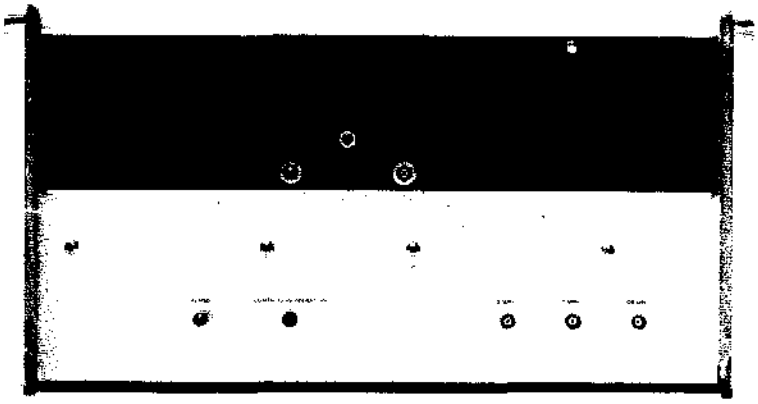
HP 5061A

OPERATING AND SERVICE MANUAL

CESIUM BEAM FREQUENCY STANDARD

5061A



HEWLETT PACKARD

HP 5061A

CERTIFICATION

Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company 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 AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of three years from the date of shipment except that in the case of certain components listed in Table 1-1 of this manual, the warranty shall be for the specified period. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

Service contracts or 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.

5061A
CESIUM BEAM FREQUENCY STANDARD
(including Options 001, 002, 003, and 004)

OPERATING AND SERVICE MANUAL

SERIAL PREFIX: 1740A

This manual applies directly to HP Model 5061A Cesium Beam Frequency Standards having Serial Prefix 1720A.

SERIAL PREFIXES NOT LISTED

For Serial Prefixes above 1740A, a "Manual Changes" sheet is included with this manual. For Serial Prefix below this number, refer to Section VII for manual changes.

OPTIONS

This manual applies directly to Model 5061A instruments with Option 001 (Time Standard), Option 002 (Standby Power Supply), Option 003 (Time Standard and Standby Power Supply options combined), and Option 004 (High Performance Beam Tube).

MANUAL PART NUMBER 05061-9052
MICROFICHE PART NUMBER 05061-9053

Printed: JUNE 1978

HEWLETT PACKARD

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

SAFETY CONSIDERATIONS

GENERAL

This is a Safety Class I instrument. This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring Apparatus."

OPERATION

BEFORE APPLYING POWER verify that the power transformer primary is matched to the available line voltage and the correct fuse is installed (see Section II). Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

SERVICE

Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition. Service and adjustments should be performed only by qualified service personnel.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

WARNING

IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTOTRANSFORMER (FOR VOLTAGE REDUCTION) MAKE SURE THE COMMON TERMINAL IS CONNECTED TO THE EARTHED POLE OF THE POWER SOURCE.

WARNING

BEFORE SWITCHING ON THE INSTRUMENT, THE PROTECTIVE EARTH TERMINALS OF THE INSTRUMENT MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR OF THE (MAINS) POWER CORD. THE MAINS PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).

WARNING

THE SERVICE INFORMATION FOUND IN THIS MANUAL IS OFTEN USED WITH POWER SUPPLIED AND PROTECTIVE COVERS REMOVED FROM THE INSTRUMENT. ENERGY AVAILABLE AT MANY POINTS MAY, IF CONTACTED, RESULT IN PERSONAL INJURY.

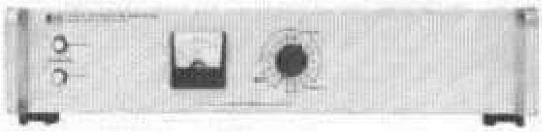
CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT:

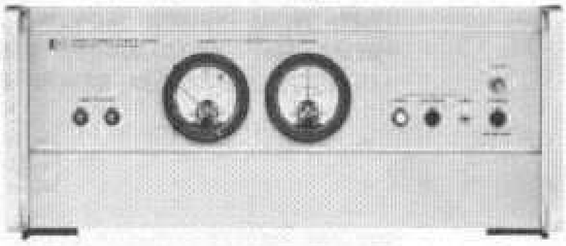
1. MAKE SURE THE INSTRUMENT IS SET TO THE VOLTAGE OF THE POWER SOURCE.
2. ENSURE THAT ALL DEVICES CONNECTED TO THIS INSTRUMENT ARE CONNECTED TO THE PROTECTIVE (EARTH) GROUND.
3. ENSURE THAT THE LINE POWER (MAINS) PLUG IS CONNECTED TO A THREE-CONDUCTOR LINE POWER OUTLET THAT HAS A PROTECTIVE (EARTH) GROUND. (GROUNDING ONE CONDUCTOR OF A TWO-CONDUCTOR OUTLET IS NOT SUFFICIENT.)
4. MAKE SURE THAT ONLY FUSES WITH THE REQUIRED RATED CURRENT AND OF THE SPECIFIED TYPE (NORMAL BLOW, TIME DELAY, ETC.) ARE USED FOR REPLACEMENT. THE USE OF REPAIRED FUSES AND THE SHORT-CIRCUITING OF FUSE HOLDERS MUST BE AVOIDED.

Figure 1-1. Model 5061A and Accessories

5061A WITH POWER CABLE

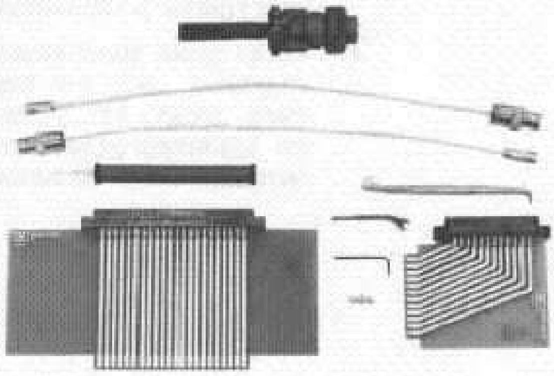


5087A
DISTRIUBTION AMPLIFIER
(ACCESSORY)



5085A
STANDBY POWER SUPPLY
(ACCESSORY)

10638A
DEGAUSSER
(ACCESSORY)



ACCESSORY KIT
(INCLUDED)

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. The Hewlett-Packard Model 5061A Cesium Beam Frequency Standard is a compact, self-contained frequency standard which uses a cesium beam tube resonator to stabilize the output frequency of a quartz crystal oscillator. Solid-state components and the closed-loop, self-checking control circuit provide an accuracy of ±1 part in 10^{11}. When the high-performance tube Option 004 is installed into the 5061A, accuracy increases to $\pm 7 \times 10^{-12}$. Available output frequencies are 5 MHz, 1 MHz, and 100 kHz. Figure 1-1 shows Model 5061A and accessories.

1-2. In the beam tube, a state-selected beam of Cesium 133 atoms passes through a microwave cavity. When the frequency of the applied microwave magnetic field, derived by multiplying the quartz crystal oscillator frequency, is near the hyperfine transition frequency of Cesium 133 (9,192,631,770.0 Hz), the microwave signal induces transitions from one hyperfine energy level to another. Those atoms which have undergone such a transition are detected by a hot wire ionizer and electron multiplier. The microwave field is phase-modulated at a low frequency of 137 Hz. When the microwave frequency deviates from the center of the atomic resonance, the current from the electron multiplier contains a frequency component which is the same as the modulation frequency. The magnitude of this component is proportional to the frequency deviation and the phase indicates whether the microwave signal is above or below the transition frequency. This component is filtered, amplified, and synchronously detected to provide a dc voltage proportional to the frequency deviation. The integral of this dc voltage automatically corrects the quartz oscillator frequency. The standard cesium beam tube exhibits outstanding reliability for its guaranteed life of 3 years. Cesium beam tube life may be extended by operating the cesium beam oven at a lower temperature (see Paragraph 3-10). However, the signal-to-noise ratio decreases, causing decreased short-term stability as shown in Figure 1-2. The high-performance Option 004 tube operation is guaranteed for 14 months from date of shipment. Operating the Option 004 tube at a lower temperature is not recommended since it degrades the tube's high-performance capability.

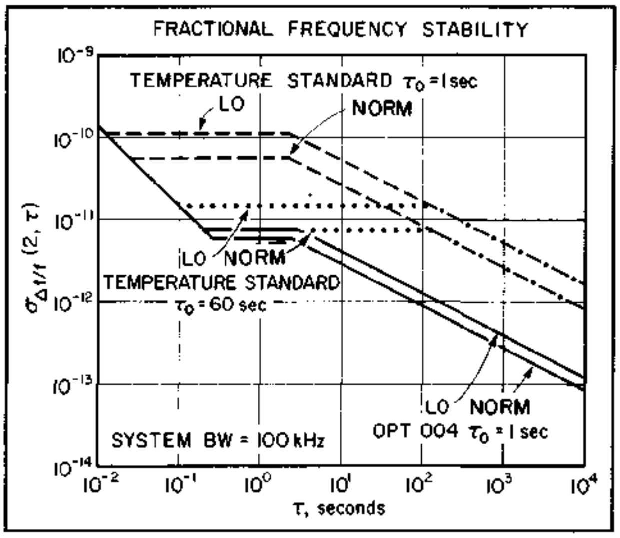
1-4. OPTIONS

1-5. Several options are available. These are:

a. Option 001 Time Standard: This option includes a 24-hour clock display and switches to allow the clock display to be set to the nearest second. A one-pulse-per-second output at front and rear panel BNC connectors is provided by this option. An internal "sync" button permits automatic synchronization of the 1PPS output to an external "sync" pulse. By the use of six thumbwheel switches, the output clock pulse is adjustable from 1 μsec ti 1 second with respect to a reference pulse.

b. Option 002 Standby Power Supply: Standby power capability for a minimum of 30 minutes (1-hour typically) is provided by an internal battery. Recharging of the battery is automatic, through the use of a digital timing system. A front panel lamp indicats when battery is being used or fast-charged.

Figure 1-2. Cesium Oven Temperature versus Stability (typical standard instrument)



c. Option 003. Combines Option 001 and Option 002.

d. Option 004 High Performance Cesium Beam Tube: (see Table 1-1 for performance specifications) Option 004 provides improvement in specifications such as accuracy, settability, reproducibility, and short-term stability. Warranty on this tube is 10,000 hours (about 14 months).

e. Option 908 Rack Mounting Kit is available, at additional cost, when ordered at the same time as the instrument. If ordered separately, rack mounting kit is HP Part Number 5060-8742.

1-6. Circuit Checks and Outputs

1-7. Check circuits provide continuous monitoring of the 5 MHz output signal. Automatic logic circuits present an indication of correct operation. The 5 MHz, 1 MHz, and 100 kHz output levels are at least 1-volt rms when terminated with 50 ohms.

1-8. TERMINOLOGY

1-9. The following definitions apply to terms used throughout this manual.

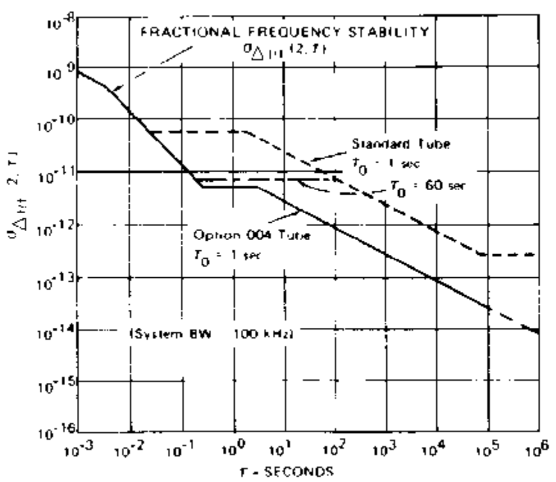
a. UNIVERSAL COORDINATED TIME (UTC). An internationally agreed upon time scale which has the same rate as Atomic Time. UTC is corrected by step adjustments of exactly 1-second, as needed to remain within 0.7 seconds of Astronomical Time (UT1). The "Bureau International de L'Heure" (BIH) determines when step adjustments are needed.

b. ATOMIC TIME. Time scale based on the hyperfine resonance of Cesium 133.

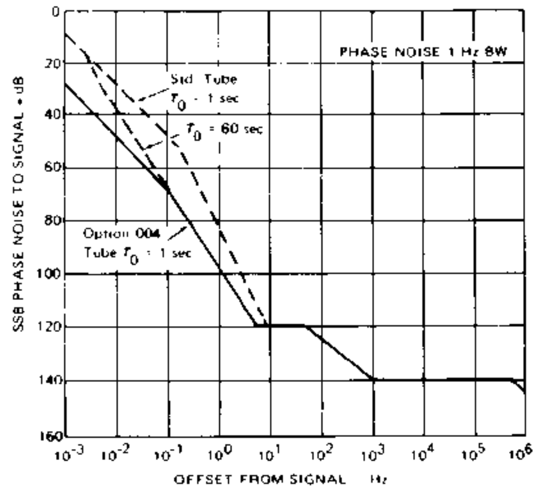
Table 1-1. Specifications

	Standard Beam Tube	Option 004 High Performance Beam Tube
Accuracy[1]: Maintained over a temperature range of 0 to 50°C and magnetic fields up to 0.2 millitesla (2 gauss) or any combination thereof.	$\pm 1 \times 10^{-11}$	$\pm 7 \times 10^{-12}$
Reproducibility[1] [2]	$\pm 5 \times 10^{-12}$	$\pm 3 \times 10^{-12}$ [3]
Settability (Frequency)[1]	$\pm 7 \times 10^{-13}$	$\pm 1 \times 10^{-13}$ [3]
Long-term stability (for life of cesium beam tube)	$\pm 5 \times 10^{-12}$	$\pm 3 \times 10^{-12}$
DC Magnetic Field Stability, frequency change, any orientation in a 2 gauss field.	$\pm 2 \times 10^{-12}$	$\pm 2 \times 10^{-13}$
Time Constant, quartz oscillator control loop (τ_0)	1 and 60 s[4]	1 s
Warm-up time at 25°C	45 min.	30 min.
Beam Tube Warranty	3 years	14 months (10,000 hrs)

FREQUENCY STABILITY [1], 5 MHz



PHASE NOISE, 5 MHz



NOTES:
(1) See definitions, page 1-4
(2) See Figure 1-3
(3) With 10638A Degausser
(4) Use 60 second time constant for increased short-term stability in controlled environments

τ (s)	FREQUENCY STABILITY, τ_0 = 1 SECOND	
	Standard Tube	Option 004 Tube
10^{-3}	8.2×10^{-10}	8.2×10^{-10}
10^{-2}	1.5×10^{-10}	1.5×10^{-10}
10^{0}	5.6×10^{-11}	5×10^{-12}
10^{1}	2.5×10^{-11}	2.7×10^{-12}
10^{2}	8×10^{-12}	8.5×10^{-13}
10^{3}	2.5×10^{-12}	2.7×10^{-13}
10^{4}	8×10^{-13}	8.5×10^{-14}

Δf	PHASE NOISE, τ_0 = 1 SECOND	
	Standard Tube	Option 004 Tube
10^{-1}	-8	-28
10^{-2}	-28	-48
10^{0}	-82	-96
10^{1}	-120	-120
10^{2}	-125	-125
10^{3}	-140	-140
10^{6}	-146	-146

Table 1-1. Specifications (Continued)

SINUSOIDAL OUTPUTS
5 MHz, 1 MHz, and 100 kHz, front and rear panel BNC.
Output Voltage: > 1 Vrms into 50 ohms.
Harmonic Distortion: Down more than 40 dB from rated output.
Non-Harmonically Related Output: Down more than 80 dB from rated output.
Signal-to-Phase Noise Ratio: For 5 MHz and 1 MHz outputs, >87 dB at rated output in a 30 kHz noise bandwidth, 1 Hz centered on carrier rejected (5 MHz output filter bandwidth is approximately 100 Hz).

CESIUM BEAM TUBES
Length: 16 inches.
Operating Life: 5 years typical.
Shelf Life: 2 years in temperature up to 35°C for new tube with full operating life expectancy remaining, if storage is according to recommended procedures.

QUARTZ OSCILLATOR
The high quality internal oscillator may be used without turning on the cesium beam tube.
Aging Rate: $<5 \times 10^{-10}$ per 24 hours.
Frequency Adjustments:
Fine: 5×10^{-8} range, with dial reading parts in 10^{10}.
Coarse: 1×10^{-6} range, screwdriver adjustment at front panel.
Stability:
As a function of ambient temperature: $<2.5 \times 10^{-9}$ total from 0° to +50°C.
As a function of load: $<\pm 2 \times 10^{-11}$ for open circuit to short, and 50Ω R, L, C load change.
As a function of supply voltage: $<\pm 5 \times 10^{-11}$ for 22 to 30 Vdc, or for 115/230 Vac, ±10%.

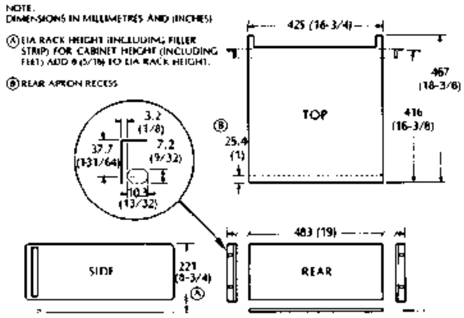
ENVIRONMENTAL:
Temperature: Operating, 0 to 50°C. Stability, over full operating temperature range, $<5 \times 10^{-12}$ change from 25°C reference. Nonoperating, –40 to +75°C (+50°C with Options 001 and 002).
Production units have passed type testing as follows:
Humidity: Operating, to 95% at 40°C.
Altitude: $<2 \times 10^{-12}$ change up to 12.2 km (40,000 ft.) operating.
AC Magnetic Field: Less than 2×10^{-12} for 0.2 millitesla (2 gauss) peak for 50, 60 or 400 Hz (±10%) fields.
Vibration: MIL-T-21200 with isolators and MIL-STD-167-1.
Shock: MIL-T-21200, Class 1 (30 G's, 11 ms)
EMC: MIL-I-6181D and MIL-STD-461A, Notice 3, Class A.

POWER: 115V ±10%, 50 to 400 Hz, 230V ±10%, 50 to 60 Hz, or 22 to 30V dc.
Approximate power required:

	DC	AC
5061A and 5061A with Option 004	27W	43W
Option 001 Option 002 Option 003	Add 7.5W Add 4.5W Add 12W	10W 22W 32W

NET WEIGHT: 30.5 kg (67 lbs); Option 001, add 0.9 kg (2 lbs.); Option 002, add 2.3 kg (5 lbs.); Option 004, add 1.4 kg (3 lbs.). Add 5.5 kg (12 lbs.) for shipping weight.
ACCESSORIES FURNISHED: Power Cord, 180 cm (6 ft.), detachable. Accessory Kit, HP 05061-6070, includes two extender boards, test cables, maintenance tools, and a mating connector 1251-0126 for EXT DC input.

DIMENSIONS:



ACCESSORIES AVAILABLE: EXT DC cable connects 5061A to 5085A Standby Supply, 103A-16A. 10638A Degausser for use with Option 004 High Performance Tube. See page 1-2 for details. Rack Mounting Kit, Opt. 908.
MATING CONNECTORS:
EXT DC input: 1251-0126 (5-contact), Cannon MS 3106E-14S-5S (Series ME) furnished.
AC line: 1251-2457, Cannon MS3106A-18-22SW.
Degausser: 1251-2797, Bendix PT06A-14-18P100S).
WARRANTY: Instrument, 3 years; optional battery, 1 year (see page 1-2 for beam tube warranty).

OPTION 001 TIME STANDARD
CLOCK DISPLAY: 24 hour LED readout in hours, minutes and seconds driven by Clock Pulse. Normally lighted. Push-to-read button for readout when on standby battery or external dc.

Rate: 1 pulse-per-second.
Amplitude: +10V ±10% peak.
Width: 20μs min.
Rise Time: < 50 ns.
Fall Time: <2 μs.
Jitter: <5 ns rms pulse-to-pulse and pulse-to-5 MHz.
Output: Buffered front and rear BNC connectors. All specs are with 50Ω load.
SYNCHRONIZATION (REAR BNC): Automatic, 10 μs (±1 μs) delayed from reference input pulse. Manual adj. to <±50 ns. Reference pulse must be >+5V, with a rise time of <50 ns.

OPTION 002 STANDBY POWER SUPPLY
CAPACITY (WITH OPTION 001 CLOCK): 30 minutes minimum at 25°C at full charge from sealed nickel-cadmium batteries.
CHARGE CONTROL: Automatic when ac power is connected.
INDICATOR: A front panel light flashes when ac power is interrupted and battery is being used.

OPTION 003 (COMBINES OPTION 001 and 002)

OPTION 004
HIGH PERFORMANCE CESIUM BEAM TUBE
Replaces standard beam tube and may be installed with any of the above options. See page 1-2 for specifications and warranty. For optimum performance the 10638A Degausser should be ordered.

Table 1-1. Specifications (Continued)

DEFINITION OF TERMS

Accuracy

The degree to which an oscillator frequency corresponds to that of an accepted definition. The currently accepted definition is that of the 13th General Conference of Weights and Measures. In practice, this involves comparison with some generally accepted physical embodiment of this definition such as the NBS Frequency Standard. The specified accuracy of the 5061A Cesium Beam Frequency Standard is intrinsic to it and is achieved without calibration.

Reproducibility

The degree to which an oscillator will produce the same frequency from one occasion to another after proper alignment. This does not include calibration.

Intrinsic Reproducibility

Intrinsic reproducibility of the 5061A (see Figure 1-3) is a measure of the repeatability from one independently aligned unit to another. The small spread indicates that any HP 5061A with a standard beam tube will produce a frequency within $\pm 5 \times 10^{-12}$ *without calibration. The data was acquired from over 150 units by continuous phase comparison for an interval of 48 hours or more against the Hewlett-Packard House Standard.*

Settability

The degree to which the frequency of an oscillator may be adjusted to correspond with a reference. This is also termed calibration.

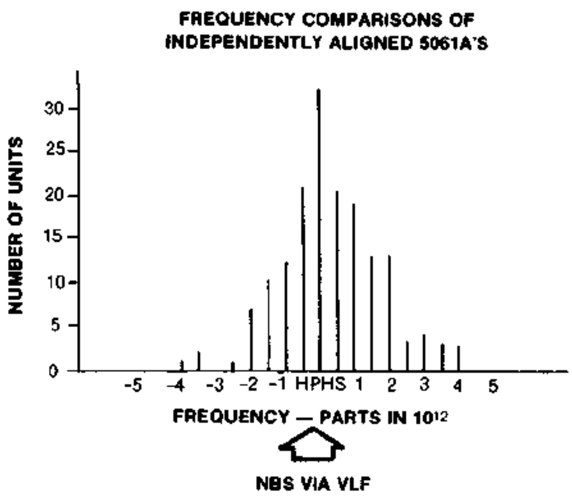
Stability

A. Long-Term frequency stability is defined as the absolute value (magnitude) of the fractional frequency change with time. An observation time sufficiently long to reduce the effects of random noise to an insignificant value is implied. Frequency changes due to environmental effects must be considered separately.

B. Short-term stability is defined as the standard deviation of fractional frequency fluctuations due to random noise in the cesium standard. It may also be expressed as standard deviation of phase. This specification must include the number of samples, the averaging time, the repetition time, and the system bandwidth.

See "Statistics of Atomic Frequency Standards" by David W. Allan, Proceedings of IEEE, Feb. 1966. P. 221, and HP Application Note 116 for measurement details.

Figure 1-3. Frequency of Independently Aligned 5061A Cesium Beam Standards with Standard Beam Tube



c. CESIUM BEAM TUBE. Passive atomic resonator using the hyperfine resonance of Cesium 133.

d. "C" FIELD. Magnetic field within the cesium beam tube for fine frequency adjustments.

e. ZEEMAN TRANSITIONS. Transitions excited by application of the Zeeman frequency. These additional energy levels in the hyperfine structure are caused by applying the "C" field (Zeeman splitting). They are used to accurately measure the magnetic field inside the beam tube.

f. LOW FREQUENCY TRANSITIONS. These frequencies appear in the spectrum and are dependent upon the "C" field value. They can be excited independent of the microwave power source.

g. MASS SPECTROMETER. Directs cesium ions to the electron multiplier and prevents impurity ions from reaching the electron multiplier.

h. HOT WIRE IONIZER. Heated tantalum ribbon ionizes cesium atoms which strike it.

i. ELECTRON MULTIPLIER. Amplifies the electron current initiated by a cesium ion striking the first dynode.

j. BEAM CURRENT. Current resulting from the action of the hot wire ionizer and electron multiplier.

Table 1-2. Equipment Supplied

Equipment	Description	HP Part No.
AC Power Cable	Three-conductor with ground pin	05061-6091
Accessory Kit:		05061-6070
Adapter	Micon, male-to-male	1250-0813
Connector	Plug female	1251-0126
Screwdriver	Ceramic	8710-0033
Wrench	Key 4 spline	8710-0055
Screwdriver	Offset	8730-0007
Wrench	⅛ inch open-end	8710-1111
Board Extender	22 pin	5060-7202
Cable Assembly	Test Micon-to-BNC (2 supplied)	05060-6116
Extender, 90° bend	12 pin	05061-6073

k. ION PUMP. Maintains a vacuum in the cesium beam tube by continuously pumping when the instrument is on.

1-10. SPECIFICATIONS

1-11. Table 1-1 lists the technical specifications for the Model 5061A.

1-12. INSTRUMENT IDENTIFICATION

1-13. Hewlett-Packard instruments have a 10-character serial number (0000A-00000). The 4-digit serial prefix identifies instrument changes. The 5-digit number is the serial number of each instrument. If the serial prefix does not appear on the title page of this manual, there are differences between your instrument and the manual. A manual supplement included with the manual describes the differences. If the supplement is missing, contact the nearest Hewlett-Packard Sales and Service Office listed on the inside rear cover of this manual.

1-14. ACCESSORIES

1-15. Table 1-2 lists equipment supplied and Table 1-3 lists accessories available for the Model 5061A.

Table 1-3. Accessories Available

Accessory	Description	HP Part No.
Standby Power Supply	24V dc, 2-amp supply with 18 amp-hours standby capacity	Model 5085A
Cable	Connects 5061A to 5085A dc output	103A-16A
Extension Slides and slide adapters	Permits sliding instrument out and tilting from rack-mounted position	1490-0718 1490-0721
Degausser	For degaussing Option 004 High Performance Cesium Beam Tube	10638A
Rack Mounting Kit	Provides conversion from bench to rack	5060-8742
Distribution Amplifier	Amplifies and allows 5061A output RF signal distriubtion to remote locations	5087A

SECTION II

INSTALLATION

2-1. UNPACKING AND INSPECTION

2-2. Inspect instrument for damage (scratches, dents, broken knobs, etc). If instrument is damaged or fails Performance Check, notify the carrier and the nearest Hewlett-Packard Sales and Service office immediately (Sales and Service offices listed inside back cover). Retain the shipping carton and the padding material for the carrier's inspection. The office will arrange for repair or replacement without waiting for the claim against the carrier to be settled.

2-3. STORAGE AND SHIPMENT

2-4. ENVIRONMENT. The shelf life of the cesium beam tube is two years at storage temperatures up to +35°C (+95°F) if the ion pump is operated 2 to 3 times a year. If the ion pump is not operated to maintain the vacuum within the cesium beam tube, the expected shelf life is reduced. Instructions for pumping the cesium beam tube are found in Paragraph 3-19 of this manual.

2-5. Temperatures during storage and shipment should be limited as follows:

a. Maximum temperature: +75°C (167°F). Long-Term Storage: +35°C (95°F).

b. Minimum temperature: −40°C (−40°F).

NOTE

When storing the 5061A for 6 months or longer, set MODE switch to CS OFF and apply continuous ac line power to the instrument. This enables the ion pump to maintain the vacuum within the cesium beam tube with the cesium beam tube off.

2-6. PACKAGING. To protect valuable electronic equipment during storage or shipment always use the best packaging methods available. Your Hewlett-Packard field office can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here is a recommended method:

a. Wrap the instrument in a large plastic sheet or bag such as HP Part No. 1920-0012.

b. Obtain a "same-size" carton (HP Part No. 9211-1102). Into the bottom of this carton, install a protector pad (HP Part No. 9220-1304).

c. Place the wrapped instrument into the "same-size" carton.

d. When the carton is sealed, install four polyurethane foam, post-packs (HP Part No. 9220-1875) on each corner of the carton.

e. Install the boxed instrument into a final cardboard outer carton (HP Part No. 9211-1730), seal the carton effectively and label it properly.

2-7. ELECTRICAL POWER CONNECTIONS

CAUTION

The Model 5061A has the negative side of its power supply grounded. When operating with auxiliary equipment such as an external battery or clock, check to ensure that the equipment can be connected together.

2-8. AC LINE VOLTAGE. Before reading further, read caution below. The Model 5061A can be operated from either 115- or 230-volt (±10%) power lines. A slide switch on the rear panel permits quick conversion for operation from either voltage. Insert a narrow-blade screwdriver in the switch slot and set the switch to expose the correct numbers to correspond to the line voltage used (Table 2-1). The instrument is supplied with a 115-volt fuse; change this fuse for 230-volt operation (Table 2-1). AC power requirements are:

Standard instrument and
Option 004: 43W
Option 001: add 10W
Option 002: add 22W
Option 003: add 32W

CAUTION

Before connecting ac power to the instrument, be certain slide switch is properly positioned for 115 or 230 volt operation.

Table 2-1. 115/230 Volt Conversion

Conversion	115 Volts	230 Volts
Slide Switch	Right	Left
AC Line Fuse	1.25A	0.8A

2-9. DC LINE VOLTAGE. In addition to ac power capability, the Model 5061A can also operate from an external dc source with a voltage range of +22 to +30 Vdc. The dc power source may be applied simultaneously, with the ac power source. Dc power requirements are:

Without Options:	27W	at 24 Vdc
With Option 001:	add 7.5W	
With Option 002:	add 4.5W	
With Option 003:	add 12W	

Dc power connections are through the rear-panel EXT DC connector.

2-10. POWER CABLES. The Model 5061A is equipped with a detachable ac and dc power cable. Install as follows:

a. AC CABLE.

1. Connect the round, three-conductor female plug to the ac line jack on the instrument rear panel.

2. Connect male plug (two-blade with round grounding pin) to three-conductor (grounded) outlet. Exposed portions of the instrument are grounded for safety through the round pin; when only two-conductor outlets are available, use connector adapter (HP Stock No. 1251-0048) and connect short wire from adapter to a suitable ground.

b. DC CONNECTION.

1. Use the dc power mating connector shipped with the instrument, and connect the external dc source "-" (negative or ground) to connector pin c; connect the external dc source "+" (positive +22 to +30 Vdc) to connector pin A. Remaining three pins are not used.

2-11. Mating Connectors

2-12. Table 2-2 lists the Model 5061A front and rear panel connectors and their respective mating connectors. Not all connectors listed are shipped with the instrument but are included in the table as useful information for installation.

2-13. OPERATION AS BENCH OR RACK INSTRUMENT

2-14. The Model 5061A is shipped from the factory ready for operation as a bench instrument. Parts necessary to convert the instrument for operation as a rack-mounted instrument are supplied as a kit with the instrument. To convert for rack operation, refer to Figure 2-1 and proceed as follows:

Figure 2-1. Conversion for Rack Mounting

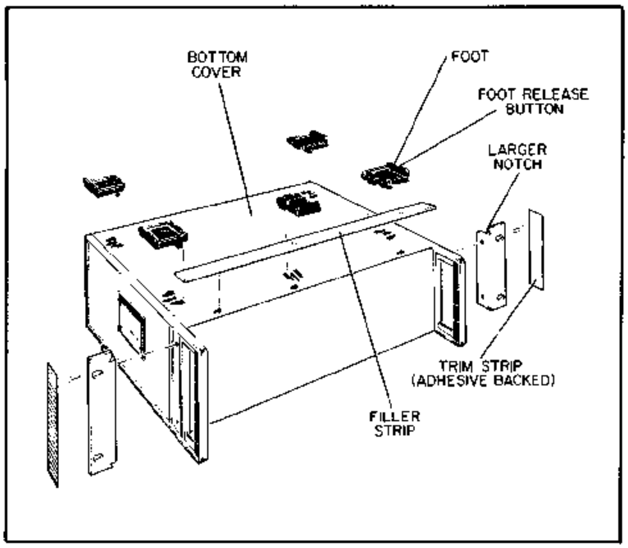


Table 2-2. Mating Connectors

Connector Description	Connector HP Part No.	Mating Connector HP Part No.	Mating Connector Description
BNC female jacks (J2, 6, 8, 10, 11, 12, 14 & 15)	1250-0140	1250-0061*	BNC male plug, UG88/U
ZEEMAN MOD INPUT, female jack (J1)	1250-0102	1250-0061*	BNC male plug, UG88/U
EXT DC, 5-pin male jack (J19)	1251-0111	1251-0126	5-pin female plug Cannon MS3106E-14S (Series ME)
AC LINE, 3-pin male jack (J20)	1251-2458	1251-2457	3-pin female plug Cannon MS3106A-18-22SW
OUTPUT Signal, jacks (J5, 7 and 9)	1250-0102	1250-0061*	BNC male plug, UG88/U
1PPS, BNC jack (J13) Option 001 only	1250-0102	1250-0061*	BNC male plug, UG88/U
-2500V, 1-pin female jack (J3)	1251-1977 1251-1979 1251-1981	1251-1977 1251-1978 1251-1980	Hood Connector receptacle Lock Spring
+3500V, 1-pin male jack (J4)	1251-1977 1251-1979 1251-1980	1251-1977 1251-1978 1251-1980	Hood Connector receptacle Lock spring
Degausser		1251-2797*	Bendix PT06A-14-18P1005
*These connectors not shipped with the instrument			

a. Remove feet (press the foot-release button, slide foot forward toward center of instrument, and lift off).

b. Remove adhesive-backed trim strips on sides, just behind front handles.

c. Attach filler strip along bottom edge of front panel.

d. Attach mounting brackets to sides (larger corner notch toward bottom of instrument, see Figure 2-1). Instrument is now ready to mount in standard 19-inch rack.

2-15. INSTALLATION LOCATION

2-16. The cesium beam tube installed in the Model 5061A is slightly sensitive to external magnetic fields. Avoid installing the instrument near large motors, generators, transformers, or other equipment which radiates strong fields of 2 Gauss or more. Also avoid placing a strong permanent magnet near the beam tube. These devices can radiate magnetic fields which are strong enough to permanently affect the magnetic shielding within the beam tube. The front-panel C FIELD control compensates for small magnetic field effects such as the earth's magnetic field with respect to the instrument location. For maximum accuracy, check the C FIELD adjustment when the instrument is relocated (see Paragraph 3-14, step k.)

SECTION III
OPERATION

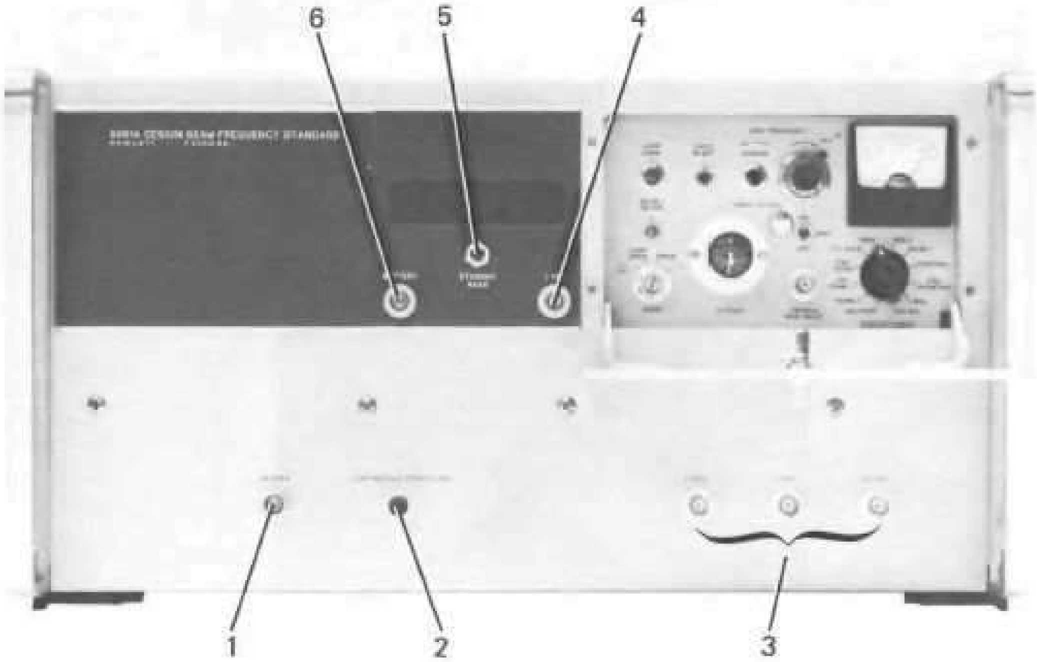
3-1. INTRODUCTION

3-2. This section explains the functions of the operating controls and indicators of the 5061A Cesium Beam Frequency Standard. Operating modes, including options, are described, and turn on procedures are given.

3-3. CONTROLS AND INDICATORS ON FRONT, REAR, AND TOP PANELS

3-4. Controls and indicators on the front, rear, and top panels are described in Figures 3-1, 3-2, and 3-3.

Figure 3-1. Front-Panel Controls



1. ALARM light: Normally off to indicate:

   a. The multiplied quartz crystal oscillator frequency is frequency-locked to the center maximum of cesium resonance;

   b. The instrument is correctly frequency-locked and beam trube current is satisfactory;

   c. The quartz crystal oscillator dc correction voltage is less than the dynamic limit of ±5.0V dc.

2. CONTINUOUS OPERATION light: Normally on to indicate that circuits are functioning properly and instrument is operating as a primary frequency standard.

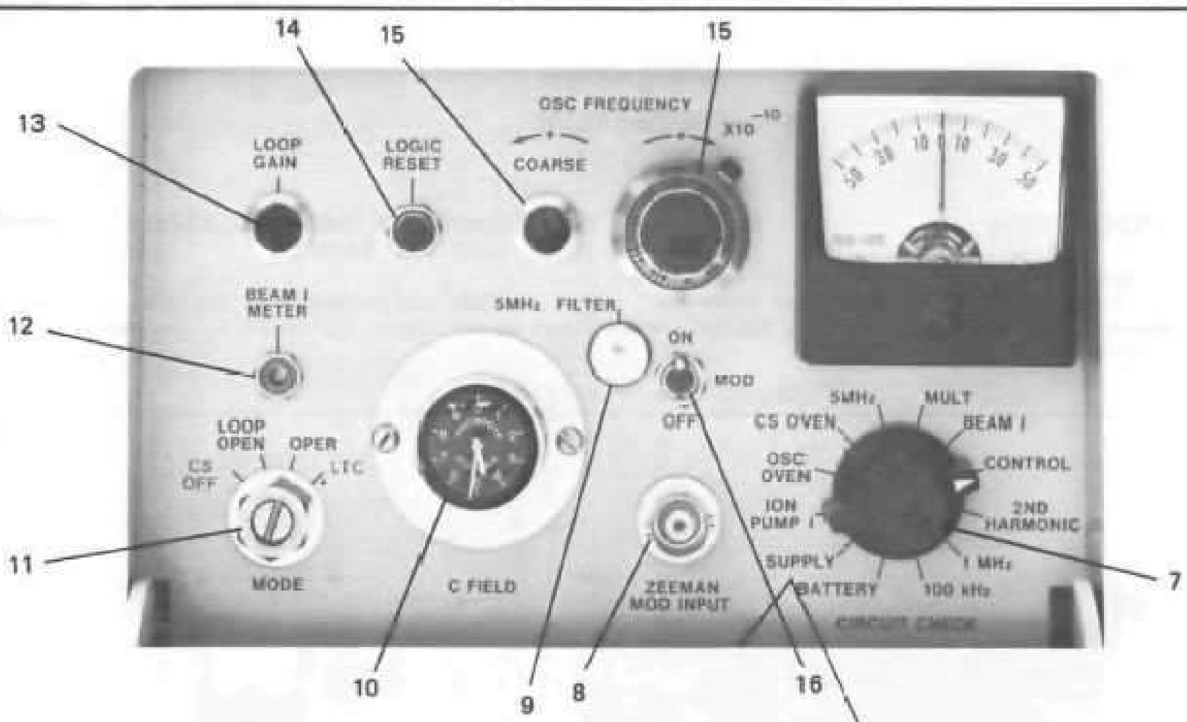
3. OUTPUTS — 5 MHz, 1 MHz, 100 kHz: BNC jacks paralleled with rear-panel outputs to provide these standard frequencies. Output level is 1-volt rms (minimum) into 50 ohm load.

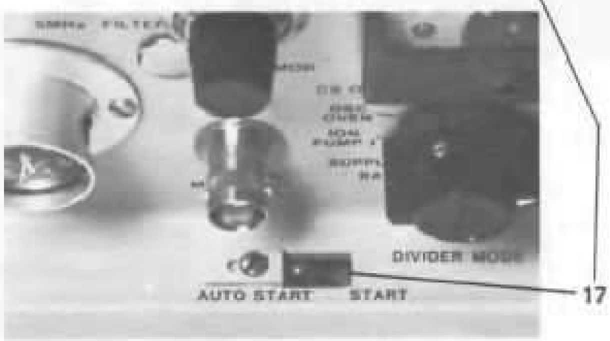
4. 1 PPS jack (Options 001 and 003): Provides 10 volt, 20 µs, 1 PPS into 50 ohms from digital clock.

5. STANDBY READ switch. Allows LED clock display to be lighted momentarily when the instrument is operating from internal battery.

6. BATTERY light (Options 002 and 003): Normally off. Flashes when 5061A is drawing power from internal battery. On when battery is being fast charged.

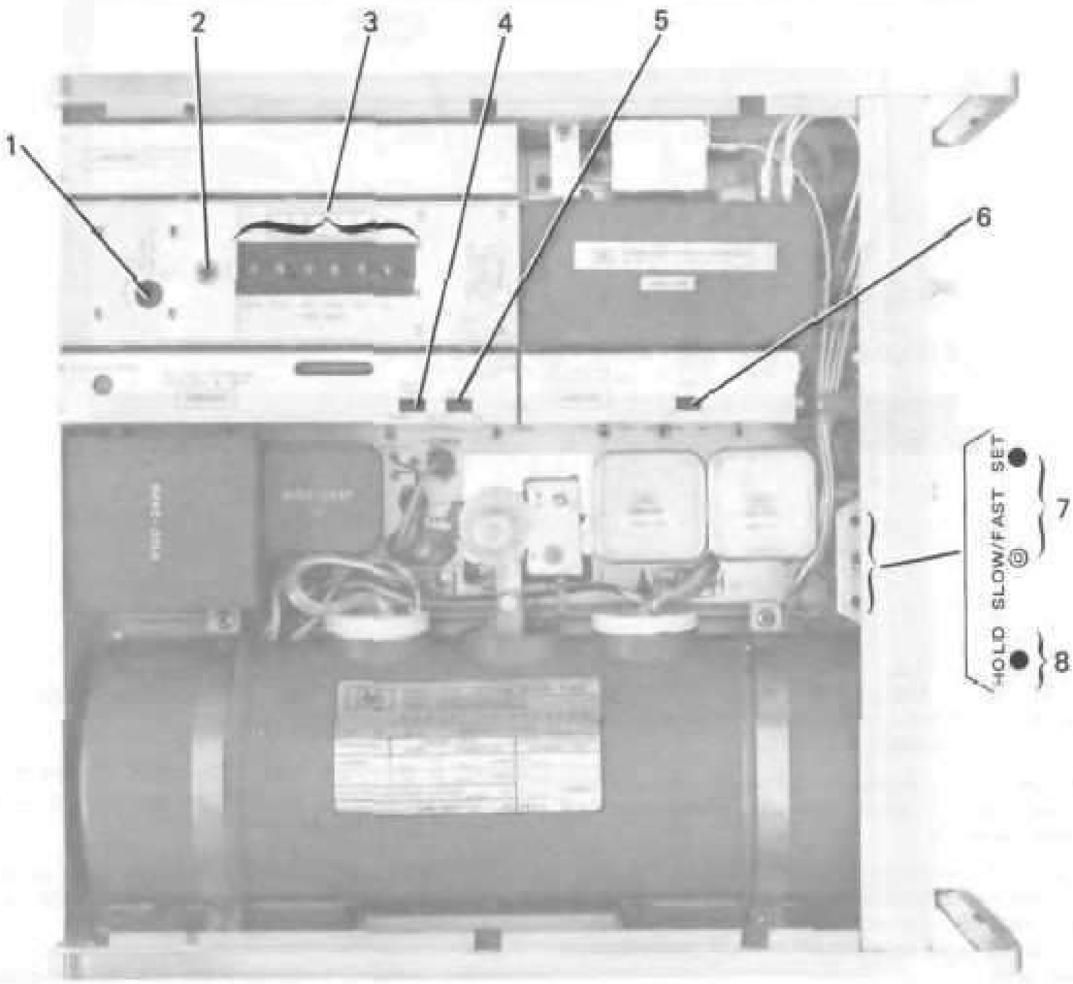
Figure 3-1. Front Panel Controls (Continued)





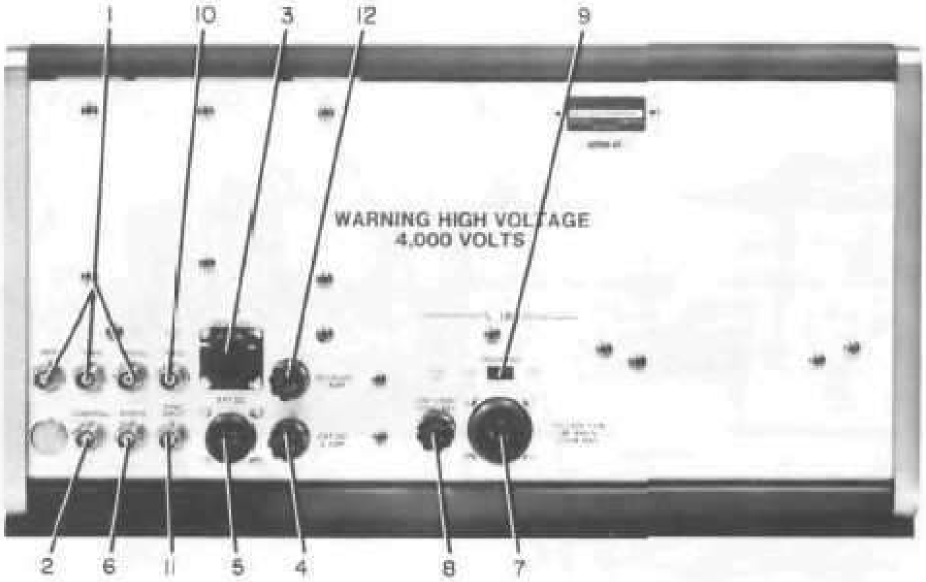
7. CIRCUIT CHECK switch and meter: Provide monitoring of various circuits for operation checks and trouble indication.
8. ZEEMAN MOD INPUT: Apply Zeeman frequency at this BNC jack during C-FIELD adjustment (see paragraph 3-14k.)
9. 5 MHz FILTER: Access hole for adjusting 5 MHz crystal filter.
10. C-FIELD control: Provides minor adjustment of the magnetic field inside the beam tube. Frequency resolution is 5 x 10^{-14}/minor division.
11. MODE switch: Controls the mode of operation. See Table 3-2 for details.
12. BEAM I METER adjust: Adjusts for meter reading of 20.
13. LOOP GAIN control: Adjusts ac amplifier gain.
14. LOGIC RESET switch: Push to enable CONTINUOUS OPERATION light after power interruption, repair, or adjustment.
15. OSC FREQUENCY controls: COARSE control provides crystal oscillator frequency adjustment of ±500 parts in 10^9. Use only COARSE control to correct oscillator frequency with frequency-locked operation. Fine control X10^{-10} provides adjustment range of 500 parts in 10^{-10}. Set control to 250 for frequency-locked operation with beam tube.
16. MOD ON-OFF switch: Controls 137 Hz modulation of microwave frequency applied to beam tube. Normally ON.
17. DIVIDER MODE switch: Allows dividers to be operated in one of two modes: AUTO START or START. To manually start the dividers the switch should be momentarily set to START, then released.

Figure 3-2. Top Operating Controls



1. 0—1 μSEC TIME DELAY control (Option 001 only): Allows continuous adjustment of clock pulse delay over any *1 μsec range.*
2. Clock SYNC switch (Option 001 only): Synchronizes 5061A Digital Clock with an external clock when depressed; clock remains synchronized when released.
3. Clock TIME DELAY switch (Option 001 only): Selects time delay between an externa reference pulse and the internal 1 pulse-per-second clock pulse. Adjustable in decade steps from 1 μs to 1 sec.
4. OVEN TEMP NORM-LO switch: Selects operating temperature for the cesium beam tube oven. Normally set to NORM.
5. OVEN-OFF-ON switch: Switch for cesium beam tube oven. Used in ON position.
6. AC Amplifier GAIN switch: Selects HI or LO gain of amplifier.
7. Clock SET-SLOW/FAST switches (Option 001 only): Clock will be advanced if SET switch is pressed. Advance speed is deremined by SLOW/FAST switch. (Advance is about 1 minute per second in "SLOW", and 1 hour per second in "FAST".
8. Clock HOLD switch (Option 001 only): Clock will stop if HOLD switch is pressed. (Advance clock with SET-SLOW/FAST and HOLD until correct time occurs.)

Figure 3-3. Rear-Panel Controls



1. OUTPUTS — 5 MHz, 1 MHz, 100 kHz: BNC jacks paralleled with front-panel outputs to provide these standard frequencies.

2. CONTROL jack: Normally not used. Connected to voltage control point between integrator and crystal oscillator.

3. DEGAUSS Connector: Used with Option 004 only. Provides connections for external degaussing equipment which is used only when Option 004 is installed. Option 004 consists of a high performance beam tube.

4. EXT DC fuse: Use 3 ampere fuses (HP No. 2100-0003) when external 24-bolt dc is used.

5. EXT DC connector: Five-pin male connector. Used to connect 5061A to external 22—30-volt dc supply. Connect positive terminal to pin A and negative to pin C. Pin C is connected to chassis ground.

6. SYNC test jack: Synthesizer output frequency of 12,631,771.6 Hz is available at this jack. Amplitude is approximately 150 mV.

7. AC LINE jack: Accepts round female connector on power cable supplied.

8. AC LINE fuse: 1.25-ampere Slo-Blo fuse (HP No. 2100-0305) for 115V ac operation or 0.8 ampere for 230V ac operation.

9. SELECTOR switch: 115/230 volts ac line switch. Set to expose correct numbers ("115" or "230") for the ac line voltage used.

10. 1PPS jack (Options 001 and 003): Provides 10 volts, 20 μsec pulse from digital clock circuits.

11. SYNC INPUT jack (Options 001 and 003): Input to digital divider circuits for external synchronizing pulse. External synchronizing pulse must be +5V or more with rise time of less than 50 nsec.

12. DEGAUSS 1 AMP fuse: Provides protection for a +25V to +33V line from A15 Power Regulator to the J18(A) DEGAUSS connector.

3-5. Front Panel Light Indications

3-6. Conditions indicated by the front panel lights are given in Table 3-1.

Table 3-1. Front-Panel Light Indications

Front Panel Lights		Description
ALARM	CONTINUOUS OPERATION	
Off	On	Indicates normal operation.
On	Off	Indicates one or more of the following troubles: 1. Quartz crystal oscillator not locked to cesium resonance peak. 2. Quartz oscillator locked to secondary peak of cesium resonance. To correct the above faults, see Troubleshooting Tables (Section V). 3. 2nd Harmonic signal is low, caused by low beam current, but oscillator is still locked to peak of cesium resonance. Adjust front-panel BEAM I METER control for BEAM I meter indication of 20-30, and front-panel LOOP GAIN control for 2ND HARMONIC meter indication of 35-45.
Off	Off	Press RESET switch. If not OK, indicates one or more of the following troubles: 1. Light bulb failure. 2. Synthesizer circuits. 3. Power interruption.
On	On	Indicates the following trouble: Quartz crystal oscillator is locked to resonant frequency of cesium beam tube, but the oscillator has exceeded one-half its control range. To correct this trouble, proceed as follows: 1. Set CIRCUIT CHECK switch to CONTROL. 2. Slowly and carefully adjust OSC FREQUENCY COARSE control for zero on CIRCUIT CIRCUIT CHECK meter. 3. ALARM light should go off and the CONTINUOUS OPERATION light should remain on. NOTE: Making adjustment 2 may cause CONTINUOUS OPERATION light to go off. If this occurs, wait 30 seconds and press LOGIC RESET switch. Light will come on and stay on.
Internal Standby Battery Light (Option 002 only)		
BATTERY		Description
Off		Indicates normal operation.
Flashing		Indicates instrument is powered from internal battery supply.
On		Indicates battery is being charged.

3-7. Front Panel MODE Switch Functions

3-8. The front panel MODE switch functions are described in Table 3-2.

3-9. Front Panel CIRCUIT CHECK Switch and Meter

3-10. Functions and use of the front panel CIRCUIT CHECK switch are listed in Table 3-3.

Table 3-2. MODE Switch Functions

MODE Switch Position	MODE Description
CS OFF (Cesium Off)	Only quartz crystal oscillator circuits energized. Power removed from cesium beam tube except ion pump (+3500V dc). **NOTE** CS OFF used for test purposes and storage.
LOOP OPEN	All circuits operating with atomic control loop open.
OPER	Instrument operating with quartz crystal oscillator locked to the atomic frequency.
LTC	Instrument operating with quartz oscillator locked to cesium resonance. Servo loop time constant is approximately 60 seconds. This mode should be used only in a benign laboratory environment.

Table 3-3. Operating Checks

CIRCUIT CHECK SWITCH		
Switch Position	Correct Meter Indication	Description
BATTERY	0 (35 to 50 with Option 002)	Indicates battery voltage
SUPPLY	35-45	Indicates +18.7 volts regulated supply voltage
ION PUMP I	0-15	Indicates vacuum in cesium beam tube by monitoring ion pump current. Fail-safe circuit removes power to cesium beam tube if current exceeds 40-30 μA.
OSC OVEN	*20-45 (changes with temperature)	Indicates power to oscillator oven heater
CS OVEN	*5-35 (changes with temperature)	Indicates power to oven in cesium beam tube
5 MHz	35-45 (no load)	Indicates level of 5 MHz output
MULT	35-45	Indicates bias to harmonic generator diode
BEAM I	*15-30	Indicates dc beam current from cesium beam tube
CONTROL	0 (may be up to ±50)	Indicates dc control voltage to quartz crystal oscillator
2ND HARMONIC**	*20-45	Indicates 2nd harmonic amplitude (may have small fluctuations)
1 MHz	35-45 (no load)	Indicates 1 MHz divider output level
100 kHz	25-45 (no load)	Indicates 100 kHz divider output level

*During the first several days of operation, this CIRCUIT CHECK meter indication may not fall within the limits shown in this table. This is a normal indication if the CONTINUOUS OPERATION light remains on.

**When meter reading has stabilized it should be set to 40 by adjusting the front panel LOOP GAIN control.

3-11. TURN-ON PROCEDURES

3-12. General

3-13. These procedures should be followed when the instrument is to be turned on. When the instrument has been off and the quartz crystal and cesium beam tube ovens are cool, 3/4 hour warmup time is required. Table 3-1 lists normal and abnormal front panel light indications. Table 3-3 lists normal meter indications. Table 3-2 lists MODE switch functions. Use these tables as a guide for circuit checks during the turn-on procedure or during operation.

3-14. Initial Turn-On Procedure

a. The front panel MODE switch should be set to OPER when adjusting the quartz crystal oscillator frequency. When set to LTC, the instrument takes long to respond and adjustment is difficult.

b. Set instrument controls as follows:

(1) 115/230V switch — match ac line voltage used.
(2) MOD switch — ON.
(3) MODE switch — LOOP OPEN.
(4) CIRCUIT CHECK switch — ION PUMP I.
(5) OSC FREQUENCY X10^{-10} control — adjust to 250.

c. Connect power cord to ac power source. Instrument is on as soon as power is connected.

NOTE

When the 5061A is shipped with Option 002 (Internal Standby Battery), the battery is discharged. Thus, when the instrument is initially turned on, the battery will charge for appoximately 20 hours and the BATTERY light will be on during the charge cycle.

d. Observe the ION PUMP I current indication. Meter indication may fluctuate and then decrease. After indication decreases below 40-30, the -2500 volt supply and cesium oven heater will be enabled. If ION PUMP I does not decrease within 24 hours, see Paragraph 3-15.

e. For standard instruments, allow 45 minutes for cesium oven and quartz crystal oven to warm-up. For Option 004, allow 30 minutes.

f. Start the divder circuits by:

(1) DIVIDER MODE switch — momentarily set to START, or
(2) DIVIDER MODE switch — set to AUTO START.

NOTE

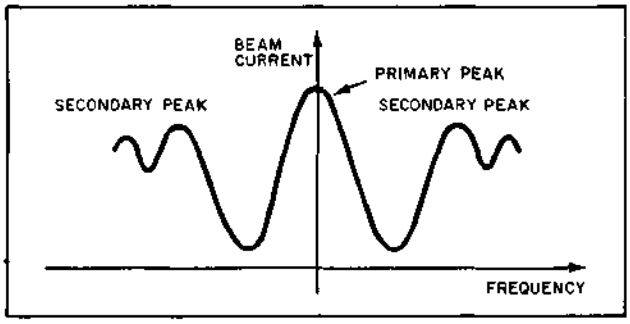
The divider circuits require an initial start signal. The DIVIDER MODE switch (momentary on-off-on type) provides this signal. When the switch is in AUTO START, the dividers start and a start signal is available if the dividers stop. When the switch is set to START, the dividers start and the switch returns to OFF when released. If the dividers stop, they will not start until the switch is again set to START.

g. Set CIRCUIT CHECK switch to BEAM I.

h. Slowly adjust OSC FREQUENCY COARSE for maximum on CIRCUIT CHECK meter. It is possible to peak the BEAM I on a secondary peak. Check the maximum by adjusting OSC FREQUENCY COARSE for a secondary peak on each side of the primary peak (see Figure 3-4). These secondary peaks will be smaller than the primary peak. (Note: Do not use OSC FREQUENCY X10^{-10} control for this adjustment.)

i. Set MODE switch to OPER. Wait 30 seconds, then press LOGIC RESET button. CONTINUOUS OPERATION light should come on and stay on. The quartz crystal oscillator is now locked to the resonant frequency of the cesium beam tube for instruments equipped with Option 004. Do the HI CURRENT degauss, using HP 10638A DEGAUSSER ACCESSORY. Procedures are in the HP 10638A Operating Manual.

Figure 3-4. Beam Current and Applied Frequency



j. The cesium beam tube is slightly sensitive to the earth's magnetic field and local magnetic fields. The "C" field within the cesium beam tube compensates for these minor variations and should be adjusted when the instrument is first placed into service or relocated.

k. C-Field Adjustment:

(1) With instrument operating normally, set CIRCUIT CHECK switch to CONTROL and carefully adjust OSC FREQUENCY COARSE for zero on CIRCUIT CHECK meter.

(2) Set instrument controls as follows:
MOD switch — OFF
MODE switch — LOOP OPEN
CIRCUIT CHECK switch — BEAM I

(3) If the unit contains the high performance cesium beam tube (Option 004), and has just been placed into service, do the HIGH and LOW CURRENT degaussing procedures. These procedures use the HP Model 10638A Degausser. Degaussing instructions are in the 10638A Operating and Service Manual. If unit does not contain Option 004, proceed with step (4).

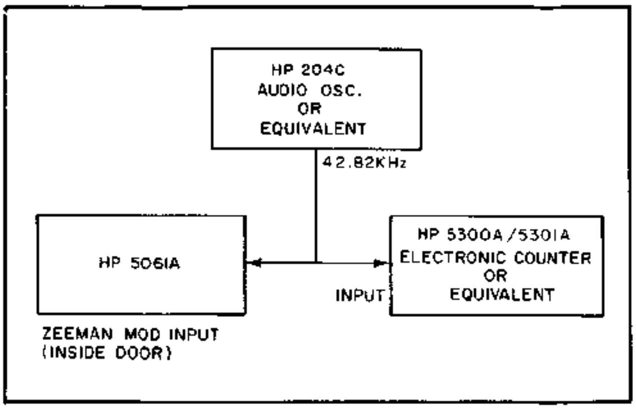
(4) Connect the 5061A and other instruments as shown in Figure 3-5.

(5) Set Audio Oscillator to 42.82 kHz ±50 Hz.

NOTE

If counter reads erratically disconnect cable from 5061A. Set oscillator, then reconnect cable to 5061A.

Figure 3-5. Test Setup for "C" Field Adjustment



(6) Adjust audio oscillator output amplitude to zero then slowly adjust it to first peak reading on CIRCUIT CHECK meter.

(7) Adjust C-FIELD control to top of maximum peak as indicated on BEAM I meter. See NOTE below.

NOTE

When making this adjustment, at least three peaks can be seen. The three largest peaks consist of two peaks of lower amplitude on either side of a higher amplitude peak. The C-FIELD CONTROL should be adjusted through sufficient range to reproduce the three peaks. It then must be set to the exact top of the center (highest amplitude) peak.

When correctly set, the C-FIELD dial will read between 4.0 and 6.0 (applies to instruments with serial numbers 1220A00561 and above only). On these instruments the resolution of the C-FIELD dial is 5×10^{-14} per minor division. On instruments with lower serial numbers, the resolution is 1×10^{-12} per minor division.

(8) On units which contain the high performance cesium beam tube (Option 004) only, do the LOW CURRENT degauss using HP 10638A Degausser. Procedures are in 10638A Operating and Operating Manual. If unit does not have Option 004, proceed with step 9.

(9) After setting, the C-FIELD must be checked as follows:

(a) Observing the CIRCUIT CHECK meter, adjust audio oscillator about 1 kHz off frequency then slowly adjust it through the cesium resonance reproducing the three resonance peaks desribed in the previous note. Set the oscillator to the exact top of the center (highest amplitude) peak.

(b) Measure frequency of audio oscillator on counter. It must be 42.82 kHz ±100 Hz (±70 Hz on units with Option 004 high performance cesium tube). If frequency is not within these specifications, repeat steps 5 through 9. On Option 004 units be sure to repeat step 8 if frequency is not within ±70 Hz.

(10) Disconnect oscillator and counter. Set MOD switch to ON, MODE switch to OPER. Wait for ALARM light to go off. Push LOGIC RESET button. CONTINUOUS OPERATION light should come on and stay on. The instrument is now frequency locked to the hyperfine transition frequency of the cesium tube and is ready for use.

l. Set the CIRCUIT CHECK switch to each position and record each reading in 5061A Operating Record (Table 3-4).

3-15. Turn-On After Long Storage

3-16. If the instrument has not been operated for six months or more, the following procedure should be performed. This procedure checks the cesium beam tube vacuum. Until beam tube vacuum is satisfactory, the hot wire ionizer and electron multiplier are held off. During initial warmup of the beam tube, with MODE switch set to LOOP OPEN or OPER, the ion pump may reduce the beam tube pressure to a satisfactory level and thus enable the hot wire ionizer and electron multiplier circuits. This in turn may cause these circuits to be disabled. This is normal operation. The cycle may occur several times before the electron multiplier and hot wire ionizer remain enabled. Power should remain connected to the instrument during this cycling to permit the ion pump to evacuate the beam tube.

a. Before applying power to the instrument, set controls as follows:

(1) 115/230V ac switch — match ac line voltage used.
(2) MOD switch — OFF
(3) MODE switch — CS OFF
(4) CIRCUIT CHECK switch — ION PUMP I

b. Connect power to the instrument and observe ION PUMP I indication. If at the end of 24 hours the indication is less than 25, the cesium beam tube vacuum is satisfactory and the turn-on procedure can be completed.

c. If at the end of 24 hours the ION PUMP I indication is still full scale, DISCONNECT POWER FROM THE INSTRUMENT.

d. Remove instrument top cover. Disconnect the red lead from the cesium beam tube at J4 on instrument chassis after turning the metal lock on the connector plug.

e. With power off, connect the positive lead of a +3500V dc, 5 milliampere power supply (HP Model 6525A or equivalent) to the plug that was removed in step d. Connect the negative lead to the 5061A chassis.

f. If power supply used will not indicate less than 100 microamperes, connect a Clip-on DC Milliammeter (HP Model 428B or equivalent) to the insulated red lead disconnected in step d.

g. Set +3500V dc power supply to +3500 volts and turn the power supply ON. Turn on DC Milliammeter and observe current. If after 1 minute the current indication remains 5 milliamperes or more, the cesium beam tube is leaky and must be replaced. Contact your nearest Hewlett-Packard Sales and Service office for assistance.

h. If after 1 minute the current indication is less than 5 milliamperes, leave the +3500V dc supply connected and observe the current for 15 minutes. The current should decrease slowly. When the current indication is less than 25 microamperes, turn off the +3500V dc supply and disconnect the DC Milliammeter.

i. Connect and lock the plug to J4.

j. Apply operating power to 5061A and observe ION PUMP I indication. CIRCUIT CHECK meter may indicate full scale for a few minutes and should then decrease. When the ION PUMP I reading is less than 25, the beam tube vacuum is satisfactory and the turn-on procedure can be used.

3-17. Cesium Beam LOW Flux Operation Adjustments

3-18. The NORM-LO switch on Cesium Oven Controller Assembly A11 is factory-set to the NORM position. Cesium beam tube life may be extended by operating the tube at a lower flux level. However, by changing the NORM-LO siwtch to the LO position, the signal-to-noise ratio of the beam tube output is decreased causing decrease in the short-term stability. The long-term stability is not affected. If LO flux operation is desired, proceed as follows:

a. Set the 5061A for normal operation. Refer to Paragraph 3-11.

b. When 5061A is operational, remove top cover, set NORM-LO switch on Cesium Oven Controller Assembly A11 to LO.

NOTE

Wait at least 1 hour before proceeding. During the cooling period of the cesium oven, decreasing beam current will cause the CONTINUOUS OPERATION light to go off and the ALARM light to come on.

c. Replace top cover.

d. Set CIRCUIT CHECK switch to 2nd HARMONIC.

e. Check that TIME CONSTANT switch is set to SHORT.

f. Adjust LOOP GAIN control, on front panel, for a reading of 40 on the CIRCUIT CHECK meter.

g. If CONTINUOUS OPERATION light is off, press LOGIC RESET button.

h. With instrument operating and CONTINUOUS OPERATION light on, set CIRCUIT CHECK switch to BEAM I. Set BEAM I METER ADJ for 20 on the CIRCUIT CHECK meter.

i. Set CIRCUIT CHECK switch to each position and record meter reading in the 5061A Operating Record (Table 3-4).

3-19. Pumping the Cesium Beam During Storage

3-20. When a cesium beam tube is stored more than 6 months, the ion vacuum pump must be operated two to three times each year to obtain the expected shelf life of the tube. To pump the tube, proceed as follows:

a. Connect the positive (+) lead of a +3500V dc, 5 milliamp Power Supply (Harrison Labs Model 6525A or equivalent) to P4 of the beam tube.

NOTE

The cable connected to P4 enters the beam tube at the same place as the cable containing the brown, green, and yellow wires.

b. Connect the negative lead of the +3500V dc Power Supply to P17(5) of the beam tube. (P17 is the smaller of the multiple pin connectors).

c. If Power Supply used will not indicate less than 100 microamps, connect a Clip-on DC Milliammeter (HP 428B or equivalent) to the insulated cable of P4.

d. Set the +3500V dc Power Supply to +3500V dc and turn Power Supply ON.

e. Allow Power Supply to remain connected to the beam tube until the current decrases to 10 microamps.

f. Disconnect the Power Supply and DC Milliammeter (if used).

g. The tube is evacuated and can be stored.

3-21. OPERATION WITH TIME STANDARD (Option 001)

3-22. Option 001 provides the 5061A with a 1 pulse-per-second (1 PPS) clock output available at both front and rear-panel BNC jacks. The divider drive is an internally connected, 1 MHz signal from the Frequency Divider Assembly A6. The TIME DELAY, six thumbwheel decade switch (A5S1A through S1F) controls the phase of the clock pulse from 1 μsec to 1 sec with respect to an external reference. The 0—1 μsec TIME DELAY screwdriver adjustment (A5C2) allows fine adjustment over any 1 μsec portion of the thumbwheel settings. The TIME DELAY switch and the 0—1 μsec TIME DELAY control are located under the access door in the top cover.

3-23. The time standard option includes a 24 hour LED digital clock which indicates time in hours, minutes, and seconds. The SYNC button on A5 assembly enables the instrument to synchronize to an external reference standard. The digital clock is set by pressing the SET and SLOW/FAST switches (located at rear of the clock).

CAUTION

It is necessary to synchronize the clock each time the MODE switch is switched from CS OFF.

3-24. Setting the Clock Phase to an External Clock

3-25. The phase difference between the 5061A 1 PPS output and an external reference clock may be set to any desired point between coincidence and 1 second by using the following procedure. The technique used will depend upon the 5061A application and individual user requirements.

3-26. Automatic Synchronization

3-27. To automatically have the 5061A synchronized and delayed from the reference by 9 to 11 μsec, proceed as follows:

a. Remove the top cover.

b. Set the 6 thumbwheel switch to 0 0 0 0 0 0, and 0—1 μsec TIME DELAY control maximum clockwise (do not overtighten).

c. Connect a reference pulse to the 5061A rear-panel SYNC INPUT jack. The reference input pulse must be greater than +5V, with a rise time of less than 0.5 μsec.

d. Press the SYNC pushbutton on the clock module and hold down for at least 1-second. The next tick of the 5061A will be synchronized to the input reference pulse and delayed in time by 9 to 11 μsec. Any additional offset may be selected by using the 6 thumbwheel switch.

e. Set the hours, minutes, and seconds by momentarily pressing SET and placing toggle switch at FAST (for rapid advance of the display). Set toggle switch to SLOW and momentarily press the SET pushbutton switch (for slow advance of the display) and set the seconds slightly ahead of the reference clock.

f. Press HOLD pushbutton.

g. When the reference clock time is identical to the digital clock display, release the HOLD pushbutton. The digital clock will count time in synchronism with the synchronized instrument 1 PPS signal.

h. Replace the instrument top cover.

3-28. Manual Synchronization

3-29. EXAMPLE 1. When a delay of less than 10 μsec is desired or the reference pulse is not of sufficient amplitude, polarity or rise time for automatic synchronization, proceed as follows:

a. Perform Paragraph 3-26, steps a, b, c, and d.

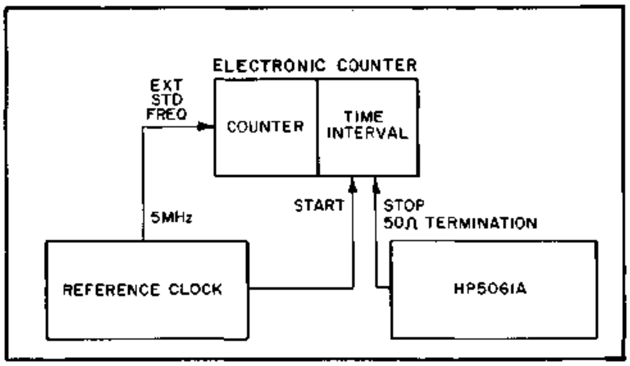
b. Set the 6 thumbwheel switch to 9 9 9 9 9 9, and 0—1 μSEC TIME DELAY control maximum clockwise (do not over-tighten).

c. Connect circuit shown in Figure 3-6.

NOTE

A 50-ohm resistive termination should be used when connecting the 5061A 1 PPS output to the time interval unit to prevent ringing in the pulse.

Figure 3-6. Clock Offset Test Setup, Example 1



d. Set counter time base for best resolution to measure desired time offset.

e. Set time interval unit to trigger on the leading edges of the two input pulses.

f. Set the 6 thumbwheel switch and the 0—1 μSEC TIME DELAY adjustment for desired offset as indicated on counter.

3-30. EXAMPLE 2. When precise coincidence of the reference pulse and the 5061A clock tick or an offset between coincidence and 1 μsec is desired, proceed as follows:

a. Perform Paragraph 3-26, steps a, b, c, and d.

b. Set the 6 thumbwheel switch to 9 9 9 9 9 9, and 0—1 μSEC TIME DELAY adjustment maximum clockwise (do not over-tighten).

c. Connect circuit shown in Figure 3-7. No 50-ohm termination is required for this test setup.

d. Adjust the oscilloscope for comparison of the two pulses.

e. Adjust the 6 thumbwheel switch and the 0—1 μSEC TIME DELAY for coincidence or the desired offset between the 5061A clock tick and the reference clock pulse.

3-31. OPERATION WITH INTERNAL STANDBY BATTERY (Option 002)

3-32. Option 002 provides the 5061A with 30 minutes of standby power (typically 1 hour at 25°C) if ac line power should fail. Recharging the battery is automatic by means of an internal digital timing system each time standby power is used. Maximum recharge takes about 20 hours. Minimum recharge is about 120 minutes each time ac power is interrupted. The front-panel BATTERY warning light indicates three battery circuit conditions:

a. Flashes; when instrument is powered from internal battery supply.

b. On; when battery is being charged.

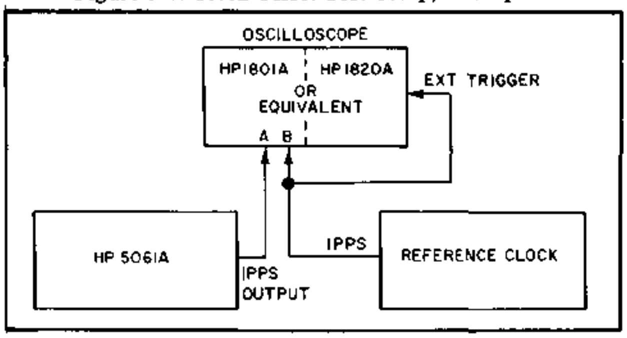
c. Off; when charging cycle is automatically completed.

3-33. If the instrument must be turned off for any reason, disconnect the ac power, remove the bottom cover, and press pushbutton switch S8 located on the bracket supporting A14, A2, and A15 plug-in boards. This disconnects the internal battery supply. The instrument will be on as soon as ac power is reconnected. When operating the instrument from an external dc power supply, leave ac power connected.

NOTE

When Standby Power Supply Option is installed, switching MODE switch from CS OFF to LOOP OPEN may cause internal battery charging circuits to switch to "fast" charge mode. If this occurs remove instrument bottom cover and momentarily connect A2TP5 to ground. This will reset charging circuits to "trickle" charge and turn BATTERY light off.

Figure 3-7. Clock Offset Test Setup, Example 2



3-34. OPERATION WITH HIGH PERFORMANCE TUBE (Option 004)

3-35. GENERAL. Option 004 provides the Model 5061A with improved performance in Accuracy, Reproducibility, Settability, Long- and Short-term Stability, and Warm-up Time (see Table 1-1). To achieve the specified accuracy and settability the HP 10638A Degausser must be used. Degaussing must be performed after turn-on (see Paragraoh 3–14(i)) and after any change in the C-FIELD setting (Paragraph 3-14(k) item 7). These changes are included in the appropriate paragraphs.

3-36. OPERATION AS CRYSTAL OSCILLATOR ONLY

3-37. General

3-38. The Model 5061A may be operated as a quartz oscillator frequency standard with only Oscillator Assembly A10 operating and the cesium beam tube switched off. In this operation mode, the instrument has the stability of the crystal oscillator (Table 1-1) and cesium beam tube life is extended.

3-39. Front-panel OSC FREQUENCY X10^{-10} control does not require adjustment when the instrument is operated with MODE switch set to OPER. In this mode, oscillator frequency is set with OSC FREQUENCY COARSE control outlined in Paragraph 3-14. However, when the instrument is to be operated as an oscillator only (MODE switch set to CS OFF) the oscillator frequency must be set accurately with OSC FREQUENCY X10^{-10} control.

3-40. Oscillator-Only Turn-On Procedure

a. Complete the procedure in Paragraph 3-14.

b. Set instrument controls to:

(1) MOD switch — ON
(2) MODE switch — OPER
(3) CONTINUOUS OPERATION light — ON
(4) ALARM light — OFF
(5) OSC FREQUENCY X10^{-10} — 250
(6) CIRCUIT CHECK switch — CONTROL

c. Adjust OSC FREQUENCY COARSE control for zero CIRCUIT CHECK meter indication.

d. Connect DC Voltmeter to rear panel CONTROL jack.

e. Slowly adjust OSC FREQUENCY X10^{-10} for less than ±20 mV voltmeter indication. The quartz oscillator is now adjusted within ±1 part in 10^{10} of the cesium resonance.

f. Set MODE switch to CS OFF. Instrument is now operating as a quartz oscillator frequency standard.

NOTE

When the Model 5061A front-panel MODE switch is set to CS OFF position, instrument operating power is reduced by about 2/3. However, if Standby Power Supply Option 002 is installed, battery charager timing circuits will continue to function as if full operating power is being used.

3-41. OPERATING RECORD

3-42. Table 3-4 may be used to keep a record of the front-panel meter reading which can be used to compare instrument performance periodically.

NOTE

A copy of the Operating Record table is also fastened to the inside of the front-panel control door for operator use.

Table 3-4. 5061A Operating Record (Meter Readings)

5061A OPERATING RECORD

INSTR. SER. NO. ____________
TUBE SER. NO. ____________

C FIELD DIAL ____________
ZEEMAN FREQUENCY : 42.82 kHz

CIRCUIT	METER READINGS					
DATE						
BATTERY						
SUPPLY						
ION PUMP I						
OSC OVEN						
CS OVEN						
5 MHz						

CIRCUIT	METER READINGS					
DATE						
MULT						
BEAM I						
CONTROL						
2ND HARM						
1 MHz						
100 kHz						

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION

4-2. This section includes details of circuit operation. A description of overall instrument operation is given first with logic symbology following. Then each assembly in the instrument is discussed in order of its designation (A1, A2, A3, etc). Designations and names are listed in Table 4-1.

4-3. GENERAL DESCRIPTION

4-4. The Model 5061A Cesium Beam Frequency Standard is capable of defining frequency and therefore needs no calibration. The instrument is capable of realizing the frequency corresponding to the international time interval standard specified by the 12th General Conference of Weights and Measures (9, 192, 631, 770 Hz undisturbed by external fields). The instrument uses a passive atomic resonator of Cesium 133 capable of producing the necessary hyperfine transitions to achieve the frequency 9, 192, 631, 771.6 Hz. The stability of this frequency is 5 parts in 10^{12} for the life of the cesium beam tube. The passive resonator serves as an atomic frequency standard by stabilizing a quartz oscillator in a feedback control circuit. The quartz oscillator, when stabilized, is used for various functions of frequency and time measurement.

4-5. A simplified block diagram is shown in Figure 4-1. The 5 MHz Quartz Oscillator Assembly A10 output is phase modulated by a 137 Hz signal from Phase Detector Assembly A8. The modulation index is kept small to keep modulation distortion low. The modulated 5 MHz signal is multiplied by 18 in Multiplier Assembly A3 and then by 102 in Harmonic Generator Assembly A4.

4-6. Synthesizer Assembly A1 output, also derived from the 5 MHz quartz oscillator, is mixed with the multiplied signal in Harmonic Generator Assembly A4. The result of the multiplying and mixing is a frequency very close to 9, 192, 6 . . . Hz, the Cesium 133 transition frequency. This finalized microwave field is applied to the cesium beam tube.

4-7. Since the 5 MHz quartz oscillator frequency was phase modulated by 137 Hz in Multiplier Assembly /3, the 9, 192, 63 . . . . Hz microwave field contains this modulation. When the phase modulated microwave field is precisely at the peak of cesium resonance, the cesium beam tube output is the 2nd harmonic (274 Hz) of the modulation frequency. When off of the peak, the output is the fundamental (137 Hz) frequency. These two signals are separated in AC Amplifier Assembly A7. The 137 Hz signal is sent to Phase Detector Assembly A8 and Logic Assembly A14. The 274 Hz signal is also sent to Logic Assembly A14.

4-8. Phase Detector Assembly A8 output is a dc voltage proportional to the difference in frequency between the cesium resonance and the applied microwave field. This dc signal is supplied to Operational Amplifier and Integrator A9.

Table 4-1. Assembly Designations

Assembly Number and Name		HP Part No.
A1	Synthesizer	05061-6097
A2	Battery Charger (Option 002)	05061-6019
A3	Multiplier	05061-6108
A4	Harmonic Generator	05060-6029
A5	Digital Divider (Option 001)	05061-6011
A6	Frequency Divider	05061-6102
A7	AC Amplifier	05061-6005
A8	Phase Detector	05061-6095
A9	Operational Amplifier	05061-6092
A10	Quartz Oscillator	00105-6013
A11	Cesium Oven Controller	05061-6009
A12	Cesium Beam Tube	05061-6077
A13	Buffer Amplifier	05061-6030
A14	Logic	05061-6016
A15	Power Regulator	05061-6099
A16	Clock Display Assy (opt 001)	05061-60125
A16	Clock Display Assy (opt 003)	05061-60136
A17	Terminal Board	05061-6018
A18	+3500 Vdc Power Supply	05060-6093
A19	−2500 Vdc Power Supply	05060-6092

4-9. The output of Operational Amplifier A9 is a voltage which electrically tunes the 5 MHz quartz oscillator to eliminate any frequency difference between the cesium beam tube resonance and the microwave field.

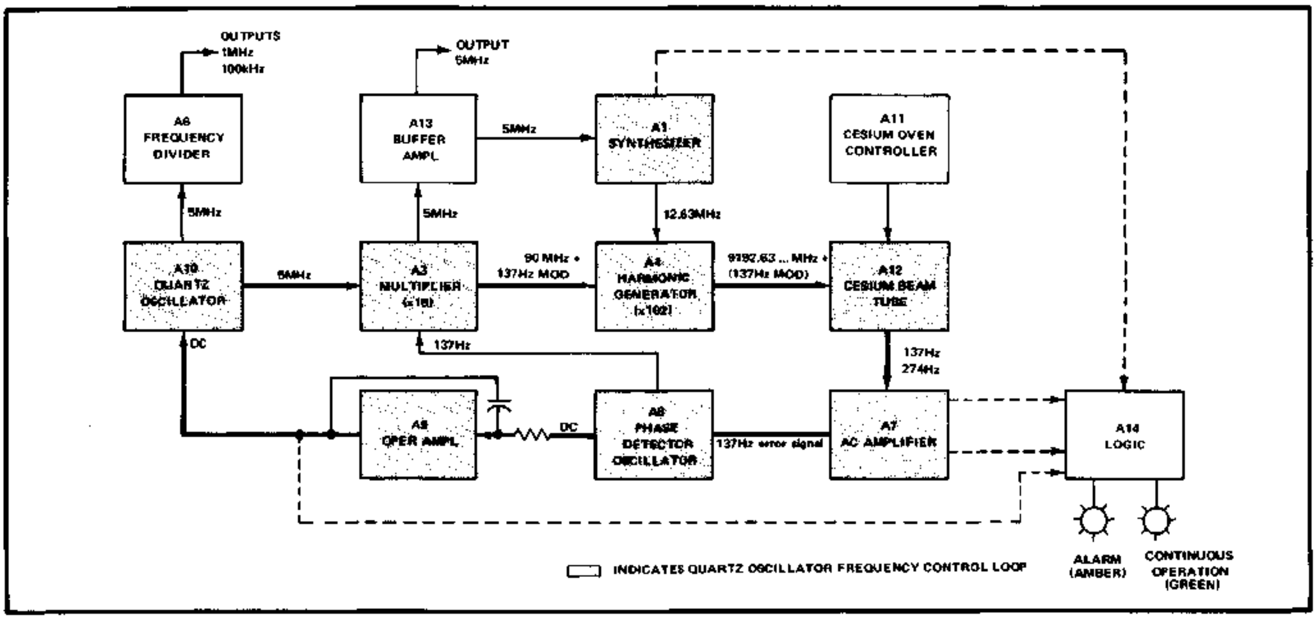
4-10. Buffer Amplifier Assembly A13 isolates the 5 MHz quartz oscillator signal from external loading effects and provides 5 MHz signals to front and rear-panel output jacks.

4-11. Frequency Divider Assembly A6 divides the 5 MHz signal to 1 MHz and 100 kHz and provides these signals to front and rear panel output jacks. This assembly also supplies 1 MHz to Digital Divider Assembly A5 (Option 001).

4-12. Logic Assembly A14 receives signals from assemblies A1, A7, A8, and A9 to control front-panel CONTINUOUS OPERATION and ALARM lights.

4-13. Cesium Oven Controller A11 provides power to the cesium beam oven and to Operational Amplifier Assembly A9.

Figure 4-1. Model 5061A Simplified Block Diagram



4-14. GATING AND LOGIC

4-15. The 5061A uses integrated circuits in Synthesizer Assembly A1, Battery Charger Assembly A2 (Option 002), and Digital Divider Assembly A5 (Option 001). As a result, it is necessary to understand basic logic symbols and their application in gating. In the circuit diagrams, AND gate and OR gate symbols are used. The following paragraphs and illustrations introduce logic symbols.

4-16. Logic Symbols

4-17. The symbol shown in Figure 4-2A is for the basic AND function. This AND gate output is high (H) if all inputs are high. The AND gate can have two or more inputs. The symbol in Figure 4-2D is for the basic OR gate. This OR gate output is high when one or more of the inputs is high. The OR gate can also have two or more inputs. A small circle at the input line of a logic symbol indicates a low (L) level activates the function. The symbol of Figure 4-2B shows a low input on all lines causes a high (H) output. A small circle at the output line of a logic symbol indicates a low (L) level when activated, as shown in Figure 4-2C. Thus the small circle indicates inversion. This applies to both types of gates. Figure 4-2 lists examples and truth tables for logic actions. When the output of the OR gate is inverted, it is referred to as a NOR gate. Similarly, an inverted AND gate output gives a NAND gate.

4-18. In a binary system there are only two states, referred to as H or L. The H is the relatively more positive level and L is the relatively less positive level. Positive logic means that the voltage level assigned to the "one" state is more positive than that assigned to the "zero" state. Negative logic has the "one" state less positive than the "zero" state. An H state could be logical "one" or "zero." Thus, positive logic (logical one) or negative logic (logical zero) must be clearly specified. However, H must always represent the more positive level. Figure 4-2 shows four pairs of symbols that have the same truth tables and can be used interchangeably. The same output function can be performed by what appear to be two different logic symbols. The following discussion will show that they are the same. Therefore, more than one symbol can be used to represent a particular function.

4-19. DeMorgan's Theorem and Logic Symbols

4-20. DeMorgan's Theorem states: $\overline{A \cdot B} = \bar{A} + \bar{B}$ and $\overline{A + B} = A \cdot B$, where the dot (·) is read as "and" and the cross (+) is read as "or." The bar across the letters is read as "not." The theorem shows that an AND gate with an inverted output is the same as an OR gate with inverted inputs. The expression $X = \overline{A \cdot B}$ is correct for the AND gate with the inverted output as in Figure 4-2J. From DeMorgan's theorem, $X = \overline{A \cdot B} = \bar{A} + \bar{B}$ and the symbol for $\bar{A} + \bar{B}$ is the OR gate with inverted inputs shown in Figure 4-2J. Thus, the same truth table will work for both symbols. Remember that the symbol used must describe the logic function performed. Positive and negative logic differences are shown in Figure 4-2. When positive logic symbology is used to represent negative logic functions, the dual of the function is produced. For example, a positive logic AND gate becomes a negative logic OR gate. Thus, AND is the dual of OR and NOR is the dual of NAND.

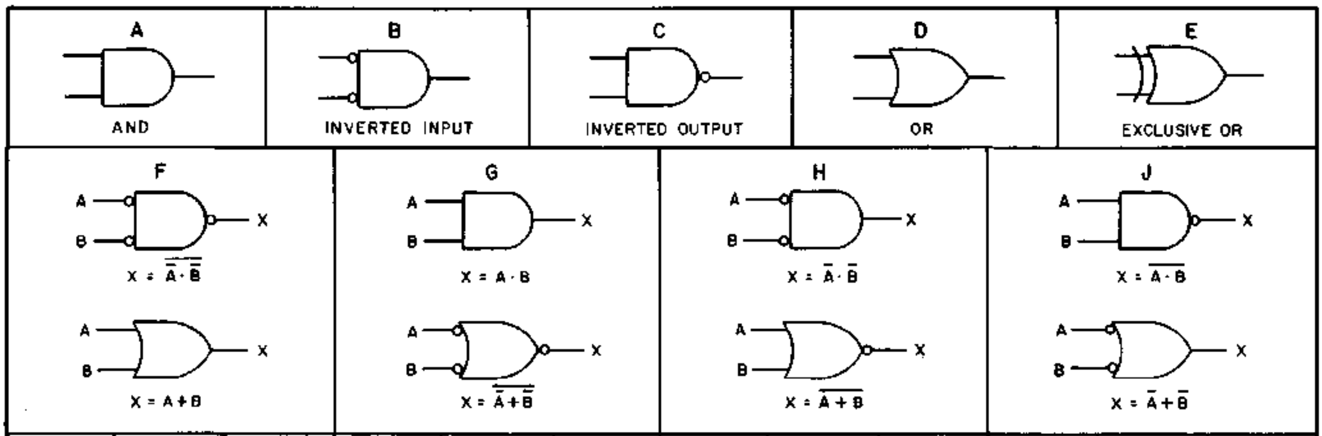
4-21. SYNTHESIZER ASSEMBLY A1

4-22. General

4-23. Synthesizer Assembly A1, Figures 8-8 and 8-9, generates a 12.631, 771, 6 MHz signal that is mixed with 9,180 MHz in Harmonic Generator Assembly A4, producing the 9, 192, 631, 771.6 Hz microwave field which is applied to the cesium beam tube. Synthesizer output frequency of 12.631, 771.6 MHz corresponds to zero-UTC-offset (Atomic Time Scale presently in use).

4-24. Figure 4-3 is a simplified block diagram of Synthesizer Assembly A1. The 5 MHz input signal is first isolated through Buffer Amplifier Assembly A13. This signal is then applied to the synthesizer preset divider circuits. The

Figure 4-2. Gate Symbols and Logic Function Comparison



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

5 MHz is multiplied by the rational fraction m/n through the action of the synthesizer. The integer "n" is predetermined and controls the preset digital divider output frequency; thus, the preset divider output frequency is 5 MHz/n.

4-25. The preset divider is made up of four decades giving a total dividing capability of 10,000. With each 10,000 count divider input, there will be one output. With the addition of the preset capability this divider can be set to divide by any integer (except 1 through 9, due to preset time, see Figure 4-4). Since the divider can be set to divide by any predetermined integer, the system is considered a divide-by-n preset divider. For example; if the divider were to divide by 2,000, an 8,000 would be preset into the decade before the counting sequence starts, since an 8,000 count is already in the decade from the preset, it will take only 2,000 inputs to get 1 output. Conversely, to divide by 8,000, 2,000 counts are preset into the divider prior to counting.

4-26. During a normal counting sequence, the input gate to the divider is closed for 1.8 microseconds so the divider can be preset. The gate is then opened and the decades divide the input 5 MHz by the preset n integer.

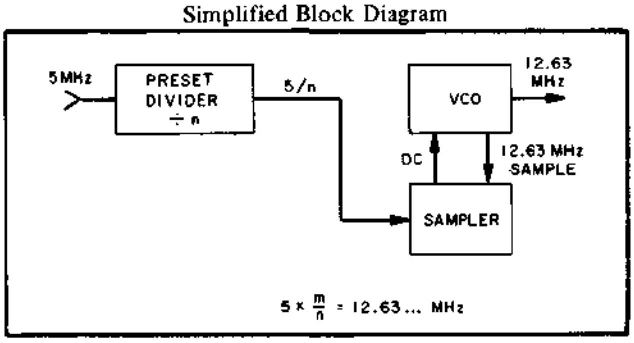
4-27. The integer "m" is determined by the 12.631 ... MHz phase locked voltage controlled oscillator. This oscillator is electrically controlled to oscillate at the "m"th harmonic of 5 MHz/n. To the synthesizer M = 3451 and N = 1366 giving an output frequency of 12.631, 771, 6 MHz.

4-28. The preset divider output frequency, 5 MHz/n, drives a sampling circuit. This circuit samples the 12.631 ... MHz voltage controlled, phase locked oscillator signal. The filtered sampler output is a dc signal proportional to the harmonic relationship between the oscillator frequency and the 5 MHz/n sampler drive frequency. This dc signal controls the 12.631 ... MHz oscillator frequency, thus phase locking the oscillator to the correct m/n ratio. The signal sent to Harmonic Generator Assembly A4 is 12.631 ... MHz. It is also available as a test signal at rear panel SYNTH output jack.

4-29. The preset divider receives 5 MHz from A10 and A13 and provides a 1.8 μsec wide pulse output with a 5 MHz/n repetition rate. The factor n is predetermined by hard-wiring the preset decades to the number which produces the zero UTC OFFSET frequency.

4-30. The preset divider (Figure 8-8) consists of an input gate, Q2-Q3; four preset decades IC1, 2, 5, and 6; one-shot M.V., IC4; NAND gate IC3; and test point driver Q4. The input to A1J1 consists of a 5 MHz sine wave from A13. The input gate, Q2 and Q3, closes for 1.8 μsec as determined by one-shot M.V. IC4. With the decade preset to zero, each decade divides by ten, thus the overall circuit can divide by 10,000. If the decade has a number preset into it, the decade starts its count from the preset number. Counting is performed on the negative going pulse at pin 8 of the decade. The BCD inputs and outputs are positive logic. When the strobe line is low, the counting operation is stopped and the BCD inputs are preset in.

Figure 4-3. Synthesizer Assembly A1
Simplified Block Diagram



4-31. Considering all four decades as a preset divider, the "9" outputs of IC6, 5, and 2 connect to IC3. Note however, that only the "1" output of IC1 connects to IC3. This arrangement allows the decade divider to count to 9991. When a count of 9991 is reached, that is, when all seven inputs of IC3 are HI, IC3(8) goes low to trigger one-shot M.V., IC4. The time (1.8 μsec) from pulse 9991 to 9999 is required to preset the decades. The output of IC4 drives four different points:

a. Blocking Oscillator Q17.

b. Test Point Driver Q4.

c. Strobe line to IC1, 2, 5, and 6.

d. Input Gate Q2 and Q3.

4-32. The output to the blocking oscillator is the divider output. The test point driver is used in selecting C2. The output to Q3 closes the input gate to prevent the 5 MHz pulses from entering the decade divider during the time when the decades are preset. A negative pulse on the strobe line causes the preset numbers to be entered into the decades. Figure 4-4 shows the sequence of events for the divider.

4-33. Capacitor C2 is selected to determine the proper RC time constant for the one-shot M.V. Since the 5 MHz input has a period of 0.2 μsec, C2 is chosen to block out 9 pulses of the input waveform. See paragraph 5-53A for adjustment procedures.

4-34. The jumper wires program the inputs to preset decades IC1, IC2, IC5 and IC6. For example, IC1 input is programmed for a BCD of 4. IC1 (3) is HI and IC1 (4, 10, 11) are LO. IC1 requires positive logic levels at its preset inputs, therefore the HI level at pin 3 represents the BCD 4.

4-35. Q1, CR1 and associated circuitry serve to reduce the 18.7 volts from the regulated supply to a nominal 5 volts for use as V_{CC} power for the IC's.

4-36. Phase Locked Voltage Controlled Oscillator

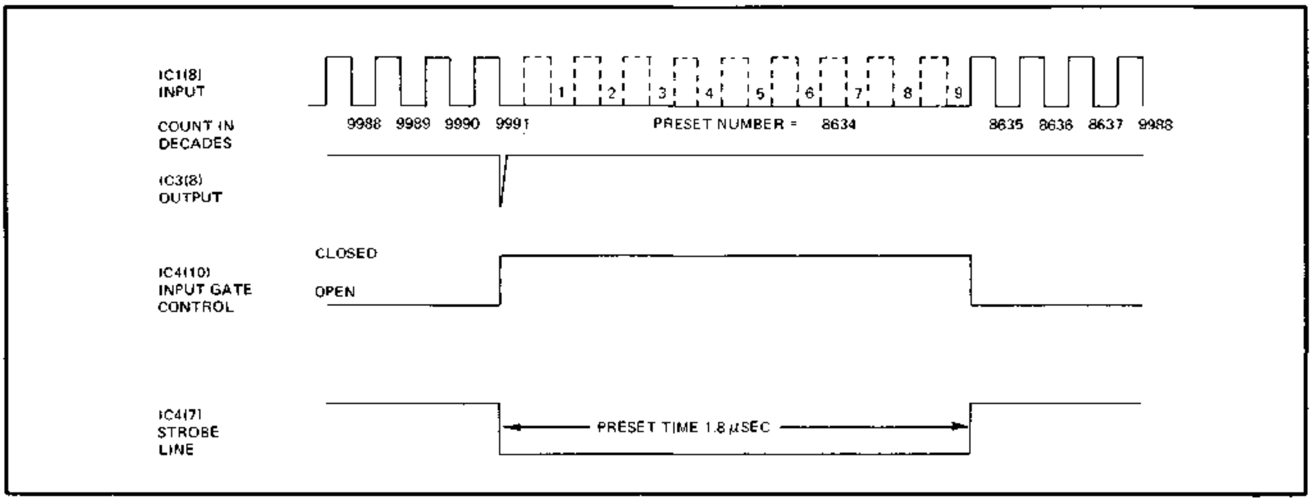
4-37. The phase locked voltage controlled oscillator produces the 12.631, 771, 6 MHz signal applied to Harmonic Generator Assembly A4 for mixing with the 9180 MHz phase modulated signal. Oscillator frequency is determined by the bias voltage applied to varactor CR28.

4-38. Prior to phase locking, the 12.631 . . . MHz voltage controlled oscillator (Q19 and associated components), oscillates at approximately 12.631 . . . MHz, dependent on dc biasing by R71A-B. Transistor Q21 buffers the oscillator and drives Q22. The 12.631 MHz signal is present at T3 primary and in turn through capacitive voltage divider C33, C34 at T2 secondary. This is the input signal for the sampler.

4-39. Transistors Q17, Q18 and associated components are a trigger blocking oscillator circuit driven by output pulses from preset divider output gate IC5. This trigger blocking oscillator in turn drives sampler blocking oscillator Q20 and associated components. Transformer T2 secondary receives 40 nsec pulses from sampler blocking oscillator at the 5 MHz/n frequency. These pulses "turn on" CR36 and CR37 each time they occur. The 12.631 . . . MHz signal, also present in T2 secondary, is very close to the "m"th harmonic of 5 MHz/n. This "m"th harmonic is sampled at 5 MHz/n rate, filtered by C36, and applied to dc amplifier Q23 to control the voltage applied to CR28. This controls the oscillator frequency. Therefore, the voltage level at Q23 gate determines the oscillator frequency.

4-40. When oscillator frequency is the exact "m"th harmonic of 5 MHz/n, the input level at Q23 base will not change since the filtered dc average remains constant. This holds the voltage on CR28 constant and the oscillator frequency does not change. If the oscillator frequency should change, the input level to Q23 will change, changing the voltage on CR28, bringing the oscillator back to correct frequency. When the loop is locked, synthesizer output frequency is 5 MHz(m/n). The dc control voltage to CR28 is also applied to Terminal Board Assembly A17, TP7 (SYNTH).

Figure 4-4. Synthesizer Assembly A1 Timing Diagram



4-41. Transformer T3 couples the synthesized frequency to tuned output amplifier Q26, improving signal purity, and providing two outputs. One output is a 150 mV signal to rear panel SYNTH output jack for test purposes, the other is a 300 mV signal applied to Harmonic Generator Assembly A4 for mixing with the modulated 9180 MHz microwave signal.

4-42. The 12.631 ... MHz voltage controlled oscillator phase-lock range is kept narrow to prevent phase-locking to incorrect harmonics. Diodes CR38, CR39, with C40, C43, R82, and R84 provide AGC dc feedback to Q19 base.

4-43. Transistor Q27 and associated components provide a synthesizer failure signal to Logic Assembly A14. During normal synthesizer operation, Q27 is off and no output signal results. If the synthesizer loses phase-lock, the input to Q23 becomes a random ac signal, coupled through C41 to Q24 base, amplified in Q24, Q25, and rectified by CR40 and CR41. This rectified signal forward biases CR42 and turns Q27 "on" sending a signal to Logic Assembly A14. This turns off the CONTINUOUS OPERATION light. If blocking oscillator Q20 fails, a signal through CR43 will turn on Q27 and apply the same signal to the logic circuits.

4-44. BATTERY CHARGER ASSEMBLY A2 (Option 002)

Figure 8-10

4-45. General

4-46. Standby battery BT1 provides 30 minutes of dc power should the normal power supply or supplies to the instrument fail. If standby battery power is used, and input power returned, battery charger circuits charge the standby battery for the correct period determined by battery use time. The battery charger circuits disconnect the standby battery if battery voltage level reaches +21 Vdc. Front panel BATTERY light DS3 is an indicator of Battery Charger Assembly A2 operation. During normal 5061A operation, the internal standby battery is "trickle" charged. When external power is removed and re-applied, the battery is "fast" charged.

4-47. The battery charger operates in one of three modes:

a. Normal operation: Front panel BATTERY light off. Battery Charger Assembly A2 operating as "trickle" charger for internal standby battery.

b. External ac 5061A power lost: Front panel BATTERY light flashing. Internal battery furnishing power to 5061A.

c. External ac power restored: Front panel BATTERY light on. Battery charger "fast" charging internal battery. Continues to "fast" charge depending on time battery supplied power. When "fast" charge cycle is complete, BATTERY light will go off.

NOTE

The internal standby battery is fully discharged prior to shipment from the factory. When the instrument is initially connected to ac power, the BATTERY light will remain on until internal battery is completely charged (about 20 hours).

4-48. Figure 4-5 is the battery charger block diagram. Diodes CR1, CR2, CR3, CR4, and capacitor C4 are a full wave rectifier and filter for the battery charging circuits. During normal instrument operation, current through series regulator transistor Q1 is regulated to maintain the internal battery, trickle-charged. This current regulation is determined by R28 and Q14 base-emitter voltage. Transistor Q11 is normally biased "off" by Q10 and Q15. Since Q15 is normally "off," the regulated current through R28 trickle charges the battery and operates the battery disconnect circuit. When transistor Q15 is turned "on," Q10 turns "off," Q11 turns "on" to shunt R28 and increase the charging current for "fast" charge mode. "Fast" charge current is set by R19. During normal operation, battery light control Q25 and Q26 are biased "off," holding the front panel BATTERY light off. All other circuits are in a standby state.

4-49. For explanation purposes, assume the 5061A is operated by external dc supply. When the 5061A is operating on external dc power and ac line voltage fails, battery charger circuits see no change and remain in their standby state. When ac line power is restored the charger circuits will continue to trickle charge the standby battery. If ac line power and external dc power fail, the internal standby battery is switched into operation through standby power supply gate circuit in Power Regulator Assembly A15.

NOTE

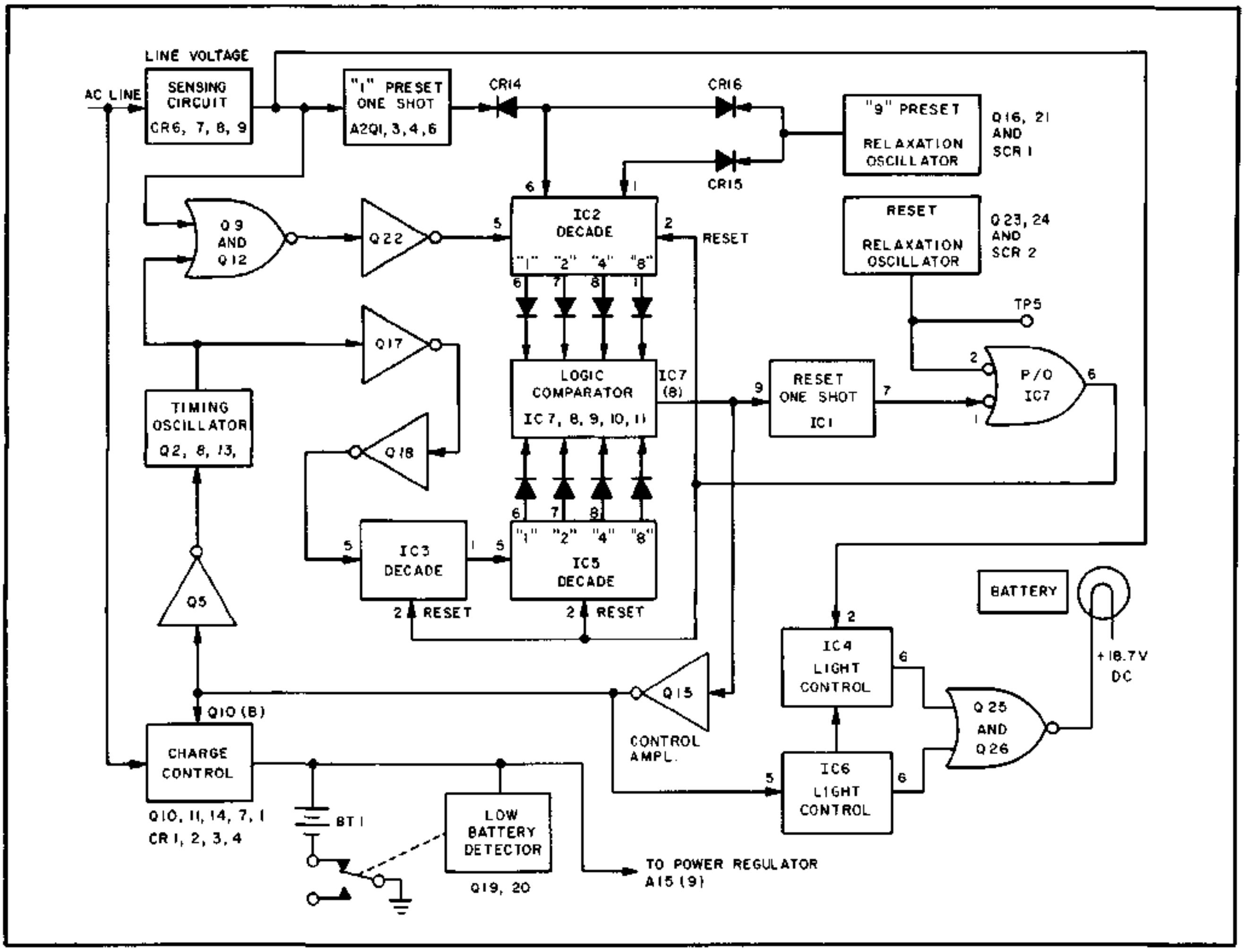
When the 5061A is operated with external standby dc power, instrument ac power must remain connected to charge and re-charge the internal standby battery.

4-50. The positive voltage applied at Q9 and Q4 base circuits holds the battery charger circuits in their standby state. This voltage is present when ac power or external dc power is applied. Diodes CR6, CR7, CR8, CR9, and components C4, R12, R13, and CR13 are an ac sensing circuit. When ac power fails, the positive voltage is still present at Q9 and Q4 through CR10 and CR13 from EXT DC input. When ac and dc power fail, the bias at Q9 and Q4 is no longer present, NOR gate Q9 and Q12 opens, and Q4 collector goes "H". This triggers one-shot circuit Q1, Q3, and Q6 to produce a single negative pulse coupled through CR14 to IC2(6), presetting a "1" into this decade.

4-51. The IC3, IC5 decade combination forms one input to logic comparator IC7, IC8, IC9, IC10, and IC11. Decade IC2 is the other input. The comparator output, IC7(8), controls the operation of Battery Charger Assembly A2. During normal operation, decade IC2 and decades IC3, IC5, are set to "0" allowing the logic comparator to sense coincidence between IC2 and IC5. For each input to IC2, IC3 must have 10 inputs for the count in IC5 to equal IC2. When IC2 and IC5 agree, logic comparator output at IC7(8) is "L".

4-52. As mentioned in Paragraph 4-50, when power is removed from the instrument a "1" is preset into IC2 upsetting the coincidence between IC5 and IC2. When this occurs, IC7(8) goes "H" and remains "H" until coincidence is again established.

Figure 4-5. Battery Charger Block Diagram



4-53. Comparator IC7 output is applied at Q15 base circuit to control Q15 collector voltage. Therefore, IC7 controls battery charger operation through Q15. When Q15 changes state, three circuit functions are affected:

a. Transistor Q10 changes state and sets the charging circuits for "fast" charge when ac line power is returned. The circuit remains in "fast" charge until Q15 returns to normal state.

b. Transistor Q5 changes state and starts the timing oscillator. The oscillator will oscillate until Q15 returns to normal state.

c. Battery light control circuits are activated and front panel BATTERY light flashes on and off until Q15 returns to normal state.

4-54. Timing Oscillator

4-55. When transistor Q15 changes state, Q5 is switched "off" to start the timing oscillator. This circuit produces a positive trigger pulse every 13 minutes until Q15 returns to normal state. Unijunction transistor Q2 acts as a relaxation oscillator causing a switching action on Q8. Each time Q8 is triggered, C7 step-charges until the charge voltage is sufficient to turn "on" Q13. When this occurs, C7 discharges through Q13 to form the positive output trigger pulse. The time required to charge C7 to the correct voltage level is 13 minutes. The output trigger is applied to shaping amplifier Q17-Q18 and NOR gate Q9, Q12.

4-56. Shaping amplifier Q17, Q18, and associated components amplify and shape the input trigger so the signal applied to IC3(5) is a positive input count pulse. The other oscillator output trigger is applied to NOR gate Q12 base circuit. This signal changes amplifier Q22 state, forming a positive input count pulse to IC2(5). Each time the timing oscillator triggers, IC2 receives a count pulse (if NOR gate Q9, Q12 is open). The NOR gate remains open until ac line or external dc power is restored.

4-57. Battery Disconnect

4-58. Transistors Q19, Q20, and associated components form a low-voltage-sensing circuit. If standby battery voltage drops to +21 volts, relay K1 disconnects the battery to prevent battery damage.

4-59. When external power is returned to the 5061A, NOR gate Q9, Q12 is closed by the voltage applied to Q9 base circuit. This same voltage is applied to battery light control

IC2 causing front-panel BATTERY light to remain on. With NOR gate Q9, Q12 closed, decade counter IC2 no longer receives count pulses from the timing oscillator. However, decade counters IC3, IC5 continue to count pulses from the timing oscillator.

4-60. The battery charging circuit, having been preset for "fast" charge described in Paragraph 4-48, fast charges the battery for a period dependent on the number of pulses sent to IC2. The battery continues to "fast" charge, IC3, IC5 continue to count until the total count in IC5 equals the count in IC2. The time required for this coincidence to occur is about 10 times the time required to accumulate the same count in IC2. Mimimum charge time is about 120 minutes.

4-61. Logic Comparator

4-62. Integrated circuits IC8, IC9, IC10, and IC11 operations are similar. Therefore, only IC11 will be discussed. Each output pin of IC2 and IC5 is connected to a NAND gate so that pins 1 are connected to IC11 input, pins 8 connected to IC10 input, pins 7 connected to IC9 input, and pins 6 connected to IC8 input. Each of the IC outputs are connected to NAND gate IC7. All inputs to IC7 (pins 9, 10, 11, 12, and 13) must be "H" for coincidence to occur. If any input remains "L", IC7 output state is "H". During normal instrument operation, the output state of IC7 is "L". Figure 4-6 shows the internal IC functions between IC2 and IC5 applied to IC11 and this output applied to IC7. All other IC inputs to IC7 are similar.

4-63. Assume identical outputs from IC2(1) and IC5(1) are applied to IC11(1 and 10). Pin 1 input is inverted through amplifier A and applied as one input to NAND gate B. The other input to NAND gate B is a complement pulse from IC5(1) to IC11(10). Since NAND gate B has opposite signals at the input, the output applied to IC7(12) is "H". The input to IC11(10) is inverted through amplifier B and applied as one input to NAND gate A. The other input to NAND gate A is a complement signal from IC2(1). NAND gate A has opposite signals at the input so that the output applied to IC7(13) is "H". When this occurs, IC7 senses coincidence between IC2(1) and IC5(1). Only if both inputs to IC11 are the same will IC7 inputs be "H". When all IC7 inputs are "H" the NAND gate output will be "L". This "L" signal at IC7(8) will return the battery charger circuits to normal operation (standby).

4-64. When IC7 changes to the normal "L" operation state, Q15 is cut off. This transition triggers coincidence one-shot IC1, applying a reset signal through an amplifier in IC7 to decades IC2, IC3, and IC5 resetting them to "0". With Q15 cut off, Q10 switches the charging circuit to trickle mode. Transistor Q15 also changes Q5 state, stopping the timing oscillator. Inputs to battery light control return to normal, turning off front panel BATTERY light, indicating Battery Charger Assembly A2 has returned to normal standby condition..

4-65. Battery Light Control

4-66. Figure 4-7 is a simplified schematic of the battery light control circuit. During normal operation an "H" signal is applied to IC4(1), inverted to "L", and applied to NOR gate IC6(3). The other NOR gate input is an "H" signal from Q15 collector. With an "H" and "L" signal present, the output at IC6(6) is "L" and Q26 is held off. The "L" signal at IC4(7) will not start the multivibrator and Q25 is held off. With Q25 and Q26 held off, front panel BATTERY light is off.

4-67. With ac power removed from the instrument, the input at IC4(1) and IC6(5) go "L", IC6(3) goes "H" and IC6(6) output remains "L" holding off Q26. However, the "L" at IC4(2) is inverted to "H" starting the multivibrator.

Figure 4-6. Logic Comparator

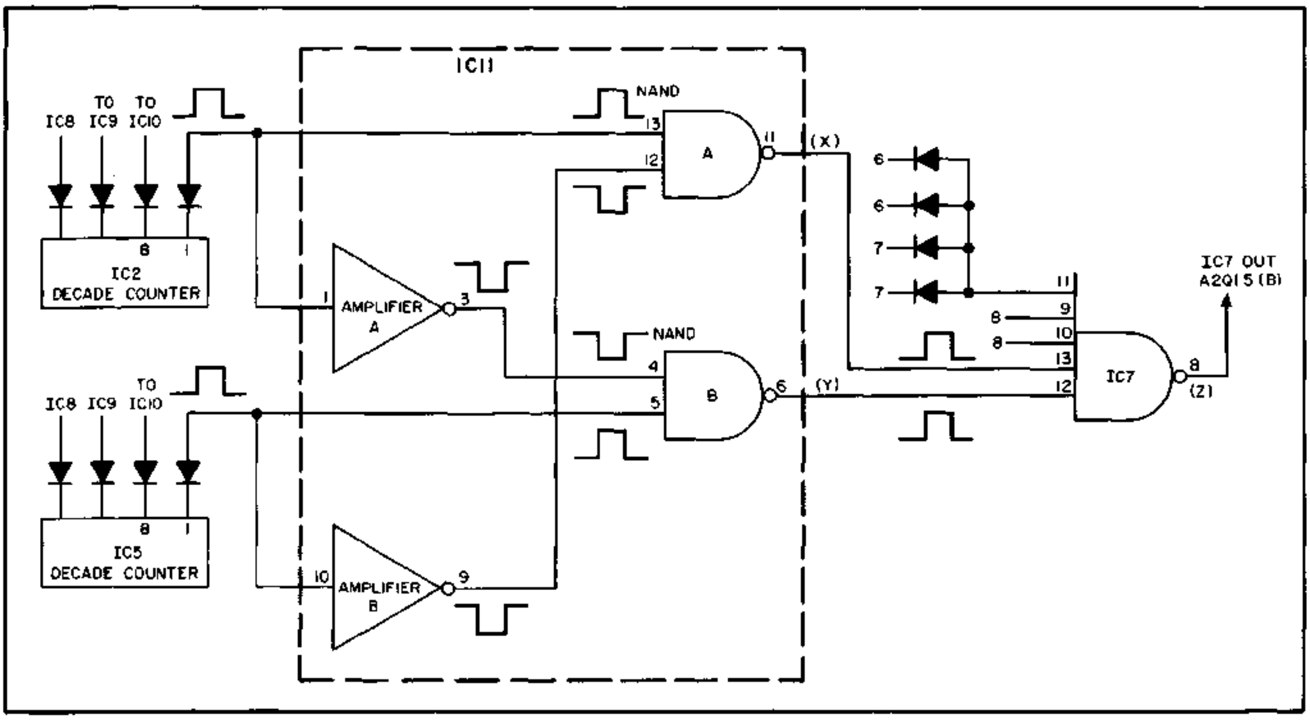
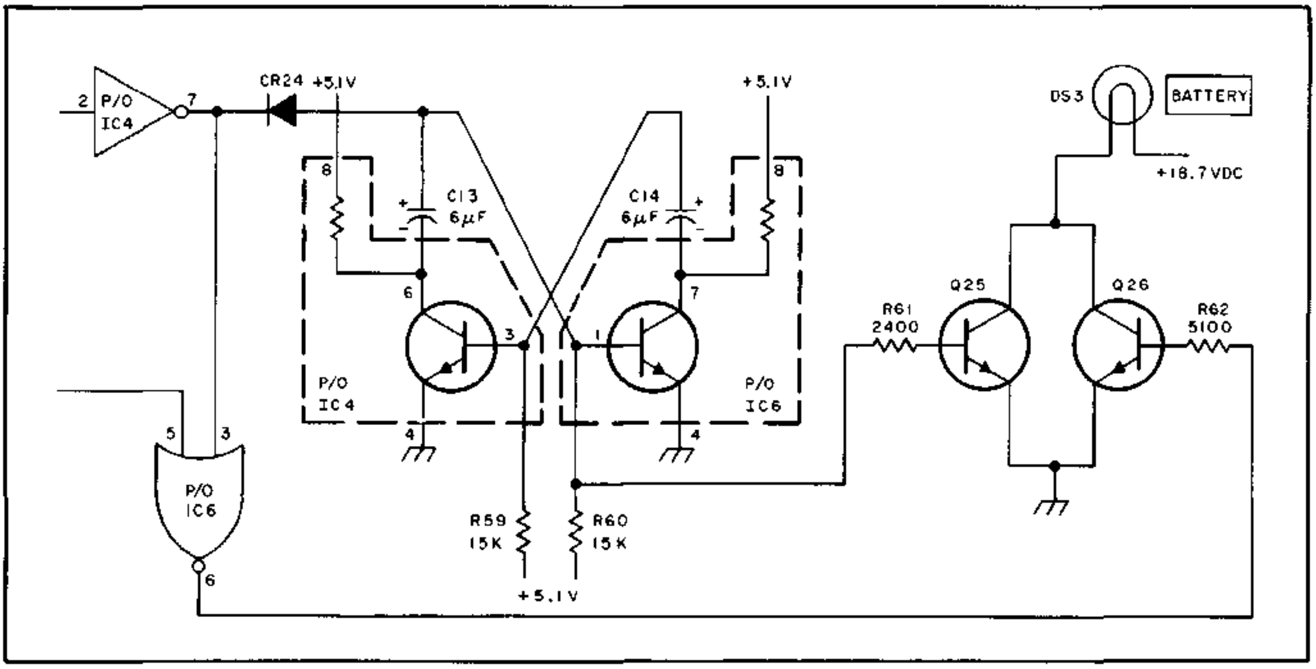


Figure 4-7. Battery Charger Light Control



Transistor Q25 base circuit is alternately biased "H" and "L" at the multivibrator frequency, alternately switching one side of front panel BATTERY light "L", turning the light on and off. This continues until ac power is restored.

4-68. When ac power is returned, IC4(1) goes "H" but the signal at IC6(5) remains "L" until battery "fast" charging is complete. The "H" at IC4(1) is inverted and applied to IC6(3). The output at IC6(6) goes "H" causing Q26 to change state, holding front panel BATTERY light on. The "L" at IC4(7) turns off the multivibrator. When the battery has completely recharged, the signal at NOR gate IC6(5) goes "H", normal operation is restored, and the BATTERY light is off.

4-69. Reset and Preset Relaxation Oscillators

4-70. When the 5061A is shipped with Option 002 or 003, the standby battery is discharged. The reset and preset oscillators reset the decade circuits to "0" and preset a "9" into decade counter IC2. This allows the charging circuits to "fast" charge the internal standby battery for approximately 20 hours (maximum charge time). The full re-charge cycle will also function if relay K1 disconnects the standby battery from the circuit because of low battery voltage, or if the battery is disconnected by switch S8.

4-71. Before initial operating power is applied to the 5061A, SCR2 is off. This silicon switch will turn on 3 seconds after power is applied to the instrument, thus turning off the 3-second reset oscillator. The time required to turn on the silicon switch is determined by C12. With SCR2 off, Q24 applies a reset signal to IC7(2). The signal at IC7(6) resets decade counters IC2, IC3, and IC5 to "0". When C12 charges to the conduction point of Q23, SCR2 turns on, turning off Q24, removing the reset pulse.

4-72. The preset oscillator functions the same except C11 in Q21 gate circuit produces the necessary time constant to hold SCR1 off for 6 seconds. The preset pulse is present during reset time but will not affect the decades until the reset oscillator circuit turns off. With the reset oscillator off, the preset oscillator remains on 3 additional seconds, setting a "9" into IC2(6, 1). When C11 charges to the conduction point of Q21, SCR1 turns on, turning off Q16, removing the preset pulse. Integrated circuit IC2 causes the battery charging circuits to "fast" charge for approximately 20 hours. This same sequence will occur if relay K1 disconnects the battery from the circuit due to low battery voltage.

NOTE

When it is necessary to remove all power from the 5061A, disconnect the ac power cord from the ac source and press battery disconnect switch S8. When ac power is connected, the battery charging circuits will "fast" charge the internal standby battery for 20 hours. If the internal standby battery is fully charged, this additional 20 hour "fast" charge may damage the battery. To inhibit the 20 hour charging cycle, momentarily connect a shorting strap between A2TP5 and chassis, resetting all decades to "0".

4-73. MULTIPLIER ASSEMBLY A3

4-74. General

4-75. Multiplier Assembly A3, Figure 8-11, provides a stable, spectrally clean, 300-milliwatt, 90 MHz signal to Harmonic Generator Assembly A4 and an isolated 5 MHz signal to Buffer Amplifier Assembly A13. The 5 MHz signal from Quartz Oscillator Assembly A10 is applied through J5 to A3 for multiplication and to the 5 MHz isolation amplifier. Prior to multiplication, the 5 MHz is modulated by 137 Hz from Phase Detector Assembly A8. The modulated 5 MHz is doubled to 10 MHz, tripled to 30 MHz, and tripled again to 90 MHz. Isolation amplifier Q2 provides a 50 ohm, 5 MHz source to drive Buffer Amplifier Assembly A13.

4-76. Phase Modulator

4-77. The phase modulator circuit consists of CR2, C10, C12, and L2. A 5 MHz signal is applied through J2, R3, and C3 to Q1 base. A second signal, at 137 Hz, is applied through J1, R13, and R20 to Q1 collector circuit. Varactor CR2, coil L2, and capacitor C12 form a resonant circuit at 5 MHz. When 137 Hz is applied to this tuned circuit, the capacity of varactor CR2 varies at 137 Hz and phase modulates the 5 MHz signal. Diode CR1 and resistor R15 establish dc operating voltage for CR2. In addition to amplifying the input 5 MHz signal, Q1 isolates the 5 MHz modulated signal and prevents feedback to Quartz Oscillator Assembly A10. Breakdown diode CR5 establishes a +7-volt reference for the bases of Q1, Q3, Q4, Q6 and Q9.

4-78. Balanced Doubler

4-79. The 5 to 10 MHz balanced doubler circuit receives modulated 5 MHz through C14 to Q4 base. Amplifier Q4 drives T2 primary at 5 MHz. Transistor Q4 is a class A amplifier and C17 tunes T2 primary to 5 MHz. Gain stability is provided by negative feedback through R23. Ferrite bead E2 suppresses parasitic oscillations. Transformer T2, diode CR3-CR4, form a full-wave rectifier which supplies 10 MHz pulses through C32 to the 10 MHz filter circuit. Inductor L9 provides a current return path for the diodes.

4-80. 10 MHz Filter

4-81. Transistor Q6 is connected as a common-base amplifier and matches the low-impedance balanced doubler circuit to the high-impedance double-tuned 10 MHz filter circuit. Components C34, R30, L12, C36, L14, and C38 form a double tuned 10 MHz filter. Capacitor C40 provides high impedance coupling between the filter and the 10-30 MHz tripler input.

4-82. 10 to 30 MHz Tripler

4-83. Transistor Q9 amplifies the filtered 10 MHz signal for 30 MHz tripler circuit drive. Negative feedback for gain stability is provided by R34. Resonant circuit L18, C48 in Q9 collector circuit is tuned to 10 MHz and provides maximum signal to the tripler circuit. Diodes CR8, CR9, and the two RC networks R36, C49 and R37, C50 generate 10 MHz pulses which are optimum for 3rd harmonic. Capacitor C51 and inductor L20 are tuned to 30 MHz and select this harmonic for amplification and filtering.

4-84. 30 MHz Filter

4-85. Transistor Q3 is connected as a common-base 30 MHz amplifier and provides impedance matching between the low-impedance 30 MHz tripler circuit and the high-impedance double-tuned 30 MHz filter circuit. Components C15, L3, C18, L4, C21, and C23 form the double-tuned 30 MHz filter. Inductor L5 provides a dc return for Q5 base circuit.

4-86. 30 to 90 MHz Class C Tripler and Filter

4-87. Transistor Q5 is a class C tripler with gain controlled by feedback through Q7. Transistor Q5 conducts pulses of current that are rich in 3rd harmonic content. The 90 MHz third harmonic is filtered by double tuned circuit C24, L7, C28, C30, and L10. The filtered 90 MHz signal is applied through C33 to base circuit. Inductor L11 provides a dc return for Q8 base.

4-88. Output amplifier Q8 amplifies the 90 MHz from the 90 MHz filter circuit. Tuned circuit L15, C43 provide additional filtering. Variable capacitor C44 is adjusted to match Q8 output impedance to a 50 ohm load. Capacitor C45 provides a 90 MHz sample to diodes CR6 and CR7 for rectification. The emitter current of Q5 is controlled by Q7. The base current of Q7 is the difference between the current through R31 and diodes CR6 and CR7. Feedback is such that as output level increases or decreases, current through CR6 and CR7 is about equal to current through R31. Resistor R31 is factory selected to set the 90 MHz output at 3.9 volts into 50 ohms.

4-89. 5 MHz Isolation Amplifier

4-90. Isolation amplifier Q2 and associated components provide an unmodulated 5 MHz output signal through J3 to Buffer Amplifier Assembly A13. Transformer T1 isolates the 5 MHz signal from external variations and provides a low impedance output to drive buffer amplifier circuits.

4-91. HARMONIC GENERATOR ASSEMBLY A4

4-92. Harmonic Generator Assembly A4, Figure 8-12, receives a phase modulated 90 MHz signal from Multiplier Assembly A3, a 12.63. . . . . MHz signal from Synthesizer Assembly A1, and generates the 9192.63. . . MHz phase modulated microwave field applied to the cesium beam tube. The heart of this harmonic generator is step recovery diode CR2. The conductivity of this p-n junction device, during reverse recovery, approximates a step function. The transition from reverse conduction to cutoff occurs in approximately 0.1 nanosecond. This results in high-order harmonics with greater efficiency than conventional non-linear harmonic generators.

4-93. The phase modulated 90 MHz signal is applied through J1 to Harmonic Generator A4. Resistors R3, R4, and R5 form a 3 dB matching attenuator to isolate diode input impedance from multiplier output impedance. Capacitors C6, C7, C8, C11, C12 and inductor L3 are a pi-matching network for the 90 MHz signal. Transistor Q1 and associated components provide a low impedance biasing voltage with R2 setting the bias level for CR2.

4-94. The 12.63. . . . . MHz is applied to CR2 bias voltage. The resultant CR2 output is a phase modulated, multiple harmonic signal, including 9180 MHz (102nd harmonic of 90 MHz) and associated 12.63 . . . MHz sidebands. The filter cavity, a high "Q" transmission type, selects the 9180 MHz + 12.63 . . . MHz upper sideband and applies this 9192.63 . . . MHz microwave signal to Cesium Beam Tube Assembly A12. Resistor R1 is adjusted for optimum sideband presence at CR2 output. Inductor L1 and capacitor C5 form a parallel resonant circuit preventing 90 MHz from feeding back to Synthesizer Assembly A1. Test point A4TP1 is used for setting the step recovery diode bias point. Transistor Q1 collector output is a dc voltage applied to CIRCUIT CHECK meter for front panel MULT bias monitoring.

4-95. Front panel input jack, designated ZEEMAN MOD INPUT, allows application of a low frequency to the cesium beam tube causing atomic transitions at field-dependent hyperfine frequencies. This permits accurate magnetic field ("C" Field) adjustment within the beam tube.

4-96. DIGITAL DIVIDER ASSEMBLY A5
(Time Standard Option 001)

4-97. General

4-98. Digital divider circuits provide one pulse-per-second output ticks available at front and rear panel 1 PPS BNC output jacks. The divider drive is an internally connected, 1 MHz signal from Frequency Divider Assembly A6. TIME DELAY, six thumbwheel, decade switch S1A-F (located under top access door) provides 1 μsec to 1 sec delay control of the output tick. A 0-1 μsec TIME DELAY adjustment allows delay control over any 1 μsec portion of the TIME DELAY thumbwheel switch setting.

4-99. The time standard option includes a 24 hr. clock display which indicates time in hours, minutes, and seconds. Pushbuttons at the rear of the digital clock permit time to be set.

4-100. Figure 4-8 is a simplified block diagram of Digital Divider Assembly A5. Five sub-assemblies make up the overall assembly:

a. A5A1 Power supply and 1 PPS output.

b. A5A2 Master clock.

c. A5A3 Preset clock.

d. A5A4 Switch circuit.

e. A5A5 Interconnecting board.

f. Clock Display

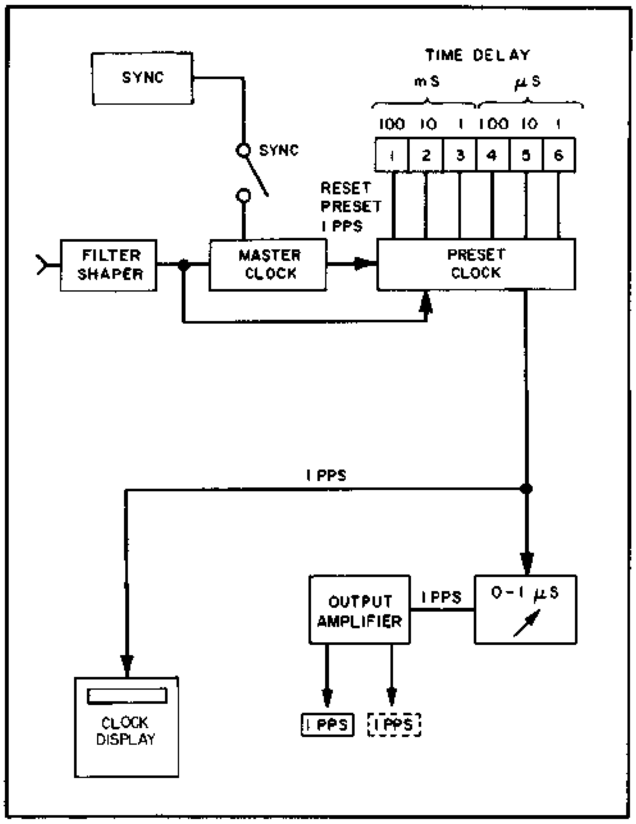
NOTE

Reference designators in Paragraphs 4-101 through 4-141 are abbreviated; for complete reference designators, add prefix "A5" to reference designators used.

4-101. The input drive signal from Frequency Divider Assembly A6 is applied to an input filter and shaping network; then to the gated 1 MHz multivibrator. Multivibrator output is applied to the following stage (1 MHz clock drive multivibrator) and to preset clock output logic gates A3IC2 and A3IC12B. This signal is the gated output pulse.

4-102. The negative transition of A2IC2 output pulse triggers A2IC3 to produce negative 150 nsec 1 MHz pulses supplied to master clock and preset clock as count pulse inputs.

Figure 4-8. Digital Divider A5 Block Diagram



4-103. The master clock produces a 1 PPS 100 msec output master tick that resets and presets the preset clock. Six decade dividers make up the master clock. The master tick triggers the reset one-shot which triggers the preset one-shot. During reset and preset time, NOR gate A3IC17B holds the preset clock input circuits closed for the preset and reset period.

4-104. The preset clock produces a 1 PPS, 1 μsec pulse, adjustable in phase from 1 μsec to 1 sec depending on the thumbwheel switch settings. This output pulse is sent to the output logic gates together with the gated 1 MHz signal from A2IC2. When coincidence between these two pulses occur, a 150 nsec output pulse at 1 PPS is applied to output blocking oscillator A1Q7-Q8. The variable delay circuit allows delay control over any 1 μsec portion of the .1 μsec to 1 sec time delay produced by the thumbwheel switch setting.

4-105. Blocking oscillator output is amplified and applied to front and rear panel 1 PPS BNC output jacks. The same output pulse from the preset divider logic circuits is applied to the clock display through a connection on A5A1. Power Supply and 1 PPS output assembly.

4-106. The clock display can be set to the nearest second with FAST/SLOW, SET, and HOLD switches. These switches are located on A16 Clock Display Assembly and are accessed by removing instrument top cover.

4-107. The SYNC pushbutton allows Digital Divider Assembly A5 to be synchronized to an external input reference pulse applied at rear panel SYNC input jack. This reference pulse is applied to A2IC2 which synchronizes the master clock within 9 to 11 μsec of the external reference. The pushbutton must be depressed for at least 1 second.

4-108. Input Filter and Shaping Circuits

4-109. The 1 MHz input signal from Frequency Divider Assembly A6 is applied through A2R1 and A2C2 (Figure 8-15) to input amplifiers A2Q1 and A2Q2. Diodes A2CR1-A2CR2 limit the input signal level. Capacitor A2C4 tunes A2T1 primary for 1 MHz. The input signal is amplified by A2Q2, coupled to A2T1 secondary, and applied to a high "Q" 1 MHz filter (A2R9, A2R12, A2C6, A2C7, A2C8, A2C9, A2L1, A2L2, A2L3, and A2Y1) to suppress unwanted signals. The spectrally clean 1 MHz signal is then applied to shaper amplifiers A2Q4 and A2Q6 which square the 1 MHz for application to gated 1 MHz multivibrator A2IC2(9).

4-110. Gated 1 MHz Multivibrator A2IC2

4-111. Integrated circuit A2IC2 produces a 1 MHz, 150 nsec, positive pulse applied to 1 MHz clock drive multivibrator A2IC3(9) and to preset clock output NAND gates A3IC2(1) – A3IC12B(9). When proper gate sequencing occurs, A2IC2 output pulse is gated through A3IC2C or A3IC12B (Figures 4-10 and 4-11) to 1 μsec variable delay multivibrator A4IC1(1) and output tick blocking oscillator A1Q7-Q8, to front and rear panel 1 PPS output jacks.

4-112. Clock Drive Multivibrator A2IC3

4-113. The 1 MHz clock drive mv is triggered by the negative transition of A2IC2 output pulse, producing a negative 1 MHz output pulse at A2IC3(7) delayed by 150 nsec. This pulse is the count pulse input for the master clock and preset clock.

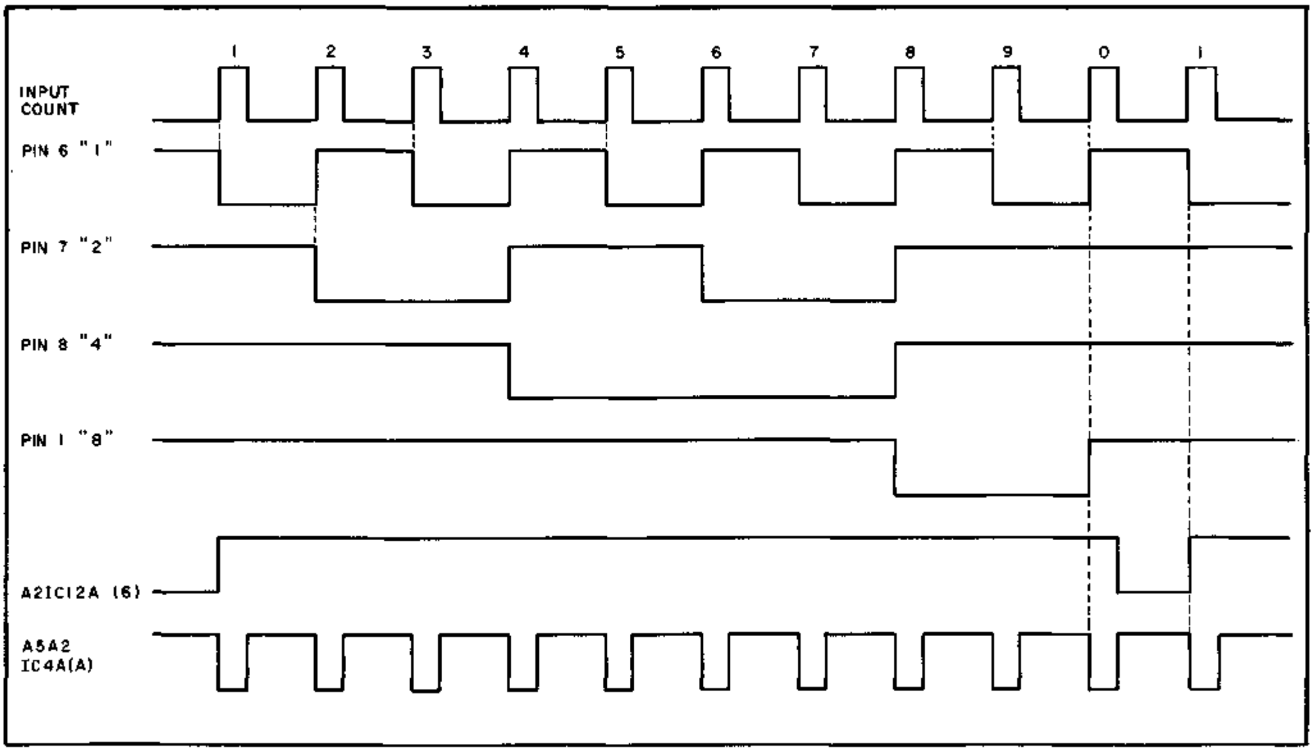
4-114. Master Clock Divider

4-115. The master clock divider is a six decade divider producing a negative, 100 msec, 1 PPS output. This master tick controls the preset clock divider 1 PPS output phase. Since all decades are identical, only A21IC6 (Figure 8-15) will be discussed. Figure 4-9 shows A2IC6 timing diagram.

4-116. Normally, decade dividers are allowed to fill until the count cycles to "0" at which time an output pulse is applied to the next decade. Thus, for each 10 inputs, 1 output pulse is applied to the next stage. However, this technique introduces error due to decade cycling time and decade temperature sensitivity. This error is accumulative through a divider chain and, with 6 decades, could amount to as much as 1 μsec. The technique used in the master clock divider reduces this error to less than 100 nanoseconds.

4-117. An "H" input pulse at A2IC6(5) is necessary for the decade to divide; therefore all count inputs to the inverter A2IC4A(1) must be "L". When the decade is at "0", voltage levels at pins 6, 7, 8, and 1 are "H" and output NAND gate A2IC12A(6) will be "L", applying a "L" count pulse to the following decade inverter. If any input signal to the NAND gate is "L", the following decade inverter will receive an "H" which will not count.

Figure 4-9. Decade-Divider Timing Diagram



4-118. 1 MHz "L" pulses are applied to A2IC4A(1), inverted and applied to the divider. As the count progresses within the IC, pins 6, 7, 8, and 1 will change from "H" to "L" at various counts shown in Figure 4-9. When the tenth count pulse is applied to A2IC6(5), the divider cycles to "0", A2IC6(6, 7, 8, and 1) place an "H" at A2IC12A(1, 2, 4, 5). However A2IC12A(6) is still "H" because the same pulse cycling the decade to "0" places an "L" through A2CR6 to the NAND gate, holding it closed. When this pulse goes "H", the NAND gate applies an "L" to the following decade input inverter as a count pulse. This state will remain until the next "L" count pulse, "1", is applied to A2IC4A(1). A2IC12A(3) goes "L", closes the gate and ends the "L" input to the following decade input inverter. Since the actual output pulse was not processed through the decade, delay due to the decade is eliminated.

4-119. This process is repeated through the five remaining decades with the final output master tick, 1 PPS, 100 msec, negative pulse applied to the following preset clock divider and associated circuits.

4-120. Reset and Preset One-Shot Circuits

4-121. Figures 4-10 and 4-11 show typical timing for Digital Divider Assembly A5. The 1 PPS master clock tick triggers reset one-shot A3IC15 producing complementary 1.3 µsec pulses at pins 7 and 10. The "L" signal at pin 7 drives reset amplifiers A3Q7, Q9, Q11, and decade control NOR gate A3IC17B. This resets A3IC3, IC4, IC5, IC6, IC7, and IC8 to "0". During the decade reset time, A3IC17B(7) output holds all decade input NAND gates closed to any input count. Each time the reset one-shot is triggered a 1.3 µsec "H" signal is also placed at NAND gate A3IC12B(10).

4-122. When the 1.3 µsec pulse at A3IC15(10) goes "L", it triggers preset one-shot A3IC16. The output at pin 10 is inverted by A3Q8, A3Q10, and A3Q12 applying a 0.5 µsec "L" preset pulse into the thumbwheel switch to preset the desired time delay into the preset clock. The same signal at A3IC16(10) causes NOR gate A3IC17B(7) to remain "L" an additional 0.5 µsec which holds the decade input NAND gates closed to any input count. The preset clock decades are now reset and preset.

4-123. Preset Clock Dividers

4-124. Six adjustable decade dividers make up the preset clock divider. The dividing scheme allows division by any integer between 1 and 10^6 by simply setting TIME DELAY thumbwheel switch S1A through S1F. This adjusts the divider output phase from 1 µsec to 1 sec. The phase adjustable output pulse is a 1 PPS, 1 µsec, "L" signal sensed at 9's detector NAND gate A3IC12A(6), applied to inverter A3Q6 and gate-around one-shot A3IC13(9). Figures 4-10 and 4-11 are typical timing diagrams. Figure 4-13 shows preset clock decade A3IC3 and associated components.

4-125. The standard decade divider provides one output pulse for each 10 input pulses. Preset divider A3IC3 provides an output pulse through NAND gate A3IC9A to 9's detector A3IC12A(5) and to the following decade when the preset count and input count total "9" (input to following stage occurs at "8" and continues through "9"). Figure 4-12 shows a standard decade counting diagram such as A3IC3.

4-126. When the decade count is "0", all binary outputs are "H" but as the count progresses, levels at pins 6, 7, 8, and 1 change state depending on the number of pulses into the decade. At the count of "9" pins 1 and 6 are "L" (representing "9") and pins 7 and 8 are "H". The next input pulse "10" will cycle the decade to "0" and the count begins again.

4-127. To change the decade to a divide by 2 divider; when the decade state is "0" (pins 6, 7, 8, 1 "H") and before any input signal is applied to pin 5, pulses are applied to pins 6, 7, and 8 driving them "L". The decade state is "7" before any input signal is applied. The first 2 input pulses cause pins 6 and 1 to go "L" and a "9" is sensed at the output IC9A(3, 5). Thus with only two inputs there is an output or divide by 2 action.

4-128. The preset clock divider chain may be set to divide by any integer from 1 to 10^6 by setting the complement 9 into the decades prior to the counting sequence. This is done automatically by TIME DELAY thumbwheel switch S1A through F. Whatever time delay is set on the switch, the complement "9" is set into the preset clock dividers prior to counting.

