	10393575	1	
-3	2A3	. PCB ASSY, 1 MHZ SYNTHESIZER .	10393557	1	
-4	2A4	. PCB ASSY, 5 MHZ AMPLITUDE DETECTOR	10392368	1	
-5	2A5	. PCB ASSY, PHASE SHIFTER . . .	10392375	1	
-6	2A6	. PCB ASSY, 1.544/1.536 MHZ SYNTHESIZER	10393562	1	
	2A7	. CHASSIS ASSY.	11493577	1	
-7		. . BRACKET, RACK MOUNTING . . (ATTACHING PARTS)	00490942	2	
		. . SCREW, P/H, 8-32x½ IN (73734)	17086	4	
		- - - - - - - - * - - - - - - - -			
-8		. . HANDLE (71218). . . . . . . (ATTACHING PARTS)	H-9102	2	
		. . SCREW, FH, 6-32x3/8 IN (73734)	MS35249-35	4	
		- - - - - - - - * - - - - - - - -			
-9		. . COVER, CHASSIS, TOP . . . . (ATTACHING PARTS)	00793514-2	1	
		. . SCREW, PH, 6-32x¼ IN (73734)	17062	20	
		. . SCREW, PH, 4-40x¼ IN (73734)	17042	2	
		- - - - - - - - * - - - - - - - -			
-10		. . EXTRUSION, COVER, MODIFIED.	02090936	1	
-11		. . PANEL, FRONT, RIGHT . . . . (ATTACHING PARTS)	00993540	1	
		. . SCREW, TH, PHILLIPS, 6-32 x3/8 IN (73734)	23444	2	
		- - - - - - - * - - - - - - - -			
-12		. . FASTENER, PAWL, ADJUST. . . (94222)	27-10-301-10	1	
-13	2A7XDS1 THRU DS8	. . HOLDER, LAMP (72619). . . .	359-8430 09-502	8	
-14	2A7DS1 THRU DS8	. . LAMP, STYLE T-1 (24453) . .	327	8	
-15		. . LENS, TRANSPARENT, RED (72619)	162-0931	3	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usab On Code
1-17-16		. . LENS, TRANSPARENT, GREEN (72619)	162-0932	3	
-17		. . LENS, TRANSPARENT, CLEAR (72619)	162-0937	2	
-18	2A7S2,3	. . SWITCH, PUSHBUTTON (81073).	30-1	2	
-19		. . KNOB, SWITCH, MODIFIED. . .	02092801	1	
-20	2A7S1	. . SWITCH, ROTARY (71590). . .	PA2003	1	
-21	2A7C1	. . CAPACITOR, 10 UF, 20 VDC, 10% (56289)	CS13BE106K	1	
-22	2A7C2	. . CAPACITOR, .1 UF, 35 VDC, 10% (56289)	CS13BC107K	1	
-23	2A7R1,2	. . RESISTOR, ¼W, 10%, 100K (81349)	RC07GF104K	2	
-24	2A7R3,4	. . RESISTOR, ¼W, 10%, 10K (81349)	RC07GF103K	2	
-25	2A7J18 THRU J21	. . CONNECTOR, BNC (74868) . .	UG625/U	4	
-26		. . PANEL, FRONT, LEFT	00992080	1	
		(ATTACHING PARTS)			
		. . SCREW, TH, PHILLIPS, 6-32 3/8 IN (73734)	23444	2	
		- - - - - - - - - * - - - - - - -			
-27	2A7A1	. . RECORDER, MODIFIED.	12093938	1	
-28		. . PLATE, SPACER (24672)	01092085	1	
-28A		. . HINGE, MODIFIED	02092105	1	
-28B		. . BRACKET, MODIFIED	00492084	1	
		(ATTACHING PARTS)			
		. . SCREW, TH, PHILLIPS, 8-32x½ IN (73734)	23466	2	
		. . WASHER, INT LOCK, NO. 8 (73734)	1305	2	
		. . NUT, HEX, 8-32x3/8 IN (73734)	8008	2	
		. . SCREW, PH, 4-40x¼ IN (73734)	17042	2	
		. . WASHER, INT LOCK, NO. 4 (73734)	1302	2	
		NUT, HEX, 4-40x¼ IN (73734)	8003	2	
		- - - - - - - - * - - - - - - - - -			
-29		. . LABEL, RUSTRACK	12292611	1	
-30		. . FASTENER, PAWL, ADJUST (94222)	27-10-201-10	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-17 cont.					
		- - - - - - - - - * - - - - - - - -			
-31		. . . BLOCK, HINGE.	00290935	1	
-32		. . . BRACKET, HINGE	00490933	4	
		(ATTACHING PARTS)			
		. . . SCREW, PH, 4-40x½ IN (73734)	17046	8	
		- - - - - - - - - * - - - - - - - -			
-33		. . . PIN, HINGE	02090939	4	
-34		. . . WASHER, FLAT, NO. 6 (73734)	1404	4	
-35		. . . PLATE, HINGE	01090937	2	
-36	2A7P1	. . CONNECTOR (71785)	S-3060-AB	1	
-37		. . PANEL, REAR	00393534	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x1/4 IN (73734).	17062	4	
		- - - - - - - - - * - - - - - - - -			
-38	2A7J16	. . CONNECTOR (74868)	MS3102A--14S-1P		
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x3/8 IN (73734).	17044	4	
		. . WASHER, INT LOCK, NO. 4 (73734).	1302	4	
		. . NUT, HEX, 4-40x¼ IN (73734).	8003	4	
		- - - - - - - - - * - - - - - - - -			
-39	2A7J17	. . CONNECTOR (74868).	160-5N	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x¼ IN (73734)	17042	2	
		. . WASHER, INT LOCK, NO. 4 (73734).	1302	2	
		. . NUT, HEX, 4-40x¼ IN (73734).	8003	2	
		- - - - - - - - - * - - - - - - - -			
-40	2A7J1 THRU J15	. . CONNECTOR, BNC (74868) . . .	UG625/U	15	
-41		. . LUG, SOLDER (83330).	1497	19	
-42		. . PLATE, GROUND.	01093567	1	
-43		. . PCB, INTERCONNECT.	00393543	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x3/8 IN (73734).	17064	4	
		- - - - - - - - - * - - - - - - - -			

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-17-44		. . BAR, REINFORCING, TOP. . . .	00190959-2	1	
-45		. . BAR, REINFORCING, BOTTOM . .	00190959-1	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x5/8 IN (73734).	17045	14	
		. . WASHER, INT LOCK, NO. 4 (73734).	1302	14	
		. . NUT, HEX, 4-40x¼ IN (73734).	8003	14	
		- - - - - - - - - * - - - - - - -			
-46	2A7J22 THRU J28	. . CONNECTOR, PCB (71785) . . .	50-44-B-10	7	
-47	2A7C3	. . CAPACITOR, 100 UF, 10 VDC (56289).	CS13BC107K	1	
-48	2A7C4	. . CAPACITOR, 100 UF, 20 VDC (56289).	CS13BE107K	1	
-49		. . PANEL, SIDE.	00990945	2	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x¼ IN (73734)	17062	7	
		- - - - - - - - * - - - - - - - -			
-50		. . BRACKET, LATCH	00490941	2	
-51		. . BRACKET, REAR PANEL.	00490943	2	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x¼(73734)	17062	4	
		- - - - - - - - * - - - - - - - -			
-52		. . BRACE, SHIELD.	00991941	1	
-53	2A7Q1	. . TRANSISTOR (04713)	MJE3055	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x½ IN (73734).	17066	1	
		. . WASHER, INT LOCK, NO.6 (73734).	1304	1	
		. . NUT, HEX, 6-32x¼ IN (73734).	8005	1	
		- - - - - - - - * - - - - - - - -			
-54		. . PLATE, SHIELD	01091942	4	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x¼ IN (73734)	17062	8	
		- - - - - - - - * - - - - - - - -			
-55		. . BRACKET, POWER SUPPLY . . .	00490955	1	
-56		. . ANGLE, RETAINER, LONG . . .	02090938	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x¼ IN (73734)	17062	2	
		- - - - - - - - - * - - - - - - -			

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
-17-57		. . BRACKET, RETAINER.	00490940	2	
-58		. . GUIDE, PCB, MODIFIED	02091942	14	
-59		. . EXTRUSION, COVER, MODIFIED .	02090936	1	
-60		. . COVER, CHASSIS, BOTTOM . . .	00793514-1	1	

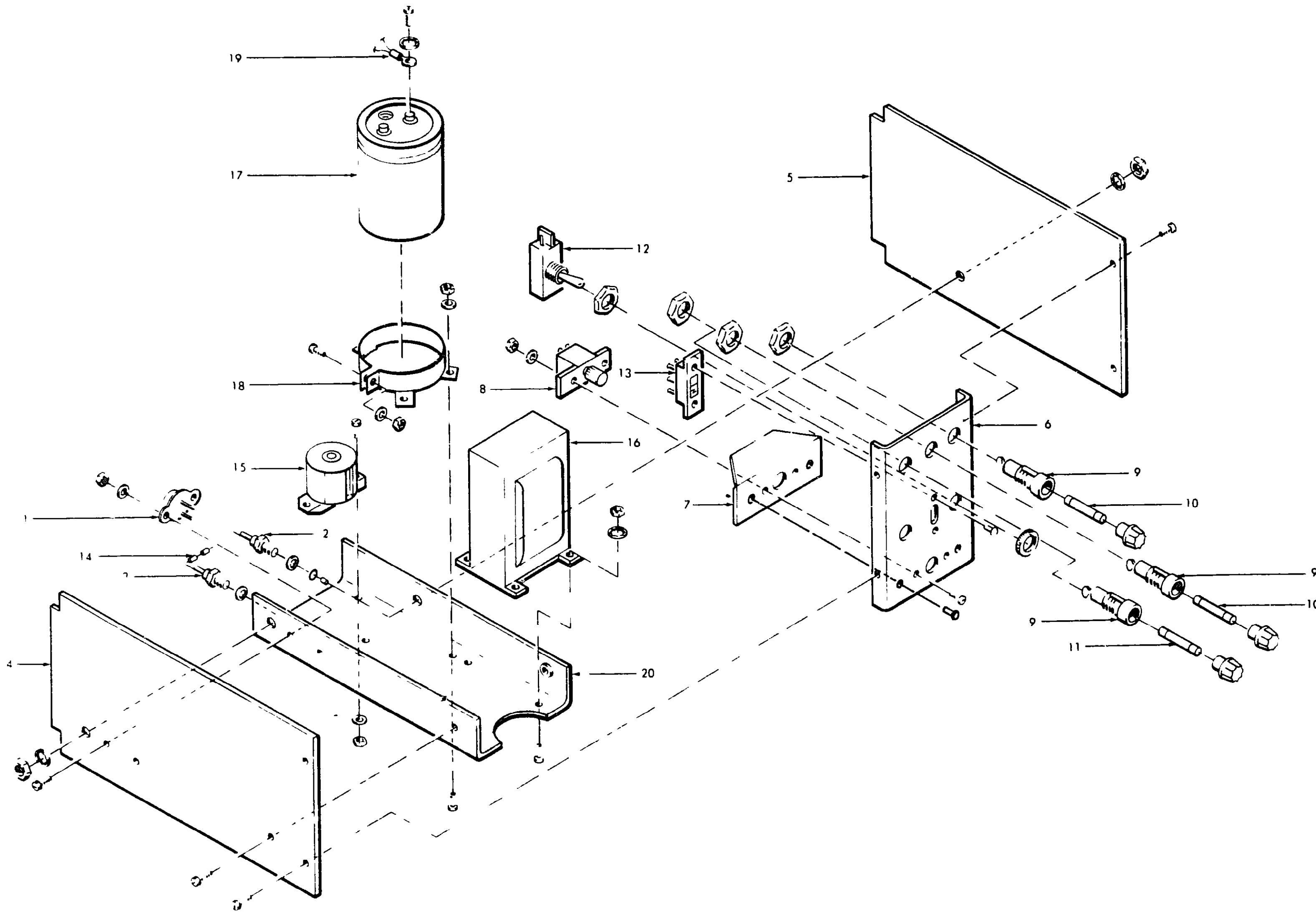


Figure 1-18. Power Supply Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-18-	2A1	POWER SUPPLY ASSY	20392396	REF	
-1	2A1Q13	. TRANSISTOR (02735)	40364	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 6-32x3/8 IN (73734)	17064	2	
		. WASHER, INT LOCK, No. 6 (73734)	1304	2	
		. NUT, HEX, 6-32x5/16 IN (73734)	8005	2	
		- - - - - - - - - * - - - - - - - -			
-2	2A1CR1	DIODE (04713)	MR1125	1	
-3	2A1CR11	DIODE (04713)	13879	1	
-4	2A1A1	PCP ASSY, 5V REGULATOR . . .	10391994	1	
		(ATTACHING PARTS)			
		SCREW, PH, 6-32x1/4 IN (73734)	17062	1	
		- - - - - - - - - * - - - - - - - -			
-5	2A1A2	. PCB ASSY, +20 & +10V REGULATOR	10391993	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 6-32x1/4 IN (73734)	17062	1	
		- - - - - - - - - * - - - - - - - -			
-6		PANEL, FRONT	00990932	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 6-32x1/4 IN (73734)	17062	4	
		- - - - - - - - - * - - - - - - - -			
-7		. BRACKET, REINFORCING	00491872	1	
-8		LATCH, PAWL, MODIFIED . . .	02092086	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 6-32x3/8 IN (73734)	17062	2	
		. WASHER, INT LOCK, NO 6 (73734)	1304	2	
		. NUT, HEX, 6-32x5/16 IN (73734)	8005	2	
		- - - - - - - - - * - - - - - - - -			
-9	2A1XF1 THRU 2A1XF3	. HOLDER, FUSE (71400) . . .	HKP	3	
-10	2A1F1, 2A1F2	. FUSE, 2A, 250 VDC (75915) . .	312002	2	
-11	2A1F3	FUSE, 5A, 250 VDC (71400). .	312005	1	
-12	2A1S1,2A1S2	. SWITCH, TOGGLE (04009). . . .	20994-LH	2	
-13	2A1S3	. SWITCH, SLIDE (82389). . .	46256LFR	1	
		(ATTACHING PARTS)			
		RIVET (07707)	AD41ABS	2	
		- - - - - - - - - * - - - - - - - -			
-14		BEAD SHIELDING (02114) . . .	5659065/3B	2	
-15	2A1L1	CHOKE, POWER SUPPLY (24672)	751 92035	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-18		(ATTACHING PARTS)			
		. SCREW, PH, 4-40x3/8 IN (73734)	17044	2	
		. WASHER, INT LOCK, NO. 4 (73734)	1302	2	
		. NUT, HEX, 4-40x1/4 IN (73734)	8003	2	
		- - - - - - - - * - - - - - - -			
-16	2A1T1	. TRANSFORMER, POWER (24672). .	751 92036	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 6-32x1/2 IN (73734)	17066	4	
		. WASHER, INT LOCK, NO. 6 (73734)	1304	4	
		. NUT, HEX, 6-32x5/16 IN (73734)	8005	4	
		- - - - - - - - * - - - - - - -			
-17	2A1C1	. CAPACITOR, 8400 UF, 40 VDC (56289)	36D842G-040BB2A	1	
		(ATTACHING PARTS)			
-18		. CLAMP, CAPACITOR MTG (37942)	VR8	1	
		. SCREW, PH, 6-32x3/8 IN (73734)	17064	3	
		. WASHER, INT LOCK, NO. 6 (73734)	1304	3	
		. NUT, HEX, 6-32x5/16 IN (73734)	8005	3	
		. SCREW, PH, 8-32x1/2 IN (73734)	17086	2	
		. WASHER, INT LOCK, NO. 8 (73734)	1305	2	
		- - - - - - - - * - - - - - - -			
-19		. LUG, TERMINAL (59730)	D8-10 47	2	
-20		. CHASSIS PLATE	01091009	1	

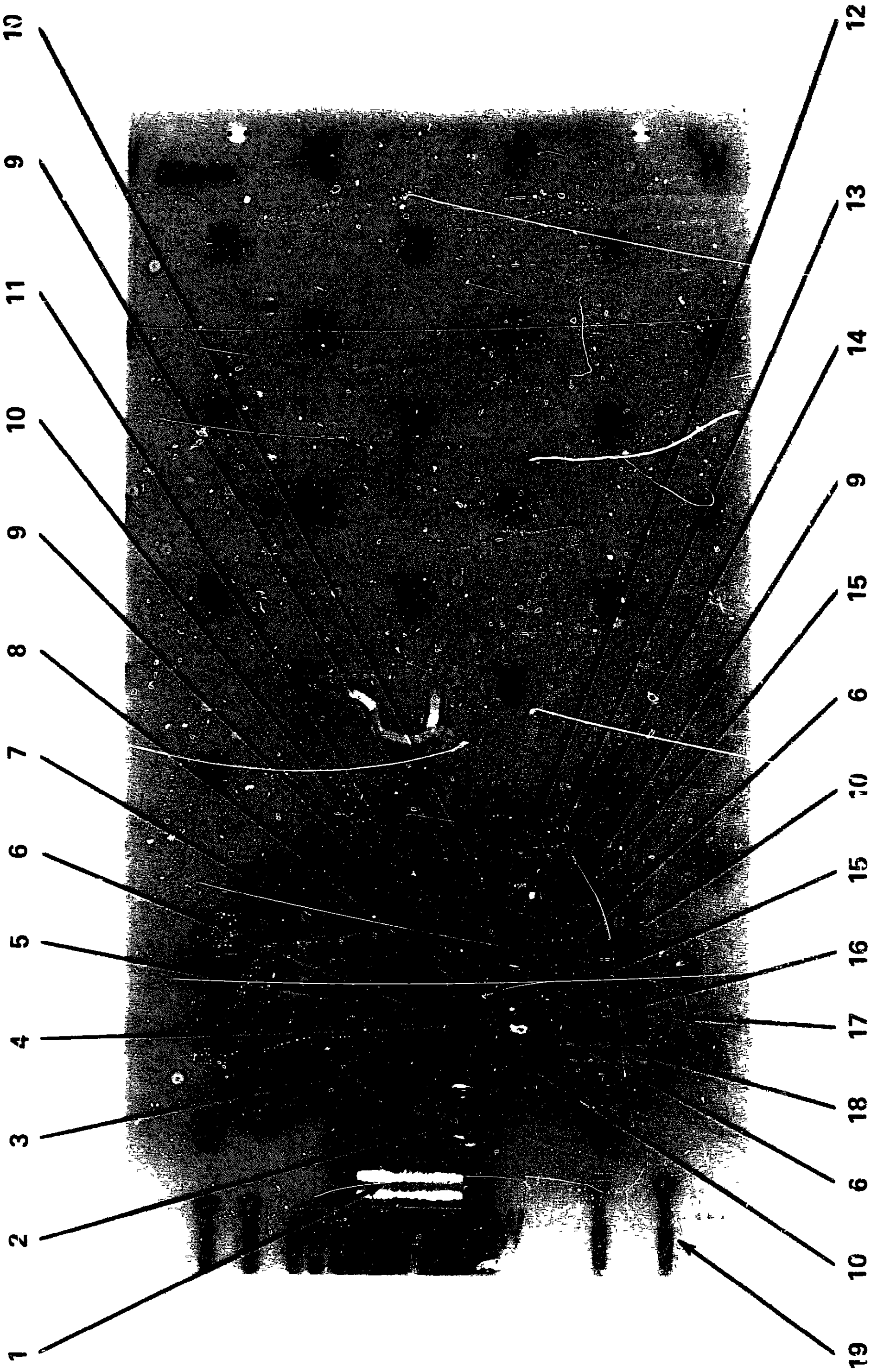


Figure 1-19. +5V Regulator Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-19-	2A1A1	+5V REGULATOR ASSY.	10391994	REF	
-1	2A1A1C8	. CAPACITOR, 330 UF, 20 VDC (81349)	CS13BB337K	1	
-2	2A1A1VR2	. DIODE ZENER (04713)	1N1602	1	
-3	2A1A1C5	. CAPACITOR, 22 UF, 35 VDC, 10% (56289).	CS13BF226K	1	
-4	2A1A1R36	. RESISTOR, ¼W, 10%, 12K (81349)	RC07GF123K	1	
-5	2A1A1R32	. RESISTOR, ¼W, 10%, 47 OHM (81349)	RCO7GF470K	1	
-6	2A1A1R25, 33,34	. RESISTOR, ¼W, 10%, 6.8K (81349)	RC07GF682K	3	
-7	2A1A1R31	. RESISTOR, ¼W, 10%, 10 OHM (81349).	RC07GF100K	1	
-8	2A1A1C7	. CAPACITOR, .01 UF, 200 VDC, 10% (56289)	192P10392	1	
-9	2A1A1Q10, 11,12	. TRANSISTOR (01295).	2N3702	3	
-10	2A1A1R27, 29,30,35	. RESISTOR, ¼W, 10%, 680 OHM (81349)	RC07GF681K	4	
-11	2A1A1CR10	. DIODE (01295)	1N914	1	
-12	2A1A1R28	. RESISTOR, ¼W, 10%, 1.2K (81349).	RC07GF122K	1	
-13	2A1A1C3	. CAPACITOR, 1000 PF, 100 VDC, 5% (84171).	DM15-102J	1	
-14	2A1A1C4	. CAPACITOR, .0056 UF, 200 VDC, 10% (56289)	192P56292	1	
-15	2A1A1Q14, 15	. TRANSISTOR (01295).	2N3704	2	
-16	2A1A1R26	. RESISTOR, 1/8W, 1%, 1.1K (81349).	RN55D1101F	1	
-17	2A1A1R39	. RESISIOR, 1/8W, 1%, 3.4K (81349).	RN55D3401F	1	
-18	2A1A1C6	. CAPACITOR, .1 UF, 200 VDC, 10% (56289)	192P10492	1	
-19		. PCB, 5V REGULATOR	00390833	1	

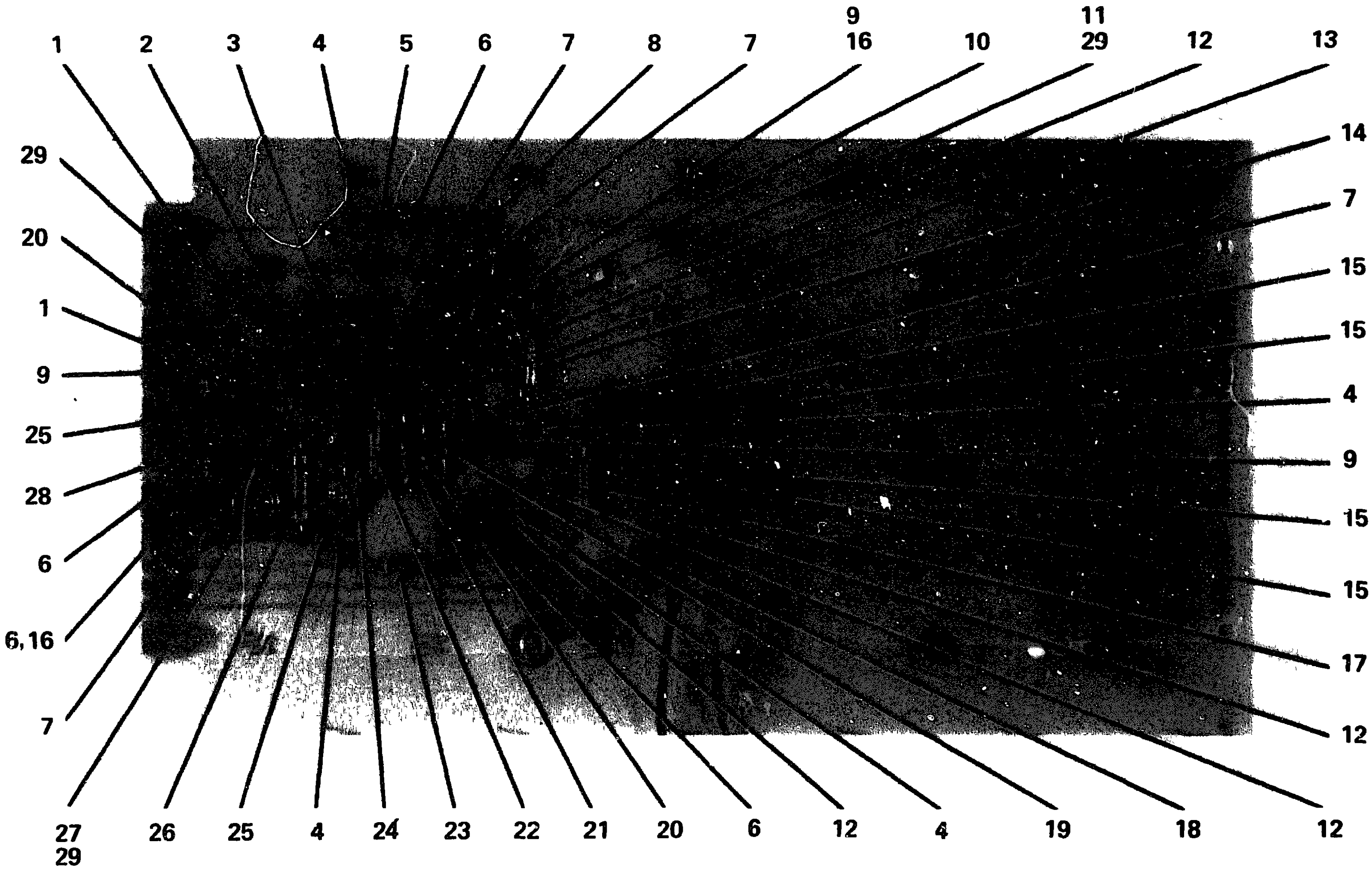


Figure 1-20. +20 & +10V Regulator Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-20-	2A1A2	+20 & +10V REGULATOR ASSY . . .	10391993	REF	
-1	2A1A2R11, 22	. RESISTOR, ¼W, 10%, 1K (81349)	RC07GF102K	2	
-2	2A1A2R3	. RESISTOR, 1/8W, 1%, 2.21K (81349).	RN55D2211F	1	
-3	2A1A2R4	. RESISTOR, VARIABLE, 100 OHM (80294)	3067P 1-101	1	
-4	2A1A2R9,21 37,38	. RESISTOR, ¼W, 10%, 12K (81349)	RC07GF123K	4	
-5	2A1A2R10	. RESISTOR, ¼W, 10%, 56 OHM (81349).	RC07GF560K	1	
-6	2A1A2Q3,7, 8,16	. TRANSISTOR (01295).	2N3702	4	
-7	2A1A2R8, 12,15,20	. RESISTOR, ¼W, 10%, 560 OHM (81349)	RC07GF561K	4	
-8	2A1A2R13	. RESISTOR, ¼W, 10%, 56K (81349).	RC07GF563K	1	
-9	2A1A2Q1,2, 6	. TRANSISTOR (01295).	2N3704	3	
-10	2A1A2R14	. RESISTOR, ¼W, 10%, 560K (81349).	RCO7GF564K	1	
-11	2A1A2Q5	. TRANSISTOR (01295).	2N1671	1	
-12	2A1A2CR6, 7,8,9	. DIODE (01295)	1N914	4	
-13	2A1A2R16	. RESISTOR, ¼W, 10%, 22K (81349)	RC07GF22K	1	
-14	2A1A2C2	. CAPACITOR, 1 UF, 35 VDC, 20% (56289)	CS13BF105K	1	
-15	2A1A2CR2,3 4,5	. DIODE (04713)	1N4002	4	
-16		CLIP, TRANSISTOR (05820)	256 D	2	
-17	2A1A2R2	. RESISTOR, ½W, 10%, 220 OHM (81349)	RC20GF221K	1	
-18	2A1A2R1	. RESISTOR, ½W, 10%, 120 OHM (81349)	RC20GF121K	1	
-19	2A1A2VR1	. DIODE (04713)	1N4733	1	
-20	2A1A2R6,19	. RESISTOR, ½W, 10%, 5 6K (81349).	RC20GF562K	2	
-21	2A1A2R7	. RESISTOR, ¼W, 10%, 2.2K (81349)	RC07GF222K	1	
-22	2A1A2C9	. CAPACITOR, .01 UF, 200 VDC (56289)	192P10392	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-20	2A1A2	Continued			
-23	2A1A2R24	. RESISTOR, ½W, 10%, 470 OHM (81349).	RC20GF471K	1	
-24	2A1A2R5	. RESISTOR, 1/8W, 1%, 750 OHM (81349).	RN55D6810F	1	
-25	2A1A2R17, 18	. RESISTOR, ¼W, 10%, 4.7K (81349)	RC07GF472K	2	
-26	2A1A2C10	. CAPACITOR, .022 UF, 200 VDC (80183)	192P22392	1	
-27	2A1A2Q9	. TRANSISTOR (02735)	2N2270	1	
-28	2A1A2R23	. RESISTOR, ¼W, 10%, 100 OHM (81349).	RC07GF101K		
-29		. PAD, TRANSISTOR (07047) .	10123	2	
-30		. PCB, +20 & +10V REGULATOR	00390832	1	

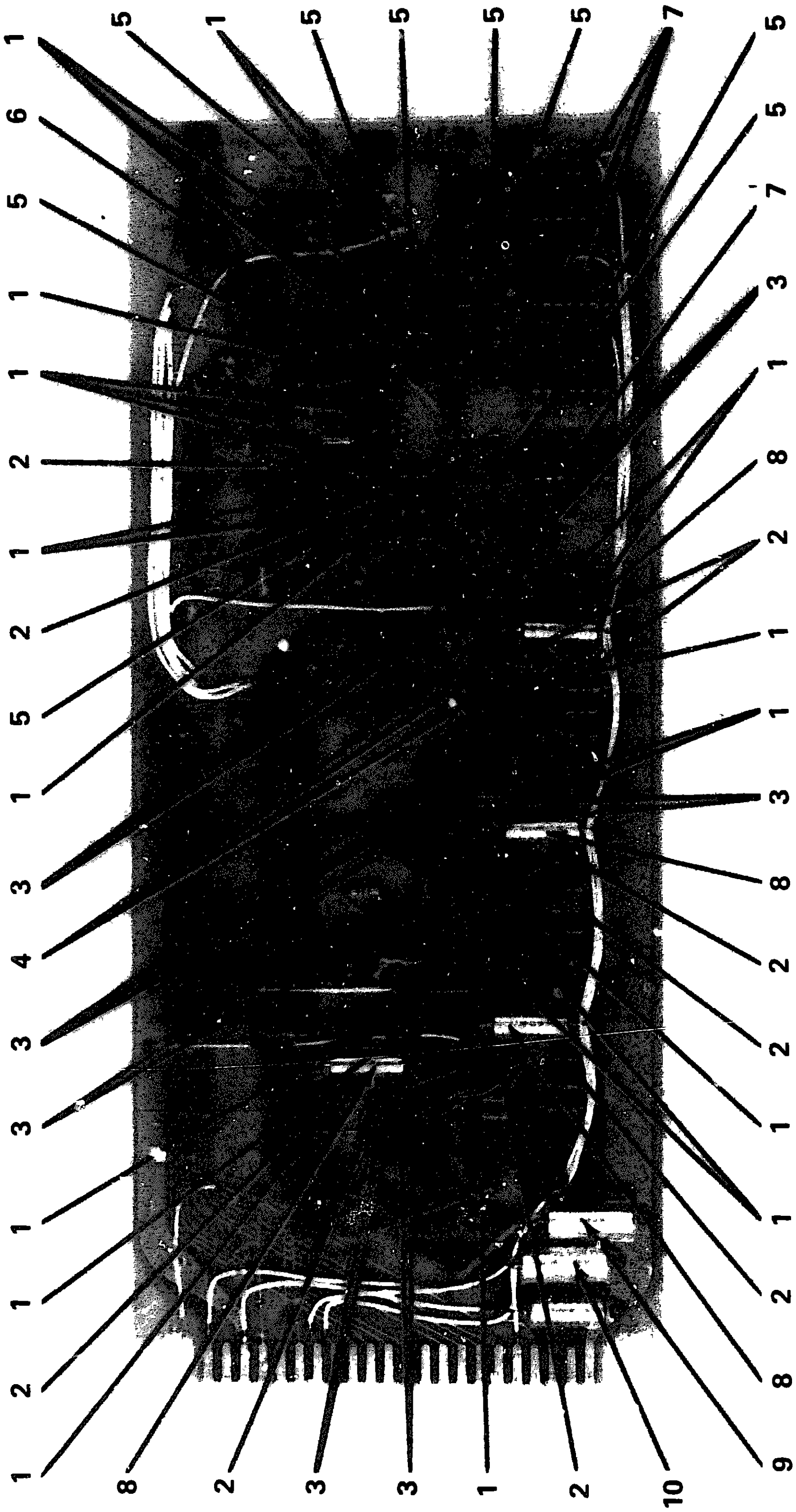


Figure 1-21. System Reference Logic Assembly (Sheet 1 of 3)

Figure 1-21. System Reference Logic Assembly (Sheet 2 of 3)

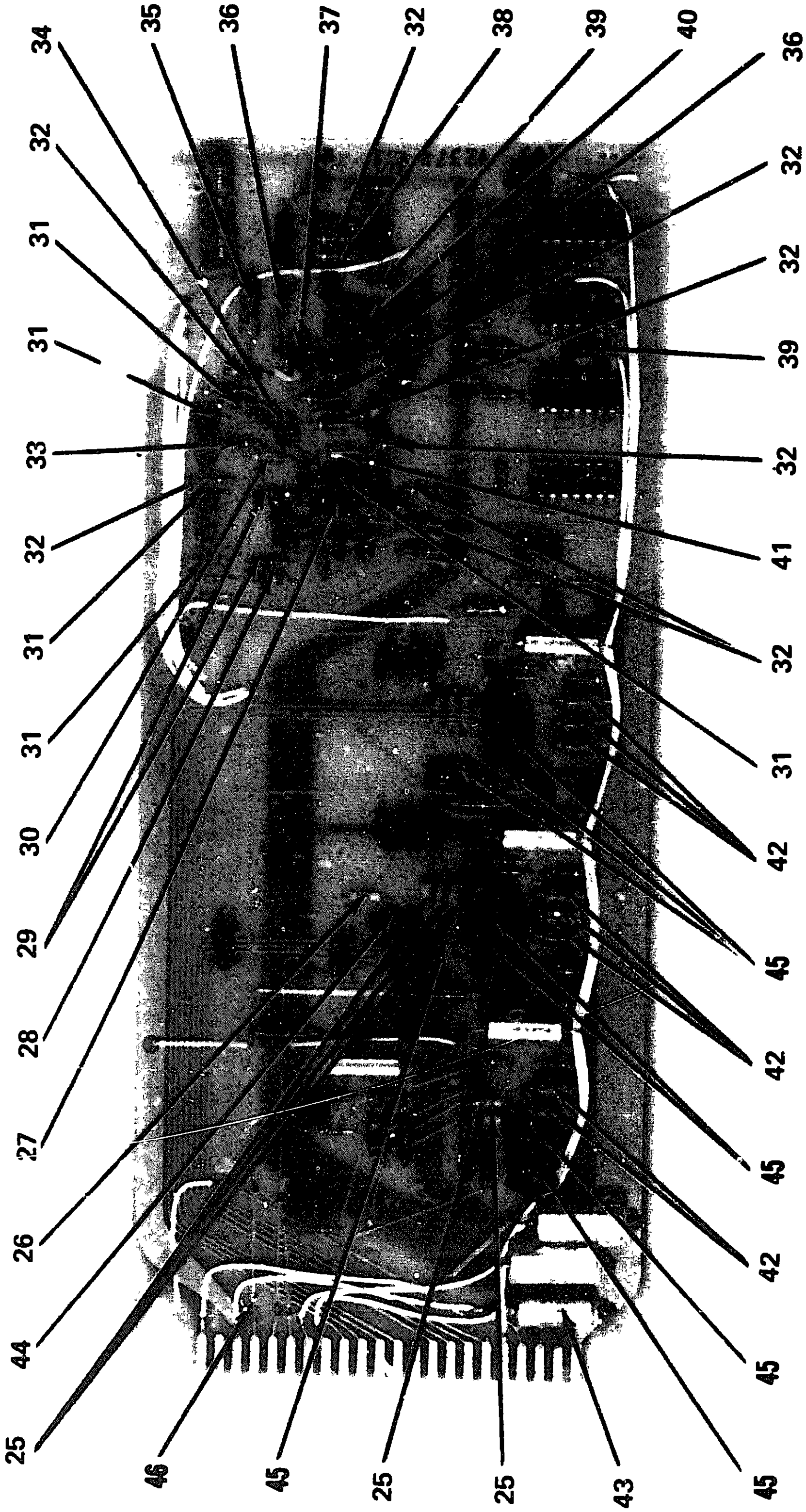


Figure 1-21. System Reference Logic Assembly (Sheet 3 of 3)

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-21-	2A2	SYSTEM REFERENCE LOGIC ASSY	10393575	REF	
-1	2A2Q1,4,7 THRU 28	. TRANSISTOR (04713).	MPS3646	24	
-2	2A2R9,14, 41,42,52, 53,63,64, 70,71	. RESISTOR, 1/4W, 10%, 680 OHM (81349)	RC07GF681K	10	
-3	2A2R43,44, 45,46,47, 48,54,55, 56,57,58, 59,65,66, 72THRU75	. RESISTOR, 1/4W, 10%, 22 OHM (81349)	RC07GF220K	18	
-4	2A2L4,5,6	. CHOKE, COIL, 10%, 100 UH (99800)	1025-68	3	
-5	2A2C2,3,5, 6,7,42, 43,44,45	. CAPACITOR, .01 UF, 100 VDC (56289).	TG-S10	9	
-6	2A2R77	. RESISTOR, 1/2W, 5% (80294). .	3067P 1-202	1	
-7	2A2U1,2,3, 4	. INTEGRATED CIRCUIT (01295). .	SN7400N	4	
-8	2A2C14,16, 18,34	. CAPACITOR, 22 UF, 35 VDC, 10%, (56289)	CS13BF226K	4	
-9	2A2C39	. CAPACITOR, 100 UF, 20 VDC (81349).	CS13BE107K	1	
-10	2A2C41	. CAPACITOR, 330 UF, 6 VDC (81349).	CS13BB337K	1	
-11	2A2CR1 THRU 13	. DIODE (01295)	1N914	13	
-12	2A2R40,51, 62 ,68	. RESISTOR, 1/4W 10%, 150 OHM (81349)	RC07GF151K	4	
-13	2A2C32	. CAPACITOR, 100 PF, 500 VDC 5% (72136)	DM15-101J	1	
-14	2A2R39,50, 61,69	. RESISTOR, 1/2W, 10% 1.8 K (81349)	RC20GF182K	4	
-15	2A2C31	. CAPACITOR, 39 PF, 500 VDC, 5% (72136)	DM15--390J	1	
-16	2A2C13,15, 17,33	. CAPACITOR, 22 PF, 500 VDC, 5% (72136)	DM15-220J	4	
-17	2A2R1,33, 38,49,60 67	. RESISTOR, 1/4W, 10%, 2.2 K (81349)	RC07GF222K	6	

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-21-	2A2	Continued			
-18	2A2C25,27, 29	. CAPACITOR, 150 PF, 500 VDC, 5% (72136)	DM15-151J	3	
-19	2A2Q2,3,5,6	. TRANSISTOR (04713).	2N3906	4	
-20	2A2R8, 15, 17,23,24, 25,26,36, 79,80,81	. RESISTOR, 1/4W, 10%, 1 K (81349)	RC07GF102K	11	
-21	2A2C8	. CAPACITOR, 47 PF, 500 VDC, 5% (72136).	DM15-470J	1	
-22	2A2C9,10	. CAPACITOR, 33 PF, 500 VDC, 5% (72136).	DM15-330J	2	
-23	2A2R29,30	. RESISTOR, 1/4W, 10%, 100 OHM (81349).	RC07GF101K	2	
-24	2A2C19,21, 23,35,37	. CAPACITOR, 270 PF, 500 VDC, (84171)	DM15-2715	5	
-25	2A2L1,2,3, 8,9	. CHOKE, COIL, 10%, 33 UH (99800)	1025-56	5	
-26	2A2L7	. CHOKE, COIL, 10%, 22 UH (99800)	1025-52	1	
-27	2A2C1	. CAPACITOR, 1000 PF, 100 VDC 5% (84171)	DM15-102J	1	
-28	2A2R3	. RESISTOR, 1/4W, 10%, 100 K (81349)	RC07GF104K	1	
-29	2A2R5,6	. RESISTOR, 1/4W, 10%, 1.2 K (81349)	RC07GF122K	2	
-30	2A2R12	. RESISTOR, 1/4W, 10%, 47 OHM (81349)	RC07GF470K	1	
-31	2A2R2,4,11, 21,78	. RESISTOR, 1/4W, 10%, 10 K (81349)	RC07GF103K	5	
-32	2A2R7,10, 18,19,20, 22,27,76	. RESISTOR, 1/4W, 10%, 4.7 K (81349)	RC07GF472K	8	
-33	2A2R16	. RESISTOR, 1/4W, 10%, 5.6 K (81349)	RC07GF562K	1	
-34	2A2R13	. RESISTOR, 1/4W, 10%, 1.5 K (81349)	RC07GF152K	1	
-35	2A2C11	. CAPACITOR, .0047 UF, 200 VDC, 10% (56289)	192P47292	1	
-36	2A2R31,35	. RESISTOR, 1/4W, 10%, 220 OHM (81349)	RC07GF221K	2	
-37	2A2R34	. RESISTOR, 1/4W, 10%, 820 OHM (81349)	RC07GF821K	1	

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-21-	2A2	Continued			
-38	2A2R28	. RESISTOR, 1/4W, 10%, 470 OHM (81349)	RC07GF471K	1	
-39	2A2R32,37	. RESISTOR, 1/4W, 10%, 56 OHM (81349)	RC07GF560K	2	
-40	2A2C12	. CAPACITOR, 820 PF, 500 VDC, 5% (84171).	DM15-821J	1	
-41	2A2C4	. CAPACITOR, 1 UF, 35 VDC, 10% (56289)	CK13BF105K	1	
-42	2A2C20,22, 24,26,28, 30,36,38	. CAPACITOR, .0033 UF, 200 VDC, 10% (56289)	192P33292	8	
-43	2A2C40	. CAPACITOR, 100 UF, 10 VDC (80131).	CS13BC107K	1	
-44	2A2C52	. CAPACITOR, SELECT ONE OF THE FOLLOWING:		1	
		5 PF, 500 VDC,5% (72136)	DDDDM15-050J		
		10 PF, 500 VDC,5% (72136)	DM15-100J		
		12 PF, 500 VDC,5% (72136)	DM15-120J		
		15 PF, 500 VDC,5% (84171)	DM15-150J		
-45	2A2C46 THRU 51, 53,54	. CAPACITOR, SELECT ONE OF FOLLOWING FOR EACH		*	
		100 PF,500 VDC,5%(84171)	DM15-101J		
		120PF,500VDC,5% (72136)	DM15-121J		
		150 PF,500VDC,5% (72136)	DM15-151J		
		180PF,500VDC,5% (84171)	DM15-181J		
		220 PF,550VDC,5% (84171)	DM15-221J		
-46		.PCB, SYSTEM REFERENCE LOGIC	00393574	1	

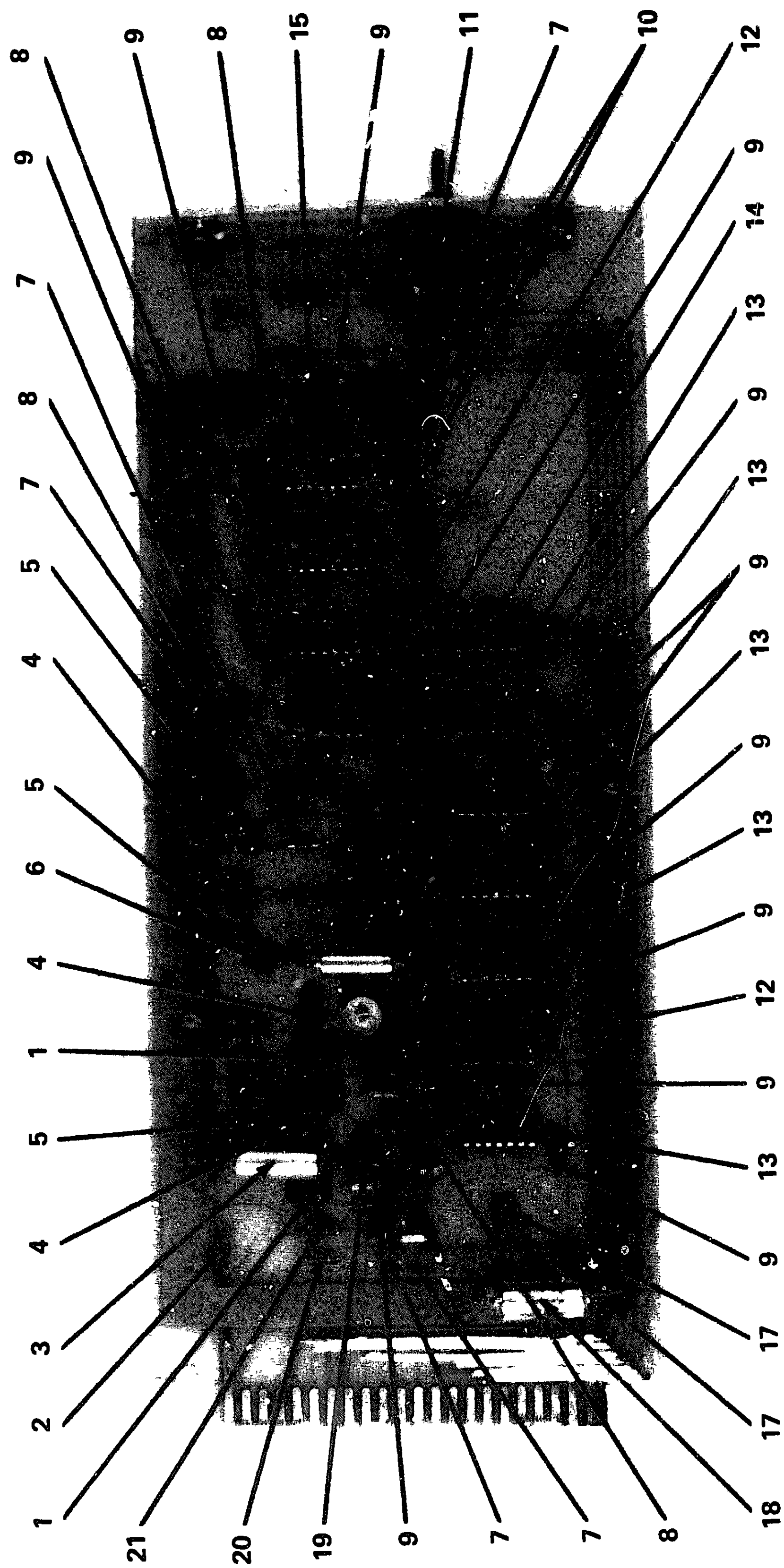


Figure 1-22. 1 MHz Synthesizer Assembly (Sheet 1 of 2)

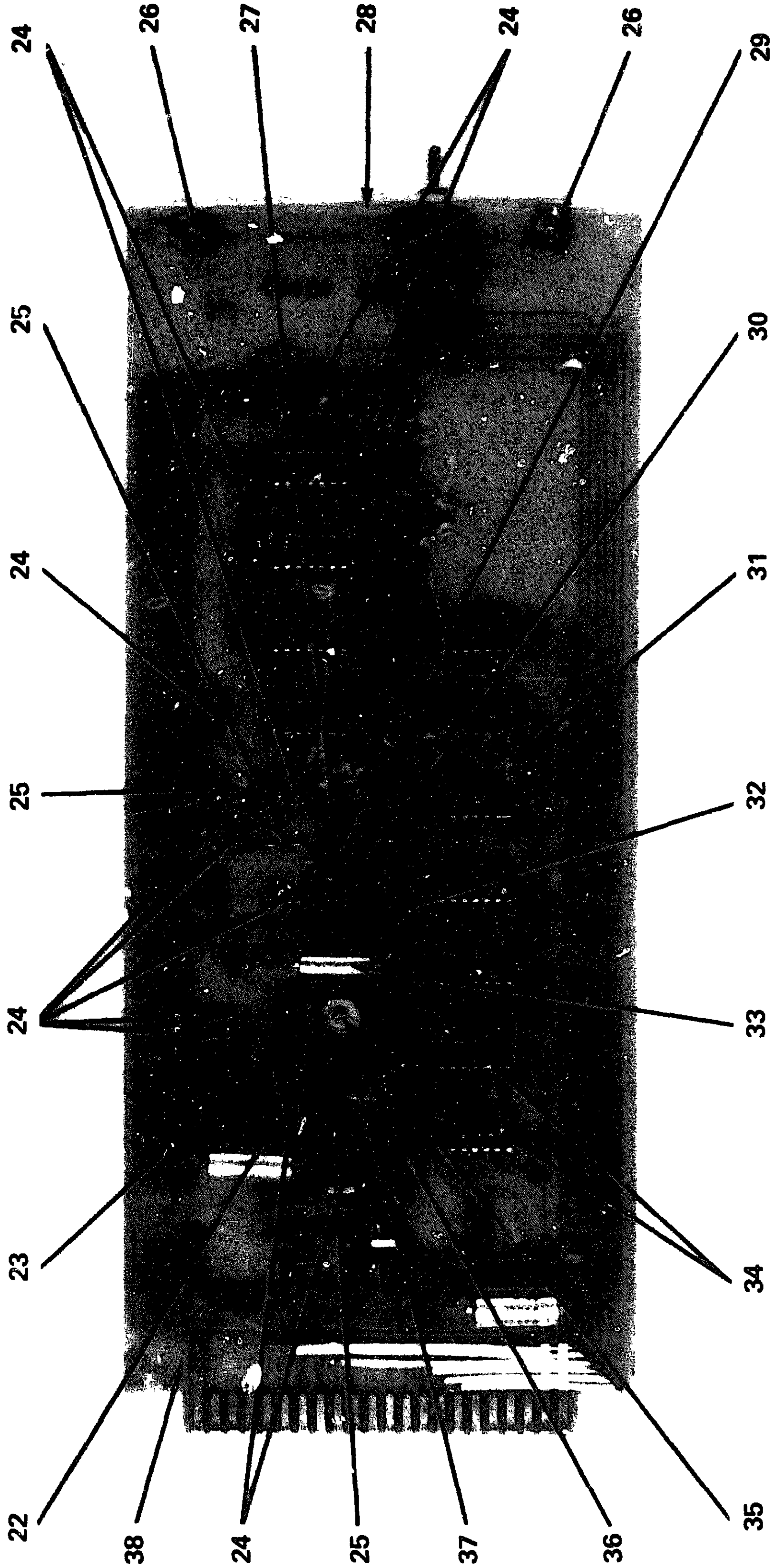


Figure 1-22. 1 MHz Synthesizer Assembly (Sheet 2 of 2)

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-22-	2A3	1 MHz SYNTHESIZER ASSY	10393557	REF	
-1	2A3C7,9	. CAPACITOR, 47 PF, 500 VDC, 5% (72136)	DM15-470J	2	
-2	2A3R24	. RESISTOR, ¼W, 10%, 22 OHM (81349)	RC07GF220K	1	
-3	2A3C11	. CAPACITOR, 100 UF, 20 VDC (56289)	CS13BE107K	1	
-4	2A3Q4,5,6	. TRANSISTOR (04713).	2N3906	3	
-5	2A3R6,8,16	. RESISTOR, ¼W, 10%, 2.2K (81349)	RC07GF222K	3	
-6	2A3CR3	. DIODE, EPICAP (04713)	MV1642	1	
-7	2A3Q1,2,3, 7,8	. TRANSISTOR (04713).	MPS3646	5	
-8	2A3R12,25, 26 ,27	. RESISTOR, ¼W, 10%, 1K (81349)	RC07GF102K	4	
-9	2A3C5,13 THRU 23	. CAPACITOR, .01 UF, 100 VDC (80183)	TG-S10	12	
-10	2A3U2,3	. INTEGRATED CIRCUIT (01295). .	SN7493N	2	
-11	2A3S1	. SWITCH, TOGGLE, 3PDT (95146).	MST305D	1	
-12	2A3U1,6	. INTEGRATED CIRCUIT (01295). .	SN7400N	2	
-13	2A3U5,7,8, 9,10	. INTEGRATED CIRCUIT (01295)...	SN7490N	5	
-14	2A3U11	. INTEGRATED CIRCUIT (01295). .	SN7473N	1	
-15	2A3U4	. INTEGRATED CIRCUIT (01295). .	SN7410N	1	
-16		DELETED			
-17	2A3R21,23	. RESISTOR, ¼W, 10%, 56 OHM (81349)	RC07GF560K	2	
-18	2A3C12	. CAPACITOR, 330 UF, 6 VDC (81349)	CS13BB337K	1	
-19	2A3L2	. COIL, CHOKE, 10%, 12 UH (99800)	1025-46	1	
-20	2A3R18	. RESISTOR, ¼W, 10%, 100 OHM (81349)	RC07GF101K	1	
-21	2A3R17	. RESISTOR, ¼W, 10%, 560 OHM (81349)	RC07GF561K	1	
-22	2A3C6	. CAPACITOR, 330 PF, 500 VDC, 5% (84171)	DM15-331J	1	
-23	2A3C8	. CAPACITOR, 1000 PF, 100 VDC, 5% (84171)	DM15-102J	1	
-24	2A3R1, THRU 5,7 11,13,14 15,19,28	. RESISTOR, ¼W, 10%, 4.7K (81349)	RC07GF472K	12	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-22-	2A3	Continued			
-25	2A3CR1,2,4	. DIODE (01295)	1N914	3	
-26		. BRACKETS (72653)	6261	2	
-27	2A3C1	. CAPACITOR, .0033 UF, 200 VDC, 10% (56289)	192P33292	1	
-28		. PANEL, SWITCH MOUNTING. . . .	00391967-	1	
-29	2A3Q9	. TRANSISTOR (04713)	2N4220	1	
-30	2A3R9	. RESISTOR, ¼W, 10%, 5.6K (81349)	RC07GF562	1	
-31	2A3R10	. RESISTOR, ¼W, 10%, 100K (81349)	RC07GF104	1	
-32	2A3C2	. CAPACITOR, 470 PF, 500 VDC, 5% (84171)	DM15-471J	1	
-33	2A3C10	. CAPACITOR, 22 UF, 35 VDC, 10% (56289)	CS13BF226	1	
-34	2A3R20,22	. RESISTOR, ¼W, 10%, 470 OHM (81349)	RC07GF471	2	
-35	2A3C3	. CAPACITOR, VARIABLE 5.5-18 (81349)	CV31-C100	1	
-36	2A3C4	. CAPACITOR, 27 PF, 500 VDC, 5% (72136)	DM15-270J	1	
-37	2A3L1	. COIL, CHOKE, 10%, 2.2 UH (99800)	1025-28	1	
-38		. PCB, 1 MHz SYNTHESIZER	00393556	1	

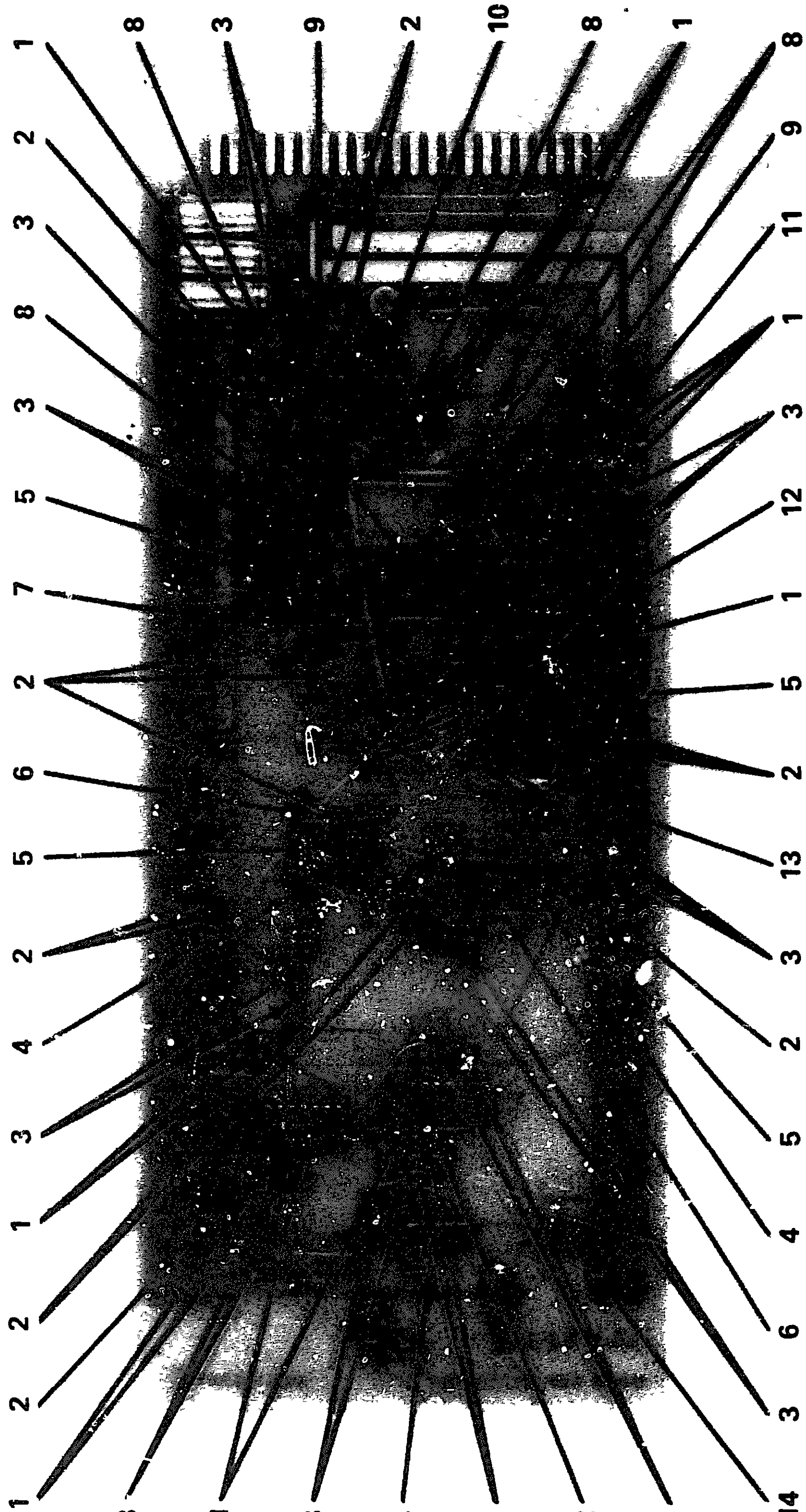


Figure 1-23. 5 MHz Amplitude Detector Assembly (Sheet 1 of 2)

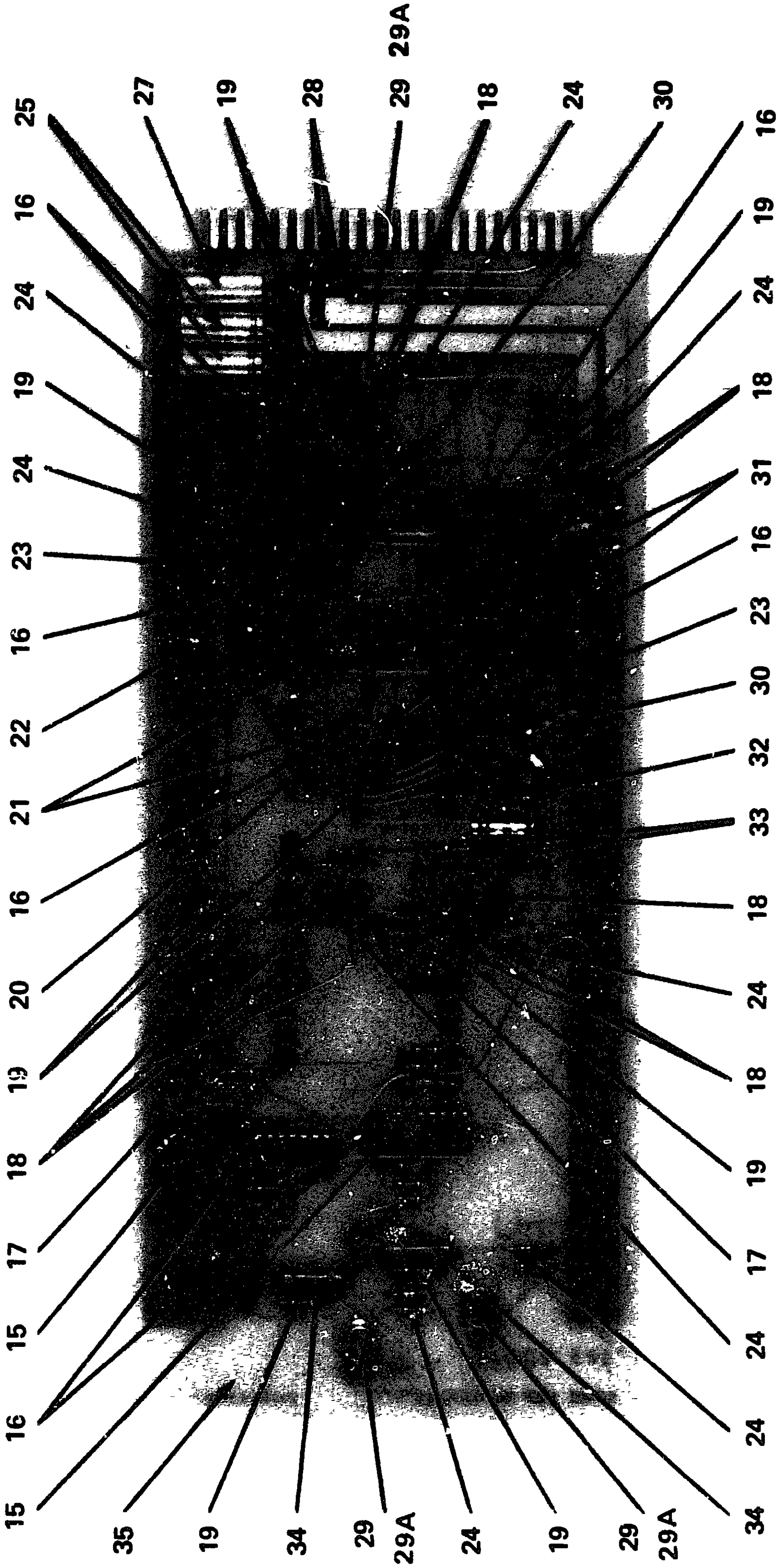


Figure 1-23. 5 MHz Amplitude Detector Assembly (Sheet 2 of 2)

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-23-	2A4	5 MHz AMPLITUDE DETECTOR ASSY	10392368	REF	
-1	2A4R2,3,6, 14,15, 17,20, 27,28, 31,32, 33,35, 51,52, 53,56	. RESISTOR, 1/4W, 10%, 4.7 K (81349)	RC07GF472K	17	
-2	2A4R7,9, 10,24, 25,26, 37,39, 41,44, 46,47, 61,62, 63,68	. RESISTOR, 1/4W, 10%, 1 K (81349)	RC07GF102K	16	
-3	2A4Q6 THRU 17,20, 21,22, 26,27, 28,29	. TRANSISTOR (04713).	MPS3646	19	
-4	2A4R11,48	. RESISTOR, 1/4W, 10%, 2.2 K (81349)	RC07GF222K	2	
-5	2A4C4,9, 13,20	. CAPACITOR, 220 PF, 500 VDC, 5% (84171).	DM15-221J	4	
-6	2A4C3,19	. CAPACITOR, 330 PF, 500 VDC, (84171)	DM15-331J	2	
-7	2A4T1	. TRANSFORMER (24672)	751 92635	1	
-8	2A4R1,5, 42,43,64	. RESISTOR, 1/4W, 10%, 680 OHM (81349)	RC07GF681K	5	
-9	2A4C1,15	. CAPACITOR, 1000 PF, 100 VDC, 5% (72136).	DM15-102J	2	
-10	2A4U4	. INTEGRATED CIRCUIT (01295). .	SN7404N	1	
-11	2A4U1,2,3	. INTEGRATED CIRCUIT (01295). .	SN7400N	3	
-12	2A4R23	. RESISTOR, 1/4W, 10%, 560 OHM (81349)	RC07GF561K	1	
-13	2A4C8	. CAPACITOR, VARIABLE (72982) .	563-013	1	
-14	2A4R18,54	. RESISTOR, 1/4W, 10%, 100 K (81349)	RC07GF104K	2	
-15	2A4C5,21	. CAPACITOR, .001 UF, 200 VDC, 10% (56289)	192P10292	2	

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-23-	2A4	Continued			
-16	2A4C2,14, 23,24, 25,26, 27,28	. CAPACITOR, .01 UF, 100 VDC, (56289)	TG-S10	8	
-17	2A4R13,50	. RESISTOR, 1/4W, 10%, 8.2 K (81349)	RCO7GF822K	2	
-18	2A4Q1,2,3, 4,5,18, 19,23, 24,25	. TRANSISTOR, (04713)	2N3906	10	
-19	2A4R4,8, 21,34, 38,40, 45,57,58	. RESISTOR, 1/4W, 10%, 47 OHM (81349)	RC07GF470K	9	
-20	2A4L1	. COIL, CHOKE, 12 UH (99800) .	1025-46	1	
-21	2A4Q31,32	. TRANSISTOR (04713).	2N5555	2	
-22	2A4C12	. CAPACITOR, 750 PF, 300 VDC, 5% (72136).	DM15-751J	1	
-23	2A4R22,29	. RESISTOR, 1/4W, 10%, 100 OHM (81349).	RC07GF101K	2	
-24	2A4R12,16, 19,30, 36,49, 55,65	. RESISTOR, 1/4W, 10%, 470 OHM (81349).	RC07GF471K	8	
-25	2A4C16,17	. CAPACITOR, 100 UF, 20 VDC (56289)	CS13BE107K	2	
-26		DELETED			
-27	2A4C18	. CAPACITOR, 330 UF, 6 VDC (56289)	CS13BB337K	1	
-28	2A4R66,67	. RESISTOR, 1/4W, 10%, 10 OHM (81349).	RC07GF100K	2	
-29	2A4Q30,33, 34	. TRANSISTOR (01295).	2N1671B	3	
-29A		. PAD, TRANSISTOR MTG (07047).	10123	3	
-30	2A4CR1,2	. DIODE (01295)	1N914	2	
-31	2A4C10,11	. CAPACITOR, 22 PF, 500 VDC, 5% (84171).	DM15-220J	2	
-32	2A4C7	. CAPACITOR, 10 PF, 500 VDC, 5% (72136).	DM15-1005	1	
-33	2A4R59,60	. RESISTOR, 1/4W, 10%, 6.8 K (81349)	RCO7GF682K	2	
-34	2A4C6,22	. CAPACITOR, .022 UF, 200 VDC, 10% (56289)	192P22392	2	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-23-	2A4	Continued			
-35		PCB, 5 MHz AMPLITUDE DETECTOR	00392367	1	

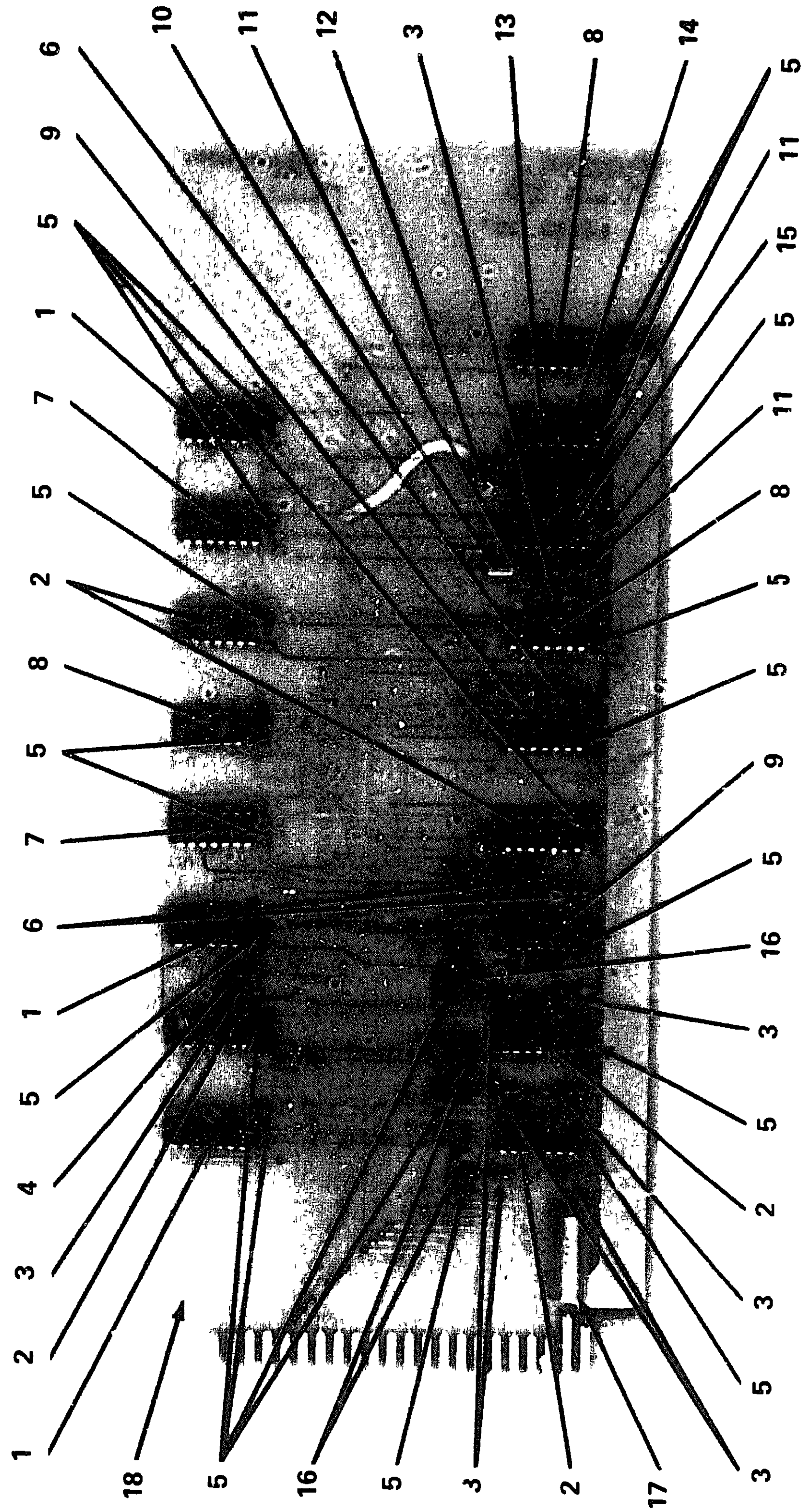


Figure 1-24. Phase Shifter Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No,	Units Per Assy.	Usable On Code
1-24-	2A5	PHASE SHIFTER ASSY	10392375	REF	
-1	2A5U10,12, 17	INTEGRATED CIRCUIT (01295) : :	SN7474N	3	
-2	2A5U1,2,4, 11,15	INTEGRATED CIRCUIT (01295) .	SN7400N	5	
-3	2A5R1-6, 14,18	RESISTOR, ¼W', 10%, 1K (81349).	RC07GF102K	8	
-4	2A5R19	RESISTOR, ¼W, 10%, 56 OHM (82349).	RC07GF560K	1	
-5	2A5C1,2,3,5 THRU 21	CAPACITOR, .01 UF, 100 VDC (80183).	TG-S10	20	
-6	2A5R8,9,10	RESISTOR, ¼W, 10%, 4.7K (81349).	RC07GF472K	3	
-7	2A5U13,16	INTEGRATED CIRCUIT (01295) . .	SN7486N	2	
-8	2A5U6,9,14	INTEGRATED CIRCUIT (01295) . .	SN7490N	3	
-9	2A5U3,5	INTEGRATED CIRCUIT (01295) . .	SN7410N	2	
-10	2A5C22	CAPACITOR, 1 UF, 35 VDC (56289).	CS13BF105K	1	
-11	2A5R11,12, 13	RESISTOR, ¼W, 10%, 6.8K (81349).	RC07GF682K	3	
-12	2A5Q4	TRANSISTOR (04713) . .	2N3904	1	
-13	2A5C24	CAPACITOR, 56 PF, 500 VDC (72136).	DM15-5605	1	
-14	2A5U8	INTEGRATED CIRCUIT (04713) . .	MC4024P	1	
-15	2A5U7	INTEGRATED CIRCUIT (04713) . .	MC4044P	1	
-16	2A5Q1,2,3	TRANSISTOR (01295)	2N3704	3	
-17	2A5C4	CAPACITOR, 330 UF, 6 VDC (81349)	CS13BB337K	1	
-18		PCB, PHASE SHIFTER	00392374	1	

