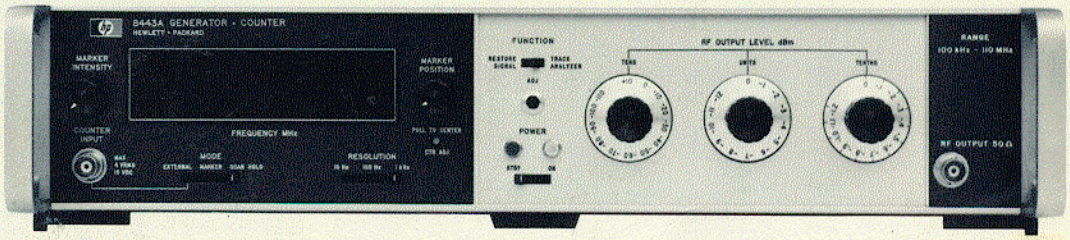
OPERATION AND SERVICE MANUAL

8443A TRACKING GENERATOR-COUNTER



HEWLETT PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

HEWLETT PACKARD

OPERATION AND SERVICE MANUAL

8443A
TRACKING GENERATOR—COUNTER

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2204A.

With modifications described in Section VII this manual also applies to earlier serial number prefixes.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

1400 FOUNTAIN GROVE PARKWAY, SANTA ROSA, CALIFORNIA, 95404, USA

MANUAL PART NO. 08443-90059
Microfiche Part No. 08443-90060

Printed: MARCH 1982

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SAFETY CONSIDERATIONS

Safety Symbols

The following safety symbols are used throughout this manual and in the instrument. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

Instruction manual symbol: the apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

Indicates dangerous voltages.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operation procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

Operation

WARNING

BEFORE THIS INSTRUMENT IS SWITCHED ON, its rear panel power module protective earth terminal must be connected through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact. Failure to ground the instrument can result in personal injury.

WARNING

The 8443A Tracking Generator should not be operated without protective covers. Adjustments, performance tests, and service procedures which require operation of the 8443A with the covers removed should be performed only by trained service personnel.

CAUTION

BEFORE THIS INSTRUMENT IS SWITCHED ON, make sure that its rear panel power module switch is set to the voltage of the ac power source. Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

Service and Adjustments

WARNING

There are voltages at many points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Service and adjustments should be performed only by trained service personnel.

WARNING

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal may cause personal injury.

8443A TRACKING GENERATOR-COUNTER

JOINING KIT

POWER CABLE

Figure 1-1. Model 8443A Tracking Generator-Counter and Accessories

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains all information required to install, operate, test, adjust and service the Hewlett-Packard Model 8443A Tracking Generator-Counter. This section covers instrument identification, description, accessories, specifications and other basic information.

1-3. The Model 8443A Tracking Generator-Counter and the accessories supplied with it are shown in Figure 1-1.

1-4. The eight sections in this manual provide information as follows:

SECTION I, GENERAL INFORMATION; contains the instrument description and specifications, explains accessories and options, and lists recommended test equipment.

SECTION II, INSTALLATION, contains information concerning initial mechanical inspection, preparation for use, operating environment, and packaging and shipping.

SECTION III, OPERATION, contains detailed instructions for operating the instrument.

SECTION IV, PERFORMANCE TESTS, contains tests necessary to verify that the electrical operation of the instrument is in accordance with published specifications.

SECTION V, ADJUSTMENTS, contains the adjustment procedures required to properly adjust the instrument after repair.

SECTION VI, REPLACEABLE PARTS, contains the information necessary to order parts or assemblies for the instrument.

SECTION VII, MANUAL BACKDATING CHANGES, contains backdating information to make this manual compatible with earlier equipment configurations.

SECTION VIII, SERVICE, contains schematic diagrams, block diagrams, component location illustrations, circuit descriptions, and troubleshooting information to aid in repair of the instrument.

1-5. Supplied with this manual is an Operating Information Supplement. The Supplement is a copy of the first three sections of the manual, and should be kept with the instrument for use by the operator.

1-6. Also listed on the title page of this manual is a microfiche part number. This number can be used to order 4 x 6-inch microfilm transparencies containing up to 60 photoduplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement and all pertinent Service Notes.

1-7. SAFETY CONSIDERATIONS

1-8. Before operating this instrument, you should familiarize yourself with the safety markings on the instrument and safety instructions in this manual. This instrument has been manufactured and tested according to international safety standards. However, to ensure safe operation of the instrument and personal safety of the user and service personnel, the cautions and warnings in this manual must be followed. Refer to the summary of safety considerations in the front of this manual. Refer also to individual sections of this manual for detailed safety notations concerning the use of the instrument as described in those individual sections.

1-9. INSTRUMENTS COVERED BY MANUAL

1-10. Attached to the instrument is a serial number plate (Figure 1-2). The serial number is in two parts. The first four digits and the letter are the serial number prefix; the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments

with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-11. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains 'change information' which tells you how to adapt the manual to the newer instrument.

1-12. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with this manual's print date and part number, both of which appear on the manual title page. Complementary copies of the supplement are available from Hewlett-Packard.

1-13. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

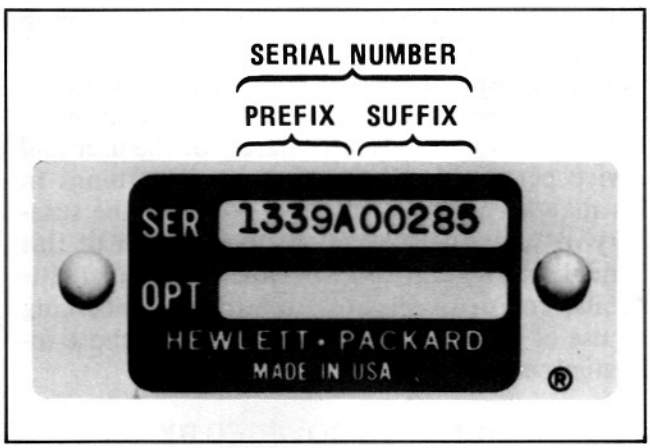


Figure 1-2. Typical Serial Number Plate

1-14. DESCRIPTION

1-15. The HP Model 8443A Tracking Generator-Counter is designed for use with the Hewlett-Packard 8553/8552 Spectrum Analyzer. It provides a CW signal to the spectrum analyzer from its front-panel RF OUTPUT connector in either of two selectable functional modes. In the TRACK ANALYZER mode, the RF output from the HP 8443A tracks the tuning frequency of the spectrum analyzer. In the RESTORE SIGNAL mode, the HP 8443A provides an enhanced replica of the signal indicated by the marker on the spectrum analyzer CRT. In both of these functional modes, the counter readout displays the marker frequency as long as the counter mode switch is set to MARKER or SCAN HOLD. Signal amplitude in both functional modes is adjustable with the front-panel RF OUTPUT dBm control.

1-16. In addition to indicating the HP 8443A RF output frequency (as established by the spectrum analyzer marker position), the HP 8443A counter can measure and display the frequency of an externally generated signal. A front-panel COUNTER INPUT connector is provided for this purpose.

1-17. The time base for the counter is a stable, oven – contained 1 MHz crystal oscillator. There are, however, provisions for using an external 1 MHz source for the time base instead of the internal oscillator. The 1 MHz output from the oscillator is also available at a rear-panel connector for use in other equipment.

1-18. The counter has three modes of operation: External, Marker, and Scan Hold. The External mode is used to measure frequencies between 10 kHz and 120 MHz of external signals unrelated to the 8443A or the spectrum analyzer. The counter receives these signals through the front-panel COUNTER INPUT connector.

1-19. In the Marker mode, the scan ramp is stopped momentarily at a point selected with the HP 8443A MARKER POSITION control. The marker itself appears as a bright spot on the spectrum analyzer CRT at the frequeny point where the scan ramp is stopped. During the brief scan stop period, the RF output from the Tracking Generator is counted in the 8443A Counter. If the HP 8443A FUNCTION switch is set to TRACK ANALYZER, the Counter display indicates the marker frequency independently of the spectrum analyzer input signal frequency. If the FUNCTION switch is set to RESTORE SIGNAL, the Counter display indicates the frequency of the restored signal being fed to the spectrum analyzer input *if:* (1) the marker is positioned somewhere within the spectrum analyzer scan, and (2) the signal of interest, as indicated by the marker, is at least 15 dB above the signal noise. (If the signal of interest is less than 15 dB above the noise, it cannot be restored by the 8443A.)

1-20. Operation in the Scan Hold mode is similar to operation in the Marker mode, except that once the scan stops, it will not restart until the operator changes the operating mode. Also, the Counter continually measures the frequency at the marker position, and the marker position can be moved with the MARKER POSITION control to measure the frequency at other points on the CRT display.

1-21. Counter display resolutions of 10 Hz, 100 Hz, and 1 kHz are selectable with the front-panel, three-position RESOLUTION switch. The three front-panel RF OUTPUT LEVEL dBm controls enable the RF output to be adjusted to any level between +10 dBm and −123.2 dBm.

1-22. SPECIFICATIONS

1-23. Specifications for the HP 8443A Tracking Generator-Counter are listed in Table 1-1. These specifications are the performance standards against which the instrument is tested. The instrument's supplemental characteristics are listed in Table 1-2. These are included as additional information only; they are not specifications.

1-24. COMPATIBILITY

1-25. Currently-manufactured HP 8443A Tracking Generator-Counters are directly compatible with currently-manufactured HP 8553/8552/140 or HP 141 Spectrum Analyzers. Older equipment may require a modification to achieve compatibility between the HP 8443A and the spectrum analyzer. Compatibility requirements for various configurations and generations of HP 8443A Tracking Generator-Counters and HP 8553/8552/140 or HP 141 Spectrum Analyzers are shown in Table 1-3.

NOTE

The TG labels for modified instruments are normally affixed to the instrument rear panel next to the serial number.

1-26. ACCESSORIES SUPPLIED

1-27. The following accessories are provided with the HP Model 8443A Tracking Generator-Counter:

An interconnecting cable (HP Part Number 08443-60009) for use between the spectrum analyzer and the HP 8443A

A power cable

A joining bracket kit (HP Part Number 5060-8543)

1-28. ACCESSORIES AVAILABLE

1−29. A Service Kit, HP Part Number 08443-60011 (see Figure 1-3), is recommended for use in servicing the HP 8443A. Interface Cable, HP Part Number 562A−16C, is available for connecting the HP 8443A rear-panel BCD output to a printer. A Rack Mounting Kit (HP 5060−8739) is also available for installing the HP 8443A in a 19−inch equipment rack. These accessories may be ordered through your nearest Hewlett-Packard office.

1-30. TEST EQUIPMENT AND ACCESSORIES REQUIRED

1-31. Test equipment and accessories recommended for servicing the HP 8443A Tracking Generator-Counter are listed in Table 1-4. If substitute equipment is used, it must meet the minimum specifications shown in the table.

Table 1-1. Model 8443A Tracking Generator-Counter Specifications

TRACKING GENERATOR SECTION

Frequency Range: 100 kHz to 110 MHz

Amplitude Range: < -100 dBm to +10 dBm in 10 and 1 dB steps with a continuous 1.2 dB vernier. Output attenuation is controllable in 10 dB steps ±0.2 dB, and 1 dB steps ±0.1 dB.

Amplitude Accuracy
Frequency Response (flatness): ±0.5 dB
Absolute (0 dBm at 30 MHz): ±0.3 dB

Output Impedance: 50 ohms, BNC connector, ac coupled
Reflection Coefficient: $\leq$ 0.09 (1.2 SWR) with $\leq$0 dBm output

COUNTER SECTION

Display: 8 digits

Resolution (gate time): Selectable 1 kHz (1 ms), 100 Hz (10 ms), 10 Hz (100 ms)

Accuracy: ±1 count ± time base accuracy

Time Base Aging Rate: $< 3 \times 10^{-9}$ per day (0.003 Hz/day) after warmup. (Warmup is 7 days of continuous operation, or 72 hours of continuous operation after being off for less than 72 hours.)

Time Base Frequency Drift with Temperature Change: $< 3 \times 10^{-8}$ (.03 Hz) variation from 0 to 55°C

R.F.I.: Meets or exceeds MIL-I-6181D

Power Requirement: 115 VAC ±10 percent, 48-440 Hz; or 230 VAC ±10 percent, 48-66 Hz; 75 watts

Dimensions: 88.2 mm High x 425 mm Wide x 467 mm Deep (3.3 in. x 16.8 in. x 18.4 in.)

Weight: Net 11.04 kg (24.3 lbs.), Shipping 14.47 kg (31.9 lbs.)

Table 1-2. Model 8443A Tracking Generator-Counter Supplemental Characteristics

Signal-To-Noise Requirement for Restore Signal Function: $\geq$15 dB

External Counter Input: 10 kHz to 120 MHz, 50 ohms, –10 dBm minimum, +25 dBm maximum

External Time Base Input: 1.0 MHz, 50 ohms, 1 Vrms

Time Base Output: 1.0 MHz, 1.0 Vrms nominal

Digital Frequency Output: BCD 8-4-2-1, positive logic

Table 1-3. Compatibility Chart (1 of 2)

Spectrum Analyzer Sections	Required to Make Section Compatible with 8443A	Modification Kit Number
RF Section		
8553L without TG-1 modification	Installation of modification kit indicated in column at right.	HP 08553-6065. This modification changes the section model number to 8553L-TG-2.
8553L with TF-1 modification	Installation of additional modification kit (indicated in right column) IF used with an 8443A with a serial number prefix of 1217A or higher. No modification required if used with an 8443A with a serial number prefix lower than 1217A.	HP 08553-60142. This modification changes the section model number to 8553L-TG-2.
8553B with serial number prefix 1215A or higher	No modification required.	
8553B with serial number prefix 1144A or lower.	No modification required IF the 8443A used with the RF section has a serial number prefix lower than 1217A.	
	If the 8443A has a serial number prefix of 1217A or higher, the modification kit indicated in the right column must be installed.	HP 08553-60142. This modification changes the section model number to 8553B-TG-2.
IF Section		
8552A with serial number prefix 1213A or higher	No modification required.	
8552A with serial number prefix 945 or lower, and without TG-1 modification	Installation of modification kit indicated in column at right.	HP 08552-6060. This modification changes the section model number to 8552A-TG-2.
8552A with serial number prefix 1144A or lower, and which includes TG-1 modification	No modification required IF the 8443A used with the IF section has a serial number prefix lower than 1217A. If the 8443A has a serial number prefix of 1217A or higher, the modification kit indicated in the right column must be installed.	HP 08552-60159. This modification changes the IF section model number to 8552A-TG-2.
8552B with serial number prefix 1210A and higher	No modification required.	

Table 1-3. Compatibility Chart (2 of 2)

Spectrum Analyzer Sections	Required to Make Section Compatible with 8443A	Modification Kit Number
8552B with serial number prefix 1209A and lower	No modification required if 8443A serial number prefix is lower than 1217A.	
	If 8443A serial number prefix is 1217A or higher, modification kit indicated in right column must be installed in 8552B.	HP 08552-60159. This modification changes the IF section model number to 8552B-TG-2.
Display Section		
140A, 140S, 141A, or 141S	Installation of modification kit indicated in column at right.	HP 00140-69504.
140T or 141T	No modification required.	

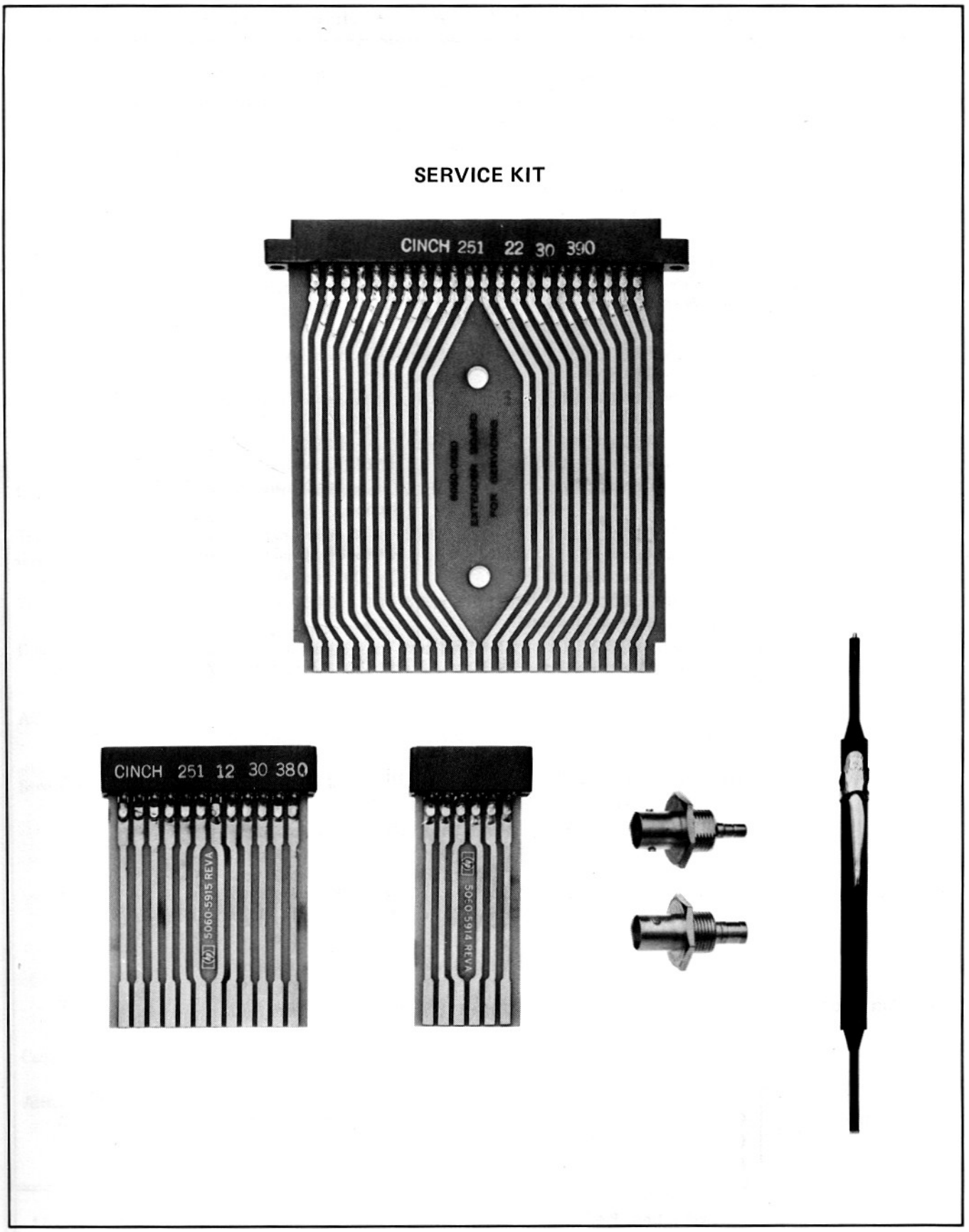


Figure 1-3. Service Kit Required for Maintenance

Table 1-4. Recommended Test Equipment and Accessories (1 of 3)

Item	Minimum Specifications	Suggested Model	Use*
Digital Voltmeter	Voltage Accuracy: ±0.2% Range Selection: Manual or Automatic Voltage Range: 1–1000 Vdc full scale Input Impedance: 10 megohms Polarity: Automatic Indication	HP 3455A Digital Voltmeter	A,T
Oscilloscope	Frequency Range: dc to 50 MHz Time Base: 1 μs/div to 10 ms/div Time Base Accuracy: ±3% Dual Channel, Alternate Operation Ac or dc Coupling External Sweep Mode Voltage Accuracy: ±3% Sensitivity: 0.020 V/div	HP 1740A or 1741A	P,A,T
Spectrum Analyzer	Frequency Range: 0–100 MHz Scan Width: 10 MHz	HP 141T mainframe with 8553B Tuning Section and 8552A/B IF Section	P,A,T
VHF Signal Generator	Frequency Range: 40–150 MHz Frequency Accuracy: ±1% Output Amplitude: >–20 dBm Output Impedance: 50 ohms	HP 8640B Signal Generator Opt. 001 and 002	P,A
Frequency Counter	Frequency Range: 100 kHz–300 MHz Accuracy: ±0.001% Sensitivity: 100 mVrms Readout Digits: 7	HP 5303B Frequency Counter	T
Tunable RF Voltmeter	Bandwidth: 1 kHz Frequency Range: 1–1000 MHz Sensitivity: 10 mV–1 Vrms Input Impedance: ≥0.1 megohms	HP 8405A Vector Voltmeter	P,A
Frequency Counter	Frequency Range: 10Hz–50 MHz Sensitivity: 100 Vrms Readout Digits: 8	HP 5300B Measuring System Mainframe with 5302A 50 MHz Universal Counter	P
Three-Port Mixer	Frequency Range: 0.2–500 MHz Impedance: 50 ohms Connectors: Female BNC on all ports Input Power: 5 mW nominal	HP 15014A Mixer (2)	P
Power Supply	Output Voltage: Variable, 0–30 Vdc Output Current: 0–400 mA Meter Resolution: <5 mV	HP 6205B Power Supply	A

*A = Adjustments; T = Troubleshooting; P = Performance Tests

Table 1-4. Recommended Test Equipment and Accessories (2 of 3)

Item	Minimum Specifications	Suggested Model	Use*
Spectrum Analyzer	0–350 MHz	HP 8557A/182T Spectrum Analyzer	A
Digital to Analog Converter	Accuracy: 5% of full scale Command Pulse: ±20 μsec or greater, 6 to 20 volts	HP 5311B	P
Strip Recorder	Recorder: Response time <1/2 second Accuracy: Better than 0.2% full scale	HP 680	P
Recorder Paper	Std. 5" roll chart: 50 minor divisions	HP 9270-1012	P
Frequency Standard	Output Frequency: 1, 2, 5, and 10 MHz	HP 5061A Cesium Beam Standard	P,A
Attenuator Standard	Range: 120 dB in 10 dB steps (2 req.)	HP H80-355D	P
RF Amplifier	20 dB or 40 dB gain –30 MHz	HP 8447D, Opt. 001	P
Temperature Controlled Oven	Adjustable from 0° to +55°C	Statham Model 325	P
Test Oscillator	10 Hz to 10 MHz, 3.16V max into 50Ω	HP 651B	P
Digital Recorder	Eight column printout from BNC 8-4-2-1 input, positive logic, TTL levels	HP 5150A Thermal Printer with Opt. 002	P
AC Voltmeter	0.5V to 300V full scale Frequency Range: 20 Hz to 4 MHz	HP 3455A	
Service Kit	Contents: 12 Pin extender board (HP 5060-5915) 6 Pin extender board (HP 5060-5914) 22 Pin extender board (HP 5060-0630) Coax Adapter, Selectro plug to BNC jack (HP 1250-1236) Coax Adapter, Selectro jack to BNC jack (HP 1250-1237) Oscilloscope probe Adapters (4 each) (HP 10035-53202) Alignment Screwdriver (HP 8710-1010)	HP 08443-60011 Service Kit	P,A,T
Cable Assembly (4)	Male BNC Connectors, 48 inches long	HP 10503A	P,A,T
Attenuator Standard	Range: 12.0 dB in 0.1 dB steps Accuracy: 0.01 dB	HP H80-355C	P

*A = Adjustments; T = Troubleshooting; P = Performance Tests

Table 1-4. Recommended Test Equipment and Accessories (3 of 3)

Item	Minimum Specifications	Suggested Model	Use*
HP Signal Generator	Frequency Range: 50 kHz–50 MHz Frequency Accuracy: ±1% Output Amplitude: >–20 dBm Output Impedance: 50 ohms	HP 8640B, Opt. 001 and 002	P
Power Meter	Frequency Range: 100 kHz–110 MHz Accuracy: 1% Resolution: .01 dB Power Range: –20 to +10 dBm	HP 436A	P
Power Sensor	Frequency Range: 100 kHz–110 MHz Power Range: –20 to +10 dBm	HP 8482A	P
Spectrum Analyzer	Frequency Range: .01 to 350 MHz	HP 182T/HP 8557A	T,P,A
Accessory Kit		HP 11570A	T,A
Type N to BNC-Male Adapter		HP 1250-0077	T,A,P

*A = Adjustments; T = Troubleshooting; P = Performance Tests

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section includes information on initial inspection, preparation for use, storage and shipment of the HP Model 8443A Tracking Generator-Counter.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electronically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV. For an abbreviated electrical performance test, use the Operator's Check procedure in Section III. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The HP Model 8443A requires a power source of 115V ±10%, 48−440 Hz; or 230V ±10%, 48−66 Hz. Maximum power consumption is 75 watts.

2-8. Line Voltage and Fuse Selection

2-9. Select the line voltage and fuse as follows:

a. Measure the ac line voltage.

b. Set the rear panel line voltage selector 115/230 VAC switch to the correct ac power level (the instrument is normally shipped with the switch set to 115).

c. Make sure a 2 ampere fuse is installed in the fuse holder. The fuse rating is the same for both ac power input levels.

d. Connect the ac power cord to the instrument ac power receptacle.

2-10. Power Cable

2-11. In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet. Figure 2-1 shows the styles of mains plugs available on power cables supplied with HP instruments. The numbers shown with the plugs are part numbers for complete power cables.

WARNING

The protection provided by grounding the instrument may be lost if any power cable other than the 3-pronged type is used to couple the ac line voltage to the instrument.

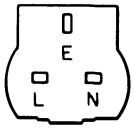
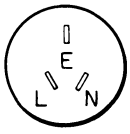
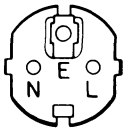
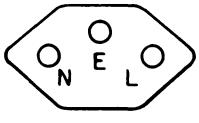
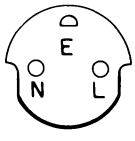
2-12. Operating Environment

2-13. The operating environment should be within the following limits:

Temperature	0 to 55°C
Humidity	<95% relative
Altitude	<4572 meters (15,000 feet)

2-14. Installation Instructions

2-15. When it is being used with a spectrum analyzer, the Tracking Generator-Counter should be both mechanically and electrically connected to the spectrum analyzer. The preferred mounting configuration is with the Tracking Generator mounted on top of and secured to the spectrum analyzer. A joining bracket kit is supplied to secure the HP 8443A to the spectrum analyzer. A rigid coaxial cable (for the preferred mounting configuration) is supplied to connect the OUTPUT on the HP 8443A to the INPUT connector of the spectrum analyzer.

Plug Type	HP Part Number	C D	Plug Description	Length cm (inches)	Color	Country of Use
250V 	8120-1351 8120-1703	0 6	Straight *BS1363A 90°	229 (90) 229 (90)	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Rhodesia, Singapore, South Africa, India
250V 	8120-3169 8120-0696	0 4	Straight *NZSS198/ASC112 90°	201 (79) 221 (87)	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	7 2	Straight *CEE7-Y11 90°	201 (79) 201 (79)	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt, South Africa, India, (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight *NEMA5-15P 90° Straight *NEMA5-15P Straight *NEMA5-15P 90° Straight *NEMA5-15P	203 (80) 203 (80) 91 (36) 203 (80) 203 (80) 91 (36)	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
250V 	8120-2104	3	Straight *SEV1011 1959-24507 Type 12	201 (79)	Gray	Switzerland
220V 	8120-1957 8120-2956	2 3	Straight *DHCK 107 90°	201 (79) 201 (79)	Gray Gray	Denmark

*Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.
E = Earth Ground; L = Line; N = Neutral

Figure 2-1. AC Power Cables and Plugs

2-16. Bench Operation

2-17. The instrument cabinet has plastic feet and a foldaway tilt stand for convenience in bench operation. The tilt stand raises the front of the instrument for easier viewing of the control panel, and the plastic feet are shaped to make full-width modular instruments self-aligning when stacked.

2-18. Rack Mounting

2-19. A rack mounting kit (HP Part Number 5060−8739) is available for installing the HP 8443A in a 19-inch rack. The kit contains all the necessary hardware and installation instructions. Installation instructions are also given in Figure 2-2.

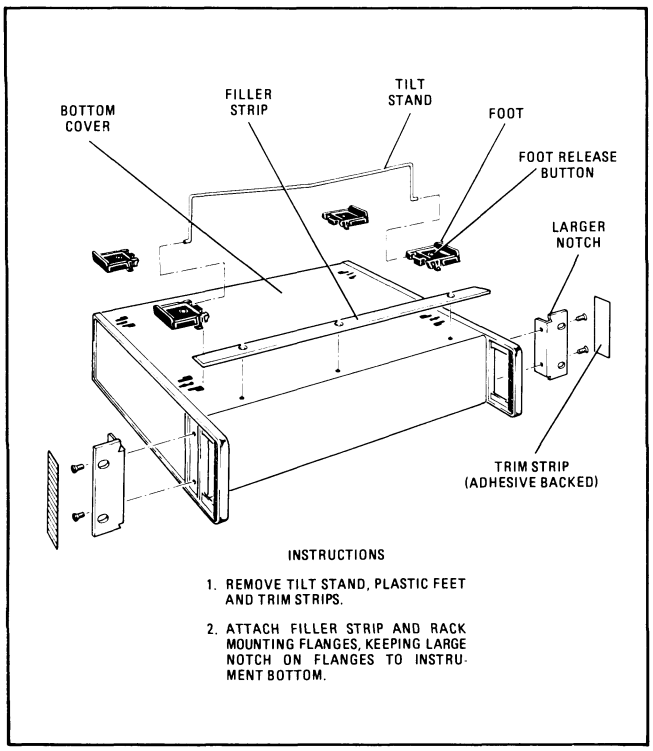


Figure 2-2. Preparation for Rack Mounting

2-20. MODIFICATIONS REQUIRED

2-21. If you are using a late model HP 8443A with an older spectrum analyzer, the spectrum analyzer may require modification. To determine whether or not your spectrum analyzer requires a modification to adapt it to your HP 8443A, refer to Table 1-3.

2-22. STORAGE AND SHIPMENT

2-23. Environment

2-24. The instrument should be stored in a clean dry environment. The following environmental limitations apply to both storage and shipment:

Temperature . . . . . −40 to +75°C
Humidity . . . . . <95% relative
Altitude . . . . . <7620 meters (25,000 feet)

2-25. Packaging

2-26. Original Packaging. Containers and materials identical with those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-27. Other Packaging. The following general instructions should be used for repackaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial. A supply of these tags is included at the back of this section.)

b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Use enough shock-absorbing material (3-to-4-inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to ensure careful handling.

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section provides instructions for operating the HP Model 8443A Tracking Generator-Counter. Before attempting to use the HP 8443A you should be familiar with the operation of the spectrum analyzer, or have the spectrum analyzer manuals readily available. Spectrum analyzer operating instructions are not included in this manual except as required for initial control settings and instrument interconnections.

3-3. PANEL FEATURES

3-4. The tracking generator-counter's front and rear panel controls, indicators, and connectors are identified and described in Figures 3-1 and 3-2.

3-5. OPERATING INSTRUCTIONS

3-6. The HP 8443A is relatively simple to operate, and you can learn most of what you need to know about it by performing the operator's checks referenced below. You should, however, experiment with the instrument to thoroughly familiarize yourself with its capabilities.

3-7. The output of any device within the frequency and amplitude range of the spectrum analyzer can be connected to the spectrum analyzer RF Section RF input, and then the frequency at any point on the input signal can be identified with the HP 8443A. The input to the device under test may be provided by an external signal generator, or by the output of the tracking generator-counter itself.

3-8. OPERATOR'S CHECKS

3-9. Procedures to be used by the operator to check out the HP 8443A are described in Figure 3-3. The primary purpose of these procedures is to verify proper operation of the instrument's main functions. Their secondary purpose is to show the operator how to use the instrument.

3-10. SPECIAL FEATURES

3-11. 1 MHz Output. The output of the internal 1 MHz time base reference oscillator is available at J4 (BNC) on the HP 8443A rear panel.

WARNING

Use of external time base signal necessitates removing the instrument top cover to change the setting of a switch on the Time Base Assembly. This operation should be performed only by qualified service personnel who are aware of the hazards involved.

3-12. External Time Base Input. An external time base reference signal may be used instead of the 1 MHz internal reference. The external time base reference input is rear-panel receptacle J3 (BNC). Before an external time base signal is applied to the HP 8443A, the reference-external switch on the Time Base Board Assembly (A5) must be set to EXT.)

3-13. OPERATOR MAINTENANCE

WARNING

There are four power fuses on the HP 8443A Rectifier Board Assembly (A15) which are accessible only with the HP 8443A top cover removed. Operating personnel must NOT attempt to change these fuses. They are to be changed only by service-trained personnel who are aware of the hazards involved. AC power must be removed from the instrument before ANY fuse is changed.

3-14. Operator maintenance on the HP 8443A is limited to replacement of the ac line fuse (2 amperes). See Section VIII, Service, for fuse information.

3-15. The level of the HP 8443A RF output can be set in 1.0 dB steps from +10 dBm to −122 dBm with the RF OUTPUT LEVEL TENS and UNITS controls. It can then be adjusted with the TENTHS vernier, which is calibrated in 0.1 dB increments, over a continuous range of 1.2 dB.

3-16. Measuring Passive Devices

3-17. To measure the frequency response of a passive device quickly, set the spectrum analyzer to display the desired frequency range. Then set the tracking generator-counter RF OUTPUT LEVEL controls so that:

1. The signal level at the spectrum analyzer's input mixer does not exceed −10 dBm. (Signal level at input mixer = Signal level at RF INPUT connector minus the INPUT ATTENUATION.)

2. The signal level out of the HP 8443A cannot damage or overdrive the device under test (DUT).

3-18. Set the spectrum analyzer LOG REF LEVEL controls so that the log reference level is the same as the HP 8443A RF output level set above. Connect the device-under-test (DUT) between the 8443A RF OUTPUT and the spectrum analyzer RF INPUT. The frequency response and insertion loss of the DUT can now be observed on the spectrum analyzer CRT.

3-19. Measuring Active Devices

CAUTION

When you are making measurements on active devices, you must be careful that the signal gain provided by the device does not result in damage to the spectrum analyzer or the HP 8443A. The level of the signal output from the HP 8443A is easily adjusted with the HP 8443A RF OUTPUT LEVEL controls.

3-20. Set up the tracking generator-counter and the spectrum analyzer as described above for passive device measurements. Before connecting the active device between the HP 8443A and the spectrum analyzer, however, decrease the signal level out of the HP 8443A by an amount greater than the gain of the device. The gain of the device then becomes the sum of the decrease and the dB reading determined from the CRT graticule lines. (Remember that this is a negative number on the graticule.)

3-21. For example: the spectrum analyzer is calibrated for a reference at the top graticule line of the CRT. Then the setting of the RF OUTPUT LEVEL TENS control is decreased to 40 dB and the device-under-test is connected between the HP 8443A RF OUTPUT and the spectrum analyzer RF INPUT. If the response curve is at the −7 dB graticule line, the gain of the device-under-test is 33 dB (40 dB minus 7 dB).

3-22. IMPORTANT CONSIDERATIONS

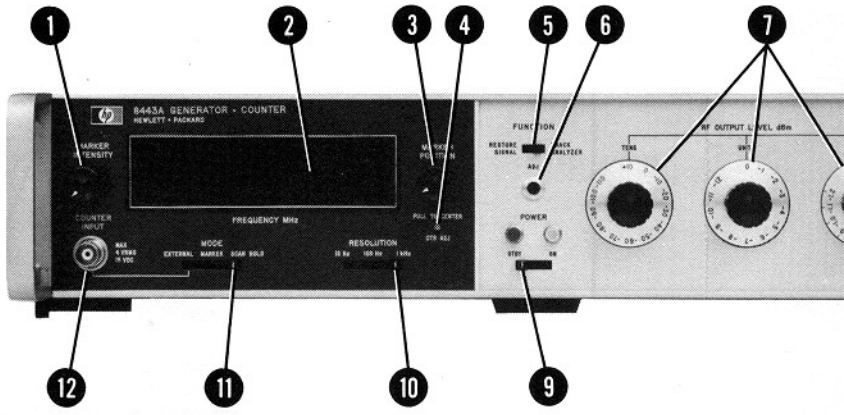
3-23. When you are using the tracking generator for swept response measurements, the functions of the spectrum analyzer BANDWIDTH control and DISPLAY UNCAL lamp are changed somewhat. That is, the BANDWIDTH setting mainly affects the average noise level of the spectrum analyzer, and has only a secondary effect on resolution. Narrowing the bandwidth for swept response measurements improves the dynamic range, but necessitates slower scan rates.

3-24. The DISPLAY UNCAL lamp during swept response measurements is effectively disabled and its condition, on or off, is essentially meaningless. The recommended procedure, therefore, is to slow down the scan rate (that is, increase the scan time per division) to where the display amplitude remains constant. At this point the scan is at the proper rate to satisfy the requirements of both the spectrum analyzer and the device-under-test.

3-25. Because the signal source (the tracking generator) tracks the receiver (the spectrum analyzer), spurious responses are not displayed on the spectrum analyzer CRT. For this reason, measurements are possible over a dynamic range limited only by gain compression for the upper limit, and by system noise for the lower limit.

3-26. For response measurements on devices having more than 100 dB of attenuation (filters, for example), use the HP 8443A RF OUTPUT LEVEL controls to trace the signal on the spectrum analyzer CRT in two 70-dB segments, photographing each segment separately to obtain a composite picture. (Refer to Hewlett-Packard Applications Note 150-3.)

FRONT PANEL FEATURES



1 **MARKER INTENSITY:** adjusts the intensity of the marker displayed on the Spectrum Analyzer's CRT.

2 **FREQUENCY MHz:** LED display of counter readout.

3 **MARKER POSITION:** when pushed in, sets position of marker on CRT. When out, marker automatically goes to center of CRT display.

4 **CTR ADJ:** adjusts position of marker when MARKER POSITION knob is out.

5 **FUNCTION:** controls the function of the Tracking Generator Counter.

TRACK ANALYZER: the signal at RF OUTPUT tracks the spectrum analyzer's tuning frequency. The counter reads the frequency at the marker (if MODE switch is set to MARKER or SCAN HOLD). This function is used for frequency response measurements.

RESTORE SIGNAL: if the marker is placed anywhere on a signal response that appears on the CRT, a restored version of that signal appears at RF OUTPUT (i.e., frequency characteristics are the same, and the amplitude depends upon RF OUTPUT LEVEL controls); also, the COUNTER reads that signal's frequency (if MODE switch is set to MARKER or SCAN HOLD). If the marker is not placed on a signal response, little or no output appears at RF OUTPUT and any COUNTER reading should be disregarded. This function is used to precisely measure the frequency of unknown signals.

6 **TRACKING ADJUST:** centers the tracking signal in the IF passband of the spectrum analyzer when the FUNCTION switch is set to TRACK ANALYZER.

7 **RF OUTPUT LEVEL dBm:** three controls used to set the signal level at the RF OUTPUT connector.

TENS: 10 dB steps from +10 to −110 dB.

UNITS: 1 dB steps from 0 to −12 dB.

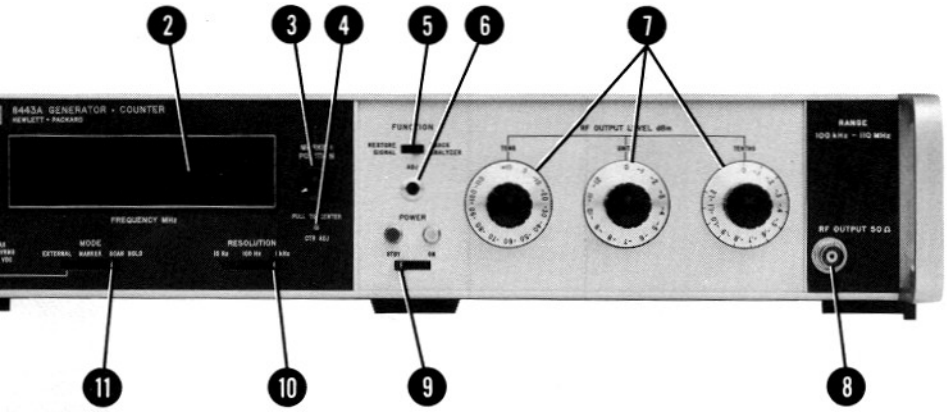
TENTHS: 0 to −1.2 vernier, calibrated at one-tenth dB points.

8 **RF OUTPUT 50Ω:** BNC output connector for the tracking signal developed in the tracking generator section of the HP 8443A.

9 **POWER:** when set to ON, this switch applies power to all the tracking generator and

Figure 3-1. Front Panel Controls, Indicators, and Conne

FRONT PANEL FEATURES



LEVEL controls); also, the COUNTER reads that signal's frequency (if MODE switch is set to MARKER or SCAN HOLD). If the marker is not placed on a signal response, little or no output appears at RF OUTPUT and any COUNTER reading should be disregarded. This function is used to precisely measure the frequency of unknown signals.

6 **TRACKING ADJUST:** centers the tracking signal in the IF passband of the spectrum analyzer when the FUNCTION switch is set to TRACK ANALYZER.

7 **RF OUTPUT LEVEL dBm:** three controls used to set the signal level at the RF OUTPUT connector.

TENS: 10 dB steps from +10 to −110 dB.

UNITS: 1 dB steps from 0 to −12 dB.

TENTHS: 0 to −1.2 vernier, calibrated at one-tenth dB points.

8 **RF OUTPUT 50Ω:** BNC output connector for the tracking signal developed in the tracking generator section of the HP 8443A.

9 **POWER:** when set to ON, this switch applies power to all the tracking generator and counter circuitry (white lamp lights). When it is set to STBY, power is removed from the tracking generator and counter circuits (blue lamp lights), but power remains applied to the counter reference oscillator heater.

10 **RESOLUTION:** sets the frequency resolution of the counter.

11 **MODE:** controls the operating mode of the counter as follows:

EXTERNAL: the counter reads out the frequency of the signal applied to the COUNTER INPUT receptacle (up to 110 MHz).

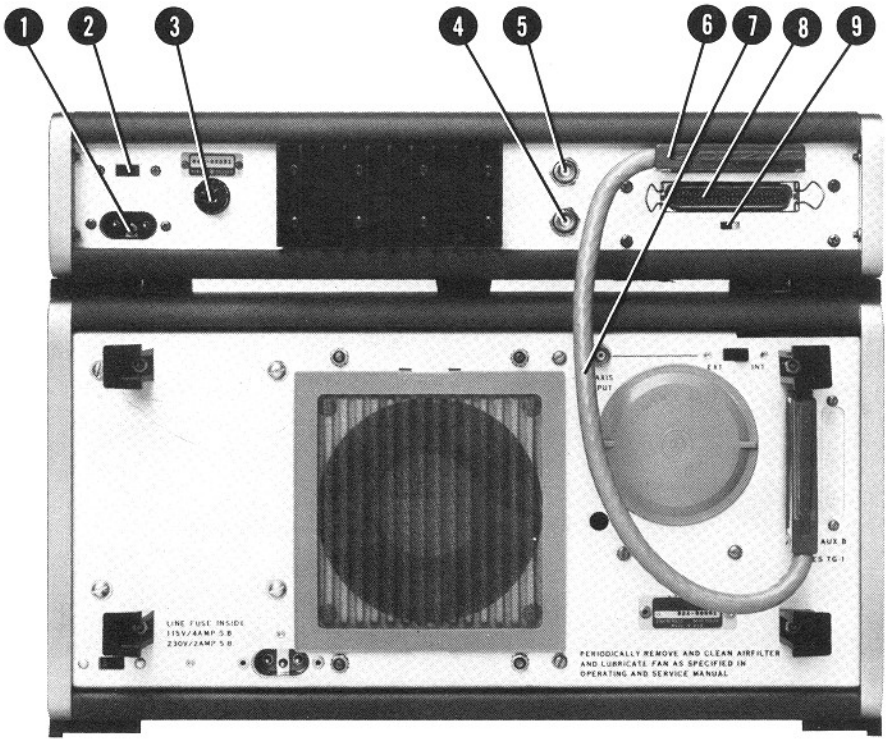
MARKER: the counter reads out the frequency of the marker.

SCAN HOLD: the spectrum analyzer stops scanning and the tuning frequency follows the marker position as set with the MARKER POSITION control. The counter reads out the frequency at the marker.

12 **COUNTER INPUT:** a 50 ohm BNC connector for applying an external input to the counter. Signal level requirements are > −10 dBm and < +15 dBm.

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

REAR PANEL FEATURES



1. **LINE Power Jack:** connection for ac line power cable.

2. **LINE SELECTOR:** used to select 115 or 230 Vac operation.

3. **LINE FUSE:** houses line power fuse (fuse value is the same for both voltages).

4. **1 MHz OUT:** output for internal time base signal, 1 Vrms.

5. **EXT TIME BASE IN:** input for external time base signal, 1 MHz, >1 Vrms.

6. **Interconnection Jack:** connects to spectrum analyzer display section AUX A receptacle through interconnection cable.

7. **Interconnection Cable:** connects between Tracking Generator-Counter interconnection receptacle and spectrum analyzer display section AUX A receptacle.

8. **DIGITAL OUTPUT:** BCD output of Counter indication.

9. **UNBLANKED/BLANKED:** in UNBLANKED position, all seven digits are always lit. In BLANKED position, insignificant zeros to the left of the decimal point are blanked.

Figure 3-2. Rear Panel Controls and Connectors

1. Set the LINE SELECTOR switch on the rear panel (see Figure 3-2) to the value compatible with the available ac line voltage. (For line voltages 103.5 to 126.5 Vac, set the switch to 115V; for line voltages 207 to 253 Vac, set it to 230V.)

2. Connect the line power cable to the LINE power receptacle on the rear panel. Plug the power cable into an ac line power outlet. The blue STBY lamp ⑩ should light.

NOTE

The Tracking Generator-Counter should remain connected to the ac line power, even when it is not in use, to maintain a constant temperature in the time base reference oscillator oven.

3. Connect the interconnection cable between the 8443A interconnection receptacle and the spectrum analyzer's AUX A receptacle (see Figure 3-2).

4. Set the POWER switch ⑩ to ON. The white ON lamp should light, and the counter display should run through the start-up sequence confidence check.

NOTE

In the start-up sequence, the counter cycles all the display ICs so that the readout first shows all zeros, then all ones, then all twos, and so on up through all nines. The counter normally goes through this cycle once as a confidence check, each time the line POWER switch is set to ON, before displaying the actual frequency count.

5. Apply power to the spectrum analyzer and adjust its display section controls. Set the other spectrum analyzer controls as follows:

FREQUENCY	50 MHz
BANDWIDTH	300 kHz
SCAN WIDTH	PER DIVISION
SCAN WIDTH PER DIVISION	10 MHz
INPUT ATTENUATION	10 dB
BASE LINE CLIPPER	ccw
SCAN TIME PER DIVISION	1 MILLISECOND
LOG REF LEVEL	0 dBm
LOG/LINEAR	10 dB LOG
VIDEO FILTER	OFF
SCAN MODE	INT
SCAN TRIGGER	AUTO

6. Set the FUNCTION switch ③ to TRACK ANALYZER. Set the MODE switch ③ to MARKER, the RESOLUTION switch ⑤ to 100 Hz, and the RF OUTPUT LEVEL controls 11 for 0 dBm.

7. Connect RF OUTPUT ⑫ to the spectrum analyzer RF INPUT with a BNC to BNC cable assembly. The trace on the spectrum analyzer CRT display should rise from the baseline to the top graticule line.

8. Set RF OUTPUT LEVEL ⑪ to −30 dBm. Set the spectrum analyzer SCAN WIDTH to ZERO, BANDWIDTH to the narrowest bandwidth, LOG/LINEAR to LINEAR and LINEAR SENSITIVITY to 1 mV/Div. Adjust TRACKING ADJUST ⑤ for maximum vertical deflection on the CRT. (This ensures that the Tracking Generator is accurately tracking the spectrum analyzer's tuning frequency.) Reset the spectrum analyzer as set in step 5.

9. Change the RF OUTPUT LEVEL controls ⑪ ; the trace on the CRT should change as indicated by the controls. (At low output levels it will be necessary to change the spectrum analyzer LOG REF LEVEL control to keep the signal above the baseline.)

5. Apply power to the spectrum analyzer and adjust its display section controls. Set the other spectrum analyzer controls as follows:

FREQUENCY	50 MHz
BANDWIDTH	300 kHz
SCAN WIDTH	PER DIVISION
SCAN WIDTH PER DIVISION	10 MHz
INPUT ATTENUATION	10 dB
BASE LINE CLIPPER	ccw
SCAN TIME PER DIVISION	1 MILLISECOND
LOG REF LEVEL	0 dBm
LOG/LINEAR	10 dB LOG
VIDEO FILTER	OFF
SCAN MODE	INT
SCAN TRIGGER	AUTO

6. Set the FUNCTION switch ❸ to TRACK ANALYZER. Set the MODE switch ❸ to MARKER, the RESOLUTION switch ❺ to 100 Hz, and the RF OUTPUT LEVEL controls 11 for 0 dBm.

7. Connect RF OUTPUT ⓬ to the spectrum analyzer RF INPUT with a BNC to BNC cable assembly. The trace on the spectrum analyzer CRT display should rise from the baseline to the top graticule line.

8. Set RF OUTPUT LEVEL ⓫ to −30 dBm. Set the spectrum analyzer SCAN WIDTH to ZERO, BANDWIDTH to the narrowest bandwidth, LOG/LINEAR to LINEAR and LINEAR SENSITIVITY to 1 mV/Div. Adjust TRACKING ADJUST ❷ for maximum vertical deflection on the CRT. (This ensures that the Tracking Generator is accurately tracking the spectrum analyzer's tuning frequency.) Reset the spectrum analyzer as set in step 5.

9. Change the RF OUTPUT LEVEL controls ⓫ ; the trace on the CRT should change as indicated by the controls. (At low output levels it will be necessary to change the spectrum analyzer LOG REF LEVEL control to keep the signal above the baseline.)

10. Adjust MARKER INTENSITY ❷ for the desired marker intensity. The marker is a bright spot on the trace on the CRT. If it is not visible, check that the MARKER POSITION knob ❻ is in (push toward the panel) and turn the knob to position the marker on-screen. (If the marker cannot be positioned on-screen, follow the adjustment procedures specified in paragraph 5-19.)

11. Rotate MARKER POSITION ❻ to position the marker to various points on the CRT. The counter should display whatever frequency is represented by the position of the marker.

12. Pull the MARKER POSITION knob ❻ away from the panel; the marker should be near the center vertical graticule line on the CRT. Adjust CRT ADJ ❼ to position the marker on the line.

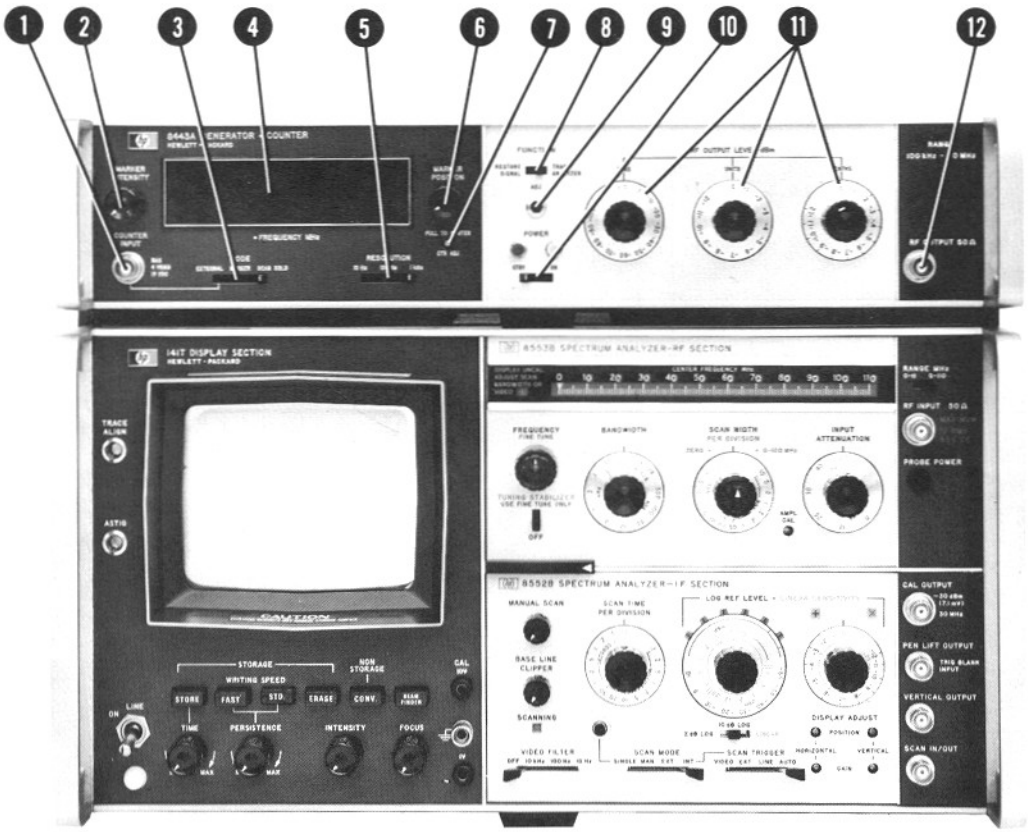
13. Tune the spectrum analyzer FREQUENCY control through its range. The counter should again display whatever frequency is represented by the position of the marker.

14. Set the spectrum analyzer to a narrow scan width (20 kHz PER DIVISION or less), and set TUNING STABILIZER to on. Set RESOLUTION ❺ to 10 Hz and then to 1 kHz. The counter readout ❹ should have 10 Hz and then 1 kHz resolution.

15. Push the MARKER POSITION knob ❻ in, and set MODE ❸ to EXTERNAL. Set RF OUTPUT LEVEL ⓫ to 0 dBm and connect RF OUTPUT ⓬ to COUNTER INPUT ❼ . Set spectrum analyzer SCAN WIDTH to ZERO. The counter should display the frequency the spectrum analyzer is tuned to; the marker should not be visible. Return spectrum analyzer SCAN WIDTH to PER DIVISION.

16. Set MODE ❸ to SCAN HOLD. The spectrum analyzer scan should stop at the marker, and the counter should display the frequency represented by the position of the marker. The marker (the point at which the scan is

OPERATOR'S CHECKS



stopped) can be positioned at any point on the CRT with the MARKER POSITION control ❻.

Set MODE ❸ to MARKER RESOLUTION ❺ to 1 kHz, and tune the spectrum analyzer to a frequency below 10 MHz. Set MARKER POSITION ❻ ccw and set the rear panel UNBLANKED/BLANKED switch (see Figure 3-2) to UNBLANKED. The digits to the left of any significant digits that are left of the decimal point should display zeros. Set UNBLANKED/BLANKED to blanked; the zeros should blank (i.e., disappear).

⓲ Set the spectrum analyzer as set in step 5. Connect analyzer CAL OUTPUT to RF INPUT. Set FUNCTION ❽ to RESTORE SIGNAL. Using MARKER POSITION ❻, set marker on skirt of 30 MHz signal; the counter should indicate approximately 30 MHz. Set marker off signal into baseline noise; the counter should indicate 0 MHz or random frequencies.

Figure 3-3. Operator's Checks

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4−2. This section contains instructions for testing the performance of the HP Model 8443A Tracking Generator-Counter. The performance test procedures are used to check the instrument at incoming inspection and for periodic evaluation. The tests are designed to verify the specifications listed for the instrument in Table 1-1.

4-3. Test equipment required for the performance tests is listed in Table 1-4 and at the beginning of each test description. Test instruments other than those listed may be used, provided their performance equals or exceeds the critical specifications listed in Table 1-4. The Spectrum Analyzer used with the HP 8443A in the performance tests in an HP 141T or HP 140T Mainframe equipped with an HP 8553B Tuning Section and an HP 8552A or HP 8552B IF Section.

4-4. TEST RECORD

4-5. At the back of this section there is a Performance Test Record Card, Table 4-3, which can be used for recording the performance test data.

4-6. ABBREVIATED PERFORMANCE TESTS

4-7. To make sure the tracking generator-counter is operating properly without testing it for all the specifications listed in Table 1-1, do the Operator's Checks described in Figure 3-3 of the Operation section.

4-8. PERFORMANCE TEST PROCEDURES

4-9. Each performance test is contained in a single paragraph. The first entry in each paragraph is the specification, as described in Table 1-1 (HP 8443A Specifications), for the parameter being measured. This is followed by a general description of the test and any special instructions or problem areas. When the test requires equipment in addition to the spectrum analyzer, an illustration of the test setup and a test equipment list precedes the step-by-step instructions. You should do the performance tests and the steps within each test in the order given.

PERFORMANCE TESTS

4-10. FREQUENCY RANGE TEST

SPECIFICATION:

100 kHz to 110 MHz. (Output frequency tracks the HP 8553/8552 Spectrum Analyzer tuning.)

DESCRIPTION:

The frequency range is checked by applying reference signals to the spectrum analyzer, centering these signals on the CRT and counting the signal frequency. At 110 MHz the reference signal is obtained from the RF output of the signal generator. At 100 kHz the reference signal is obtained from the AM output of the signal generator.

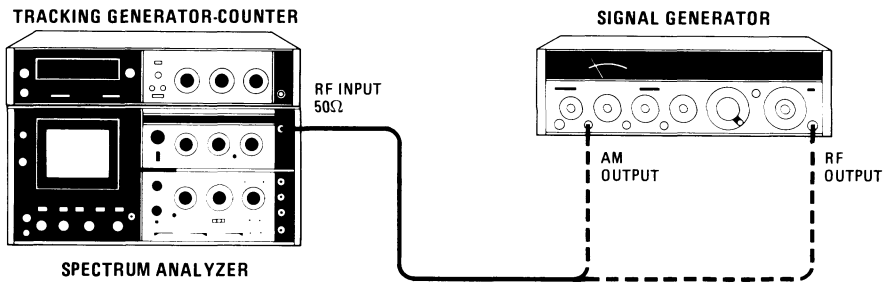


Figure 4-1. Frequency Range Test Setup

EQUIPMENT:

Signal Generator ..... HP 8640B Option 001

1. Set the controls on the instruments shown in Figure 4-1 as follows:

Tracking Generator-Counter:

MODE ..... MARKER
RESOLUTION ..... 10 Hz
MARKER POSITION ..... Knob pulled out
MARKER INTENSITY ..... Mid-range

4-10. FREQUENCY RANGE TEST (Cont'd)

Spectrum Analyzer:

DISPLAY SECTION	Clearly defined trace
RANGE MHz	0-11
INPUT ATTENUATION	10 dB
FREQUENCY	100 kHz
SCAN WIDTH	PER DIVISION
SCAN WIDTH PER DIVISION	5 kHz
BANDWIDTH	1 kHz
SCAN TIME PER DIVISION	20 mSec
LOG REF LEVEL	0 dBm
TUNING STABILIZER	On

Signal Generator:

AM	INT
AUDIO OUTPUT LEVEL	1V
MODULATION FREQUENCY	approximately 100 kHz
COUNTER MODE	EXPAND X 100
EXT 0 – 10 pushbutton	On (pushed in)
MODULATION 1 – 100%	80%

2. Connect the signal generator (HP 8640B) AM OUTPUT directly to the signal generator COUNTER INPUT. Adjust the signal generator MODULATION FREQUENCY to obtain a counter readout of .100000 ± .000100 MHz.

3. Connect the signal generator AM OUTPUT to the RF INPUT 50Ω on the spectrum analyzer RF Section.

4. Adjust the spectrum analyzer FINE TUNE control to center the signal on the CRT display. (The marker should be at the peak of the signal.)

5. Record the reading observed on the tracking generator-counter digital display. It should be .10000 ± .0010 MHz.

.10000 MHz_____

6. Disconnect the cable from the signal generator AM OUTPUT connector and connect it to the signal generator RF OUTPUT connector. The other end of the cable should remain connected to the spectrum analyzer RF Section RF INPUT 50Ω connector.

7. Reset the signal generator controls as follows:

COUNTER MODE	All pushbuttons out
INT EXT pushbutton	pushed in
AM	OFF
RANGE MHz	64 to 128
FREQUENCY MHz	110.000 MHz
RF	ON
OUTPUT LEVEL	– 10 dBm

PERFORMANCE TESTS

4-10. FREQUENCY RANGE TEST (Cont'd)

8. Reset the spectrum analyzer controls as follows:

BANDWIDTH	30 kHz
SCAN WIDTH	PER DIVISION
SCAN WIDTH PER DIVISION	2 MHz
SCAN TIME PER DIVISION	20 MILLISECONDS
LOG REF LEVEL	0 dBm
RANGE MHz	0–110
FREQUENCY	110 MHz

9. Adjust the spectrum analyzer FREQUENCY control to center the 110 MHz signal on the CRT display. Keeping the signal centered, reduce the SCAN WIDTH and BANDWIDTH to 5 kHz per division and 1 kHz respectively.

10. With the signal centered on the CRT display, record the reading on the tracking generator-counter digital display. The readout should be 110.00000 ± .0100 MHz.

110.00000 MHz_____

11. Now that you have checked the performance of the tracking generator-counter at the high and low ends of its range, you can check its operation at any other frequency or frequencies between 100 kHz and 110 MHz using the same procedure.

PERFORMANCE TESTS

4-11. AMPLITUDE RANGE TEST

SPECIFICATION:

< −120 dBm to +10 dBm in 10 and 1 dB steps with a continuous 1.2 dB vernier. Output attenuation is controllable in 10 dB steps ±0.2 dB, and in 1 dB steps ±0.1 dB.

DESCRIPTION:

The amplitude range and the step-to-step variation of the HP 8443A internal step attenuators is tested. Specially calibrated step attenuators are used to check the 10 dB and 1 dB steps of the RF OUTPUT LEVEL dBm controls.

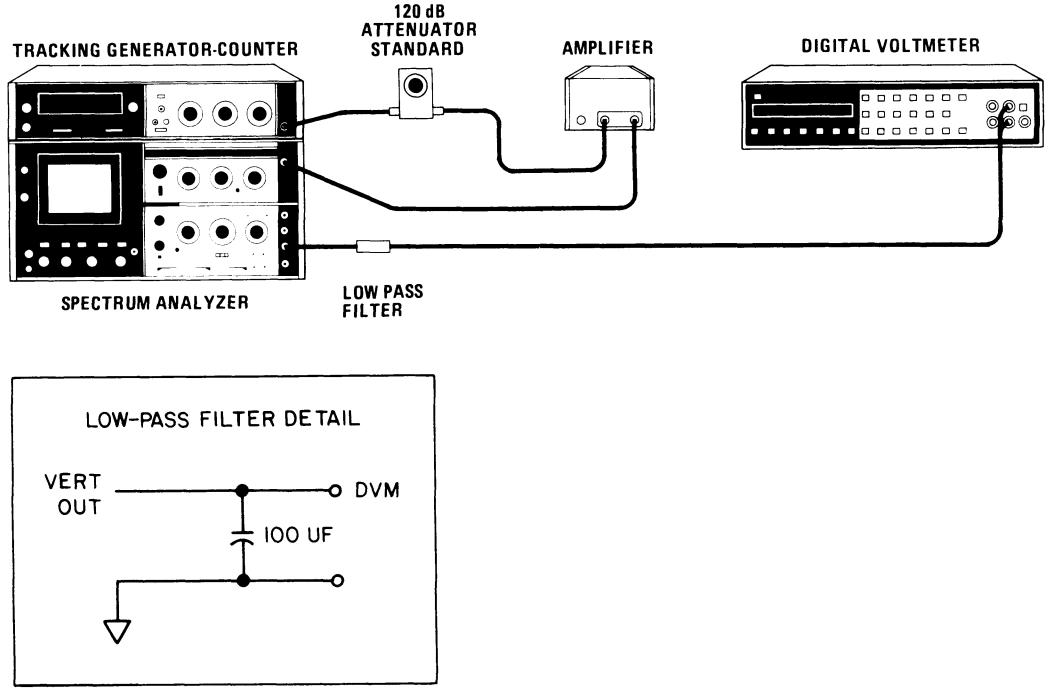


Figure 4-2. Amplitude Range Test Setup

EQUIPMENT:

120 dB Attenuator Standard (10 dB Steps)	HP 355D Option H80
12 dB Attenuator Standard (1 dB Steps)	HP 355C Option H80
RF Amplifier (40 dB gain, 30 MHz)	HP 8447D Option 001
Digital Voltmeter	HP 3455A

PERFORMANCE TESTS

4-11. AMPLITUDE RANGE TEST (Cont'd)

1. Connect the 120 dB attenuator to the HP 8443A RF OUTPUT using a BNC-to-BNC adapter (do not use a cable). Set the attenuator for 120 dB attenuation. Set the controls on the other instruments as follows:

   Tracking Generator-Counter:

MODE	MARKER
RESOLUTION	1 kHz
MARKER POSITION	Any
FUNCTION	TRACK ANALYZER

   Attenuators:

TENS	+10
UNITS	0
TENTHS	0

   Spectrum Analyzer:

FREQUENCY	30 MHz
BANDWIDTH	100 Hz
SCAN WIDTH	ZERO
SCAN WIDTH PER DIVISION	Any
INPUT ATTENUATION	0
SCAN TIME PER DIVISION	1 MILLISECOND
LOG REF LEVEL	−40 dBm
LOG REF LEVEL VERNIER	0
LOG/LINEAR	LOG
SCALE FACTOR	10 dB LOG
VIDEO FILTER	10 Hz
TUNING STABILIZER	ON

   RF Amplifier: Power ON, 40 dB gain

   Digital Voltmeter: AUTORANGE or 1000 Millivolts

2. Use very short double-shielded cables to connect the equipment as shown in Figure 4-2. A low-pass filter (100 microfarad) is required between the VERTICAL OUTPUT of the spectrum analyzer IF Section and the digital voltmeter.

3. Adjust the spectrum analyzer FREQUENCY to 30 MHz.

4. Adjust the tracking ADJ control on the HP 8443A to peak the signal on the spectrum analyzer CRT display.

4-11. AMPLITUDE RANGE TEST (Cont'd)

5. Set the HP 8443A RF OUTPUT LEVEL dBm TENS control and the 120 dB Attenuator Standard to the settings indicated in Table 4-1. (Note that the sum of the two attenuators – the TENS control and the 120 dB Attenuator Standard – should always total 110 dB.) The Digital Voltmeter must be reset to 400 millivolts before each step.

6. Remove the RF Amplifier and the 120 dB calibrated attenuator from the test setup. Connect the 12 dB calibrated attenuator between the HP 8443A RF OUTPUT and the spectrum analyzer RF INPUT. Set the HP Model 8443A TENS attenuator to 60 dBm and the spectrum analyzer LOG REF LEVEL to 0 dBm. Set the calibrated 12 dB attenuator to 12 dB. Adjust the spectrum analyzer LOG REF LEVEL (and the continuous vernier) to obtain a reading of 400 mV on the digital voltmeter.

Table 4-1. Amplitude Range Test Data, 10 dB Steps

RF OUTPUT LEVEL dBm TENS Control	120 dB Step Attenuator Setting (dB)	Deviation from 400 mV Reference		120 dB Step Attenuator Error (dB) (Calibration)**	Corrected Deviation (dB)
		mV	(dB)*		
+10	120	400	0 (Ref.)	0 (Ref.)	0 (Ref.)
0	110	_____	_____	_____	_____
–10	100	_____	_____	_____	_____
–20	90	_____	_____	_____	_____
–30	80	_____	_____	_____	_____
–40	70	_____	_____	_____	_____
–50	60	_____	_____	_____	_____
–60	50	_____	_____	_____	_____
–70	40	_____	_____	_____	_____
–80	30	_____	_____	_____	_____
–90	20	_____	_____	_____	_____
–100	10	_____	_____	_____	_____
–110	0	_____	_____	_____	_____

*To convert millivolts to dB, use: $dB = 20 \text{ Log } \frac{\text{DVM Reading in mV}}{400 \text{ mV}}$

**Attenuation greater than dial setting is positive (+). Attenuation less than dial setting is negative (–). For example, a 9.99 dB calibration for a 10 dB attenuator setting represents an error of –0.01 dB.

7. Set the HP 8443A RF OUTPUT LEVEL dBm UNITS control and the 12 dB step attenuator to the settings indicated in Table 4-2. (Note that the sum of the two attenuator – the UNITS control and the

4-11. AMPLITUDE RANGE TEST (Cont'd)

12 dB Attenuator Standard – should always total 12 dB.) The digital voltmeter must be reset to 400 millivolts before each step.

Table 4-2. Amplitude Range Test Data, 1 dB Steps

RF OUTPUT LEVEL dBm TENS Control	120 dB Step Attenuator Setting (dB)	Deviation from 400 mV Reference		120 dB Step Attenuator Error (dB) (Calibration)**	Corrected Deviation (dB)
		mV	(dB)*		
0	12	_____	_____	_____	_____
–1	11	_____	_____	_____	_____
–2	10	_____	_____	_____	_____
–3	9	_____	_____	_____	_____
–4	8	_____	_____	_____	_____
–5	7	_____	_____	_____	_____
–6	6	_____	_____	_____	_____
–7	5	_____	_____	_____	_____
–8	4	_____	_____	_____	_____
–9	3	_____	_____	_____	_____
–10	2	_____	_____	_____	_____
–11	1	_____	_____	_____	_____
–12	0	_____	_____	_____	_____

*To convert millivolts to dB, use: $dB = 20 \text{ Log } \frac{\text{DVM Reading in mV}}{400 \text{ mV}}$

**Attenuation greater than dial setting is positive (+). Attenuation less than dial setting is negative (–). For example, a 9.99 dB calibration for a 10 dB attenuator setting represents an error of –0.01 dB.

4-12. AMPLITUDE ACCURACY TEST

SPECIFICATION:

Frequency Response (Flatness): 0.5 dB
Absolute (0 dBm at 30 MHz): 0.3 dB

DESCRIPTION:

With the tracking generator-counter RF OUTPUT connected to the spectrum analyzer RF INPUT, the tracking generator-counter is set to 30 MHz (indicated on the HP 8443A digital readout), the spectrum analyzer calibration point, with the spectrum analyzer FREQUENCY control. The HP 8443A output is then set for maximum signal amplitude on the spectrum analyzer CRT display. Finally, the RF output level of the HP 8443A is observed on a power meter as the HP 8443A and the spectrum analyzer are tuned from 100 kHz to 110 MHz. The power variation over the 100 kHz–to–110 MHz range must not exceed 1 ± 0.5 dB.

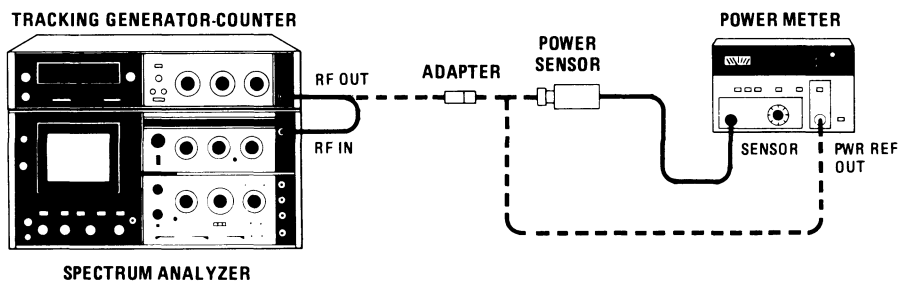


Figure 4-3. Amplitude Accuracy Test Setup

EQUIPMENT:

Power Meter	HP 436A
Power Sensor	HP 8482A
Adapter, Type N Female-to-BNC Male	HP 1250-0077

1. Connect the HP 8443A Tracking Generator-Counter RF OUTPUT 50Ω to the spectrum analyzer RF INPUT 50Ω as shown in Figure 4-3. Set the tracking generator-counter and spectrum analyzer controls as follows:

   Tracking Generator-Counter:

MODE	MARKER
RF OUTPUT LEVEL dBm attenuators	0 dBm
MARKER POSITION	CCW
RESOLUTION	100 Hz

PERFORMANCE TESTS

4-12. AMPLITUDE ACCURACY TEST (Cont'd)

Spectrum Analyzer:

FREQUENCY	30 MHz
BANDWIDTH	300 kHz
SCAN WIDTH	ZERO
INPUT ATTENUATION	20 dB
TUNING STABILIZER	OFF
BASE LINE CLIPPER	CCW
SCAN TIME PER DIVISION	2 MILLISECONDS
LOG/LINEAR	10 dB LOG
LOG REF LEVEL	0 dBm
LOG REF LEVEL vernier	0
VIDEO FILTER	OFF
SCAN MODE	INT
SCAN TRIGGER	LINE or AUTO

2. Adjust the spectrum analyzer FREQUENCY control for an indication of 30 MHz ± 10 kHz on the HP 8443A digital readout.

3. Set the spectrum analyzer BANDWIDTH to .1 kHz and tune the tracking generator-counter Track Analyzer Adjustment (ADJ) control for maximium signal amplitude on the spectrum analyzer CRT.

4. Connect the power sensor between the power meter SENSOR connector and POWER REF OUTPUT. Set the power meter MODE to dBm (pushbutton in) and RANGE HOLD off (pushbutton out). With the power meter POWER REF off (pushbutton out), momentarily press the SENSOR ZERO pushbutton to zero the power meter. Then set the POWER REF on (pushbutton in), press the WATT pushbutton, and adjust the CAL ADJ (screwdriver adjustment) for an indication of 1.00 milliwatt on the power meter digital readout. Disconnect the power sensor from the power meter POWER REF output and turn off the power meter POWER REF (pushbutton out).

5. Disconnect the cable from the tracking generator-counter RF OUTPUT 50Ω connector and set the HP 8443A POWER switch to STBY.

6. Connect the unconnected end of the power sensor through the adapter to the HP 8443A RF OUTPUT 50Ω connector. Then push the power meter SENSOR ZERO pushbutton momentarily to zero the power meter.

7. Set the HP 8443A POWER switch to ON. Press the power meter MODE dBm pushbutton and observe the reading on the power meter digital readout. Record the reading.

Maximum	Actual	Minimum
+0.3 dBm	_____	−0.3 dBm

8. With the spectrum analyzer FREQUENCY control, slowly tune the spectrum analyzer and tracking generator-counter between 100 kHz and 110 MHz as indicated on the HP 8443A counter display. Record the largest power deviation observed.

Maximum	Actual
1.0 ± 0.5 dB	_____

PERFORMANCE TESTS

4-13. OUTPUT IMPEDANCE – SWR TEST

SPECIFICATION:

50 ohms, ac coupled, reflection coefficient ≤ 0.09 (1.2 SWR) with ≤ 0 dBm output.

DESCRIPTION:

The RF output from the tracking generator is measured with an RF voltmeter, first with no load, then terminated in 50 ohms. The source resistance (R_s) of the tracking generator is then calculated and finally the SWR is determined by dividing Z_o by R_s (R_s by Z_o if R_s is greater than Z_o).

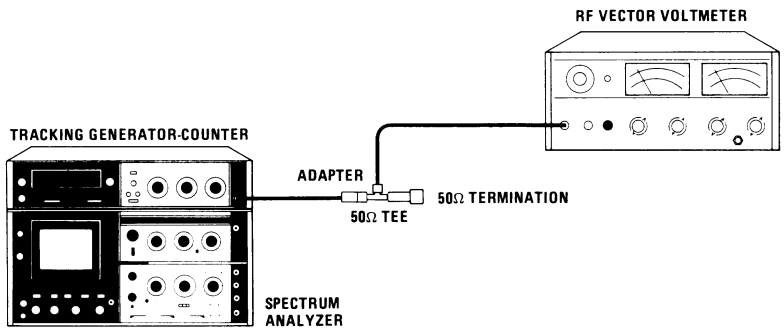


Figure 4-4. Output Impedance-SWR Test Setup

EQUIPMENT:

RF Vector Voltmeter	HP 8405A
50 ohm Termination	HP 908A*
50 ohm Tee	HP 11536A*
Adapter, Type N Female-to-BNC Male	HP 1250-0077

1. Connect the equipment as shown in Figure 4-4 and set the controls as follows:

   Tracking Generator-Counter:

RF OUTPUT LEVEL dBm	All controls set to 0
POWER	ON

*Part of HP 8405A RF Vector Voltmeter Accessory Kit, HP 11570A

4-13. OUTPUT IMPEDANCE – SWR TEST (Cont'd)

Spectrum Analyzer:

FREQUENCY ..... 30 MHz
SCAN WIDTH ..... ZERO
ALL OTHER CONTROLS ..... Any setting

RF Vector Voltmeter:

CHANNEL ..... A
FREQ RANGE-MHz ..... 30 MHz (APC locked)
RANGE ..... 1000 mV
PHASE CONTROLS ..... Not used

2. Disconnect the 50-ohm termination from the 50-ohm tee and measure the RF output of the tracking generator with the RF vector voltmeter. Record the reading:

V_{oc} =_____mVrms

3. Reconnect the 50-ohm termination to the 50-ohm tee as shown in Figure 4-4. Measure the RF output with the RF vector voltmeter. Record the reading:

V_L =_____mVrms

4. Find the source resistance of the tracking generator by the following formula:

$$R_s = \frac{R_L V_{oc}}{V_L} - R_L$$

V_{oc} = Tracking generator RF output open circuit voltage

V_L = Tracking generator RF output terminated in 50 ohms

$R_L = Z_o$ = Characteristic impedance = 50 ohms

5. Find SWR by the formula:

$$SWR = \frac{Z_o}{R_s}$$

$\frac{R_s}{Z_o}$ if R_s is greater than Z_o

6. Record this value; maximum allowable is 1.2

1.2_____SWR

PERFORMANCE TESTS

4-14. COUNTER RESOLUTION (GATE TIME) TEST

SPECIFICATION:

Selectable: 1 kHz (1 millisecond), 100 Hz (10 milliseconds), and 10 Hz (100 milliseconds).

DESCRIPTION:

In this test, the HP 8443A front-panel RESOLUTION switch is set to each of its three positions, and at each position the counter digital readout is observed.

1. Set the HP 8443A MODE switch to MARKER and pull the MARKER POSITION control knob to its out position.

2. Tune the spectrum analyzer to any frequency between 100 MHz and 110 MHz, and set the HP 8443A RESOLUTION switch to each of its three positions. Observe the HP 8443A counter readout at each position. The readouts should be as follows:

   10 Hz position. All eight digital readouts are lighted. The decimal point is between the third and fourth digital readouts.

   100 Hz position. The far left digital readout is blanked or shows a zero (depending on the setting of the rear-panel UNBLANKED-BLANKED switch). The decimal point is between the fourth and fifth digital readouts.

   1 kHz position. The two far left digital readouts are blanked or show zeros (depending on the setting on the rear-panel UNBLANKED-BLANKED switch). The decimal point is between the fifth and sixth digital readouts.

PERFORMANCE TESTS

4-15. COUNTER ACCURACY TEST

SPECIFICATION:

± 1 count ± time base accuracy.

DESCRIPTION:

This test examines the ± 1 count error of the frequency counter. Time base accuracy is tested in paragraphs 4-16 and 4-17.

1. Connect the HP 8443A rear-panel 1 MHz OUT receptable to the front-panel COUNTER INPUT receptacle, and set the MODE switch to EXTERNAL.

2. Set the RESOLUTION switch to each of its three positions and observe the counter digital readout at each position. In any of the three positions of the RESOLUTION switch, the last digit in the readout must be 0, 1, or 9.

PERFORMANCE TESTS

4-16. TIME BASE AGING RATE

SPECIFICATION:

$< 3 \times 10^{-9}$ per day. (0.003 Hz/day at 1 MHz after warmup.)

DESCRIPTION:

This test checks long term frequency stability. This is accompished by mixing the reference oscillator frequency of the HP 8443A with a stable 1.000001 MHz signal and recording the drift on a strip recorder.

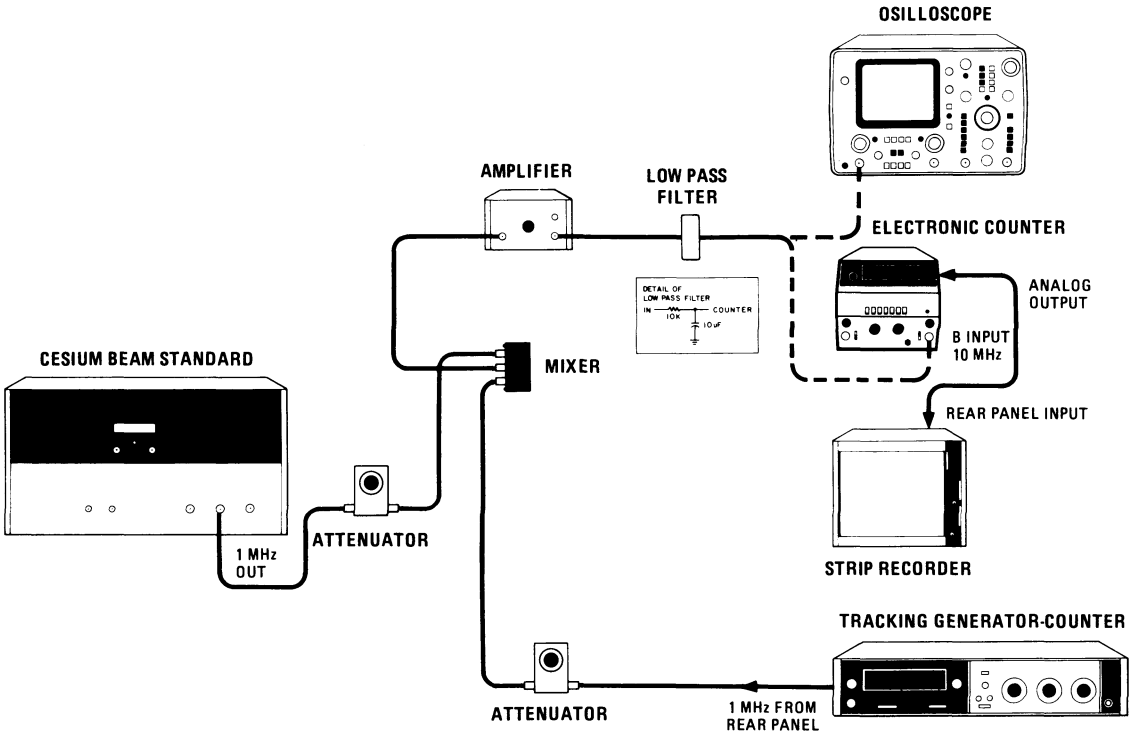


Figure 4-5. Time Base Aging Rate Test Setup

EQUIPMENT:

Cesium Beam Frequency Standard	HP 5061A
Frequency Counter and Digital to Analog Converter	HP 5300B/HP 5302A/HP 5311B
Strip-Chart Recorder	HP 680
Double Balanced Mixer	HP 10514A
Step Attenuator	HP 355D-H80
Step Attenuator	HP 355D
Amplifier, Dc to 1 MHz	HP 461A
Oscilloscope	HP 1740A or HP 1741A
Temperature Controlled Oven	Statham Model 325

PERFORMANCE TESTS

4-16. TIME BASE AGING RATE (Cont'd)

PROCEDURE:

1. Set controls as follows:

   Frequency Counter:

Function	PER AVG B
Input	Channel B (set to sine wave)
Time Base	10 μs
Sensitivity	Full Clockwise
Sample Rate	Full Counterclockwise

   Digital to Analog Converter:

COLUMN SELECTOR	Three right-most digits
MODE	OFFset
RANGE (rear panel)	0.1V Full Scale
OPERATE (rear panel)	OPERATE position

   Amplifier:

   Remove ground strap from low output terminal.

GAIN	20 dB

   Attenuators:

Attenuation	10 dB

   Strip Chart Recorder:

Line Power	ON
MIN – N – HR	HR
div	2
PEN	DOWN
RANGE	100 mV

2. After connecting the equipment as shown in Figure 4-5 and setting the controls, use the oscilloscope to check for the presence of 50 Hz ac on the input to the frequency counter. If 60 Hz ac is present, it is probably caused by a ground loop. Check all equipment grounds.

3. After warmup (seven days of continuous operation, or 72 hours of continuous operation after being off for less than 72 hours) test the time base aging rate in accordance with the following steps.

4. Disconnect the input to the frequency counter. Then set the OPERATE switch on the rear panel of the Digital-to-Analog Converter (DAC) (HP 5311B) to zero. Set the zero adjust on the DAC Recorder rear panel for a mid-range display on the Strip Chart Recorder.

5. Set the OPERATE switch on the DAC to F.S., then set the full reach adjust on the HP 5311B rear panel for a full scale deflection on the Strip Chart Recorder.

PERFORMANCE TESTS

4-16. TIME BASE AGING RATE (Cont'd)

6. Set the OPERATE switch to the operate position. Reconnect the signal input to the HP 5303A channel B input.

7. After the Digital-to-Analog Converter/Recorder has been calibrated, position the recorder stylus to a convenient point on the recording paper. Check the time base for a 24-hour period. The recorder excursions must not exceed 1.4 minor divisions.

_____ divisions

PERFORMANCE TESTS

4-17. TIME BASE TEMPERATURE DRIFT

SPECIFICATION:

$< 3 \times 10^{-8}$ (0.03 Hz) variation referenced to 100 MHz 0 to 55°C.

DESCRIPTION:

This test verifies frequency stability over the specified operating temperature range.

EQUIPMENT:

Same as for Time Base Aging Rate Test, paragraph 4-16, plus a temperature controllable oven.

PROCEDURE:

1. With the equipment connected and adjusted as indicated in paragraph 4-16, place the HP 8443A in a temperature controllable oven. Adjust the temperature to +24°C and allow the temperature to stabilize.

2. Make a reference plot on the recorder at +24°C.

3. Lower the oven temperature to 0°C and allow three hours for the temperature to stabilize. Record the deviation from the +24°C trace.

4. Increase the oven temperature to +55°C and allow three hours for the temperature to stabilize. Record the deviation from the previous traces.

5. Total deviation must be not more than 3×10^{-8}.

_____ Deviation

Table 4-3. Performance Test Record

Paragraph No.	Test	Specification	Actual Measurement
4-10	**Frequency Range**		
	Low End:	.10000 ± .0010 MHz	_____
	High End:	110.00000 ± .0100 MHz	_____
4-11	**Amplitude Range**		
	10 dB Steps:	See Table 4-1	
	1 dB Steps:	See Table 4-2	
4-12	**Amplitude Accuracy**		
	Frequency Response (Flatness):	1.0 ± 0.5 dB	_____
	Absolute (0 dBm at 30 MHz):	+0.3 to –0.3 dBm	_____
4-13	**Output Impedance - SWR**		
	SWR:	1.2 max.	_____
4-14	**Counter Resolution**		
	10 Hz	See paragraph 4-14 for	_____
	100 Hz	decimal point positions	_____
	1000 Hz		_____
4-16	**Time Base Aging Rate**	$<3\times10^{-9}$/day	_____ divisions
4-17	**Time Base Temperature Drift**	$\leqslant 3\times10^{-8}$ variation referenced to 100 MHz at 0 to 55°C	_____ deviation

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes the adjustments used to restore the HP 8443A to its peak operating condition after a repair, or to compensate for changes resulting from component aging. In addition to the adjustment procedures, this section contains illustrations showing the adjustment test setups.

5-3. EQUIPMENT REQUIRED

5-4. Each adjustment procedure includes a list of the test equipment needed to accomplish it. Minimum specifications for the test equipment are given in Table 1-4. If you must substitute other test equipment for the recommended equipment, make sure it meets these specifications.

5-5. FACTORY-SELECTED COMPONENTS

5-6. The values of some components used in the HP 8443A are selected during final assembly and test of the instrument. These components are indicated by an asterisk (*) on the schematic diagrams in this section and on the Replaceable Parts lists in Section VI.

5-7. SERVICE KIT

5-8. A Service Kit (HP Part Number 08443-60011) is available as an accessory for maintaining the HP 8443A. A complete list of the kit contents is included in Table 1-2 (see also Figure 1-2). Any item in the Service Kit may be ordered separately.

5-9. LOCATIONS OF ADJUSTMENTS AND TEST POINTS

5-10. Most of the assemblies and their adjustment controls and test points are identified by name or reference designator on the assembly covers. Locations of unlabeled assemblies and chassis-mounted parts are shown in Figure 8-42 at the back of this manual.

5-11. ADJUSTMENT PROCEDURES

5-12. There is a separate adjustment procedure for each assembly containing adjustment controls. For best results, you should do the procedures and the steps within them in the order in which they are given.

ADJUSTMENTS

5-13. POWER SUPPLIES

DESCRIPTION:

The power supplies in the HP 8443A provide regulated outputs of +6 volts, +24 volts, +20 volts, and −12 volts. These checks verify proper operation of the power supplies.

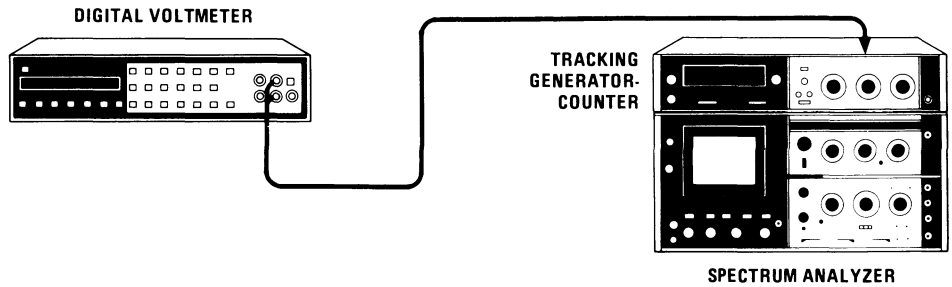


Figure 5-1. Power Supply Adjustment Test Setup

EQUIPMENT:

Digital Voltmeter	HP 3455A
Service Kit	HP 11593A

PROCEDURE:

1. Measure the dc levels and the ac ripple at the test points on the A14 Sense Amplifier.

Level	Tolerance	Ripple
+24V	±10.00 mV	<0.2 mV
+20V	±0.40V	<1.0 mV
+6.0V	±0.12V	<1.0 mV
−12V	±0.24V	<1.0 mV

2. If the voltages are not within tolerance, connect the digital voltmeter to the +24 volt test point on the A14 assembly and adjust reference level potentiometer R50. If the voltage cannot be adjusted to +24 volts, or if other dc outputs are not within tolerance, refer to Service Sheet 4 in Section VIII and repair the power supply. Repeat these tests after completing repairs.

NOTE

Resistors R33, R38, and R43 are all factory selected at time of final assembly to provide the proper reference level for the sense amplifier in which they appear. The value of these resistors determines the dc level of the supply output.

ADJUSTMENTS

5-14. FIRST CONVERTER ASSEMBLY A13

DESCRIPTION:

The first converter contains a 3 MHz crystal controlled oscillator, 3 MHz and 47 MHz amplifiers and a diode quad mixer. These tests verify proper operation of the assembly.

