

Errata

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HP References in this Manual

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TEMPORARY OPERATING MANUAL

HEWLETT-PACKARD MODEL 5061A

CESIUM BEAM FREQUENCY STANDARD

All Serials

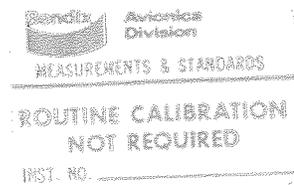


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SECTION I GENERAL INFORMATION

1.1. INTRODUCTION

1-2. Description

1-3. 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} . Output frequencies are 5 MHz, 1 MHz, 100 kHz, and 100 kHz signal for applications such as use with a HP Model 115BR/CR Frequency Divider and Digital Clock. Atomic or UT2 (UTC) time reference is available with the 5061A. The time scale is easily changed by setting a four thumbwheel switch and a slide switch.

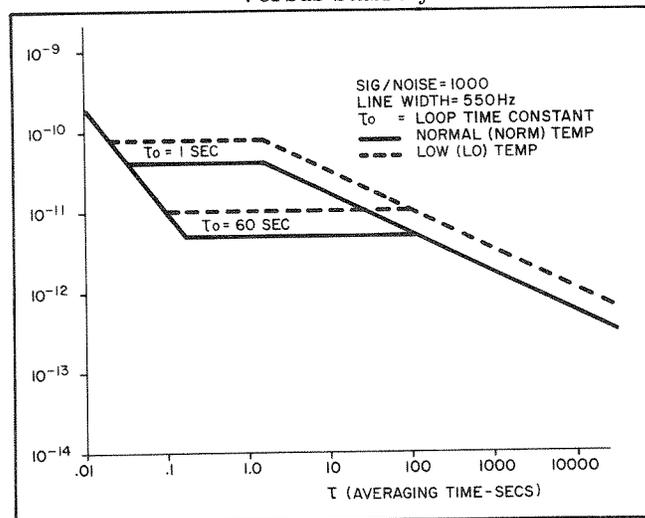
1-4. In the beam tube, a state-selected beam of Cesium 133 atoms passes through a microwave cavity. When the frequency of the applied microwave magnetic field, derived by multiplying the quartz crystal oscillator frequency, is near the hyperfine transition frequency of Cesium 133 (9,192,631,770.0 Hz), 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 is used to automatically correct the quartz oscillator frequency.

1-5. The cesium beam tube exhibits outstanding reliability for its guaranteed life of 10,000 hours. 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.

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. The output of the separate 100 kHz signal, used for external clock applications, is 0.5 volts rms (minimum) when terminated with 1000 ohms.

Figure 1-2. Cesium Oven Temperature Versus Stability



1-8. TERMINOLOGY

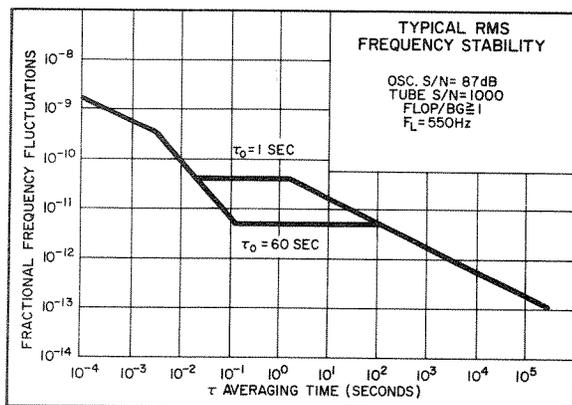
1-9. The definitions of the following terms apply to these terms as used throughout this manual.

- a. UNIVERSAL TIME (UT2). Time scale based on the earth's rotation about its axis with correction for angular position and seasonal variation.
- b. UNIVERSAL TIME (COORDINATED) (UTC). A piecewise uniform scale which approximates UT2 to 0.1 second by offset adjustments and step adjustments in phase as announced by the International Time Bureau (BIH).
- c. ATOMIC TIME. Time scale based on the hyperfine resonance of Cesium 133.
- d. CESIUM BEAM TUBE. Passive atomic resonator using the hyperfine resonance of Cesium 133.
- e. "C" FIELD. Magnetic field within the cesium beam tube for fine frequency adjustments.
- f. 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.
- g. 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.
- h. MASS SPECTROMETER. Directs cesium ions to the electron multiplier and prevents impurity ions from reaching the electron multiplier.

Table 1-1. Specifications

5061A CESIUM BEAM STANDARD

Accuracy: $\pm 1 \times 10^{-11}$.
Reproducibility: $\pm 5 \times 10^{-12}$.
Long Term Stability: $\pm 1 \times 10^{-11}$ (for life of tube).
Short Term Stability: Front panel switch (behind door) selects 1 sec or 60 sec loop time constant (see figure below).



Warm-up Time: 3/4 hour to fully operational from 25°C ambient temperature.
Harmonic Distortion: (5 MHz, 1 MHz, and 100 kHz): down more than 40 dB from rated output.
Non-harmonically Related Output: 5 MHz, 1 MHz, and 100 kHz): down more than 80 dB from rated output.
Output Frequencies: 5 MHz, 1 MHz, 100 kHz sinusoidal, 100 kHz clock drive (1 MHz clock drive optional).
Output Voltages: 1V rms into 50Ω; clock drive suitable for Hewlett-Packard Frequency Divider and Clocks.
Output Terminals: 5 MHz, 1 MHz, 100 kHz, front and rear BNC connectors, 100 kHz clock drive, rear BNC connector.
Time Scale: Adjustable with 4 thumbwheel switches and a slide switch from 0 to -700×10^{-10} . 12.63 . . . MHz test frequency available on rear panel.

***DEFINITION OF TERMS**

Accuracy: The degree to which oscillator frequency is the same as that of an accepted primary standard (for example, the U.S. Frequency Standard) or the degree to which oscillator frequency corresponds to the accepted definition, presently that of the 12th General Conference of Weights and Measures (see "Time Scales").
Reproducibility: The degree to which an oscillator will produce the same frequency from unit to unit and from one occasion of operation to another.

CESIUM BEAM TUBE

Tube Life:
 10,000 hours guaranteed (operating) within 2 years of receipt of tube.
Length:
 16 ± 1/16 in. (42,3 cm)
Diameter:
 Approximately 5-5/8 in. (14,3 cm)
Weight: 16 lbs. (8,9 kg)
Line Width: 550 Hz (± 20%).
S/N Ratio (Voltage):
 Typical, 1000 (1/4 Hz noise bandwidth).
RF Power (9192 + MHz): 30 μW.
Power Input, 25°C, Typical: 6.5 W.

QUARTZ OSCILLATOR

Aging Rate: < 5 parts in 10¹⁰ per 24 hours.
Signal-to-Noise Ratio: For 1 and 5 MHz, > 87 dB at rated output (in a 30 kHz noise bandwidth, 5 MHz output filter bandwidth is approx. 100 Hz). For 100 kHz, > 60 dB in 30 kHz noise bandwidth.
Frequency Adjustments:
 Fine Adjustment: 5 parts in 10⁸ range, with dial reading parts in 10¹⁰.
 Coarse Adjustment: 1 part in 10⁶, screwdriver adjustment at front panel.
Stability:
 As a Function of Ambient Temperature: < 2.5 x 10⁻¹⁰ total from 0° to +50°C.
 As a Function of Load: < ± 2 x 10⁻¹¹ for open circuit to short, and 50 ohm R, L, C load change.
 As a Function of Supply Voltage: < ± 5 x 10⁻¹¹ for 22 to 30 V dc, or for 115/230 V ac, ± 10%.

Included within this definition is the degree to which the frequency of an oscillator can be set by a calibration procedure.
Intrinsic Reproducibility: The degree to which an oscillator will reproduce a given frequency without the need for calibrating adjustments either during manufacture or afterward. This quality is a characteristic of an apparatus design, not of a resonance.
Long Term Stability: Total fractional frequency drift for the life of the cesium beam tube.

Table 1-1. Specifications (cont'd)

GENERAL

Environmental

Temperature:

Operating, 0-50°C. Typical stability better than $\pm 5 \times 10^{-12}$ over temperature range. Non-operating, -40° to +75°C.

Production units have passed type testing as follows:

Humidity: 0 to 95% operating.

Altitude: 40,000 feet operating.

Magnetic: Typical stability in 2 gauss field, any orientation, better than 5×10^{-12} .

Vibration: Passed MIL-STD-167.

Shock: Passed MIL-T-21200, Class 1.

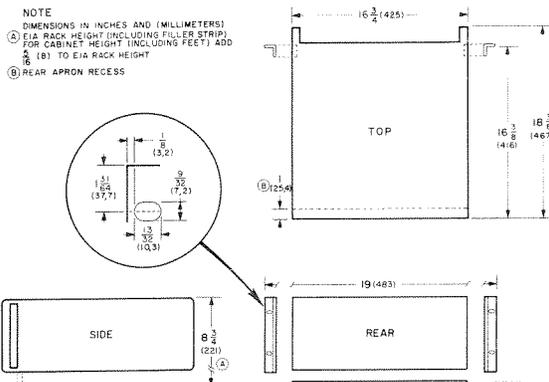
EMC: MIL-I-6181D. Also known as RFI.

Power:

115 or 230V ac $\pm 10\%$, 50 to 400 Hz; or 22 to 30V dc. Approx. power required:

	DC	AC
Without Options:	27 W	43 W
Option 01	Add 7.5W	10 W
Option 02	Add 4.5W	22 W
Option 03	Add 12 W	32 W

Dimensions:



Weight: Net 60 lbs (33,3 kg), no options. Option 01 add 2 lbs. (1,1 kg). Option 02 add 5 lbs (2,27 kg)

Equipment Furnished:

Power Cord, 6 ft. (180 cm), detachable.

Rack Mounting Kit

Accessory Kit, includes two extender boards, test cables, maintenance tools, and a mating connector for EXT DC input.

Accessories Available:

EXT DC Cable: connects 5061A to 5085A standby supply.

OPTION 01 TIME STANDARD

Clock Pulse:

Rate: 1 pulse per second

Amplitude: +10V peak

Width: 20 μ s minimum

Rise Time: < 50 ns

Fall Time: < 1 μ s

Jitter: < 20 ns.

All specs are with 50-ohm load.

Synchronization: 10 μ s ($\pm 1 \mu$ s) delayed from reference input pulse. Reference pulse must be > +5V, with a rise time < 50 ns.

Clock Movement:

24 hours, Patek Philippe.

**OPTION 02 STANDBY
POWER SUPPLY**

Capacity: 30 minutes minimum (1 hour typical at 25°C) at full charge.

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 03

Combines Options 01 and 02

Section I
General

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

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

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

m. **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.

Table 1-2. Equipment Supplied

Equipment	Description	HP Part No.
Ac Power Cable	3-conductor with ground pin	114B-16A
Rack Mount Kit	Provides conversion from bench to rack	5060-0777
Accessory Kit includes:		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 Board	Offset	8730-0007
Extender	22 pin	5060-7202
Cable Assy	Test Micon-to-BNC (2 supplied)	05060-6116

1-12. INSTRUMENT IDENTIFICATION

1-13. Hewlett-Packard uses a two-section, eight digit serial number to identify instruments. The serial number is located on the rear panel. The first three digits are a serial prefix number and the last five digits refer to a specific instrument. If the first three digits of your instrument do not appear on the title page of this manual, there are differences between the manual and your instrument which are described in a change sheet included with the manual. If the change sheet is missing, the information can be supplied by your nearest Hewlett-Packard sales/service office (see lists at the rear of this manual).

1-14. ACCESSORIES

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

Table 1-3. Accessories Available

Accessory	Description	HP Part No.
Standby Power Supply	24Vdc, 2-amp supply with 18 amp-hours standby capacity	Model 5085A
Cable	Connects 5061A to 5085A dc output	103A-16A
Extension Slides and Rack Adapters	Permits sliding instrument out and tilting from rack-mounted position	0403-0051 0403-0052

SECTION II INSTALLATION

2-1. UNPACKING AND INSPECTION

2-2. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. 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 five years at storage temperatures up to +35°C (+95°F) if the ion pump is operated once a year. If the ion pump is not operated to maintain the vacuum within the cesium beam tube, the expected shelf life is reduced to 1-2 years. Instructions for pumping the cesium beam tube are found in Paragraph 3-13 of this manual.

2-5. Temperatures during storage and shipment should normally 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 ac line power to the instrument. This will allow 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 are two recommended packaging methods:

- a. RUBBERIZED HAIR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument securely in strong corrugated container (350 lb/sq in. bursting test) with 2-inch rubberized hair pads placed along all surfaces of the instrument. Insert fillers between pads and container to ensure a snug fit.
- b. EXCELSIOR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument

in strong corrugated container (350 lb/sq in. bursting test) with a layer of excelsior about 6 inches thick packed firmly against all surfaces of the instrument.

2-7. ELECTRICAL CONNECTIONS

2-8. Power Connection

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.

2-9. LINE VOLTAGE. The Model 5061A can be operated from either 115- or 230-volt ($\pm 10\%$) 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).

IMPORTANT

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	1A	0.5 A

2-10. POWER CABLE. The Model 5061A is equipped with a detachable three-conductor power cable. Install as follows:

- a. Connect the round, three-conductor female plug to the ac line jack on the instrument rear panel.
- b. Connect male plug (two-blade with round grounding pin) to three-conductor (grounded) outlet. Exposed portions of the instrument are grounded through the round pin for safety; 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.

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.

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	1251-0129*	5-pin female plug
CLOCK, 4-pin male (J18)	1251-0128	1251-0127*	4-pin male plug
AC LINE, 3-pin male jack (J20)	1251-0146	1251-0155	3-pin female plug
OUTPUT Signal, jacks (J5, 7, and 9)	1250-0102	1250-0061*	BNC male plug, UG88/U
9-pin female cesium beam tube connector (J16)	1251-0214	1251-1551	9-pin male plug
5-pin female cesium beam tube connector with two coax connectors (J17)	1251-0181	1251-0182	5-pin male plug with two coax connector
1 PPS, BNC jack (J13) Option 1 only	1250-0102	1250-0061*	BNC male plug, UG88/U
-2500V, 1-pin female jack (J3)	1251-1977	1251-1977	Hood
	1251-1979	1251-1978	Connector receptacle
	1251-1981	1251-1980	Lock Spring
+3500V, 1-pin male jack (J4)	1251-1977	1251-1977	Hood
	1251-1979	1251-1978	Connector receptacle
	1251-1980	1251-1980	Lock spring

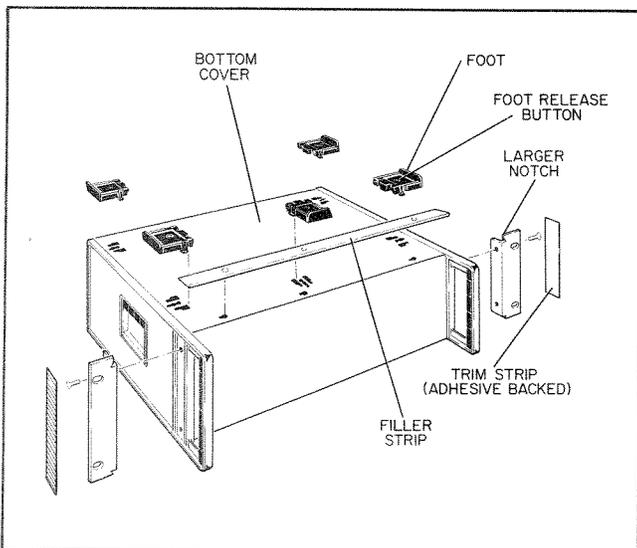
*These connectors not shipped with the instrument.

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:

- 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.

Figure 2-1. Conversion for Rack Mounting



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 3-8, step k).

SECTION III OPERATION

3-1. INTRODUCTION

3-2. This section provides operating procedures for the Cesium Beam Frequency Standard. Figure 3-1 provides turn-on procedure. Figures 3-4, 3-5, and 3-6 explain front, top, and rear controls and connectors. The procedures include power connections, warmup after initial turn-on, circuit checks with front panel meter, and initial adjustments. Initial checkout is divided into the following two procedures:

- a. Initial Turn-on.
- b. Turn-on after Long Storage.

3-3. OPTION 01 AND 02

3-4. Operating procedures for Option 01 (Digital Clock) and Option 02 (Internal Standby Battery) are given in Paragraphs 3-15 and 3-16.

3-5. TURN-ON PROCEDURES

3-6. General

3-7. 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 3-5 lists normal and abnormal front panel light indications. Table 3-1 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.

3-8. Initial Turn-On Procedure

a. Remove instrument top cover. Locate Synthesizer Assembly A1 (Figure 3-5). Set TIME SCALE switch to either "Atomic Time Scale" (thumbwheel switch set to 2095) or the current UT2 offset (Table 3-3). Replace top cover.

- 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.
 - (6) TIME CONSTANT switch - SHORT.

Note

The front panel TIME CONSTANT switch should be set to SHORT when adjusting the quartz crystal oscillator frequency. When set to LONG, the instrument takes too long to respond and adjustment is difficult.

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 02 (Internal Standby Battery), the battery is discharged. Thus, when the instrument is initially turned on, the battery will charge for approximately 14 hours and the BATTERY light is 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, the -2500 volt supply and cesium oven heater will be enabled. If ION PUMP I does not decrease within 30 minutes, see Paragraph 3-9.

e. Allow 45 minutes for cesium oven and quartz crystal oven to warm up.

f. Start the divider 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 3-1). These secondary peaks will be smaller than the primary peak. (Note: Do not use OSC FREQUENCY X10⁻¹⁰ control for this adjustment.)