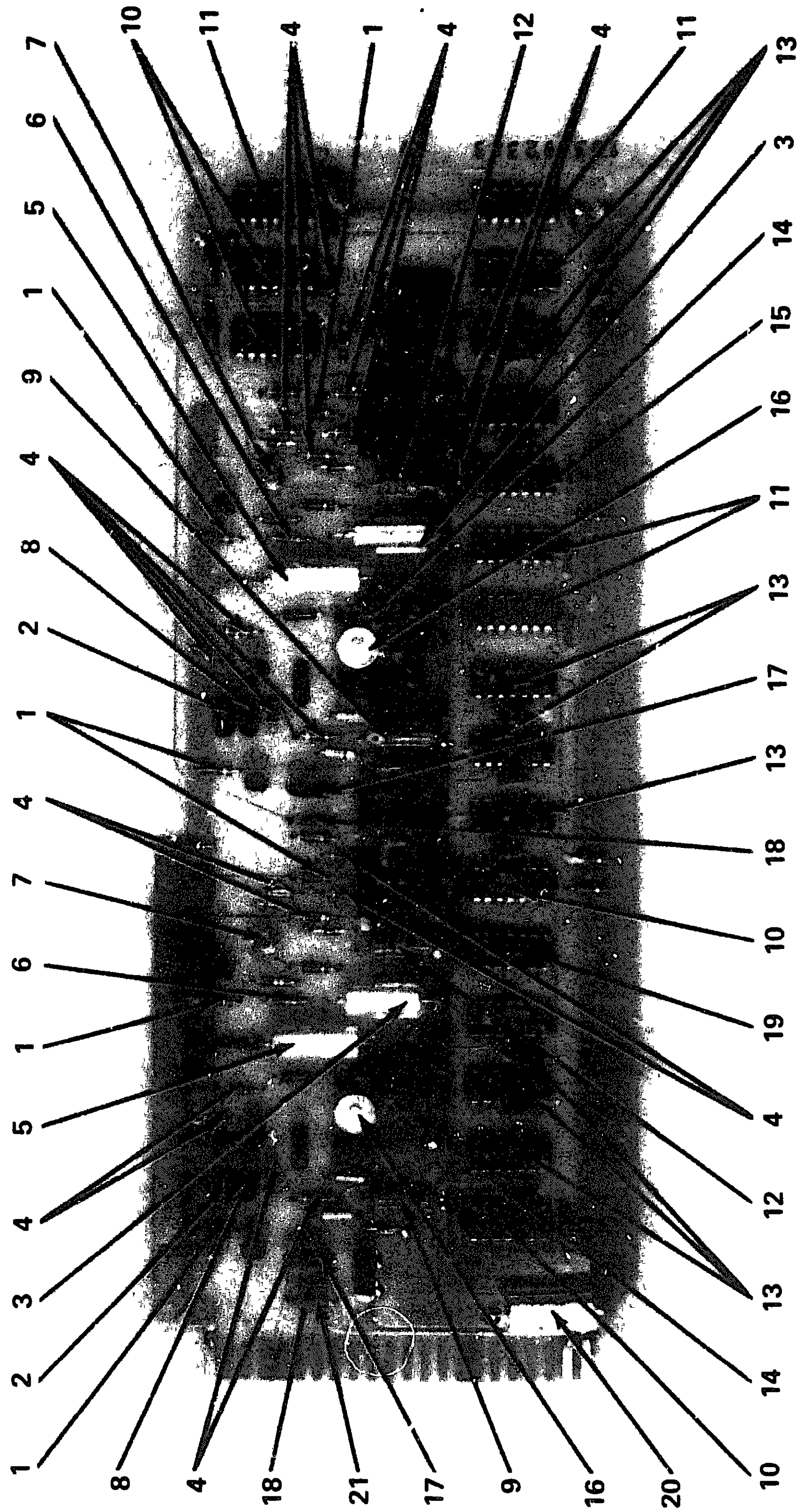


Figure 1-25. 1.544/1.536 MHz Synthesizer (Sheet 1 of 2)

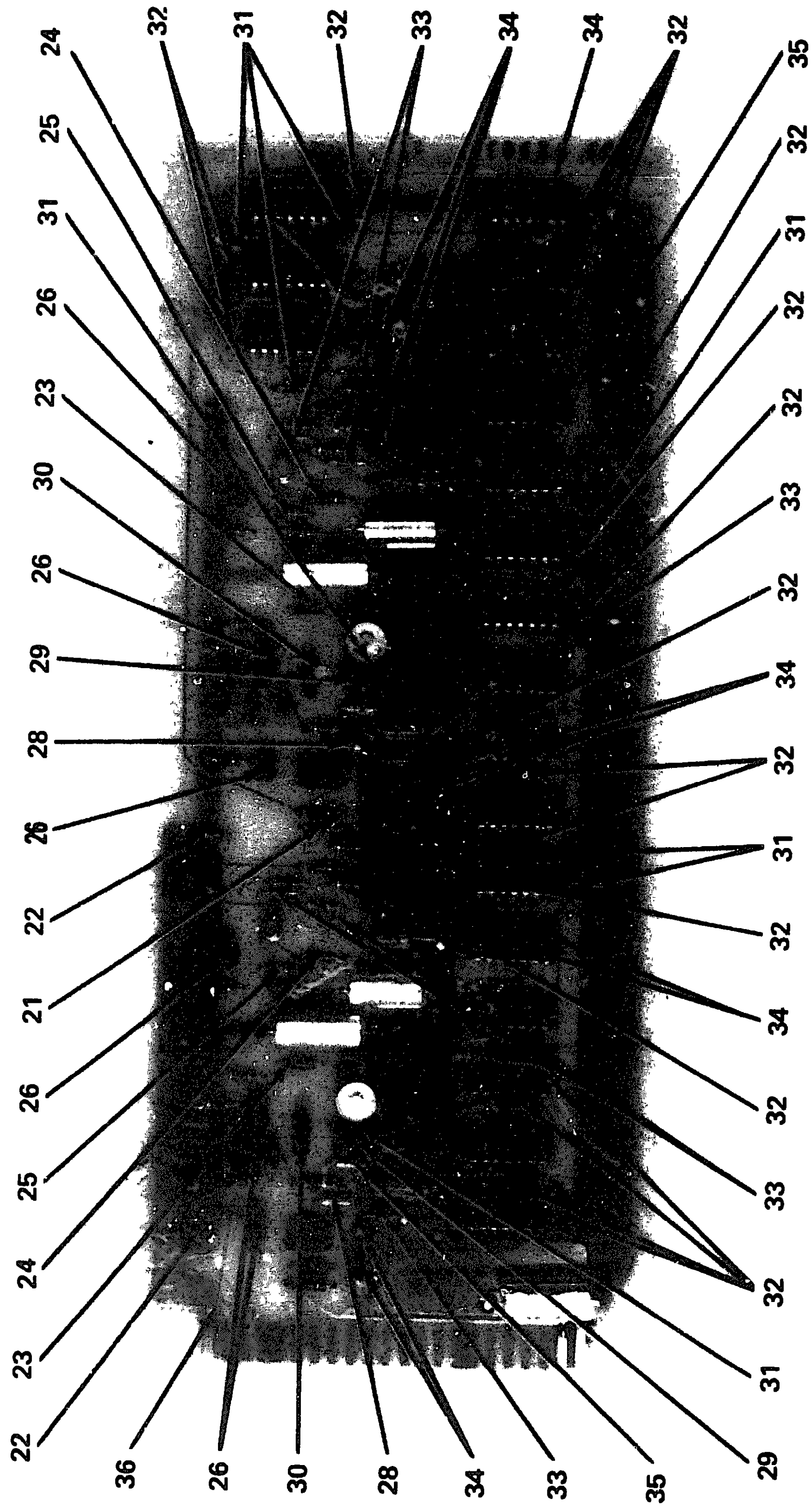
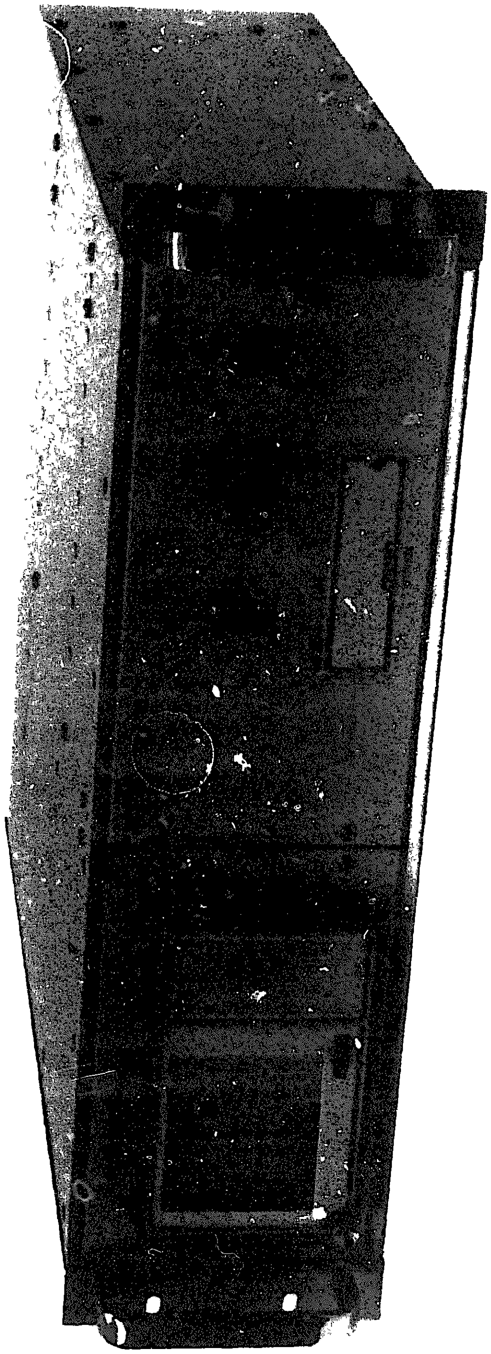


Figure 1-25. 1.544/1,536 Mhz Synthesizer (Sheet 2 of 2)

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-25-	2A6	1.544/1.536 MHz SYNTHESIZER ASSY	10393562	REF	
-1	2A6R4,6,15 31,33,41	. RESISTOR, 1/4W, 10%, 2.2 K (81349).	RC07GF222K	6	
-2	2A6C11,21	. CAPACITOR, 1000 PF, 100 VDC, 5% (72136)	DM15-102J	2	
-3	2A6C4,14	. CAPACITOR, 22 UF, 35 VDC, (56289).	CS13BF226K	2	
-4	2A6R1,2,3, 5,11,12, 13,14,18, 19,24,25, 27,29,30, 32,37,38, 39,40	. RESISTOR, 1/4W, 10%, 4.7 K (81349).	RC07GF472K	20	
-5	2A6C2,42	. CAPACITOR, 100 UF, 20 VDC (56289).	CS13BE107K	2	
-6	2A6R9,36	. RESISTOR, 1/4W, 10%, 10K (81349).	RC07GF103K	2	
-7	2A6Q3,13	. TRANSISTOR (04713)	2N4220	2	
-8	2A6C9,19	. CAPACITOR, 330 PF, 500 VDC, 5% (84171)	DM15-331J	2	
-9	2A6C8,18	. CAPACITOR, .01 UF, 200 VDC, 10% (56289).	192P10392	2	
-10	2A6U1,6, 18,19	. INTEGRATED CIRCUIT (01295) . .	SN7400N	4	
-11	2A6U10,11, 16,17	. INTEGRATED CIRCUIT (01295) . .	SN7493N	4	
-12	2A6C3,13	. CAPACITOR, .0033 UF, 200 VDC, 10% (56289).	192P33292	2	
-13	2A6U2,3,4, 7,8,9, 13,14,50	. INTEGRATED CIRCUIT (01295)	SN7490N	9	
-14	2A6C5,15	. CAPACITOR, 470 PF, 500 VDC, 5% (84171)	DM15-471J	2	
-15	2A6U12	. INTEGRATED CIRCUIT (01295) . .	SN7410N	1	
-16	2A6C6,16	. CAPACITOR, 5.5 TO 18 (81349) .	CV31-C100	2	
-17	2A6C12,22	. CAPACITOR, 180 PF, 500 VDC, 5% (72136)	DM15-181J	2	
-18	2A6R16,42	. RESISTOR, 1/4W, 10%, 560 OHM (81349).	RC07GF561K	2	
-19	2A6U5	. INTEGRATED CIRCUIT (01245) . .	SN7473N	1	

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-25-	2A6	Continued			
-20	2A6C1	. CAPACITOR, 330 UF, 6 VDC (56289).	CS13BB337K	1	
-21	2A6R17,43	. RESISTOR, 1/4W, 10%, 100 OHM (81349)	RC07GF101K	2	
-22	2A6R44,45	. RESISTOR, 1/4W, 10%, 22 OHM (81349).	RC07GF220K	2	
-23	2A6CR3,CR7	. DIODF, EPICAP (04713). . . .	MV1642	2	
-24	2A6R8,R34	. RESISTOR, 1/4W, 10%, 5.6K (81349).	RC07GF562K	2	
-25	2A6R7,35	. RESISTOR, 1/4W, 10%, 100 K (81349).	RC07GF104K	2	
-26	2A6Q4,5,6, 14,15,16	. TRANSISTOR (04713)	2N3906	6	
-27		DELETED			
-28	2A6L2,4	. COIL, CHOKE, 33 UH , 10% (99800).	1025-56	2	
-29	2A6C7,17	. CAPACITOR, 27 PF, 500 VDC, 5% (72136).	DMN15-270J	2	
-30	2A6C10,20	. CAPACITOR, 33 PF, 500 VDC, 5% (72136).	DM15-33CJ	2	
-31	2A6R10,20 21,22, 23,26, 28,46	. RESISTOR, 1/4W, 10%, 1 K (81349).	RC07GF102K	8	
-32	2A6C23 THRU 41	. CAPACITOR, .01 UF, 100 VDC, (80183).	TG-S10	19	
-33	2A6CR1,2, 4,5,6, 8	. DIODE (01295).	1N914	6	
-34	2A6Q1,2,7, 8,9,10, 11,12, 17,18	. TRANSISTOR (04713)	MPS3646	10	
-35	2A6L1,3	. COIL, CHOKE, 1.5 UH (99800).	1025-24	2	
-36		. PCB, LOCKED OSCILLATOR	00393561		



Section IV. R-1776/GSQ-174 Loran Receiver

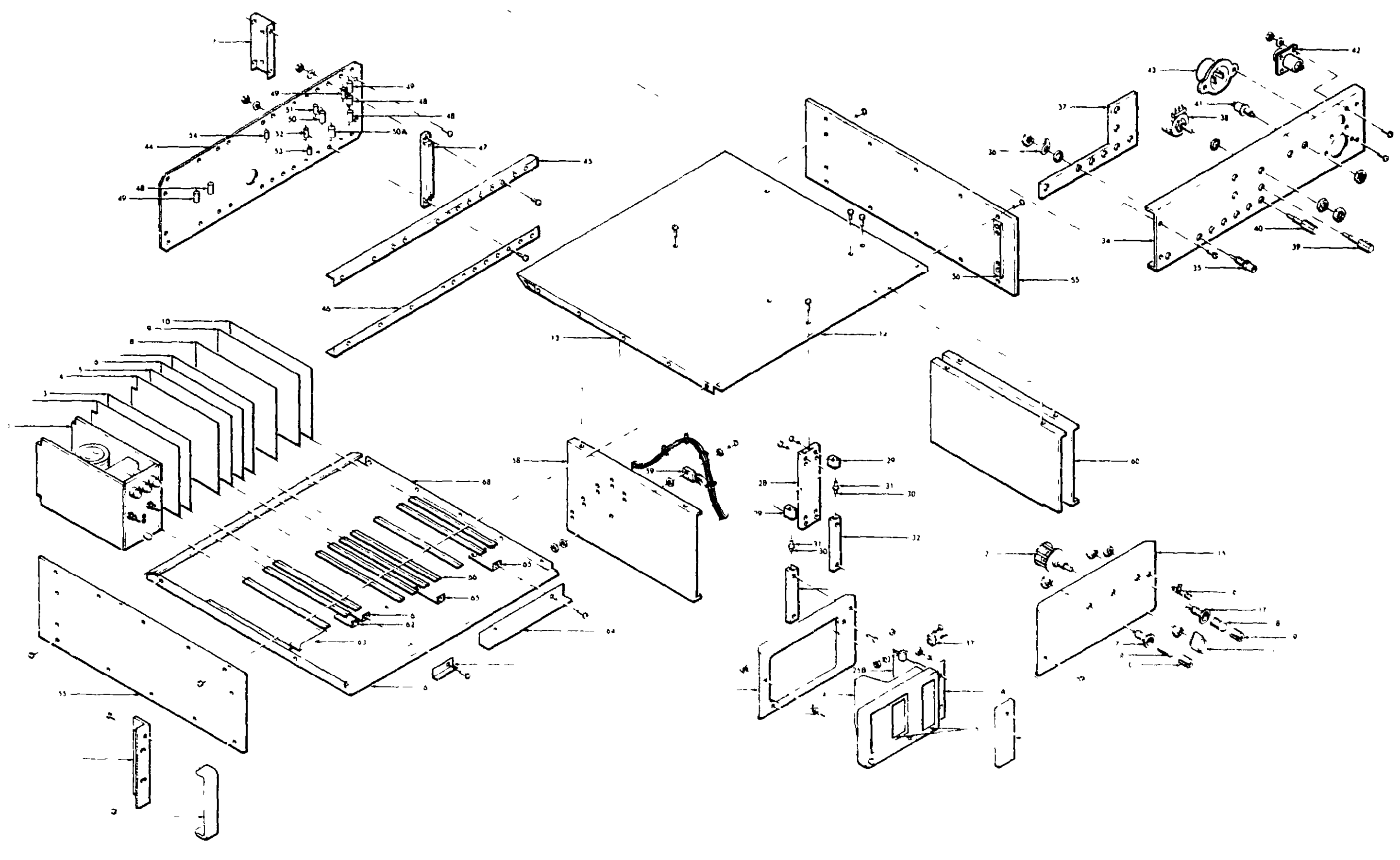


Figure 1-26. Loran Receiver, R-1776/GSQ-174

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-26	3	RECEIVER, LORAN R-1776/GSQ-174	30493409	REF	
-1	3A1	. POWER SUPPLY ASSY (ASSY'S 3A1 THRU 10 ACCESSIBLE WHEN CHASSIS COVER IS REMOVED) .	20392396	1	
-2	3A2	. PCB ASSY, OUTPUT BUFFERS . . .	10392395	1	
-3	3A3	. PCB ASSY, VIEWING FILTER . . .	10392394	1	
-4	3A4	. PCB ASSY, STANDARD INPUT . . .	10392393	1	
-5	3A5	. PCB ASSY, GRP DIVIDER . . .	10392392	1	
-6	3A6	. PCB ASSY, PHASE CODE . . .	10392391	1	
-7	3A7	. PCB ASSY, SERVO CONTROL . . .	10392390	1	
-8	3A8	. PCB ASSY, AMPLITUDE STROBE . .	10392388	1	
-9	3A9	. PCB ASSY, PHASE STROBE . .	10392386	1	
-10	3A10	. PCB ASSY, RF AMPLIFIER	10392385	1	
	3A11	. CHASSIS ASSY	11493576	1	
-11		. . BRACKET, RACK MOUNTING . . .	00490942	2	
		(ATTACHING PARTS)			
		. . SCREW, PH, 8-32x½ IN (73734)	17086	4	
		- - - - - - - - * - - - - - - - -			
-12		. . HANDLE (71218)	H-9102	2	
		(ATTACHING PARTS)			
		. . SCREW, FH, 6-32x3/8 IN (96906)	MS35249-35	4	
		- - - - - - - - * - - - - - - - -			
-13		. . COVER, CHASSIS, TOP	00793513-2	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x¼ IN (73734)	17042	2	
		. . SCREW, PH, 6-32x¼ IN (73734)	17062	18	
		- - - - - - - - * - - - - - - - -			
-14		. . EXTRUSION, COVER, MODIFIED .	02090936	1	
-15		. . PANEL, FRONT, RIGHT.	00993532	1	
		(ATTACHING PARTS)			
		. . SCREW, TRUSS HD PHIL 6-32x3/8 IN (73734) . .	23444	2	
		- - - - - - - - * - - - - - - - -			
-16		. . FASTENER, PAWL, ADJUST (94222).	27-10-301-10	3	
-17	3A11XDS1,2	. . HOLDER, LAMP (72619)	359-8430-09-502	2	
-18	3A11DS1,2	. . LAMP, STYLE T-1 (24453). . .	327	2	
-19		. . LENS, TRANSPARENT, GREEN (72619).	162-0932	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref. Design	DESCRIPTION	Part No.	Unit Per Assy.	Usable on Cod
1-26-20		. . LENS, TRANSPARENT, RED (72619).	162-0931	1	
-21		. . KNOB, MIL TYPE 1K2B (49956	70-5-26	1	
-22	3A11S3	. . SWITCH, ROTARY (71590) . .	PA2003	1	
-23		. . PANEL, FRONT, LEFT	00992080	1	
		(ATTACHING PARTS)			
		. . SCREW, TRUSS HD, PHIL 6-32 x 3/8 IN (73734)	23444	2	
		- - - - - - - - * - - - - - - -			
-24	3A11A1	. . RECORDER, MODIFIED (24672)	12093938		
-25		. . PAPER, CHART (96853) . . .	STYLE A	1	
-25A		. . PLATE, SPACER (24672). . .	01092085	1	
-25B		. . HINGE, MODIFIED.	02092105	1	
		. . BRACKET, MODIFIED.	00492084	1	
		(ATTACHING PARTS)			
		. . SCREW, TRUSS HD, PHIL, 8-32x1/2 IN (70318). . . .	23466	2	
		. . WASHER, INT LOCK, NO. 8, (73734).	1305	2	
		. . NUT, HEX, 8-32x1/2 IN (73734).	8008	2	
		. . SCREW, PH, 4-40x1/4 IN (73734).	17042	2	
		. . WASHER, INT LOCK, NO. 4, (73734).	1302	2	
		. . NUT, HEX, 4-40x1/4 IN, (73734).	8003	2	
		- - - - - - - - * - - - - - - -			
-26		. . LABEL, RUSTRAK	12292612	1	
-27		. . FASTENER, PAWL ADJUST, (94222)...	27-10-301-10	1	
		. . HINGE ASSY	12090951	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x1/2 IN (73734).	17046	2	
		- - - - - - - - * - - - - - - -			
-28		. . BLOCK, HINGE	00290935	1	
-29		. . BRACKET, HINGE	00490933	4	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x1/2IN, (73734).	17046	8	
		- - - - - - - - * - - - - - - -			
-30		. . PIN, HINGE	02090939	4	
-31		. . WASHER, FLAT,NO. 6 (73734)	1404	4	
-32		. . PLATE, HINGE	01090937	2	

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-26-33	3A11P1	. . CONNECTOR (71785)	S-306-AB	1	
-34		. . PANEL, REAR	00993522	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x3/8 IN (73734)	17064	4	
		- - - - - - - - - * - - - - - - -			
-35	3A11J1 THRU J8	. . CONNECTOR, BNC (74868). . .	UG625/U	8	
-36		. . LUG, SOLDER (83330)	1497	4	
-37		. . PLATE, GROUND	01093568	1	
-38	3A11R1	. . RESISTOR, VARIABLE, LOCK SAFETY (81349) . . .	RV4LAYSA 502A	1	
-39	3A11E1	. . POST, BINDING, RED (74970).	111-10200	1	
-40	3A11E2	. . POST, BINDING, BLK (74970).	111-10300	1	
-41	3A11S1,2	. . SWITCH, PUSHBUTTON (81073).	30-1	2	
-42	3A11J9	. . CONNECTOR (74868)	MS3102A-14S.1P	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x3/8 IN (73734)	17044	4	
		. . WASHER, INT LOCK, NO. 4 (73734)	1302	4	
		. . NUT, HEX, 4-40x¼ IN (73734)	8003	4	
		- - - - - - - - - * - - - - - - -			
-43	3A11J10	. . CONNECTOR (74868)	160-5N	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x¼ IN (73734)	17042	2	
		. . WASHER, INT LOCK, NO. 4 (73734)	1302	2	
		. . NUT, HEX, 4-40x¼ IN (73734)	8003	2	
		- - - - - - - - - * - - - - - - -			
-44		. . PCB, INTERCONNECT	00391959	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x3/8 IN (73734)	17064	4	
		- - - - - - - - - * - - - - - - -			
-45		. . BAR, REINFORCING, TOP . . .	001909591	1	
-46		. . BAR, REINFORCING, BOTTOM. .	001909592	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 4-40x5/8 IN (73734)	17047	22	

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-26		. . WASHER, INT LOCK, NO. 4 (73734)	1302	22	
		. . NUT, HEX, 4-40x¼ IN (73734)	8003	22	
-47	3A11J11 THRU J21	. . CONNECTOR, PCB (71785). . .	50-44B-10	11	
-48	3A11C5,6,7	. . CAPACITOR, 100 UF, 20 VDC (81349)	CS13BE107K	3	
-49	3A11C2,3,4	. . CAPACITOR, 100 UF, 10 VDC (80131)	CS13BC107K	3	
-50	3A11C1	. . CAPACITOR, .27 UF, 200 VDC 10% (09134)	31-274C	1	
-50A	3A11C8	. . CAPACITOR, .082 UF, 200 VDC 10% (09134)	31-823C	1	
-51	3A11R4	. . RESISTOR, ¼W, 10%, 47 OHM (81349)	RC07GF470K	1	
-52	3A11R2	. . RESISTOR, ¼W, 10%, 18K (81349).	RC07GF183K	1	
-53	3A11R3	. . RESISTOR, ¼W, 10%, 22K (81349)	RC07GF223K	1	
-54	3A11R5	. . RESISTOR, ¼W, 10%, 4.7K (81349)	RC07GF472K	1	
-55		. . PANEL, SIDE	00990945	2	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x¼ IN (73734)	17062	10	
		- - - - - - - - * - - - - - - - -			
-56		. . BRACKET, LATCH.	00490941	2	
-57		. . BRACKET, REAR PANEL	00490943	2	
-58		. . BRACE, SHIELD	00991941	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x¼ IN (73734)	17062	2	
		- - - - - - - - * - - - - - - - -			
-59	3A11Q1	. . TRANSISTOR (04713)	MJE3055	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x½ IN (73734)	17066	1	
		. . WASHER, MICA, NO. 4 (73734)	1470	1	
		. . WASHER, INT LOCK, NO. 4 (73734)	1302	1	
		. . NUT, HEX, 4-40x¼ IN (73734)	8003	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-26-60		. . PLATE, SHIELD	01091942	2	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x¼ IN (73734)	17062	4	
		- - - - - - - - - * - - - - - - - -			
-61		. . ANGLE, RETAINER, SHORT. . .	02090934	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x¼ IN (73734)	17062	2	
		- - - - - - - - - * - - - - - - - -			
-62		. . BRACKET, RETAINER, SHORT. .	00491943	2	
-63		. . BRACKET, POWER SUPPLY . . .	00490955	1	
-64		. . ANGLE, RETAINER, LONG . . .	02090938	1	
		(ATTACHING PARTS)			
		. . SCREW, PH, 6-32x¼ IN (73734)	17062	2	
		- - - - - - - - - * - - - - - - - -			
-65		. . BRACKET, RETAINER, LONG . .	00490940	2	
-66		. . GUIDE, PCB, MODIFIED . . .	02092403	26	
-67		. . EXTRUSION, COVER, MODIFIED.	02090936	1	
-68		. . COVER, CHASSIS, BOTTOM. . .	007935131	1	

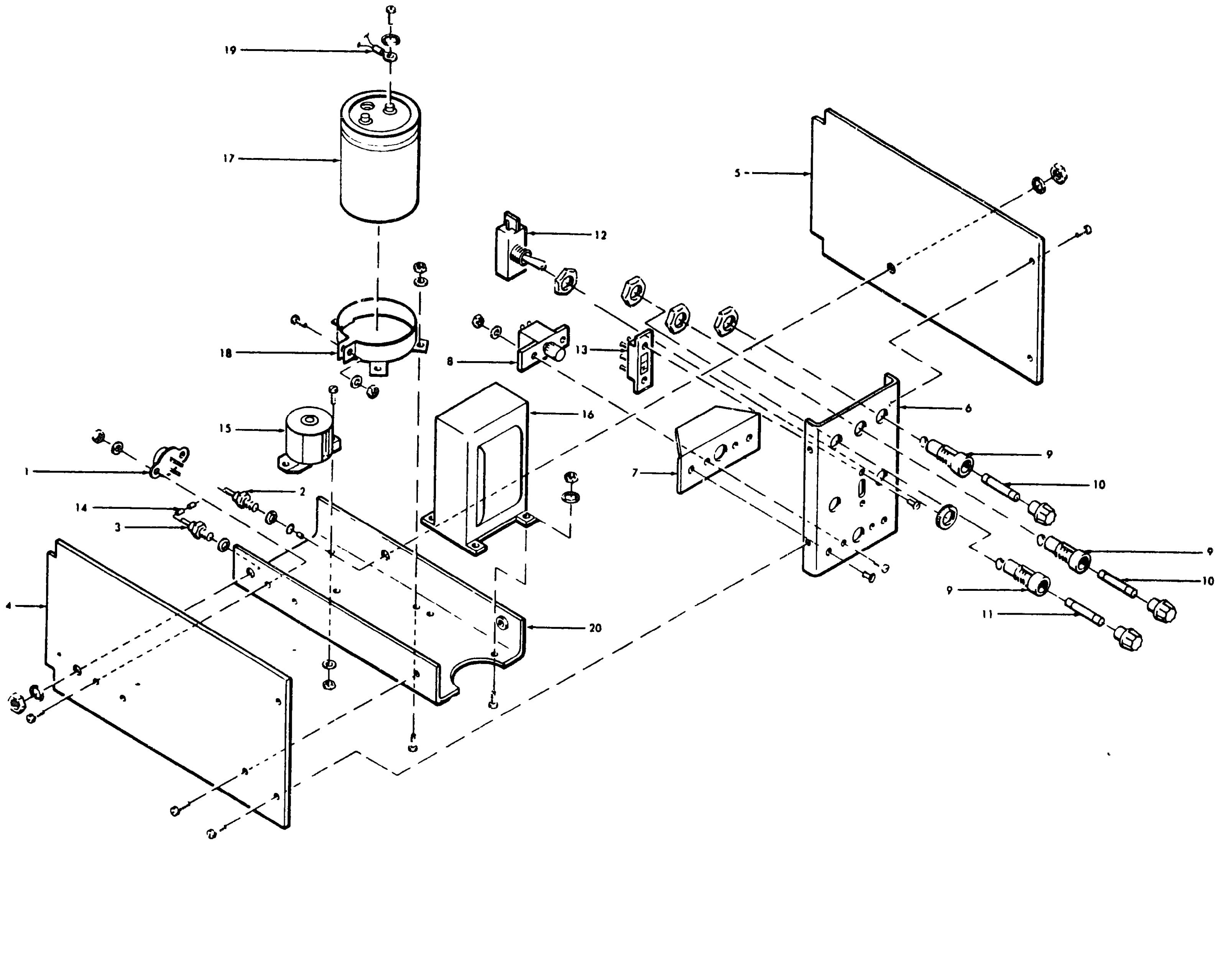


Figure 1-27. Power Supply Assembly.

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-27	3A1	POWER SUPPLY ASSY.	20392396	REF	
-1	3A1Q13	. TRANSISTOR (02735)	40364	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 6-32x3/8 IN (73734)	17064	2	
		. WASHER, INT LOCK, NO. 6 (73734).	1304	2	
		. NUT, HEX, 6-32x5/16 IN (73734)	8005	2	
		- - - - - - - - - * - - - - - -			
-2	3A1CR1	. DIODE (04713).	MR1125	1	
-3	3A1CR11	DIODE (04713).	1N3879	1	
-4	3A1A1	. PCB ASSY, +5V REGULATOR. . . .	10391994	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 6-32x1/4 IN (73734)	17062	1	
		- - - - - - - - - * - - - - - - - -			
5	3A1A2	. PCB ASSY, +20 & +10V REGULATOR	10391993	1	
		(ATTACHING PARTS)			
		SCREW, PH, 6-32x1/4 IN (73734)	17062	1	
		- - - - - - - - - * - - - - - - - -			
-6		. PANEL, FRONT	00990932	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 6-32x1/4 IN (73734)	17062	4	
		- - - - - - - - - * - - - - - - - -			
-7		BRACKET, REINFORCING	00491872	1	
-8		. LATCH, PAWL, MODIFIED.	02092086	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 6-32x1/4 IN (73734)	17062	2	
		. WASHER, INT LOCK, NO. 6 (73734)	1304	2	
		. NUT, HEX, 6-32x5/16 IN (73734)	8005	2	
		- - - - - - - - - * - - - - - - - -			
-9	3A1XF1 THRU 3A1XF3	HOLDER, FUSE (71400)	HKP	3	
-10	3A1F1, 3A1F2	. FUSE, 2A, 250 VDC (75915). . .	312002	2	
-11	3A1F3	. FUSE, 5A, 250 VDC (71400) . .	312005	1	
-12	3A1S1, 3A1S2	SWITCH, TOGGLE (04009)	20994-LH	2	
-13	3A1S3	SWITCH, SLIDE, DPDT, (82389)	46256LFR	1	
		(ATTACHING PARTS)			
		. RIVET (07707)	AD41ABS	2	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-27-14		. BEAD, SHIELDING (02114). . . .	5659065/3B	2	
-15	3A1L1	. CHOKE, POWER SUPPLY (24672)	75192035	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 4-40x3/8 IN (73734)	17044	2	
		. WASHER, INT LOCK, NO 4 (73734)	1302	2	
		. NUT, HEX, 4-40x1/4 IN (73734)	8003	2	
		- - - - - - - - - * - - - - - - - -			
-16	3A1T1	. TRANSFORMER, POWER (24672). .	75192036	1	
		(ATTACHING PARTS)			
		. SCREW, PH, 6-32x1/2 IN (73734)	17066	4	
		. WASHER, INT LOCK, NO. 6 (73734)	1304	4	
		. NUT, HEX, 6-32x5/16 IN (73734)	8005	4	
		- - - - - - - - - * - - - - - - - -			
-17	3A1C1	. CAPACITOR, 8400 UF, 40 VDC (56289)	36D842G-040BB2A	1	
		(ATTACHING PARTS)			
-18		. CLAMP, CAPACITOR MT6 (90201)	VR8	1	
		. SCREW, PH, 6-32x3/8 IN (73734)	17064	3	
		. WASHER, INT LOCK, NO. 6 (73734)	1304	3	
		. NUT, HEX, 6-32x5/16 IN (73734)	8005	3	
		. SCREW, PH, 8-32x1/2 IN (73734)	17086	2	
		. WASHER, INT LOCK, NO. 8 (73734)	1305	2	
		- - - - - - - - - * - - - - - - - -			
-19		. LUG, TERMINAL (59730)	D8-10	1	
-20		. CHASSIS PLATE	01091009	1	

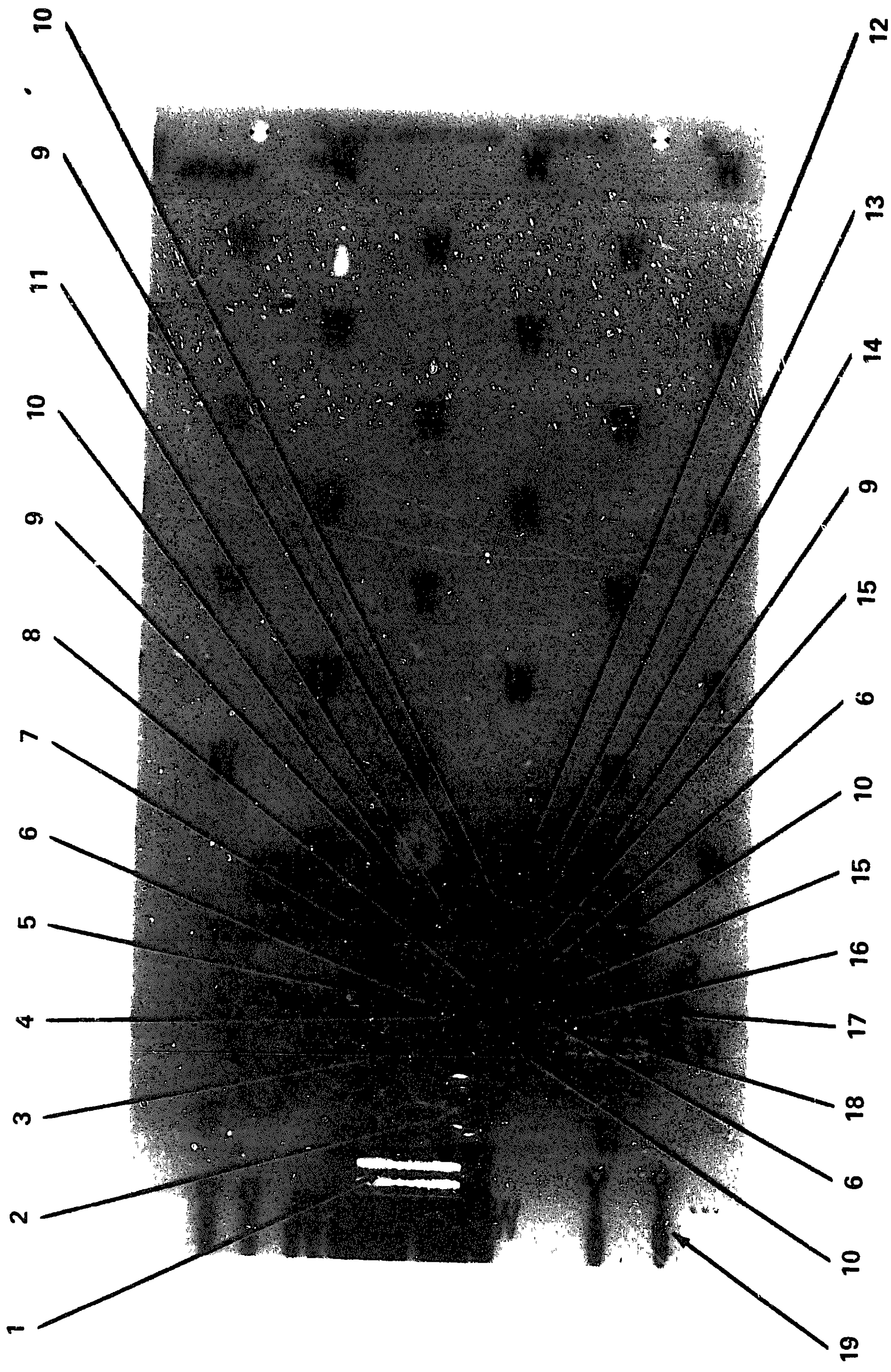


Figure 1-28. +5V Regulator Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-28	3A1A1	+5V REGULATOR ASSY.	10391994	REF	
-1	3A1A1C8	. CAPACITOR, 330 UF, 20 VDC (81349)	CS13BB337K	1	
-2	3A1A1VR2	. DIODE ZENER, 6.8V (04713).	1N1602	1	
-3	3A1A1C5	. CAPACITOR, 22 UF, 35 VDC, 10% (56289)	CS13BF226K	1	
-4	3A1A1R36	. RESISTOR, ¼W, 10%, 12K (81349)	RC07GF123K	1	
-5	3A1A1R32	. RESISTOR, ¼W, 10%, 47 OHM (81349).	RC07GF470K	1	
-6	3A1A1R25, 33,34	. RESISTOR, ¼W, 10%, 6.8K (81349).	RC07GF682K	3	
-7	3A1A1R31	. RESISTOR, ¼W, 10%, 10 OHM (81349).	RC07GF100K	1	
-8	3A1A1C7	. CAPACITOR, .01 UF, 200 VDC, 10% (56289)	192P10392	1	
-9	3A1A1Q10, 11,12	. TRANSISTOR (01295).	2N3702	3	
-10	3A1A1R27, 29,30,35	. RESISTOR, ¼W, 10%, 680 OHM (81349).	RC07GF681K	4	
-11	3A1A1CR10	. DIODE (01295)	1N914	1	
-12	3A1A1R28	. RESISTOR, ¼W, 10%, 1.2K (81349).	RC07GF122K	1	
-13	3A1A1C3	. CAPACITOR, 1000 PF, 100 VDC, 5% (84171)	DM15-102J	1	
-14	3A1A1C4	. CAPACITOR, 56 UF, 200 VDC, 10% (56289)	192P56292	1	
-15	3A1A1Q14, 15	. TRANSISTOR (01295).	2N3704	2	
-16	3A1A1R26	. RESISTOR, 1/8W, 1%, 1.1K (81349).	RN55D1101F	1	
-17	3A1A1R39	. RESISTOR, 1/8W, 1%, 3.4K (81349).	RN55D3401F	1	
-18	3A1A1C6	. CAPACITOR, .1 UF, 200 VDC, 10% (56289)	192P10492	1	
-19		. PCB, 5V REGULATOR	00390833	1	

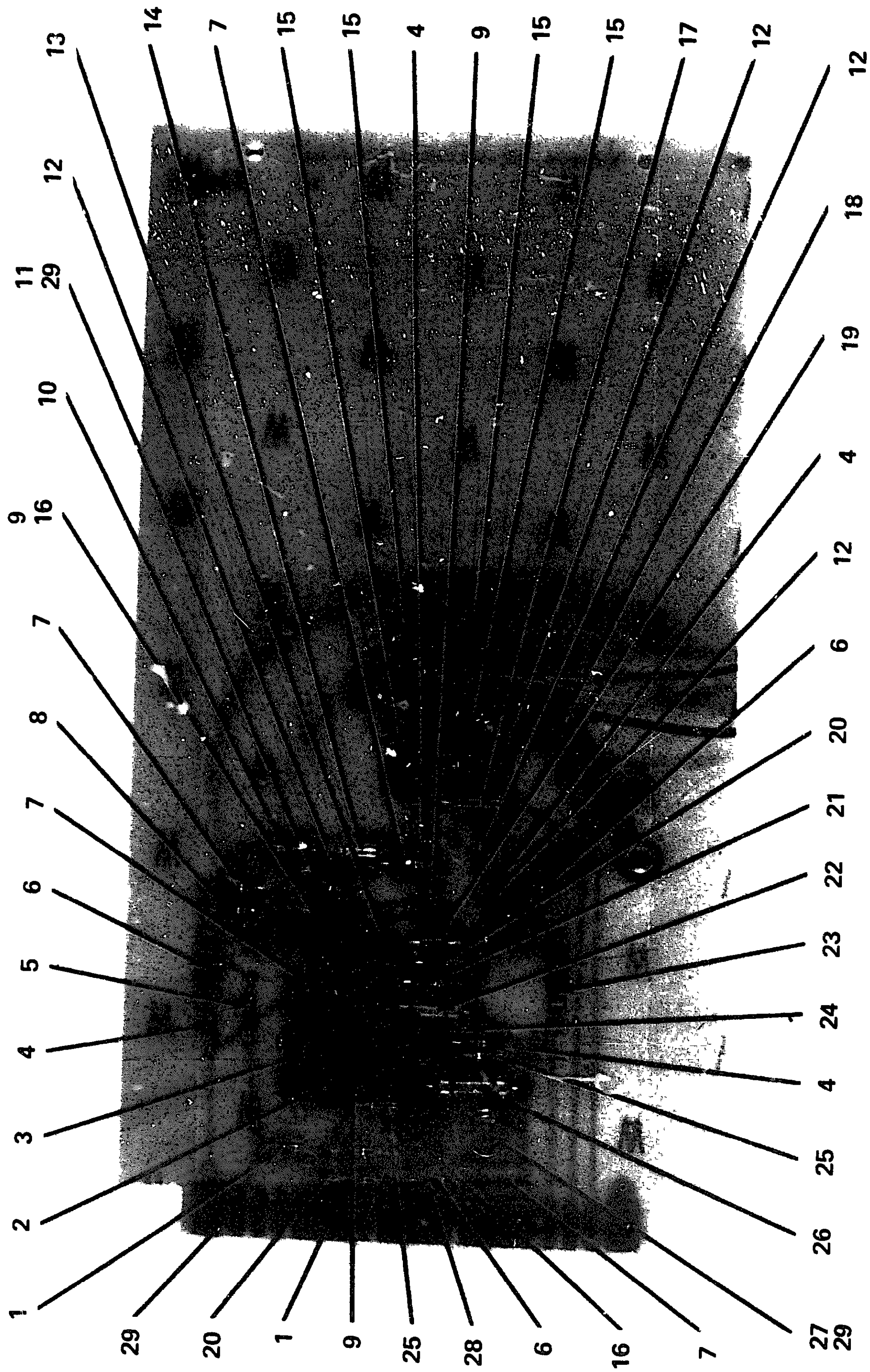


Figure 1-29. +20 & +10V Regulator Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-29	3A1A2	+20 & +10V ""GULATOR ASSY . . .	10391993	REF	
-1	3A1A2R11, 22	. RESISTC J, 10%, 1K (81349)	RC07GF102K	2	
-2	3A1A2R3	. RESISTOR, 1/8W, 1%, 2.21K (81349).	RN55D2211F	1	
-3	3A1A2R4	. RESISTOR, VARIABLE, 100 OHM (80294)	3067P 1-101	1	
-4	3A1A2R9,21 37,38	. RESISTOR, ¼W, 10%, 12K (81349).	RC07GF123K	4	
-5	3A1A2R10	..RESISTOR, ¼W, 10%, 56 OHM (81349).	RC07GF560K	1	
-6	3A1A2Q3,7, 8,16	. TRANSISTOR (02735).	2N3702	4	
-7	3A1A2R8, 12,15,20	. RESISTOR, ¼W, 10%, 560 OHM (81349).	RC07GF561K	4	
-8	3A1A2R13	. RESISTOR, ¼W, 10%, 56K (81349).	RC07GF563K	1	
-9	3A1A2Q1,2, 6	. TRANSISTOR (01295)	2N3704	3	
-10	3A1A2R14	. RESISTOR, ¼W, 10%, 560K (81349).	RC07GF564K	1	
-11	3A1A2Q5	. TRANSISTOR (01295)	2N1671B	1	
-12	3A1A2CR6, 7,8,9	. DIODE (01295)	1N914	4	
-13	3A1A2R16	. RESISTOR, ¼W, 10%, 22K (81349).	RC07GF223K	1	
-14	3A1A2C2	. CAPACITOR, 1 UF, 35 VDC, 20% (56289)	CS13BF105K	1	
-15	3A1A2CR2,3 4,5	. DIODE (04713)	1N4002	4	
-16		. CLIP, TRANSISTOR (05820). . .	256D	2	
-17	3A1A2R2	. RESISTOR, 1/2W, 10%, 220 OHM (81349).	RC20GF221K	1	
-18	3A1A2R1	. RESISTOR, 1/2W, 10%, 120 OHM (81349).	RC20GF121K	1	
-19	3A1A2VR1	. DIODE, ZENER, 5.1V (04713)	1N4733	1	
-20	3A1A2R6,19	. RESISTOR, 1/2W, 10%, 5.6K (81349).	RC20GF562K	2	
-21	3A1A2R7	. RESISTOR, 1/4W, 10%, 2.2K (81349).	RC07GF222K	1	
-22	3A1A2C9	. CAPACITOR, .01 UF, 200 VDC 10% (56289).	192P10392	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-29-23	3A1A2R24	. RESISTOR, ½W, 10%, 470 OHM (81349).	RC20GF471K	1	
-24	3A1A2R5	. RESISTOR, 1/8W, 1%, 680 OHM (81349).	RN55D6810R	1	
-25	3A1A2R17, 18	. RESISTOR, ¼W, 10%, 4.7K (81349).	RC07GF472K	2	
-26	3A1A2C10	. CAPACITOR, .022 UF, 200 VDC 10% (56289)	192P22392	1	
-27	3A1A2Q9	. TRANSISTOR (02735)	2N2270	1	
-28	3A1A2R23	. RESISTOR, ¼W, 10%, 100 OHM (81349).	RC07GF101K	1	
-29		. PAD, TRANSISTOR (07047) . . .	10123	2	
-30		. PCB, +20 & +10V REGULATOR . .	00390832	1	

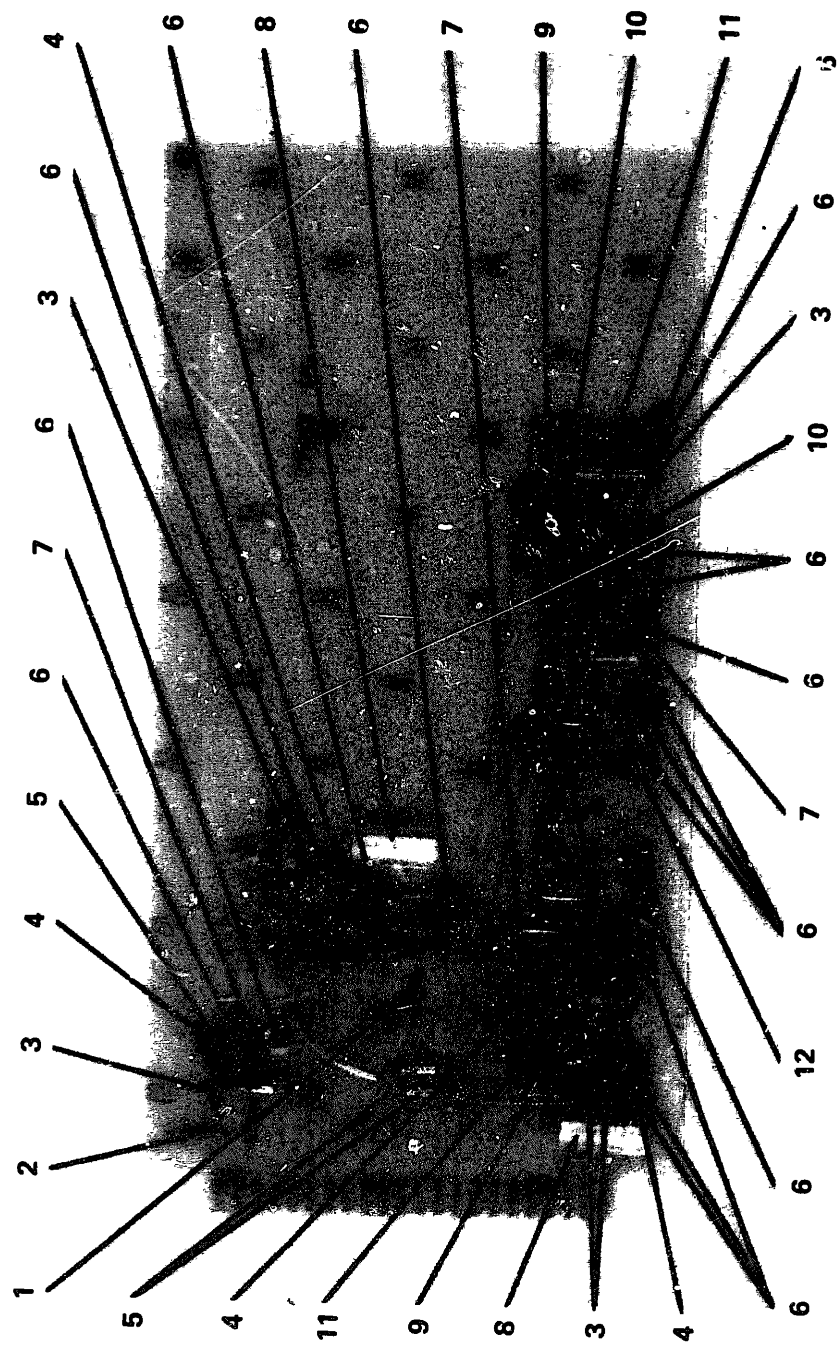


Figure 1-30. Output Buffers Assembly (Sheet 1 of 2)

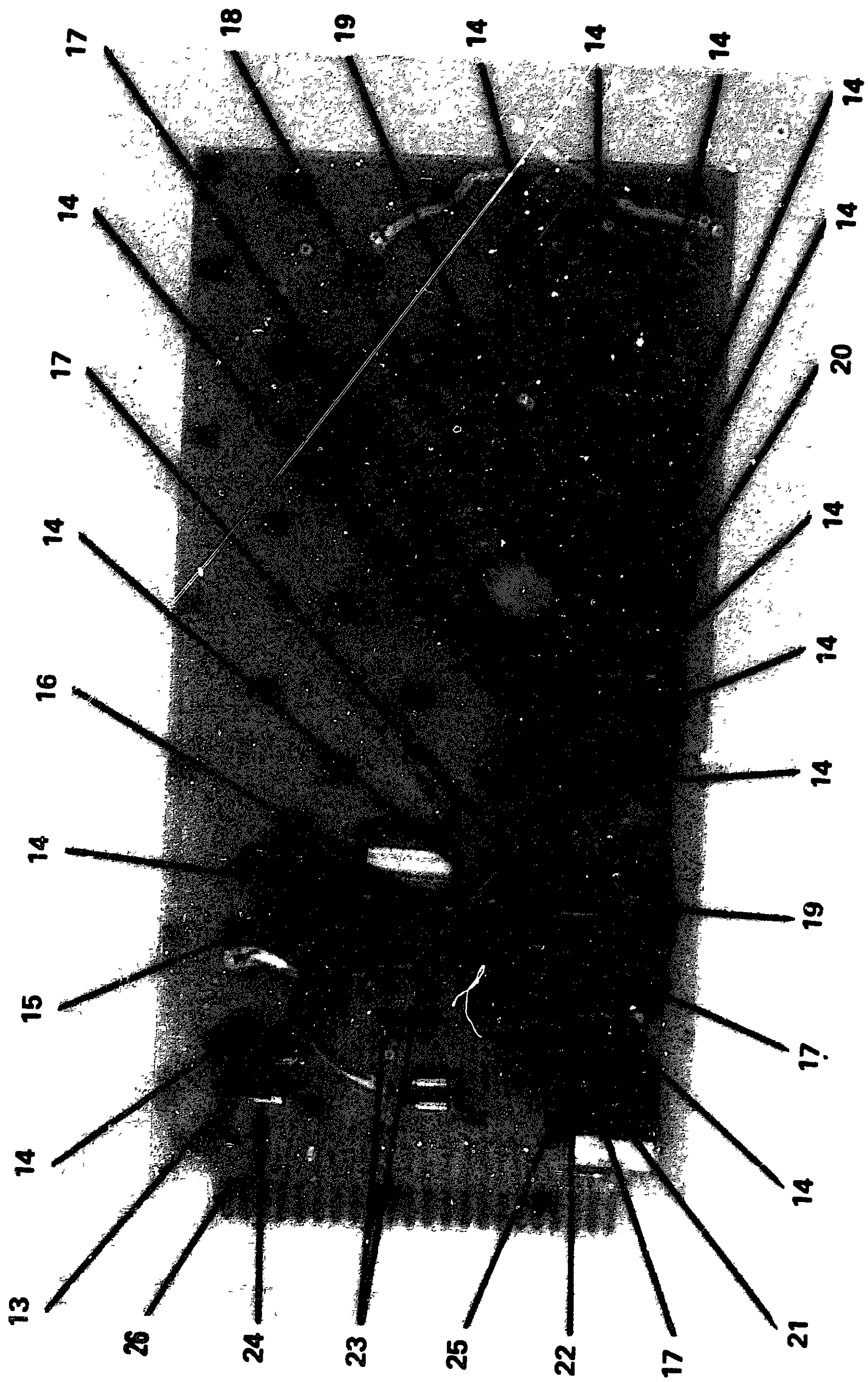


Figure 1-30. Output Buffers Assembly (Sheet 2 of 2)

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-30	3A2	OUTPUT BUFFERS ASSY	10392395	REF	
-1	3A2R20	. RESISTOR, ¼W, 10%, 2.2K (81349)	RC07GF222K	1	
-2	3A2R1	. RESISTOR, ¼W, 10%, 100 OHM (81349).	RC07GF101K	1	
-3	3A2R2,25, 32,36,42	. RESISTOR, ¼W, 10%, 10K (81349)	RC07GF103K	5	
-4	3A2C2,6,12, 20	. CAPACITOR, 12 PF, 500 VDC, 5% (84171)	DM15-120J	4	
-5	3A2C1,7,8	. CAPACITOR, 1 UF, 35 VDC, 20% (56289)	CS13BF105K	3	
-6	3A2Q1,2,6 THRU 12, 15 THRU 22	. TRANSISTOR (04713)	MPS3646	17	
-7	3A2CR1,2,3	. DIODE (01295)	1N914	3	
-8	3A2C18,19	. CAPACITOR, 330 UF, 6 VDC (81349)	CS13BB337K	2	
-9	3A2R24,41	. RESISTOR, VARIABLE, 20K (80294)	3067P 1-203	2	
-10	3A2R39,43	. RESISTOR, ¼W, 10%, 8.2K (81349)	RC07GF822K	2	
-11	3A2C10,15	. CAPACITOR, .0056 UF, 200 VDC, 5% (09134)	192P56292	2	
-12	3A2C17	. CAPACITOR, .022 UF, 200 VDC, 10%(56289)	192P22392	1	
-13	3A2R17	. RESISTOR, ¼W, 10%, 6.8K (81349)	RC07GF682K	1	
-14	3A2R4,13, 21,23, 29,30,38, 40,44,46, 47,49,50	. RESISTOR, ¼W, 10%, 4.7K (81349)	RC07GF472K	13	
-15	3A2R18	. RESISTOR, VARIABLE, 5K (80294)	3067P 1-502	1	
-16	3A2R15	. RESISTOR, ¼W, 10%, 470 OHM (81349).	RC07GF471K	1	
-17	3A2R22,28, 37,51	. RESISTOR, ¼W, 10%, 47K (81349).	RC07GF473K	4	
-18	3A2R48	. RESISTOR, ¼W, 10%, 33K (81349)	RC07GF333K	1	
-19	3A2C14,16	. CAPACITOR, 470 PF, 500 VDC, 5% (84171)	DM15-471J	2	
-20	3A2R45	. RESISTOR, ¼W, 10%, 22K (81349)	RC07GF223K	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-30					
-21	3A2C11	. CAPACITOR, .01 UF, 100 VDC, 10% (80183)	TG-S10	1	
-22	3A2R27	. RESISTOR, ¼W, 10%, 15K (81349)	RC07GF153K	1	
-23	3A2R16,19	. RESISTOR, ¼W, 10%, 330 OHM (81349)	RC07GF331K	2	
-24	3A2R3	. RESISTOR, ¼W, 10%, 56 OHM (81349)	RC07GF560K	1	
-25	3A2R26	. RESISTOR, 1/4W, 10%, 1.5K (81349)	RC07GF152K	1 1	
-26		. PCB, OUTPUT BUFFERS . .	00390842	1	

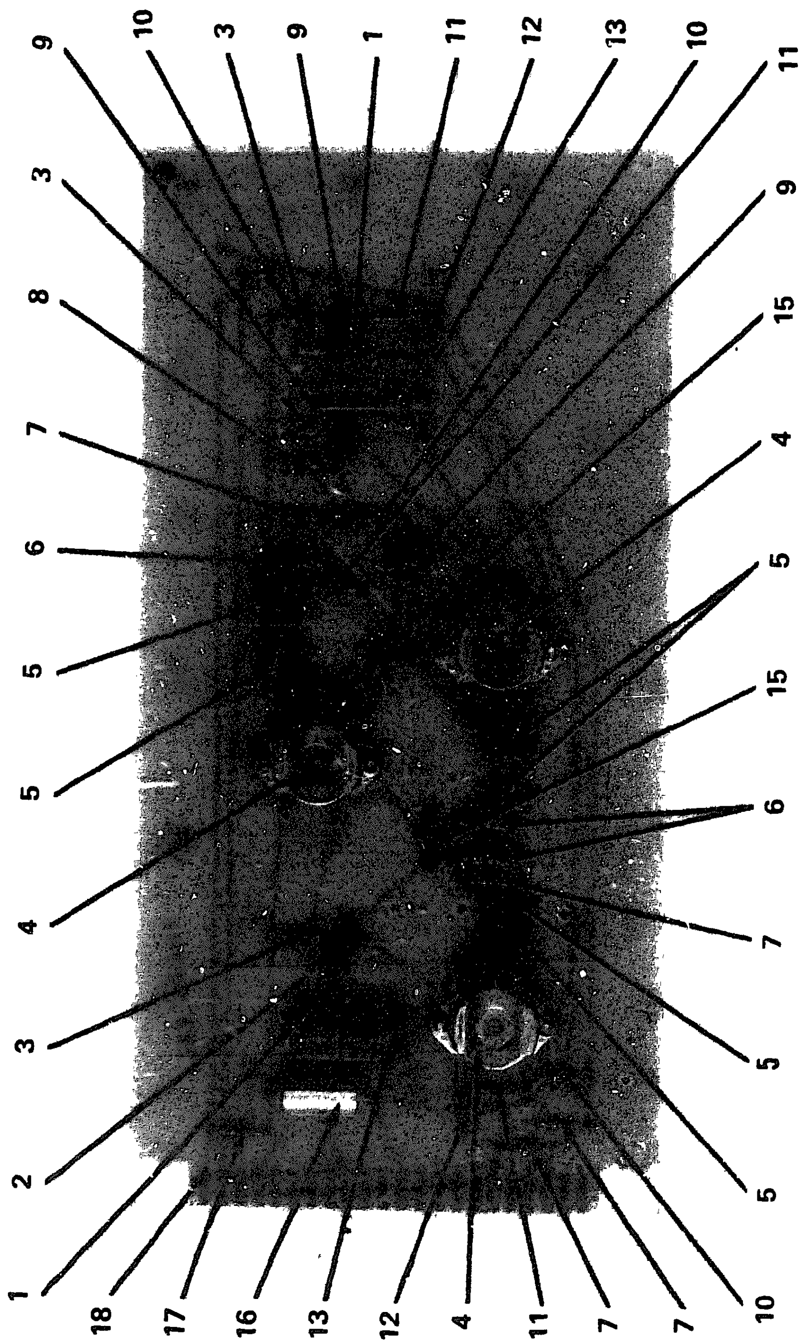


Figure 1-31. Viewing Filter Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-31	3A3	VIEWING FILTER ASSY	10392394	REF	
-1	3A3C9,12	. CAPACITOR, .1 UF, 100VDC (71590)	UK 10-104	2	
-2	3A3Q2	. TRANSISTOR (01295).	2N3702	1	
-3	3A3R6,13, 16	. RESISTOR, 1/4w, 10%, 2.2K (81349)	RC07GF222K	3	
-4	3A3L1,2,3	. CHOKE (24672)	75192521	3	
-5	3A3C2A, 2B,5A, 5B,8A, 8B	. CAPACITOR, 5%,SELECT ONE OF THE FOLLOWING PREFERRED VALUE CAPACITOR FOR EACH:		6	
		390 PF, 500VDC (84171). .	DM15-391J		
		470 PF, 500VDC (84171). .	DM15-471J		
		560 PF, 300VDC (84171). .	DM15-561J		
		680 PF, 300VDC (84171). .	DM15-681J		
		820 PF, 300VDC (84171). .	DM15-821J		
		1000 PF, 100VDC (84171) .	DM15-102J		
-6	3A3C1,4, 7	. CAPACITOR, .0033 UF, 200VDC 10% (56289)	192P33292	3	
-7	3A3R4,10, 18,20	. RESISTOR, 1/4w, 10%, 10K (81349)	RC07GF103K	4	
-8	3A3R12	. RESISTOR, 1/4w, 10%, 56 OHM (81389)	RC07GF560K	1	
-9	3A3Q1,3,4	. TRANSISTOR (01295).	2N3704	3	
-10	3A3R5,9, 15	. RESISTOR, 1/4w, 10%, 1K (81349)	RC07GF102K	3	
-11	3A3R8,17, 19	. RESISTOR, 1/4w, 10%, 100 OHM (81349)	RC07GF101K	3	
-12	3A3C10,13	. CAPACITOR, .01 UF, 100 VDC 10% (56289)	192P10392	2	
-13	3A3R7,14	. RESISTOR, VAR, 1K (80294) .	3067P1-102	2	
-14		. DELETED		.	
-15	3A3C3,6	. CAPACITOR, 220 PF, 500 VDC (84171)	DM15-221J	2	
-16	3A3C11	. CAPACITOR, 100 UF, 10 VDC (80131)	CS13BC107K	1	
-17	3A3R11	. RESISTOR, 1/4w, 10%, 33 OHM (81349)	RC07GF330K	1	
-18		. PCB, VIEWING FILTER	00390831	1	

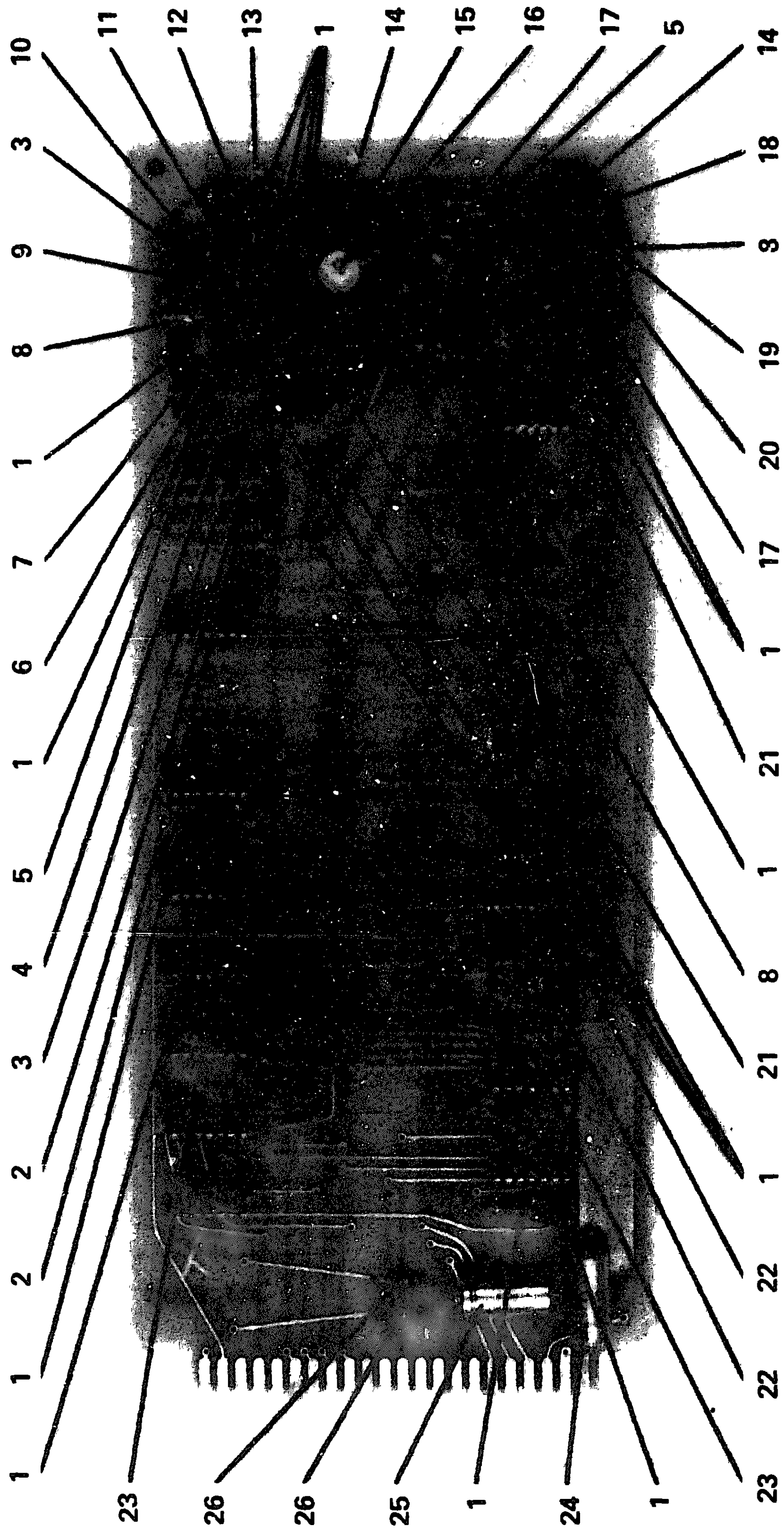


Figure 1-32. Standard Input Assembly (Sheet 1 of 2)

