UNCLASSIFIED

NAVSHIPS 0969-125-7010

# TECHNICAL MANUAL

*for*

# TEST SET, TELEGRAPH
# TS-2616/UGM

DEPARTMENT OF THE NAVY

NAVAL ELECTRONIC SYSTEMS COMMAND

UNCLASSIFIED

Publication: JANUARY 1970

## LIST OF EFFECTIVE PAGES

| PAGE NUMBERS | CHANGE IN EFFECT | PAGE NUMBERS | CHANGE IN EFFECT |
|---|---|---|---|
| Title Page | | 2-1 and 2-2 | |
| ii and iii/iv | | 3-1 to 3-10 | |
| v to vii | | 4-1 to 4-27/4-28 | |
| 1-0 | | 5-1 to 5-51/5-52 | |
| 1-1 to 1-3/1-4 | | 6-1 to 6-34 | |

STELMA, Incorporated
17 Amelia Place
Stamford, Connecticut

Contract: N600-67-C-0410

Errors found in this publication (other than obvious typographical errors) which have not been corrected by means of Temporary Changes or Permanent Changes should be reported on a user activity comment sheet NAVSHIPS 4914 (10-62) FSN 0105-503-9850. Such report should include the complete title of the publication and the publication number, identify the page and line or figure and location of the error, and be forwarded to the Code 0453

All requests for this publication should be directed to the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania, 19120.

# TABLE OF CONTENTS

## LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont'd)

## LIST OF TABLES

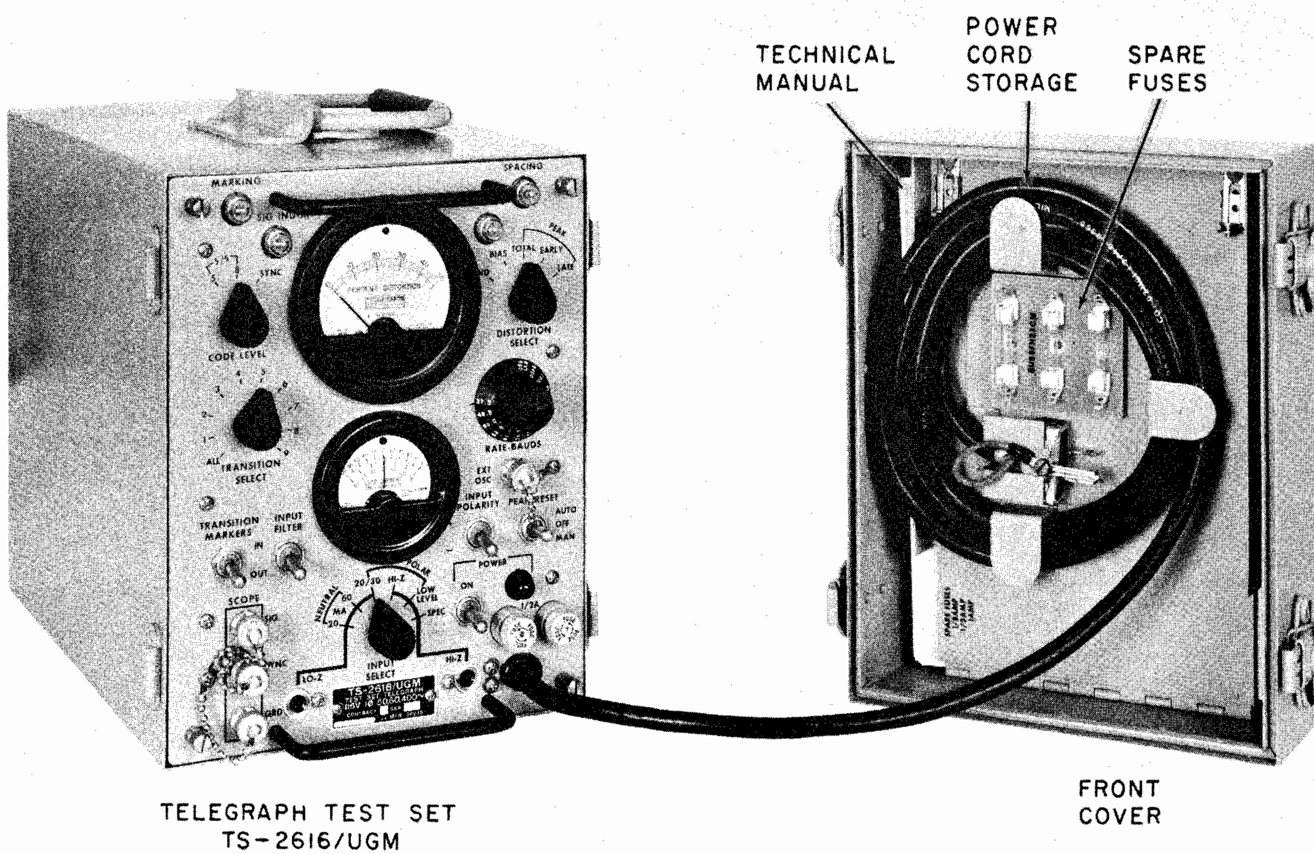



Figure 1-1. Test Set, Telegraph TS-2616/UGM

# SECTION 1

# GENERAL INFORMATION

## 1-1. SCOPE.

This manual describes installation, operation, principles of operation, troubleshooting, and maintenance of Test Set, Telegraph TS-2616/UGM (see figure 1-1), hereafter referred to as the Analyzer. This Technical Manual is in effect upon receipt. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.

## 1-2. DESCRIPTION.

a. The Analyzer consists of a component board carriage, housed in a portable watertight case. All operating controls are mounted on the front panel of the carriage, behind the front cover. The unit has a self-contained power supply and time base generator. The power cord and technical manual are stored inside the front cover, with spare fuses.

b. The Analyzer measures and indicates timing distortion present in a start-stop or synchronous data/telegraph signal. Measurement is accomplished by comparing the time positions of the signal transitions with accurate reference transitions established by an internal or external time base. The internal time base permits measuring 37.5, 45.5, 50, 56.8, 61.1, 74.2, 75, 110, 150, 300, 600, 1200, or 2400 baud signals. Using an external time base, signals with other rates up to 2400 baud may be measured. Distortion indication is obtained from the PERCENT DISTORTION meter deflection, which indicates transition displacement in per cent of unit interval. The Analyzer also permits breaking down the peak distortion readings to determine which distortion components (end, bias, early and late) contribute to the total distortion. An on-line signal may be measured without disrupting traffic. The unit meets the requirements of FED-STD-222, is rfi protected, and does not radiate the signal under test, thus minimizing external detection.

## 1-3. REFERENCE DATA.

| | |
|---|---|
| a. CIRCUIT COMPOSITION. | Solid state. |
| b. POWER REQUIRED. | 115-volt ac, single phase, 50, 60, or 400Hz, 25 watts. |
| c. AMBIENT TEMPERATURE. | $0^{\circ}$ to $+50^{\circ}$C ($30^{\circ}$ to $122^{\circ}$F). |
| d. RELATIVE HUMIDITY. | 95 per cent maximum. |
| e. PERCENT DISTORTION INDICATION ACCURACY. | ±2 per cent. |
| f. LOOP CURRENT INDICATION ACCURACY. | ±2 per cent of full scale. |
| g. CRYSTAL OSCILLATOR ACCURACY. | Less than 5 parts in $10^4$. |

h. INPUT SIGNAL MODES ACCEPTED. 20-milliampere neutral.
60-milliampere neutral.
20-milliampere polar.
30-milliampere polar.
Low-level polar.
High-impedance polar.
Special input.

i. INPUT SIGNALING RATES ACCEPTED. 37.5, 45.5, 50, 56.8, 61.1, 74.2, 75, 110, 150, 300, 600, 1200, and 2400 bauds.

j. INPUT SIGNAL CODING ACCEPTED. 5-level start-stop, 8-level start-stop, synchronous.

k. INPUT IMPEDANCE. Less than 300 ohms (20 and 30 milliamperes).
Less than 100 ohms (60 milliamperes).
Greater than 50K ohms (high Z).
Greater than 5K ohms (low-level).

## 1-4. EQUIPMENT SUPPLIED.

TABLE 1-1. EQUIPMENT SUPPLIED

| QTY PER EQUIP | NOMENCLATURE | DIMENSIONS (IN.) | | | VOLUME (CU. IN.) | WEIGHT (LB) |
|---|---|---|---|---|---|---|
| | | HEIGHT | WIDTH | DEPTH | | |
| 1 | Test Set, Telegraph AN/TS-2616/UGM (Analyzer) | 11-1/8 | 9-3/8 | 16-1/8 | 1682 | 33* |
| 1 | Front Cover | - | - | - | - | - |
| 1 | Spare Fuse, 1/2 ampere | - | - | - | - | - |
| 1 | Spare Fuse, 1/8 ampere | - | - | - | - | - |
| 1 | Spare Fuse, 1 ampere | - | - | - | - | - |
| 1 | Technical Manual for Test Set, Telegraph AN/TS-2616/UGM, NAVSHIPS 0969-125-7010 | - | - | - | - | - |

*Weight of unit includes weight of separate items.

## 1-5. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED.

TABLE 1-2. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QUANTITY: ONE PER EQUIPMENT

| ITEM NO. | NOMENCLATURE | | REQUIRED USE |
|---|---|---|---|
| | NAME | LATEST MODEL DESIGNATION | |
| 1 | Multimeter | AN/PSM-4D | Trouble shooting and maintenance procedures |
| 2 | Oscilloscope | AN/USM-281 | Trouble shooting and maintenance procedures |
| 3 | Transistor Test Set | AN/USM-206 | Trouble shooting and maintenance procedures |
| 4 | Test Set, Distortion Generator | AN/UGM-8 | Trouble shooting and maintenance procedures |
| | Note<br>In lieu of items 2 and 4, the following may be substituted: | | |
| | Digital Data Signal Generating and Analyzing Equipment | AN/USM-329 | |
| 5 | Instruction Book for Multimeter AN/PSM-4D | | |
| 6 | Instruction Book for Oscilloscope AN/USM-281 | | |
| 7 | Instruction Book for Transistor Test Set AN/USM-206 | | |
| 8 | Instruction Book for Test Set, Distortion Generator AN/UGM-8 | | |

# SECTION 2

# INSTALLATION

## 2-1. POWER REQUIREMENTS.

The Analyzer receives 115-volt ac, single phase, 50, 60, or 400Hz, 25-watt power through its 8-foot, 3-wire plug-in power cord. Primary power distribution is shown in figure 5-25.

## 2-2. INSTALLATION REQUIREMENTS.

The Analyzer is portable and may be operated in any position and in any location where ambient temperature is within 0° to +50°C. Mounting dimensions are shown in figure 2-1.

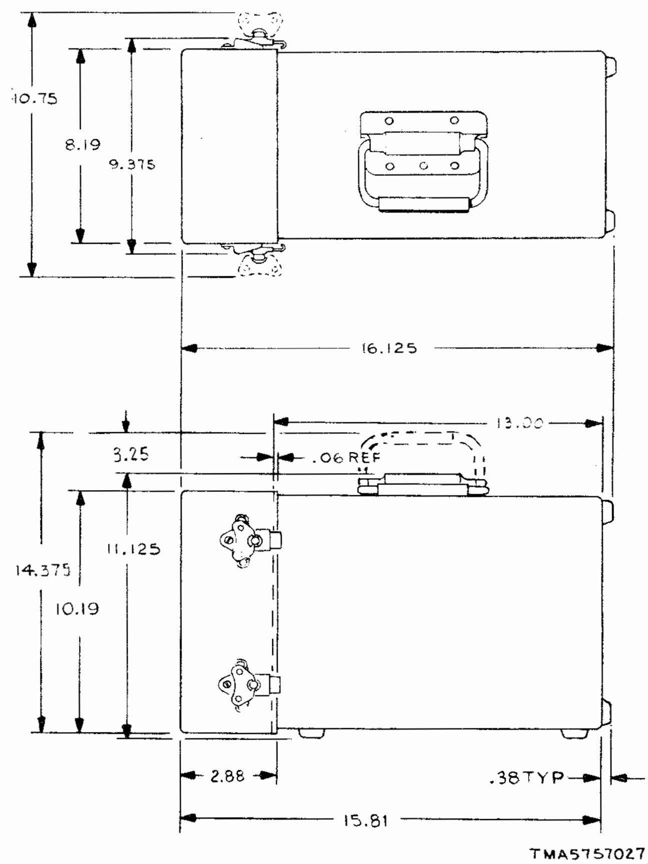



Figure 2-1. Test Set Telegraph TS-2616/UGM, Mounting Dimensions

## 2-3. INSPECTION AND ADJUSTMENT.

The Analyzer is correctly adjusted at the factory. Upon receipt of the unit, make the following checks.

a. INITIAL POWER APPLICATION.

(1) Remove front cover by turning four wing-knobs counterclockwise one-half turn.

(2) Check that front panel fuses are present and of correct current rating as marked on front panel.

(3) Unwind power cord from inside front cover and plug it into a 115-volt ac receptacle.

(4) Set POWER AC switch to ON. AC POWER lamp should light.

(5) Allow a 10-minute warmup to stabilize the oscillator.

b. INITIAL CHECKS.- Perform the operational checks outlined in paragraph 5-3.

# SECTION 3

# OPERATION

## 3-1. FUNCTIONAL OPERATION.

a. GENERAL.

(1) The Analyzer measures timing distortion in start-stop and synchronous data/telegraph signals. It permits the operator to determine what distortion components (marking end, spacing end, marking bias, spacing bias) constitute the total distortion. It also permits measurement of any one mark-to-space or space-to-mark transition. Refer to "Principles of Telegraph (Teletypewriter) Part E "Navships 0967-255-0010 for a concise introductory discussion on the teletypewriter signal, its distortion and analysis.

(2) The time positions of the data signal transitions are compared with those of an internal time-base signal.

(a) For start-stop signals, the first transition of the start code element is synchronized with the time base.

(b) For synchronous signals, the average time position of the signal transitions is synchronized with the time base.

(3) The time displacement between the signal transition(s) and time-base transition(s) is indicated on the PERCENT DISTORTION meter as a percentage of one unit interval. The MARKING or SPACING lamp lights to indicate which of the signal elements (mark of space) is longer in duration.

(a) When measuring end distortion, the MARKING lamp indicates that the transition(s) occurred late. When measuring bias distortion, the MARKING lamp indicates that the transition(s) occurred early.

(b) When measuring end distortion, the SPACING lamp indicates that the transition(s) occurred early. When measuring bias distortion, the SPACING lamp indicates that the transition(s) occurred late.

(4) The setting of the DISTORTION SELECT switch determines which component (end, bias, peak, early peak, or late peak) of distortion is measured. For total peak, early peak, or late peak measurements, the meter pointer holds at its highest deflection until the PEAK RESET switch is momentarily depressed to MAN. When the PEAK RESET switch is set to AUTO, the meter is automatically reset to zero every five seconds.

(5) Depending on the setting of the TRANSITION SELECT switch, the meter records either the displacement of a specific transition selected or the average displacement of all transitions.

Note

Only bias and peak distortion can be measured on synchronous signals. The measurement of end distortion and of individual transitions applies only to start-stop signals.

b. SIMPLIFIED BLOCK DIAGRAM ANALYSIS (see figure 3-1, 4-1 and 4-2).

(1) The data signal under test is coupled through the input circuits, which isolate and distribute data signal MS to the time-base, baud counter, and transfer control circuits.

(2) The time-base circuits generate timing signal CTB, whose rate is 100 times that of the MS bit rate. CTB is distributed to the transfer control and distortion counter circuits.

(3) The distortion counter circuits count CTB to produce timing signal N, whose rate is the same as the MS bit rate.

(4) CTB is synchronized with MS in one of two ways.

(a) For measuring synchronous data signals, CTB is synchronized with the average time position of the MS transitions. In the time-base circuits, N is compared with MS, and any difference in rate is corrected by adding a pulse to or removing a pulse from CTB.

(b) For measuring start-stop data signals, CTB is synchronized with the first transition of each MS start element. In the time-base circuits, CTB is enabled at each MS start element and disabled at each MS stop element.

(5) The baud counter circuits count N and monitor MS to derive three control signals (SC, ST, and $\overline{RST}$) which synchronize the Analyzer circuitry for start-stop signal measurement.

(a) SC inhibits CTB at each MS stop element and enables CTB at each MS start element.

(b) ST inhibits the transfer control circuits during each start element.

(c) $\overline{RST}$ resets the distortion counter circuits at the first transition of each MS start element.

(6) The distortion counter circuits count CTB. They count from 50 to 0 to 50 for each possible MS transition. If the MS transition is not distorted, it will occur as the count reaches 0. If the MS transition is early or late, the count, at the time the transition occurs, will be numerically equal to the per cent of displacement.

(7) The transfer control circuits monitor MS. Each time an MS transition occurs, ET or LT shifts the count present in the distortion counter, into the distortion register circuits. There the count is stored until the next MS transition occurs.

(8) The distortion register circuits convert the stored digital count into an equivalent analog level, which deflects the PERCENT DISTORTION meter. Meter-movement damping averages the distortion indications of a series of MS transitions.

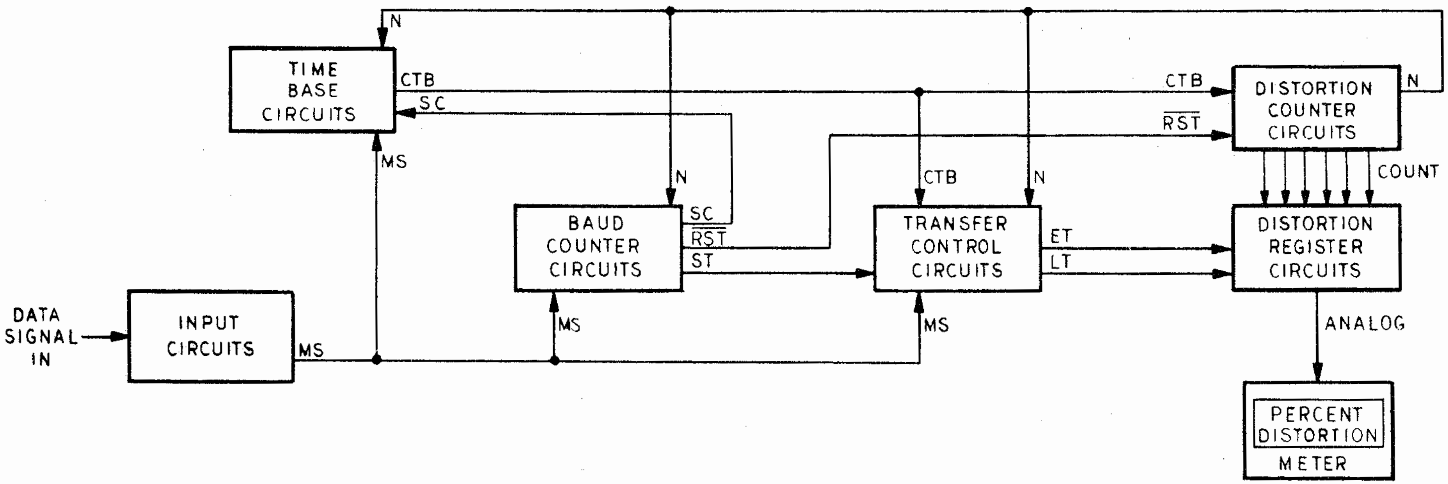



Figure 3-1. Test Set, Telegraph TS-2616/UGM, Simplified Block Diagram

## 3-2. CONTROLS AND INDICATORS (see figure 3-2).

Table 3-1 describes the function of each control and indicator.

TABLE 3-1. ANALYZER CONTROLS, INDICATORS, AND JACKS

| PANEL IDENTIFICATION | DESCRIPTION | FUNCTION | |
|---|---|---|---|
| AC POWER | Toggle switch | Applies primary power to unit. | |
| AC POWER | Indicator lamp, red | Lights when primary power is applied to unit. | |
| 1/2 A (2) | Cartridge-type fuse | Fuse both sides of primary power line. | |
| PERCENT DISTORTION | Meter | Indicates distortion of data signal under test in per cent of unit interval. | |
| LOOP CURRENT | Meter | Indicates current magnitude, in milliamperes of high-level data signal under test. | |
| INPUT SELECT | 6-position rotary switch | Sw Pos | Function |
| | | NEUTRAL 20MA | Adjusts input circuits to accept 20-milliampere neutral signals. |
| | | NEUTRAL 60MA | Adjusts input circuits to accept 60-milliampere neutral signals. |
| | | POLAR 20/30 | Adjusts input circuits to accept 20- or 30-milliampere polar signals. |
| | | POLAR HI-Z | Adjusts input circuits to accept high-impedance polar signals. |

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

| PANEL IDENTIFICATION | DESCRIPTION | FUNCTION |
|---|---|---|
| | | Sw Pos — Function<br>POLAR LOW-LEVEL — Adjusts input circuits to accept low-level polar signals.<br>SPEC — Special input to be wired by user as required. |
| INPUT POLARITY | Toggle switch | Reverses sense of input signal. |
| INPUT FILTER | Toggle switch | Sw Pos — Function<br>IN — Inserts filter into input circuits to remove transients from input signal under test.<br>OUT — Removes filter from input circuits. |
| CODE LEVEL | 3-position rotary switch | Adjusts Analyzer circuits to accommodate input signals of either 5- or 8-element start-stop codes or synchronous signals |
| RATE BAUDS | 14-position rotary switch | Sets internal time-base generator to correspond to input signals of 37.5, 45.5, 50, 56.8, 61.1, 74.2, 75, 110, 150, 300, 600, 1200, or 2400 bauds. EXT OSC position permits use of external time-base signal (see EXT OSC below). |
| TRANSITION SELECT | 10-position rotary switch | Selects specific transition (of 1 through 9) to be analyzed or all transitions. |
| DISTORTION SELECT | 5-position rotary switch | Sw Pos — Function<br>END — Adjusts circuits to measure mark-to-space transition displacement.<br>BIAS — Adjusts circuits to measure space-to-mark transition displacement. |

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

| PANEL IDENTIFICATION | DESCRIPTION | FUNCTION |
|---|---|---|
| | | <u>Sw Pos</u> — <u>Function</u><br>TOTAL PEAK — Adjusts circuits to record the maximum transition displacement that occurs during a measuring period (see PEAK RESET below).<br>EARLY PEAK — Adjusts circuits to record the maximum advanced transition displacement.<br>LATE PEAK — Adjusts circuits to record maximum delayed transition displacement. |
| PEAK RESET | 3-position toggle switch, nonlocking at MAN position | When set to AUTO, peak distortion readings (above) are reset to zero every five seconds. When momentarily set to MAN, peak readings are reset to zero. |
| TRANSITION MARKERS | 2-position toggle switch | When set to IN, inserts timing markers (at ideal transition points) into data signal available at SCOPE SIG connector. |
| SCOPE SIG | Connector | Provides output signal to display signal under test on an external oscilloscope. |
| SCOPE GRD | Connector | Provides ground connection for external oscilloscope. |
| SCOPE SYNC | Connector | Provides sync connection for external oscilloscope. |
| EXT OSC | Connector | Provides connection for external time base signal (see RATE BAUDS, above). |
| LO-Z | Jack | Provides connection for low-impedance signal to be analyzed. |
| HI-Z | Jack | Provides connection for high-impedance signal to be analyzed. |

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

| PANEL IDENTIFICATION | DESCRIPTION | FUNCTION |
|---|---|---|
| MARKING | Indicator lamp, white | Lights when bias distortion component is advanced or when end distortion component is delayed. |
| SPACING | Indicator lamp, white | Lights when bias distortion component is delayed or when end distortion component is advanced. |
| SIG IND-M | Indicator lamp, white | Lights when input signal is at mark.* |
| SIG IND-S | Indicator lamp, white | Lights when input signal is at space.* |

*Steady mark or space causes corresponding lamp to glow brightly. Data signal conditions cause both lamps to glow dimly. Relative brightness of lamps indicates the ratio of marks and spaces in signal.

## 3-3. SEQUENCE OF OPERATION.

a. Remove front cover from Analyzer (turn the four wing-knobs 1/2 turn counterclockwise).

b. Unwind power cord, from inside front cover, and plug it into a 115-volt ac outlet.

c. Set AC POWER switch to ON (AC POWER lamp should light) and allow a 10 minute warmup.

d. Make the following preliminary control settings.

(1) Set INPUT SELECT switch to position that corresponds to mode of signal to be analyzed.

(2) Set INPUT POLARITY switch to (+).

(3) Set INPUT FILTER switch to OUT.

(4) Set PEAK RESET switch to OFF.

(5) Set TRANSITION MARKERS switch to OUT.

(6) Set CODE LEVEL switch to:

(a) SYNC, if signal to be analyzed is synchronous.

(b) S/S 5, if signal to be analyzed is start-stop, 5-level code.

(c) S/S 8, if signal to be analyzed is start-stop, 8-level code.

(7) Set RATE BAUDS switch to rate that corresponds to bit rate of signal to be analyzed.

Note

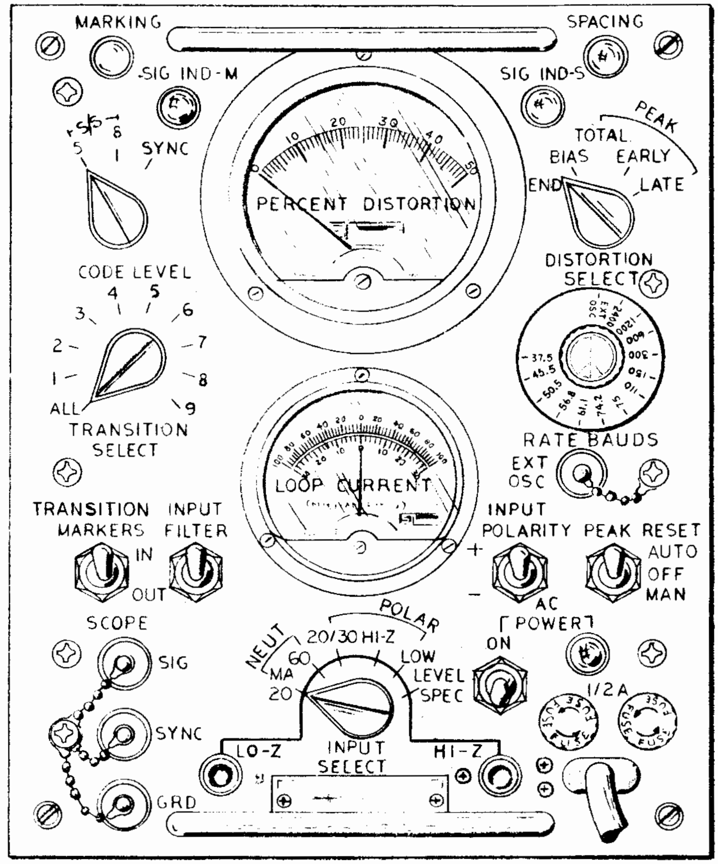
If external time base is to be used instead of internal time base, set RATE BAUDS switch to EXT OSC. Connect external time-base generator (square wave) to EXT OSC connector. Set frequency of generator to 200 times the baud rate of the signal to be analyzed (external signal level should not exceed 5 volts peak to peak).

(8) Set TRANSITION SELECT switch to ALL.

(9) If the signal to be analyzed is to be displayed on an external oscilloscope, connect the oscilloscope to the SCOPE SIG, SCOPE SYNC, and SCOPE GRD connectors.

e. Connect signal to be analyzed to either the LO-Z or HI-Z jack as follows.

(1) Connect 20-, 30-, or 60-milliampere signal to LO-Z jack. Externally adjust signal current rate for correct indication on LOOP CURRENT meter.




TMC5757026

Figure 3-2. Test Set Telegraph TS-2616/UGM, Controls and Indicators

(2) Connect low-level or high-impedance signal to HI-Z jack.

f. Place signal under test in the steady marking condition. SIG IND-M lamp should light. If not, reverse position of INPUT POLARITY switch.

g. Return signal under test to its normal signaling mode.

Note

If external oscilloscope display reveals transients (of less than 2 milliseconds in duration), set the INPUT FILTER switch to IN to remove the transients (do not use filter when data signal rate is greater than 75 baud). To display timing markers on oscilloscope to show ideal time positions for signal transitions, set TRANSITION MARKERS switch to IN.

h. Set DISTORTION SELECT switch to the name of the component of distortion to be measured. When the switch is set to:

(1) END (not used when measuring synchronous signals), the PERCENT DISTORTION meter indicates the average distortion of all mark-to-space transitions. When the MARKING lamp lights, the distortion is late. When the SPACING lamp lights, the distortion is early.

(2) BIAS, the PERCENT DISTORTION meter indicates the average distortion of all space to mark transitions. When the MARKING lamp lights, the distortion is early. When the SPACING lamp lights, the distortion is late.

(3) TOTAL PEAK, the PERCENT DISTORTION meter indicates the largest distortion that occurs during a given measuring period.

Note

With the PEAK RESET switch set to OFF, the measuring period extends until the PEAK RESET switch is momentarily set to MAN, which resets the reading to zero. With the PEAK RESET switch set to AUTO, the reading is reset automatically every five seconds.

(4) EARLY PEAK, same as TOTAL PEAK except only early transitions are measured.

(5) LATE PEAK, same as TOTAL PEAK except only late transitions are measured.

i. Only for start-stop signals under test, perform step h again, except set the TRANSITION SELECT switch to positions 1 through 9 for each setting of the DISTORTION SELECT switch.

Note

Positions 1 through 9 correspond to the 9 transitions between the start element and stop element of 8-level code signals (positions 7 through 9 do not apply for 5-level code signals). The PERCENT DISTORTION meter indicates the end, bias, total, early, or late peak distortion of the selected transition.

j. To stop Analyzer, set AC POWER switch to OFF.

3-4. OPERATOR'S MAINTENANCE.

a. PREVENTIVE MAINTENANCE.- Refer to Section 5 of this manual for preventive maintenance information.

WARNING

Voltages dangerous to life and limb exist inside unit.

b. EMERGENCY MAINTENANCE.- Operator's emergency maintenance is confined to the replacement of open fuses (see figure 5-1). Spare fuses are stored inside the front cover. If, immediately after replacement, a fuse opens again, notify maintenance personnel.

(1) The two fuses (F1 and F2) on the front panel protect the primary power line.

(2) The two fuses (F3 and F4) on bottom of component board carriage protect the secondary power circuits. To obtain access to these fuses, loosen the four front-panel slotted captive screws and slide the component board carriage out of the case.

# 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 for significant check points to aid in isolating the faulty section. Also, where applicable, test data (such as information on control settings, critical adjustments, and required 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.

g. TROUBLE SHOOTING THE ANALYZER. - First become familiar with its operation (refer to Section 3) and its principles of operation (refer to paragraphs 4-3 and 4-4). Then, use paragraph 4-2 as a general guide to localize and isolate the trouble; see figures 4-1 through 4-12, as required.

WARNING

Voltages dangerous to life and limb exist in this unit.

## 4-2. TROUBLE SHOOTING PROCEDURE.

When the Analyzer is suspected of malfunction, use the test equipment listed in table 1-2 to perform the following procedure.

a. Check that unit is being used correctly, in accordance with Section 3.

b. Remove unit from case and check that all component boards are secure in their correct receptacles.

c. Check that fuses F3 (1 ampere) and F4 (1/8 ampere), located beneath component board carriage, are good.

d. Measure secondary voltages at test points on component board A10 (see figures 5-19 and 5-20):

(1) +15 volts, TP1 (TP3 common).

(2) -15 volts, TP4 (TP3 common).

(3) +5.8 volts, TP2 (TP3 common).

e. Visually inspect unit.

(1) Check wafer switches for damage, corrosion, and bent contacts.

(2) Check all wiring and mounted components for damage and burns.

f. Check each of component boards A1 through A9 (see figures 5-2 through 5-18) by substitution. When a faulty component board is found, perform (1) through (3) below.

Note

If substitute component boards are not available, perform the following for each component board.

(1) Use extender board A11 to extend suspected component board in its slot. Remove suspected component board from its slot, insert extender in slot, and insert component board in extender. The component board is then electrically connected and mechanically supported with all components and test points accessible for troubleshooting.

(2) Refer to appropriate schematic diagram (see Section 5), and use an oscilloscope to observe each waveform shown.

Note

See apron of fold-out schematic diagrams for waveforms, voltages, and resistances.

(3) When an incorrect waveform is found, use a multimeter to measure the voltages and resistances of the logic stages associated with that output, to isolate trouble to a faulty component.

CAUTION

Read paragraph 5-5 (special repair data) before attempting disassembly.

4-3. OVER-ALL FUNCTIONAL DESCRIPTION (see figure 4-1 through 4-3).

Note

See paragraph 3-1 for simplified block diagram analysis.

a. INPUT CIRCUITS. - The INPUT SELECT switch adjusts the input select network to accept data signals of various modes and connects the LOOP CURRENT meter in series with the loop when the data signal is of high-level mode. The data signal is coupled through the input select network to key the electronic relay, which converts the data signal (of any mode) to a voltage mode acceptable by the delay and mixer network. The electronic relay also isolates the input select network and the external loop from the rest of the Analyzer circuitry. The delay and mixer network distributes data signal MS to the SIG IND lamps, baud counter, transfer control, and time-base circuits — and to the SCOPE SIG connector for display on an external oscilloscope. Timing spikes from the distortion counter are superimposed on the data signal available at the SCOPE SIG connector.

b. TIME-BASE CIRCUITS. - The primary timing signal is generated by the crystal oscillator and then counted down to produce a timing signal rate of 200 times the signaling rate of the data signal under test (MS). Output of the down counter is coupled through the sync network, which halves the rate, to produce a timing signal (CTB) rate of 100 times the MS baud rate. The setting of the RATE BAUDS switch determines which of six crystals controls the oscillator and how many of seven stages are used in the down counter to produce CTB. Timing signal CTB is distributed to the transfer control and distortion counter circuits.

c. SYNCHRONOUS SIGNAL DISTORTION MEASUREMENT (see figure 4-1 and 4-3).

(1) SYNCHRONIZATION. - The distortion counter counts CTB and, therefore, counts to 100 each time an MS transition occurs. It counts from 50 to 0 to 50, reaching 0 at the time of each possible MS transition. Each time the count reaches 0, a pulse (N) is sent to the sync network in the time-base circuits. There, the time positions of the N transitions are compared with the time positions of the MS transitions. If the rate of CTB (as reflected by the time position of N) is higher than the rate of MS, pulses are removed from CTB. If the rate of CTB is lower than the rate of MS, pulses are added to CTB. In this way CTB is synchronized with MS. (The removal or addition of a CTB pulse produces only a slight shift in the time position of N.)

(2) DISTORTION COUNT. - Each time a space-to-mark transition occurs in MS, the count in the distortion counter is 0, provided the MS transition is not distorted. If an MS transition occurs early or late, the count will be at some number between 0 and 50; the count will be numerically equal to the per cent of displacement of the MS transition. The transfer control circuits shift the count into the distortion register.

(3) TRANSFER CONTROL. - A pulse generator in the transfer control network is set each time a space-to-mark transition occurs in MS. The very next CTB transition resets the pulse generator, producing a pulse. The pulse is gated with N, producing a transfer pulse (either ET or LT). If the MS transition is late, LT strobes the transfer gates. If the MS transition is early, ET strobes the transfer gates. In either case, the transfer gates parallel-shift the count from the distortion counter to the distortion register, where the count is stored until the next count is shifted in.

(4) DISTORTION READINGS. - When early transfer pulse ET initiates the shift, the distortion register lights the MARKING indicator lamp. When late transfer pulse LT initiates the shift, the distortion register lights the SPACING lamp. In either case, the meter drive network drives the PERCENT DISTORTION meter with a current that is proportional to the digital number stored in the distortion register.

(5) DISTORTION SELECT. - When the DISTORTION SELECT switch is set to BIAS, each space-to-mark transition of MS initiates the transfer pulse (ET or LT). When the switch is set to TOTAL, EARLY, or LATE PEAK, the comparator gates inhibit the transfer pulse except when the count in the distortion counter is greater than the count stored in the distortion register. When the switch is set to EARLY PEAK, LT is inhibited. When the switch is set to LATE PEAK, ET is inhibited.

(6) PEAK RESET. - When the PEAK RESET switch is set to AUTO, the reset timer resets the distortion register to 0 every five seconds. When the PEAK RESET switch is set to OFF, the operator can reset the distortion register at any time by momentarily setting the PEAK RESET switch to MAN.

d. START-STOP SIGNAL MEASUREMENT (see figure 4-2 and 4-3).

