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TECHNICAL MANUAL

for

REPEATER, GROUP TELEGRAPH AN/UGA-5

DEPARTMENT OF THE NAVY

NAVAL ELECTRONIC SYSTEMS COMMAND

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PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
Title Page ii to v 1-0 to 1-5/1-6 2-1 to 2-3/2-4		3-1 to 3-2 4-1 to 4-24 5-1 to 5-23/5-24 6-1 to 6-19/6-20	

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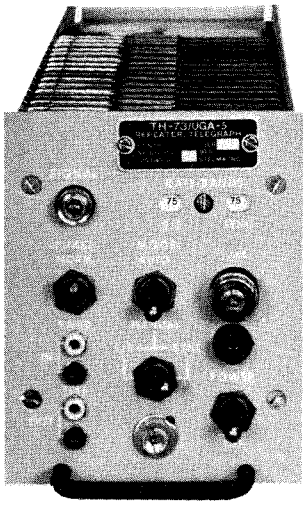
TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES



Repeater, Regenerative TH-73

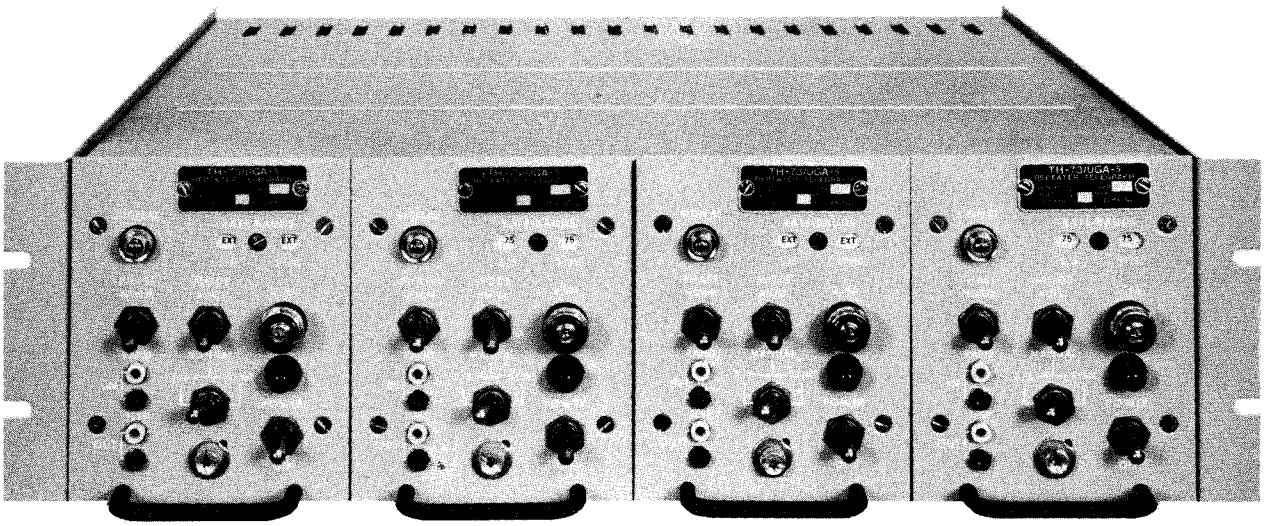


Figure 1-1. Repeater Group, Telegraph AN/UGA-5

SECTION 1

GENERAL INFORMATION

1-1. SCOPE.

This manual describes Regenerator Repeater Group, Telegraph AN/UGA-5 (see figure 1-1), hereafter referred to as AN/UGA-5, and provides the information required for its installation, operation, and maintenance. This Technical Manual is in effect upon receipt. Extracts from this publication may be made to facilitate preparation of other Department of Defense publications.

1-2. DESCRIPTION.

a. FUNCTIONAL.- The AN/UGA-5 provides facilities for (1) signal regeneration on four synchronous channels (at one of four modulation rates: 37.5 bauds, 61.1 bauds, 75 bauds, and 150 bauds) or on four start-stop channels (at one of three modulation rates: 45.5 bauds, 74.2 bauds, and 75 bauds). Although any code-level may be used for synchronous channels, start-stop operation allows use in systems employing only 5-, 6-, 7-, or 8-level codes. The AN/UGA-5 regenerates signals containing up to 45 per cent distortion and produces output signals that contain a maximum of up to 1 per cent distortion. The AN/UGA-5, which may be used on channels carrying synchronous and start-stop signals, automatically switches from one mode to the other according to the type of incoming signal.

(1) Since output signals are provided through an electronic relay, a supply battery is required locally or at the receiving station.

(2) The input and output circuits permit high-level keying (260-volt dc, 20- or 60-milliampere, neutral; or ±130-volt, 30-milliampere polar), as well as low-level keying (±6-volt polar) for compatibility with interface requirements of associated military standards (MIL-STD-188B).

(3) False-start protection prevents production of an output signal when noise-pulses up to 1/2-bit are developed on the line during character stop- and rest-Mark intervals.

(4) An automatic mode-control circuit detects the type of incoming data, and establishes the equipment's mode of operation accordingly so that output data is the same type as the input data.

(5) An automatic disconnect circuit inhibits the output and places a steady Mark on the line when an incoming synchronous signal is lost.

(6) Provision is made for on-line testing of each of the four channels.

b. PHYSICAL.- The AN/UGA-5 comprises four Regenerative Repeaters, Automatic TH-73/UGA-5 (hereafter referred to as TH-73) enclosed in a rack shelf adapter (see figure 1-1) that can be mounted in a 19-inch equipment rack or cabinet.

(1) Each TH-73 plugs into a separate receptacle (mounted on the inside at the rear of the rack shelf adapter), through which it receives all necessary inputs (power and signal); each receptacle is connected to a terminal strip mounted on the back of the rack shelf adapter, to which all external connections are made. Incoming power connections to the AN/UGA-5 are also made to a terminal strip on the rear of the rack shelf adapter.

(2) Test connections for in-line testing of each channel are provided on the front panel of each TH-73.

(3) All operator controls, and the fuse, are mounted on the front panel of the TH-73.

(4) Each TH-73 contains 17 plug-in assemblies. Assemblies A1 through A15 are printed-circuit cards, and A16 and A17 are sealed units. Table 1-1 enumerates the reference designations and distribution of PC assemblies employed.

TABLE 1-1. PRINTED-CIRCUIT CARD DISTRIBUTION

PRINTED-CIRCUIT ASSEMBLY DESIGNATION	MATING HARNESS-BOARD CONNECTOR DESIGNATION
A1	XA1
A2	XA2
A3	XA3
A4	XA4
A5	XA5
A6	XA6
A7	XA7
A8	XA8
A9	XA9
A10	XA10
A11	XA11
A12	XA12
A13	XA13
A14	XA14
A15	XA15

1-3. REFERENCE DATA.

The following reference data is applicable to each of the four TH-73 units mounted in the AN/UGA-5.

a. INPUT SIGNAL.

(1) Mode — Synchronous or start-stop; either type may be switch-selected or automatically selected as determined by front-panel Mode switch setting.

(2) Rate — Four internal combinations. (Rates are selected by setting of switch accessible through hole in front panel (screwdriver adjustment); corresponding baud-rates are automatically selected by mode (start-stop or synchronous) of received data-signal.)

37.5-baud synchronous, 45.5-baud start-stop (60 words per minute, nominal).

61.1-baud synchronous, 74.2-baud start-stop (100 words per minute, nominal).

Combination 75-baud synchronous and 75-baud start-stop.

150-baud synchronous.

(If required, other rates and/or more precise timing may be obtained from an external source.)

(3) Code (strap-selectable) — 5-, 6-, 7-, or 8-level (7-, 8-, 9-, 10-, or 11-unit) start-stop code; any unit-interval synchronous code.

(4) Type (strap-selectable) — High-level 260-volt dc neutral, or ±130-volt polar; low-level ±6 volts (per MIL-STD-188B).

(5) Current (strap-selectable) — Input loop dc-isolated from ground. High-level, 20- or 60-milliampere neutral. (90 milliampere maximum at the high level input.)

(6) Distortion	45 per cent total Marking or Spacing distortion.
(7) Impedance	100 ohms nominal for 60-milliampere (ma) operation and 300 ohms nominal for 20ma operation, which are provided by internal strapping.
(8) Sensitivity	Input signal variation of 2ma above or below the average current.
b. OUTPUT SIGNAL.	
(1) Type	High-level 260-volt dc neutral or 130-volt dc polar; low level ±6 volts (per MIL-STD-188B).
(2) Current	Output loop dc-isolated from ground. High-level, 20- or 60-ma neutral or polar; 100ma maximum (continuous duty).
(3) Distortion	Less than 1 per cent at maximum keying rate.
(4) Impedance	Less than 200 ohms when the output is in the Marking or closed circuit condition.
c. TIMING.	
(1) Internal	Oscillator-supplied frequencies of 76.8kc, 93.237kc, 125.217kc, or 152.016kc.
(2) External	MIL-STD-188B input required. Frequency must be 256 times bit-rate. For example: bit-rate = 150 baud, frequency of external oscillator must be 38.4kc.
(3) Send and Receive equipment	Synchronization of equipment clocks at send and receive points is mantained for a period up to 30 minutes, with up to three TH-73 units connected in tandem between the send and receive ends of a communications link, after the input data is removed and reconnected within the 30-minute period.
d. SYNCHRONIZATION.	
(1) Correction increment	1 part in 128 of bit.
(2) Timing	128 times bit-timing derived from internal clock.
e. MODES OF OPERATION.	Automatically switches to regenerate start-stop signals on detection of: (a) long Mark (1-second duration or longer); (b) start-stop data-pattern within 50 characters; (c) detection of start-stop rate selected.
(1) Automatic	Automatically switches to regenerate synchronous data-signals on detection of absence of start-stop signals (distinguished by missing Mark rest-pulse segments).
(2) Manual	Regenerates either synchronous or start-stop signals (separate switch selects synchronous or start-stop mode, when in the manual Mode select switch position).
f. MARK-HOLD OPTION (Strap-Selectable) start-stop operation only.	When connected by strapping, a Mark is produced at the end of each character and maintained for the duration of the stop-Mark interval, regardless of the input signal during that time.
g. FALSE-START PREVENTION (start-stop operation only).	Prevents start of operation when noise-pulses up to 1/2-baud in duration are developed on the line.
h. NOISE-SWITCHING THRESHOLD (strap-selectable).	Determines level of noise switching.
i. RADIO FREQUENCY INTERFERENCE (RFI) SUPPRESSION.	Meets all limits specified in MIL-I-16910A. In addition, the radiated interference level does

not exceed 1 microvolt per meter per kilocycle of bandwidth (measured at a distance of 3 feet in all directions), nor does the conducted interference level exceed 1 microvolt per kilocycle of bandwidth over the range of frequencies specified in MIL-I-16910A.

j. POWER REQUIREMENTS. 120 volts ±10 per cent at 50 or 60 cycles per second ±5 per cent, 20 watts.

k. OPERATING TEMPERATURE RANGE. 0 to 50 degrees centigrade.

l. DIMENSIONS. 5-1/4 high, 4-1/4 wide, and 20 inches deep. (Four units mounted abreast in 19-inch rack shelf adapter.)

m. WEIGHT. 8 pounds (AN/UGA-5, 41 pounds).

1-4. EQUIPMENT SUPPLIED.

Table 1-2 lists equipment supplied as Repeater Group, Telegraph AN/UGA-5.

TABLE 1-2. EQUIPMENT SUPPLIED

QTY PER EQUIP.	NOMENCLATURE		COMMON NAME	OVER-ALL (DIM. (IN.)	VOLUME (CU FT)	WEIGHT (LB)
	NAME	DESIGNATION				
1	Repeater Group, Telegraph	AN/UGA-5	AN/UGA-5	5-1/4 high 4-1/4 wide 20 deep	0.32	41
	Technical Manual for Repeater Group, Telegraph AN/UGA-5	NAVSHIPS 0967-204-3010	-	11 high 8-1/2 wide 3/4 thick		

1-5. EQUIPMENT, MATERIALS, AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED.

Table 1-3 lists equipment, materials and publications required but not supplied as a part of the AN/UGA-5.

TABLE 1-3. EQUIPMENT, MATERIALS, AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QTY PER EQUIP	NOMENCLATURE		REQUIRED USE
	NAME	DESIGNATION	
1	Oscilloscope	AN/USM-105A	Trouble shooting and maintenance
1	Electronic Multimeter	AN/USM-116	Trouble shooting and maintenance
1	Multimeter	AN/PSM-4(C)	Trouble shooting and maintenance
1	Frequency Counter	AN/USM-207	Testing and adjustment procedures
1	Transistor Test Set	AN/USM-206	Trouble shooting and maintenance

TABLE 1-3. EQUIPMENT, MATERIALS, AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED (CONT'D)

QTY PER EQUIP	NOMENCLATURE		REQUIRED USE
	NAME	DESIGNATION	
2	Power Resistor	2000 ohms, 10 watts	Current limiting for 20-ma loop operation and testing
1	Test Set, Telegraph	AN/GGM-1	Testing and adjustment
1	130-Volt Polar Loop Supply	PP-351	Maintenance
1	Technical Manual for Electronic Multimeter AN/USM-116	Navships 0280-667-7005	
1	Technical Manual for Multimeter AN/PSM-4(C)	Navships 92051	
1	Technical Manual for Oscilloscope AN/USM-105A	Navships 93658A	
1	Technical Manual for Frequency Counter AN/USM-207	TM11-2698*	
1	Technical Manual for Transistor Test Set AN/USM-206	Navships 0969-002-7011,7020	
1	Technical Manual for Test Set, Telegraph AN/GGM-1	Navships 94244	

*Dept. of the Army Technical Manual

SECTION 2

INSTALLATION

2-1. UNPACKING AND HANDLING.

Exercise normal care when unpacking the contents of the shipping case. Inspect the equipment for evidence of any damage incurred in shipment and handling.

2-2. INSTALLATION PROCEDURES.

a. SITING AND INSTALLATION.- The AN/UGA-5 must be located in an area accessible to operating personnel and where 115-volt ac power is available.

(1) Provide a mounting facility that accommodates the physical dimensions of the AN/UGA-5.

(2) Set the AN/UGA-5 into the mounting facility, and secure the unit in position.

b. CONNECTIONS.- Make all required signal and power connections at the rear of the unit, as indicated in figure 2-1. Incoming power connections are made to terminal board TB5; external timing connections to the respective units are made at terminal boards TB1 through TB5.

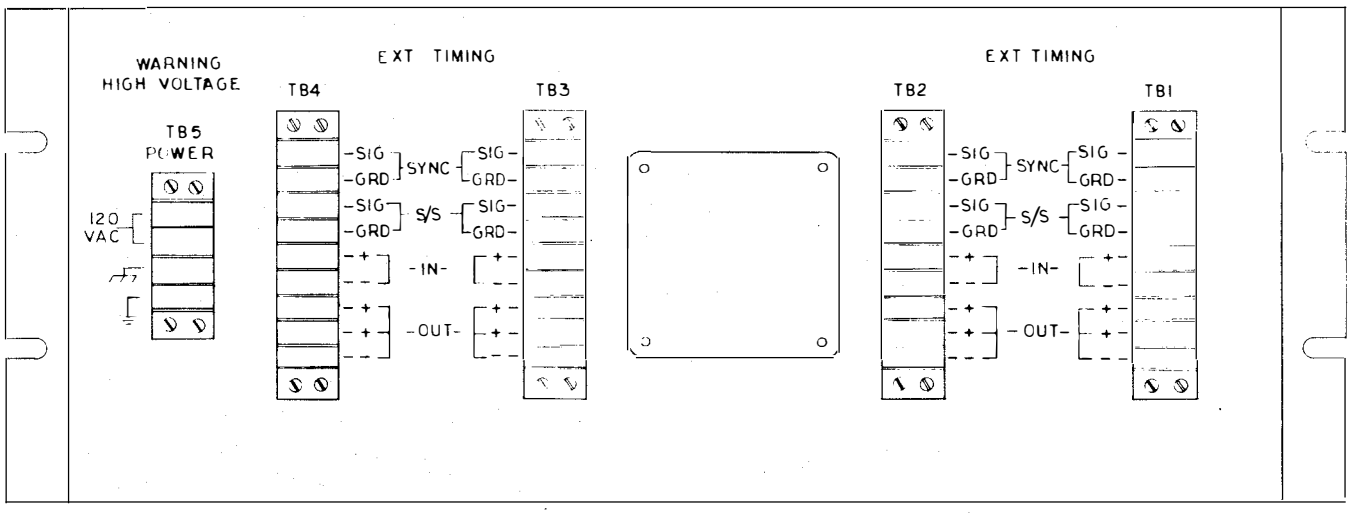


Figure 2-1. AN/UGA-5, Rear View

c. STRAPPING OPTIONS.

(1) INPUT SIGNAL.- Before operating the AN/UGA-5, strap for the input signal to each TH-73 as described below.

(a) Obtain access to the bottom of the TH-73 by unscrewing the chassis lock-screw (located in the center at the bottom of the front panel) and sliding the unit out of the rack shelf adapter.

(b) Locate the strapping terminals on the bottom of the chassis (see figure 2-2).

(c) Select the terminals for the desired operating loop conditions, and strap as follows:

1 For 20-ma loops, connect and solder terminal E3 to E4.

2 For 60-ma loops, connect and solder terminal E4 to E5.

3 For neutral loops, leave terminals E1 and E2 open.

4 For polar loop and low-level (±6V) signal, connect and solder terminal E1 to E2.

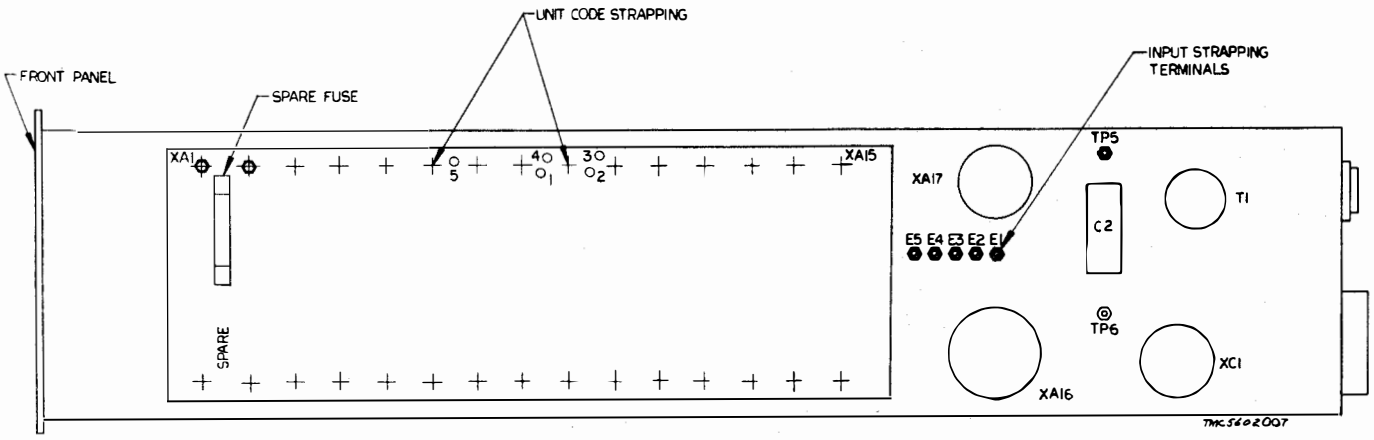


Figure 2-2. TH-73, Bottom View

(2) MARK-HOLD.- To include the Mark-hold provision, strap terminals 2 and 3 (see figure 2-3). When the Mark-hold is not desired, strap terminals 1 and 2.

(3) UNIT CODE.- Select the desired unit code, and strap as indicated below, using figure 2-2 as guide.

(a) For 5-unit code, connect and solder terminal 1 to 2, and terminal 4 to 5.
(b) For 6-unit code, connect and solder terminal 1 to 3, and terminal 4 to 5.
(c) For 7-unit code, connect and solder terminal 4 to 2, and terminal 1 to 5.
(d) For 8-unit code, connect and solder terminal 4 to 3, and terminal 1 to 5.

(4) NOISE SWITCHING SENSITIVITY.- To provide a decrease in the probability of noise-pulses switching the equipment's mode of operation from synchronous to start-stop, strap terminal 1 to 2 on printed-circuit card A11 (see figure 2-4). When noise will not interfere with switching (on lines employing start-stop signals only or on low noise lines), strap terminal 2 to 3.

2-3. INITIAL CHECKS.

a. Before power is applied to the AN/UGA-5, check that the proper fuses are installed in the fuseholders on the front panels. Assure that all printed-circuit cards are securely seated in their respective harness-board receptacles. Check that all rear connections are properly installed, observing correct signal polarity.

b. After power is applied:

(1) Check that POWER indicator lamp lights.
(2) With signal applied, check that SIGNAL indicator lamp reacts appropriately.

Note

If proper indications are not obtained, refer to Section 4.

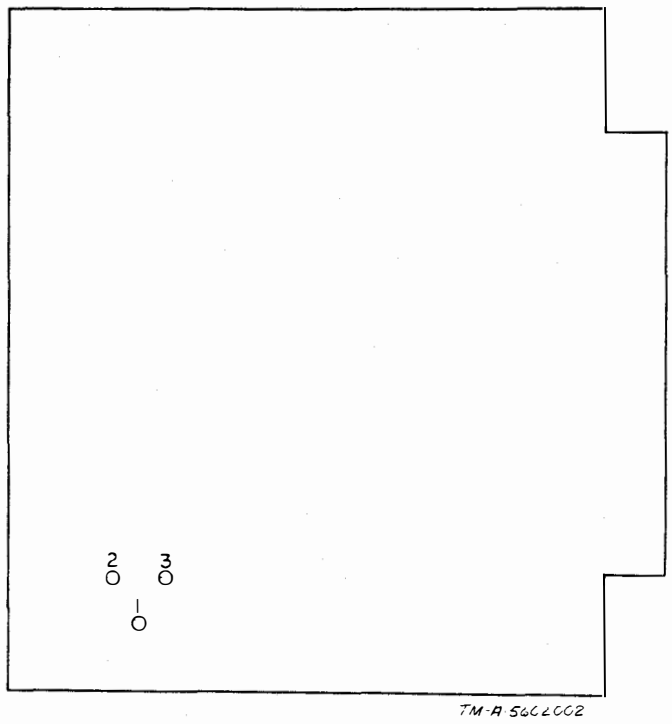


Figure 2-3. Mark-hold Strapping On Printed Circuit Card A9

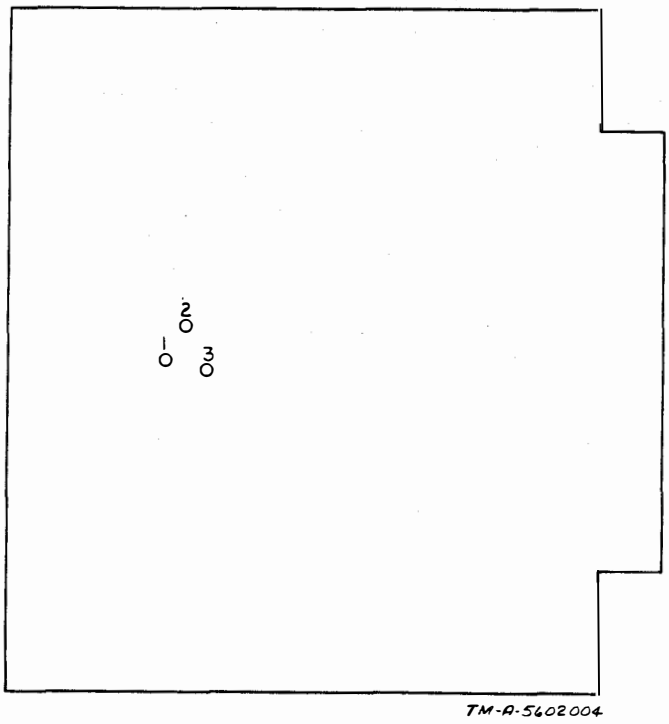


Figure 2-4. Noise Switching Level Strapping On Printed Circuit Card A11

SECTION 3

OPERATION

3-1. PREPARATION FOR USE.

After the AN/UGA-5 is set up for operation in accordance with Section 2 of this manual, no further preparation or setup procedures are required except when an external timing source (oscillator) is to be used to obtain the upper range of output bit-rates. Connection of this external oscillator is effected by connecting to the EXT TIMING IN terminals at the rear of the rack shelf adapter (see figure 2-1).

3-2. OPERATING PROCEDURES.

a. DESCRIPTION OF CONTROLS.- Table 3-1 lists TH-73 operating controls and indicators (see figure 3-1) and provide descriptive and functional information for each.

TABLE 3-1. CONTROLS, INDICATORS, AND JACKS

PANEL IDENTIFICATION	DESCRIPTION	FUNCTION
SIGNAL	Indicator lamp, yellow	Lights when input signal is in a Mark condition; flashes during normal traffic.
RATE, BAUDS	5-position rotary switch, screwdriver turn	When set to 60wpm (37.5-45.5), 100 wpm (61.1-74.2), 75 - 75 baud, or 150 baud, the TH-73 accepts start-stop or synchronous signals at the designated rate. (When set to EXT, other rates may be obtained from an external timing source.)
MODE	2-position toggle switch	When set to: (1) AUTO, TH-73 regenerates start-stop or synchronous signals automatically. (2) MANUAL, the MANUAL switch (listed below) is enabled.
MANUAL	2-position toggle switch	Operative when MODE switch is set to MANUAL. When MANUAL switch is set to: (1) S/S, TH-73 regenerates only start-stop signals. (2) SYNC, TH-73 regenerates only synchronous signals.
PHASE	2-position toggle switch	Sets the time for bit-synchronization (synchronous mode only). When set to: (1) NORM, causes TH-73 to be within 10 per cent of ideal synchronization by the time

TABLE 3-1. CONTROLS, INDICATORS, AND JACKS (Cont'd)

PANEL IDENTIFICATION	DESCRIPTION	FUNCTION
		approximately 1000 M/S transitions have been received at the input. (2) RAPID, causes TH-73 to be within 2 per cent of ideal synchronization by the time approximately 64 M/S transitions have been received at the input. (These are the specification values for normal and rapid times for bit synchronization. Corresponding factory tested values are 64 and 56, respectively.)
IN	Test jacks, white and black	Permit oscilloscope connection, to check input signal.
OUT	Test jack, white and black	Permit oscilloscope connection, to check regenerated output signal.
POWER	2-position toggle switch	Controls application of ac power to the repeater.
	Indicator lamp, red	Lights when ac power is applied to the repeater.
3/4 AMP	Fuse	AC line fuse indicator-type: red button indicates blown fuse.

b. SEQUENCE OF OPERATION.- Set front-panel controls to the desired mode of operation, apply power, and check that POWER lamp lights. Operation from this point on is automatic unless the manual mode of operation is in effect (i.e., MODE switch set to MANUAL), in which case the MANUAL switch must be set to the position appropriate for the type of incoming signal.

c. OPERATOR'S MAINTENANCE.

(1) PREVENTIVE MAINTENANCE.- Refer to Section 5 of this manual for preventive maintenance information.

(2) EMERGENCY MAINTENANCE.- In the event the AN/UGA-5 fails when continued operation is of paramount importance, the operator may resort to the following emergency procedure to attempt to restore operation:

(a) Check that POWER indicators on all TH-73 units light. If all of them are out, check for 115 volts at the appropriate terminals on terminal board TB5 at rear of rack shelf adapter (see figure 2-1); if voltage is not present, check power source. If correct voltage is present, check front-panel fuse. If fuses are good, proceed to step (d), below.

(b) Check for SIGNAL lamp indication when signal is applied. If correct indication is not obtained, use multimeter or oscilloscope to check for signal at signal IN test points on front panel. If no signal is present, replace assembly A16. If signal is present, proceed to step (d), below.