4-129. Assume a 1 µsec delay is set on the thumbwheel switch; this presets 999998 into the dividers (switch setting is 000001). Figure 4-10 shows the timing diagram for this switch setting. When the master clock has completed its counting sequence, the master tick output triggers the reset and preset circuits in the preset divider section. During reset and preset time, preset divider decade inputs are held closed. During preset time, 999998 is set into the decades via the thumbwheel switch and "H" signals are preset at A3IC12A(2, 3, 1, 4). However, this gate will not change state since an "L" is present from A3IC9A(6) (this decade has the count of "8"). The first decade receives the first count pulse causing A3IC9A(6) to go "H", which causes A3IC12A(6) to go "L" until the next input pulse to A3IC1A(13), 1 µsec later. The 1 µsec "L" signal is inverted by A3Q6 and applied as an "H" to NAND gate A3IC2C(2). The next gated 1 MHz output pulse from A2IC2 will also place an "H" at A3IC2(1). This causes the gate to change state and apply an "H" signal through NOR gate A3IC2D to 1 µsec variable delay mv A4IC1(9).

4-130. If a delay of 2 µsec is desired, the sequence of events is the same except 999997 would be the preset input information. Instead of the first pulse into A3IC3(5) causing A3IC12A to change state, the second pulse causes the state change; thus the pulse applied to 1 µsec variable delay mv is changed in phase by an additional microsecond. This same sequence of events occurs for all switch settings except 999999.

4-131. When 999999 (Figure 4-11) is set on the thumbwheel switch, no preset information is set into the dividers and they divide by 10^6. When this occurs, the preset divider and master clock are dividing by the same number. The dividers reach a count of 999999 and a small pulse is produced at IC12A(6). This pulse triggers gate-around one-shot A3IC13, producing an "H" 1.1 µsec pulse applied to A3IC12B(12). When the master tick goes "L", A3IC12A(6) goes "H", and the reset one-shot is triggered. This places another "H" at NAND gate A3IC12B(10). With 2 "H" 's present, the next gated 1 MHz pulse will gate through this NAND gate, providing an input pulse to 1 µsec variable delay mv A4IC1(9) through NOR gate A3IC2D.

Figure 4-10. Timing Diagram Thumbwheel Switch Set 000001 & 000002

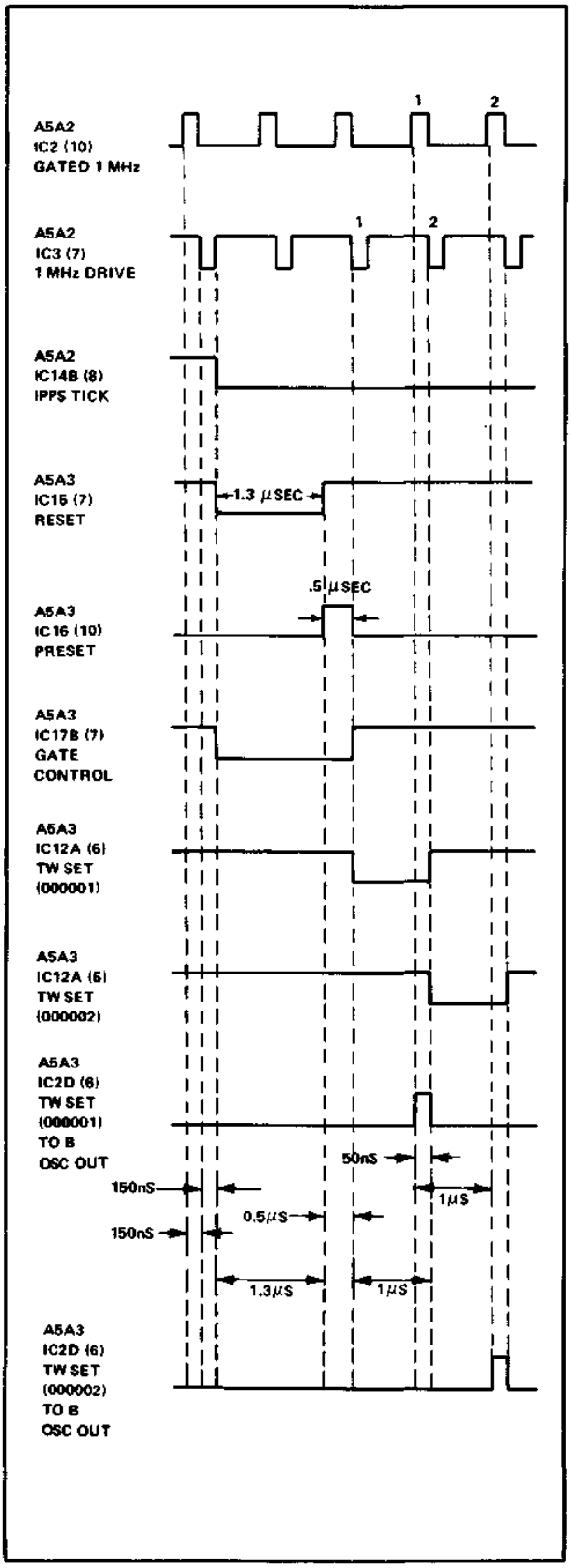


Figure 4-11. Timing Diagram Thumbwheel Switch Set 999999

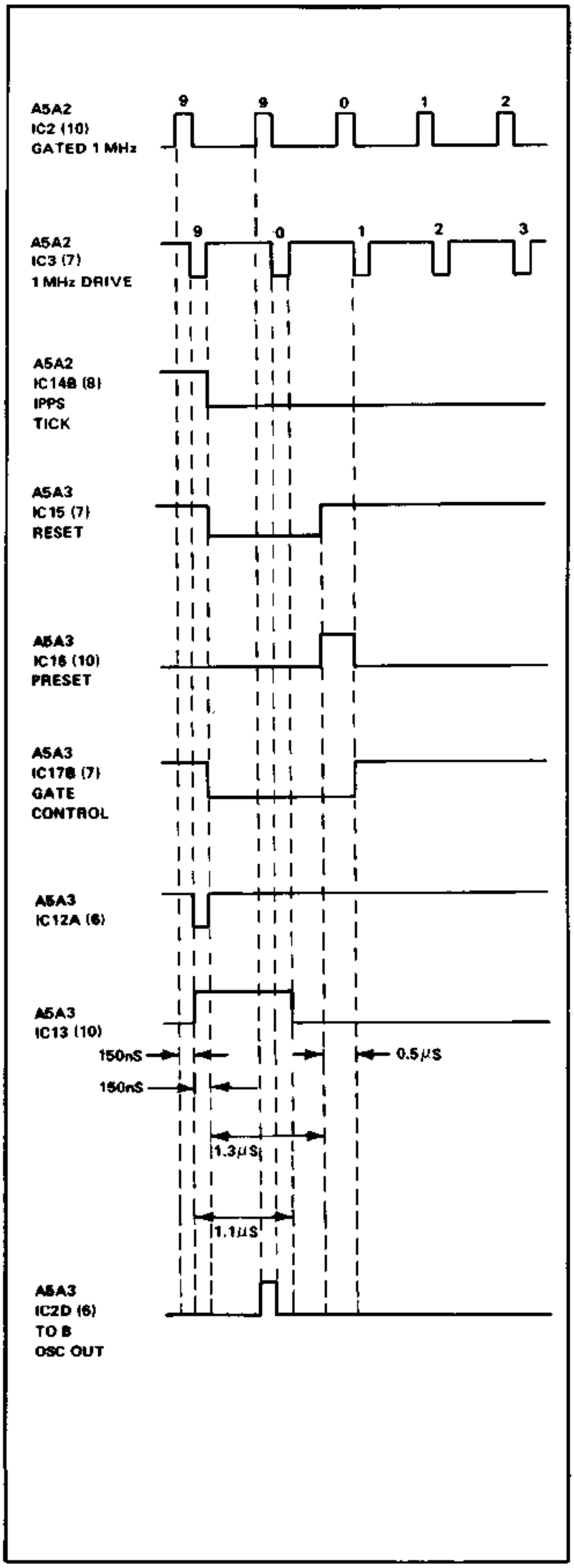
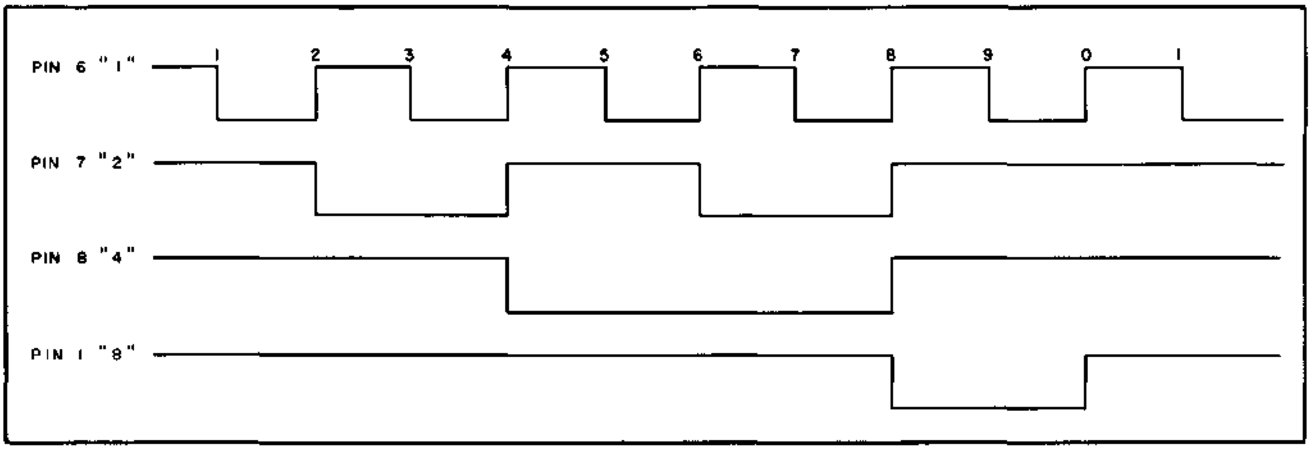


Figure 4-12. Timing Diagram (Typical IC Decade)



4-132. The output pulse is also applied to inverter A3Q13, amplified by A3Q15, and applied to A16 clock display input.

4-133. Digital Divider Assembly A5 can be synchronized to an external pulse by pressing SYNC pushbutton S2. This allows the external pulse to trigger sync one-shot A2IC1, resetting the master clock to "0" and holding the input to 1 MHz gated one-shot 1 M.V. for 7.3 microseconds. At the end of the 7.3 μsec period the counting sequence will start. Resistor A2R16 and capacitor A2C10 are adjusted for the 7.3 μsec period.

4-134. Output Circuits

4-135. The phase adjustable 1 PPS output pulse at A3IC2D(6) is applied to variable delay one-shot A4IC1(9). The output, A4IC1(10), is adjustable from 0 to 1 μsec by A4C2 TIME DELAY adjustment. The circuit output is applied through A1C12 and A1CR15 to output tick blocking oscillator A1Q7. The blocking oscillator output is applied through emitter followers A1Q9-Q10 to front and rear panel 1 PPS BNC output jacks. This output is a 1 PPS, 20 μsec, +10V pulse.

4-136. Inverter Power Supply

4-137. The power inverter supplies the low voltage, high current required to operate the integrated circuits in Digital Divider Assembly A5. The power supply has +4.2 Vdc and +13.3 Vdc supplies. Transistors A1Q1 and A1Q2 provide a 2 kHz pulse input through A1T1 to the two supplies.

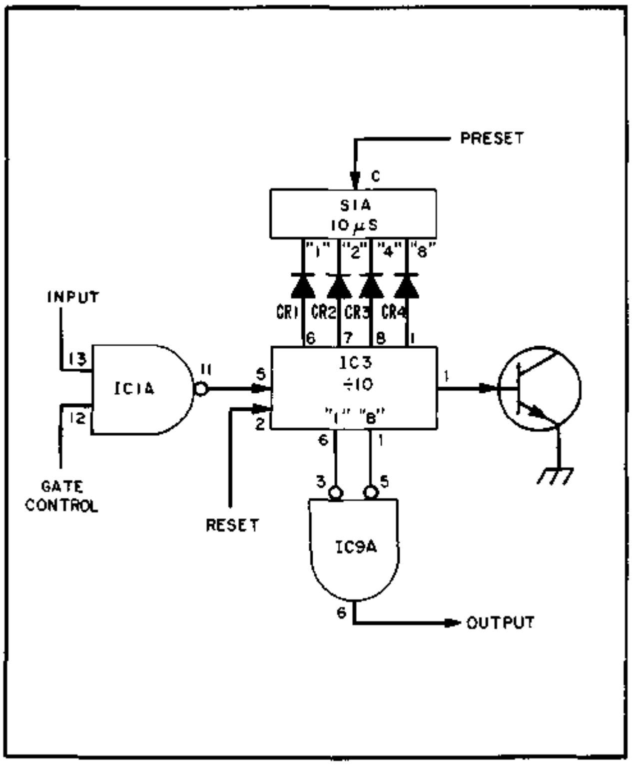
4-138. +4.2 Vdc Supply

4-139. Diodes A1CR2-CR3 and capacitor A1C6 are a full wave rectifier and filter. The unregulated voltage is applied to series regulator A1Q5. Differential amplifier A1Q4 and A1Q6 sense line variations controlling driver A1Q3. Differential amplifier reference is applied from the +13.3 volt supply. Potentiometer A1R3 adjusts the +4.2 Vdc level. Capacitors A1C17-C18 provide additional filtering.

4-140. +13.3 Vdc Supply

4-141. Diodes A1CR4, CR5, CR6, and CR7 are a full wave bridge rectifier. Components A1C7, A1C9, A1C11, A1R4, and A1R9 are the supply filter. Breakdown diode regulates the +13.3 volt supply. Components A1C13, A1C16, A1R11, and A1L2 prevent output tick blocking oscillator pulses from feeding back into the supply.

Figure 4-13. Preset Divider



4-142. FREQUENCY DIVIDER ASSEMBLY A6

4-143. General

4-144. Frequency Divider Assembly A6, Figure 8-17, is a regenerative divider, supplying front and rear-panel output jacks with 1 MHz and 100 kHz signals. Divider start selection is by front-panel DIVIDER MODE switch. Two positions may be selected, AUTO START or START. DIVIDER MODE switch is a momentary on-off-on type. The switch is spring loaded in the START position and returns to off when released. If the dividers stop, they will not re-start unless DIVIDER MODE switch is set to AUTO START or momentarily set to START. When the 5061A is used for time keeping, START position is normally used.

4-145. Two divider circuits make up Frequency Divider Assembly A6. The 1 MHz divider supplies 1 MHz to the 100 kHz divider, 1 MHz to front and rear-panel output jacks, and to Digital Divider Assembly A5 (Option 001). The 100 kHz divider provides 100 kHz to front and rear-panel 100 kHz output jacks. Both divider circuits provide output level indications to front-panel CIRCUIT CHECK meter M1.

4-146. 1 MHz Divider

4-147. The 1 MHz divider is a regenerative divide-by-5 circuit followed by an amplifier stage. This assembly includes signal-sensing logic circuitry to control the divider-start circuits. Assume the 5 MHz signal from A10 Oscillator Assembly is present at the divider circuit input, but the 1 MHz output has not started. Producing the 1 MHz output requires a 1 MHz signal at the base of X4 Multiplier Q4 (this 1 MHz signal is derived from the output signal once the divider starts). Prior to divider start, the required 1 MHz signal is obtained by converting the tuned-amplifier circuit of Q6 into a 1 MHz oscillator by feeding a signal from its output back to its input through field-effect transistor Q5.

4-148. The 5 MHz signal input to A6 is amplified by Q1. Capacitive voltage divider C5, C6 couples a portion of Q1 output to the start-circuit detector stage of CR1, CR2, Q2, and Q3. With the START/AUTO-START switch completing a signal path to Q5 base with this switch in either position, the detector stage biases Q5 "on" to complete the feedback path for Q6 which then oscillates at 1 MHz.

4-149. Multiplier stage Q4 converts 1 MHz at its base to 4 MHz in its tuned collector circuit. The resulting 4 MHz mixes with the input 5 MHz from T1 in mixing diode CR4. The parallel resonance of L2 and C11 tuned to 1 MHz, traps all undesired frequencies in the mixing product. The remaining 1 MHz couples to Q6 to complete the regenerative feedback path. Sustained regenerative oscillation produces 1 MHz which is amplified by Q8 and Q9. This 1 MHz output is also rectified by CR7 and filtered by C28, R35, and C29 for a dc output to the 1 MHz position of the CIRCUIT CHECK meter.

4-150. The 1 MHz output also couples to the start-circuit detector stage of CR5, CR6, and Q7 which sends a dc start signal to start amplifier Q3 for automatic start action with the START/AUTO START switch at AUTO START.

4-151. 100 kHz Divider

4-152. The 100 kHz divider consists of a tuned 1 MHz input amplifier Q10, an integrated circuit decade-divider IC1 and a tuned output amplifier. Low pass filters and traps are used to shape the I.C. divider output and to reduce harmonic distortion. The filtered signal drives a tuned amplifier which provides the 1 Vrms sine-wave output. The 1 MHz input signal from A6(Q6) is amplified by Q10 and saturating transistor amplifier Q13. Decade divider IC1 provides a symmetric 100 kHz square wave at IC1(12).

4-153. The divided output is amplified by Q14, Q15, and Q16 and is available as the 100 kHz output to J2 and J4. A portion of this output is rectified by CR9, filtered by C46, R60, and displayed on front-panel meter at the 100 kHz position. The 1 MHz input signal is also coupled through emitter-follower Q11 and provides the 1 MHz signal to A5 Digital Divider.

4-154. AC AMPLIFIER ASSEMBLY A7

4-155. AC Amplifier Assembly A7, Figure 8-18, is a low noise, narrow-band, high-gain amplifier. This amplifier receives a low-level signal from cesium beam tube electron multiplier and provides an ac voltage, proportional to the amplitude and phase of the input, to Phase Detector Assembly A8. The input signal contains a large 274 Hz second harmonic and small 137 Hz fundamental signal. This signal is separated, amplified and the ac fundamental is applied to Phase Detector Assembly A8. The high level second harmonic is sent to Logic Assembly A14 along with a fundamental sample. These logic circuit inputs are two of the signals controlling front panel CONTINUOUS OPERATION and ALARM lights. The amplifier circuits also contain a differential amplifier that controls current through front panel CIRCUIT CHECK meter when monitoring BEAM I.

4-156. The input signal from Cesium Beam Tube Assembly A12 is applied through J1 and noise filter C1-R1. Transistors Q1, Q2, and Q3 are a low-noise amplifier with negative feedback for gain stability. Both fundamental and second harmonic signals are amplified. Diodes CR1-CR2 are forward biased providing coupling between amplifier stages. The R1-C2 network stabilizes the amplifier at high frequencies. Negative feedback through R12, R3, or R12, R4 stabilizes the amplifier gain. HI-LO GAIN switch A7S1 selects R3 or R4 in the feedback loop extending the range of LOOP GAIN control R17. This improves the amplifier input signal level dynamic range.

4-157. The signal developed across R17 is coupled through C6 to emitter follower Q7. The signal at Q7 emitter is divided. One signal is amplified by Q8 and applied through J3 to Logic Assembly A14. Test output jack J2 is a monitor point for the signal applied to the logic circuits. Capacitors C9 and C11 provide additional noise filtering. The other signal is applied to twin-T-filter C7, C8, C10, R25, R27, and R28. This filter, turned to 274 Hz, greatly reduces second harmonic content applied to emitter follower Q9. Transistor Q9 matches impedance between the twin-T-filter and amplifier Q10. The 137 Hz signal is amplified by Q10 and again filtered through C12, C14, C15, R35, R36; then applied to Q11, Q12, and Q13. These amplifiers provide additional gain and, with the twin-T-filter/feedback loop, operate as a narrow-band tuned amplifier. Twin-T-filter C20, C22, C23, R47, R49, and R50 offer maximum attenuation to 137 Hz. Therefore, the negative feedback signal at Q14 emitter is minimum and amplifier Q11-Q13 gain is maximum at this frequency.

4-158. The two RC networks R37-C16 and R40-C18, stabilize amplifier gain at higher frequencies. Breakdown diodes CR3 and CR4 establish the operating point for Q11-Q13. The 137 Hz at Q13 collector is applied through J4 to Phase Detector Assembly A8, through J5 to Logic Assembly A14, and to Test Output J6.

4-159. Beam current differential amplifier provides current through CIRCUIT CHECK meter M1 when the CIRCUIT CHECK switch is set to BEAM I. Transistors Q4A and Q4B establish a zero "no signal applied" condition to Q5-Q6 bases. With no signal applied the current through R16 and R20 will be equal and CIRCUIT CHECK meter M1 will indicate zero. When an input signal is applied to the differential amplifier the balanced condition is upset causing the CIRCUIT CHECK meter to indicate the current difference through R16 and R20. This current difference is dependent on the signal applied to Q4; hence, proportional to the beam current.

4-160. PHASE DETECTOR ASSEMBLY A8

4-161. Figure 4-14 is a simplified block diagram of Phase Detector Assembly A8. This assembly contains the modulation reference oscillator and 137 Hz phase detector.

4-162. The reference oscillator is a Wien bridge oscillator producing a 274 Hz sine wave output. This signal is shaped in a Schmitt trigger for driving a frequency divider. The frequency divider output is a 137 Hz square wave applied to a phase shifter, phase detector, and sweep amplifier. The phase shifter filters the square wave and provides a 137 Hz, spectrally pure, signal to Multiplier Assembly A3 to modulate the 5 MHz quartz oscillator signal.

4-163. The phase detector produces a dc voltage proportional to the error signal received from AC Amplifier Assembly A7. This dc voltage is applied to Operational Amplifier A9. The sweep amplifier provides a triangular 137 Hz signal for test purposes. Reference oscillator Q1, Q2, Q3 is a Wien bridge oscillator which operates at 274 Hz. The frequency is determined by C1, C3, R4, R7, and R10 with R10 providing a fine frequency adjustment. These components complete the positive feedback loop from Q3 to Q1 to maintain oscillation. A second feedback loop through CR1, CR2, R5, R6, and C2 provides negative feedback for amplitude limiting.

4-164. The 274 Hz signal at Q3 emitter is fed to a Schmitt trigger circuit Q4, Q5, and associated components. This circuit is a shaping circuit with very fast rise and fall times. Capacitor C7 bypasses R14 to couple fast voltage changes from Q4 collector to Q5 base. Either Q4 or Q5 conducts depending on the input signal. When Q5 conducts, the negative-going transition at its collector is supplied to the frequency divider (÷2) circuit. The network composed of C8, CR3, C11, R19, and R21 ensures that only negative pulses are fed to the frequency divider.

4-165. Frequency divider Q6-Q7 is a binary divider producing an output pulse after receiving two similar input pulses from Q5. A negative pulse from Q5 is applied to Q6-Q7 bases simultaneously through gating diodes CR4 and CR5. This negative pulse turns off a conducting transistor. Capacitor C13 provides filtering for Q6-Q7 emitters and R26 establishes a small voltage at the common emitter junction to ensure that one of the two transistors is cut off.

4-166. The phase shift network includes Q8, Q9, and associated components, and allows phase adjustment of the 137 Hz sine wave. This phase shift is necessary to establish the correct relationship between the modulating 137 Hz and the 137 Hz reference sent to the phase detector. Phase Adj control R42 provides the phase adjustment. Because the signals driving transistors Q8 and Q9 are symmetrical square waves, second harmonic content is very low (zero for perfect symmetry). Components R48, C24, R50 and C25 provide low pass filtering. The signal output at J5 is a 137 Hz sine wave with second harmonic distortion at least 80 dB below the signal level.

4-167. Phase detector Q13A-B and associated components receive the 137 Hz reference square wave through Q10 and Q11, the error signal from AC Amplifier Assembly A7, and supplies a dc error signal to Operational Amplifier Assembly A9. Emitter followers Q10-Q11 drive the phase detector and also provide a 137 Hz square wave to Logic Assembly A14. Transistors Q13A-Q13B are alternately turned on and off by the 137 Hz reference square wave. The ac error signal is applied through C27 to T1 secondary. A signal results at T1 center tap which represents the phase and amplitude of the error signal. This resulting signal is filtered by R54 and C29 to provide the output dc error signal to Operational Amplifier Assembly A9. Potentiometer R39 is a dc balance adjustment.

4-168. The square wave signal at Q11 emitter is amplified by Q12. Capacitor C19 provides an integrating action and a triangular 137 Hz wave results at sweep test output J2. This signal is useful for checking phase detector operation and as an oscilloscope sync signal.

4-169. OPERATIONAL AMPLIFIER ASSEMBLY A9

4-170. Figure 8-20 shows the schematic diagram and component locator for Operational Amplifier A9. The amplifier, in conjunction with external feedback capacitor C2 (see Figure 8-20), forms a double integrator circuit. A9 receives dc error voltages from Phase Detector A8 and supplies a dc control voltage to tune the 5 MHz quartz crystal oscillator. A double integrator control loop, or second-order loop, is employed within the A9 amplifier circuitry (U1, U2, and associated components) to compensate for linear frequency drift of the 5MHz oscillator A10. Consequently, linear drift is limited to the extent that frequency error or accumulated time error are negligible.

4-171. QUARTZ CRYSTAL OSCILLATOR ASSEMBLY A10

4-172. General

4-173. The voltage controlled 5 MHz signal is generated by the circuits in Quartz Oscillator Assembly A10 (Figure 8-21). This assembly is composed of 4 major sections:

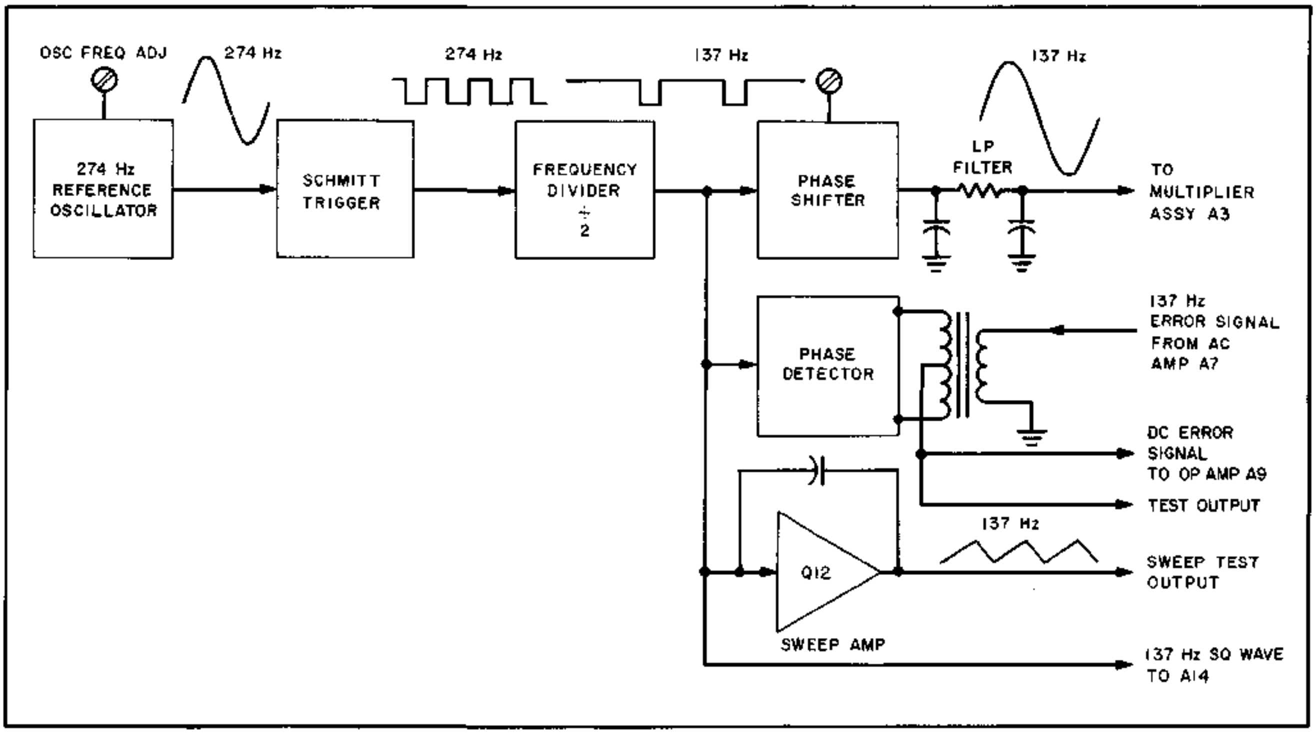
1. Temperature control circuits (Figure 8-22)

2. 5 MHz quartz oscillator circuits (Figure 8-23)

3. Automatic gain control circuits (Figure 8-23)

4. Power amplifier circuits (Figure 8-24)

Figure 4-14. Phase Detector Block Diagram



4-174. The quartz oscillator generates the 5 MHz signal. The AGC amplifier provides feedback to stabilize oscillator crystal current. Power amplifier circuits and a crystal filter isolate the quartz oscillator from external variations and supply the buffered 5 MHz to Frequency Divider Assembly A6 and Multiplier Assembly A3. Oven control circuits maintain the factory set temperature through proportional control of the internal heater.

4-175. The oven temperature is set at the factory to operate the crystal at a temperature where changes in crystal temperature have the smallest effect on oscillator frequency. Placing the quartz oscillator and AGC components inside the oven further improves the oscillator temperature vs frequency stability. Shielding and decoupling networks in all leads, except the 5 MHz output, reduce the Radio Frequency Interference radiated or received by the oscillator assembly. The assembly is sealed at the factory; the only adjustments accessible are the front panel OSC FREQUENCY COARSE, OSC FREQUENCY X10^{-10}, and 5 MHz FILTER controls.

4-176. Temperature Control Circuits

4-177. PROPORTIONAL CONTROL. Two heaters maintain oven temperature: HR1, which is proportionally controlled to provide continuous oven temperature control; and HR2, which is thermostatically controlled, and provides fast warm-up. The heater current in a proportional control circuit is a continuous function of oven temperature. The heater current in a thermostat control circuit is either "on" or "off", depending on oven temperature setting. Both control circuits contain a thermal fuse to prevent damage to components within the oven, if the assembly overheats.

NOTE

Reference designators in Paragraphs 4-178 to 4-186 are abbreviated; for complete reference designators, add prefix "A10" to reference designators used.

4-178. PROPORTIONAL TEMPERATURE CONTROL CIRCUIT. AC controller A1 is a Wien bridge oscillator with emitter follower and detector providing a dc signal voltage, proportional to oven temperature, for the dc controller. The Wien bridge oscillator frequency (about 3 kHz) is determined by a phase-shifting network in the bridge A1R1, A1R2, A1C1, and A1C2. The oscillator amplitude is determined by the degenerative feedback through A1R3, A1R4, and RT1 (inside the oven). Since thermistor RT1 is within the oven, Wien bridge oscillator output level is determined by the oven temperature. The thermistor has a negative temperature coefficient so a decrease in oven temperature causes thermistor resistance to increase, increasing oscillator amplitude. Diodes A1CR1, A1CR2, and capacitor A1C10 translate this to a negative dc level applied to dc controller A3.

4-179. DC controller A3Q2, A3Q3, A3Q4, and associated components receives the dc signal (proportional to Wien bridge oscillator amplitude) from ac controller circuits and controls current through HR1. The HR1 heater current is controlled by A3Q4 which is driven through A3Q3 by amplifier A3Q2. Diodes A3CR1 and A3CR2 develop 1.2 volts. The voltage across A3R8 depends on heater current through it, and is added to the voltage across the diodes. This forms a degenerative bias signal for A3Q2. Thus, an increase in current through A3R8 increases A3Q2 current decreases A3Q4 current and decreases current through A3R8 and HR1.

4-180. 5 MHz Oscillator and AGC Circuits

4-181. GENERAL. The 5 MHz signal is generated by an electrically controlled quartz crystal oscillator within the oven. An AGC circuit, also in the oven, provides some amplification for the 5 MHz signal and AGC to prevent crystal mechanical vibrations from causing damage. The oscillator frequency is coarse-tuned by A2A1C7 (front panel OSC FREQUENCY COARSE), and fine-tuned by front panel OSC FREQUENCY X10^{-10} control (R3). The oscillator is electrically tuned by Operational Amplifier Assembly A9 integrated output applied to the -EFC side of varactor A2A1CR1. This electrical tuning is present when front panel MODE switch is set to OPER. The frequency response of the crystal filter in the power amplifier circuit A3 can be tuned by Adjusting A3C10 (front panel 5 MHz CRYSTAL FILTER).

CAUTION

Quartz Oscillator Assembly A10 adjustments OSC FREQUENCY COARSE, OSC FREQUENCY X10^{-10}, and 5 MHz CRYSTAL FILTER are the only adjustments that can be made in the field.

4-182. Oscillator transistor A2A1Q1 drives resonant circuit A2A1L2, A2A1C6, A2A1C7, A2A1C9, and A2A1CR1. Oscillator feedback is through A2A1C10, A2A1C11, A2A1C12, and A2A1L3 to A2A1Q1 base. Capacitor A2A1C8 is an ac ground return at 5 MHz. Base bias for oscillator transistor A2A1Q1 is controlled by the AGC circuit in A2A2; as the oscillator output level increases, the AGC circuit decreases A2A1Q1 base bias, and decreases oscillator output amplitude. Varactor A2A1CR1 capacitance decreases as the reverse-biasing voltage across it increases. This technique controls 5 MHz oscillator with Operational Amplifier Assembly A9 integrated output voltage. Oscillator frequency increases as the reverse-biasing voltage increases.

4-183. The AGC assembly contains two tuned amplifiers, the AGC circuit, and the reference sources for the +6 volt supply for A2A1Q1 and +15 volts for OSC FREQUENCY X10^{-10} control R3. The open-loop gain of tuned amplifier A2A2Q1 is adjusted by A2A2R3; the closed-loop gain is determined by A2A2R9 and A2A2R10. The amplifier output is in phase with its inputs, and drives the tuned amplifier and AGC circuit A2A2Q2. One secondary winding A2A2T2 provides an output signal that is in phase with the input signal from the oscillator; this signal is fed back to A2A2Q1 emitter for gain stabilization of the amplifier pairs, to A2A2Q2 base for neutralization, and through A2A2C13 to the AGC detector circuit. The AGC signal is a dc voltage, proportional to the output level of A2A2T2; it is subtracted from the bias established by A2A2R11 and A2A2R12 to provide the dc bias voltage that controls the gain of oscillator A2A1Q1 to decrease the base bias as the sensed output level increases.

4-184. A10A3 POWER AMPLIFIER

4-185. The A10A3 assembly contains the 5 MHz output amplifiers and the dc controller circuit which supplies dc current for the oscillator oven heater. For a discussion of the dc controller, see "proportional Control Circuit" Paragraph 4-176. 5 MHz from A2A2 couples through A3C1 to buffer amplifier A3Q1. Selected resistor A3R9 sets A3Q1 gain for the correct output at J4 (factor adjustment). This stage feeds adjustable crystal filter network of A3Y1 A3R12, A3C9, 5 MHz crystal filter adjustment A3C10, A3C11, A3C6, and A3C8. Capacitor A3C6 and A3C8 provide ac voltage division for the 5 MHz output to the A4 Frequency Divider Assembly.

4-186. Emitter follower A3Q5 couples the filter network to output amplifier A3Q6. The gain of A3Q6 stage is adjusted by A3R19 and collector resonance is tuned with A3C12. Output transformer A3T1 feeds A10J3. Supply voltage filtering is supplied by A3L1 and A3C5 for A3Q1 and by A3R11 and A3C15 for A3Q5 and A3Q6. Additional RF decoupling for A3Q1 is supplied by A3R5 and A3C3.

4-187. CESIUM OVEN CONTROLLER A11

4-188. General

4-189. Cesium Oven Controller A11 includes a temperature controller for the cesium oven in the cesium beam tube and four voltage supply sections. The controller provides power to heat the Cesium 133 in the beam tube. The voltage sections provide +16 and −16 volts to Operational Amplifier Assembly A9, a square wave to the cesium beam tube hot wire ionizer, and −10 Vdc to AC Amplifier Assembly A7. The 300 Vdc section connects to A9J2, but the voltage is not used.

4-190. Outputs

4-191. GENERAL. Transistors Q2, Q3, transformer T1, and associated components are a 2 kHz multivibrator which magnetically couples square waves through T1 to voltage supply sections and to the cesium oven control circuit. These square waves are isolated from the +17.9 volt supply by C1 and L1. Capacitor C19 suppresses switching transients in T1 primary.

4-192. 16 VOLT SUPPLY. Diodes CR4 through CR7 rectify the square wave from T1 secondary. Resistors R18-R19 and capacitors C14-C15 provide RC filtering for the plus and minus 16 volt supply.

4-193. −10 VOLT SUPPLY. Breakdown diode CR13 and capacitor C20 establish −10 Vdc supply for AC Amplifier Assembly A7.

4-194. HOT WIRE IONIZER SUPPLY. Power to heat the hot wire ionizer is supplied from T1 secondary. These secondary terminals may be connected in various ways, depending upon the hot wire ionizer voltage required for each cesium beam tube. The proper hot wire ionizer taps are indicated on the decal label with each beam tube. Since only heating power is required, the square wave from T1 is applied without rectification to the hot wire ionizer. Potentiometer R27, with R22 and R23, provides an adjustment for changing hot wire ionizer potential. This adjusts a mass spectrometer inside the beam tube. Capacitor C17 prevents variations in the +17.9 V supply from modulating the mass spectrometer voltage.

4-195. 300 VOLT SUPPLY. Full-wave rectifier CR8 through CR11 generates 300 volts which is connected to Operational Amplifier Assembly A9J2, but is not used. The output is filtered by C16 and R20.

4-196. CESIUM OVEN SUPPLY. The oven inside the cesium beam tube must be heated to cause emission of cesium atoms. Power to heat the oven is supplied from the +25 to 33 volt dc input through transistor switches Q5, Q6, and magnetic amplifier T3. Transistors Q2 and Q3 provide a square wave through T1 for alternately switching Q5 and Q6. A dc current, derived from control oscillator Q1 and Q4, controls magnetic amplifier T3. Current to the cesium oven heater is supplied from terminals 6 and 8 of auto-transformer T4.

4-197. Resistor R21A-B and cesium oven thermistor RT (in the oven) are two arms of an ac bridge. Transformer T2 secondary windings form the other bridge arms. The difference voltage across the bridge is applied in series with the emitter of Q1. Transistor Q1 output is amplified in Q4 and appears across T2 primary. This ac voltage is used for the bridge circuit completing the oscillator loop. Feedback to Q1 emitter is such that as the resistance of thermistor in the cesium oven decreases, the amplitude of the control oscillator output decreases. Capacitor C8 and transformer T1 determine the control oscillator frequency.

4-198. DC current through diodes CR2 and CR3 is determined by control oscillator amplitude which is determined by cesium oven thermistor resistance; hence by the oven temperature. Diodes CR3-CR4 rectify the oscillator output and R15, R16, C10, C11, and C12 filter the signal. This rectified and filtered signal is applied to magnetic amplifier transformer primary T3.

4-199. The magnetic amplifier primary is dc biased by the +25 to 33 volt input established across R17. This dc bias controls the constant current of the magnetic amplifier. Control amplifier dc output signal subtracts from this established bias to control the current through the magnetic amplifier. If the cesium oven increases in temperature, the oven thermistor resistance decreases. The control amplifier output decreases, causing an increase in current through the magnetic amplifier. The causes T4 current to decrease, decreasing heater current in the cesium beam tube. Thus, decreasing oven temperature. With the cesium oven at operating temperature, the oven controller circuit functions as a proportional controller, neither fully on nor off.

4-200. Resistor R24 is selected to set cesium oven operating temperature nearly 20°C below normal. This mode allows operation with reduced cesium beam tube flux (about 1/5) and extends beam tube life with slight reduction in short-term stability.

4-201. Diode CR12 with R25, and C18 provide dc voltage to CIRCUIT CHECK meter M1 for monitoring power to the cesium beam tube oven. This CIRCUIT CHECK meter voltage will fluctuate depending on the oven heating current.

4-202. CESIUM BEAM TUBE ASSEMBLY A12

NOTE

Cesium Beam Tube Assembly A12 is a complex sealed unit and is not designed for repair. The instrument warranty is void if repair is attempted inside the tube. When it is definitely established that the beam tube is defective, notify the nearest Hewlett-Packard Sales and Service Office for repair or replacement. Refer to Paragraph 2-6 (Packaging for Shipment) for packing instructions.

4-203. General

4-204. The cesium beam tube acts as a passive resonator whose outstanding characteristics are an accurately defined resonant frequency and an extremely high Q. The beam tube is excited with a frequency modulated, microwave signal at the atomic transition frequency. This microwave signal is developed from the 5 MHz quartz oscillator frequency. The output signal from the cesium beam tube, when processed by the 5061A circuits, represents the frequency difference between the applied microwave signal and the atomic transition frequency. This processed signal is then used, in a feedback control loop, to stabilize the quartz oscillator frequency. The quartz oscillator frequency is therefore locked to the cesium resonant frequency.

4-205. Beam Tube Physics

4-206. Cesium beam tube resonator operation depends upon the energy transition between two hyperfine levels of the Cesium 133 atom. Energy levels, and transitions between levels, are determined by the fixed quantum mechanical selection rules (Figure 4-15). Atoms can occupy only certain discrete energy levels and transitions between energy levels occur by "jumps" predicted by quantum mechanical rules. Since energy transitions are precisely defined for the cesium atom, the frequency corresponding to these transitions is also precisely defined. The transition frequency of interest lies in the microwave region and is determined by the relationship $E = hf$, where E is the energy difference between states, h is Planck's constant, and f is the frequency. It is upon this frequency f, corresponding to a transition between two atomic states separated by E, that the 5061A frequency standard is based.

4-207. The cesium atom has a single valence electron. The quantum mechanical effects of interest lie in the electronic ground state of the atom and arise from the magnetic interaction of this electron-spin-dipole-moment and the nuclear-spin-dipole-moment. In the absence of external magnetic fields, the electron spin has two possible orientations with respect to the nuclear spin, giving two different energy levels. Upon application of an external magnetic field, the two states are split into additional levels corresponding to the possible orientation of the atom with respect to the external field. In the cesium beam tube resonator, a transition state is used which is least sensitive to environmental magnetic fields (Figure 4-15).

4-208. Cesium Beam Tube

4-209. The cesium beam tube schematic is shown in Figure 4-16. Cesium atoms effuse from the oven source and are formed into a beam by collimating slits. The beam passes through the inhomogeneous magnetic field of the first state selector "A" magnet. This magnet selects the desired state atoms for deflection into the interaction cavity. Within this cavity the selected atoms of cesium are acted upon by the injected microwave magnetic field derived from the 5 MHz quartz oscillator. If this injected microwave field frequency corresponds to the transition frequency of the cesium atom (9,192.631... MHz), the atom undergoes a quantum mechanical change which "flops" it into the desired state. Following the interaction within the resonant cavity, the beam passes through the second state selector "B" magnet. This "B" magnet separates the "flopped" atoms and deflects them on to a detector for conversion to a signal current.

4-210. The detector consists of a hot wire to ionize the impinging atoms. An electric field directs the cesium ions into a mass spectrometer which selects cesium ions by directing only cesium ions to the first dynode of an electron multiplier for amplification to a suitable output level. The output current as a function of injected microwave frequency is indicated in Figure 4-17. Beam current goes through a maximum when the frequency of the microwave field sweeps through the resonant frequency of the cesium transition. Width of the central peak and the distance between peaks are functions of the length of the interaction cavity and of the average velocity of the atoms. The line width of the 5061A beam tube output, measured between the peak and valley points is approximately 550 Hz for the standard instrument and 360 Hz for Option 004.

4-211. To ensure that only the desired transition contributes to the signal output, a small, uniform, steady-state magnetic field ("C" field) is maintained around the interaction cavity. This field is set to a value of 61 milligauss to precisely set the cesium resonant point. The complete system is enclosed in additional magnetic shields to reduce the effects of external environmental fields and closed off in a sealed package for evacuation. Continuous vacuum pumping maintains the very low pressure within the system to prevent beam scattering. Spent cesium is collected by getters.

4-212. Beam Tube Discrimination Action

4-213. The beam tube can be thought of as a frequency discriminator. During normal operation, input microwave frequency f_c will lie at the central point. Figure 4-18 shows one cycle of the resulting variation for three values of f_c, the carrier. With f_c centered at f_o the hyperfine transition frequency, the output beam current varies at twice the modulation frequency. If the carrier lies above f_o, as shown by the plot labelled f_{c1}, output current varies at the same rate as the modulation. When the carrier lines below f_o, case f_{c2}, output current varies at the modulation rate but is shifted by 180°. When the applied microwave signal is matched to the cesium resonant frequency, only the second harmonic component of the modulation signal appears in the beam current output. When the applied signal lies above or below this desired value, beam current output contains both fundamental and second harmonic modulation components. These components are used by the instrument to evaluate the correction necessary to tune the quartz oscillator to zero frequency error.

4-214. Beam Tube Test Input (LF Coil)

4-215. LF Coil test point TP2, located on Terminal Board Assembly A17, is connected to the coil within the beam tube. This test point permits introducing a low frequency signal into the beam tube causing low-frequency transitions in the absence of a microwave field. A 1K ohm resistor A17R8 is connected in series with the coil thus requiring a 1 V rms input signal to excite the low-frequency transitions.

4-216. The applied low frequency is dependent upon the "C" field within the beam tube. The "C" field value depends upon the frequency offset and time scale used. Therefore, the low frequency value also depends upon the frequency offset and time scale used.

4-217. When this frequency is applied to the beam tube via TP2, BEAM I indication on CIRCUIT CHECK meter M1 should be maximum if the beam tube is operating normally and MODE switch is set to LOOP OPEN or OPER.

4-218. BUFFER AMPLIFIER ASSEMBLY A13

4-219. Buffer amplifier circuits, Figure 8-26, receive the 5 MHz quartz oscillator signal from Multiplier Assembly A3 and provide 1 volt, 5 MHz signals to front and rear panel output jacks and 5 MHz to Synthesizer Assembly A1.

4-220. Transistors Q2, Q4, and associated components are one of the amplifier circuits. Resistors R2, R4, and R6 provide a 50-ohm input impedance for the 5 MHz. Resistor R4 is selected to set circuit overall gain. Breakdown diode CR1 establishes Q2 and Q4 operating point. Degeneration in Q2 and Q4 emitter circuits is provided by R15 and R21. The amplified Q2 output is coupled through C8 to Q4 base. Transformer T2 isolates the external circuit from buffer amplifier circuits and couples the 5 MHz signal to output jacks J3-J4. Capacitor C10 is factory selected to tune T2 to 5 MHz. A portion of the 5 MHz signal is rectified and filtered by CR2, R24, R25, C13, and C14 supplying the CIRCUIT CHECK meter when CIRCUIT CHECK switch is set to 5 MHz. Network L1-C1 decouple the +18.7 Vdc power supply.

4-221. Transistors Q1, Q3, and associated components are the other amplifier supplying 5 MHz to Synthesizer Assembly A1. This amplifier operation is similar to that previously described in Paragraph 4-220.

Figure 4-15. Energy Level Beam Tube

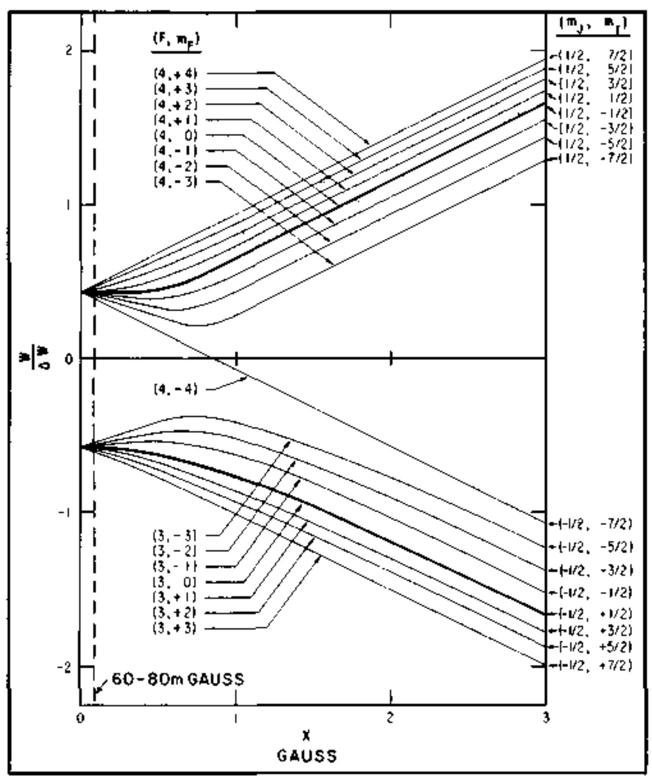


Figure 4-16. Beam Tube Schematic

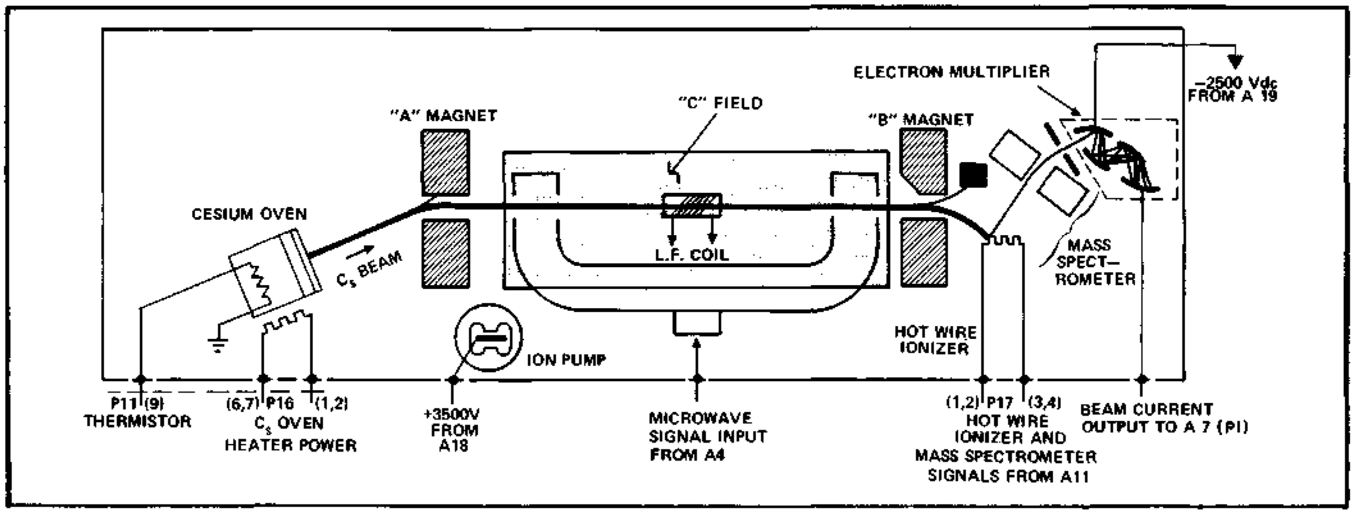


Figure 4-17. Beam Tube Output Current

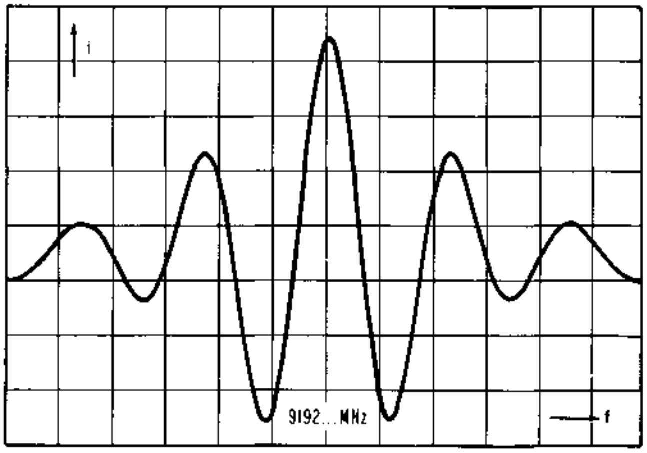
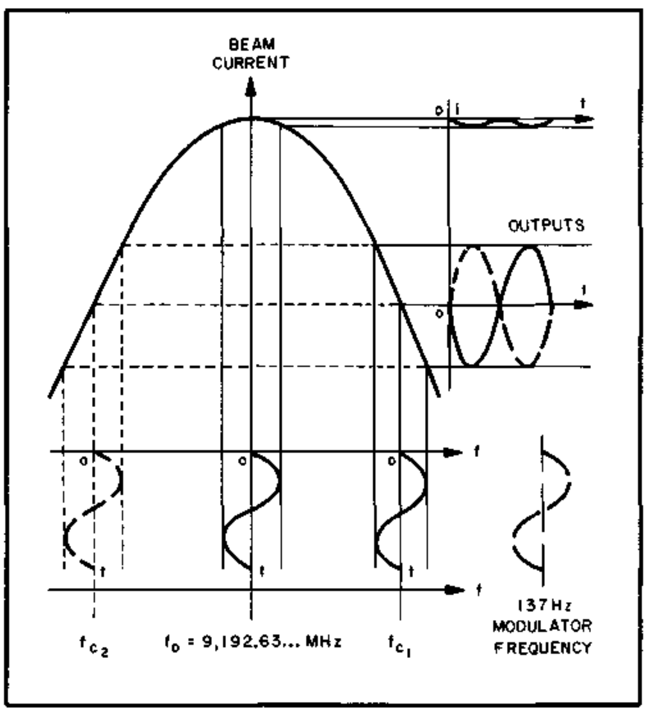


Figure 4-18. Discrimination Action Beam Tube



4-222. LOGIC ASSEMBLY A14

4-223. Logic Assembly A14, Figure 8-27, monitors various circuits and controls front panel CONTINUOUS OPERATION and ALARM lights. These two lights give a constant indication of instrument operation.

4-224. Figure 4-19 is a simplified block diagram of the logic circuits. Four input signals to the logic circuits determine front panel CONTINUOUS OPERATION and ALARM light on/off conditions: 1) 137 Hz from AC Amplifier Assembly A7, 2) 274 Hz from AC Amplifier Assembly A7, 3) dc voltage from Synthesizer Assembly A1, and 4) dc integrator voltage from Operational Amplifier Assembly A9.

4-225. The logic circuits are basically divided into two channels; 1) fundamental channel, and 2) second harmonic channel. Each channel has an OR gate controlling one front panel indicator light. Each OR gate has three inputs. One input to each OR gate is cross-coupled to the other so a signal on the cross-coupled input will operate both OR gates, thus control both front panel lights.

4-226. 2nd Harmonic Channel

4-227. During normal operation, all inputs to the OR gates are "L", causing CONTINUOUS OPERATION light to be on and ALARM light off. Only when the circuits being monitored fail, will "H" inputs be present at the OR gates. CONTINUOUS OPERATION light DS1 is controlled by silicon controlled switch SCR1 through Q23. Transistor Q23 is controlled by the OR gate through Q19. Any "H" input to the OR gate will turn Q19 "on", turning SCR1 "on", turning Q23 "off", turning CONTINUOUS OPERATION light DS1 off. Three inputs are available at the OR gate. The presence of an "H" signal at either input will cause CONTINUOUS OPERATION light DS1 to go off.

4-228. The 274 Hz 2nd Harmonic signal from AC Amplifier Assembly A7 is applied to emitter follower Q1 base. The signal is coupled through C3 and applied to 2nd harmonic tuned amplifier Q2, Q4, Q5, and associated components. Transistor Q6 and components C14, C15, C12, R22, R18, and R19 are an active notch filter at 274

Hz for the negative feed-back loop. The overall gain of second harmonic amplifier circuits is 1500. The 2nd harmonic amplifier output is detected by CR3-CR4, filtered, and applied to emitter follower Q8 base. The output is a dc signal, proportional to the input signal at Q1, applied at integrating amplifier Q11 base. Capacitor C21 integrates the amplified dc input and establishes a steady state condition on Schmitt trigger circuit Q12, Q13, and associated components. With a normal 2nd harmonic signal input, Q12 is "off", Q13 "on", 2nd harmonic switch Q17 "off", and OR gate CR20 senses an "L" input. Therefore, CONTINUOUS OPERATION light DS1 remains on.

4-229. If the 2nd harmonic input signal decreases, the signal at Q12 base increases, causing the Schmitt trigger to change state. Transistor Q12 turns "on", Q13 "off", Q17 "on", and the OR gate senses a "H" signal. This turns "on" SCR1 to turn "off" CONTINUOUS OPERATION light DS1. This "H" signal is also cross-coupled to the fundamental OR gate to turn "on" front panel ALARM light DS2.

4-230. During normal operation, the 2nd harmonic OR gate has an "L" signal present at CR14 from Synthesizer Assembly A1. If the synthesizer unlocks or synthesizer blocking oscillators fail, the signal at CR14 goes "H" to turn "on" SCR1 and turn off the CONTINUOUS OPERATION light.

4-231. The third signal that will turn off CONTINUOUS OPERATION light DS1 is received from the fundamental channel. This signal also turns "on" front panel ALARM light DS2.

4-232. When the 5061A returns to normal operation the CONTINUOUS OPERATION light will remain off due to the action of SCR1. Momentarily depressing LOGIC RESET switch S7 removes anode voltage from SCR1 turning it "off", turning DS1 "on".

4-233. Fundamental Channel

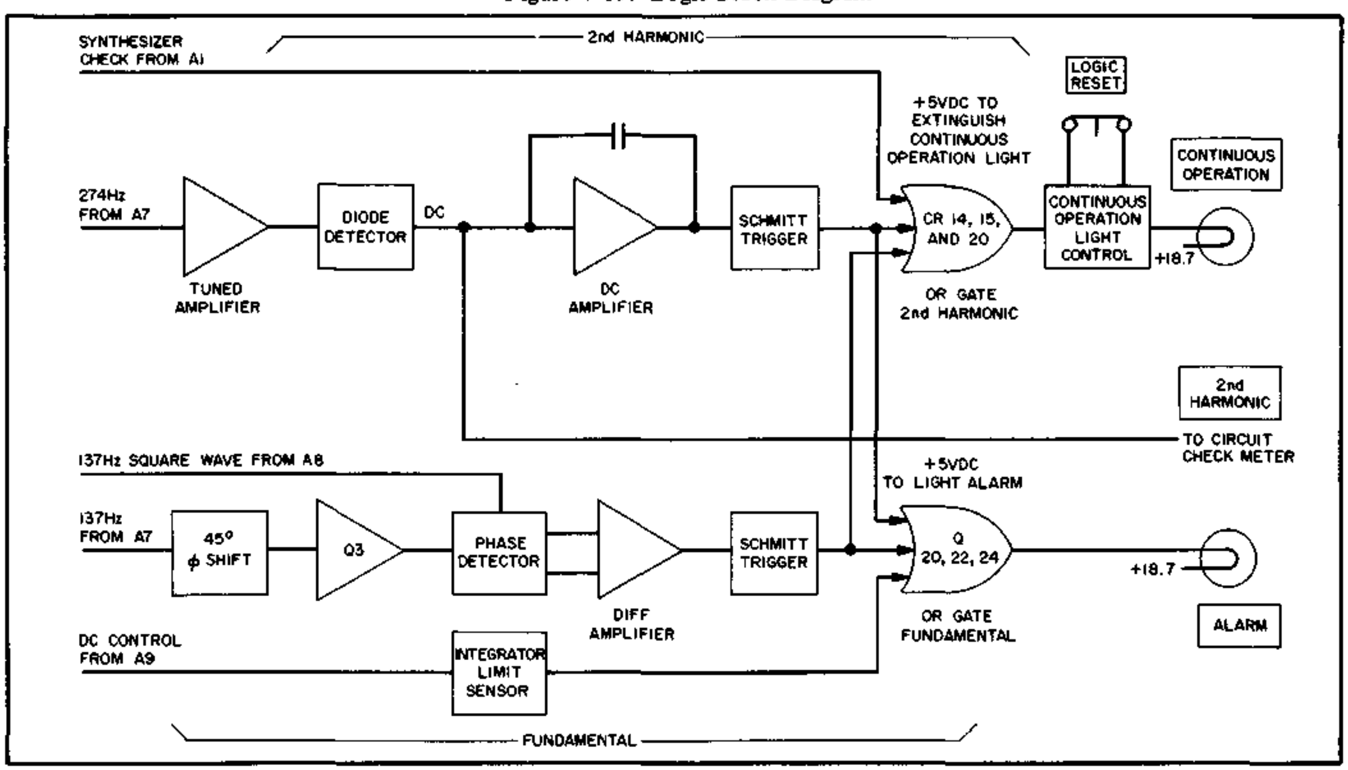
4-234. During normal instrument operation, front-panel ALARM light DS2 is "off". The light on/off function is controlled by fundamental OR gate Q20, Q22, Q24, and associated components. Normally, all OR gate inputs are "L". The ALARM light will go on when one or more OR gate inputs go "H".

4-235. Three inputs to the fundamental OR gate are present. The signal at Q20 is from the second harmonic channel. When this signal is "H", Q20 collector is "L", and the ALARM light is on. Since this signal is also applied to the 2nd harmonic OR gate, CONTINUOUS OPERATION light DS1 goes off.

4-236. Integrator Limit Sensor

4-237. The signal at Q24 base is supplied by integrator limit sensor circuit Q18, Q21, and associated components. The input to this circuit from Operational Amplifier Assembly A9 is the "control voltage" controlling the 5 MHz quartz oscillator frequency. This can be positive or negative dc. During normal instrument operation, the "control voltage" amplitude will be below the breakdown level of CR12 and CR13; Q21 is "on", Q24 is "off", and ALARM light DS2 is off. If the dc "control voltage" exceeds CR12 or CR13 breakdown point, a signal is applied to Q21 base through CR12 (if the signal is negative) or through CR13-Q18 (if the signal is positive). Regardless of signal polarity, Q21 turns "off", Q24 turns "on", and ALARM light DS2 is on. Note that the CONTINUOUS OPERATION light remains on.

Figure 4-19. Logic Block Diagram



4-238. The 137 Hz signal from AC Amplifier Assembly A7 is applied through 45° phase shift network C5, R8 to transistor amplifier Q3 base circuit. The phase shifted signal is synchronously detected by phase detector Q7. This detector is driven by a 137 Hz square wave from Phase Detector Assembly A8.

4-239. Differential amplifier Q9, Q10, and associated components are dc balanced so the output signal is "L" during normal instrument operation. If the instrument should drift from the cesium peak or lock to a secondary peak, the input to Q9 base will unbalance the amplifier, placing a "H" at Q14 base. Normally "off", Q14 changes state turning Q15 "off", and Q16 "on". This turns Q22 "on", and front panel ALARM light turns on. The "H" signal at Q22 base is also coupled to second harmonic OR gate CR15 to turn CONTINUOUS OPERATION light DS1 off. Dc balance for Q10 base is established by R26, R27, R28, R29, and R30. Components C2, R2, and C4 decouple the +18.7 volt supply.

4-240. POWER REGULATOR ASSEMBLY A15

NOTE

In the following discussion, components are identified by complete reference designations. This is to avoid confusion between components located on the chassis and components located on regulator assembly A15. For example, "Q1" refers to a component located on the chassis and "A15Q1" refers to a component located on the regulator assembly.

4-241. Power Regulator Assembly, Figure 8-28, contains the circuits which provide: 1) +18.7 volts to operate the instrument, 2) standby power supply gate to select operating source for instrument, 3) regulated dc current to the C field coil in the cesium beam tube, 4) ion pump current monitor, and 5) electron multiplier regulator. The ion pump current monitor and electron multiplier regulator circuits are located on Power Regulator Assembly A15. However, these circuits relate to the +3500 VDC Power Supply Assembly A18 and the -2500 VDC Power Supply Assembly A19 and are discussed in Paragraph 4-264 and 4-270.

4-242. Input Rectifier and Filter

4-243. AC power is supplied to the instrument through a three conductor ac power cord. The ac power cord ground lead is connected to the instrument chassis. Rear panel 115/230 selector switch S3 is set to match input power source. Fuse F1 is selected depending on the input line voltage used. Capacitor C8A,B is an input line filter. Transformer T1 (7 & 8) provide operating power to Battery Charger Assembly A2 when Standby Power Supply Option 002 is installed. Diodes A15CR1, A15CR2, A15CR3, A15CR4, and components A15C1, C5, L1, and R9 are the power regulator rectifier-filter network. The unregulated dc is applied to series regulator transistor Q2.

4-244. Standby Power Supply Gate

4-245. When Standby Power Supply Option 002 is installed, and the 5061A is connected to ac and external dc power, three unregulated dc voltage sources are available to series regulator Q2. Standby power supply gate selects which unregulated dc voltage is used.

4-246. For discussion purposes assume three unregulated dc voltages are available to series regulator Q2. During normal operation A15Q1 is biased "on" by the rectifier/filter output and the EXT DC input voltage. Breakdown diodes A15CR5 and A15CR7 set the bias levels. With A15Q1 "on", A15Q2 is "off", and A15Q3-Q4 is "off" to prevent the internal standby battery (Option 002) voltage from reaching Q2. When ac power is operating the instrument, A15CR6 is back-biased to prevent the EXT DC input from operating the 5061A. If ac line power fails, A15Q1 is held "on" to prevent the internal battery from operating the instrument. Back bias on A15CR6 is removed, placing the EXT DC input at series regulator Q2. If the EXT DC fails, A15Q1 turns "off", turning A15Q2 "on", turning A15Q3-Q4 "on", placing the internal standby battery voltage at series regulator Q2.

4-247. Power Regulator +18.7 Volts

4-248. The regulator circuit consists of Q2, A15Q5, A15Q6, A15Q8, and associated components. Series regulator Q2 provides the regulation action as controlled by the driver and differential amplifier circuits. Diode A15CR9 establishes the reference bias voltage for A15Q6. Output voltage can be changed by adjusting A15R15. The output from A15Q6, Q8 differential amplifier changes and through A15Q5 controls the Q2 regulator output. Regulator operation may be traced as follows: assume that the output voltage tends to increase. This causes A15Q8 base voltage to increase, increasing the current through this transistor. Since A15R13 carries a constant current, the increase in current in A15Q8 causes a corresponding decrease in current through A15Q6. The current through A15Q6 is the base drive for A15Q5. Therefore, the current through A15Q5 decreases. In a like manner, this decreases the base drive to series regulator Q2, causing the load current to decrease and the output voltage to return to +18.7 volts. Regulator shunt resistor A15R9 provides an initial current to establish bias voltage for the differential amplifier when voltage is initially applied.

4-249. Resistor A15R12 and transistor A15Q7 form a current limiter circuit which provides protection against an abnormal load on the +18.7 line. The current limiter circuit holds regulator current to about 1.5 Amperes. Transistor A15Q7 monitors the +18.7 volt output current. The voltage drop across series resistor A15R12 is applied across the base-emitter junction of A15Q7. When the output current increases, A15Q7 conducts causing A15Q8 to conduct more current. This causes the current through Q2 to be reduced and limits the output current.

4-250. C Field Regulator

4-251. The C field regulator circuit controls the current to the C field coil in the cesium beam tube. Front panel C FIELD potentiometer R8 provides an adjustable reference to one input of differential amplifier U1. The other input is the voltage developed by the C field current through the parallel combination of R19 and R21 (C field coil resistance is negligible). Any disturbance in the "C" field current causes an unbalance in the differential amplifier which then changes the conduction of A15Q9 to counteract the disturbance. Capacitor A15C6 filters noise from U1 input circuit.

4-252. CLOCK DISPLAY ASSEMBLY A16

4-253. The Clock Display Assembly, Figure 8-29, is a solid-state 24 hour clock with a seven segment LED (light emitting diode) display. It indicates time in hours, minutes, and seconds in synchronism with the 5061A generated 1 PPS signal. Time may be set and synchronized using the HOLD, SLOW/FAST, and SET switches.

The required inputs which enable the clock to operate are connected to the clock by five wires. These are:

1. Unregulated +28Vdc from the 5061A used to generate a regulated +5Vdc and used exclusively to drive the display.
2. Regulated +12Vdc from the A5 assembly used exclusively to operate the CMOS circuits in the display.
3. 1 PPS signal from the 5061A used to synchronize the clock and increment the display.
4. AC line sense signal from A15(10) turns off the display portion if instrument AC power fails or is removed. To display time, when AC power is not available, the clock front-panel STANDBY READ must be pressed.
5. 1 PPS and 12Vdc common. Circuit ground connects to the chassis through the LED digital clock circuits.

Two circuit boards make up the A16 LED digital clock: the A16A1, Regulator/Driver (located at the rear of the A16 Assembly), and the A16A2, Display board.

4-254. A16A1 Regulator/Driver

4-255. The A16A1 Assembly contains two separate circuits. The regulator portion takes the unregulated 28Vdc from the 5061A and regulates it down to +5Vdc to provide power for the display light-emitting diodes. The driver portion takes the 1 PPS signal from the 5061A and shapes it for use by the clock accumulator/driver chip on A16A2. These two separate circuits are described in the following paragraphs under appropriate headings.

4-256. REGULATOR. The regulator portion of the A16A1 Assembly consists of U2, Q3, Q4 input and output filter circuits. U2 is a switching regulator circuit that contains the switching oscillator, voltage reference, and switching transistor drive circuitry. The +5V regulator output voltage is sampled through R13 at U2(1). This voltage is compared to the reference input at U2(2). U1 adjusts the amount of time Q1 conducts based on whether the output voltage (+5V) is too high or too low. C9, L1, and C10 form a filter to keep switching transients out of the 5061A power supply. R9 and C7 set the switching frequency of the regulator. U2 provides a regulated +5Vdc at pin 16. This voltage provides the reference as well as providing power for Q2. L2 keeps current flowing to the load when Q1 is off. C14 and C15 filter the +5Vdc output. The circuitry of Q2 turns off the power supply to conserve power when the 5061A is operating from battery power. Under normal operation, when ac power is applied, zener diode CR1 conducts turning on Q2. This allows U2 to operate normally. When ac power is lost, Q2 turns off, forward biasing CR2 which in turn prevents the power supply from operating.

Pressing the STANDBY DISPLAY switch enables power supply operation, lighting the display. Current limiting and over-voltage protection is provided by Q4 and CR3 respectively.

4-257. DRIVER. The Driver portion of the A16A1 Assembly operates in the following manner. A short (+150 nsec) low level pulse (≈1V) is applied to the input of Q1 from A5A1 (WHT). This pulse is amplified (by Q1) and shaped by 555 timer U1. The output of U1 goes to A16A2 where it drives the clock accumulator/display IC. In normal operation U1 behaves like a one-shot multivibrator outputting one pulse for each input pulse. When the SET pushbutton is activated, U1 free-runs, and generates a signal whose frequency is set by the position of the SLOW/FAST switch. In SLOW, the frequency is approximately 60 Hz, 500 Hz in FAST. These two frequencies allow the hours, minutes, and seconds on the display to be easily set.

4-258. A16A2, Clock Display Board

4-259. The clock display board consists of a MOS clock chip, a transistor array, a buffer amplifier array, four driver transistors, and six LED displays. This assembly's function is to accumulate and display time-of-day in synchronism with the instrument's 1 PPS signal. Operation is as follows. The MOS circuit U1 normally operates from 50 or 60 Hz. It is enabled to operate by the 1 PPS signal from A16A1 by grounding the "slow set" line at U1 (17). U1 divides the 1 PPS input to form the hours, minutes, and seconds count. In addition, it formats the outputs so that this count may be displayed on a seven-segment strobed LED display. The time display signals from U1 are composed of two parts:

1. The digit enable signal
2. The multiplexed seven-segment signal.

4-260. The digits enable signals from U1 are:

Pin 23: tens-of-hours.
Pin 24: units-of-hours.
Pin 25: tens-of-minutes.
Pin 26: units-of-minutes.
Pin 21: tens-of-seconds.
Pin 22: units-of-seconds.

These signals enable the LED displays through U3 gates, and allow the multiplexed seven segment outputs to turn on the correct display segment.

4-261. The multiplexed seven-segment signals from U1 are shown in Figure 4-20. These "segment enabling signals" are buffered through U2 stages and applied to the LED displays. Thus, the segments of an individual number display are enabled by outputs from U1 (6 to 12) while the display itself is turned on by one of the U1 (21 to 26) outputs.

Legend:

Pin 6: for segment a.
Pin 7: for segment b.
Pin 8: for segment c.
Pin 9: for segment d.
Pin 10: for segment e.
Pin 11: for segment f.
Pin 12: for segment g.

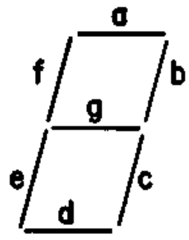


FIGURE 4-20. Example of Display Segments

4-262. TERMINAL BOARD ASSEMBLY A17

4-263. Printed circuit board assembly A17 (Figure 8-30) contains the series resistors for CIRCUIT CHECK meter M1. This meter can be switched by the CIRCUIT CHECK switch to monitor operation of various circuits in the instrument. Test points TP1 through TP9 are found on the board. Resistors R2 through R7 are factory-selected to normalize the CIRCUIT CHECK meter readings. Standby Power Supply Option 002 fuse F1 is also located on this board.

4-264. +3500 VDC POWER SUPPLY ASSEMBLY A18

4-265. Power Supply

4-266. This assembly includes a blocking oscillator, a voltage transformer, and a voltage doubler circuit which provide +3500 volts to the ion pump in the cesium beam tube. These circuits are inside a hermetically sealed assembly and are not accessible for repair. The ion pump operates any time power is applied to the instrument and maintains pressure within the beam tube to less than 5×10^{-7} mm of Hg. This corresponds to a current of approximately 2 microamperes from the supply for normal beam tube operation after warmup. When the beam tube is first turned on, ion pump current may be more than 40 microamperes. Ion pump current monitor circuits, located on assembly A15, monitor the current and prevents application of +17.9 volts to Cesium Oven Controller Assembly A11, hot wire ionizer, and the electron multiplier until ion pump current is less than 40 microamperes. CIRCUIT CHECK meter monitors ion pump current in the ION PUMP I position.

4-267. Blocking oscillator Q1 generates pulses to trigger switching transistor Q2. Resistor R1 is factory selected to set the output voltage by adjusting the blocking oscillator repetition rate. The voltage doubler and filter includes capacitors C3, C4 and diodes CR2, CR3.

4-268. Ion Pump Current Monitor
(Part of Power Regulator Assembly A15)

4-269. Transistors A15Q10 through A15Q15 and associated components form a current monitor circuit which senses the ion pump current. When this current is less than 40 microamperes, the +17.9 volts at A15(4) is supplied to Cesium Oven Controller Assembly A11. However, when current exceeds 40 microamperes, the +17.9 volts is disabled, removing beam tube operating voltages until tube pressure is correct. During normal operation (proper beam tube pressure), current through divider network A18R4, A18R5, A18R6, and A18R7 is sensed at A15Q10 base, turning "off" this transistor. Transistors A15Q11 and A15Q12 are "on" and A15Q13 is "off", turning "on" A15Q14–A15Q15. The +17.9 volts is then applied to the required circuits. When current through the divider exceeds 40 microamperes, A15Q10 turns "on", turning A15Q11, Q12 "off". This turns A15Q13 "on", turning A15Q14, Q15, disabling the +17.9 volt output. The +3500 Vdc supply is on whenever the instrument is connected to operating power.

4-270. -2500 VDC POWER SUPPLY ASSEMBLY A19

4-271. Power Supply

4-272. This supply includes a blocking oscillator, a voltage transformer, and a voltage doubler circuit providing -2500 Vdc to the electron multiplier in the cesium beam tube. These components are in a hermetically sealed assembly and not accessible for repair. Operation is similar to that of +3500 Volt Power Supply Assembly A18 as discussed in Paragraph 4-254. The -2500 volt supply is regulated by electron multiplier regulator circuits located on Power Regulator Assembly A15.

4-273. Electron Multiplier Regulator
(Part of Assembly A15)

4-274. Transistors A15Q16 through A15Q19 and associated components are a series regulator for the -2500 volt supply. Resistors A15R33 and A15R34 are factory selected to establish the regulator operating voltage. When a new beam tube is installed in the 5061A, these two resistors must be selected for the new tube.

4-275. Differential amplifier A15Q16, A15Q17, and driver A15Q18 control series regulator A15Q19. Breakdown diode A15CR10 establishes a reference at A15Q17 base. For discussing regulator operation, assume the -2500 volts increases to -2600 volts. Differential amplifier A15Q16-Q17 causes A15Q18 to change A15Q19 conduction opposing the voltage change. Resistor A15R38 and capacitor A15C11 stabilizes the feedback loop.

SECTION V

MAINTENANCE

5-1. INTRODUCTION

5-2. This section provides maintenance and service information for the Model 5061A Cesium Beam Frequency Standard. Included is a table of recommended test equipment, an in-cabinet performance check, troubleshooting aids, adjustment procedures, and test setup diagrams.

5-3. TEST EQUIPMENT

5-4. Recommended test equipment for performance checking and troubleshooting is listed in Table 5-1. Other test instruments may be used if their specifications equal the required characteristics. The recommended measuring systems must be composed of a number of standard and special instruments connected together. Therefore, the performance of the measurement system is being checked as well as the performance of the Cesium Beam Frequency Standard. Some measurement systems will require considerable effort to duplicate and also to verify that an "out of specification" reading is traceable to the instrument under test or to the test equipment.

5-5. CIRCUIT CHECK SWITCH

5-6. A check of general operation is made by noting the front panel CIRCUIT CHECK meter indications as the switch is rotated through its twelve positions and comparing these readings with those recorded in Table 3-4. All readings should agree with Table 3-1. Any reading deviation from Table 3-4 or Table 3-1 may readily isolate the instrument problem.

Table 5-1. Recommended Test Equipment

Instrument	Required Characteristics	Use	Model
Primary Frequency Standard	Frequency: 5 MHz and 1 MHz Output Level: 1 Vrms @ 50 ohms Accuracy: $\geq\pm7 \times 10^{-12}$	Performance Check Troubleshooting	HP 5061A with option 001 and 004
Electronic Counter *	Frequency Range: 0 to 90 MHz Sensitivity: 20 m V rms EXT STD input: 5 MHz	Performance Check Troubleshooting Adjustments	HP 5345A*
Feedthru Termination	50-ohms male and female BNC	Performance Check Troubleshooting	HP 11048B
RMS Voltmeter	Voltage Range: .3 V to 3 V full scale Frequency Range: 10 Hz to 10 MHz Accuracy: ±5% full scale	Performance Check Troubleshooting	HP 3400A
Oscilloscope	Vertical Frequency Response: dc to 100 MHz Sensitivity: .005 V/cm Calibrated Sweeps: 1 sec to .05 μsec/cm	Performance Check Troubleshooting Adjustments	HP 180A with HP 1820C and HP 1805A HP 10006A Probe
Spectrum Analyzer	Frequency Range: 1 kHz to 110 MHz Response: ±0.5 dB Sensitivity: −130 dBm Scan Width: 2 kHz to 100 MHz Stability: Residual FM less than 20 Hz peak-to-peak	Performance Check Troubleshooting	HP 8552B and HP 8553B
Vector Voltmeter	Frequency: 1 MHz to 1 GHz Voltage Range: 1.5 mV to 1 Vrms	Performance Check Troubleshooting	HP 8405A

Table 5-1. Recommended Test Equipment (Cont'd.)

Instrument	Required Characteristics	Use	Model
Strip Chart Recorder	Chart Speed: 1, 2, 4, 8 in./hr Spans: .1, .5, 1, and 5V full scale Input Resistance: 200 k Ω/volt Accuracy: .2% full scale	Performance Check Troubleshooting	HP 680A
RF Voltmeter	Range: 10 mV to 10 Vrms Frequency Range: 500 kHz to 15 MHz Accuracy: ±3% full scale	Performance Check Troubleshooting	HP 411A
DC Power Supply	Range: 0 to 20 Vdc Output I: 0 to 1 A Line Regulation: 0.001%	Troubleshooting	HP 6101A
Audio Oscillator	Frequency Range: 5 Hz to 1.2 MHz Dial Accuracy: ±3% Output Impedance: 600 ohms Output Voltage >5V into open circuit	Performance Check Troubleshooting Adjustments	HP 204C
Step Attenuator	Attenuation: 120 dB Frequency Range: dc to 1 GHz Impedance: 50 ohms nominal	Troubleshooting	HP 355D
Signal Generator	Frequency: 50 kHz to 65 MHz Level: 0 to 3 Vrms into 50 ohms	Troubleshooting	HP 606A
Amplifier/Filter	Gain: 40 dB Noise Figure: 6 dB Bandwidth: .1 Hz - 9.5 kHz (Noise BW of 15 kHz)	Troubleshooting	Fairchild μA739C with appropriate compensation
Clip-On DC Milliammeter	Range: 3mA to 300 mA Accuracy: ±0.1 mA ±3% full scale	Troubleshooting	HP 428B
Electronic Voltmeter	DC Voltage Range: ±15 mV to ±1500 volts full scale Accuracy: ±2% full scale Resistance Range: 10 Ω to 10 M Ω DC Current Range: ±1.5 μA to ±150mA Accuracy: ±3% AC Voltmeter Range: .5 V to 300 V	Troubleshooting Adjustments	HP 410C
DC Divider Probe	Division: 100:1	Troubleshooting	HP 11045A for HP 410C
Variable Line Source	Variable from 103 Vrms to 127 Vrms and 206 Vrms to 254 Vrms	Troubleshooting	Superior electric powerstat (115V line) 3PF116 or (230V line) 3PF216
AC Voltmeter	Range: 1 mV to 300 V, full scale Frequency: 5 Hz to 1 MHz	Troubleshooting	HP 403B
Frequency Stability Analyzer system	Capable of automatically measuring short term frequency fluctuations with averaging times of 10 msec and greater	Performance Check	HP 5390A Opt 010 with H66-105A
Time Interval Counter*	Resolution of > 2 nsec per measurement	Performance Check	HP5370A*

*Not needed if HP 5390A Frequency Stability Analyzer available

Table 5-2. In-Cabinet Performance Check

OPERATIONAL CHECK

1. CIRCUIT CHECK METER CHECK

The circuit checks below involve setting the front panel CIRCUIT CHECK switch to its 12 positions and observing the corresponding indication on CIRCUIT CHECK meter. Switch positions and normal indications are listed in Table 3-1 and if instrument has been operational, in Table 3-4. Refer to Section III, Paragraph 3-8 for turn-on procedure. Perform the circuit checks as follows: Set CIRCUIT CHECK switch to its 12 positions. CIRCUIT CHECK meter indications should be as in Table 3-1.

2. OUTPUT FREQUENCIES

Place instrument in operation (CONTINUOUS OPERATION light on, ALARM light off).

Connect 5 MHz from a Primary Frequency Standard as an external time base to an Electronic Counter.

Connect the Counter to each of the following OUTPUTS of the instrument under test:

FRONT PANEL	REAR PANEL
1 MHz	1 MHz
5 MHz	5 MHz
100 kHz	100 kHz

Counter should display the correct frequency, plus or minus the inherent 1-count error of the Counter.

3. OUTPUT VOLTAGES

Place instrument in operation (CONTINUOUS OPERATION light on, ALARM light off).

Connect an RMS Voltmeter through a 50-ohm Feedthru to front panel 5 MHz, 1 MHz, 100 kHz, rear panel 5 MHz, 1 MHz, and 100 kHz output jacks. Voltmeter should indicate between 1.0 and 1.5 Vrms for each frequency checked. Connect the same outputs to the vertical channel of an Oscilloscope. Oscilloscope display should be a clean sine wave.

Table 5-2. In-Cabinet Performance Check (Cont'd.)

PERFORMANCE CHECK

1. HARMONIC DISTORTION CHECK

Harmonic distortion in the 5 MHz, 1 MHz, and 100 kHz output signals should be at least 40 dB down from the 1 Vrms output. To perform this check, a Spectrum Analyzer is tuned to the fundamental frequency and an amplitude reference is established. The output frequency spectrum is then investigated to determine fundamental-to-sideband amplitude relationship at harmonic points of the fundamental.

Set instrument to normal operation mode (CONTINUOUS OPERATION light on).

Connect equipment shown in Figure 5-1.

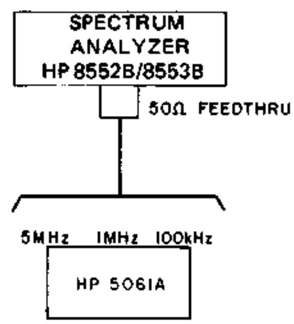
To perform the check proceed as follows:

a. Connect 5 MHz output through 50-ohm Feedthru to Spectrum Analyzer input. Check spectrum at 5 MHz center to 4th harmonic (20 MHz). Harmonics should be below 40 dB.

b. Remove connection from instrument 5 MHz output and connect to 1 MHz output jack. Check spectrum at 1 MHz center to 5th harmonic (5 MHz). Harmonics should be below 40 dB.

c. Remove connection from instrument 1 MHz output and connect to 100 kHz output jack. Check spectrum at 100 kHz center to 50th harmonic (5 MHz). Harmonics should be below 40 dB. Disconnect Spectrum Analyzer from instrument.

Figure 5-1. Harmonic and Non-Harmonic Distortion Test Setup



2. NON-HARMONIC DISTORTION CHECK

Non-harmonic distortion in the 5 MHz, 1 MHz, and 100 kHz output signals should be at least 80 dB down from the 1 Vrms output. To perform this check, a Spectrum Analyzer is tuned to the fundamental frequency and an amplitude reference is established. The output frequency spectrum is then investigated to determine fundamental-to-sideband amplitude relationship at non-harmonic points in the spectrum.

Set instrument to normal operation mode (CONTINUOUS OPERATION light on).

Connect equipment shown in Figure 5-1.

To perform the check proceed as follows:

a. Connect 5 MHz output through 50-ohm Feedthru to Spectrum Analyzer input. Check spectrum at 5 MHz ±5 kHz. All sidebands should be at least 80 dB below the carrier.

b. Remove connection from instrument 5 MHz output and connect to 1 MHz output jack. Check spectrum at 1 MHz center ±5 kHz. All sidebands should be 80 dB below the carrier.

c. Remove connection from instrument 1 MHz output and connect to 100 kHz output jack. Check spectrum at 100 kHz ±5 kHz. All sidebands, except harmonically related, should be 80 dB below the carrier. Disconnect equipment from instrument.

3. ACCURACY CHECK

Place instrument in normal operation (CONTINUOUS OPERATION light on, ALARM light off). Check that front panel TIME CONSTANT switch is set to SHORT. Check "C" Field setting given in Paragraph 3-14k.

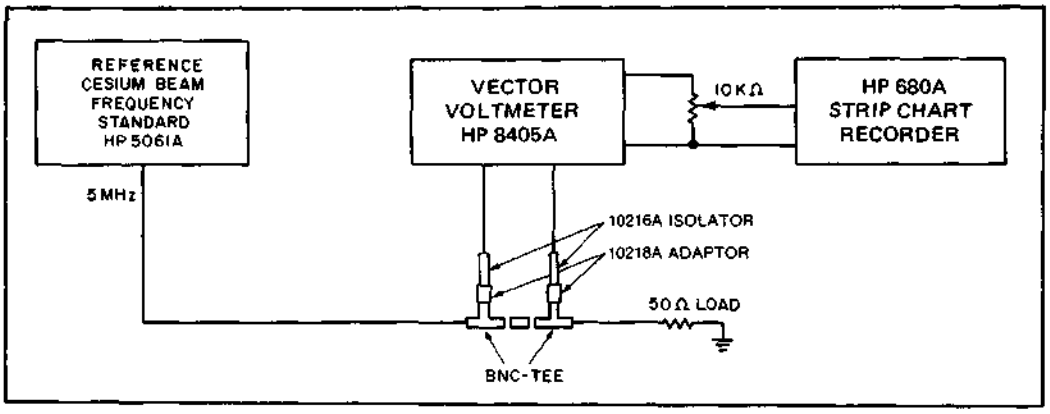
Table 5-2. In-Cabinet Performance Check (Cont'd.)

PERFORMANCE CHECK

3. ACCURACY CHECK Cont'd.

Connect equipment as shown in Figure 5-2. This test setup is for calibrating the measurement system for the accuracy check.

Figure 5-2. Accuracy Measurement Test Setup Calibration



To calibrate the measurement system proceed as follows:

a. Set reference Frequency Standard for normal operation (CONTINUOUS OPERATION light on, ALARM light off).

b. Set Vector Voltmeter FREQ RANGE to agree with input frequency (5 MHz).

c. Zero the Vector Voltmeter, phase-meter on ±6° range using PHASE METER ZERO.

d. Set Strip Chart Recorder range to 0.5 V. Set pen to chart scale center with recorder ZERO control.

e. Set Vector Voltmeter phase range to ±180° and change METER OFFSET by +180°.

f. Adjust 10 k ohm potentiometer for full scale pen deflection on recorder.

g. Change METER OFFSET polarity to (-). Pen should move to opposite chart edge. Make required adjustments to recorder zero and 10 k pot for full scale chart deflection. The recorder is now calibrated for 360° full scale or 0.2 μsec full scale.

Accuracy Measurement. To perform the accuracy measurement proceed as follows:

a. Connect equipment as shown in Figure 5-3.

b. Set both Cesium Beam Frequency Standards for closed loop operation with CONTINUOUS OPERATION light on and ALARM light off.

c. Set Vector Voltmeter PHASE RANGE to 180°.

d. Set Vector Voltmeter PHASE METER ZERO and OFFSET for zero degrees indicated on recorder (center), start strip chart drive at 1 in./hr and record phase change for 8 hours.

e. Determine frequency error using the relationship $\frac{\Delta t}{t} = \frac{\Delta f}{f}$. Since $\frac{\Delta t}{t} = \frac{\Delta f}{f}$ and chart calibration is 0.2 μsec full scale, error in proportional parts is easily found. Accuracy should be ±1 part in 10^{11} or better for standard tube. For Option 004, accuracy should be ±7 x 10^{-12} or better.

Δt = ∅ change in μsec
t = total measurement time

Table 5-2. In-Cabinet Performance Check (Cont'd.)

PERFORMANCE CHECK

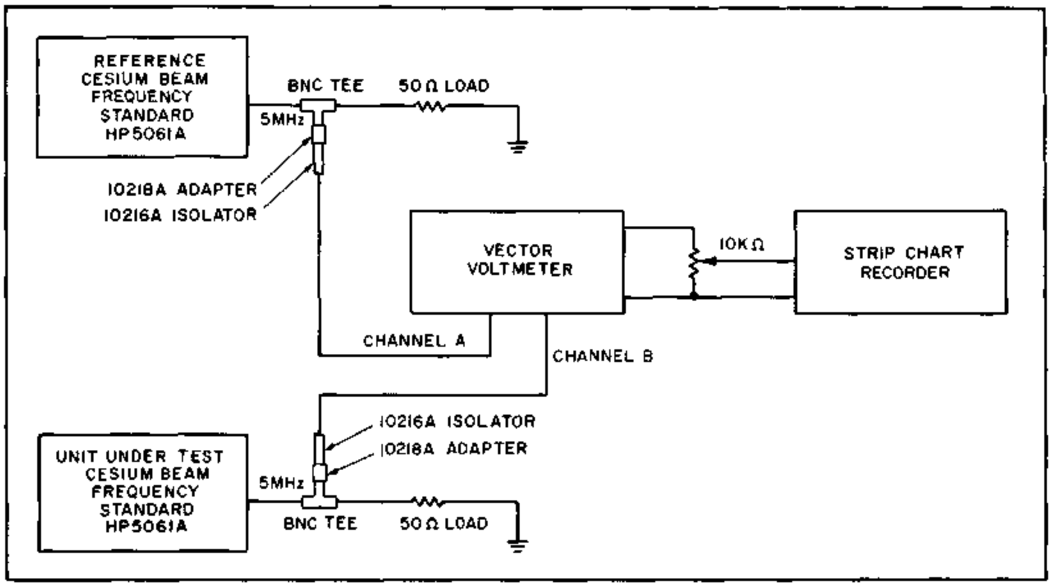
3. ACCURACY CHECK Cont'd.

Example: Assume the instrument under test's phase change over the 8 hour measurement period is 0.1 μsec.

Then $\frac{\Delta t}{t} = \frac{1 \times 10^{-7} \text{ seconds}}{2.88 \times 10^{4} \text{ seconds}} = 3.4 \times 10^{-12}$

To determine instrument frequency difference with respect to the accepted frequency definition, Reference Standard frequency difference must also be known and considered in the calculation.

Figure 5-3. Accuracy Measurement Test Setup



4. CLOCK PULSE CHECK (OPTION 001 and 003)

a. Pulse Parameters. Connect 5061A 1 PPS output to Oscilloscope vertical input. Set instrument for normal operation (CONTINUOUS OPERATION light on, ALARM light off, DIVIDER MODE switch to AUTO START). Parameters should be as indicated:

Rate:	1 pulse-per-second	Rise Time:	$<$ 50 nsec
Amplitude:	+10V peak ±10%	Fall Time:	$<$ 2 μsec
Width:	20 μsec minimum		

b. Pulse Jitter. To verify pulse jitter specification ($<$ 5 nS rms pulse to pulse) one of two methods may be used. If the HP Model 5390A system is to be used for checking short term frequency stability, use the procedure described in Method 1 below. If the 5390A system is not available, use the procedure described in Method 2.

Method 1.

In this procedure the Model 9825A Computing Controller is used to control the model 5345A frequency counter. The counter takes data under the direction of the Controller. The Controller performs the RMS calculation. Proceed as follows:

(1) Set 5345A front panel controls as follows:

SAMPLE RATE	CCW
FUNCTION	TIME INT. A TO B
GATE TIME	MIN
CHANNEL A and B	
Input Resistance	1MΩ
ATTEN	X20
Coupling	DC
SLOPE	+
Input	COM A

Table 5-2. In-Cabinet Performance Check (Cont'd)

(2) If a cable is connected to Channel B input remove it.

(3) Connect 1 PPS output from 5061A through a 50 ohm feedthrough termination to the Channel A input of the 5345A. Adjust Channel A and B LEVEL controls so that each channel triggers about in the middle of the pulse (+5V) and the counter displays approximately 1 second.

(4) Remove cassette from 9825A controller and set power switch off.

(5) Set 9825A controller power switch on and type the following program into controller. Press STORE after each line (do not type line number).

```
0: flt 2
1: dim A[100]
2: wrt 710,"I2F3
 G5ES1I"
3: wait 50
4: for I=1 to
 100
5: red 710,A[I]
6: next I
7: 0→S;0→T
8: for I=1 to 99
9: S+(A[I]-A[I+
 1])↑2→S
10: T+(A[I]-A[I+
 1])→T
11: next I
12: √(.01*S-(.01
 *T)↑2)→D
13: prt "RMS
 jitter =",D,
 "seconds"
14: end
```

(6) Press RUN. Controller will take measurements and print results. Measurement takes approximately 200 seconds.

Method 2.

Alternate method for checking pulse jitter. This method uses the HP model 5370A Time Interval Counter to check pulse jitter. This procedure may be used if the 5345A/9825A combination is not available. The 5370A may also be used to check synchronization and time delay in Section 5 of this performance check.

(1) Connect 5 MHz from 5061A under test to FREQ STD INPUT on 5370A rear panel. Set FREQ STD switch to EXT.

(2) On 5370A turn on AC power, and set START and STOP Channel Controls as follows:

Slope	⨍
Attenuation	X10
Input Resistance	1MΩ
Coupling	DC
Com/Sep	START COM

(3) Set FUNCTION:TRIG LVL. Set START and STOP trigger LEVEL controls for a reading of $\simeq$ 0.5.

(4) Connect 1 PPS from 5061A **through 50 ohm feedthrough termination** to START input.

(5) Set FUNCTION:TI. 5370A should display appoixmately 1 second. Reading will change slightly every other second. START and STOP lights should be flashing at a 1 second rate.

(6) Set STATISTICS:STD DEVIATION. SAMPLE SIZE will automatically go to 100.

(7) Measurement of RMS pulse jitter takes about 3-1/2 minutes. During this time the display will not change. RMS pulse jitter must be less than 5 nanoseconds.

5. SYNCHRONIZATION AND TIME DELAY CHECK

The Digital Clock output pulse can be automatically synchronized with a reference pulse to within 10 ± 1 μsecond. To check synchronization, proceed as follows:

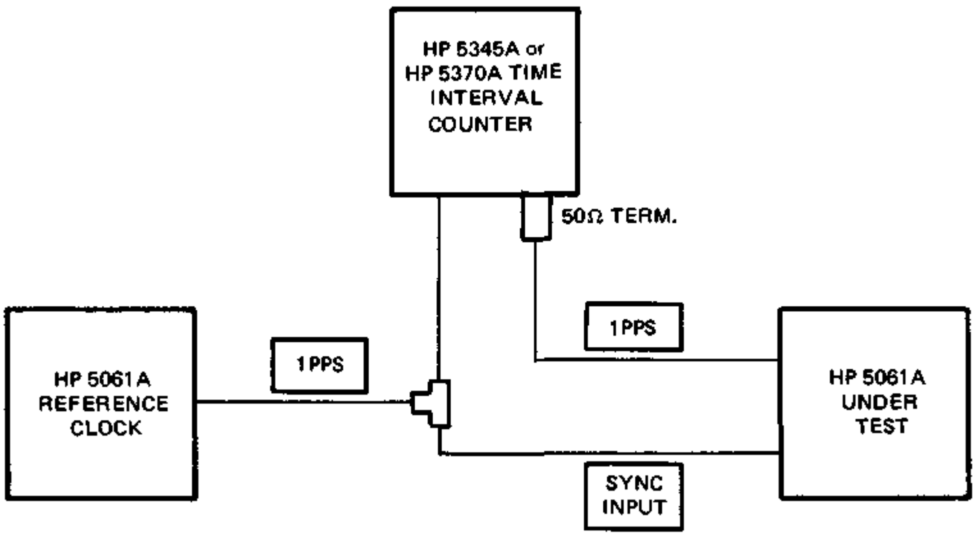
a. With 5061A in normal operation (see paragraph 3-8) connect equipment as shown in Figure 5-4.

NOTE: Reference pulse must be greater than +5V with a rise time of 50 nsec or less.

Table 5-2. In-Cabinet Performance Check (Cont'd)

Note: Set input triggers for + slope and +5V.

Figure 5-4. Equipment Setup for Synchronization and Delay Checks



b. Press and hold Clock SYNC button located on Digital Divider Assembly A5 (Figure 3-2) for at least one second. The digital clock will synchronize on the first pulse input after the SYNC button is pressed. The time interval counter will display a 10 ±1 μs time delay.

c. Time Delay. To check the time delay thumbwheels, proceed as follows:

1. Connect equipment as shown in Figure 5-4.
2. Check TIME DELAY by setting thumbwheel switch to following positions and observing output pulse delay on Time Interval Counter. Time interval change should correspond with switch settings.

7 μsec	800 μsec	80 msec
8 μsec	7 msec	700 msec
70 μsec	8 msec	800 msec
80 μsec	70 msec	999.999 msec
700 μsec		

3. Adjust 0-1 μsec TIME DELAY control. Time interval counter should show delay change of 1 μs.

6. STANDBY POWER SUPPLY (Option 002) CAPACITY CHECK

Place instrument in normal operation so that CONTINUOUS OPERATION light is on. BATTERY light is off, and ALARM light is off. Disconnect instrument ac power cord from ac line source for 30 minutes. BATTERY light should flash during entire period. Connect instrument ac power cord to ac line. BATTERY light should stay on for approximately 18-21 hours. At completion of recharge cycle BATTERY light should go off. During entire check period, CONTINUOUS OPERATION light should stay on and ALARM light off.

7. FREQUENCY STABILITY OF 5 MHz OUTPUT (Sigma y of Tau)

The rms deviation of the 5 MHz output is measured using the HP model 5390A Frequency Stability Analyzer option 010, and the Model 105B option H66. This equipment enables measurements of Sigma y of Tau for averaging times as short as 50 msec.

In this procedure measurements will be made with averaging times between 50 msec and 100 seconds. Since the 100 second averaging time measurement takes over 3 hours to complete, this portion of the test may be deleted.

Table 5-2. In-Cabinet Performance Check (Cont'd)

The information given below is designed to be used in conjunction with the 5390A FSA option 010 "Sigma y of Tau" users manual. System connection should be done per this manual. The following information provides the necessary operating parameters to enable the operator to verify the 5061A specification over the measurement range.

The test assumes that the reference standard is an HP model 5061A with option 004. If this is not the case, this test can be performed only on a unit which contains the standard Cesium Beam Tube.

To perfrom the tests set the 5061A for normal operation (MODE switch set to OPER, CONTINUOUS OPERATION light on) and connect to 5390A FSA System as shown in Figure 5-5. Input information to FSA System as follows:

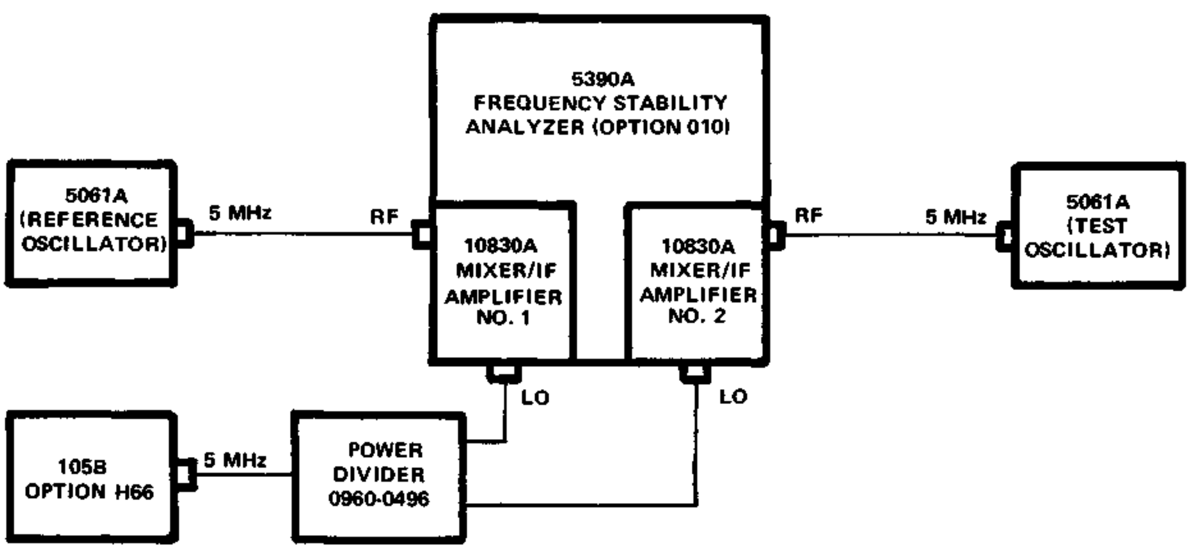
step	data requested	input data
1	Program name	ffddmtd (See Note 1)
2	Max data array size	100
	Max numb. tau's	10
3	Year	Last 2 digits of year
4	Key function	ENTER MEAS PARAMETERS (fo)
	tau	.05 CONTINUE
		.1 CONTINUE
		1 CONTINUE
		10 CONTINUE
		100 CONTINUE
		0 CONTINUE
	number of samples	100
	measurement bandwidth	100,000
	carrier frequency	5e6
	correction coefficient	1 or 1.414 (See Note 2)
5	Key function	START MEASUREMENTS (f5)
	Measurement description	5061A s/n Performance Test

Notes:

1. ffddmtd = fractional frequency difference: dual-mixer time difference method.
2. If unit under test is option 004 use 1.414, otherwise use 1.

The 5390A will type heading, measurement parameter data, and then proceed with the measurement. Measured values should be equal to or less than the corresponding values given in the specifications, table 1-1.

Figure 5-5. 5 MHz Output Stability Test Setup



5-7. IN-CABINET PERFORMANCE CHECK

5-8. The In-Cabinet Performance Check outlined in Table 5-2 lists checks to verify specifications. The Performance Check Test Record page can be filled out during the checks to provide a permanent performance record of each instrument. In-Cabinet Performance Checks can be used:

a. as part of an incoming inspection check of instrument specifications,

b. as part of a troubleshooting procedure, and

c. after any repairs or adjustments, before returning the instrument to regular service.

5-9. MODULE DESIGNATIONS

5-10. Table 5-3 gives designations, names, and part numbers of all assemblies and modules used.

5-11. INSTRUMENT COVER REMOVAL

5-12. For access to modules in the unit, remove top and bottom covers. Remove the four screws from the cover and slide cover toward rear of instrument. To replace cover, reverse procedure.

Table 5-3. Assembly Designations

Assembly Number	and Name	HP Part No.
A1	Synthesizer	05061-6097
A2	Battery Charger (Option 002)	05061-6019
A3	Multiplier	05061-6108
A4	Harmonic Generator	05060-6029
A5	Digital Divider (Option 001)	05061-6118
A6	Frequency Divider	05061-6102
A7	AC Amplifier	05061-6005
A8	Phase Detector	05061-6095
A9	Operational Amplifier	05061-6092
A10	Quartz Oscillator	00105-6013
A11	Cesium Oven Controller	05061-6009
A12	Cesium Beam Tube	05061-6077
A13	Buffer Amplifier	05061-6030
A14	Logic	05061-6016
A15	Power Regulator	05061-6099
A16	Clock Display Assy (opt 001)	05061-60125
A16	Clock Display Assy (opt 003)	05061-60136
A17	Terminal Board	05061-6018
A18	+3500 Vdc Power Supply	05060-6093
A19	-2500 Vdc Power Supply	05060-6092

5-13. TROUBLESHOOTING

5-14. The best approach to isolating trouble in the instrument is first obtain all possible information from controls, indicators, and connectors; then logically apply this information to locate the defective unit or module. Figures 3-1 (front panel), 3-2 (top controls), 3-3 (rear panel), 8-3 (top internal), 8-4 (bottom internal), 8-2 (block diagram with waveforms) can help understand operation and locate modules and parts. To further aid analysis, each CIRCUIT CHECK switch position is discussed in Paragraph 5-22. Table 5-4 indicates basic instrument trouble indications and checks for their cause. Section VIII in this manual provides circuit diagrams, circuit board component locations, waveforms, and voltage checks. This section, in conjunction with the In-Cabinet Performance Check of Table 5-2, are good troubleshooting aids. When a defective assembly is isolated, refer to that assembly corresponding paragraphs in Section V of this manual.

5-15. When Operational Checks indicate an instrument frequency offset greater than 1 part in 10^{11}, (7×10^{-12} for Option 004) the following checks should be made prior to troubleshooting:

a. Check "C" Field setting given in Paragraph 3-14K.

b. Check Synthesizer frequency given in the In-Cabinet Performance Check Table 5-2.

c. Re-tune control loop (see Paragraph 5-195).

d. Demagnetize cesium beam tube. (See Beam Tube Demagnetization procedure Paragraph 5-172.) For option 004 only: Do the CURRENT degauss procedure using HP 10638A DEGAUSSER ACCESSORY. Procedure is in the HP10638A Operating Manual.

5-16. PERIODIC MAINTENANCE

5-17. The only maintenance necessary to maintain the Model 5061A is periodic checks of the front panel CIRCUIT CHECK meter indications. When the instrument is initially turned on, all CIRCUIT CHECK meter positions should be checked and recorded in Table 3-4. After several days of continuous operation, the meter indications should again be checked and recorded in Table 3-4. If any meter indication changes value, all indications should be again recorded in Table 3-4.

5-18. During the life of the beam tube it is typical for beam current to change due to aging of the electron multiplier within the beam tube. When meter reading in 2ND HARMONIC position decreases to 20, or increases to 50, adjustments are required to front panel BEAM I METER and LOOP GAIN controls.

5-19. When the 2ND HARMONIC indication has decreased to 20 or increased to 50, proceed as follows:

a. Set instrument control as follows:

MOD .... ON
MODE .... OPER
OSC FREQUENCY X10^{-10} 250
CIRCUIT CHECK .... 2ND HARMONIC

b. Adjust front panel LOOP GAIN control for 40 indication on CIRCUIT CHECK meter. If CONTINUOUS OPERATION light goes off, momentarily press front panel LOGIC RESET button.

c. Set CIRCUIT CHECK switch to BEAM I.

d. Adjust BEAM I METER adjust for 20 on CIRCUIT CHECK meter.

e. Rotate CIRCUIT CHECK switch through all 12 positions and record readings in Table 3-4. After several days, re-check meter indications and record in Table 3-4. This completes the adjustments.

5-20. STANDBY BATTERY PERIODIC MAINTENANCE (Option 002)

5-21. When Option 002 is installed, the internal battery should be "exercised" every 60 days. To "exercise" the battery, disconnect instrument ac power cord from line source for 15 to 20 minutes. This operates the 5061A on internal standby battery power. During internal battery operation, front panel BATTERY light will flash on and off. Connect instrument ac power cord to ac line voltage. BATTERY light will remain on until battery is re-charged. Re-charge cycle is about ten times usage time. CONTINUOUS OPERATION light should remain on during "exercise" period.

5-22. CIRCUIT CHECK SWITCH AND METER

5-23. BATTERY Position

5-24. Meter signal is supplied from the internal standby battery positive side (Option 002 only) through Terminal Board Assembly A17 to S1A(1).

5-25. SUPPLY Position

5-26. Meter signal is supplied from Power Regulator Assembly A15 through Terminal Board Assembly A17 to S1A(2). The meter monitors the regulated +18.7 volt output from this assembly. This voltage is supplied to most circuits in the instrument; therefore a meter indication other than 38–42 indicates trouble in this circuit.

5-27. ION PUMP I Position

5-28. Meter signal is supplied from +3500 Volt Power Supply Assembly A18 through Terminal Board Assembly A17 to S1A(3). The meter indication represents the ion pump current. The beam tube ion pump operates any time power is applied to the instrument. A fail-safe current monitor circuit holds off beam tube power if beam tube pressure is unsatisfactory. The normal meter indication is zero (less than 5.0 microamperes) for the ION PUMP I position.

5-29. OSC OVEN Position

5-30. Meter signal is supplied from Crystal Oscillator Assembly A10 through Terminal Board Assembly A17 to S1A(4). The meter monitors power applied to the proportional oven in the oscillator assembly. At an ambient temperature of +25°C, the meter should indicate between 35 and 45, provided the oven has been operating long enough to reach operating temperature (about 1 hour).

5-31. CS OVEN Position

5-32. Meter signal is supplied from Oven Controller Assembly A11 through Terminal Board Assembly A17 to S1A(5). The meter monitors power applied to the cesium oven in the beam tube with a normal indication between 5 and 35. The normal temperature is dependent on ambient; operation in a cooler environment will cause the indication to increase while a warmer will cause a decrease.

5-33. 5 MHz Position

5-34. Meter signal is supplied from Buffer Amplifier Assembly A13 through Terminal Board Assembly A17 to S1A(6). The meter monitors the 5 MHz standard frequency output. Normal indication is 38 to 42, with no load connected to front or rear panel output connectors. Meter will indicate less when the output is loaded.

5-35. MULT Position

5-36. Meter signal is supplied from Harmonic Generator Assembly A4 through Terminal Board Assembly A17 to S1A(7). The meter monitors the bias current applied to step recovery diode A4CR2. Normal meter indication is 20 to 45. This meter reading indicates the 90 MHz input to Harmonic Generator Assembly A4 is present and the step recovery diode is not open or shorted.

5-37. BEAM I Position

5-38. Meter signal is supplied from AC Amplifier Assembly A7 through Terminal Board Assembly A17 to S1A(8). The meter monitors dc beam current from the beam tube electron multiplier. Normal indication is between 15 and 30 and will be maximum when the beam tube applied frequency is exactly equal to cesium resonance.

5-39. CONTROL Position

5-40. Meter signal is supplied from Operational Amplifier A9 through Terminal Board Assembly A17 to S1A(9) and rear panel CONTROL output jack. The CONTROL indication represents crystal oscillator frequency-correcting dc voltage. When the dc voltage exceeds about ±5.0 volts (50 right or left on CIRCUIT CHECK meter), this approaches the ±7 volt dynamic limit of frequency control and front panel ALARM light will come on. When this occurs, adjust OSC FREQUENCY COARSE control for zero indication on CIRCUIT CHECK meter.

5-41. 2ND HARMONIC Position

5-42. Meter signal is supplied from Logic Assembly A14 through Terminal Board A17 to S1A(10). This signal represents the 274 Hz second harmonic signal voltage level from AC Amplifier Assembly A7, which in turn comes from the beam tube electron multiplier. Normal meter indication is between 35 and 45.

5-43. 1 MHz Position

5-44. Meter signal is supplied from Frequency Divider Assembly A6 through Terminal Board Assembly A17 to S1A(11). The meter monitors the 1 MHz standard frequency output. Normal indication is 38 to 42 with no load connected to front or rear panel output jack. Meter will indicate less when the output is loaded.

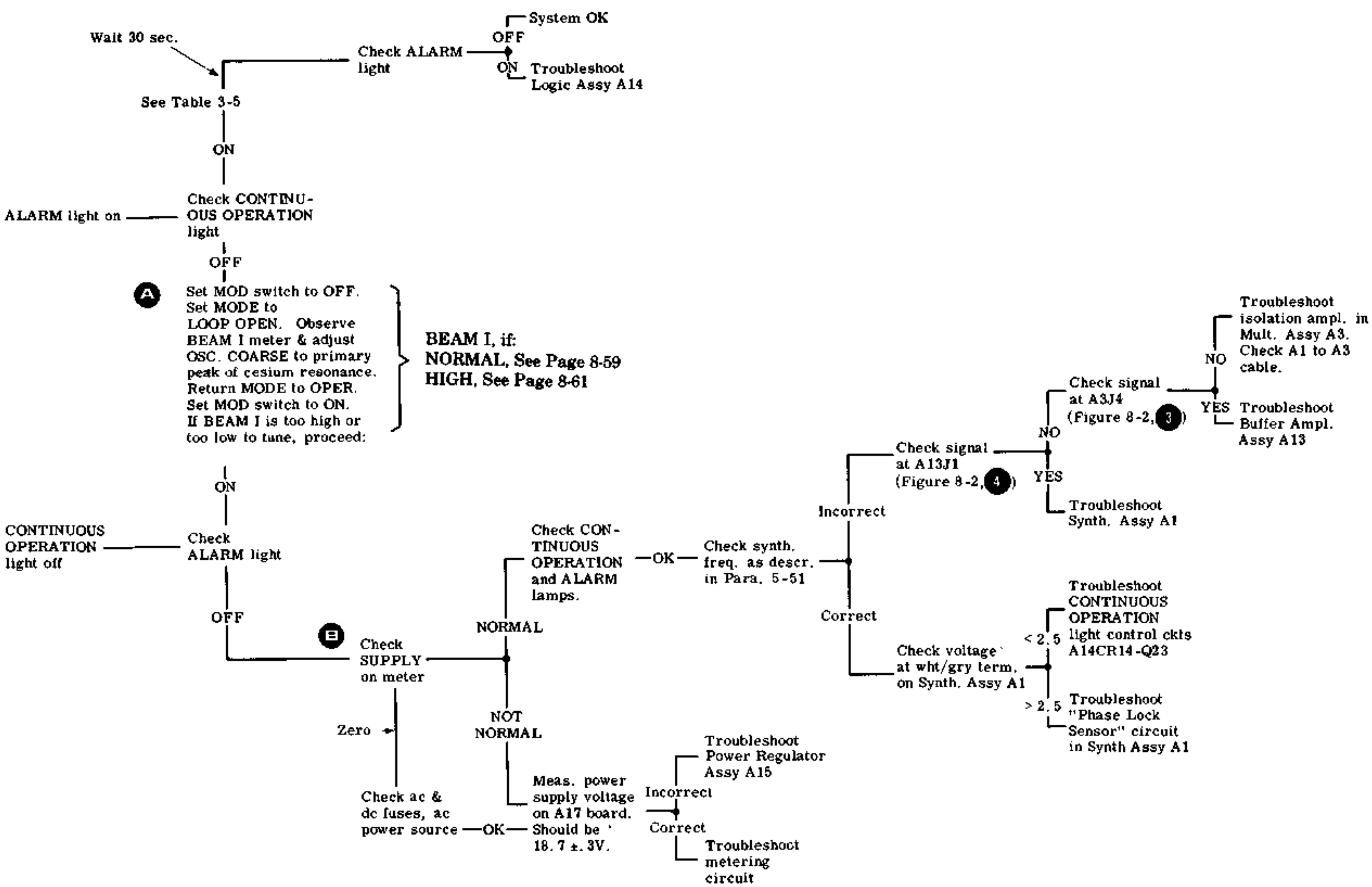


Table 5-4. 5061A Troubleshooting Chart

5-45. 100 kHz Position

5-46. Meter signal is supplied from Frequency Divider Assembly A6 through Terminal Board Assembly A17 to S1A(12). The meter monitors the 100 kHz standard frequency output. Normal indication is 38 to 42 with no load connected to front or rear panel output connectors. The meter will indicate less when the output is loaded.

5-47. SYNTHESIZER ASSEMBLY A1

5-48. Normal Operation

5-49. 5061A Synthesizer Module Assembly A1 Series No. 1152A and Above

5-49A. Thumbwheel switches included with earlier synthesizer assemblies have been removed. The function of the switches was to make minor changes to the U.T.C. Time Scale. Since January 1, 1972, the common reference time scale throughout the world has been changed. The previous rate-offset from the Atomic Time Scale has been eliminated and adjustments in U.T.C. time will be in increments of 1 second every 6 to 12 months to maintain the approximate agreement with the time scale based on the earth's rotation.

5-50. Operational Check

5-51. To determine if synthesizer circuits are working properly, connect equipment as shown in Figure 5-6. Counter should indicate a frequency of 12,631,771.6 Hz ±1 count. The RF Voltmeter should indicate 100 mV or more.

5-52. Troubleshooting

5-53. When synthesizer circuits are not functioning properly, remove assembly from instrument, remove module cover, and reconnect the assembly electrically. Connect a ground lead from instrument chassis to synthesizer circuit board ground. Check thoroughly for physical damage, burned or broken components. Check all connectors.

5-53A. One-shot MV IC4, Check and Adjustment. If IC4 is replaced, C2 should be checked and adjusted as follows:

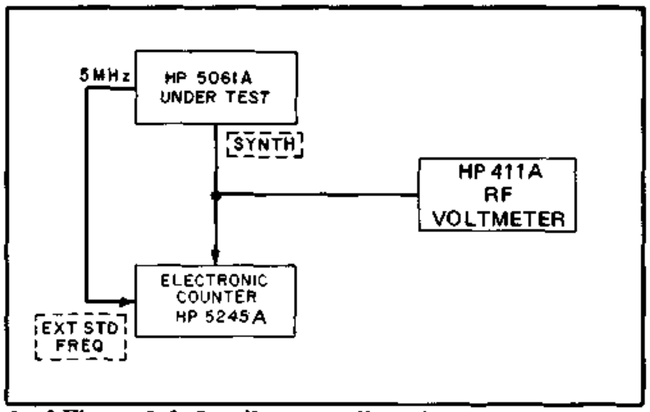
a. Connect a clip lead between either side of R5 and the instrument chassis. This holds the input gate open.

b. Connect an oscilloscope to Q3(C). Set the oscilloscope sweep to 0.2 μseconds/division. Adjust horizontal position and sweep speed controls so that each pulse falls on a graticule line as in waveform 2 , of Figure 8-8.

c. Connect scope external trigger input to TP1. Set scope to trigger on negative slope of pulse. Remove clip lead from R5 to chassis.

d. Check that oscilloscope displays waveform 1 of Figure 8-8. If not, adjust C2 so that 9 pulses are blocked out. These can be easily counted by counting the graticule lines during the period when the input gate is closed. If possible, no partially blocked pulses should appear at the end of the blockout period. However, the first part of the tenth pulse may be blocked out as shown in waveform 1 of Figure 8-8. In all cases, all of the ninth pulse must be blocked out. A partial pulse may appear at the beginning, but should be counted as blocked out.

Figure 5-6. Synthesizer Operational Check Setup



5-54. Table 5-5 lists the signal period at A1TP1. Table 5-6 is a step-by-step troubleshooting aid, helpful in isolating the trouble area. Once the problem area is located, normal repair techniques should be used.

5-55. A1L2 and A1L3 Replacement and Y1 Frequency Check

5-56. When A1L2 and A1L4 need replacement, the following procedure should be used:

a. Set instrument controls as indicated:
MODE . . . . LOOP OPEN

b. Remove synthesizer assembly from instrument, remove module cover, and reconnect synthesizer 5 MHz input and +18.7 Vdc lead. Connect chassis ground to synthesizer circuit board ground.

c. Lift the end of A1R81 connected to A1R88-R78 junction.

d. Connect this lifted end to the positive lead of a DC Power Supply set to +6.5 V ±0.3 V. Connect DC Power Supply negative lead to synthesizer ground.

e. Measure synthesizer frequency at A1J3 using setup shown in Figure 5-7.

f. If counter indication is greater than 12.631871 MHz or less than 12.631671 MHz, select L2 or L4 as necessary for a counter indication of 12.631771 MHz ±100 Hz. If the values of L2 and L3 exceed a range of 0.15 μh to 2.2 μh replace Y1 and repeat this procedure.

g. When frequency indication is correct, reconnect R81, replace synthesizer cover, and replace synthesizer assembly into the instrument.

h. Reconnect all electrical connections and using test setup in Figure 5-6, check synthesizer output frequencies using Table 3-3.

Table 5-5. Synthesizer A1TP1 Output Period

Digital Divider Hardwired for	Signal Period at A1TP1
8634	273.2 μsec

Table 5-6. Synthesizer Troubleshooting Chart

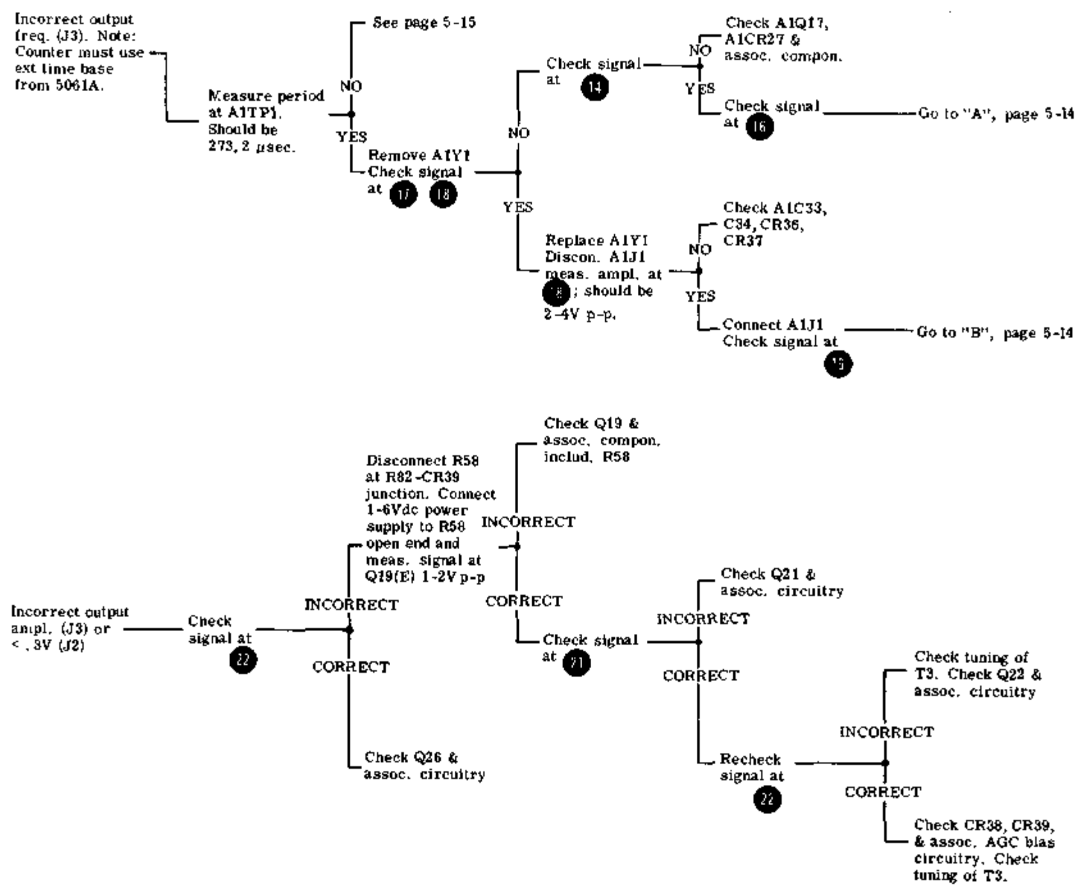
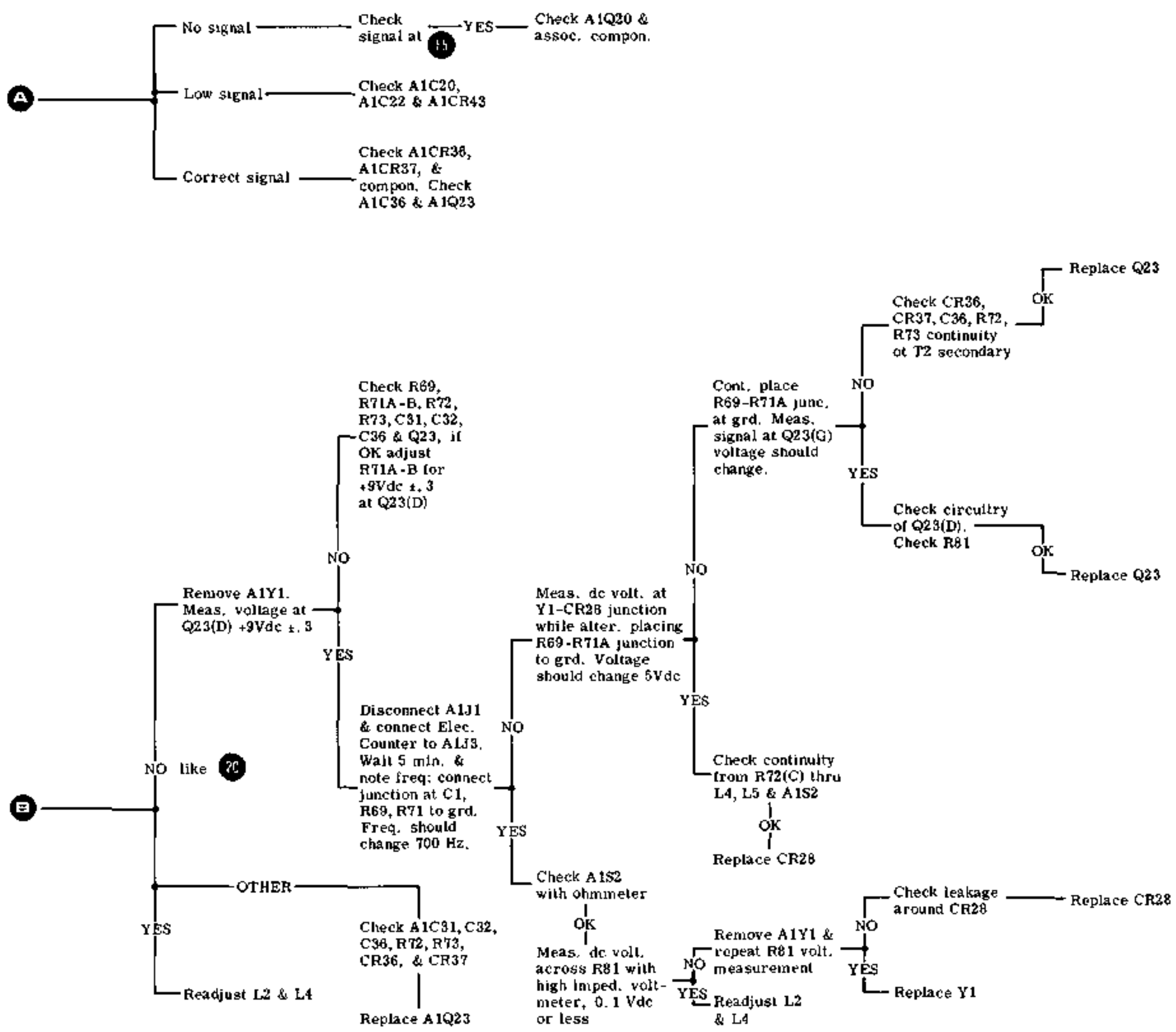
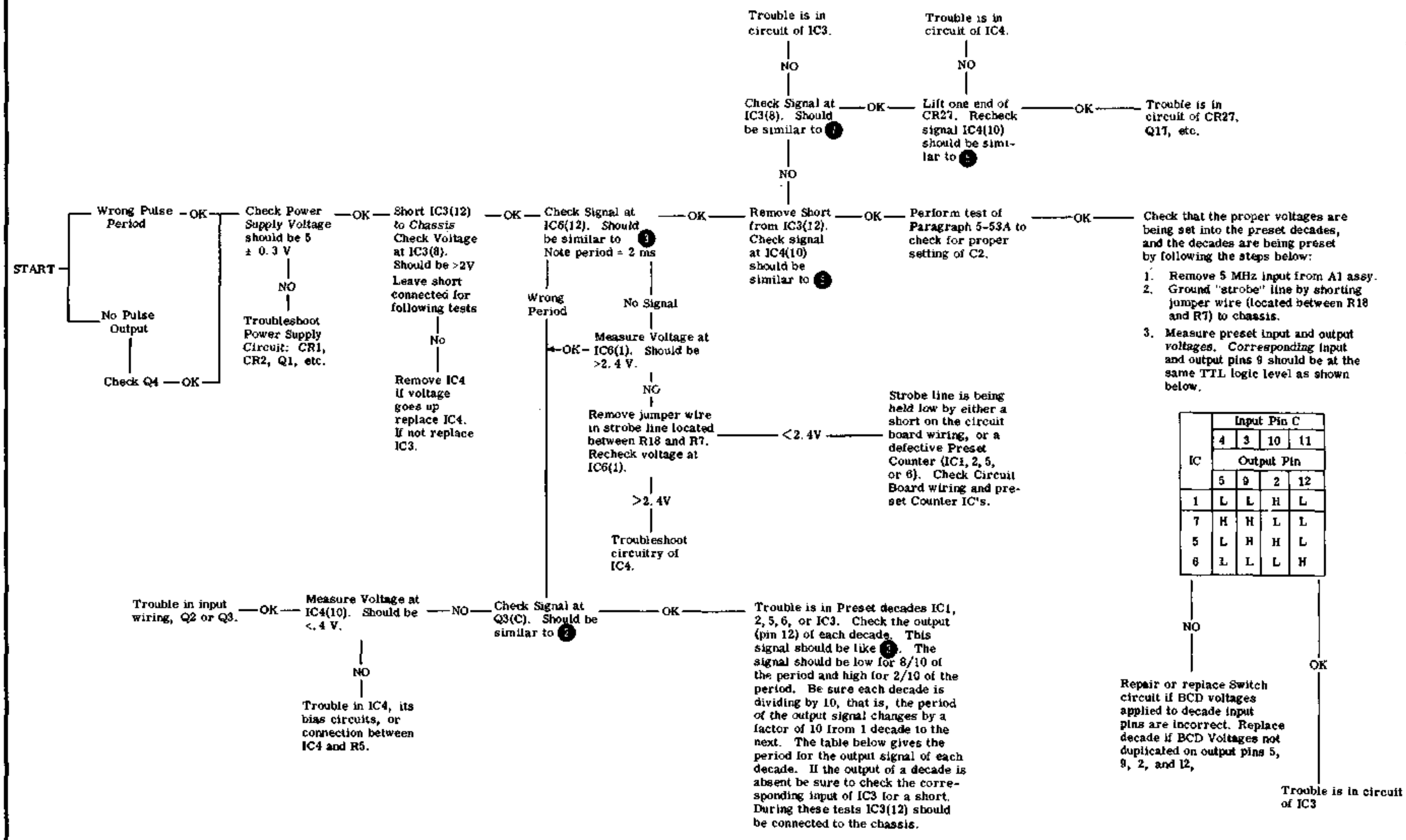


Table 5-6. Synthesizer Troubleshooting Chart (Cont'd.)



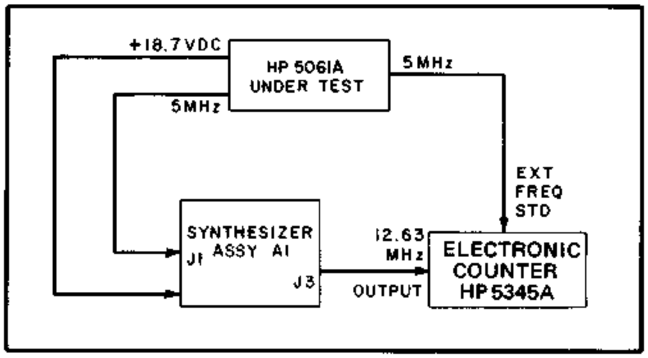


IC	Input Pin C			
	4	3	10	11
	Output Pin			
	5	9	2	12
1	L	L	H	L
7	H	H	L	L
5	L	H	H	L
6	L	L	L	H

IC	Period of Output Signal
1	2 μs
2	20 μs
5	.2 ms
6	2 ms

Table 5-6. Synthesizer Troubleshooting Chart (Cont'd.)

Figure 5-7. Synthesizer Frequency Check Setup



5-57. Module Replacement

5-58. When Synthesizer Assembly A1 is replaced the following adjustment is necessary:

a. Set instrument to normal operation (CONTINUOUS OPERATION light on, ALARM light off).

b. Set CIRCUIT CHECK switch to BEAM I.

c. Remove instrument top cover and locate Harmonic Generator Assembly A4 (Figure 8-3).

d. Adjust A4R1 maximum counterclockwise, then clockwise for maximum CIRCUIT CHECK meter indication. Replace instrument top cover. This completes the adjustment.

5-59. BATTERY CHARGER ASSEMBLY A2 (Option 002)

5-60. See Paragraph 5-252 covering options.

5-61. MULTIPLIER ASSEMBLY A3

5-62. Normal Operation

5-63. Multiplier circuits are part of a stable microwave power source supplying a 300 milliwatt, phase modulated, 90 MHz signal to Harmonic Generator Assembly A4. The multiplier is tuned at the factory to match the specific harmonic generator and cesium beam tube used. Do not adjust multiplier circuits until it is definitely established that fault exists in the multiplier.

5-64. Operational Check

5-65. To determine if the multiplier is operating normally, check inputs and outputs shown in Figure 8-11 with an oscilloscope. To check the 90 MHz output signal, disconnect cable from A3J2 and connect a Sampling Oscilloscope, terminated in 50 ohms. Sync the Sampling Oscilloscope with 5 MHz from the instrument. The 90 MHz displayed on the oscilloscope should be a clean sine wave at 8 to 12 volts peak-to-peak. Remove the Sampling Oscilloscope and replace cable to A3J2.

5-66. Troubleshooting

5-67. When multiplier circuits are not operating properly, the assembly should be removed from the instrument, cover removed, and re-connected allowing access to circuit components.

5-68. When any components in tuned circuits are replaced, the circuit must be retuned. To retune, connect a decoupled oscilloscope to the following stage collector circuit. Re-tune the repaired circuit for maximum amplitude on the oscilloscope. For example: if A3C34 is replaced, connect the oscilloscope to A3Q9 collector and adjust A3L12 and A3L14 for maximum amplitude on the oscilloscope.

5-69. The only externally accessible adjustment on the multiplier is MOD LEVEL A3R20. This control normally needs no adjustment. However, if repair or instrument trouble requires that the output be checked or A3R20 setting be checked, perform the following procedure:

a. Set 5061A controls as follows:

MOD	ON
MODE	LOOP OPEN
OSC FREQUENCY $X10^{-10}$	250
CIRCUIT CHECK	BEAM I

b. Observe CIRCUIT CHECK meter indication and adjust OSC FREQUENCY COARSE control to central peak of cesium resonance.

c. Adjust OSC FREQUENCY $X10^{-10}$ to 200. This offsets the quartz oscillator by −50 parts in 10^{10}.

d. Using the Micon-to-BNC cable supplied, connect test output A7J6, on the bottom instrument deck, to the vertical input of an Oscilloscope.

NOTE

This waveform should be a 137 Hz sine wave. If there is clipping or distortion, reduce ac gain by adjusting front panel LOOP GAIN control for a clean waveform.

e. Adjust MOD LEVEL (A3R20) on Multiplier Assembly A3 for maximum amplitude indication on Oscilloscope.

f. Remove oscilloscope connection from A7J6.

g. Reset Loop Gain and 2nd Harmonic level outlined in Paragraphs 5-108 and 5-197.

5-70. Module Replacement

5-71. When Multiplier A3 is replaced, perform the adjustments in Paragraphs 5-193 through 5-195.

5-72. HARMONIC GENERATOR ASSEMBLY A4

5-73. Normal Operation

5-74. Harmonic generator circuits produce the microwave field applied to the cesium beam tube. This assembly is factory adjusted for optimum performance with a specific multiplier and cesium beam tube assembly. It is not intended for field repair. Make only those adjustments called for in this manual.

5-75. Operational Check

5-76. To determine if harmonic generator circuits are operating normally, check CIRCUIT CHECK meter indication in MULT position. Meter should indicate 35 to 45 for normal operation. Check the 90 MHz input at A4J1 and 12.63.... MHz input at A4J2 with a Sampling Oscilloscope.

5-77. Troubleshooting

5-78. When a trouble in the harmonic generator is found, retune the assembly as outlined in Paragraphs 5-187 and 5-188. If retuning has no effect, remove assembly from instrument. Contact your nearest Hewlett-Packard Sales and Service office listed at the back of this manual.

5-79. When a new beam tube is replaced, the harmonic generator and multiplier assemblies must be adjusted. Use procedure in Paragraphs 5-187 through 5-198.

5-80. Module Replacement

5-81. When Harmonic Generator A4 is replaced, perform the adjustments in Paragraphs 5-187 through 5-197.

5-82. DIGITAL DIVIDER ASSEMBLY A5 (Option 001)

5-83. See Paragraph 5-240 covering options.

5-84. FREQUENCY DIVIDER ASSEMBLY A6

5-85. Normal Operation

5-86. Frequency divider circuits provide 1 MHz and 100 kHz signals to front and rear panel output jacks and 1 MHz to Digital Divider Assembly A5 (Option 001).

5-87. Operational Check

5-88. Divider operation can be easily checked by monitoring CIRCUIT CHECK meter indications and checking output frequencies with an electronic counter. When measuring output frequencies, the counter should be driven with the 5061A, 5 MHz output.

5-89. Troubleshooting

5-90. The divider circuits can be divided into two parts: 1) 1 MHz divider, and 2) 100 kHz divider. Front panel DIVIDER MODE switch may be disconnected during troubleshooting to prevent starting the 1 MHz divider. To start the dividers with DIVIDER MODE switch open, short the pins that connect the blue and gray wires to the divider. Figure 8-17 is furnished as an aid in locating malfunctions. When the divider has been repaired, the following tuning procedure should be performed.

5-91. Tuning Procedure

5-92. ASSEMBLY REMOVAL. The frequency divider assembly must be removed from its mounted position to expose tuning adjustments. If care is exercised during removal, power to instrument can remain on.

a. Remove mounting screws holding divider assembly in instrument.

b. Leave cables and connectors intact and carefully remove assembly from instrument. Place assembly across top of other mounted assemblies with adjustment holes exposed.

5-93. 1 MHz TUNING.

a. Connect a BNC tee to front panel 1 MHz output jack. Connect an Electronic Counter and RMS Voltmeter to the BNC tee. Connect the 5061A 5 MHz output to Counter EXT STD INPUT and set counter for external standard operation.

b. Connect 50-ohm Termination to the rear panel 1 MHz output jack.

c. Connect the blue and gray wires to the divider.

d. Set front panel DIVIDER MODE switch to AUTO START. Tune A6T1, T2, C21 and T3 for maximum indication on RF Voltmeter. Counter should indicate 1 MHz ±1 count.

e. Set DIVIDER MODE switch to center off position. Momentarily disconnect J6 from the instrument. The divider should stop. Set DIVIDER MODE switch to START and release. The divider should start and remain running.

f. Carefully retune A6C21, T1, T2, and T3 for maximum indication on RMS voltmeter. Output level should be between 1.0 and 1.5 Vrms. If less, decrease the value of A6R31 until the output level is between 1.0 and 1.5 volts. This completes the 1 MHz divider tuning.

5-94. 100 kHz TUNING

NOTE

The 100 kHz divider is started by the 1 MHz divider signal. Before tuning the 100 kHz divider make sure the 1 MHz divider is started and running.

a. Observe the CIRCUIT CHECK 100 kHz indication and compare it to Table 3-1.

b. Check for 100 kHz, 1 Vrms into 50-ohms at front and rear panel 100 kHz jacks.

c. Connect oscilloscope probe at Q10 collector. Adjust T4 for maximum amplitude at 1 MHz.

d. Connect oscilloscope probe at Q16 collector. Adjust T5 for maximum amplitude at 100 kHz.

e. Make minor readjustments of T4, T5 for a stable 100 kHz, 1 Vrms into 50-ohms at J2, J4.

f. Disconnect all test equipment from 5061A and re-install divider assembly in instrument. This completes the divider checks and tuning.

5-95. Module Replacement

5-96. No other module adjustments are necessary when Frequency Divider Assembly A6 is replaced.

5-97. AC AMPLIFIER ASSEMBLY A7

5-98. Normal Operation

5-99. The amplifier circuits receive the low-level modulating signal from Cesium Beam Tube Assembly A12 and provide amplified outputs to Phase Detector Assembly A8 and Logic Assembly A14. BEAM I current indication for CIRCUIT CHECK meter is also furnished from the amplifier circuits. The 274 Hz second harmonic and 137 Hz fundamental are contained in the input signal. The 274 Hz is filtered out and supplied to logic circuits while the 137 Hz is further amplified and supplied to phase detector and logic circuits.

5-100. Operational Check

5-101. To determine if AC Amplifier Assembly is operating normally proceed as follows:

a. Set instrument to normal operation (CONTINUOUS OPERATION light on, ALARM light off).

b. With the Micon-to-BNC adapter supplied, connect the vertical input of an Oscilloscope to A7J6 error signal test jack.

c. Set front panel MODE switch to LOOP OPEN.

d. With CIRCUIT CHECK switch to BEAM I, adjust OSC FREQUENCY COARSE for resonant peak.

e. Set OSC FREQUENCY X10^{-10} control to 300. Waveform should be similar to Figure 8-2, (9). Disconnect oscilloscope and cable from instrument.

5-102. Noise Check

a. With instrument operating and MODE switch set to LOOP OPEN, disconnect A7P1 from A7J1. This removes the AC Amplifier input signal.

b. Set AC Amplifier Gain switch A7S1 to HI and set front panel LOOP GAIN control maximum clockwise.

c. Connect an RMS Voltmeter to A7J6 output test jack. Voltmeter indication should be less than 0.5 Vrms. Disconnect RMS Voltmeter.

d. Return switch A7S1 to original position and LOOP GAIN to mid-range.

e. Connect A7P1 to A7J1.

f. Set OSC FREQUENCY X10^{-10} to 250.

g. Set MODE switch to OPER.

h. Set CIRCUIT CHECK switch to 2ND HARMONIC.

i. Adjust LOOP GAIN control for an indication of 40 on CIRCUIT CHECK meter.

5-103. Troubleshooting

5-104. Amplifier components can be easily reached if the assembly is removed from the instrument and connected to an external +18.7 Vdc Power Supply.

5-105. The external dc supply (+) lead should be connected to W-R terminal on the AC Amplifier Assembly and the common (-) lead to circuit board common. If the trouble is in the Beam Current differential amplifier (Q4A/B,5,6) an additional voltage of -10 V must be supplied to the "VIO" terminal. Troubleshooting may now be done in a straightforward manner. DC collector voltages for each amplifier stage are given on the schematic.

5-106. Module Replacement

5-107. When AC amplifier components are repaired or replaced, LOOP GAIN control A7A1R7, 2ND HARMONIC level Paragraph 5-197, modulation phase Paragraph 5-194, and BEAM I meter zero Paragraph 5-196, should be adjusted. To adjust LOOP GAIN, perform procedures listed in next paragraph (Loop Gain Adjustment).