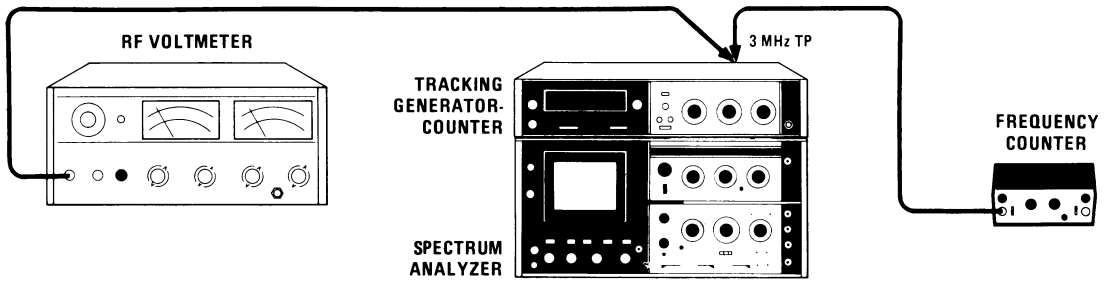


Figure 5-2. First Converter Adjustment Test Setup

EQUIPMENT:

Oscilloscope Probe	HP 10008B
RF Voltmeter	HP 8405A
Service Kit	HP 11592A
Frequency Counter	HP 5300B/5302A

PROCEDURE:

1. Set the TRACKING ADJUST control fully ccw and monitor the 3 MHz test point on the A13 assembly with the rf voltmeter Probe A. Set HP 8405A FREQ RANGE to 3 MHz (center), Channel A, and Range to 300 mV. Adjust L1 PEAK ADJ for maximum indication on the rf voltmeter.

2. Monitor the 3 MHz test point with the frequency counter and oscilloscope probe. Set L2, RANGE ADJ, for a frequency of 2.99982 MHz.

3. Turn the TRACKING ADJUST control full cw. The frequency at the 3 MHz test point should be 3.00025 MHz. If the frequency is greater than 3.00025 MHz, replace R20 with a higher value. If the frequency is less than 3.00025 MHz, replace R20 with a lower value.

4. Connect the rf voltmeter to the 3 MHz test point (Test Point 1). The maximum output level over the range of the TRACKING ADJUST control should be 240 mVrms.

   240 mVrms _____

5. Place the A13 assembly on an extender and measure the output of the 3 MHz oscillator (Test Point 4 – Q4c) with the rf voltmeter. Signal level should be 260 mVrms minimum.

   260 mVrms _____

6. Reinstall the A13 assembly and connect the 50 MHz output to the spectrum analyzer RF INPUT. The 50 MHz signal should be –26 dBm minimum.

   –26 dBm _____

ADJUSTMENTS

5-15. 50 MHz IF AMPLIFIER ASSEMBLY A12

DESCRIPTION:

The 50 MHz amplifier provides about 12 dB of gain. These tests verify proper operation of the bandpass filter and the 44 and 47 MHz traps.

EQUIPMENT:

Service Kit ..... HP 11592A

PROCEDURE:

1. Set BANDWIDTH to 10 kHz, SCAN WIDTH to 2 MHz/DIV and AMPLITUDE SCALE FACTOR to 2 dB Log.

2. Connect the.50 MHz output of the A12 assembly to the spectrum analyzer RF INPUT. Adjust the BPF ADJ capacitors for maximum 50 MHz signal on the analyzer CRT. Minimum signal level is −17 dBm.

   −17 dBm _____

3. Set AMPLITUDE SCALE FACTOR to 10 dB Log. Adjust C8 and C17 for minimum signal at 44 MHz, and C10 for minimum signal at 47 MHz. Check for minimum separation of 60 dB between the 50 MHz signal and the 44 and 47 MHz signals.

   Separation 60 dB _____

ADJUSTMENTS

5-16. 200 MHz IF Amplifier Assembly A10

DESCRIPTION:

The A10 assembly contains a two-stage variable gain (about 20 dB) amplifier and a bandpass filter. These tests verify proper operation of the assembly.

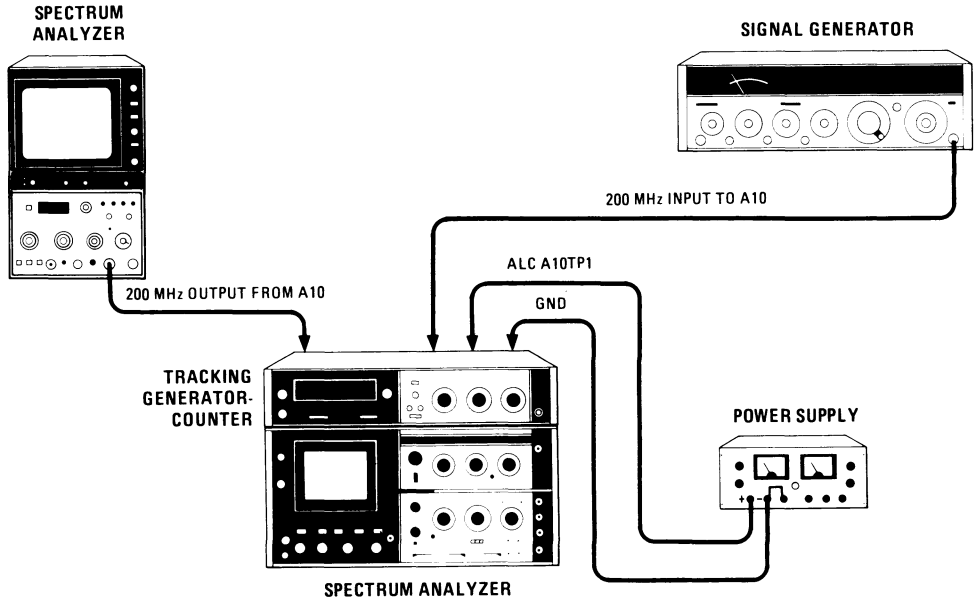


Figure 5-3. 200 MHz IF Adjustment Test Setup

EQUIPMENT:

Signal Generator	HP 8640B
Service Kit	11592A
0 – 350 MHz Spectrum Analyzer	182T/8557A
DC Power Supply	HP 6205B

PROCEDURE:

1. Apply a −10 dBm, 100 MHz CW signal to the 200 MHz input (green cable) on the A10 assembly. Connect the 200 MHz output of the A10 assembly to the INPUT 50Ω of the 0 – 350 MHz spectrum analyzer and tune the analyzer to 100 MHz. Adjust A10A1C5 (100 MHz Zero) for minimum response on the analyzer CRT.

2. Change the input signal to 150 MHz and adjust A10A1C4 (150 MHz Zero) for minimum 150 MHz response.

3. Change the input signal to 200 MHz, center the signal on the 0 – 350 spectrum analyzer CRT and adjust the bandpass filter (C3, C5 and C6) for maximum response. Reduce the output of the signal generator to −35 dBm. The minimum signal level displayed on the 0 – 350 spectrum analyzer should be −18 dBm (17 dB gain).

4. Remove the A8 assembly and apply a 23 volt dc level to the ALC Test Point (A10TP1) on the A10 assembly. Tune the ALC RANGE ADJ for minimum signal level out as observed on the 0 – 350 spectrum analyzer CRT.

ADJUSTMENTS

5-17. ALC/VIDEO AMPLIFIER ASSEMBLY A8

DESCRIPTION:

The A8 assembly contains two integrated circuit RF amplifiers and a leveling circuit which controls the gain of the 200 MHz IF amplifier. These tests verify proper operation of the assembly.

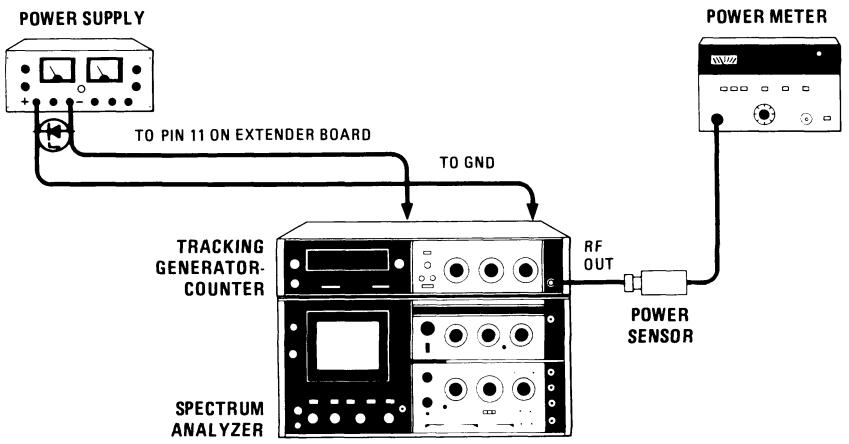


Figure 5-4. ALC/Video Amplifier Adjustment Test Setup

EQUIPMENT:

Type N to BNC Male Adapter	HP 1250-0077
Power Supply	HP 6205B
Service Kit	HP 11592A
Power Meter	HP 436A
Power Sensor	HP 8482A
3.7 Volt Zener Diode	

PROCEDURE:

1. Remove the A8 assembly and reinstall it using an extender board from the service kit.

2. Connect the 3.7 volt zener diode across the external power supply output terminals. Connect the negative power supply lead to pin 11 on the extender board and the positive lead to ground (pin 1 on extender board).

3. Set the OUTPUT LEVEL dBm TENS to (UNITS and TENTHS to 0) and connect the power meter to the RF OUTPUT. Set the analyzer to ZERO scan at 100 MHz.

4. Set OUTPUT LEVEL UNITS to −9 and TENTHS to −1. Adjust the power supply for a 0 dBm output from the HP 8443A as read on the power meter.

5. Set OUTPUT LEVEL dBm UNITS to −10 and TENTHS to 0. Adjust R16, 0 dB ADJ, on the A8 assembly for a 0 dBm output from the HP 8443A as read on the power meter.

ADJUSTMENTS

5-17. ALC/VIDEO AMPLIFIER ASSEMBLY A8 (Cont'd)

6. Repeat steps 4 and 5 until further adjustment is unnecessary.

7. Disconnect the external power supply and set OUTPUT LEVEL dBm UNITS to −9 and TENTHS to −1.

8. Adjust −1 dB ADJ (R14) on the A8 assembly for a 0 dBm output from the HP 8443A as read on the power meter.

9. Set OUTPUT LEVEL dBm UNITS to −10 and TENTHS to 0. Verify 0 dBm output with the power meter.

ADJUSTMENTS

5-18. REFERENCE OSCILLATOR ASSEMBLY A4

DESCRIPTION:

This procedure allows adjustment of the reference oscillator (A4) in comparison with an external frequency standard.

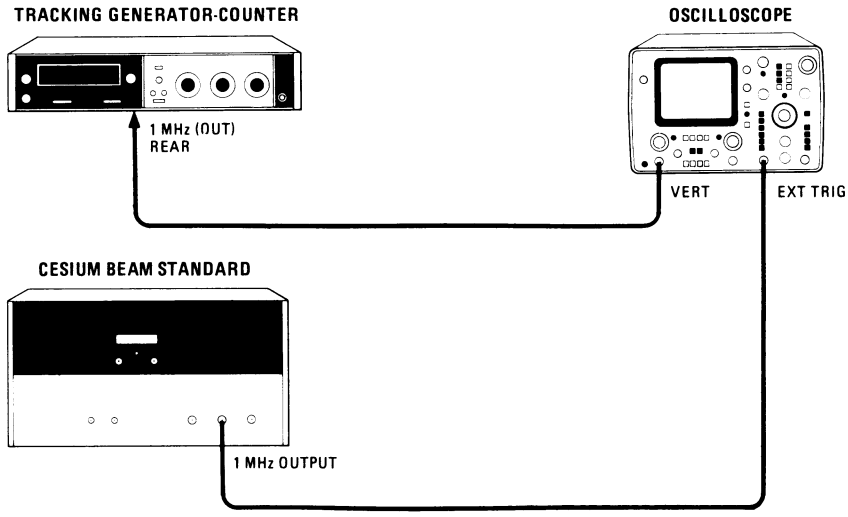


Figure 5-5. Reference Oscillator Adjustment Test Setup

EQUIPMENT:

1 MHz Frequency Standard	HP 5061A
Oscilloscope	HP 1740A/HP1741A

PROCEDURE:

After warmup (seven continuous days of operation or 72 hours of operation after an off time of 72 hours or less), connect the oscilloscope and frequency standard as shown in Figure 5-5; set the oscilloscope to .05 μSec/Div and adjust the vertical sensitivity for full scale sinusoid. Adjust the reference oscillator COARSE and FINE controls until the display moves in either direction no faster than one division in five seconds.

ADJUSTMENTS

5-19. MARKER ADJUSTMENT A7R11

DESCRIPTION:

This adjustment applies only if the marker position cannot be adjusted with the front-panel MARKER POSITION control, as described in step 10 of the Operator's Checks in Figure 3-3. Equipment, test setup, and control settings are same as indicated in Figure 3-3 (Operation section).

PROCEDURE:

1. Set front-panel MARKER POSITION control fully clockwise.

2. Adjust front-panel CTR ADJ control to place marker approximately one minor division from far right CRT graticule line.

3. Set MARKER POSITION control fully counterclockwise. The marker should appear two minor divisions or less from the far left graticule line.

4. Pull MARKER POSITION control out from front-panel and adjust trimmer potentiometer A7R11 (on Marker Control Board Assembly A7) to place the marker on the CRT center graticule line.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Table 6-1 includes a list of reference designations and a list of abbreviations used in the parts list. Table 6-2 lists names and addresses that correspond to the manufacturer code numbers in the parts list. Table 6-3 lists all replaceable parts in alpha-numerical order by reference designation.

6-3. REPLACEABLE PARTS LIST

6-4. Table 6-3, the list of replaceable parts, is organized as follows:

1. Electrical assemblies and their components in alpha-numerical order by reference designation

2. Miscellaneous parts, with appropriate electrical assembly

3. Chassis-mounted electrical parts, in alpha-numerical order by reference designation

4. Mechanical chassis parts, at end of parts list

6-5. The following information is listed for each part:

1. The Hewlett-Packard part number

2. The part number check digit (CD)

3. The total quantity (Qty) in the instrument. This quantity is given only once, at the first apppearance of the part in the list.

4. The description of the part

5. A five-digit code indicating a typical manufacturer of the part

6. The manufacturer's part number

6-6. ORDERING INFORMATION

6-7. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number (with check digit), indicate the quantity required, and address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

6-8. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

Table 6-1. Reference Designations and Abbreviations (1 of 3)

REFERENCE DESIGNATIONS

A ..... Assembly
AT ..... Attenuator, Isolator, Limiter, Termination
B ..... Fan, Motor
BT ..... Battery
C ..... Capacitor
CP ..... Coupler
CR ..... Diode, Diode Thyristor, Step Recovery Diode (SCR), Varactor
DC ..... Directional Coupler
DL ..... Delay Line
DS ..... Annunciator, Lamp, Light Emitting Diode (LED), Signaling Device (Audible or Visible)
E ..... Miscellaneous Electrical Part
F ..... Fuse
FL ..... Filter
H ..... Hardware
HY ..... Circulator
J ..... Electrical Connector (Stationary Portion), Jack
K ..... Relay
L ..... Coil, Inductor
M ..... Meter
MP .... Miscellaneous Mechanical Part
P ..... Electrical Connector (Movable Portion), Plug
Q ..... Silicon Controlled Rectifier (SCR), Transistor, Triode Thyristor
R ..... Resistor
RT ..... Thermistor
S ..... Switch
T ..... Transformer
TB ..... Terminal Board
TC ..... Thermocouple
TP ..... Test Point
U ..... Integrated Circuit, Microcircuit
V ..... Electron Tube
VR ..... Breakdown Diode (Zener), Voltage Regulator
W ..... Cable, Transmission Path, Wire
X ..... Socket
Y ..... Crystal Unit (Piezoelectric, Quartz)
Z ..... Tuned Cavity, Tuned Circuit

ABBREVIATIONS

A

A ..... Across Flats, Acrylic, Air (Dry Method), Ampere
ADJ ..... Adjust, Adjustment
ANSI ..... American National Standards Institute (formerly USASI-ASA)
ASSY ..... Assembly
AWG ..... American Wire Gage

B

BCD ..... Binary Coded Decimal
BD ..... Board, Bundle
BE-CU ..... Beryllium Copper
BNC ..... Type of Connector
BRG ..... Bearing, Boring
BRS ..... Brass
BSC ..... Basic
BTN ..... Button

C

C ..... Capacitance, Capacitor, Center Tapped, Centistoke, Cermet, Circular Mil Foot, Closed Cup, Cold, Compression
CCP ..... Carbon Composition Plastic
CD ..... Cadmium, Card, Cold-Drawn, Cord
CER ..... Ceramic
CHAM ..... Chamfer
CHAR ..... Character, Characteristic, Charcoal
CMOS ..... Complementary Metal Oxide Semiconductor
CNDCT ..... Conducting, Conductive, Conductivity, Conductor
CONT ..... Contact, Continuous, Control, Controller
CONV ..... Converter
CPRSN ..... Compression
CUP-PT ..... Cup Point
CW ..... Clockwise, Continuous Wave

D

D ..... Deep, Depletion, Depth, Diameter, Direct Current
DA ..... Darlington
DAP-GL ..... Diallyl Phthalate Glass
DBL ..... Double
DCDR ..... Decoder
DEG ..... Degree
D-HOLE ..... D-Shaped Hole
DIA ..... Diameter
DIP ..... Dual In-Line Package
DIP-SLDR ..... Dip Solder
D-MODE ..... Depletion Mode
DO ..... Package Type Designation
DP ..... Deep, Depth, Diametric Pitch, Dip
DP3TMINTR ..... Double Pole Three Throw, Miniature
DPDTMINTR .... Double Pole Double Throw, Miniature
DWL ..... Dowel

E

E-R ..... E-Ring
EXT ..... Extended, Extension, External, Extinguish

F

F ..... Fahrenheit, Farad, Female, Film (Resistor), Fixed, Flange, Flint, Fluorine, Frequency
FC ..... Carbon Film / Composition, Edge of Cutoff Frequency, Face
FDTHRU ..... Feed Through
FEM ..... Female
FIL-HD ..... Fillister Head
FL ..... Flash, Flat, Fluid
FLAT-PT ..... Flat Point
FR ..... Front
FREQ ..... Frequency
FT ..... Current Gain Bandwidth Product (Transition Frequency); Feet, Foot
FXD ..... Fixed

G

GEN ..... General, Generator
GND ..... Ground
GP ..... General Purpose, Group

H

H ..... Henry, Hermaphrodite, High, Hole Diameter, Hot, Hub Inside Diameter, Hydrogen
HDW ..... Hardware
HEX ..... Hexadecimal, Hexagon, Hexagonal
HLCL ..... Helical
HP ..... Hewlett-Packard Company, High Pass, Horsepower

I

IC ..... Collector Current, Integrated Circuit
ID ..... Identification, Inside Diameter
IF ..... Forward Current, Intermediate Frequency
IN ..... Inch, Indium
INCL ..... Including
INT ..... Integral, Intensity, Internal
INTL ..... Internal, International

J

J-FET ..... Junction Field Effect Transistor
JFET ..... Junction Field Effect Transistor

K

K ..... Kelvin, Key, Kilo, Potassium
KNRLD ..... Knurled
KVDC ..... Kilovolts Direct Current

Table 6-1. Reference Designations and Abbreviations (2 of 3)

L

LED ..... Light Emitting Diode
LG ..... Length, Long
LIN.... Linear, Linear Taper, Linearity
LK ..... Link, Lock
LKG ..... Leakage, Locking
LOGO ..... Logotype
LUM ..... Luminous

M

M ..... Male, Maximum, Mega, Mil, Milli, Mode, Momentary, Mounting Hole Centers, Mounting Hole Diameter
MA ..... Milliampere
MACH ..... Machined
MAX ..... Maximum
MC ..... Hot Molded Carbon Composition, Megacycle, Microcircuit, Molded Carbon Composition
MET ..... Metal, Metallic, Metallized, Metallurgical
MHZ ..... Megahertz
MIT ..... Miter
MLD ..... Mold, Molded
MM ..... Magnetized Material (Restricted Articles Code); Millimeter
MOM ..... Momentary
MTG ..... Mounting
MTLC ..... Metallic
MUW ..... Music Wire
MW ..... Milliwatt

N

N ..... Fan Out, Intrinsic Stand Off Ratio, Nano, Nanosecond, Nitrogen, None
N-CHAN ..... N-Channel
NH ..... Nanohenry
NM ..... Nanometer, Nonmetallic
NO ..... Normally Open, Number
NOM ..... Nominal
NPN ..... Negative Positive Negative (Transistor)
NS... Nanosecond, Non-Shorting, Nose
NUM ..... Numeric, Numerical
NYL ..... Nylon (Polyamide)

O

OA ..... Other Restricted Articles, Group A (Restricted Articles Code); Over-All
OD ..... Olive Drab, Outside Diameter
OP AMP..... Operational Amplifier
OPT ..... Optical, Option, Optional

P

PA ..... Picoampere, Power Amplifier, Pressure Angle, Protactinium
PAN-HD ..... Pan Head
PAR ..... Parallel, Parity
PB ..... Lead (Metal), Push Button
PC ..... Picocoulomb, Piece, Printed Circuit
PCB ..... Printed Circuit Board
P-CHAN ..... P-Channel
PD ..... Pad, Palladium, Pitch Diameter, Power Dissipation
PF ..... Picofarad; Pipe, Female Connection; Power Factor
PKG ..... Package
PLSTC ..... Plastic
PNL ..... Panel
PNP ..... Positive Negative Positive (Transistor)
POLYC ..... Polycarbonate
POLYE ..... Polyester
POT ..... Potentiometer
POZI ..... Pozidriv Recess
PREC ..... Precision
PRP ..... Purple, Purpose
PSTN ..... Piston
PT ..... Part, Pint, Platinum, Point, Pulse Time
PW ... Power Wirewound, Pulse Width

Q

Q ..... Figure of Merit

R

R ..... Range, Red, Resistance, Resistor, Right, Ring, Rosin, Rubber-Resin, Run Torque
REF ..... Reference
RES .... Research, Resistance, Resistor
RF ..... Radio Frequency
RGD ..... Rigid
RND ..... Round
RR ..... Rear
RVT ..... Rivet, Riveted

S

SAWR ..... Surface Acoustic Wave Resonator
SEG ..... Segment
SGL ..... Single
SI ..... Silicon, Square Inch
SL ..... Slide, Slow
SLT ..... Slate, Slot, Slotted
SMA ..... Subminiature, A Type (Threaded Connector)
SMC ..... Subminiature, C Type (Threaded Connector)
SPCG ..... Spacing
SPDTSUBMIN .... Single Pole Double Throw, Subminiature
SPST .....Single Pole Single Throw
SQ ..... Square
SST ..... Stainless Steel
STL ..... Steel
SZ ..... Size

T

T ..... Tab Width, Taper, Teeth, Temperature, Tera, Tesla, Thermoplastic (Insulation), Thickness, Time, Timed, Tooth, Turns Ratio, Typical
TA ..... Ambient Temperature, Tantalum
TC ..... Thermoplastic
THD ..... Thread, Threaded
THK ..... Thick
TO ..... Package Type Designation, Troy Ounce
TPG ..... Tapping
TR-HD ..... Truss Head
TRMR ..... Trimmer
TRN ..... Turn, Turns
TRSN ..... Torsion

U

UCD ..... Microcandela
UF ..... Microfarad
UH ..... Microhenry
UL ..... Microliter, Underwriters' Laboratories, Inc.
UNHDND ..... Unhardened

V

V ..... Vanadium, Variable, Violet, Volt, Voltage
VAC ..... Vacuum; Volts, Alternating Current
VAC/DC ..... Volts, Alternating and Direct Current
VAR ..... Variable
VDC ..... Volts, Direct Current

W

W ..... Watt, Wattage, White, Wide, Width, Wire
W/CP ..... Wire / Conductive Plastic
W/SW ..... With Switch
WW ..... Wire Wound

X

X ..... By (Used With Dimensions), Reactance
XSTR ..... Transistor

Y

YIG ..... Yttrium-Iron-Garnet

Z

ZNR ..... Zener

Table 6-1. Reference Designations and Abbreviations (3 of 3)

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-2. Manufacturers Code List

Mfr. No.	Manufacturer Name	Address	Zip Code
H9027	SCHURTER A G H	LUZERN, SW	
00000	ANY SATISFACTORY SUPPLIER		
00853	SANGAMO ELEC CO S CAROLINA DIV	PICKENS, SC	29671
01121	ALLEN-BRADLEY CO	MILWAUKEE, WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS, TX	75222
0192B	RCA CORP SOLID STATE DIV	SOMERVILLE, NJ	08876
03888	KDI PYROFILM CORP	WHIPPANY, NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX, AZ	85062
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW, CA	94042
1F556	PRECISION LAMP INC	MOUNTAIN VIEW, CA	94040
11236	CTS OF BERNE INC	BERNE IN	46711
18736	VOLTRONICS CORP	HANOVER, NJ	07936
19701	MEPCO/ELECTRA CORP	MINERAL WELLS, TX	76067
24046	TRANSITRON ELECTRONIC CORP	WAKEFIELD, MA	01880
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD, PA	16701
25088	SIEMENS CORP	ISELIN, NJ	08830
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO, CA	94304
30983	MEPCO/ELECTRA CORP	SAN DIEGO, CA	92121
32997	BOURNS INC TRIMPOT PROD DIC	RIVERSIDE, CA	92507
34649	INTEL CORP	MOUNTAIN VIEW, CA	95051
51642	CENTRE ENGINEERING INC	STATE COLLEGE, PA	16801
52763	STETTNER-TRUSH INC	CAZENOVIA, NY	13035
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS, MA	01247
75042	TRW INC PHILADELPHIC DIV	PHILADELPHIA, PA	19108
75915	LITTELFUSE INC	DES PLAINES, IL	60016

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	08443-60117	3	1	LOW FREQUENCY COUNTER ASSEMBLY	28480	08443-60117
A1E1	08443-00069	8	1	INSULATOR FREQ COUNTER	28480	08443-00069
A1MP14	0460-0198	3	1	TAPE: CORK	28480	0460-0198
A1A1	08443-60090	1	1	LOW FREQUENCY COUNTER BOARD ASSEMBLY	28480	08443-60090
A1A1C1	0160-4084	8	6	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A1C2	0180-2215	5	1	CAPACITOR-FXD 170UF+75-10% 15VDC AL	56289	30D177G015DD2
A1A1C3	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A1C4	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A1C5	0160-0127	2	1	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A1A1C6	0160-3879	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A1C7	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A1C8	0160-3875	3	2	CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A1A1C9	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A1A1C10	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A1C11	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A1C12	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A1C13	0160-0575	4	1	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A1A1CR1	1901-0535	9	4	DIODE-SM SIG SCHOTTKY	28480	1901-0535
A1A1CR2	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A1A1CR3	1901-0743	1	9	DIODE-PWR RECT 1N4004 400V 1A DO-41	01295	1N4004
A1A1L1	9100-1616	9	13	INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A1A1L2	9100-1618	1	2	INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A1A1L3	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A1A1L4	9100-1621	6	1	INDUCTOR RF-CH-MLD 18UH 10% .166DX.385LG	28480	9100-1621
A1A1Q1	1853-0281	9	9	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1A1Q2	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1A1Q3	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1A1Q4	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1A1Q5	1854-0477	7	20	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q6	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q7	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q8	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q9	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q10	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q11	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q12	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q13	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1A1Q14	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1A1Q15	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1A1Q16	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1A1Q17	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q18	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q19	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q20	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q21	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q22	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q23	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q24	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q25	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q26	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q27	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A1Q28	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1A1R1	0757-0465	6	1	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1A1R2	0757-0442	9	26	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R3	0698-3442	9	3	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A1R4	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A1R5	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A1R6	0683-1555	0	1	RESISTOR 1.5M 5% .25W FC TC=-900/+1100	01121	CB1555
A1A1R7	0757-0420	3	2	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1A1R8	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1A1R9	0698-3132	4	2	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A1A1R10	0698-3153	9	6	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A1A1R11	0698-0085	0	4	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A1A1R12	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A1A1R13	0757-0280	3	9	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1TP1	0360-0124	3	5	CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A1A1TP2	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A1A1TP3	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A1A1TP4	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A1A1U1	1810-0422	0	1	NETWORK-RES 10-SIP10.0 OHM X 9	01121	210A100
A1A1U2	1810-0037	3	1	NETWORK-RES 16-DIP1.0K OHM X 8	11236	761-3-R1K
A1A1U3	1820-1442	7	1	IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS290N
A1A1U4	1820-1644	1	1	IC DCDR TTL LS BCD-TO-7-SEG 4-TO-7-LINE	01295	SN74LS248N
A1A1U5	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A1U6	1820-1216	3	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A1A1U7	1820-2271	2	1	IC MICPROC NMOS 8-BIT	34649	D8039
A1A1U8	1820-2102	8	1	IC LCH TTL LS D-TYPE OCTL	01295	SN74LS373N
A1A1U9	08443-80002	7	1	IC-PROGRAMMED ROM	28480	08443-80002
A1A1U10	1818-0735	4	1	IC 2K RAM 400-NS	34649	P8155
A1A1U11	1820-2177	7	1	IC MICPROC-ACCESS NMOS 4-BIT	34649	P8243
A1A1XA2	1251-2035	9	1	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A1A1XU7	1200-0694	5	2	SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0694
A1A1XU9	1200-0565	9	1	SOCKET-IC 24-CONT DIP-SLDR	28480	1200-0565
A1A1XU10	1200-0694	5		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0694
A1A2	08443-60091	2	1	COUNTER DISPLAY BOARD ASSEMBLY	28480	08443-60091
A1A2DS1	1990-0725	6	8	DISPLAY-NUM-SEG 1-CHAR .43-H YEL	28480	HDSP-4130
A1A2DS2	1990-0725	6		DISPLAY-NUM-SEG 1-CHAR .43-H YEL	28480	HDSP-4130
A1A2DS3	1990-0725	6		DISPLAY-NUM-SEG 1-CHAR .43-H YEL	28480	HDSP-4130
A1A2DS4	1990-0725	6		DISPLAY-NUM-SEG 1-CHAR .43-H YEL	28480	HDSP-4130
A1A2DS5	1990-0725	6		DISPLAY-NUM-SEG 1-CHAR .43-H YEL	28480	HDSP-4130
A1A2DS6	1990-0725	6		DISPLAY-NUM-SEG 1-CHAR .43-H YEL	28480	HDSP-4130
A1A2DS7	1990-0725	6		DISPLAY-NUM-SEG 1-CHAR .43-H YEL	28480	HDSP-4130
A1A2DS8	1990-0725	6		DISPLAY-NUM-SEG 1-CHAR .43-H YEL	28480	HDSP-4130
				COUNTER DISPLAY MISCELLANEOUS PARTS		
	4040-0749	4	1	EXTR-PC BD BRN POLYC .062-BD-THKNS	28480	4040-0749
	4040-0750	7	1	EXTR-PC BD RED POLYC .062-BD-THKNS	28480	4040-0750
	1480-0059	8	2	PIN-ROLL .062-IN-DIA .25-IN-LG STL	28480	1480-0059
A1A3	08443-60095	6	1	+6V SWITCHED BOARD ASSEMBLY	28480	08443-60095
A1A3C1	0180-2620	6	1	CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A1A3CR1	1901-0050	3	7	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3CR2	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A1A3MP1	0380-0885	5		STANDOFF-RVT-ON .156-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
A1A3MP2	0380-0885	5		STANDOFF-RVT-ON .156-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
A1A3Q1	1853-0213	7	1	TRANSISTOR PNP 2N4236 SI TO-5 PD=1W	04713	2N4236
A1A3Q2	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A3R1	0757-1000	7	1	RESISTOR 51.1 1% .5W F TC=0+-100	28480	0757-1000
A1A3R2	0757-1094	9	2	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A1A3R3	0698-3439	4	1	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A1A3R4	0757-0405	4	5	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A1A3R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A3R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A3R7	0698-3454	3	1	RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A1A3TP1	1251-0600	0	9	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A3TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A3TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A3TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A3U1	1826-0161	7	1	IC OP AMP GP QUAD 14-DIP-P PKG	04713	MLM324P
A1A3VR1	1902-0126	6	1	DIODE-ZNR 2.61V 5% DO-7 PD=.4W TC=-.072%	28480	1902-0126
A1A3XA1	1251-1887	7		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1887
A2	5086-7358	2	1	ATTENUATOR ASSY:10DB(NOT FIELD REPAIRABL	28480	5086-7358
A2W1	00355-60005	5	1	CABLE ASSEMBLY:ATTENUATOR INPUT	28480	00355-60005
A3	5086-7357	1	1	ATTENUATOR ASSY:1DB(NOT FIELD REPAIRABLE	28480	5086-7357
A3W1	00355-60006	6	2	CABLE ASSEMBLY-OUTPUT, RED	28480	00355-60006
A3W2	00355-60006	6		CABLE ASSEMBLY-OUTPUT, RED	28480	00355-60006
A4	0960-0079	9	1	OSCILLATOR-CRYSTAL ASSEMBLY:1.0 MHZ	28480	0960-0079
A4W1	08443-60067	2	1	CABLE-+24V (OSC. POWER) WHITE/BLACK	28480	08443-60067
A5	08443-60094	5	1	BOARD ASSEMBLY-TIME BASE	28480	08443-60094
A5C1	0160-2055	9	25	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C5	0160-0174	9	1	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5C6	0180-0229	7	1	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A5C7	0180-0116	1	6	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A5C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C9	0180-1735	2	2	CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
A5C10*	0160-3456	6	1	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A5C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C12	0180-1735	2		CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
A5C13	0160-3453	3	9	CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3453
A5C14-C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5CR1	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A5CR2	1910-0016	0	5	DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
A5CR3	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A5CR4	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A5CR5	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A5E1	8159-0005	0	2	WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A5E2	8159-0005			WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A5J1	1250-1195	8	9	CONNECTOR-RF SM-SLD M PC 50-OHM	28480	1250-1195
A5J2	1250-1195	8		CONNECTOR-RF SM-SLD M PC 50-OHM	28480	1250-1195
A5L1	9100-1629	4	6	INDUCTOR RF-CH-MLD 47UH 5% .166DX.385LG	28480	9100-1629
A5L2	9100-1629	4		INDUCTOR RF-CH-MLD 47UH 5% .166DX.385LG	28480	9100-1629
A5L3	9100-1629	4		INDUCTOR RF-CH-MLD 47UH 5% .166DX.385LG	28480	9100-1629
A5L4	9100-1643	2		INDUCTOR RF-CH-MLD 300UH 5% .166DX.385LG	28480	9100-1643
A5Q1	1854-0404	0	3	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A5Q2	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A5Q3	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A5Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q5	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q6	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q7	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5R1	0757-0438	3	8	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A5R2	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A5R3	0757-0458	7	1	RESISTOR 51.1K 1% .125W FC TC=400/+800	28480	0757-0458
A5R4*	0757-0316	6	1	RESISTOR 42.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-42R2-F
A5R5	0757-0440	7	1	RESISTOR 7.5K 1% .125W FC TC=400/+700	28480	0757-0440
A5R6	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A5R7	0757-0416	7	11	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R8	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A5R9	0757-0394	0	6	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A5R10	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R11	0698-3441	8	7	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A5R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A5R13	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A5R14*	0757-0420	3	7	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A5R15	0757-0280	4		RESISTOR 1K 1% .125W FC TC=-400/+600	28480	0757-0280
A5R16	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A5R17	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A5R18	0757-0159	5	2	RESISTOR 1K 1% .5W F TC=0+-100	28480	0757-0159
A5R19	0757-0280	3		RESISTOR 1K 1% .125W FC TC=-400/+600	28480	0757-0280
A5R20	0757-1094	9		RESISTOR 1.47K 1% .125W FC TC=-400/+600	28480	0757-1094
A5R21	0698-3441	8		RESISTOR 1K 1% .125W FC TC=-400/+600	28480	0698-3441
A5R22	0757-0280	3		RESISTOR 1K 1% .125W FC TC=-400/+600	28480	0757-0280
A5R23	0757-0290	5		RESISTOR 6.19K 1% .125W FC TC=-400/+600	28480	0757-0290
A5R24	0698-3441	8		RESISTOR 1K 1% .125W FC TC=-400/+600	28480	0698-3441
A5R25	0757-0438	3		RESISTOR 5.11K 1% .25W FC TC=-400/+600	28480	0757-0438
A5R26	0757-0438	3	1	RESISTOR 5.11K 1% .25W FC TC=-400/+700	28480	0757-0438
A5R27	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	28480	0757-0438
A5R28	0757-0280	3		RESISTOR 1K 1% .125W FC TC=-400/+600	28480	0757-0280
A5R29	0698-8821	8	1	RESISTOR 5.62 OHM 1% .125W F TC=0+-100	24546	C4-1/8-T0-5R62-F
A5S1	3101-1213	8	1	SWITCH-TGL SUBMIN DPST .5A 120VAC PC	28480	3101-1213
A5TP1	08443-00041	6	16	TEST POINT	28480	08443-00041
A5TP2	08443-00041	6		TEST POINT	28480	08443-00041
A5TP3	08443-00041	6		TEST POINT	28480	08443-00041
A5TP4	08443-00041	6		TEST POINT	28480	08443-00041
A5TP5	08443-00041	6		TEST POINT	28480	08443-00041
A5TP6	08443-00041	6		TEST POINT	28480	08443-00041
A5U1	1820-0054	5	2	IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A5U2	1820-0304	8	2	IC FF TTL J-K M/S PULSE PRESET/CLEAR	01295	SN7472N
A5U3	1820-2078	7	5	IC 74LS490 P2 CNTR	28480	1820-2078
A5U4	1820-2078	7		IC 74LS490 P2 CNTR	28480	1820-2078
A5U5	1820-2078	7		IC 74LS490 P2 CNTR	28480	1820-2078
A5U6	1820-1217	0		IC 74LS151P MUXR	28480	1820-1217

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5W1	08443-60051	4	1	CABLE ASSEMBLY-TIME BASE INPUT	28480	08443-60051
A6	08443-60047	8		HIGH FREQUENCY DECADE ASSEMBLY (8443A ONLY)	28480	08443-60047
A6C1	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	51642	150-110-X5R-102M
A6C2	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	51642	150-110-X5R-102M
A6C3	0180-0376	5		CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A6C4	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C5	0160-2930	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2930
A6C6	0160-2930	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2930
A6C7	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	51642	150-110-X5R-102M
A6C8	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	51642	150-110-X5R-102M
A6C9	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C10	0180-0376	5		CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A6C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C12	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A6C13	0160-2930	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2930
A6C14	0160-2930	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2930
A6C15	0160-3877	5	2	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A6C16	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	51642	150-110-X5R-102M
A6C17	0180-0376	5		CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A6C18	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C19	0180-0376	5		CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A6C20	0160-2930	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2930
A6C21	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C22	0180-0376	5		CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A6C23	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C24	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	51642	150-110-X5R-102M
A6C25	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C26	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	51642	150-110-X5R-102M
A6C27	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	51642	150-110-X5R-102M
A6C28	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	51642	150-110-X5R-102M
A6C29	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C30	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C31	0160-2204	0	4	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A6C32	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C33	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C34	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C35	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A6C36	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6CR1	1901-0047	8	12	DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR2	1901-0047	8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR3	1901-0518	8	6	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6CR4	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6CR5	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	01295	1N4004
A6CR6	1901-0047	8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR7	1901-0047	8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR8	1901-0047	8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR9	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6CR10	1901-0047	8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR11	1901-0539	3	3	DIODE-SM SIG SCHOTTKY	28480	1901-0539
A6CR12	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A6CR13	1901-0039	8	4	DIODE-SWITCHING 50V 300MA 8NS	28480	1901-0039
A6CR14	1901-0039	8		DIODE-SWITCHING 50V 300MA 8NS	28480	1901-0039
A6CR15	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A6J1	1250-1194	7	12	CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
A6J2	1250-1194	7		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
A6L1	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A6L2	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A6L3	9100-1630	7	4	INDUCTOR RF-CH-MLD 51UH 5% .166DX.385LG	28480	9100-1630
A6L4	9100-1623	8	2	INDUCTOR RF-CH-MLD 27UH 5% .166DX.385LG	28480	9100-1623
A6L5	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A6L7						
A6L6	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10% COIL-.05UH (P.C. BOARD TRACE)	28480	9100-1616
A6L8	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A6L9	9100-1611	4	7	INDUCTOR RF-CH-MLD 220NH 20%	28480	9100-1611
A6L10	9100-1611	4		INDUCTOR RF-CH-MLD 220NH 20%	28480	9100-1611
A6L11	9100-1611	4		INDUCTOR RF-CH-MLD 220NH 20%	28480	9100-1611
A6L12	9100-1630	7		INDUCTOR RF-CH-MLD 51UH 5% .166DX.385LG	28480	9100-1630
A6MP1	08443-20041	8	1	COVER-HF DECADE ASSEMBLY	28480	08443-20041
A6Q1	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A6Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A6Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A6Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A6Q5	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6Q6	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A6Q7	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A6R1	0698-7229	8	4	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A6R2	0757-0395	1		RESISTOR 56.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-56R2-F
A6R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R4	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A6R5	0757-0395	1		RESISTOR 56.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-56R2-F
A6R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R7	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R8	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R9	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R10	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R11	0757-0440	7	5	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A6R12	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A6R13	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R14	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	28480	0698-0085
A6R15	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R16	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A6R17	0698-3434	9		RESISTOR 34.8 1% .125W F TC=0+-100	24546	C4-1/8-T0-34R8-F
A6R18	0757-0416	7	4	R:FXD MET FLM 511 OHMS 1% .125W	28480	0757-0416
A6R19	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R20	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A6R21	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A6R22*	0698-3434	9		RESISTOR 34.8 1% .125W F TC=0+-100	24546	C4-1/8-T0-34R8-F
A6R23	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R24*	0698-3429	2	5	RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A6R25	0698-0082	7	1	R:FXD MET FLM 464 OHMS 1% .125W	28480	0698-0082
A6R26	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R27	0757-0395	1		RESISTOR 56.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-56R2-F
A6R28	0698-7236	7	11	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R29	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R30	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R31	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R33	0698-7240	3		R:FXD MET FLM 1.47K 1% .05W	28480	0698-7240
A6R34	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R35	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R36	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R37	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R38	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6TP1	08443-00041	6		TEST POINT CONNECTOR	28480	08443-00041
A6TP2	08443-00041	6		TEST POINT CONNECTOR	28480	08443-00041
A6TP3	1250-1194	7		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
A6TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6U1	1820-0820	3	1	IC FF ECL J-BAR K-BAR COM CLOCK DUAL	04713	MC10135L
A6U2	1820-0802	1	1	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A6U3	1820-1383	5	1	IC CNTR ECL BCD POS-EDGE-TRIG	04713	MC10138L
A6U4	1820-1052	5	1	IC XLTR ECL ECL-TO-TTL QUAD 2-INP	04713	MC10125L
A6U5	1810-0204	6	1	NETWORK-RES 8-SIP1.0K OHM X 7	01121	208A102
A6VR1	1902-1291	8	1	DIODE-ZNR 1N5338B 5.1V 5% PD=5W IR=1UA	04713	1N5338B
A6VR2	1902-0048	1		DIODE-ZNR 6.81V 5% DO-35 PD=.4W	28480	1902-0048
A6VR3	1902-0048	1		DIODE-ZNR 6.81V 5% DO-35 PD=.4W	28480	1902-0048
A6W1	08443-60056	9	2	CABLE ASSEMBLY-RF, TIME BASE INPUT	28480	08443-60056
A7	08443-60097	8	1	MARKER CONTROL ASSEMBLY	28480	08443-60097
A7C	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C5	0160-2257	3	2	CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A7C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C10	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A7C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A7C12	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A7C13	0180-0098	8	1	CAPACITOR-FXD 100UF+-20% 20VDC TA	56289	150D107X0020S2

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7C14	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A7C15	0160-2139	0	9	CAPACITOR-FXD 220PF +80-20% 1KVDC CER	28480	0160-2139
A7C16	0160-2143	6		CAPACITOR-FXD 2000PF +80-20% 1KVDC CER	28480	0160-2143
A7C17	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A7C18	0180-0376	5		CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A7C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7CR1	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR2	1902-3268	3	2	DIODE-ZNR 26.1V 5% DO-35 PD=.4W	28480	1902-3268
A7CR3	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR4	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR5	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR6	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	01295	1N4004
A7CR7	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR8	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR9	1910-0016	0		DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
A7CR10	1910-0016	0		DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
A7CR11	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR12	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR13	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR14	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR15	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR16	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR17	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR18	1910-0016	0		DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
A7CR19	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR20	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR21	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A7CR22	1910-0016	0		DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
A7J1	1250-1195	8		CONNECTOR-RF SM-SLD M PC 50-OHM	28480	1250-1195
A7J2	1250-1195	8		CONNECTOR-RF SM-SLD M PC 50-OHM	28480	1250-1195
A7L1	9140-0129	1	4	INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A7L2	9100-1629	4		INDUCTOR RF-CH-MLD 47UH 5% .166DX.385LG	28480	9100-1629
A7L3	9100-1629	4		INDUCTOR RF-CH-MLD 47UH 5% .166DX.385LG	28480	9100-1629
A7L4	9100-1629	4		INDUCTOR RF-CH-MLD 47UH 5% .166DX.385LG	28480	9100-1629
A7L5	9140-0129	1		INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A7L6	9140-0129	1		INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A7L7	9140-0129	1		INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A7Q1	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A7Q2	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A7Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q5	1854-0221	9	4	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
A7Q6	1854-0221	9		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
A7Q7	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q8	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q9	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q10	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A7Q11	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A7Q12	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q13	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q14	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q15	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q16	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q17	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q18	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q19	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q20	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A7R1	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R3	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R4	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A7R5	0698-3155	1	5	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A7R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R7	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A7R8	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A7R9	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A7R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R11	2100-1758	3	1	RESISTOR-TRMR 1K 5% WW SIDE-ADJ 1-TRN	28480	2100-1758
A7R12	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A7R13	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A7R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R15	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R17	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R18	0757-0458	7	3	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A7R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A7R20	0757-0401	0	7	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A7R21	0757-0199	3	7	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A7R22	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A7R23	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A7R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R25	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A7R26	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R27	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R28	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A7R29	0698-3452	1	1	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A7R30	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R31	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A7R32	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A7R33	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A7R34	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A7R35	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A7R36	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A7R37	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A7R38	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A7R39	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A7R40	0698-3260	9	1	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A7R41	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R42	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A7R43	0757-0317	7	1	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A7TP1	08443-00041	6		TEST POINT CONNECTOR	28480	08443-00041
A7TP2	08443-00041	6		TEST POINT CONNECTOR	28480	08443-00041
A7TP3	08443-00041	6		TEST POINT CONNECTOR	28480	08443-00041
A7TP4	08443-00041	6		TEST POINT CONNECTOR	28480	08443-00041
A7TP5	08443-00041	6		TEST POINT CONNECTOR	28480	08443-00041
A7U1	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A7U2	1820-0304	8		IC FF TTL J-K M/S PULSE PRESET/CLEAR	01295	SN7472N
A8	08443-60045	6	1	VIDEO ASSEMBLY-AMPLIFIER ALC	28480	08443-60045
A8C1	0160-2145	8	12	CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A8C2	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A8C3	0180-1743	2	3	CAPACITOR-FXD .1UF+-10% 35VDC TA	56289	150D104X9035A2
A8C4	0160-2145	8		CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A8C5	0160-2145	8		CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A8C6	0160-2145	8		CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A8C7	0160-2145	8		CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A8J1	1250-1194	7		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
A8J2	1250-1194	7		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
A8J3	1250-1194	7		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
A8L1	9100-1618	1		INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A8MP1	08443-20002	1	1	HOUSING-VIDEO AMPLIFIER	28480	08443-20002
A8MP2	08443-00029	0	1	SHIELD-COVER, VIDEO AMPLIFIER	28480	08443-00029
A8Q1	1854-0221	9		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
A8Q2	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A8Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A8Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A8R1	0683-1135	2	5	RESISTOR 11K 5% .25W FC TC=-400/+800	01121	CB1135
A8R2	0683-1565	2	1	RESISTOR 15M 5% .25W FC TC=-900/+1200	01121	CB1565
A8R3	0683-1135	2		RESISTOR 11K 5% .25W FC TC=-400/+800	01121	CB1135
A8R4	0683-1045	3	3	RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A8R5	0683-1315	0	3	RESISTOR 130 5% .25W FC TC=-400/+600	01121	CB1315
A8R6	0683-1315	0		RESISTOR 130 5% .25W FC TC=-400/+600	01121	CB1315
A8R7	0683-3035	5	1	RESISTOR 30K 5% .25W FC TC=-400/+800	01121	CB3035
A8R8	0683-1135	2		RESISTOR 11K 5% .25W FC TC=-400/+800	01121	CB1135
A8R9	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A8R10	0683-1135	2		RESISTOR 11K 5% .25W FC TC=-400/+800	01121	CB1135
A8R11	0683-1135	2		RESISTOR 11K 5% .25W FC TC=-400/+800	01121	CB1135
A8R12	0757-0459	8	1	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A8R13	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A8R14	2100-2489	9	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	30983	ET50X502
A8R15	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A8R16	2100-2517	4	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	30983	ET50X503
A8R17	0683-1315	0		RESISTOR 130 5% .25W FC TC=-400/+600	01121	CB1315

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8A1	08443-60022	9	1	BOARD ASSEMBLY-VIDEO AMPLIFIER	28480	08443-60022
A8A1C1	0160-3060	8	3	CAPACITOR-FXD .1UF +-20% 25VDC CER	28480	0160-3060
A8A1C2	0160-3060	8		CAPACITOR-FXD .1UF +-20% 25VDC CER	28480	0160-3060
A8A1C3	0180-0160	5	1	CAPACITOR-FXD 22UF+-20% 35VDC TA	56289	150D226X0035R2
A8A1C4	0160-3060	8		CAPACITOR-FXD .1UF +-20% 25VDC CER	28480	0160-3060
A8A1C5	0160-3036	8	3	CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A8A1C6	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A8A1J1	1251-1556	7	1	CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A8A1R1	0683-1005	5	3	RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
A8A1R2	0683-1005	5		RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
A8A1R3	0699-0001	2	1	RESISTOR 2.7 10% .5W CC TC=0+412	01121	EB27G1
A8A1R4	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A8A1R5	0757-0421	4	2	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A8A1R6*	0698-7222	1	1	RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-G
A8A1U1	5086-7010	3	1	MC-PRE-AMP 2.1-100 MHZ	28480	5086-7010
A8A1U2	5086-7099	8	1	MC-POWER AMP 100 MHZ	28480	5086-7099
A9	08443-60044	5	1	CONVERTER ASSEMBLY-THIRD	28480	08443-60044
A9C1	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	51642	150-110-X5R-102M
A9C2	0160-2140	3	7	CAPACITOR-FXD 470PF +80-20% 1KVDC CER	28480	0160-2140
A9C3	0160-2139	0		CAPACITOR-FXD 220PF +80-20% 1KVDC CER	28480	0160-2139
A9C4	0160-2139	0		CAPACITOR-FXD 220PF +80-20% 1KVDC CER	28480	0160-2139
A9C5	0160-3425	9	1	CAPACITOR-FXD 33PF +-5% 500VDC CER	28480	0160-3425
A9C6	0160-2139	0		CAPACITOR-FXD 220PF +80-20% 1KVDC CER	28480	0160-2139
A9C7	0160-2139	0		CAPACITOR-FXD 220PF +80-20% 1KVDC CER	28480	0160-2139
A9C8	0160-2139	0		CAPACITOR-FXD 220PF +80-20% 1KVDC CER	28480	0160-2139
A9C9	0160-2260	8	1	CAPACITOR-FXD 13PF +-5% 500VDC CER 0+-30	28480	0160-2260
A9C10	0160-2139	0		CAPACITOR-FXD 220PF +80-20% 1KVDC CER	28480	0160-2139
A9C11	0160-2139	0		CAPACITOR-FXD 220PF +80-20% 1KVDC CER	28480	0160-2139
A9C12	0160-2139	0		CAPACITOR-FXD 220PF +80-20% 1KVDC CER	28480	0160-2139
A9J1	1250-1194	7		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
A9J2	08443-20011	2		CONNECTOR-RECESS	28480	08443-20011
A9L1	9140-0158	6	6	INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A9L2	9100-2248	5	1	INDUCTOR RF-CH-MLD 120NH 10% .105DX.26LG	28480	9100-2248
A9L3	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A9L4	9100-2247	4	5	INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A9L5	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A9Q1	1854-0247	9	3	TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A9Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A9Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A9R1	0757-0398	4	2	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A9R2	0757-0403	2	1	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A9R3	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A9R4	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A9R5	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A9R6	0757-0346	2	3	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A9R7	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9R8	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A9R9	0698-3431	6	2	RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
A9R10	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9R11	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A9R12	0757-0419	0	1	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A9R13	0757-0422	5	1	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A9R14	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A9R15	0757-1060	9	1	RESISTOR 196 1% .5W F TC=0+-100	28480	0757-1060
A9R16	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9T1	08552-6018	6	4	TRANSFORMER-RF (CODE=RED)	28480	08552-6018
A9T2	08552-6018	6		TRANSFORMER-RF (CODE=RED)	28480	08552-6018
A9W1	08443-60058	1	2	CABLE ASSEMBLY:RF, GREEN	28480	08443-60058
A9W2	08443-60057	0	3	CABLE ASSEMBLY:RF, VIOLET	28480	08443-60057
A9A1	08443-60005	8	1	MIXER ASSEMBLY:THIRD	28480	08443-60005
A9A1CR1	5080-0271	2	2	DIODE-SILICON (MATCHED QUAD)	28480	5080-0271
A9A1CR2				PART OF A9A1CR1		
A9A1CR3				PART OF A9A1CR1		
A9A1CR4				PART OF A9A1CR1		
A9A1J1	1250-0828	2	1	CONNECTOR-RF SMC M SGL-HOLE-RR 50-OHM	28480	1250-0828

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9A1R1	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A9A1R2	0698-3438	3	4	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A9A1R3	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A9A1T1	08552-6024	9	4	TRANSFORMER-RF (CODE=YELLOW)	28480	08552-6024
A9A1T2	08552-6012	4	4	TRANSFORMER-RF (CODE=BLUE)	28480	08552-6012
A9A1T3	08552-6012	4		TRANSFORMER-RF (CODE=BLUE)	28480	08552-6012
A9A1T4	08552-6024	9		TRANSFORMER-RF (CODE=YELLOW)	28480	08552-6024
				A9A1 MISCELLANEOUS PARTS		
	0340-0038	6	1	TERMINAL-STUD DBL-TUR PRESS-MTG	28480	0340-0038
	0340-0039	7	1	TERMINAL BUSHING - TEFLON: MOUNTS IN	28480	0340-0039
	08443-00031	4	1	SHIELD-COVER, THIRD MIXER	28480	08443-00031
	08443-00037	0	1	SHIELD-CAN, THIRD MIXER	28480	08443-00037
	08443-00038	1	1	INSULATOR, THIRD MIXER	28480	08443-00038
A9A2	08443-60006	9	1	FILTER ASSEMBLY- 120 MHZ	28480	08443-60006
A9A2C1	0160-2013	9	2	CAPACITOR-FXD 39PF +-5% 300VDC MICA	28480	0160-2013
A9A2C2	0160-2016	2	2	CAPACITOR-FXD 62PF +-5% 500VDC MICA	28480	0160-2016
A9A2C3	0160-0949	6	1	CAPACITOR-FXD 68PF +-5% 300VDC MICA	28480	0160-0949
A9A2C4	0160-2016	2		CAPACITOR-FXD 62PF +-5% 500VDC MICA	28480	0160-2016
A9A2C5	0160-2013	9		CAPACITOR-FXD 39PF +-5% 300VDC MICA	28480	0160-2013
A9A2L1	08553-6018	7	4	INDUCTOR ASSEMBLY-AIR CORE	28480	08553-6018
A9A2L2	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A9A2L3	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A9A2L4	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A9A2L5	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A9A2L6	08553-6018	7		INDUCTOR ASSEMBLY-AIR CORE	28480	08553-6018
A9A2P1	1250-0880	6	1	CONNECTOR-RF SMC FEM SGL-HOLE-FR 50-OHM	28480	1250-0880
				A9A2 MISCELLANEOUS PARTS		
	08443-00034	7	1	SHIELD-COVER,120 MHZ	28480	08443-00034
	08443-00035	8	1	SHIELD-CAN 120 MHZ	28480	08443-00035
	08443-00068	7	1	INSULATOR-SECOND MIXER	28480	08443-00068
A10	08443-60043	4	1	IF ASSEMBLY-200 MHZ	28480	08443-60043
A10C1	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A10C2	0160-2140	3		CAPACITOR-FXD 470PF +80-20% 1KVDC CER	28480	0160-2140
A10C3	0160-2140	3		CAPACITOR-FXD 470PF +80-20% 1KVDC CER	28480	0160-2140
A10C4	0121-0446	6	1	CAPACITOR-V TRMR-CER 4.5-20PF 160V	28480	0121-0446
A10C5	0121-0105	4	1	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A10C6	0160-2140	3		CAPACITOR-FXD 470PF +80-20% 1KVDC CER	28480	0160-2140
A10C7	0150-0050	9	29	CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A10C8	0160-2140	3		CAPACITOR-FXD 470PF +80-20% 1KVDC CER	28480	0160-2140
A10C9	0160-2140	3		CAPACITOR-FXD 470PF +80-20% 1KVDC CER	28480	0160-2140
A10C10	0122-0285	3	1	DIODE-VVC 6.8PF 5% C2/C20-MIN=2 BVR=20V	28480	0122-0285
A10C11	0160-2140	3		CAPACITOR-FXD 470PF +80-20% 1KVDC CER	28480	0160-2140
A10C12	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A10C13	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A10C14	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A10C15				NOT ASSIGNED		
A10C16	0160-2145	8		CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A10C17	0160-2244	8	1	CAPACITOR-FXD 3PF +-.25PF 500VDC CER	28480	0160-2244
A10CR1	1902-3104	6	2	DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A10CR2	1902-3104	6		DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A10L1	9100-1611	4		INDUCTOR RF-CH-MLD 220NH 20%	28480	9100-1611
A10L2	9100-1610	3	2	INDUCTOR RF-CH-MLD 150NH 20%	28480	9100-1610
A10L3	9100-1610	3		INDUCTOR RF-CH-MLD 150NH 20%	28480	9100-1610
A10L4	9140-0141	7	2	INDUCTOR RF-CH-MLD 680NH 10% .105DX.26LG	28480	9140-0141
A10L5	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A10L6	9100-3101	1	1	COIL-VAR 142NH-158NH Q=80 PC-MTG	28480	9100-3101
A10L7	9100-1612	5	3	INDUCTOR RF-CH-MLD 330NH 20%	28480	9100-1612
A10L8	9140-0141	7		INDUCTOR RF-CH-MLD 680NH 10% .105DX.26LG	28480	9140-0141
A10L9	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A10L10	9140-0120	2	1	INDUCTOR RF-CH-MLD 100NH 20%	28480	9140-0120
A10Q1	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A10Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A10R1	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A10R2	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R3	0757-0417	8	4	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A10R4	0683-3025	3		RESISTOR 3K 5% .25W FC TC=-400/+700	01121	CB3025
A10R5	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10R6	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R7	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A10TP1	08443-00041	6		TEST POINT CONNECTOR	28480	08443-00041
A10W1	08443-60058	1		CABLE ASSEMBLY-RF, GREEN	28480	08443-60058
A10A1	08443-60007	0	1	FILTER ASSEMBLY-200 MHZ	28480	08443-60007
A10A1C	0160-3121	2	2	CAPACITOR-FDTHRU 15PF 10% 500V CER	01121	FB2B 1501
A10A1C2	0160-2266	4	2	CAPACITOR-FXD 24PF +-5% 500VDC CER 0+-30	28480	0160-2266
A10A1C3	0121-0457	9	3	CAPACITOR-V TRMR-PSTN .8-8.5PF 750V	18736	TP9
A10A1C4	0160-2257	3		CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A10A1C5	0121-0457	9		CAPACITOR-V TRMR-PSTN .8-8.5PF 750V	18736	TP9
A10A1C6	0121-0457	9		CAPACITOR-V TRMR-PSTN .8-8.5PF 750V	18736	TP9
A10A1C7				NOT ASSIGNED		
A10A1C8	0160-2266	4		CAPACITOR-FXD 24PF +-5% 500VDC CER 0+-30	28480	0160-2266
A10A1C9	0160-3121	2		CAPACITOR-FDTHRU 15PF 10% 500V CER	01121	FB2B 1501
A10A1J1	1250-1194	7		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
	2190-0057	2	4	WASHER-LK INTL T NO. 12 .218-IN-ID	28480	2190-0057
	0590-0060	3	4	NUT-HEX-DBL-CHAM 12-32-THD .078-IN-THK	00000	ORDER BY DESCRIPTION
A10A1L1	08553-6018	7		INDUCTOR ASSEMBLY-AIR CORE	28480	08553-6018
A10A1L2	08553-6017	5	1	INDUCTOR ASSEMBLY-200 MHZ	28480	08553-6017
A10A1L3	08553-6018	7		INDUCTOR ASSEMBLY-AIR CORE	28480	08553-6018
				A10A1 MISCELLANEOUS PARTS		
	08443-00039	2	1	SHIELD-CAN 200 MHZ	28480	08443-00039
	08553-0026	8	1	SHIELD-COVER FIRST MIXER	28480	08553-0026
	08553-0027	0	1	INSULATOR-FIRST MIXER	28480	08553-0027
	0380-0810	6	2	STANDOFF-RVT-ON .437-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
A11	08443-60042	3	1	CONVERTER ASSEMBLY-SECOND	28480	08443-60042
A11C1	0160-2145	8		CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A11C2	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A11C3	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A11C4	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A11C5	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A11C6	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A11C7	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A11C8	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A11C9	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A11C10	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A11C11	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A11CR1	1902-3139	7	2	DIODE-ZNR 8.25V 5% DO-35 PD=.4W	28480	1902-3139
A11CR2	5080-0271	2		DIODE-SILICON (MATCHED QUAD)	28480	5080-0271
A11CR3				PART OF A11CR2		
A11CR4				PART OF A11CR2		
A11CR5				PART OF A11CR2		
A11J1	1250-1195	8		CONNECTOR-RF SM-SLD M PC 50-OHM	28480	1250-1195
A11J2	1250-1195	8		CONNECTOR-RF SM-SLD M PC 50-OHM	28480	1250-1195
A11L1	9140-0144	0	3	INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A11L2	9100-1612	5		INDUCTOR RF-CH-MLD 330NH 20%	28480	9100-1612
A11Q1	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A11Q2	1853-0018	0	1	TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A11Q3	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A11R1	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A11R2	0757-0397	3	2	RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A11R3	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A11R4	0757-0276	7	3	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A11R5	0698-3428	1	1	RESISTOR 14.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-14R7-F
A11R6	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A11R7	0757-0269	8	1	RESISTOR 270 1% .125W F TC=0+-100	24546	C4-1/8-T0-271-F
A11R8	0698-7200	5	1	RESISTOR 31.6 1% .05W F TC=0+-100	24546	C3-1/8-T00-31R6-G
A11R9	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A11R10	0757-0815	0	2	RESISTOR 562 1% .5W F TC=0+-100	28480	0757-0815
A11R11	0698-3334	8	1	RESISTOR 178 1% .5W F TC=0+-100	28480	0698-3334
A11R12	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A11R13	0698-3401	0	1	RESISTOR 215 1% .5W F TC=0+-100	28480	0698-3401
A11R15	0757-0394	0		NOT ASSIGNED RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A11R16	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A11R17	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A11R18	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A11R19	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A11R20	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11R21	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A11T1	08552-6024	9		TRANSFORMER-RF (CODE=YELLOW)	28480	08552-6024
A11T2	08552-6012	4		TRANSFORMER-RF (CODE=BLUE)	28480	08552-6012
A11T3	08552-6012	4		TRANSFORMER-RF (CODE=BLUE)	28480	08552-6012
A11T4	08552-6024	9		TRANSFORMER-RF (CODE=YELLOW)	28480	08552-6024
A11W1	08443-60057	0		CABLE ASSEMBLY-RF, VIOLET	28480	08443-60057
A12	08443-60041	2	1	IF ASSEMBLY-50 MHZ	28480	08443-60041
A12C1	0160-2145	8		CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A12C2	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A12C3	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A12C4	0160-2142	5	1	CAPACITOR-FXD 1500PF +100-0% 500VDC CER	28480	0160-2142
A12C5	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A12C6	0160-2254	0	3	CAPACITOR-FXD 7.5PF +-.25PF 500VDC CER	28480	0160-2254
A12C7	0160-2307	4	1	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A12C8	0121-0059	7	3	CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304324 2/8PF NPO
A12C9	0160-2254	0		CAPACITOR-FXD 7.5PF +-.25PF 500VDC CER	28480	0160-2254
A12C10	0121-0059	7		CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304324 2/8PF NPO
A12C11	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A12C12	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A12C13	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A12C14	0160-2201	7	1	CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A12C15	0160-2254	0		CAPACITOR-FXD 7.5PF +-.25PF 500VDC CER	28480	0160-2254
A12C16				NOT ASSIGNED		
A12C17	0121-0059	7		CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304324 2/8PF NPO
A12L1	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A12L2	9100-0346	0	1	INDUCTOR RF-CH-MLD 50NH 20% .105DX.26LG	29480	9100-0346
A12L3	9140-0096	1	3	INDUCTOR RF-CH-MLD 1UH 10% .166DX.385LG	28480	9140-0096
A12L4	9140-0114	4	1	INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A12L5	9140-0096	1		INDUCTOR RF-CH-MLD 1UH 10% .166DX.385LG	28480	9140-0096
A12L6	9140-0096	1		INDUCTOR RF-CH-MLD 1UH 10% .166DX.385LG	28480	9140-0096
A12Q1	1853-0089	5	1	TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A12Q2	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A12R1	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A12R2	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A12R3	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A12R4	0757-0159	5		RESISTOR 1K 1% .5W F TC=0+-100	28480	0757-0159
A12R5	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A12R6	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A12R7	0757-1092	7	1	RESISTOR 287 1% .5W F TC=0+-100	28480	0757-1092
A12R8	0698-3437	2	1	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A12R9	0757-0382	6	1	RESISTOR 16.2 1% .125W F TC=0+-100	28480	0757-0382
A12R10	0698-4037	0	1	RESISTOR 46.4 1% .125W F TC=0+-100	28480	0698-4037
A12T1	08552-6018	6		TRANSFORMER-RF (CODE=RED)	28480	08552-6018
A12T2	08552-6018	6		TRANSFORMER-RF (CODE=RED)	28480	08552-6018
A12W1	08443-60057	0		CABLE ASSEMBLY-RF, VIOLET	28480	08443-60057
A12A1	08443-60004	7	1	FILTER ASSEMBLY-50 MHZ	28480	08443-60004
A12A1C1	0160-0778	9	1	CAPACITOR-FDTHRU 56PF 10% 500V CER	01121	FB2B56-500WV-K
A12A1C2	0160-0145	4	1	CAPACITOR-FXD 82PF +-2% 100VDC MICA	28480	0160-0145
A12A1C3				NOT ASSIGNED		
A12A1C4	0160-2258	4	4	CAPACITOR-FXD 11PF +-5% 500VDC CER 0+-30	28480	0160-2258
A12A1C5	0121-0036	0	4	CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A12A1C6	0121-0036	0		CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A12A1C7	0160-2258	4		CAPACITOR-FXD 11PF +-5% 500VDC CER 0+-30	28480	0160-2258
A12A1C8	0160-2258	4		CAPACITOR-FXD 11PF +-5% 500VDC CER 0+-30	28480	0160-2258
A12A1C9	0121-0036	0		CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A12A1C10	0121-0036	0		CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A12A1C11	0160-2258	4		CAPACITOR-FXD 11PF +-5% 500VDC CER 0+-30	28480	0160-2258
A12A1C12	0160-2362	1	1	CAPACITOR-FXD 140PF +-2% 300VDC MICA	28480	0160-2362
A12A1J1	1250-1194	7		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
	0590-0060	3		NUT-HEX-DBL-CHAM 12-32-THD .078-IN-THK	00000	ORDER BY DESCRIPTION
	2190-0057	2		WASHER-LK INTL T NO. 12 .218-IN-ID	28480	2190-0057
A12A1L1	08552-6023	7	1	INDUCTOR ASSEMBLY-AIR CORE	28480	08552-6023
A12A1L2	08552-6017	4	1	INDUCTOR ASSEMBLY-50 MHZ	28480	08552-6017
A12A1MP1	08443-00032	5	1	SHIELD-CAN 50 MHZ FL	28480	08443-00032
A12A1MP2	08443-00033	6	1	SHIELD-COVER 50 MHZ	28480	08443-00033
A12A1MP3	08552-0023	1	1	INSULATOR-47 MHZ OSC.	28480	08552-0023

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13	08443-60077	4	1	CONVERTER ASSEMBLY-FIRST	28480	08443-60077
	08443-20046	3	1	COVER-FIRST CONVERTER	28480	08443-20046
	0624-0097	9	3	SCREW-TPG 4-40 .188-IN-LG PAN-HD-POZI	28480	0624-0097
A13C1	0160-2145	8		CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A13C2	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A13C3	0160-2145	8		CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A13C4	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A13C5	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A13C6	0160-3453	3		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3453
A13C7	0160-3453	3		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3453
A13C8	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A13C9	0160-3453	3		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3453
A13C10	0160-2229	9	1	CAPACITOR-FXD 3000PF +-5% 300VDC MICA	28480	0160-2229
A13C11	0160-0157	8	1	CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A13C12	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A13C13	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A13C14	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A13C15	0122-0049	7	1	DIODE-VVC 92.5PF 10% C3/C20-MIN=3	28480	0122-0049
A13C17	0150-0050	9		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A13C18	0160-3453	3		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3453
A13C19	0160-2145	8		CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A13C20	0160-2145	8		CAPACITOR-FXD 5000PF +80-20% 100VDC CER	28480	0160-2145
A13C21	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A13C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C23	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C24	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C26	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13CR1	1902-3139	7		DIODE-ZNR 8.25V 5% DO-35 PD=.4W	28480	1902-3139
A13CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13J1	1250-1195	8		CONNECTOR-RF SM-SLD M PC 50-OHM	28480	1250-1195
A13J2	1250-1195	8		CONNECTOR-RF SM-SLD M PC 50-OHM	28480	1250-1195
A13J3	1250-1195	8		CONNECTOR-RF SM-SLD M PC 50-OHM	28480	1250-1195
A13L1	9100-3102	2	1	COIL-VAR 1.42UH-1.58UH PC-MTG	28480	9100-3102
A13L2	9100-3103	3	1	COIL-VAR 42UH-51.5UH PC-MTG	28480	9100-3103
A13L3	9100-1612	5		INDUCTOR RF-CH-MLD 330NH 20%	28480	9100-1612
A13L4	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A13L5	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A13Q1	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A13Q2	1853-0034	0	1	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A13Q3	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A13Q4	1854-0023	9	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A13Q5	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13Q6	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13Q7	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13Q8	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A13Q9	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A13Q10	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13R1	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A13R2	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A13R3	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A13R4	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A13R5	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A13R6	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A13R7	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A13R8	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A13R9	0757-0288	1	6	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A13R10	0683-1045	3		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A13R11	0698-3443	0	1	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A13R12	0698-3431	6		RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
A13R13	0757-0815	0		RESISTOR 562 1% .5W F TC=0+-100	28480	0757-0815
A13R14	0698-0082	7	1	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A13R15	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R16	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A13R17	0683-1085	5		RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
A13R18	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A13R19	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A13R20	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13R21	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A13R22	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A13R23	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A13R24	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A13R25	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R26	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A13R27	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R28	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R29	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A13R30	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R31	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R32	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A13R33	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R34	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A13T1	08443-80001	6	2	TRANSFORMER-RF	28480	08443-80001
A13T2	08443-80001	6		TRANSFORMER-RF	28480	08443-80001
A13XY1	1200-0770	8	1	SOCKET-XTAL 2-CONT HC-6/U DIP-SLDR	28480	1200-0770
A13Y1	0410-0474	3	1	CRYSTAL-QUARTZ 3.000 MHZ	28480	0410-0474
A14	08443-60015	0	1	SENSE AMPLIFIER BOARD ASSEMBLY	28480	08443-60015
A14C1	0160-0163	6	1	CAPACITOR-FXD .033UF +-10% 200VDC POLYE	28480	0160-0163
A14C2	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A14C3	0180-1743	2		CAPACITOR-FXD .1UF+-10% 35VDC TA	56289	150D104X9035A2
A14C4	0180-1743	2		CAPACITOR-FXD .1UF+-10% 35VDC TA	56289	150D104X9035A2
A14C5	0180-1745	4	1	CAPACITOR-FXD 1.5UF+-10% 20VDC TA	56289	150D155X9020A2
A14C6	0180-0291	3	3	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A14C7	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A14C8	0160-2208	4	1	CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A14C9	0180-1747	6	1	CAPACITOR-FXD 150UF+-20% 15VDC TA	56289	150D157X0015
A14C10	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A14CR1	1901-0200	5	11	DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A14CR2	1902-0048	1		DIODE-ZNR 6.81V 5% DO-35 PD=.4W	28480	1902-0048
A14CR3	1902-3193	3	1	DIODE-ZNR 13.3V 5% DO-35 PD=.4W	28480	1902-3193
A14CR4	1884-0012	9	2	THYRISTOR-SCR 2N3528 TO-8 VRRM=200	0192B	2N3528
A14CR5	1902-0033	4	1	DIODE-ZNR 1N823 6.2V 5% DO-7 PD=.4W	24046	1N823
A14CR6	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A14CR7	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A14CR8	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A14CR9	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A14CR10	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A14CR11	1884-0012	9		THYRISTOR-SCR 2N3528 TO-8 VRRM=200	0192B	2N3528
A14CR12	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A14CR13	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A14CR14	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A14CR15	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A14CR16	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A14CR17	1902-3268	3		DIODE-ZNR 26.1V 5% DO-35 PD=.4W	28480	1902-3268
A14CR18	1902-3256	9	1	DIODE-ZNR 23.7V 5% DO-35 PD=.4W	28480	1902-3256
A14CR19	1902-0049	2	1	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A14Q1	1854-0039	7	4	TRANSISTOR NPN 2N3053S SI TO-39 PD=1W	0192B	2N3053S
A14Q2	1854-0039	7		TRANSISTOR NPN 2N3053S SI TO-39 PD=1W	0192B	2N3053S
A14Q3	1854-0039	7		TRANSISTOR NPN 2N3053S SI TO-39 PD=1W	0192B	2N3053S
A14Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A14Q5	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q6	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q7	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q8	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q9	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q10	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q11	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q12	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q13	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q14	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q15	1854-0039	7		TRANSISTOR NPN 2N3053S SI TO-39 PD=1W	0192B	2N3053S
A14Q16	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q17	1854-0221	9		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
A14Q18	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14Q19	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A14R1	0683-5115	6	5	RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A14R2	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A14R3	0683-0275	9	4	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A14R4	0683-1015	7	4	RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A14R5	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14R6	0683-1635	7	2	RESISTOR 16K 5% .25W FC TC=-400/+800	01121	CB1635
A14R7	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A14R8	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A14R9	0683-5125	8	3	RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A14R10	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A14R11	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A14R12	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A14R13	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A14R14	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A14R15	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A14R16	0683-6205	7	2	RESISTOR 62 5% .25W FC TC=-400/+500	01121	CB6205
A14R17	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A14R18	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A14R19	0698-3409	8	2	RESISTOR 2.37K 1% .5W F TC=0+-100	28480	0698-3409
A14R20	0683-1125	0	1	RESISTOR 1.1K 5% .25W FC TC=-400/+700	01121	CB1125
A14R21	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A14R22	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A14R23	0698-3159	5	1	RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A14R24	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A14R25	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A14R26	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A14R27	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A14R28	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A14R29	0683-6235	3	2	RESISTOR 62K 5% .25W FC TC=-400/+800	01121	CB6235
A14R30	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A14R31	0683-1635	7		RESISTOR 16K 5% .25W FC TC=-400/+800	01121	CB1635
A14R32	0757-0821	8	1	RESISTOR 1.21K 1% .5W F TC=0+-100	28480	0757-0821
A14R33*	0757-0418	9	1	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A14R34	0698-3150	6	2	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A14R35	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A14R36	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R37	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A14R38*	0757-0428	1	3	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A14R39	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R40	0683-4315	6	1	RESISTOR 430 5% .25W FC TC=-400/+600	01121	CB4315
A14R41	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A14R42	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R43*	0698-0084	9	7	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A14R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R45	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A14R46	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A14R47	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A14R48	0683-6235	3		RESISTOR 62K 5% .25W FC TC=-400/+800	01121	CB6235
A14R49	0698-3409	8		RESISTOR 2.37K 1% .5W F TC=0+-100	28480	0698-3409
A14R50	2100-2632	4	1	RESISTOR-TRMR 100 10% C SIDE-ADJ 1-TRN	30983	ET50X101
A14R51	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A14R52	0683-6205	7		RESISTOR 62 5% .25W FC TC=-400/+500	01121	CB6205
A14R53	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A14S1	3101-1277	4	1	SWITCH-TGL SUBMIN SPDT .5A 120VAC PC	28480	3101-1277
A14TP1				NOT ASSIGNED		
A14TP2	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A14TP3	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A14TP4	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A14TP5	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15	08443-60118	4	1	BOARD ASSY: RECTIFIER	28480	08443-60118
A15C1	0170-0040	9	2	C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A15C2	0170-0040	9		C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A15C3	0160-3453	3	4	C:FXD CER 0.05 UF +80–20% 100VDCW	56289	C023A101L503ZS25-CD4
A15C4	0160-3453	3		C:FXD CER 0.05 UF +80–20% 100VDCW	56289	C023A101L503ZS25-CD4
A15C5	0160-3453	3		C:FXD CER 0.05 UF +80–20% 100VDCW	56289	C023A101L503ZS25-CD4
A15C6	0160-3453	3		C:FXD CER 0.05 UF +80–20% 100VDCW	56289	C023A101L503ZS25-CD4
A15CR1	1901-0200	5	4	DIODE:SILICON 100 PIV 3A	02735	IN4998
A15CR2	1901-0200	5		DIODE:SILICON 100 PIV 3A	02735	IN4998
A15CR3	1901-0200	5		DIODE:SILICON 100 PIV 3A	02735	IN4988
A15CR4	1901-0200	5		DIODE:SILICON 100 PIV 3A	02735	IN4988
A15CR5	1901-0743	1	2	DIODE:SILICON 1A 400 PIV	28480	1901-0743
A15CR6	1901-0743	1		DIODE:SILICON 1A 400 PIV	28480	1901-0743
A15CR7	1902-3002	3	1	DIODE:ZENER 2.3V 5%	28480	1902-3002
A15F1	2110-0001	8	3	FUSE:1 AMP 250V FB	75915	312001.
A15F2	2110-0001	8		FUSE:1 AMP 250V FB	75915	312001.
A15F3	2110-0002	9		FUSE:2 AMP 250V FB	75915	312.002
A15F4	2110-0001	8		FUSE:1 AMP 250V FB	75915	312001.
A15Q1	1853-0007	7	1	TSTR:SI PNP 2N3251	28480	1853-0007
A15R1	0812-0012	7	1	R:FXD WW 18 OHM 5% 3W	28480	0812-0012
A15R2	0698-0084	9	1	R:FXD MET FLM 2.15K OHM 1% .120W	28480	0698-0084
A15R3	0757-0833	2	1	R:FXD MET FLM 5.11K OHM 1% .05W	28480	0757-0833
A15XF1	2110-0269	0	8	CLIP:FUSE 0.250 IN DIA	91506	6008-32CN
A15XF2	2110-0269	0		CLIP:FUSE 0.2550 IN DIA	91506	6008-32CN
A15XF3	2110-0269	0		CLIP:FUSE 0.250 IN DIA	91506	6008-32CN
A15XF4	2110-0269	0		CLIP:FUSE 0.250 IN DIA	91506	6008-32CN
A16	08443-60038	7	1	SWITCH BOARD ASSEMBLY (8443A ONLY)	28480	08443-60038
A16S1	08443-60073	0	1	SWITCH ASSEMBLY:SLIDE	28480	08443-60073
A16S2	08443-60072	9	3	SWITCH ASSEMBLY:SLIDE	28480	08443-60072
A16S3	08443-60072	9		SWITCH ASSEMBLY:SLIDE	28480	08443-60072
A16	08443-60138	8	1	SWITCH BOARD ASSEMBLY	28480	08443-60138
A16S1				NOT ASSIGNED		
A16S2	08443-60072	9		SWITCH ASSEMBLY-SLIDE	28480	08443-60072
A16S3				NOT ASSIGNED		
A17				JACK ASSEMBLY-INTERCONNECTION		
A17J1	1251-2366	9	1	CONNECTOR 8-PIN M D SERIES	28480	1251-2366
A17MP1	08443-00123	5	1	COVER-BCD HOLE	28480	08443-00123
A17W1	08443-60052	5	1	CABLE ASSEMBLY-BLANK CONTROL	28480	08443-60052
A17W2	08443-60055	8	1	CABLE ASSEMBLY-THIRD LOCAL OSCIL	28480	08443-60055
A17W3	08443-60054	7	1	CABLE ASSEMBLY-SECOND LOCAL OSCI	28480	08443-60054
A17W4	08443-60053	6	1	CABLE ASSEMBLY-SCAN CONTROL	28480	08443-60053
A17W5	08443-60063	8	1	CABLE ASSEMBLY-FIRST LOCAL OSCIL	28480	08443-60063
A18	08443-60016	1	1	MOTHERBOARD ASSEMBLY	28480	08443-60016
A18C1-A18C4			2	NOT ASSIGNED		
A18MP1	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A18MP2	0380-0756	9	20	STANDOFF-RVT-ON .125-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
A18MP3	0380-0884	4	2	STANDOFF-RVT-ON .156-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
A18MP4	0380-0895	7	2	STANDOFF-RVT-ON .312-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
A18MP5	1251-2229	3	2	CONNECTOR-SGL CONT SKT .033-IN-BSC-SZ	28480	1251-2229
A18MP6	1251-2313	6	8	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A18R1				NOT ASSIGNED		
A18R2	0811-1666	7	3	RESISTOR 1 5% 2W PW TC=0+-800	75042	BWH2-1R0-J
A18R3	0811-1666	7		RESISTOR 1 5% 2W PW TC=0+-800	75042	BWH2-1R0-J
A18R4	0811-1661	2	1	RESISTOR .39 5% 2W PW TC=0+-800	75042	BWH2-39/100-J
A18R5	0811-1666	7		RESISTOR 1 5% 2W PW TC=0+-800	75042	BWH2-1R0-J
A18R6	0683-3615	7	1	RESISTOR 360 5% .25W FC TC=-400/+600	01121	CB3615
A18R7	0683-2015	9	1	RESISTOR 200 5% .25W FC TC=-400/+600	01121	CB2015
A18XA1	1251-1887	7		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1887
A18XA2				NOT ASSIGNED		
A18XA3				NOT ASSIGNED		
A18XA4				NOT ASSIGNED		
A18XA5	1251-1626	2	5	CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	28480	1251-1626

Table 6-3. Replaceable Parts

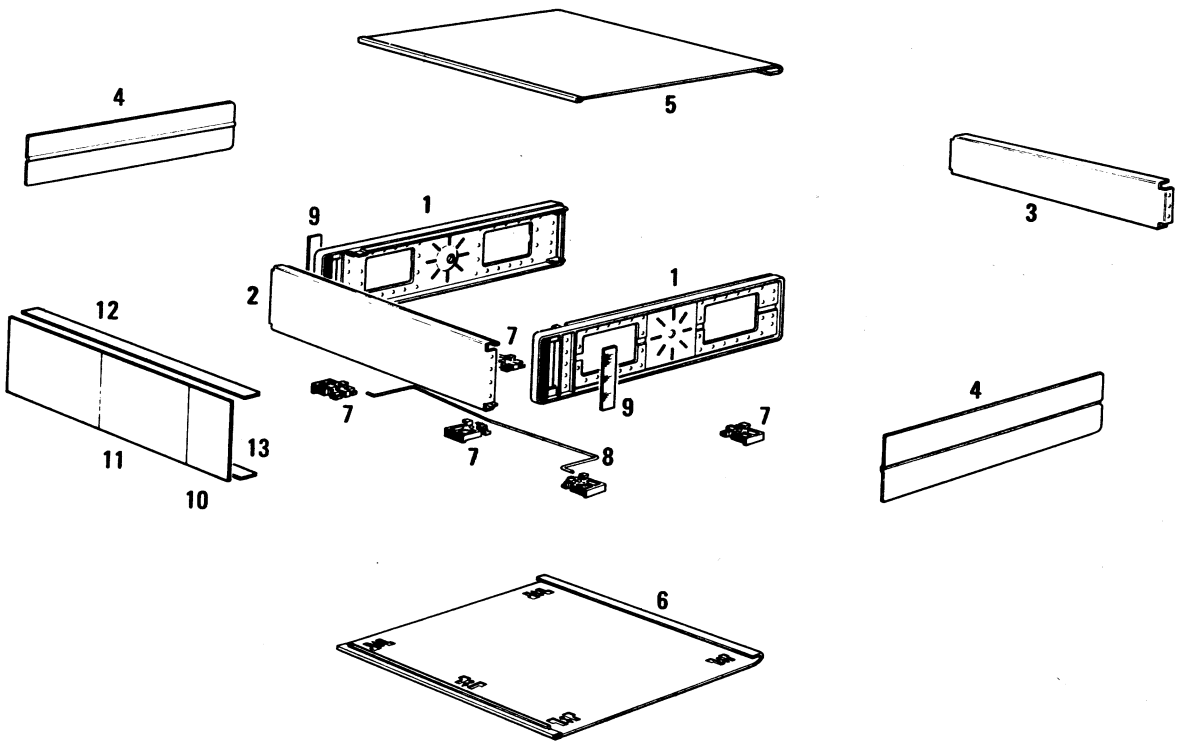
Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A18XA6	1251-1626	2		CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	28480	1251-1626
A18XA7	1251-1626	2		CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	28480	1251-1626
A18XA8	1251-0472	4	6	CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A18XA9	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A18XA10	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A18XA11	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A18XA12	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A18XA13	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A18XA14	1251-1626	2		CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	28480	1251-1626
A18XA15	1251-1626	2		CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	28480	1251-1626
A18XA16	1251-2091	7	1	CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-2091
A19	08443-60089	8	1	DIGITAL OUTPUT BOARD ASSEMBLY	28480	08443-60089
A19J1	1251-0087	7	1	CONNECTOR 50-PIN F MICRO RIBBON	28480	1251-0087
A19MP1	08443-00023	4	1	SHIELD-BCD	28480	08443-00023
A19S1	3101-0070	3	3	SWITCH-SL DPDT MINTR .5A 125VAC/DC	28480	3101-0070
A20	08443-60003	6	1	MARKER POSITION ASSEMBLY	28480	08443-60003
A20MP1	08443-00014	3	1	BRACKET-MARKER POSITION POT	28480	08443-00014
A20MP2	08443-20009	8	1	COUPLER-MARKER POSITION POT	28480	08443-20009
A20R1-A20R10				NOT ASSIGNED		
A20R11	2100-2066	8	1	RESISTOR-VAR CONTROL CCP 2K 20% LIN	28480	2100-2066
A20R12*	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A20R13	2100-2898	4	1	RESISTOR-VAR DUAL 50K-20%-C 5K-20%-C	28480	2100-2898
A20S1	3101-0070	3		SWITCH-SL DPDT MINTR .5A 125VAC/DC	28480	3101-0070
				MISCELLANEOUS/MECHANICAL & ATTACHING PTS		
A1MP1	08443-00072	3	1	LF COUNTER ENCLOSURE	28480	08443-00072
A1W1	08443-60064	9		CABLE ASSEMBLY-HF DECADE D OUTPUT	28480	08443-60064
A1W2	8150-0453	4	1	WIRE-24AWG (HF DECADE D INPUT, 0.1FT)	28480	8150-0453
	08443-00044	9		GUIDE,+6V SWITCH BOARD ASSEMBLY	28480	08443-00044
	0460-0079	9	1	BUSHING-RUBBER, ADHESIVE, 0.2FT	28480	0460-0079
	2200-0103	2	6	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0121	2	2	SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	3050-0010	2	2	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0010

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS		
C1	0180-2181	4	2	CAPACITOR-FXD 1300UF+75-10% 50VDC AL	00853	539-7471-02
C2	0180-2290	6	1	CAPACITOR-FXD 2700UF+75-10% 25VDC AL	28480	0180-2290
C3	0180-2181	4		CAPACITOR-FXD 1300UF+75-10% 50VDC AL	00853	539-7471-02
DS1	2140-0253	5	2	LAMP-INCAND 6839 28VDC 24MA T-1-BULB	1F556	6839
DS2	2140-0253	5		LAMP-INCAND 6839 28VDC 24MA T-1-BULB	1F556	6839
E1	0340-0140	1	1	INSULATOR TO-66 (FOR XSTR Q5)	28480	0340-0140
F1	2110-0002	9		FUSE 2A 250V NTD 1.25X.25 UL	75915	312002
FL1	9100-3121	5	1	FILTER-LINE CEE 22-TERMS	28480	9100-3121
J1				PART OF W1		
J2	08553-6063	2	1	CAPACITOR ASSEMBLY	28480	08553-6063
J3	6960-0002	4	2	PLUG-HOLE DOME-HD FOR .5-D-HOLE STL	28480	6960-0002
J4	6960-0002	4		PLUG-HOLE DOME-HD FOR .5-D-HOLE STL	28480	6960-0002
J5				PART OF FL1		
MP1	5040-0331	1	2	ABSORBER-RF	28480	5040-0331
MP2	5040-0331	1		ABSORBER-RF	28480	5040-0331
MP3	0370-0084	5	2	KNOB RND:BLK:FOR .250SHFT:1 ARO:.625D	28480	0370-0084
MP4	0370-0084	5		KNOB RND:BLK:FOR .250SHFT:1 ARO:.625D	28480	0370-0084
MP5	1251-0218	6	2	LOCK-SUBMIN D CONN	28480	1251-0218
MP6	1251-0218	6		LOCK-SUBMIN D CONN	28480	1251-0218
MP7	1410-0112	7	1	BUSHING:5/16-32 THREAD (TRACK AD	28480	1410-0112
MP8	3150-0214	0	1	FOAM-POLYU .25-IN-THK 1.45-IN-WD	28480	3150-0214
MP9	08443-00048	3	1	RETAINER-FILTER	28480	08443-00048
MP10	5060-0254	9	3	COUPLER-SHAFT	28480	5060-0254
MP11	5060-0254	9		COUPLER-SHAFT	28480	5060-0254
MP11	5060-0254	9		COUPLER-SHAFT	28480	5060-0254
MP12	08443-00004	1	1	SUPPORT-MOTHERBOARD, FRONT	28480	08443-00004
MP13	08443-00005	2	1	SUPPORT-MOTHERBOARD, REAR	28480	08443-00005
MP14	08443-00006	3	1	DECK-ATTENUATOR MOUNTING	28480	08443-00006
MP15	08443-00012	1	1	BRACKET MOUNTING-SIDE FRAME	28480	08443-00012
MP16	08443-00018	7	1	BRACKET-REGULATOR MOUNTING	28480	08443-00018
MP17	08443-00019	8	1	BRACKET-CAPACITOR MOUNTING	28480	08443-00019
MP18	08443-00020	1	1	BRACKET-TRANSFORMER MOUNTING	28480	08443-00020
MP19	08443-00021	2	4	BRACKET-FRONT PANEL	28480	08443-00021
MP20	08443-00021	2		BRACKET-FRONT PANEL	28480	08443-00021
MP21	08443-00021	2		BRACKET-FRONT PANEL	28480	08443-00021
MP22	08443-00021	2		BRACKET-FRONT PANEL	28480	08443-00021
MP23	08443-00022	3	1	SHIELD-MOTHERBOARD	28480	08443-00022
MP24	08443-00061	0	1	DIAL KNOB ASSEMBLY- "TENS"	28480	08443-00061
MP25	08443-00062	1	1	DIAL KNOB ASSEMBLY- "UNITS"	28480	08443-00062
MP26	08443-00063	2	1	DIAL KNOB ASSEMBLY- "TENTHS"	28480	08443-00063
MP27	08443-00043	8	1	COVER-POWER SUPPLY	28480	08443-00043
MP28	08443-00046	1	1	COVER-SERIES REGULATOR	28480	08443-00046
MP29	08443-20001	0	11	SHIELD-P.C. BOARD	28480	08443-20001
MP30	08443-20001	0		SHIELD-P.C. BOARD	28480	08443-20001
MP31	08443-20001	0		SHIELD-P.C. BOARD	28480	08443-20001
MP32	08443-20001	0		SHIELD-P.C. BOARD	28480	08443-20001
MP33	08443-20001	0		SHIELD-P.C. BOARD	28480	08443-20001
MP34	08443-20001	0		SHIELD-P.C. BOARD	28480	08443-20001
MP35	08443-20001	0		SHIELD-P.C. BOARD	28480	08443-20001
MP36	08443-20001	0		SHIELD-P.C. BOARD	28480	08443-20001
MP37	08443-20001	0		SHIELD-P.C. BOARD	28480	08443-20001
MP38	08443-20001	0		SHIELD-P.C. BOARD	28480	08443-20001
MP39	08443-20001	0		SHIELD-P.C. BOARD	28480	08443-20001
MP40	08443-20004	3	2	SHAFT-ATTENUATOR KNOB	28480	08443-20004
MP41	08443-20004	3		SHAFT-ATTENUATOR KNOB	28480	08443-20004
MP42	08443-20005	4	3	BUSHING-KNOB SHAFT (ATTENUATORS)	28480	08443-20005
MP43	08443-20005	4		BUSHING-KNOB SHAFT (ATTENUATORS)	28480	08443-20005
MP44	08443-20005	4		BUSHING-KNOB SHAFT (ATTENUATORS)	28480	08443-20005
MP45	08443-20006	5	1	HEAT SINK (Q1 THRU Q6)	28480	08443-20006
MP46	08443-40009	0	1	WINDOW-COUNTER DISPLAY, YELLOW	28480	08443-40009
MP47	08443-40003	4	1	INSULATOR-REGULATOR (Q1 THRU Q5)	28480	08443-40003
MP48	5000-0206	5	1	SPRING-WASHER	28480	5000-0206
MP49	08443-40006	7	1	HANDLE-FUNCTION SWITCH	28480	08443-40006
MP50	1460-0297	4	1	SPRING-CPRSN .058-IN-OD .235-IN-OA-LG	28480	1460-0297
MP51	0380-0793	4	2	SPACER-RND .156-IN-LG .093-IN-ID	28480	0380-0793
MP52	0380-0793	4		SPACER-RND .156-IN-LG .093-IN-ID	28480	0380-0793
MP53	08443-20008	7	1	MOUNT-TRACK ADJ POT	28480	08443-20008
MP54	08443-20010	1	1	TRACK ADJ POT:5K OHM	28480	08443-20010
MP55	5040-0327	5	1	HOOD-CONNECTOR (FOR XA15)	28480	5040-0327
MP56	1450-0493	1	1	LENS CAP BLU-TL .219-DIA 12-40 THD (FOR XDS1)	28480	1450-0493
MP57	1450-0157	4	1	LENS CAP WHT-TL .219-DIA 12-40 THD (FOR XDS2)	28480	1450-0157

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
Q1	1854-0063	7	4	TRANSISTOR NPN 2N3055 SI TO-3 PD=115W	0192B	2N3055
Q2	1854-0063	7		TRANSISTOR NPN 2N3055 SI TO-3 PD=115W	0192B	2N3055
Q3	1854-0063	7		TRANSISTOR NPN 2N3055 SI TO-3 PD=115W	0192B	2N3055
Q4	1854-0063	7		TRANSISTOR NPN 2N3055 SI TO-3 PD=115W	0192B	2N3055
R1- R7				NOT ASSIGNED		
R8	2100-2886	0	1	RESISTOR-VAR PREC WW 10-TRN 5K 5%	28480	2100-2886
R9	2100-2501	6	1	RESISTOR-VAR PREC WW 1-TRN 2K 20%	28480	2100-2501
R10	2100-2729	0	1	RESISTOR-VAR CONTROL C 2.5K 20% LIN	32997	3852K-222-252A
S1	3101-1234	3	1	SWITCH-SL DPDT STD 1.5A 250VAC SLDR-LUG (PART OF REAR PANEL)	28480	3101-1234
S2	3101-0070	3		SWITCH-SL DPDT MINTR .5A 125VAC/DC (FUNCTION)	28480	3101-0070
T1	9100-2886	7	1	TRANSFORMER-POWER PRI: 115/230VAC; FREQ	28480	9100-2886
W1	08443-60061	6	1	CABLE ASSEMBLY-EXT INPUT	28480	08443-60061
W2				NOT ASSIGNED		
W3	08443-60059	2	1	CABLE ASSEMBLY- 1 MHZ INPUT	28480	08443-60059
W4	08443-60060	5	1	CABLE ASSEMBLY- 1 MHZ OUTPUT	28480	08443-60060
W5	08443-60009	2	1	CABLE ASSEMBLY-INTERCONNECT	28480	08443-60009
W6	8120-1348	5	1	CABLE ASSY 18AWG 3-CNDCT BLK-JKT	28480	8120-1348
W7	08443-60079	6	1	CABLE ASSEMBLY-3 MHZ IF	28480	08443-60079
W8	08443-60080	9	1	CABLE ASSEMBLY-FUNCTION SWITCH	28480	08443-60080
XA15	1251-0198	1	1	CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0198
XA18	1251-2400	2	1	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2400
XDS1	1450-0153	0	2	LAMPHOLDER MDGT-SC-FLG-SKT TUR-TERM	28480	1450-0153
XDS2	1450-0153	0		LAMPHOLDER MDGT-SC-FLG-SKT TUR-TERM	28480	1450-0153
XF1	2110-0564	8	1	FUSEHOLDER BODY 12A MAX FOR UL	H9027	031.1657
XF2	2110-0565	9	1	FUSEHOLDER CAP 12A MAX FOR UL	28480	2110-0565
XF3	2110-0569	3	1	NUT-HEX	28480	2110-0569
	0624-0268	6	51	SCREW-TPG 4-24 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION



Reference Designation	HP Part Number	C D	Qty	Description
1	5060-0730	6	2	FRAME ASSY: 3 x 16
2	08443-00055	2	1	SUB-PANEL
3	08443-00003	0	1	REAR PANEL
4	5000-8595	1	2	SIDE COVER
5	5060-8569	5	1	TOP COVER
6	5060-8713	1	1	BOTTOM COVER
7	5060-0767	9	5	FOOT ASSY
8	1490-0030	6	1	TILT STAND
9	5000-0050	7	2	SIDE TRIM
10	08443-00051	8	1	CONNECTOR PLATE
11	08443-00053	0	1	FRONT PANEL
12	5020-6850	9	1	PANEL TRIM
13	5020-6851	0	1	PANEL TRIM

Figure 6-1. Cabinet Parts

SECTION VII
MANUAL BACKDATING CHANGES

7-1. INTRODUCTION

7-2. This section contains information for adapting this manual to earlier 8443A Tracking Generator-Counters. If the serial number prefix of your Tracking Generator-Counter is the same as the serial number prefix shown on the title page of this manual, the contents of this manual are directly applicable to your instrument and no changes to the manual are required. If, however, your Tracking Generator-Counter has a lower serial number prefix than the one shown on the title page, you must adapt this manual to your instrument by changing the manual as indicated in this section.