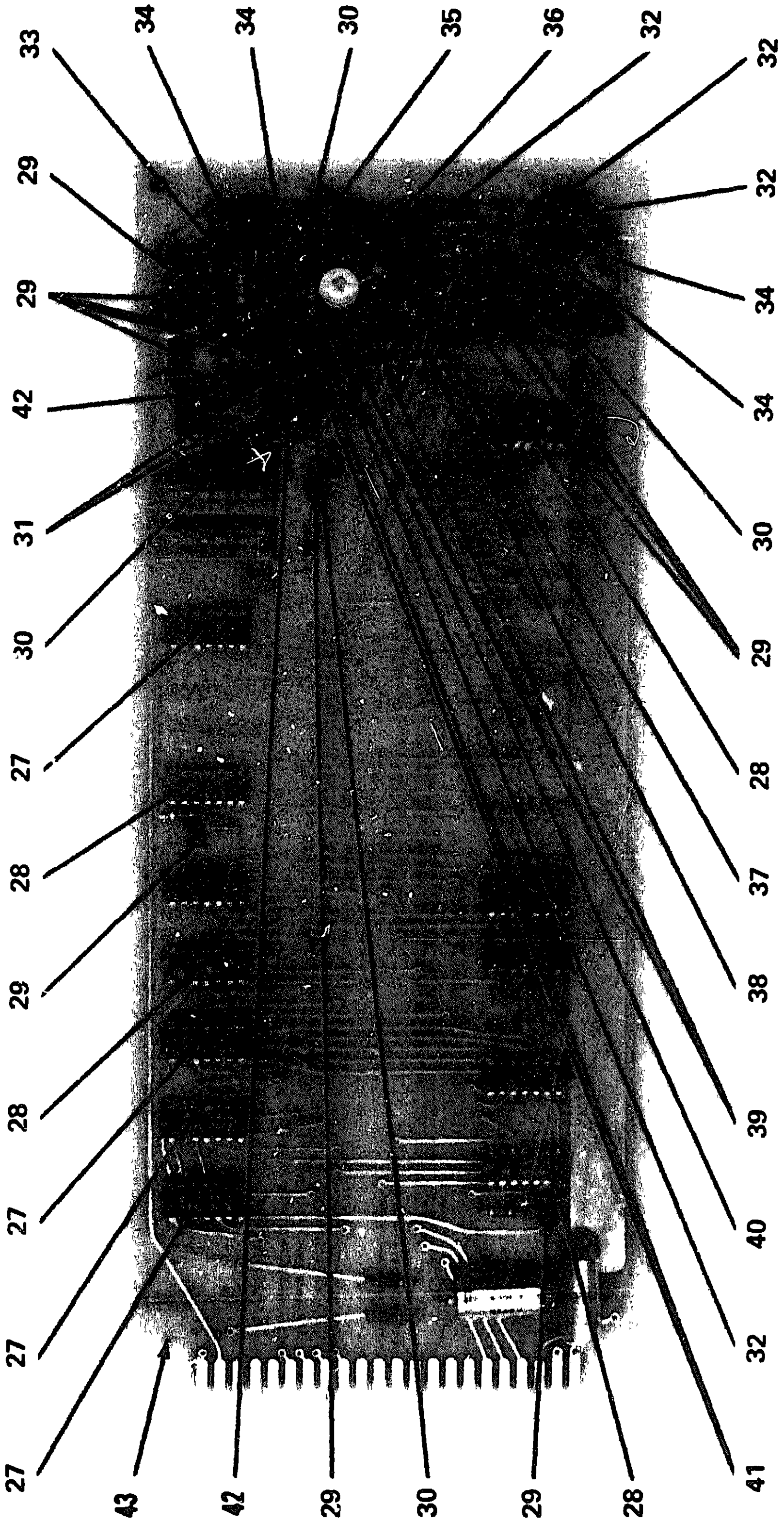


Figure 1-32. Standard Input Assembly (Sheet 2 of 2)

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-32	3A4	STANDARD INPUT ASSY.	10392393	REF	
-1	3A4R7,8, 10,16, 17,18, 20,23,24 25,32, 37,38, 43,46,47	. RESISTOR, ¼W, 10%, 4.7K (81349).	RC07GF472K	16	
-2	3A4R2,27	. RESISTOR, VARIABLE, 5K (80294)	3067P 1-502	2	
-3	3A4R15,22	. RESISTOR, ¼W, 10%, 100 OHM (81349)	RC07GF101K	2	
-4	3A4R28	. RESISTOR, ¼W, 10%, 3.3K (81349).	RC07GF332K	1	
-5	3A4R9,26	. RESISTOR, ¼W, 10%, 22K (81349).	RC07GF223K	2	
-6	3A4C11	. CAPACITOR, .001 UF, 200 VDC 10% (56289).	192P10292	1	
-7	3A4C12	. CAPACITOR, 12 PF, 500 VDC 5% (84171).	DM15-120J	1	
-8	3A4C15,16, 18	. CAPACITOR, 1 UF, 35 VDC, (56289).	CS13BF105K	3	
-9	3A4CR2	. DIODE (01295).	1N914	1	
-10	3A4R21	. RESISTOR, ¼W, 10%, 560 OHM (81349).	RC07GF561K	1	
-11	3A4L2	. INDUCTOR, 18 UF, 10% (99800)	1025-50	1	
-12	3A4R19	. RESISTOR, ¼W, 10%, 2.2K (81349).	RC07GF222K	1	
-13	3A4C20	. CAPACITOR, 1000 PF, 100 VDC 5% (84171)	DM15-102J	1	
-14	3A4C2,8	. CAPACITOR, 68 PF, 500 VDC 5% (72136)	DM15-680J	2	
-15	3A4CR1	. DIODE (04713).	MV1642	1	
-16	3A4C6	. CAPACITOR, VARIABLE, 5.5-18 PF (81349)	CV31-C100	1	
-17	3A4R4,13	. RESISTOR, ¼W, 10%, 470 OHM (81349)	RC07GF471K	2	
-18	3A4R1	. RESISTOR, ¼W, 10%, 680 OHM (81349).	RC07GF681K	1	
-19	3A4C1	. CAPACITOR, 680 PF, 300 VDC,5% (72136).	DM15-681J	1	
-20	3A4R3	. RESISTOR, ¼W, 10%, 6.8K (81349).	RC07GF682K	1	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-32	3A4	Continued			
-21	3A4C3,7	. CAPACITOR, .01 UF, 100 VDC (80183)	TG-S10	2	
-22	3A4U14,15	. INTEGRATED CIRCUIT (01295). .	SN7490N	2	
-23	3A4U21,53	. INTEGRATED CIRCUIT (01295). .	SN7473N	2	
-24	3A4C19	. CAPACITOR, 330 UF, 6 VDC, (81349).	CS13BB337K	1	
-25	3A4C17	. CAPACITOR, 100 UF, 20 VDC, (81349).	CS13BE107K	1	
-26	3A4R40,41	. RESISTOR, ¼W, 10%, 10 OHM (81349).	RC07GF100K	2	
-27	3A4U13,23, 33,83	. INTEGRATED CIRCUIT (01295). .	SN7474N	4	
-28	3A4U11,43, 63,121	. INTEGRATED CIRCUIT (01295). .	SN7400N	4	
-29	3A4Q3,4,7, 8,9,10, 13,15, 16,17,18	. TRANSISTOR (04713).	MPS3646	11	
-30	3A4R6,14, 33,44	. RESISTOR, ¼W, 10%, 1K (81349)	RC07GF102K	4	
-31	3A4C13,14	. CAPACITOR, 75 PF, 500 VDC, 5% (84171).	DM15-750J	2	
-32	3A4R5,11, 12,29,	. RESISTOR, ¼W, 10%, 10K (81349).	RC07GF103K	4	
-33	3A4C10	. CAPACITOR, 47 PF, 500 VDC, 5% (84171).	DM15-470J.	1	
-34	3A4Q1,2,5, 6	. TRANSISTOR (04713).	2N3906	4	
-35	3A4C9	. CAPACITOR, 470 PF, 500 VDC, 5% (84171)	DM15-471J	1	
-36	3A4C4	. CAPACITOR, .0047 UF, 200 VDC 10%, (56289).	192P47292	1	
-37	3A4C5	. CAPACITOR, 22 UF, 35 VDC, (56289)	CS13BF226K	1	
-38	3A4R42	. RESISTOR, ¼W, 10%, 47 OHM (81349)	RC07GF470K	1	
-39	3A4Q11,12	. TRANSISTOR (01295).	2N3704	2	
-40	3A4L1	. INDUCTOR, 2.2 UH, 10% (99800)	1025-32	1	
-41	3A4R30,34	. RESISTOR, ¼W, 10%, 100K (81349).	RC07GF104K	2	
-43		. PCB, STANDARD INPUT	00391912	1	
-42	3A4R31, 45	. RESISTORS, 1/8W, 1%, 12 12.1K (81349)	RN55D1212F	2	

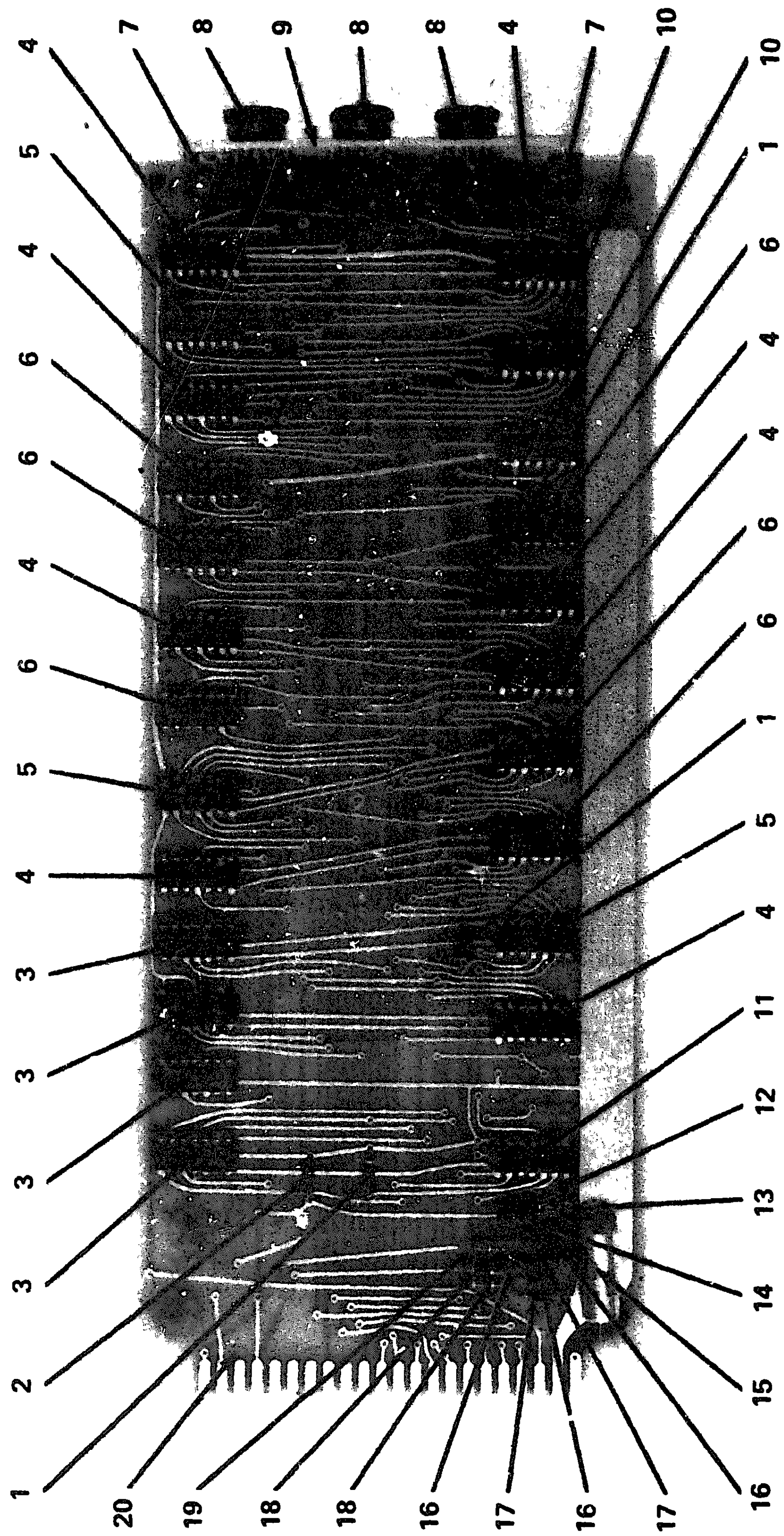


Figure 1-33. GPR Divider Assembly

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-33	3A5	GRP DIVIDER ASSY.	10392392	REF	
-1	3A5R1,2,16	. RESISTOR, ¼W, 10%, 4.7K (81349)	RC07GF472K	3	
-2	3A5R10	. RESISTOR, ¼W, 10%, 1K (81349)	RC07GF102K	1	
-3	3A5U13,23, 33,43	. INTEGRATED CIRCUIT (01295). .	SN7490N	4	
-4	3A5U31,53, 71,81, 83,113, 121,133	. INTEGRATED CIRCUIT (01295). .	SN7400N	8	
-5	3A5U41,63, 123	. INTEGRATED CIRCUIT (01295). .	SN7410N	3	
-6	3A5U51,61, 73,91, 93,103	. INTEGRATED CIRCUIT (01295). .	SN7474N	6	
-7		. BRACKETS (72653).	6261	2	
-8	3A5S1,2,3	. SWITCH, ROTARY (02111). . . .	87-22-10 6915	3	
-9		. PANEL, SWITCH MOUNTING . . .	0039167-1	1	
-10	3A5U101, 111	. INTEGRATED CIRCUIT (01295). .	SN7473N	2	
-11	3A5U11	. INTEGRATED CIRCUIT (01295). .	SN7420N	1	
-12	3A5R9	. RESISTOR, ¼W, 10%, 22K (81349)	RC07GF222K	1	
-13	3A5R11	. RESISTOR, ¼W, 10%, 150 OHM (81349)	RC07GF151K	1	
-14	3A5C4	. CAPACITOR, 12 PF, 500 VDC, 5% (84171)	DM15-120J	1	
-15	3A5C5	. CAPACITOR, 330 UF, 6 VDC (81349)	CS13BB337K	1	
-16	3A5Q3,4,5	. TRANSISTOR (04713).	MPS3646	3	
-17	3A5R12,15	. RESISTOR, ¼W, 10%, 560 OHM (81349)	RC07GF561K	2	
-18	3A5R13,14	. RESISTOR, ¼W, 10%, 47 OHM (81349)	RC07GF470K	2	
-19	3A5R17	. RESISTOR, ¼W, 10%, 1.8K (81349)	RC07GF182K	1	
-20		. PCB, GRP, DIVIDER	0391939	1	

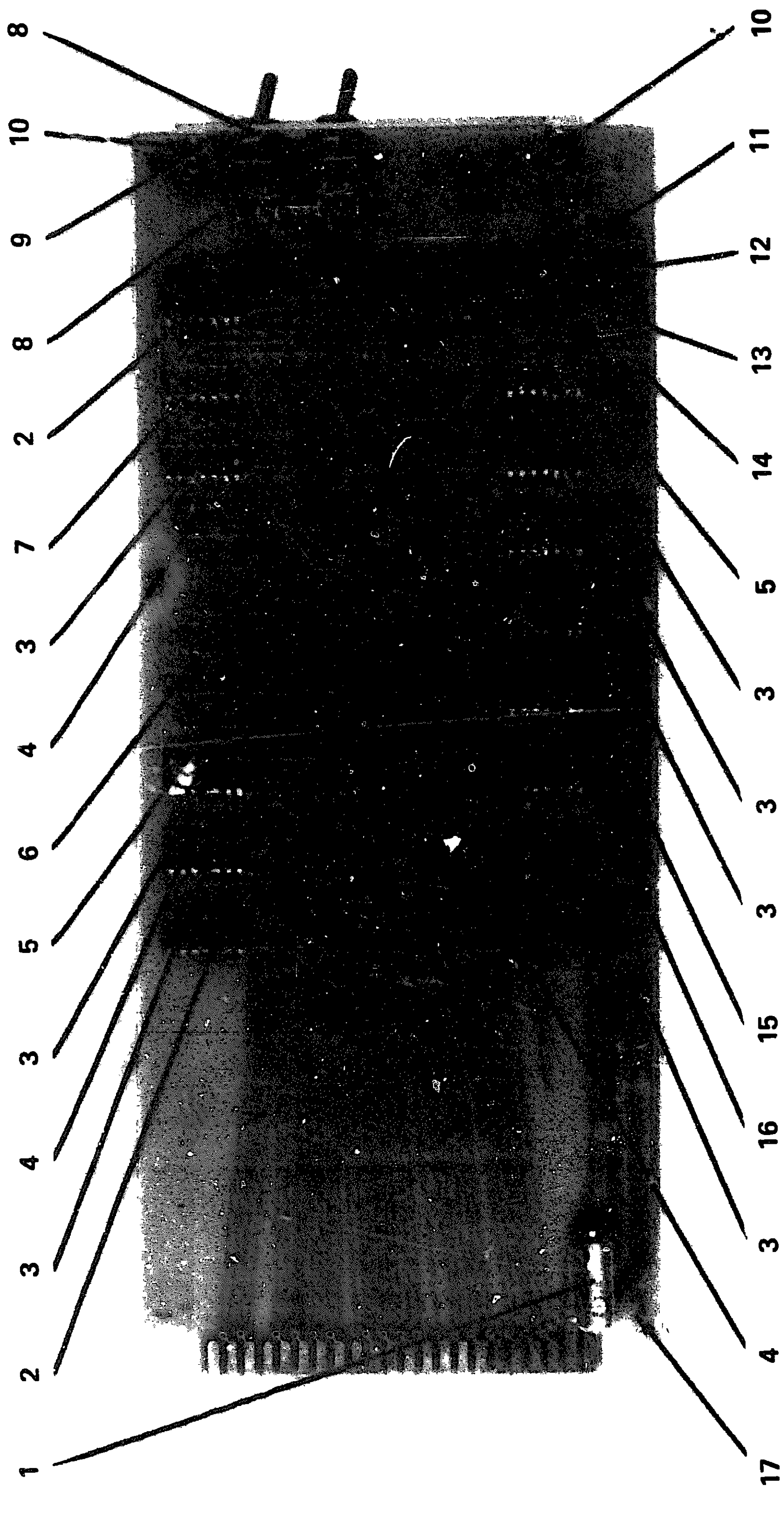


Figure 1-34. Phase Code Assembly

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-34	3A6	PHASE CODE ASSY.	10392391	REF	
-1	3A6C1	. CAPACITOR, 330 UF, 6 VDC (81349).	CS13BB337K	1	
-2	3A6U13,93	. INTEGRATED CIRCUIT (01295) . .	SN747N	2	
-3	3A6U23,31, 33,61,71, 73,81	. INTEGRATED CIRCUIT (01295) . .	SN7400N	7	
-4	3A6R1,2,9	. RESISTOR, ¼W, 10%, 4.7K (81349).	RC07GF472K	3	
-5	3A6R6	. RESISTOR, ¼W, 10%, 1K (81349).	RC07GF102K	1	
-6		. DELETED			
-7	3A6U83	. INTEGRATED CIRCUIT (01295) . .	SN7473N	1	
-8	3A6S1,2	. SWITCH, DPDT, TOGGLE (95146) .	MST205N	2	
-9		. PANEL SWITCH MOUNTING.	00391967-8	1	
-10		. BRACKET (72653).	6261	2	
-11	3A6C2	. CAPACITOR, 12 PF, 500 VDC, 5% (84171)	DM15-120J	1	
-12	3A6R8	. RESISTOR, ¼W, 10%, 2.2K (81349).	RC07GF222K	1	
-13	3A6R10	. RESISTOR, ¼W, 10%, 220 OHM (81349).	RC07GF221K	1	
-14	3A6Q2	. TRANSISTOR (04713)	MPS3646	1	
-15	3A6U51	. INTEGRATED CIRCUIT (01295) . .	SN7420N	1	
-16	3A6U41	. INTEGRATED CIRCUIT (01295) . .	SM7410N	1	
-17		. PCB, PHASE CODE	00391907	1	

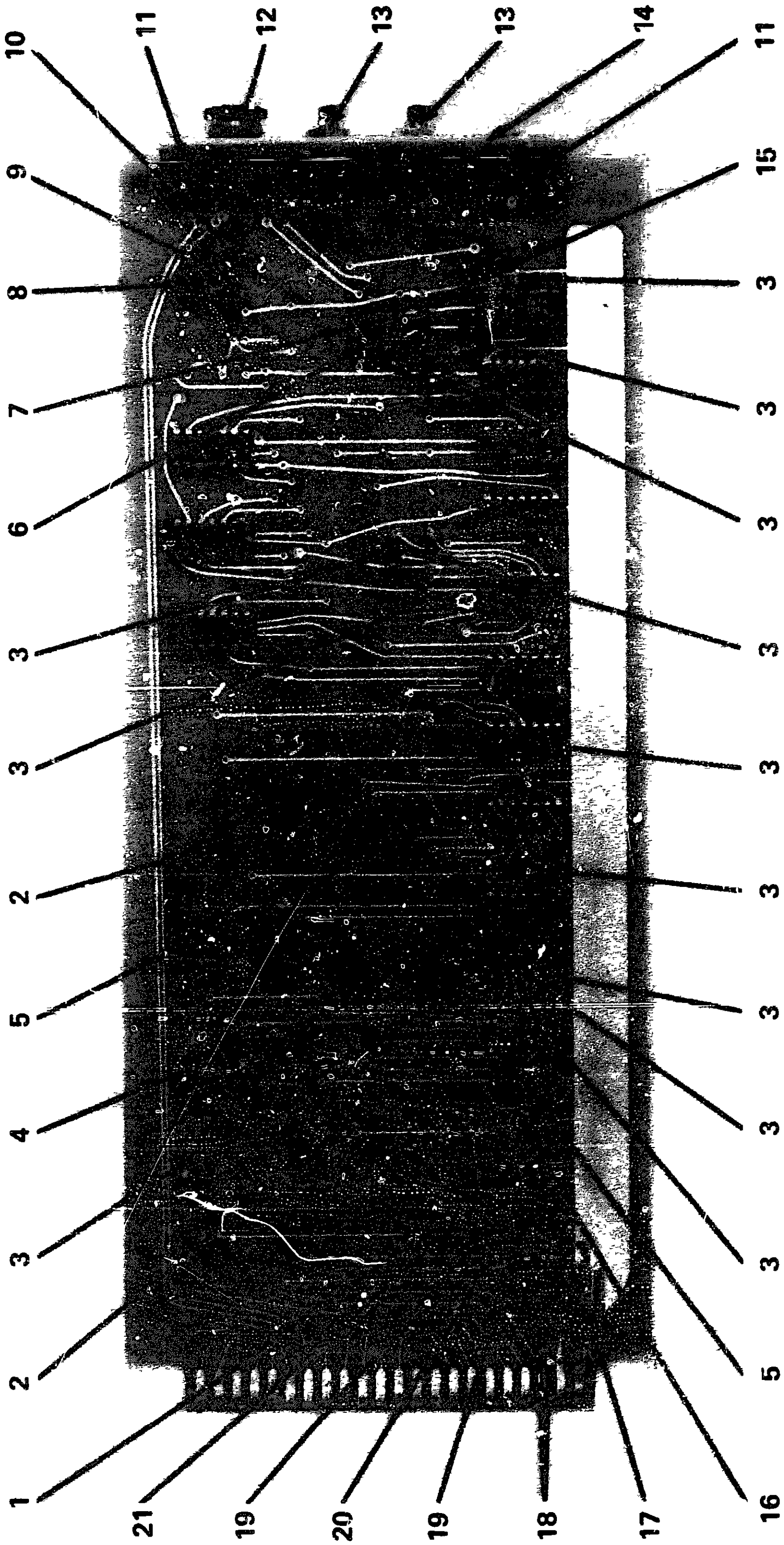


Figure 1-35. Serve Control Assembly (Sheet 1 of 2)

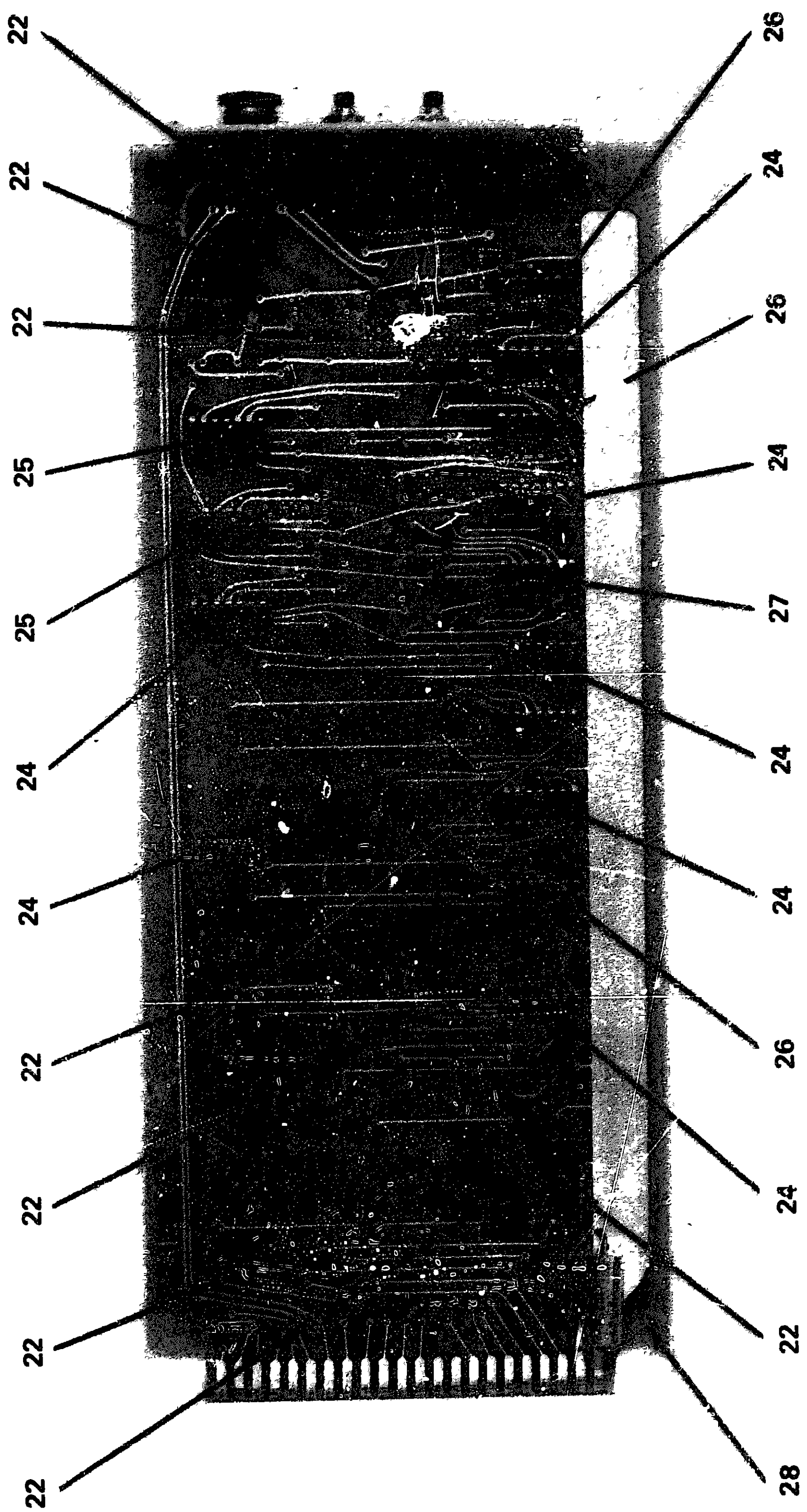


Figure 1-35. Servo Control Assembly {Sheet 2 of 2)

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-35	3A7	SERVO CONTROL ASSY.	10392390	REF	
-1	3A7R24	. RESISTOR, ¼W, 10%, 1.8K (81349)	RC07GF182K	1	
-2	3A7R10	. RESISTOR, ¼W, 10%, 470 OHM (81349).	RC07GF471K	1	
-3	3A7R2,3,5,6 7,8,19,20 29,30,33 34,37,38	. RESISTOR, ¼W, 10%, 4.7K (81349)	RC07GF472K	14	
-4	3A7C3	. CAPACITOR, .01 UF, 100 VDC (80183)	TG-S10	1	
-5	3A7R9	. RESISTOR, ¼W, 10%, 1K (81349)	RC07GF102K	1	
-6	3A7C6	. CAPACITOR, 1 UF, 35 VDC, 20% (56289)	CS13BF105K	1	
-7	3A7R36	. RESISTOR, ¼W, 10%, 10K (81349)	RC07GF103K	1	
-8	3A7R4	. RESISTOR, ¼W, 10%, 15K(81349)	RC07GF153K	1	
-9	3A7C1	. CAPACITOR, 220 PF, 500 VDC, 5% (84171).	DM15-221J	1	
-10	3A7R1	. RESISTOR, ¼W, 10%, 1.5K (81349)	RC07GF152K	1	
-11		. BRACKET (72653)	6261	2	
-12	3A7S1	. SWITCH, ROTARY (02111). . . .	87-22-10	1	
-13	3A7S2,3	. SWITCH, PUSHBUTTON (81073). .	30-1	2	
-14		. PANEL, SWITCH MOUNTING . . .	00391967-3	1	
-15	3A7R35	. RESISTOR, ¼W, 10%, 100K (81349).	RC07GF104K	1	
-16	3A7C5	. CAPACITOR, 12 PF, 500 VDC, 5% (72136)	DM15-120J	1	
-17	3A7C2	. CAPACITOR, 330 UF, 6 VDC (81349).	CS13BB337K	1	
-18	3A7R26,27	. RESISTOR, ¼W, 10%, 47 OHM (81349)	RC07GF470K	2	
-19	3A7R28,32	. RESISTOR, ¼W, 10%, 560 OHM (81349)	RC07GF561K	2	
-20	3A7R25	. RESISTOR, ¼W, 10%, 150 OHM (81349)	RC07GF151K	1	
-21	3A7R23	. RESISTOR, ¼W, 10%, 2.2K (81349)	RC07GF222K	1	
-22	3A7Q1,2,3 5 THRU 9	. TRANSISTOR (04713).	MPS3646	8	
-23		DELETED			
-24	3A7U21,41,	. INTEGRATED CIRCUIT (01295). .	SN7400N		

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-35-25	3A7U83,93	. INTEGRATED CIRCUIT (01295). .	SN7410N	2	
-26	3A7U31,91, 111	. INTEGRATED CIRCUIT (01295). .	SN7474N	3	
-27	3A7U71	. INTEGRATED CIRCUIT (01295). .	SN7420N	1	
-28		. PCB, SERVO CONTROL	00391955	1	

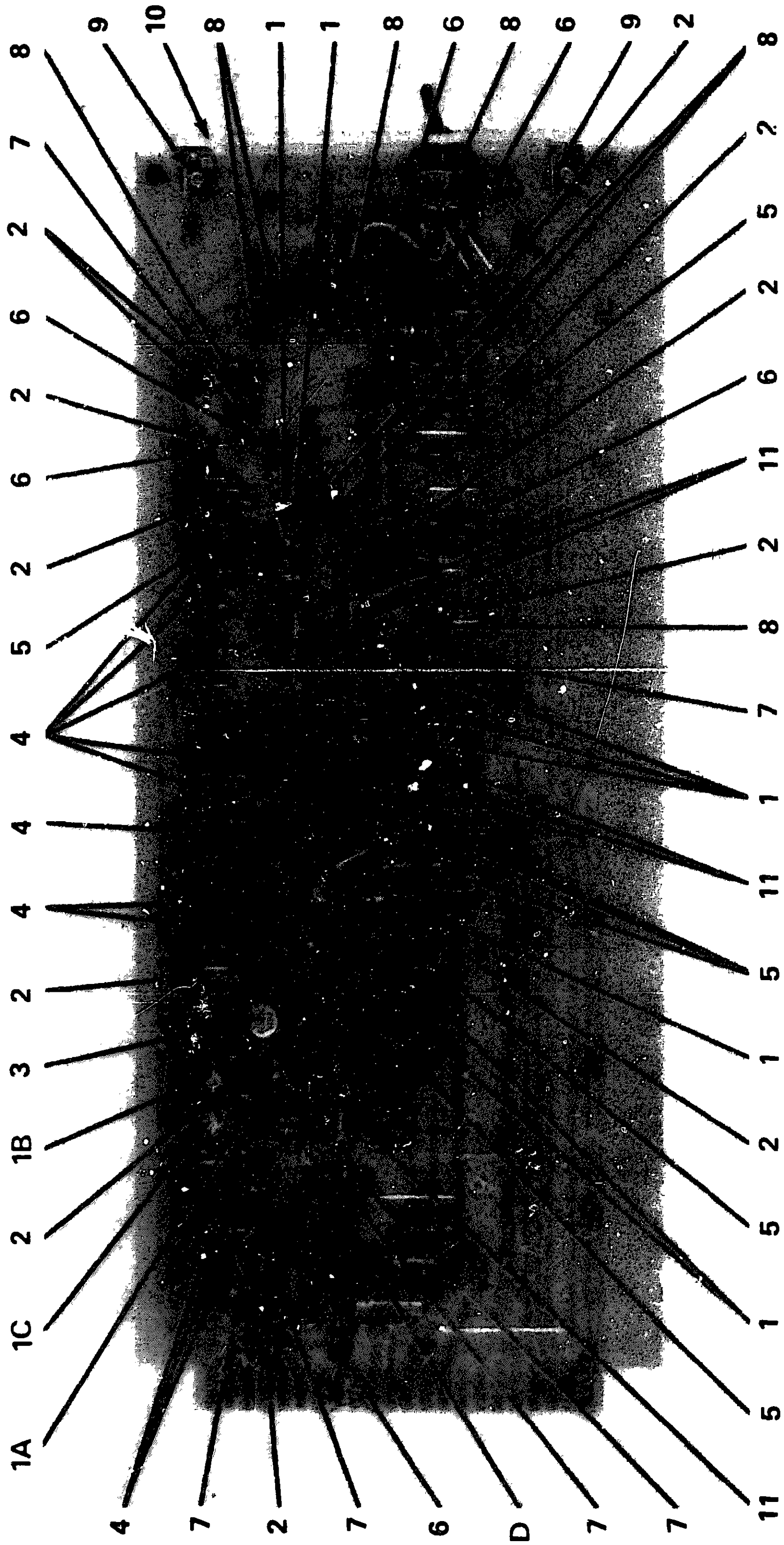


Figure 1-36. Amplitude Strobe Assembly (Sheet 1 of 3)

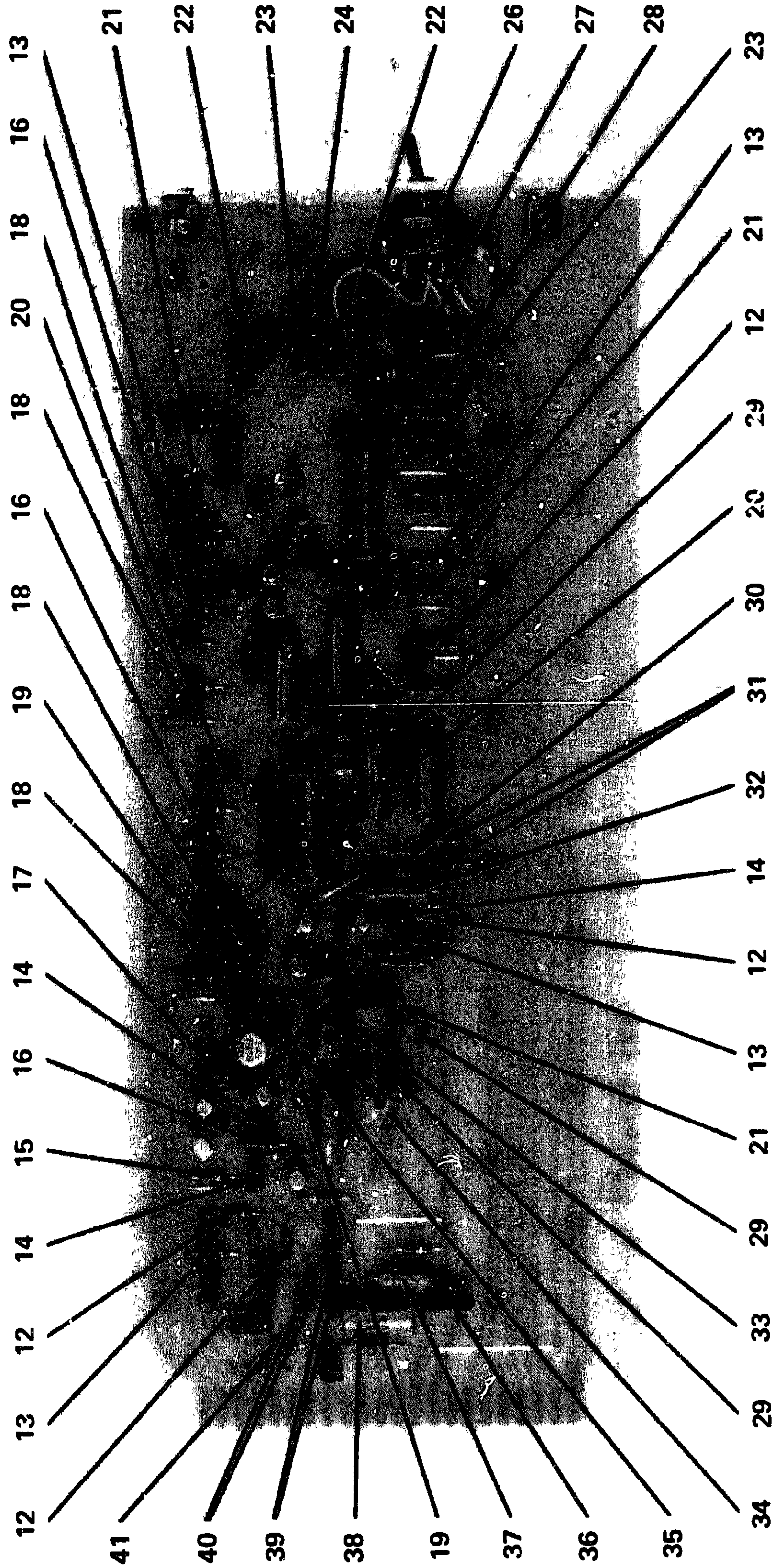


Figure 1-36. Amplitude Strobe Assembly (Sheet 2 OF 3)

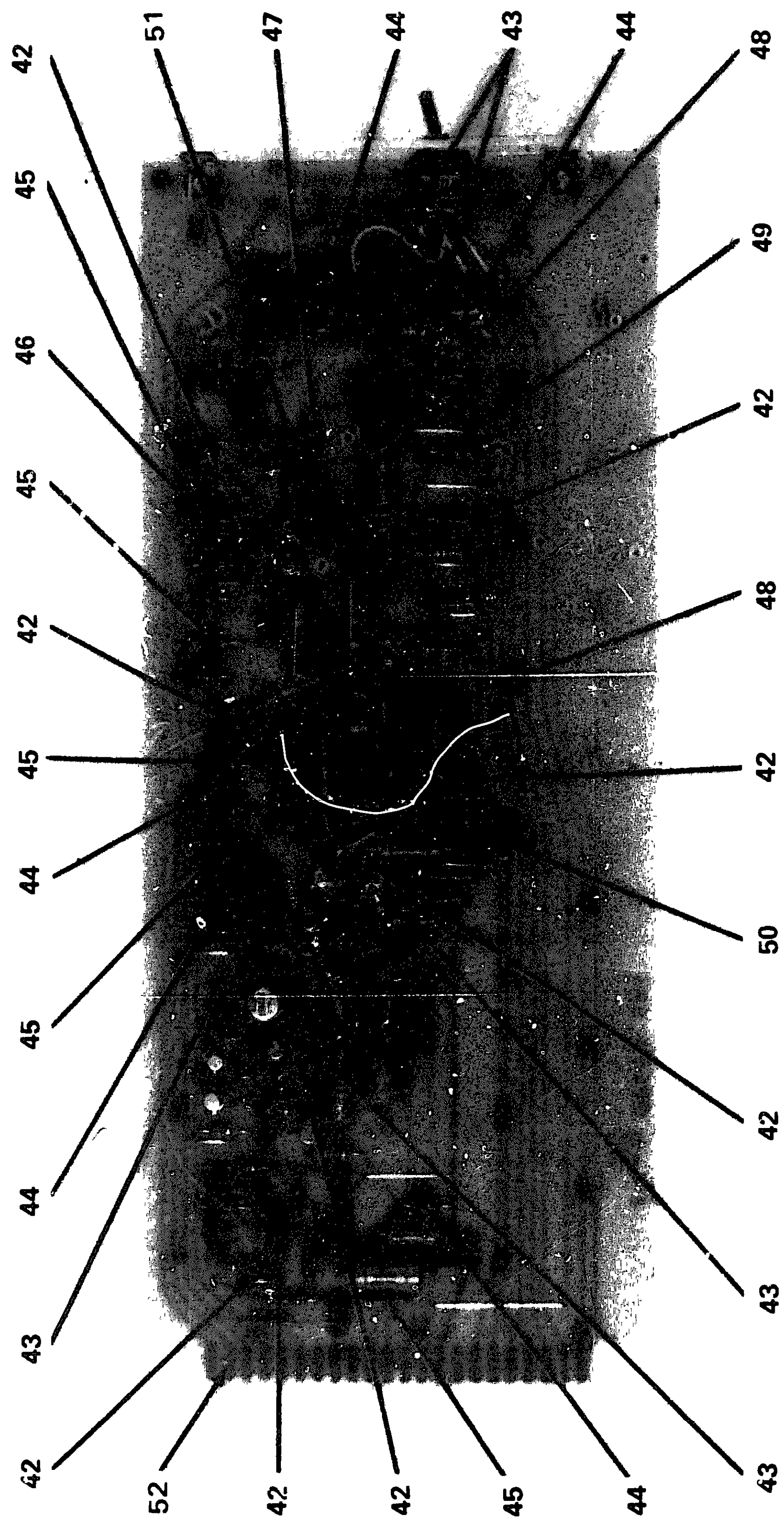


Figure 1-36. Amplitude Strobe Assembly (Sheet 3 of 3)

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-36	3A8	AMPLITUDE STROBE ASSY. . . .	10392388	REF	
-1	3A8Q5,6,7 8,9,12, 13,40	. TRANSISTOR (04713)	2N4220	8	
-1A	3A8Q4	. TRANSISTOR (24672)	7022N4220-2A	1	
-1B	3A8Q11	. TRANSISTOR (24672)	7022N4220-2B	1	
-1C	3A8Q29	. TRANSISTOR (24672)	7022N4220-4	1	
-1D	3A8Q37	. TRANSISTOR (24672)	7022N4220-3	1	
-2	3A8R1,8, 11,32,39 40,41,43 48,70,75 78	. RESISTOR, 1/4W, 10% 560 OHM (81349)	RC07GF560K	12	
-3	3A8U1	. INTEGRATED CIRCUIT (07263)	U5B7709393	1	
-4	3A8Q26,27 28,30,31 32,33,34 35,36,44	. TRANSISTOR (04713)	MPS3646	11	
-5	3A8R14,16 20,21,28 29,74	. RESISTOR, 1/4W, 10%, 22M (81349)	RC07GF226K	7	
-6	3A8Q1, 16 17,18,24 25	. TRANSISTOR (01295)	2N3704	6	
-7	3A8R17,23 27,38,53 54	. RESISTOR, 1/4W, 10%, 4.7K (81349)	RC07GF472K	6	
-8	3A8Q10,14 15,19,20 21,22,23	. TRANSISTOR, (01295). . . .	2N3702	8	
-9		. BRACKETS (72653)	6261	2	
-10		. PANEL, SWITCH MOUNTING . .	003919674	1	
-11	3A8C13,14 15,16,27	. CAPACITOR, 22UF, 35 VDC, (56289)	CS13BF226K	5	
-12	3A8R26,55 57,73	. RESISTOR, 1/4W, 10%, 2.7K (81349)	RC07GF272K	4	
-13	3A8R37,56 76,79	. RESISTOR, 1/4W, 10%, 10K (81349)	RC07GF103K	4	
-14	3A8Q38,39 41	. TRANSISTOR, (04713) . . .	2N3906	3	

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-36 -15	3A8R71	. RESISTOR, 1/4W, 10%,(81349) SELECT ONE OF THE FOLLOWING PREFERRED VALUE RESISTORS:		1	
		560 OHM	RC07GF561K		
		680 OHM	RC07GF681K		
		820 OHM	RC07GF821K		
		1K	RCO7GF102K		
		1.2K	RC07GF122K		
		1.5K	RC07GF152K		
		1.8K	RC07GF182K		
		2.2K	RC07GF222K		
-16	3A8R24,62 68	. RESISTOR, 1/4W, 10%, 22K (81349)	RC07GF223K	3	
-17	3A8C6	. CAPACITOR, 680 PF, 300 VDC 5%, (72136)	DM15-681J	1	
-18	3A8R60,61 65,66	. RESISTOR, 1/4W, 10%, 330OHM (81349)	RC07GF331K	4	
-19	3A8C22,23	. CAPACITOR, .01 UF, 100 VDC (80183)	TG-S10	2	
-20	3A8C25,26	. CAPACITOR, 22 PF, 500 VDC 5%, (80131)	DM15-220J	2	
-21	3A8R22,30 33	. RESISTOR, 1/4W, 10%, 100K (81349)	RCO7GF104K	3	
-22	3A8R42,46	. RESISTOR, 1/4W, 10%, 47K (81349)	RC07GF473K	2	
-23	3A8R44,50	. RESISTOR, 1/4W, 10%, 18K (81349)	RCO7GF183K	2	
-24	3A8C19	. CAPACITOR, 1 UF, 35 VDC (56289)	CS13BF105K	1	
-25		DELETED			
-26	3A8S1	. SWITCH, DPDT, TOGGLE (95146	MST205N	1	
-27	3A8R52	. RESISTOR, 1/4W, 10%, 3.9K (81349)	RC07GF392K	1	
-28	3A8R34	. RESISTOR, 1/4W, 10%, 1.5K (81349)	RC07GF152K	1	
-29	3A8R7, 13 77	. RESISTOR, 1/4W, 10%, 560 OHM, (81349)	RC07GF561K	3	
-30	3A8R12	. RESISTOR, 1/4W, 10%, 27K (81349)	RCO7GF273K	1	
-31	3A8R15,25	. RESISTOR, 1/4W, 10%, 8.2K (81349)	RC07GF822K	2	
-32	3A8C12	. CAPACITOR, .022 UF, 200 VD(10%, (56289)	192P22392	1	
-33	3A8C4	. CAPACITOR, .22 UF, 200 VDC 5%, (09134)	31-224C5	1	

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-36 -34	3A8C7	. CAPACITOR, 1 UF, 200 VDC 5%, (09134)	31-105C5	1	
-35	3A8C5	. CAPACITOR, 47 PF, 500 VDC 5%, (84171)	DM15-470J	1	
-36	3A8C2	. CAPACITOR, 220 PF, 500 VDC, 5%, (84171)	DM15-221J	1	
-37	3A8C3	. CAPACITOR, .0056 UF, 200 VDC, 10%, (56289) . . .	192P56292	1	
-38	3A8C1	. CAPACITOR, .1 UF, 200 VDC 10%, (56289).	192P10492	1	
-39	3A8Q2,3	. TRANSISTOR (04713) . . .	2N5555	2	
-40	3A8R4,6	. RESISTOR, 1/4W, 10%, 56K (81349)	RC07GF563K	2	
-41	3A8R2	. RESISTOR, 1/4W, 10%, 820 OHM, (81349)	RC07GF821K	1	
-42	3A8C8,9 10,11,17 18,20,21	. CAPACITOR, 12 PF, 500 VDC (84171)	DM15-120J	8	
-43	3A8R10,31 45,49,72	. RESISTOR, 1/4W, 10%, 1K (81349)	RC07GF102K	5	
-44	3A8R9,47 51,58,63	. RESISTOR, 1/4W, 10%, 12K (81349)	RC07GF123K	5	
-45	3A8R3,59 64,67,69	. RESISTOR, 1/4W, 10%, 2.2K (81349)	RC07GF222K	5	
-46	3A8C24	. CAPACITOR, .1UF, 10 VDC (71590)	UK-10-104	1	
-47	3A8R35	. RESISTOR, 1/4W, 10%, 120K (81349)	RC07GF124K	1	
-48	3A8R19,36	. RESISTOR, VARIABLE, 100K (80294)	3068P1-104	2	
-49	3A8R80	. RESISTOR, 1/4W, 10%, 1.2K (81349)	RC07GF122K	1	
-50	3A8R18	. RESISTOR, 1/4W, 10%, 12M (81349)	RC07GF126K	1	
-51		. HEAT SINK CLIP (05820). .	256-D	1	
-52		. PCB, AMPLITUDE STROBE . .	00390830	1	

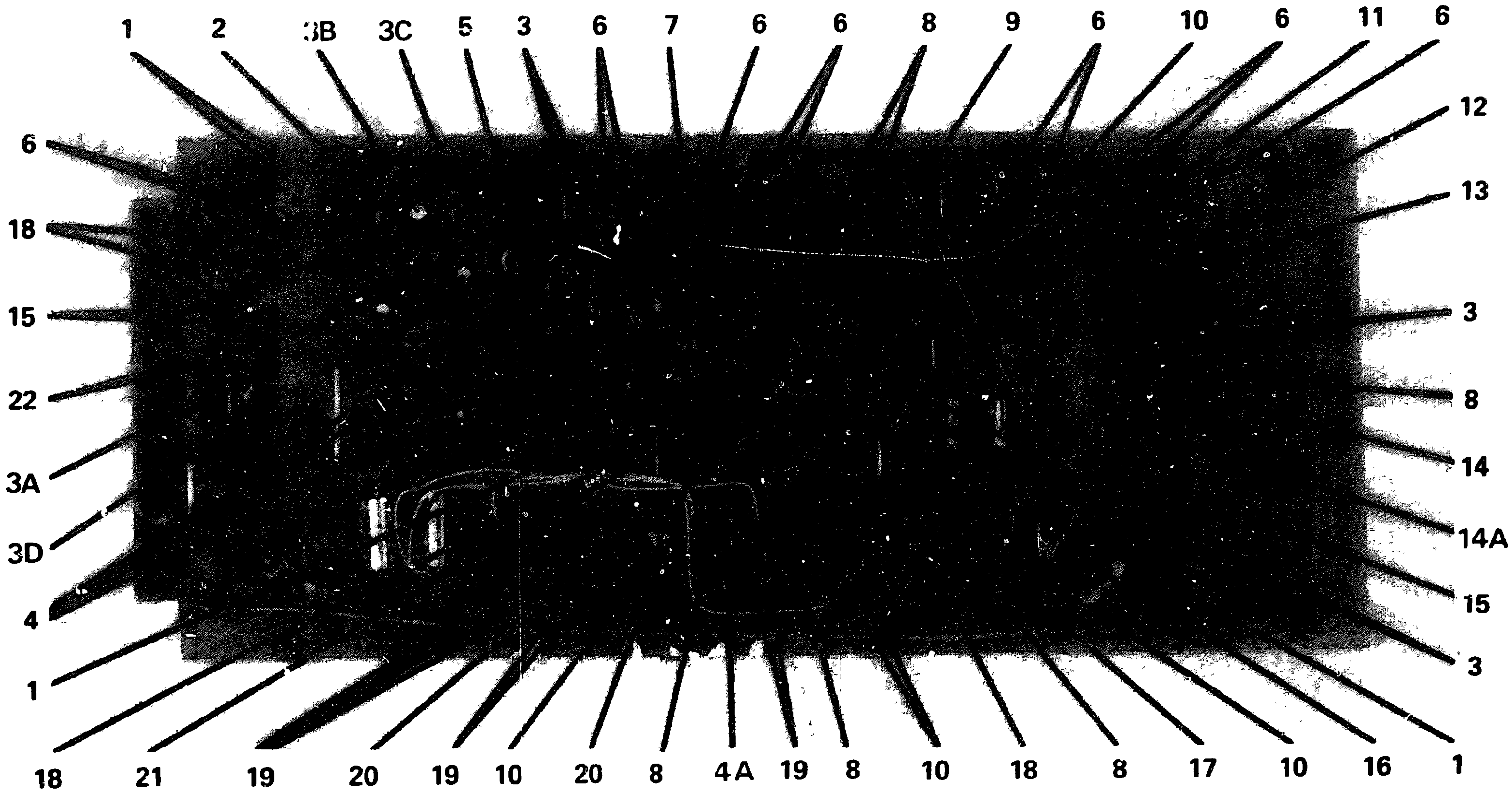


Figure 1-37. Phase Strobe Assembly (Sheet 1 of 3)

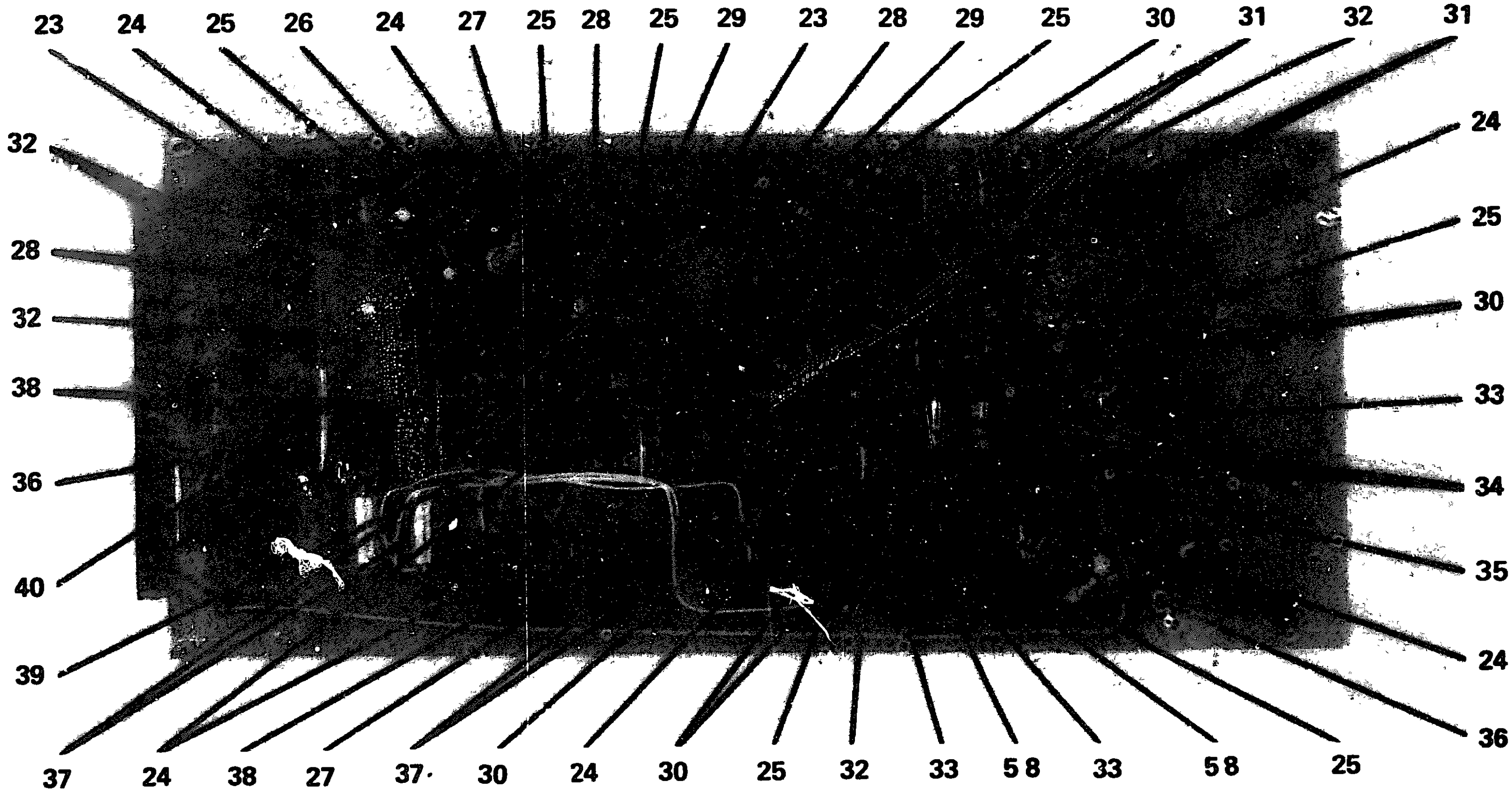


Figure 1-37. Phase Strobe Assembly (Sheet 2 of 3)

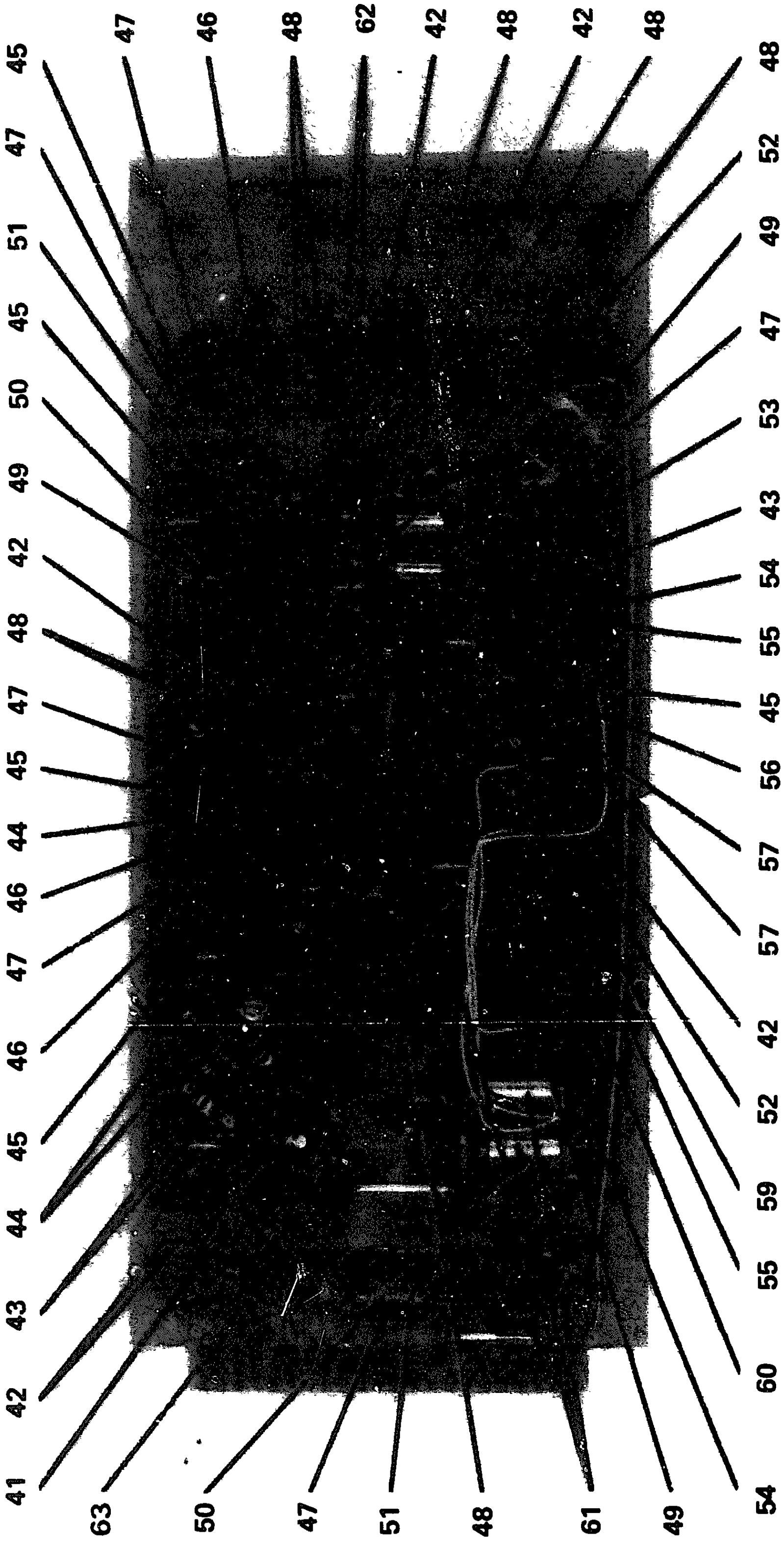


Figure 1-37. Phase Strobe Assembly (Sheet 3 of 3)

Fig. & Index No.	Ref. Design	DESCRIPTION	Part No.	Units Per Assy.	Usable on Code
1-37	3A9	PHASE STROBE ASSY.	10392386	REF	
-1	3A9Q8,9,46 51	. TRANSISTOR (04713)	2N3906	4	
-2	3A9R23	. RESISTOR, 1/4W, 10%, SELECT ONE OF THE FOLLOWING:		1	
		560 OHM (81349)	RC07GF561K		
		680 OHM (81349)	RC07GF681K		
		820 OHM (81349)	RC07GF821K		
		1 K (81349)	RC07GF102K		
		1.2K (81349)	RC07GF122K		
		1.5K (81349)	RC07GF152K		
		1.8K (81349)	RC07GF182K		
		2.2K (81349)	RC07GF222K		
-3	3A9Q4,5,6, 7,14,15, 45,50	. TRANSISTOR (04713)	2N4220	8	
-3A	3A9Q3	. TRANSISTOR (24672)	7022N4220-3	1	
-3B	3A9Q47	. TRANSISTOR (24672)	7022N4220-4	1	
-3C	3A9Q48	. TRANSISTOR (24672)	7022N4220-2B	1	
-3D	3A9Q49	. TRANSISTOR (24672)	7022N4220-2A	1	
-4	3A9C1,2,24, 25	. CAPACITOR, .01 UF, 100 VDC, (80183).	TG-S10	4	
-4A	3A9C30	. CAPACITOR, 0.1 UF, 10 VDC, (71590).	UK-10-104	1	
-5	3A9U1	. INTEGRATED CIRCUIT (07263) .	U5B7709393	1	
-6	3A9Q13,20 21,22,23, 24,25,26, 27,28,29, 30,31	. TRANSISTOR (04713)	MPS95846	13	
-7	3A9R14	. RESISTOR, VARIABLE, 100 K (80294).	3068P1-104	1	
-8	3A9Q10,11, 16,17,34, 37,39	. TRANSISTOR (01295)	2N3702	7	
-9	3A9R33	. RESISTOR, 1/4W, 10%, 270 K (81349).	RC07GF274K	1	
-10	3A9C19,28, 29,36,37	. CAPACITOR, 1000 PF, 100 VDC, 5%, (84171).	DM15-102J	5	
-11	3A9R69	. RESISTOR, 1/4W, 10%, 15K (81349).	RC07GF153K	1	
-12	3A9R46	. RESISTOR, 1/8W, 1%, 14.7 K (81349).	RN55D1473F	1	
-13	3A9R47	. RESISTOR, 1/8W, 1%, 4.87 K (81349).	RN55D4871F	1	

Fig. & Index No.	Ref. Design	DESCRIPTION	Part No.	Units Per Assy.	Usable on Code
1-37	3A9	Continued			
-14	3A9R48	. RESISTOR, 1/8W, 1%, SELECT ONE OF THE FOLLOWING:		1	
		4.02K (81349).	RN55D4021F		
		4.12K (81349).	RN55D4121F		
		4.22K (81349).	RN55D4221F		
		4.32K (81349).	RN55D4321F		
		4.42K (81349).	RN55D4421F		
		4.53K (81349).	RN55D4531F		
		4.64K (81349).	RN55D641F		
		4.75K (81349).	RN55D4751F		
		4.87K (81349).	RN55D4871F		
		4.99K (81349).	RN55D4991F		
		5.11K (81349).	RN55D5111F		
		5.23K (81349).	RN55D5231F		
		5.36K (81349).	RN55D5361F		
		5.49K (81349).	RN55D5491F		
		5.62K (81349).	RN55D621F		
		5.76K (81349).	RN55D761F		
		5.90K (81349).	RN55D5901F		
		6.04K (81349).	RN55D6041F		
-14A	3A9R49	. RESISTOR, 1/8W, 1%, SELECT ONE OF THE FOLLOWING:		1	
		8.06K (81349).	RN55D8061F		
		8.25K (81349).	RN55D8251F		
		8.45K (81349).	RN55D8451F		
		8.66K (81349)	RN55D8661F		
		8.87K (81349).	RN55D8871F		
		9.09K (81349).	RN55D9091F		
		9.31K (81349).	RN55D9311F		
		9.53K (81349).	RN55D9531F		
		9.76K (81349).	RN55D9761F		
		10.0K (81349).	RN55D1002F		
-15	3A9R8,15, 37	. RESISTOR, 1/4W, 10%, 5.6 K (81349).	RC07GF563K	3	
-16	3A9T1	. TRANSFORMER.	7S192520	1	
-17	3A9C7	. CAPACITOR, 470 PF, 500 VDC, 5%, (84171).	DM15-471J	1	
-18	3A9R4,5,7(86	. RESISTOR, 1/4W, 10%, 2.7K (81349).	RC07GF272K	4	
-19	3A9CR1 THRU 8	. DIODE (01295).	1N914	8	
-20	3A9R10 ,9	. RESISTOR, 1/4W, 10%, 47 K (81349).	RC07GF473K	2	
-21	3A9R17	. RESISTOR, 1/4W, 10%, 12 M (81349).	RC07GF126K	1	
-22	3A9Q1,2	. TRANSISTOR (04713)	2N5555	2	
-23	3A9R56,63	RESISTOR, 1/4W, 10%, 22 K (81349).	RC07GF223K	2	

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-37 -24	3A9R6,16, 21,22, 55,81,93	. RESISTOR, ¼W, 10%, 1K (81349)	R07GF102K	7	
-25	3A9R18,28, 45,72, 73,79, 106	. RESISTOR, ¼W, 10%, 56 OHM (81349)	RC07GF560K	7	
-26	3A9C10	. CAPACITOR, 330 PF, 500 VDC, 5% (84171)	DM15-331J	1	
-27	3A9C9,33	. CAPACITOR, 18 PF, 500 VDC, 5% (84171)	DM15-180J	2	
-28	3A9C12,13, 22,23	. CAPACITOR, 12 PF, 500 VDC, 5% (84171).	DM15-120J	4	
-29	3A9C42,43	. CAPACITOR, 22 PF, 500 VDC, 5% (80131).	DM15-220J	2	
-30	3A9Q12,18, 19,32,33, 35,36,38	. TRANSISTOR (01295).	2N3704	8	
-31	3A9R24,25, 29,34,35	. RESISTOR, ¼W, 10%, 5.6K (81349)	RC07GF562K	5	
-32	3A9R2,51, 52,53,67 78	. RESISTOR, ¼W, 10%, 4.7K (81349)	RC07GF472K	6	
-33	3A9R50,74, 75	. RESISTOR, ¼W, 10%, 150 OHM (81349)	RC07GF151K	3	
-34	3A9C15,20, 21	. CAPACITOR, 6.8 UF, 35 VDC (80131)	CS13BE685K	3	
-35	3A9R111	. RESISTOR,1/4W, 10%, 1.2K (81349).	RC07GF122K	1	
-36	3A9R3,104	. RESISTOR, ¼W, 10%, 12K (81349)	RC07GF123K	2	
-37	3A9R85,87, 88,89	. RESISTOR, ¼W, 10%, 100 OHM (81349).	RC07GF101K	4	
-38	3A9R9,57, 94,107	. RESISTOR, ¼W, 10%, 560 OHM (81349)	RC07GF561K	4	
-39	3A9R26	. RESISTOR, ¼W, 10%, 33K (81349).	RC07GF333K	1	
-40	3A9C4	. CAPACITOR, 220 PF, 500 VDC, 5% (84171)	DM15-221J	1	
-41	3A9C6,11	. CAPACITOR, 22 UF, 35 VDC, (56289)	CS13BE226K	2	
-42	3A9R27,38, 40,54, 83,90	. RESISTOR, ¼W, 10%, 10K (81349)	RC07GF103K	6	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable On Code
1-37					
-43	3A9C8,27, 41	. CAPACITOR, .022 UF, 200 VDC 10%, (56289)	192P22392	3	
-44	3A9R11,12, 13	. RESISTOR, ¼W, 10%, 22M (81349)	RC07GF26K	3	
-45	3A9R58,60, 65,66,82	. RESISTOR, ¼W, 10%, 8.2K (81349)	RC07GF822K	5	
-46	3A9R31,59, 62	. RESISTOR, ¼W, 10%, 330 OHM (81349)	RC07GF331K	3	
-47	3A9R1,61, 64,68, 70,71	. RESISTOR, ¼W, 10%, 2.2K (81349)	RC07GF222K	6	
-48	3A9R7,19, 20,36, 39,41, 42,43,44	. RESISTOR, ¼W, 10%, 100K (81349)	RC07GF104K	9	
-49	3A9R30,32, 92	. RESISTOR, ¼W, 10%, 6.8K (81349)	RC07GF682K	3	
-50	3A9C3,16	. CAPACITOR, .1 UF, 200 VDC,10% (56289)	192P10492	2	
-51	3A9C5,17	. CAPACITOR, .0056 UF, 200 VDC 10%, (56289).	192P56292	2	
-52	3A9C18,34	. CAPACITOR, 1 UF, 35 VDC (56289)	CS13BF105K	2	
-53	3A9R110	. RESISTOR, ¼W, 10%, 10 OHM (81349)	RC07GF100K	1	
-54	3A9C26,35	. CAPACITOR, 82 PF, 500 VDC,5% (84171)	DM15-820J	2	
-55	3A9R77,84	. RESISTOR, ¼W, 10%, 3.9K (81349).	RC07GF392K	2	
-56	3A9R80	. RESISTOR, ¼W, 10%, 33 OHM (81349)	RC07GF330K	1	
-57	3A9R105, 108	. RESISTOR, ¼W, 10%, 220 OHM (81349)	RC07GF221K	2	
-58		. BEAD, FERRITE (02114)	5659065/3B	2	
-59	3A9R91	. RESISTOR, ¼W, 10%, 3.3K (81349)	RC07GF332K	1	
-60	3A9VR1	. DIODE ZENER (04713)	1N4733	1	
-61	3A9C14,31, 32	. CAPACITOR, 100 UF, 10 VDC (80131)	CS13BC107K	3	
-62	3A9	. HEAT SINK CLIP (05820). .	256-D	2	
-63		. PCB, PHASE STROBE	00390829	1	