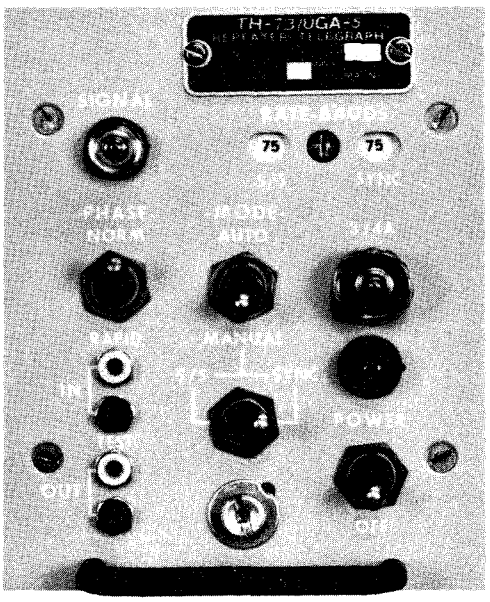


Figure 3-1. TH-73, Front Panel

(c) Check for signal at front-panel signal OUT test-points. If signal is present, replace assembly A17.

(d) If the above procedures have failed to restore the TH-73 to operating condition, refer the unit to a maintenance technician.

SECTION 4

TROUBLE SHOOTING

4-1. LOGICAL TROUBLE SHOOTING.

This section contains information to aid in quickly and efficiently determining the cause of equipment malfunction. The information is given in order of over-all trouble shooting technique, operational data (functional and logical), and trouble shooting data.

a. SYMPTOM RECOGNITION.- This is the first step in the trouble shooting procedure and is based on a complete knowledge and understanding of equipment operating characteristics. All equipment troubles are not necessarily the direct result of component failure. Therefore, a trouble in an equipment is not always easy to recognize since all conditions of less than peak performance are not always apparent. This type of equipment trouble is usually discovered while accomplishing preventive maintenance procedures. It is important that the "not so apparent" troubles, as well as the apparent troubles, be recognized.

b. SYMPTOM ELABORATION.- After an equipment trouble has been "recognized," all the available aids designed into the equipment should be used to elaborate, further, on the original trouble symptom. Use of front-panel controls and other built-in indicating or testing aids should provide better identification of the original trouble symptoms. Also, checking or otherwise manipulating the operating controls may eliminate the trouble.

c. LISTING PROBABLE FAULTY FUNCTION.- The next step in logical trouble shooting is to formulate a number of "logical choices" as to the cause and likely location (functional section) of the trouble. The "logical choices" are mental decisions which are based on knowledge of the equipment operation, a full identification of the trouble symptom, and information contained in this manual. The over-all functional description and its associated block diagram should be referred to when selecting possible faulty functional sections.

d. LOCALIZING THE FAULTY FUNCTION.- For the greatest efficiency in localizing trouble, the functional sections which have been selected by the "logical choice" method should be tested in an order that will require the least time. This requires a mental selection to determine which section to test first. The selection should be based on a further extension of the "logical choice" method. If the tests do not prove that functional section to be at fault, the next section should be tested, and so on until the faulty functional section is located. As aids in this process, this manual contains a functional description and a servicing block diagram for each functional section. Waveforms are included at significant check points on servicing block diagrams to aid in isolating the faulty section. Also, where applicable, test data (such as information on control settings, critical adjustments, and requires test equipment) are supplied to augment the functional description and servicing block diagram for each functional section.

e. LOCALIZING TROUBLE TO THE CIRCUIT.- After the faulty functional section has been isolated, it is often necessary to make additional "logical choices" as to which group of circuits or circuit (within the functional section) is at fault. Servicing block diagrams for each functional section provide the signal-flow and test-location information needed to bracket and then isolate the faulty circuit.

f. FAILURE ANALYSIS.- After the trouble (faulty component, etc.) has been located (but prior to performing corrective action), the procedures followed up to this point should be reviewed to determine exactly why the fault affected the equipment in the manner it did. This review is usually necessary to make certain that the fault discovered is actually the cause of the malfunction, and not just the result of the malfunction.

4-2. OVER-ALL FUNCTIONAL DESCRIPTION (see figure 4-1).

a. GENERAL.- The TH-73 consists primarily of a synchronous (sync) regenerative repeater and a start-stop (s/s) regenerative repeater, together with mode-decision and -switching mechanisms

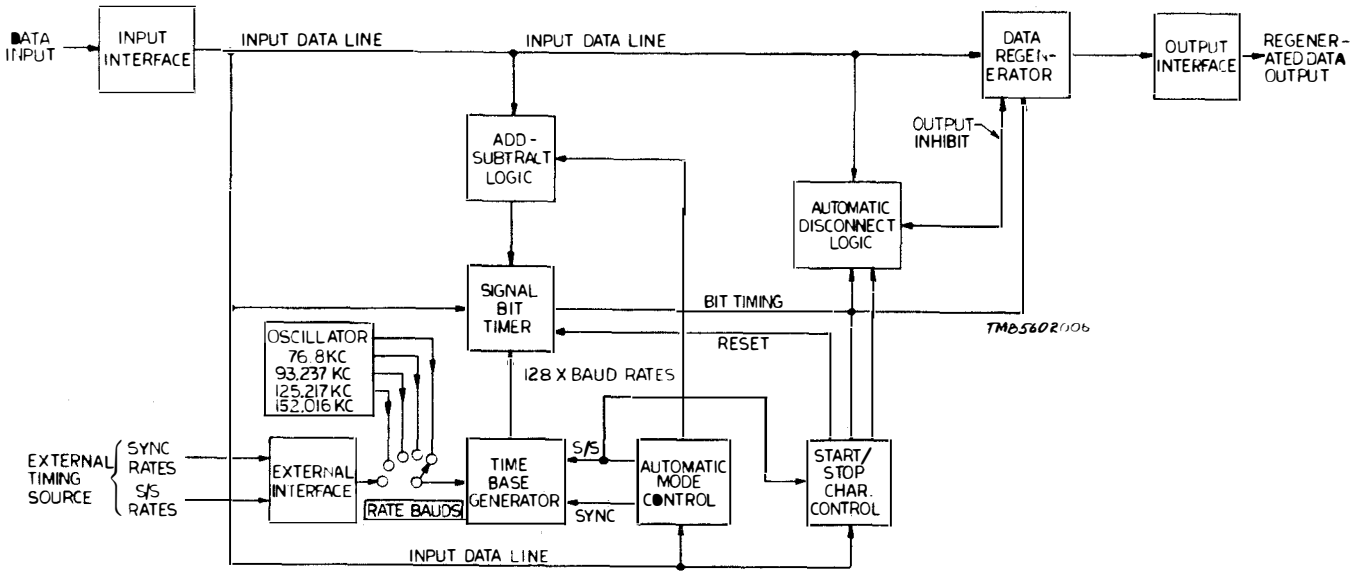


Figure 4-1. TH-73, Block Diagram

that provide automatic or manual control for signal regeneration. The following paragraphs describe their operation in regenerating synchronous and start/stop signals; a discussion of the switching from start-stop synchronous and from synchronous to start-stop is also included.

b. SYNCHRONOUS OPERATION.

(1) Input data is applied to the input interface where it is converted to logic-level signals and developed on the input data line. These logic-level signals are fed to all TH-73 circuits except the timing circuits.

(2) The timing signal is generated in an oscillator whose frequency is chosen on the basis of the incoming signal's baud-rate and mode (start-stop or synchronous). This output frequency (76.8kc, 93.23kc, 125.21kc, or 152.016kc) is then fed to the time-base generator, where it is counted down to a rate 128 times that of the incoming signal.

(3) The add-subtract logic operates automatically, in conjunction with the signal bit-timer, to produce and maintain correct phasing. An incoming Mark-to-Space (M/S) data transition is compared to the internal clock-signal (bit-timing from signal bit-timer). If these two signals match in time, the internal clock is in proper phase. If they do not match, add-subtract logic determines whether the internal clock is to be advanced or retarded: when the internal clock is to be advanced in time, clock-pulses are added (inserted into the time-base output); for retardation, clock-pulses are subtracted (deleted) from the time-base output.

(a) If initial phasing is incorrect, each M/S data-transition produces a 1/128 of a bit-interval correction and the clock shifts its timing until correct phasing is realized. Thereafter, alternate add and subtract pulses are generated to maintain correct phasing.

(b) The frequency-error between the synchronous data-rate and the internal time-base is automatically corrected for by add-subtract logic. When the correct phase is reached, the frequency-error appears as a slow-changing phase-difference between the data-transitions and the internal clock-signals, in the process of obtaining correct phasing. Consequently, add-subtract logic generates add- or subtract- pulses, as required, to correct the slow phase-change. Therefore, when the error accumulates to one clock-pulse at the input to add-subtract logic, it is corrected for by a phase-adjustment of 1/128 of a bit.

(c) For every M/S data-transition, early or late, a pulse is subtracted. When the M/S data-transition is early with respect to bit-timing, two pulses (one pulse added to second stage of the chain) are also added, giving a net effect of adding one pulse; when the transition is late, no pulses are added, and the net result is the subtraction of one pulse. This sequence forces bit-timing to move into phase with M/S data-transitions.

(4) The in-phase bit-timing is applied to the data regenerator and to automatic-disconnect logic.

(a) As it is applied to the data regenerator, the positive-going edge of the timing signal is lined up with an M/S transition of the incoming data. The negative-going transition of the timing signal (one cycle per bit) occurs at the mid-point of an ideal data-signal bit -- the optimum point for signal-bit sampling. The incoming data sets the data regenerator, and the bit-timing pulse allows the incoming data to be sampled. The data regenerator then changes the output signal to conform to the input signal (1/2-bit delayed), thereby regenerating the incoming data with less than 1 per cent distortion.

(b) Bit-timing is also applied to the automatic-disconnect logic, where the output is inhibited and a steady Mark is produced when no transitions exist at the input for a 32 bit-time period. The output remains inhibited for 63 bit-times after resumption of incoming data, allowing the TH-73 to synchronize before applying the regenerated data to the output line.

(c) Synchronization between send and receive clocks at the respective ends of a communications link is maintained even though the link is interrupted. Synchronization is maintained for a period up to 30 minutes with an absence of data on a link containing up to three TH-73 units in tandem. Once synchronization is established, data can be removed and replaced within the 30-minute period, without loss of synchronization.

c. START/STOP OPERATION.- In this mode, TH-73 operation is essentially the same as for synchronous operation except that, instead of establishing phase-position by addition and subtraction of pulses, character-framing is used to eliminate biasing distortion. Furthermore, a start/stop-character control is added to the circuits, and the automatic-disconnect circuit is not used.

(1) The beginning of a character (a M/S transition occuring during a stop-Mark interval) is detected by the start/stop-character control, which applies a pulse to reset the signal bit-timer, to its nocount state -- thereby character-framing and bit-synchronizing local bit-timing with the incoming data.

(2) In 5-level code, after 6-1/2 bit-intervals, the start-stop-character control prepares to start timing for the next character; the characteristic Mark that appears at the end of each character in start-stop operation is produced, regardless of the input line state. The operation is basically the same for 6-, 7-, and 8-level codes, except the character-interval is longer for these speeds.

(3) A false-start feature in the start-stop-character control prevents initiation of erroneous character-count by noise-pulses.

Note

During synchronous operation, start-stop-character control output is inhibited, permitting the signal bit-timer to operate continuously as described in b, above.

d. MODE-DECISION OPERATION.

(1) Bit-timing is also applied to the automatic mode control, which senses the incompatibility of line signals while in a given mode (either synchronous or start-stop), and switches to the opposite mode by controlling operation of the time-base generator.

(2) The long-Mark and missing-Mark rest-elements characteristic of the start-stop and sync mode; respectively, serve in detection of data-mode. Switching to the synchronous mode involves sensing the missing Mark-rest elements while in the start-stop mode; switching to start-stop mode involves sensing of a long-Mark line interval (one second or greater).

(3) Switching to the start/stop mode is also performed on detection of a speed-error (in the absence of the long-Mark interval). Speed errors occur when distortion is excess of 45 per cent or when the incoming data-mode and the setting of the mode-decision are incompatible.

(4) For 75-baud operation, both synchronous and start-stop(where the start-stop code is isochronous; unit-interval rest elements such as 7.0 or 8.0 code), there may or may not be a significant speed-difference; hence, speed recognition alone cannot be relied on to recognize start-stop code on continuous pattern while operating in the synchronous mode. In this case, detection of repetitive stop -Marks (indicating start/stop code) while operating in the synchronous mode serves to sense mode change, when no speed-error exists between corresponding codes.

4-3. LOGIC ANALYSIS.

a. GENERAL.

(1) The logic symbols used in this manual conform to the rules set forth in MIL-STD-806B. The more negative of two given logic levels is represented by the presence of a small circle at the input or output points of the logic symbol; conversely, the more positive level is represented by the absence of the circle. The logical levels shown at the inputs and outputs of gate and amplifier logic symbols are those present when the logic element is "active" (i.e., when it is performing its principle function). For example, if the symbol is that of an AND function, the logic levels shown are the required input and resultant output levels when the AND function is performed. For describing functional operation of those sections of the TH-73 containing logic elements and circuitry, the following set of definitions is established and will be consistently observed:

(a) Logical-0 equals approximately 0 (zero) volt; this is represented by a plain line entering or leaving a gate or amplifier logic symbol.

(b) Logical-1 equals approximately -12 volts; this is represented by a small circle terminating the line entering or leaving a gate or amplifier logic symbol.

(c) Flip-flops are "set" by applying a positive-going transition (logical-1 to logical-0) to the set (S) input, thereby producing a logical-1 at the 1 output and a logical-0 at the 0 output; an identical input transition applied to the clear (C) input "resets" the flip-flop producing a logical-0 at the 1 output and a logical-1 at the 0 output. When a logical-1 is present at the 1-output, the flip-flop is defined as being in its 1-state; a logical-0 at the 1 output defines the 0-state of the flip-flop.

(d) Triggering of logic-elements such as flip-flops and single-shot multivibrators is accomplished by positive-going transitions, -12 to 0 volt (logical-1 to logical-0).

(2) The following logic diagram (see figure 4-2) analysis describes TH-73 operation, indicating circuit relationships. Timing diagrams are included to aid in the discussion. During synchronous operation (c, below), the input interface, the timing circuits (b, below), the data regenerator, and the output interface regenerate the synchronous signal. Start-stop signals (d, below) are regenerated using the input interface, the timing circuits, the start-stop-character control, the data regenerator, and the output interface.

b. TIMING CIRCUITS.

(1) OSCILLATOR AND TIME BASE GENERATOR.- The oscillator comprises four separate oscillator circuits, each producing a different frequency (76.8kc, 93.23kc, 125.217kc, and 152.016kc) that is fed through amplifiers AM-1, AM-2, AM-5, and AM-6, respectively. AM-1 and AM-5 outputs are applied through squaring amplifier AM-3 to the input of (rate selection) AND gate GA-1; outputs from AM-2 and AM-6 are applied through squaring amplifier AM-4 to one input of rate selection AND gate GA-2. RATE, BAUDS switch S1 is set to the incoming data-rate, thereby providing power to the appropriate oscillator and connecting the enabling low level (from the mode-decision bistable) to either GA-1 or GA-2 so that the frequency can pass. The two enabling low levels applied to either GA-1 (for 37.5-, 61.1-, 75-, and 150-baud synchronous, or 75-baud start-stop) or to GA-2 (for 45.5-baud and 74.2-baud start-stop) produce an enabling level for OR gate GO-1. The pulses produced at the output of GA-1 or GA-2 are applied through GO-1 to a 4-stage divider (bistables F1 and F4 constituting the time base generator) where they are counted down to 128 times the incoming data-rate. Switch S1 allows the output to be picked off different divider stages, which one depending on the rate. All four stages are used for 37.5 synchronous or 45.5 start-stop; only two stages are used for 150 synchronous. The 128 times baud signal is applied through add-subtract logic (c, below) as a timing signal to the signal-bit timer.

(2) SIGNAL-BIT TIMER.- A 7-stage divider (bistable F5 through F11), this circuit produces bit-timing pulses at twice the incoming data-rate. When data is applied, the positive-going bit-timing transitions are moved to an in-phase position with respect to the M/S transitions of the incoming data, by means of add-subtract logic.

(a) During synchronous operation, the signal-bit timer reset is inhibited by the state of mode-decision bistable F14. The high level on the sync output of F14 inhibits amplifier AM-12, because AM-12 requires a low-level input to produce the reset signal. When AM-12 is inhibited, reset pulses from the start-stop-character control do not reach the signal-bit timer, which therefore operates in normal manner and is not reset after each character.

(b) During start-stop operation, the signal-bit timer is reset, at the beginning of each character, by a reset pulse from the start-stop-character control. The reset signal character-frames and bit-synchronizes bit-timing pulses with the data M/S transitions.

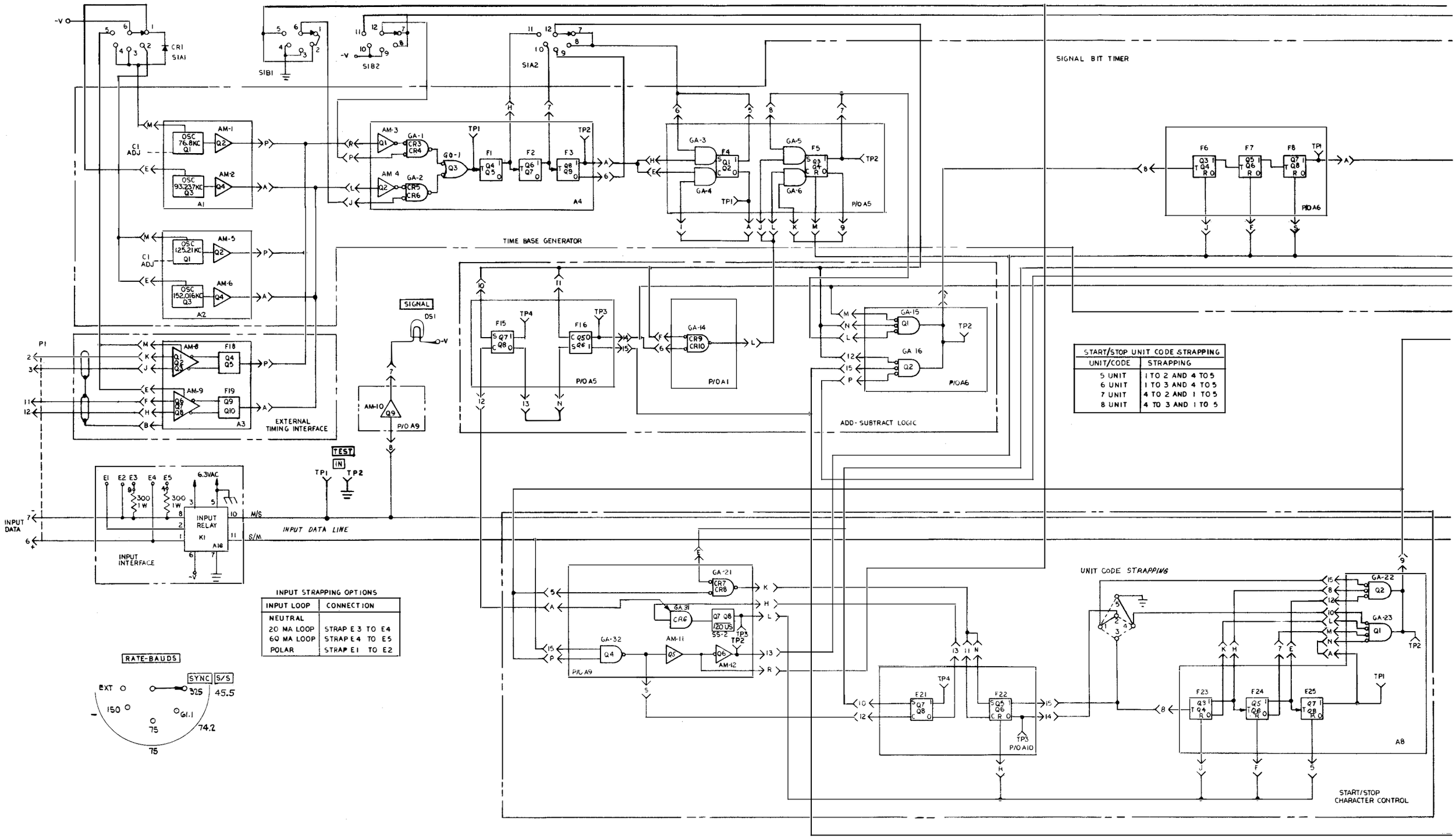
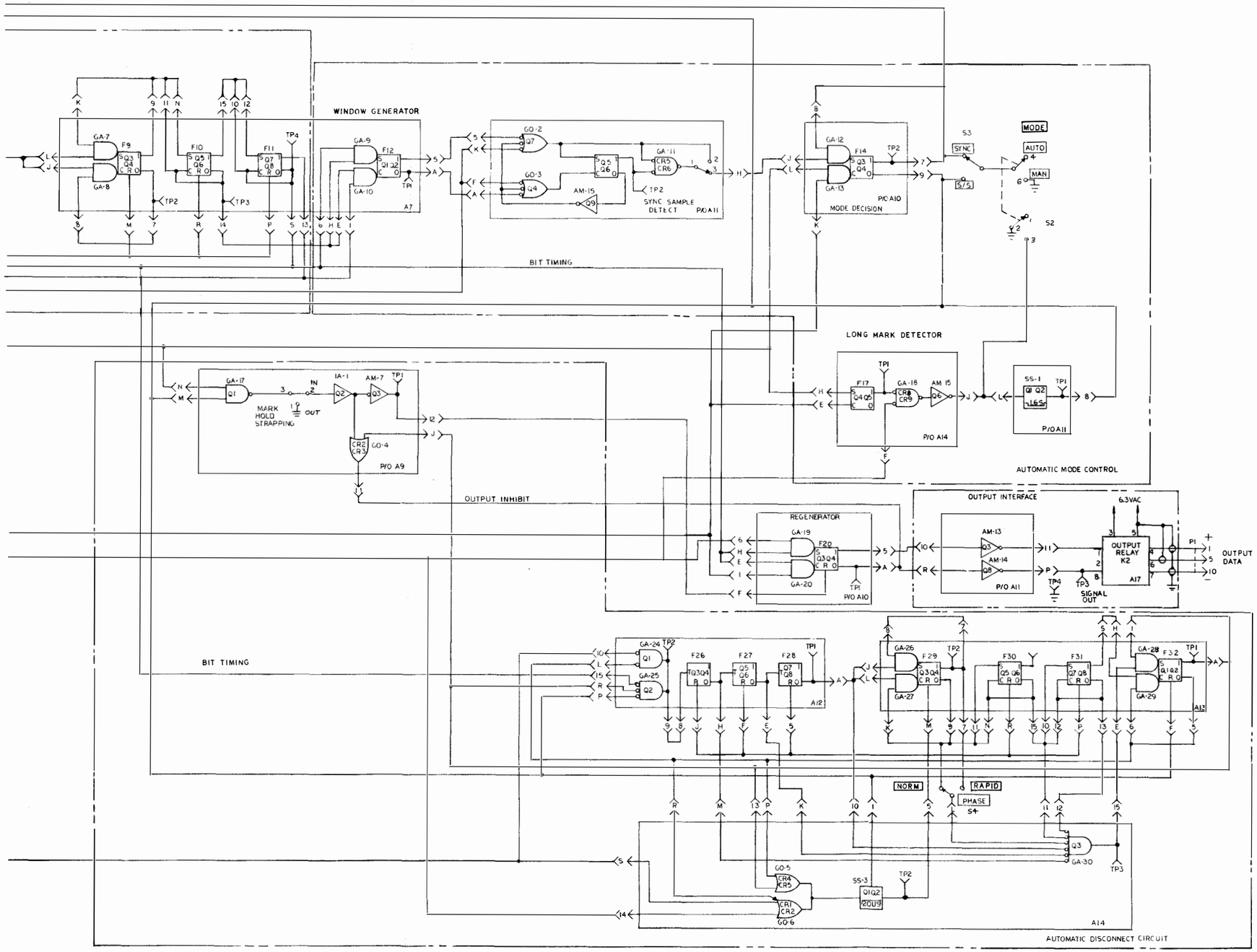
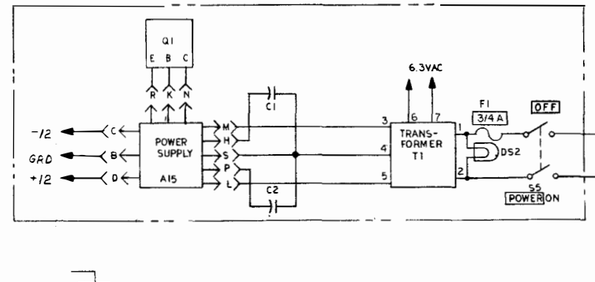


Figure 4-2. TH-73, Logic Diagram (Sheet 1 of 2)





SINE WAVE GENERATOR OPERATING AT INDICATED FREQUENCY WITH NO ADJUSTMENTS

SINE WAVE GENERATOR OPERATING AT INDICATED FREQUENCY WITH FREQUENCY ADJUSTMENT

AMPLIFIER THAT PRODUCES LOW LEVEL WHEN INPUT IS HIGH LEVEL.

AMPLIFIER-INVERTER THAT PRODUCES OUTPUT A LEVEL OPPOSITE OF THE INPUT

AMPLIFIER THAT PRODUCES HIGH LEVEL OUT FOR HIGH LEVEL IN(EMITTER FOLLOWER)

AMPLIFIER THAT PRODUCES HIGH LEVEL FOR LOW LEVEL IN.

AND GATE THAT PRODUCES HIGH LEVEL OUT WHEN BOTH INPUTS ARE HIGH.

AND GATE THAT PRODUCES LOW LEVEL OUT WHEN BOTH INPUTS ARE HIGH.

AND GATE THAT PRODUCES HIGH LEVEL OUT WHEN BOTH INPUTS ARE LOW.

AND GATE THAT PRODUCES LOW LEVEL OUT WHEN BOTH INPUTS ARE LOW.

PEDESTAL AND GATE THAT PRODUCES A HIGH LEVEL PULSE WHEN A NEGATIVE TO POSITIVE TRANSITION IS APPLIED WITH A HIGH PEDESTAL LEVEL

OR GATE THAT PRODUCES HIGH LEVEL WHEN EITHER OR BOTH INPUTS ARE HIGH

OR GATE THAT PRODUCES HIGH LEVEL WHEN EITHER OR BOTH INPUTS ARE LOW

OR GATE THAT REQUIRES HIGH LEVEL PEDESTAL TO ACTIVATE THE OR FUNCTION: I.E. A HIGH LEVEL IS PRODUCED WHEN EITHER OR BOTH INPUTS ARE HIGH

FLIP-FLOP THAT REQUIRES A HIGH LEVEL AT THE "S" INPUT TO OBTAIN LOW AT THE "1" OUTPUT; A HIGH AT THE "C" TO OBTAIN A HIGHER "0". A HIGH LEVEL AT "T" CHANGES THE STATE. A HIGH LEVEL AT "R" PROVIDES A LOW LEVEL AT "0" AND A HIGH LEVEL AT "1".

FLIP-FLOP WITH AND GATE INPUTS. TWO HIGH LEVEL INPUTS AT EITHER GATE PRODUCES THE ASSOCIATED OUTPUT LEVEL; LOW AT "1" AND HIGH AT "0".

SINGLE-SHOT (MONOSTABLE) THE UNACTUATED STATE IS EITHER HIGH OR LOW. WHEN ACTUATED, IT CHANGES TO THE OPPOSITE STATE AND REMAINS IN THAT STATE FOR THE DURATION OF THE ACTIVE TIME OF THE DEVICE AS INDICATED BY THE WAVEFORM IN THE SYMBOL.

FLIP FLOP THAT REQUIRES LOW LEVEL AT S TO PRODUCE HIGH LEVEL OUT OR A LOW LEVEL AT C TO PRODUCE A LOW LEVEL OUT.

DIFFERENTIAL AMPLIFIER THAT REQUIRES A HIGH LEVEL AT THE INPUT TO PRODUCE A LOW LEVEL OUT AT THE OPPOSITE LINE.

Figure 4-2. TH-73, Logic Diagram (Sheet 2 of 2)

c. SYNCHRONOUS OPERATION.- During synchronous operation, add-subtract logic adjusts the timing circuitry so that it is in phase with the incoming data. The corrected (in-phase) timing signal is applied to the data regenerator.