NOTE

The backdating information in this section also applies to the discontinued Model 8443B Tracking Generator (identical with the 8443A, but without the frequency counter) if you ignore change instructions pertaining only to the frequency counter circuitry.

7-3. To adapt this manual to your instrument, refer to Table 7-1 and make all the manual changes listed opposite your instrument serial number. Make the changes in the sequence in which they are given.

7-4. If your instrument serial number is not shown on the title page of this manual, or in Table 7-1 below, it may be documented in a yellow MANUAL CHANGES supplement. For additional important information about serial number effectivity, refer to INSTRUMENTS COVERED BY MANUAL in section I.

NOTE

In instruments with serial numbers listed in Table 7-1 below, some parts have part numbers that are different from those listed in the Replaceable Parts list (Table 6-3) of this manual. Unless otherwise indicated by the 'change' instructions in this section, however, the listed parts are the recommended replacement parts.

Table 7-1. Manual Change Requirements by Serial Number

Serial Number, Prefix Only or Complete Number	Make Manual Changes	Serial Number, Prefix Only or Complete Number	Make Manual Changes
2141A	A	Serial number 1049A00295 thru all serial numbers prefixed 1145A	A – G
2140A	A, B		
All serial numbers prefixed 2101A	A – C	Serial numbers 1049A00246 thru 1049A00270	A – H
All serial numbers prefixed 2044A	A – D		
All serial numbers prefixed 1821A	A – E	All serial numbers prefixed 964-	A – I
All serial numbers prefixed 1217A thru 1742A inclusive	A – F	All serial numbers prefixed 955-	A – J

7-5. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Page 6-6, Table 6 – 3:
Change A5 to HP Part Number 08443-60048, CD 9.

Page 6-7, Table 6-3:
Delete A5C15, C16, C17, and E2.
Change A5L2 to HP Part Number 9100-1643, CD 2, INDUCTOR RF-CH-MLD 300UH 5%.
Change A5L4 to HP Part Number 9100-1629, CD 4, INDUCTOR RF-CH-MLD 47UH 5%.
Change A5R3 to HP Part Number 0683-5135, CD 0, RESISTOR 51K 5% .25W.
Change A5R5 to HP Part Number 0683-7525, CD 6, RESISTOR 7.5K 5% .25W.
Change A5R15 and A5R19 through R25 to HP Part Number 0683-1025, CD 9, RESISTOR 1K 5% .25W.
Change A5R27 and R29 to HP Part Number 0698-3441, CD 8, RESISTOR 215 OHM 1% .125W.
Change A5U3 to A5U3A, HP Part Number 1820-0413, CD 0, IC DRIVER TTL DECD.
Add A5U3B, HP Part Number 1820-0413, CD 0, IC DRIVER TTL DECD.
Change A5U4 to HP Part Number 1820-0413, CD 0, IC DRIVER TTL DECD.
Change A5U5 to A5U5A, HP Part Number 1820-0413, CD 0, IC DRIVER TTL DECD.
Add A5U5B, HP Part Number 1820-0413, CD 0, IC DRIVER TTL DECD.
Delete A5U6.

Page 8-51, Figure 8-26:
Change Time Base A5 portion of Counter Circuits Logic Diagram as shown in Figure 7-1 (CHANGE A).

Page 8-75, Figure 8-31:
Substitute Figure 7-2 (CHANGE A) from this section for Figure 8-31, Time Base Assembly A5 Parts Locations.

Page 8-75, Figure 8-32:
Substitute Figure 7-3 (CHANGE A) of this section for Figure 8-32, Time Base Assembly A5 Schematic Diagram.

NOTE

The later Time Base Assembly A5 described in Section VIII of this manual, and the earlier Time Base Assembly shown in this section have identical functions. The main difference between the two versions is in the divide-by-ten circuitry. In the later A5, the divide-by-ten function is accomplished with three dual divide-by-ten counter ICs, designated U3, U4, and U5; and an 8-to-2 multiplexer IC, U6. In the earlier A5, the divide-by-ten circuitry consists of five flip-flops: U3A, U3B, U4, U5A, and U5B.

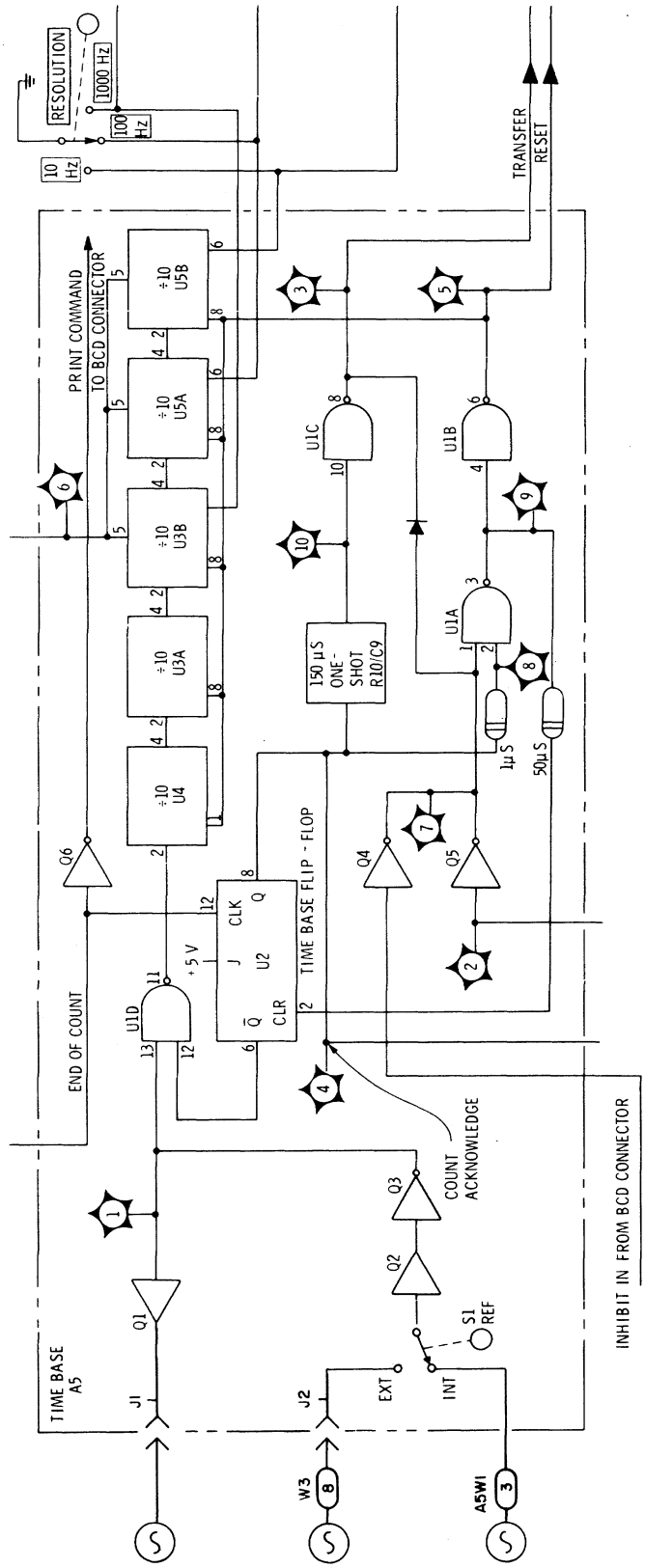
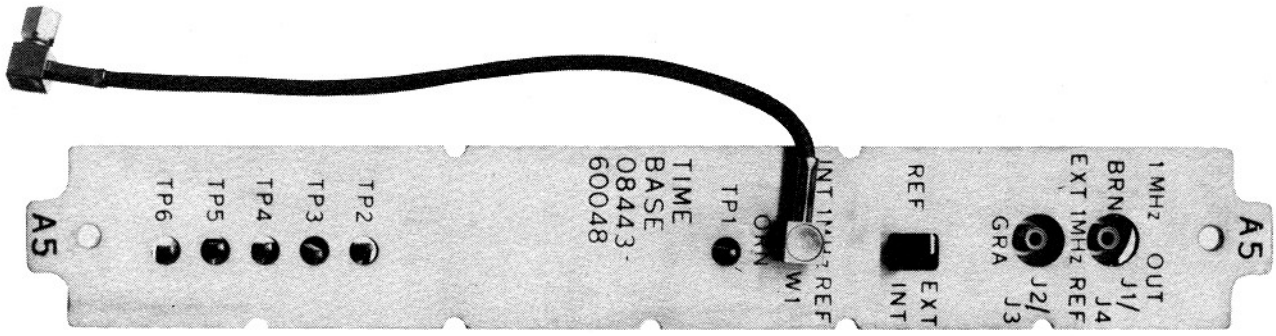


Figure 7-1. Time Base Assembly A5 Portion of Counter Logic Diagram (CHANGE A)

A5 TOP VIEW



A5

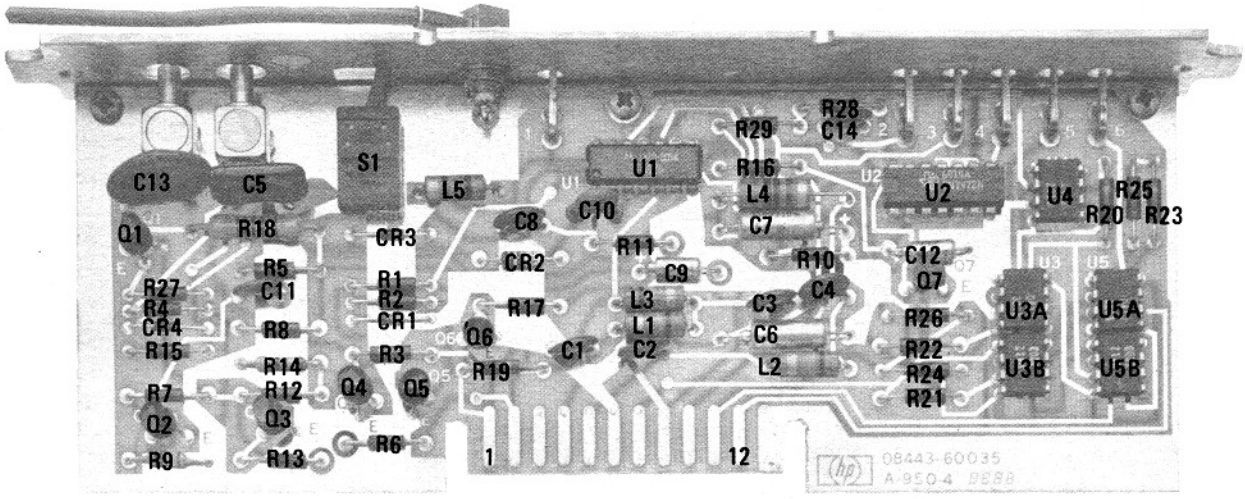
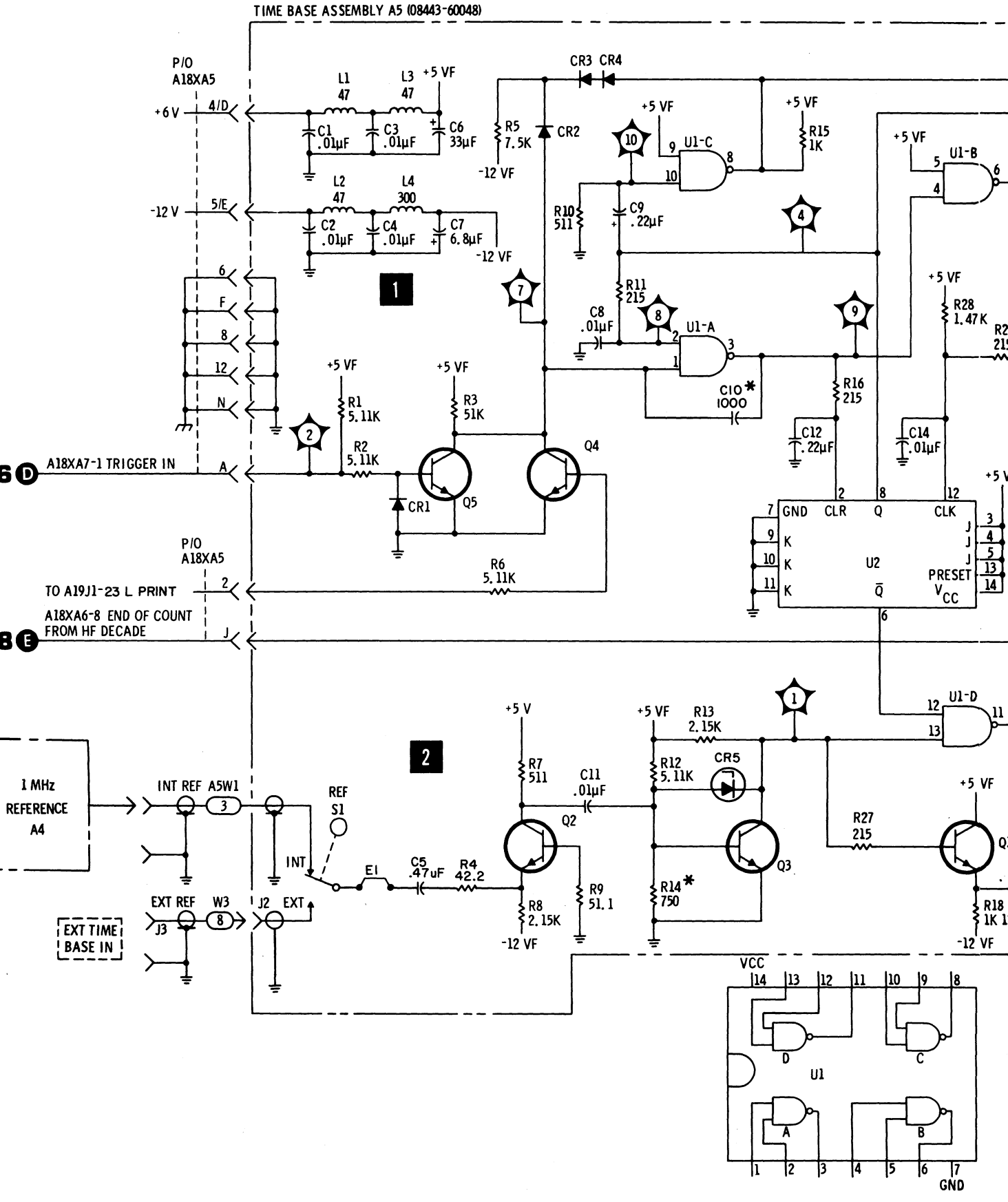
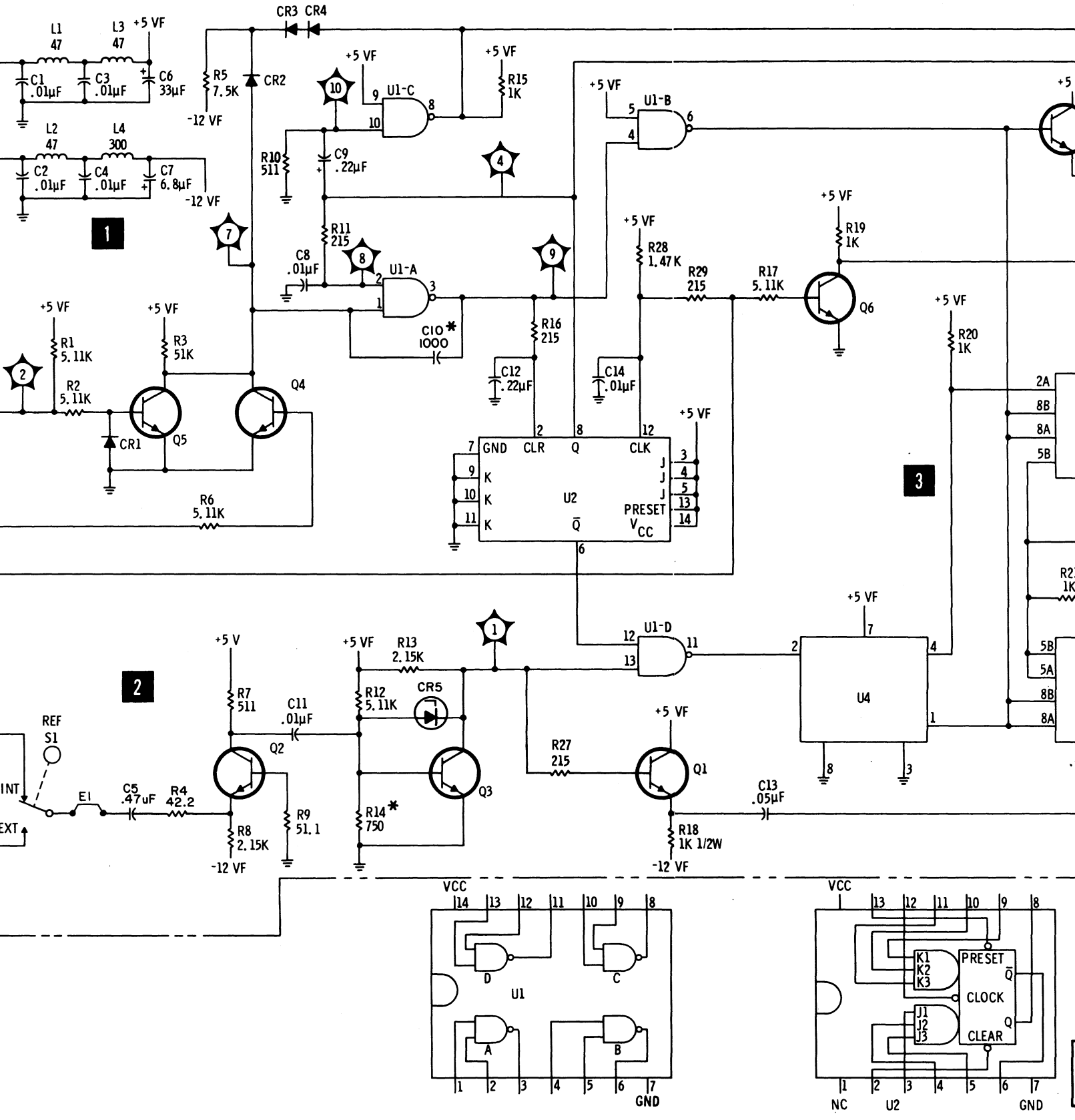
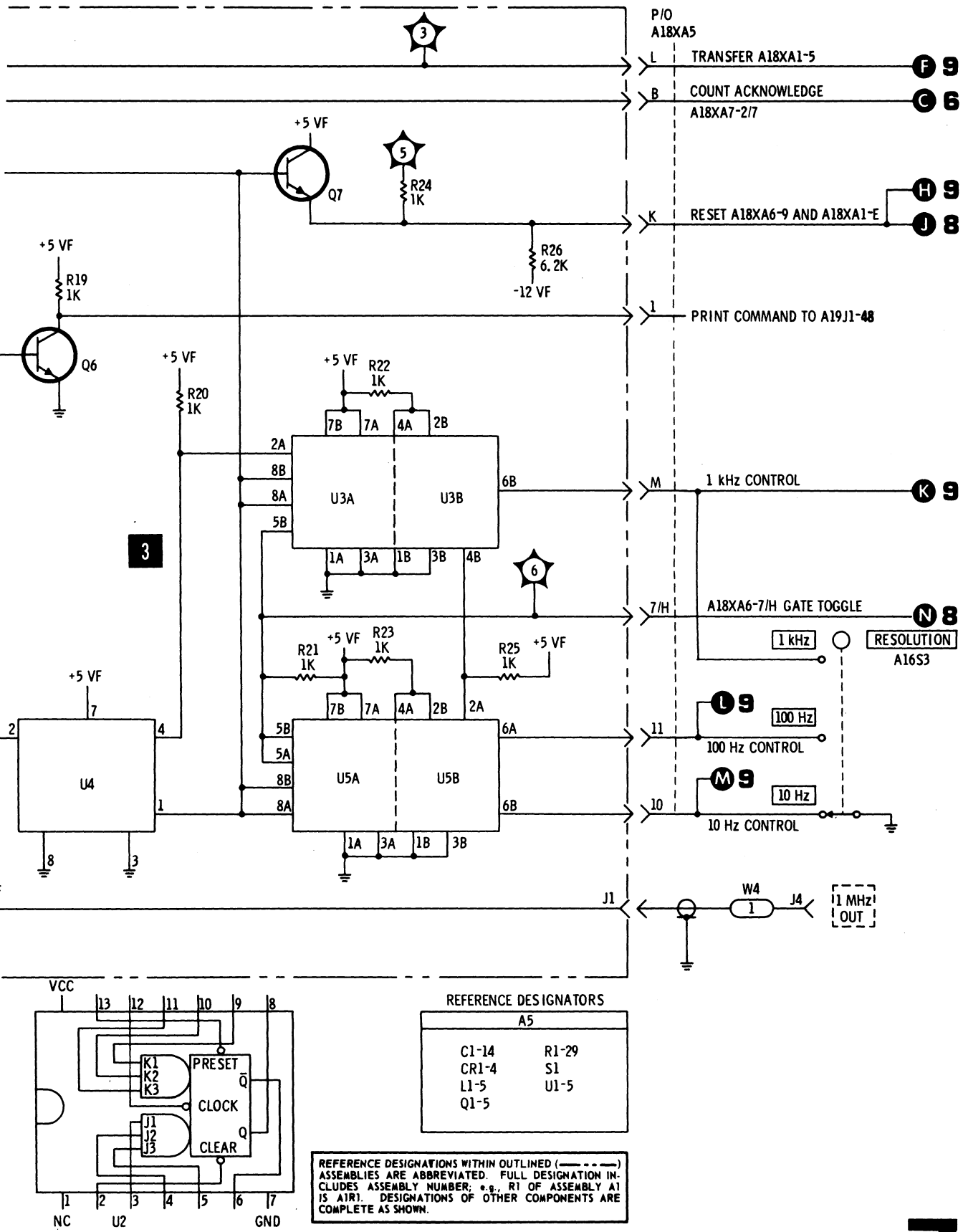


Figure 7-2. Time Base Assembly A5 Parts Locations (CHANGE A)


TIME BASE ASSEMBLY A5 (08443-60048)
P/O A18XA5
+6 V
4/D
-12 V
5/E
L1 47
L3 47
L2 47
L4 300
C1 .01µF
C3 .01µF
C6 33µF
C2 .01µF
C4 .01µF
C7 6.8µF
+5 VF
-12 VF
R5 7.5K
CR2
CR3 CR4
R10 511
C9 .22µF
R11 215
C8 .01µF
U1-A
U1-B
U1-C
R15 1K
R28 1.47K
C10* 1000
R16 215
C12 .22µF
C14 .01µF
U2
GND
CLR
CLK
PRESET
R1 5.11K
R2 5.11K
R3 51K
Q4
Q5
CR1
R6 5.11K
A18XA7-1 TRIGGER IN
TO A19J1-23 L PRINT
A18XA6-8 END OF COUNT FROM HF DECADE
1 MHz REFERENCE A4
INT REF A5W1
REF S1
INT
EXT REF
W3
J2
EXT
J3
EXT TIME BASE IN
E1
C5 .47uF
R4 42.2
R7 511
Q2
C11 .01µF
R12 5.11K
CR5
R13 2.15K
Q3
R14* 750
R8 2.15K
R9 51.1
R27 215
R18 1K
+5 V
-12 VF
VCC
U1
GND


L1 47
L3 47
+5 VF
C1 .01µF
C3 .01µF
C6 33µF
L2 47
L4 300
C2 .01µF
C4 .01µF
C7 6.8µF
-12 VF
CR3 CR4
R5 7.5K
CR2
-12 VF
+5 VF
U1-C
R15 1K
R10 511
C9 .22µF
U1-B
R11 215
C8 .01µF
U1-A
C10 * 1000
R16 215
R28 1.47K
R29 215
R17 5.11K
R19 1K
Q6
R20 1K
R1 5.11K
R3 51K
R2 5.11K
Q4
Q5
CR1
R6 5.11K
C12 .22µF
C14 .01µF
U2
GND
CLR
CLK
PRESET
U1-D
U4
R13 2.15K
R7 511
C11 .01µF
R12 5.11K
CR5
Q2
Q3
Q1
R27 215
R14 * 750
R8 2.15K
R9 51.1
R18 1K 1/2W
C13 .05µF
REF
S1
INT
EXT
E1
C5 .47uF
R4 42.2
1
2
3
4
7
8
9
10
2A
8B
8A
5B
5A
VCC
U1
GND
NC
PRESET
CLOCK
CLEAR



REFERENCE DESIGNATORS

A5	
C1-14	R1-29
CR1-4	S1
L1-5	U1-5
Q1-5	

REFERENCE DESIGNATIONS WITHIN OUTLINED (— - - —) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER; e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

Figure 7-3. Time Base Assembly A5 Schematic Diagram (CHANGE A)

CHANGE B

Page 6-19, Table 6-3:
Replace entire A15 listing with Table 7-2, Replaceable Parts (CHANGE B) of this section.

Page 8-30, Rectifier Assembly A15 Circuit Description:
Substitute Rectifier Assembly A15 Circuit Description (CHANGE B) for A15 Circuit Description in Manual.

Page 8-43, Figure 8-24:
Replace Figure 8-24 with A15 parts location diagram shown in Figure 7-4 (CHANGE B).

Page 8-43, Figure 8-25:
Replace Figure 8-25 with A14/A15 schematic shown in Figure 7-5 (CHANGE B).

Table 7-2. Replaceable Parts (CHANGE B)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15	08443-60014	9	1	BOARD ASSY:RECTIFIER	28480	08443-60014
A15C1	0160-3043	7	2	C:FXD CER 2 X 0.005 UF 20% 250VAC	56289	29C147A-CDH
A15C2	0160-3043	7		C:FXD CER 2 X 0.005 UF 20% 250VAC	56289	29C147A-CDH
A15C3	0180-2212	2	1	C:FXD ELECT 10 UF +50—10% 450VDCW	56289	39D106F450FL4-DSB
A15C4	0170-0040	9	2	C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A15C5	0170-0040	9		C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A15C6	0160-3453	3		C:FXD CER 0.05 UF +80—20% 100VDCW	56289	C023A101L503ZS25-CD4
A15C7	0160-3453	3		C:FXD CER 0.05 UF +80—20% 100VDCW	56289	C023A101L503ZS25-CD4
A15C8	0160-3453	3		C:FXD CER 0.05 UF +80—20% 100VDCW	56289	C023A101L503ZS25-CD4
A15C9	0160-3453	3		C:FXD CER 0.05 UF +80—20% 100VDCW	56289	C023A101L503ZS25-CD4
A15C10	0160-0168	1	1	C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A15CR1	1901-0743	1	6	DIODE:PWR RECTIFIER 400V	00000	1N4004
A15CR2	1901-0743	1		DIODE:PWR RECTIFIER 400V	00000	1N4004
A15CR3	1901-0743	1		DIODE:PWR RECTIFIER 400V	00000	1N4004
A15CR4	1901-0743	1		DIODE:PWR RECTIFIER 400V	00000	1N4004
A15CR5	1901-0200	5		DIODE:SILICON 100 PIV 3A	02735	1N4998
A15CR6	1901-0200	5		DIODE:SILICON 100 PIV 3A	02735	1N4998
A15CR7	1901-0200	5		DIODE:SILICON 100 PIV 3A	02735	1N4998
A15CR8	1901-0200	5		DIODE:SILICON 100 PIV 3A	02735	1N4998
A15CR9	1901-0743	1		DIODE:PWR RECTIFIER 400V	00000	1N4004
A15CR10	1901-0743	1		DIODE:PWR RECTIFIER 400V	00000	1N4004
A15CR11	1901-0025	2		DIODE:SILICON 100MA/1V	07263	FD 2387
A15CR12	1902-0041	4	1	DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A15F1	2110-0201	0	1	FUSE:CARTRIDGE 1/4 AMP 250V SLO-BLO	04480	MDL-1/4
A15F2	2110-0001	8	3	FUSE:1 AMP 250V	75915	312001.
A15F3	2110-0001	8		FUSE:1 AMP 250V	75915	312001.
A15F4	2110-0002	9	1	FUSE:CARTRIDGE 2 AMP 3 AG	75915	312.002
A15F5	2110-0001	8		FUSE:1 AMP 250V	75915	312001.
A15Q1	1854-0071	7		TSTR:SI NPN (SELECTED FROM 2N3704)	28480	1854-0071
A15Q2	1854-0232	2	2	TSTR:SI NPN (SELECTED FROM 2N3440)	28480	1854-0232
A15Q3	1854-0232	2		TSTR:SI NPN (SELECTED FROM 2N3440)	28480	1854-0232
A15R1	0812-0012	7	1	R:FXD WW 18 OHM 5% 3W	28480	0812-0012
A15R2	0757-0063	0	3	R:FXD MET FLM 196K OHM 1% 1/2W	28480	0757-0063
A15R3	0757-0063	0		R:FXD MET FLM 196K OHM 1% 1/2W	28480	0757-0063
A15R4	0757-0063	0		R:FXD MET FLM 196K OHM 1% 1/2W	28480	0757-0063
A15R5	0683-1025	9		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A15R6	0757-0443	9		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A15R7	0683-1025	9		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A15R8	0757-0855	8	1	R:FXD MET FLM 68.1K OHM 1% 1/2W	28480	0757-0855
A15R9	0683-1045	3		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A15R10	0757-0442	9		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A15R11	0757-0274	5		R:FXD MET FLM 1.21K OHM 1% 1/4W (FACTORY SELECTED)	28480	0757-0274
A15R12	0757-0442	9		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A15R13	0683-1855	3	1	R:FXD COMP 1.8 MEGOHM 5% 1/4W	01121	CB 1855
A15XF1	2110-0269	0	10	CLIP:FUSE 0.250" DIA	91506	6008-32CN
A15XF2	2110-0269	0		CLIP:FUSE 0.250" DIA	91506	6008-32CN
A15XF3	2120-0269	0		CLIP:FUSE 0.250" DIA	91506	6008-32CN
A15XF4	2110-0269	0		CLIP:FUSE 0.250" DIA	91506	6008-32CN
A15XF5	2110-0269	0		CLIP:FUSE 0.250" DIA	91506	6008-32CN

RECTIFIER ASSEMBLY A15 CIRCUIT DESCRIPTION (CHANGE B) (See Service Sheet 4)

The Rectifier Assembly contains three two-diode, full-wave rectifiers; a four-diode, full-wave bridge rectifier; a regulator control circuit; and five fuses. The rectifiers supply the dc voltages that are regulated by the regulator (sense amplifier) circuits on Sense Amplifier Assembly A14 and the series regulator transistors mounted inside the 8443A rear panel. All together, these components make up five dc power supplies to furnish regulated dc power levels of +175 volts, +24 volts, +6 volts, +20 volts, and −12 volts.

NOTE

The high-voltage (+175 volts) power supply is purposely disabled by removal of fuse A15A1 when the Rectifier Assembly is installed in Model 8443A Tracking Generator-Counters with serial number prefix 2044A and higher.

The four-diode, full-wave rectifier and the regulator control circuit on the Rectifier Assembly, and series regulator transistor Q5, make up a +175 volts power supply. Full-wave rectifier CR5-CR6 supplies +39 volts to the +24 volts and the +20 volts series regulator transistors, Q3 and Q1 respectively, both of which are controlled by sense amplifiers on Sense Amplifier Assembly A14. The other two rectifiers, CR7-CR8 and CR9-CR10, supply +13.2 volts and +8.8 volts to the +6 volts and −12 volts regulators.

Rectifier Assembly A15 Troubleshooting

To troubleshoot the Rectifier Assembly, proceed as follows:

1. Check the voltage levels at the upper ends of the fuses mounted on the Rectifier Board Assembly. (See Service Sheet 4 for fuse locations and voltage levels.)

2. If there is no voltage present at the upper end of a fuse, check the fuse. If you replace a blown fuse with a new one, and it too burns out, the problem is most likely in the associated sense amplifier circuit on Sense Amplifier Assembly A14. (Unless the +175 volts supply fuse is the one that keeps blowing, in which case the problem is probably in the +175 volts sense amplifier circuitry on A15.)

3. If the problem is not a blown fuse, set the front-panel POWER switch to STBY, disconnect the ac power cable, and place the Rectifier Assembly on an extender circuit board. Then reconnect the ac power cable and set the POWER switch to ON.

4. With an ac voltmeter, measure the voltages across the primary and secondary windings of the ac input power transformer. If there is voltage across the transformer primary, but none across one or more of the secondary windings, replace the tranformer. If there is no voltage across the transformer primary, check the ac line fuse and the LINE SELECTOR switch on the rear panel, the front-panel POWER switch, the line filter (FL1), and the ac power cable.

5. If the voltage across the transformer secondary windings is normal, use the digital voltmeter to check for the dc voltages shown on the schematic diagram.

SENSE AMPLIFIER ASSEMBLY A14 CIRCUIT DESCRIPTION (CHANGE B) (See Service Sheet 4)

The Sense Amplifier Assembly contains four sense amplifier (series regulator control) circuits. Each sense amplifier controls the series regulator transistor for a particular one of the dc outputs: +24 volts, +20 volts, +6 volts, and −12 volts. (The sense amplifier for the +175 volt output is on Rectifier Assembly A15.) In each sense amplifier, a comparator circuit compares the output voltage of its associated regulator transistor with a fixed dc reference derived from the +24 volts supply. Any variation in the output is translated by the comparator and an amplifier circuit into a signal which causes the series regulator to counteract the change in output level.

The sense amplifier circuits and their associated series regulators are made up as follows:

+24 volts sense amplifier A14Q14 through A14Q19 controls series regulator Q3
+20 volts sense amplifier A14Q1, A14Q5, A14Q6, and A14Q11 controls series regulator Q1
+6 volts sense amplifier A14Q2, A14Q7, A14Q8, and A14Q12 controls series regulator Q2 – 12 volts sense amplifier A14Q3, A14Q9, A14Q10, and A14Q13 controls series regulator Q4

The Sense Amplifier Assembly also contains two crowbar circuits, one (CR11 through CR19) for the +dc supplies, and one (CR2 through CR4, and Q4) for the −12 volts supply. Reset switch S1 on the Sense Amplifier Assembly is a momentary pushbutton used to reset the +dc crowbar. The +12 volts crowbar resets automatically.

SENSE AMPLIFIER ASSEMBLY A14 TROUBLESHOOTING

To troubleshoot the Sense Amplifier Assembly, place it on an extender circuit board and use a digital voltmeter to check for the voltage levels shown in the assembly schematic diagram on Service Sheet 4.

NOTE

The voltages shown on the Sense Amplifier Assembly schematic diagram are nominal values and may vary slightly from instrument to instrument.

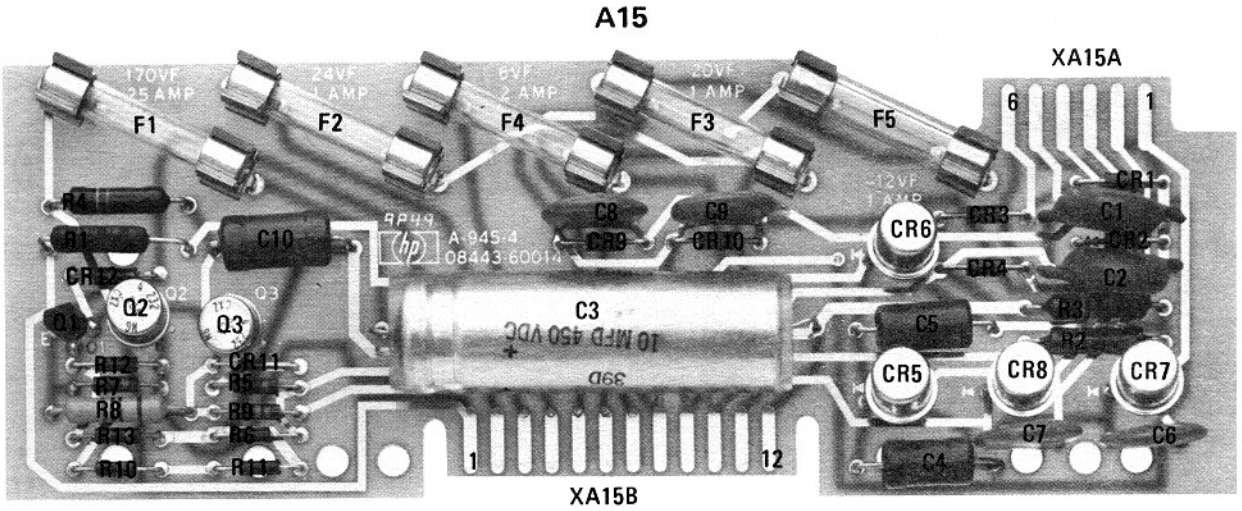


Figure 7-4. Rectifier Assembly A15 Parts Locations (CHANGE B)

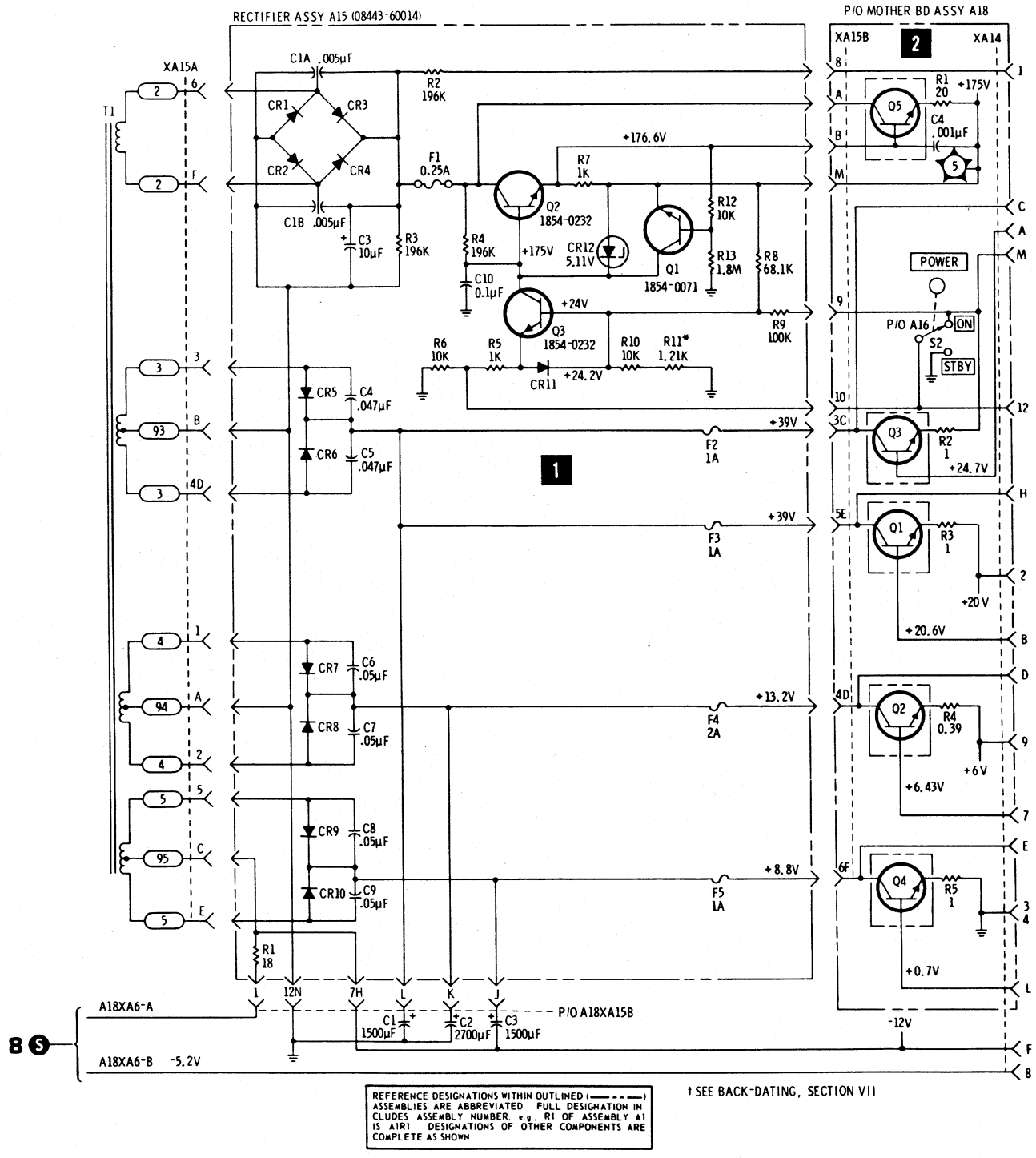


Figure 7-5. Sense Amplifier and Rectifier Assemblies A14 and A15 Partial Schematic Diagram (CHANGE B)

CHANGE C

Page 6-8, Table 6-3:
Replace the entire A6 listing with Table 7-3 Replaceable Parts (CHANGE C), from this section.

Page 8-51, Figure 8-26:
Change High Frequency Decade A6 portion of Counter Logic Diagram as shown in Figure 7-6 (CHANGE C).

Page 8-77, Figure 8-34:
Replace Figure 8-34 with A6 parts location diagram (CHANGE C) shown in Figure 7-7.

Page 8-77, Figure 8-35:
Replace Figure 8-35 with the A6 High Frequency Decade Schematic Diagram (CHANGE C) shown in Figure 7-8.

NOTE

The later High Frequency Decade Assembly A6 described in Section VIII of this manual, and the earlier High Frequency Decade Assembly A6 shown in this section have identical functions. The main differences between the two versions are in the main gate flip-flop, the reset translator, and the divide-by-ten decade. In the later A6 assembly, the main gate flip-flop is designated U1; in earlier A6 assemblies, it is U2. The later A6 assembly does not have a reset translator. In the earlier A6, a zener diode, CR9, is used to translate the reset input level to make it compatible with the reset level requirement of the divide-by-ten counter ICs. In the later A6 the divide-by-ten function is accomplished in a single IC, U3. The original divide-by-ten consists of four flip-flop ICs: U3, U4, U5, and U6. The output level translators, U4A through U4D, are, in earlier versions of A6, designated U1A through U1D.

Table 7-3. Replaceable Parts (1 of 3) (CHANGE C)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6	08443-60047	8	2	BOARD ASSEMBLY-RF DECADE	28480	08443-60047
A6C1	0160-2327	8	19	CAPACITOR-FXD 1000PF +—20% 100VDC CER	51642	150-110-X5R-102M
A6C2	0160-2327	8		CAPACITOR-FXD 1000PF +—20% 100VDC CER	51642	150-110-X5R-102M
A6C3	0180-0376	5	11	CAPACITOR-FXD .47UF +—10% 35VDC TA	56289	150D474X9035A2
A6C4	0180-0197	8		CAPACITOR-FXD 2.2UF +—10% 20VDC TA	56289	150D225X9020A2
A6C5	0160-2930	9		CAPACITOR-FXD .01UF +80—20% 100VDC CER	28480	0160-2930
A6C6	0160-2930	9		CAPACITOR-FXD .01UF +80—20% 100VDC CER	28480	0160-2930
A6C7	0160-2327	8		CAPACITOR-FXD 1000PF +—20% 100VDC CER	51642	150-110-X5R-102M
A6C8	0160-2327	8		CAPACITOR-FXD 1000PF +—20% 100VDC CER	51642	150-110-X5R-102M
A6C9	0180-0197	8		CAPACITOR-FXD 2.2UF +—10% 20VDC TA	56289	150D225X9020A2
A6C10	0180-0376	5		CAPACITOR-FXD .47UF +—10% 35VDC TA	56289	150D474X9035A2
A6C11	0180-0197	8		CAPACITOR-FXD 2.2UF +—10% 20VDC TA	56289	150D225X9020A2
A6C12	0180-0116	1		CAPACITOR-FXD 6.8UF +—10% 35VDC TA	56289	150D685X9035B2
A6C13	0160-2930	9		CAPACITOR-FXD .01UF +80—20% 100VDC CER	28480	0160-2930
A6C14	0160-2930	9		CAPACITOR-FXD .01UF +80—20% 100VDC CER	28480	0160-2930
A6C15				NOT ASSIGNED		
A6C16	0160-2327	8		CAPACITOR-FXD 1000PF +—20% 100VDC CER	51642	150-110-X5R-102M
A6C17	0180-0376	5		CAPACITOR-FXD .47UF +—10% 35VDC TA	56289	150D474X9035A2
A6C18	0180-0197	8		CAPACITOR-FXD 2.2UF +—10% 35VDC TA	56289	150D225X9020A2
A6C19	0180-0376	5		CAPACITOR-FXD .47UF +—10% 35VDC TA	56289	150D474X9035A2
A6C20	0160-2930	9		CAPACITOR-FXD .01UF +80—20% 100VDC CER	28480	0160-2930
A6C21	0180-0197	8		CAPACITOR-FXD 2.2UF +—10% 20VDC TA	56289	150D225X9020A2
A6C22	0180-0376	5		CAPACITOR-FXD .47UF +—10% 35VDC TA	56289	150D474X9035A2
A6C23	0180-0197	8		CAPACITOR-FXD 2.2UF +—10% 20VDC TA	56289	150D225X9020A2
A6C24	0160-2327	8		CAPACITOR-FXD 1000PF +—20% 100VDC CER	51642	150-110-X5R-102M
A6C25	0180-0197	8		CAPACITOR-FXD 2.2UF +—10% 20VDC TA	56289	150D225X9020A2
A6C26	0160-2327	8		CAPACITOR-FXD 1000PF +—20% 100VDC CER	51642	150-110-X5R-102M
A6C27	0160-2327	8		CAPACITOR-FXD 1000PF +—20% 100VDC CER	51642	150-110-X5R-102M
A6C28	0160-2327	8		CAPACITOR-FXD 1000PF +—20% 100VDC CER	51642	150-110-X5R-102M
A6C29	0160-2327	8		CAPACITOR-FXD 1000PF +—20% 100VDC CER	51642	150-110-X5R-102M
A6C30	0180-0197	8		CAPACITOR-FXD 2.2UF +—10% 20VDC TA	56289	150D225X9020A2
A6C31	0160-2204	0		CAPACITOR-FXD 100PF +—5% 300VDC MICA	28480	0160-2204
A6CR1	1901-0047	8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR2	1902-0047	8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR3	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6CR4	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6CR5	1902-0518	0	1	DIODE-ZNR 5.11V 5% DO-15 PD=2W PC=+.03%	28480	1902-0518
A6CR6	1901-0047	8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR7	1901-0047	8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR8	1901-0047	8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR9	1902-3024	9	1	DIODE-ANR 2.87V 5% DO-7 PD=.4W TC=—.07%	28480	1902-3024
A6CR10	1901-0047	8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A6CR11	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6CR12	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A6CR13	1902-0048	1	5	DIODE-ZNR 6.81V 5% DO-35 PD=.4W	28480	1902-0048
A6CR14	1902-0048	1		DIODE-ZNR 6.81V 5% DO-35 PD=.4W	28480	1902-0048
A6CR15	1901-0179	7	2	DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A6CR16	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A6CR17	1901-0039	8		DIODE-SWITCHING 50V 300MA 8NS	28480	1901-0039
A6CR18	1901-0039	8		DIODE-SWITCHING 50V 300MA 8NS	28480	1901-0039

Table 7-3. Replaceable Parts (2 of 3) (CHANGE C)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6J1	1250-1194	7		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
	08443-20011	2		CONNECTOR-RECESS	28480	08443-20011
A6J2	1250-1194	7		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
	08443-20011	2		CONNECTOR-RECESS	28480	08443-20011
A6L1	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A6L2	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A6L3	9100-1630	7		INDUCTOR RF-CH-MLD 51UH 5% .166DX.385LG	28480	9100-1630
A6L4	9100-1623	8		INDUCTOR RF-CH-MLD 27UH 5% .166DX.385LG	28480	9100-1623
A6L5	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A6L6	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A6L7				NOT ASSIGNED		
A6L8	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A6L9	9100-1611	4		INDUCTOR RF-CH-MLD 220NH 20%	28480	9100-1616
A6L10	9100-1611	4		INDUCTOR RF-CH-MLD 220NH 20%	28480	9100-1611
A6L11	9100-1611	4		INDUCTOR RF-CH-MLD 220NH 20%	28480	9100-1611
A6L12	9100-1630	7		INDUCTOR RF-CH-MLD 51UH 5% .166DX.385LG	28480	9100-1630
A6Q1	1854-0345	8	9	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A6Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A6Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A6Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A6Q5	1854-0019	3	9	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A6Q6	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A6Q7	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A6R1	0698-7229	8		RESISTOR 511 1% .05W F TC=0+—100	24546	C3-1/8-TO-511R-G
A6R2	0757-0395	1	5	RESISTOR 56.2 1% .125W F TC=0+—100	24546	C4-1/8-TO-56R2-F
A6R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+—100	24546	C4-1/8-TO-1002-F
A6R4	0698-7229	8		RESISTOR 511 1% .05W F TC=0+—100	24546	C3-1/8-TO-511R-G
A6R5	0757-0395	1		RESISTOR 56.2 1% .125W F TC=0+—100	24546	C4-1/8-TO-56R2-F
A6R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+—100	24546	C4-1/8-TO-1002-F
A6R7	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+—100	24546	C4-1/8-TO-5111-F
A6R8	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+—100	24546	C4-1/8-TO-5111-F
A6R9	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+—100	24546	C4-1/8-TO-5111-F
A6R10	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+—100	24546	C4-1/8-TO-5111-F
A6R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+—100	24546	C4-1/8-TO-1001-F
A6R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+—100	24546	C4-1/8-TO-5111-F
A6R13	0698-3151	7	5	RESISTOR 2.87K 1% .125W F TC=0+—100	24546	C4-1/8-TO-2871-F
A6R14	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+—100	24546	C4-1/8-TO-2871-F
A6R15	0698-0083	8	10	RESISTOR 1.96K 1% .125W F TC=0+—100	24546	C4-1/8-TO-1961-F
A6R16	0757-0405	4		RESISTOR 162 1% .125W F TC=0+—100	24546	C4-1/8-TO-162R-F
A6R17	0698-3434	9		RESISTOR 34.8 1% .125W F TC=0+—100	24546	C4-1/8-TO-34R8-F
A6R18	0698-3444	1		RESISTOR 316 1% .125W F TC=0+—100	24546	C4-1/8-TO-316R-F
A6R19	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+—100	24546	C4-1/8-TO-1961-F
A6R20	0757-0279	0	9	RESISTOR 3.16K 1% .125W F TC=0+—100	24546	C4-1/8-TO-3161-R
A6R21	0757-0405	4		RESISTOR 162 1% .125W F TC=0+—100	24546	C4-1/8-TO-162R-F
A6R22*	0698-3434	9	4	RESISTOR 34.8 1% .125W F TC=0+—100	24546	C4-1/8-TO-34R8-F
A6R23	0757-0416	7		RESISTOR 511 1% .125W F TC=0+—100	24546	C4-1/8-TO-511R-F
A6R24*	0698-3435	0	3	RESISTOR 38.3 1% .125W F TC=0+—100	24546	C4-1/8-TO-38R3-F
A6R25	0757-0416	7		RESISTOR 511 1% .125W F TC=0+—100	24546	C4-1/8-TO-511R-F
A6R26	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+—100	24546	C4-1/8-TO-1961-F
A6R27	0757-1001	8	1	RESISTOR 56.2 1% .5W F TC=0+—100	28480	0757-1001
A6R28	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+—100	24546	C4-1/8-TO-1001-G
A6R29	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+—100	24546	C4-1/8-TO-1001-G
A6R30	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+—100	24546	C4-1/8-TO-1001-G

Table 7-3. Replaceable Parts (3 of 3) (CHANGE C)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6R31	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+—100	24546	C4-1/8-TO-1002-F
A6R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+—100	24546	C4-1/8-TO-1961-F
A6R33	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+—100	24546	C4-1/8-TO-1211-F
A6TP1	08443-00041	6		TEST POINT	28480	08443-00041
A6TP2	08443-00041	6		TEST POINT	28480	08443-00041
A6TP3	1250-1194	7		CONNECTOR-RF SM-SLD M SGL=HOLE-FR 50-OHM	28480	1250-1194
	08443-20011	2		CONNECTOR-RECESS	28480	08443-20011
A6TP4	0360-1514	7	8	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A6TP5	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A6TP6	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A6TP7	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A6U1	1820-0275	2	1	IC XLTR ECL ECL-TO-TTL QUAD 2-INP	04713	MC1039P
A6U2	1820-0102	4	4	IC FF ECL J-K	04713	MC1013P
A6U3	1820-0101	3	1	IC FF ECL D-TYPE	04713	MC1034P
A6U4	1820-0102	4		IC FF ECL J-K	04713	MC1013P
A6U5	1820-0102	4		IC FF ECL J-K	04713	MC1013P
A6U6	1820-0102	4		IC FF ECL J-K	04713	MC1013P
A6W1	08443-60056	9		CABLE ASSEMBLY-TRIGGER GENERATOR	28480	08443-60056

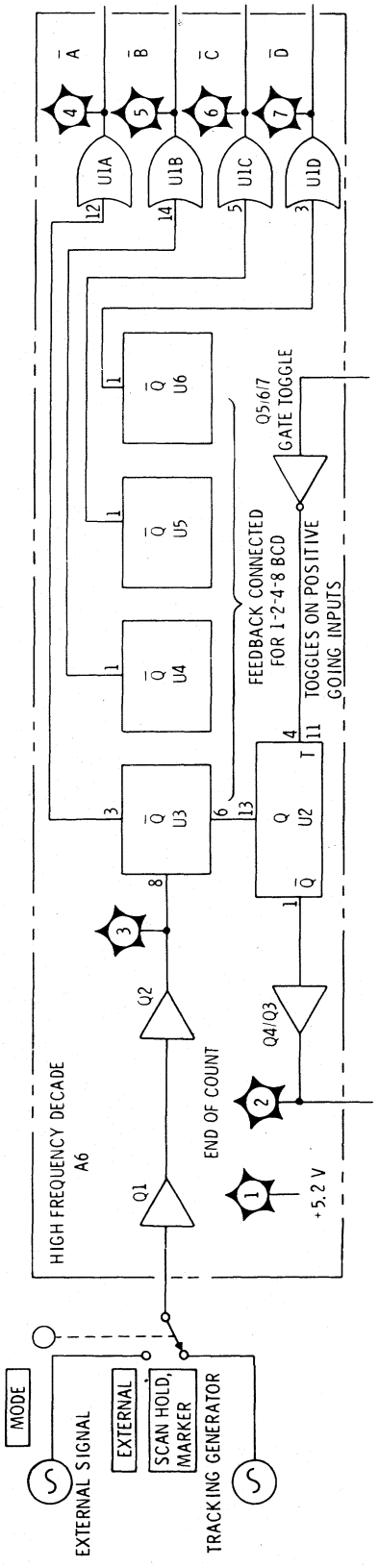


Figure 7-6. High Frequency Decade Assembly A6 Portion of Counter Logic Diagram (CHANGE C)

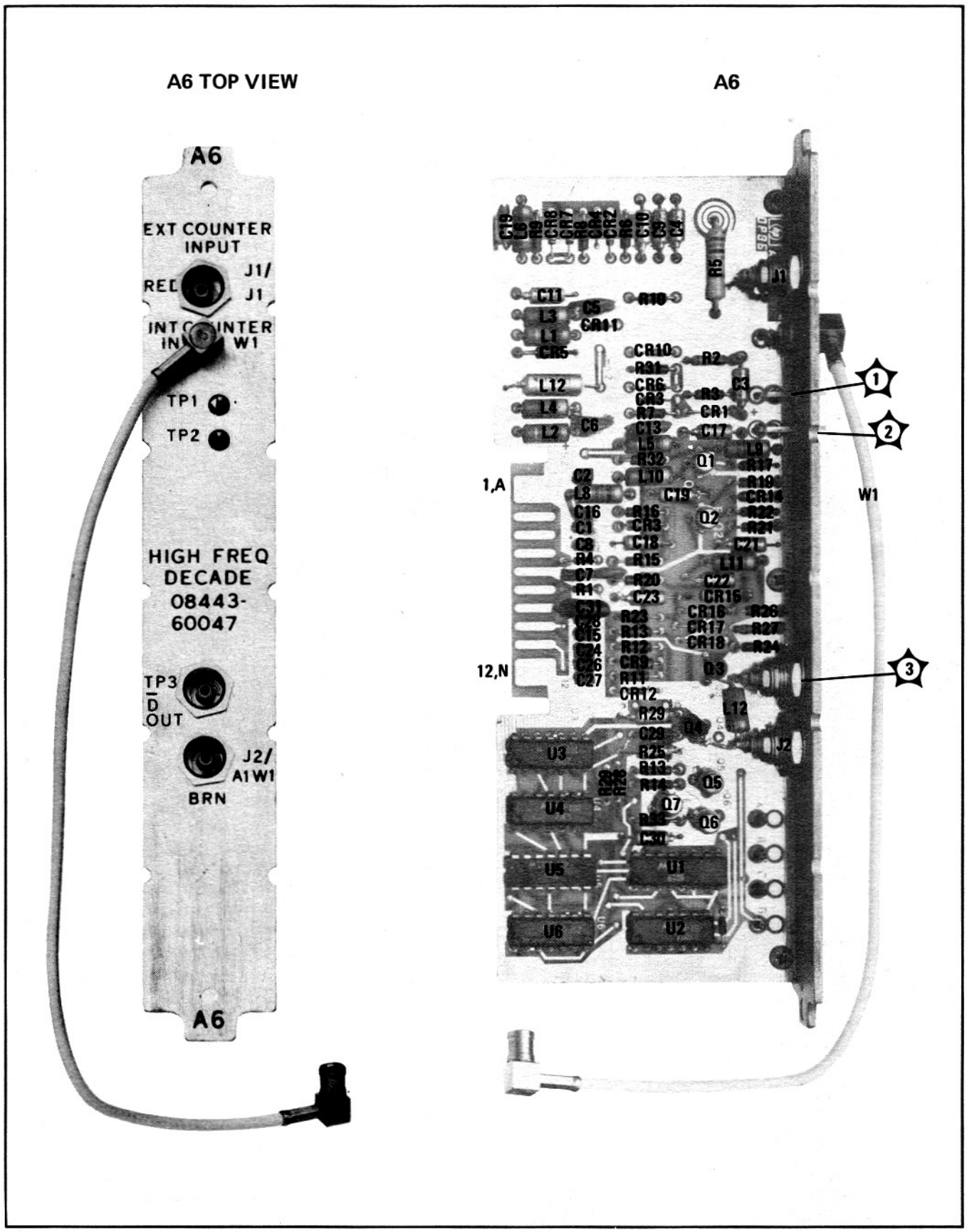
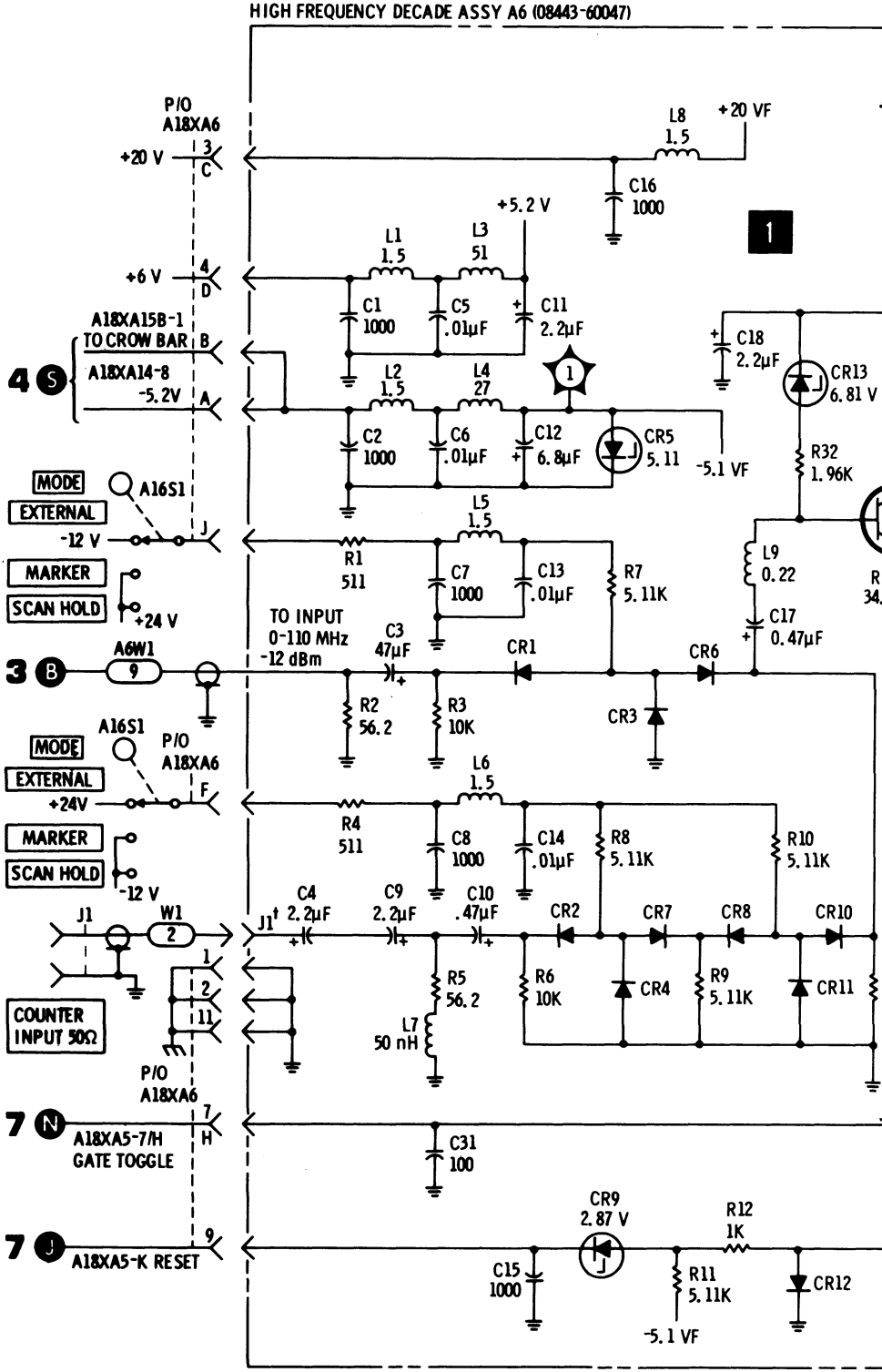
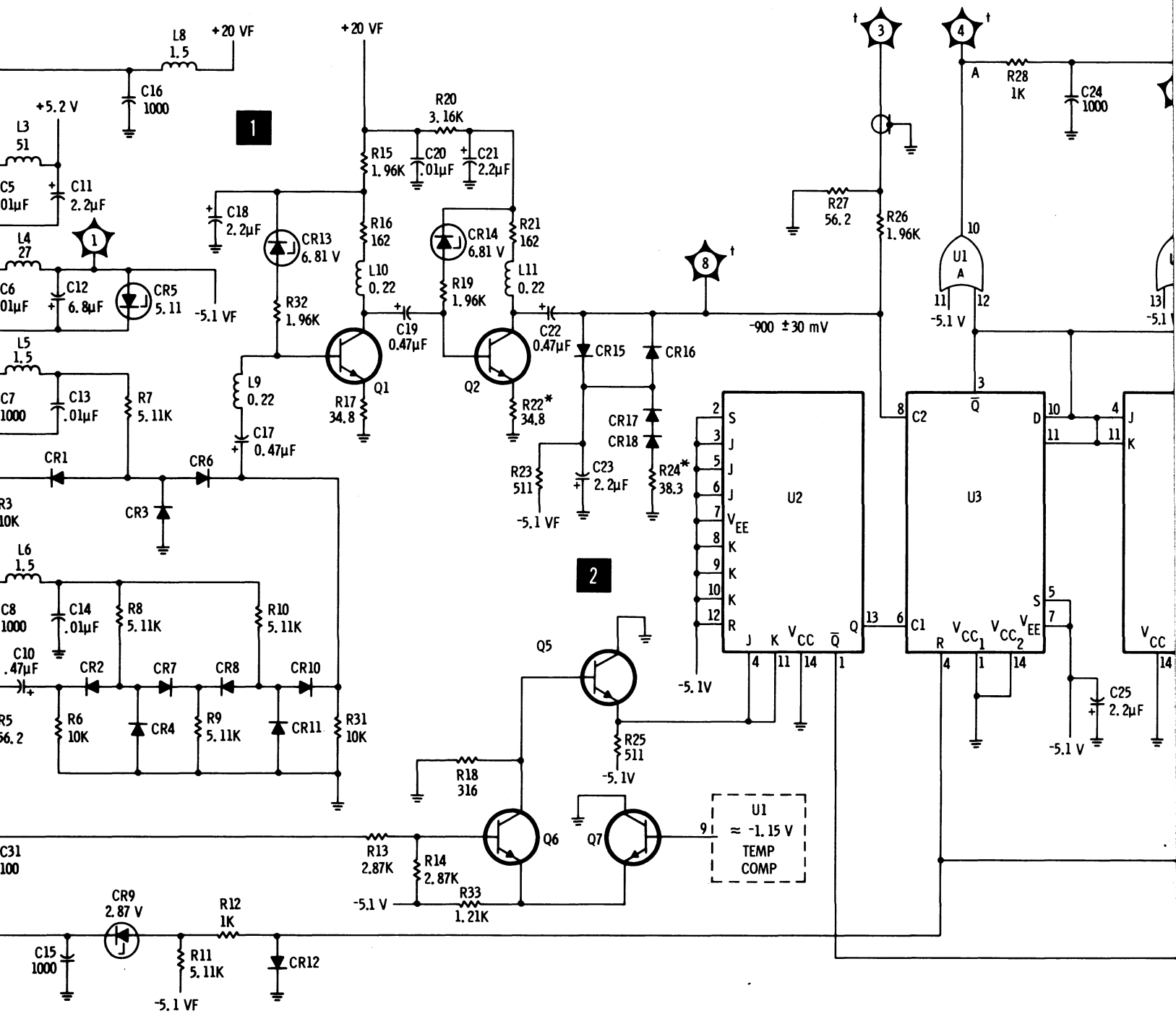


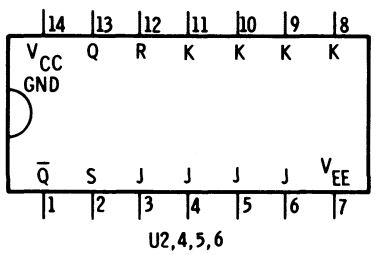
Figure 7-7. High Frequency Decade Assembly A6 Parts Locations (CHANGE B)



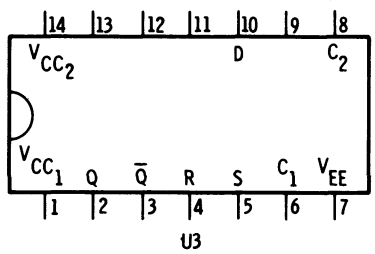
REFERENCE DESIGN
ASSEMBLIES ARE AB
CLUDES ASSEMBLY
IS A1R1. DESIGNA
COMPLETE AS SHOWN



REFERENCE DESIGNATIONS WITHIN OUTLINED (— - - —) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER; e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.



U2,4,5,6



U3

Figu

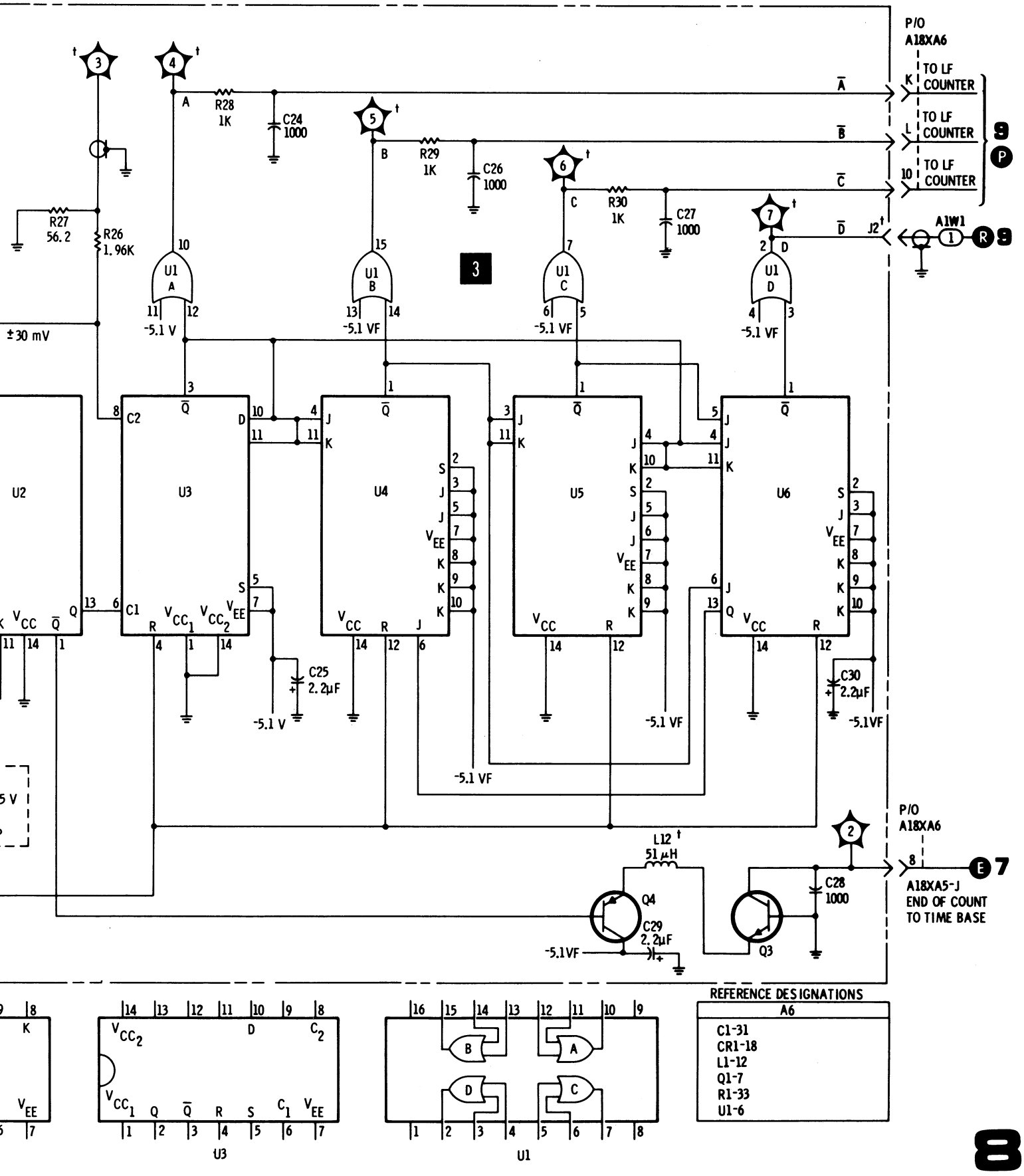


Figure 7-8. High Frequency Decade Assembly A6 Schematic Diagram (CHANGE C)

CHANGE D

Page 6-5, Table 6-3:
Replace the entire A1 listing with Table 7-2, Replaceable Parts (CHANGE D), from this section.

Page 6-7, Table 6-3:
Change A5C10 to HP Part Number 0160-2139, CD 0, C FXD:CER 220PF +80−20% 1000 VDCW, 91418, Type B.

Page 6-11, Table 6-3:
Change A7R43 to HP Part Number 0757-0279, CD 0, R:FXD MET FLM 3.16K OHM 1% 1/8W, 28480, 0757-0279.

Page 8-48, Low Frequency Counter Assembly A1A1 and Counter Display A1A2:
Change Paragraph headed 'Low Frequency Counter Assembly A1' to read as shown below:

Low Frequency Counter A1 (CHANGE D)

The least significant digit (10°) circuit consists of a buffer store, a decoder driver and a numerical readout device. When the transfer pulse occurs the numerical readout device displays the count that remained in the high frequency decade when the count period ended.

The circuits for the next six digits are identical in function and configuration. Each circuit has a blanking decade counter which provides a BCD output to the buffer store and a divide-by-ten output to drive the next blanking decade counter. The buffer store circuits store the count remaining in the decade counters when the count period ended until the next transfer pulse appears. When the transfer pulse appears the buffer stores provide BCD information to the decoder drivers (A, B, C, and D) and to a rear panel connector (A, B, C and D) for use in external equipment. The decoder driver stages convert the BCD information to an output which drives one of the ten elements in the numerical readout devices. The third, fourth and fifth numerical readout devices (from the right side) have decimal point inputs. The decimal point to be displayed is selected by the RESOLUTION switch.

All leading zeros to the left of the decimal point, which are also to the left of the first significant digit, are blanked.

The eighth display circuit consists of two flip-flops and two amplifiers. It detects and displays an overflow from the previous decades. One of the amplifiers drives the 1 element in the numerical readout device when an overflow is present. The other amplifier provides an overflow BCD output for external use.

Page 8-51, Figure 8-26:
Change Low Frequency Counter A1 portion of Counter Logic Diagram as shown in Figure 7-9 (CHANGE D).

Page 8-65, LOW FREQUENCY COUNTER ASSEMBLY A1:
Substitute paragraphs in this section headed LOW FREQUENCY COUNTER ASSEMBLY A1 (Operation and Troubleshooting) (CHANGE D) for Low Frequency Counter description.

Page 8-73, Figure 8-29, Marker Control Assembly A7 schematic:
Connect end of R8 shown connected to the cathode of CR4 to +20VF instead of CR4.
Connect emitter of Q16 to circuit board ground instead of switched ground.
Change value of R43 to 3160 (ohms).
Change MARKER CONTROL ASSY A7 part number at top of schematic diagram to 08443-60046.

Page 8-75, Figure 8-32, Time Base Assembly A5 schematic:
Change value of capacitor C10 to 220PF.

Pages 8-78, 8-79, Figures 8-36, 8-37, and 8-38:
Replace Figures 8-36, 8-37, and 8-38, with Figure 7-10 (CHANGE D) from this section.
Pages 8-81–8-83, Figure 8-39, Low Frequency Counter Assembly A1 Schematic:
Replace Figure 8-39 with Figure 7-11 from this section.

Page 8-83, Figure 8-39:
Add, after Figure 8-39, Figures 7-12, 7-13, and 7-14 from this section.

Table 7-4. Replaceable Parts (CHANGE D) (1 of 3)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	08443-60071	8	1	ASSY: LOW FREQUENCY COUNTER	28480	08443-60071
A1A1	08443-60037	6	1	BOARD ASSY:LOW FREQ COUNTER	28480	08443-60037
A1A1C1	0160-2143	6	3	CAPACITOR-FXD 2000PF +80—20% 1KVDC CER	28480	0160-2143
A1A1C2	0160-2143	6		CAPACITOR-FXD 2000PF +80—20% 1KVDC CER	28480	0160-2143
A1A1C3	0160-2930	9	11	CAPACITOR-FXD .01UF +80—20% 100VDC CER	28480	0160-2930
A1A1C4	0180-0197	8	20	CAPACITOR-FXD 2.2UF +—10% 20VDC TA	56289	150D225X9020A2
A1A1C5	0180-0137	6	1	CAPACITOR-FXD 100UF +—20% 10VDC TA	56289	150D107X0010R2
A1A1CR1	1901-0025	2	30	DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A1A1CR2	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A1A1CR3	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A1A1CR4	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A1A1CR5	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A1A1DS1	1970-0042	8	8	TUBE-ELECTRON IND-ALPHANUMERIC	28480	1970-0042
	1200-0405	6	8	SOCKET-TUBE 14-CONT NIXIE	28480	1200-0405
A1A1DS2	1970-0042	8		TUBE-ELECTRON IND-ALPHANUMERIC	28480	1970-0042
	1200-0405	6		SOCKET—TUBE 14-CONT NIXIE	28480	1200-0405
A1A1DS3	1970-0042	8		TUBE-ELECTRON IND-ALPHANUMERIC	28480	1970-0042
	1200-0405	6		SOCKET-TUBE 14-CONT NIXIE	28480	1970-0042
A1A1DS4	1970-0042	8		TUBE-ELECTRON IND-ALPHANUMERIC	28480	1970-0042
	1200-0405	6		SOCKET-TUBE 14-CONT NIXIE	28480	1200-0405
A1A1DS5	1970-0042	8		TUBE-ELECTRON IND-ALPHANUMERIC	28480	1970-0042
	1200-0405	6		SOCKET-TUBE 14-CONT NIXIE	28480	1200-0405
A1A1DS6	1970-0042	8		TUBE-ELECTRON IND-ALPHANUMERIC	28480	1970-0042
	1200-0405	6		SOCKET-TUBE 14-CONT NIXIE	28480	1200-0405
A1A1DS7	1970-0042	8		TUBE-ELECTRON IND-ALPHANUMERIC	28480	1970-0042
	1200-0405	6		SOCKET-TUBE 14-CONT NIXIE	28480	1200-0405
A1A1DS8	1970-0042	8		TUBE-ELECTRON IND-ALPHANUMERIC	28480	1970-0042
	1200-0405	6		SOCKET-TUBE 14-CONT NIXIE	28480	1200-0405
A1A1L1	9100-1643	2	2	INDUCTOR RF-CH-MLD 300UH 5% .2DS.45LG	28480	9100-1643
A1A1L2	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-1616
A1A1L3	9140-0051	8	1	INDUCTOR 400UH 5% 1.125DX.813LG Q-3.3	28480	9140-0051
A1A1Q1	1854-0022	8	4	TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A1A1Q2	1854-0071	7	41	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q3	1854-0022	8		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A1A1Q4	1854-0022	8		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A1A1Q5	1854-0022	8		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A1A1R1	0683-6825	7	7	RESISTOR 6.8K 5% .25W FC TC=—400/+700	01121	CB6825
A1A1R2	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=—400/+700	01121	CB6825
A1A1R3	0683-3025	3	7	RESISTOR 3K 5% .25W FC TC=—400/+700	01121	CB3025
A1A1R4	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=—400/+700	01121	CB6825
A1A1R5	0683-3025	3		RESISTOR 3K 5% .25W FC TC=—400/+700	01121	CB3025
A1A1R6	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=—400/+700	01121	CB6825
A1A1R7	0683-3025	3		RESISTOR 3K 5% .25W FC TC=—400/+700	01121	CB3025
A1A1R8	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=—400/+700	01121	CB6825
A1A1R9	0683-3025	3		RESISTOR 3K 5% .25W FC TC=—400/+700	01121	CB3025
A1A1R10	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=—400/+700	01121	CB6825
A1A1R11	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=—400/+700	01121	CB6825
A1A1R12	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=—400/+700	01121	CB6825
A1A1R13	0683-1025	9	13	RESISTOR 1K 5% .25W FC TC=—400/+600	01121	CB1025
A1A1R14	0683-3025	3		RESISTOR 3K 5% .25W FC TC=—400/+700	01121	CB3025
A1A1R15	0683-3025	3		RESISTOR 3K 5% .25W FC TC=—400/+700	01121	CB3025

Table 7-4. Replaceable Parts (CHANGE D) (2 of 3)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A1U1	1820-0092	1	7	IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	28480	1820-0092
A1A1U2	1820-0092	1		IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	28480	1820-0092
A1A1U3	1820-0092	1		IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	28480	1820-0092
A1A1U4	1820-0092	1		IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	28480	1820-0092
A1A1U5	1820-0092	1		IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	28480	1820-0092
A1A1U6	1820-0092	1		IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	28480	1820-0092
A1A1U7	1820-0092	1		IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	28480	1820-0092
A1A1U8	1820-0116	0	7	IC MISC TTL 4-BIT	28480	1820-0116
A1A1U9	1820-0116	0		IC MISC TTL 4-BIT	28480	1820-0116
A1A1U10	1820-0116	0		IC MISC TTL 4-BIT	28480	1820-0116
A1A1U11	1820-0116	0		IC MISC TTL 4-BIT	28480	1820-0116
A1A1U12	1820-0116	0		IC MISC TTL 4-BIT	28480	1820-0116
A1A1U13	1820-0116	0		IC MISC TTL 4-BIT	28480	1820-0116
A1A1U14	1820-0116	0		IC MISC TTL 4-BIT	28480	1820-0116
A1A1U15	1820-0077	2	1	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A1A1U16	1820-0117	1	1	IC CNTR TTL DECD	28480	1820-0117
A1A1U17	1820-0119	3	5	IC CNTR TTL DECD	28480	1820-0119
A1A1U18	1820-0119	3		IC CNTR TTL DECD	28480	1820-0119
A1A1U19	1820-0119	3		IC CNTR TTL DECD	28480	1820-0119
A1A1U20	1820-0119	3		IC CNTR TTL DECD	28480	1820-0119
A1A1U21	1820-0119	3		IC CNTR TTL DECD	28480	1820-0119
A1A1U22	1820-0174	0	1	IC INV TTL HEX	01295	SN7404N
A1A2	08443-60070	7	1	COOLING FAN ASSEMBLY	28480	08443-60070
A1A2C1	0180-0155	8	1	CAPACITOR-FXD 2.2UF +—20% 20VDC TA	56289	150D225X0020A2
A1A2C2	0160-3451	1	1	CAPACITOR-FXD .01UF +80—20% 100VDC CER	28480	0160-3451
A1A2CR1	1901-0040	1	6	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A2CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A2CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A2CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A2CR5	1901-0049	0	1	DIODE-PWR RECT 50V 750MA DO-29	28480	1901-0049
A1A2CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A2CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A2CR8	1902-3094	3	1	DIODE-ZNR 5.11V 2% DO-35 PD=.4W	28480	1902-3094
A1A2M1	3140-0487	8	1	MOTOR-DC BRSHLS 10V 2550-RPM .001-HP	28480	3140-0487
A1A2Q1	1853-0027	1	4	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0027
A1A2Q2	1853-0027	1		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0027
A1A2Q3	1853-0027	1		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0027
A1A2Q4	1853-0027	1		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHz	28480	1853-0027
A1A2Q5	1854-0045	5	1	TRANSISTOR NPN SI TO-18 PD=500MW	28480	1854-0045
A1A2Q6	1853-0020	4	11	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q7	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A2R1	0683-0335	2	1	RESISTOR 3.3 5% .25W FC TC=—400/+500	01121	CB33G5
A1A2R2	0684-3311	2	2	RESISTOR 330 10% .25W FC TC=—400/+600	01121	CB3311
A1A2R3	0684-3311	2		RESISTOR 330 10% .25W FC TC=—400/+600	01121	CB3311
A1A2R4	0698-7255	0	2	RESISTOR 6.19K 1% .05W F TC=0+—100	24546	C3-1/8-TO-6191-G
A1A2R5	0698-7255	0		RESISTOR 6.19K 1% .05W F TC= 0+—100	24546	C3-1/8-TO-6191-G
A1A2R6	0698-7239	0	1	RESISTOR 1.33K 1% .05W F TC= 0+—100	24546	C3-1/8-TO-1331-G
A1A2R7	0698-7253	8	1	RESISTOR 5.11K .05W F TC= 0+—100	24546	C3-1/8-TO-5111-G
A1A2W1	08443-60064	9		CABLE ASSEMBLY-"D" INPUT	28480	08443-60064

Table 7-4. Replaceable Parts (CHANGE D) (3 of 3)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				A1 MISCELLANEOUS PARTS		
	08443-00009	6	1	COVER-TOP COUNTER BOX	28480	08443-00009
	08443-00016	5	1	BRACKET-RETAINING	28480	08443-00016
	08443-00042	7	1	COUNTER BOX	28480	08443-00042
	08443-00007	4	1	PANEL-REAR C-BOX	28480	08443-00007
	08443-00008	5	1	PANEL-REAR C-BOX	28480	08443-00008
	08443-00010	9	1	BRACKET MOUNTING-LEFT C-BOX	28480	08443-00010
	08443-00011	0	1	BRACKET MOUNTING-RIGHT C-BOX	28480	08433-00011
	08443-00015	4	1	SCREEN-NIXIE SHIELD	28480	08443-00015
	08443-40004	5	1	BRACKET-SCREEN	28480	08443-40004
	08443-00044	9	2	GUIDE-CONNECTOR BOARD	28480	08443-00044
	08443-60039	8	1	CONNECTOR BOARD ASSEMBLY	28480	08443-60039
	0380-0885	5	4	STANDOFF-RVT-ON .156-IN-LG 4-40THD	00000	Order by descript.
	1251-1887	7	4	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1887
	1400-0818	9	1	CLAMP MOTOR	28480	1400-0818
	0400-0009	9	15	GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
	3160-0231	2	1	FAN BLADE 2.5-OD .079-ID	28480	3160-0231
	0400-0009	9		GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
	0400-0009	9		GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
	0400-0009	9		GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
	0400-0009	9		GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
	0400-0009	9		GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
	0400-0009	9		GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
	0400-0009	9		GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
	08443-60064	9	3	CABLE ASSEMBLY	28480	08443-60064

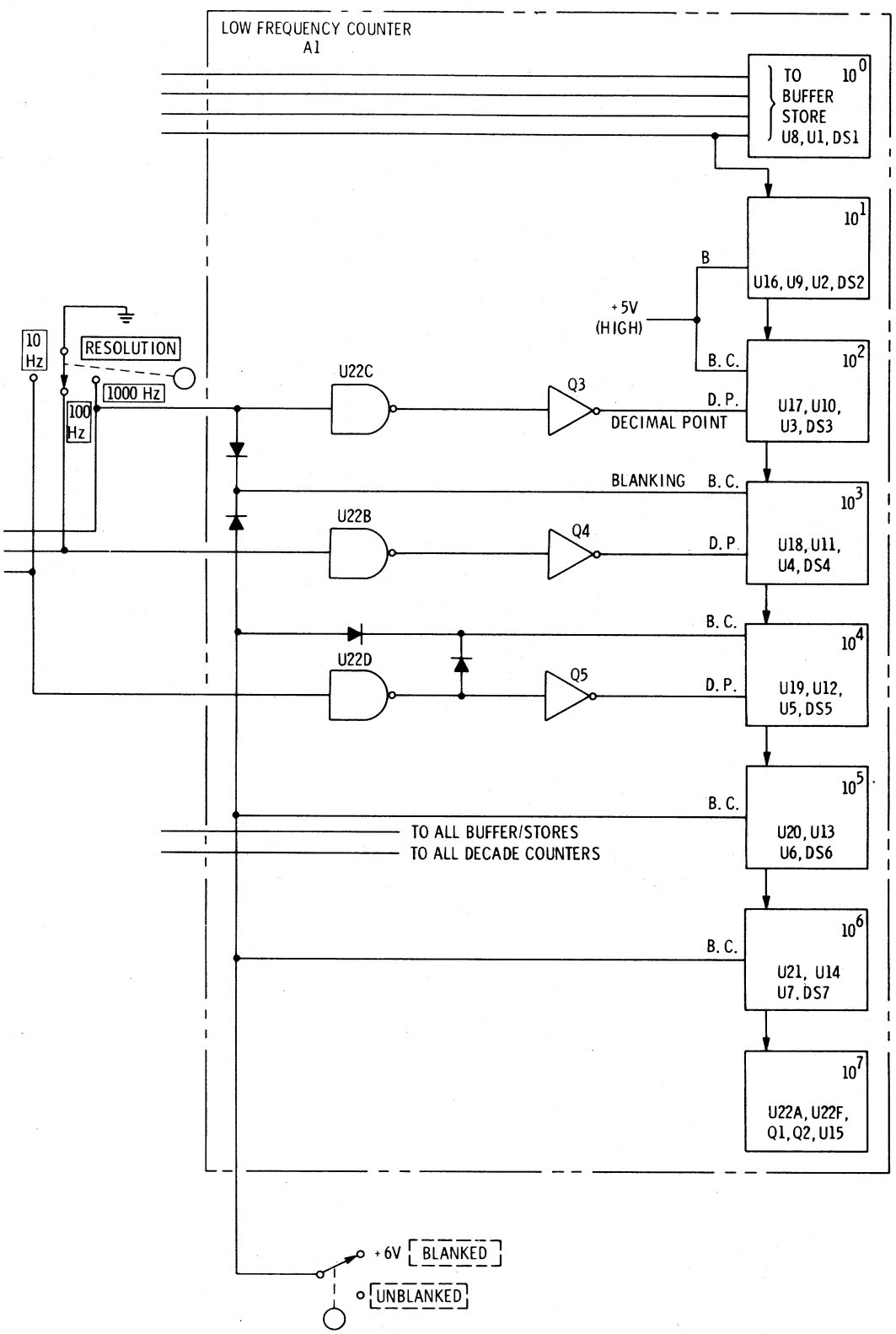


Figure 7-9. Low Frequency Counter A1 Portion of Counter Logic Diagram (CHANGE D)

LOW FREQUENCY COUNTER ASSEMBLY A1 (OPERATION AND TROUBLESHOOTING) (See Service Sheet 9) (CHANGE C)

When trouble has been isolated to low frequency counter assembly (A1), it should be removed from the chassis and reinstalled on an extender board to provide easy access to test points and components.