(1) SYNC NETWORK. - For measuring start-stop signals, the Analyzer functions the same as described above for synchronous signal measurement, except that the sync network is not used to synchronize MS with CTB. The baud counter circuits perform that function. (For synchronous signal measurement, the baud counter circuits serve only to provide a sync signal for an external oscilloscope.)

(2) START-STOP SYNC. - The baud counter circuits synchronize CTB with the first transition of each start element of MS as described below. The baud counter counts N (occurring at the bit rate of MS) to produce four signals: $\overline{RST}$, SC, ST, and $\overline{XS}$. $\overline{RST}$ resets the distortion counter to zero at the first transition of each start element. Distortion measurement then proceeds the same as for synchronous signals until the stop element arrives. At this time SC inhibits CTB and enables it again at the first transition of the next start element. ST inhibits the transfer control network during the period of the start element. At the first transition of the start element, $\overline{RST}$ resets the distortion counter and distortion measurement again proceeds.

(3) TRANSITION SELECT. - When the TRANSITION SELECT switch is set to ALL, control signal $\overline{XS}$ supplies a constant enable to the transfer control network. When the switch is set to any of positions 1 through 9 (corresponding to the nine time-intervals following the start element), control signal $\overline{XS}$ supplies an enable to the transfer control network only during that particular time interval of each character. (One MS transition occurs at about the center of each interval.)

(4) CODE LEVEL. - The CODE LEVEL switch is set to S/S 5 or S/S 8 to adjust the baud counter circuits to accommodate either 5- or 8-element characters. When set to SYNC, the four control signals (SC, ST, $\overline{RST}$, and $\overline{XS}$) have no effect.

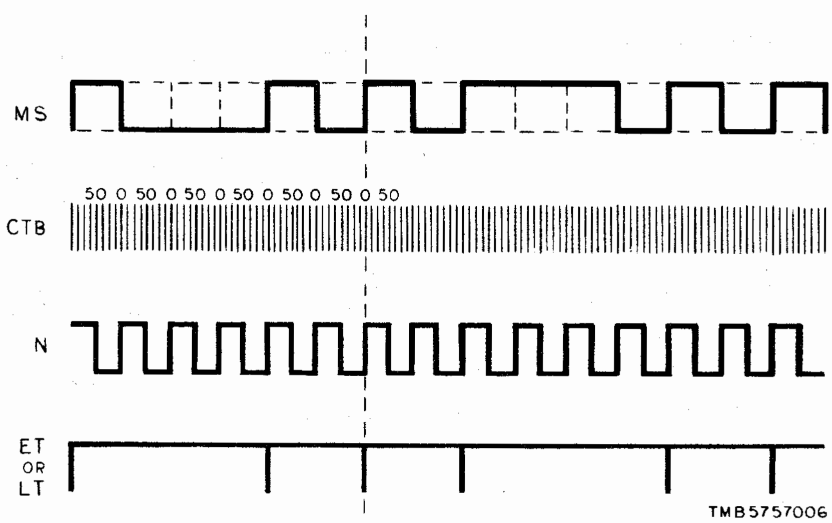



Figure 4-1. Over-All Synchronous Timing Chart

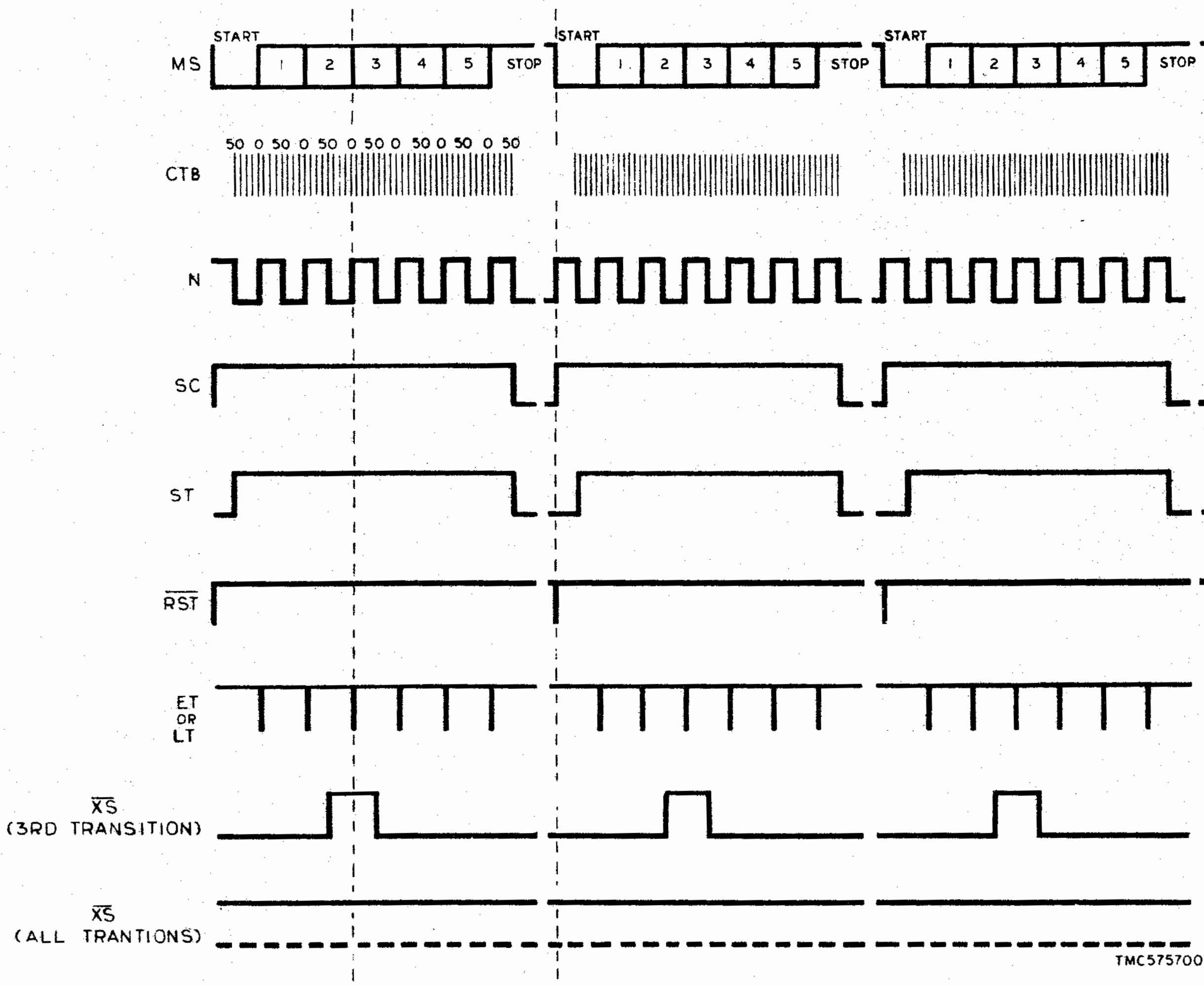



Figure 4-2. Over-All Start-Stop Timing Chart

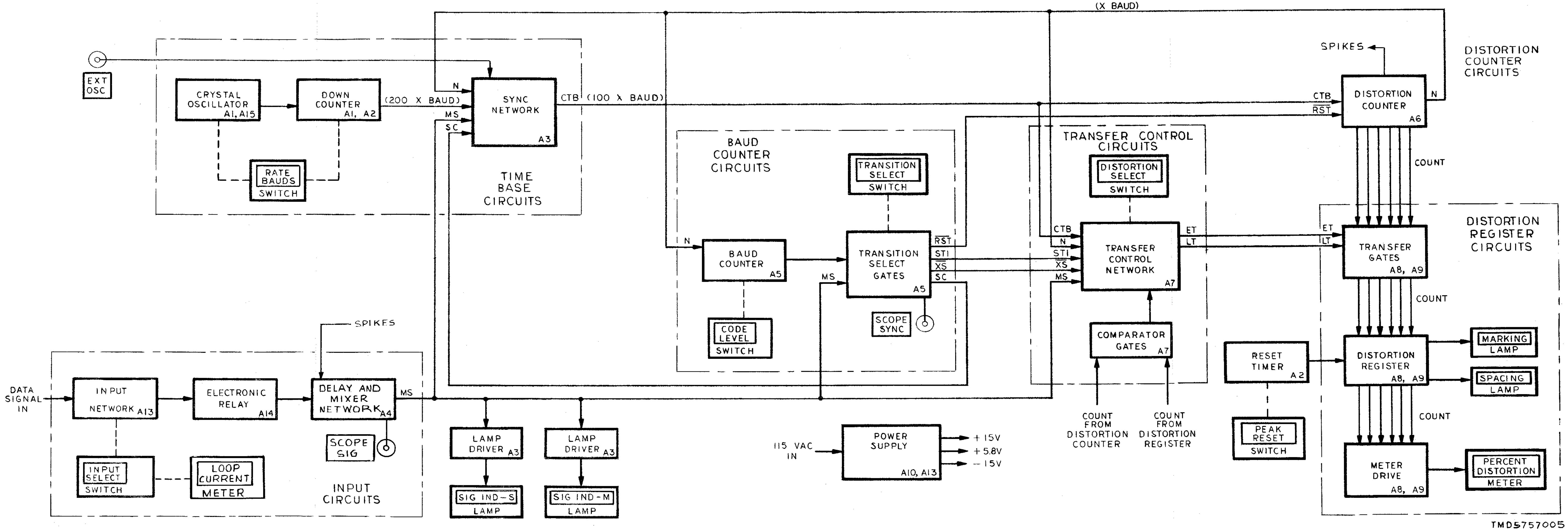



Figure 4-3. Test Set, Telegraph TS-2616/UGM, Detailed Block Diagram

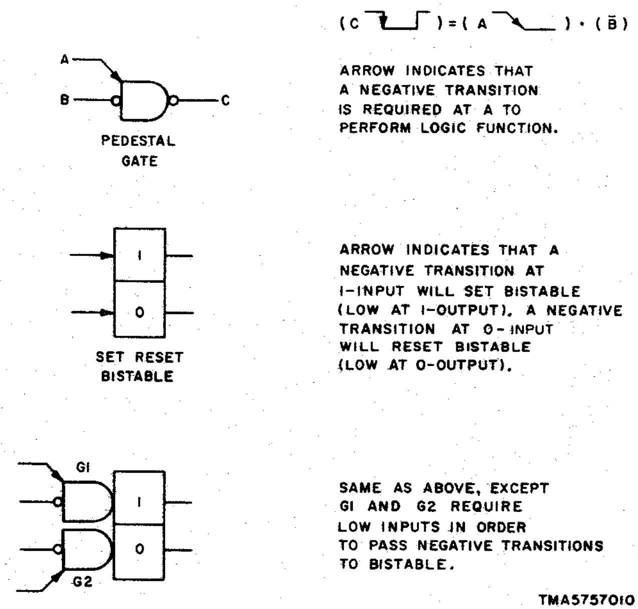



Figure 4-4. Graphic Symbols

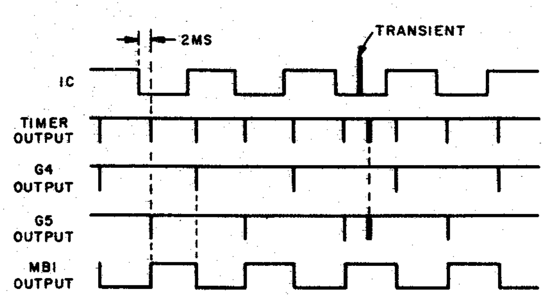



Figure 4-5. Delay Filter Timing

## 4-4. LOGIC ANALYSIS.

Note

All circuits in this functional section are standard logic or electronic circuits for which detailed descriptions may be found in the Handbook of Electronic Circuits, NAVSHIPS 900,000.102.

a. GENERAL. - Paragraphs c through h describe in detail the logic analysis of each of the six major circuit areas of the Analyzer: input circuits, time-base circuits, distortion counter circuits, distortion register circuits, baud counter circuits, and transfer control circuits.

b. LOGIC DEFINITIONS.

(1) +6 and +15 volts = logical-0 (high-level).

(2) Zero volt (ground) and -15 volts = logical-1 (low-level).

(3) Graphic symbols used are explained in MIL-STD-806B, with the exception of those shown in figure 4-4.

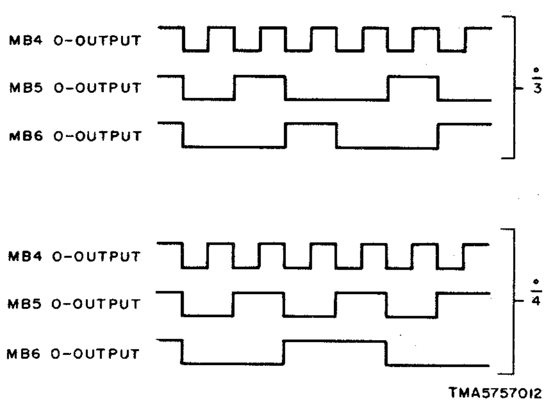



Figure 4-6 Down Counter Timing

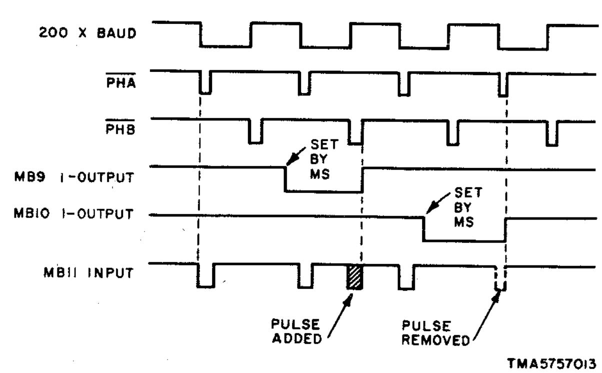



Figure 4-7. Sync Network Timing

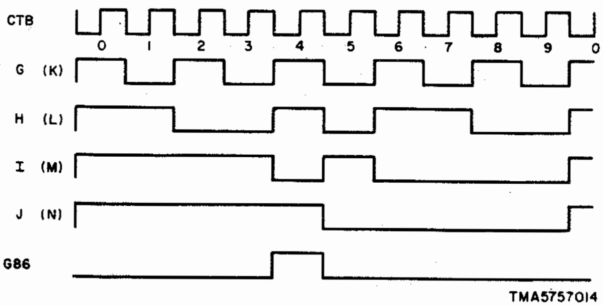



Figure 4-8. Distortion Counter Decade Timing

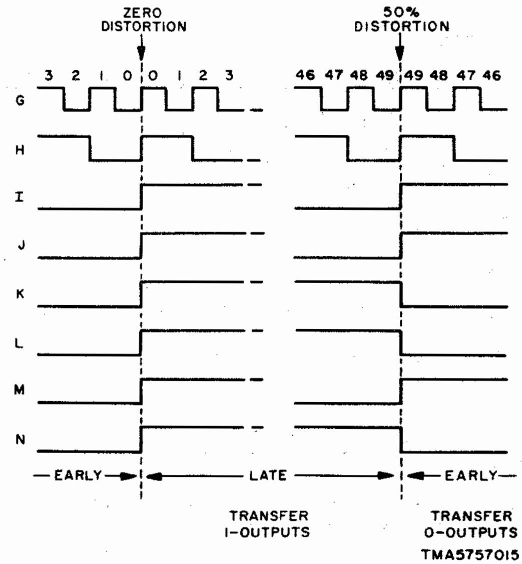



Figure 4-9. Distortion Counter Timing

c. INPUT CIRCUITS (see figure 4-5 and 4-12).

(1) INPUT SELECT NETWORK. - The data signal is coupled through the LO-Z or HI-Z jack, INPUT POLARITY switch, and INPUT SELECT switch to key electronic relay A14.

(a) The INPUT POLARITY switch permits reversal of data signal sense.

(b) R1, R2, R3, C6, and C7 provide rfi filtering.

(c) The INPUT SELECT switch adjusts input impedance to match various data signal modes to the electronic relay. Resistor A13R3 shunts the loop for 20- and 30-milliampere signals, A13R3 shunts the loop for 60-milliampere signals, and A13R1 is connected in series with the loop for high-impedance signals. The switch also connects the LOOP CURRENT meter in series with the loop for 20-, 30-, and 60-milliampere signals.

(d) The electronic relay converts any of the data signal modes to a voltage mode (IC and $\overline{IC}$) acceptable by the delay and mixer network.

(2) DELAY AND MIXER NETWORK. - At data signal rates of not more than 75 bauds, INPUT FILTER switch S7 may be set to IN, to remove transients (from data signal $\overline{IC}$) whose durations do not exceed two milliseconds.

(a) When set to OUT, S7 enables G8 and disables G6, so that $\overline{IC}$ is coupled through G8 and G7, and so that the MB-1 output is stopped at G6. Since G6 is disabled, its output enables G7 to invert $\overline{IC}$, which becomes data signal MS. Inverter IN-1 inverts MS to produce $\overline{MS}$.

(b) When set to IN, S7 disables G8 and enables G6, so that $\overline{IC}$ is stopped at G8, and so that the output of MB-1 is coupled through G6. Since G8 is disabled, its output enables G7, which therefore inverts the MB-1 output to become signal MS. Output of MB-1 is a delayed replica of $\overline{IC}$; delayed $\overline{IC}$ does not contain transients experienced by $\overline{IC}$, due to action of the delay filter, which functions as described below (see figure 4-5).

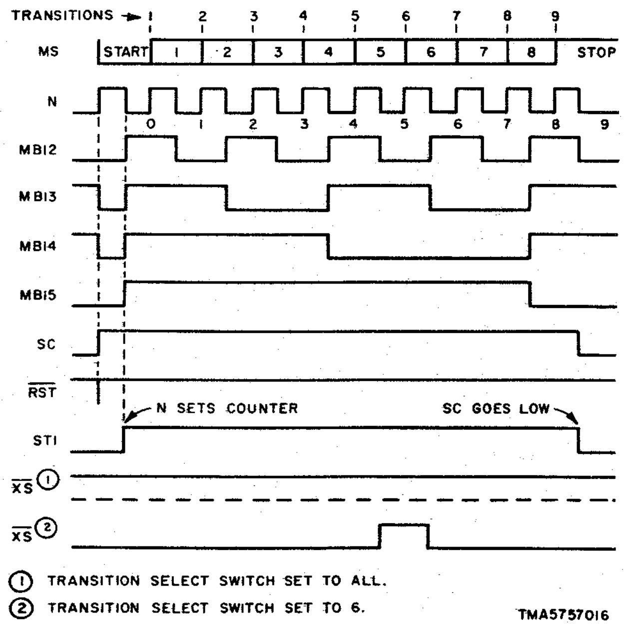



Figure 4-10. Baud Counter Timing

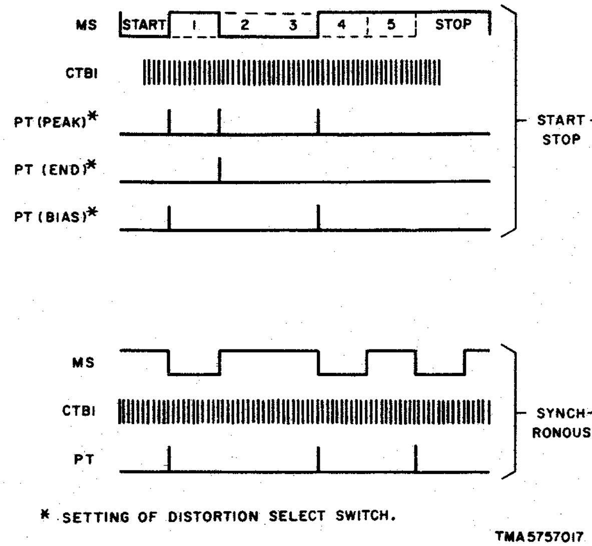



Figure 4-11. Transfer Pulse Generator Timing

1 Each negative transition of IC is coupled through G2 and G3 to start the timer. Each negative transition of $\overline{IC}$ is coupled through G1 and G3 to start the timer. Two milliseconds after each IC transition, therefore, the timer produces a negative transition output.

2 When IC is high, $\overline{IC}$ enables G4 to pass the timer transition to set MB-1. When IC is low, it enables G5 to pass the timer transition to reset MB-1. Output of MB-1 therefore produces a delayed replica of $\overline{IC}$.

3 If IC experiences a transient, the transient initiates an extra timer transition, but, delayed by two milliseconds, the transient is not able to change the state of MB-1.

## EXAMPLE

Consider the transient shown in figure 4-5. The extra timer transition (delayed by two milliseconds) cannot pass through G4 to set MB-1, because $\overline{IC}$ is high at that instant. Note that if the transient endures for more than two milliseconds, $\overline{IC}$ would be low, so MB-1 would be toggled.

(3) SPIKE MIXER NETWORK. - Timing spikes H, I, J, K, L, and M are coupled through G9 when the TRANSITION MARKERS switch is set to IN. The spikes (from the distortion counter) occur at the ideal transition points (of MS) and are superimposed on MS at G10. The output of G10 is coupled to the SCOPE SIG connector. Spike duration is two per cent of one unit internal; spike amplitude is about 0.4 volt.

(4) SIGNAL INDICATOR LAMPS. - Data signal MS and $\overline{MS}$ are connected through IN-11 and IN-12, respectively, to drive the SIG IND-M and SIG IND-S indicator lamps, respectively. When MS goes high (mark condition), IN-11 lights SIG IND-M; when $\overline{MS}$ goes high (space condition), IN-12 lights SIG IND-S.

d. TIME-BASE CIRCUITS (see figure 4-6, 4-7, and 4-12).

(1) CRYSTAL OSCILLATOR. - Determined by the setting of RATE BAUDS switch S3, the oscillator frequency is controlled by one of six crystals. Oscillator output is coupled through four shaper/buffer stages (IN-2, -3, -4, and -5) to the down counter, which divides the crystal frequency by a factor that produces a timing signal whose rate is 200 times the particular baud rate to which the RATE BAUDS switch is set.

(2) DOWN COUNTER (see figure 4-6). - The down counter (bistables MB-2 through -8) divides the selected crystal frequency by a factor (see table 4-1) required to produce an output rate of 200 times the baud rate of the data signal (MS) under test. Depending on the RATE BAUDS switch setting, one, two, three, four, five, six, or seven bistables are used in the down count. At four settings (50, 56.8, 61.1, and 110) of the RATE BAUDS switch, MB-5 and MB-6 are implemented to divide by 3 (instead of the normal divide-by-4). When the RATE BAUDS switch is set to 50, 56.8, 61.1, or 110 (÷3), the 1-output of MB-6 is connected to IN-6 and G26. When the switch is set to any other position (÷4), the 1-output of MB-5 connects to G26 and IN-6.

TABLE 4-1. TIMING SIGNAL FREQUENCIES

| CRYSTAL | CRYSTAL FREQ (KHZ) | RATE BAUDS SWITCH SETTING | 200 TIMES BAUD RATE (KHZ) | DOWN COUNT FACTOR | NUMBER OF DOWN-COUNT STAGES USED | DIVIDE-BY-3 USED |
|---|---|---|---|---|---|---|
| Y1 | 1164.80 | 45.5 | 9.10 | 128 | 7 | |
| Y2 | 949.76 | 74.2 | 14.84 | 64 | 6 | |
| Y3 | 960.00 | 37.5 | 7.5 | 128 | 7 | |
| | | 50 | 10 | 96 | 7 | * |
| | | 75 | 15 | 64 | 6 | |
| | | 150 | 30 | 32 | 5 | |

TABLE 4-1. TIMING SIGNAL FREQUENCIES (Cont'd)

| CRYSTAL | CRYSTAL FREQ (KHZ) | RATE BAUDS SWITCH SETTING | 200 TIMES BAUD RATE (KHZ) | DOWN COUNT FACTOR | NUMBER OF DOWN-COUNT STAGES USED | DIVIDE-BY-3 USED |
|---|---|---|---|---|---|---|
| | | 300 | 60 | 16 | 4 | |
| | | 600 | 120 | 8 | 3 | |
| | | 1200 | 240 | 4 | 2 | |
| | | 2400 | 480 | 2 | 1 | |
| Y4 | 1056.00 | 110 | 22 | 48 | 6 | * |
| Y5 | 1090.56 | 56.8 | 11.36 | 96 | 7 | * |
| Y6 | 1173.12 | 61.1 | 12.22 | 96 | 7 | * |

(3) SYNC NETWORK (see figure 4-7). - The primary function of the sync network is to synchronize phase and frequency of timing signal CTB with data signal MS during synchronous operation.

(a) The 200-times-baud signal from the down counter is coupled through IN-9 and IN-7 to monostables MM-1 and MM-2. At each negative transition of the 200 times baud signal, MM-2 generates a pulse ($\overline{PHA}$); at each positive transition, MM-1 generates a pulse ($\overline{PHB}$).

(b) The negative transition of pulses $\overline{PHA}$ are coupled through gate G30 to toggle MB-11, whose output becomes the 100-times-baud signal, CTB. Inverters IN-8 and IN-10 produce CTB1 and $\overline{CTB1}$.

(c) Gate G30 is able to pass $\overline{PHA}$ because the 1-output of MB-10 is normally high; signal $\overline{PHA}$ does not toggle MB-10 because the 1-output of MB-10 is normally high, and therefore disables G35.

1 For start-stop operation, SC is normally high; however, SC goes low during each stop element of data signal MS, thus inhibiting CTB during the stop element. For start-stop operation, the sync network serves no other purpose.

2 For synchronous operation, SC is constantly high.

(d) Gate G29 is unable to pass $\overline{PHB}$ because the 0-output of MB-9 is normally low; signal $\overline{PHB}$ does not toggle MB-9 because the 1-output of MB-9 is normally high and therefore disables G28.

(e) With the CODE LEVEL switch set to SYNC, the lower input to G33 is at a constant high, thus enabling G33 to pass MS to the inputs of MB-9 and MB-10.

(f) Each negative transition of MS toggles either MB-9 or MB-10, depending on the levels of N and $\overline{N}$.

Note

The negative transitions of $\overline{N}$ occur at the bit rate of MS and should occur at the time of MS transitions. If CTB rate is higher than MS rate, $\overline{N}$ transitions occur early. If CTB rate is lower than MS rate, $\overline{N}$ transitions occur late.

(g) If the $\overline{N}$ transition is advanced with respect to its corresponding MS transition, $\overline{N}$ is low (enabling G34) when the MS transition occurs. Bistable MB-10 is therefore toggled by the negative MS transition from G33. The 1-output of MB-10 goes low and disables G30. Since the next $\overline{PHA}$ pulse cannot pass through G30 to toggle MB-11, a pulse is removed from CTB. Signal $\overline{PHA}$ does toggle MB-10, however, to enable G30 to pass the next $\overline{PHA}$ pulse.

(h) If the $\overline{N}$ transition is delayed with respect to its corresponding MS transition, N is low when the MS transition occurs. Bistable MB-9 is therefore toggled by the negative MS transition from G33. As a result, the 0-output of MB-9 goes high, enabling G29, so that the next $\overline{PHB}$ pulse passes through G29 to toggle MB-11, adding a pulse to CTB. Signal $\overline{PHB}$ does toggle MB-9, however, thus disabling G29 before the next $\overline{PHB}$ pulse occurs.

e. DISTORTION COUNTER CIRCUITS (see figure 4-8, 4-9, and 4-12).

(1) TIMING SIGNAL N. - The distortion counter consists of two decade counters (MB-19 through MB-22, and MB-23 through MB-26). The first is stepped by CTB at 100 times the bit rate of the data signal (MS) under test. The second is stepped by the output of the first decade counter, at ten times the bit rate of MS. The output (N and $\overline{N}$) of the second decade counter is a timing signal whose negative transitions occur at the bit rate of MS.

(2) DISTORTION COUNT. - The distortion counter counts from 50 to 0 to 50 for each transition of MS. Both decade counters repeatedly count from 0 to 9. The first counts CTB, and the second counts each ninth count of the first decade counter.

(3) UNITS AND TENS. - The coded binary output (G, H, I, J,) of the first decade counter denotes the units decimal-digit of the count. The coded binary output (K, L, M, N) of the second decade counter denotes the tens decimal-digit of the count.

(4) WEIGHTING. - The coded decimal notation of the coded binary outputs of both decade counters is 2-4-2-1 instead of the normal 8-4-2-1 (see table 4-2 and figure 4-8). The 2-4-2-1 weighting is implemented by gates G86 (first decade counter) and G97 (second decade counter). In the first decade counter, for example, at count 4, G, $\overline{I}$, and J are gated at G86 to produce a pulse whose negative transition sets MB-20 and resets MB-21, which sets MB-22.

(5) COUNT TRANSFER (see figure 4-9). - The count in the counter at the time of each MS transition is shifted into the distortion register circuits. The count at the time of an MS transition is numerically equal to the per cent of distortion in that transition. If the displacement is late, the <u>true</u> (1-outputs) coded binary outputs are shifted. If the displacement is early, the <u>complement</u> (0-outputs) coded binary outputs are shifted. In either case, the count reaching the distortion register is of the same sense, the reason

being that the 50-to-0 count appears on the 0-outputs of the bistables, and the 0-to-50 count appears on the 1-outputs.

(6) TIMING SIGNAL RST.- During start-stop operation only, an RST pulse (from the baud counter circuits) resets the distortion counter to 0 at the beginning of each start element.

(7) EXTRA COUNT.- In figure 4-9, note that the count changes from 49 to 49, skipping 50. Since the second 49 count is initiated by the 50th count, all counts between 49 and 0 register 1 count short. In other words, for 20 per cent early distortion, counter output would register 19 per cent. An extra count (generated by the extra-count generator) is therefore applied directly to the distortion register circuits. Bistable MB-27 is set by ET and reset by LT.

Note

Signal ET occurs when an MS transition occurs early. Signal LT occurs when an MS transition occurs late.

For an MS transition that occurs early, the count in the distortion counter is shifted into the distortion register by ET, which also sets MB-27; when MB-27 is set, its 0-output is inverted by IN-20 to produce the extra count (XC), which is coupled to the PERCENT DISTORTION meter. For an MS transition that occurs late, the count in the distortion counter is shifted into distortion register by LT, which also resets MB-27, thus removing the extra count from the meter. When measuring peak distortion, MRT resets MB-27 at the same time that it resets the distortion register circuits.

TABLE 4-2. WEIGHTING

| 8-4-2-1 WEIGHTING | | | | | 2-4-2-1 WEIGHTING* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| COUNT | 8 | 4 | 2 | 1 | COUNT | 2 | 4 | 2 | 1 |
| 0 = | 0 | 0 | 0 | 0 | 0 = | 0 | 0 | 0 | 0 |
| 1 = | 0 | 0 | 0 | 1 | 1 = | 0 | 0 | 0 | 1 |
| 2 = | 0 | 0 | 1 | 0 | 2 = | 0 | 0 | 1 | 0 |

*The counter counts as an ordinary binary counter, with 8-4-2-1 weighting until count 4. Then gating inverts count 4 to produce count 5 (2-4-2-1 weighting). The counter then again counts as an ordinary binary counter.

TABLE 4-2. WEIGHTING (Cont'd)

| 8-4-2-1 WEIGHTING | | | | | 2-4-2-1 WEIGHTING* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| COUNT | 8 | 4 | 2 | 1 | COUNT | 2 | 4 | 2 | 1 |
| 3 = | 0 | 0 | 1 | 1 | 3 = | 0 | 0 | 1 | 1 |
| 4 = | 0 | 1 | 0 | 0 | 4 = | 0 | 1 | 0 | 0 |
| 5 = | 0 | 1 | 0 | 1 | 5 = | 1 | 0 | 1 | 1 |
| 6 = | 0 | 1 | 1 | 0 | 6 = | 1 | 1 | 0 | 0 |
| 7 = | 0 | 1 | 1 | 1 | 7 = | 1 | 1 | 0 | 1 |
| 8 = | 1 | 0 | 0 | 0 | 8 = | 1 | 1 | 1 | 0 |
| 9 = | 1 | 0 | 0 | 1 | 9 = | 1 | 1 | 1 | 1 |

*The counter counts as an ordinary binary counter, with 8-4-2-1 weighting until count 4. Then gating inverts count 4 to produce count 5 (2-4-2-1 weighting). The counter then again counts as an ordinary binary counter.

f. DISTORTION REGISTER CIRCUITS (see figure 4-12).

(1) GENERAL.- The distortion register accepts any binary coded count from the distortion counter and converts it to a proportional current magnitude to deflect the PERCENT DISTORTION meter to indicate the decimal equivalent of the count.

(2) LATE DISTORTION.- Assume that an MS transition occurs 21 per cent late. At that instant, the binary coded outputs of the distortion counter would be as follows (see figure 4-8 and 4-9):

FIRST DECADE COUNTER { G low, H high, I high, J high } = 1

SECOND DECADE COUNTER { K high, L low, M high } = 2

(a) Since G and L are low and the MS transition occurred late, late transfer pulse LT is coupled through transfer gates G100 and G120 to set bistables MB-28 and MB-33.

(b) Since $\overline{H}$, $\overline{I}$, $\overline{J}$, $\overline{K}$, and $\overline{M}$ are low, LT is coupled through transfer gates G106, G110, G114, G118, and G126 to reset bistables MB-29, MB-30, MB-31, MB-32, and MB-34.

(c) The highs at the 0-outputs of MB-28 and MB-33 are inverted by IN21 and IN26. The resultant lows at the outputs of IN21 and IN26 supply current through limiting resistors A8R16 and A9R31. The sum of the two currents deflects the PERCENT DISTORTION meter to indicate 21 per cent.

(3) EARLY DISTORTION.- Assume that an MS transition occurs 21 per cent early. At that instant, the binary coded output of the distortion counter would be one count short, as follows (see figure 4-8 and 4-9):

| | | | |
|---|---|---|---|
| FIRST DECADE COUNTER | G | low | = 0 |
| | H | low | |
| | I | low | |
| | J | low | |
| SECOND DECADE COUNTER | K | low | = 2 |
| | L | high | |
| | M | low | |

(a) Since $\overline{L}$ is low and the MS transition occurred early, early transfer pulse ET is coupled through transfer gate G121 to set bistable MB-33.

(b) The resultant high at the 0-output of MB-33 is inverted by IN26 to supply current through A9R31 to deflect PERCENT DISTORTION meter M1 to indicate 20 per cent. The extra-count generator, however, provides the extra current required to increase the meter deflection to the correct indication of 21 per cent distortion (see paragraph e (7)).

(4) SPACING AND MARKING LAMPS.- Bistable MB-35 sets or resets to light the MARKING or SPACING indicator lamp. If, for example, end distortion is being measured and an MS mark-to-space transition occurs late, LT gates with MS to set MB-35, whose 0-output thus goes high to light the MARKING indicator lamp. If the MS transition occurs early, ET gates with MS to reset MB-35 to light the SPACING indicator lamp. When measuring bias distortion, ET gates with MS to set MB-35, lighting the MARKING indicator lamp, or LT gates with MS to reset MB-35, lighting the SPACING indicator lamp.

(5) PEAK RESET.- Every peak reset signal $\overline{MRT}$ resets bistables MB-28 through MB-35. The reset timer circuit generates the reset pulse MRT. Astable MA-1, when energized by setting the PEAK RESET switch to AUTO, produces a pulse every five seconds; this pulse is coupled through inverter IN-19 to trigger monostable MM-3, which produces the MRT pulse.

g. BAUD COUNTER CIRCUITS (see figure 4-10 and 4-12).

(1) BAUD COUNTER.- The baud counter (MB-12 through MB-15) counts the negative transitions of timing signal N (bit rate of MS from the distortion counter). The binary-coded count appears at the 1-outputs of MB-12, MB-13, MB-14, and MB-15; these outputs are applied to gate G49 via the CODE LEVEL switch and three inverters as described in (a) through (c) below.

(a) With the CODE LEVEL switch set to 5 (TRANSITION SELECT switch set to ALL), the 1-outputs of MB-12 and MB-15 are applied directly to G49, and the 1-outputs of MB-13 and MB-14 are applied to G49 through inverters IN-14 and IN-15. When the binary count reaches 6 (shortly after the first transition of the MS stop element), all gate G49 inputs are high, causing the output (SC) to go low. With SC low gate, G50 is enabled. The first transition of the next MS start element then passes through G50 to become reset pulse $\overline{\text{RST}}$, which sets the baud counter. When the baud counter is set, all its 1-outputs go low, causing SC to go high, which disables G50 until the count again reaches 6. Once set, the counter is reset by the next negative transition of N, and the count begins again.