(1) ADD-SUBTRACT LOGIC.- For each M/S transition, add-subtract logic bistables F15 and F16, subtract gate GA-14, and add gates GA-15 and GA-16, subtracts one pulse from the timing chain; when the M/S transition is early with respect to bit-timing; when required, it adds two pulses per transition to the 128 times baud signal (net effect of adding a pulse). Addition and/or subtraction takes place until synchronization is obtained, at which point, a pulse is subtracted for the M/S transition and one is added on the next transition; the add-subtract action is repetitive.

(a) A pulse is subtracted from the output of subtract gate GA-14 for both early and late M/S transitions. When late (see figure 4-3A), one pulse is subtracted by having F15 set F16 on the second timing pulse; more is required. When the M/S transition is early (see figure 4-3B) with respect to bit-timing, a pulse is added to the output of bistable F5; the subtraction of one pulse at the input to the signal-bit timer, with the addition of a pulse to the second stage of the divider, has the over-all effect of adding one pulse to the signal-bit timing.

(b) The timing signal from switch S1A2, terminal 12 is applied to bistable F15. The initial data-transition can occur at any time with respect to bit-timing; for this discussion, assume that it is late with respect to bit-timing (see figure 4-3A) .

1 The bit-timing positive transition (see figure 4-3A, line 1) occurs, and at some arbitrary time later (before the next timing transition) an M/S transition occurs on the data line (see figure 4-3A, line 2), resetting bistable F15. The next positive transition from the output of the time base generator (see figure 4-3A, line 3) -- via switch S1A2, terminal 12 -- sets bistable F15 (see figure 4-3A, line 4) which, in turn, resets bistable F16 (see figure 4-3A), line 5).

2 While F16 is reset and a positive transition from the time base generator's timing signal occurs, subtract gate GA-14 is enabled, so that timing pulses are applied to gate GA-4. Before a data-transition is applied, the time base generator timing pulses are produced at the output of the subtract gate; when an M/S transition occurs, the level of bistable F16 inhibits subtract gate GA-14. The timing pulse's positive transition is therefore prevented from reaching the bit-timing counter, thereby causing one pulse to be removed (or subtracted) from the pulse-train (see figure 4-3A, line 6). The resulting output of bistable F5 (see figure 4-3A, line 7) indicates loss of one count, which, at this point, is 1/128 of a bit. This train is applied to gate GA-15. Once the pulse-train from F5 (at TP2), the timing from time base generator, and the output of F16 (at TP3) are in coincidence, gate GA-15 is enabled, producing a waveform (figure 4-3A), line 8) that is applied to F6. For addition of a pulse, (i.e., M/S transition early with respect to bit-timing; see figure 4-3B), the incoming M/S transition sets bistable F15 and the subtraction process takes place (see figure 4-3B, lines 1 through 7). The low level of bit-timing bistable F11 is applied to add gate GA-16 with time base generator timing and the bistable F16 (at logical-1) output. When these three levels are low, in coincidence, gate GA-16 is enabled, and a positive-going transition provides a pulse at the second bistable of the counter (see figure 4-3B, line 8). An additional pulse is inserted in the pulse-train, advancing the signal-bit timer by a count of two (because the insertion is made at the input to the second bistable). The add/subtract process occurs for each M/S data-transition, until synchronization is obtained.

3 The corrected (in-phase) timing is applied to the data regenerator (and other related circuits discussed below), with the incoming data.

(2) DATA REGENERATOR.- A gate-triggered bistable, this circuit samples and regenerates the incoming data as controlled by bit-timing.

(a) A high-level signal generated by an M/S transition applies an operating level to gate GA-20. When the gate receives a positive-going transition of the bit-timing pulse a high-level spike is produced, resetting bistable F20. If already reset, F20 remains reset.

(b) A positive-going transition from gate GA-19 sets F20, which remains set until reset by a positive-going transition from GA-20. The spike from GA-20 regenerates the M/S data-transition, and that from GA-19 regenerates the S/M data transition. The regenerated data is displaced, in time, by 1/2-bit (see figure 4-4).

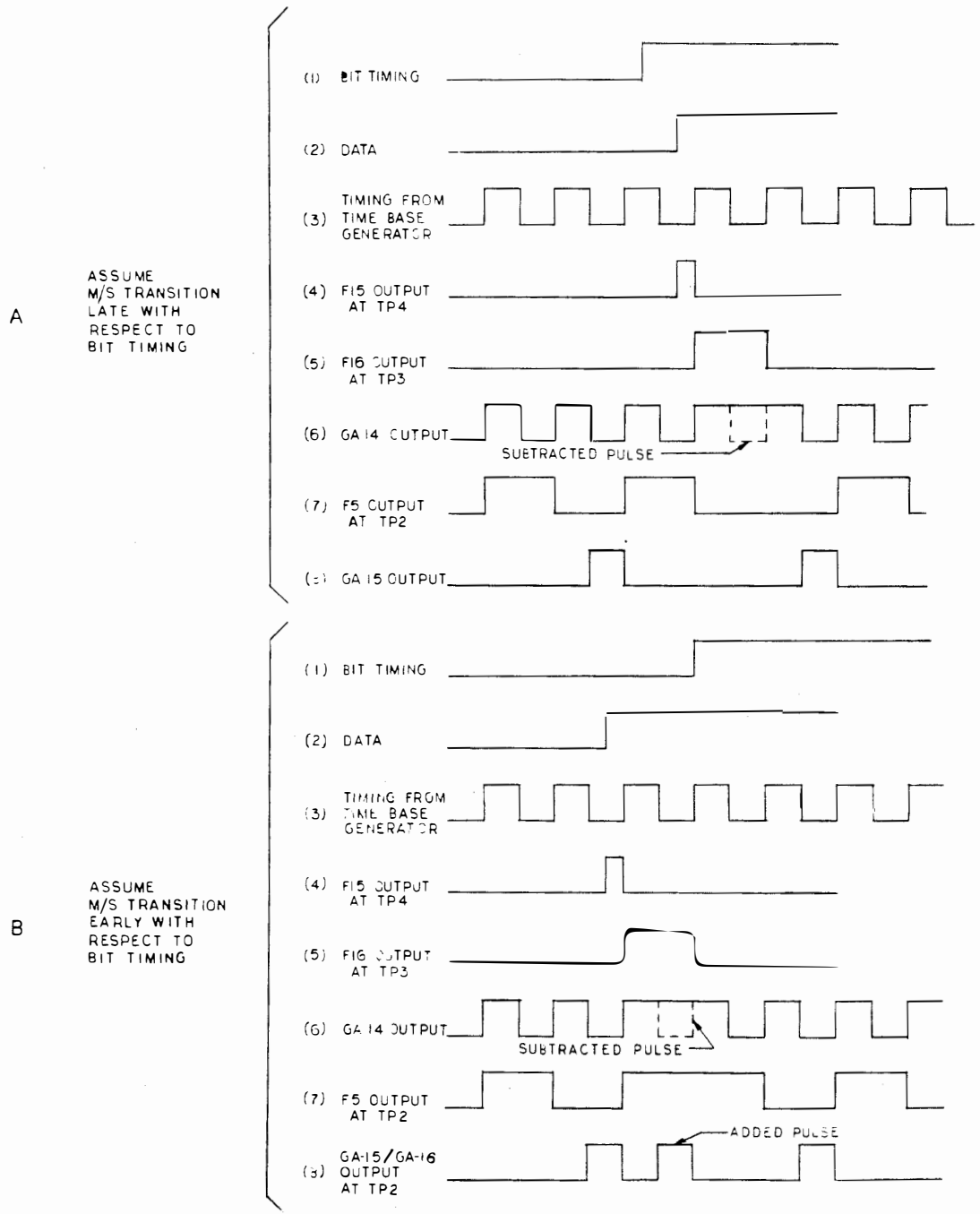


Figure 4-3. Synchronizing Technique for Phase Bit Timing to the Mark/Space Transition of the Data

(c) The data regenerator produces a steady Mark on the output line, regardless of input, after a signal of the selected unit-code has been received (with Mark-hold in) during start-stop operation, and during periods of no transitions for synchronous operation. The start-stop-inhibit

high level, generated in the Mark-hold circuit, clamps the reset input of bistable F20 to the set state. The synchronous-inhibit high level is generated in automatic-disconnect logic and clamps F20 output to the set state, to produce a Mark on the output line.

(3) AUTOMATIC-DISCONNECT LOGIC.- This logic determines when the data regenerator output should be inhibited. Absence of transitions for a 32-bit period causes the logic to inhibit the output; the output remains inhibited, after transitions resume, until synchronization is realized.

(a) A low level from disconnect-logic control bistable F-32, with a low-level from mode-decision bistable F14, enables gate GA-25; bit-timing low levels are therefore applied to a 6-stage counter (bistables F26 through F31). As each signal-transition occurs (detected by gate GO-6), the counter is reset to its no-count position through monostable SS-3, permitting the counter to resume a 32-bit count-period. If no data-transitions occur within a 32-bit period, the counter reaches binary number 32 and triggers the disconnet-logic control bistable F32. This action:

1 Blocks bit-timing pulses applied through gate GA-25 (inhibited by F32) and enables gate GA-24, so that data-transitions may be applied to the counter.

2 Resets the counter to its no-count position, and prevents additional data-transitions from resetting the counter.

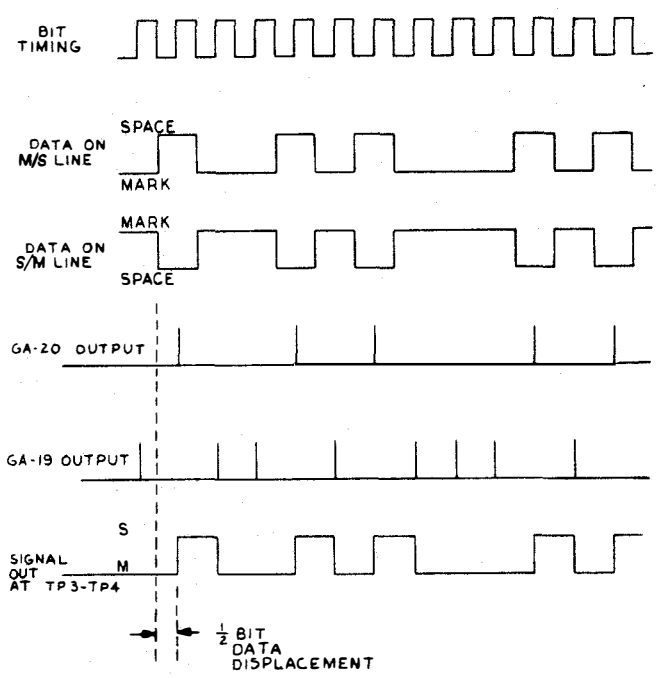


Figure 4-4. Regenerated Data Displacement Diagram

3 Forces data regenerator F20 to a steady-Mark condition until transitions are resumed and synchronization is obtained.

(b) While the output is inhibited, the counter counts the number of M/S transitions; either 56 or 63 transitions as counted, depending on the setting of PHASE switch S4. When the appropriate number is reached, the inhibit on the data regenerator is removed.

1 To obtain a phase-position of 10 per cent of ideal synchronization by the time 56 M/S transitions are received, the PHASE switch is set to the RAPID position.

2 For phase-position of 2 per cent in 64 M/S transitions, the PHASE switch is set to NORM.

When the required number of transitions is counted, disconnect-control output gate GA-30 is enabled, setting F32, which removes the inhibit condition from data regenerator F20. During the count-period, incoming data is synchronized in the add-subtract and bit-timing circuits so that the desired phase-position is obtained at the indicated count.

(c) During normal transmission, gate GO-6 (provided with the required pedestal by F32) supplies a pulse to monostable SS-3, to increase the pulse-width to 20 microseconds; this additional time is required to reset the automatic-disconnect counter, which is reset (1) on each incoming data-transition, and (2), via gate GO-5, when F32 changes state. As mode-decision bistable F14 changes from start-stop to synchronous, monostable SS-3 and bistable F32 are reset, causing the counter to be reset.

d. START/STOP OPERATION.- For start/stop operation, the bit-timing circuit character-frames, rather than bit-synchronizes, the data. Although bit-synchronization occurs within each character, distortion is primarily removed by character-framing, as performed by the start/stop-character control. Incoming data and bit-timing are simultaneously applied to the start/stop-character control.

(1) START/STOP CHARACTER CONTROL.- Start/stop-character control uses a 4-stage counter (bistables F22 through F25), input gates (GA-21, GA-31, and GA-32), a timing monostable (SS-2), amplifiers (AM-11 and AM-12), and output gates (GA-22 and GA-23) to produce reset pulses for the signal-bit timer and to frame each character.

(a) The beginning of a character (an M/S transition occurring during a stop-Mark interval) is detected by initial-Space detector gate GA-32; the leading edge of the resulting output signal sets the signal bit-timer (through AM-11 and AM-12) to its no-count state. This action character-frames and bit-synchronizes local bit-timing with the incoming data. To insure that a noise-pulse on the line cannot initiate an erroneous character-count, the start-stop character counter (bistables F22 through F25) is reset only if a Space condition exists one-half of a bit-interval after M/S transition occurs (indicative of a true start signal). This is accomplished as follows:

1 False-start binary F21 is set at the same time the signal-bit timer is set.

2 One-half bit later, the input line is monitored for a Space condition (start-pulse) by gate GA-31.

3 If a Space condition exists (indicative of a normal character), the start-stop character distributor is reset through recycling monostable SS-2, thus permitting bit-intervals to be counted. However, if a Mark condition exists (indicative of a false-start), the reset pulse to the start-stop character counter is inhibited by GA-32.

(b) Figure 4-5 illustrates the waveforms of the logic functions for a 5-, 7-, and 8-level input signal. After 6-1/2 bit-intervals (5-level code), output of gate GA-22 blocks the bit-timing signal (in gate GA-21) to the start-stop character counter, and conditions gate GA-23 to restart the cycle whenever an M/S transition (start of a new character) is detected.

(2) MARK-HOLD OPTION.- To produce a Mark on the output line after the required number of bits, the Mark-hold feature is strapped into the circuit, so that the output is forced to Mark state regardless of the input. Since, by definition, the stop-pulse must be a Mark, the output signal is correct regardless of the state of the input line. Normally, a high level is applied to one input of gate GA-17 by bistable F14. During the stop-Mark interval, the start/stop-character control produces a high level through enabled gate GA-22 (5-level code). This high level is also applied to enable GA-17, providing an inhibiting signal through amplifiers IA-1 and AM-7 to data-regenerator bistable F20. (To disable the Mark-hold provision, remove strapping from terminal 3 to 2, and connect strap from terminal 1 to 2.)

e. AUTOMATIC-MODE CONTROL.- The automatic-mode control distinguishes between input start-stop and synchronous signals and sets or resets a bistable accordingly. The circuit uses a synchronous detector a start/stop detector, and a mode memory device to set the mode automatically. The mode may be set manually, using a switch.

(1) For start/stop operation, when a Space condition exists during the stop-Mark interval, mode-decision bistable F14 is reset through enable gate GA-13; GA-13 is enabled by the high level on the M/S data line and the positive transition at the output of character-control output gate GA-22 or GA-23, depending on the unit code in use. This Space condition constitutes a violation of start/stop signals; therefore, the input data-signal must be a synchronous type, so that the mode of operation is changed to conform with such a determination.

(2) During synchronous operation, indication of a forthcoming start-stop signal is provided in any of three ways: (1) when the bit-synchronizer add-subtract logic cannot hold synchronization due to excessive speed-error, (2) when a long-Mark (greater than 1 second) appears on the input line or (3) when continuous pattern of rest-Mark pulses occurs (see (a), (b), and (c), respectively, below).

(a) Window-generator bistable F12 generates a threshold limit, which is 25 per cent of a bit-interval on either side of the phasing edge of the bit-timing signal, as shown in figure 4-6. When the phase-position of F11 and the incoming data exceed the threshold limit established by window-generator F12 (indication of excessive speed-error), mode-decision bistable F14 is triggered to the start-stop mode. When an M/S occurs inside the window, a pulse passes through gates GO-2 and GO-3 to trigger mode-decision bistable F14 directly, or through delaying logic (bistable F14 and GA-11) which is strapped into the circuit when less sensitivity is required. Gating of F13 and GA-11 requires that two M/S transitions, separated by approximately 200 milliseconds, exceed the phase threshold before the mode of operation is changed to start-stop. This action reduces the possibility of noise-pulses erroneously changing the mode of operation.

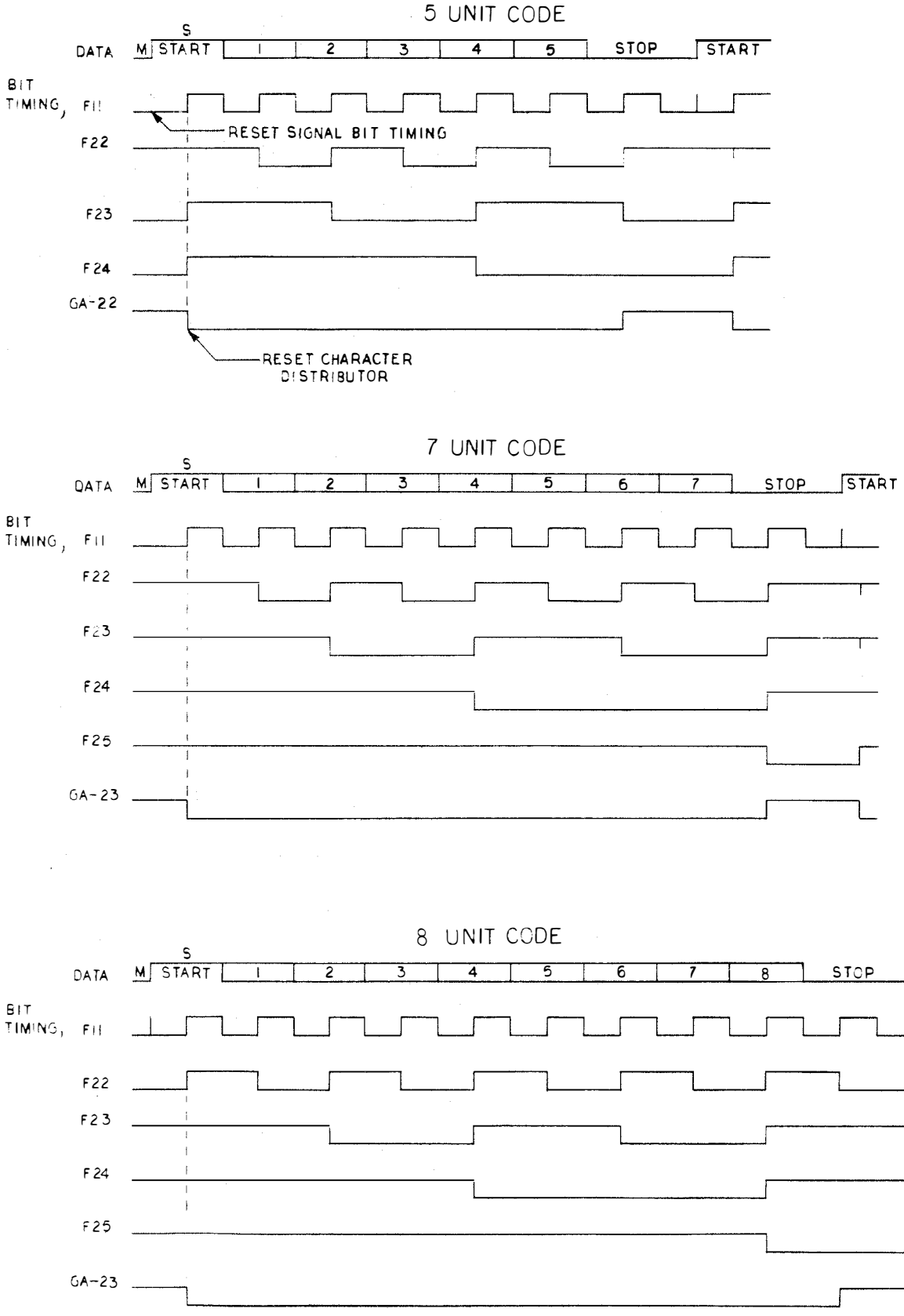


Figure 4-5. Start/Stop Signal Synchronization Waveforms

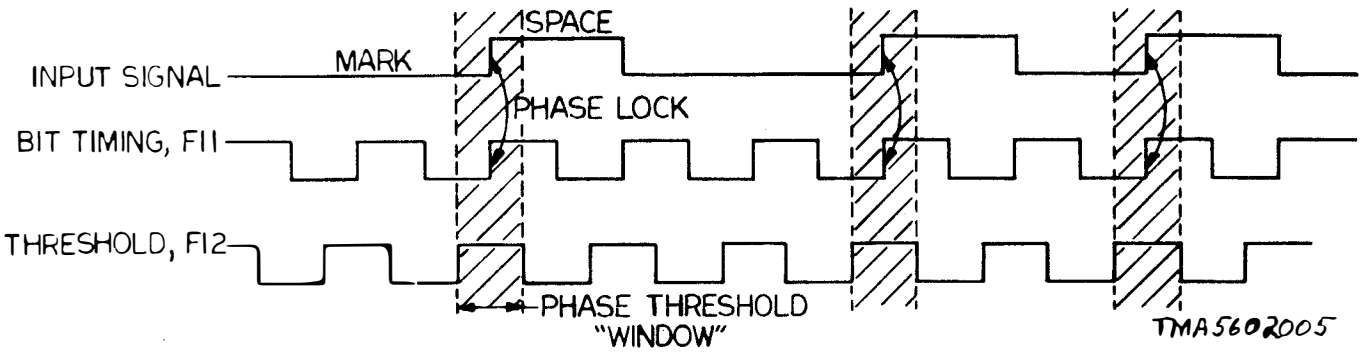


Figure 4-6. Start/Stop Signal Detection Logic

(b) Bistable F17, gate GA-18, and recyling monostable SS-1 form the long-Mark detector. Recycling timer (SS-1) "runs out" when a steady-Mark is on the data line for at least one second. A steady-Mark allows the high level generated by the start-stop character control circuit, to produce a positive-going transition to set bistable F17. The high level on the S/M data line inhibits gate GA-18, preventing SS-1 from recycling. After approximately one second the monostable returns to its stable (high level) state, clamping F14 to its reset state and forcing mode-decision to the start/stop mode.

(c) Consecutive Mark levels occurring during each rest-interval cause the mode-decision bistable to change from synchronous to start-stop. The character-frame counter (although not actually required in synchronous operation) is permitted to function. If character-frames only when a start-stop signal appears at the input at this time, a consecutive Mark in the rest-pulse is detected, permitting the recycling monostable to "run out", clamping F14 to the reset state. The change occurs when gate GA-13 is enabled by the high level of the Mark on the data line and the positive-going transition of the start-stop character control output gate.

(3) For manual mode operation, bistable F14 is forced to the desired mode of operation by clamping the appropriate side of the bistable to ground, through the MODE and MANUAL switches. In addition, the MODE switch disables the long-Mark detector by grounding the input to the recycling monostable SS-1.

f. EXTERNAL TIMING INTERFACE.- A differential amplifier and bistable multivibrator are used in the external timing interface to connect an external timing source to the time base generator. The input must conform to MIL-STD-188B (±6 volts).

(1) A polarized signal is required by differential amplifiers AM-8 and AM-9 for application to bistable F18 and F19, respectively. Each bistable converts the applied frequency to logic-level signals that are coupled to amplifiers AM-3 and AM-4 (respectively) when the external timing interface receives power through switch S1A1.

(2) Amplifiers AM-8 and AM-9 respond to negative-level portions of the timing frequency; bistables F18 and F19 require low-level signals for switching.

(3) Since the timing frequency applied to external input passes through only one bistable in the time base generator, the frequency of the external signal must be 256 times the bit-rate used. For example: when the bit-rate is 150, the frequency must be 38.4kc.

g. POWER SUPPLY.- The power supply consists of a transformer, rectifier, filter and series voltage regulator. The power supply operates to produce ±12-volt dc. In addition, an isolated 6.3-volt ac is provided to the input and output relays to maintain the required dc-isolation at the input and output interfaces.

4-4. TROUBLE SHOOTING DATA.

a. INTRODUCTION.- The following instructions prescribe general trouble shooting techniques and provide specific instructions for trouble shooting units of the AN/UGA-5. Within each unit's

trouble shooting procedure, required connections are specified, and a trouble shooting chart (where required) is provided. Directions for trouble shooting transistor circuits and for repair are also supplied. Applicable illustrations, including printed-circuit card layouts that facilitate location of component parts, are presented in Section 5.

b. GENERAL TECHNIQUES.- Systematic trouble shooting of the AN/UGA-5 begins with the initial checks (par. 2-3); the following procedures carry sectionalization, localization, and isolation to a more advanced level.

Note

When trouble shooting the Repeater Group, connect 115-volt ac, 50-60 cycles, to the indicated terminals on the rear of the unit, as shown in figure 2-1.

(1) REQUIRED TEST EQUIPMENT.- Test equipment required for performing trouble shooting are listed in Table 1-3.

(2) PROCEDURE.- Servicing a defective unit involves sectionalizing the fault to a printed-circuit card, localizing the fault to a circuit on that card, and isolating the fault to the defective part responsible for the abnormal condition. Some faults, such as burned-out resistors and overheated transistors, may often be located by sensory examination; the majority of faults, however, must be localized by observing waveforms and checking voltages and resistance. While trouble shooting, tap or jar the equipment to make any existing intermittent trouble appear. Check for cause of such trouble; check all wiring and connections for satisfactory contact.

(a) Since printed-circuit cards assigned the same assembly numbers are interchangeable, a card suspected of being defective can be interchanged with one having the identical assembly number, in order to sectionalize circuit troubles. Operating and maintenance personnel having complete, thorough knowledge of unit operation, and an awareness of which circuits (on a particular printed-circuit card) function in the various sections of the TH-73 can interchange printed-circuit cards to isolate operating difficulties rapidly.

(b) Localize the fault to a stage or group of stages responsible for the abnormal condition by performing a visual inspection of the equipment, observing all visual signs that might limit the fault to a particular stage, and making the following preliminary check.

1 Before removing and trouble shooting the AN/UGA-5, make sure that power is applied; check for 115-volt ac between the indicated terminals at the rear of the AN/UGA-5 (see figure 2-1), if these voltages are not present, trouble exists in the external power source; eliminate this trouble before trouble shooting the AN/UGA-5.

2 To assure that the power is applied to the TH-73 unit, remove any inoperative TH-73 and check that ac power appears at the connector on the inside rear of the rack shelf adapter.

Note

To trouble shoot the TH-73, the unit must receive (in addition to power) a line signal, as generated by the test pattern distortion generator.

(c) To isolate the fault, perform voltage resistance, and continuity measurements of the defective stage. Refer to Tables 4-3 through 4-6 below, for details in logic circuit trouble shooting. To isolate a fault:

1 Use an oscilloscope to signal trace suspected circuit(s).

2 Make voltage and resistance measurements on component parts of the faulty circuit.

CAUTION

Observe all precautions to prevent transistor damage. When measuring voltages, insulate the entire test probe, except for the tip, with tape or sleeving; however, momentary, a short-circuit can destroy a transistor (e.g., excessive emitter-base current resulting from shorting out the bias).

3 Use the symptoms listed in the trouble shooting charts as a guide, to isolate malfunctions to component parts in a unit suspected of being faulty.

c. PROCEDURES.- Table 4-1 presents trouble shooting procedures for the TH-73, refer to figures 5-1 through 5-21, as required, for circuit tracing and locating components. Details on trouble shooting particular circuits are provided in (1) through (5), below. Refer to d below, for information on trouble shooting logic circuits.