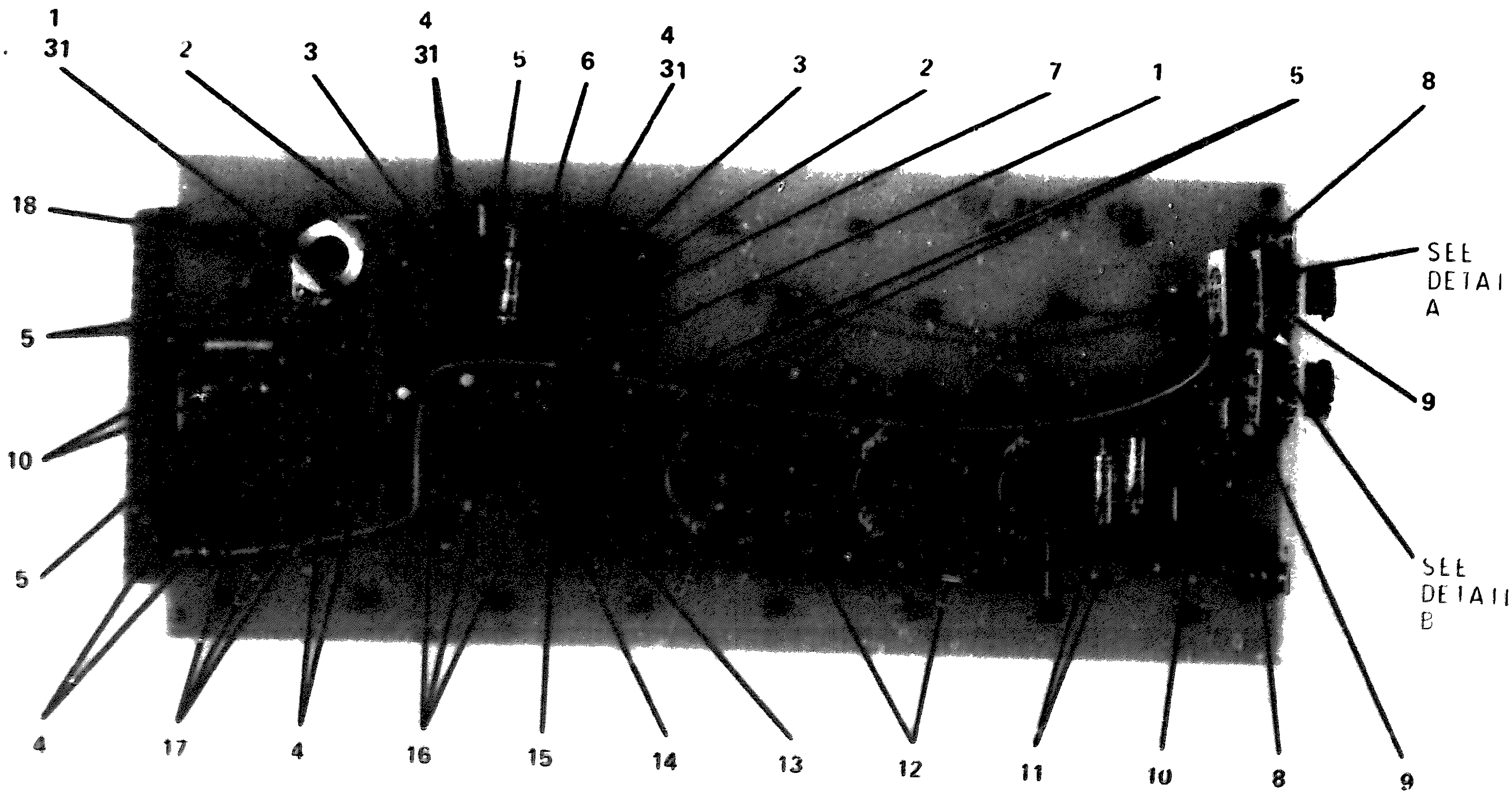


Figure 1-38. RF Amplifier Assembly (Sheet 1 of 3)

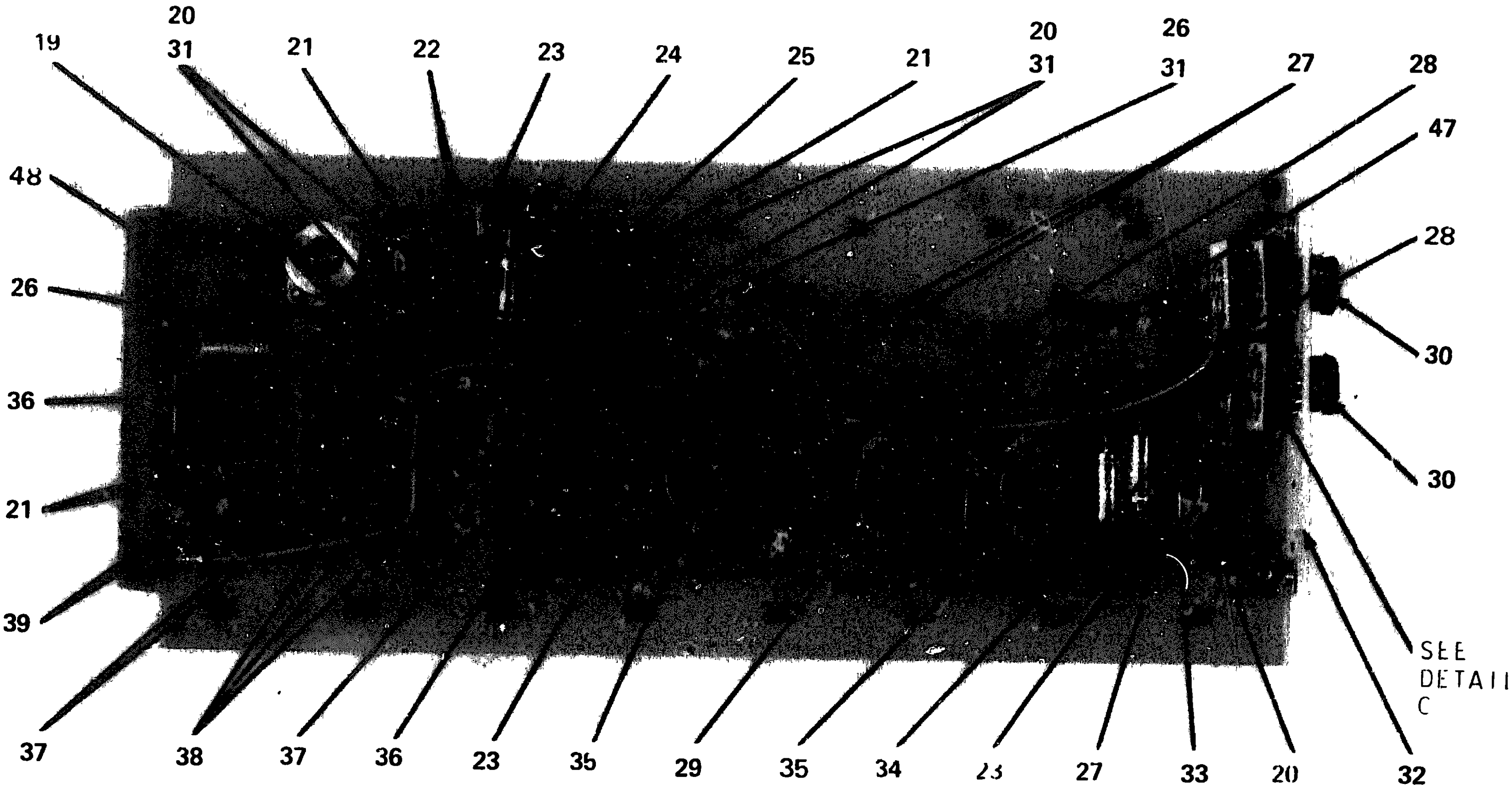
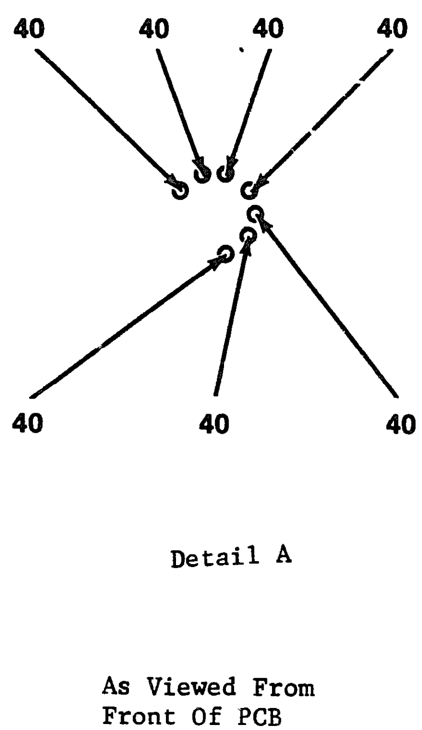
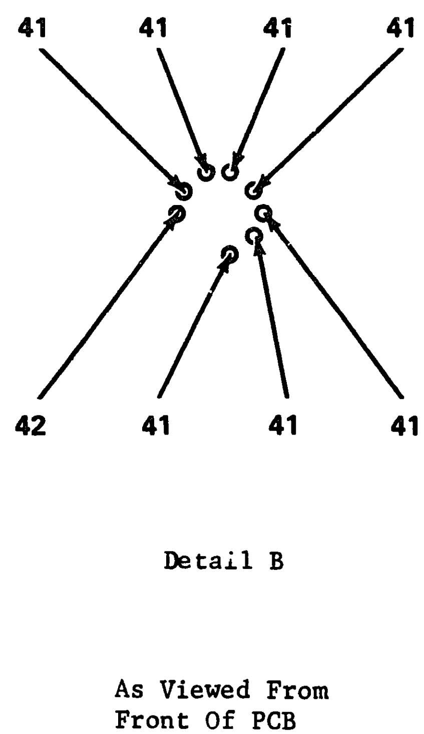


Figure 1-38. RF Amplifier Assembly (Sheet 2 of 3)





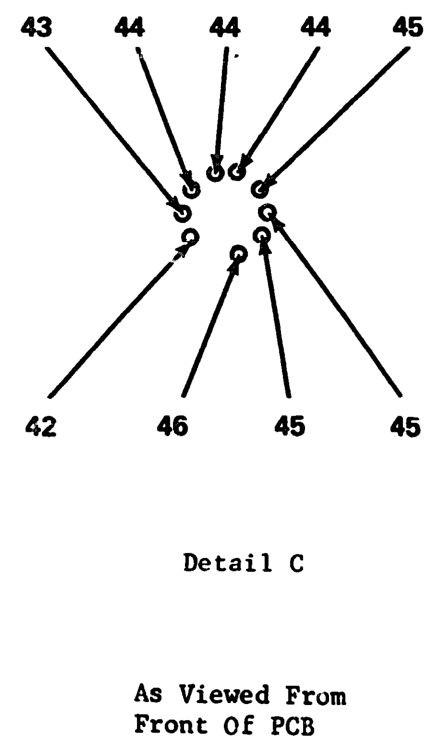


Figure 1-38. RF Amplifier Assembly (Sheet 3 of 3)

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable on Code
1-38	3A10	RF AMPLIFIER ASSY.	10392385	REF	
-1	3A10Q2,5	. TRANSISTOR (04713)	2N3906	2	
-2	3A10R4,62	. RESISTOR, 1/8W, 1%, 8.25K (81349).	RNSSD8251F	2	
-3	3A10R3,8	. RESISTOR, 1/4W, 10%, 2.7K (81349).	RC07GF272K	2	
-4	3A10C1,2, 4,5,6,7 15	. CAPACITOR, 12PF, 500 VDC, 5% (84171)	DM15-120J	7	
-5	3A10R5,56 60,61,64 65	. RESISTOR, 1/4W, 10%, 100 OHM (81349).	RC07GF101K	6	
-6	3A10R59	. RESISTOR, 1/8W, 1%, 100 OHM (81349).	RN55D1000F	1	
-7	3A10R6	. RESISTOR, 1/4W, 10%, 270K (81349).	RC07GF274Y	1	
-8		. BRACKETS (72653)	6261	2	
-9		. PCB, RF ATTENUATOR, (24672)	003919661	2	
-10		. PCB, RF ATTENUATOR, (24672)	003919662	1	
-11	3A10C13, 14,18,19	. CAPACITOR, 100 UF, 10 VDC (80131).	CS13BC107K	4	
-12	3A10C20, 23	. CAPACITOR, 200 VDC, 10%, SELECT ONE OF THE FOLLOWING FOR EACH		2	
		.0056 UF, (09134). . . .	25-562C		
		.0068 UF, (09134). . . .	25-682C		
		.0082 UF, (09134). . . .	25-822C		
-13	3A10Q14	. TRANSISTOR (01295)	2N3702	1	
-14	3A10R24	. RESISTOR, 1/4W, 10%,560 OHM (81349).	RC07GF561K	1	
-15	3A10R25	. RESISTOR, 1/4W, 10%, 56 OHM (81349).	RC07GF560K	1	
-16	3A10C8,9 10	. CAPACITOR, .0056 UF, 200 VDC, 10%, (56289). . . .	192P56292	3	
-17	3A10Q10, 11,12	. TRANSISTOR (04713)	MPS3646	3	
-18	3A10C17	. CAPACITOR, .01 UF, 200 VDC 10% (56289).	192P10392	1	
-19	3A10T1	TRANSFORMER, INPUT (24672)	75192519	1	
-20	3A10Q1,3 4,6,15	. TRANSISTOR (01295)	2N3704	5	
-21	3A10R2,9 13,16, 18	. RESISTOR, 1/4W,10%, 5.6K (81349).	RC07GF562K	5	
-22	3A10R57, 58	. RESISTOR, 1/8W, 1%, 68.1K (81349)	RN55D6812F	2	
-23	3A10C11, 12,16	CAPACITOR, 1 UF, 35 VDC (56289).	CS13BF105K	3	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable on Code
1-38	3A10	Continued			
-24	3A10C3	. CAPACITOR, VARIABLE, 0.7-36 PF, (72982).	525-000	1	
-25	3A10R7	. RESISTOR, VARIABLE, 500 OHM (80294)	3067P 1-501	1	
-26	3A10R1,10	. RESISTOR, 1/4W, 10%, 12K (81349)	RC07GF123K	2	
-27	3A10R22, 27,63	. RESISTOR, 1/4W, 10%, 1 K (81349)	RC07GF102K	3	
-28	3A10C21, 24	. CAPACITOR, DIP-MICA, 5%, SELECT ONE OF THE FOLLOWING FOR EACH:		2	
		1000 PF, 100 VDC (84171)	DM15-102J		
		470 PF, 500 VDC (84171)	DM15-471J		
		10 PF, 500 VDC (72136)	DM15-100J		
-29	3A10L2	. CHOKE, (24672).	751925231	1	
-30	3A10S2,3	. SWITCH, ROTARY (02111). . .	82-22-10	2	
-31		. BEAD, FERRITE (02114) . . .	5659065/3B	6	
-32		. PANEL, SWITCH MOUNTING. . .	003919679	1	
-33	3A10R26	. RESISTOR, 1/4W, 10%, 220 OHM (81349)	RC07GF221K	1	
-34	3A10R25	. RESISTOR, 1/4W, 10%, 680 OHM (81349)	RC07GF681K	1	
-35	3A10L1,3	. CHOKE (24672)	751925232	2	
-36	3A10Q7,8 9,13	. TRANSISTOR (04713).	2N4220	4	
-37	3A10R11, 14,17	. RESISTOR, 1/4W, 10%, 47K (81349)	RC07GF473K	3	
-38	3A10R19, 20.21	. RESISTOR, 1/4W, 10%, 100 K (81349)	RC07GF104K	3	
-39	3A10R12, 15,	. RESISTOR, 1/4W, 10%, 22 K (81349)	RC07GF223K	2	
-40	3A10R46, 47,48 49,50, 51,52	. RESISTOR, 1/4W, 10%, 68 OHM (81349)	RC07GF680K	7	
-41	3A10R37, 38,39, 40,41, 42,43	. RESISTOR, 1/4W, 10%, 47 OHM (81349)	RC07GF470K	7	
-42	3A10R36, 45	. RESISTOR, 1/4W, 10%, 33 OHM (81349)	RC07GF330K	2	
-43	3A10R35	. RESISTOR, 1/4W, 10%, 27 OHM (81349)	RC07GF270K	1	
-44	3A10R32, 33,34	. RESISTOR, 1/4W, 10%, 22 OHM (81349)	RC07GF220K	3	

GROUP ASSEMBLY PARTS LIST

Fig. & Index No.	Ref Design.	Description	Part No.	Units Per Assy.	Usable on Code
1-38	3A10	Continued			
-45	3A10R29, 30,31	. RESISTOR, 1/4W, 10%, 15 OHM (81349).	RC07GF150K	3	
-46	3A10R28	. RESISTOR, 1/4W, 10%, 12 OHM (81349).	RC07GF120K	1	
-47	3A10C22	. CAPACITOR, DIP MICA, 5%, SELECT ONE OF THE FOLLOWING:		1	
		910 PF, 100 VDC, (84171). .	DM15-911J		
		680 PF, 300 VDC, (84171). .	DM15-681J		
		470 PF, 500 VDC, (84171). .	DM15-471J		
		390 PF, 500 VDC, (84171). .	DM15-391J		
		150 PF, 500 VDC, (72136). .	DM15-151J		
		120 PF, 500 VDC, (72136). .	DM15-121J		
		82 PF, 500 VDC, (84171). .	DM15-820J		
-48		. PCB, RF AMPLIFIER	00390828	1	

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	1-33-15	1-34-1			
	1-35-17				
CS13BC107K	1-17-22	1-17-47	14		
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	1-38-11				
CS13BE106K	1-17-21		1		
CS13BE107K	1-17-48	1-21-9	11		
	1-22-3	1-23-25			
	1-25-5	1-26-48			
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CS13BE225K	1-16-16		1		
CS13BF105K	1-13-13	1-16-18	21		
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	1-30-5	1-32-8			
	1-35-6	1-36-24			
	1-37-52	1-38-23			
CS13BF226K	1-12-30	1-19-3	25		
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CS13BF685K	1-37-34		3		
CV31-C 100	1-22-35	1-25-16	4		
	1-32-16				
DM15-050J	1-21-44		1		
DM15-100J	1-21-44	1-23-32	4		
	1-38-28				
DM15-101J	1-21-13	1-21-45	9		
DM15-102J	1-12-13	1-16-22	25		
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PART NO.	FIG. & INDEX NO.	QTY PER ART	SOURCE CODE	REPAIR CODE
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DM15-120J	1-21-44 1-30-4 1-32-7 1-33-14 1-34-11 1-35-16 1-36-42 1-37-28 1-38-4	28		
DM15-121J	1-21-45 1-38-47	9		
DM15-150J	1-21-44	1		
DM15-151J	1-21-45 1-38-47	9		
DM15-180J	1-37-27	2		
DM15-181J	1-21-18 1-21-45 1-25-17	13		
DM15-220J	1-12-17A 1-12-24 1-16-19 1-21-16 1-23-31 1-36-20 1-37-29 1-6-10	18		
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DM15-270J	1-12-17A 1-22-36 1-25-29	4		
DM15-271J	1-21-24	5		
DM15-330J	1-12-17A 1-25-30 1-21-22	5		
DM15-331J	1-12-10 1-12-17B 1-22-22 1-23-6 1-25-8 1-37-26	8		
DM15-390J	1-12-17A 1-21-15	2		
DM15-391J	1-12-17B 1-31-5 1-31-5A 1-31-5B 1-31-5C 1-31-5D 1-31-5E 1-38-47	8		
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DM15-560J	1-24-13		1		
DM15-561J	1-12-17C	1-31-5	7		
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	1-31-5C	1-31-5D			
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DM15-680J	1-32-14		2		
DM15-681Jl	1-12-17C	1-31-5	10		
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DM15-750J	1-32-31		2		
DM15-751J	1-23-22		1		
DM15-820J	1-37-54	1-38-47	3		
DM15-821J	1-21-40	1-31-5	7		
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	1-31-5F				
DM15-911J	1-38-47		1		
D8-10	1-18-19	1-27-19	2		
HKP	1-18-9	1-2-41	9		
	1-27-9				
H9102	1-17-8	1-26-12	4		
MC4024P	1-24-14		1		
MC4044P	1-24-15		1		
MJE3055	1-17-53	1-26-59	3		
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MPS3646	1-21-1	1-22-7	125		
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MR1125	1-18-2	1-27-2	3		
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MS3102A14S1	1-17-38	1-26-42	2		
MS3102A14S2P	1-2-40		1		
MS35249-21	1-2		4		
MS35249-22	1-2		16		
MS35249-35	1-17	1-2	12		
	1-26				
MS35249-37	1-2		7		
MV1638	1-12-18		1		
MV1642	1-22-6	1-25-23	4		
	1-32-15				
PA2003	1-17-20	1-26-22	2		
PA2011	1-2-28		2		
RC07GF100K	1-19-7	1-23-28	8		
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RC07GF101K	1-12-21	1-20-28	30		
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	1-23-23	1-25-21			
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RC07GF102K	1-10-3	1-12-11	100		
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	1-20-1	1-21-20			
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	1-29-1	1-3-1			
	1-31-10	1-32-30			
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RCO7GF103K	1-12-9	1-13-6	45		
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	1-6-19				
RC07GF120K	1-38-46		1		
RC07GF122K	1-19-2	1-21-29	8		
	1-28-12	1-36-15			
	1-36-49	1-37-2			
	1-37-35				
RC07GF123K	1-19-4	1-20-4	23		
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	1-3-27	1-36-44			
	1-37-36	1-38-26			
	1-4-8				
RC07GF124K	1-36-47		1		
RC07GF126K	1-36-50	1-37-21	2		
RC07GF150K	1-38-45		3		
RC07GF151K	1-16-8	1-21-12	11		
	1-33-13	1-35-20			
	1-37-33				
RC07GF152K	1-16-10	1-21-34	9		
	1-30-25	1-35-10			
	1-36-15	1-36-28			
	1-37-2				
RC07GF153K	1-30-22	1-35-8	3		
	1-37-11				
RCO7GF182K	1-33-19	1-35-1	4		
	1-36-15	1-37-2			
RC07GF183K	1-26-52	1-36-23	3		
RGO7GGF220K	1-21-3	1-22-2	24		
	1-25-22	1-38-44			
RC07GF271K	1-21-36	1-34-13	6		
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RC07GF222K	1-20-21	1-21-17	42		
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RC07GF223K	1-12-3	1-13-8	20		
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RC07GF224K	1-12-29		1		
RC07GF226K	1-36-5	1-37-44	10		
RC07GF270K	1-38-43		1		
RC07GF272K	1-36-12	1-37-18	10		
	1-38-3				
RC07GF273K	1-36-30		1		
RC07GF274K	1-37-9	1-38-7	2		
RC07GF330K	1-31-17	1-37-56	4		
	1-38-42				
RC07GF331K	1-30-23	1-36-18	9		
	1-37-46				
RC07GF332K	1-3-8	1-32-4	3		
	1-37-59				
RC07GF333K	1-3-12	1-30-18	4		
	1-37-39	1-6-17			
RC07GF392K	1-36-27	1-37-55	3		
RC07GF470K	1-12-12	1-13-2	38		
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	1-28-5	1-3-18			
	1-32-38	1-33-18			
	1-35-18	1-38-41			
RC07GF471K	1-13-16	1-16-3	22		
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	1-32-1	1-33-1			
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RC07F473K	1-12-27	1-30-17	13		
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RC07GF560K	1-20-5	1-21-39	30		
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RC07GF562K	1-21-33	1-22-30	16		
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RC07GF563K	1-20-8	1-29-8	7		
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RC07GF564K	1-20-10	1-29-10	2		
RC07GF680K	1-38-40		7		
RC07GF681K	1-13-10	1-16-4	35		
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RC07GF821K	1-21-37	1-36-15	4		
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RC07GF822K	1-23-17	1-30-10	11		
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RC20GF121K	1-20-18	1-29-18	2		
RC20GF151K	1-4-14		1		
RC20GF182K	1-21-14		4		
RC20GF221K	1-20-17	1-29-17	2		
RC2OGF471K	1-20-23	1-29-23	3		
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RC20GF562K	1-20-20	1-29-20	4		
RC07GF470K	1-19-5		1		
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RN55D1001F	1-12-7		2		
RN55D1002F	1-12-4	1-37-14A	2		
RN55D1101F	1-19-16	1-28-16	2		
RN55D1212F	1-32-42		2		
RN55D1472F	1-37-12		1		
RN55D2151F	1-12-6	1-3-15	2		
RNJ55D2211F	1-20-2	1-29-2	3		
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RN55D2371F	1-3-4		1		
RN55D2873F	1-6-18		2		
RN55D3012F	1-12-26		1		
RN55D3401F	1-19-17	1-28-17	2		
RN55D4021F	1-37-14		1		
RN55D4121F	1-37-14		1		
RN55D4221F	1-37-14		1		
RN55D4321F	1-37-14		1		
RN55D4421F	1-37-14		1		
RN55D4531F	1-37-14		1		
RN55D4641F	1-37-14	1-4-9	3		
RN55D4751F	1-37-14		1		
RN55D4871F	1-37-13	1-37-14	2		
RN55D4991F	1-37-14		1		
RN55D5111F	1-37-14		1		

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RN55D5491F	1-37-14		1		
RN55D5621F	1-37-14		1		
RN55D05761F	1-37-14		1		
RN55D05901F	1-37-14		1		
RN55D6041F	1-12-1	1-37-14	2		
RN55D6341F	1-3-17		1		
RN55D6810F	1-20-24	1-29-24	2		
RN55D6812F	1-38-22		2		
RN55D7682F	1-6-21		1		
RN55D8061F	1-37-14A		1		
RN55D8250F	1-3-21		1		
RN55D8251F	1-37-14A	1-3?-2	3		
RN55D8451F	1-37-14A		1		
RN55D8661F	1-37-14A		1		
RN55D8871F	1-37-14A		1		
RN55D9091F	1-37-14A		1		
RN55D9311F	1-37-14A		1		
RN55D9531F	1-37-14A		1		
RN55D9761F	1-37-14A		1		
RV4LAYSA502A	1-26-38		1		
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	1-25-15	1-33-5			
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SN7420N	1-33-11	1-34-15	3		
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SN7486N	1-24-7		2		
SN7490N	1-13-1	1-15-1	51		
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	1-25-13	1-32-22			
	1-33-3	1-7-1			
	1-8-1	1-9-1			
SN7493N	1-22-10	1-25-11	6		
STYLE A	1-17	1-26	2		
S306AB	1-17-36	1-26-33	2		
TGS10	1-12-8	1-13-17	84		
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TM1828	1-3-28		1		
UG625U	1-17-25	1-17-40	39		
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UG88U	1-2-56		1		
UK10-104	1-31-1	1-36-46	4		
	1-37-4A				
U5B7709393	1-36-3	1-37-5	2		
U9T7741393	1-12-28		1		
	1-18-18	1-2-22	3		
	1-27-18				
001909591	1-17-45	1-26-45	2		
001909592	1-17-44	1-26-46	2		
00193646	1-2-24		2		
00290935	1-17-31	1-26-28	2		
00390828	1-38-48		1		
00390829	1-37-63		1		
00390830	1-36-52		1		
00390831	1-31-18		1		
00390832	1-20-30	1-29-30	2		
00390833	1-19-19	1-28-19	2		

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00391907	1-34-17		1		
00391912	1-32-43		1		
00391939	1-33-20		1		
00391955	1-35-28		1		
00391959	1-26-44		1		
003919661	1-38-9		2		
003919662	1-38-10		1		
003919671	1-33-9		1		
003919673	1-35-14		1		
003919674	1-22-28	1-36-10	2		
009319678	1-34-9		1		
003919679	1-38-32		1		
00392171	1-11-5	1-14-5	2		
00392207	1-7-3 1-9-3	1-8-3	3		
00392212	1-6-23		1		
00392215	1-10-7		1		
00392218	1-15-8		1		
003922366	1-13-18		1		
00392242	1-16-23		1		
00392244	1-12-31		1		
00392247	1-5-5		1		
00392257	1-3-36		1		
00392259	1-4-16		1		
00392271	1-2-58		1		
00393367	1-23-35		1		
00392374	1-24-18		1		
00393543	1-17-43		1		
00393556	1-22-38		1		
00393561	1-25-36		1		
00393574	1-21-46		1		
00490933	1-17-32	1-26-29	8		
00490940	1-17-57	1-26-65	4		
0940941	1-17-50	1-26-56	4		
00490942	1-17-7	1-26-11	4		
90490943	1-17-51	1-26-57	4		
99490955	1-17-55	1-26-63	2		
00491559	1-2-36		2		
00491561	1-2-48		2		
00491872	1-18-7	1-27-7	2		

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00492084	1-17-28B 1-26-25B	2		
00492126	1-2-51	1		
00492217	1-3-33	1		
00493936	1-2-17	2		
00494162	1-2-59	1		
007935131	1-26-68	1		
007935132	1-26-13	1		
007935141	1-17-60	1		
007935142	1-17-9	1		
00793645	1-2-15	2		
00990932	1-18-6 1-27-6	2		
00990945	1-17-49 1-26-55	4		
00991941	1-17-52 1-26-58	2		
00992080	1-17-26 1-26-23	2		
00992083	1-2-23	1		
00992095	1-2-37	1		
00992128	1-2-49	1		
00992129	1-2-50	1		
00993522	1-26-34	1		
00993532	1-26-15	1		
00993534	1-17-37	1		
00993540	1-17-11	1		
009939371	1-2-18	1		
009939372	1-2-19	1		
01090937	1-17-35 1-26-32	4		
01091009	1-18-20 1-27-20	2		
01091942	1-17-54 1-26-60	6		
01092085	1-17-28 1-26-25	2		
01093567	1-17-42	1		
01093568	1-26-37	1		
01093661	1-2-47	1		
02090934	1-26-61	1		
02090936	1-17-10 1-17-59 1-26-14 1-26-67	4		
02090938	1-17-56 1-26-64	2		
02099939	1-17-33 1-26-30	8		
03092086	1-18-8 1-27-8	2		
02092105	1-17-28A 1-26-25A	2		
02092403	1-17-58 1-26-66	40		
02092801	1-17-19	1		

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1N1602	1-19-2	1-28-2	2		
1N3879	1-18-3	1-27-3	3		
	1-3-29				
1N4002	1-20-15	1-29-15	12		
	1-4-2				
1N4733	1-20-19	1-29-19	4		
	1-3-22	1-37-60			
1N662	1-15-7	1-3-14	2		
1N821	1-6-2		1		
1N914	1-16-13	1-19-11	50		
	1-20-12	1-21-11			
	1-22-25	1-23-30			
	1-25-33	1-28-11			
	1-29-12	1-30-7			
	1-32-9	1-37-19			
	1-4-15				
10123	1-20-29	1-23-29A	7		
	1-29-29				
1025-24	1-25-35		2		
1025-28	1-22-37		1		
1025-32	1-32-40		1		
1025-46	1-22-19	1-23-20	2		
1025-50	1-32-11		1		
1025-52	1-21-26		1		
1025-56	1-12-16	1-21-25	8		
	1-25-28				
1025-58	1-12-16		1		
1025-60	1-12-16		1		
1025-68	1-12-22	1-21-4	4		
10391993	1-18-5	1-27-5	2		
10391994	1-18-4	1-27-4	2		
10392172	1-2-12	1-2-9	2		
103922081	1-2-5		1		
103922082	1-2-6		1		
103922083	1-2-7		1		
10392213	1-2-4		1		
10392216	1-2-8		1		
10392219	1-2-13		1		
10392237	1-2-11		1		
10392243	1-2-14		1		
10392245	1-2-10		1		

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PART NO.	FIG. & INDEX NO.		QTY PER ART	SOURCE CODE	REPAIR CODE
10392248	1-2-3		1		
10392258	1-2-1		1		
10392260	1-2-2		1		
10392368	1-17-4		1		
10392375	1-17-5		1		
10392385	1-26-10		1		
10392386	1-26-9		1		
10392388	1-26-8		1		
10392390	1-26-7		1		
10392391	1-26-6		1		
10392392	1-26-5		1		
10392393	1-26-4		1		
10392394	1-26-3		1		
10392395	1-26-2		1		
10393557	1-17-3		1		
10393562	1-17-6		1		
10393575	1-17-2		1		
1043	1-2-53		1		
1110102001	1-26-39		1		
1110103001	1-26-40		1		
11493576	1-26		1		
11493577	1-17		1		
11493647	1-2		1		
1209951	1-17	1-26	2		
12093938	1-17-27	1-26-24	2		
12200102	1-2-31		2		
12292611	1-17-29		1		
12292612	1-26-26		1		
12294160	1-2		1		
1302	1-17	1-18	86		
	1-2	1-26			
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1304	1-17	1-18	26		
	1-2	1-27			
	1-3				
1305	1-17	1-18	8		
	1-26	1-27			
1355	1-2		12		
1358	1-2		7		
1402	1-2		4		
1404	1-17-34	1-2	15		
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1407	1-17-41 1-2-45 1-26-36	29		
160-5N	1-17-39 1-2-38 1-26-43	3		
1620931	1-17-15 1-2-34 1-26-20	5		
1620932	1-17-16 1-2-35 1-26-19	5		
1620937	1-17-17	2		
17042	1-17 1-2 1-26	44		
17044	1-17 1-18 1-26 1-27 1-3	13		
17045	1-17 1-2 1-26	52		
17047	1-17 1-26	36		
17062	1-17 1-18 1-2 1-26 1-27	111		
17064	1-17 1-18 1-2 1-26 1-27	24		
17066	1-17 1-18 1-26 1-27 1-3	11		
17086	1-17 1-18 1-26 1-27	12		
192P10292	1-23-15 1-32-6	3		
192P10392	1-19-8 1-20-22 1-25-9 1-28-8 1-29-22 1-3-19 1-31-12 1-38-18	11		
192P10492	1-19-18 1-28-18 1-36-38 1-37-50	5		
192P22292	1-12-25	1		
192P22392	1-10-6 1-11-3 1-12-20 1-13-11 1-14-3 1-15-6 CONTINUED	25		

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PART NO.	FIG. & INDEX NO.		QTY PER ART	SOURCE CODE	REPAIR CODE
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	1-23-34	1-29-26			
	1-30-12	1-37-43			
	1-4-10	1-5-4			
	1-6-16	1-7-2			
	1-8-2	1-9-2			
192P22393	1-36-32		1		
192P33292	1-21-42	1-22-27	14		
	1-25-12	1-31-6			
192P47292	1-21-35	1-32-36	2		
192P56292	1-19-14	1-28-14	10		
	1-30-11	1-36-37			
	1-37-51	1-38-16			
2N1671B	1-16-21	1-20-11	6		
	1-23-29	1-29-11			
2N2270	1-20-27	1-29-27	3		
	1-4-7				
2N2907	1-3-35		1		
2N3646	1-10-4	1-12-2	34		
	1-13-4	1-15-4			
	1-16-14	1-5-2			
	1-6-5				
2N3702	1-19-9	1-20-6	32		
	1-28-9	1-29-6			
	1-3-25	1-31-2			
	1-36-8	1-37-8			
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2N3704	1-13-7	1-16-17	46		
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2N3904	1-24-12	1-3-9	2		
2N3906	1-12-5	1-16-15	45		
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	1-36-14	1-37-1			
	1-38-1	1-4-1			

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PART NO.	FIG. & INDEX NO.	QTY PER ART	SOURCE CODE	REPAIR CODE
2N4220	1-22-29 1-25-7 1-36-1 1-37-3 1-38-36	23		
2N5192	1-3-30	1		
2N5555	1-23-21 1-3-24 1-36-39 1-37-22 1-6-1	8		
20392396	1-17-1 1-26-1	2		
20994LH	1-18-12 1-27-12	4		
23443	1-2	4		
23444	1-17 1-26	8		
23466	1-17 1-26	4		
25-562C	1-38-12	2		
25-682C	1-38-12	2		
25-822C	1-38-12	2		
2560	1-20-16 1-29-16 1-36-51 1-37-62	7		
271030110	1-17-12 1-17-30 1-26-16 1-26-27	6		
30-1	1-17-18 1-2-29 1-26-41 1-35-13	8		
30294320	1-2-54	1		
30493409	1-1-3	1		
30493531	1-1-2	1		
30493634	1-1-1	1		
3067P1-101	1-20-3 1-29-3 1-3-5	3		
3067P1-102	1-31-13	2		
3067P1-202	1-21-6	1		
3067P1-203	1-30-9	2		
3067P1-501	1-38-25	1		
30767P1-502	1-13-14 1-30-15 1-32-2 1-6-9	5		
3068P1-104	1-36-48 1-37-7	3		
31-105C5	1-36-34	1		
31-224	1-5-20	3		
31-22505	1-36-33	1		
31-274C	1-26-50	1		
31-823C	1-26-50A	1		
312002	1-18-10 1-2-42 1-27-10	6		

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PART NO.	FIG. & INDEX NO.		QTY PER ART	SOURCE CODE	REPAIR CODE
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32192613	1-27-11		3		
327	1-1-4				
	1-17-14	1-2-33	1		
359843009583	1-26-18		12		
	1-17-13	1-2-32			
	1-26-17		12		
360842G04BB2A	1-18-17	1-2-21			
40364	1-27-17		3		
40364	1-18-1	1-27-1			
4051122	1-12-15		2		
	1-18-13	1-2-39	1		
50-44B-10	1-27-13		3		
	1-17-46	1-2-57			
5060010001	1-26-47		32		
525000	1-2-52				
5570000005	1-12-14	1-38-24	28		
553013	1-2-25		2		
565906532	1-23-13		1		
	1-18-14	1-27-14	1		
	1-3-34	1-37-58	14		
6261	1-38-31				
	1-22-26	1-33-7			
	1-34-10	1-35-11	11		
6653	1-36-9	1-38-8			
7022N4220-2A	1-2-46				
7022N4220-2A	1-36-1A	1-37-3D	1		
7022N4220-2B	1-36-1B	1-37-3C	2		
7022N4220-3	1-36-1D	1-37-3A	2		
7022N4220-4	1-36-1C	1-37-3B	2		
7052G	1-2-27	1-26-21	2		
75192035	1-18-15	1-27-15	3		
	1-18-16	1-2-20	2		
75192036	1-27-16		3		
75192519	1-38-19				
75192520	1-37-16		1		
75192521	1-31-4		1		
751925231	1-38-29		3		
751925232	1-38-35		1		
75192635	1-23-7		2		
7555K6	1-2-30		1		
			1		

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8005	1-17	1-18	33		
	1-2	1-27			
	1-3				
8008	1-17	1-26	4		
87-22-10	1-33-9	1-35-12	6		
	1-38-30				
9EM	1-2-55		1		

CHAPTER 3

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1A1CR1	1-3-31	MR1125
1A1CR3	1-3-14	1N662
1A1CR4	1-3-29	1N3879
1A1C1	1-3-19	192P10392
1A1C2	1-3-10	CS13BF226K
1A1C3	1-3-19	192P10392
1A1C4	1-3-11	CS13BB337K
1A1L1	1-3-28	TM1828
1A1Q1	1-3-25	2N3702
1A1Q2	1-3-32	MJE3055
1A1Q3	1-3-35	2N2907
1A1Q4	1-3-30	2N5192
1A1Q5	1-3-9	2N3904
1A1Q6	1-3-7	2N3906
1A1Q7	1-3-24	2N5555
1A1Q8	1-3-23	2N3704
1A1Q9	1-3-23	2N3704
1A1R1	1-3-3	R07GF561K
1A1R10	1-3-13	RC07GF101K
1A1R11	1-3-16	RC07GF471K
1A1R12	1-3-15	RN55D2151F
1A1R13	1-3-17	RN55D6341F
1A1R14	1-3-1	RC07GF102K
1A1R15	1-3-1	RC07GF102K
1A1R16	1-3-2	RC07GF562K
1A1R17	1-3-21	RN55D8250F
1A1R18	1-3-5	3067P1-101
1A1R19	1-3-4	RN55D2371F
1A1R2	1-3-27	RC07GF123K
1A1R3	1-3-26	RC07GF560K
1A1R4	1-3-1	RC07GF102K
1A1R5	1-3-12	RC07GF333K
1A1R6	1-3-6	RC07GF681K
1A1R7	1-3-8	RC07GF332K
1A1R8	1-3-20	RC07GF100K
1A1R9	1-3-18	RC07470K
1A1VR1	1-3-22	1N4733
1A10	1-2-10	10392245
1A10CR1	1-12-18	MV1638
1A10C1	1-12-17A	DM15-220J

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1A10C1	1-12-17A	DM15-330J
1A10C1	1-12-17A	DM15-390J
1A10C10	1-12-24	DM15-220J
1A10C11	1-12-24	DM15-220J
1A10C12	1-12-13	DM15-102J
1A10C13	1-12-25	192P22292
1A10C14	1-12-30	CS13BF226K
1A10C15	1-12-30	CS13BF226K
1A10C16	1-12-8	TGS10
1A10C17	1-12-20	192P22392
1A10C18	1-12-20	192P22392
1A10C2	1-12-17B	DM15-331J
1A10C2	1-12-17B	DM15-391J
1A10C2	1-12-17B	DM15-471J
1A10C3	1-12-17C	DM15-471J
1A10C3	1-12-17C	DM15-561J
1A10C3	1-12-17C	DM15-681J
1A10C4	1-12-14	525000
1A10C5	1-12-13	DM15-102J
1A10C6	1-12-10	DM15-331J
1A10C7	1-12-8	TGS10
1A10C8	1-12-8	TGS10
1A10C9	1-12-8	TGS10
1A10L1	1-12-16	1025-56
1A10L1	1-12-16	1025-58
1A10L1	1-12-16	1025-60
1A10L2	1-12-22	1025-68
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1A10Q2	1-12-5	2N3906
1A10Q3	1-12-2	2N3646
1A10Q4	1-12-2	2N3646
1A10Q5	1-12-2	2N3646
1A10Q6	1-12-2	2N3646
1A10Q7	1-12-2	2N3646
1A10Q8	1-12-5	2N3906
1A10Q9	1-12-2	2N3646
1A10R1	1-12-12	RC07GF470K
1A10R10	1-12-11	RC07GF102K
1A10R11	1-12-23	RC07GF472K
1A10R12	1-12-27	RC07GF473K
1A10R13	1-12-3	RC07GF223K
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1A10R16	1-12-23	RC07GF472K
1A10R17	1-12-1	RN55D6041F
1A10R18	1-12-3	RC07GF223K
1A10R19	1-12-27	RC07GF473K
1A10R2	1-12-11	RC07GF102K
1A10R20	1-12-7	RN55D1001F
1A10R21	1-12-6	RN55D2151F
1A10R22	1-12-7	RN55D1001F
1A10R23	1-12-4	RN55D1002F
1A10R24	1-12-11	RC07GF102K
1A10R25	1-12-29	R07GF224K
1A10R26	1-12-21	RC07GF101K
1A10R27	1-12-11	RC07GF102K
1A10R28	1-12-19	RC07GF104K
1A10R3	1-12-9	RC07GF103K
1A10R4	1-12-11	RC07GF102K
1A10R5	1-12-21	RC07GF101K
1A10R6	1-12-3	RC07GF223K
1A10R7	1-12-21	RC07GF101K
1A10R8	1-12-9	RC07GF103K
1A10R9	1-12-3	RC07GF223K
1A10U1	1-12-28	09T7741393
1A10Y1	1-12-15	4051122
1A11	1-2-11	10392237
1A11C1	1-13-17	TGS10
1A11C2	1-13-13	CS13BF105K
1A11C3	1-13-11	192P22392
1A11Q1	1-13-4	2N3646
1A11Q2	1-13-4	2N3646
1A11Q3	1-13-4	2N3646
1A11Q4	1-13-7	2N3704
1A11Q5	1-13-7	2N3704
1A11Q6	1-13-4	2N3646
1A11Q7	1-13-4	2N3646
1A11R1	1-13-2	RC07GF470K
1A11R10	1-13-8	RC07GF223K
1A11R11	1-13-3	RC07GF472K
1A11R12	1-13-8	RC07GF223K
1A11R13	1-13-3	RC07GF472K
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1A11R15	1-13-3	RC07GF472K
1A11R16	1-13-3	RC07GF472K

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1A11R2	1-13-16	RC07GF471K
1A11R3	1-13-3	RC07GF472K
1A11R4	1-13-14	3067P1-502
1A11R5	1-13-15	RC07GF102K
1A11R6	1-13-6	RC07GF103K
1A11R7	1-13-10	RC07GF681K
1A11R8	1-13-6	RC07GF103K
1A11R9	1-13-10	RC07GF681K
1A11U1	1-13-9	SN74H00N
1A11U2	1-13-9	SN74H00N
1A11U3	1-13-12	SN7474N
1A11U4	1-13-5	SN7402N
1A11U5	1-13-1	SN7490N
1A11U6	1-13-1	SN7491N
1A11U7	1-13-1	SN7490N
1A12	1-2-12	10392172
1A12C1	1-14-3	192P22392
1A12R1	1-14-4	RC07GF472K
1A12R2	1-14-4	RC07GF472K
1A12R3	1-14-4	RC07GF472K
1A12R4	1-14-4	RC07GF472K
1A12R5	1-14-4	RC07GF472K
1A12R6	1-14-4	RC07GF472K
1A12U1	1-14-2	SN7474N
1A12U2	1-14-1	SN7400N
1A12U3	1-14-2	SN7474N
1A12U4	1-14-2	SN7474N
1A12U5	1-14-2	SN7474N
1A12U6	1-14-1	SN7400N
1A12U7	1-14-2	SN7474N
1A12U8	1-14-2	SN7474N
1A13	1-2-13	10392219
1A13CR1	1-15-7	1N662
1A13C1	1-15-6	192P22392
1A13Q1	1-15-4	2N3646
1A13Q2	1-15-4	2N3646
1A13R1	1-15-3	RC07GF472K
1A13R2	1-15-3	RC07GF472K
1A13R3	1-15-3	RC07GF472K
1A13R4	1-15-3	RC07GF472K
1A13U1	1-15-5	SN7400N
1A13U2	1-15-5	SN7400N

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1A13U5	1-15-2	SN7474N
1A13U6	1-15-1	SN7490N
1A14	1-2-14	10392243
1A14CR1	1-16-13	1N914
1A14C1	1-16-22	DM15-102J
1A14C10	1-16-20	192P22392
1A14C11	1-16-20	192P22392
1A14C2	1-16-12	TGS10
1A14C3	1-16-18	CS13BF105K
1A14C4	1-16-16	CS13BE225K
1A14C5	1-16-19	DM15-220J
1A14C6	1-16-18	CS13BE105K
1A14C7	1-16-19	DM15-220J
1A14C8	1-16-18	CS13BE105K
1A14C9	1-16-20	192P22392
1A14Q1	1-16-15	2N3906
1A14Q10	1-16-17	2N3704
1A14Q11	1-16-17	2N3704
1A14Q12	1-16-14	2N3646
1A14Q13	1-16-14	2N3646
1A14Q14	1-16-14	2N3646
1A14Q15	1-16-14	2N3646
1A14Q16	1-16-14	2N3646
1A14Q17	1-16-14	2N3646
1A14Q2	1-16-15	2N3906
1A14Q3	1-16-14	2N3646
1A14Q4	1-16-14	2N3646
1A14Q5	1-16-17	2N3704
1A14Q6	1-16-17	2N3704
1A14Q7	1-16-14	2N3646
1A14Q8	1-16-15	2N3906
1A14Q9	1-16-21	2N1671B
1A14R1	1-16-4	RC07GF681K
1A14R10	1-16-1	RC07GF102K
1A14R11	1-16-9	RC07GF472K
1A14R12	1-16-9	RC07GF472K
1A14R13	1-16-9	RC07GF472K
1A14R14	1-16-2	RC07GF103K
1A14R15	1-16-9	RC07GF472K
1A14R16	1-16-1	RC07GF102K
1A14R17	1-16-4	RC07GF681K

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
1A14R18	1-16-1	RC07GF102K
1A14R19	1-16-5	RC07GF681K
1A14R2	1-16-9	RC07GF472K
1A14R20	1-16-3	RC07GF471K
1A14R21	1-16-6	RC07GF470K
1A14R22	1-16-1	RC07GF102K
1A14R23	1-16-1	RC07GF102K
1A14R24	1-16-3	RC07GF471K
1A14R25	1-16-4	RC07GF681K
1A14R26	1-16-6	RC07GF470K
1A14R27	1-16-1	RC07GF102K
1A14R28	1-16-9	RC07GF472K
1A14R29	1-16-10	RC07GF152K
1A14R3	1-16-2	RC07GF103K
1A14R30	1-16-8	RC07GF151K
1A14R31	1-16-7	RC07GF561K
1A14R32	1-16-7	RC07GF561K
1A14R33	1- -6	RC07GF470K
1A14R34	1-16-6	RC07GF470K
1A14R35	1-16-6	RC07GF470K
1A14R36	1-16-6	RC07GF470K
1A14R37	1-16-1	RC07GF102K
1A14R38	1-16-9	RC07GF472K
1A14R39	1-16-10	RC07GF152K
1A14R4	1-16-6	RC07GF470K
1A14R40	1-16-8	RC07GF151K
1A14R41	1-16-7	RC07GF561K
1A14R42	1-16-7	RC07GF561K
1A14R43	1-16-6	RC07GF470K
1A14R44	1-16-6	RC07GF470K
1A14R45	1-16-6	RC07GF470K
1A14R46	1-16-6	RC07GF470K
1A14R5	1-16-10	RC07GF152K
1A14R6	1-16-4	RC07GF681K
1A14R7	1-16-9	RC07GF472K
1A14R8	1-16-11	RC07GF104K
1A14R9	1-16-2	RC07GF103K
1A15	1-2	11493647
1A15C1	1-2-21	36DB42G04BB2A
1A15DS1	1-2-33	327
1A15DS2	1-2-33	327
1A15F1	1-2-42	312002
1A15F2	1-2-42	312002

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
1A15F3	1-2-43	312005
1A15J1	1-2-57	50-44B-10
1A15J10	1-2-57	50-44B-10
1A15J11	1-2-57	50-44B-10
1A15J12	1-2-57	50-44B-10
1A15J13	1-2-57	50-44B-10
1A15J14	1-2-57	50-44B-10
1A15J19	1-2-44	UG625U
1A15J2	1-2-57	50-44B-10
1A15J20	1-2-44	UG625U
1A15J21	1-2-44	UG625U
1A15J22	1-2-44	UG625U
1A15J23	1-2-44	UG625U
1A15J24	1-2-44	UG625U
1A15J25	1-2-44	UG625U
1A15J26	1-2-44	UG625U
1A15J27	1-2-44	UG625U
1A15J28	1-2-44	UG625U
1A15J29	1-2-44	UG625U
1A15J3	1-2-57	50-44R-10
1A15J30	1-2-44	UG625U
1A15J33	1-2-40	MS3102A14S2P
1A15J34	1-2-38	160-5N
1A15J4	1-2-57	50-44B-10
1A15J5	1-2-57	50-44B-10
1A15J6	1-2-57	50-44B-10
1A15J7	1-2-57	50-44B-10
1A15J8	1-2-57	50-44B-10
1A15J9	1-2-57	50-44B-10
1A15M1	1-2-25	5570000005
1A15P1	1-2-55	9EM
1A15P2	1-2-56	UG88U
1A15S1	1-2-28	PA2011
1A15S2	1-2-29	30-1
1A15S3	1-2-29	30-1
1A15S4	1-2-28	PA2011
1A15S5	1-2-30	7565K6
1A15S6	1-2-39	46256LFR
1A15S7	1-2-60	MST305D
1A15T1	1-2-20	75192036
1A15XDS1	1-2-32	359843009502
1A15XDS2	1-2-32	359843009502
1A15XF1	1-2-41	HKP

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
1A15XF2	1-2-41	HKP
1A15XF3	1-2-41	HKP
1A2	1-2-2	10392260
1A2CR1	1-4-15	1N914
1A2CR2	1-4-15	1N914
1A2CR3	1-4-15	1N914
1A2CR4	1-4-2	1N4002
1A2CR5	1-4-2	1N4002
1A2CR6	1-4-2	1N4002
1A2CR7	1-4-2	1N4002
1A2C1	1-4-4	CS13BE226K
1A2C2	1-4-10	192P22392
1A2C3	1-4-4	CS13BE226K
1A2Q1	1-4-1	2N3906
1A2Q2	1-4-1	2N3906
1A2Q3	1-4-1	2N3906
1A2Q4	1-4-7	2N2270
1A2R1	1-4-8	RC07GF123K
1A2R10	1-4-11	RC07GF561K
1A2R11	1-4-12	RC07GF102K
1A2R12	1-4-5	RC07GF101K
1A2R13	1-4-13	RC07GF472K
1A2R2	1-4-8	RC07GF123K
1A2R3	1-4-3	RC20GF471K
1A2R5	1-4-14	RC20GF151K
1A2R6	1-4-9	RN5D4641F
1A2R7	1-4-9	RN55D4641F
1A2R8	1-4-6	RC07GF562K
1A2R9	1-4-8	RC07GF123K
1A3	1-2-3	10392248
1A3C1	1-5-4	192P22392
1A3Q1	1-5-2	2N3646
1A3Q2	1-5-2	2N3646
1A3Q3	1-5-2	2N3646
1A3Q4	1-5-2	2N3646
1A3R1	1-5-1	RC07GF472K
1A3R2	1-5-1	RC07GF472K
1A3R3	1-5-1	RC07GF472K
1A3R4	1-5-1	RC07GF472K
1A3R5	1-5-1	RC07GF472K
1A3R6	1-5-1	RC07GF472K
1A3R7	1-5-1	
1A3R8	1-5-1	

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
1A3U1	1-5-3	SN7400N
1A4	1-2-4	10392213
1A4C1	1-6-10	DM15-220J
1A4C10	1-6-16	192P22392
1A4C11	1-6-16	192P22392
1A4C2	1-6-20	31-224
1A4C3	1-6-20	31-224
1A4C4	1-6-20	31-224
1A4C5	1-6-6	CS13BE226K
1A4C6	1-6-10	DM15-220J
1A4C7	1-6-6	CS13BE226K
1A4C8	1-6-10	DM15-220J
1A4C9	1-6-6	CS13BE226K
1A4Q1	1-6-5	2N3646
1A4Q2	1-6-5	2N3646
1A4Q3	1-6-7	2N3704
1A4Q4	1-6-5	2N3646
1A4Q5	1-6-5	2N3646
1A4Q6	1-6-5	2N3646
1A4Q7	1-6-1	2N5555
1A4R1	1-6-11	RC07GF472K
1A4R10	1-6-18	RN55D2873F
1A4R11	1-6-18	RN55D2873F
1A4R12	1-6-19	RC07GF104K
1A4R13	1-6-19	RC07GF104K
1A4R14	1-6-3	RC07GF103K
1A4R15	1-6-11	RC07GF472K
1A4R16	1-6-14	RC07GF471K
1A4R17	1-6-3	RC07GF103K
1A4R18	1-6-14	RCO7GF471K
1A4R19	1-6-11	RC07GF472K
1A4R2	1-6-11	RC07GF472K
1A4R20	1-6-11	RC07GF472K
1A4R21	1-6-15	RC07GF102K
1A4R22	1-6-11	RCO7GF472K
1A4R23	1-6-8	RC07GF222K
1A4R24	1-6-17	RC07GF333K
1A4R25	1-6-9	3067P1-502
1A4R26	1-6-15	RC07GF102K
1A4 [illegible]27	1-6-11	RCO7GF472K
1A4R[illegible]	1-6-14	RCO7GF471Y
1A4R[illegible]	1-6-3	RC07GF103K
1A4R3	1-6-15	RC07GF102K

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
1A4R30	1-6-14	RC07GF471K
1A4R4	1-6-11	RC07GF472K
1A4R5	1-6-3	RC07GF103K
1A4R6	1-6-3	RC07GF103K
1A4R7	1-6-22	RC07GF223K
1A4R8	1-6-4	RN55D2211F
1A4R9	1-6-21	RN55D7682F
1A4U1	1-6-12	SN7400N
1A4U2	1-6-13	SN7473N
1A4VR1	1-6-2	1N821
1A5	1-2-5	103922081
1A5C1	1-7-2	192P22392
1A5U1	1-7-1	SN7490N
1A5U2	1-7-1	SN7490N
1A5U3	1-7-1	SN7490N
1A5U4	1-7-1	SN7490N
1A5U5	1-7-1	SN7490N
1A5U6	1-7-1	SN7490N
1A5U7	1-7-1	SN7490N
1A5U8	1-7-1	SN7490N
1A6	1-2-6	103922082
1A6C1	1-8-2	192P22392
1A6U1	1-8-1	SN7490N
1A6U2	1-8-1	SN7490N
1A6U3	1-8-1	SN7490N
1A6U4	1-8-1	SN7490N
1A6U5	1-8-1	SN7490N
1A6U6	1-8-1	SN7490N
1A6U7	1-8-1	SN7490N
1A6U8	1-8-1	SN7490N
1A7	1-2-7	103922083
1A7C1	1-9-2	192P22392
1A7R1	1-9-4	RC07GF222K
1A7U1	1-9-1	SN7490N
1A7U2	1-9-1	SN7490N
1A7U3	1-9-1	SN7490N
1A7U4	1-9-1	SN7490N
1A7U5	1-9-1	SN7490N
1A7U6	1-9-1	SN7490N
1A7U7	1-9-1	SN7490N
1A7U8	1-9-1	SN7490N
1A8	1-2-8	10392216
1A8C1	1-10-6	192P22392

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
1A8Q1	1-10-4	2N3646
1A8Q2	1-10-4	2N3646
1A8R1	1-10-2	RC07GF472K
1A8R2	1-10-2	RC07GF472K
1A8R3	1-10-3	RC07GF102K
1A8R4	1-10-2	RC07GF472K
1A8R5	1-10-2	RC07GF472K
1A8R6	1-10-3	RC07GF102K
1A8R7	1-10-2	RC07472K
1A8R8	1-10-2	RC07GF472K
1A8U1	1-10-5	SN7400N
1A8U2	1-10-5	SN7400N
1A8U3	1-10-1	SN7474N
1A8U4	1-10-1	SN7474N
1A9	1-2-9	10392172
1A9C1	1-11-3	192P22392
1A9R1	1-11-4	RC07GF472K
1A9R2	1-11-4	RC07GF472K
1A9R3	1-11-4	RC07GF472K
1A9R4	1-11-4	RC07GF472K
1A9R5	1-11-4	RC07GF472K
1A9R6	1-11-4	RC07GF472K
1A9U1	1-11-2	SN7474N
1A9U2	1-11-1	SN7400N
1A9U3	1-11-2	SN7474N
1A9U4	1-11-2	SN7474N
1A9U5	1-11-2	SN7474N
1A9U6	1-11-1	SN7400N
1A9U7	1-11-2	SN7474N
1A9U8	1-11-2	SN7474N

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2	1-1-2	30493531
2A1	1-17-1	20392396
2A1A1	1-18-4	10391994
2A1A1CR10	1-19-11	1N914
2A1A1C3	1-19-13	DM15-102J
2A1A1C4	1-19-14	192P56292
2A1A1C5	1-19-3	CS13BE226K
2A1A1C6	1-19-18	192P10492
2A1A1C7	1-19-8	192P10392
2A1A1C9	1-19-1	CS13BB337K
2A1A1Q10	1-19-9	2N3702
2A1A1Q11	1-19-9	2N3702
2A1A1Q12	1-19-9	2N3702
2A1A1Q14	1-19-15	2N3704
2A1A1Q15	1-19-15	2N3704
2A1A1R25	1-19-6	RC07GF682K
2A1A1R26	1-19-16	RN55D1101F
2A1A1R27	1-19-10	RC07GF681K
2A1A1R28	1-19-2	RC07GF122K
2A1A1R29	1-19-10	RC07GF681K
2A1A1R30	1-19-10	RC07GF681K
2A1A1R31	1-19-7	RC07GF100K
2A1A1R32	1-19-5	RC07GF470K
2A1A1R33	1-19-6	RC07GF682K
2A1A1R34	1-19-6	RC07GF682K
2A1A1R35	1-19-10	RC07GF681K
2A1A1R36	1-19-4	RC07GF123K
2A1A1R39	1-19-17	RN55D3401F
2A1A1VR2	1-19-2	1N1602
2A1A2	1-18-5	10391993
2A1A2CR2	1-20-15	1N4002
2A1A2CR3	1-20-15	1N4002
2A1A2CR4	1-20-15	14002
2A1A2CR5	1-20-15	1N4002
2A1A2CR6	1-20-12	1N914
2A1A2CR7	1-20-12	1N914
2A1A2CR8	1-20-12	1N914
2A1A2CR9	1-20-12	1N914
2A1A2C10	1-20-26	192P22392
2A1A2C2	1-20-14	CS13BE105K

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A1A2C9	1-20-22	192P10392
2A1A2Q1	1-20-9	2N3704
2A1A2Q16	1-20-6	2N3702
2A1A2Q2	1-20-9	2N3704
2A1A2Q3	1-20-6	2N3702
2A1A2Q5	1-20-11	2N16718
2A1A2Q6	1-20-9	2N3704
2A1A2Q7	1-20-6	2N3702
2A1A2Q8	1-20-6	2N3702
2A1A2Q9	1-20-27	2N2270
2A1A2R1	1-20-18	RC20GF121K
2A1A2R10	1-20-5	RC07GF560K
2A1A2R11	1-20-1	RC07GF102K
2A1A2R12	1-20-7	RC07GF561K
2A1A2R13	1-20-8	RC07GF563K
2A1A2R14	1-20-10	RC07GF564K
2A1A2R15	1-20-7	RC07GF561K
2A1A2R16	1-20-13	RC07GF223K
2A1A2R17	1-20-25	RC07GF472K
2A1A2R18	1-20-25	RC07GF472K
2A1A2R19	1-20-20	RC20GF562K
2A1A2R2	1-20-17	RC20GF221K
2A1A2R20	1-20-7	RC07GF561K
2A1A2R21	1-20-4	RC07GF123K
2A1A2R22	1-20-1	RC07GF102K
2A1A2R23	1-20-28	RC07GF101K
2A1A2R24	1-20-23	RC20GF471K
2A1A2R3	1-20-2	RN55D2211F
2A1A2R37	1-20-4	RC07GF123K
2A1A2R38	1-20-4	RC07GF123K
2A1A2R4	1-20-3	3067P1-101
2A1A2R5	1-20-24	RN55D6810F
2A1A2R6	1-20-20	RC20GF562K
2A1A2R7	1-20-21	RC07GF222K
2A1A2R8	1-20-7	RC07GF5261K
2A1A2R9	1-20-4	RC07GF123K
2A1A2VR1	1-20-10	1N4733
2A1CR1	1-18-2	MR1125
2A1CR11	1-18-3	1N3879
2A1C1	1-18-17	36D842G040BB2A
2A1F1	1-18-10	31202
2A1F2	1-18-10	312002
2A1F3	1-18-11	312005

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A1L1	1-18-15	75192035
2A1Q13	1-18-1	40364
2A1S1	1-18-12	20994LH
2A1S2	1-18-12	20994LH
2A1S3	1-18-13	46256LFR
2A1T1	1-18-16	75192036
2A1XF1	1-18-9	HKP
2A1XF2	1-18-9	HKP
2A1XF3	1-18-9	HKP
2A2	1-17-2	10393575
2A2CR1	1-21-11	1N914
2A2CR10	1-21-11	1N914
2A2CR11	1-21-11	1N914
2A2CR12	1-21-11	1N914
2A2CR13	1-21-11	1N914
2A2CR2	1-21-11	1N914
2A2CR3	1-21-11	1N914
2A2CR4	1-21-11	1N914
2A2CR5	1-21-11	1N914
2A2CR6	1-21-11	1N914
2A2CR7	1-21-11	1N914
2A2CR8	1-21-11	1N914
2A2CR9	1-21-11	1N914
2A2C1	1-21-27	DM15-102J
2A2C10	1-21-22	DM15-330K
2A2C11	1-21-35	192P47292
2A2C12	1-21-40	DM15-821J
2A2C13	1-21-16	DM15-220J
2A2C14	1-21-8	CS13BE226K
2A2C15	1-21-16	DM15-220J
2A2C16	1-21-8	CS13BE226K
2A2C17	1-21-16	DM15-220J
2A2C18	1-21-8	CS13BE226K
2A2C19	1-21-24	DM15-271J
2A2C2	1-21-5	TGS10
2A2C20	1-21-42	192P33292
2A2C21	1-21-24	DM15-271J
2A2C22	1-21-42	192P33292
2A2C23	1-21-24	DM15-271J
2A2C24	1-21-42	192P33292
2A2C25	1-21-18	DM15-181J
2A2C26	1-21-42	192P33292
2A2C27	1-21-18	DM15-161J

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A2C28	1-21-42	192P33292
2A2C29	1-21-19	DM15-161J
2A2C3	1-21-5	TGS10
2A2C30	1-21-42	192P33292
2A2C31	1-21-15	DM15-390J
2A2C32	1-21-13	DM15-101J
2A2C33	1-21-16	DM15-220J
2A2C34	1-21-8	CS13BE226K
2A2C35	1-21-24	DM15-271J
2A2C36	1-21-42	192P33292
2A2C37	1-21-24	DM15-271J
2A2C38	1-21-42	192P33292
2A2C39	1-21-9	CS13BE107K
2A2C4	1-21-41	CS13BE105K
2A2C40	1-21-43	CS13BC107K
2A2C41	1-21-10	CS13BB337K
2A2C42	1-21-5	TGS10
2A2C43	1-21-5	TGS10
2A2C44	1-21-5	TGS10
2A2C45	1-21-5	TGS10
2A2C46	1-21-45	DM15-101J
2A2C46	1-21-45	DN15-121J
2A2C46	1-21-45	DM15-151J
2A2C46	1-21-45	DM15-181J
2A2C46	1-21-45	DM15-221J
2A2C47	1-21-45	DM15-101J
2A2C47	1-21-45	DM15-121J
2A2C47	1-21-45	DM15-151J
2A2C47	1-21-45	DM15-181J
2A2C47	1-21-45	DM15-221J
2A2C48	1-21-45	DM15-101J
2A2C48	1-21-45	DM15-121J
2A2C48	1-21-45	DM15-151J
2A2C48	1-21-45	DM15-181J
2A2C48	1-21-45	DM15-221J
2A2C49	1-21-45	DM15-101J
2A2C49	1-21-45	DM15-121J
2A2C49	1-21-45	DM15-151J
2A2C49	1-21-45	DM15-181J
2A2C49	1-21-45	DM15-221J
2A2C5	1-21-5	TGS10
2A2C50	1-21-45	DM15-101J
2A2C50	1-21-45	DM15-121J

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A2C50	1-21-45	DM15-151J
2A2C50	1-21-45	DM15-181J
2A2C50	1-21-45	DM15-221J
2A2C51	1-21-45	DM15-101J
2A2C51	1-21-45	DM15-121J
2A2C51	1-21-45	DM15-151J
2A2C51	1-21-45	DM15-181J
2A2C51	1-21-45	DM15-221J
2A2C52	1-21-44	DM15-050J
2A2C52	1-21-44	DM15-100J
2A2C52	1-21-44	DM15-120J
2A2C52	1-21-44	DM15-150J
2A2C53	1-21-45	DM15-101J
2A2C53	1-21-45	DM15-121J
2A2C53	1-21-45	DM15-151J
2A2C53	1-21-45	DM15-181J
2A2C53	1-21-45	DM15-221J
2A2C54	1-21-45	DM15-101J
2A2C54	1-21-45	DM15-121J
2A2C54	1-21-45	DM15-151J
2A2C54	1-21-45	DM15-181J
2A2C54	1-21-45	DM15-221J
2A2C6	1-21-5	TGS10
2A2C7	1-21-5	TGS10
2A2C8	1-21-21	DM15-470J
2A2C9	1-21-22	DM15-330J
2A2L1	1-21-25	1025-56
2A2L2	1-21-25	1025-56
2A2L3	1-21-25	1025-56
2A2L4	1-21-4	1025-68
2A2L5	1-21-4	1025-68
2A2L6	1-21-4	1025-68
2A2L7	1-21-26	1025-52
2A2L8	1-21-25	1025-56
2A2L9	1-21-25	1025-56
2A2Q1	1-21-1	MPS3646
2A2Q10	1-21-1	MPS3646
2A2Q11	1-21-1	MPS3646
2A2Q12	1-21-1	MPS3646
2A2Q13	1-21-1	MPS3646
2A2Q14	1-21-1	MPS3646
2A2Q15	1-21-1	MPS3646
2A2Q16	1-21-1	MPS3646

REFERENCE DESIGNATOR INDEX

REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A2Q17	1-21-1	MPS3646
2A2Q18	1-21-1	MPS3646
2A2Q19	1-21-1	MPS3646
2A2Q2	1-21-19	2N3906
2A2Q20	1-21-1	MPS3646
2A2Q21	1-21-1	MPS3646
2A2Q22	1-21-1	MPS3646
2A2Q23	1-21-1	MPS3646
2A2Q24	1-21-1	MPS3646
2A2Q25	1-21-1	MPS3646
2A2Q26	1-21-1	MPS3646
2A2Q27	1-21-1	MPS3646
2A2Q28	1-21-1	MPS3646
2A2Q3	1-21-19	2N3906
2A2Q4	1-21-1	MPS3646
2A2Q5	1-21-19	2N3905
2A2Q6	1-21-19	2N3906
2A2Q7	1-21-1	MPS3646
2A2Q8	1-21-1	MPS3646
2A2Q9	1-21-1	MP3646
2A2R1	1-21-17	RC07GF222K
2A2R10	1-21-32	RC07GF472K
2A2R11	1-21-31	RC07GF103K
2A2R12	1-21-30	RC07GF470K
2A2R13	1-21-34	RC07GF152K
2A2R14	1-21-2	RC07GF681K
2A2R15	1-21-20	RCO7GF102K
2A2R16	1-21-33	RC07GF562K
2A2R17	1-21-20	RC07GF102K
2A2R18	1-21-32	RCO7GF472K
2A2R19	1-21-32	RC07GF472K
2A2R2	1-21-31	RC07GF103K
2A2R20	1-21-32	RC07GF472KK
2A2R21	1-21-31	RCQ7GF103K
2A2R22	1-21-32	RC07GF472K
2A2R23	1-21-20	RC07GF102K
2A2R24	1-21-20	RC07GF102K
2A2R25	1-21-20	RC07GF102K
2A2R26	1-21-20	RC07GF102K
2A2R27	1-21-32	RC07GF472K
2A2R28	1-21-38	RC07GF471K
2A2R29	1-21-23	RC07GF101K
2A2R3	1-21-28	RC07GF104K

REFERENCE DESIGNATOR INDEX

REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A2R30	1-21-23	RC07GF101K
2A2R31	1-21-36	RC07GF221K
2A2R32	1-21-39	RC07GF560K
2A2R33	1-21-17	RC07GF222K
2A2R34	1-21-37	RC07GF821K
2A2R35	1-21-36	RC07GF221K
2A2R36	1-21-20	RC07GF102K
2A2R37	1-21-39	RC07GF560K
2A2R38	1-21-17	RC07GF222K
2A2R39	1-21-14	RC20GF182K
2A2R4	1-21-31	RC07GF103K
2A2R40	1-21-12	RC07GF151K
2A2R41	1-21-2	RC07GF681K
2A2R42	1-21-2	RC07GF681K
2A2R43	1-21-3	RC07GF220K
2A2R44	1-21-3	RC07GF220K
2A2R45	1-21-3	RC07GF220K
2A2R46	1-21-3	RC07GF220K
2A2R47	1-21-3	RC07GF220K
2A2R48	1-21-3	RC07GF220K
2A2R49	1-21-17	RC07GF222K
2A2R5	1-21-29	RC07GF122K
2A2R50	1-21-14	RC20GF182K
2A2R51	1-21-12	RC07GF151K
2A2R52	1-21-2	RC07GF681K
2A2R53	1-21-2	RCO7GF681K
2A2R54	1-21-3	RC07GF220K
2A2R55	1-21-3	RC07GF220K
2A2R56	1-21-3	RC07GF220K
2A2R57	1-21-3	RC07GF220K
2A2R58	1-21-3	RC07GF220K
2A2R59	1-21-3	RC07GF220K
2A2R6	1-21-29	RC07GF122K
2A2R60	1-21-17	RC07GF222K
2A2R61	1-21-14	RC07GF182K
2A2R62	1-21-12	RC07GF151K
2A2R63	1-21-2	RC07GF681K
2A2R64	1-21-2	RC07GF681K
2A2R65	1-21-3	RC07GF220K
2A2R66	1-21-3	RC07GF220K
2A2R67	1-21-17	RC07GF222K
2A2R68	1-21-12	RC07GF151K
2A2R69	1-21-14	RC20GF182K