(b) With the CODE LEVEL switch set to 8 (TRANSITION SELECT switch set to ALL), the 1-output of MB-12 is applied through IN-13 to G49, the 1-outputs of MB-13 and MB-14 are applied directly to G49, and the 0-output of MB-15 is applied to G49. When the binary count reaches 9, all inputs to G49 go high causing SC to go low. When SC goes low (shortly after the first transition of the MS stop element), it enables G50. The first transition of the MS start element passes through G50 to become $\overline{\text{RST}}$, which sets the counter. The next negative transition of N resets the counter and the count again begins.

(c) With the CODE LEVEL switch set to SYNC, S2A grounds one input to G49, thus locking SC at the high level.

(2) TRANSITION SELECT.- Gates G45 and G46 produce signal $\overline{\text{XS}}$; this signal, when high, enables the transfer control circuits. Signal $\overline{\text{XS}}$ is high only when all inputs to gate G45 are low. When the TRANSITION SELECT switch is set to ALL, the four inputs to G45 are grounded so that $\overline{\text{XS}}$ is high at all times. For the other nine settings of the TRANSITION SELECT switch, the four inputs to G45 will be low only during the unit interval of the selected transition. The setting of TRANSITION SELECT switch S4 determines which outputs of the baud counter bistables connect to G45 and which of inverters IN-13, IN-14, and IN-15 are implemented.

(3) STOP SIGNAL ST1.- Signal ST1 goes high to inhibit the transfer control circuits during part of each stop and start element of MS (see figure 4-10). With the CODE LEVEL switch set to 5 or 8 (for start-stop operation), one input to G44 is at a constant high; gate G44 therefore inverts its other input, $\overline{\text{ST}}$. Output of G44 (ST1) thus follows the output of G48 (ST), which goes low during part of each stop and start element of MS. At all other times G48 has two high inputs, SC and the output of G47. Shortly after the first transition of the stop element, SC goes low, causing ST to go low. SC goes high at the first transition of the start element, however; at the same instant, $\overline{\text{RST}}$ sets the counter, whose 0-outputs cause the output of G47 to go low, so that ST remains low. The next negative transition of N resets the counter, causing the output of G47 to go high, which causes ST to go high.

Note

When the CODE LEVEL switch is set to SYNC, one input to G44 is at a constant low, thus locking ST1 at a constant high.

h. TRANSFER CONTROL CIRCUITS (see figure 4-11 and 4-12).

(1) PULSE GENERATOR.- The pulse generator produces a pulse at the time of (a) each MS transition, (b) each mark-to-space transition, or (c) each space-to-mark transition. Which MS transitions do initiate pulses are determined by the settings of the CODE LEVEL switch and the DISTORTION SELECT switch.

(a) START-STOP.- For start-stop operation, CODE LEVEL switch S2 is set either to 5 or 8, which connects the input of gate G51 to the output of the DISTORTION SELECT switch S1.

1 PEAK.- When set to one of its three PEAK positions, S1 applies two lows to enable gates G51 and G52. Each negative MS transition and each negative $\overline{MS}$ transition is coupled through G51 and G52 to set bistable MB-16. Bistable MB-16 is therefore set at each transition of MS. Every time MB-16 is set, its 1-output enables gate G54, permitting the next negative transition of $\overline{CTB1}$ to set MB-17; the next negative transition of CTB1 then resets MB-17 and MB-16. Consequently, the 0 output of MB-17, produces a positive transfer pulse (PT) each time an MS transition occurs.

2 BIAS.- When set to BIAS, S1 applies a low to G52 and a high to G51. Since G51 is thus disabled, a transfer pulse (PT) is generated only for each space-to-mark transition of MS.

3 END.- When S1 is set to END, G52 is disabled and G51 is enabled. Transfer pulse PT is thus generated only for each mark-to-space transition of MS.

(b) SYNCHRONOUS.- For synchronous operation, CODE LEVEL switch S2 is set to SYNC, thus connecting a high to disable G51. Transfer pulse PT is thus generated only for each mark-to-space transition of MS. Note that, if S1 were set to END, both G51 and G52 would be disabled and no transfer pulses would be generated.

(2) COMPARATOR GATES.

(a) The comparator gates compare the count stored in the distortion register with the changing count in the distortion counter. When the two counts become equal, bistable MB-18 is set, causing $\overline{GR}$ to go high. When the two counts become opposite (complementary), MB-18 is reset, causing $\overline{GR}$ to go low.

(b) Bistable MB-18 is set by a negative transition of $\overline{CTB1}$ when gate G73 is enabled by a low from the output of gate G72. Gate G72 produces the required low only when none of gates G58 through G64 has two lows applied to it. This condition is satisfied only when the count in the distortion counter is equal to the count in the distortion register. When the two counts are equal, the coded binary levels at 1-outputs P, Q, R, S, T, U, and V of the register are the complement of the coded binary levels at the corresponding 0-outputs $\overline{G}$, $\overline{H}$, $\overline{I}$, $\overline{J}$, $\overline{K}$, $\overline{L}$, and M of the counter. All of gates G58 through G64 therefore supply high outputs to gate G128, causing it to produce a low output.

(c) Bistable MB-18 is reset by a negative transition of $\overline{CTB1}$ when gate G75 is enabled by a low from the output of G74. Gate G74 produces the required low only when none of gates G65 through G71 has two lows applied to it. This condition is satisfied only when the count in the distortion counter is the complement of the count in the distortion register. When the two counts are opposite, the coded binary levels at 0-outputs $\overline{P}$, $\overline{Q}$, $\overline{R}$, $\overline{S}$, $\overline{T}$, $\overline{U}$, and $\overline{V}$ of the register are the complement of the coded binary levels at the corresponding 0-outputs G, $\overline{H}$, $\overline{I}$, $\overline{J}$, $\overline{K}$, $\overline{L}$, and $\overline{M}$ of the counter. All of gates G65 through G71 therefore supply high outputs to gate G74, causing it to produce a low output.

(3) TRANSFER GATES.- Transfer pulse PT is gated through G56 or G57 to become transfer pulse ET or LT, respectively.

(a) EARLY TRANSFER PULSE ET.- If PT occurs early, $\overline{N}$ is high, permitting PT to pass through G56 to become early transfer pulse ET (N is low, thus disabling G57).

(b) LATE TRANSFER PULSE LT.- If PT occurs late, N is high, permitting PG to pass through G57 to become late transfer pulse LT (N is low, thus disabling G56).

(c) END AND BIAS MEASUREMENT.- When DISTORTION SELECT switch S1 is set to END or BIAS, pin 7 of SIA applies highs to enable G56 and G57.

(d) PEAK MEASUREMENT.- When S1 is set to one of its three PEAK positions, $\overline{GR}$ is applied to G56 and G57 (GR must then be high to enable G56 and G57).

(e) TOTAL PEAK MEASUREMENTS.- When S1 is set to TOTAL, pins 3 and 6 of SIA apply highs to enable G57 and G56, respectively.

(f) EARLY PEAK MEASUREMENTS.- When S1 is set to EARLY, pin 5 of SIA applies a low to disable G57 (permitting only early transfer pulses (ET) to be initiated).

(g) LATE PEAK MEASUREMENTS.- When S1 is set to LATE, pin 6 of SIA applies a low to disable G56 (permitting only late transfer pulses (LT) to be initiated).


Figure 4-12. Test Set, Telegraph TS-2616/UGM, Over-All Logic Diagram (Sheet 1 of 3)

MAJOR LOGIC SIGNALS

| LOGIC SIGNAL | NAME | ORIGIN | DESTINATION AND FUNCTION |
|---|---|---|---|
| MS, $\overline{MS}$ | Data signal (under test) | Delay and mixer network | Lamp drivers, A3, to light SIG IND-S and SIG IND-M lamps.<br>Sync network, A3, to synchronize timing signal CTB, CTB1, and $\overline{CTB1}$ with MS.<br>Baud counter, A5, to initiate reset pulse $\overline{RST}$.<br>Transfer control, A7, to initiate transfer pulse ET and LT.<br>Transfer gates, A9, to light SPACING and MARKING lamps. |
| CTB, CTB1, $\overline{CTB1}$ | Timing signal (100 x baud of MS) | Sync network, A3 | Transfer control, A7, to synchronize transfer pulse ET and LT.<br>Distortion counter, A6, to step counter. |
| N, $\overline{N}$ | Timing signal (1 x baud of MS) | Distortion counter, A6 | Transfer control, A7, to select either ET or LT.<br>Baud counter, A5, to step counter.<br>Sync network, A3, to sync MS with CTB during synchronous operation. |
| ET | Early transfer | Transfer control, A7 | Transfer gates, A8 and A9, to transfer early distortion count from distortion counter, A6, to distortion register, A8 and A9, and to light MARKING and SPACING lamp.<br>Extra count generator, A2, to initiate extra count XC. |
| LT | Late transfer | Transfer control, A7 | Transfer gates, A8 and A9, to transfer late distortion count from distortion counter, A6, to distortion register, A8 and A9, and to light MARKING or SPACING lamp.<br>Extra count generator, A2, to disable extra count XC. |
| $\overline{RST}$ | Reset | Baud counter, A5 | Distortion counter, A6, to reset counter and to baud counter, A5, to set counter (to sync counters for start-stop operation). |
| ST1 (ST) | Stop transfer | Baud counter, A5 | Transfer control, A7, to prevent distortion count transfer between characters during start-stop operation. |
| SC | Stop count | Baud counter, A5 | Sync network, A3 to sync MS with CTB during start-stop operation. |
| $\overline{XS}$ | Transition select | Baud counter, A5 | Transfer control, A7, to disable distortion count transfer except during time of selected transition(s), for start-stop operation. |
| XC | Extra count | Extra count generator, A2 | PERCENT DISTORTION meter, to provide extra 1 per cent deflection for early distortion readings. |
| MRT | Manual/Auto reset | Reset timer, A2 | Distortion registers, A8, A9, to reset stored count to zero. |
| G, H, I, J, K, L, and M<br>$\overline{G}$, $\overline{H}$, $\overline{I}$, $\overline{J}$, $\overline{K}$, $\overline{L}$, and $\overline{M}$ | Distortion count | Distortion counter, A6 | Distortion register, A8 and A9, to store count in register to be converted to meter drive current.<br>Delay and mixer network, A4, to provide timing spikes for external oscilloscope display.<br>Comparator gates, A7, to be compared with stored count for peak distortion measurement. |
| P, Q, R, S, T, U, and V<br>$\overline{P}$, $\overline{Q}$, $\overline{R}$, $\overline{S}$, $\overline{T}$, $\overline{U}$, and $\overline{V}$ | Stored distortion count | Distortion register, A8 and A9 | Comparator gates, A7, to be compared with distortion count for peak distortion measurement. |

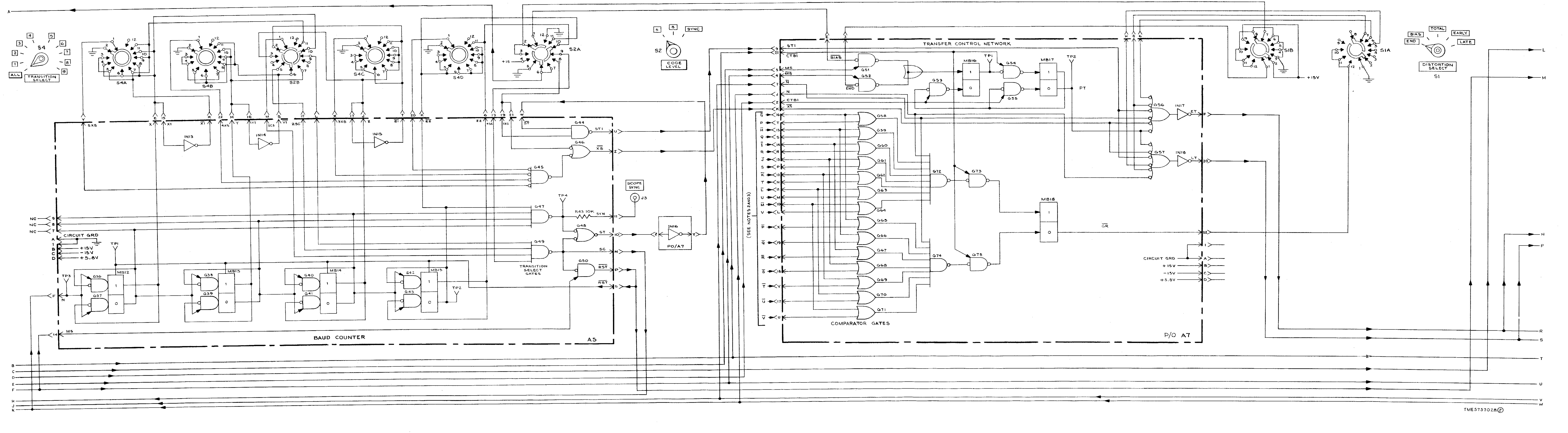



Figure 4-12. Test Set, Telegraph TS-2616/UGM, Over-All Logic Diagram (Sheet 2 of 3)

NOTES:
1. ALL WAFER SWITCHES ARE SHOWN AS VIEWED FROM REAR AND ARE SHOWN SET TO THE POSITION DEPICTED BY THE ASSOCIATED FRONT PANEL VIEW.
2. DISTORTION COUNTER OUTPUT LINES OF G THRU M AND $\overline{G}$ THRU $\overline{M}$ CONNECT TO THE DELAY AND MIXER NETWORK, COMPARATOR GATES AND DISTORTION REGISTER AS MARKED.
3. DISTORTION REGISTER OUTPUT LINES P THRU V AND $\overline{P}$ THRU $\overline{V}$ CONNECT TO THE COMPARATOR GATES AS MARKED.
4. FILLED IN ARROWS ON LOGIC SYMBOLS INDICATE THAT A NEGATIVE TRANSITION PERFORMS REQUIRED FUNCTION.

5. DOWN COUNTER BISTABLES MB5 AND MB6 PERFORM DIVIDE BY 3 FUNCTION WHEN RATE BAUDS SWITCH IS SET TO 50, 56.8, 61.1, AND 110 FOR ALL OTHER SETTING OF RATE BAUDS SWITCH THEY PERFORM DIVIDE BY 4 FUNCTION.

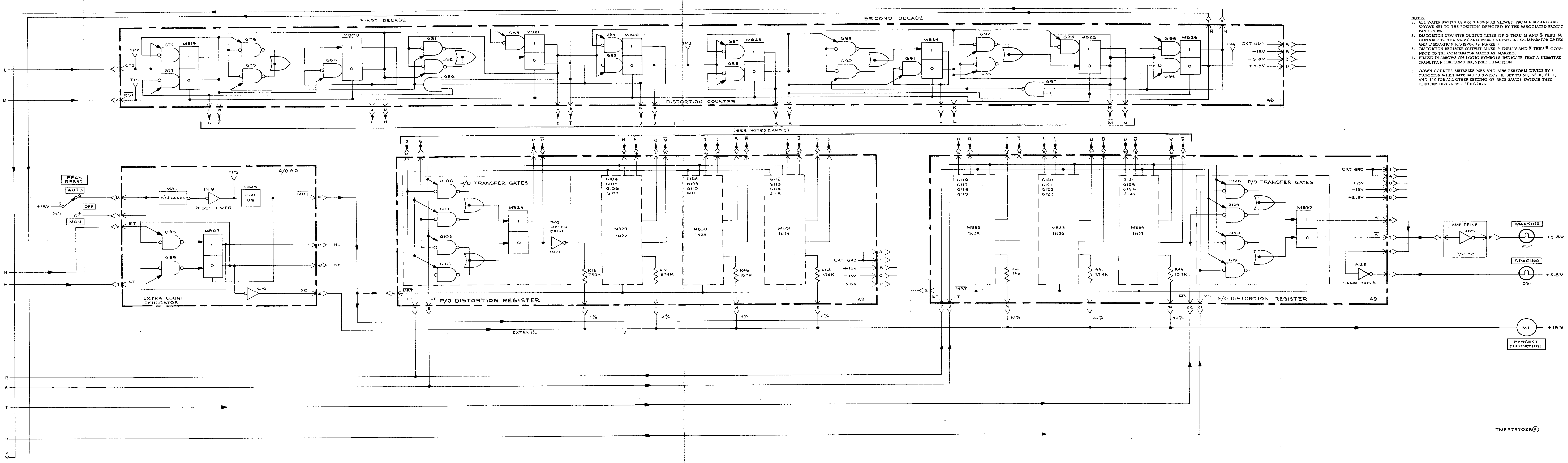



Figure 4-12. Test Set, Telegraph TS-2616/UGM, Over-All Logic Diagram (Sheet 3 of 3)

# SECTION 5

# MAINTENANCE

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

Failure Reports and Performance and Operational Reports shall be submitted in accordance with existing directives.

## 5-2. PREVENTIVE MAINTENANCE.

a. OPERATOR'S PROCEDURE.- Perform the following each day the Analyzer is in use.

(1) Clean front panel, front cover, and case with a soft, lint-free cloth. Dampen cloth with Cleaning Compound (Federal Stock No. 7930-395-9542) as required, and wipe panel dry with a clean cloth.

(2) Check to see that the three spare fuses (1 ampere, 1/8 ampere, and 1/2 ampere) are affixed inside front cover.

(3) Inspect power cord and plug for damaged insulation, and clean as required.

(4) Inspect meters for loose or damaged windows.

(5) Check that all switches operate smoothly without binding. All knobs should be secure to their shafts and should align properly with panel markings.

b. TECHNICIAN'S PROCEDURE.- Every 90 days, perform the operational checks (paragraph 5-3). Every 30 days, perform the adjustment procedure (paragraph 5-4) to insure the specified measuring accuracy of the unit. Correct any malfunction revealed. See Section 4 for trouble shooting procedures and refer to figures 5-1 through 5-26 as necessary.

## 5-3. OPERATIONAL CHECKS.

a. START-STOP PROCEDURE.

(1) Energize Analyzer and allow a 10-minute warmup.

(2) Set controls as follows:

(a) INPUT SELECT, NEUTRAL 60MA.
(b) INPUT POLARITY, (+).
(c) INPUT FILTER, OUT.
(d) PEAK RESET, OFF.
(e) TRANSITION MARKERS, OUT.
(f) CODE LEVEL, S/S 8.
(g) RATE BAUDS, 37.5.
(h) TRANSITION SELECT, ALL.
(i) DISTORTION SELECT, END.

(3) Use a distortion generator to apply a test signal (60-milliampere neutral, 37.5 baud, 8-level message, 40 per cent marking end distortion) to the LO-Z jack.

(4) Set test signal to steady mark. Check that LOOP CURRENT meter indicates 60 milliamperes, SIG IND-M indicator lamp lights, but SIG IND-S indicator lamp does not.

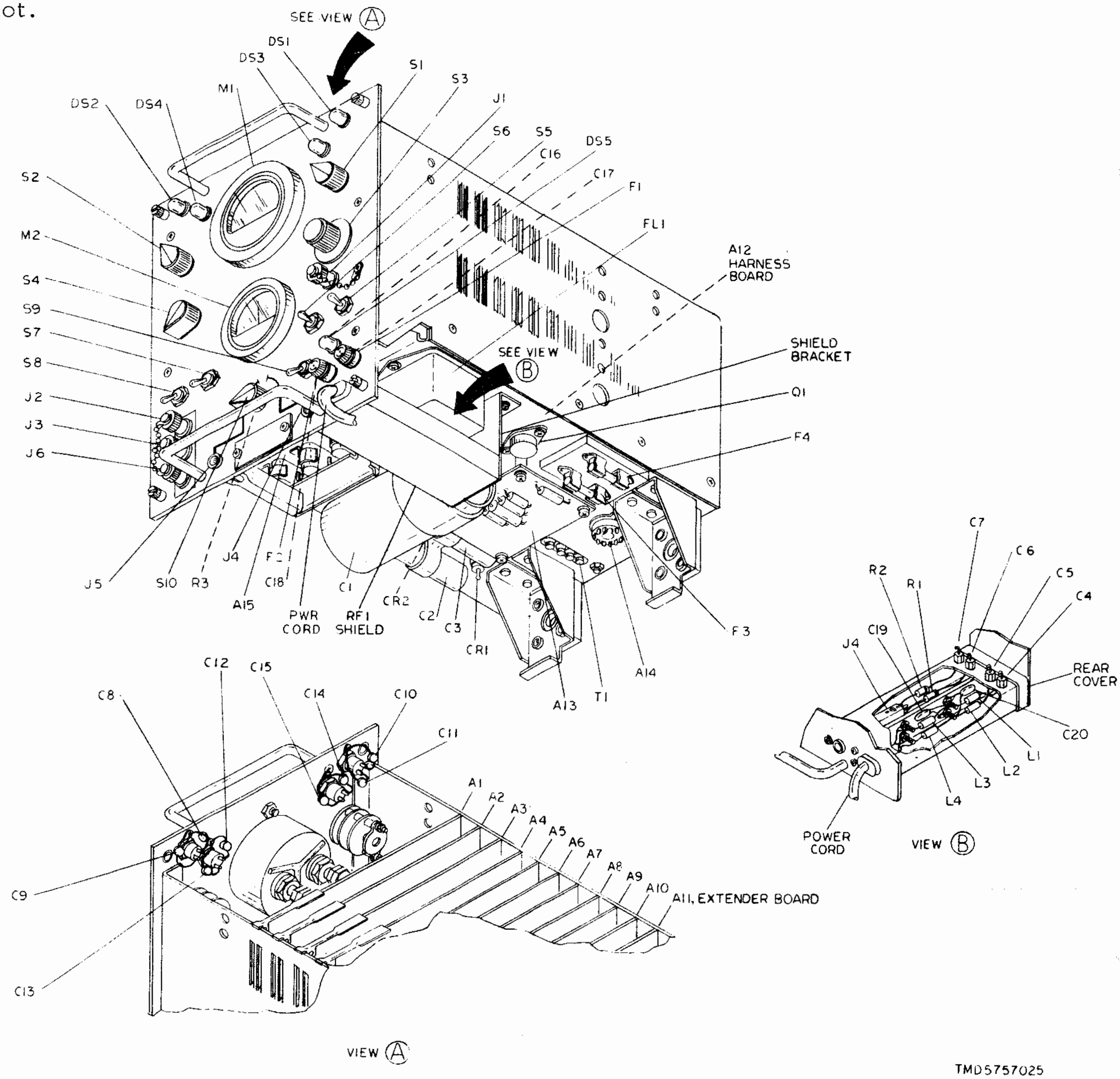



Figure 5-1. Test Set, Telegraph TS-2616/UGM, Parts Locations

Note

If SIG IND-M indicator lamp does not light, set INPUT POLARITY switch to (-).

(5) Set test signal to steady space. Check that LOOP CURRENT meter indicates 0, SIG IND-S indicator lamp lights, but SIG IND-M indicator lamp does not.

(6) Set test signal to start-stop mode. Check that both indicator lamps light.

(7) Connect an oscilloscope to SCOPE SIG, SCOPE SYNC, and SCOPE GRD connectors, and check that test message is displayed on oscilloscope.

(8) Set TRANSITION MARKERS switch to IN. Check that spikes (-4-volt amplitude) appear at ideal transition points of test message display, and that test message transitions are displaced from spikes by 40 per cent of one unit interval, delayed.

(9) Check that PERCENT DISTORTION meter indicates 40 per cent, and that MARKING indicator lamp is lighted.

(10) Adjust test signal, and set RATE BAUDS switch to 45.5, 50, 61.1, 75, 150, 300, 600, 1200, and 2400 bauds, inturn. Check that, at each setting, the PERCENT DISTORTION meter indicates 40 per cent.

(11) Adjust test signal, and set RATE BAUDS switch to 37.5 bauds.

(12) Adjust test signal, in 1 per cent increments, from 1 per cent to 49 per cent distortion. Check that PERCENT DISTORTION meter indications follow the increments.

(13) Adjust test signal to 40 per cent spacing end distortion. Check that PERCENT DISTORTION meter indicates 40 per cent, and SPACING indicator lamp lights.

(14) Set DISTORTION SELECT switch to BIAS.

(15) Adjust test signal to 40 per cent marking bias distortion. Check that PERCENT DISTORTION meter indicates 40 per cent, and MARKING indicator lamp lights.

(16) Adjust test signal to 40 per cent spacing bias distortion. Check that PERCENT DISTORTION meter indicates 40 per cent, and SPACING indicator lamp lights.

(17) Set DISTORTION SELECT switch to EARLY PEAK.

(18) Momentarily depress PEAK RESET switch to MAN, and check that PERCENT DISTORTION meter indicates 0.

(19) Adjust test signal to marking bias, and check that PERCENT DISTORTION meter pointer is deflected to (and holds at) 40 per cent.

(20) Momentarily depress PEAK RESET switch to MAN, and check that PERCENT DISTORTION meter resets to 0 and then to 40 per cent and holds at 40 per cent.

(21) Set PEAK RESET switch to AUTO. Check that PERCENT DISTORTION meter pointer is deflected to 40 per cent (at which it holds for about five seconds) and then reset to 0, repeatedly.

(22) Set PEAK RESET switch to OFF.

(23) Set DISTORTION SELECT switch to LATE PEAK.

(24) Momentarily depress PEAK RESET switch to MAN, and check that PERCENT DISTORTION meter indicates 0.

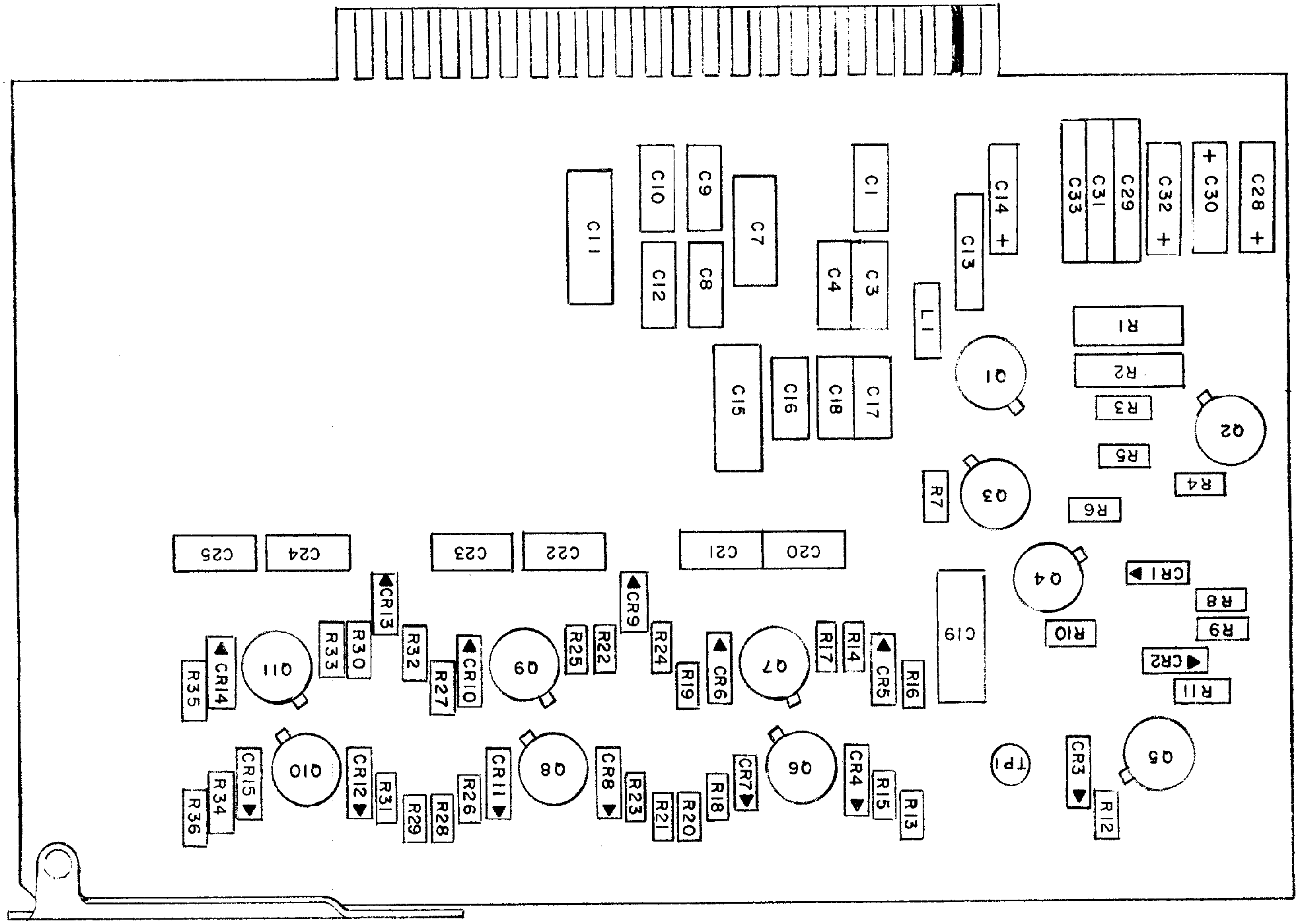



Figure 5-2. Component Board A1, Parts Locations

(25) Adjust test signal to spacing bias. Check that PERCENT DISTORTION meter pointer is deflected to (and holds at) 40 per cent.

(26) Momentarily depress PEAK RESET switch to MAN. Check that PERCENT DISTORTION meter pointer is reset to 0 and is then deflected to 40 per cent, at which it holds.

(27) Set PEAK RESET switch to AUTO. Check that PERCENT DISTORTION meter pointer is deflected to 40 per cent (at which it holds for about five seconds) and then reset to 0, repeatedly.

(28) Adjust test signal to marking/spacing (switched) bias distortion, and check that PERCENT DISTORTION meter pointer continues to be deflected and reset.

(29) Set DISTORTION SELECT switch to EARLY and TOTAL PEAK. Check that, at each setting, the PERCENT DISTORTION meter pointer continues to be deflected and reset.

(30) Adjust test signal to marking bias distortion and selected character (mark-space-mark-space-mark-space-mark-space).

(31) Set DISTORTION SELECT switch to BIAS.

(32) Set TRANSITION SELECT switch to each of positions 1 through 9, inturn. Check that PERCENT DISTORTION meter indicates 40 per cent at positions 1, 3, 5, 7, and 9--and 0 at positions 2, 4, 6, and 8.

(33) Adjust test signal to marking end distortion.

(34) Set DISTORTION SELECT switch to END.

(35) Set TRANSITION SELECT switch to each of positions 1 through 9, in-turn. Check that PERCENT DISTORTION meter indicates 40 per cent at positions 2, 4, 6, and 8--and 0 at positions 1, 3, 5, 7, and 9.

b. SYNCHRONOUS PROCEDURE.

(1) Energize Analyzer and allow a 10-minute warmup.

(2) Set controls as follows:

(a) INPUT SELECT, LOW LEVEL.
(b) INPUT POLARITY, (+).
(c) INPUT FILTER, OUT.
(d) PEAK RESET, OFF.
(e) TRANSITION MARKERS, OUT.
(f) CODE LEVEL, SYNC.
(g) RATE BAUDS, 37.5.
(h) TRANSITION SELECT, ALL.
(i) DISTORTION SELECT, BIAS.

(3) Use a distortion generator to apply a test signal (low-level, 37.5 baud, 40 per cent marking bias distortion) to the HI-Z jack.

(4) Check that PERCENT DISTORTION meter indicates 40 per cent, and that MARKING indicator lamp is lighted.

(5) Adjust test signal and set RATE BAUDS switch to 45.5, 50, 61.1, 75, 150, 300, 600, 1200, and 2400 bauds, in turn. At each setting, check that PERCENT DISTORTION meter indicates 40 per cent.

(6) Adjust test signal and set RATE BAUDS switch to 37.5 bauds.

(7) Adjust test signal, in 1 per cent increments, from 1 per cent to 49 per cent distortion. Check that PERCENT DISTORTION meter indications follow the increments.

(8) Adjust test signal to 40 per cent spacing bias distortion. Check that PERCENT DISTORTION meter indicates 40 per cent and that SPACING indicator lamp lights.

(9) Set DISTORTION SELECT switch to EARLY PEAK.

(10) Momentarily depress PEAK RESET switch to MAN. Check that PERCENT DISTORTION meter indicates 0.

(11) Adjust test signal to marking bias. Check that PERCENT DISTORTION meter pointer is deflected to (and holds at) 40 per cent.

(12) Momentarily depress PEAK RESET switch to MAN. Check that PERCENT DISTORTION meter resets to 0 and then to 40 per cent and holds at 40 per cent.

(13) Set PEAK RESET switch to AUTO. Check that PERCENT DISTORTION meter pointer is deflected to 40 per cent(at which it holds for about five seconds) and then reset to 0, repeatedly.

(14) Set PEAK RESET switch to OFF.

(15) Set DISTORTION SELECT switch to LATE PEAK.

(16) Momentarily depress PEAK RESET switch to MAN. Check that PERCENT DISTORTION meter indicates 0.

(17) Adjust test signal to spacing bias. Check that PERCENT DISTORTION meter pointer is deflected to (and holds at) 40 per cent.

(18) Momentarily depress PEAK RESET switch to MAN. Check that PERCENT DISTORTION meter pointer is reset to 0 and is then deflected to 40 per cent, at which it holds.

(19) Set PEAK RESET switch to AUTO. Check that PERCENT DISTORTION meter pointer is deflected to 40 per cent (at which it holds for about five seconds) and then reset to 0, repeatedly.

(20) Adjust test signal to marking/spacing (switched) bias distortion. Check that PERCENT DISTORTION meter pointer continues to be deflected and reset.

(21) Set DISTORTION SELECT switch to EARLY and TOTAL PEAK. Check that, at each setting, PERCENT DISTORTION meter pointer continues to be deflected and reset.

## 5-4. ADJUSTMENTS.

Perform the following procedures every 90 days.

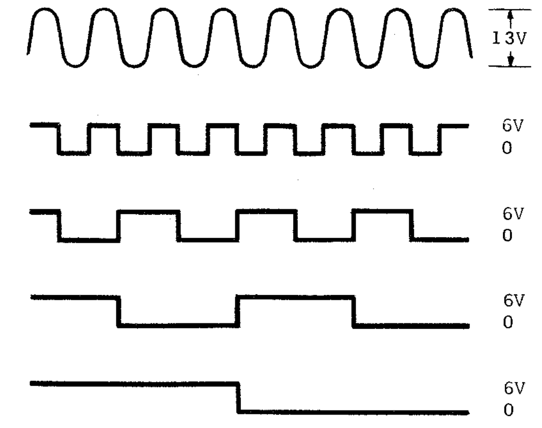
a. TEST EQUIPMENT REQUIRED.

(1) Test Set, Distortion Generator AN/UGM-8.
(2) Multimeter AN/PSM-4D.

b. PRELIMINARY OPERATIONS.