Figure 3-1. Beam Current and Applied Frequency

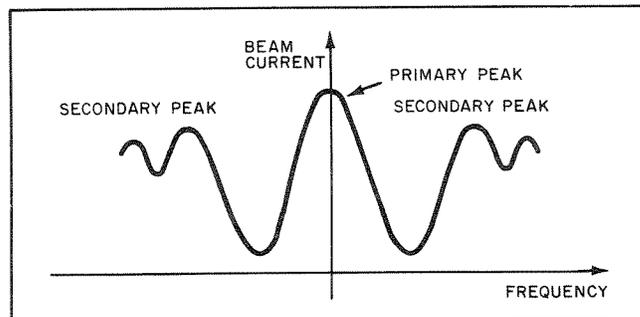


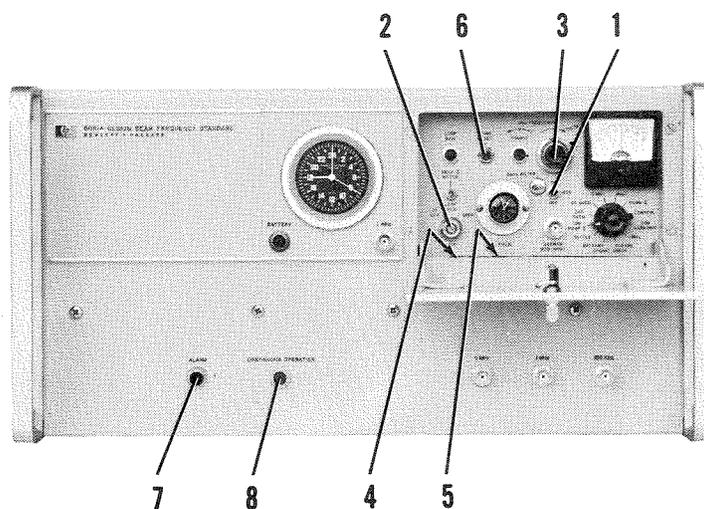
Table 3-1. Operating Checks

CIRCUIT CHECK		
Switch Position	Meter Indication	Description
BATTERY	0 (40 with Option 02)	Indicates battery voltage
SUPPLY	38-42	Indicates +18.7 volts regulated supply voltage
ION PUMP I	*0	Indicates vacuum in cesium beam tube by monitoring ion pump current. Fail-safe circuit removes power to cesium beam tube if current exceeds 40 μ a.
OSC OVEN	*35-45 (changes with temperature)	Indicates power to oscillator oven heater
CS OVEN	*15-35 (changes with temperature)	Indicates power to oven in cesium beam tube
5 MHz	38-42 (no load)	Indicates level of 5 MHz output
MULT	35-40	Indicates bias to harmonic generator diode
BEAM I	*20-30	Indicates dc beam current from cesium beam tube
CONTROL	0 (may be up to \pm 50)	Indicates dc control voltage to quartz crystal oscillator
2ND HARMONIC	*35-45	Indicates 2nd harmonic amplitude (may have small fluctuations)
1 MHz	38-42 (no load)	Indicates 1 MHz divider output level
100 kHz	38-42 (no load)	Indicates 100 kHz divider output level
<p>*During the first several days of operation, this CIRCUIT CHECK meter indication may not fall within the limits shown in Table 3-1 . This is a normal indication if the CONTINUOUS OPERATION light remains on.</p>		

Table 3-2. MODE Switch Functions

MODE Switch Position	Description
OPER	Instrument operating with quartz crystal oscillator locked to the atomic frequency
LOOP OPEN	All circuits operating with atomic control loop open
CS OFF	Only quartz crystal oscillator circuits energized. Power removed from cesium beam tube except ion pump (+3500 Vdc).
	<p>Note</p> <p>CS OFF used for test purposes and storage.</p>

Figure 3-1. Turn-On Procedure



1. Before connecting the 5061A to the ac line, check that the rear panel 115/230V switch is set to match ac line voltage. Open front panel door.
2. Set MOD switch to ON.
3. Set MODE switch to LOOP OPEN.
4. Set OSC FREQUENCY X10-10 control to 250.
5. Set TIME CONSTANT switch to SHORT. Connect power cord to ac source. Instrument is on. Wait at least 45 minutes.
6. Set DIVIDER MODE switch to START or AUTO START. If Option 01 (Digital Clock) is installed, START position should be used. Set MODE switch to OPER.
7. Wait 30 seconds, press LOGIC RESET button.
8. ALARM light should be off.
9. CONTINUOUS OPERATION light should be on. The 5061A is operating on Atomic Time. Several days are required after turn-on for some of the internal circuits to stabilize. However, if CONTINUOUS OPERATION light remains on and ALARM light off, the instrument is operating. If any problems are encountered during turn-on, refer to Paragraph 3-5 for more comprehensive turn-on information.
10. Perform "C" Field adjustment, (Par: 3-8 stepk).

Table 3-3. Synthesized Frequencies

UT2 (UTC) OFFSET Part in 10 ¹⁰	SYNTHESIZED FREQUENCY	NUMBER ON THUMBWHEEL	SLIDE SWITCH	ZEEMAN FREQUENCY
0 (Atomic)	12631771.5 Hz	2095	LO	42.82 kHz
-50	12631818.1 Hz	0076	LO	50.49 kHz
-100	12631863.6 Hz	3036	LO	44.80 kHz
-150	12631909.5 Hz	6186	LO	43.65 kHz
-200	12631955.8 Hz	2115	LO	47.42 kHz
-250	12632001.6 Hz	9105	LO	45.35 kHz
-300	12632047.4 Hz	0366	LO	44.18 kHz
-350	12632093.9 Hz	4396	HI	50.18 kHz
-400	12632139.8 Hz	4567	HI	49.20 kHz
-450	12632185.9 Hz	4634	HI	51.17 kHz
-500	12632231.4 Hz	0736	HI	45.14 kHz
-550	12632277.6 Hz	7274	HI	48.48 kHz
-600	12632322.2 Hz	5257	HI	43.86 kHz
-650	12632369.5 Hz	7337	HI	47.78 kHz
-700	12632415.2 Hz	8617	HI	45.10 kHz

The Universal Time Scale, UT2, is related to the earth's rotation and has been proceeding at a rate slightly slower than that of the atomic scale. The UT2 time interval second is slightly longer. A UTC time scale which approximates UT2 can be produced by oscillations offset from the atomic frequency by an amount proportional to the difference in their intervals.

By international agreement, this frequency offset is fixed each year by the Bureau International de l'Heure in Paris. For 1965 the offset was -150×10^{-10} , and for 1966, 1967, and 1968 it is -300×10^{-10} .

The above table lists the thumbwheel switch settings for frequency offsets between 0 (Atomic time scale) and -700 parts in 10^{10} .

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.

j. The hyperfine transition frequency is slightly sensitive to the earth's magnet 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 moved or relocated.

k. C FIELD ADJUSTMENT.

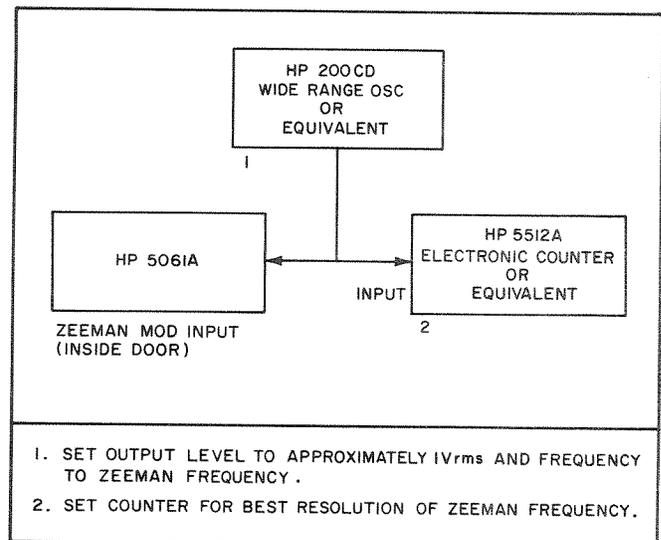
(1) With instrument operating normally, set CIRCUIT CHECK switch to CONTROL and carefully adjust OSC FREQUENCY COARSE for zero on CIRCUIT CHECK meter.

(2) Set instrument controls as follows:

- (a) MOD switch - OFF
- (b) MODE switch - LOOP OPEN
- (c) CIRCUIT CHECK switch - BEAM I
- (d) OSC FREQUENCY X10⁻¹⁰ control - adjust to 250.

(3) Connect the circuit shown in Figure 3-2.

Figure 3-2. Test Setup for "C" Field Adjustment



- (4) Set 200CD oscillator to the Zeeman frequency (Table 3-3) as displayed on the counter. An error of 1% in the Zeeman frequency causes an error of 3.6 parts in 10^{12} in the 5 MHz output frequency.
- (5) Alternately adjust the 200CD oscillator amplitude and C FIELD control for maximum on CIRCUIT CHECK meter.
- (6) Check the C FIELD setting by tuning the 200CD oscillator about 500 Hz off peak. Then tune the 200CD oscillator for maximum beam current on CIRCUIT CHECK meter. The oscillator frequency should be within ± 100 Hz of the Zeeman frequency initially set on counter. If not, repeat the C Field adjustment.
- (7) Disconnect oscillator and counter. Set MOD switch to ON, MODE switch to OPER. Wait 30 seconds 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 source and is ready for use.

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

3-9. Turn-On After Long Storage

3-10. 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) 115 230 VAC switch - match ac line voltage used.
- (2) MOD switch - OFF
- (3) MODE switch - CS OFF
- (4) CIRCUIT CHECK switch - ION PUMP I.
- (5) TIME CONSTANT switch - SHORT.

b. Connect power to the instrument and observe ION PUMP I indication. If at the end of 1 hour the indication is less than 25, the cesium beam tube vacuum is satisfactory and the turn-on procedure (Paragraph 3-5) can be completed.

c. If at the end of 1 hour the ION PUMP I indication is still full scale, DISCONNECT POWER FROM THE INSTRUMENT.

d. Wait 1 minute and disconnect the white lead from the cesium beam tube at J4 of the +3500 volt supply after turning the metal lock on the connector plug.

e. With power off, connect the positive lead of a +3500 Vdc, 5 milliampere power supply (Harrison Labs 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 528B or equivalent) to the insulated white lead disconnected in step d.

g. Set +3500 Vdc 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 +3500 Vdc 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 +3500 Vdc 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 in Paragraph 3-5 can be used.

3-11. Cesium Beam LOW Flux Operation Adjustments

3-12. 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 switch 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 3-5.

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

Note

Wait at least one 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.

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- 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).

3-13. Pumping the Cesium Beam During Storage

3-14. When a cesium beam tube is stored more than 6 months, the ion pump must be operated at least once 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 +3500 Vdc, 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 of the same place the cable containing the brown, green, and yellow wires.

- b. Connect the negative lead of the +3500 Vdc 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 +3500 Vdc Power Supply to +3500 Vdc and turn Power Supply ON.
- e. Allow Power Supply to remain connected to the beam tube until the current decreases to 10 microamps.
- f. Disconnect the Power Supply and DC Milliammeter (if used).
- g. The tube is evacuated and can be stored.

3-15. OPERATION WITH DIGITAL CLOCK (Option 01)

3-16. Option 01 provides the 5061A with a one pulse-per-second (1 PPS) clock output available at both front and rear-panel BNC jacks. The clock drive is an internally connected, 1 MHz signal from the Frequency Divider Assembly A6. The TIME DELAY, six thumbwheel decade switch (A5S1A thru S1F) controls the phase of the clock pulse from 1 μ sec to 1 sec with respect to an external reference. The 0-1 μ sec TIME DELAY screwdriver adjustment (A5C2) allows fine

adjustment over any 1 μ sec portion of the thumbwheel settings. The TIME DELAY switches and the 0-1 μ sec TIME DELAY control are located under the access door in the top cover.

3-17. The time standard option includes a mechanical clock movement indicating time in hours, minutes, and seconds. FAST and STOP pushbuttons on the clock module (Figure 3-5) 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 minute adjustment is the knob located on the back of the clock movement (pull to engage and adjust, push to release), (see Figure 3-5).

CAUTION

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

3-18. Setting the Clock Phase to an External Clock

3-19. The phase difference between the 5061A 1PPS 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.

3-20. Automatic Synchronization

3-21. To automatically have the 5061A synchronized and delayed from the reference by 9 to 11 μ sec, 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 μ sec 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 0.05 μ sec.
- 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 μ sec. Any additional offset may be selected by using the 6 thumbwheel switch.

Figure 3-7. Clock Offset Test Setup, Example 1

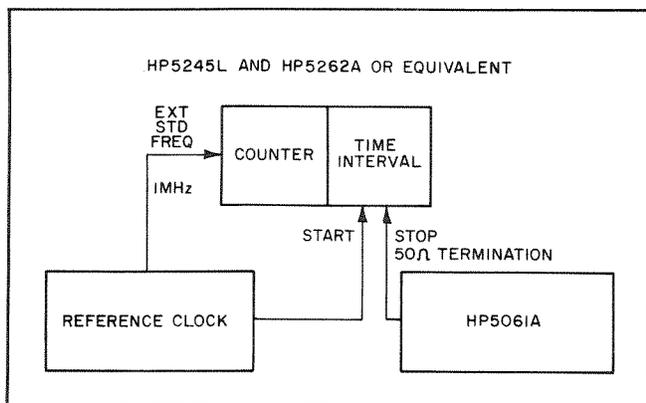
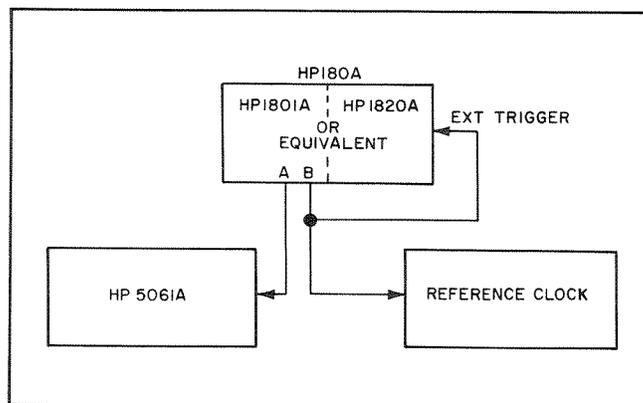


Figure 3-8. Clock Offset Test Setup, Example 2



3-22. Manual Synchronization

3-23. EXAMPLE 1. When a delay of less than 10 μ sec is desired or the reference pulse is not of sufficient amplitude, polarity or rise time for automatic synchronization, proceed as follows:

- Perform Paragraph 3-20, steps a, b, c, and d.
- Set the 6 thumbwheel switch to 9 9 9 9 9 9, and 0-1 μ SEC TIME DELAY control maximum clockwise (do not over-tighten).
- Connect circuit shown in Figure 3-7.

Note

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

- Set counter time base for best resolution to measure desired time offset.
- Set time interval unit to trigger on the leading edges of the two input pulses.
- Set the 6 thumbwheel switch and the 0-1 μ SEC TIME DELAY adjustment for desired offset as indicated on counter.

3-24. EXAMPLE 2. When precise coincidence of the reference pulse and the 5061A clock tick or an offset between coincidence and 1 μ sec is desired, proceed as follows:

- Perform Paragraph 3-20, steps a, b, c, and d.
- Set the 6 thumbwheel switch to 9 9 9 9 9 9, and 0-1 μ SEC TIME DELAY adjustment maximum clockwise (do not over-tighten).
- Connect circuit shown in Figure 3-8. No 50-ohm termination is required for this test setup.
- Adjust the oscilloscope for comparison of the two pulses.
- Adjust the 6 thumbwheel switch and the 0-1 μ SEC TIME DELAY for coincidence or the desired offset between the 5061A clock tick and the reference clock pulse.

3-25. OPERATION WITH INTERNAL STANDBY BATTERY (Option 02)

3-26. Option 02 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

Table 3-4. 5061A Operating Record

Serial Number _____					Time Scale: Atomic <input type="checkbox"/> UT2 <input type="checkbox"/>				
Zeeman Frequency _____ kHz					UT2 Offset _____ x 10 ⁻¹⁰				
CIRCUIT		METER READINGS			CIRCUIT		METER READINGS		
BATTERY					MULT				
SUPPLY					BEAM I				
ION PUMP I					CONTROL				
OSC. OVEN					2ND HARMONIC				
CS. OVEN					1 MHz				
5 MHz					100 kHz				
DATE					DATE				

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time standby power is used. Maximum recharge takes about 14 hours. Minimum recharge is about 80 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.

3-27. 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.