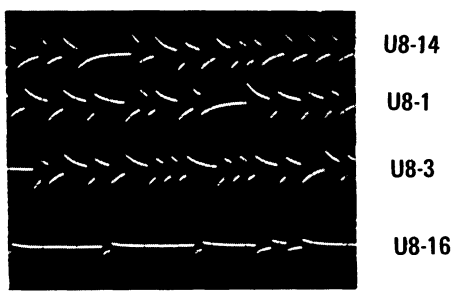
DS1 Drive Circuit

The least significant digit is displayed on DS1. When the transfer pulse from the time base is applied to buffer/store U8, the information in the high frequency decade is transferred to decoder/driver U1. U1 decodes the 1-2-4-8 information to cause the appropriate number in the numerical readout to be illuminated. U8 also provides a BCD output to a rear panel connector for use in external equipment.

DS1 Drive Circuit Troubleshooting

Test 1-a. Use the digital voltmeter to verify the presence of dc levels at pins A and B/2 shown on the schematic diagram.

Test 1-b. If the A, B, C and D inputs are as shown in Waveform SS9-1, and none of the numerical readouts illuminate, trouble is probably in the +175 volt or +5 volt circuits. Check for an open circuit in L1, L2 or L3.



Waveform SS9-1
(See Test 1-c)

Test 1-c. If some, or all of the other numerical readouts illuminate, trouble is probably in DS1, U1 or U8. Isolate the cause of trouble as follows: Ground (one at a time) pins 1, 2, 3, 4, 11, 12, 13, 14, 15 and 16 of U1. Refer to the schematic and verify that the proper number illuminates for each pin as they are grounded. If none of the numbers illuminate, check R1. If R1 is providing power to DS1, DS1 is defective.

If DS1 numbers illuminate as they should in the previous test, connect the oscilloscope to U8 as follows: Channel A — pin 14, Channel B — pin 1, Channel C — pin 3 and Channel D — pin 16. Set the oscilloscope TIME/DIV to .5 second and the Volts/Div to .5. Operate the model 8443A in the MARKER mode at 10 Hz resolution. Place the analyzer SCAN WIDTH PER DIVISION to 10 MHz, SCAN WIDTH to PER DIVISON and SCAN TIME PER DIVISION to 1 MILLISECOND. At these analyzer settings, the least significant digit of the counter will change numbers quite rapidly; as a result, the output from the buffer store will also change rapidly. The oscilloscope display should appear (to the eye) as four dots moving from left to right and changing in amplitude erratically. A time exposure of the oscilloscope CRT should be similar to that shown in waveform SS9-1. If the oscilloscope display is correct, U1 is defective. If the display is not correct, U8 is defective.

DS2 through DS7 Drive Circuits

The six counter circuits following that of the least significant digit each consist of a blanking decade counter, a buffer/store, a decoder/driver and a numerical readout device. DS3, DS4 and DS5 have inputs that will cause a decimal point to illuminate in one of them; the position of the RESOLUTION switch determines which decimal point is illuminated. Blanking inputs are provided to the circuits driving DS4, DS5, DS6 and DS7.

Each of the last five blanking decade counters is driven by the divide-by-ten output of the blanking decade counter which precedes it. The first blanking decade counter (U16) is driven by the $\overline{D}$ output of the high frequency decade. When the transfer pulse is received, each buffer/store transfers the count information from the blanking decade counter to the decoder/driver and to a BCD output connector on the rear panel. The

decoder/drivers operate on negative logic; the rear panel BCD outputs are positive logic. When the reset pulse appears all of the blanking decade counters and the high frequency decade are set to zero.

Test Procedure 2

General

The numerical readout indicators, in many instances, will help to localize a problem to a specific area within the low frequency counter circuits.

If any one of the numerical readouts does not function, but numerical readouts to the left of it do, the trouble is likely to be the readout itself, the decoder/driver, or the buffer/store associated with that readout. It is not likely that the associated blanking decade counter is defective.

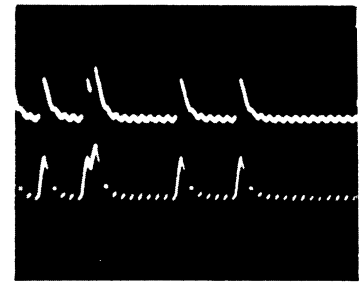
If any numerical readout is blank or reads only one number and the readouts to the left consistently read 0, the blanking decade counter for the first readout affected (from the right) is probably defective.

Test 2-a. If a single numerical readout is not functioning, ground (one at a time) pins 1, 2, 3, 4, 11, 12, 13, 14, 15 and 16 of the decoder/driver which drives it. Refer to the schematic diagram to verify that the right number is illuminating.

If none of the numbers illuminate, check the 6800 ohm resistor associated with that readout. If the 6800 ohm resistor is supplying power, the readout device is defective.

If the readout device illuminates correctly when the specified pins are grounded, proceed to test 2-b.

Test 2-b. Connect the oscilloscope to the buffer/store associated with the malfunctioning readout as follows: Channel A — pin 14, Channel B — pin 1, Channel C — pin 3 and Channel D — pin 16. Set the oscilloscope TIME/DIV to 1 second and the VOLTS/DIV to .5. Operate the model 8443A in the EXTERNAL mode at 10 Hz resoltion with the RF OUTPUT connected to the COUNTER INPUT. Set the analyzer SCAN WIDTH PER DIVISION to 10 MHz, the SCAN WIDTH to PER



Waveform SS9-2
(See Test 2-c)

DIVISION and the SCAN TIME PER DIVISION to 1 second. The oscilloscope CRT display should appear (to the eye) as four dots moving from left to right and changing erratically in amplitude. A time exposure of the oscilloscope CRT should be similar to waveform SS9-1. If the oscilloscope CRT display is as shown, the decoder/driver is defective. If the display is not correct, proceed to test 2-c.

Test 2-c. Connect the oscilloscope to the blanking decade counter associated with the malfunctioning readout as follows: Channel A — pin 15, Channel B — pin 1, Channel C — pin 2 and Channel D — pin 16. With all equipment operating as it was in test 2-b, the oscilloscope CRT should again show four dots moving from left to right and varying erratically in amplitude. If the signal is present, but was not in test 2-b, the buffer/store is defective. If the signal is not present, connect one channel of the oscilloscope to pin 9 of the blanking decade counter. All controls remain the same except that the oscilloscope CRT trace is centered and VOLTS/DIV is set to .2. The oscilloscope CRT presentation should be similar to that shown in Waveform SS9-2. If this waveform is present and the previous one was not, the blanking decade counter is probably defective. If the signal is not present, the preceeding blanking decade counter is defective.

3 DS8 Drive Circuit

The most significant digit, displayed by DS8 in the 10 Hz resolution mode, is used only when the input frequency to the high frequency decade is 100 MHz or higher. Below 100 MHz, DS8 is blanked because there is no positive-going output from U21. The output of U21 changes state on a count of 8 (representative of 80 MHz), but since

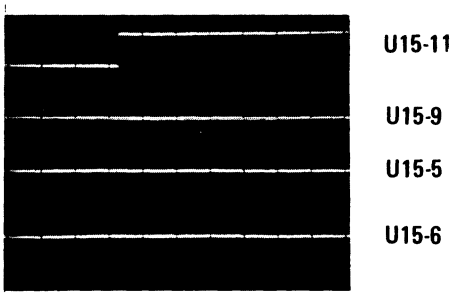
this transition is negative-going, it has no effect on U15A. When U21 receives a tenth input pulse (representative of 100 MHz), it again changes state and the positive-going transition clocks U15A. The Q output of U15A goes high and is applied to the D input of U15B, which acts as a buffer/store. When the transfer pulse appears and the D input to U15B is high, U15B is clocked and the Q output is used to turn on Q1. When Q1 conducts it completes the circuit for the numeral 1 in DS8. The $\overline{Q}$ output of U15B is inverted by Q2 and applied as a BCD bit to the rear panel BCD connector.

Test Procedure 3

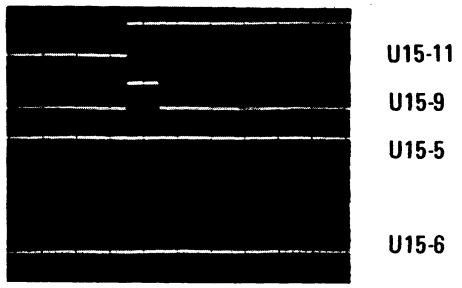
Test 3-a. Connect the oscilloscope to U15 as follows: Channel A — pin 11, Channel B — pin 9, Channel C — pin 5 and Channel D — pin 6. Set the oscilloscope SWEEP MODE to NORM, INTernal Sync, 5 mSec/Div, .5 VOLTS/DIV and DC inputs. Set the model 8443A to operate in the SCAN HOLD mode, MARKER POSITION knob pulled out, 10 Hz resoltion. Operate the analyzer in the ZERO scan mode at 95 MHz. The oscilloscope CRT display should be as shown in waveform SS9-3.

Change the analyzer FREQUENCY to 105 MHz. Note that U15A Channel B Q output (pin 9) goes high when the frequency reaches 100 MHz. The Q output of U15B (Channel C), goes high and the $\overline{Q}$ output of U15B (Channel D) goes low. The oscilloscope CRT display should now be as shown in Waveform SS9-4.

In the above tests, if the Channel A and B waveforms were correct and the Channel C and/or D were not, proceed to test 3-b. If all waveforms were correct and the numeral 1 did not light in



Waveform SS9-3
(See Test 3-a)



Waveform SS9-4
(See Test 3-a)

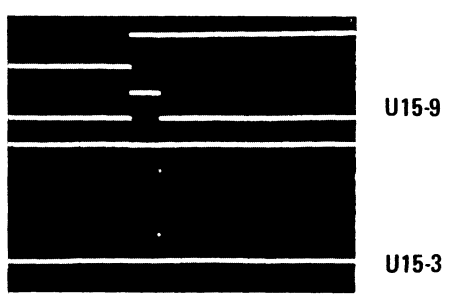
DS8 when the frequency was over 100 MHz, proceed to test 3-c. If the Channel A waveform was correct, but channel B was not, U15 is defective.

Test 3-b. Leave Channel A and B of the oscilloscope connected as they were in the above tests. Connect the Channel C input to U15 pin 13 and the Channel D input to U15 pin 3. The oscilloscope CRT display should be as shown in waveform SS9-5. If either the transfer or reset pulses are missing and the other counter digits function properly, U22 is defective.

Test 3-c. Apply a ground to Q1-c. If DS8 numeral 1 illuminates, Q1 is defective. If it does not, DS8 is defective.

4 Blanking

When the UNBLANKED-BLANKED switch on the rear panel is in the BLANKED position, all zeros which are to the left of the decimal point and also to the left of the first significant digit are blanked.



Waveform SS9-5
(See Test 3-b)

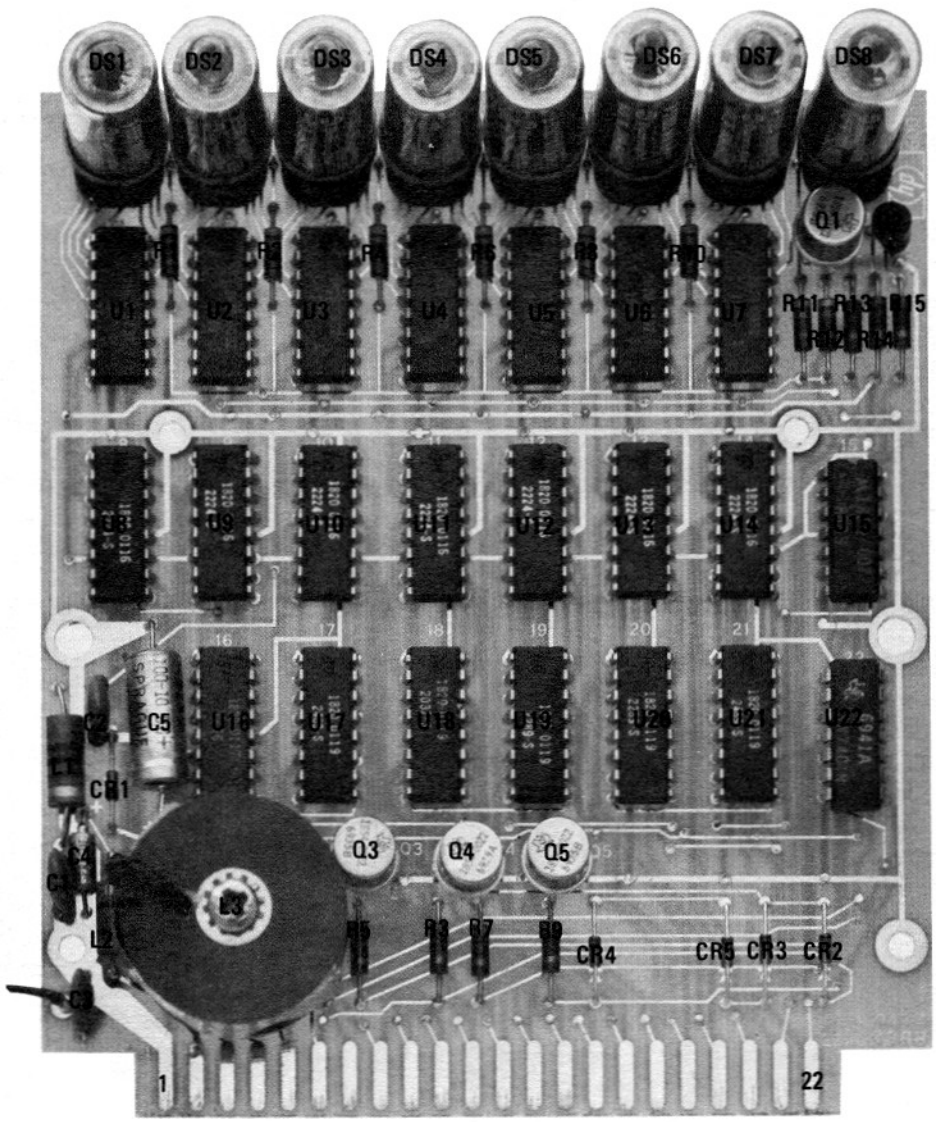
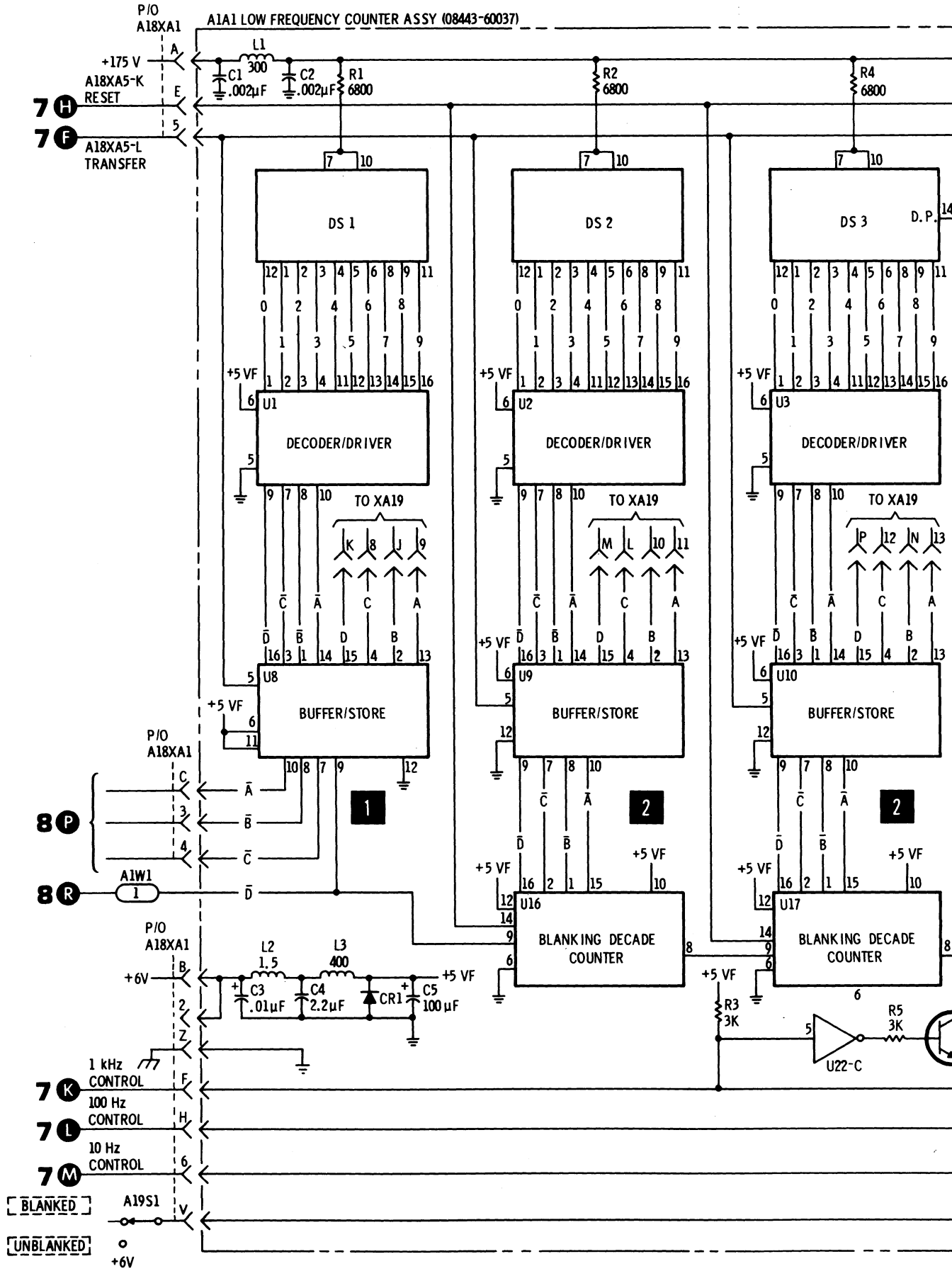


Figure 7-10. Low Frequency Counter Board Assembly A1A1 Parts Locations (CHANGE D)


A1A1 LOW FREQUENCY COUNTER ASSY (08443-60037)
P/O A18XA1
+175 V
A18XA5-K RESET
A18XA5-L TRANSFER
L1 300
C1 .002µF
C2 .002µF
R1 6800
R2 6800
R4 6800
DS 1
DS 2
DS 3
D.P.
U1 DECODER/DRIVER
U2 DECODER/DRIVER
U3 DECODER/DRIVER
TO XA19
U8 BUFFER/STORE
U9 BUFFER/STORE
U10 BUFFER/STORE
U16 BLANKING DECADE COUNTER
U17 BLANKING DECADE COUNTER
+5 VF
A1W1
L2 1.5
L3 400
+6V
C3 .01µF
C4 2.2µF
CR1
C5 100 µF
R3 3K
R5 3K
U22-C
1 kHz CONTROL
100 Hz CONTROL
10 Hz CONTROL
A19S1
BLANKED
UNBLANKED
+6V

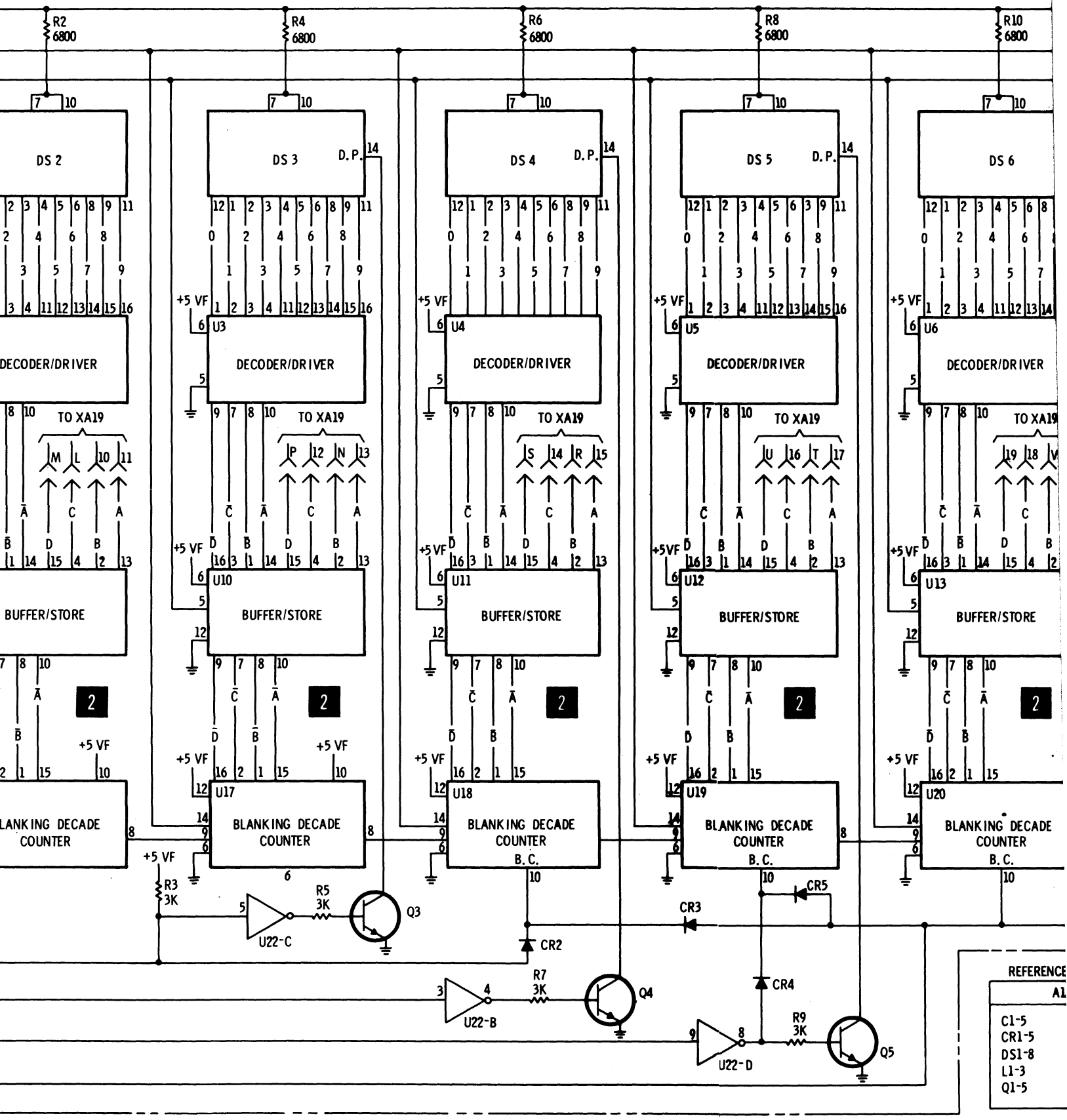


Figure 7-11. Low Frequ

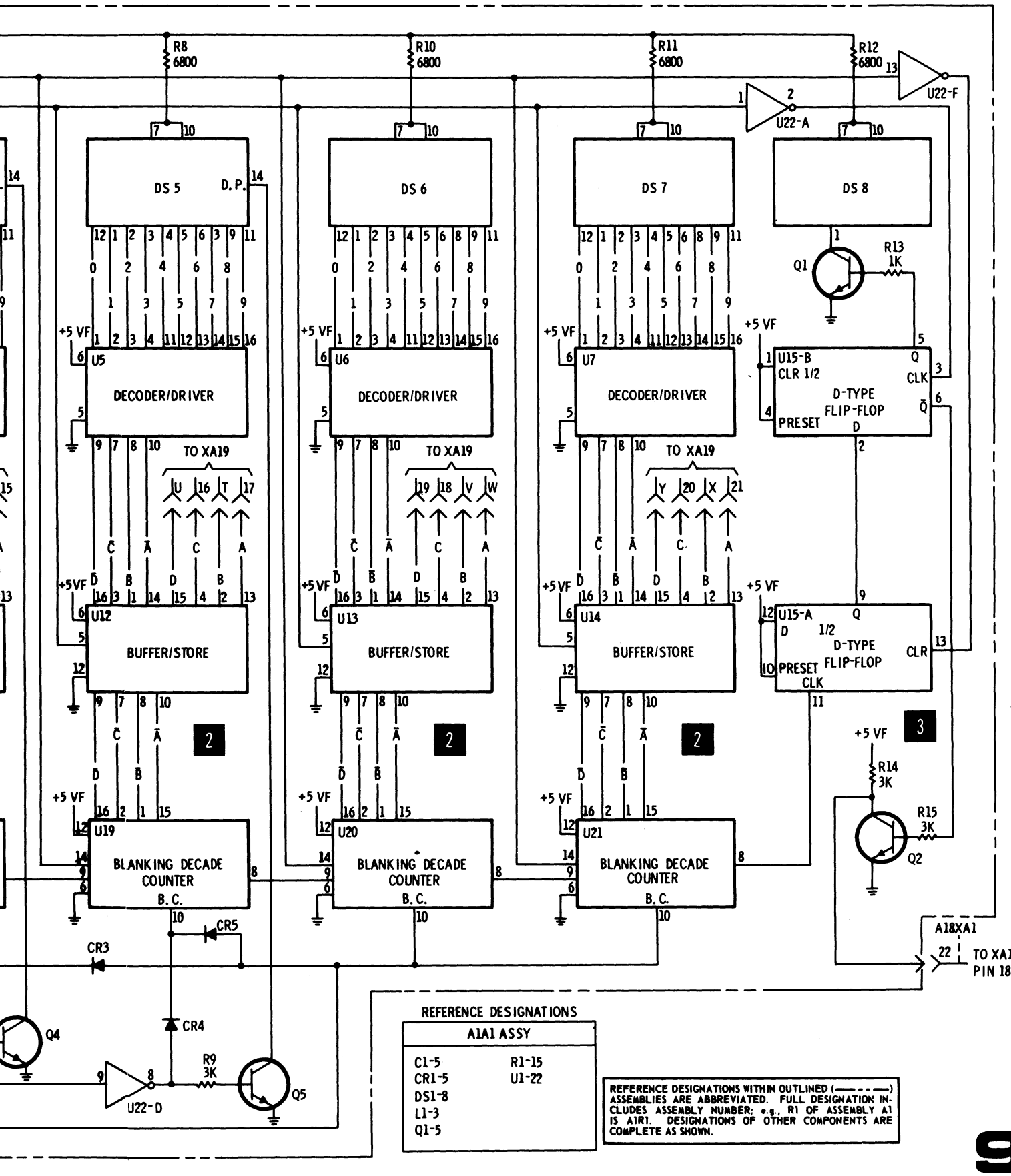


Figure 7-11. Low Frequency Counter Assembly A1A1 Schematic Diagram (CHANGE D)

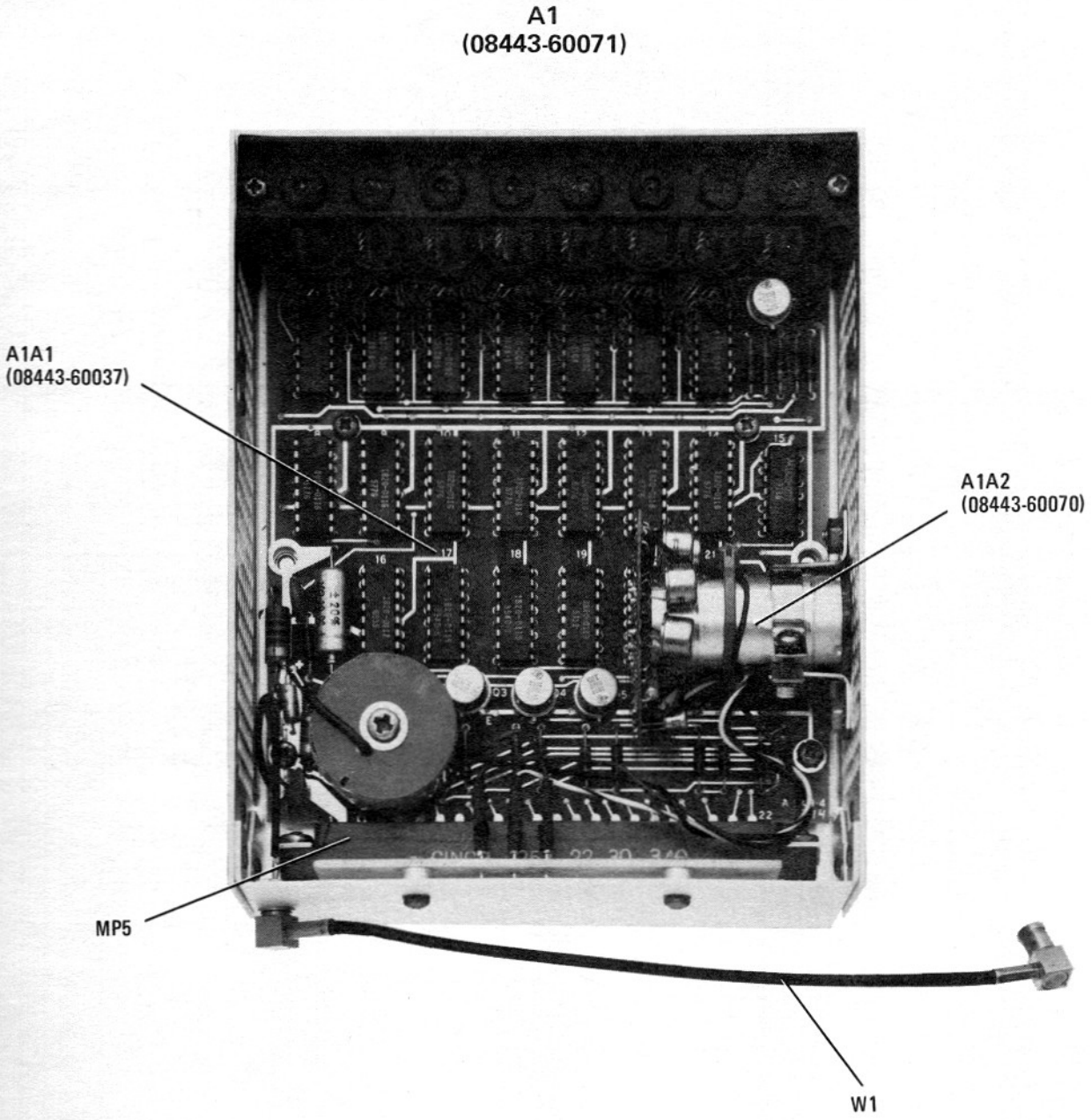


Figure 7-12. Low Frequency Counter Assembly A1 Subassemblies (CHANGE D)

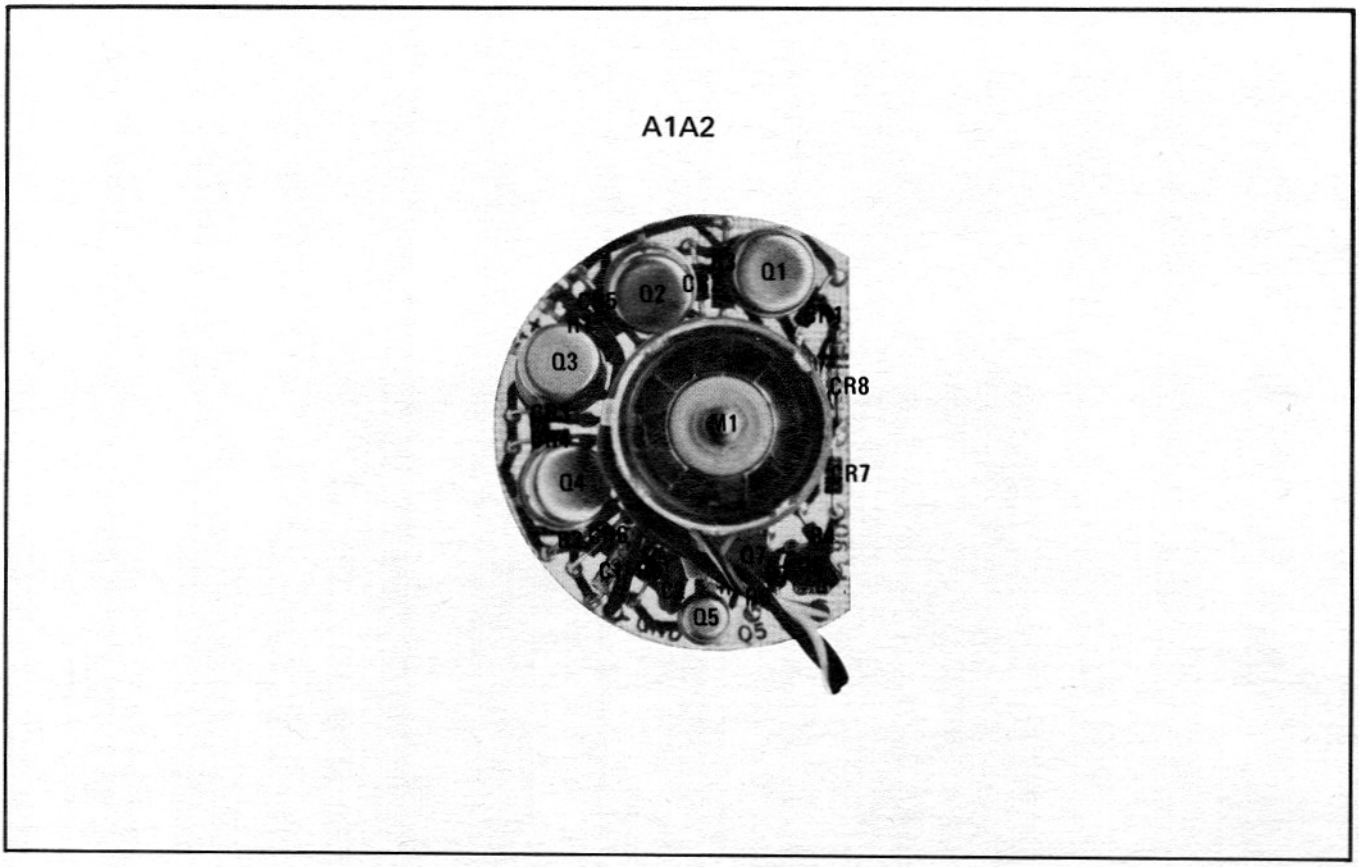


Figure 7-13. Fan Motor Assembly A1A2 Parts Locations (CHANGE D)

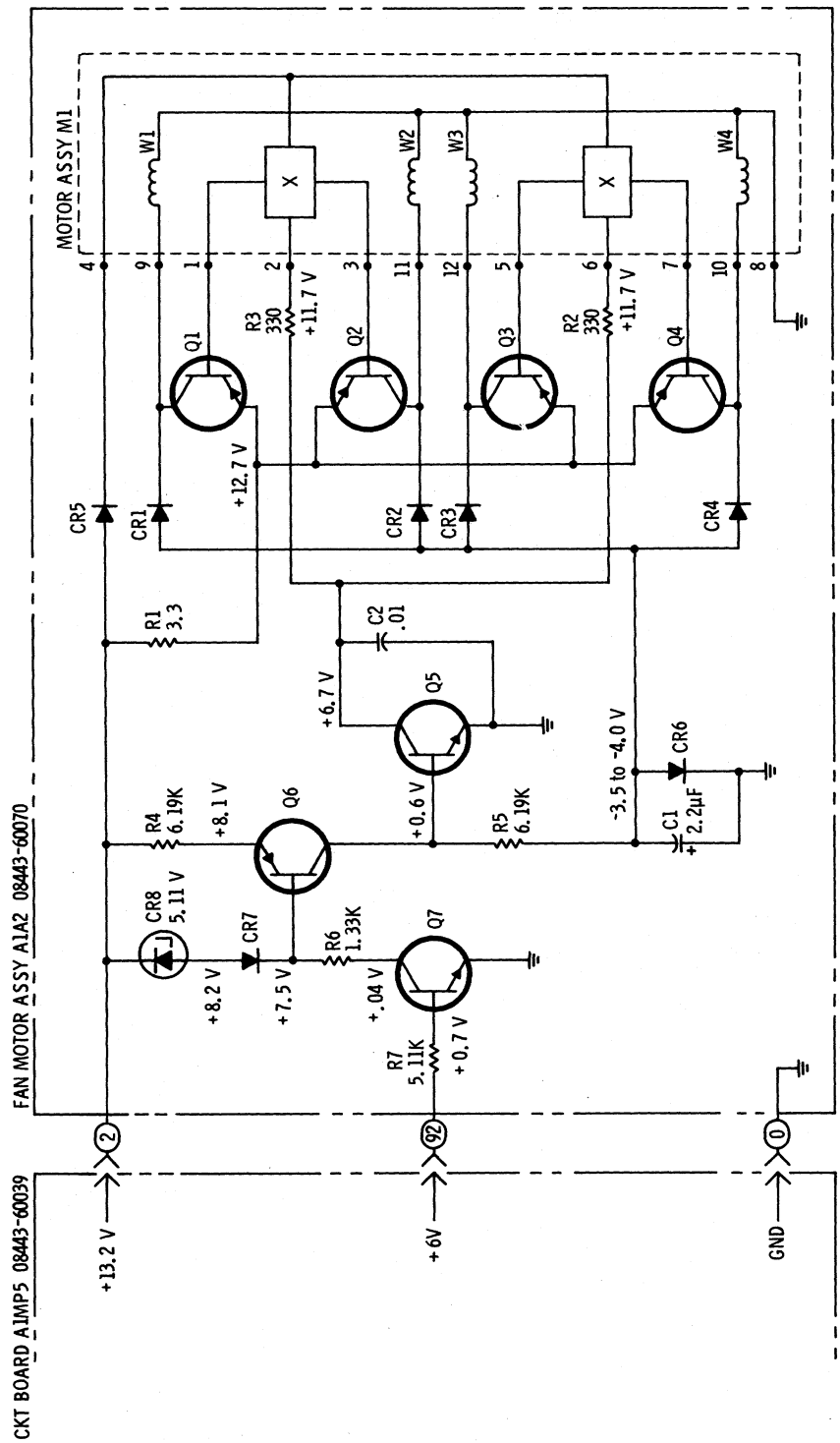


Figure 7-14. Fan Motor Assembly A1A2 Schematic Diagram (CHANGE D)

CHANGE E

The Digital Output Board Assembly, A19, used on early 8443A instruments (serial prefix 1742A and lower) was HP Part Number 08443-60068. Starting with 8443A serial number prefix 1821A, the A19 assembly was changed to part number 08443-60089. The only difference between the -60068 and the -60089 A19 assemblies is the wiring connections to A19J1-22, A19J1-23, and A19J1-48. These connections for the two assemblies are as follows:

Instrument Serial Number Prefix 1821A or higher (A19 Part Number 08443-60089)

A19J1-22	No connection
A19J1-23	LPRINT (in to A5 Assy pin 2)
A19J1-48	PRINT COMMAND (out from A5 Assy pin 1)

Instrument Serial Number Prefix 1742A or lower (A19 Part Number 08443-60068)

A19J1-22	INHIBIT IN (in to A5 Assy pin 2)
A19J1-23	PRINT COMMAND (out from A5 Assy pin 1)
A19J1-48	No connection

CHANGE F

Page 6-6, Table 6-3:
Change A5C5 to HP Part Number 0160-2218, CD 6, C:FXD MICA 1000PF 5%, 28480, 0160-2218.

Page 6-7, Table 6-3:
Delete A5CR5 and A5E1.

Page 6-7, Table 6-3:
Add A5L5, HP Part Number 9100-1622, CD 7, COIL/CHOKE 24.0UH 5%, 28480, 9100-1622.
Change A5Q1, A5Q2, and A5Q3 to HP Part number 1854-0071, CD 7, TSTR:SI NPN (SELECTED FROM 2N3704), 28480, 1854-0071.

CHANGE G

Page 6-16, Table 6-3:
Change A13 to HP and Mfr Part Number 08443-60040, CD 1.

Page 6-22, Table 6-3:
Delete S2, W7, and W8 entries.

CHANGE H

Page 6-21, Table 6-3:
Delete MP1 and MP2 entires.

CHANGE I

Page 6-5, Table 6-3:
Change A1 to HP and Mfr Part Number 08443-60066, CD 1 (NOTE: This assembly is no longer available.)

Page 6-8, Table 6-3:
Delete A6L12 entry.

Page 8-77, Figure 8-35:
Delete the inductor, L12, shown connected between Q3 and Q4. Connect the emitter of Q4 directly to the emitter of Q3.

CHANGE J

Page 6-13, Table 6-3:
Delete A10C17 and A10L10 entries.

Page 6-21, Table 6-3:
Change FL1 to HP and Mfr Part Number 9100-2878, CD 7.

Page 6-21, Table 6-3:
Change J5 to HP and Mfr Part Number 1251-2357, CD 8.

Page 8-41, Figure 8-22: (Schematic A8, A9, A10)
Delete C17 and L10 in 200 MHz IF Assembly A10.

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section provides instructions for troubleshooting and repairing the Hewlett-Packard Model 8443A Tracking Generator-Counter. It includes general servicing information, block diagrams of the instrument, circuit descriptions, parts identification illustrations, and schematic diagrams.

WARNING

Maintenance described in this section is performed with power supplied to the instrument and with the protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved. Where maintenance can be accomplished without power applied to the instrument, the power should be removed. When you have completed a repair, make sure all safety features are intact and functioning, and that all protective grounds are connected.

8-3. SERVICE INFORMATION INDEX

8-4. Specific kinds of maintenance and the instrument's main assemblies are listed in Table 8-1, with the pertinent paragraphs, figures, and service sheets. Service sheets are foldout pages containing schematic or wiring diagrams and parts location illustrations. In most cases, each service sheet applies to a particular one of the instrument's assemblies, or to a functional group of assemblies, and is complete on one foldout page. In some instances, however, a service sheet may include two or more foldout pages. Service sheet numbers are printed in large bold-face numerals in the lower right-hand corner of the page.

8-5. SCHEMATIC DIAGRAM SYMBOLS AND TERMS

8-6. Symbols and terms used on the schematic diagrams are explained in Table 8-2, Schematic Diagram Notes.

8-7. TEST EQUIPMENT

8-8. Test instruments and accessories used to maintain the Tracking Generator-Counter are listed in Table 1-4. If the listed instrument is not available, another instrument that meets the required minimum specifications may be substituted.

8-9. GENERAL TROUBLESHOOTING

8-10. Troubleshooting to the assembly level is most easily accomplished by using the overall block diagram (Service Sheet 1), or the counter logic diagram (Service Sheet 5), to follow the signal path through the assemblies. Once the problem is isolated to a particular assembly, the circuit description, troubleshooting information, and schematic diagram for the suspect assembly can then be used to locate the faulty component.

8-11. Before pursuing any troubleshooting in the HP 8443A Tracking Generator-Counter, you should first make sure the problem is not in the spectrum analyzer, or is not caused by a faulty connection between the spectrum analyzer plug-in sections. To determine that the problem is actually in the tracking generator-counter, proceed as follows:

1. Turn off the ac power to the spectrum analyzer and put the tracking generator in the standby (STBY) power mode.

2. Remove the IF and RF sections from the spectrum analyzer mainframe or display section, decouple them from each other, then recouple them carefully.

Table 8-1. Service Information Index (1 of 2)

Subject	Location
General Troubleshooting	Paragraph 8-9
Mechanical Parts Maintenance and Repair	Paragraphs 8-3 thru 8-17
Transistors and Diodes Operation, Testing, Markings	Paragraphs 8-19, 8-22 Figures 8-1, 8-2
Fuses	Paragraph 8-24, Table 8-4
Logic Circuits and Symbols	Paragraphs 8-25 thru 8-47 Figures 8-3 through 8-13 Tables 8-5 thru 8-7
Tracking Generator Principles of Operation, General Description Block Diagram (Service Sheet 1)	 Paragraph 8-48 Figure 8-14
First Converter Assembly A13 (Service Sheet 2) Description Parts Locations Schematic	 Page 8-23 Figure 8-16 Figure 8-18
50 MHz Amplifier Assembly A12 (Service Sheet 2) Description Parts Locations Schematic	 Page 8-24 Figure 8-17 Figure 8-18
Second Converter Assembly A11 (Service Sheet 2) Description Parts Locations Schematic	 Page 8-25 Figure 8-15 Figure 8-18
Video Amplifier–ALC Assembly A8 (Service Sheet 2) Description Parts Locations Schematic	 Page 8-28 Figure 8-19 Figure 8-22
Third Converter Assembly A9 (Service Sheet 3) Description Parts Locations Schematic	 Page 8-27 Figure 8-20 Figure 8-22
200 MHz IF Amplifier Assembly A10 (Service Sheet 3) Description Parts Locations Schematic	 Page 8-26 Figure 8-21 Figure 8-22
RF Attenuators A2 and A3 (Service Sheet 3) Description Schematic	 Page 8-28 Figure 8-22

Table 8-1. Service Information Index (2 of 2)

Subject	Locations
Rectifier Assembly A15 and Series Regulators (Service Sheet 4) Description Parts Locations Schematic	 Page 8-30 Figure 8-24 Figure 8-25
Sense Amplifier Assembly A14 (Service Sheet 4) Description Parts Locations Schematic	 Page 8-31 Figure 8-23 Figure 8-25
Counter Principles of Operation, General Description Logic Diagram (Service Sheet 5)	 Page 8-45 Figure 8-26
Marker Control Assembly A7 (Service Sheet 6) Description Test Waveforms Parts Locations Schematic	 Page 8-53 Figure 8-27 Figure 8-28 Figure 8-29
Time Base Assembly A5 (Service Sheet 7) Description Test Waveforms Parts Locations Schematic	 Page 8-57 Figure 8-30 Figure 8-31 Figure 8-32
High Frequency Decade Assembly A6 (Service Sheet 8) Description Test Waveforms Parts Locations Schematic	 Page 8-60 Figure 8-33 Figure 8-34 Figure 8-35
Low Frequency Counter Assembly A1 (Service Sheet 9) Description Parts Locations, A1A1 Parts Locations, A1A2 Parts Locations, A1A3 Schematic (includes A19)	 Page 8-65 Figure 8-36 Figure 8-37 Figure 8-38 Figure 8-39
Motherboard Assembly A18, Marker Position Assembly A20, and Switchboard Assembly A16 (Service Sheet 10) Wiring Diagram	 Figure 8-40
Major Assemblies and Chassis-Mounted Parts Locations	Figure 8-41

Table 8-2. Schematic Diagram Notes

SCHEMATIC DIAGRAM NOTES

Refer to ANSI Y32.2

R, C, L	Resistance is in ohms, capacitance is in picofarads, and inductance in millihenries unless otherwise noted.
P/O	Part Of
*	Asterisk on component denotes a factory-selected value. Value shown is typical. Capacitors may be omitted or resistors jumpered.
	Screwdriver adjustment .
	Panel control.
	Encloses front panel name.
	Encloses rear panel name
	Circuit assembly borderline.
	Other assembly borderline.
	Heavy line with arrows indicates path and direction of main signal.
	Heavy dashed line with arrows indicates path and direction of main feedback.
	Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.
	Test Point. Measurement terminal provided.
	Test Point. No measurement terminal provided.
	Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number identifies the narrower stripe, e.g. (947) denotes white base, yellow wide stripe, violet narrow stripe.
	Letter = off page connection. Number = Service Sheet location for off page connection.
	Chassis ground
	Assembly ground

3. Plug the IF and RF sections firmly into the mainframe or display section and lock them into position.

4. Disconnect the rear-panel interconnect cable from both the spectrum analyzer and the tracking generator; then reconnect it carefully and lock the cable plugs into the intrument receptacles.

5. Check the ac power voltage selector switch at the HP 8443A rear panel to make sure the voltage selection matches the ac source voltage.

6. Turn on the spectrum analyzer and tracking generator ac power and check to see if the system is now functioning properly.

7. If the system is still malfunctioning, check the operation of the spectrum analyzer without the tracking generator connected to it. If the spectrum analyzer operates properly without the tracking generator, go ahead with the tracking generator troubleshooting.

8-12. GENERAL MAINTENANCE

8-13. Rigid Cables

8-14. When you have to loosen or remove one of the rigid RF cables, be very careful not to bend it. Bending one of these cables can change its electrical characteristics.

8-15. Cleaning Switches

8-16. Front-panel and board-mounted switches can be cleaned without removing them. The recommended cleaning agent is isopropl alcohol (HP Part Number 8500-0755). Spray the cleaning agent into the switch and rotate or slide it several times. Continue operating the switch until the cleaning agent is evaporated.

8-17. Repairs on Circuit Boards

8-18. Component mounting holes on the HP 8443A circuit boards are plated through to both sides of the board. Because of this, you can solder, or unsolder, from either side. Table 8-3 lists the tools and materials recommended for making repairs on etched circuit boards.

CAUTION

Do not use a high-wattage soldering iron on the etched circuit boards. Excessive heat can lift the printed wiring or burn the board. Also avoid using sharp metal objects to clean solder from plated-through component mounting holes. You may damage the plating and cause an open circuit. Use a suction device or a toothpick for solder removal.

8-19. Transistors and Diodes

8-20. Transistor In-Circuit Testing. The common causes of transistor failure are internal short circuits and open circuits. In transistor circuit testing, the most important consideration is the transistor base-to-emitter junction. Figure 8-1A shows the biasing required to cause conduction and cut-off in NPN and PNP transistors. The voltage drop across a forward-biased, emitter-base junction varies with transistor collector current. For example, a germanium transistor has a typical forward-bias, base-emitter voltage of 0.2 – 0.3 volt when collector current is 1 – 10 mA, and 0.4 – 0.5 volt when collector current is 10 – 11 mA. In contrast, forward-bias voltage for silicon transistors is about twice that for germanium types; about 0.5 – 0.6 volt when collector current is low, and about 0.8 – 0.9 volt when collector current is high.

8-21. Figure 8-1B shows simplified versions of the three basic transistor circuits and gives the characteristics of each. When examining a transistor stage, first determine if the emitter-base junction is biased for conduction (forward-biased) by measuring the voltage difference between the emitter and base. When using an electronic voltmeter, do not measure directly between the emitter and base; there may be sufficient loop current between the voltmeter leads to damage the transistor. Instead, measure each voltage separately with respect to a common point (e.g., chassis). If the emitter-base junction is forward-biased, check for amplifier action by short-circuiting the base to the emitter while observing the collector voltage. The short circuit eliminates base-emitter bias and should cause the transistor to stop conducting (cut off). Collector voltage should then change and approach the supply voltage. Any difference is due to leakage current through the tran-

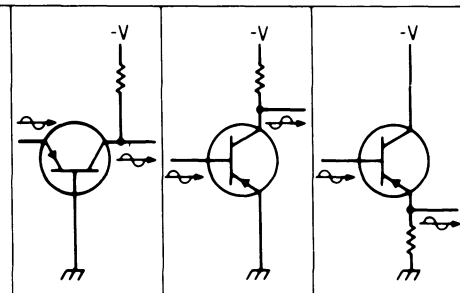
A

Transistor Biasing

TYPE	CUTOFF	CONDUCTION
NPN COLLECTOR BASE EMITTER	+V 0V	+V MAIN CURRENT +V CONTROL CURRENT
PNP COLLECTOR BASE EMITTER	-V 0V	-V -V CONTROL CURRENT MAIN CURRENT

B

Amplifier Characteristics



CHARACTERISTIC	COMMON BASE	COMMON EMITTER	COMMON COLLECTOR
Input Impedance	30Ω - 50Ω	500Ω - 1500Ω	20KΩ - 500KΩ
Output Impedance	300KΩ - 500KΩ	30KΩ - 50KΩ	50Ω - 1000Ω
Voltage Gain	500 - 1500	300 - 1000	<1
Current Gain	<1	25 - 50	25 - 50
Power Gain	20 dB - 30 dB	25 dB - 40 dB	10 dB - 20 dB (Emitter Follower)

Figure 8-1. Transistor Characteristics and Biasing

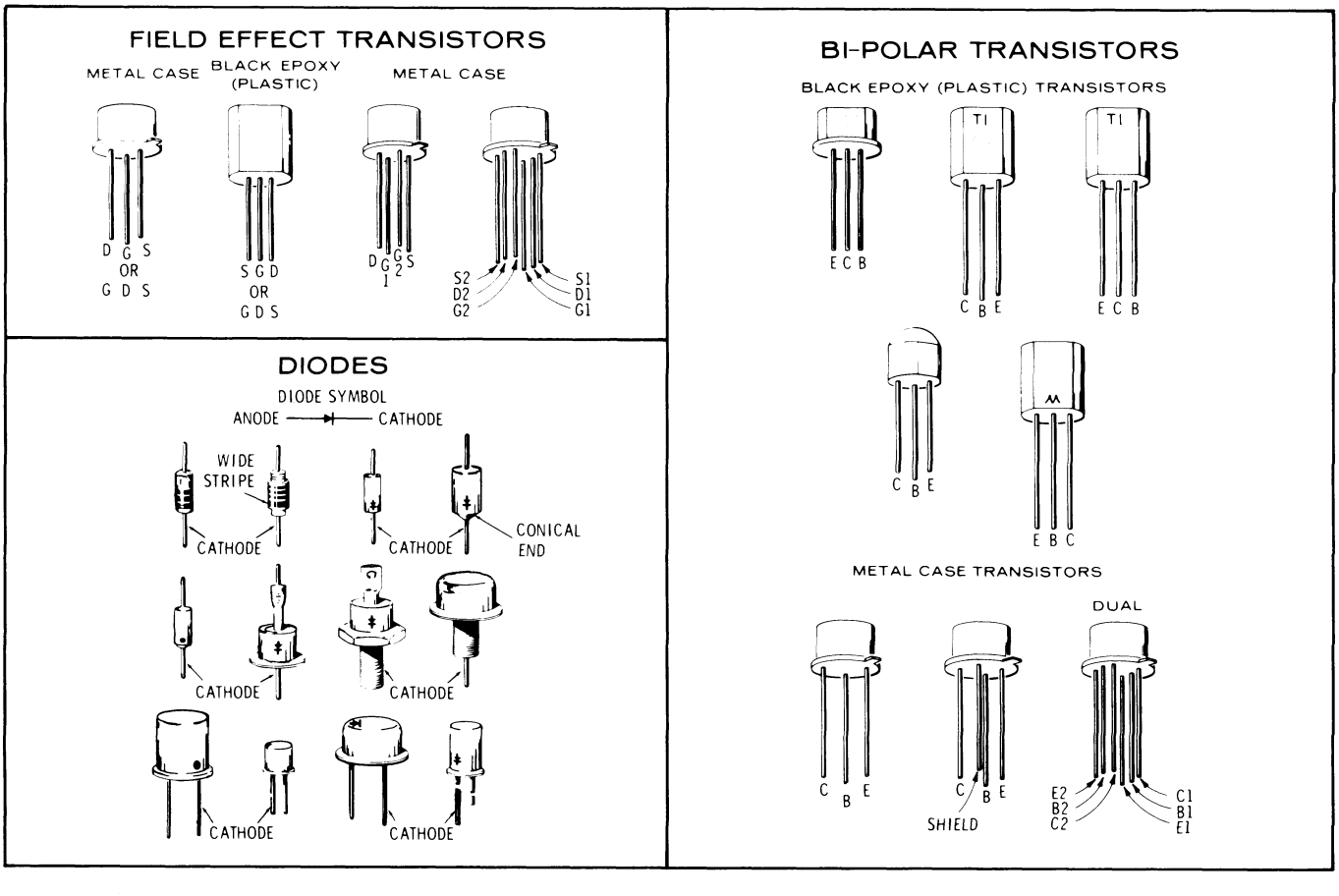


Figure 8-2. Examples of Diode and Transistor Marking Methods

Table 8-3. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering	Soldering Unsoldering	Wattage rating: 47½–56½ Tip Temp: 850–900 degrees	Ungar No. 776 handle with *Ungar No. 4037 Heating Unit
Soldering* tip	Soldering Unsoldering	*Shape: pointed	*Ungar No. PL111
De-soldering aid	To remove molten solder from connection	Suction device	Soldapult by Edsyn Co., Arleta, California
Resin (flux)	Remove excess flux from soldered area before application of protective coating	Must not dissolve etched base board material or conductor bonding agent	Freon, Aceton, Lacquer, Thinner, Isopropyl Alcohol (100% dry)
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	
Protective coating	Contamination, corrosion protection	Good electrical insulation, corrosion-prevention properties	Silicone Resin such as GE DRI-FILM** 88

*For working on etched boards; for general purpose work, use Ungar No. 1237 Heating Unit (37.5W. tip temperature of 750–800 degrees) and Ungar No. PL113, 1/8 inch chisel tip.
**General Electric Co., Silicone Products Dept., Waterford, New York, U.S.A.

sistor and, in general, the smaller this current the better the transistor. If the collector voltage does not change, the transistor has either an emitter-collector short circuit or emitter-base open circuit.

8-22. Transistor and Diode Markings. Figure 8-2 shows diode and transistor marking methods. In addition, the emitter lead for a bipolar transistor is identified on the printed circuit board by connecting it to a square rather then a round pad.

8-23. Printed Circuit Board Markings. On the printed circuit board, a square pad is etched around one pin of some components to facilitate identification of the component terminals. The square pad indicates the following:

a. The cathode of a diode

b. Emitter of a transistor

c. Source terminal of an FET

d. Pin one of an integrated circuit

e. Pin one of an integrated circuit socket

f. Pin one of a cable connector.

8-24. FUSES

8-25. The HP 8443A contains five fuses. One of them, the primary (ac) power fuse, is accessible at the HP 8443A rear panel. The other four fuses protect the dc power circuits and are on Rectifier Board Assembly A15. To gain access to the dc power fuses, you must remove the Rectifier Board Assembly. Additional information about the fuses is contained in Table 8-4.

8-26. LOGIC CIRCUITS AND SYMBOLS

8-27. The logic circuit descriptions in the following paragraphs are provided as basic information for the technician who has little or no experience with digital circuitry. Common logic symbols, as depicted on the schematic and logic diagrams, are shown and explained in Table 8-5.

8-28. Digital circuits have outputs that are always in one of two possible states: 1 or 0. These two states are also referred to as high (H) or low (L). The high and low states are relative; that is, a low is less positive (more negative) than a high. In positive logic, the more positive high (H) state is a logical 1, and the more negative low (L) state is a

Table 8-4. 8443A Fuse Information

Reference Designation	Purpose	Rating	HP and Manufacturer's Part Number
F1	Primary power fuse for ac power input. This fuse is accessible at instrument rear panel.	2 Amp., 250V, 3 AG (Regardless of line voltage level)	HP 2110-0002 Littlefuse Inc. 312002
A15F1	Protects +24 Vdc supply circuitry.	1 Amp., 250V, 3 AG	HP 2110-0001 Littlefuse Inc. 312001
A15F2	Protects +5 Vdc supply circuitry.	1 Amp., 250V, 3AG	HP 2110-0001 Littlefuse Inc. 312001
A15F3	Protects +20 Vdc supply circuitry.	2 Amp., 250V, 3 AG	HP 2110-0002 Littlefuse Inc. 312001
A15F4	Protects –12 Vdc supply circuitry.	1 Amp., 250V, 3 AG	HP 2110-0001 Littlefuse Inc. 312001

logical 0. Conversely, in negative logic the more negative low (L) stateis a logical 1, and the more positive high (H) state is a logical 0.

8-29. Basic Logic Circuits

8-30. Two basic building blocks of logic circuits are the AND gate and the OR gate. These gates with their respective truth tables are shown in Figure 8-3.

8-31. AND Gate. The AND gate produces a 1 output if, and only if, all of its inputs are 1s. As shown in Figure 8-3, output terminal X of the AND gate is high (assuming positive logic) only when input terminals A and B are both high. If either A or B is low, the output is low. The Boolean expression for the two-input AND gate shown in Figure 8-3 is X = AB (X equals A and B).

8-32. OR Gate. The OR gate produces a 1 out put if any one (or more) of its inputs is a 1. As shown in Figure 8-3, output terminal X of the OR gate is high only if input A or B (or both) is high (assuming positive logic). If both inputs are low, the output is low. The Boolean expression for the two-input OR gate shown in Figure 8-3 is X = A + B (X equals A or B).

8-33. Truth Tables. Truth tables are a means of presenting the output state of logic devices for any set of inputs in tabular form. Truth tables contain one column for each of the inputs and a column for the output. In basic truth tables the colum notations are usually H or L (for high and low) or, for binary notation, 1 or 0. More complex truth tables may use other terms.

8-34. Logic Inversion. Adding inversion to AND and OR gates changes their characteristics. Inversion is usually accompished by adding an inverter stage (common emitter) in front of an input or after an output. A circle added to the input or output leads indicates the portion of the circuit in which the inversion takes place. The simplest of these devices are AND and OR gates in which the output is inverted. These gates are called NAND (for Not AND) and NOR (for Not OR). Basic NAND and NOR gates are shown in Figure 8-4. When all inputs and outputs of an AND gate are inverted, it functions as an OR gate. When all inputs and outputs of an OR gate are inverted, it functions as an AND gate. Figure 8-5 shows various gate inversion functions. When inversion is used the designation at the inverted terminal is frequently termed $\bar{A}$, (not A), $\bar{B}$ (not B), $\bar{X}$ (not X), etc.

8-35. Binary Circuits. Many types of flipflops are used in binary circuits. Each half of a flip-flop is in one of two states at any given time. The outputs are complementary; when one stage is on, the other is off. The outputs are termed 1 and 0, high and low, or true and false, by the same rules that apple to AND and OR gates. The outputs may be identified in many different ways. This text identifies these outputs as Q and $\bar{Q}$ for

Table 8-5. Logic Symbology (1 of 3)

1 indicates true signal

0 indicates false signal.

○ on symbol indicates logical inversion (not necessarily electrical) of the input or output signal(s). The logic indicated within the symbol remains the same.

→ indicates direction of signal flow.

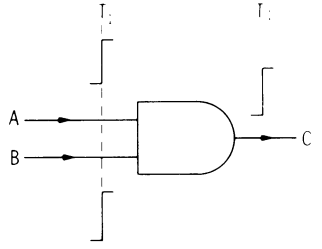
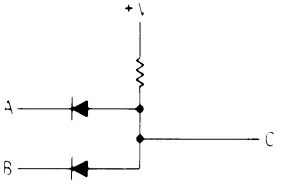
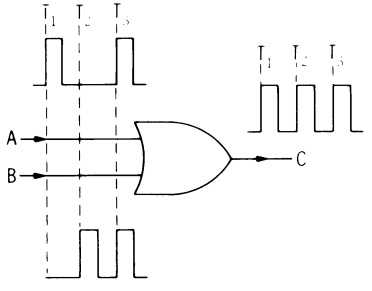
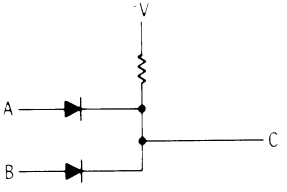
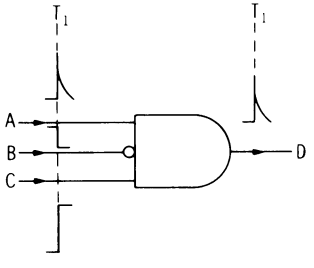
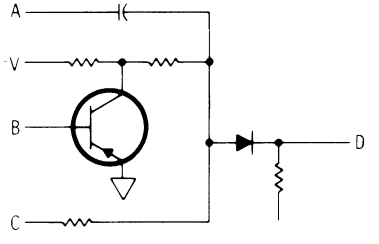
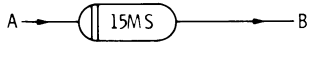
Designation	Logic Symbol	Description	Truth Table	Typical Circuit
AND Gate (Positive True)		Both input signals (A and B) must be true simultaneously to produce a true output at C.	A | B | C 0 | 0 | 0 0 | 1 | 0 1 | 0 | 0 1 | 1 | 1	
OR Gate (Positive True)		If either input signal (A or B) or both is true, the output at C is true.	A | B | C 0 | 0 | 0 0 | 1 | 1 1 | 0 | 1 1 | 1 | 1	
Multiple Input Gate (Positive True)		Any combinations of inputs may be used with an AND or OR Gate to obtain a desired output. In the AND gate shown, input B is inverted and inputs A and C are without inversion. Inputs A and C must both be true and input B must be false simultaneously to produce a true output at D.	A | B | C | D 0 | 0 | 0 | 0 0 | 0 | 1 | 0 0 | 1 | 0 | 0 0 | 1 | 1 | 0 1 | 0 | 0 | 0 1 | 0 | 1 | 1 1 | 1 | 0 | 0 1 | 1 | 1 | 0	
Time Delay		Input signal delayed by the time indicated. True input at A produces a true output at B after a 15 ms delay.		RC and RL Coupling

Table 8-5. Logic Symbology (2 of 3)

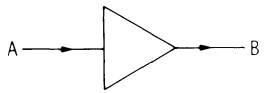
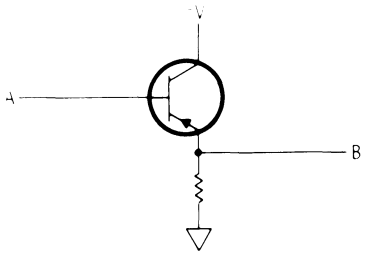
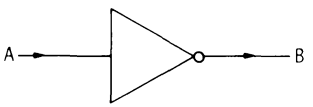
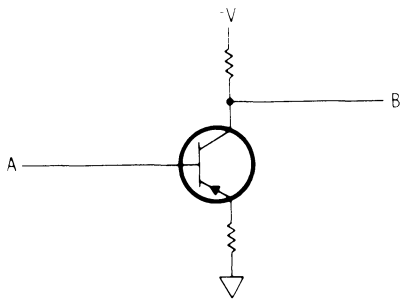
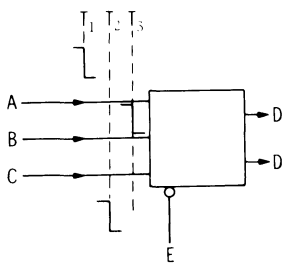
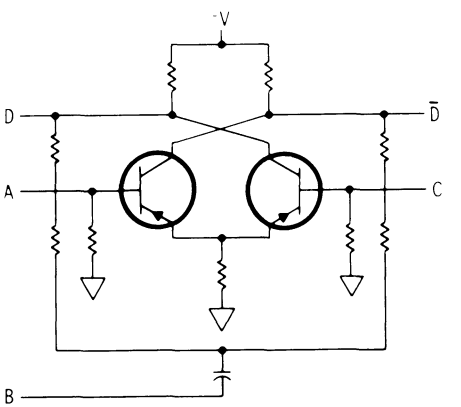
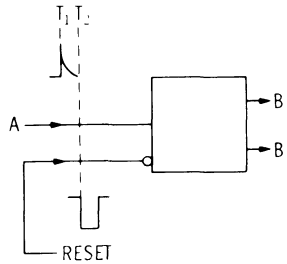
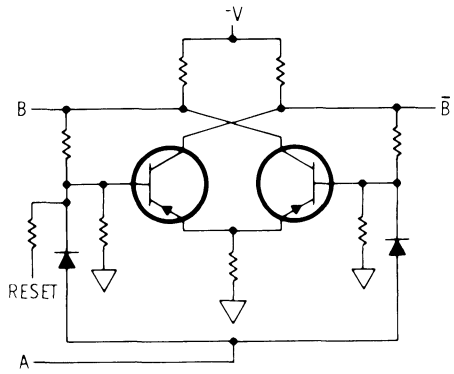
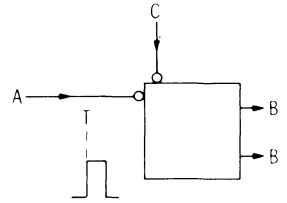
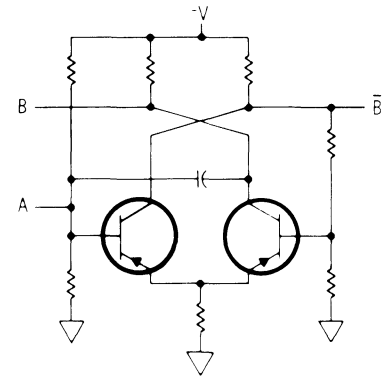
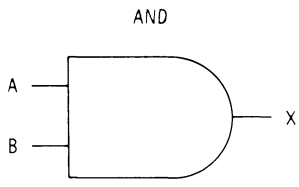
Designation	Logic Symbol	Description	Truth Table	Typical Circuit
Amplifier		True input at A produces amplified true output at B. An amplifier will function with either positive true or negative true signals.		
Inverter Amplifier		True input at A produces false output at B and fase input at A produces a true output at B (inverts the input logic level).		
Flip-Flop		Outputs $\overline{D}$ and D are always in opposite states — if D is true, $\overline{D}$ is false. A true input will cause the output directly across to go true — true input at A sets output D true. With no input, the flip-flop remains in the state set by the last input signal. A true input at B will cause the flip-flop to reverse state. A true input at the direct reset input E holds the flip-flop in the $\overline{D}$ true state.		

Table 8-5. Logic Symbology (3 of 3)

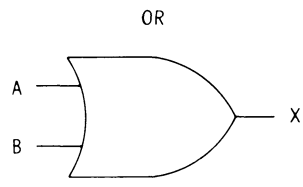
Designation	Logic Symbol	Description	Truth Table	Typical Circuit
Trigger		The binary is a flip-flop which changes state with every true input pulse at A. Since A is applied to the bases of both transistors, it is shown centered in the symbol. The negative pulse produces the same effect as a positive pulse applied to the opposite base. To preserve the positive logic, the reset pulse is shown inverted and applied to the opposite side. A reset pulse sets $\overline{B}$ true.		
One-Shot		True input at A sets the one-shot to unstable state (active) and produces a true output at B. In the symbol shown, the A input must be false (positive) with respect to negative true logic of the one-shot. During the stable state, the $\overline{B}$ output is true. A true input at C (direct set) holds the one-shot in the unstable state.		



X = A • B
(X EQUALS A AND B)

TRUTH TABLE

A	B	X
H	H	H
H	L	L
L	H	L
L	L	L

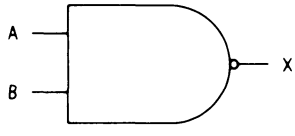


X = A + B
(X EQUALS A OR B)

TRUTH TABLE

A	B	X
H	H	H
H	L	H
L	H	H
L	L	L

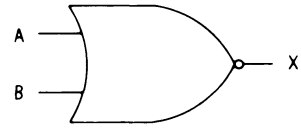
Figure 8-3. Basic AND and OR Gates



X = $\overline{A \bullet B}$
(X EQUALS A AND B NOT)

TRUTH TABLE

A	B	X
H	H	L
H	L	H
L	H	H
L	L	H

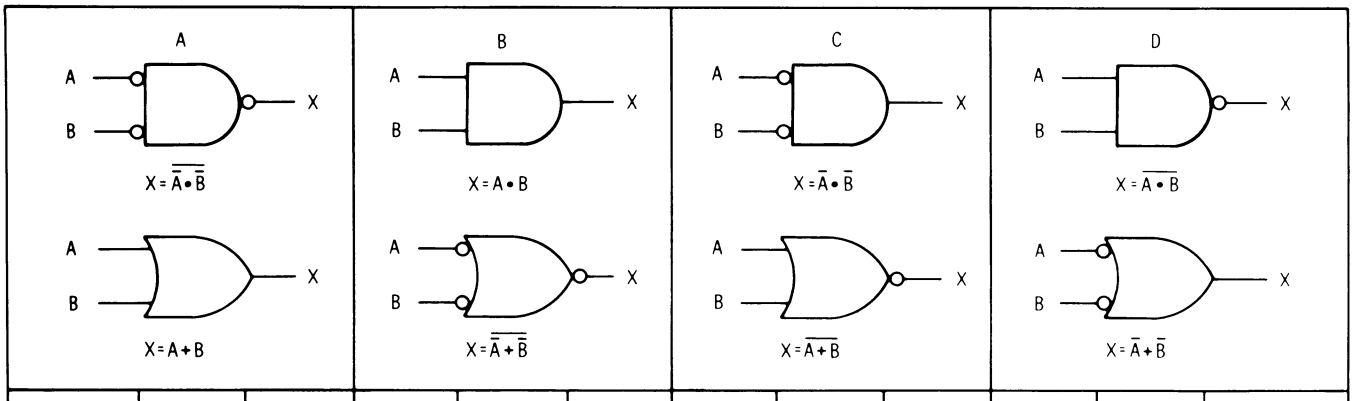


X = $\overline{A + B}$
(X EQUALS A OR B NOT)

TRUTH TABLE

A	B	X
H	H	L
H	L	L
L	H	L
L	L	H

Figure 8-4. Basic NAND and NOR Gates



A	B	X	A	B	X	A	B	X	A	B	X
H	H	H	H	H	H	H	H	L	H	H	L
H	L	H	H	L	L	H	L	L	H	L	H
L	H	H	L	H	L	L	H	L	L	H	H
L	L	L	L	L	L	L	L	H	L	L	H

Figure 8-5. Logic Comparison Diagrams

the sake of uniformity. Basic flip-flops which are particularly adaptable to binary circuits and combinations of flip-flops are discussed in the following paragraphs.

8-36. Basic NOR Gate Flip-Flop. Figure 8-6 shows a flip-flop constructed with two NOR gates. Assume that initially Q is high and $\bar{Q}$ is low, and A and B are both low. When a high is applied to input A, Q goes low and, since there are now two lows applied to NOR gate 2, $\bar{Q}$ will go high. The $\bar{Q}$ high is applied back to NOR gate 1, but since Q is already low, no change in state results. When a high is applied to input B the flip-flop again reverses state. Since the flip-flop remains in the last state to which it is set, it "remembers" which signal was last received, and can be used as a memory circuit.

8-37. Triggered Flip-Flop. Figure 8-7 shows a triggered flip-flop which changes state each time a pulse of a given polarity is applied to the input. The output of a triggered flip-flop is a square wave at one half the frequency of the input triggers. In the circuit shown in Figure 8-7 the input may be negative-going triggers or a square wave. If the input is a square wave it will be differentiated by C2 to produce both negative-going and positive-going pulses. Assume that initially Q is low (Q2 on) and $\bar{Q}$ is high (Q1 off). When a negative-going trigger appears at the junction of CR1 and CR2 it has no effect on Q2 because output Q is low, back-biasing CR2. CR1, however, is forward-biased by the high at $\bar{Q}$ and the trigger is coupled to the collector of Q1. As the collector of Q1 is driven in a negative direction, the trigger is also coupled through C1 to the base of Q2. As Q2 begins to cut off, the positive-going collector voltage is coupled to the base of Q1 through C3 to drive Q1 into conduction. The process is regenerative; Q2 cuts off quickly and Q1 goes into saturation. The next negative-going trigger reverses the procedure just described.

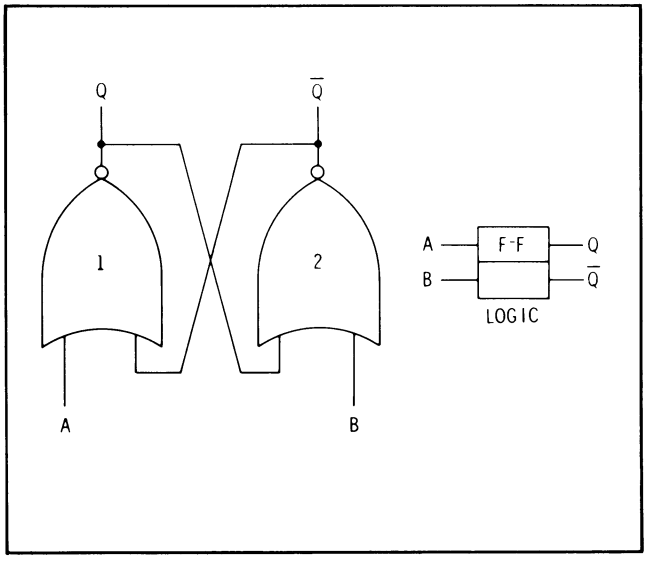


Figure 8-6. Basic NOR Gate Flip-Flop

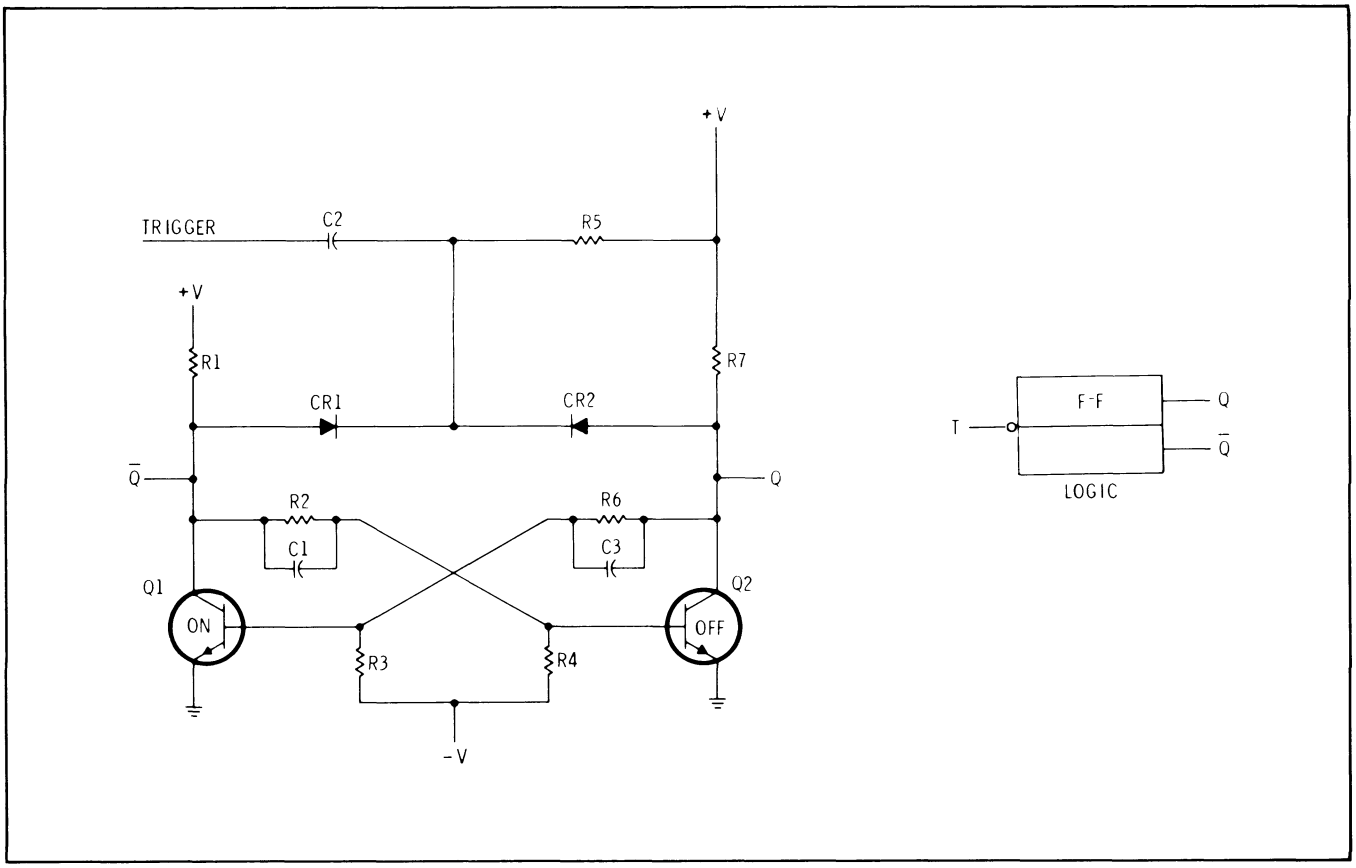


Figure 8-7. Triggered Flip-Flop

8-38. (RS) Flip-Flop. Figure 8-8 shows an RS flip-flop. The RS flip-flop has two inputs, S for Set and R for Reset (sometimes labeled S for set and C for clear). Assume that initially Q is high (Q2 off) and $\bar{Q}$ is low (Q1 on). In this state the flip-flop is set and a positive pulse at the set input will not affect the circuit. When a positive pulse is applied to the reset input, it is coupled through C4 qnd CR2 to the base of Q2. Q2 begins to conduct and the negative-going collector voltage is coupled through C3 to the base of Q1 to cut Q1 off. The process is regenerative; Q1 is quickly cut off and Q2 saturates. The flip-flop remains in the reset state until a positive set pulse is applied through C2 and CR1 to the base of Q1. Note that operation of the RS flip-flop is the same as operation of the basic NOR gate flip-flop described earlier.

8-39. RST Flip-Flop. Figure 8-9 illustrates an RST flip-flop, which is a combination of reset-set and triggered flip-flops. In the circuit shown, negative trigger pulses make the flip-flop change state. Positive pulses are required for the set and reset inputs. A positive set input causes Q to go high and a positive reset pulse causes $\bar{Q}$ to go high.

8-40. Clocked JK Flip-Flop. A clocked JK flip-flop is triggered by an input clock pulse when certain conditions are present at the J and K inputs. Figure 8-10 shows a logic diagram for a JK flip-flop derived from an RS flip-flop and two three-input AND gates. Figure 8-11 shows a typical JK flip-flop integrated circuit schematic diagram. JK flip-flops have three inputs (J, K and Clock) and complementary outputs. JK flip-flops used as decade counters also have clear or reset inputs, preset, and in some cases, a blanking input. When the J and K inputs are both high the flip-flop changes state every time a clock pulse appears; operation is the same as a triggered flip-flop. When the J input is high and the K input is low $\bar{Q}$ goes high; the operation is the same as the reset in RS flip-flops. When the J input is low and the K input is high Q goes high; the operation is the same as the reset in RS flip-flops. When the J and K inputs are both low clock pulses do not affect the circuit. Frequently JK flip-flops are shown schematically with no connection shown to the J and K inputs. In this event, both J and K are actually held high and the circuit functions as a triggered flip-flop. A truth table for a JK flip-flop is provided in Table 8-6.