TABLE 4-1. TH-73 TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	CORRECTION
1. SIGNAL lamp does not flash off and on during data transmission.	Defective Amplifier AM-10 on Printed-circuit card A9.	Check amplifier.
2. Line signal not repeated to output terminal; POWER indicator extinguished on all TH-73 units.	Defective line filter FL1, on chassis.	Check line filter.
	Defective cable or connection.	Perform continuity checks on wiring.
3. Line signal not regenerated at output terminal; POWER indicator extinguished on defective channel only.	Defective power supply.	Check power-supply circuits of inoperative channel.
4. Line signal not regenerated; POWER indicator lighted.	Defective output relay K2.	Check for signal at front-panel TEST OUT. If present, replace relay K2. If not present, proceed to next probable cause.
	Defective interface amplifier AM-14 and/or AM-13 on printed-circuit card A11.	Check for logic-level signal at TP1 on printed-circuit card A10. If present, check amplifiers AM-14 and AM-13.

TABLE 4-1. TH-73 TROUBLE SHOOTING CHART (Cont'd)

TROUBLE	PROBABLE CAUSE	CORRECTION
	Defective data-regenerator bistable F20 on printed-circuit card A10.	Check for logic-level signal at front-panel TEST IN. If present, check bistable F20. If not present, proceed to next probable cause.
	Defective input relay K1 on TH-73 chassis.	Check input relay K1.
5. Steady Mark on output after more than 64 bits have been received, during synchronous operation.	Defective bistable F32 on PC card A13.	Check bistable F32.
	Defective gate GA-24 on printed-circuit card A12, gate GO-6, or SS-3 on printed-circuit card A14.	Check gates and monostable.
6. Steady Mark on output line after initial M/S transition, during start-stop operation.	Defective gate GO-4 on printed-circuit card A9.	Check gate GO-4.
	Defective amplifier IA-1 on printed-circuit card A9.	Check amplifier IA-1.
	Defective gate GA-17 on printed-circuit card A9.	Check gate GA-17.
	Defective start gate GA-32 on printed-circuit card A9.	Check gate.
7. Excessive distortion (greater than 1%) on in start-stop operation only.	Defective mode-decision bistable F14 on printed-circuit card A10.	Check bistable F14.
	Defective window-generator bistable F12 on printed-circuit card A7.	Check bistable F12.
	Defective character-control counter gate GA-21 on printed-circuit card A9.	Check gate.
	Defective character-control counter(bistable F22 to F25) on printed-circuit cards A10 and A8.	Check bistables.
	Defective pedestal gate GA-31 on printed-circuit card A9.	Check gate.
	Defective counter-reset monostable SS-2 on printed-circuit card A9.	Check monostable.

TABLE 4-1. TH-73 TROUBLE SHOOTING CHART (Cont'd)

TROUBLE	PROBABLE CAUSE	CORRECTION
	Defective character-control output gate GA-22 or GA-23 on printed-circuit card A8.	Check gates.
	Defective sync sample-detector circuit gates GO-2, GO-3, GA-11, bistable F13, or amplifier AM-15 on printed-circuit card A11.	Check gates, bistable, and amplifier circuit.
8. Excessive distortion (greater than 1%) in synchronous operation only.	Defective add-subtract logic; bistables F15 and F16 on printed-circuit card A5, gate GA-14 and gates.	Check bistables and gates.
	GA-15 and GA-16 on printed-circuit card A6.	Check gates.
9. Excessive distortion (greater than 1%) in both modes of operation, at all speeds.	Defective time base generator bistables F1 through F4 on printed-circuit cards A4 and A5.	Check bistables.
	Defective RATE, BAUDS switch on unit front panel.	Check switch.
10. No timing when external timing is used.	Defective external-timing interface amplifiers AM-8 and AM-9 or bistables F18, F19 on printed-circuit card A3.	Check amplifiers and bistables.
	Defective RATE, BAUDS switch S1.	Check switch.
11. Space appears on output line during stop-intervals, when synchronous mode is used.	Defective output relay K2 on chassis.	Check relay.
	Defective output interface amplifier AM-13 or AM-14 on printed-circuit card A11.	Check amplifier.
	Defective data-regenerator bistable F20 on printed-circuit card A10.	Check bistable.
	Defective output-inihibit gate GO-4 on printed-circuit card A9.	Check gate.
	Defective disconnect-input gate GA-25 on printed-circuit card A12.	Check gate.

TABLE 4-1. TH-73 TROUBLE SHOOTING CHART (Cont'd)

TROUBLE	PROBABLE CAUSE	CORRECTION
	Defective disconnect-counter bistables F26 through F31 on printed-circuit cards A12 and A13.	Check bistables.
	Defective disconnect-logic control bistable F32 on printed-circuit card A13.	Check bistable.
	Defective disconnect-output control gate GA-30 on printed-circuit card A14.	Check gate.
	Defective monostable SS-3 on printed-circuit card A14.	Check monostable.
12. Long-Mark on input line does not switch mode of operation to start-stop.	Defective long-Mark monostable SS-1 on printed-circuit card A11.	Check monostable.
	Defective long-Mark amplifier AM-15 on printed-circuit card A14.	Check amplifier.
	Defective long-Mark gate GA-18 on printed-circuit card A14.	Check gate.
	Defective long-Mark bistable F17 on printed-circuit card A14.	Check bistable.
13. Incorrect frequency at TP1 on printed-circuit card A4 when RATE, BAUDS switch is set for for the following modes of operation, at the indicated rate:	Defective gate GO-1, GA-1, or GA-2 on printed-circuit card A4.	Check gates.
	Defective amplifier AM-3 or AM-4 on printed-circuit card A4.	Check amplifier.
BAUD MODE		
37.5 synchronous	Defective oscillator 76.8kc on printed-circuit card A1.	Check and/or adjust oscillator.
61.1 synchronous	Defective oscillator 125.217kc on printed-circuit card A2.	Check and/or adjust oscillator.
45.5 start-stop	Defective oscillator 93.237kc on printed-circuit card A1.	Check oscillator.
74.2 start-stop	Defective oscillator 152.016kc on printed-circuit card A2.	Check oscillator.

(1) TROUBLE SHOOTING THE TIME BASE GENERATOR.

(a) Check that the waveform at test-points TP1 and TP2 on printed-circuit card A4 and at terminal 12 of switch S1A2 is a square wave of the frequency indicated in Table 4-2. If unsatisfactory results are obtained, check bistables or gates immediately preceding the test-point. If bistables and gates are operating properly, perform following steps to check the oscillator.

(b) Remove printed-circuit card A1 or A2, depending on the rate at which the unit is malfunctioning.

(c) Remove adapter card and place in connector XA1.

(d) Plug printed-circuit card A1 into adapter-card receptacle.

(e) Check output of oscillator/amplifier combination at terminal P or A, depending on the rate.

TABLE 4-2. FREQUENCY AT VARIOUS TEST-POINTS

TEST POINT	PC CARD	INCOMING RATE					
		37.5	45.5	61.1	74.2	75	150
TP1	A4	76.8kc	93.237kc	125.217kc	152.016kc	76.8kc	76.8kc
TP2	A4	9.6kc	11.654kc	15.650kc	19.0kc	9.6kc	9.6kc
Terminal	Switch						
12	S1(A2)	4.8kc	5.827kc	7.825kc	9.5kc	9.6kc	19.2kc
P	A1	76.8kc	76.8kc	-	-	76.8kc	76.8kc
A	A1	93.237kc	93.237kc	-	-	-	-
P	A2	-	-	125.217kc	125.217kc	-	-
A	A2	-	-	152.016kc	152.016kc	-	-
TP2	A5	2.4kc	2.91kc	3.9kc	4.75kc	4.8kc	9.6kc
TP1	A6	300 cps	364.2 cps	489 cps	5.938kc	600 cps	1.2kc
TP2	A7	150 cps	182.1 cps	244.5 cps	296.9 cps	300 cps	600 cps
TP3	A7	75 cps	91.05 cps	122.2 cps	148.4 cps	150 cps	300 cps
TP4	A7	37.5 cps	45.5 cps	61.1 cps	74.2 cps	75 cps	150 cps
TP1	A7	18.75 cps	22.7 cps	30.5 cps	37.1 cps	37.5 cps	75 cps

(2) TROUBLE SHOOTING SIGNAL-BIT TIMER AND ADD-SUBTRACT LOGIC.

(a) Check that waveform is square wave of the frequency indicated, in Table 4-2, at the following points:

Test-Point	Printed-Circuit Card
TP2	A5
TP1	A6

Test-Point	Printed-Circuit Card
TP2	A7
TP3	A7
TP4	A7

If unsatisfactory results are obtained at any test-point, check bistables immediately preceding the test-point at which difficulty is encountered.

(b) Check the incoming data waveform against the bit-timing waveform; the positive-going transitions should coincide. If not, check add gates GA-15 and/or GA-16.

(3) TROUBLE SHOOTING AUTOMATIC MODE CONTROL.

(a) Check for square wave of data-rate at test-point TP1 on printed-circuit card A7. If not present or if unsatisfactory, check bistable F12.

(b) Using Test Pattern Distortion Generator (part of AN/GGM-1; see Table 1-4), provide a start-stop test message and check for low-level at test-point TP2 on printed-circuit card A11. If not present, check preceding bistable, amplifier, and gates of sync detector.

(c) Check for low level at test-point TP2 on printed-circuit card A10. If not present, check bistable F14.

(d) Check start-stop character control; see (4), below.

(4) START-STOP CHARACTER CONTROL.

(a) Using Test Pattern Distortion Generator, provide start-stop signal at input of TH-73, and check for periodic high levels (that coincide with stop-Mark intervals) at test-point TP2 on printed-circuit card A8. If satisfactory results are not obtained, check bistables and gates on printed-circuit card A8.

(b) Check for high level at test-point TP2 on printed-circuit card A9, during stop-Mark interval. If not present, check amplifiers AM-11 and AM-12, and gate GA-32.

(c) Check for high level at test-point TP3 on printed-circuit card A9 during stop-Mark interval. If satisfactory results are not obtained, check gate GA-31, monostable SS-2, and bistable F21.

(5) TROUBLE SHOOTING AUTOMATIC-DISCONNECT LOGIC.

(a) Remove data from input, and check for low level at test-point TP3 on printed-circuit card A14. If not present, check bistables in counter, counter input gates, and output gate.

(b) Check for high level at test-point TP1 on printed-circuit card A13. If not present, check bistable F32.

(c) Resume data transmission into unit. Check for high level at test-point TP2 on printed-circuit card A14. If not present, check monostable SS-3 gates GO-5 and GO-6.

d. TRANSISTOR CIRCUIT TROUBLE SHOOTING.

(1) GENERAL.- When trouble has been localized to a logic circuit, measurements should be made with each transistor in the circuit cut off and then conducting. Cut-off and conducting conditions are obtained as follows:

(a) BISTABLES.

1 Eliminate any inputs from the TH-73 by removing connections from the input terminal.

2 To cut off one transistor of a bistable, momentarily short the transistor's base and emitter.

3 To cause one transistor of a bistable to conduct, momentarily short the other transistor's base and emitter.

Note

Placing of meter test prods at various points in the circuit may cause bistable switching. In some cases, observation of collector-voltage levels, using oscilloscope, may be convenient. Set the oscilloscope for dc input and for free-running operation. Where bistables are conditioning gate circuits in which measurements are being made, monitor bistables to insure that gate input conditions remain as set up.

(b) GATES.- Set bistables and switches that furnish inputs to gates so as to obtain combinations of inputs desired. All possible input combinations should be established and rechecked for normal indication.

(c) SCHMITT TRIGGERS.- Normally, one transistor of each Schmitt trigger is cut off, and the other is conducting. To reverse conditions for test purposes place a jumper from base to emitter on the normally conducting transistor.

(d) MONOSTABLES.- Normally, one transistor of the monostable is cut off and the other is conducting. To activate the monostable for test purposes, place a jumper from base to emitter on the normally conducting transistor. The quasi-stable state should remain for the indicated period, after the jumper is removed.

(2) NORMAL TRANSISTOR-ELEMENT CONDITIONS.

(a) BASE TO EMITTER.- The base is normally negative by an amount in the order of 0.25 volt, with respect to the emitter, when the transistor is conducting. Cut-off bias establishes a value in the order of +1 volt on the base with respect to the emitter.

(b) COLLECTOR.- When the transistor is conducting, the collector voltage is very close to 0 volt. When the transistor is cut off, the voltage depends on the load and, in bistables, on the cross-coupling resistor values. Collector voltages are in the order of -10.5 volts.

(3) EVALUATION OF MEASUREMENTS.- Tables 4-3 through 4-7 summarize abnormal indications that may result, indicating (for each) probable causes and suggested corrective actions.

TABLE 4-3. GENERAL LOGIC-CIRCUIT (PNP TRANSISTOR) TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Collector voltage remains near 0 volt, with positive base-to-emitter bias.	Defective transistor or short-circuited load resistance.	Unsolder collector lead from circuit, and measure resistance (to ground) from point in circuit from which lead was removed. Refer to appropriate schematic to determine whether or not measured resistance is normal for circuit. If external circuit is shorted, replace defective resistor.
2. Collector voltage remains near -10.5 volts with base-to-emitter voltage in order of -0.4 volt.	Defective transistor.	Replace transistor.
3. Base-to-emitter voltage in order of -7 to -10 volts (value determined by resistor network furnishing input to base).	Defective transistor.	Replace transistor.
4. Excessively positive bias on base.	Defective base-to-positive-supply resistor or coupling resistor.	Replace transistor.
5. -12 volts on collector.	Defective collector load resistor.	Replace resistor.
6. Positive potential on collector of transistor.	Open-circuited collector load resistor.	Replace resistor.

TABLE 4-4. GENERAL LOGIC-CIRCUIT (NPN TRANSISTOR) TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Collector voltage remains near -12 volts with negative base-to-emitter bias.	Defective or short-circuited load resistance.	
2. Collector voltage remains near 0 volt with base-to-emitter voltage in order of +0.4 volt.	Defective transistor.	Replace transistor.
3. Base-to-emitter voltage in order of +7 to +10 volts (value determined by resistor network furnishing input to base).	Defective transistor.	Replace transistor.
4. Excessively negative bias on base.	Defective base-to-negative supply resistor or coupling resistor.	Replace transistor.
5. 0 volt on collector of conducting transistor.	Defective collector load resistor.	Replace transistor.
6. Negative potential on collector of transistor.	Open-circuit collector load resistor.	Replace resistor.

TABLE 4-5. DIODE AND-GATE TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	CORRECTION
-12 volts on junction of cathodes, with 0 volt applied to one anode and -12 volts to other.	Shorted or opened diode.	Measure forward resistance of diode to which 0 volt was applied; should be on the order of 7 or 8 ohms. If high resistance, replace diode. If normal, replace diode to which -12 volts was applied.

TABLE 4-6. BISTABLE TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Excessive rise-or fall-time.	Open-circuited coupling capacitor.	Replace capacitor connected to base of transistor which

TABLE 4-6. BISTABLE TROUBLE SHOOTING CHART (Cont'd)

TROUBLE	PROBABLE CAUSE	CORRECTION
		switches from cut-off to conduction at unsatisfactory rate.
2. Bistable switches normally when operated by shorting base to emitter, but not when triggered in normal manner.	Defective triggering circuit component.	Check forward-resistance of triggering diodes, where used. Replace diode, if high (should be on order of 7 or 8 ohms). Check defective coupling capacitor or bias resistor. Replace, if defective.

SECTION 5

MAINTENANCE

5-1. FAILURE, AND PERFORMANCE AND OPERATIONAL REPORTS.

5-2. PREVENTIVE MAINTENANCE.

a. OPERATOR'S PROCEDURE. - The operator of the TH-73 should perform the procedure in (2) below at daily intervals, or, if the unit is used only intermittently, prior to each use. Materials required are given in (1) below.

(1) MATERIALS REQUIRED. - The only materials required for the operator's preventive maintenance procedures are Cleaning Compound (Federal Stock No. 7930-395-9542) and some dry lint-free cloths.

(2) PROCEDURE. - Proceed as described below.

(a) Use a clean cloth to remove dust, dirt, moisture, or grease from the front panel and controls. If necessary, dampen the cloth with cleaning compound, then wipe the panel and controls with a clean dry cloth.

(b) Check to see that all controls operate smoothly with no binding in any position. Check for proper indexing of rotary selector switches. All knobs should be tight on shafts.

(c) Inspect line cord and plug for evidence of wear, cuts, kinks, or poor electrical connection.

(d) Inspect front panel LOOP OUTPUT jack for security and inspect 25 rear panel character matrix board strap connectors for completeness and secureness.

b. TECHNICIAN'S PROCEDURE. - The procedure given in (2) below should be performed by a maintenance technician at monthly intervals if the TH-73 is used intermittently or at weekly intervals if the TH-73 is subject to repeated daily use.

(1) REQUIRED TEST EQUIPMENT AND MATERIALS. - Equipment and materials used for testing the TH-73 are listed in Table 5-1, which also specifies the quantity required and the common name by which each is called in subsequent procedural text.

TABLE 5-1. TEST EQUIPMENT AND MATERIAL REQUIRED FOR PREVENTIVE MAINTENANCE

QTY PER EQUIP	NOMENCLATURE		COMMON NAME
	NAME	DESIGNATION	
1	Frequency Counter	AN/USM-207	Counter
1	Test Set, Teletypewriter	AN/GGM-1	Test set

(2) PROCEDURE. - Proceed as described below.

(a) OSCILLATOR. - The TH-73 has for four oscillator circuits, each producing a different frequency. The components that make up the oscillator circuits are mounted on Assemblies A1 and A2.

1 Remove TH-73 from rack, and apply power. Operate POWER switch to on position.

2 Operate RATE, BAUDS switch to 37.5 position on SYNC scale. Operate MODE switch to MANUAL and SYNC, and then check for 78.5kc at test-point TP1 on printed-circuit card A4.

3 Using counter, check that frequency indicated below is obtained for specified RATE, BAUDS switch setting.

RATE, BAUDS switch setting	Mode	Frequency
37.5	synchronous	76.8kc
45.5	start-stop	93.237kc
61.13	synchronous	125.217kc
74.2	start-stop	152.016kc

4 If correct indication is not obtained, adjust associated oscillator trimmer to bring frequency into range. Since only the 76.8kc and 125.217kc oscillators have trimmers, out-of-limit frequency indication for the other oscillators point out a circuit defect.

(b) TIMING CIRCUIT. - Measure frequency at points indicated in Table 4-2 to determine that the timing circuits are operating properly.

5-3. REPAIR PROCEDURES AND DATA.

a. REMOVAL AND DISASSEMBLY PROCEDURES.

(1) TH-73 REMOVAL.

(a) Loosen front-panel captive screw, at bottom just above the handle.

(b) Pull straight out.

(2) PRINTED-CIRCUIT ASSEMBLY REMOVAL. - Remove any printed-circuit assembly, A1 through A15, by lifting the extractor handle and pulling the card straight out.

(3) HARNESS BOARD REMOVAL.

(a) Remove all printed-circuit cards, as described in (2), above.

(b) Remove screws holding harness board to chassis.

(4) FRONT-PANEL REMOVAL. - To gain access to components and wiring on rear of front panel, remove four screws holding front panel to side panels, and carefully pull front panel forward.

b. TRANSISTOR REPLACEMENT AND PRINTED-CIRCUIT-CARD REPAIR. - To avoid damage to transistors and printed-circuit cards, follow the procedures provided in (1) and (2), below, when replacing transistors or repairing a printed-circuit card.

(1) TRANSISTOR REPLACEMENT TECHNIQUES. - Extremely sensitive to heat, transistors may be destroyed if subjected to excessive temperatures for even short periods of time. For this reason, the soldering technique used in transistor replacement is extremely important.

(a) Whenever possible, use a low-powered soldering iron, preferably 25 watts maximum. Provide a heat sink of some sort between the soldering iron and the transistor lead. This is easily done by grasping the transistor lead being soldered (using long-nosed pliers) just above point of soldering iron contact. The pliers will absorb excess heat before it is conducted to the transistor. Use of the heat sink is essential, and should be employed whenever a soldering iron contacts a transistor lead.

(b) Apply the soldering iron to the transistor lead only long enough to melt the solder. Never bring the soldering iron into contact with the body of the transistor, or metal that is in direct contact with the body of the transistor.

(c) Transistor connection points on the printed-circuit card are not keyed. To avoid the possibility of inserting the replacement transistor backwards (which would reverse the connections to the emitter and collector), mark the emitter-terminal connection point on the printed-circuit card, before removing the transistor. Refer to figures 5-1, 5-3, 5-5, 5-7, 5-9, 5-11, 5-13, 5-15, 5-17, 5-19, 5-20, and 5-21 for location of transistors and other components on printed-circuit cards. Schematic diagrams of the cards are provided in figures 5-2, 5-4, 5-6, 5-8, 5-10, 5-12, 5-14, 5-16, and 5-18, respectively.

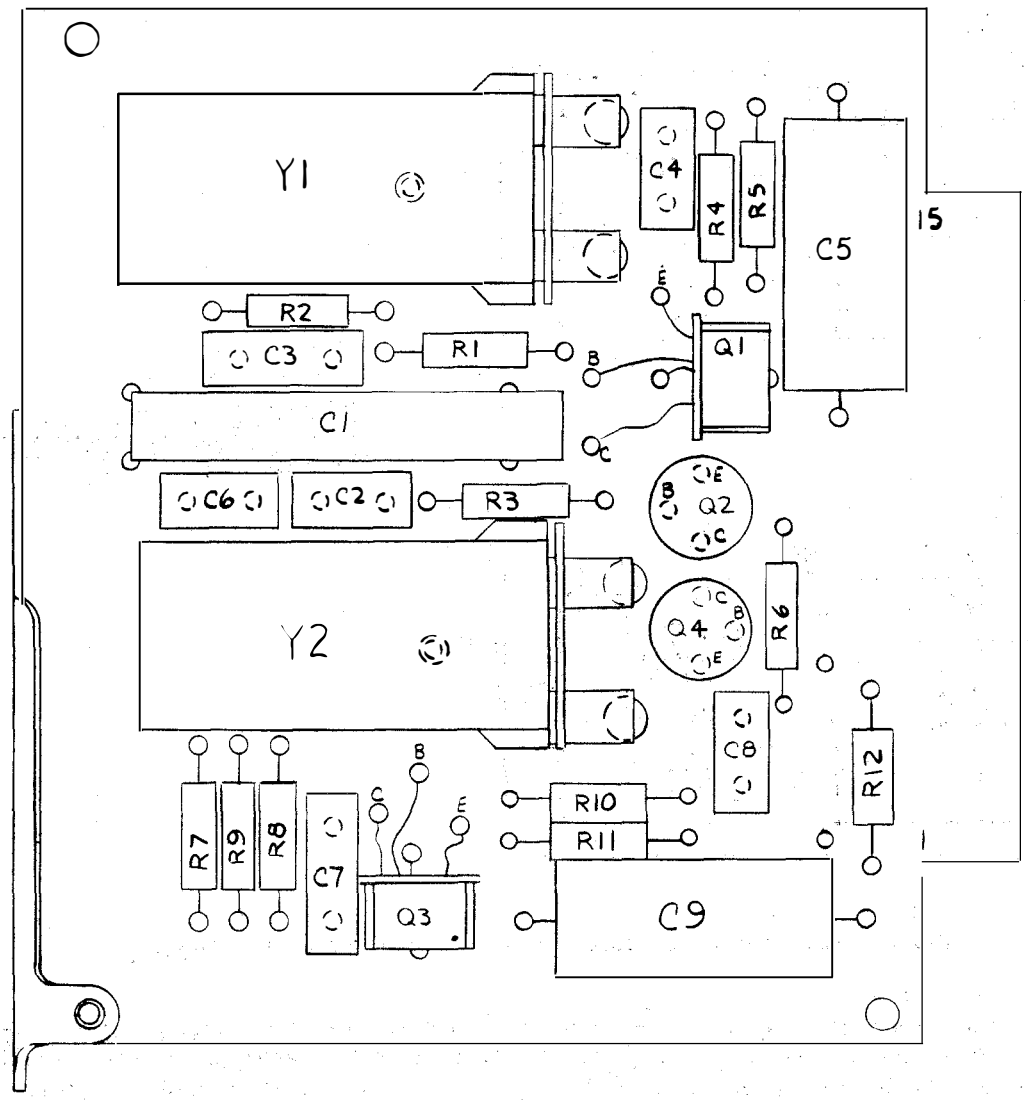
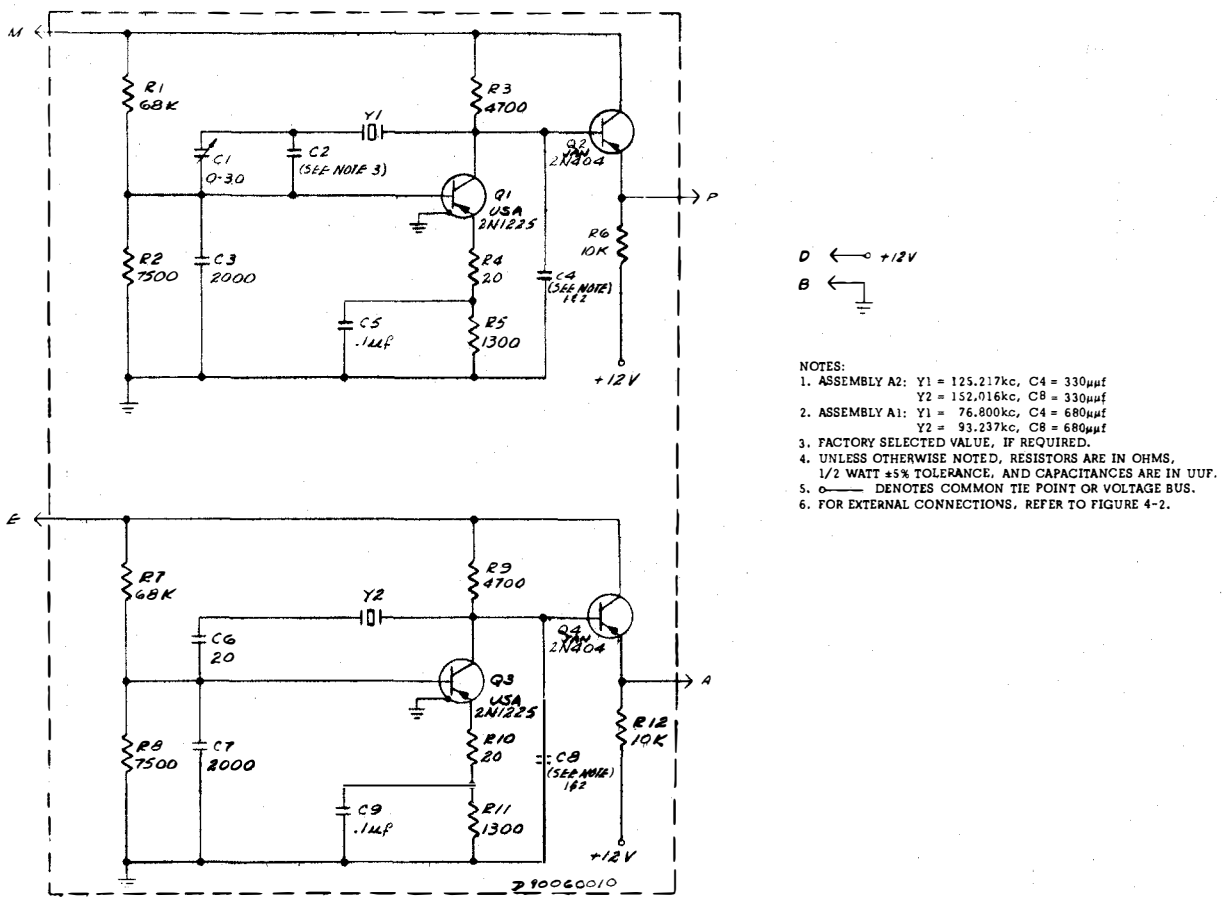


Figure 5-1. Printed Circuit Cards A1 and A2 (80060010) Component Location Diagram

(d) Some soldering irons, when plugged into the ac line, have a voltage existing between the metal body of the iron and earth ground. This voltage may cause leakage currents that can destroy a transistor when the iron is brought into contact with a transistor lead if the printed-circuit card or the Distortion Test Set case is connected to ground. Such effects can be nullified by coneting a jumper lead from the metal body of the iron, to the ground point of the printed-circuit card or to the chassis or GRD terminal of the Distortion Test Set.