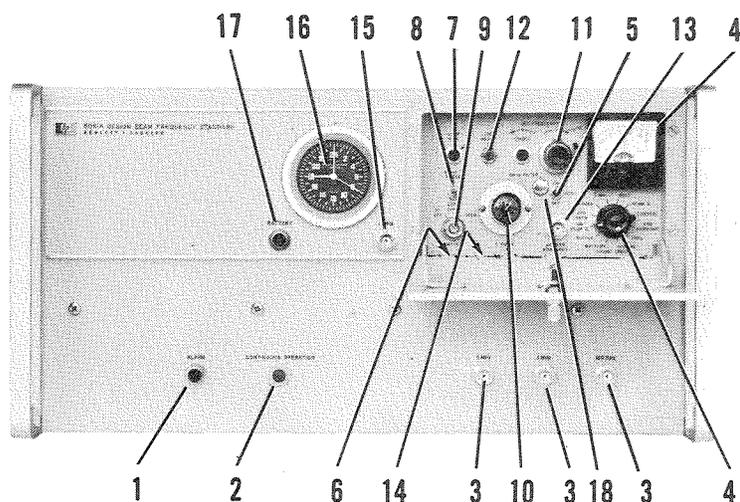
CAUTION

The front-panel MODE switch should not be set to CS OFF when Internal Standby Battery Option 02 is installed. The battery charge circuits will not function properly when the MODE switch is returned to LOOP OPEN or OPER position.

Table 3-5. Front Panel Light Indications

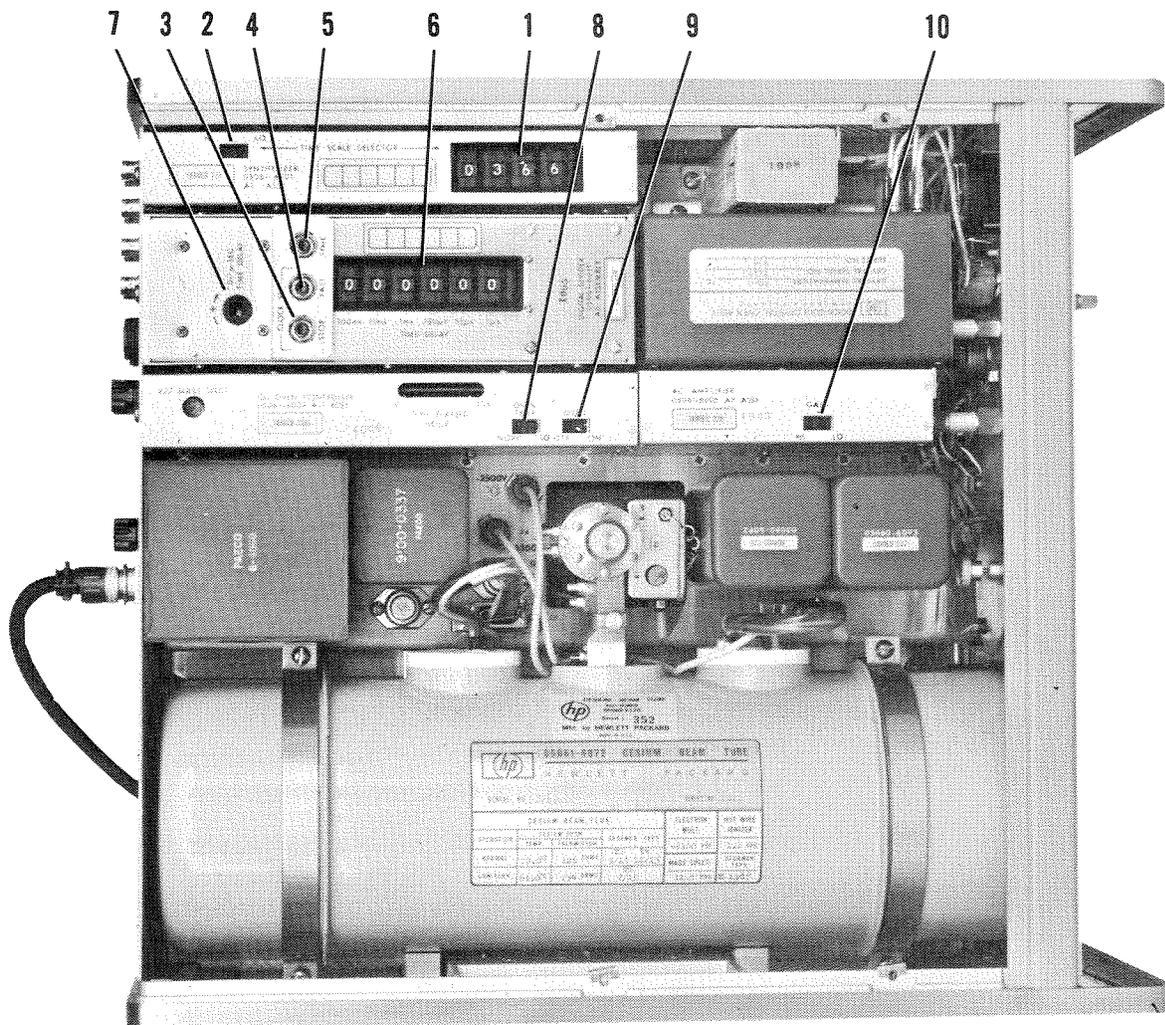
Front Panel Lights		Description
ALARM	CONTINUOUS OPERATION	
Off	On	Indicates normal operation.
On	Off	Indicates one or more of the following troubles: 1. Quartz crystal oscillator not locked to cesium resonance peak. 2. Quartz oscillator locked to secondary peak of cesium resonance. To correct the above faults, retune 5061A as outlined in Paragraph 3-8 , steps 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 CHECK meter. 3. ALARM light should go off and the CONTINUOUS OPERATION light should remain on. NOTE: Making adjustment 3 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 02 only)		
BATTERY		Description
Off		Indicates normal operation.
Flashing		Indicates instrument is powered from internal battery supply.
On		Indicates battery is being charged.

Figure 3-4. Front-Panel Controls



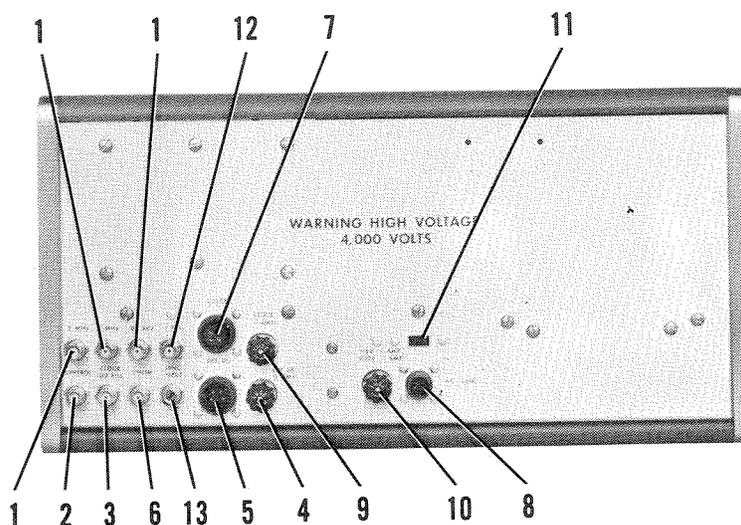
1. ALARM light: Normally off to indicate:
 - a. the multiplied quartz crystal oscillator frequency is frequency-locked to the center maximum of cesium resonance;
 - b. the instrument is correctly frequency-locked and beam tube current is satisfactory;
 - c. the quartz crystal oscillator dc correction 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. DIVIDER MODE switch: allows regenerative 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.
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 to set the desired hyperfine transition frequency.
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. TIME CONSTANT switch: controls instrument loop time constant. Set to SHORT for normal operation. Use LONG position for best short-term stability.
15. 1 PPS jack (Option 01 only): provides 10 volt, 20 μ s, 1 pps into 50 ohms from digital clock.
16. 24-Hour Digital Clock (Option 01 only).
17. BATTERY light (Option 02 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.

Figure 3-5. Top Operating Controls

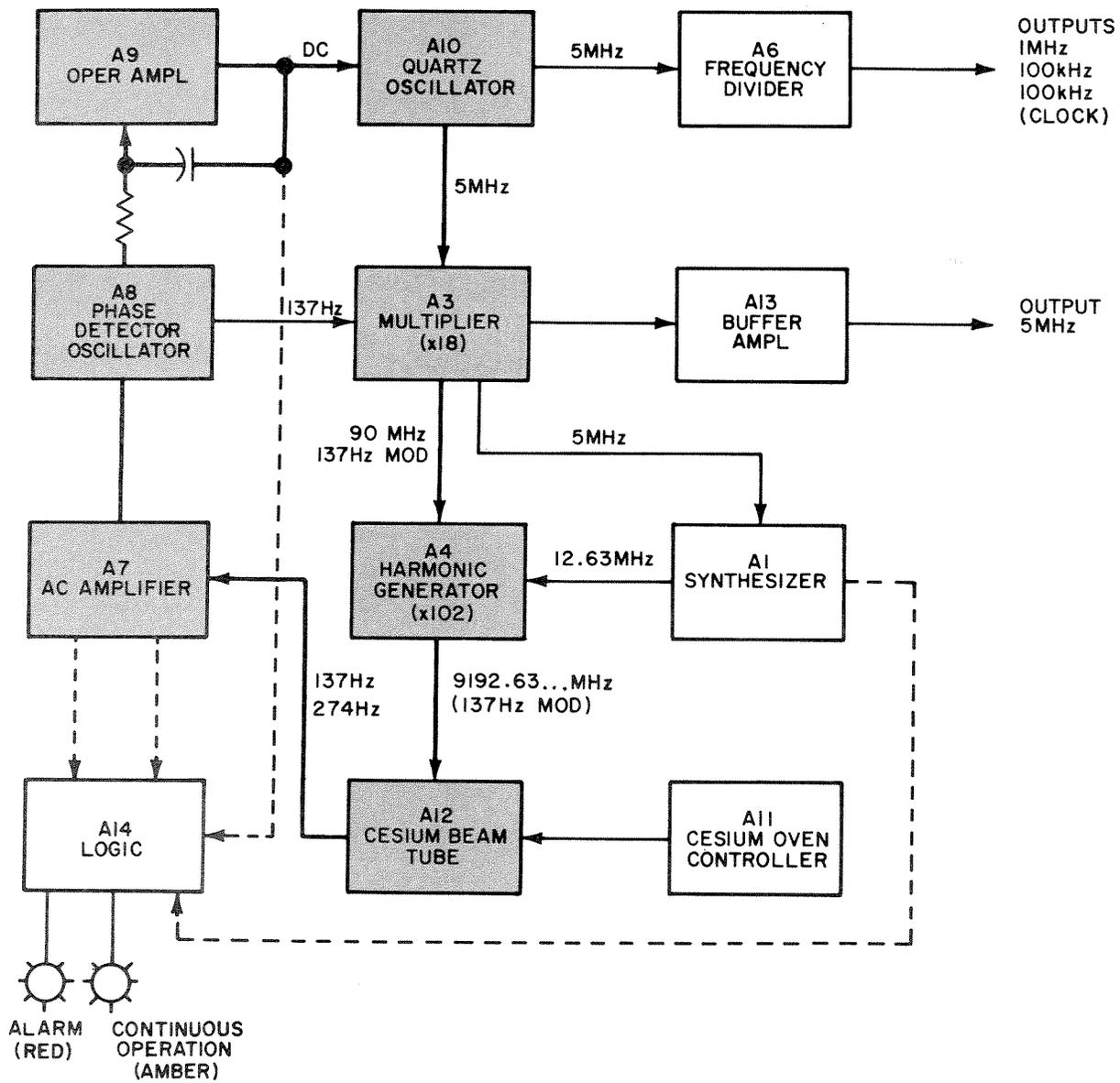


1. Synthesizer TIME SCALE SELECTOR thumbwheel switch: Selects synthesized frequency input to Harmonic Generator.
2. Synthesizer TIME SCALE SELECTOR HI-LO switch: Used in conjunction with thumbwheel switch to select synthesized frequency.
3. CLOCK SET STOP switch (Option 01 only): Digital clock is stopped when switch is depressed, starts when released.
4. CLOCK SET FAST switch (Option 01 only): Digital clock second hand is accelerated when switch is depressed, resumes normal operation when released.
5. Clock SYNC switch (Option 01 only): Synchronizes 5061A Digital Clock with an external clock when depressed; clock remains synchronized when released.
6. Clock TIME DELAY switch (Option 01 only): Selects time delay between an external reference pulse and the internal 1 pulse-per-second clock pulse. Adjustable in decade steps from 1 μ s to 1 sec.
7. 0-1 μ SEC TIME DELAY control (Option 01 only): Allows continuous adjustment of clock pulse delay over any 1 μ sec range.
8. OVEN TEMP NORM-LO switch: Selects operating temperature for the cesium beam tube oven. Normally set to NORM.
9. OVEN OFF-ON switch: Switch for cesium beam tube oven. Used in ON position.
10. AC Amplifier GAIN switch: Selects HI or LO gain of amplifier.

Figure 3-6. Rear-Panel Operating Controls



1. OUTPUTS - 5 MHz, 1 MHz, 100kHz: 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.
4. CLOCK 100 kHz jack: 0.5 volt rms (min), 100 kHz sine wave into 1000 ohm load for driving HP 115BR Frequency Divider and Digital Clock or equivalent.
5. EXT DC fuse: Use 3 ampere fuse (HP #2110-0003) when external 24 volt dc is used.
6. EXT DC connector: Five-pin male connector. Used to connect 5061A to external 24-volt dc supply.
7. SYNTH test jack: Synthesizer output frequency is available at this jack, frequency depends on time scale used (see Table 3-3).
8. CLOCK power: Four-pin female connector. Provides 25-33 Vdc for driving a Frequency Divider and Digital Clock such as HP 115BR or equivalent. Total current output should not exceed 200 milliamperes.
9. AC LINE jack: Accepts round female connector on power cable supplied.
10. CLOCK fuse (Option 01 only): 1-ampere fuse supplied with instrument.
11. AC LINE fuse: 1-ampere Slo-Blo fuse (HP No. 2110-0007) for 115 Vac operation or 0.5 ampere for 230 Vac operation.
12. 115/230 volt ac line switch: Set to expose correct numbers ("115" or "230") for the ac line voltage used.
13. 1 PPS jack (Option 01 only): Provides 10 volts, 20 μ sec pulse from digital clock circuits.
14. SYNC INPUT jack (Option 01 only): Input to digital clock circuits for external synchronizing pulse. External synchronizing pulse must be +5V or more with rise time of less than 50 nsec.



INDICATES QUARTZ OSCILLATOR FREQUENCY CONTROL LOOP

Figure 4-1. Simplified Block Diagram

SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. This section includes details of Model 5061A 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 assembly designation (A1, A2, A3, etc.) Assembly designations and their respective names are listed in Table 4-1.

Table 4-1. Assembly Designations

Assembly No.	Assembly Name
A1	Synthesizer
A2	Battery Charger (Option 02)
A3	Multiplier
A4	Harmonic Generator
A5	Digital Clock (Option 01)
A6	Frequency Divider
A7	AC Amplifier
A8	Phase Detector
A9	Operational Amplifier
A10	Quartz Oscillator
A11	Cesium Oven Controller
A12	Cesium Beam Tube
A13	Buffer Amplifier
A14	Logic
A15	Power Regulator
A17	Terminal Board
A18	+3500 Vdc Power Supply
A19	-2500 Vdc Power Supply

4-3. GENERAL DESCRIPTION.

4-4. The Model 5061A Cesium Beam Frequency Standard is itself capable of defining frequency and therefore needs no calibration. The 5061A is a cesium beam, atomic resonance standard and is capable of realizing the frequency corresponding to the international standards of time interval 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 of 9.182... GHz. The stability of this frequency is 1×10^{-11} for the life of the beam tube. The passive atomic resonator serves as an atomic frequency standard

by stabilizing a quartz oscillator in a feedback control circuit. The output of the quartz oscillator is used for various functions of frequency and time measurement.

4-5. A simplified block diagram of the 5061A is shown in Figure 4-1. The output of the 5 MHz Quartz Oscillator Assembly A10 is first 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 first by 18 in Multiplier Assembly A3 and then by 102 in Harmonic Generator Assembly A4. The output of Synthesizer Assembly A1, also driven by the 5 MHz quartz oscillator, is then added to the multiplied signal in the harmonic generator. The result of this multiplying and synthesizing is a frequency which is very close to 9.192631... GHz, the hyperfine transition frequency of Cesium 133. This microwave signal is used to excite the microwave cavity in the beam tube.

4-6. The beam tube can be thought of as a frequency discriminator. During normal operation of the 5061A, the input microwave, f_c , will lie within the central peak. Figure 4-2 shows one cycle of the resulting variation for three values of f_c , the carrier. With f_c centered at f_0 , the hyperfine transition frequency, f_c , the output beam current varies at twice the modulation frequency. If the carrier lies above f_0 , as shown by the plot labelled f_{c1} , output current varies at the same rate as the modulation but has been shifted by 180° with respect to it; when the carrier lies below f_0 , case f_{c2} , no phase shift occurs. When the applied microwave signal is matched to the cesium resonant frequency, only the second harmonic component of the modulation signal appears at 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.

4-7. The fundamental (137 Hz) and second harmonic (274 Hz) output from the beam tube are separated in AC Amplifier Assembly A7. The 274 Hz signal is used as one of the inputs to Logic Assembly A14. The 137 Hz signal is sent to Phase Detector Assembly A8. The output of the Phase Detector is a dc voltage proportional to the difference in frequency between the cesium resonance and the microwave field. This dc voltage is supplied to an integrator consisting of Operational Amplifier A9 with a resistor and integrating capacitors. The output of Operational Amplifier A9 is a voltage that electrically tunes the 5 MHz Quartz Oscillator to eliminate any frequency difference between the beam tube and the microwave field.