(1) Energize Analyzer and Distortion Generator. Allow 10-minute warmup.
(2) Set Analyzer controls as follows:

(a) INPUT SELECT, NEUTRAL 60MA.
(b) INPUT POLARITY, (+).
(c) INPUT FILTER, OUT.
(d) PEAK RESET, OFF.
(e) TRANSITION MARKERS, OUT.
(f) CODE LEVEL, S/S 5.
(g) RATE BAUDS, 37.5.



| TEST POINT | WAVEFORM | OSCILLOSCOPE |
|---|---|---|
| Q1 CASE [4] | 13V | 5V/CM 1us/CM |
| TP1 | 6V 0 | 5V/CM 1us/CM |
| Q6 CASE [4] | 6V 0 | 5V/CM 1us/CM |
| Q8 CASE [4] | 6V 0 | 5V/CM 1us/CM |
| Q10 CASE [4] | 6V 0 | 5V/CM 1us/CM |

NOTES

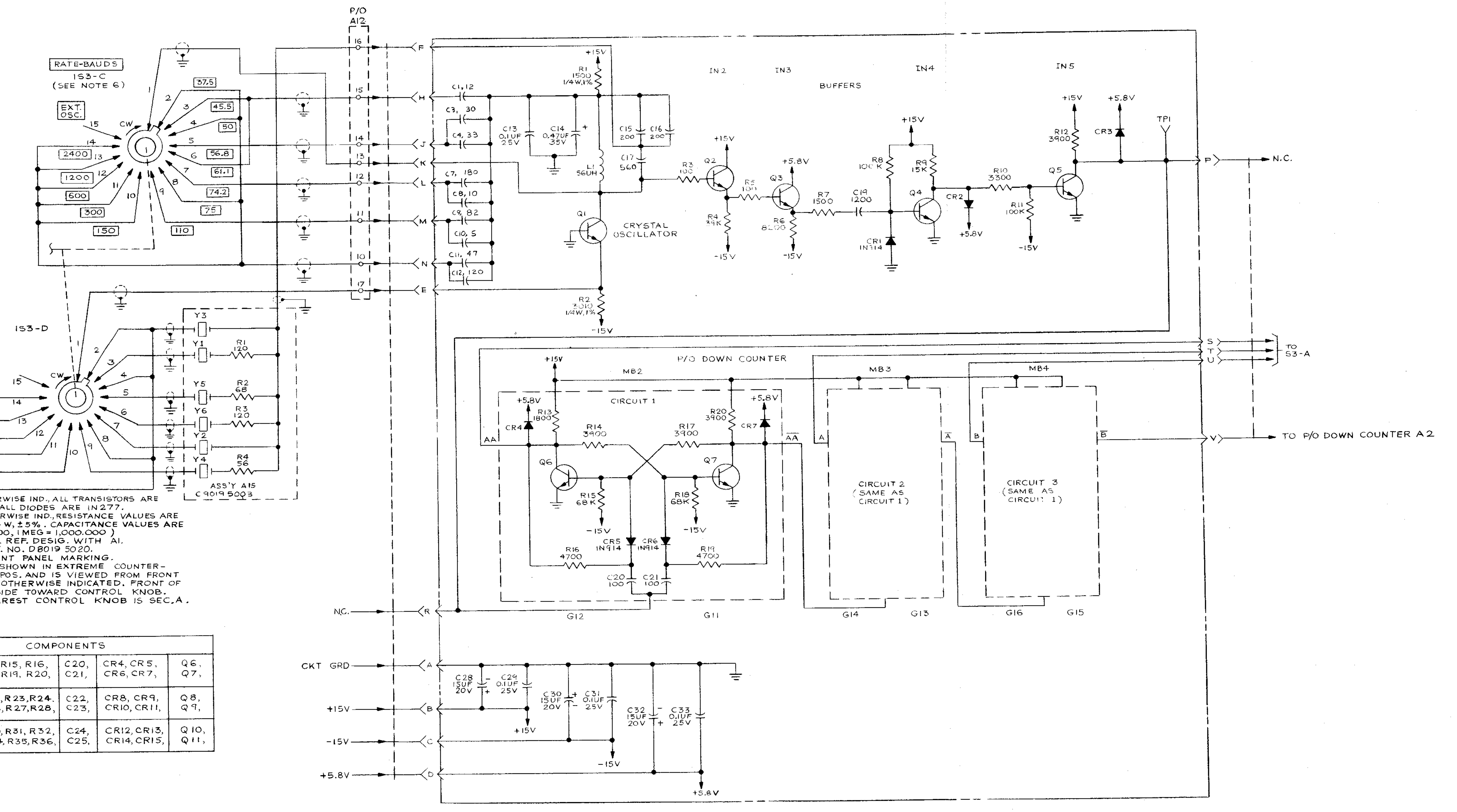
1. Chassis ground common.
2. No input signal required.
3. Do not extend component board A1 while observing waveforms. (All test points can be probed with A1 in place.)

④ Case is electrically connected to collector.

VOLTAGES AND RESISTANCES

| TRANSISTOR | EMITTER | | BASE | | COLLECTOR | |
|---|---|---|---|---|---|---|
| | VOLTS [a] | OHMS [b] | VOLTS [a] | OHMS [b] | VOLTS [a] | OHMS [b] |
| Q1 | -1 | 20K | 0 | 0 | + 8 | 3.6K |
| Q2 | +9 | 50K | +8 | 3.8K | +15 | 1.4K |
| Q3 | +4 | 30K | +6 | 50K | + 6 | 200K |
| Q4 | 0 | 0 | +0.5 | 1K | + 1 | 6K |
| Q5 | 0 | 0 | +0.5 | 1.1K | + 3.5 | 8K |
| Q6 | 0 | 0 | -0.5 | 1K | + 3.5 | 3K |
| Q7 | 0 | 0 | -0.5 | 1K | + 3 | 3.8K |
| Q8 | 0 | 0 | -0.5 | 1K | + 3.5 | 3K |
| Q9 | 0 | 0 | 0 | 1K | + 3 | 3.8K |
| Q10 | 0 | 0 | -0.8 | 1K | + 3.5 | 3K |
| Q11 | 0 | 0 | 0 | 1K | + 0.5 | 3.8K |

[a] Chassis ground common.
[b] Pin A common — component board disconnected.




NOTES:
1. UNLESS OTHERWISE IND., ALL TRANSISTORS ARE 2N706 AND ALL DIODES ARE IN277.
2. UNLESS OTHERWISE IND. RESISTANCE VALUES ARE IN OHMS, 1/4 W, ±5%. CAPACITANCE VALUES ARE IN PF (K=1000, 1 MEG=1,000,000).
3. PREFIX ALL REF. DESIG. WITH A1.
4. COMP. ASSY. NO. D8019 5020.
5. ▭ IND. FRONT PANEL MARKING.
6. WAFER SW. SHOWN IN EXTREME COUNTER-CLOCKWISE POS. AND IS VIEWED FROM FRONT EXCEPT AS OTHERWISE INDICATED. FRONT OF WAFER IS SIDE TOWARD CONTROL KNOB. WAFER NEAREST CONTROL KNOB IS SEC.A.

| CKTS | COMPONENTS | | | |
|---|---|---|---|---|
| 1 | R13, R14, R15, R16, R17, R18, R19, R20, | C20, C21, | CR4, CR5, CR6, CR7, | Q6, Q7. |
| 2 | R21, R22, R23, R24, R25, R26, R27, R28, | C22, C23, | CR8, CR9, CR10, CR11, | Q8, Q9. |
| 3 | R29, R30, R31, R32, R33, R34, R35, R36, | C24, C25, | CR12, CR13, CR14, CR15, | Q10, Q11. |

Figure 5-3. Component Board A1 (Time Base, Oscillator, and P/O Downcounter), Schematic Diagram

(h) TRANSITION SELECT, ALL.

(i) DISTORTION SELECT, END.

c. PROCEDURE.

(1) Adjust PERCENT DISTORTION meter pointer (screwdriver adjustment on front of meter) to indicate 0.

(2) Connect test signal from Distortion Generator (60-milliampere neutral, 5-level code, 40 per cent end distortion, 37.5 bauds) to the LO-Z jack on Analyzer.

WARNING

Voltages dangerous to life and limb exist inside case.

(3) Connect AN/PSM-4D to TP1 (+) and TP3 (-) on component board A10.

(4) Adjust R8 (on A10) for an indication of 40 per cent on PERCENT DISTORTION meter of Analyzer. (AN/PSM-4D should indicate about +15.2 or +15.3 volts.)

(5) Connect AN/PSM-4D to TP4 (-) and TP3 (+) on component board A10.

(6) Adjust R38 (on A10) for an indication of -15 volts on AN/PSM-4D.

(7) Connect AN/PSM-4D to TP2 (+) and TP3 (-) on component board A10.

(8) Adjust R18 (on A10) for an indication of +5.8 volts on AN/PSM-4D.

5-5. SPECIAL REPAIR DATA.

a. ELECTRONIC RELAY REMOVAL. - To remove electronic relay, (A14, see figure 5-1), first remove four nuts from studs on relay case. The nuts are accessible from underside of chassis. Then un-plug relay.

b. RFI SHIELD REMOVAL. - Remove the rfi shield, located inside the chassis behind the power cord entrance (see figure 5-1) as follows:

(1) Remove two screws that fasten the shield bracket and the three ground leads to chassis.

(2) Remove two screws that fasten the shield bracket to the rear of rfi shield, and remove bracket.

(3) Being careful not to move rfi shield, remove cover from rear of rfi shield.

(4) See view B of figure 5-1. Unsolder four leads from external sides of feed-through capacitors C4, C5, C6, and C7.

(5) Referring to view B of figure 5-1, unsolder R1 from C6, R2 from C7, L2 from C5, and L1 from C4.

(6) With care, remove rfi shield by moving it directly away from the front panel far enough to clear internal assembly (which remains fixed to front panel).

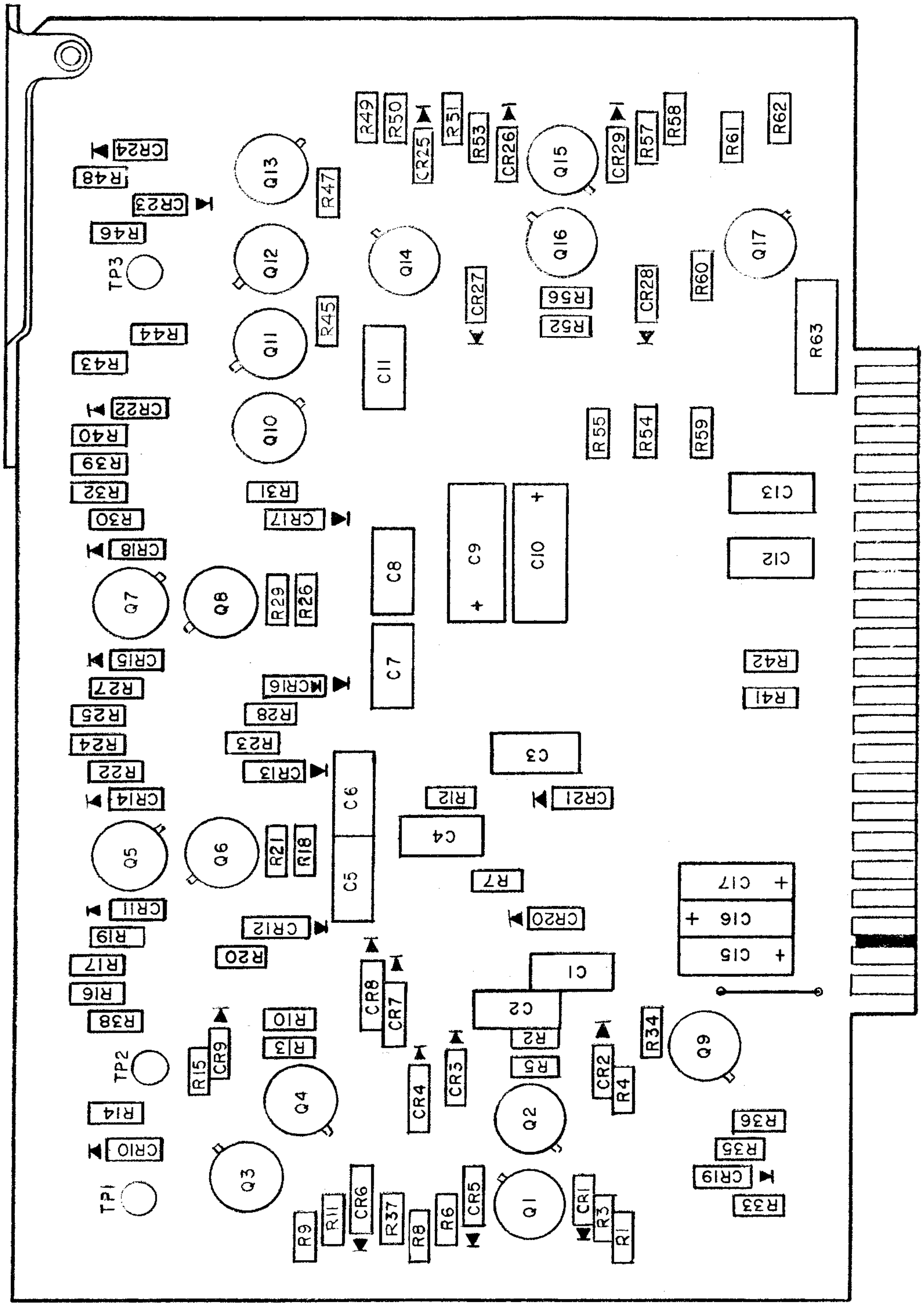
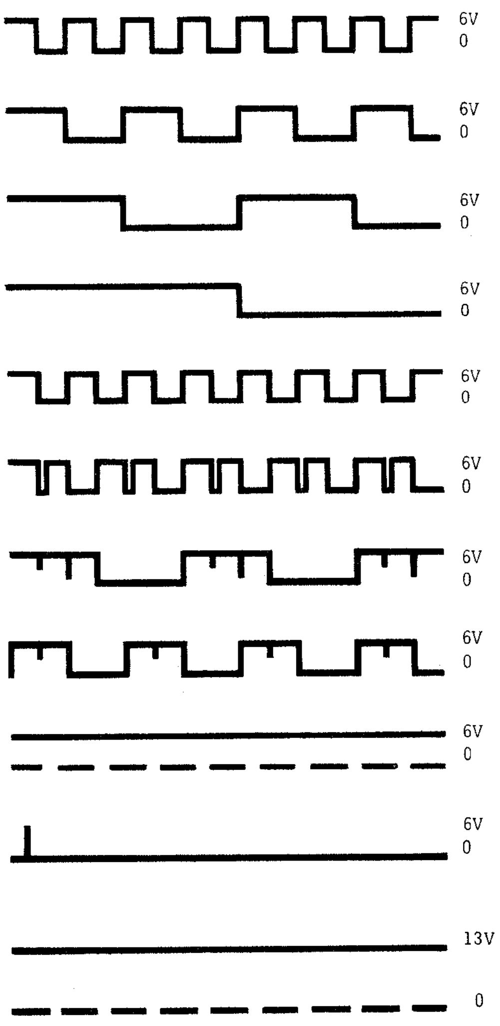



Figure 5-4. Component Board A2, Parts Locations

| TEST POINT | WAVEFORM | | OSCILLOSCOPE | |
|---|---|---|---|---|
| Q1 CASE ③ | | 6V / 0 | 5V/CM | 10us/CM |
| Q3 CASE ③ | | 6V / 0 | 5V/CM | 10us/CM |
| Q5 CASE ③ | | 6V / 0 | 5V/CM | 10us/CM |
| Q7 CASE ③ | | 6V / 0 | 5V/CM | 10us/CM |
| TP1 ④ | | 6V / 0 | 5V/CM | 10us/CM |
| TP1 ⑤ | | 6V / 0 | 5V/CM | 10us/CM |
| TP2 ④ | | 6V / 0 | 5V/CM | 10us/CM |
| TP2 ⑤ | | 6V / 0 | 5V/CM | 10us/CM |
| TP3 ⑥ | | 6V / 0 | 5V/CM | 10us/CM |
| Q14 CASE ③ | | 6V / 0 | 5V/CM | 10us/CM |
| Q17 CASE ③⑦ | | 13V / 0 | 5V/CM | 10us/CM |



VOLTAGES AND RESISTANCES

| TRANSISTOR | EMITTER | | BASE | | COLLECTOR | |
|---|---|---|---|---|---|---|
| | VOLTS[a] | OHMS[b] | VOLTS[a] | OHMS[b] | VOLTS[a] | OHMS[b] |
| Q1 | 0 | 0 | 0 | 1K | +3 | 2.5K |
| Q2 | 0 | 0 | 0 | 1K | +3 | 2.5K |
| Q3 | 0 | 0 | 0 | 1K | +3 | 2.5K |
| Q4 | 0 | 0 | 0 | 1K | +3 | 2.5K |
| Q5 | 0 | 0 | 0 | 1K | +3 | 2.5K |
| Q6 | 0 | 0 | 0 | 1K | +3 | 2.5K |
| Q7 | 0 | 0 | 0 | 1K | +3 | 2.5K |
| Q8 | 0 | 0 | 0 | 1K | +3 | 2.5K |
| Q9 | 0 | 0 | 0 | 1K | +3 | 4.8K |
| Q10 | 0 | 0 | +1 | 1K | +.5 | 11K |
| Q11 | 0 | 0 | -5 | 1K | +9 | 11K |
| Q12 | -0.9 | 15K | +9 | 25K | +6 | 15K |
| Q13 | 0 | 0 | -0.5 | 1K | +6 | 3.5K |
| Q14 | 0 | 0 | +1 | 1K | +0.5 | 6.K |
| Q15 | 0 | 0 | -1 | 1K | +6 | 3.4K |
| Q16 | 0 | 0 | +1 | 1K | +0.2 | 2.6K |
| Q17 | 0 | 0 | -1 | 1.1K | +15 | 25K |

[a] Chassis ground common.
[b] Pin A common — component board disconnected.

WAVEFORM NOTES

1. Chassis ground common.
2. No input signal required except when observing level at testpoint Q17 CASE (refer to ⑦ below).

③ Case is electrically connected to collector.

④ RATE BAUDS switch set to 37.5, 45.5, 74.2, 75, 150, 300, 600, 1200, 2400.

⑤ RATE BAUDS switch set to 50, 56.8, 61.1, or 110.

⑥ With PEAK RESET switch set to AUTO, signal is alternately high for two seconds and low for two seconds.

⑦ Apply input signal (synchronous, reversals, 10 per cent marking bias distortion). Level should remain low. change input signal to spacing bias. Signal should go high.

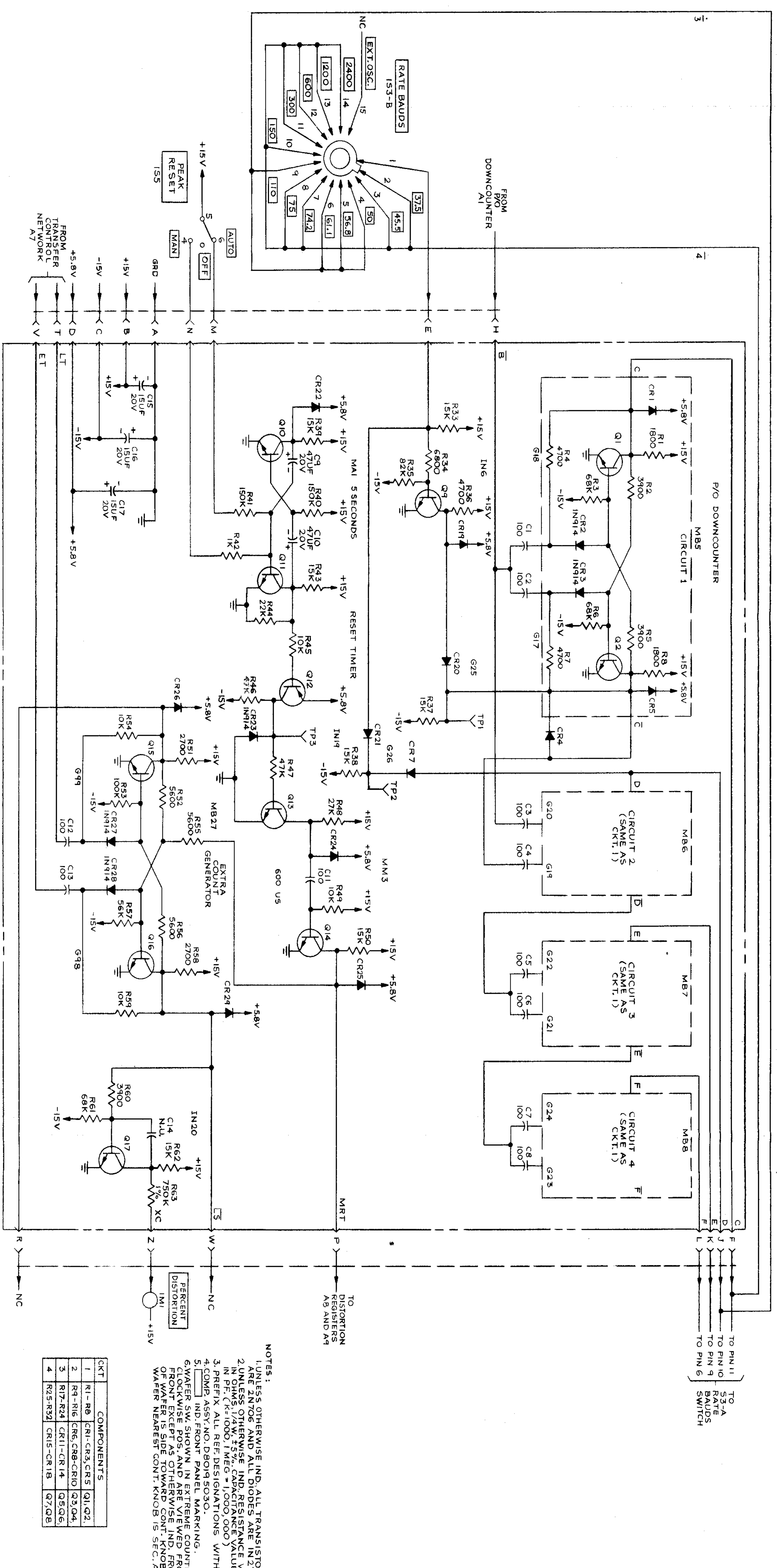



Figure 5-5. Component Board A2 (Time Base, P/O Downcounter), Schematic Diagram

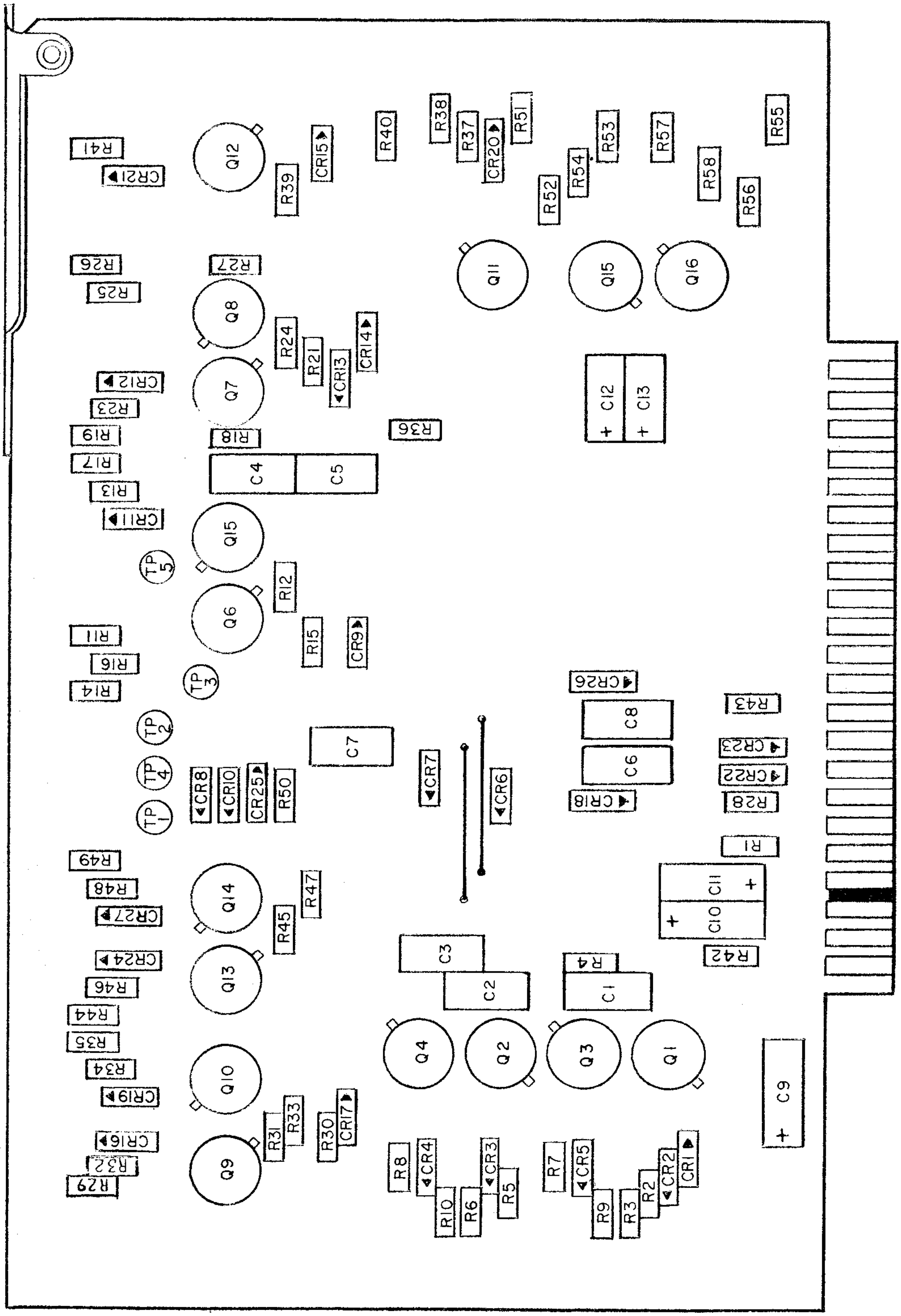
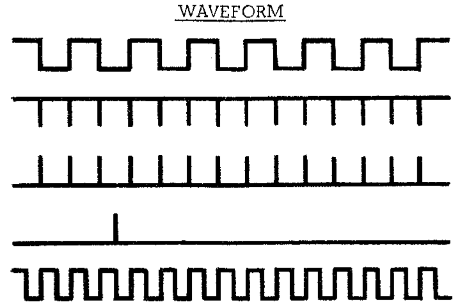



Figure 5-6. Component Board A3, Parts Locations



| TEST POINT | WAVEFORM | OSCILLOSCOPE | | |
|---|---|---|---|---|
| Q7 CASE (3)<br>Q11 CASE (3)<br>Q12 CASE (3) | | 6V<br>0 | 5V/CM | 100us/CM |
| TP5 | | 6V<br>0 | 5V/CM | 100us/CM |
| TP1, TP2, TP4 (4) | | 6V<br>0 | 5V/CM | 100us/CM |
| TP3 (5) | | 6V<br>0 | 5V/CM | 100us/CM |
| Q1 CASE (3) | | 6V | 5V/CM | 100us/CM |

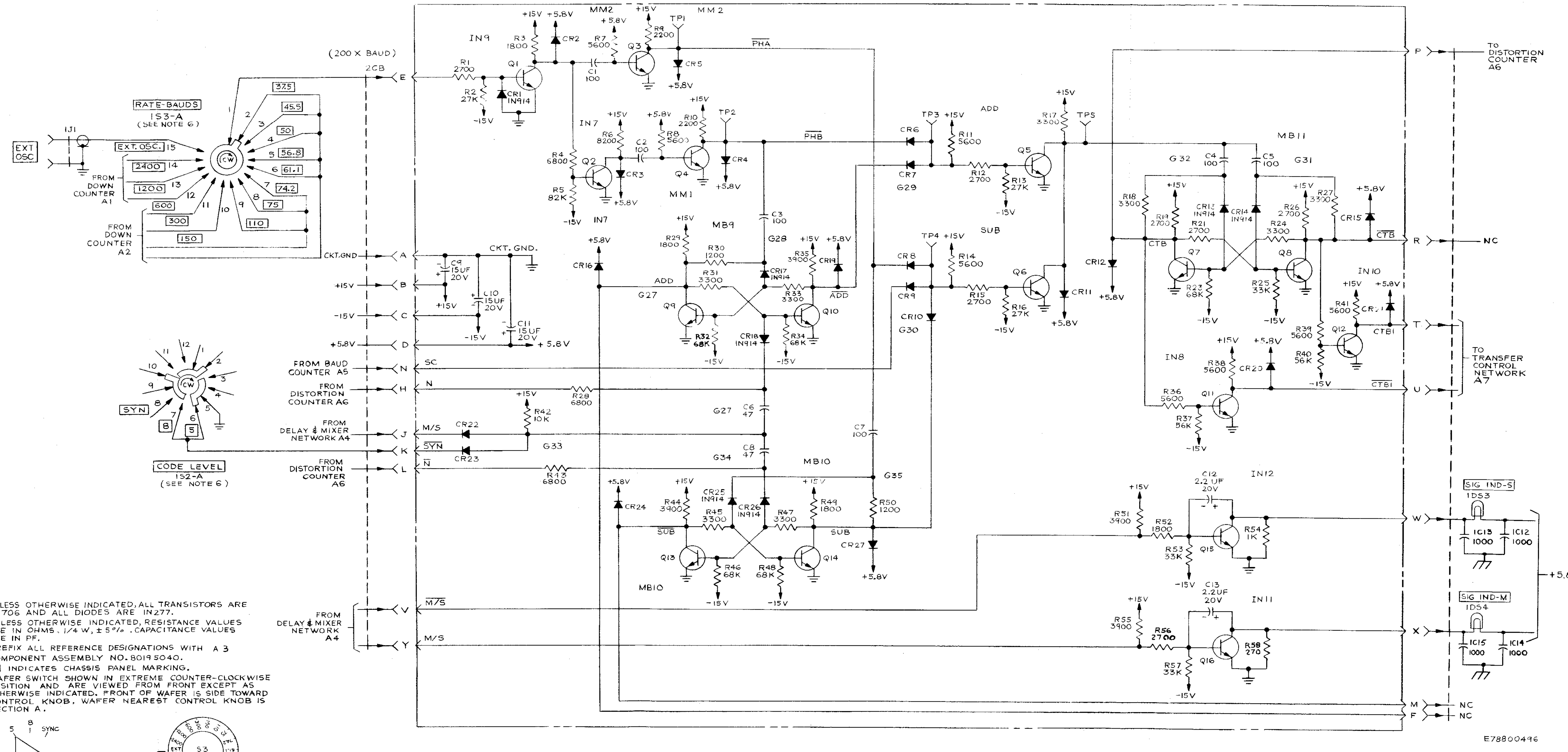
NOTES

1. Chassis ground common.
2. Input signal: 20 milliamperes, synchronous, reversals, zero distortion.
3. Case is electrically connected to collector.
4. When timing signal CTB is fast compared to MS, a pulse will be missing at TP4.
5. When timing signal CTB is slow compared to MS, a pulse will occur at TP3.

VOLTAGES AND RESISTANCES

| TRANSISTOR | EMITTER | | BASE | | COLLECTOR | |
|---|---|---|---|---|---|---|
| | VOLTS[a] | OHMS[b] | VOLTS[a] | OHMS[b] | VOLTS[a] | OHMS[b] |
| Q1 | 0 | 0 | +0.2 | 1.1K | +3 | 2.2K |
| Q2 | 0 | 0 | -0.2 | 1K | +3 | 4.6K |
| Q3 | 0 | 0 | +1 | 1K | +.2 | 1.5K |
| Q4 | 0 | 0 | +1 | 1K | +0.2 | 1.5K |
| Q5 | 0 | 0 | -1 | 1K | +6 | 3.2K |
| Q6 | 0 | 0 | -1 | 1.1K | +6 | 3.2K |
| Q7 | 0 | 0 | +1 | 1K | +0.2 | 2K |
| Q8 | 0 | 0 | -1 | 1K | +6 | 2K |
| Q9 | 0 | 0 | -1 | 1K | +6 | 2K |
| Q10 | 0 | 0 | +1 | 1K | +0.2 | 2.5K |
| Q11 | 0 | 0 | -1.5 | 1K | +6 | 4K |
| Q12 | 0 | 0 | +1 | 1K | +0.1 | 4K |
| Q13 | 0 | 0 | +1 | 1K | +0.1 | 2.5K |
| Q14 | 0 | 0 | -0.9 | 1K | +6 | 2K |
| Q15 | 0 | 0 | +1 | 1K | +0.1 | 0.24K |
| Q16 | 0 | 0 | -1 | 1K | +5 | 0.24K |

[a]Chassis ground common.
[b]Pin A common — component board disconnected.




NOTES:

1. UNLESS OTHERWISE INDICATED, ALL TRANSISTORS ARE 2N706 AND ALL DIODES ARE IN277.
2. UNLESS OTHERWISE INDICATED, RESISTANCE VALUES ARE IN OHMS, 1/4 W, ±5%. CAPACITANCE VALUES ARE IN PF.
3. PREFIX ALL REFERENCE DESIGNATIONS WITH A3
4. COMPONENT ASSEMBLY NO. 80195040.
5. ☐ INDICATES CHASSIS PANEL MARKING.
6. WAFER SWITCH SHOWN IN EXTREME COUNTER-CLOCKWISE POSITION AND ARE VIEWED FROM FRONT EXCEPT AS OTHERWISE INDICATED. FRONT OF WAFER IS SIDE TOWARD CONTROL KNOB. WAFER NEAREST CONTROL KNOB IS SECTION A.

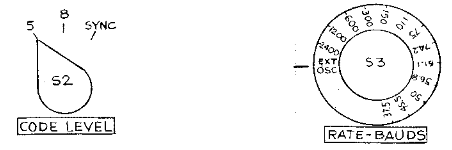



Figure 5-7. Component Board A3 (Time Base, Sync Network), Schematic Diagram

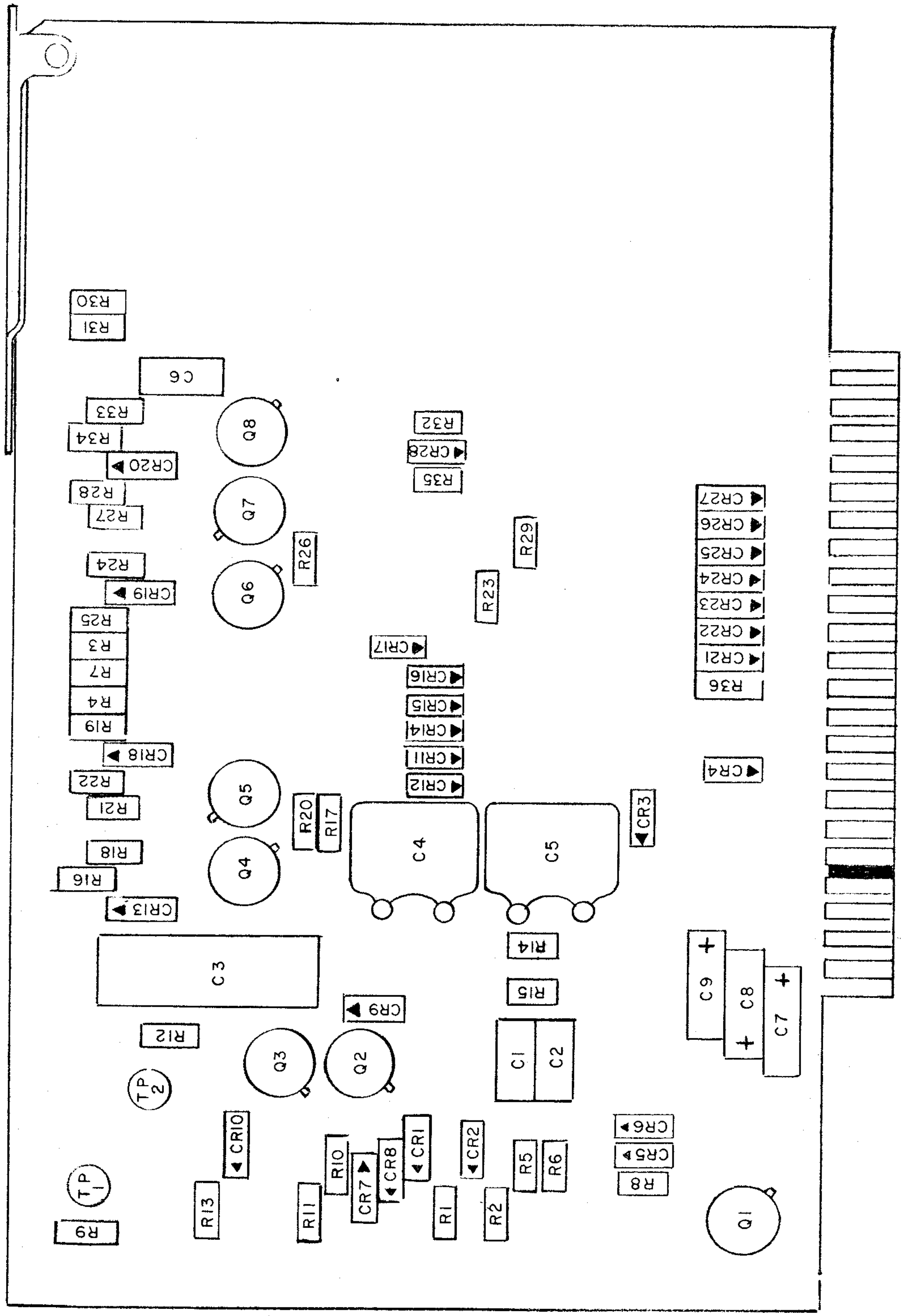
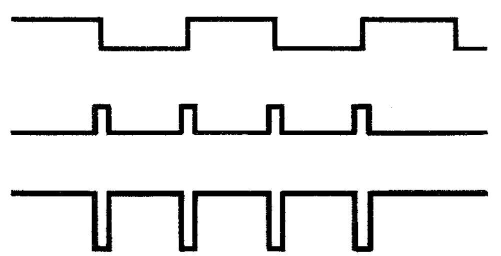



Figure 5-8. Component Board A4, Parts Locations

| TEST POINT | WAVEFORM | | OSCILLOSCOPE |
|---|---|---|---|
| J1-E, J1-F | | 6V / 0 | 5V/CM 10us/CM |
| Q6,Q7,Q4, Q5 CASE ③ | | 6V / 0 | 5V/CM 10us/CM |
| TP2 | | 13V / 0 | 5V/CM 10us/CM |



NOTES

1. Chassis ground common.
2. Input signal: 20 milliamperes, synchronous, reversals, zero distortion.
③. Case is electrically connected to collector.