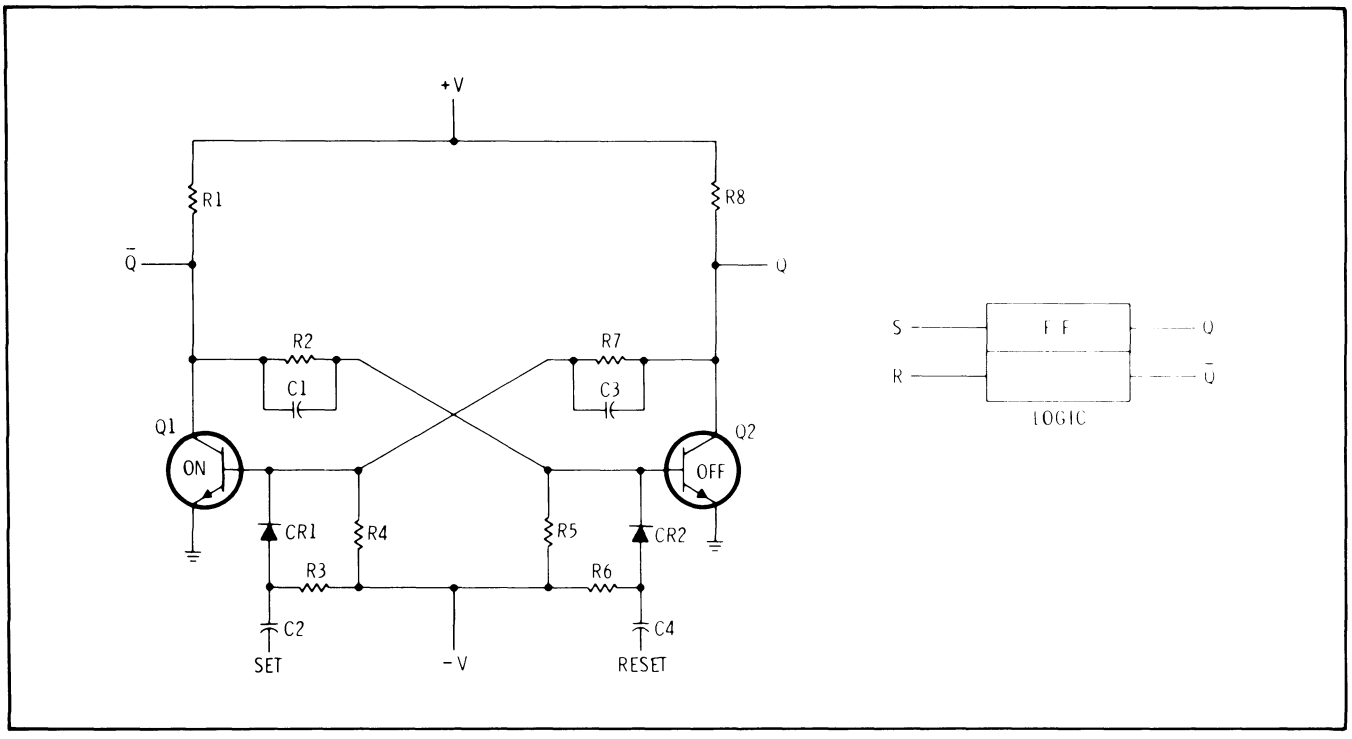


Figure 8-8. RS Flip-Flop

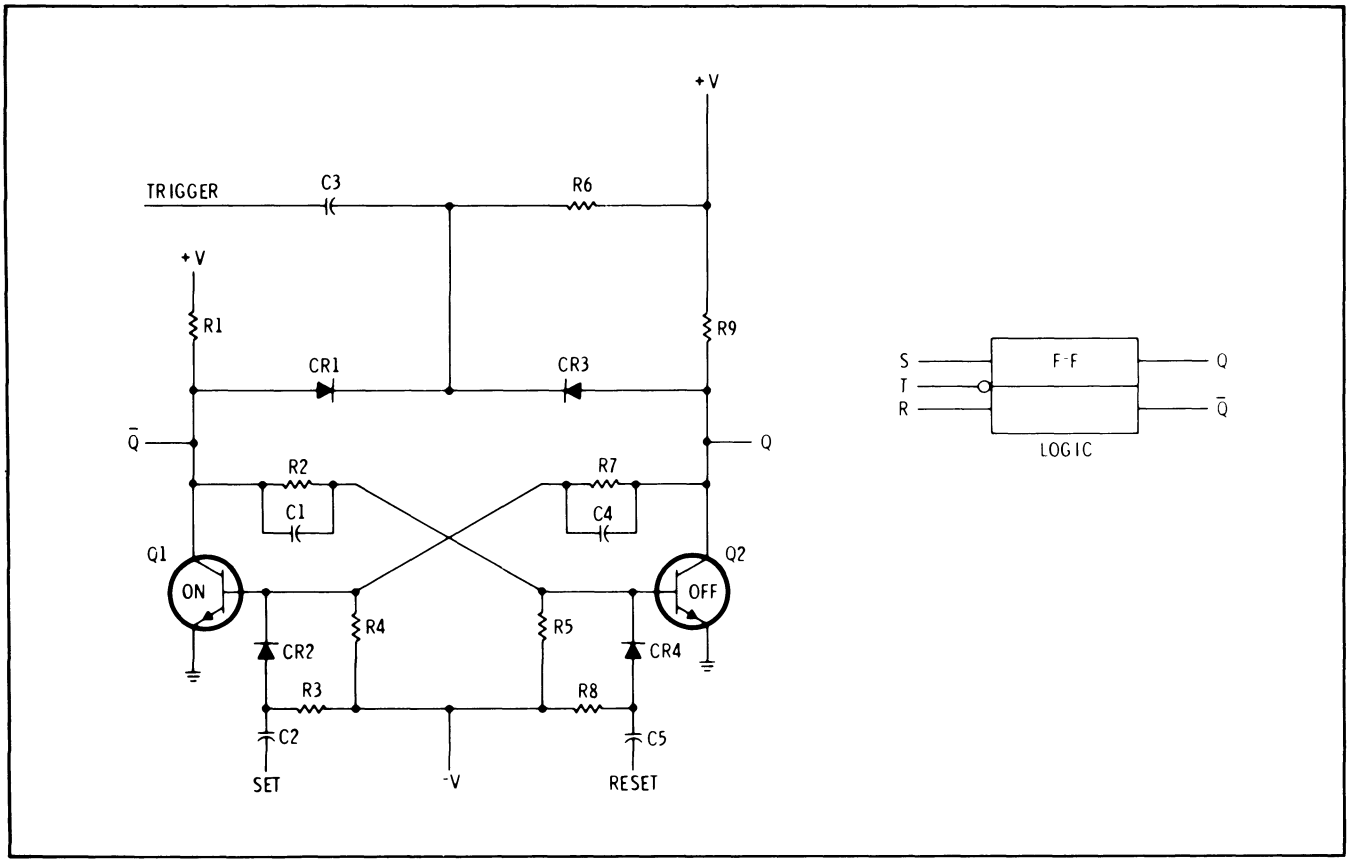


Figure 8-9. RST Flip-Flop

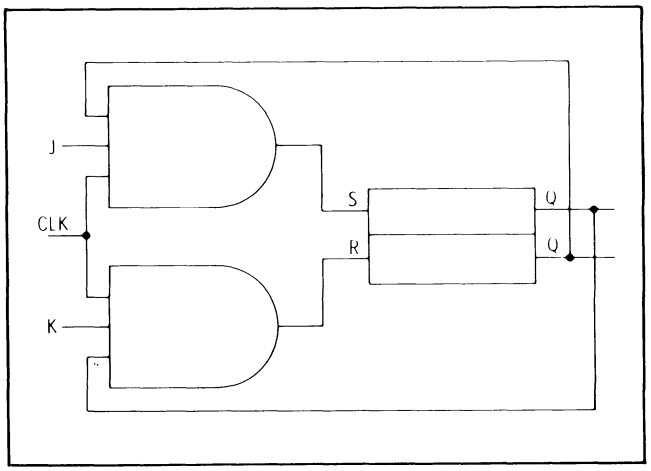


Figure 8-10. Clocked JK Flip-Flop

Table 8-6. JK Flip-Flop Truth Table

		Before Trigger		After Trigger	
J	K	Q	$\overline{Q}$	Q	$\overline{Q}$
0	0	1	0	1	0
0	1	1	0	0	1
1	0	0	1	1	0
1	1	0	1	1	0

8-41. Binary Logic. The following paragraphs explain the basic binary logic required to understand the operation of the dividers and decade counters used in a frequency counter.

8-42. In frequency counters the decimal numbers 0 through 9 are displayed on each readout device. For this reason, only binary numbers 0000 through 1001, which correspond to decimal numbers 0 through 9, are discussed in this text. The only exception to this is the discussion of Figure 8-12 in the next paragraph.

8-43. Figure 8-12 shown four triggered flip-flops in series, with the Q outputs of the first three driving the trigger inputs of the next flip-flop. Since each flip-flop is triggered only by negative-going excursions of the input signal, each provides one cycle of output signal for two cycles of input signal. The flip-flops then are weighted in ascending powers of two. The first flip-flop has a weighted value of 2^0 (1), the second has a weighted value of 2^1 (2), the third has a weighted value of 2^2 (2 x 2 = 4), and the fourth has a weighted value of 2^3 (2 x 2 x 2 = 8).

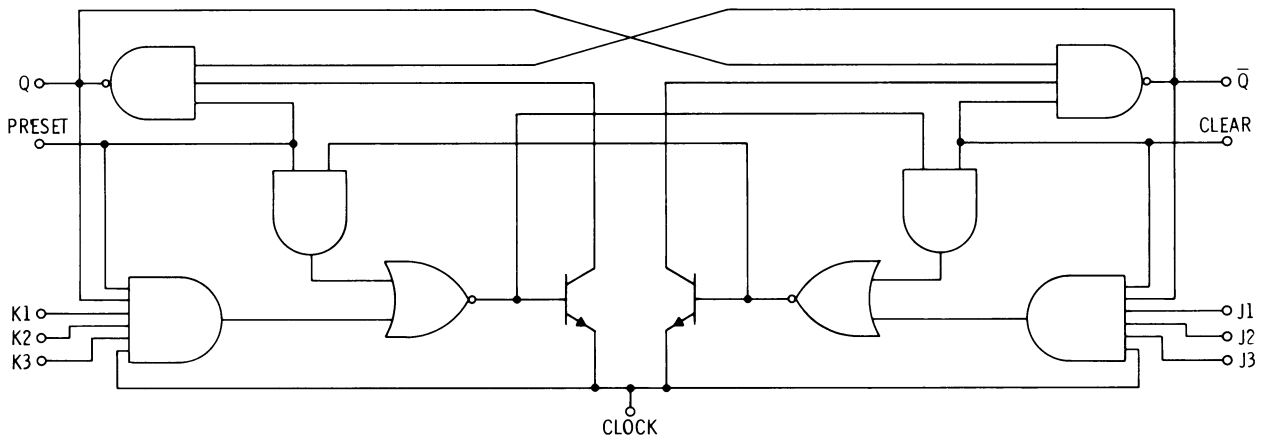
8-44. Assume that initially the flip-flops in Figure 8-12 are all set to 0 (Q low). When seven input cycles have been received the flip-flops have operated as follows: the first has been turned on (Q high) by inputs 1, 3, 5 and 7, and turned off (Q low) by inputs 2, 4 and 6. The second flip-flop has been turned on by the first and third outputs of the first flip-flop (coincident with initial inputs of 2 and 6) and turned off by the second output of the first flip-flop (coincident with initial input 4). The third flip-flop has been turned on by the first negative-going output of the second flip-flop (coincident with initial input 4). The fourth flip-flop has not been triggered because there has been no negative-going output from flip-flop three. The first three flip-flops are now in the 1 state (Q high) and the binary state is 1110. Their decimal weighted value then is $2^0 + 2^1 + 2^2 = 1 + 2 + 4 = 7$. The next negative input to the chain causes the first three flip-flops to turn off and the fourth to turn on. The binary state then is 0001; the decimal weighted value of $0 + 0 + 0 + 2^3 = 0 + 0 + 0 + 8 = 8$.

8-45. As the timing diagram in Figure 8-12 indicates, the four flip-flops in this configuration are capable of counting up to 16. Since only the decimal digits 0 through 9 are used in counter circuits, a means of limiting the count to 10 is built into the circuit. Similarly, another built-in device resets the flip-flops to zero before a new count is started.

8-46. Since binary numbers, like decimal numbers, are written in ascending order from right to left, the weighted values of the flip-flops are easier to understand in 8, 4, 2, 1 order. Table 8-7 lists the true binary numbers for 8, 4, 2, 1 binary weights, and their decimal equivalents.

8-47. A Simple 8-4-2-1 BCD Code Decade Counter. Figure 8-13 shows a simpified decade counter using triggered RS flip-flops. This circuit operates like the circuit shown in Figure 8-12 up through decimal count 9 (binary 1001). When the tenth pulse is received at the input flip-flop, point A goes low, point B goes high and the flip-flops are temporarily in the 1010 state. Almost immediately the output from B causes D to reset, and the output from D then causes B to reset. The end result is that all flip-flops are reset to 0 by the tenth pulse and are ready to begin the next count. This circuit is useful as a divide-by-ten decade. If it is to be used as a frequency counter, a reset must be provided to reset all flip-flops to zero when the count ends at a number other than ten.

BLOCK DIAGRAM



SCHEMATIC

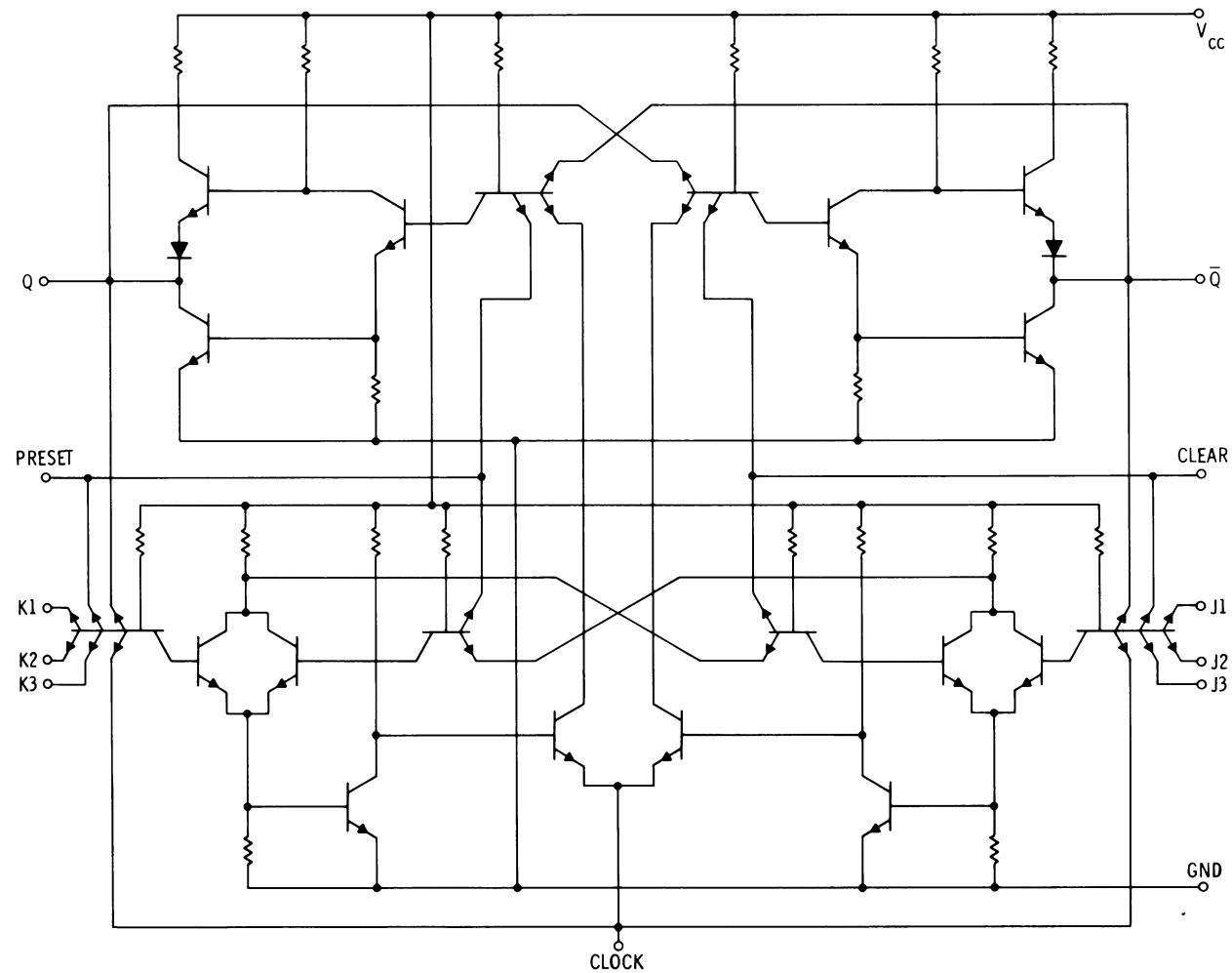


Figure 8-11. JK Master-Slave Flip-Flop (Typical)

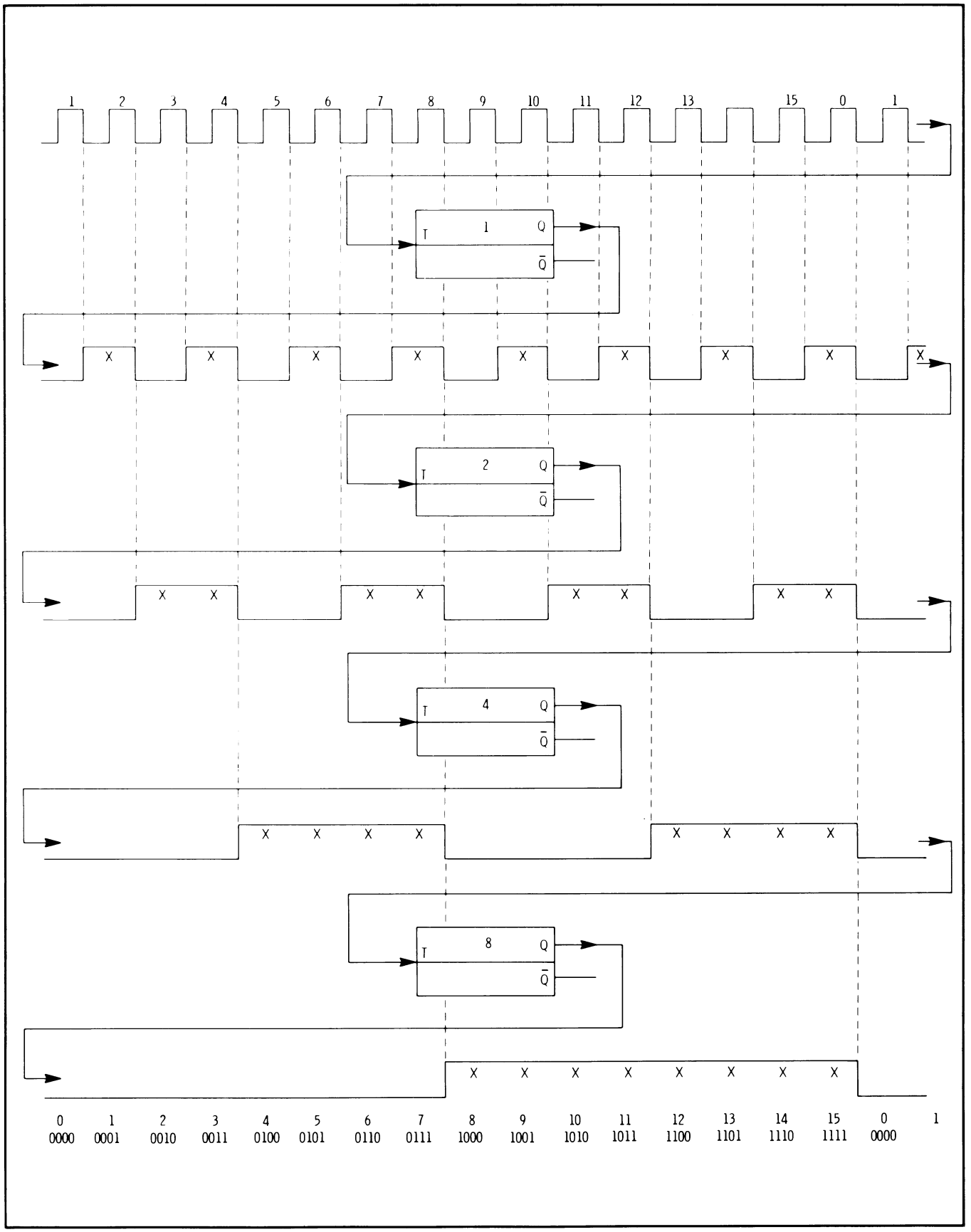


Figure 8-12. 16-Count Binary Counter Chain

Table 8-7. 16-Count Binary Truth Table

Binary				Decimal
$8 = 2^3$	$4 = 2^2$	$2 = 2^1$	$1 = 2^0$	
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
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1	1	0	1	13
1	1	1	0	14
1	1	1	1	15
0	0	0	0	0

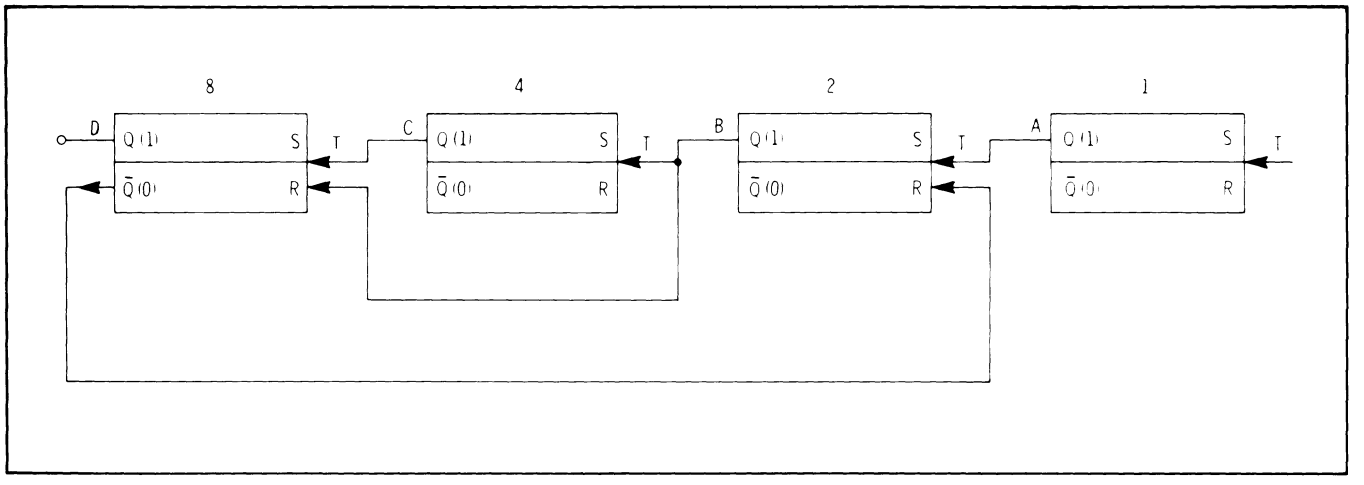


Figure 8-13. 8-4-2-1 BCD Decade Counter

8-48. TRACKING GENERATOR OVERALL PRINCIPLES OF OPERATION

The HP 8443A Tracking Generator-Counter is designed for use with the HP 8553B/8552A or B/140 Series Spectrum Analyzer. A block diagram of the HP 8443A connected to a spectrum analyzer is shown in Figure 8-14.

The tracking generator section of the HP 8443A has two functional modes of operation: Track Analyzer and Restore Signal. In the Track Analyzer mode, the tracking generator provides an output signal which precisely tracks the spectrum analyzer tuning. In the Restore Signal mode, the tracking generator merely produces an output signal that is identical in frequency with the signal at the spectrum analyzer input.

Track Analyzer Operation

To generate a signal at the tuned frequency of the spectrum analyzer, the tracking generator circuits in the HP 8443A recombine all three LO outputs of the spectrum analyzer with the output of the HP 8443A 3 MHz crystal oscillator (in First Converter Assembly A13). The crystal in the HP 8443A oscillator and the crystal in the spectrum analyzer's 3 MHz IF filter are the same type. This ensures accurate frequency tracking regardless of temperature variations and aging. In addition, a front-panel TRACKING ADJUST control permits the crystal oscillator to be adjusted plus or minus 150 Hz from its center frequency to compensate for any slight differences between the IF filter and oscillator frequencies.

To prevent spurious mixing products from entering the output, the IF amplifiers and filter used in the HP 8443A are the same as those used in the spectrum analyzer. With voltage-variable gain, 200 MHz IF Amplifier Assembly A10 delivers the modulation required to level the output signal. The 120 MHz low-pass filter in Third Converter Assembly A9 blocks the LO signal and upper-sideband mixing products.

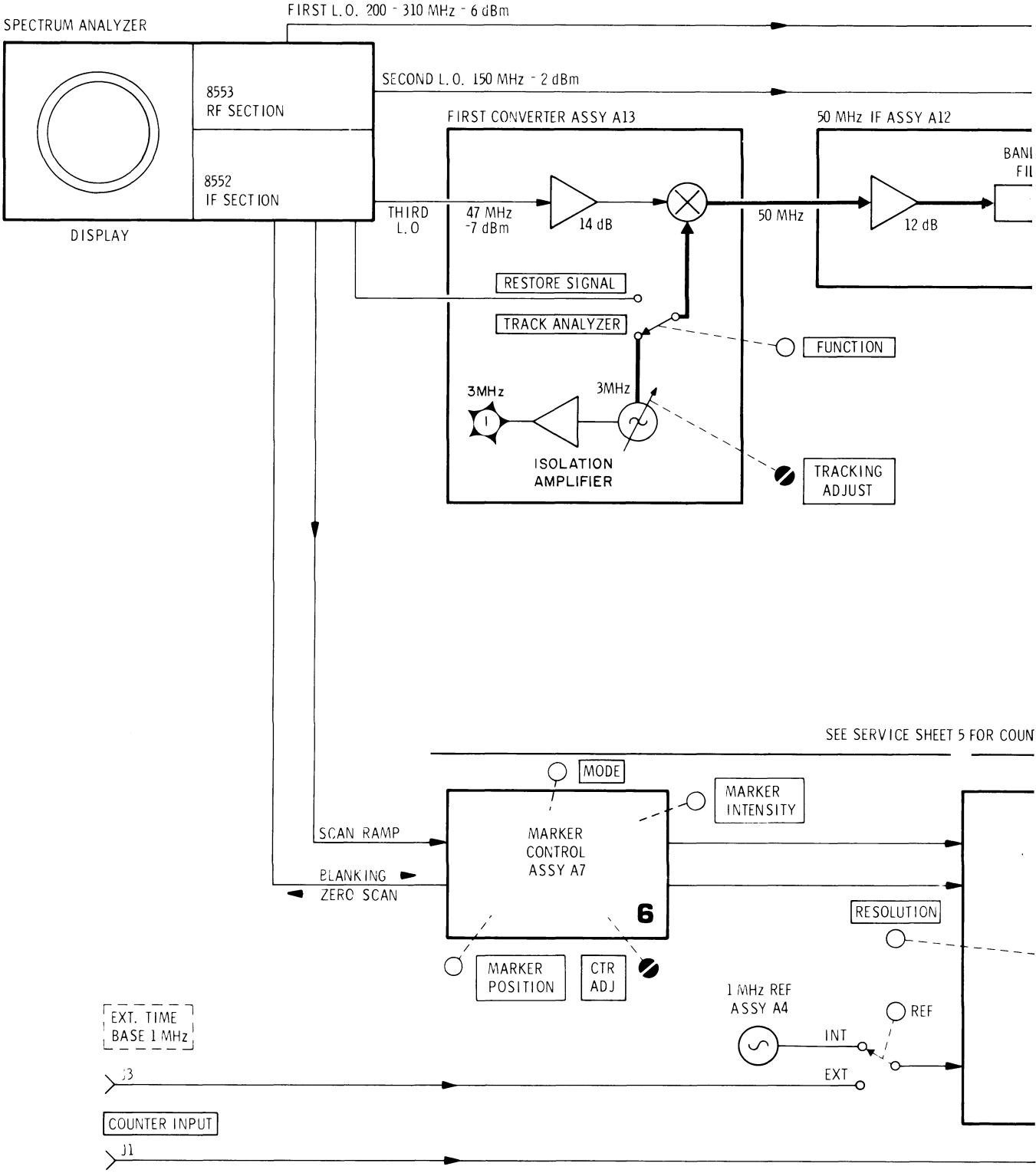
A preamplifier and a power amplifier in Video Amplifier and ALC Assembly A8 follow the low-pass filter. The power amplifier includes a peak detector used as an automatic level control (ALC), which feeds back a control signal to the variable-gain 200 MHz IF amplifier. Two precision attenuators (A2 and A3), which follow the power amplifier, provide an adjustable output level (120 dB range in 1 and 10 dB steps to +10 dBm maximum). In the ALC loop, a vernier calibrated to 0.1 dB allows 1.2 dB variation in output level.

The tracking generator output is a high-level tracking signal which coincides with the tuning of the spectrum analyzer. To count the frequency of the tracking signal, the sweep of the spectrum analyzer (thus, the sweep of the tracking generator) is stopped at some predetermined point. Then the counter gate is momentarily opened to allow a frequency measurement. This pause in the sweep puts an intensified marker on the spectrum analyzer CRT to identify the point at which the counter reading was taken. With a front-panel MARKER POSITION control, the operator can place the marker on any signal, or anywhere along a swept-frequency response displayed on the CRT. (Counter operation is explained more thoroughly later in this section.)

Restore Signal Operation

In Restore Signal operation, the HP 8443A 3 MHz crystal oscillator is turned off (that is, the crystal bias is changed to shut off oscillations) and its output is replaced with the 3 MHz IF signal from the spectrum analyzer final IF stage. This is the only circuit change, but it causes the tracking generator to produce an entirely different output. The output level in Restore Signal operation depends on the level of the unknown signal at the spectrum analyzer input, as well as the precision attenuators in the HP 8443A.

To count the frequency of the unknown signal, the marker is placed anywhere on the signal, typically 15 dB above the noise lvel (15 dB is the minimum signal-to-noise ratio at which the counter can be triggered). The Restore Signal function makes it easier to measure the frequency of signals displayed on the CRT because it eliminates the necessity for going to very narrow scanning to place the marker in the middle of the signal.


SPECTRUM ANALYZER
FIRST L.O. 200 - 310 MHz - 6 dBm
8553
RF SECTION
8552
IF SECTION
DISPLAY
SECOND L.O. 150 MHz - 2 dBm
FIRST CONVERTER ASSY A13
50 MHz IF ASSY A12
THIRD
L.O
47 MHz
-7 dBm
14 dB
50 MHz
12 dB
RESTORE SIGNAL
TRACK ANALYZER
FUNCTION
3MHz
3MHz
ISOLATION
AMPLIFIER
TRACKING
ADJUST
SEE SERVICE SHEET 5 FOR COUN
MODE
MARKER
INTENSITY
SCAN RAMP
BLANKING
ZERO SCAN
MARKER
CONTROL
ASSY A7
6
RESOLUTION
MARKER
POSITION
CTR
ADJ
1 MHz REF
ASSY A4
REF
INT
EXT
EXT. TIME
BASE 1 MHz
J3
COUNTER INPUT
J1

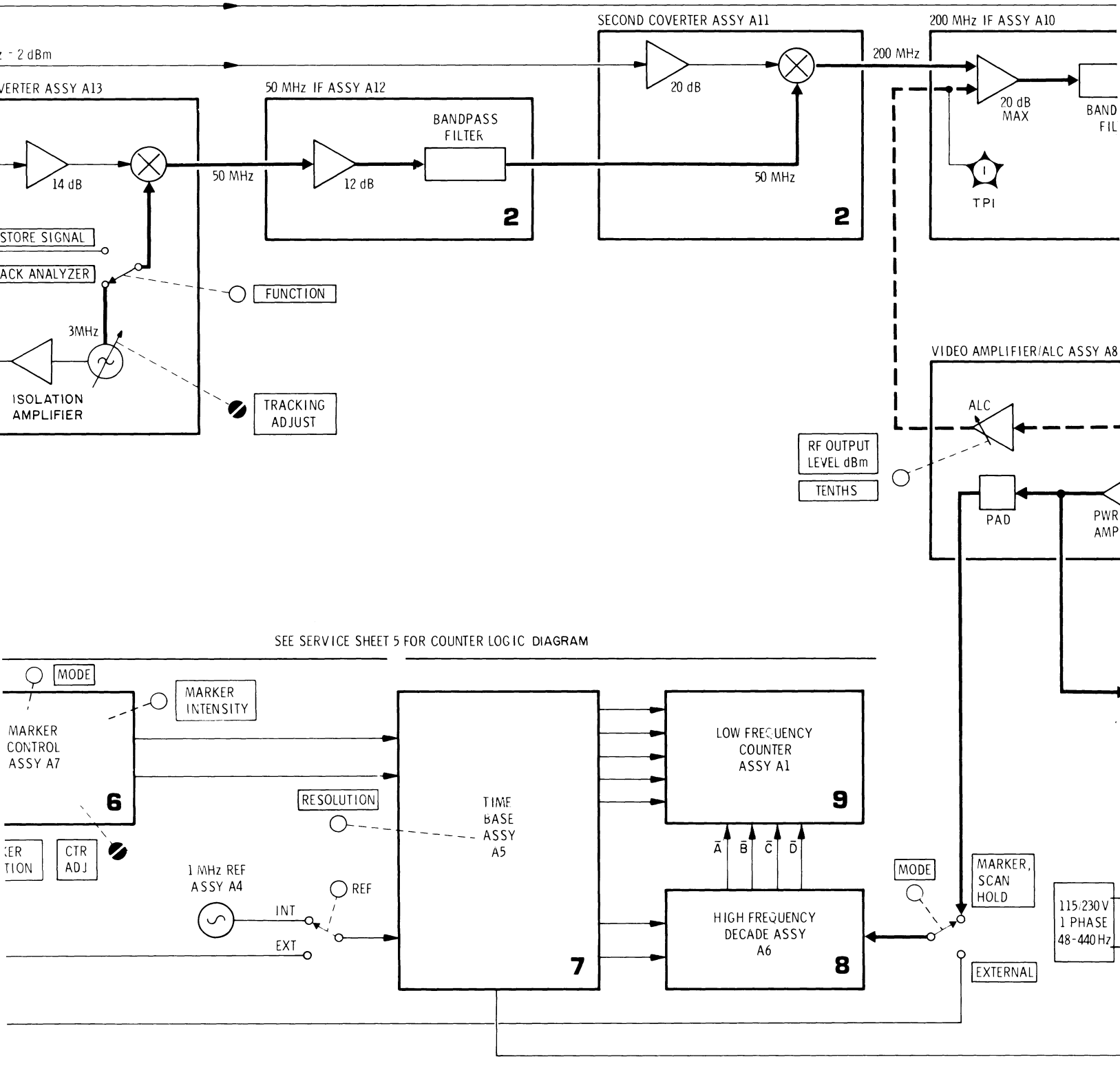

SECOND COVERTER ASSY A11
200 MHz IF ASSY A10
- 2 dBm
VERTER ASSY A13
50 MHz IF ASSY A12
BANDPASS FILTER
20 dB
200 MHz
20 dB MAX
BAND FIL
14 dB
50 MHz
12 dB
50 MHz
2
2
TPI
STORE SIGNAL
ACK ANALYZER
FUNCTION
3MHz
ISOLATION AMPLIFIER
TRACKING ADJUST
VIDEO AMPLIFIER/ALC ASSY A8
ALC
RF OUTPUT LEVEL dBm
TENTHS
PAD
PWR AMP
SEE SERVICE SHEET 5 FOR COUNTER LOGIC DIAGRAM
MODE
MARKER INTENSITY
MARKER CONTROL ASSY A7
6
RESOLUTION
TIME BASE ASSY A5
LOW FREQUENCY COUNTER ASSY A1
9
CTR ADJ
1 MHz REF ASSY A4
REF
INT
EXT
HIGH FREQUENCY DECADE ASSY A6
8
7
MODE
MARKER, SCAN HOLD
EXTERNAL
115/230 V 1 PHASE 48-440 Hz

Figure 8-14.

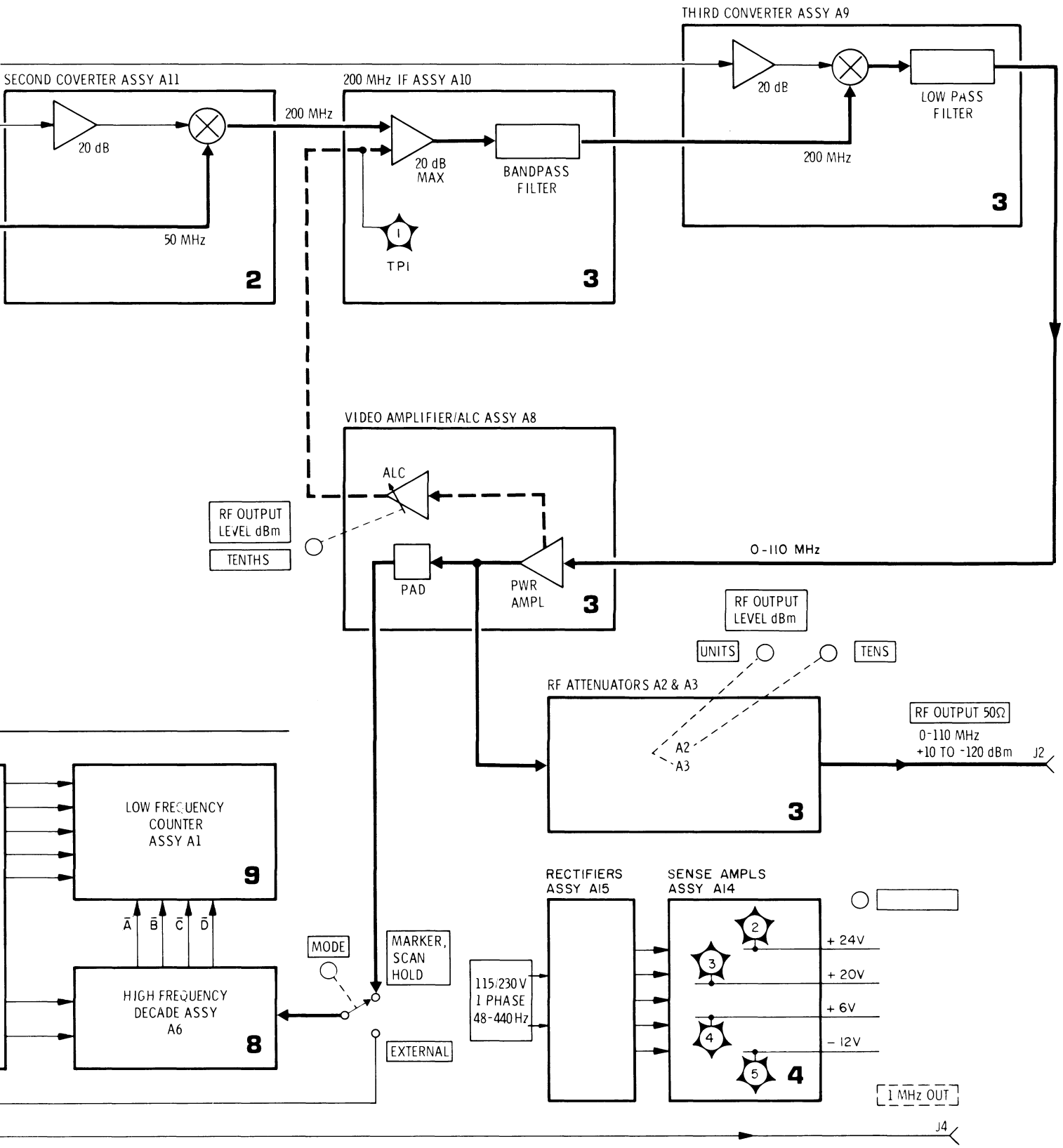


Figure 8-14. 8443A Tracking Generator-Counter Overall Block Diagram

8-49. TRACKING GENERATOR CIRCUIT DESCRIPTIONS AND TROUBLESHOOTING

First Converter Assembly A13 Circuit Description (See Service Sheet 2)

The First Converter Assembly contains a 3 MHz crystal-controlled oscillator (Y1, Q4), a 47 MHz buffer amplifier (Q1, Q2), a diode bridge mixer (CR2-CR5), a 3 MHz buffer amplifier (Q5-Q9), and a restore-signal amplifier (Q10).

The 3 MHz oscillator is a Colpitts crystal-controlled oscillator with a varactor as a fine-frequency control element. Because a decrease in the capacity of the varactor results in an increase in oscillator frequency, inductor L2 is tuned as required to lower the frequency and center the range of the varactor control. The frequency is variable by the varactor approximately 400 Hz. The 3 MHz oscillator supplies approximately 12 mV to one side of the diode mixer. A buffer stage is provided which isolates the 3 MHz test point to prevent loading the circuit during measurements.

The 47 MHz buffer isolates the spectrum analyzer third local oscillator from the HP 8443A and provides about 14 dB of gain. When the spectrum analyzer is operated in wide scan modes (unstabilized), the 47 MHz signal from the analyzer is a fixed frequency. When the spectrum analyzer is operated in narrow scan width modes (stabilized), the 47 MHz signal is swept in frequency.

The restore-signal amplifier circuitry disables the 3 MHz oscillator and applies the 3 MHz IF signal from the spectrum analyzer IF Section to the mixer when the FUNCTION switch is set to RESTORE SIGNAL. The signal at the base of Q5 is approximately 0.4 to 8 mVrms; gain from Q5-b to Q7-E is 10. Q8 and Q9 usually function as a limiter. The signal at Q9-c is approximately 40 mVp-p.

The diode bridge mixer is a conventional mixer circuit which accepts the 3 MHz and 47 MHz signals and produces a 50 MHz output. (When the analyzer is operated in narrow-scan, stabilized modes the bridge output is swept, in frequency, by an amount determined by the setting of the SCAN WIDTH control on the spectrum analyzer.)

First Converter Assembly A13 Troubleshooting

To troubleshoot the First Converter Assembly, place it on an extender circuit board and proceed as follows:

1. Set the spectrum analyzer and tracking generator-counter controls as follows:

Spectrum Analyzer Controls:

Power	ON
DISPLAY CONTROLS	Set for clear display
SCAN WIDTH PER DIVISION	.2 MHz
SCAN WIDTH	PER DIVISION
BANDWIDTH	100 kHz
INPUT ATTENUATION	10 dB
LOG REF LEVEL	0 dBm
LOG/LINEAR	LOG
SCAN TIME PER DIVISION	2 MILLISECONDS
VIDEO FILTER	OFF

Tracking Generator-Counter Controls:

POWER	ON
RF OUTPUT LEVEL dBm	All controls set to 0
FUNCTION	TRACK ANALYZER

NOTE

Unless otherwise indicated, all measurements are made with the HP 1121A Active Probe wih 10:1 Divider and with an HP 8553B RF Section. Actual signal levels are 20 dB greater than the measured values.

2. Refer to the schematic diagram on Service Sheet 2 and use the digital voltmeter to verify the presence of −12 volts and +20 volts on the circuit board's power buses.

3. Connect the 50 MHz output from the First Converter Assembly directly (i.e., without using the active probe) to the spectrum analyzer's RF INPUT receptacle. Tune the spectrum analyzer to a center frequency of 50 MHz and center the 50 MHz signal on the CRT. The absolute amplitude of the signal must be −26 dBm (±3 dB). If the signal level is correct, the First Converter Assembly is operating properly. If the signal level is not correct, proceed to step 4.

4. Connect the 47 MHz input (blue cable) to the A13 assembly to the spectrum analyzer RF INPUT without using the active probe. Tune the spectrum analyzer to 47 MHz. The signal should be approximately −7 dBm (±3 dB). If the signal level is correct, proceed to step 5. If it is not, check the wiring to the spectrum analyzer.

5. Connect Test Point 2 (Q2-c) through the active probe to the spectrum analyzer RF INPUT. The signal should be approximately −15 dBm (±3 dB). If the signal level is correct, proceed to step 7. If it is not, proceed to step 6.

6. Connect Test Point 3 (Q1-c) through the active probe to the spectrum analyzer RF INPUT. The signal level should be approximately 5 to 10 dB less than the signal observed at Test Point 2 in step 5. If the signal level is correct, check Q2 and its associated components. If the signal level is not correct, check Q1 and its associated components.

7. Connect Test Point 1 through the active probe to the spectrum analyzer RF INPUT and tune the spectrum analyzer to display the 3 MHz signal. The signal level should be approximately −19 dBm (±3 dB). If the signal level is not at the correct amplitude, check Q3 and its associated components before proceeding to step 8.

8. Connect Test Point 4 (Q4-c) directly (without the active probe) to the spectrum analyzer RF INPUT. The signal level should be approximately −19 dBm (±3 dB). If the signal level is not correct, check Q4 and its associated components.

9. If the cause of the malfunction has not been found in any of the preceding tests, trouble is probably T1, T2, or the diode bridge. Repair as required and repeat step 3.

NOTE

After repairing the First Converter Assembly, adjust it in accordance with the instructions in paragraph 5-14 of this manual.

50 MHz IF Amplifier Assembly A12 Circuit Description (See Service Sheet 2)

The 50 MHz IF Amplifier Assembly contains a two-stage amplifier (Q1, Q2) and a 50 MHz bandpass filter (subassembly A12A1). The amplifier gain is approximately 12 dB, and the bandwidth of the filter at the 3 dB points is about 4 MHz. LC networks L3-C6-C8 and L6-C15-C17 are 44 MHz traps. LC network L5-C9-C10 is a 47 MHz trap.

50 MHz IF Amplifier Assembly A12 Troubleshooting

To troubleshoot the 50 MHz IF Amplifier Assembly, place it on an extender circuit board and proceed as follows:

1. Set the spectrum analyzer and tracking generator-counter controls as described earlier under First Converter Assembly A13 Troubleshooting, step 1.

2. Refer to the schematic diagram on Service Sheet 2 and use the digital voltmeter to verify the presence of +20 volts on the assembly's +20 volt power bus.

3. Connect the 50 MHz output of the A12 assembly directly (i.e., without the active probe) to the spectrum analyzer RF INPUT and tune the spectrum analyzer to 50 MHz. Signal level on the display should be at least −14 dBm. If the display is correct, the assembly is functioning properly. If the display is incorrect, perform the adjustment procedure in paragraph 5-15 to make sure the BPF ADJ capacitors are properly adjusted. If the signal level is still incorrect, proceed to step 4.

4. Connect Test Point 1 through the active probe to the spectrum analyzer RF INPUT (be sure to ground the probe at the A12 assembly). The signal level should be approximately −31 dBm (±3 dB) at 50 MHz. If the display is incorrect, proceed to step 5. If the display is correct, the bandpass filter is probably defective.

5. Connect Test Point 2 (Q1-c) through the active probe to the spectrum analyzer RF INPUT. The signal level should be approximately −47 dBm (±3 dB). If the signal level is incorrect, check Q1 and its associated components.

   If the signal level is correct check Q2 and its associated components. Repeat step 3.

NOTE

After repairing the 50 MHz amplifier assembly, adjust it in accordance with the instructions in paragraph 5-15 of this manual.

Second Converter Assembly A11 Circuit Description (See Service Sheet 2)

The Second Converter Assembly contains a three-stage amplifier (Q1-Q3) and a diode bridge mixer (CR2-CR5). The amplifier isolates the spectrum analyzer second local oscillator (2nd L.O.) from the HP 8443A and provides approximately 20 dB of gain. The diode bridge mixes the 150 MHz signal from the spectrum analyzer with the signal from 50 MHz IF Amplifier Assembly A12 to produce an IF signal of 200 MHz. This signal is fed to 200 MHz IF Amplifier Assembly A10 at a level of about −33 dBm.

Second Converter Assembly A11 Troubleshooting

To troubleshoot the Second Converter Assembly, place it on an extender circuit board and proceed as follows:

1. Set the spectrum analyzer and tracking generator-counter controls as described earlier under First Converter Assembly A13 Trouleshooting, step 1.

2. Refer to the schematic diagram on Service Sheet 2 and use the digital voltmeter to verify the presence of +20 volts on the assembly's +20 volt power bus.

3. Disconnect the 200 MHz output cable (green cable) from the A11 assembly. Then connect the 200 MHz output from the A11 assembly to the RF INPUT of the HP 8557A Spectrum Analyzer. The signal level indicated on the HP 8557A should be approximately −33 dBm (±3 dB). If the signal level is correct, the A11, A12 and A13 assemblies are functioning properly. If the signal level is incorrect, proceed to step 4.

4. Using the active probe with 100:1 divider, check the output from the amplifier to the mixer (Test Point 1, Q3-c) at 150 MHz. The signal level should be −22 dBm (±3 dB). If the signal level is correct, the trouble is probably in the diode bridge mixer or its associated components. Repair and repeat step 3. If the display level is incorrect, proceed to step 5.

5. Remove the 100:1 divider from the active probe and replace it with the 10:1 divider. Check the signal level at Test Point 2 (Q2-c). The signal level should be approximately −16 dBm (±3 dB). If the signal level is correct, check Q3 and its associated components. If the signal level is incorrect, proceed to step 6.

6. Connect Test Point 3 (Q1-c) through the active probe to the RF INPUT of the second (HP 8557A) spectrum analyzer. The signal level should be −12 dBm (±3 dB). If the signal level is correct, check Q2 and its associated components. If the signal level is not correct, check the 150 MHz input to assembly A11. The signal level should be approximately 0 dBm (±3 dB) (when terminated in 50 ohms). If a 0 dBm signal is present, the problem is most likely Q1 or an associated component.

NOTE

Before proceeding with the troubleshooting tests, disable the ALC signal by lifting the A8 assembly out of its socket. Unless otherwise indicated, all measurements are made with an HP 1121A Active Probe with 10:1 Divider.

200 MHz IF Amplifier Assembly A10 Circuit Description (See Service Sheet 3)

The 200 MHz IF Amplifier Assembly contains a two-stage, variable-gain amplifier (Q1, Q2) and a bandpass filter (subassembly A10A1). The amplifier gain is controlled by the automatic level control (ALC) signal from Video Amplifier/ALC Assembly A8. It also contains three frequency trap networks: L10-C17 for 250 MHz, L2-C3 for 150 MHz, and L3-C5 for 100 MHz. Maximum gain of the 200 MHz IF Amplifier is about 20 dB. The bandwidth of the 200 MHz RF bandpass filter is ±2 MHz. The insertion loss is about 2 dB.

200 MHz IF Amplifier Assembly A10 Troubleshooting

To troubleshoot the 200 MHz IF Amplifier Assembly, place it on an extender circuit board, disable the ALC signal by removing Video Amplifier/ALC Assembly A8 from the tracking generator-counter, then proceed as follows:

1. Set the spectrum analyzer and tracking generator-counter controls as described in First Converter Assembly A13 Troubleshooting, step 1, except set SCAN WIDTH PER DIVISION to 2 MHz.

2. Refer to the schematic diagram on Service Sheet 3 and use the digital voltmeter to verify the presence of −12 volts at the assembly's −12 volt power input.

3. Connect the 200 MHz output from the A10 assembly to the RF INPUT of the second (0−350 MHz) spectrum analyzer and tune the CENTER FREQUENCY MHz to 200 MHz. Set the controls of the second spectrum analyzer the same as the HP 8553/8552 except set SCAN WIDTH to .5 MHz/Div. Center the signal on the spectrum analyzer CRT. The signal level should be approximately −18 dBm. If the correct display is present, the A10 assembly is functioning properly. If the display is incorrect, proceed to step 4.

4. Connect the input of the bandpass filter to the RF INPUT of the 0−350 MHz spectrum analyzer. The signal level should be approximately −28 dBm. If the correct waveform is present, but was not present in step 3, the trouble is probably in the bandpass filter. Repair as required and repeat step 3. If the correct display is not present, proceed to step 5.

5. Connect Test Point 3 (junction of C8/C9) to the RF INPUT of the 0 – 350 MHz spectrum analyzer. The signal level should be approximately – 34 dBm. If the correct display is present, but was not present in step 4, check Q2 and its associated components. If the display is not present proceed to step 6.

6. Connect Test Point 4 (Q1-b) to the RF INPUT of the 0 – 350 MHz spectrum analyzer. The signal level should be approximately – 47 dBm. If the correct display is present, but was not in step 5, check Q1 and its associated components. If the display is not present, check the frequency traps for a short and the cabling to the A11 assembly. Proceed to step 7.

7. Connect the 200 MHz output from the A10 assembly to the RF INPUT of the 0 – 350 MHz spectrum analyzer. Connect the variable voltage power supply to TP1 and vary the voltage from 0 to + 20 volts. Signal level should vary approximately 25 dB (± 3 dB). If the signal level does not vary approximately 25 dB, check C1, R4, C8, C9, C10, L6 and the adjustment of L6 as specified in paragraph 5-16 of this manual.

NOTE

After repairing the 200 MHz amplifier assembly adjust it in accordance with paragraph 5-16 of this manual.

Third Converter Assembly A9 Circuit Description (See Service Sheet 3)

The Third Converter Assembly consists of a three-stage, fixed-gain, 200 to 310 MHz amplifier (Q1-Q3), a diode bridge mixer (subassembly A9A1), and low-pass filter (subassembly A9A2). The three-stage amplifier isolates the HP 8443A from the spectrum analyzer's first local oscillator and provides about 20 dB of gain. The width of the band of frequencies processed through the amplifier is determined by the setting of the SCAN WIDTH switch on the spectrum analyzer. When the spectrum analyzer is operated at a narrow scan width (20 kHz per division or less) in the stabilized mode, the spectrum analyzer first local oscillator output is a fixed frequency, and the third local oscillator, instead of being fixed, is swept.

The diode mixer mixes the output of the three-stage amplifier and 200 MHz IF Amplifier Assembly A10 to provide a 0 to 110 MHz signal, or a signal that is any portion of the 0 to 110 MHz frequency range. When the spectrum analyzer is operated in the ZERO scan mode, the output from the mixer is a fixed frequency.

The 120 MHz low-pass filter provides about 75 dB rejection to frequencies above 200 MHz.

Third Converter Assembly A9 Troubleshooting

To troubleshoot the Third Converter Assembly, place it on an extender circuit board and proceed as follows:

NOTE

Unless otherwise indicated, all measurements are made with an HP 1121A Active Probe with 10:1 Divider.

1. Set the spectrum analyzer and tracking generator-counter controls as described in First Converter Assembly A13 Troubleshooting, step 1.

2. Refer to the schematic diagram on Service Sheet 3 and use the digital voltmeter to verify the presence of – 12 volts at the assembly's – 12 volt power input.

3. Connect the output from the A9 assembly to the RF INPUT of the HP 8553 spectrum analyzer, and set the spectrum analyzer frequency to 80 MHz. The signal level, as indicated by the position of the horizontal trace on the CRT, should be approximately – 40 dBm (± 5 dB). If the signal level is correct, assembly A9 is functioning properly. If the signal level is incorrect, proceed to step 4.

4. Connect LO IN to the mixer through the active probe with a 100:1 divider to the INPUT 50Ω connector of the 0 – 350 MHz spectrum analyzer.

   Set the 8553/8552 controls as follows:

CENTER FREQUENCY	50 MHz
BANDWIDTH	100 kHz
SCAN WIDTH	ZERO
INPUT ATTEN	10 dB
SCAN TIME PER DIVISION	2 msec
LOG REF LEVEL	–30 dBm

5. Adjust the reference level control on the 0 – 350 MHz spectrum analyzer to place the 250 MHz signal 1 division below the reference level. Manually tune the 8553 FREQUENCY control across the full range of the analyzer. The signal level should not vary more than 10 dB (peak-to-peak variation). If the display is correct, proceed to step 6. If it is incorrect, proceed to step 7.

6. Remove the cover from third converter (diode bridge mixer), assembly A9A1 and connect the 0 – 110 MHz MIXER OUT to the HP 8553 RF INPUT. (Be sure to ground the active probe close to the pickup point.) Remove the 100:1 divider from the active probe. (It should be noted that with the third converter assembly cover removed, the mixer circuit may be affected by radiation from nearby devices. If the CRT display shows that the output frequency goes from 0 to 100 MHz, the low pass filter is probably defective. If the mixer output is not present, repair or replace the mixer and repeat step 3.

7. Connect Test Point 2 to the INPUT 50Ω connector of the 0 – 350 MHz spectrum analyzer, with all controls set as in step 4. Adjust the 0 – 350 MHz spectrum analyzer reference level control to place the CRT trace 1 division below the reference level line. Manually tune the 8553 FREQUENCY control from 0 to 110 MHz. The signal level should not vary more than 10 dB (peak-to-peak variation). If the signal level is now correct, but was not in step 5, check Q1 and its associated components. If the signal level is incorrect, proceed to step 8.

8. Connect Test Point 1 (Q3-c) to the INPUT 50Ω connector of the 0 – 350 MHz spectrum analyzer, with all controls set as in step 4. Adjust the 0 – 350 MHz spectrum analyzer reference level control to place the CRT trace 1 division below the reference level line. Manually tune the 8553 FREQUENCY control from 0 to 110 MHz. The signal level should not vary more than 10 dB (peak-to-peak variation). If the signal level is now correct, but was not in step 7, check Q2 and its associated components. If the signal level is incorrect, check Q3, its associated components, and the cabling to the spectrum analyzer. After repairs repeat step 3.

Video Amplifier/ALC Assembly A8 and Attenuator Assemblies A2 and A3 Circuit Description (See Service Sheet 3)

The Video Amplifier/ALC (Automatic Level Control) Assembly contains a video amplifier (subassembly A8A1) and a comparator circuit (Q1-Q4). Video amplifier subassembly A8A1 contains two integrated-circuit amplifiers: U1 and U2. U1 provides a gain of 32 dB, and U2 provides an additional gain of 20 dB. Of the three outputs taken from the video amplifier subassembly, one is fed to High Frequency Decade Assembly A6 in the Counter section, and another is supplied to the HP 8443A front-panel RF OUTPUT connector through Attenuator Assemblies A2 and A3. The third output of the video amplifier subassembly is fed to dual-transistor Q1 in the comparator circuit.

The comparator is referenced to a fixed level which is controlled by the 0-to-1.2 dB vernier (TENTHS) control. The comparator output is the automatic level control (ALC) signal for 200 MHz IF Amplifier Assembly A10.

When the TENTHS control is set to 0, the RF output from video amplifier subassembly A8A1 to 0 – 120 dB Attenuator Assembly A2 is a constant +10 dBm. The two Attenuator Assemblies are controlled from the front panel with the TENS and UNITS controls. With these two controls and the TENTHS control the RF level at the RF OUTPUT connector can be accurately set to any level between +10 dBm and –123.2 dBm.

Video Amplifier/ALC Assembly A8 and Attenuator Assemblies A2 and A3 Troubleshooting

NOTE

Unless otherwise indicated, all measurements are made with an HP 1121A AC Active Probe with a 10:1 Divider.

To troubleshoot the Video Amplifier/ALC Assembly, place it on an extender circuit board and proceed as follows:

NOTE

Attenuator Assemblies A2 and A3 are passive devices and are easily checked with an ohmmeter.

1. Set the spectrum analyzer and tracking generator-counter controls as described in First Converter Assembly A13 Troubleshooting, step 1.

2. Refer to the schematic diagram on Service Sheet 3 and use the digital voltmeter to verify the presence of +20 volts and –12 volts at the assembly's +20 and –12 volt power inputs.

3. Connect the HP 8443A RF OUTPUT to the HP 8553 RF INPUT. A straight line should appear along the LOG REF (top graticule) line on the spectrum analyer CRT. If the correct display is observed, the tracking generator portion of the HP 8443A is functioning properly. If the CRT display is not correct proceed to step 4.

NOTE

To make accurate amplitude measurements with the 8553B you must adjust the INPUT ATTENuation control on the 8553B so that the level at the input mixer (signal level minus input attenuation) is never greater than –10 dBm (1 dB gain compression point).

4. Connect the 0 – 110 MHz OUT from the A8 assembly directly (i.e., without the active probe) to the spectrum analyzer RF INPUT and increase the spectrum analyzer INPUT ATTENUATION to 20 dB. The signal level should be approximately +10 dBm. If the CRT display is now correct, but was incorrect in step 3, check the attenuators.

NOTE

Component selection and placement in the attenuators is extremely critical. Factory service is recommended.

If the CRT display is incorrect proceed to step 5.

5. Connect the A8 output to the HF Decade (A6J1) to the spectrum analyzer RF INPUT (without using the active probe) and reset the spectrum analyzer INPUT ATTENUATION to 0 dB. The spectrum analyzer CRT display should show a straight line across the CRT at approximately –14 dBm. If the display is now correct, but was not in step 4, U2 is probably defective. After repairs, repeat step 3. If the CRT display is not correct, proceed to step 6.

NOTE

The signal level measured at Test Point 1 in step 6 will vary significantly from instrument to instrument. This variation is the result of A8A1R6 being a factory selected value chosen to give a +10 dBm signal at A8J2 (input to 120 dB step attenuator).

6. Using the ac active probe with a 10:1 divider (the divider prevents the circuit from becoming loaded down), connect Test Point 1 (A8A1R6 lead closest to R1) to the spectrum analyzer RF Input. The signal level at 50 MHz should be approximately −40 dBm. (Actual signal level, attenuated by 10:1 probe, is 20 dB higher.) If the display is correct now, but was not correct in step 5, U2 is probably defective. If the display is not correct, U1 is probably defective. Replace the suspect IC and repeat step 3. If the assembly is still not functioning properly, proceed to step 7.

7. Connect the HP 8553B RF Input through the active probe (remove the 10:1 divider) to Test Point 2 (ALC input on A8A1). Set SCAN width to 0−100 MHz. Maximum displayed signal level should be approximately −35 dBm. If the display is not correct, U2 is probably defective. Repair as required and repeat step 3. If the display is correct and the assembly still does not function properly, proceed to step 8.

8. Connect the spectrum analyzer RF INPUT to TP3 (junction of R1 and C12). The maximum displayed signal level should be approximately −40 dBm. If the display is incorrect, check Q1, Q2, Q3, Q4 and their associated components. After repairs repeat step 3.

NOTE

After repairs, adjust the Video Amplifier/ALC assembly in accordance with instructions in paragraph 5-17 of this manual.

Rectifier Assembly A15 Circuit Description (See Service Sheet 4)

The Rectifier Assembly contains three two-diode, full-wave rectifiers; a regulator circuit; and four fuses. The rectifiers on this board assembly supply the dc voltages that are regulated by the sense amplifier (regulator control) circuits on Sense Amplifier Assembly A14 and the series regulator transistors mounted inside the HP 8443A rear panel. All together, these components make up four dc power supplies to furnish regulated dc power levels of +24 volts, +6 volts, +20 volts, and −12 volts.

Full-wave rectifier CR1-CR2 supplies +39 volts to the +24 volts and +20 volts series regulators, Q3 and Q1 respectively, both of which are controlled by sense amplifiers on Sense Amplifier Assembly A14. Full-wave rectifiers CR3-CR4 and CR5-CR6 furnish +13.2 volts and +8.8 volts to transistors Q2 and Q4 respectively, the +6 volts and −12 volts regulators. Q2 and Q4 are also each controlled by a separate sense amplifier circuit on the Sense Amplifier Assembly. The regulator circuit comprising CR7, Q1, R2 and R3 taps off the +39 volts output of rectifier CR1-CR2 to provide a +25.3 volts reference for the +24 volts sense amplifier. The output of the +24 volts sense amplifier, switched through the POWER STBY-ON switch, serves as the reference for the other three sense amplifier circuits.

Rectifier Assembly A15 Troubleshooting

To troubleshoot the Rectifier Assembly, proceed as follows:

1. Check the voltage levels at the upper ends of the fuses mounted on the Rectifier Board Assembly. (See Service Sheet 4 for fuse locations and voltage levels.)

2. If there is no voltage present at the upper end of a fuse, check the fuse. If you replace a blown fuse with a new one, and it too burns out, the problem is most likely in the associated sense amplifier circuit on Sense Amplifier Assembly A14.

3. If the problem is not a blown fuse, set the front-panel POWER switch to STBY, disconnect the ac power cable, and place the Rectifier Assembly on an extender circuit board. Then reconnect the ac power cable and set the POWER switch to ON.

4. With an ac voltmeter, measure the voltages across the primary and secondary windings of the ac input power transformer. If there is voltage across the transformer primary, but none across one or more of the secondary windings in use, replace the transformer. If there is no voltage across the transformer primary, check the ac line fuse and the LINE SELECTOR switch on the rear panel, the front-panel POWER switch, the line filter (FL1), and the ac power cable.

5. If the voltage across the transformer secondary windings is normal, use the digital voltmeter to check for the dc voltages shown on the schematic diagram.

Sense Amplifier Assembly A14 Circuit Description (See Service Sheet 4)

The Sense Amplifier Assembly contains four sense amplifier (series regulator control) circuits. Each sense amplifier controls the series regulator transistor for a particular one of the dc outputs: +24 Volts, +20 Volts, +6 Volts, and −12 Volts. In each sense amplifier, a comparator circuit compares the output voltage of its associated regulator transistor with a fixed dc reference derived from the +24 volts supply. Any variation in the output is translated by the comparator and an amplifier circuit into a signal which causes the series regulator to counteract the change in output level.

The sense amplifier circuits and their associated series regulators are made up as follows:

+24 Volts sense amplifier A14Q14 through A14Q19 controls series regulator Q3

+20 Volts sense amplifier A14Q1, A14Q5, A14Q6, and A14Q11 controls series regulator Q1

+6 Volts sense amplifier A14Q2, A14Q7, A14Q8, and A14Q12 controls series regulator Q2

−12 Volts sense amplifier A14Q3, A14Q9, A14Q10, and A14Q13 controls series regulator Q4

The Sense Amplifier Assembly also contains two crowbar circuits, one (CR11 through CR19) for the +dc supplies, and one (CR2 through CR4, and Q4) for the −12 Volts supply. Reset switch S1 on the Sense Amplifier Assembly is a momentary pushbuutton used to reset the +dc crowbar. The −12 Volts crowbar resets automatically.

Sense Amplifier Assembly A14 Troubleshooting

To troubleshoot the Sense Amplifier Assembly, place it on an extender circuit board and use a digital voltmeter to check for the voltage levels shown in the assembly schematic diagram on Service Sheet 4.

NOTE

The voltages shown on the Sense Amplifier assembly schematic diagram are nominal values and may vary slightly from instrument to instrument.

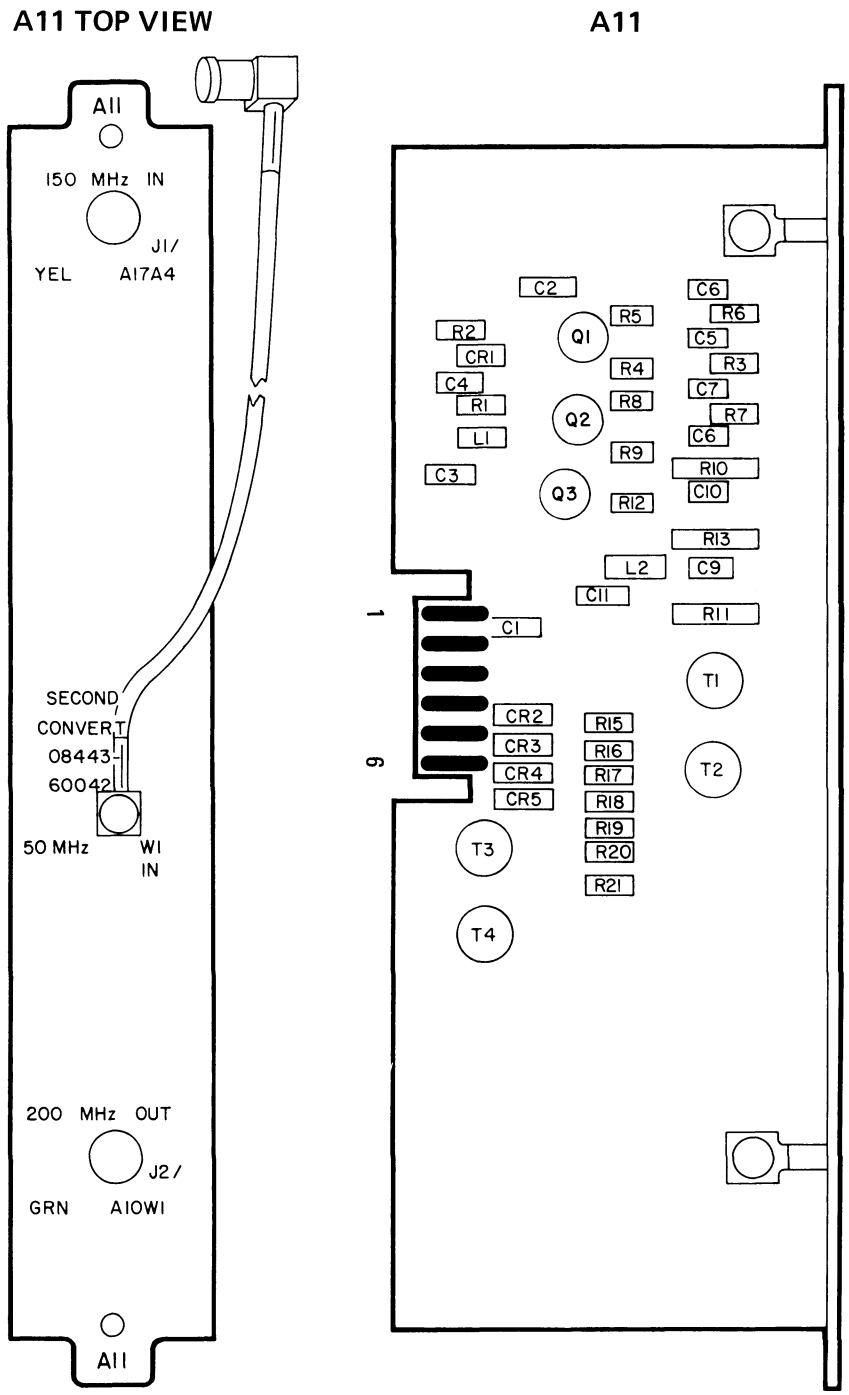


Figure 8-15. Second Converter Assembly A11 Parts Locations

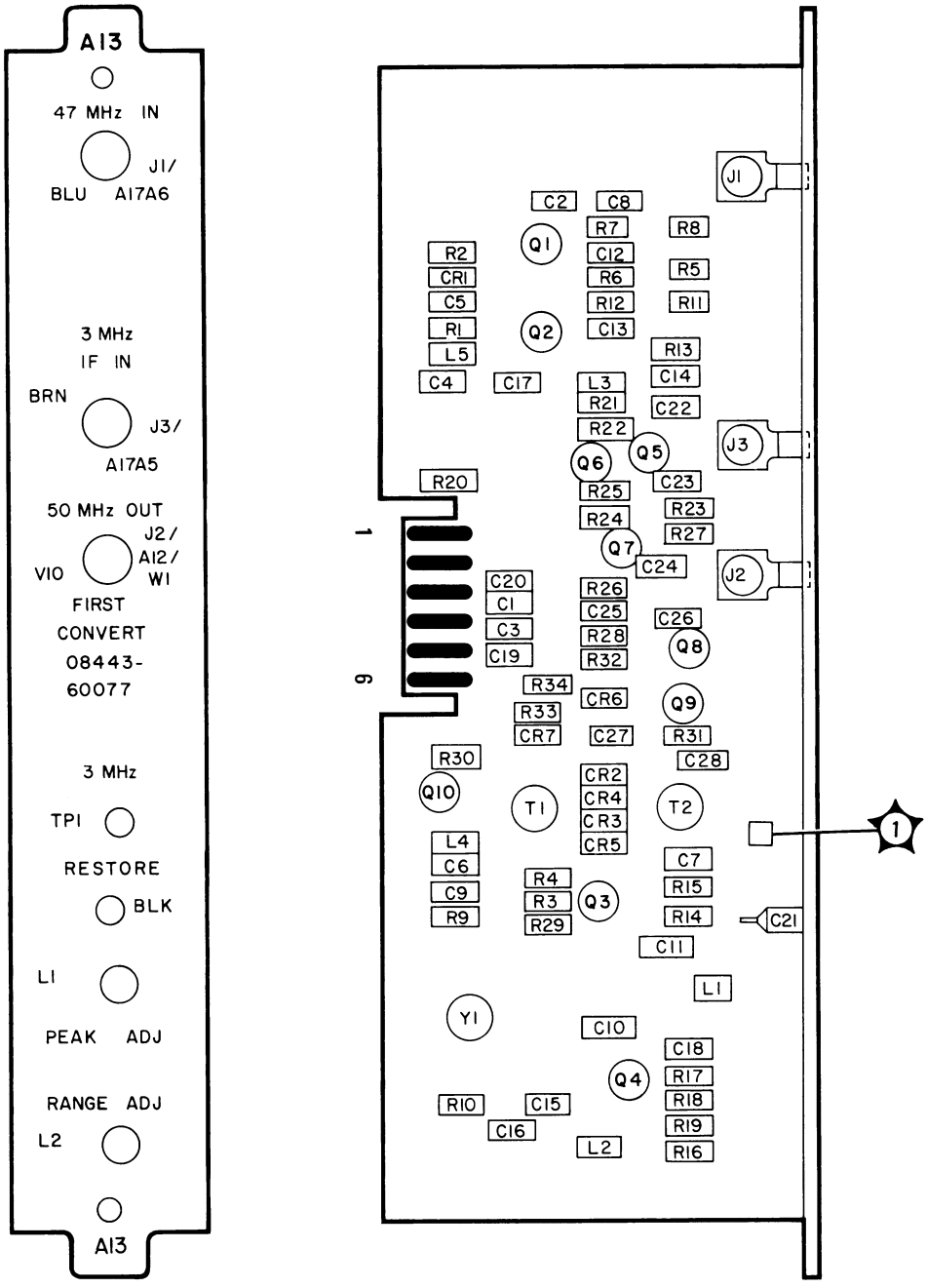


Figure 8-16. First Converter Assembly A13 Parts Locations

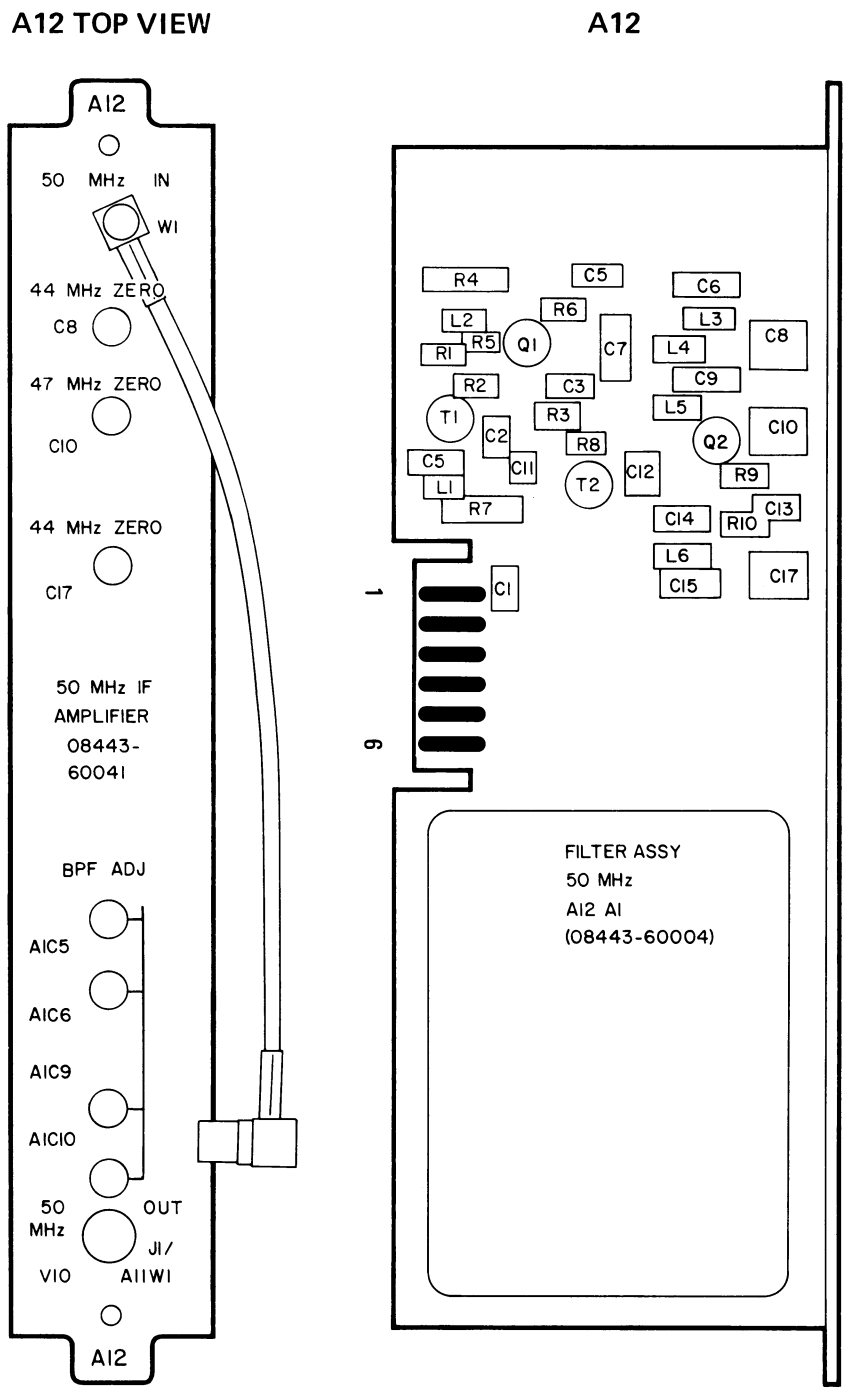


Figure 8-17. 50 MHz IF Amplifier Assembly A12 Parts Locations (1 of 2)

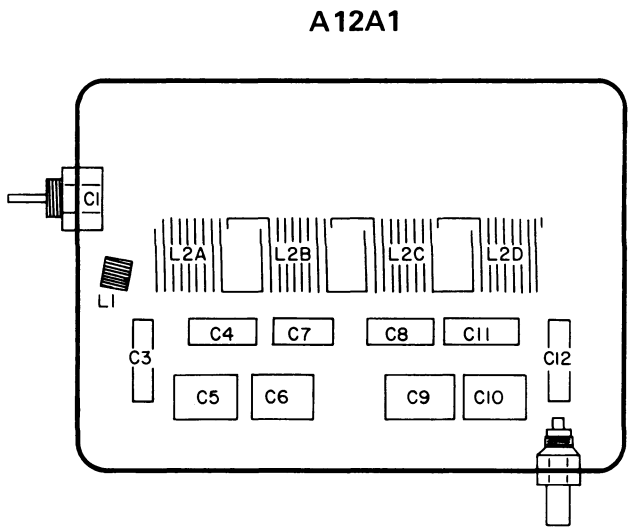
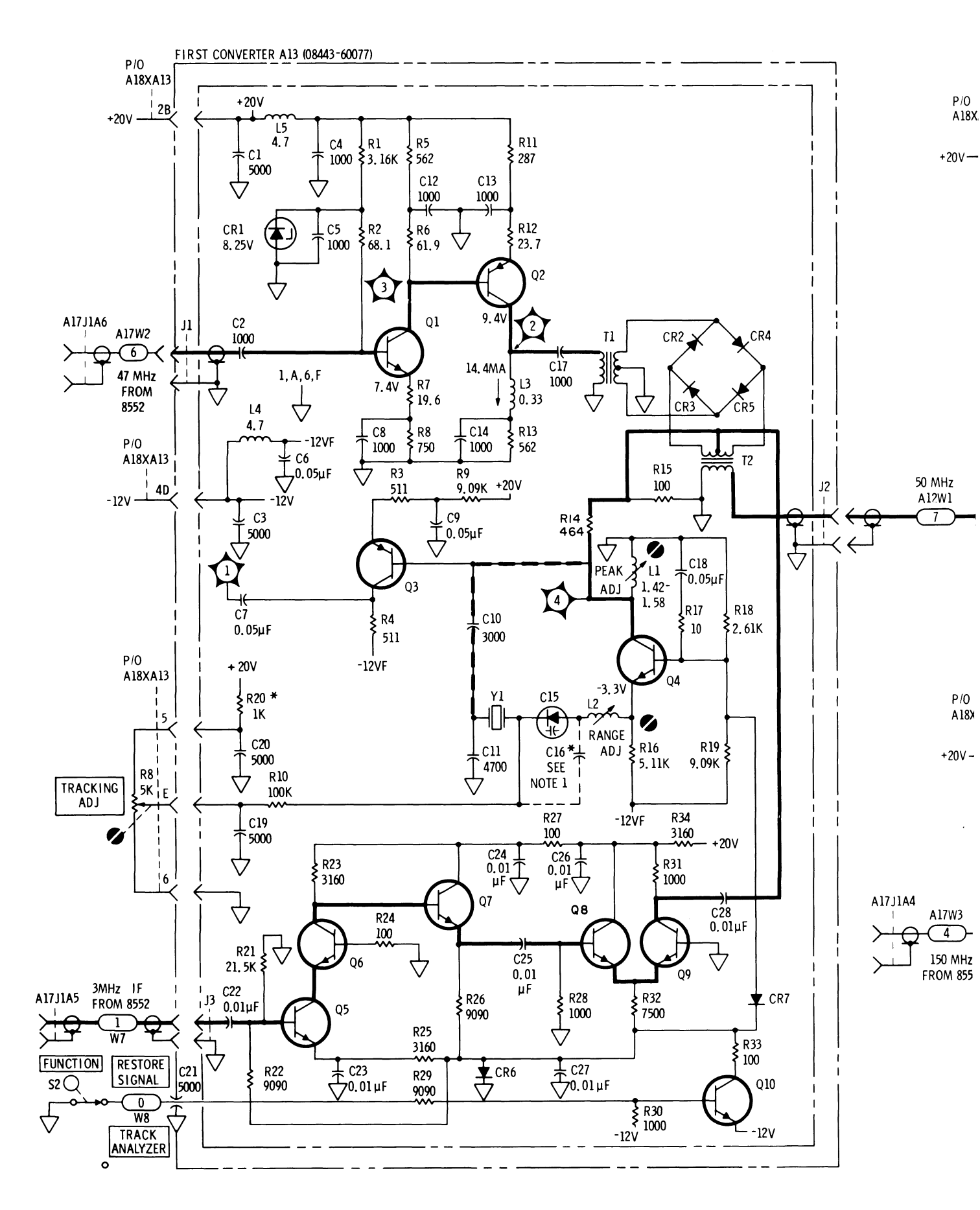
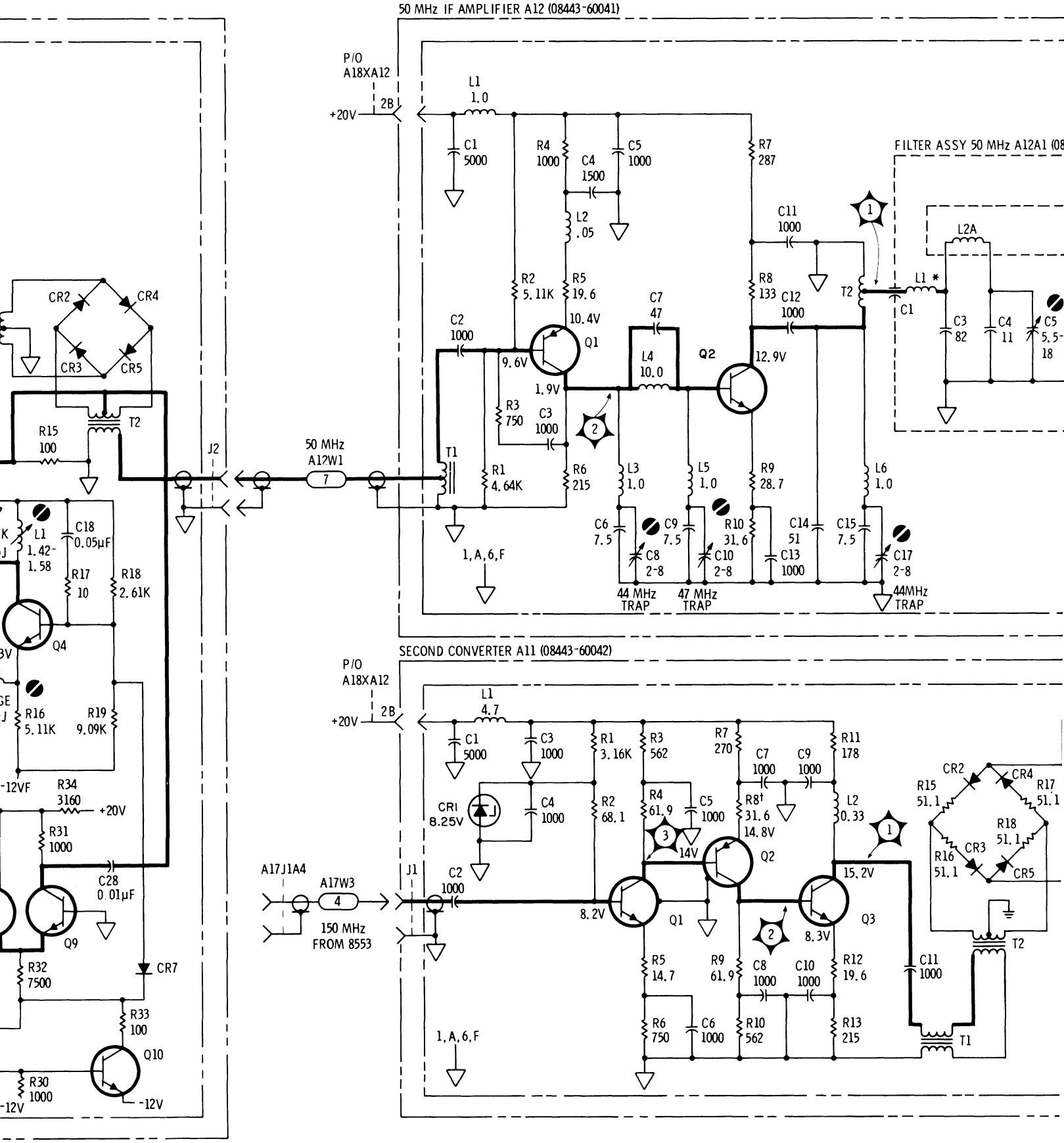
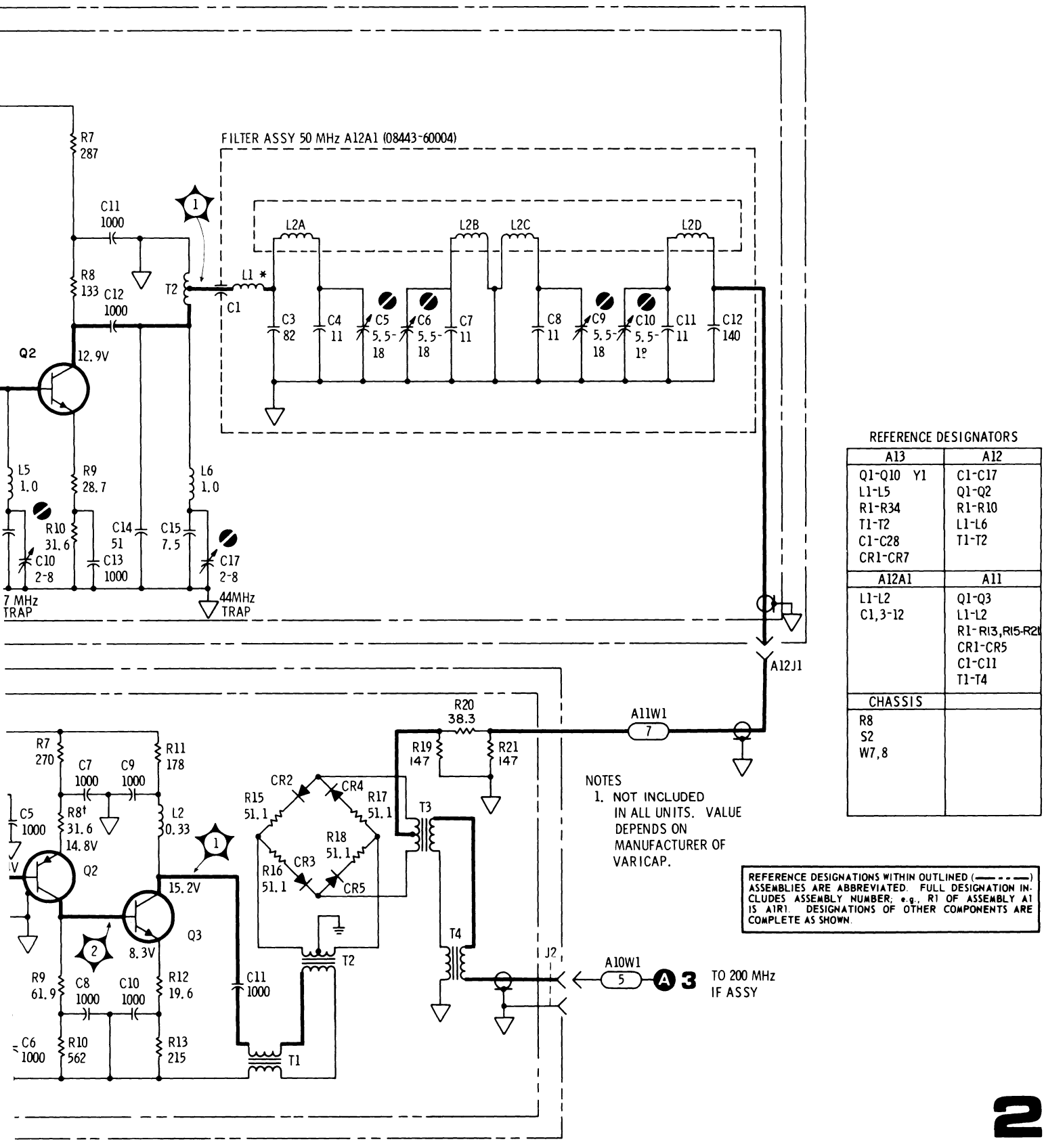


Figure 8-17. 50 MHz IF Amplifier Assembly A12 Parts Locations (2 of 2)


FIRST CONVERTER A13 (08443-60077)
P/O A18XA13
+20V
2B
L5 4.7
C1 5000
C4 1000
R1 3.16K
R5 562
R11 287
C12 1000
C13 1000
CR1 8.25V
C5 1000
R2 68.1
R6 61.9
R12 23.7
Q2
9.4V
Q1
7.4V
A17J1A6
A17W2
6
47 MHz FROM 8552
J1
C2 1000
1, A, 6, F
14.4MA
R7 19.6
L3 0.33
C17 1000
T1
CR2
CR4
CR3
CR5
L4 4.7
-12VF
C6 0.05µF
C8 1000
R8 750
C14 1000
R13 562
T2
P/O A18XA13
4D
-12V
R3 511
R9 9.09K
+20V
R15 100
J2
50 MHz A12W1
7
C3 5000
C9 0.05µF
R14 464
Q3
PEAK ADJ
L1 1.42-1.58
C18 0.05µF
C7 0.05µF
R4 511
C10 3000
R17 10
R18 2.61K
Q4
P/O A18XA13
+ 20V
-3.3V
R20 * 1K
Y1
C15
L2
C20 5000
C11 4700
C16 * SEE NOTE 1
RANGE ADJ
R16 5.11K
R19 9.09K
TRACKING ADJ
R8 5K
R10 100K
C19 5000
R27 100
-12VF
R34 3160
+20V
R23 3160
C24 0.01 µF
C26 0.01 µF
R31 1000
Q7
Q8
C28 0.01µF
R24 100
R21 21.5K
Q6
Q9
C25 0.01 µF
A17J1A4
A17W3
4
150 MHz FROM 855
A17J1A5
3MHz IF FROM 8552
J3
C22 0.01µF
Q5
R26 9090
R28 1000
R32 7500
CR7
1
W7
R25 3160
R33 100
FUNCTION
RESTORE SIGNAL
S2
C21 5000
R22 9090
C23 0.01µF
R29 9090
CR6
C27 0.01µF
Q10
0
W8
R30 1000
-12V
-12V
TRACK ANALYZER


50 MHz IF AMPLIFIER A12 (08443-60041)
P/O A18XA12
2B
+20V
L1 1.0
C1 5000
R4 1000
C4 1500
C5 1000
R7 287
L2 .05
C11 1000
FILTER ASSY 50 MHz A12A1 (08
L2A
L1 *
C1
C3 82
C4 11
C5 5.5-18
R2 5.11K
R5 19.6
10.4V
Q1
C2 1000
C7 47
R8 133
C12 1000
T2
9.6V
1.9V
Q2
12.9V
L4 10.0
R3 750
C3 1000
R15 100
T2
J2
50 MHz A12W1
7
T1
R1 4.64K
R6 215
L3 1.0
L5 1.0
R9 28.7
L6 1.0
C6 7.5
C9 7.5
C8 2-8
R10 31.6
C10 2-8
C13 1000
C14 51
C15 7.5
C17 2-8
1,A,6,F
44 MHz TRAP
47 MHz TRAP
44MHz TRAP
CR2
CR4
CR3
CR5
C18 0.05µF
L1 1.42-1.58
R17 10
R18 2.61K
Q4
R16 5.11K
R19 9.09K
-12VF
R34 3160
+20V
R31 1000
C28 0.01µF
Q9
R32 7500
CR7
R33 100
Q10
R30 1000
-12V
SECOND CONVERTER A11 (08443-60042)
P/O A18XA12
2B
+20V
L1 4.7
C1 5000
C3 1000
R1 3.16K
R3 562
R7 270
C7 1000
C9 1000
R11 178
CR1 8.25V
C4 1000
R2 68.1
R4 61.9
C5 1000
R8† 31.6
14.8V
L2 0.33
14V
Q2
15.2V
A17J1A4
A17W3
4
J1
C2 1000
8.2V
Q1
Q3
8.3V
150 MHz FROM 8553
R5 14.7
R9 61.9
C8 1000
C10 1000
R12 19.6
R6 750
C6 1000
R10 562
R13 215
1,A,6,F
CR2
CR4
R15 51.1
R17 51.1
R18 51.1
R16 51.1
CR3
CR5
T2
T1
C11 1000



REFERENCE DESIGNATORS

A13	A12
Q1-Q10 Y1 L1-L5 R1-R34 T1-T2 C1-C28 CR1-CR7	C1-C17 Q1-Q2 R1-R10 L1-L6 T1-T2
A12A1	**A11**
L1-L2 C1,3-12	Q1-Q3 L1-L2 R1-R13,R15-R21 CR1-CR5 C1-C11 T1-T4
CHASSIS	
R8 S2 W7,8	

NOTES
1. NOT INCLUDED IN ALL UNITS. VALUE DEPENDS ON MANUFACTURER OF VARICAP.