4-8. Buffer Amplifier A13 isolates the 5 MHz quartz crystal oscillator signal from external loading effects and provides a 5 MHz output to front and rear panel jacks.

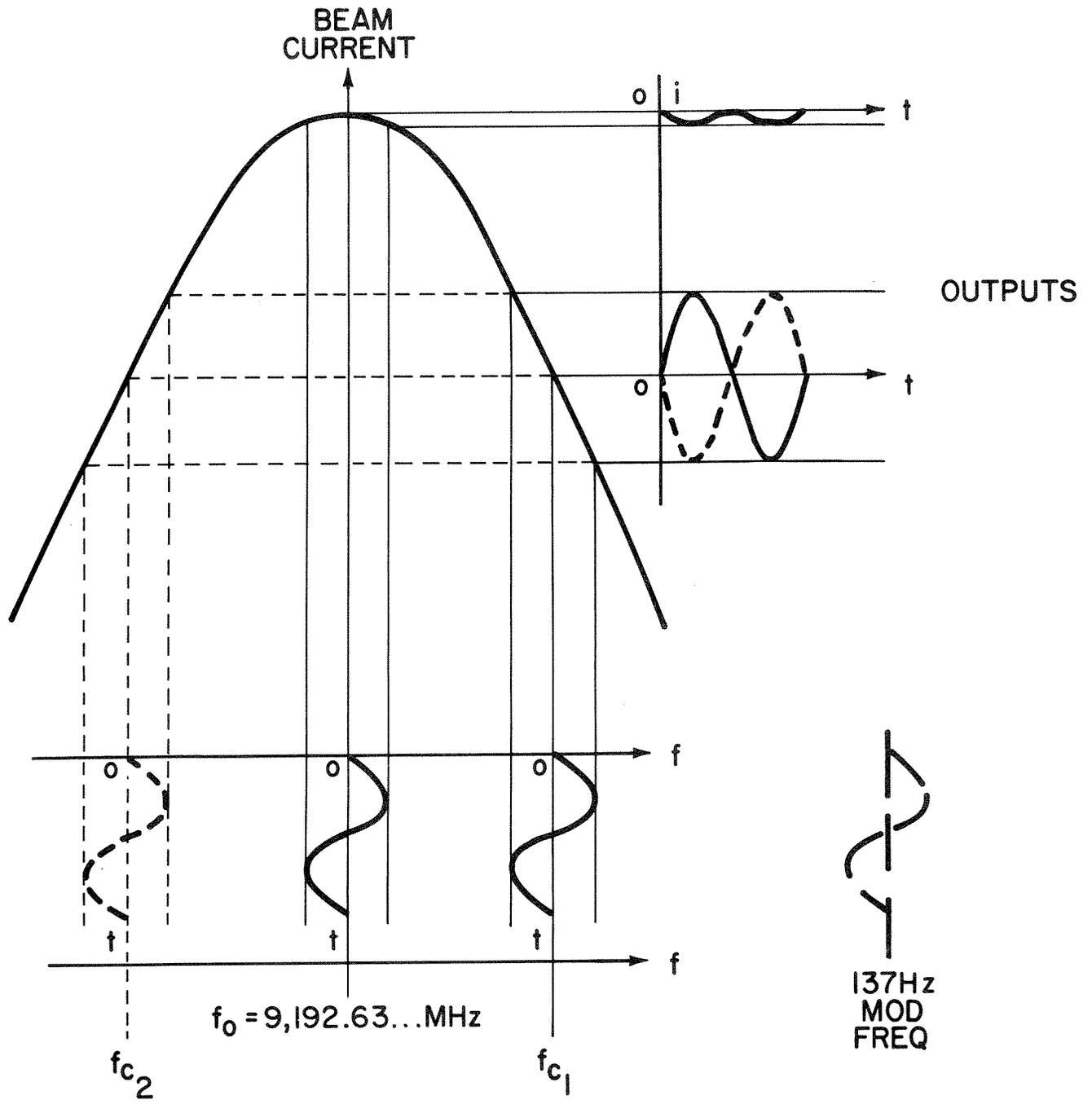


Figure 4-2. Discriminator Action of Cesium Beam Tube

4-9. Frequency Divider A6 provides outputs to front and rear panel jacks and a drive signal for internal Digital Clock (Option 01).

4-10. Logic Assembly A14 receives signals from Assemblies A1, A7, A8, and A9 integrator to control the front-panel CONTINUOUS OPERATION and ALARM lights.

4-11. Cesium Oven Controller A11 provides power to the cesium beam oven as required to maintain operating temperature.

4-12. GATING AND LOGIC.

4-13. The 5061A uses some integrated circuits in Synthesizer Assembly A1, Battery Charger A2 (Option 02), and Digital Clock Assembly A5 (Option 01). 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.

4-14. LOGIC SYMBOLS.

4-15. The symbol shown in Figure 4-3A is for the basic AND function. The basic AND gate output is high if all inputs are high. The AND gate can have two or more inputs. The symbol in Figure 4-3D is for the basic OR gate. The basic 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 4-3C. Thus, the small circle indicates inversion. This applies to both types of gates. Figure 4-4 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.

4-16. In a binary system there are only two states, which are referred to as H or L. 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. Thus, positive logic (logical one) or negative logic (logical zero) must be clearly specified. An H state could be a logical one or a logical zero. However, H must always represent the more positive level. A circle at the symbol input shows signal polarity required to activate the function. Figure 4-4 shows four pairs of symbols that have the same truth tables and can be used interchangeably. The same output function is performed by what appears 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.

Figure 4-3. Gate Symbols

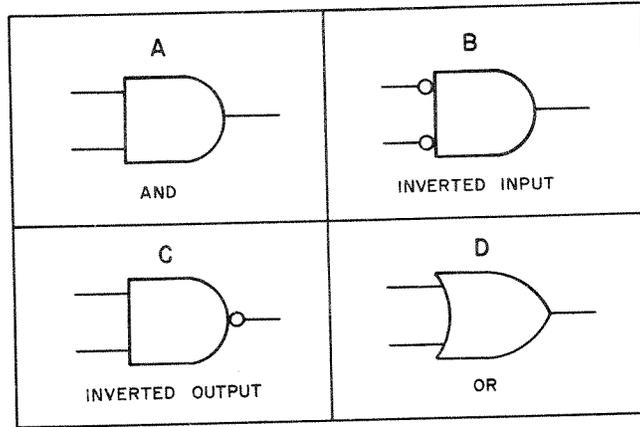
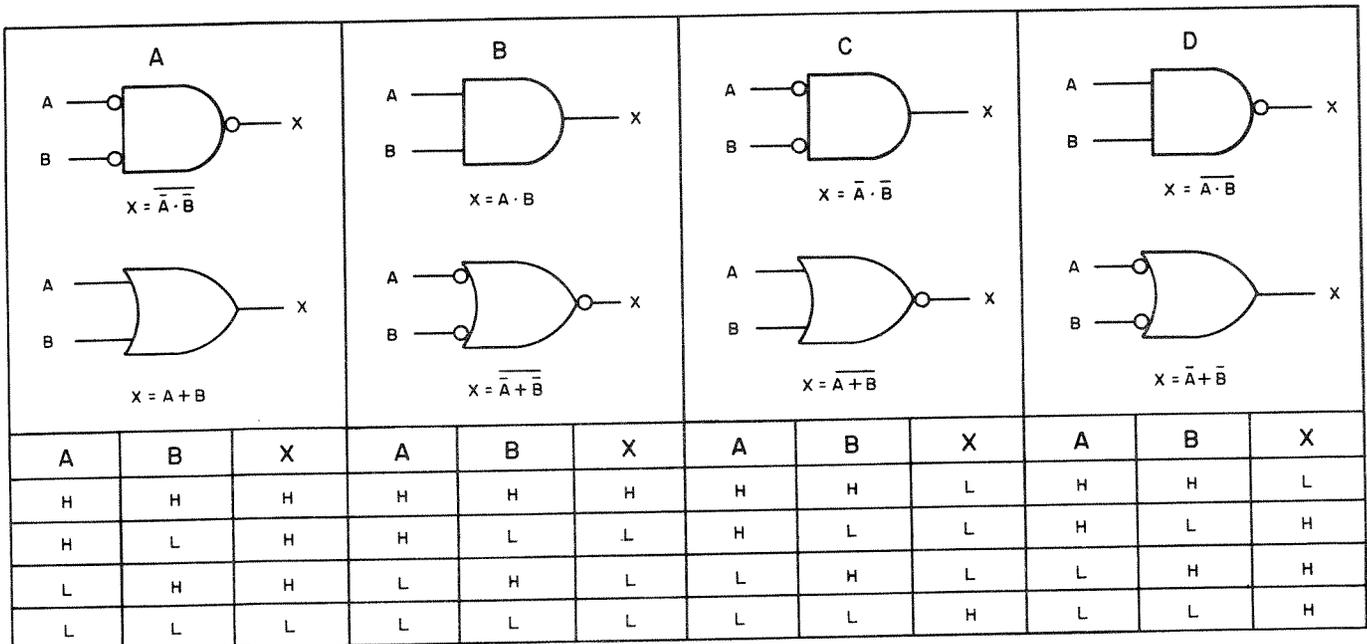


Figure 4-4. Logic Function Comparison



4-15. DeMORGAN'S THEOREM AND LOGIC SYMBOLS.

4-16. De Morgan's Theorem states: $\overline{A \cdot B} = \overline{A} + \overline{B}$ and $\overline{A + B} = \overline{A} \cdot \overline{B}$, 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 4-4D. From De Morgan's theorem, $X = \overline{A \cdot B} = \overline{A} + \overline{B}$ and the symbol for $\overline{A} + \overline{B}$ is the OR gate with inverted inputs shown in Figure 4-4D. 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 listed in Figure 4-4. 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.

SECTION V
CESIUM BEAM TUBE REPLACEMENT PROCEDURE

5-1. GENERAL.

5-2. 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.

5-3. REMOVING THE CESIUM BEAM TUBE.

5-4. To remove the tube, proceed as follows:

- a. Disconnect power from the Model 5061A and remove instrument top and bottom covers.
- b. If Option 02 (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.
- c. Remove three miniature plugs P1, P2, and P3 from the bottom of Harmonic Generator Assembly A4.
- e. Locate the two large white wires connected between the beam tube and power supply. These wires are the +3500V and -2500V supply leads. Unplug +3500V plug J4 and -2500V plug J3 by turning the metal lock on each connector plug.
- f. Loosen four screws in the beam tube hold-down straps. Do not remove straps at this time.
- g. 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.
- h. Rotate beam tube 45° to allow removal of Harmonic Generator Assembly. If beam tube is stuck in place, carefully loosen each end.
- i. 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).

j. Disconnect Harmonic Generator Assembly by removing four screws from flange attached to beam tube. The harmonic generator will be mounted on the new cesium beam tube.

k. Carefully lift out beam tube after removing screws and hold-down straps. Save plastic straps under holding straps.

5-5. CESIUM BEAM TUBE INSTALLATION.

5-6. 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 3-5). Place the two plastic straps and 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 +3500V plug J4 and -2500V 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. Note the hot wire ionizer taps called out on the new beam tube decal. Refer to the Cesium Oven Controller schematic and note Hot Wire Ionizer Secondary of T1 chart located at the lower right portion of the schematic. Connect A11T1 orange wires as indicated on the new beam tube decal. Be certain that A11T1 secondary strapping is correct.

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.

m. Locate A11R21A, B and A11R24A, B stand-off terminals near the slide switches. Remove the resistors on these terminals.

n. Install the resistors supplied with the new cesium beam tube on A11R21A, B and A11R24A, B terminals.

o. Replace A11 cover.

p. Replace A11 assembly in the instrument and tighten the three mounting screws.

q. 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.

5-7. ADJUSTMENT PROCEDURE.

5-8. To adjust the 5061A for optimum performance, proceed as follows:

5-9. ELECTRON MULTIPLIER VOLTAGE ADJUST (A15R30, R31).

a. Connect the voltage probe lead of a high-impedance dc voltmeter (HP Model 412A or equivalent), set to measure approximately -0.25 Vdc, to -2500 Vdc power supply assembly A19, pin 3. Connect the common lead of 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 gives -0.25V dc for the -2500V dc supply.

b. Set MODE switch to LOOP OPEN.

c. 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, the -2500V dc supply and cesium oven heater will be enabled. If ION PUMP I does not decrease, see Paragraph 3-9.

e. Set TIME CONSTANT switch to SHORT.

f. Locate R30 and R31 on Power Regulator Assembly A15. These resistors are used to adjust the electron multiplier -2500 Vdc supply.

g. 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 power (and battery with Option 01) from the 5061A and reduce the value of A15R30. If the voltage is too high, increase the value of A15R30. 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 A15R30 resistance until the electron multiplier voltage is at the value specified for the new beam tube. It may be necessary to increase A15R31 for proper electron multiplier voltage.

5-10. HARMONIC GENERATOR ASSEMBLY A4 ADJUSTMENTS.

5-11. 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. During adjustment of the Harmonic Generator Assembly, beam current is most easily measured by connecting directly to the beam tube output. To do this, disconnect the cable from AC Amplifier A7J1, located on the bottom, center front of the instrument deck. Using the micon male-to-male adapter and the micon-to-BNC cable provided with the 5061A, connect the BNC end of this cable to a picoammeter or to the voltage probe of a high impedance voltmeter (HP Model 412A or equivalent).

Note

The high impedance voltmeter is used in the voltmeter mode to measure beam current by measuring the voltage drop across the 200 megohm input impedance of the voltmeter .

Note

The following adjustments should be made only after the 5061A is at operating temperature and the instrument is tuned to primary peak of the cesium resonance (refer to Paragraph 3-5, 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:

TIME CONSTANT SHORT
MOD OFF
MODE LOOP OPEN

- b. Loosen microwave attenuator locking screw (see Figure 5-1) on Harmonic Generator near beam tube flange and slide attenuator all the way out. This is minimum attenuation position.

- c. To monitor beam current, remove the cable from A7J1, connect proper adapter cable to A7J1, and connect this cable to the voltage probe of a high impedance voltmeter such as the HP 412A.

- d. Locate A11R27 MASS SPECT on Cesium Oven Controller A11 and adjust for maximum beam current as indicated on the HP 412A. Tuning screw A4S5 (Figure 5-1) may require a slight adjustment at this time before a significant beam current can be measured while adjusting A11R27.

CAUTION

Less than 1/2 turn of A4S5 should be necessary.

- e. Adjust A4R1 on Harmonic Generator Assembly A4 (see Figure 5-1) fully counterclockwise and observe beam current indication on the HP412A Voltmeter. This current is the background level.

- f. While observing beam current, slowly turn A4R1 clockwise to the first peak maximum.

- g. Loosen attenuator locking screw (Figure 5-1) and slide attenuator in until the beam current is half-way between the first peak maximum and the background level.

h. Adjust tuning screw A4S5 to obtain maximum beam current.

Note

It is necessary to adjust A5S5 screw and locknut simultaneously.

i. Repeat steps e, f, g, and h to insure that the atomic transition is not saturated.

j. Pull out the attenuator slightly. The beam current should increase. If the beam current remains the same or decreases, the cesium beam tube is saturated and steps e through j should be repeated.

k. Loosen knurled tuning control lock on filter cavity of Harmonic Generator A4 (see Figure 5-1).

l. Adjust the cavity tuning control on the filter cavity (see Figure 5-1) for maximum beam current as indicated on the HP412A Voltmeter. Be certain the cesium beam tube is not saturated. Adjust attenuator for more attenuation if necessary. Tighten knurled tuning control lock on filter cavity.

m. Adjust OSC FREQUENCY COARSE control on front panel to insure the beam tube is tuned to the central peak of the atomic resonance.

n. Adjust A4R1 to its maximum counterclockwise position. Then slowly turn it clockwise to the first beam current maximum. Continue rotating A4R1 through its range to check for a second maximum. If second maximum appears, there is enough RF power available to saturate the beam tube. When this condition exists, do not perform steps o, p; proceed to step q.

o. If no second beam current maximum occurs, gently pull the attenuator knob out about 1/8 inch.

p. Again rotate A4R1 to check for two maxima. Decrease attenuation and rotate A4R1 to check for two maxima. Repeat until two maxima are present.

q. When two maxima are obtained, push attenuator knob down in small increments (increase attenuation) and adjust A4R1 after each attenuation change until only one maximum beam current point is reached. Adjust A4R1 for maximum beam current as indicated on HP412A Voltmeter. Carefully tighten attenuator locking screw.

NOTE

If there are still two maxima present with the attenuator set to maximum attenuation, set the attenuator 1/16 inch out and lock in this position. Starting at its maximum counterclockwise position, adjust A4R1 clockwise to the peak of the first beam current maximum.