5-108. Loop Gain Adjustment

a. Set 5061A controls as follow:

MOD	ON
MODE	LOOP OPEN
OSC FREQUENCY X10^{-10}	250
CIRCUIT CHECK	BEAM I

b. Tune OSC FREQUENCY COARSE control to primary cesium resonance indicated on CIRCUIT CHECK meter.

c. Using the Micon-to-BNC adapter supplied, connect a DC Voltmeter to A8J1 on Phase Detector Assembly A8.

d. Carefully adjust OSC FREQUENCY COARSE control for zero voltmeter indication. Some noise will be present in meter indication. Adjust for minimum meter indication.

e. Set OSC FREQUENCY X10^{-10} control to 200.

f. Adjust front panel LOOP GAIN control for Voltmeter indication of +1.6 ±0.15 volts.

NOTE

AC Amplifier Assembly A7 GAIN switch (A7S1) setting should be changed if LOOP GAIN control range is insufficient to perform step f.

g. Set OSC FREQUENCY X10^{-10} control to 300. Voltmeter should indicate -1.6 ±0.15 Volts. If not, repeat steps b through g.

h. Set MODE switch to OPER. Voltmeter indication should fall to zero. This verifies proper frequency control loop operation.

i. Set OSC FREQUENCY X10^{-10} to 250. Disconnect Voltmeter and adapter cable.

5-109. PHASE DETECTOR ASSEMBLY A8

5-110. Normal Operation

5-111. Phase detector circuits provide the following outputs:

a. 137 Hz, 80 to 300 mV p-p sine wave at A8J5. This is the phase modulation applied to Multiplier Assembly A3.

b. 137 Hz, 12 to 16 V p-p square wave at A8J4. Synchronous detector signal applied to Logic Assy A14.

c. 137 Hz, 1.5 to 2.1 V p-p triangular signal at A8J2. Available for synchronization.

d. Full wave phase detected signal, derived from AC Amplifier Assembly A7, at A8J1 and A8J6. This signal is applied to Operational Amplifier Assembly A9.

NOTE

When the 5061A is operating normally (with the atomic loop closed), the error signal at A8J1 is very small, containing mostly noise. When viewed with an oscilloscope it should appear similar to Figure 8-2, waveform (11).

5-112. Operational Check

5-113. To determine if Phase Detector Assembly is operating normally, perform the following operational checks:

a. Operation mode of 5061A is not important for this check. Remove the cable at A8J5 and with the Micon-to-BNC adapter furnished, connect the vertical input of an Oscilloscope to A8J5. The waveform should be similar to Figure 8-19, (6).

b. Operation mode of 5061A is not important for this check. Remove the cable at A8J4 and with the Micon-to-BNC adapter furnished, connect the vertical input of an Oscilloscope to A8J4. The waveform should be similar to Figure 8-2, (13). Remove the oscilloscope connection and reconnect A8J4.

c. Operation mode of 5061A is not important for this check. Connect vertical channel of an Oscilloscope to A8J2. The waveform should be triangular with 1.5 to 2.1 V p-p amplitude. Disconnect oscilloscope and connect Electronic Counter in its place. The frequency at A8J2 should be 137 Hz ±1 Hz. If not, adjust A8R10 (MOD FREQ) for 137 Hz ±1 Hz as indicated on Counter. Disconnect Counter from instrument.

d. Set 5061A controls to:

OSC FREQUENCY X10^{-10}	250
MODE	LOOP OPEN
CIRCUIT CHECK	BEAM I

Adjust OSC FREQUENCY COARSE control for peak of cesium resonance indicated on CIRCUIT CHECK meter. Set OSC FREQUENCY X10^{-10} control to 300. Remove cable from A8J3 and connect vertical input of Oscilloscope to this cable (A8P3). The waveform should be similar to Figure 8-2, (9). Disconnect Oscilloscope and reconnect A8P3 to A8J3. Connect Oscilloscope to A8J1. The waveform observed should be similar to Figure 8-2, (10). Disconnect Oscilloscope.

NOTE

If this signal is clipped or distorted, readjust OSC FREQUENCY X10^{-10} control for waveform shown in Figure 8-2, (9). This is the amplified error signal from AC Amplifier Assembly A7.

e. Remove cable from A8J3 and connect a DC Voltmeter to A8J1. Signal amplitude should be less than ±1.0 mV. If voltage is incorrect, adjust Phase Zero adjust (A8R39) for zero Vdc ±0.2 mV.

5-114. Troubleshooting

5-115. When any components are repaired or replaced the assembly should be adjusted. When cesium beam tube assembly A12 is replaced, phase detector circuits should be checked and adjusted. For complete check and adjustments, see Paragraphs 5-118 to 5-120.

5-116. Module Replacement

5-117. A new phase detector module may be replaced without removing power from the 5061A. After replacement, new module should be adjusted as follows.

5-118. PHASE MODULATION FREQUENCY ADJUST.

a. Set front panel controls as follows:

MOD	ON
MODE	LOOP OPEN
OSC FREQUENCY X10^{-10}	250
CIRCUIT CHECK	BEAM I

b. Adjust OSC FREQUENCY COARSE control for maximum peak indication shown on CIRCUIT CHECK meter.

c. Connect an Electronic Counter to phase detector SWEEP TEST OUTPUT jack A8J2 located on instrument bottom front deck.

d. Adjust Mod Freq control (A8R10) for 137 Hz ±1 Hz display on Electronic Counter. Disconnect Counter from instrument.

5-119. PHASE DETECTOR ZERO ADJUSTMENT.

a. Set front panel MOD switch to OFF.

b. Disconnect +18.7 Vdc lead (white-red) from AC Amplifier A7.

c. Using adapter cables supplied, connect DC Voltmeter to phase detector test output A8J1.

d. Adjust Phase Detector Zero control A8R39 for less than 1.0 mV indication on voltmeter. Disconnect voltmeter and adapter cable.

e. Connect the +18.7 Vdc lead (white-red) to AC Amplifier Assembly A7.

5-120. PHASE MODULATION PHASE ADJUST.

a. Set 5061A controls as follows:

MOD .... ON
MODE .... OPER
OSC FREQUENCY X10^{-10} 250
CIRCUIT CHECK .... CONTROL

b. Adjust OSC FREQUENCY COARSE for zero CIRCUIT CHECK meter indication.

c. Set MODE switch to LOOP OPEN.

d. Set OSC FREQUENCY X10^{-10} control to 200.

e. Using the adapter cables provided, connect vertical input of Oscilloscope to A8J1.

f. Adjust A8R42 (Phase Adj) for correct waveform shown in Figure 5-8.

NOTE

If A8R42 has insufficient range, reverse the positions of A8R34 and A8R35, located inside the module, so that A8Q8 emitter is connected to A8R35 and A8Q9 emitter is connected to A8R34.

g. Disconnect Oscilloscope and adapter cable from instrument.

h. Set OSC FREQUENCY X10^{-10} to 250. This completes the phase adjustment.

i. Perform steps a through e, Paragraph 5-192. This will complete the adjustment.

5-121. OPERATIONAL AMPLIFIER ASSEMBLY A9

5-122. Normal Operation

5-123. This integrating amplifier provides the dc control voltage to Oscillator Assembly A10 for controlling quartz oscillator frequency.

5-124. Operational Check

5-125. To determine if amplifier assembly is operating normally proceed as follows:

a. Remove wht-red wire from A7 AC Amplifier Assembly. Set front panel MOD switch to OFF.

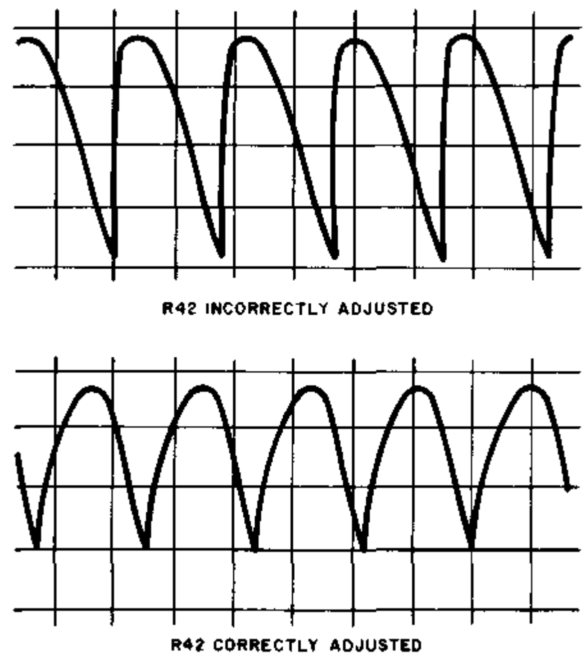
b. Connect DC Voltmeter to CONTROL test point on A17 terminal board. Set voltmeter to read -10V.

c. Adjust A8R39 PHASE ZERO control full clockwise.

d. Set MODE switch to LOOP OPEN. Wait 10 seconds and set MODE switch to OPER. Voltmeter will jump initially then will indicate a very slow negative drift. Allow voltage to drift to about -5V (approximately 3 to 5 minutes).

e. Set MODE switch to LOOP OPEN.

Figure 5-8. A8R42 Adjustment



f. Adjust A8R39 PHASE ZERO control full counter clockwise.

g. Set MODE switch to OPER. Again meter will jump. It will now show a slow positive change in voltage. Allow test to run until meter reads about +5V. This verifies partial operation of Operational Amplifier Assembly A9. If trouble is encountered check C2 and the circuitry of amplifiers A9A1U1 and A9A1U2 (See fig. 8-20).

h. Reset A8R39 to middle of its range and perform procedure of paragraph 5-192. This will finish the check of the operational amplifier circuit and reset A8R39.

5-126. Troubleshooting

a. Circuit board in area of input terminals must be clean. Contamination here can cause excessive zero drift.

b. Integrating Capacitor C2 should also be checked when troubleshooting operational amplifier A9. Resistance across this capacitor should be >5 kM ohms. Check C2 as follows:

1. Remove AC and DC power.

2. Set MODE switch to LTC mode.

Measure resistance between TP5 (on bracket near front center of bottom deck) and CONTROL test point on A17. Resistance should be >5000 megohms.

5-127. Module Replacement

a. After module replacement, restore AC power.

b. Proceed as directed in Paragraph 5-192, steps a through m.

5-128. OSCILLATOR ASSEMBLY A10

5-129. General

5-130. The oscillator assembly is not recommended for field repair. Instrument warranty is void if repair or adjustment is attempted inside the assembly. Adjustments other void the warranty. If it is established that a defective component or circuit trouble exists within the oscillator assembly, contact the nearest Hewlett-Packard Sales and Service office for shipping instructions and for packing information.

5-131. Operational Check

5-132. The following procedures may be used to determine proper operation and should be used if the assembly is replaced.

5-133. CIRCUIT CHECKS. The following circuit checks involve checking oscillator inputs and outputs.

a. Set instrument to normal operation with front panel MODE switch set to LOOP OPEN.

b. Disconnect the +20 red wire from the oscillator assembly. Connect a high impedance DC Voltmeter positive lead (+) to the disconnected red wire. Connect common (-) Voltmeter lead to instrument chassis. Voltmeter should indicate between +18.2 and +18.9 volts. Disconnect Voltmeter and connect red wire back to +20 terminal on oscillator assembly.

c. Disconnect the +24 white-red-blue wire from oscillator assembly. Connect a high impedance DC Voltmeter positive lead (+) to the disconnected white-red-blue wire. Connect common (-) Voltmeter lead to instrument chassis. Voltmeter should indicate between +22 and +33 Volts. Disconnect Voltmeter and connect white-red-blue wire back to +24 terminal on oscillator assembly.

d. Connect high impedance DC Voltmeter to white-orange wire on OSC FREQUENCY X10^{-10} control. Connect common (-) lead to chassis ground. Voltmeter should indicate between +14 and +16 Volts. Disconnect Voltmeter.

e. Connect DC Voltmeter to OSC OVEN pin on Terminal Board Assembly A17(17). Connect common (-) lead to chassis ground. Voltmeter should indicate about +16 Volts. Disconnect Voltmeter.

f. Connect an oscilloscope vertical channel through a 50-ohm Feedthru to A10J3. Oscilloscope display should be similar to Figure 8-2, (1). Remove Oscilloscope and replace A10P3.

g. Connect Oscilloscope vertical channel through 50-ohm Feedthru to A10J4. Oscilloscope display should be similar to Figure 8-2, (2). Remove oscilloscope and reconnect A10J4. If waveform amplitudes observed in steps g and f are low, adjust front panel 5 MHz FILTER control for maximum amplitude of oscilloscope display.

h. Set CIRCUIT CHECK switch to 2ND HARMONIC. Adjust OSC FREQUENCY X10^{-10} control maximum clockwise, maximum counterclockwise, and return to 250. CIRCUIT CHECK meter should track with control movement.

i. Disconnect cable from -EFC on oscillator assembly. Connect DC Power Supply common lead (-) to -EFC on oscillator assembly. Connect positive lead (+) to chassis ground. Slowly adjust DC Power Supply to -5 Volts. CIRCUIT CHECK meter should track with Power Supply. Disconnect Power Supply and re-connect -EFC cable.

j. Set CIRCUIT CHECK switch to OSC OVEN, 5 MHz, SUPPLY, and observe CIRCUIT CHECK meter indication at each position. Meter indications should agree with Table 3-3. This completes the oscillator circuit checks.

5-134. OUTPUT VOLTAGE AND WAVEFORMS. In addition to the circuit checks, the following checks can be performed, using equipment listed in Table 5-1. To observe 5 MHz output voltage and waveforms:

a. Terminate rear panel 5 MHz output jack with 50-ohm Termination and connect an RMS Voltmeter to front panel 5 MHz output jack. Output level should be at least 1 Volt rms.

b. Repeat step a, using an Oscilloscope. Signal should be a sine wave with no apparent distortion.

5-135. SIGNAL-TO-NOISE RATIO. Figure 5-9 shows the test setup diagram for the signal-to-noise ratio test. The required test equipment and characteristics are listed in Table 5-1. To perform the signal-to-noise ratio test, proceed as follows:

a. Using BNC "tee", connect RF millivoltmeter to L input of mixer.

b. Adjust attenuator so that mixer is operating with linear characteristics. That is, a 1 dB change in attenuator setting causes a 1 dB change in the RF millivoltmeter. This is the minimum amount of attenuation that must remain in the system at all times.

c. Record voltage indication of RF millivoltmeter.

d. Disconnect Cesium Standard under test from attenuator.

e. Set signal generator dial to 5 MHz, output level to minimum.

f. Connect signal generator RF output to attenuator input.

g. Adjust signal generator output level to give same indication on RF millivoltmeter as in step c.

h. Connect reference frequency standard 5 MHz output to mixer R input.

i. Set attenuator to 70 dB.

j. Set AC voltmeter FUNCTION switch to 1 CPS range. Adjust RANGE switch for an on-scale reading.

k. Adjust signal generator frequency for maximum on AC voltmeter.

l. Record the following:

1. Attenuator setting 70 dB

2. AC voltmeter range _______ dB

3. Voltmeter scale reading (±) _______ dB

4. Reference signal level (algebraic sum of 1, 2, and 3) _______ dB

m. Disconnect signal generator from attenuator input and reconnect the 5 MHz output from the instrument under test to the attenuator input.

n. Set attenuators to value noted in step b. Connect DC voltmeter to 50-ohm termination at output of mixer and adjust for on-scale reading.

o. Slowly adjust reference oscillator (COARSE AND FINE) frequency adjustments so that reading on DC voltmeter stops moving, and, is less than ±1 mV. It will not be possible to keep this voltage stable for more than a few seconds but this initial setting will suffice.

p. Reconnect amplifier to mixer output. Increase AC voltmeter sensitivity until an on-scale reading is obtained. Record the following:

1. Attenuator setting _______ dB

2. AC voltmeter range _______ dB

3. Voltmeter scale reading (±) _______ dB

4. Noise signal level (algebraic sum of 1, 2, and 3) _______ dB

q. Calculate the signal-to-noise ratio using the following format as a guide:

1. Noise level, step p-4 _______ dB

2. Reference signal level, step l-4 _______ dB

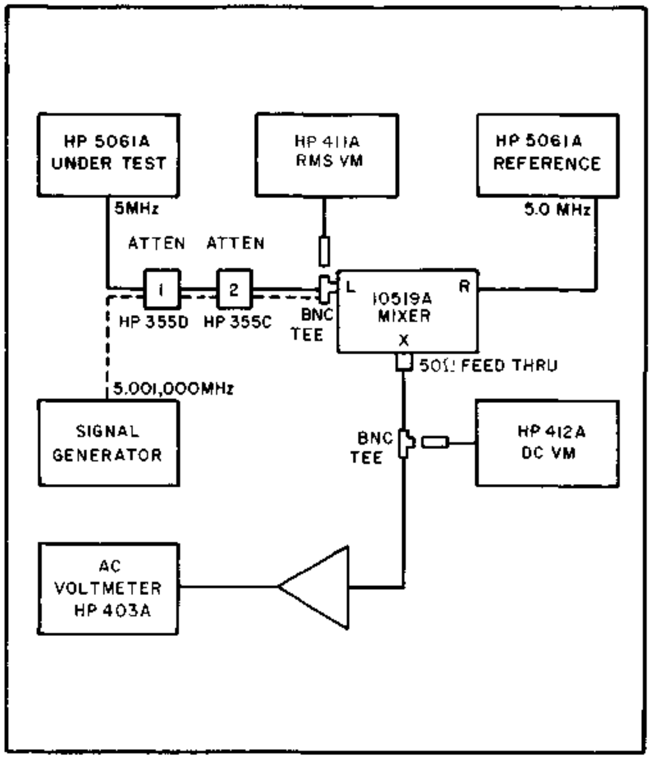
3. Subtract 2 from 1 (sign should be negative) _______ dB

The result obtained on line 3 should be corrected by -3 dB to account for noise contribution from the reference oscillator, and by a 1 dB meter correction to arrive at the RMS noise figure (the meter is an average reading device and its indication is 1 dB low for noise measurements).

4. Add -2 dB to 3.

The result obtained on line 4 shall be less than -87 dB.

Figure 5-9. Signal-to-Noise Ratio Test Setup



5-136. NON-HARMONIC DISTORTION. Non-harmonically related distortion for oscillator operation is at least 80 dB below the 1 Vrms output level. To measure non-harmonic distortion, a Spectrum Analyzer is tuned to the 5 MHz fundamental and an amplitude reference is established. Output frequency spectrum is then investigated to determine fundamental to sideband amplitude relationship at non-harmonic points of the spectrum. To check non-harmonic distortion, proceed as follows:

a. Set instrument to normal operation (CONTINUOUS OPERATION light on, ALARM light off).

b. Set CIRCUIT CHECK switch to CONTROL.

d. Set MODE switch to LOOP OPEN. Frequency loop is open and Oscillator Assembly A10 is operating without control.

e. Connect instrument 5 MHz output through 50 ohm Termination to Spectrum Analyzer input. Check Spectrum at 5 MHz center from 4 MHz to 6 MHz. All sidebands, except 5 MHz point, should be 80 dB below the carrier. This completes non-harmonic distortion check.

5-137. HARMONIC DISTORTION. Harmonic distortion for oscillator operation, should be at least 40 dB down from the 1 Vrms output. To perform this check, a Spectrum Analyzer is tuned to the 5 MHz output and an amplitude reference is established. Output frequency spectrum is then investigated to determine fundamental to sideband amplitude relationship at harmonic points of the fundamental.

a. Set instrument to normal operation (CONTINUOUS OPERATION light on, ALARM light off).

b. Set CIRCUIT CHECK switch to CONTROL.

c. Adjust OSC FREQUENCY COARSE control for zero CIRCUIT CHECK meter indication.

d. Set MODE switch to LOOP OPEN. Frequency loop is open and Oscillator Assembly A10 is operating without control.

e. Connect instrument 5 MHz output through 50 ohm Termination to Spectrum Analyzer input. Check Spectrum at 5 MHz center to 4th harmonic (20 MHz). Harmonics should be 40 dB below the carrier. This completes harmoic distortion check.

5-138. STABILITY. Stability specifications for the 5 MHz output are as follows:

a. As a function of ambient temperature: less than 2.5×10^{-9} from 0°C to +50°C.

b. As a function of load: less than $\pm 2 \times 10^{-11}$ for open circuit to short circuit, and 50-ohms, R, L, and C load changes.

c. As a function of supply voltage: less than $\pm 5 \times 10^{-11}$ for 10% change from nominal (115 or 230 Vac) line voltage or a dc voltage change between 22 and 30 V.

5-139. Figure 5-10 is the block diagram of a system used to test the stability as a function of temperature, load, and supply voltage. The equipment used is listed in Table 5-1; equipment with equivalent characteristics may be used. Perform the stability test as follows:

a. Connect equipment as shown in Figure 5-10.

b. Connect channel A of voltmeter to reference source and channel B to oscillator under test.

c. Set 5061A under test to normal operation (CONTINUOUS OPERATION light on, ALARM light off). Set CIRCUIT CHECK switch to CONTROL. Adjust OSC FREQUENCY COARSE control for zero CIRCUIT CHECK meter indication. Set MODE switch to LOOP OPEN. Frequency loop is open and Oscillator Assembly A10 is operating without control.

d. Set reference 5061A to normal operation (CONTINUOUS OPERATION light on, ALARM light off).

e. Set oscillator under test to same frequency as reference source by adjusting Test 5061A OSC FREQUENCY COARSE and OSC FREQUENCY $X10^{-10}$ frequency for minimum movement on most sensitive range of voltmeter RANGE and METER OFFSET.

f. Set PHASE METER ZERO and OFFSET for zero.

g. Record PHASE METER reading after 100 sec.

h. Determine frequency difference between A and B inputs using following equation:

Since

$$360^\circ/\text{sec} = 1\text{ Hz, then } \frac{360^\circ/\text{sec}}{1\text{ Hz}} = \frac{\Delta\phi/t}{\Delta f}$$

solving for Δf;

$$\Delta f = \frac{\Delta\phi}{360^\circ(t)}$$

t = time in seconds, required for the phase change measured

Δf = frequency difference between input signals

$\Delta\phi$ = phase change in degrees (8405A reading)

Dividing Δf by the frequency of the reference oscillator then gives the frequency difference in proportional parts. Example:

Standard frequency f = 5 MHz

$\Delta\phi$ measured on 8405A = 1.3°

Δt = 100 seconds

$$\frac{\Delta f}{f} = \frac{\Delta\phi}{t(360^\circ)(f)} = \frac{1.3^\circ}{360^\circ(100)(5 \times 10^6)} = \frac{1.3}{1.8 \times 10^{11}} =$$

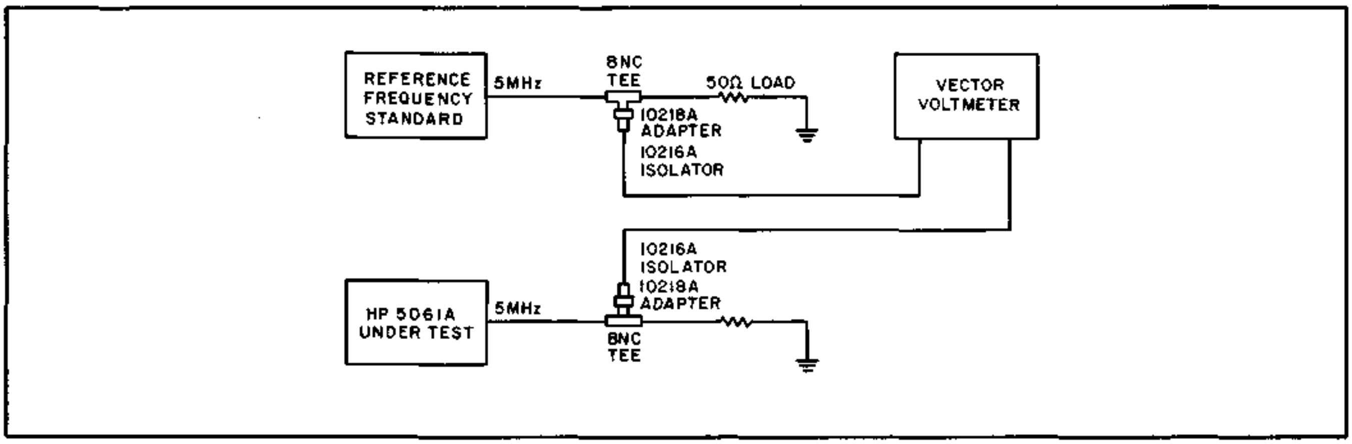
7.2×10^{-12} or 7.2 parts in 10^{12}.

i. Repeat step h after 24-hours; stability should be ≤5 parts in 10^{10}.

5-140. To check oscillator stability as a function of temperature, place oscillator under test in a controlled temperature chamber. Set temperature to 0°C and after 4 hours perform stability test. Stability should be as stated in Table 1-1. Set temperature to 50°C and after 4 hours repeat the above test. Stability should be as stated in Table 1-1.

5-141. To check oscillator stability with load change, leave system connected as for temperature check with the temperature now set to 25°C. Remove all loads from oscillator under test. Perform stability test with the following loads on 5 MHz OUTPUT: open circuit, 50-ohm resistive, inductive and capacitive. To perform stability test with 5 MHz OUTPUT shorted, leave system connected as in temperature check and connect vector voltmeter channel A to reference source 1 MHz OUTPUT and channel B to 1 MHz OUTPUT of unit under test. Connect short to 5 MHz Output connector.

Figure 5-10. *Stability Test Setup*



5-142. To check oscillator stability with supply voltage changes, leave system connected as for temperature test. Without interrupting power, connect 5061A under test to +22 to +30 volt dc source and perform stability test. Stability should be as stated in Table 1-1. Repeat test with oscillator connected to variable line voltage source set to 103 Vac and then to 127 Vac. Stability should be as stated in Table 1-1.

5-143. Module Replacement

5-144. To remove Oscillator Assembly A10, proceed as follows:

a. Remove all operating power.

NOTE

If Standby Battery Option 002 is installed, remove instrument bottom cover. Remove ac power and press S8 located on bottom instrument deck (Figure 8-4).

b. Remove instrument top cover.

c. Remove 4 screws holding the oven in place. One screw is on bottom, three on top. One is attached in front of AC Amplifier Assembly A7. Use offset screwdriver provided.

d. Partially remove oscillator and frame assembly.

e. Disconnect all electrical connections.

f. Remove oscillator and frame assembly from instrument.

g. Remove oscillator from frame assembly.

h. Replace oscillator by reversing the above procedure.

NOTE

When replacing the oscillator and frame assembly, care should be taken in handling the gray and white-yellow-gray wires. These wires carry ac line voltage to the oscillator assembly. If Time Standard Option 001 is installed, Digital Divider Assembly A5 (Figure 8-7) should be removed when reconnecting the gray and white-yellow-gray wires.

i. After replacing the new oscillator assembly, operational check should be performed (Paragraphs 5-131 through 5-141).

5-145. CESIUM OVEN CONTROLLER ASSEMBLY A11

5-146. Normal Operation

5-147. Oven controller circuits provide power to the cesium beam tube as required. In addition, they supply power to the hot wire ionizer, mass spectrometer (in beam tube), 16 volts and 300 volts to Operational Amplifier A9, minus 10 volts to AC Amplifier Assembly A7, and voltage for front panel CIRCUIT CHECK meter indication when set to CS OVEN. During cesium oven warmup, front panel meter indication should be full scale and will decrease to between 5 and 35 depending on oven temperature. Mass Spectrometer adjust A11R27 and voltage checks are outlined in the following paragraphs. Make these checks only when oven controller failure is suspected or after repair.

5-148. Operational Checks

5-149. MASS SPECTROMETER ADJUSTMENT.

a. Place 5061A in normal operation (MODE switch to OPER, CONTINUOUS OPERATION light on, ALARM light off).

b. Set CIRCUIT CHECK switch to BEAM I.

c. Remove instrument bottom cover, locate Cesium Oven Controller Assembly A11 (Figure 8-3), and adjust A11R27 Mass Spectrometer adjust for maximum CIRCUIT CHECK meter indication.

5-150. 300 VOLT CHECK

NOTE

300 V is not used by A9 Assembly with Stock Number 05061-6089.

a. Disconnect ALL operating voltages from 5061A.

b. Remove instrument top and bottom covers.

c. Remove Cesium Oven Controller Assembly A11 (Figure 8-3), remove assembly cover, and reconnect oven controller to instrument so components are accessible.

d. Connect instrument to operating power and place in normal operation (Paragraph 3-14).

e. Connect DC Voltmeter positive lead (+) to A11J1 (11). Connect common lead (-) to A11J1(10). Voltmeter should indicate between +270 and +360 volts. Disconnect Voltmeter.

5-151. 16 VOLT CHECK

a. Connect DC Voltmeter (set to measure negative voltage) positive lead (+) to A11J1(7). Connect common lead (-) to instrument chassis. Voltmeter should indicate between -16 and -18 Volts.

b. Disconnect positive Voltmeter lead, set Voltmeter to measure negative voltage (-), and connect Voltmeter to A11J1(8). Voltmeter should indicate between +16 and +18 Volts. Disconnect Voltmeter.

5-152. 10 VOLT CHECK. Connect DC Voltmeter (set to measure negative voltage) positive lead (+) to A11J1(6). Connect common lead to chassis ground. Voltmeter should indicate between -8 and -10 volts. This completes the voltage checks. Disconnect Voltmeter and disconnect ALL instrument operating power. Replace module cover and re-install in instrument. Instrument is ready for turn-on.

5-153. Module Replacement

a. Disconnect AC and DC power whenever removing or replacing A11 assembly.

b. On new A11 assembly, wire A11T1, A11T2, and A11T4 the same as these transformers in the old A11 assembly.

NOTE

Wiring of the transformer taps should agree with information given on cesium beam tube decal.

c. Remove R21A and B, R24, R33, and R34 from old assembly. Install these resistors in the same positions in the new assembly.

d. Replace cover. Install new A11 in 5061A and connect AC power.

e. Perform mass spectrometer adjustment Paragraph 5-149.

5-154. Figure 8-25 is provided and is a good troubleshooting aid. When repair or replacement is made, perform Mass Spectrometer adjustment (Paragraph 5-149) and all voltage checks (Paragraphs 5-150 through 5-152).

5-155. CESIUM BEAM TUBE ASSEMBLY A12

5-156. Warranty

5-157. The Cesium Beam Tube Assembly (05061-6077) used in the Standard 5061A is guaranteed for three years from date of shipment. The High Performance Cesium Beam Tube (05061-6101) used in Option 004 is guaranteed for 14 months from the date of shipment. When the checks and adjustments in the following paragraphs determine that the cesium beam tube is defective, contact the nearest Hewlett-Packard Sales and Service office for shipping instructions.

5-158. General

5-159 (A). No adjustments are provided for Cesium Beam Tube Assembly A12. It is a sealed unit and repair inside should not be attempted. However, the following paragraphs outline checks for the beam tube, a replacement procedure (with necessary adjustments after replacement), and an adjustment procedure for optimizing instrument operation if beam tube output current decreases. Regarding beam tube operation in the Model 5061A, the following points should be remembered:

1. The BEAM I indication on front panel CIRCUIT CHECK meter may decrease slowly with time. This is normal. Along with the BEAM I, the 2ND HARMONIC indication will decrease. When the 2ND HARMONIC INDICATION falls to about 20, the LOOP GAIN and BEAM I METER adjustments should be made as described in Paragraph 5-19.

2. Adjusting loop gain and meter indications does not decrease the beam tube output current, but rather compensates for the current decrease.

3. The adjustments in (2) can be made with confidence that instrument operation will remain well within specifications.

5-159 (B) **Normal Operation.** During normal operation the output of the Cesium Beam Tube is a negative current with a peak magnitude of roughly 0.2 μ a. The magnitude of this current varies with applied frequency as shown in Figure 3-1. This current is displayed on the front-panel meter in the BEAM I position. The 2ND HARMONIC meter reading is also an indication of the magnitude of the beam current.

There are 5 supplies which provide power and high voltages to the Cesium Beam Tube. These are the Cesium Oven, Hot-Wire Ionizer, and Mass Spectrometer power supplies, located in the A11 cesium oven controller; A18 +3500 V and A19 -2500 V power supplies. Each of these supplies must be working properly for the Cesium Beam Tube to produce an output current. Magnitude of the beam current is also controlled by the amount of microwave power sent to the tube, from the A4 Harmonic Generator. Up to the saturation point, more micro-wave power causes more beam current. Thus, the beam current can be used as a power indicator when tuning the A4 Harmonic Generator Assembly. Beyond this point the beam current reduces with increasing power. The microwave tuning procedure insures that the tube is not in saturation. A schematic of the Cesium Beam Tube is shown in Figure 8-5 and may be used to check circuit continuity through the tube.

5-159 (C) **Troubleshooting.** There are two types of Cesium Beam Tube failures; Systemic, and End-Of-Life. Systemic failures are caused by a malfunction inside the tube and are usually characterized by a sudden loss or change in beam current. These symptoms may also be caused by failures in the beam tube power supplies or in the circuits which generate the applied microwave signal. Before replacing the tube, these circuits should be eliminated as a cause-of-the-change in beam current. Table 5-4 should be used for a step-by-step procedure in isolating faults of this type. Table 5-6a summarizes the beam tube input, and power supply signals, and their measurement.

5-159 (D) **End-Of-Life Failure.** This failure is characterized by a gradual increase in noise from the tube accompanied by either an increasing or decreasing signal from the tube. End-Of-Life failures result from the tube running out of cesium or from excess free cesium inside the tube causing noise in the detector system. A cesium beam tube is considered to be at the end of its life when the cesium standard will no longer meet its short-term-stability specification.

Table 5-6a. Beam Tube Signals Summary

INPUT	Voltage or Waveform	Where Measured	Applicable Procedure
Cesium Oven Power	Fig. 8-2(7)	J16 (1,2) Front Panel Meter	
Hot Wire Ionizer	Fig. 8-2(6)	J17 (1,2)	
-2500V			Para 5-233
+3500V			Para 5-228
LF Coil			Para 5-162
Microwave Power			Para 5-163
Beam Tube Signal			Para 5-165

However, it is not absolutely necessary to replace the cesium tube at this point. Even though the cesium tube may be somewhat noisy it can continue to operate the instrument and define frequency with sufficient accuracy and stability for many applications. To obtain as much useful life as possible, the user should replace the cesium beam tube only when the instrument performance has degraded to where it is unsuitable in its specific application. Minimum specifications for the standard cesium tube (05061-6077) are as follows: The paragraph notations show where to find the procedure for the measurement.

Signal to Noise Ratio (Para. 5-167) = 300
Peak-valley/background (Para. 5-189) = 1
Peak beam current = 0.8×10^{-8}A

If the cesium tube output signal falls below any of these specifications it is considered to be at the end of its life. The end of life criteria for the "High Performance" beam tube (05061-6101) Option 004, is called the figure-of-merit (F_m):

$$F_m = \frac{s/n}{(LW)} \sqrt{\frac{PVB + 1}{PVB + 2}} \geq 10$$

Where:

s/n = Signal to noise ratio (Para. 5-167)
(LW) = Line width (on cesium beam tube label)
PVB = Peak-Valley/background (Para. 5-189)

As the formula indicates, the tube is functioning normally if the figure-of-merit (F_m) is 10 or greater. However, the instrument will function very well even if the figure-of-merit drops below 10. The standard cesium tube has a figure-of-merit of 1 to 2. If tests performed in this section indicate a low figure-of-merit, perform A7 noise check (paragraph 5-102) before replacing tube. If A7 fails noise check, redo Cesium Beam Tube noise test (paragraph 5-170) after repairing A7, and recalculate figure-of-merit.

5-160. Operational Checks

5-161. GENERAL. Beam tube failure should be definitely established prior to replacement. Failure indications can be due to associated circuitry and this aspect should be thoroughly investigated. Table 5-4 is a good aid in checking associated circuits and assemblies. For example: low beam current indication may be caused by low microwave field output from Harmonic Generator Assembly A4 or no beam current indication may be caused by absence of one or more operating voltages. The following checks should determine if cesium beam tube replacement is required. Before performing the procedures, determine if operating voltages are present at Cesium Beam Tube Assembly A12.

WARNING

High voltages are present at Cesium Beam Tube Assembly A12.

5-162. LF COIL CHECK. The L.F. (low frequency) coil input to the cesium tube enables a beam current to be generated independent of the microwave input. This check is very useful for troubleshooting. A failure in the microwave generating circuits (A1, A3, A4), the beam tube power supplies (A11, A18, A19), or the tube itself can cause a loss of beam current. If performing this test restores the beam current, it indicates the failure is in the microwave generating circuits. If beam current is not restored, it indicates that the fault is in the cesium beam tube power supplies or the tube itself.

a. Set MODE switch to LOOP OPEN.

b. Remove instrument bottom cover and disconnect A4J2 from Harmonic Generator Assembly A4. This removes the beam tube microwave field.

c. On Terminal Board Assembly A17, locate LF Coil test point.

d. Connect a low frequency oscillator to A17 LF Coil test point.

e. Set the Oscillator to 21.41 kHz about 1 Vrms.

f. If beam current increases, it indicates the beam tube and power supplies are operating properly.

g. Set instrument CIRCUIT CHECK switch to BEAM I and adjust the Oscillator frequency and amplitude for maximum indication on CIRCUIT CHECK meter. Note this reading.

h. Disconnect the oscillator and connect A4J2.

5-163. MICROWAVE-FIELD CHECK. This check determines if the microwave field is of sufficient power to saturate the beam tube microwave cavity. Do the check as follows:

a. MODE switch to LOOP OPEN; MOD switch to OFF.

b. Set CIRCUIT CHECK to BEAM I.

c. Carefully adjust OSC FREQUENCY COARSE to the primary peak of the cesium resonance as indicated on the CIRCUIT CHECK meter (see Figure 3-1).

NOTE

Three peaks will be encountered: two peaks of lower amplitude and one peak of higher amplitude. The higher amplitude peak represents the primary peak of the cesium resonance.

d. Disconnect A7P1 from A7J1 and connect a high impedance dc voltmeter to A7P1.

e. The saturation check is performed by turning A4R1 maximum ccw, then slowly cw until the dc voltmeter just indicates a peak (see Figure 5-10a).

f. Continue turning A4R1 cw. The dc voltmeter indication will remain the same, or decrease then increase again to the peak level of step e. This indicates saturation.

g. If A4R1 is turned further cw, the dc voltmeter indication will decrease, then increase to a peak of lower amplitude than in step e.

h. The correct peak is the one listed in step e. Always reset A4R1 by turning it full ccw and then cw to the first peak.

i. If the double peak (step e and f) is not evident (not saturated), pull A4 Attenuator out slightly and repeat steps e and f (see Figure 5-11). If saturation cannot be attained with the attenuator pulled out all the way, realign A4 Harmonic Generator as described in Paragraph 5-187.

5-164. BEAM TUBE SIGNAL CHECK. The useful output beam current ("flop" signal) from the beam tube is a measure of its efficiency. The "flop" -signal-to-background-noise-current-ratio is easily measured and thus is a quick check of beam tube operation. A high-input impedance Electronic Voltmeter is used to measure the "flop" signal and background noise current; then these values are used to compute the ratio. The relationship used is:

$$\frac{V_p - V_v}{V_B} > 1$$

Where:

V_p = Cesium resonance central peak voltage
V_v = Adjacent Cesium resonance valley voltage
V_B = Background noise with no RF signal applied to tube

5-165. With instrument tuned to the central maximum outlined in Paragraphs 3-8a through 3-8h, remove instrument top and bottom covers, and set controls to:

MOD	OFF
CIRCUIT CHECK	BEAM I
MODE	OPER

a. Remove the input cable from A7J1 and connect DC Voltmeter to this cable. This is the beam tube output signal. Record the voltmeter indication as peak voltage value (V_p).

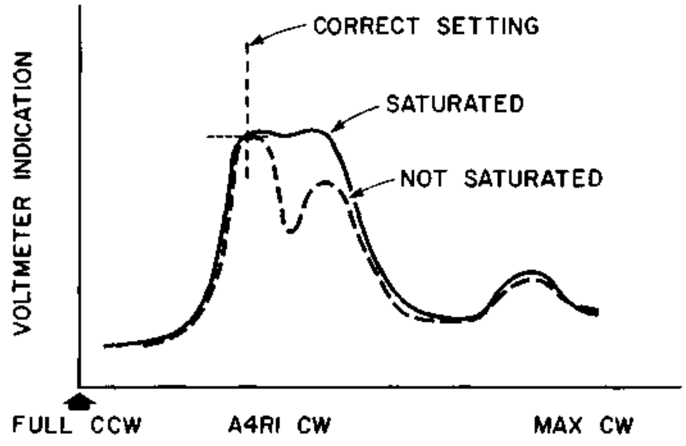
b. Set MODE switch to LOOP OPEN.

c. Slowly adjust OSC FREQUENCY COARSE control for valley signal (adjacent to the peak) indicated on DC Voltmeter. Record the voltmeter indication as valley voltage (V_v).

d. Retune OSC FREQUENCY COARSE control to central maximum indication on voltmeter.

e. Locate Harmonic Generator Assembly A4 (Figure 8-3). Disconnect 12.63.... MHz signal by removing cable connected to A4J2. Voltmeter indication is background noise. Record this value as V_B.

Figure 5-10a. Saturation Check



f. Compute the "flop" -signal-to-background ratio using

$$\frac{V_p - V_v}{V_B} > 1.$$

5-166. A value greater than 1 is a good indication that transitions within the beam tube are occurring and beam tube operation is satisfactory. This completes the check.

5-167. SIGNAL-TO-NOISE CHECK. The signal-to-noise ratio of the cesium beam tube output helps determine the short-term-stability performance of the instrument. On instruments equipped with the Standard Cesium Beam Tube (HP P/N 05061-6077), the tube must have a signal-to-noise ratio of 300 or greater in order for the instrument to meet specifications. On instruments equipped with the Option 004 High Performance Cesium Beam Tube (HP P/N 05061-6101), this test is used to determine the figure-of-merit. Figure-of-merit must be ≥10. See Paragraph 5-159 (C) for further details. Failure of this test may not necessarily mean that the cesium beam tube is defective. Be sure to read Paragraph 5-159 (A), (B), (C), and (D).

5-168. The signal-to-noise ratio for the cesium beam tube is defined as the ratio of beam resonance current (I_p) minus the resonance current valley (I_v), divided by the noise current (I_n). This relationship is expressed by:

$$\frac{S}{N} = \frac{I_p - I_v}{I_n} = \frac{I_s}{I_n}$$

Where:

I_s = Useful beam current

I_n = Beam tube noise current in a 1/4 cycle bandwidth

The values of I_s and I_n are computed from the measurements made in the procedure outlined in Paragraphs 5-170 and 5-171.

5-169. To find the useful beam current signal value I_s, the instrument is tuned to the beam current resonance peak and valley. A high input impedance (100 megohms or more) DC Voltmeter is used to determine this value. This meter input impedance value (R_{meter}) is the denominator when the measured peak and valley voltages are converted to current. With this method the beam current peak becomes

$$I_p = \frac{V_p}{R_{meter}}$$

and the beam current valley becomes

$$I_v = \frac{V_v}{R_{meter}}$$

where Vp is the peak voltage measured and V_v is the valley or minimum voltage measured adjacent to the peak.

5-170. To find the cesium beam tube noise current a sensitive wave analyzer (HP Model 302A) is connected to the output of the beam tube signal preamplifier (located in the A7 assembly). Because the analyzer will be reading noise, an RC filter circuit is added to the analyzer's recorder output to average the meter reading. The bandwidth of the HP 302A wave analyzer is nominally 6 Hz, but should be checked before making this test as this value is used in computing the noise current. The preamplifier in the instrument's A7 assembly produces a voltage output, which is proportional to its noise-current input from the cesium beam tube. The constant of proportionality is called the "transfer impedance". When the average value of the noise voltage is determined, it is divided by the transfer impedance to obtain the noise current.

5-171. The following procedure outlines the method for computing the cesium beam tube signal-to-noise ratio.

a. Set MOD switch OFF and MODE switch to LOOP OPEN.

b. Remove cable from A7J1, and using the adapters provided, connect the cable to the input of a high-impedance voltmeter. The meter reading is the dc beam current.

c. Tune the oscillator COARSE control to the primary peak of the cesium resonance as displayed on the meter (see Figure 3-1). Record this voltage as V_P.

d. Adjust the COARSE control to the "valley", or minimum beam current, indication adjacent to the primary peak. Record this voltage as V_V.

e. Compute the signal current (I_S) by using

$$I_s = \frac{V_p - V_v}{R_{meter}} = \_\_\_\_\_\_$$

f. Readjust the COARSE control to the primary peak of the cesium resonance. Remove the voltmeter and reconnect the cable to A7J1.

g. Connect HP Model 403B AC Voltmeter input to A7J2.

h. Set GAIN switch on A7 assembly to LOW, and adjust LOOP GAIN control on front panel full clockwise. Ensure MOD switch is OFF; if it is not, repeat steps a through h.

i. Adjust range of Model 403B for a reading in the mid 1/3 of the scale.

j. The signal will be quite noisy. Watch the meter for a few minutes and record the average voltage as "V_{403}".

k. Calculate the actual noise current by using the following formula:

$$I_n = 2.3 \times 10^{13} V_{403}$$

l. The formula converts the noise voltage reading on the voltmeter to noise current from the tube.

m. Compute the beam tube signal-to-noise ratio:

$$S/N = \frac{I_s}{I_n}$$

NOTE

Be sure to reset LOOP GAIN as described in step n.

n. Remove voltmeter connection and reset LOOP GAIN control by following the procedure of paragraphs 5-19(a) through (e). If the LOOP GAIN control has insufficient range to perform the adjustment, set the GAIN switch on the A7 assembly to HI. This will enable the adjustment to be performed.

5-172. BEAM TUBE DEMAGNETIZATION

5-173. General

5-174. When the cesium beam tube has been exposed to a strong magnetic field the tube may require demagnetization. Frequency offsets greater than 1 part in 10^{11} may be due to beam tube magnetization. The following procedure can be used to demagnetize the beam tube. A 6.3 Vac filament transformer is used for degaussing the inner shield. This procedure is for the standard tube only. For Option 004 High Performance Beam Tube, use the HP 10638A Degausser. User instructions are included with the HP 10638A.

5-175. Procedure for Standard Tube

5-176. To degauss the beam tube inner shield, a transformer is required (HP Part No. 9100-0058, or equivalent) with a 6.3 Vac secondary winding capable of carrying 2 Amperes. A 1-ohm, 5-watt resistor (HP Part No. 0811-0040) and variable line voltage source are also required. Proceed as follows:

a. Remove ALL instrument operating power and remove bottom cover.

b. Connect the primary of the transformer to Variable Line Voltage Source output. Connect 1-ohm, 5-watt resistor between A17TP3 and 6.3 Vac terminal and the other transformer 6.3 Vac output terminal to ground.

c. Set Variable Line Voltage Source for "0" volts output and connect to proper voltage, 60 Hz power.

d. Within a 15-second interval, rotate the Variable Line Source to supply 125 Volts to the transformer input and then rotate back to zero input. (A shorter interval for this operation does not degauss satisfactorily and a longer interval may damage "C" Field coil in the beam tube. This completes inner shield degaussing. Disconnect leads, replace instrument cover. Instrument is ready for turn on.

5-177. CESIUM BEAM TUBE REPLACEMENT PROCEDURE

5-178. General

5-179. When it is definitely established that the cesium beam tube is defective, the following replacement procedure should be used. The procedure consists of three parts:

a. Removing the old cesium beam tube.

b. Installing the new tube.

c. Adjustments required for optimum performance with the new tube.

5-180. Removing the Cesium Beam Tube

5-181. To remove the tube, proceed as follows:

a. Disconnect power from the Model 5061A and remove instrument top and bottom covers.

b. If Option 002 (Internal Standby Battery) is installed, depress battery disconnect pushbutton switch S8 located on a bracket on the bottom of the instrument near the center of the deck. Remove A2 assembly.

c. Remove three miniature plugs P1, P2, and P3 from the bottom of Harmonic Generator Assembly A4.

d. Locate the two large wires connected between the beam tube and power supply. These wires are the +3500 V and -2500 V supply leads. Unplug +3500 V plug J4 and -2500 V plug J3 by turning the metal lock on each connector plug.

e. Loosen four screws in the beam tube hold-down straps. Do not remove straps at this time.

f. Release snap-locks on both cable plugs P16 and P17 by moving the bar at the bottom of the plug toward the front panel. Disconnect P16 and P17. Remove White/Red and blue wires from Harmonic Generator assembly A4.

g. Rotate beam tube 45°C to allow removal of Harmonic Generator Assembly A4. If beam tube is stuck in place, carefully loosen each end.

h. Remove Cesium Oven Controller Module A11 by unplugging A11P1 from the bottom of the instrument, removing two screws at the rear of the module, and one screw accessible from the bottom at the front of the module (There are two screws located at this point; the screw closer to the rear of the module is the correct one.)

i. Disconnect Harmonic Generator Assembly A4 by removing four screws from flange attached to beam tube. The harmonic generator will be mounted on the new cesium beam tube.

j. Carefully lift out beam tube after removing screws and hold-down straps.

5-182. Cesium Beam Tube Installation

5-183. To install new beam tube, proceed as follows:

a. Place new beam tube in the instrument with the label facing up so the waveguide flange for the harmonic generator faces toward the center of the instrument (see Figure 3-7). Place the two metal hold-down straps over the beam tube. Insert the four screws in the hold-down straps and loosely fasten the beam tube in place. Rotate the tube so that harmonic generator may be installed.

b. Connect +3500 V plug J4 and -2500 V plug J3 and lock connectors in place.

c. Connect the two beam tube cable plugs to their jacks, J16 and J17, and lock connectors in place.

d. Attach Harmonic Generator Assembly A4 to the new beam tube. The knurled cavity tuning control on the harmonic generator is positioned up. Tighten the four mounting screws securely to insure a good electrical connection.

e. Rotate the beam tube to provide top cover clearance and permit electrical connections to the Harmonic Generator Assembly. Tighten the four screws in the beam tube hold-down straps.

f. Observe identification markings on Harmonic Generator Assembly A4 and connect the white-red and blue wires.

g. Connect three miniature plugs P1, P2, and P3 to the bottom of the Harmonic Generator. Note the connector markings for proper connections.

h. Remove A11 cover.

NOTE

Refer to Cesium Oven Controller A11 schematic diagram in this manual to identify components referred to in the following steps.

i. Locate A11T1 (9100-0335) near the plug. On some instruments there may be a resistor connected to either terminal 14, 15, 16, or 17 of T1. Any resistors connected between these terminals, or between these terminals and the circuit board, should be removed at this time. If there are no resistors connected to the terminals of T1, proceed to the next step.

1. Some cesium tubes may require installation of a current limiting resistor (or resistors) on the output of T1 to optimize the ionizer current. These resistors are designated R33 and R34. Check the parts envelopes provided with your new cesium beam tube to see whether R33, R34 (or both) have been supplied:

(a) If they have been supplied go to step 2.

(b) If they have not been supplied:

(1) Check to see if there is a wire connected between T1(17) and the circuit board hole directly beneath it. If not, install a wire in this position.

(2) Perform step 2 (d) below.

2. Installation of R33 and/or R34. Before proceeding, read through steps a, b, and c, below to become familiar with the procedure. Also read the example in step e which is a typical installation.

(a) If only R33 is provided, go to step b. When R34 is provided, solder one end of R34 in the circuit board hole directly below terminal 14 of T1 (9100-0335). If there is a wire connected between T1 and this point, remove the wire and replace it with R34. Check circuit board wiring against schematic to verify proper placement of R34. Do not connect other end of R34 at this time.

(b) Solder one end of R33 in the circuit board hole below terminal 17 of T1 (9100-0335). If there is a wire connected between T1 and this point, remove it to allow installation of R33. Solder other end of R33 to terminal 17 of T1. Check circuit board wiring against schematic to verify proper placement of R33. **If only R33 was provided, go to step d below; otherwise go to step c.**

(c) Note the Hot Wire Ionizer taps called out on the new cesium beam tube decal. Connect R34 to T1 as shown in Table 5-6c. When this has been completed, go on to step j.

(d) Note the Hot Wire Ionizer taps called out on the new cesium beam tube decal. Connect orange wire from circuit board to T1 as shown in Table 5-6b. When this has been completed, go to step j.

Table 5-6b. Hot Wire Ionizer Taps

Taps Called for on Beam Tube Decal	Connect R34 or Orange Wire to Terminals	Strap Terminals
15, 17	15	14 and 16
16, 17	16	none
14, 17	14	15 and 16

(e) **Example:** R33 is provided, and the new cesium beam tube decal specifies use of terminals 14 and 17 on T1. The Hot Wire Ionizer circuit should be wired as follows (refer to schematic).

(1) R33 will be connected between terminal 17 of T1 and the output line on the circuit board.

(2) A wire will be connected to terminal 14 of T1 and the output line on the circuit board.

(3) Terminals 15 and 16 of T1 will be connected together.

j. Locate A11T2 (9100-0333) near the NORMAL-LOW switch. Note the transformer taps called out on the new beam tube decal. Connect A11T2 white wires as indicated on the new beam tube decal for LOW flux, and yellow wires as indicated for NORMAL flux.

k. Locate A11T4 (9100-2234). Note taps called for T4 brown wires on the new beam tube decal. Connect brown wires for NORMAL flux.

l. Locate A11R21A, B and A11R24A, B stand-off terminals near the slide switches. Remove the resistors on these terminals.

m. Install the resistors supplied with the new cesium beam tube on A11R21A, B and A11R24A, B terminals.

n. Replace A11 cover.

o. Replace A11 assembly in the instrument and tighten the three mounting screws.

p. Connect plug A11P1 to assembly and fasten snap-lock. This completes installation of the new cesium beam tube. Leave the top and bottom covers off since several adjustments are now required.

WARNING

Do not apply power to instrument at this time.

5-184. Adjustment Procedure

5-185. To adjust the 5061A for optimum performance, proceed as follows:

WARNING

Do not apply instrument power at this time.

5-186. ELECTRON MULTIPLIER VOLTAGE ADJUST (A15R33, A15R34).

a. Connect high voltage probe lead of a high impedance DC Voltmeter, set to measure approximately -0.25 Vdc, to -2500 Vdc power supply assembly A19, pin 3. Connect the common lead to the voltmeter to 5061A chassis. The test point is located at the bottom, center front of the instrument deck.

NOTE

An internal resistive 10,000:1 divider allows measurement of this voltage with a standard Voltmeter.

b. Set MODE switch to LOOP OPEN.

c. Replace A2 assembly. Connect power to the 5061A.

d. Set CIRCUIT CHECK switch to ION PUMP I and observe current indication on CIRCUIT CHECK meter of 5061A. Meter may indicate full scale and then decrease. After indication decreases below 40, -2500 Vdc supply and cesium oven heater will be enabled. If ION PUMP I does not decrease, see Paragraph 3-15.

e. Locate R33 and R34 on Power Regulator Assembly A15. These resistors are used to adjust the electron multiplier -2500 Vdc supply.

f. Note the electron multiplier voltage called out on the new beam tube decal. The voltmeter should indicate 1/10,000 of this value. For example: if the electron multiplier voltage on the beam tube decal is -2200 Vdc, the voltmeter should indicate -0.22 Vdc. If the voltage is too low, disconnect all power (and battery with Option 002) from the 5061A and reduce the value of A15R33. If the voltage is too high, increase the value of A15R33. Connect power to the 5061A, wait for the -2500 Vdc power supply to enable (see step d) and observe the voltage on the dc voltmeter. Adjust A15R33 resistance until the electron multiplier voltage is within ±50V of the value specified for the new beam tube. It may be necessary to increase A15R34 for proper electron multiplier voltage.

5-187. HARMONIC GENERATOR ASSEMBLY A4 ADJUSTMENTS. The Harmonic Generator Assembly removed from the old beam tube should require only slight adjustment to operate with the new beam tube. RF level in the beam tube cavity is adjusted by first optimizing the harmonic generator for maximum 9192.63 MHz signal; then adjusting this level into the beam tube to obtain maximum beam current. Beam current is measured by connecting a picoammeter or the voltage probe of a high impedance DC Voltmeter directly to the beam tube output.

NOTE

The high impedance voltmeter is used to measure beam current by measuring the voltage drop across its input impedance.

5-188. The following adjustments should be made only after the 5061A is at operating temperature and the instrument is tuned to primary peak of cesium resonance (refer to Paragraph 3-14, Turn-On Procedure).

CAUTION

Adjust only those controls on Harmonic Generator Assembly A4 which are specifically referred to in the following procedure. The others are factory set and should NOT be adjusted.

a. Set 5061A controls as follows:

MOD .... OFF
MODE .... LOOP OPEN

b. To monitor beam current, disconnect A7P1 from A7J1. Use the Micon, male-to-male adapter and the Micon-to-BNC cable (provided with the 5061A) to connect A7P1 to the dc voltmeter.

c. Locate A11R27 MASS SPECT adjustment on Cesium Oven Controller A11 and adjust for maximum beam current as indicated on the voltmeter.

d. Carefully adjust front-panel OSC FREQUENCY COARSE control to the primary peak of the cesium resonance as indicated on the dc voltmeter. If this cannot be done, adjust OSC FREQUENCY COARSE for an output frequency of 5 MHz ±0.1 Hz at the front-panel 5 MHz OUTPUT.

NOTE

Three peaks will be encountered: two peaks of lower amplitude and one peak of higher amplitude. The higher amplitude peak represents the primary peak of the cesium resonance (see Figure 3-1).

e. Loosen Attenuator locking screw (Figure 5-11) and pull attenuator maximum out (minimum attenuation). Adjust A4R1 maximum ccw and note the voltmeter indication: this is the background level. Adjust A4R1 cw for a peak indication on the dc voltmeter. If no increase in beam current is indicated on the voltmeter, go to step g.

f. Push A4 Attenuator in for an indication about halfway between the background level and the peak level attained. Then, go to step i.

g. If no increase is attained, set A4R1 maximum ccw, then 1/8 to 1/4 turn cw. Loosen the knurled locknut on A4 tuning cavity (see Figure 5-11) and adjust the cavity tuning control maximum ccw, then 3/4 turn cw. This sets the alignment starting point to ≅9192 MHz. Adjust A4S5 for a beam current peak indication on the dc voltmeter. Keep A4S5 locking nut snug when making this adjustment.

CAUTION

Less than 1/2 turn of A4S5 should be needed.

h. Carefully push A4 attenuator in, until dc voltmeter indication is halfway between the background level noted in step e and the peak level attained.

i. Adjust A4R1 maximum ccw, then carefully cw for a peak indication on the dc voltmeter. When a peak indication is attained, carefully readjust A4R1 ccw for a dc voltmeter indication which is halfway between the peak and background levels to ensure that the beam tube is not saturated.

j. Adjust A4 cavity tuning control (see Figure 5-11) for a peak indication on the dc voltmeter. Tighten the cavity Tuning Control Lock.

k. Keeping lock-nut snug, adjust A4S5 for a peak indication on the dc voltmeter.

l. Push attenuator in until dc voltmeter indication is about halfway between the background level noted in step e and the peak indication attained.

NOTE

On some Harmonic Generator/Cesium Beam Tube combinations, it may occur that the attenuator will be pushed all the way in before a beam current level halfway between the peak and background levels can be reached. If this occurs, leave the attenuator pushed all the way in.

m. Adjust A4R1 maximum ccw, then cw until a peak indication on the dc voltmeter is attained. Then, readjust A4R1 ccw, slightly, until the dc voltmeter indication is halfway between the background level noted in step e and the peak indication attained in this step. Repeat steps k, l, m **until no further beam I increase is attained by adjusting A4S5.**

n. Adjust A4S5 for a peak indication on the dc voltmeter. When making the final adjustment, tighten the lock nut, while adjusting A4S5, so that the peak indication is obtained when the locknut is tight (do not over-tighten).

o. Adjust A4R1 full ccw, and then cw to the first peak indication on the dc voltmeter.

CAUTION

In Step p, if the attenuator has previously been pushed all the way in, the beam current may decrease as the attenuator is pulled out. Should this occur, lock the attenuator all the way in and adjust A4R1 as in step p.

p. Pull A4 attenuator out until dc voltmeter peaks then decreases slightly, about 1 minor division of the voltmeter, (this is the optimum beam current). Carefully lock the set-screw, then adjust A4R1 ccw for a dc voltmeter peak indication. This peak should be equal to the maximum beam current previously measured in this step.

q. To check for saturation, turn A4R1 maximum ccw, then cw until the dc voltmeter indicates a peak (see Figure 5-10a).

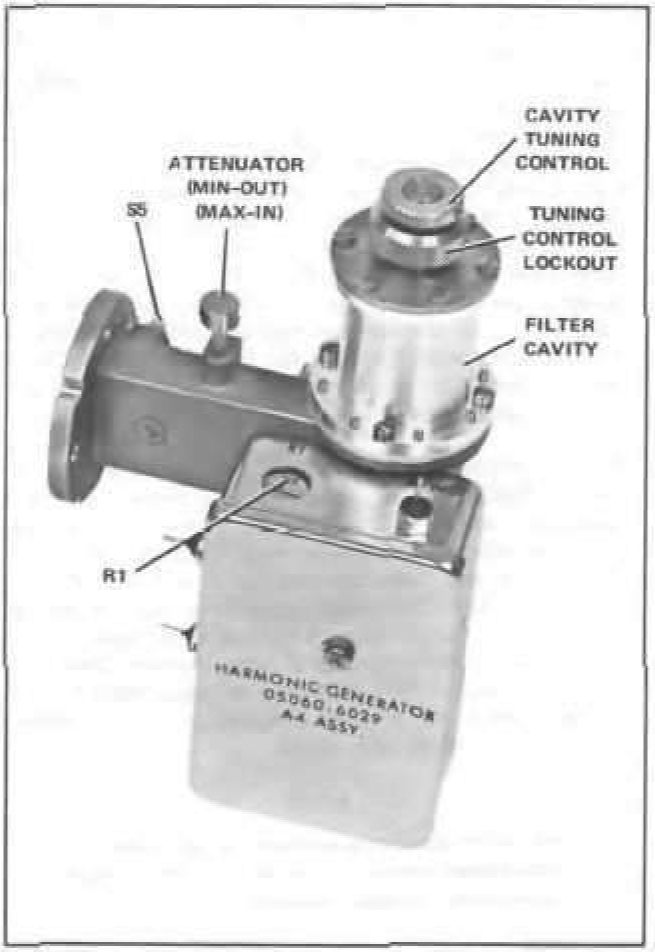
r. Continue turning A4R1 cw. The dc voltmeter indication will remain the same, or decrease then increase again to the peak level of step p. This double peaking indicates saturation.

s. If A4R1 is turned further cw, the dc voltmeter indication will decrease, then increase to a peak of lower amplitude than in step p.

t. The correct peak is the one listed in step p. Always reset A4R1 by turning it full ccw and then cw to the first peak.

u. If the double peak (step p and r) is not evident (not saturated), pull A4 attenuator out slightly and repeat steps q and r (see Figure 5-11). If saturation cannot be attained with the attenuator pulled out all the way, realign A4 Harmonic Generator as described in Paragraph 5-187.

Figure 5-11. Harmonic Generator Assembly A4



5-189. BEAM CURRENT RECORD. The Voltmeter connection used in the previous adjustment procedure (Harmonic Generator A4) will remain connected for the Beam Current Record check. The "peak", "Valley", and "background" figures should be recorded and referred to, along with the beam tube serial number, should it be necessary to contact Hewlett-Packard. The quotient,

$$\frac{\text{Peak Signal - Valley Signal}}{\text{Background Signal}}$$

is a good indicator on the beam tube's performance. A value greater than 1 indicates that the beam tube is performing satisfactorily.

a. Check the 5061A front panel controls. They should be as follows:

TIME CONSTANT . . . . SHORT
MOD . . . . OFF
MODE . . . . LOOP OPEN

b. Adjust the front panel OSC FREQUENCY COARSE adjustment for the primary peak of cesium resonance. Record this reading as the "peak signal".

c. Adjust the OSC FREQUENCY COARSE to the first minimum adjacent to the primary beam current peak. Record this reading as the "valley signal".

d. Adjust the OSC FREQUENCY COARSE for the primary peak of cesium resonance.

e. Remove A4P2 on the bottom center of the instrument deck from the Harmonic Generator Assembly. Record the meter reading as the "background signal".

f. Reconnect A4P2 to the Harmonic Generator Assembly.

g. Disconnect the voltmeter and adapter cable from 5061A.

h. Reconnect cable to A7J1 of AC Amplifier Assembly.

5-190. PHASE MODULATION FREQUENCY ADJUSTMENT.

a. Connect an Electronic Counter to the sweep test output of Phase Detector Module A8J2 located on the bottom front of the deck.

b. Adjust A8R10 MOD FREQ for 137 Hz ±1 Hz on the counter.

c. Remove counter from A8J2.

5-191. PHASE DETECTOR ZERO ADJUSTMENTS.

a. Check that MOD switch on front panel is OFF.

b. Disconnect +18.7 Vdc lead (white-red) from AC Amplifier A7.

c. Using adapter cables supplied, connect a dc voltmeter to phase detector test output A8J1.

d. Adjust A8R39, Phase Detector Zero, for a voltage reading of less than 1 mV.

e. Disconnect dc voltmeter and adapter cable.

f. Leave the +18.7 Vdc lead (white-red) disconnected.

5-192. OPERATIONAL AMPLIFIER ZERO ADJUSTMENTS.

a. Set MODE switch to LOOP OPEN.

b. Disconnect 18.7V (W-R) lead from AC Amplifier Assembly A7.

c. Connect 3 clip leads as follows:
(1) TP1 and TP2
(2) TP3 and TP4
(3) TP5 and CONTROL test point on A17 terminal board assembly.

NOTE: Test points 1 through 5 are located on bracket near front center of instrument on bottom deck (next to C2).

d. Connect dc Voltmeter to rear panel CONTROL connector. Set voltmeter so voltages below 5 MV may be easily read.

e. Set MODE switch to LTC. Disconnect jumper from TP5 and CONTROL test point on A17 assembly.

f. Voltmeter indication may drift somewhat. Drift should not exceed 1.2 MV/minute. Voltmeter indication may be reset to approximately zero by momentarily connecting jumper between R5 terminal and CONTROL test point on A17. If drift is excessive check circuit board in vicinity of A9U1 input for dirt or leakage paths. If board is clean replace A9U1.

g. Momentarily reconnect clip lead between TP5 and CONTROL test point on A17 terminal board assembly; this zeroes the integrator circuit. Now disconnect the clip lead. Also remove clip lead from between TP1 and TP2.

h. Adjust A8R39 PHASE ZERO control so drift indication on dc voltmeter is minimized. After adjustment is made, voltmeter may drift somewhat. Adjustment is properly made if drift rate does not exceed 3.7 mV/minute.

i. Reconnect clip lead between TP5 and CONTROL test point. Reconnect clip lead between TP1 and TP2.

j. Set MODE switch to OPER.

k. Disconnect clip lead between TP5 and CONTROL test point on A17.

l. Voltmeter indication should drift less than 100 mV/minute. If this is exceeded, check circuit board in vicinity of U2 input. If board is clean, replace U2. If repairs are made, repeat procedure starting at paragraph 5-192(a).

m. Disconnect clip leads between TP1 and TP2 and TP3 and TP4. Reconnect W-R lead to AC Amplifier Assembly A7.

5-193. PHASE MODULATION AMPLITUDE ADJUSTMENT.

a. Set 5061A controls as follows:

MOD .... ON
MODE .... LOOP OPEN
OSC FREQUENCY X10 ^{10} 250
CIRCUIT CHECK .... BEAM I

b. Observe CIRCUIT CHECK meter indication and adjust OSC FREQUENCY COARSE to the central peak of atomic resonance.

c. Adjust OSC FREQUENCY X10^{-10} to 200. The quartz oscillator is now offset by 50 parts in 10^{10}.

d. Using the Micon-to-BNC cable supplied, connect test output A7J6 on the bottom instrument deck to the vertical input of an oscilloscope.

NOTE

This waveform should be a sine wave. If there is clipping or distortion of this waveform, reduce ac gain by adjusting LOOP GAIN control on front panel. It will be reset later.

e. Adjust MOD LEVEL A3R20 on Multiplier Assembly A3 for maximum voltage on oscilloscope.

f. Remove the oscilloscope connection from A7J6.

5-194. PHASE MODULATION PHASE ADJUSTMENT.

a. Check that the 5061A is set as follows:

MOD .... ON
MODE .... LOOP OPEN
OSC FREQUENCY X10^{-10} 200
CIRCUIT CHECK .... BEAM I

b. Using Micon-to-BNC cable provided, connect an oscilloscope to A8J1 on Phase Detector Assembly A8.

c. Adjust A8R42 Mod Phase for the correct waveform as shown in Figure 5-8.

NOTE

If A8R42 has insufficient range, reverse the positions of A8R34 and A8R35, located inside the module, so that A8Q8 emitter is connected to A8R35 and A8Q9 emitter is connected to A8R34. Repeat step c.

d. Reset OSC FREQUENCY X10^{-10} to 250.

5-195. AC GAIN ADJUSTMENT.

a. Set 5061A controls as follows:

MOD .... ON
MODE .... LOOP OPEN
OSC FREQUENCY X10^{-10} 250
CIRCUIT CHECK .... BEAM I

b. Tune OSC FREQUENCY COARSE control to primary cesium resonance indicated on CIRCUIT CHECK meter.

c. Using the Micon-to-BNC adapter supplied, connect DC Voltmeter to A8J1 located on Phase Detector Assembly A8.

d. Carefully adjust OSC FREQUENCY COARSE control for zero voltmeter indication. Some noise will be present in meter indication. Make adjustment for minimum meter indication.

e. Set OSC FREQUENCY 10^{-10} control to 200.

f. Adjust front panel LOOP GAIN control for +1.6 ±0.15 Volts Voltmeter indication.

NOTE

AC Amplifier Assembly A7 GAIN switch (A7S1) position should be changed if LOOP GAIN control range is insufficient to perform step f.

g. Set OSC FREQUENCY X10^{-10} control to 300. Voltmeter should indicate -1.6 ±0.15 Volts. If not, repeat steps a through g.

h. Set MODE switch to OPER. Voltmeter indication should fall to zero. This verifies proper frequency control loop operation.

i. Set OSC FREQUENCY X10^{-10} to 250. Disconnect Voltmeter and adapter cable.

5-196. BEAM I METER ADJUSTMENT.

a. Locate AC Amplifier Assembly A7 (Figure 8-3) and disconnect A7J1. Front panel CIRCUIT CHECK meter (switch set to BEAM I) should indicate zero. If not, adjust AMPLIFIER BALANCE (A7R18 inside module) for zero CIRCUIT CHECK meter indication. Reconnect A7J1.

b. With instrument operating and CONTINUOUS OPERATION light on, set CIRCUIT CHECK switch to BEAM I. Adjust BEAM I METER adjust for 20 on CIRCUIT CHECK meter.

5-197. LOGIC CIRCUIT ADJUSTMENTS.

a. Check and set 5061A front panel controls as indicated:

MOD .... ON
MODE .... LOOP OPEN
OSC FREQUENCY X10 ^{10} 250
CIRCUIT CHECK .... BEAM I

b. Tune OSC FREQUENCY COARSE control to primary cesium resonance indicated on CIRCUIT CHECK meter.

c. Set MODE switch to OPER. Momentarily press LOGIC RESET. CONTINUOUS OPERATION light should come on and stay on.

NOTE

Power may remain connected in the following step if care is taken in removal and installation of Logic Assembly A14.

d. Remove Logic Assembly A14 and re-install using 22-pin extender board (HP Part No. 5060-7202) provided. Be certain that Logic Assembly A14 orientation is correct before insertion.

e. Set CIRCUIT CHECK switch to 2ND HARMONIC.

f. Adjust A14R1 (2ND HARM GAIN ADJ) for a CIRCUIT CHECK meter indication of 40.

g. Locate Oven Controller Assembly A11 and adjust MASS SPECT control (A11R27) maximum counterclockwise.

h. Set front panel MOD switch to OFF.

i. Connect the common lead (-) of a DC Voltmeter to chassis ground. With the positive (+) lead, measure A14Q9 and A14Q10 collector voltages.

j. Adjust BAL control (A14R27) for equal voltages at A14Q9 and A14Q10 collectors ±0.3 Volt. The voltage indications should be between +9 and +11 Vdc.

k. Set front panel controls as indicated:

MOD .... ON
MODE .... LOOP OPEN
CIRCUIT CHECK .... BEAM I

l. Adjust MASS SPECT control (A11R27) for maximum CIRCUIT CHECK meter indication.

m. Adjust OSC FREQUENCY COARSE control for peak of cesium resonance observed on CIRCUIT CHECK meter. Note meter reading.

n. Adjust MASS SPECT control (A11R27) for half indication noted in step m.

o. Adjust OSC FREQUENCY COARSE control to the adjacent secondary peak of cesium resonance observed on CIRCUIT CHECK meter.

p. Adjust FUND GAIN ADJ (A14R12) maximum counterclockwise.

q. Connect a clip-lead from A14Q11 collector to ground. Set MODE switch to OPER.

r. In small increments, adjust FUND GAIN ADJ (A14R12) clockwise until front panel ALARM turns on. Due to circuit time constant, wait a few seconds between incremental adjustments. Remove clip-lead.

s. Set MODE switch to LOOP OPEN. Adjust OSC FREQUENCY COARSE control for peak of cesium resonance observed on CIRCUIT CHECK meter.

t. Adjust MASS SPECT control (A11R27) for maximum indication on CIRCUIT CHECK meter.

u. Set MODE switch to OPER. Wait 30 seconds. Momentarily press LOGIC RESET button. CONTINUOUS OPERATION light should come on and stay on. Remove all test equipment and cables. Reinstall A14.

5-198. C FIELD ADJUSTMENT.

a. Perform steps in Paragraph 3-14k, C Field Adjustment.

b. Replace top and bottom covers. This completes the cesium beam tube replacement procedure.

5-199. BUFFER AMPLIFIER ASSEMBLY A13

5-200. Normal Operation

5-201. Buffer Amplifier, A13, amplifies and distributes the 5 MHz signal from Multiplier Assembly A3J3. One output goes to A1 Synthesizer Assembly. A dc signal is sent, via A17 Terminal Board, to the CIRCUIT CHECK Meter, 5 MHz position. The front and rear panel 5 MHz outputs, also originate from A13 Buffer Amplifiers. The normal input level to A13J2 is about 1 Vrms (3 Volts peak-to-peak) into 50-ohms. Output level at A13J3, J4 should be > 1 Vrms into 50 ohms. The CIRCUIT CHECK meter indication should be > 38 with the front and rear panel BNC connectors unterminated.

5-202. Module Replacement

5-203. Replacement module needs no adjustment.

5-204. LOGIC ASSEMBLY A14

5-205. Normal Operation

5-206. This assembly controls front panel CONTINUOUS OPERATION and ALARM lights and also supplies a dc signal through Terminal Board Assembly A17 to front panel CIRCUIT CHECK meter when CIRCUIT CHECK switch is set to 2ND HARMONIC.

5-207. Operational Checks

5-208. Logic circuits may be easily checked for operation by simulating various instrument failures. To check the assembly proceed as follows:

5-209. FUNDAMENTAL CHANNEL.

a. Carefully remove Logic Assembly A14 (Figure 8-4) from the instrument, re-insert using 22-pin adapter board (HP Part No. 5060-7202) supplied.

NOTE

Power need not be removed from the instrument during logic assembly removal.

b. With power applied to the instrument set front panel controls as indicated:

MOD	ON
MODE	LOOP OPEN
OSC FREQUENCY X10^{-10}	250
CIRCUIT CHECK	BEAM I

c. Adjust OSC FREQUENCY COARSE control for peak cesium resonance indication on CIRCUIT CHECK meter.

d. Set MODE switch to OPER. Momentarily press LOGIC RESET button. CONTINUOUS OPERATION light should come on and stay on.

e. Set CIRCUIT CHECK switch to CONTROL. Carefully adjust OSC FREQUENCY COARSE control for zero CIRCUIT CHECK meter indication.

f. Connect shorting jumper between A14Q11 collector and ground.

g. Connect high impedance DC Voltmeter to A14CR15 anode.

h. Rapidly turn OSC FREQUENCY X10^{-10} control 1/2 turn clockwise.

i. ALARM light should turn on then off. DC Voltmeter indication should rise to +5 Volts then decrease to normal.

j. Set MODE switch to LOOP OPEN and CIRCUIT CHECK switch to BEAM I.

k. Adjust OSC FREQUENCY COARSE control to an adjacent secondary peak indication on CIRCUIT CHECK meter. Set MODE switch to OPER.

l. ALARM light should come on and stay on. DC Voltmeter indication should rise to +5 Volts.

m. Remove shorting jumper from A14Q11 and disconnect DC Voltmeter.

n. Set MODE switch to LOOP OPEN and OSC FREQUENCY X10^{-10} control to 250.

o. Tune OSC FREQUENCY COARSE control for peak cesium resonance indication on CIRCUIT CHECK meter. Set MODE switch to OPER.

5-210. 2ND HARMONIC CHANNEL.

a. Connect high impedance DC Voltmeter to A14CR20 anode. Voltage indication should be zero or very low +dc.

b. Set front panel MOD switch to OFF. DC Voltmeter should indicate +5.5 Volts. ALARM light should turn on.

c. Set front panel MOD switch to ON. ALARM light should go off and DC Voltmeter indication should return to normal. Disconnect Voltmeter.

5-211. INTEGRATOR LIMIT CHECK.

a. Connect DC Voltmeter to CONTROL test point on Terminal Board Assembly A17.

b. Slowly adjust OSC FREQUENCY COARSE control clockwise until ALARM light comes on and stays on. Voltmeter indication should be between -3.5 and -6.5 Volts.

c. Slowly adjust OSC FREQUENCY COARSE control counterclockwise until ALARM light comes on and stays on. Voltmeter indication should be between +3.5 and +6.5 Volts.

d. Disconnect voltmeter and connect it to A14CR14 anode.

5-212. SYNTHESIZER CHECK.

a. Set MODE switch to LOOP OPEN.

b. Adjust OSC FREQUENCY COARSE control for peak cesium resonance indication on CIRCUIT CHECK meter. Set MODE switch to OPER.

c. Momentarily press LOGIC RESET button. CONTINUOUS OPERATION light should come on and stay on.

d. Locate Buffer Amplifier Assembly A13 (Figure 8-3). Disconnect A13(J1); CONTINUOUS OPERATION lamp should go off and voltmeter indication should be greater than +5.5 Volts (ALARM lamp may come on). Reconnect A13J1. Disconnect Voltmeter.

5-213. Troubleshooting

5-214. Logic Assembly A14 operational checks, waveforms and voltage levels given in Figure 8-27 are good troubleshooting aids.

5-215. Module Replacement

5-216. When components are replaced or a new module is installed, adjustment procedure in Paragraphs 5-195 through 5-197 should be performed.

5-217. POWER REGULATOR ASSEMBLY A15

5-218. Normal Operation

5-219. This assembly contains 5 functional circuits:

a. Standby Power Supply Gate

b. +18.7V Power Regulator

c. C Field Regulator

d. Ion Pump Current Monitor

e. Electron Multiplier Regulator.

5-220. Operational Checks

5-221. POWER REGULATOR AND C FIELD REGULATOR. The C Field control on instrument front panel adjusts the C Field regulator. This regulates the current to the beam tube C Field coil. Adjustment procedure for the C FIELD control is outlined in Section III, Operation. To perform the checks proceed as follows:

a. Remove ALL instrument power.

b. Remove instrument bottom cover. Remove Regulator Assembly (Figure 8-4), re-install using 22-pin adapter board extender furnished (HP Part No. 5060-7202).

c. Connect instrument to operating power.

d. Connect DC Voltmeter to pin 15 on the Regulator board. Adjust A15R15 for a meter indication of +18.7V. Disconnect Voltmeter.

e. Connect Clip-on DC Milliammeter probe to yellow wire connected to A17(29) (Figure 8-4). The "C" Field current should be between 10 mA and 25 mA. Disconnect clip-on meter.

5-222. ION PUMP CURRENT MONITOR AND ELECTRON MULTIPLIER REGULATOR. There are no adjustments to these circuits. The current monitor disables the +17.9 volts to the Cesium Oven Controller when ion pump current exceeds 40 microamperes. This same +17.9 is supplied to the electron multiplier regulator thus disabling the -2500 Vdc supply. Figure 8-31 shows the relationship between Power Regulator Assembly A15 and the +3500 and -2500 Vdc power supplies. The checks outlined below will verify proper operation and should be performed after repair, replacement, or when regulator circuit failure is suspected.

NOTE

When a defective A15 Assembly is replaced with a new assembly, resistors R33 and R34 from the defective A15 Assembly must be transferred to the new A15 Assembly.

5-223. VOLTAGE CHECKS. Leave instrument "on" with circuit board connected to instrument through 22-pin extender board.

a. Connect a DC Voltmeter to A15(2). Voltage should be between +25 and +33 Vdc.

b. Connect DC Voltmeter to A15(3). Voltage should be between +18.4 and +19.0 Volts.

c. Connect DC Voltmeter to A15(1). Voltage should be greater than +1V.

d. Connect DC Voltmeter to A15(4). Voltage should be at at least +17.5 volts. This completes the circuit checks. Disconnect all instrument power, remove extender board, reinstall A15. Connect power.

WARNING

When installing or removing Power Regulator Assembly A15, ALL instrument power MUST be removed. If Standby Power Supply Option 002 is installed, press battery disconnect switch S8 (Figure 8-4) after removing external power.

5-224. MODULE REPLACEMENT

5-225. If a new A15 Assembly is to be installed, perform the following steps.

a. Before installing new A15 Assembly, remove A15R19, R21, R33 and R34 from the old A15 Assembly. Install these parts in the same locations on the new A15 Assembly.

b. Install new A15 in 5061A and restore power. Allow about one hour warmup.

c. Connect DC Voltmeter to A15(15). Adjust A15R15 for a reading of 18.7V dc.

d. Measure voltage at A19(4). This voltage should measure 1/10,000 of the ELECTRON MULTIPLIER voltage given on the Cesium Beam Tube label. Typical voltage measured at this test point is -0.2V indicating an electron multiplier voltage of -2000 volts. If Electron Multiplier voltage is off by more than 100 volts perform the procedure of paragraph 5-186.

e. Reset C-field using procedure of paragraph 3-14k. When adjustments is completed C-field dial must read between 400 and 600. If it does not, change value of A15R19 (and A15R21 if necessary) until C-field dial reads within this range.

5-226. TERMINAL BOARD ASSEMBLY A17

5-227. This assembly contains no active components. All front panel CIRCUIT CHECK meter resistors are on this assembly. Nine test points and Standby Power Supply Option 002 fuse F2 are also on the terminal board. Figure 8-30 (A17 schematic and component locator) indicate component location and wire colors of leads connected to A17 terminals. Test points are labeled as follows:

TP1	"Control"
TP2	"LF Coil"
TP3	"C Field"
TP4	"25 to 33 Volts"
TP5	"+18.7V"
TP6	"+18.7 V(A)"
TP7	"Synth"
TP8	"+18.7 V(D)"
TP9	"F1"

5-228. +3500 VDC POWER SUPPLY ASSEMBLY A18

5-229. Power supply components are contained in a hermetically sealed unit and are not accesible for repair or replacement. When trouble occurs in +3500 Vdc circuits, power is automatically removed from Cesium Oven Controller Assembly A11 and the electron multiplier. The following procedure will check A18 circuit operation. If this procedure indicates a failure, remove module assembly and ship to nearest Hewlett-Packard Sales and Service office (see list at back of this manual).

5-230. Operational Check

a. With instrument power on, remove top cover.

b. Set front panel MODE switch to LOOP OPEN.

c. Set CIRCUIT CHECK switch to ION PUMP I. CIRCUIT CHECK meter should indicate less than two minor divisions (after normal warmup) for normal operation.

d. Connect high voltage probe to Electronic Voltmeter. Set Voltmeter to measure +100V and connect Voltmeter common (-) to instrument chassis. Turn on Voltmeter and let warm up for normal operation.

e. Disconnect ALL instrument power.

f. Locate large red wire coming from beam tube and connecting to +3500V receptacle on instrument chassis. Disconnect this wire from +3500V receptacle P4.

g. Connect instrument power.

h. Carefully contact the center conductor of chassis receptacle P4 with the High Voltage Probe. Voltmeter should indicate greater than 30(3000) Volts for normal operation.

i. Disconnect ALL instrument power. Disconnect Voltmeter. Re-connect wire removed in step f. This completes operational check.

5-231. Module Replacement

5-232. No adjustments are necessary when module is replaced.

5-233. -2500 VDC POWER SUPPLY ASSEMBLY A19

5-234. The power supply components are contained in a hermetically sealed unit and are not accessible for repair or replacement. This supply is for the electron multiplier inside the cesium beam tube. Resistors A15R30 and A15R31 are selected to establish the correct -2500V power supply output voltage for a specific beam tube. Power Regulator Assembly A15 circuits control the -2500 volt supply, therefore, they can prevent a -2500 volt output. The following operational check procedure should determine if the -2500 volt supply is operating normally. If this procedure indicates module failure, remove the unit from the instrument and return to your nearest Hewlett-Packard Sales and Service office for repair or replacement (see list at the back of this manual).

5-235. Operational Check

a. With instrument power on, remove bottom covers.

b. Set Front panel MODE switch to LOOP OPEN.

c. Set CIRCUIT CHECK switch to ION PUMP I. CIRCUIT CHECK meter should indicate less than two minor divisions (after normal warmup) for normal operation.

d. Set DC Voltmeter to measure -0.3 Vdc. Connect common (-) Voltmeter lead to instrument chassis. Connect the positive (+) lead to -2500 Vdc Power Supply Assembly A19(3). This test point is located at the bottom, center front of the instrument deck.

NOTE

An internal resistive 10,000:1 divider allows measurement of this voltage with a standard Voltmeter.

5-236. Voltmeter should indicate electron multiplier voltage P±50V) called out on beam tube decal. If voltage is incorrect, A15R30 and A15R31 should be adjusted as outlined in Paragraph 5-186.

NOTE

When adjusting A15R30 and A15R31, care should be taken to make the adjustment very carefully since a 1% change in electron multiplier voltage will cause a 9% change in beam current.

5-237. Since A19 is controlled by a feedback loop starting at A19(4), through a 55 Megohm resistor string in the beam tube, ending at A15(6), an open circuit or poor connection in this loop will cause incorrect module output.

5-238. Module Replacement

5-239. If assembly A19 is replaced, A15R30 and A15R31 must be adjusted (see Paragraph 5-186).

5-240. DIGITAL DIVIDER ASSEMBLY A5 (Option 001)

5-241. Normal Operation

5-242. Digital divider circuits provide one pulse-per-second output ticks available at front and rear panel 1 PPS BNC output jacks. The divider drive is an internally connected 1 MHz signal from Frequency Divider Assembly A6. Option 001 circuits also provide drive for front panel digital clock.

5-243. Operational Check

5-244. Complete operational check is given in Table 5-2, items 4 and 5.

5-245. Troubleshooting

5-246. The entire digital divider assembly may be removed and re-connected for troubleshooting. Extender board (HP Part No. 05061-6073) furnished, makes circuit board components available for testing.

5-247. Digital divider power supply common is isolated from instrument common. To observe waveforms and measure divider voltages, divider common may be connected to instrument common for troubleshooting with no adverse effect. However, this connection must be removed when divider is re-assembled.

5-248. Each circuit board inputs and outputs are available on interconnection board assembly A5A5. Thus trouble may be isolated to one specific board assembly before disassembling the entire unit. Tables 5-7 and 5-8, and Figures 8-13, 8-14, 8-15, and 8-16 provide troubleshooting information.

5-249. Periodic adjustments to divider circuits are not necessary. When adjustable components or components related to adjustable components are replaced, the following adjustments should be made.

a. A5A2T1 Adjustment. With instrument in normal operation (frequency divider on) connect RMS Voltmeter to A5A2T1 secondary (Figure 8-15). Adjust A5A2T1 for maximum voltage indication on Voltmeter.

b. A5A2C9 Adjustment. With instrument in normal operation (frequency divider on) connect Oscilloscope to A5A2Q6 collector (Figure 8-15). Adjust A5A2C9 for most symmetrical square wave observed on oscilloscope.

c. A5A2C10 Adjustment. With instrument in normal operation (frequency dividers on) set TIME DELAY thumbwheel switch to "000000" and 0–1 μsec TIME DELAY adjust to max. cw. Externally synchronize digital divider circuits (Paragraph 3-18). Using an Oscilloscope, compare external synchronization pulse with 1 PPS output pulse. Adjust A5A2C10 for 10 μsec 1 PPS delay ±1 μsec.

Table 5-7. Troubleshooting Table

Trouble	Check
Will not synchronize to external pulse.	Check external pulse characteristics (Table 1-1). Check sync circuitry A5A2 (Q3, IC1, Q5, and Q7).
Incorrect output pulse shape.	Check output circuits A5A4 (IC1, Q1), A5A1 (Q7 and Q10), and 13.3V supply (A5A1).
TIME DELAY switch does not affect output pulse time delay.	Check each switch position (Table 5-2, Item 4). If symptom is in only 1 or 2 switch positions, check preset circuitry associated with those positions including preset coupling diodes and the associated decade. If symptoms are present regardless of thumbwheel settings, refer to Table 5-8. If output stops only when thumbwheel switch setting is "999999" trouble is probably in A5A3 (IC13, IC12B, or IC2D).

d. A5A1R13 Adjustment. With instrument power connected, connect DC Voltmeter across A5A1C17. Adjust A5A1R13 for +4.2V ±0.1V Voltmeter indication.

5-250. Module Replacement

5-251. No adjustments required when Digital Divider Assembly or circuit board assemblies are replaced.

5-252. STANDBY POWER SUPPLY (Option 002)

5-253. Normal Operation

5-254. Standby battery BT1 provides 30 minutes of dc power should instrument external oeprating supplies fail. If standby power is used, and ac line power returned, Battery Charger Assembly A2 charges the standby battery for the correct period determined by battery use time.

5-255. Operational Check and Troubleshooting

5-256. All instrument operating power must be removed before removing Battery Charger Assembly A2 from the instrument. The following checks should be performed only if trouble is suspected in the circuits.

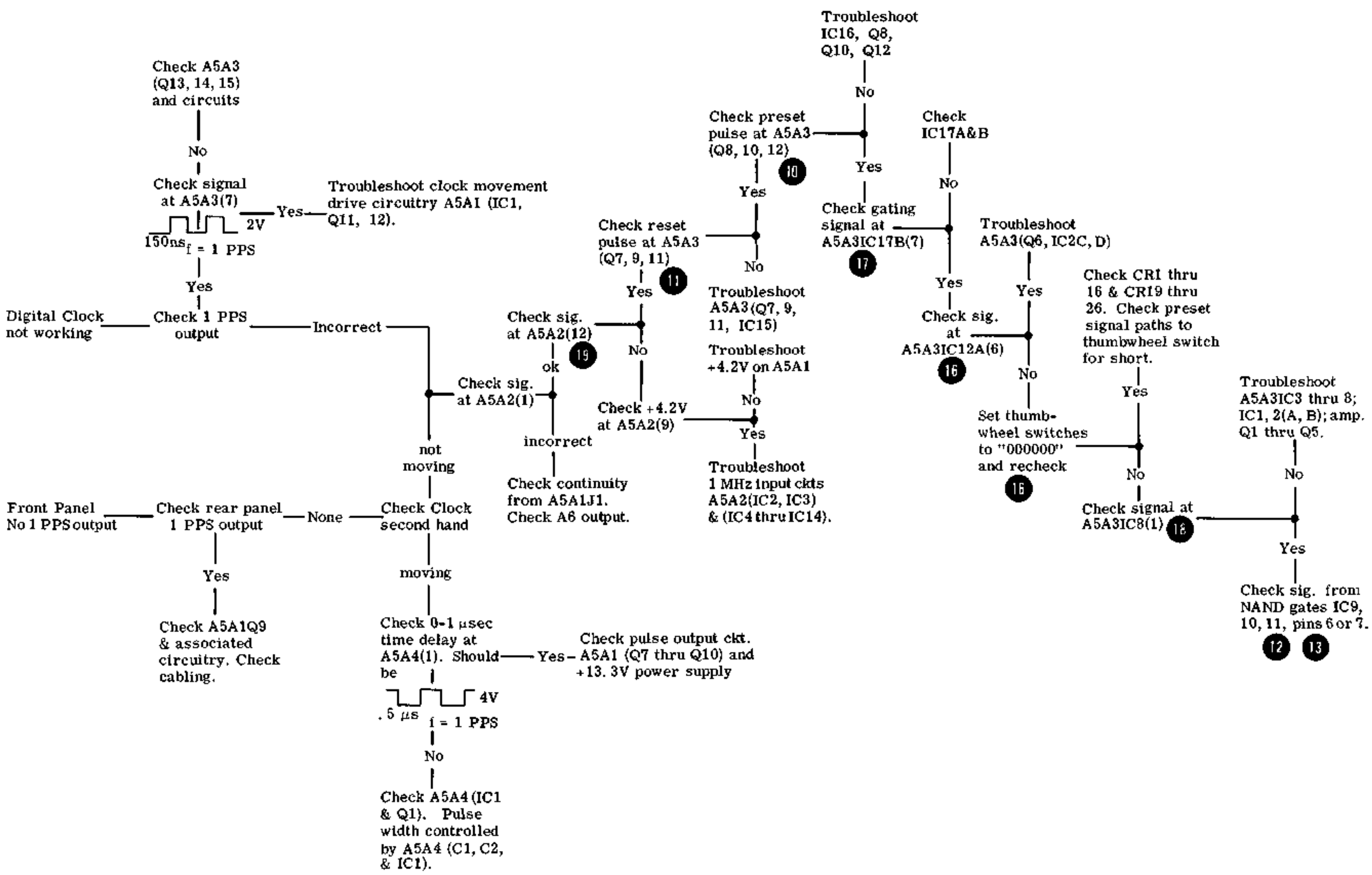


Table 5-8. Assembly A5 Troubleshooting Chart

5-257. Assembly Removal and Replacement

5-258. REMOVAL. To remove Battery Charger Assembly A2 proceed as follows:

a. Remove instrument bottom cover.

b. Remove instrument external ac power then press battery disconnect switch S8 (Figure 8-4).

c. Remove battery charger board A2 (Figure 8-3).

NOTE

Instrument may be operated with Battery Charger Assembly A2 removed.

5-259. REPLACEMENT. To replace the assembly proceed as follows:

a. Measure resistance between A2(1) and A2(2). If open, proceed to step c.

b. If short (relay A2K1 closed), connect the positive (+) lead of a DC Power Supply to A2(1). Connect the common (-) lead to A2Q20 collector. Adjust Power Supply for +18.7 Volts. This will open the relay.

c. The assembly may now be re-installed in the instrument. If checks and measurements are to be made, re-connect the circuit board through extender board (HP Part No. 05060-7202) provided.

5-260. Internal Battery and Battery Circuit Checks

a. Disconnect ALL external instrument power, Front panel BATTERY light should flash on/off and instrument should remain operational on internal standby battery. If internal battery does not take over instrument operation, check battery condition and standby power supply gate circuit on Power Regulator Assembly A15. If front panel BATTERY light does not flash, check DS3 lamp then voltage at A2IC4(1). This voltage should be about 0 Vdc. If voltage is correct, most probable trouble is battery light control circuit (A2IC4, IC6, Q25, and Q26).

b. Allow instrument to operate on internal standby battery until protective relay A2K1 opens battery circuit. This should occur when battery voltage reaches between +23 and +21 Volts. Battery should supply power for at least 1/2 hour. If battery does not supply power for 30 minutes, step c should be performed to recondition battery.

NOTE

When instrument has been operated with internal standby battery on "trickle" charge for long periods of time (BATTERY light off), steps b and c may have to be performed several times to completely recondition the battery. If battery will not provide power for 1/2 hour after 4 reconditioning cycles (steps b and c), and charging current and charging time are correct (steps c and d), replace battery.

c. Reconnect instrument ac power. BATTERY light should come on and stay on for 18 to 21 hours "fast" charge time. Battery charging circuits should return to "trickle" charge and BATTERY light should go off at the conclusion of this period.

d. During "fast" charge cycle, connect Clip-on Milliammeter to either internal battery lread. "Fast" charge current should be 250 ±30 mA.

e. During "trickle" charge mode, connect Clip-on Milliammeter to either internal lead. "Trickle" charge current should be between 25 and 55 mA.

5-261. "Fast" charge rate is controlled by A2R19. Adjustment range, for this resistor, is 1K to 3K ohms. "Fast" charge mode is turned on by an "L" signal at A2Q15 colle-tor (+0.5V or less). Transistor A2Q15 is turned on by an "H" (about +2.5V) resulting from out of coincidence between A2IC2 and A2IC5. If the correct signal is not present at A2IC7(8), perform the following checks in the order given: 1) Reset/Preset (Paragraph 5-265), 2) Logic Comparator (Paragraph 5-267), and 3) Decades (Paragraph 5-269).

5-262. Incorrect "fast" charge time can be caused by troubles in timing oscillator, decades, or logic comparator. To isolate the trouble circuit, perform following checks in order given: 1) Timing Oscillator (Paragraph

5-263. With internal battery charged and instrument operating on external ac line power, disconnect ac power to instrument for 15 minutes, then reconnect. Battery should "fast" charge for 4 to 8 hours as indicated by BATTERY light. If charge time is incorrect, perform following checks in order given: 1) Reset (Paragraph 5-267), 2) Timing Oscillator (Paragraph 5-268), 3) Logic Comparator (Paragraph 5-269), and 4) Decades (Paragraph 5-271).

5-264. Circuit Tests

5-265. These tests will check individual circuits on Battery Charger Assembly A2. If failure is indicated in a circuit, repair circuit and perform battery charger operational check.

5-266. RESET TEST. With external ac power connected perform the following test:

a. Set Oscilloscope to trigger on a negative pulse and connect vertical channel to A2IC7(1).

b. Momentarily ground A2TP4.

c. Momentarily grund A2TP5 and observe Oscilloscope display. Should be negative 4 μsec wide, 4 Volt pulse.

5-267. RESET/PRESET TEST. With external ac power connected perform the following tests:

a. Connect DC Voltmeter, set to measure +3 Volts, to A2TP6.

b. Disconnect AC power and press battery disconnect switch S8.

c. Reconnect AC power. Voltage should rise to about +1.5 Volts for 1-1/2 sec to 3 sec then fall below 0.5 Volts.

d. If no response, repeat steps b and c with Voltmeter connected to A2TP5. When AC power is restored, voltage should remain low for about 1.5 to 3 seconds then rise to +5V. If correct indication is noted in this step but not in step c, NAND gate IC7 is probable trouble. If incorrect indication is noted in this step, troubleshoot reset relaxation oscillator.

e. Connect DC Voltmeter to A2TP4.

f. Disconnect AC power and press battery disconnect switch S8.

g. Reconnect AC power. Voltmeter should indicate "L" for about 4 to 6 seconds then rise to about +4.5V. Failure of this test indicates possible troulble in preset relaxation oscillator circuit. Check diodes A2CR14, CR15, and CR16.

5-268. TIMING OSCILLATOR TEST. With external ac power connected perform the following test:

a. Connect shorting jumper between A2Q15 collector and ground. This turns on the timing oscillator.

b. Connect 15K ohm resistor between A2TP1 and A2TP2. This speeds up the timing oscillator frequency for oscilloscope viewing.

c. Connect Oscilloscope to A2Q8 collector. Waveform should be similar to Figure 8-10, (1).

d. Remove ac line power and observe waveform at A2Q12 collector. Should be negative, 1V p-p, 1 pulse-per-13 sec, 40 msec pulse width.

e. Restore ac line power and measure dc voltage at A2Q12 collector. Should be less than 0.5V.

f. Remove 15K ohm resistor between A2TP1 and A2TP2 and replace with 150K ohm resistor.

g. Connect Electronic Counter, set to measure period, to A2Q18 collector. Period should be between 170 and 230 seconds. If period is incorrect, adjust A2R16 for correct period.

h. Remove short from A2Q15 and the 150K ohm resistor from A2TP1-TP2, and disconnect Counter.

5-269. LOGIC COMPARATOR TEST. With external ac line power connected, internal battery fully charged, perform the following test:

NOTE

This test is made by forcing A2IC2 and A2IC5 into specific states (Table 5-9) and monitoring resulting logic comparator output, A2IC7(8), at A2Q15 collector.

a. Connect shorting jumper between A2Q5 collector and ground. This turns off the timing oscillator.

b. Connect DC Voltmeter, set to indicate 3V, to A2Q15 collector.

c. Connect shorting jumper between A2TP6 and ground.

d. Force all decade outputs to their "H" (greater than +1.5V) state by:

(1) Removing short from A2TP6.

(2) Momentarily shorting A2TP5 to ground.

(3) Re-connecting short between A2TP6 and ground.

NOTE

Step d resets ALL decades to zero. Therefore, perform this step before forcing in "L" states described in step e.

e. Using Table 5-9, force specific terminals of A2IC2 and A2IC5 "L" while observing Voltmeter connected in step b. Voltmeter indication should agree with Table 5-9.

NOTE

To force desired decade output to "L" (less than +0.5V) state, momentarily short that output to ground. Decade outputs are most easily reached at coupling diode (A2CR20 through A2CR23 and A2CR25 through A2CR28) cathode terminal.

f. If logic comparator fails one or more logic checks (Table 5-9), leave the failed state set in and measure voltages at all comparator gates and inverters. Thus it can be determined which gate or inverter is malfunctioning.

5-267. RESET/PRESET TEST. With external ac power connected perform the following tests:

a. Connect DC Voltmeter, set to measure +3 Volts, to A2TP6.

b. Disconnect AC power and press battery disconnect switch S8.

c. Reconnect AC power. Voltage should rise to about +1.5 Volts for 1-1/2 sec to 3 sec then fall below 0.5 Volts.

d. If no response, repeat steps b and c with Voltmeter connected to A2TP5. When AC power is restored, voltage should remain low for about 1.5 to 3 seconds then rise to +5V. If correct indication is noted in this step but not in step c, NAND gate IC7 is probable trouble. If incorrect indication is noted in this step, troubleshoot reset relaxation oscillator.

e. Connect DC Voltmeter to A2TP4.

f. Disconnect AC power and press battery disconnect switch S8.

g. Reconnect AC power. Voltmeter should indicate "L" for about 4 to 6 seconds then rise to about +4.5V. Failure of this test indicates possible troulble in preset relaxation oscillator circuit. Check diodes A2CR14, CR15, and CR16.

5-268. TIMING OSCILLATOR TEST. With external ac power connected perform the following test:

a. Connect shorting jumper between A2Q15 collector and ground. This turns on the timing oscillator.

b. Connect 15K ohm resistor between A2TP1 and A2TP2. This speeds up the timing oscillator frequency for oscilloscope viewing.

c. Connect Oscilloscope to A2Q8 collector. Waveform should be similar to Figure 8-10, (1).

d. Remove ac line power and observe waveform at A2Q12 collector. Should be negative, 1V p-p, 1 pulse-per-13 sec, 40 msec pulse width.

e. Restore ac line power and measure dc voltage at A2Q12 collector. Should be less than 0.5V.

f. Remove 15K ohm resistor between A2TP1 and A2TP2 and replace with 150K ohm resistor.

g. Connect Electronic Counter, set to measure period, to A2Q18 collector. Period should be between 170 and 230 seconds. If period is incorrect, adjust A2R16 for correct period.

h. Remove short from A2Q15 and the 150K ohm resistor from A2TP1-TP2, and disconnect Counter.

5-269. LOGIC COMPARATOR TEST. With external ac line power connected, internal battery fully charged, perform the following test:

NOTE

This test is made by forcing A2IC2 and A2IC5 into specific states (Table 5-9) and monitoring resulting logic comparator output, A2IC7(8), at A2Q15 collector.

a. Connect shorting jumper between A2Q5 collector and ground. This turns off the timing oscillator.

b. Connect DC Voltmeter, set to indicate 3V, to A2Q15 collector.

c. Connect shorting jumper between A2TP6 and ground.

d. Force all decade outputs to their "H" (greater than +1.5V) state by:

(1) Removing short from A2TP6.

(2) Momentarily shorting A2TP5 to ground.

(3) Re-connecting short between A2TP6 and ground.

NOTE

Step d resets ALL decades to zero. Therefore, perform this step before forcing in "L" states described in step e.

e. Using Table 5-9, force specific terminals of A2IC2 and A2IC5 "L" while observing Voltmeter connected in step b. Voltmeter indication should agree with Table 5-9.

NOTE

To force desired decade output to "L" (less than +0.5V) state, momentarily short that output to ground. Decade outputs are most easily reached at coupling diode (A2CR20 through A2CR23 and A2CR25 through A2CR28) cathode terminal.

f. If logic comparator fails one or more logic checks (Table 5-9), leave the failed state set in and measure voltages at all comparator gates and inverters. Thus it can be determined which gate or inverter is malfunctioning.

Table 5-9. Logic Comparator Logic Check

A2IC2 Terminal				A2IC5 Terminal				A2Q15(c) H ≈ +1V L ≈ +.5V
6	7	8	1	6	7	8	1	
H	H	H	H	H	H	H	H	H
L	H	H	H	H	H	H	H	L
L	H	H	H	L	H	H	H	H
H	H	H	H	L	H	H	H	L
H	L	H	H	H	H	H	H	L
H	L	H	H	H	L	H	H	H
H	H	H	H	H	L	H	H	L
H	H	L	H	H	H	H	H	L
H	H	L	H	H	H	L	H	H
H	H	H	H	H	H	L	H	L
H	H	H	L	H	H	H	H	L
H	H	H	L	H	H	H	L	H
H	H	H	H	H	H	H	L	L

5-270. POWER-LOSS ONE-SHOT TEST. With external ac line power connected, perform the following test:

a. Connect Oscilloscope to A2Q6 collector.

b. Disconnect instrument AC line power. Oscilloscope waveform should be negative 3 Volt p-p, 15 msec pulse.

5-271. DECADE TESTS.

Counting. With external ac line power connected, perform the following test:

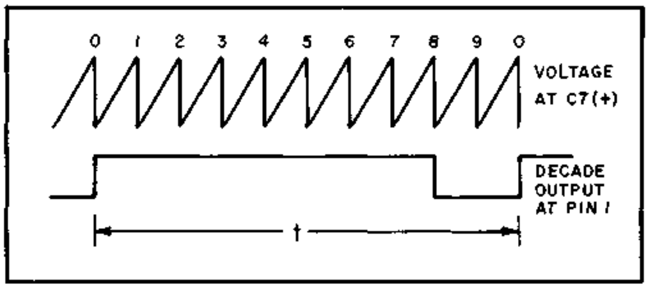
a. Connect shorting jumper between A2Q5 collector and ground.

b. Connect shorting jumper between A2TP6 and ground.

c. Connect 10K ohm resistor between +18.7 Volt supply and positive (+) side of A2C7. This increases A2Q13 output frequency.

d. Connect one Dual Channel Oscilloscope input to positive (+) side of A2C7. Connect other Oscilloscope input to A2CR23 cathode. Set Oscilloscope A2C7 input to 2 V/cm and A2CR23 input to 0.5 V/cm.

Figure 5-12. Battery Charger Counting Waveform



e. Remove AC line power. Oscilloscope waveforms should be similar to Figure 5-12.

f. Re-connect ac line power.

g. Remove Oscilloscope connection at A2CR23 and connect to A2IC(1). Note t in Figure 5-12.

h. Remove Oscilloscope connection at A2IC(1) and connect to A2IC5(1). This period should be 10 times that noted in step g.

i. Remove short from A2TP6, 10K ohm resistor installed in step c, and Oscilloscope connections.

Reset. With external ac line power connected and shorting jumper between A2Q5 collector and ground, perform the following test:

a. Connect DC Voltmeter to IC2(8). If voltage is "L" (< +0.5V) go to step b. If "H" (about +1.5V), momentarily short IC2(8) to ground. This will cause "H" state to go "L".

b. Momentarily short A2TP5 to ground. Voltmeter indication should go from "L" to "H". If decade does not respond, connect DC Voltmeter to decade reset terminal (pin 2). Voltage at this point should be "L".

c. Momentarily short A2TP5 to ground. Voltmeter indication should go from "L" to "H". If this does not occur; check NAND gate A2IC7. If A2IC7 is operating correctly, A2IC2 is not resetting.

d. Repeat steps a, b, and c for A2IC3(8) and A2IC5(8).

5-272. Module Replacement

5-273. No adjustments required when Battery Charger Assembly A2 is replaced.

5-274. CLOCK DISPLAY ASSEMBLY A16

5-275. General

5-276. The A16 LED Clock Display Assembly has no adjustments and requires no periodic maintenance. Should repair be necessary, the unit may be removed and operated on the bench while remaining connected to the instrument.

When operating in this manner, however, the Clock Display chassis or circuit common **must be connected to the instrument chassis** with a CLIP LEAD OR JUMPER WIRE. The following paragraphs describe assembly removal, fault finding procedures for the clock system, and troubleshooting information for the individual circuits.

5-277. Repairs

5-278. Before attempting repairs, perform the following procedures:

NOTE

Most of the circuits on the 50 Hz LOGIC and CLOCK DISPLAY assemblies are CMOS. Use high impedance test equipment when checking signals. Precautions should be taken when removing or replacing these circuits to prevent damage from static charges.

a. Momentarily set front panel DIVIDER MODE switch to START.

b. Check CIRCUIT CHECK meter in 1 MHz position for reading of approximately 40. If reading not present, troubleshoot A6 assembly.

c. Check front panel 1 PPS output. If not present, troubleshoot A5 assembly.

d. If the display is not lit, press STANDBY DISPLAY switch. If display lights and operates normally, the instrument is not operating from AC power. This condition is normal. If the display does not light when the STANDBY DISPLAY switch is pressed, perform troubleshooting procedures (paragraph 5-281).

e. Read LED Clock Display Theory of Operation (paragraph 4-252).

5-279. A16 Assembly Removal

5-280. Prior to removing or reinstalling the Clock Display, turn off all operating power. Wire and cable length to the clock panel or clock rear board is sufficient to permit removal of the clock without disconnecting these wires or the cable. Place the clock on a pad or cloth to minimize scratch damage or shorting of circuit traces. Then, proceed as follows:

a. Turn off all operating power.

b. Remove the instrument top cover. In Option 002 and 003 disable the internal standby battery.

c. Use a 5/16" spin-type wrench and remove two 5/16" nuts which secure the clock to the instrument front panel. Retain the nuts for reinstallation. The bottom of the clock is secured in place by a ball-stud fastener which does not need to be removed.

d. Press firmly at the bottom-rear then at the top-rear of the clock until it is loose.

e. Carefully remove the clock. Gently pull the connected wires and cable forward and set the clock on the work surface.

f. Before applying operating power ensure that the exposed LED Clock boards and wires are not in contact with any metal objects or surfaces. Apply operating power.

g. To reinstall the Clock Display, turn off all operating power. In Option 002 and 003, disable the internal standby battery.

h. Perform steps b to e in reverse order. (See Note.)

NOTE

While installing the clock into the instrument front panel, check that wires are not pinched by screws or metal work. Position the wires for a neat appearance after installation.

i. When clock is reinstalled, apply power and set time as described in paragraph 3-26.

5-281. Troubleshooting

5-282. General

5-283. Procedures in this section describe fault isolation to the circuit board level, disassembly of the clock, and troubleshooting information for each of the three circuits.

5-284. Clock System Troubleshooting

5-285. To perform the following tests, remove the clock from the instrument and connect as described in A16 ASSEMBLY REMOVAL (paragraph 5-279).

5-286. A16A1 Power Supply Check

NOTE

All voltages measured with respect to instrument chassis.

a. Measure voltages indicated below. Be sure clock chassis is grounded to instrument chassis.

VOLTAGE	LOCATION
+26±4V dc	A16A1(3)
+12±2Vdc	A16A1(R)
+5 ±.5V dc	A16A1(4)

b. If the +26 or +12 volt supplies are out of tolerance, troubleshoot the source of these voltages. If the +5V supply is out of tolerance, remove the A16A2 Assembly and measure the voltage again. If voltage now is correct, go to step b(2).

(1) If voltage remains out of tolerance, troubleshoot A16A1, 5V regulator assembly.

(2) If voltage is now correct it indicates a short or low impedance on 5V line or defective current-limit circuit; troubleshoot 5V line and circuits on A16A2 which use 5V. If these are OK, check current-limit circuit of A16A1.

NOTE

An external 5V can be used in place of A16A1 output.

c. Check for +1V, 150 nsec, 1 PPS signal at A16A1(W). Be sure Clock Display chassis is grounded to instrument chassis. If pulse not present, troubleshoot A5 Digital Divider Assembly.

d. Check for 12V, .3 ms, 1 PPS signal at A16A1(5). If incorrect or not present, check circuit of A16A1U1.

5-287. A16A3 Clock Display Check

a. If display is not lit go directly to "Display Not Lit" step b. If display is lit but not functioning correctly, proceed as follows:

(1) Check for 1 PPS signal at A16A2U1(19). It should be as shown on schematic. If not, troubleshoot Driver Circuit of A16A1U2.

(2) Check operation of digit and segment drivers U2, U3 and Q1 thru 6. If these check OK, replace U1. See Note 4 on figure 8-29 for typical waveform.

b. Display Not Lit

(1) Check voltage at A16A2(4). It should be 5V ±.5V dc. If incorrect, troubleshoot circuit of A16A2U1.

(2) Check +12V input at A16A3(5). It should be the same as measured at "R" terminal on A16A1. If not, check continuity of +12V line from A16A1 to A16A2.

(3) Substitute a new LED in one of the display positions.

(4) Trouble is in A16A2U1, 2, or 3. Check for switching waveforms at U1 (6-12) and (21-26). Check for switching waveforms at U2 and U3 outputs. See Figure 8-29 for typical waveforms.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Tables 6-1, 6-2 (Option 002), and 6-3 (Option 001) list parts in reference designator alphanumerical order and indicates the description, quantity and HP part number of each part, together with any applicable notes. Included are:

a. Description of part (see abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-4.

c. Manufacturer's part number.

d. Total quantity used in the instrument (Qty column).

6-3. Miscellaneous parts are listed with Tables 6-1, 6-2, and 6-3.

6-4. ORDERING INFORMATION

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Sales and Service office (see lists at rear of this manual for addresses). Identify parts by their Hewlett-Packard part numbers.

6-6. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

REFERENCE DESIGNATORS

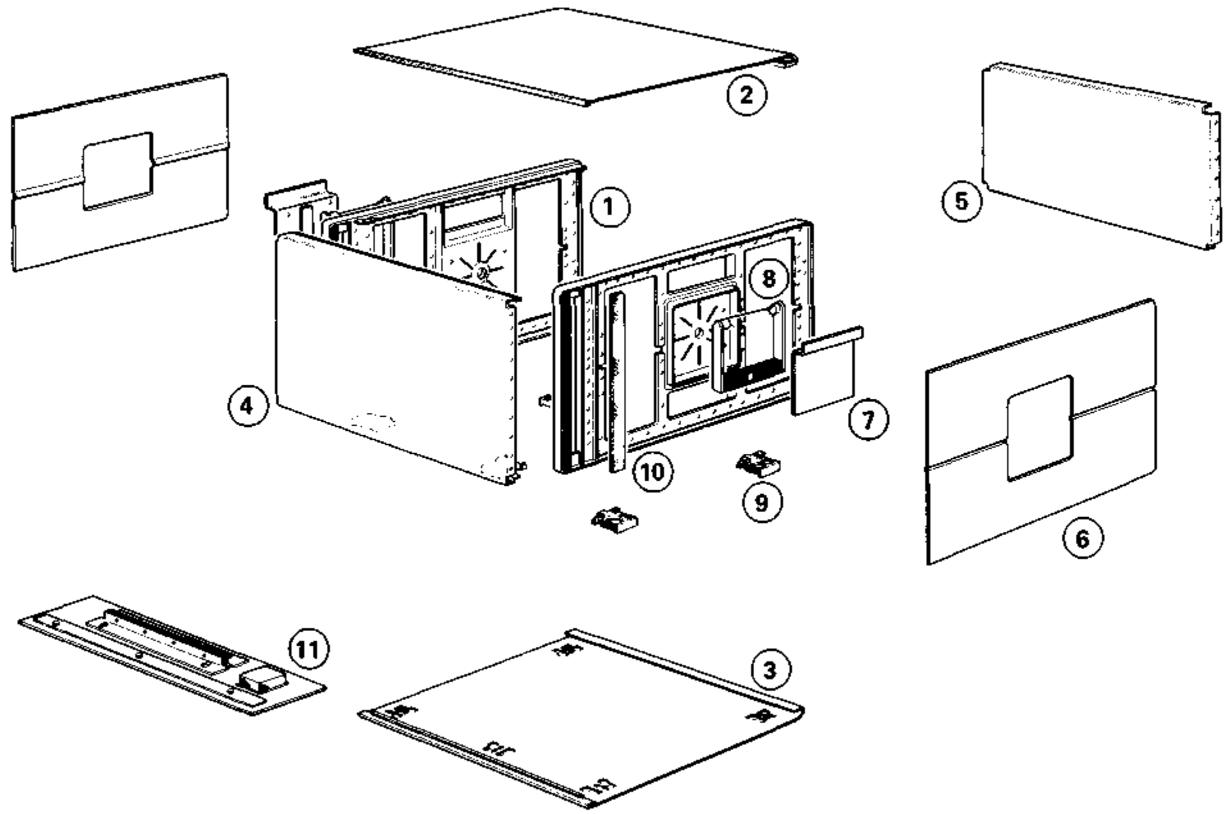
A	= assembly	F	= fuse	MP	= mechanical part	U	= integrated circuit
B	= motor	FL	= filter	P	= plug	V	= vacuum, tube, neon bulb, photocell, etc.
BT	= battery	IC	= integrated circuit	Q	= transistor		
C	= capacitor	J	= jack	R	= resistor	VR	= voltage regulator
CP	= coupler	K	= relay	RT	= thermistor	W	= cable
CR	= diode	L	= inductor	S	= switch	X	= socket
DL	= delay line	LS	= loud speaker	T	= transformer	Y	= crystal
DS	= device signaling (lamp)	M	= meter	TB	= terminal board	Z	= tuned cavity, network
E	= misc electronic part	MK	= microphone	TP	= test point		

ABBREVIATIONS

A	= amperes
AFC	= automatic frequency control
AMPL	= amplifier
BFO	= beat frequency oscillator
BE CU	= beryllium copper
BH	= binder head
BP	= bandpass
BRS	= brass
BWO	= backward wave oscillator
CCW	= counter-clockwise
CER	= ceramic
CMO	= cabinet mount only
COEF	= coefficient
COM	= common
COMP	= composition
COMPL	= complete
CONN	= connector
CP	= cadmium plate
CRT	= cathode-ray tube
CW	= clockwise
DEPC	= deposited carbon
DR	= drive
ELECT	= electrolytic
ENCAP	= encapsulated
EXT	= external
F	= farads
FH	= flat head
FIL H	= fillister head
FXD	= fixed
G	= giga (10^9)
GE	= germanium
GL	= glass
GRD	= ground(ed)
H	= henries
HDW	= hardware
HEX	= hexagonal
HG	= mercury
HR	= hour(s)
HZ	= hertz
IF	= intermediate freq
IMPG	= impregnated
INCD	= incandescent
INCL	= include(s)
INS	= insulation(ed)
INT	= internal
K	= kilo = 1000
LH	= left hand
LIN	= linear taper
LK WASH	= lock washer
LOG	= logarithmic taper
LPF	= low pass filter
M	= milli = 10^{-3}
MEG	= meg = 10^6
MET FLM	= metal film
MET OX	= metallic oxide
MFR	= manufacturer
MHZ	= mega hertz
MINAT	= miniature
MOM	= momentary
MOS	= metal ozide substrate
MTG	= mounting
MY	= "mylar"
N	= nano (10^{-9})
N/C	= normally closed
NE	= neon
NI PL	= nickel plate
N/O	= normally open
NOM	= nominal
NPO	= negative positive zero (zero temperature coefficient)
NPN	= negative-positive-negative
NRFR	= not recommended for field replacement
NSR	= not separately replaceable
OBD	= order by description
OH	= oval head
OX	= oxide
P	= peak
PC	= printed circuit
PF	= picofarads = 10^{-12} farads
PH BRZ	= phosphor bronze
PHL	= Phillips
PIV	= peak inverse voltage
PNP	= positive-negative-positive
P/O	= part of
POLY	= polystyrene
PORC	= porcelain
POS	= position(s)
POT	= potentiometer
PP	= peak-to-peak
PT	= point
PWV	= peak working voltage
RECT	= rectifier
RF	= radio frequency
RH	= round head or right hand
RMO	= rack mount only
RMS	= root-mean square
RWV	= reverse working voltage
S-B	= slow-blow
SCR	= screw
SE	= selenium
SECT	= section(s)
SEMICON	= semiconductor
SI	= silicon
SIL	= silver
SL	= slide
SPG	= spring
SPL	= special
SST	= stainless steel
SR	= split ring
STL	= steel
TA	= tantalum
TD	= time delay
TGL	= toggle
THD	= thread
TI	= titanium
TOL	= tolerance
TRIM	= trimmer
TWT	= traveling wave tube
U	= micro = 10^{-6}
VAR	= variable
VDCW	= dc working volts
W/	= with
W	= watts
WIV	= working inverse voltage
WW	= wirewound
W/O	= without

01194-14

Figure 6-1. Cabinet Parts



Item	Description	HP Part No.
1	Frame Assembly	5060-0736
2	Cover: Top	05061-2041
3	Bottom Cover Assembly	5060-0755
4	Panel: Front	05061-0015
5	Panel: Rear	05061-0016
6	Cover: Side	5000-0747
7	Retainer-Handle Assembly	5060-0765
8	Handle Assembly: Side	5060-0763
9	Foot Assembly: FM	5060-0767
10	Plate: Fluted Aluminum	5000-0053
11	Kit: Rack Mount	5060-0777

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	05061-6097	1	MODULE ASSY: SYNTHESIZER, SERIES 1724	28480	05061-6097
A1 MISC PARTS	05061-0053	1	CHASSIS:SYNTHESIZER	28480	05061-0053
	05061-2003	2	PLATE:END	28480	05061-2003
	05061-0054	1	COVER:SYNTHESIZER	28480	05061-0054
	05061-2005	1	PLATE:END	28480	05061-2005
A1J1	1250-0258	33	JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A1J1	0340-0119	13	INSULATED FEED THRU:TEFLON	98291	FT-SM-023-P20
A1J2	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A1J2	0340-0119		INSULATED FEED THRU:TEFLON	98291	FT-SM-023-P20
A1J3	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A1J3	0340-0119		INSULATED FEED THRU:TEFLON	98291	FT-SM-023-P20
A1A1	05061-6098	1	BOARD ASSY: SYNTHESIZER, SERIES 1724	28480	05061-6098
A1A1 MISC PARTS	0340-0039	22	INSULATOR:BUSHING	28480	0340-0039
A1A1 MISC PARTS	0340-0162	1	INSULATOR:TSTR FOR TO-66	13103	A0340-0162-1
A1A1C1	0160-0127	22	C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C2	0160-3046		C:FXD MICA 250 PF 300V 1%		0160-3046
A1A1C3 THRU A1A1C14			- NOT ASSIGNED		
A1A1C15	0150-0121	17	C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML
A1A1C16	0160-0174	7	C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A1A1C17	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML
A1A1C18	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C19	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C20	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML
A1A1C21	0140-0180	2	C:FXD MICA 2000 PF 2%	28480	0140-0180
A1A1C22	0170-0082	2	C:FXD MY 0.01UF 20% 50VDCW	84411	601PE STYLE 1
A1A1C23	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C24	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C25	0140-0220	2	C:FXD MICA 200 PF 1% 300VDCW	28480	0140-0220
A1A1C26	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C27	0150-0093	45	C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1A1C28	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C29	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C30	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C31	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C32	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C33	0140-0208	2	C:FXD MICA 680 PF 5%	72136	RDM15F681J3C
A1A1C34	0140-0222	1	C:FXD MICA 240 PF 1% 300VDCW	28480	0140-0222
A1A1C35	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1A1C36	0160-0340	2	C:FXD MICA 600 PF 1%	28480	0160-0340
A1A1C37	0180-0291	5	C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A1A1C38	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1A1C39			NOT ASSIGNED		
A1A1C40	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1A1C41	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1A1C42	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1A1C43	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1A1C44	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A1A1C45	0180-0106	8	C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A1A1C46	0140-0220		C:FXD MICA 200 PF 1% 300VDCW	28480	0140-0220
A1A1C47	0180-0197	2	C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A1C48	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1A1C49	0180-0010	1	C:FXD ELECT 8 UF -15+20% 30VDCW	56289	132D805C2030UO DYM
A1A1CR1	1902-3086	1	DIODE BREAKDOWN:4.75 V 2%	28480	1902-3086
A1A1C50	0160-0342	1	C: FXD 800 PF 300VDCW		
A1A1CR2	1901-0025	5	DIODE:SILICON 100MA/1V	07263	FD 2387
A1A1CR3 THRU A1A1CR26			NOT ASSIGNED NOT ASSIGNED		
A1A1CR27	1902-3024	1	DIODE:BREAKDOWN 2.87V 5%	04713	SZ10939-26
A1A1CR28	0122-0013	1	C:VOLTAGE VAR 39 PF 30VDCW	28480	0122-0013
A1A1CR29	1901-0050	10	DIODE:SI 200 MA AT 1V	07263	FDA 6308
A1A1CR30	1901-0040	38	DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A1A1CR31	1902-3193	1	DIODE BREAKDOWN:13.3V 5%	28480	1902-3193
A1A1CR32	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A1A1CR33	1902-0064	1	DIODE BREAKDOWN:7.5V	28480	1902-0064
A1A1CR34	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A1A1CR35	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A1A1CR36	05061-8014	2	DIODE:SILICO		05061-8014
A1A1CR37	05061-8014		DIODE:SILICON 3		05061-8014
A1A1CR38	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A1A1CR39	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A1A1CR40	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A1A1CR41	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A1A1CR42	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A1A1CR43	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1IC1	1820-0322	4	IC:TTL DECADE DIVIDER	56289	N8280A
A1A1IC2	1820-0322		IC:TTL DECADE DIVIDER	56289	N8280A
A1A1IC3	1820-0070	1	IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A1A1IC4	1820-0315		INTEGRATED CIRCUIT	28480	1820-0315
A1A1IC5	1820-0322		IC:TTL DECADE DIVIDER	56289	N8280A
A1A1IC6	1820-0322		IC:TTL DECADE DIVIDER	56289	N8280A
A1A1L1	9140-0237	1	COIL:FXD 200 UH 5%	28480	9140-0237
A1A1L2	9140-0046	2	COIL:FXD RF 1.2 MH	28480	9140-0046
A1A1L3	9140-0187	1	COIL:FXD RF 0.15 UH 10%	36196	31503M
A1A1L4	9140-0046		COIL:FXD RF 1.2 MH	28480	9140-0046
A1A1L5	9140-0190	1	COIL:FXD RF 0.22 UH 20% } SELECTABLE	82142	4411-2M
A1A1L5	9100-1617	1	COIL/CHOKE:3.90 UH 10% } RANGE	28480	9100-1617
A1A1L6	9140-0137	2	COIL:FXD RF 1000 UH 5%	28480	9140-0137
A1A1Q1	1854-0072	1	TSTR:SI NPN	80131	2N3054
A1A1Q2	1854-0009	3	TSTR:SI NPN	80131	2N709
A1A1Q3	1854-0009		TSTR:SI NPN	80131	2N709
A1A1Q4	1854-0009		TSTR:SI NPN	80131	2N709
A1A1Q5			-		
A1A1Q16			NOT ASSIGNED		
A1A1Q17	1854-0032	1	TSTR:SI NPN	80131	2N2221
A1A1Q18	1854-0035	3	TSTR:SI NPN	28480	1854-0035
A1A1Q19	1854-0092	4	TSTR:SI NPN	80131	2N3563
A1A1Q20	1854-0273	1	TSTR:SI NPN	28480	1854-0273
A1A1Q21	1854-0092		TSTR:SI NPN	80131	2N3563
A1A1Q22	1854-0092		TSTR:SI NPN	80131	2N3563
A1A1Q23	1855-0096	1	TSTR:SI FET	28480	1855-0096
A1A1Q24	1854-0003	48	TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A1A1Q25	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A1A1Q26	1854-0092		TSTR:SI NPN	80131	2N3563
A1A1Q27	1854-0023	13	TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A1A1R1	0757-0818	1	R:FXD MET FLM 825 OHM 1% 1/2W	28480	0757-0818
A1A1R2	0757-0900	23	R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A1A1R3	0698-3311		R:FXD MET FLM 51 OHM 5% 2W	28480	0698-3311
A1A1R4	0757-0924	35	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A1A1R5	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A1A1R6	0757-0948	75	R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R7	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R8	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R9	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R10	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R11	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R12	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R13	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R14	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R15	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R16	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R17	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R18	0757-0917	8	R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A1A1R19	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R20	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A1A1R21	0757-0940	11	R:FXD FLM 4700 OHM 2% 1/8W	28480	0757-0940
A1A1R22	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A1A1R23	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R24	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R25	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R26	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R27 THRU			-		
A1A1R51			NOT ASSIGNED		
A1A1R52	0757-0967	2	R:FXD FLM 62K OHM 2% 1/8W	28480	0757-0967
A1A1R53	0757-0916	14	R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A1A1R54	0757-0962	3	R:FXD FLM 39K OHM 2% 1/8W	28480	0757-0962
A1A1R55	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R56	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A1A1R57	0721-0011	1	R:FXD DEPC 500K OHM 1% 1/8W	28480	0721-0011
A1A1R58	0757-0957	10	R:FXD FLM 24K OHM 2% 1/8W	28480	0757-0957
A1A1R59	0757-0940		R:FXD FLM 4700 OHM 2% 1/8W	28480	0757-0940
A1A1R60	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A1A1R61	0757-0907	10	R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A1A1R62	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A1A1R63	0757-0931	17	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A1A1R64	0757-0944	4	R:FXD FLM 6.8K OHM 2% 1/8W	28480	0757-0944
A1A1R65	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A1A1R66	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R67	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A1A1R68	0757-0935	8	R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1R69	0757-0972	17	R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A1A1R70	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A1A1R71	0757-0942	7	R:FXD FLM 5.6K OHM 2% 1/8W	28480	0757-0942
A1A1R72	0698-3130	2	R:FXD MET FLM 2.70 MEGOHM 1% 1/8W	28480	0698-3130
A1A1R73	0698-3130		R:FXD MET FLM 2.70 MEGOHM 1% 1/8W	28480	0698-3130
A1A1R74	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A1A1R75	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A1A1R76	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A1A1R77	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A1A1R78	0757-0964	6	R:FXD FLM 47K OHM 2% 1/8W	28480	0757-0964
A1A1R79	0757-0950	3	R:FXD FLM 12K OHM 2% 1/8W	28480	0757-0950
A1A1R80	0757-0960	8	R:FXD FLM 33K OHM 2% 1/8W	28480	0757-0960
A1A1R81	0698-3129	5	R:FXD DEPC 1.00 MEGOHM 1% 1/8W	28480	0698-3129
A1A1R82	0757-0943	3	R:FXD FLM 6.2K OHM 2% 1/8W	28480	0757-0943
A1A1R83	0698-3126	1	R:FXD DEPC 2.21 MEGOHM 1% 1/8W	28480	0698-3126
A1A1R84	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R85	0698-3127	1	R:FXD DEPC 4.75 MEGOHM 2% 1/8W	28480	0698-3127
A1A1R86	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A1A1R87	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A1A1R88	0698-3129		R:FXD DEPC 1.00 MEGOHM 1% 1/8W	28480	0698-3129
A1A1R89	0757-0950		R:FXD FLM 12K OHM 2% 1/8W	28480	0757-0950
A1A1R90	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A1A1R91	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A1A1R92	0757-0942		R:FXD FLM 5.6K OHM 2% 1/8W	28480	0757-0942
A1A1R93	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A1A1R94	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A1A1R96	0757-0896	2	R:FXD MET FLM 68 OHM 2% 1/8W	28480	0757-0896
A1A1R97	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A1A1R98	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A1A1R99	0757-0962		R:FXD FLM 39K OHM 2% 1/8W	28480	0757-0962
A1A1R100	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A1A1T1	05061-8001	1	TRANSFORMER:BLOCK OSCILLATOR #1	28480	05061-8001
A1A1T2	05061-8011	1	TRANSFORMER:BLACK OSCILLATOR 2	28480	05061-8011
A1A1T3	05061-8003	1	TRANSFORMER SAMPLER:DR	28480	05061-8003
A1A1T4	05061-8004	1	TRANSFORMER:MHZ OUTPUT	28480	05061-8004
A1A1XY1	1200-0758	1	SOCKET:CRYSTAL	91506	8004-1G17
A1A1Y1	0410-0143	1	CRYSTAL:QUARTZ 12.632 MHZ	28480	0410-0143
A2			FOR A2 PARTS LIST REFER TO TABLE 6-2.		
A3	05061-6108	1	MULTIPLIER ASSY:5-90 MHZ	28480	05061-6108
A3 MISC PARTS	0360-1680	1	TERMINAL:SOLDER STUD 4-40 UNC-2A THREAD	01255	755
	1205-0011	1	HEAT DISSIPATOR:FOR TO-5 AND TO-9 CASES	98978	TXBF-032-025B
	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
	2230-0024	32	SCREW:STL PAN HD 4-40 THD	00000	OBD
FL1,FL2	00106-6059	2	FILTER:FEED-THRU (C1-L1 AND C53-L21)	28480	00106-6059
A3 MISC PARTS	05061-0050	1	COVER:BOTTOM	28480	05061-0050
	05061-2047	1	PLATE:END	28480	05061-2047
	05061-0051	1	COVER:TOP	28480	05061-0051
	05061-2048	1	PLATE:END	28480	05061-2048
A3A1	05060-6106	1	ASSY:MULTIPLIER P.C. BOARD	28480	05060-6106
A3A1C1			PART OF FL1		
A3A1C2	0180-2614	15	C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A3A1C3	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C4	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C5	0160-3067	5	C: FXD MICAD 200PF+-5% 300VDCW	28480	0160-3067
A3A1C6	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C7	0160-3067	3	C: FXD MICAD 200PF+-5% 300VDCW	28480	0160-3067
A3A1C8	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C9	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C10	0180-0100	17	C:FXD ELECT 4.7 UF 10% 35VDCW	56289	1500475X903582-DYS
A3A1C11	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C12	0160-0937	3	C: FXD 1000PF+-2% 300VDCW	28480	0160-0937
A3A1C13	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C14	0160-0179	3	C:FXD MICA 33 PF 5% 300VDCW	14655	RDM15E330J3S
A3A1C15	0140-0176	4	C:FXD MICA 100 PF 2%	28480	0140-0176
A3A1C16	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C17	0160-0187	2	C: FXD 42PF +-.5PF 300VDCW	28480	0160-0187
A3A1C18	0150-0059	3	C:FXD CER 3.3-0.25 PF 500VDCW	72982	301-000-COJ0-339C
A3A1C19	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C20	0180-0137	1	C:FXD ELECT 100 UF 20% 10VDCW	56289	1500107X0010R2-DYS
A3A1C21	0160-3067		C: FXD MICAD 200PF +-5% 300VDCW	28480	0160-3067
A3A1C22	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C23	0160-3067		C: FXD MICAD 200PF +-5% 300VDCW	28480	0160-3067
A3A1C24	0160-0178	2	C:FXD MICA 27PF 5% 300VDCW	04062	RDM15E270J3S
A3A1C25	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3A1C26	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C27	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C28	0160-2240	1	C:FXD CER 2.0 PF 500VDCW	72982	301-000-COKO-209C
A3A1C29	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C30	0160-0196	1	C:FXD MICA 24PF 5% 300VDCW	04062	RDM15C240J3S
A3A1C31	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C32	0140-0176		C:FXD MICA 100 PF 2%	28480	0140-0176
A3A1C33	0150-0062	2	C:FXD CER 8.2-0.25 PF 500VDCW	72982	301-000-COHO-829C
A3A1C34	0160-3067		C: FXD MICAD 200PF +-5% 300VDCW	28480	0160-3067
A3A1C35	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C36	0150-0062		C:FXD CER 8.2-0.25 PF 500VDCW	72982	301-000-COHO-829C
A3A1C37	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A3A1C38	0160-3067		C: FXD MICAD 200PF +-5% 300VDCW	28480	0160-3067
A3A1C39	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C40	0140-0201	1	C:FXD MICA 12 PF 5%	28480	0140-0201
A3A1C41	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C42	0180-2614		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A3A1C43	0140-0202	1	C:FXD MICA 15 PF 5% 500VDCW	28480	0140-0202
A3A1C44	0130-0016	2	C:VAR CER 5-25 PF NPO	28480	0130-0016
A3A1C45	0150-0059		C:FXD CER 3.3-0.25 PF 500VDCW	72982	301-000-COJO-339C
A3A1C46	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C47	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C48	0140-0210	1	C:FXD MICA 270 PF 5%	28480	0140-0210
A3A1C49	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C50	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3A1C51	0160-2534	2	C: FXD MICAD 300 PF +-1% 300VDCW	28480	0160-2534
A3A1C52	0160-2201	1	C:FXD MICA 51 PF 5%	72136	RDM15E510J1C
A3A1CR1	1902-0018	1	DIODE BREAKDOWN:11.7V 5%	04713	1N941
A3A1CR2	0122-0016	1	C:VOLTAGE VAR 150-180 PF 20% 15VDCW	28480	0122-0016
A3A1CR3	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A3A1CR4	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A3A1CR5	1902-0006	1	DIODE: ZNR 7V 1%	28480	1902-0006
A3A1CR6	1901-0347	2	DIODE:SILICON 8V	28480	1901-0347
A3A1CR7	1901-0347		DIODE:SILICON 8V	28480	1901-0347
A3A1CR8	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A3A1CR9	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A3A1E1	9170-0029		CORE:FERRITE BEAD	02114	56-590-65A2/4A
A3A1E2	9170-0029		CORE:FERRITE BEAD	02114	56-590-65A2/4A
A3A1E3	9170-0029		CORE:FERRITE BEAD	02114	56-590-65A2/4A
A3A1E4	9170-0029		CORE:FERRITE BEAD	02114	56-590-65A2/4A
A3A1E5	9170-0029		CORE:FERRITE BEAD	02114	56-590-65A2/4A
A3A1E6	9170-0029		CORE:FERRITE BEAD	02114	56-590-65A2/4A
A3A1E7			NOT ASSIGNED		
A3A1E8	9170-0029		CORE:FERRITE BEAD	02114	56-590-65A2/4A
A3A1L1			NSR PART OF FL1, FL2.		
A3A1L2	05060-6033	1	COIL ASSY:5MC	28480	05060-6033
A3A1L3	05060-6031	2	COIL ASSY:30MC	28480	05060-6031
A3A1L4	05060-6031		COIL ASSY:30MC	28480	05060-6031
A3A1L5	9140-0146	2	COIL:FXD RF 10.0 UH	99800	1025-44
A3A1L6	9140-0138	5	COIL/CHOKE 180 UH 5%	28480	9140-0138
A3A1L7	05060-6030	4	COIL ASSY:90MC	28480	05060-6030
A3A1L8	9140-0138		COIL/CHOKE 180 UH 5%	28480	9140-0138
A3A1L9	9140-0180	2	COIL/CHOKE 2.70 UH 10%	28480	9140-0180
A3A1L10	05060-6030		COIL ASSY:90MC	28480	05060-6030
A3A1L11	9140-0158	3	COIL:FXD RF 1 UH 10%	99800	1025-20
A3A1L12	05060-6032	2	COIL ASSY:10MC	28480	05060-6032
A3A1L13	9140-0138		COIL/CHOKE 180 UH 5%	28480	9140-0138
A3A1L14	05060-6032		COIL ASSY:10MC	28480	05060-6032
A3A1L15	05060-6030		COIL ASSY:90MC	28480	05060-6030
A3A1L16	9140-0138		COIL/CHOKE 180 UH 5%	28480	9140-0138
A3A1L17	9140-0138		COIL/CHOKE 180 UH 5%	28480	9140-0138
A3A1L18	9140-0158		COIL:FXD RF 1 UH 10%	99800	1025-20
A3A1L19	9140-0180		COIL/CHOKE 2.70 UH 10%	28480	9140-0180
A3A1L20	05060-6030		COIL ASSY:90MC	28480	05060-6030
A3A1L21			NSR PART OF FL1, FL2.		
A3A1L23	9140-0146		COIL:FXD RF 10.0 UH	99800	1025-44
A3A1L24	9140-0096	1	COIL/CHOKE 1.00 UH 10%	99800	1537-12
A3A1Q1	1854-0005	29	TSTR:SI NPN	80131	2N708
A3A1Q2	1854-0005		TSTR:SI NPN	80131	2N708
A3A1Q3	1854-0005		TSTR:SI NPN	80131	2N708
A3A1Q4	1854-0005		TSTR:SI NPN	80131	2N708
A3A1Q5	1854-0233	2	TSTR:SI NPN	80131	2N3866
A3A1Q6	1854-0005		TSTR:SI NPN	80131	2N708
A3A1Q7	1854-0045	1	TSTR:SI NPN	04713	2N956
A3A1Q8	1854-0233		TSTR:SI NPN	80131	2N3866
A3A1Q9	1854-0005		TSTR:SI NPN	80131	2N708