(2) PRINTED-CIRCUIT REPAIR TECHNIQUES. - Printed-circuit repair is more difficult and requires more skill than conventional-equipment repair. The following discussion describes acceptable procedures for replacing components and servicing printed-circuit cards, and identifies the tools and materials required for performing these procedures. Read these instructions carefully before attempting any printed-circuit repair; follow them scrupulously while performing any repair.

(a) GENERAL. - Since the cost of a printed-circuit card is high, particularly when compared with that of any individual component, never try to save the component at the expense of a printed-circuit card. Most components may be clipped from the card, thereby protecting the card's printed-circuit conductor (i.e., the copper foil beneath the visible solder coating) and preventing



NOTES:
1. ASSEMBLY A2: Y1 = 125.217kc, C4 = 330μμf
   Y2 = 152.016kc, C8 = 330μμf
2. ASSEMBLY A1: Y1 = 76.800kc, C4 = 680μμf
   Y2 = 93.237kc, C8 = 680μμf
3. FACTORY SELECTED VALUE, IF REQUIRED.
4. UNLESS OTHERWISE NOTED, RESISTORS ARE IN OHMS, 1/2 WATT ±5% TOLERANCE, AND CAPACITANCES ARE IN UUF.
5. o—— DENOTES COMMON TIE POINT OR VOLTAGE BUS.
6. FOR EXTERNAL CONNECTIONS, REFER TO FIGURE 4-2.

Figure 5-2. Printed Circuit Cards A1 and A2 Schematic Diagram

any undue component damage. In using the soldering iron to remove the leads of a clipped-off component, to connect a new component, or to repair the printed-circuit card itself, take care when applying the iron to the printed-circuit card. These cards are easily damaged by heat; prolonged application of heat destroys the adhesiveness of the bonding agent that holds the printed-circuit conductor to the card.

(b) SPECIAL EQUIPMENT REQUIRED.

1 Pencil-type soldering iron, 25 watts maximum, 3/16-inch diameter tip.
2 Twist drill and assorted bits, numbers 30 through 60.
3 Wire clipper (diagonal cutting pliers).
4 Long-nose pliers.
5 One-half inch brush.
6 Rosin-alcohol solder flux.
7 Alcohol.
8 Knife, metal pick, or equivalent.

(c) REMOVING A DEFECTIVE COMPONENT.

1 REMOVING PROTECTIVE COATING. - Using the metal pick, knife, or equivalent, chip the card's protective coating (epoxy) from the component leads and from the area surrounding its juncture to the card. If necessary, first soften the coating by applying the tip of a hot pencil-type soldering iron, taking care to keep the iron away from any printed-circuit conductor (foil); then scrape the softened coating away. Do not use solvent to remove the coating.

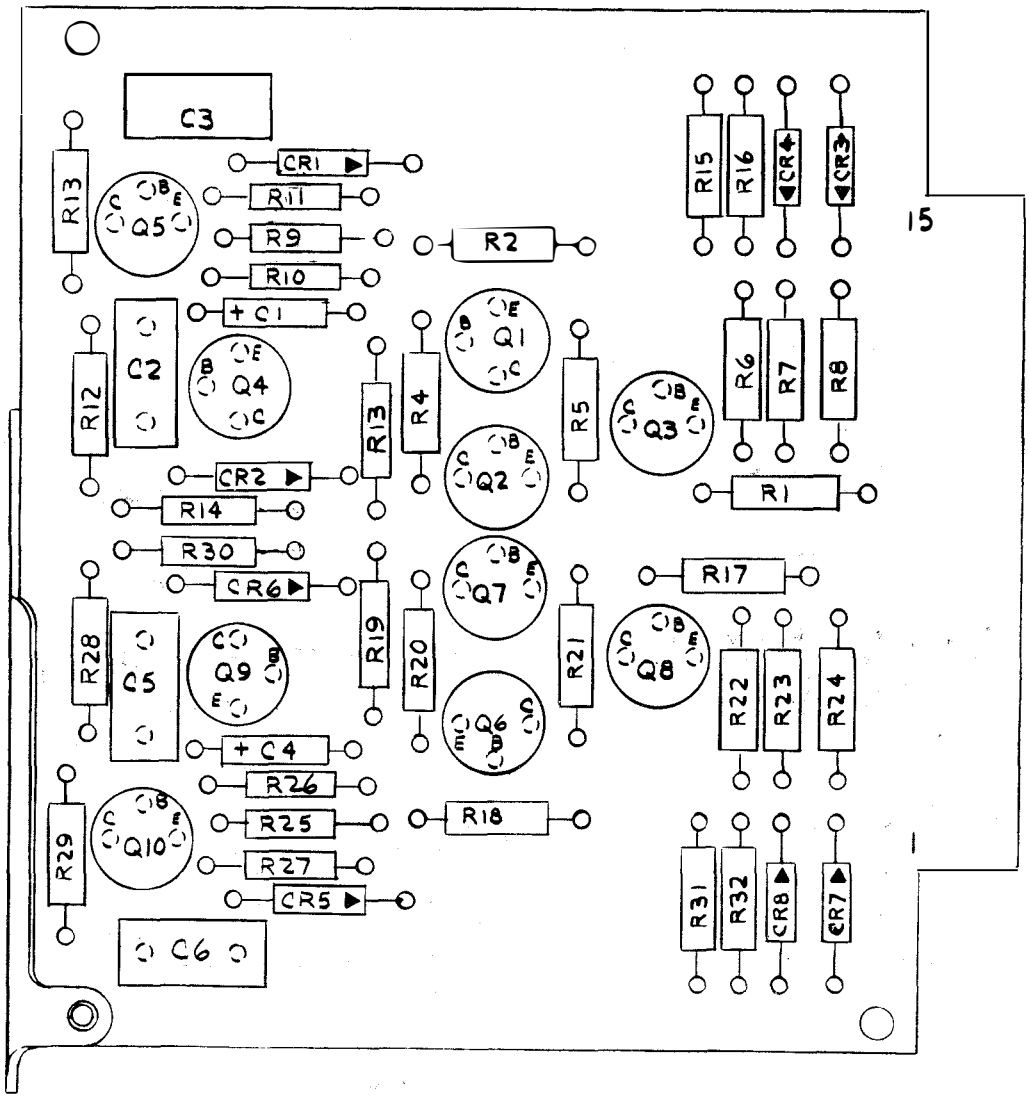


Figure 5-3. Printed Circuit Card A3 (80060020) Component Location Diagram

2 CLIPPING OUT THE COMPONENT. - Using the wire clipper, cut (close to the lead hole, but allowing some of the lead to extend through the hole) both leads of the component, and remove the component. Carefully straighten the lead end that extends through each hole, so that it may be easily withdrawn as described in 3, below.

3 UNSOLDERING LEAD ENDS. - Exerting minimum pressure, apply the tip of a hot pencil-type soldering iron to the tip of the lead end. (Keep the iron away from the printed-circuit foil.) As the lead end absorbs the heat, the solder will melt and the lead will break from its juncture to the printed-circuit foil. Remove the soldering iron immediately, and, using the pliers, quickly pull the lead free; brush away excess solder. Do not force or twist the lead to remove it from the card.

4 CLEANING LEAD HOLE. - As the lead end is removed, solder may flow into the open hole and cause shorts on the printed-circuit foil. To remove the solder, tap the card gently while the solder is soft. Should this fail to clean out the hole, carefully drill (using a drill bit of appropriate size) out the solder. Apply the drill to the printed-circuit side of the card; drilling from the other side may ruin the card by loosening the foil as the drill passes through it.

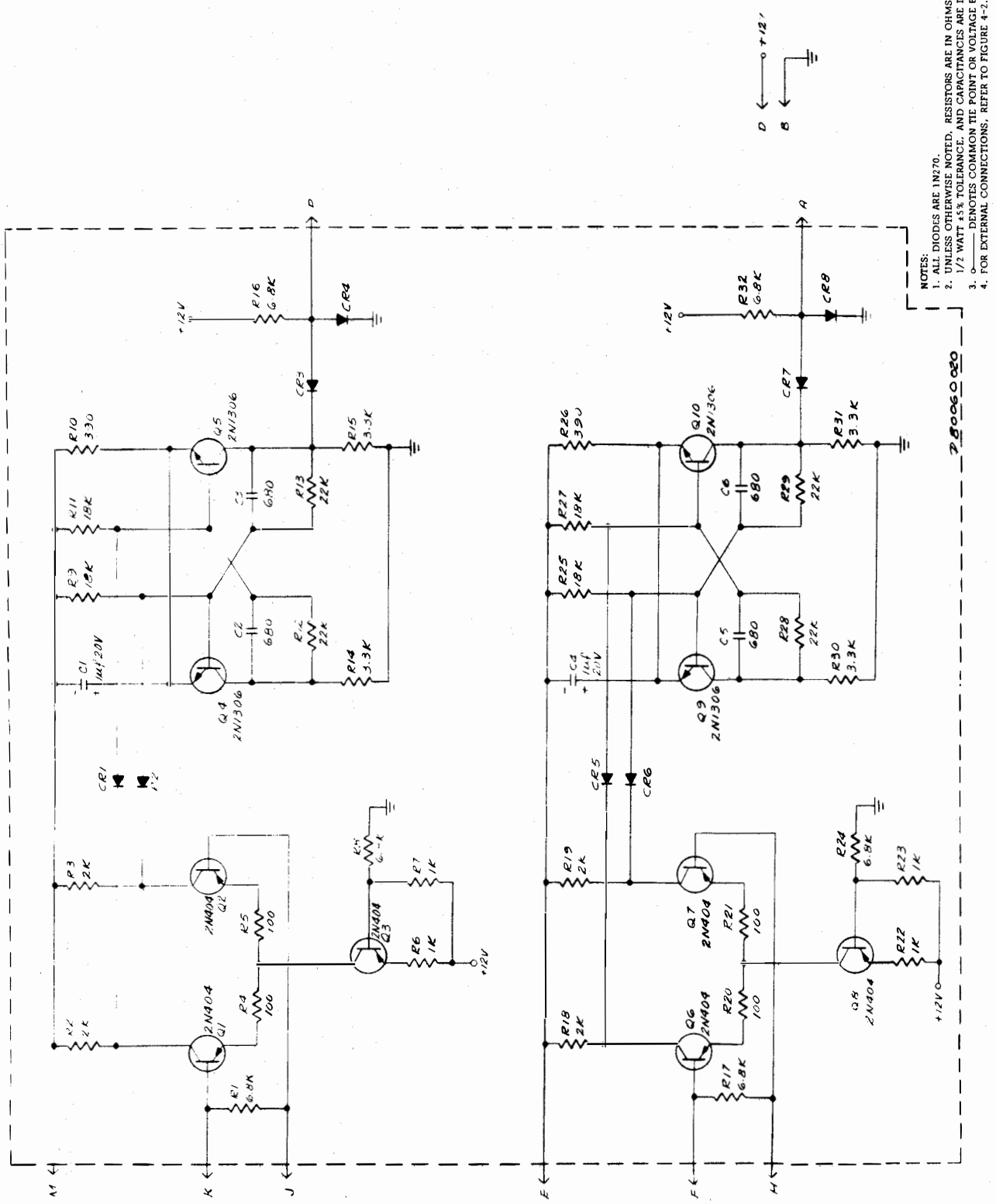


Figure 5-4. Printed Circuit Card A3 Schematic Diagram

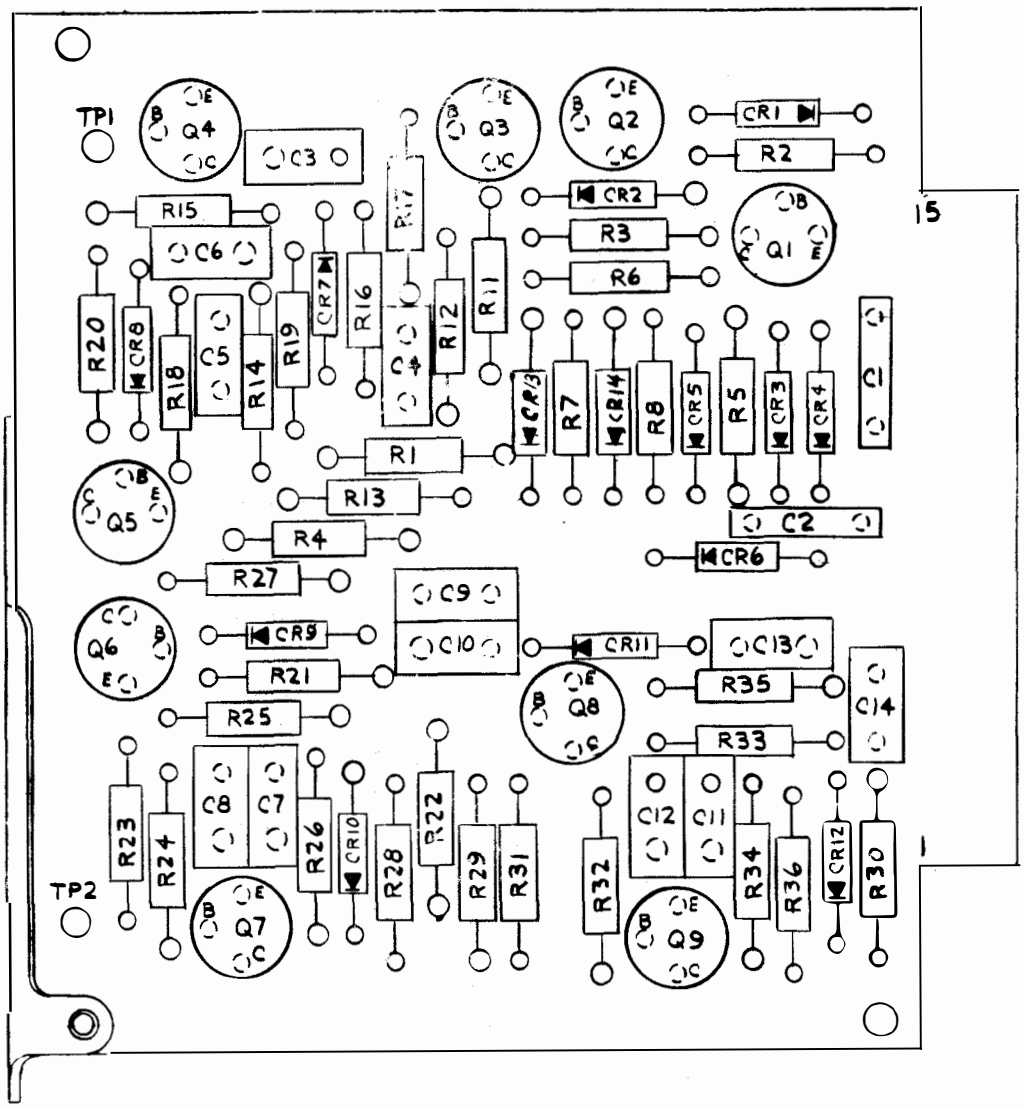


Figure 5-5. Printed Circuit Card A4 (80060030) Component Location Diagram

(d) INSTALLING NEW COMPONENT.

1 Using a knife, scrape the leads of the component to be installed.

2 Bend the leads so that they fit snugly into the holes where the component is to be installed. Mount the component on the card, gently pushing the leads through the holes. Bend each end of the lead close to the foil.

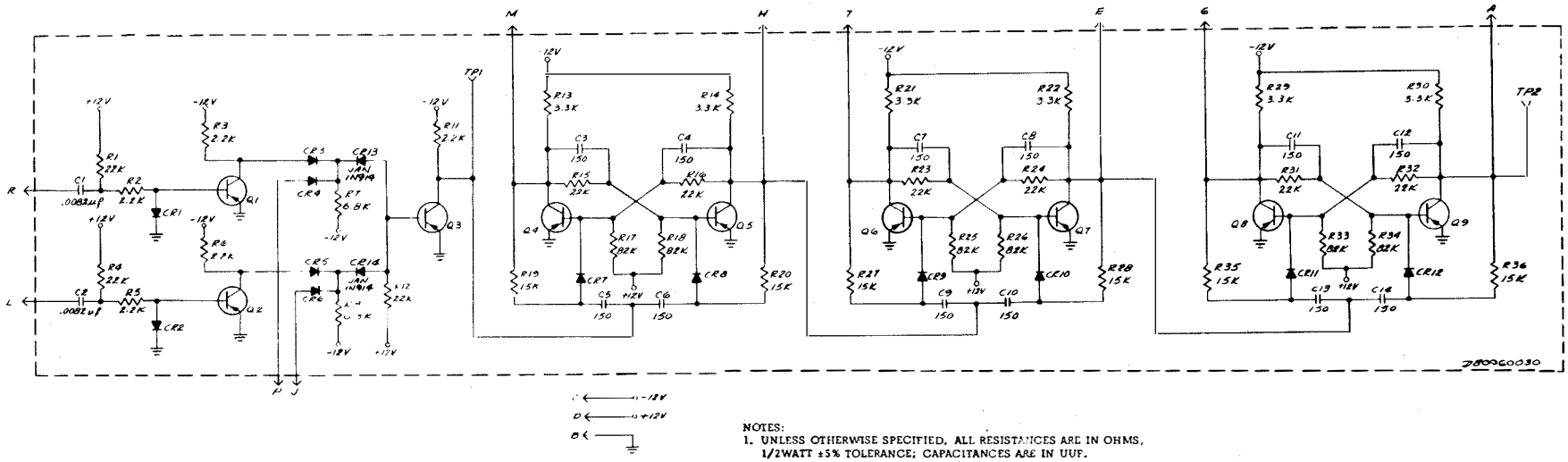
3 Apply flux to the joint. Touch the lead with the tip of the hot soldering iron, and apply a small amount of fluxless 60/40 solder to the junction.

4 Remove the soldering iron as soon as solder flows into the joint. Hold the component firmly until the solder sets.

5 Using a small amount of alcohol, remove excess flux.

6 Once the solder cools, check that the joint is secure and clean. Remove any solder that may have flowed onto the foil, thereby eliminating the possibility of a short circuit.

(e) REPAIRING PRINTED-CIRCUIT CONDUCTOR. - The printed-circuit conductor is, essentially, the thin copper foil which effects required connections to the circuit components; it is bonded to the card proper and is covered by a solder coating. Although the printed-circuit conductor



NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCES ARE IN OHMS, 1/2WATT ±5% TOLERANCE; CAPACITANCES ARE IN UUF.
2. o—— DENOTES COMMON TIE POINT OR VOLTAGE BUS.
3. UNLESS OTHERWISE SPECIFIED, ALL TRANSISTORS ARE 2N404.
4. UNLESS OTHERWISE SPECIFIED, ALL DIODES ARE 1N270.
5. FOR EXTERNAL CONNECTIONS, REFER TO FIGURE 4-2.

Figure 5-6. Printed Circuit Card A4 Schematic Diagram

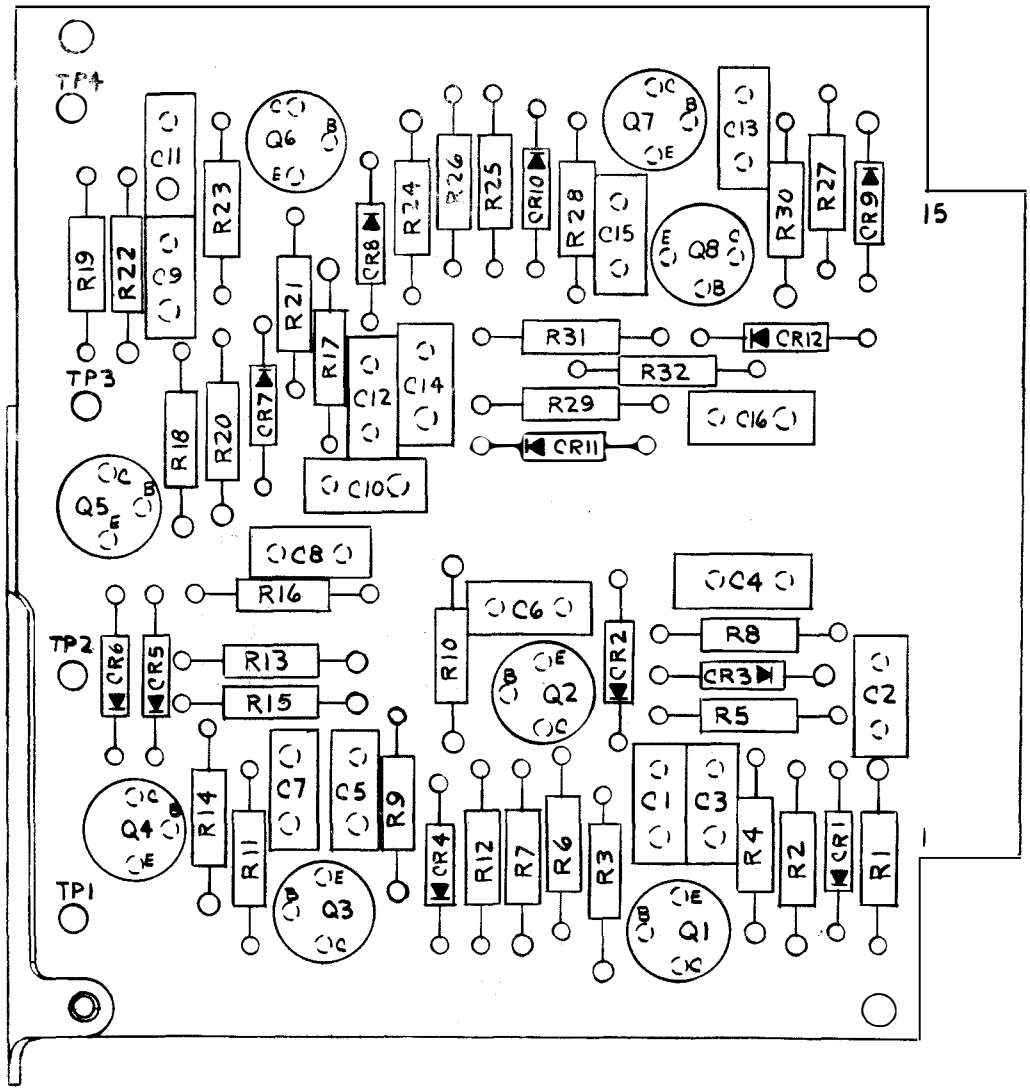


Figure 5-7. Printed Circuit Cards A5, A7, A10, and A13 (80060040) Component Location Diagram

can withstand proper handling and will operate with no trouble under normal rated service conditions, it is liable to damage. Should any part of the conductor be damaged (i.e., split or raised from the card proper), perform required repairs as follows:

1 When part of the conductor has raised from the card, remove it by snipping both its ends close to the card; a split in the conductor does not require cutting.

2 Bend a piece of tinned 20- or 22-gauge copper wire into the shape of a staple. The staple should be long enough to span defective portion of the conductor and to allow clinching at approximately one-fourth of an inch from either end, once placed into position on the printed-circuit card.

3 From the printed-circuit side of the card, drill two small holes (of proper size) to receive the staple ends. Unless the printed-circuit conductor is approximately one-fourth of an inch wide, do not drill these holes directly into the foil, but drill them near enough so that the staple is parallel to the foil. Should the foil be one-fourth of an inch wide, drill the two holes directly into the

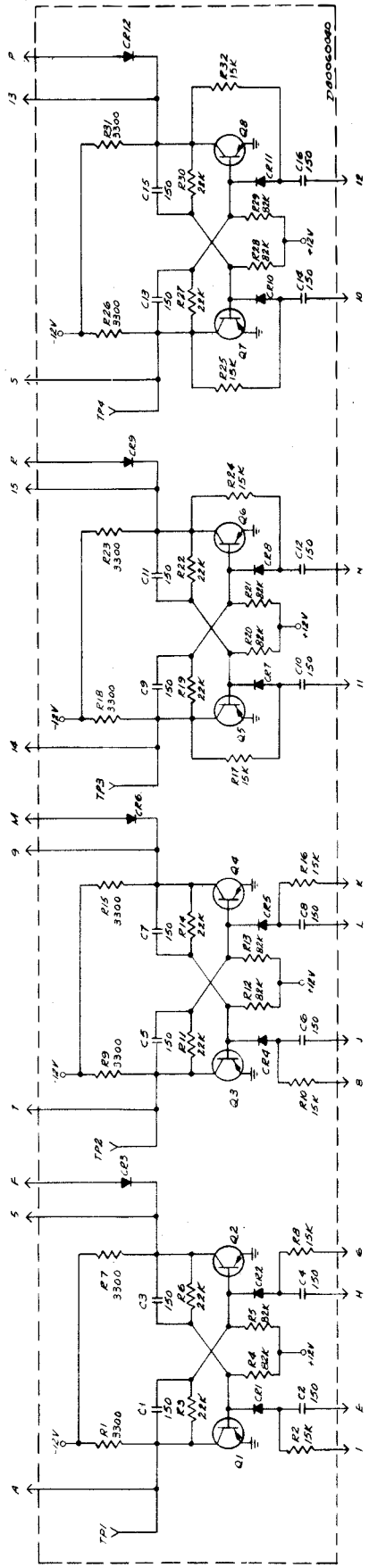


Figure 5-8. Printed Circuit Cards A5, A7, A10, and A13 Schematic Diagram

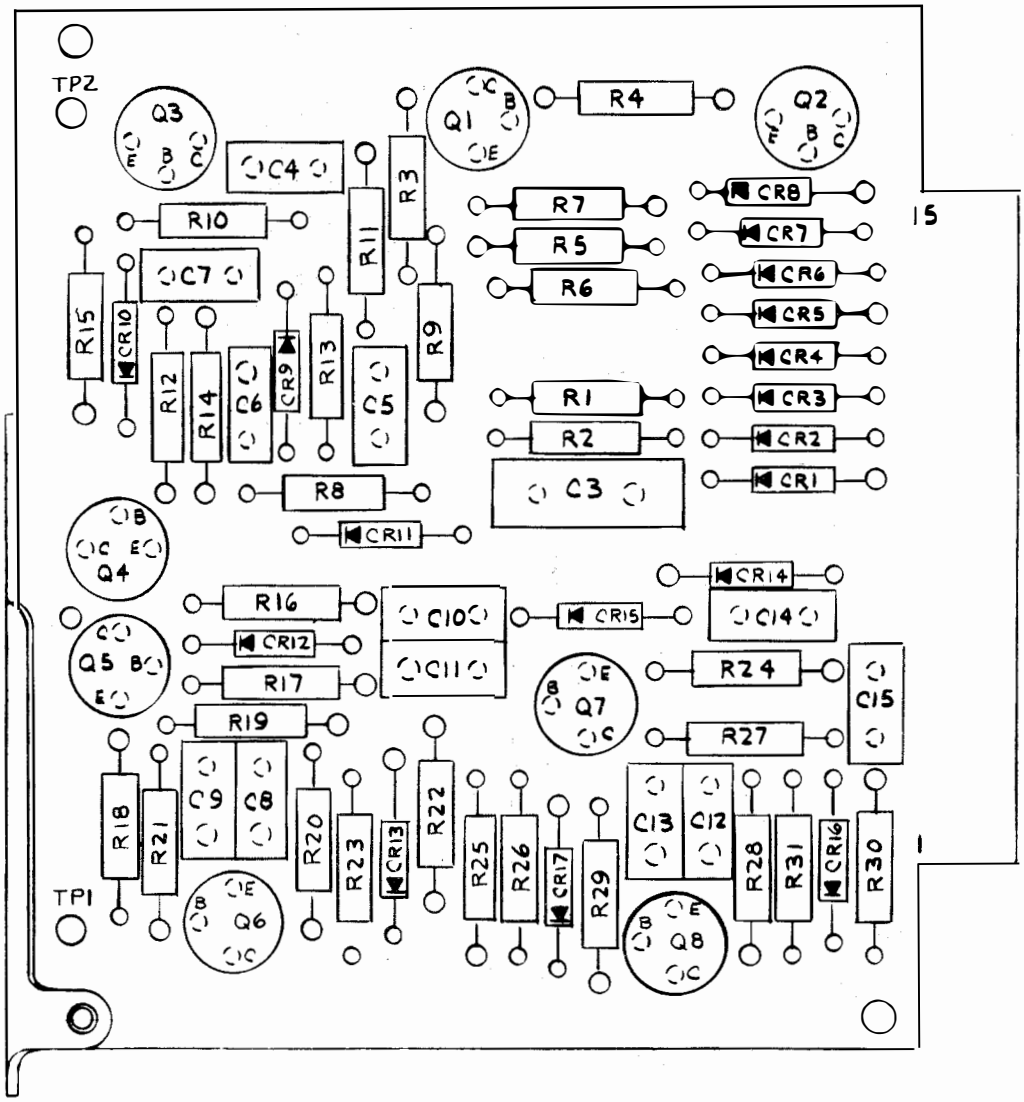


Figure 5-9. Printed Circuit Cards A6, A8, and A12 (80060050) Component Location Diagram

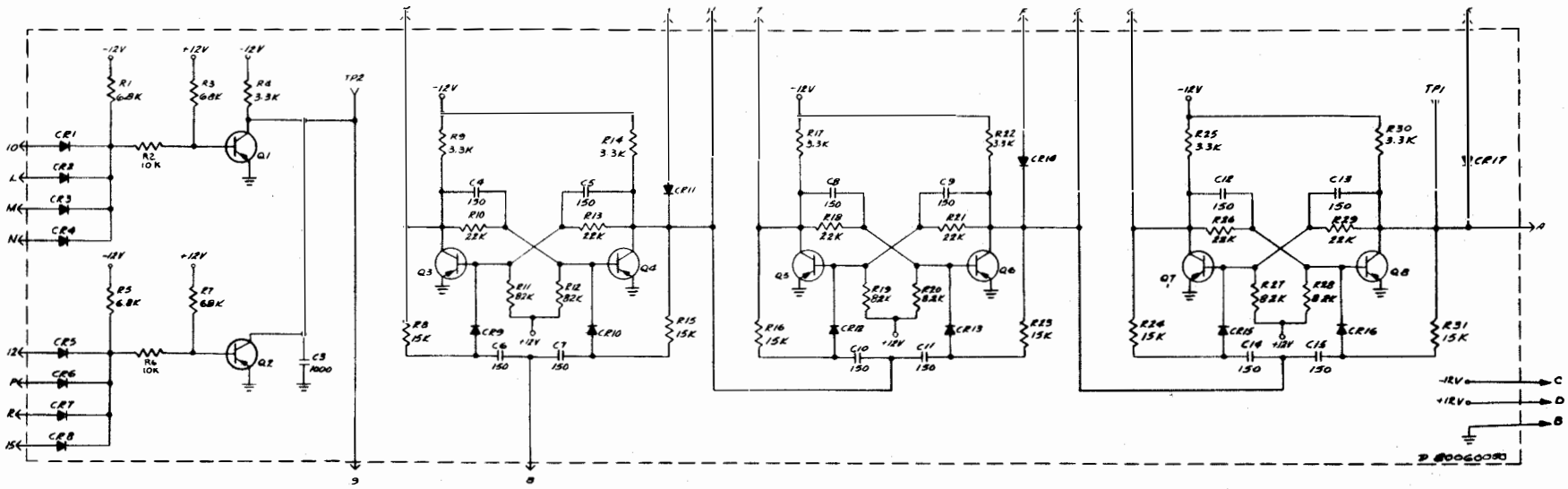
printed-circuit foil. If the repair is not in a congested printed-circuit area, proceed to step 4, below. Otherwise, insert the staple from the component side of the card, and, on the other side, clinch each end diagonally across the printed-circuit conductor. Then proceed to step 5, below.