REFERENCE DESIGNATIONS WITHIN OUTLINED (—— - - —) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER; e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

2

Figure 8-18. First and Second Converter Assemblies A11 and A13 and 50 MHz IF Amplifier Assembly A12 Schematic Diagram

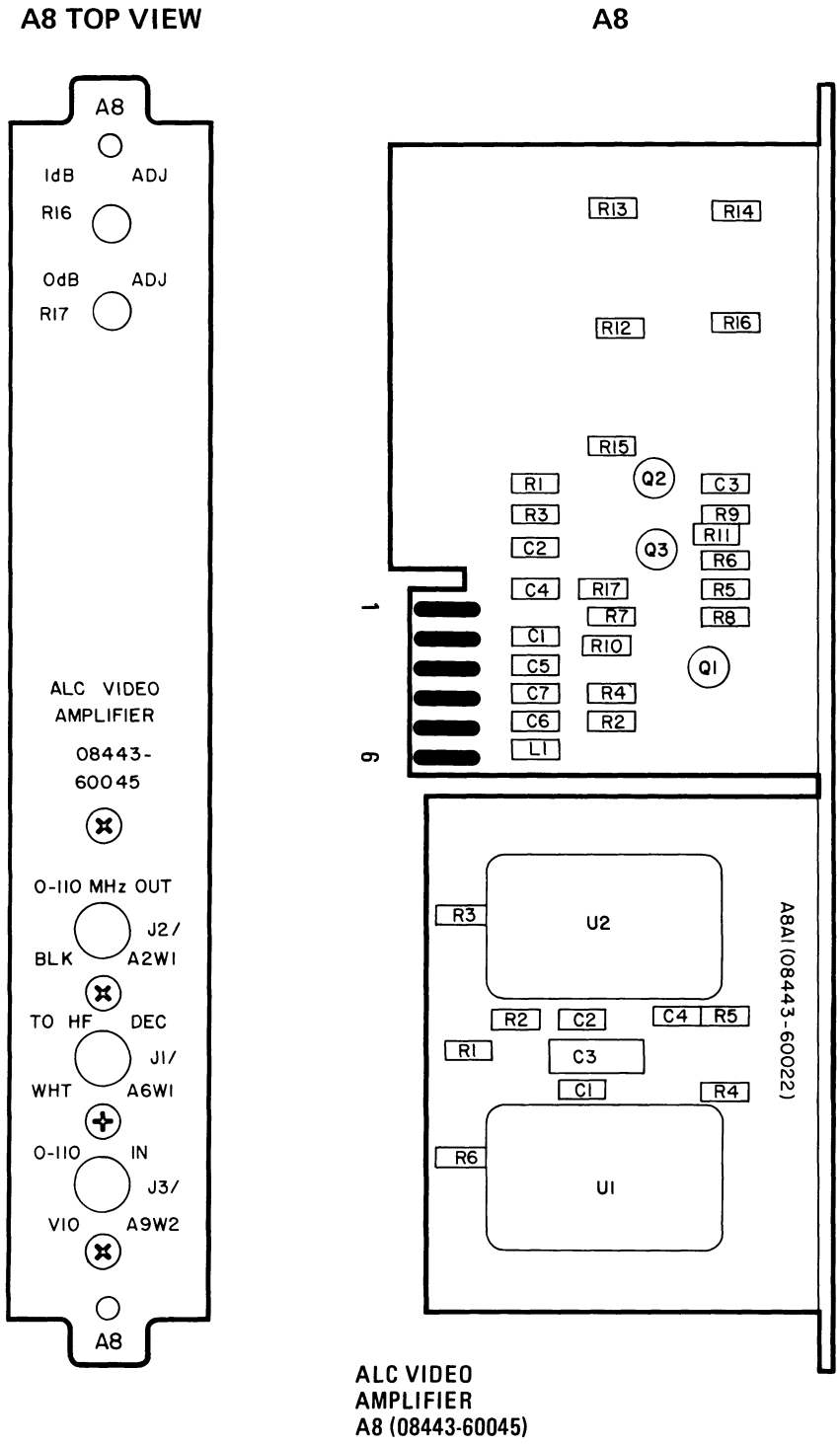


Figure 8-19. ALC Video Amplifier Assembly A8 Parts Locations

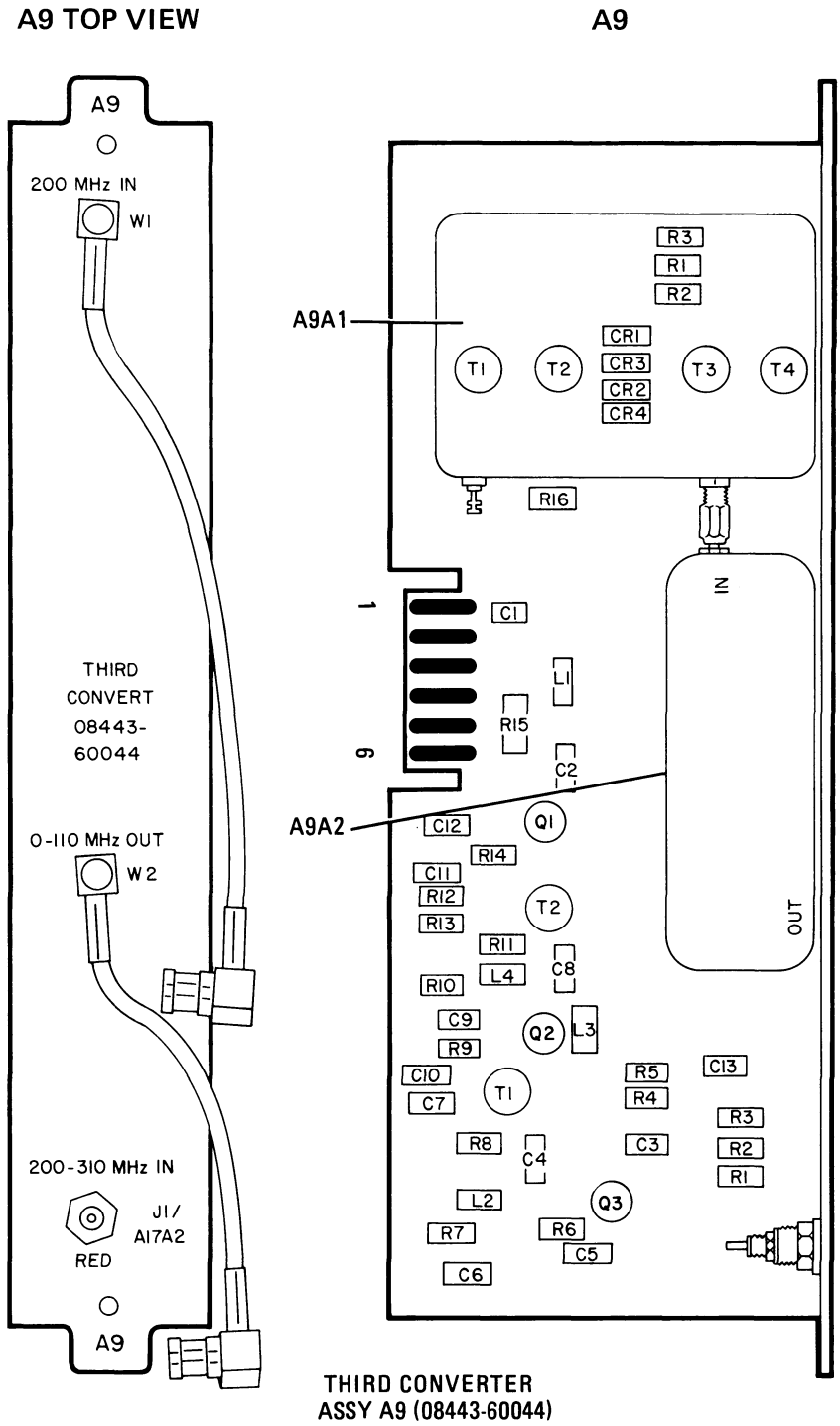


Figure 8-20. Third Converter Assembly A9 Parts Locations (1 of 2)

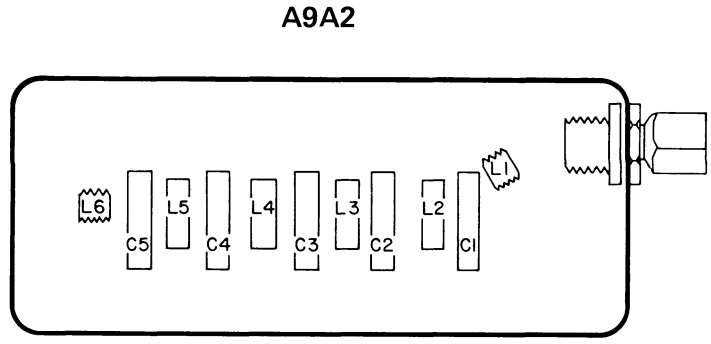


Figure 8-20. Third Converter Assembly A9 Parts Locations (2 of 2)

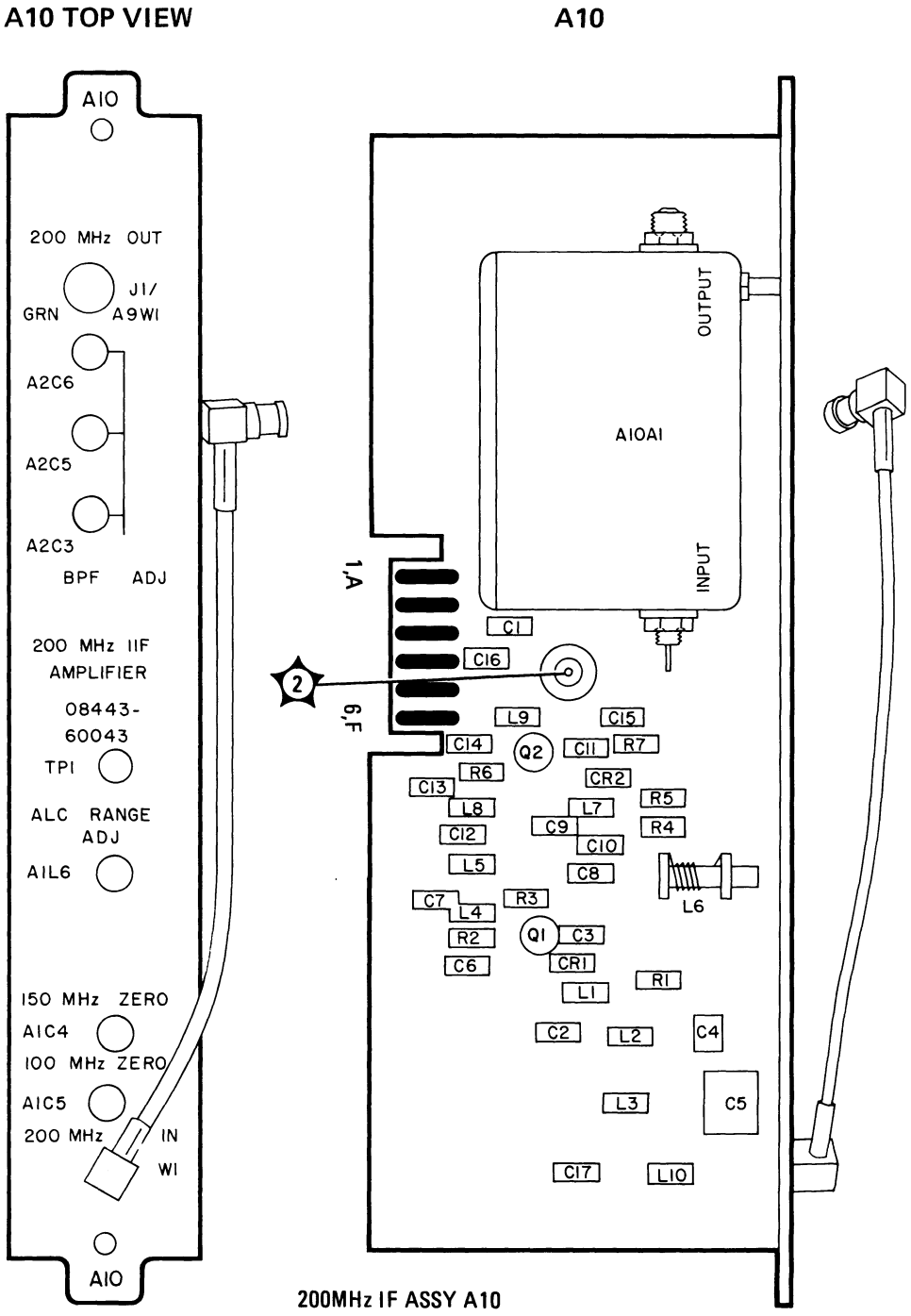


Figure 8-21. 200 MHz IF Amplifier Assembly A10 Parts Locations (1 of 2)

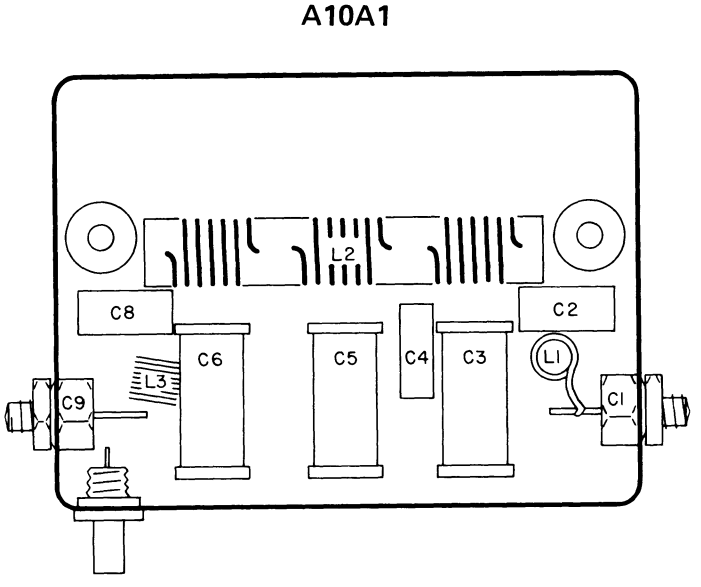
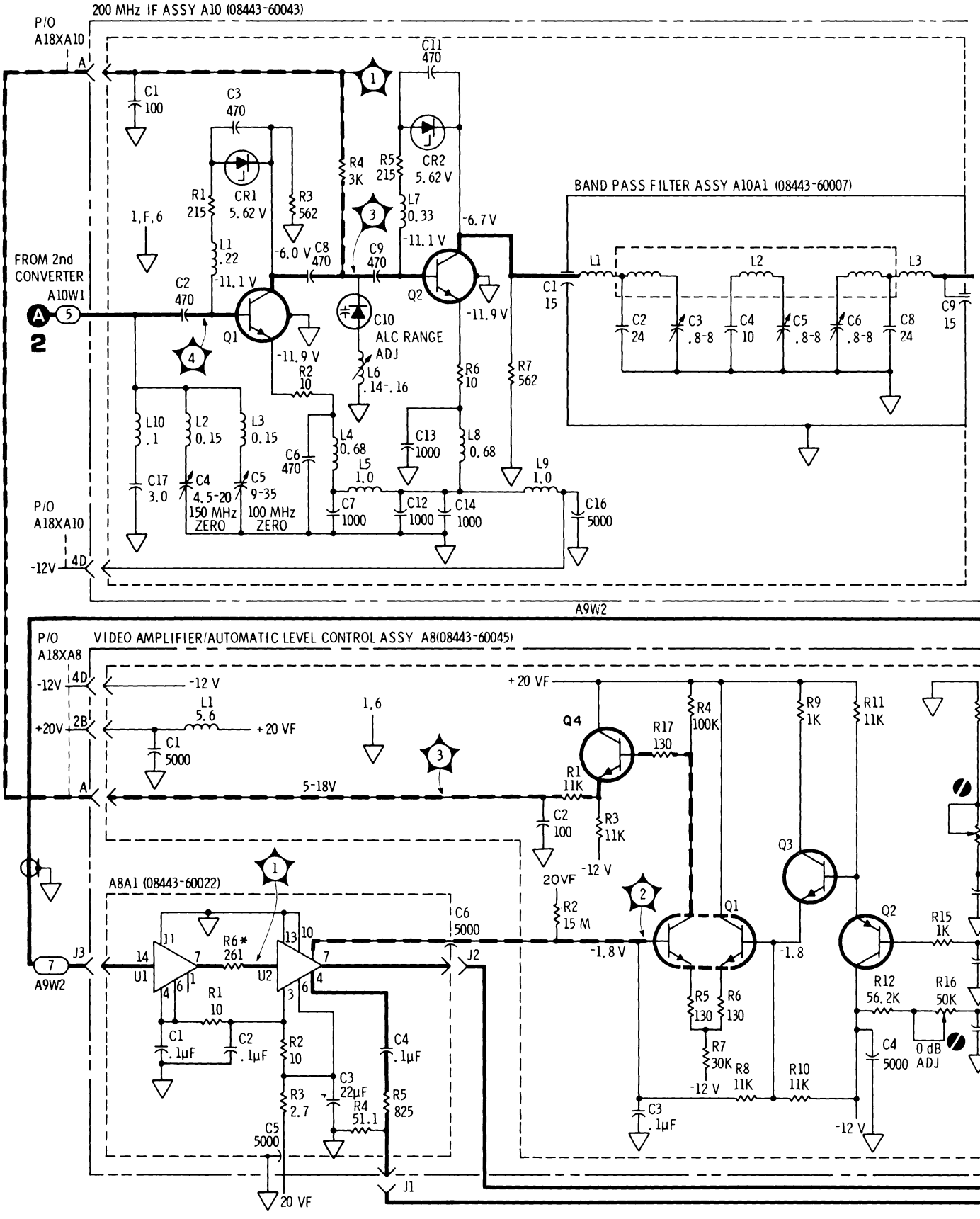
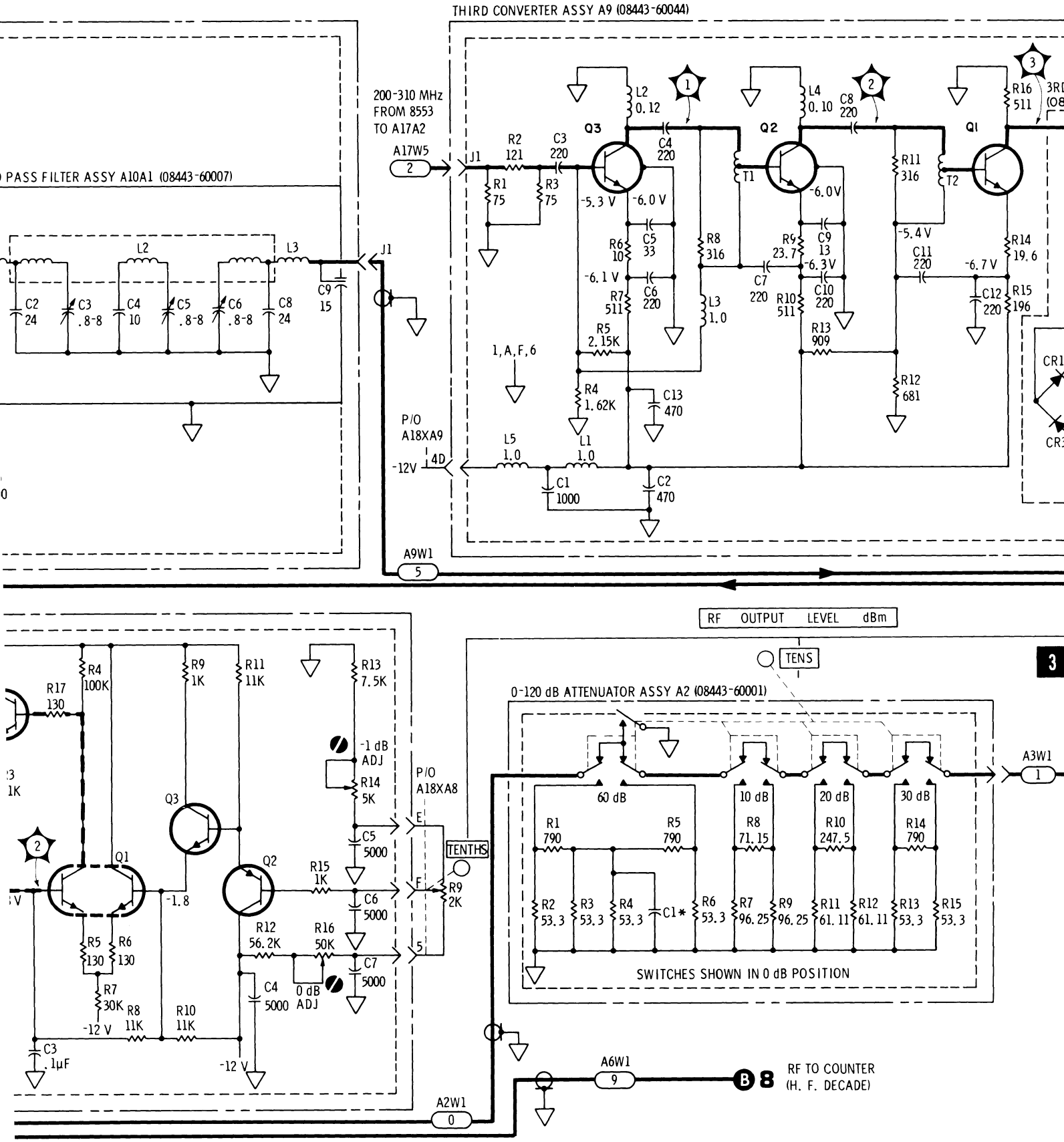
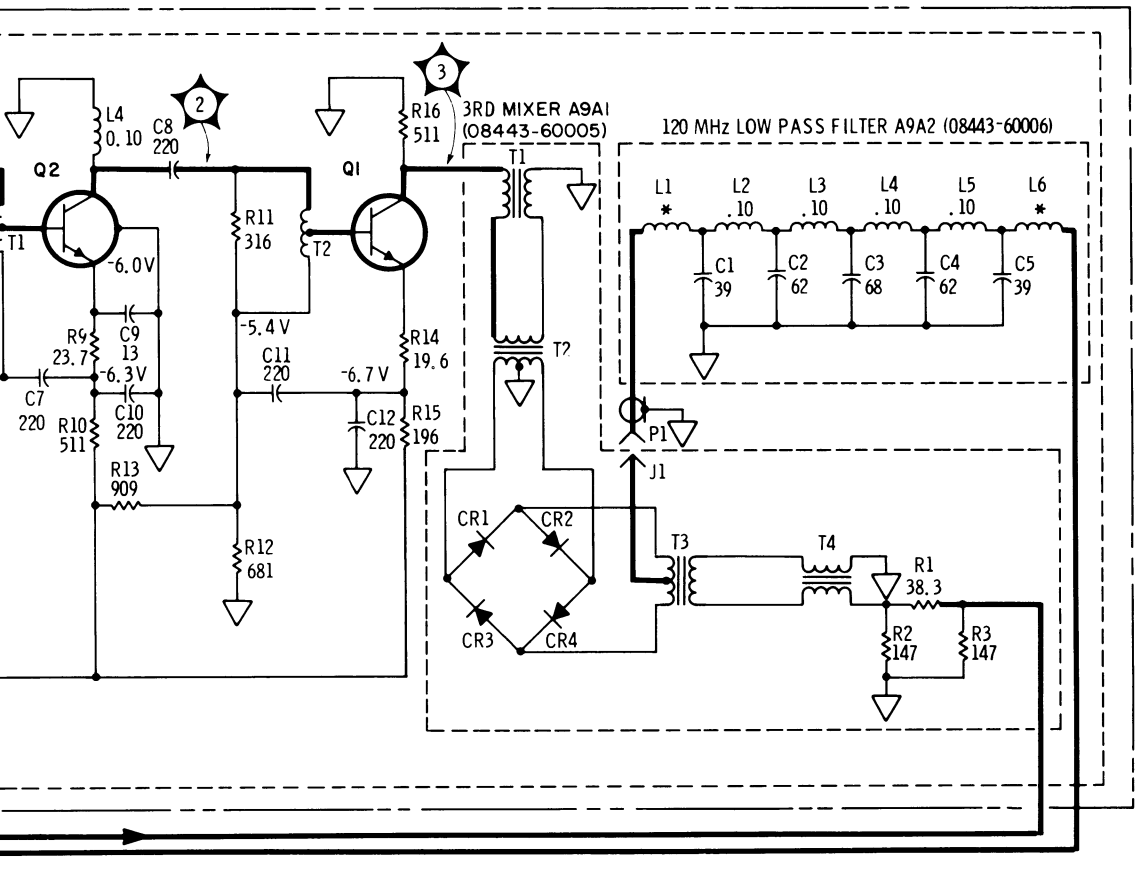


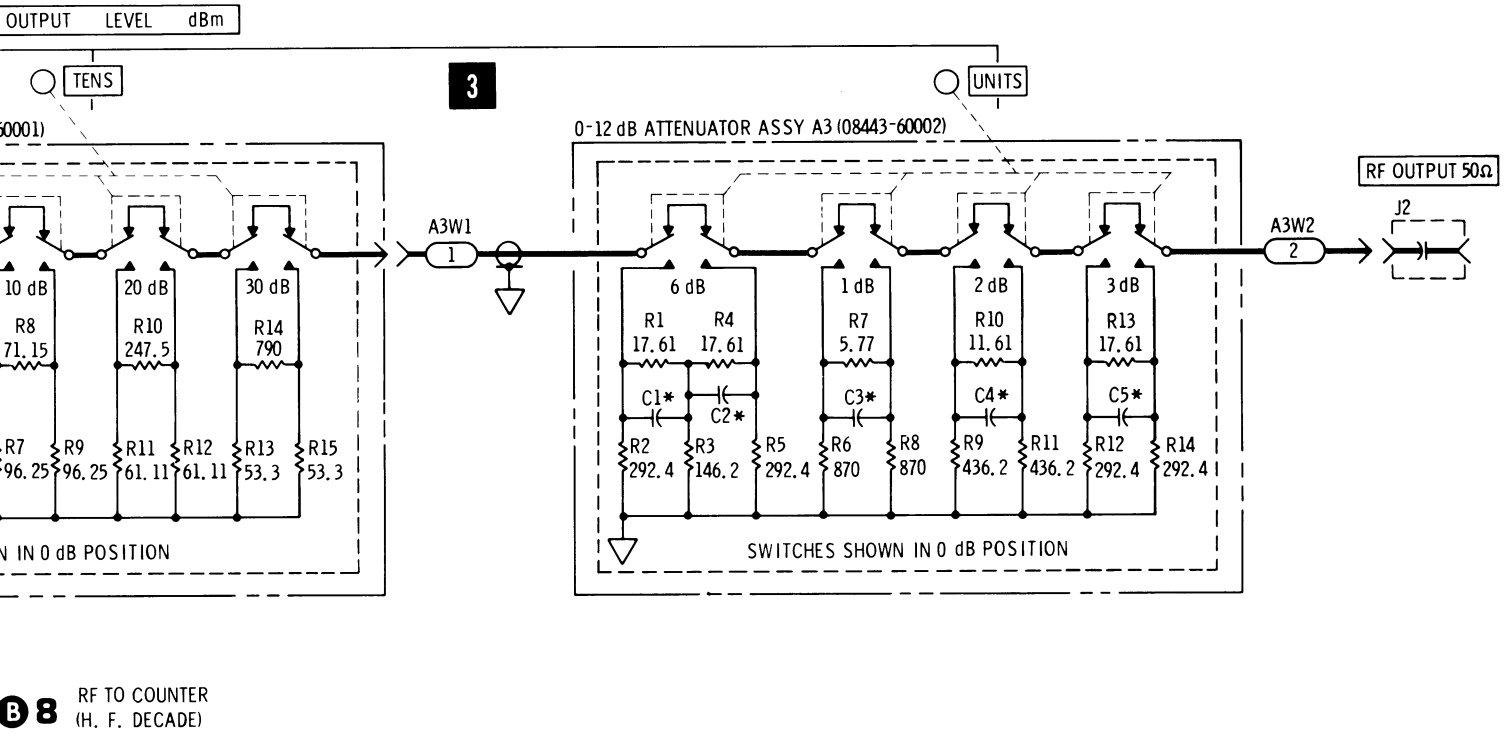
Figure 8-21. 200 MHz IF Amplifier Assembly A10 Parts Locations (2 of 2)


200 MHz IF ASSY A10 (08443-60043)
P/O A18XA10
A
C1 100
C3 470
C11 470
R1 215
CR1 5.62 V
R3 562
R4 3K
R5 215
CR2 5.62 V
L7 0.33
1, F, 6
L1 .22
-6.0 V
C8 470
C9 470
-6.7 V
-11.1 V
FROM 2nd CONVERTER A10W1
A 5
2
C2 470
-11.1 V
Q1
Q2
-11.9 V
C10 ALC RANGE ADJ
L6 .14-.16
R2 10
R6 10
R7 562
L10 .1
L2 0.15
L3 0.15
C6 470
L4 0.68
C13 1000
L8 0.68
L5 1.0
L9 1.0
C17 3.0
C4 4.5-20 150 MHz ZERO
C5 9-35 100 MHz ZERO
C7 1000
C12 1000
C14 1000
C16 5000
P/O A18XA10
-12V 4D
BAND PASS FILTER ASSY A10A1 (08443-60007)
L1
L2
L3
C1 15
C2 24
C3 .8-8
C4 10
C5 .8-8
C6 .8-8
C8 24
C9 15
A9W2
P/O A18XA8
VIDEO AMPLIFIER/AUTOMATIC LEVEL CONTROL ASSY A8(08443-60045)
-12V 4D
-12 V
+20V 2B
L1 5.6
+ 20 VF
C1 5000
1, 6
5-18V
+ 20 VF
Q4
R17 130
R4 100K
R9 1K
R11 11K
R1 11K
C2 100
R3 11K
-12 V
20VF
R2 15 M
-1.8 V
Q3
Q1
Q2
R15 1K
R12 56.2K
R16 50K
R5 130
R6 130
R7 30K
R8 11K
R10 11K
C4 5000
0 dB ADJ
C3 .1µF
-12 V
A8A1 (08443-60022)
C6 5000
J3
7
A9W2
J1
J2
U1
U2
R6* 261
R1 10
C1 .1µF
C2 .1µF
R2 10
C3 22µF
R3 2.7
R4 51.1
C4 .1µF
R5 825
C5 5000
20 VF


THIRD CONVERTER ASSY A9 (08443-60044)
PASS FILTER ASSY A10A1 (08443-60007)
200-310 MHz
FROM 8553
TO A17A2
A17W5
2
J1
L2
0.12
L4
0.10
C8
220
R16
511
Q3
Q2
Q1
R2
121
C3
220
C4
220
R1
75
R3
75
-5.3 V
-6.0 V
-6.0V
R11
316
-5.4 V
R6
10
C5
33
R8
316
R9
23.7
C9
13
C11
220
-6.7 V
R14
19.6
-6.1 V
C6
220
C7
220
R10
511
C10
220
R7
511
L3
1.0
R15
196
C12
220
R5
2.15K
R13
909
1,A,F,6
R12
681
R4
1.62K
C13
470
P/O
A18XA9
4D
-12V
L5
1.0
L1
1.0
C1
1000
C2
470
A9W1
5
L2
L3
C2
24
C3
.8-8
C4
10
C5
.8-8
C6
.8-8
C8
24
C9
15
J1
R4
100K
R9
1K
R11
11K
R13
7.5K
R17
130
-1 dB
ADJ
R14
5K
P/O
A18XA8
Q3
C5
5000
E
TENTHS
Q1
Q2
R15
1K
C6
5000
F
R9
2K
-1.8
R12
56.2K
R16
50K
C7
5000
5
R5
130
R6
130
C4
5000
0 dB
ADJ
R7
30K
R8
11K
R10
11K
-12 V
C3
.1μF
-12 V
A2W1
0
RF OUTPUT LEVEL dBm
TENS
3
0-120 dB ATTENUATOR ASSY A2 (08443-60001)
A3W1
1
60 dB
10 dB
20 dB
30 dB
R1
790
R5
790
R8
71.15
R10
247.5
R14
790
R2
53.3
R3
53.3
R4
53.3
C1*
R6
53.3
R7
96.25
R9
96.25
R11
61.11
R12
61.11
R13
53.3
R15
53.3
SWITCHES SHOWN IN 0 dB POSITION
A6W1
9
B 8
RF TO COUNTER
(H. F. DECADE)



REFERENCE DESIGNATIONS	
A2	A3
R15 C1 W1	R14 C5 W1,2
A8	A8A1
R1-17 C1-C7 Q1-Q4 L1	U1,U2 R1-R6 C1-C6
A9	A9A1
R1-R16 Q1-Q3 C1-C12 W1,2 L1,-L4 T1,T2	T1-T4 CR1-4 R1-R3
A9A2	A10
L1-L6 C1-C5	C1-C17 R1-R7 L1-L10 W1 Q1,Q2 CR1,CR2
A10A1	CHASSIS
L1 C1-C9	R9 J2



B8 RF TO COUNTER (H. F. DECADE)

3

Figure 8-22. ALC Video Amplifier Assembly A8, Third Converter Assembly A9, and 200 MHz IF Amplifier Assembly A10 Schematic Diagram

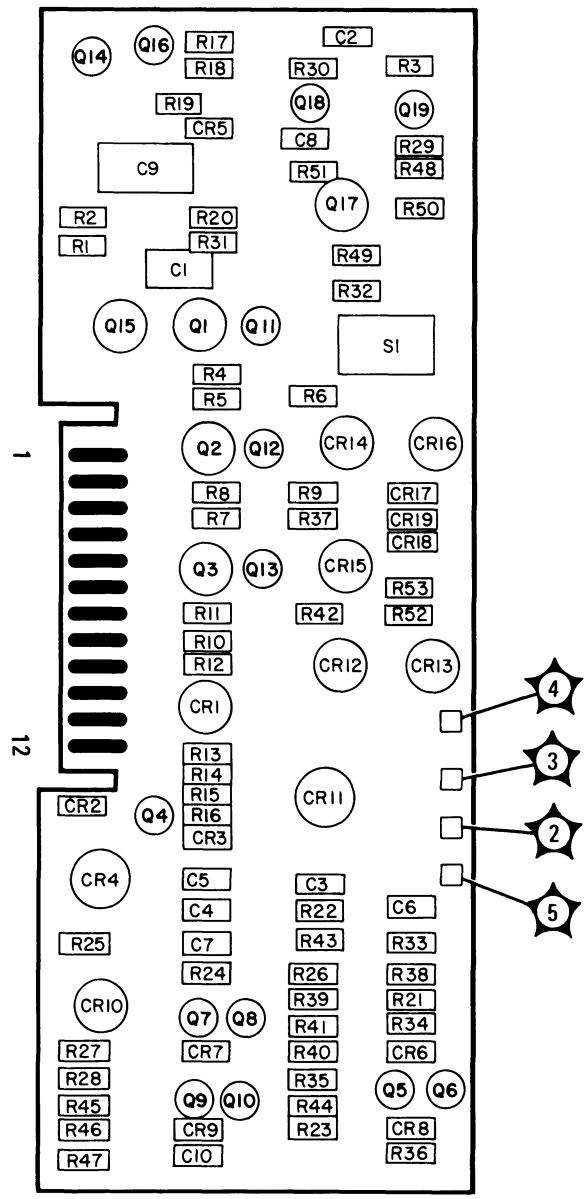


Figure 8-23. Sense Amplifier Assembly A14 Parts Locations

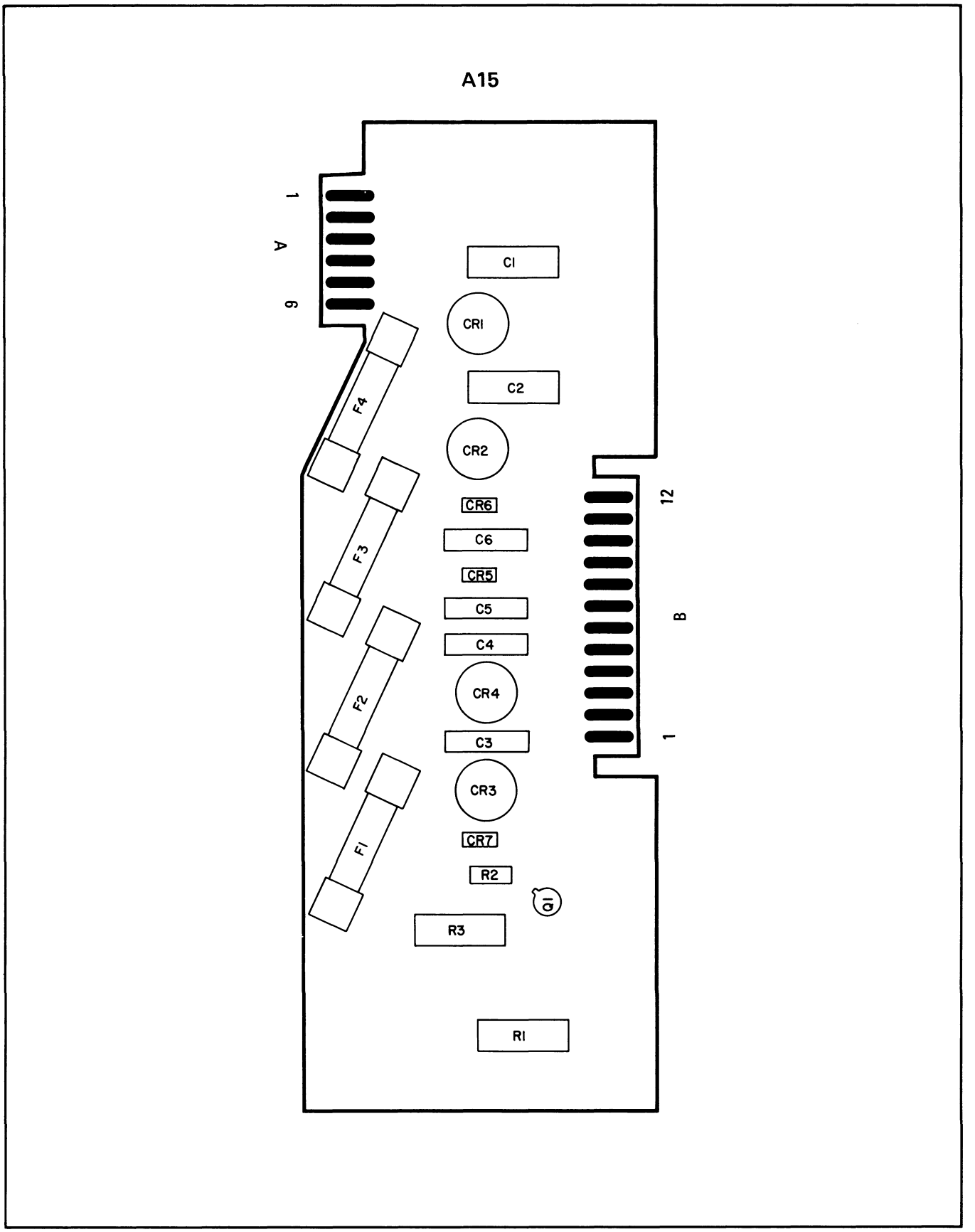
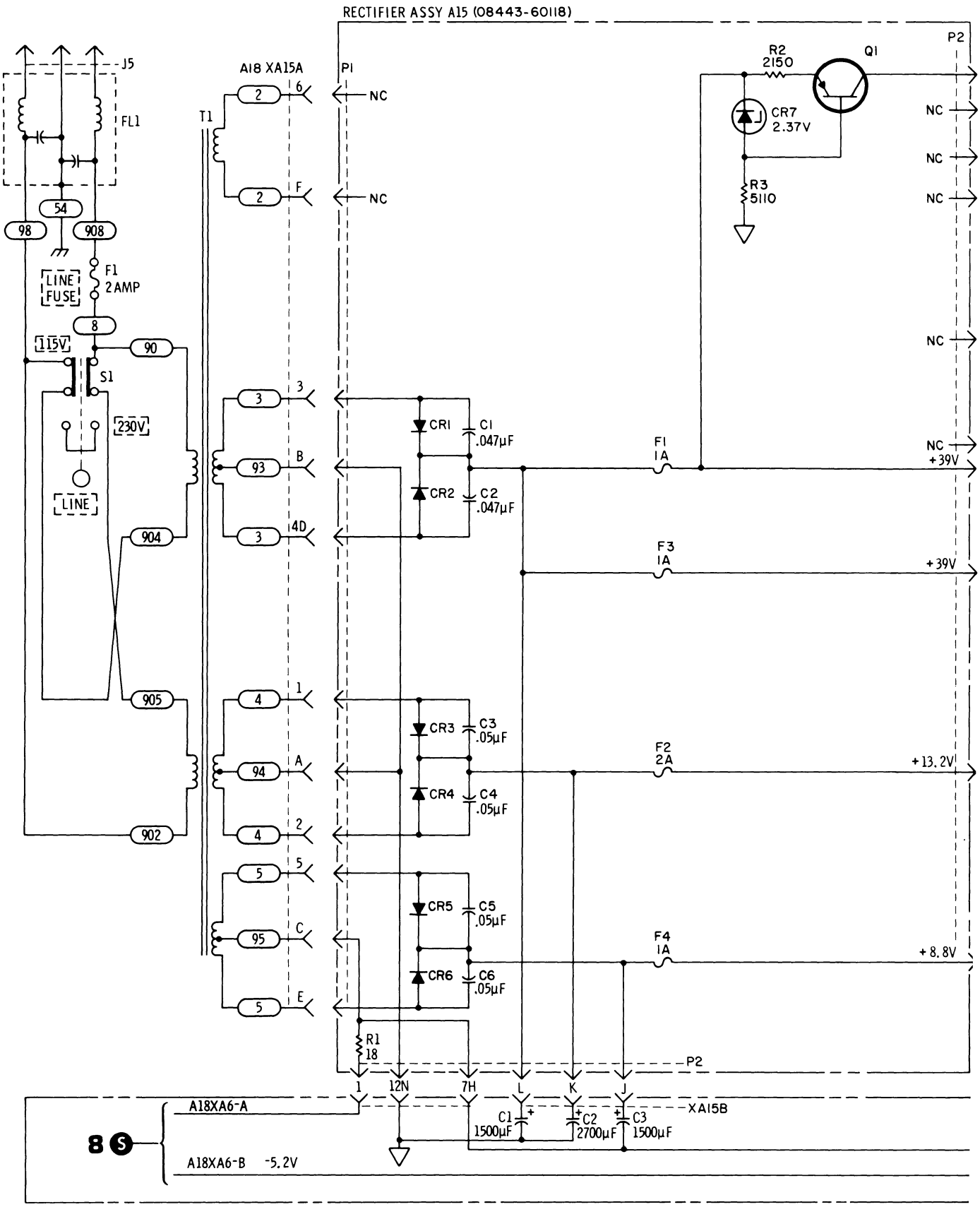
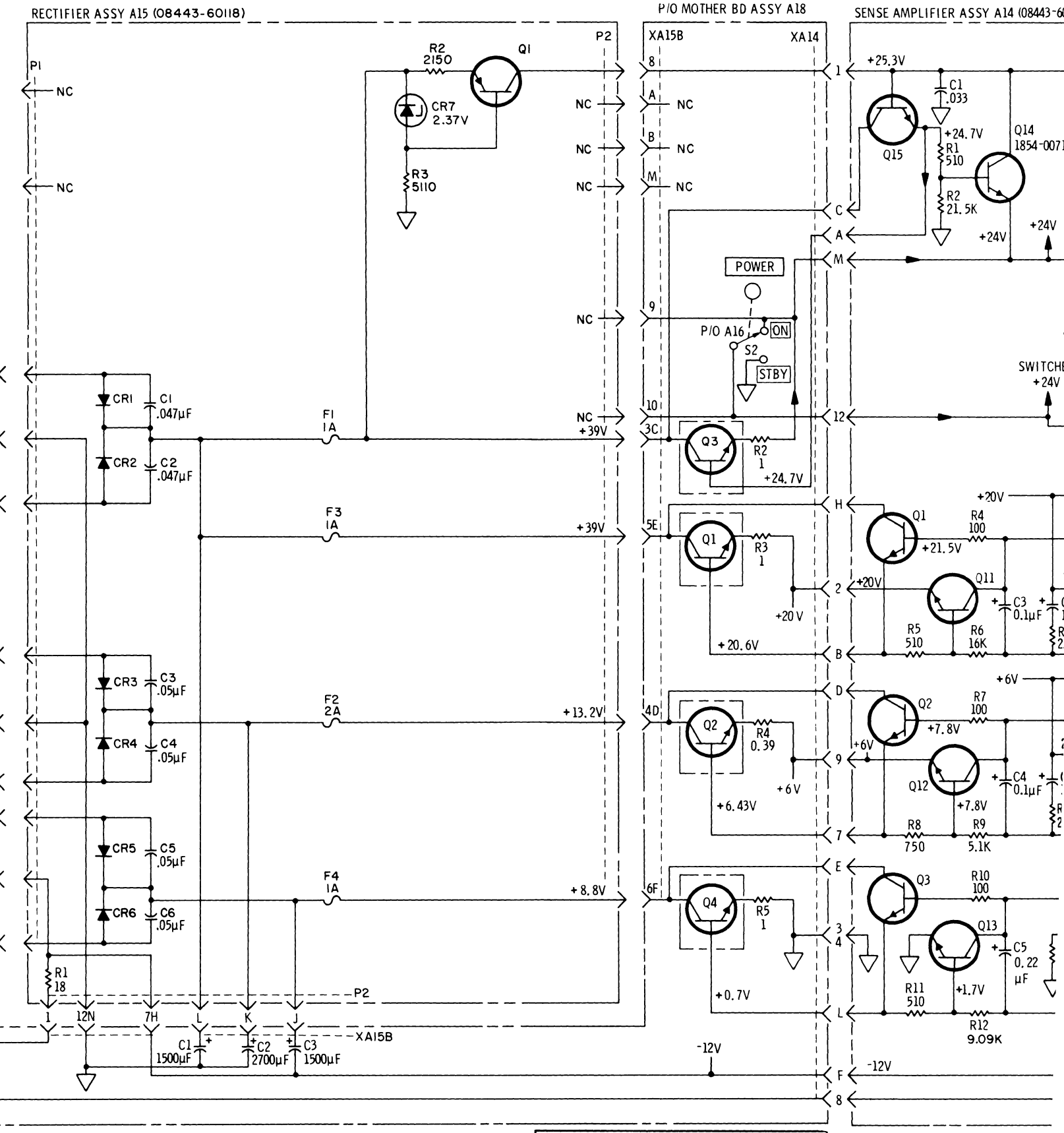


Figure 8-24. Rectifier Assembly A15 Parts Locations



REFERENCE DES
ASSEMBLIES ARI
CLUDES ASSEMI
IS A1R1. DESI
COMPLETE AS SI



REFERENCE DESIGNATIONS WITHIN OUTLINED (— - - —) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER; e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

Fig

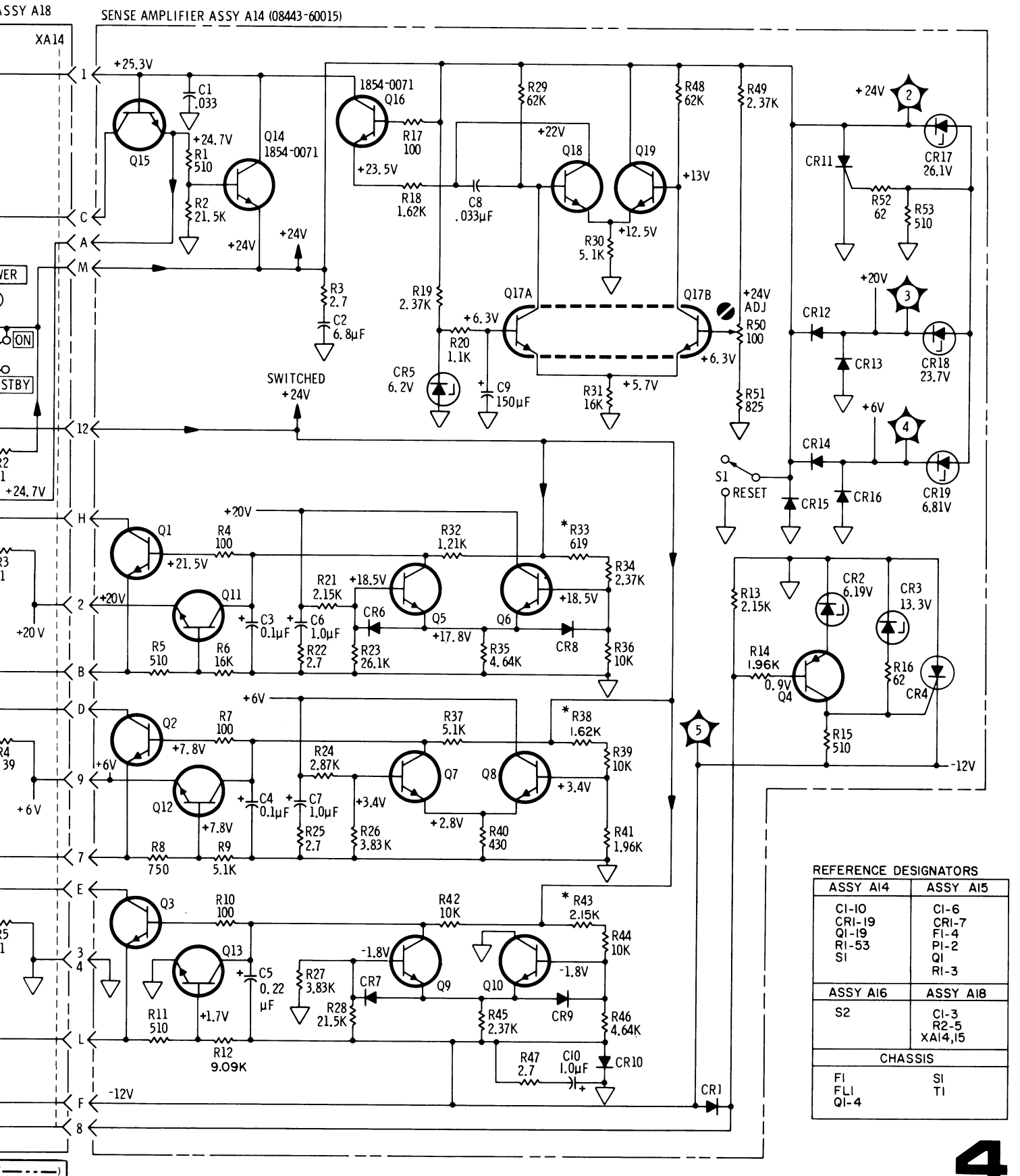


Figure 8-25. Sense Amplifier and Rectifier Assemblies A14 and A15 Schematic Diagram

8-50. COUNTER OVERALL PRINCIPLES OF OPERATION

The Counter section of the 8443A provides a digital readout of the frequency of a signal 'marked' on the spectrum analyzer CRT (Marker and Scan Hold modes) or applied to the COUNTER INPUT receptacle (External mode). It comprises five major assemblies: Marker Control Assembly (pc board) A7, Time Base Assembly (pc board) A5, High Frequency Decade Assembly (pc board) A6, Low Frequency Counter Assembly (three pc boards) A1, and 1 MHz Reference Oscillator Assembly (enclosed unit) A4. A logic diagram of the circuits in the counter section of the 8443A is shown in Figure 8-26.

The function of the marker control circuit is to stop the scan ramp in the IF section of the spectrum analyzer when the Tracking Generator-Counter is operated in the Marker and Scan Hold modes. The marker control circuit also provides blanking to the spectrum analyzer and, when operated in the Marker or Scan Hold modes, a signal to the time base circuit which initiates the count cycle.

When the 8443A is operated in the Marker mode, the active clamp in the Marker Control Assembly causes the scan ramp of the spectrum analyzer to stop at a point determined by the Marker Position control. Usually, the scan is stopped for a period determined by the position of the RESOLUTION control. The scan stop period may be extended, for short count periods, with the MARKER INTENSITY control.

When the 8443A is operated in the Scan Hold mode, the active clamp in the Marker Control Assembly again causes the scan ramp of the analyzer to stop at a point set with the MARKER POSITION control. In this mode the scan remains stopped until the mode of operation is changed. The operator can manually position the marker to any point on the scan with the MARKER POSITION control. In the Scan Hold mode, the counter counts continually.

When the 8443A is operated in the External mode, the counter section is used to count signals applied to the COUNTER INPUT receptacle, J1. The marker control function has no effect, and the counter counts continually.

When the spectrum analyzer is operated in Zero scan, the marker is ineffective and again the counter counts continually.

The time base may be referenced to the internal 1 MHz crystal-controlled oscillator or to an external 1 MHz source. The time base controls the main gate flip-flop in the high frequency decade which, in turn, enables the counter. The time base also generates the transfer and reset pulses. These pulses transfer the information from the decade counters to the numerical readout device drivers and reset the decade counters in both the High Frequency Decade and the Low Frequency Counter Assemblies.

The counter signal input is gated to the high frequency decade by the main gate flip-flop, which is toggled by the decade divider circuits in Time Base Assembly A5. Besides dividing the input frequency by 10, High Frequency Decade Board Assembly A6 provides BCD information (A, B, C, D) to Low Frequency Counter Board Assembly A1A1.

Low Frequency Counter Board Assembly A1A1 uses the BCD inputs (A, B, C, D) to drive its timer and BCD driver circuit. The D signal input also drives the prescaler, which develops four additional BCD inputs for the timer and BCD driver. The signals derived from the eight-level BCD light the segments in the numerical display ICs on Counter Display Board Assembly A1A2, and are supplied to Digital Output Assembly A19 on the rear panel of the 8443A.

MARKER CONTROL ASSEMBLY A7

The marker control circuit has three inputs from the spectrum analyzer IF section. These are the scan ramp input, the blanking input and the Zero scan input. The spectrum analyzer provides a ground reference.

The paragraphs below describe the marker control circuit operation when the 8443A is operated in the Marker mode. Differences in circuit operation for other modes of operation are described later.

The scan ramp (a 0 to approximately 8-volt signal) is developed across a capacitor in the spectrum analyzer by current from a constant current source. A comparator in the market control circuit compares the voltage of the scan ramp to a dc level determined by the position of the MARKER POSITION control. When the charge on the scan ramp capacitor reaches the predetermined level, the comparator acts as an active clamp to sink the current from the spectrum analyzer constant current source at a rate that effectively clamps the scan ramp voltage. The spectrum analyzer scan is stopped and the output frequency of the 8443A Tracking Generator is counted once.

In addition to the scan ramp and the dc level from the MARKER POSITION control, the active clamp has a control input and a control output. The input is from the $\overline{Q}$ output (TP4) of the stop-enable flip-flop. When this input is low, it allows the active clamp to operate, and informs the other circuits that the scan ramp has been stopped.

The stop-enable flip-flop is reset at the beginning of each scan by the end of the blanking pulse (TP1) from the spectrum analyzer. When the spectrum analyzer scan ramp ends, TP1 goes positive until the next scan ramp begins. At the end of the blanking pulse (1), TP6 is low, AND gate (U1A/B/D) output TP7 goes low and clocks the stop-enable flip-flop. This makes the stop-enable output (TP4) low and enables the active clamp. The active clamp, however, has no effect on the scan ramp voltage until it reaches the level set by the MARKER POSITION control. When this occurs the spectrum analyzer scan is stopped for a period determined by the setting of the RESOLUTION control and, in some instances, by the MARKER INTENSITY control.

When the scan ramp stops, the active clamp stop signal at TP8 goes low and causes the output (TP9) of one-shot C16/R21, the count trigger signal, to go low. It also closes a switch on a current sink in the marker intensity control circuit.

The marker intensity control circuit controls the intensity of the marker on the spectrum analyzer CRT. This is accomplished by providing blanking for long count periods or by extending the scan stop time for short count periods.

The output from amplifier Q18 is applied to NAND gate U1C which then provides the clear input to the stop-enable flip-flop and to AND gate U1A/B/D, which controls the clock input to the stop-enable flip-flop. The signal at TP6 also causes the analyzer CRT to be blanked as determined by the marker intensity circuit. Blanking is required to protect the spectrum analyzer CRT from excessive intensity (blooming) during long count periods. During short count periods, when it is desired to keep the marker on the spectrum analyzer CRT longer than the count period, TP6 is held low for a period set with the MARKER INTENSITY control, and NAND gate U1C is held high. This prevents the stop-enable flip-flop from being cleared.

The period the scan is stopped ends when the clear input to the stop-enable flip-flop goes low, the $\overline{Q}$ output goes high, and the active clamp is disabled. This occurs only when signals at TP6 and TP10 are both high. The signal at TP6 is high only when the 8443A is causing the spectrum analyzer CRT to be blanked. The signal at TP10 is the count acknowledge signal from the time base circuit signalling that the frequency count has been completed.

In the External mode the clear input to the stop-enable flip-flop is held low. This causes the $\overline{Q}$ output (TP4) to remain high and disable the active clamp. The inverted input to NAND gate Q16/Q17 is also held low and, since the input to NAND gate Q16/Q17 is normally high, the count trigger of TP9 is held low. When the count acknowledge at TP10 is received, one-shot C18/R40 provides a 200-millisecond low to disable NAND gate Q16/17 and inhibit the count trigger (TP9) for 200 milliseconds.

In the Scan Hold mode the signals at TP5 and TP6 are held low; clear gate U1C cannot reset the stop-enable flip-flop, the active clamp remains active, and the counter counts continually. The major difference between the Scan Hold mode and the Marker mode is that in the Scan Hold mode the scan remains stopped until the operator changes the mode of operation.

In the Zero scan mode (initiated when the spectrum analyzer is set to ZERO scan), operation is the same as in the external mode, except that the counter counts the output of the 8443A instead of an external frequency source.

TIME BASE ASSEMBLY A5

The time base circuit controls all timing and control functions of the counter section. The internal timing reference is a stable 1 MHz crystal oscillator, enclosed in a temperature-controlled assembly to improve stability. The internal reference signal may be used as a reference for other equipment. An external reference signal may be used instead of the internal reference.

Operation of the time base circuit with the 8443A operating in the MARKER mode is as follows: During the first 200 microseconds after the marker control circuits stop the analyzer scan, the count trigger signal goes low. When the count trigger goes low, the signal at TP7 goes high, provided that the input to the inhibit inverter Q4 is low. This initiates the count cycle.

At the beginning of the timing sequence, the time base flip-flop Q output (TP4) is high and the $\overline{Q}$ output is low. The signal at TP8 is also high, and when the signal at TP7 goes high, the signal at TP9 goes low. The signal at TP5 then goes high and the six divide-by-10 (decade) counters in U3, U4, and U5 get reset. The signal at TP5 remains high about 50 microseconds.

The time base flip-flop is cleared about 50 microseconds after TP9 goes low. This causes the time base flip-flop $\overline{Q}$ output to go high and the Q output (TP4) to go low. About 1 microsecond after TP4 goes low, TP8 goes low, TP9 goes high, and TP5 goes low to end the reset pulse.

The first decade divider in the time base circuit was set to 0 by the reset pulse, and the other five decade dividers were set to 9. When the time base flip-flop $\overline{Q}$ output goes high, NAND gate U1D couples the 1 MHz reference signal to the first of the five decade dividers. After ten cycles the second decade divider receives an input. Since the last four decade dividers were set to 9, each resets to 0 on the first input. The reset output of each divider resets the following decade divider.

Resolution in the 8443A counter is determined by the length of the counting period, and this is determined by the period of the time base data (i.e., frequency) selector gate toggle pulse output to the maingate flip-flop on High Frequency Decade Assembly A6.

If the front-panel RESOLUTION switch is set to 1 kHz, the time base gate toggle output is a pulse 1 millisecond wide, derived from the divide-by-10^3 input to the data selector. If the switch is set to 100 Hz, the output pulse is 10 milliseconds wide, and is derived from the divide-by-10^4 input to the data selector. A RESOLUTION switch setting of 10 Hz produces a gate toggle pulse 100 milliseconds wide, developed from the divide-by-10^5 input to the data selector.

NOTE

The divide-by-10^6 input to the data selector is used to produce a 1-second gate toggle pulse when the 8443A is equipped with the 1 Hz resolution option.

At the end of the count period, the main gate flip-flop in the high frequency decade changes state and provides a low output to clock the time base flip-flop. On the clock input, the time base flip-flop $\overline{Q}$ output goes low and the Q output (TP4) goes high. NAND gate U1D is inhibited and the reference signal can no longer reach the decade dividers. In addition, the signal at TP4 triggers a 150 microsecond one-shot which sets the level at TP10 high and the transfer level at TP3 low to start the transfer pulse. The transfer input to the low frequency counter starts the transfer of information from the low frequency counter board to the counter display board (A1A2). It also initiates the transfer of digital information from the low frequency counter board to the digital output assembly (A19) on the 8443A rear panel.

The 1 microsecond delay between the time the count acknowledge signal at TP4 goes high and the signal at TP8 goes high prevents generation of a reset before the transfer pulse (negative-going) begins in the event the signal TP7 is still high. Once initiated, the transfer signal prevents generation of a reset signal by forward biasing a diode to keep the signal level at TP7 low for the duration of the transfer pulse.

When the Q output (TP4) of the time base flip-flop goes high, it also signals the marker control circuit to permit the spectrum analyzer scan to continue. The time base circuit then becomes dormant until the next count trigger input from the Marker Control Assembly.

When the 8443A is operated in the Scan Hold mode, the count trigger from the Marker Control Assembly is held low. Counting periods are separated by the time required for transfer and reset functions. In the External mode the count trigger is inhibited by a 200-millisecond one-shot in the marker control circuit, which is triggered by the count acknowledge signal at TP4.

High Frequency Decade Assembly A6

The main gate flip-flop, which is controlled by the gate toggle from the Time Base Assembly controls the start and stop of the count period. The count duration is controlled by the RESOLUTION switch. The input to the High Frequency Decade Assembly may be either the 8443A Tracking Generator output or any signal within the counter frequency and amplitude range from an external source.

In the High Frequency Decade Assembly, the input frequency of 100 kHz to 110 MHz is converted to a 0 to 11 MHz signal, which is then applied to the Low Frequency Counter Assembly.

Low Frequency Counter A1A1 and Counter Display A1A2

The Low Frequency Counter develops two groups of outputs using the inputs it receives from High Frequency Decade Assembly A6 and Time Base Assembly A5. Twenty-nine digital outputs make up the first group. These are supplied to Digital Output Assembly A19 on the 8443A rear panel for use in external equipment. The second group of outputs drives the numeric display ICs on Counter Display Assembly A1A2, which plugs into a socket on the Low Frequency Counter Board Assembly. The functions of the inputs to the Low Frequency Counter are described below:

Transfer. The Transfer input is a negative-going pulse which interrupts the central processing unit (CPU) in microcomputer U7's microprocessor. This interruption permits the transfer of readout data from U7 to the readout decoders (U4 and U6), and digital data to rear-panel connector assembly A19. During the 'write' portion of the CPU cycle, a negative-going WR (active-low write) input to transfer flip-flop U5A-U5B resets the interrupt function.

Resolution Control. There are three resolution inputs. In a standard 8443A they are 1000 Hz, 100 Hz, and 10 Hz. If, however, the 8443A has been modified to equip it with the 1 Hz resolution option, the reslution inputs are 1000 Hz, 10 Hz, and 1 Hz. Notice that the 1 Hz resolution option deletes the 100 Hz resolution selection available in the standard instrument.

These inputs determine the placement of the decimal point in the numerical display (display indicates frequency in MHz). If the front-panel RESOLUTION switch is set to 1000 Hz, the 1000 Hz line is grounded and the other two resolution input lines (100 Hz and 10 Hz) are open. In the display, the decimal point appears five places to the right of the far left numeral (e.g., 00105.555). Similarly, if 100 Hz or 10 Hz resolution is selected, the 100 Hz or 10 Hz line is grounded and the other two lines are open. For 100 Hz resolution the decimal point appears four places to the right of the far left numeral (e.g., 0105.5555), and for 10 Hz resolution it is three places to the right (e.g., 105.55555). The optional 1 Hz resolution sets the decimal point two places to the right of the far left numeral and is usable for frequency counts up to 99.999999 MHz.

Blanked/Unblanked. When the blanking selector switch on the 8443A rear panel is set to UNBLANKED, all eight of the numeric display ICs light, with those to the left of the most significant digit showing a zero. If the blanking selector switch is set to BLANKED, numeric display ICs to the left of the most significant digit, or to the left of the decimal point if it precedes the most significant digit, are blanked. Thus, if the display in the UNBLANKED mode shows 00105.555 MHz, setting the blanking switch to BLANKED changes the display to 105.555 MHz. An unblanked display of 00000.500 MHz, if blanked, changes to .500 MHz.

Reset. The Reset input is a positive-going pulse approximately 50 microseconds wide that sets the counter to zero and holds it there for its 50-microsecond duration. At the end of the Reset pulse a new sampling of the input frequency is taken and the counter develops a new readout display.

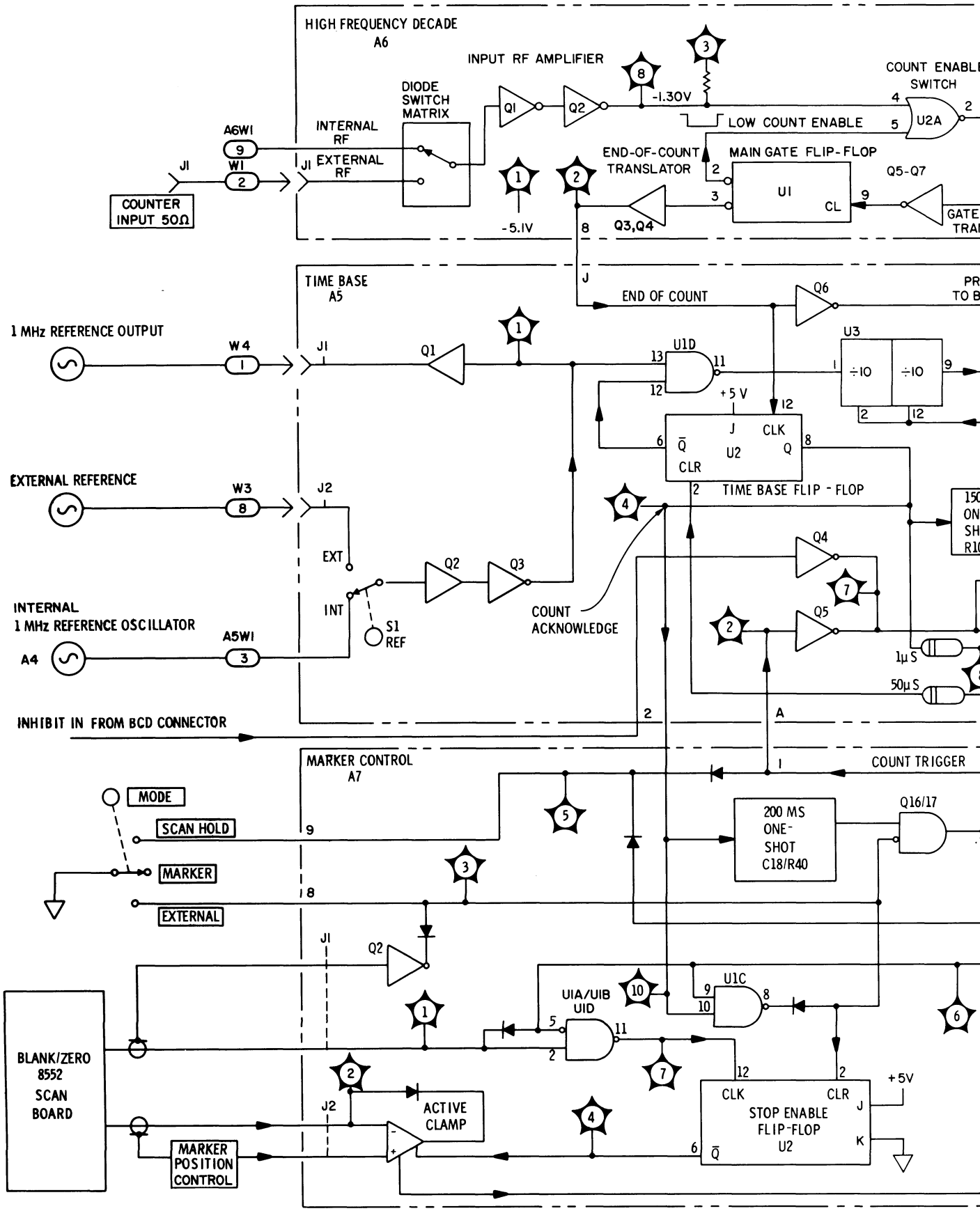
$\overline{A}$, $\overline{B}$, $\overline{C}$, $\overline{D}$. Inputs $\overline{A}$, $\overline{B}$, $\overline{C}$, and $\overline{D}$ make up a 1-2-4-8 BCD input to Timer and BCD Driver circuit U10-U11. The BCD represents the counter input frequency divided by 10. The $\overline{D}$ input is also fed to the Prescaler where it is transformed into four more BCD levels: 10, 20, 40 and 80, which are also fed to the Timer and BCD Driver (U10-U11). In the Timer and BCD Driver ICs, the eight-level BCD and the inputs from the microcomputer (U7) are translated into two groups of signals: the first group comprises 29 digital signals which are fed to rear-panel connector assembly A19. The second group consists of eight address signals which are fed via the counter address bus to microcomputer IC U7.

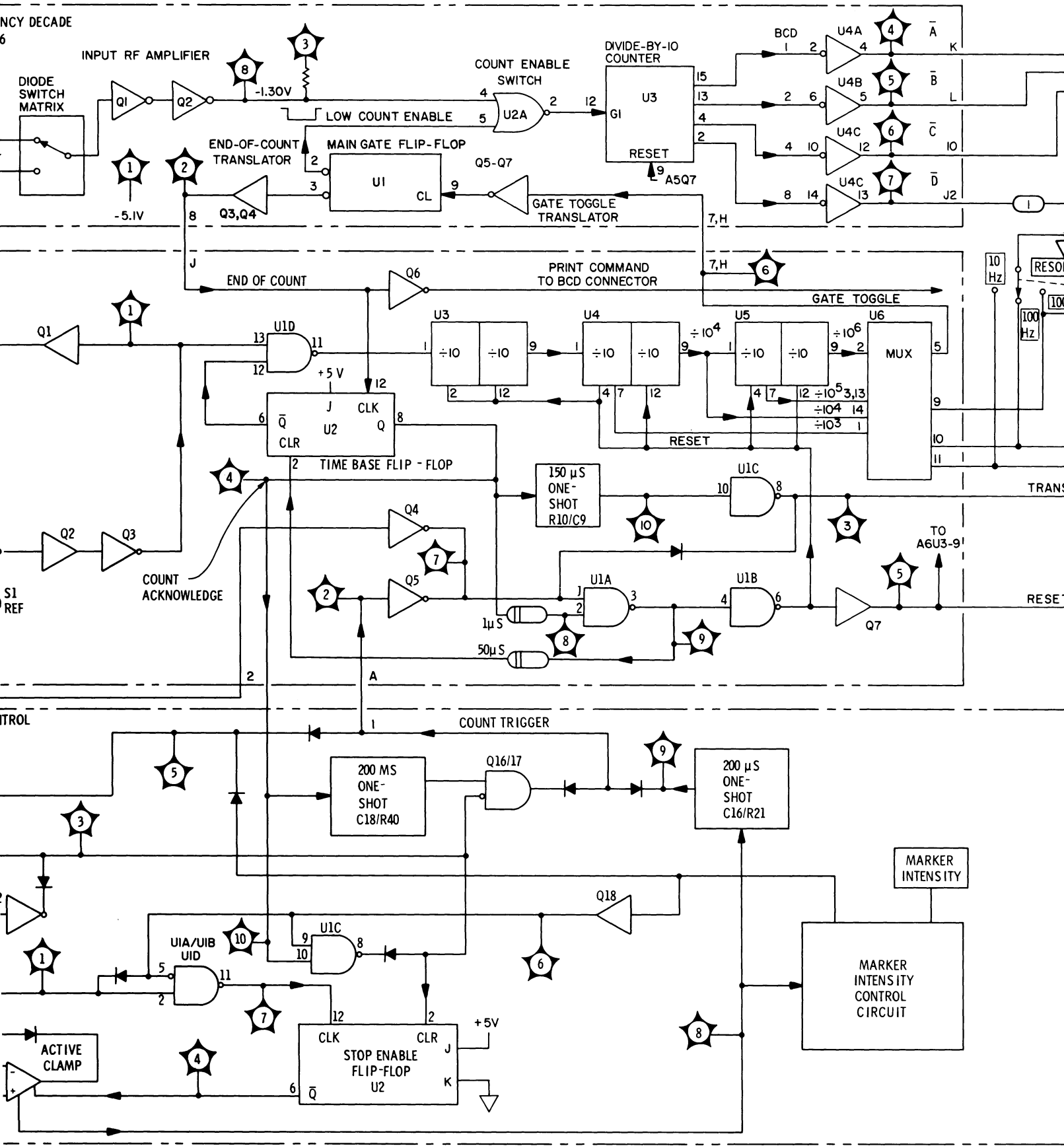
In U7 the signals received from the Timer and BCD Driver via the address bus are converted into two groups of BCD. The first group is a four-level BCD which is translated in the LED Segment Driver circuit into seven lines, each for a particular numerical display IC segment. These lines are connected in parallel to all eight of the numerical display ICs on the Counter Display Assembly (A1A2).

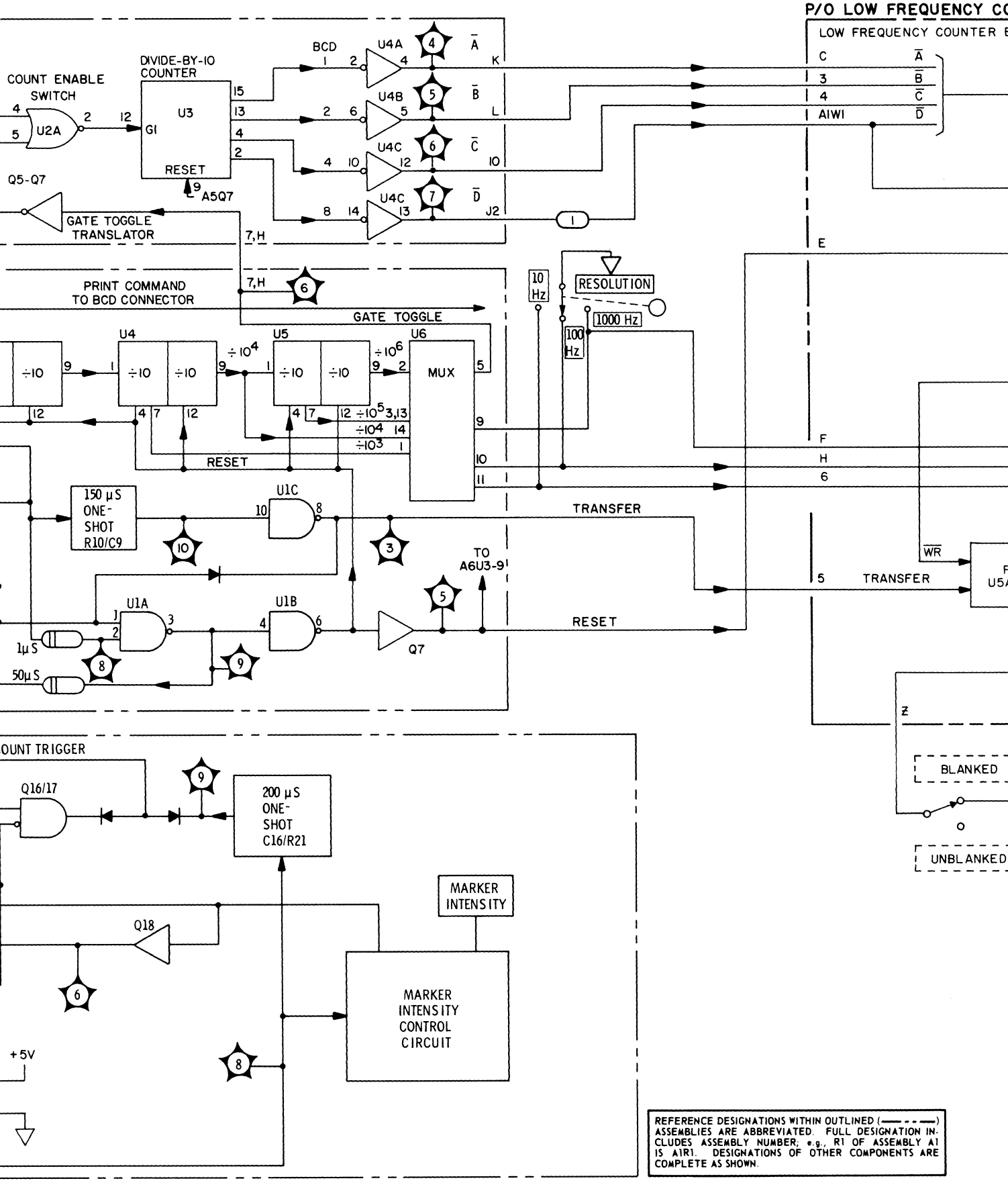
The second group is a three-level BCD which is converted into eight numerical display IC turnon outputs. Each of these outputs is fed, one at a time, to a particular one of the eight numerical display ICs on the Counter Display Assembly. Their purpose is to turn the numerical display ICs on and off sequentially so that only one of the eight is on at a time. Thus, although the segment drives are applied simultaneously to all eight numerical display ICs, only one IC actually displays a numeral in a given instant.

For example, if the input to the counter is a frequency of 105.72348 MHz, the segments drive for a '1' is received at the eight display ICs at the same time as the turn-on signal for the far left IC. This causes the '1' to appear on the far left IC only. The next numeral generated by the BCD-to-7- Segment Decoder is the '0,' and this output to the display ICs coincides with the enable signal to the second display IC. The second IC, therefore, displays a '0,' and the seven other display ICs are blanked.

This sequence continues until the entire eight-digit number has been displayed. Then, following a brief delay (equal to the 'on' period of one numerical display), the cycle starts over again. Although each display IC is turned on for only an instant during a single readout cycle, the sequencing occurs so fast that all eight display ICs appear to be on simultaneously.


HIGH FREQUENCY DECADE
A6
INPUT RF AMPLIFIER
DIODE SWITCH MATRIX
Q1
Q2
-1.30V
COUNT ENABLE SWITCH
LOW COUNT ENABLE
U2A
A6W1
INTERNAL RF
EXTERNAL RF
J1
W1
COUNTER INPUT 50Ω
END-OF-COUNT TRANSLATOR
MAIN GATE FLIP-FLOP
U1
CL
Q5-Q7
-5.1V
Q3,Q4
TIME BASE
A5
END OF COUNT
Q6
1 MHz REFERENCE OUTPUT
W4
U1D
U3
÷10
÷10
+5 V
J
CLK
Q̄
U2
Q
CLR
TIME BASE FLIP - FLOP
EXTERNAL REFERENCE
W3
J2
EXT
INT
S1
REF
Q2
Q3
Q4
Q5
COUNT ACKNOWLEDGE
INTERNAL
1 MHz REFERENCE OSCILLATOR
A4
A5W1
1μS
50μS
INHIBIT IN FROM BCD CONNECTOR
MARKER CONTROL
A7
COUNT TRIGGER
MODE
SCAN HOLD
MARKER
EXTERNAL
200 MS ONE-SHOT C18/R40
Q16/17
U1A/U1B U1D
U1C
BLANK/ZERO 8552 SCAN BOARD
ACTIVE CLAMP
MARKER POSITION CONTROL
STOP ENABLE FLIP-FLOP U2
+5V


INPUT RF AMPLIFIER
DIODE SWITCH MATRIX
Q1
Q2
-1.30V
COUNT ENABLE SWITCH
U2A
LOW COUNT ENABLE
DIVIDE-BY-10 COUNTER
U3
GI
RESET
A5Q7
BCD
U4A
U4B
U4C
U4C
END-OF-COUNT TRANSLATOR
MAIN GATE FLIP-FLOP
U1
CL
Q5-Q7
GATE TOGGLE TRANSLATOR
-5.1V
Q3,Q4
END OF COUNT
Q6
PRINT COMMAND TO BCD CONNECTOR
GATE TOGGLE
U1D
+5 V
U2
CLR
TIME BASE FLIP - FLOP
U3
U4
U5
U6
MUX
RESET
150 µS ONE-SHOT R10/C9
U1C
TO A6U3-9
COUNT ACKNOWLEDGE
Q4
Q5
U1A
U1B
Q7
1µS
50µS
COUNT TRIGGER
200 MS ONE-SHOT C18/R40
Q16/17
200 µS ONE-SHOT C16/R21
MARKER INTENSITY
Q18
U1A/U1B U1D
U1C
MARKER INTENSITY CONTROL CIRCUIT
ACTIVE CLAMP
STOP ENABLE FLIP-FLOP U2
+5V
10 Hz
100 Hz



REFERENCE DESIGNATIONS WITHIN OUTLINED (— - - —) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER; e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

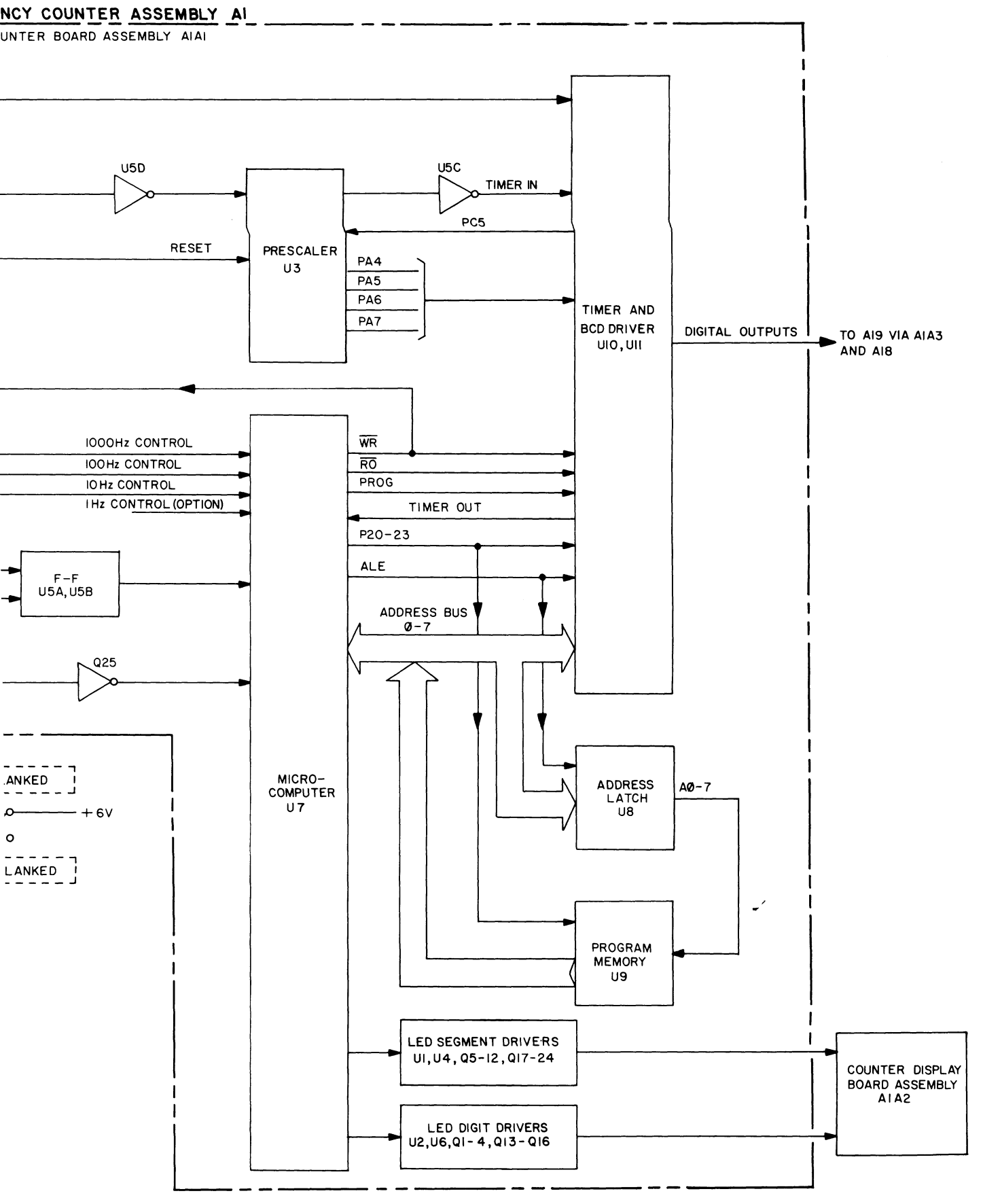


Figure 8-26. Counter Circuits Logic Diagram

8-51. COUNTER CIRCUIT DESCRIPTIONS AND TROUBLESHOOTING

Marker Control Assembly A7 Operation and Troubleshooting (See Service Sheet 6)

The Marker Control Assembly contains circuits that stop the analyzer scan ramp temporarily, stop the scan ramp for an indefinite period, or that enable the counter section to count a signal identical with a signal applied to the spectrum analyzer RF INPUT from an external source. It also contains a circuit which controls the intensity of the marker on the spectrum analyzer CRT, and a circuit which provides a trigger to start the cycle of the time base circuit.

When the Marker Control Assembly is functioning properly, the waveforms shown in composite waveform A of Figure 8-27 (P/O Service Sheet 6) appear at the five test points accessible at the top cover of the assembly. The timing functions of the waveforms are also identified. Control settings used to obtain the waveforms shown in inset A of Figure 8-27 are given below. Except as indicated in the text, these control settings also apply to the other waveform illustrations in Figure 8-27.

Spectrum Analyzer: (Set unlisted controls to any position.)

SCAN TIME PER DIVISION ..... 1 MILLISECOND
SCAN MODE ..... INT
SCAN TRIGGER ..... AUTO

Tracking Generator-Counter:

MODE ..... MARKER
RESOLUTION ..... 100 Hz
MARKER INTENSITY ..... Full CW
MARKER POSITION KNOB ..... Pulled out

Oscilloscope:
Triggered by Analyzer Scan IN/OUT

TIME/DIV ..... 2 Milliseconds
VOLTS/DIV 1
10:1 probes ..... DC input
TIME/DIV VERNIER set to show one analyzer scan

Active Clamp Circuit Operation (Instrument in MARKER mode.) The active clamp consists of a comparator (Q5, Q6, Q7) and a current source (Q4, Q8, Q9). The purpose of the active clamp is to stop the analyzer scan ramp at a predetermined voltage level. The reference level for the comparator portion of the active clamp is established by MARKER POSITION dual potentiometer R13, CTR ADJ (center adjust) potentiometer R11, and by MARKER ADJ potentiometer A7R11 on the cover of the A7 assembly.

The active clamp is enabled when U2, the stop-enable flip-flop, is clocked by the negative-going trailing edge of the spectrum analyzer blanking pulse; $\overline{Q}$ goes low and causes Q20 to conduct, when Q20 conducts, it enables Q9 to provide a path for the current sink and enable the active clamp. Note that Q9 does not actually conduct at this time, it will conduct only when the scan ramp reaches the voltage level predetermined by the MARKER POSITION control. Enabling the active clamp has no immediate effect on the spectrum analyzer scan ramp.

The signal input to the comparator is the scan ramp from the spectrum analyzer. When the spectrum analyzer scan ramp voltage reaches the reference level established by the MARKER POSITION control, it is clamped at that level. When the base of Q5A reaches the reference level, Q5B is turned off, Q5B collector goes high and CR2 biases Q4 on to complete the current sink path. The current from the constant current source in the spectrum analyzer scan generator circuit is then sunk to the 8443A −12 volt supply.

Q8, in addition to being in the current sink path, acts as a detector. Since the current from the spectrum analyzer scan generator must pass through the emitter-base junction of Q8, Q8 conducts while the scan ramp is stopped and turns on Q1. (The function of Q1 is discussed later.)

The spectrum analyzer scan ramp is stopped until pins 9 and 10 of NAND gate U1C are high. The input to U1C pin 10 is the count acknowledge signal from Time Base Assembly A5, which signifies that the count has been completed. The input to U1C pin 9 is generated in the marker intensity circuit. (Generation of the signal applied to U1C pin 9 is discussed later.)

When both inputs to NAND gate U1C are high, the output (pin 8) goes low and clears the stop-enable flip-flop. The $\overline{Q}$ output of U2 then goes high and turns off Q20. Subsequently, Q9 turns off to open the current sink path and the analyzer scan ramp is permitted to continue.

The shield of the scan ramp coaxial cable from the spectrum analyzer is not grounded in the 8443A. The shield is used as a ground reference to ensure a common ground between the analyzer scan generator and the active clamp and to prevent ground loops.

CR1 protects Q5 when the connecting cable between the spectrum analyzer and the 8443A is not connected.

Active Clamp Troubleshooting

Test 1-a. Use the digital voltmeter to verify the presence of the dc voltages shown at terminals 3, C, 4, D, 5, and E on the schematic diagram.

Test 1-b. Connect the digital voltmeter between Q5B-b and ground; rotate the MARKER POSITION control through its range. The dc level at Q5B-b should vary from about ground level (control full ccw) to about +8 volts (control full cw). If the observed levels are correct, proceed to test 1-c. If the levels are incorrect, check Q5B, Q6B, Q7, the MARKER POSITION control and associated components.

Test 1-c. Connect the oscilloscope in turn to A7TP2, Q8-b, Q7-c, and Q9-b. Set all controls as shown for waveform illustration A in Figure 8-27, except that the oscilloscope TIME/DIV is 5 Milliseconds and the TIME/DIV VERNIER is in the CAL position (off). The oscilloscope CRT display should be as shown in inset B of Figure 8-27. If the display is as shown, the marker control circuit is functioning properly. If the display is not as shown, proceed to test 1-d.

Test 1-d. With the equipment connected as in test 1-c, ground TP4. The spectrum analyzer scan should stop and the oscilloscope CRT display for A7TP2, Q8-b, Q7-c, and Q9-b should be straight horizontal lines. If the scan does not stop when TP4 is grounded, place the 8443A MODE switch in the EXTERNAL position (remove ground from TP4). The oscilloscope CRT display should be as shown in inset C of Figure 8−27. If the correct waveform is now present, check Q8, Q9, Q20 and U2. If the AlTP2 and Q7-c displays are correct, but Q8-b is not, check CR2, CR3 and Q4. If the A7TP2 display is as shown, but Q8-b and Q7-c are not, check Q5, Q6, Q7 and associated components.

Test 1-e. With the equipment connected as in test 1-c, return the 8443A MODE switch to MARKER. Place the REF switch on Time Base Assembly A5 in the EXT position. The oscilloscope CRT display should appear as horizontal lines and the spectrum analyzer CRT should be blanked. If these conditions exist, proceed to test 1-f. If not, check U1A, U1D, U2, Q3 and associated components.

Test 1-f. With test conditions as described in test 1-e, short pin 2 of U2 to ground. The oscilloscope CRT display should be as shown in inset C of Figure 8-27 and the spectrum analyzer CRT baseline should reappear (no marker). If these conditions are met, check U1B, U1C, Q18 and associated compnents. If the trouble persists, check the intensity circuit (R10, Q1, Q10−Q15, and associated components). If the above conditions are not met, U2 is probably defective.