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3A1R1	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A3A1R2	0757-0895	1	R:FXD FLM 62 OHM 2% 1/8W	28480	0757-0895
A3A1R3	0757-0894	7	R:FXD FLM 56 OHM 2% 1/8W	28480	0757-0894
A3A1R4	0757-0912	2	R:FXD MET FLM 330 OHM 2% 1/8W	28480	0757-0912
A3A1R5	0757-0894		R:FXD FLM 56 OHM 2% 1/8W	28480	0757-0894
A3A1R6	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A3A1R7	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A3A1R8	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A3A1R9	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A3A1R10	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A3A1R11	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A3A1R12	0757-0911	4	R:FXD FLM 300 OHM 2% 1/8W	28480	0757-0911
A3A1R13	0757-0965	8	R:FXD FLM 51K OHM 2% 1/8W	28480	0757-0965
A3A1R14	0757-0920	2	R:FXD FLM 680 OHM 2% 1/8W	28480	0757-0920
A3A1R15	0758-0017	1	R:FXD MET OX 1500 OHM 5% 1/2W	28480	0758-0017
A3A1R16	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A3A1R17	0757-0385	3	R:FXD MET FLM 22.1 OHM 1% 1/8W	28480	0757-0385
A3A1R18	0698-3431	1	R:FXD MET FLM 23.7 OHM 1% 1/8W	28480	0698-3431
A3A1R19	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A3A1R20	2100-1761	2	R:VAR WW 10K OHM 5% TYPE V 1W	28480	2100-1761
A3A1R21	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A3A1R22	0757-0932	9	R:FXD MET FLM 2.2K OHM 2% 1/8W	28480	0757-0932
A3A1R23	0757-0932		R:FXD MET FLM 2.2K OHM 2% 1/8W	28480	0757-0932
A3A1R24	0757-0919	1	R:FXD FLM 620 OHM 2% 1/8W	2848C	0757-0919
A3A1R25	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A3A1R26	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A3A1R27	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A3A1R28	0757-0899	2	R:FXD FLM 91 OHM 2% 1/8W	28480	0757-0899
A3A1R29	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A3A1R30	0757-0928	4	R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A3A1R31	0757-0942		R:FXD FLM 5.6K OHM 2% 1/8W	28480	0757-0942
A3A1R32	0698-3106	5	R:FXD DEPC 5 OHM 1% 1/8W	28480	0698-3106
A3A1R33	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A3A1R34	0757-0932		R:FXD MET FLM 2.2K OHM 2% 1/8W	28480	0757-0932
A3A1R35	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A3A1R36	0757-0932		R:FXD MET FLM 2.2K OHM 2% 1/8W	28480	0757-0932
A3A1R37	0757-0932		R:FXD MET FLM 2.2K OHM 2% 1/8W	28480	0757-0932
A3A1R38	0698-6283	2	R:FXD DEPC 10 OHM 5% 1/8 W	28480	0698-6283
A3A1R39	0698-6283		R:FXD DEPC 10 OHM 5% 1/8 W	28480	0698-6283
A3A1T1	107A-65J-3A	3	TRANSFORMER ASSY:5MC	28480	107A-65J-3A
A3AITI	107A-69A-278	6	PAD:MOUNTING, FOR T1 AND T2	28480	107A-69A-278
A3A1T2	05060-6035	1	TRANSFORMER ASSY:5MC	28480	05060-6035
	107A-69A-278		PAD:MOUNTING, FOR T1 AND T2	28480	107A-69A-278
A4	05060-6029	1	ASSY:GENERATOR HARMONIC NOT RECOMMENDED FOR FIELD REPAIR.	28480	05060-6029
	05060-0050	1	RING:CONTACT	28480	05060-0050
	3030-0150	1	SCREW:SET 2-56 THD 4-SPLINE SOCKET OR	0000C	OBD
	05060-2039	1	COVER	28480	05060-2039
	05060-2051	1	PLUNGER:FILTER CAVITY	28480	05060-2051
	05060-2052	1	COVER:FILTER CAVITY	28480	05060-2052
	05060-2053	1	LOCKNUT:FILTER	28480	05060-2053
	05060-2054	1	KNOB:FILTER CAVITY	28480	05060-2054
	05060-2069	1	HOLDER:BIMETAL	28480	05060-2069
	05061-2061	1	STRIP	28480	05061-2061
	05060-2071	4	SCREW ADJUSTMENT	28480	05060-2071
	05060-2085	1	ATTENUATOR:PLATE	28480	05060-2085
	05060-2086	1	ROD:ATTENUATOR	28480	05060-2086
	05060-2087	1	KNOB:ATTENUATOR	28480	05060-2087
A4	05060-2089	1	CAP:ATTENUATOR	28480	05060-2089
MISC	05060-2092	1	CORE C	28480	05060-2092
PARTS	05060-2093	1	HOLDER:DIODE	28480	05060-2093
	05060-2094	1	SLEEVE:FLANGE	28480	05060-2094
	05060-2095	1	PIN:FLANGE SLEEVE	28480	05060-2095
	05060-2097	1	HOLDER:DIODE	28480	05060-2097
	05060-2098	1	SPRING:COMPRESSION	28480	05060-2098
	05060-2099	1	PLUG:THREADED	28480	05060-2099
	05060-2100	1	CAVITY WAVEGUIDE	28480	05060-2100
	05060-2101	1	CAVITY:FILTER	28480	05060-2101
	05060-2102	1	PLATE:FILTER CAVITY	28480	05060-2102
	0570-1167	1	SCREW:TUNING 55	28480	05061-2062
	05060-6091	1	CAN ASSY:HARMONIC GENERATOR	28480	05060-6091
	05060-2038	1	CAN	28480	05060-2038
	107A-69A-15C	1	SPACER:POWER AMPLIFIER	28480	107A-69A-15C
A4CR2	1901-0167	2	DIODE:SILICON	28480	1901-0167
A4A1	05060-6037	1	ASSY:HARMONIC GENERATOR P.C. BOARD	28480	05060-6037
A4A1C2	0140-0196	1	C:FXD MICA 150 PF 5%	72136	RDM15F151J3C
A4A1C3	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4A1C4	0180-0160	1	C:FXD ELECT 22 UF 20% 35VDCW	28480	0180-0160
A4A1C5	0150-0059		C:FXD CER 3.3-0.25 PF 500VDCW	72982	301-000-COJ0-339C
A4A1C6	0160-0181	2	C:FXD MICA 30PF 5% 300VDCW	14655	RDM15E300J3S
A4A1C7	0140-0215	1	C:FXD MICA 80 PF 2% 300VDCW	28480	0140-0215
A4A1C8	0130-0016		C:VAR CER 5-25 PF NPO	28480	0130-0016
A4A1C12	0160-2257	1	C:FXD CER 10 PF 5% 500VDCW	72982	301-000-COH0-100J
A4A1CR1	1901-0025		DIODE:SILICON 100MA/1V	07263	FD 2387
A4A1L1	9140-0158		COIL:FXD RF 1 UH 10%	99800	1025-20
A4A1L2	9140-0179	1	COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A4A1L3	05060-6087	1	COIL ASSY:90MC	28480	05060-6087
A4A1L4	9140-0106	1	COIL:FXD 0.47 UH	28480	9140-0106
A4A1Q1	1853-0001	5	TSTR:SI PNP(SELECTED FROM 2N1132)	28480	1853-0001
A4A1R1	2100-1756	1	R:VAR WW 200 OHM 5% TYPE V 1W	28480	2100-1756
A4A1R2	2100-0896	1	R:VAR WW 15K OHM 5% LIN 1W	28480	2100-0896
A4A1R3	0757-0346	7	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A1R4	0757-0911		R:FXD FLM 300 OHM 2% 1/8W	28480	0757-0911
A4A1R5	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A1R6	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A4A1R7	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A4A1R8	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A4 C1	0160-2049	5	C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A4 C9	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A4 C10	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A4 CR1	1901-0167		DIODE:SILICON	28480	1901-0167
A4 J1	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A4 J1	5020-0176		INSULATOR FOR SNAP-ON PINS	28480	5020-0176
A4 J2	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A4 J2	5020-0176		INSULATOR FOR SNAP-ON PINS	28480	5020-0176
A4 J3	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A4 J3	5020-0176		INSULATOR FOR SNAP-ON PINS	28480	5020-0176
A5			FOR A5 PARTS LIST, REFER TO TABLE 6-3.		
A6	05061-6102	1	MODULE ASSY:FREQUENCY DIVIDER	28480	05061-6102
	0340-0119		INSULATED FEED THRU:TEFLON	98291	FT-SM-023-P20
	2230-0024		SCREW:STL PAN HD 4-40 THD	00000	OBD
	05060-0012	1	SHIELD:DIVIDER	28480	05060-0012
A6 MISC PARTS	05061-0003	1	COVER:BOTTOM	28480	05061-0003
	05061-0004	1	COVER:TOP	28480	05061-0004
	05061-2028	1	PLATE:END	28480	05061-2028
	05061-2029	1	PLATE:END	28480	05061-2029
A6FL1	05060-6061	1	FILTER ASSY:FEED-THRU	28480	05060-6061
A6FL2	00106-6059		FILTER:FEED-THRU	28480	00106-6059
A6FL3	00106-6059		FILTER:FEED-THRU	28480	00106-6059
A6J1	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A6J2	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A6J3	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A6J4	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A6J5	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A6J6	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A6J7	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A6A1	05061-6103	1	BOARD ASSY:FREQUENCY DIVIDER	28480	05061-6103
A6A1C1	0160-0161	5	C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A6A1C2	0180-2614		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A6A1C3	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A6A1C4	0140-0178	1	C:FXD MICA 560 PF 2%	72136	RDM15F561G3C
A6A1C5	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A6A1C6	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A6A1C7	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C8	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A6A1C9	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C10	0140-0176		C:FXD MICA 100 PF 2%	28480	0140-0176
A6A1C11	0140-0208		C:FXD MICA 680 PF 5%	72136	RDM15F681J3C
A6A1C12	0140-0179		C:FXD MICA 1000 PF 2%	28480	0140-0179
A6A1C13	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A6A1C14	0140-0221		C:FXD MICA 220 PF 1%	28480	0140-0221
A6A1C15	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A6A1C16	0140-0231	1	C:FXD MICA 440PF 1% 300VDCW	04062	RDM15F441F3C
A6A1C17	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C18	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C19	0140-0154	1	C:FXD MICA 1300 PF 5%	28480	0140-0154
A6A1C20	0140-0204	1	C:FXD MICA 47 PF 5% NPO 500VDCW	14655	RDM15E470J5C
A6A1C21	0121-0046	5	C:VARI CER 9-35 PF	28480	0121-0046
A6A1C22	0140-0179		C:FXD MICA 1000 PF 2%	28480	0140-0179
A6A1C23	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C24	0140-0159	1	C:FXD MICA 3000 PF 2%	28480	0140-0159
A6A1C25	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6A1C26	0140-0180		C:FXD MICA 2000 PF 2%	28480	0140-0180
A6A1C27	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C28	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C29	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C30	0180-2614		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A6A1C31	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C32	0160-2566	1	C:FXD MICA 2000 PF 2% 300VDCW	00853	RDM19F202G3S
A6A1C33	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C34	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C35	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A6A1C36	0160-0194	1	C:FXD MY 0.015 UF 10%	56289	192P15392-PTS
A6A1C37	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A6A1C38	0160-0340		C:FXD MICA 600 PF 1%	28480	0160-0340
A6A1C39	0160-3064	1	C:FXD MICA 1000 PF 5% 300VDCW	00853	RDM19F102J3S
A6A1C40	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A6A1C41	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A6A1C42	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A6A1C43	0160-2331	2	C:FXD MICA 8200 PF 1%	00853	RDM20F822F1S
A6A1C44	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A6A1C45	0160-2331		C:FXD MICA 8200 PF 1%	00853	RDM20F822F1S
A6A1C46	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A6A1CR1	1902-0006	1	DIODE BREAKDOWN:7.0V 1%	28480	1902-0006
A6A1CR2	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A6A1CR3	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A6A1CR4	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A6A1CR5	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A6A1CR6	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A6A1CR7	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A6A1CR8	1902-3105	1	DIODE BREAKDOWN:5.62V 2%	04713	SZ10939 111
A6A1CR9	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A6A1IC1	1820-0055	1	IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A6A1L1	9140-0129	6	COIL:FXD RF 220 UH	28480	9140-0129
A6A1L2	9140-0107	1	COIL:FXD RF 27 UH 10%	99800	1840-38
A6A1L3	9140-0129		COIL:FXD RF 220 UH	28480	9140-0129
A6A1L4	9140-0118	2	COIL:FXD 500 UH 5%	28480	9140-0118
A6A1L5	9140-0118		COIL:FXD 500 UH 5%	28480	9140-0118
A6A1L6	9140-0129		COIL:FXD RF 220 UH	28480	9140-0129
A6A1L7	9140-0129		COIL:FXD RF 220 UH	28480	9140-0129
A6A1L8	9140-0129		COIL:FXD RF 220 UH	28480	9140-0129
A6A1L9	9140-0129		COIL:FXD RF 220 UH	28480	9140-0129
A6A1L10	9100-1647	1	COIL/CHOKE 470 UH 5%	82142	19-1331-27J
A6A1Q1	1854-0005		TSTR:SI NPN	80131	2N708
A6A1Q2	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A6A1Q3	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A6A1Q4	1854-0005		TSTR:SI NPN	80131	2N708
A6A1Q5	1855-0056	1	TSTR:SI FET	80131	2N4342
A6A1Q6	1854-0005		TSTR:SI NPN	80131	2N708
A6A1Q7	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A6A1Q8	1854-0005		TSTR:SI NPN	80131	2N708
A6A1Q9	1854-0005		TSTR:SI NPN	80131	2N708
A6A1Q10	1854-0005		TSTR:SI NPN	80131	2N708
A6A1Q11	1854-0005		TSTR:SI NPN	80131	2N708
A6A1Q12	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A6A1Q13	1854-0005		TSTR:SI NPN	80131	2N708
A6A1Q14	1853-0010	1	TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0010
A6A1Q15	1854-0005		TSTR:SI NPN	80131	2N708
A6A1Q16	1854-0005		TSTR:SI NPN	80131	2N708
A6A1R1	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A6A1R2	0757-0940		R:FXD FLM 4700 OHM 2% 1/8W	28480	0757-0940
A6A1R3	0757-0936	6	R:FXD FLM 3.3K OHM 2% 1/8W	28480	0757-0936
A6A1R4	0757-0893	15	R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A6A1R5	0757-0921	3	R:FXD MET FLM 750 OHM 2% 1/8W	28480	0757-0921
A6A1R5	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A6A1R6	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A6A1R7	0757-0897	1	R:FXD FLM 75 OHM 2% 1/8W	28480	0757-0897
A6A1R8	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A6A1R9	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A6A1R10	0757-0957		R:FXD FLM 24K OHM 2% 1/8W	28480	0757-0957
A6A1R11	0757-0929	4	R:FXD FLM 1.6K OHM 2% 1/8W	28480	0757-0929
A6A1R12	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A6A1R13	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A6A1R14	0757-0963	3	R:FXD FLM 43K OHM 2% 1/8W	28480	0757-0963
A6A1R15	0757-0955	8	R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A6A1R16	0757-0944		R:FXD FLM 6.8K OHM 2% 1/8W	28480	0757-0944
A6A1R17	0757-0930	2	R:FXD FLM 1.8K OHM 2% 1/8W	28480	0757-0930

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6A1R18	0757-0958	3	R:FXD MET FLM 27K OHM 2% 1/8W	28480	0757-0958
A6A1R19	0757-0976	7	R:FXD FLM 150K OHM 2% 1/8W	28480	0757-0976
A6A1R20	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A6A1R21	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A6A1R22	0757-0474	2	R:FXD MET FLM 243K OHM 1% 1/8W	28480	0757-0474
A6A1R22	0757-0474		R:FXD MET FLM 243K OHM 1% 1/8W	28480	0757-0474
A6A1R23	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A6A1R24	0757-0929		R:FXD FLM 1.6K OHM 2% 1/8W	28480	0757-0929
A6A1R25	0757-0940		R:FXD FLM 4700 OHM 2% 1/8W	28480	0757-0940
A6A1R26	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A6A1R27	0757-0952	11	R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A6A1R28	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A6A1R29	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A6A1R30	0757-0920		R:FXD FLM 680 OHM 2% 1/8W	28480	0757-0920
A6A1R31	0757-0898	4	R:FXD FLM 82 OHM 2% 1/8W	28480	0757-0898
A6A1R32	0757-0922	2	R:FXD FLM 820 OHM 2% 1/8W	28480	0757-0922
A6A1R33	0757-0942		R:FXD FLM 5.6K OHM 2% 1/8W	28480	0757-0942
A6A1R34	0757-0951	3	R:FXD FLM 13K OHM 2% 1/8W	28480	0757-0951
A6A1R35	0757-0944		R:FXD FLM 6.8K OHM 2% 1/8W	28480	0757-0944
A6A1R36	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A6A1R37	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A6A1R38	0757-0927	4	R:FXD FLM 1.3K OHM 2% 1/8W	28480	0757-0927
A6A1R39	0757-0927		R:FXD FLM 1.3K OHM 2% 1/8W	28480	0757-0927
A6A1R40	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A6A1R41	0757-0915	3	R:FXD FLM 430 OHM 2% 1/8W	28480	0757-0915
A6A1R42	0757-0927		R:FXD FLM 1.3K OHM 2% 1/8W	28480	0757-0927
A6A1R43	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A6A1R44	0757-1060	1	R:FXD MET FLM 196 OHM 1% 1/2W	28480	0757-1060
A6A1R45	0757-0938	5	R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A6A1R46	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A6A1R47	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A6A1R48	0757-0941	14	R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A6A1R49	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A6A1R50	0757-0940		R:FXD FLM 4700 OHM 2% 1/8W	28480	0757-0940
A6A1R51	0757-0929		R:FXD FLM 1.6K OHM 2% 1/8W	28480	0757-0929
A6A1R52	0757-0936		R:FXD FLM 3.3K OHM 2% 1/8W	28480	0757-0936
A6A1R53	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A6A1R54	0757-0932		R:FXD MET FLM 2.2K OHM 2% 1/8W	28480	0757-0932
A6A1R55	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A6A1R56	0757-0911		R:FXD FLM 300 OHM 2% 1/8W	28480	0757-0911
A6A1R57	0757-0915		R:FXD FLM 430 OHM 2% 1/8W	28480	0757-0915
A6A1R58	0757-0899		R:FXD FLM 91 OHM 2% 1/8W	28480	0757-0899
A6A1R59	0757-0922		R:FXD FLM 820 OHM 2% 1/8W	28480	0757-0922
A6A1R60	0757-0942		R:FXD FLM 5.6K OHM 2% 1/8W	28480	0757-0942
A6A1T1	05061-8006	1	TRANSFORMER:5MHZ INPUT	28480	05061-8006
A6A1T2	05061-8005	2	TRANSFORMER:1MHZ-4MHZ	28480	05061-8005
A6A1T3	05061-8007	1	TRANSFORMER:1MHZ OUTPUT	28480	05061-8007
A6A1T4	05061-8007		TRANSFORMER:1MHZ OUTPUT	28480	05061-8007
A6A1T5	107A-9C	1	TRANSFORMER ASSY:100KHZ	28480	107A-9C
A7	05061-6005	1	MODULE ASSY:AC AMPLIFIER	28480	05061-6005
A7 MISC PARTS	0340-0119		INSULATED FEED THRU:TEFLON	98291	FT-SM-023-P20
	00105-2010	1	TIP:INPUT	28480	00105-2010
	05061-0005	1	CHASSIS:AC AMPLIFER	28480	05061-0005
	05061-0006	1	COVER:AC AMPLIFIER	28480	05061-0006
	05061-2001	2	PLATE:END	28480	05061-2001
	05061-2007	1	PLATE:END	28480	05061-2007
	05061-2039	1	SHAFT	28480	05061-2039
A7J1	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A7J2	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A7J3	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A7J4	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A7J5	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A7J6	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A7R17	2100-3182	1	R:VAR CERMET 10K OHM 20% LOG 1/4W	28480	2100-3182
A7A1	05061-6006	1	BOARD ASSY:AC AMPLIFIER	28480	05061-6006
A7A1C1	0160-2415	1	C:FXD MY 0.0082 UF 5% 200VDCW	28480	0160-2415
A7A1C2	0140-0225		C:FXD MICA 300 PF 1%	28480	0140-0225
A7A1C3	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A7A1C4	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A7A1C5	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A7A1C6	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A7A1C7	0160-0180	4	C:FXD MY 0.033 UF 5%	28480	0160-0180
A7A1C8	0170-0084	2	C:FXD MY 0.068UF 20% 50VDCW	84411	601PE STYLE 3
A7A1C9	0170-0094	3	C:FXD MY 0.047UF 20% 50VDCW	84411	TYPE 602
A7A1C10	0160-0180		C:FXD MY 0.033 UF 5%	28480	0160-0180

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7A1C11	0170-0094		C:FXD MY 0.047UF 20% 50VDCW	84411	TYPE 602
A7A1C12	0160-0128	4	C:FXD CER 2.2 UF 20% 25VDCW	56289	5C152C2S-CML
A7A1C13	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A7A1C14	0170-0085	7	C:FXD MY 0.1UF 20% 50VDCW	84411	601PE STYLE 3
A7A1C15	0170-0085		C:FXD MY 0.1UF 20% 50VDCW	84411	601PE STYLE 3
A7A1C16	0150-0086	1	C:FXD CER 0.0047 UF 20% 500VDCW	56289	29C333A3-CDH
A7A1C17	0180-2614		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A7A1C18	0170-0082		C:FXD MY 0.01UF 20% 50VDCW	84411	601PE STYLE 1
A7A1C19	0180-2614		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A7A1C20	0170-0091	3	C:FXD POLY 0.01213 UF 2% 50VDCW	56289	P146504 PYP
A7A1C21	0180-2614		C: FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A7A1C21	0180-0113		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	109D107C2030T2
A7A1C22	0170-0090	2	C:FXD POLY 0.0252 UF 1% 50VDCW	56289	P246505 PYP
A7A1C23	0170-0091		C:FXD POLY 0.01213 UF 2% 50VDCW	56289	P146504 PYP
A7A1CR1	1901-0033	12	DIODE:SILICON 100MA 180WV	07263	F03369
A7A1CR2	1901-0033		DIODE:SILICON 100MA 180WV	07263	F03369
A7A1CR3	1902-0245	1	DIODE:BREAKDOWN 6.8V 5% 1N4099	04713	1N4099
A7A1CR4	1902-1172	1	DIODE BREAKDOWN:9.1V 5%	04713	1N4103
A7A1CR5	1901-0033		DIODE:SILICON 100MA 180WV	07263	F03369
A7A1Q1	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A7A1Q2	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A7A1Q3	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A7A1Q4	1855-0049	1	TSTR:SI FET N-CHANNEL DUAL	28480	1855-0049
A7A1Q5	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A7A1Q6	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A7A1Q7	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A7A1Q8	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A7A1Q9	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A7A1Q10	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A7A1Q11	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A7A1Q12	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A7A1Q13	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A7A1Q14	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A7A1R1	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A7A1R2	0757-0966	3	R:FXD FLM 56K OHM 2% 1/8W	28480	0757-0966
A7A1R3	0730-0168	1	R:FXD DEPC 10 MEGOHM 1% 1W	28480	0730-0168
A7A1R4	0698-3131	1	R:FXD DEPC 3.30 MEGOHM 1% 1/8W	28480	0698-3131
A7A1R5	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A7A1R6	0757-0966		R:FXD FLM 56K OHM 2% 1/8W	28480	0757-0966
A7A1R7	0757-0966		R:FXD FLM 56K OHM 2% 1/8W	28480	0757-0966
A7A1R8	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A7A1R9	0757-0955		R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A7A1R10	0698-3129		R:FXD DEPC 1.00 MEGOHM 1% 1/8W	28480	0698-3129
A7A1R11	0757-0946	1	R:FXD FLM 8.2K OHM 2% 1/8W	28480	0757-0946
A7A1R12	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A7A1R13	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A7A1R14	0757-0957		R:FXD FLM 24K OHM 2% 1/8W	28480	0757-0957
A7A1R15	0757-0959	4	R:FXD FLM 30K OHM 2% 1/8W	28480	0757-0959
A7A1R16	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A7A1R17	NOT ASSIGNED				
A7A1R18	2100-1772	1	R:VAR WW 500 OHM 5% TYPE H 1W	28480	2100-1772
A7A1R19	0757-0929		R:FXD FLM 1.6K OHM 2% 1/8W	28480	0757-0929
A7A1R20	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A7A1R21	0757-0957		R:FXD FLM 24K OHM 2% 1/8W	28480	0757-0957
A7A1R22	0757-0970	1	R:FXD FLM 82K OHM 2% 1/8W	28480	0757-0970
A7A1R23	0757-0976		R:FXD FLM 150K OHM 2% 1/8W	28480	0757-0976
A7A1R24	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A7A1R25	0698-4308	2	R:FXD MET FLM 16.9K OHM 1% 1/8W	28480	0698-4308
A7A1R26	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A7A1R27	0698-5469	1	R:FXD MET FLM 8665 OHM 1% 1/8W	28480	0698-5469
A7A1R28	0698-4308		R:FXD MET FLM 16.9K OHM 1% 1/8W	28480	0698-4308
A7A1R29	0757-0940		R:FXD FLM 4700 OHM 2% 1/8W	28480	0757-0940
A7A1R30	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A7A1R31	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A7A1R32	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A7A1R33	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A7A1R34	0757-0896		R:FXD MET FLM 68 OHM 2% 1/8W	28480	0757-0896
A7A1R35	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A7A1R36	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A7A1R37	0757-0940		R:FXD FLM 4700 OHM 2% 1/8W	28480	0757-0940
A7A1R38	0757-0940		R:FXD FLM 4700 OHM 2% 1/8W	28480	0757-0940
A7A1R39	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A7A1R40	0757-0894		R:FXD FLM 56 OHM 2% 1/8W	28480	0757-0894
A7A1R41	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A7A1R42	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A7A1R43	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7A1R44	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A7A1R45	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A7A1R46	0698-3129		R:FXD DEPC 1.00 MEGOHM 1% 1/8W	28480	0698-3129
A7A1R47	0698-0077	2	R:FXD MET FLM 93.1K OHM 1% 1/8W	28480	0698-0077
A7A1R48	0757-0955		R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A7A1R49	0757-0457	2	R:FXD MET FLM 47.5K OHM 1% 1/8W	28480	0757-0457
A7A1R50	0698-0077		R:FXD MET FLM 93.1K OHM 1% 1/8W	28480	0698-0077
A7A1R51	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A7A1R52	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A7A1R53	0757-0900	1	R:FXD 100Ω 2% 1/8W	28480	0757-0900
A7A1	0340-0037	4	POST:TERMINAL		0340-0037
MISC PARTS	0340-0039		INSULATOR:BUSHING	28480	0340-0039
A8	05061-6095	1	MODULE ASSY:PHASE DETECTOR	28480	05061-6095
	0340-0119		INSULATED FEED THRU:TEFLON	98291	FT-SM-023-P20
	2230-0024		SCREW:STL PAN HD 4-40 THD	00000	OBD
	5020-0176		INSULATOR FOR SNAP-ON PINS	28480	5020-0176
A8 MISC PARTS	05060-0008	1	COVER:BOTTOM	28480	05060-0008
	05061-0007	1	COVER:TOP	28480	05061-0007
	05061-2033	1	PLATE:END	28480	05061-2033
	05061-2034	1	PLATE:END	28480	05061-2034
A8J1	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A8J2	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A8J3	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A8J4	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A8J5	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A8J6	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A8E1, E2	9170-0029	2	BEAD:FERRITE		9170-0029
A8A1	05060-6096	1	BOARD ASSY:PHASE DETECTOR	28480	05060-6096
A8A1C1	0170-0091		C:FXD POLY 0.01213 UF 2% 50VDCW	56289	P146504 PYP
A8A1C2	0180-0117	6	C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A8A1C3	0170-0090		C:FXD POLY 0.0252 UF 1% 50VDCW	56289	P246505 PYP
A8A1C4	0180-0116	3	C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A8A1C5	0140-0209	1	C:FXD MICA 5.0 PF 10%	28480	0140-0209
A8A1C6	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML
A8A1C7	0140-0176		C:FXD MICA 100 PF 2%	28480	0140-0176
A8A1C8	0160-0370	3	C:FXD MICA 20 PF 5%	28480	0160-0370
A8A1C9	0180-0113		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	109D107C2030T2
A8A1C10	0180-0113		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	109D107C2030T2
A8A1C11	0160-2307		C:FXD MICA 47 PF 5%	28480	0160-2307
A8A1C12	0160-0370		C:FXD MICA 20 PF 5%	28480	0160-0370
A8A1C13	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8A1C14	0160-0370		C:FXD MICA 20 PF 5%	28480	0160-0370
A8A1C15	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A8A1C16	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A8A1C17	0160-0869	2	C:FXD MY 0.47 UF 10% 50VDCW	82047	65F17AA474
A8A1C18	0160-0869		C:FXD MY 0.47 UF 10% 50VDCW	82047	65F17AA474
A8A1C19	0170-0085		C:FXD MY 0.1UF 20% 50VDCW	84411	601PE STYLE 3
A8A1C20	0170-0086	2	C:FXD MY 0.22UF 20% 50VDCW	84411	601PE STYLE 3
A8A1C21	0180-0116		C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A8A1C22	0180-0113		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	109D107C2030T2
A8A1C23	0170-0085		C:FXD MY 0.1UF 20% 50VDCW	84411	601PE STYLE 3
A8A1C24	0170-0094		C:FXD MY 0.047UF 20% 50VDCW	84411	TYPE 602
A8A1C25	0170-0085		C:FXD MY 0.1UF 20% 50VDCW	84411	601PE STYLE 3
A8A1C26	0170-0085		C:FXD MY 0.1UF 20% 50VDCW	84411	601PE STYLE 3
A8A1C27	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A8A1C28	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A8A1C29	0170-0085		C:FXD MY 0.1UF 20% 50VDCW	84411	601PE STYLE 3
A8A1CR1	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A8A1CR2	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A8A1CR3	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A8A1CR4	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A8A1CR5	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A8A1CR6	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A8A1CR7	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A8A1Q1	1854-0541		TSTR:SI NPN	28480	1854-0541
A8A1Q2	1854-0541		TSTR:SI NPN	28480	1854-0541
A8A1Q3	1854-0541		TSTR:SI NPN	28480	1854-0541
A8A1Q4	1854-0005		TSTR:SI NPN	80131	2N708
A8A1Q5	1854-0005		TSTR:SI NPN	80131	2N708
A8A1Q6	1854-0005		TSTR:SI NPN	80131	2N708
A8A1Q7	1854-0005		TSTR:SI NPN	80131	2N708
A8A1Q8	1854-0541		TSTR:SI NPN	28480	1854-0541
A8A1Q9	1854-0541		TSTR:SI NPN	28480	1854-0541
A8A1Q10	1854-0541		TSTR:SI NPN	28480	1854-0541
A8A1Q11	1854-0541		TSTR:SI NPN	28480	1854-0541
A8A1Q12	1854-0541		TSTR:SI NPN	28480	1854-0541
A8A1Q13	1853-0005	1	TSTR:SI PNP	80131	2N941

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8A1R1	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A8A1R2	0757-0957		R:FXD FLM 24K OHM 2% 1/8W	28480	0757-0957
A8A1R3	0757-0927		R:FXD FLM 1K OHM 2% 1/8W	28480	0757-0927
A8A1R4	0757-0457		R:FXD MET FLM 47.5K OHM 1% 1/8W	28480	0757-0457
A8A1R5	0757-0444	1	R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A8A1R6	0757-0959		R:FXD FLM 30K OHM 2% 1/8W	28480	0757-0959
A8A1R7	0757-0450	1	R:FXD MET FLM 22.1K OHM 1% 1/8W	28480	0757-0450
A8A1R8	0757-0894		R:FXD FLM 56 OHM 2% 1/8W	28480	0757-0894
A8A1R9	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A8A1R10	2100-1760	1	R:VAR WW 5K OHM 5% TYPE V 1W	28480	2100-1760
A8A1R11	0757-0945	1	R:FXD FLM 7.5K OHM 2% 1/8W	28480	0757-0945
A8A1R12	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A8A1R13	0757-0442	2	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8A1R14	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A8A1R15	0757-0914	3	R:FXD FLM 390 OHM 2% 1/8W	28480	0757-0914
A8A1R16	0757-0957		R:FXD FLM 24K OHM 2% 1/8W	28480	0757-0957
A8A1R17	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8A1R18	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A8A1R19	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A8A1R20	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A8A1R21	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A8A1R22	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A8A1R23	0757-0273	3	R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A8A1R24	0757-0957		R:FXD FLM 24K OHM 2% 1/8W	28480	0757-0957
A8A1R25	0757-0958		R:FXD MET FLM 27K OHM 2% 1/8W	28480	0757-0958
A8A1R26	0757-0914		R:FXD FLM 390 OHM 2% 1/8W	28480	0757-0914
A8A1R27	0757-0958		R:FXD MET FLM 27K OHM 2% 1/8W	28480	0757-0958
A8A1R28	0757-0957		R:FXD FLM 24K OHM 2% 1/8W	28480	0757-0957
A8A1R29	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A8A1R30	0757-0427	4	R:FXD MET FLM 1.5K OHM 1% 1/8W	28480	0757-0427
A8A1R31	0757-0427		R:FXD MET FLM 1.5K OHM 1% 1/8W	28480	0757-0427
A8A1R32	0757-0427		R:FXD MET FLM 1.5K OHM 1% 1/8W	28480	0757-0427
A8A1R33	0757-0427		R:FXD MET FLM 1.5K OHM 1% 1/8W	28480	0757-0427
A8A1R34	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A8A1R35	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A8A1R36	0757-0965		R:FXD FLM 51K OHM 2% 1/8W	28480	0757-0965
A8A1R37	0757-0976		R:FXD FLM 150K OHM 2% 1/8W	28480	0757-0976
A8A1R38	0727-0013	2	R:FXD DEPC 24.3 OHM 1% 1/2W	28480	0727-0013
A8A1R39	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A8A1R39	2100-1762	1	R:VAR WW 20K 5% 1W	75042	CT-106-4
A8A1R40	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A8A1R41	0757-0964		R:FXD FLM 47K OHM 2% 1/8W	28480	0757-0964
A8A1R42	2100-1923	1	R:VAR WW 50K OHM 5% LIN 1W	28480	2100-1923
A8A1R43	0757-0964		R:FXD FLM 47K OHM 2% 1/8W	28480	0757-0964
A8A1R44	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A8A1R45	0757-0955		R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A8A1R46	0757-0964		R:FXD FLM 47K OHM 2% 1/8W	28480	0757-0964
A8A1R47	0727-0013		R:FXD DEPC 24.3 OHM 1% 1/2W	28480	0727-0013
A8A1R48	0757-0965		R:FXD FLM 51K OHM 2% 1/8W	28480	0757-0965
A8A1R49	0727-0002	1	R:FXD DEPC 3.0 OHM 1% 1/2W	28480	0727-0002
A8A1R50	0757-0965		R:FXD FLM 51K OHM 2% 1/8W	28480	0757-0965
A8A1R51	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A8A1R52	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A8A1R53	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A8A1R54	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A8A1T1	9100-0340	1	TRANSFORMER	28480	9100-0340
A9	05061-6134	1	MODULE ASSY:OPERATIONAL AMPLIFIER	28480	05061-6134
	1251-0215	2	RETAINER:CONNECTOR SUBMINAT TYPE D	71468	DE51224-1
MISC PARTS	05061-0047	1	COVER:BOTTOM	28480	05061-0047
	1251-1636	1	CONNECTOR: SGL CONT SKT	28480	1251-1636
	05061-2035	1	PLATE:END	28480	05061-2035
	05061-2036	1	PLATE:END	28480	05061-2036
	0340-0037	2	TERMINAL STUD	28480	0340-0037
	0340-0039	2	TERMINAL BUSHING	28480	0340-0039
	05061-0083	1	COVER: TOP	28480	05061-0083
	1250-0258		JACK: COAXIAL 50-OHM SUB-MINIATURE CHASSIS	28480	1250-0258
A9J1	1251-0216		CONNECTOR: MALE 9-CONTACT TYPE D	28480	1251-0216
A9J2					
A9A1	05061-6135	1	BOARD ASSEMBLY OPERATIONAL AMPLIFIER	28480	05061-6135
A9A1C1	0160-0127	2	C: FXD CER 1.0 µF 20% 25VDCW	28480	0160-0127
A9A1C2	0160-0127		C: FXD CER 1.0 µF 20% 25VDCW	28480	0160-0127
A9A1C3	0160-2199	1	C: FXD MICA 30PF 5% 300VDCW	28480	0160-2199
A9A1C4	0160-0138	1	C. FXD POLYE .047 µF 10% 200VDCW	28480	0160-0138
A9A1C5	0160-3830	1	C: FXD MET POLYE 5 µF 10% 50VDCW	28480	0160-3830

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9A1CR1	1901-0376	2	DIODE: Si 50 mA 35WV	28480	1901-0376
A9A1CR2	1901-0376		DIODE: Si 50 mA 35WV	28480	1901-0376
A9A1CR3	1902-0063	2	DIODE BREAKDOWN: 15V 1%	28480	1902-0063
A9A1CR4	1902-0063		DIODE BREAKDOWN: 15V 1%	28480	1902-0063
A9A1R1	0757-0897		R: FXD MET FLM 75 OHM 2% 1/8W	24546	C4-1/8-TO-75RO-G
A9A1R2	0757-0897		R: FXD MET FLM 75 OHM 2% 1/8W	24546	C4-1/8-TO-75RO-G
A9A1R3	0757-0924		R: FXD MET FLM 1000 OHM 2% 1/8W	24546	C4-1/8-TO-1001-G
A9A1R4	0757-0472		R: FXD MET FLM 200K OHM 1% 1/8W	24546	C4-1/8-TO-2003-F
A9A1R5	0757-0472		R: FXD MET FLM 200K OHM 1% 1/8W	24546	C4-1/8-TO-2003-F
A9A1R6	0757-0472	1	R: FXD MET FLM 200K OHM 1% 1/8W		
A9A1R7	0757-0924	1	R: FXD MET FLM 200K OHM 1% 1/8W		
		1			
A9A1U1	0960-0089	1	IC: OP. AMP	28480	0960-0089
A9A1U2	1826-0059	1	IC: OP. AMP LM201AH	04713	MLM201AG
A9A1Z4	8150-0072	1	WIRE 22AWG 1KV	28480	8150-0072

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10			REBUILT OSC. ASSY. IS AVAILABLE; ORDER HP PART NO. 00105-6034. COMPONENTS INSIDE A10 NOT RECOMMENDED FOR CUSTOMER FACILITY REPAIR.		
A10A1	00105-6006	1	ASSY:CONTROLLER AC	28480	00105-6006
A10A1C1	0160-2671	2	C:FXD MY 0.1 UF 5% 80VDCW	56289	192P1045R8-PTS
A10A1C2	0160-2672	1	C:FXD MY 0.047 UF 5% 80VDCW	28480	0160-2672
A10A1C3	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A10A1C4	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A10A1C5			NOT ASSIGNED		
A10A1C6	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A10A1C7	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A10A1C8	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A10A1C9	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A10A1C10	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A10A1C11	0150-0122	1	C:FXD CER 2000 PF 20% 500VDCW	72982	8C1-000-Y5S-202M
A10A1C12	0160-0182	1	C:FXD MICA 47PF 5% 300VDCW	14655	RDM15E470J3S
A10A1CR1	1901-0025		DIODE:SILICON 100MA/1V	07263	FD 2387
A10A1CR2	1901-0025		DIODE:SILICON 100MA/1V	07263	FD 2387
A10A1F1	2110-0254	2	FUSE:THERMAL 15A	15558	1194
A10A1F2	2110-0254		FUSE:THERMAL 15A	15558	1194
A10A1Q1	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A10A1Q2	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A10A1R1	0757-0422	2	R:FXD MET FLM 909 OHM 1% 1/8W	28480	0757-0422
A10A1R2	0757-0415	1	R:FXD MET FLM 475 OHM 1% 1/8W	28480	0757-0415
A10A1R3	2100-2224	1	R:VAR WW 200 OHM 5% LIN 1W	28480	2100-2224
A10A1R4	0757-0419	1	R:FXD MET FLM 681 OHM 1% 1/8W	28480	0757-0419
A10A1R4			FACTORY SELECTED VALUE.		
A10A1R4	0757-0420	1	R:FXD MET FLM 750 OHM 1% 1/8W	28480	0757-0420
A10A1R4			FACTORY SELECTED VALUE.		
A10A1R4	0757-0421	1	R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A10A1R4			FACTORY SELECTED VALUE.		
A10A1R4	0757-0422		R:FXD MET FLM 909 OHM 1% 1/8W	28480	0757-0422
A10A1R4			FACTORY SELECTED VALUE.		
A10A1R5	0757-0939	2	R:FXD FLM 4.3K OHM 2% 1/8W	28480	0757-0939
A10A1R6	0757-0939		R:FXD FLM 4.3K OHM 2% 1/8W	28480	0757-0939
A10A1R7	0757-0976		R:FXD FLM 150K OHM 2% 1/8W	28480	0757-0976
A10A1R8	0757-0904	2	R:FXD FLM 150 OHM 2% 1/8W	28480	0757-0904
A10A1R9	0757-0913	2	R:FXD MET FLM 360 OHM 2% 1/8W	28480	0757-0913
A10A1R10	0757-0913		R:FXD MET FLM 360 OHM 2% 1/8W	28480	0757-0913
A10A1R11	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A10A1R12	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A10A2	00105-6010	1	ASSY:OSCILLATOR AND AGC 5MHZ	28480	00105-6010
A10A2	0340-0039		INSULATOR:BUSHING	28480	0340-0039
A10A2	3050-0253	2	WASHER:SPRING	28480	3050-0253
A10A2	00105-0002	2	COVER:OVEN	28480	00105-0002
A10A2	00105-2008	2	SCREW:GUIDE	28480	00105-2008
A10A2	00105-2015	1	COVER:CRYSTAL	28480	00105-2015
A10A2	00105-4003	2	SPACER:PLASTIC	28480	00105-4003
A10A2	00105-4007	1	SHAFT:COARSE	28480	00105-4007
A10A2	00105-4015	4	SPACER:PLASTIC	28480	00105-4015
A10A2C5	0160-2437	4	C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A10A2C6	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A10A2C7	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A10A2C8	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A10A2L2	00105-8004		COIL:FREQ PADDING(TYPICAL VALUE 30UH)	28480	00105-8004
A10A2L2	00105-8006		COIL FREQUENCY-PAD	28480	00105-8006
A10A2L2	00105-8008	1	COIL FREQUENCY-PAD	28480	00105-8008
A10A2R3	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A10A2R4	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A10A2W1	00105-6008	1	CABLE:AGC OUTPUT	28480	00105-6008
A10A2Y1	5080-0049	1	CRYSTAL:5MHZ	28480	5080-0049
A10A3	00105-6007	1	ASSY:POWER AMPLIFIER BOARD	28480	00105-6007
A10A3C1	0160-2055	19	C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A3C2	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A3C3	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A3C4	0180-2182	1	C:FXD ELECT 18 UF 10% 50VDCW	28480	0180-2182
A10A3C5	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A3C6	0160-2326	1	C:FXD MICA 150 PF 5%	28480	0160-2326
A10A3C7	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A3C8	0160-2188	1	C:FXD MY 0.0039 UF 5% 200VDCW	56289	292P39252-PTS
A10A3C9	0160-0178		C:FXD MICA 27PF 5% 300VDCW	04062	RDM15E270J3S
A10A3C9	0160-0179		C:FXD MICA 33 PF 5% 300VDCW	14655	RDM15E330J3S
A10A3C9	0160-0181		C:FXD MICA 30PF 5% 300VDCW	14655	RDM15E300J3S
A10A3C10	0121-0046		C:VARI CER 9-35 PF	28480	0121-0046

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10A3C11	0160-2328	1	C:FXD MICA 200 PF 1% 300VDCW	04062	RDM15F201F3S
A10A3C12	0121-0046		C:VARI CER 9-35 PF	28480	0121-0046
A10A3C13	0140-0197	1	C:FXD MICA 180 PF 5% 300VDCW	14655	RDM15F181J3C
A10A3C13	0160-2005	1	C:FXD MICA 230PF 1% 500VDCW	04062	RDM15F231F5C
A10A3C13	0160-2025	1	C:FXD MICA 220 PF 5% 500VDCW	28480	0160-2025
A10A3C13	0160-2531	1	C:FXD MICA 240 PF 1% 300VDCW	00853	RDM15F241F3S
A10A3C14	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A3C15	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A3CR1	1901-0049	2	DIODE:SILICON 50PIV	28480	1901-0049
A10A3CR2	1901-0049		DIODE:SILICON 50PIV	28480	1901-0049
A10A3CR3	1901-0025		DIODE:SILICON 100MA/1V	07263	FD 2387
A10A3L1	9100-2430	3	INDUCTOR:220 UH	82142	15S-221K
A10A3L2	9100-2430		INDUCTOR:220 UH	82142	15S-221K
A10A3L3	9100-2430		INDUCTOR:220 UH	82142	15S-221K
A10A3Q1	1854-0005		TSTR:SI NPN	80131	2N708
A10A3Q2	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A10A3Q3	1854-0039	2	TSTR:SI NPN	80131	2N3053
A10A3Q4	1854-0020	2	TSTR:SI NPN	28480	1854-0020
A10A3Q5	1854-0005		TSTR:SI NPN	80131	2N708
A10A3Q6	1854-0251	1	TSTR:SI NPN	28480	1854-0251
A10A3R1	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A10A3R2	0757-0954	4	R:FXD FLM 18K OHM 2% 1/8W	28480	0757-0954
A10A3R3	0757-0962		R:FXD FLM 39K OHM 2% 1/8W	28480	0757-0962
A10A3R4	0757-0956	4	R:FXD FLM 22K OHM 2% 1/8W	28480	0757-0956
A10A3R5	0757-0910	1	R:FXD MET FLM 270 OHM 2% 1/8W	28480	0757-0910
A10A3R6	0757-0956		R:FXD FLM 22K OHM 2% 1/8W	28480	0757-0956
A10A3R7	0757-0937	1	R:FXD FLM 3.6K OHM 2% 1/8W	28480	0757-0937
A10A3R8	0698-0001	1	R:FXD COMP 4.7 OHM 5% 1/2W	01121	EB 47G5
A10A3R9	0757-0895		R:FXD FLM 62 OHM 2% 1/8W	28480	0757-0895
A10A3R9	0757-0896		R:FXD MET FLM 68 OHM 2% 1/8W	28480	0757-0896
A10A3R9	0757-0897		R:FXD FLM 75 OHM 2% 1/8W	28480	0757-0897
A10A3R9	0757-0898		R:FXD FLM 82 OHM 2% 1/8W	28480	0757-0898
A10A3R10	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A10A3R11	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A10A3R12	0698-3427	1	R:FXD MET FLM 13.3 OHM 1% 1/8W	28480	0698-3427
A10A3R12	0698-3428	1	R:FXD MET FLM 14.7 OHM 1% 1/8W	28480	0698-3428
A10A3R12	0698-3432	1	R:FXD MET FLM 26.1 OHM 1% 1/8W	28480	0698-3432
A10A3R12	0698-3435	1	R:FXD MET FLM 38.3 OHM 1% 1/8W	28480	0698-3435
A10A3R12	0698-4037	1	R:FXD MET FLM 46.4 OHM 1% 1/8W	28480	0698-4037
A10A3R12	0698-4088	1	R:FXD MET FLM 27 OHM 1% 1/8W	28480	0698-4088
A10A3R12	0698-4364	1	R:FXD FLM 17.4 OHM 1% 1/8W	28480	0698-4364
A10A3R12	0698-4366	1	R:FXD FLM 19.1 OHM 1% 1/8W	28480	0698-4366
A10A3R12	0698-4368	1	R:FXD FLM 21 OHM 1% 1/8W	28480	0698-4368
A10A3R12	0698-4369	1	R:FXD FLM 23.2 OHM 1% 1/8W	28480	0698-4369
A10A3R12	0757-0180	1	R:FXD MET FLM 31.6 OHM 1% 1/8W	28480	0757-0180
A10A3R12	0757-0295	1	R:FXD MET FLM 11.5 OHM 1% 1/8W	28480	0757-0295
A10A3R12	0757-0316	1	R:FXD MET FLM 42.2 OHM 1% 1/8W	28480	0757-0316
A10A3R12	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A10A3R12	0757-0368	1	R:FXD MET FLM 34 OHM 1% 1/8W	28480	0757-0368
A10A3R12	0757-0378	1	R:FXD MET FLM 11.0 OHM 1% 1/8W	28480	0757-0378
A10A3R12	0757-0379	1	R:FXD MET FLM 12.1 OHM 1% 1/8W	28480	0757-0379
A10A3R12	0757-0382	1	R:FXD MET FLM 16.2 OHM 1% 1/8W	28480	0757-0382
A10A3R12	0757-0383	5	R:FXD MET FLM 18.2 OHM 1% 1/8W	28480	0757-0383
A10A3R12	0757-0384		R:FXD FLM 20 OHM 1% 1/8W	28480	0757-0384
A10A3R12	0757-0385		R:FXD MET FLM 22.1 OHM 1% 1/8W	28480	0757-0385
A10A3R12	0757-0386		R:FXD FLM 24.3 OHM 1% 1/8W	28480	0757-0386
A10A3R12	0757-0390		R:FXD MET FLM 36.5 OHM 1% 1/8W	28480	0757-0390
A10A3R13	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A10A3R14	0757-0957		R:FXD FLM 24K OHM 2% 1/8W	28480	0757-0957
A10A3R15	0757-0959		R:FXD FLM 30K OHM 2% 1/8W	28480	0757-0959
A10A3R16	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A10A3R17	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A10A3R18	0757-0918	3	R:FXD FLM 560 OHM 2% 1/8W	28480	0757-0918
A10A3R19	2100-1788	1	R:VAR FLM 500 OHM 10% LIN 1/2W	28480	2100-1788
A10A3R20	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A10A3R21	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A10A3T1	00105-8007	1	TRANSFORMER:POWER AMPLIFIER	28480	00105-8007
A10A 2A1	00105-6005	1	ASSY:OSCILLATOR 5MHZ	28480	00105-6005
A10A 2C1	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C2	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C3	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C4	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C5	0160-3222	1	C:FXD PORC 100 PF 5% 100VDCW	95275	VY10CA101JA
A10A 2C6	0160-3223	1	C:FXD PORC 11 PF 5% 500VDCW	95275	VY10CA110JA
A10A 2C7	0121-0179	1	C:VARI GLASS 1-28 PF	28480	0121-0179

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10A 2C8	0180-0218	4	C:FXD ELECT 0.15 UF 10% 35VDCW	28480	0180-0218
A10A 2C9	0160-3224	1	C:FXD PORC 75 PF 5% 300VDCW	95275	VY10CA750JA
A10A 2C9	0160-3464	1	C:FXD PORC 82 PF 5% 300VDCW	95275	VY10CA820JA
A10A 2C10	0160-3221	1	C:FXD PORC 300 PF 5% 50VDCW	95275	VY10CA301JA
A10A 2C11	0160-3225	1	C:FXD PORC 3000 PF 5% 100VDCW	95275	VY20CA302JA
A10A 2C12	0160-2671		C:FXD MY 0.1 UF 5% 80VDCW	56289	192P1045R8-PTS
A10A 2CR1	0122-0011	1	DIODE:CAPACITOR VARI 100 PF	01281	V739
A10A 2L1	9100-2820	1	CHOKE:180 UH 5%	76493	72F184AP
A10A 2L3	00105-8005	1	COIL:MODE SUPRESSOR .47UH	28480	00105-8005
A10A 2Q1	1854-0073	3	TSTR:SI NPN(SELECTED FROM 2N2857)	28480	1854-0073
A10A 2R1	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A10A 2R2	0757-0909	1	R:FXD FLM 240 OHM 2% 1/8W	28480	0757-0909
A10A 2R3	0721-0025	4	R:FXD DEPC 4.99 MEGOHM 2% 1/8W	28480	0721-0025
A10A 2R4	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A10A 2R5	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A10A 2R6	0721-0025		R:FXD DEPC 4.99 MEGOHM 2% 1/8W	28480	0721-0025
A10A 2	00105-6009	1	ASSY:AGC N.S.R. ORDER ASSY00105-6010	28480	00105-600.
A10A 2	00105-6003	1	ASSY:AGC INPUT BOARD	28480	00105-6003
A10A 2C1	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C2	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C3	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C4	0180-0218		C:FXD ELECT 0.15 UF 10% 35VDCW	28480	0180-0218
A10A 2C5	0121-0046		C:VARI CER 9-35 PF	28480	0121-0046
A10A 2C6	0160-0179		C:FXD MICA 33 PF 5% 300VDCW	14655	RDM15E330J3S
A10A 2C7	0180-0218		C:FXD ELECT 0.15 UF 10% 35VDCW	28480	0180-0218
A10A 2CR1	1902-0049	1	DIODE:BREAKDOWN 6.19V 5%	04713	SZ10939-122
A10A 2CR2	1902-0063		DIODE BREAKDOWN:15V	28480	1902-0063
A10A 2Q1	1854-0073		TSTR:SI NPN(SELECTED FROM 2N2857)	28480	1854-0073
A10A 2R1	0757-0936		R:FXD FLM 3.3K OHM 2% 1/8W	28480	0757-0936
A10A 2R2	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A10A 2R3	2100-1738	1	R:VAR FLM 10K OHM 10% LIN 1/2W	28480	2100-1738
A10A 2R4	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A10A 2R5	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A10A 2R6	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A10A 2R7	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A10A 2R8	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A10A 2R9	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A10A 2T1	00105-8001	1	TRANSFORMER:AGC INPUT	28480	00105-8001
A10A 2	00105-6004	1	ASSY:AGC OUTPUT BOARD	28480	00105-6004
A10A 2C8	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C9	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C10	0160-2010	1	C:FXD MET MYLAR 0.47UF 20% 200VDCW	14752	21031C474
A10A 2C11	0121-0046		C:VARI CER 9-35 PF	28480	0121-0046
A10A 2C12	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C13	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C14	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10A 2C15	0160-2013	1	C:FXD MICA 39 PF 5% 300VDCW	04062	RDM15E390J3S
A10A 2C16	0180-0218		C:FXD ELECT 0.15 UF 10% 35VDCW	28480	0180-0218
A10A 2CR3	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A10A 2CR4	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A10A 2Q2	1854-0073		TSTR:SI NPN(SELECTED FROM 2N2857)	28480	1854-0073
A10A 2R10	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A10A 2R11	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A10A 2R12	2100-2216	1	R:VAR FLM 5K OHM 10% LIN 1/2W	28480	2100-2216
A10A 2R13	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A10A 2R14	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A10A 2R15	0757-0954		R:FXD FLM 18K OHM 2% 1/8W	28480	0757-0954
A10A 2R16	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A10A 2T2	00105-8002	1	TRANSFORMER:AGC OUTPUT	28480	00105-8002
A11	05061-6009	1	CESIUM OVEN CONTROLLER	28480	05061-6009
A11 MISC PARTS	1251-1042	1	RETAINER:CONNECTOR	71468	08 51221-1
	05061-0009	1	CHASSIS:CESIUM OVEN	28480	05061-0009
	05061-0010	1	COVER:CESIUM OVEN	28480	05061-0010
	05061-2001		PLATE:END	28480	05061-2001
	05061-2003		PLATE:END	28480	05061-2003
A11J1	1251-0063	1	CONNECTOR MALE SUBMIN TYPE D 25CONTACT	71468	M-25P
A11A1	05061-6010	1	BOARD ASSY:CESIUM OVEN CONTROLLER	28480	05061-6010
A11A1C1	0180-0097	11	C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A11A1C2	0160-0128		C:FXD CER 2.2 UF 20% 25VDCW	56289	5C15C2S-CML
A11A1C3	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A11A1C4	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A11A1C5	0180-2614		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A11A1C6	0150-0096	4	C:FXD CER 0.05 UF +80-20% 100VDCW	91418	TA
A11A1C7	0150-0096		C:FXD CER 0.05 UF +80-20% 100VDCW	91418	TA
A11A1C8	0160-0845	1	C:FXD MY 0.22 UF 10% 400VDCW	84411	HEW 29

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A11A1C9	0180-0022	1	C:FXD ELECT 3.9 UF 10% 35VDCW	28480	0180-0022
A11A1C10	0180-0159	2	C:FXD ELECT 220 UF 20% 10VDCW	28480	0180-C159
A11A1C11	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A11A1C12	0180-0159		C:FXD ELECT 220 UF 20% 10VDCW	28480	0180-0159
A11A1C13	0180-0097		C:FXD TANT .47 UF 10% 35VDCW	56289	150D107X903052
A11A1C14	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A11A1C15	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A11A1C16	0170-0086		C:FXD MY 0.22UF 20% 50VDCW	84411	601PE STYLE 3
A11A1C17	0180-0116		C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A11A1C18	0160-0128		C:FXD CER 2.2 UF 20% 25VDCW	56289	5C152C2S-CML
A11A1C19	0160-0162	2	C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A11A1C20	0180-1746	1	C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A11A1C21	0150-0096		C:FXD CER 0.05 UF +80-20% 100VDCW	91418	TA
A11A1C22	0150-0096		C:FXD CER 0.05 UF +80-20% 100VDCW	91418	TA
A11A1CR1	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A11A1CR2	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A11A1CR3	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A11A1CR4	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A11A1CR5	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A11A1CR6	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A11A1CR7	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A11A1CR8	1901-0030	4	DIODE:SILICON 800 PIV	28480	1901-0030
A11A1CR9	1901-0030		DIODE:SILICON 800 PIV	28480	1901-0030
A11A1CR10	1901-0030		DIODE:SILICON 800 PIV	28480	1901-0030
A11A1CR11	1901-0030		DIODE:SILICON 800 PIV	28480	1901-0030
A11A1CR12	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A11A1CR13	1902-0025	1	DIODE,BREAKDOWN:10.0V 5% 400 MW	28480	1902-0025
A11A1CR14	1902-3048	2	DIODE BREAKDOWN:SILICON 3.48V 5%	28480	1902-3048
A11A1CR15	1902-3048		DIODE BREAKDOWN:SILICON 3.48V 5%	28480	1902-3048
A11A1CR16	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A11A1L1	05060-6034	1	COIL ASSY:27 UH FILTER	28480	05060-6034
A11A1L2	05060-6073	1	COIL ASSY:350 UH FILTER	28480	05060-6073
A11A1Q1	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-C003
A11A1Q2	1854-0062	8	TSTR:SI NPN	80131	2N1701
A11A1Q3	1854-0062		TSTR:SI NPN	80131	2N1701
A11A1Q4	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-C003
A11A1Q5	1854-0613		TSTR:SI NPN SELECTED	28480	05061-8013
A11A1Q6	1854-0613		TSTR:SI NPN SELECTED	28480	05061-8013
A11A1R1	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A11A1R2	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A11A1R3	0757-0964		R:FXD FLM 47K OHM 2% 1/8W	28480	0757-0964
A11A1R4	0757-0944		R:FXD FLM 6.8K OHM 2% 1/8W	28480	0757-C944
A11A1R5	0757-0942		R:FXD FLM 5.6K OHM 2% 1/8W	28480	0757-0942
A11A1R6	0757-0943		R:FXD FLM 6.2K OHM 2% 1/8W	28480	0757-0943
A11A1R7	0757-0930		R:FXD FLM 1.8K OHM 2% 1/8W	28480	0757-C930
A11A1R8	0757-0940		R:FXD FLM 4700 OHM 2% 1/8W	28480	0757-0940
A11A1R9	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-C346
A11A1R10	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A11A1R11	0757-0905	1	R:FXD FLM 160 OHM 2% 1/8W	28480	0757-0905
A11A1R12	0757-0912		R:FXD MET FLM 330 OHM 2% 1/8W	28480	0757-0912
A11A1R13	0757-0383		R:FXD MET FLM 18.2 OHM 1% 1/8W	28480	0757-0383
A11A1R14	0757-0383		R:FXD MET FLM 18.2 OHM 1% 1/8W	28480	0757-C383
A11A1R15	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A11A1R16	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A11A1R17	0757-0943		R:FXD FLM 6.2K OHM 2% 1/8W	28480	0757-0943
			SELECTABLE VALUE.		
A11A1R17	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
			SELECTABLE VALUE.		
A11A1R18	0757-0383		R:FXD MET FLM 18.2 OHM 1% 1/8W	28480	0757-0383
A11A1R19	0757-0383		R:FXD MET FLM 18.2 OHM 1% 1/8W	28480	0757-0383
A11A1R20	0757-0932		R:FXD MET FLM 2.2K OHM 2% 1/8W	28480	0757-0932
A11A1R21	0757-0400	1	R:FXD MET FLM 90.9 OHM 1% 1/8W	28480	0757-C400
			FACTORY SELECTED VALUE.		
A11A1R22	0757-0907		R.FXD FLM 200 OHM 2% 1/8W		
A11A1R23	0757-0907		R.FXD FLM 200 OHM 2% 1/8W		
A11A1R24	0757-0904		R:FXD FLM 150 OHM 2% 1/8W	28480	0757-0904
			FACTORY SELECTED VALUE.		
A11A1R25	0757-0467	1	R:FXD MET FLM 121K OHM 1% 1/8W	28480	0757-0467
A11A1R26	0757-0477	1	R:FXD MET FLM 332K OHM 1% 1/8W	28480	0757-C477
A11A1R27	2100-1761		R:VAR WW 10K OHM 5% TYPE V 1W	28480	2100-1761
A11A1R28			NOT ASSIGNED		
A11A1R29			NOT ASSIGNED		
A11A1R30			NOT ASSIGNED		
A11A1R31	0757-0955		R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A11A1R32	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938

See introduction to this section for ordering information

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Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A11A1R33	0812-0017	3	R:FXD WW 0.25 OHM 5% 3W	28480	0812-0017
A11A1R34	0812-0017		R:FXD WW 0.25 OHM 5% 3W	28480	0812-0017
A11A1R35	0757-0921		R:FXD MET FLM 750 OHM 2% 1/8W	28480	0757-0921
A11A1R36	0757-0934	1	R:FXD FLM 2.7K OHM 2% 1/8W FACTORY SELECTED VALUE.	28480	0757-0934
A11A1R37	0686-4755		R:FXD 4.7M 5% .5W CCTC=041000	01121	EB-4755
A11A1T1	9100-0335	1	TRANSFORMER	28480	9100-0335
A11A1T2	9100-0333	1	TRANSFORMER	28480	9100-0333
A11A1T3	9100-0336	1	TRANSFORMER	28480	9100-0336
A11A1T4	9100-2234	1	TRANSFORMER:AUDIO	28480	9100-2234
A12	05061-6077	1	CESIUM BEAM TUBE ASSY (NOT FIELD REPAIRABLE)	28480 *	05061-6077 — 54549.-
A12	05061-6101	1	(NOT FIELD REPAIRABLE(OPT 004)) CESIUM BEAM TUBE ASSY(OPT. 004)	28480	05061-6101 — 43798.-
A12J16	1251-0215		RETAINER:CONNECTOR SUBMINAT TYPE D	71468	DE51224-1
A12J17	1251-0220	1	RETAINER:CONNECTOR SUBMINAT TYPE D	71468	DA51220-1
A12P16	1251-0216		CONNECTOR:MALE 9-CONTACT TYPE D	71468	DEM-9P
A12P16 MISC	1251-0217	1	CONNECTOR:HOOD SUBMINAT TYPE D	71468	DE-24657
A12P16 MISC	1251-0218	1	CONNECTOR:LOCK POST SUBMINAT TYPE D	71468	D53018
A12P17	1251-0179	1	CONNECTOR:COAXIAL	71468	DM-53740-5001
A12P17 MISC	1251-0222	1	HOOD:CONNECTOR FOR SUB-MINAT CONN TYPE	91468	DA-24658
A13	05061-6030	1	AC AMPLIFIER ASSY	28480	05061-6030
A13 MISC PARTS	05061-0030	1	CHASSIS:BUFFER	28480	05061-0030
	05061-2008	1	PLATE:END	28480	05061-2008
	05061-2009	1	PLATE:END	28480	05061-2009
	05061-0031	1	COVER:BUFFER AMPLIFIER	28480	05061-0031
A13C1	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A13C2	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A13J1	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A13J2	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A13J3	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A13J4	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A13A1	05061-6107	1	BOARD ASSY:AC AMPLIFIER	28480	05061-6107
A13A1 MISC PARTS	7100-0101	2	SHIELD:MU-METAL	02875	MU8920-11/16-MU-HTD
	107A-69A-278		PAD:MOUNTING, FOR T1 AND T2	28480	107A-69A-278
A13A1C1	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A13A1C2	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A13A1C3	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A13A1C4	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A13A1C5	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A13A1C6	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A13A1C7	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A13A1C8	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A13A1C9	0140-0223		C:FXD MICA 260 PF 1% 300VDCW FACTORY SELECTED VALUE.	28480	0140-0223
A13A1C10	0140-0223		C:FXD MICA 260 PF 1% 300VDCW	28480	0140-0223
A13A1C11	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A13A1C12	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A13A1C13	0160-0128		C:FXD CER 2.2 UF 20% 25VDCW	56289	5C152C2S-CML
A13A1C14	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A13A1CR1	1902-3149	1	DIODE BREAKDOWN:9.09V 5%	28480	1902-3149
A13A1CR2	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A13A1L1	9140-0137		COIL:FXD RF 1000 UH 5%	28480	9140-0137
A13A1Q1	1854-0005		TSTR:SI NPN	80131	2N708
A13A1Q2	1854-0005		TSTR:SI NPN	80131	2N708
A13A1Q3	1854-0005		TSTR:SI NPN	80131	2N708
A13A1Q4	1854-0019	1	TSTR:SI NPN	28480	1854-0019
A13A1R1	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A13A1R2			NOT ASSIGNED		
A13A1R3	0757-0918		R:FXD FLM 560 OHM 2% 1/8W	28480	0757-0918
A13A1R4	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A13A1R5	0757-0894		R:FXD FLM 56 OHM 2% 1/8W	28480	0757-0894
A13A1R6	0757-0894		R:FXD FLM 56 OHM 2% 1/8W	28480	0757-0894
A13A1R7	0757-0936		R:FXD FLM 3.3K OHM 2% 1/8W	28480	0757-0936
A13A1R8	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A13A1R9	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A13A1R10	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A13A1R11	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A13A1R12	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A13A1R13	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A13A1R14	0757-0385		R:FXD MET FLM 22.1 OHM 1% 1/8W	28480	0757-0385
A13A1R15	0757-0385		R:FXD MET FLM 22.1 OHM 1% 1/8W	28480	0757-0385
A13A1R16	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A13A1R17	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A13A1R18	0757-0923	1	R:FXD FLM 910 OHM 2% 1/8W	28480	0757-0923
A13A1R19	0757-0921		R:FXD MET FLM 750 OHM 2% 1/8W	28480	0757-0921
A13A1R20	0757-0898		R:FXD FLM 82 OHM 2% 1/8W	28480	0757-0898

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A13A1R21	0757-0898		R:FXD FLM 82 OHM 2% 1/8W	28480	0757-0898
A13A1R22	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A13A1R23	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A13A1R24	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A13A1R25	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A13A1T1	00105-8007		TRANSFORMER ASSY:5MC	28480	
A13A1T2	00105-8007		TRANSFORMER ASSY:5MC	28480	
A14	05061-6016	1	BOARD ASSY:LOGIC	28480	05061-6016
A14C1	0180-0117		C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A14C2	0180-2614		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A14C3	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A14C4	0180-2614		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A14C5	0170-0084		C:FXD MY 0.068UF 20% 50VDCW	84411	601PE STYLE 3
A14C6	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A14C7	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A14C8	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A14C9	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A14C10	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A14C11	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A14C12	0160-3302	1	C:FXD MY 0.068 UF 5% 50VDCW	84411	601CPE
A14C13	0180-2614		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A14C14	0160-0180		C:FXD MY 0.033 UF 5%	28480	0160-0180
A14C15	0160-0180		C:FXD MY 0.033 UF 5%	28480	0160-0180
A14C16	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C17	0180-0117		C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A14C18	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A14C19	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML
A14C20	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A14C21	0180-0117		C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A14C22	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A14C23	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A14CR1	1902-0074	3	DIODE:BREAKDOWN 7.15V 5%	04713	SZ10939-140
A14CR2	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A14CR3	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A14CR4	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A14CR5	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A14CR6	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A14CR7	1902-0034	2	DIODE:5.76V 10%	28480	1902-0034
A14CR8	1902-0074		DIODE:BREAKDOWN 7.15V 5%	04713	SZ10939-140
A14CR9	1902-0074		DIODE:BREAKDOWN 7.15V 5%	04713	SZ10939-140
A14CR10	1902-0067	2	DIODE:BREAKDOWN 11.5V 5%	28480	1902-0067
A14CR11	1902-0067		DIODE:BREAKDOWN 11.5V 5%	28480	1902-0067
A14CR12	1902-0034		DIODE:5.76V 10%	28480	1902-0034
A14CR13	1902-0041	1	DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A14CR14	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A14CR15	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A14CR16	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A14CR17	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A14CR18	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A14CR19	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A14CR20	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A14Q1	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q2	1854-0005		TSTR:SI NPN	80131	2N708
A14Q3	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q4	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q5	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q6	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q7	1853-0022	1	TSTR:SI PNP	80131	2N941
A14Q8	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A14Q9	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A14Q10	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A14Q11	1854-0023		TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A14Q12	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q13	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q14	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q15	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q16	1854-0005		TSTR:SI NPN	80131	2N708
A14Q17	1854-0005		TSTR:SI NPN	80131	2N708
A14Q18	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q19	1854-0005		TSTR:SI NPN	80131	2N708
A14Q20	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q21	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q22	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14Q23	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A14Q24	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A14R1	2100-1775	1	R:VAR WW 5K OHM 5% TYPE H 1W	28480	2100-1775
A14R2	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A14R3	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A14R4	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A14R5	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A14R6	0757-0965		R:FXD FLM 51K OHM 2% 1/8W	28480	0757-0965
A14R7	0757-0976		R:FXD FLM 150K OHM 2% 1/8W	28480	0757-0976
A14R8	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R9	0757-0965		R:FXD FLM 51K OHM 2% 1/8W	28480	0757-0965
A14R10	0757-0383		R:FXD MET FLM 18.2 OHM 1% 1/8W	28480	0757-0383
A14R11	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R12	2100-1774	1	R:VAR WW 2K OHM 5% TYPE H 1W	28480	2100-1774
A14R13	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R14	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A14R15	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A14R16	0757-0950		R:FXD FLM 12K OHM 2% 1/8W	28480	0757-0950
A14R17	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R18	0757-0954		R:FXD FLM 18K OHM 2% 1/8W	28480	0757-0954
A14R19	0757-0954		R:FXD FLM 18K OHM 2% 1/8W	28480	0757-0954
A14R20	0757-0965		R:FXD FLM 51K OHM 2% 1/8W	28480	0757-0965
A14R21	0757-0960		R:FXD FLM 33K OHM 2% 1/8W	28480	0757-0960
A14R22	0757-0947	1	R:FXD FLM 9.1K OHM 2% 1/8W	28480	0757-0947
A14R23	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R24	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A14R25	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A14R26	0757-0960		R:FXD FLM 33K OHM 2% 1/8W	28480	0757-0960
A14R27	2100-1773	1	R:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A14R28	0757-0949	1	R:FXD FLM 11K OHM 2% 1/8W	28480	0757-0949
A14R29	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A14R30	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A14R31	0757-0960		R:FXD FLM 33K OHM 2% 1/8W	28480	0757-0960
A14R32	0698-3129		R:FXD DEPC 1.00 MEGOHM 1% 1/8W	28480	0698-3129
A14R33	0757-0951		R:FXD FLM 13K OHM 2% 1/8W	28480	0757-0951
A14R34	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R35	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A14R36	0757-0936		R:FXD FLM 3.3K OHM 2% 1/8W	28480	0757-0936
A14R37	0757-0916		R:FXD MET FLM 470 OHM 2% 1/8W	28480	0757-0916
A14R38	0757-0951		R:FXD FLM 13K OHM 2% 1/8W	28480	0757-0951
A14R39	0757-0955		R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A14R40	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R41	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R42	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A14R43	0757-0963		R:FXD FLM 43K OHM 2% 1/8W	28480	0757-0963
A14R44	0757-0960		R:FXD FLM 33K OHM 2% 1/8W	28480	0757-0960
A14R45	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R46	0757-0955		R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A14R47	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A14R48	0757-0976		R:FXD FLM 150K OHM 2% 1/8W	28480	0757-0976
A14R49	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A14R50	0757-0976		R:FXD FLM 150K OHM 2% 1/8W	28480	0757-0976
A14R51	0757-0965		R:FXD FLM 51K OHM 2% 1/8W	28480	0757-0965
A14R52	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R53	0757-0955		R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A14R54	0757-0933	2	R:FXD FLM 2.4K OHM 2% 1/8W	28480	0757-0933
A14R55	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A14R56	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A14R57	0757-0963		R:FXD FLM 43K OHM 2% 1/8W	28480	0757-0963
A14R58	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A14R59	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R60	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A14R61	0757-0960		R:FXD FLM 33K OHM 2% 1/8W	28480	0757-0960
A14R62	0757-0960		R:FXD FLM 33K OHM 2% 1/8W	28480	0757-0960
A14R63	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A14R64	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A14R65	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R66	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A14R67	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A14R68	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R69	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14R70	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A14SCR1	1884-0070	1	SWITCH:SC SI PNPN	03508	3N81

See introduction to this section for ordering information

Table 6–1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A15	05061-6099	1	BOARD ASSY:POWER REGULATOR	28480	05061-6099
A15C1	0170-0072	1	C:FXD MY 1 UF 10% 200VDCW	84411	HEW 54
A15C2	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A15C3	0180-0117		C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A15C4	0180-0117		C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A15C5	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A15C6	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A15C7	0160-2199	1	C:FXD MICA 30 PF 5% 300VDCW	28480	0160-2199
A15C8	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11875-CML
A15C9	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A15C10	0170-0019	1	C:FXD MY 0.1 UF 5% 200VDCW	28480	0170-0019
A15C11	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A15C12	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A15CR1	1901-0200	6	DIODE:SI 3 A 100 PRRV	28480	1901-0200
A15CR2	1901-0200		DIODE:SI 3 A 100 PRRV	28480	1901-0200
A15CR3	1901-0200		DIODE:SI 3 A 100 PRRV	28480	1901-0200
A15CR4	1901-0200		DIODE:SI 3 A 100 PRRV	28480	1901-0200
A15CR5	1902-3234	2	DIODE BREAKDOWN:19.6V 5%	28480	1902-3234
A15CR6	1901-0200		DIODE:SI 3 A 100 PRRV	28480	1901-0200
A15CR7	1902-3234		DIODE BREAKDOWN:19.6V 5%	28480	1902-3234
A15CR8	1901-0200		DIODE:SI 3 A 100 PRRV	28480	1901-0200
A15CR9	1902-0672	1	DIODE BREAKDOWN:9.0V 5% 500MW	28480	1N939
A15CR10	1902-0071	1	DIODE:BREAKDOWN 9.0V 5%	28480	1902-0071
A15L1	9100-0339	2	COIL:FXD RF AIR 5 MICROHENRIES	28480	9100-0339
A15Q1	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A15Q2	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A15Q3	1853-0024	3	TSTR:SI PNP	80131	2N3778
A15Q4	1854-0062		TSTR:SI NPN	80131	2N1701
A15Q5	1853-0024		TSTR:SI PNP	80131	2N3778
A15Q6	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A15Q7	1853-0024		TSTR:SI PNP	80131	2N3778
A15Q8	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A15Q9	1854-0039		TSTR:SI NPN	80131	2N3053
A15Q10	1853-0001		TSTR:SI PNP(SELECTED FROM 2N1132)	28480	1853-0001
A15Q11	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A15Q12	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A15Q13	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A15Q14	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A15Q15	1854-0062		TSTR:SI NPN	80131	2N1701
A15Q16	1853-0001		TSTR:SI PNP(SELECTED FROM 2N1132)	28480	1853-0001
A15Q17	1853-0001		TSTR:SI PNP(SELECTED FROM 2N1132)	28480	1853-0001
A15Q18	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A15Q19	1853-0001		TSTR:SI PNP(SELECTED FROM 2N1132)	28480	1853-0001
A15R1	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A15R2	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A15R3	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A15R4	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A15R5	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A15R6	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A15R7	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A15R8	0757-0914		R:FXD FLM 390 OHM 2% 1/8W	28480	0757-0914
A15R9	0767-0001	1	R:FXD MET FLM 400 OHM 5% 3W	28480	0767-0001
A15R10	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A15R11	0757-0927		R:FXD FLM 1.3K OHM 2% 1/8W	28480	0757-0927
A15R12	0812-0017		R:FXD WW 0.25 OHM 5% 3W	28480	0812-0017
A15R13	0757-0932		R:FXD MET FLM 2.2K OHM 2% 1/8W	28480	0757-0932
A15R14	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A15R15	2100-1770	1	R:VAR WW 100 OHM 5% TYPE H 1W	28480	2100-1770
A15R16	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A15R17	0757-0918		R:FXD FLM 560 OHM 2% 1/8W	28480	0757-0918
A15R18	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A15R19	0757-0933		R:FXD FLM 2.4K OHM 2% 1/8W	28480	0757-0933
A15R20	0757-0915		R:FXD FLM 430 OHM 2% 1/8W	28480	0757-0915
A15R21	0811-3260	1	R: FXD 235 OHM FAC. SEL.		
A15R22	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A15R23	0757-0960		R:FXD FLM 33K OHM 2% 1/8W	28480	0757-0960
A15R24	0757-0940		R:FXD FLM 4700 OHM 2% 1/8W	28480	0757-0940
A15R25	0757-0481	1	R:FXD MET FLM 475K OHM 1% 1/8W	28480	0757-0481
A15R26	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893
A15R27	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A15R28	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A15R29	0757-0911		R:FXD FLM 300 OHM 2% 1/8W	28480	0757-0911
A15R30	0757-0932		R:FXD MET FLM 2.2K OHM 2% 1/8W	28480	0757-0932
A15R31	0757-0893		R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A15R32	0757-0940		R:FXD FLM 4700 OHM 2% 1/8W	28480	0757-0940
A15R33	0698-4345	1	R:FXD MET FLM 2 MEGOHM 1% 1/4W	28480	0698-4345
A15R34	0727-0229	1	R:FXD CARBON 265K OHM 1% 1/2W	28480	0727-0229
A15R35	0757-0473	3	R:FXD MET FLM 221K OHM 1% 1/8W	28480	0757-0473
A15R36	0757-0473		R:FXD MET FLM 221K OHM 1% 1/8W	28480	0757-0473
A15R37	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A15R38	0757-0936		R:FXD FLM 3.3K OHM 2% 1/8W	28480	0757-0936
A15R39	0727-0012	1	R:FXD DEPC 20 OHM 1% 1/2W	28480	0727-0012
A15R40	0757-0942		R:FXD FLM 5.6K OHM 2% 1/8W	28480	0757-0942
A15U1	1826-0045	1	IC:LINEAR, OP. AMPL.	12040	LM201AH

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A17	05061-6018	1	TERMINAL BOARD ASSY	28480	05061-6018
A17F1	2110-0274	1	FUSE:3A	75915	276003
A17R1	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A17R2	0757-0959		R:FXD FLM 30K OHM 2% 1/8W	28480	0757-0959
A17R3	0757-0956		R:FXD FLM 22K OHM 2% 1/8W	28480	0757-0956
A17R4	0757-0967		R:FXD FLM 62K OHM 2% 1/8W	28480	0757-0967
A17R5	0757-0956		R:FXD FLM 22K OHM 2% 1/8W	28480	0757-0956
A17R6	0757-0964		R:FXD FLM 47K OHM 2% 1/8W	28480	0757-0964
A17R7	0698-3456	1	R:FXD MET FLM 287K OHM 1% 1/8W	28480	0698-3456
A17R8	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A17R9	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A17R10	0698-3260	1	R:FXD MET FLM 464K OHM 1% 1/8W	28480	0698-3260
A17R11	0757-0485	1	R:FXD MET FLM 681K OHM 1% 1/8W	28480	0757-0485
A17R12	0811-1792	2	R:FXD WW 66.2K OHM 0.1% 1/40W	28480	0811-1792
A17R13	0811-1792		R:FXD WW 66.2K OHM 0.1% 1/40W	28480	0811-1792
A18	05060-6093	1	ASSY+3500VDC POWER SUPPLY(NSR) FIELD REPAIR NOT RECOMMENDED.	28480	05060-6093
	0900-0011	6	O RING	28480	0900-0011
A18 MISC PARTS	0950-0140	1	BASE ASSY:POWER SUPPLY	28480	0950-0140
	05060-2077	4	BLOCK MOUNTING	28480	05060-2077
	05060-2081	6	SPACER	28480	05060-2081
A18C1	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A18C2	0160-0157	2	C:FXD MY 0.0047 UF 10% 200VDCW	56289	192P47292-PTS
A18C3	0160-0994	2	C:FXD MY 0.001 UF 10% 4000VDCW	71436	PMS 102-4M
A18C4	0160-0995	3	C:FXD MY 0.01 UF 10% 4000VDCW	71436	PMS 103-4M
A18C5	0170-0078	1	C:FXD MY 0.47 UF 5% 150VDCW	11711	107V474J
A18C6	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A18CR1	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A18CR2	1901-0405	4	DIODE:SILICON 5000 PIV 10MA	28480	1901-0405
A18CR3	1901-0405		DIODE:SILICON 5000 PIV 10MA	28480	1901-0405
A18Q1	1854-0035		TSTR:SI NPN	28480	1854-0035
A18Q2	1854-0062		TSTR:SI NPN	80131	2N1701
A18R1	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A18R2	0698-3106		R:FXD DEPC 5 OHM 1% 1/8W	28480	0698-3106
A18R3	0698-3106		R:FXD DEPC 5 OHM 1% 1/8W	28480	0698-3106
A18R4	0698-3305	1	R:FXD DEPC 200 MEGOHM 10% 1W	28480	0698-3305
A18R5	0757-0473		R:FXD MET FLM 221K OHM 1% 1/8W	28480	0757-0473
A18R6	0757-0969	2	R:FXD FLM 75K OHM 2% 1/8W	28480	0757-0969
A18R7	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A18R8	0757-0894		R:FXD FLM 56 OHM 2% 1/8W	28480	0757-0894
A18T1	05060-6113	2	TRANSFORMER ASSY	28480	05060-6113
A18T2	05060-6109	1	TRANSFORMER ASSY	28480	05060-6109
A19	05060-6092	1	ASSY:-2500VDC POWER SUPPLY(NSR) FIELD REPAIR NOT RECOMMENDED	28480	05060-6092
	0900-0011		O RING	28480	0900-0011
A19 MISC PARTS	0950-0139	1	BASE ASSY:POWER SUPPLY	28480	0950-0139
	7100-0435	1	CAN:SQUARE	28480	7100-0435
	05060-2077		BLOCK MOUNTING	28480	05060-2077
	05060-2081		SPACER	28480	05060-2081
A19C1	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A19C2	0160-0157		C:FXD MY 0.0047 UF 10% 200VDCW	56289	192P47292-PTS
A19C3	0160-0994		C:FXD MY 0.001 UF 10% 4000VDCW	71436	PMS 102-4M
A19C4	0160-0995		C:FXD MY 0.01 UF 10% 4000VDCW	71436	PMS 103-4M
A19C5	0160-0995		C:FXD MY 0.01 UF 10% 4000VDCW	71436	PMS 103-4M
A19CR1	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A19CR2	1901-0405		DIODE:SILICON 5000 PIV 10MA	28480	1901-0405
A19CR3	1901-0405		DIODE:SILICON 5000 PIV 10MA	28480	1901-0405
A19Q1	1854-0035		TSTR:SI NPN	28480	1854-0035
A19Q2	1854-0062		TSTR:SI NPN	80131	2N1701
A19R1	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A19R2	0698-3106		R:FXD DEPC 5 OHM 1% 1/8W	28480	0698-3106
A19R3	0698-3106		R:FXD DEPC 5 OHM 1% 1/8W	28480	0698-3106
A19R4	0727-0287	1	R:FXD CARBON 2 MEGOHM 1% 1/2W	28480	0727-0287
A19R5	0698-8419	1	R:FXD DEPC 200 MEGOHM 10% 1W	28480	0698-8419
A19R6	0721-0025		R:FXD DEPC 4.99 MEGOHM 2% 1/8W	28480	0721-0025
A19R7	0721-0025		R:FXD DEPC 4.99 MEGOHM 2% 1/8W	28480	0721-0025
A19R8	0757-0969		R:FXD FLM 75K OHM 2% 1/8W	28480	0757-0969
A19R9	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A19T1	05060-6113		TRANSFORMER ASSY	28480	05060-6113
A19T2	05060-6112	1	TRANSFORMER ASSY	28480	05060-6112

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS & MISC PARTS		
C1	0160-0975	1	C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
C2	0160-4201	1	C:FXD 8 UF	28480	0160-4201
C4			SEE OPTION 002		
C5	0180-0090	1	C:FXD ELECT 1000 UF 50VDCW	56289	D31972
C6	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
C7	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
C8	0160-3611	1	C:FXD CER DISC 7200 PF 10% 250VDCW	56289	41C407-CDH
CR1	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR2	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
DS1	1450-0705	1	LAMPHOLDER:FRONT MOUNTING DISPLAY LITE	07137	RDL-83-F12-000
DS1	2140-0245	2	LAMP:INCANDESCENT 28.0V	08806	387
DS2	1450-0114	1	LAMPHOLDER:AMBER LENS	07137	RDL-B3-F3-000
DS2	2140-0245		LAMP:INCANDESCENT 28.0V	08806	387
F1	2110-0020	1	FUSE:0.8A 250V SLOW-BLOW FOR 230V OPERATION	75915	313.800S
F1	2110-0305	1	FUSE:1.25 AMP SLOW BLOW	71400	MDX-1-1/4A
F1	1400-0084	4	FUSEHOLDER:EXTRACTOR POST TYPE FOR 115V OPERATION	75915	342014
F2	2110-0007	1	FUSE:CARTRIDGE 1 AMP 250V SLOW BLOW	75915	313001
F2	1400-0084		FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014
F3	2110-0003	1	FUSE:CARTRIDGE 3 AMP 3 AG	75915	312003
F3	1400-0084		FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014
J1	1250-0102	4	CONNECTOR:BNC	28480	1250-0102
J2	1250-0140	8	BODY:RF CONNECTOR, MALE BNC SERIES	02660	31-357-1022
J3	1251-1978	2	CONNECTOR:RACK AND PANEL	81312	PM1P
J4	1251-1979	2	CONNECTOR:RACK AND PANEL	81312	PM1S
J5	1250-0102		CONNECTOR:BNC	28480	1250-0102
J6	1250-0140		BODY:RF CONNECTOR, MALE BNC SERIES	02660	31-357-1022
J7	1250-0102		CONNECTOR:BNC	28480	1250-0102
J8	1250-0140		BODY:RF CONNECTOR, MALE BNC SERIES	02660	31-357-1022
J9	1250-0102		CONNECTOR:BNC	28480	1250-0102
J10	1250-0140		BODY:RF CONNECTOR, MALE BNC SERIES	02660	31-357-1022
J11	1250-0140		BODY:RF CONNECTOR, MALE BNC SERIES	02660	31-357-1022
J12	1250-0140		BODY:RF CONNECTOR, MALE BNC SERIES	02660	31-357-1022
J14	1250-0140		BODY:RF CONNECTOR, MALE BNC SERIES	02660	31-357-1022
J15	1250-0140		BODY:RF CONNECTOR, MALE BNC SERIES	02660	31-357-1022
J18	1251-2796	1	CONNECTOR:18 FEMALE CONTACTS	83298	PT02A-14-18S(005)
J19	1251-0111	1	CONNECTOR:RECEPTACLE MALE 5-CONTACT	71468	MS3102R14S-5P
J20	1251-2458	1	CONNECTOR:CIR. 3 MALE #16 CONTACT	02660	MS3102A-18-22PW
L1	9100-0337	1	REACTOR:50 MILLIHENRIES	28480	9100-0337
L2	9100-0339		COIL:FXD RF AIR 5 MICROHENRIES	28480	9100-0339
M1	1120-1472	1	METER:50-0-50 UA	28480	1120-1472
P3	1251-1980	2	LOCKSPRING:RACK AND PANEL CONNECTOR	81312	M4LS
P3	1251-1981	2	LOCKRING:R & P CONNECTOR	81312	M4LR
P3	1251-1977	2	HOOD:RACK AND PANEL CONNECTOR	81312	H10
P3	1251-1979		CONNECTOR:RACK AND PANEL	81312	PM1S
P4	1251-1980		LOCKSPRING:RACK AND PANEL CONNECTOR	81312	M4LS
P4	1251-1981		LOCKRING:R & P CONNECTOR	81312	M4LR
P4	1251-1977		HOOD:RACK AND PANEL CONNECTOR	81312	H10
P4	1251-1978		CONNECTOR:RACK AND PANEL	81312	PM1P
Q2	1854-0020		TSTR:SI NPN	28480	1854-0020
Q2	0340-0487	1	INSULATOR:TSTR FOR TO-8 CASE	76530	293233
Q2	1200-0087	1	CLAMP:TRANSISTOR	02735	DF-13-A
Q2	1200-0092	1	BUSHING:TRANSISTOR	02735	495334 1
R1	0757-0440	1	R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
R2	0698-3136	1	R:FXD MET FLM 17.8K OHM 1% 1/8W	28480	0698-3136
R3	2100-2425	1	R:VAR WW 20K OHM 3% LIN 1.5W	28480	2100-2425
R3	2100-2427	1	MOUNTING BRACKET FOR VAR. RESISTOR	73138	568W
R4	0757-0948		R:FXD MET FLM 10K OHM 2% 1/8W	28480	0757-0948
R5	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
R6	0730-0145	1	R:FXD DEPC 12 MEGOHM 1% 1W	28480	0730-0145
R7	2100-2429	1	R:VAR WW 250K OHM 20% LIN 3/4W	28480	2100-2429
R8	2100-1414	1	R:VAR WW 5K OHM 5% LIN 10-TURN 3/4W	28480	2100-1414
R9	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
S1	3100-0893	1	SWITCH:ROTARY	28480	3100-0893
S2	3100-3429	1	SWITCH: ROTARY, 3 SECTION, 4 POSITION	28480	3100-0894
S3	3101-1234	1	SWITCH:SLIDE DPDT	82389	11A-1242
S4	3101-1155	1	SWITCH:TOGGLE SPDT	28480	3101-1155
S5	3101-0163	1	SWITCH:TOGGLE SPDT	04009	MST-105D
S7	3101-0124	1	SWITCH:PUSHBUTTON SPST N/O MOMENTARY	28480	3101-0124
T1	9100-2449	1	TRANSFORMER	28480	9100-2449
W1	05061-6035	1	CABLE ASSY:FRONT	28480	05061-6035

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
W1	1250-0050	10	NUT:RF CONNECTOR BNC SERIES	02660	31-2125-2
W1	1250-0051	10	CONTACT:RF CONNECTOR BNC SERIES	02660	31-2109
W1	1250-0259	24	CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W1	1250-0260	24	CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W1	1250-0261	24	INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W1	1250-0262	24	FERRULE FOR RF CONNECTOR	28480	1250-0262
W1	1250-0263	24	WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W1	1250-0264	24	WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W1	1250-0265	24	NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W1	8120-0229	26	CABLE:RF COAX RG	04217	421-105
W2	05061-6036	1	CABLE ASSY:BUFFER REAR	28480	05061-6036
W2	1250-0050		NUT:RF CONNECTOR BNC SERIES	02660	31-2125-2
W2	1250-0051		CONTACT:RF CONNECTOR BNC SERIES	02660	31-2109
W2	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W2	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W2	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W2	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W2	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W2	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W2	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W2	8120-0229		CABLE:RF COAX RG	04217	421-105
W3	05061-6037	1	CABLE ASSY:SYNTH	28480	05061-6037
W3	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W3	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W3	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W3	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W3	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W3	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W3	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W3	8120-0229		CABLE:RF COAX RG	04217	421-105
W4	05061-6038	1	CABLE ASSY:MULTIPLIER	28480	05061-6038
W4	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W4	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W4	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W4	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W4	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W4	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W4	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W4	8120-0229		CABLE:RF COAX RG	04217	421-105
W5	05061-6039	1	CABLE ASSY:OSCILLATOR	28480	05061-6039
W5	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W5	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W5	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W5	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W5	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W5	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W5	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W5	8120-0229		CABLE:RF COAX RG	04217	421-105
W6	05061-6040	1	CABLE ASSY:OSCILLATOR	28480	05061-6040
W6	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W6	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W6	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W6	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W6	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W6	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W6	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W6	8120-0229		CABLE:RF COAX RG	04217	421-105
W7	05061-6041	1	CABLE ASSY:2ND HARMONIC	28480	05061-6041
W7	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W7	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W7	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W7	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W7	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W7	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W7	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W7	8120-0229		CABLE:RF COAX RG	04217	421-105
W8	05061-6042	1	CABLE ASSY:COAX FROM AC TO LOG	28480	05061-6042
W8	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W8	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W8	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W8	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W8	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W8	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W8	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W8	8120-0229		CABLE:RF COAX RG	04217	421-105

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
W9	05061-6043	1	CABLE ASSY:PHASE DETECTOR	28480	05061-6043
W9	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W9	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W9	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W9	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W9	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W9	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W9	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W9	8120-0229		CABLE:RF COAX RG	04217	421-105
W10	05061-6044	1	CABLE ASSY:MODULE MULTIPLIER	28480	05061-6044
W10	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W10	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W10	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W10	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W10	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W10	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W10	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W10	8120-0229		CABLE:RF COAX RG	04217	421-105
W11	05061-6045	1	CABLE ASSY:SYNTH	28480	05061-6045
W11	1250-0050		NUT:RF CONNECTOR BNC SERIES	02660	31-2125-2
W11	1250-0051		CONTACT:RF CONNECTOR BNC SERIES	02660	31-2109
W11	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W11	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W11	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W11	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W11	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W11	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W11	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W11	8120-0229		CABLE:RF COAX RG	04217	421-105
W12	05061-6046	1	CABLE ASSY:FREQUENCY DIVIDER	28480	05061-6046
W12	1250-0050		NUT:RF CONNECTOR BNC SERIES	02660	31-2125-2
W12	1250-0051		CONTACT:RF CONNECTOR BNC SERIES	02660	31-2109
W12	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W12	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W12	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W12	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W12	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W12	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W12	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W12	8120-0229		CABLE:RF COAX RG	04217	421-105
W13	05061-6047	1	CABLE ASSY:FREQUENCY DIVIDER	28480	05061-6047
W13	1250-0050		NUT:RF CONNECTOR BNC SERIES	02660	31-2125-2
W13	1250-0051		CONTACT:RF CONNECTOR BNC SERIES	02660	31-2109
W13	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W13	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W13	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W13	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W13	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W13	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W13	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W13	8120-0229		CABLE:RF COAX RG	04217	421-105
W14	05061-6048	1	CABLE ASSY:TUBE	28480	05061-6048
W14	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W14	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W14	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W14	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W14	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W14	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W14	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W14	1251-0180	2	INSERT:R & P CONNECTOR	08718	DM-53742-5001
W14	8120-0229		CABLE:RF COAX RG	04217	421-105
W15			NOT ASSIGNED		
W16	05061-6050	1	CABLE ASSY:PHASE	28480	05061-6050
W16	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W16	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W16	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W16	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W16	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W16	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W16	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W16	8120-0229		CABLE:RF COAX RG	04217	421-105
W17	05061-6051	1	CABLE ASSY:RETURN	28480	05061-6051
W17	1251-0180		INSERT:R & P CONNECTOR	08718	DM-53742-5001
W17	8120-0229		CABLE:RF COAX RG	04217	421-105
W18	05061-6052	1	CABLE ASSY:FREQUENCY	28480	05061-6052

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
W18	1250-0050		NUT:RF CONNECTOR BNC SERIES	02660	31-2125-2
W18	1250-0051		CONTACT:RF CONNECTOR BNC SERIES	02660	31-2109
W18	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W18	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W18	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W18	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W18	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W18	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W18	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W18	8120-0229		CABLE:RF COAX RG	04217	421-105
W19	05061-6053	1	CABLE ASSY:DIVIDER	28480	05061-6053
W19	1250-0050		NUT:RF CONNECTOR BNC SERIES	02660	31-2125-2
W19	1250-0051		CONTACT:RF CONNECTOR BNC SERIES	02660	31-2109
W19	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W19	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W19	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W19	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W19	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W19	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W19	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W19	8120-0229		CABLE:RF COAX RG	04217	421-105
W20			NOT ASSIGNED		
W21	05061-6055	1	CABLE ASSY:PHASE	28480	05061-6055
W21	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W21	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W21	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W21	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W21	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W21	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W21	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W21	8120-0229		CABLE:RF COAX RG	04217	421-105
W22	05061-6056	1	CABLE ASSY:PHASE	28480	05061-6056
W22	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W22	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W22	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W22	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W22	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W22	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W22	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W22	8120-0229		CABLE:RF COAX RG	04217	421-105
W23	05061-6057	1	CABLE ASSY:MODULATOR	28480	05061-6057
W23	1250-0050		NUT:RF CONNECTOR BNC SERIES	02660	31-2125-2
W23	1250-0051		CONTACT:RF CONNECTOR BNC SERIES	02660	31-2109
W23	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W23	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W23	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W23	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W23	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W23	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W23	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W23	8120-0229		CABLE:RF COAX RG	04217	421-105
W24	05061-6058	1	CABLE ASSY:TERMINAL	28480	05061-6058
W24	1250-0050		NUT:RF CONNECTOR BNC SERIES	02660	31-2125-2
W24	1250-0051		CONTACT:RF CONNECTOR BNC SERIES	02660	31-2109
W24	8120-0229		CABLE:RF COAX RG	04217	421-105
W25	05061-6059	1	CABLE ASSY:OPER. AMPLIFIER	28480	05061-6059
W25	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W25	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W25	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W25	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W25	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W25	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W25	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W25	8120-0229		CABLE:RF COAX RG	04217	421-105
W26			-		
W28			NOT ASSIGNED		
W29	05061-6064	1	CABLE ASSY:OSCILLATOR	28480	05061-6064
W29	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W29	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W29	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W29	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W29	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W29	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W29	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W29	8120-0229		CABLE:RF COAX RG	04217	421-105

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
W30	05061-6065	1	CABLE ASSY:BUFFER SYNTH	28480	05061-6065
W30	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W30	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W30	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W30	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W30	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W30	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W30	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W30	8120-0229		CABLE:RF COAX RG	04217	421-105
W31			NOT ASSIGNED		
W32	05061-6069	1	CABLE ASSY:DIGITAL DIVIDER	28480	05061-6069
W32	1250-0050		NUT:RF CONNECTOR BNC SERIES	02660	31-2125-2
W32	1250-0051		CONTACT:RF CONNECTOR BNC SERIES	02660	31-2109
W32	1250-0259		CONNECTOR:RF SUB-MINIATURE 50 OHM	28480	1250-0259
W32	1250-0260		CENTER CONTACT:FEMALE CONNECTOR	28480	1250-0260
W32	1250-0261		INSULATOR:BACK FOR RF CONNECTOR	28480	1250-0261
W32	1250-0262		FERRULE FOR RF CONNECTOR	28480	1250-0262
W32	1250-0263		WASHER,RECESSED FOR RF CONNECTOR	28480	1250-0263
W32	1250-0264		WASHER:CLAMP FOR RF CONNECTOR	28480	1250-0264
W32	1250-0265		NUT:CLAMP FOR RF CONNECTOR	28480	1250-0265
W32	8120-0229		CABLE:RF COAX RG	04217	421-105
W33	05061-6091	1	CABLE ASSY:POWER	28480	05061-6091
W33	0360-0057	1	TERMINATION:CRIMP LUG FOR #8 SCREW	00000	OBD
W33	1251-0037	1	CONNECTOR:AC POWER 3 MALE PLUG CONTACT	97534	UP-131-M
W33	1251-0193	1	INSULATOR:CONNECTOR	97534	UP-121
W33	1251-0352	1	BUSHING:CIRCULAR CONNECTOR(SIZE 14S)	91737	18220-6
W33	1251-2457	1	CONNECTOR:CIR. 3 FEMALE #16 CONTACT	02660	MS3106A-18-22SW
W33	1251-2479	1	CLAMP:CIR. CONNECTOR	02660	97-3057-10-6
W33	8120-0022	1	CABLE:18/3 300V RMS	70903	SJC-18/3
	0340-0039		INSULATOR:BUSHING	28480	0340-0039
	0340-0119		INSULATED FEED THRU:TEFLON	98291	FT-SM-023-P20
	0362-0187	3	CAP:WIRE TERMINATION	06090	TC4008
	0370-0104	1	KNOB:BLK BAR W/ARROW 1/4" SHAFT	28480	0370-0104
	0403-0131	12	GUIDE:P.C. BOARD, GREY	28480	0403-0131
	0510-0182	1	FASTENER:LATCH	94222	27-10-301-30
	0590-0035	1	NUT:CLAMP	08145	1510 NUT
	1140-0014	1	DIAL:TURNS COUNTING 15 TURN	73138	MODEL 2606
	1410-0052	2	BUSHING:POTENTIOMETER	28480	1410-0052
	1480-0017	2	PIN:DOWEL 0.1252" DIA	00000	OBD
	1480-0059	1	PIN:SPRING 0.062" NOM. DIA	00000	OBD
	2950-0040	2	NUT:HEX 3/8"-32 X 1/2"	28480	2950-0040
	5000-0053	2	PLATE:FLUTED ALUMINUM	28480	5000-0053
	5000-0232	3	INSULATOR:PC BOARD CONNECTOR 22 PIN	28480	5000-0232
	5000-0747	2	COVER:SIDE	28480	5000-0747
	5020-0176		INSULATOR FOR SNAP-ON PINS	28480	5020-0176
	5060-0222	2	HANDLE ASSY:5H SIDE	28480	5060-0222
	5060-0736	2	FRAME ASSY	28480	5060-0736
	5060-0755	1	BOTTOM COVER ASSY	28480	5060-0755
	5060-0765	2	RETAINER HANDLE ASSY(OPTIONS)	28480	5060-0765
	5060-0767	5	FOOT ASSY:FM	28480	5060-0767
	5060-0777	1	KIT:RACK MOUNT	28480	5060-0777
	05060-0001	2	CLAMP TUBE SUPPORT, TOP	28480	05060-0001
	05060-0021	2	INSULATOR:BEAM TUBE STRAP	28480	05060-0021
	05060-0024	2	INSULATOR:BEAM TUBE BRACKET	28480	05060-0024
	05060-2002	2	ROD:TUBE SUPPORT	28480	05060-2002
XF2	1400-0084		FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014
	05060-2014	2	SPACER:PANEL	28480	05060-2014
	05060-2064	2	BRACKET:CHASSIS	28480	05060-2064
	05060-2082	1	BRACKET:MT C FIELD	28480	05060-2082
	05060-2083	1	COVER:FIELD DIAL	28480	05060-2083
	05061-0008	1	BRACKET CAP	28480	05061-0008
	05061-0015	1	PANEL:FRONT	28480	05061-0015
	05061-0016	1	PANEL:REAR	28480	05061-0016
	05061-0017	1	CHASSIS:SMALL	28480	05061-0017
	05061-0018	1	CHASSIS:LARGE	28480	05061-0018
	05061-0019	1	PANEL:DOOR INSIDE	28480	05061-0019
	05061-0020	1	PANEL:LEFT	28480	05061-0020
	05061-0025	1	BRACKET:BUFFER AMPLIFIER	28480	05061-0025
	05061-0028	1	BRACKET:P.C. BOARD	28480	05061-0028
	05061-0029	1	PANEL:INSIDE	28480	05061-0029
	05061-0032	1	BRACKET:OSCILLATOR	28480	05061-0032
	05061-0035	1	BRACKET:P.C. BOARD	28480	05061-0035
	05061-0042	1	CAN ROUND-HALF, BEAM TUBE	28480	05061-0042
	05061-0043	1	CAN ROUND-HALF, BEAM TUBE	28480	05061-0043
	05061-0045	1	BRACKET	28480	05061-0045

See introduction to this section for ordering information

Table 6-1. Replaceable Parts, 5061A W/O Option

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	05061-0046	1	BRACKET	28480	05061-0046
	05061-2020	1	DOOR:FRONT	28480	05061-2020
	05061-2032	1	BRACKET:MOUNT	28480	05061-2032
	05061-2037	2	BRACKET:TUBE	28480	05061-2037
	05061-2038	1	SPACER:OPERATIONAL AMPLIFIER	28480	05061-2038
	05061-2041	1	COVER:TOP	28480	05061-2041
	05061-2042	1	BAR:DOOR TO CLOCK	28480	05061-2042
	05061-2043	2	GUIDE:DOOR TO CLOCK	28480	05061-2043
	05061-2044	1	LOCK:DOOR TO CLOCK	28480	05061-2044
	05061-2045	1	PLATE:LEFT	28480	05061-2045
	05061-6060	1	CABLE ASSY:MAIN	28480	05061-6060
	05061-6066	1	CABLE ASSY:PANEL	28480	05061-6066
	05061-6067	1	CABLE ASSY:PANEL	28480	05061-6067

See introduction to this section for ordering information

Table 6–2. Option 002 Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			TABLE 6-2, OPTION 002		
OPTION 002	05061-6075	1	STANDBY POWER SUPPLY(OPTION 002)	28480	05061-6075
	05061-0014	1	BRACKET:CAPACITOR	28480	05061-0014
OPT.002	05061-0021	1	PANEL:LEFT	28480	05061-0021
MISC	05061-0026	1	BRACKET:BATTERY	28480	05061-0026
PARTS					
	05061-0027	1	GASKET:BATTERY	28480	05061-0027
BT1	1420-0053	1	BATTERY:24 V 2.3A	8822C	TYPE HP 607W
C4	0180-0047	1	C:FXD ELECT 500 UF 75VDCW	56289	D32443 DFP
DS3	2140-0025	1	LAMP:INCANDESCENT 28.0V 0.04 AMPS	08806	327
DS3	1450-0114	1	LAMPHOLDER:AMBER LENS	07137	RDL-B3-F3-000
Q1	1854-0062	1	TSTR:SI NPN	80131	2N1701
Q1	0340-0487	1	INSULATOR:TSTR FOR TO-8 CASE	76530	293233
Q1	1200-0087	1	CLAMP:TRANSISTOR	02735	DF-13-A
Q1	1200-0092	1	BUSHING:TRANSISTOR	02735	495334 1
S8	3101-0124	1	SWITCH:PUSHBUTTON SPST	28480	3101-0124
A2	05061-6019	1	BOARD ASSY:BATTERY CHARGER	28480	05061-6019
A2C1	0150-0093	2	C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A2C2	0160-0127	4	C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A2C3	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A2C4	0180-0106	3	C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A2C5	0180-2614	2	C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	150D107X903052
A2C6	0150-0121	1	C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A2C7	0180-2614		C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	109D107C2030T2
A2C8	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A2C9	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A2C10	0140-0234	5	C:FXD MICA 500 PF 1%	28480	0140-0234
A2C11	0180-0116	1	C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A2C12	0180-0117	1	C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A2C13	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A2C14	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A2C15	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A2C16	0160-3875	1	C:FXD 22 PF 200VDC		
A2CR1	1901-0029	8	DIODE:SILICON 600 PIV	28480	1901-0029
A2CR2	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A2CR3	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A2CR4	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A2CR5	1902-0579		DIODE:BREAKDOWN 5.11V 5%	04713	1902-0579
A2CR6	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A2CR7	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A2CR8	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A2CR9	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A2CR10	1902-0523		DIODE BREAKDOWN 16.9V 2% DO-7 PD = .4W TC = +0.084%	28480	1902-0523
A2CR11	1902-0041	3	DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A2CR12	1902-3290	1	DIODE BREAKDOWN:SILICON 31.6V 5%	28480	1902-3290
A2CR13	1902-0041		DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A2CR14	1910-0016	12	DIODE:GE 60 WIV	28480	1910-0016
A2CR15	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A2CR16	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A2CR17	1902-0523	1	DIODE:ZENER 16.9V 2MA	28480	1902-0523
A2CR18	1901-0040	5	DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2CR19	1902-0041		DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A2CR20	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A2CR21	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A2CR22	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A2CR23	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A2CR24	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A2CR25	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A2CR26	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A2CR27	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A2CR28	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A2CR29	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2CR30	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2CR31	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2CR32	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2IC1	1820-0315	1	INTEGRATED CIRCUIT	28480	1820-0315
A2IC2	1820-0329	3	IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A2IC3	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A2IC4	1820-0080	2	IC:RTL GATE QUAD 2-INPT	28480	1820-0080
A2IC5	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A2IC6	1820-0080		IC:RTL GATE QUAD 2-INPT	28480	1820-0080
A2IC7	1820-0086	1	IC:DTL DUAL 4-INPUT GATE (EXPANDABLE)	04713	SC6900PK
A2IC8	1820-0094	4	IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A2IC9	1820-0094		IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A2IC10	1820-0094		IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A2IC11	1820-0094		IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A2K1	0490-0475	1	RELAY:DPDT 28V 2A	99928	LSA-2C-24B
A2Q1	1854-0568		TSTR 2N5845A		

See introduction to this section for ordering information

Table 6-2. Option 002 Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2Q2	1855-0010	3	TSTR:SI	80131	2N2646
A2Q3	1854-0005		TSTR:SI NPN	80131	2N708
A2Q4	1854-0005		TSTR:SI NPN	80131	2N708
A2Q5	1854-0005		TSTR:SI NPN	80131	2N708
A2Q6	1854-0005		TSTR:SI NPN	80131	2N708
A2Q7	1854-0039	4	TSTR:SI NPN	80131	2N3053
A2Q8	1853-0001	1	TSTR:SI PNP(SELECTED FROM 2N1132)	28480	1853-0001
A2Q9	1854-0005		TSTR:SI NPN	80131	2N708
A2Q10	1854-0039		TSTR:SI NPN	80131	2N3053
A2Q11	1854-0210		TSTR:NPN SI TO-18 PD = 500 MW 04713 2N2222	28480	1854-0201
A2Q12	1854-0005		TSTR:SI NPN	80131	2N708
A2Q13	1855-0027	1	TSTR:SI	80131	2N2647
A2Q14	1854-0039		TSTR:SI NPN	80131	2N3053
A2Q15	1854-0005		TSTR:SI NPN	80131	2N708
A2Q16	1854-0005		TSTR:SI NPN	80131	2N708
A2Q17	1854-0005		TSTR:SI NPN	80131	2N708
A2Q18	1854-0005		TSTR:SI NPN	80131	2N708
A2Q19	1854-0003	4	TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A2Q20	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A2Q21	1855-0010		TSTR:SI	80131	2N2646
A2Q22	1854-0005		TSTR:SI NPN	80131	2N708
A2Q23	1855-0010		TSTR:SI	80131	2N2646
A2Q24	1854-0005		TSTR:SI NPN	80131	2N708
A2Q25	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A2Q26	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A2R1	0757-0924	12	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R2	0764-0013	2	R:FXD MET OX 56 OHM 5% 2W	28480	0764-0013
A2R3	0757-0938	8	R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A2R4	0757-0928	1	R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A2R5	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R6	0757-0907	3	R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A2R7	0757-0952	5	R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A2R8	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A2R9	0757-0486	3	R:FXD MET FLM 750K OHM 1% 1/8W	28480	0757-0486
A2R10	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A2R11	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R12	0757-0962	1	R:FXD FLM 39K OHM 2% 1/8W	28480	0757-0962
A2R13	0757-0955	1	R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A2R14	0757-0931	10	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A2R15	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A2R16	2100-1769	1	R:VAR WW 50 OHM 5% TYPE H 1W	28480	2100-1769
A2R17	0758-0063	1	R:FXD MET OX 1600 OHM 5% 1/2W	28480	0758-0063
A2R18	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R19	0757-0933		R: FXD FLM 2.4K OHM 2% 1/8W	28480	0757-0933
A2R20	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R21	0757-0900	2	R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A2R22	0757-0896	1	R:FXD MET FLM 68 OHM 2% 1/8W	28480	0757-0896
A2R23	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A2R24	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R25	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A2R26	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R27	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A2R28	0757-0346	1	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A2R29	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A2R30	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R31	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A2R32	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R33	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R34	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A2R35	0757-0948	5	R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A2R36	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A2R37	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A2R38	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A2R39	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R40	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A2R41	0757-0933		R: FXD FLM 2.4K OHM 2% 1/8W	28480	0757-0933
A2R42	0757-0909	1	R:FXD FLM 240 OHM 2% 1/8W	28480	0757-0909
A2R43	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A2R44	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A2R45	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A2R46	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A2R47	0757-0486		R:FXD MET FLM 750K OHM 1% 1/8W	28480	0757-0486
A2R48	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2R49	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A2R50	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931

See introduction to this section for ordering information

Table 6-2. Option 002 Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2R51	0757-0486		R:FXD MET FLM 750K OHM 1% 1/8W	28480	0757-0486
A2R52	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A2R53	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A2R54	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A2R55	0757-0933		R: FXD FLM 2.4K OHM 2% 1/8W	28480	0757-0933
A2R56	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A2R57	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A2R58	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A2R59	0757-0917	1	R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A2R60	0757-0952		R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A2R61	0757-0933	1	R:FXD FLM 2.4K OHM 2% 1/8W	28480	0757-0933
A2R62	0757-0941		R:FXD FLM 5.1K OHM 2% 1/8W	28480	0757-0941
A2R63	0757-0942	1	R:FXD FLM 5.6K OHM 2% 1/8W	28480	0757-0942
A2R64	0764-0013		R:FXD MET OX 56 OHM 5% 2W	28480	0764-0013
A2SCR1	1884-0070	2	SWITCH:SC SI PNPN	03508	3N81
A2SCR2	1884-0070		SWITCH:SC SI PNPN	03508	3N81
A17F1	2110-0274	1	FUSE:3A	75915	276003

See introduction to this section for ordering information

Table 6-3. Option 001 Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			TABLE 6-3, OPTION 001		
	1250-0102	1	CONNECTOR:BNC	28480	1250-0102
	1390-0036	1	FASTENER:STUD RECEIVER	78553	C-1663-017-24
	1390-0144	1	FASTENER:PANEL,BALL STUD	78553	P101-525
	05061-0076	1	PANEL· LEFT	25480	05061-0076
	05061-2023	1	PLATE:LEFT	28480	05061-2023
OPT.001 MISC PARTS	05061-6034	1	COVER:ASSY TOP	28480	05061-6034
	05061-6061	1	CABLE ASSY:FREQUENCY DIVIDER	28480	05061-6061
	05061-6062	1	CABLE ASSY:DIGITAL DIVIDER	28480	05061-6062
	05061-6068	1	CABLE ASSY:DIGITAL DIVIDER	28480	05061-6068
	05061-6069	1	CABLE ASSY:DIGITAL DIVIDER	28480	05061-6069
	05061-6071	1	CABLE ASSY:CLOCK	28480	05061-6071
	0400-0084	1	BUSHING:SNAP 0.250" ID	28520	SB-437-4
	05061-0080	1	CHASSIS: DIGITAL ϕ	25480	05061-0080
	05061-0012	1	COVER:DIGITAL DIVIDER	28480	05061-0012
A5 MISC PARTS	05061-0013	1	BRACKET:DIGITAL DIVIDER	28480	05061-0013
	05061-0079	1	BRACKET, GUARD		05061-0079
	05061-2026	1	PLATE:END	28480	05061-2026
	05061-2027	1	PLATE:END	28480	05061-2027
A5A1	05061-0114	1	BOARD ASSY· POWER SUPPLY	28480	05061-6114
A5A1C1	0180-0097	2	C:FXD TANT. 47 UF 10% 35VDCW	56289	1500476X903552-DYS
A5A1C2	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	1500476X903552-DYS
A5A1C3	0160-0162	1	C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A5A1C4	0150-0096	2	C:FXD CER 0.05 UF +80-20% 100VDCW	91418	TA
A5A1C5	0150-0096		C:FXD CER 0.05 UF +80-20% 100VDCW	91418	TA
A5A1C6	0180-0098	3	C:FXD ELECT 100 UF 20% 20VDCW	56289	150D107X0020S2-DYS
A5A1C7	0180-0098		C:FXD ELECT 100 UF 20% 20VDCW	56289	150D107X0020S2-DYS
A5A1C8	0180-0117	4	C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A5A1C9	0180-0117		C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A5A1C10	0150-0093	4	C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5A1C11	0180-0117		C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A5A1C12	0140-0203	1	C:FXD MICA 30 PF 5%	28480	0140-0203
A5A1C13	0160-0127	2	C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A5A1C14	0180-0117		C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A5A1C15	0160-0174	1	C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A5A1C16	0180-0116	1	C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A5A1C17	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5A1C18	0180-0098		C:FXD ELECT 100 UF 20% 20VDCW	56289	150D107X0020S2-DYS
A5A1C19	0180-0532	1	C.FXD CER 6.8 UF 20% 25VDCW		DGR8GS2B35M
A5A1CR1	1901-0040	16	DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A1CR2	1901-0410	2	DIODE:SILICON 100 PIV 3 AMP 1N4720	02735	1N4720
A5A1CR3	1901-0410		DIODE:SILICON 100 PIV 3 AMP 1N4720	02735	1N4720
A5A1CR4	1901-0028	4	DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A5A1CR5	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A5A1CR6	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A5A1CR7	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A5A1CR8	1902-3193	1	DIODE BREAKDOWN:13.3V 5%	28480	1902-3193
A5A1CR9	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A1CR10	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A1CR11	1902-0554	4	DIODE BREAKDOWN:10V 1W	28480	1902-0554
A5A1CR12	1902-0554		DIODE BREAKDOWN:10V 1W	28480	1902-0554
A5A1CR15	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A1J1	1250-0257	4	CONNECTOR:RF 50 OHM PC MOUNT	28480	1250-0257
A5A1J2	1250-0257		CONNECTOR:RF 50 OHM PC MOUNT	28480	1250-0257
A5A1J3	1250-0257		CONNECTOR:RF 50 OHM PC MOUNT	28480	1250-0257
A5A1J4	1250-0257		CONNECTOR:RF 50 OHM PC MOUNT	28480	1250-0257
A5A1L1, L2	9100-1630	2	COIL:FXD RF 51 UH	28480	9100-1630
A5A1Q1	1854-0613	3	TSTR:SI NPN	28480	1854-0613
A5A1Q2	1854-0613		TSTR:SI NPN	28480	1854-0613
A5A1Q3	1853-0001	1	TSTR:SI PNP(SELECTED FROM 2N1132)	28480	1853-0001
A5A1Q4	1854-0003	3	TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A5A1Q5	1854-0020		TSTR:SI NPN	28480	1854-0020
A5A1Q6	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A5A1Q7	1854-0005	6	TSTR:SI NPN	80131	2N708

See introduction to this section for ordering information

Table 6-3. Option 001 Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5A1Q8	1854-0035	1	TSTR:SI NPN	28480	1854-0035
A5A1Q9	1854-0039	2	TSTR:SI NPN	80131	2N3053
A5A1Q10	1854-0039		TSTR:SI NPN	80131	2N3053
A5A1R1	0757-0942	1	R:FXD FLM 5.6K OHM 2% 1/8W	28480	0757-0942
A5A1R2	0757-0900	11	R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R3	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R4	0757-0894	1	R:FXD FLM 56 OHM 2% 1/8W	28480	0757-0894
A5A1R5	0757-0929	1	R:FXD FLM 1.6K OHM 2% 1/8W	28480	0757-0929
A5A1R6	0757-0914	2	R:FXD FLM 390 OHM 2% 1/8W	28480	0757-0914
A5A1R7	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R8	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R9	0757-0346	2	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A5A1R10	0757-0948	11	R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A1R11	0757-0914		R:FXD FLM 390 OHM 2% 1/8W	28480	0757-0914
A5A1R12	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R13	2100-1773	1	R:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A5A1R14	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A5A1R15	0757-0907	3	R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A5A1R16	0757-0920	5	R:FXD FLM 680 OHM 2% 1/8W	28480	0757-0920
A5A1R17	0757-0920		R:FXD FLM 680 OHM 2% 1/8W	28480	0757-0920
A5A1R18	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R19	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A5A1R20	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A5A1T1	9100-2448	1	TRANSFORMER	28480	9100-2448
A5A1T2	05061-8010	1	TRANSFORMER	28480	05061-8010
A5A2	05061-6014	1	BOARD ASSY:MASTER CLOCK	28480	05061-6014
A5A2C1	0150-0121	2	C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML
A5A2C2	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5A2C3	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A5A2C4	0140-0180	1	C:FXD MICA 2000 PF 2%	28480	0140-0180
A5A2C5	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML
A5A2C6	0140-0234	2	C:FXD MICA 500 PF 1%	28480	0140-0234
A5A2C7	0160-0196	1	C:FXD MICA 24PF 5% 300VDCW	04062	RDM15C240J3S
A5A2C8	0140-0234		C:FXD MICA 500 PF 1%	28480	0140-0234
A5A2C9	0121-0105	10	C:VAR CER 9-35 PF NPO	28480	0121-0105
A5A2C10	0160-0342	1	C:FXD MICA 800 PF 5%		
A5A2C11	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5A2C12	0140-0202	2	C:FXD MICA 15 PF 5% 500VDCW	28480	0140-0202
A5A2C13	0140-0202		C:FXD MICA 15 PF 5% 500VDCW	28480	0140-0202
A5A2CR1	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR2	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR3	1902-0064	1	DIODE BREAKDOWN:7.5V	28480	1902-0064
A5A2CR4	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR5	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR6	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR7	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR8	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR9	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR10	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR11	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2IC1	1820-0580	6	IC:DIGITAL	28480	1820-0580
A5A2IC2	1820-0580		IC:DIGITAL	28480	1820-0580
A5A2IC3	1820-0580		IC:DIGITAL	28480	1820-0580
A5A2IC4	1820-0094	4	IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A5A2IC5	1820-0094		IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A5A2IC6	1820-0329	12	IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC7	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC8	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC9	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC10	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC11	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC12	1820-0086	4	IC:DTL DUAL 4-INPUT GATE (EXPANDABLE)	04713	SC6900PK
A5A2IC13	1820-0086		IC:DTL DUAL 4-INPUT GATE (EXPANDABLE)	04713	SC6900PK
A5A2IC14	1820-0086		IC:DTL DUAL 4-INPUT GATE (EXPANDABLE)	04713	SC6900PK
A5A2L1	9100-1630		COIL:FXD RF 51 UH	28480	9100-1630
A5A2L2	9140-0137	1	COIL:FXD RF 1000 UH 5%	28480	9140-0137
A5A2L3	9100-1630		COIL:FXD RF 51 UH	28480	9100-1630

See introduction to this section for ordering information

Table 6-3. Option 001 Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5A2Q1	1854-0005		TSTR:SI NPN	80131	2N708
A5A2Q2	1854-0005		TSTR:SI NPN	80131	2N708
A5A2Q3	1854-0009	19	TSTR:SI NPN	80131	2N709
A5A2Q4	1854-0009		TSTR:SI NPN	80131	2N709
A5A2Q5	1854-0009		TSTR:SI NPN	80131	2N709
A5A2Q6	1854-0009		TSTR:SI NPN	80131	2N709
A5A2Q7	1854-0009		TSTR:SI NPN	80131	2N709
A5A2R1	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R2	0757-0946	1	R:FXD FLM 8.2K OHM 2% 1/8W	28480	0757-0946
A5A2R3	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R4	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R5	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A2R6	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A2R7	0757-0920		R:FXD FLM 680 OHM 2% 1/8W	28480	0757-0920
A5A2R8	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A2R9	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R10	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A2R11	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R12	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R13	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R14	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R15	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R16	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R17	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R18	0757-0917	4	R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A5A2R19	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R20	0757-0972	1	R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A5A2R21	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R22	0757-0938	2	R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A5A2R23	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R24	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A2R25	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R26	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R27	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R28	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R29	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R30	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R31	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R32	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R33	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R34	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R35	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R36	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R37	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R38	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R39	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R40	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R41	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R42	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R43	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R44	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R45	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R46	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2T1	05061-8005	1	TRANSFORMER:1MHZ-4MHZ	28480	05061-8005
A5A2T2	05061-8009	1	TRANSFORMER:SYNC	28480	05061-8009
A5A2XY1	1200-0159	1	CRYSTAL HOLDER	28480	1200-0159
A5A2Y1	0410-0012	1	CRYSTAL: 1MC +/-0.001%	00136	OBD
A5A3	05061-6013	1	BOARD ASSY:PRESET CLOCK	28480	05061-6013
A5A3	05061-2024	6	CONNECTOR:6 PIN	28480	05061-2024
A5A3C1	0140-0198	2	C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A5A3C2	0140-0191	1	C:FXD MICA 56 PF 5% 300VDCW	19701	RDM15E560J 300V
A5A3C3	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A5A3CR1	1910-0016	24	DIODE:GE 60 WIV	28480	1910-0016
A5A3CR2	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR3	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR4	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR5	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR6	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR7	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR8	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR9	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR10	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR11	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR12	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR13	1910-0016		DIODE:GE 60 WIV	28480	1910-0016

See introduction to this section for ordering information

Table 6-3. Option 001 Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5A3CR14	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR15	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR16	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR17	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A3CR18	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A3CR19	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR20	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR21	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR22	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR23	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR24	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR25	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR26	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3IC1	1820-0094		IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A5A3IC2	1820-0094		IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A5A3IC3	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC4	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC5	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC6	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC7	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC8	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC9	1820-0080	4	IC:RTL GATE QUAD 2-INPT	28480	1820-0080
A5A3IC10	1820-0080		IC:RTL GATE QUAD 2-INPT	28480	1820-0080
A5A3IC11	1820-0080		IC:RTL GATE QUAD 2-INPT	28480	1820-0080
A5A3IC12	1820-0086		IC:DTL DUAL 4-INPUT GATE (EXPANDABLE)	04713	SC6900PK
A5A3IC13	1820-0580		IC:DIGITAL	28480	1820-0580
A5A3IC15	1820-0580		IC:DIGITAL	28480	1820-0580
A5A3IC16	1820-0580		IC:DIGITAL	28480	1820-0580
A5A3IC17	1820-0080		IC:RTL GATE QUAD 2-INPT	28480	1820-0080
A5A3Q1	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q2	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q3	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q4	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q5	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q6	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q7	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q8	1854-0018	3	TSTR:SI NPN	80131	1854-0018
A5A3Q9	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q10	1854-0018		TSTR:SI NPN	80131	1854-0018
A5A3Q11	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q12	1854-0018		TSTR:SI NPN	80131	1854-0018
A5A3Q13	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q14	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A5A3Q15	1854-0009		TSTR:SI NPN	80131	2N709
A5A3R1	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R2	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R3	0757-0928	12	R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R4	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R5	0757-0935	5	R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A5A3R6	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R7	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R8	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R9	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R10	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R11	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A5A3R12	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R13	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R14	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R15	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R16	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R17	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A5A3R18	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R19	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R20	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R21	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R22	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R23	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A5A3R24	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R25	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R26	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R27	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R28	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R29	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A5A3R30	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R31	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931

See introduction to this section for ordering information

Table 6-3. Option 001 Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5A3R32	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R33	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R34	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R35	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R36	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R37	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R38	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R39	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R40	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R41	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R42	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A5A3R43	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A3R44	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R45	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R46	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A3R47	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R48	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R49	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R50	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A5A3R51	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R52	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R53	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R54	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A5A3R55	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R56	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R57	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A3R58	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R59	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A5A3R60	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R61	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R62	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3S1	3100-2061	1	SWITCH:THUMBWHEEL	28480	3100-2061
A5A4	05061-6033	1	BOARD ASSY:SWITCH	28480	05061-6033
A5A4C1	0140-0176	1	C:FXD MICA 100 PF 2%	28480	0140-0176
A5A4C2	0121-0425	1	C:VAR MICA 70 TO 350 PF 175VDCW	14655	T5181C-7
A5A4IC1	1820-0315	1	INTEGRATED CIRCUIT	28480	1820-0315
A5A4Q1	1854-0005		TSTR:SI NPN	80131	2N708
A5A4R1	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A4R2	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A4R3	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A5	05061-6012	1	BOARD ASSY:INTERCONNECTION	28480	05061-6012
A5A5XA1	05061-2025	4	CONNECTOR:12 PIN	28480	05061-2025
A5A5XA2	05061-2025		CONNECTOR:12 PIN	28480	05061-2025
A5A5XA3	05061-2025		CONNECTOR:12 PIN	28480	05061-2025
A5A5XA4	05061-2025		CONNECTOR:12 PIN	28480	05061-2025

See introduction to this section for ordering information

Table 6-3. Option 001 Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16	05061-6125 3	1	CLOCK DISPLAY ASSEMBLY (OPT 001 ONLY) (SERIES 1740)	28480	05061-6125
	05061-6136	or 1	CLOCK DISPLAY ASSEMBLY (OPT 003 ONLY) (SERIES 1740)	28480	05061-6136
	05061-6137 6	1	CABLE ASSEMBLY, CLOCK DISPLAY	28480	05061-6137
	1200-0063 2	2	CONNECTOR-SGL CONT SKT RND	28480	1200-0063
	1250-0102 5	1	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0102
	3101-0052 1	1	SWITCH-PB SPST-NO MOM ,25A 30VAC BLK-BTN	82389	961
	5020-0176 0	2	INSULATOR FOR SNAP-ON PINS	28480	5020-0176
	05061-2118 4	1	PANEL, CENTER (OPT 001 ONLY)	28480	05061-2118
	05061-2119	or 1	PANEL, CENTER (OPT 003 ONLY)	28480	05061-2119
	05061-2120 9	1	PLATE, CENTER	28480	05061-2120
	05062-20162 7	1	WINDOW, DISPLAY	28480	05062-20162
	05061-6146 7	1	REGULATOR/DRIVE(SERIES 1740)	28480	05061-6146
A16A1C1	0180-2827 5	4	CAPACITOR-FXD 47UF+100-10% 40VDC AL	28480	0180-2827
A16A1C2	0180-2827 5		CAPACITOR-FXD 47UF+100-10% 40VDC AL	28480	0180-2827
A16A1C3	0160-0576 5	6	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A16A1C4	0180-0210 6	1	CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A16A1C5	0160-3879 7	3	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16A1C6	0160-0576 5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A16A1C7	0160-0573 2	1	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A16A1C8	0180-0291 3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A16A1C9	0160-0576 5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A16A1C10	0180-2827 5		CAPACITOR-FXD 47UF+100-10% 40VDC AL	28480	0180-2827
A16A1C11	0160-0576 5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A16A1C12	0160-3879 7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16A1C13	0160-0576 5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A16A1C14	0180-2827 5		CAPACITOR-FXD 47UF+100-10% 40VDC AL	28480	0180-2827
A16A1C15	0160-0576 5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A16A1CR1	1902-3234 3	1	DIODE-ZNR 19.6V 5% DO-7 PD=.4W TC=+.073%	28480	1902-3234
A16A1CR2	1901-0040 1	2	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A16A1CR3	1902-1286 1	1	DIODE-ZNR 1N5342B 6.8V 5% PD=5W TC=+200%	04713	1N5342B
A16A1CR4	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A16A1CR5	1901-0693 0	1	DIODE-PWR RECT 1N4934 100V 1A 200NS	04713	1N4934
A16A1F1	2110-0099 4	2	FUSE 1A 125V FAST-BLO .281X.093	28480	2110-0099
A16A1F2	2110-0099 4		FUSE 1A 125V FAST-BLO .281X.093	28480	2110-0099
A16A1L1	9140-0237 2	1	COIL-MLD 200UH 5% Q=65 .155DX.375LG-NOM	28480	9100-0237
A16A1L2	9100-0537 1	1	COIL 400UH 15% 1.12D-NOM SRF=1MHZ	28480	9100-0537
A16A1Q1	1854-0215 1	2	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A16A1Q2	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A16A1Q3	1853-0314 9	1	TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A16A1Q4	1853-0036 2	1	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A16A1R1	0757-0442 9	10	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16A1R2	0757-0280 3	3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16A1R3	0757-0465 6	2	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A16A1R4	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16A1R5	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16A1R6	0757-0427 0	1	RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A16A1R7	0757-0465 6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A16A1R8	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16A1R9	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16A1R10	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16A1R11	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16A1R12	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16A1R13	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16A1R14	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16A1R15	0757-0338 2	1	RESISTOR 1K 1% .25W F TC=0+-100	27167	C5-1/4-T0-1001-F
A16A1R16	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16A1R17	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16A1R18	0698-8812 7	1	RESISTOR 1 1% .125W F TC=0+-100	28480	0698-8812
A16A1S1	3101-0878 9	1	SWITCH-TGL SUBMIN SPDT NS 2A 250VAC	28480	3101-0878
A16A1S2	3101-0557 1	2	SWITCH-PB SPST-NO MOM .5A 120VAC	28480	3101-0557
A16A1S3	3101-0557 1		SWITCH-PB SPST-NO MOM .5A 120VAC	28480	3101-0557
A16A1U1	1826-0180 0	1	IC 555 8-DIP-P	18324	NE555V
A16A1U2	1826-0428 9	1	IC 3524 MODULATOR 16-DIP-C	01295	SG3524J
	1241-3955 3	1		28480	1241-3955
	3050-0107 8	1	WASHER-FL MTLC NO. 6 .156-IN-ID	28480	3050-0107
	05061-0085 1	1	BRACKET, SWITCH	28480	05061-0085
	05061-2037 2	3	SPACER, RIVET-ON	28480	05061-2037
A16A2	05061-6145 5	1	BOARD ASSEMBLY, DISPLAY (SERIES 1740)	28480	05061-6145
A16A2C1	0160-3879 7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16A2DS1	1990-0452 6	6	DISPLAY-NUM SEG 1-CHAR .3-H	28480	5082-7731, CAT C-E
A16A2DS2	1990-0452 6		DISPLAY-NUM SEG 1-CHAR .3-H	28480	5082-7731, CAT C-E
A16A2DS3	1990-0452 6		DISPLAY-NUM SEG 1-CHAR .3-H	28480	5082-7731, CAT C-E
A16A2DS4	1990-0452 6		DISPLAY-NUM SEG 1-CHAR .3-H	28480	5082-7731, CAT C-E
A16A2DS5	1990-0452 6		DISPLAY-NUM SEG 1-CHAR .3-H	28480	5082-7731, CAT C-E

See introduction to this section for ordering information

Table 6-3. Option 001 Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16A2DS6	1990-0452 6		DISPLAY-NUM SEG 1-CHAR .3-H	28480	5082-7731, CAT C-E
A16A2Q1	1853-0058 8	6	TRANSISTOR PNP SI PD=300MW FT=200MHZ	07263	832248
A16A2Q2	1853-0058 8		TRANSISTOR PNP SI PD=300MW FT=200MHZ	07263	832248
A16A2Q3	1853-0058 8		TRANSISTOR PNP SI PD=300MW FT=200MHZ	07263	832248
A16A2Q4	1853-0058 8		TRANSISTOR PNP SI PD=300MW FT=200MHZ	07263	832248
A16A2Q5	1853-0058 8		TRANSISTOR PNP SI PD=300MW FT=200MHZ	07263	832248
A16A2Q6	1853-0058 8		TRANSISTOR PNP SI PD=300MW FT=200MHZ	07263	832248
A16A2R1	0698-7284 5	1	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A16A2R2	0698-7244 7	7	RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A16A2R3	0698-7244 7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A16A2R4	0698-7244 7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A16A2R5	0698-7244 7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A16A2R6	0698-7244 7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A16A2R7	0698-7244 7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A16A2R8	0698-7244 7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A16A2R9	0698-7202 7	7	RESISTOR 38.3 1% .05W F TC=0+-100	24546	C3-1/8-T00-38R3-G
A16A2R10	0698-7202 7		RESISTOR 38.3 1% .05W F TC=0+-100	24546	C3-1/8-T00-38R3-G
A16A2R11	0698-7202 7		RESISTOR 38.3 1% .05W F TC=0+-100	24546	C3-1/8-T00-38R3-G
A16A2R12	0698-7202 7		RESISTOR 38.3 1% .05W F TC=0+-100	24546	C3-1/8-T00-38R3-G
A16A2R13	0698-7202 7		RESISTOR 38.3 1% .05W F TC=0+-100	24546	C3-1/8-T00-38R3-G
A16A2R14	0698-7202 7		RESISTOR 38.3 1% .05W F TC=0+-100	24546	C3-1/8-T00-38R3-G
A16A2R15	0698-7202 7		RESISTOR 38.3 1% .05W F TC=0+-100	24546	C3-1/8-T00-38R3-G
A16A2RP1	1810-0055 5	1	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0055
A16A2RP2	1810-0151 2	1	NETWORK-RES 7-PIN-SIP .15-PIN-SPCG	28480	1810-0151
A16A2U1	1820-2126 6	1	IC MISC PMOS	27014	MM5313N(76+)
A16A2U2	1858-0023 7	1	TRANSISTOR ARRAY	01928	CA3081
A16A2U3	1820-1146 8	1	IC BFR CMOS NON-INV HEX 1-INP	01928	CD4050AF
	1200-0496 5	1	SOCKET,IC 14-PIN	28480	1200-0496

See introduction to this section for ordering information

Table 6-4. Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
00000	U.S.A. COMMON	ANY SUPPLIER OF U.S.A.	
00136	MC COY ELECTRONICS CO.	MT. HOLLY SPRINGS, PA.	17065
00853	SANGAMO ELECTRIC CO.PICKENS DIV.	PICKENS, S.C.	29671
01121	ALLEN BRADLEY CO.	MILWAUKEE, WIS.	53204
01255	LITTON INDUSTRIES INC. (USECO)	BEVERLY HILLS, CALIF.	90210
01281	TRW SEMICONDUCTOR INC.	LAWNDALE, CALIF.	90260
01295	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.	75231
02114	FERROXCUBE CORP.	SAUGERTIES, N.Y.	12477
02660	AMPHENOL CORP.	BROADVIEW, ILL.	60153
02735	RCA SOLID STATE & RECEIVING TUBE DIV.	SOMERVILLE, N.J.	08876
02875	HUDSON TOOL & DIE CO.	NEWARK, N.J.	07105
03508	G.E. CO. SEMICONDUCTOR PROD. DEPT.	SYRACUSE, N.Y.	13201
04009	ARROW, HART & HEGEMAN ELECT. CO.	HARTFORD, CONN.	06106
04062	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
04217	ESSEX WIRE CORP. & CABLE DIV.	ANAHEIM, CALIF.	92801
04713	MOTOROLA SEMICONDUCTOR PROD.INC.	PHOENIX, ARIZ.	85008
06090	RAYCHEM CORP.	MENLO PARK, CALIF.	94025
07137	TRANSISTOR ELECTRONICS CORP.	MINNEAPOLIS, MINN.	55424
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
08145	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
08718	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
08806	G.E. CO. MINIATURE LAMP DEPT.	CLEVELAND, OHIO	44112
11711	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
12040	NATIONAL SEMICONDUCTOR CORP.	DANBURY, CONN.	06810
12574	GULTON IND. INC. DATA SYSTEM DIV.	ALBUQUERQUE, N.M.	87108
13103	THERMALLOY CO.	DALLAS, TEX.	75247
14655	CORNELL DUBLIER ELECT. DIV.FEDERAL PACIFIC ELECT. CO.	NEWARK, N.J.	07105
14752	ELECTRO-CUBE INC.	SAN GABRIEL, CALIF.	91776
15558	MICON ELECTRONICS INC.	GARDEN CITY LONG IS., N.Y.	11530
19701	ELECTRA/MIDLAND CORP.	MINERAL WELLS, TEX.	76067
28480	HEWLETT-PACKARD CO. CORPORATE HQ	YOUR NEAREST HP OFFICE	
28520	HEYMAN MFG. CO.	KENILWORTH N.J.	07033
36196	STANWYCK COIL PROD. LTD.	HAWKSBURY ONTARIO, CANADA	
42190	MUTER CO. THE	CHICAGO, ILL.	60638
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
70903	BELDEN CORP.	CHICAGO, ILL.	60644
71400	BUSSMANN MFG. DIV. MC GRAW-EDISON CO.	ST. LOUIS, MO.	63017
71436	CHICAGO CONDENSER CORP.	CHICAGO, ILL.	60647
71468	ITT CANNON ELECT. INC.	LOS ANGELES, CALIF.	90031
71785	CINCH MFG. CO. DIV TRW INC.	ELK GROVE VILLAGE, ILL.	
72136	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.	06226
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
73138	BECKMAN INST. INC. HELIPOT DIV.	FULLERTON, CALIF.	92634
75042	INTERNATIONAL RESISTANCE CO. INC.	PHILADELPHIA, PA.	19108
75915	LITTELFUSE INC.	DES PLAINES, ILL.	60016
76493	MILLER J.W. CO.	COMPTON, CALIF.	90024
76530	CINCH MONADNOCK MILLS DIV. TRW INC.	CITY OF INDUSTRY, CALIF.	91746
78553	TINNERMAN PROD. INC.	CLEVELAND, OHIO	44129
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON D.C.	20006
81312	WINCHESTER ELECTRONICS DIV. LITTON IND. INC.	OAKVILLE, CONN.	06779
82047	SPERTI FARADAY INC. COOPER HEWITT ELECT. CO. DIV.	HOBOKEN, N.J.	07030
82142	AIRCO SPEER ELECT. COMP.	DU BOIS, PA.	15801
82389	SWITCHCRAFT INC.	CHICAGO, ILL.	60630
83298	BENDIX CORP. ELECTRIC POWER DIV.	EATONTOWN, N.J.	07724
84411	TRW CAPACITOR DIV.	OGALLALA, NEBR.	69153
88220	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
91418	RADIO MATERIALS CO.	CHICAGO, ILL.	60646
91468	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
91506	AUGAT INC.	ATTLEBORO, MASS.	02703
91737	ITT GREMAR INC.	WOBURN, MASS.	01801
94222	SOUTHCO INC.	LESTER, PA.	19113
95275	VITRAMON INC.	BRIDGEPORT, CONN.	06601
97534	A.P.M. HEXSEAL CORP.	ENGLEWOOD N.J.	07631
98291	SEALECTRO CORP.	MAMARONECK, N.Y.	10544
98978	INTERNATIONAL ELECT. RESEARCH CORP.	BURBANK, CALIF.	91502
99800	DELEVAN ELECTRONICS CORP.	E. AURORA, N.Y.	14052
99928	BRANSON CORP.	DENNVILLE, N.J.	834

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information necessary to adapt this manual to apply to older instruments. Information is included regarding the use of MANUAL CHANGES sheets for updating manuals to newer instruments.

7-3. MANUAL CHANGES

7-4. This manual applies directly to 5061A Cesium Beam Frequency Standards with serial number prefix 1740A. Manual changes for instruments with lower or higher prefixes are described in the following paragraphs.

7-4. Newer Instruments

7-6. As engineering changes are made, newer instruments may have higher serial prefix numbers than those listed on the title page of this manual. The manuals for these instruments will be provided with MANUAL CHANGES sheets that contain the required information. Replace affected pages or modify existing manual information as directed in the MANUAL CHANGES pages. Contact the nearest Hewlett-Packard Sales and Service Office if the change information is missing.

7-7. Older Instruments

7-8. Instruments with serial number prefix 1428A and below are covered in Operating and Service Manual Part Number 05061-9034. For instruments having serial number prefixes between 1428A and 1740A, refer to Table 7-1 below for backdating that applies to the instruments' serial prefix number.

Table 7-1. Manual Backdating

If Instrument has Serial Prefix No.	Make the Following Changes to Manual
1724A (All)	1
1724A (except -01378, -01379, and -01384. Also -01388 and above with Opt. 002 & 003)	1,2
1640A	1,2,3,
1540A01221 and below, (except 1540A01213 and 1540A01218)	1,2,3,4
1536A (except 1536A01204, -01212, -01214, and -01216)	1,2,3,4,5,
1532A	1,2,3,4,5,6
1524A	1,2,3,4,5,6,7
1508A	1,2,3,4,5,6,7,8
1444A	1,2,3,4,5,6,7,8,9
1428A	1,2,3,4,5,6,7,8,9,10

NOTE: For instruments with serial prefix numbers lower than 1428A, refer to 5061A Operating and Service Manual Part No. 05061-9034.

CHANGE 1

Page 3-9, Paragraph 3-23:
Replace with the following:
"The time standard option includes a 24 Hr. LED digital clock which indicates time in hours, minutes, and seconds. The SYNC button on A5 assembly enables the instrument to synchronize to an external reference standard. The digital clock is set by pressing the SLOW and FAST pushbutton (located at the rear of the clock). The HOLD pushbutton (on the clock) permits synchronization of the clock with the instrument 1PPS."

Page 3-9, Paragraph 3-27:
Delete step b, c, and d. Change step e to step b, step f to step c, and step g to step d.

Add the following steps:

e. Press and hold the HOLD pushbutton at the rear of digital clock. Set the hours, minutes, and seconds by momentarily pressing FAST (for rapid advance of the display) and set the seconds slightly ahead of the reference clock.

f. When the reference clock time is identical to the digital clock display, release the HOLD pushbutton. The digital clock will count time in synchronism with the synchronized instrument 1PPS signal.

g. Replace the instrument top cover.

Page 4-10, Paragraph 4-99:
Replace with the following:
"The time standard Option includes a 24 Hr. LED digital clock which indicates time in hours, minutes, and seconds. HOLD, FAST and SLOW pushbuttons at the rear of the digital clock permit time to be set and enables the clock to count and display time in synchronism with the 1PPS signal."

Page 4-24, Paragraphs 4-252 through 4-261:
Replace with Table 7-2.

Page 5-46, Paragraph 5-274 through 5-287:
Replace with Table 7-3.

Page 6-34, Table 6-3, Option 001 Replaceable Parts:
Replace with Table 7-4.

Page 6–39, Table 6-3, A16 Replaceable Parts:
Replace with Table 7-5.

Page 8-7. Figure 8-6, Wiring Diagram:
Delete two lines labeled "TO LED CLOCK" at upper middle of diagram.
Change label "A16 CLOCK DISPLAY" within Option 001 TIME STANDARD BLOCK to read "B1 CLOCK MOVEMENT."

Page 8-19, Figure 8-13, A5 Schematic:
Replace with Figure 7-1.