4 If room permits, drill two extra holes in the printed-circuit card, each one adjacent to the one of the previously drilled holes. From the printed-circuit side of the card, insert the staple ends into the holes furthest from the area under repair. Holding the staple flush against the card, bend each end back through to the adjacent hole closest to it. Pulling it taut, clinch each lead end across the printed-circuit conductor.

5 Solder the two joints as described in paragraph 4, above.

c. REPLACING FACTORY-SELECT COMPONENTS. - If a factory-select component is to be replaced in the time base oscillator circuit (refer to the parts list for component assortment values), proceed as described below:

(1) Remove the defective component, and replace it with a decade box (resistance or capacitance, depending on the type of component to be replaced).



NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCES ARE IN OHMS, 1/2WATT ±5% TOLERANCE; CAPACITANCES ARE IN UUF.
2. o——— DENOTES COMMON TIE POINT OR VOLTAGE BUS.
3. UNLESS OTHERWISE SPECIFIED, ALL TRANSISTORS ARE 2N404.
4. UNLESS OTHERWISE SPECIFIED, ALL DIODES ARE 1N270.
5. FOR EXTERNAL CONNECTIONS, REFER TO FIGURE 4-2.

Figure 5-10. Printed Circuit Cards A6, A8, and A12 Schematic Diagram

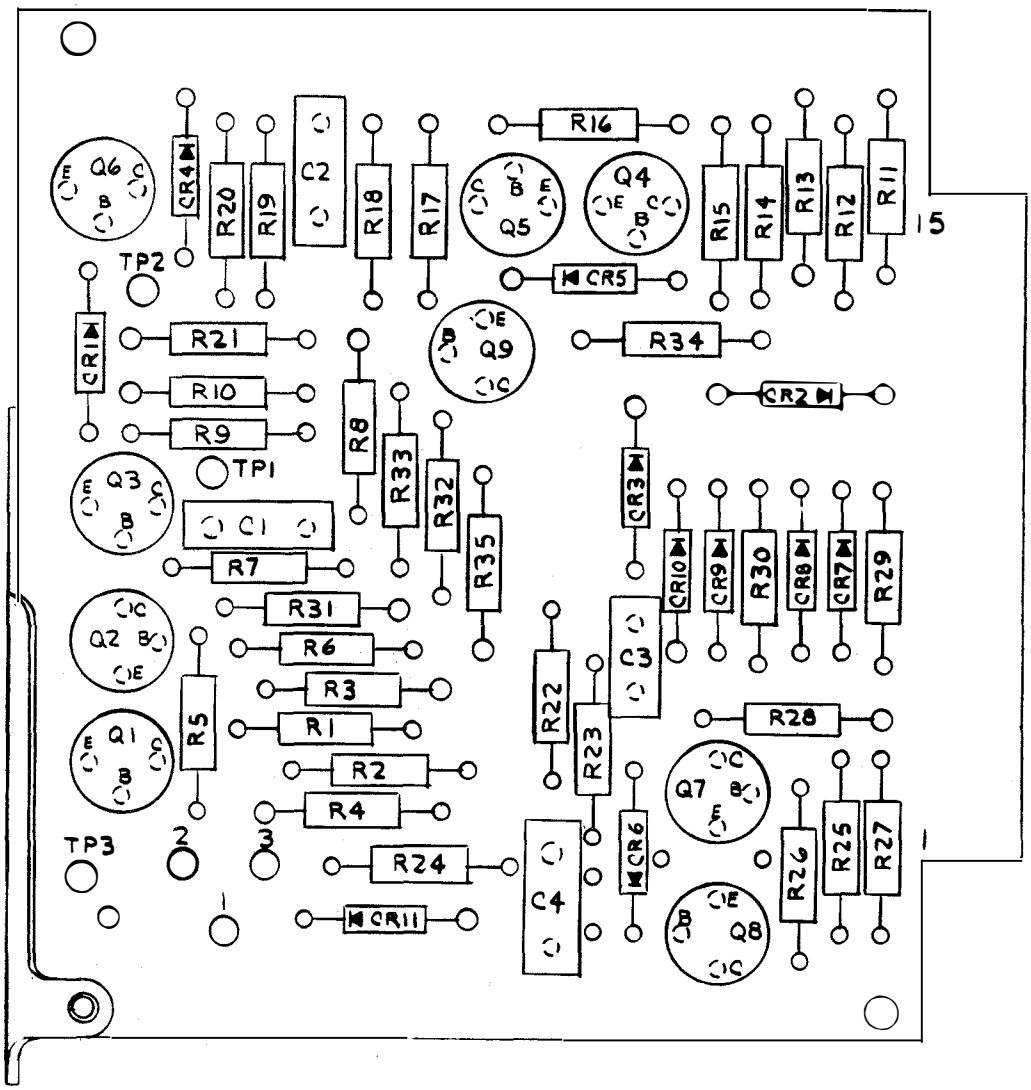


Figure 5-11. Printed Circuit Card A9 (80060060) Component Location Diagram

(2) Adjust the decade box controls until the required frequency counter indication is correct.

(3) Observe the setting of the decade box controls; remove the decade box and install a component equal in value to that indicated by the decade box controls.

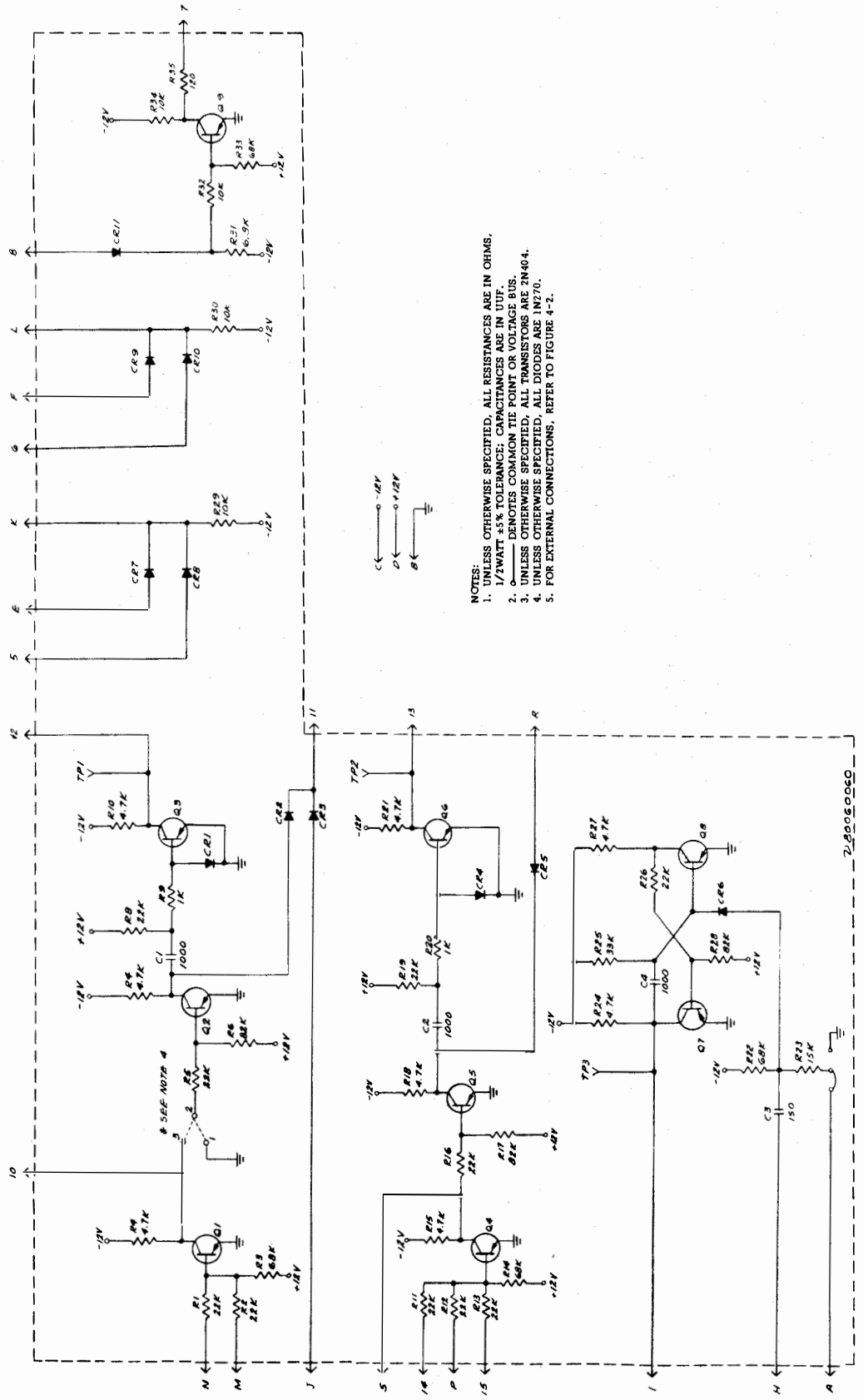


Figure 5-12. Printed Circuit Card A9 Schematic Diagram

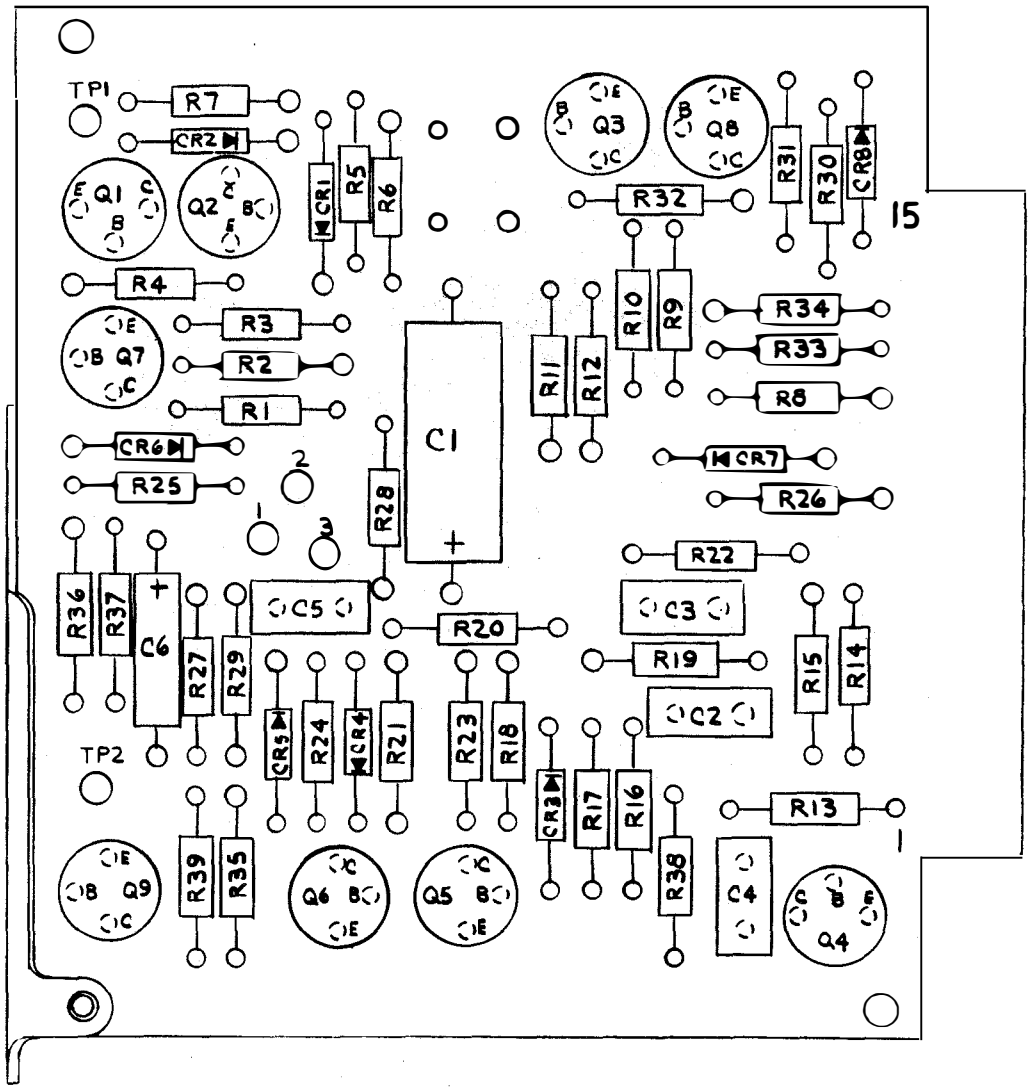
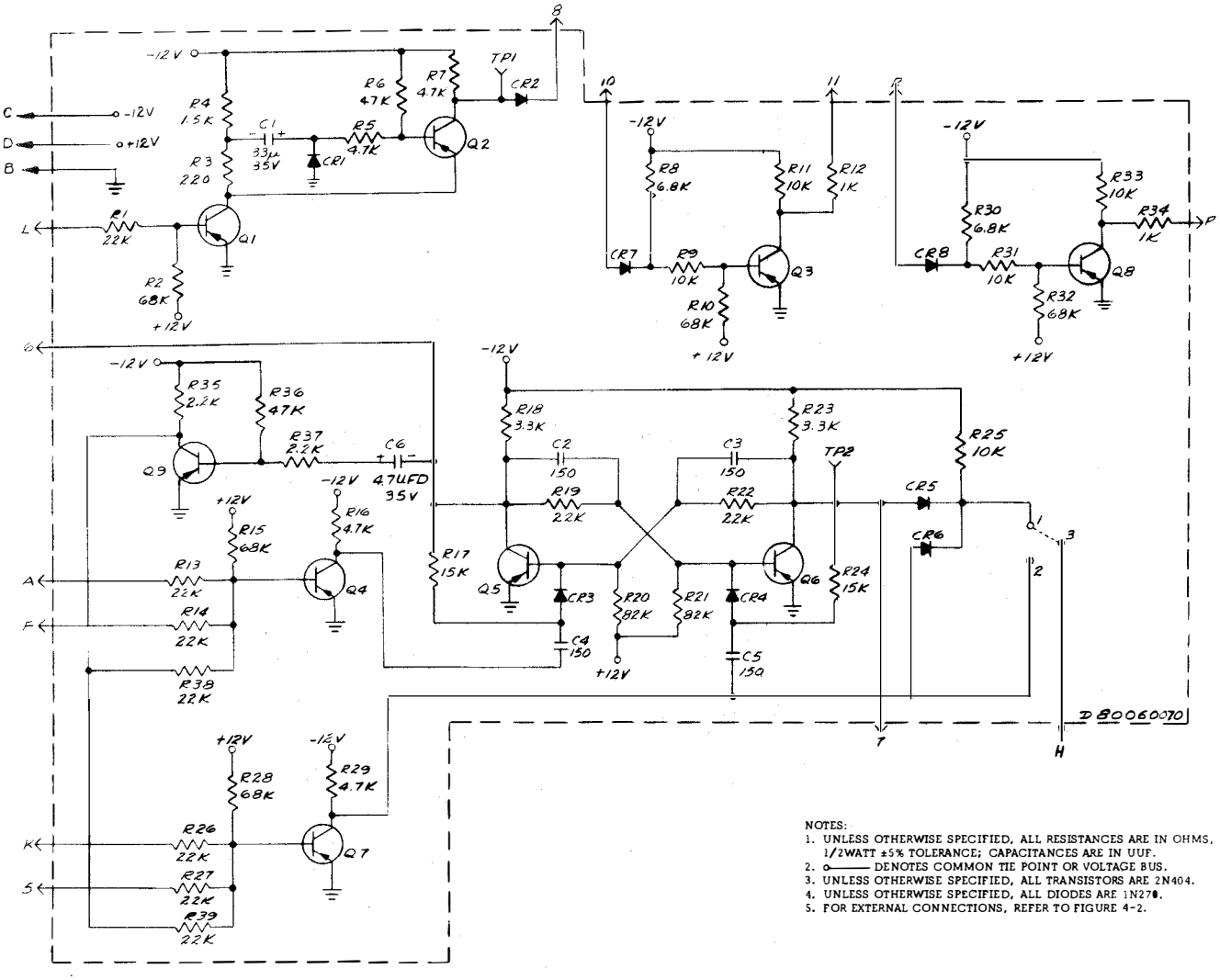


Figure 5-13. Printed Circuit Card A11 (80060070) Component Location Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCES ARE IN OHMS, 1/2WATT ±5% TOLERANCE; CAPACITANCES ARE IN UUF.
2. o——— DENOTES COMMON TIE POINT OR VOLTAGE BUS.
3. UNLESS OTHERWISE SPECIFIED, ALL TRANSISTORS ARE 2N404.
4. UNLESS OTHERWISE SPECIFIED, ALL DIODES ARE 1N270.
5. FOR EXTERNAL CONNECTIONS, REFER TO FIGURE 4-2.