REFERENCE DESIGNATOR INDEX

REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A2R7	1-21-32	RC07GF472K
2A2R70	1-21-2	RC07GF681K
2A2R71	1-21-2	RC07GF681K
2A2R72	1-21-3	RC07GF220K
2A2R73	1-21-3	RC07GF220K
2A2R74	1-21-3	RC07GF220K
2A2R75	1-21-3	RC07GF220K
2A2R76	1-21-32	RC07GF472K
2A2R77	1-21-6	3067P1-202
2A2R78	1-21-31	RC07GF103K
2A2R79	1-21-20	RC07GF102K
2A2R8	1-21-20	RC07GF102K
2A2R80	1-21-20	RC07GF102K
2A2R81	1-21-20	RC07GF102K
2A2R9	1-21-2	RC07GF681K
2A2U1	1-21-7	SN7400N
2A2U2	1-21-7	SN7400N
2A2U3	1-21-7	SN74OON
2A2U4	1-21-7	SN7400N
2A3	1-17-3	10393557
2A3CR1	1-22-25	1N914
2A3CR2	1-22-25	1N914
2A3CR3	1-22-6	MV1642
2A3CR4	1-22-25	1N914
2A3C1	1-22-27	192P33292
2A3C10	1-22-33	CS13BE226K
2A3C11	1-22-3	CS13BE107K
2A3C12	1-22-18	CS13BB337K
2A3C13	1-22-9	TGS10
2A3C14	1-22-9	TGS10
2A3C15	1-22-9	TGS10
2A3C16	1-22-9	TGS10
2A3C17	1-22-9	TGS10
2A3C18	1-22-9	TGS10
2A3C19	1-22-9	TGS10
2A3C2	1-22-32	DM15-471J
2A3C20	1-22-9	TGS10
2A3C21	1-22-9	TGS10
2A3C22	1-22-9	TGS10
2A3C23	1-22-9	TGS10
2A3C3	1-22-35	CV31-C100
2A3C4	1-22-36	DM15-270J
2A3C5	1-22-9	TGS10

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A3C6	1-22-22	DM15-3313
2A3C7	1-22-1	DM15-470J
2A3C8	1-22-23	DM15-102J
2A3C9	1-22-1	DM15-470J
2A3L1	1-22-37	1025-28
2A3L2	1-22-19	1025-46
2A3Q1	1-22-7	MPS3646
2A3Q2	1-22-7	MPS3646
2A3Q3	1-22-7	MPS3646
2A3Q4	1-22-4	2N3906
2A3Q5	1-22-4	2N3906
2A3Q6	1-22-4	2N3906
2A3Q7	1-22-7	MPS3646
2A3Q8	1-22-7	MPS3646
2A3Q9	1-22-29	2N4220
2A3R1	1-22-24	RC07GF472K
2A3R10	1-22-31	RC07GF104K
2A3R11	1-22-24	RC07GF472K
2A3R12	1-22-8	RC07GF102K
2A3R13	1-22-24	RC07GF472K
2A3R14	1-22-24	RC07GF472K
2A3R15	1-22-24	RC07GF472K
2A3R16	1-22-5	RC07GF222K
2A3R17	1-22-21	RC07GF561K
2A3R18	1-22-20	RC07GF101K
2A3R19	1-22-24	RC07GF472K
2A3R2	1-22-24	RC07GF472K
2A3R20	1-22-34	RC07GF471K
2A3R21	1-22-17	RC07GF560K
2A3R22	1-22-34	RC07GF471K
2A3R23	1-22-17	RC07GF560K
2A3R24	1-22-2	RC07GF220K
2A3R25	1-22-8	RC07GF102K
2A3R26	1-22-8	RC07GF102K
2A3R27	1-22-8	RC07GF102K
2A3R28	1-22-24	RC07GF472K
2A3R3	1-22-24	RC07GF472K
2A3R4	1-22-24	RC07GF472K
2A3R5	1-22-24	RC07GF472K
2A3R6	1-22-5	RC07GF222K
2A3R7	1-22-24	RC07GF472K
2A3R8	1-22-5	RC07GF222K
2A3R9	1-22-30	RC07GF562K

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A3S1	1-22-11	MST3050
2A3U1	1-22-12	SN7400N
2A3U10	1-22-13	SN7490N
2A3U11	1-22-14	SN743N
2A3U2	1-22-10	SN7493N
2A3U3	1-22-10	SN7493N
2A3U4	1-22-15	SN7410N
2A3U5	1-22-13	SN7490N
2A3U6	1-22-12	SN7400N
2A3U7	1-22-13	SN7490N
2A3U8	1-22-13	SN7490N
2A3U9	1-22-13	SN7490N
2A4	1-17-4	10392368
2A4CR1	1-23-30	1N914
2A4CR2	1-23-30	1N914
2A4C1	1-23-9	DM15-102J
2A4C10	1-23-31	DM15-220J
2A4C11	1-23-31	DM15-220J
2A4C12	1-23-22	DM15-751J
2A4C13	1-23-5	DM15-221J
2A4C14	1-23-16	TGS10
2A4C15	1-23-9	DM15-102J
2A4C16	1-23-25	CS13BE107K
2A4C17	1-23-25	CS13BE107K
2A4C18	1-23-27	CS13BB337K
2A4C19	1-23-6	DM15-331J
2A4C2	1-23-16	TGS10
2A4C20	1-23-5	DM15-221J
2A4C21	1-23-15	192P10292
2A4C22	1-23-34	192P22392
2A4C23	1-23-16	TGS10
2A4C24	1-23-16	TGS10
2A4C25	1-23-16	TGS10
2A4C26	1-23-16	TGS10
2A4C27	1-23-16	TGS10
2A4C28	1-23-16	TGS10
2A4C3	1-23-6	DM15-331J
2A4C4	1-23-5	DM15-221J
2A4C5	1-23-15	192P10292
2A4C6	1-23-34	192P22392
2A4C7	1-23-32	DM15-100J
2A4C8	1-23-13	563013
2A4C9	1-23-5	DM15-221J

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A4L1	1-23-20	1025-46
2A4Q1	1-23-18	2N3906
2A4Q10	1-23-3	MPS3646
2A4Q11	1-23-3	MPS3646
2A4Q12	1-23-3	MPS3646
2A4Q13	1-23-3	MPS3646
2A4Q14	1-23-3	MPS3646
2A4Q15	1-23-3	MPS3646
2A4Q16	1-23-3	MPS3646
2A4Q17	1-23-3	MPS3646
2A4Q18	1-23-18	2N3906
2A4Q19	1-23-18	2N3906
2A4Q2	1-23-18	2N3906
2A4Q20	1-23-3	MPS3646
2A4Q21	1-23-3	MPS3646
2A4Q22	1-23-3	MPS3646
2A4Q23	1-23-18	2N3906
2A4Q24	1-23-18	2N3906
2A4Q25	1-23-18	2N3906
2A4Q26	1-23-3	MPS3646
2A4Q27	1-23-3	MPS3646
2A4Q28	1-23-3	MPS3646
2A4Q29	1-23-3	MPS3646
2A4Q3	1-23-18	2N3906
2A4Q30	1-23-29	2N1671B
2A4Q31	1-23-21	2M5555
2A4Q32	1-23-21	2N5555
2A4Q33	1-23-29	2N1671B
2A4Q34	1-23-29	2N1671B
2A4Q4	1-23-18	2N3906
2A4Q5	1-23-18	2N3906
2A4Q6	1-23-3	MPS3646
2A4Q7	1-23-3	MPS3646
2A4Q8	1-23-3	MPS3646
2A4Q9	1-23-3	MPS3646
2A4R1	1-23-8	RC07GF681K
2A4R10	1-23-2	RC07GF102K
2A4R11	1-23-4	RCO7GF222K
2A4R12	1-23-24	RC07GF471K
2A4R13	1-23-17	RC07GF822K
2A4R14	1-23-1	RC07GF472K
2A4R15	1-23-1	RCO7GF472K
2A4R16	1-23-24	RC07GF471K

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A4R17	1-23-1	RC07GF472K
2A4R18	1-23-14	RC07GF104K
2A4R19	1-23-24	RC07GF471K
2A4R2	1-23-1	RC07GF472K
2A4R20	1-23-1	RC07GF472K
2A4R21	1-23-19	RC07GF470K
2A4R22	1-23-23	RC07GF101K
2A4R23	1-23-12	RC07GF561K
2A4R24	1-23-2	RC07GF102K
2A4R25	1-23-2	RC07GF102K
2A4R26	1-23-2	RC07GF102K
2A4R27	1-23-1	RC07GF472K
2A4R28	1-23-1	RC07GF472K
2A4R29	1-23-23	RC07GF101K
2A4R3	1-23-1	RC07GF472K
2A4R30	1-23-24	RC07GF471K
2A4R31	1-23-1	RC07GF472K
2A4R32	1-23-1	RC07GF472K
2A4R33	1-23-1	RCO7GF472K
2A4R34	1-23-19	RC07GF470K
2A4R35	1-23-1	RC07GF472K
2A4R36	1-23-24	RCO7GF471K
2A4R37	1-23-2	RC07GF102K
2A4R38	1-23-19	RC07GF470K
2A4R39	1-23-2	RC07GF102K
2A4R4	1-23-19	RCO7GF470K
2A4R40	1-23-19	RC07GF470K
2A4R41	1-23-2	RC07GF102K
2A4R42	1-23-8	RCO7GF681K
2A4R43	1-23-8	RC07GF681K
2A4R44	1-23-2	RC07GF102K
2A4R45	1-23-19	RC07GF470K
2A4R46	1-23-2	RC07GF102K
2A4R47	1-23-2	RC07G102K
2A4R48	1-23-4	RCO7GF222K
2A4R49	1-23-24	RC07GF47lK
2A4R5	1-23-8	RC07GF681K
2A4R50	1-23-17	RC07GF822K
2A4R51	1-23-1	RC07GF472K
2A4R52	1-23-1	RCO7GF472K
2A4R53	1-23-1	RC07GF472K
2A4R54	1-23-14	**RCO7GF104K**
2A4R55	1-23-24	RC07GF471K

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A4R56	1-23-1	RC07GF472K
2A4R57	1-23-19	RC07GF470K
2A4R58	1-23-19	RC07GF470K
2A4R59	1-23-33	RC07GF682K
2A4R6	1-23-1	RC07GF472K
2A4R60	1-23-33	RCO7GF682K
2A4R61	1-23-2	RC07GF102K
2A4R62	1-23-2	RC07GF102K
2A4R63	1-23-2	RC07GF102K
2A4R64	1-23-5	RC07GF681K
2A4R65	1-23-24	RC07GF471K
2A4R66	1-23-28	RC07GF100K
2A4R67	1-23-28	RC07GF100K
2A4R68	1-23-2	RC07GF102K
2A4R7	1-23-2	RC07GF102K
2A4R8	1-23-19	RC07GF470K
2A4R9	1-23-2	RC07GF102K
2A4T1	1-23-7	75192635
2A4U1	1-23-11	SN7400N
2A4U2	1-23-11	SN7400N
2A4U3	1-23-11	SN7400N
2A4U4	1-23-10	SN7404N
2A5	1-17-5	10392375
2A5C1	1-24-5	TGS10
2A5C10	1-24-5	TGS10
2A5C11	1-24-5	TGS10
2A5C12	1-24-5	TGS10
2A5C13	1-24-5	TGS10
2A5C14	1-24-5	TGS10
2A5C15	1-24-5	TGS10
2A5C16	1-24-5	TGS10
2A5C17	1-24-5	TGS10
2A5C18	1-24-5	TGS10
2A5C19	1-24-5	TGS10
2A5C2	1-24-5	TGS10
2A5C20	1-24-5	TGS10
2A5C21	1-24-5	TGS10
2A5C22	1-24-10	CS13BE105K
2A5C24	1-24-13	DM15-560J
2A5C3	1-24-5	TGS10
2A5C4	1-24-17	CS13BB337K
2A5C5	1-24-5	TGS10
2A5C6	1-24-5	TGS10

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A5C7	1-24-5	TGS10
2A5C8	1-24-5	TGS10
2A5C9	1-24-5	TGS10
2A5Q1	1-24-16	2N3704
2A5Q2	1-24-16	2N3704
2A5Q3	1-24-16	2N3704
2A5Q4	1-24-12	2N3904
2A5R1	1-24-3	RC07GF102K
2A5R10	1-24-6	RC07GF472K
2A5R11	1-24-11	RC07GF682K
2A5R12	1-24-11	RC07GF682K
2A5R13	1-24-11	RC07GF682K
2A5R14	1-24-3	RC07GF102K
2A5R18	1-24-3	RC07GF102K
2A5R19	1-24-4	RC07GF560K
2A5R2	1-24-3	RC07GF102K
2A5R3	1-24-3	RC07GF102K
2A5R4	1-24-3	RC07GF102K
2A5R5	1-24-3	RC07GF102K
2A5R6	1-24-3	RC07GF102K
2A5R8	1-24-6	RC07GF472K
2A5R9	1-24-6	RC07GF472K
2A5U1	1-24-2	SN7400N
2A5U10	1-24-1	SN7474N
2A5U11	1-24-2	SN7400N
2A5U12	1-24-1	SN7474N
2A5U13	1-24-7	SN7486N
2A5U14	1-24-8	SN7490N
2A5U15	1-24-2	SN7400N
2A5U16	1-24-7	SN7486N
2A5U17	1-24-1	SN7474N
2A5U2	1-24-2	SN7400N
2A5U3	1-24-9	SN7410N
2A5U4	1-24-2	SN7400N
2A5U5	1-24-9	SN7410N
2A5U6	1-24-8	SN7490N
2A5U7	1-24-15	SN4044P
2A5U8	1-24-14	MC4024P
2A5U9	1-24-8	SN7490N
2A6	1-17-6	10393562
2A6CR1	1-25-33	1N914
2A6CR2	1-25-33	1N914
2A6CR3	1-25-23	MV1642

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A6CR4	1-25-33	1N914
2A6CR5	1-25-33	1N914
2A6CR6	1-25-33	1N914
2A6CR7	1-25-23	MV1642
2A6CR8	1-25-33	1N914
2A6C1	1-25-20	CS13BB337K
2A6C10	1-25-30	DM15-330J
2A6C11	1-25-2	DM15-102J
2A6C12	1-25-17	DM15-181J
2A6C13	1-25-12	192P33292
2A6C14	1-25-3	CS13BE226K
2A6C15	1-25-14	DM15-471J
2A6C16	1-25-16	CV31-C 100
2A6C17	1-25-29	DM15-270J
2A6C18	1-25-9	192P10392
2A6C19	1-25-8	DM15-331J
2A6C2	1-25-5	CS13BE107K
2A6C20	1-25-30	DM15-330J
2A6C21	1-25-2	DM15-102J
2A6C22	1-25-17	DM15-181J
2A6C23	1-25-32	TGS10
2A6C24	1-25-32	TGS10
2A6C25	1-25-32	TGS10
2A6C26	1-25-32	TGS10
2A6C27	1-25-32	TGS10
2A6C28	1-25-32	TGS10
2A6C29	1-25-32	TGS10
2A6C3	1-25-12	192P33292
2A6C30	1-25-32	TGS10
2A6C31	1-25-32	TGS10
2A6C32	1-25-32	TGS10
2A6C33	1-25-32	TGS10
2A6C34	1-25-32	TGS10
2A6C35	1-25-32	TGS10
2A6C36	1-25-32	TGS10
2A6C37	1-25-32	TGS10
2A6C38	1-25-32	TGS10
2A6C39	1-25-32	TGS10
2A6C4	1-25-3	CS13BE226K
2A6C40	1-25-32	TGS10
2A6C41	1-25-32	TGS10
2A6C42	1-25-5	CS13BE107K
2A6C5	1-25-14	DM15-471J

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A6C6	1-25-16	CV31-C 100
2A6C7	1-25-29	DM15-270J
2A6C8	1-25-9	192P10392
2A6C9	1-25-8	DM15-331J
2A6L1	1-25-35	1025-24
2A6L2	1-25-28	1025-56
2A6L3	1-25-35	1025-24
2A6L4	1-25-28	1025-56
2A6Q1	1-25-34	MPS3646
2A6Q10	1-25-34	MPS3646
2A6Q11	1-25-34	MPS3646
2A6Q12	1-25-34	MPS3646
2A6Q13	1-25-7	2N4220
2A6Q14	1-25-26	2N3906
2A6Q15	1-25-26	2N3906
2A6Q16	1-25-26	2N3906
2A6Q17	1-25-34	MPS3646
2A6Q18	1-25-34	MPS3646
2A6Q2	1-25-34	MPS3646
2A6Q3	1-25-7	2N4220
2A6Q4	1-25-26	2N3905
2A6Q5	1-25-26	2N3906
2A6Q6	1-25-26	2N3906
2A6Q7	1-25-34	MPS3646
2A6Q8	1-25-34	MPD3646
2A6Q9	1-25-34	MPD3646
2A6R1	1-25-4	RC07GF472K
2A6R10	1-25-31	RC07GF102K
2A6R11	1-25-4	RC07GF472K
2A6R12	1-25-4	RC07GF472K
2A6R13	1-25-4	RC07GF472K
2A6R14	1-25-4	RC07GF472K
2A6R15	1-25-1	RC07GF222K
2A6R16	1-25-18	RC07GF561K
2A6R17	1-25-21	RC07GF101K
2A6R18	1-25-4	RC07GF472K
2A6R19	1-25-4	RC07GF472K
2A6R2	1-25-4	RC07GF472K
2A6R20	1-25-31	RC07GF102K
2A6R21	1-25-31	RC07GF102K
2A6R22	1-25-31	RC07GF102K
2A6R23	1-25-31	RC07GF102K
2A6R24	1-25-4	RC07GF472K

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A6R25	1-25-4	RC07GF472K
2A6R26	1-25-31	RC07GF102K
2A6R27	1-25-4	RC07GF472K
2A6R28	1-25-31	RC07GF102K
2A6R29	1-25-4	RC07GF472K
2A6R3	1-25-4	RC07GF472K
2A6R30	1-25-4	RC07GF472K
2A6R31	1-25-1	RC07GF222K
2A6R32	1-25-4	RC07GF472K
2A6R33	1-25-1	RC07GF222K
2A6R34	1-25-24	RC07GF562K
2A6R35	1-25-25	RC07GF104K
2A6R36	1-25-6	RC07GF103K
2A6R37	1-25-4	RC07GF472K
2A6R38	1-25-4	RC07GF472K
2A6R39	1-25-4	RC07GF472K
2A6R4	1-25-1	RC07GF222K
2A6R40	1-25-4	RC07GF472K
2A6R41	1-25-1	RC07GF222K
2A6R42	1-25-18	RC07GF561K
2A6R43	1-25-21	RC07GF101K
2A6R44	1-25-22	RC07GF220K
2A6R45	1-25-22	RC07GF220K
2A6R46	1-25-31	RC07GF102K
2A6R5	1-25-4	RC07GF472K
2A6R6	1-25-1	RC07GF222K
2A6R7	1-25-25	RC07GF104K
2A6R8	1-25-24	RC07GF562K
2A6R9	1-25-6	RC07GF103K
2A6U1	1-25-10	SN7400N
2A6U10	1-25-11	SN7493N
2A6U11	1-25-11	SN7493N
2A6U12	1-25-15	SN7410N
2A6U13	1-25-13	SN7490N
2A6U14	1-25-13	SN7490N
2A6U16	1-25-11	SN7493N
2A6U17	1-25-11	SN7493N
2A6U18	1-25-10	SN7400N
2A6U19	1-25-10	SN7400N
2A6U2	1-25-13	SN7490N
2A6U3	1-25-13	SN7490N
2A6U4	1-25-13	SN7490N
2A6U5	1-25-19	SN7473N

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
[illegible]	1-25-13	SN7490N
2A6U6	1-25-10	SN7400N
2A6U7	1-25-13	SN7490N
2A6U8	1-25-13	SN7490N
2A6U9	1-25-13	SN7490N
2A7	1-17	1149357
2A7C1	1-17-21	CS13BE106K
2A7C2	1-17-22	CS13BC107K
2A7C3	1-17-47	CS13BC107K
2A7C4	1-17-48	CS13BE107K
2A7DS1	1-17-14	327
2A7DS2	1-17-14	327
2A7DS3	1-17-14	327
2A7DS4	1-17-14	327
2A7DS5	1-17-14	327
2A7DS6	1-17-14	327
2A7DS7	1-17-14	327
2A7DS8	1-17-14	327
2A7J1	1-17-40	UG625U
2A7J10	1-17-40	UG625U
2A7J11	1-17-40	UG625U
2A7J12	1-17-40	UG625U
2A7J13	1-17-40	UG625U
2A7J14	1-17-40	UG625U
2A7J15	1-17-40	UG625U
2A7J16	1-17-38	MS3102A14S1P
2A7J17	1-17-39	160-5N
2A7J18	1-17-25	UG625U
2A7J19	1-17-25	UG625U
2A7J2	1-17-40	UG625U
2A7J20	1-17-25	UG625U
2A7J21	1-17-25	UG625U
2A7J22	1-17-46	50-448-10
2A7J23	1-17-46	50-448-10
2A7J24	1-17-46	50-448-10
2A7J25	1-17-46	50-448-10
2A7J26	1-17-46	50-448-10
2A7J27	1-17-46	50-448-10
2A7J28	1-17-46	50-448-10
2A7J3	1-17-40	UG625U
2A7J4	1-17-40	UG625U
2A7J5	1-17-40	UG625U
2A7J6	1-17-40	UG625U

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
2A7J7	1-17-40	UG625U
2A7J8	1-17-40	UG625U
2A7J9	1-17-40	UG625U
2A7Q1	1-17-53	MJE3055
2A7R1	1-17-23	RC07GF104K
2A7R2	1-17-23	RC07GF104K
2A7R3	1-17-24	RC07GF103K
2A7R4	1-17-24	RC07GF103K
2A7S1	1-17-18	30-1
2A7S2	1-17-18	30-1
2A7S3	1-17-20	8A2003
2A7XA1P1	1-17-36	5306AB
2A7XDS1	1-17-13	359843009502
2A7XDS2	1-17-13	359843009502
2A7XDS3	1-17-13	359843009502
2A7XDS4	1-17-13	359843009502
2A7XDS5	1-17-13	359843009502
2A7XDS6	1-17-13	359843009502
2A7XDS7	1-17-13	359843009502
2A7XDS8	1-17-13	359843009502

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3	1-1-3	30493409
3A1	1-26-1	20392396
3A1A1	1-27-4	10391994
3A1A1CR10	1-28-11	1N914
3A1A1C3	1-28-13	DM15-1023
3A1A1C4	1-28-14	192P56292
3A1A1C5	1-28-3	CS13BE226K
3A1A1C6	1-28-18	192P10492
3A1A1C7	1-28-8	192910392
3A1A1C8	1-28-1	CS13BB337K
3A1A1Q10	1-28-9	2N3702
3A1A1Q11	1-28-9	2N3702
3A1A1Q12	1-28-9	2N3702
3A1A1Q14	1-28-15	2N3704
3A1A1Q15	1-28-15	2N3704
3A1A1R25	1-28-6	RC07GF682K
3A1A1R26	1-28-16	RN55D1101F
3A1A1R27	1-28-10	RC07GF681K
3A1A1R28	1-28-12	RC07GF122K
3A1A1R29	1-28-10	RC07GF681K
3A1A1R30	1-28-10	RC07GF681K
3A1A1R31	1-28-7	RC07GF100K
3A1A1R32	1-28-5	RC07GF470K
3A1A1R33	1-28-6	RC07GF682K
3A1A1R34	1-28-6	RC07GF682K
3A1A1R35	1-28-10	RC07GF681K
3A1A1R36	1-28-4	RC.07GF123K
3A1A1R39	1-28-17	RN55D3401F
3A1A1VR2	1-28-2	1N1602
3A1A2	1-27-5	10391993
3A1A2CR2	1-29-15	1N4002
3A1A2CR3	1-29-15	1N4002
3A1A2CR4	1-29-15	1N4002
3A1A2CR5	1-29-15	1N4002
3A1A2CR6	1-29-12	1N914
3A1A2CR7	1-29-12	1N914
3A1A2CR8	1-29-12	1N914
3A1A2CR9	1-29-12	1N914
3A1A2C10	1-29-26	192P22392
3A1A2C2	1-29-14	CS13BE105K
3A1A2C9	1-29-22	192P10392
3A1A2Q1	1-29-9	2N3704

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A1A2Q16	1-29-6	2N3702
3A1A2Q2	1-29-9	2N3704
3A1A2Q3	1-29-6	2N3702
3A1A2Q5	1-29-11	2N1671B
3A1A2Q6	1-29-9	2N3704
3A1A2Q7	1-29-6	2N3702
3A1A2Q8	1-29-6	2N3702
3A1A2Q9	1-29-27	2N2270
3A1A2R1	1-29-18	RC20GF121K
3A1A2R10	1-29-5	RC07GF560K
3A1A2R11	1-29-1	RC07GF102K
3A1A2R12	1-29-7	RC07GF561K
3A1A2R13	1-29-8	RC07GF563K
3A1A2R14	1-29-10	RC07GF564K
3A1A2R15	1-29-7	RC07GF561K
3A1A2R16	1-29-13	RC07GF223K
3A1A2R17	1-29-25	RC07GF472K
3A1A2R18	1-29-25	RC07GF472K
3A1A2R19	1-29-20	RC20GF562K
3A1A2R2	1-29-17	RC20GF221K
3A1A2R20	1-29-7	RC07GF561K
3A1A2R21	1-29-4	RC07GF123K
3A1A2R22	1-29-1	RC07GF102K
3A1A2R23	1-29-28	RC07GF101K
3A1A2R24	1-29-23	RC20GF471K
3A1A2R3	1-29-2	RN55D2211F
3A1A2R37	1-29-4	RC07GF123K
3A1A2R38	1-29-4	RC07GF123K
3A1A2R4	1-29-3	3067P1-101
3A1A2R5	1-29-24	RN55D6810F
3A1A2R6	1-29-20	RC20GF562K
3A1A2R7	1-29-21	RC07GF222K
3A1A2R8	1-29-7	RC07GF561K
3A1A2R9	1-29-4	RC07GF123K
3A1A2VR1	1-29-19	1N4733
3A1CR1	1-27-2	MR1125
3A1CR11	1-27-3	1N3879
3A1C1	1-27-17	36D842G040BB2A
3A1F1	1-27-10	312002
3A1F2	1-27-10	312002
3A1F3	1-27-11	312005
3A1L1	1-27-15	75192035
3A1Q13	1-27-1	40364

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A1R24	1-32-1	RC07GF472K
3A1R28	1-32-4	RC07GF332K
3A1S1	1-27-12	20994LH
3A1S2	1-27-12	20994LH
3A1S3	1-27-13	46256LFR
3A1T1	1-27-16	75192036
3A1XF1	1-27-9	HKP
3A1XF2	1-27-9	HKP
3A1XF3	1-27-9	HKP
3A10	1-26-10	10392385
3A10C1	1-38-4	DM15-120J
3A10C10	1-38-16	192P56292
3A10C11	1-38-23	CS13BE105K
3A10C12	1-38-23	CS13BE105K
3A10C13	1-38-11	CS13BC107K
3A10C14	1-38-11	CS13BC107K
3A10C15	1-38-4	DM15-120J
3A10C16	1-38-23	CS13BF105K
3A10C17	1-38-18	192P10392
3A10C18	1-38-11	CS13BC107K
3A10C19	1-38-11	CS13BC107K
3A10C2	1-38-4	DM15-120J
3A10C20	1-38-12	25-562C
3A10C20	1-38-12	25-682C
3A10C20	1-38-12	25-822C
3A10C21	1-38-28	DM15-102J
3A10C21	1-38-28	**DM15-471J**
3A10C21	1-38-28	**DM15-100J**
3A10C22	1-38-47	DM15-911J
3A10C22	1-38-47	DM15-681J
3A10C22	1-38-47	**DM15-471J**
3A10C22	1-38-47	DM15-391J
3A10C22	1-38-47	DM15-151J
3A10C22	1-38-47	DM15-121J
3A10C22	1-38-47	DM15-820J
3A10C23	1-38-12	25-562C
3A10C23	1-38-12	25-682C
3A10C23	1-38-12	**25-822C**
3A10C24	1-38-28	DM15-102J
3A10C24	1-38-28	DM15-471J
3A10C24	1-38-28	DM15-100J
3A10C3	1-38-24	525000
3A10C4	1-38-4	DM15-120J

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A10C5	1-38-4	DM15-120J
3A10C6	1-38-4	DM15-120J
3A10C7	1-38-4	DM15-120J
3A10C8	1-38-16	192P56292
3A10C9	1-38-16	192P56292
3A10L1	1-38-35	751925232
3A10L2	1-38-29	751925231
3A10L3	1-38-35	751925232
3A10Q1	1-38-20	2N3704
3A10Q10	1-38-17	MPS3646
3A10Q11	1-38-17	MPS3646
3A10Q12	1-38-17	MPS3646
3A10Q13	1-38-36	2N4220
3A10Q14	1-38-13	2N3702
3A10Q15	1-38-20	2N3704
3A10Q2	1-38-1	2N3906
3A10Q3	1-38-20	2N3704
3A10Q4	1-38-20	2N3704
3A10Q5	1-38-1	2N3906
3A10Q6	1-38-20	2N3704
3A10Q7	1-38-36	2N4220
3A10Q8	1-38-36	2N4220
3A10Q9	1-38-36	2N4220
3A10R1	1-38-26	RC07GF123K
3A10R10	1-38-26	RC07GF123K
3A10R11	1-38-37	RC07GF473K
3A10R12	1-38-39	RC07GF223K
3A10R13	1-38-21	RC07GF562K
3A10R14	1-38-37	RC07GF473K
3A10R15	1-38-39	RC07GF223K
3A10R16	1-38-21	RC07GF562K
3A10R17	1-38-37	RC07GF473K
3A10R18	1-38-21	RC07GF562K
3A10R19	1-38-38	RC07GF104K
3A10R2	1-38-21	RC07GF562K
3A10R20	1-38-33	RC07GF104K
3A10R21	1-38-38	RC07GF104K
3A10R22	1-38-27	RC07GF102K
3A10R23	1-38-15	RC07GF560K
3A10R24	1-38-14	RC07GF561K
3A10R25	1-38-34	RC07GF681K
3A10R26	1-38-33	RC07GF221K
3A10R27	1-38-27	RC07GF102K

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A10R28	1-38-46	RC07GF120K
3A10R29	1-38-45	RC07GF150K
3A10R3	1-38-3	RC07GF272K
3A10R30	1-38-45	RC07GF150K
3A10R31	1-38-45	RC07GF150K
3A10R32	1-38-44	RC07GF220K
3A10R33	1-38-44	RC07GF220K
3A10R34	1-38-44	RC07GF220K
3A10R35	1-38-43	RC07GF270K
3A10R36	1-38-42	RC07GF330K
3A10R37	1-38-41	RC07GF470K
3A10R38	1-38-41	RC07GF470K
3A10R39	1-38-41	RC07GF470K
3A10R4	1-38-2	RN55D8251F
3A10R40	1-38-41	RC07GF470K
3A10R41	1-38-41	RC07GF470K
3A10R42	1-38-41	RC07GF470K
3A10R43	1-38-41	RC07GF470K
3A10R45	1-38-42	RC07GF330K
3A10R46	1-38-40	RC07GF3680K
3A10R47	1-38-40	RC07GF680K
3A10R48	1-38-40	RC07GF680K
3A10R49	1-38-40	RC07GF680K
3A10R5	1-38-5	RC07GF101K
3A10R50	1-38-40	RC07GF680K
3A10R51	1-38-40	RC07GF680K
3A10R52	1-38-40	RC07GF680K
3A10R56	1-38-5	RC07GF101K
3A10R57	1-38-22	RN55D6812F
3A10R58	1-38-22	RN55D6812F
3A10R59	1-38-6	RN55D1000F
3A10R6	1-38-7	RC07GF274K
3A10R60	1-38-5	RC07GF101K
3A10R61	1-38-5	RC07GF101K
3A10R62	1-38-2	RN55D8251F
3A10R63	1-38-27	RC07GF102K
3A10R64	1-38-5	RC07GF101K
3A10R65	1-38-5	RC07GF101K
3A10R7	1-38-25	3057P1-501
3A10R8	1-38-3	RC07GF272K
3A10R9	1-38-21	RC07GF562K
3A10S2	1-38-30	87-22-10
3A10S3	1-38-30	87-22-10

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3A10T1	1-38-19	75192519
3A11	1-26	11493576
3A11A1	1-26-24	12093938
3A11C1	1-26-50	31-274C
3A11C2	1-26-49	CS13BC107K
3A11C3	1-26-49	CS13BC107K
3A11C4	1-26-49	CS13BC107K
3A11C5	1-26-48	CS13BE107K
3A11C6	1-26-48	CS13BE107K
3A11C7	1-26-48	CS13BE107K
3A11C8	1-26-50A	31-823C
3A11DS1	1-26-18	327
3A11DS2	1-26-18	327
3A11F1	1-26-39	1110102001
3A11F2	1-26-40	1110103001
3A11J1	1-26-35	UG625U
3A11J10	1-26-43	160-5N
3A11J11	1-26-47	50-44B-10
3A11J12	1-26-47	50-44B-10
3A11J13	1-26-47	50-44B-10
3A11J14	1-26-47	50-44B-10
3A11J15	1-26-47	50-44B-10
3A11J16	1-26-47	50-44B-10
3A11J17	1-26-47	50-44B-10
3A11J18	1-26-47	50-44B-10
3A11J19	1-26-47	50-44B-10
3A11J2	1-26-35	UG625U
3A11J20	1-26-47	50-44B-10
3A11J21	1-26-47	50-44B-10
3A11J3	1-26-35	UG625U
3A11J4	1-26-35	UG625U
3A11J5	1-26-35	UG625U
3A11J6	1-26-35	UG625U
3A11J7	1-26-35	UG625U
3A11J8	1-26-35	UG625U
3A11J9	1-26-42	MS3102A14S1P
3A11P1	1-26-33	S306AB
3A11Q1	1-26-59	MJE3055
3A11R1	1-26-38	RV4LAYSA502A
3A11R2	1-26-52	RC07GF183K
3A11R3	1-26-53	RC07GF223K
3A11R4	1-26-51	RC07GF470K
3A11R5	1-26-54	RC07GF472K

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A11S1	1-26-41	30-1
3A11S2	1-26-41	30-1
3A11S3	1-26-22	PA2003
3A11XDS1	1-26-17	359843009502
3A11XDS2	1-26-17	359843009502
3A2	1-26-2	10392395
3A2CR1	1-30-7	1N914
3A2CR2	1-30-7	1N914
3A2CR3	1-30-7	1N914
3A2C1	1-30-5	CS13BF105K
3A2C10	1-30-11	192P56292
3A2C11	1-30-21	TGS10
3A2C12	1-30-4	DM15-120J
3A2C14	1-30-19	DM15-471J
3A2C15	1-30-11	192P56292
3A2C16	1-30-19	DM15-471J
3A2C17	1-30-12	192P22392
3A2C18	1-30-8	CS13BB337K
3A2C19	1-30-8	CS13BB337K
3A2C2	1-30-4	DM15-120J
3A2C20	1-30-4	DM15-120J
3A2C6	1-30-4	DM15-120J
3A2C7	1-30-5	CS13BE105K
3A2C8	1-30-5	CS13BE105K
3A2Q1	1-30-6	MPS3646
3A2Q10	1-30-6	MPS3646
3A2Q11	1-30-6	MPS3646
3A2Q12	1-30-6	MPS3646
3A2Q15	1-30-6	MPS3646
3A2Q16	1-30-6	MPS3646
3A2Q17	1-30-6	MPS3646
3A2Q18	1-30-6	MPS3646
3A2Q19	1-30-6	MPS3646
3A2Q2	1-30-6	MPS3646
3A2Q20	1-30-6	MPS3646
3A2Q21	1-30-6	MPS3646
3A2Q22	1-30-6	MPS3646
3A2Q6	1-30-6	MPS3646
3A2Q7	1-30-6	MPS3646
3A2Q8	1-30-6	MPS3646
3A2Q9	1-30-6	MPS3646
3A2R1	1-30-2	RC07GF101K
3A2R13	1-30-14	RC07GF472K

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3A2R15	1-30-16	RC07GF471K
3A2R16	1-30-23	RC07GF331K
3A2R17	1-30-13	RC07GF682K
3A2R18	1-30-15	3067O1-502
3A2R19	1-30-23	RC07GF331K
3A2R2	1-30-3	RC07GF103K
3A2R20	1-30-1	RC07GF222K
3A2R21	1-30-14	RC07GF472K
3A2R22	1-30-17	RC07GF473K
3A2R23	1-30-14	RC07GF472K
3A2R24	1-30-9	3067P1-203
3A2R25	1-30-3	RC07GF103K
3A2R26	1-30-25	RC07GF152K
3A2R27	1-30-22	RC07GF153K
3A2R28	1-30-17	RC07GF473K
3A2R29	1-30-14	RC07GF472K
3A2R3	1-30-24	RC07GF560K
3A2R30	1-30-14	RC07GF472K
3A2R32	1-30-3	RC07GF103K
3A2R36	1-30-3	RC07GF103K
3A2R37	1-30-17	RC07GF473K
3A2R38	1-30-14	RC07GF472K
3A2R39	1-30-10	RC07GF822K
3A2R4	1-30-14	RC07GF472K
3A2R40	1-30-14	RC07GF472K
3A2R41	1-30-9	3067P-1203
3A2R42	1-30-3	RC07GF103K
3A2R43	1-30-10	RC07GF822K
3A2R44	1-30-14	RC07GF472K
3A2R45	1-30-20	RC07GF223K
3A2R46	1-30-14	RC07GF472K
3A2R47	1-30-14	RC07GF472K
3A2R48	1-30-18	RC07GF333K
3A2R49	1-30-14	RC07GF472K
3A2R50	1-30-14	RC07GF472K
3A2R51	1-30-17	RC07GF473K
3A3	1-26-3	10392394
3A3C1	1-31-6	192P33292
3A3C10	1-31-12	192P10392
3A3C11	1-31-16	CS13BC107K
3A3C12	1-31-1	UK10-104
3A3C13	1-31-12	192P10392
3A3C2A	1-31-5	DM15-391J

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3A3C2A	1-31-5	DM15-471J
3A3C2A	1-31-5	DM15-561J
3A3C2A	1-31-5	DM15-681J
3A3C2A	1-31-5	DM15-821J
3A3C2A	1-31-5	DM15-102J
3A3C2B	1-31-5A	DM15-391J
3A3C2B	1-31-5A	DM15-471J
3A3C2B	1-31-5A	DM15-561J
3A3C2B	1-31-5A	DM15-681J
3A3C2B	1-31-5A	DM15-821J
3A3C2B	1-31-5A	DM15-102J
3A3C3	1-31-15	DM15-221J
3A3C4	1-31-6	192P33292
3A3C5A	1-31-5B	DM15-391J
3A3C5A	1-31-5B	DM15-471J
3A3C5A	1-31-5B	DM15-561J
3A3C5A	1-31-5B	DM15-681J
3A3C5A	1-31-5B	DM15-821J
3A3C5A	1-31-5B	DM15-102J
3A3C5B	1-31-5C	DM15-391J
3A3C5B	1-31-5C	DM15-471J
3A3C5B	1-31-5C	DM15-561J
3A3C5B	1-31-5C	DM15-681J
3A3C5B	1-31-5C	DM15-821J
3A3C5B	1-31-5C	DM15-102J
3A3C6	1-31-15	DM15-221J
3A3C7	1-31-6	192P33292
3A3C8A	1-31-5D	DM15-391J
3A3C8A	1-31-5D	DM15-471J
3A3C8A	1-31-5D	DM15-561J
3A3C8A	1-31-5D	DM15-681J
3A3C8A	1-31-5D	DM15-821J
3A3C8A	1-31-5D	OM15-102J
3A3C8B	1-31-5E	DM15-391J
3A3C8B	1-31-5E	DM15-471J
3A3C8B	1-31-5E	DM15-561J
3A3C8B	1-31-5E	OM15-681J
3A3C8B	1-31-5E	DM15-821J
3A3C8B	1-31-5E	DM15-102J
3A3C9	1-31-1	UK10-104
3A3L1	1-31-4	75192521
3A3L2	1-31-4	75192521
3A3L3	1-31-4	

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3A3Q1	1-31-9	2N3704
3A3Q2	1-31-2	2N3702
3A3Q3	1-31-9	2N3704
3A3Q4	1-31-9	2N3704
3A3R10	1-31-7	RC7GF103K
3A3R11	1-31-17	RC07GF330K
3A3R12	1-31-8	RC07GF560K
3A3R13	1-31-3	RC07GF222K
3A3R14	1-31-13	3067P1-102
3A3R15	1-31-10	RC07GF102K
3A3R16	1-31-3	RC07GF222K
3A3R17	1-31-11	RC07GF101K
3A3R18	1-31-7	RC07GF103K
3A3R19	1-31-11	RC07GF101K
3A3R20	1-31-7	RC07GF103K
3A3R4	1-31-7	RC07GF103K
3A3R5	1-31-10	RC07GF102K
3A3R6	1-31-3	RC07GF222K
3A3R7	1-31-13	3067P1-102
3A3R8	1-31-11	RC07GF101K
3A3R9	1-31-10	RC07GF102K
3A4	1-26-4	10392393
3A4CR1	1-32-15	MV1642
3A4CR2	1-32-9	1N914
3A4C1	1-32-19	DM15-681J
3A4C10	1-32-33	DM15-470J
3A4C11	1-32-6	192P10292
3A4C12	1-32-7	DM15-120J
3A4C13	1-32-31	DM15-750J
3A4C14	1-32-31	DM15-750J
3A4C15	1-32-8	CS13BE105K
3A4C16	1-32-8	VS13BE105K
3A4C17	1-32-25	CS13BE107K
3A4C18	1-32-8	CS13BE105K
3A4C19	1-32-24	CS13BB337K
3A4C2	1-32-14	DM15-680J
3A4C20	1-32-13	DM15-102J
3A4C3	1-32-21	TSG10
3A4C4	1-32-36	192P47292
3A4C5	1-32-37	CS13BE226K
3A4C6	1-32-16	CV31-C 100
3A4C7	1-32-21	TSG10
3A4C8	1-32-14	DM15-680J

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3A4C9	1-32-35	DM15-471J
3A4L1	1-32-40	1025-32
3A4L2	1-32-11	1025-50
3A4Q1	1-32-34	2N3906
3A4Q10	1-32-29	MPS3646
3A4Q11	1-32-39	2N3704
3A4Q12	1-32-39	2N3704
3A4Q13	1-32-29	MPS3646
3A4Q15	1-32-29	MPS3646
3A4Q16	1-32-29	MPS3646
3A4Q17	1-32-29	**MPS3646**
3A4Q18	1-32-29	**MPS3646**
3A4Q2	1-32-34	**2N3906**
3A4Q3	1-32-29	**MPS3646**
3A4Q4	1-32-29	**MPS3646**
3A4Q5	1-32-34	**2N3906**
3A4Q6	1-32-34	**2N3906**
3A4Q7	1-32-29	**MPS3646**
3A4Q8	1-32-29	**MPS3646**
3A4Q9	1-32-29	**MPS3646**
3A4R1	1-32-18	RC07GF681K
3A4R10	1-32-1	RC07GF472K
3A4R11	1-32-32	RC07GF103K
3A4R12	1-32-32	RC07GF103K
3A4R13	1-32-17	RC07GF471K
3A4R14	1-32-30	RCO7GF102K
3A4R15	1-32-3	RC07GF10lK
3A4R16	1-32-1	RC07GF472K
3A4R17	1-32-1	RC07GF472K
3A4R18	1-32-1	RC07GF472K
3A4R19	1-32-12	RC07GF222K
3A4R2	1-32-2	**3067P1-502**
3A4R20	1-32-1	RC07GF472K
3A4R21	1-32-10	RC07GF561K
3A4R22	1-32-3	RC07GF101K
3A4R23	1-32-1	RC07GF472K
3A4R25	1-32-1	RC07GF472K
3A4R26	1-32-5	RC07GF223K
3A4R27	1-32-2	**3067P1-502**
3A4R29	1-32-32	RCO7GFl03K
3A4R3	1-32-20	RC07GF682K
3A4R30	1-32-41	RC07GF104K
3A4R31	1-32-42	RN55D1212F

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3A4R32	1-32-1	RC07GF472K
3A4R33	1-32-30	RC07GF102K
3A4R34	1-32-41	RC07GF104K
3A4R37	1-32-1	RC07GF472K
3A4R39	1-32-1	RC07GF472K
3A4R4	1-32-17	RC07GF471K
3A4R40	1-32-26	RC07GF100K
3A4R41	1-32-26	RC07GF100K
3A4R42	1-32-38	RC07GF470K
3A4R43	1-32-1	RC07GF472K
3A4R44	1-32-30	RC07GF102K
3A4R45	1-32-42	RN55D1212F
3A4R46	1-32-1	RC07GF472K
3A4R47	1-32-1	RC07GF472K
3A4R5	1-32-32	RC07GF103K
3A4R6	1-32-30	RC07GF102K
3A4R7	1-32-1	RC07GF472K
3A4R8	1-32-1	RC07GF472K
3A4R9	1-32-5	RC07GF223K
3A4U11	1-32-28	SN7400N
3A4U121	1-32-28	SN7400N
3A4U13	1-32-27	SN7474N
3A4U14	1-32-22	SN7490N
3A4U15	1-32-22	SN7490N
3A4U21	1-32-23	SN7473N
3A4U23	1-32-27	SN7474N
3A4U33	1-32-27	SN7474N
3A4U43	1-32-28	SN7400N
3A4U53	1-32-23	SN7473N
3A4U63	1-32-28	SN7400N
3A4U83	1-32-27	SN7474N
3A5	1-26-5	10392392
3A5C4	1-33-14	DM15-120J
3A5C5	1-33-15	CS13BB337K
3A5Q3	1-33-16	MPS3646
3A5Q4	1-33-16	MPS3646
3A5Q5	1-33-16	MPS3646
3A5R1	1-33-1	RC07GF472K
3A5R10	1-33-2	RC07GF102K
3A5R11	1-33-13	RC07GF151K
3A5R12	1-33-17	RC07GF561K
3A5R13	1-33-18	RC07GF470K
3A5R14	1-33-19	RC07GF470K

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3A5R15	1-33-17	RC07GF561K
3A5R16	1-33-1	RC07GF472K
3A5R17	1-33-19	RC07GF182K
3A5R2	1-33-1	RC07GF472K
3A5R9	1-33-12	RC07GF222K
3A5S1	1-33-8	87-22-10
3A5S2	1-33-8	87-22-10
3A5S3	1-33-8	87-22-10
3A5U101	1-33-10	SN7473N
3A5U103	1-33-6	SN7474N
3A5U11	1-33-11	SN7420N
3A5U111	1-33-10	SN7473N
3A5U113	1-33-4	SN7400N
3A5U121	1-33-4	SN7400N
3A5U123	1-33-5	SN7410N
3A5U13	1-33-3	SN7490N
3A5U133	1-33-4	SN7400N
3A5U23	1-33-3	SN7490N
3A5U31	1-33-4	SN7400N
3A5U33	1-33-3	SN7490N
3A5U41	1-33-5	SN7410N
3A5U43	1-33-3	SN7490N
3A5U51	1-33-6	SN7474N
3A5U53	1-33-4	SN7400N
3A5U61	1-33-6	SN7474N
3A5U63	1-33-5	SN7410N
3A5U71	1-33-4	SN7400N
3A5U73	1-33-6	SN7474N
3A5U81	1-33-4	SN7400N
3A5U83	1-33-4	SN7400N
3A5U91	1-33-6	SN7474N
3A5U93	1-33-6	SN7474N
3A6	1-26-6	10392391
3A6C1	1-34-1	CS15T3BB337K
3A6C2	1-34-11	DM15-120J
3A6Q2	1-34-14	MPS3646
3A6R1	1-34-4	RC07GF472K
3A6R10	1-34-13	RC07GF221K
3A6R2	1-34-4	RC07GF472K
3A6R6	1-34-5	RC07GF102K
3A6R8	1-34-12	RC07GF222K
3A6R9	1-34-4	RC07GF472K
3A6S1	1-34-8	MSP205N

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3A6S2	1-34-8	MST205N
3A6U13	1-34-2	SN7474N
3A6U23	1-34-3	SN7400N
3A6U31	1-34-3	SN7400N
3A6U33	1-34-3	SN7400N
3A6U41	1-34-16	SN7410N
3A6U51	1-34-15	SN7420N
3A6U61	1-34-3	SN7400N
3A6U71	1-34-3	SN7400N
3A6U73	1-34-3	SN7400N
3A6U81	1-34-3	SN7400N
3A6U83	1-34-7	SN7473N
3A6U93	1-34-2	SN7474N
3A7	1-26-7	10392390
3A7C1	1-35-9	DM15-221J
3A7C2	1-35-17	CS13BB337K
3A7C3	1-35-4	TSG10
3A7C5	1-35-16	DM15-120J
3A7C6	1-35-6	CS13BE105K
3A7Q1	1-35-22	MPS3646
3A7Q2	1-35-22	MPS3646
3A7Q3	1-35-22	MPS3646
3A7Q5	1-35-22	MPS3646
3A7Q6	1-35-22	MPS3646
3A7Q7	1-35-22	MPS3646
3A7Q8	1-35-22	MPS3646
3A7Q9	1-35-22	MPS3646
3A7R1	1-35-10	RC07GF152K
3A7R19	1-35-3	RC07GF472K
3A7R2	1-35-3	RC07GF472K
3A7R20	1-35-3	RC07GF472K
3A7R23	1-35-21	RC07GF222K
3A7R24	1-35-1	RC07GF182K
3A7R25	1-35-20	RC07GF151K
3A7R26	1-35-18	RC07GF470K
3A7R27	1-35-18	RC7GF470K
3A7R28	1-35-19	RC07GF561K
3A7R29	1-35-3	RC07GF472K
3A7R3	1-35-3	RC07GF472K
3A7R30	1-35-3	RC07GF472K
3A7R32	1-35-19	RC07GF561K
3A7R33	1-35-3	RC07GF472K
3A7R34	1-35-3	RC07GF472K

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3A7R35	1-35-15	RC07GF104K
3A7R36	1-35-7	RC07GF103K
3A7R37	1-35-3	RC07GF472K
3A7R38	1-35-3	RC07GF472K
3A7R4	1-35-8	RC07GF153K
3A7R5	1-35-3	RC07GF472K
3A7R6	1-35-3	RC07GF472K
3A7R7	1-35-3	RC07GF472K
3A7R8	1-35-3	RC07GF472K
3A7S1	1-35-12	87-22-10
3A7S2	1-35-13	30-1
3A7S3	1-35-13	30-1
3A7U101	1-35-24	SN7400N
3A7U111	1-35-26	SN7474N
3A7U21	1-35-24	SN7400N
3A7U31	1-35-26	SN7474N
3A7U41	1-35-24	SN7400N
3A7U51	1-35-24	SN7400N
3A7U61	1-35-24	SN7400N
3A7U71	1-35-27	SN7420N
3A7U73	1-35-24	SN7400N
3A7U81	1-35-24	SN7400N
3A7U83	1-35-25	SN7410N
3A7U91	1-35-26	SN7474N
3A7U93	1-35-25	SN7410N
3A8	1-26-8	10392388
3A8C1	1-36-38	192P10492
3A8C10	1-36-42	DM15-120J
3A8C11	1-36-42	DM15-120J
3A8C12	1-36-32	192P22393
3A8C13	1-36-11	CS13BE226K
3A8C14	1-36-11	CS13BE226K
3A8C15	1-36-11	CS13BE226K
3A8C16	1-36-11	CS13BE226K
3A8C17	1-36-42	DM15-120J
3A8C18	1-36-42	DM15-120J
3A8C19	1-36-24	CS13BE105K
3A8C2	1-36-36	DM15-221J
3A8C20	1-36-42	DM15-120J
3A8C21	1-36-42	DM15-120J
3A8C22	1-36-19	TGS10
3A8C23	1-36-19	TGS10
3A8C24	1-36-46	UK10-104

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A8C25	1-36-20	DM15-220J
3A8C26	1-36-20	DM15-220J
3A8C27	1-36-11	CS13BE226K
3A8C3	1-36-37	192P56292
3A8C4	1-36-33	31-224C5
3A8C5	1-36-35	DM15-470J
3A8C6	1-36-17	DM15-681J
3A8C7	1-36-34	31-105C5
3A8C8	1-36-42	DM15-120J
3A8C9	1-36-42	DM15-120J
3A8Q1	1-36-6	2N3704
3A8Q10	1-36-8	2N3702
3A8Q11	1-36-13	7022N4220-2B
3A8Q12	1-36-1	2N4220
3A8Q13	1-36-1	2N4220
3A8Q14	1-36-8	2N3702
3A8Q15	1-36-8	2N3702
3A8Q16	1-36-6	2N3704
3A8Q17	1-36-6	2N3704
3A8Q18	1-36-6	2N3704
3A8Q19	1-36-8	2N3702
3A8Q2	1-36-39	2N5555
3A8Q20	1-36-8	2N3702
3A8Q21	1-36-8	2N3702
3A8Q22	1-36-8	2N3702
3A8Q23	1-36-8	2N3702
3A8Q24	1-36-6	2N3704
3A8Q25	1-36-6	2N3704
3A8Q26	1-36-4	MPS3646
3A8Q27	1-36-4	MPS3646
3A8Q28	1-36-4	MPS3646
3A8Q29	1-36-10	7022N4220-4
3A8Q3	1-36-39	2N5555
3A8Q30	1-36-4	MPS3646
3A8Q31	1-36-4	MPS3646
3A8Q32	1-36-4	MPS3646
3A8Q33	1-36-4	MPS3646
3A8Q34	1-36-4	MPS3646
3A8Q35	1-36-4	MPS3646
3A8Q36	1-36-4	MPS3646
3A8Q37	1-36-10	7022N4220-3
3A8Q38	1-36-14	2N3906
3A8Q39	1-36-14	2N3906

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A8Q4	1-36-1A	7022N4220-2A
3A8Q40	1-36-1	2N4220
3A8Q41	1-36-14	2N3906
3A8Q44	1-36-4	MPS3646
3A8Q5	1-36-1	2N4220
3A8Q6	1-36-1	2N4220
3A8Q7	1-36-1	2N4220
3A8Q8	1-36-1	2N4220
3A8Q9	1-36-1	2N4220
3A8R1	1-36-2	RC07GF560K
3A8R10	1-36-43	RC07GF102K
3A8R11	1-36-2	RC07GF560K
3A8R12	1-36-30	RC07GF273K
3A8R13	1-36-29	RC07GF561K
3A8R14	1-36-5	RC07GF226K
3A8R15	1-36-31	RC07GF822K
3A8R16	1-36-5	RC07GF226K
3A8R17	1-36-7	RC07GF472K
3A8R18	1-36-50	RC07GF126K
3A8R19	1-36-48	3068P1-104
3A8R2	1-36-41	RC07GF821K
3A8R20	1-36-5	RC07GF226K
3A8R21	1-36-5	RC07GF226K
3A8R22	1-36-21	RC07GF104K
3A8R23	1-36-7	RC07GF472K
3A8R24	1-36-16	RC07GF223K
3A8R25	1-36-31	RC07GF822K
3A8R26	1-36-12	RC07GF272K
3A8R27	1-36-7	RC07GF472K
3A8R28	1-36-5	RCO7GF226K
3A8R29	1-36-5	RCO7GF226K
3A8R3	1-36-45	RC07GF222K
3A8R30	1-36-21	RC07GF104K
3A8R31	1-36-43	RC07GF102K
3A8R32	1-36-2	RC07GF560K
3A8R33	1-36-21	RCO7GF104K
3A8R34	1-36-28	RC07GF152K
3A8R35	1-36-47	RC07GF124K
3A8R36	1-36-48	3068P1-104
3A8R37	1-36-13	RC07GF103K
3A8R38	1-36-7	RC07GF472K
3A8R39	1-36-2	RC07GF560K
3A8R4	1-36-40	RC07GF563K

REFERENCE DESIGNATOR INDEX

REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A8R40	1-36-2	RC07GF560K
3A8R41	1-36-2	RC07GF560K
3A8R42	1-36-22	RC07GF473K
3A8R43	1-36-2	RC07GF560K
3A8R44	1-36-23	RC07GF183K
3A8R45	1-36-43	RC07GF102K
3A8R46	1-36-22	RC07GF473K
3A8R47	1-36-44	RC07GF123K
3A8R48	1-36-2	RC07GF560K
3A8R49	1-36-43	RC07GF102K
3A8R50	1-36-23	RC07GF183K
3A8R51	1-36-44	RC07GF123K
3A8R52	1-36-27	RC07GF392K
3A8R53	1-36-7	RC07GF472K
3A8R54	1-36-7	RC07GF472K
3A8R55	1-36-12	RC07GF272K
3A8R56	1-36-13	RC07GF103K
3A8R57	1-36-12	RC07GF272K
3A8R58	1-36-44	RC07GF123K
3A8R59	1-36-45	RC07GF222K
3A8R6	1-36-40	RC07GF563K
3A8R60	1-36-18	RC07GF331K
3A8R61	1-36-18	RC07GF331K
3A8R62	1-36-16	RC07GF223K
3A8R63	1-36-44	RC07GF123K
3A8R64	1-36-45	RC07GF222K
3A8R65	1-36-18	RC07GF331K
3A8R66	1-36-18	RC07GF331K
3A8R67	1-36-45	RC07GF222K
3A8R68	1-36-16	RC07GF223K
3A8R69	1-36-45	RC07GF222K
3A8R7	1-36-29	RC07GF551K
3A8R70	1-36-2	RC07GF560K
3A8R71	1-36-15	RC07GF561K
3A8R71	1-36-15	RC07GF681K
3A8R71	1-36-15	RC07GF821K
3A8R71	1-36-15	RC07GF102K
3A8R71	1-36-15	RC07GF122K
3A8R71	1-36-15	RC07GF152K
3A8R71	1-36-15	RC07GF182K
3A8R71	1-36-15	RC07GF222K
3A8R72	1-36-43	RC07GF102K
3A8R73	1-36-12	RC07GF272K

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A8R74	1-36-5	RC07GF225K
3A8R75	1-36-2	RC07GF560K
3A8R76	1-36-13	RC07GF103K
3A8R77	1-36-29	RC07GF561K
3A8R78	1-36-2	RC07GF560K
3A8R79	1-36-13	RC07GF103K
3A8R8	1-36-2	RC07GF560K
3A8R80	1-36-49	RC07GF122K
3A8R9	1-36-44	RC07GF123K
3A8S1	1-36-26	MST205N
3A8U1	1-36-3	U5B7709393
3A9	1-26-9	10392386
3A9CR1	1-37-19	1N914
3A9CR2	1-37-19	1N914
3A9CR3	1-37-19	1N914
3A9CR4	1-37-19	1N914
3A9CR5	1-37-19	1N914
3A9CR6	1-37-19	1N914
3A9CR7	1-37-19	1N914
3A9CR8	1-37-19	1N914
3A9C1	1-37-4	TGS10
3A9C10	1-37-26	DM15-331J
3A9C11	1-37-41	CS13BE226K
3A9C12	1-37-28	DM15-120J
3A9C13	1-37-28	DM15-120J
3A9C14	1-37-61	CS13BC107K
3A9C15	1-37-34	CS13BE685K
3A9C16	1-37-50	192P10492
3A9C17	1-37-51	192P56292
3A9C18	1-37-52	CS13BE105K
3A9C19	1-37-10	DM15-102J
3A9C2	1-37-4	TGS10
3A9C20	1-37-34	CS13BE685K
3A9C21	1-37-34	CS13BE685K
3A9C22	1-37-28	DM15-120J
3A9C23	1-37-28	DM15-120J
3A9C24	1-37-4	TSG10
3A9C25	1-37-4	TSG10
3A9C26	1-37-54	DM15-820J
3A9C27	1-37-43	192P22392
3A9C28	1-37-10	DM15-102J
3A9C29	1-37-10	DM15-102J
3A9C3	1-37-50	192P10492

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A9C30	1-37-4A	UK10-104
3A9C31	1-37-61	CS13BC107K
3A9C32	1-37-61	CS13BC107K
3A9C33	1-37-27	DM15-180J
3A9C34	1-37-52	CS13BE105K
3A9C35	1-37-54	DM15-820J
3A9C36	1-37-10	DM15-102J
3A9C37	1-37-10	DM15-102J
3A9C4	1-37-40	DM15-221J
3A9C41	1-37-43	192P22392
3A9C42	1-37-29	DM15-220J
3A9C43	1-37-29	DM15-220J
3A9C5	1-37-51	192P56292
3A9C6	1-37-41	CS13BF226K
3A9C7	1-37-17	DM15-471J
3A9C8	1-37-43	192P22392
3A9C9	1-37-27	DM15-180J
3A9Q1	1-37-22	2N5555
3A9Q10	1-37-8	2N3702
3A9Q11	1-37-8	2N3702
3A9Q12	1-37-30	2N3704
3A9Q13	1-37-6	MPS3646
3A9Q14	1-37-3	2N4220
3A9Q15	1-37-3	2N4220
3A9Q16	1-37-8	2N3702
3A9Q17	1-37-8	2N3702
3A9Q18	1-37-30	2N3704
3A9Q19	1-37-30	2N3704
3A9Q2	1-37-22	2N5555
3A9Q20	1-37-6	MPS3646
3A9Q21	1-37-6	MPS3646
3A9Q22	1-37-6	MPS3646
3A9Q23	1-37-6	MPS3646
3A9Q24	1-37-6	MPS3646
3A9Q25	1-37-6	MP3646
3A9Q26	1-37-6	MPS3646
3A9Q27	1-37-6	MPS3646
3A9Q28	1-37-6	MPS3646
3A9Q29	1-37-6	MPS3646
3A9Q3	1-37-3A	7022N4220-3
3A9Q30	1-37-6	MPS3646
3A9Q31	1-37-6	MPS3646
3A9Q32	1-37-30	2N3704

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A9Q33	1-37-30	2N3704
3A9Q34	1-37-8	2N3702
3A9Q35	1-37-30	2N3704
3A9Q36	1-37-30	2N3704
3A9Q37	1-37-8	2N3702
3A9Q38	1-37-30	2N3704
3A9Q39	1-37-8	2N3702
3A9Q4	1-37-3	2N4220
3A9Q45	1-37-3	2N4220
3A9Q46	1-37-1	2N3906
3A9Q47	1-37-3B	7022N4220-4
3A9Q48	1-37-3C	7022N4220-2B
3A9Q49	1-37-3D	7022N4220-2A
3A9Q5	1-37-3	2N4220
3A9Q50	1-37-3	2N4220
3A9Q51	1-37-1	2N3906
3A9Q6	1-37-3	2N4220
3A9Q7	1-37-3	2N4220
3A9Q8	1-37-1	2N3906
3A9Q9	1-37-1	2N3906
3A9R1	1-37-47	RC07GF222K
3A9R10	1-37-20	
3A9R104	1-37-36	RC07GF123K
3A9R105	1-37-57	RC07GF221K
3A9R106	1-37-25	RCO7GF560K
3A9R107	1-37-38	RC07GF561K
3A9R108	1-37-57	RCO7GF221K
3A9R109	1-37-20	RCO7GF473K
3A9R11	1-37-44	RC07GF226K
3A9R110	1-37-53	RCO7GF100K
3A9R111	1-37-35	RCO7GF122K
3A9R12	1-37-44	RC07GF224K
3A9R13	1-37-44	RCO7GF226K
3A9R14	1-37-7	3068P1-104
3A9R15	1-37-15	RC07GF563K
3A9R16	1-37-24	RC07GF102K
3A9R17	1-37-21	RC07GF126K
3A9R18	1-37-25	RC07GF560K
3A9R19	1-37-48	RC07GF104K
3A9R2	1-37-32	RC07GF472K
3A9R20	1-37-48	RC07GF104K
3A9R21	1-37-24	RC07GF102K
3A9R22	1-37-24	RC07GF102K

REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A9R23	1-37-2	RC07GF561K
3A9R23	1-37-2	RC07GF681K
3A9R23	1-37-2	RC07GF821K
3A9R23	1-37-2	RC07GF102K
3A9R23	1-37-2	RC07GF122K
3A9R23	1-37-2	RC07GF152K
3A9R23	1-37-2	RC07GF182K
3A9R23	1-37-2	RC07GF222K
3A9R24	1-37-31	RC07GF552K
3A9R25	1-37-31	RC07GF562K
3A9R26	1-37-39	RC07GF333K
3A9R27	1-37-42	RC07GF103K
3A9R28	1-37-25	RC07GF560K
3A9R29	1-37-31	RC07GF562K
3A9R3	1-37-36	RC07GF125K
3A9R30	1-37-49	RC07GF682K
3A9R31	1-37-46	RCO7GF331K
3A9R32	1-37-49	RC07GF682K
3A9R33	1-37-9	RC07GF274K
3A9R34	1-37-31	RCO7GF562K
3A9R35	1-37-31	RCO7GF562K
3A9R36	1-37-48	RCO7GF1O4K
3A9R37	1-37-15	RC07GF563K
3A9R38	1-37-42	RC07GF103K
3A9R39	1-37-48	RC07GF104K
3A9R4	1-37-18	RC07GF272K
3A9R40	1-37-42	RCO7GF103K
3A9R41	1-37-48	RCO7GF104K
3A9R42	1-37-48	RCO7GF104K
3A9R43	1-37-48	RCO7GF104K
3A9R44	1-37-48	RCO7GF104K
3A9R45	1-37-25	RC07GF560K
3A9R46	1-37-12	RN55D1472F
3A9R47	1-37-13	RN55D4871F
3A9R48	1-37-14	RN55D4021F
3A9R48	1-37-14	RN55D4121F
3A9R48	1-37-14	RN5504221F
3A9R48	1-37-14	RN55D4321F
3A9R48	1-37-14	RN55D4421F
3A9R48	1-37-14	RN55D4531F
3A9R48	1-37-14	RN55D4641F
3A9R48	1-37-14	RN55D4751F
3A9R48	1-37-14	RN55D4871F

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A9R48	1-37-14	RN55D4991F
3A9R48	1-37-14	RN55D5111F
9R48	1-37-14	RN55D5231F
3A9R48	1-37-14	RN55D536lF
3A9R48	1-37-14	RN55D5491F
3A9R48	1-37-14	RN55D5621F
3A9R48	1-37-14	RN55D5761F
3A9R48	1-37-14	RN55D5901F
3A9R48	1-37-14	RN55D6041F
3A9R49	1-37-14A	**RN5D8061F**
3A9R49	1-37-14A	RN55D8251F
3A9R49	1-37-14A	RN55D845lF
3A9R49	1-37-14A	RN55D8661F
3A9R49	1-37-14A	RN55D8871F
3A9R49	1-37-14A	RN55D9091F
3A9R49	1-37-14A	RN55D9311F
3A9R49	1-37-14A	RN55D9531F
3A9R49	1-37-14A	RN559761F
3A9R49	1-37-14A	RN5501002F
3A9R5	1-37-18	RC07GF272K
3A9R50	1-37-33	RC07GF151K
3A9R51	1-37-32	RCO7GF472K
3A9R52	1-37-32	RC07GF472K
3A9R53	1-37-32	**RC07GF472K**
3A9R54	1-37-42	RC07GF103K
3A9R55	1-37-24	RC07GF102K
3A9R56	1-37-23	**RC07GF223K**
3A9R57	1-37-38	RC07GF561K
3A9R58	1-37-45	RC07GF822K
3A9R59	1-37-46	RC07GF331K
3A9R6	1-37-24	RCO7GF102K
3A9R60	1-37-45	RC07GF822K
3A9R61	1-37-47	RC07GF222K
3A9R62	1-37-46	RC07GF331K
3A9R63	1-37-23	RC07GF223K
3A9R64	1-37-47	RC07GF222K
3A9R65	1-37-45	RC07GF822K
3A9R66	1-37-45	RC07GF822K
3A9R67	1-37-32	RC07GF472K
3A9R68	1-37-47	RC07GF222K
3A9R69	1-37-11	RC07GF153K
3A9R7	1-37-48	RC07GF104K
3A9R70	1-37-47	RC07GF222K

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REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
3A9R71	1-37-47	RC07GF222K
3A9R72	1-37-25	RC07GF560K
3A9R73	1-37-25	RC07GF560K
3A9R74	1-37-33	RC07GF151K
3A9R75	1-37-33	RC07GF151K
3A9R76	1-37-19	RC07GF272K
3A9R77	1-37-55	RC07GF392K
3A9R78	1-37-32	RC07GF472K
3A9R79	1-37-25	RC07GF560K
3A9R8	1-37-15	RC07GF563K
3A9R80	1-37-56	RC07GF330K
3A9R81	1-37-24	RC07GF102K
3A9R82	1-37-45	RC07GF822K
3A9R83	1-37-42	RC07GF103K
3A9R84	1-37-55	RC07GF392K
3A9R85	1-37-37	RC07GF101K
3A9R86	1-37-18	RC07GF272K
3A9R87	1-37-37	RC07GF101K
3A9R88	1-37-37	RC07GF101K
3A9R89	1-37-37	RC07GF101K
3A9R9	1-37-38	RCO7GF561K
3A9R90	1-37-42	RCO7GF103K
3A9R91	1-37-59	RCO7GF332K
3A9R92	1-37-49	RC07GF682K
3A9R93	1-37-24	RCO7GF102K
3A9R94	1-37-38	RC07GF561K
3A9T1	1-37-16	75192520
3A9U1	1-37-5	U587709393
3A9VR1	1-37-60	1N4733