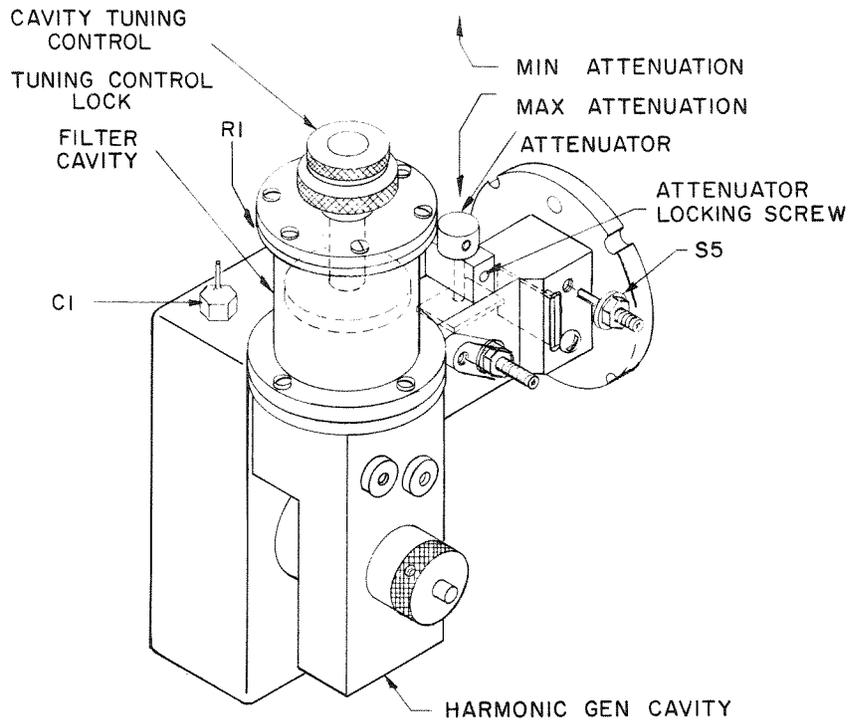


Figure 5-1. Harmonic Generator Assembly

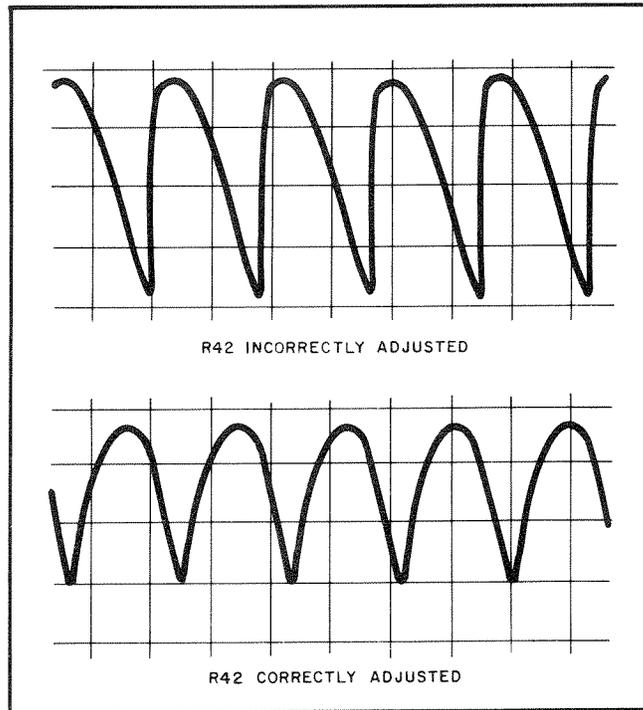


Figure 5-2. A8R42 Adjustment

5-12. BEAM CURRENT RECORD.

5-13. The HP 412A 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,

$$\frac{\text{Peak Signal} - \text{Valley Signal}}{\text{Background Signal}}$$

is a good indicator of 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 HP 412A meter reading as the "background signal".

- f. Reconnect A4P2 to the Harmonic Generator Assembly.

- g. Disconnect the HP 412A and adapter cable from 5061A.

- h. Reconnect cable to A7J1 of AC Amplifier assembly.

5-14. PHASE MODULATION FREQUENCY ADJUSTMENT.

- a. Connect a frequency counter to the sweep test output of Phase Detector Module A8J2 located on the bottom front of the deck.

- b. Adjust A8R10 MOD FREQUENCY 137Hz \pm 1 Hz on the counter.

- c. Remove counter from A8J2.

5-15. 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 (HP 412A or equivalent) 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.

5-16. OPERATIONAL AMPLIFIER ZERO ADJUSTMENTS.

- a. Locate TP1 and TP2 on bracket at bottom right side of instrument deck near the front panel. Connect a clip lead between TP1 and TP2 to short the input of the Operational Amplifier.
- b. Connect a dc voltmeter (HP 412A or equivalent) to CONTROL BNC jack on rear panel.
- c. Switch MODE switch to LOOP OPEN and then to OPER. Observe the voltage on 10 mV range of Voltmeter. This voltage will probably be drifting since the operational amplifier integrates its internal zero offset. Adjust A9R28, Integrator Zero, to stop this drift. Switch MODE switch from OPER to LOOP OPEN and back to OPER. This will discharge the integrating capacitor and permit using the voltmeter on a lower range for a more precise zero setting. Again adjust A9R28 to stop any drift in the control voltage.
- d. Remove dc voltmeter, and shorting jumper between TP1 and TP2.
- e. Connect the +18.7 Vdc lead (white-red) to the Operational Amplifier assembly A9.

5-17. PHASE MODULATION AMPLITUDE ADJUSTMENT.

- a. Set 5061A controls as follows:
MOD ON
MODE LOOP OPEN
OS FREQUENCY X10⁻¹⁰ 250
CIRCUIT CHECK BEAM I
TIME CONSTANT SHORT

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

c. Adjust OSC FREQUENCY $\times 10^{-10}$ to 100. The quartz oscillator is now offset by -150 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.

e. Adjust MOD LEVEL A3R20 on Multiplier Assembly A3 for maximum voltage on oscilloscope. Then, turn A3R20 counterclockwise to reduce this voltage slightly (5 to 10%).

f. Remove the oscilloscope connection from A7J6.

5-18. PHASE MODULATION PHASE ADJUST.

a. Check that the 5061A is set as follows:

MOD	ON
MODE	LOOP OPEN
OSC FREQUENCY $\times 10^{-10}$	100
CIRCUIT CHECK	BEAM I
TIME CONSTANT	SHORT

b. Using the Micon-to-BNC cable provided, connect an oscilloscope to A8J1 on Phase Detector Assembly A8.

c. Adjust A8R42 Phase Adj for the correct waveform as shown in Figure 5-2.

Note

If A8R42 has insufficient range, reverse the positions of A8R42 and A8R35, located inside the module, so that A8Q8 emitter is connected to A8R42 and A8Q9 emitter is connected to A8C20. Repeat step c.

d. Reset OSC FREQUENCY $\times 10^{-10}$ to 250.

5-19. AC GAIN ADJUSTMENT.

- a. Set the 5061A as follows:

MOD	ON
MODE	OPER
OSC FREQUENCY X10 ⁻¹⁰	250
CIRCUIT CHECK	2ND HARMONIC
TIME CONSTANT	SHORT

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

5-20. BEAM I METER ADJUSTMENT.

- a. With instrument operating and CONTINUOUS OPERATION light on, set CIRCUIT CHECK switch to BEAM I. Adjust BEAM I METER adjust for 20 on the CIRCUIT CHECK meter.

5-21. C FIELD ADJUSTMENT.

- a. Perform steps in Paragraph 3-8, k, C Field Adjustment.
- b. Replace bottom cover. This completes the Cesium Beam tube replacement procedure. Adjustments are complete and the instrument is ready for use. Perform the Initial Turn-on Procedure of Paragraph 3-5.

REFD	DESCRIPTION OPTIONS 01,02,03	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
C1	C F .001 MF 75V		0160-0975	M1	METER 50-0-50 UA		1120-1472
C2	C F 4 MF 30V		0160-2048		DIAL TURNS COUNT		1140-0014
C3	C F .005 MF 250V		0160-3043		TRANSISTOR INSUL		1200-0076
C5	C F 1000 MF 50V		0180-0090		CLAMP TRANSISTOR		1200-0087
C6	C F 47 MF 35V		0180-0097		BUSHNG TRANSISTR		1200-0092
C7	TRMINAL FEEDTHRU		0340-0038	J5	RECEPT BNC		1250-0102
	PUSH INSULATOR		0340-0039	J7,9,1			
	INSUL FEED THRU		0340-0119	J6	CONN RF		1250-0140
	CAP WIRE TERMIN		0362-0187	J8,10,11,12,14,			
	KNOB BAR .625D		0370-0104	15,2			
	TAPE FOAM 1.25 W 18"		0460-0114	J19	CONN 5PIN MALE		1251-0111
	FASTNER		0510-0182	J18	CONN 4PIN FEMALE		1251-0128
	SHAFT LOCK NUT		0590-0035	J20	CONN 3PIN MALE		1251-0146
R6	R F 12M 1% 1W		0730-0145		INSERT COAX PLUG		1251-0179
R4	R F 1K 2% .250W		0757-0924	P17	CONN 5 PIN 2COAX		1251-0182
R1	R F 8.2K 2%.250W		0757-0946		RETAIN CONN		1251-0215
R9	R F 10K 2% .250W		0757-0948	P16	CONNECTOR 9 PIN		1251-0216
R2	R F 15K 2% .250W		0757-0952		CONN HOOD		1251-0217
R5	R F 100K 2%.250W		0757-0972		LOCK POSTS		1251-0218
	TUBING HS BLU 2 1/2"		0890-0878		CONN RET 15PIN		1251-0220
					CONNECTOR HOOD		1251-0222
					HOOD R&P CONN HX		1251-1977
				J3	CONN R&P HEX		1251-1978
				P4			
				P3	CONN R&P HEX		1251-1979
				J4			

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
A10	OVEN ASSY. XTAL. (Rebuilt = 00105-6034)		00105-6013		BRACKET-BUFF AMP		05061-0025
W1	CABLE AC POWER		1148-16A		BRACKET-P.C.B		05061-0028
	CLAMP TUBE SUPP		05060-0001		PANEL-INSIDE		05061-0029
	INSUL TUBE SUPP		05060-0013		BRACKET-USC		05061-0032
	INSUL BEM TBE ST		05060-0021		BRACKET-PCB		05061-0035
	INSUL BM TBE BRA		05060-0024		DOOR-FRONT		05061-2020
	ROD TB SUPP		05060-2002		PLATE-NUT		05061-2032
	SPACER PANEL		05060-2014		BRACKET-TUBE		05061-2037
	BRACK CHASS SUPP		05060-2064		SPACER-OPER AMP		05061-2038
	BRACK MT C FEILD		05060-2082		COVER-TOP	01 03	05061-2041
	COVER C FIELD		05060-2083		BAR		05061-2042
A3	MULT ASSY 5 90MC (Not Field Repairable)		05060-6001		GUIDE		05061-2043
A4	GEN ASSY HARMONI (Not Field Repairable)		05060-6029		LOCK		05061-2044
A19	PW SPY A 2500VDC (Not Field Repairable)		05060-6092		PLATE-LEFT	01 03	05061-2045
A18	PW SPY A 3500VDC (Not Field Repairable)		05060-6093	A1	MUD AY-SYNTH		05061-6001
A12	TUBE AY CES BEAM		05060-6120	A6	MOD AY-FREQ DIV		05061-6003
	BRACKET CAP		05061-0008	A7	MUD AY-AC AMP		05061-6005
	PANEL-FRONT		05061-0015	A8	MOD AY-PHASE DET		05061-6007
	PANEL-REAR		05061-0016	A9	MOD AY-OPER AMP		05061-6008
	CHASSIS-SMALL		05061-0017	A11	CS OVEN CONTRO		05061-6009
	CHASSIS-LARGE		05061-0018	A14	BD AY-LOG CIR		05061-6016
	PANL-DOOR		05061-0019	A15	BD AY-PWR REG		05061-6017
	PANEL-LEFT	01 02 03	05061-0020				

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
	CONN RING R&P HX		1251-1981	S5	SWITCH TOGGLE		3101-0163
F1 F2,3	FUSEHOLDER		1400-0084	S4	SWITCH TOGGLE		3101-1155
	BUSHING POT EXT		1410-0052		PLATE IDENT		7120-1255
DS2	LIGHT RED		1450-0113		PLATE SERIAL		7122-0082
DS1	LIGHT AMBER		1450-0114		LABEL IDENT		7124-0960
	PIN DOWEL .125 D		1480-0017	L1	CHUKE FILTER50MH		9100-0337
	PIN ROLL		1480-0059	L2	COIL FXD 5 UH		9100-0339
Q2	TRANSISTR 2N1701		1854-0020	T1	TRANSFORMER		9100-2449
CR1 CP2	DIODE SIL 30WV		1901-0040		CT 18.38X17X9.25		9211-1126
R8	R V 5K 5% .75W		2100-1414		CT 22.25X21X15.4		9211-1128
R3	R VAR 20K3%5TURN		2100-2425		BAG POLYETHYL		9220-0012
	R VAR MTG BRACKT		2100-2427		PAD-TOP-BOTTOM		9220-1304
R7	R VAR 250K 20%		2100-2429		PUST POLY 6X6		9220-1347
F2	FUSE LAMP 115V		2110-0001		PLATE FLUTED AL		5000-0053
F3	FUSE 3A		2110-0003		SIDE COVER		5000-0747
F1	FUSE 230V 1 AMP		2110-0007		GUIDE BOARD PC		5040-4528
	LAMP INCD		2140-0025		FRAME AY 8X16 FM		5060-0736
	NUT HEX		2950-0040		BUTT COVER ASSY		5060-0755
S1	SWTCH 2SEC12POS		3100-0893		HNDLE ASSY SIDE		5060-0763
S2	SWTCH 3SEC 3POS		3100-0894		RTNR HNDLE ASSY		5060-0765
S3	SWITCH SLIDE		3101-0033		FT AY-FULL MUD		5060-0767
S6	SWITCH SLIDE		3101-0045		KIT-8H RACK MT		5060-0777
S7	SWITCH P-BUTTON		3101-0124		APPLICATION-NOTE 52		5951-0052

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
W24	CABLE-AY TERM		05061-6058	A17	BD AY-TERMINAL		05061-6018
W25	CBL AY-OPER AMP		05061-6059	A13	MOD AY-BUFF AMP		05061-6030
	CBL AY-MAIN		05061-6060	W1	CABLE-AY FRONT		05061-6035
W29	CBL AY-OSC		05061-6064	W2	CBL-AY BUFF REAR		05061-6036
W30	CBL AY-BUFF SYNT		05061-6065	W3	CBL-AY SYNTH		05061-6037
	CBL AY-PANEL		05061-6066	W4	CABLE AY-MULT		05061-6038
	CBL AY-PANEL		05061-6067	W5	CABLE AY-OSC		05061-6039
W32	CBL AY-DIG DIV		05061-6069	W6	CABLE AY-USC		05061-6040
	KIT-ACCESSORY		05061-6070	W7	CBL-AY 2ND HAR		05061-6041
	OPT 1 AY-CLUCK	01	05061-6074	W8	CABLE AY-E TO LO		05061-6042
	OPT 2 AY-BAT	02	05061-6075	W9	CBL-AY PHASE DET		05061-6043
	OPT 3 AY-CLK BAT	03	05061-6076	W10	CBL AY MOD MULT		05061-6044
				W11	CBL AY-SYNTH		05061-6045
				W12	CBL AY FREQ DIV		05061-6046
				W13	CBL AY-FREQ DIV		05061-6047
				W14	CBL AY-TUBE		05061-6048
				W15	CBL AY-MULT		05061-6049
				W16	CBL AY-PHASE		05061-6050
				W18	CBL AY-FREQ		05061-6052
				W19	CBL AY-FREQ DIV		05061-6053
				W20	CBL AY-FREQ DIV		05061-6054
				W21	CBL AY- PHASE		05061-6055
				W23	CBL AY-MOD		05061-6057

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
	INSUL FEED THRU		0340-0119	CR28	C V VAR 39PF 30V		0122-0013
J1 J2,3	CONN BULKHEAD		1250-0258	C21	C F 2000 PF 300V		0140-0180
S1	SWITCH THUMBWHEL		3100-2063	C10	C F 68 PF 300V		0140-0192
	LABEL MAKING		7124-0845	C14 25,39,46	C F 200 PF 300V		0140-0220
	CHASSIS-SYNTH		05061-0001	C34	C F 300 PF 300V		0140-0225
	COVER-SYNTH		05061-0002	C33	C F 500 PF 300V		0140-0234
	PLATE-END		05061-2003	C4 8,12,22,27,35, 38,40,41,42,43, 48	C F .01 MF 100V		0150-0093
	PLATE-END		05061-2005	C3	C F .1 MF 50V		0150-0121
	BD AY-SYNTH		05061-6002	6,7,15,17,20	C F .1 MF 50V		0150-0121
				C11 23,24,26,28,29, 30,31,32,44	C F 1 MF 25V		0160-0127
				C16	C F .47 MF 25V		0160-0174
				C36	C F 600 PF 300V		0160-0340
				C49	C F 8 MF 30V		0180-0010
				C45	C F 60 MF 6V		0180-0106
				C5 9,13	C F 6.8 MF 35V		0180-0116
				C47	C F 2.2 MF 20V		0180-0197
				C1 2,18,19,37	C F 1 MF 35V		0180-0291
					TERMINAL TURRET		0340-0037
					BUSH INSULATOR		0340-0039
				Y1,	CRYSTAL 12.632MH		0410-0143