Trigger and Marker Intensity Circuit Operation (Instrument in MARKER mode.) When Q1 is turned on as the scan stops, the positive-going signal at Q1-c is coupled through C16 to the base of Q15. Q15 is normally off and its collector is at +5 volts (the +5 volts is provided by Time Base Assembly A5). Because of the time constant of C16 and R21, the signal from Q1-c causes Q15 to conduct for about 200 microseconds; this provides a negative-going pulse at Q15-c to trigger the time base flip-flop in the Time Base Assembly.

During the period the analyzer scan ramp is stopped, the positive dc level at the collector of Q1 turns on Q12 through the MARKER INTENSITY control. For discussion purposes, the junction of Q12-c, Q11-c, Q13-b, R29 and C17 is called a 'current node.' Q12 acts as a current sink for the current node. The rate at which C17 is discharged is determined by the setting of the MARKER INTENSITY control; the more heavily Q12 conducts, the shorter the discharge time of C17. When the MARKER INTENSITY control is turned cw, the conduction rate of Q12 decreases, and more time is required to discharge C17 to the ground reference level. This extends the period the scan is stopped and provides a brighter marker. Q13 and Q14 act as a differential amplifier to sense when C17 has been discharged to ground reference.

Initially (before Q12 is turned on), C17 is charged, Q13 is conducting and Q14 is turned off. Since Q14 is off, so are Q11 and Q10. When Q12 is turned on C17 begins to discharge. When the current node reaches the ground reference established by Q14, both Q13 and Q14 are conducting. When Q14 conducts, the voltage at the base of Q11 is reduced and Q11 conducts; current is now being sourced to the current node by Q11 and R29 at the same rate that current is being sunk from the current node by Q12. When Q11 conducts, the voltage on the base of Q10 decreases, Q10 conducts and Q18 is turned on.

When Q18 conducts, U1C pin 9 goes high (about +4 volts). If the count acknowledge signal is a high at U1C pin 10, U1C pin 8 goes low and the stop-enable flip-flop, U2, is cleared. This disables the active clamp current sink and permits the spectrum analyzer scan to continue. If Q18 conducts before the count acknowledge signal at U1C pin 10 goes high, the high dc level at Q18-e blanks the spectrum analyzer CRT through R33 and CR16 until the count acknowledge signal goes positive. The count acknowledge signal also turns on Q19, which for all practical purposes provides a ground at the junction of R33 and CR16. This prevents the CRT display in the spectrum analyzer from being blanked when the scan ramp is released. Thus, the scan ramp continues to the limits set by the analyzer.

Trigger and Marker Intensity Troubleshooting. When the instrument is functioning properly, the waveforms shown in inset D of Figure 8-27 appear at the following points: A – Q1-b, B – A5TP2, C – junction of Q11-c/Q12-c/Q13-b and D – Q18-b. Initial control settings for these waveforms are as follows:

Spectrum Analyzer: (control settings not listed are not important)

SCAN TIME PER DIVISION	1 MILLISECOND
SCAN MODE	INT
SCAN TRIGGER	AUTO

Tracking Generator-Counter:

Mode	MARKER
RESOLUTION	100 Hz
MARKER INTENSITY	Full CW
MARKER POSITION KNOB	Pulled out

Oscilloscope:
Triggered by Analyzer SCAN IN/OUT

Time/DIV	5 Milliseconds
VOLTS/DIV	A – .2, B – .5, C – .05, D – 5
DC inputs	10:1 probes

Test 2-a. Connect the digital voltmeter between Q13-b and ground. The average dc level measured should vary considerably with rotation of the MARKER INTENSITY control (the level should be higher when the control is full cw). In the SCAN HOLD and MARKER modes the average voltage read should be below 1 volt. In the EXTERNAL mode the dc level should rise to approximately 18.5 volts. Proceed to test 2-b.

Test 2-b. If the dc level remains at about +18.5 volts in test 2-a in all positions of the MODE control switch, connect a 10K ohm resistor between Q1-b and the −12 volt supply (XA7-5) with the MODE switch in the EXTERNAL position. The digital voltmeter should indicate the same dc levels specified for the SCAN HOLD mode shown above. If the voltage level still remains at about +18.5 volts, check Q1, Q12, the MARKER INTENSITY control and associated components. If the voltage drops to the level specified for the SCAN HOLD mode in test 2-a, and the scan can be stopped in the SCAN HOLD mode, Q8 may be defective. If the dc levels differ greatly from those listed in tests 2-a and 2-b, check Q13, Q14 and associated components.

Test 2-c. If the dc levels for the SCAN HOLD and EXTERNAL modes were as specified in test 2-a and the instrument functions properly in these modes, but will not function in the MARKER mode, check Q10 and Q18. (Q18 may have been checked in test procedure 1-f.)

Blanking, Scan Hold, External and Zero Scan Circuits Description. Whenever the blanking signal is high (from the spectrum analyzer or originating in the 8443A), Q3 conducts. When the blanking is originating in the 8443A, the high input at pin 2 of U1A has no effect because U1B is holding pin 1 of U1A low. When the 8443A blanking pulse ends, pin 9 of U1C and pin 5 of U1B go low, and pin 6 of U1B and pin 1 of U1A go high. Q3, however, has stopped conducting, and the output of U1A at pin 3 remains unchanged. When the spectrum analyzer scan ramp ends and the spectrum analyzer blanking begins, Q3 again conducts. Now both inputs to U1A are high and the output, pin 3, goes low. The output of U1D pin 11 goes high, but this has no effect on U2 because U2 is clocked only on negative-going signals. When the spectrum analyzer blanking pulse ends, Q3 is turned off, the U1A output (pin 3) goes high and pin 11 of U1D goes low. This clocks the stop-enable flip-flop (U2) and enables the active clamp.

In the SCAN HOLD mode the cathodes of CR11 and CR22 are grounded. CR22 provides a continuous ground (enable) to the count trigger output. CR11 prevents Q18 from conducting. This disables the 8443A blanking output to the analyzer and also holds pin 9 of U1C low to prevent U2 from being cleared. The count periods are separated only by the time it takes Time Base Assembly A5 to provide transfer and reset pulses, and a toggle to the main gate flip-flop in High Frequency Decade Assembly A6. The count acknowledge has no effect on the counter in the scan hold mode.

In the External mode, the cathode of CR10 is grounded and U2 cannot be clocked. The counter trigger is held low by Q17, which is initially conducting. When the count acknowledge signal is received Q16 is turned on. C18 couples the signal to the base of Q17 through CR17 to turn off Q17. This causes the count trigger signal to go high. Q17 stays off for a period determined by C18 and R40. When C18 has charged to approximately 1.4 volts, as determined by CR17 and the emitter-base junction of Q17, Q17 again conducts and causes the count trigger to go low. The count periods are separated by the time Q17 is off, the transfer and reset pulse periods and the time required for the time base circuit to toggle the main gate flip-flop in the High Frequency Decade Assembly.

When the spectrum analyzer is operated in the Zero Scan mode, and the 8443A is in the Marker mode, the marker control circuit works just as it does in the External mode, except that the low at TP3 is provided by CR21 instead of by a ground through the MODE switch. When the spectrum analyzer is not in the Zero Scan mode, there is about −10 volts on the blanking coaxial cable shield. This causes Q2 to conduct and reverse bias CR21. When the spectrum analyzer is operating in the Zero Scan mode, the −10 volts is no longer on the blanking coaxial cable shield, and Q2 is turned off. Q2-c is held slightly below ground by CR20, CR21 is forward biased and TP2 is essentially at ground potential. Q16 and Q17 operate as they did in the External mode.

Blanking, Scan Hold, External and Zero Scan Circuits Troubleshooting. When this portion of the Marker Control Assembly is functioning properly in the Marker mode, the critical points in the circuit will be working as indicated in inset E of Figure 8−27. These waveforms represent the following: Q3-e blanking, U1C pin 9 internal blanking, the count acknowledge signal, and U1C pin 8. Initial control settings for these waveforms are the same as those specified for Trigger and Marker Intensity Troubleshooting except for oscilloscope VOLTS/DIV, which is .5 volts.

Test 3-a. Connect the oscilloscope in turn to U1 pin 9, U1 pin 10, U1 pin 8 and Q3-e. Set oscilloscope VOLTS/DIV to .5 for all channels. The oscilloscope CRT display should be as shown in inset F of Figure 8-27 (8443A in Marker mode). Note that the U1 pin 8 waveform goes negative only during the short period the U1 pin 9 and U1 pin 10 waveforms are both high. If the waveforms are not correct, proceed to test 3-b.

Test 3-b. Connect the digital voltmeter between pin 9 of U1 and ground, and set the RESOLUTION control to 10 Hz. With the 8443A in the External mode, the digital voltmeter should indicate about −590 mVolts. With the 8443A in the Marker mode, the digital voltmeter should indicate about +3 volts, and in the Scan Hold mode, about −580 mVolts. If the dc level is high (+4 volts or more) with the 8443A in the Marker mode, and the scan remains stopped, ground U1 pin 8; the scan should continue. If the scan does not continue, check U2. If it does, check U1.

Test 3-c. If the waveform at Q3-e is incorrect, check for the same waveform (slightly higher in amplitude) at Test Point 1. If the waveform is present at TP1, but not at Q3-e, Q3 is probably defective. If the waveform is not present at either point, check the cabling to the spectrum analyzer.

Test 3-d. If the 8443A functions properly in the Marker mode but not in the External mode, check Q16, Q17, the MODE switch, and associated components.

Test 3-e. If the 8443A does not function properly in the Scan Hold mode, but does in other modes, check CR11, CR22 and the MODE switch.

Test 3-f. If the counter does not work when the spectrum analyzer is placed in the Zero Scan mode, check Q2 and associated components.

Time Base Assembly A5 Operation and Troubleshooting (See Service Sheet 7)

Time Base Assembly A5 develops transfer and reset commands for Low Frequency Counter Assembly A1, a count-acknowledge signal, which it supplies to Marker Control Assembly A7, and a print command which is fed to rear-panel BCD Connector Assembly A19. It also amplifies and passes the 1 MHz internal or external reference signal to a rear-panel BNC connector to make it available for use in external equipment.

When the Time Base Assembly is functioning properly, the waveforms shown in inset A of Figure 8-30 (P/O Service Sheet 7) appear at the six test points accessible at the top cover of the assembly. Initial control setting for these waveforms are as follows:

Spectrum Analyzer:

SCAN TIME PER DIVISION ..... 1 MILLISECOND
SCAN MODE ..... INT
SCAN TRIGGER ..... AUTO
Other controls ..... Any setting

Tracking Generator-Counter:

MODE ..... Marker
RESOLUTION ..... 1 kHz
Marker INTENSITY ..... full cw
Marker POSITION knob ..... pulled out
Other controls ..... Any setting

Oscilloscope:
Synchronize to spectrum analyzer SCAN IN/OUT unless otherwise instructed in test procedure.

Trigger, Transfer, and Reset Circuit Descriptions. The trigger input through XA5-A to the base of Q5 is normally high, and is taken from the open collector of Q15 in Marker Control Assembly A7. Because of the high trigger input, Q5 is normally conducting. When the trigger input goes low, Q5 turns off. Q4 conducts and defeats the trigger input only if the LPRINT signal is high. (The high LPRINT signal is provided by external equipment connected to and receiving BCD outputs through the 8443A rear-panel DIGITAL OUTPUT connector. The presence of this signal means the external equipment needs additional time to process the previous count.)

When the low trigger input turns off Q5, the high Q5 collector potential at pin 1 of NAND gate U1A, combined with the high already at pin 2 of U1A when the low trigger is received, sets U1A pin 3 low. A capacitor, C10, between pins 1 and 3 of U1A prevents loop oscillations by imposing a slight delay in the pulse fall time at U1A pin 3. When U1A pin 3 goes low, pin 6 of NAND gate U1B goes high, starting the reset pulse. This pulse is fed through emitter-follower Q7 to Low Frequency Counter Assembly A1, and directly to the counters (6 total) in dual divide-by-10 counter ICs U3, U4, and U5. In the counter ICs, this pulse resets the first counter to zero and the remaining five counters to nine.

The positive-going reset pulse is about 50 microseconds wide. It ends when the Q output (pin 8) of time base flip-flop U2, set low by a low clear input to U2 pin 2, drives pin 2 of U1A low. The clear input to U2 is the leading edge of the negative-going pulse from U1A pin 3, delayed approximately 50 microseconds by the time constant of resistor R16 and capacitor C12. When U1A pin 2 goes low, the output (pin 3) of U1A goes high, and the reset output of U1B returns low.

When the count has been completed, the main gate flip-flop in High Frequency Decade Assembly A6 provides a signal to clock time base flip-flop U2. Capacitor C14 at the clock input to U2 delays application of the end-of-count signal input to U2. The purpose of this delay is to make sure the transfer pulse is applied to the Low Frequency Counter Assembly **after** the overflow information has been stored.

When U2 is clocked, the $\overline{Q}$ output at pin 6 goes low and the Q output at pin 8 goes high. The high Q output from U2 pin 8, applied across the differentiating network of C9 – R10, places a momentary high on pin 10 of NAND gate U1C which causes the gate output at pin 8 to go low for about 150 microseconds. This negative-going pulse is the 'transfer' input to Low Frequency Counter Assembly A1. In A1, it initiates the transfer of digital information from the decoders to the display circuitry, and from the expanders to rear-panel Digital Output Connector Assembly A19. The high Q output from U2 also serves as the 'count acknowledge' signal which is fed to Marker Control Assembly A7.

Diodes CR2, CR3 and CR4 prevent the start of the reset pulse during the transfer pulse. When the transfer pulse is present, CR3 and CR4 are reverse biased, and the −12 volt source forward biases CR2 to prevent a high from appearing on U1A pin 1. When the transfer pulse is not present, CR3 and CR4 are forward biased and CR2 is reversed biased.

Trigger, Transfer, and Reset Circuit Troubleshooting

Test 1-a. Use the digital voltmeter to verify the presence of dc voltages at terminals 4/D and 5/C as shown on the schematic diagram.

Test 1-b. Connect the oscilloscope in turn to Q5-c, U1-3, U1-6 and Q7-e. Set VOLTS/DIV to .5 V/Div, TIME/DIV to 5 mSec. The oscilloscope display should be as shown in inset B of Figure 8-30. If the display is correct, use the oscilloscope to check the transfer signal at TP3. The waveform should be as shown in trace 3 of the composite waveform shown in inset A of Figure 8-30. If the waveforms are correct proceed to the Reference Signal Amplifiers and Gate Troubleshooting test procedure. If the waveforms are not correct, proceed to test 1-c.

Test 1-c. With the oscilloscope connected as it was for waveform B, set the oscilloscope TIME/DIV to 1 mSec and Main Triggering to internal. Place the model 8443A MODE switch to SCAN HOLD. The oscilloscope display should be as shown in waveform C of Figure 8-30. If the display is correct now but was not correct in test 1-b, the trouble is in the marker control circuit. If the waveform at Q5-c is correct, and none of the others are correct, check U1A. If the waveforms at Q5-c and U1-3 are correct, but those at U1-6 and Q7-e are not correct, check U1B. If only the waveform for Q7-e is incorrect, Q7 is probably defective. Use the oscilloscope probe to check the transfer pulse at TP3. The transfer pulse should occur 1 ms after the input trigger pulse and be almost identical with it in appearance. If the waveforms shown in inset C of Figure 8-30 are correct and the transfer pulse is not, check U1C, CR2, CR3, CR4 and associated components.

Reference Signal Amplifiers and Gate Circuit Descriptions. The reference signal (internal or external) is selected by a switch, A5S1, on the cover of the A5 assembly. R4 and the intrinsic resistance of Q2 provide a 50-ohm load for the reference source. Q2 is a common-base amplifier with a voltage gain of ten. Q3 is a common emitter amplifier which saturates on positive half cycles of the reference signal. Q1 is a buffer amplifier which serves to isolate the time base circuits from external loads when the 1 MHz reference output is used in external equipment.

NAND gate U1D couples the 1 MHz reference signal to the first divide-by-ten circuit in U3, when the $\overline{Q}$ signal from U2 is high.

Reference Signal Amplifiers and Gate Circuits Troubleshooting

Test 2-a. junction of R17 and R21, U1-13, U1-11 and U1-12. The oscilloscope display should be as shown in inset D of Figure 8-30. If the U1-13 signal is not present, the other signals cannot be present either, because they are derived from the gate toggle output of the divide-by-ten circuits. If the U1-13 signal is not present check for it first, at the base of Q3, then at the emitter of Q2. After making repairs, if the oscilloscope display is as shown in inset D of Figure 8-30, and the counter still does not function properly, proceed to the divide-by-ten circuits troubleshooting procedure.

Divide-By-Ten Circuit Description. The divide-by-ten circuitry derives four different frequencies from the 1 MHz output of Reference Oscillator A4. It then feeds a particular one of these frequencies, selected with the front-panel RESOLUTION switch, to High Frequency Decade Assembly A6 to toggle the main gate flip-flop.

The circuit comprises six decade counters (two each in ICs U3, U4, and U5) and an eight-to-one multiplexer/data selector IC (U6) used as a four-to-one data selector. When pin 6 of NAND gate U1B goes high to start the reset pulse, it sets the first decade counter in U3 to zero and the remaining five decade counters in the circuit to nine. The count period starts when pin 6 of NAND gate U1B goes high to start the reset pulse. It sets the first decade counter in U3 to zero and the remaining five decade counters in the circuit to nine. The count starts when pin 6 of time base flip-flop U2 goes high, allowing NAND gate U1D to pass the 1 MHz reference signal to the clock input (pin 1) of the first decade counter.

Selection of a particular one of the four frequencies present at the data input pins of U6 is accomplished with the resolution control inputs to U6 pins 9, 10, and 11. In a standard HP 8443A the resolution control selections available are 1000 Hz, 100 Hz, and 10 Hz. If the RESOLUTION switch is set to 10 Hz, it

grounds pin 11 (data select A) of U6; the other two data select input pins, 9 and 10 (C and B), are held high by their respective connections to +5 volts through pull-up resistors R27 and R26. This particular combination (A low, B high, C high) selects the D6 input (10 Hz) as the gate toggle output from U6 pin 5.

Setting the RESOLUTION switch to 100 Hz grounds U6 pin 10 (data select B), leaving U6 pins 9 (C) and 11 (A) high. In this case, the data select combination passes the 100 Hz signal at U6 pin 14 (D5) out U6 pin 5 to the gate toggle line. A 1 kHz setting of the switch grounds data select C (U6-9) and passes the 1000 Hz input at U6 pin 1 to the gate toggle output.

NOTE

The resolution controls applied to U6 are also fed to the microcomputer on Low Frequency Counter A1A1. On A1A1, different combinations of high or low control lines tell the microcomputer where to place the decimal point in the counter digital display.

The 1 Hz input to U6 pin 2 (D2) is used only when the 8443A is modified for the 1 Hz resolution option. For this modification, the jumper wire connecting U6 pin 9 to the pull-up resistor and board connector pin M is removed. A jumper wire is then added to connect U6 pin 9 to ground. The 10 Hz position on the RESOLUTION switch is changed to read 1 Hz, and the 100 Hz position is changed to read 10 Hz. The 1 kHz position remains unchanged. The 100 Hz resolution selection is no longer available. With U6 pin 9 permanently grounded, setting the RESOLUTION switch to 1 Hz (formerly marked 10 Hz), grounds U6 pin 11 (A data select). This provides a data-select combination of A low, B high, C low, which selects the D2 (pin 2) input of 1 Hz to be passed to the gate toggle output. Selecting 10 Hz (formerly marked 100 Hz) grounds U6 pin 10 (B) providing a data-select combination of A high, B low, C low, which causes the D1 (pin 3) input of 10 Hz to pass to the gate toggle output.

Although the 1 kHz position (unchanged by the 1 Hz option) of the RESOLUTION switch no longer connects to U6 pin 9, setting the switch to 1 kHz allows U6 pins 10 (B) and 11 (A) to both go high, producing a data-select combination of A high, B high, C low, which passes the 1000 Hz D3 input at U6 pin 1 through to the gate toggle output.

When the end-of-count signal from High Frequency Decade Assembly A6 goes low, Q6 is turned off and a high is provided as an external print command to devices connected to the 8443A rear panel Digital (BCD) Output connector.

Divide-By-Ten Troubleshooting

Test 3-a. Inset E of Figure 8-30 illustrates the correct gate toggle outputs from the time base circuit for various settings of the RESOLUTION switch referenced to the analyzer scan ramp.

Waveform 1 (at A7T2) represents an analyzer scan time of 1 mSec per division, displayed on the oscilloscope at 5 mSec per division with the 8443A RESOLUTION switch set to 1 kHz. Waveform 2 is the gate toggle pulse at A5TP6 with the Model 8443A in the 1 kHz resolution mode. Waveform 3 is the gate toggle pulse at A5TP6 with the Model 8443A in the 100 Hz resolution mode. Waveform 4 is the analyzer scan (1 mSec/Div) displayed on the oscilloscope at 20 mSec/Div with the 8443A RESOLUTION switch set to 10 Hz, and waveform 5 is the gate toggle with the Model 8443a in the 10 Hz resolution mode.

High Frequency Decade Assembly A6 Operation and Troubleshooting (See Service Sheet 8)

High Frequency Decade Assembly A6 supplies a four-line BCD representation of the Tracking Generator frequency to the Low Frequency Counter. It also furnishes an end-of-count signal to Time Base Assembly A5. If the High Frequency Decade does not supply a correct BCD count to the Low Frequency Counter, the counter display shows an incorrect frequency. Test points on all four BCD outputs from the High Fre-

quency decade enable you to check for their presence. There is also a test point for the end-of-count output. To troubleshoot the High Frequency Decade successfully, you must be familiar with its circuits and with digital troubleshooting techniques.

The High Frequency Decade Assembly uses timing signals from Time Base Assembly A5 and a divide-by-ten counter to convert the RF supplied to the counter section into four-line BCD (1-2-4-8) and end-of-count outputs. The BCD drives Low Frequency Counter Assembly A1, and the end-of-count output is fed to the timing circuits on A5.

When the High Frequency Decade is operating properly, and the spectrum analyzer and tracking generator-counter controls are set as shown below, the BCD outputs to the Low Frequency Counter Assembly should appear as shown in A of Figure 8-33. Connect the oscilloscope in turn to A6 assembly test points TP4(A), TP5(B), TP6(C), and TP7(D).

Initial Control Settings (for waveform A)

Spectrum Analyzer: (setting of controls not listed is unimportant.)

SCAN WIDTH PER DIVISION	10 MHz
SCAN WIDTH	PER DIVISION
FREQUENCY	10 MHz
SCAN TIME PER DIVISION	1 MILLISECOND
SCAN MODE	INT
SCAN TRIGGER	AUTO

Tracking Generator-Counter:

MODE	MARKER
RESOLUTION	100 Hz
MARKER CONTROL knob	Pulled out

Oscilloscope:

MAIN TRIGGERING	INT (Trigger on TP5, i.e., B)
TIME/DIV	.2 ec
VOLTS/DIV	0.2

Input Amplifier and Switching Matrix Circuits Description. Input RF amplifier Q1-Q2 provides flat amplification of signals with frequencies up to 120 MHz. Inductors L10 and L11 peak the gain at the high frequency end of the bandpass. Resistor R22 in the emitter circuit of Q2 is selected for a value that enables a nominal −18 dBm signal to toggle count-enable switch (NOR gate) U2A. The value of R24 is selected to provide a dc level at pin 4 of U2A that is −1.30 volts with no signal input.

Diodes CR1 through CR4 and CR6 through CR10 make up a switching matrix for the input RF signal. When the front-panel MODE switch is set to MARKER or SCAN HOLD, the switch inputs forward bias switching diodes CR1, CR4, CR6, and CR9, while back biasing CR2, CR3, CR7, CR8, and CR10. This allows the input RF signal to be coupled through C3, CR1, CR6, C17, and L9 to the base of RF amplifier transistor Q1. When the MODE switch is set to EXTERNAL, the bias on the switching diodes is the exact opposite of what it is for the MARKER and SCAN HOLD modes: diodes CR1, CR4, CR6, and CR9 are now back biased, while CR2, CR3, CR7, CR9, and CR10 are forward biased. Thus the internal RF signal is passed to Q1.

Input Amplifier and Swtiching Matrix Troubleshooting

- Connect a 1 MHz source at +10 dBm to the 8443A COUNTER INPUT and set the 8443A MODE switch to EXTERNAL. Connect the oscilloscope in turn to the base of Q1, the base of Q2, and pin 4

of U2. Set the oscilloscope VOLTS/DIV to .2 and the TIME/DIV to 1 ec. The waveform at the base of Q1 should be a positive-going, half-wave rectified sine wave with an amplitude of approximately 70 millivolts, and a period of 1 microsecond. The waveform at the base of Q2 should be a square wave with a period of 1 microsecond and an amplitude of approximately 40 millivolts. The waveform at test point A6TP8 should be a square wave with a period of 1 microsecond and an amplitude of approximately 100 millivolts.

- If the waveform at Q1-b is present, but the waveforms at Q2-b and at TP8 are not, check transistor Q1 and its associated components. If waveforms are present at Q1-b and Q2-b, but the waveform at TP8 is not, check transistor Q2 and its associated components. If all the waveforms are present, do the Gate Toggle Translator and Main Gate Flip-Flop Test Procedure described on this Service Sheet.

Gate Toggle Translator and Main Gate Flip-Flop Circuits Description. Main gate flip-flop U1 is clocked by the gate toggle input from Time Base Assembly A5. This input is a periodically interrupted series of square waves with a repetition rate (in a single series) of 1 kHz, 100 Hz, or 10 Hz, selectable with the front-panel RESOLUTION switch. It is developed in the A5 assembly decade dividers circuitry, and is started and stopped by the A5 assembly time base flip-flop.

In the MARKER and SCAN HOLD modes of operation, the time base flip-flop starts the gate toggle square waves shortly after (less than 250 microseconds) the spectrum analyzer scan ramp is stopped at the frequency point set with the MARKER POSITION control. (The scan ramp is stopped by a signal fed to the spectrum analyzer from 8443A Marker Control Assembly A7.) The end-of-count output from the High Frequency Decade Assembly signals the end of the counting period. It is used to clock the time base flip-flop in A5 into the opposite state and thus stop the gate toggle square waves.

Gate Toggle Translator. The gate toggle is fed to U1 through a gate toggle translator circuit. This circuit inverts the gate toggle input and translates it from a TTL level to the ECL level required by U1. The translator consists of a comparator circuit, Q6-Q7, and an emitter follower, Q5. In addition to translating the gate toggle level, the comparator is a temperature compensation device. For this purpose, the base of comparator transistor Q7 is driven by a temperature-compensating dc voltage (VBB) output from pin 1 of the output level translators IC, U4. This dc voltage is also the non-inverting input to each output level translator. Any ambient temperature change that affects the input requirements of main gate flip-flop U1 and the output levels from divide-by-10 counter U3 also causes a corresponding change in the VBB level applied to the base of Q7 and the non-inverting inputs of the output level translators. The gate toggle translator then changes the translated gate toggle signal level to compensate for the temperature-induced change in the clock input requirement of U1. Simultaneously, the level change at the non-inverting inputs of the output level translators compensates for temperature-induced changes in the output levels from U3.

Main Gate Flip-Flop. Flip-flop U1 is connected so that its output state reverses each time a positive-going gate toggle pulse transition is applied to its clock input, pin 9. (Because the gate toggle input is inverted in translator Q5-Q6, the positive-going transitions that clock U1 are the negative-going transitions at the gate toggle input to the A6 board assembly.) The frequency counting period starts when output pin 2 of U1 is clocked low. It ends when the next positive-going transition at U1 pin 9 clocks U1 pin 2 high and U1 pin 3 low.

The duration of the counting period depends on the frequency of the gate toggle input, which in turn depends on the setting of the front-panel RESOLUTION switch. If the RESOLUTION switch is set to 1 kHz, the positive-going transitions at the clock input to U1 are 1 millisecond apart; therefore, the counting period (the period when U1 pin 2 is low) has a duration of 1 millisecond. For a RESOLUTION selection of 100 Hz, the counting period is 10 milliseconds, and for 10 Hz it is 100 milliseconds.

The length of the interval between counting periods depends on the mode in which the 8443A is being operated. In the Marker mode, the spectrum analyzer scan ramp is allowed to continue when the counting period is over, and a new counting period is initiated on the next ramp. In the Scan Hold mode, the scan ramp is **not** allowed to continue when the counting period ends; the preliminary operations to set up a new counting period start immediately. Thus, in the Scan Hold mode, the counting periods are continual,

separated only by the transfer and reset periods. If the 8443A is being operated in the External mode, the counting periods are separated by the combined widths of the transfer and reset pulses, a 200-millisecond delay, and the very short period required to start a new gate toggle output from Time Base Assembly A5.

Count Enable Switch. Count enable switch U2A is a NOR gate which switches the RF input through to U3 pin 12 (G1) during the count period, and blocks it at all other times. The dc level at input pin 4 of U2A is fixed at −1.30 volts; the other input, pin 5, follows the pin 2 output of main gate flip-flop U1. The enabling condition for U2A is both inputs low (in this regard, it functions as a negative-logic NAND gate). Thus, when U1 pin 2 is high, U2A blocks the RF input. When pin 2 of U1 is clocked low, U2A passes the RF to U3 where it toggles the G1 (pin 12) input at the RF rate.

End-of-Count Translator. Transistors Q3 and Q4, and their associated components make up the end-of-count translator circuit. The end-of-count signal is the low output from U1 pin 3, which occurs when U1 pin 2 is clocked high to end the counting period. The purpose of this circuit is to translate the ECL level of the U1 output into the TTL level required to drive the associated circuitry on Time Base Assembly A5.

Gate Toggle Translator and Main Gate Flip-Flop Troubleshooting

- Set the 8443A MODE switch to Marker and the RESOLUTION switch to 100 Hz. Set the spectrum analyzer SCAN TIME PER DIVISION to 1 MILLISECOND. Externally trigger the oscilloscope using the spectrum analyzer SCAN out. Set TIME/DIV to 5 mSec and VOLT/DIV to .2 for each measurement except the one at TP2. Use .5 Volts/Division at TP2. The waveforms you should obtain under these conditions at five points in the gate toggle signal path are shown in B of Figure 8-33.

NOTE

These tests are valid only if Time Base Assembly A5 is operating properly.

- If you obtain waveforms 1 and 2 (Q6 base, Q5 emitter), but are unable to obtain waveforms 3, 4, and 5 (U1 pin 2, U1 pin 3, and TP2), main gate flip-flop U1 is probably defective.
- If you obtain waveform 1, but cannot get waveform 2, check transistors Q5 and Q6, and the components associated with them.
- If you obtain the first four waveforms, but get an abnormal indication for the fifth (at TP2), transistor Q3 or Q4 or an associated component is probably defective.
- If the gate toggle input (waveform 1) is missing, try grounding test point TP2 on Time Base Assembly A5. Grounding A5TP2, in effect, provides a continuous count trigger. It should produce a square wave gate toggle input with a repetition rate that is much higher than the normal gate toggle, but which can be used to check the gate toggle signal path circuitry. You should note, however, that if grounding A5TP2 is necessary to produce a signal at the gate toggle input to the High Frequency Decade Assembly, there is very likely a problem with the count trigger output of Marker Control Assembly A7.

Divide-By-10 Counter and Output Level Translators

Reset Input and Reset Translator. The reset input to the High Frequency Decade Assembly resets divide-by-10 counter U3 to zero before each counting period. It is a positive-going pulse approxiately 50 microseconds wide. Its leading edge starts less than 200 microseconds after the scan ramp in the spectrum analyzer is stopped, coincidently with the negative-going count trigger supplied by Marker Control Assembly A7 to Time Base Assembly A5.

In the resistive voltage divider network of R38, R11, and R12, the reset pulse is translated from the TTL level at which is received to the ECL level required by the counter. About one microsecond after the end of the reset pulse, the decade counters in Time Base Assembly A5 start generating the gate toggle square waves that clock main gate flip-flop U1. (See Gate Toggle Translator and Main Gate Flip-Flop circuit description.)

When the dc level at pin 2 of NOR gate U2A is clocked high to start the counting period, the RF passed through U2A starts toggling the clock 1 (G1) input (pin 12) to divide-by-10 counter U3.

Divide-By-10 Counter. Divide-by-10 counter U3 divides the RF input to provide the four-line BCD (1-2-4-8) required to drive the Low Frequency Counter. Because of the way the counter is connected, the BCD 8 output from U3 pin 2 is one-tenth the input RF rate. At the end of every 10th RF input cycle to pin 12, the count starts over again at 1. At the end of the counting period, the RF input stops and the counter outputs remain as they were at the last count. Before a new counting period starts, however, the reset input returns all four outputs to zero.

Output Level Translators. The outputs from the divide-by-10 counter are positive logic at ECL levels, while the requirements of the Low Frequency Counter are for negative logic at TTL levels. Therefore, the output level translators (U4A-D) have two primary functions: first, to invert the divide-by-10 counter outputs to convert them to negative logic, and second, to shift the outputs to TTL levels to make them conform to the Low Frequency Counter requirements.

The output level translators integrated circuit (IC) package, U4, contains a temperature-compensating dc reference supply (VBB), which maintains the IC outputs at a constant level. This supply responds to environmental temperature changes by altering the dc reference level sufficiently to cancel any level shifts that would otherwise be incurred in the IC circuitry as a result of the temperature variations.

The temperature-compensating dc reference (VBB) is available at pin 1 of U4. It is connected to the noninverting inputs of the level translators to compensate for temperature-induced variations in the counter output levels. It also drives comparator transistor Q7 in the gate toggle translator. In this instance, changes in the VBB level cause comparator Q6-Q7 to shift the gate toggle level in accordance with temperature-induced changes in the U1 clock input level requirement.

Divide-By-10 Counter and Output Level Translators Troubleshooting

- Check for the reset pulses with the oscilloscope at Motherboard socket XA6 pin 9, or at the junction of C15 and R38. The reset pulses should be positive-going, three to four volts in amplitude (0.3 to 0.4 volts when using 10:1 probe).

- Set the 8443A controls for operation in the Marker mode at 100 Hz Resolution. Set the spectrum analyzer SCAN TIME PER DIVISION to 1 MILLISECOND.

- Connect the oscilloscope in turn to output test points 4, 5, 6, and 7 respectively on the High Frequency Decade Assembly. Set the oscilloscope TIME/DIV to 5 msec and the VOLTS/DIV to .5. The oscilloscope display should appear as shown in C of Figure 8-33.

- If the oscilloscope display shows a malfunction, and the input RF amplifier (Q1-Q2) circuits and main gate flip-flop (U1) are functioning normally, the problem is in NOR gate U2A, counter U3, or in output level translators U4. If only one output is missing, the problem is most likely a defective output level translator in U4. If all the outputs are missing, either U2 or U3 could be at fault.

Low Frequency Counter Assembly A1 Operation and Troubleshooting (See Service Sheet 9)

The complete Low Frequency Counter Assembly (A1) comprises three plug-in board assemblies surrounded by an aluminum shield. The board assemblies are:

Low Frequency Counter Board Assembly A1A1
Counter Display Board Assembly A1A2
+6V Switch Board Assembly A1A3

Counter Display Board Assembly A1A2 contains eight seven-segment digital display ICs. It plugs into a pc board edge connector on the front edge of the horizontally-mounted Low Frequency Counter Board Assembly A1A1. The Low Frequency Counter Board Assembly contains the electronic circuits that drive the counter digital display ICs, and which supply digital signals to the 8443A rear-panel DIGITAL OUTPUT connector. It plugs into a pc board edge connector receptacle on +6V Switch Board Assembly A1A3.

Board Assembly A1A3 plugs into a pc board edge connector receptacle on the 8443A Motherboard Assembly (A18). Its purpose is to provide interconnections between the Low Frequency Counter Board Assembly and the Motherboard. It also contains a +6V switching circuit. When the ac line POWER is switched on at the 8443A front panel, the +6V switching circuit delays the dc power input (+5.5V nominal) to the counter circuits until the dc power input to the switching circuits stabilizes.

For Counter troubleshooting, the A1A3 board, with the A1A1 board plugged into it, and with A1A2 plugged into A1A1, is extended above the Motherboard on an extender board (included in the Service Kit).

Counter Circuits Description. The Low Frequency Counter receives four BCD inputs, $\overline{A}$-$\overline{B}$-$\overline{C}$-$\overline{D}$, corresponding to 1-2-4-8, from High Frequency Decade Board Assembly A6; a reset and a transfer input from Time Base Board Assembly A5; three control inputs from the front-panel RESOLUTION switch; and a blanking input from the rear-panel BLANKED-UNBLANKED switch. In the Low Frequency Counter circuits, these inputs are transformed into signals which light the seven-segment numeric display ICs, and into digital signals for use in external equipment.

Prescaler U3 is a divide-by-ten counter which is clocked by the active-low D ($\overline{D}$) input. NAND gate U5D is connected as an inverter to reverse the polarity of the D input so it conforms with the active-high input requirements of U3. The four outputs of U3, corresponding to BCD 1-2-4-8, are fed to four port A inputs, PA4 through PA7, of U10 (pins 25-28). The BCD 8 (PA7) output is also fed through another NAND gate-turned-inverter, U5C, to the T.I. input (pin 3) of U10.

The reset input to U3 precedes each counting period to clear U3 of any count remaining in it. If the count remaining in U3 is any digit from 0 through 7, the reset operates normally to clear it out. If, however, U3 has a remaining count of 8 or 9, the reset input, in the act of clearing U3, toggles it an additional count. If this inconsistency were not compensated for, the next counting period would produce an erroneous number. To prevent such counting errors, the PC5 output of U10 is fed back to pin 3 of U3 at the end of each counting period to preset U3 to a count of 9. With this arrangement, the reset input always toggles U3 an additional count. Thus, the state of U3 immediately following the preset input and preceding the counting period is always the same, and the software program deletes the purposely-introduced error. For the duration of the preset (PC5) input, the U3 outputs are shut off.

In addition to the four BCD outputs of U3, which are derived from the D (MSB) input, port A of U10 receives the active-low A-B-C-D inputs at its PA0 through PA3 input terminals (pins 21-24). The eight port A inputs are continually read by U10 and, subject to a "read" or "write" request from microcomputer U7, are available to the address data bus.

The input from NAND gate-inverter U5C to U10 pin 3 (T.I.) drives a 14-bit binary event counter which keeps track of the number of 8-bit counts received at port A. This particular counting function starts on the first D input and continues through successive D inputs until the 8443A is turned off. The event counter is reset to its count-start state each time the 8443A line POWER switch is set from STBY to ON by a sharply rising output from power-up circuit Q26, Q27, and Q28.

The event counter overflows out U10 pin 6 (T.O.) to microcomputer U7 pin 39 (T.I.) where it feeds a software overflow register. The presence of the overflow output from U10 verifies proper operation of the event counter and of prescaler U3. The U7 software keeps track of the total event count. When the transfer input is received, the U7 software reads the event count for the new readout and does the arithmetic to determine how many counts have occurred since the last readout.

I/O expander and timer U10 communicates with microcomputer U7 over the two-way multiplex address data bus in response to read (RD), write (WR), and address latch enable (ALE) commands from the microcomputer.

The transfer input to the Low Frequency Counter Assembly is a negative-going pulse which signals the end of the counting period and the start of the read and display update period. It is latched low in a flip-flop made up of two cross-coupled NAND gates, U5A and U5B. At the end of the read and update period, the negative-going write pulse (WR) from U7 resets the transfer flip-flop.

The three control inputs to U7 pins 36, 37, and 38 originate at the front-panel RESOLUTION switch. The active input line is grounded through the switch; the two inactive control lines are held high (to +5V) through pull-up resistors in Time Base Assembly A5. Microcomputer U7 reads these three inputs at the beginning of each read-update period to determine which numerical display IC requires a lighted decimal point. A fourth control input to U7 at pin 35 is unconnected unless the 1 Hz control option is built into the instrument.

Simultaneously grounding all four of the control input test points, TP1 through TP4, causes the counter to count from 00000000 through 99999999, lighting the decimal points on the even numbers, then blank the display, and finally show a four-character group on the four inner display ICs (DS3, DS4, DS5, and DS6), with the four outer ICs (DS1, DS2, DS7, and DS8) blank. This cycle continues as long as the four test points remain grounded. (The four-character display is shown in Table 8-8, Low Frequency Counter Troubleshooting.)

The blanking input originates at the BLANKED/UNBLANKED switch on the 8443A rear panel. With the switch set to UNBLANKED, the input is approximately +6 volts. When the switch is set to BLANKED, the input is an open circuit. The blanking input drives NPN transistor Q25, which inverts the input and drives pin 1 of microcomputer U7. By setting U7 pin 1 solidly to either ground (unblanked) or +5 volts (blanked), Q25 makes sure the open-circuit input is not misinterpreted by U7. An unblanked input causes all the numeric display ICs to be lighted during the display update. A blanked input, however, causes all zeros preceding the most significant digit or the decimal point (whichever occurs first) to be blanked. The microcomputer reads this input during each read-update period to determine whether or not to eliminate the leading zeros.

The multiplexed address data on the address data bus is latched into address latch U8 by the ALE (address latch enable) output from U7. U8 then provides 8 lines of the 11-line address required by programmed read-only memory (PROM) U9. The three upper address lines to U9 are from port 2 (P20, P21, P22) of U7. Shortly after the addresses are latched by U8, the address data bus clears and becomes ready to function as an input bus instead of an output bus. Next, the active-low PSEN output from U7 pin 9 is strobed low, which causes the 8-bit instruction from U9 to be placed on the address data bus and fed back to U7. U7 then performs the action dictated by the 8-bit instruction output of U9.

There are 29 digital outputs from the I/O expander circuits in U10 and U11. Thirteen of these outputs are from ports B and C of U10; the remaining sixteen are from ports 4, 5, 6, and 7 of U11. Fed to a rear-panel connector through Digital Output Assembly A19, they provide seven and one-half digits to external equipment.

The eight numeric display ICs on Counter Display Assembly A1A2 are controlled by eight outputs from port 1 of microcomputer U7. U7 outputs P10, P11, P12, and P13 provide a four-line BCD input to BCD-to-7-segment decoder U4. Outputs P14, P15, and P16 drive 3-to-8 decoder U6; and P17 controls the lighting of the decimal point.

BCD-to-7-segment decoder U4 translates the levels on its four inuts into seven outputs, each one driving a particular alphabetically designated segment in all eight numerical display ICs. A dual-transistor current source in each segment drive line provides the segment turn-on power (U4 outputs are open-collector with internal pull-up resistors). This portion of the display drive circuitry determines the numeral that is to be displayed.

Decoder U6 translates the levels on its three inputs into eight digit-drive signals, each on at a different time. The "on" output turns on one of the eight display ICs, which then shows the numeral selected by the BCD-to-7-segment decoder circuit. The transistors in the digit drive outputs from U6 function as digit drive current switches.

Output P17 from U7 represents the most significant bit output from U7 port 1. It is fed in parallel to the decimal point inputs of the eight display ICs. Its state, on or off, determines whether or not the "on" display IC shows a decimal point. Transistors Q12 and Q24 make up a dual-transistor current source for the decimal point drive.

Although there are eight numerical display ICs, and each is on for a different period, the counter is set to run as if there were nine display periods with the display blanked during the ninth. There is also a short display blanking period that occurs with each transfer input. This allows the microcomputer to make the transfer without affecting the display.

When the 8443A line POWER switch is first on, and after a brief delay purposely introduced by the +6 volt switch circuit on board assembly A1A3, the counter automatically performs a confidence check. At the start of this check, the counter display shows all zeros, then it changes to all ones, then to all twos, and so on up through all nines. The counter does the confidence check once before displaying the frequency count.

If the confidence check repeats, it is because the software has detected an apparent error in the event count arithmetic. This sometimes happens when the event counter in U10 is not far enough along in the operation cycle to have produced an overflow output to the microcomputer when the count update begins, a condition regarded as an "underflow." Therefore, when the software overflow register in the microcomputer does the arithmetic required to determine the number of counts since the last readout, it obtains a negative number, an answer it views as an arithmetic error. It then returns the counter to its start-up condition, initiating another confidence check. Usually the period of one additional confidence check is enough to establish the event counter overflow and start normal counter operation.

+6 Volts switch (Part of A1A3) Circuit Description. Board assembly A1A3 serves as an interconnect device between the Low Frequency Counter and the 8443A Motherboard Assembly. It also contains a power-up switching circuit which supplies +5.5 volts to the Low Frequency Counter. The purpose of this power-up switch is to hold off the counter operating power until the power stabilizes and is relatively free of "switch-bounce" glitches.

When the ac line power is first turned on, the dc input to the switching circuit appears across two parallel resistive voltage dividers. Voltage divider R5-R6 applies a voltage equal to one-half the input level to the minus input (pin 2) of comparator U1A and the plus input (pin 5) of comparator U1B.

At the same time, voltage divider R3-R4 applies a voltage that is just slightly more than one-half the input level, but never exceeding +2.61 volts, to the minus input (pin 6) of U1B. Since at first (that is, until the input dc reaches about +5 volts) the minus input of U1B is more positive that its plus input, U1B produces a zero output. As a result of this zero output from U1B, the plus input of U1A is lower than its minus input. Thus, U1A also produces a zero output, which in turn holds Q2 off and prevents Q1 from conducting.

If, when the LINE power switch is turned on, the input dc rises cleanly to its nominal level of +6 volts, the circuit operates as follows: at an input level of approximately +5 volts, zener diode VR1 breaks down and sets the minus input of U1B at a maximum level of +2.61 volts. (At inputs less than approximately +5 volts, the input to the minus terminal of U1B is the voltage across R3.) As the input approaches +6 volts,

the plus input of U1B becomes more positive than the minus input. Now, U1B produces a positive output which charges capacitor C1 across R7, developing a positive-going ramp at the plus input of U1A. As soon as the level of this ramp exceeds the level at the minus input of U1A, U1A produces a positive output which turns on Q2 and Q1. With Q1 conducting, approximately +5.5 volts is passed to the Low Frequency Counter Board.

If, however, on initial power turn-on, the input dc fluctuates so that the output of U1B is turned on and off by polarity reverses at its inputs, C1, instead of charging, discharges through CR2 and U1B. (Remember, it requires approximately +5 volts input to hold the output of U1B above zero volts.) In this event, the plus input of U1A remains lower than its minus input, and the resulting zero output holds off Q2 and Q1.

Once the switch is closed so that dc is supplied to the Low Frequency Counter, the switching circuit is not affected by narrow, negative-going, widely-spaced glitches. A series of closely spaced glitches, however, may cause the switch to open until the input dc stabilizes.

Table 8-8. Low Frequency Counter Troubleshooting (1 of 3)

Symptom	Probable Cause
Display blanked or unintelligible	**Low Frequency Counter Board Assembly A1A1** 1. Failure of 3-to-8 decoder U6 (check U6 for BCD inputs and sequential outputs). 2. Failure of BCD-to-7-segment decoder U4 (check U4 for BCD inputs). 3. Failure of microcomputer U7 port 1 output circuitry (if possible, substitute another microcomputer IC for U7).
Counter display intermittently or successively repeats the start-up sequence confidence check. **NOTE** **In the start-up sequence, the counter cycles all the display ICs so that the readout is all zeros, then all ones, then all twos, and so on up through all nines. The counter normally goes through this cycle once as a confidence check, each time the line POWER switch is turned on, before displaying the actual frequency count.**	1. Failure of the event counter in I/O expander and timer U10. You can check this by looking at the output signal on U10 pin 6 (T.O.), the event counter overflow to U7 pin 39. The signal should be toggling at some very low frequency. In the external mode with an input frequency of 55 MHz and the RESOLUTION control set to 10 Hz, you should see approximately 25 signal excursions per second. Because of the overflow pulse timing, the excursions may appear somewhat irregular. 2. Failure of the reset power-up circuitry (Q26, Q27, Q28) connected to U10 pin 4. 3. Failure of prescaler IC U3. 4. Failure of gate U5D or U5C.
One or more display ICs fail to light. **NOTE** **Make sure the unlighted display IC isn't just being blanked to eliminate leading zeros. Check the setting of the BLANKED/UNBLANKED switch on the 8443A rear panel.**	1. Partial failure of 3-to-8 decoder U6. Check U6 for BCD inputs and sequential outputs. 2. Failure of U7 port 1 outputs. 3. Failure of the unlighted display ICs on the Counter Display Board Assembly, or open connections between the Display Board Assembly and the Low Frequency Counter Board Assembly. 4. Failure of the current-source transistor(s) in the applicable digit drive output(s) from U6.
Display shows a count of 777215 and two random numerals.	1. Failure of I/O expander and timer U10. 2. Failure of Reset circuit Q26, Q27, and Q28.

Table 8-8. Low Frequency Counter Troubleshooting (2 of 3)

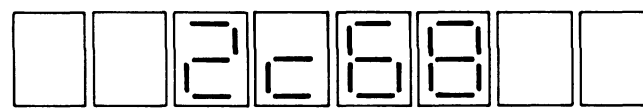
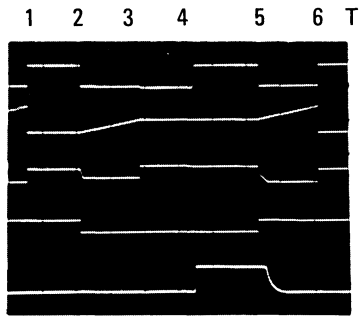
Symptom	Probable Cause
Displayed number does not agree with actual input frequency. Digital outputs from U10 and/or U11 also erroneous.	1. If the digital outputs from both U10 and U11 are in error, the fault can be in U7, U8, U9, or U10. To eliminate U8 and U9, ground test points TP1, TP2, TP3, and TP4; then look at the address data bus during the negative-going PSEN output from U7 pin 9. The signals on the bus should appear as distinct highs and lows. If, instead, the bus seems to be floating, there is probably a failure in U9. 2. If the bus appears normal, and there doesn't seem to be anything wrong with U8 or U9 at this point, the problem could be in U7. To check U7, ground the four control input test points, TP1 through TP4, just as in step 1 above. With the test points grounded, the display should count from 00000000 through 99999999, showing decimal points with the even numbers. Following the count of 99999999, the display should blank momentarily, exhibit the four-character group shown below for two to five seconds, again blank momentarily, then repeat the entire cycle from the zeros display through the four-character group. The display should continue to cycle in this manner as long as test points TP1 through TP4 are grounded. (Note that if the test points are not **solidly** grounded to the 8443A chassis, the cycle will stop on the four-character group.)  The presense of the four-character group shown above is a fairly good indication that U7, U8, and U9 are performing most of their required functions, and that the problem is most likely in U10. If a character group other than the one shown above is displayed, U9 is the most likely suspect. If no characters at all are displayed, the problem source can be U7, U8, or U9. Note that the signal for this character group should also be available at the DIGITAL OUTPUT connector on the 8443A rear panel.
Digital outputs from U11 ports 4, 5, 6, and 7 missing or incorrect. Display is normal.	1. Failure of U11.
Digital outputs from U10 ports B and C missing or incorrect. Display is normal.	1. Partial failure of U10.

Table 8-8. Low Frequency Counter Troubleshooting (3 of 3)

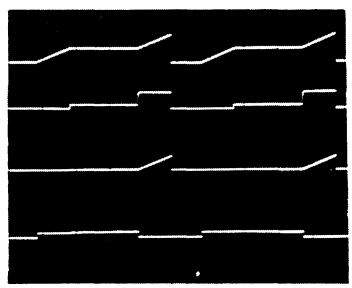
Symptom	Probable Cause
Zero dc at switch output test point TP4 with a steady +6 volts at input test point TP2.	**+6 Volts Switching Circuit (on A1A3)** 1. Series switching transistor Q1 open. 2. Failure of control transistor Q2. 3. Failure of comparator U1A or U1B. 4. Zener diode VR1 open. 5. Capacitor C1 shorted. 6. Diode CR1 shorted.
Voltage at switch output test point TP4 is less than +5.5 volts with a steady +6 volts at input test point TP2.	1. Partial failure of series transistor Q1 or control transistor Q2. 2. Partial failure of comparator U1A or U1B.
Switch fails to open with a significant reduction of the input voltage level.	1. Zener diode VR1 shorted.

(A)

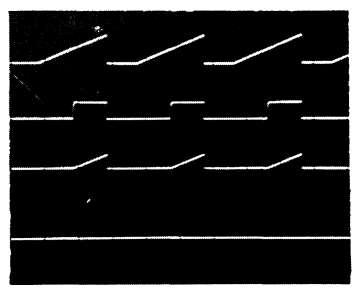


Time 1. Analyzer CRT is being blanked by the analyzer scan generator.
Time 2. Analyzer blanking ends TP1; Scan ramp starts TP2; Active clamp is enabled TP4.
Time 3. Analyzer scan ramp is stopped TP2.
Time 4. Analyzer CRT is blanked by Model 8443A TP1.
Time 5. Analyzer scan ramp is released TP2.
Time 6. Analyzer scan ramp ends TP2; Analyzer blanking begins TP1.

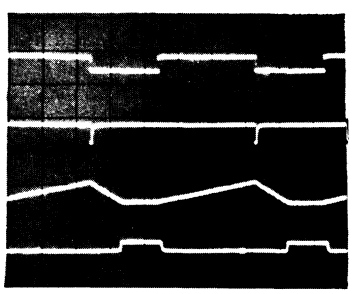
(B)



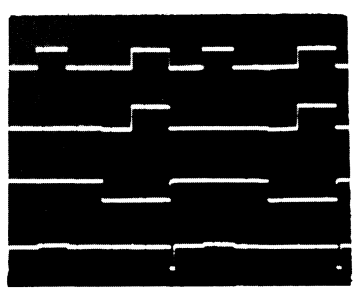
(C)



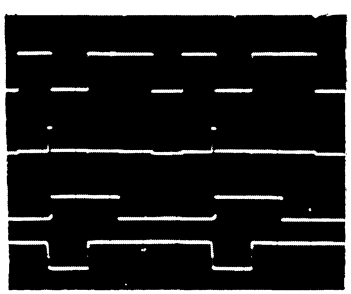
(D)



(E)



(F)



NOTE

Refer to Operation and Troubleshooting text for appropriate instrument control settings.

Figure 8-27. Marker Control Assembly A7 Test Waveforms

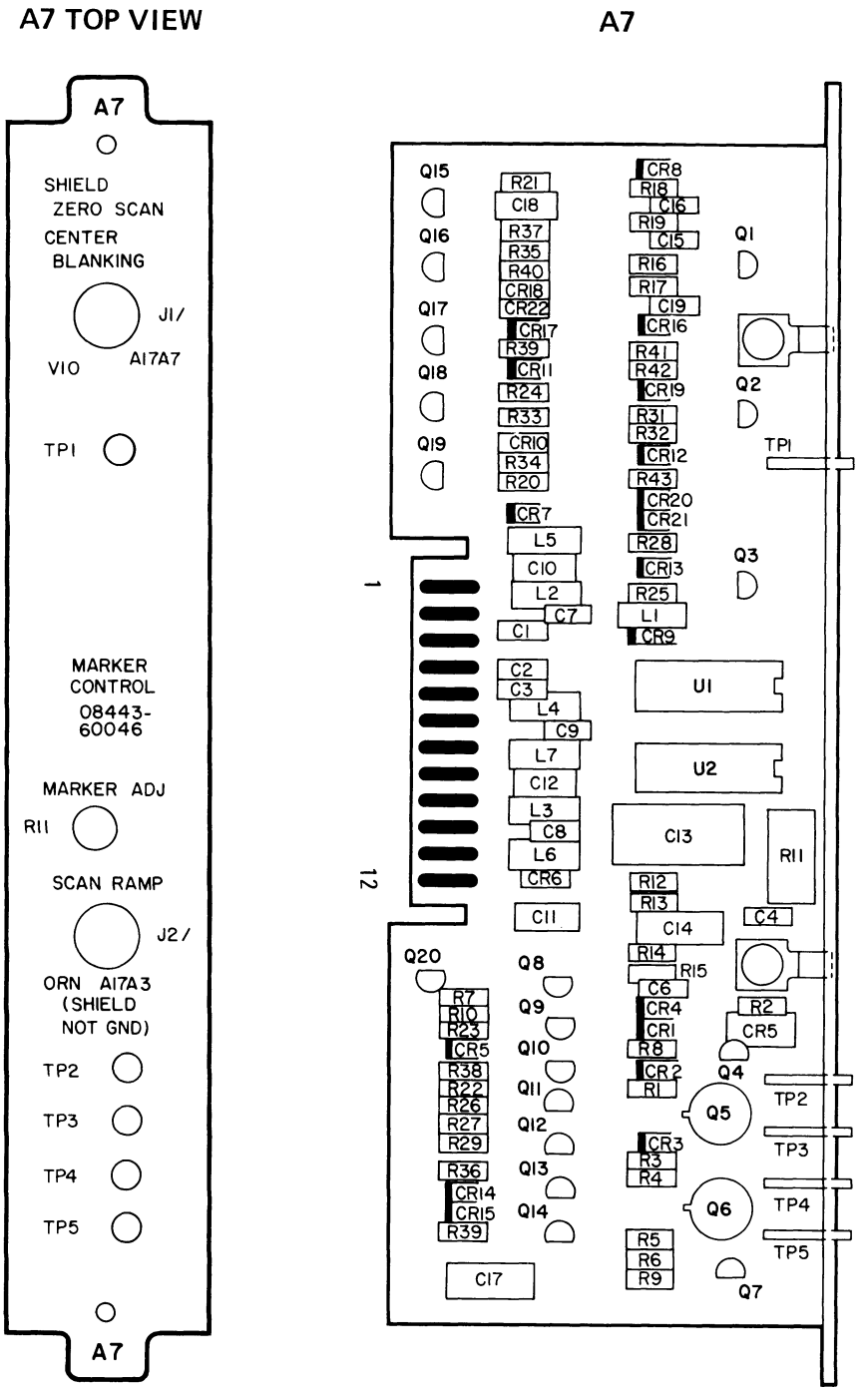
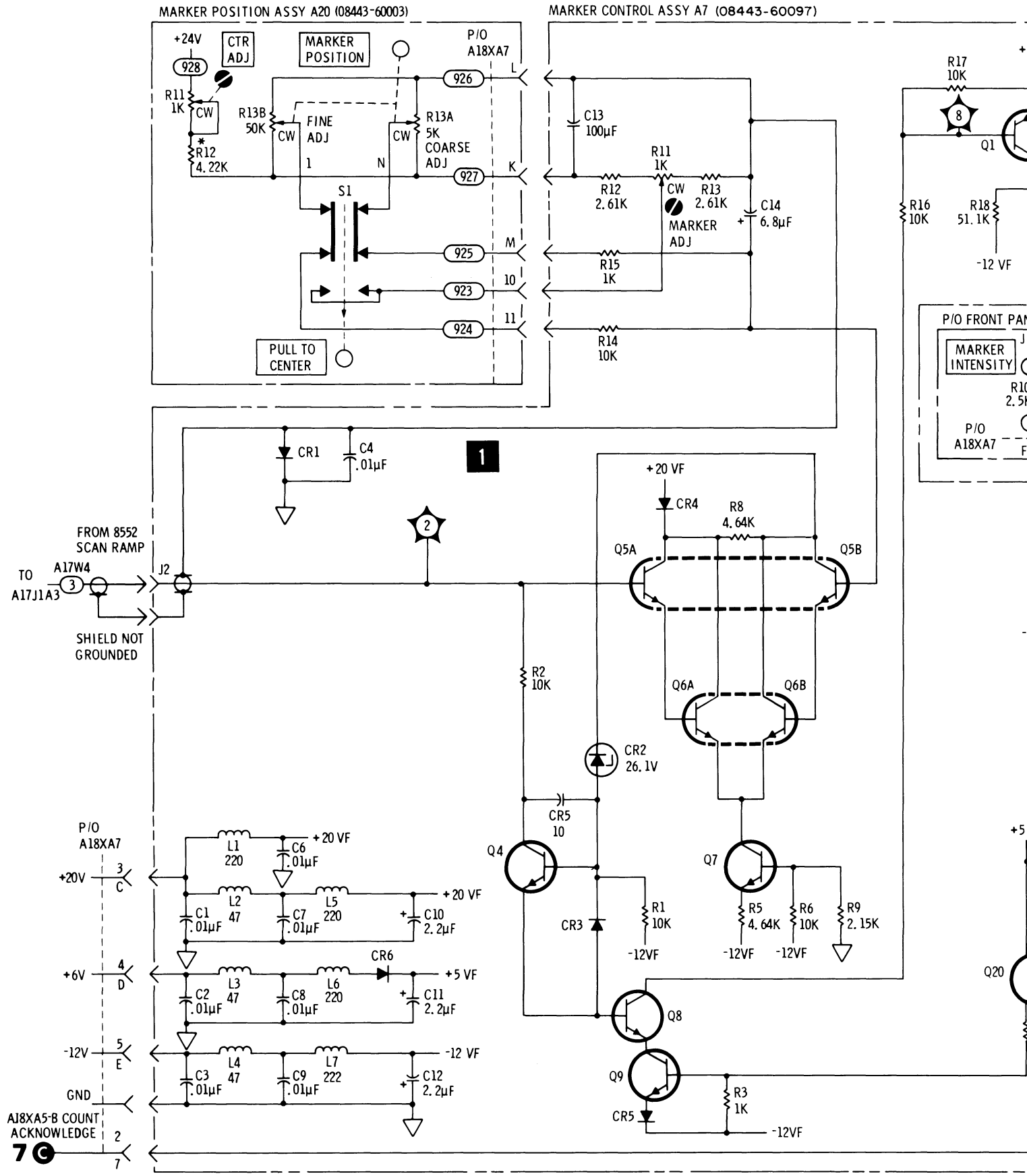
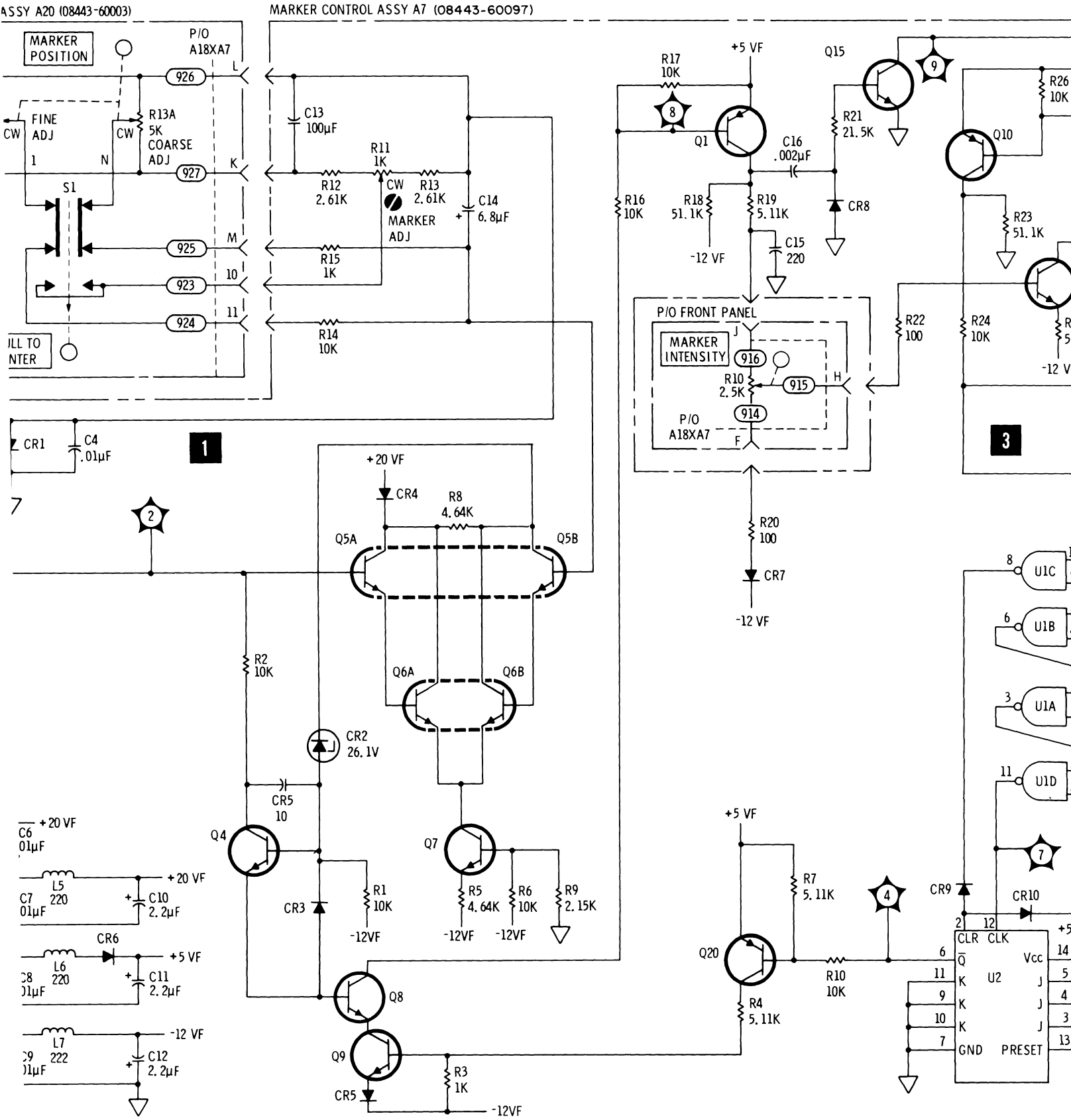


Figure 8-28. Marker Control Assembly A7 Parts Locations


MARKER POSITION ASSY A20 (08443-60003)
MARKER CONTROL ASSY A7 (08443-60097)
+24V
CTR ADJ
928
R11 1K
CW
*R12 4.22K
MARKER POSITION
P/O A18XA7
926
927
925
923
924
L
K
M
10
11
R13B 50K
CW
FINE ADJ
1
N
R13A 5K COARSE ADJ
S1
PULL TO CENTER
C13 100µF
R11 1K
R12 2.61K
CW
R13 2.61K
MARKER ADJ
C14 6.8µF
R15 1K
R14 10K
R17 10K
8
Q1
R16 10K
R18 51.1K
-12 VF
P/O FRONT PAN
MARKER INTENSITY
P/O A18XA7
1
CR1
C4 .01µF
2
FROM 8552 SCAN RAMP
TO A17J1A3
A17W4
3
J2
SHIELD NOT GROUNDED
+20 VF
CR4
R8 4.64K
Q5A
Q5B
R2 10K
Q6A
Q6B
CR2 26.1V
CR5 10
Q4
Q7
CR3
R1 10K
-12VF
R5 4.64K
R6 10K
R9 2.15K
-12VF
-12VF
Q20
P/O A18XA7
+20V
3
C
+6V
4
D
-12V
5
E
GND
AJ8XA5-B COUNT ACKNOWLEDGE
2
7
L1 220
C6 .01µF
+20 VF
L2 47
C1 .01µF
C7 .01µF
L5 220
C10 2.2µF
CR6
+5 VF
L3 47
C2 .01µF
C8 .01µF
L6 220
C11 2.2µF
-12 VF
L4 47
C3 .01µF
C9 .01µF
L7 222
C12 2.2µF
Q8
Q9
CR5
R3 1K
-12VF
7 C


ASSY A20 (08443-60003)
MARKER CONTROL ASSY A7 (08443-60097)
MARKER POSITION
P/O A18XA7
926
927
925
923
924
FINE ADJ
COARSE ADJ
R13A 5K
S1
C13 100µF
R11 1K
R12 2.61K
R13 2.61K
MARKER ADJ
C14 6.8µF
R15 1K
R14 10K
CR1
C4 .01µF
1
2
3
4
+20 VF
CR4
R8 4.64K
Q5A
Q5B
Q6A
Q6B
R2 10K
CR2 26.1V
CR5 10
Q4
Q7
CR3
R1 10K
R5 4.64K
R6 10K
R9 2.15K
-12VF
Q8
Q9
CR5
R3 1K
+5 VF
R17 10K
Q1
Q15
R21 21.5K
C16 .002µF
R16 10K
R18 51.1K
R19 5.11K
CR8
C15 220
-12 VF
P/O FRONT PANEL
MARKER INTENSITY
916
915
914
R10 2.5K
R22 100
R20 100
CR7
Q10
R23 51.1K
R24 10K
R26 10K
Q20
R7 5.11K
R4 5.11K
R10 10K
CR9
CR10
U1C
U1B
U1A
U1D
U2
CLR CLK
Vcc
PRESET
GND
L5 220
C10 2.2µF
L6 220
C11 2.2µF
L7 222
C12 2.2µF

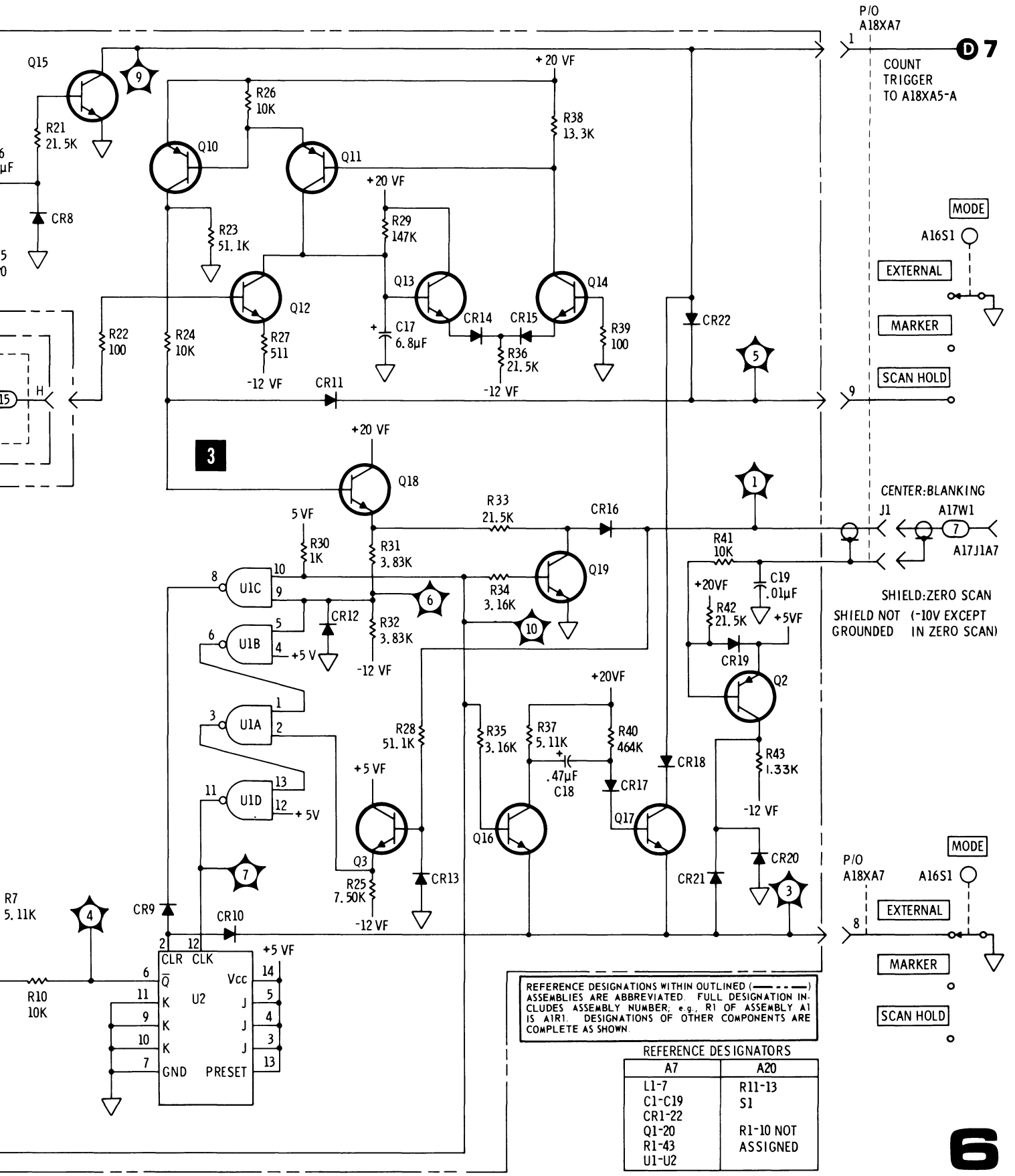


Figure 8-29. Marker Control Assembly A7 Schematic Diagram

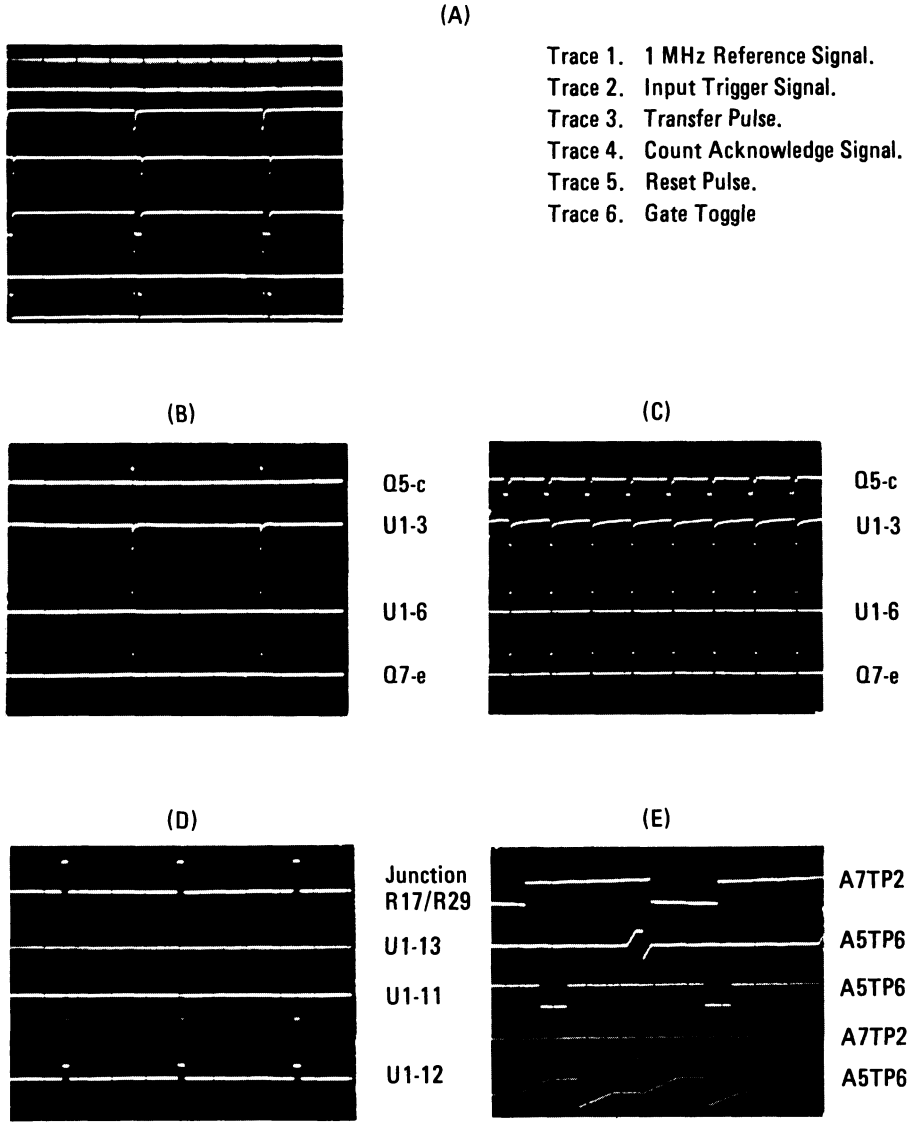


Figure 8-30. Time Base Assembly A5 Test Waveforms

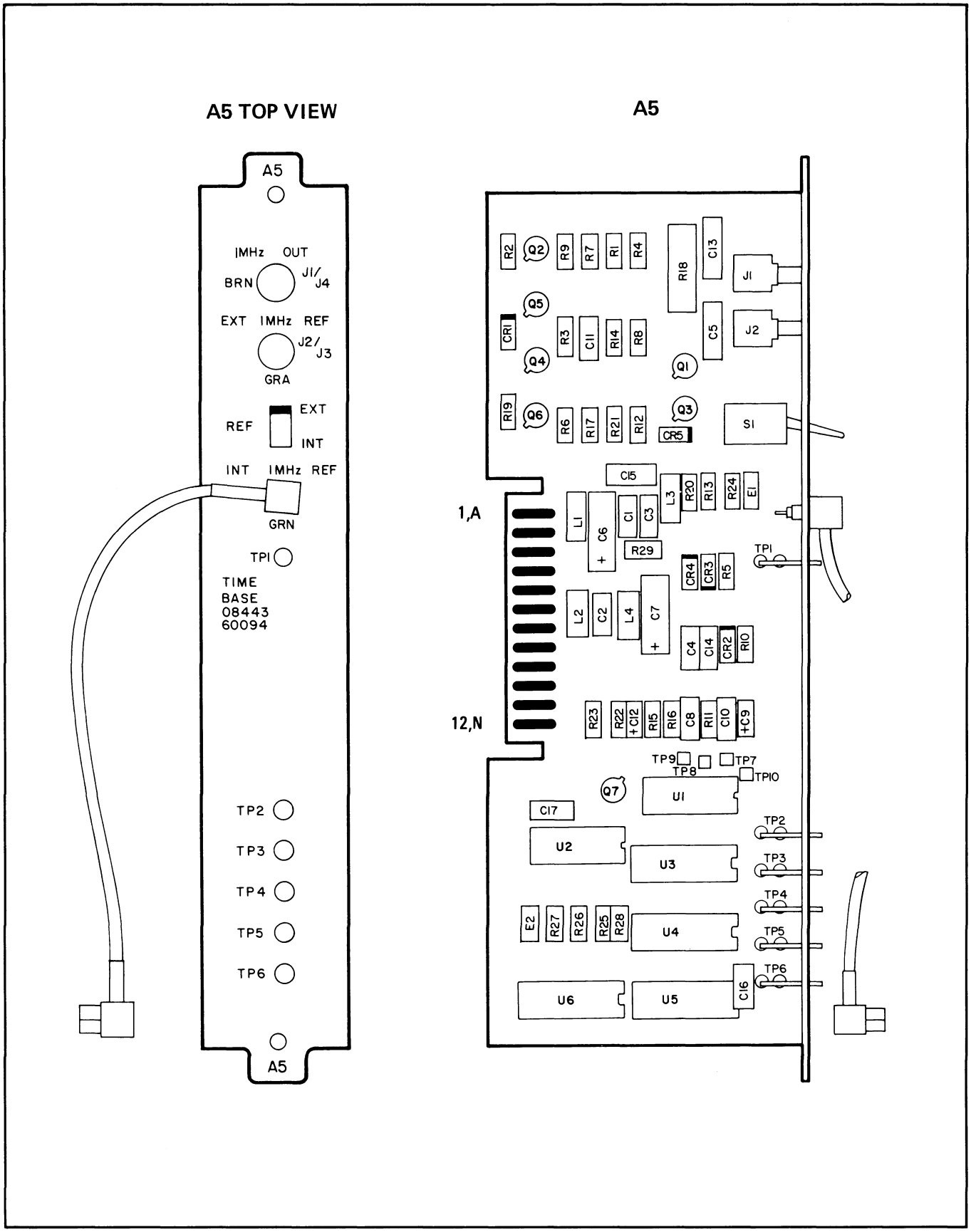
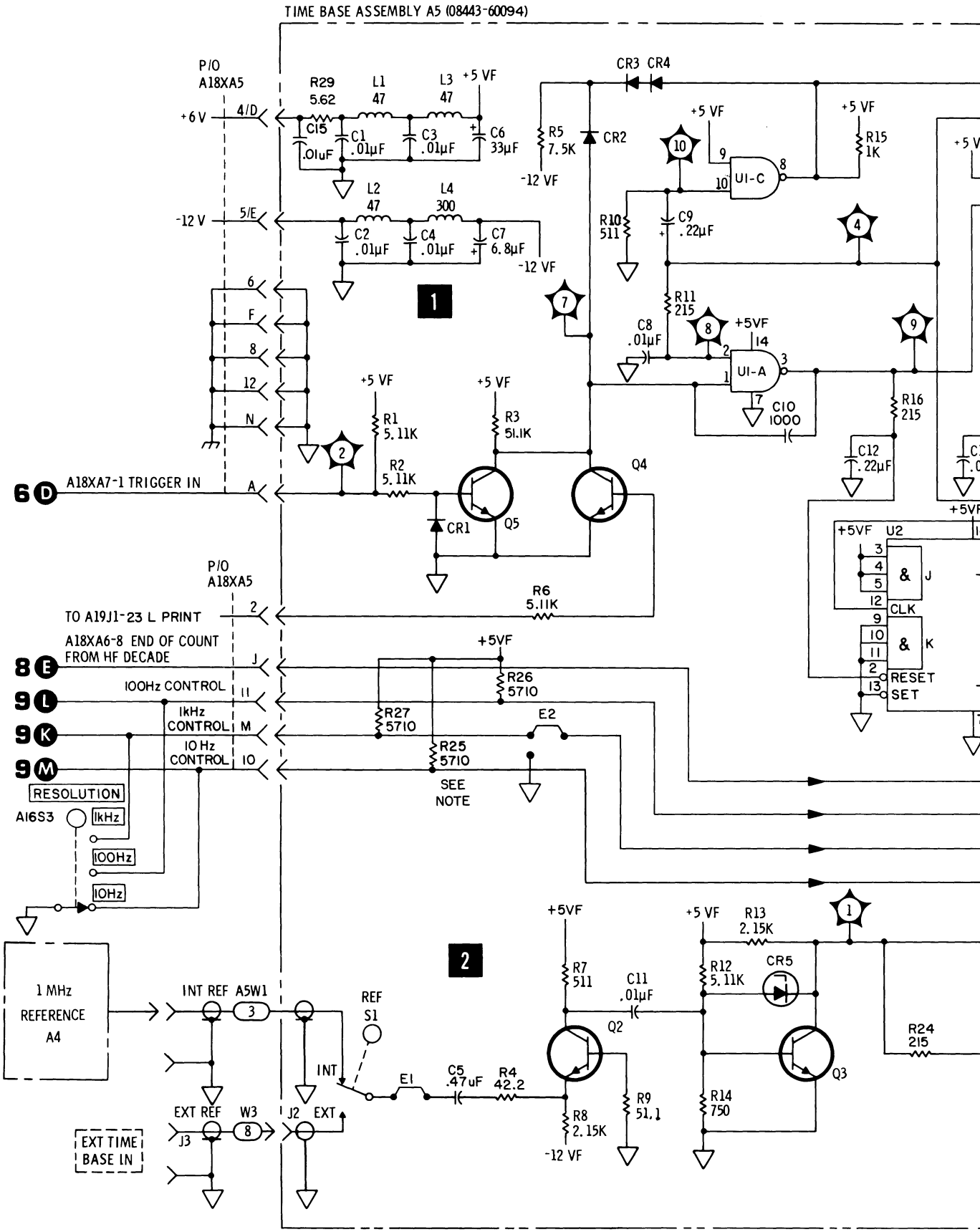
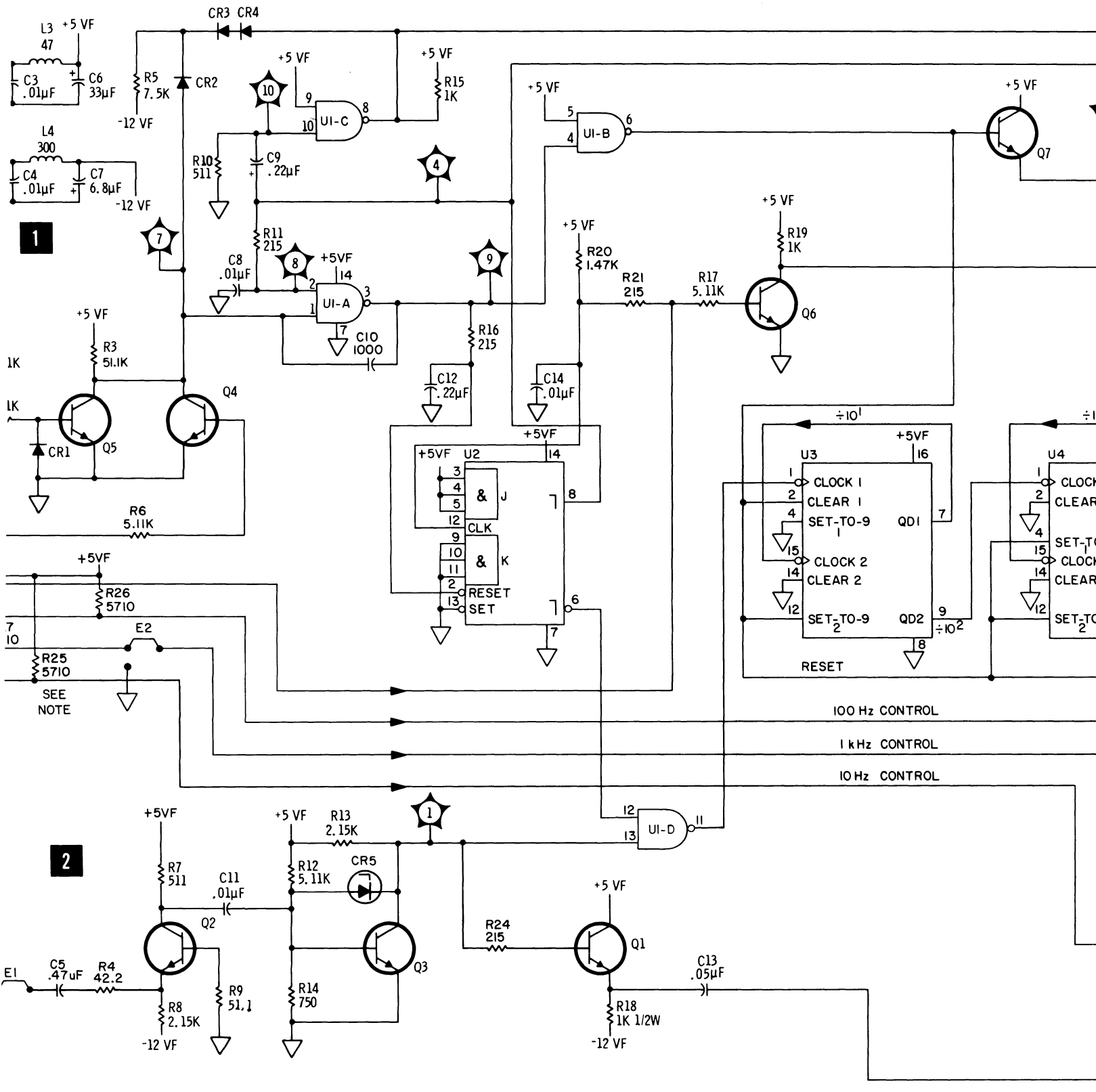


Figure 8-31. Time Base Assembly A5 Parts Locations


TIME BASE ASSEMBLY A5 (08443-60094)
P/O A18XA5
+6 V
4/D
-12 V
5/E
R29 5.62
L1 47
L3 47
+5 VF
C15 .01uF
C1 .01µF
C3 .01µF
C6 33µF
L2 47
L4 300
C2 .01µF
C4 .01µF
C7 6.8µF
-12 VF
CR3 CR4
R5 7.5K
CR2
+5 VF
R15 1K
U1-C
R10 511
C9 .22µF
R11 215
C8 .01µF
+5VF
U1-A
C10 1000
R16 215
C12 .22µF
+5VF U2
J
CLK
K
RESET
SET
6 D
A18XA7-1 TRIGGER IN
A
R1 5.11K
R2 5.11K
R3 5.11K
Q4
Q5
CR1
P/O A18XA5
TO A19J1-23 L PRINT
2
R6 5.11K
A18XA6-8 END OF COUNT FROM HF DECADE
8 E
J
+5VF
R26 5710
100Hz CONTROL
9 L
11
1kHz CONTROL
9 K
M
R27 5710
E2
10 Hz CONTROL
9 M
10
R25 5710
SEE NOTE
RESOLUTION
A16S3
1kHz
100Hz
10Hz
1 MHz REFERENCE A4
INT REF A5W1
3
REF S1
INT
E1
C5 .47uF
R4 42.2
EXT REF
W3
8
J2 EXT
J3
EXT TIME BASE IN
+5VF
R7 511
C11 .01µF
Q2
R8 2.15K
R9 51.1
-12 VF
+5 VF
R13 2.15K
R12 5.11K
CR5
Q3
R14 750
R24 215


L3 47
C3 .01µF
C6 33µF
+5 VF
R5 7.5K
-12 VF
CR2
CR3 CR4
L4 300
C4 .01µF
C7 6.8µF
-12 VF
R10 511
C9 .22µF
U1-C
U1-B
U1-A
R15 1K
R11 215
C8 .01µF
C10 1000
R20 1.47K
R21 215
R17 5.11K
R19 1K
Q6
Q7
R16 215
C12 .22µF
C14 .01µF
R3 51.1K
Q4
Q5
CR1
R6 5.11K
U2
J
K
CLK
RESET
SET
U3
U4
CLOCK 1
CLEAR 1
SET-TO-9
QD1
CLOCK 2
CLEAR 2
SET-TO-9
QD2
RESET
÷10¹
÷10²
R26 5710
R25 5710
E2
SEE NOTE
100 Hz CONTROL
1 kHz CONTROL
10 Hz CONTROL
U1-D
R13 2.15K
R7 511
C11 .01µF
R12 5.11K
CR5
Q2
Q3
R24 215
Q1
C13 .05µF
R18 1K 1/2W
C5 .47uF
R4 42.2
R8 2.15K
R9 51.1
R14 750
E1
1
2