VOLTAGES AND RESISTANCES

| TRANSISTOR | EMITTER | | BASE | | COLLECTOR | |
|---|---|---|---|---|---|---|
| | VOLTS [a] | OHMS [b] | VOLTS [a] | OHMS [b] | VOLTS [a] | OHMS [b] |
| Q1 | -15 | 18K | -15 | 22K | -15 | 21K |
| Q2 | + 1 | 30K | -15 | 14K | -15 | 2K |
| Q3 | + 1 | 0 | + 0.1 | 1.1K | 0 | 100K |
| Q4 | 0 | 0 | - 1 | 1.1K | + 6 | 12K |
| Q5 | 0 | 0 | + 1 | 1.1K | + 0.1 | 12K |
| Q6 | 0 | 0 | + 1 | 1.1K | + 0.1 | 4K |
| Q7 | 0 | 0 | - 1 | 1.1K | + 6 | 10K |
| Q8 | 0 | 0 | - 1.5 | 1.1K | + 0.1 | 6K |

[a]Chassis ground common.
[b]Pin A common — component board disconnected.

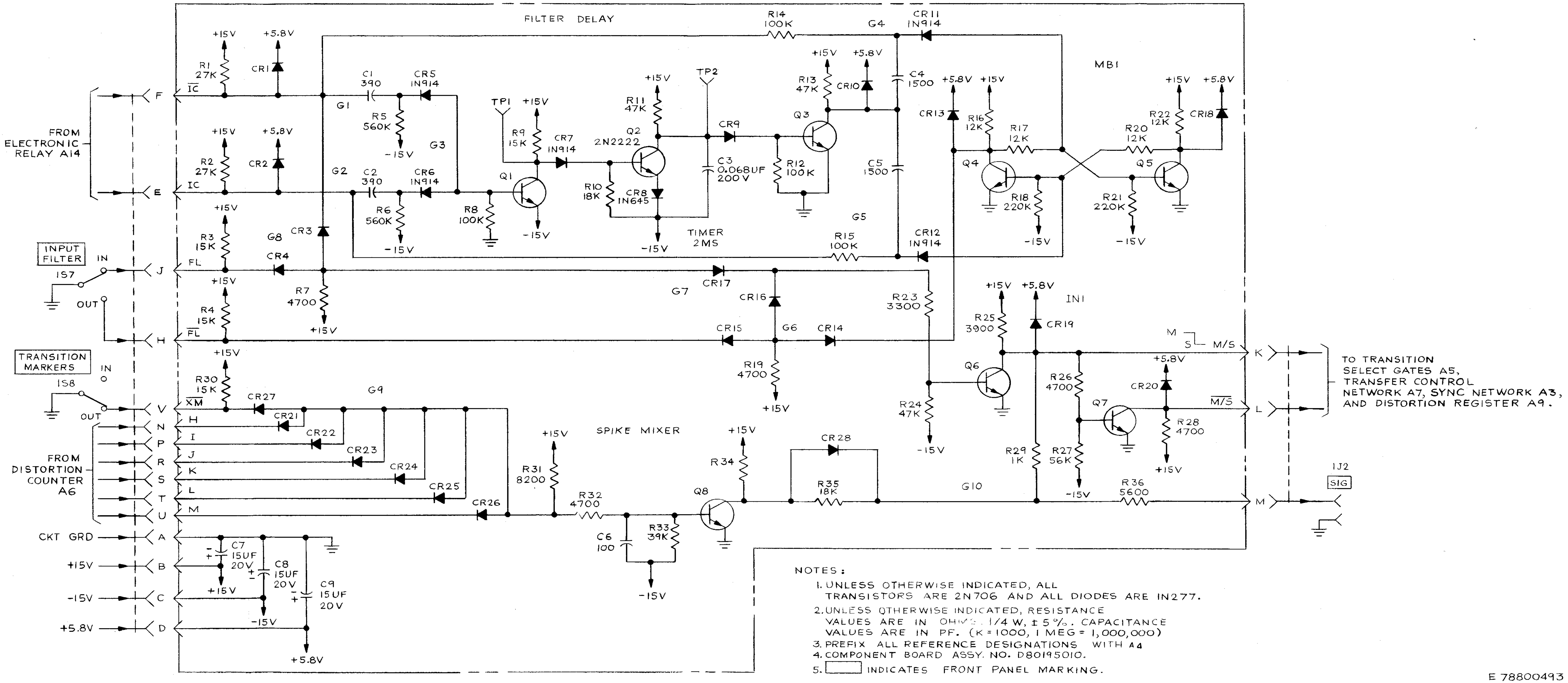



Figure 5-9. Component Board A4 (Input Circuits, Delay and Mixer Network), Schematic Diagram

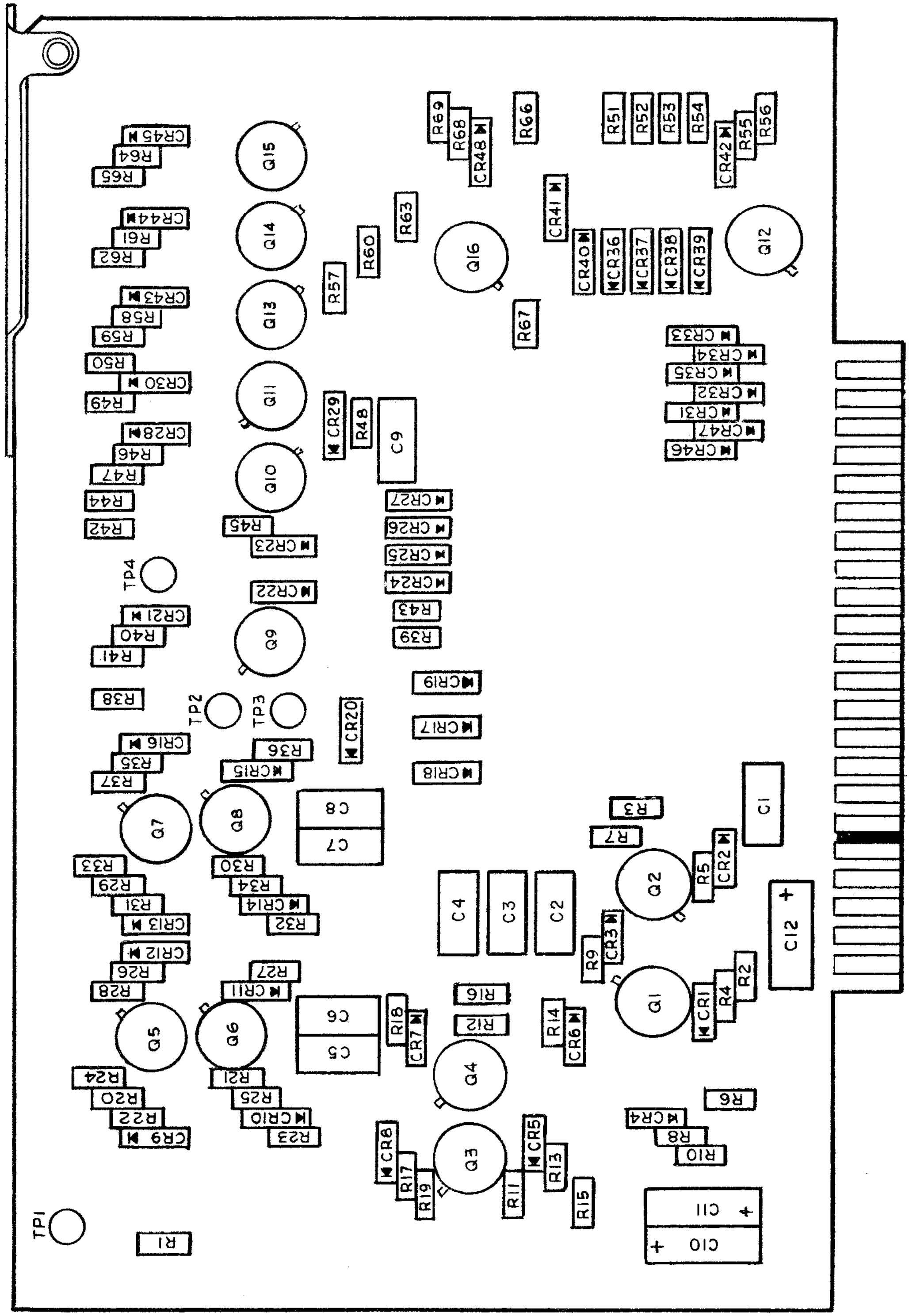
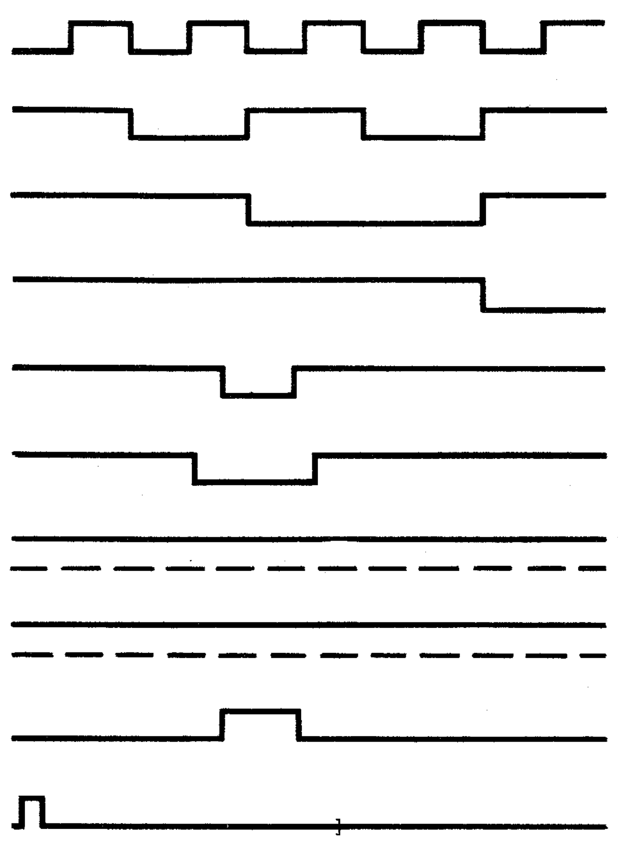


Figure 5-10. Component Board A5, Parts Locations



| TEST POINT | WAVEFORM | | OSCILLOSCOPE |
|---|---|---|---|
| Q1,Q13 CASE ③ | | 6V / 0 | 5V/CM 10us/CM |
| Q3,Q14 CASE ③ | | 6V / 0 | 5V/CM 10us/CM |
| Q5,Q15 CASE ③ | | 6V / 0 | 5V/CM 10us/CM |
| Q7 CASE ③ | | 6V / 0 | 5V/CM 10us/CM |
| Q9,Q16 CASE ③ | | 6V / 0 | 5V/CM 10us/CM |
| Q10 CASE ③④ | | 6V / 0 | 5V/CM 10us/CM |
| Q10 CASE ③⑤ | | 6V / 0 | 5V/CM 10us/CM |
| Q12 CASE ③⑥ | | 6V / 0 | 5V/CM 10us/CM |
| Q12 CASE ③⑦ | | 6V / 0 | 5V/CM 10us/CM |
| TP1 (RST) | | 6V / 0 | 5V/CM 10us/CM |

VOLTAGES AND RESISTANCES

| TRANSISTOR | EMITTER | | BASE | | COLLECTOR | |
|---|---|---|---|---|---|---|
| | VOLTS[a] | OHMS[b] | VOLTS[a] | OHMS[b] | VOLTS[a] | OHMS[b] |
| Q1 | 0 | 0 | -1 | 1K | +6 | 2.6K |
| Q2 | 0 | 0 | +1 | 1K | +0.1 | 2.6K |
| Q3 | 0 | 0 | +1 | 1K | +0.1 | 2.6K |
| Q4 | 0 | 0 | -1 | 1K | +6 | 2.6K |
| Q5 | 0 | 0 | +1 | 1K | +0.1 | 2.6K |
| Q6 | 0 | 0 | -1 | 1K | +6 | 2.6K |
| Q7 | 0 | 0 | -1 | 1K | +6 | 2.6K |
| Q8 | 0 | 0 | +1 | 1K | +0.1 | 2.6K |
| Q9 | 0 | 0 | -1 | 1K | +6 | 20K |
| Q10 | 0 | 0 | +1 | 1K | +0.1 | 6K |
| Q11 | 0 | 0 | +1 | 0.8K | +0.1 | 2.1K |
| Q12 | 0 | 0 | +1 | 1K | +0.1 | 3.5K |
| Q14 | 0 | 0 | -1 | 1K | +6 | 3.5K |
| Q15 | 0 | 0 | -1 | 1K | +6 | 3.5K |
| Q16 | 0 | 0 | +1 | 1K | +0.1 | 6K |

[a] Chassis ground common.
[b] Pin A common — component board disconnected.

WAVEFORM NOTES

1. Chassis ground common.
2. Input signal: 20 milliamperes, start-stop, 8 level, reversals, zero distortion.
③ Case is electrically connected to collector.
④ SC with code level switch set to 8 or 5.
⑤ SC with code level switch set to SYNC.
⑥ XS with TRANSITION SELECT switch set to ALL.
⑦ XS with TRANSITION SELECT switch set to any position of 1 through 9.

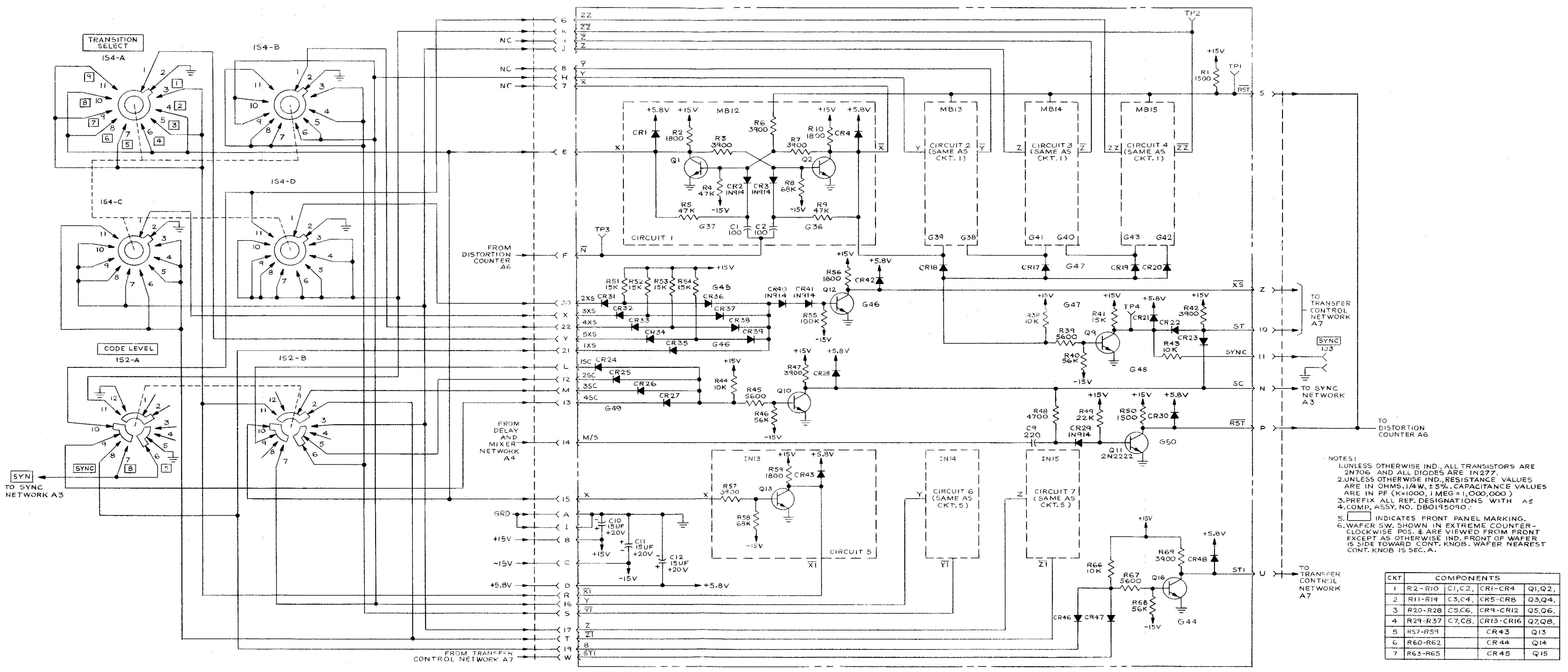



Figure 5-11. Component Board A5 (Baud Counter and Transition Select Gates, Schematic Diagram

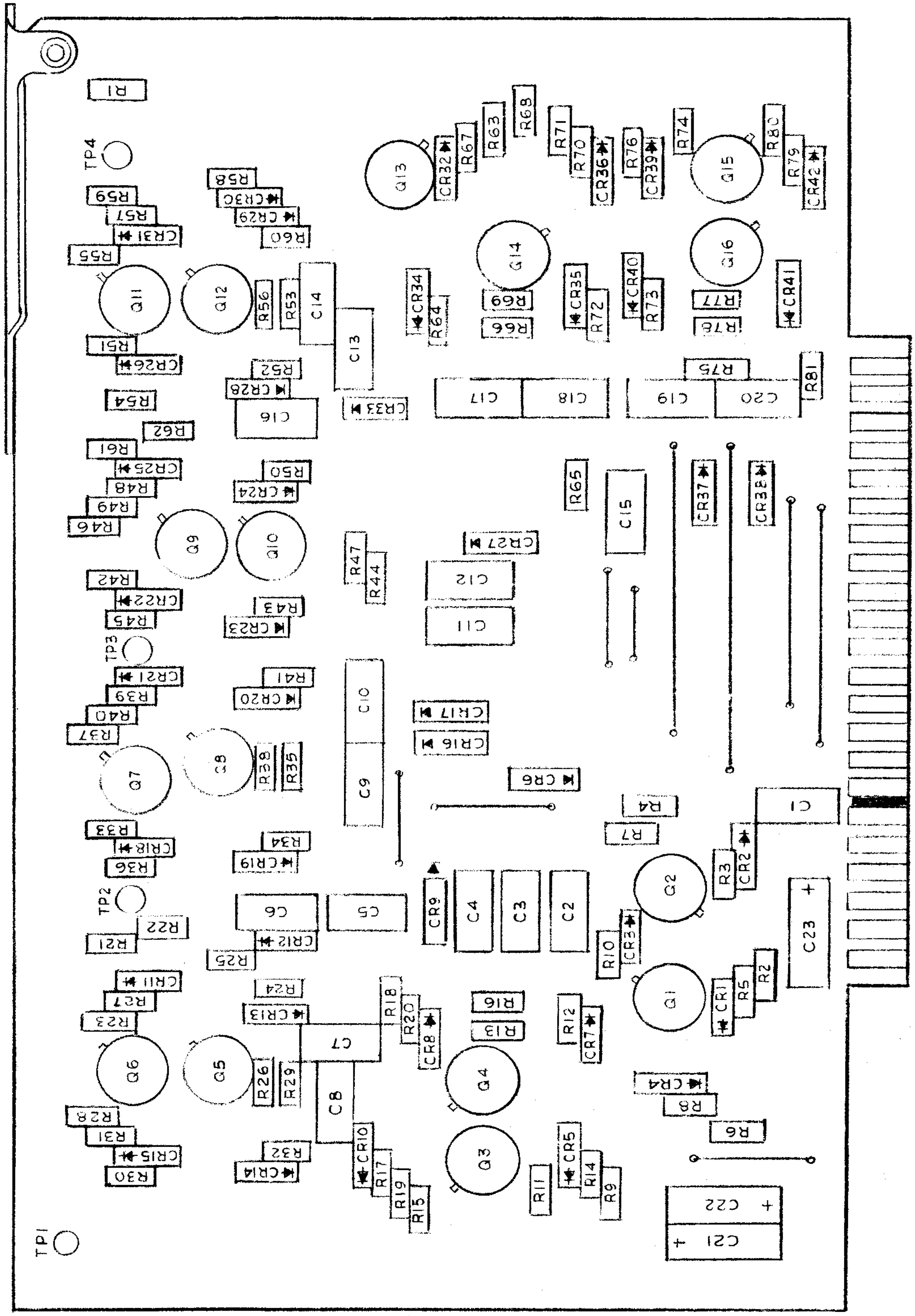
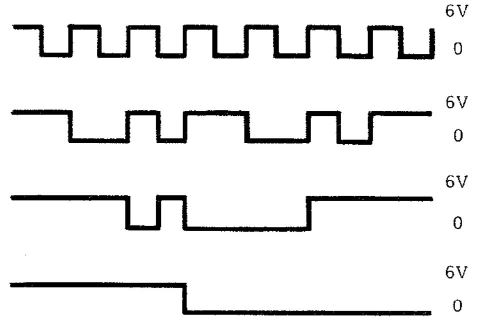



Figure 5-12. Component Board A6, Parts Locations

| TEST POINT | WAVE FORM | OSCILLOSCOPE |
|---|---|---|
| Q1, Q9 CASE ③ | | 5V/CM 1-10ms/CM [4] |
| Q3, Q11 CASE ③ | | 5V/CM 1-10ms/CM [4] |
| Q5, Q13 CASE ③ | | 5V/CM 1-10ms/CM [4] |
| Q7, Q15 CASE ③ | | 5V/CM 1-10ms/CM [4] |




NOTES.

1. Chassis ground common.
2. Input signal: 20 millimperes, synchronous.
③ Case is electrically connected to collector.
④ For Q1, Q3, Q5, and Q7 set oscilloscope for 1 millisecond/CM. For Q9, Q11, Q13, and Q15 set oscilloscope for 10 milliseconds/CM.

VOLTAGES AND RESISTANCES

| TRANSISTOR | EMITTER | | BASE | | COLLECTOR | |
|---|---|---|---|---|---|---|
| | VOLTS[a] | OHMS[b] | VOLTS[a] | OHMS[b] | VOLTS[a] | OHMS[b] |
| Q1 | 0 | 0 | -1 | 1.1K | +6 | 2.6K |
| Q2 | 0 | 0 | +1 | 1.1K | +0.1 | 2.6K |
| Q3 | 0 | 0 | +6 | 1.1K | -1 | 2.6K |
| Q4 | 0 | 0 | +1 | 1.1K | +0.1 | 2.6K |
| Q5 | 0 | 0 | -1 | 1.1K | +6 | 2.6K |
| Q6 | 0 | 0 | +1 | 1.1K | +0.1 | 2.6K |
| Q7 | 0 | 0 | -1 | 1.1K | +6 | 2.6K |
| Q8 | 0 | 0 | +1 | 1.1K | +0.1 | 2.6K |
| Q9 | 0 | 0 | +1 | 1.1K | +0.1 | 2.6K |
| Q10 | 0 | 0 | -1 | 1.1K | +6 | 2.6K |
| Q11 | 0 | 0 | +1 | 1.1K | +0.1 | 2.6K |
| Q12 | 0 | 0 | -1 | 1.1K | +6 | 2.6K |
| Q13 | 0 | 0 | -1 | 1.1K | +6 | 2.6K |
| Q14 | 0 | 0 | +1 | 1.1K | +0.1 | 2.6K |
| Q15 | 0 | 0 | +1 | 1.1K | +0.1 | 2.6K |
| Q16 | 0 | 0 | -1 | 1.1K | +6 | 2.6K |

[a] Chassis ground common.
[b] Pin A common — component board disconnected.

NOTES:

1. UNLESS OTHERWISE INDICATED, ALL TRANSISTORS ARE 2N706 & ALL DIODES ARE IN277.
2. UNLESS OTHERWISE INDICATED, RESISTANCE VALUES ARE IN OHMS 1/4 WATT, CAPACITANCE VALUES ARE IN PF. (K=1000, MEG=1,000,000).

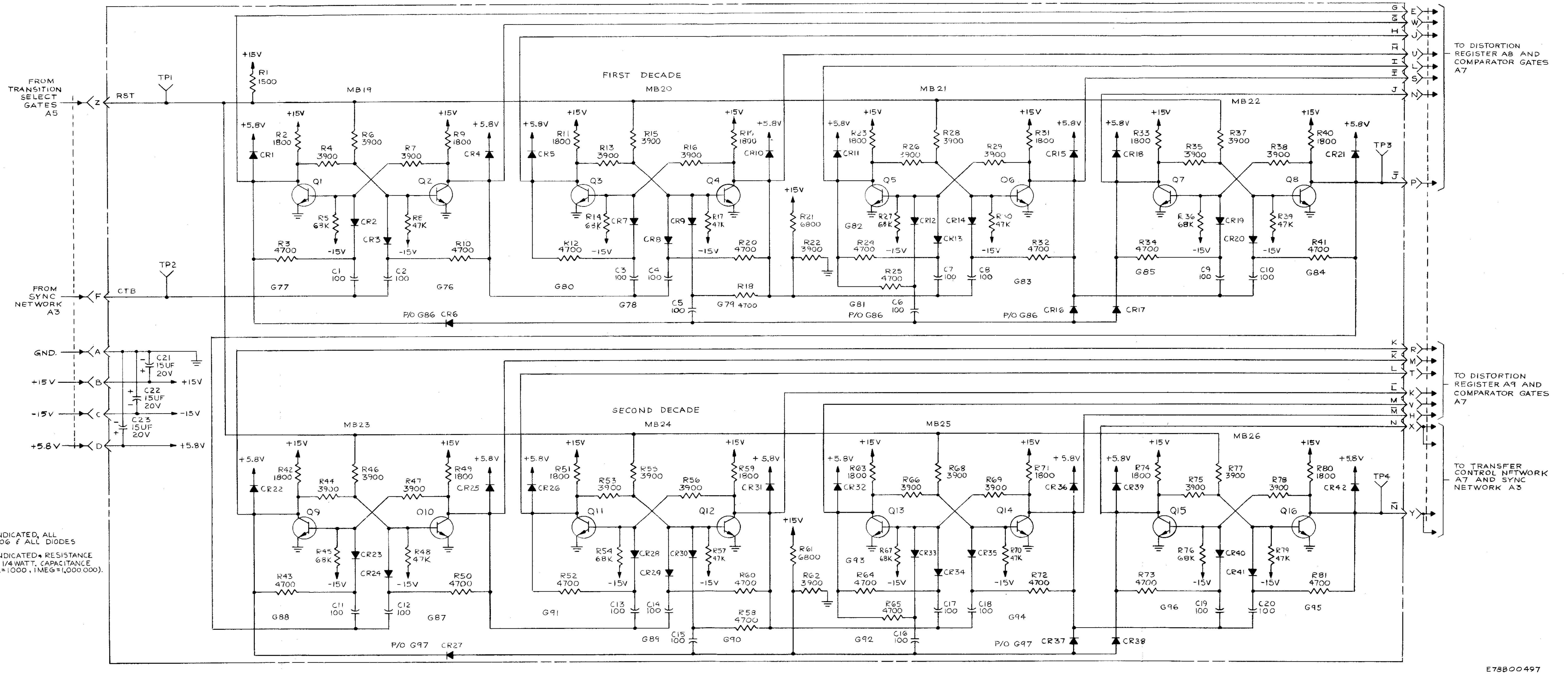



Figure 5-13. Component Board A6 (Distortion Counter), Schematic Diagram

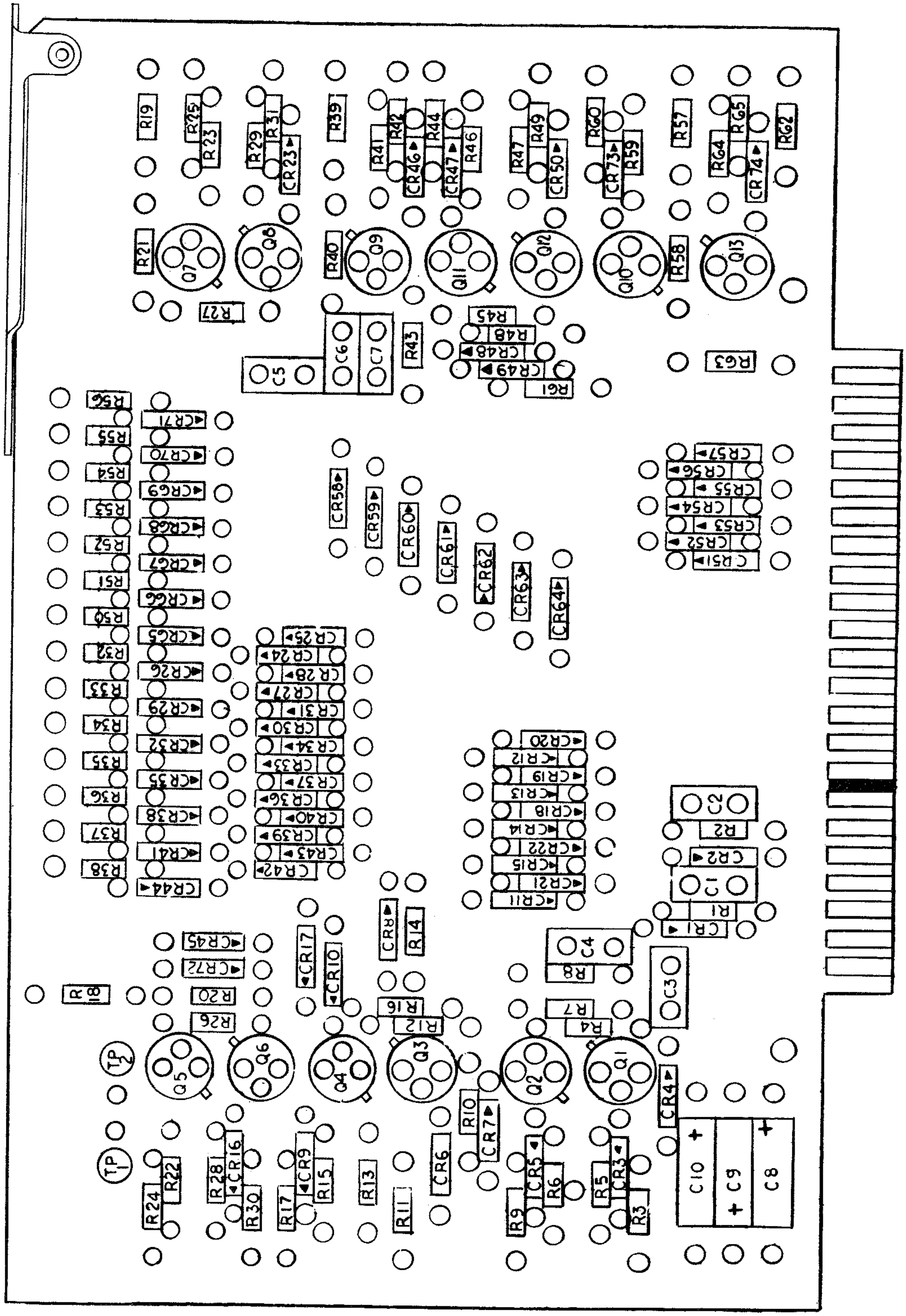
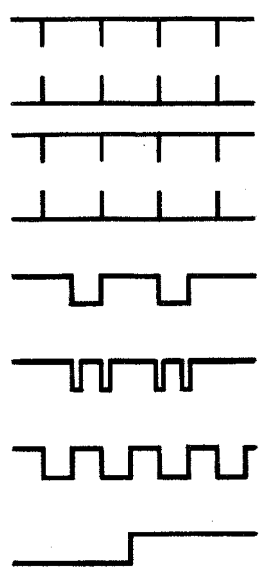



Figure 5-14. Component Board A7, Parts Locations



| TEST POINT | WAVEFORM | OSCILLOSCOPE | |
|---|---|---|---|
| Q1,Q3,Q5 CASE (3)(4) | 6V 0 | 5V/CM | 10MS/CM |
| Q2,Q4,Q6 CASE (3)(4) | 6V 0 | 5V/CM | 10MS/CM |
| Q7 CASE (3)(5) | 6V 0 | 5V/CM | 10MS/CM |
| Q8 CASE (3)(5) | 6V 0 | 5V/CM | 10MS/CM |
| Q9 CASE (3)(5) | 6V 0 | 5V/CM | 10MS/CM |
| Q10 CASE (3)(5) | 6V 0 | 5V/CM | 10MS/CM |
| Q11 CASE (3)(5) | 6V 0 | 5V/CM | 10MS/CM |
| Q13 CASE (3)(5) | 6V 0 | 5V/CM | 10MS/CM |

NOTES

1. Chassis ground common.
2. Input signal: 20 milliampere-neutral, synchronous 37.5 baud.
3. Case is electrically connected to collector.
4. 20 per cent marking bias.
5. 20 per cent spacing bias.

VOLTAGES AND RESISTANCES

| TRANSISTOR | EMITTER | | BASE | | COLLECTOR | |
|---|---|---|---|---|---|---|
| | VOLTS [a] | OHMS [b] | VOLTS [a] | OHMS [b] | VOLTS [a] | OHMS [b] |
| Q1 | 0 | 0 | -1 | 1K | +6 | 4K |
| Q2 | 0 | 0 | +1 | 1K | +0.1 | 4K |
| Q3 | 0 | 0 | -1 | 1K | +6 | 4K |
| Q4 | 0 | 0 | +1 | 1K | +0.1 | 4K |
| Q5 | 0 | 0 | -1.5 | 1.1K | +6 | 2.4K |
| Q6 | 0 | 0 | +1 | 0.9K | +0.1 | 3.5K |
| Q7 | 0 | 0 | -1.5 | 1K | +6 | 2.4K |
| Q8 | 0 | 0 | +1 | 1K | 0 | 4.5K |
| Q9 | 0 | 0 | -1.5 | 1K | +6 | 40K |
| Q10 | 0 | 0 | -1.5 | 1K | +6 | 40K |
| Q11 | 0 | 0 | +1 | 1K | +0.1 | 3.5K |
| Q12 | 0 | 0 | -1 | 1K | +6 | 3.7K |
| Q13 | 0 | 0 | -0.2 | 1K | +6 | 3.7K |

[a] Chassis ground common.
[b] Pin A common — component board disconnected.