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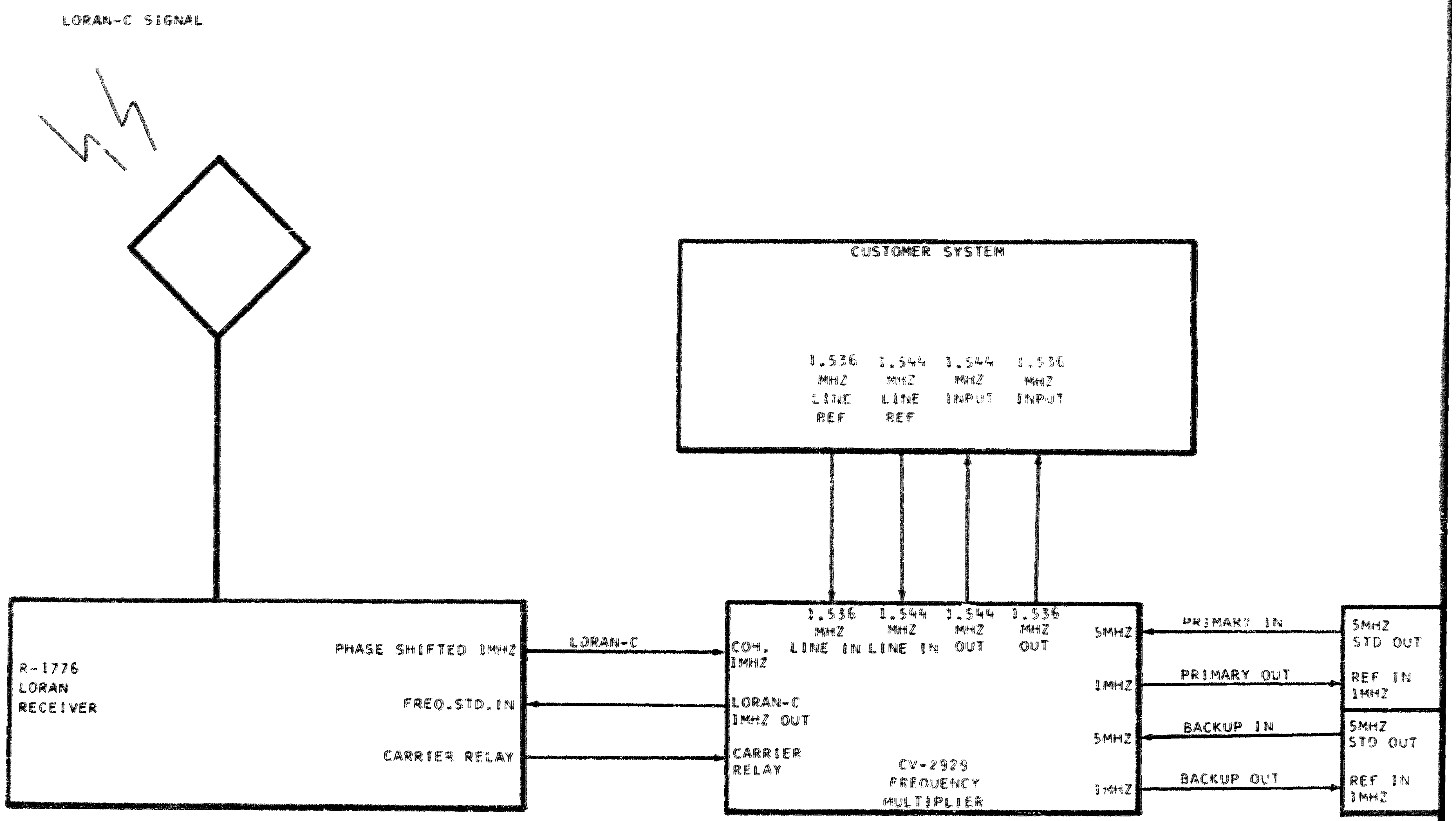
REFERENCE DESIGNATION	FIGURE & INDEX NO.	PART NUMBER
4	1-1-4	32192613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1.544 MHZ LINE REF
1.544 MHZ INPUT
1.536 MHZ INPUT
R-1776 LORAN RECEIVER
PHASE SHIFTED 1MHZ
FREQ.STD.IN
CARRIER RELAY
LORAN-C
COH. 1MHZ
LORAN-C 1MHZ OUT
CARRIER RELAY
1.536 MHZ LINE IN
1.544 MHZ LINE IN
1.544 MHZ OUT
1.536 MHZ OUT
5MHZ
1MHZ
5MHZ
1MHZ
CV-2929 FREQUENCY MULTIPLIER
PRIMARY IN
PRIMARY OUT
BACKUP IN
BACKUP OUT
5MHZ STD OUT
REF IN 1MHZ
5MHZ STD OUT
REF IN 1MHZ

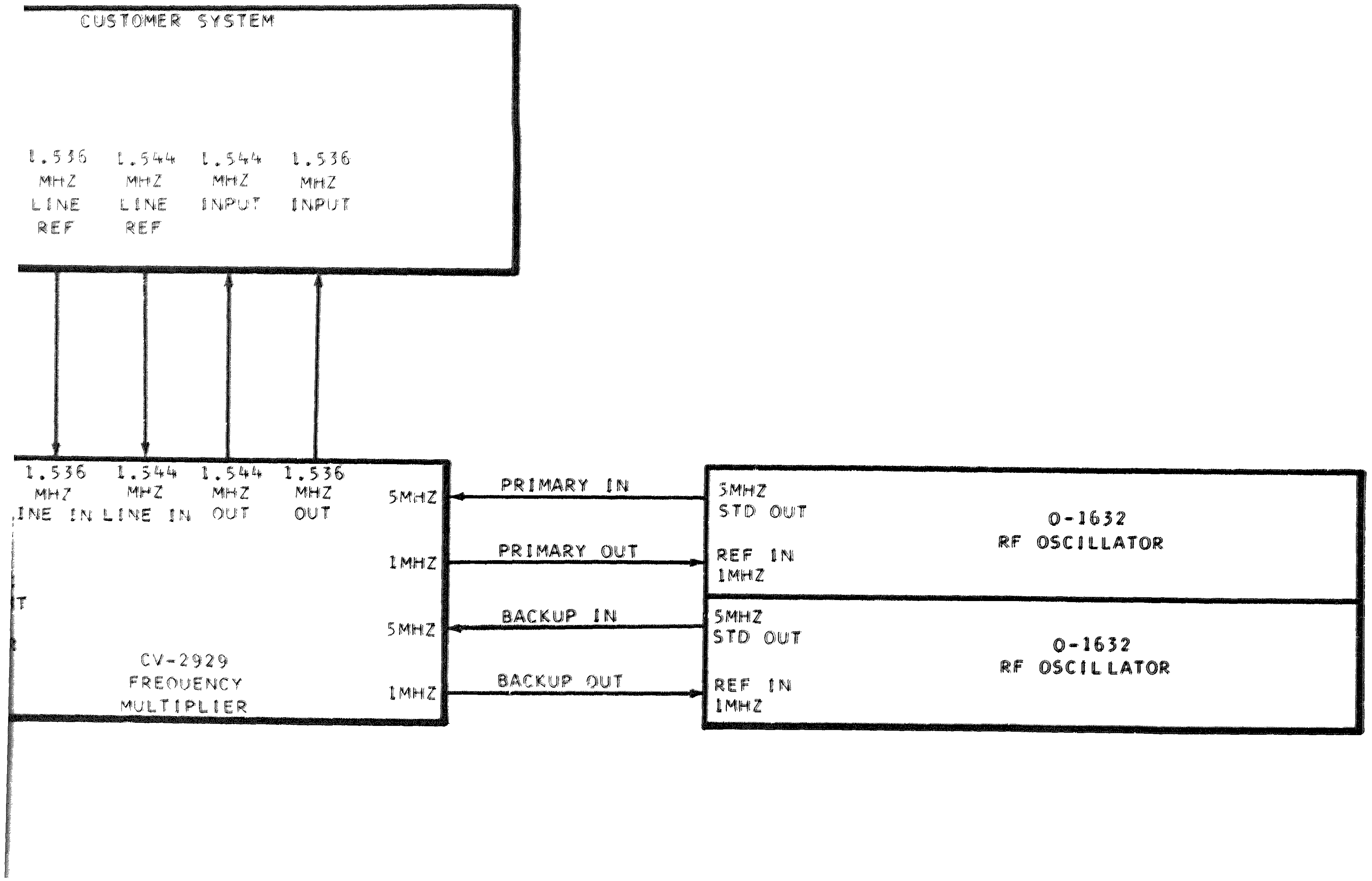


Figure 4-1. AN/GSQ-174 Phaselocked 1.536/ 1.544 MHz Sythesizer System

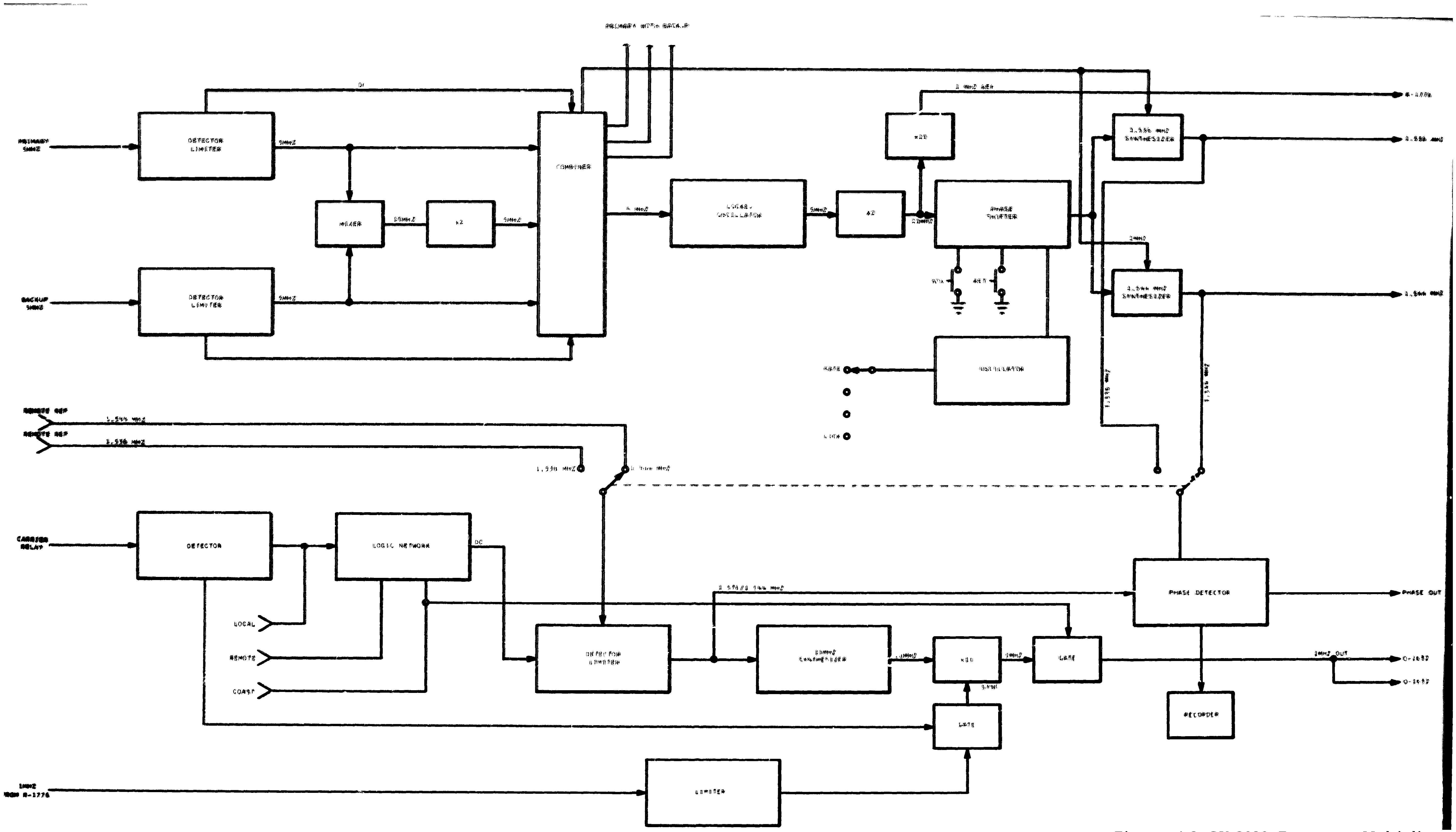


Figure. 4-2 CV-2929 Frequency Multiplier, AN/GSQ-174 System

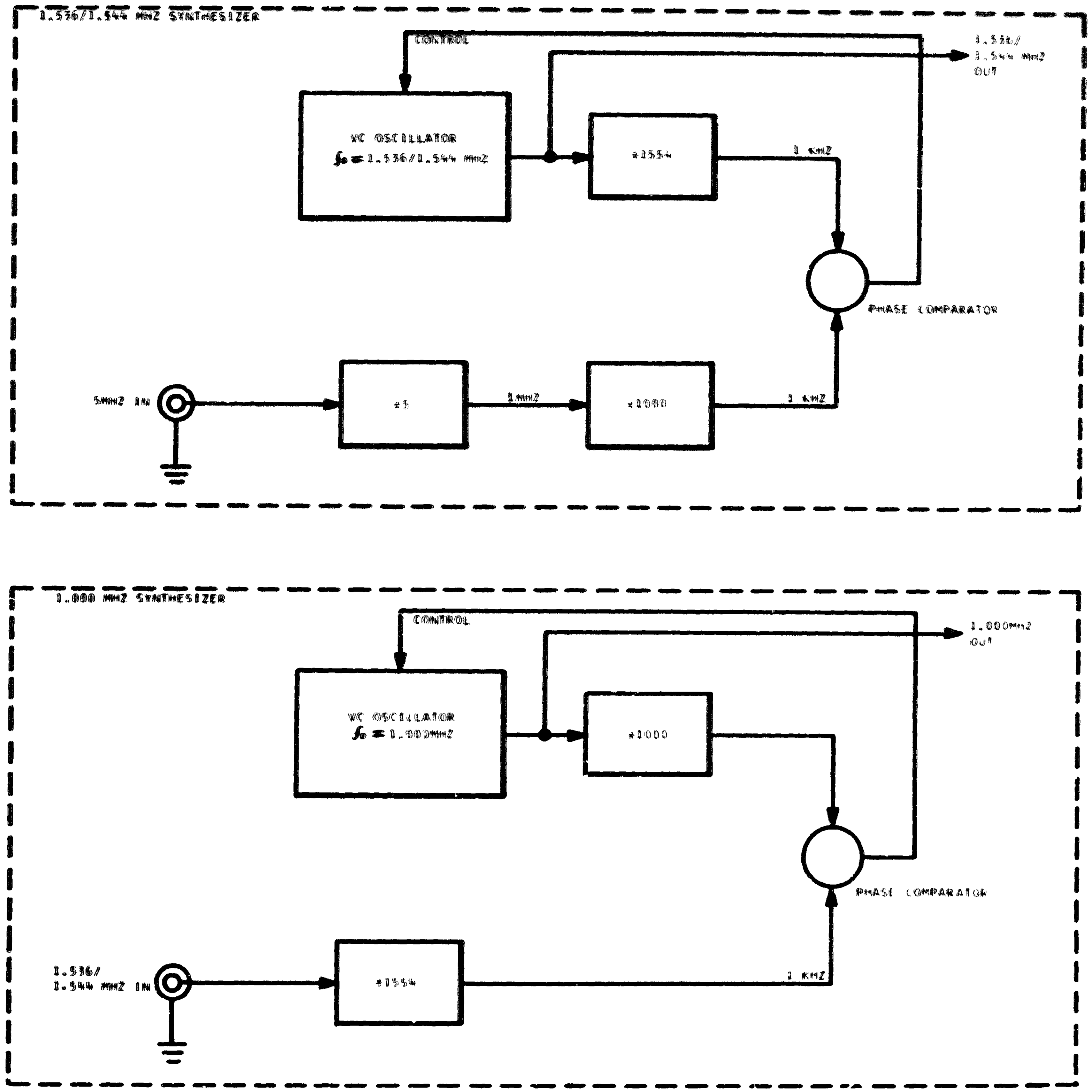
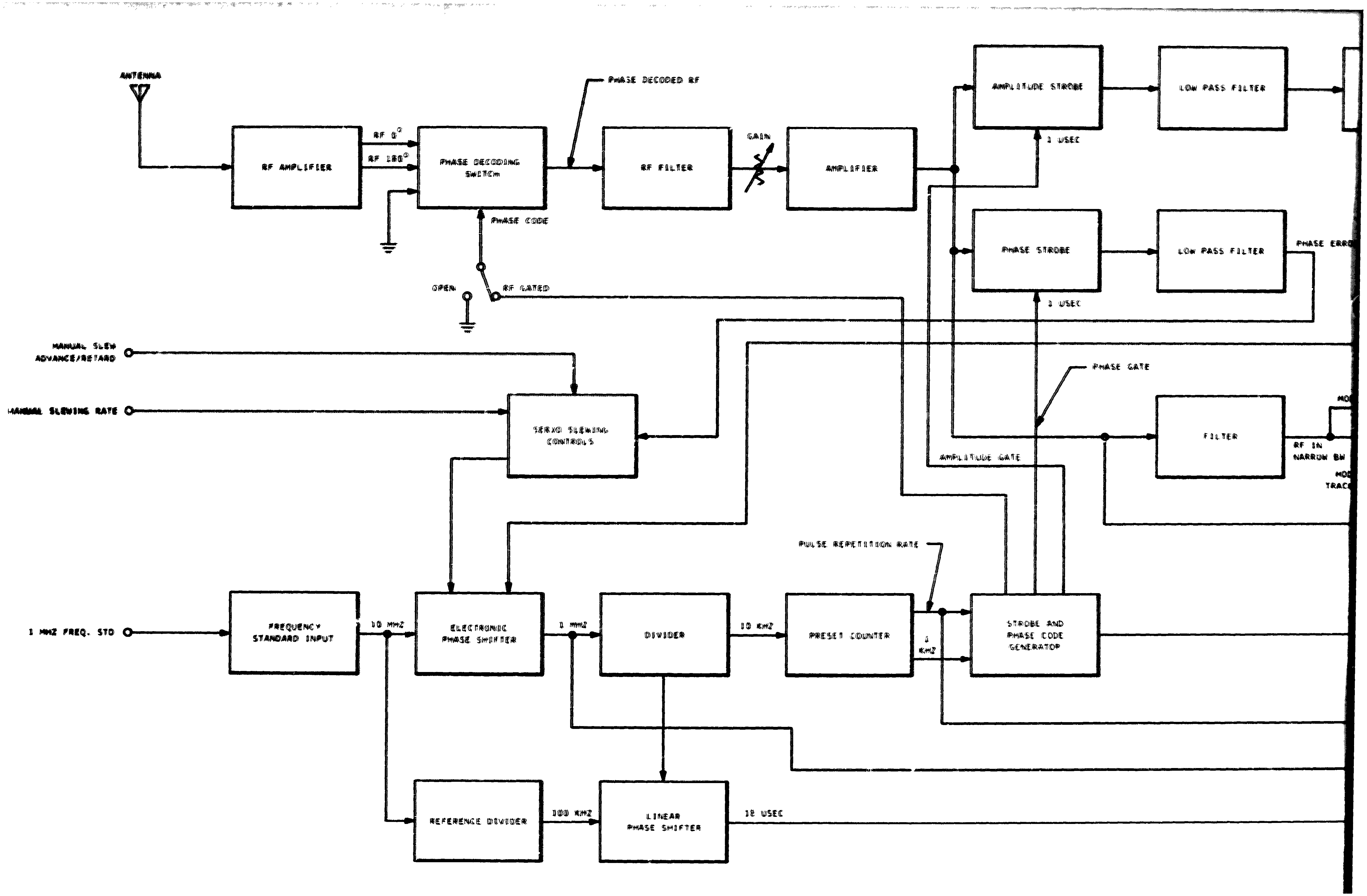


Figure 4-3 CV-2929 Frequency Multiplier, Synthesizer System for AN/GSQ-174



ANTENNA
RF AMPLIFIER
RF 0°
RF 180°
PHASE DECODING SWITCH
PHASE DECODED RF
PHASE CODE
OPEN
RF GATED
RF FILTER
GAIN
AMPLIFIER
AMPLITUDE STROBE
LOW PASS FILTER
1 USEC
PHASE STROBE
LOW PASS FILTER
PHASE ERRO
1 USEC
MANUAL SLEW
ADVANCE/RETARD
MANUAL SLEWING RATE
SERVO SLEWING CONTROLS
PHASE GATE
FILTER
RF IN
NARROW BW
AMPLITUDE GATE
PULSE REPETITION RATE
1 MHZ FREQ. STD
FREQUENCY STANDARD INPUT
10 MHZ
ELECTRONIC PHASE SHIFTER
1 MHZ
DIVIDER
10 KHZ
PRESET COUNTER
1 KHZ
STROBE AND PHASE CODE GENERATOR
REFERENCE DIVIDER
100 KHZ
LINEAR PHASE SHIFTER
10 USEC

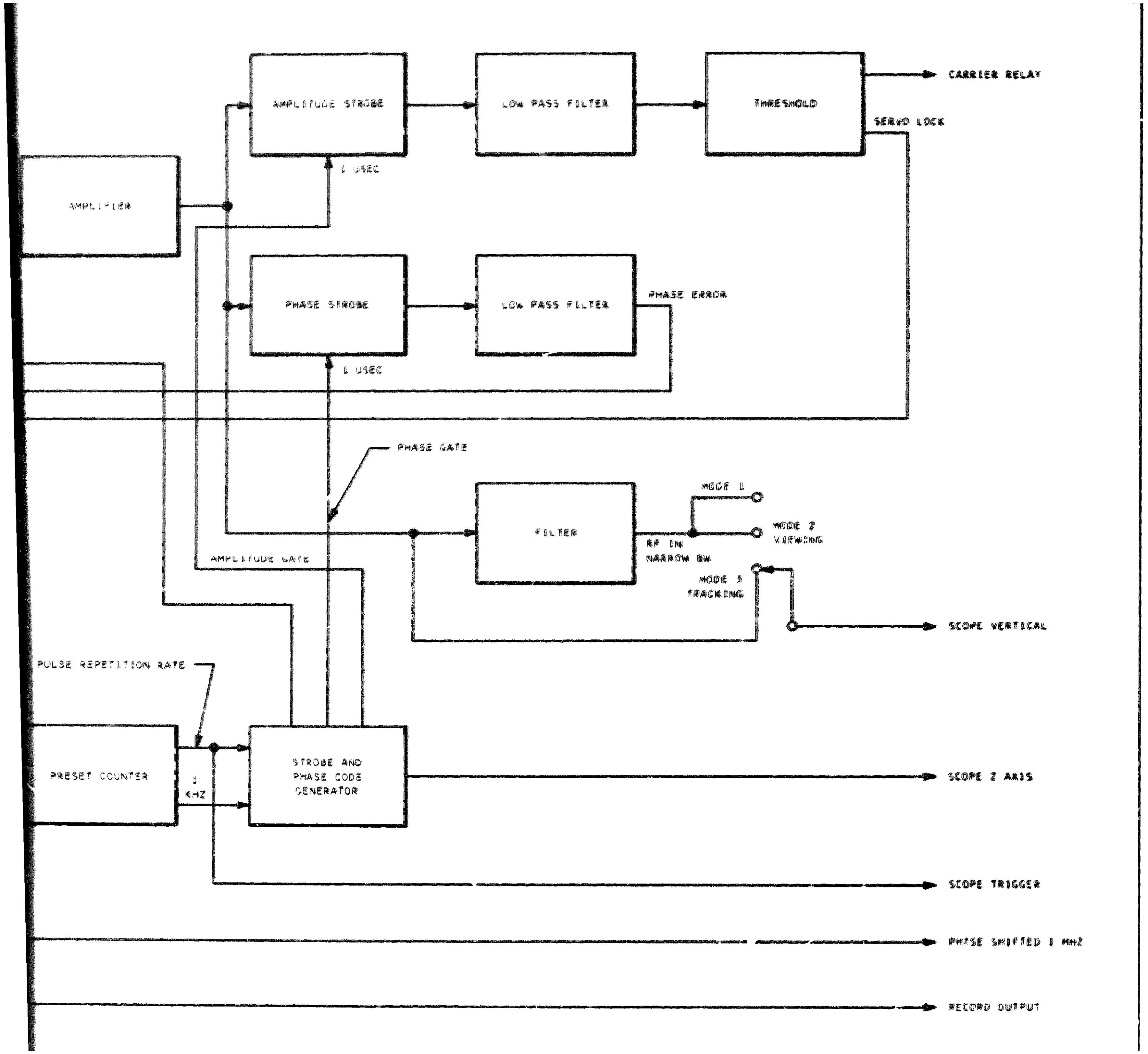


Figure 4-4 R-1776 Loran Receiver,
AN/GSQ-174 System

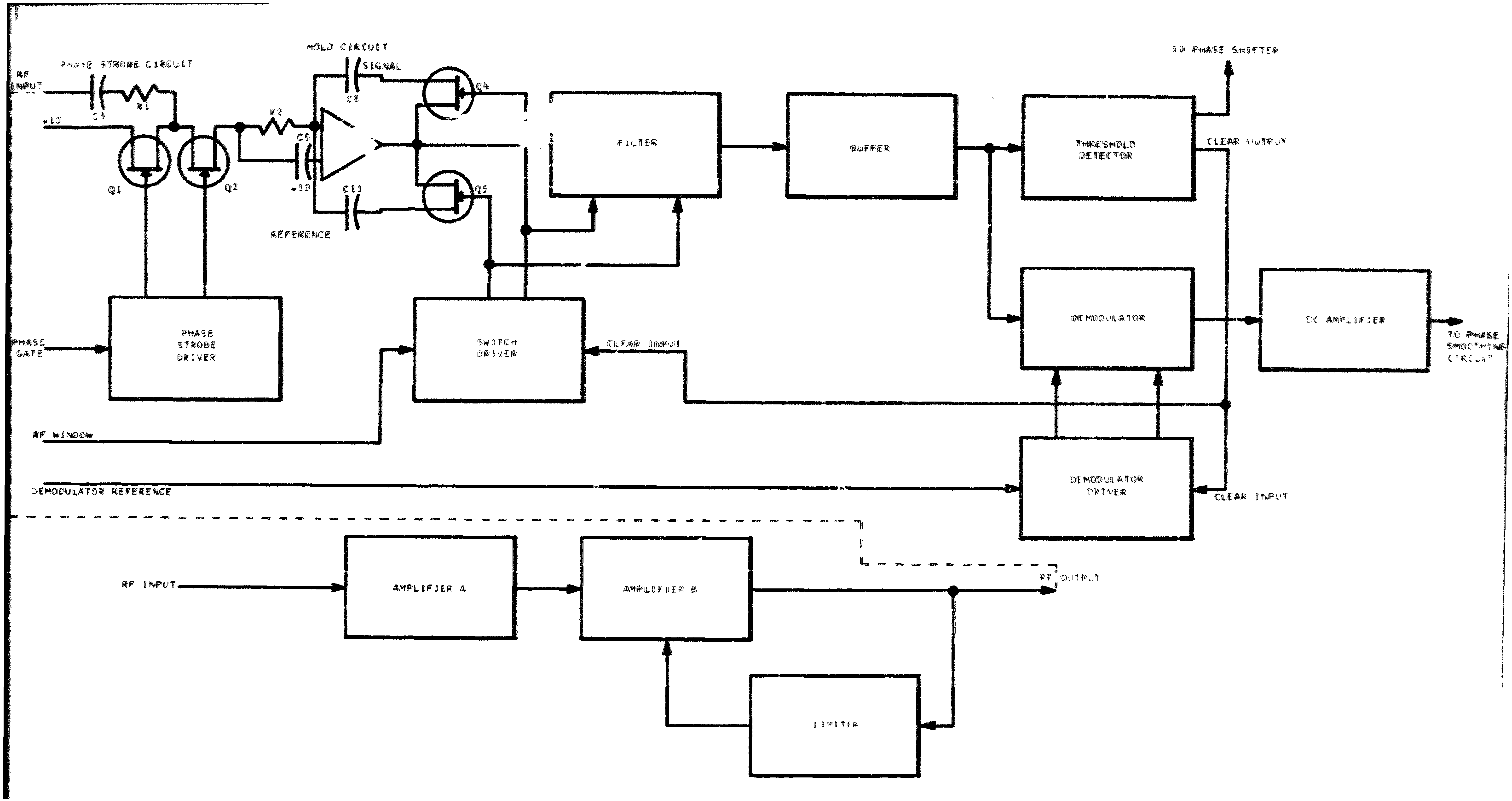
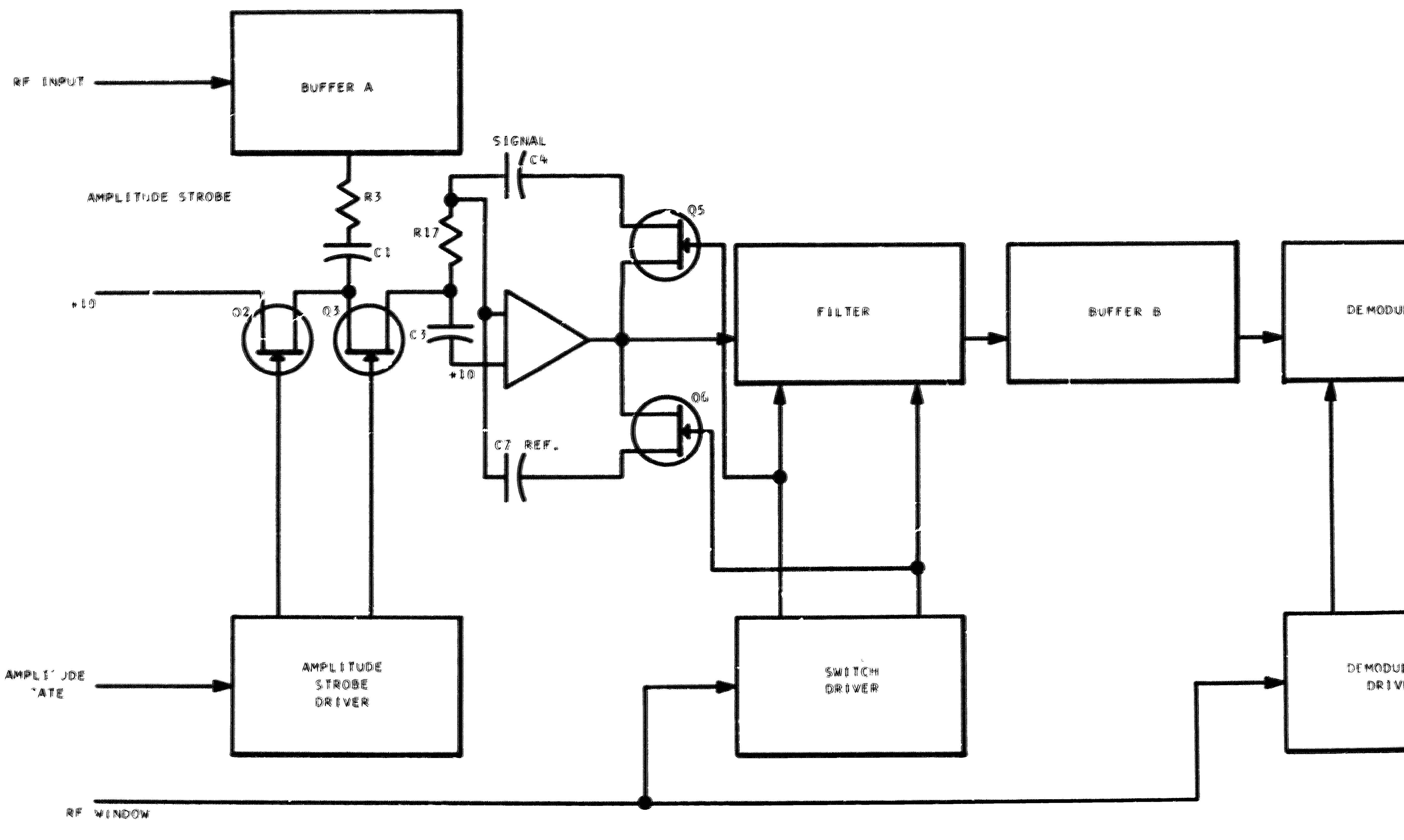


Figure. 4-5 Phase Strobe Block Diagram
R-1776 System



RF INPUT
BUFFER A
AMPLITUDE STROBE
R3
C1
+10
Q2
Q3
SIGNAL
C4
R17
C3
+10
Q5
Q6
C7 REF.
FILTER
BUFFER B
AMPLITUDE STROBE DRIVER
SWITCH DRIVER
RF WINDOW

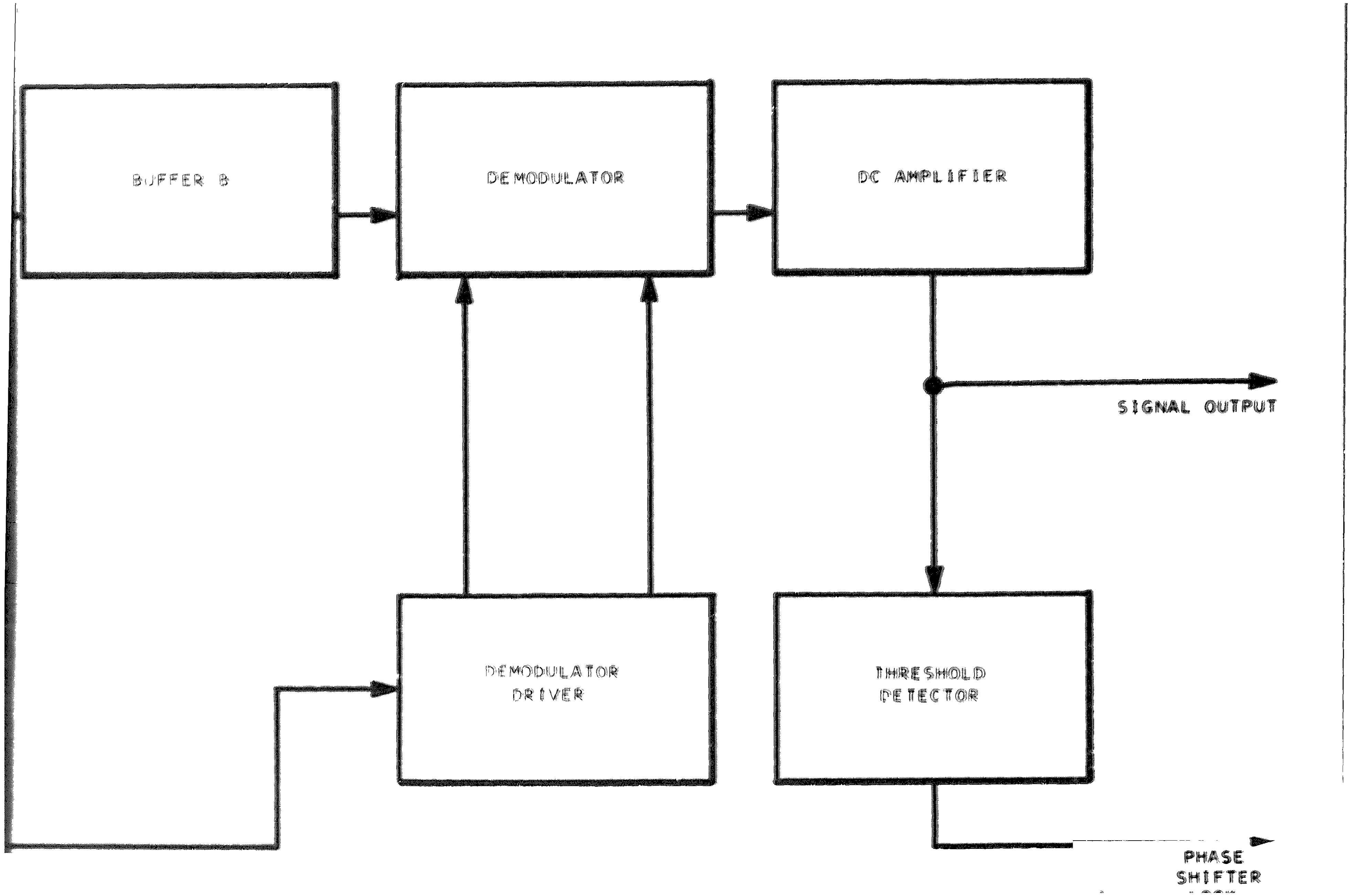
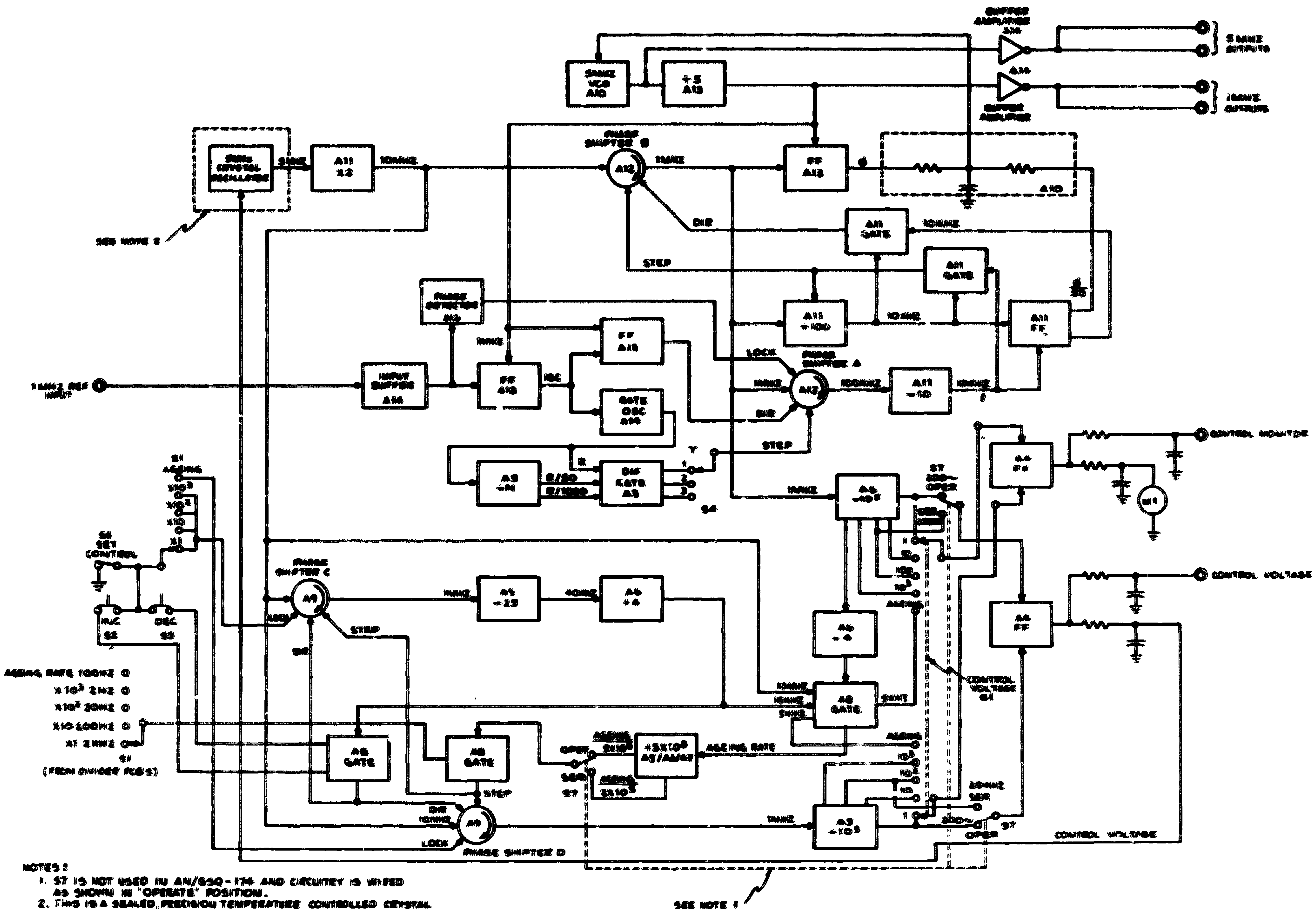
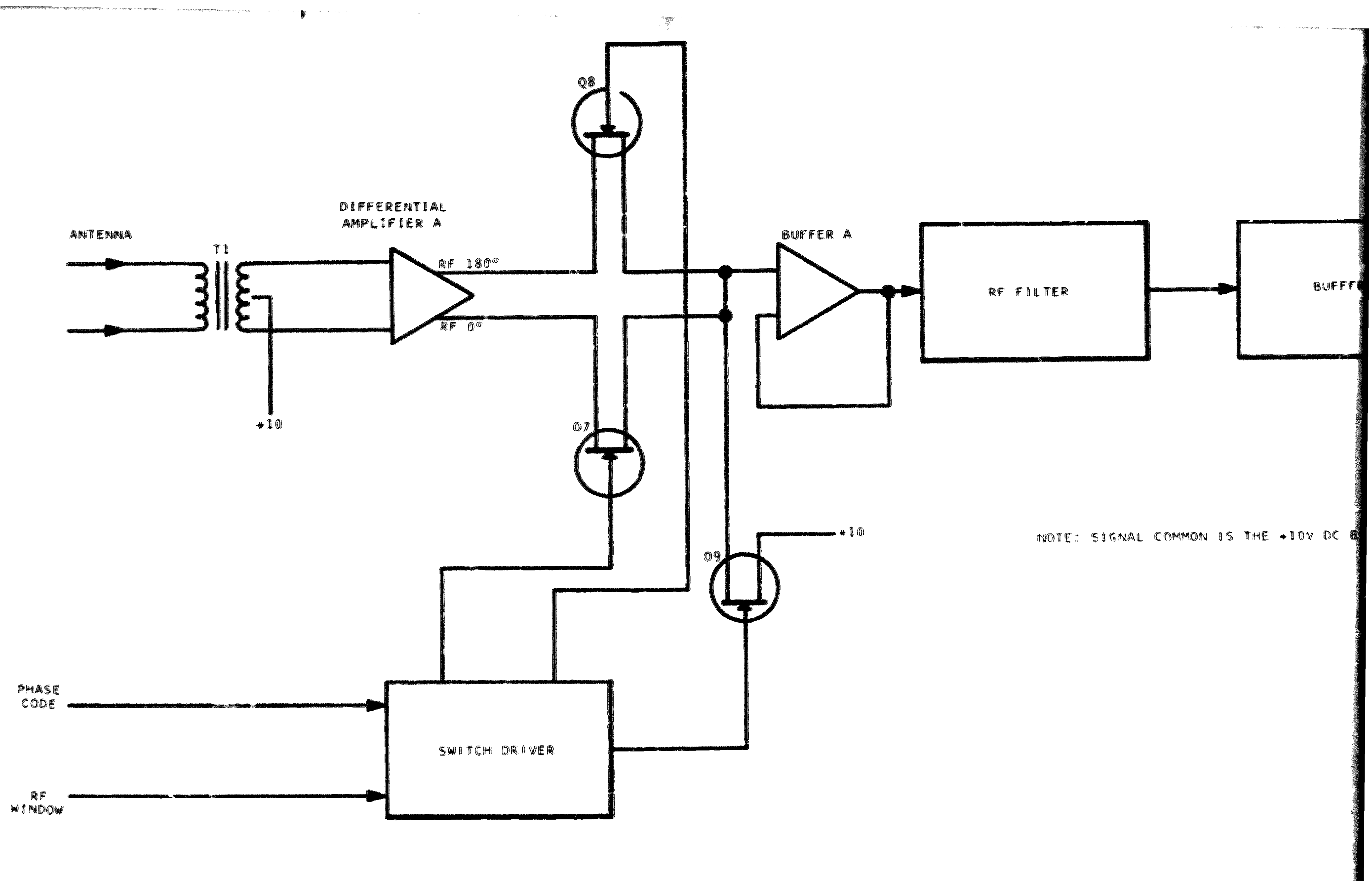


Figure 4-6 Amplitude Strobe Block Diagram, R-1776 System



NOTES:
1. S7 IS NOT USED IN AN/GSQ-174 AND CIRCUITRY IS WIRED AS SHOWN IN "OPERATE" POSITION.
2. THIS IS A SEALED, PRECISION TEMPERATURE CONTROLLED CRYSTAL OSCILLATOR UNIT SUPPLIED FOR THE AN/GSQ 174.

Figure. 4-7 O-1632 RF Oscillator, AN/GSQ-174 System



ANTENNA
T1
+10
DIFFERENTIAL
AMPLIFIER A
RF 180°
RF 0°
Q8
Q7
Q9
+10
BUFFER A
RF FILTER
BUFFE
NOTE: SIGNAL COMMON IS THE +10V DC B
PHASE
CODE
RF
WINDOW
SWITCH DRIVER

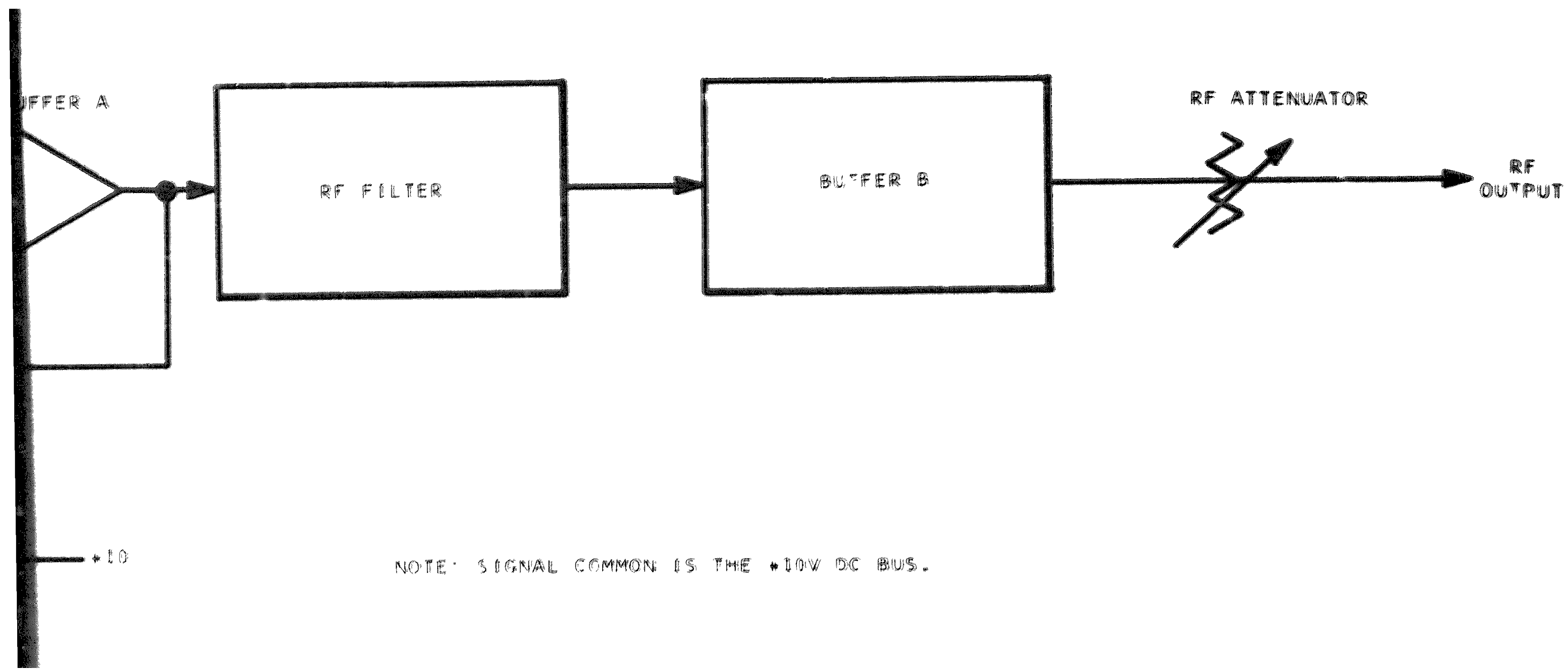


Figure. 4-8 RF Amplifier Block Diagram,
R-1776 System

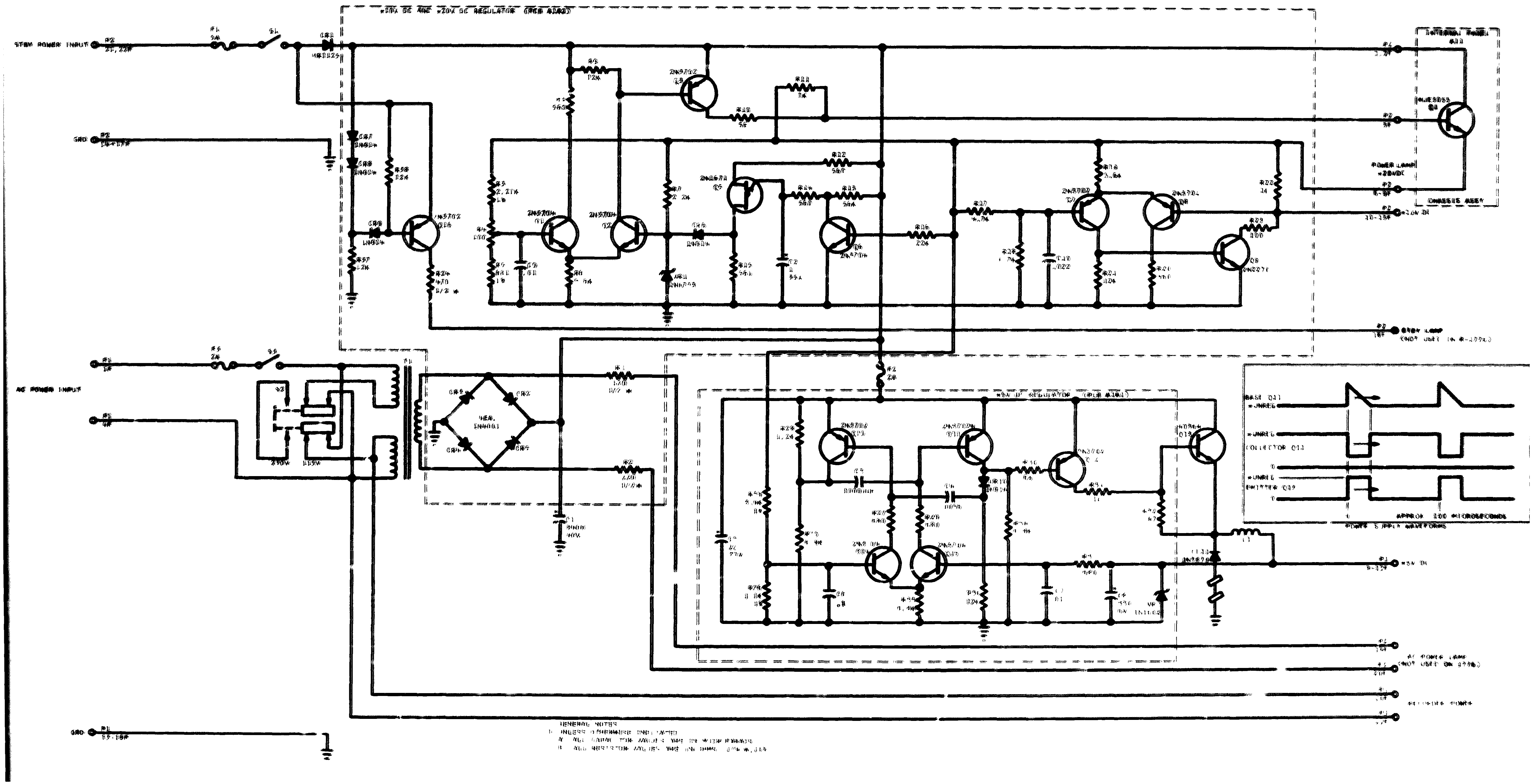


Figure. 6-1 Power Supply Assembly A1. PCB No. A1A1, A1A2, R-1776, Schematic

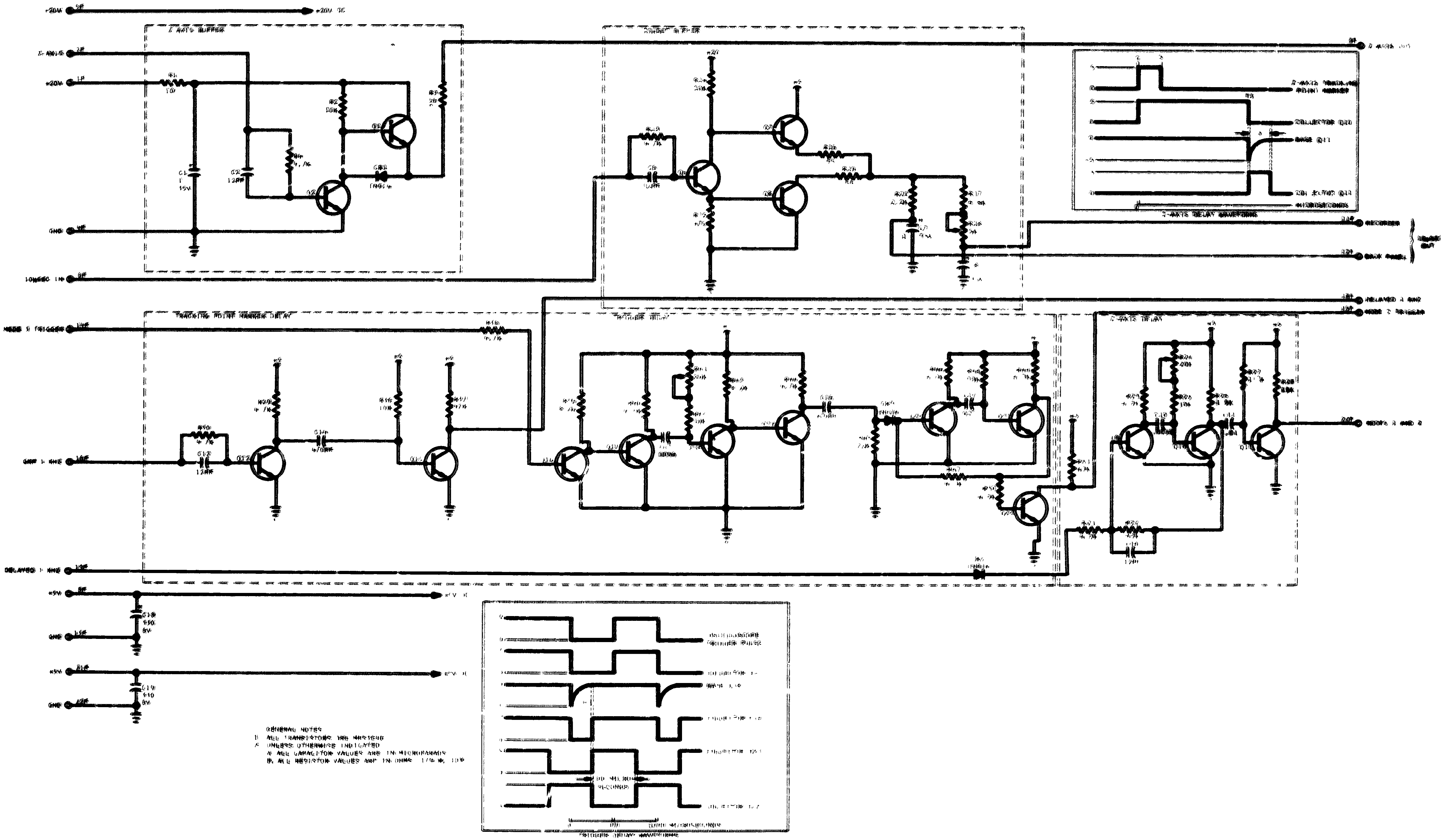
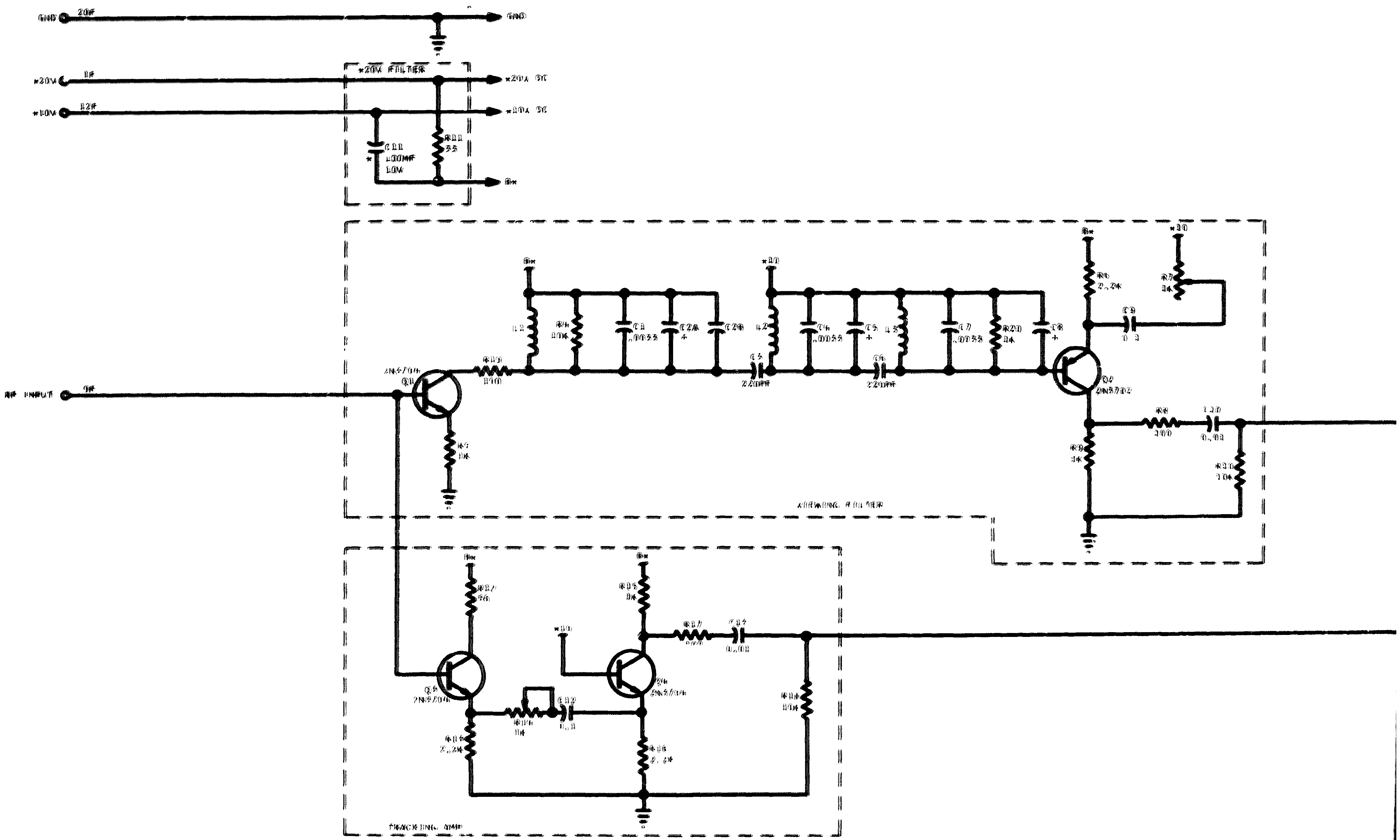


Figure 6-2 Output Buffers, PCB No. A2, R-1776 Schematic



GENERAL NOTES:
1. * INDICATES SELECTED VALUE.
2. UNLESS OTHERWISE INDICATED:
A. ALL CAPACITOR VALUES ARE IN MICROFARADS
B. ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%

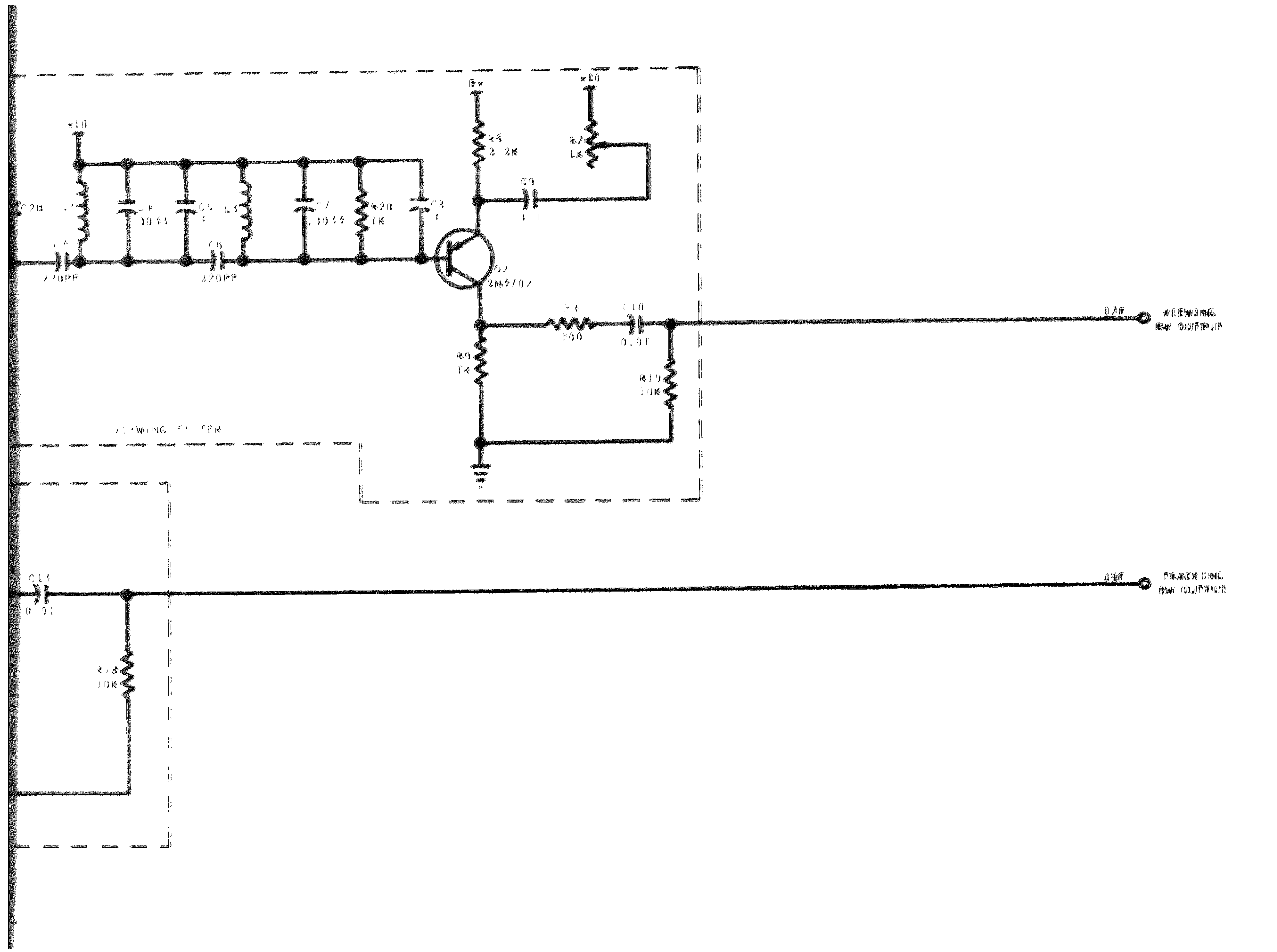


Figure 6-3. Viewing Filter, PCB No. A3, R-1776, Schematic

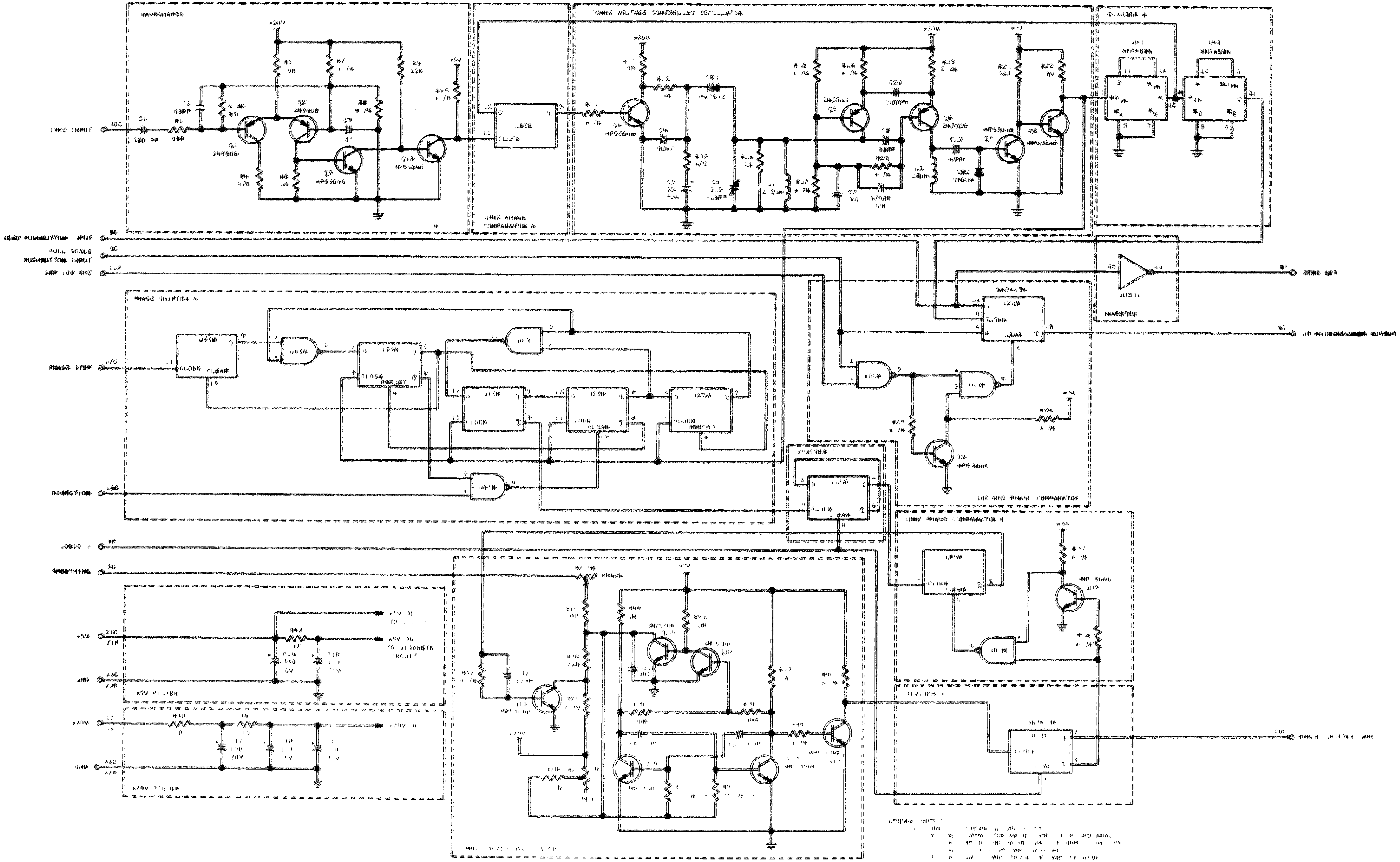
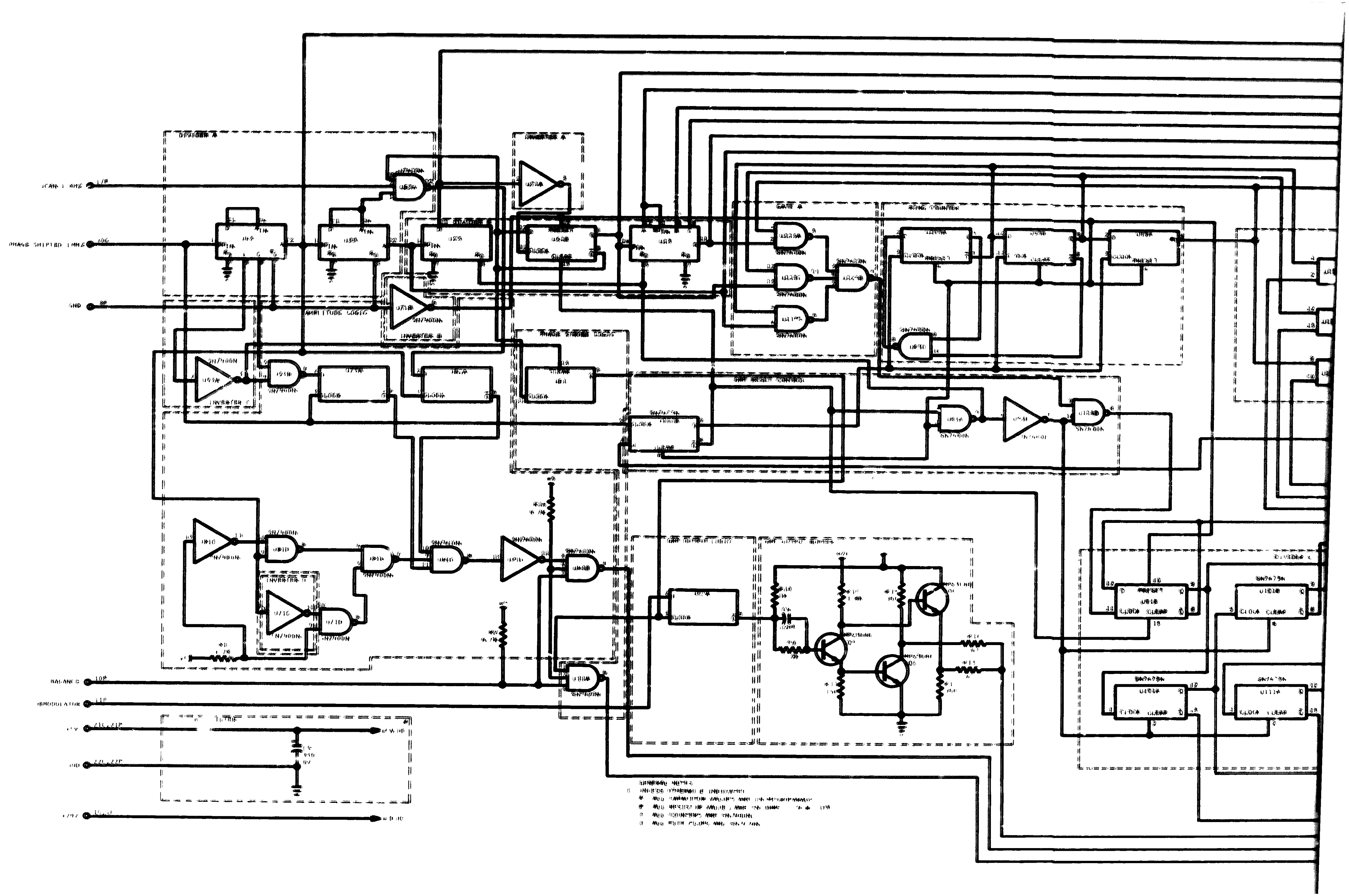