Page 8-21, Figure 8-14, A5 and A5A1 Schematic:
Replace with Figure 7-2.

Page 8-53, Figure 8-29, A16 Schematic:
Replace with Figure 7-3.

Page 4-16, Paragraphs 4-169 and 4-170:
Replace with the following:

"**4-169. OPERATIONAL AMPLIFIER ASSEMBLY A9**

4-170. Figure 8-20 shows the schematic diagram and component locator for Operational Amplifier A9. The amplifier, in conjunction with external feedback capacitors C2 and C3 (see Figure 8-2) forms an integrator circuit. A9 receives dc error voltages from Phase Detector A8 and supplies a dc control voltage to tune the 5 MHz quartz oscillator."

Page 6-14, Table 6-1, A9 Replaceable Parts:
Replace all of A9 (05061-6134) parts list with Table 7-6.

Page 8-35, Figure 8-20, A9 Schematic Diagram:
Replace with Figure 7-4.

Page 6-25, Table 6-1, Replaceable Parts:
Change switch S2 from 3100-3429 to "3100-0894, SWITCH ROTARY, 3 SEC, 3 POS."
Add switch "S6, 3101-0045, SWITCH, SLIDE, DPDT, 0.5A, 125VDC."
Change resistor R4 from 0757-0948 to "0757-0924, Resistor, Fxd Met Film 1K."

Page 6-30, Table 6-1, Replaceable Parts:
Delete "05061-0082, PANEL, INNER MINT GRAY, 28480, 05061-0082."

Page 3-3, Table 3-2, MODE switch functions:
Delete LTC (long time constant) and description.
Add references to TIME CONSTANT switch S6 in manual as follows:

Page 3-7, Paragraph 3-14a:
Change "MODE" to "TIME CONSTANT"
Change "OPER" to "SHORT"
Change "LTC" to "LONG"

Page 3-7, Paragraph 3-14b:
Add "TIME CONSTANT switch SHORT"

Page 3-3, Figure 3-2:
Replace with Appendix, Figure 7-5.

Page 3-1, Figure 3-1:
Replace with Appendix Figure 7-6.

Page 5-11, Paragraph 5-19a:
Add TIME CONSTANT . . . . . SHORT

Page 5-13, TAble 5-4:
Near A add set TIME CONSTANT to SHORT

Page 5-18, Paragraph 5-69a:
Add TIME CONSTANT . . . . . . SHORT

Page 5-20, Paragraph 5-108a:
Add TIME CONSTANT . . . . . . SHORT

Page 5-21, Paragraph 5-118a:
Add TIME CONSTANT . . . . . . SHORT

Page 5-22, Paragraph 5-120a:
Add TIME CONSTANT . . . . . . SHORT

Page 5-34, Paragraphs 5-186e, 5-188a:
Add TIME CONSTANT . . . . . . SHORT

Page 5-36, Paragraphs 5-193a, 5-194a
Add TIME CONSTANT . . . . . . SHORT

Page 5-37, Paragraph 5-195a, 5-197a:
Add TIME CONSTANT . . . . . . SHORT

Page 5-38, Paragraph 5-209b:
Add TIME CONSTANT . . . . . . SHORT

Page 8-3, Figure 8-2:
Replace with Figure 7-7.

Page 8-4, Figure 8-3:
Replace with Figure 7-8.

Page 8-5, Figures 8-4 and 8-5:
Replace with Figure 7-9.

Page 8-7, Figure 8-6:
Replace with Figure 7-10.

Page 8-55, Figure 8-30:
Replace with Figure 7-11.

CHANGE 2

Page 6-31, Table 6-2, Option 002 Replaceable Parts:
Change A2CR5 from 1902-0579 to 1902-0041.

Page 8-13, Figure 8-10:
Change Series No. (at top of diagram) from 1724 to 1512A.
Delete asterisk from R2 and from R64.

CHANGE 3

Page 6-5, Table 6-1, A1A1 (05061-6098) Replaceable Parts:
Change A1A1R3 from 0698-3311, 51 ohms, to 0698-3617, 75 ohms.

Page 8-9, Figure 8-8, A1 and A1A1 Schematic Diagrams:
Change A1 and A1A1 from Series 1724 to Series 1536A (top of diagram).
Change A1A1R3 from 51 ohms to 75 ohms.

CHANGE 4

Page 6-8, Table 6-1, A3 Replaceable Parts:
Delete A3R38 and A3R39

Page 8-15, Figure 8-11:
Delete A3R38 and A3R39
Change A3 and A3A1 Series No. (top of diagram) to 1248A.

CHANGE 5

Page 6-4, Table 6-1, A1A1 Replaceable Parts:
Change A1A1C2 to 0140-0221, 220 PF, Mfr. Code 28480.

Page 6-5, Table 6-1, A1A1 Replaceable Parts:
Change A1A1IC4 to 1820-0580.

Page 8-9, Figure 8-8:
Change A1A1C2 to 220 PF
Change A1A1IC4 to 1820-0580.
Change A1 and A1A1 series (top of diagram) to 1152A.

CHANGE 6

Page 4-24, Paragraphs 4-252 through 4-261:
Replace with Table 7-2
Change third paragraph that starts with "Four circuit boards . . ." to read "Three circuit boards . . . " and delete "4. Shield board between A1 and A2."

Page 5-45, Paragraph 5-274, CLOCK DISPLAY ASSEMBLY A16:
Replace with Table 7-3.

Page 6-38, Table 6-3, A16 Replaceable Parts:
Replace with Table 7-5 and delete "BOARD ASSEMBLY, SHIELD" (two places).
Delete "A16A2C6, 0180-0228, CAPACITOR-FXD .22 UF."

Page 8-53, Figure 8-29:
Replace with Figure 7-3.
Delete A16A2C6 from Figure 7-3.

CHANGE 7

Page 3-9, Paragraph 3-23:
Replace with the following:

3-23. The time standard option includes a mechanical clock movement indicating time in hours, minutes, and seconds. FAST and STOP pushbuttons on the divider module (Figure 7-6) permit setting the clock movement to the nearest second. The SYNC pushbutton allows the clock to be synchronized to an external clock or pulse. The hours and minutes adjustment is the knob located on the back of the clock movement (pull to engage and adjust, push to release).

Page 3-9 and 3-10, Paragraph 3-27:
Replace with the following:

3-27. To automatically have the 5061A synchronized and delayed from the reference by 9 to 11 μsec, proceed as follows:

a. Remove the top cover.

b. Using the knob on back of clock movement, set hours and minutes.

c. Replace the top cover and open the access door in the top cover.

d. Using the FAST pushbutton to speed up the clock tick, or STOP pushbutton to stop the clock (release the pushbutton to start clock tick), set the clock to the nearest second.

e. Set the 6 thumbwheel switch to 0 0 0 0 0 0, and 0-1 μsec TIME DELAY control maximum clockwise (do not over-tighten).

f. Connect a reference pulse to the 5061A rear-panel SYNC INPUT jack. The reference input pulse must be greater than +5V, with a rise time of less than 0.5 μsec.

g. Press the SYNC pushbutton on the clock module and hold down for at least 1 second. The next tick of the 5061A will be synchronized to the input reference pulse and delayed in time by 9 to 11 μsec. Any additional offset may be selected by using the 6 thumbwheel switch.

Page 4-10, Paragraph 4-99:
Replace with the following:

4-99. The time standard option includes a mechanical clock movement indicating time in hours, minutes, and seconds. FAST and STOP pushbuttons on the divider module (Figure 7-6) permit setting the clock movement to the nearest second. Hours and minutes are mechanically set. SYNC pushbutton (Figure 7-6) allows the digital divider to be automatically synchronized within 9 to 11 μ of an external reference input pulse. This external reference must be greater than +5V with a rise time of less than 0.05 μsec.

Page 4-10, Paragraph 4-106:
Replace with the following:

4-106. The mechanical clock movement can be set to the nearest second with FAST and STOP pushbuttons located under the top cover access door. When the FAST button is depressed, the second hand advances at a rate 10 times faster than normal. The STOP button, when pressed, will stop the movement until released.

Page 4-24, Paragraphs 4-252 through 4-261:
Replace with Table 7-2. Change that part of the third paragraph that reads "Four circuit boards make up the . . ." to read "Three circuit boards make up the . . .". Delete the statement: "4. A fourth circuit board is placed between the A1 and A2 assemblies to act as a shield."

Page 6-39, Table 6-3, A16 Replaceable Parts:
Replace with Table 7-5 and delte "BOARD ASSEMBLY, SHIELD" (two places).
Delete "A16A2C6, 0180-0238, CAPACITOR-FXD .22 UF."

Page 8-53, Figure 8-29:
Replace with Figure 7-3.
Delete C6 from +12V line in Figure 7-3 and change Series No. (top of diagram) to 1532A.

CHANGE 8

Page 6-4, Table 6-1, A1 Replaceable Parts:
Change A1A1CR36 and A1A1CR37 to 1901-0146, Diode, Silicon, 35WUV

Page 8-11, Figure 8-9:
Change A1 and A1A1 Series (top of diagram) to 1524A.

CHANGE 9

Page 6-18, Table 6-1, A11 Replaceable Parts:
Change A11A1R22 and A11A1R23 to 0757-0948, Resistor, 10K, 2%, 1/8W.

Page 8-45, Figure 8-25, A11 Schematic:
Change R22 and R23 to 10K.
Change A11 and A11A1 Series (top of diagram) to 1428A.

Page 6-32, Table 6-2, A2 Replaceable Parts:
Change A2Q11 to 1854-0039.

Page 8-13, Figure 8-10, A2 Schematic
Change A2Q11 to 1854-0039.
Change A2 Series (top of diagram) to 1420A.

CHANGE 10

Page 6-14, Table 6-1, A9 Replaceable Parts:
Replace with Table 7-6. Delete A9A1CR3, A9A1CR4, A9A1R3, Terminal Stud 0340-0037 (2) and Terminal Bushing 0340-0039 (2).

Page 8-35, Figure 8-20, A9 Schematic Diagram:
Replace with Figure 7-4. Delete A9A1CR3, A9A1CR4, and A9A1R3 from Figure 7-4.

Table 7-2. Digital Clock Theory of Operation

GENERAL

The digital clock is a solid-state 24-hour clock with a seven-segment LED (light emitting diode) display. It indicates time in hours, minutes, and seconds in synchronism with the 5061A generated 1PPS signal. Time may be set and synchronized using the HOLD/SLOW/FAST pushbuttons of the LED clock.

The required inputs which enable the clock to operate are connected to the clock by five wires. These are:

1. Unregulated +28V dc from the 5061A used to generate a regulated +5V dc and used exclusively to drive the display.
2. Regulted +12V dc from the 5061A used exclusively to operate the CMOS circuits in the clock.
3. 1PPS signal from the 5061A used to synchronize the clock and increment the display.
4. AC line sense signal from A15(10) turns off the display portion if instrument AC power fails or is removed. To display time, when AC power is not available, the clock front-panel STANDBY READ must be pressed.
5. 1PPS and 12V dc common. Circuit ground connects to the chassis through the LED digital clock circuits.

Four circuit boards make up the A16 LED digital clock. These are:

1. A1, +5V switching regulator. This is the rear board.
2. A2, 50 Hz logic. This is the middle board.
3. A3, clock display. This is the front board.
4. Shield board between A1 and A2.

A16A1, +5V Switching Regulator

This assembly is a 9 kHz to 18 kHz switching regulator which generates +5V, ±0.4V dc from the instruments' unregulated +28V dc input. It consists of switch Q1, voltage regulator U1, current limit circuit Q2, and input and output filter circuits.

The +28V dc input voltage is filtered by C1, L1, C2, and is applied to U1(8) and Q1. U1(7) output is a +5V dc rectangular wave signal which switches Q1 at a 9 to 18 kHz rate depending on load current and input voltage.

A reference voltage output is generated at U1(4) and is applied to U1(3). The filtered +5V dc output is monitored at U1(2) and any differences between U1(3) and U1(2) changes the duty-cycle of U1(7) output. The duty-cycle change adjusts Q1 on-off times. If the +5V dc output tends to increase, Q1 on-time decreases which reduces the output voltage. If the +5V dc output tends to decrease, Q1 on-time increases which increases the output voltage.

Current limiter Q1 senses the current flow through R8. Excessive current turns Q1 on and is sensed at U1(9). This sets U1 into current-limit mode which reduces the +5V dc output to zero. Current limit occurs at about 450 mA. When the cause of excessive current is removed, the +5V dc output returns to normal.

Diode CR1 is a commutating diode which conducts L2 coil current during Q1 off-times. R1, C8 are part of an ac sense circuit which monitors the unregulated, instrument generated dc and switches the clock display off whenever ac power is not available.

A16A2, 50 Hz Logic Board

The 50 Hz logic board generates the 50 Hz signal which operates the clock display. It also synchronizes the clock display advance with the instrument generated 1PPS signal. This board also contains the ac sense circuits which turn off the clock display whenever ac power to the instrument is not available.

When power is first applied, the RC time constant of R3, C1 causes one-shot MV U3B(13) to generate a pulse output. The pulse period is determined by the RC time constant of (R7-C3). U3B(13) output resets U3A which sets U3A(1) low and disables gate U1B. With this gate disabled, no clock pulses are gated through U1B to U2(1).

U3B(13) one-shot output is also gated through U5B, clocks U6B and turns on the 65 Hz free-running MV comprised of U1D, U5D and its associated components. The 65 Hz output from U5D is gated through U5A to the A16A3 clock display board U1(19). U1, on A16A3 clock display board, accumulates the 65 Hz pulses and generates a pulse output at 50th pulse (1 second). This pulse is used to synchronize the clock display with the instruments' 1PPS. The 1 second clocks U3A on A16A2, 50 Hz logic board. U3A(1) by U4C. U4C output is inverted by U4A, gated through U4B and inverted again to a high level through U5C. This level resets U6B and turns off free-running MV U1D, U5D.

Accumulator U1, on A16A3 clock display board, has counted to 49. The instrument 1PPS input to the 50 Hz logic board is "stretched" and level-changed through Q2 and clocks U6A. U6A is a one-shot MV whose 75 μsec period is determined by R6, C2, RC time-constant. U6A(1) output is gated through U5A to A16A3 clock display board U1, as the 50th cycle. The clock display then advances 1 second. The U6A output pulse is delayed by R8-C4, gated through U5B(5) and clocks U6B which starts free-running MV U1D, U5D.

the delay circuit R8, C4 provides a time delay between the 1PPS generated 50th cycle, which causes the display to increment 1 second, and the start of the next free-running MV cycle, which enables U1 on A16A3 clock display board to count to 49.

A16A3, Clock Display Board

The clock display board consists of a MOS clock chip, a transistor array, a buffer amplifier array, four driver transistors, and six LED displays. This assembly's function is to accumulate and display time-of-day in synchronism with the instruments' 1PPS signal.

The MOS clock circuit U1 operates from the 50 Hz input from A16A2 50 Hz logic board. U1 divides the 50 Hz signal by 50 and generates a 1PPS output at pin 20 which is used to synchronize the display to the instrument 1PPS signal.

Counter stages within U1 divide the input 50 Hz signal and generate the hours, minutes, and seconds outputs for the LED displays.

Table 7-2. Digital Clock Theory of Operation (Continued)

The time display signals from U1 are comprised of two parts

1. The digit enable signal.
2. The multiplexed 7-segment signal.

The digits enable signals from U1 are:

Pin 23: tens-of-hours.
Pin24: units-of-hours.

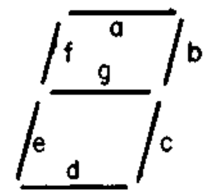
The digits enable signals from U1 are:

Pin 23: tens-of-hours.
Pin 24: units-of-hours.
Pin 25: tens-of-minutes.
Pin 26: units-of-minutes.
Pin 21: tens-of-seconds.
Pin 22: units-of-seconds.

The signals enable the LED displays through U3 gates, and allow the multiplex seven segments outputs to turn-on the correct display segment.

The multiplex seven segment signals from U1 are shown below:

Pin 6: for segment a.
Pin 7. for segment b.
Pin 8: for segment c.
Pin 9: for segment d.
Pin 10: for segment e.
Pin 11: for segment f.
Pin 12: for segment g.



These "segment enabling signals" are buffered through U2 stages and applied to the LED displays. Thus, the segments of an individual number display are enabled by outputs from U1 (6 to 12) while the display itself is turned on by one of the U1 (21 to 26) outputs.

Table 7-3. Digital Clock Maintenance

MAINTENANCE

General

The A16 LED Digital Clock Assembly has no adjustments ar requires no periodic maintenance. Should repair be necessar the unit may be removed and operated on the bench while r maining connected to the instrument. When operating in th manner, however, the clock chassis or circuit common **must l connected to the instrument chassis** with a CLIP LEA OR JUMPER WIRE. The following paragraphs describe a sembly removal, fault finding procedures for the clock syster and troubleshooting information for the dividual circuits.

NOTE

Most of the circuits on the 50 Hz LOGIC and CLOCK DISPLAY assemblies are CMOS. Use high impedance test equipment when checking signals. Precautions should be taken when removing or replacing these circuits to prevent damage from static charges.

Repairs

Before repairs are attempted:

a. Momentarily set front panel DIVIDER MODE switch start.

b. Check CIRCUIT CHECK meter in 1 MHz position f reading of approximately 40. If not, troubleshoot A assembly.

c. Check front panel 1PPS output. If not present, troubl shoot A5 assembly.

d. If the display is not lit, press STANDBY DISPLA switch. If display lights and operates normally, tl instrument is not operating from AC power. This co dition is normal. If the display does not light when tl STANDBY DISPLAY switch is pressed, perfor troubleshooting procedures.

e. Read LED Digital Clock Theory of Operation.

A16 Assemby Removal

Prior to removing or reinstalling the LED Digital Clock, operating power must be removed. Wire and cable length to clock panel or clock rear board is sufficient to enable removal o the clock without disconnecting these wires or the cable. Th clock should be placed on a pad or cloth to minimize scratc damage or shorting of circuit traces.

To remove the clock:

a. Remove all operating power.

b. Remove the instrument top cover. In Options 002 an 003 disable the internal standby battery.

c. Use a 5⁄16" spin-type wrench and remove two 5⁄16" nut which secure the clock to the instrument front pane Retain the nuts for reinstallation. The bottom of th clock is retained in place by a ball-stud fastener whic does not need to be removed.

d. Press firmly at the bottom-rear then at the top-rear of th the clock until it is loose.

e. Carefully remove the clock. Gently pull the connected wires and cable forward and set the clock on the work surface.

f. Before applying operating power ensure that the exposed LED CLOCK boards and wires are not in contact with any metal objects or surfaces. Reapply operating power.

g. To reinstall the LED clock, removal all operating power. In Options 002 and 003, disable the internal standby battery.

h. Do steps b to e in reverse order. (See Note.)

NOTE

While installing the clock into the instrument front panel, check that wires are not pinched by screws or metal work. Position the wires for a neat appearance after installation.

i. When clock is reinstalled, reapply power and set time as described in replacement paragraph for page 3-8, paragraph 3-21 of your 5061A Operating and Service Manual.

TROUBLESHOOTING

General

Each of the circuit boards in this assembly perform a specific function, requiring only 1 or 2 inputs to generate its output. These can easily be checked without disassembling the clock.

Procedures in this section describe fault isolation to the circuit board level, disassembly of the clock, and troubleshooting information for each of the three circuits.

Clock System Troubleshooting

To perform the following tests the clock must be removed from the instrument and connected as described in A16 ASSEMBLY REMOVAL.

A16A1 Power Supply Check

NOTE

All voltages measured with respect to instrument chassis.

a. Measure voltages indicated below. Be sure clock chassis is grounded to instrument chassis.

VOLTAGE	LOCATION
+26 ±4V dc	A16A1(3)
+12 ±2V dc	A16A1(R)
+5 ±0.2V dc	A16A1(4)

b. If the +26 or +12 volt supplies are out of tolerance, troubleshoot are source of these voltages. If the +5V supply is out of tolerance, remove the connection between A16A1(4) and A16A2(4) and measure the voltage again. If voltage now is correct, go to step b(2).

Table 7-3. Digital Clock Maintenance (Continued)

(1) If voltage remains out of tolerance, troubleshoot A16A1, 5V Regulator Assembly. See clock repair and disassembly, step 1 and "Circuit Board Troubleshooting", step 1.

(2) If voltage is now correct it indicates a short or low impedance on 5V line or defective current-limit circuit; troubleshoot 5V line and circuits on A16A3 which use 5V. If these are OK, check current-limit circuit of A16A1Q2.

NOTE

An external 5V can be used in plae of A16A1 output.

c. Check for +1V, 150 ns, 1PPS signal at A16A1(W). Be sure clock chassis is grounded to instrument chassis. If pulse not present, troubleshoot A5 Digital Divider Assembly.

A16A3 Clock Display Check

a. If display is not lit go to "Display not lit" step 2. If display is lit but not functioning correctly continue:

1. Check waveform at A16A3(2). It should be as shown on schematic.
2. If correct, go to item 5 of this paragraph. If incorrect or not present, cut 1PPS wire between A16A3(1) and A16A2.
3. Press and release HOLD pushbutton. Momentarily connect a clip lead from the +12V supply A16A3(R) to where 1PPS wire (cut in previous step) connects to A16A2 assembly.
4. Recheck waveform at A16A3(2). If correct, replace A16A3U1. If incorrect troubleshoot A16A2. See "Clock Repair and Disassembly", step 3, and "Circuit Board Troubleshooting", step 3.
5. Connect a counter, set to totalize (manual gate open) to A16A3(2).
6. Unplug the white wire (which connects the clock assembly to the instrument chassis) at the instrument chassis.
7. Reset counter to zero and momentarily reconnect white wire removed in step 6. Disconnect white wire as soon as the counter starts counting.
8. Counter should read 51 pulses or multiples of 51 depending on how quickly the white wire was disconnected). If the counter reads correctly, go to the next step. If the counter reads incorrectly troubleshoot A16A2. See "Clock Repair and Disassembly", step 3, and "Circuit Board Troubleshooting", step 3.
9. Check A16A3(1) for a 1PPS square wave. If not present, check for +12V at A16A3(11). If +12V is present, replace A16A3U1. If 1PPS is present, troubleshoot A16A3. See "Clock Repair and Disassembly", step 2, and "Circuit Board Troubleshooting", step 2.

b. Display Not Lit

1. Check voltage at A16A3(5). It should be a few tenths of a volt less than the voltage at A16A1(4). If incorrect, troubleshoot "AC sense" circuit on A16A2. See "Clock Repair and Disassembly", step 3, and "Circuit Board Troubleshooting", step 3.
2. Check +12V input at A16A3(11). It should be the same as measured at A16A1(R). If not, check continuity of +12V line from A16A1 to A16A3.
3. Substitute a new LED in one of the display positions.
4. Trouble is U1, 2, or 3. Check for switching waveforms at U1(6-12) and (21-26). Check for switching waveforms at U2 and U3 outputs. See schematic for typical waveforms.

A16A2 50 Hz Logic Check

Troubleshooting checks to this point have isolated most problems to the failed circuit board. Problems of a more subtle nature such as clock not keeping correct time, or display not synchronized to the instrument's 1PPS output signal, are the type of problems associated with the 50 Hz logic board.

Clock Repair and Disassembly

1. To troubleshoot A16A1 5V regulator board it is not necessary to disassemble the clock. The board may be removed when making repairs, if soldering is required on the backside of the board.
2. To troubleshoot A16A3 display assembly remove three nuts which secure the circuit boards to the front panel assembly. Remove STANDBY DISPLAY switch from front panel. Remove Clock Circuit Board Assembly from front panel assembly. Remove six spacers from between boards. Reconnect all wires. Be sure to connect clock circuit ground (pads under spacers) to instrument chassis.
3. To troubleshoot A16A2 50 Hz LOGIC do step 2 above, but do not connect wires. Unsolder A16A3 from A16A2. Connect only the black and red wires (from A16A1 to instrument). Also connect clock circuit ground (pads under spacers) to instrument chassis.

CIRCUIT BOARD TROUBLESHOOTING

A16A1 Power Supply

Since this circuit contains only four active components, it is relatively easy to troubleshoot. With power disconnected check Q1, Q2, CR1, and capacitors. If these are good, trouble is probably in A16A1U1.

A16A3 Clock Display

U1 accumulates time, and drives the LED displays through U2, U3, and transistors Q1-6. To troubleshoot, observe that switching signal originating at U1(6-12) is reaching U3 outputs, and signal at U1(21-26) is reaching collectors of Q1-6. LEDs can be checked by substitution. If all signals are correct trouble is in U1.

Table 7-3. Digital Clock Maintenance (Continued)

c. If clock time is incorrect or out of sync:

1. Check 65 Hz oscillator (U6B, U1D, U5D), 49-counter (U2), 49-sense, (U4C, U4A) and amplifier circuits (U2, 4, 5).

2. Check operation of U3A and U3B (press HOLD to trigger U3A and reset U3B. Connect +12V to U3(3) to operate U3A.

d. If there is no output from A16A3, check 1PPS signal path through U5A.

NOTE

U6A is enabled by a high level (12V) at U6(5). If this level is incorrect repeat steps a and b. If level does not change, trouble is in 49-count or sense circuits (U2, U4C, U4A).

A16A2 50 Hz Logic

a. Momentarily press HOLD button.

b. Momentarily connect a jumper from +12V supply to U3(3). This resets the counters and enables input one-shot U6A. Circuit cannot operate until this is done.

NOTE

When viewing A16A2 waveforms it is helpful to synchronize oscilloscope from front panel 1PPS output.

Table 7-4. Option 001 Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			TABLE 6-3, OPTION 001		
A1 OPTION 001	05061-6074	1	DIGITAL DIVIDER ASSY	28480	05061-6074
	1250-0102	1	CONNECTOR:BNC	28480	1250-0102
	1390-0036	1	FASTENER:STUD RECEIVER	78553	C-1663-017-24
	1390-0144	1	FASTENER:PANEL,BALL STUD	78553	P101-525
	05061-0022	1	PANEL:CENTER	28480	05061-0022
	05061-0024	1	PANEL:LEFT	28480	05061-0024
	05061-2023	1	PLATE:LEFT	28480	05061-2023
OPT.001 MISC PARTS	05061-6011	2	MODULAT[illegible] ASSY:DIGITAL DIVIDER	28480	
	05061-6034	1	COVER:ASSY TOP	28480	05061-6034
	05061-6061	1	CABLE ASSY:FREQUENCY DIVIDER	28480	05061-6061
	05061-6062	1	CABLE ASSY:DIGITAL DIVIDER	28480	05061-6062
	05061-6068	1	CABLE ASSY:DIGITAL DIVIDER	28480	05061-6068
	05061-6069	1	CABLE ASSY:DIGITAL DIVIDER	28480	05061-6069
	05061-6071	1	CABLE ASSY:CLOCK	28480	05061-6071
	05061-6085	1	CLOCK ASSY:LOT 01-33	28480	05061-6085
A5	05061-6011		MODULE ASSY:DIGITAL DIVIDER	28480	05061-6011
	0400-0084	1	BUSHING:SNAP 0.250" ID	28520	SB-437-4
	05061-0011	1	CHASSIS: DIGITAL ϕ	28480	05061-0011
A5 MISC PARTS	05061-0012	1	COVER:DIGITAL DIVIDER	28480	05061-0012
	05061-0013	1	BRACKET:DIGITAL DIVIDER	28480	05061-0013
	05061-0037	1	BRACKET, GUARD	28480	05061-0037
	05061-2026	1	PLATE:END	28480	05061-2026
	05061-2027	1	PLATE:END	28480	05061-2027
A5S1	3101-0052	2	SWITCH:PUSHBUTTON SPST	82389	961 LESS HWD
A5S2	3101-1159	1	SWITCH:PUSHBUTTON SPDT	82389	10S-1051
A5S3	3101-0052		SWITCH:PUSHBUTTON SPST	82389	961 LESS HWD
A5A1	05061-6015	1	BOARD ASSY: POWER SUPPLY	28480	05061-6015
A5A1C1	0180-0097	2	C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A5A1C2	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A5A1C3	0160-0162	1	C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A5A1C4	0150-0096	2	C:FXD CER 0.05 UF +80-20% 100VDCW	91418	TA
A5A1C5	0150-0096		C:FXD CER 0.05 UF +80-20% 100VDCW	91418	TA
A5A1C6	0180-0098	3	C:FXD ELECT 100 UF 20% 20VDCW	56289	150D107X0020S2-DYS
A5A1C7	0180-0098		C:FXD ELECT 100 UF 20% 20VDCW	56289	150D107X0020S2-DYS
A5A1C8	0180-0117	4	C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A5A1C9	0180-0117		C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A5A1C10	0150-0093	4	C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5A1C11	0180-0117		C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A5A1C12	0140-0203	1	C:FXD MICA 30 PF 5%	28480	0140-0203
A5A1C13	0160-0127	2	C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A5A1C14	0180-0117		C:FXD ELECT 2.7 UF 10% 35VDCW	28480	0180-0117
A5A1C15	0160-0174	1	C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A5A1C16	0180-0116	1	C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A5A1C17	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5A1C18	0180-0098		C:FXD ELECT 100 UF 20% 20VDCW	56289	150D107X0020S2-DYS
A5A1C19	0180-0532	1	C:FXD CER 6.8 UF 20% 25VDCW		DGR8GS2B35M
A5A1CR1	1901-0040	16	DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A1CR2	1901-0410	2	DIODE:SILICON 100 PIV 3 AMP 1N4720	02735	1N4720
A5A1CR3	1901-0410		DIODE:SILICON 100 PIV 3 AMP 1N4720	02735	1N4720
A5A1CR4	1901-0028	4	DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A5A1CR5	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A5A1CR6	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A5A1CR7	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A5A1CR8	1902-3193	1	DIODE BREAKDOWN:13.3V 5%	28480	1902-3193
A5A1CR9	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A1CR10	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A1CR11	1902-0554	4	DIODE BREAKDOWN:10V 1W	28480	1902-0554
A5A1CR12	1902-0554		DIODE BREAKDOWN:10V 1W	28480	1902-0554
A5A1CR13	1902-0554		DIODE BREAKDOWN:10V 1W	28480	1902-0554
A5A1CR14	1902-0554		DIODE BREAKDOWN:10V 1W	28480	1902-0554
A5A1CR15	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A1IC1	1820-0313	1	IC:DTL RS/JK CLOCKED F/F	28480	1820-0313
A5A1J1	1250-0257	4	CONNECTOR:RF 50 OHM PC MOUNT	28480	1250-0257
A5A1J2	1250-0257		CONNECTOR:RF 50 OHM PC MOUNT	28480	1250-0257
A5A1J3	1250-0257		CONNECTOR:RF 50 OHM PC MOUNT	28480	1250-0257
A5A1J4	1250-0257		CONNECTOR:RF 50 OHM PC MOUNT	28480	1250-0257
A5A1L1, L2	9100-1630	2	COIL:FXD RF 51 UH	28480	9100-1630
A5A1Q1	1854-0613	3	TSTR:SI NPN	28480	1854-0613
A5A1Q2	1854-0613		TSTR:SI NPN	28480	1854-0613
A5A1Q3	1853-0001	1	TSTR:SI PNP(SELECTED FROM 2N1132)	28480	1853-0001
A5A1Q4	1854-0003	3	TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A5A1Q5	1854-0020		TSTR:SI NPN	28480	1854-0020
A5A1Q6	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A5A1Q7	1854-0005	6	TSTR:SI NPN	80131	2N708

See introduction to this section for ordering information

Table 7-4. Option 001 Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5A1Q8	1854-0035	1	TSTR:SI NPN	28480	1854-0035
A5A1Q9	1854-0039	2	TSTR:SI NPN	80131	2N3053
A5A1Q10	1854-0039		TSTR:SI NPN	80131	2N3053
A5A1Q11	1854-0005		TSTR:SI NPN	80131	2N708
A5A1Q12	1854-0005		TSTR:SI NPN	80131	2N708
A5A1R1	0757-0942	1	R:FXD FLM 5.6K OHM 2% 1/8W	28480	0757-0942
A5A1R2	0757-0900	11	R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R3	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R4	0757-0894	1	R:FXD FLM 56 OHM 2% 1/8W	28480	0757-0894
A5A1R5	0757-0929	1	R:FXD FLM 1.6K OHM 2% 1/8W	28480	0757-0929
A5A1R6	0757-0914	2	R:FXD FLM 390 OHM 2% 1/8W	28480	0757-0914
A5A1R7	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R8	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R9	0757-0346	2	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A5A1R10	0757-0948	11	R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A1R11	0757-0914		R:FXD FLM 390 OHM 2% 1/8W	28480	0757-0914
A5A1R12	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R13	2100-1773	1	R:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A5A1R14	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A5A1R15	0757-0907	3	R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A5A1R16	0757-0920	5	R:FXD FLM 680 OHM 2% 1/8W	28480	0757-0920
A5A1R17	0757-0920		R:FXD FLM 680 OHM 2% 1/8W	28480	0757-0920
A5A1R18	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A1R19	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A5A1R20	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A5A1R21	0757-0931	48	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A1R22	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A1R23	0757-0924	26	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A1R24	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A1R25	0757-0920		R:FXD FLM 680 OHM 2% 1/8W	28480	0757-0920
A5A1R26	0757-0920		R:FXD FLM 680 OHM 2% 1/8W	28480	0757-0920
A5A1T1	9100-2448	1	TRANSFORMER	28480	9100-2448
A5A1T2	05061-8010	1	TRANSFORMER	28480	05061-8010
A5A2	05061-6014	1	BOARD ASSY:MASTER CLOCK	28480	05061-6014
A5A2C1	0150-0121	2	C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C5081S-CML
A5A2C2	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5A2C3	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A5A2C4	0140-0180	1	C:FXD MICA 2000 PF 2%	28480	0140-0180
A5A2C5	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A5A2C6	0140-0234	2	C:FXD MICA 500 PF 1%	28480	0140-0234
A5A2C7	0160-0196	1	C:FXD MICA 24PF 5% 300VDCW	04062	RDM15C240J3S
A5A2C8	0140-0234		C:FXD MICA 500 PF 1%	28480	0140-0234
A5A2C9	0121-0105	10	C:VAR CER 9-35 PF NPO	28480	0121-0105
A5A2C10	0160-0342	1	C:FXD MICA 800 PF 5%		
A5A2C11	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5A2C12	0140-0202	2	C:FXD MICA 15 PF 5% 500VDCW	28480	0140-0202
A5A2C13	0140-0202		C:FXD MICA 15 PF 5% 500VDCW	28480	0140-0202
A5A2CR1	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR2	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR3	1902-0064	1	DIODE BREAKDOWN:7.5V	28480	1902-0064
A5A2CR4	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR5	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR6	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR7	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR8	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR9	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR10	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2CR11	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A2IC1	1820-0580	6	IC:DIGITAL	28480	1820-0580
A5A2IC2	1820-0580		IC:DIGITAL	28480	1820-0580
A5A2IC3	1820-0580		IC:DIGITAL	28480	1820-0580
A5A2IC4	1820-0094	4	IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A5A2IC5	1820-0094		IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A5A2IC6	1820-0329	12	IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC7	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC8	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC9	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC10	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC11	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A2IC12	1820-0086	4	IC:DTL DUAL 4-INPUT GATE (EXPANDABLE)	04713	SC6900PK
A5A2IC13	1820-0086		IC:DTL DUAL 4-INPUT GATE (EXPANDABLE)	04713	SC6900PK
A5A2IC14	1820-0086		IC:DTL DUAL 4-INPUT GATE (EXPANDABLE)	04713	SC6900PK
A5A2L1	9100-1630		COIL:FXD RF 51 UH	28480	9100-1630
A5A2L2	9140-0137	1	COIL:FXD RF 1000 UH 5%	28480	9140-0137
A5A2L3	9100-1630		COIL:FXD RF 51 UH	28480	9100-1630

See introduction to this section for ordering information

Table 7-4. Option 001 Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5A2Q1	1854-0005		TSTR:SI NPN	80131	2N708
A5A2Q2	1854-0005		TSTR:SI NPN	80131	2N708
A5A2Q3	1854-0009	19	TSTR:SI NPN	80131	2N709
A5A2Q4	1854-0009		TSTR:SI NPN	80131	2N709
A5A2Q5	1854-0009		TSTR:SI NPN	80131	2N709
A5A2Q6	1854-0009		TSTR:SI NPN	80131	2N709
A5A2Q7	1854-0009		TSTR:SI NPN	80131	2N709
A5A2R1	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R2	0757-0946	1	R:FXD FLM 8.2K OHM 2% 1/8W	28480	0757-0946
A5A2R3	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R4	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R5	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A2R6	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A2R7	0757-0920		R:FXD FLM 680 OHM 2% 1/8W	28480	0757-0920
A5A2R8	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A2R9	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R10	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A2R11	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R12	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R13	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R14	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R15	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R16	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R17	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R18	0757-0917	4	R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A5A2R19	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R20	0757-0972	1	R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A5A2R21	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R22	0757-0938	2	R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A5A2R23	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R24	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A5A2R25	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A2R26	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R27	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R28	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A2R29	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R30	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R31	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R32	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R33	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R34	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R35	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R36	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R37	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R38	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R39	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R40	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R41	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R42	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R43	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R44	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R45	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2R46	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A2T1	05061-8005	1	TRANSFORMER:1MHZ-4MHZ	28480	05061-8005
A5A2T2	05061-8009	1	TRANSFORMER:SYNC	28480	05061-8009
A5A2XY1	1200-0159	1	CRYSTAL HOLDER	28480	1200-0159
A5A2Y1	0410-0012	1	CRYSTAL: 1MC +/-0.001%	00136	OBD
A5A3	05061-6013	1	BOARD ASSY:PRESET CLOCK	28480	05061-6013
A5A3	05061-2024	6	CONNECTOR:6 PIN	28480	05061-2024
A5A3C1	0140-0198	2	C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A5A3C2	0140-0191	1	C:FXD MICA 56 PF 5% 300VDCW	19701	RDM15E560J 300V
A5A3C3	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A5A3CR1	1910-0016	24	DIODE:GE 60 WIV	28480	1910-0016
A5A3CR2	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR3	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR4	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR5	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR6	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR7	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR8	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR9	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR10	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR11	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR12	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR13	1910-0016		DIODE:GE 60 WIV	28480	1910-0016

See introduction to this section for ordering information

Table 7-4. Option 001 Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5A3CR14	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR15	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR16	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR17	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A3CR18	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5A3CR19	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR20	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR21	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR22	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR23	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR24	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR25	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3CR26	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A5A3IC1	1820-0094		IC:DTL QUAD 2-INPUT GATE	04713	SC6503PK
A5A3IC2	1820-0094		IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A5A3IC3	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC4	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC5	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC6	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC7	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC8	1820-0329		IC:TTL DECADE COUNTER 5 MHZ MIN.	28480	1820-0329
A5A3IC9	1820-0080	4	IC:RTL GATE QUAD 2-INPT	28480	1820-0080
A5A3IC10	1820-0080		IC:RTL GATE QUAD 2-INPT	28480	1820-0080
A5A3IC11	1820-0080		IC:RTL GATE QUAD 2-INPT	28480	1820-0080
A5A3IC12	1820-0086		IC:DTL DUAL 4-INPUT GATE (EXPANDABLE)	04713	SC6900PK
A5A3IC13	1820-0580		IC:DIGITAL	28480	1820-0580
A5A3IC15	1820-0580		IC:DIGITAL	28480	1820-0580
A5A3IC16	1820-0580		IC:DIGITAL	28480	1820-0580
A5A3IC17	1820-0080		IC:RTL GATE QUAD 2-INPT	28480	1820-0080
A5A3Q1	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q2	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q3	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q4	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q5	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q6	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q7	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q8	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q9	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q10	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q11	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q12	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q13	1854-0009		TSTR:SI NPN	80131	2N709
A5A3Q14	1854-0003		TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A5A3Q15	1854-0009		TSTR:SI NPN	80131	2N709
A5A3R1	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R2	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R3	0757-0928	12	R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R4	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R5	0757-0935	5	R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A5A3R6	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R7	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R8	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R9	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R10	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R11	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A5A3R12	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R13	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R14	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R15	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R16	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R17	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A5A3R18	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R19	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R20	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R21	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R22	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R23	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A5A3R24	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R25	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R26	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R27	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R28	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R29	0757-0935		R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935
A5A3R30	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R31	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931

See introduction to this section for ordering information

Table 7-4. Option 001 Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5A3R32	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R33	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R34	0757-0928		R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0928
A5A3R35	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R36	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R37	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R38	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R39	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R40	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R41	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R42	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A5A3R43	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A3R44	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R45	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R46	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A3R47	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R48	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R49	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R50	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A5A3R51	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R52	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R53	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R54	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A5A3R55	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R56	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R57	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A3R58	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R59	0757-0938		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A5A3R60	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A3R61	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3R62	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A3S1	3100-2061	1	SWITCH:THUMBWHEEL	28480	3100-2061
A5A4	05061-6033	1	BOARD ASSY:SWITCH	28480	05061-6033
A5A4C1	0140-0176	1	C:FXD MICA 100 PF 2%	28480	0140-0176
A5A4C2	0121-0425	1	C:VAR MICA 70 TO 350 PF 175VDCW	14655	T51810-7
A5A4IC1	1820-0315	1	INTEGRATED CIRCUIT	28480	1820-0315
A5A4Q1	1854-0005		TSTR:SI NPN	80131	2N708
A5A4R1	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A5A4R2	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A5A4R3	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A5A5	05061-6012	1	BOARD ASSY:INTERCONNECTION	28480	05061-6012
A5A5XA1	05061-2025	4	CONNECTOR:12 PIN	28480	05061-2025
A5A5XA2	05061-2025		CONNECTOR:12 PIN	28480	05061-2025
A5A5XA3	05061-2025		CONNECTOR:12 PIN	28480	05061-2025
A5A5XA4	05061-2025		CONNECTOR:12 PIN	28480	05061-2025

See introduction to this section for ordering information

Table 7-5. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16	05061-6120	1	CLOCK ASSEMBLY, LED 001	28480	05061-6120
A16A1	05061-6117	1	BOARD ASSEMBLY, REGULATOR	28480	05061-6117
A16A2	05061-6116	1	BOARD ASSEMBLY, 50 HZ LOGIC	28480	05061-6116
A16A3	05061-6115	1	BOARD ASSEMBLY, DISPLAY	28480	05061-6115
A16J13	1250-0102	1	CONNECTOR-RF BNC FEM SGL HOLE FR	28480	1250-0102
A16S1	3101-0052	1	SWITCH-PB SPST NO MOM .25A 30VAC	82389	961
A16S2	3101-0557	3	SWITCH-PB SPST NO MOM .5A 120VAC	09353	8631-E
A16S3	3101-0557		SWITCH-PB SPST NO MOM .5A 120VAC	09353	8631-E
A16S4	3101-0557		SWITCH-PB SPST NO MOM .5A 120VAC	09353	8631-E
			MISCELLANEOUS		
	1200-0063	3	CONNECTOR-SGL CONT SKT (FOR GOLD-POST CONNECTORS)	28480	1200-0063
	5020-0176	3	INSULATOR FOR SNAP-ON PINS (FOR GOLD-POST CONNECTORS)	28480	5020-0176
	05061-0078	1	BRACKET, SWITCH	28480	05061-0078
	05061-2118	1	PANEL, CENTER	28480	05061-2118
	05061-2120	1	PLATE, CENTER	28480	05061-2120
	05062-20162	1	WINDOW, DISPLAY	28480	05062-20162
	05061-2122	1	BOARD ASSEMBLY, SHIELD	28480	05061-2122
A16	05061-6119	1	CLOCK ASSEMBLY, LED 003	28480	05061-6119
A16 A1	05061-6117		BOARD ASSEMBLY, REGULATOR	28480	05061-6117
A16 A2	05061-6116		BOARD ASSEMBLY, 50 HZ, LOGIC	28480	05061-6116
A16 A3	05061-6115		BOARD ASSEMBLY, DISPLAY	28480	05061-6115
A16 DS3	2140-0025	1	LAMP-INCAND T-1-3/4 BULB 28V	28480	2140-0025
	1450-0114	1	LIGHT-IND LAMPHOLDER AMB TP LENS	07137	RDL-83-F3-000
A16 J13	1250-0102		CONNECTOR-RF BNC FEM SGL HOLE FR	28480	1250-0102
A16 S1	3101-0052		SWITCH-PB SPST NO MOM .25A 30VAC	82389	961
A16 S2	3101-0557		SWITCH-PB SPST NO MOM .5A 120VAC	09353	8631-E
A16 S3	3101-0557		SWITCH-PB SPST NO MOM .5A 120VAC	09353	8631-E
A16 S4	3101-0557		SWITCH-PB SPST NO MOM .5A 120VAC	09353	8631-E
			MISCELLANEOUS		
	1200-0063		CONNECTOR-SGL CONT SKT (FOR GOLD-POST CONNECTORS)	28480	1200-0063
	5020-0176		INSULATOR FOR SNAP-ON PINS (FOR GOLD-POST CONNECTORS)	28480	5020-0176
	05061-0078		BRACKET, SWITCH	28480	05061-0078
	05061-2119	1	PANEL, CENTER	28480	05061-2119
	05061-2120		PLATE, CENTER	28480	05061-2120
	05062-20162		WINDOW, DISPLAY	28480	05062-20162
	05061-2122	1	BOARD ASSEMBLY, SHIELD	28480	05061-2122
A16A1	05061-6117		BOARD ASSEMBLY, +5V REGULATOR	28480	05061-6117
A16A1C1	0160-3879	3	CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A16A1C2	0180-0141	2	CAPACITOR-FXD; 50UF+75-10% 50VDC AL	56289	30D506G050DD2
A16A1C3	0180-1743	2	CAPACITOR-FXD; .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A16A1C4	0180-1743		CAPACITOR-FXD; .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A16A1C5	0180-0098	1	CAPACITOR-FXD; 100UF+-20% 20VDC TA	56289	150D107X0020S2
A16A1C6	0160-2204	1	CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A16A1C7	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A16A1C8	0180-0141		CAPACITOR-FXD; 50UF+75-10% 50VDC AL	56289	30D506G050DD2
A16A1CR1	1901-0693	1	DIODE-PWR RECT 1N4934 100V 1A 200NS	04713	1N4934
A16A1L1	9140-0237	1	COIL-FXD MOLDED RF CHOKE 200UH 5%	24226	15/203
A16A1L2	9100-0536	1	COIL-FXD NON-MOLDED RF CHOKE 1.5MH 8%	28480	9100-0536
A16A1Q1	1853-0012	1	TRANSISTOR PNP 2N2904A SI TO-5 PD=600MW	01295	2N2904A
A16A1Q2	1854-0215	3	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A16A1R1	0757-0928	2	RESISTOR 1.5K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1501-G
A16A1R2	0757-0935	1	RESISTOR 3K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3001-G
A16A1R3	0683-3605	1	RESISTOR 36 5% .25W FC TC=-400/+500	01121	CB3605
A16A1R4	0683-1055	2	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A16A1R5	0757-0928		RESISTOR 1.5K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1501-G
A16A1R6	0757-0937	1	RESISTOR 3.6K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3601-G
A16A1R7	0757-0924	4	RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A16A1R8	0698-8177	1	RESISTOR 1.5 5% .25W F TC=0+-100	11502	TF07-1/4-T0-1R5-J
A16A1R9	0757-0924		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A16A1U1	1820-0196	1	IC RGLTR	07263	723HC

See introduction to this section for ordering information

Table 7-5. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16A2	05061-6116		BOARD ASSEMBLY, 50 HZ, LOGIC	28480	05061-6116
A16A2C1	0160-3878	4	CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A16A2C2	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A16A2C3	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A16A2C4	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A16A2C5	0160-0207	1	CAPACITOR-FXD .01UF +-5% 200WVDC POLYE	56289	292P10352
A16A2C6	0180-0238		CAPACITOR-FXD .22 UF +-10% 15VDC TA	28480	0180-0238
A16A2CR1	1902-3234	1	DIODE-ZNR 19.6V 5% DO-7 PD=.4W TC=+.073%	04713	SZ 10939-266
A16A2Q1	1854-0215		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A16A2Q2	1854-0215		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A16A2Q3	1853-0036	7	TRANSISTOR PNP SIL PD=310MW FT=250MHZ	04713	SPS-3612
A16A2R1	0757-0924		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-TO-1001-G
A16A2R2	0757-0948	2	RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-TO-1002-G
A16A2R3	0683-1055		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A16A2R4	0757-0955	2	RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-TO-2002-G
A16A2R5	0757-0950	1	RESISTOR 12K 2% .125W F TC=0+-100	24546	C4-1/8-TO-1202-G
A16A2R6	0757-0969	1	RESISTOR 75K 2% .125W F TC=0+-100	24546	C4-1/8-TO-7502-G
A16A2R7	0757-0945	1	RESISTOR 7.5K 2% .125W F TC=0+-100	24546	C4-1/8-TO-7501-G
A16A2R8	0757-0955		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-TO-2002-G
A16A2R9	0683-1555	1	RESISTOR 1.5M 5% .25W FC TC=-900/+1100	01121	CB1555
A16A2R10	0757-0485	1	RESISTOR 681K 1% .125W F TC=0+-100	24546	NA4
A16A2R11	0757-0963	1	RESISTOR 43K 2% .125W F TC=0+-100	24546	C4-1/8-TO-4302-G
A16A2R12	0757-0948		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-TO-1002-G
A16A2R13	0757-0924		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-TO-1001-G
A16A2R14	0757-0905	1	RESISTOR 160 2% .125W F TC=0+-100	24546	C4-1/8-TO-161-G
A16A2U1	1820-0949	1	IC CD4011AE GATE	02735	CD4011AE
A16A2U2	1820-0936	1	IC CD4024AE COUNTER	02735	CD4024AE
A16A2U3	1820-0939	2	IC CD4013AE FLIP-FLOP	02735	CD4013AE
A16A2U4	1820-0943	1	IC CD4023AE GATE	02735	CD4023AE
A16A2U5	1820-0946	1	IC CD4001AE GATE	02735	CD4001AE
A16A2U6	1820-0939		IC CD4013AE FLIP-FLOP	02735	CD4013AE
A16A3	05061-61152		BOARD ASSEMBLY, DISPLAY	28480	05061-61152
A16A3C1	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A16A3DS1	1990-0452	6	DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
A16A3DS2	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
A16A3DS3	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
A16A3DS4	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
A16A3DS5	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
A16A3DS6	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
A16A3Q1	1853-0036		TRANSISTOR PNP SIL PD=310MW FT=250MHZ	04713	SPS-3612
A16A3Q2	1853-0036		TRANSISTOR PNP SIL PD=310MW FT=250MHZ	04713	SPS-3612
A16A3Q3	1853-0036		TRANSISTOR PNP SIL PD=310MW FT=250MHZ	04713	SPS-3612
A16A3Q4	1853-0036		TRANSISTOR PNP SIL PD=310MW FT=250MHZ	04713	SPS-3612
A16A3Q5	1853-0036		TRANSISTOR PNP SIL PD=310MW FT=250MHZ	04713	SPS-3612
A16A3Q6	1853-0036		TRANSISTOR PNP SIL PD=310MW FT=250MHZ	04713	SPS-3612
A16A3R1	0698-7964	1	RESISTOR 100K 5% .125W CC TC=0+-850	01121	BB1045
A16A3R2	0698-5180	7	RESISTOR 2K 5% .125W CC TC=0+882	01121	BB2025
A16A3R3	0698-5180		RESISTOR 2K 5% .125W CC TC=0+882	01121	BB2025
A16A3R4	0698-5180		RESISTOR 2K 5% .125W CC TC=0+882	01121	BB2025
A16A3R5	0698-5180		RESISTOR 2K 5% .125W CC TC=0+882	01121	BB2025
A16A3R6	0698-5180		RESISTOR 2K 5% .125W CC TC=0+882	01121	BB2025
A16A3R7	0698-5180		RESISTOR 2K 5% .125W CC TC=0+882	01121	BB2025
A16A3R8	0698-5180		RESISTOR 2K 5% .125W CC TC=0+882	01121	BB2025
A16A3R9	0698-4130	7	RESISTOR 39 5% .125W CC TC=0+588	01121	BB3905
A16A3R10	0698-4130		RESISTOR 39 5% .125W CC TC=0+588	01121	BB3905
A16A3R11	0698-4130		RESISTOR 39 5% .125W CC TC=0+588	01121	BB3905
A16A3R12	0698-4130		RESISTOR 39 5% .125W CC TC=0+588	01121	BB3905
A16A3R13	0698-4130		RESISTOR 39 5% .125W CC TC=0+588	01121	BB3905
A16A3R14	0698-4130		RESISTOR 39 5% .125W CC TC=0+588	01121	BB3905
A16A3R15	0698-4130		RESISTOR 39 5% .125W CC TC=0+588	01121	BB3905
A16A3RP1	1810-0055	1	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0055
A16A3RP2	1810-0151	1	NETWORK-RES 7-PIN-SIP .15-PIN-SPCG	28480	1810-0151
A16A3U1	1820-1364	1	IC MM5313N DIGITAL	27014	MM5313N
A16A3U2	1858-0023	1	IC CA3081 XSTR ARRAY	02735	CA3081
A16A3U3	1820-1146	1	IC CD4050AE BUFFER	02735	CD4050AE
A16A3XDS1	1200-0496	6	SOCKET, IC 16-PIN	01295	OBD
A16A3XDS2	1200-0496		SOCKET, IC 16-PIN	01295	OBD
A16A3XDS3	1200-0496		SOCKET, IC 16-PIN	01295	OBD
A16A3XDS4	1200-0496		SOCKET, IC 16-PIN	01295	OBD
A16A3XDS5	1200-0496		SOCKET, IC 16-PIN	01295	OBD
A16A3XDS6	1200-0496		SOCKET, IC 16-PIN	01295	OBD

See introduction to this section for ordering information

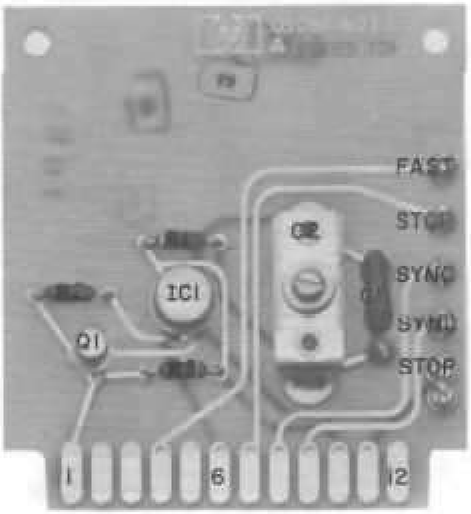
Table 7-6. A9 Replaceable Parts, Series 1116, Rev. A

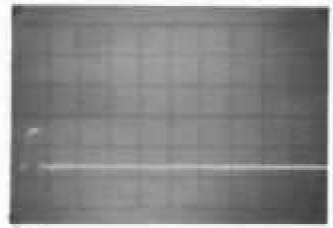
Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9	05061-6092	1	MODULE ASSY:OPERATIONAL AMPLIFIER	28480	05061-6092
	1200-0080	2	INSULATOR:TRANSISTOR MTG.	71785	294834
	1251-0215	2	RETAINER:CONNECTOR SUBMINAT TYPE D	71468	DE51224-1
	2230-0024		SCREW:STL PAN HD 4-40 THD	00000	OBD
A9	1251-0631	1	CONN. SPRING SOCKET		1251-0631
MISC	05061-0047	1	COVER:BOTTOM	28480	05061-0047
PARTS	05061-0048	1	COVER:TOP	28480	05061-0048
	05061-2035	1	PLATE:END	28480	05061-2035
	05061-2036	1	PLATE:END	28480	05061-2036
	0340-0037	2	TERMINAL STUD	28480	0340-0037
	0340-0039	2	TERMINAL BUSHING	28480	0340-0039
A9A1	05061-6093	1	BOARD ASSY:OPERATIONAL AMPLIFIER	28480	05061-6093
A9A1AMP1	0960-0089	1	OPERATIONAL AMPLIFIER	28480	0960-0089
A9A1C1	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A9A1C2	0160-0127		C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A9A1CR1	1902-0063	3	DIODE BREAKDOWN:15V	28480	1902-0063
A9A1CR2	1902-0063		DIODE BREAKDOWN:15V	28480	1902-0063
A9A1CR3	1901-0376	2	DIODE:35V, 50 MA	28480	1901-0376
A9A1CR4	1901-0376		DIODE:35V, 50 MA	28480	1901-0376
A9A1R1	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A9A1R2	0757-0900		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A9J1	1250-0258		JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	15558	9287
A9J2	1251-0216	2	CONNECTOR:MALE 9-CONTACT TYPE D	71468	DEM-9P
A10	00105-6013	1	OSCILLATOR ASSY: 5 MHZ REBUILT OSCILLATOR IS AVAILABLE; ORDER HP PART NO. 00105-6034. COMPONENTS INSIDE A10 ARE NOT RECOMMENDED FOR CUSTOMER FACILITY REPAIR	28480	00105-6013

See introduction to this section for ordering information

NOTE: EARLY MODEL

Figure 7-1
DIGITAL DIVIDER ASSEMBLY A5 (OPTION 01)
SWITCH CIRCUIT BOARD ASSEMBLY A5A4
INTERCONNECTION BOARD A5A5

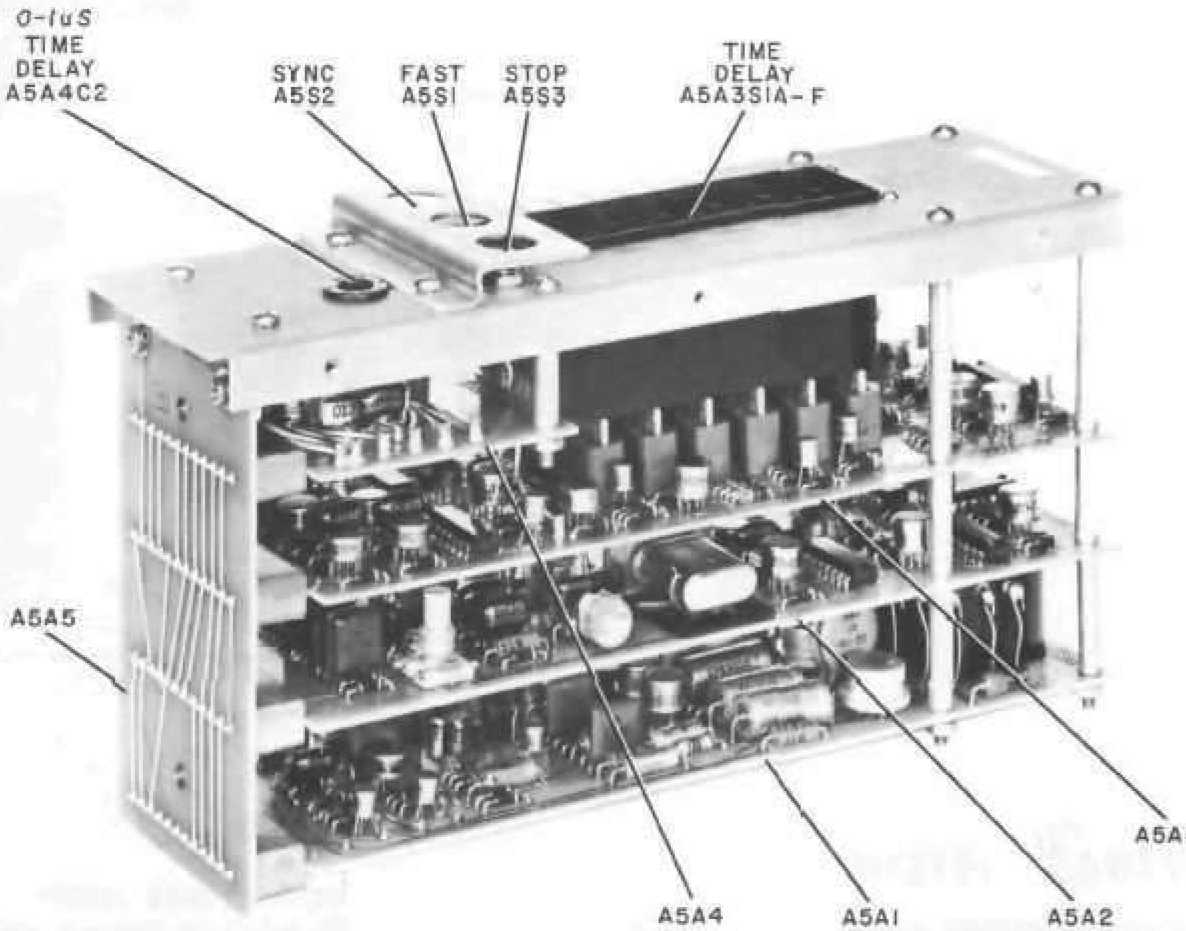


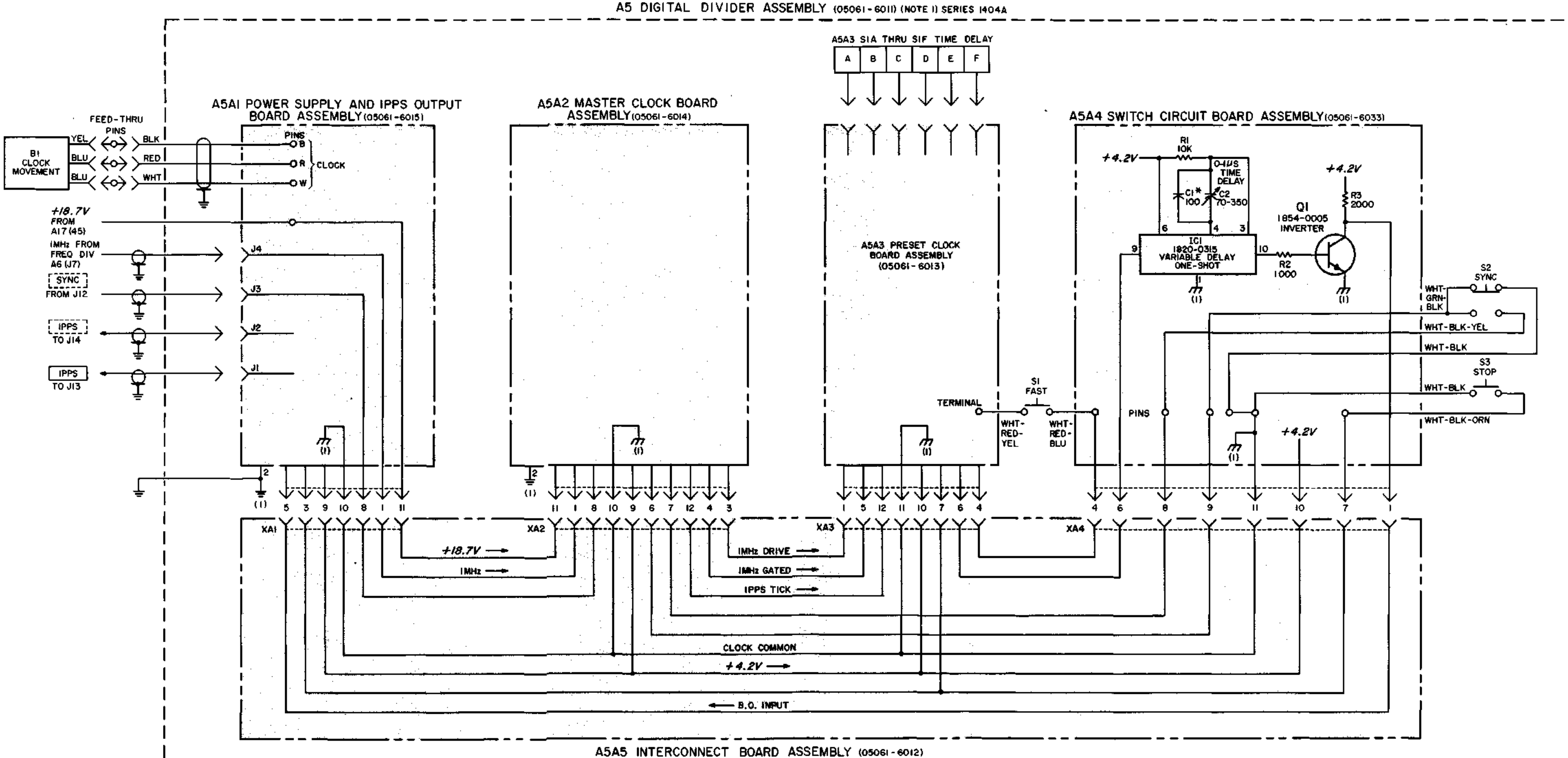


15 2V/cm, 0.5 s/cm

Oscilloscope: DC coupled.

5061A: Divider running, TIME DELAY set to 000000.





NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

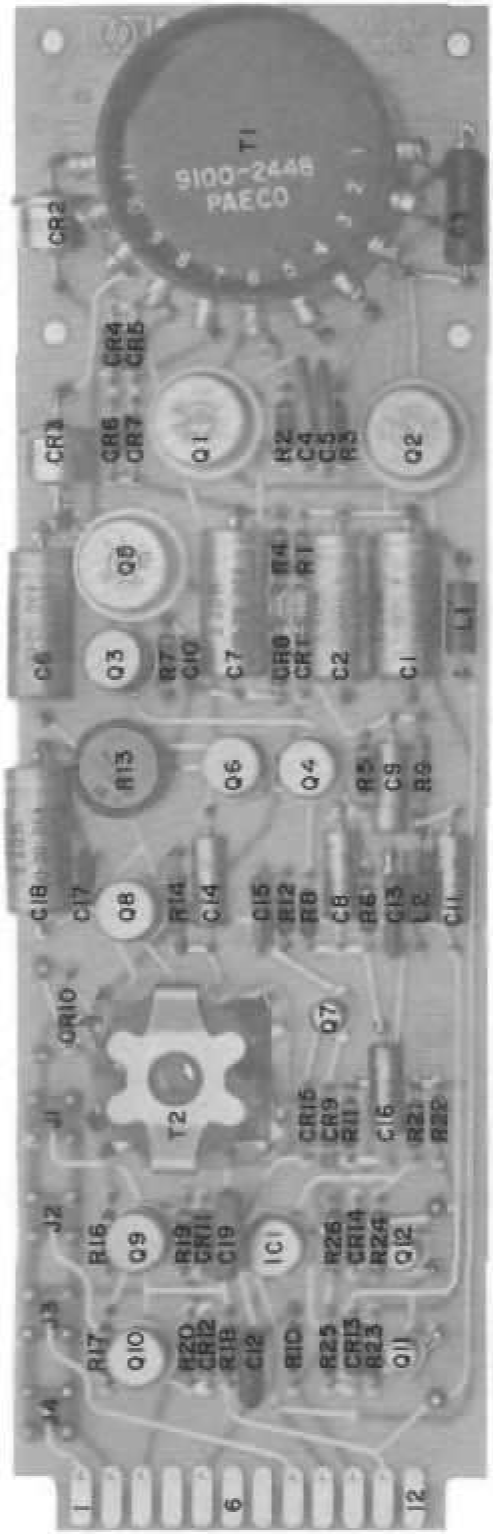
NO PREFIX	A5A4
B1 S1-3	C1, 2 IC1 Q1 R1-3

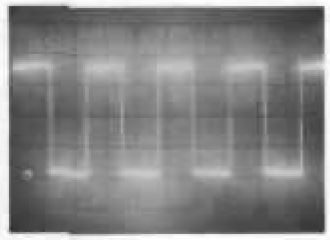
NOTE: EARLY MODEL

Figure 7-1. Digital Divider Assembly A5 (Option 01)
Switch Circuit Board Assembly A5A4
Interconnection Board A5A5

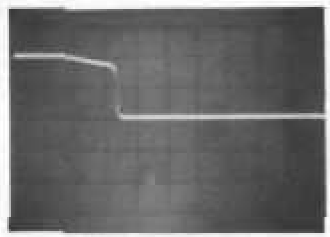
NOTE: EARLY MODEL

Figure 7-2
DIGITAL DIVIDER ASSEMBLY A5 (OPTION 01)
POWER SUPPLY AND 1 PPS OUTPUT BOARD
ASSEMBLY A5A1

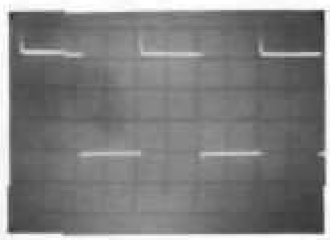




1 10V/cm, 0.2 ms/cm



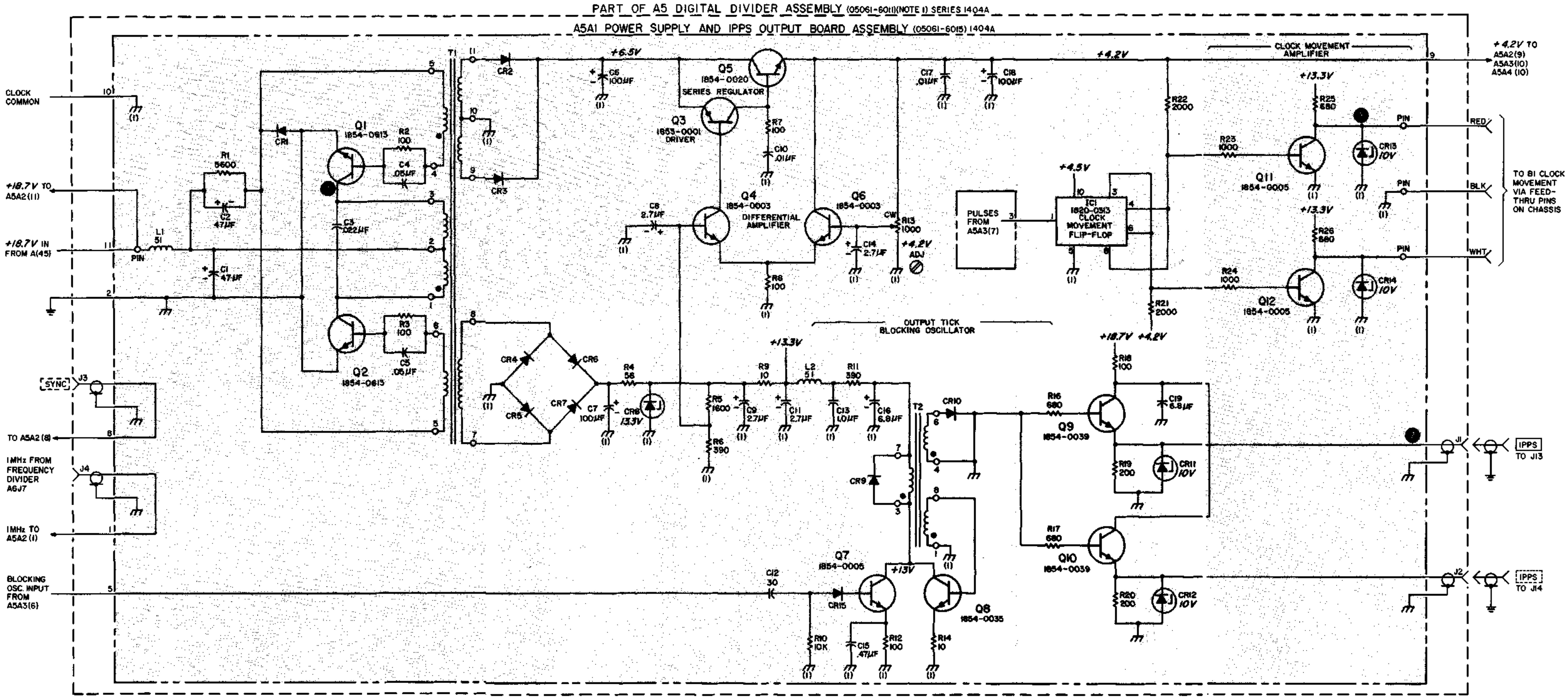
2 5V/cm, 10 μs/cm
use 50Ω Feedthru



3 2V/cm, 0.5 μs/cm

Oscilloscope: DC coupled.

5061A: Divider running, TIME DELAY set to 000000.



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

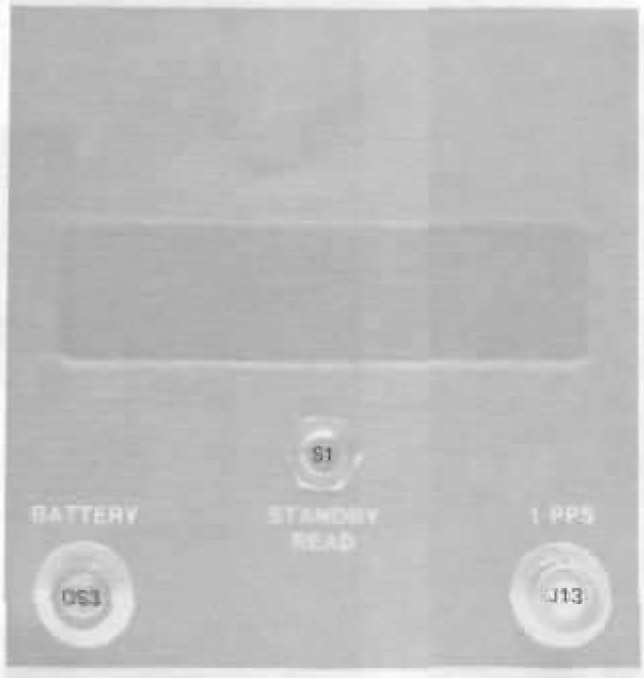
REFERENCE DESIGNATIONS

A5	A5A1
J1-4	C1-19 CR1-15 IC1 L1,2 Q1-12 R1-26 T1,2

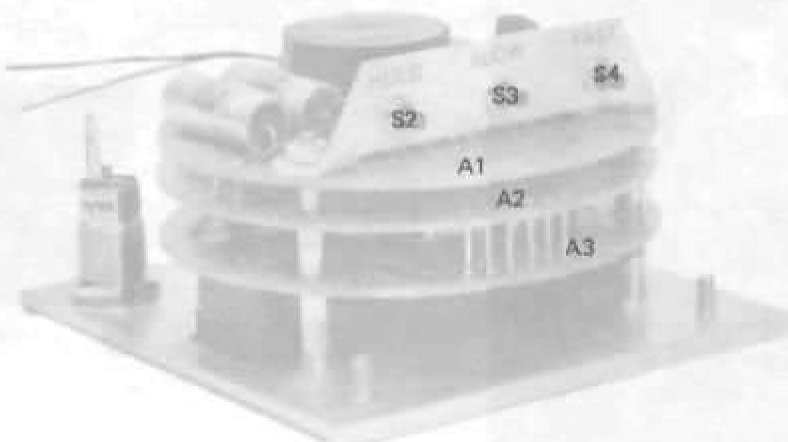
NOTE: EARLY MODEL

Figure 7-2. Digital Divider Assembly A5 (Option 01) Power Supply and 1 PPS Output Board Assembly A5A1

Part of Figure 7-3. LED Digital Clock Assembly A16

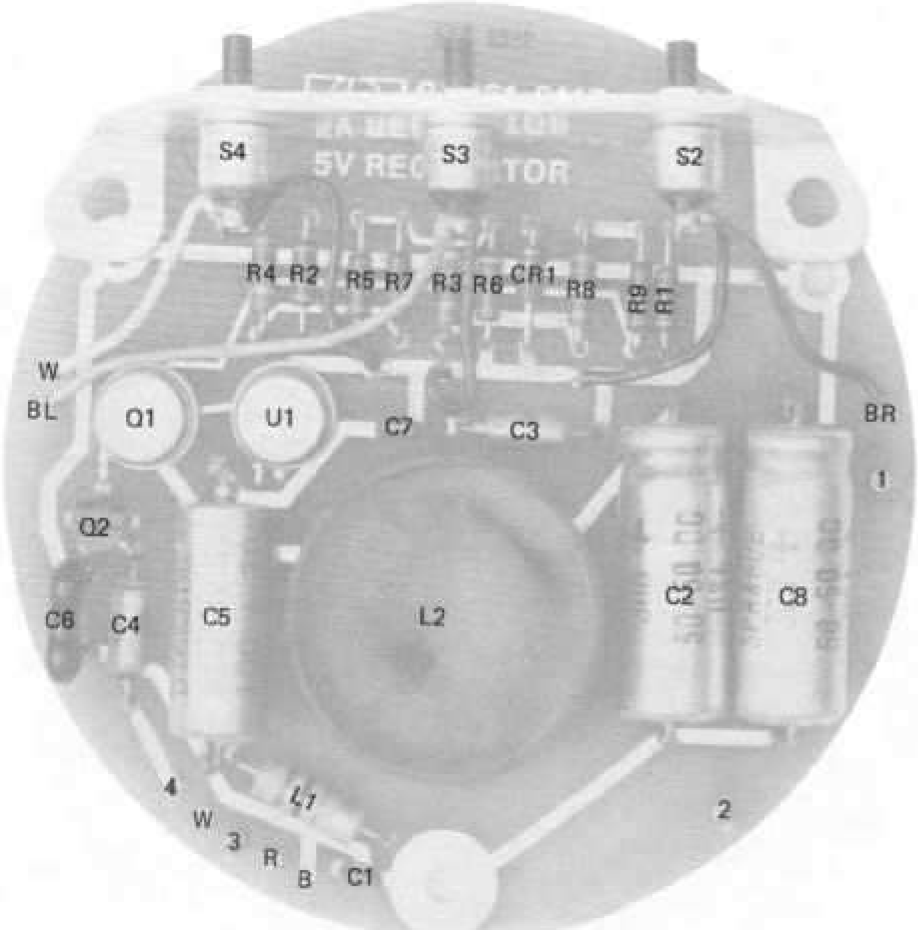


A16 FRONT PANEL



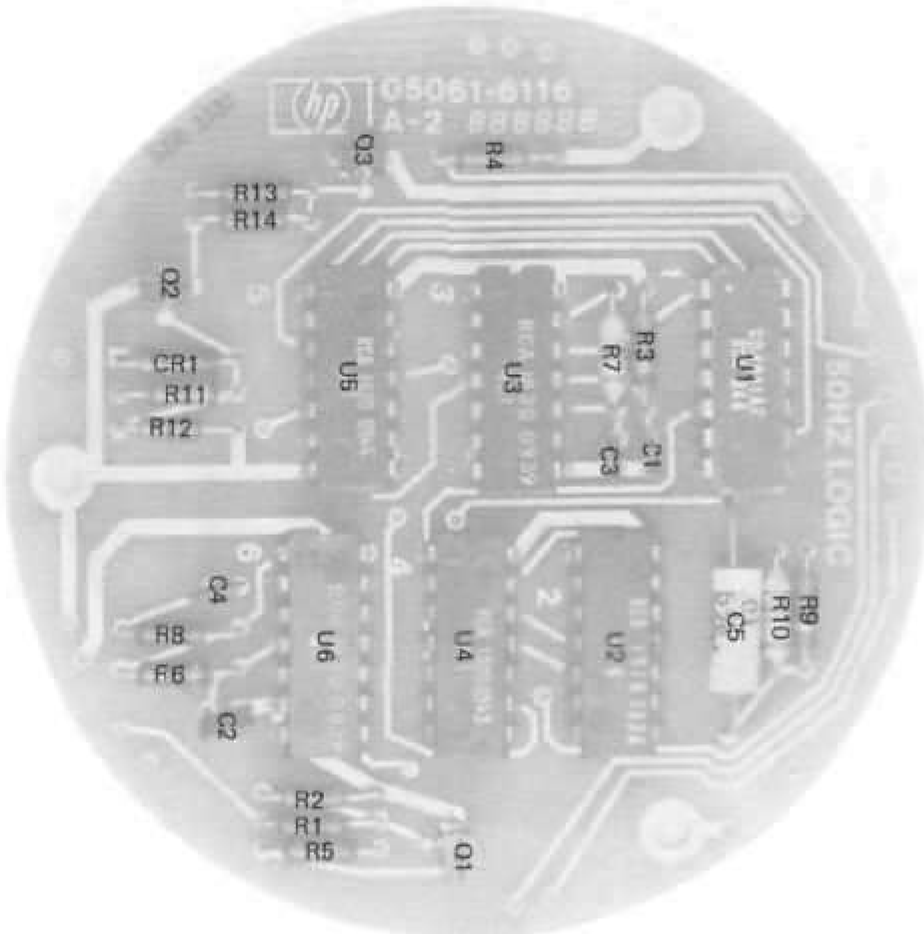
A16

Part of Figure 7-3. LED Digital Clock Assembly A16



A16A1

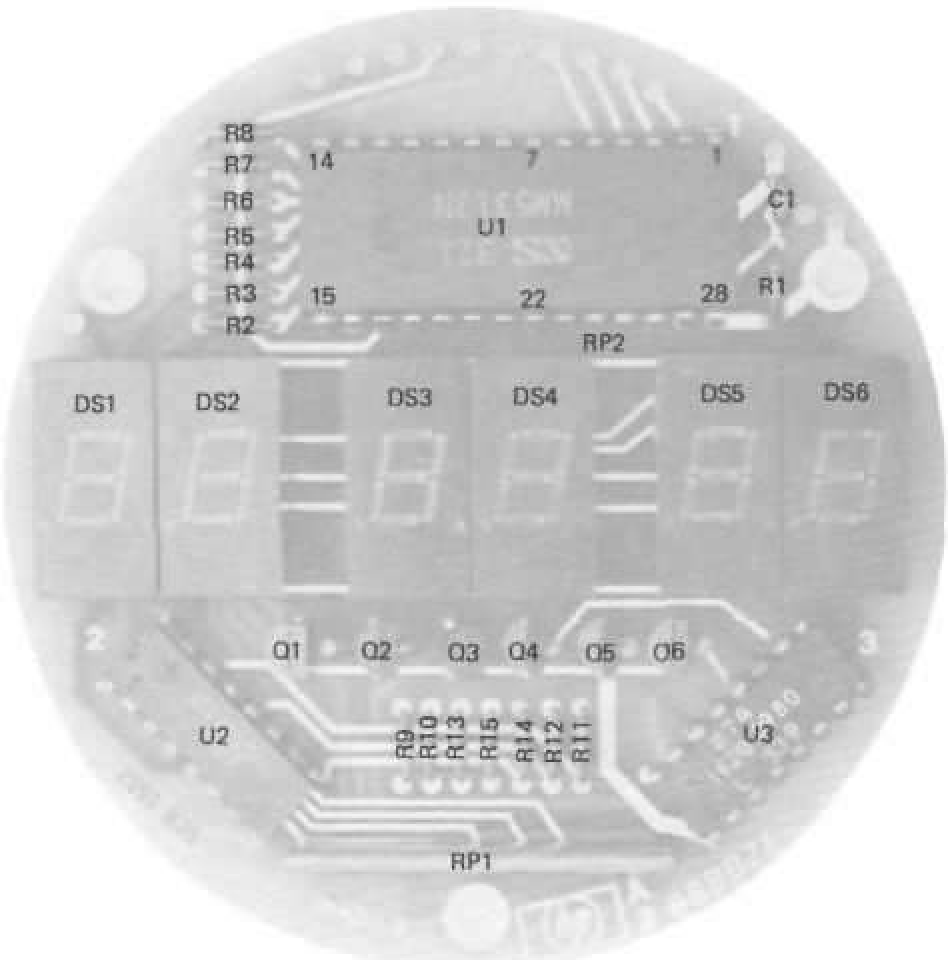
Part of Figure 7-3. LED Digital Clock Assembly A16



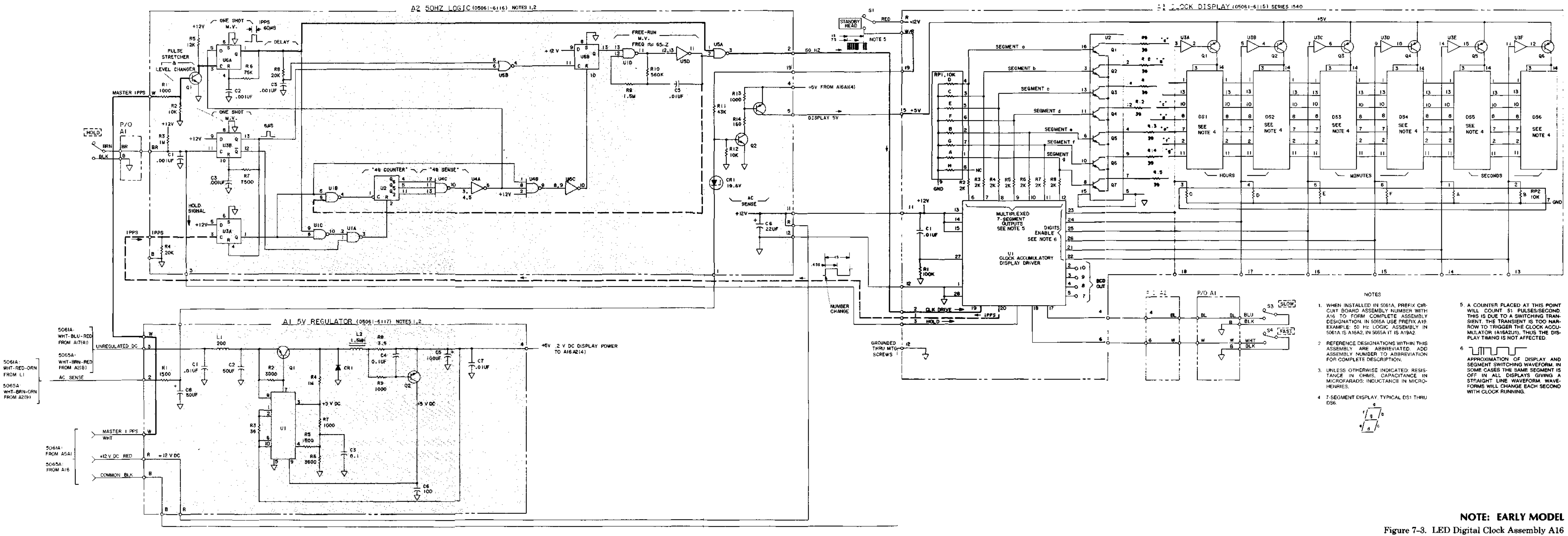
A16A2

NOTE: EARLY MODEL

Figure 7-3
LED DIGITAL CLOCK ASSEMBLY A16


R8
R7
14
7
1
C1
R6
U1
R5
R4
R3
15
22
28
R1
R2
RP2
DS1
DS2
DS3
DS4
DS5
DS6
2
3
Q1
Q2
Q3
Q4
Q5
Q6
U2
R9
R10
R13
R15
R14
R12
R11
U3
RP1

A16A3



NOTES

1. WHEN INSTALLED IN 5061A, PREFIX CIRCUIT BOARD ASSEMBLY NUMBER WITH A16 TO FORM COMPLETE ASSEMBLY DESIGNATION. IN 5065A USE PREFIX A19. EXAMPLE: 50 Hz LOGIC ASSEMBLY IN 5061A IS A16A2, IN 5065A IT IS A19A2.

2. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

3. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS, CAPACITANCE IN MICROFARADS; INDUCTANCE IN MICROHENRIES.

4. 7-SEGMENT DISPLAY, TYPICAL DS1 THRU DS6.

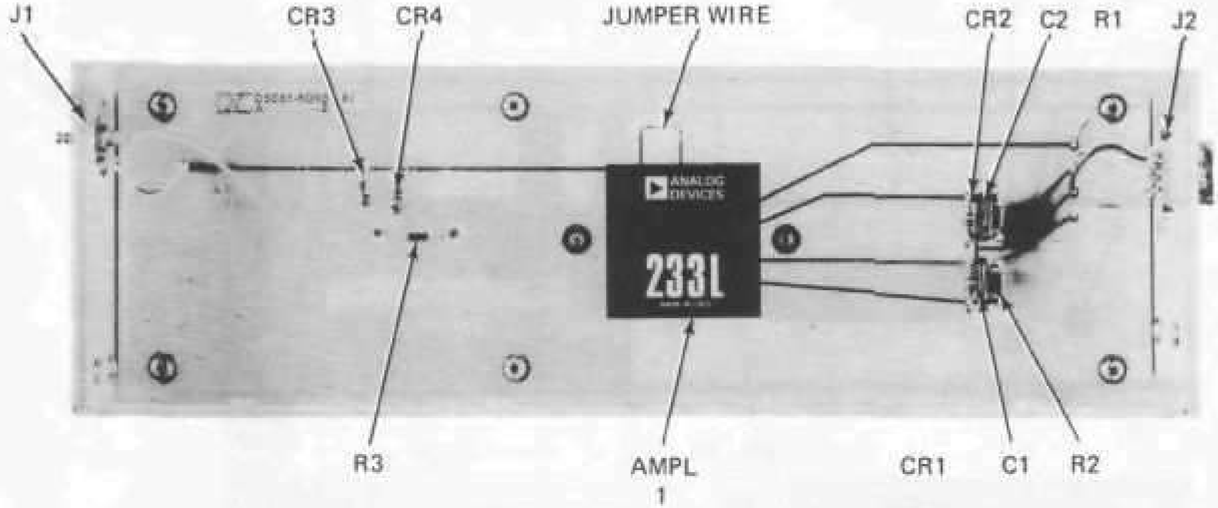
5. A COUNTER PLACED AT THIS POINT WILL COUNT 51 PULSES/SECOND. THIS IS DUE TO A SWITCHING TRANSIENT. THE TRANSIENT IS TOO NARROW TO TRIGGER THE CLOCK ACCUMULATOR (A16A2U1). THUS THE DISPLAY TIMING IS NOT AFFECTED.

6. APPROXIMATION OF DISPLAY AND SEGMENT SWITCHING WAVEFORM. IN SOME CASES THE SAME SEGMENT IS OFF IN ALL DISPLAYS GIVING A STRAIGHT LINE WAVEFORM. WAVEFORMS WILL CHANGE EACH SECOND WITH CLOCK RUNNING.

NOTE: EARLY MODEL

Figure 7-3. LED Digital Clock Assembly A16

Figure 7-4. Operational Amplifier Assembly A9



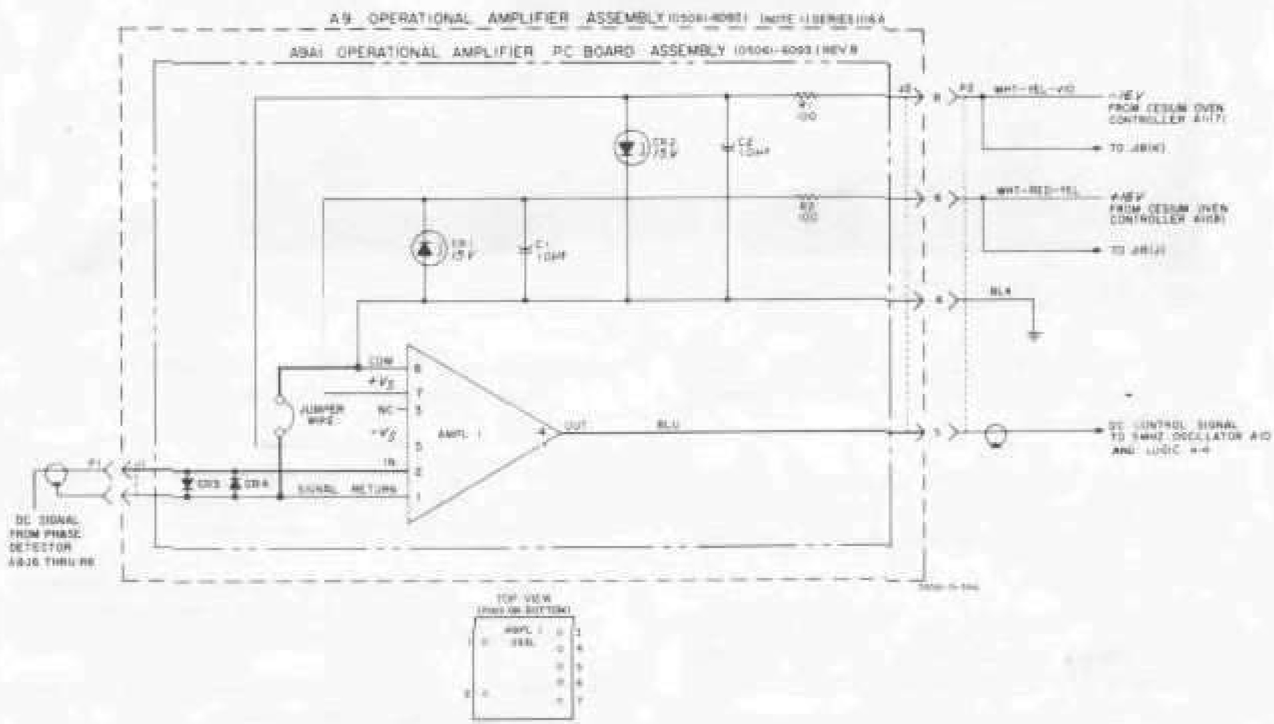
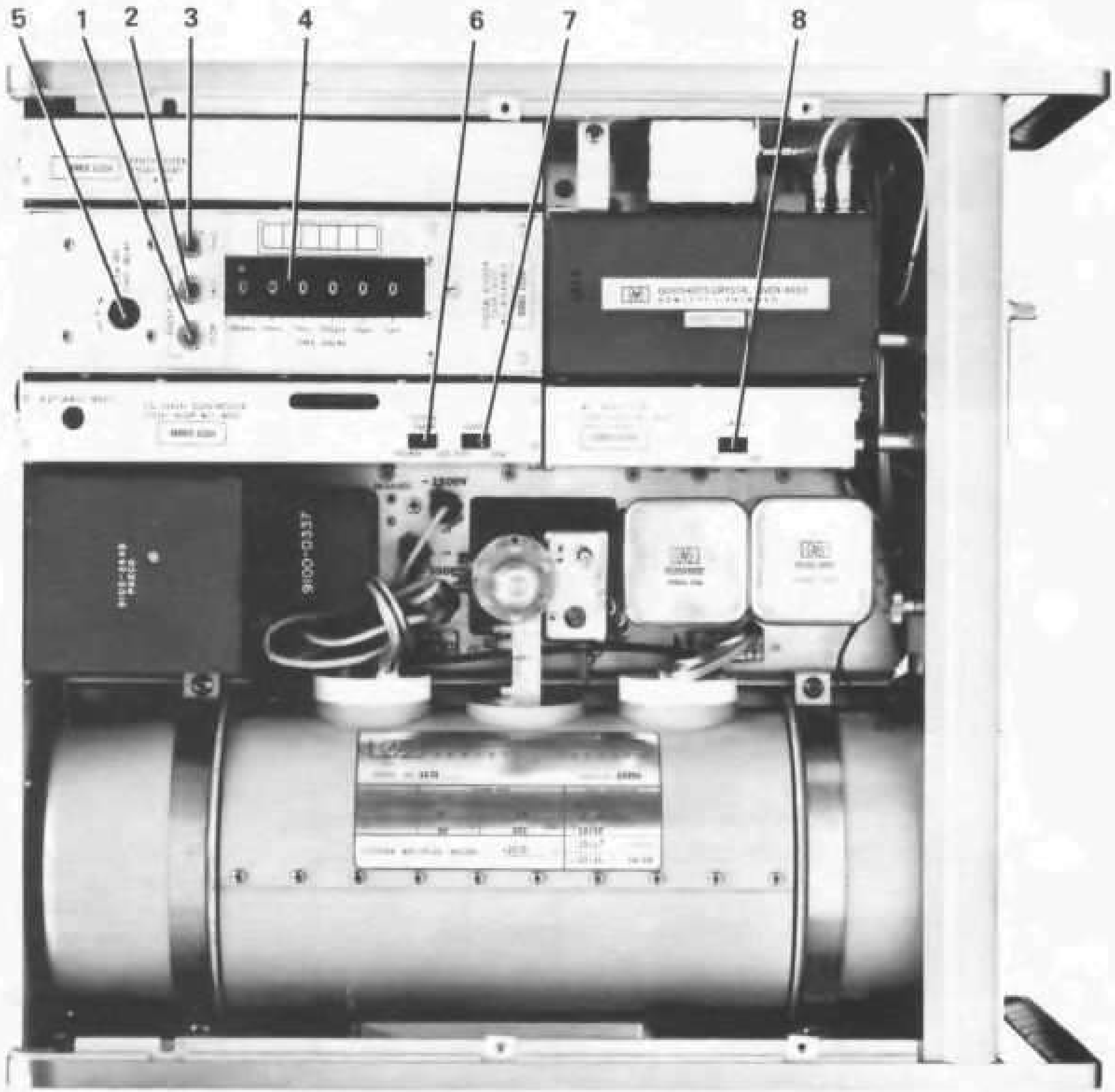


Figure 7-5. Top Operating Controls



1. CLOCK SET STOP switch (Option 001 only): Digital clock is stopped when switch is depressed, starts when released.

2. CLOCK SET FAST switch (Option 001 only): Digital clock second hand is accelerated when switch is depressed, resumes normal operation when released.

3. Clock SYNC switch (Option 001 only): Synchronizes 5061A Digital Clock with an external clock when depressed; clock remains synchronized when released.

4. Clock TIME DELAY switch (Option 001 only): Selects time delay between an external reference pulse and the internal 1 pulse-per-second clock pulse. Adjustable in decade steps from 1 μs to 1 sec.

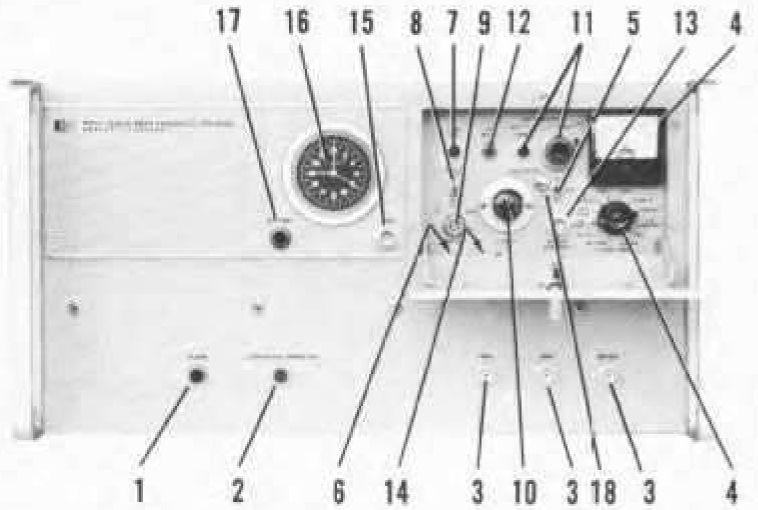
5. 0-1 μSEC TIME DELAY control (Option 001 only): Allows continuous adjustment of clock pulse delay over any 1 μsec range.

6. OVEN TEMP NORM-LO switch: Selects operating temperature for the cesium beam tube oven. Normally set to NORM.

7. OVEN-OFF-ON switch: Switch for cesium beam tube oven. Used in ON position.

8. AC Amplifier GAIN switch: Selects HI or LO gain of amplifier.

Figure 7-6. Front-Panel Controls



1. ALARM light: Normally off to indicate:

   a. The multiplied quartz crystal oscillator frequency is frequency-locked to the center maximum of cesium resonance;

   b. the instrument is correctly frequency-locked and beam tube current is satisfactory;

   c. the quartz crystal oscillator dc correction voltage is less than the dynamic limit of ±5.0 Vdc.

2. CONTINUOUS OPERATION light: Normally on to indicate that circuits are functioning properly and instrument is operating as a primary frequency standard.

3. OUTPUTS – 5 MHz, 1 MHz, 100 kHz: BNC jacks paralleled with rear-panel outputs to provide these standard frequencies. Output level is 1 volt rms (minimum) into 50 ohm load.

4. CIRCUIT CHECK switch and meter: Provide monitoring of various circuits for operation checks and trouble indication.

5. MOD ON-OFF switch: Controls 137 Hz modulation of microwave frequency applied to beam tube. Normally ON.

6. TIME CONSTANT switch: Controls instrument loop time constant. Set to SHORT for normal operation. Use Long position for best short-term stability when operating in a controlled environment. For time constant values see Table 1-1.

7. LOOP GAIN control: Adjusts ac amplifier gain.

8. BEAM I METER adjust: Adjusts for on-scale meter reading.

9. MODE switch: Controls the mode of operation. Normally set to OPER.

10. C FIELD control: Provides minor adjustment of the magnetic field inside the beam tube frequency. Resolution is 5×10^{-14}/minor division.

11. OSC FREQUENCY controls: COARSE control provides crystal oscillator frequency adjustment of ±500 parts in 10^9. Use only COARSE control to correct oscillator frequency with frequency-locked operation. Fine control $X10^{-10}$ provides adjustment range of 500 parts in 10^{-10}. Set control to 250 for frequency-locked operation with beam tube.

12. LOGIC RESET switch: Push to enable CONTINUOUS OPERATION light after power interruption, repair, or adjustment.

13. ZEEMAN MOD INPUT: Apply Zeeman frequency at this BNC jack during C Field adjustment (see Table 3-3).

14. DIVIDER MODE switch: Allows dividers to be operated in one of two modes; AUTO START or START. To manually start the dividers the switch should be momentarily set to START, then released.

15. 1 PPS jack (Option 001 only): Provides 10 volt, 20 μs, 1 pps into 50 ohms from digital clock.

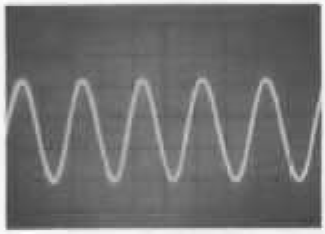
16. 24-Hour Digital Clock (Option 001 only).

17. BATTERY light (Option 002 only): Normally off. Flashes when 5061A is drawing power from internal battery. On when battery is being fast charged.

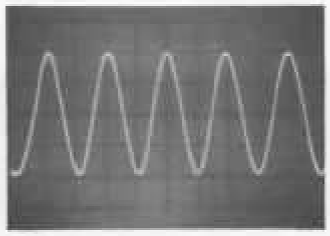
18. 5 MHz FILTER: Access hole for adjusting 5 MHz crystal filter.

NOTE: EARLY MODEL

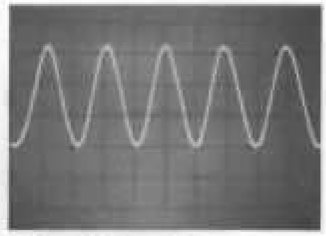
Figure 7-7
BLOCK DIAGRAM



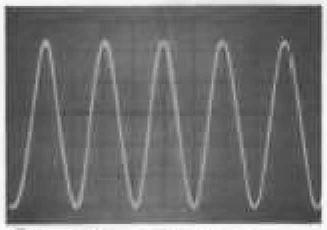
1 1V/cm, 0.1 μs/cm
50Ω Term. at scope



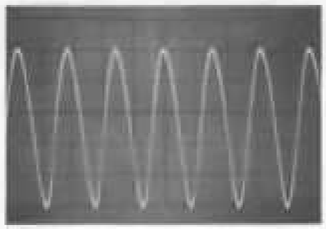
2 0.05V/cm, 0.1 μs/cm



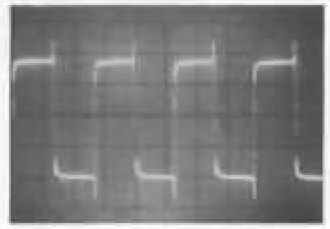
3 1V/cm, 0.1 μs/cm
50Ω Term. at scope



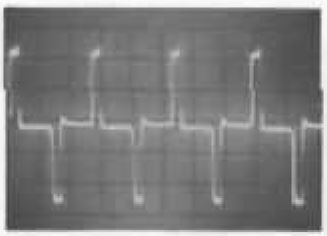
4 0.5/cm, 0.1 μs/cm



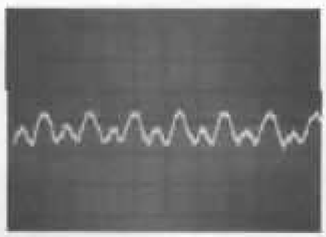
5 0.2V/cm, 0.05 μs/cm
Synth. time scale 0366



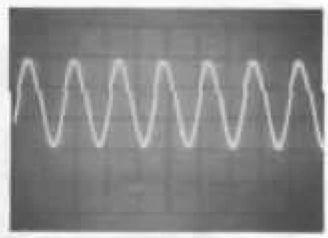
6 0.5V/cm, 0.2 ms/cm
at J17 (3-4)



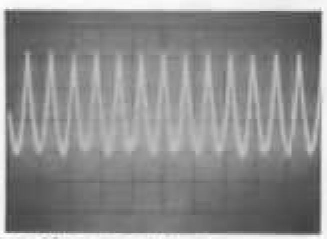
7 2V/cm, 0.2 ms/cm
at J16 (6-7)



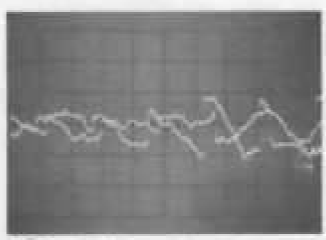
8 20 mV/cm, 5 ms/cm OSC
FREQ X10^{-10} set to 300.
MODE to LOOP OPEN



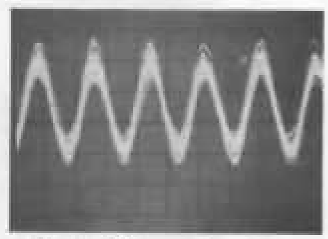
9 5V/cm, 5 ms/cm
MODE to LOOP OPEN
OSC FREQ X10^{-10} at 300



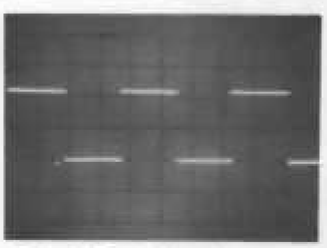
10 1V/cm, 5 ms/cm
MODE to LOOP OPEN
OSC FREQ X10^{-10} at 300



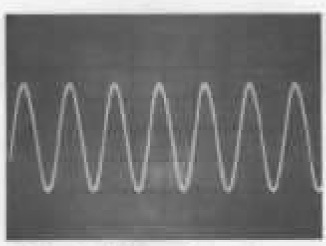
11 0.2V/cm, 5 ms/cm



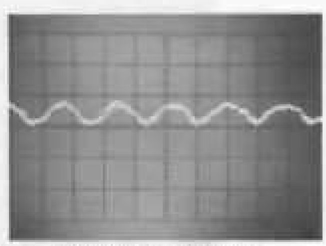
12 0.02V/cm, 2 ms/cm



13 5V/cm, 2 ms/cm



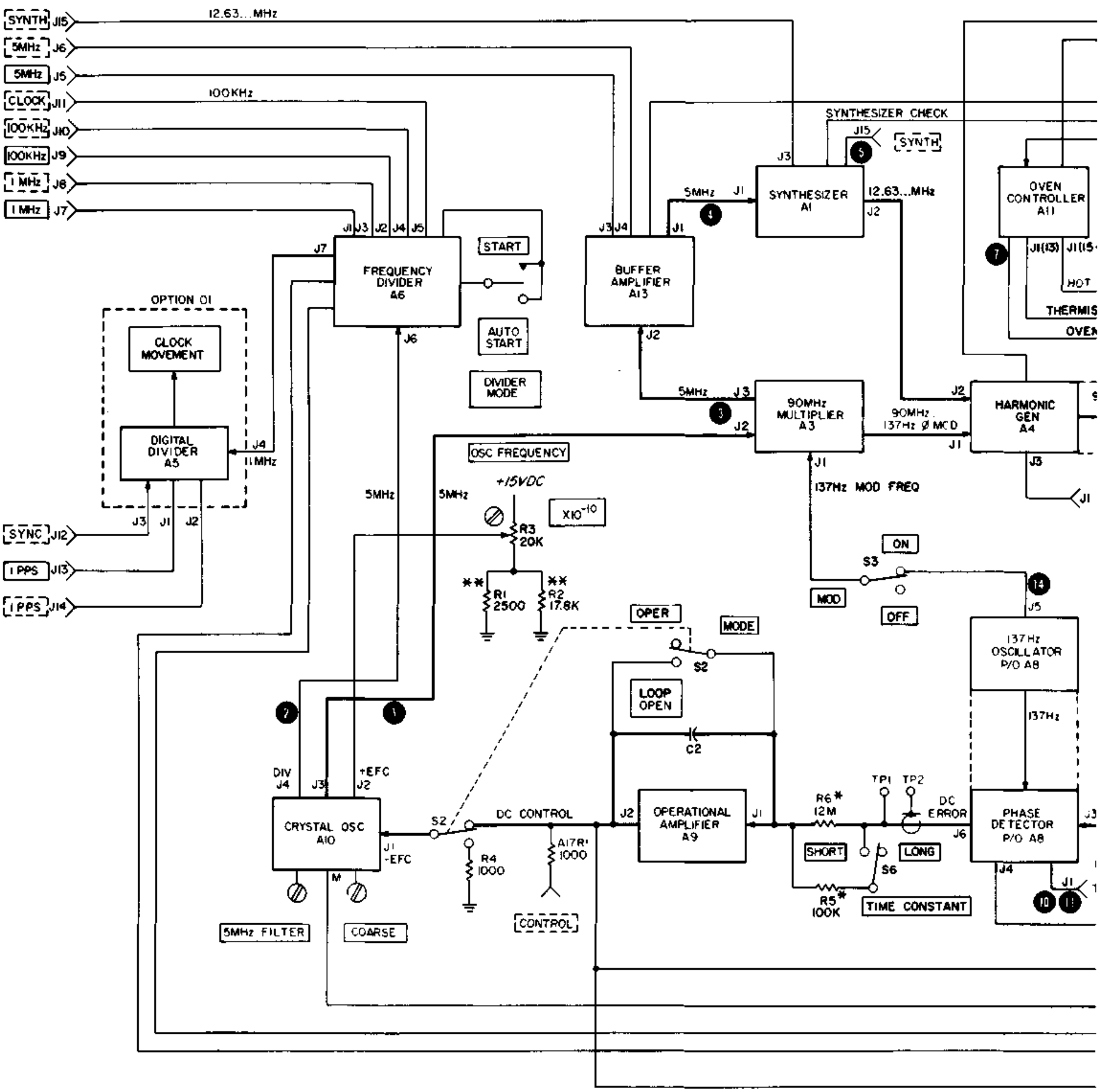
14 0.05V/cm, 5 ms/cm



15 0.05V/cm, 2 ms/cm
MODE to LOOP OPEN
OSC on cesium peak

Oscilloscope: DC coupled.

5061A: Normal operation unless noted.



NOTE

* R6 OPTION 004 C3: DELETED

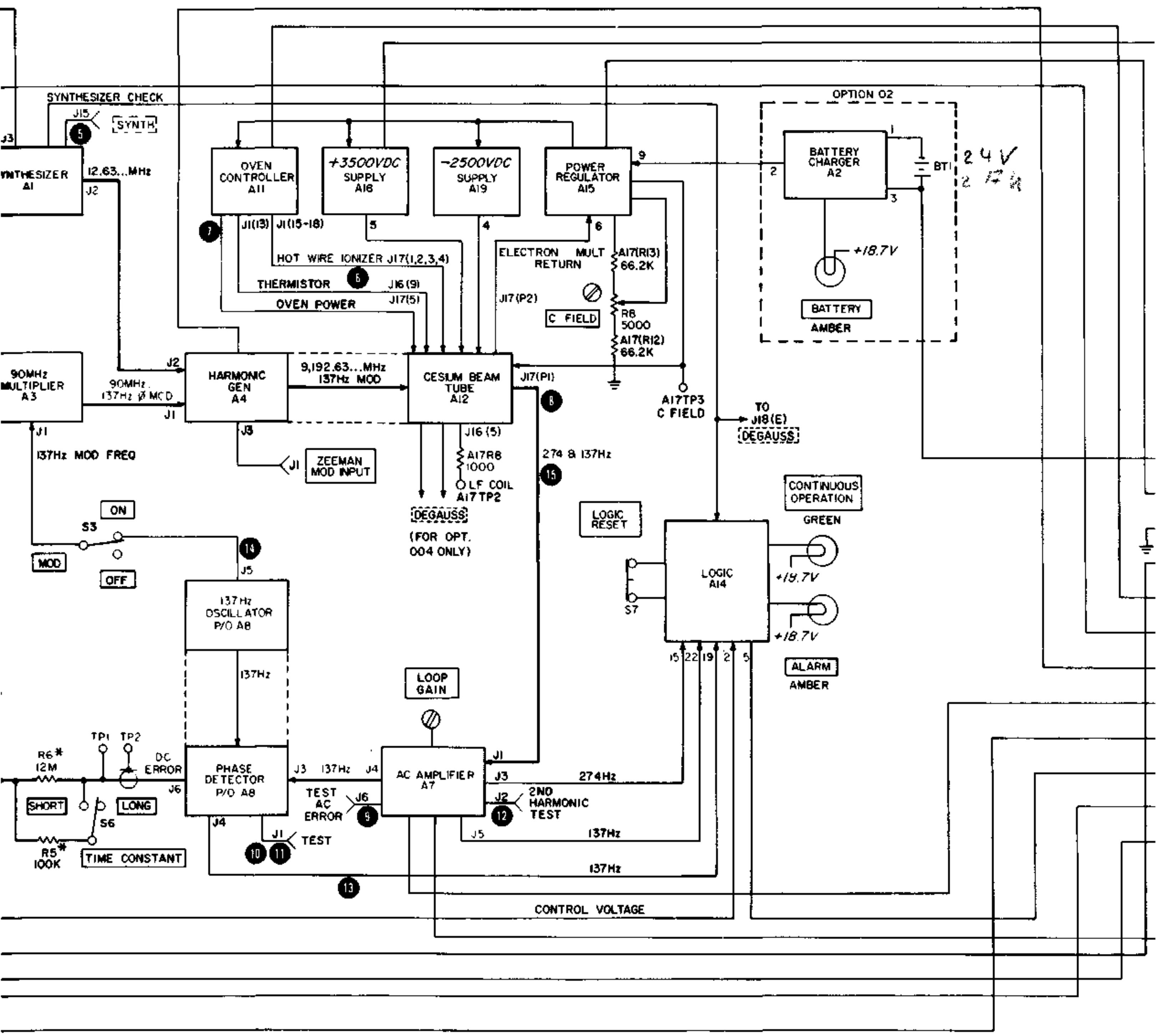
2.4M <2 X 10^{-12}

2.0M 2 TO 3 X 10^{-12}

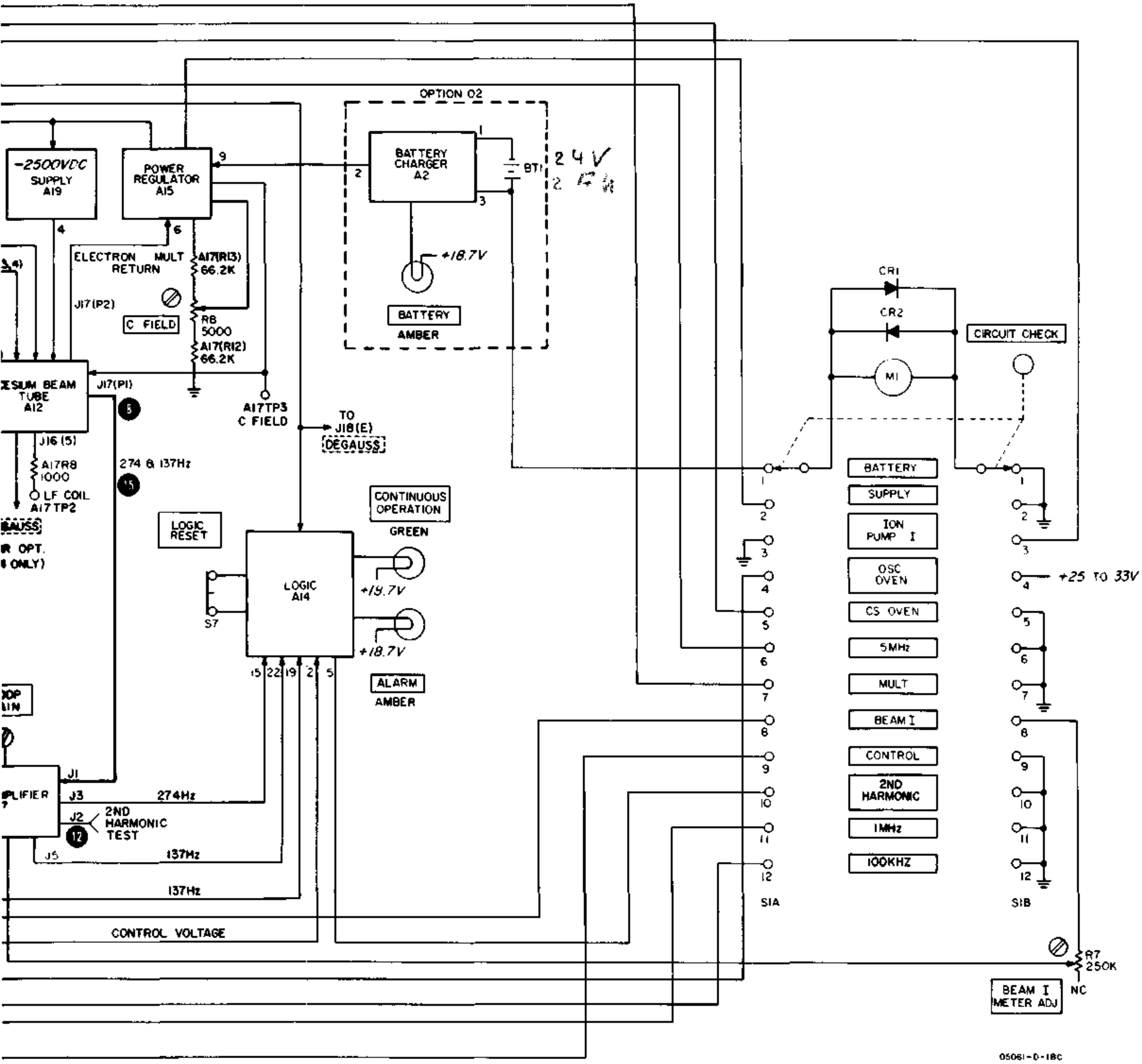
1.0M 3 TO 4 X 10^{-12}

400K 4 TO 5 X 10^{-12}

** FACTORY SELECT



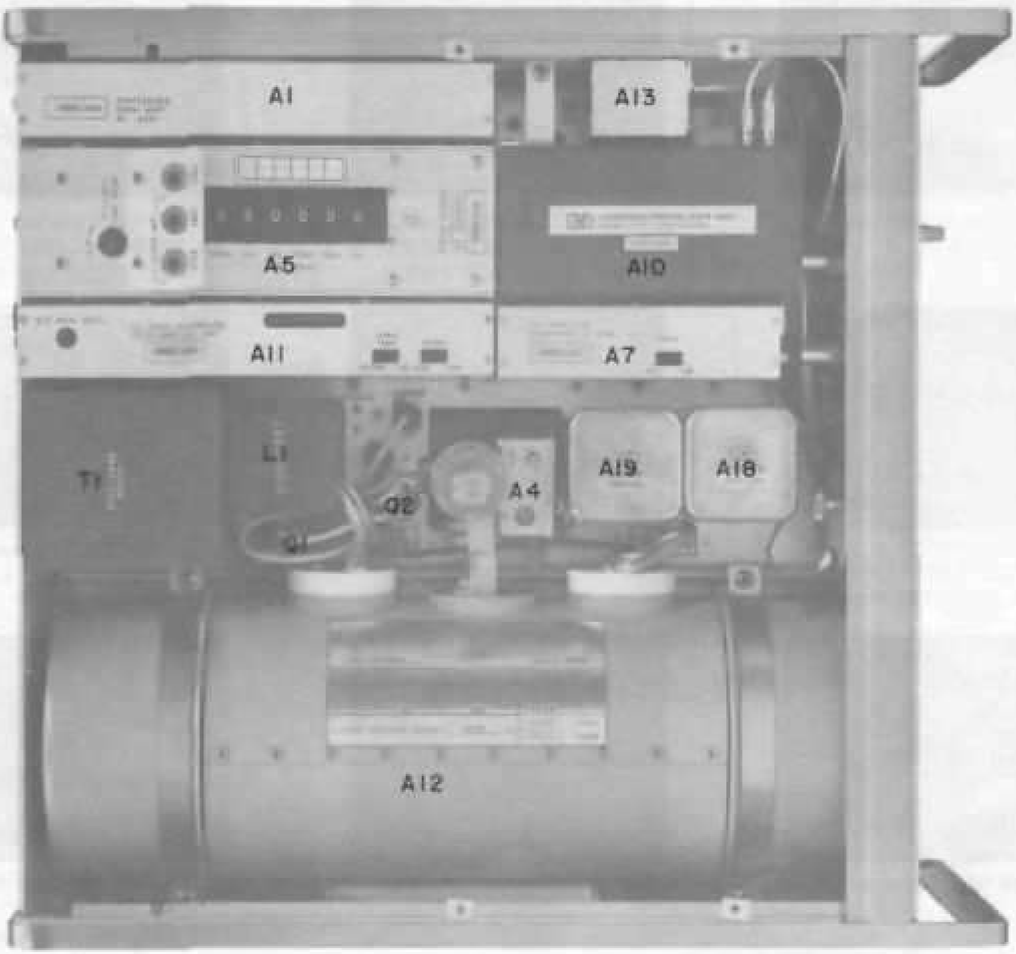
004 C3: DELETED



NOTE: EARLY MODEL

Figure 7-7. Block Diagram

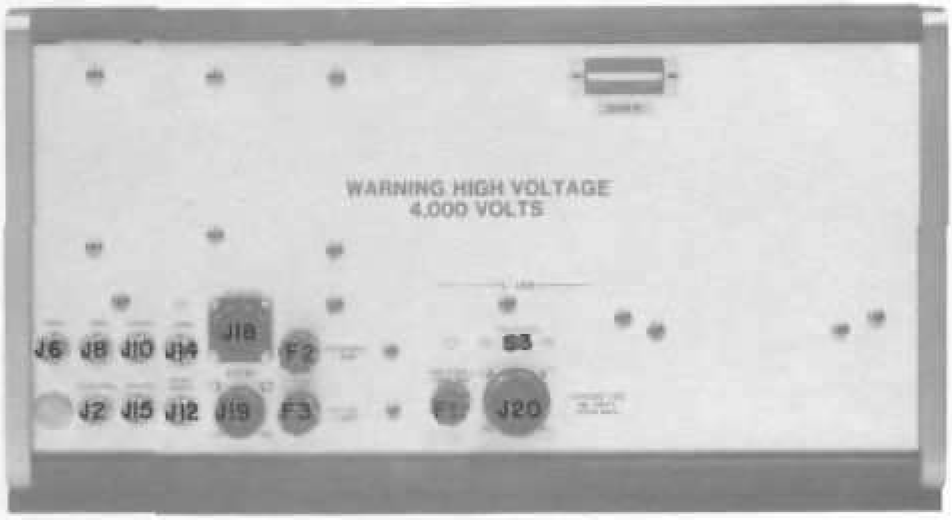
Figure 7-8. Top Internal and Front Panel Views

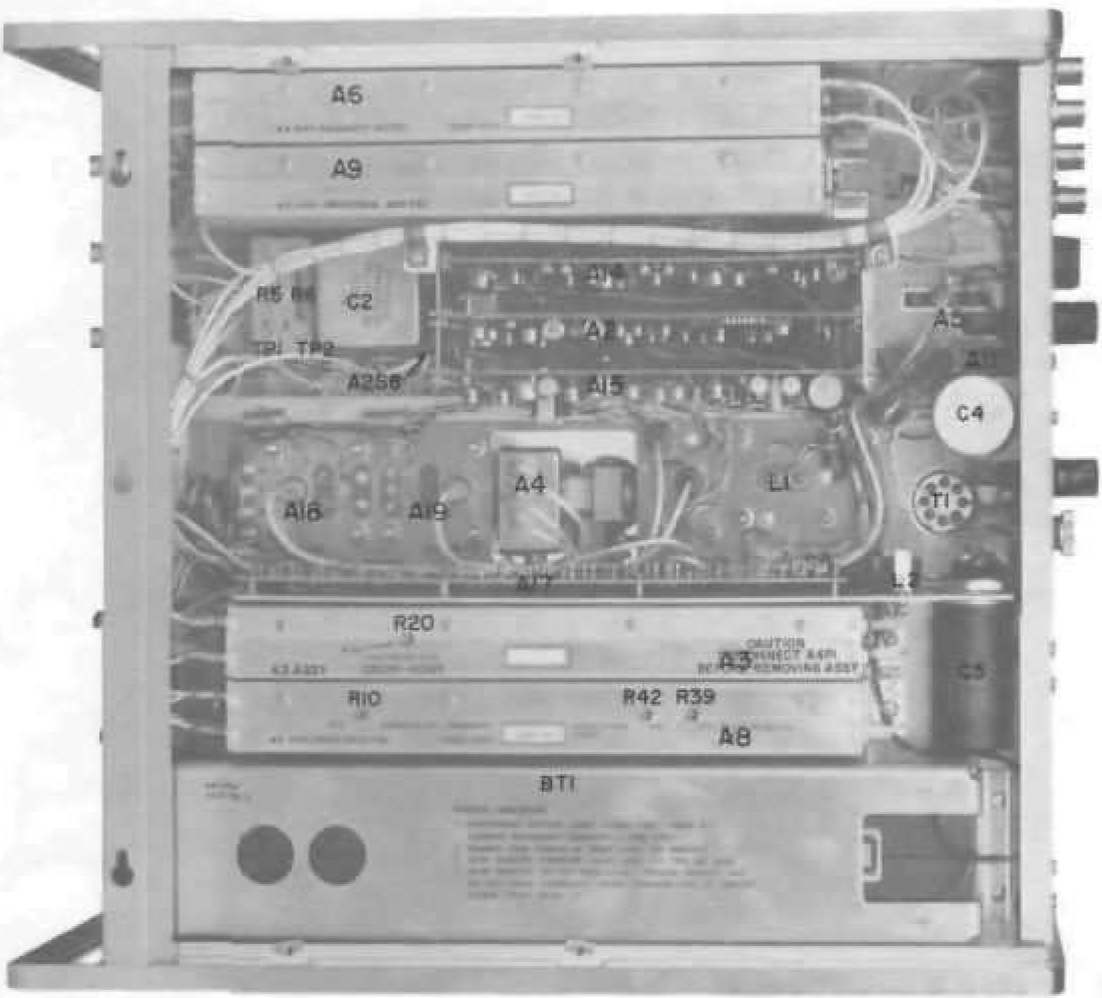


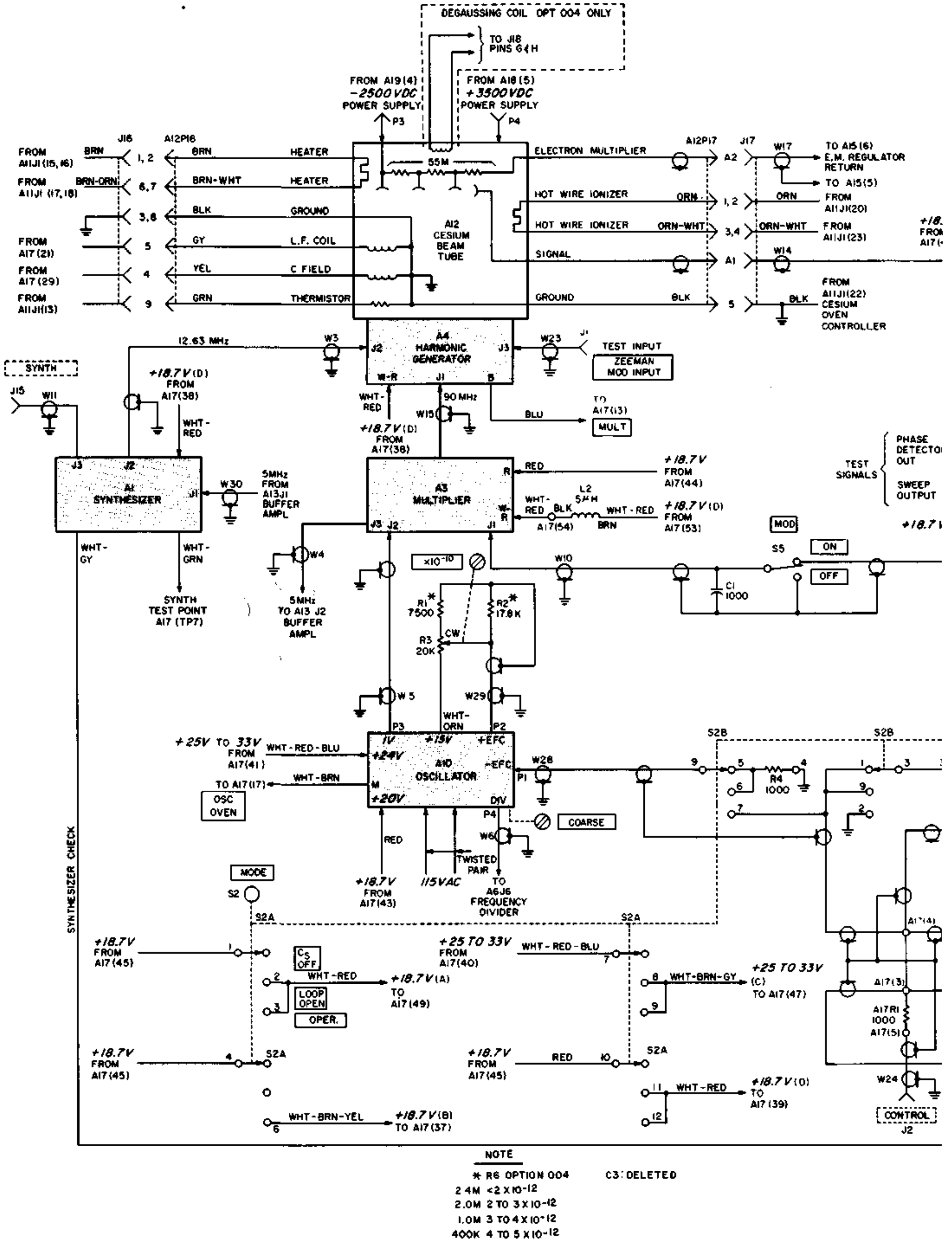
NOTE: EARLY MODEL

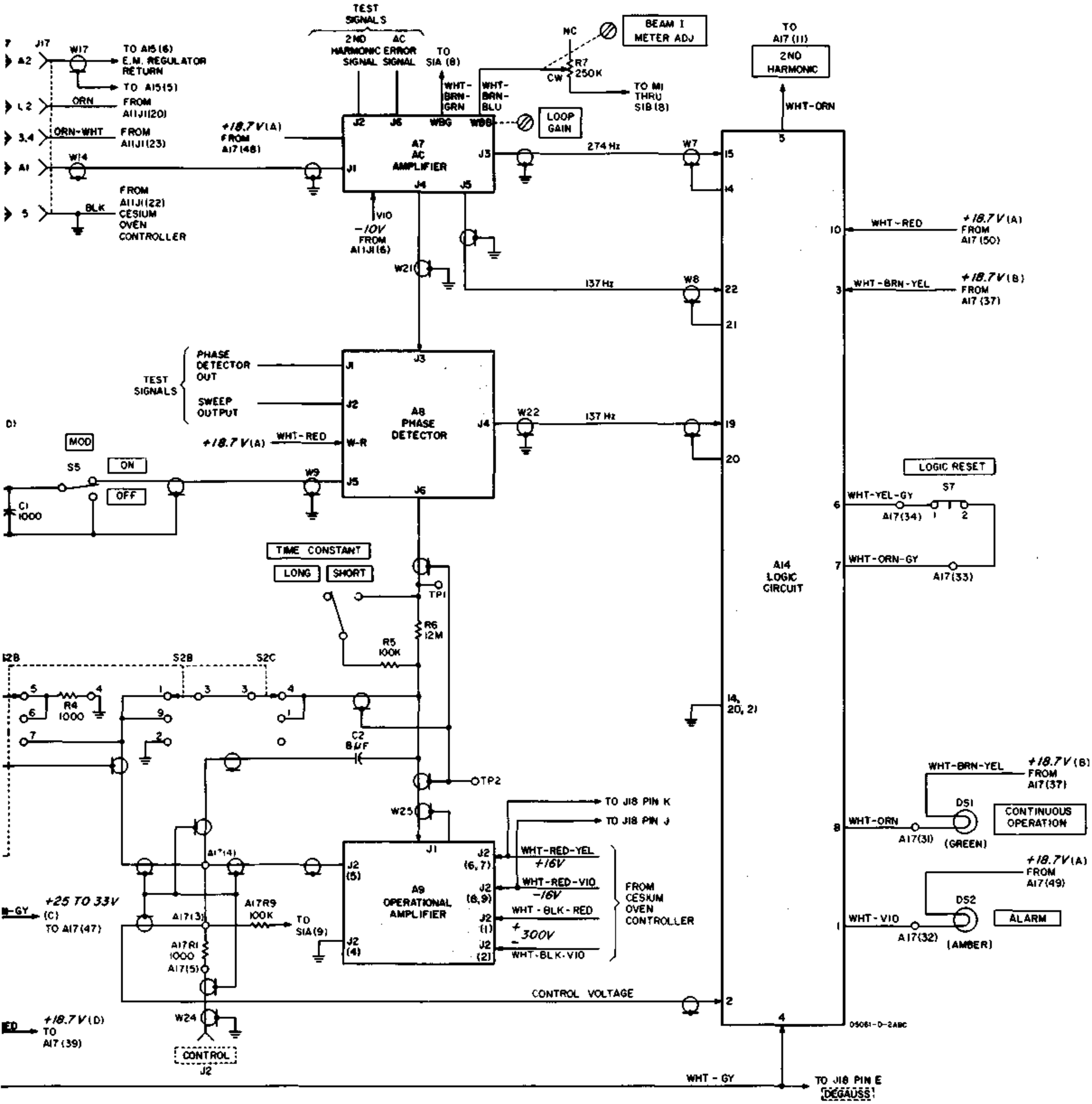
Figure 7-9
WIRING DIAGRAM
(Sheet 1 of 2)

Part of Figure 7-8. Bottom Internal and Rear Views (Continued)






DEGAUSSING COIL OPT 004 ONLY
TO J18 PINS G & H
FROM A19(4) -2500 VDC POWER SUPPLY
FROM A18(5) +3500 VDC POWER SUPPLY
HEATER
GROUND
L.F. COIL
C FIELD
THERMISTOR
ELECTRON MULTIPLIER
HOT WIRE IONIZER
SIGNAL
A12 CESIUM BEAM TUBE
55M
A4 HARMONIC GENERATOR
12.63 MHz
TEST INPUT
ZEEMAN MOD INPUT
SYNTH
A1 SYNTHESIZER
A3 MULTIPLIER
A10 OSCILLATOR
OSC OVEN
MODE
MOD
ON
OFF
COARSE
TWISTED PAIR
115VAC
TO A6J6 FREQUENCY DIVIDER
SYNTH TEST POINT A17 (TP7)
5MHz TO A13 J2 BUFFER AMPL
5MHz FROM A13J1 BUFFER AMPL
TEST SIGNALS
PHASE DETECTOR OUT
SWEEP OUTPUT
SYNTHESIZER CHECK
CS OFF
LOOP OPEN
OPER.
CONTROL
NOTE
* R6 OPTION 004
C3: DELETED
2.4M <2 X 10-12
2.0M 2 TO 3 X 10-12
1.0M 3 TO 4 X 10-12
400K 4 TO 5 X 10-12

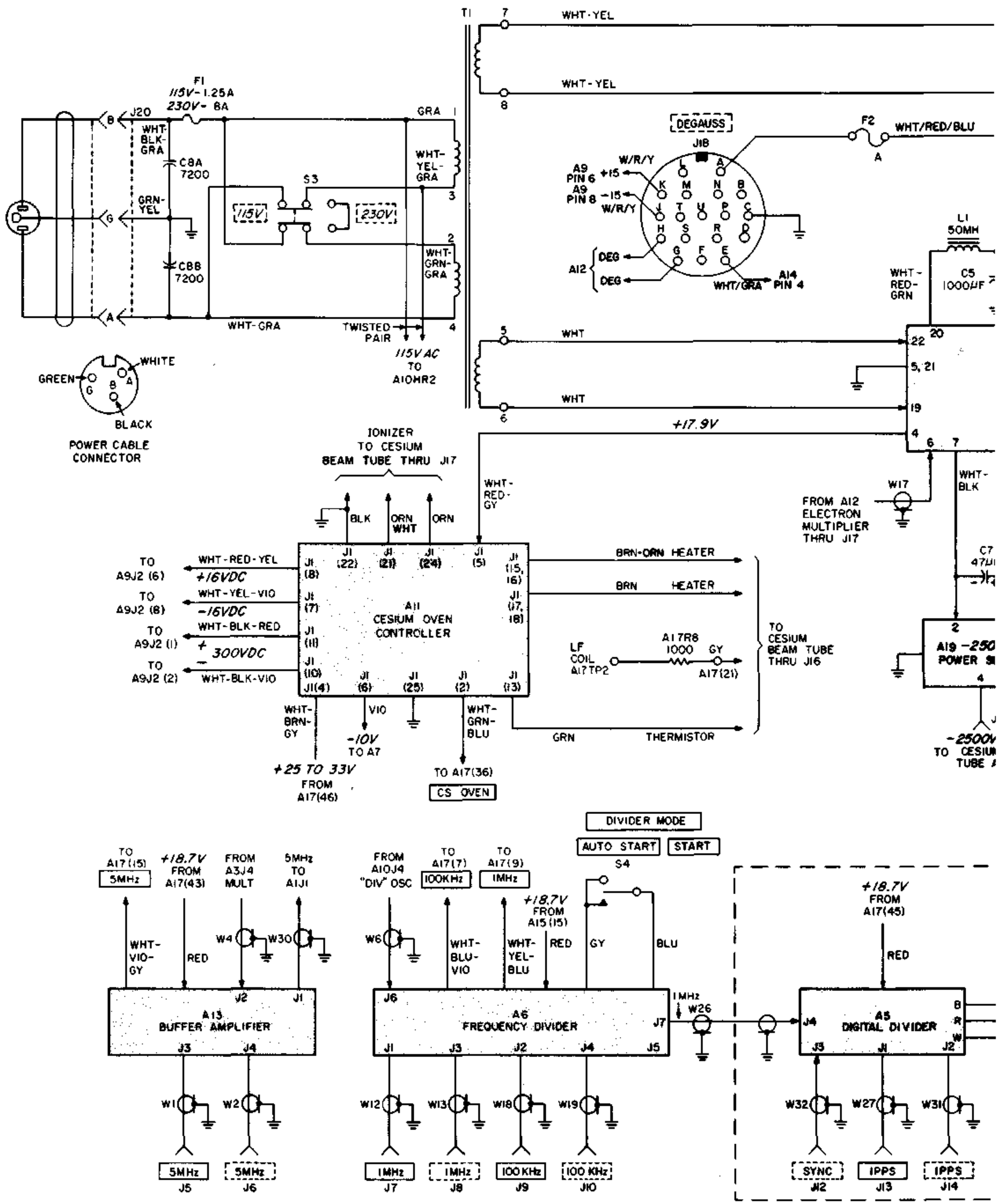


NOTE: EARLY MODEL

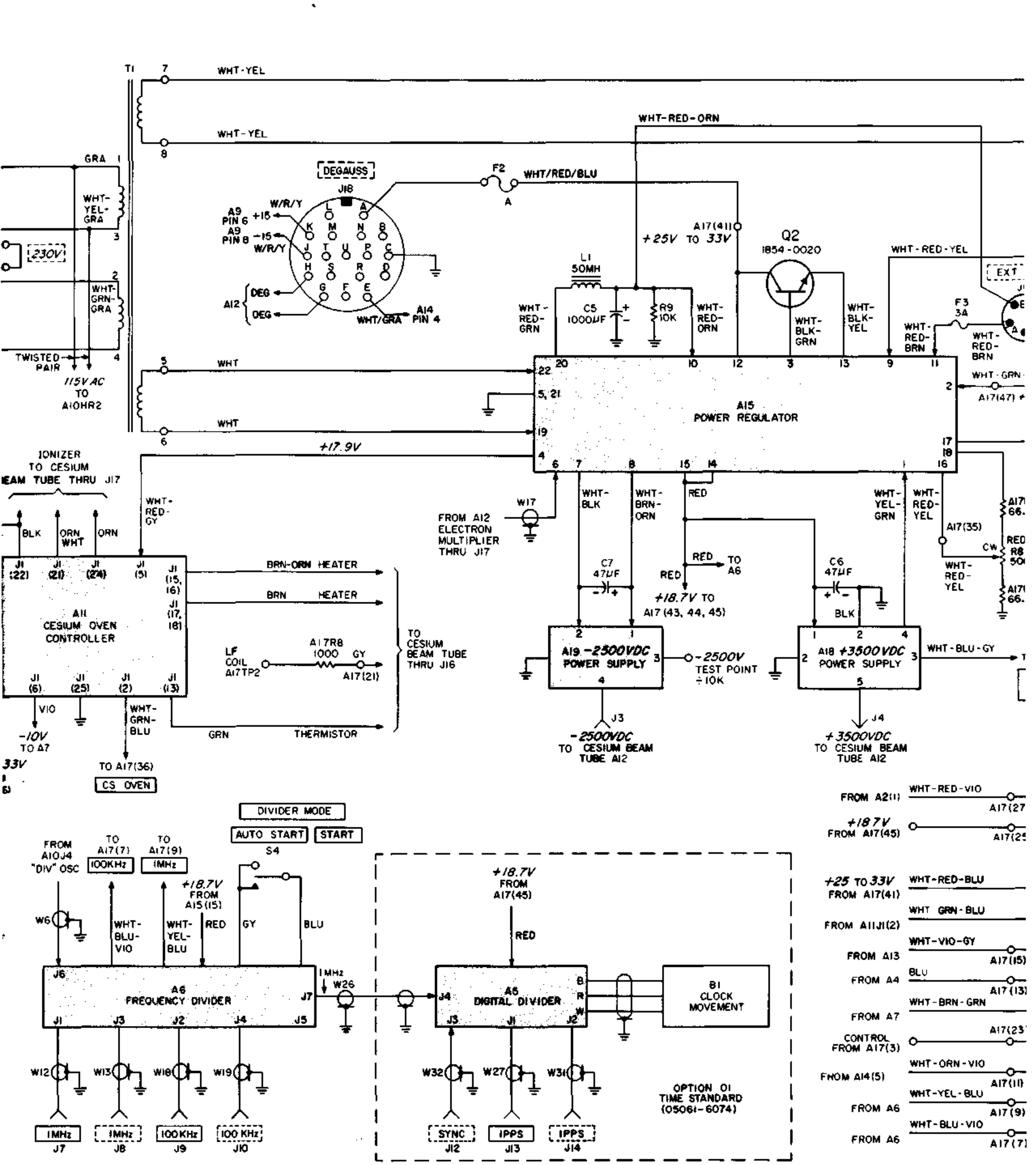
Figure 7-9. Wiring Diagram
(Sheet 1 of 2)