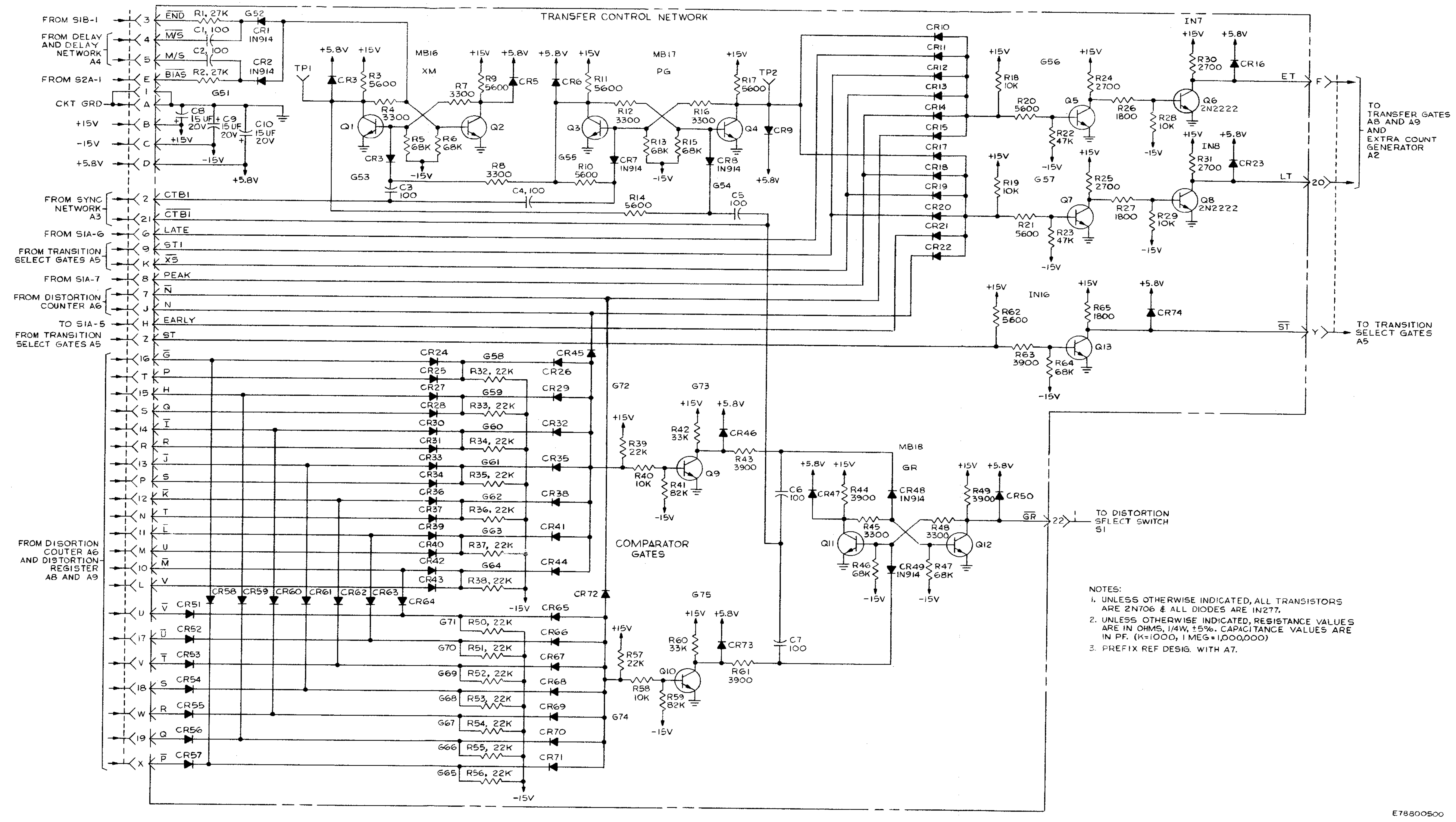



Figure 5-15. Component Board A7 (Transfer Control Network and Comparator Gates), Schematic Diagram

| PER CENT DISTORTION ±2% | | TEST POINTS | | | |
|---|---|---|---|---|---|
| LATE | EARLY | Q3 CASE | Q6 CASE | Q9 CASE | Q12 CASE |
| 3% | 2% | Low | High | High | High |
| 2% | 1% | High | Low | High | High |
| 4% | 3% | High | High | Low | High |
| 6% | 5% | High | High | Low | Low |

NOTES

1. Chassis ground common.
2. Input signal: The above table lists the states of inverters Q3, Q6, Q9, and Q12 for four different values of input signal distortion.
3. Since the Analyzer is limited to two per cent accuracy, the value of input signal distortion may have to be changed by one or two per cent in order to achieve the states listed. If an inverter can be observed to change state, it and its associated bistable can be presumed to be good.

VOLTAGES AND RESISTANCES

| TRANSISTOR | EMITTER | | BASE | | COLLECTOR | |
|---|---|---|---|---|---|---|
| | VOLTS[a] | OHMS[b] | VOLTS[a] | OHMS[b] | VOLTS[a] | OHMS[b] |
| Q1 | 0 | 0 | -1 | 1K | +6 | 3.6K |
| Q2 | 0 | 0 | +1 | 1K | +0.1 | 2.8K |
| Q3 | 0 | 0 | -1 | 1K | +15 | 25K |
| Q4 | 0 | 0 | -1 | 1K | +6 | 3.8K |
| Q5 | 0 | 0 | +1 | 1K | +0.1 | 2.8K |
| Q6 | 0 | 0 | -1 | 1K | +15 | 25K |
| Q7 | 0 | 0 | -1 | 1K | +6 | 3.8K |
| Q8 | 0 | 0 | +1 | 1K | +0.1 | 3.8K |
| Q9 | 0 | 0 | -1 | 1K | +15 | 25K |
| Q10 | 0 | 0 | -1 | 1K | +6 | 3.8K |
| Q11 | 0 | 0 | +1 | 1K | +0.1 | 2.8K |
| Q13 | 0 | 0 | -1 | 1K | +13 | 1K |

[a]Chassis ground common.
[b]Pin A common — component board disconnected.

NOTES:
1. UNLESS OTHERWISE IND. ALL TRANSISTORS ARE 2N706 AND ALL DIODES ARE 1N277.
2. UNLESS OTHERWISE IND. RESISTANCE VALUES ARE IN OHMS, 1/4 W, ±5%. CAPACITANCE VALUES ARE IN PF. (K=1000, 1 MEG=1,000,000)
3. PREFIX ALL REF. DESIG. WITH A8.
4. COMP. ASSY. NO. D8019 5060 001.
5. ▭ IND. FRONT PANEL MARKING.

| CKT | COMPONENTS | | | |
|---|---|---|---|---|
| 1 | R2-R15 | C1-C5 | CR1-CR6 | Q1-Q3 |
| 2 | R17-R30 | C6-C10 | CR7-CR12 | Q4-Q6 |
| 3 | R32-R45 | C11-C15 | CR13-CR18 | Q7-Q9 |
| 4 | R47-R57 R59-R61 | C16-C20 | CR19-CR24 | Q10-Q12 |

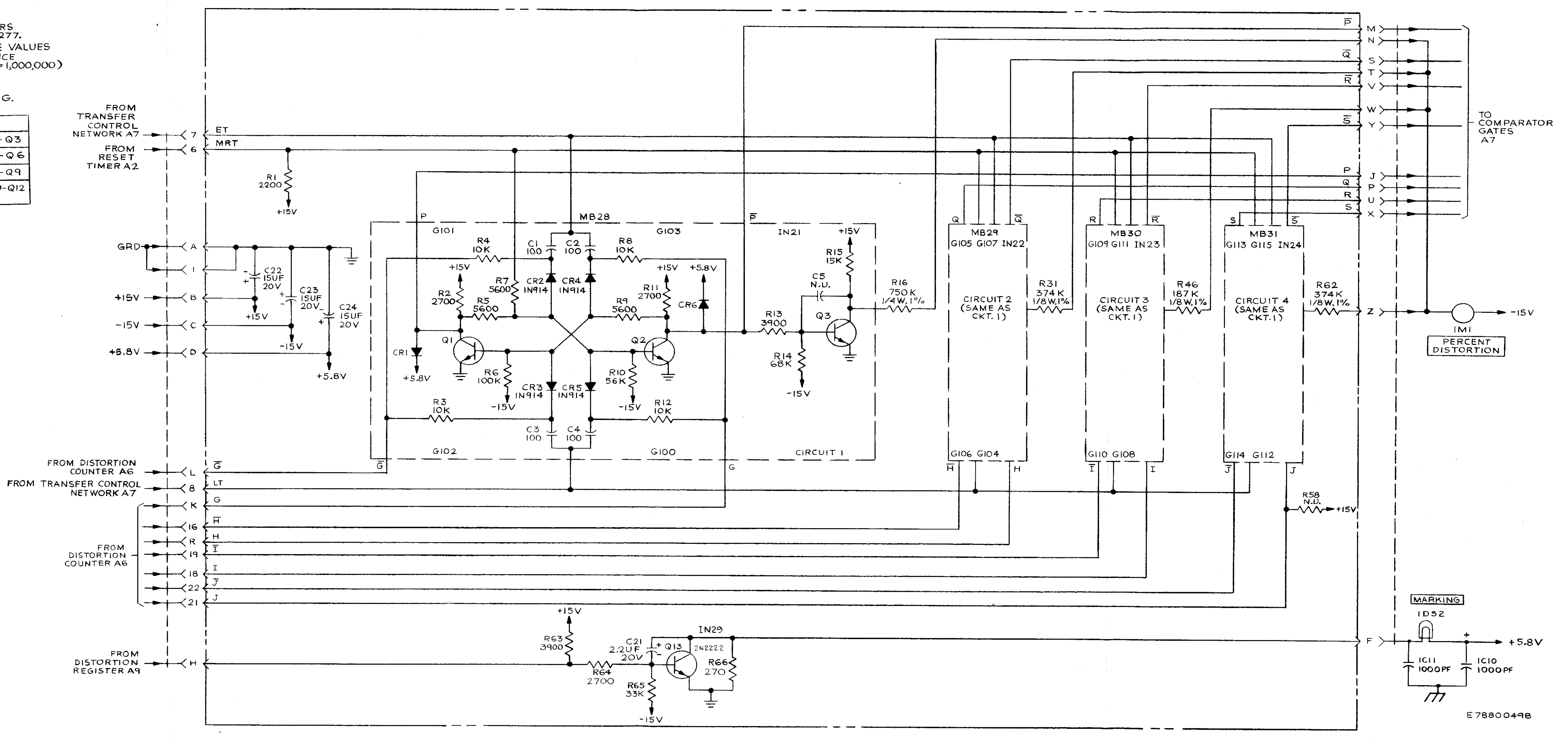



Figure 5-16. Component Board A8 (P/O Distortion Register, Transition Gates, and Meter Drive), Schematic Diagram

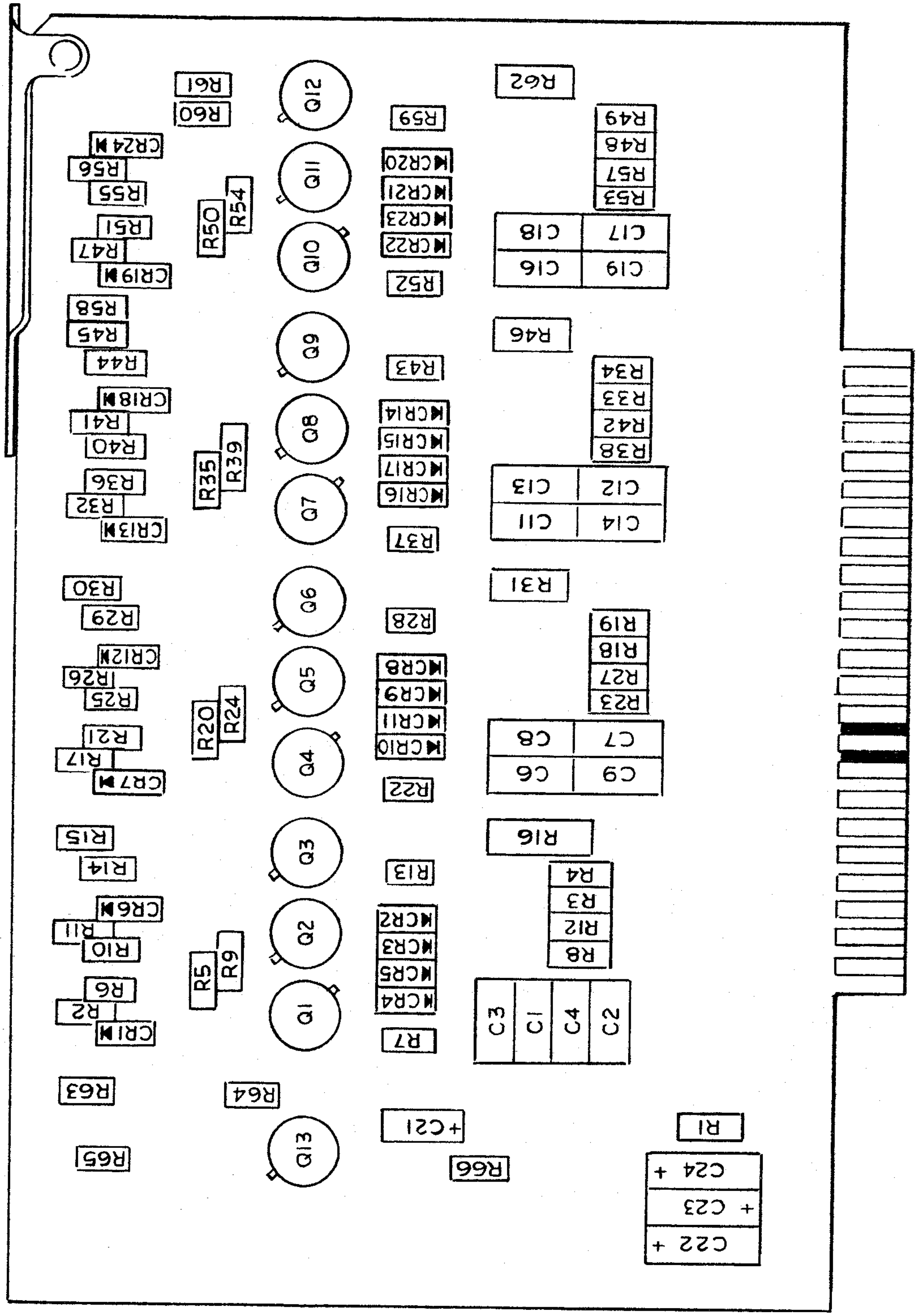



Figure 5-17. Component Boards A8 and A9, Parts Locations

| PER CENT DISTORTION ±2% | | TEST POINTS | | |
|---|---|---|---|---|
| LATE | EARLY | Q3 CASE | Q6 CASE | Q9 CASE |
| 10% | 9% | Low | High | High |
| 20% | 19% | High | Low | High |
| 40% | 39% | High | High | Low |

NOTES

1. Chassis ground common.
2. Input signal: The above table lists the states of inverters Q3, Q6 and Q9 for three different values of input signal distortion.
3. Since the Analyzer is limited to two per cent accuracy, the values of input signal distortion may have to be changed by one or two per cent in order to achieve the states listed. If an inverter can be observed to change state, it and its associated bistable can be presumed to be good.

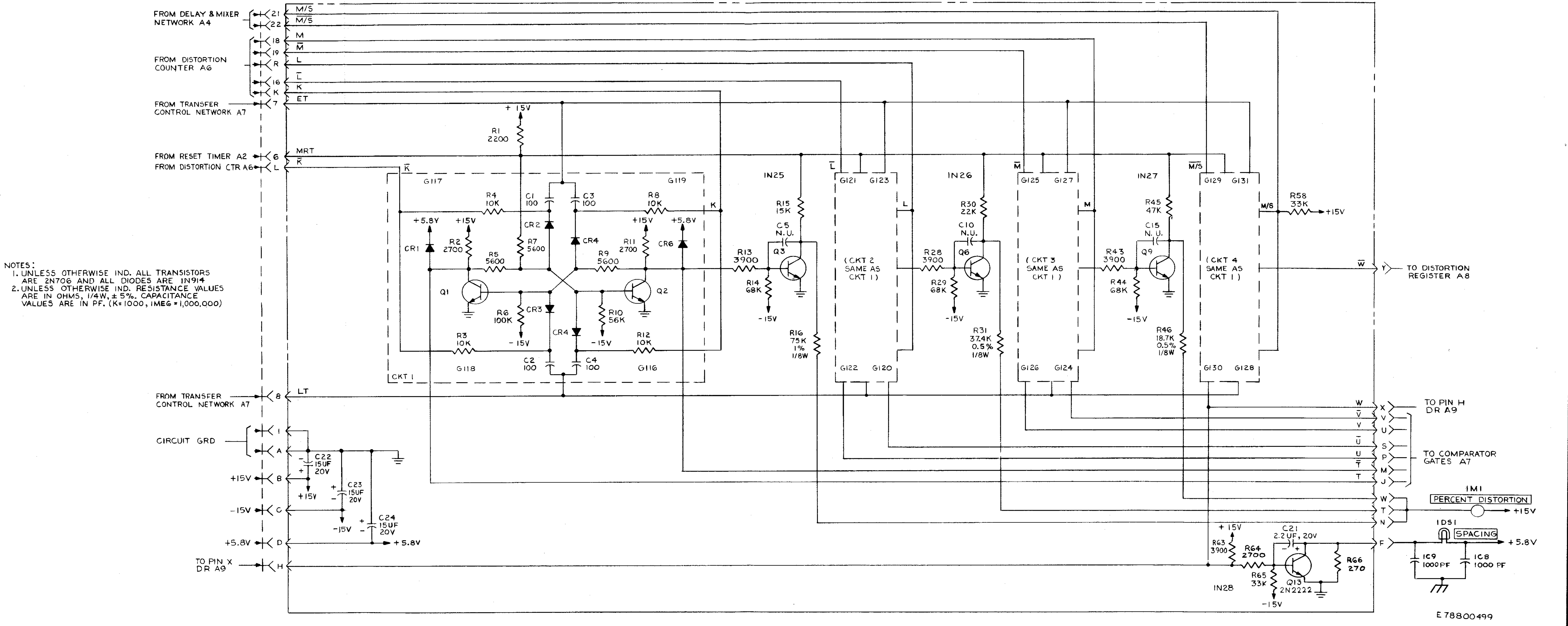



Figure 5-18. Component Board A9 (P/O Distortion Register, Transition Gates, and Meter Drive), Schematic Diagram

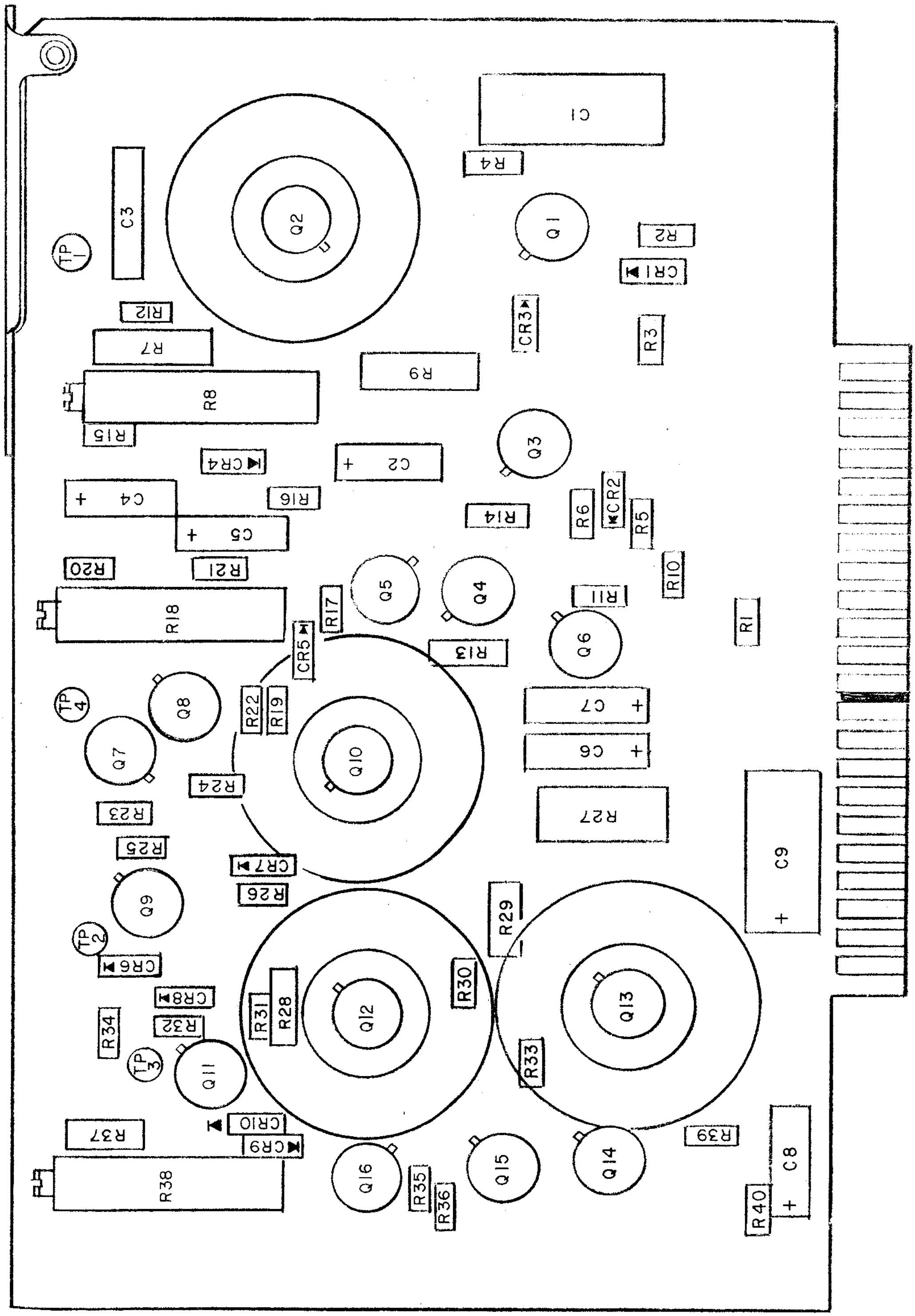
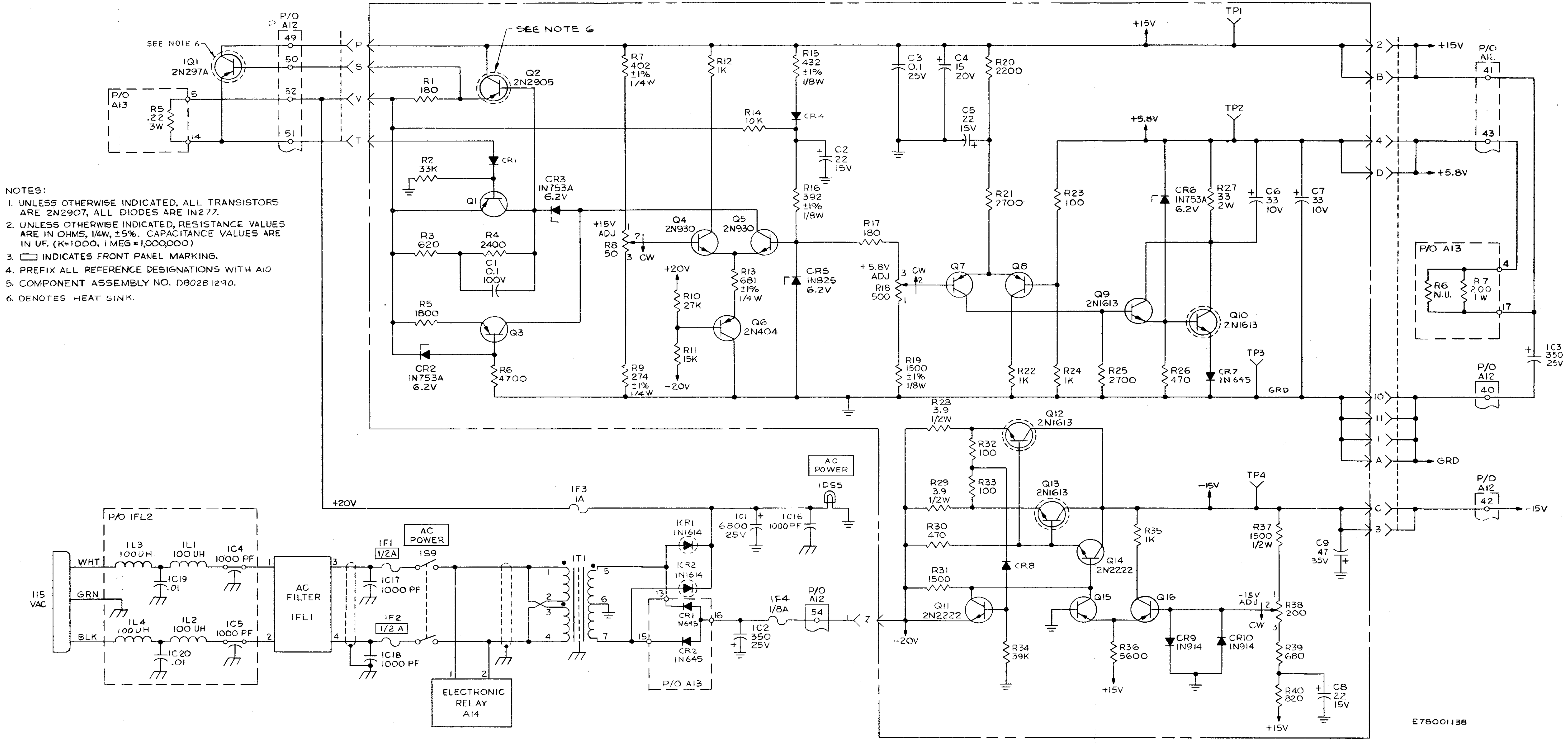



Figure 5-19. Component Board A10, Parts Locations

VOLTAGES AND RESISTANCES

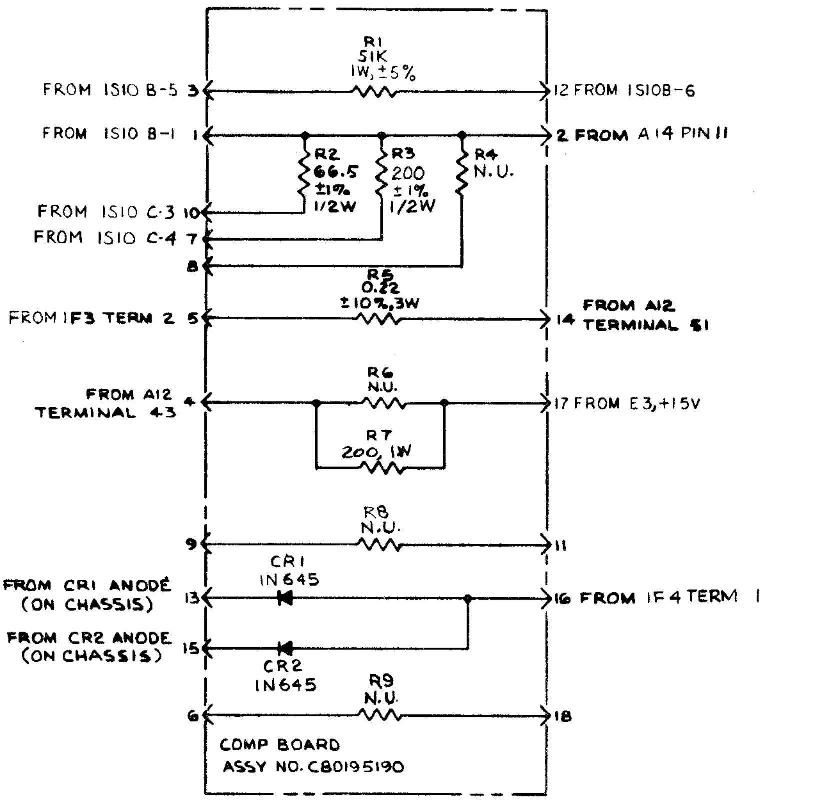
| TRANSISTOR | EMITTER | | BASE | | COLLECTOR | |
|---|---|---|---|---|---|---|
| | VOLTS [a] | OHMS [b] | VOLTS [a] | OHMS [b] | VOLTS [a] | OHMS [b] |
| Q1 | +22 | 6K | +22 | 35K | +21 | 8K |
| Q2 | +22 | 6K | +21 | 8K | +15 | 0.6 |
| Q3 | +16 | 5K | +16 | 4K | +15 | 5K |
| Q4 | + 6 | 1.6K | + 6 | 0.3K | +10 | 1.6K |
| Q5 | + 6 | 1.6K | + 6 | 2K | +15 | 5K |
| Q6 | + 0.02 | 0.8K | - 0.1 | 15K | 0 | 0 |
| Q7 | + 6 | 0.8K | + 5 | 1.6K | + 2 | 1K |
| Q8 | + 6 | 0.8K | + 5.5 | 1K | + 1 | 0.8K |
| Q9 | + 1.5 | 0.5K | + 2 | 1K | + 4.5 | 1.1K |
| Q10 | + 1 | 0.7K | + 1.5 | 0.5 | + 5 | 1.1K |
| Q11 | -22 | 2.5K | -22 | 3.5K | -21 | 1K |
| Q12 | -22 | 3.5K | -21.5 | 3K | -16 | 3K |
| Q13 | -22 | 3.5K | -22 | 3K | -16 | 3K |
| Q14 | -22 | 3K | -22 | 1K | -16 | 3K |
| Q15 | + 1 | 1K | 0 | 0 | -21 | 1K |
| Q16 | + 1 | 1K | 0 | 0.8K | -14.5 | 3K |

[a] Chassis ground common.
[b] Pin A common — component board disconnected.




NOTES:
1. UNLESS OTHERWISE INDICATED, ALL TRANSISTORS ARE 2N2907, ALL DIODES ARE IN277.
2. UNLESS OTHERWISE INDICATED, RESISTANCE VALUES ARE IN OHMS, 1/4W, ±5%. CAPACITANCE VALUES ARE IN UF. (K=1000, 1 MEG = 1,000,000)
3. ▭ INDICATES FRONT PANEL MARKING.
4. PREFIX ALL REFERENCE DESIGNATIONS WITH A10
5. COMPONENT ASSEMBLY NO. D80281290.
6. DENOTES HEAT SINK.

Figure 5-20. Component Board A10 (Power Supply), Schematic Diagram




NOTES:
1. UNLESS OTHERWISE INDICATED, RESISTANCE VALUES ARE IN OHMS.

Figure 5-21. Component Board A13 (Miscellaneous Circuits) Schematic Diagram

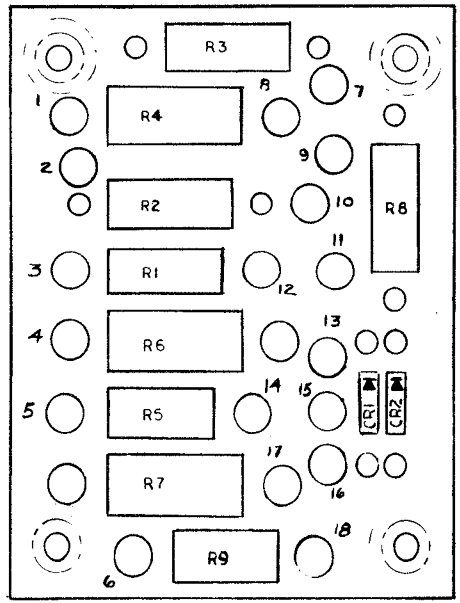
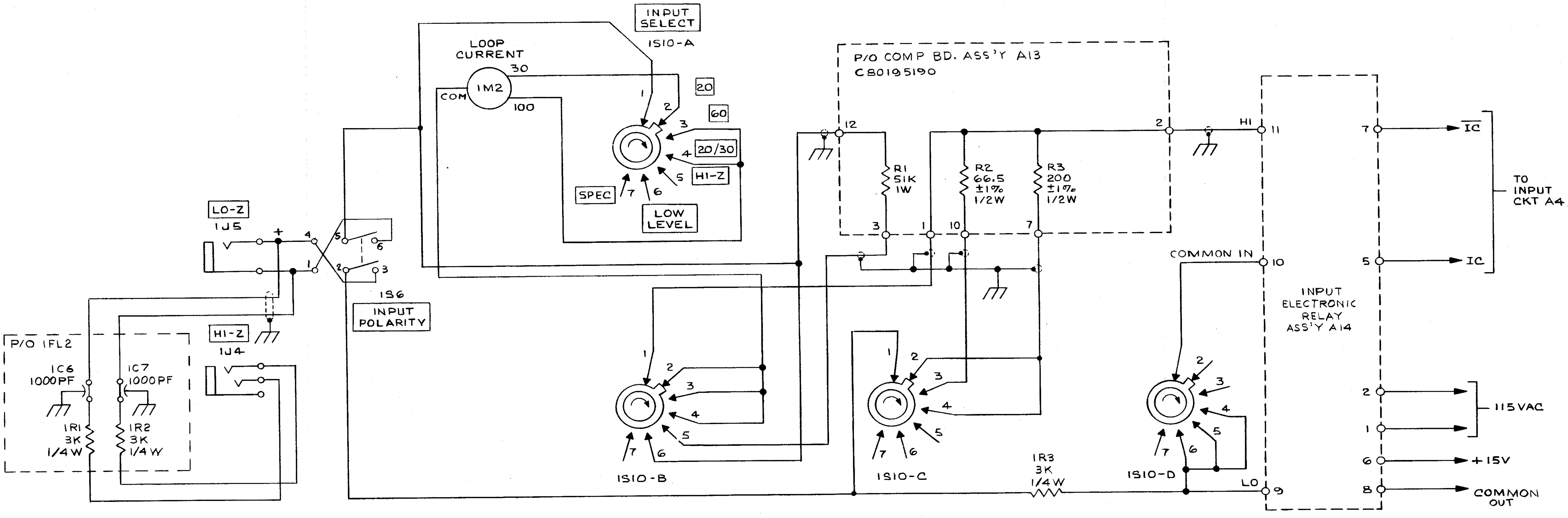



Figure 5-22. Component Board A13, Parts Locations




NOTES:

1. UNLESS OTHERWISE INDICATED RESISTANCE VALUES ARE IN OHMS.
2. ▭ INDICATES CHASSIS PANEL MARKING.
3. WAFER SWITCHES SHOWN IN EXTREME COUNTER-CLOCKWISE POSITION, AND ARE VIEWED FROM FRONT EXCEPT AS OTHERWISE INDICATED. FRONT OF WAFER IS SIDE TOWARD CONTROL KNOB. WAFER NEAREST CONTROL KNOB IS SECTION A.