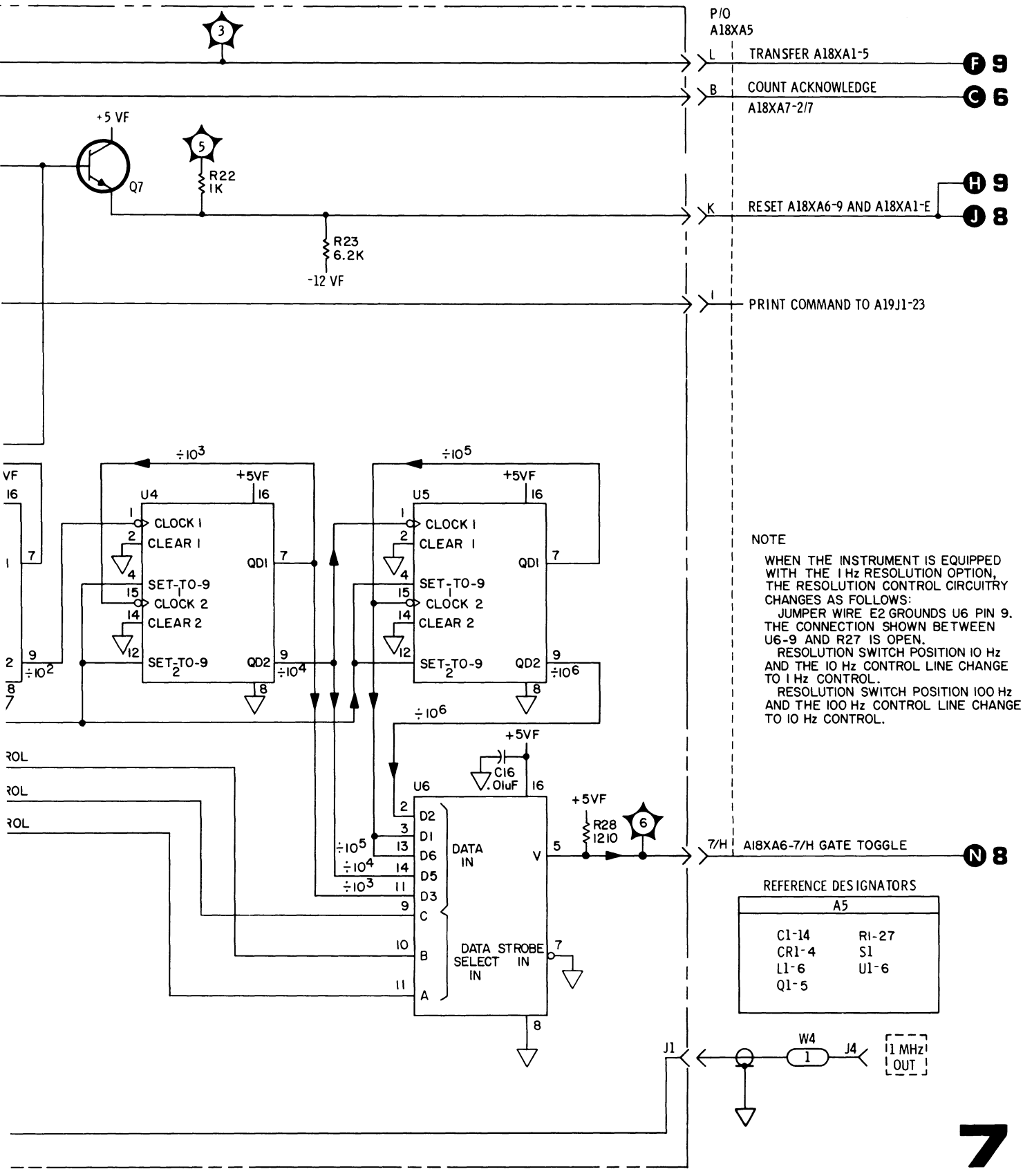


Figure 8-32. Time Base Assembly A5 Schematic Diagram

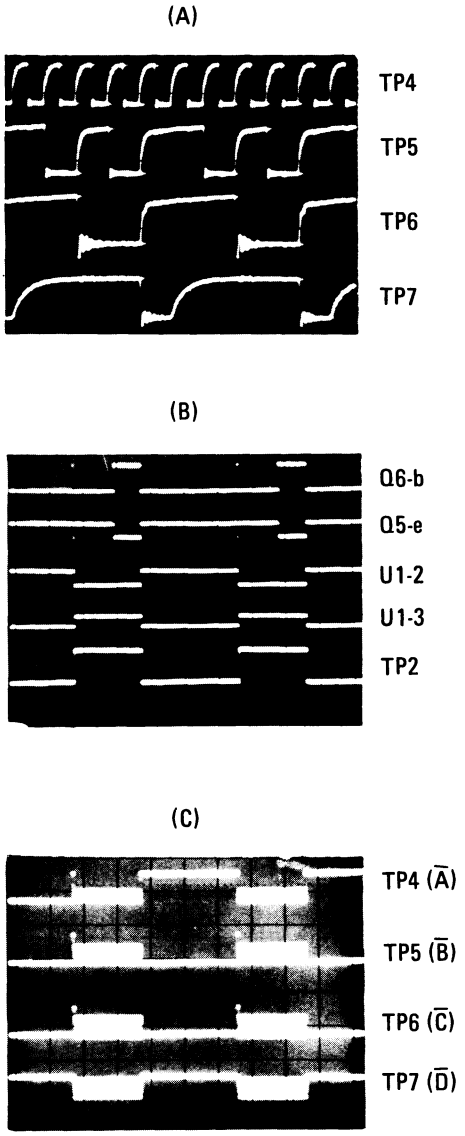


Figure 8-33. High Frequency Decade Assembly A6 Test Waveforms

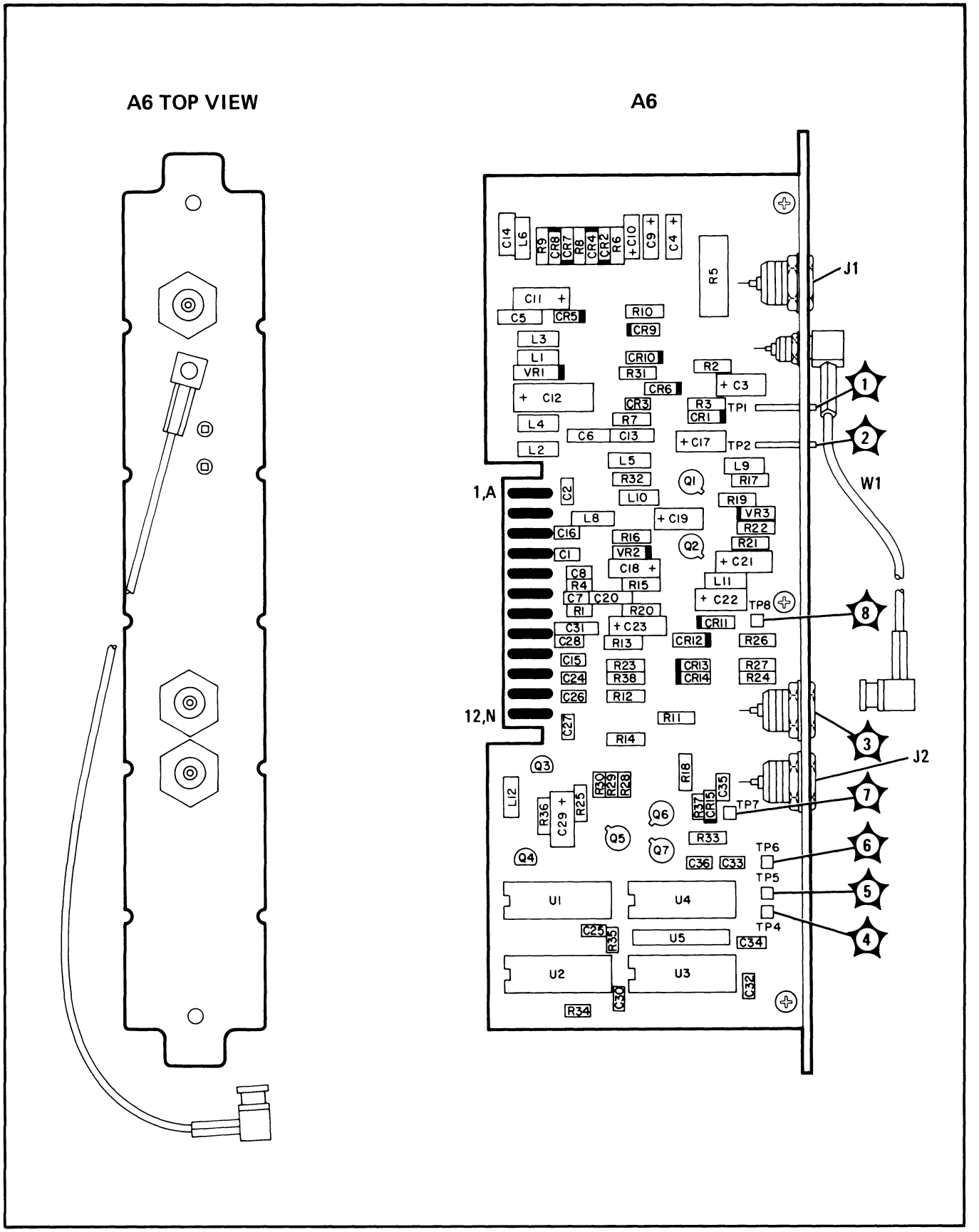
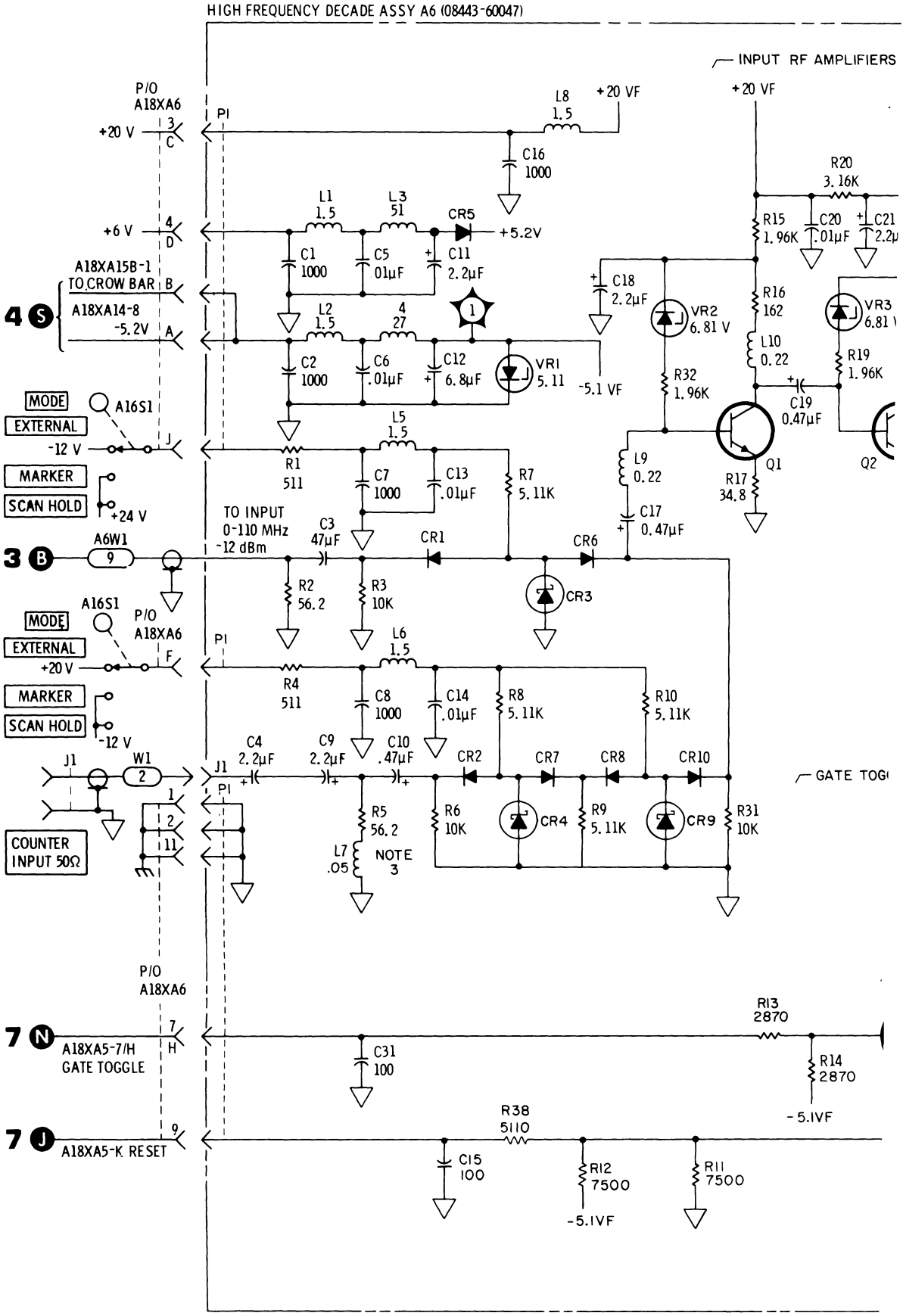
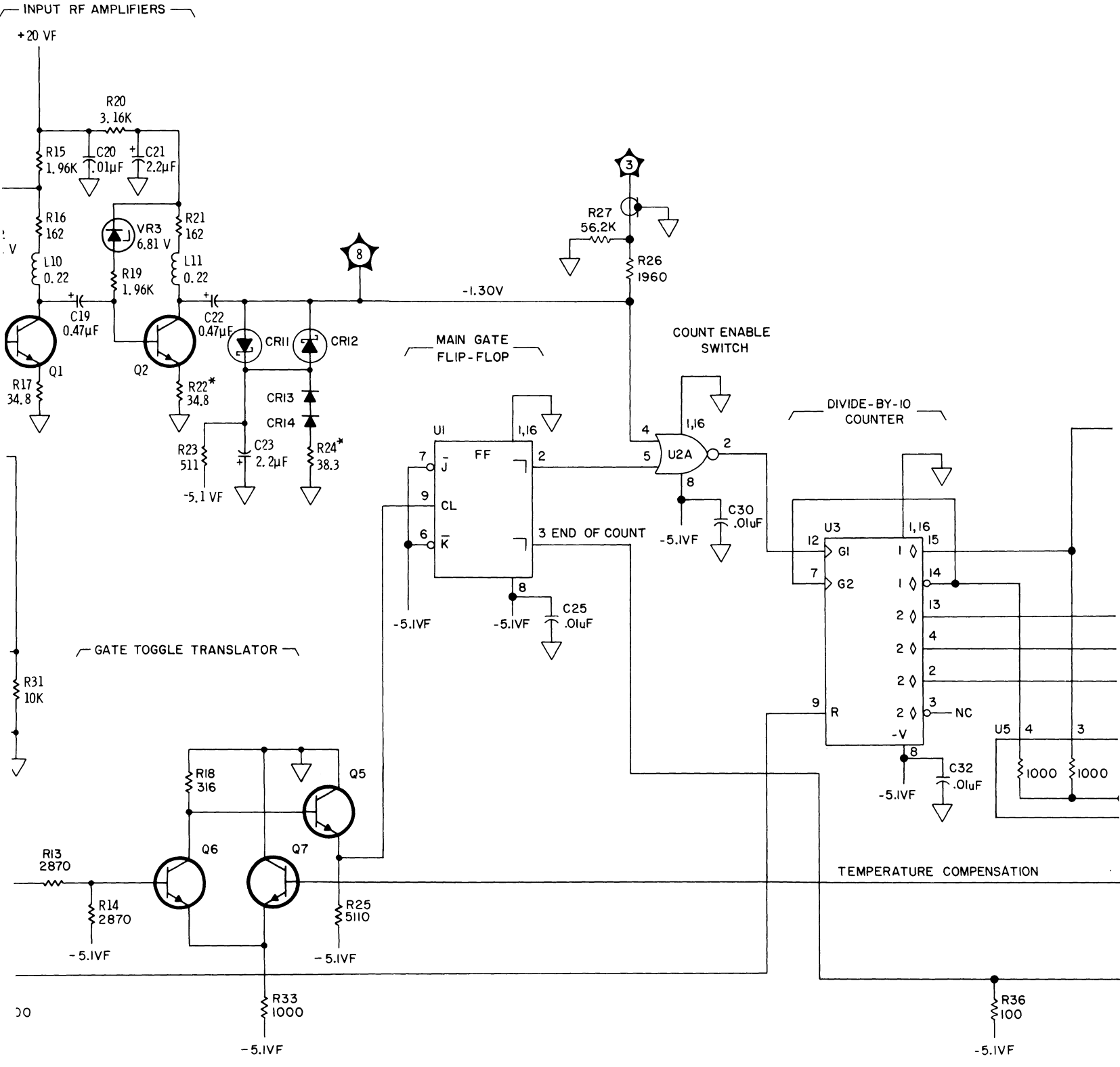


Figure 8-34. High Frequency Decade Assembly A6 Parts Locations


HIGH FREQUENCY DECADE ASSY A6 (08443-60047)
INPUT RF AMPLIFIERS
P/O A18XA6
+20 V
3
C
PI
L8 1.5
+20 VF
C16 1000
+20 VF
R20 3.16K
L1 1.5
L3 51
CR5
+5.2V
+6 V
4
D
C1 1000
C5 .01µF
C11 2.2µF
R15 1.96K
C20 .01µF
C21 2.2µ
A18XA15B-1 TO CROW BAR
B
4 S
A18XA14-8 -5.2V
A
L2 1.5
4
27
C18 2.2µF
VR2 6.81 V
R16 162
VR3 6.81
C2 1000
C6 .01µF
C12 6.8µF
VR1 5.11
-5.1 VF
L10 0.22
R19 1.96K
R32 1.96K
C19 0.47µF
MODE
A16S1
EXTERNAL
-12 V
J
L5 1.5
MARKER
SCAN HOLD
+24 V
R1 511
C7 1000
C13 .01µF
R7 5.11K
L9 0.22
Q1
Q2
R17 34.8
C17 0.47µF
TO INPUT 0-110 MHz -12 dBm
A6W1
3 B
9
C3 47µF
CR1
CR6
CR3
R2 56.2
R3 10K
A16S1
P/O A18XA6
MODE
EXTERNAL
+20 V
F
PI
L6 1.5
MARKER
SCAN HOLD
-12 V
R4 511
C8 1000
C14 .01µF
R8 5.11K
R10 5.11K
J1
W1
2
C4 2.2µF
C9 2.2µF
C10 .47µF
CR2
CR7
CR8
CR10
GATE TOG
J1
PI
1
2
11
R5 56.2
R6 10K
CR4
R9 5.11K
CR9
R31 10K
L7 .05
NOTE 3
COUNTER INPUT 50Ω
P/O A18XA6
R13 2870
7 N
7
H
A18XA5-7/H GATE TOGGLE
C31 100
R14 2870
-5.1VF
R38 5110
7 J
9
A18XA5-K RESET
C15 100
R12 7500
R11 7500
-5.1VF


INPUT RF AMPLIFIERS
+20 VF
R20
3.16K
R15
1.96K
C20
.01μF
C21
2.2μF
R16
162
VR3
6.81 V
R21
162
L10
0.22
R19
1.96K
L11
0.22
C19
0.47μF
C22
0.47μF
Q1
Q2
R17
34.8
R22*
34.8
CR11
CR12
CR13
CR14
R23
511
C23
2.2μF
R24*
38.3
-5.1 VF
8
-1.30V
3
R27
56.2K
R26
1960
MAIN GATE
FLIP-FLOP
U1
FF
J
CL
K
1,16
2
3 END OF COUNT
-5.1VF
C25
.01uF
COUNT ENABLE
SWITCH
U2A
4
5
2
8
C30
.01uF
DIVIDE-BY-10
COUNTER
U3
GI
G2
R
-V
12
7
9
15
14
13
4
2
3
NC
C32
.01uF
U5
1000
GATE TOGGLE TRANSLATOR
R31
10K
R18
316
Q5
Q6
Q7
R13
2870
R14
2870
R25
5110
TEMPERATURE COMPENSATION
R33
1000
R36
100

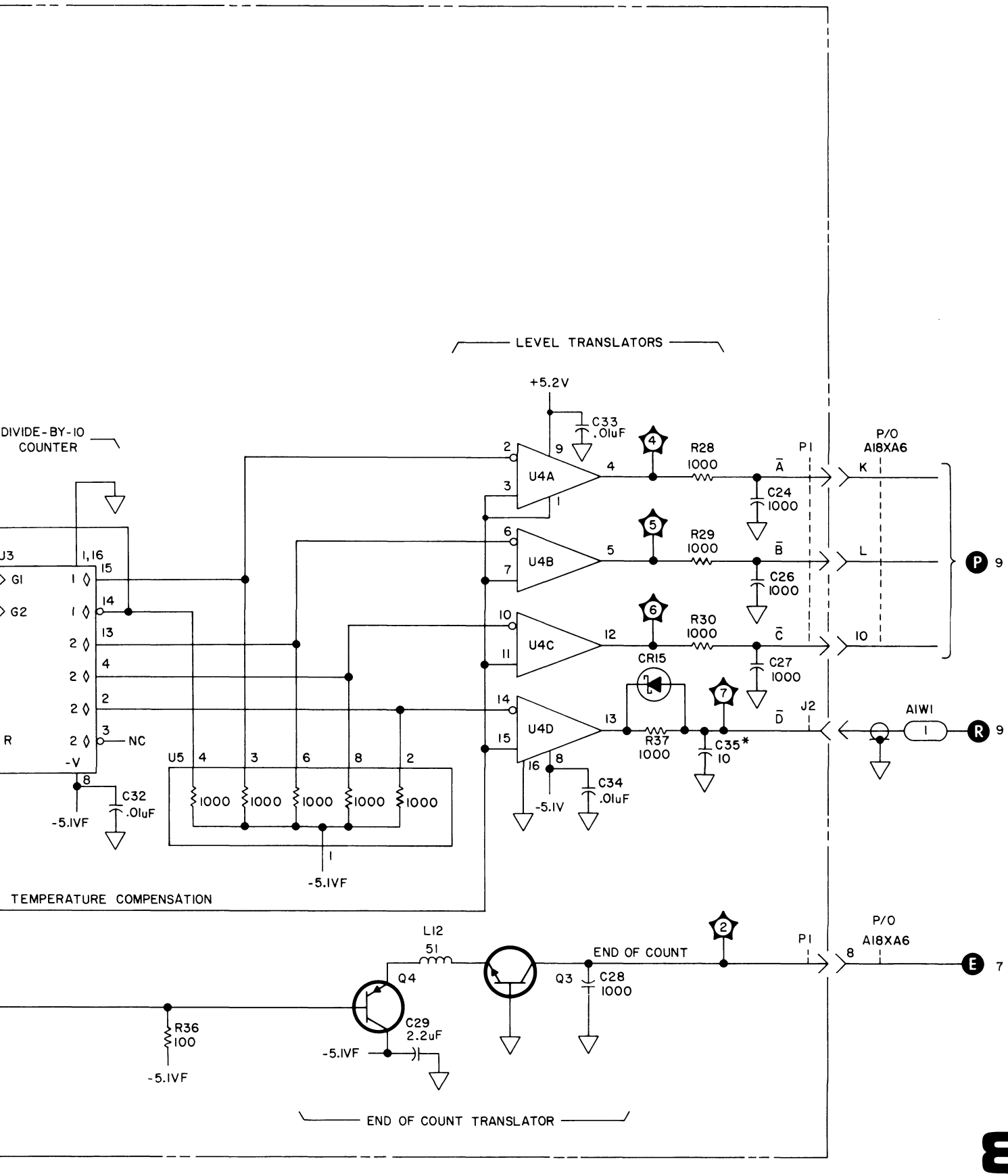


Figure 8-35. High Frequency Decade Assembly A6 Schematic Diagram

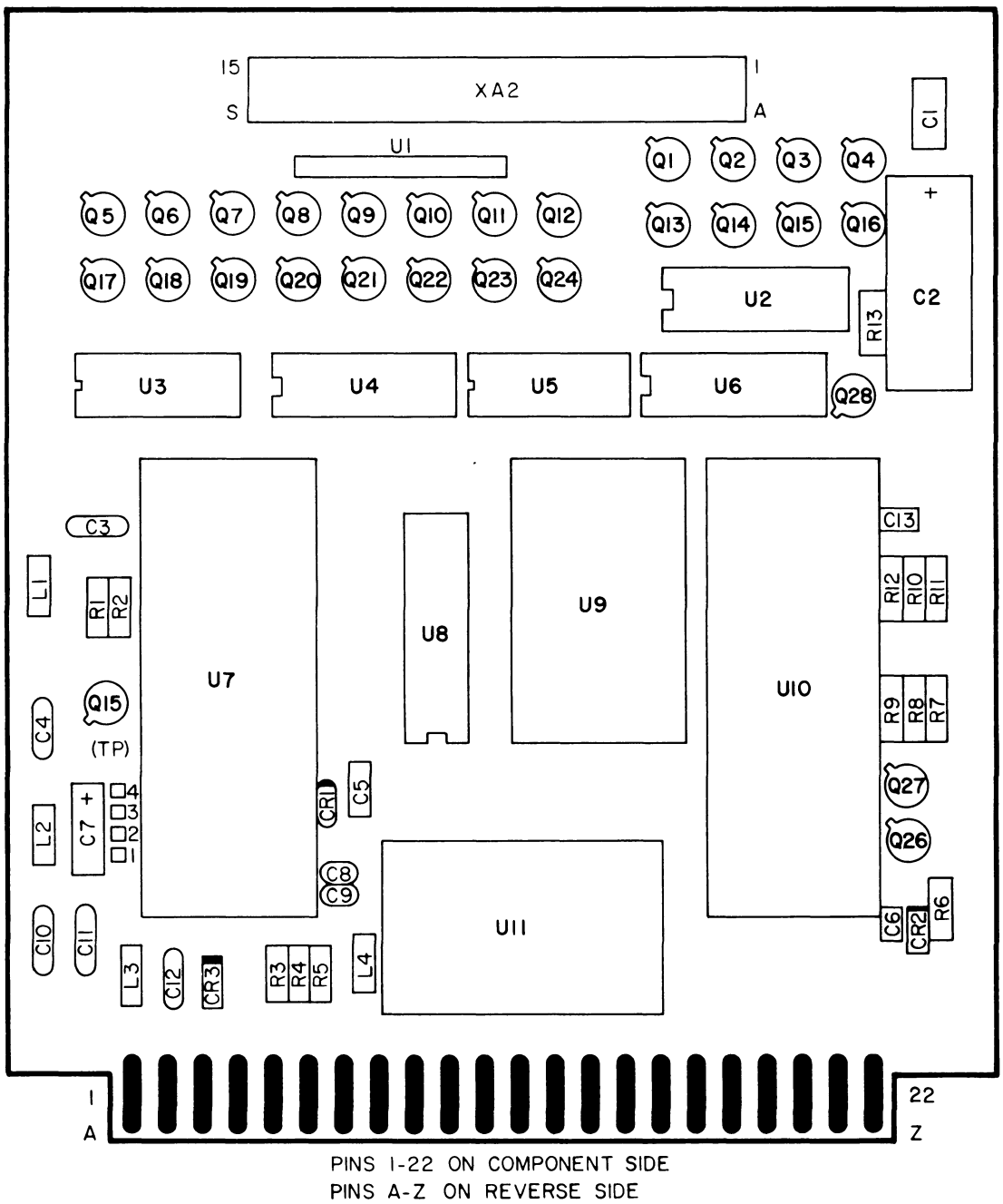


Figure 8-36. Low Frequency Counter Board Assembly A1A1 Parts Locations

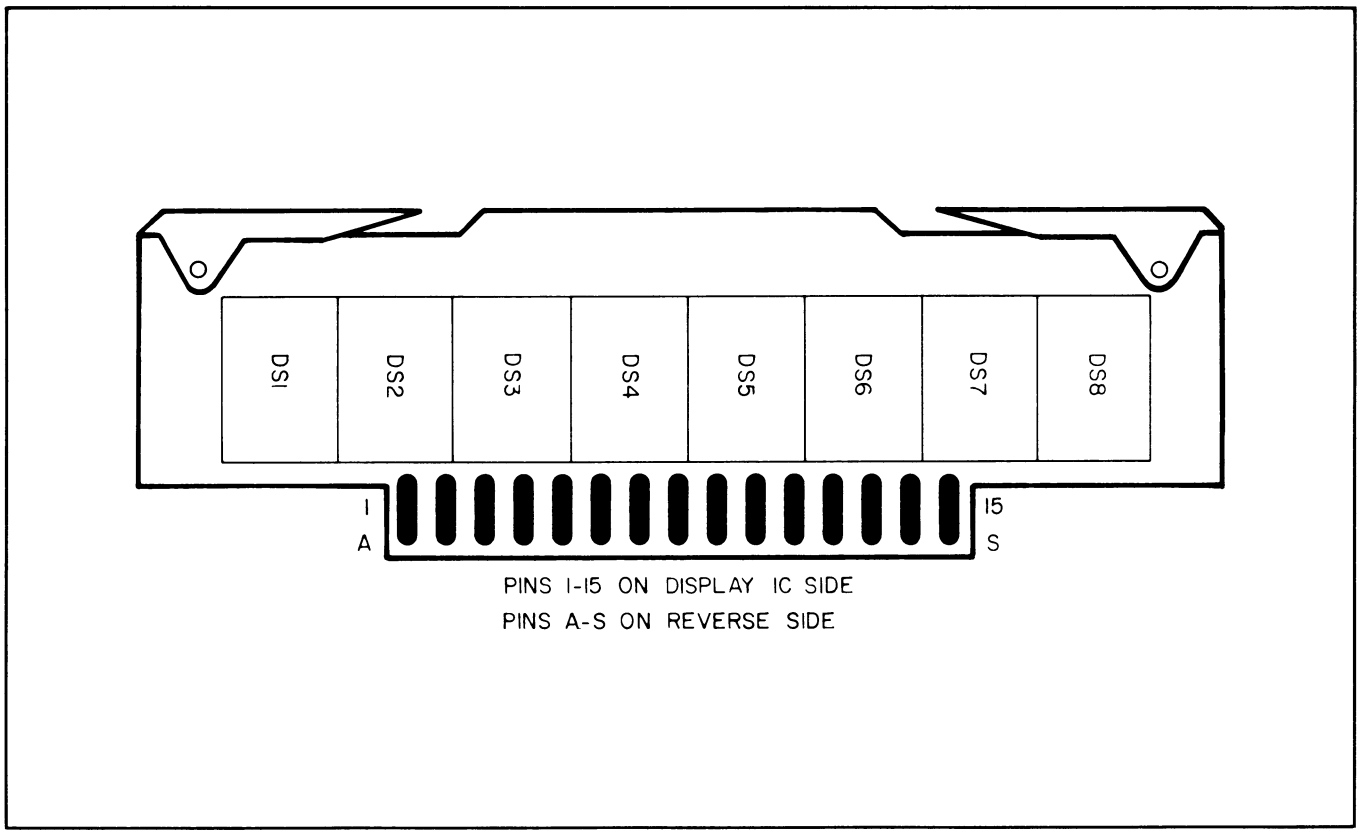


Figure 8-37. Counter Display Board Assembly A1A2 Parts Locations

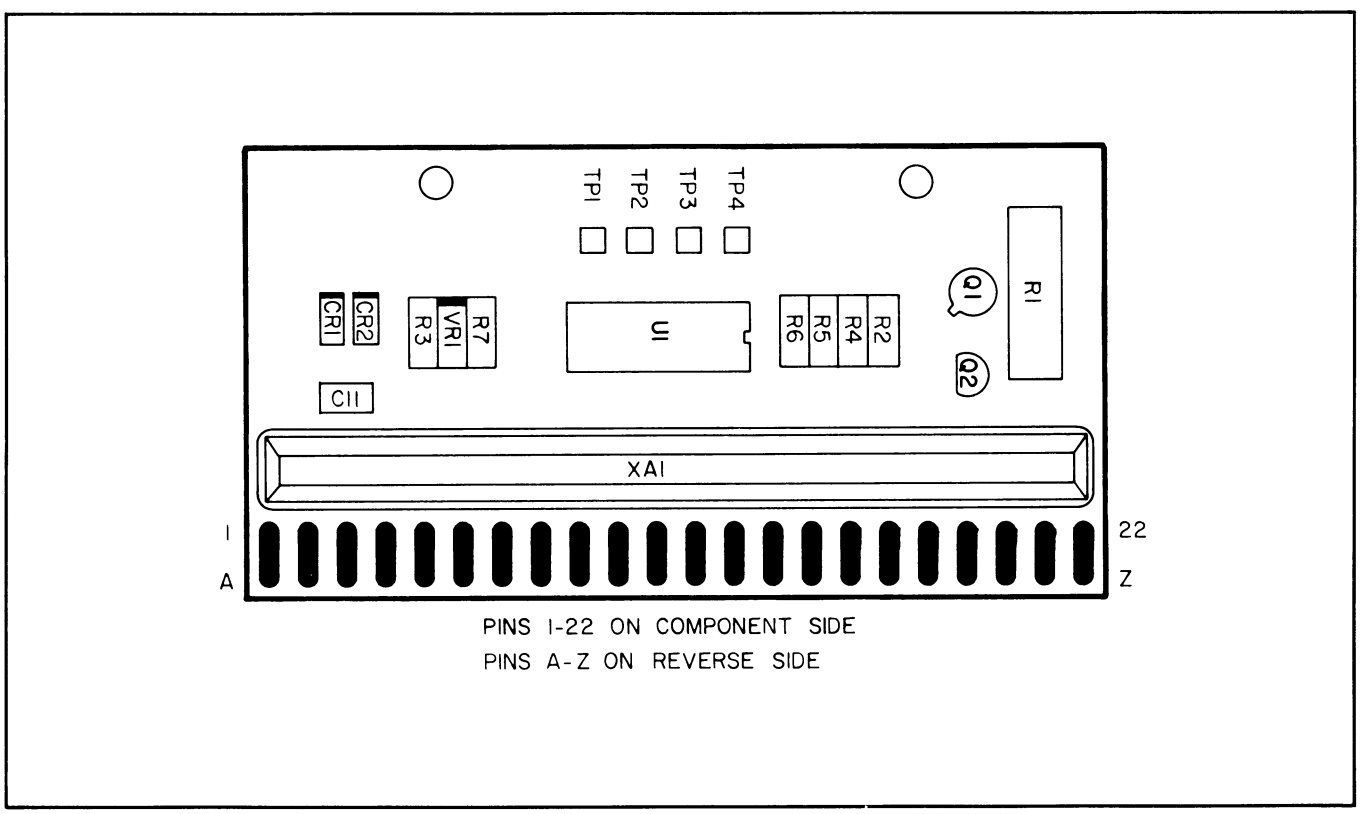
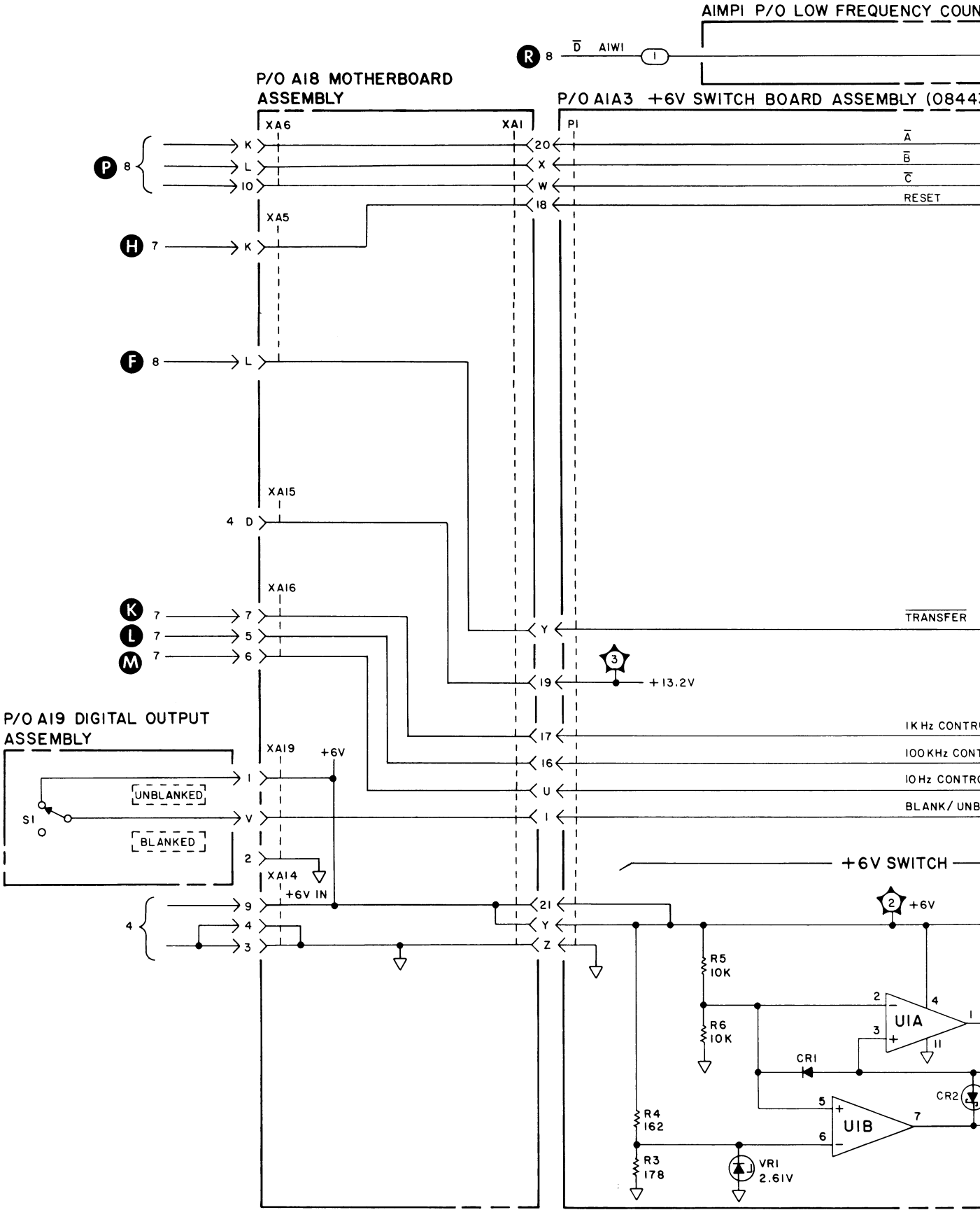


Figure 8-38. +6V Switch Board Assembly A1A3 Parts Locations


AIMPI P/O LOW FREQUENCY COUN
R 8 D AIWI 1
P/O A18 MOTHERBOARD ASSEMBLY
P/O AIA3 +6V SWITCH BOARD ASSEMBLY (0844
XA6
XA1
P1
P 8 K L 10
20 X W 18
A
B
C
RESET
XA5
H 7 K
F 8 L
XA15
4 D
XA16
K 7 7
L 7 5
M 7 6
Y
TRANSFER
3
19
+13.2V
P/O A19 DIGITAL OUTPUT ASSEMBLY
XA19
+6V
1
UNBLANKED
S1
V
BLANKED
2
17
1K Hz CONTR
16
100 KHz CONT
U
10 Hz CONTRO
I
BLANK/ UNB
XA14
+6V IN
+6V SWITCH
4 9 4 3
21 Y Z
2
+6V
R5 10K
R6 10K
UIA
CR1
CR2
R4 162
R3 178
UIB
VR1 2.61V

REQUENCY COUNTER ENCLOSURE

AIAI LOW FREQUENCY COUNTER
(08443-60090)

AIA2 COUNTER DISPLAY AS

AIW2

$\overline{D}$

SSEMBLY (08443-60095)

XAIAI

PI

$\overline{A}$ — C

$\overline{B}$ — 3

$\overline{C}$ — 4

RESET — E

XA2

PI

DP (DECIMAL POINT)

A-S — g

14 — f

15 — e

9 — d

10 — c

11 — b

12 — a

13

DS8

11 2 7 8 10 13 1

g f e d c b a

a

f b

g

e c

d

COM ANODE

3

SEE SHEET 2

TRANSFER — 5

XA2

PI

8 — D8

7 — D7

6 — D6

5 — D5

4 — D4

3 — D3

2 — D2

1 — D1

1KHz CONTROL

100KHz CONTROL

10Hz CONTROL — F

BLANK/UNBLANKED — H

-6V SWITCH — 6

2 +6V

Q1

4 +5.5V — Z

SWITCHED — B

R1 51.1

2

4

R2 1470

U1A

1

3

11

Q2

CR2

R7 215K

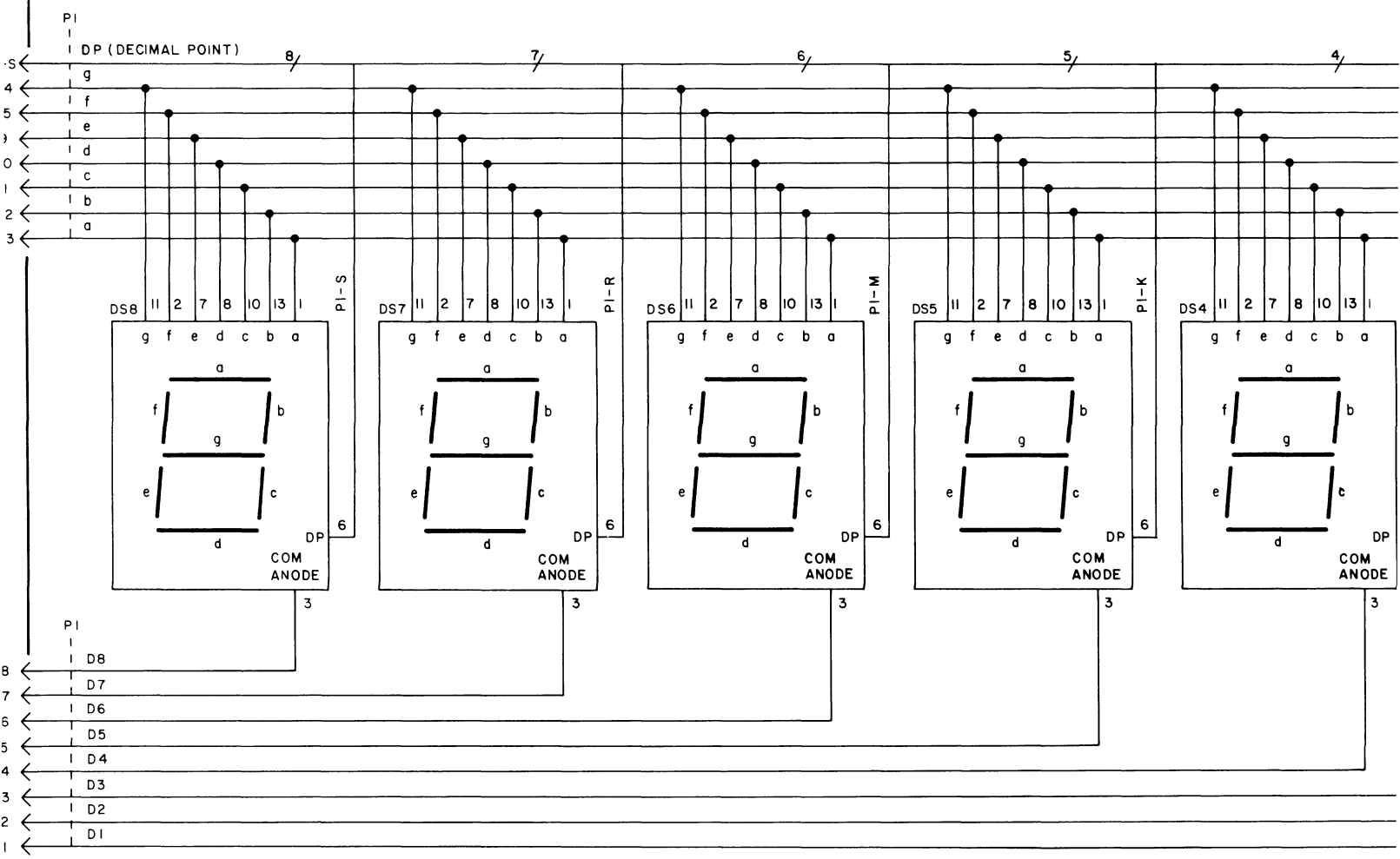
7

U1B

C1 2.2

1

A1A2 COUNTER DISPLAY ASSEMBLY (08443-60091)



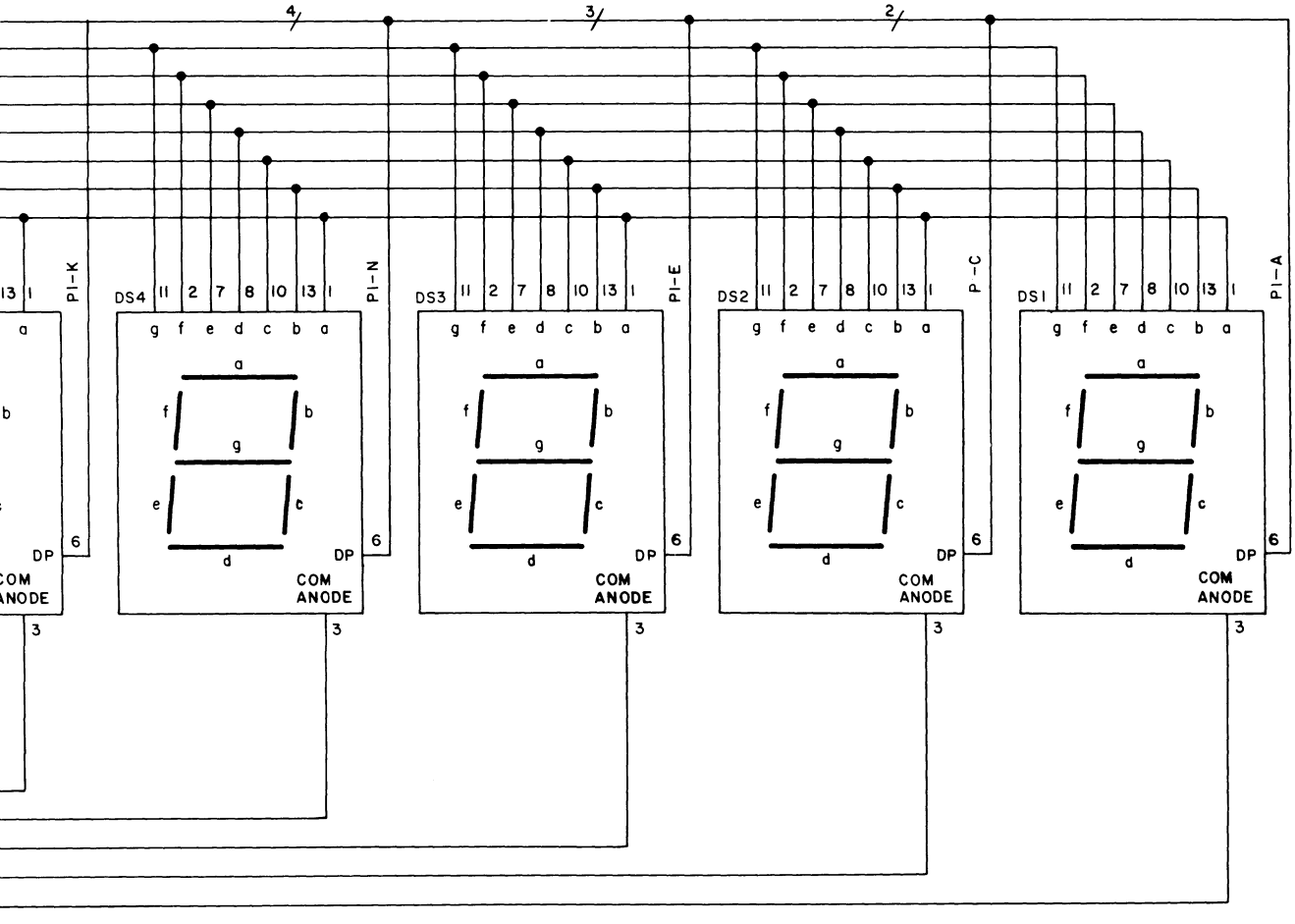
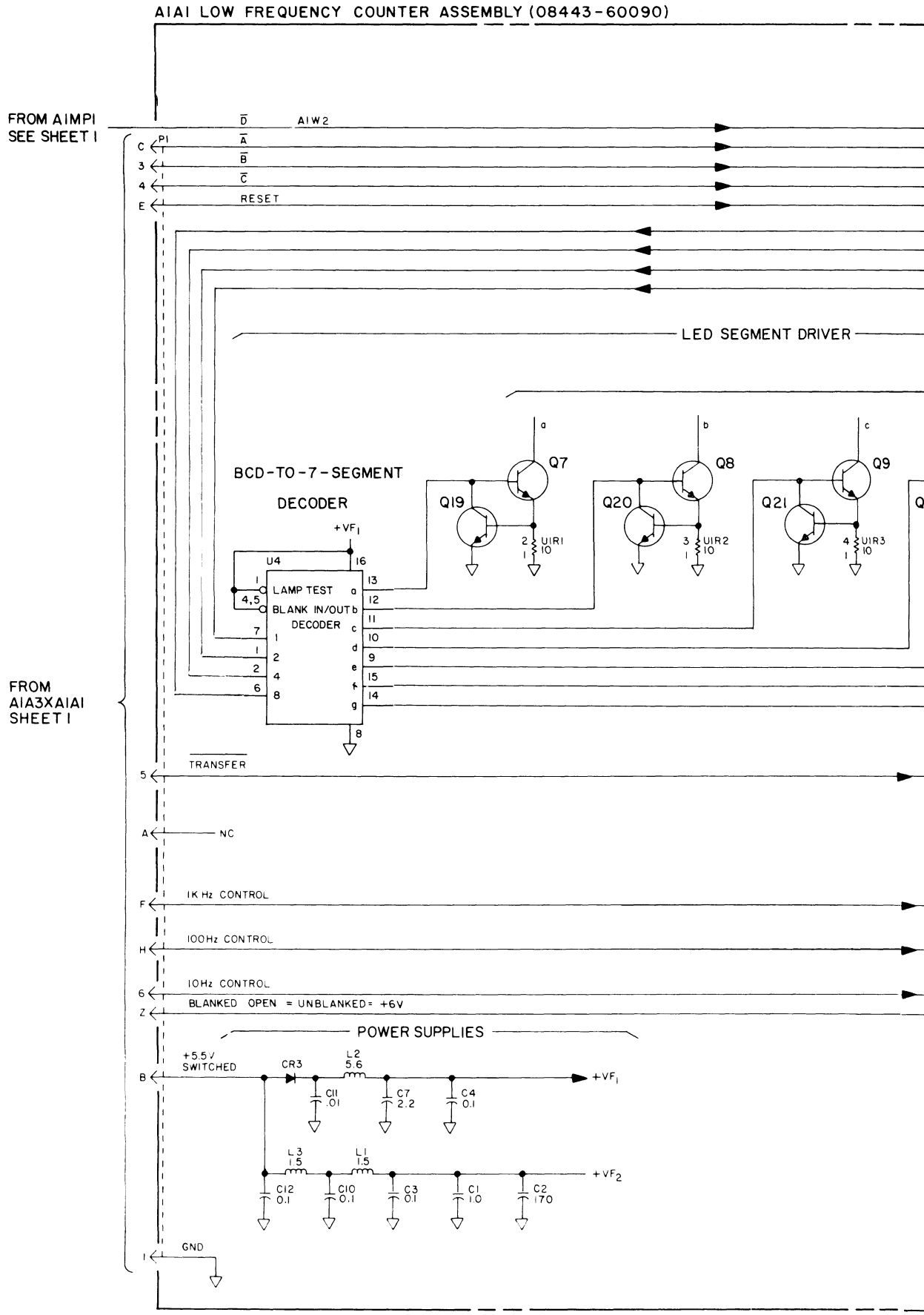
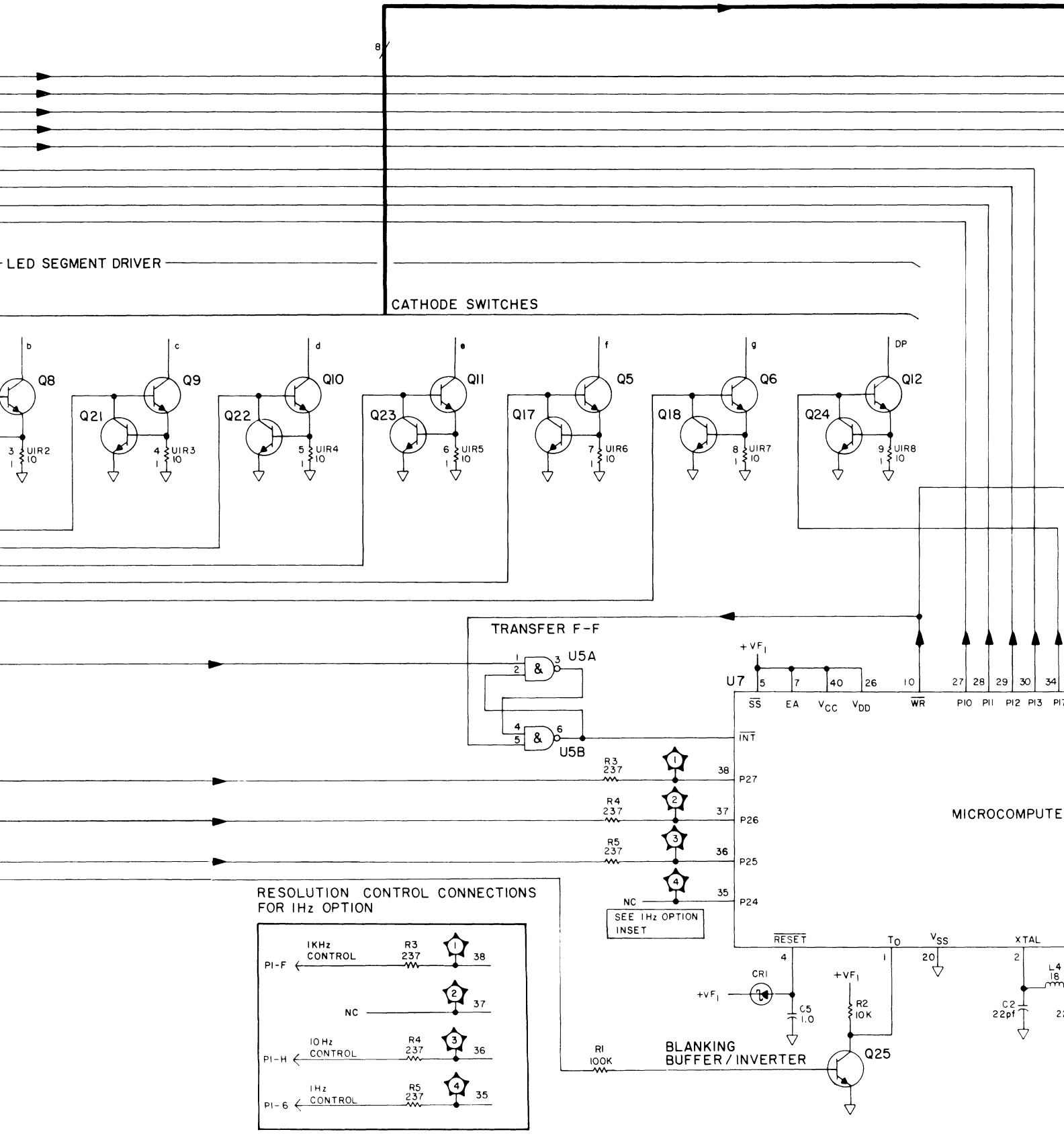
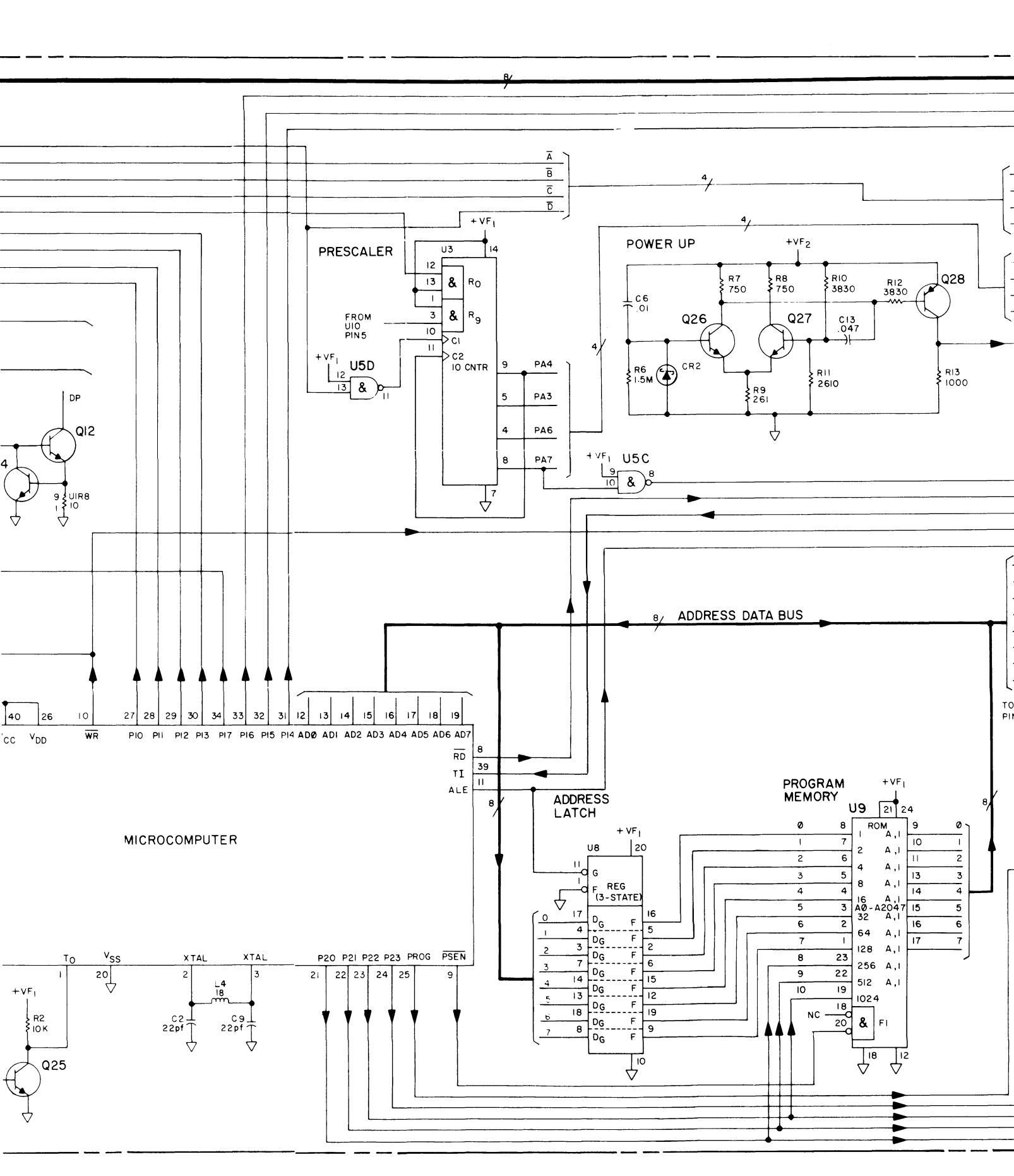
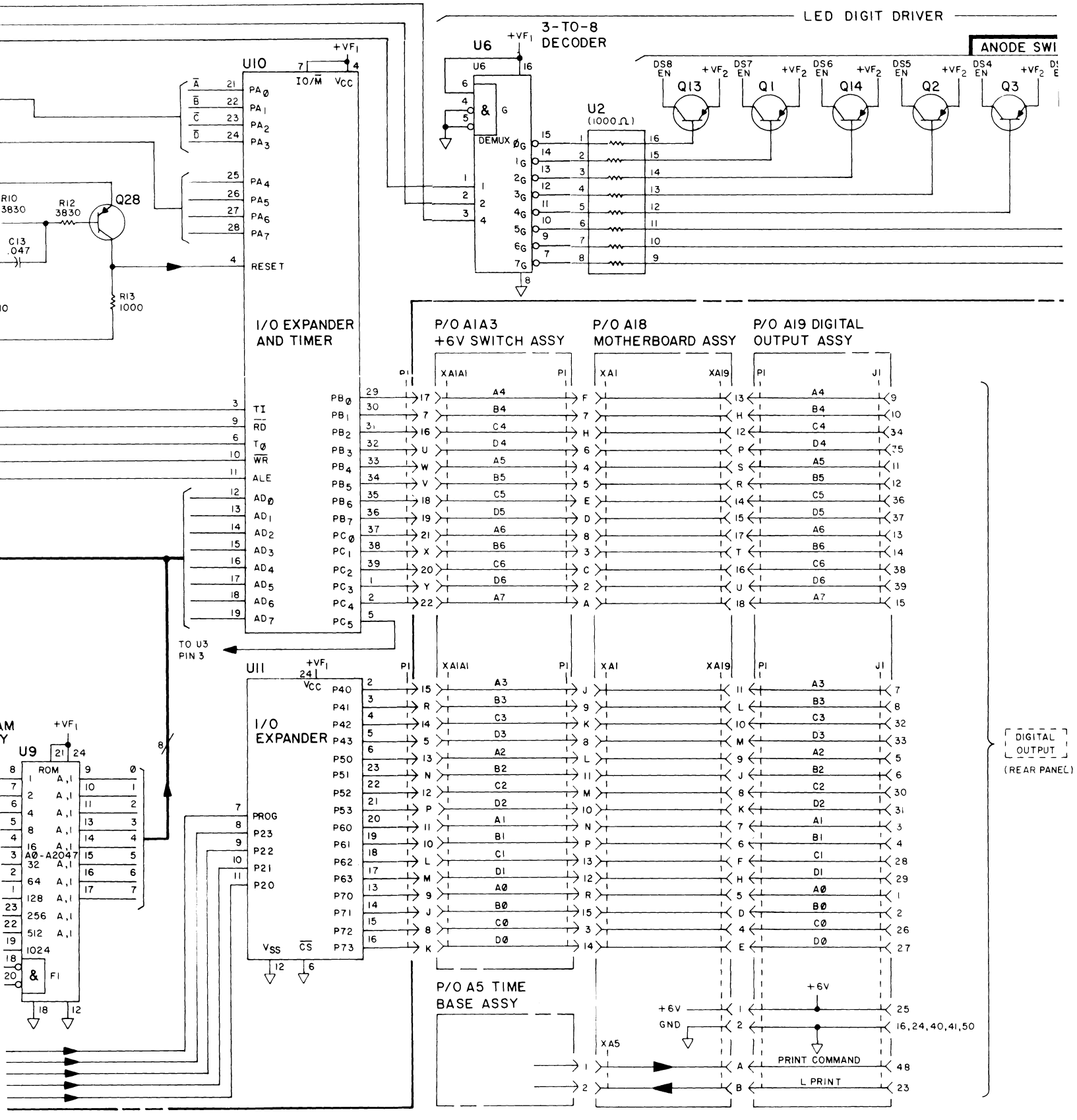


Figure 8-39. Low Frequency Counter Assembly A1 and Digital Output Assembly A19 Schematic Diagram (1 of 2)


A1A1 LOW FREQUENCY COUNTER ASSEMBLY (08443-60090)
FROM A1MP1 SEE SHEET 1
D
A1W2
A
B
C
RESET
LED SEGMENT DRIVER
BCD-TO-7-SEGMENT DECODER
U4
LAMP TEST
BLANK IN/OUT
DECODER
+VF1
Q7
Q8
Q9
Q19
Q20
Q21
R1 10
R2 10
R3 10
FROM A1A3XA1A1 SHEET 1
TRANSFER
NC
1K Hz CONTROL
100Hz CONTROL
10Hz CONTROL
BLANKED OPEN = UNBLANKED= +6V
POWER SUPPLIES
+5.5V SWITCHED
CR3
L2 5.6
C11 .01
C7 2.2
C4 0.1
+VF1
L3 1.5
L1 1.5
C12 0.1
C10 0.1
C3 0.1
C1 1.0
C2 170
+VF2
GND


8
LED SEGMENT DRIVER
CATHODE SWITCHES
b
c
d
e
f
g
DP
Q8
Q9
Q10
Q11
Q5
Q6
Q12
Q21
Q22
Q23
Q17
Q18
Q24
UIR2 10
UIR3 10
UIR4 10
UIR5 10
UIR6 10
UIR7 10
UIR8 10
TRANSFER F-F
U5A
U5B
+VF1
U7
SS
EA
VCC
VDD
WR
P10
P11
P12
P13
INT
R3 237
R4 237
R5 237
P27
P26
P25
P24
NC
SEE 1Hz OPTION INSET
MICROCOMPUTE
RESET
T0
VSS
XTAL
CR1
C5 1.0
R2 10K
R1 100K
BLANKING BUFFER/INVERTER
Q25
C2 22pf
L4 18
RESOLUTION CONTROL CONNECTIONS FOR 1Hz OPTION
1KHz CONTROL
10Hz CONTROL
1Hz CONTROL
PI-F
PI-H
PI-6
NC


8
A
B
C
D
4
+VF1
PRESCALER
U3
14
12
13
&
R0
1
&
R9
3
10
C1
11
C2
10 CNTR
FROM
U10
PIN5
+VF1
U5D
12
13
&
11
9
PA4
5
PA3
4
PA6
8
PA7
7
+VF1
U5C
9
10
&
8
POWER UP
+VF2
R7
750
R8
750
R10
3830
R12
3830
Q28
C6
.01
Q26
Q27
C13
.047
R6
1.5M
CR2
R11
2610
R9
261
R13
1000
DP
Q12
9
UIR8
10
8
ADDRESS DATA BUS
40
26
10
27
28
29
30
34
33
32
31
12
13
14
15
16
17
18
19
VCC
VDD
WR
PI0
PI1
PI2
PI3
PI7
PI6
PI5
PI4
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
RD
8
TI
39
ALE
11
8
MICROCOMPUTER
ADDRESS
LATCH
+VF1
U8
20
11
G
1
F
REG
(3-STATE)
0
17
DG
F
16
1
4
5
2
3
2
7
6
3
14
15
4
13
12
5
18
19
6
8
9
7
10
PROGRAM
MEMORY
+VF1
U9
21
24
ROM
A,I
A0-A2047
0
8
1
7
2
6
3
5
4
4
5
3
6
2
7
1
8
23
9
22
10
19
18
NC
20
&
F1
9
0
10
1
11
2
13
3
14
4
15
5
16
6
17
7
18
12
8
T0
VSS
XTAL
XTAL
P20
P21
P22
P23
PROG
PSEN
1
20
2
3
21
22
23
24
25
9
+VF1
R2
10K
Q25
L4
18
C2
22pf
C9
22pf


LED DIGIT DRIVER
3-TO-8 DECODER
U6
U2 (1000Ω)
ANODE SWI
Q13
Q1
Q14
Q2
Q3
Q28
U10
I/O EXPANDER AND TIMER
U11
I/O EXPANDER
U9
ROM
A0-A2047
P/O A1A3 +6V SWITCH ASSY
P/O A18 MOTHERBOARD ASSY
P/O A19 DIGITAL OUTPUT ASSY
P/O A5 TIME BASE ASSY
TO U3 PIN 3
DIGITAL OUTPUT (REAR PANEL)
PRINT COMMAND
L PRINT
+6V
GND

NOTE

UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS (Ω).
CAPACITANCE IN MICROFARADS (μF).
INDUCTANCE IN MICROHENRIES (μH).

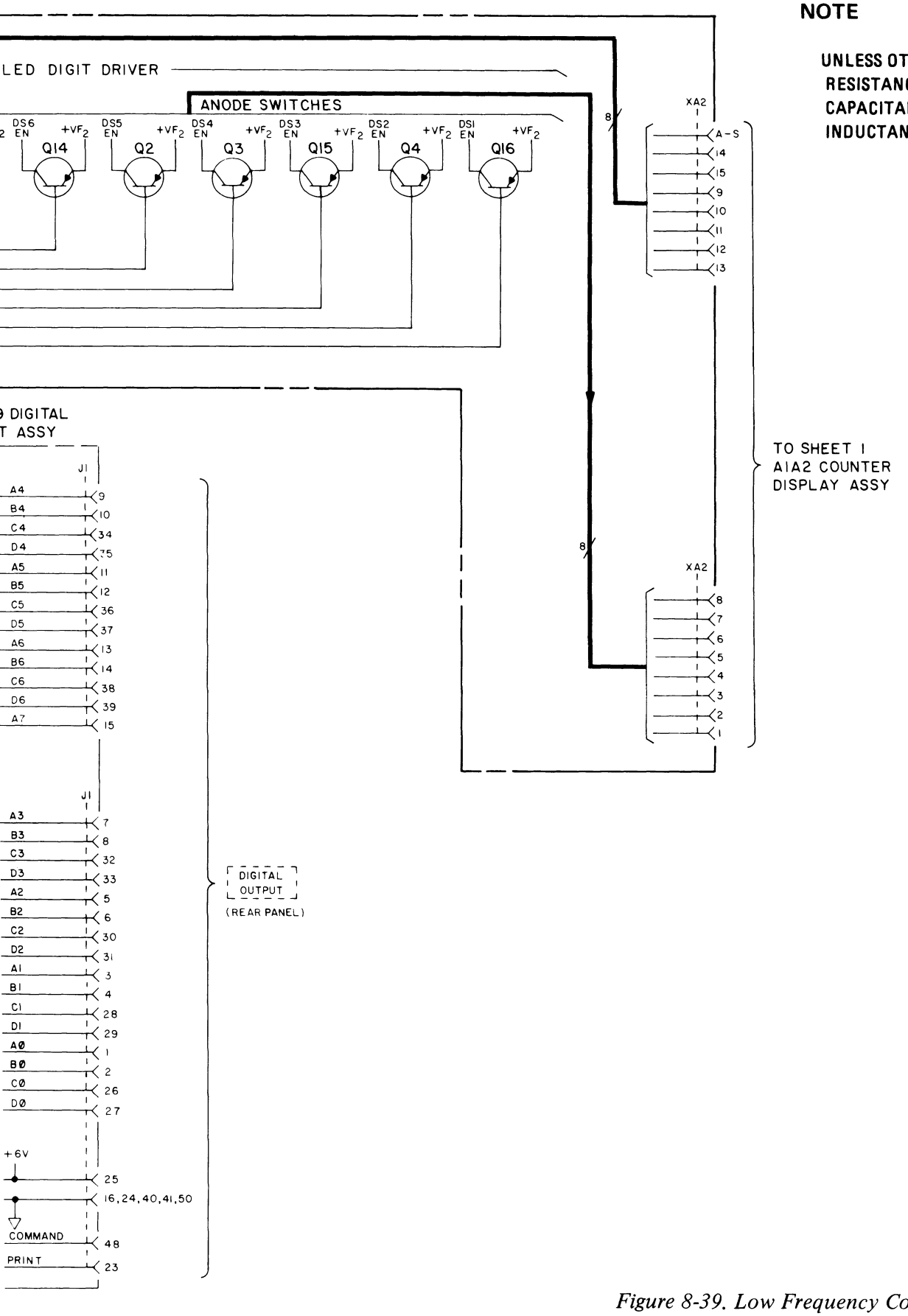
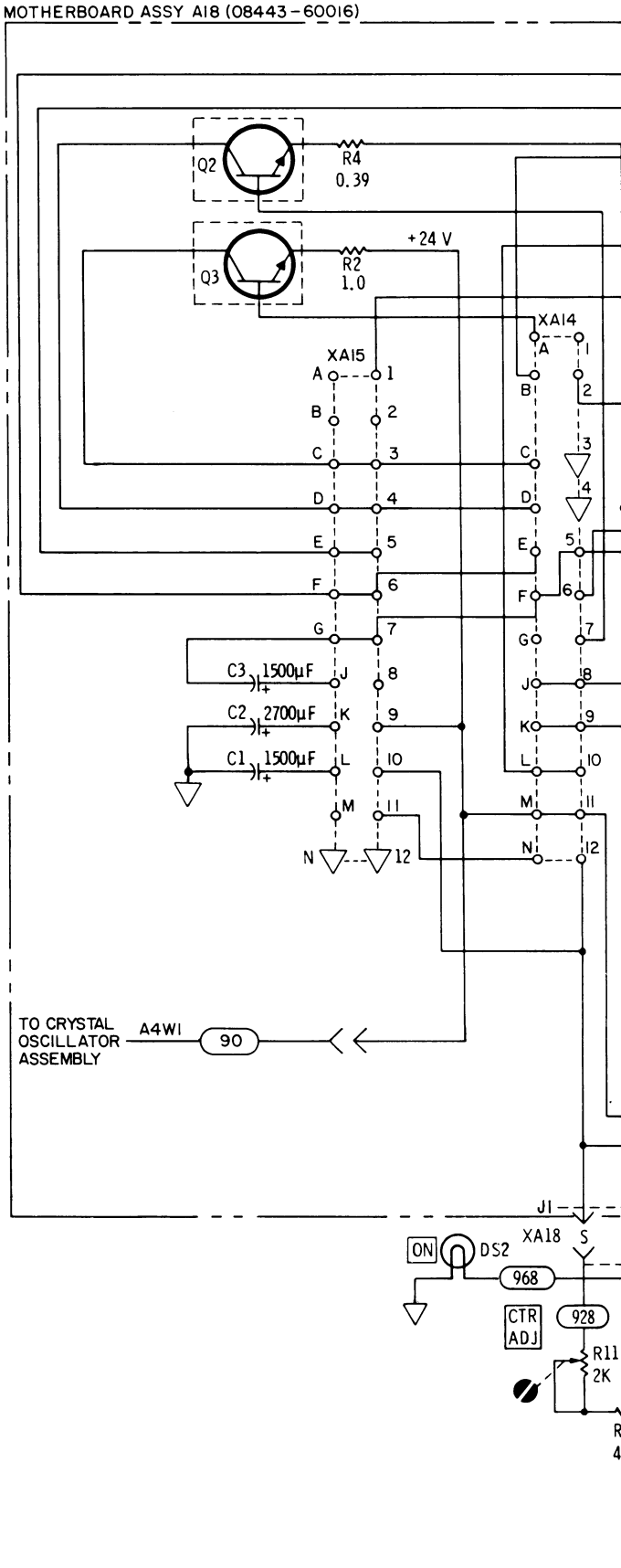
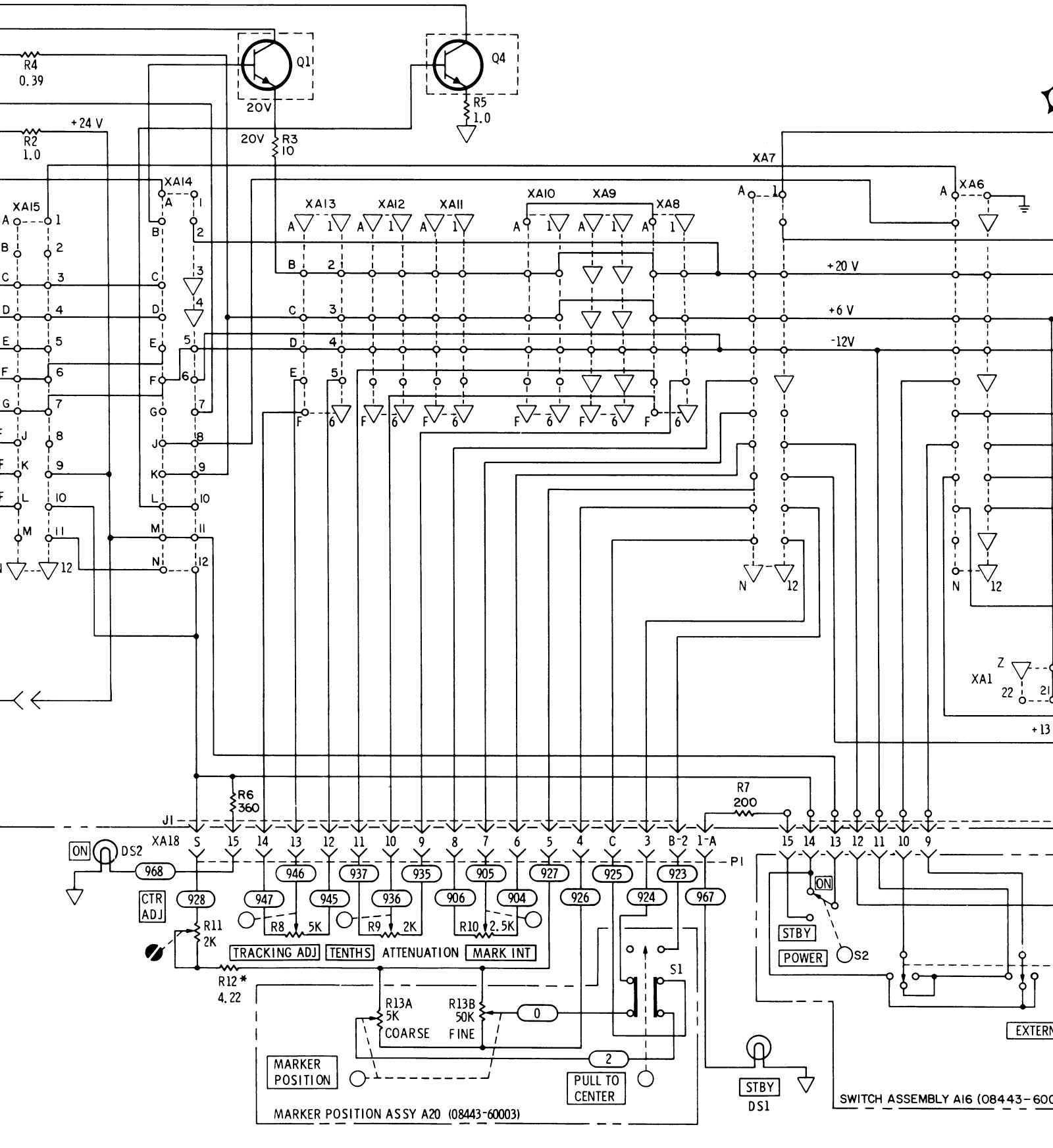


Figure 8-39. Low Frequency Counter Assembly A1 and Digital Output Assembly A19 Schematic Diagram (2 of 2)

MOTHERBOARD ASSY A18 (08443-60016)




Q1
Q4
R4
0.39
R5
1.0
R2
1.0
+24 V
20V
R3
10
XA14
XA15
XA13
XA12
XA11
XA10
XA9
XA8
XA7
XA6
+20 V
+6 V
-12V
XA1
+13
R6
360
R7
200
J1
XA18
ON
DS2
968
928
CTR
ADJ
R11
2K
946
947
945
937
936
935
906
905
904
927
926
925
924
923
967
R8 5K
R9 2K
R10 2.5K
TRACKING ADJ
TENTHS
ATTENUATION
MARK INT
R12 *
4.22
R13A
5K
COARSE
R13B
50K
FINE
0
2
S1
MARKER
POSITION
PULL TO
CENTER
MARKER POSITION ASSY A20 (08443-60003)
P1
STBY
POWER
S2
STBY
DS1
EXTERN
SWITCH ASSEMBLY A16 (08443-600

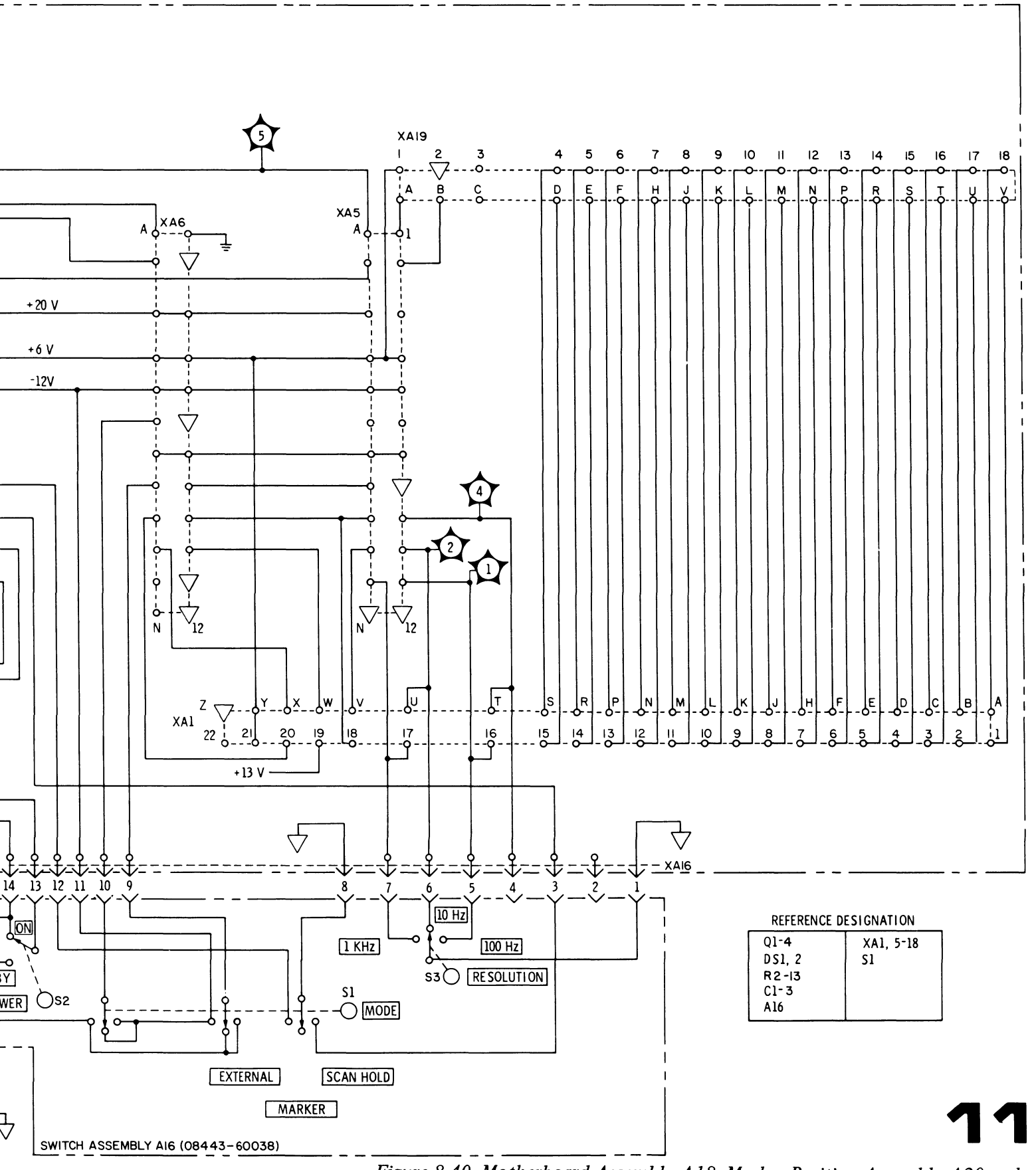
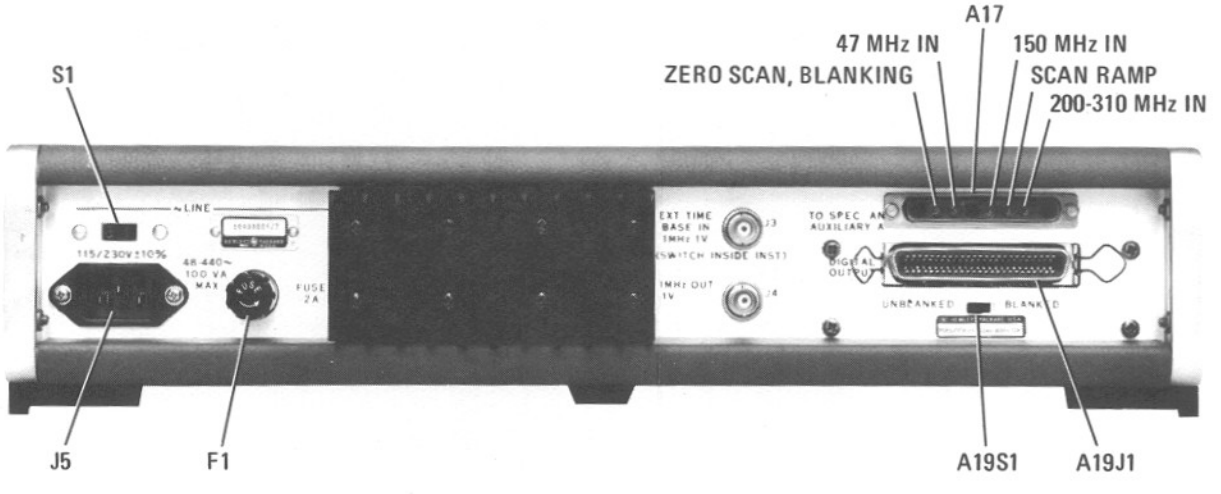
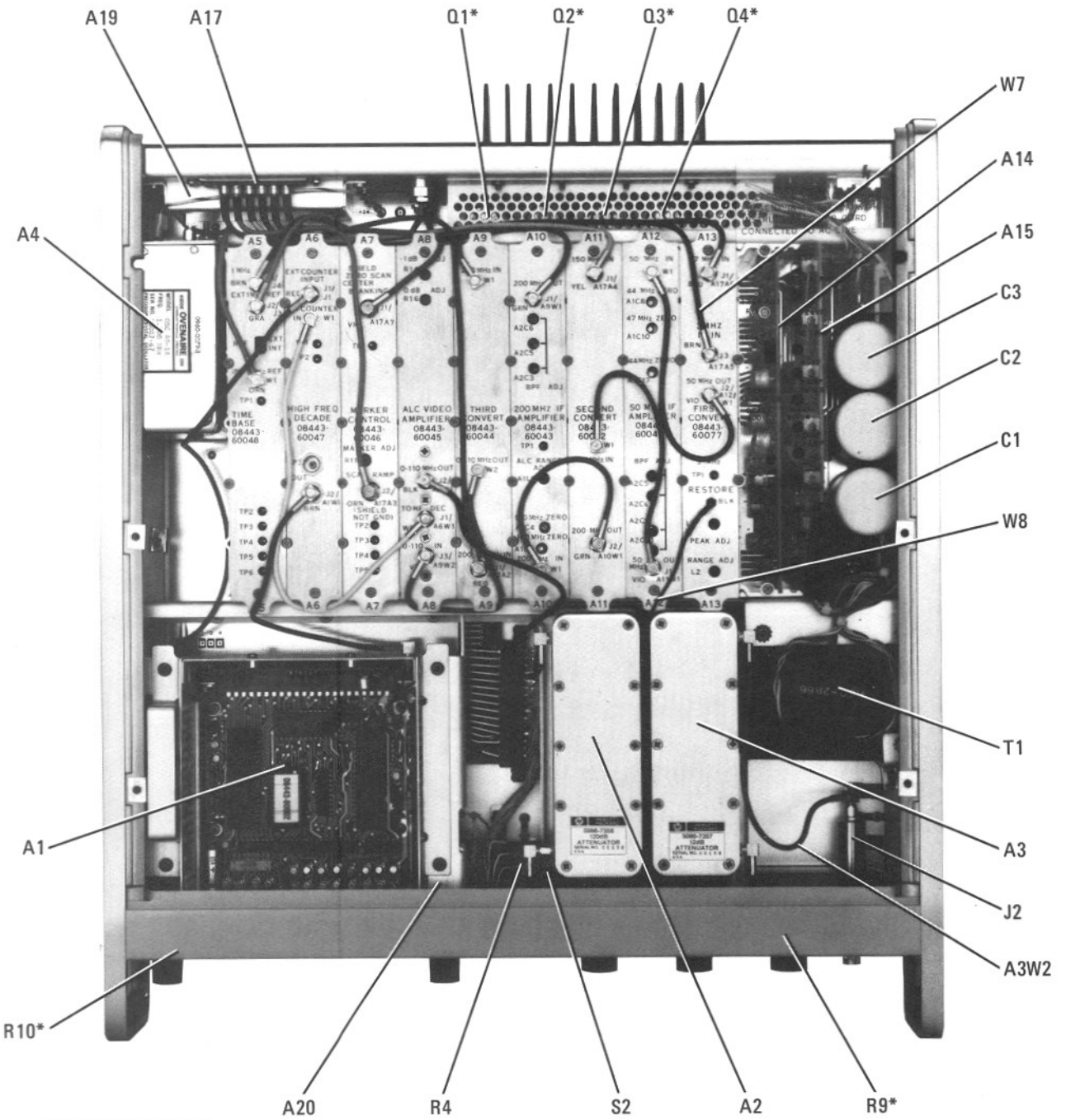


Figure 8-40. Motherboard Assembly A18, Marker Position Assembly A20 and Switchboard Assembly A16 Wiring Diagram

REAR VIEW


A17
47 MHz IN
150 MHz IN
ZERO SCAN, BLANKING
SCAN RAMP
200-310 MHz IN
S1
J5
F1
A19S1
A19J1

TOP VIEW



*LOCATED INSIDE

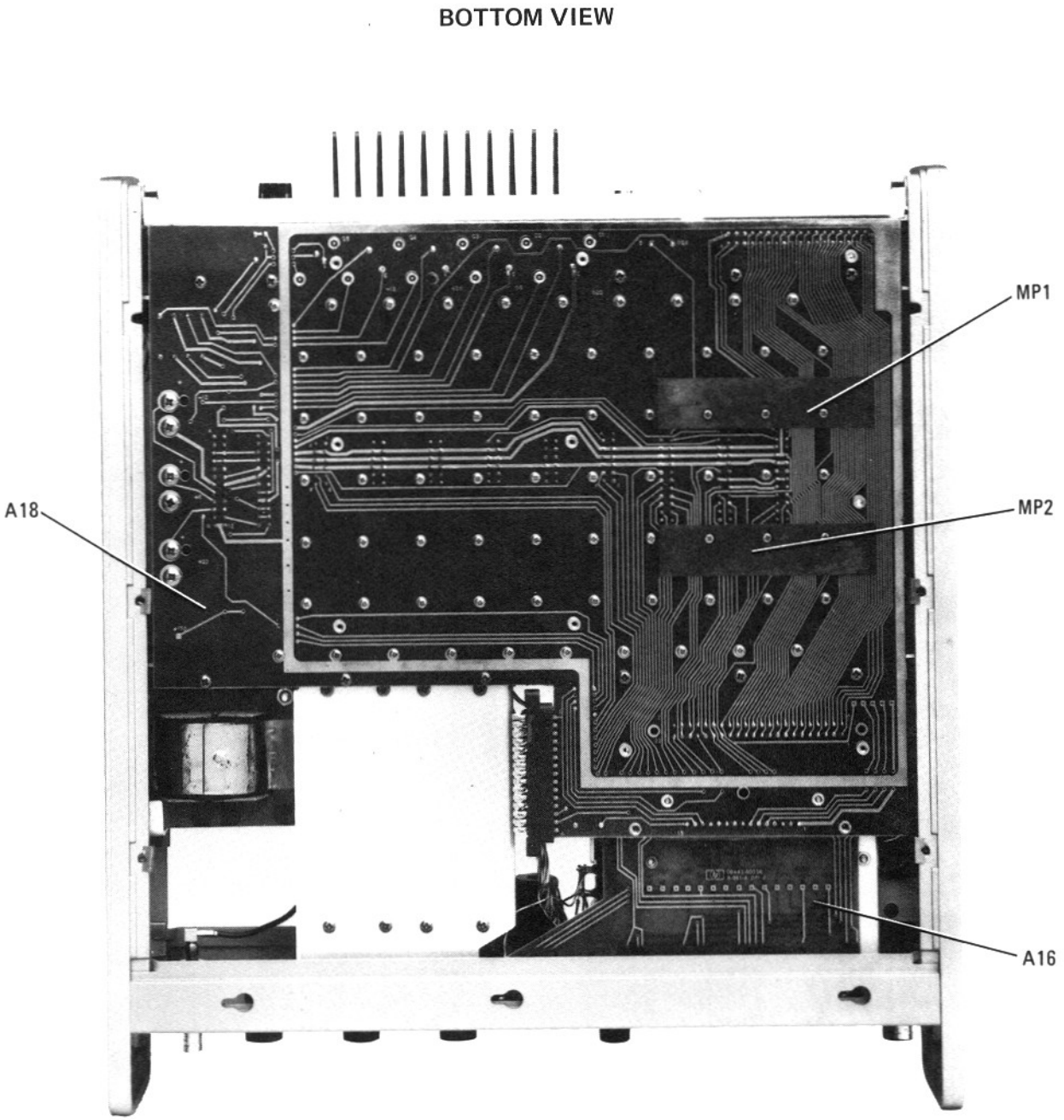


Figure 8-41. Major Assemblies and Chassis-Mounted Parts Locations

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