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
Q23 27	TRANSISTOR NPN S		1854-0023	L3	COIL F RF		9140-0187
Q18	TRANSISTOR NPN S		1854-0035	L5	COIL:F .22UH		9140-0190
Q19, 21,22,26,	TRANSISTOR 2N3563		1854-0092	L1	COIL CHUKE 200UH		9140-0237
Q20	TRANSISTOR NPN S		1854-0273		BD-BLANK		05061-2002
CR9, 19,26,30,38,39, 40,41,42,43,	DIODE SIL 30WV		1901-0040	T1	XFMR BLK OSC		05061-8001
CR29 32,34,35	DIODE SIL 75WV		1901-0050	T2	XFMR BLK OSC		05061-8002
CR36 CR37	DIODE SIL 35WIV		1901-0146	T3	XFMR SAMPLER-DR		05061-8003
CR20	DIODE BRKDN 10V		1902-0025	T4	XFMR MHZ OUTPUT		05061-8004
CR8	DIODE BRKDN6.81V		1902-0052				
CR33	DIODE BRKDN7.5 V		1902-0064				
CR27	DIODE BRKDN2.87V		1902-3024				
CR1 CR2	DIODE BRKDN5.62V		1902-3104				
CR7	DIODE BRKDN9.09V		1902-3149				
CR14	DIODE BRKDN13.3V		1902-3193				
CR25	DIODE BRKDN14.7V		1902-3203				
CR3 CR4 THRU 6 CR10 THRU 13 CR15 THRU 18 CR21 THRU 24	DIODE GERM 60WIV		1910-0016				
L2 L4	COIL RF 1.2 MH		9140-0046				
L7	COIL 1UH		9140-0096				
L6	COIL FXD 1000 UH		9140-0137				

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
R83	R F 2.21M1%.125W		0698-3126	R27	R F 5.1K 2%.250W		0757-0941
R85	R F 4.75M2%.125W		0698-3127	R92	R F 5.6K 2%.250W		0757-0942
R81 R88	R F 1M 1% .125W		0698-3129	R84*	R F 6.2K 2%.250W		0757-0943
R72 R73	R F 2.7M 1%.125W		0698-3130	R64	R F 6.8K 2%.250W		0757-0944
R2	R:F 39U UHM5% 2W		0698-3633	R29 43, 51, 55, 58, 66, 86	R F 10K 2% .250W		0757-0948
R57	R F 500K 1%.125W		0721-0011	R89	R F 12K 2% .250W		0757-0950
R78	R F 392K 1%.125W		0757-0479	R82*	R F 20K 2% .250W		0757-0955
R44 96, 98	R F 56 UHM2%.25W		0757-0894	R80	R F 33K 2% .250W		0757-0960
R1 75, 93	R F 100 UHM2%.2W		0757-0900	R54* 71, 99	R F 39K 2% .250W		0757-0962
R61 R97	R F 200 UHM2%.2W		0757-0907	R52	R F 62K 2% .250W		0757-0967
R95*	R F 240 UHM2%.2W		0757-0909	R11 24, 34, 69, 79	R F 100K 2%.250W		0757-0972
R53 60, 62, 65, 56	R F 470 UHM2%.2W		0757-0916		CRYSTAL SOC HC6U		1200-0758
R3 4, 5, 6, 13, 16, 21, 25, 28, 33, 35, 38, 40, 42, 45, 47, 50, 70, 87, 90, 100	R F 1K 2% .250W		0757-0924	1C2	INTEGRATED CIRC		1820-0079
R8 17, 31, 32, 46, 48	R F 1.5K 2%.250W		0757-0928	1C1 3, 6, 9	INTEGRATED CIRC		1820-0080
R19 20, 30, 34, 49, 63, 67, 74, 76, 77, 91, 94, 101	R F 2K 2% .250W		0757-0931	1C5	INTEGRATED CIRC		1820-0081
R7 9, 12, 14, 15, 26, 41, 68	R F 3K 2% .250W		0757-0935	1C8 11	INTEGRATED CIRC		1820-0315
R10 18, 22, 23, 36, 37	R F 3.9K 2%.250W		0757-0938	1C4 7, 10	INTEGRATED CIRC		1820-0320
R59	R F 4.7K 2%.250W		0757-0940	Q24 25	TRANSISTOR NPN S		1854-0005
				Q17	TRANSISTOR 2N708		1854-0005
				Q1 Q2 THRU 16	TRANSISTOR 2N709		1854-0005

OPTION 02 BATTERY CHARGER A2
(P. C. BOARD IS 05061-6019)

REFD	DESCRIPTION (Option 02 = 05021-6075)	OPT	PART-NUMBER	REFD	DESCRIPTION (Option 03 = 05061-6076)	OPT	PART-NUMBER
	C F 500 MF 75V		0180-0047		C F 500 MF 75V		0180-0047
	R F 10K 2% .250W		0757-0948		R F 10K 2% .250W		0757-0948
	TRANSISTUR INSUL		1200-0076		CLOCK 24 HR		1010-0021
	CLAMP TRANSISTOR		1200-0087		RING THRD CLOCK		1010-0022
	BUSHNG TRANSISTR		1200-0092		BEZEL AND WINDOW		1010-0023
	BATTERY 24V2.3A		1420-0053		TRANSISTOR INSUL		1200-0076
	LIGHT RED		1450-0113		CLAMP TRANSISTOR		1200-0087
	TRANSISTR 2N1701		1854-0020		BUSHNG TRANSISTR		1200-0092
	FUSE 3A RADIAL		2110-0274		RECEPT BNC		1250-0102
	LAMP INCD		2140-0025		BALL -STUD RECVR		1390-0143
	SWITCH P-BUTTON		3101-0124		BALL STUD FASTNR		1390-0144
	BRACKET-CAP		05061-0014		BATTERY 24V2.3A		1420-0053
	PANEL-LEFT		05061-0021		LIGHT RED		1450-0113
	BRACKET-BATT		05061-0026		TRANSISTR 2N1701		1854-0020
	GASKET-BATT		05061-0027		FUSE 3A RADIAL		2110-0274
	BD AY-BATT CHARG		05061-6019		LAMP INCD		2140-0025
					SWITCH P-BUTTON		3101-0124
					CAN RND		7100-1065
					INSULATOR RECEPT		5020-0176
					BRACKET-CAP		05061-0014
					PANEL-CENTER		05061-0023
					PAEL-LEFT		05061-0024

OPTION 03
A5 DIGITAL CLOCK AND A2 BATTERY CHARGER
(05061-6076)

REFD	DESCRIPTION (Option 03 = 05061-6076)	OPT	PART-NUMBER	REFD	DESCRIPTION (Battery Charger Board = 05061-6019)	OPT	PART-NUMBER
	BRACKET-BATT		05061-0026	C10	C F 500 PF 300V		0140-0234
	GASKET-BATT		05061-0027	C1 C8	C F .01 MF 100V		0150-0093
	KNOB-CLOCK		05061-2011	C6	C F .1 MF 50V		0150-0121
	PLATE-CENTER		05061-2022	C2 C3,9,15	C F 1 MF 25V		0160-0127
	PLATE-LEFT		05061-2023	C4 C13,14	C F 60 MF 6V		0180-0106
	MOD AY-DIG DIV		05061-6011	C5 C7	C F 100 MF 30V		0180-0113
	BD AY-BATT CHARG		05061-6019	C11	C F 6.8 MF 35V		0180-0116
	COVER-AY TOP		05061-6034	C12	C F 2.7 MF 35V		0180-0117
	CBL AY-FREQ DIV		05061-6061		TERMINAL SOLDER		0360-0065
	CBL AY-DIG DIV		05061-6062		TERMINAL .04 D		0360-0124
	CBL AY-DIG DIV		05061-6068		RELAY DPDT 28V2A		0490-0475
	CBL AY-CLOCK		05061-6071	R2	R:F 120 OHM5% 2W		0698-3622
				R28	R F 10 OHM1%.12W		0757-0346
				R9 R47,51	R F 750K 1%.125W		0757-0486
				R22	R F 68 OHM2%.25W		0757-0896
				R21 R25	R F 100 OHM2%.2W		0757-0900
				R6 R45,53	R F 200 OHM2%.2W		0757-0907
				R42	R F 240 OHM2%.2W		0757-0909
				R59	R F 510 OHM2%.2W		0757-0917

OPTION 02

A2 BATTERY CHARGER BOARD
(05061-6019)

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
R1 R5,11,18,20,24, 26,30,32,33,39 4R	R F 1K 2% .250W		0757-0924	Q19 20,26,25	TRANSISTOR NPN S		1854-0003
R4	R F 1.5K 2%.250W		0757-0928	Q1 3,4,5,6,12,9,15, 16,17,18,22,24	TRANSISTOR 2N708		1854-0005
R14* 15,19*,29,34,36, 44,46,50,52	R F 2K 2% .250W		0757-0931	Q7 10,11,14	TRANSISTOR 2N3053		1854-0039
R23 R61	R F 2.4K 2%.250W		0757-0933	Q2 21,23,13	TRANSISTOR 2N2646		1855-0010
R3 R8,10,27,31,38, 58	R F 3.9K 2%.250W		0757-0938	SCR1 SCR2	SWTH SILI CONTRO		1884-0003
R62	R F 5.1K 2%.250W		0757-0941	CR1 CR2 THRU 4 CR6 THRU 9	DIODE SIL 600PIV		1901-0029
R63	R F 5.6K 2%.250W		0757-0942	CR18 29,30,31,32	DIODE SIL 30WV		1901-0040
R35 37,41,43,49,55, 57	R F 10K 2% .250W		0757-0948	CR5 CR11,13	DIODE BRKDN5.11V		1902-0041
R7 40,54,56,60	R F 15K 2% .250W		0757-0952	CR19	DIODE BRKDN5.62V		1902-3104
R13,	R F 20K 2% .250W		0757-0955	CR17	DIODE BRKDN14.7V		1902-3203
R12	R F 39K 2% .250W		0757-0962	CR10	DIODE BRKDN17.8V		1902-3224
R17	R F 1.6K 5% .5W		0758-0063	CR12	DIODE BRKDN31.6V		1902-3290
C4 C6	INTEGRATED CIRC		1820-0080	CR14, 15,16,20,21,22, 23,25,26,27,28, 24,	DIODE GERM 60WIV		1910-0016
C7	INTEGRATED CIRC		1820-0086	R15	R V 50 OHM 10%		2100-1769
C8 ,10,11	INTEGRATED CIRC		1820-0094		BD-BLANK		05061-2019
C1	INTEGRATED CIRC		1820-0315				
C2 ,5	INTEGRATED CIRC		1820-0329				
R	TRANSISTOR PNP S		1853-0001				

A5 DIGITAL CLOCK MODULE (05061-6011)

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
	CLOCK 24 HR		1010-0021		BUSHING SNAP BLK		0400-0084
	RING THRD CLOCK		1010-0022	S7	SWITCH P-BUTTON		3101-0052
	BEZEL AND WINDOW		1010-0023	S9			
	RECEPT BNC		1250-0102	S8	SWITCH P-BUTTON		3101-1159
	BALL -STUD RECVR		1390-0143		LABEL MARKING		7124-0845
	BALL STUD FASTNR		1390-0144		CHASSIS-DIG 0		05061-0011
	CAN RND		7100-1065		COVER-DIG DIV		05061-0012
	INSULATOR RECEPT		5020-0176		BRACKET-DIG DIV		05061-0013
	PANEL-CENTER		05061-0022		BRACKET-GUARD		05061-0037
	PAEL-LEFT		05061-0024		PLATE-END		05061-2026
	KNOB-CLOCK		05061-2011		PLATE-END		05061-2027
	PLATE-CENTER		05061-2022		BD AY-INTER CONN		05061-6012
	PLATE-LEFT		05061-2023		BD AY-PRE CLOCK		05061-6013
	MOD AY-DIG DIV		05061-6011		BD AY-MAST CLOCK		05061-6014
	COVER-AY TOP		05061-6034		BD AY-PWR SUP		05061-6015
	CBL AY-FREQ DIV		05061-6061		BD AY SWITCH		05061-6033
	CBL AY-DIG DIV		05061-6062				
	CBL AY-DIG DIV		05061-6068				
	CBL AY-CLOCK		05061-6071				

A5A1 POWER SUPPLY AND 1 PPS OUTPUT
BOARD ASSEMBLY (05061-6015)

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
C12	C F 30 PF 500 V		0140-0203	R5	R F 1.6K 2%.250W		0757-0929
C10 C17	C F .01 MF 100V		0150-0093	R21 R22	R F 2K 2% .250W		0757-0931
C4 C5	C F .05 MF 100V		0150-0096	R1	R F 5.6K 2%.250W		0757-0942
C13	C F 1 MF 25V		0160-0127	R10	R F 10K 2% .250W		0757-0948
C19	C F 2.2 MF 25V		0160-0128	J1, THRU 4,	CUNN RF PC		1250-0257
C3	C F .022 MF 200V		0160-0162	IC1	INTEGRATED CIRC		1820-0313
C15	C F .47 MF 25V		0160-0174	Q3	TRANSISTOR PNP S		1853-0001
C1 C2	C F 47 MF 35V		0180-0097	Q4 Q6,9,10	TRANSISTOR NPN S		1854-0003
C6 C7,18	C F 100 MF 20V		0180-0098	Q11 Q12,7	TRANSISTOR 2N708		1854-0005
C16	C F 6.8 MF 35V		0180-0116	Q1 Q2,5	TRANSISTR 2N1701		1854-0020
C8 C9,11,14	C F 2.7 MF 35V		0180-0117	Q8	TRANSISTOR NPN S		1854-0035
	TERMINAL .04 D		0360-0124	CR1 CR9,10,15	DIODE SIL 30WV		1901-0040
R9 R14	R F 10 OHM1%.12W		0757-0346	CR4 CR5,6,7	DIODE SIL 50PIV		1901-0049
R4	R F 56 OHM2%.25W		0757-0894	CR2 CR3	DIODE SIL 100PIV		1901-0410
R2 R3,7,8,12,18	R F 100 OHM2%.2W		0757-0900	CR13 CR14,11,12	DIODE BRKDN 10V		1902-0554
R15 R19,20	R F 200 OHM2%.2W		0757-0907	CR8	DIODE BRKDN13.3V		1902-3193
R6 R11	R F 390 OHM2%.2W		0757-0914	R13	R V 1K 10% .5W		2100-1773
R16 R17,25,26	R F 680 OHM2%.2W		0757-0920	T1	TRANSFORMER		9100-2448
R23 R24	R F 1K 2% .250W		0757-0924	L1 L2	COIL 53.8UH 1PFR		9140-0154
					BD-BLANK		05061-2015
				T2	TRANS-1PPS		05061-8010

(05061-6014)

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
C9	C VAR		0121-0105	R20	R F 100K 2%.250W		0757-0972
C4	C F 2000 PF 300V		0140-0180		CRYSTAL SOCKET		1200-0159
C12 C13	C F 15 PF 500 V		0140-0202	IC12 13,14	INTEGRATED CIRC		1820-0086
C10,	C F 680 PF 300V		0140-0208	IC4 IC5	INTEGRATED CIRC		1820-0094
C6 C8	C F 500 PF 300V		0140-0234	IC2 IC3	INTEGRATED CIRC		1820-0315
C2 C11	C F .01 MF 100V		0150-0093	IC6 IC7,8,9,10,11	INTEGRATED CIRC		1820-0329
C1 C5	C F .1 MF 50V		0150-0121	Q1 Q2	TRANSISTOR 2N708		1854-0005
C3	C F 1 MF 25V		0160-0127	P3 P4,5,6,7	TRANSISTOR 2N709		1854-0009
C7	C F 24 PF 300V		0160-0196	CR1	DIODE SIL 30WV		1901-0040
	TERMINAL SULDR		0360-0065	2,4,5,6,7,8,9, 10,11			
Y1	CRYSTAL 1MC		0410-0012	CR3	DIODE BRKDN7.5 V		1902-0064
R5 6,8,24,10	R F 100 OHM2%.2W		0757-0900	L2	COIL FXD 1000 UH		9140-0137
R18	R F 510 OHM2%.2W		0757-0917	L1 L3	COIL 53.8UH 1PER		9140-0154
R7	R F 680 OHM2%.2W		0757-0920		BD-BLANK		05061-2014
R1 4,9,12,11,17,21 23,25	R F 1K 2% .250W		0757-0924	T1	TRANS-1MHZ-4MHZ		05061-8005
R13 19,26,29, 30 THRU 46	R F 2K 2% .250W		0757-0931	T2,	TRANS-SYNC		05061-8009
R22	R F 3.9K 2%.250W		0757-0938				
R2	R F 8.2K 2%.250W		0757-0946				
R14,15,16,27,28	R F 10K 2% .250W		0757-0948				

A5A3 PRESET CLOCK BOARD ASSY
(05061-6013)