D 78800668

Figure 5-23. Input Select Network, Schematic Diagram

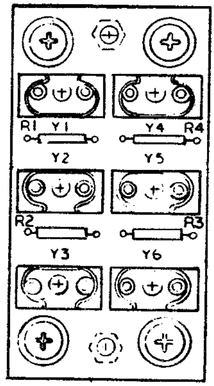



Figure 5-24. Component Board A15 (Crystals), Parts Locations

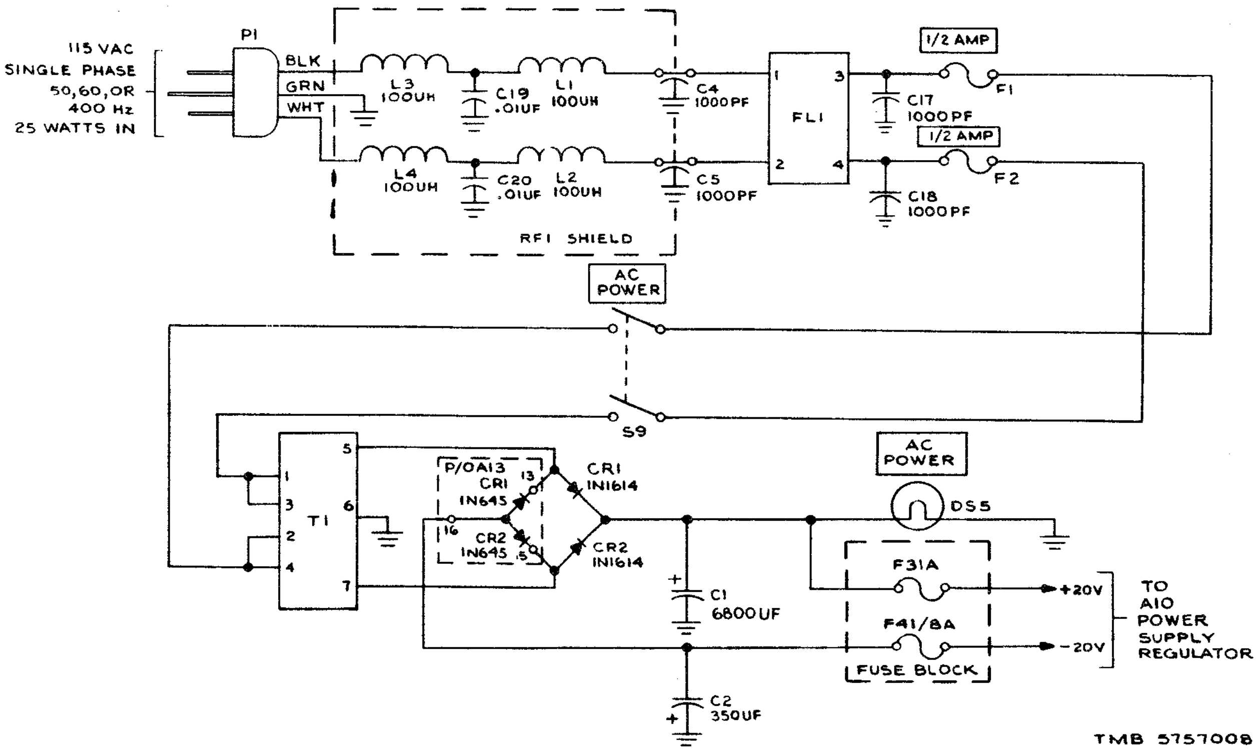



Figure 5-25. Primary Power Distribution

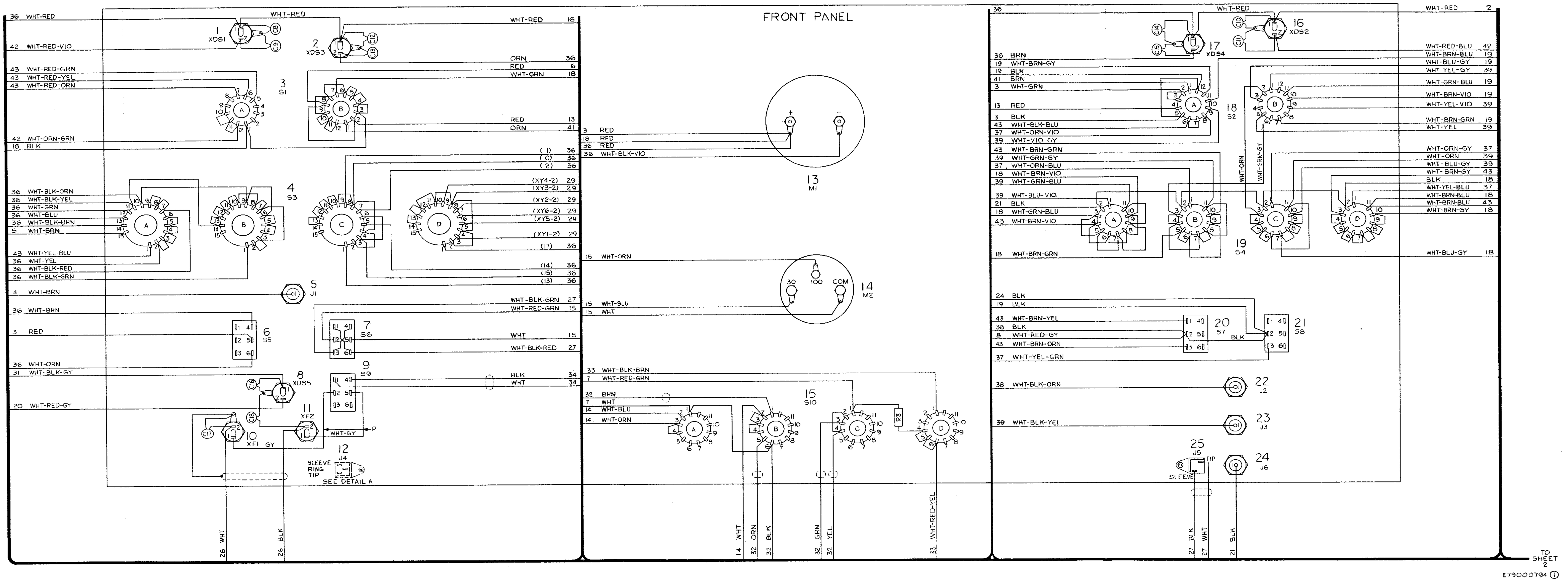
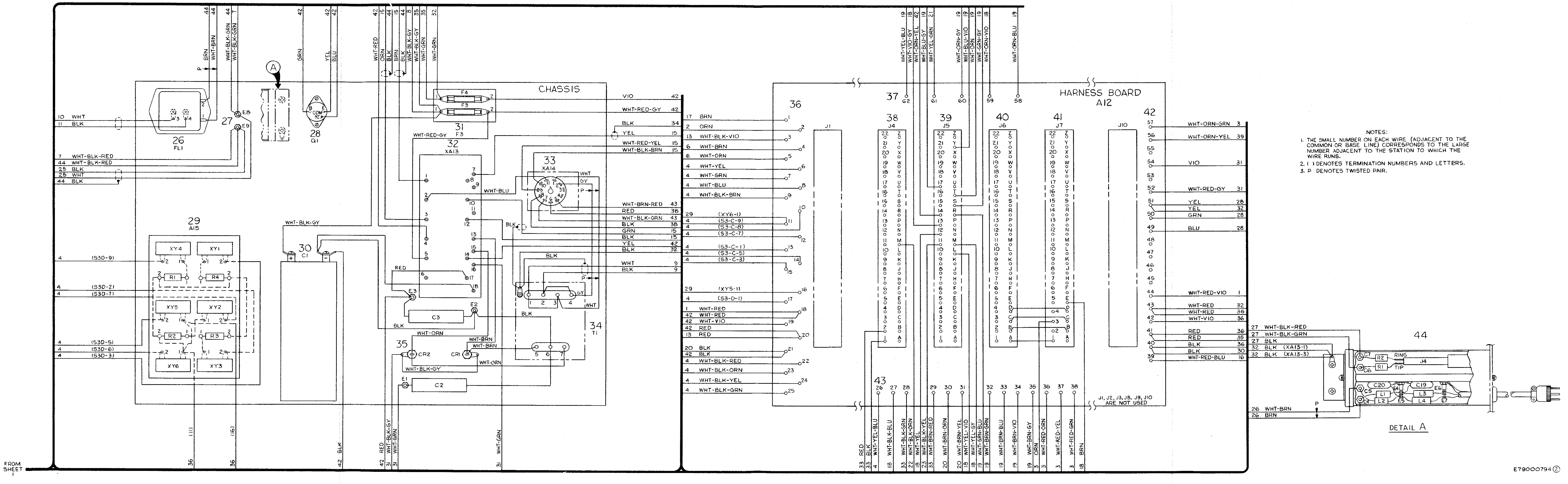



Figure 5-26. Over-All Wiring Diagram (Sheet 1 of 2)




NOTES:

1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON OR BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION TO WHICH THE WIRE RUNS.
2. ( ) DENOTES TERMINATION NUMBERS AND LETTERS.
3. P DENOTES TWISTED PAIR.

Figure 5-26. Over-All Wiring Diagram (Sheet 2 of 2)

# SECTION 6

# PARTS LIST

## 6-1. INTRODUCTION.

a. REFERENCE DESIGNATIONS.- A uniform identification method has been used to identify the unit, assemblies, and maintenance parts of the Analyzer. 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 Identification No. | Class of Part | Item 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. This table provides a listing of printed-circuit identification numbers 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 MAJOR ASSEMBLIES

| ASSY REF DESIG | QTY PER EQUIP | CIRCUIT BOARD ASSEMBLY PART NUMBER | COLLOQUIAL NAME | PARTS LIST PAGE |
|---|---|---|---|---|
| 1A1 | 1 | 80195020 | Circuit Card Assembly | 6-5 |
| 1A2 | 1 | 80195030 | Circuit Card Assembly | 6-7 |
| 1A3 | 1 | 80195040 | Circuit Card Assembly | 6-10 |
| 1A4 | 1 | 80195010 | Circuit Card Assembly | 6-13 |
| 1A5 | 1 | 80195090 | Circuit Card Assembly | 6-15 |
| 1A6 | 1 | 80195050 | Circuit Card Assembly | 6-18 |
| 1A7 | 1 | 80195080 | Circuit Card Assembly | 6-21 |
| 1A8 | 1 | 80195060-001 | Circuit Card Assembly | 6-23 |
| 1A9 | 1 | 80195060-002 | Circuit Card Assembly | 6-26 |
| 1A10 | 1 | 80281290 | Circuit Card Assembly | 6-29 |
| 1A11 | 1 | 80195120 | Extender Card Assembly | 6-31 |
| 1A12 | 1 | 80195160 | Harness Card Assembly | 6-32 |
| 1A13 | 1 | 80195190 | Circuit Card Assembly | 6-32 |
| 1A14 | 1 | 48092015 | Converter Telegraph Signal | 6-32 |
| 1A15 | 1 | 90195003 | Crystal Holder | 6-33 |

## 6-3. MAINTENANCE PARTS LIST.

Table 6-2 lists the telegraph signal analyzer unit and all assemblies, and their respective maintenance parts, except for the converter telegraph signal (assembly A14) which is a sealed plug-in unit. Maintenance parts, in each case, are listed alphanumerically following the telegraph signal analyzer unit identification and assembly designation (where applicable). The table provides the following information: (1) the complete reference designation of each maintenance parts, (2) reference to explanatory notes as required, (3) name and description of maintenance part, (4) listing of illustration which pictorially locates the part.

## 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.

## 6-5. NOTES.

The following notes provide information as referenced in table 6-2.

1. Spare fuse located in cover.
2. Fuseholder located in cover, used to accommodate spare fuses.

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1 | | TELEGRAPH SIGNAL ANALYZER UNIT: Consists of a front panel, cover, and main chassis. It provides circuitry for the below listed items and the assemblies referenced in table 6-1; mfr 96238, dwg C90195000 | 5-1 |
| 1CR1 | | SEMICONDUCTOR: MIL type 1N1614 | |
| 1CR2 | | Same as 1CR1 | |
| 1C1 | | CAPACITOR: MIL type CE71C682E | |
| 1C2 | | CAPACITOR: MIL type CE13C351F | |
| 1C3 | | Same as 1C2 | |
| 1C4-1C7 | | CAPACITOR: 1000uuf, 500V; type FB3B-102W (01121) | |
| 1C8-1C18 | | CAPACITOR: MIL type CK60AW102M | |
| 1C19-1C20 | | CAPACITOR: MIL type CK63AW103M | |
| 1FL1 | | FILTER,RADIO INTERFERENCE: 115vac, 0.5 amp; 230vac 0.25amp, 0 to 440 cps; type 43020109 (96238) | |
| 1F1 | | FUSE: MIL type FO2A2501-2A | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF DESIG | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1F2 | 1 | Same as 1F1 | 5-1 |
| 1F3 | | FUSE: MIL type F02A250V001A | |
| 1F4 | | FUSE: MIL type F02A250V1-8A | |
| 1J1 | | CONNECTOR: MIL type MS27035-625B | |
| 1J2, 1J3 | | Same as 1J1 | |
| 1J4 | | JACK: MIL type JJ022 | |
| 1J5 | | JACK: MIL type JJ086 | |
| 1J6 | | Same as 1J1 | |
| 1L1-1L4 | | COIL,RF: MIL type MS91189-37 | |
| 1MP1 | | KNOB: round dial skirt with baud rate markings, 1.525in. high, 1.010 in. long, 0.250in. shaft hole; type 57025110 (96238) | |
| 1MP2 | | KNOB: MIL type MS91528-1K2B | |
| 1MP3-1MP5 | | Same as 1MP1 | |
| 1M1 | | METER,SPECIAL SCALE: 0 to 50% scale, 0 to 1ma ±2% accuracy, rugged panel type; type 48081061 (96238) | |
| 1M2 | | AMMETER: 30-0-30ma scale, 100-0-100ma scale, ±1% accuracy, rugged panel type: type 48081072 (96238) | |
| 1P1 | | CONNECTOR: MIL type UP221M | |
| R1-R3 | | RESISTOR: MIL type RC07GF302J | |
| 1Q1 | | TRANSISTOR: MIL type 2N297A | |
| 1S1 | | SWITCH,ROTARY: 5 positions, 2 sections; non-shorting contacts; type 46020325 (96238) | |
| 1S2 | | SWITCH,ROTARY: 3 positions, 2 sections; non-shorting contacts; type 46020326 (96238) | |
| 1S3 | | SWITCH,ROTARY: 14 positions, 4 sections; non-shorting contacts; type 46020322 (96238) | |
| 1S4 | | SWITCH,ROTARY: 10 positions, 4 sections; non-shorting contacts type 46020331 (96238) | |
| 1S5 | | SWITCH,TOGGLE: MIL type MS35059-31 | |
| 1S6 | | SWITCH,TOGGLE: MIL type MS25100-23 | |
| 1S7-1S9 | | Same as 1S6 | |
| 1S10 | | SWITCH,ROTARY: 6 positions, 4 sections; non-shorting contacts; type 46020322 (96238) | |
| 1T1 | | TRANSFORMER,POWER STEP-DOWN: Primary 115/230vac 47 to 420 cps secondary; 36vac center tap; type 43000216 (96238) | |
| 1XA14 | | SOCKET,RELAY: 11 contacts, 500v; 3 amp rating, black phenolic body; type 78S11-101 (02660) | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF DESIG | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1XDS1 | | LIGHT: MIL type MS25256-8-327 | 5-1 |
| 1XDS2- | | | |
| 1XDS4 | | Same as 1XDS1 | |
| 1XDS5 | | LIGHT: MIL type MS25256-6-327 | |
| 1XF1 | | FUSEHOLDER: MIL type FHN26G | |
| 1XF2 | | Same as 1XF1 | |
| 1XF3 | | FUSEHOLDER: MIL type FH23BM | |
| | 2 | FUSEHOLDER: MIL type FH23CM | |

ASSEMBLY 1A1 CIRCUIT CARD ASSEMBLY

| REF DESIG | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A1 | | CIRCUIT CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80195020 (96238) | 5-2 |
| 1A1CR1 | | SEMICONDUCTOR: MIL type 1N914 | |
| 1A1CR2 | | SEMICONDUCTOR: MIL type 1N277 | |
| 1A1CR3, | | | |
| 1A1CR4 | | Same as 1A1CR2 | |
| 1A1CR5, | | | |
| 1A1CR6 | | Same as 1A1CR1 | |
| 1A1CR7, | | | |
| 1A1CR8 | | Same as 1A1CR2 | |
| 1A1CR9, | | | |
| 1A1CR10 | | Same as 1A1CR1 | |
| 1A1CR11, | | | |
| 1A1CR12 | | Same as 1A1CR2 | |
| 1A1CR13, | | | |
| 1A1CR14 | | Same as 1A1CR1 | |
| 1A1CR15 | | Same as 1A1CR2 | |
| 1A1C1 | | CAPACITOR: MIL type CM05ED270J03 | |
| 1A1C2 | | Not used | |
| 1A1C3 | | CAPACITOR: MIL type CM05FD271J03 | |
| 1A1C4 | | CAPACITOR: MIL type CM05FD101J03 | |
| 1A1C5, | | | |
| 1A1C6 | | Not used | |
| 1A1C7 | | CAPACITOR: MIL type CM06FD332J03 | |
| 1A1C8 | | CAPACITOR: MIL type CM05FD131J03 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF DESIG | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A1C9 | | CAPACITOR: MIL type CM05FD391J03 | 5-2 |
| 1A1C10 | | CAPACITOR: MIL type CM05FD241J03 | |
| 1A1C11 | | CAPACITOR: MIL type CM05FD241J03 | |
| 1A1C11 | | CAPACITOR: MIL type CM06FD242J03 | |
| 1A1C12 | | CAPACITOR: MIL type CM05FD361J03 | |
| 1A1C13 | | CAPACITOR,FXD,CERAMIC: 0.1uf +80% -20%, 25vdcw; type 5815Y5U104Z (72982) | |
| 1A1C14 | | CAPACITOR: MIL type CS13BF474M | |
| 1A1C15 | | CAPACITOR: MIL type CM06FD431J03 | |
| 1A1C16 | | CAPACITOR: MIL type CM05FD181J03 | |
| 1A1C17 | | Same as 1A1C9 | |
| 1A1C18 | | Same as 1A1C16 | |
| 1A1C19 | | CAPACITOR: MIL type CM06FD122J03 | |
| 1A1C20 | | CAPACITOR: MIL type CM05FD101J03 | |
| 1A1C21-1A1C25 | | Same as 1A1C20 | |
| 1A1C26, 1A1C27 | | Not used | |
| 1A1C28 | | CAPACITOR: MIL type CS13BE156M | |
| 1A1C29 | | Same as 1A1C13 | |
| 1A1C30 | | Same as 1A1C28 | |
| 1A1C31 | | Same as 1A1C13 | |
| 1A1C32 | | Same as 1A1C28 | |
| 1A1C33 | | Same as 1A1C13 | |
| 1A1L1 | | CHOKE,RADIO FREQUENCY: 56uh ±2%; type SW056 (72259) | |
| 1A1MP1 | | INSULATOR,DISK: Nylon, 0.350 in. outside diameter; 0.200 in. inside diameter type RC-T01800-1A (24227) | |
| 1A1MP2-1A1MP11 | | Same as 1A1MP1 | |
| 1A1Q1 | | TRANSISTOR: MIL type 2N706 | |
| 1A1Q2-1A1Q11 | | Same as 1A1Q1 | |
| 1A1R1 | | RESISTOR: MIL type RN65C1501F | |
| 1A1R2 | | RESISTOR: MIL type RN65C3011F | |
| 1A1R3 | | RESISTOR: MIL type RC07GF101J | |
| 1A1R4 | | RESISTOR: MIL type RC07GF393J | |
| 1A1R5 | | Same as 1A1R3 | |
| 1A1R6 | | RESISTOR: MIL type RC07GF822J | |
| 1A1R7 | | RESISTOR: MIL type RC07GF152J | |
| 1A1R8 | | RESISTOR: MIL type RC07GF104J | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A1R9 | | RESISTOR: MIL type RC07GF153J | 5-2 |
| 1A1R10 | | RESISTOR: MIL type RC07GF332J | |
| 1A1R11 | | Same as 1A1R8 | |
| 1A1R12 | | RESISTOR: MIL type RC07GF392J | |
| 1A1R13 | | RESISTOR: MIL type RC07GF182J | |
| 1A1R14 | | Same as 1A1R12 | |
| 1A1R15 | | RESISTOR: MIL type RC07GF683J | |
| 1A1R16 | | RESISTOR: MIL type RC07GF472J | |
| 1A1R17 | | Same as 1A1R12 | |
| 1A1R18 | | Same as 1A1R15 | |
| 1A1R19 | | Same as 1A1R16 | |
| 1A1R20 | | Same as 1A1R12 | |
| 1A1R21 | | Same as 1A1R13 | |
| 1A1R22 | | Same as 1A1R12 | |
| 1A1R23 | | Same as 1A1R15 | |
| 1A1R24 | | Same as 1A1R16 | |
| 1A1R25 | | Same as 1A1R12 | |
| 1A1R26 | | Same as 1A1R15 | |
| 1A1R27 | | Same as 1A1R16 | |
| 1A1R28 | | Same as 1A1R12 | |
| 1A1R29 | | Same as 1A1R13 | |
| 1A1R30 | | Same as 1A1R12 | |
| 1A1R31 | | Same as 1A1R15 | |
| 1A1R32 | | Same as 1A1R16 | |
| 1A1R33 | | Same as 1A1R12 | |
| 1A1R34 | | Same as 1A1R15 | |
| 1A1R35 | | Same as 1A1R16 | |
| 1A1R36 | | Same as 1A1R12 | |

ASSEMBLY 1A2 CIRCUIT CARD ASSEMBLY

| REF DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A2 | | CIRCUIT CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80195030 (96238) | 5-4 |
| 1A2CR1 | | SEMICONDUCTOR: MIL type 1N277 | |
| 1A2CR2 | | SEMICONDUCTOR: MIL type 1N914 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A2CR3 | | Same as 1A2CR2 | 5-4 |
| 1A2CR4-<br>1A2CR7 | | Same as 1A2CR1 | |
| 1A2CR8,<br>1A2CR9 | | Same as 1A2CR2 | |
| 1A2CR10,<br>1A2CR11 | | Same as 1A2CR1 | |
| 1A2CR12,<br>1A2CR13 | | Same as 1A2CR2 | |
| 1A2CR14,<br>1A2CR15 | | Same as 1A2CR1 | |
| 1A2CR16,<br>1A2CR17 | | Same as 1A2CR2 | |
| 1A2CR18-<br>1A2CR22 | | Same as 1A2CR1 | |
| 1A2CR23 | | Same as 1A2CR2 | |
| 1A2CR24-<br>1A2CR26 | | Same as 1A2CR1 | |
| 1A2CR27,<br>1A2CR28 | | Same as 1A2CR2 | |
| 1A2CR29 | | Same as 1A2CR1 | |
| 1A2C1 | | CAPACITOR: MIL type CM05FD101K03 | |
| 1A2C2-<br>1A2C8 | | Same as 1A2C1 | |
| 1A2C9 | | CAPACITOR: MIL type CS13BE476K | |
| 1A2C10 | | Same as 1A2C9 | |
| 1A2C11-<br>1A2C13 | | Same as 1A2C1 | |
| 1A2C14 | | Not used | |
| 1A2C15 | | CAPACITOR: MIL type CS13BE156M | |
| 1A2C16,<br>1A2C17 | | Same as 1A2C15 | |
| 1A2MP1 | | INSULATOR,DISK: Nylon, 0.350 in. outside diameter; 0.200 in. inside diameter; RC-T01800-1A (24227) | |
| 1A2MP2-<br>1A2MP17 | | Same as 1A2MP1 | |
| 1A2Q1 | | TRANSISTOR: MIL type 2N706 | |
| 1A2Q2-<br>1A2Q11 | | Same as 1A2Q1 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A2Q12-1A2Q17 | | TRANSISTOR: MIL type 2N404 | 5-4 |
| 1A2R1 | | RESISTOR: MIL type RC07GF182J | |
| 1A2R2 | | RESISTOR: MIL type RC07GF392J | |
| 1A2R3 | | RESISTOR: MIL type RC07GF683J | |
| 1A2R4 | | RESISTOR: MIL type RC07GF472J | |
| 1A2R5 | | Same as 1A2R2 | |
| 1A2R6 | | Same as 1A2R3 | |
| 1A2R7 | | Same as 1A2R4 | |
| 1A2R8, 1A2R9 | | Same as 1A2R1 | |
| 1A2R10 | | Same as 1A2R2 | |
| 1A2R11 | | Same as 1A2R3 | |
| 1A2R12 | | Same as 1A2R4 | |
| 1A2R13 | | Same as 1A2R2 | |
| 1A2R14 | | Same as 1A2R3 | |
| 1A2R15 | | Same as 1A2R4 | |
| 1A2R16, 1A2R17 | | Same as 1A2R1 | |
| 1A2R18 | | Same as 1A2R2 | |
| 1A2R19 | | Same as 1A2R3 | |
| 1A2R20 | | Same as 1A2R4 | |
| 1A2R21 | | Same as 1A2R2 | |
| 1A2R22 | | Same as 1A2R3 | |
| 1A2R23 | | Same as 1A2R4 | |
| 1A2R24, 1A2R25 | | Same as 1A2R1 | |
| 1A2R26 | | Same as 1A2R2 | |
| 1A2R27 | | Same as 1A2R3 | |
| 1A2R28 | | Same as 1A2R4 | |
| 1A2R29 | | Same as 1A2R2 | |
| 1A2R30 | | Same as 1A2R3 | |
| 1A2R31 | | Same as 1A2R4 | |
| 1A2R32 | | Same as 1A2R1 | |
| 1A2R33 | | RESISTOR: MIL type RC07GF153J | |
| 1A2R34 | | RESISTOR: MIL type RC07GF682J | |
| 1A2R35 | | RESISTOR: MIL type RC07GF823J | |
| 1A2R36 | | Same as 1A2R4 | |
| 1A2R37-1A2R39 | | Same as 1A2R33 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A2R40 | | RESISTOR: MIL type RC07GF154J | 5-4 |
| 1A2R41 | | Same as 1A2R40 | |
| 1A2R42 | | RESISTOR: MIL type RC07GF102J | |
| 1A2R43 | | Same as 1A2R33 | |
| 1A2R44 | | RESISTOR: MIL type RC07GF223J | |
| 1A2R45 | | RESISTOR: MIL type RC07GF103J | |
| 1A2R46 | | RESISTOR: MIL type RC07GF473J | |
| 1A2R47 | | Same as 1A2R46 | |
| 1A2R48 | | RESISTOR: MIL type RC07GF273J | |
| 1A2R49 | | Same as 1A2R45 | |
| 1A2R50 | | Same as 1A2R33 | |
| 1A2R51 | | RESISTOR: MIL type RC07GF272J | |
| 1A2R52 | | RESISTOR: MIL type RC07GF562J | |
| 1A2R53 | | RESISTOR: MIL type RC07GF104J | |
| 1A2R54 | | Same as 1A2R45 | |
| 1A2R55, 1A2R56 | | Same as 1A2R52 | |
| 1A2R57 | | RESISTOR: MIL type RC07GF563J | |
| 1A2R58 | | Same as 1A2R51 | |
| 1A2R59 | | Same as 1A2R45 | |
| 1A2R60 | | Same as 1A2R2 | |
| 1A2R61 | | Same as 1A2R3 | |
| 1A2R62 | | Same as 1A2R33 | |
| 1A2R63 | | RESISTOR: MIL type RN65C7503F | |

ASSEMBLY 1A3 CIRCUIT CARD ASSEMBLY

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A3 | | CIRCUIT CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80195040 (96238) | 5-6 |
| 1A3CR1 | | SEMICONDUCTOR: MIL type 1N914 | |
| 1A3CR2 | | SEMICONDUCTOR: MIL type 1N277 | |
| 1A2CR3-1A3CR12 | | Same as 1A3CR2 | |
| 1A3CR13, 1A3CR14 | | Same as 1A3CR1 | |
| 1A3CR15, 1A3CR16 | | Same as 1A3CR2 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A3CR17, 1A3CR18 | | Same as 1A3CR1 | 5-6 |
| 1A3CR19-1A3CR24 | | Same as 1A3CR2 | |
| 1A3CR25, 1A3CR26 | | Same as 1A3CR1 | |
| 1A3CR27 | | Same as 1A3CR2 | |
| 1A3C1 | | CAPACITOR: MIL type CM05FD101J03 | |
| 1A3CR2-1A3CR5 | | Same as 1A3C1 | |
| 1A3C6 | | CAPACITOR: MIL type CM05ED470J03 | |
| 1A3C7 | | Same as 1A3C1 | |
| 1A3C8 | | Same as 1A3C6 | |
| 1A3C9 | | CAPACITOR: MIL type CS13BE156M | |
| 1A3C10, 1A3C11 | | Same as 1A3C9 | |
| 1A3C12 | | CAPACITOR: MIL type CS13BE225M | |
| 1A3C13 | | Same as 1A3C12 | |
| 1A3MP1 | | INSULATOR,DISK: Nylon, 0.350 in. outside diameter; 0.200 in. inside diameter, type RC-T01800-1A (24227) | |
| 1A3MP2-1A3MP16 | | Same as 1A3MP1 | |
| 1A3Q1-1A3Q14 | | TRANSISTOR: MIL type 2N706 | |
| 1A3Q15 | | TRANSISTOR: MIL type 2N2222 | |
| 1A3Q16 | | Same as 1A3Q15 | |
| 1A3R1 | | RESISTOR: MIL type RC07GF272J | |
| 1A3R2 | | RESISTOR: MIL type RC07GF273J | |
| 1A3R3 | | RESISTOR: MIL type RC07GF182J | |
| 1A3R4 | | RESISTOR: MIL type RC07GF682J | |
| 1A3R5 | | RESISTOR: MIL type RC07GF823J | |
| 1A3R6 | | RESISTOR: MIL type RC07GF822J | |
| 1A3R7 | | RESISTOR: MIL type RC07GF562J | |
| 1A3R8 | | Same as 1A3R7 | |
| 1A3R9 | | RESISTOR: MIL type RC07GF222J | |
| 1A3R10 | | Same as 1A3R9 | |
| 1A3R11 | | Same as 1A3R7 | |
| 1A3R12 | | Same as 1A3R1 | |
| 1A3R13 | | Same as 1A3R2 | |
| 1A3R14 | | Same as 1A3R7 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A3R15 | | Same as 1A3R1 | 5-6 |
| 1A3R16 | | Same as 1A3R2 | |
| 1A3R17 | | RESISTOR: MIL type RC07GF332J | |
| 1A3R18 | | Same as 1A3R17 | |
| 1A3R19 | | Same as 1A3R1 | |
| 1A3R20 | | Not used | |
| 1A3R21 | | Same as 1A3R1 | |
| 1A3R22 | | Not used | |
| 1A3R23 | | RESISTOR: MIL type RC07GF683J | |
| 1A3R24 | | Same as 1A3R17 | |
| 1A3R25 | | RESISTOR: MIL type RC07GF333J | |
| 1A3R26 | | Same as 1A3R1 | |
| 1A3R27 | | Same as 1A3R17 | |
| 1A3R28 | | Same as 1A3R4 | |
| 1A3R29 | | Same as 1A3R3 | |
| 1A3R30 | | RESISTOR: MIL type RC07GF122J | |
| 1A3R31 | | Same as 1A3R17 | |
| 1A3R32 | | Same as 1A3R23 | |
| 1A3R33 | | Same as 1A3R17 | |
| 1A3R34 | | Same as 1A3R23 | |
| 1A3R35 | | RESISTOR: MIL type RC07GF392J | |
| 1A3R36 | | Same as 1A3R7 | |
| 1A3R37 | | RESISTOR: MIL type RC07GF563J | |
| 1A3R38, 1A3R39 | | Same as 1A3R7 | |
| 1A3R40 | | Same as 1A3R37 | |
| 1A3R41 | | Same as 1A3R7 | |
| 1A3R42 | | RESISTOR: MIL type RC07GF103J | |
| 1A3R43 | | Same as 1A3R4 | |
| 1A3R44 | | Same as 1A3R35 | |
| 1A3R45 | | Same as 1A3R17 | |
| 1A3R46 | | Same as 1A3R23 | |
| 1A3R47 | | Same as 1A3R17 | |
| 1A3R48 | | Same as 1A3R23 | |
| 1A3R49 | | Same as 1A3R3 | |
| 1A3R50 | | Same as 1A3R30 | |
| 1A3R51 | | Same as 1A3R35 | |
| 1A3R52 | | Same as 1A3R1 | |
| 1A3R53 | | Same as 1A3R25 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A3R54 | | RESISTOR: MIL type RC07GF271J | 5-6 |
| 1A3R55 | | Same as 1A3R35 | |
| 1A3R56 | | Same as 1A3R1 | |
| 1A3R57 | | Same as 1A3R25 | |
| 1A3R58 | | Same as 1A3R54 | |

ASSEMBLY 1A4 CIRCUIT CARD ASSEMBLY

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A4 | | CIRCUIT CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80195010 (96238) | 5-8 |
| 1A4CR1 | | SEMICONDUCTOR: MIL type 1N277 | |
| 1A4CR2-1A4CR4 | | Same as 1A4CR1 | |
| 1A4CR5 | | SEMICONDUCTOR: MIL type 1N914 | |
| 1A4CR6, 1A4CR7 | | Same as 1A4CR5 | |
| 1A4CR8 | | SEMICONDUCTOR: MIL type 1N645 | |
| 1A4CR9, 1A4CR10 | | Same as 1A4CR1 | |
| 1A4CR11, 1A4CR12 | | Same as 1A4CR5 | |
| 1A4CR13-1A4CR28 | | Same as 1A4CR1 | |
| | | CAPACITOR: MIL type CM05FD391J03 | |
| 1A4C2 | | Same as 1A4C1 | |
| 1A4C3 | | CAPACITOR: MIL type CP05A1KC683K3 | |
| 1A4C4 | | CAPACITOR: MIL type CM06FD152J03 | |
| 1A4C5 | | Same as 1A4C4 | |
| 1A4C6 | | CAPACITOR: MIL type CM05FD101J03 | |
| 1A4C7 | | CAPACITOR: MIL type CS13BE156M | |
| 1A4C8, 1A4C9 | | Same as 1A4C7 | |
| 1A4MP1 | | INSULATOR,DISK: Nylon, 0.350 in. outside diameter; 0.200 in. inside diameter; type RC-T01800-1A (24227) | |
| 1A4MP2-1A4MP8 | | Same as 1A4MP1 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A4Q1 | | TRANSISTOR: MIL type 2N706 | 5-8 |
| 1A4Q2 | | TRANSISTOR: MIL type 2N2222 | |
| 1A4Q3-1A4Q8 | | Same as 1A4Q1 | |
| 1A4R1 | | RESISTOR: MIL type RC07GF273J | |
| 1A4R2 | | Same as 1A4R1 | |
| 1A4R3 | | RESISTOR: MIL type RC07GF153J | |
| 1A4R4 | | Same as 1A4R3 | |
| 1A4R5 | | RESISTOR: MIL type RC07GF564J | |
| 1A4R6 | | Same as 1A4R5 | |
| 1A4R7 | | RESISTOR: MIL type RC07GF472J | |
| 1A4R8 | | RESISTOR: MIL type RC07GF104J | |
| 1A4R9 | | Same as 1A4R3 | |
| 1A4R10 | | RESISTOR: MIL type RC07GF183J | |
| 1A4R11 | | RESISTOR: MIL type RC07GF473J | |
| 1A4R12 | | Same as 1A4R8 | |
| 1A4R13 | | Same as 1A4R11 | |
| 1A4R14, 1A4R15 | | Same as 1A4R8 | |
| 1A4R16 | | RESISTOR: MIL type RC07GF123J | |
| 1A4R17 | | Same as 1A4R16 | |
| 1A4R18 | | RESISTOR: MIL type RC07GF224J | |
| 1A4R19 | | Same as 1A4R7 | |
| 1A4R20 | | Same as 1A4R16 | |
| 1A4R21 | | Same as 1A4R18 | |
| 1A4R22 | | Same as 1A4R16 | |
| 1A4R23 | | RESISTOR: MIL type RC07GF332J | |
| 1A4R24 | | Same as 1A4R11 | |
| 1A4R25 | | RESISTOR: MIL type RC07GF392J | |
| 1A4R26 | | Same as 1A4R7 | |
| 1A4R27 | | RESISTOR: MIL type RC07GF563J | |
| 1A4R28 | | Same as 1A4R7 | |
| 1A4R29 | | RESISTOR: MIL type RC07GF102J | |
| 1A4R30 | | Same as 1A4R3 | |
| 1A4R31 | | RESISTOR: MIL type RC07GF822J | |
| 1A4R32 | | Same as 1A4R7 | |
| 1A4R33 | | RESISTOR: MIL type RC07GF393J | |
| 1A4R34, 1A4R35 | | Same as 1A4R10 | |
| 1A4R36 | | RESISTOR: MIL type RC07GF562J | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

ASSEMBLY 1A5 CIRCUIT CARD ASSEMBLY

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A5 | | CIRCUIT CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed item; D80195090 (96238) | 5-10 |
| 1A5CR1 | | SEMICONDUCTOR: MIL type 1N277 | |
| 1A5CR2 | | SEMICONDUCTOR: MIL type 1N914 | |
| 1A5CR3 | | Same as 1A5CR2 | |
| 1A5CR4, 1A5CR5 | | Same as 1A5CR1 | |
| 1A5CR6, 1A5CR7 | | Same as 1A5CR2 | |
| 1A5CR8, 1A5CR9 | | Same as 1A5CR1 | |
| 1A5CR10, 1A5CR11 | | Same as 1A5CR2 | |
| 1A5CR12, 1A5CR13 | | Same as 1A5CR1 | |
| 1A5CR14, 1A5CR15 | | Same as 1A5CR2 | |
| 1A5CR16-1A5CR28 | | Same as 1A5CR1 | |
| 1A5CR29 | | Same as 1A5CR2 | |
| 1A5CR30-1A5CR39 | | Same as 1A5CR1 | |
| 1A5CR40, 1A5CR41 | | Same as 1A5CR2 | |
| 1A5CR42-1A5CR48 | | Same as 1A5CR1 | |
| 1A5C1 | | CAPACITOR: MIL type CM05FD101J03 | |
| 1A5C2-1A5C8 | | Same as 1A5C1 | |
| 1A5C9 | | CAPACITOR: MIL type CM05FD221J03 | |
| 1A5C10 | | CAPACITOR: MIL type CS13BE156M | |
| 1A5C11, 1A5C12 | | Same as 1A5C10 | |
| 1A5MP1 | | INSULATOR,DISK: Nylon, 0.350 in. outside diameter; 0.200 in. inside diameter; RC-T01800-1A (24227) | |