Figure 5-14. Printed Circuit Card A11 Schematic Diagram

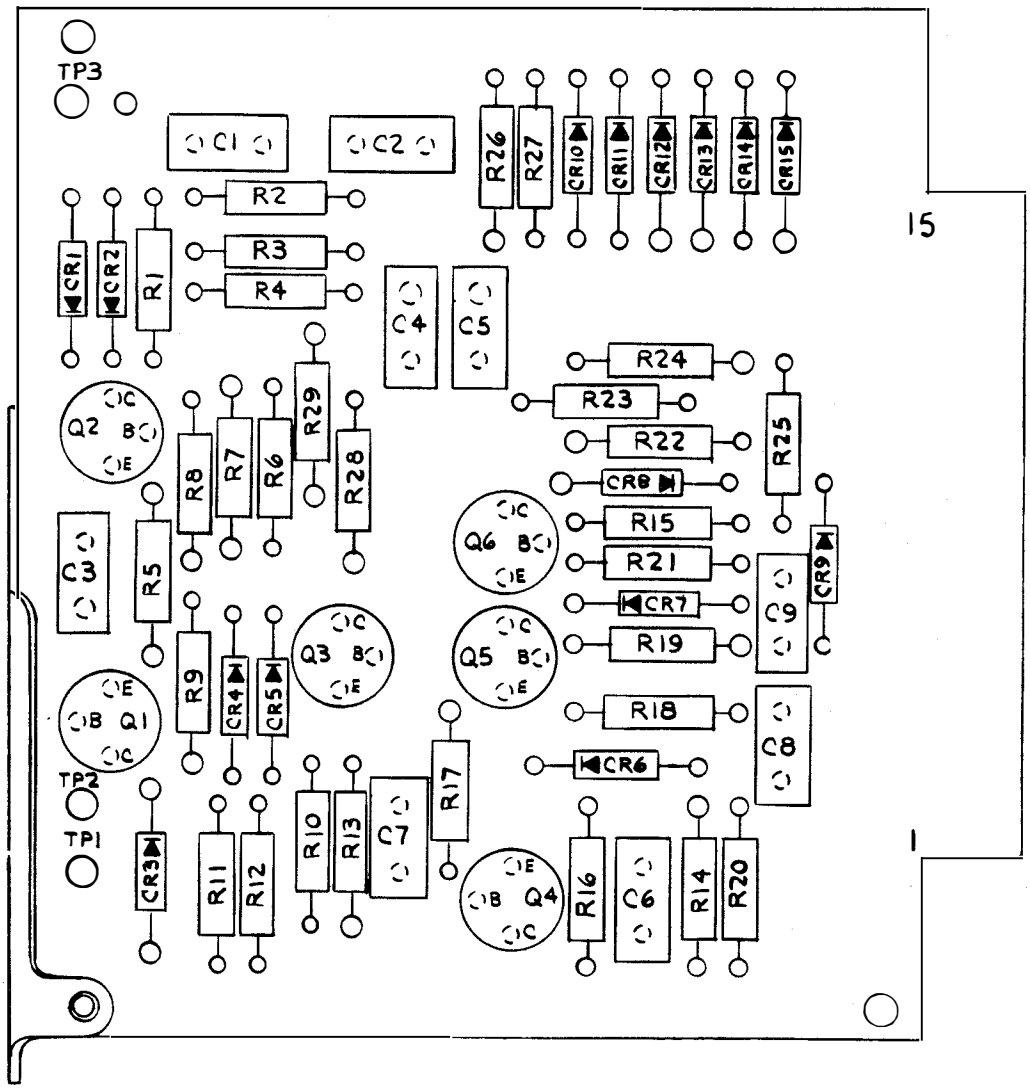


Figure 5-15. Printed Circuit Card A14 (80060080) Component Location Diagram

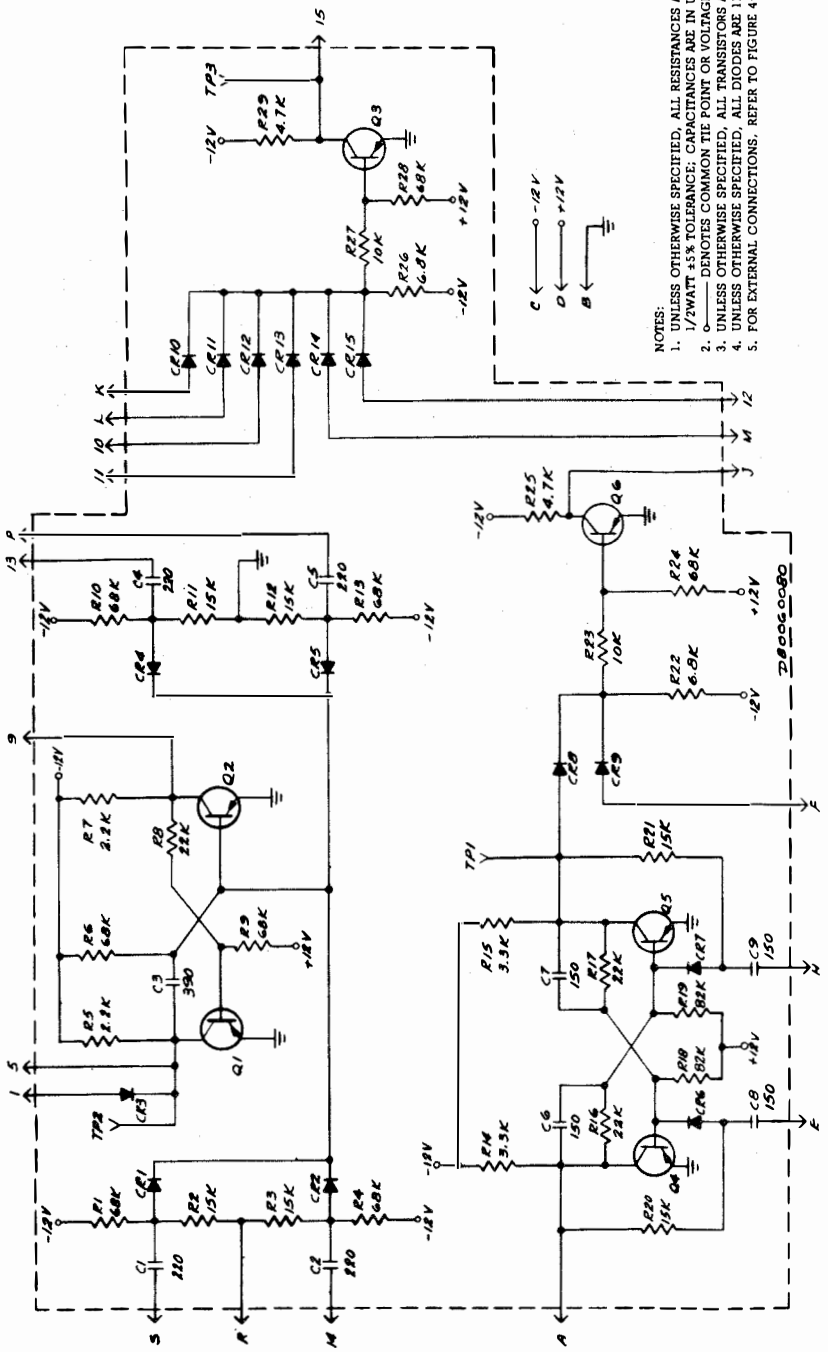


Figure 5-16. Printed Circuit Card A14 Schematic Diagram

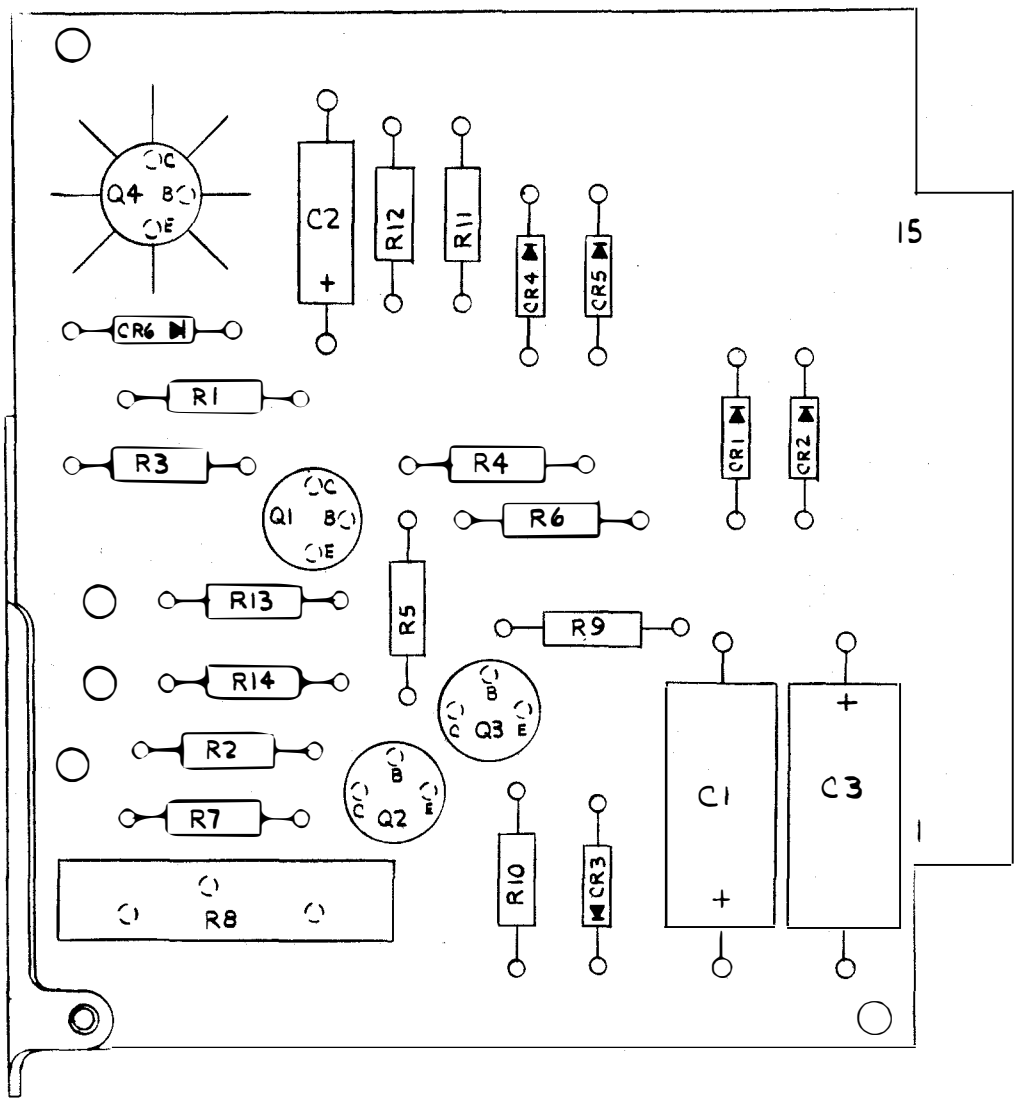
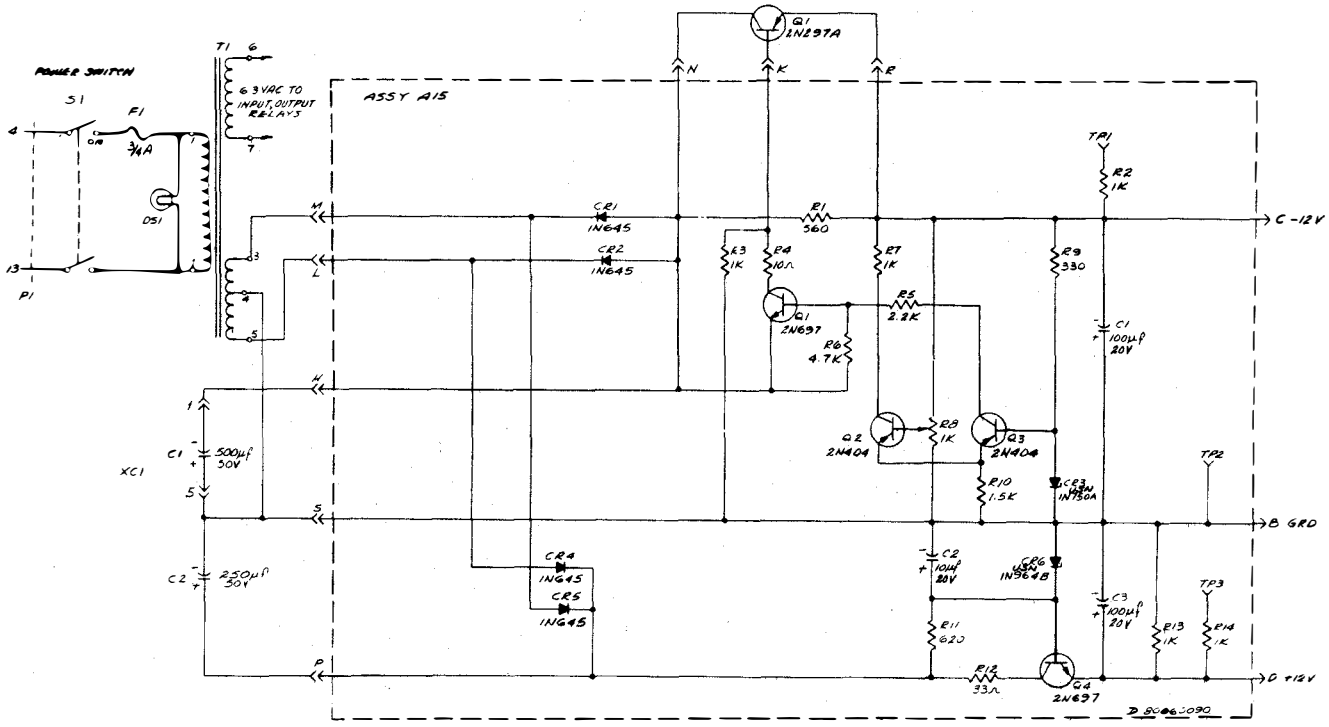


Figure 5-17. Printed Circuit Card A15 (80060090) Component Location Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCES ARE IN OHMS, 1/2WATT ±5% TOLERANCE; CAPACITANCES ARE IN UUF.
2. o——— DENOTES COMMON TIE POINT OR VOLTAGE BUS.
3. UNLESS OTHERWISE SPECIFIED, ALL TRANSISTORS ARE 2N404.
4. UNLESS OTHERWISE SPECIFIED, ALL DIODES ARE 1N270.
5. FOR EXTERNAL CONNECTIONS, REFER TO FIGURE 4-2.

Figure 5-18. Printed Circuit Card A15 Schematic Diagram

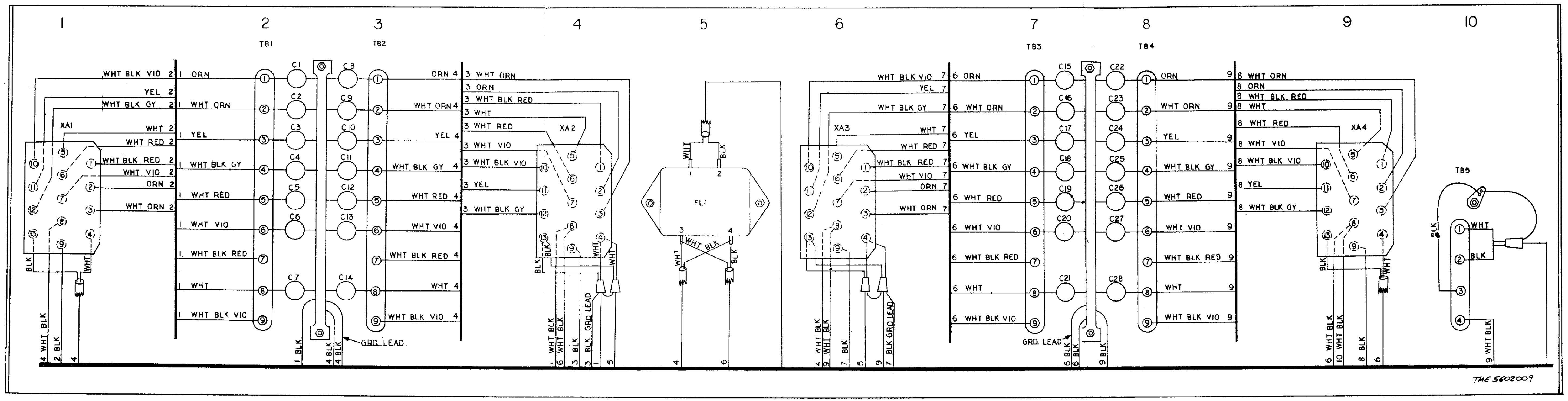


Figure 5-19. Wiring Diagram for Rack Shelf Adapter

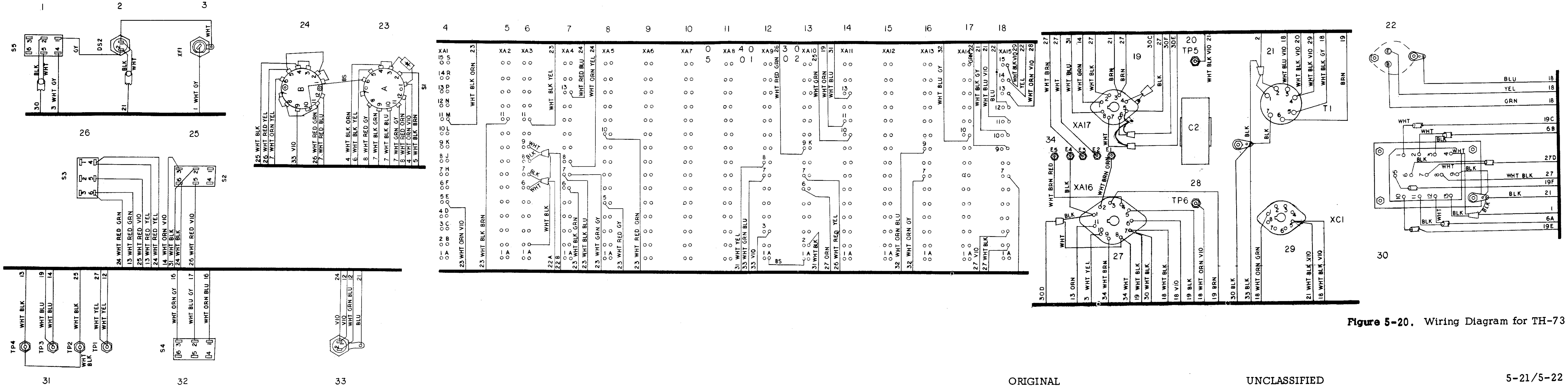


Figure 5-20. Wiring Diagram for TH-73

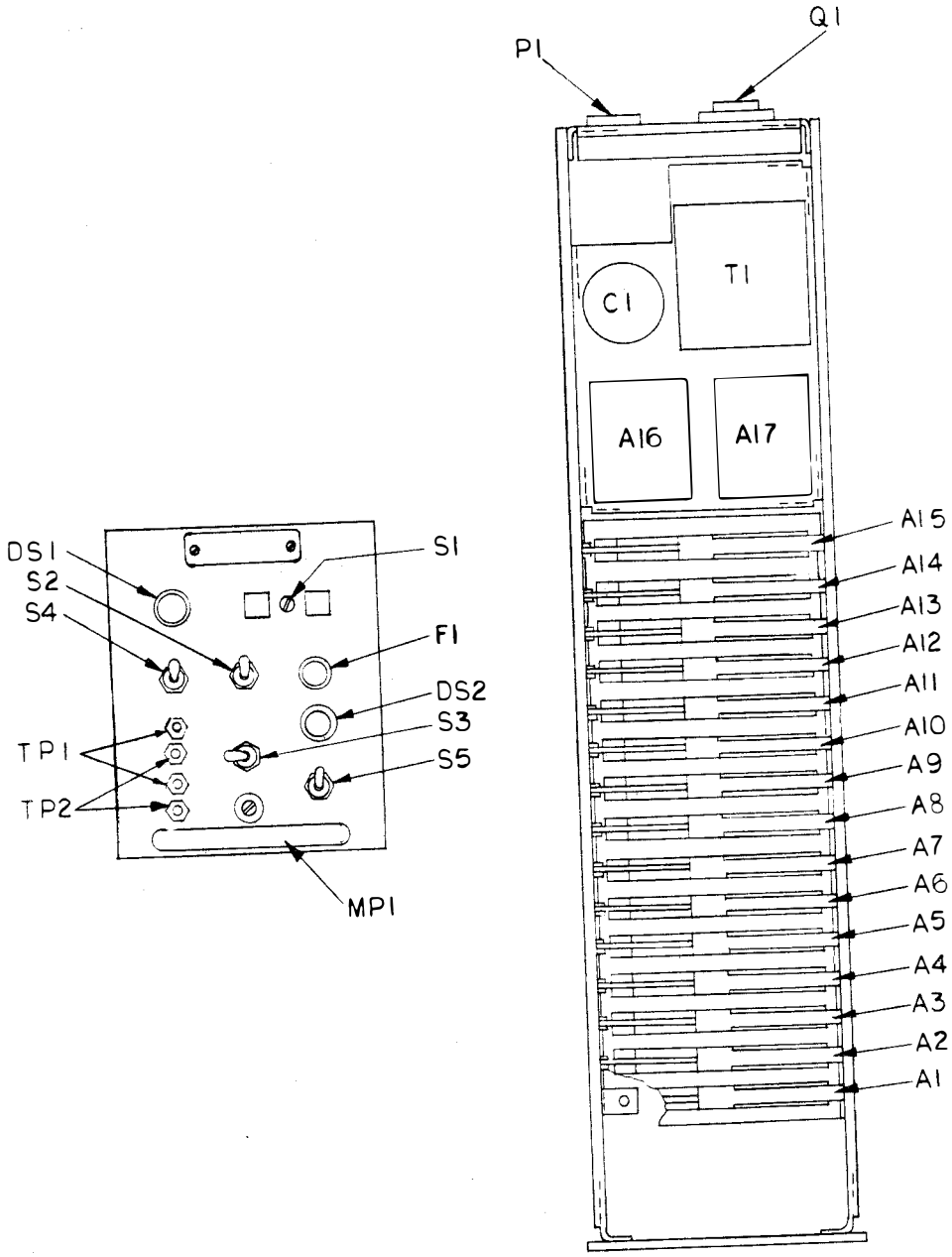


Figure 5-21. Parts Location Diagram for TH-73

SECTION 6

PARTS LIST

6-1. INTRODUCTION.

a. REFERENCE DESIGNATIONS. - A uniform identification method has been used to identify the chassis unit, assemblies, and maintenance parts of the AN/UGA-5. This method adequately covers the several degrees of subdivision of the equipment. Examples of this method are illustrated by the following:

Example 1:

1 R 1

Chassis Unit Idenfitication No.	Class of Part	Part No. within class

Read as: First (1) resistor (R) of chassis unit (1).

Example 2:

1 A 1

Chassis Unit Identification No.	Assembly Designation	Assembly No.

Read as: First (1) assembly (A) of chassis unit (1).

Example 3:

1 A1 R1

Chassis Unit Identification No.	Assembly Designation and No.	Class and No. of Part

Read as: First (1) resistor (R) of first (1) assembly (A) of chassis unit (1).

b. REF DESIG PREFIX. - Partial reference designations are used on the equipment and illustrations. The partial reference designations consist of the class letter(s) and the identifying item number. The complete reference designations may be obtained by placing the proper prefix before the partial reference designations. Prefixes are provided on illustrations following the notation "REF DESIG PREFIX."

6-2. LIST OF ASSEMBLIES.

Table 6-1 identifies the assemblies contained in the equipment. For the printed-circuit subassemblies, the table lists identification numbers (and colloquial names) which will enable identification of these assemblies if the assembly reference designations on the extractor handle tabs become obliterated.

The last column of the table provides an index to facilitate location of the maintenance parts list for each assembly.

TABLE 6-1. LIST OF ASSEMBLIES

ASSY REF DESIG	QTY PER EQUIP	PRINTED-CIRCUIT IDENTIFICATION NUMBER	COLLOQUIAL NAME	PARTS LIST PAGE
1	1	-	Cabinet, Electrical Equipment	6-3
1A1	1	-	Repeater, Telegraph TH-73/UGA-5	6-3
1A1	1	-	Chassis Unit (Chassis, Electrical Equipment)	6-3
1A1A1	1	D80060010-01	Oscillator (76.8kc and 93.237kc)	6-4
1A1A2	1	D80060010-02	Oscillator (125.217kc and 152.016kc)	6-5
1A1A3	1	D80060020	External Timing Interface	6-5
1A1A4	1	D80060030	Time Base Generator	6-7
1A1A5	1	D80060040-01	Add-Subtract Logic	6-8
1A1A6	1	D80060050-01	Signal Bit Timer	6-8
1A1A7	1	D80060040-02	Window Generator and Signal Bit Timer	6-9
1A1A8	1	D80060050-02	Start-Stop Character Control	6-10
1A1A9	1	D80060060	Mark-Hold (P/O Automatic Disconnect Logic)	6-11
1A1A10	1	D80060040-03	Mode Decision and Data Regenerator	6-12
1A1A11	1	D80060070	Sync Sample Detector	6-13
1A1A12	1	D80060050-03	Automatic Disconnect Counter Input Gates	6-14
1A1A13	1	D80060040-04	Automatic Disconnect Counter	6-15
1A1A14	1	D80060080	Automatic Disconnect Data Input and Counter Output Gates	6-16
1A1A15	1	D80060090	Power Supply	6-17
1A1A16	1	A46000002	Input Interface	
1A1A17	1	*A46000003	Output Interface	
1A1A18	1	D80060100	Harness Board	6-18

*Replaced by A46000003-001 (both types are interchangeable)

TABLE 6-1. LIST OF ASSEMBLIES (Cont'd)

ASSY REF DESIG	QTY PER EQUIP	PRINTED-CIRCUIT IDENTIFICATION NUMBER	COLLOQUIAL NAME	PARTS LIST PAGE
1A2	1	-	Same As 1A1	6-3
1A3	1	-	Same As 1A1	6-3
1A4	1	-	Same As 1A1	6-3
1A5	1	-	Adapter Card	6-18
1W1	1	-	Cable Assembly	6-18

6-3. MAINTENANCE PARTS LIST.

Table 6-2 lists the cabinet, chassis unit, and all assemblies, and their respective maintenance parts, except for input and output interfaces (subassembly A16 and A17), which are sealed plug-in units. Maintenance parts, in each case, are listed alphanumerically following the chassis unit identification and the assembly designation (where applicable). The table provides the following information: (1) the complete reference designation of each maintenance part, (2) reference to explanatory notes, as required, (3) name and description of maintenance part, (4) listing of illustration which pictorially locates the part.

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST

ASSEMBLY 1, CABINET

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1		CABINET, ELECTRICAL EQUIPMENT: consists of front panel and parts mounted thereon; D90060001 (96238)	5-21
1C1-1C28		CAPACITOR: MIL type CK62BX102K	5-19
1FL1		FILTER, BP: A43020007 (96238)	5-19
1TB1-1TB4		TERMINAL BOARD: 20109 (75382)	5-19
1XA1-1XA4		CONNECTOR, RECEPTACLE, ELECTRICAL: female, 13 contact, 10 amps; A48030058-8 (96238)	5-19

ASSEMBLY 1A1, CHASSIS UNIT

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1		CHASSIS, ELECTRICAL EQUIPMENT: used to mount the below listed items; D90060002 (96238)	5-21
1A1C1		CAPACITOR: MIL type CE 51C501G	5-21
1A1C2		CAPACITOR: MIL type CE13C221G	5-20
1A1DS1		LAMP, INCANDESCENT: 349 (08806)	5-21
1A1DS2		LAMP: MIL type MS25252NE2D	5-21
1A1F1		FUSE, CARTRIDGE: visual indicating, 3/4 amp; GBA3-4 (71400)	5-21

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1J1		CONNECTOR, RECEPTACLE, ELECTRICAL: male, 13 contacts; A48030057-8 (96238)	5-21
1A1MP1		HANDLE, BOW: B10131-2 (96238)	5-21
1A1Q1		TRANSISTOR: MIL type 2N297A	5-21
1A1S1		SWITCH, ROTARY: A46020101 (96238)	5-21
1A1S2-1A1S5		SWITCH: MIL type MS25100-23	5-21
1A1TP1		JACK, TIP: MIL type MS16108-1A	5-21
1A1TP2-1A1TP4		JACK, TIP: MIL type MS16108-3A	5-21
1A1T1		TRANSFORMER, POWER: step-down; A43000070 (96238)	5-21
1A1XA16		SOCKET, ELECTRON TUBE: 78RS11T (02660)	5-21
1A1XA17		SOCKET, ELECTRON TUBE: TS101P01 (81349)	5-21
1A1XC1		SAME AS 1A1XA17	5-21
1A1XDS1		LIGHT: MIL type LH73LC12CN	5-21
1A1XDS2		LIGHT: MIL type LH74LC13CN	5-21
1A1XF1		FUSEHOLDER: HLD (71400)	5-21

ASSEMBLY 1A1A1, OSCILLATOR 76.8KC and 93.237KC

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A1		OSCILLATOR: 76.8kc and 93.237kc, consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060010-01 (96238)	5-1
1A1A1C1		CAPACITOR, VARIABLE, GLASS: 0.8-30pf, 200v; VC43GWY (73899)	5-1
1A1A1C2		Not used	
1A1A1C3		CAPACITOR: MIL type CM06D202J03	5-1
1A1A1C4		CAPACITOR: MIL type CM06D681J03	5-1
1A1A1C5		CAPACITOR: MIL type CP09A1KB104K3	5-1
1A1A1C6		CAPACITOR: MIL type CM05D200J03	5-1
1A1A1C7		Same as 1A1A1C3	
1A1A1C8		Same as 1A1A1C4	
1A1A1C9		Same as 1A1A1C5	
1A1A1Q1		TRANSISTOR: MIL type 2N1225	5-1
1A1A1Q2		TRANSISTOR: MIL type 2N404	5-1
1A1A1Q3		Same as 1A1A1Q1	
1A1A1Q4		Same as 1A1A1Q2	
1A1A1R1		RESISTOR: MIL type RC20GF683J	5-1
1A1A1R2		RESISTOR: MIL type RC20GF752J	5-1
1A1A1R3		RESISTOR: MIL type RC20GF472J	5-1
1A1A1R4		RESISTOR: MIL type RC20GF200J	5-1
1A1A1R5		RESISTOR: MIL type RC20GF132J	5-1
1A1A1R6		RESISTOR: MIL type RC20GF103J	5-1
1A1A1R7		Same as 1A1A1R1	
1A1A1R8		Same as 1A1A1R2	
1A1A1R9		Same as 1A1A1R3	
1A1A1R10		Same as 1A1A1R4	
1A1A1R11		Same as 1A1A1R5	
1A1A1R12		Same as 1A1A1R6	

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A1Y1		CRYSTAL: MIL type CR37AU125-217KC	5-1
1A1A1Y2		CRYSTAL: MIL type CR37AU152-016KC	5-1

ASSEMBLY 1A1A2, OSCILLATOR 125.217KC and 152.016KC

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A2		OSCILLATOR: 125.217kc and 152.016kc, consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060010-02 (96238)	5-1
1A1A2C1		CAPACITOR, VARIABLE, GLASS: 0.8-30pf, 200v; VC43GWY (73899)	5-1
1A1A2C2		Not used	
1A1A2C3		CAPACITOR: MIL type CM06D202J03	5-1
1A1A2C4		CAPACITOR: MIL type CM-5D331J03	5-1
1A1A2C5		CAPACITOR: MIL type CP09A1KB104K3	5-1
1A1A2C6		CAPACITOR: MIL type CM05D200J03	5-1
1A1A2C7		Same as 1A1A2C3	
1A1A2C8		Same as 1A1A2C4	
1A1A2C9		Same as 1A1A2C5	
1A1A2Q1		TRANSISTOR: MIL type 2N1225	5-1
1A1A2Q2		TRANSISTOR: MIL type 2N404	5-1
1A1A2Q3		Same as 1A1A2Q1	
1A1A2Q4		Same as 1A1A2Q2	
1A1A2R1		RESISTOR: MIL type RC20GF683J	5-1
1A1A2R2		RESISTOR: MIL type RC20GF752J	5-1
1A1A2R3		RESISTOR: MIL type RC20GF472J	5-1
1A1A2R4		RESISTOR: MIL type RC20GF200J	5-1
1A1A2R5		RESISTOR: MIL type RC20GF132J	5-1
1A1A2R6		RESISTOR: MIL type RC20GF103J	5-1
1A1A2R7		Same as 1A1A2R1	
1A1A2R8		Same as 1A1A2R2	
1A1A2R9		Same as 1A1A2R3	
1A1A2R10		Same as 1A1A2R4	
1A1A2R11		Same as 1A1A2R5	
1A1A2R12		Same as 1A1A2R6	
1A1A2Y1		CRYSTAL: MIL type CR37AU125.217KC	5-1
1A1A2Y2		CRYSTAL: MIL type CR37AU152.016KC	5-1

ASSEMBLY 1A1A3, EXTERNAL TIMING INTERFACE

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A3		EXTERNAL TIMING INTERFACE: consists of a printed circuit board which mounts and supplies the circuitry for the below listed items; D80060020 (96238)	5-3
1A1A3CR1-1A1A3CR7		SEMICONDUCTOR DEVICE: MIL type 1N270	5-3
1A1A3C1		CAPACITOR: MIL type CS13AF010K	5-3
1A1A3C2, 1A1A3C3		CAPACITOR: MIL type CM-6D681J03	5-3

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A3C4		Same as 1A1A3C1	
1A1A3C5, 1A1A3C6		Same as 1A1A3C2	
1A1A3Q1-1A1A3Q3		TRANSISTOR: MIL type 2N404	5-3
1A1A3Q4, 1A1A3Q5		TRANSISTOR: MIL type 2N1306	5-3
1A1A3Q6-1A1A3Q8		Same as 1A1A3Q1	
1A1A3Q9, 1A1A3Q10		Same as 1A1A3Q4	
1A1A3R1		RESISTOR: MIL type RC20GF682J	5-3
1A1A3R2, 1A1A3R3		RESISTOR: MIL type RC20GF202J	5-3
1A1A3R4, 1A1A3R5		RESISTOR: MIL type RC20GF101J	5-3
1A1A3R6, 1A1A3R7		RESISTOR: MIL type RC20GF102J	5-3
1A1A3R8		Same as 1A1A3R1	
1A1A3R9		RESISTOR: MIL type RC20GF183J	5-3
1A1A3R10		RESISTOR: MIL type RC20GF391J	5-3
1A1A3R11		Same as 1A1A3R9	
1A1A3R12, 1A1A3R13		RESISTOR: MIL type RC20GF223J	5-3
1A1A3R14, 1A1A3R15		RESISTOR: MIL type RC20GF332J	5-3
1A1A3R16, 1A1A3R17		Same as 1A1A3R1	
1A1A3R18, 1A1A3R19		Same as 1A1A3R2	
1A1A3R20, 1A1A3R21		Same as 1A1A3R4	
1A1A3R22, 1A1A3R23		Same as 1A1A3R6	
1A1A3R24		Same as 1A1A3R1	
1A1A3R25		Same as 1A1A3R9	
1A1A3R26		Same as 1A1A3R10	
1A1A3R27		Same as 1A1A3R9	
1A1A3R28, 1A1A3R29		Same as 1A1A3R12	
1A1A3R30, 1A1A3R31		Same as 1A1A3R14	
1A1A3R32		Same as 1A1A3R1	