NOTE: EARLY MODEL

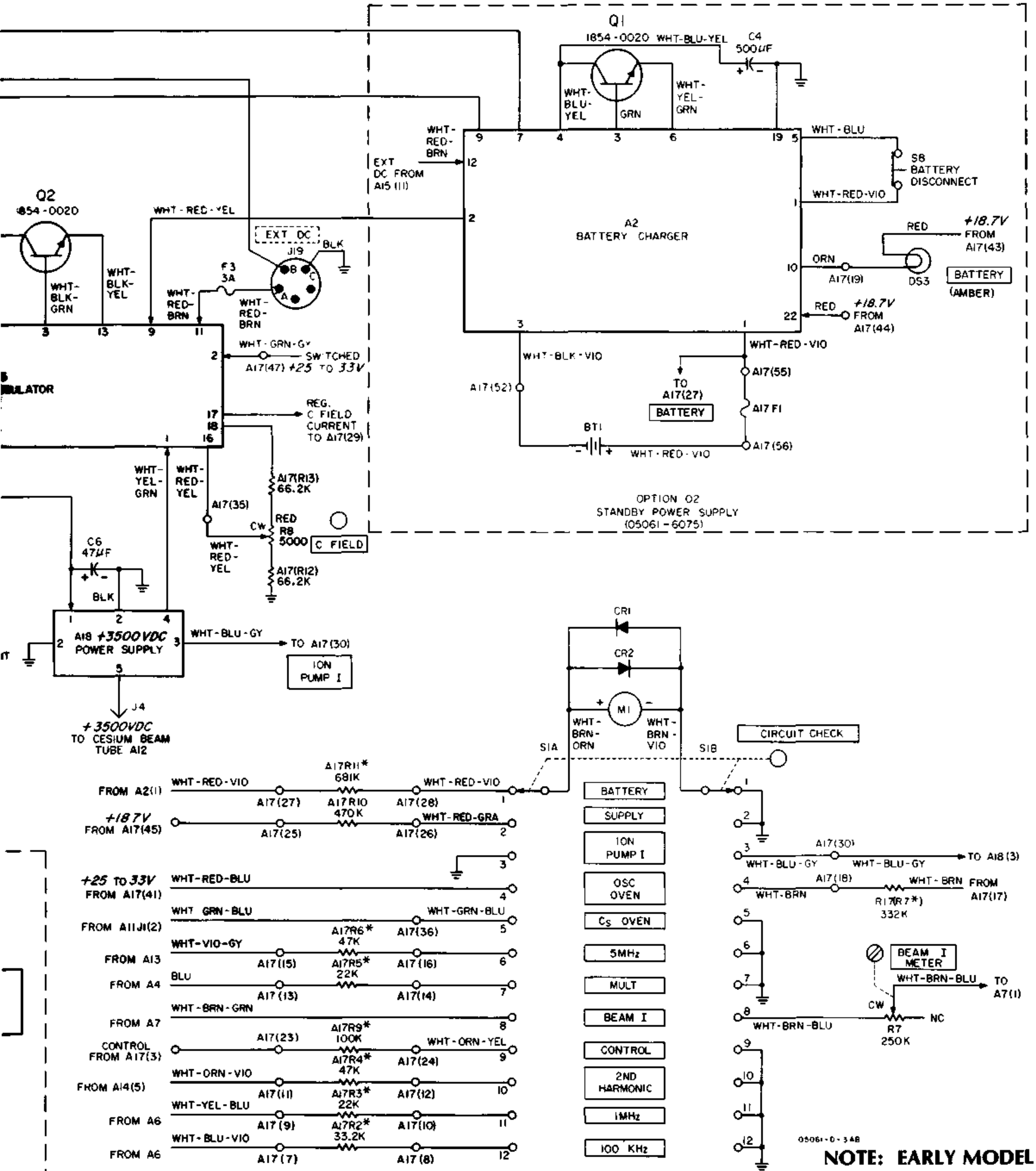
Figure 7-9
WIRING DIAGRAM
(Sheet 2 of 2)



T1
WHT-YEL
WHT-YEL
F1
115V-1.25A
230V-.6A
J20
WHT-BLK-GRA
C8A 7200
GRN-YEL
C8B 7200
GRA
WHT-YEL-GRA
S3
115V
230V
WHT-GRN-GRA
WHT-GRA
TWISTED PAIR
115V AC TO A10HR2
GREEN
WHITE
BLACK
POWER CABLE CONNECTOR
DEGAUSS
J18
F2
WHT/RED/BLU
A9 PIN 6
A9 PIN 8
W/R/Y
+15
-15
A12
DEG
DEG
WHT/GRA
A14 PIN 4
L1 50MH
C5 1000μF
WHT-RED-GRN
WHT
WHT
+17.9V
IONIZER TO CESIUM BEAM TUBE THRU J17
WHT-RED-GY
BLK
ORN WHT
ORN
W17
FROM A12 ELECTRON MULTIPLIER THRU J17
WHT-BLK
C7 47μ
TO A9J2 (6)
WHT-RED-YEL
+16VDC
TO A9J2 (8)
WHT-YEL-VIO
-16VDC
TO A9J2 (1)
WHT-BLK-RED
+ 300VDC
TO A9J2 (2)
WHT-BLK-VIO
A11 CESIUM OVEN CONTROLLER
BRN-ORN HEATER
BRN HEATER
LF COIL A17TP2
A17R8 1000
GY
A17(21)
TO CESIUM BEAM TUBE THRU J16
A19 -2500 POWER SUPPLY
WHT-BRN-GY
VIO
-10V TO A7
WHT-GRN-BLU
GRN
THERMISTOR
+25 TO 33V FROM A17(46)
TO A17(36)
CS OVEN
-2500V TO CESIUM TUBE
DIVIDER MODE
AUTO START
START
S4
TO A17(15)
5MHz
+18.7V FROM A17(43)
FROM A3J4 MULT
5MHz TO A1J1
FROM A10J4 "DIV" OSC
TO A17(7)
100KHz
TO A17(9)
1MHz
+18.7V FROM A15(15)
WHT-VIO-GY
RED
W4
W30
W6
WHT-BLU-VIO
WHT-YEL-BLU
RED
GY
BLU
+18.7V FROM A17(45)
RED
A13 BUFFER AMPLIFIER
A6 FREQUENCY DIVIDER
1MHz
W26
A5 DIGITAL DIVIDER
W1
W2
W12
W13
W18
W19
W32
W27
W31
5MHz J5
5MHz J6
1MHz J7
1MHz J8
100KHz J9
100KHz J10
SYNC J12
1PPS J13
1PPS J14



T1
WHT-YEL
WHT-RED-ORN
GRA
WHT-YEL-GRA
230V
WHT-GRN-GRA
TWISTED PAIR
115V AC TO A10HR2
DEGAUSS
J18
W/R/Y
A9 PIN 6 +15
A9 PIN 8 -15
A12 DEG
A14 PIN 4
WHT/GRA
F2
WHT/RED/BLU
A17(41)
+25V TO 33V
Q2 1854-0020
WHT-RED-YEL
EXT
L1 50MH
C5 1000μF
R9 10K
WHT-RED-GRN
WHT-RED-ORN
WHT-BLK-GRN
WHT-BLK-YEL
F3 3A
WHT-RED-BRN
WHT
A15 POWER REGULATOR
+17.9V
IONIZER TO CESIUM BEAM TUBE THRU J17
BLK
ORN WHT
ORN
WHT-RED-GY
A11 CESIUM OVEN CONTROLLER
BRN-ORN HEATER
BRN HEATER
LF COIL A17TP2
A17R8 1000
GY
A17(21)
TO CESIUM BEAM TUBE THRU J16
GRN THERMISTOR
VIO
-10V TO A7
WHT-GRN-BLU
TO A17(36)
CS OVEN
FROM A12 ELECTRON MULTIPLIER THRU J17
W17
WHT-BLK
WHT-BRN-ORN
RED
C7 47μF
RED TO A6
+18.7V TO A17 (43, 44, 45)
C6 47μF
WHT-YEL-GRN
WHT-RED-YEL
A17(35)
R8 500
A17(47)
A19 -2500VDC POWER SUPPLY
-2500V TEST POINT ÷10K
J3
-2500VDC TO CESIUM BEAM TUBE A12
A18 +3500VDC POWER SUPPLY
WHT-BLU-GY
J4
+3500VDC TO CESIUM BEAM TUBE A12
FROM A2(1) WHT-RED-VIO A17(27)
+18.7V FROM A17(45)
+25 TO 33V FROM A17(41) WHT-RED-BLU
WHT GRN-BLU FROM A11J1(2)
FROM A13 WHT-VIO-GY A17(15)
FROM A4 BLU A17(13)
FROM A7 WHT-BRN-GRN A17(23)
CONTROL FROM A17(3)
FROM A14(5) WHT-ORN-VIO A17(11)
FROM A6 WHT-YEL-BLU A17(9)
FROM A6 WHT-BLU-VIO A17(7)
DIVIDER MODE
AUTO START
START
S4
FROM A10J4 "DIV" OSC
TO A17(7) 100KHz
TO A17(9) 1MHz
+18.7V FROM A15(15)
W6
WHT-BLU-VIO
WHT-YEL-BLU
GY
BLU
A6 FREQUENCY DIVIDER
1MHz
W26
+18.7V FROM A17(45)
A5 DIGITAL DIVIDER
B1 CLOCK MOVEMENT
W12
W13
W18
W19
1MHz J7
1MHz J8
100KHz J9
100 KHz J10
W32
W27
W31
SYNC J12
1PPS J13
1PPS J14
OPTION 01 TIME STANDARD (05061-6074)

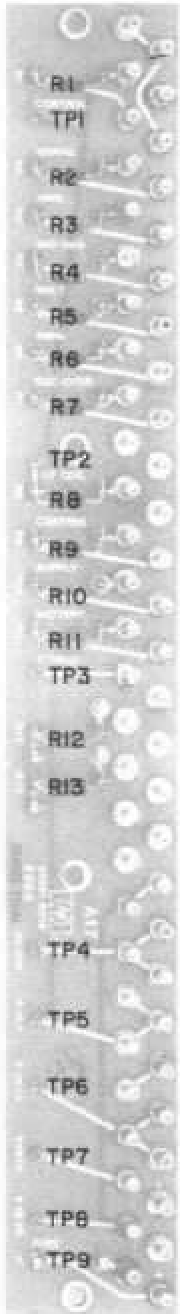


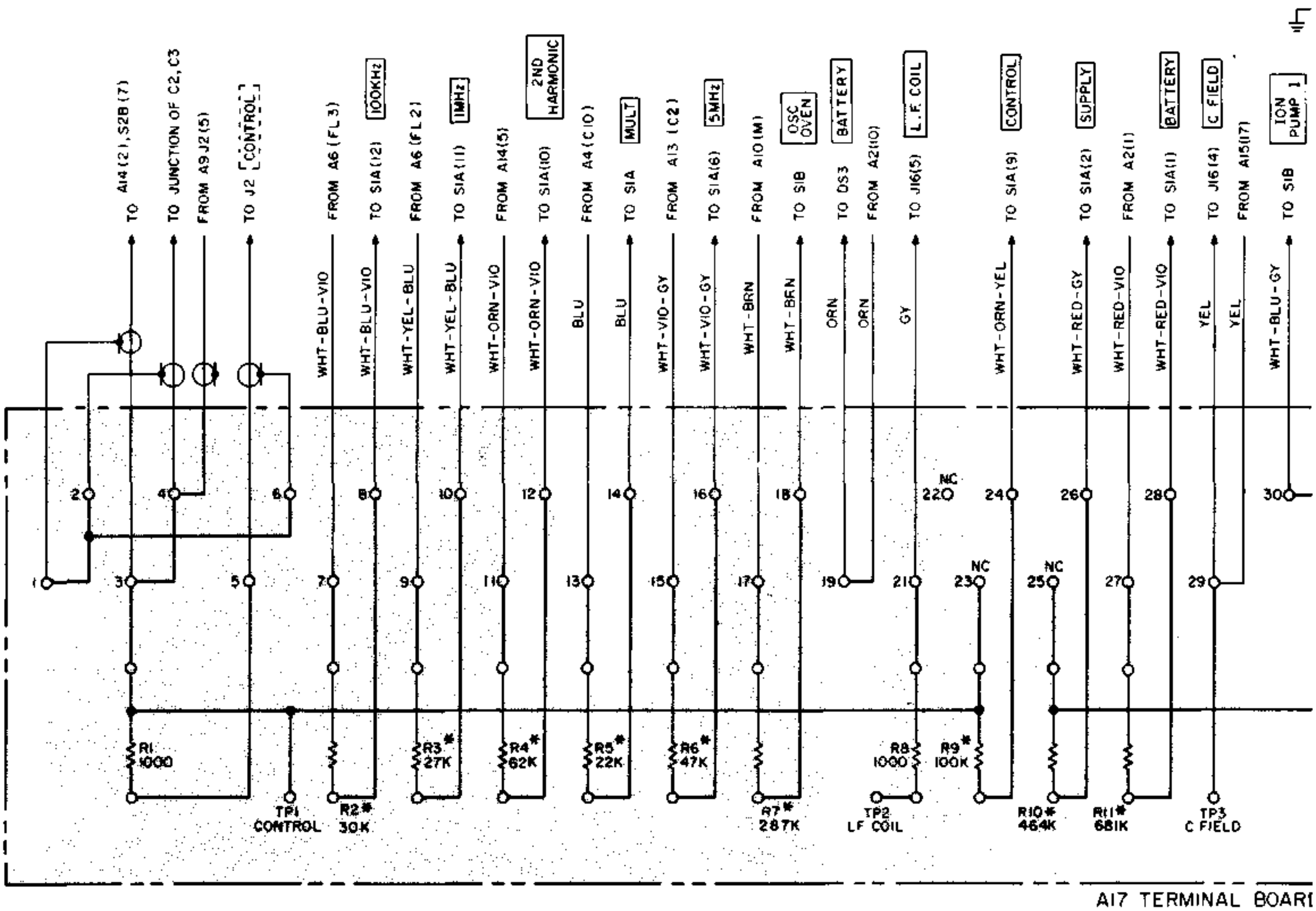
NOTE: EARLY MODEL

Figure 7-9. Wiring Diagram
(Sheet 2 of 2)

NOTE: EARLY MODEL

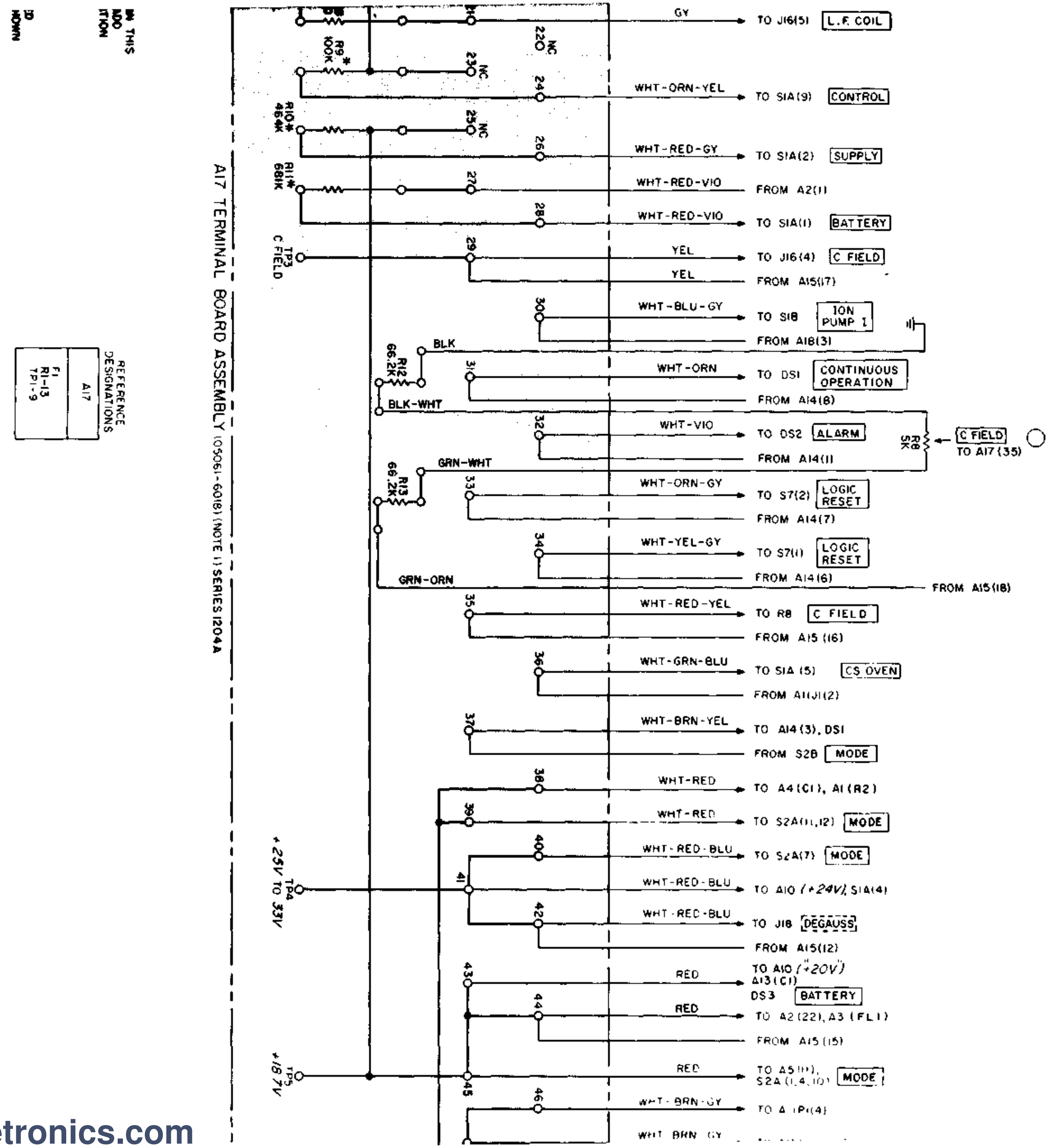
Figure 7-10
TERMINAL BOARD ASSEMBLY A17


R1
TP1
R2
R3
R4
R5
R6
R7
TP2
R8
R9
R10
R11
TP3
R12
R13
TP4
TP5
TP6
TP7
TP8
TP9



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN


A17 TERMINAL BOARD ASSEMBLY (05061-6018) (NOTE 1) SERIES 1204A
REFERENCE DESIGNATIONS
A17
F1
R1-13
TP1-9
GY
TO J16(5) L.F. COIL
WHT-ORN-YEL
TO S1A(9) CONTROL
WHT-RED-GY
TO S1A(2) SUPPLY
WHT-RED-VIO
FROM A2(1)
WHT-RED-VIO
TO S1A(1) BATTERY
YEL
TO J16(4) C FIELD
YEL
FROM A15(17)
WHT-BLU-GY
TO S1B ION PUMP I
FROM A18(3)
BLK
WHT-ORN
TO DS1 CONTINUOUS OPERATION
FROM A14(8)
BLK-WHT
WHT-VIO
TO DS2 ALARM
FROM A14(1)
R8 5K
C FIELD
TO A17(35)
GRN-WHT
WHT-ORN-GY
TO S7(2) LOGIC RESET
FROM A14(7)
WHT-YEL-GY
TO S7(1) LOGIC RESET
FROM A14(6)
GRN-ORN
FROM A15(18)
WHT-RED-YEL
TO R8 C FIELD
FROM A15 (16)
WHT-GRN-BLU
TO S1A (5) CS OVEN
FROM A11J1(2)
WHT-BRN-YEL
TO A14 (3), DS1
FROM S2B MODE
WHT-RED
TO A4 (C1), A1 (R2)
WHT-RED
TO S2A(11,12) MODE
WHT-RED-BLU
TO S2A(7) MODE
WHT-RED-BLU
TO A10 (+24V), S1A(4)
WHT-RED-BLU
TO J18 DEGAUSS
FROM A15(12)
RED
TO A10 (+20V)
A13(C1)
DS3 BATTERY
RED
TO A2 (22), A3 (FL1)
FROM A15 (15)
RED
TO A5(1),
S2A (1,4,10) MODE
WHT-BRN-GY
R9* 100K
R10* 464K
R11* 681K
R12 66.2K
R13 66.2K
TP3 C FIELD
TP4 +25V TO 33V
TP5 +18.7V
NC
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
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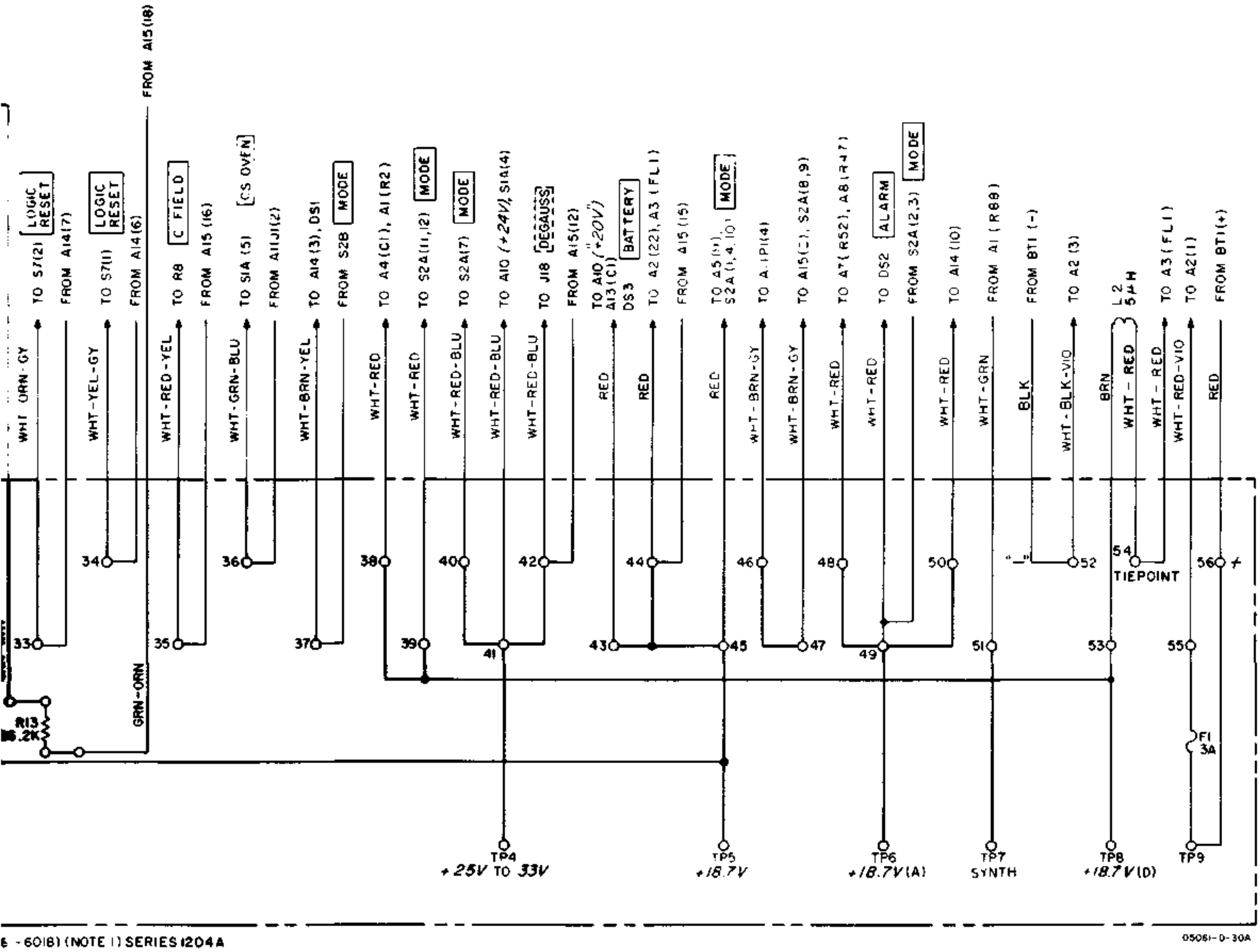
42
43
44
45
46



NOTE: EARLY MODEL

Figure 7-10. Terminal Board Assembly A17

SECTION VIII

CIRCUIT DIAGRAMS

8-1. GENERAL

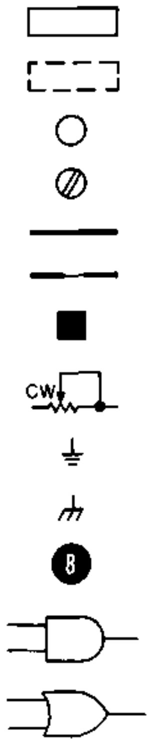
8-2. This section contains the block, wiring, schematic, waveforms, and component location diagrams for the Model 5061A including Time Standard Option 001 and Standby Power Supply Option 002.

8-3. REFERENCE DESIGNATORS

8-4. The reference designation system used for identifying assemblies and components is illustrated in Figure 8-1. The Reference Designation Index on each figure (except block and wiring diagrams) lists the components shown in the schematic diagram portion of that figure. Complete parts descriptions are given in Section VI of this manual.

Figure 8-1. Schematic Diagram Notes

SYMBOLS



FRONT PANEL

REAR PANEL

KNOB CONTROL

SCREWDRIVER ADJUST

MAIN SIGNAL PATH

FEEDBACK PATH

CONDUCTING ELEMENT

WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE

POWER LINE GROUND

CIRCUIT COMMON GROUND

TEST POINT

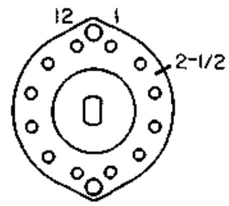
"AND" GATE

"OR" GATE

WAVEFORMS SHOWN ARE TYPICAL

SWITCH DESIGNATIONS

A3S1BR(2-1/2)



A3S1	SWITCH S1 WITHIN ASSEMBLY A3
B	2ND WAFER FROM FRONT (A=1ST, ETC)
R	REAR OF WAFER (F=FRONT)
(2-1/2)	TERMINAL LOCATION ($2\frac{1}{2}$) (VIEWED FROM FRONT)

REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

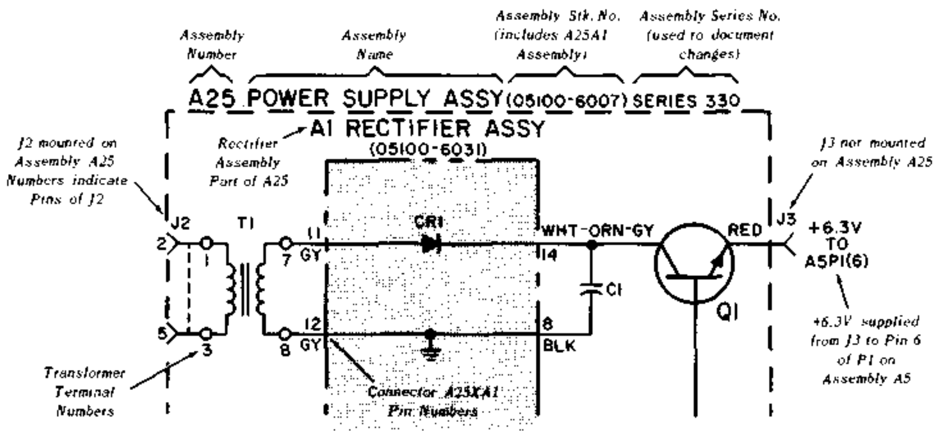
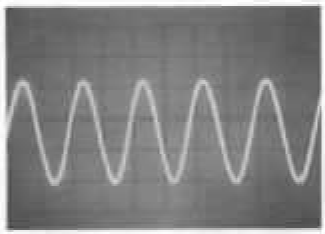
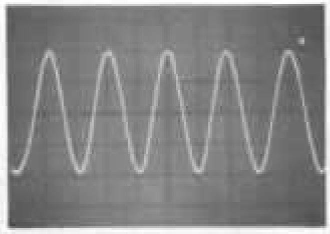


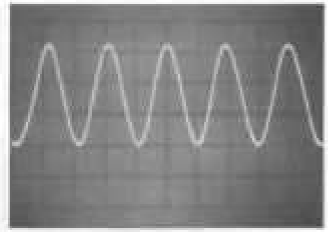
Figure 8-2
BLOCK DIAGRAM



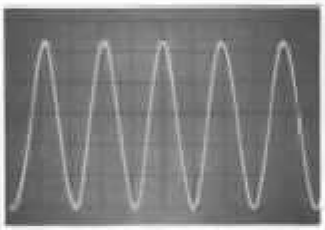
1 1V/cm, 0.1 μs/cm
50Ω Term. at scope



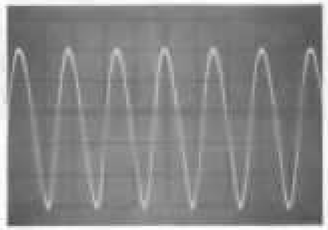
2 0.05V/cm, 0.1 μs/cm



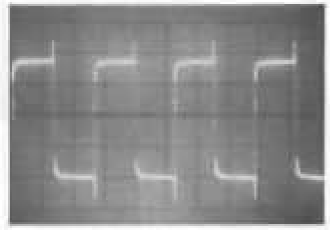
3 1V/cm, 0.1 μs/cm
50Ω Term. at scope



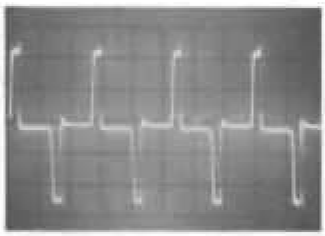
4 0.5/cm, 0.1 μs/cm



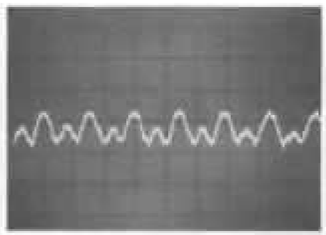
5 0.2V/cm, 0.05 μs/cm
Synth. time scale 0366



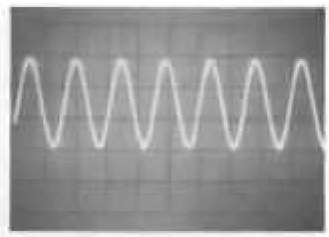
6 0.5V/cm, 0.2 ms/cm
at J17 (3-4)



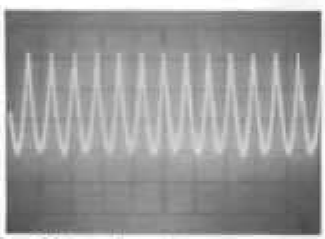
7 2V/cm, 0.2 ms/cm
at J16 (6-7)



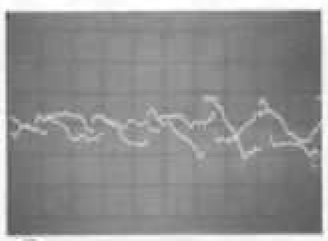
8 20 mV/cm, 5 ms/cm OSC
FREQ X10^{-10} set to 300.
MODE to LOOP OPEN



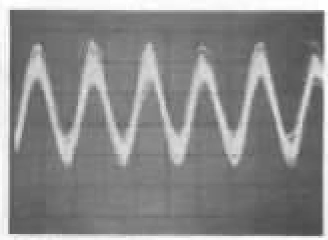
9 5V/cm, 5 ms/cm
MODE to LOOP OPEN
OSC FREQ X10^{-10} at 300



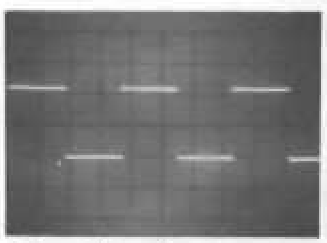
10 1V/cm, 5 ms/cm
MODE to LOOP OPEN
OSC FREQ X10^{-10} at 300



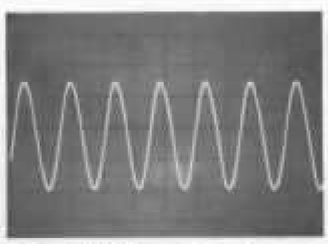
11 0.2V/cm, 5 ms/cm



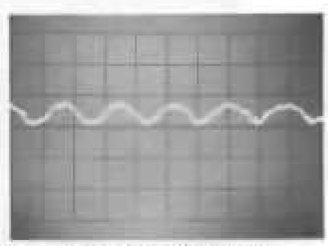
12 0.02V/cm, 2 ms/cm



13 5V/cm, 2 ms/cm



14 0.05V/cm, 5 ms/cm

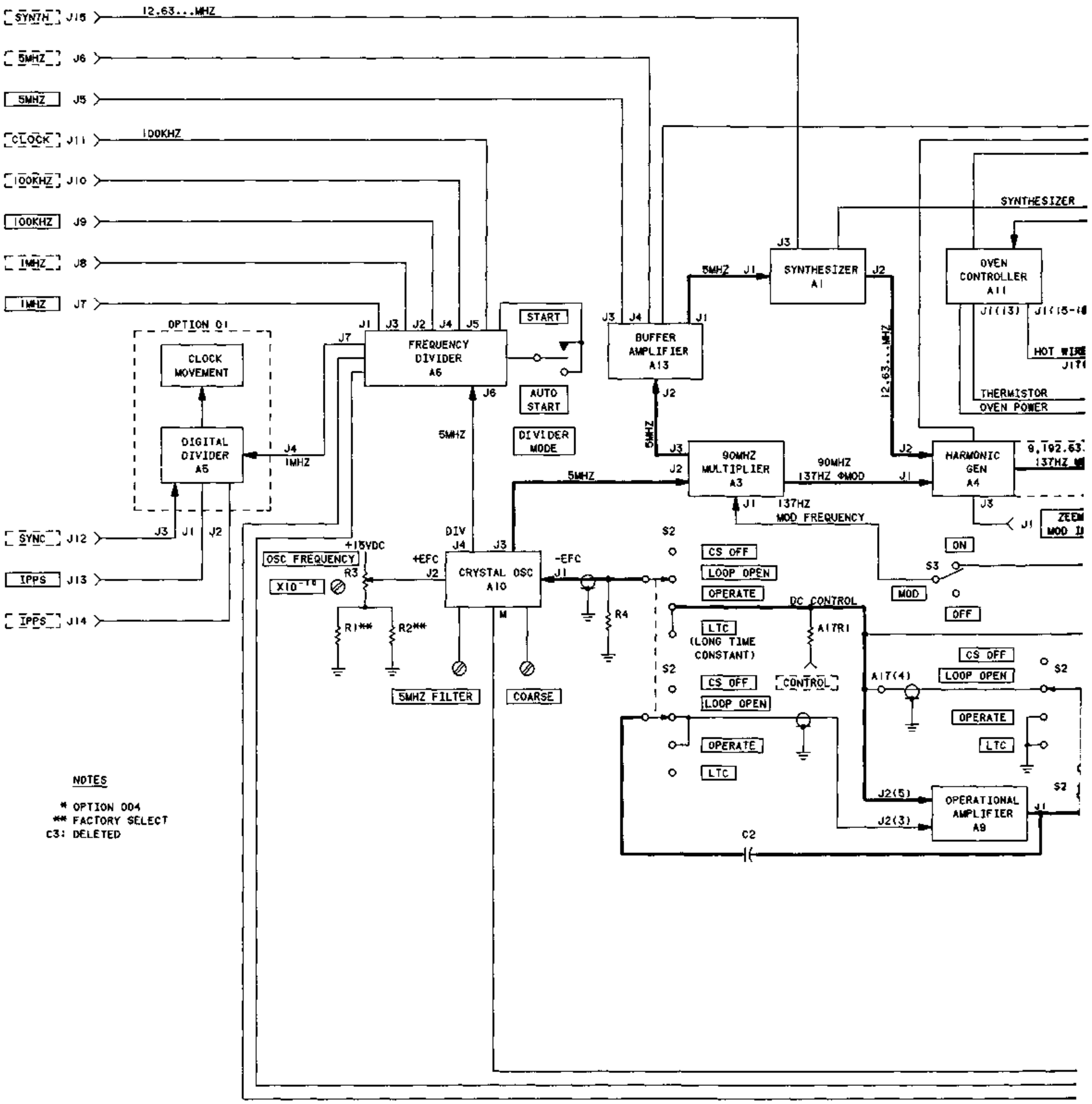


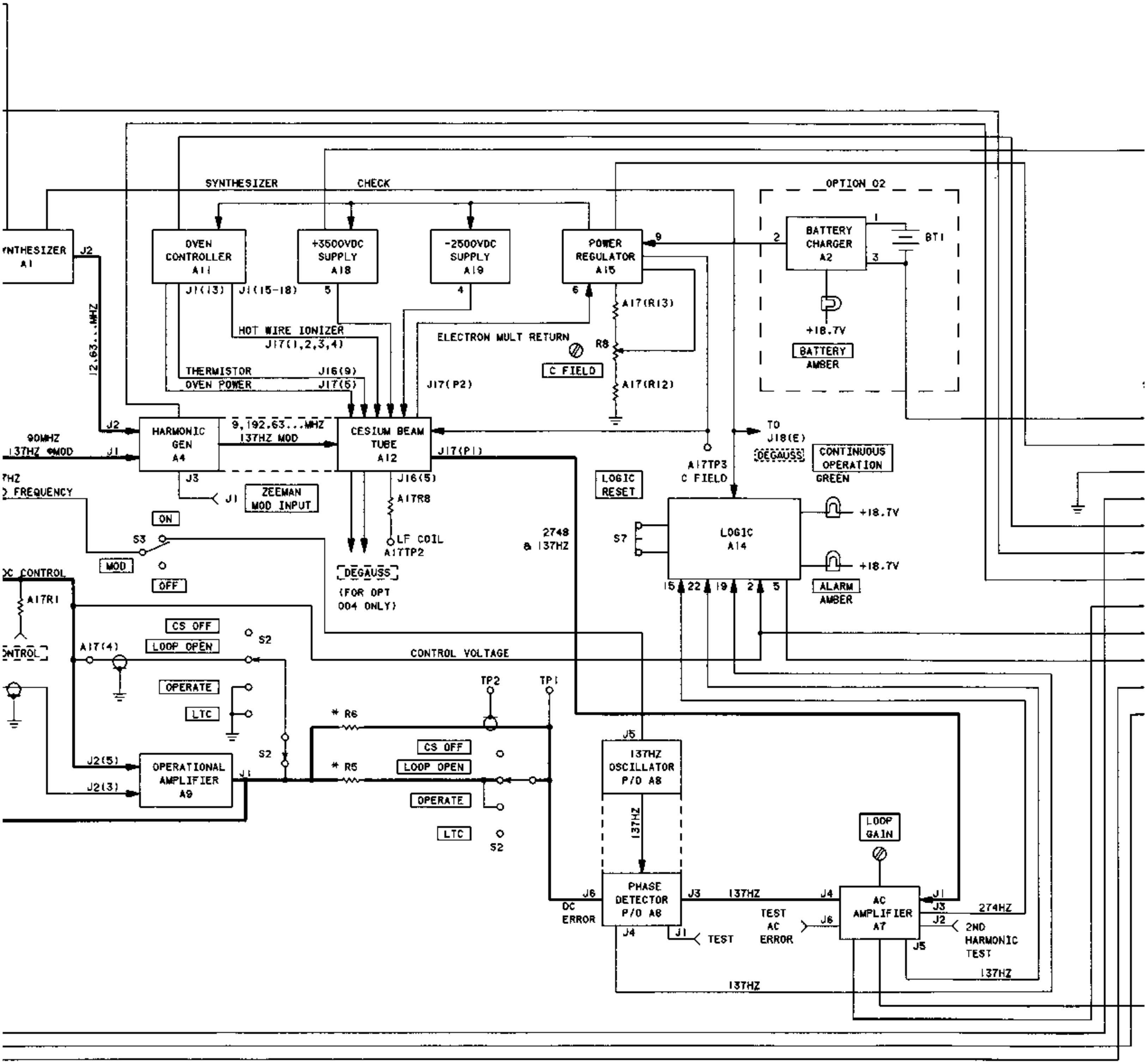
15 0.05V/cm, 2 ms/cm
MODE to LOOP OPEN
OSC on cesium peak

Oscilloscope: DC coupled.

5061A: Normal operation unless noted.

5061A


SYNTH J15
12.63...MHZ
5MHZ J6
5MHZ J5
CLOCK J11
100KHZ
100KHZ J10
100KHZ J9
1MHZ J8
1MHZ J7
OPTION 01
CLOCK MOVEMENT
DIGITAL DIVIDER A5
FREQUENCY DIVIDER A6
START
AUTO START
DIVIDER MODE
BUFFER AMPLIFIER A13
SYNTHESIZER A1
OVEN CONTROLLER A11
SYNTHESIZER
HOT WIRE
THERMISTOR
OVEN POWER
90MHZ MULTIPLIER A3
90MHZ
137HZ ΦMOD
HARMONIC GEN A4
9,192.63
137HZ
137HZ MOD FREQUENCY
ZEEM MOD
SYNC J12
1PPS J13
1PPS J14
+15VDC
OSC FREQUENCY
X10⁻¹⁰
CRYSTAL OSC A10
+EFC
-EFC
DIV
5MHZ FILTER
COARSE
S2
CS OFF
LOOP OPEN
OPERATE
LTC
(LONG TIME CONSTANT)
DC CONTROL
A17R1
CONTROL
A17(4)
S3
ON
MOD
OFF
OPERATIONAL AMPLIFIER A9
C2
R1**
R2**
R3
R4
NOTES
* OPTION 004
** FACTORY SELECT
C3: DELETED



SYNTHESIZER
CHECK
OPTION 02
YNTHESIZER A1
OVEN CONTROLLER A11
+3500VDC SUPPLY A18
-2500VDC SUPPLY A19
POWER REGULATOR A15
BATTERY CHARGER A2
BT1
+18.7V
BATTERY
AMBER
HOT WIRE IONIZER
J17(1,2,3,4)
ELECTRON MULT RETURN
C FIELD
THERMISTOR
OVEN POWER
J16(9)
J17(5)
J17(P2)
A17(R13)
A17(R12)
R8
12,63...MHZ
HARMONIC GEN A4
9,192.63...MHZ
137HZ MOD
CESIUM BEAM TUBE A12
J17(P1)
90MHZ
137HZ ΦMOD
TO J18(E)
DEGAUSS
CONTINUOUS OPERATION
GREEN
A17TP3
C FIELD
LOGIC RESET
ZEEMAN MOD INPUT
J16(5)
A17R8
LF COIL
A17TP2
DEGAUSS
(FOR OPT 004 ONLY)
2748 & 137HZ
LOGIC A14
S7
+18.7V
ALARM
AMBER
ON
MOD
OFF
S3
DC CONTROL
A17R1
CS OFF
LOOP OPEN
OPERATE
LTC
S2
A17(4)
CONTROL VOLTAGE
TP2
TP1
R6
R5
OPERATIONAL AMPLIFIER A9
J2(5)
J2(3)
137HZ OSCILLATOR P/O A8
137HZ
PHASE DETECTOR P/O A8
DC ERROR
TEST
TEST AC ERROR
LOOP GAIN
AC AMPLIFIER A7
274HZ
2ND HARMONIC TEST
137HZ

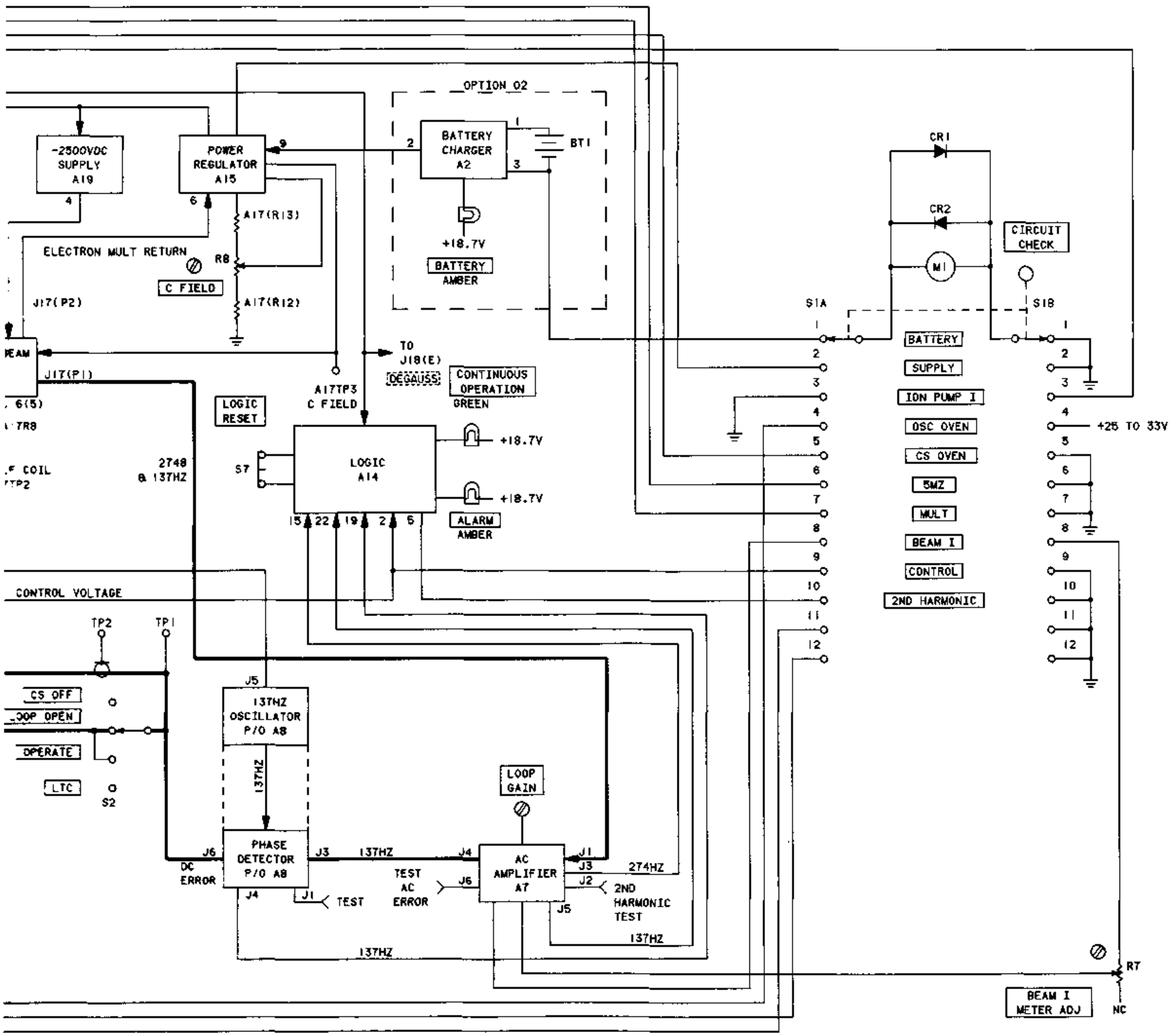
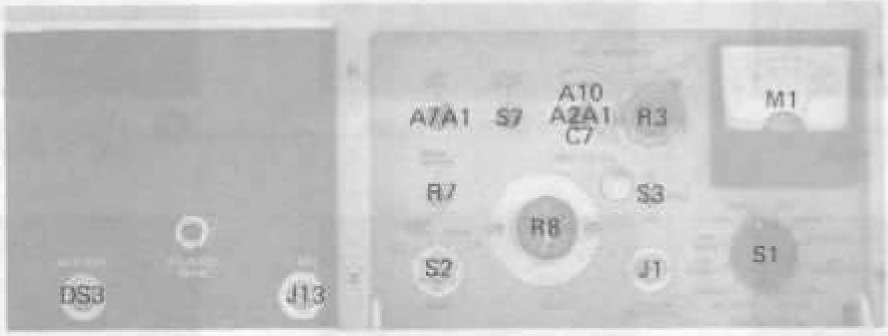


Figure 8-2. Block Diagram

Figure 8-3. Front Panel and Top Internal Views



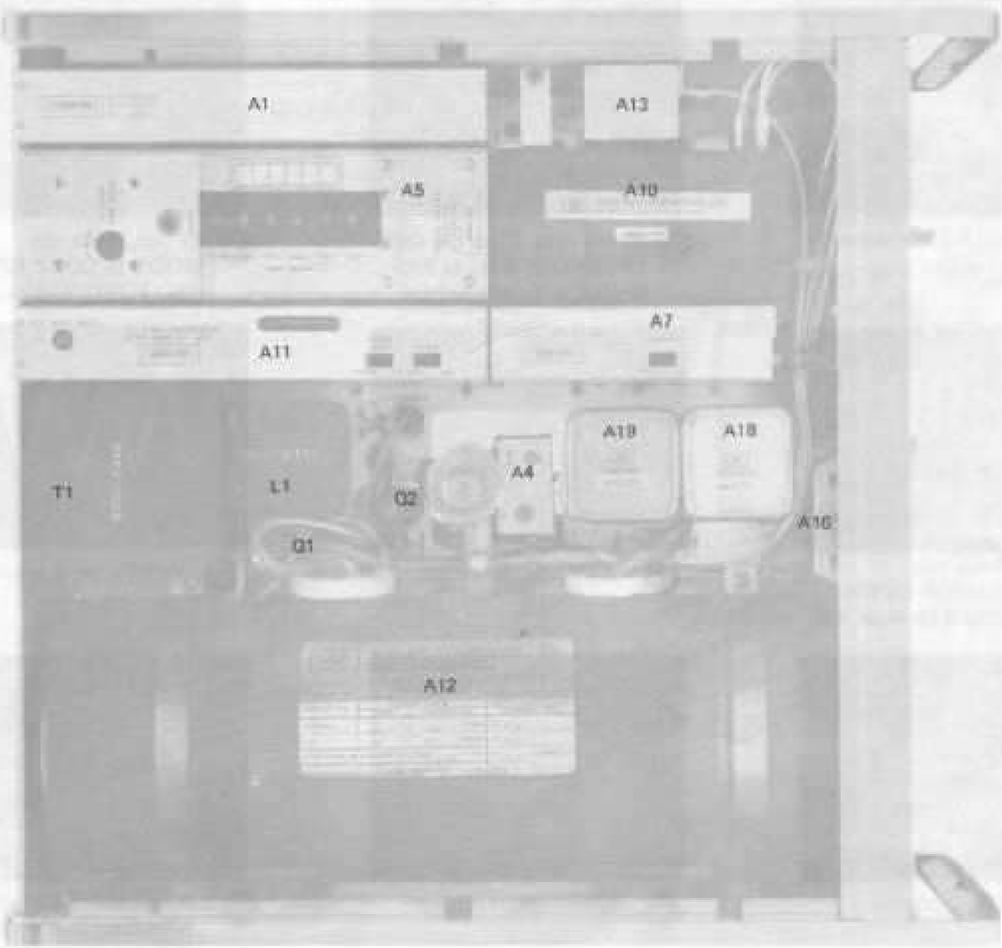
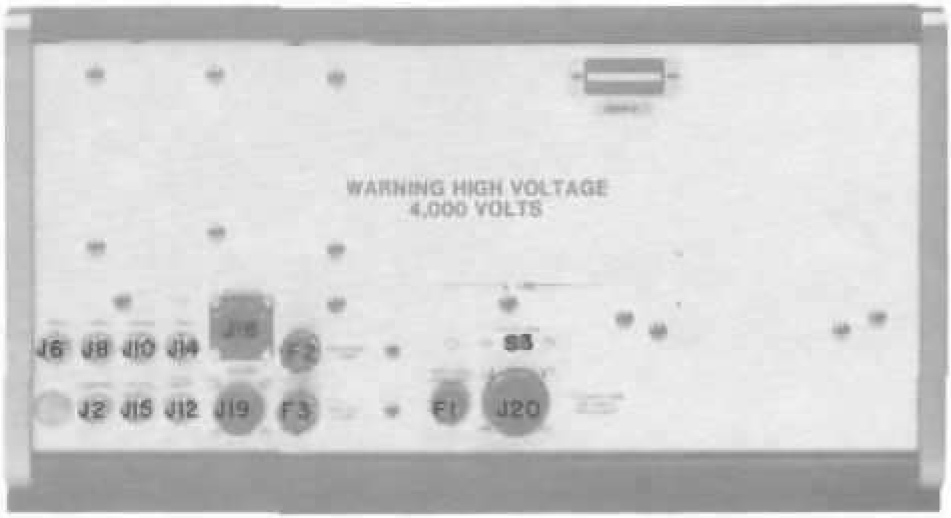
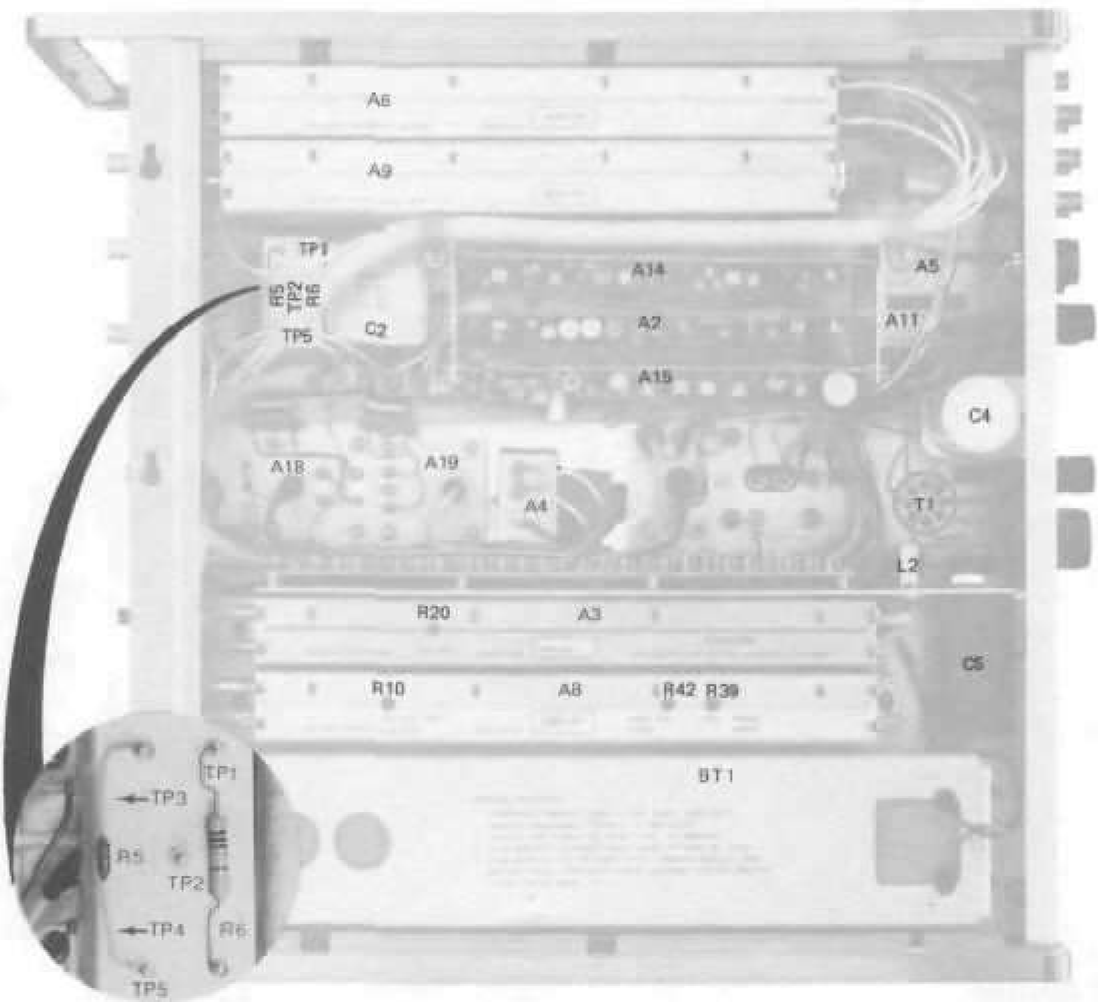
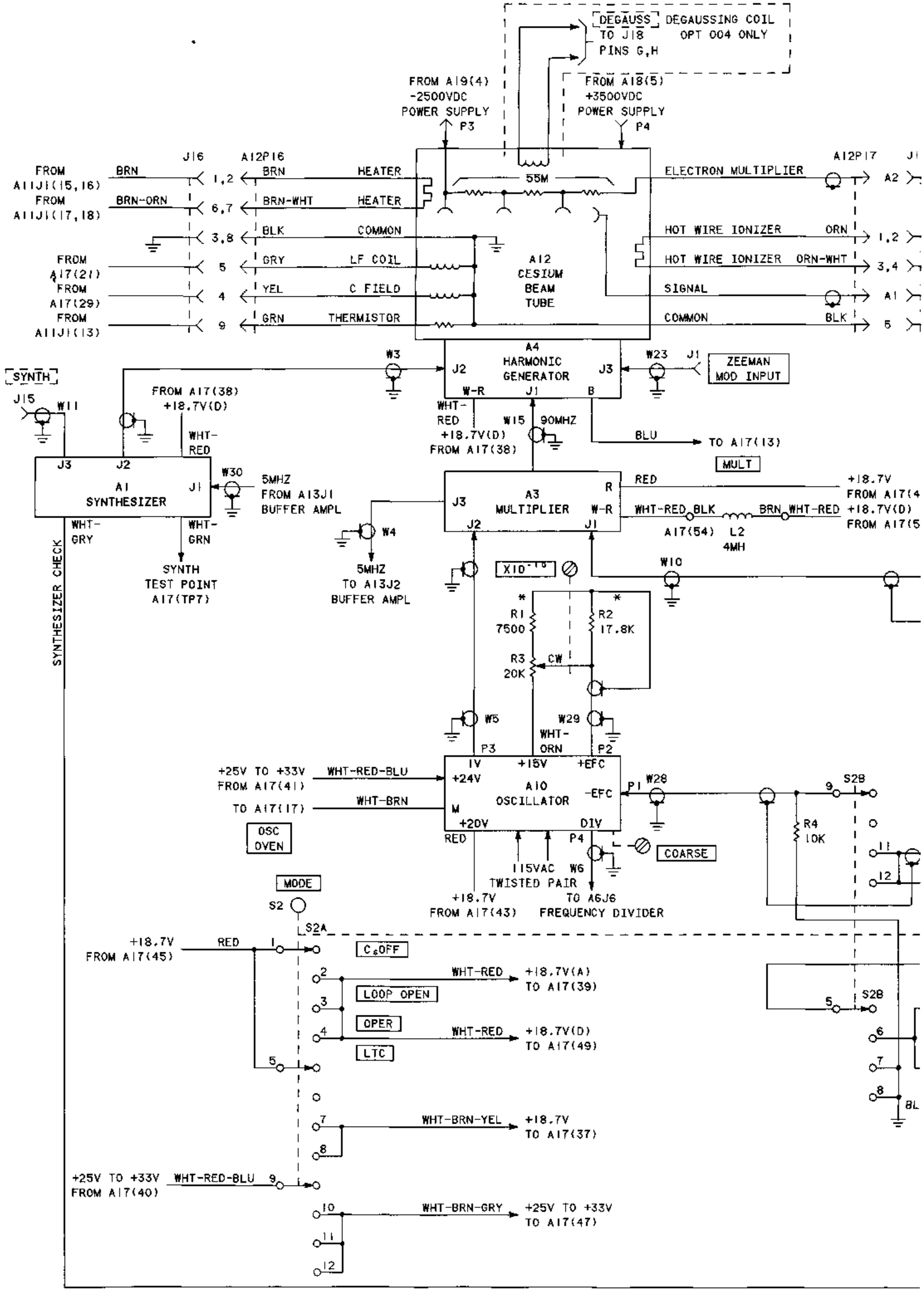


Figure 8-5
WIRING DIAGRAM

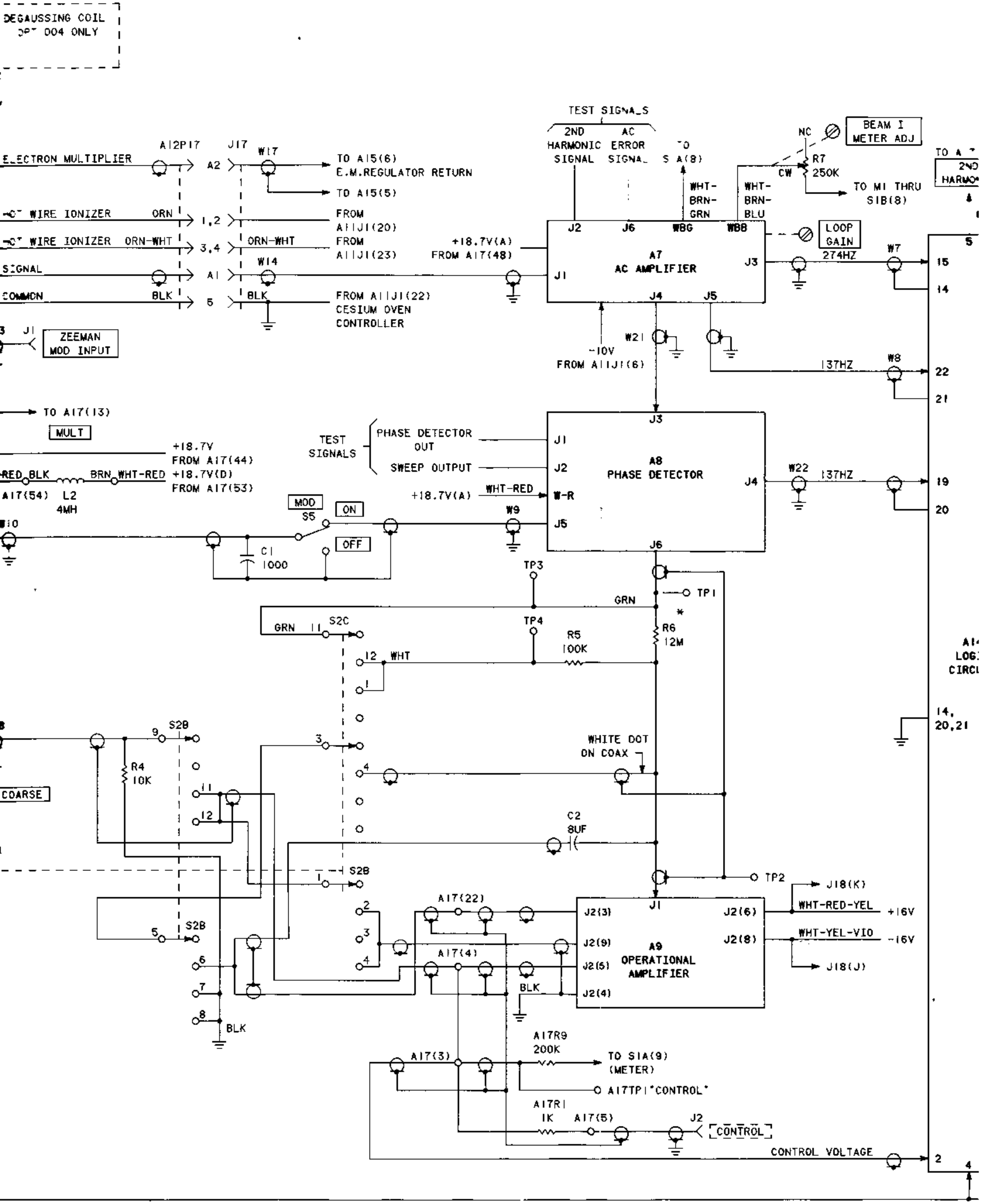
Figure 8-4. Rear Panel and Bottom Internal Views







DEGAUSS
TO J18 PINS G,H
DEGAUSSING COIL OPT 004 ONLY
FROM A19(4) -2500VDC POWER SUPPLY
FROM A18(5) +3500VDC POWER SUPPLY
P3
P4
J16
A12P16
FROM A11J1(15,16)
BRN
HEATER
FROM A11J1(17,18)
BRN-ORN
BRN-WHT
BLK
COMMON
FROM A17(21)
GRY
LF COIL
FROM A17(29)
YEL
C FIELD
FROM A11J1(13)
GRN
THERMISTOR
55M
A12 CESIUM BEAM TUBE
A12P17
ELECTRON MULTIPLIER
HOT WIRE IONIZER
ORN
ORN-WHT
SIGNAL
BLK
A4 HARMONIC GENERATOR
W3
W23
J1
ZEEMAN MOD INPUT
SYNTH
J15
W11
FROM A17(38) +18.7V(D)
WHT-RED
W15
90MHZ
+18.7V(D) FROM A17(38)
BLU
TO A17(13)
MULT
A1 SYNTHESIZER
W30
5MHZ FROM A13J1 BUFFER AMPL
WHT-GRY
WHT-GRN
SYNTH TEST POINT A17(TP7)
SYNTHESIZER CHECK
W4
5MHZ TO A13J2 BUFFER AMPL
A3 MULTIPLIER
RED
+18.7V FROM A17(4
WHT-RED BLK
BRN WHT-RED
+18.7V(D) FROM A17(5
A17(54)
L2 4MH
W10
X10⁻¹⁰
R1 7500
R2 17.8K
R3 20K
CW
W5
W29
WHT-ORN
+25V TO +33V FROM A17(41)
WHT-RED-BLU
TO A17(17)
WHT-BRN
A10 OSCILLATOR
+24V
+15V
+EFC
-EFC
+20V
DIV
W28
S2B
R4 10K
OSC OVEN
RED
115VAC TWISTED PAIR
W6
COARSE
+18.7V FROM A17(43)
TO A6J6 FREQUENCY DIVIDER
MODE
S2
S2A
+18.7V FROM A17(45)
CsOFF
LOOP OPEN
OPER
LTC
WHT-RED
+18.7V(A) TO A17(39)
+18.7V(D) TO A17(49)
WHT-BRN-YEL
+18.7V TO A17(37)
+25V TO +33V FROM A17(40)
WHT-BRN-GRY
+25V TO +33V TO A17(47)
BL



DEGAUSSING COIL
OPT 004 ONLY
TEST SIGNALS
2ND HARMONIC SIGNAL
AC ERROR SIGNAL
BEAM I METER ADJ
ELECTRON MULTIPLIER
A12P17
J17
W17
TO A15(6) E.M.REGULATOR RETURN
TO A15(5)
HOT WIRE IONIZER
ORN
FROM A11J1(20)
ORN-WHT
FROM A11J1(23)
SIGNAL
W14
+18.7V(A) FROM A17(48)
COMMON
BLK
FROM A11J1(22) CESIUM OVEN CONTROLLER
A7 AC AMPLIFIER
WHT-BRN-GRN
WHT-BRN-BLU
R7 250K
TO M1 THRU S1B(8)
LOOP GAIN
274HZ
W7
-10V FROM A11J1(6)
W21
137HZ
W8
ZEEMAN MOD INPUT
TO A17(13)
MULT
TEST SIGNALS
PHASE DETECTOR OUT
SWEEP OUTPUT
A8 PHASE DETECTOR
+18.7V FROM A17(44)
+18.7V(D) FROM A17(53)
L2 4MH
WHT-RED
+18.7V(A)
MOD S5
ON
OFF
C1 1000
W9
W22
TP3
TP1
GRN
S2C
TP4
R5 100K
R6 12M
WHT
S2B
R4 10K
COARSE
WHITE DOT ON COAX
C2 8UF
TP2
J18(K)
WHT-RED-YEL
+16V
WHT-YEL-VIO
-16V
J18(J)
A17(22)
A17(4)
A9 OPERATIONAL AMPLIFIER
BLK
A17R9 200K
TO S1A(9) (METER)
A17(3)
A17TP1 "CONTROL"
A17R1 1K
A17(5)
J2
CONTROL
CONTROL VOLTAGE
LOGIC CIRCUIT

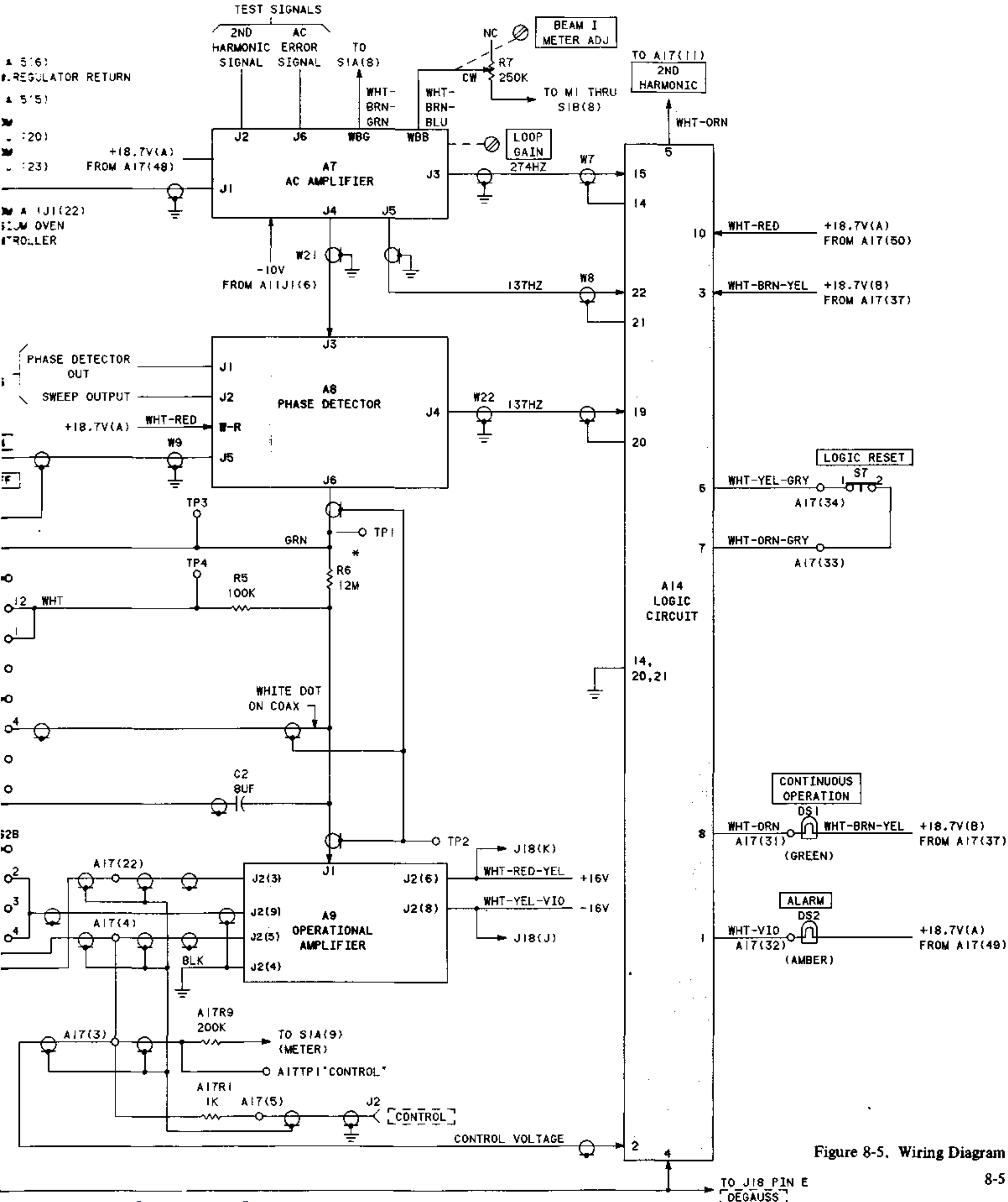


Figure 8-5. Wiring Diagram

Figure 8-6
WIRING DIAGRAM

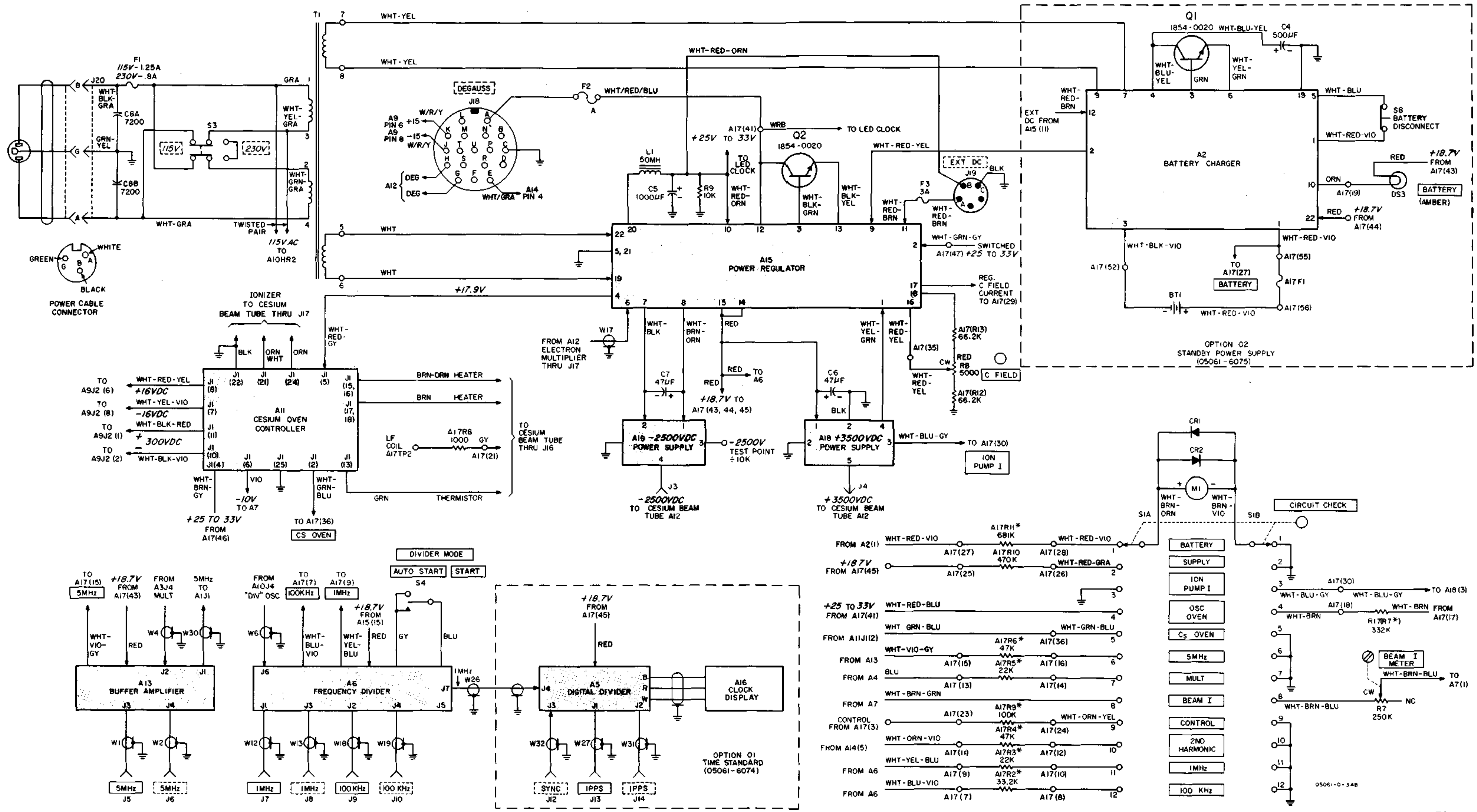
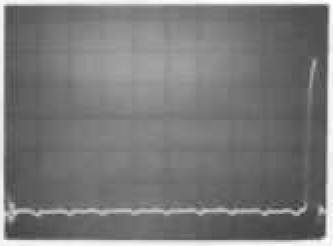
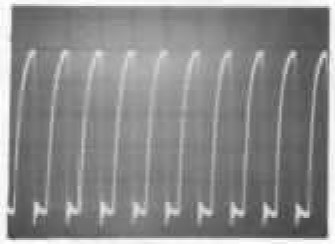


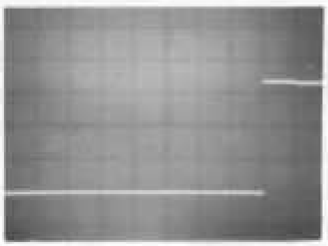
Figure 8-6. Wiring Diagram



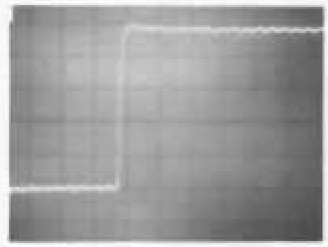
1 Q3(c). Scope sync from negative slope at TP1. H = 0.2 μsec/div, V = 1V/div pulse on right is first pulse into divider after preset (A + 1).



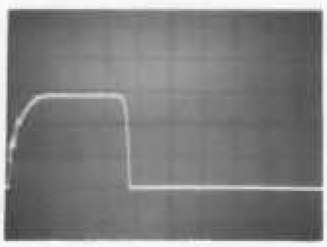
2 Q3(c). H = 0.2 μsecdiv, V = 1V/div input pulses to divider with input gate disabled (RS or IC3(12) shorted to chassis).



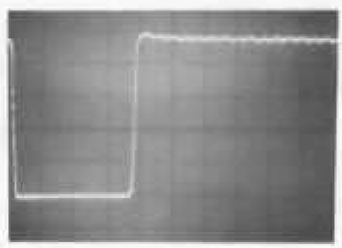
3 IC6(12). Scope internal sync on negative slope. Output of preset divider chain with IC3(12) shorted to chassis. H = 0.2 ms/div, V = 1V/div.



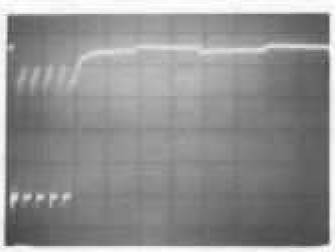
4 Strobe line @ IC4(7). Normal opperation. H = 0.5 μsec/div, V = 1V/div.



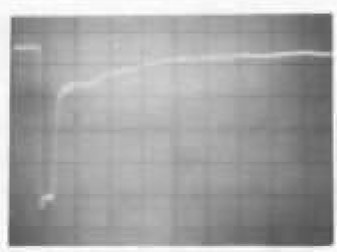
5 IC4(10). Normal operation. H = 0.5 μsec/div, V = 1V/div.



6 TP1. Normal operation. H = 0.5 μsec/div, V = 1V/div.



7 IC3(8). 1V/IC4 not operating. H = 1 μsec/div, V = 1V/div.

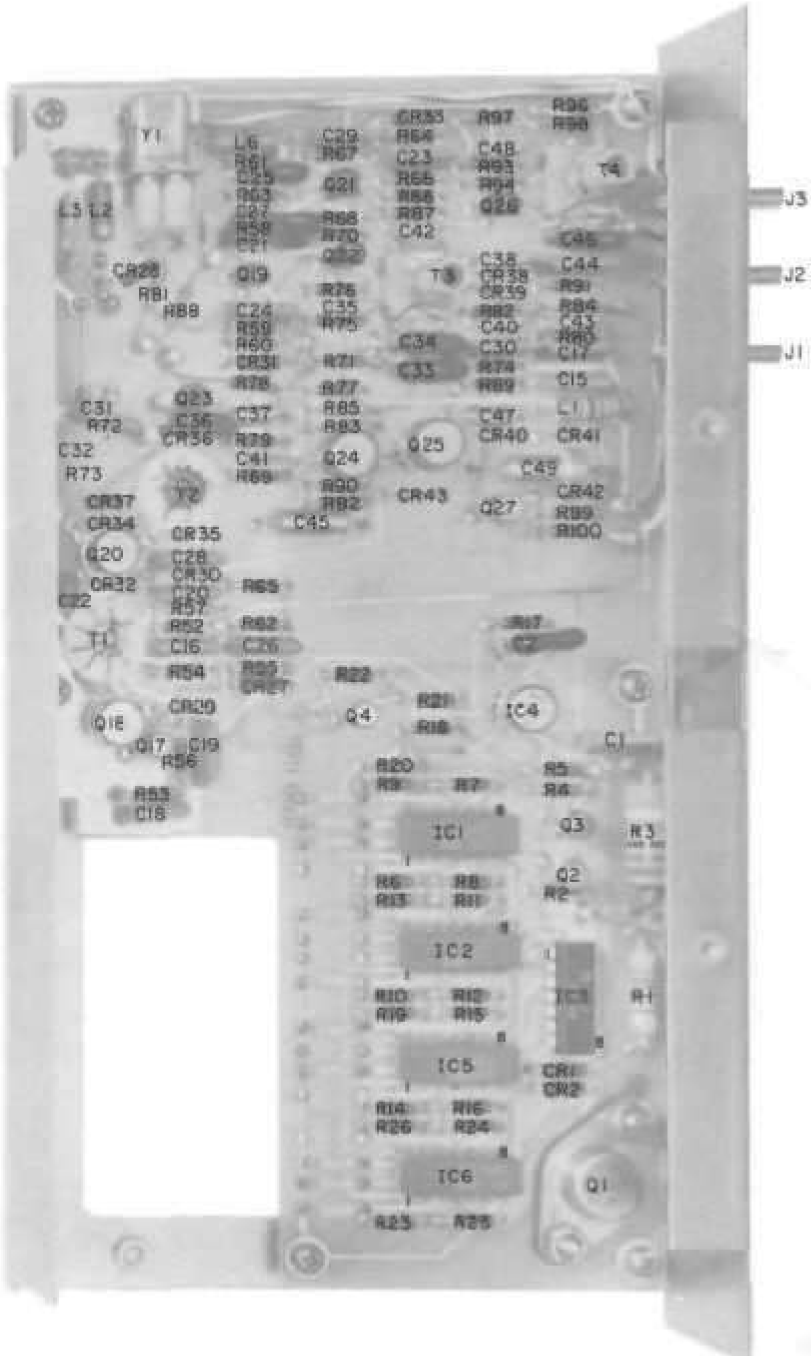


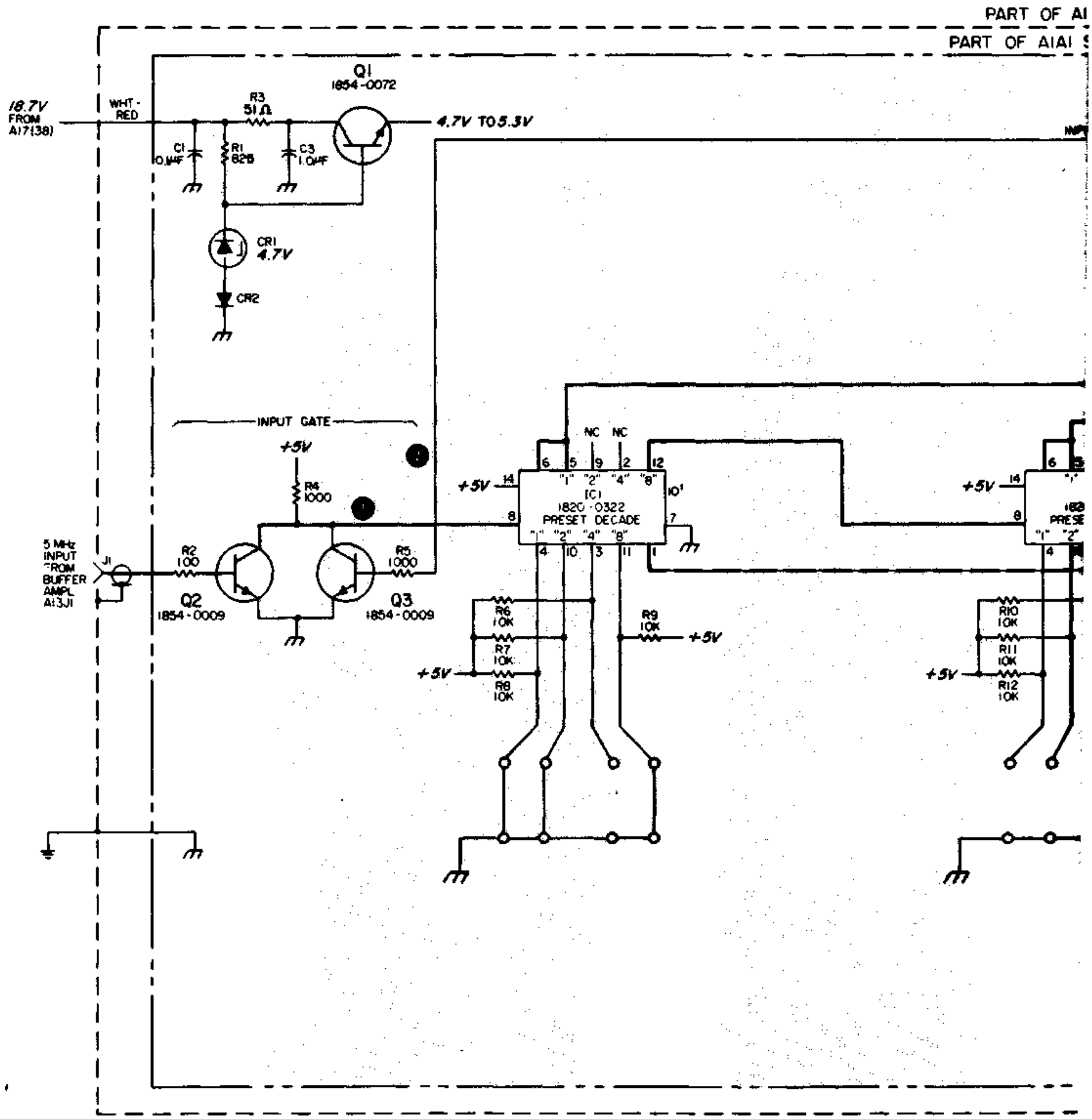
8 IC3(8). Normal operation. H = 0.1 μsec/div, V = 1V/div.

Figure 8-8

SYNTHESIZER ASSEMBLY A1
DIGITAL SECTION

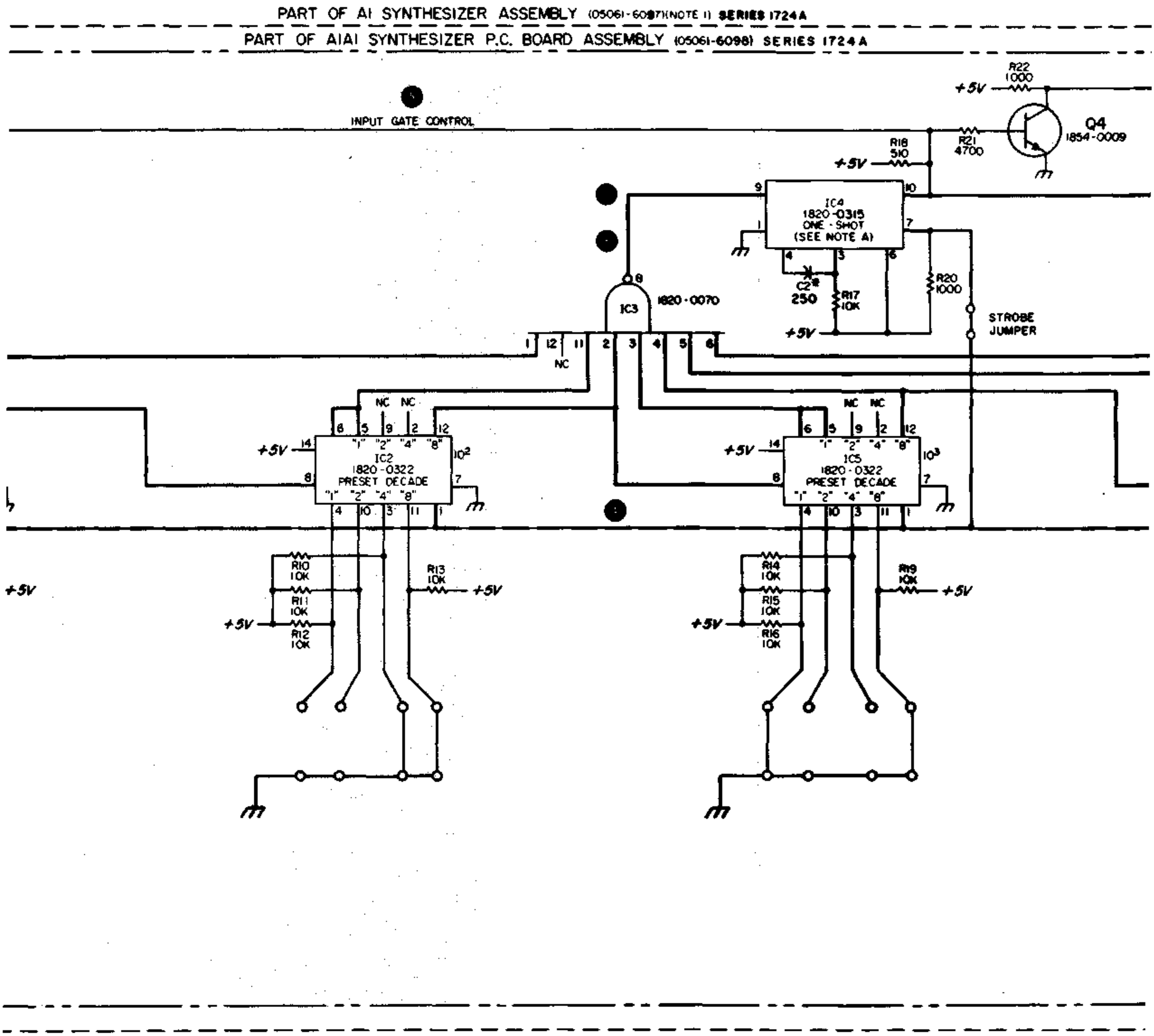
Figure 8-7. Synthesizer Assembly A1, Component Locator





TABLE

	8	4	2	1
0	1	1	1	1
1	1	1	1	0
2	1	1	0	1
3	1	1	0	0
4	1	0	1	1
5	1	0	1	0
6	1	0	0	1
7	1	0	0	0
8	0	1	1	1
9	0	1	1	0



NOTE A IF IC4 IS REPLACED, C2 MUST BE CHECKED FOR PROPER SELECTION SEE PARAGRAPH 5-53A

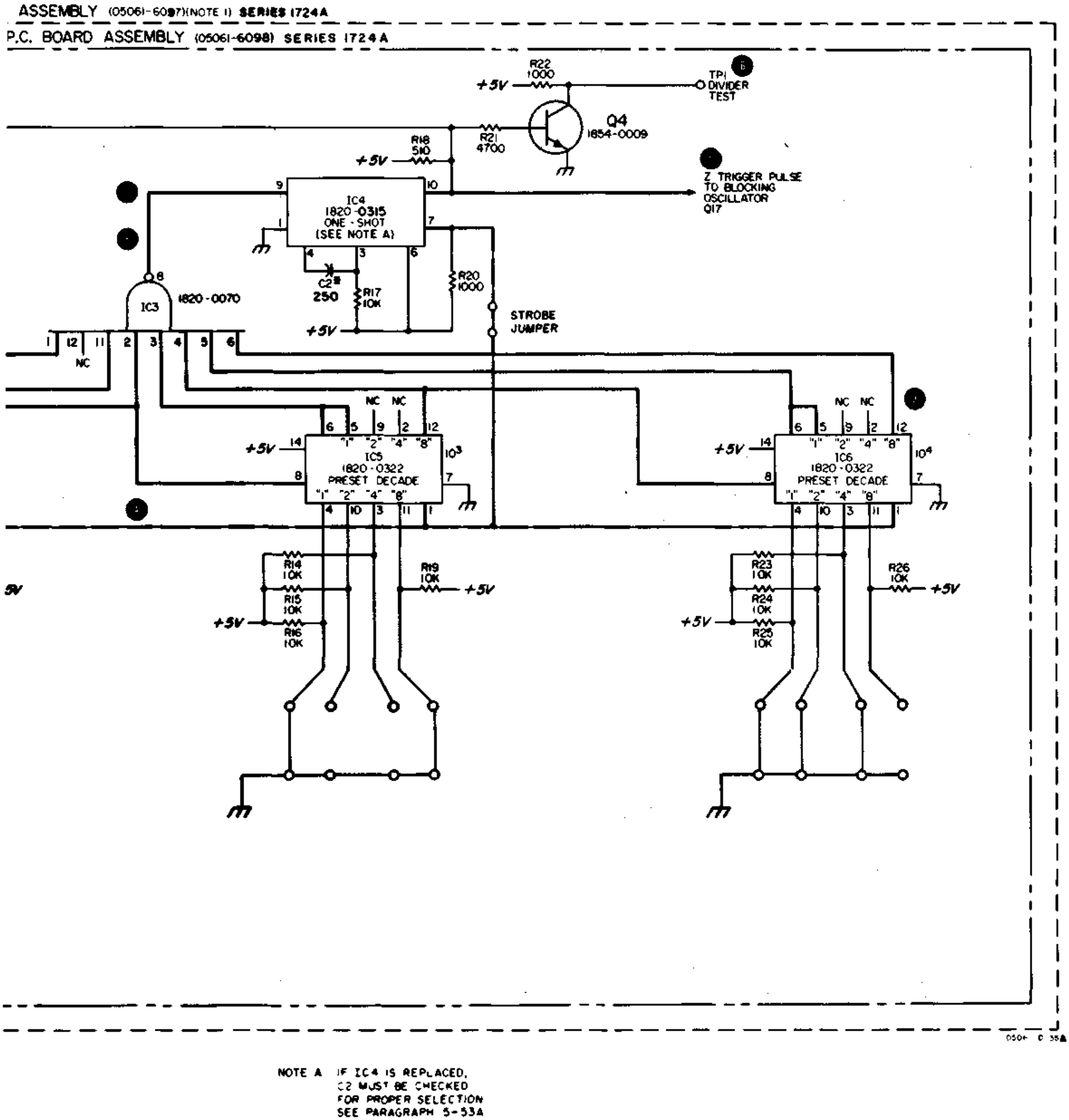
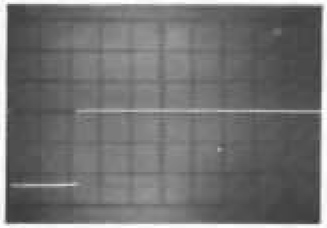


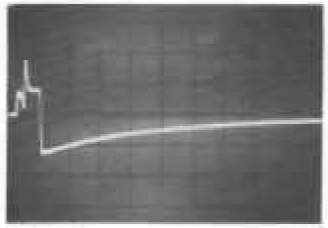
Figure 8-8. Synthesizer Assembly A1
Digital Section

Figure 8-9

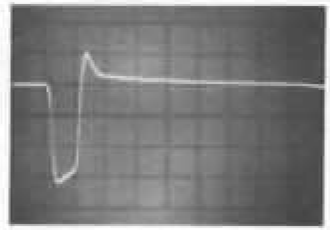
SYNTHESIZER ASSEMBLY A1
PHASE LOCKED OSCILLATOR SECTION



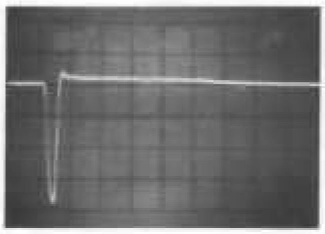
13 1V/cm, 1 μs/cm



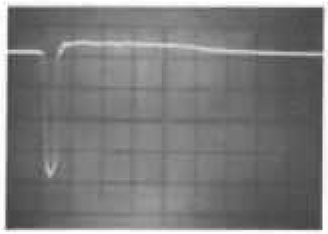
14 1V/cm, 0.5 μs/cm



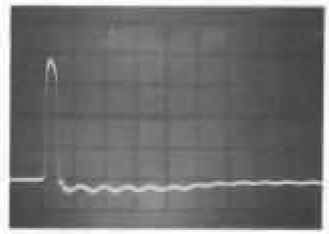
15 5V/cm, 0.1 μs/cm



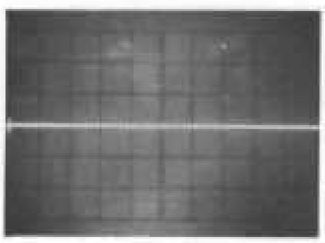
16 5V/cm, 0.1 μs/cm



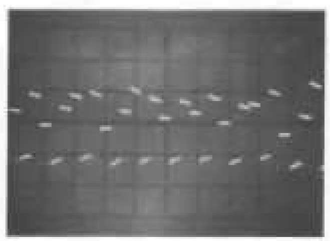
17 2V/cm, 0.1 μs/cm
A1Y1 disconnected



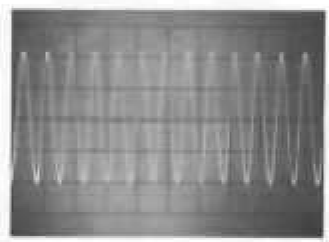
18 2V/cm, 0.1 μs/cm
A1Y1 disconnected



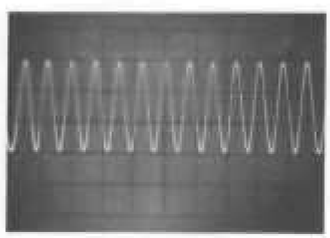
19 1V/cm, 2 μs/cm
Phase loop locked



20 0.5V/cm, 2 ms/cm
Phase loop not locked



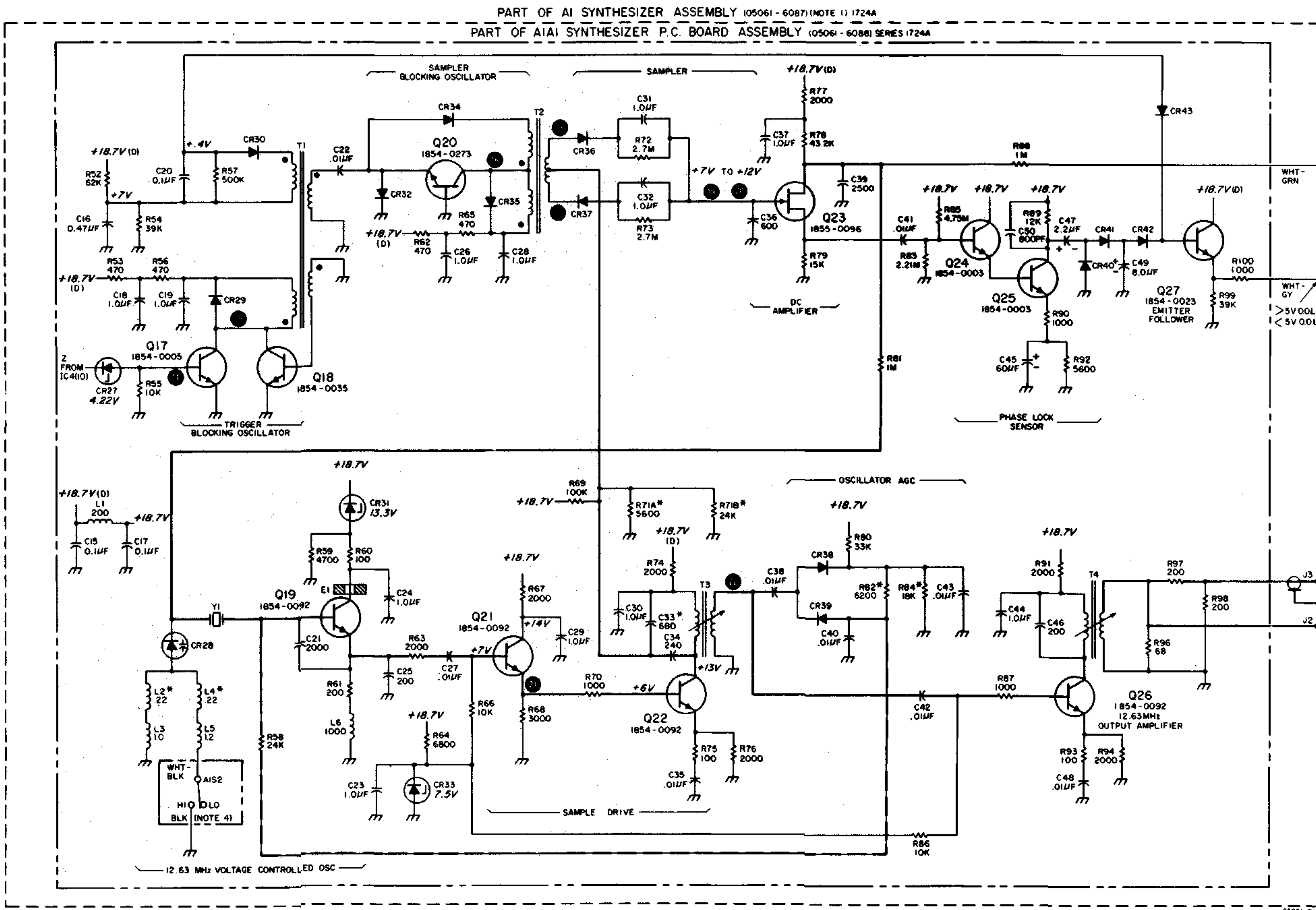
21 0.5V/cm, 0.1 μs/cm



22 1V/cm, 0.1 μs/cm

5061A: Normal operation unless noted.

Oscilloscpe: DC coupled



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN
4. PART OF "TIME SCALE SELECTOR"

REFERENCE DESIGNATIONS

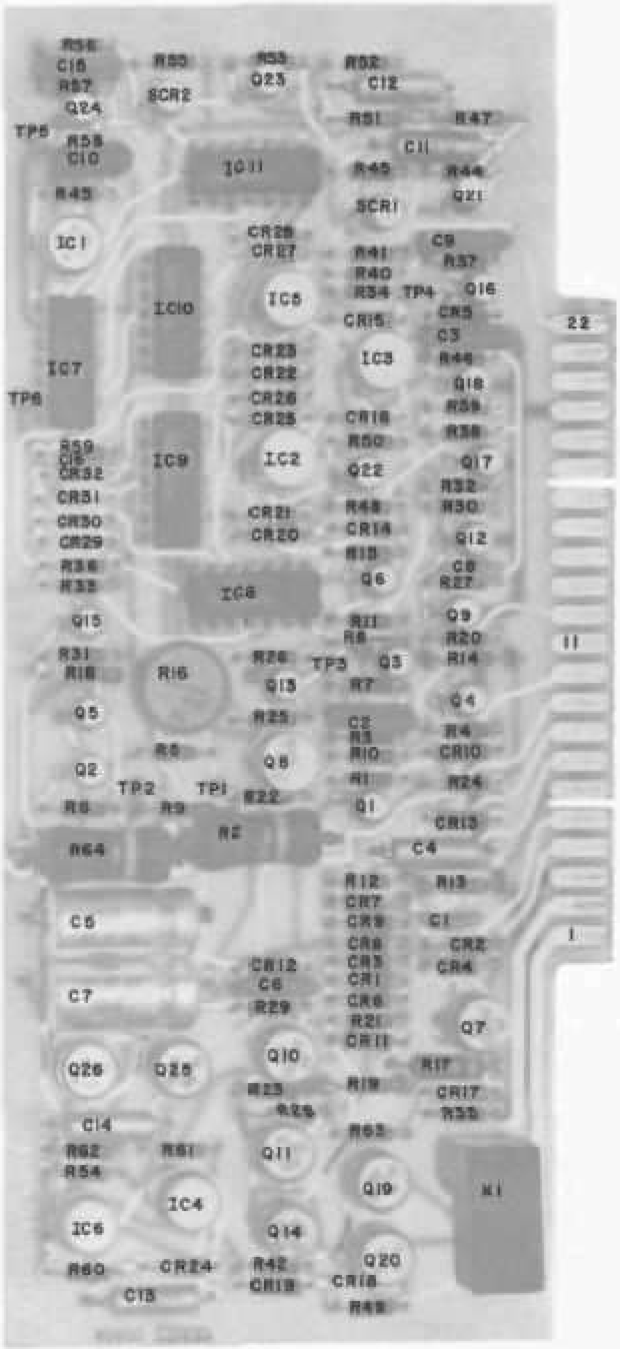
A1	A1A1
J1-3	C1-3, C15-49, CR1,2,27-43, IC1-6, L1-6, Q1-4,17-27, R1-26,52-94, R96-100
S1, 2	T1-4, TP1, Y1

Figure 8-9. Synthesizer Assembly A1 Phase Locked Oscillator Section

Figure 8-10

BATTERY CHARGER ASSEMBLY A2

OPTION 02

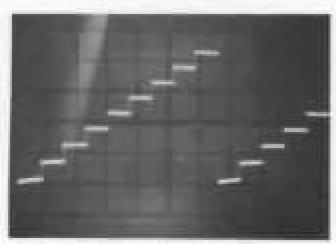


NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES.
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.
4. PROTECTIVE RELAY K1 OPENS IF BATTERY VOLTAGE DECREASES BELOW 21 VDC.

REFERENCE DESIGNATIONS

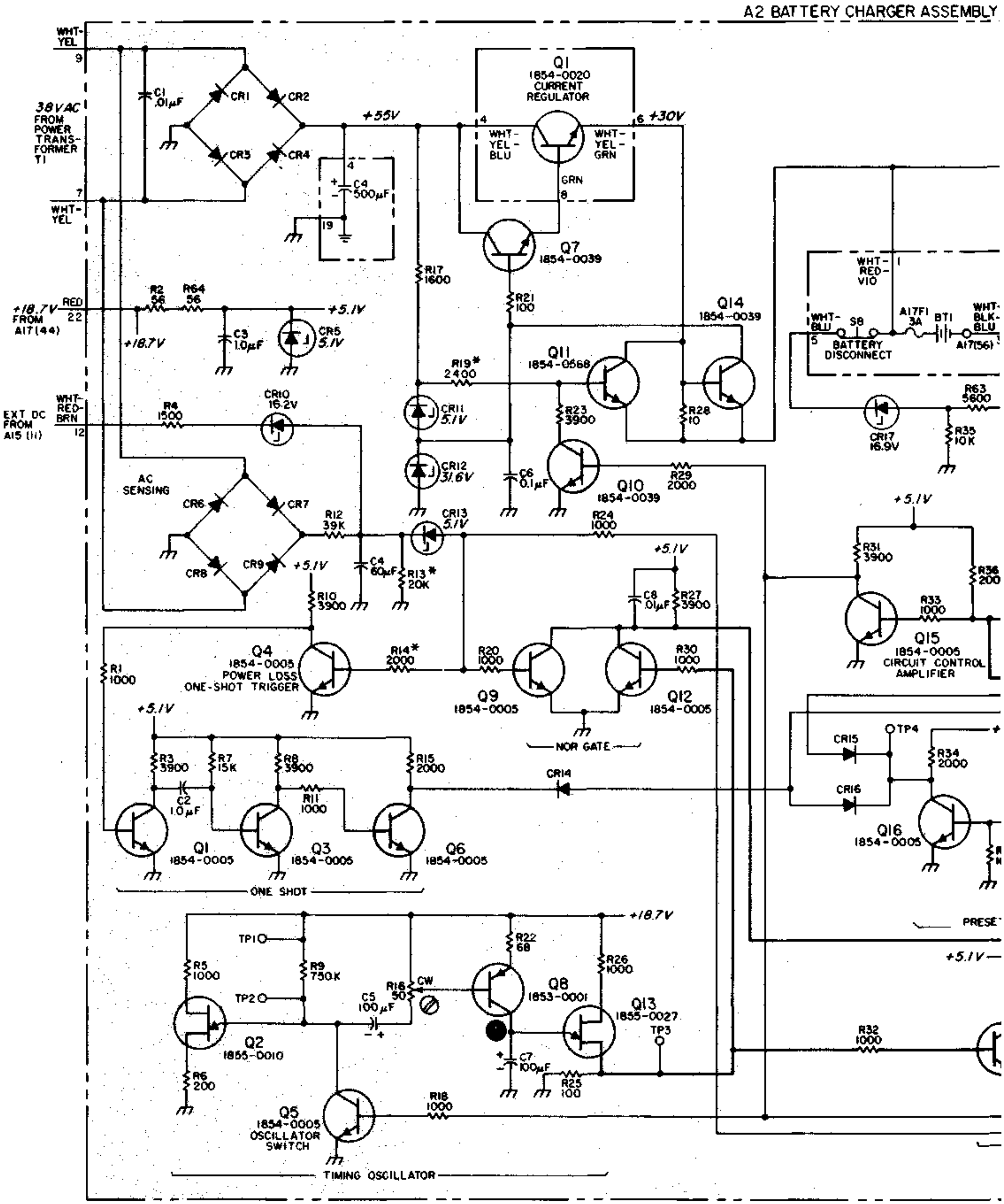
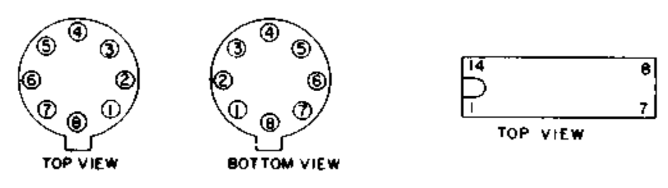
NO PREFIX	A2	A17
BT1		
C4	C1-15	
	CR1-32	
DS3		F1
	IC1-11	
	K1	
Q1	Q1-26	
	R1-64	
S8	SCR1,2	
	TP1-6	

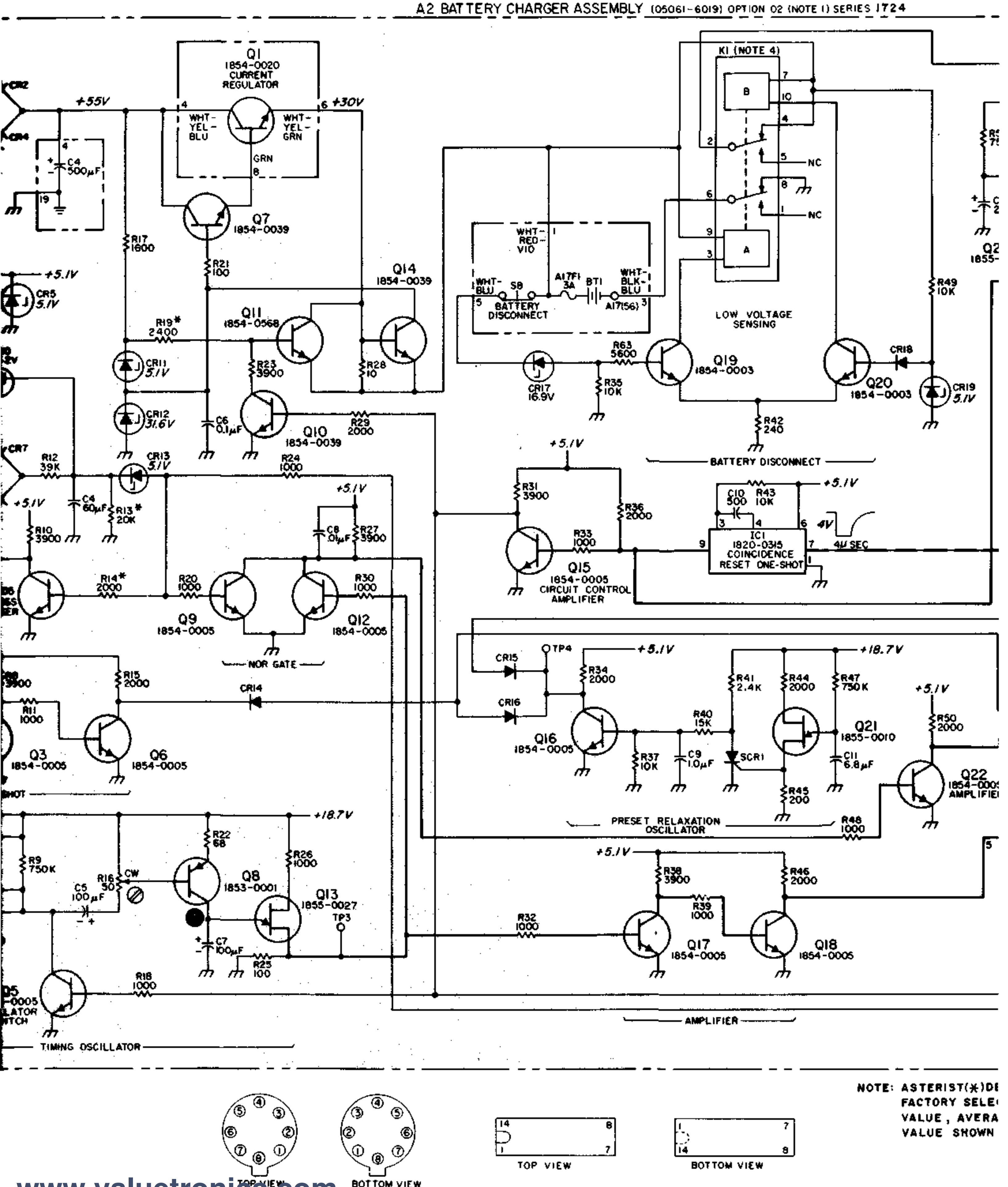


❶ 2V/cm, 2 sec/cm

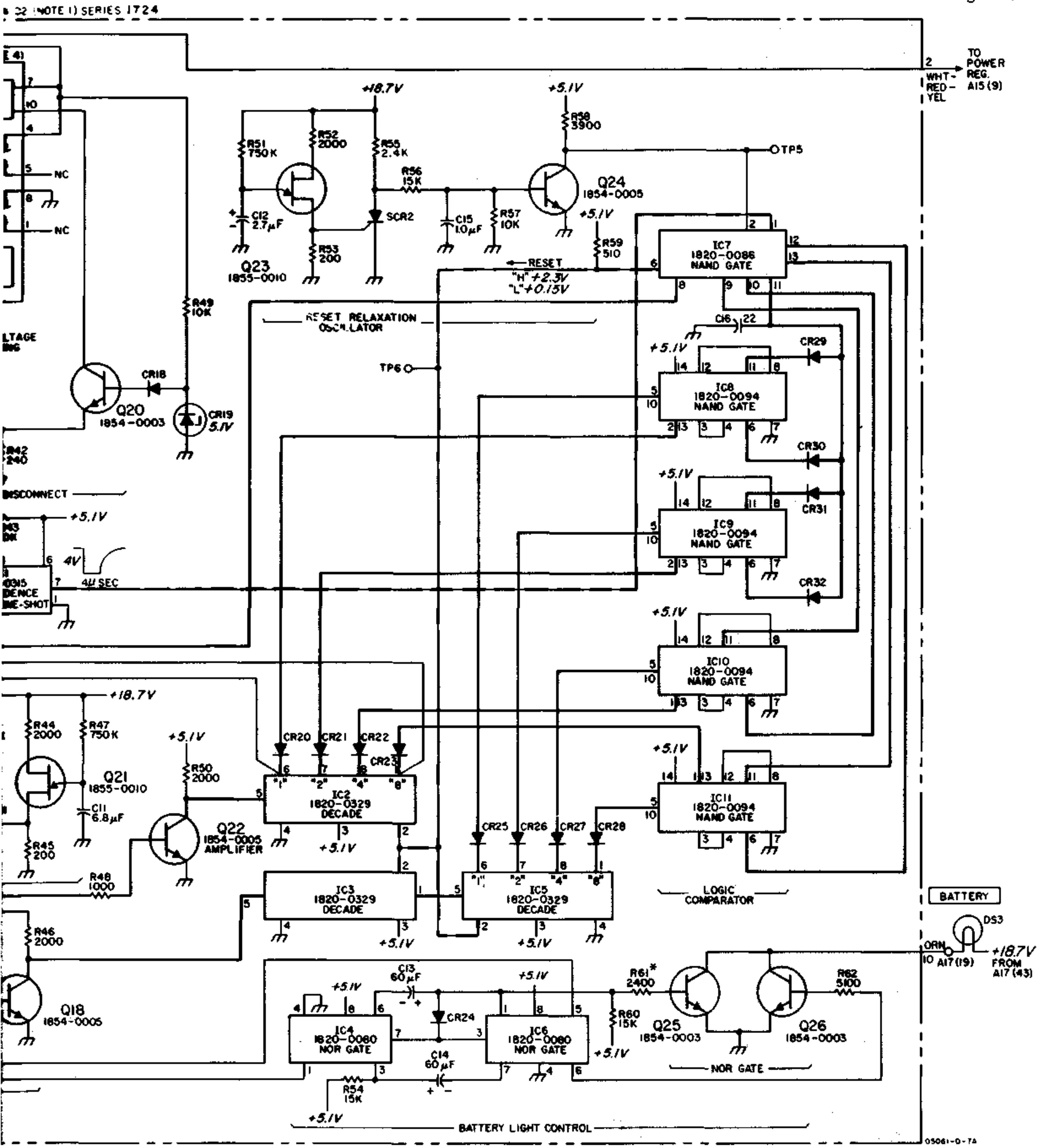
5061A: 15KΩ resistor connected between A2TP1 and A2TP2. External power disconnected BATTERY light on or flashing.

Oscilloscope: DC coupled


A2 BATTERY CHARGER ASSEMBLY
38VAC FROM POWER TRANSFORMER T1
WHT-YEL
+55V
+30V
Q1 1854-0020 CURRENT REGULATOR
WHT-YEL-BLU
WHT-YEL-GRN
GRN
Q7 1854-0039
+18.7V FROM A17(44)
+5.1V
EXT DC FROM A15 (H)
WHT-RED-BRN
AC SENSING
Q14 1854-0039
Q11 1854-0568
Q10 1854-0039
WHT-RED-VIO
S8 BATTERY DISCONNECT
A17F1 3A
BT1
A17(56)
CR17 16.9V
Q4 1854-0005 POWER LOSS ONE-SHOT TRIGGER
Q9 1854-0005
Q12 1854-0005
NOR GATE
Q15 1854-0005 CIRCUIT CONTROL AMPLIFIER
TP4
Q16 1854-0005
Q1 1854-0005
Q3 1854-0005
Q6 1854-0005
ONE SHOT
TP1
TP2
TP3
Q8 1853-0001
Q13 1855-0027
Q2 1855-0010
Q5 1854-0005 OSCILLATOR SWITCH
TIMING OSCILLATOR

TOP VIEW
BOTTOM VIEW
TOP VIEW



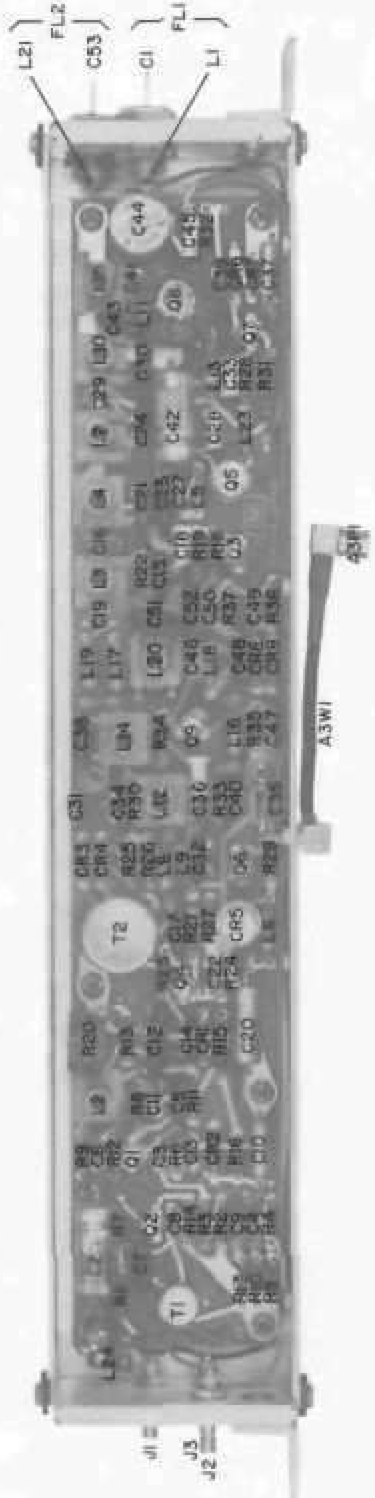
NOTE: ASTERIST(*)DE
FACTORY SELE
VALUE, AVERA
VALUE SHOWN

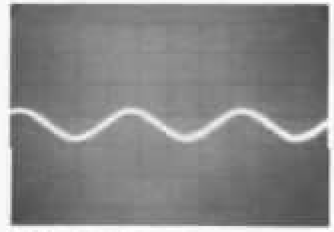


NOTE: ASTERIST(*)DENOTES FACTORY SELECTED VALUE, AVERAGE VALUE SHOWN.

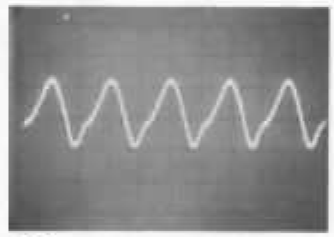
Figure 8-10. Battery Charger Assembly A2 Option 02

Figure 8-11
MULTIPLIER ASSEMBLY A3

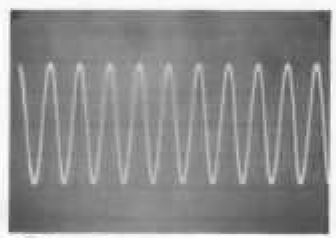




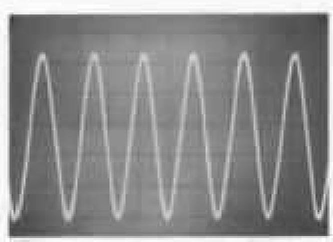
❶ 0.01V/cm, 2 ms/cm
Disconnect A3P5



❷ 0.05V/cm, 0.1 μs/cm



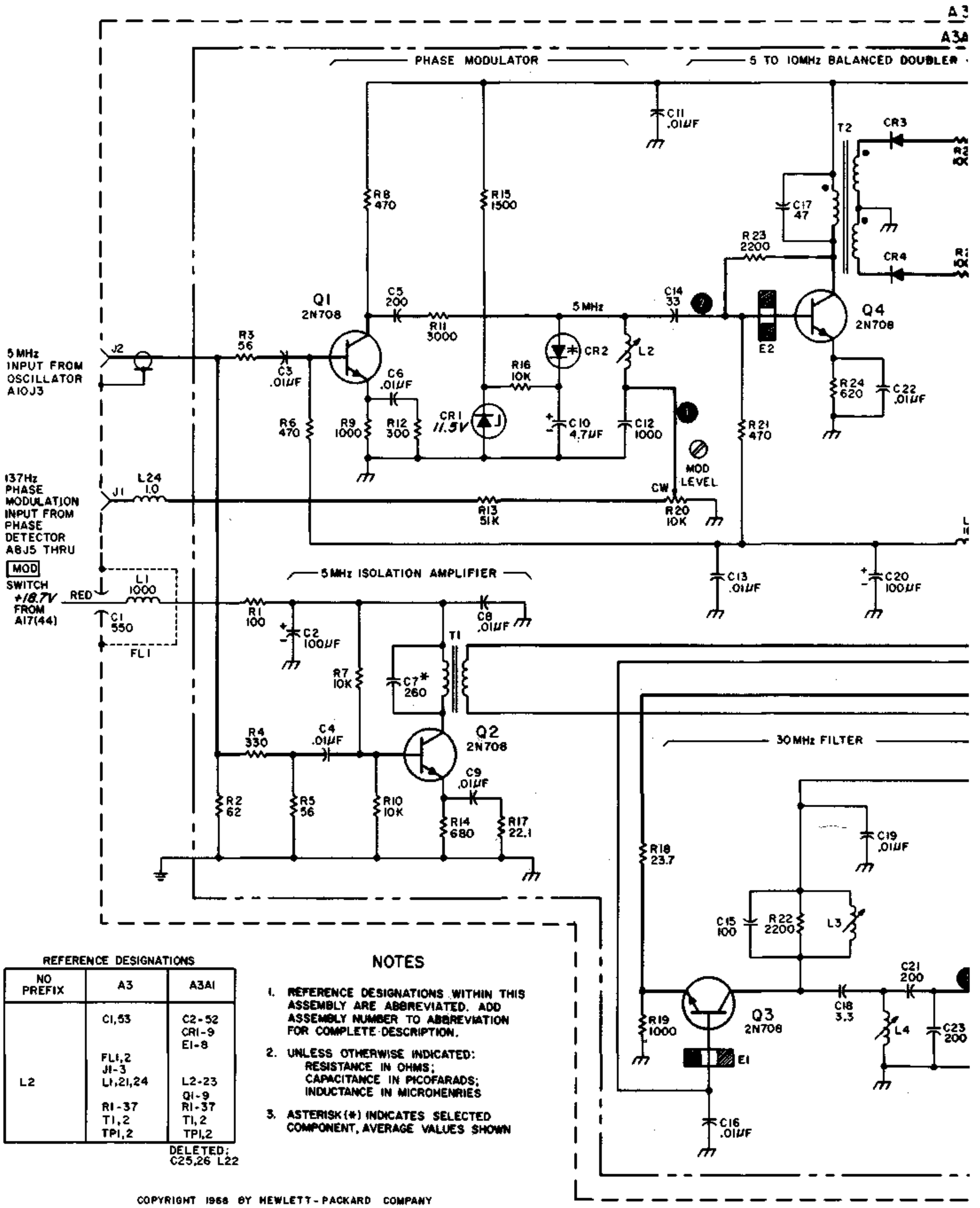
❸ 2V/cm, 0.1 μs/cm



❹ 1V/cm, 0.01 μs/cm

5061A. Normal operation unless noted.

Oscilloscope: DC coupled.



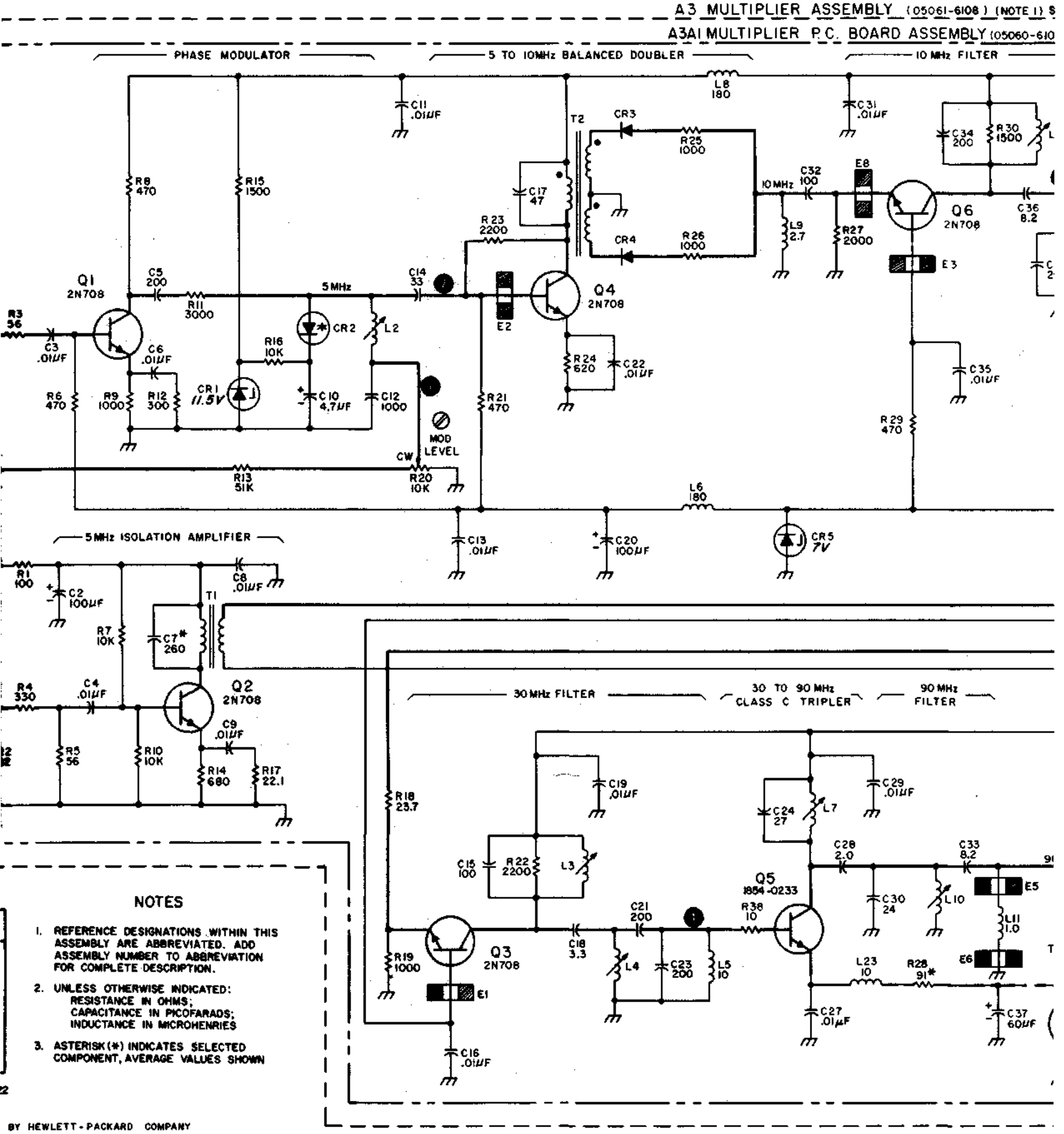
REFERENCE DESIGNATIONS

NO PREFIX	A3	A3A1
	C1,53	C2-52
		CR1-9
		E1-8
	FL1,2	
	J1-3	
L2	L1,21,24	L2-23
		Q1-9
	R1-37	R1-37
	T1,2	T1,2
	TP1,2	TP1,2

DELETED: C25,26 L22

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

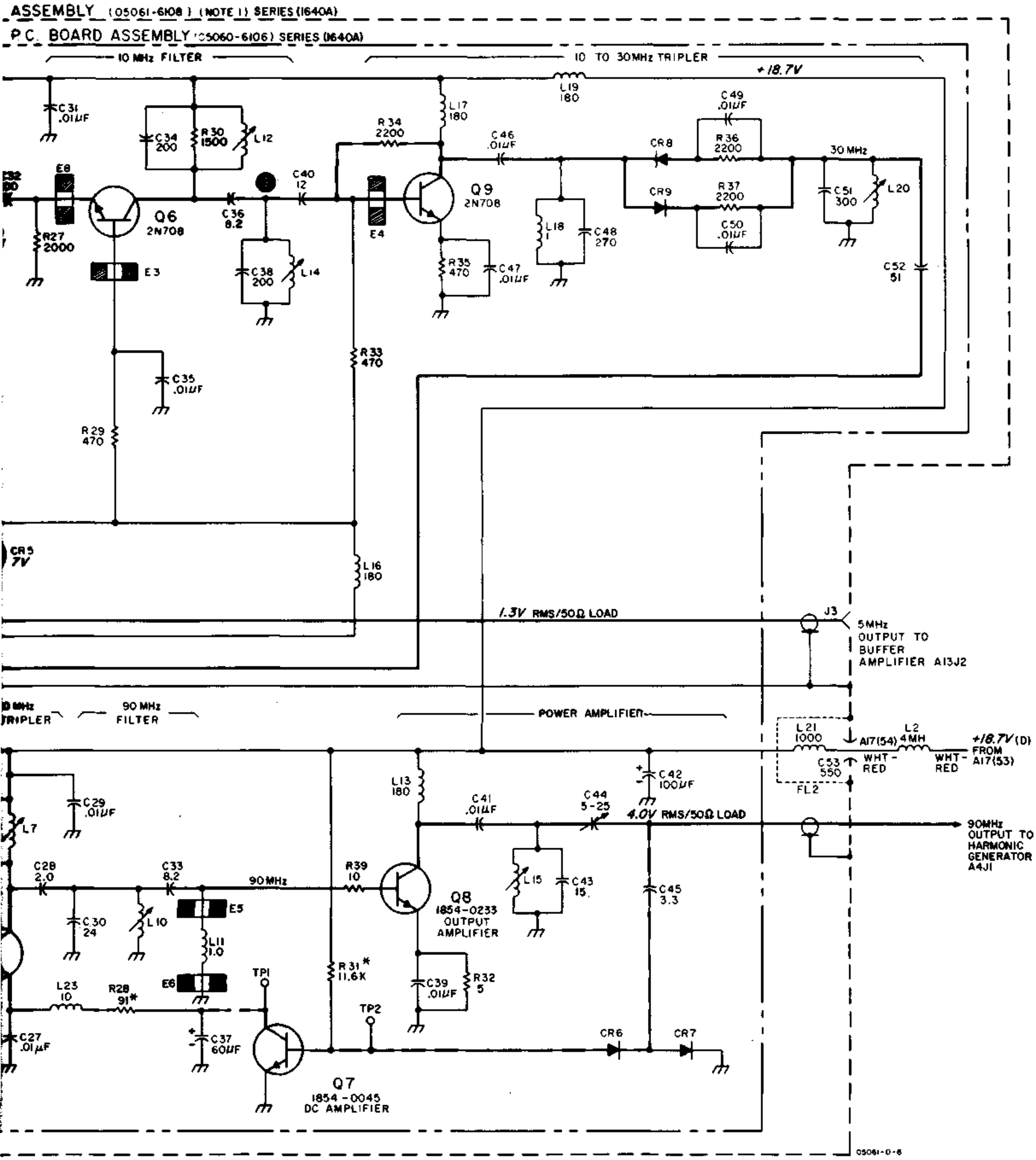
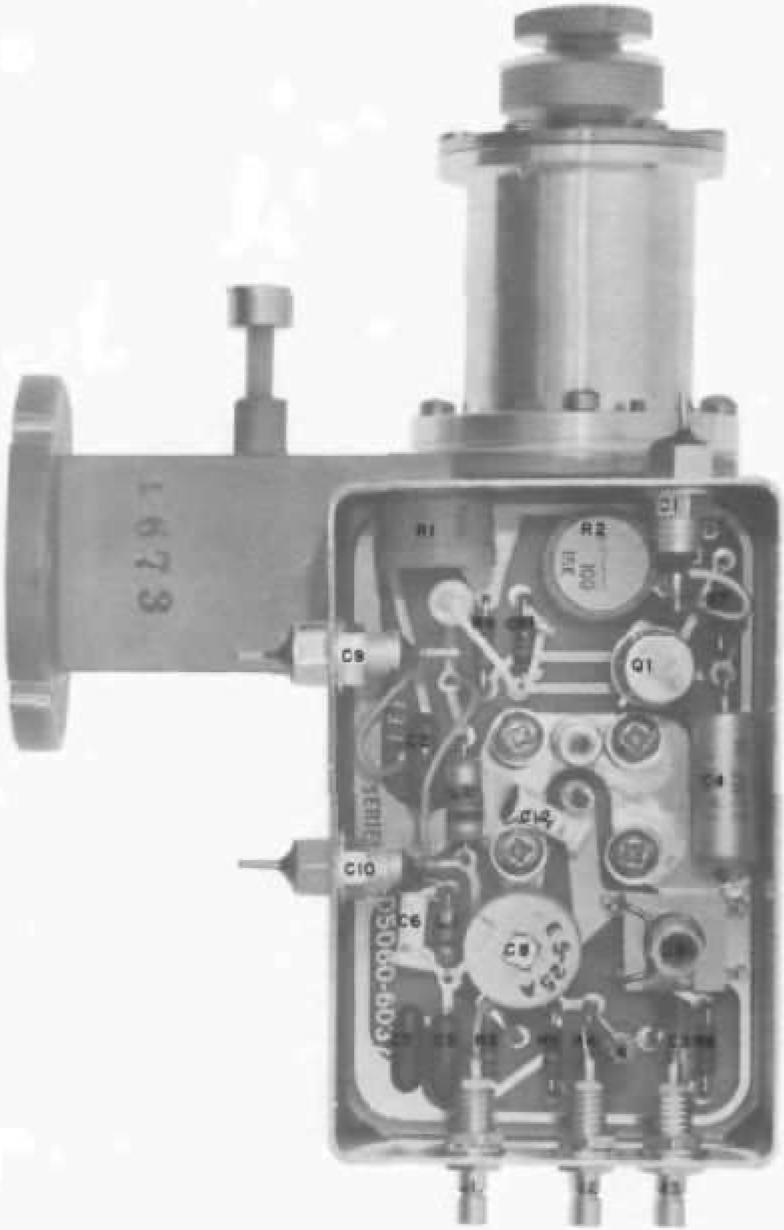
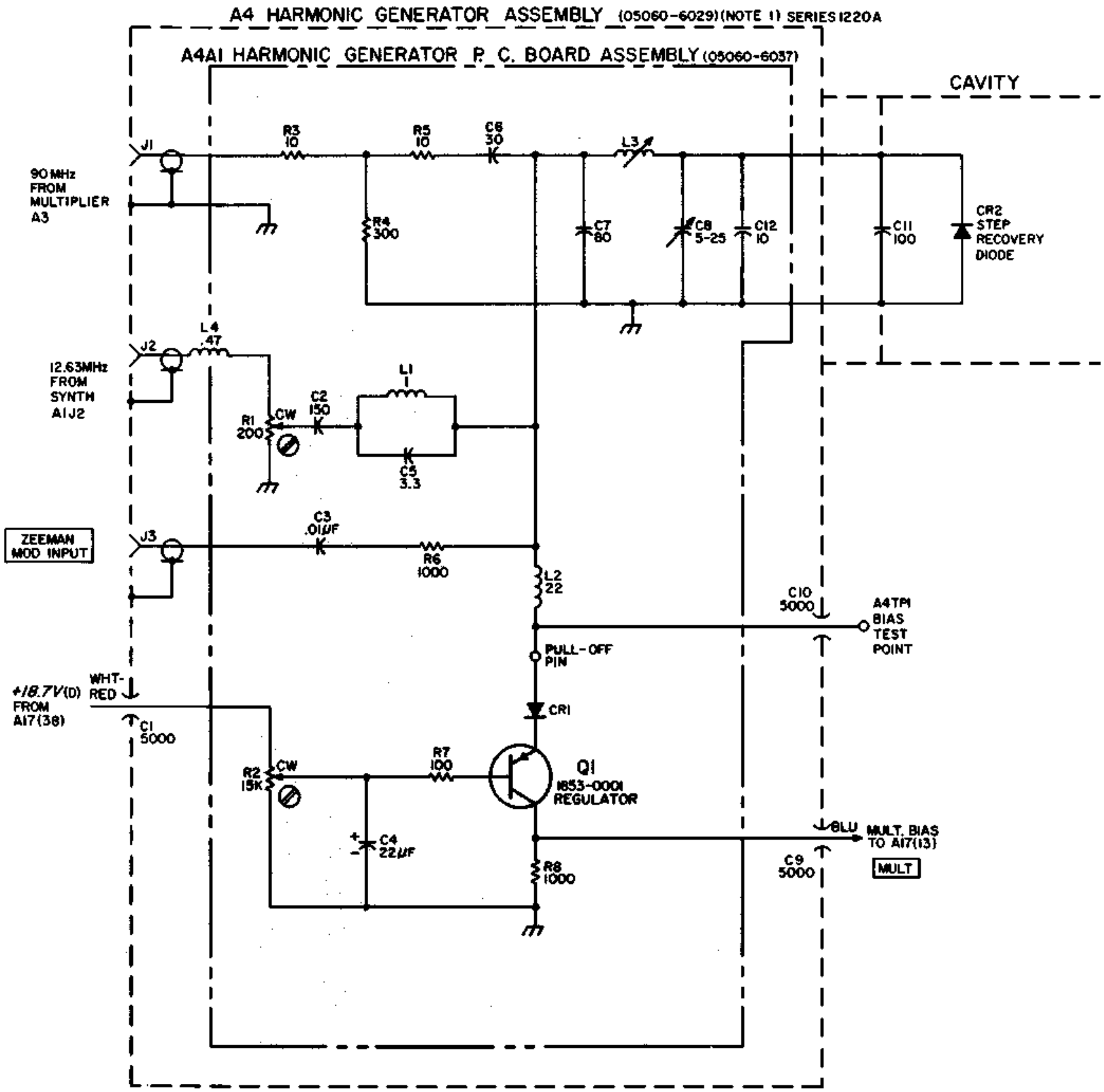
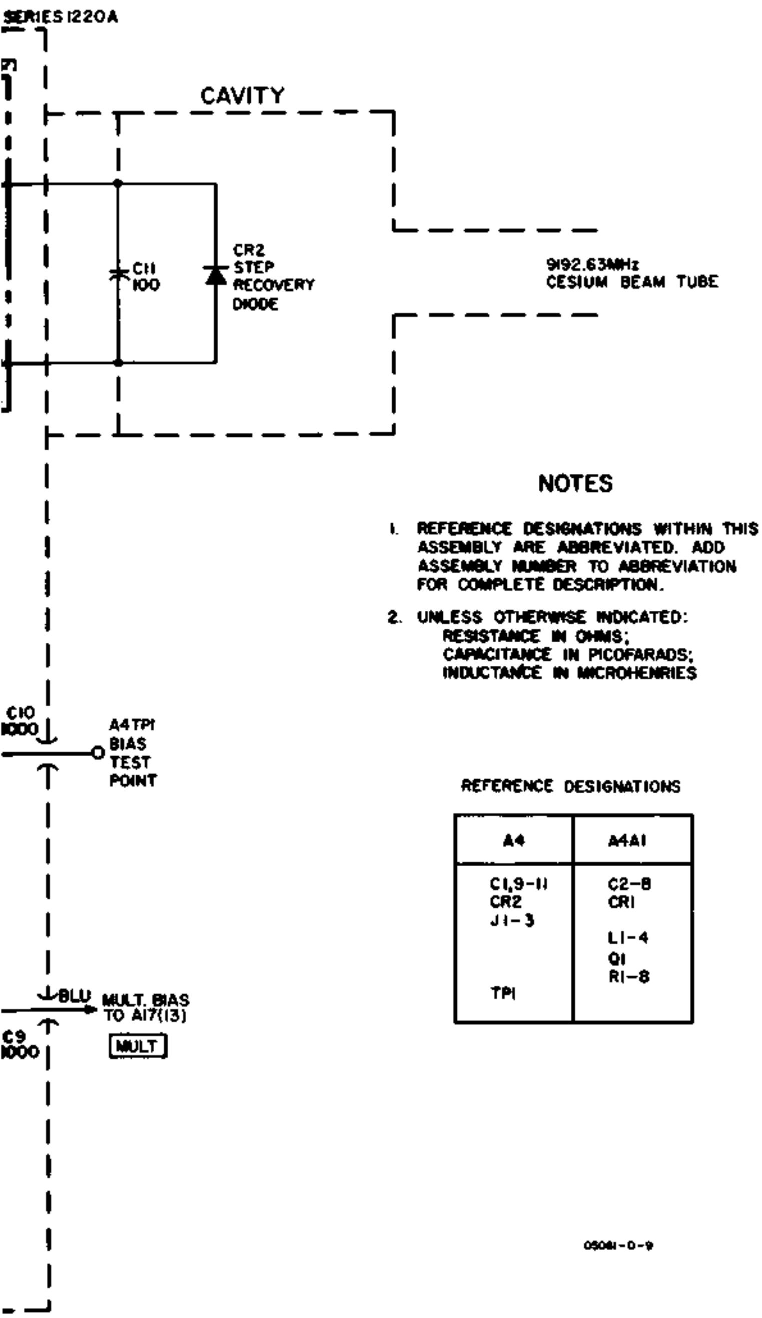


Figure 8-11. Multiplier Assembly A3

Figure 8-12
HARMONIC GENERATOR ASSEMBLY A4


R1
R2
C1
C9
Q1
C4
C10
C6
C8


A4 HARMONIC GENERATOR ASSEMBLY (05060-6029) (NOTE 1) SERIES 1220A
A4A1 HARMONIC GENERATOR P. C. BOARD ASSEMBLY (05060-6037)
CAVITY
J1
90 MHz FROM MULTIPLIER A3
R3 10
R5 10
C6 30
L3
R4 300
C7 80
C8 5-25
C12 10
C11 100
CR2 STEP RECOVERY DIODE
J2
12.63MHz FROM SYNTH A1J2
L4 .47
L1
C2 150
R1 200
CW
C5 3.3
ZEEMAN MOD INPUT
J3
C3 .01μF
R6 1000
L2 22
C10 5000
A4TP1 BIAS TEST POINT
PULL-OFF PIN
+18.7V(D) FROM A17(38)
WHT-RED
C1 5000
CR1
R2 15K
R7 100
Q1 1853-0001 REGULATOR
C4 22μF
R8 1000
BLU
C9 5000
MULT. BIAS TO A17(13)
MULT



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES

REFERENCE DESIGNATIONS

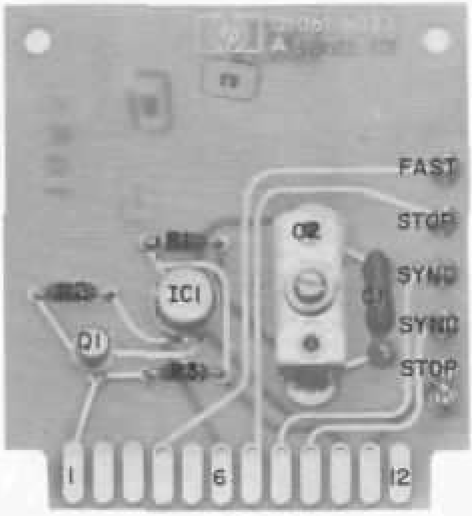
A4	A4A1
C1,9-11 CR2 J1-3 TP1	C2-8 CR1 L1-4 Q1 R1-8

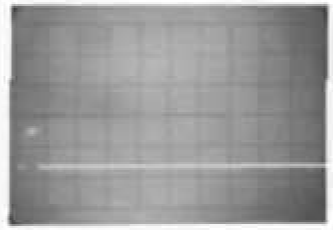
05061-0-9

Figure 8-12. Harmonic Generator Assembly A4

Figure 8-13

DIGITAL DIVIDER ASSEMBLY A5 (OPTION 01)
SWITCH CIRCUIT BOARD ASSEMBLY A5A4
INTERCONNECTION BOARD A5A5

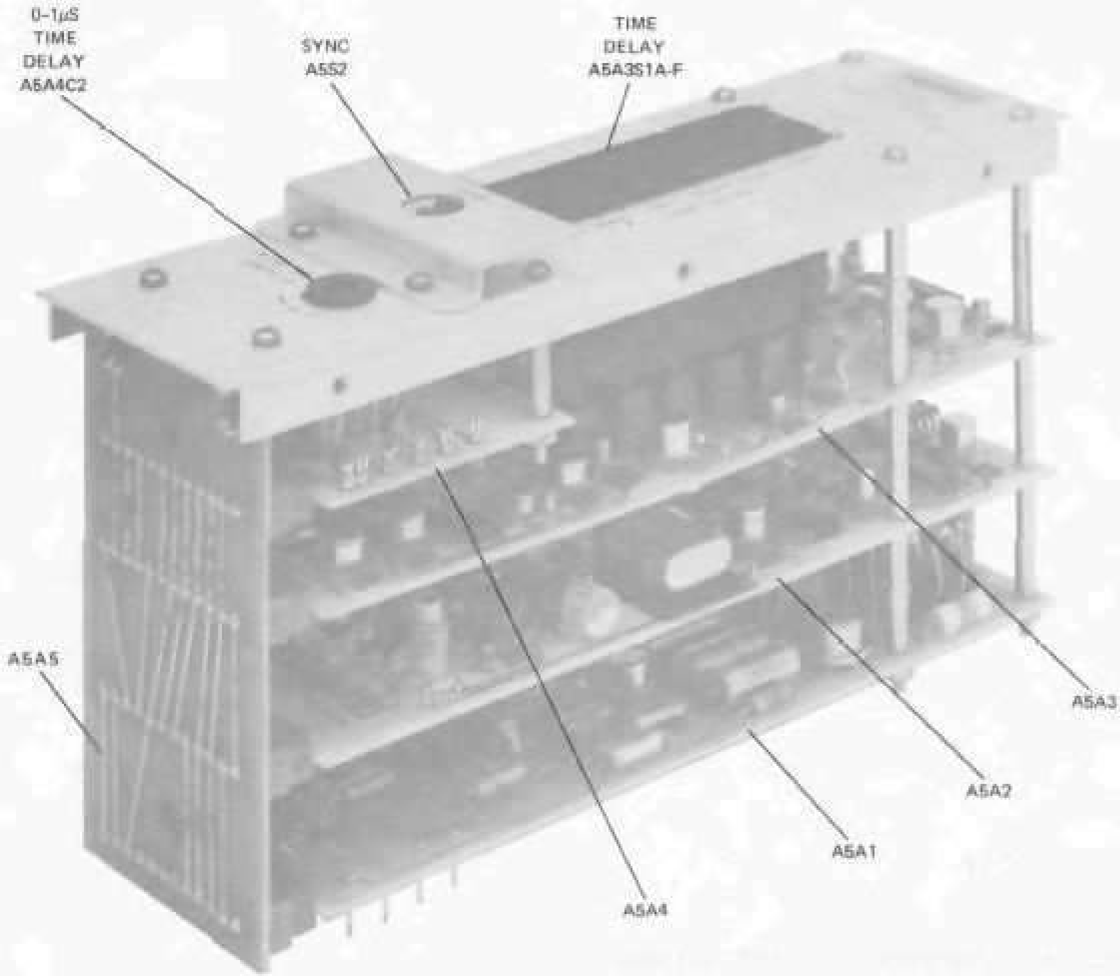


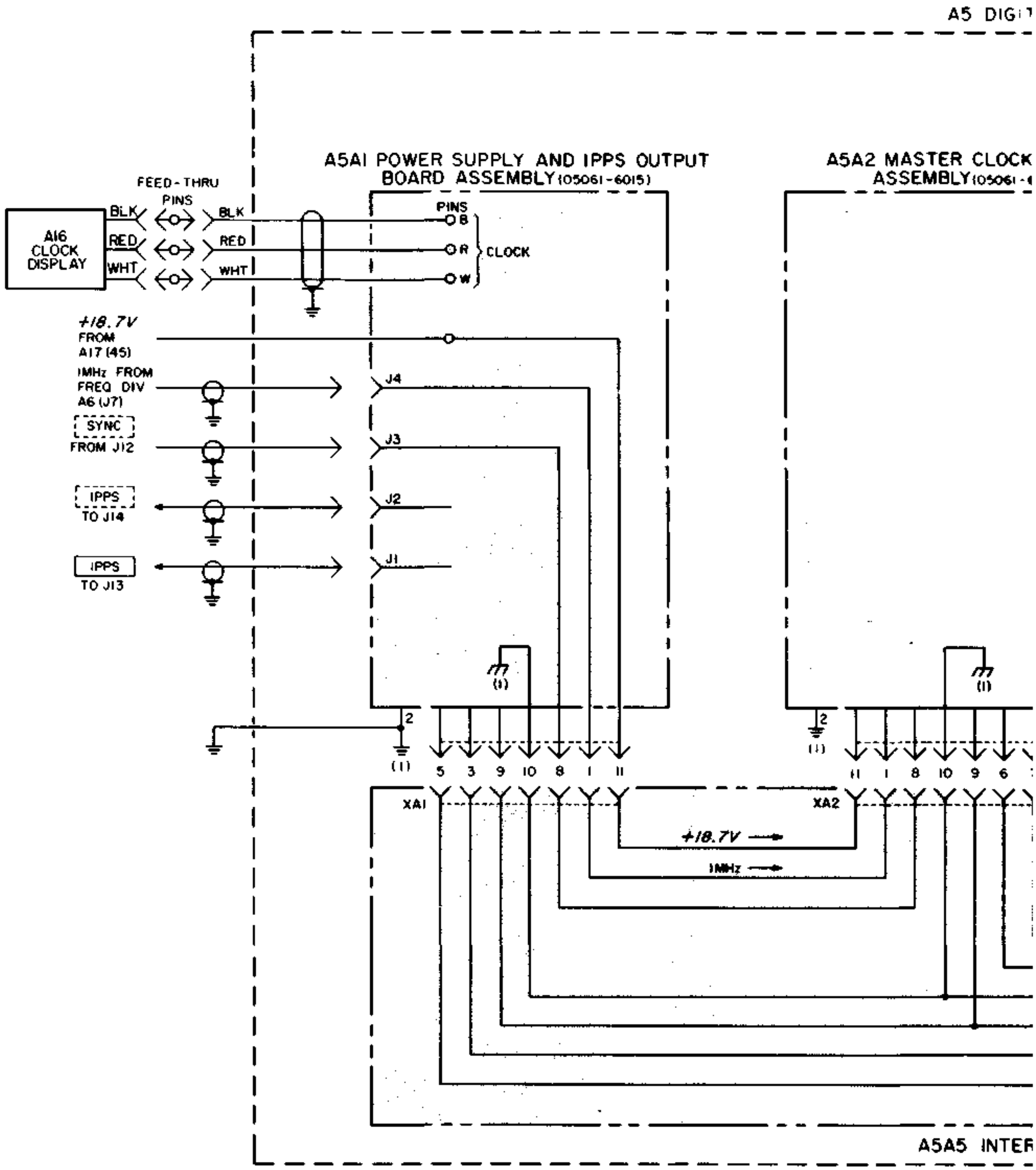


15 2V/cm, 0.5 μs/cm

Oscilloscope: DC coupled

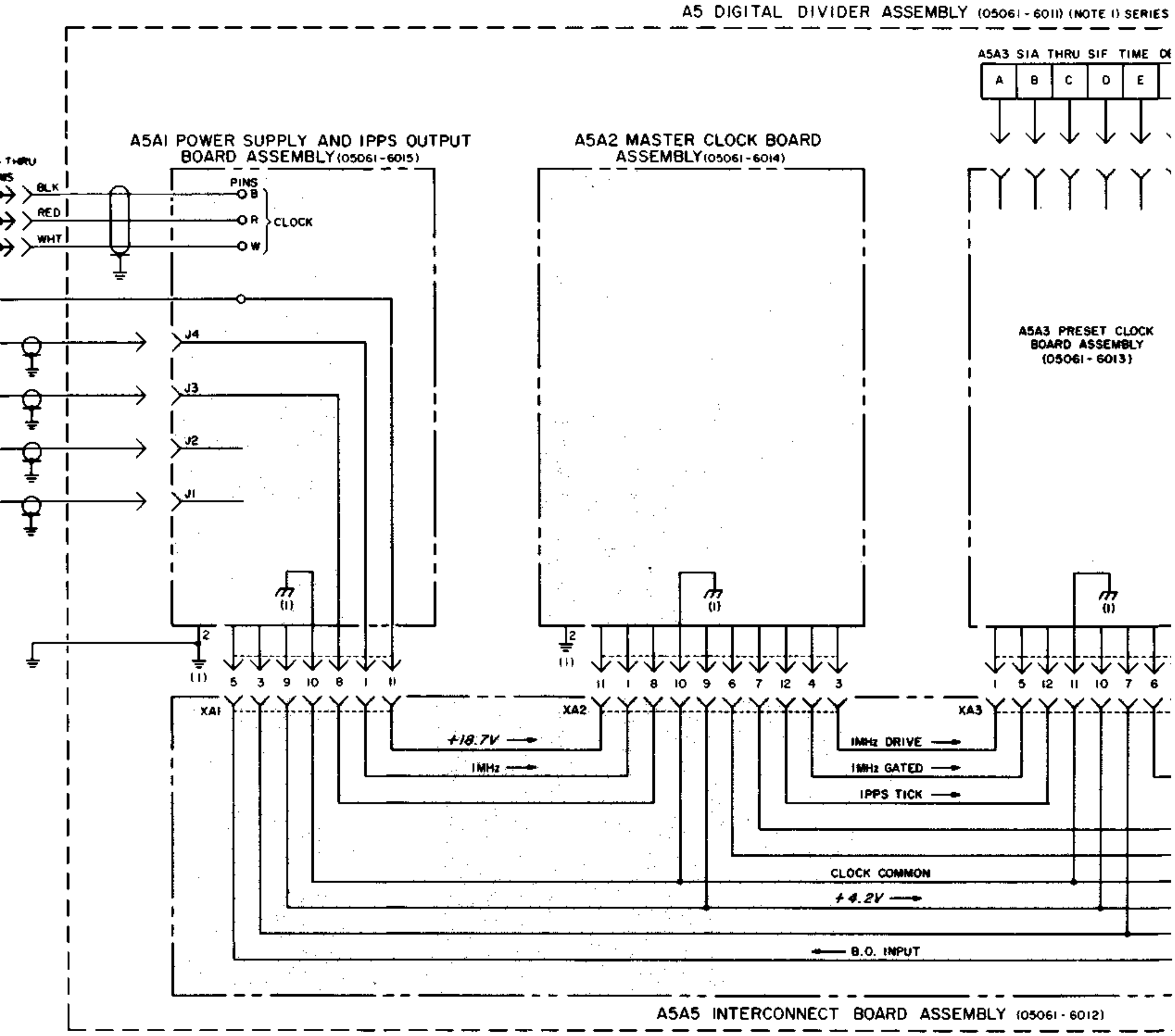
5061A: Divider running, TIME DELAY set to 000000.





NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS,
   CAPACITANCE IN PICOFARADS;
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.

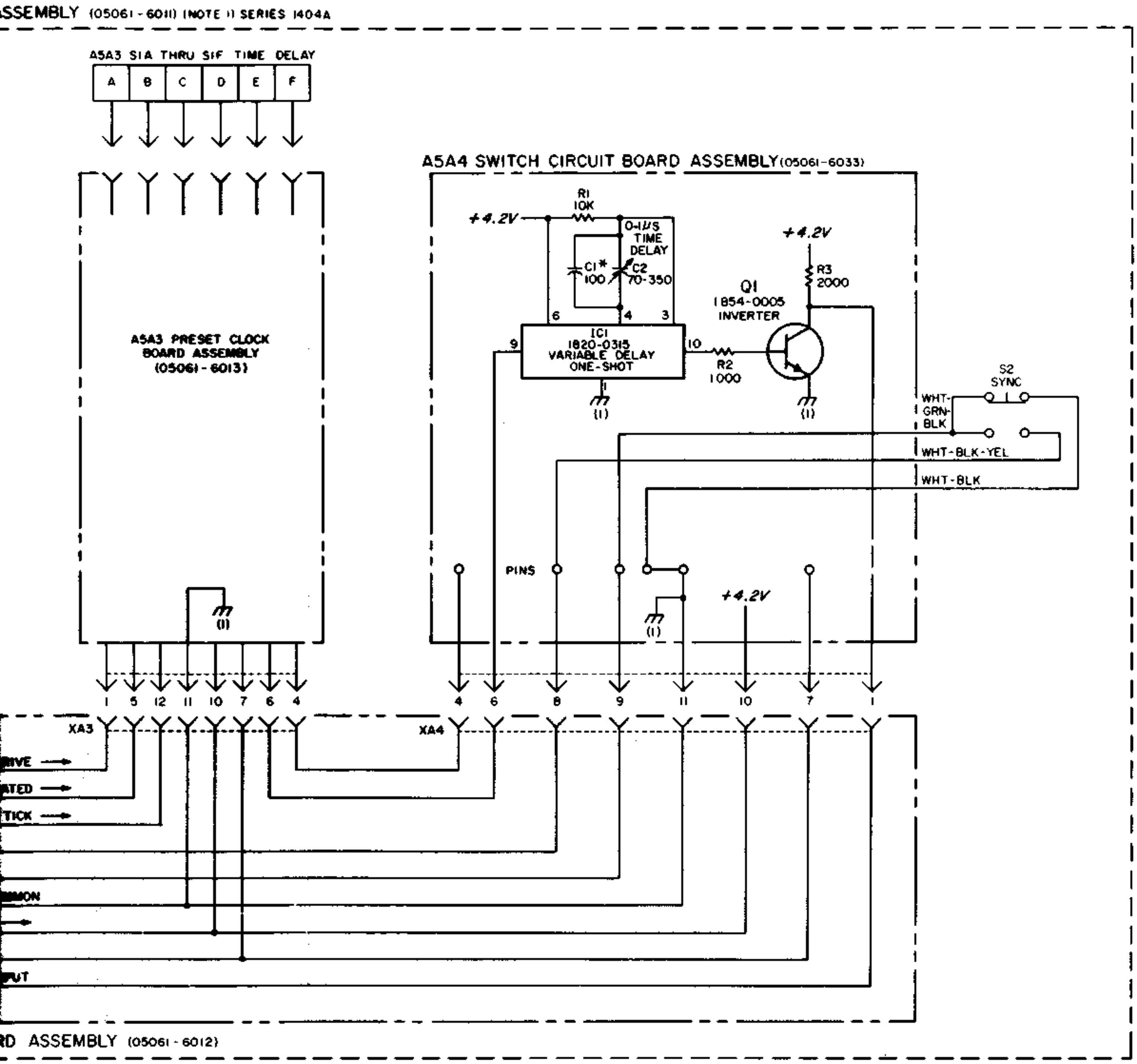


NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS,
   CAPACITANCE IN PICOFARADS,
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A5A4
B1 S1-3	C1, 2 IC1 Q1 R1-3



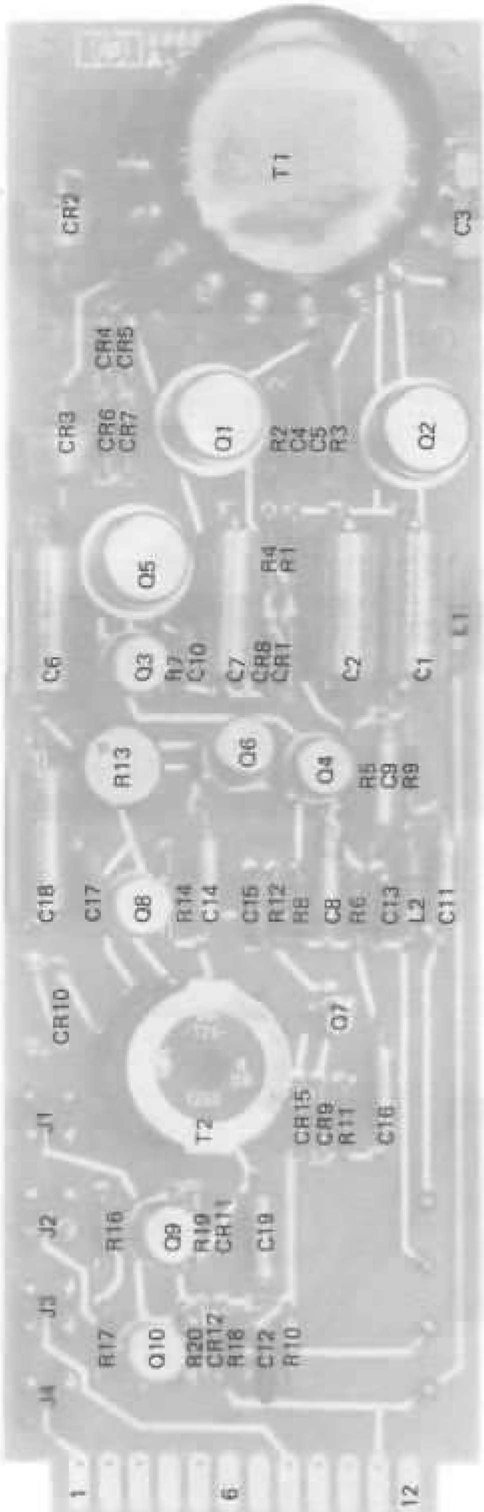
REFERENCE DESIGNATIONS

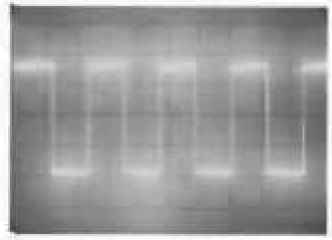
NO PREFIX	A5A4
B1 S1-3	C1, 2 IC1 Q1 R1-3

Figure 8-13. Digital Divider Assembly A5 (Option 01)
Switch Circuit Board Assembly A5A4
Interconnection Board A5A5

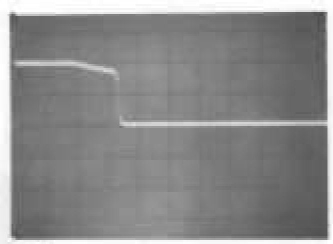
Figure 8-14

DIGITAL DIVIDER ASSEMBLY A5 (OPTION 01)
POWER SUPPLY AND 1 PPS OUTPUT BOARD A5A1

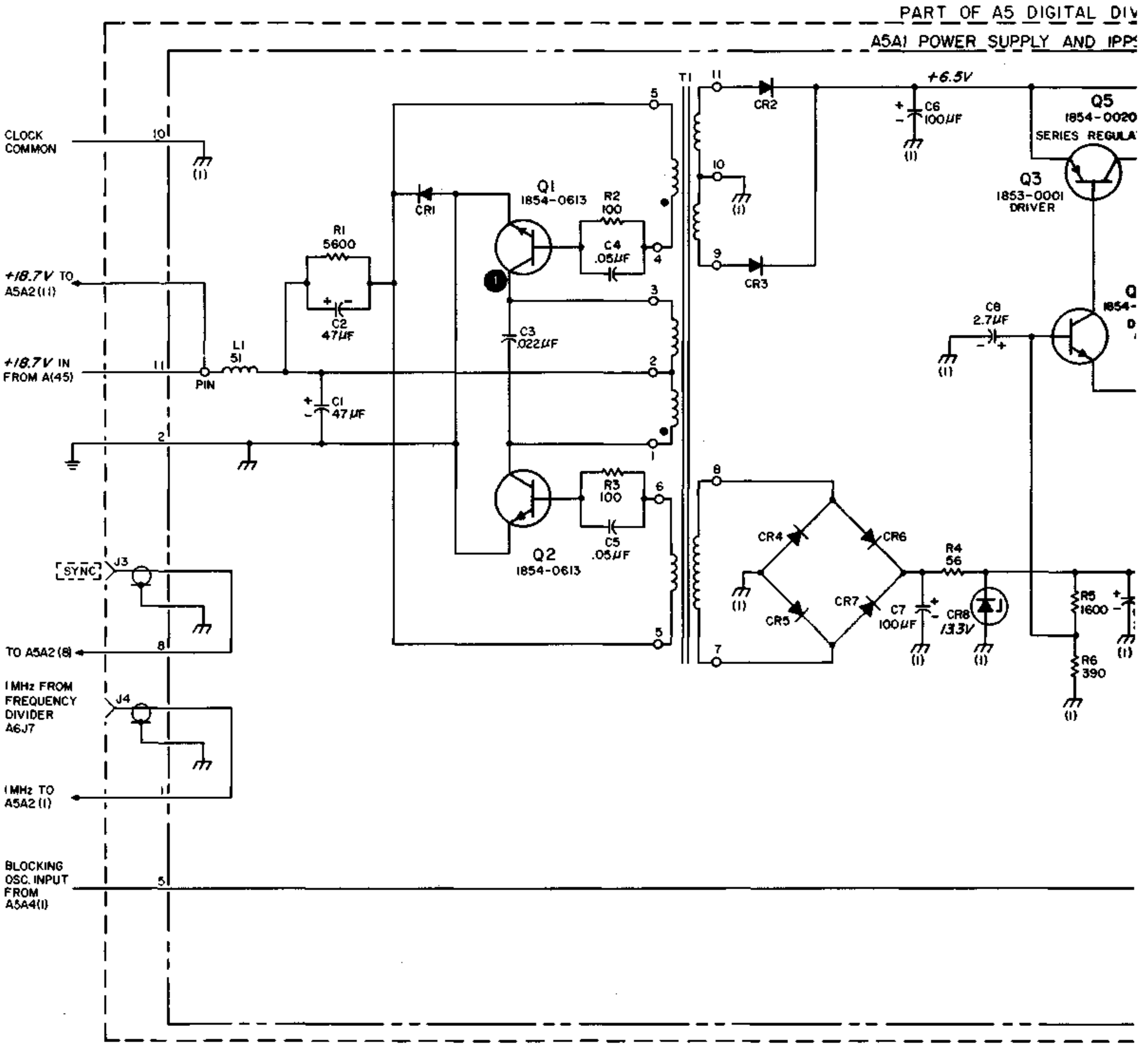




1 10V/cm, 0.2 ms/cm

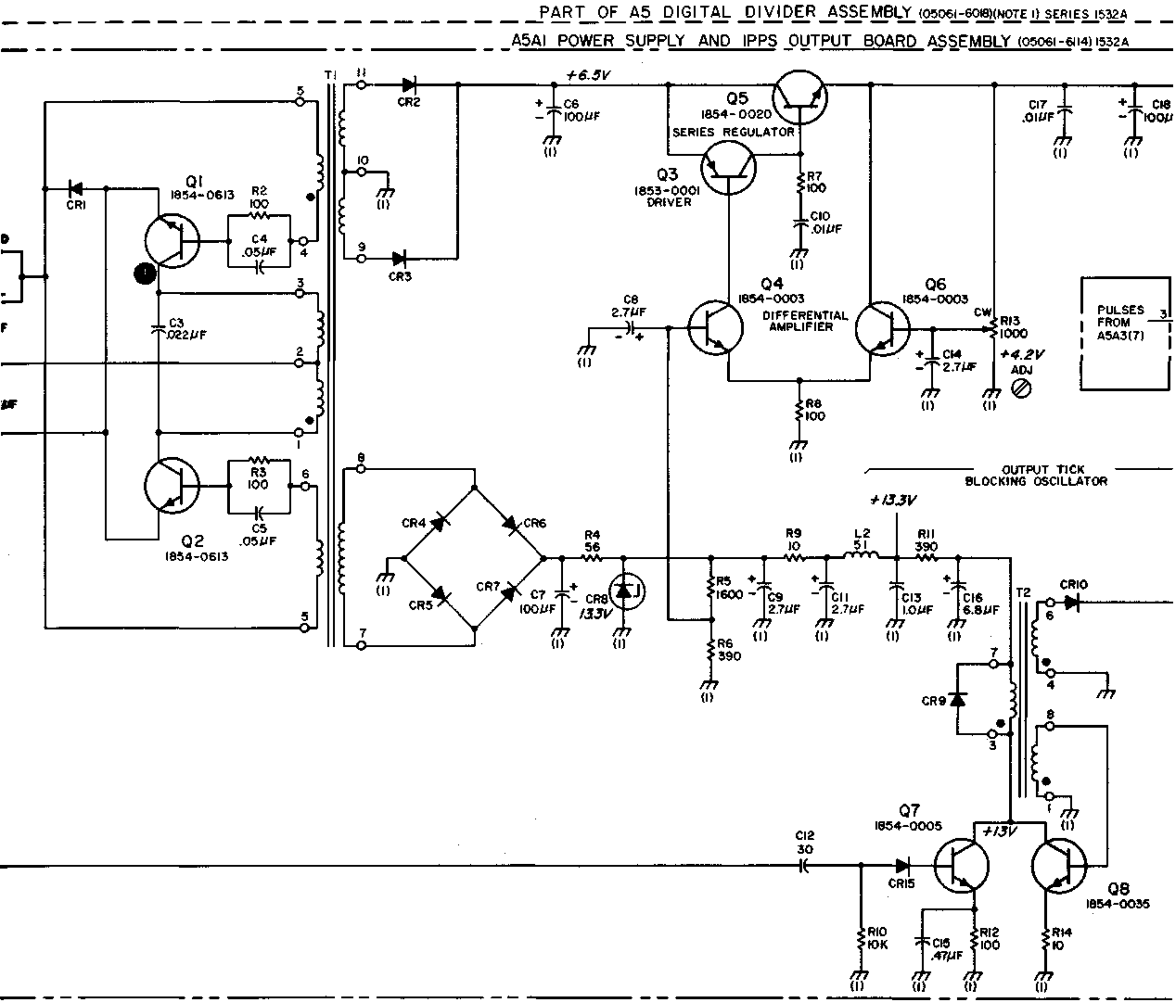


2 5V/cm, 10 μs/cm
use 50Ω Feedthru



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN



S WITHIN THIS
ATED. ADD
BBREVIATION
ION.

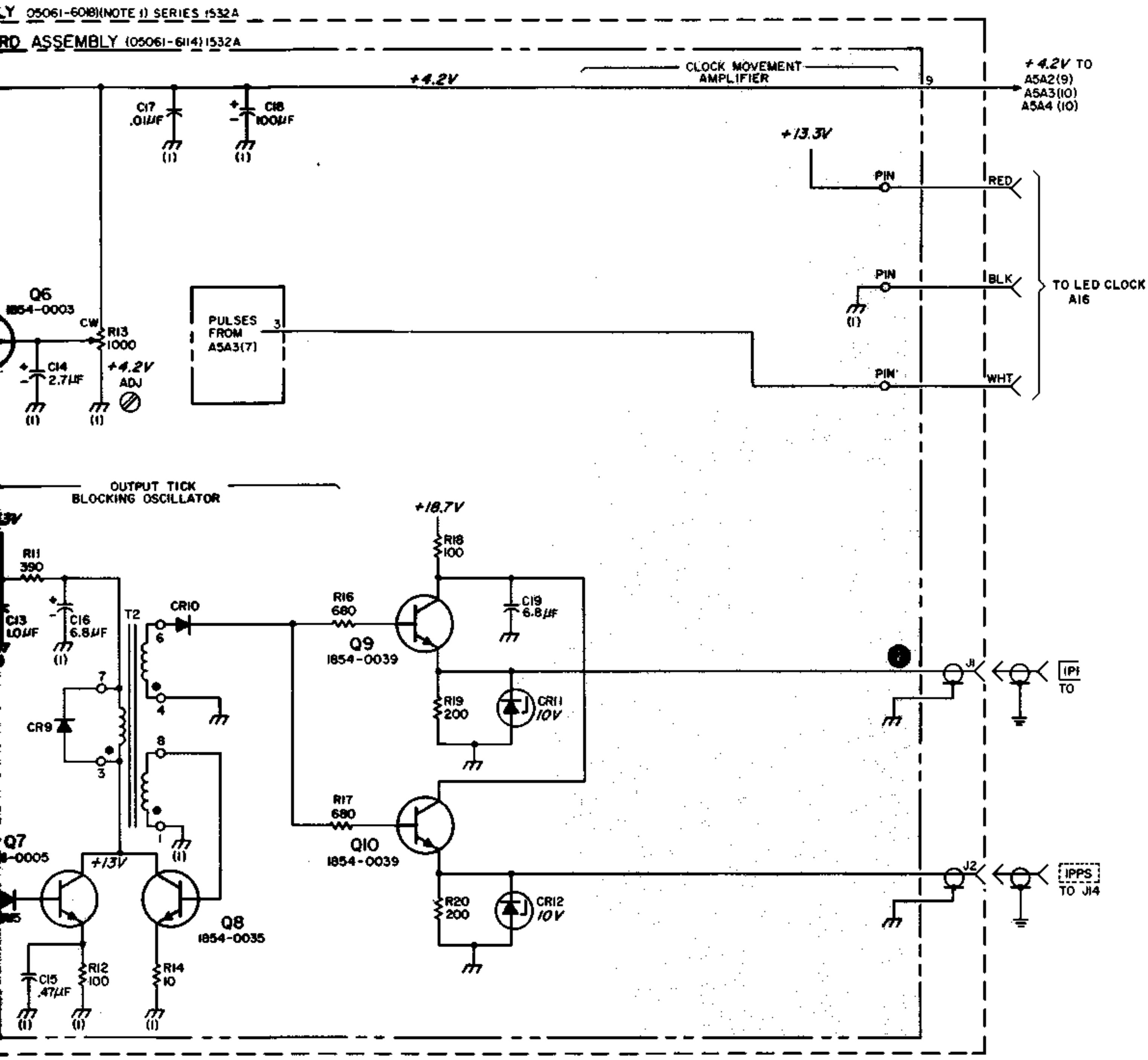
CATED:

ARADS;
ENRIES

SELECTED
LUES SHOWN

REFERENCE DESIGNATIONS

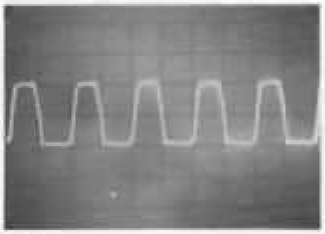
A5	A5A1
J1-4	C1-19 CR1-12,15 L1,2 Q1-10 R1-20 T1,2



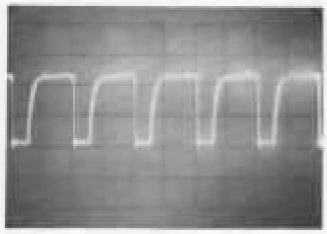
REFERENCE DESIGNATIONS

A5	A5A1
J1-4	C1-19 CR1-12,15 L1,2 Q1-10 R1-20 T1,2

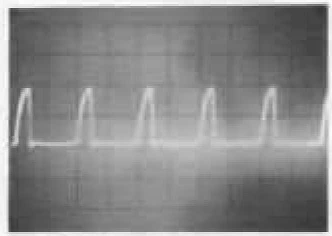
Figure 8-14. Digital Divider Assembly A5 (Option 01) Power Supply and 1 PPS Output Board Assembly A5A1



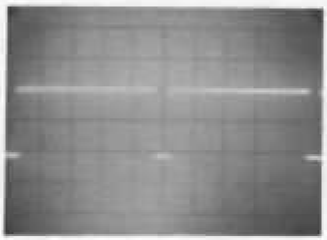
4 1V/cm, 0.5 μs/cm



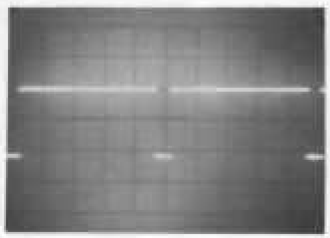
5 2V/cm, 0.5 μs/cm



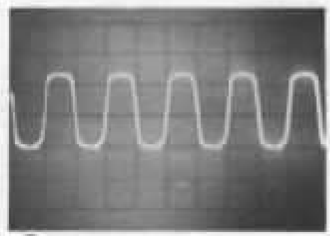
6 2V/cm, 0.5 μs/cm



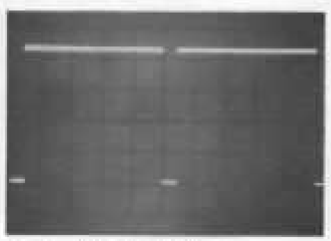
7 2V/cm, 0.2 ms/cm



8 2V/cm, 2 ms/cm



9 0.5V/cm, 0.5 μs/cm



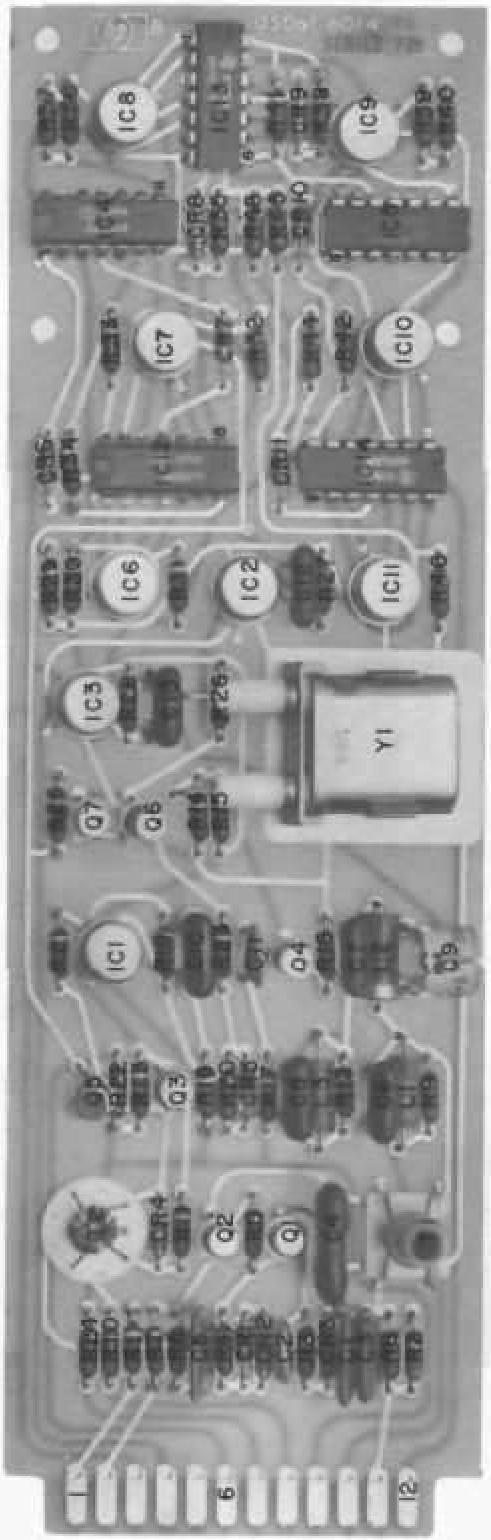
19 1V/cm, 0.2 s/cm

Oscilloscope: DC coupled.

5061A: Divider running TIME DELAY thumbwheel switch set to 000000.

Figure 8-15

DIGITAL DIVIDER ASSEMBLY A5 (OPTION 01)
MASTER CLOCK BOARD ASSEMBLY A5A2



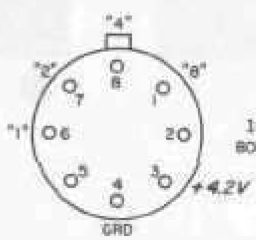
NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

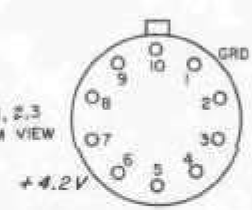
A5	A5A2
S2	C1-13 *CR1-11 IC1-14 L1-3 Q1-7 R1-46 T1,2 Y1

BOTTOM VIEW
IC4,5,12,13,14



IC6, 7, 8, 9, 10, 11
BOTTOM VIEW

IC1, 2, 3
BOTTOM VIEW



05061-D-12

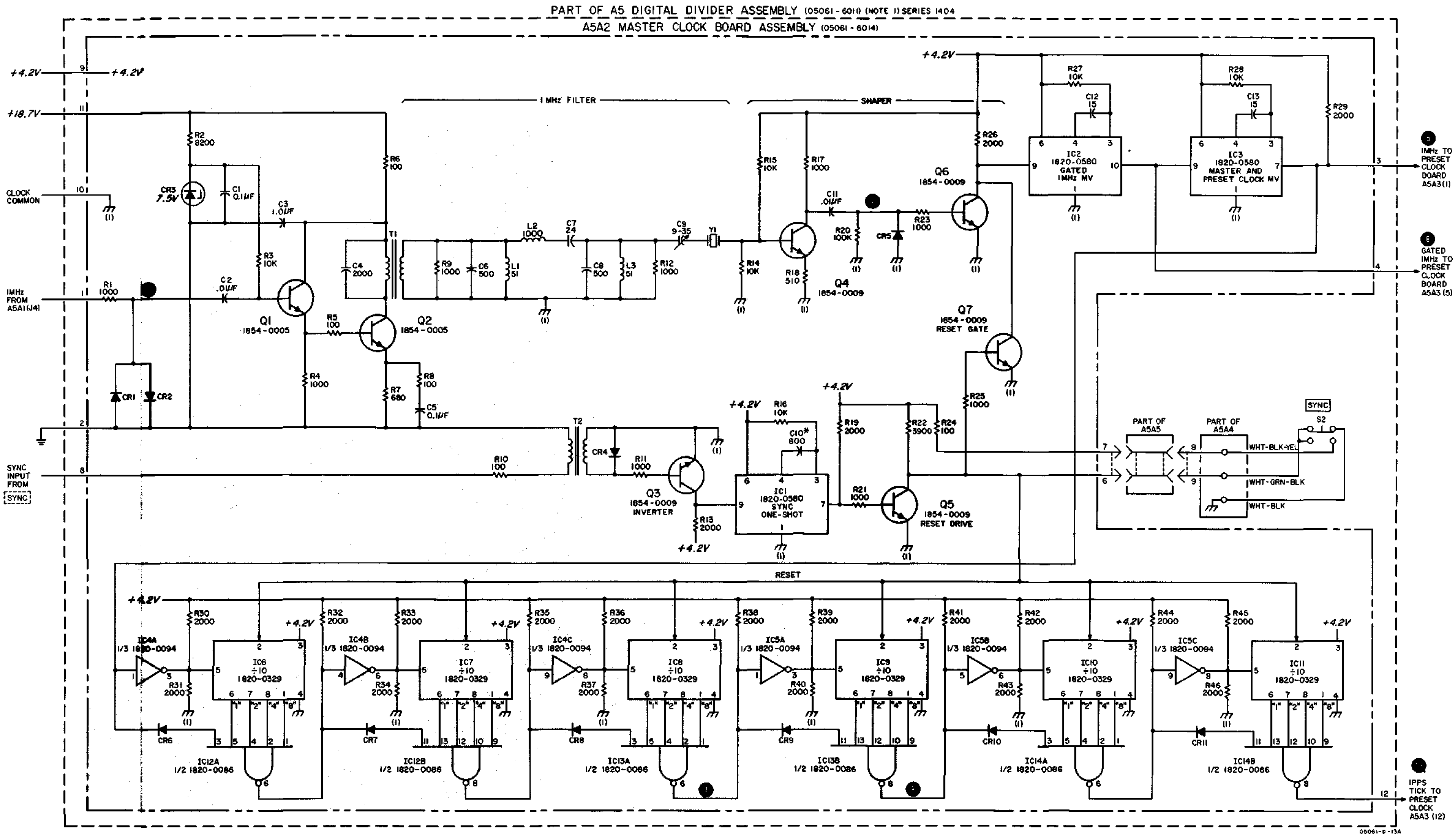
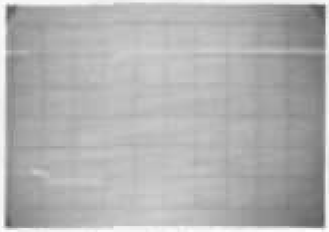
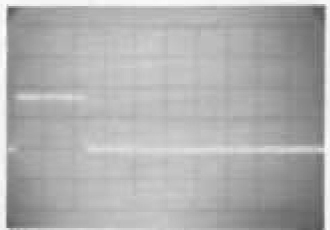


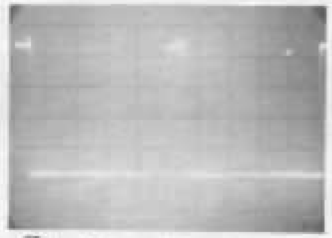
Figure 8-15. Digital Divider Assembly A5 (Option 01)
Master Clock Board Assembly A5A2



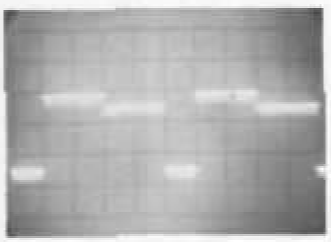
10 1V/cm, 0.2 μs/cm



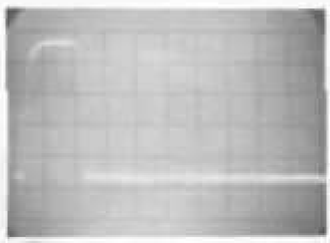
11 1V/cm, 0.5 μs/cm



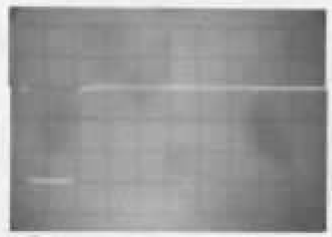
12 1V/cm, 20 μs/cm



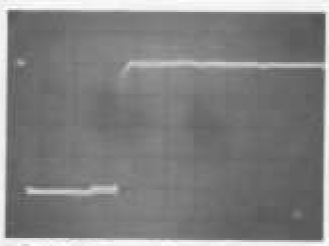
13 0.5V/cm, 0.2 ms/cm



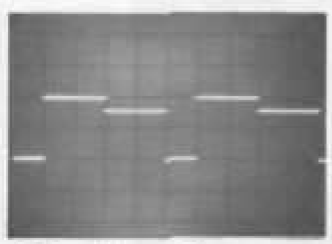
14 1V/cm, 0.5 μs/cm



15 1V/cm, 0.5 μs/cr.



16 1V/cm, 0.5 μs/cm

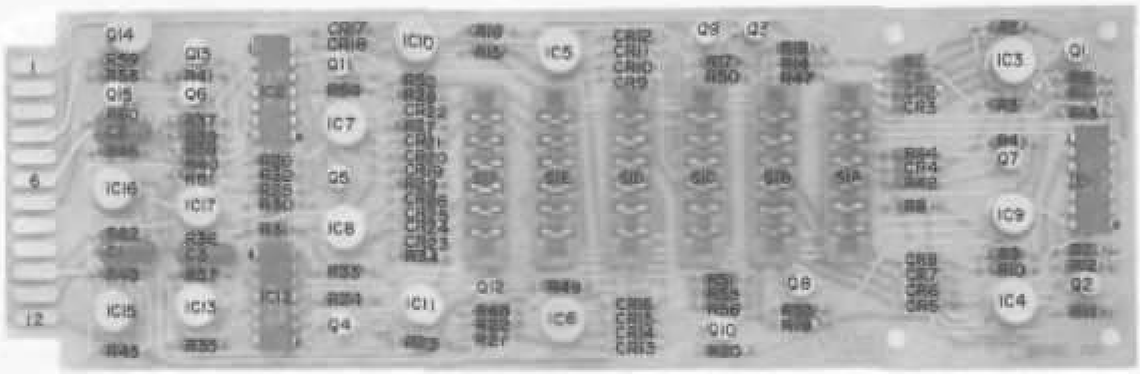


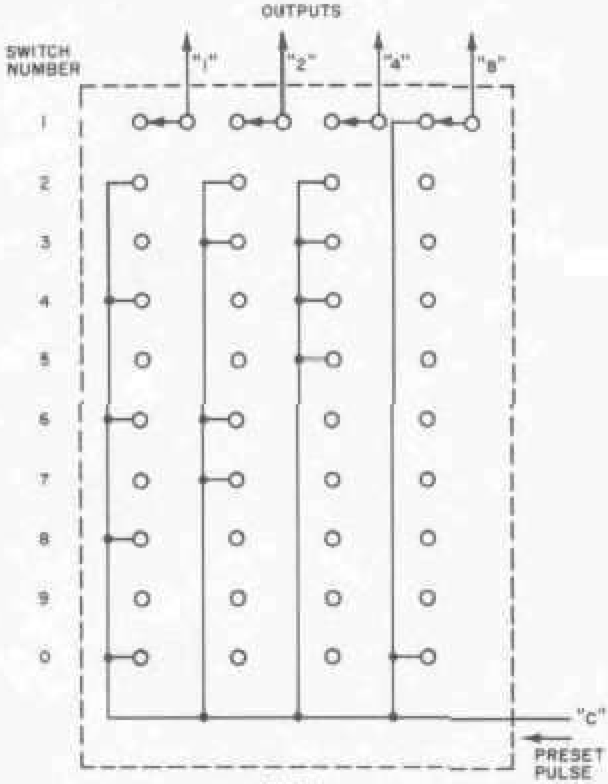
17 1V/cm, 0.2 s/cm

Oscilloscope: DC coupled.

5061A: Divider running, TIME DELAY set to 000000.

Figure 8-16
DIGITAL DIVIDER ASSEMBLY A5 (OPTION 01)
PRESET CLOCK BOARD ASSEMBLY A5A3





A5A3S1
TYPICAL SECTION

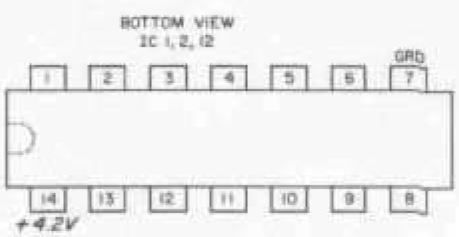
NOTES

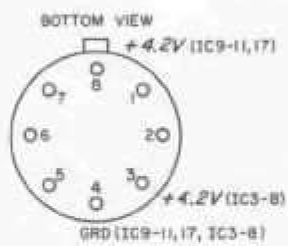
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS,
   CAPACITANCE IN PICOFARADS

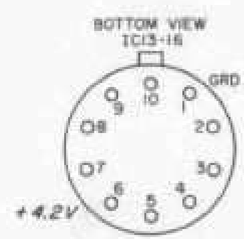
REFERENCE DESIGNATIONS

A5A3
C1-3 CR1-26 IC1-17 Q1-15 R1-62 S1

NOT ASSIGNED:
IC14







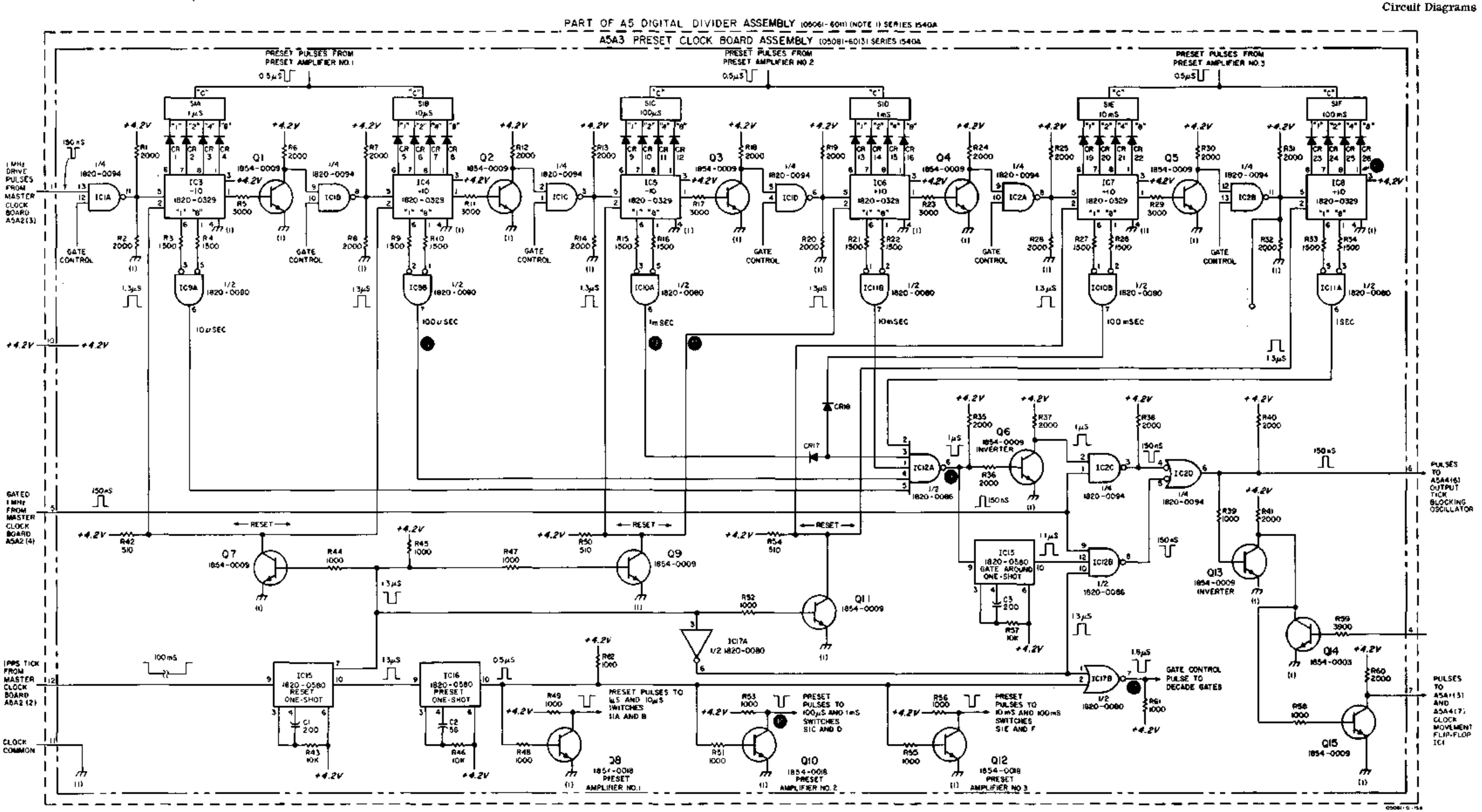
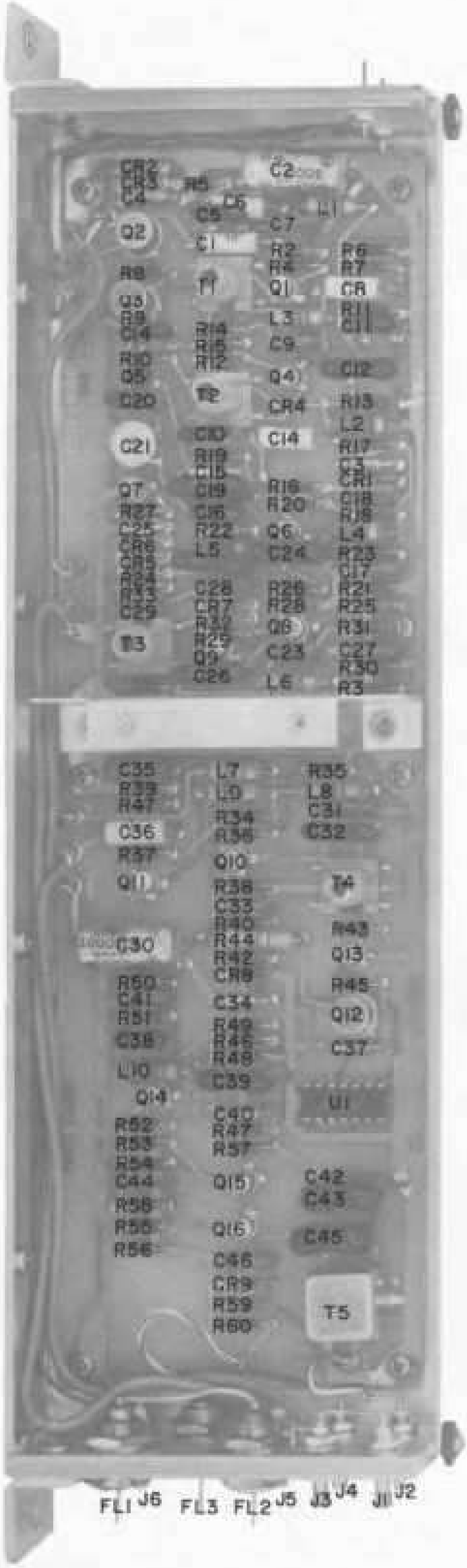
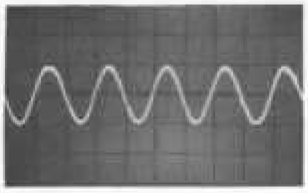
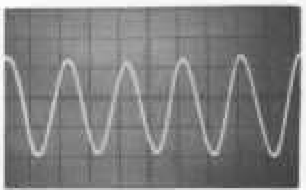


Figure 8-16. Digital Divider Assembly A5 (Option 01)
Preset Clock Board Assembly A5A3

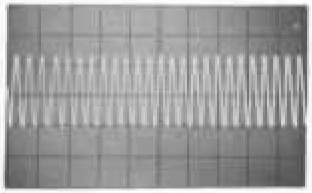




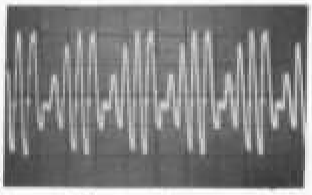
1 0.1V/cm, 0.1 μs/cm



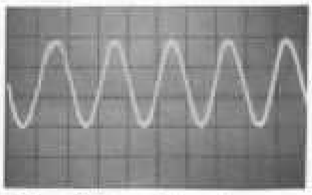
2 0.1V/cm, 0.1 μs/cm



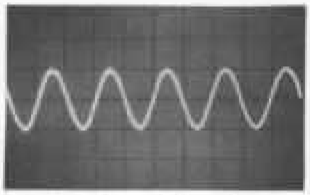
3 0.5V/cm, 0.5 μs/cm
(DIVIDER INOPERATIVE)



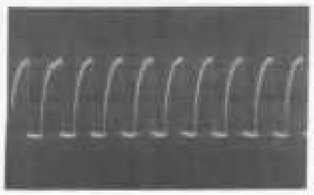
4 0.5V/cm, 0.5 μs/cm
(DIVIDER OPERATIVE)



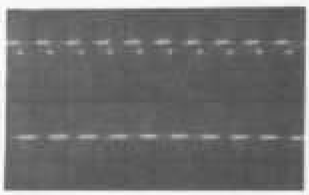
5 2V/cm, 0.5 μs/cm



6 2V/cm, 0.5 μs/cm



7 2V/cm, 1 μs/cm
dc coupled



8 1V/cm, 10 μs/cm
dc coupled

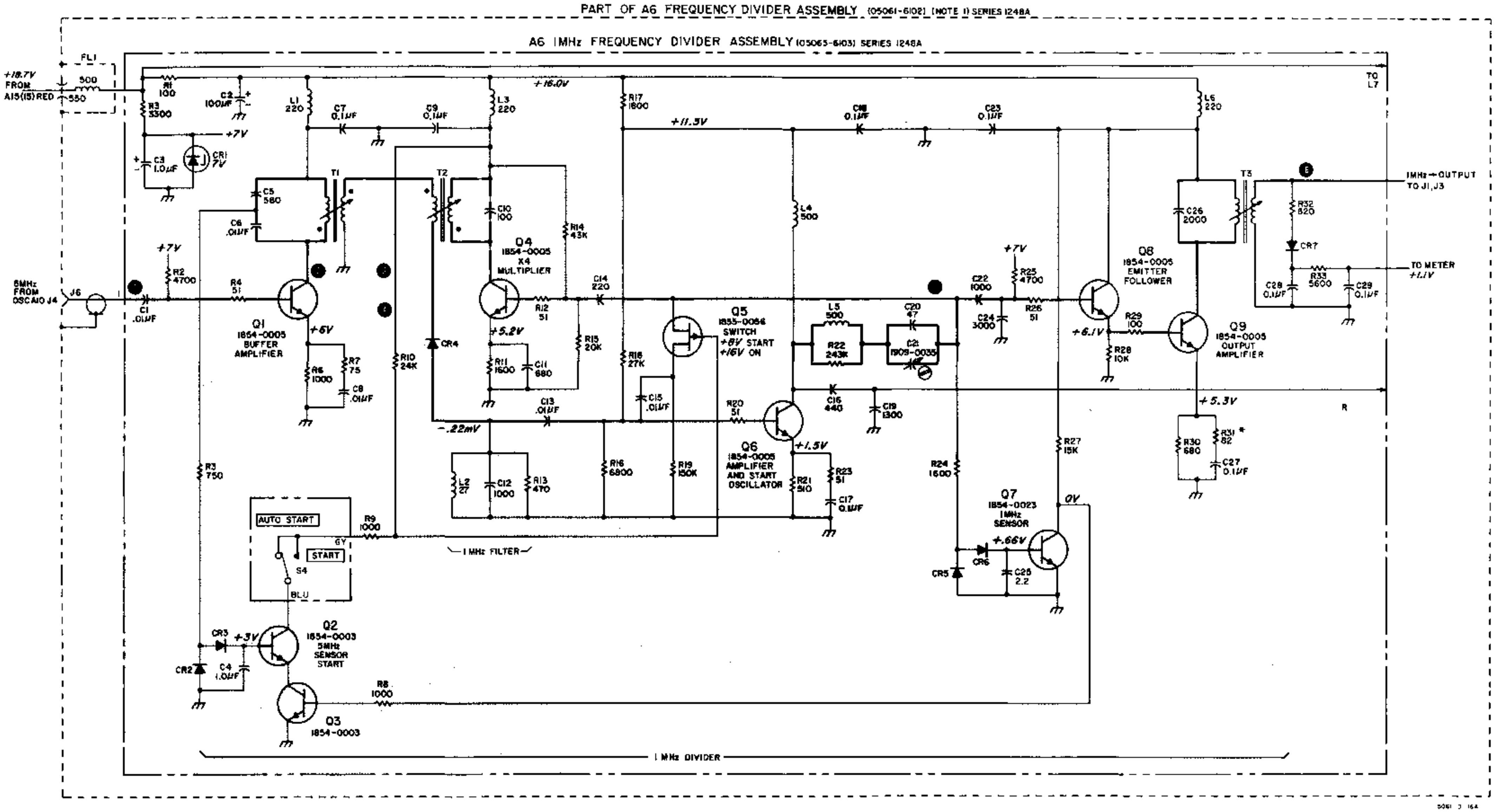


Figure 8-17. Frequency Divider Assembly A6
Frequency Divider Board Assembly A6A1
(Sheet 1 of 2)

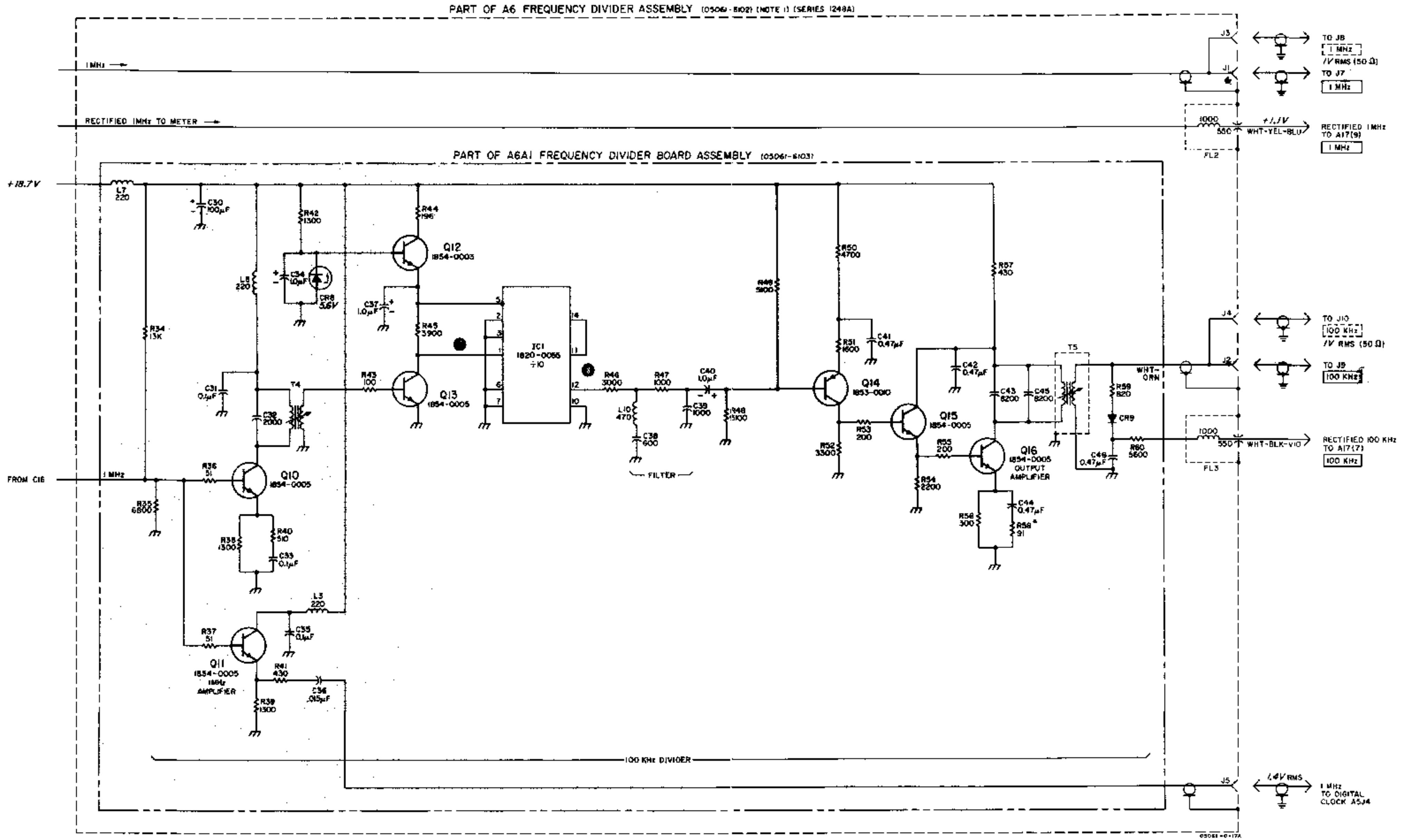
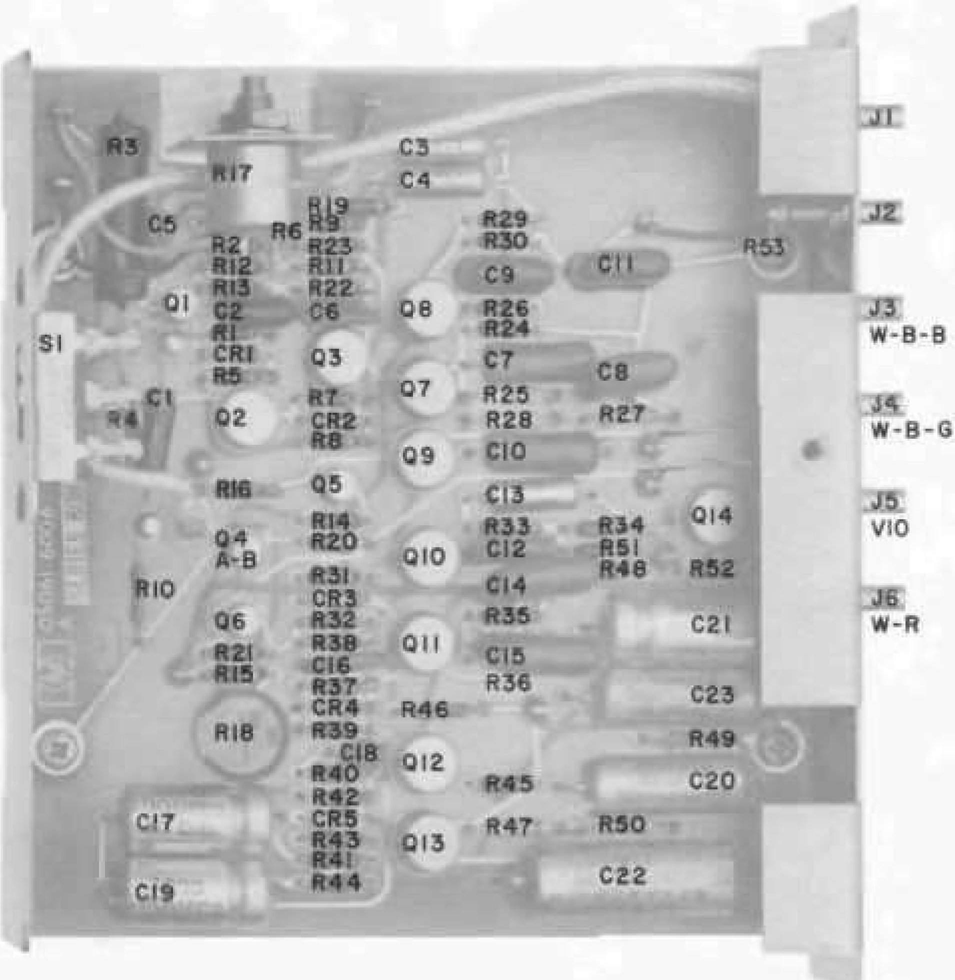
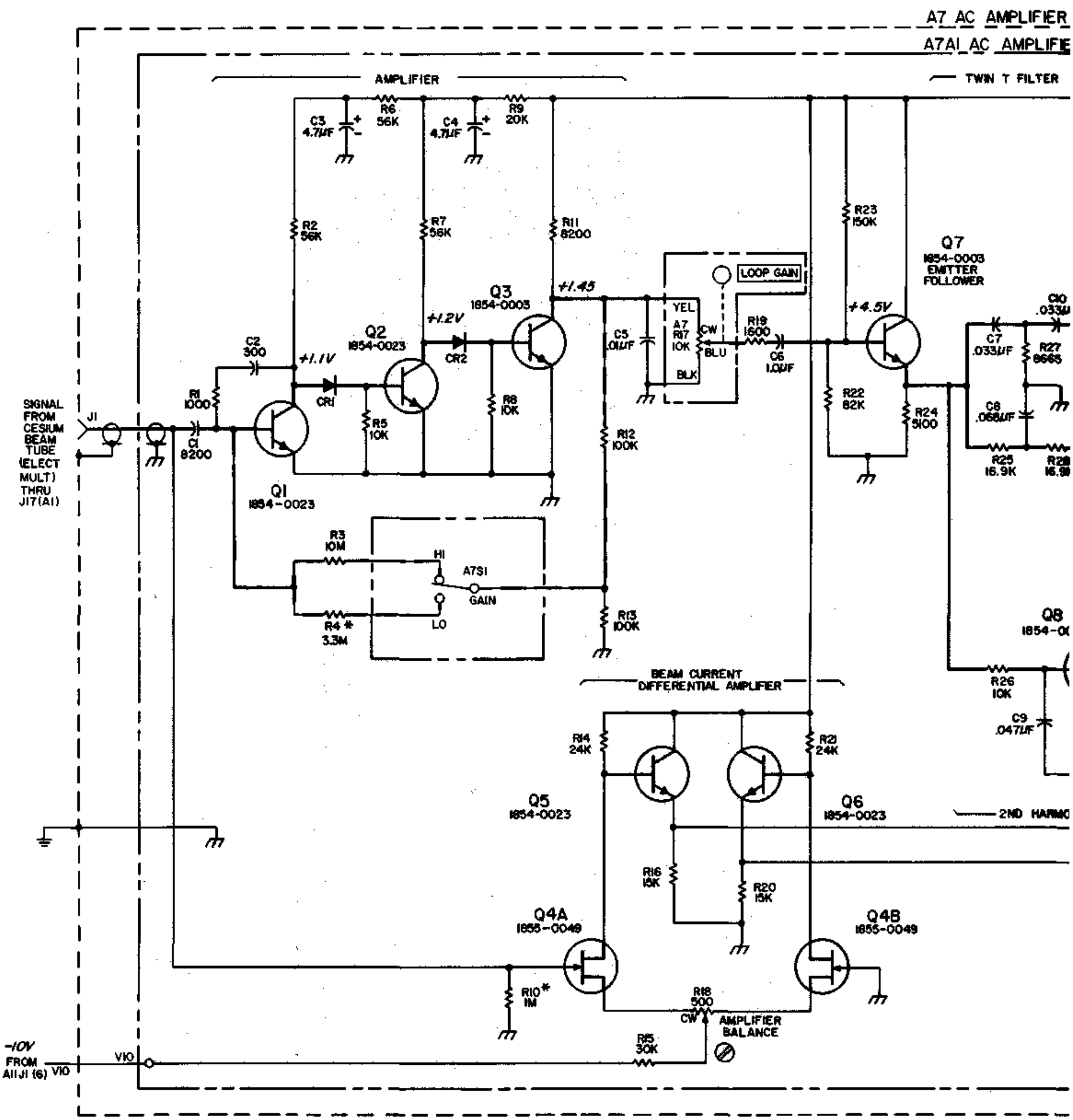


Figure 8-17. Frequency Divider Assembly A6
Frequency Divider Board Assembly A6A1
(Sheet 2 of 2)

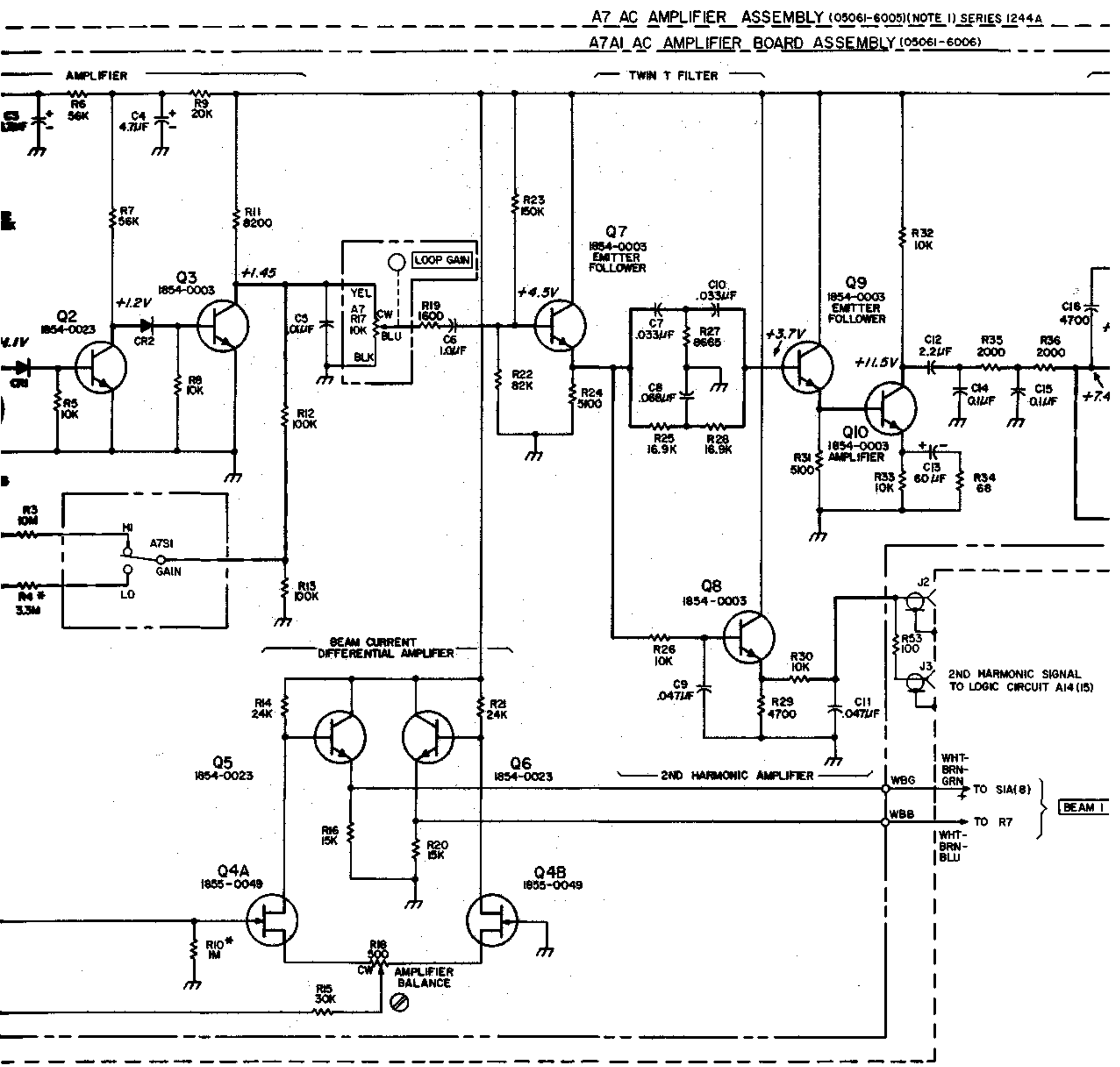
Figure 8-18

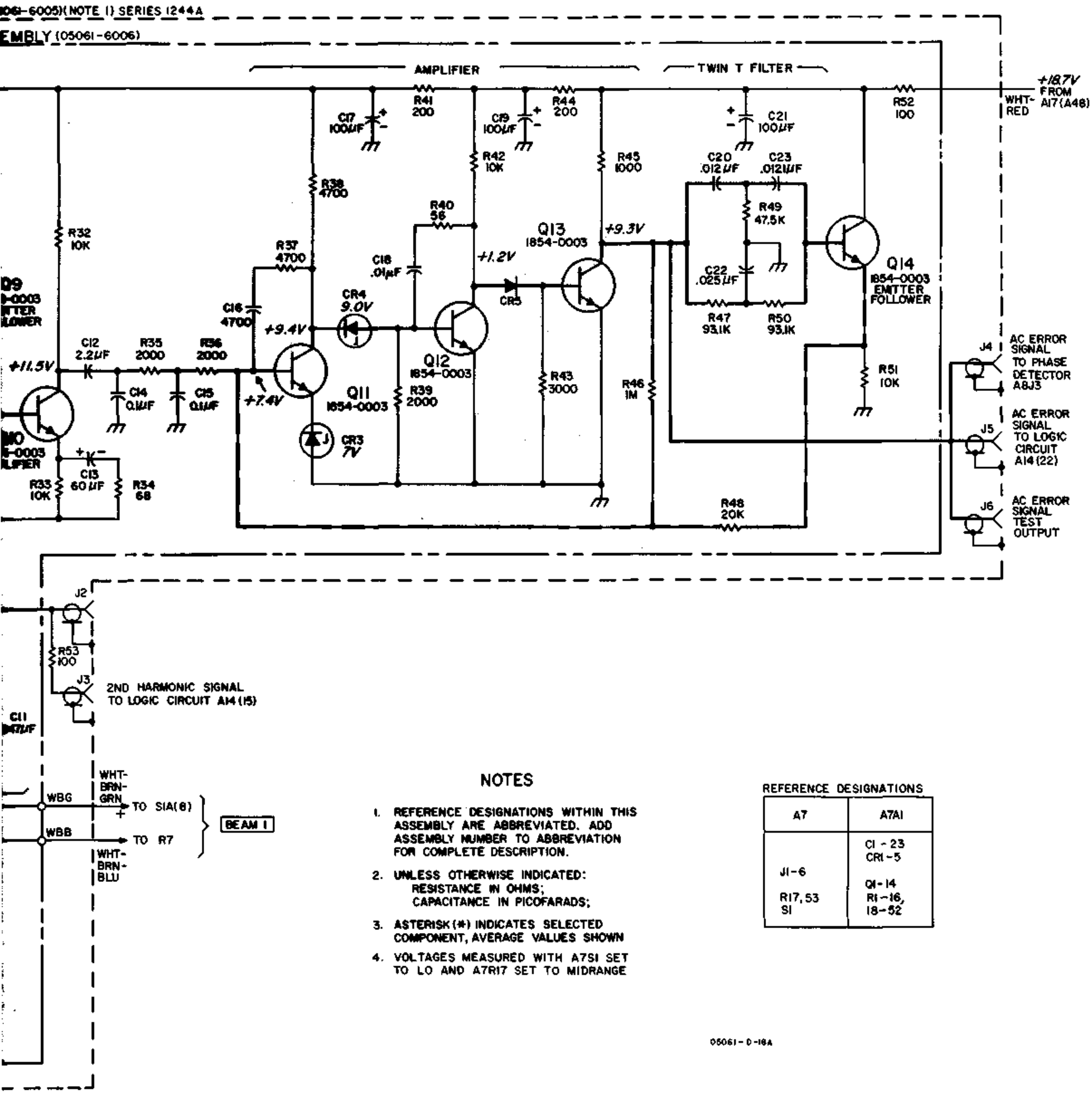
AC AMPLIFIER ASSEMBLY A7


J1
J2
J3
W-B-B
J4
W-B-G
J5
VIO
J6
W-R
R3
R17
C3
C4
C5
R6
R19
R9
R23
R11
R22
C6
R2
R12
R13
C2
R1
CR1
R5
Q1
S1
R4
C1
Q2
Q3
R7
CR2
R8
Q5
R16
Q4
A-B
R10
Q6
R21
R15
R18
R14
R20
R31
CR3
R32
R38
C16
R37
CR4
R39
C18
R40
R42
CR5
R43
R41
R44
C17
C19
Q8
Q7
Q9
Q10
Q11
R46
Q12
Q13
R29
R30
C9
R26
R24
C7
R25
R28
C10
C13
R33
C12
C14
R35
C15
R36
R45
R47
C11
R53
C8
R27
Q14
R34
R51
R48
R52
C21
C23
R49
C20
R50
C22



A7 AC AMPLIFIER
A7A1 AC AMPLIFIE
AMPLIFIER
TWIN T FILTER
SIGNAL FROM CESIUM BEAM TUBE (ELECT MULT) THRU J17(A1)
J1
C1 8200
R1 1000
C2 300
Q1 1854-0023
Q2 1854-0023
Q3 1854-0003
Q7 1854-0003 EMITTER FOLLOWER
CR1
CR2
+1.1V
+1.2V
+1.45
+4.5V
C3 4.7μF
C4 4.7μF
R6 56K
R9 20K
R2 56K
R7 56K
R11 8200
R5 10K
R8 10K
R12 100K
R13 100K
C5 .01μF
LOOP GAIN
YEL
A7 R17 10K
CW
BLU
BLK
R19 1600
C6 1.0μF
R23 150K
R22 82K
R24 5100
C7 .033μF
C10 .033μ
R27 8665
C8 .068μF
R25 16.9K
R3 10M
R4 * 3.3M
HI
LO
A7S1 GAIN
BEAM CURRENT DIFFERENTIAL AMPLIFIER
Q8 1854-0
R26 10K
C9 .047μF
R14 24K
R21 24K
Q5 1854-0023
Q6 1854-0023
2ND HARMO
R16 15K
R20 15K
Q4A 1855-0049
Q4B 1855-0049
R10* 1M
R18 500
CW
AMPLIFIER BALANCE
R15 30K
-10V FROM A11J1 (6) V10
V10


A7 AC AMPLIFIER ASSEMBLY (05061-6005)(NOTE 1) SERIES 1244A
A7A1 AC AMPLIFIER BOARD ASSEMBLY (05061-6006)
AMPLIFIER
TWIN T FILTER
LOOP GAIN
Q2 1854-0023
Q3 1854-0003
Q7 1854-0003 EMITTER FOLLOWER
Q9 1854-0003 EMITTER FOLLOWER
Q10 1854-0003 AMPLIFIER
Q8 1854-0003
Q5 1854-0023
Q6 1854-0023
Q4A 1855-0049
Q4B 1855-0049
BEAM CURRENT DIFFERENTIAL AMPLIFIER
2ND HARMONIC AMPLIFIER
2ND HARMONIC SIGNAL TO LOGIC CIRCUIT A14(15)
AMPLIFIER BALANCE
A7S1 GAIN
HI
LO
TO S1A(8)
TO R7
WHT-BRN-GRN
WHT-BRN-BLU
WBG
WBB
BEAM I



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN
4. VOLTAGES MEASURED WITH A7S1 SET TO LO AND A7R17 SET TO MIDRANGE

REFERENCE DESIGNATIONS

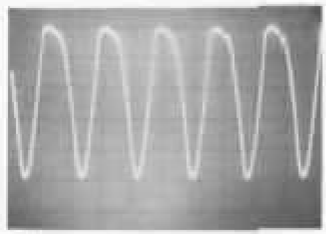
A7	A7A1
J1-6 R17, 53 S1	C1 - 23 CR1 - 5 Q1 - 14 R1 - 16, 18 - 52

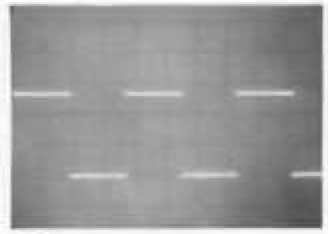
05061-D-18A

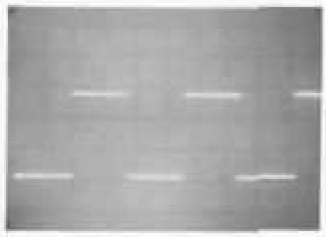
Figure 8-18. AC Amplifier Assembly A7

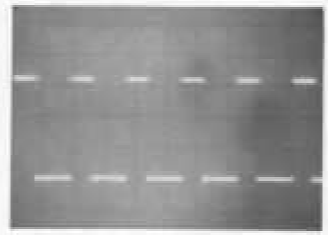
Figure 8-19

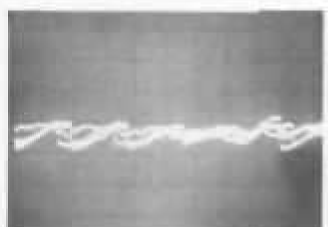
PHASE DETECTOR ASSEMBLY A8

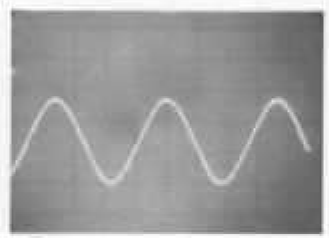

1 0.5V/cm, 2 ms/cm

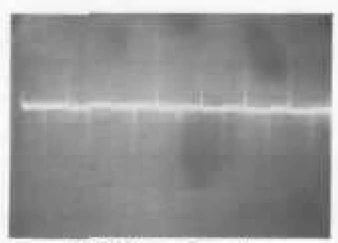

2 5V/cm, 2 ms/cm


3 5V/cm, 2 ms/cm


4 5V/cm, 2 ms/cm

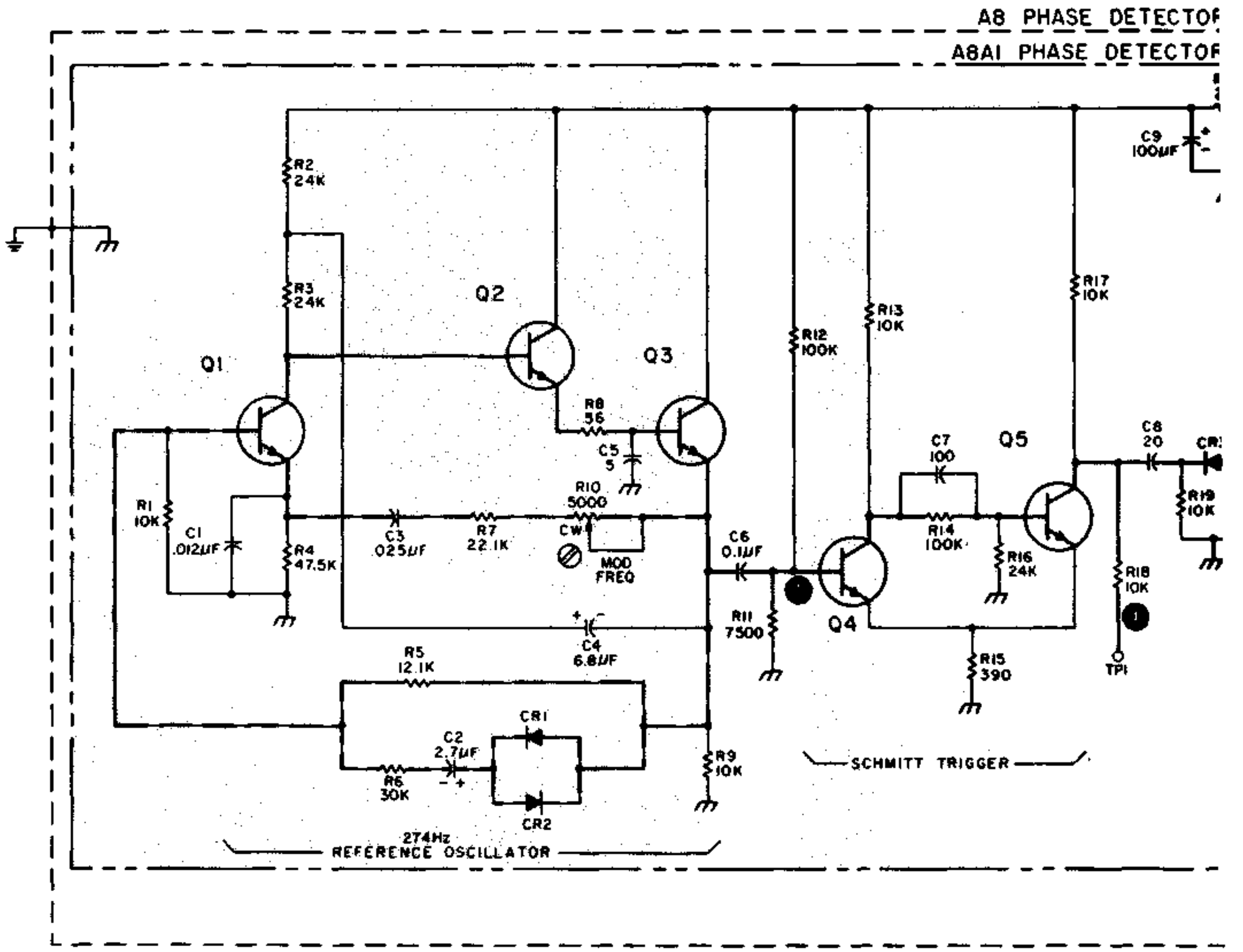

5 0.005V/cm, 2 ms/cm


6 0.05V/cm, 2 ms/cm


7 0.005V/cm, 5 ms/cm
No ac error input at A8J3

Oscilloscope: DC coupled.

5061A: Normal operation unless noted.

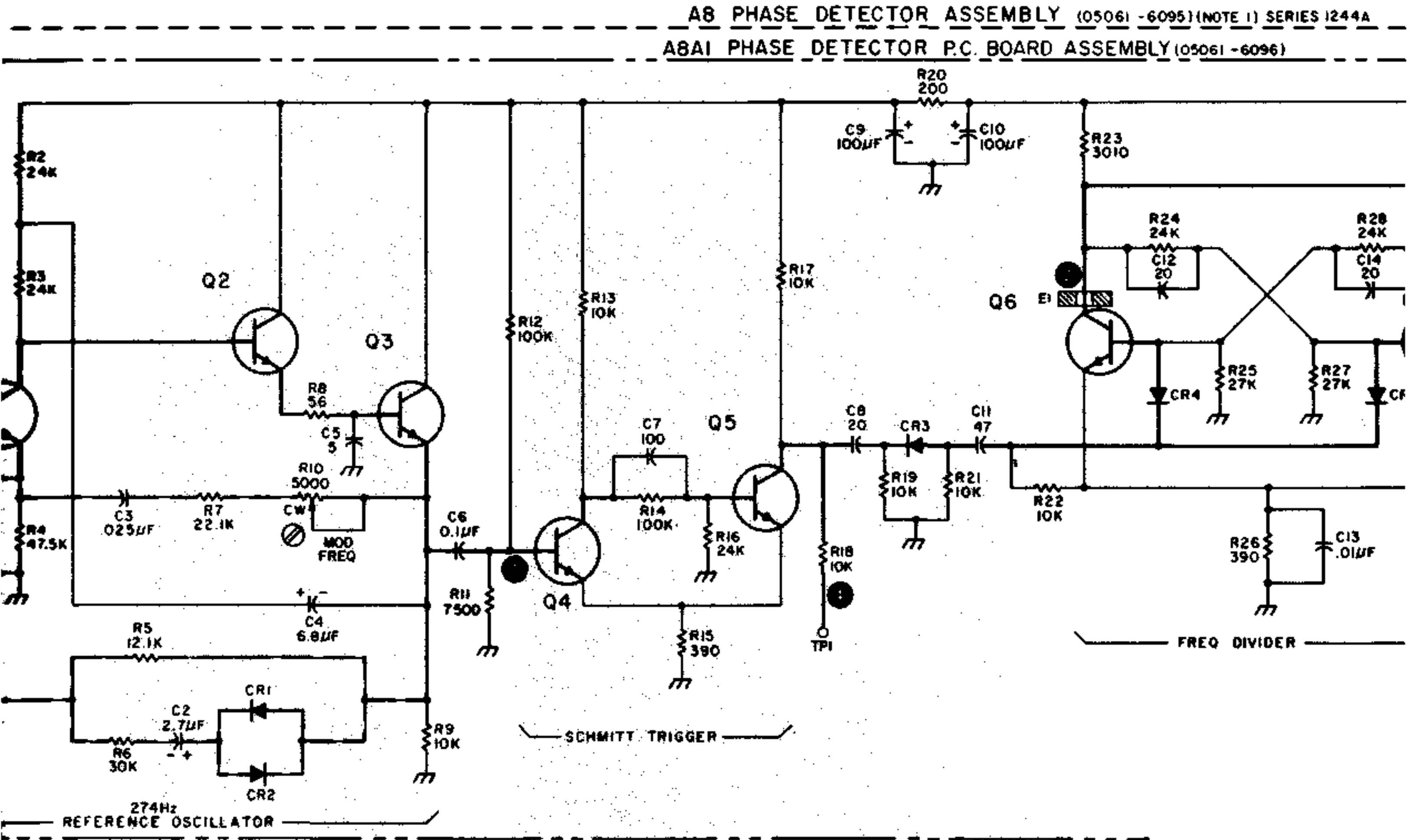


NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS,
   CAPACITANCE IN PICOFARADS.
3. Q13A AND Q13B ARE A MATCHED PAIR

REFERENCE DESIGNATIONS

A8	A8A1
C1 - 29 CR1 - 7 Q1 - 13 R1 - 54 T1	J1 - 6 TP1



NOTES

: DESIGNATIONS WITHIN THIS
ARE ABBREVIATED ADD
NUMBER TO ABBREVIATION
.ETE DESCRIPTION

THERWISE INDICATED
NCE IN OHMS.
ANCE IN PICOFARADS,

Q13B ARE A MATCHED PAIR

REFERENCE DESIGNATIONS

A8	A8A1
C1-29 CR1-7 Q1-13 R1-54 T1	J1-6 TP1

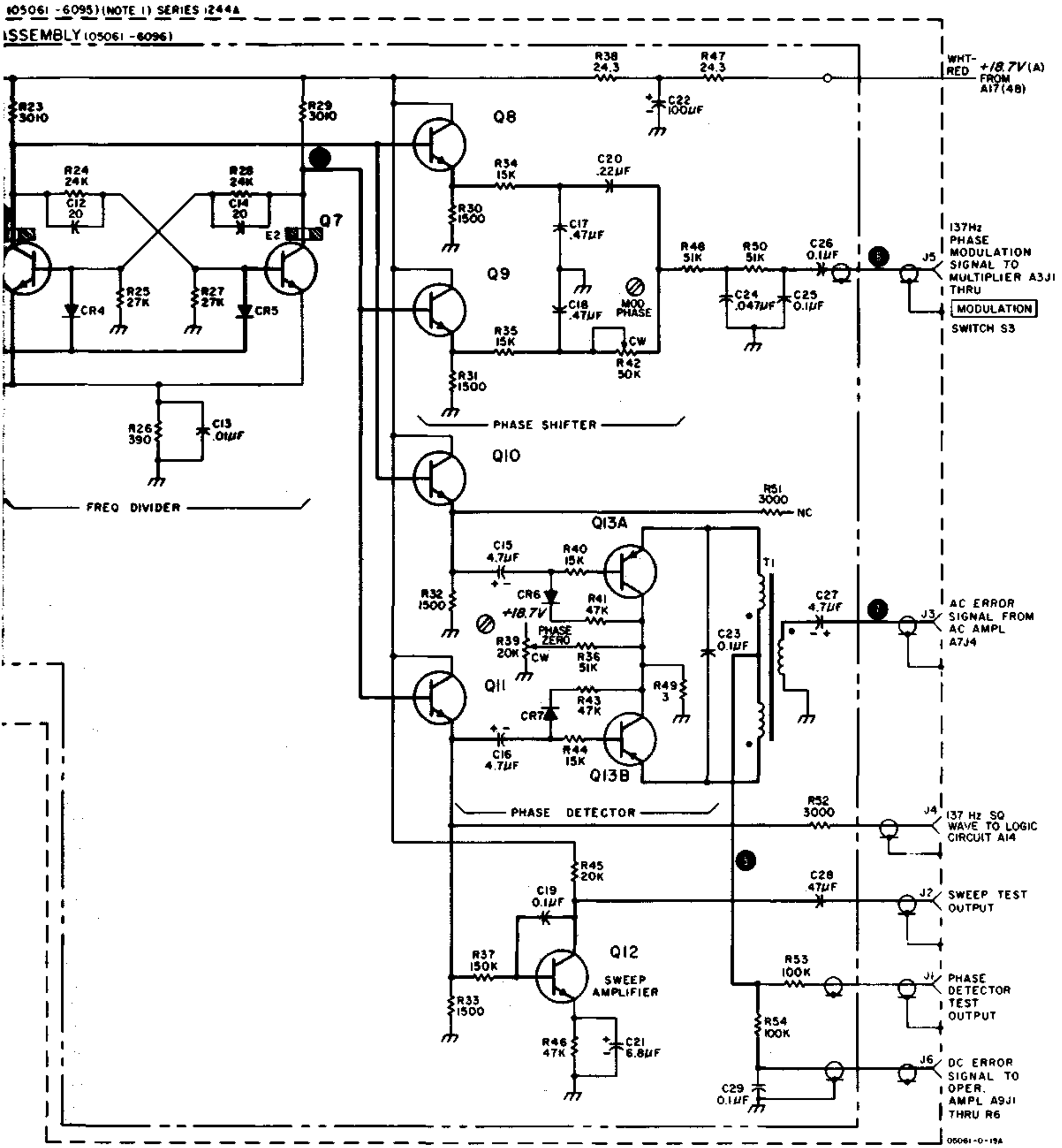
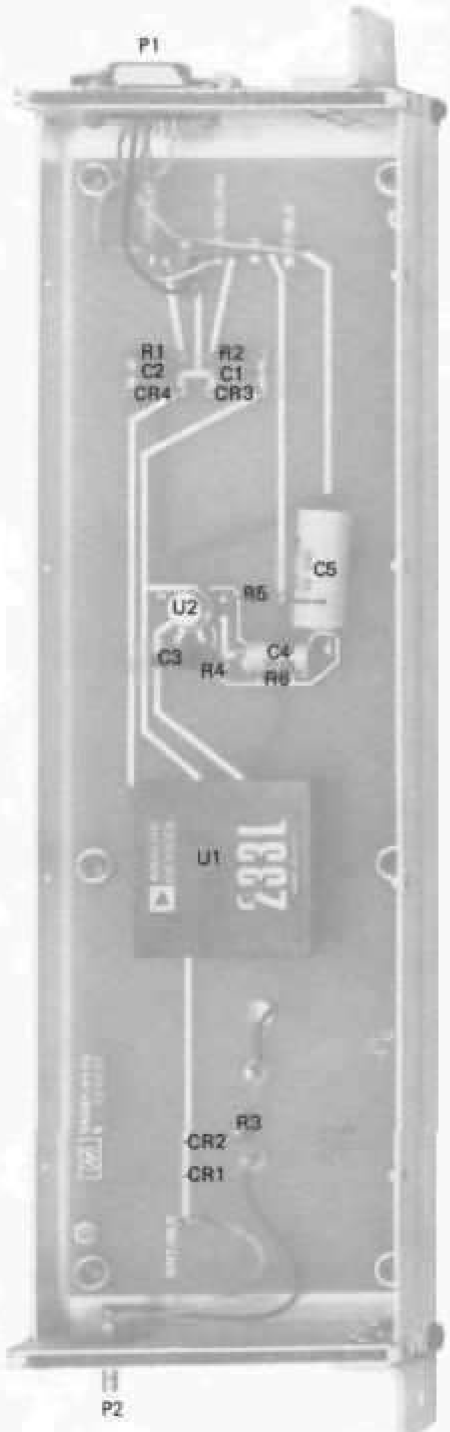
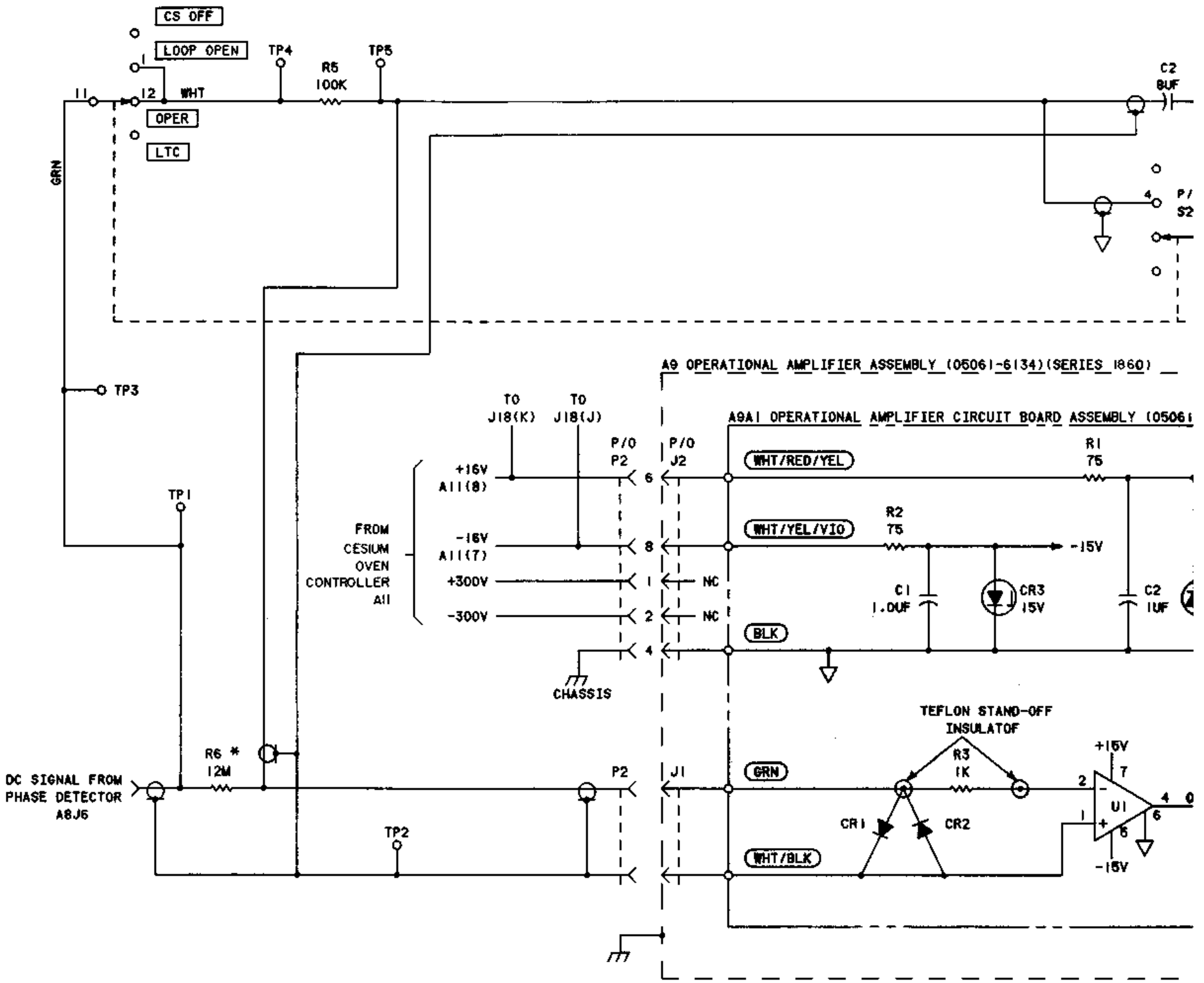


Figure 8-19. Phase Detector Assembly A8

Figure 8-20
OPERATIONAL AMPLIFIER ASSEMBLY A9


P1
R1
C2
CR4
R2
C1
CR3
C5
R5
U2
C3
R4
C4
R6
U1
R3
CR2
CR1
P2



CS OFF
LOOP OPEN
OPER
LTC
TP4
R5
100K
TP5
C2
8UF
WHT
GRN
TP3
TP1
TP2
A9 OPERATIONAL AMPLIFIER ASSEMBLY (05061-6134)(SERIES 1860)
A9A1 OPERATIONAL AMPLIFIER CIRCUIT BOARD ASSEMBLY (0506
TO J18(K)
TO J18(J)
P/O P2
P/O J2
+16V A11(8)
-16V A11(7)
+300V
-300V
FROM CESIUM OVEN CONTROLLER A11
NC
CHASSIS
WHT/RED/YEL
WHT/YEL/VIO
BLK
R1 75
R2 75
-15V
C1 1.0UF
CR3 15V
C2 1UF
TEFLON STAND-OFF INSULATOR
R3 1K
+15V
-15V
U1
GRN
WHT/BLK
CR1
CR2
DC SIGNAL FROM PHASE DETECTOR A8J6
R6 * 12M
P2
J1

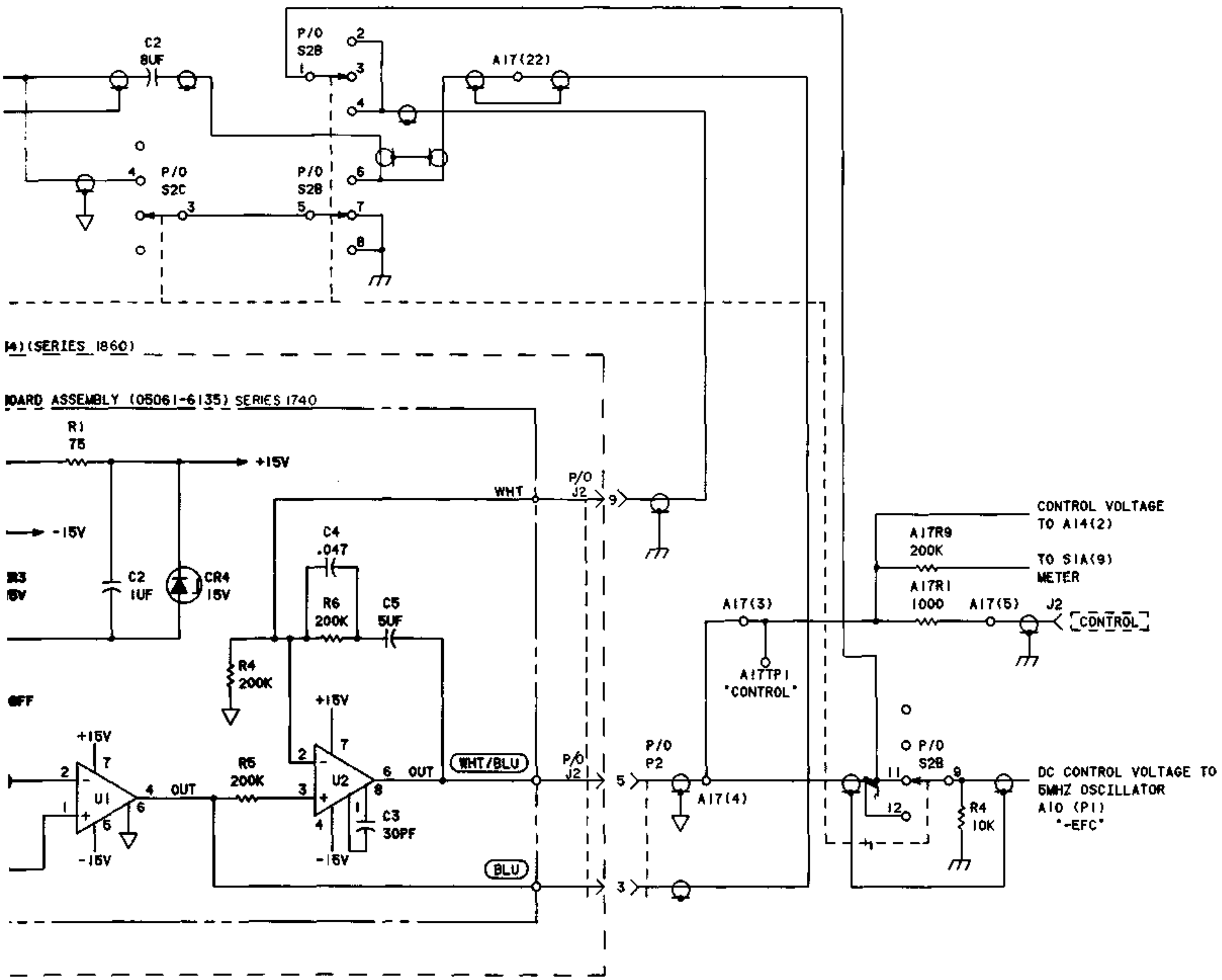
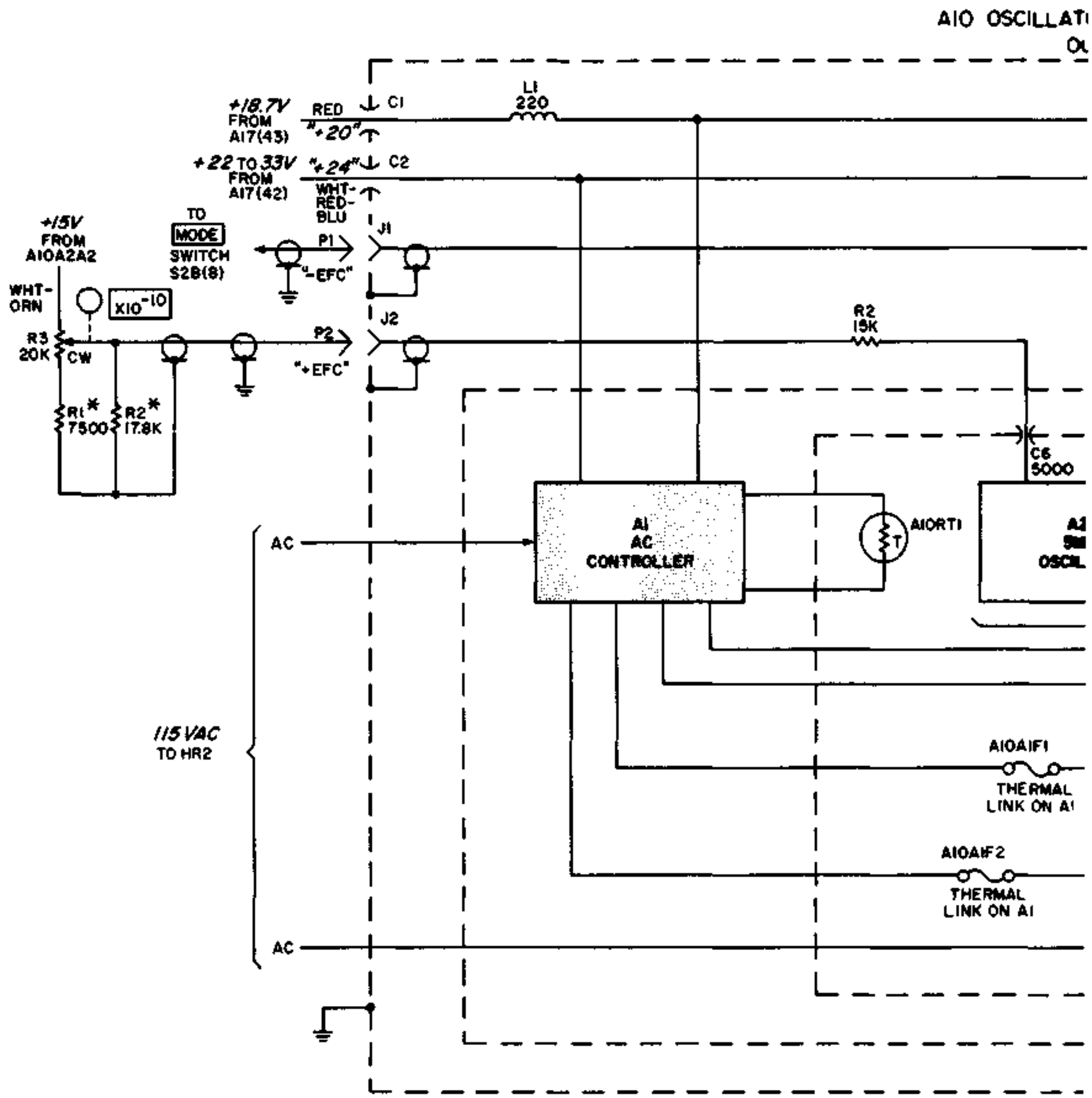


Figure 8-20. Operational Amplifier Assembly A9

Figure 8-21
OSCILLATOR ASSEMBLY A10



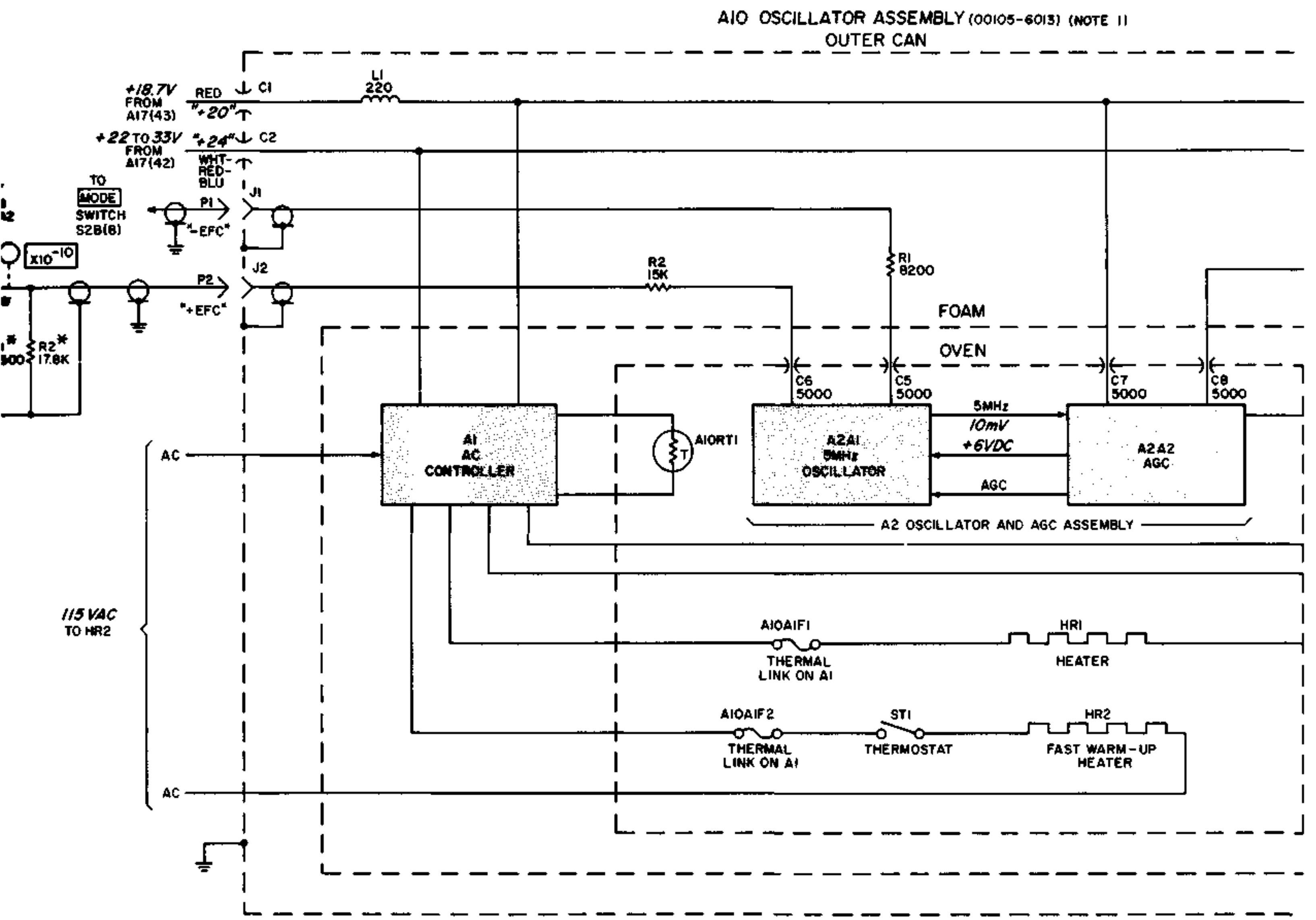
NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES

   * FACTORY SELECT VALUE.

REI

NO PREFI
P1,2 R1-3



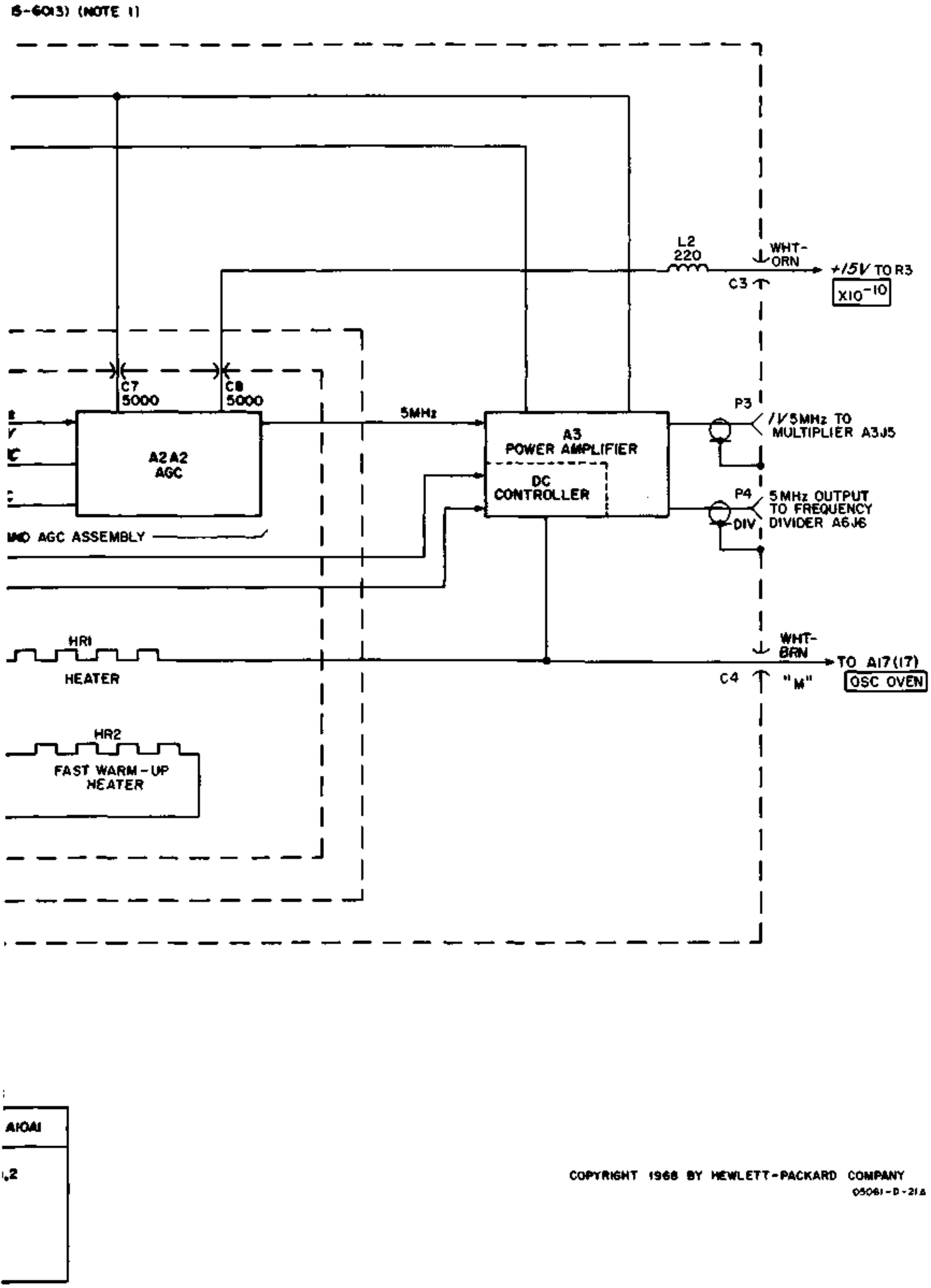
NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES

* FACTORY SELECT VALUE.

REFERENCE DESIGNATIONS

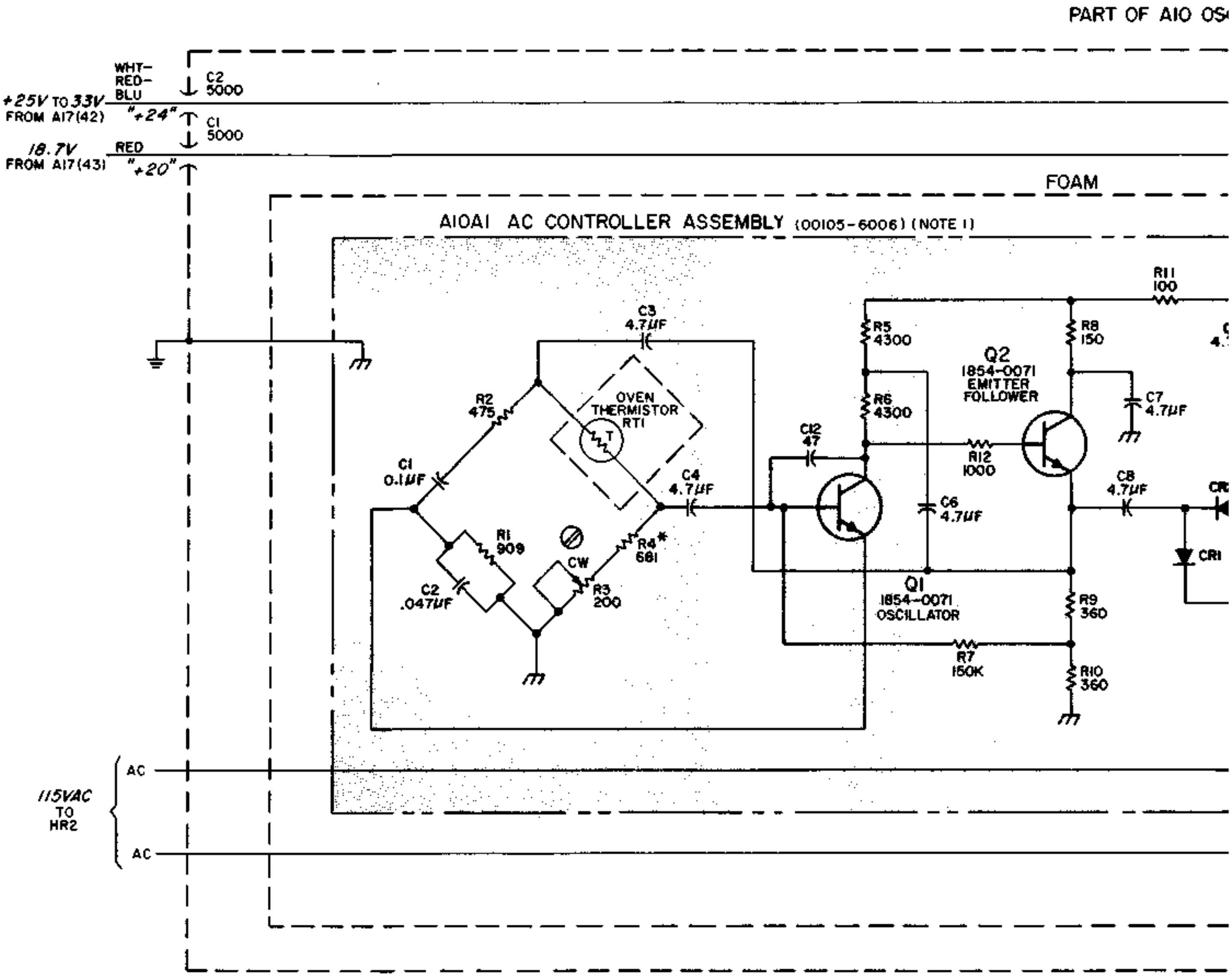
NO PREFIX	A10	A10A1
P1,2 R1-3	C1-8 HR1,2 J1,2 L1,2 P3,4 R1,2 RT1 ST1	F1,2



05061-D-21A

Figure 8-21. Oscillator Assembly A10

Figure 8-22
OSCILLATOR ASSEMBLY A10
AC CONTROLLER ASSEMBLY A10A1
POWER AMPLIFIER ASSEMBLY A10A3

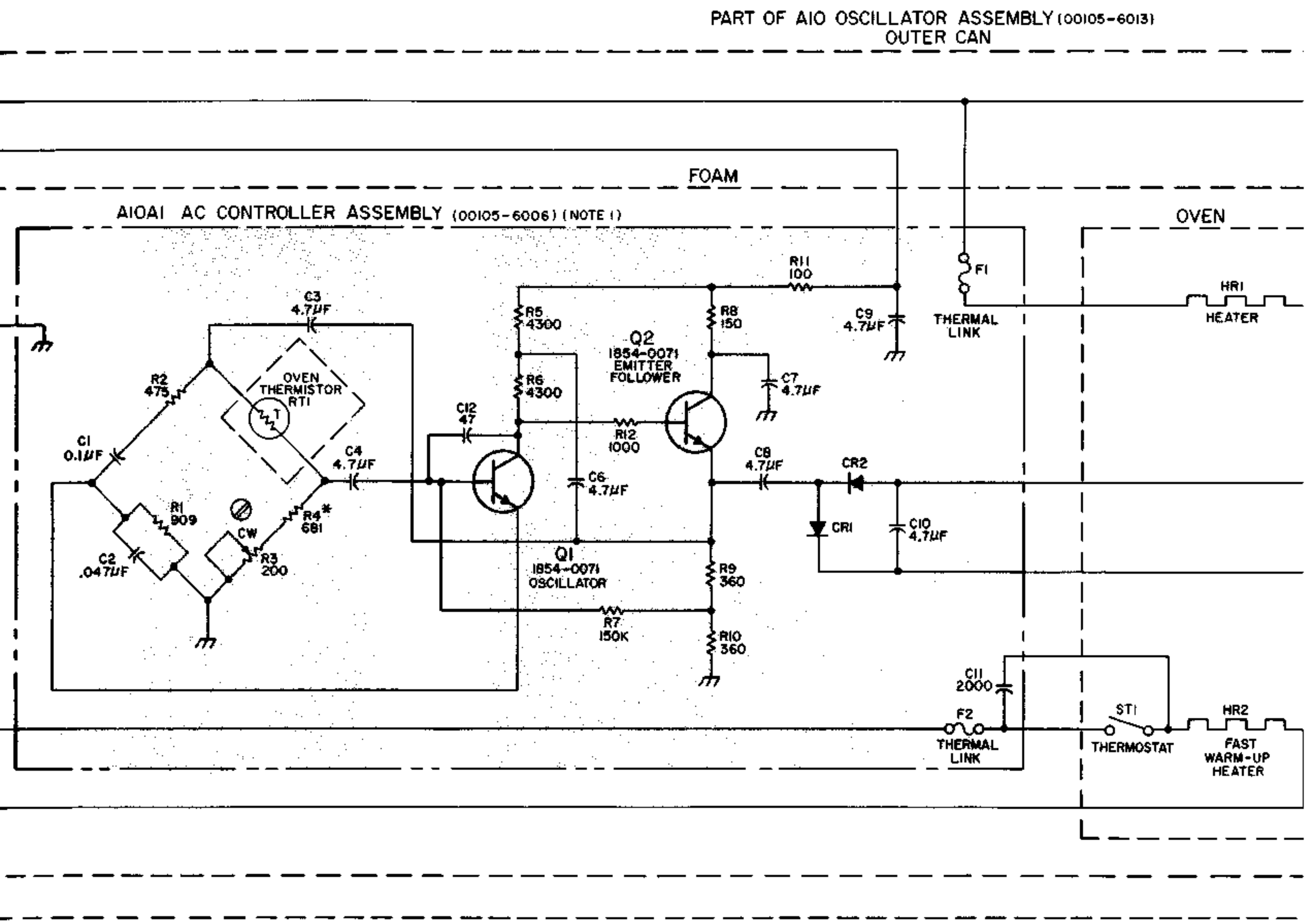


NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERE

A10
C1,2,4
HR1,2
RT1 ST1



NOTES

DESIGNATIONS WITHIN THIS
ARE ABBREVIATED. ADD
NUMBER TO ABBREVIATION
ETE DESCRIPTION.

ERWISE INDICATED:
CE IN OHMS;
NCE IN PICOFARADS;
CE IN MICROHENRIES

INDICATES SELECTED
AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

A10	A10 A1	A10 A3
C1,2,4 HR1,2 RT1 ST1	C1-12 CR1,2 F1,2 Q1,2 R1-12	C2,4 CR1-3 L3 Q2-4 R2,3,8,10, 20

DELETED C5

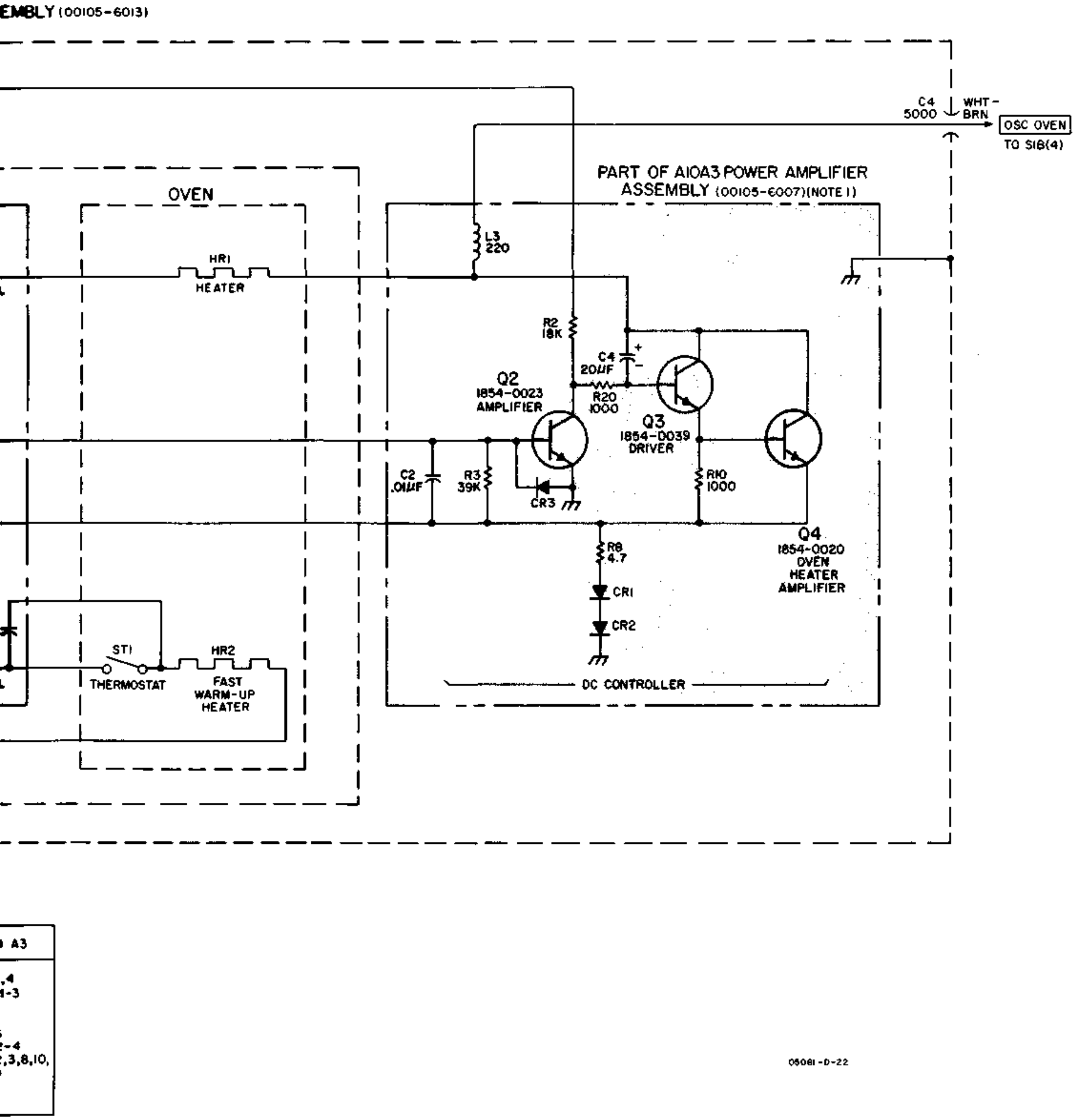
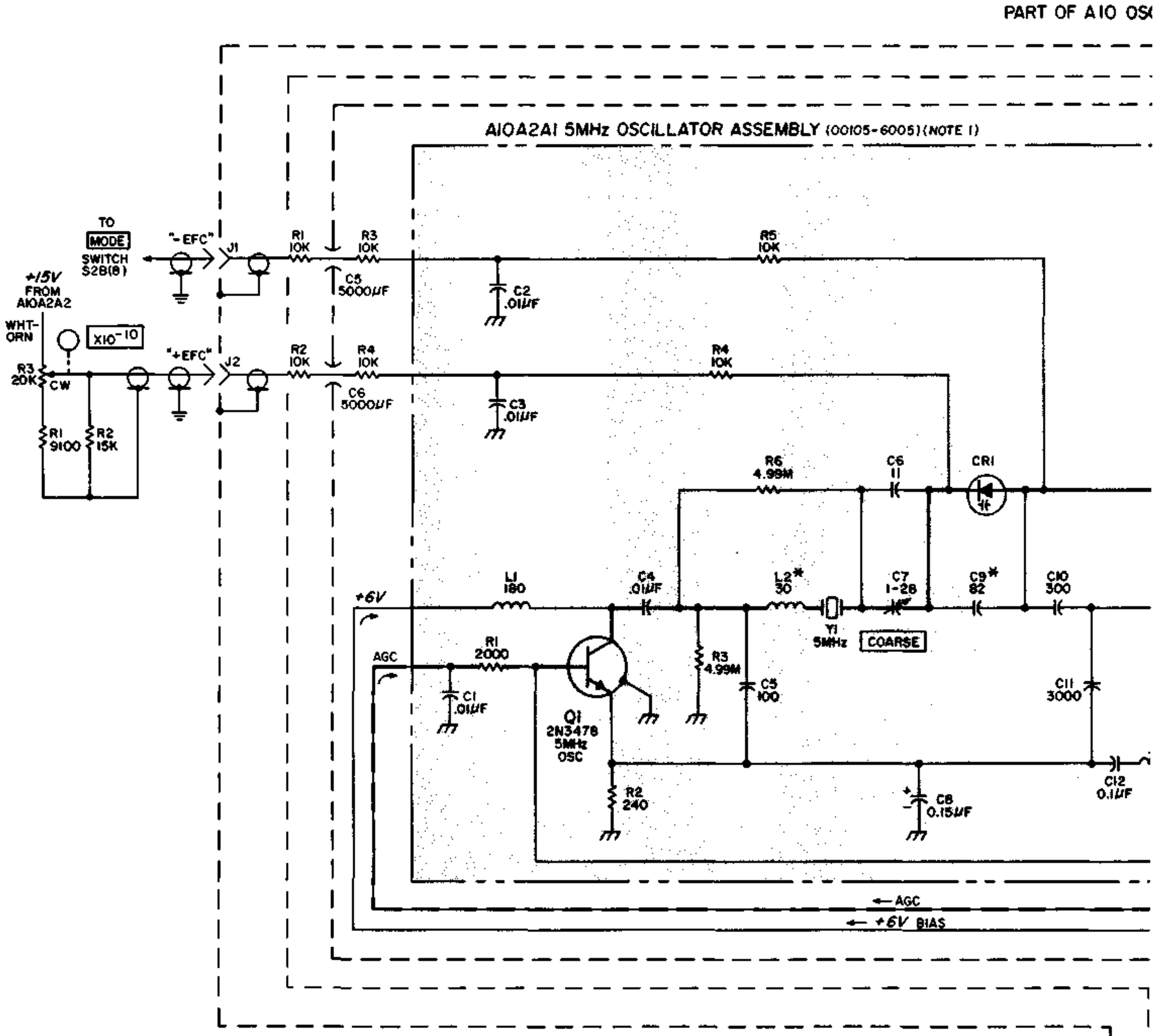


Figure 8-22. Oscillator Assembly A10
AC Controller Assembly A10A1
Power Amplifier Assembly A20A3

Figure 8-23

OSCILLATOR ASSEMBLY A10
5 MHZ OSCILLATOR ASSEMBLY A10A2A1
AGC ASSEMBLY A10A2A2

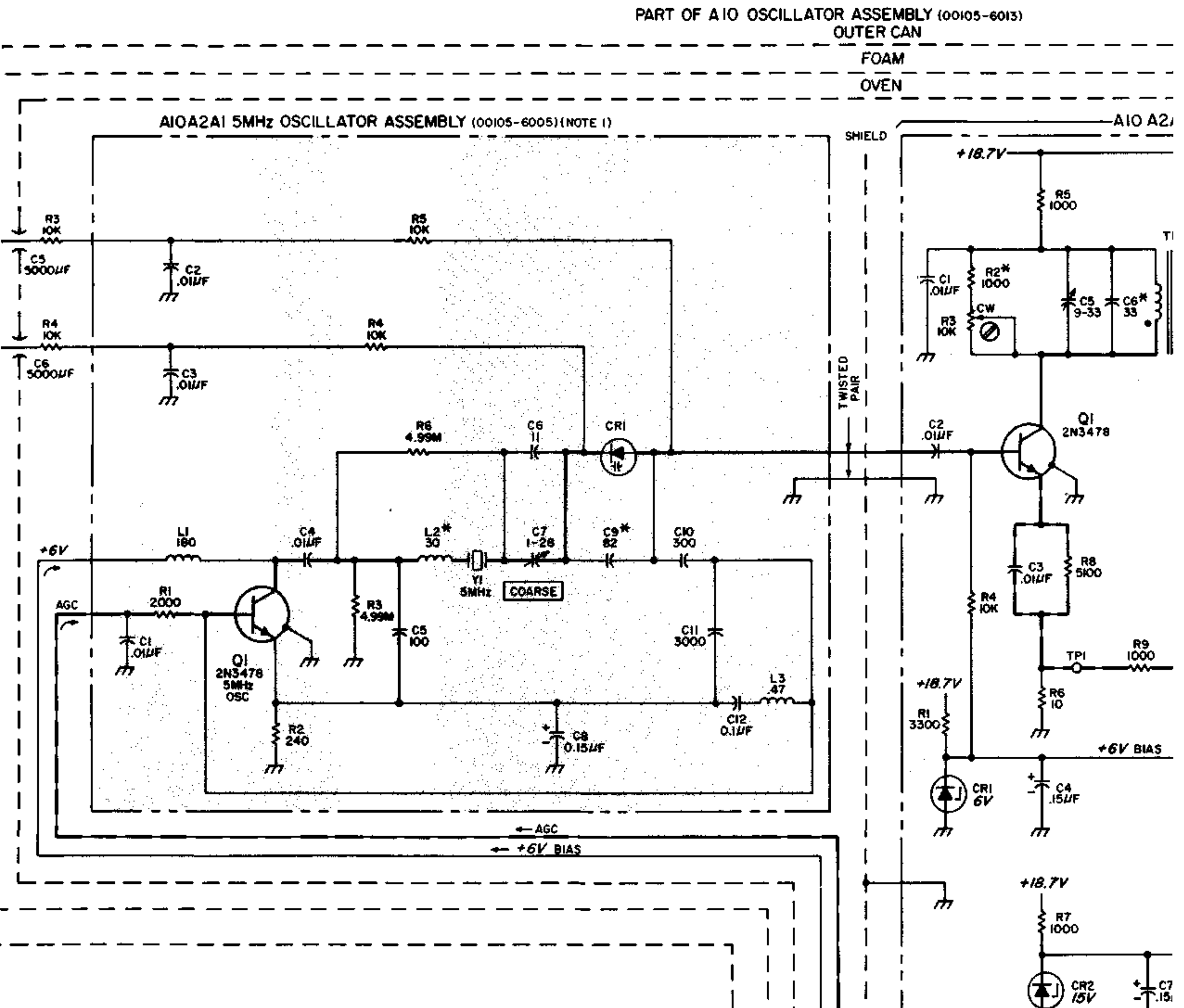


NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A10	A10A2A1	A10A2A2
R1-3	C1,3, 5-8 J1, 2 L1, 2 R1-4	C1-12 CR1 L1-3 Q1 R1-6	C1-16 CR1-4 Q1,2 R1-17 T1,2 TP1



ES

ATIONS WITHIN THIS
EVIATED. ADD
TO ABBREVIATION
RIPTION.