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
22	C F 56 PF 300V		0140-0191	Q1	TRANSISTOR 2N709		1854-0009
21	C F 150 PF 300V		0140-0196	Q2	THRU 13,15		
	TERMINAL SULDR		0360-0065	CR17	DIODE SIL 30WV		1901-0040
242	R F 510 OHM 2% .2W		0757-0917	CR18			
250, 54				CR19	DIODE GERM 60WIV		1910-0016
239	R F 1K 2% .250W		0757-0924	THRU 26			
244, 45, 47, 48, 49,				S14,	SWITCH THUMBWHEL		3100-2061
51, 52, 53, 55, 56,				S1A,			
58, 61, 62				B, C, D, F,			
					BD-BLANK		05061-2013
23	R F 1.5K 2% .250W		0757-0928		CONNECTOR-6 PIN		05061-2024
24, 9, 10, 15, 16,							
21, 22, 27, 28, 33,							
24							
1	R F 2K 2% .250W		0757-0931				
2, 6, 7, 8, 12, 13,							
4, 18, 19, 20, 24,							
5, 26, 30, 31, 32,							
15, 36, 37, 38, 40,							
1, 60							
5	R F 3K 2% .250W		0757-0935				
1, 17, 23, 29							
59	R F 3.9K 2% .250W		0757-0938				
43	R F 10K 2% .250W		0757-0948				
6, 57							
C9	INTEGRATED CIRC		1820-0080				
0, 11, 17							
C12	INTEGRATED CIRC		1820-0086				
C1	INTEGRATED CIRC		1820-0094				
C2							
C13	INTEGRATED CIRC		1820-0315				
C15, 16							
C3	INTEGRATED CIRC		1820-0329				
C4, 5, 6, 7, 8							
14	TRANSISTOR NPN S		1854-0003				

A5A4 SWITCH BOARD ASSY
(05061-6033)

A5A5 INTERCONNECT BOARD ASSY
(05061-6012)

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
C2,	C VAR 70-350PF		0131-0006		BD-BLANK		05061-2012
*C1,	C F 100 PF 300V		0140-0176		CONNECTOR-12 PIN		05061-2025
	C F 440 PF 300V		0140-0231				
R2,	R F 1K 2% .250W		0757-0924				
R3,	R F 2K 2% .250W		0757-0931				
R1,	R F 10K 2% .250W		0757-0948				
IC1,	INTEGRATED CIRC		1820-0315				
Q1,	TRANSISTOR 2N708		1854-0005				
	BD-BLANK		05061-2030				

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
	INSUL FEED THRU		0340-0119	C22	C VAR 9-35 PF		0121-0046
J1 J2 THRU 7	CONN BULKHEAD		1250-0258	C20	C F 1300 PF 500V		0140-0154
	SCREW 4-40X.250		2230-0024	C25	C F 3000 PF 300V		0140-0159
	CABLE 1 COND 23"		8120-0106	C36 C46	C F 5600 PF 300V		0140-0170
	BRAID MONEL RF 13"		8160-0035	C11	C F 100 PF 300V		0140-0176
FL2 FL3	FLTR FEEDTHRU		00106-6059	C5	C F 560 PF 300V		0140-0178
	SHIELD DIVIDER		05060-0012	C13 C23	C F 1000 PF 300V		0140-0179
FL1	FLTR A FEED THRU		05060-6061	C27 C31	C F 2000 PF 300V		0140-0180
	COVER-BOTTOM		05061-0003	C51 C52	C F 8200 PF 100V		0140-0184
	COVER-TOP		05061-0004	C21	C F 47 PF 500 V		0140-0204
	PLATE-END		05061-2028	C12	C F 680 PF 300V		0140-0208
	PLATE-END		05061-2029	C40	C F 200 PF 300V		0140-0220
	BD AY-FREQ DIV		05061-6004	C15	C F 220 PF 300V		0140-0221
				C35	C F 360 PF 300V		0140-0228
				C17	C F 440 PF 300V		0140-0231
				C42	C F 2250 PF 300V		0140-0235
				C8 C10, 18, 19, 24, 28, 29, 30, 32, 34, 55	C F .1 MF 50V		0150-0121
				C4 C7, 26, 43, 48	C F 1 MF 25V		0160-0127
				C1 C6, 9, 14, 16	C F .01 MF 200V		0160-0161
				C44	C F .022 MF 200V		0160-0162

A6 FREQUENCY DIVIDER MODULE (05061-6003) (Cont'd)
(P. C. BOARD ASSEMBLY IS 05061-6004)

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
C47	C F .033 MF 200V		0160-0163	R6 R8,40,72	R F 1K 2% .250W		0757-0924
C49 C53,54,57,58	C F .47 MF 25V		0160-0174	R54	R F 1.2K 2%.250W		0757-0926
C38 C39,41,50	C F .015 PF 200V		0160-0194	R36, R38	R F 1.3K 2%.250W		0757-0927
C37	C F .012 MF 200V		0160-0301	R56,	R F 1.5K 2%.250W		0757-0928
C45	C F 1269 PF 300V		0160-0954	R10 22,58	R F 1.6K 2%.250W		0757-0929
C2 C3	C F 100 MF 30V		0180-0113	R16 53,65	R F 1.8K 2%.250W		0757-0930
	TERMINAL SULDR		0360-0065	R54	R F 2.4K 2%.250W		0757-0933
R22	R F 243K 1%.125W		0757-0474	R57	R F 2.7K 2%.250W		0757-0934
R5 R11,19,21,25,30, 35,37,43,52,55, 63 *69	R F 51 OHM2%.25W		0757-0893	R4	R F 3.3K 2%.250W		0757-0936
R7	R F 75 OHM2%.25W		0757-0897	R61 R73	R F 3.6K 2%.250W		0757-0937
R1 R2,28,64	R F 100 OHM2%.2W		0757-0900	R3 24,33,45	R F 4.7K 2%.250W		0757-0940
R67,	R F 180 OHM2%.2W		0757-0906	R32 R71	R F 5.6K 2%.250W		0757-0942
R66	R F 220 OHM2%.2W		0757-0908	R15 R41	R F 6.8K 2%.250W		0757-0944
R68	R F 330 OHM2%.2W		0757-0912	R62	R F 8.2K 2%.250W		0757-0946
R39	R F 430 OHM2%.2W		0757-0915	R34	R F 9.1K 2%.250W		0757-0947
R12	R F 470 OHM2%.2W		0757-0916	R27 *42,46,51	R F 10K 2% .250W		0757-0948
R20	R F 510 OHM2%.2W		0757-0917	R47	R F 12K 2% .250W		0757-0950
R44	R F 560 OHM2%.2W		0757-0918	R26	R F 15K 2% .250W		0757-0952
R29	R F 680 OHM2%.2W		0757-0920	R14	R F 20K 2% .250W		0757-0955
R74	R F 750 OHM2%.2W		0757-0921	R9	R F 24K 2% .250W		0757-0957
R31 R70	R F 820 OHM2%.2W		0757-0922				

A6 FREQUENCY DIVIDER MODULE (05061-6003) (Cont'd)
(P. C. BOARD ASSEMBLY IS 05061-6004)

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REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
R17	R F 27K 2% .250W		0757-0958	T1	TRANS-5MHZ IN		05061-8006
R13	R F 43K 2% .250W		0757-0963	T3	TRANS-1MHZ OUT		05061-8007
R49	R F 51K 2% .250W		0757-0965	T5	XFER-9MHZ MULTI		05061-8008
R48	R F 56K 2% .250W		0757-0966				
R60	R F 68K 2% .250W		0757-0968				
R50 R18	R F 150K 2% .250W		0757-0976				
Q2 Q3, 17, 13, 14, 18, 16	TRANSISTOR NPN S		1854-0003				
Q1 Q4, 6, 8, 9, 10, 12, 11, 19, 20	TRANSISTOR 2N708		1854-0005				
Q7	TRANSISTOR NPN S		1854-0023				
Q5 Q15	TRANSISTOR FET		1855-0056				
CR2 CR3 THRU 11	DIODE SIL 30WV		1901-0040				
CR1	DIODE BRKDN 7V		1902-0006				
L11	INDUCTOR 5 MH		9140-0072				
.2	INDUC FXD 27UH		9140-0107				
.5 .4	COIL FXD 500 UH		9140-0118				
.1 .3, 6, 7, 9, 8, 10	L 220UHY		9140-0129				
F6	TRANSF RF 100KC		107A-9C				
.12	COIL ASSY 5.5MH		107A-9F				
	BD-BLANK		05061-2004				
F2 F4	TRANS-1MHZ-4MHZ		05061-8005				

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
	INSUL FEED THRU		0340-0119	C2	C F 300 PF 300V		0140-0225
J1 J2 THRU 6	CONN BULKHEAD		1250-0258	C16	C F .0047 MF500V		0150-0086
R17	R:VAR 10K 20%		2100-2428	C5	C F .01 MF 100V		0150-0093
	TIP-INPUT		00105-2010	C6	C F 1 MF 25V		0160-0127
	CHASSIS-AC-AMP		05061-0005	C12	C F 2.2 MF 25V		0160-0128
	COVER-AC-AMP		05061-0006	C1	C F .0082 MF200V		0160-0160
	PLATE-END		05061-2001	C7 C10	C FXD .033 UF		0160-0180
	PLATE-END		05061-2007	C18	C F .01 MF 50V		0170-0082
	SHAFT		05061-2039	C8	C F .068 MF 50V		0170-0084
	BD AY- AC AMP		05061-6006	C14 C15	C F 0.1 MF 50V		0170-0085
				C22	C F .0252 MF 50V		0170-0090
				C20 C23	C F .01213 MF 50V		0170-0091
				C9 C11	C F .047 MF 50V		0170-0094
				C3 C4	C F 4.7 MF 35V		0180-0100
				C13	C F 60 MF 6V		0180-0106
				C17 C19,21	C F 100 MF 30V		0180-0113
					TERMINAL TURRET		0340-0037
					BUSH INSULATOR		0340-0039
				R47 R50	R F 93.1K1%.125W		0698-0077
				R10 R46	R F 1M 1% .125W		0698-3129

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
14	R F 3.3M 1%.125W		0698-3131	R15	R F 30K 2% .250W		0757-0959
25 28	R F 16.9K1%.125W		0698-4308	R7	R F 39K 2% .250W		0757-0962
27	R F 8.665K1%.12W		0698-5469	R2 R6	R F 56K 2% .250W		0757-0966
33	R F 10M 1% 1W		0730-0168	R22	R F 82K 2% .250W		0757-0970
49	R F 47.5K1%.125W		0757-0457	R12 R13	R F 100K 2%.250W		0757-0972
40	R F 56 OHM2%.25W		0757-0894	R23	R F 150K 2%.250W		0757-0976
34	R F 68 OHM2%.25W		0757-0896	Q2 Q3,7,8,9,10,11, 12,13,14	TRANSISTOR NPN S		1854-0003
52	R F 100 OHM2%.2W		0757-0900	Q1 Q5,6	TRANSISTOR NPN S		1854-0023
41 44	R F 200 OHM2%.2W		0757-0907	Q4A Q4B	TRANSISTOR DUAL		1855-0049
1 45	R F 1K 2% .250W		0757-0924	CR1 CR2,5	DIODE SIL 180WV		1901-0033
19	R F 1.6K 2%.250W		0757-0929	CR3	DIODE BRKDN 6.8V		1902-0245
39 36,35	R F 2K 2% .250W		0757-0931	CR4	DIODE BRKDN 11V		1902-0246
43	R F 3K 2% .250W		0757-0935	R18	R V 500 OHM 10%		2100-1772
29 37,38	R F 4.7K 2%.250W		0757-0940		BD-BLANK		05061-2006
24 31	R F 5.1K 2%.250W		0757-0941				
11	R F 8.2K 2%.250W		0757-0946				
5 8,26,30,32,33, 2,51	R F 10K 2% .250W		0757-0948				
16 20	R F 15K 2% .250W		0757-0952				
9 48	R F 20K 2% .250W		0757-0955				
14 21	R F 24K 2% .250W		0757-0957				

A8 PHASE DETECTOR MODULE (05061-6007)
(P. C. BOARD IS 05061-6011)

RFFD	DESCRIPTION	OPT	PART-NUMBER
	INSUL FEED THRU		0340-0119
J1 J2	CUNN BULKHEAD THRU J6		1250-0258
	SCREW 4-40X.250		2230-0024
	CABLE 1 COND		8120-0106
	BRAID MONEL RF		8160-0035
	INSULATOR RECEPT		5020-0176
	COVER BUTTOM		05060-0008
	BD A PHSE DECTEC		05060-6011
	COVER-TOP		05061-0007
	PLATE-END		05061-2033
	PLATE-END		05061-2034

A8	05061-6007 05060-6011 05060-2015	ASSY:PHASE DETECTOR ASSY.- PHASE DETECTOR P.C. BOARD BOARD BLANK P.C.
ABC1	0170-0091	C:FXD POLY 0.01213UF 2% 50VDCW
ABC2	0180-0117	C:FXD ELECT TA 2.7UF 10% 35VDCW
ABC3	0170-0090	C:FXD POLY 0.0252UF 1% 50VDCW
ABC4	0180-0116	C:FXD ELECT TA 6.8 UF 10% 35VDCW
ABC5	0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW
ABC6	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW
ABC7	0140-0176	C:FXD MICA 100 PF 2% 300 VDCW
ABC8	0140-0225	C:FXD MICA 300PF 1% 300VDCW
ABC9	0180-0113	C:FXD ELECT TA 100UF +20-15% 30VDCW
ABC10	0180-0113	C:FXD ELECT TA 100UF +20-15% 30VDCW
ABC11	0140-0176	C:FXD MICA 100 PF 2% 300 VDCW
ABC12	0140-0175	C:FXD MICA 39 PF 2% 300 VDCW
ABC13	0150-0093	C:FXD CER 0.01UF +80-20% 100VDCW
ABC14	0140-0175	C:FXD MICA 39 PF 2% 300 VDCW
ABC15	0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW
ABC16	0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW

A8 PHASE DETECTOR MODULE (05061-6007) (Cont'd)
(P. C. BOARD IS 05061-6011)

Reference Designation	Stock No.	Description	Note
A8C17	0160-0869	C:FXD MY 0.47 UF 10% 50VDCW	
A8C18	0160-0869	C:FXD MY 0.47 UF 10% 50VDCW	
A8C19	0170-0085	C:FXD MY 0.1UF 20% 50VDCW	
A8C20	0170-0086	C:FXD MY 0.22UF 20% 50VDCW	
A8C21	0180-0116	C:FXD ELECT TA 6.8 UF 10% 35VDCW	
A8C22	0180-0113	C:FXD ELECT TA 100UF +20-15% 30VDCW	
A8C23	0170-0085	C:FXD MY 0.1UF 20% 50VDCW	
A8C24	0170-0094	C:FXD MY 0.047UF 20% 50VDCW	
A8C25	0170-0085	C:FXD MY 0.1UF 20% 50VDCW	
A8C26	0170-0085	C:FXD MY 0.1UF 20% 50VDCW	
A8C27	0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW	
A8C28	0160-0174	C:FXD CER 0.47UF +80-20% 25VDCW	
A8C29	0170-0085	C:FXD MY 0.1UF 20% 50VDCW	
A8CR1	1901-0033	DIODE:SILICON 100 MA AT +1V 180 WIV	
A8CR2	1901-0033	DIODE:SILICON 100 MA AT +1V 180 WIV	
A8CR3	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A8CR4	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A8CR5	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A8CR6	1901-0033	DIODE:SILICON 100 MA AT +1V 180 WIV	
A8CR7	1901-0033	DIODE:SILICON 100 MA AT +1V 180 WIV	
A8J1	1250-0258	JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	
A8J2	1250-0258	JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	
A8J3	1250-0258	JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	
A8J4	1250-0258	JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	
A8J5	1250-0258	JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	
A8J6	1250-0258	JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	
A8MP1	05060-0008	COVER- BOTTOM; WITH RECESSED NUTS	
A8MP2	05060-0018	COVER- TOP	
A8MP3	0340-0119	INSULATED FEED THRU:TEFLON	
A8Q1	1854-0003	TRANSISTOR:NPN SILICON	
A8Q2	1854-0003	TRANSISTOR:NPN SILICON	
A8Q3	1854-0003	TRANSISTOR:NPN SILICON	
A8Q4	1854-0005	TRANSISTOR:2N708 NPN SILICON	
A8Q5	1854-0005	TRANSISTOR:2N708 NPN SILICON	
A8Q6	1854-0005	TRANSISTOR:2N708 NPN SILICON	
A8Q7	1854-0005	TRANSISTOR:2N708 NPN SILICON	
A8Q8	1854-0003	TRANSISTOR:NPN SILICON	
A8Q9	1854-0003	TRANSISTOR:NPN SILICON	
A8Q10	1854-0003	TRANSISTOR:NPN SILICON	
A8Q11	1854-0003	TRANSISTOR:NPN SILICON	
A8Q12	1854-0003	TRANSISTOR:NPN SILICON	
A8Q13A,B	1853-0005	TRANSISTOR:PNP SILICON, MATCHED PAIR	
A8R1	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
A8R2	0757-0957	R:FXD MET FLM 24K OHM 2% 1/8W	
A8R3	0757-0957	R:FXD MET FLM 24K OHM 2% 1/8W	
A8R4	0757-0457	R:FXD MET FLM 47.5K OHM 1% 1/8W	
A8R5	0757-0444	R:FXD MET FLM 12.1K OHM 1% 1/8W	
A8R6	0757-0959	R:FXD MET FLM 30K OHM 2% 1/8W	

A8 PHASE DETECTOR MODULE (05061-6007) (Cont'd)
(P. C. BOARD IS 05061-6011)