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

ASSEMBLY 1A1A4, TIME BASE GENERATOR

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A4		TIME BASE GENERATOR: consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060030 (95238)	5-5
1A1A4CR1-1A1A4CR12		SEMICONDUCTOR DEVICE: MIL type 1N270	5-5
1A1A4CR13, 1A1A4CR14		SEMICONDUCTOR DEVICE: MIL type 1N914	5-5
1A1A4C1, 1A1A4C2		CAPACITOR: MIL type CK62AX822K	5-5
1A1A4C3-1A1A4C14		CAPACITOR: MIL type CM05D151J03	5-5
1A1A4Q1-1A1A4Q9		TRANSISTOR: MIL type 2N404	5-5
1A1A4R1		RESISTOR: MIL type RC20GF223J	5-5
1A1A4R2, 1A1A4R3		RESISTOR: MIL type RC20GF222J	5-5
1A1A4R4		Same as 1A1A4R1	
1A1A4R5, 1A1A4R6		Same as 1A1A4R2	
1A1A4R7, 1A1A4R8		RESISTOR: MIL type RC20GF682J	5-5
1A1A4R9		Not used	
1A1A4R10		Not used	
1A1A4R11		Same as 1A1A4R2	
1A1A4R12		Same as 1A1A4R1	
1A1A4R13		RESISTOR: MIL type RC20GF332J	5-5
1A1A4R14		Same as 1A1A4R13	
1A1A4R15, 1A1A4R16		Same as 1A1A4R1	
1A1A4R17, 1A1A4R18		RESISTOR: MIL type RC20GF823J	5-5
1A1A4R19, 1A1A4R20		RESISTOR: MIL type RC20GF153J	5-5
1A1A4R21, 1A1A4R22		Same as 1A1A4R13	
1A1A4R23, 1A1A4R24		Same as 1A1A4R1	
1A1A4R25, 1A1A4R26		Same as 1A1A4R17	
1A1A4R27, 1A1A4R28		Same as 1A1A4R19	
1A1A4R29, 1A1A4R30		Same as 1A1A4R13	
1A1A4R31, 1A1A4R32		Same as 1A1A4R1	
1A1A4R33, 1A1A4R34		Same as 1A1A4R17	
1A1A4R35, 1A1A4R36		Same as 1A1A4R19	

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

ASSEMBLY 1A1A5, ADD-SUBTRACT LOGIC

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A5		ADD-SUBTRACT LOGIC: consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060040-01 (96238)	5-7
1A1A5CR1-1A1A5CR12		SEMICONDUCTOR DEVICE: MIL type 1N270	5-7
1A1A5C1-1A1A5C16		CAPACITOR: MIL type CM-5D151J03	5-7
1A1A5Q1-1A1A5Q8		TRANSISTOR: MIL type 2N404	5-8
1A1A5R1		RESISTOR: MIL type RC20GF332J	5-9
1A1A5R2		RESISTOR: MIL type RC20GF153J	5-10
1A1A5R3		RESISTOR: MIL type RC20GF223J	5-11
1A1A5R4, 1A1A5R5		RESISTOR: MIL type RC20GF823J	5-12
1A1A5R6		Same as 1A1A5R3	
1A1A5R7		Same as 1A1A5R1	
1A1A5R8		Same as 1A1A5R2	
1A1A5R9		Same as 1A1A5R1	
1A1A5R10		Same as 1A1A5R2	
1A1A5R11		Same as 1A1A5R3	
1A1A5R12, 1A1A5R13		Same as 1A1A5R4	
1A1A5R14		Same as 1A1A5R3	
1A1A5R15		Same as 1A1A5R1	
1A1A5R16, 1A1A5R17		Same as 1A1A5R2	
1A1A5R18		Same as 1A1A5R1	
1A1A5R19		Same as 1A1A5R3	
1A1A5R20, 1A1A5R21		Same as 1A1A5R4	
1A1A5R22		Same as 1A1A5R3	
1A1A5R23		Same as 1A1A5R1	
1A1A5R24, 1A1A5R25		Same as 1A1A5R2	
1A1A5R26		Same as 1A1A5R1	
1A1A5R27		Same as 1A1A5R3	
1A1A5R28, 1A1A5R29		Same as 1A1A5R4	
1A1A5R30		Same as 1A1A5R3	
1A1A5R31		Same as 1A1A5R1	
1A1A5R32		Same as 1A1A5R2	

ASSEMBLY 1A1A6, SIGNAL BIT TIMER

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A6		SIGNAL BIT TIMER: consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060050-01 (96238)	5-9
1A1A6CR1-1A1A6CR17		SEMICONDUCTOR DEVICE: MIL type 1N270	5-9

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A6C1, 1A1A6C2		Not used	
1A1A6C3		CAPACITOR: MIL type CM06D102J03	5-9
1A1A6C4-1A1A6C15		Same as 1A1A6C1	
1A1A6Q1-1A1A6Q8		TRANSISTOR: MIL type 2N404	5-9
1A1A6R1		RESISTOR: MIL type RC20GF682J	5-9
1A1A6R2		RESISTOR: MIL type RC20GF103J	5-9
1A1A6R3		RESISTOR: MIL type RC20GF683J	5-9
1A1A6R4		RESISTOR: MIL type RC20GF332J	5-9
1A1A6R5		Same as 1A1A6R1	
1A1A6R6		Same as 1A1A6R2	
1A1A6R7		Same as 1A1A6R3	
1A1A6R8		RESISTOR: MIL type RC20GF153J	5-9
1A1A6R9		Same as 1A1A6R4	
1A1A6R10		RESISTOR: MIL type RC20GF223J	5-9
1A1A6R11		RESISTOR: MIL type RC20GF823J	5-9
1A1A6R12		Same as 1A1A6R11	
1A1A6R13		Same as 1A1A6R10	
1A1A6R14		Same as 1A1A6R4	
1A1A6R15, 1A1A6R16		Same as 1A1A6R8	
1A1A6R17		Same as 1A1A6R4	
1A1A6R18		Same as 1A1A6R10	
1A1A6R19, 1A1A6R20		Same as 1A1A6R11	
1A1A6R21		Same as 1A1A6R10	
1A1A6R22		Same as 1A1A6R4	
1A1A6R23, 1A1A6R24		Same as 1A1A6R8	
1A1A6R25		Same as 1A1A6R4	
1A1A6R26		Same as 1A1A6R10	
1A1A6R27, 1A1A6R28		Same as 1A1A6R11	
1A1A6R29		Same as 1A1A6R10	
1A1A6R30		Same as 1A1A6R4	
1A1A6R31		Same as 1A1A6R8	

ASSEMBLY 1A1A7, WINDOW GENERATOR AND SIGNAL BIT TIMER

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A7		WINDOW GENERATOR AND SIGNAL BIT TIMER: consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060040-02 (96238)	5-7
1A1A7CR1-1A1A7CR12		SEMICONDUCTOR DEVICE: MIL type 1N270	5-7

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A7C1-1A1A7C16		CAPACITOR: MIL type CM05D151J03	5-7
1A1A7Q1-1A1A7Q8		TRANSISTOR: MIL type 2N404	5-7
1A1A7R1-1A1A7R3		RESISTOR: MIL type RC20GF332J	5-7
1A1A7R4, 1A1A7R5		RESISTOR: MIL type RC20GF823J	5-7
1A1A7R6		Same as 1A1A7R3	
1A1A7R7		Same as 1A1A7R1	
1A1A7R8		Same as 1A1A7R2	
1A1A7R9		Same as 1A1A7R1	
1A1A7R10		Same as 1A1A7R2	
1A1A7R11		Same as 1A1A7R3	
1A1A7R12, 1A1A7R13		Same as 1A1A7R4	
1A1A7R14		Same as 1A1A7R3	
1A1A7R15		Same as 1A1A7R1	
1A1A7R16, 1A1A7R17		Same as 1A1A7R2	
1A1A7R18		Same as 1A1A7R1	
1A1A7R19		Same as 1A1A7R3	
1A1A7R20, 1A1A7R21		Same as 1A1A7R4	
1A1A7R22		Same as 1A1A7R3	
1A1A7R23		Same as 1A1A7R1	
1A1A7R24, 1A1A7R25		Same as 1A1A7R2	
1A1A7R26		Same as 1A1A7R1	
1A1A7R27		Same as 1A1A7R3	
1A1A7R28		Same as 1A1A7R4	
1A1A7R29		Same as 1A1A7R4	
1A1A7R30		Same as 1A1A7R3	
1A1A7R31		Same as 1A1A7R1	
1A1A7R32		Same as 1A1A7R2	

ASSEMBLY 1A1A8, START-STOP CHARACTER CONTROL

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A8		START-STOP CHARACTER CONTROL: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060050-02 (96238)	5-9
1A1A8CR1 - 1A1A8CR17		SEMICONDUCTOR DEVICE: MIL type 1N270	5-9
1A1A8C1, 1A1A8C2		Not used	
1A1A8C3		CAPACITOR: MIL type CM06D102J03	5-9
1A1A8C4 -		Same as 1A1A8C1	

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A8C15			
1A1A8Q1 - 1A1A8Q8		TRANSISTOR: MIL type 2N404	5-9
1A1A8R1		RESISTOR: MIL type RC20GF682J	5-9
1A1A8R2		RESISTOR: MIL type RC20GF103J	5-9
1A1A8R3		RESISTOR: MIL type RC20GF683J	5-9
1A1A8R4		RESISTOR: MIL type RC20GF332J	5-9
1A1A8R5		Same as 1A1A8R1	
1A1A8R6		Same as 1A1A8R2	
1A1A8R7		Same as 1A1A8R3	
1A1A8R8		RESISTOR: MIL type RC20GF153J	5-9
1A1A8R9		Same as 1A1A8R4	
1A1A8R10		RESISTOR: MIL type RC20GF223J	5-9
1A1A8R11, 1A1A8R12		RESISTOR: MIL type RC20GF823J	5-9
1A1A8R13		Same as 1A1A8R10	
1A1A8R14		Same as 1A1A8R4	
1A1A8R15, 1A1A8R16		Same as 1A1A8R8	
1A1A8R17		Same as 1A1A8R4	
1A1A8R18		Same as 1A1A8R10	
1A1A8R19, 1A1A8R20		Same as 1A1A8R11	
1A1A8R21		Same as 1A1A8R10	
1A1A8R22		Same as 1A1A8R4	
1A1A8R23, 1A1A8R24		Same as 1A1A8R8	
1A1A8R25		Same as 1A1A8R4	
1A1A8R26		Same as 1A1A8R10	
1A1A8R27, 1A1A8R28		Same as 1A1A8R11	
1A1A8R29		Same as 1A1A8R10	
1A1A8R30		Same as 1A1A8R4	
1A1A8R31		Same as 1A1A8R8	

ASSEMBLY 1A1A9, MARK-HOLD (P/O AUTOMATIC DISCONNECT LOGIC)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A9		MARK-HOLD (P/O AUTOMATIC DISCONNECT LOGIC): Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060060 (96238)	5-11
1A1A9CR1 - 1A1A9CR11		SEMICONDUCTOR DEVICE: MIL type 1N270	5-11
1A1A9C1, 1A1A9C2		CAPACITOR: MIL type CM06D102J03	5-11
1A1A9C3		CAPACITOR: MIL type CM05D151J03	5-11
1A1A9C4		Same as 1A1A9C1	
1A1A9Q1 - 1A1A9Q9		TRANSISTOR: MIL type 2N404	5-11
1A1A9R1,		RESISTOR: MIL type RC20GF223J	5-11

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A9R2			
1A1A9R3		RESISTOR: MIL type RC20GF683J	5-11
1A1A9R4		RESISTOR: MIL type RC20GF472J	5-11
1A1A9R5		Same as 1A1A9R1	
1A1A9R6		RESISTOR: MIL type RC20GF823J	5-11
1A1A9R7		Same as 1A1A9R4	
1A1A9R8		Same as 1A1A9R1	
1A1A9R9		RESISTOR: MIL type RC20GF102J	5-11
1A1A9R10		Same as 1A1A9R4	
1A1A9R11 - 1A1A9R13		Same as 1A1A9R1	
1A1A9R14		Same as 1A1A9R3	
1A1A9R15		Same as 1A1A9R4	
1A1A9R16		Same as 1A1A9R1	
1A1A9R17		Same as 1A1A9R6	
1A1A9R18		Same as 1A1A9R4	
1A1A9R19		Same as 1A1A9R1	
1A1A9R20		Same as 1A1A9R9	
1A1A9R21		Same as 1A1A9R4	
1A1A9R22		Same as 1A1A9R3	
1A1A9R23		RESISTOR: MIL type RC20GF153J	5-11
1A1A9R24		Same as 1A1A9R4	
1A1A9R25		RESISTOR: MIL type RC20GF333J	5-11
1A1A9R26		Same as 1A1A9R1	
1A1A9R27		Same as 1A1A9R4	
1A1A9R28		Same as 1A1A9R6	
1A1A9R29, 1A1A9R30		RESISTOR: MIL type RC20GF103J	5-11
1A1A9R31		RESISTOR: MIL type RC20GF682J	5-11
1A1A9R32		Same as 1A1A9R29	
1A1A9R33		Same as 1A1A9R3	
1A1A9R34		Same as 1A1A9R29	
1A1A9R35		RESISTOR: MIL type RC20GF121J	5-11

ASSEMBLY 1A1A10, MODE DECISION AND DATA REGENERATOR

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A10		MODE DECISION AND DATA REGENERATOR: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D8006004-03 (96238)	5-7
1A1A10CR1 - 1A1A10CR12		SEMICONDUCTOR DEVICE: MIL type 1N270	5-7
1A1A10C1 - 1A1A10C16		CAPACITOR: MIL type CM05D151J03	5-7
1A1A10Q1 - 1A1A10Q8		TRANSISTOR: MIL type 2N404	5-7
1A1A10R1		RESISTOR: MIL type RC20GF332J	5-7
1A1A10R2		RESISTOR: MIL type RC20GF153J	5-7
1A1A10R3		RESISTOR: MIL type RC20GF223J	5-7
1A1A10R4, 1A1A10R5		RESISTOR: MIL type RC20GF823J	5-7

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A10R6		Same as 1A1A10R3	
1A1A10R7		Same as 1A1A10R1	
1A1A10R8		Same as 1A1A10R2	
1A1A10R9		Same as 1A1A10R1	
1A1A10R10		Same as 1A1A10R2	
1A1A10R11		Same as 1A1A10R3	
1A1A10R12, 1A1A10R13		Same as 1A1A10R4	
1A1A10R14		Same as 1A1A10R3	
1A1A10R15		Same as 1A1A10R1	
1A1A10R16, 1A1A10R17		Same as 1A1A10R2	
1A1A10R18		Same as 1A1A10R1	
1A1A10R19		Same as 1A1A10R3	
1A1A10R20, 1A1A10R21		Same as 1A1A10R4	
1A1A10R22		Same as 1A1A10R3	
1A1A10R23		Same as 1A1A10R1	
1A1A10R24, 1A1A10R25		Same as 1A1A10R2	
1A1A10R26		Same as 1A1A10R1	
1A1A10R27		Same as 1A1A10R3	
1A1A10R28, 1A1A10R29		Same as 1A1A10R4	
1A1A10R30		Same as 1A1A10R3	
1A1A10R31		Same as 1A1A10R1	
1A1A10R32		Same as 1A1A10R2	

ASSEMBLY 1A1A11 SYNC SAMPLE DETECTOR

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A11		SYNC SAMPLE DETECTOR: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060070 (96238)	5-13
1A1A11CR1 - 1A1A11CR8		SEMICONDUCTOR DEVICE: MIL type 1N270	5-13
1A1A11C1		CAPACITOR: MIL type CS13AF330K	5-13
1A1A11C2 - 1A1A11C5		CAPACITOR: MIL type CM05D151J03	5-13
1A1A11C6		CAPACITOR: MIL type CS13AF4R7K	5-13
1A1A11Q1 - 1A1A11Q9		TRANSISTOR: MIL type 2N404	5-13
1A1A11R1		RESISTOR: MIL type RC20GF223J	5-13
1A1A11R2		RESISTOR: MIL type RC20GF683J	5-13
1A1A11R3		RESISTOR: MIL type RC20GF221J	5-13
1A1A11R4		RESISTOR: MIL type RC20GF152J	5-13
1A1A11R5		RESISTOR: MIL type RC20GF472J	5-13
1A1A11R6		RESISTOR: MIL type RC20GF473J	5-13
1A1A11R7		Same as 1A1A11R5	
1A1A11R8		RESISTOR: MIL type RC20GF682J	5-13

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A11R9		RESISTOR: MIL type RC20GF103J	5-13
1A1A11R10		Same as 1A1A11R2	
1A1A11R11		Same as 1A1A11R9	
1A1A11R12		RESISTOR: MIL type RC20GF100J	5-13
1A1A11R13, 1A1A11R14		Same as 1A1A11R1	
1A1A11R15		Same as 1A1A11R2	
1A1A11R16		Same as 1A1A11R5	
1A1A11R17		RESISTOR: MIL type RC20GF153J	5-13
1A1A11R18		RESISTOR: MIL type RC20GF332J	5-13
1A1A11R19		Same as 1A1A11R1	
1A1A11R20, 1A1A11R21		RESISTOR: MIL type RC20GF823J	5-13
1A1A11R22		Same as 1A1A11R1	
1A1A11R23		Same as 1A1A11R18	
1A1A11R24		Same as 1A1A11R17	
1A1A11R25		Same as 1A1A11R9	
1A1A11R26, 1A1A11R27		Same as 1A1A11R1	
1A1A11R28		Same as 1A1A11R2	
1A1A11R29		Same as 1A1A11R5	
1A1A11R30		Same as 1A1A11R8	
1A1A11R31		Same as 1A1A11R9	
1A1A11R32		Same as 1A1A11R2	
1A1A11R33		Same as 1A1A11R9	
1A1A11R34		Same as 1A1A11R12	
1A1A11R35		RESISTOR: MIL type RC20GF222J	5-13
1A1A11R36		Same as 1A1A11R6	
1A1A11R37		Same as 1A1A11R35	
1A1A11R38, 1A1A11R39		Same as 1A1A11R1	

ASSEMBLY 1A1A12, AUTOMATIC DISCONNECT COUNTER INPUT GATES

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A12		AUTOMATIC DISCONNECT COUNTER INPUT GATES: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060050-03 (96238)	5-9
1A1A12CR1-1A1A12CR17		SEMICONDUCTOR DEVICE: MIL type 1N270	5-9
1A1A12C1, 1A1A12C2		Not used	
1A1A12C3-1A1A12C15		CAPACITOR: MIL type CM06D102J03	5-9
1A1A12Q1-1A1A12Q8		TRANSISTOR: MIL type 2N404	5-9
1A1A12R1		RESISTOR: MIL type RC20GF682J	5-9
1A1A12R2		RESISTOR: MIL type RC20GF103J	5-9
1A1A12R3		RESISTOR: MIL type RC20GF683J	5-9

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A12R4		RESISTOR: MIL type RC20GF332J	5-9
1A1A12R5		Same as 1A1A12R1	
1A1A12R6		Same as 1A1A12R2	
1A1A12R7		Same as 1A1A12R3	
1A1A12R8		RESISTOR: MIL type RC20GF153J	5-9
1A1A12R9		Same as 1A1A12R4	
1A1A12R10		RESISTOR: MIL type RC20GF223J	5-9
1A1A12R11, 1A1A12R12		RESISTOR: MIL type RC20GF823J	5-9
1A1A12R13		Same as 1A1A12R10	
1A1A12R14		Same as 1A1A12R4	
1A1A12R15, 1A1A12R16		Same as 1A1A12R8	
1A1A12R17		Same as 1A1A12R4	
1A1A12R18		Same as 1A1A12R10	
1A1A12R19, 1A1A12R20		Same as R11	
1A1A12R21		Same as R10	
1A1A12R22		Same as 1A1A12R4	
1A1A12R23, 1A1A12R24		Same as 1A1A12R8	
1A1A12R25		Same as 1A1A12R4	
1A1A12R26		Same as 1A1A12R10	
1A1A12R27, 1A1A12R28		Same as 1A1A12R11	
1A1A12R29		Same as 1A1A12R10	
1A1A12R30		Same as 1A1A12R4	
1A1A12R31		Same as 1A1A12R8	

ASSEMBLY 1A1A13, AUTOMATIC DISCONNECT COUNTER

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A13		AUTOMATIC DISCONNECT COUNTER: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060040-04 (96238)	5-7
1A1A13CR1-1A1A13CR12		SEMICONDUCTOR DEVICE: MIL type 1N270	5-7
1A1A13C1-1A1A13C16		CAPACITOR: MIL type CM05D151J03	5-7
1A1A13Q1-1A1A13Q8		TRANSISTOR: MIL type 2N404	5-7
1A1A13R1		RESISTOR: MIL type RC20GF332J	5-7
1A1A13R2		RESISTOR: MIL type RC20GF153J	5-7
1A1A13R3		RESISTOR: MIL type RC20GF223J	5-7
1A1A13R4, 1A1A13R5		RESISTOR: MIL type RC20GF823J	5-7
1A1A13R6		Same as 1A1A13R3	
1A1A13R7		Same as 1A1A13R1	
1A1A13R8		Same as 1A1A13R2	

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A13R9		Same as 1A1A13R1	
1A1A13R10		Same as 1A1A13R2	
1A1A13R11		Same as 1A1A13R3	
1A1A13R12, 1A1A13R13		Same as 1A1A13R4	
1A1A13R14		Same as 1A1A13R3	
1A1A13R15		Same as 1A1A13R1	
1A1A13R16, 1A1A13R17		Same as 1A1A13R2	
1A1A13R18		Same as 1A1A13R1	
1A1A13R19		Same as 1A1A13R3	
1A1A13R20, 1A1A13R21		Same as 1A1A13R4	
1A1A13R22		Same as 1A1A13R3	
1A1A13R23		Same as 1A1A13R1	
1A1A13R24, 1A1A13R25		Same as 1A1A13R2	
1A1A13R26		Same as 1A1A13R1	
1A1A13R27		Same as 1A1A13R3	
1A1A13R28, 1A1A13R29		Same as 1A1A13R4	
1A1A13R30		Same as 1A1A13R3	
1A1A13R31		Same as 1A1A13R1	
1A1A13R32		Same as 1A1A13R2	

ASSEMBLY 1A1A14, AUTOMATIC DISCONNECT DATA INPUT AND COUNTER OUTPUT GATES

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A14		AUTOMATIC DISCONNECT DATA INPUT AND COUNTER OUTPUT GATES: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060080 (96238)	5-15
1A1A14CR1-1A1A14CR15		SEMICONDUCTOR DEVICE: MIL type 1N270	5-15
1A1A14C1, 1A1A14C2		CAPACITOR: MIL type CM05D221J03	5-15
1A1A14C3-1A1A14C5		CAPACITOR: MIL type CM05D391J03	5-15
1A1A14C6-1A1A14C9		CAPACITOR: MIL type CM05D151J03	5-15
1A1A14Q1-1A1A14Q6		TRANSISTOR: MIL type 2N404	5-15
1A1A14R1		RESISTOR: MIL type RC20GF683J	5-15
1A1A14R2		RESISTOR: MIL type RC20GF153J	5-15
1A1A14R3		Same as 1A1A14R2	
1A1A14R4		Same as 1A1A14R1	
1A1A14R5		RESISTOR: MIL type RC20GF222J	5-15
1A1A14R6		Same as 1A1A14R1	
1A1A14R7		Same as 1A1A14R5	
1A1A14R8		RESISTOR: MIL type RC20GF223J	5-15

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A14R9, 1A1A14R10		Same as 1A1A14R1	
1A1A14R11, 1A1A14R12		Same as 1A1A14R2	
1A1A14R13		Same as 1A1A14R1	
1A1A14R14		RESISTOR: MIL type RC20GF32J	5-15
1A1A14R15		Same as 1A1A14R14	
1A1A14R16, 1A1A14R17		Same as 1A1A14R8	
1A1A14R18, 1A1A14R19		RESISTOR: MIL type RC20GF823J	5-15
1A1A14R20, 1A1A14R21		Same as 1A1A14R2	
1A1A14R22		RESISTOR: MIL type RC20GF682J	5-15
1A1A14R23		RESISTOR: MIL type RC20GF103J	5-15
1A1A14R24		Same as 1A1A14R1	
1A1A14R25		RESISTOR: MIL type RC20GF472J	5-15
1A1A14R26		Same as 1A1A14R22	
1A1A14R27		Same as 1A1A14R23	
1A1A14R28		Same as 1A1A14R1	
1A1A14R29		Same as 1A1A14R25	

ASSEMBLY 1A1A15, POWER SUPPLY

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A15		POWER SUPPLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D90060090 (96238)	5-17
1A1A15CR1, 1A1A15CR2		SEMICONDUCTOR DEVICE: MIL type 1N645	5-17
1A1A15CR3		SEMICONDUCTOR DEVICE: MIL type 1N750	5-17
1A1A15CR4, 1A1A15CR5		Same as 1A1A15CR1	
1A1A15CR6		SEMICONDUCTOR DEVICE: MIL type 1N964B	5-17
1A1A15C1		CAPACITOR: MIL type CS13AE101K	5-17
1A1A15C2		CAPACITOR: MIL type CS13AE100K	5-17
1A1A15C3		Same as 1A1A15C1	
1A1A15Q1		TRANSISTOR: MIL type 2N697	5-17
1A1A15Q2		TRANSISTOR: MIL type 2N404	5-17
1A1A15Q3		Same as 1A1A15Q2	
1A1A15Q4		Same as 1A1A15Q1	
1A1A15R1		RESISTOR: MIL type RC20GF561J	5-17
1A1A15R2, 1A1A15R3		RESISTOR: MIL type RC20GF102J	5-17
1A1A15R4		RESISTOR: MIL type RC20GF100J	5-17
1A1A15R5		RESISTOR: MIL type RC20GF272J	5-17
1A1A15R6		RESISTOR: MIL type RC20GF472J	5-17
1A1A15R7		Same as 1A1A15R2	
1A1A15R8		RESISTOR, VARIABLE: MIL type RT11C2P102	5-17
1A1A15R9		RESISTOR: MIL type RC20GF331J	5-17

TABLE 6-2. REPEATER GROUP, TELEGRAPH AN/UGA-5 MAINTENANCE PARTS LIST (Cont'd)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A15R10		RESISTOR: MIL type RC20GF152J	5-17
1A1A15R11		RESISTOR: MIL type RC20GF621J	5-17
1A1A15R12		RESISTOR: MIL type RC20GF330J	5-17
1A1A15R13, 1A1A15R14		Same as 1A1A15R2	

ASSEMBLY 1A1A18, HARNESS BOARD

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A1A18		HARNESS BOARD: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80060100 (96238)	5-19
1A1A18F1		FUSE,CARTRIDGE: 3/4 amp; GBA3-4 (71400)	5-19
1A1A18XA1		CONNECTOR: MIL type M21097-1-00AD15B2A	5-19
1A1A18XA2-1A1A8XA15		Same as 1A1A18XA1	

ASSEMBLY 1A5, ADAPTER CARD

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1A5		ADAPTER CARD: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; C80060110 (96238)	
1A5J1		CONNECTOR: MIL type M21097-1-091AD15A2A	

ASSEMBLY 1W1, CABLE ASSEMBLY

REF DESIG	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER
1W1		CABLE ASSEMBLY: consists of electrical cable and associated connectors C75010003 (96238)	
1W1P1		CONNECTOR,PLUG,ELECTRICAL: A48030058-8 (96238)	
1W1P2		CONNECTOR,PLUG,ELECTRICAL: A48030057-8 (96238)	

6-4. LIST OF MANUFACTURERS.

Table 6-3 lists the manufacturers of parts used in the equipment. The table includes the manufacturer's code used in Table 6-2 to identify the manufacturers.

TABLE 6-3. LIST OF MANUFACTURERS

MFR CODE	NAME	ADDRESS
01295	Texas Instruments, Inc.	Dallas, Texas
02660	Amphenol-Borg Corp.	Maywood, Illinois
08806	General Electric-Lamp Div.	Cleveland, Ohio
71400	Bussmann Fuse Co.	St. Louis, Missouri
73899	JFD Electronics Corp.	Brooklyn, New York
75382	Kulka Electric Company	Mt. Vernon, New York
80064	Bureau of Ships	Washington, D.C.
81349	Military Specifications	
81350	Joint Army-Navy Specifications	
96238	STELMA, Incorporated	Stamford, Connecticut
96906	Military Standard	

USER ACTIVITY COMMENT SHEET

NAVSHIPS 0967-204-3010

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