TABLE 6-2. TEST SET, TEELGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A5MP2-1A5MP16 | | Same as 1A5MP1 | 5-10 |
| 1A5Q1 | | TRANSISTOR: MIL type 2N706 | |
| 1A5Q2-1A5Q10 | | Same as 1A5Q1 | |
| 1A5Q11 | | TRANSISTOR: MIL type 2N2222 | |
| 1A5Q12-1A5Q16 | | Same as 1A5Q1 | |
| 1A5R1 | | RESISTOR: MIL type RC07GF152J | |
| 1A5R2 | | RESISTOR: MIL type RC07GF182J | |
| 1A5R3 | | RESISTOR: MIL type RC07GF392J | |
| 1A5R4 | | RESISTOR: MIL type RC07GF473J | |
| 1A5R5 | | Same as 1A5R4 | |
| 1A5R6, 1A5R7 | | Same as 1A5R3 | |
| 1A5R8 | | RESISTOR: MIL type RC07GF683J | |
| 1A5R9 | | Same as 1A5R4 | |
| 1A5R10, 1A5R11 | | Same as 1A5R2 | |
| 1A5R12 | | Same as 1A5R3 | |
| 1A5R13, 1A5R14 | | Same as 1A5R4 | |
| 1A5R15, 1A5R16 | | Same as 1A5R3 | |
| 1A5R17 | | Same as 1A5R8 | |
| 1A5R18 | | Same as 1A5R4 | |
| 1A5R19, 1A5R20 | | Same as 1A5R2 | |
| 1A5R21 | | Same as 1A5R3 | |
| 1A5R22, 1A5R23 | | Same as 1A5R4 | |
| 1A5R24, 1A5R25 | | Same as 1A5R3 | |
| 1A5R26 | | Same as 1A5R8 | |
| 1A5R27 | | Same as 1A5R4 | |
| 1A5R28, 1A5R29 | | Same as 1A5R2 | |
| 1A5R30 | | Same as 1A5R3 | |
| 1A5R31, 1A5R32 | | Same as 1A5R4 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A5R33, 1A5R34 | | Same as 1A5R3 | 5-10 |
| 1A5R35 | | Same as 1A5R8 | |
| 1A5R36 | | Same as 1A5R4 | |
| 1A5R37 | | Same as 1A5R2 | |
| 1A5R38 | | RESISTOR: MIL type RC07GF103J | |
| 1A5R39 | | RESISTOR: MIL type RC07GF562J | |
| 1A5R40 | | RESISTOR: MIL type RC07GF563J | |
| 1A5R41 | | RESISTOR: MIL type RC07GF153J | |
| 1A5R42 | | Same as 1A5R3 | |
| 1A5R43, 1A5R44 | | Same as 1A5R38 | |
| 1A5R45 | | Same as 1A5R39 | |
| 1A5R46 | | Same as 1A5R40 | |
| 1A5R47 | | Same as 1A5R3 | |
| 1A5R48 | | RESISTOR: MIL type RC07GF472J | |
| 1A5R49 | | RESISTOR: MIL type RC07GF223J | |
| 1A5R50 | | Same as 1A5R1 | |
| 1A5R51-1A5R54 | | Same as 1A5R41 | |
| 1A5R55 | | RESISTOR: MIL type RC07GF104J | |
| 1A5R56 | | Same as 1A5R2 | |
| 1A5R57 | | Same as 1A5R3 | |
| 1A5R58 | | Same as 1A5R8 | |
| 1A5R59 | | Same as 1A5R2 | |
| 1A5R60 | | Same as 1A5R3 | |
| 1A5R61 | | Same as 1A5R8 | |
| 1A5R62 | | Same as 1A5R2 | |
| 1A5R63 | | Same as 1A5R3 | |
| 1A5R64 | | Same as 1A5R8 | |
| 1A5R65 | | Same as 1A5R2 | |
| 1A5R66 | | Same as 1A5R38 | |
| 1A5R67 | | Same as 1A5R39 | |
| 1A5R68 | | Same as 1A5R40 | |
| 1A5T69 | | Same as 1A5R3 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

ASSEMBLY 1A6 CIRCUIT CARD ASSEMBLY

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A6 | | CIRCUIT CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80195050 (96238) | 5-12 |
| 1A6CR1 | | SEMICONDUCTOR: MIL type 1N277 | |
| 1A6CR2 | | SEMICONDUCTOR: MIL type 1N914 | |
| 1A6CR3 | | Same as 1A6CR2 | |
| 1A6CR4-1A6CR6 | | Same as 1A6CR1 | |
| 1A6CR7-1A6CR9 | | Same as 1A6CR2 | |
| 1A6CR10, 1A6CR11 | | Same as 1A6CR1 | |
| 1A6CR12-1A6CR14 | | Same as 1A6CR2 | |
| 1A6CR15-1A6CR18 | | Same as 1A6CR1 | |
| 1A6CR19, 1A6CR20 | | Same as 1A6CR2 | |
| 1A6CR21, 1A6CR22 | | Same as 1A6CR1 | |
| 1A6CR23, 1A6CR24 | | Same as 1A6CR2 | |
| 1A6CR25-1A6CR27 | | Same as 1A6CR1 | |
| 1A6CR28-1A6CR30 | | Same as 1A6CR2 | |
| 1A6CR31, 1A6CR32 | | Same as 1A6CR1 | |
| 1A6CR33-1A6CR35 | | Same as 1A6CR2 | |
| 1A6CR36-1A6CR39 | | Same as 1A6CR1 | |
| 1A6CR40, 1A6CR41 | | Same as 1A6CR2 | |
| 1A6CR42 | | Same as 1A6CR1 | |
| 1A6C1 | | CAPACITOR: MIL type CM05FD101J03 | |
| 1A6C2-1A6C20 | | Same as 1A6C1 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A6C21 | | CAPACITOR: MIL type CS13BE156M | 5-12 |
| 1A6C22, 1A6C23 | | Same as 1A6C21 | |
| 1A6MP1 | | INSULATOR,DISK: Nylon, 0.350 in. outside diameter; 0.200 in. inside diameter; type RC-T01800-1A (24227) | |
| 1A6MP2-1A6MP16 | | Same as 1A6MP1 | |
| 1A6Q1-1A6Q16 | | TRANSISTOR: MIL type 2N706 | |
| 1A6R1 | | RESISTOR: MIL type RC07GF152J | |
| 1A6R2 | | RESISTOR: MIL type RC07GF182J | |
| 1A6R3 | | RESISTOR: MIL type RC07GF472J | |
| 1A6R4 | | RESISTOR: MIL type RC07GF392J | |
| 1A6R5 | | RESISTOR: MIL type RC07GF683J | |
| 1A6R6, 1A6R7 | | Same as 1A6R4 | |
| 1A6R8 | | RESISTOR: MIL type RC07GF473J | |
| 1A6R9 | | Same as 1A6R2 | |
| 1A6R10 | | Same as 1A6R3 | |
| 1A6R11 | | Same as 1A6R2 | |
| 1A6R12 | | Same as 1A6R3 | |
| 1A6R13 | | Same as 1A6R4 | |
| 1A6R14 | | Same as 1A6R5 | |
| 1A6R15, 1A6R16 | | Same as 1A6R4 | |
| 1A6R17 | | Same as 1A6R8 | |
| 1A6R18 | | Same as 1A6R3 | |
| 1A6R19 | | Same as 1A6R2 | |
| 1A6R20 | | Same as 1A6R3 | |
| 1A6R21 | | RESISTOR: MIL type RC07GF682J | |
| 1A6R22 | | Same as 1A6R4 | |
| 1A6R23 | | Same as 1A6R2 | |
| 1A6R24, 1A6R25 | | Same as 1A6R3 | |
| 1A6R26 | | Same as 1A6R4 | |
| 1A6R27 | | Same as 1A6R5 | |
| 1A6R28, 1A6R29 | | Same as 1A6R4 | |
| 1A6R30 | | Same as 1A6R8 | |
| 1A6R31 | | Same as 1A6R2 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A6R32 | | Same as 1A6R3 | 5-12 |
| 1A6R33 | | Same as 1A6R2 | |
| 1A6R34 | | Same as 1A6R3 | |
| 1A6R35 | | Same as 1A6R4 | |
| 1A6R36 | | Same as 1A6R5 | |
| 1A6R37, 1A6R38 | | Same as 1A6R4 | |
| 1A6R39 | | Same as 1A6R8 | |
| 1A6R40 | | Same as 1A6R2 | |
| 1A6R41 | | Same as 1A6R3 | |
| 1A6R42 | | Same as 1A6R2 | |
| 1A6R43 | | Same as 1A6R3 | |
| 1A6R44 | | Same as 1A6R4 | |
| 1A6R45 | | Same as 1A6R5 | |
| 1A6R46, 1A6R47 | | Same as 1A6R4 | |
| 1A6R48 | | Same as 1A6R8 | |
| 1A6R49 | | Same as 1A6R2 | |
| 1A6R50 | | Same as 1A6R3 | |
| 1A6R51 | | Same as 1A6R2 | |
| 1A6R52 | | Same as 1A6R3 | |
| 1A6R53 | | Same as 1A6R4 | |
| 1A6R54 | | Same as 1A6R5 | |
| 1A6R55, 1A6R56 | | Same as 1A6R4 | |
| 1A6R57 | | Same as 1A6R8 | |
| 1A6R58 | | Same as 1A6R3 | |
| 1A6R59 | | Same as 1A6R2 | |
| 1A6R60 | | Same as 1A6R3 | |
| 1A6R61 | | Same as 1A6R21 | |
| 1A6R62 | | Same as 1A6R4 | |
| 1A6R63 | | Same as 1A6R2 | |
| 1A6R64, 1A6R65 | | Same as 1A6R3 | |
| 1A6R66 | | Same as 1A6R4 | |
| 1A6R67 | | Same as 1A6R5 | |
| 1A6R68, 1A6R69 | | Same as 1A6R4 | |
| 1A6R70 | | Same as 1A6R8 | |
| 1A6R71 | | Same as 1A6R2 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A6R72, 1A6R73 | | Same as 1A6R3 | 5-12 |
| 1A6R74 | | Same as 1A6R2 | |
| 1A6R75 | | Same as 1A6R4 | |
| 1A6R76 | | Same as 1A6R5 | |
| 1A6R77, 1A6R78 | | Same as 1A6R4 | |
| 1A6R79 | | Same as 1A6R8 | |
| 1A6R80 | | Same as 1A6R2 | |
| 1A6R81 | | Same as 1A6R3 | |

ASSEMBLY 1A7 CIRCUIT CARD ASSEMBLY

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A7 | | CIRCUIT CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80195080 (96238) | 5-14 |
| 1A7CR1 | | SEMICONDUCTOR: MIL type 1N914 | |
| 1A7CR2 | | Same as 1A7CR1 | |
| 1A7CR3 | | SEMICONDUCTOR: MIL type 1N277 | |
| 1A7CR4 | | Same as 1A7CR1 | |
| 1A7CR5, 1A7CR6 | | Same as 1A7CR3 | |
| 1A7CR7, 1A7CR8 | | Same as 1A7CR1 | |
| 1A7CR9-1A7CR47 | | Same as 1A7CR3 | |
| 1A7CR48, 1A7CR49 | | Same as 1A7CR1 | |
| 1A7CR50-1A7CR74 | | Same as 1A7CR3 | |
| 1A7C1 | | CAPACITOR: MIL type CM05FD101J03 | |
| 1A7C2-1A7C7 | | Same as 1A7C1 | |
| 1A7C8 | | CAPACITOR: MIL type CS13BE156M | |
| 1A7C9, 1A7C10 | | Same as 1A7C8 | |
| 1A7MP1 | | INSULATOR,DISK: Nylon, 0.350 in. outside diameter; 0.200 in. inside diameter; type RC-T01800-1A (24227) | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A7MP2-1A7MP13 | | Same as 1A7MP1 | 5-14 |
| 1A7Q1 | | TRANSISTOR: MIL type 2N706 | |
| 1A7Q2-1A7Q5 | | Same as 1A7Q1 | |
| 1A7Q6 | | TRANSISTOR: MIL type 2N2222 | |
| 1A7Q7 | | Same as 1A7Q1 | |
| 1A7Q8 | | Same as 1A7Q6 | |
| 1A7Q9-1A7Q13 | | Same as 1A7Q1 | |
| 1A7R1 | | RESISTOR: MIL type RC07GF273J | |
| 1A7R2 | | Same as 1A7R1 | |
| 1A7R3 | | RESISTOR: MIL type RC07GF562J | |
| 1A7R4 | | RESISTOR: MIL type RC07GF332J | |
| 1A7R5 | | RESISTOR: MIL type RC07GF683J | |
| 1A7R6 | | Same as 1A7R5 | |
| 1A7R7, 1A7R8 | | Same as 1A7R4 | |
| 1A7R9-1A7R11 | | Same as 1A7R3 | |
| 1A7R12 | | Same as 1A7R4 | |
| 1A7R13 | | Same as 1A7R5 | |
| 1A7R14 | | Same as 1A7R3 | |
| 1A7R15 | | Same as 1A7R5 | |
| 1A7R16 | | Same as 1A7R4 | |
| 1A7R17 | | Same as 1A7R3 | |
| 1A7R18 | | RESISTOR: MIL type RC07GF103J | |
| 1A7R19 | | Same as 1A7R18 | |
| 1A7R20, 1A7R21 | | Same as 1A7R3 | |
| 1A7R22 | | RESISTOR: MIL type RC07GF473J | |
| 1A7R23 | | Same as 1A7R22 | |
| 1A7R24 | | RESISTOR: MIL type RC07GF272J | |
| 1A7R25 | | Same as 1A7R24 | |
| 1A7R26 | | RESISTOR: MIL type RC07GF182J | |
| 1A7R27 | | Same as 1A7R26 | |
| 1A7R28, 1A7R29 | | Same as 1A7R18 | |
| 1A7R30, 1A7R31 | | Same as 1A7R24 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A7R32 | | RESISTOR: MIL type RC07GF223J | 5-14 |
| 1A7R33-<br>1A7R39 | | Same as 1A7R32 | |
| 1A7R40 | | Same as 1A7R18 | |
| 1A7R41 | | RESISTOR: MIL type RC07GF823J | |
| 1A7R42 | | RESISTOR: MIL type RC07GF333J | |
| 1A7R43 | | RESISTOR: MIL type RC07GF392J | |
| 1A7R44 | | Same as 1A7R43 | |
| 1A7R45 | | Same as 1A7R4 | |
| 1A7R46,<br>1A7R47 | | Same as 1A7R5 | |
| 1A7R48 | | Same as 1A7R4 | |
| 1A7R49 | | Same as 1A7R43 | |
| 1A7R50-<br>1A7R57 | | Same as 1A7R32 | |
| 1A7R58 | | Same as 1A7R18 | |
| 1A7R59 | | Same as 1A7R41 | |
| 1A7R60 | | Same as 1A7R42 | |
| 1A7R61 | | Same as 1A7R43 | |
| 1A7R62 | | Same as 1A7R3 | |
| 1A7R63 | | Same as 1A7R43 | |
| 1A7R64 | | Same as 1A7R5 | |
| 1A7R65 | | Same as 1A7R26 | |

ASSEMBLY 1A8 CIRCUIT CARD ASSEMBLY

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A8 | | CIRCUIT CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; 80195060-001 (96238) | 5-17 |
| 1A8CR1 | | SEMICONDUCTOR: MIL type 1N277 | |
| 1A8CR2 | | SEMICONDUCTOR: MIL type 1N914 | |
| 1A8CR3-<br>1A8CR5 | | Same as 1A8CR2 | |
| 1A8CR6,<br>1A8CR7 | | Same as 1A8CR1 | |
| 1A8CR8-<br>1A8CR11 | | Same as 1A8CR2 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A8CR12, 1A8CR13 | | Same as 1A8CR1 | 5-17 |
| 1A8CR14- 1A8CR17 | | Same as 1A8CR2 | |
| 1A8CR18, 1A8CR19 | | Same as 1A8CR1 | |
| 1A8CR20- 1A8CR23 | | Same as 1A8CR2 | |
| 1A8CR24 | | Same as 1A8CR1 | |
| 1A8C1 | | CAPACITOR: MIL type CM05FD101J03 | |
| 1A8C2- 1A8C4 | | Same as 1A8C1 | |
| 1A8C5 | | Not used | |
| 1A8C6- 1A8C9 | | Same as 1A8C1 | |
| 1A8C10 | | Not used | |
| 1A8C11- 1A8C14 | | Same as 1A8C1 | |
| 1A8C15 | | Not used | |
| 1A8C16- 1A8C19 | | Same as 1A8C1 | |
| 1A8C20 | | Not used | |
| 1A8C21 | | CAPACITOR: MIL type CS13BE225M | |
| 1A8C22 | | CAPACITOR: MIL type CS13BE156M | |
| 1A8C23, 1A8C24 | | Same as 1A8C22 | |
| 1A8MP1 | | INSULATOR, DISK: Nylon, 0.350 in. outside diameter; 0.200 in. inside diameter; type RC-T01800-1A (24227) | |
| 1A8MP2- 1A8MP13 | | Same as 1A8MP1 | |
| 1A8Q1 | | TRANSISTOR: MIL type 2N706 | |
| 1A8Q2- 1A8Q12 | | Same as 1A8Q1 | |
| 1A8Q13 | | TRANSISTOR: MIL type 2N2222 | |
| 1A8R1 | | RESISTOR: MIL type RC07GF222J | |
| 1A8R2 | | RESISTOR: MIL type RC07GF272J | |
| 1A8R3 | | RESISTOR: MIL type RC07GF103J | |
| 1A8R4 | | Same as 1A8R3 | |
| 1A8R5 | | RESISTOR: MIL type RC07GF562J | |
| 1A8R6 | | RESISTOR: MIL type RC07GF104J | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A8R7 | | Same as 1A8R5 | 5-17 |
| 1A8R8 | | Same as 1A8R3 | |
| 1A8R9 | | Same as 1A8R5 | |
| 1A8R10 | | RESISTOR: MIL type RC07GF563J | |
| 1A8R11 | | Same as 1A8R2 | |
| 1A8R12 | | Same as 1A8R3 | |
| 1A8R13 | | RESISTOR: MIL type RC07GF392J | |
| 1A8R14 | | RESISTOR: MIL type RC07GF683J | |
| 1A8R15 | | RESISTOR: MIL type RC07GF153J | |
| 1A8R16 | | RESISTOR: MIL type RN65C7503F | |
| 1A8R17 | | Same as 1A8R2 | |
| 1A8R18, 1A8R19 | | Same as 1A8R3 | |
| 1A8R20 | | Same as 1A8R5 | |
| 1A8R21 | | Same as 1A8R6 | |
| 1A8R22 | | Same as 1A8R5 | |
| 1A8R23 | | Same as 1A8R3 | |
| 1A8R24 | | Same as 1A8R5 | |
| 1A8R25 | | Same as 1A8R10 | |
| 1A8R26 | | Same as 1A8R2 | |
| 1A8R27 | | Same as 1A8R3 | |
| 1A8R28 | | Same as 1A8R13 | |
| 1A8R29 | | Same as 1A8R14 | |
| 1A8R30 | | Same as 1A8R15 | |
| 1A8R31 | | RESISTOR: MIL type RN60C3743F | |
| 1A8R32 | | Same as 1A8R2 | |
| 1A8R33, 1A8R34 | | Same as 1A8R3 | |
| 1A8R35 | | Same as 1A8R5 | |
| 1A8R36 | | Same as 1A8R6 | |
| 1A8R37 | | Same as 1A8R5 | |
| 1A8R38 | | Same as 1A8R3 | |
| 1A8R39 | | Same as 1A8R5 | |
| 1A8R40 | | Same as 1A8R10 | |
| 1A8R41 | | Same as 1A8R2 | |
| 1A8R42 | | Same as 1A8R3 | |
| 1A8R43 | | Same as 1A8R13 | |
| 1A8R44 | | Same as 1A8R14 | |
| 1A8R45 | | Same as 1A8R15 | |
| 1A8R46 | | RESISTOR: MIL type RN60C1873F | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A8R47 | | Same as 1A8R2 | 5-17 |
| 1A8R48, 1A8R49 | | Same as 1A8R3 | |
| 1A8R50 | | Same as 1A8R5 | |
| 1A8R51 | | Same as 1A8R6 | |
| 1A8R52 | | Same as 1A8R5 | |
| 1A8R53 | | Same as 1A8R3 | |
| 1A8R54 | | Same as 1A8R5 | |
| 1A8R55 | | Same as 1A8R10 | |
| 1A8R56 | | Same as 1A8R2 | |
| 1A8R57 | | Same as 1A8R3 | |
| 1A8R58 | | Not used | |
| 1A8R59 | | Same as 1A8R13 | |
| 1A8R60 | | Same as 1A8R14 | |
| 1A8R61 | | Same as 1A8R15 | |
| 1A8R62 | | Same as 1A8R31 | |
| 1A8R63 | | Same as 1A8R13 | |
| 1A8R64 | | Same as 1A8R2 | |
| 1A8R65 | | RESISTOR: MIL type RC07GF333J | |
| 1A8R66 | | RESISTOR: MIL type RC07GF271J | |

ASSEMBLY 1A9 CIRCUIT CARD ASSEMBLY

| REF. DEISG. | NOTES | NAMES AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A9 | | CIRCUIT CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80195060-002 (96238) | 5-17 |
| 1A9CR1 | | SEMICONDUCTOR: MIL type 1N277 | |
| 1A9CR2 | | SEMICONDUCTOR: MIL type 1N914 | |
| 1A9CR3-1A9CR5 | | Same as 1A9CR2 | |
| 1A9CR6, 1A9CR7 | | Same as 1A9CR1 | |
| 1A9CR8-1A9CR11 | | Same as 1A9CR2 | |
| 1A9CR12, 1A9CR13 | | Same as 1A9CR1 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A9CR14-<br>1A9CR17 | | Same as 1A9CR2 | 5-17 |
| 1A9CR18,<br>1A9CR19 | | Same as 1A9CR1 | |
| 1A9CR20-<br>1A9CR23 | | Same as 1A9CR2 | |
| 1A9CR24 | | Same as 1A9CR1 | |
| 1A9C1 | | CAPACITOR: MIL type CM05FD101J03 | |
| 1A9C2-<br>1A9C4 | | Same as 1A9C1 | |
| 1A9C5 | | Not used | |
| 1A9C6-<br>1A9C9 | | Same as 1A9C1 | |
| 1A9C10 | | Not used | |
| 1A9C11-<br>1A9C14 | | Same as 1A9C1 | |
| 1A9C15 | | Not used | |
| 1A9C16-<br>1A9C19 | | Same as 1A9C1 | |
| 1A9C20 | | Not used | |
| 1A9C21 | | CAPACITOR: MIL type CS13BE225M | |
| 1A9C22 | | CAPACITOR: MIL type CS13BE156M | |
| 1A9C23,<br>1A9C24 | | Same as 1A9C22 | |
| 1A9MP1 | | INSULATOR,DISK: Nylon, 0.350 in. outside diameter; 0200 in. inside diameter; type RC-T01800-1A (24227) | |
| 1A9MP2-<br>1A9MP12 | | Same as 1A9MP1 | |
| 1A9Q1 | | TRANSISTOR: MIL type 2N706 | |
| 1A9Q2-<br>1A9Q11 | | Same as 1A9Q1 | |
| 1A9Q12 | | Not used | |
| 1A9Q13 | | TRANSISTOR: MIL type 2N2222 | |
| 1A9R1 | | RESISTOR: MIL type RC07GF222J | |
| 1A9R2 | | RESISTOR: MIL type RC07GF272J | |
| 1A9R3 | | RESISTOR: MIL type RC07GF103J | |
| 1A9R4 | | Same as 1A9R3 | |
| 1A9R5 | | RESISTOR: MIL type RC07GF562J | |
| 1A9R6 | | RESISTOR: MIL type RC07GF104J | |
| 1A9R7 | | Same as 1A9R5 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A9R8 | | Same as 1A9R3 | 5-17 |
| 1A9R9 | | Same as 1A9R5 | |
| 1A9R10 | | RESISTOR: MIL type RC07GF563J | |
| 1A9R11 | | Same as 1A9R2 | |
| 1A9R12 | | Same as 1A9R3 | |
| 1A9R13 | | RESISTOR: MIL type RC07GF392J | |
| 1A9R14 | | RESISTOR: MIL type RC07GF683J | |
| 1A9R15 | | RESISTOR: MIL type RC07GF153J | |
| 1A9R16 | | RESISTOR: MIL type RN60C7502F | |
| 1A9R17 | | Same as 1A9R2 | |
| 1A9R18, 1A9R19 | | Same as 1A9R3 | |
| 1A9R20 | | Same as 1A9R5 | |
| 1A9R21 | | Same as 1A9R6 | |
| 1A9R22 | | Same as 1A9R5 | |
| 1A9R23 | | Same as 1A9R3 | |
| 1A9R24 | | Same as 1A9R5 | |
| 1A9R25 | | Same as 1A9R10 | |
| 1A9R26 | | Same as 1A9R2 | |
| 1A9R27 | | Same as 1A9R3 | |
| 1A9R28 | | Same as 1A9R13 | |
| 1A9R29 | | Same as 1A9R14 | |
| 1A9R30 | | RESISTOR: MIL type RC07GF223J | |
| 1A9R31 | | RESISTOR: MIL type RN60C3742D | |
| 1A9R32 | | Same as 1A9R2 | |
| 1A9R33, 1A9R34 | | Same as 1A9R3 | |
| 1A9R35 | | Same as 1A9R5 | |
| 1A9R36 | | Same as 1A9R6 | |
| 1A9R37 | | Same as 1A9R5 | |
| 1A9R38 | | Same as 1A9R3 | |
| 1A9R39 | | Same as 1A9R5 | |
| 1A9R40 | | Same as 1A9R10 | |
| 1A9R41 | | Same as 1A9R2 | |
| 1A9R42 | | Same as 1A9R3 | |
| 1A9R43 | | Same as 1A9R13 | |
| 1A9R44 | | Same as 1A9R14 | |
| 1A9R45 | | RESISTOR: MIL type RC07GF473J | |
| 1A9R46 | | RESISTOR: MIL type RN60C1872D | |
| 1A9R47 | | Same as 1A9R2 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A9R48, 1A9R49 | | Same as 1A9R3 | 5-17 |
| 1A9R50 | | Same as 1A9R5 | |
| 1A9R51 | | Same as 1A9R6 | |
| 1A9R52 | | Not used | |
| 1A9R53 | | Same as 1A9R3 | |
| 1A9R54 | | Same as 1A9R5 | |
| 1A9R55 | | Same as 1A9R10 | |
| 1A9R56 | | Same as 1A9R2 | |
| 1A9R57 | | Same as 1A9R3 | |
| 1A9R58 | | RESISTOR: MIL type RC07GF333J | |
| 1A9R59-1A9R62 | | Not used | |
| 1A9R63 | | Same as 1A9R13 | |
| 1A9R64 | | Same as 1A9R2 | |
| 1A9R65 | | Same as 1A9R58 | |
| 1A9R66 | | RESISTOR: MIL type RC07GF271J | |

ASSEMBLY 1A10 CIRCUIT CARD ASSEMBLY

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A10 | | CIRCUIT CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80281290 (96238) | 5-19 |
| 1A10CR1 | | SEMICONDUCTOR: MIL type 1N277 | |
| 1A10CR2 | | SEMICONDUCTOR: MIL type 1N753A | |
| 1A10CR3 | | Same as 1A10CR2 | |
| 1A10CR4 | | Same as 1A10CR1 | |
| 1A10CR5 | | SEMICONDUCTOR: MIL type 1N825 | |
| 1A10CR6 | | Same as 1A10CR2 | |
| 1A10CR7 | | SEMICONDUCTOR: MIL type 1N645 | |
| 1A10CR8 | | Same as 1A10CR1 | |
| 1A10CR9 | | SEMICONDUCTOR: MIL type 1N914 | |
| 1A10CR10 | | Same as 1A10CR9 | |
| 1A10C1 | | CAPACITOR: MIL type CP05A1KB104K3 | |
| 1A10C2 | | CAPACITOR: MIL type CS13BD226M | |
| 1A10C3 | | CAPACITOR,FIXED,CERAMIC: 0.1uf +80%, -20%, 25vdcw; type 5815Y5U104Z (72982) | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A10C4 | | CAPACITOR: MIL type CS13BE156M | 5-19 |
| 1A10C5 | | Same as 1A10C2 | |
| 1A10C6 | | CAPACITOR: MIL type CS13BC336M | |
| 1A10C7 | | Same as 1A10C6 | |
| 1A10C8 | | Same as 1A10C2 | |
| 1A10C9 | | CAPACITOR: MIL type CS13BF476M | |
| 1A10MP1 | | INSULATOR,DISK: Nylon, 0.350 in. outside diameter; 0.200 in. inside diameter; type RC-T01800-1A (24227) | |
| 1A10MP2-1A10MP16 | | Same as 1A10MP1 | |
| 1A10MP17 | | HEAT SINK: 0.255 in. inside diameter; 1.280 in. outside diameter; 0.437 in. high, flex fin desig, beryllium copper; type NF209 (05820) | |
| 1A10MP18-1A10MP20 | | Same as 1A10MP17 | |
| 1A10Q1 | | TRANSISTOR: MIL type 2N2907 | |
| 1A10Q2 | | TRANSISTOR: MIL type 2N2905 | |
| 1A10Q3 | | Same as 1A10Q1 | |
| 1A10Q4 | | TRANSISTOR: MIL type 2N930 | |
| 1A10Q5 | | Same as 1A10Q4 | |
| 1A10Q6 | | TRANSISTOR: MIL type 2N404 | |
| 1A10Q7, 1A10Q8 | | Same as 1A10Q1 | |
| 1A10Q9 | | TRANSISTOR: MIL type 2N1613 | |
| 1A10Q10 | | Same as 1A10Q9 | |
| 1A10Q11 | | TRANSISTOR: MIL type 2N2222 | |
| 1A10Q12, 1A10Q13 | | Same as 1A10Q9 | |
| 1A10Q14 | | Same as 1A10Q11 | |
| 1A10Q15, 1A10Q16 | | Same as 1A10Q1 | |
| 1A10R1 | | RESISTOR: MIL type RC07GF181J | |
| 1A10R2 | | RESISTOR: MIL type RC07GF333J | |
| 1A10R3 | | RESISTOR: MIL type RC07GF621J | |
| 1A10R4 | | RESISTOR: MIL type RC07GF242J | |
| 1A10R5 | | RESISTOR: MIL type RC07GF182J | |
| 1A10R6 | | RESISTOR: MIL type RC07GF472J | |
| 1A10R7 | | RESISTOR: MIL type RN65C4020F | |
| 1A10R8 | | RESISTOR: MIL type RT11C2P500 | |
| 1A10R9 | | RESISTOR: MIL type RN65C2740F | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A10R10 | | RESISTOR: MIL type RC07GF273J | 5-19 |
| 1A10R11 | | RESISTOR: MIL type RC07GF153J | |
| 1A10R12 | | RESISTOR: MIL type RC07GF102J | |
| 1A10R13 | | RESISTOR: MIL type RN60D6810F | |
| 1A10R14 | | RESISTOR: MIL type RC07GF103J | |
| 1A10R15 | | RESISTOR: MIL type RN55D4320F | |
| 1A10R16 | | RESISTOR: MIL type RN55D3920F | |
| 1A10R17 | | Same as 1A10R1 | |
| 1A10R18 | | RESISTOR: MIL type RT11C2P501 | |
| 1A10R19 | | RESISTOR: MIL type RN55D1501F | |
| 1A10R20 | | RESISTOR: MIL type RC07GF222J | |
| 1A10R21 | | RESISTOR: MIL type RC07GF272J | |
| 1A10R22 | | RESISTOR: MIL type RC07GF102J | |
| 1A10R23 | | RESISTOR: MIL type RC07GF101J | |
| 1A10R24 | | Same as 1A10R12 | |
| 1A10R25 | | Same as 1A10R21 | |
| 1A10R26 | | RESISTOR: MIL type RC07GF471J | |
| 1A10R27 | | RESISTOR: MIL type RC42GF330J | |
| 1A10R28 | | RESISTOR: MIL type RC20GF3R9J | |
| 1A10R29 | | Same as 1A10R28 | |
| 1A10R30 | | Same as 1A10R26 | |
| 1A10R31 | | RESISTOR: MIL type RC07GF152J | |
| 1A10R32, 1A10R33 | | Same as 1A10R23 | |
| 1A10R34 | | RESISTOR: MIL type RC07GF393J | |
| 1A10R35 | | Same as 1A10R12 | |
| 1A10R36 | | RESISTOR: MIL type RC07GF562J | |
| 1A10R37 | | RESISTOR: MIL type RC20GF152J | |
| 1A10R38 | | RESISTOR: MIL type RT11C2P201 | |
| 1A10R39 | | RESISTOR: MIL type RC07GF681J | |
| 1A10R40 | | RESISTOR: MIL type RC07GF821J | |

ASSEMBLY 1A11 EXTENDER CARD ASSEMBLY

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A11 | | EXTENDER CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed item; D80195120 (96238) | 5-1 |
| 1A11J1 | | CONNECTOR: MIL type M21097-1-163 | |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

ASSEMBLY 1A12 HARNESS CARD ASSEMBLY

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A12 | | HARNESS CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; D80195160 (96238) | 5-1 |
| 1A12J1 | | CONNECTOR,RECEPTACLE,ELECTRICAL: 22 positions, double readout, supplied with two keys unassembled, 830vac rms, 1270vdc voltage ratings, 5 amperes current rating low-loss plastic body type 252-22-37-220 (71785) | |
| 1A12J2-1A12J10 | | Same as 1A12J1 | |

ASSEMBLY 1A13 CIRCUIT CARD ASSEMBLY

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A13 | | CIRCUIT CARD ASSEMBLY: Consists of a printed-circuit board which mounts and supplies the circuitry for the below listed items; C80195190 (96238) | 5-22 |
| 1A13CR1 | | SEMICONDUCTOR: MIL type 1N645 | |
| 1A13CR2 | | Same as 1A13CR1 | |
| 1A13R1 | | RESISTOR: MIL type RC32GF513J | |
| 1A13R2 | | RESISTOR: MIL type RN65D66R5F | |
| 1A13R3 | | RESISTOR: MIL type RN65D2000F | |
| 1A13R4 | | Not used | |
| 1A13R5 | | RESISTOR: MIL type RW69VR22 | |

ASSEMBLY 1A14 CONVERTER TELEGRAPH SIGNAL

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A14 | | Plug-in, bolt-down electronic relay; A48092015 (96238) | 5-1 |

TABLE 6-2. TEST SET, TELEGRAPH TS-2616/UGM MAINTENANCE PARTS LIST (Cont'd)

ASSEMBLY 1A15 CRYSTAL HOLDER

| REF. DESIG. | NOTES | NAME AND DESCRIPTION | FIG. NO. |
|---|---|---|---|
| 1A15 | | COMPONENT BOARD ASSEMBLY (FIXED): Consists of a shock-mounted board and mounts the below listed items; C90195003 (96238) | 5-24 |
| 1A15R1 | | RESISTOR: MIL type RC07GF121J | |
| 1A15R2 | | RESISTOR: MIL type RC07GF680J | |
| 1A15R3 | | Same as 1A15R1 | |
| 1A15R4 | | RESISTOR: MIL type RC07GF560J | |
| 1A15XY1 | | SOCKET,CRYSTAL: cadmium plated holding clip, phosphor bronze contacts, gold over silver plating, teflon insulation; type 8000AG4 (91506) | |
| 1A15XY2-1A15XY6 | | Same as 1A15XY1 | |
| 1A15Y1 | | CRYSTAL UNIT,QUARTZ: 1164.800kHz, resonant frequency; type 40040066-007 (96238) | |
| 1A15Y2 | | CRYSTAL UNIT,QUARTZ: 949.760kHz resonant frequency; type 40040066-002 (96238) | |
| 1A15Y3 | | CRYSTAL UNIT,QUARTZ: 960.000kHz resonant frequency; type 40040066-003 (96238) | |
| 1A15Y4 | | CRYSTAL UNIT,QUARTZ: 1056.000kHz resonant frequency; type 40040066-004 (96238) | |
| 1A15Y5 | | CRYSTAL UNIT,QUARTZ: 1090.560kHz, resonant frequency; type 40040066-005 (96238) | |
| 1A15Y6 | | CRYSTAL UNIT,QUARTZ: 1173.120kHz,resonant frequency; type 40040066-006 (96238) | |

TABLE 6-3. LIST OF MANUFACTURERS

| MFR CODE | NAME | ADDRESS |
|---|---|---|
| 05820 | Wakefield Engineering, Inc. | Wakefield, Massachusetts |
| 24227 | Tekna Products Co. | Rochester, New York |
| 71785 | Cinch Mfg. Co. and Howard B. Jones Div. | Chicago, Illinois |
| 72259 | Essex Electronics, Inc. | Berkeley Heights, New Jersey |
| 72982 | Erie Technological Products, Inc. | Erie, Pennsylvania |
| 81349 | Military Specifications | |
| 96238 | STELMA, Incorporated | Stamford, Connecticut |
| 96906 | Military Standard | |



A.F

USER ACTIVITY TECHNICAL MANUAL COMMENT SHEET
NAVSHIPS 5600/2(REV. 9/67)
(Formerly NAVSHIPS 4914)
(COG I - 11-DIGIT STOCK NUMBER: 0105-503-9850)

NAVSHIPS NO. 0969-125-7010
VOLUME NO. ________________

(Fold on dotted line on reverse side, staple, and mail to NAVELEX)

PROBLEM AREA:

Both sides of this form to be reproduced locally as required.

Fold

DEPARTMENT OF THE NAVY
NAVAL ELECTRONIC SYSTEMS COMMAND
WASHINGTON, D.C. 20360

POSTAGE AND FEES PAID
NAVY DEPARTMENT

OFFICIAL BUSINESS

COMMANDER, NAVAL ELECTRONIC SYSTEMS COMMAND
TECHNICAL PUBLICATIONS BRANCH
DEPARTMENT OF THE NAVY
WASHINGTON, D.C. 20360

Fold