Figure. 6-4 Standard Input, PCB No. A4, R-1776, Schematic



GND
BALANCE
DEMODULATOR

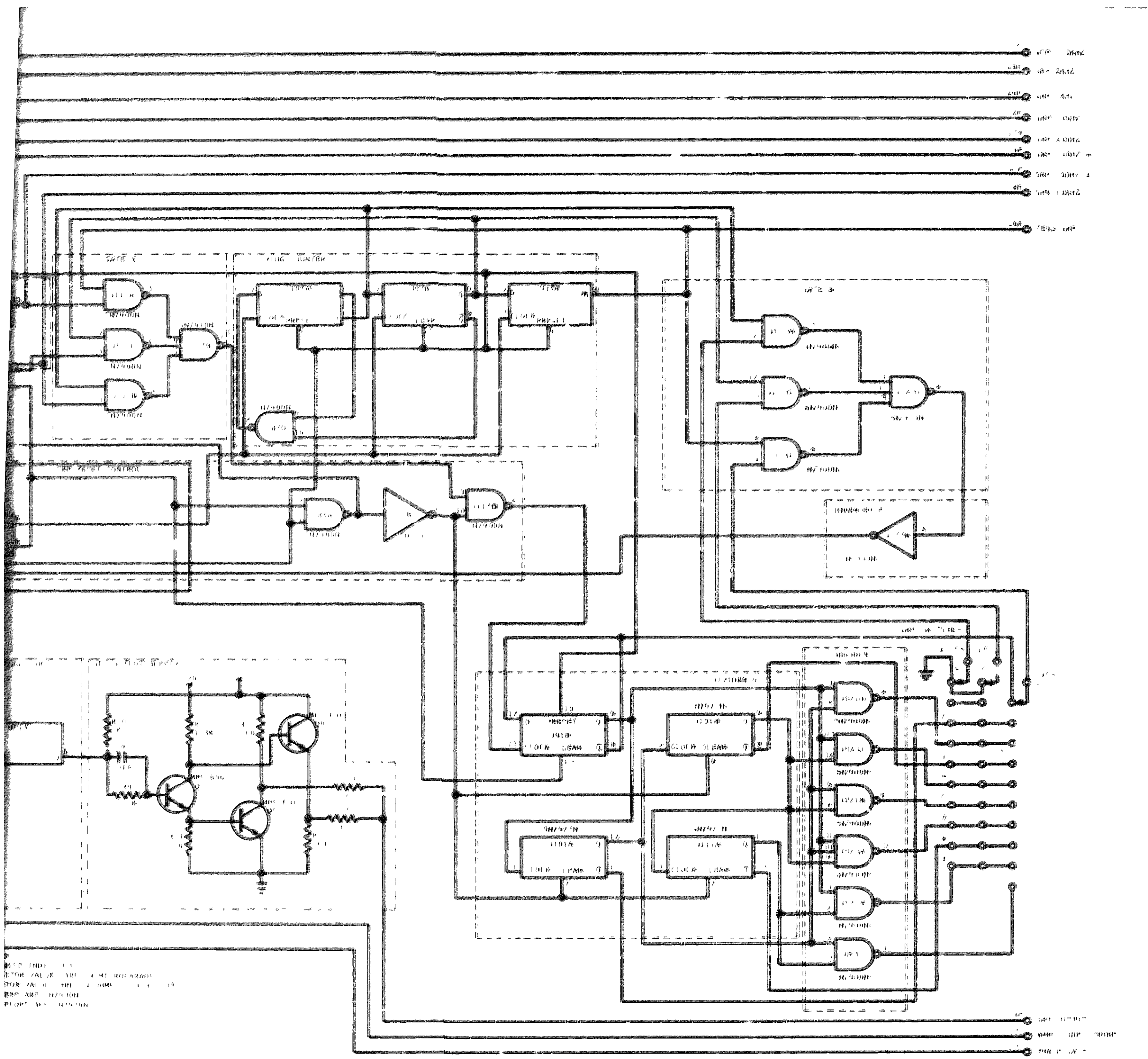


Figure. 6-5 GRP Divider, PCB No. A5, R-1776, Schematic

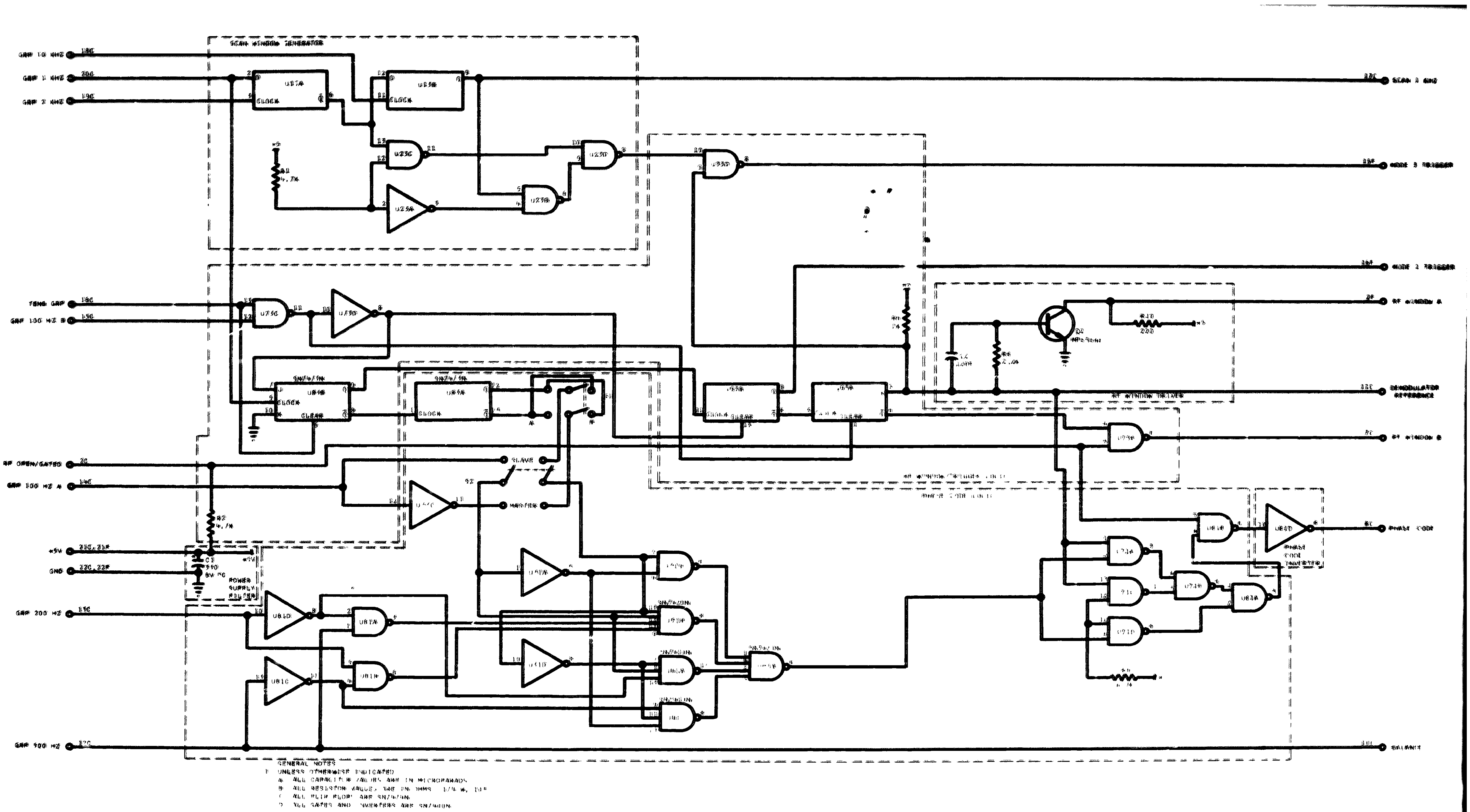
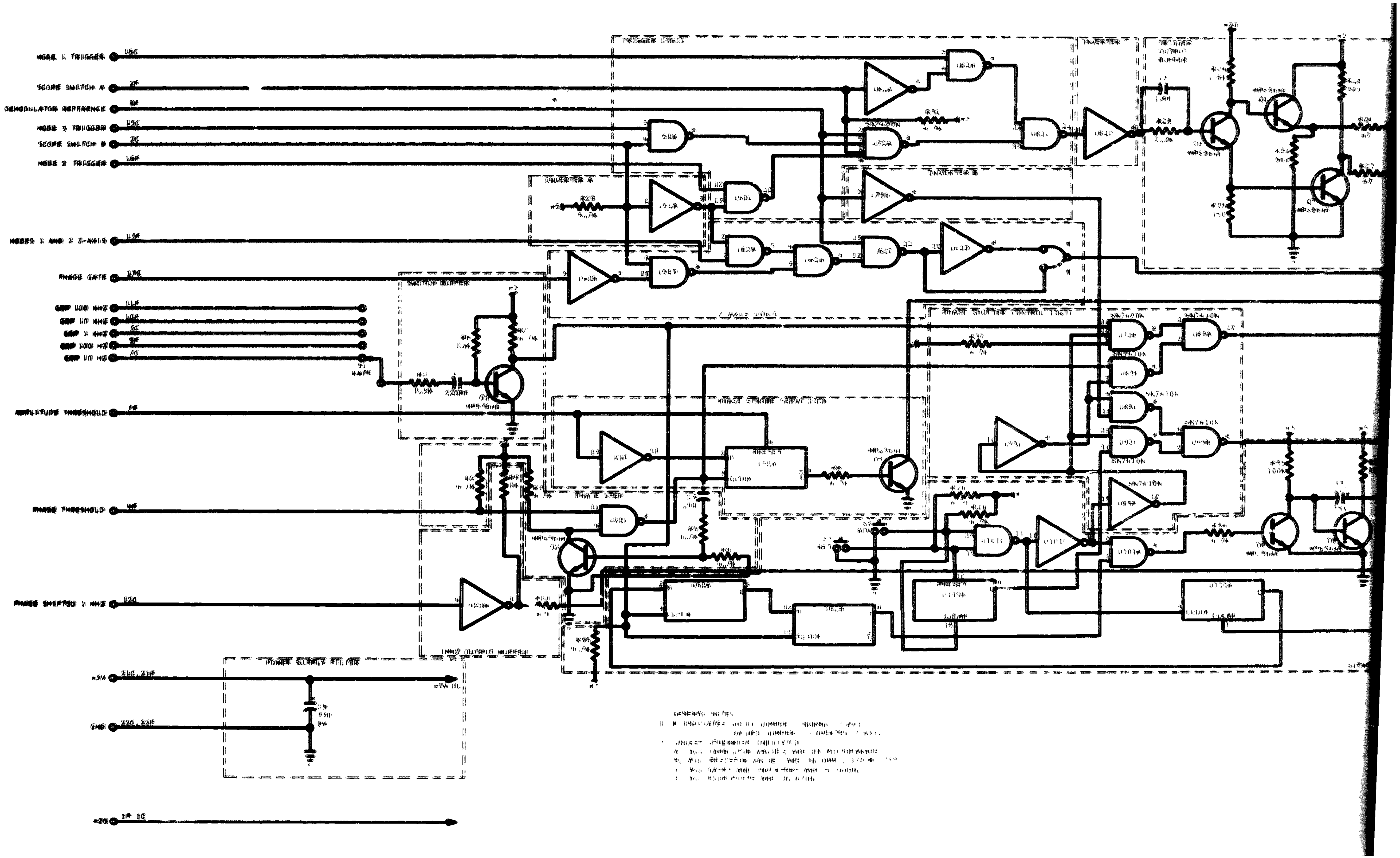


Figure. 6-6 Phase Code, PCB No. A6, R-1776, Schematic


MODE 1 TRIGGER
SCOPE SWITCH A
DEMODULATOR REFERENCE
MODE 3 TRIGGER
SCOPE SWITCH B
MODE 2 TRIGGER
MODES 1 AND 2 Z-AXIS
PHASE GATE
AMPLITUDE THRESHOLD
PHASE THRESHOLD
PHASE SHIFTED 1 KHZ
POWER SUPPLY FILTER
SWITCH BUFFER
PHASE SHIFTER CONTROL LOGIC
+5V
GND
+20

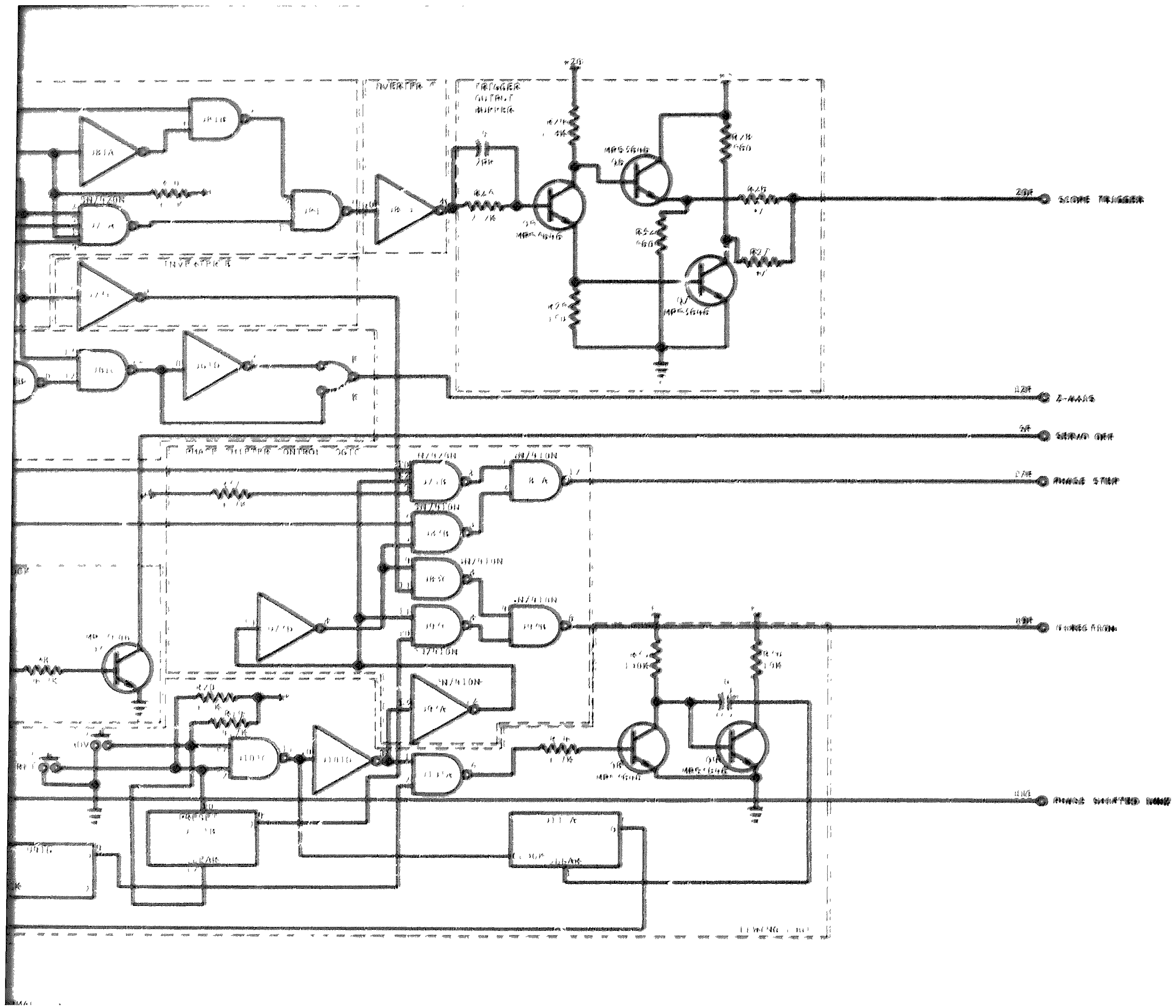


Figure. 6-7 Servo Control, PCB No,
A7, R-1776, Schematic

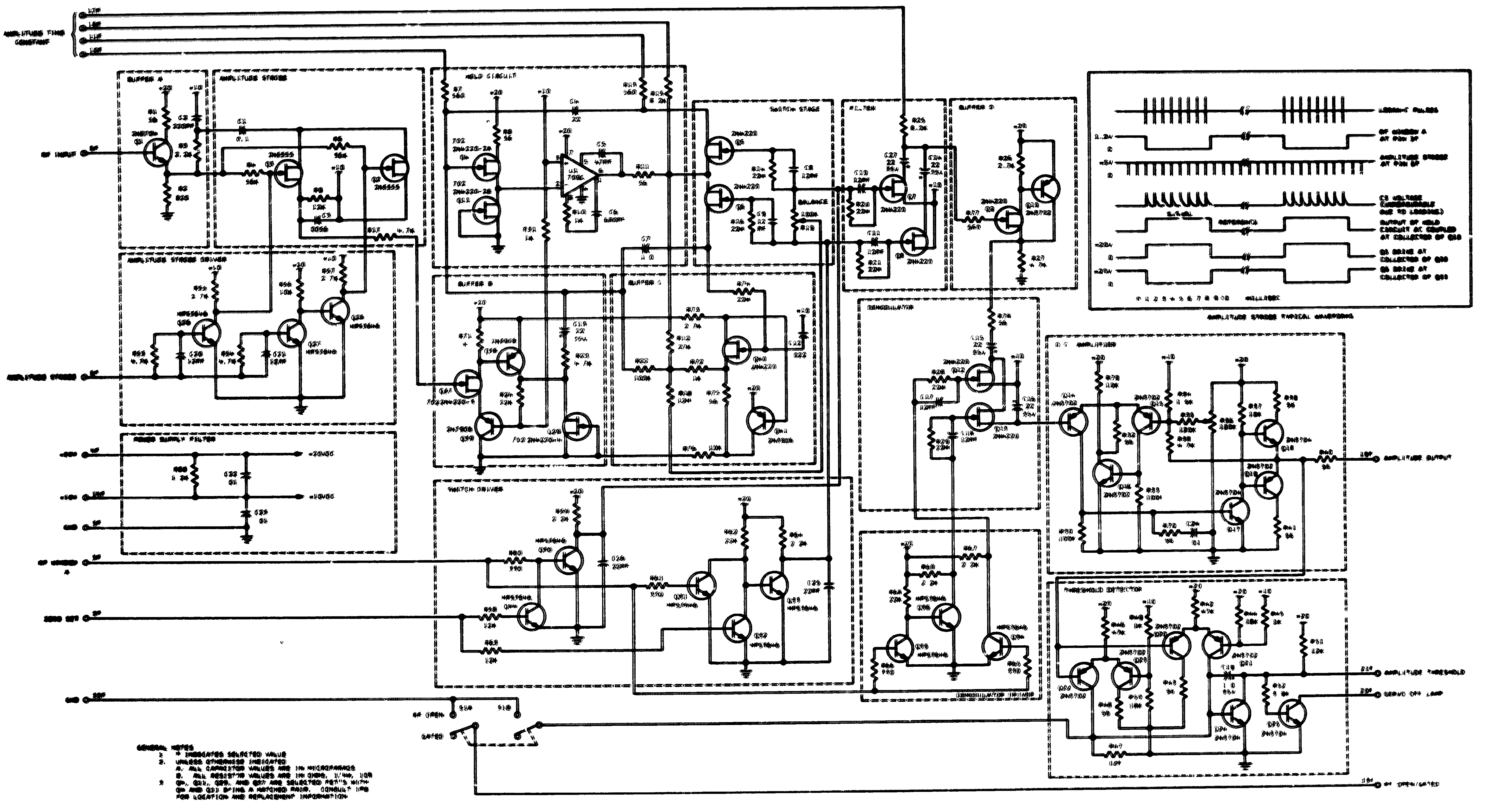
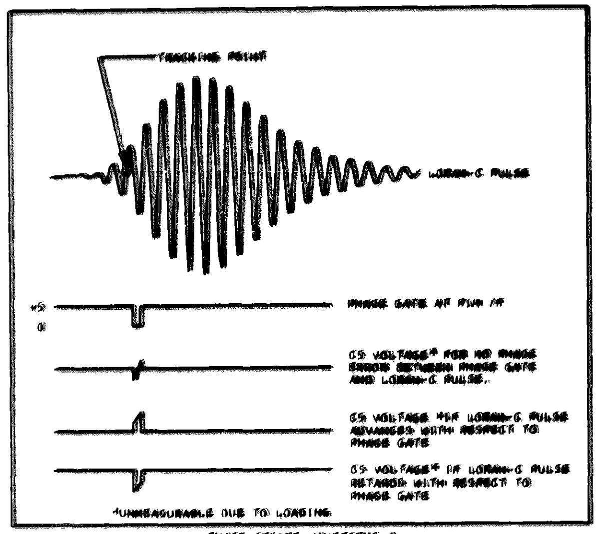
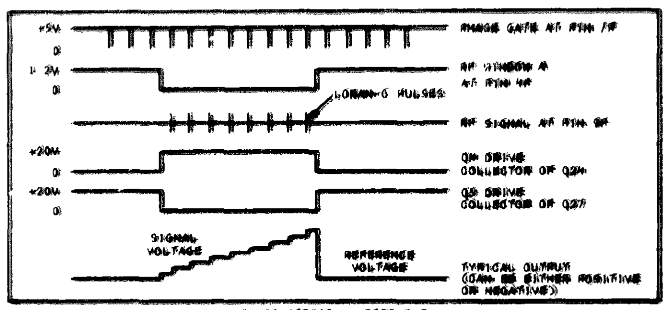


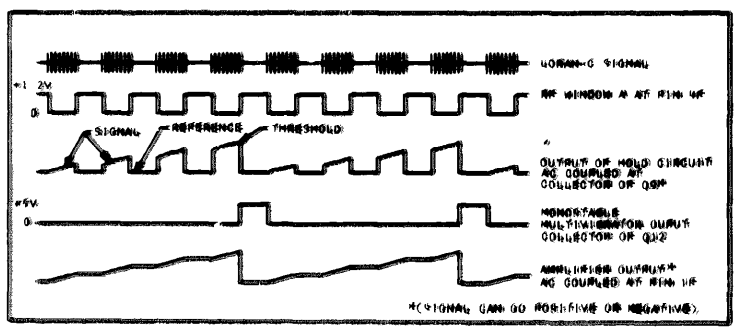
Figure. 6-8 Amplitude Strobe, PCB No. A8, R-1776, Schematic



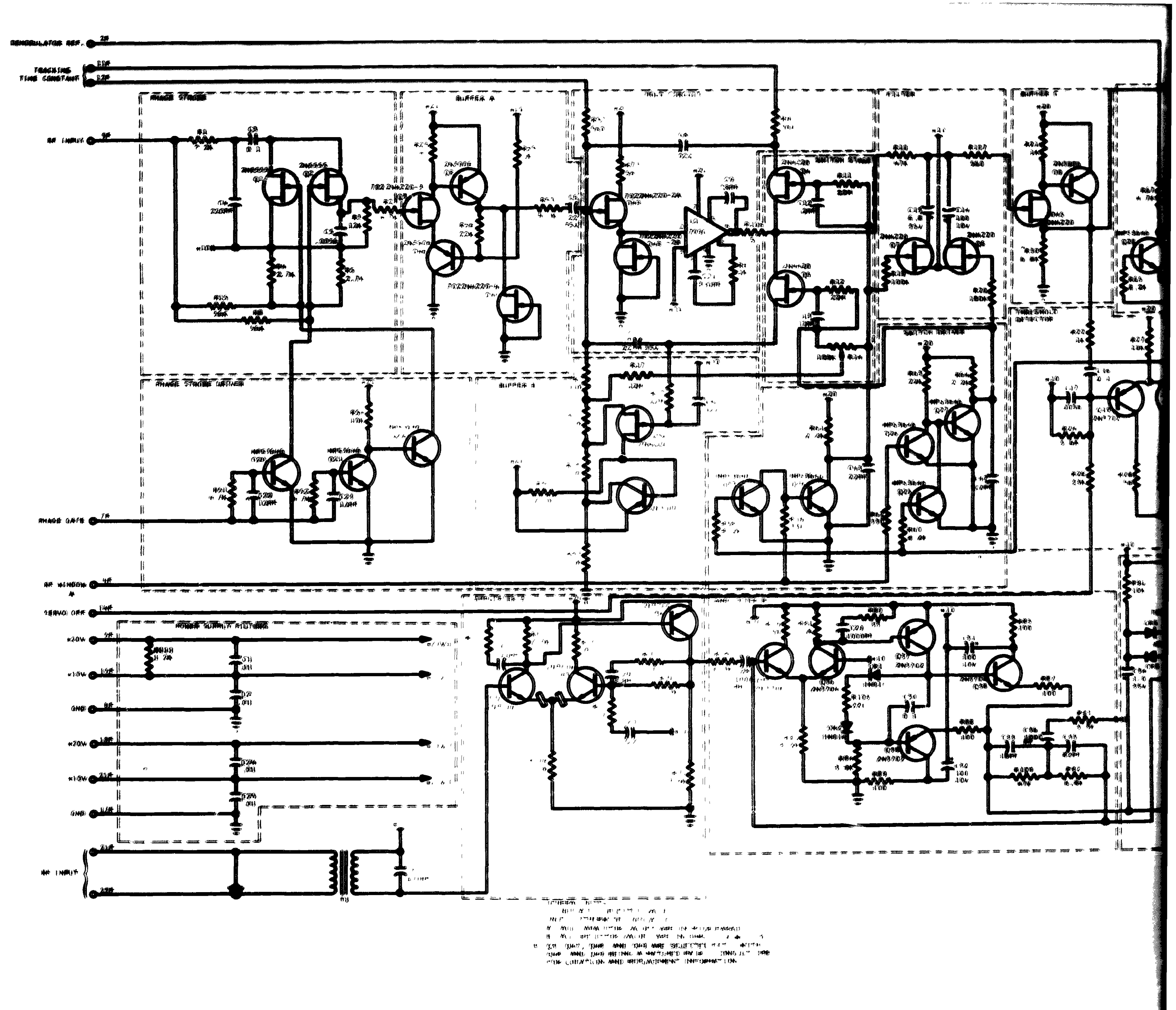
PHASE STROBE WAVEFORMS A



PHASE STROBE WAVEFORMS B



PHASE STROBE WAVEFORMS C



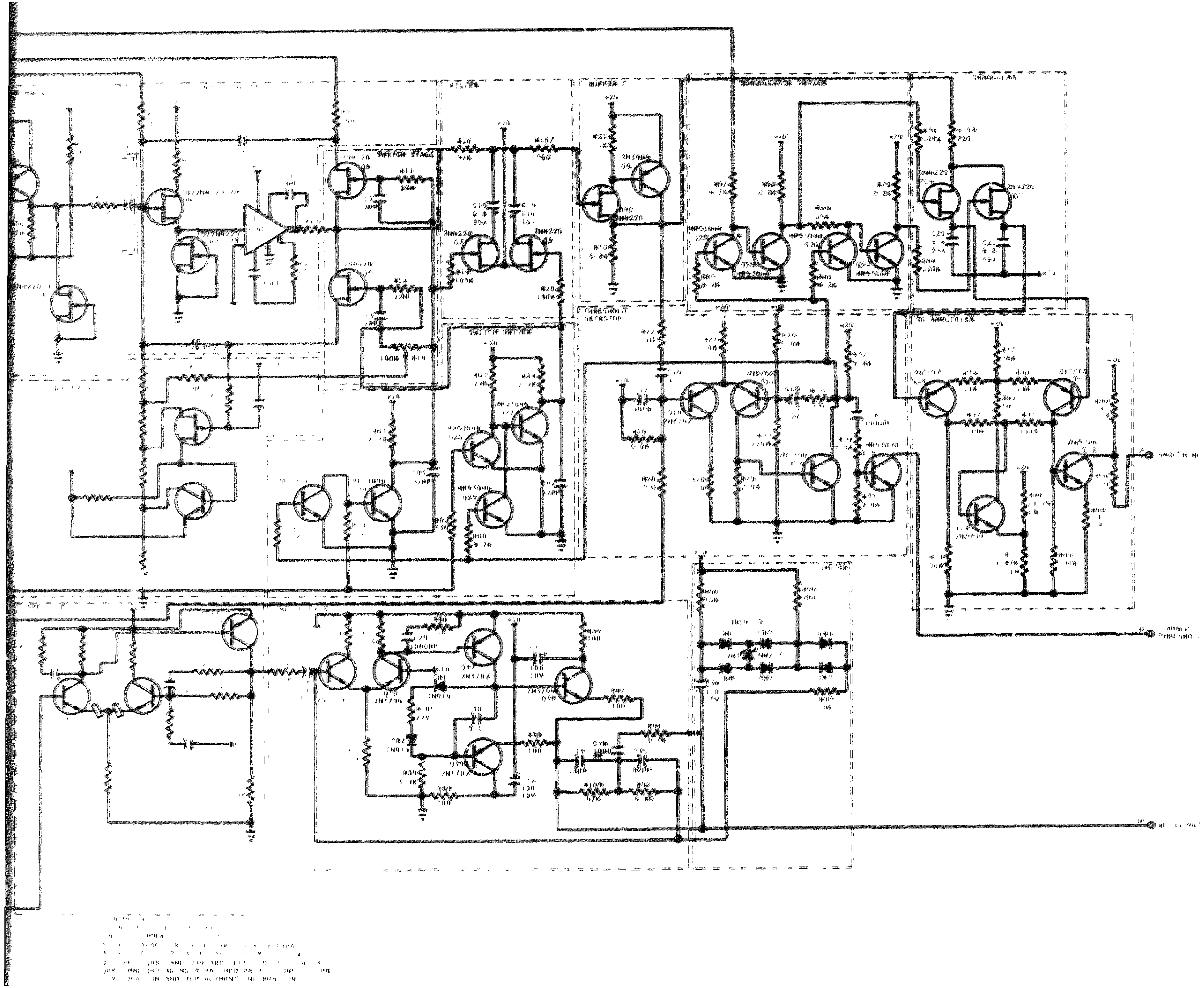


Figure. 6-9 Phase Strobe PCB No.
A9, R-1776, Schematic

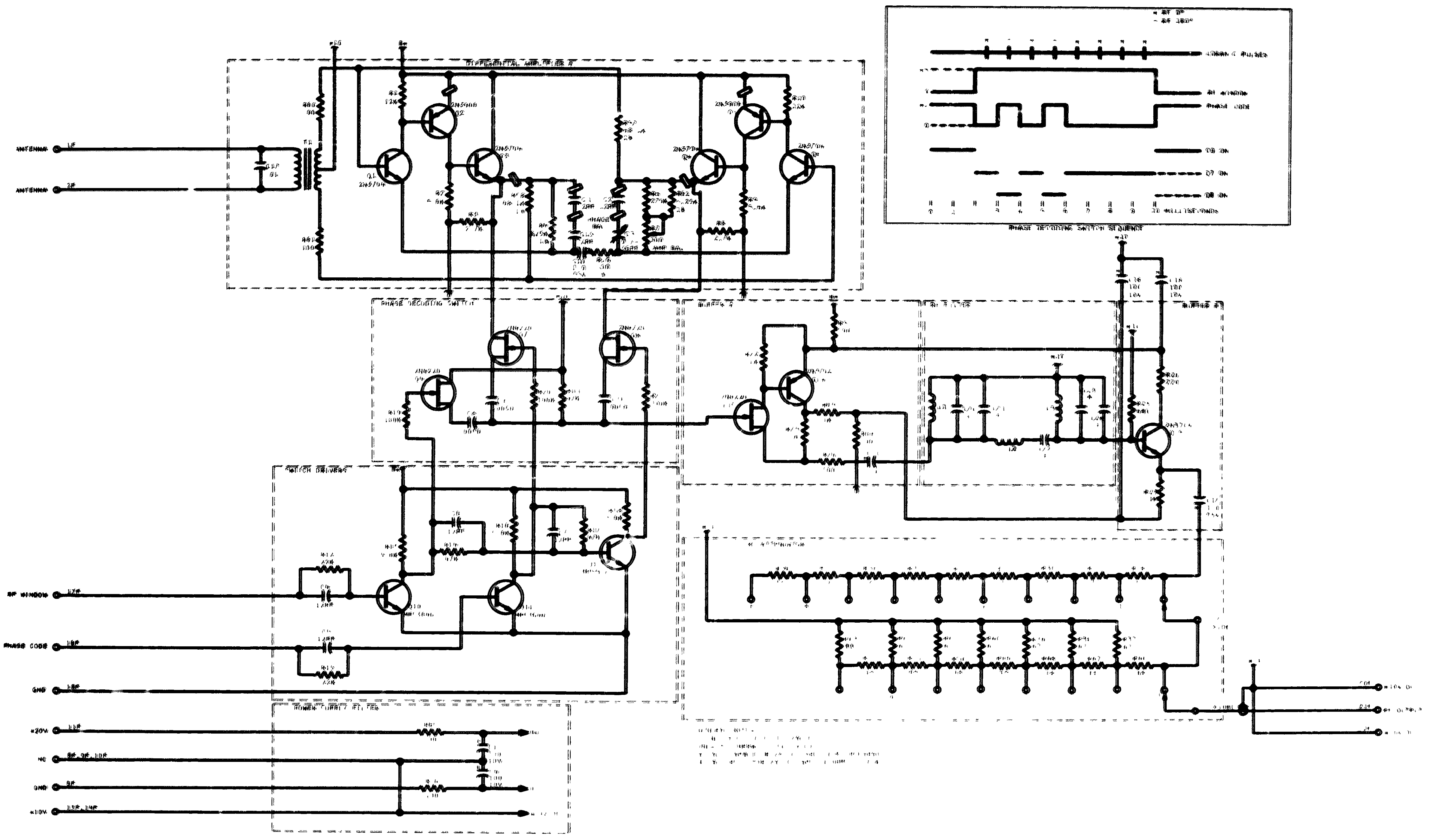


Figure. 6-10 RF Amplifier, PCB No. A10, R-1776, Schematic

FO-35/(FO-36 Blank)

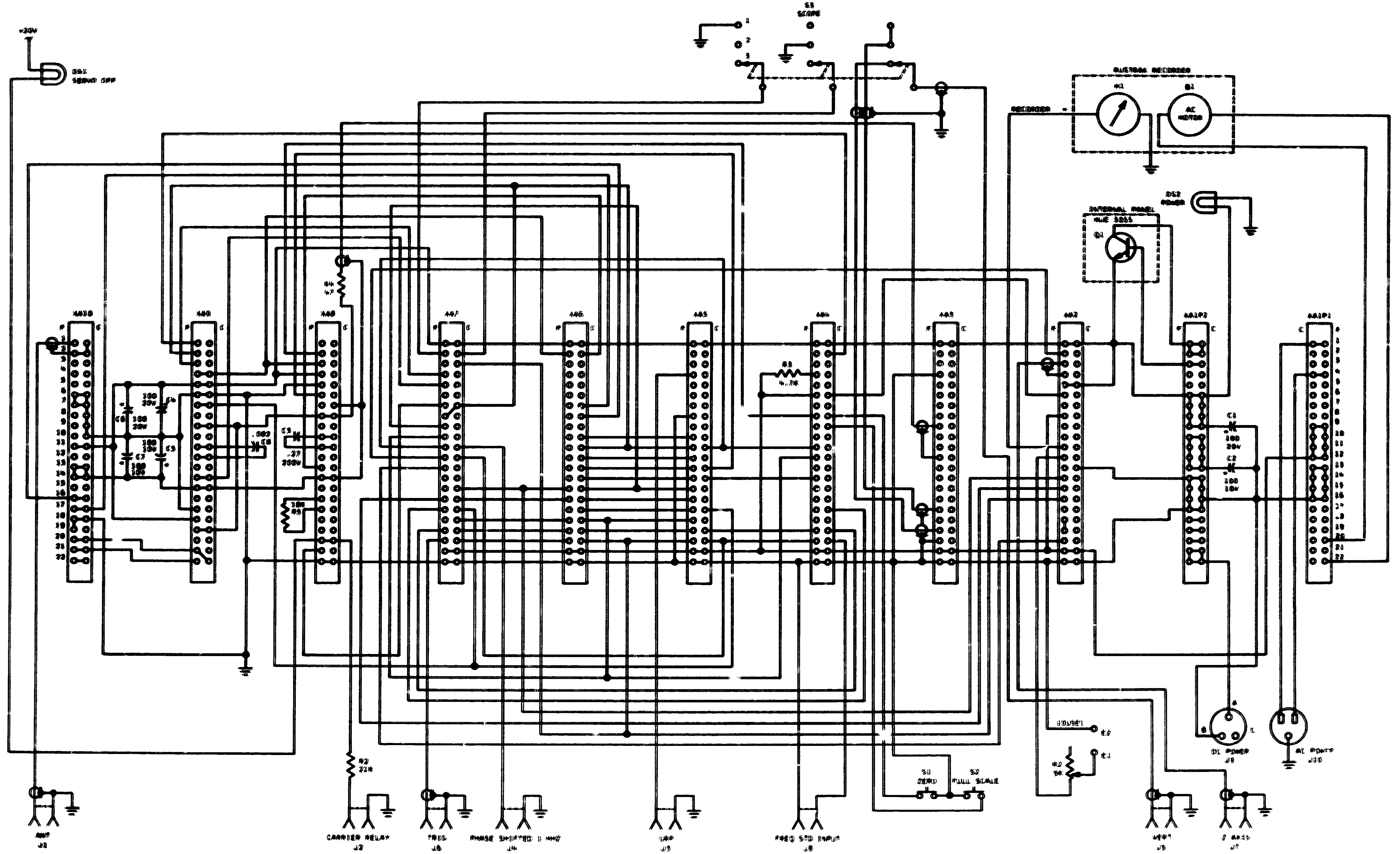
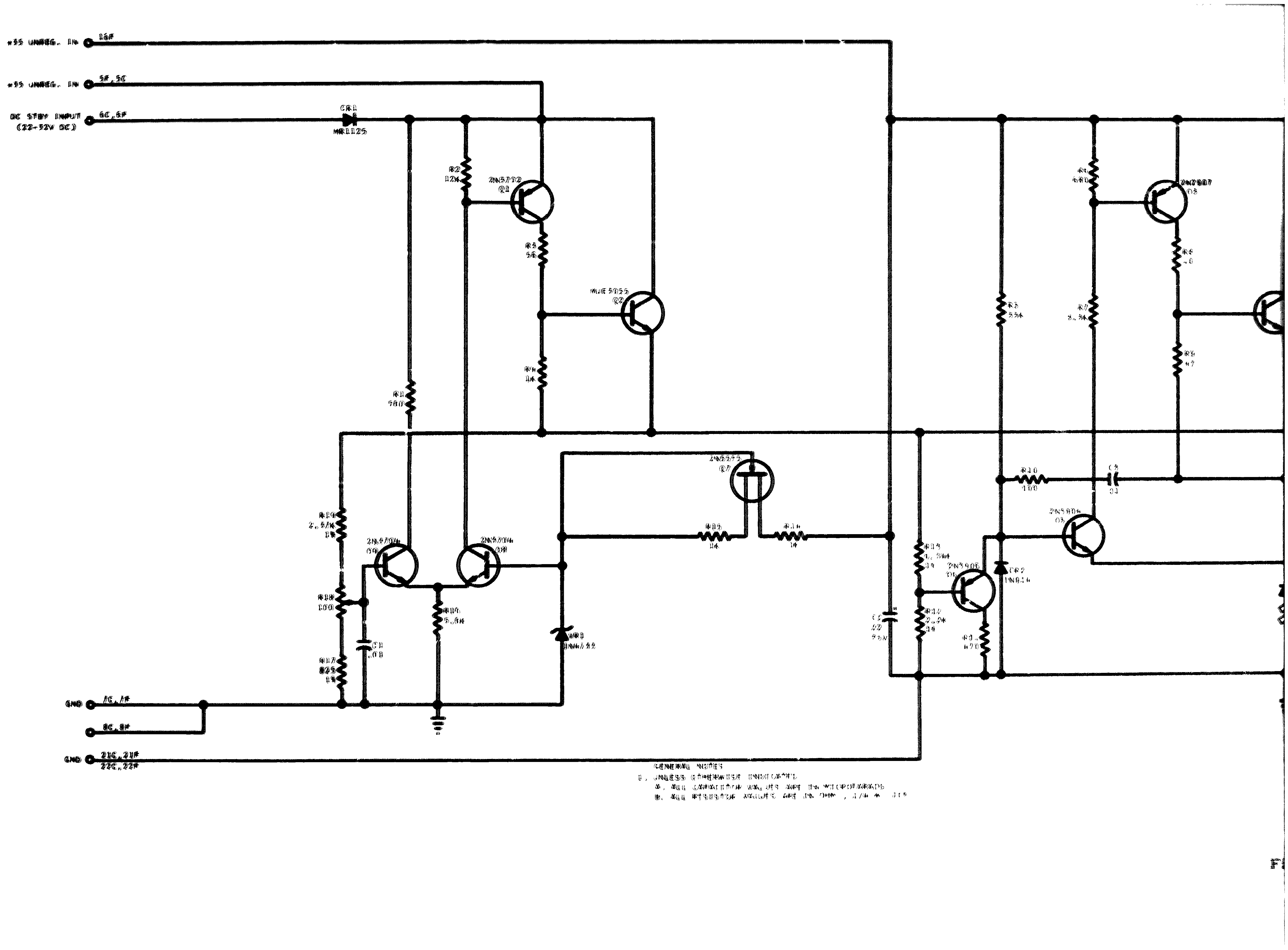


Figure. 6-11 Schematic, Chassis R-1776

FO-37/(FO-38 Blank)


+35 UNREG. IN
16F
5F, 5C
DC STBY INPUT
(22-32V DC)
6C, 6F
CR1
MR1125
GND
7C, 7F
8C, 8F
21C, 21F
22C, 22F
GENERAL NOTES
1. UNLESS OTHERWISE INDICATED
A. ALL CAPACITOR VALUES ARE IN MICROFARADS
B. ALL RESISTOR VALUES ARE IN OHM

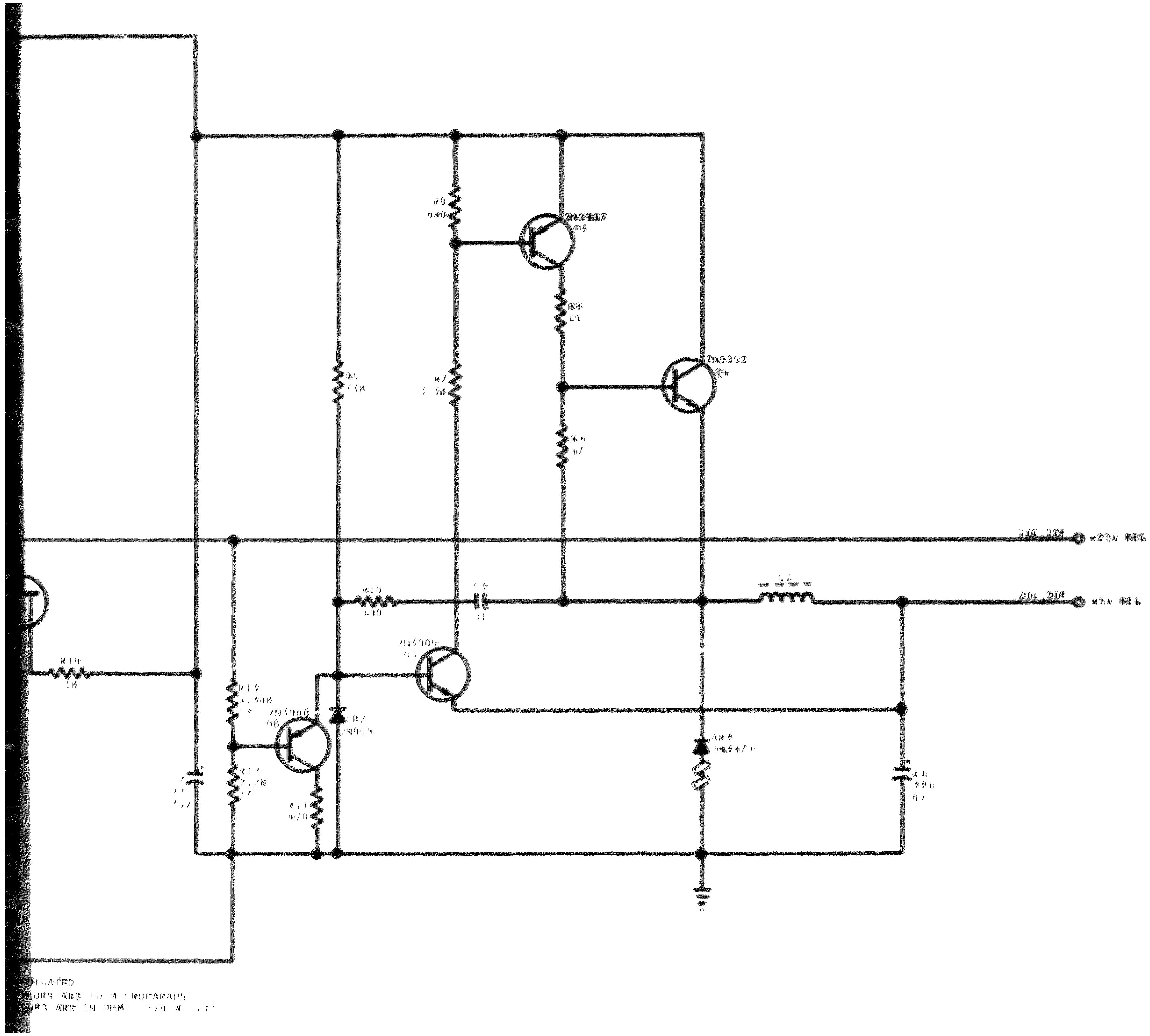
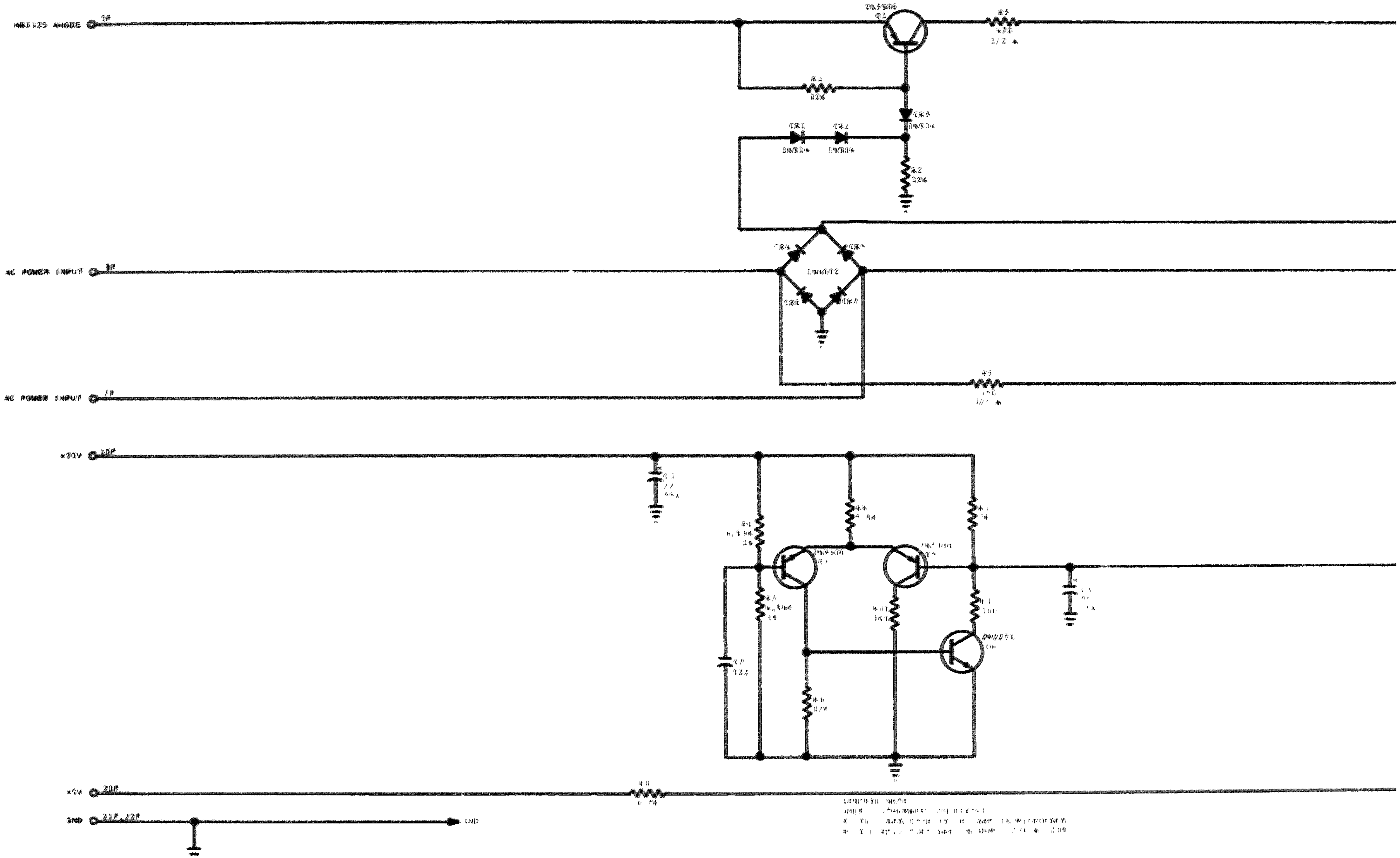


Figure. 6-12 +20 Volt and +5 Volt Regulator,
PCB No. A1, Q-1632 Schematic


AC POWER INPUT
AC POWER INPUT
+20V
+5V
GND

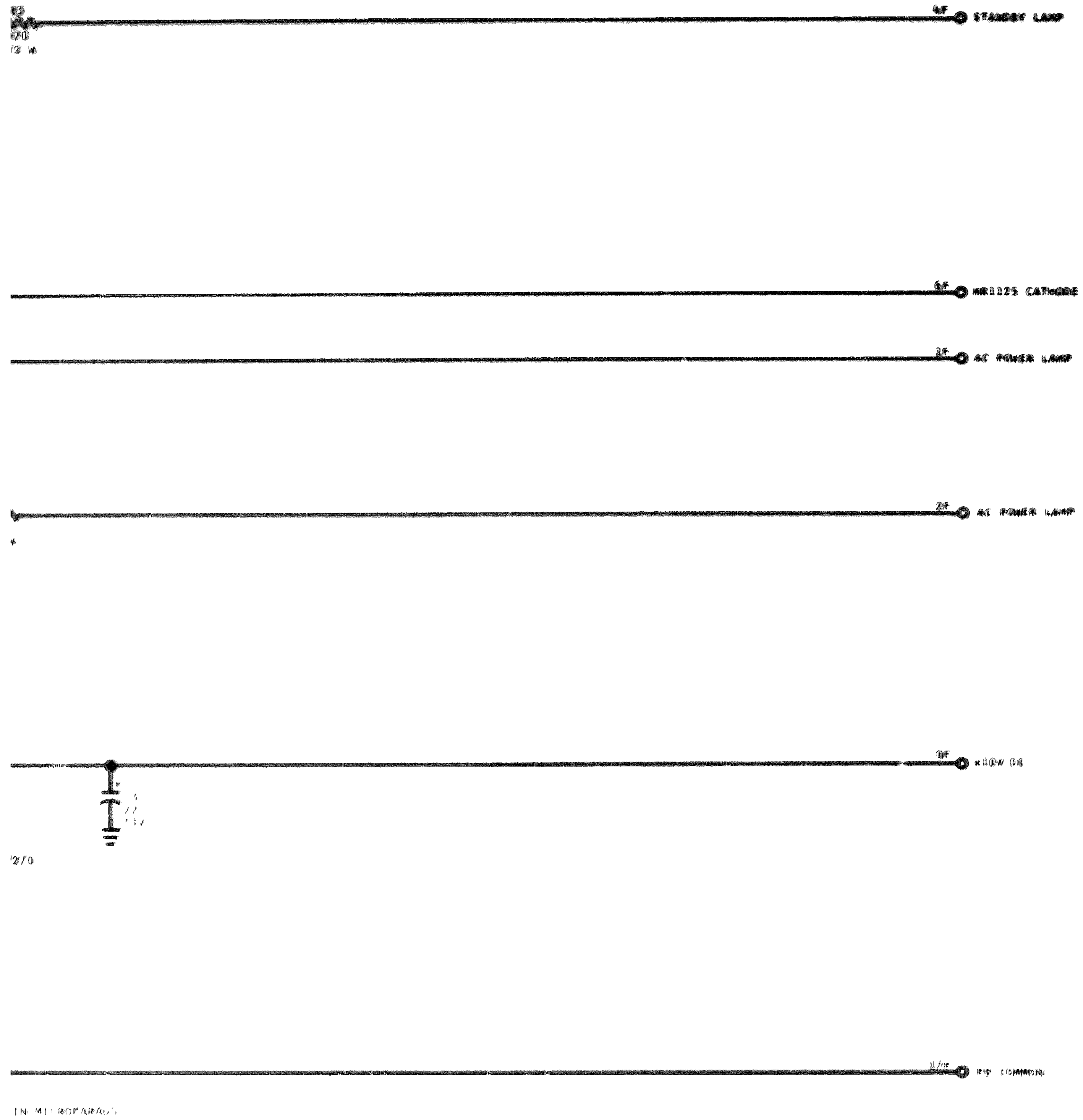


Figure. 6-13 +10 Volt Regulator, PCB No.
A2, O-1632, Schematic

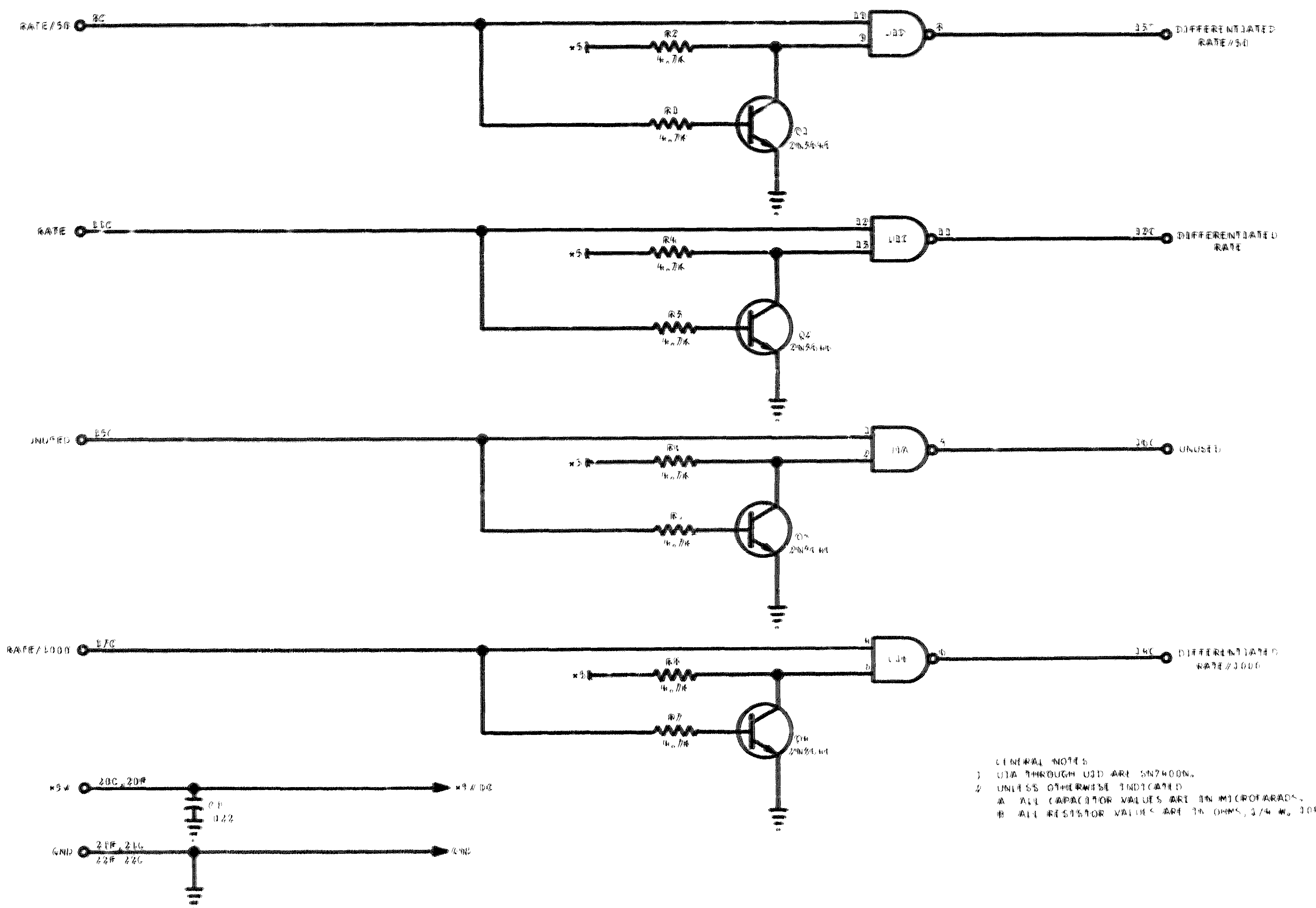


Figure. 6-14 Differentiator, PCB No. A3, O-1632, Schematic

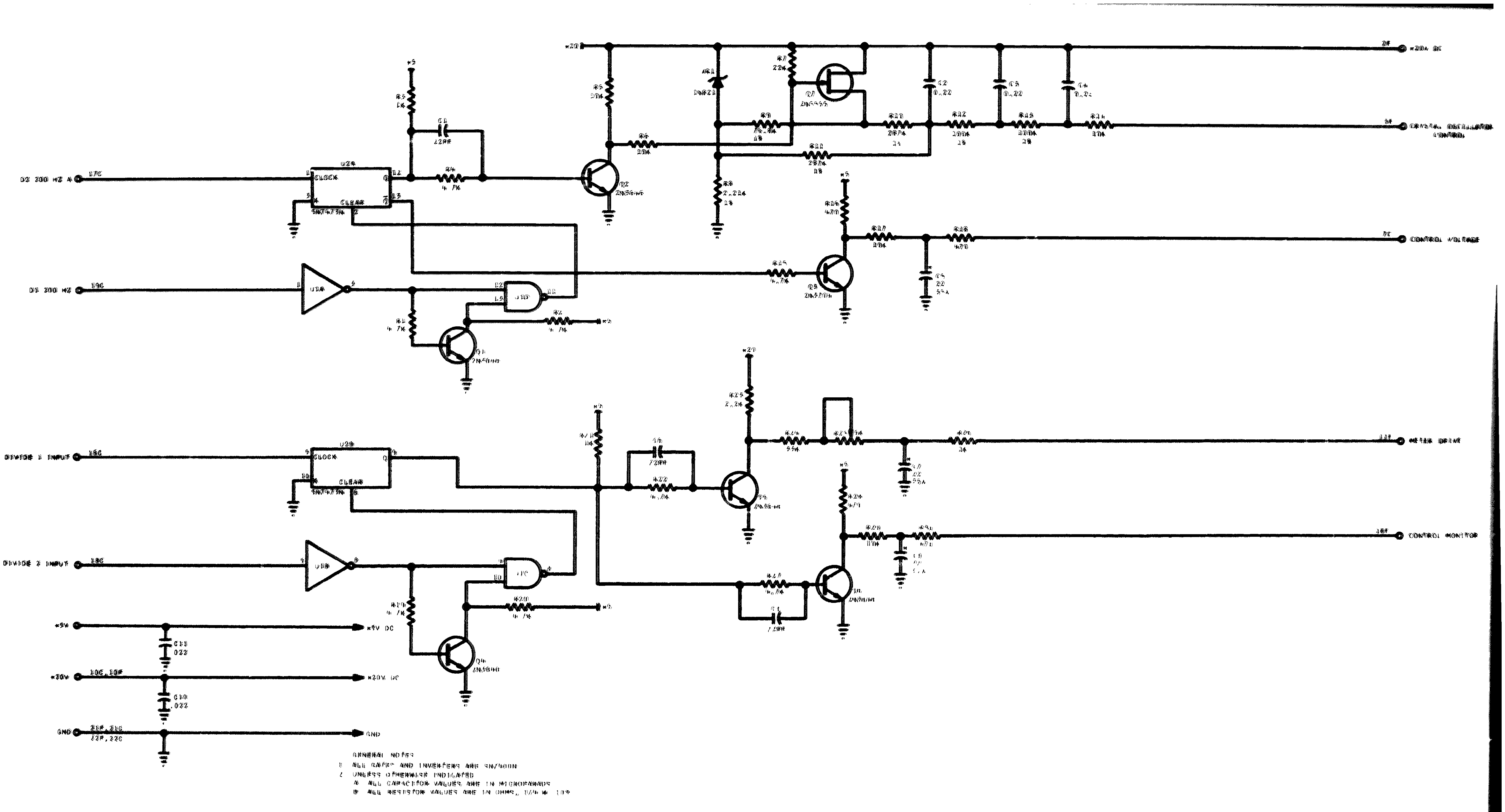


Figure 6-15 Phaase Comparator, PCB No. A4, O-1632, Schematic

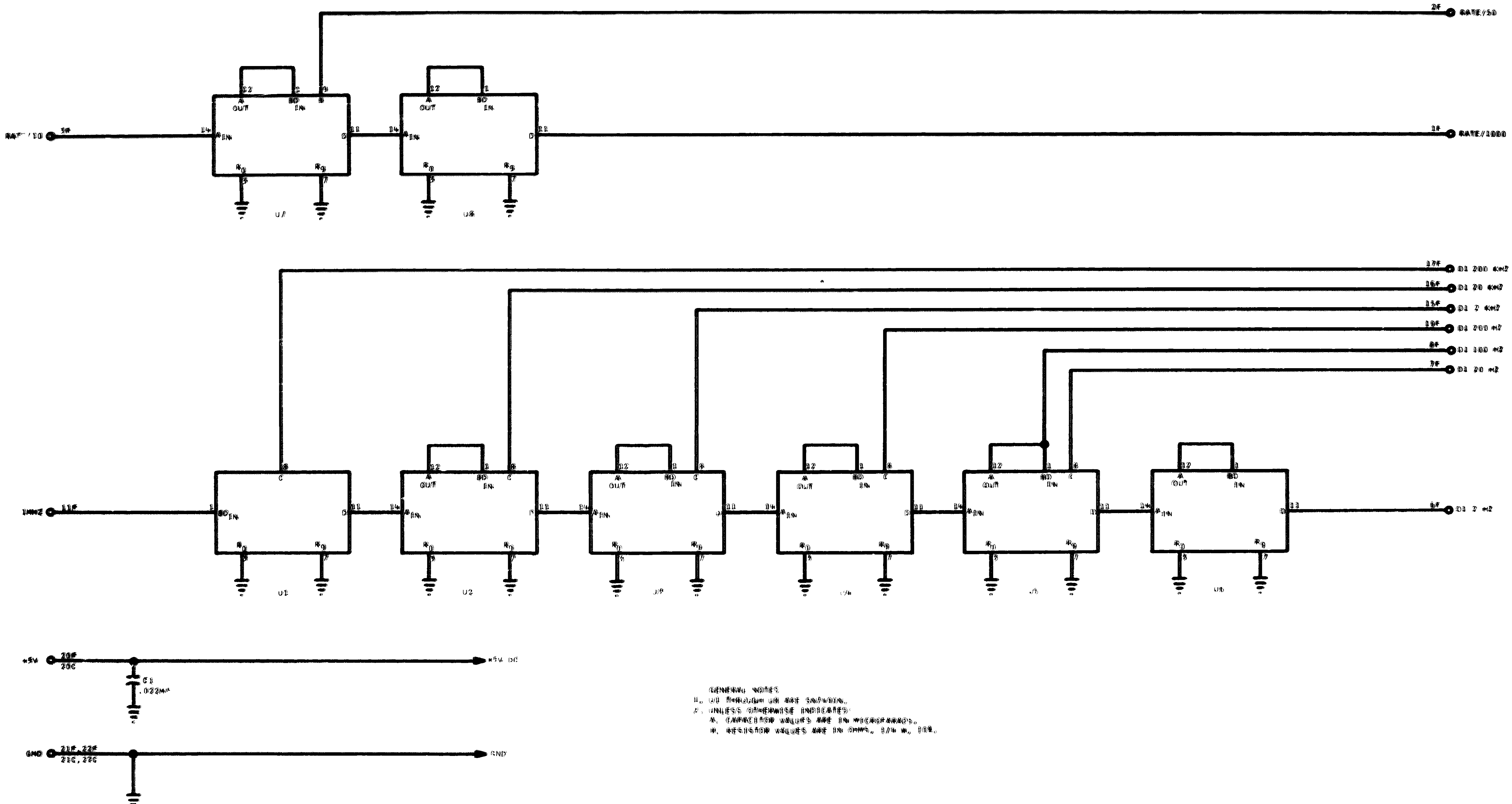


Figure. 6-16 Divider 1, PCB No. A5, O-1632, Schematic

FO-47/FO-48 Blank)