INDICATED:
MS;
COFARADS;
CROHENRIES

TES SELECTED
E VALUES SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A10	A10A2A1	A10A2A2
R1-3	C1,3, 5-8 J1, 2 L1, 2 R1-4	C1-12 CR1 L1-3 Q1 R1-6	C1-16 CR1-4 Q1,2 R1-17 T1,2 TP1

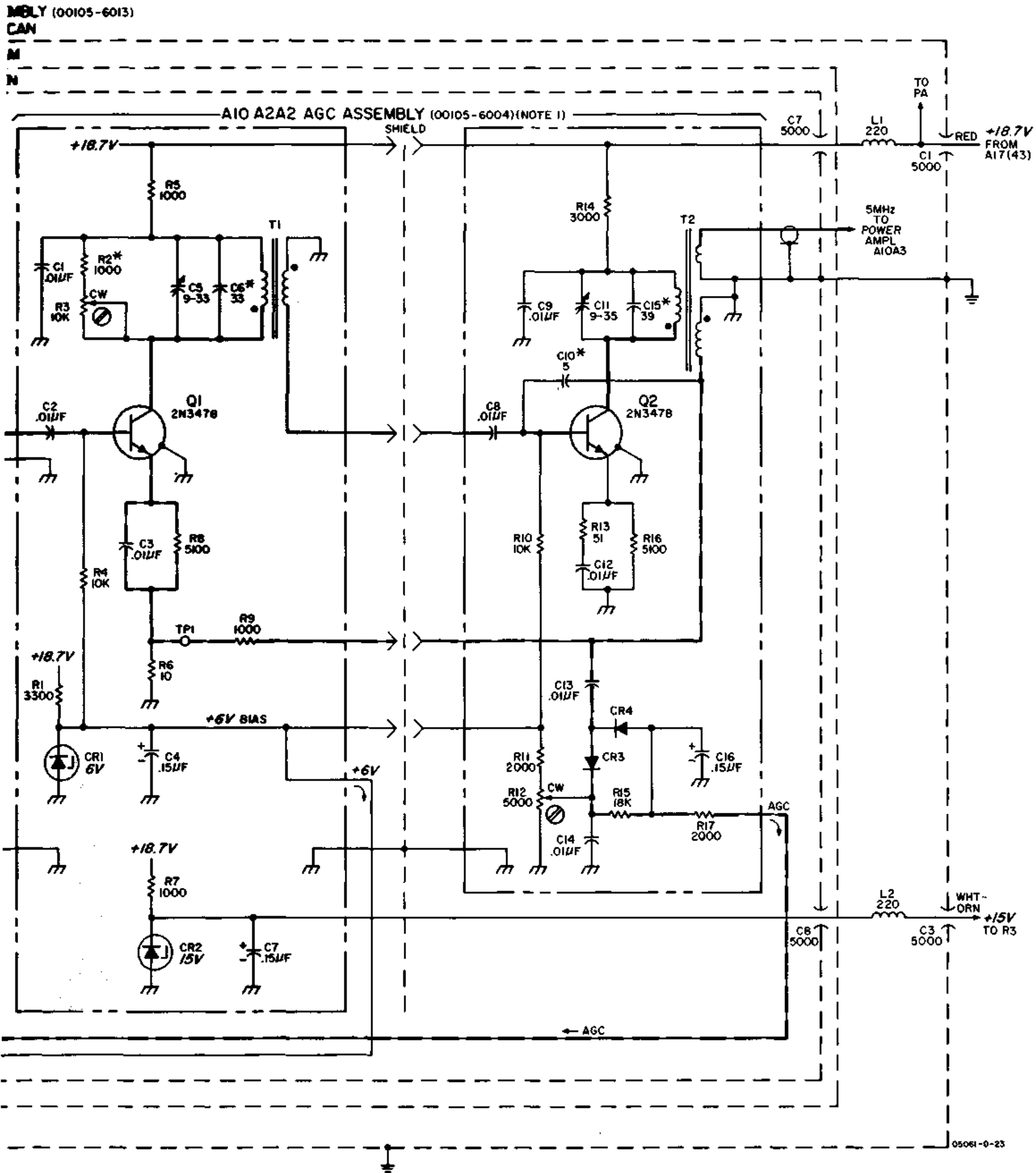
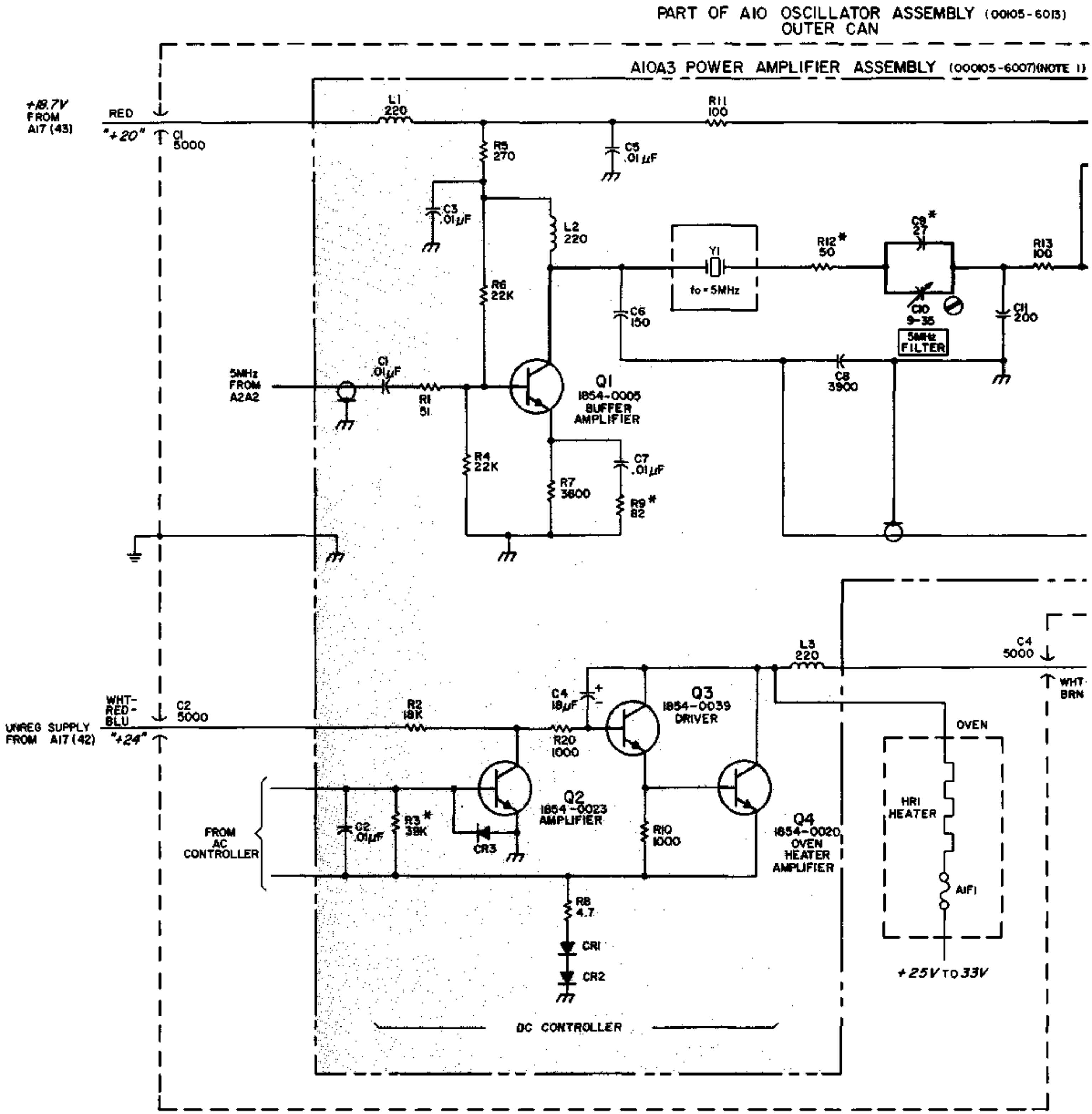


Figure 8-23. Oscillator Assembly A10
5 MHz Oscillator Assembly A10A2A1
AGC Assembly A10A2A2

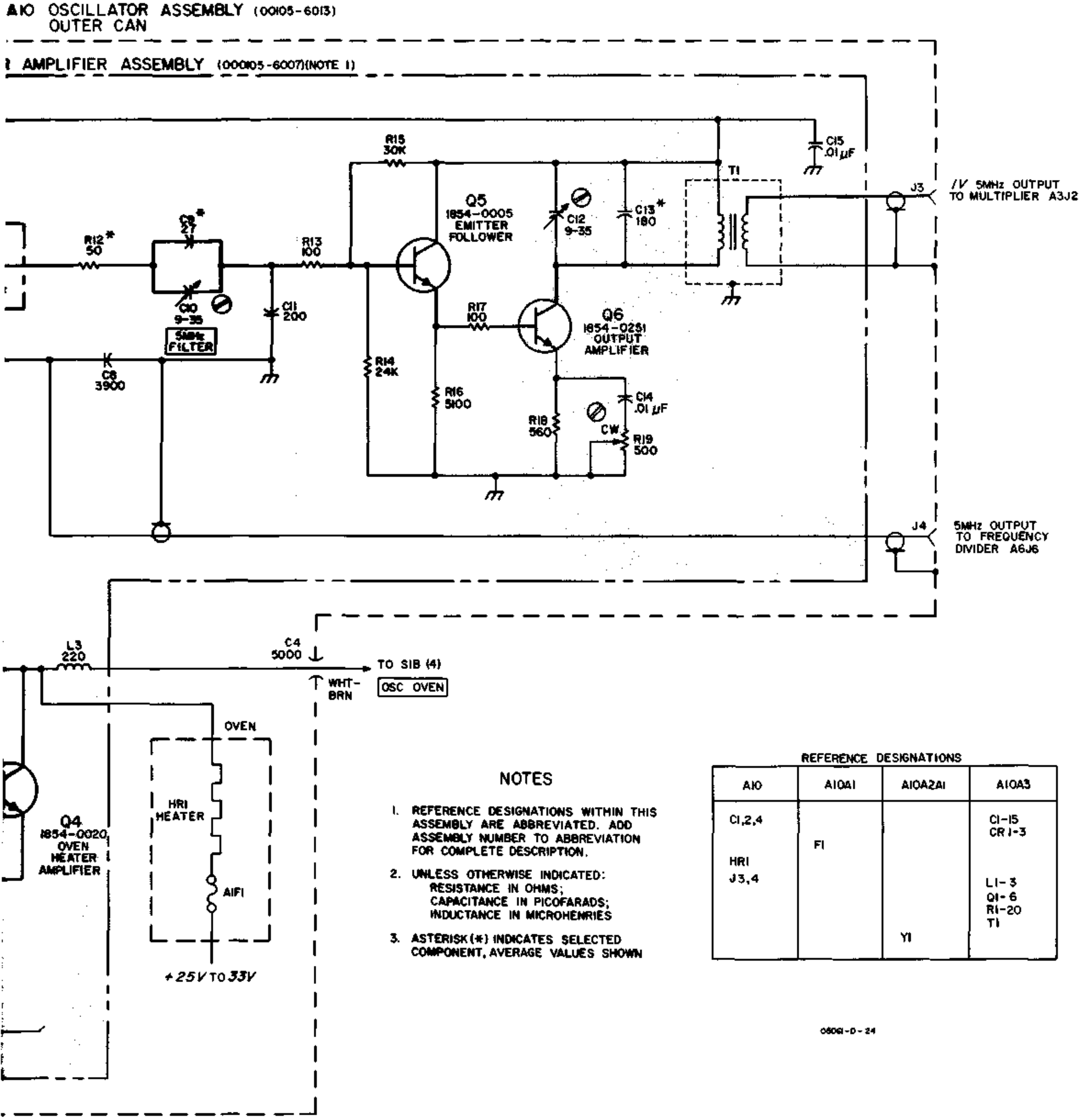
Figure 8-24

OSCILLATOR ASSEMBLY A10

POWER AMPLIFIER ASSEMBLY A10A3



PART OF A10 OSCILLATOR ASSEMBLY (00105-6013)
OUTER CAN
A10A3 POWER AMPLIFIER ASSEMBLY (000105-6007)(NOTE 1)
+18.7V FROM A17 (43)
RED
"+20"
C1 5000
L1 220
R11 100
R5 270
C5 .01µF
C3 .01µF
L2 220
R6 22K
Y1
fo = 5MHz
R12* 50
C9* 27
C10 9-35
5MHz FILTER
R13 100
C11 200
C6 150
C8 3900
5MHz FROM A2A2
C1 .01µF
R1 51
Q1 1854-0005 BUFFER AMPLIFIER
R4 22K
R7 3600
C7 .01µF
R9* 82
L3 220
C4 5000
WHT-BRN
C4 18µF
Q3 1854-0039 DRIVER
WHT-RED-BLU
C2 5000
UNREG SUPPLY FROM A17 (42)
"+24"
R2 18K
R20 1000
OVEN
FROM AC CONTROLLER
C2 .01µF
R3* 39K
CR3
Q2 1854-0023 AMPLIFIER
R10 1000
Q4 1854-0020 OVEN HEATER AMPLIFIER
HR1 HEATER
A1F1
R8 4.7
CR1
CR2
+25V TO 33V
DC CONTROLLER



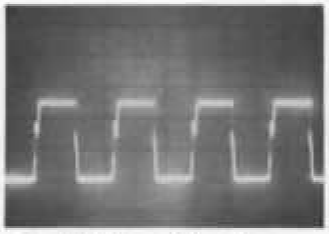
NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

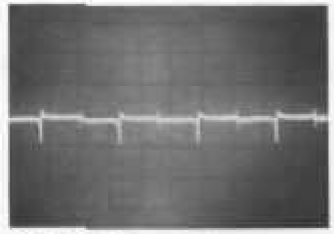
REFERENCE DESIGNATIONS

A10	A10A1	A10A2A1	A10A3
C1,2,4 HR1 J3,4	F1	Y1	C1-15 CR1-3 L1-3 Q1-6 R1-20 T1

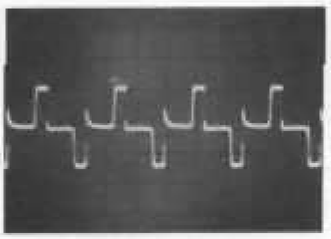
Figure 8-24. Oscillator Assembly A10
Power Amplifier Assembly A10A3



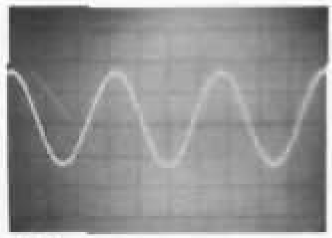
❶ A 5V/cm, 0.2 ms/cm
CS OVEN on full



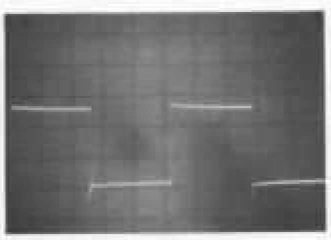
❷ B 5V/cm, 0.2 ms/cm
CS OVEN off



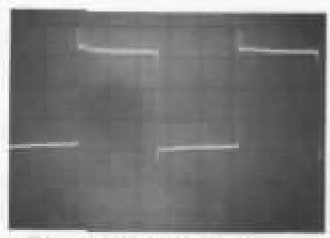
❸ C 5V/cm, 0.2 ms/cm
CS OVEN normal



❹ 5V/cm, 0.1 ms/cm



❺ 10V/cm, 0.1 ms/cm

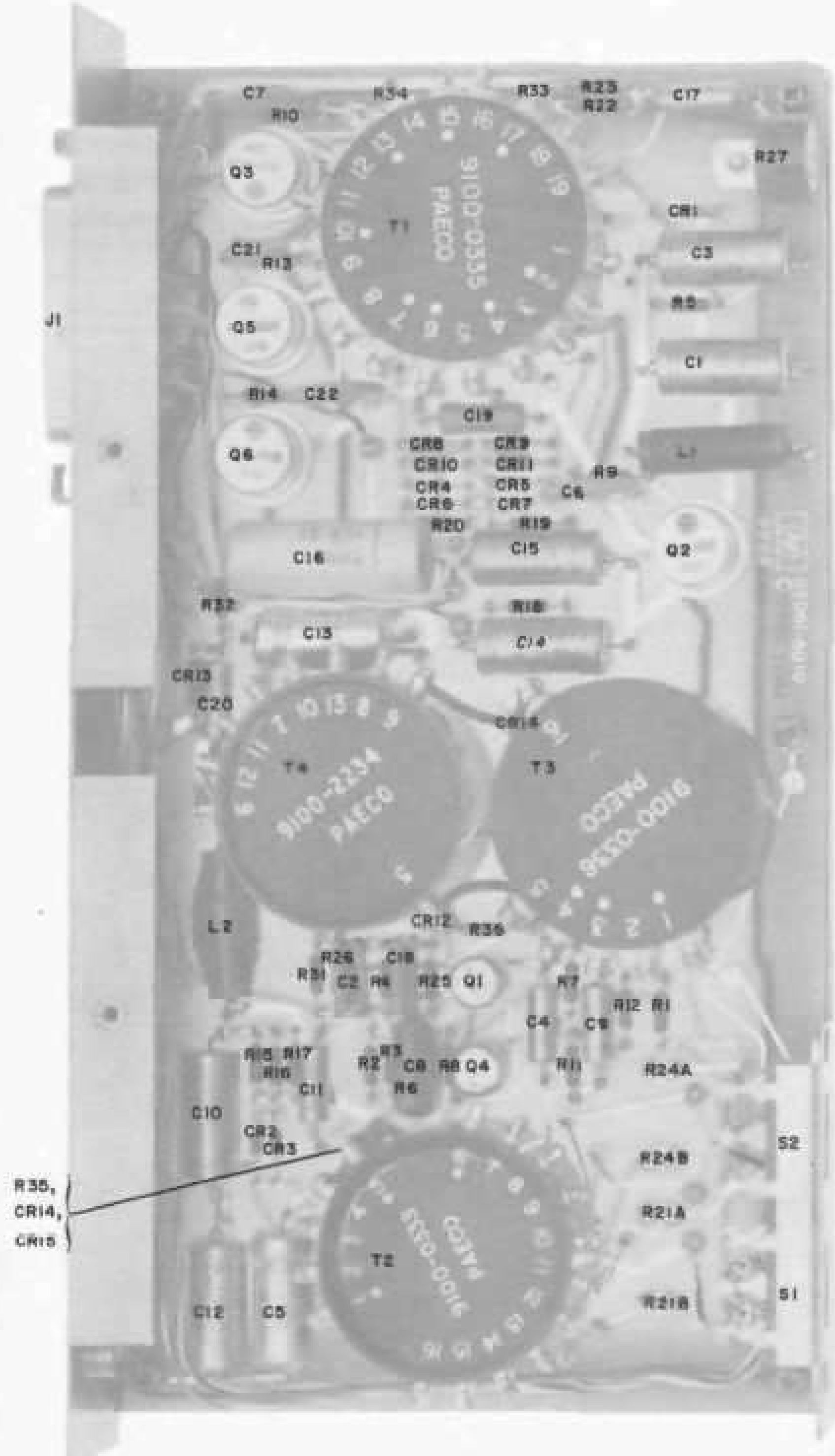


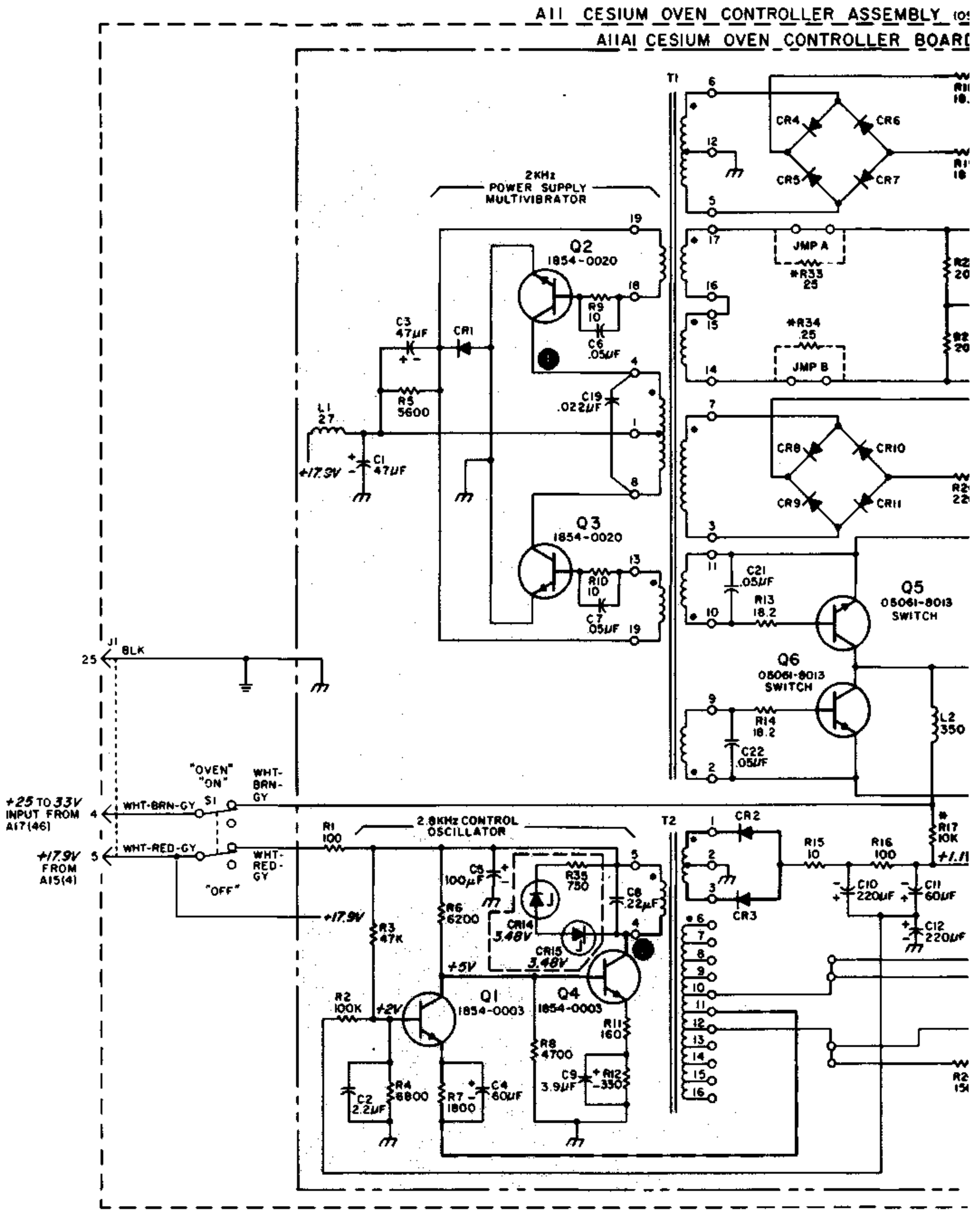
❻ 10V/cm, 0.1 ms/cm

Oscilloscope: DC coupled.

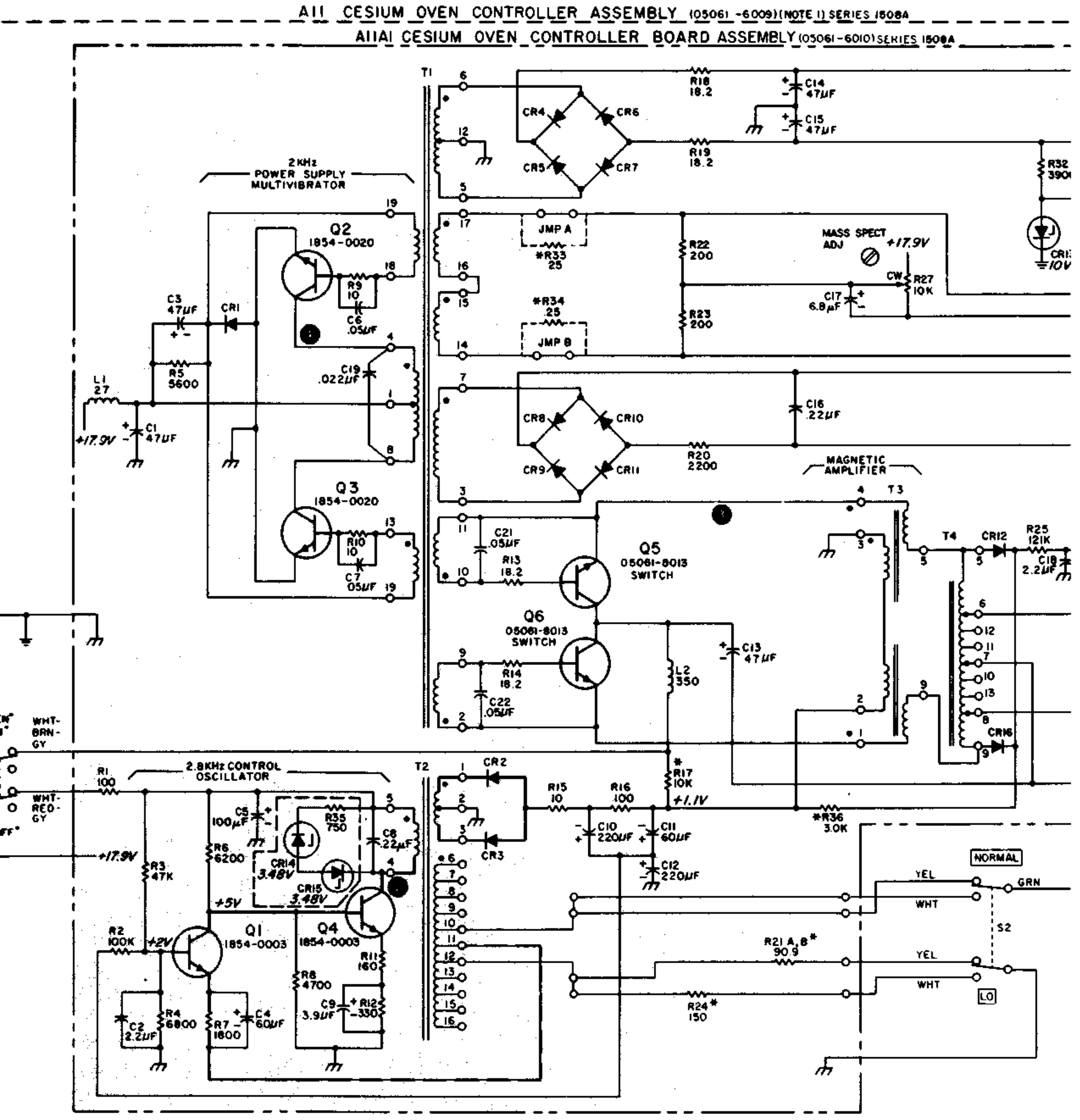
5061A: CS OVEN set to NORM

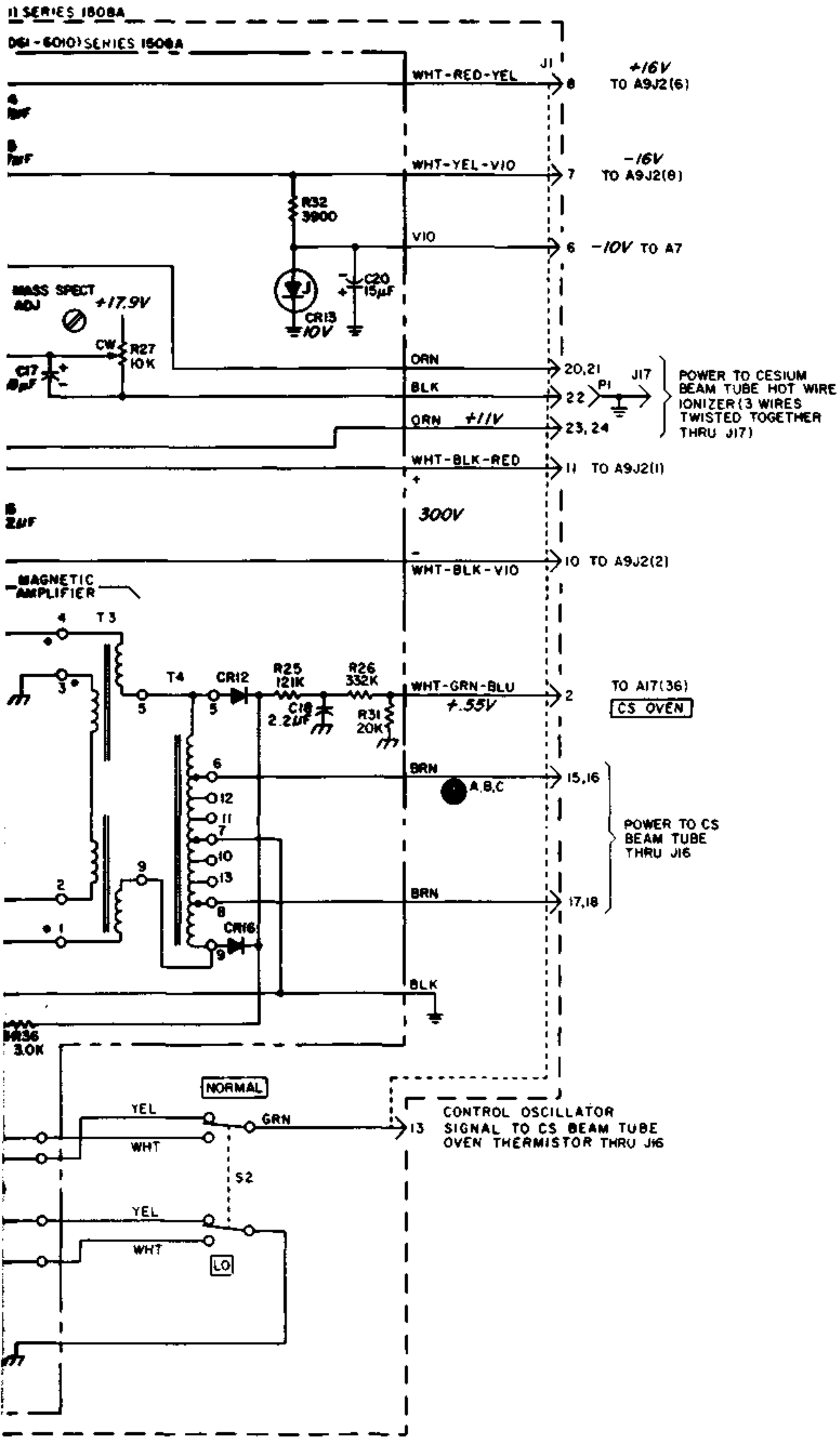
Figure 8-25
CESIUM OVEN CONTROLLER ASSEMBLY A11


C7
R10
R34
R33
R23
R22
C17
Q3
R27
T1
9100-0335
PAECO
CR1
C21
R13
C3
J1
Q5
R5
C1
R14
C22
C19
Q6
CR8
CR9
CR10
CR11
L1
CR4
CR5
R9
CR6
CR7
C6
R20
R19
C16
C15
Q2
R32
R18
C13
C14
CR13
C20
CR16
T4
9100-2234
PAECO
T3
9100-0016
PAECO
L2
CR12
R36
R26
C18
R31
C2
R4
R25
Q1
R7
R12
R1
C4
C9
R15
R17
R16
R3
R2
C8
R8
Q4
R11
R24A
C11
R6
C10
CR2
CR3
S2
R24B
R35,
CR14,
CR15
R21A
T2
C12
C5
R21B
S1



A11 CESIUM OVEN CONTROLLER ASSEMBLY
A11A1 CESIUM OVEN CONTROLLER BOARD
2KHz POWER SUPPLY MULTIVIBRATOR
Q2 1854-0020
Q3 1854-0020
Q5 05061-8013 SWITCH
Q6 05061-8013 SWITCH
2.8KHz CONTROL OSCILLATOR
Q1 1854-0003
Q4 1854-0003
+25 TO 33V INPUT FROM A17(46)
+17.9V FROM A15(4)
"OVEN" "ON"
"OFF"
WHT-BRN-GY
WHT-RED-GY
J1 BLK


A11 CESIUM OVEN CONTROLLER ASSEMBLY (05061-6009) (NOTE 1) SERIES 1508A
A11A1 CESIUM OVEN CONTROLLER BOARD ASSEMBLY (05061-6010) SERIES 1508A
2 KHz POWER SUPPLY MULTIVIBRATOR
Q2 1854-0020
Q3 1854-0020
Q5 05061-8013 SWITCH
Q6 05061-8013 SWITCH
MAGNETIC AMPLIFIER
MASS SPECT ADJ
+17.9V
2.8KHz CONTROL OSCILLATOR
Q1 1854-0003
Q4 1854-0003
+5V
+2V
+1.1V
CR14 3.48V
CR15 3.48V
T1
T2
T3
T4
JMP A
JMP B
S2
NORMAL
LO
YEL
WHT
GRN
WHT-BRN-GY
WHT-RED-GY
R1 100
R2 100K
R3 47K
R4 6800
R5 5600
R6 6200
R7 1800
R8 4700
R9 10
R10 10
R11 160
R12 330
R13 18.2
R14 18.2
R15 10
R16 100
R17 10K
R18 18.2
R19 18.2
R20 2200
R21 A,B 90.9
R22 200
R23 200
R24 150
R25 121K
R27 10K
R32 390
R33 .25
R34 .25
R35 750
R36 3.0K
C1 47UF
C2 2.2UF
C3 47UF
C4 60UF
C5 100μF
C6 .05UF
C7 .05UF
C8 .22μF
C9 3.9μF
C10 220UF
C11 60UF
C12 220UF
C13 47UF
C14 47UF
C15 47UF
C16 .22UF
C17 6.8μF
C18 2.2UF
C19 .022UF
C21 .05UF
C22 .05UF
L1 27
L2 350
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
CR11
CR12
CR16



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN
4. JUMPER A OR B OR BOTH MAY BE REPLACED BY R33 AND/OR R34.

REFERENCE DESIGNATIONS

NO PREFIX	A11	A11A1
J17 P1	J1 S1,2	C1-22 CR1-16 L1,2 R1-27 R31-36 T1-4

TAPS USED ON HOT WIRE IONIZER SECONDARY OF T1

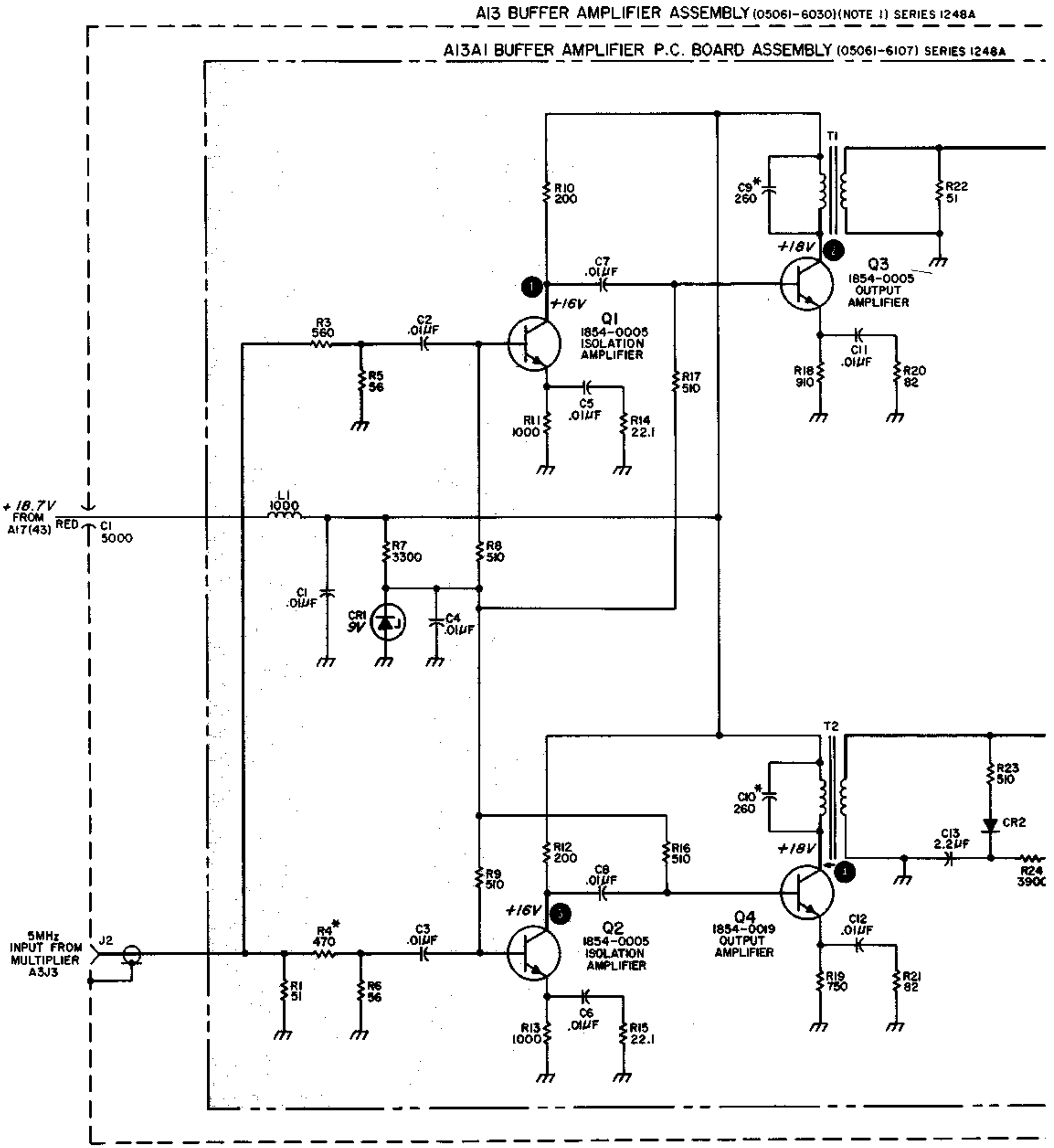
HOT WIRE IONIZER VOLTAGE	OUTPUT TAPS	STRAP TAPS
<1.2V	15, 17	14, 16
1.2V - 1.6V	16, 17	
>1.6V	14, 17	15, 16

05061-0-25

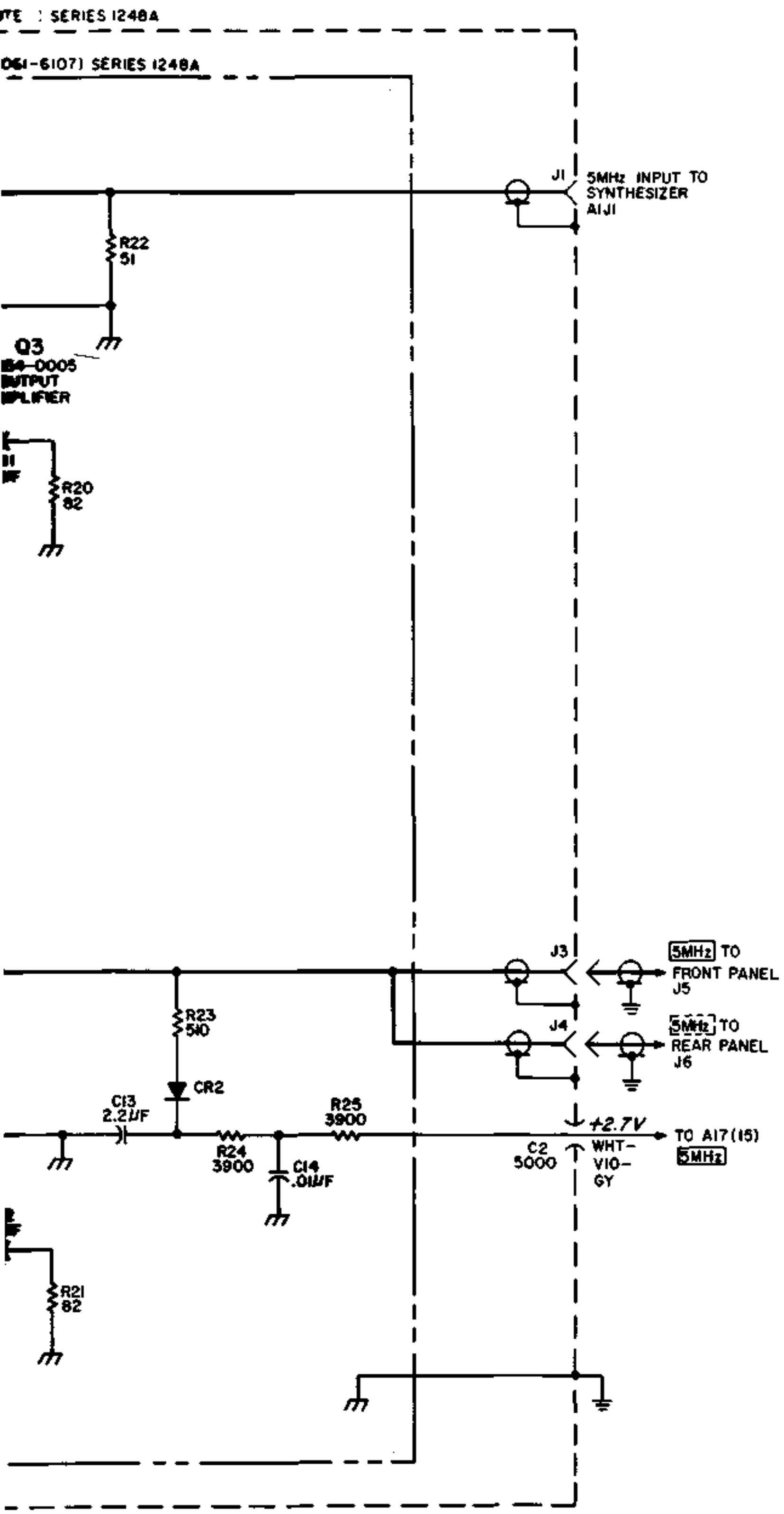
Figure 8-25. Cesium Oven Controller Assembly A11

Figure 8-26

BUFFER AMPLIFIER ASSEMBLY A13



A13 BUFFER AMPLIFIER ASSEMBLY (05061-6030) (NOTE 1) SERIES 1248A
A13A1 BUFFER AMPLIFIER P.C. BOARD ASSEMBLY (05061-6107) SERIES 1248A
+18.7V FROM A17(43)
RED
C1 5000
5MHz INPUT FROM MULTIPLIER A3J3
J2
R10 200
R11 1000
R12 200
R13 1000
R14 22.1
R15 22.1
R16 510
R17 510
R18 910
R19 750
R20 82
R21 82
R22 51
R23 510
R24 3900
R3 560
R4* 470
R5 56
R6 56
R7 3300
R8 510
R9 510
R1 51
L1 1000
C1 .01μF
C2 .01μF
C3 .01μF
C4 .01μF
C5 .01μF
C6 .01μF
C7 .01μF
C8 .01μF
C9* 260
C10* 260
C11 .01μF
C12 .01μF
C13 2.2μF
CR1 9V
CR2
T1
T2
+16V
+18V
Q1 1854-0005 ISOLATION AMPLIFIER
Q2 1854-0005 ISOLATION AMPLIFIER
Q3 1854-0005 OUTPUT AMPLIFIER
Q4 1854-0019 OUTPUT AMPLIFIER



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

A13	A13A1
C1,2	C1-14 CR1,2
J1-4	L1 Q1-4 R1,3 T1,2

R2 NOT USED

05061-D-26A

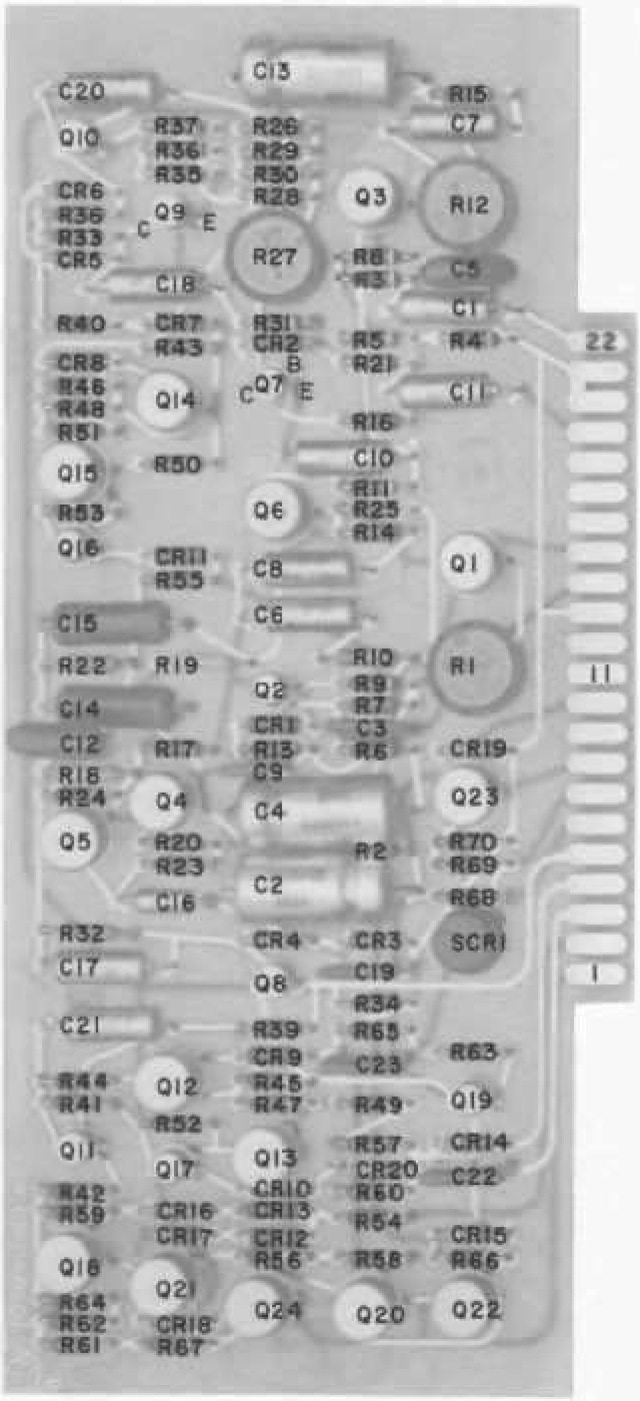
Figure 8-26. Buffer Amplifier Assembly A13

Figure 8-27
LOGIC ASSEMBLY A14

NOTES

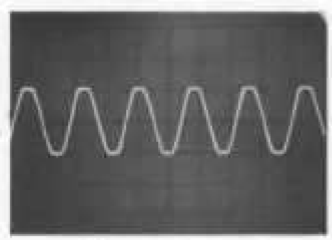
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:

   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.

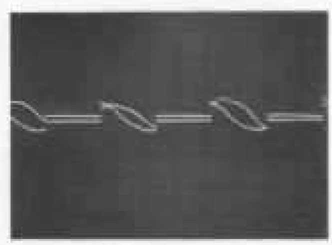


REFERENCE DESIGNATIONS

NO PREFIX	A14
DS1, 2 S7	C1—23 CR1—20 Q1—24 R1—70 SCR1



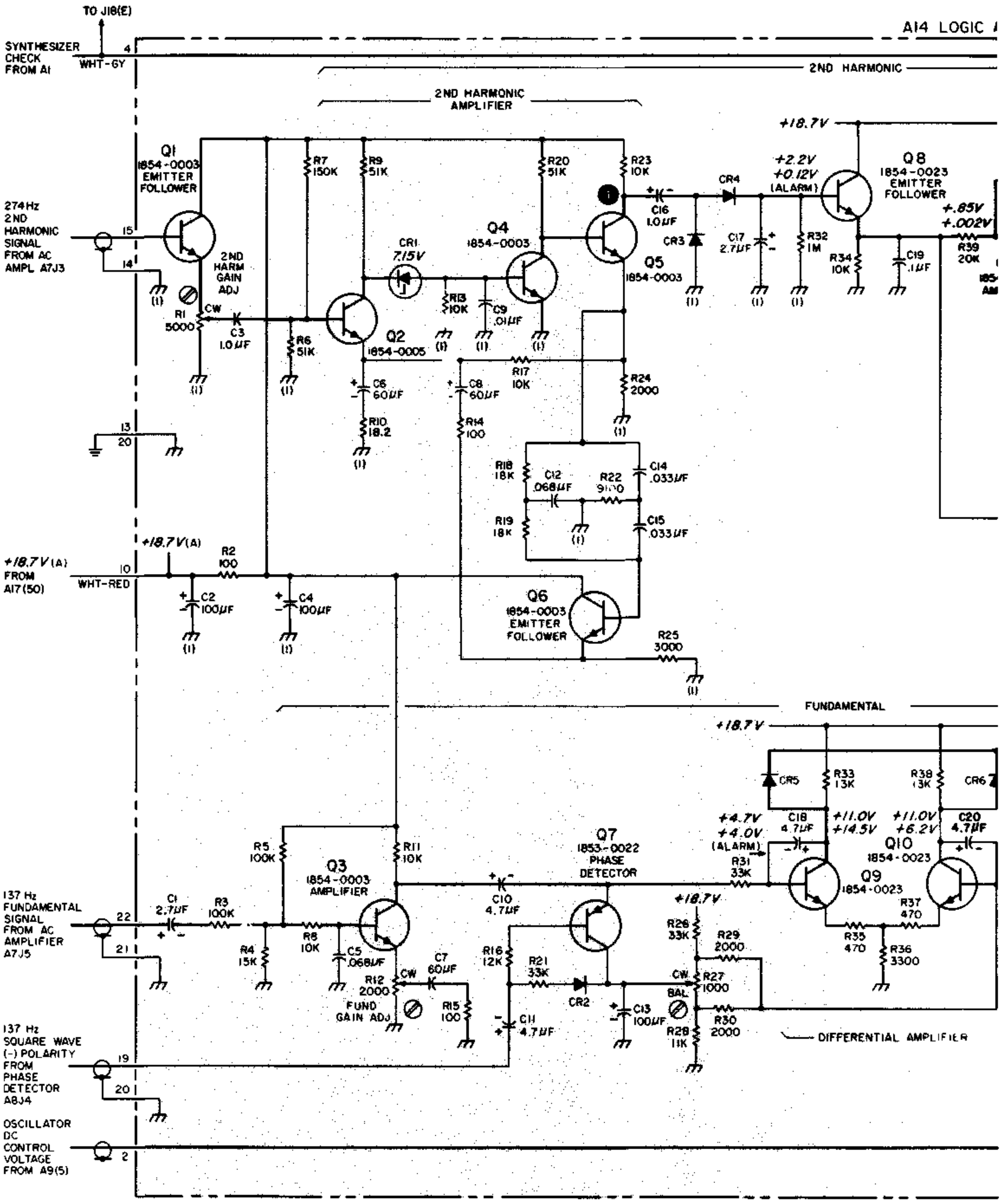
2V/cm, 2 ms/cm



0.5V/cm, 2 ms/cm

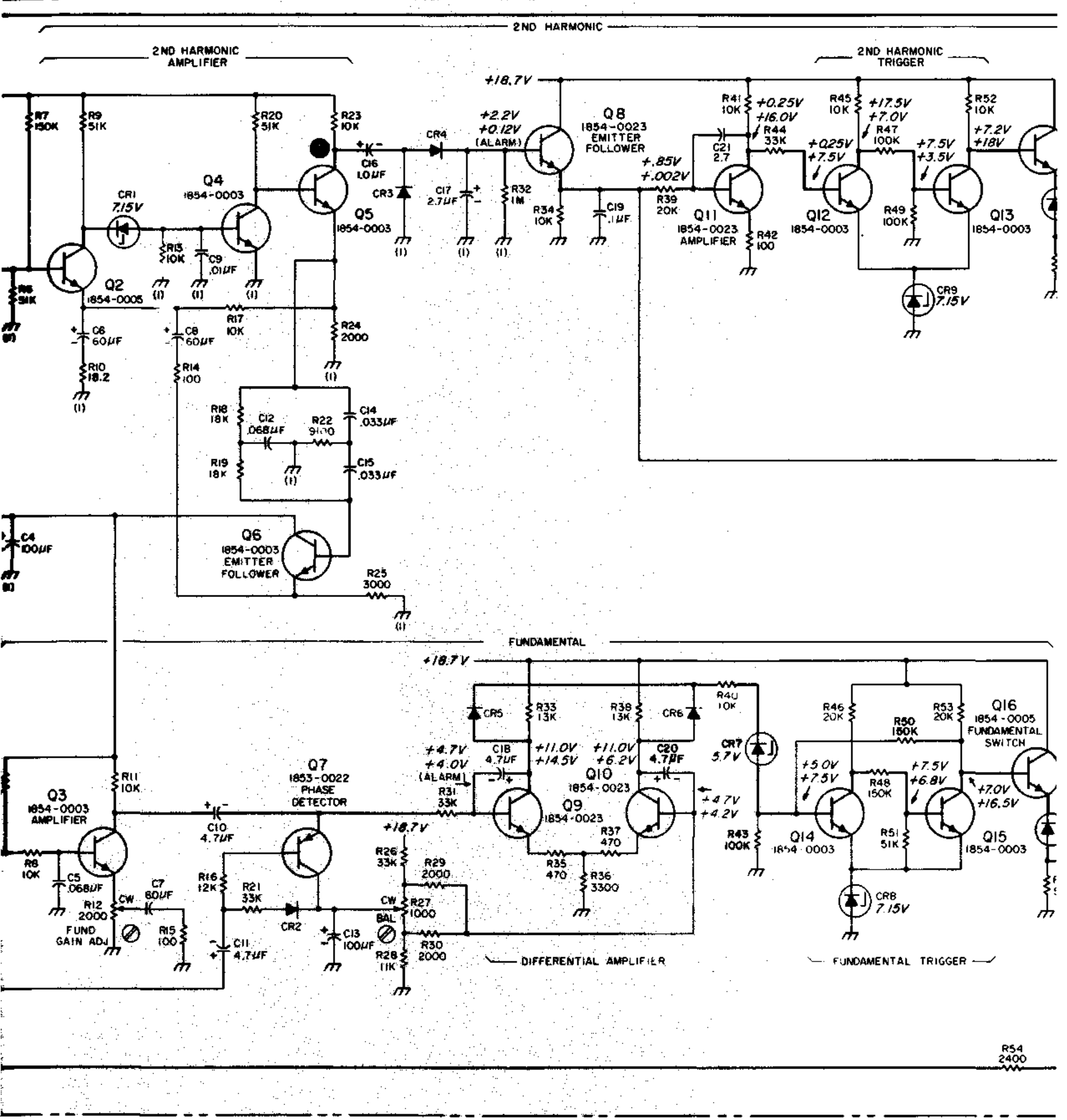
Oscilloscope: DC coupled.

5061A: Normal Operation.



TO J18(E)
SYNTHESIZER CHECK FROM A1
WHT-GY
A14 LOGIC
2ND HARMONIC
2ND HARMONIC AMPLIFIER
Q1 1854-0003 EMITTER FOLLOWER
274 Hz 2ND HARMONIC SIGNAL FROM AC AMPL A7J3
2ND HARM GAIN ADJ
R1 5000
C3 1.0µF
R6 51K
R7 150K
R9 51K
Q2 1854-0005
CR1 7.15V
R13 10K
C9 .01µF
Q4 1854-0003
R20 51K
R23 10K
Q5 1854-0003
C6 60µF
R10 18.2
C8 60µF
R14 100
R17 10K
R24 2000
C16 1.0µF
CR4
CR3
C17 2.7µF
R32 1M
+18.7V
+2.2V
+0.12V (ALARM)
Q8 1854-0023 EMITTER FOLLOWER
R34 10K
C19 .1µF
+.85V
+.002V
R39 20K
R18 18K
C12 .068µF
R22 9100
C14 .033µF
R19 18K
C15 .033µF
+18.7V(A)
+18.7V(A) FROM A17(50)
WHT-RED
R2 100
C2 100µF
C4 100µF
Q6 1854-0003 EMITTER FOLLOWER
R25 3000
FUNDAMENTAL
+18.7V
CR5
R33 13K
R38 13K
CR6
+4.7V
+4.0V (ALARM)
C18 4.7µF
+11.0V
+14.5V
+11.0V
+6.2V
C20 4.7µF
Q10 1854-0023
Q9 1854-0023
R31 33K
R37 470
R35 470
R36 3300
Q7 1853-0022 PHASE DETECTOR
C10 4.7µF
R5 100K
R11 10K
Q3 1854-0003 AMPLIFIER
137 Hz FUNDAMENTAL SIGNAL FROM AC AMPLIFIER A7J5
C1 2.7µF
R3 100K
R4 15K
R8 10K
C5 .068µF
R12 2000
FUND GAIN ADJ
C7 60µF
R15 100
R16 12K
R21 33K
CR2
C11 4.7µF
C13 100µF
+18.7V
R26 33K
R29 2000
R27 1000
BAL
R30 2000
R28 11K
DIFFERENTIAL AMPLIFIER
137 Hz SQUARE WAVE (-) POLARITY FROM PHASE DETECTOR A8J4
OSCILLATOR DC CONTROL VOLTAGE FROM A9(5)

A14 LOGIC ASSEMBLY (05061-6016) (NOTE 1) SERIES 1244A



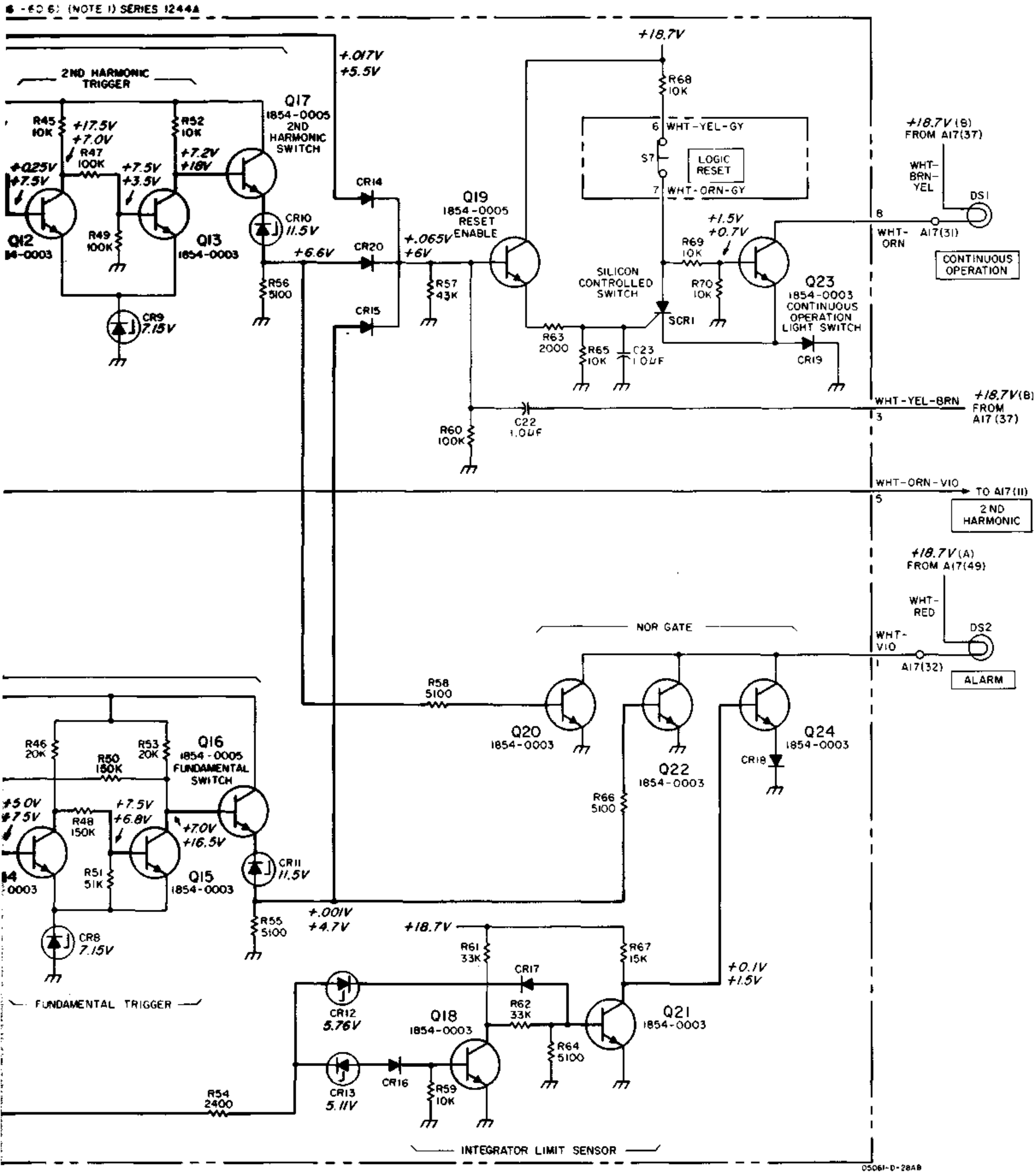
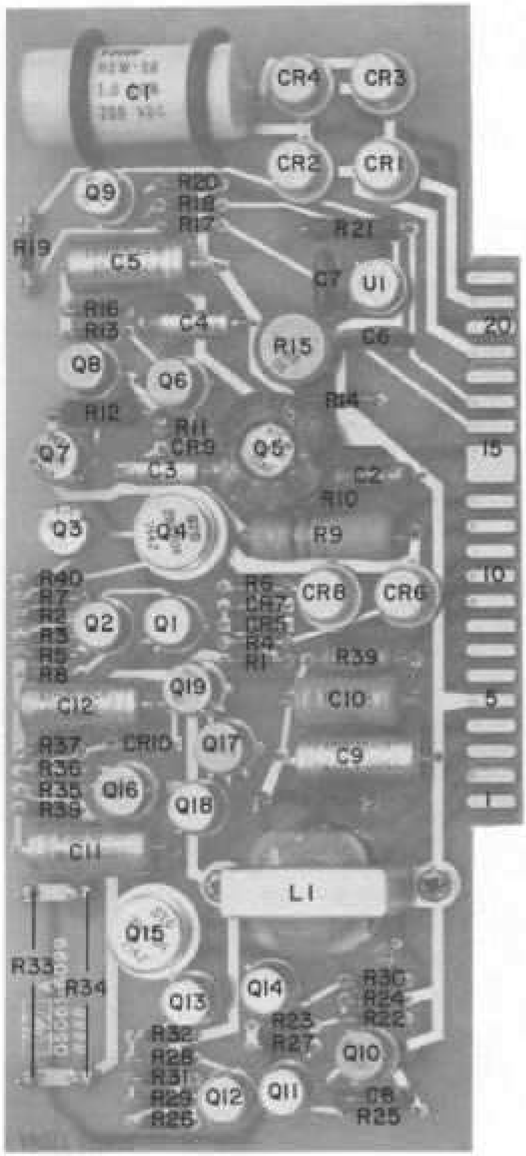
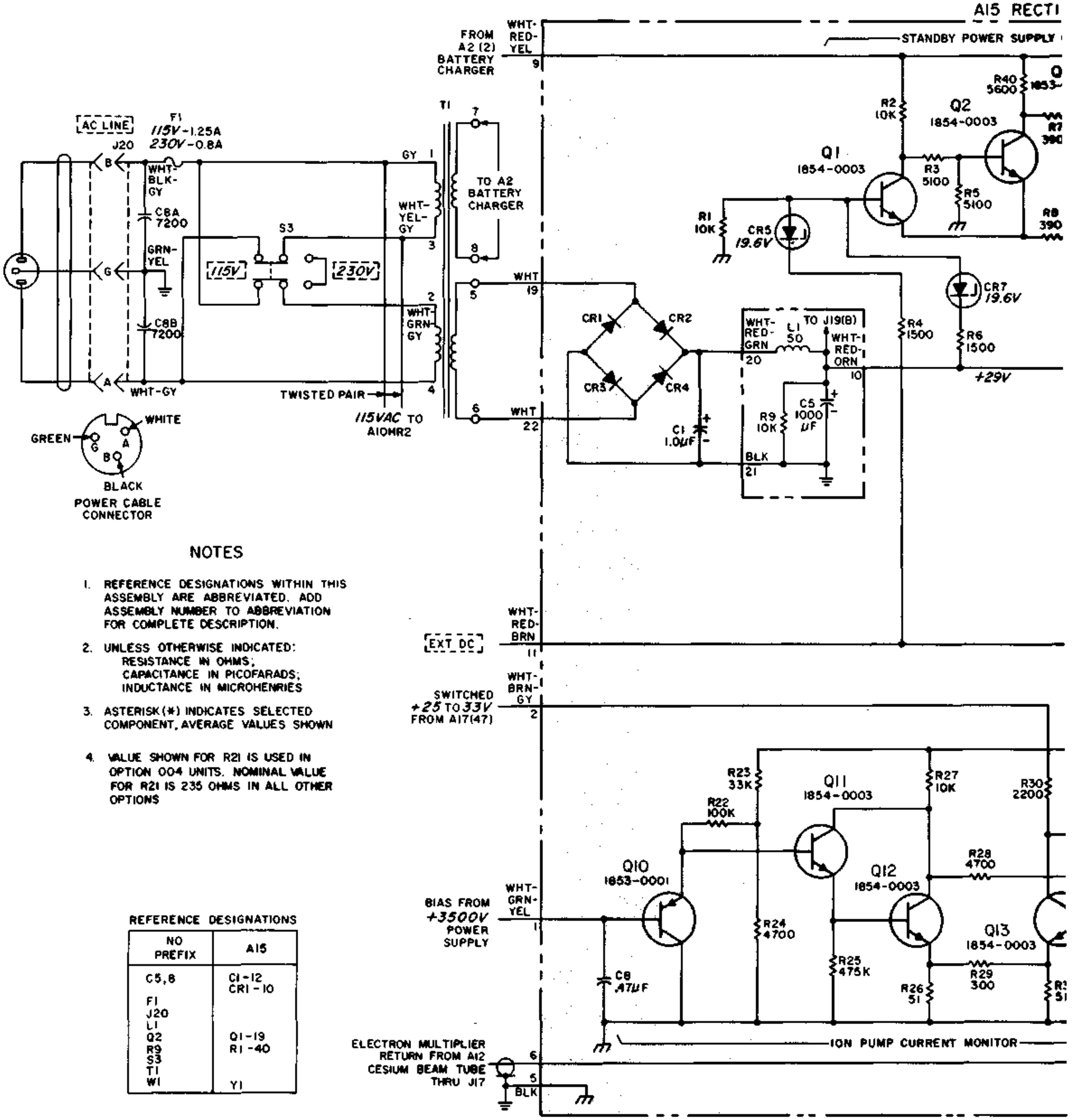


Figure 8-27. Logic Assembly A14

Figure 8-28
POWER REGULATOR ASSEMBLY A15


C1
CR4
CR3
CR2
CR1
Q9
R20
R18
R17
R21
R19
C5
C7
U1
R16
R13
C4
R15
C6
20
Q8
Q6
R14
R12
R11
CR9
Q7
Q5
15
C3
C2
R10
Q3
Q4
R9
R40
R7
R2
R3
R5
R8
Q2
Q1
R6
CR7
CR5
R4
R1
CR8
CR6
10
R39
C12
Q19
C10
5
R37
CR10
Q17
C9
R36
R35
R38
Q16
Q18
1
C11
L1
Q15
R33
R34
Q13
Q14
R30
R24
R22
R23
R27
Q10
R32
R28
R31
R29
R26
Q12
Q11
C8
R25



NOTES

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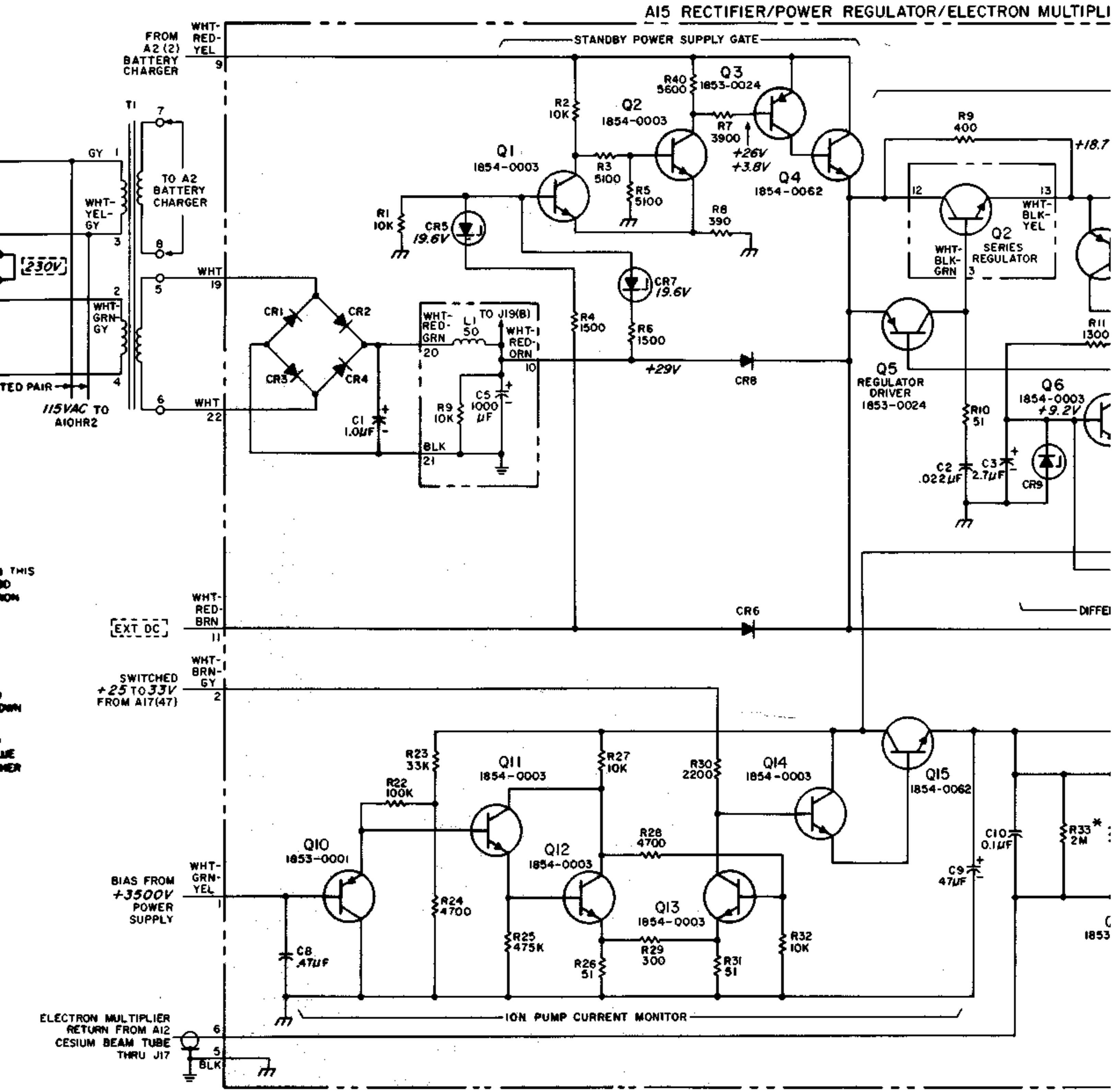
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN
4. VALUE SHOWN FOR R21 IS USED IN OPTION 004 UNITS. NOMINAL VALUE FOR R21 IS 235 OHMS IN ALL OTHER OPTIONS

REFERENCE DESIGNATIONS

NO PREFIX	A15
C5,8 F1 J20 L1 Q2 R9 S3 T1 W1	C1-12 CR1-10 Q1-19 R1-40 Y1



A15 RECTIFIER/POWER REGULATOR/ELECTRON MULTIPLI
STANDBY POWER SUPPLY GATE
FROM A2 (2) BATTERY CHARGER
WHT-RED-YEL
T1
GY
WHT-YEL-GY
WHT-GRN-GY
TO A2 BATTERY CHARGER
230V
TED PAIR
115VAC TO A10HR2
WHT
CR1
CR2
CR3
CR4
C1 1.0μF
WHT-RED-GRN
L1 50
TO J19(B)
WHT-RED-ORN
C5 1000 μF
R9 10K
BLK
R1 10K
CR5 19.6V
Q1 1854-0003
R2 10K
Q2 1854-0003
R3 5100
R5 5100
R40 5600
Q3 1853-0024
R7 3900
+26V
+3.8V
Q4 1854-0062
R8 390
CR7 19.6V
R4 1500
R6 1500
+29V
CR8
R9 400
+18.7
Q2 SERIES REGULATOR
WHT-BLK-YEL
WHT-BLK-GRN
Q5 REGULATOR DRIVER 1853-0024
R10 51
C2 .022μF
C3 2.7μF
CR9
Q6 1854-0003
+9.2V
R11 1300
WHT-RED-BRN
EXT DC
CR6
DIFFE
SWITCHED +25 TO 33V FROM A17(47)
WHT-BRN-GY
R23 33K
R22 100K
Q11 1854-0003
R27 10K
R30 2200
Q14 1854-0003
Q15 1854-0062
Q10 1853-0001
Q12 1854-0003
R28 4700
Q13 1854-0003
BIAS FROM +3500V POWER SUPPLY
WHT-GRN-YEL
R24 4700
R25 475K
R26 51
R29 300
R31 51
R32 10K
C8 .47μF
C9 47μF
C10 0.1μF
R33* 2M
1853
ION PUMP CURRENT MONITOR
ELECTRON MULTIPLIER RETURN FROM A12 CESIUM BEAM TUBE THRU J17
BLK

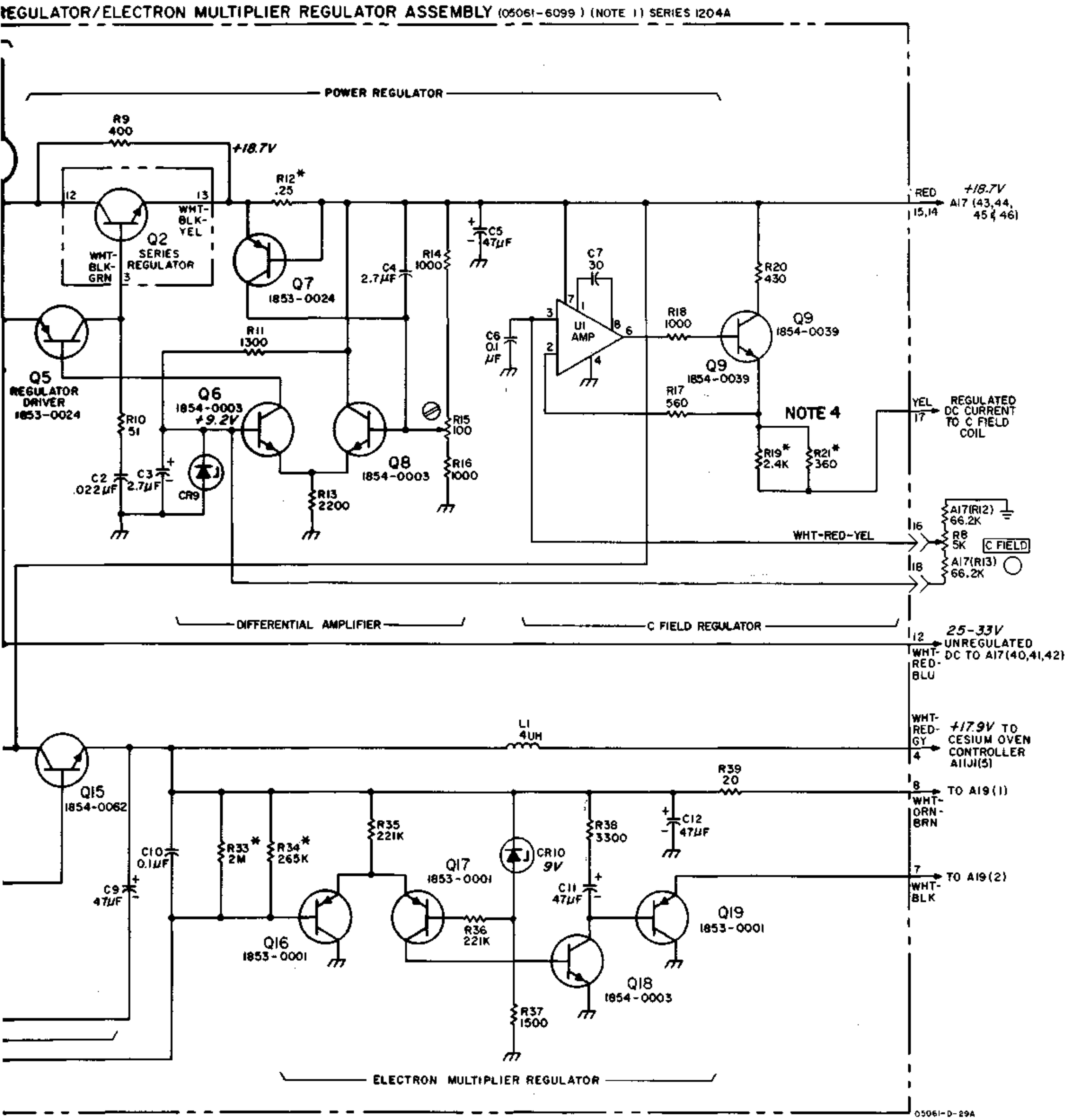
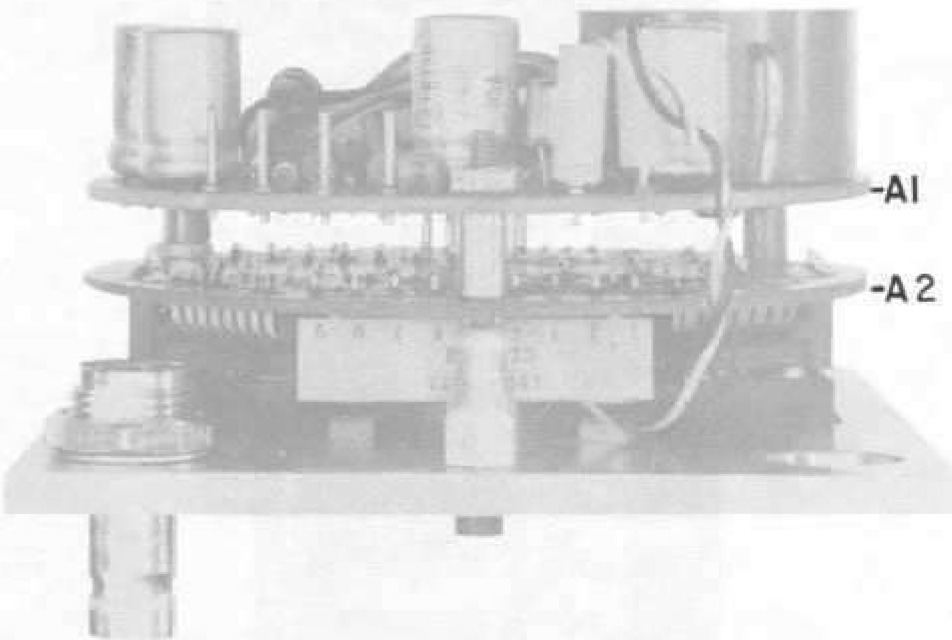


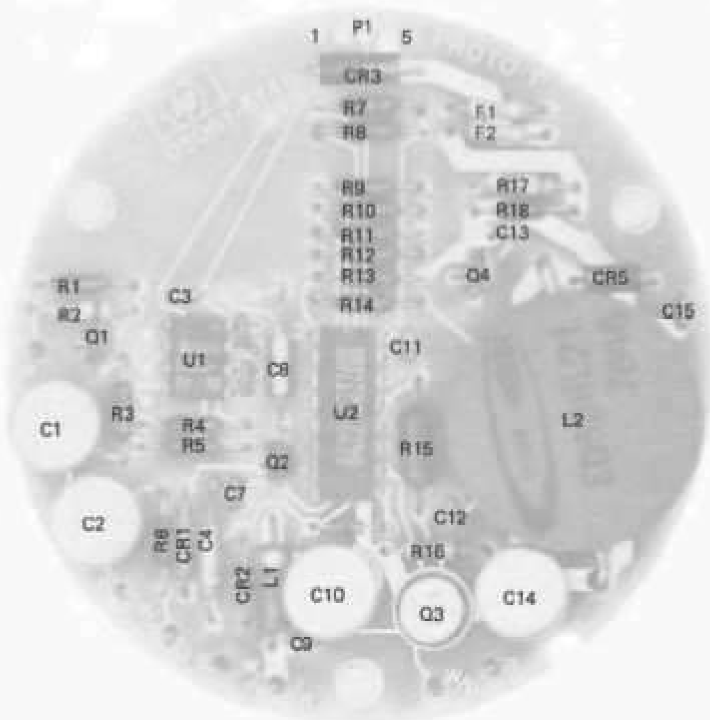
Figure 8-28. Power Regulator Assembly A15

Part of Figure 8-29.

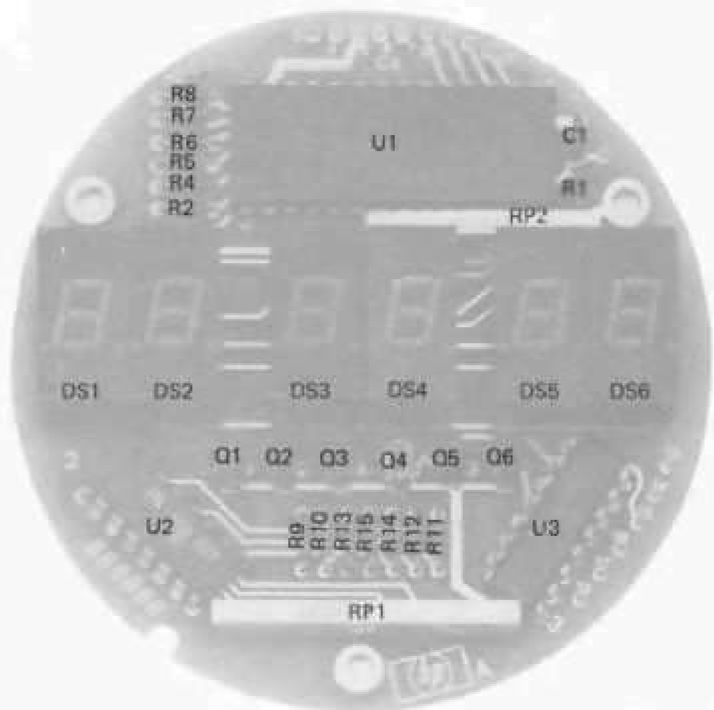


Clock Display Assembly A16 Side View

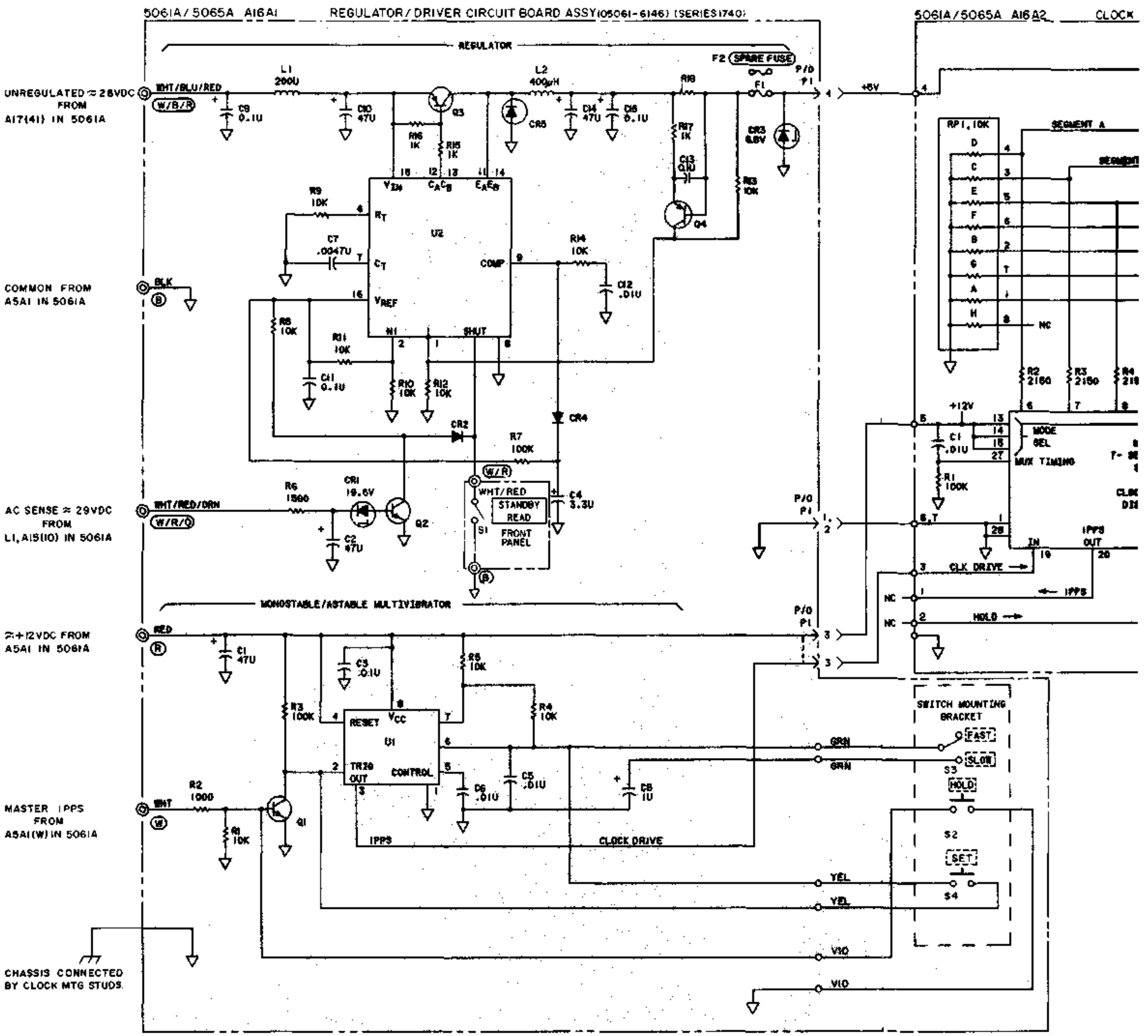
Figure 8-29
CLOCK DISPLAY ASSEMBLY A16



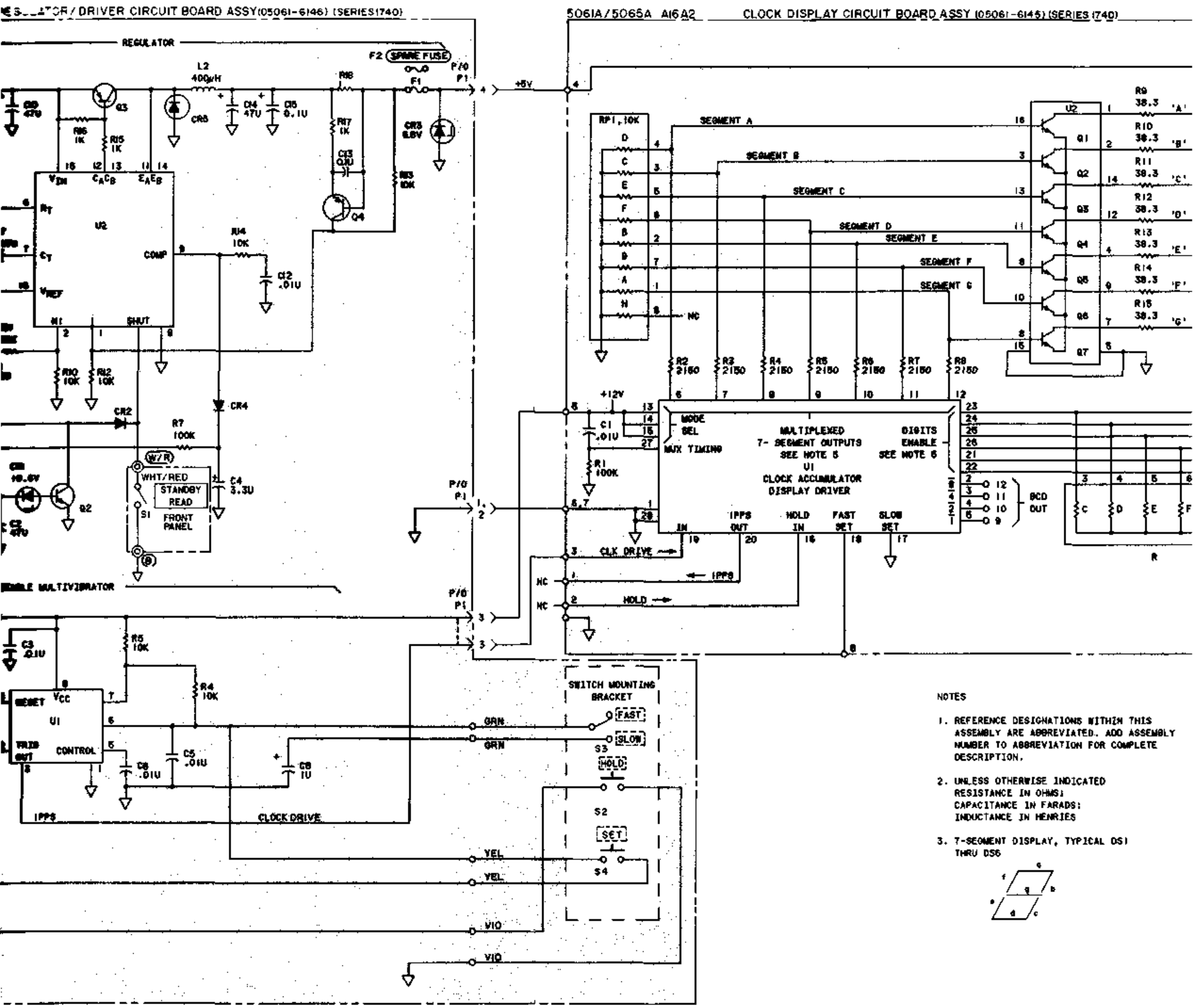
Clock Display Assembly A16A1 Regulator/Driver Component Locator



Clock Display Assembly A16A2 Display Board Component Locator



5061A/5065A A16A1
REGULATOR/DRIVER CIRCUIT BOARD ASSY (05061-6146) (SERIES 1740)
5061A/5065A A16A2
CLOCK
REGULATOR
UNREGULATED ≈ 28VDC FROM A17(41) IN 5061A
COMMON FROM A5A1 IN 5061A
AC SENSE ≈ 29VDC FROM L1, A15(10) IN 5061A
≈+12VDC FROM A5A1 IN 5061A
MASTER 1PPS FROM A5A1(W) IN 5061A
CHASSIS CONNECTED BY CLOCK MTG STUDS
MONOSTABLE/ASTABLE MULTIVIBRATOR
SWITCH MOUNTING BRACKET
FAST
SLOW
HOLD
SET
STANDBY READ
FRONT PANEL
MUX TIMING
MODE SEL
CLK DRIVE
HOLD
1PPS
CLOCK DRIVE



NOTES

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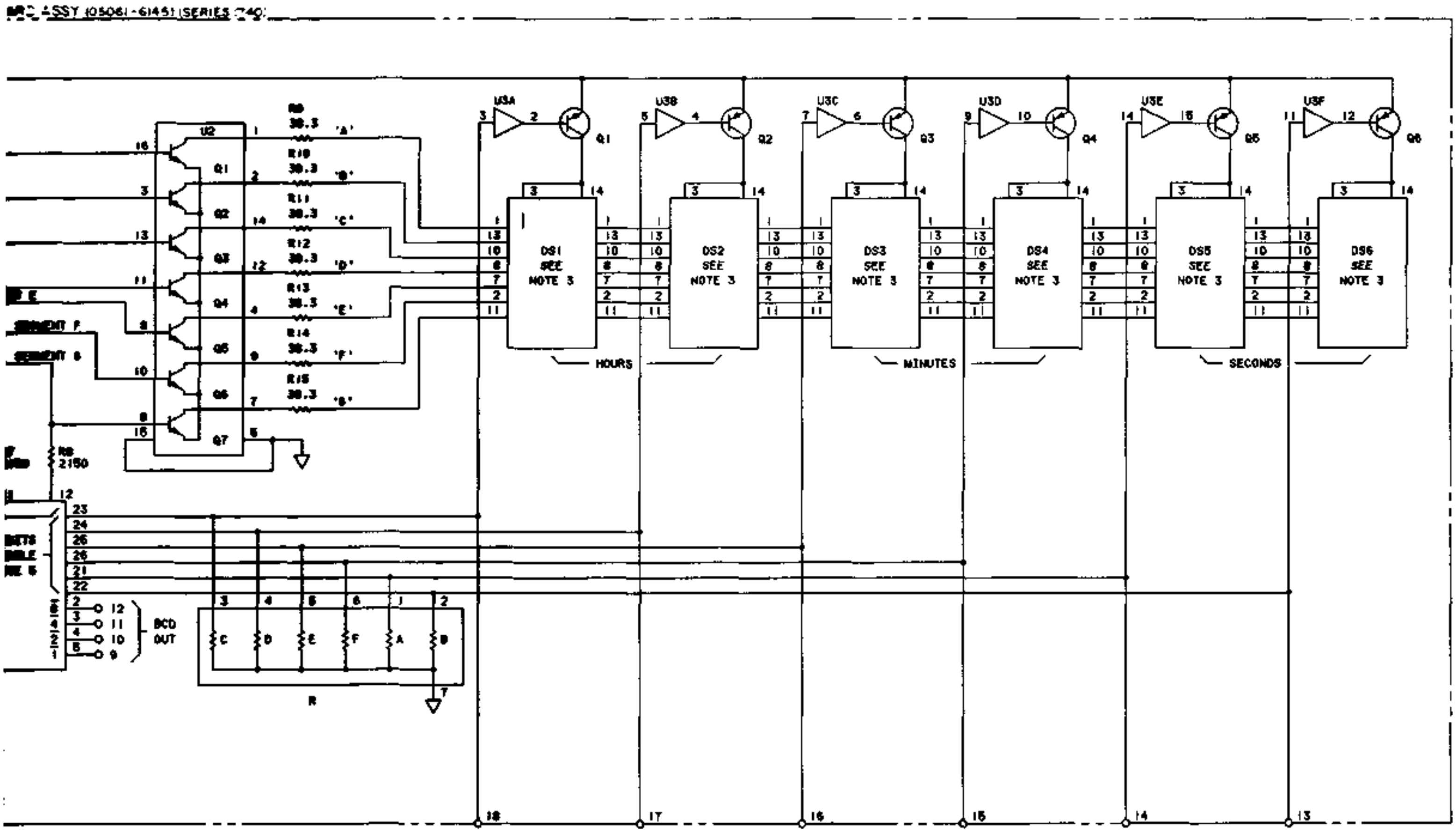
2. UNLESS OTHERWISE INDICATED RESISTANCE IN OHMS; CAPACITANCE IN FARADS; INDUCTANCE IN HENRIES

3. 7-SEGMENT DISPLAY, TYPICAL DS1 THRU DS6



NOTES

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2. UNLESS OTHERWISE INDICATED RESISTANCE IN OHMS; CAPACITANCE IN FARADS; INDUCTANCE IN HENRIES

3. 7-SEGMENT DISPLAY, TYPICAL DS1 THRU DS6

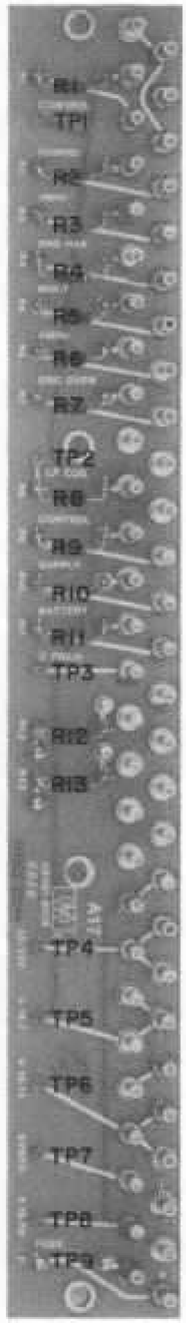
4. 

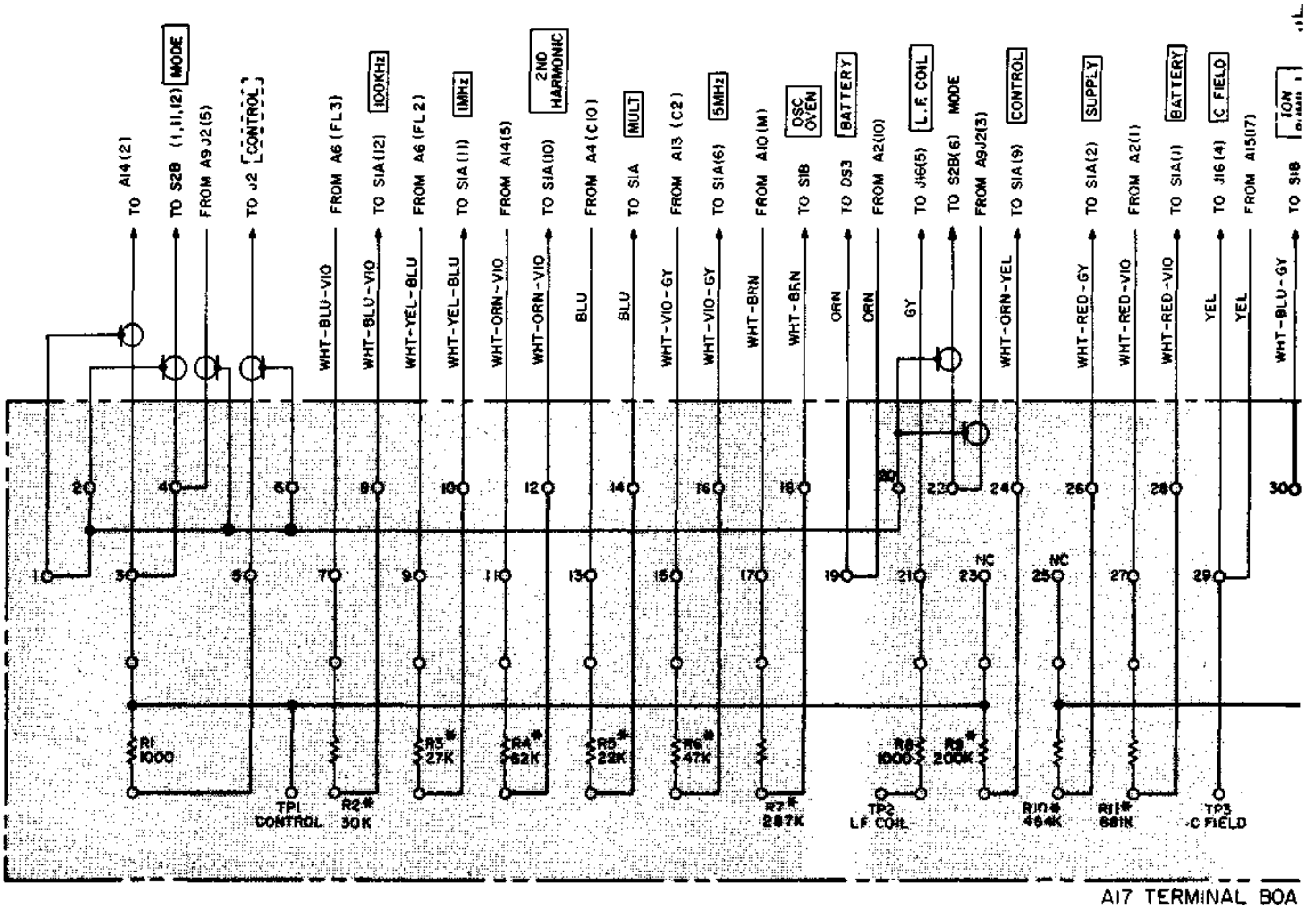
APPROXIMATION OF DISPLAY AND SEGMENT SWITCHING WAVE FORM IN SOME CASES THE SAME SEGMENT IS OFF IN ALL DISPLAY GIVING A STRAIGHT LINE WAVE FORM. WAVEFORMS WILL CHANGE EACH SECOND WITH CLOCK RUNNING.

5. LEGEND: ◎ POST TERMINALS
O WIRE SOLDERED IN BOARD

Figure 8-29. Clock Display Assembly A16

Figure 8-30
TERMINAL BOARD ASSEMBLY A17


R1
TP1
R2
R3
R4
R5
R6
R7
TP2
R8
R9
R10
R11
TP3
R12
R13
A17
TP4
TP5
TP6
TP7
TP8
TP9



NOTES

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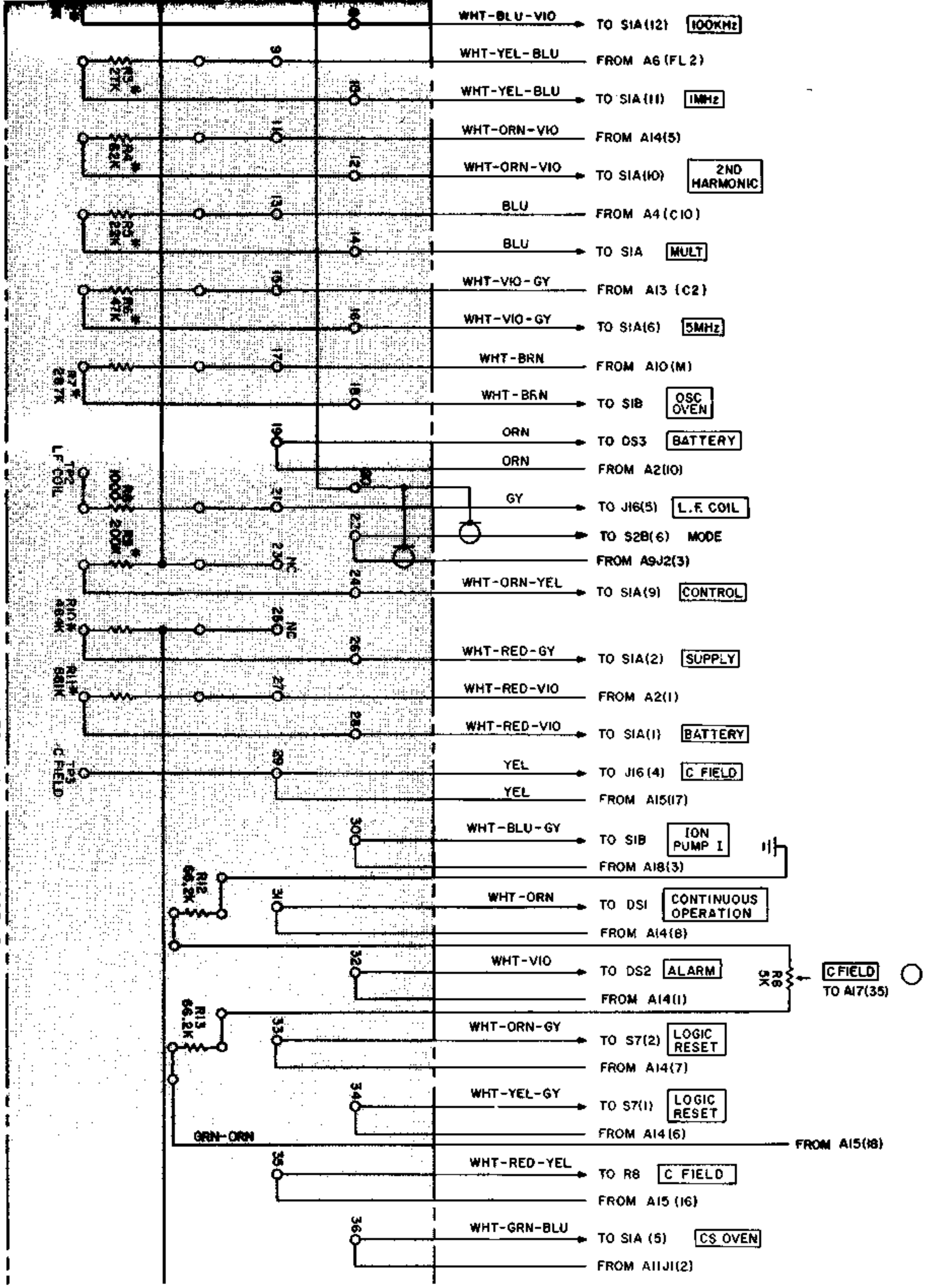
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS;

3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

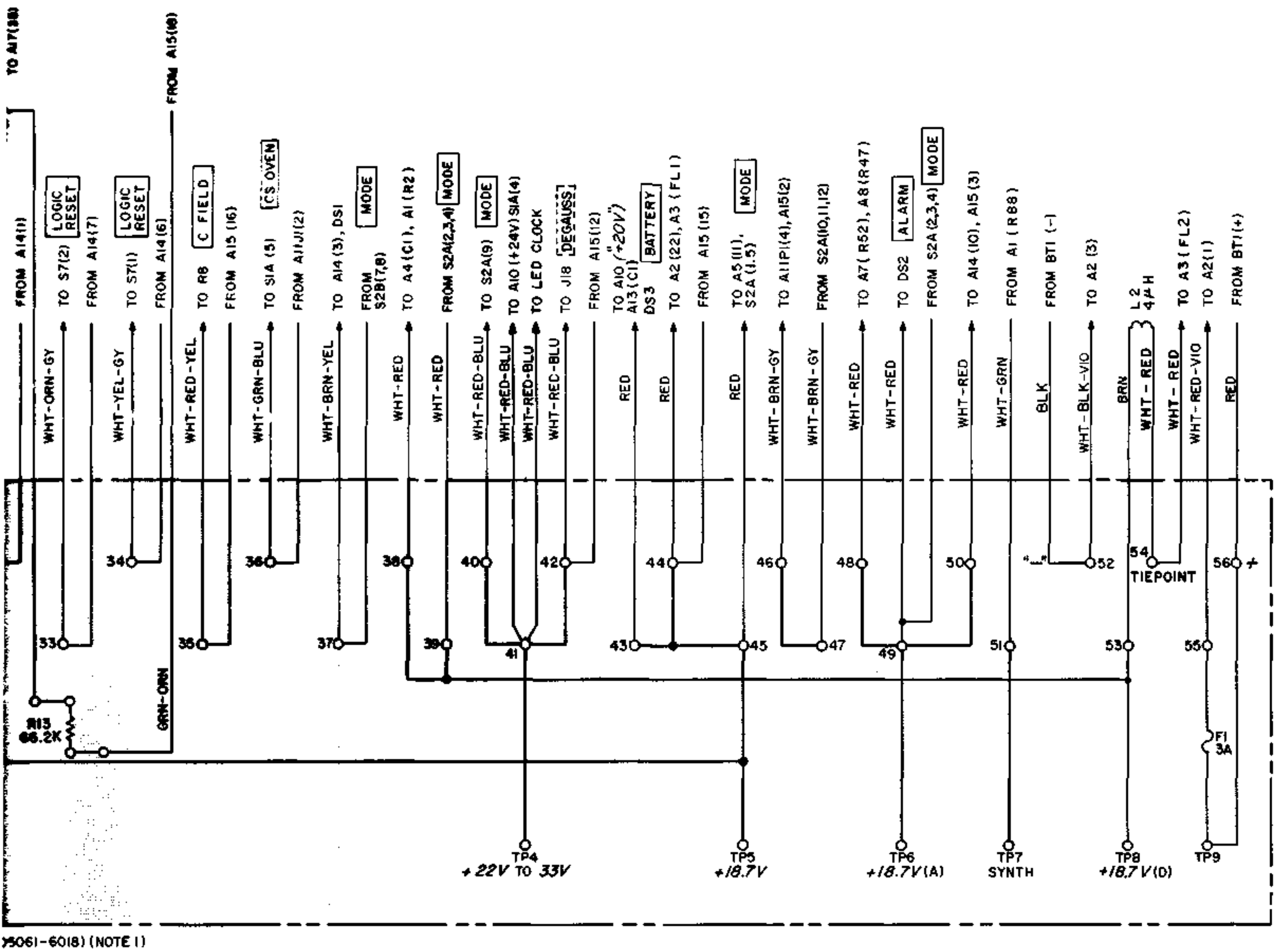
NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS;
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS	
A17	F1, R1-13, TP1-9



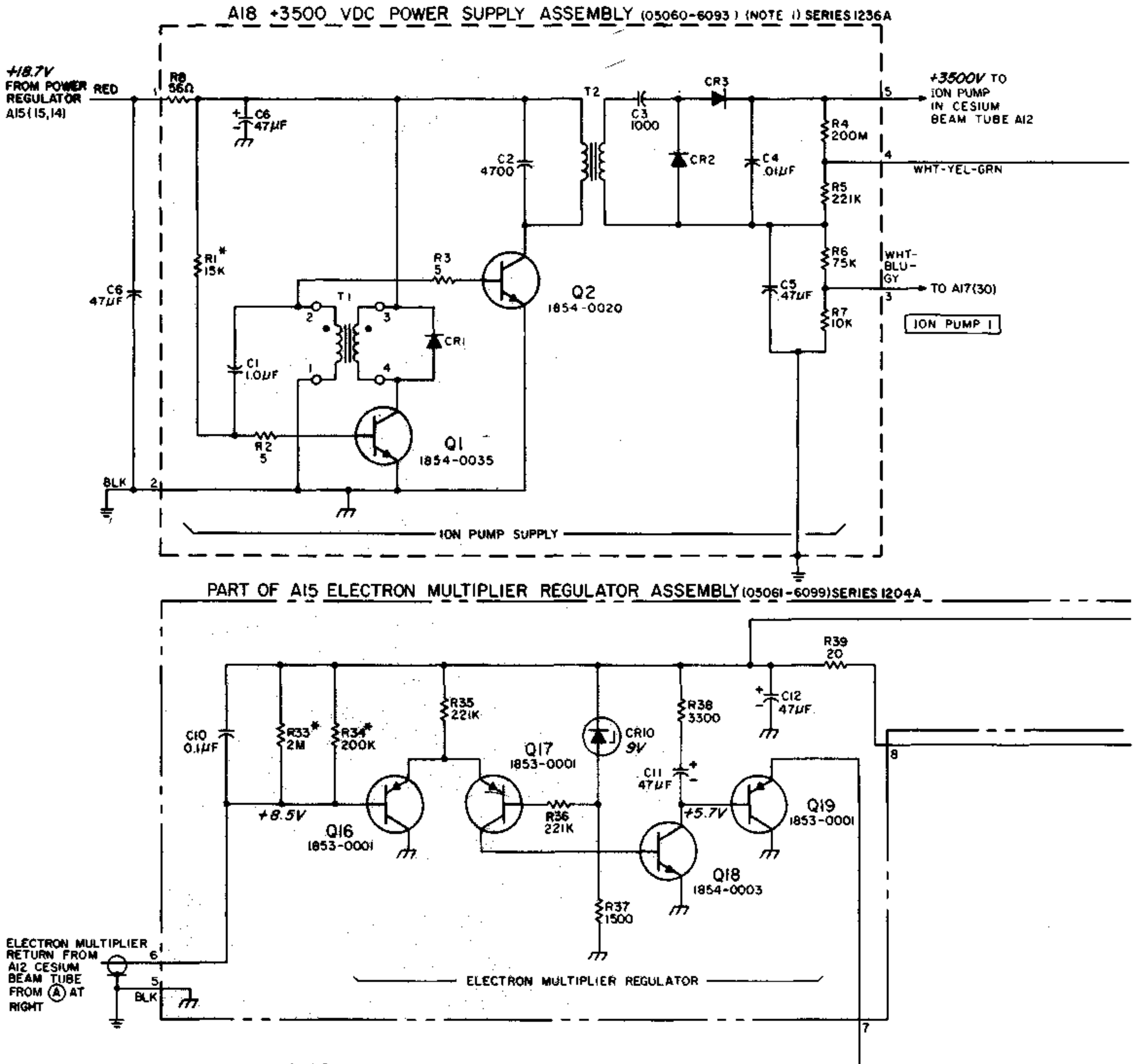
A17 TERMINAL BOARD ASSEMBLY (05061-60181) (NOTE 1)



05061-0-308

Figure 8-30. Terminal Board Assembly A17

Figure 8-31
+3500 VDC POWER SUPPLY ASSEMBLY A18
-2500 VDC POWER SUPPLY ASSEMBLY A19



NOTES

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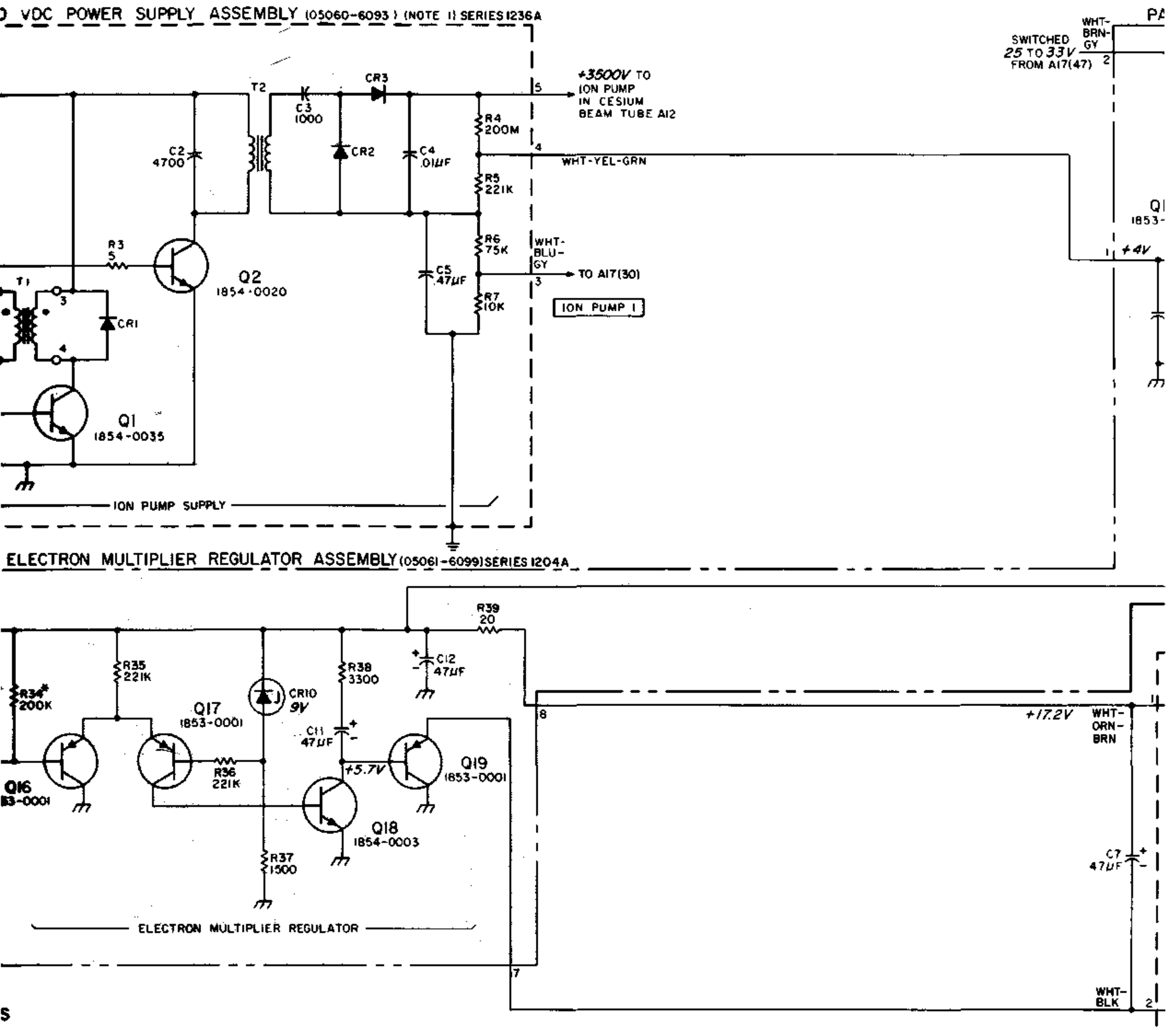
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERI

NO PREFIX	A1
C6,7	C8- CR10 L1 Q10- R22-



S

IONS WITHIN THIS
EVIATED. ADD
D ABBREVIATION
PTION.

NDICATED:
MS;
COFARADS;
ROHENRIES

S SELECTED
VALUES SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A15	A18	A19
C6,7	C8-12 CR10 L1 Q10-19 R22-39	C1-6 CR1-3 Q1,2 R1-8 T1,2	C1-5 CR1-3 Q1,2 R1-9 T1,2

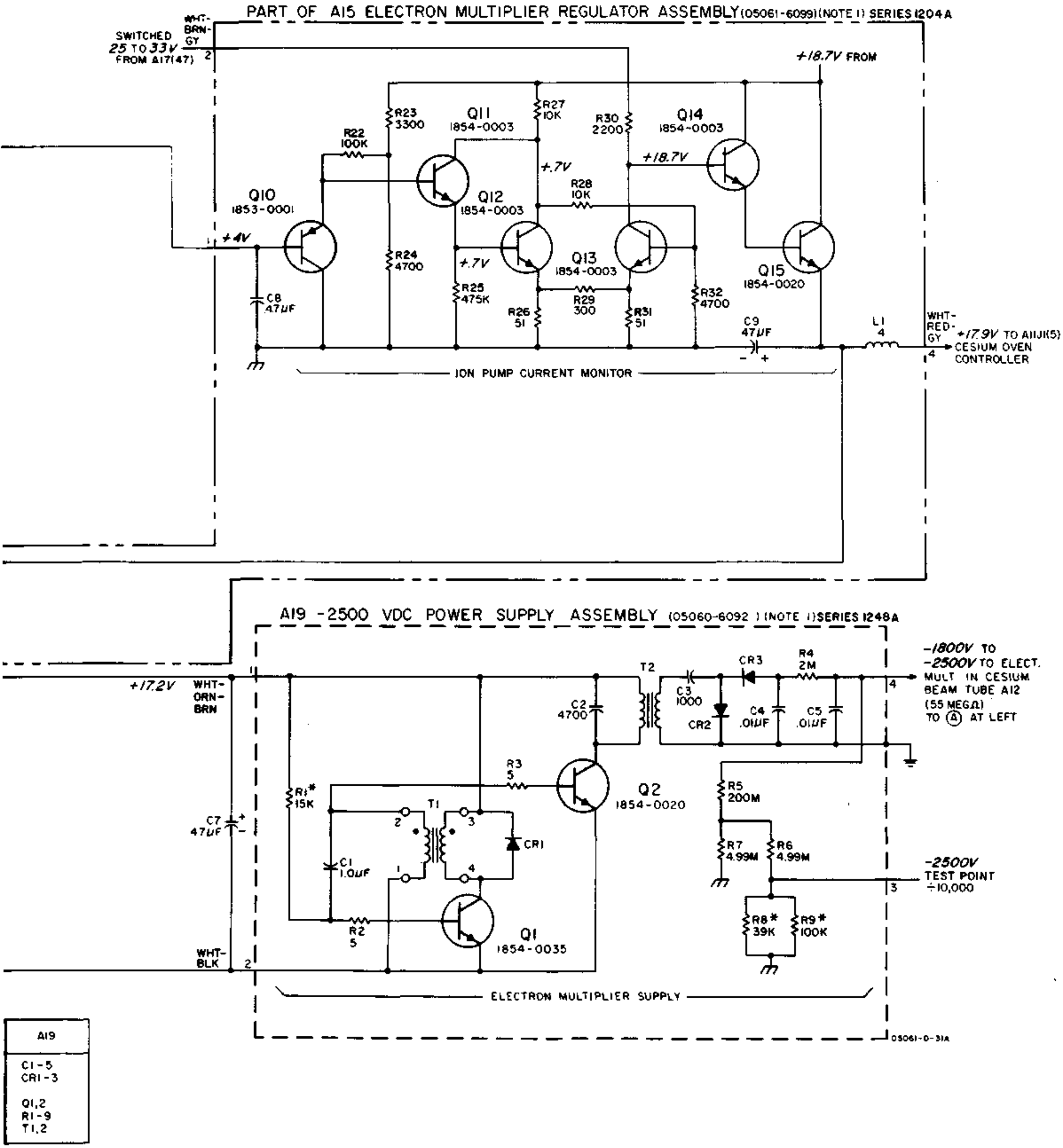
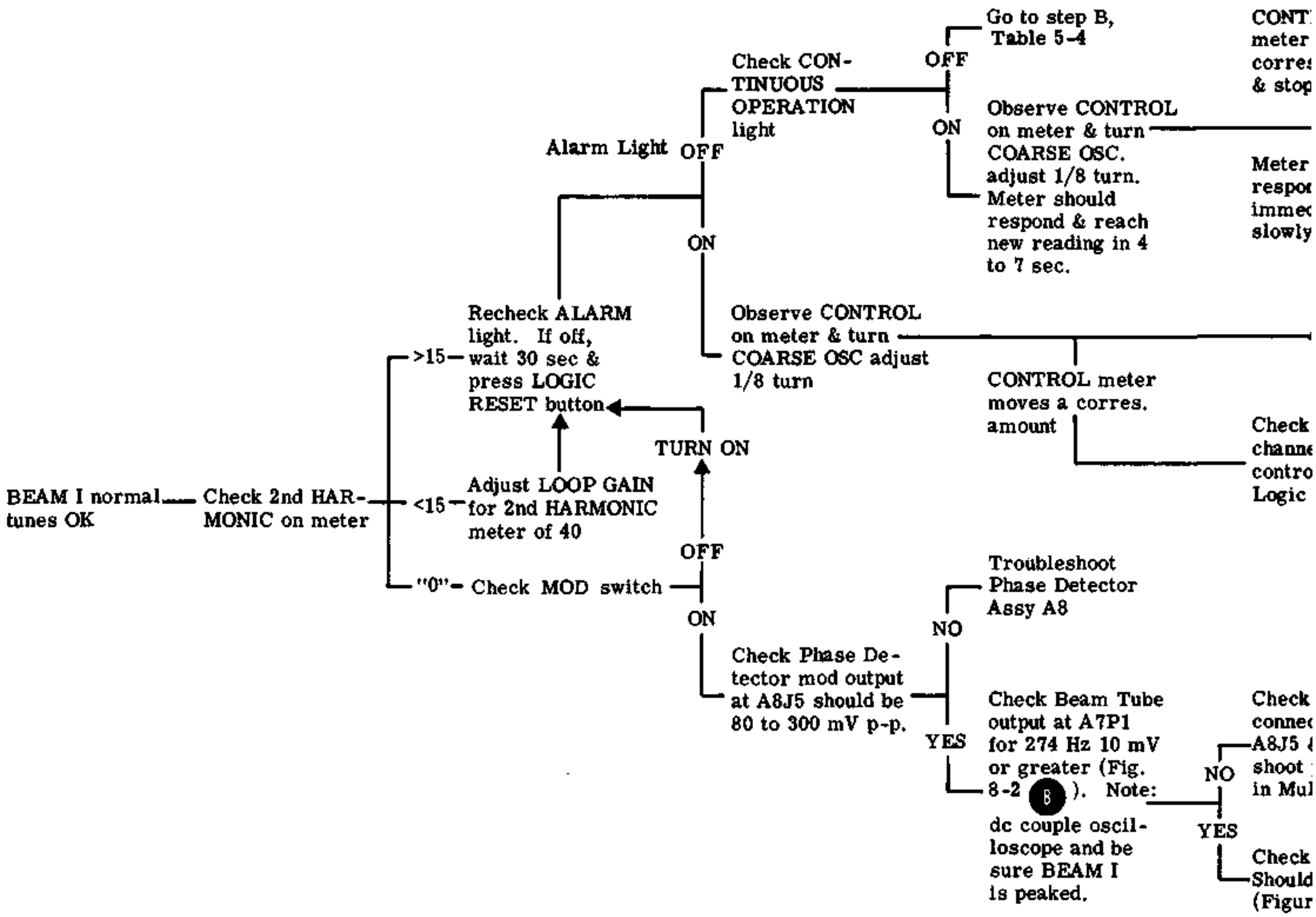
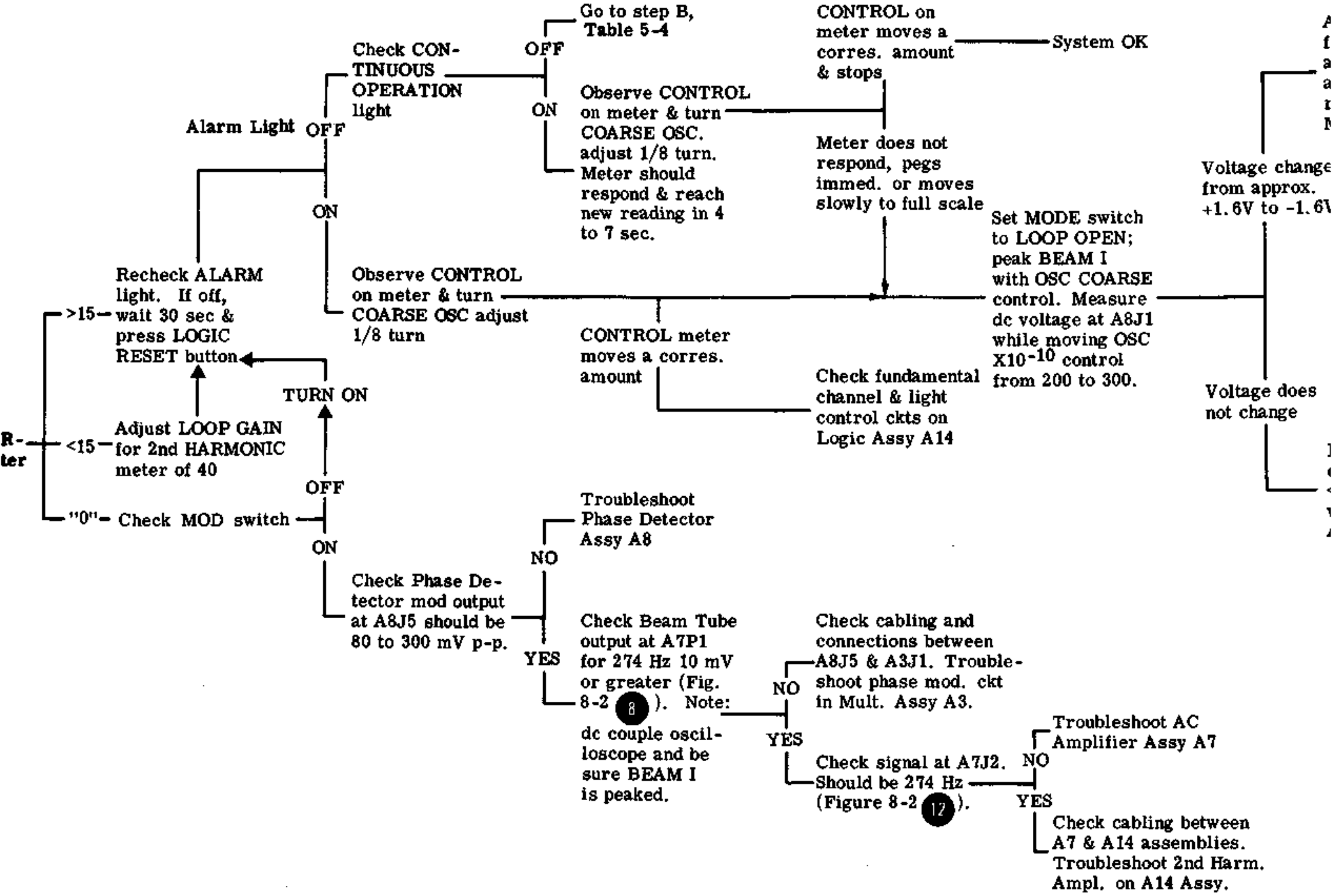
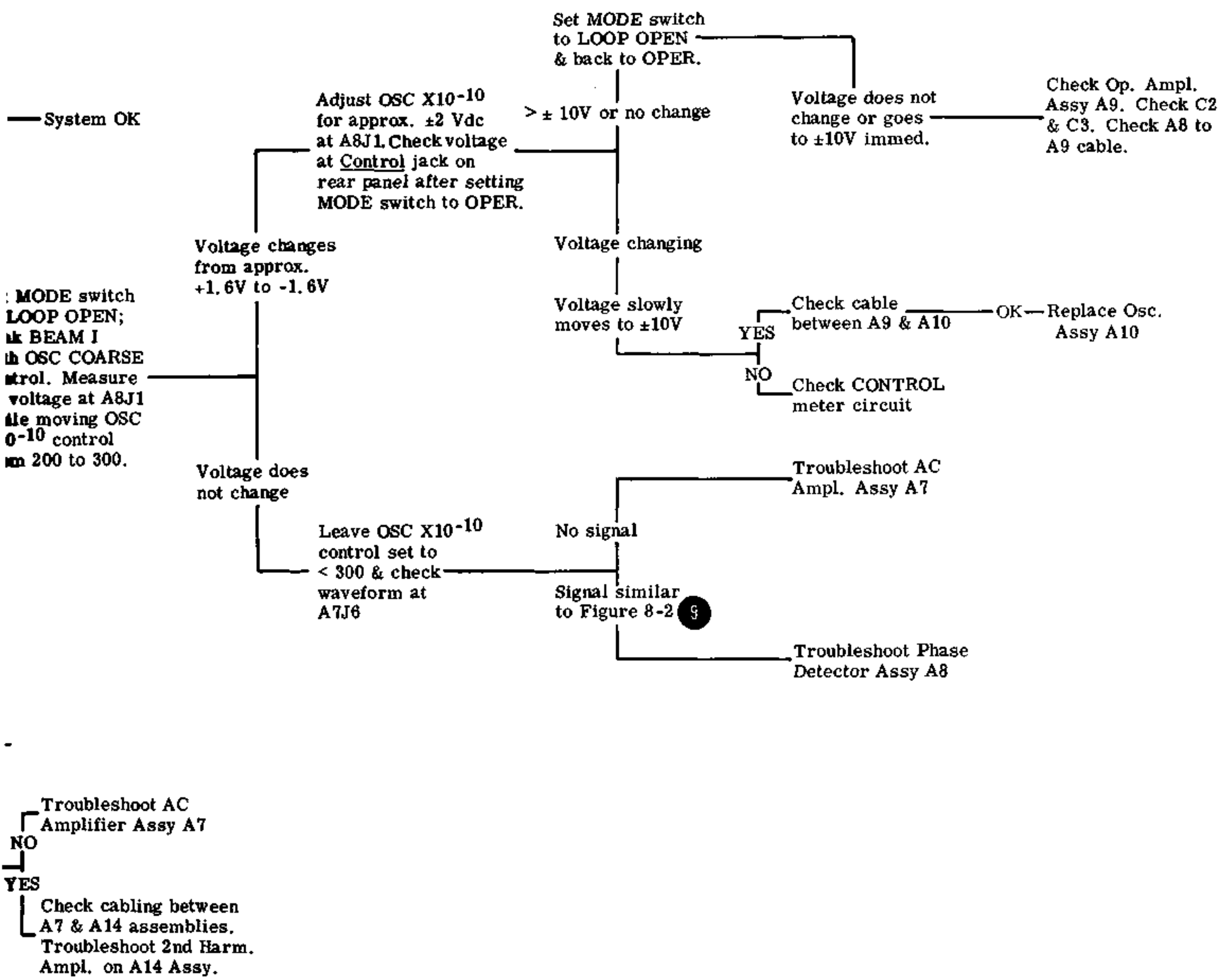


Figure 8-31. +3500 VDC Power Supply Assembly A18
-2500 VDC Power Supply Assembly A19

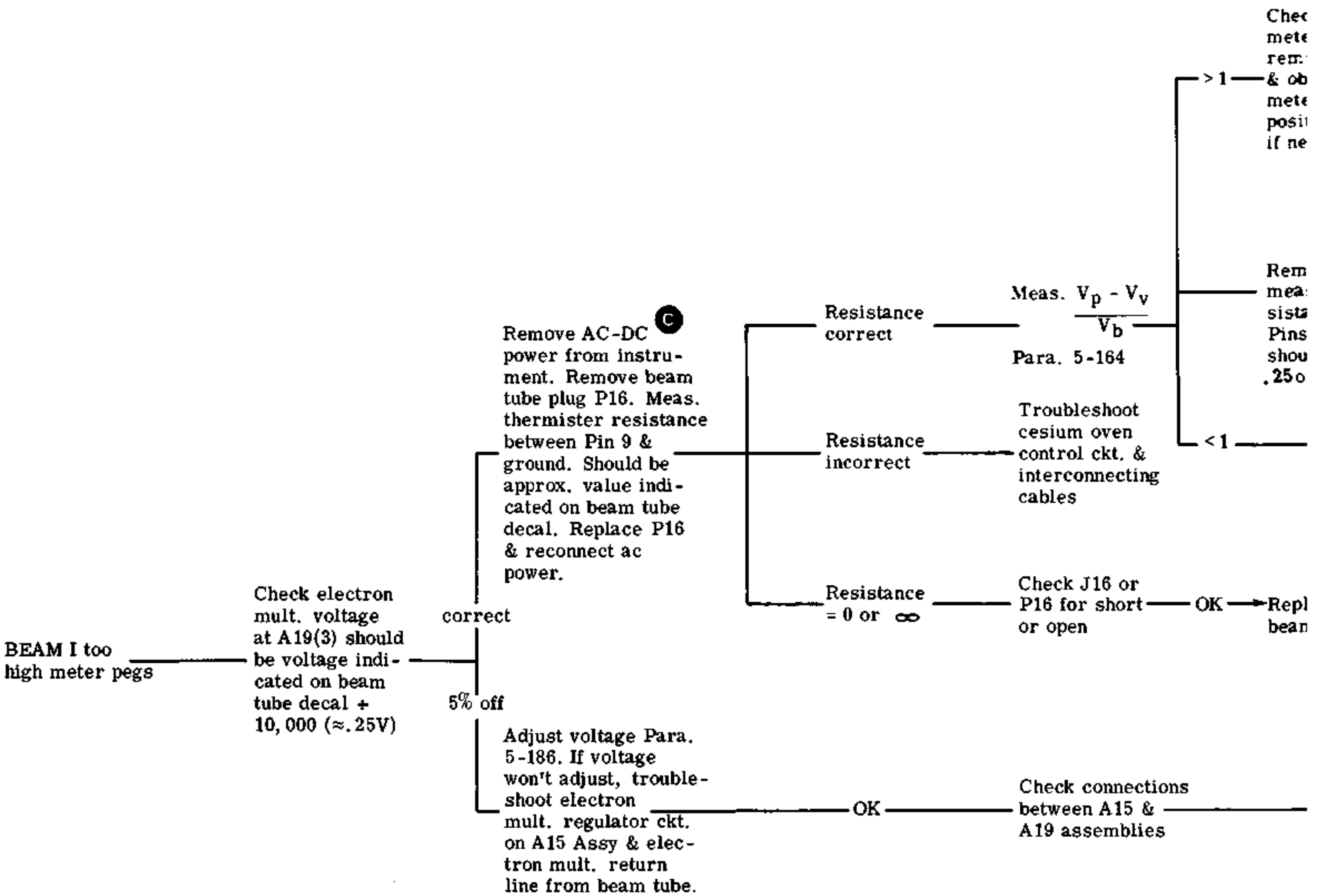


BEAM I normal
tunes OK
Check 2nd HAR-
MONIC on meter
>15
<15
"0"
Recheck ALARM
light. If off,
wait 30 sec &
press LOGIC
RESET button
Adjust LOOP GAIN
for 2nd HARMONIC
meter of 40
Check MOD switch
TURN ON
OFF
ON
Alarm Light
OFF
ON
Check CON-
TINUOUS
OPERATION
light
OFF
ON
Go to step B,
Table 5-4
Observe CONTROL
on meter & turn
COARSE OSC.
adjust 1/8 turn.
Meter should
respond & reach
new reading in 4
to 7 sec.
Observe CONTROL
on meter & turn
COARSE OSC adjust
1/8 turn
CONTROL meter
moves a corres.
amount
Check Phase De-
tector mod output
at A8J5 should be
80 to 300 mV p-p.
NO
YES
Troubleshoot
Phase Detector
Assy A8
Check Beam Tube
output at A7P1
for 274 Hz 10 mV
or greater (Fig.
8-2 B). Note:
dc couple oscil-
loscope and be
sure BEAM I
is peaked.
NO
YES

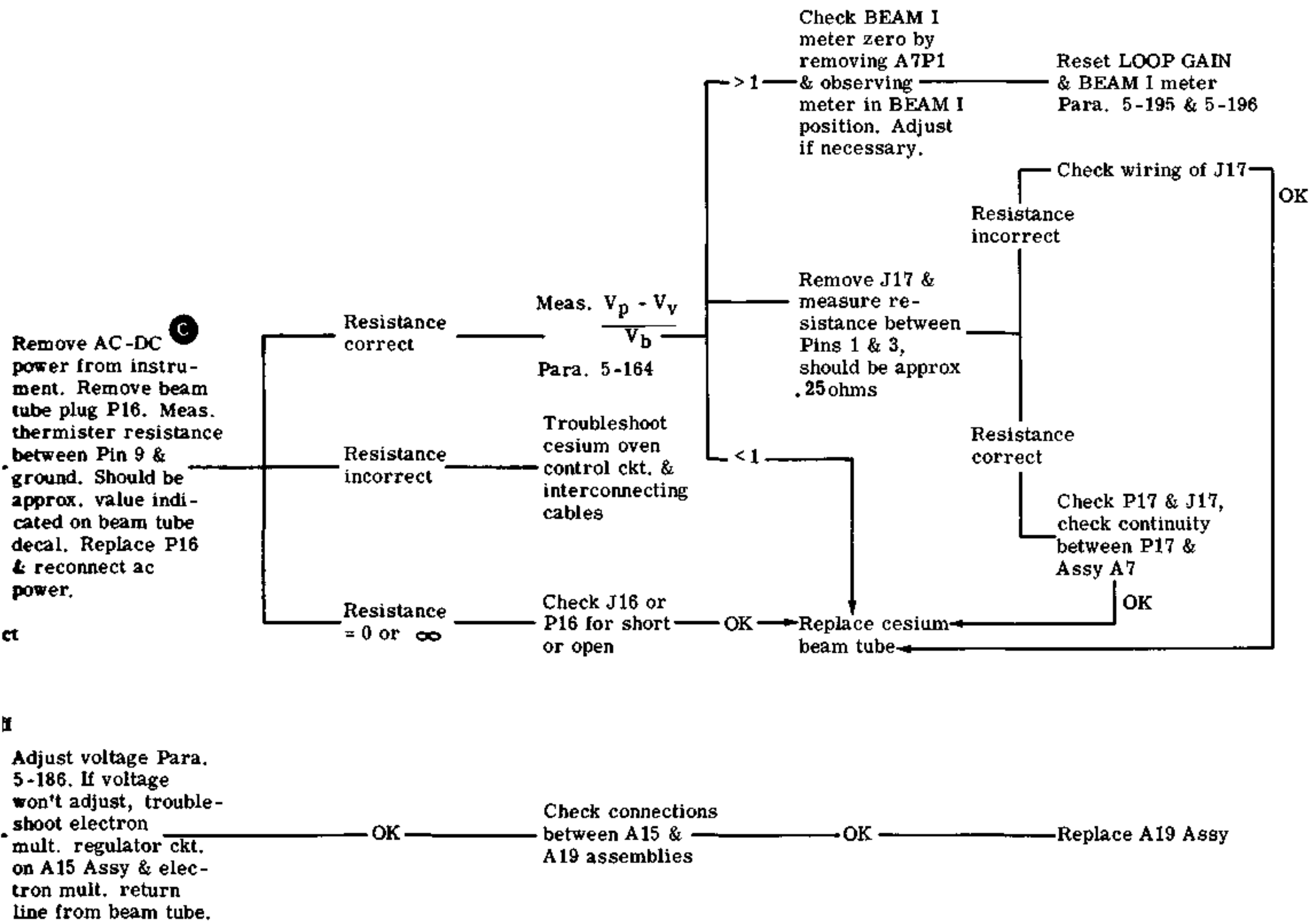

R-
ter
>15
Recheck ALARM light. If off, wait 30 sec & press LOGIC RESET button
<15
Adjust LOOP GAIN for 2nd HARMONIC meter of 40
"0"
Check MOD switch
Alarm Light
OFF
ON
TURN ON
OFF
ON
Check CON-TINUOUS OPERATION light
OFF
Go to step B, Table 5-4
ON
Observe CONTROL on meter & turn COARSE OSC. adjust 1/8 turn. Meter should respond & reach new reading in 4 to 7 sec.
CONTROL on meter moves a corres. amount & stops
System OK
Meter does not respond, pegs immed. or moves slowly to full scale
Observe CONTROL on meter & turn COARSE OSC adjust 1/8 turn
CONTROL meter moves a corres. amount
Check fundamental channel & light control ckts on Logic Assy A14
Set MODE switch to LOOP OPEN; peak BEAM I with OSC COARSE control. Measure dc voltage at A8J1 while moving OSC X10-10 control from 200 to 300.
Voltage change from approx. +1.6V to -1.6V
Voltage does not change
Check Phase Detector mod output at A8J5 should be 80 to 300 mV p-p.
NO
Troubleshoot Phase Detector Assy A8
YES
Check Beam Tube output at A7P1 for 274 Hz 10 mV or greater (Fig. 8-2 8). Note: dc couple oscilloscope and be sure BEAM I is peaked.
NO
Check cabling and connections between A8J5 & A3J1. Troubleshoot phase mod. ckt in Mult. Assy A3.
YES
Check signal at A7J2. Should be 274 Hz (Figure 8-2 12).
NO
Troubleshoot AC Amplifier Assy A7
YES
Check cabling between A7 & A14 assemblies. Troubleshoot 2nd Harm. Ampl. on A14 Assy.

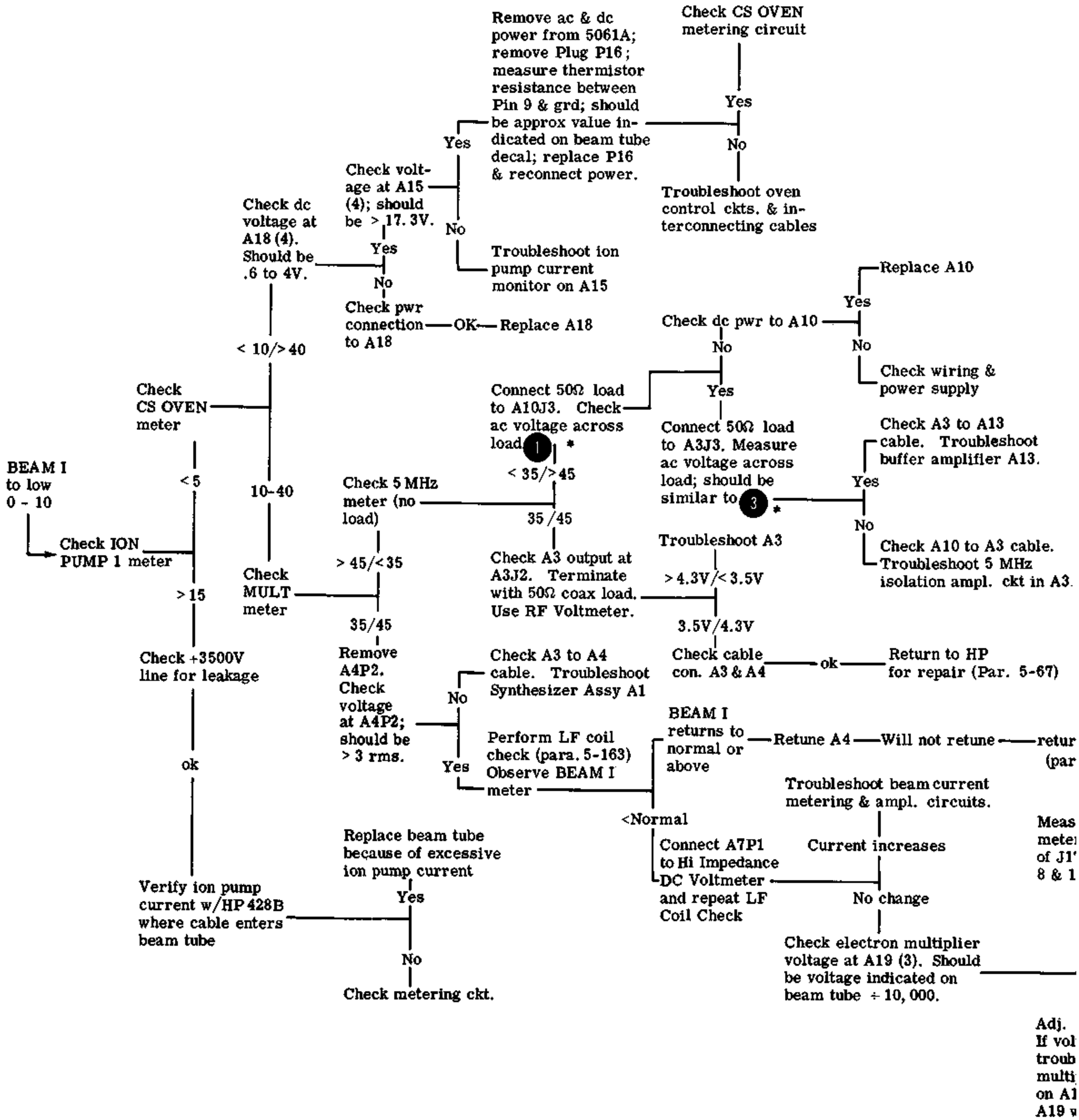


Beam I: Normal



BEAM I too high meter pegs
Check electron mult. voltage at A19(3) should be voltage indicated on beam tube decal ÷ 10,000 (≈.25V)
correct
5% off
Remove AC-DC power from instrument. Remove beam tube plug P16. Meas. thermister resistance between Pin 9 & ground. Should be approx. value indicated on beam tube decal. Replace P16 & reconnect ac power.
Resistance correct
Resistance incorrect
Resistance = 0 or ∞
Meas. $\frac{V_p - V_v}{V_b}$
Para. 5-164
> 1
< 1
Troubleshoot cesium oven control ckt. & interconnecting cables
Check J16 or P16 for short or open
OK
Adjust voltage Para. 5-186. If voltage won't adjust, troubleshoot electron mult. regulator ckt. on A15 Assy & electron mult. return line from beam tube.
OK
Check connections between A15 & A19 assemblies


Remove AC-DC power from instrument. Remove beam tube plug P16. Meas. thermister resistance between Pin 9 & ground. Should be approx. value indicated on beam tube decal. Replace P16 & reconnect ac power.
C
Resistance correct
Resistance incorrect
Resistance = 0 or ∞
Meas. $\frac{V_p - V_v}{V_b}$
Para. 5-164
Troubleshoot cesium oven control ckt. & interconnecting cables
Check J16 or P16 for short or open
OK
> 1
< 1
Check BEAM I meter zero by removing A7P1 & observing meter in BEAM I position. Adjust if necessary.
Reset LOOP GAIN & BEAM I meter Para. 5-195 & 5-196
Remove J17 & measure resistance between Pins 1 & 3, should be approx .25 ohms
Resistance incorrect
Check wiring of J17
OK
Resistance correct
Check P17 & J17, check continuity between P17 & Assy A7
OK
Replace cesium beam tube
Adjust voltage Para. 5-186. If voltage won't adjust, troubleshoot electron mult. regulator ckt. on A15 Assy & electron mult. return line from beam tube.
OK
Check connections between A15 & A19 assemblies
OK
Replace A19 Assy



Remove ac & dc power from 5061A; remove Plug P16; measure thermistor resistance between Pin 9 & grd; should be approx value indicated on beam tube decal; replace P16 & reconnect power.
Check CS OVEN metering circuit
Yes
No
Troubleshoot oven control ckts. & interconnecting cables
Check voltage at A15 (4); should be > 17.3V.
Yes
No
Troubleshoot ion pump current monitor on A15
Check dc voltage at A18 (4). Should be .6 to 4V.
Yes
No
Check pwr connection to A18
OK
Replace A18
< 10/> 40
Check CS OVEN meter
10-40
Check MULT meter
BEAM I to low 0 - 10
Check ION PUMP 1 meter
< 5
> 15
Check +3500V line for leakage
ok
Verify ion pump current w/HP 428B where cable enters beam tube
Replace beam tube because of excessive ion pump current
Yes
No
Check metering ckt.
Check 5 MHz meter (no load)
> 45/< 35
35/45
Remove A4P2. Check voltage at A4P2; should be > 3 rms.
No
Yes
Check A3 to A4 cable. Troubleshoot Synthesizer Assy A1
Perform LF coil check (para. 5-163) Observe BEAM I meter
< Normal
BEAM I returns to normal or above
Retune A4
Will not retune
retur
(par
Connect A7P1 to Hi Impedance DC Voltmeter and repeat LF Coil Check
Troubleshoot beam current metering & ampl. circuits.
Current increases
No change
Check electron multiplier voltage at A19 (3). Should be voltage indicated on beam tube ÷ 10,000.
Meas
mete
of J1'
8 & 1
Adj.
If vol
troub
multi
on A1
A19 v
Connect 50Ω load to A10J3. Check ac voltage across load 1 *
< 35/> 45
35/45
Check A3 output at A3J2. Terminate with 50Ω coax load. Use RF Voltmeter.
> 4.3V/< 3.5V
3.5V/4.3V
Troubleshoot A3
Check cable con. A3 & A4
ok
Return to HP for repair (Par. 5-67)
Check dc pwr to A10
No
Yes
Replace A10
Yes
No
Check wiring & power supply
Connect 50Ω load to A3J3. Measure ac voltage across load; should be similar to 3 *
Yes
No
Check A3 to A13 cable. Troubleshoot buffer amplifier A13.
Check A10 to A3 cable. Troubleshoot 5 MHz isolation ampl. ckt in A3.

Replace A10

Check wiring &
power supply

Check A3 to A13
cable. Troubleshoot
buffer amplifier A13.

Check A10 to A3 cable.
Troubleshoot 5 MHz
isolation ampl. ckt in A3.

Return to HP
for repair (Par. 5-67)

Will not retune — return A4 to HP
(para. 5-79)

t beam current
ampl. circuits.

ncreases

change

on multiplier
19 (3). Should
dicated on
10, 000.

Measure dc (mass spectro-
meter) voltage on orn wire
of J17; should be between
8 & 18V (note voltage *)

ok

>5% off

Adj. voltage, Para. 5-186)
If voltage will not adjust
troubleshoot electron
multiplier regulator ckt.
on A15 assy. Check A15-
A19 wiring.

OK — Replace A19

Attempt to maximize
BEAM I by adj. A11R27.
If BEAM I does not re-
spond, reset A11R27 to
original voltage noted*

ok

> 18V/< 8V

Ad. A11R27 mass spec.
while observing voltage.
Should change with con-
troll setting

voltage responds
to control

voltage does
not respond
to control

Troubleshoot mass
spectrometer. Adjust
circuit in A11 assy.

Go to C
P-
Beam I: High

ok

Observe ac
voltage hot
wire ionizer
on orn. wire
at J17 6 *

no change

BEAM I
increases
with adj.

Go to Step A
(Table 5-4)

waveform incorrect

Troubleshoot A11 ckt. &
interconnecting cables.
Check resistance of hot
wire ionizer at pins 1 & 3.
of P17. Should be approx .75Ω.

resistance
incorrect

Check wiring of P17.
If ok replace tube.

Beam I: Low