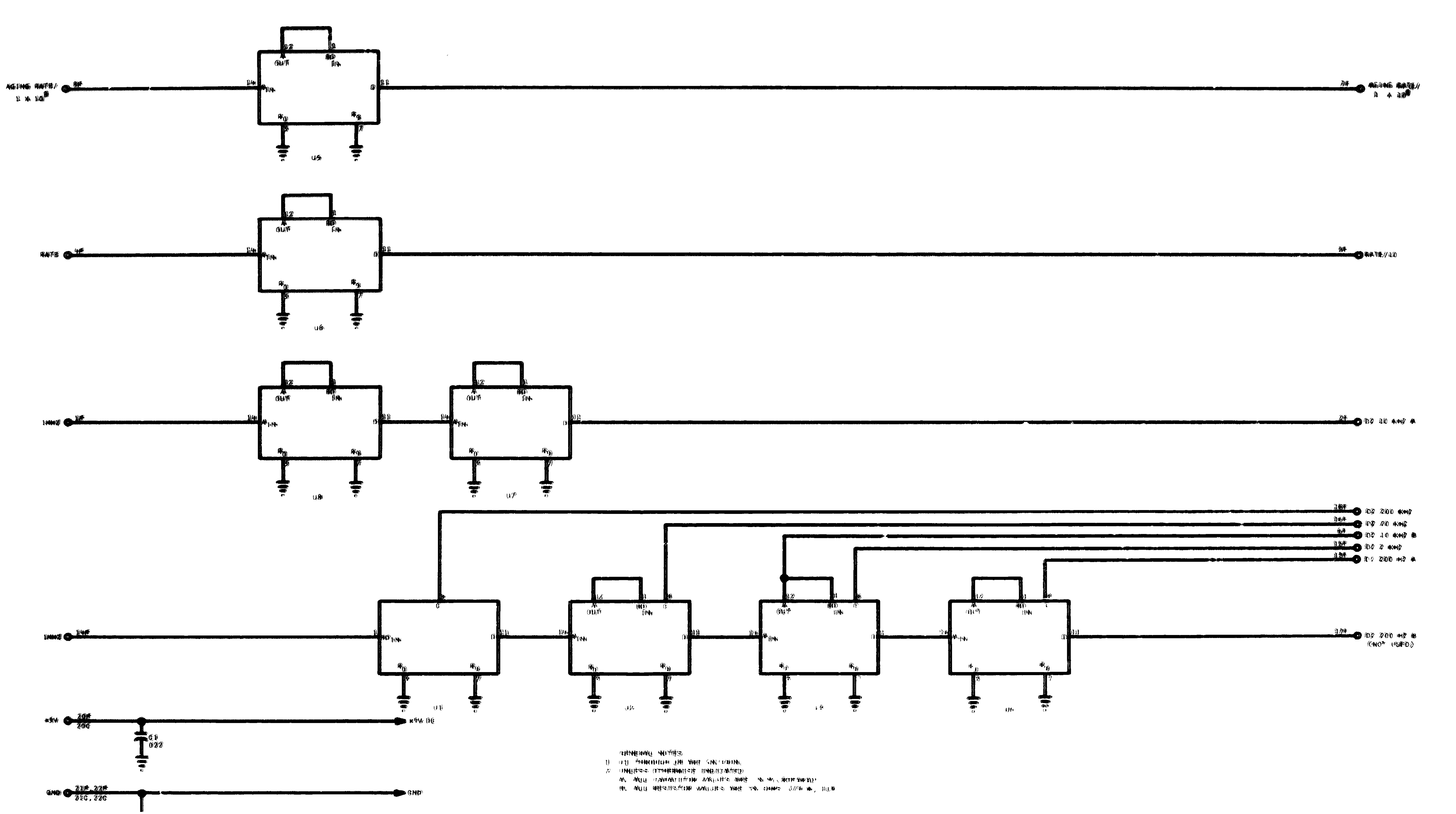


Figure. 6-17 Divider 2, PCB No. A6, O-1632, Schematic

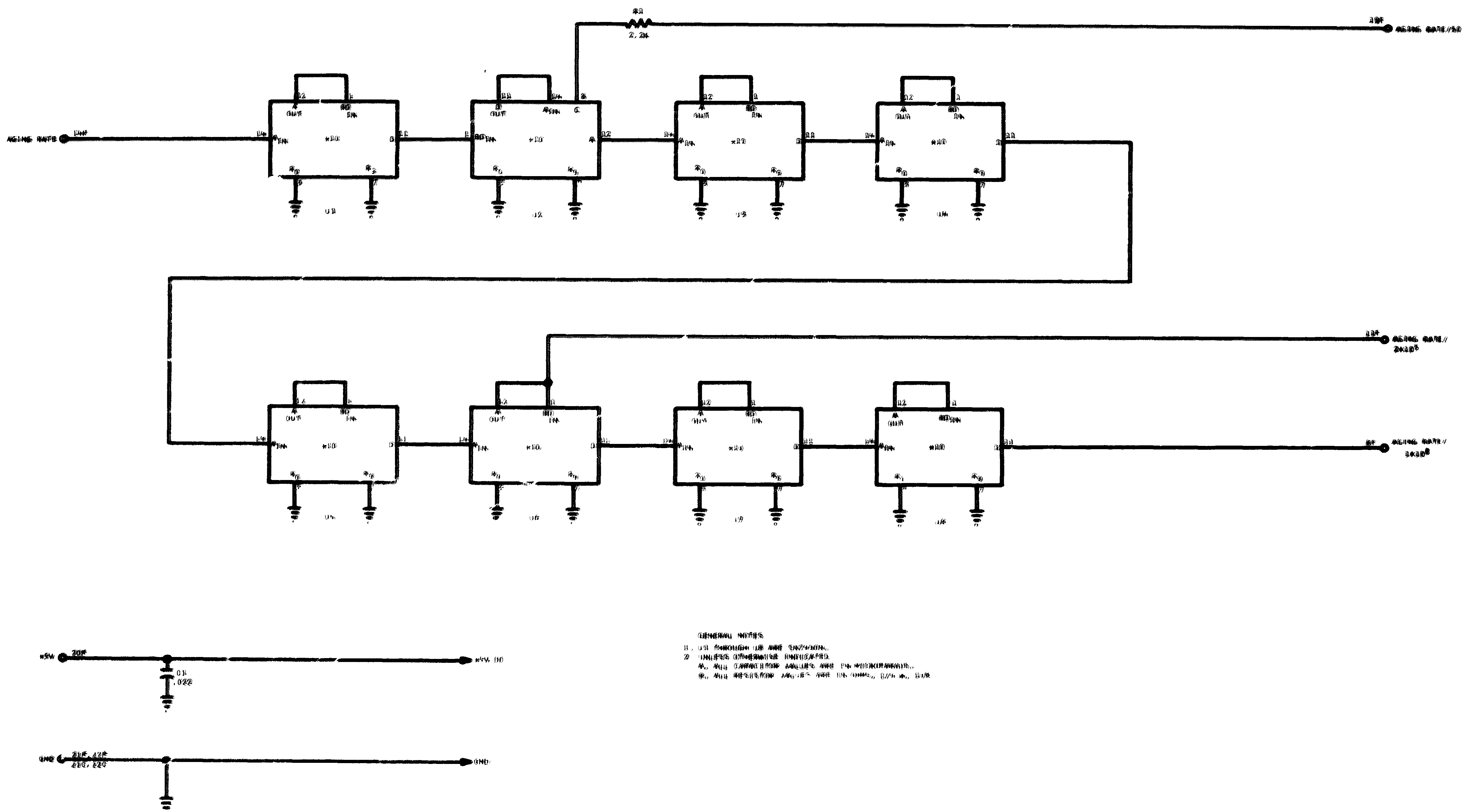


Figure. 6-18 Divider 3, PCB No. A7,
O-1632, Schematic

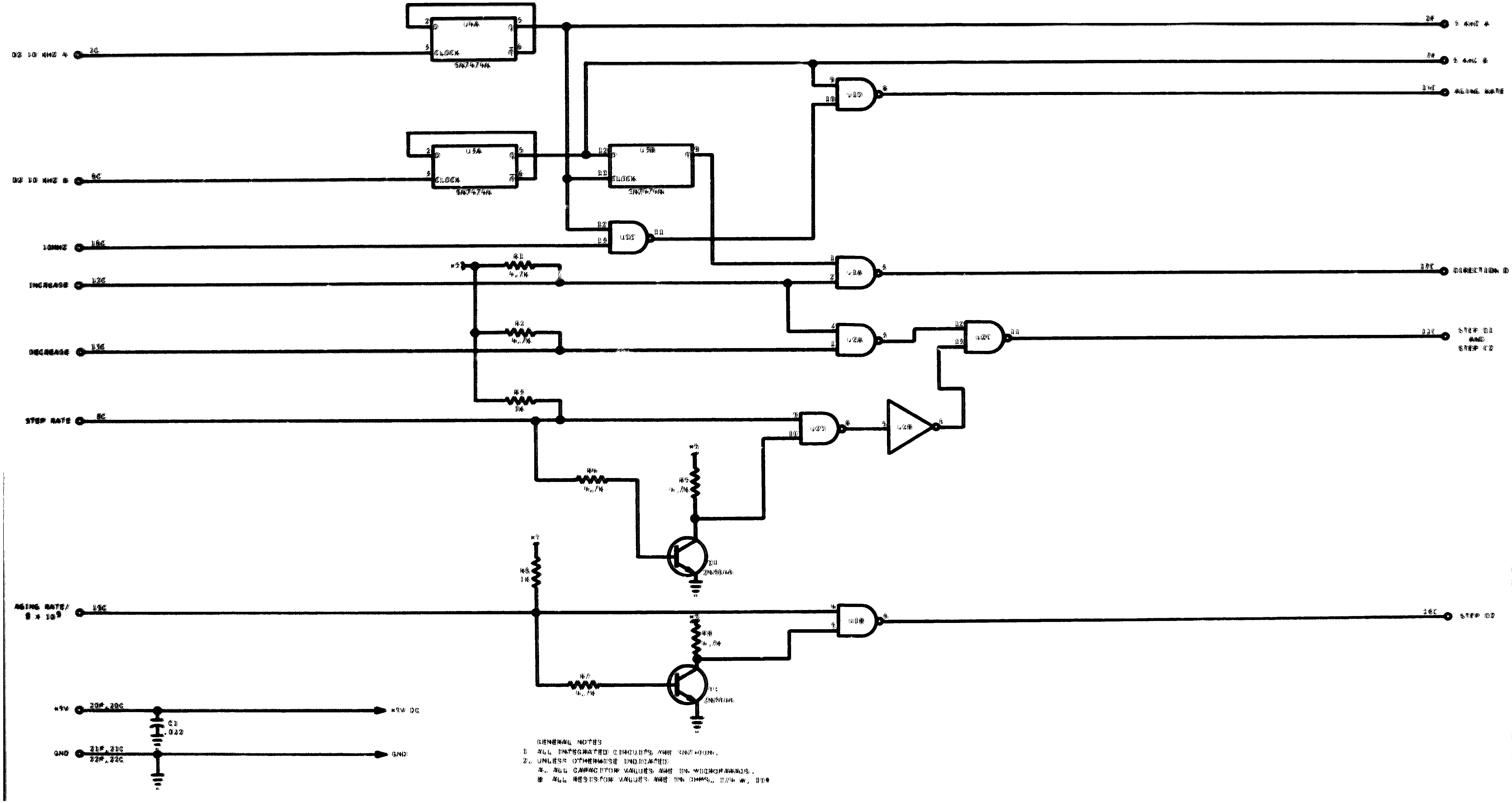


Figure. 6-19 Disciplined Oscillator Servo Control,
PCB No. A8, O-1632, Schematic

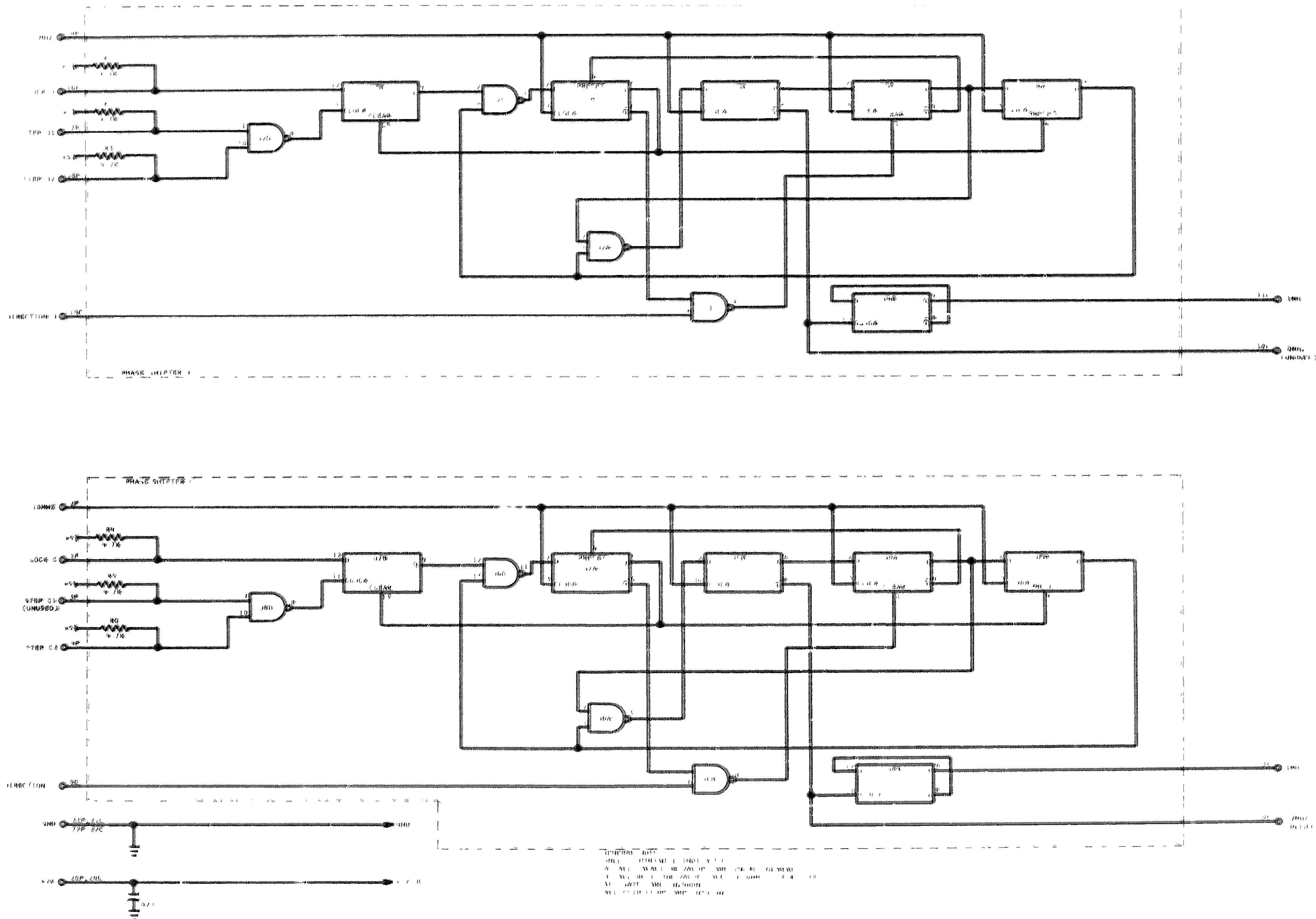


Figure. 6-20 Dual Phase Shifter, PCB No. A9, O-1632, Schematic

FO-55/(FO-56 Blank)

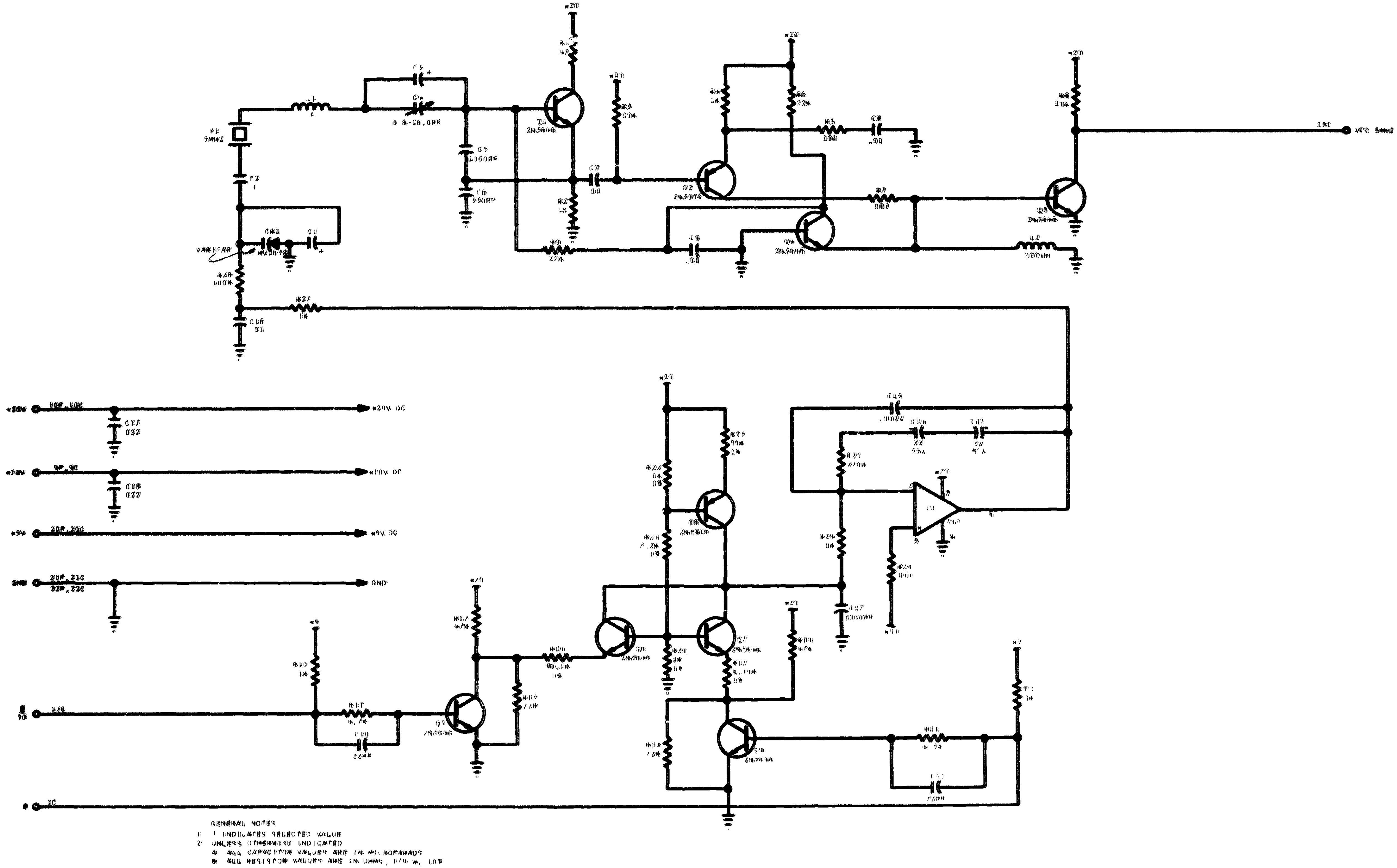


Figure. 6-21 5 MHz VCO, PCB No. A10, O-1632, Schematic

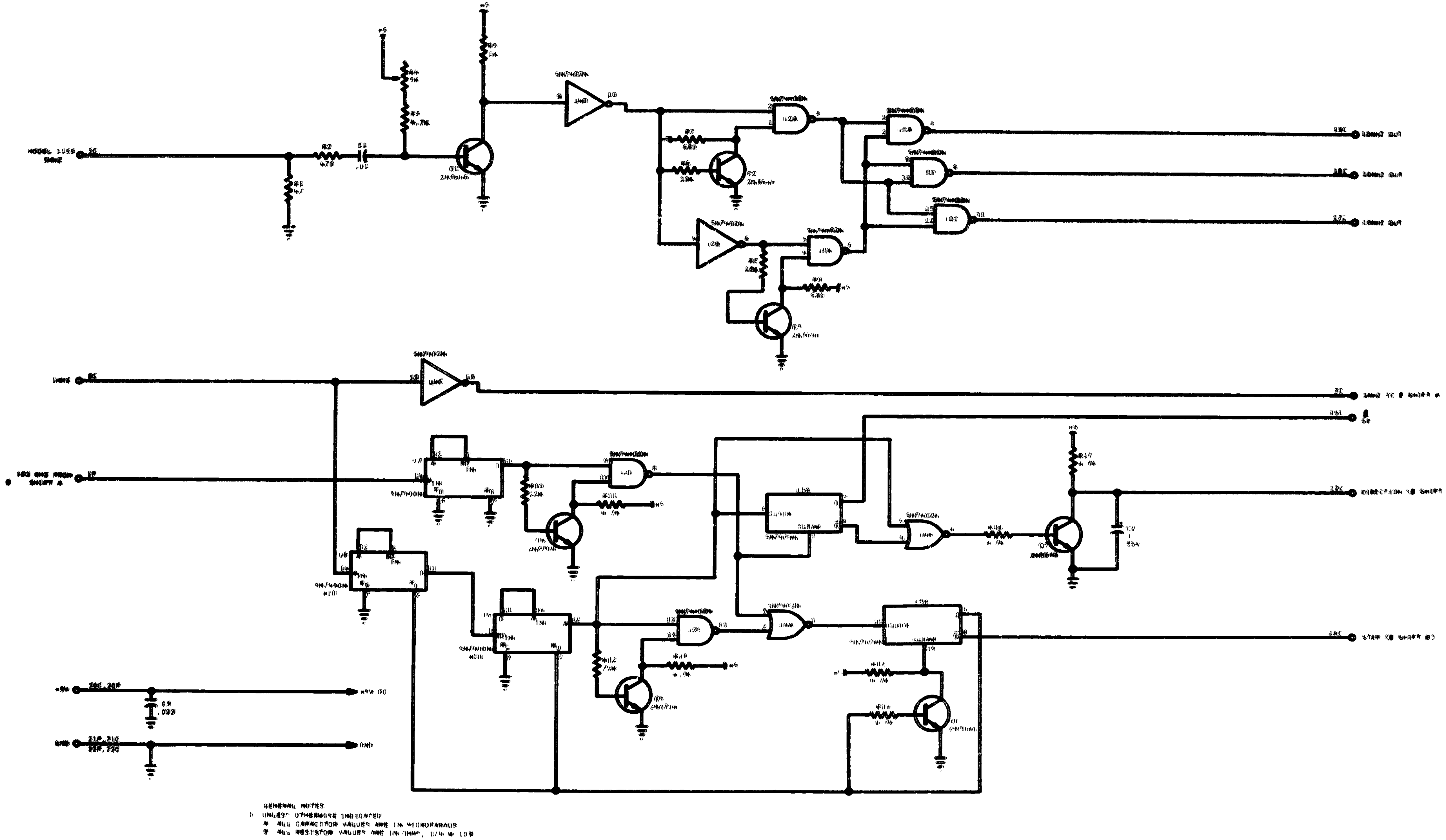


Figure. 6-22 Digital Integrator, PCB No. A11, O-1632, Schematic

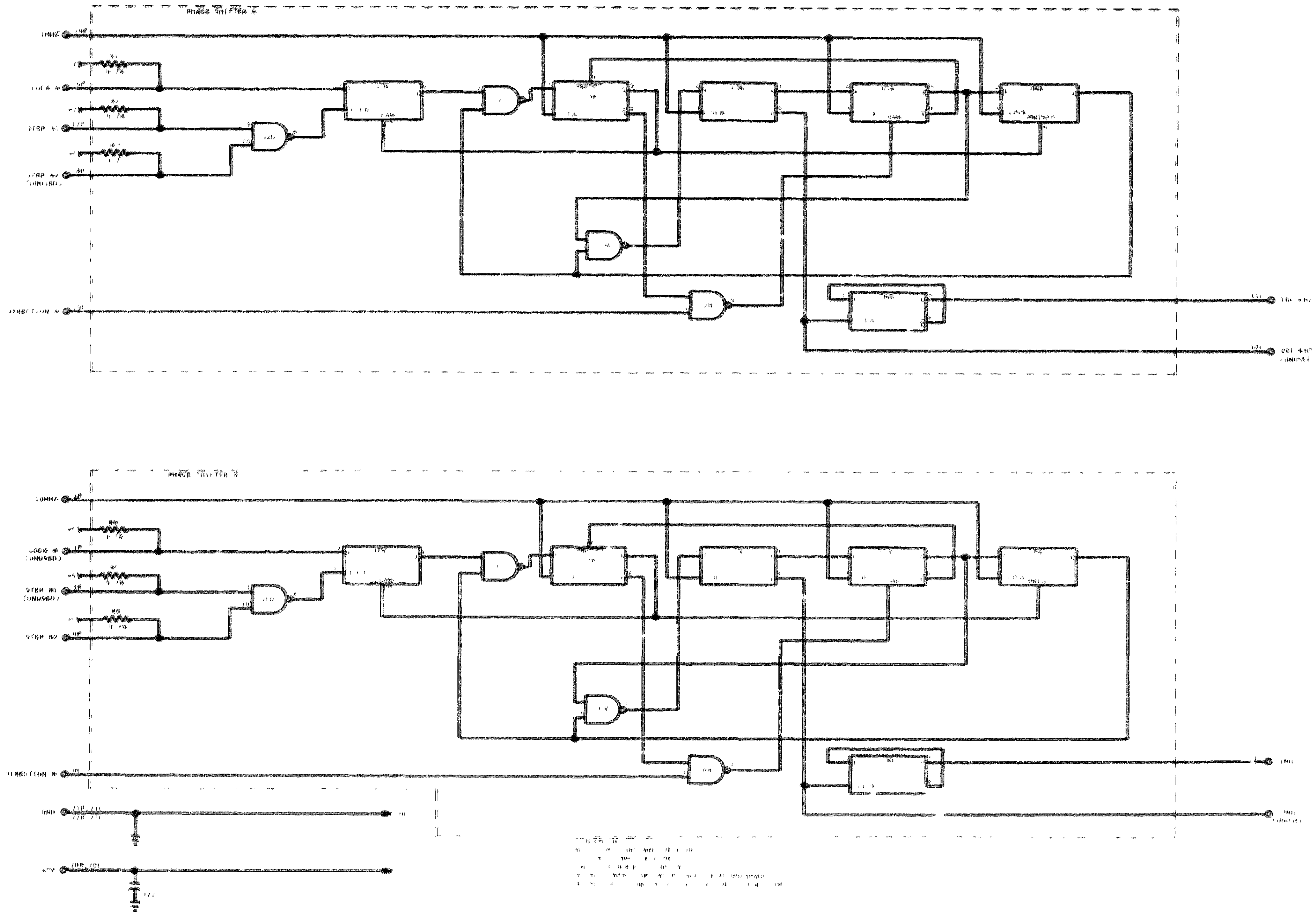


Figure. 6-23 Duel Phase Shifter, PCB No. A12, O-1632, Schematic

FO-61/(FO-62 Blank)

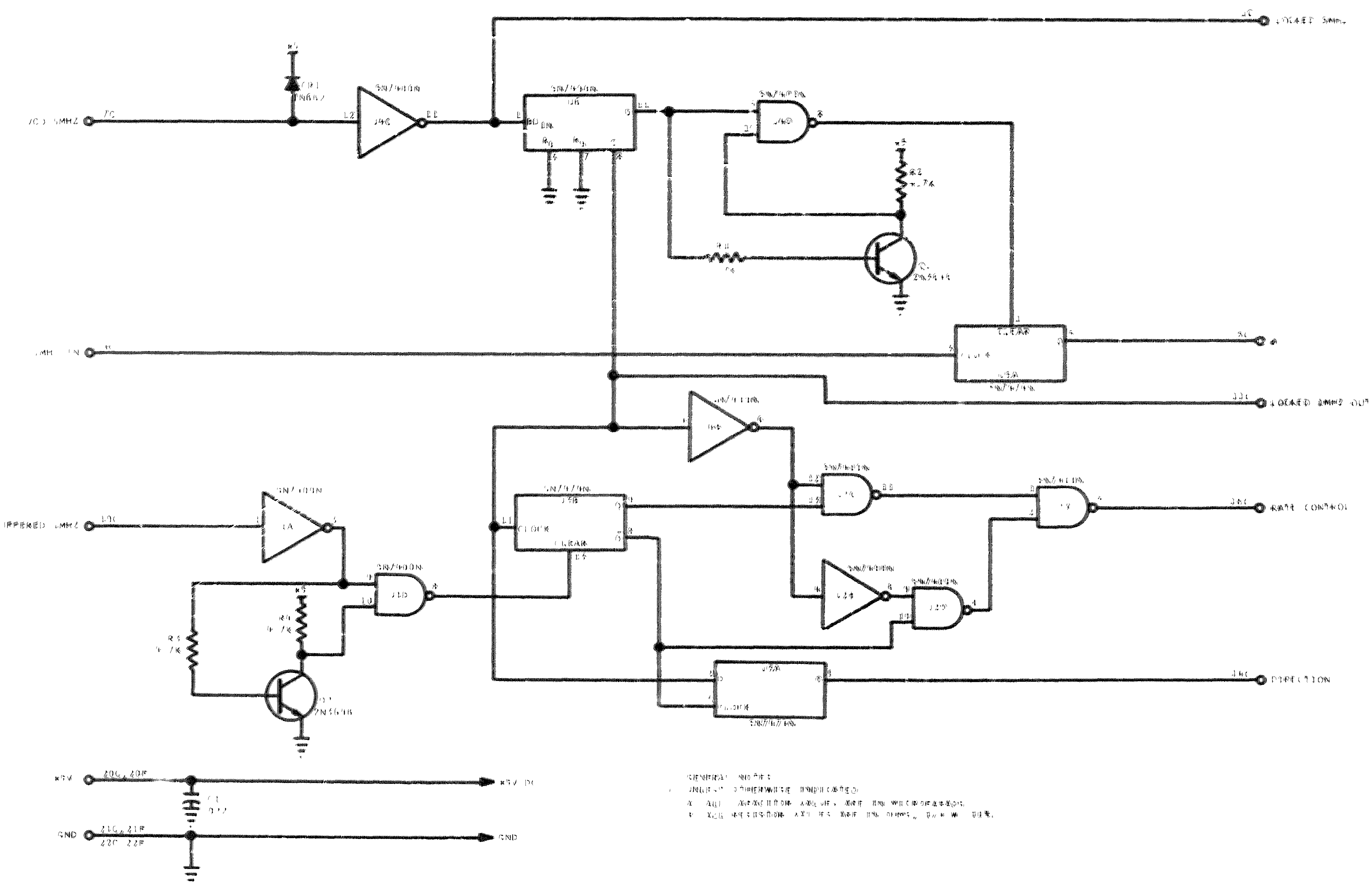
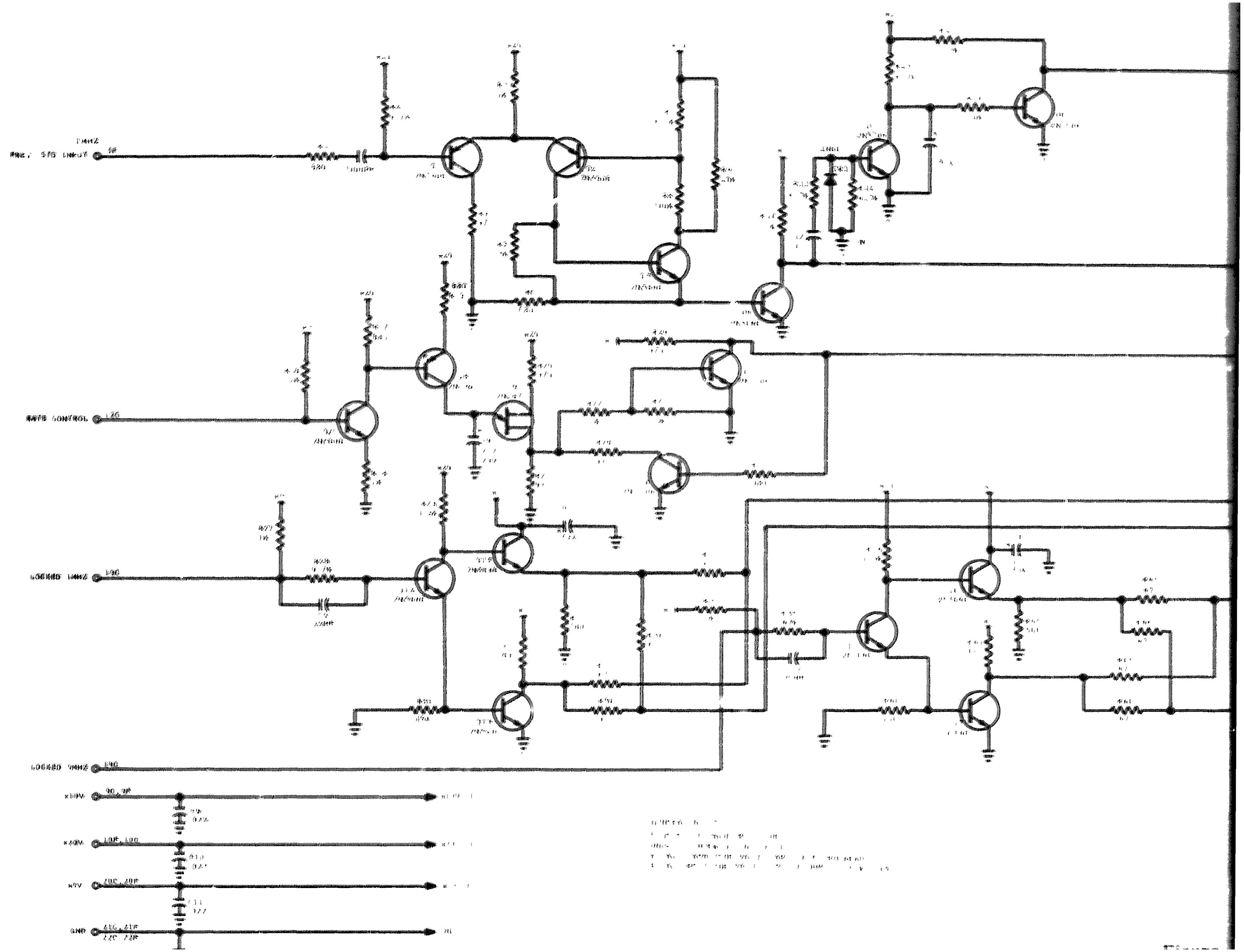


Figure. 6-24 Phase Detector, PCB No.
A13, O-1632, Schematic
FO-63/(FO-64 Blank)



1MHZ
RATE CONTROL
LOCKED 1MHZ
GND

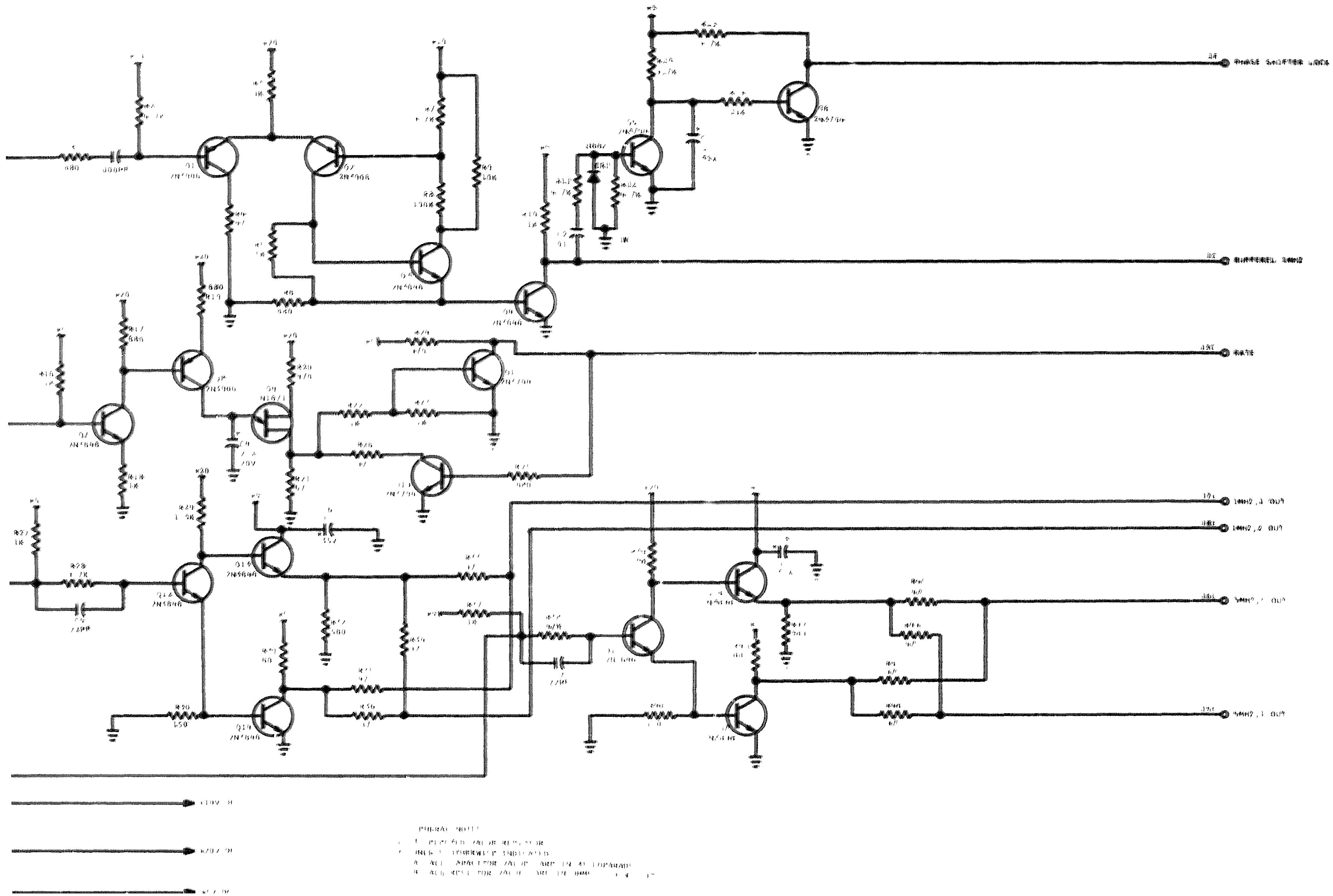


Figure. 6-25 Input/Output Buffers, PCB No. A14, O-1632, Schematic

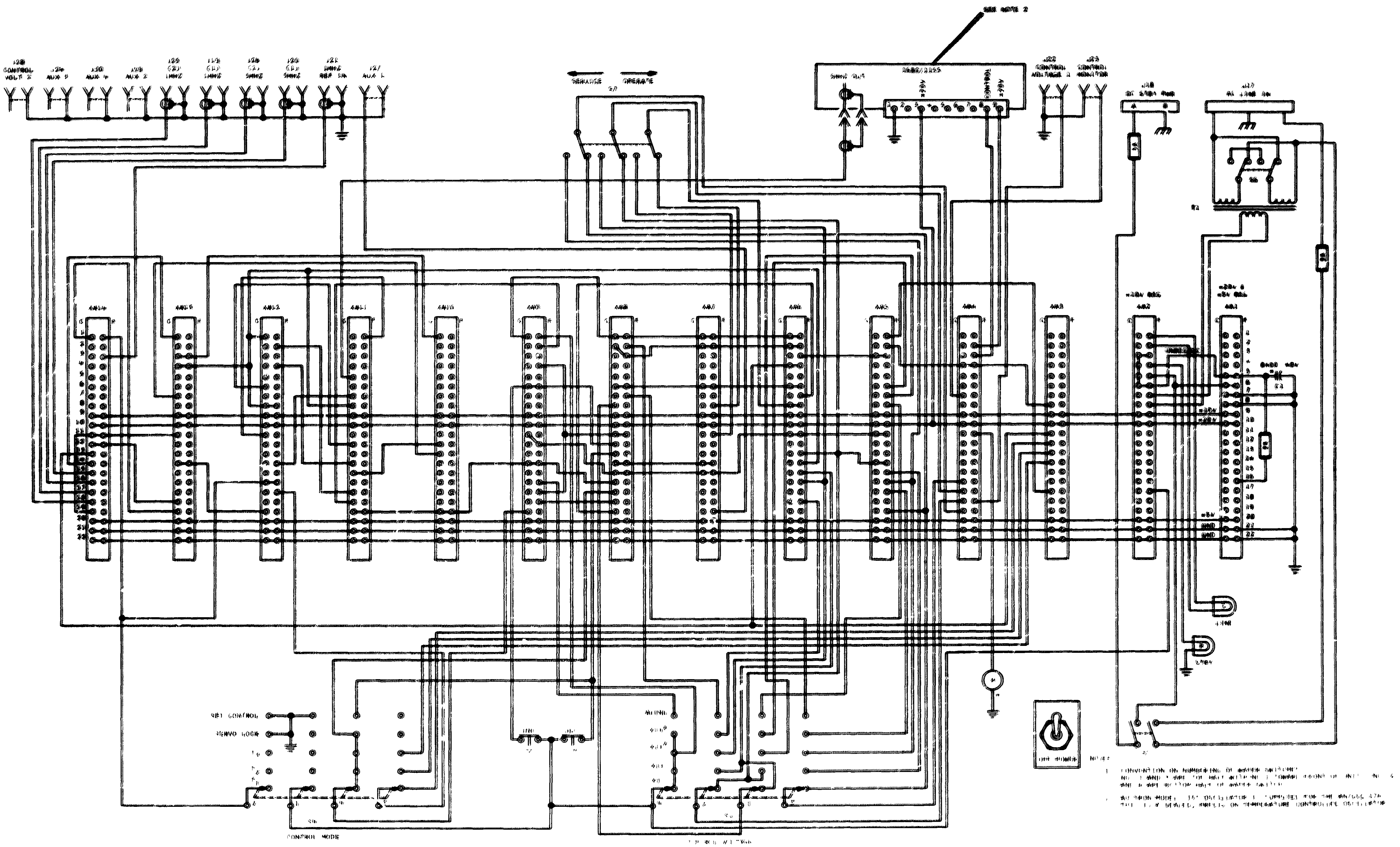


Figure 6-26. Schematic, Chassis O-1632

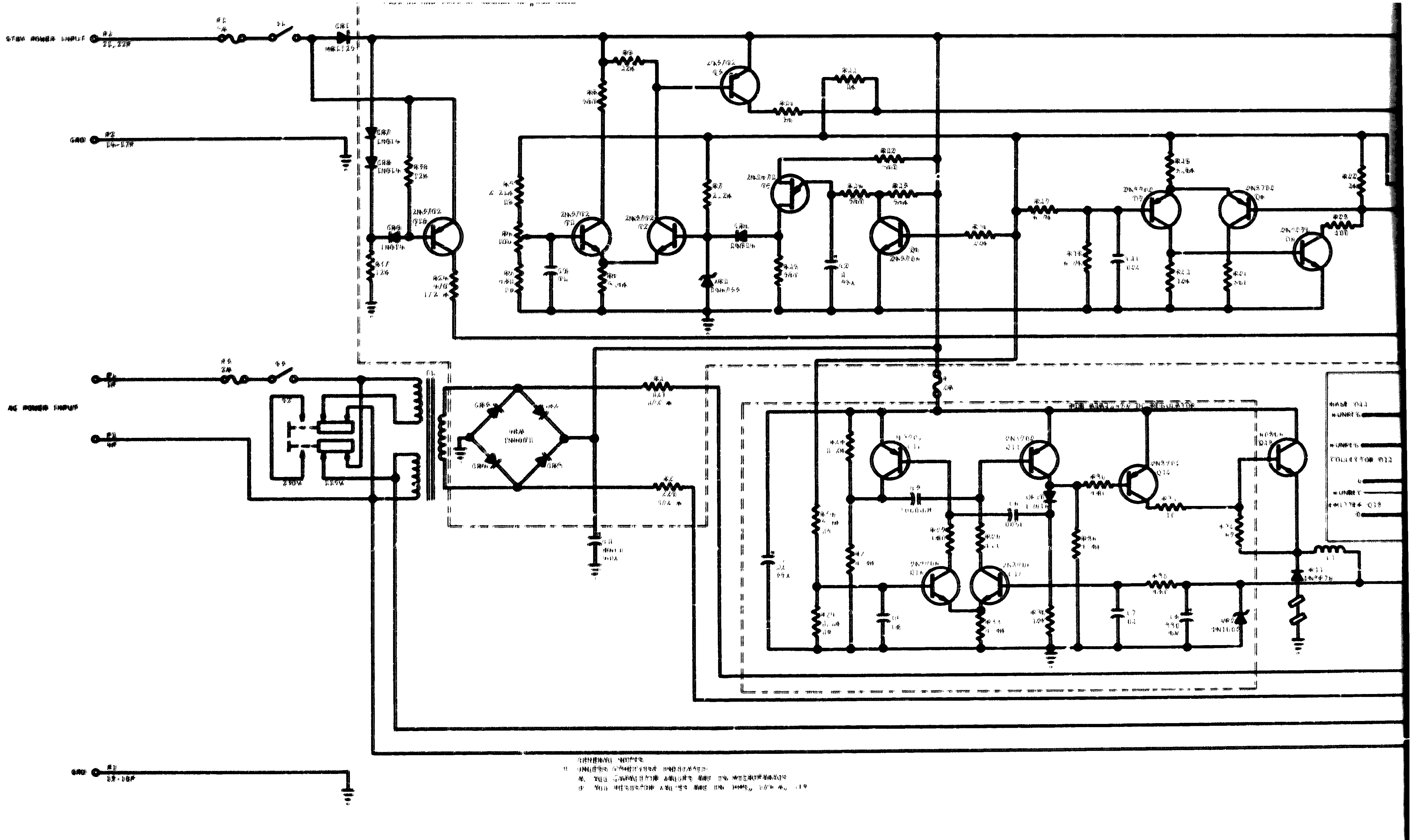


Figure. 6-27 Power Supply A1A1, A1A2

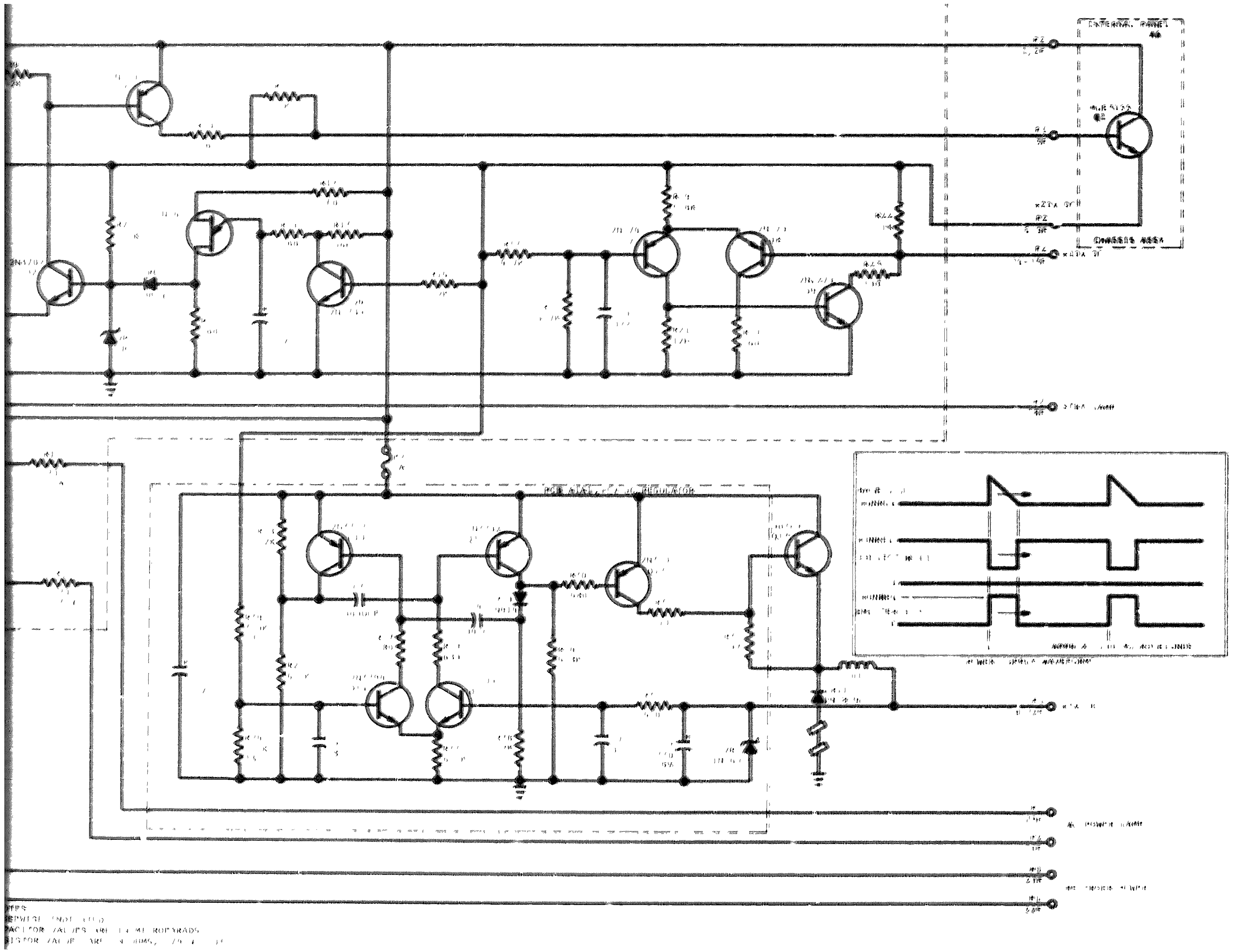


Figure. 6-27 Power Supply Assembly A1, PCB No. A1A1, A1A2, CV-2929, Schematic

FO-69/(FO-70 Blank)

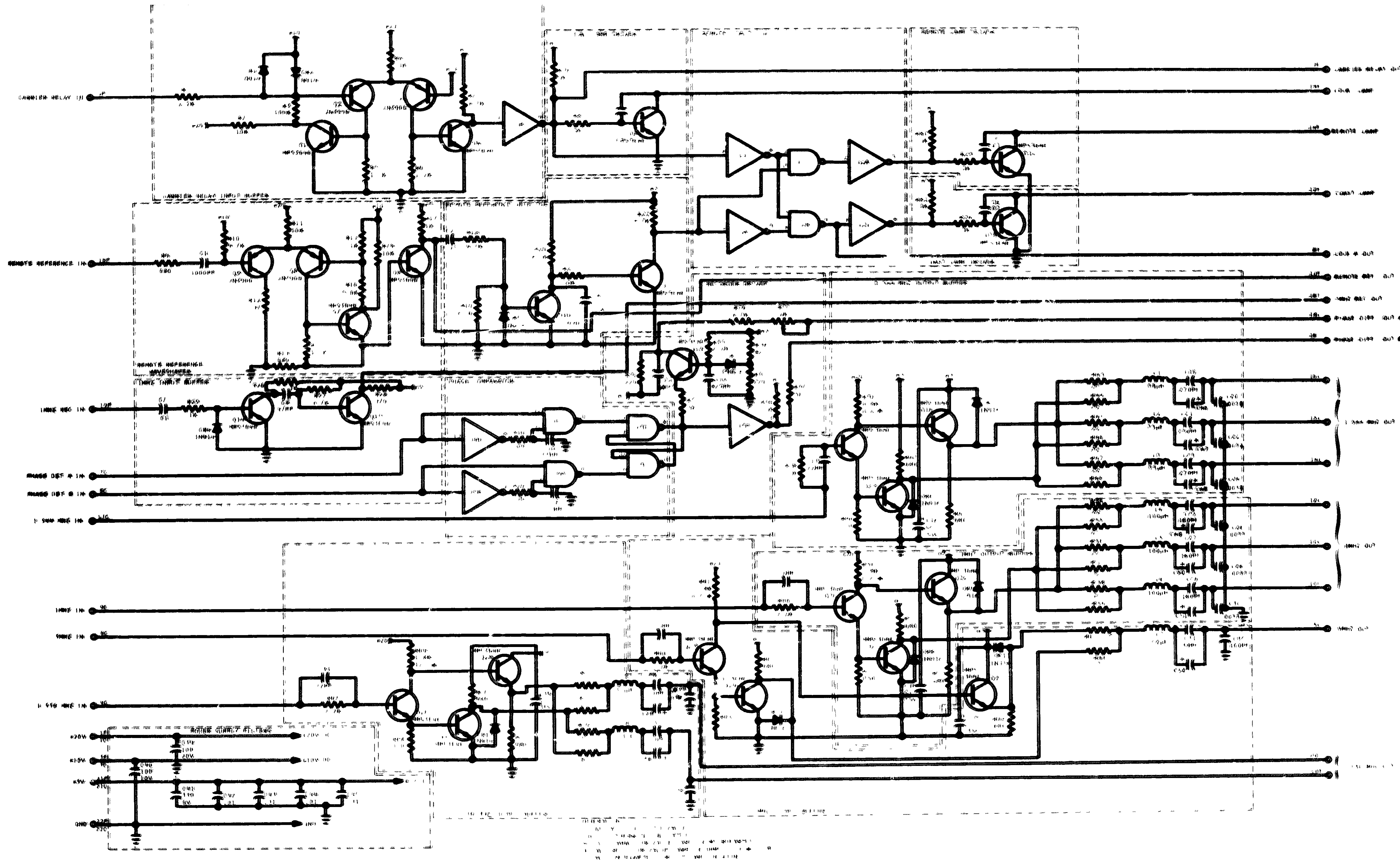


Figure. 6-28 System Reference Logic, PCB No. A2, CV-2929, Schematic

FO-71/)FO-72 Blank)

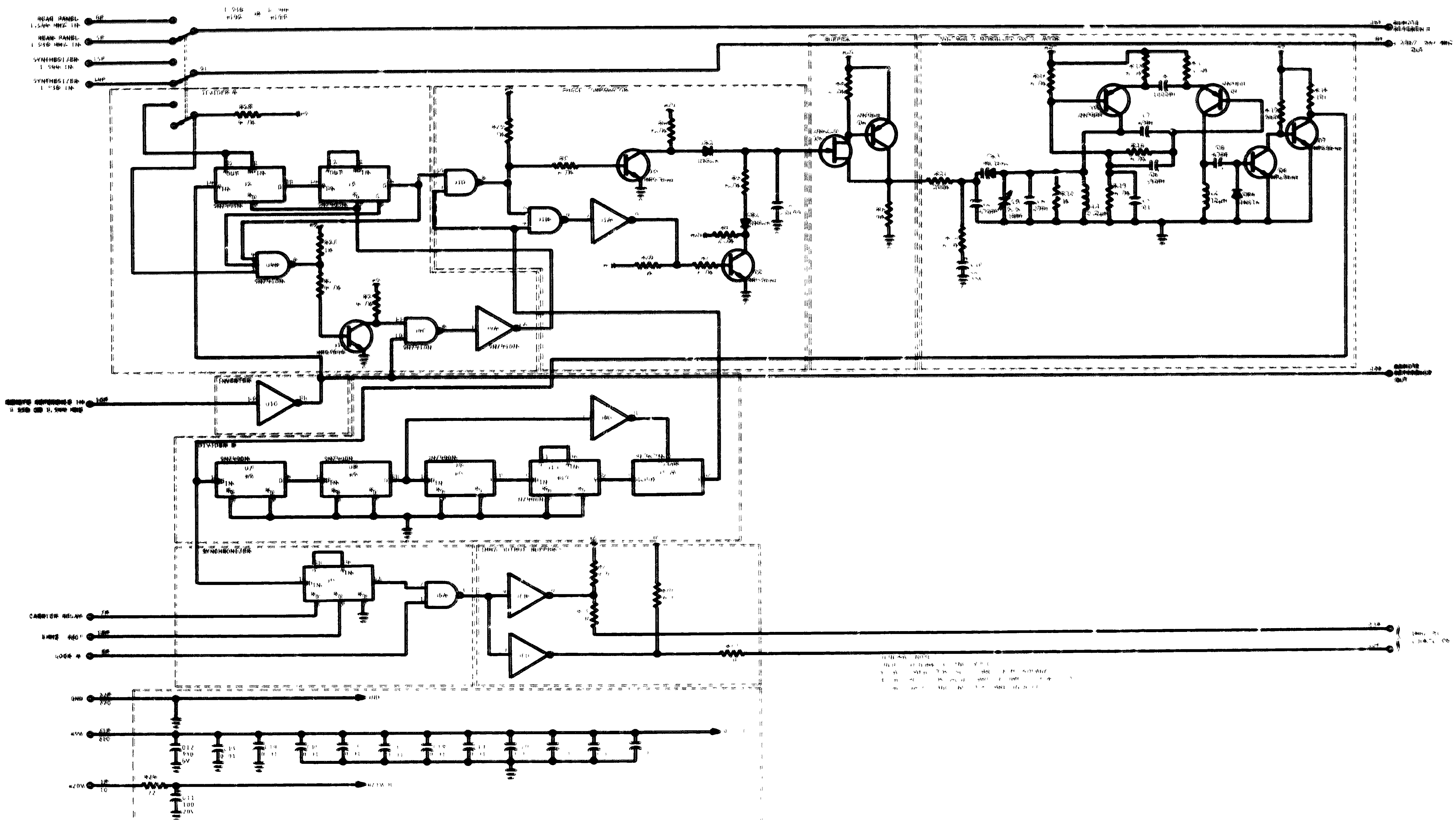


Figure. 6-29 1 MHz Synthesizer, PCB No. A3, CV-2929, Schematic

FO-73/(FO-74 Blank)

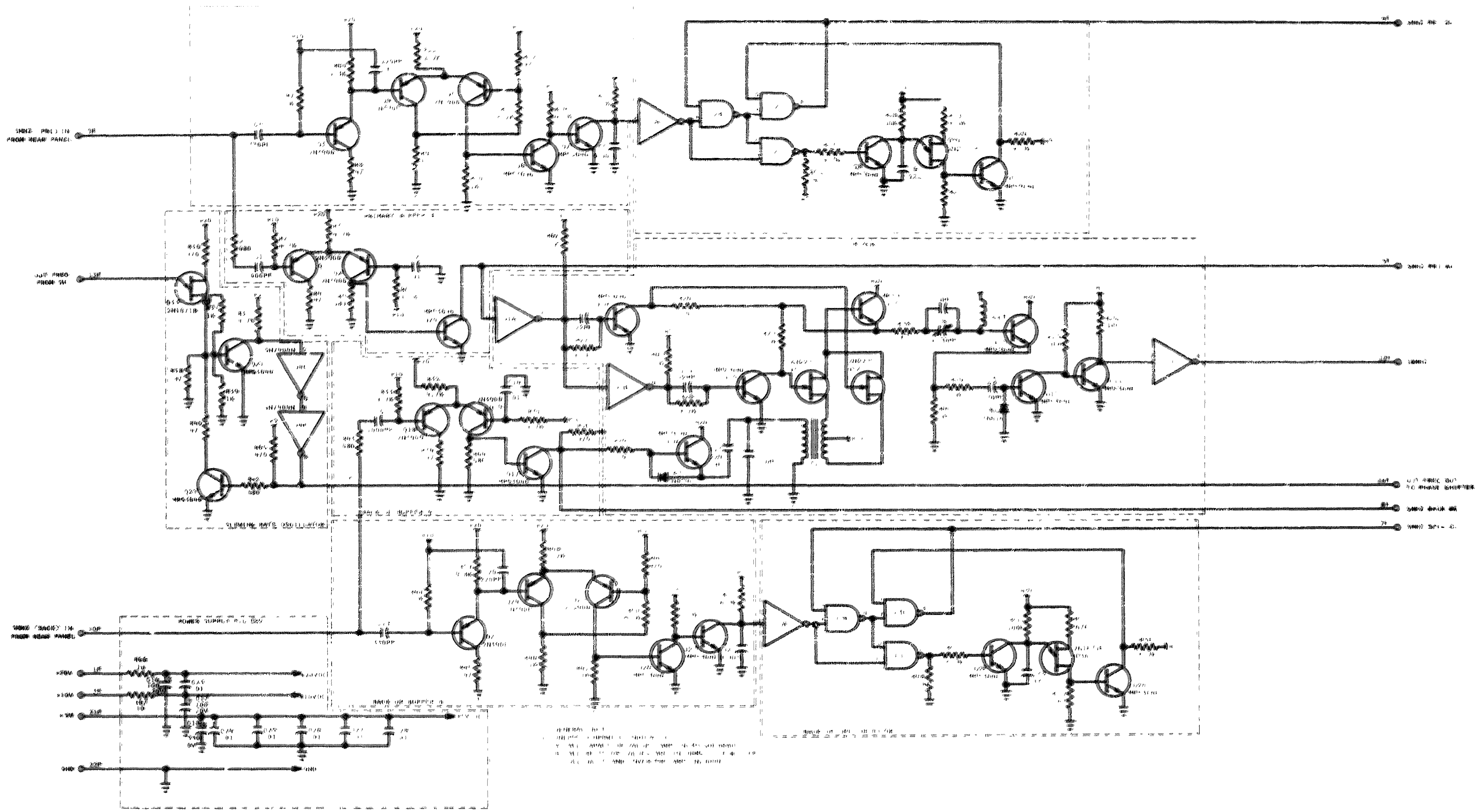


Figure 6-30. 5 MHz Amplitude Detectors, PCB No. A4, CV-2929, Schematic

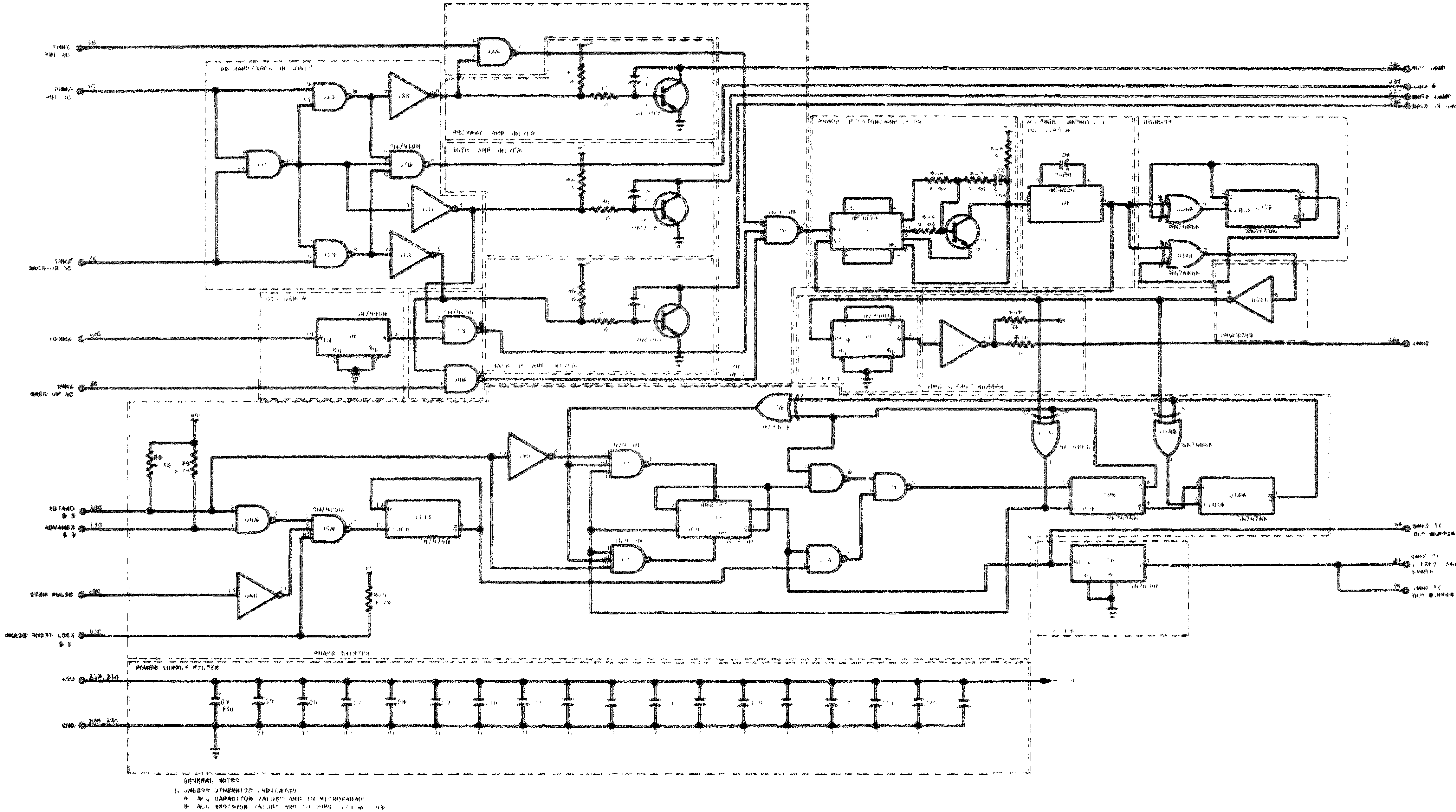


Figure. 6-31 Phase Shifter, PCB No. A5, CV-2929, Schematic

FO-77/(FO-78 Blank)

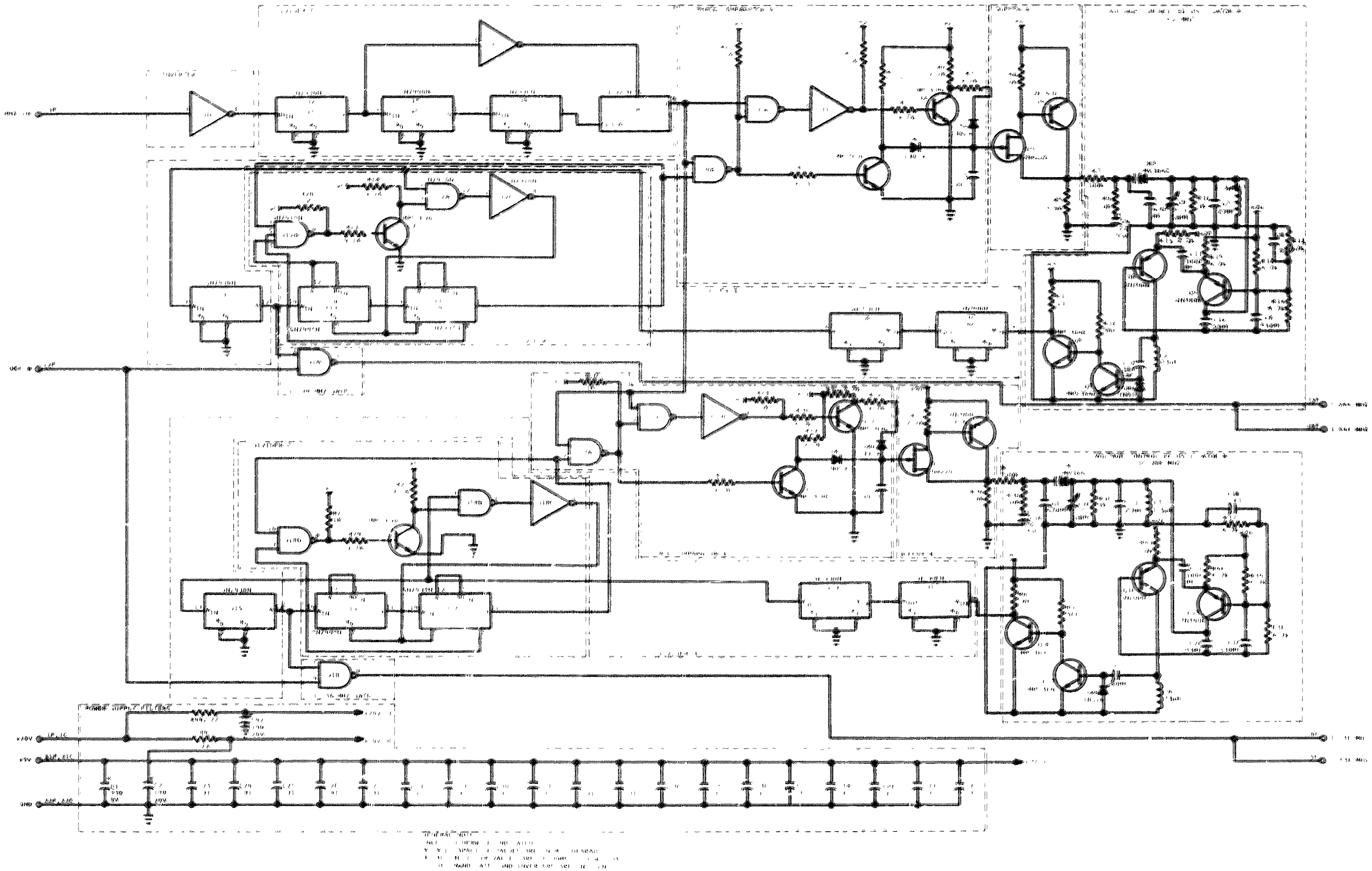


Figure. 6-32 1.53/1.544 MHz Sythesizer, PCB No. A6, CV-2929, Schematic

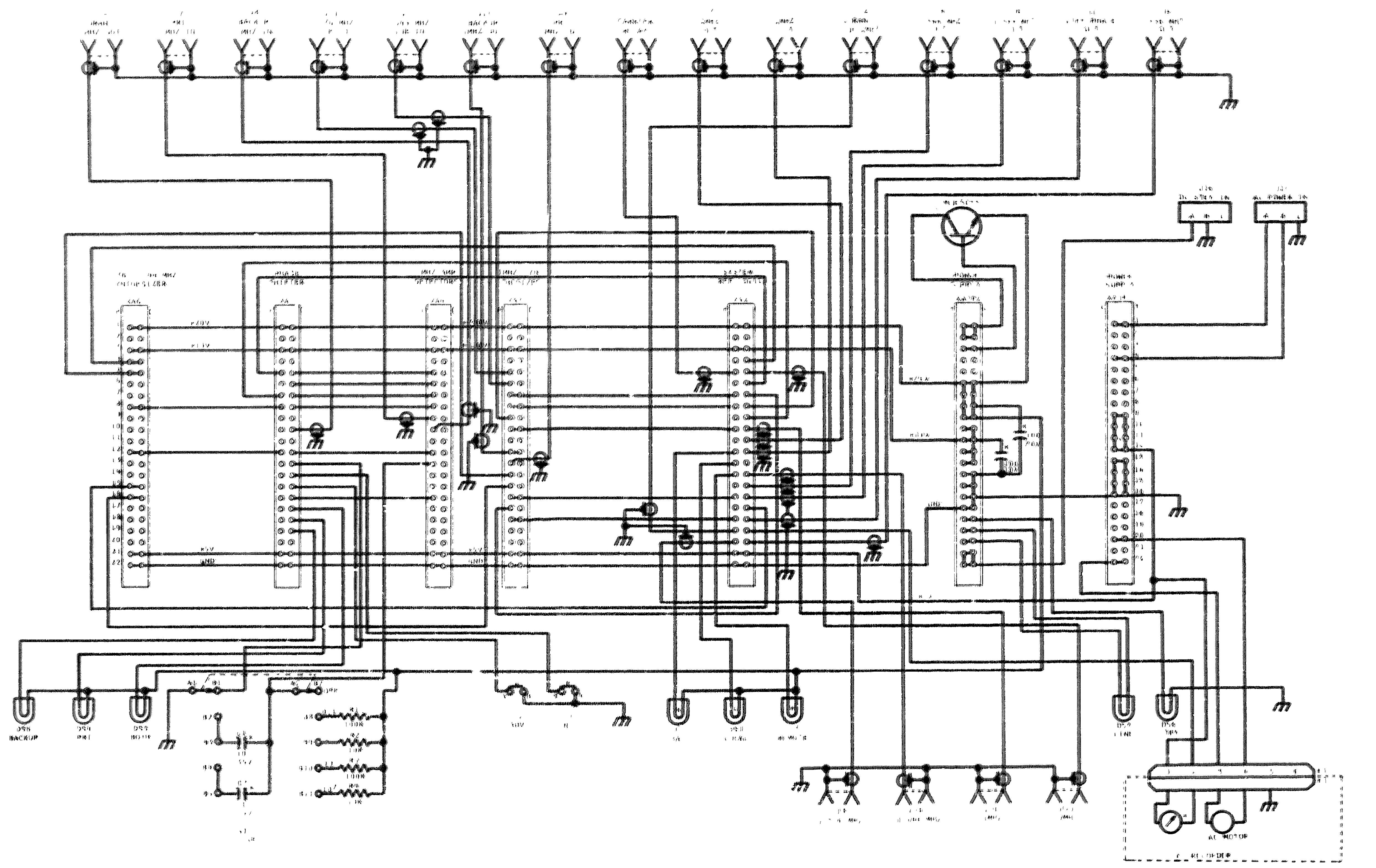


Figure. 6-33 Schematic, Chassis CV-2929

FO-81/(FO-82 Blank)

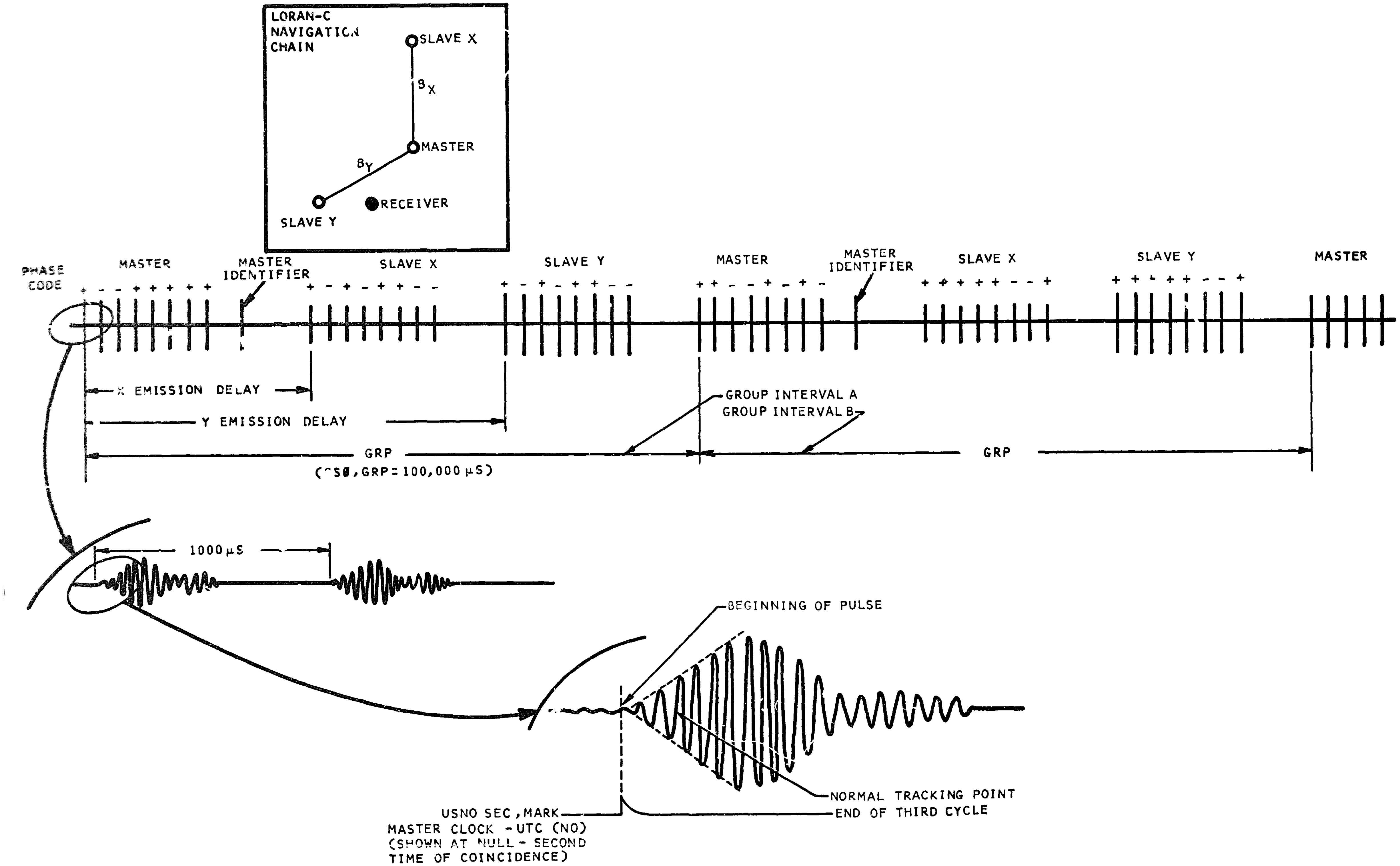


Figure. C-1 Timing of Loran-C Signals

FO-83/(FO-84 Blank)

TO.APR 74 S3-22658

END

9-18-83

DATE

DEPARTMENT OF THE ARMY
UNITED STATES OF AMERICA
1775

DEPARTMENT OF THE ARMY

MICROFORM
TEST TARGET

150 MM

1.0 mm (e= .81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

1.5 mm (e= 1.09 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

2.0 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

1.0 mm (e= .81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

1.5 mm (e= 1.09 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

2.0 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

200 MM

250 MM