Reference Designation	Ⓟ Stock No.	Description	Note
ABR7	0757-0450	R:FXD MET FLM 22.1K OHM 1% 1/8W	
ABR8	0757-0894	R:FXD MET FLM 56 OHM 2% 1/8W	
ABR9	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
ABR10	2100-0806	R:VAR WW 5K OHM 5%	
ABR11	0757-0945	R:FXD MET FLM 7.5K OHM 2% 1/8W	
ABR12	0757-0972	R:FXD MET FLM 100K OHM 2% 1/8W	
ABR13	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
ABR14	0757-0972	R:FXD MET FLM 100K OHM 2% 1/8W	
ABR15	0757-0914	R:FXD MET FLM 395 OHM 2% 1/8W	
ABR16	0757-0957	R:FXD MET FLM 24K OHM 2% 1/8W	
ABR17	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
ABR18	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
ABR19	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
ABR20	0757-0907	R:FXD MET FLM 200 OHM 2% 1/8W	
ABR21	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
ABR22	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
ABR23	0757-0273	R:FXD MET FLM 3.01K OHM 1% 1/8W	
ABR24	0757-0964	R:FXD MET FLM 47K OHM 2% 1/8W	
ABR25	0757-0958	R:FXD MET FLM 27K OHM 2% 1/8W	
ABR26	0757-0914	R:FXD MET FLM 395 OHM 2% 1/8W	
ABR27	0757-0958	R:FXD MET FLM 27K OHM 2% 1/8W	
ABR28	0757-0964	R:FXD MET FLM 47K OHM 2% 1/8W	
ABR29	0757-0273	R:FXD MET FLM 3.01K OHM 1% 1/2W	
ABR30	0757-0427	R:FXD MET FLM 1.50K OHM 1% 1/8W	
ABR31	0757-0427	R:FXD MET FLM 1.50K OHM 1% 1/8W	
ABR32	0757-0427	R:FXD MET FLM 1.50K OHM 1% 1/8W	
ABR33	0757-0427	R:FXD MET FLM 1.50K OHM 1% 1/8W	
ABR34	0757-0952	R:FXD MET FLM 15K OHM 2% 1/8W	
ABR35	0757-0952	R:FXD MET FLM 15K OHM 2% 1/8W	
ABR36	0757-0965	R:FXD MET FLM 51K OHM 2% 1/8W	
ABR37	0757-0976	R:FXD MET FLM 150K OHM 2% 1/8W	
ABR38	0727-0013	R:FXD DEPC 24.3 OHM 1% 1/2W	
ABR39	2100-1437	R:VAR WW 20K OHM 5% 1W	
ABR40	0757-0952	R:FXD MET FLM 15K OHM 2% 1/8W	
ABR41	0757-0964	R:FXD MET FLM 47K OHM 2% 1/8W	
ABR42	2100-1437	R:VAR WW 20K OHM 5% 1W	
ABR43	0757-0964	R:FXD MET FLM 47K OHM 2% 1/8W	
ABR44	0757-0952	R:FXD MET FLM 15K OHM 2% 1/8W	
ABR45	0757-0955	R:FXD MET FLM 20K OHM 2% 1/8W	
ABR46	0757-0964	R:FXD MET FLM 47K OHM 2% 1/8W	
ABR47	0727-0013	R:FXD DEPC 24.3 OHM 1% 1/2W	
ABR48	0757-0965	R:FXD MET FLM 51K OHM 2% 1/8W	
ABR49	0727-0002	R:FXD DEPC 3.0 OHM 1% 1/2W	
ABR50	0757-0965	R:FXD MET FLM 51K OHM 2% 1/8W	
ABR51	0757-0935	R:FXD MET FLM 3.0K OHM 2% 1/8W	
ABR52	0757-0935	R:FXD MET FLM 3.0K OHM 2% 1/8W	
ABR53	0757-0972	R:FXD MET FLM 100K OHM 2% 1/8W	
ABR54	0757-0972	R:FXD MET FLM 100K OHM 2% 1/8W	
ABT1	9100-0340 A8 MISC. 8160-0035 0340-0039 8120-0229 5020-0176 0340-0037	TRANSFORMER BRAID:WIRE SHIELDING MONEL 3/32 OD INSULATOR:BUSHING CABLE:COAXIAL 50 OHM RG-188A/U INSULATOR FOR SNAP-ON PINS TERMINAL:STUDS	

Reference Designation	Stock No.	Description	Note
A9	05061-6008 05060-6076 05060-2056	ASSY: OPERATIONAL AMPLIFIER ASSY: OPERATIONAL AMPLIFIER P.C. BD BOARD-BLANK P.C.	
A9C1		N.S.R. PART OF CHOPPER ASSY G1	
A9C2	0160-0288	C:FXD POLY 0.027 UF 10% 50 VDCW	
A9C3	0180-0193	C:FXD ELECT 20 UF 10VDCW	
A9C4	0140-0208	C:FXD MICA 680PF 5%	
A9C5	0180-0097	C:FXD ELECT 47UF 10% 35VDCW	
A9C6	0180-0210	C:FXD ELECT 3.3 UF 20% 15VDCW	
A9C7	0160-0291	C:FXD POLY 0.27 UF 5% 50 VDCW	
A9C8	0170-0029	C:FXD POLY 0.01UF 10% 50VDCW	
A9C9	0160-0178	C:FXD MICA 27PF 5% 300VDCW	
A9C10	0180-0097	C:FXD ELECT 47UF 10% 35VDCW	
A9C11	0170-0064	C:FXD MY 0.47UF 10% 100VDCW	
A9C12	0170-0066	C:FXD MY 0.027UF 10% 200VDCW	
A9C13	0180-0159	C:FXD ELECT 220UF 10VDCW	
A9C14	0170-0085	C:FXD MY 0.1UF 20% 50VDCW	
A9C15	0180-0137	C:FXD ELECT TA 100 UF 20% 10VDCW	
A9C16	0180-0137	C:FXD ELECT TA 100 UF 20% 10VDCW	
A9C17	0160-0178	C:FXD MICA 27PF 5% 300VDCW	
A9C18	0180-0117	C:FXD ELECT TA 2.7UF 10% 35VDCW	
A9C19	0160-0164	C:FXD MY 3900PF 10%	
A9C20	0140-0145	C:FXD MICA 22 PF 5% 500 VDCW	
A9C21	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A9C22	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A9C23	0170-0085	C:FXD MY 0.1UF 20% 50VDCW	
A9C24	0170-0085	C:FXD MY 0.1UF 20% 50VDCW	
A9CR1		N.S.R. PART OF CHOPPER ASSY G1	
A9CR2		N.S.R. PART OF CHOPPER ASSY G1	
A9CR3	1901-0156	DIODE:SILICON	
A9CR4	1901-0156	DIODE:SILICON	
A9CR5	1901-0156	DIODE:SILICON	
A9CR6	1901-0156	DIODE:SILICON	
A9CR7	1901-0156	DIODE:SILICON	
A9CR8	1901-0156	DIODE:SILICON	
A9CR9	1901-0025	DIODE,JUNCTION:5MA AT 1V 100 PIV	
A9CR10	1901-0025	DIODE,JUNCTION:5MA AT 1V 100 PIV	
A9CR11	1901-0025	DIODE,JUNCTION:5MA AT 1V 100 PIV	
A9CR12	1902-0096	DIODE:AVALANCHE 6.2V	
A9CR13	1902-0096	DIODE:AVALANCHE 6.2V	
A9CR14	1901-0025	DIODE,JUNCTION:5MA AT 1V 100 PIV	
A9CR15	1901-0025	DIODE,JUNCTION:5MA AT 1V 100 PIV	
A9CR16	1901-0025	DIODE,JUNCTION:5MA AT 1V 100 PIV	
A9CR17	1901-0025	DIODE,JUNCTION:5MA AT 1V 100 PIV	
A9CR18	1902-0025	DIODE,BREAKDOWN:10.0V 5% 400 MW	
A9CR19	1902-0025	DIODE,BREAKDOWN:10.0V 5% 400 MW	

A9 OPERATIONAL AMPLIFIER MODULE (05061-6008) (Cont'd)
(P. C. BOARD IS 05060-6076)

Reference Designation	Stock No.	Description	Note
A9DS1 A9DS2		N.S.R. PART OF CHOPPER ASSY G1 N.S.R. PART OF CHOPPER ASSY G1	
A9G1	1990-0028	CHOPPER:PHOTOELECTRIC	
A9J1 A9J2	1250-0258 1251-0216	JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS CONNECTOR:MALE 9-CONTACT TYPE D	
A9L1 A9L2	9140-0082 9140-0040	COIL:RF FXD 15 UH COIL:FXD RF 42 UH	
A9Q1 A9Q2 A9Q3 A9Q4 A9Q5	1854-0023 1854-0003 1854-0003 1853-0010 1854-0023	TRANSISTOR:SILICON NPN TRANSISTOR:PNP SILICON TRANSISTOR:PNP SILICON TRANSISTOR:SILICON PNP TRANSISTOR:SILICON NPN	
A9Q6 A9Q7 A9Q8 A9Q9 A9Q10	1854-0023 1854-0023 1854-0023 1854-0023 1853-0010	TRANSISTOR:SILICON NPN TRANSISTOR:SILICON NPN TRANSISTOR:SILICON NPN TRANSISTOR:SILICON NPN TRANSISTOR:SILICON PNP	
A9Q11 A9Q12 A9Q13 A9Q14	1853-0010 1854-0003 1854-0003 1853-0001	TRANSISTOR:SILICON PNP TRANSISTOR:PNP SILICON TRANSISTOR:PNP SILICON TRANSISTOR:PNP SILICON 30V 900MW	
A9R1 A9R2 A9R3 A9R4 A9R5	0757-0475 0757-0918 0757-0914	N.S.R. PART OF CHOPPER ASSY G1 N.S.R. PART OF CHOPPER ASSY G1 R:FXD MET FLM 274K OHM 1% 1/8W R:FXD MET FLM 560 OHM 2% 1/8W R:FXD MET FLM 395 OHM 2% 1/8W	
A9R6 A9R7 A9R8 A9R9 A9R10	0698-3124 0757-0968 0698-3125 0757-0922 0698-3116	R:FXD DEPC 1.30 MEGOHM 1% 1/8W R:FXD MET FLM 68K OHM 2% 1/8W R:FXD DEPC 1.50 MEGOHM 1% 1/8W R:FXD MET FLM 820 OHM 2% 1/8W R:FXD DEPC 562K OHM 1% 1/8W	
A9R11 A9R12 A9R13 A9R14 A9R15	0757-0926 0757-0481 0757-0924 0757-0910 0757-0471	R:FXD MET FLM 1.2K OHM 2% 1/8W R:FXD MET FLM 475K OHM 1% 1/8W R:FXD MET FLM 1.0K OHM 2% 1/8W R:FXD MET FLM 270 OHM 2% 1/8W R:FXD MET FLM 182K OHM 1% 1/8W	
A9R16 A9R17 A9R18 A9R19 A9R20	0757-0930 0757-0946 0757-0948 0757-0898 0757-0904	R:FXD MET FLM 1.8K OHM 2% 1/8W R:FXD MET FLM 8.2K OHM 2% 1/8W R:FXD MET FLM 10K OHM 2% 1/8W R:FXD MET FLM 82 OHM 2% 1/8W R:FXD MET FLM 150 OHM 2% 1/8W	
A9R21 A9R22 A9R23 A9R24 A9R25	0757-0972 0757-0479 0757-0946 0757-0482 0757-0972	R:FXD MET FLM 100K OHM 2% 1/8W R:FXD MET FLM 392K OHM 1% 1/8W R:FXD MET FLM 8.2K OHM 2% 1/8W R:FXD MET FLM 511K OHM 1% 1/8W R:FXD MET FLM 100K OHM 2% 1/8W	
A9R26 A9R27	0757-0481 0757-0948	R:FXD MET FLM 475K OHM 1% 1/8W R:FXD MET FLM 10K OHM 2% 1/8W	

Reference Designation	Stock No.	Description	Note
A9R28	2100-0451	R:VAR WW LIN 10 K OHM 10% 2W	
A9R29	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
A9R30	0698-3126	R:FXD DEPC 2.21 MEGOHM 1% 1/8W	
A9R31	0757-0936	R:FXD MET FLM 3.3K OHM 2% 1/8W	
A9R32	0757-0482	R:FXD MET FLM 511K OHM 1% 1/8W	
A9R33	0757-0958	R:FXD MET FLM 27K OHM 2% 1/8W	
A9R34	0757-0482	R:FXD MET FLM 511K OHM 1% 1/8W	
A9R35	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/8W	
A9R36	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/8W	
A9R37	0757-0965	R:FXD MET FLM 51K OHM 2% 1/8W	
A9R38	0757-0902	R:FXD MET FLM 120 OHM 2% 1/8W	
A9R39	0757-0936	R:FXD MET FLM 3.3K OHM 2% 1/8W	
A9R40	0757-0936	R:FXD MET FLM 3.3K OHM 2% 1/8W	
A9R41	0757-0952	R:FXD MET FLM 15K OHM 2% 1/8W	
A9R42	0757-0954	R:FXD MET FLM 18K OHM 2% 1/8W	
A9R43	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/8W	
A9R44	0757-0958	R:FXD MET FLM 27K OHM 2% 1/8W	
A9R45	0757-0934	R:FXD MET FLM 2.7K OHM 2% 1/8W	
A9R46	0757-0914	R:FXD MET FLM 395 OHM 2% 1/8W	
A9R47	0757-0952	R:FXD MET FLM 15K OHM 2% 1/8W	
A9R48	0757-0938	R:FXD MET FLM 3.9K OHM 2% 1/8W	
A9R49	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A9R50	0757-0916	R:FXD MET FLM 470 OHM 2% 1/8W	
A9R51	0757-0385	R:FXD MET FLM 22.1 OHM 1% 1/8W	
A9R52	0757-0387	R:FXD MET FLM 27.4 OHM 1% 1/8W	
A9R53	0757-0385	R:FXD MET FLM 22.1 OHM 1% 1/8W	
A9R54	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A9R55	0757-0952	R:FXD MET FLM 15K OHM 2% 1/8W	
A9R56	0757-0926	R:FXD MET FLM 1.2K OHM 2% 1/8W	

	WASHER INSULATOR	1200-0080
J1	CONN BULKHEAD	1250-0258
	RETAIN CONN	1251-0215
J2	CONNECTOR 9 PIN	1251-0216
	SCREW 4-40X.250	2230-0024
	BRAID MONEL RF	8160-0035
	INSULATOR RECEP	5020-0176
	COVER BOTTOM	05060-0028
	BD ASSY OPER AMP	05060-6076
	COVER-OPER AMP	05061-0034
	PLATE-END	05061-2035
	PLATE-END	05061-2036

A11 CESIUM OVEN CONTROLLER ASSY (05061-6009)
(P. C. BOARD IS 05061-6010)

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
	TERMINAL SOLDR L		0360-0353	C6 C7,21,22	C F .05 MF 100V		0150-0096
	ELAPS TIME INDIC		1010-0005	C2 C18	C F 2.2 MF 25V		0160-0128
J1	CONN 25 PIN PLUG		1251-0063	C19	C F .022 MF 200V		0160-0162
	RET CONN SUBMIN		1251-1042	C8	C F .22 MF 400V		0160-0845
	CHASSIS-CESIUM O		05061-0009	C16	C F .22 MF 50V		0170-0086
	COVER-CESIUM O		05061-0010	C9	C F 3.9 MF 35V		0180-0022
	PLATE-END		05061-2001	C1 C3,14,15	C F 47 MF 35V		0180-0097
	PLATE-END		05061-2003	C4 C11	C F 60 MF 6V		0180-0106
	BD AY-CS OVEN CT		05061-6010	C5 C13	C F 100 MF 30V		0180-0113
				C17	C F 6.8 MF 35V		0180-0116
				C10 C12	C F 220 MF 10V		0180-0159
				C20	C F 15 MF 20V		0180-1746
					TERMINAL SOLDR		0360-0065
				R9 R10	R F 10 OHM 1%.12W		0757-0346
				R13 R14,18,19	R F 18.2 OHM 1%		0757-0383
				R26	R F 332K 1%.125W		0757-0477
				R1 R30	R F 100 OHM 2%.2W		0757-0900
				R11	R F 160 OHM 2%.2W		0757-0905
				R15	R F 180 OHM 2%.2W		0757-0906

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
R16	R F 200 UHM2%.2W		0757-0907	CR1	DIODE SIL 30WV		1901-0040
R12	R F 330 UHM2%.2W		0757-0912	CR13	DIODE BRKDN 10V		1902-0025
R7	R F 1.8K 2%.250W		0757-0930	R27	R:VAR 10K 10%.5W		2100-1761
R20	R F 2.2K 2%.250W		0757-0932	T2	TRANSFORMER		9100-0333
R32	R F 3.9K 2%.250W		0757-0938	T1	TRANSFORMER		9100-0335
R8	R F 4.7K 2%.250W		0757-0940	T3	TRANSFORMER		9100-0336
R5	R F 5.6K 2%.250W		0757-0942	T4	TRANSFORMER AUTO		9100-2234
R6	R F 6.2K 2%.250W		0757-0943		DISC INSULATING		05060-0051
R4	R F 6.8K 2%.250W		0757-0944	L1	COIL A 27UH FLTR		05060-6034
R17	R F 8.2K 2%.250W		0757-0946	L2	COIL A 350UH FLT		05060-6073
R22 R23	R F 10K 2% .250W		0757-0948		BD BLANK		05061-2010
R28	R F 18K 2% .250W		0757-0954				
	R F 20K 2% .250W		0757-0955				
R3	R F 47K 2% .250W		0757-0964				
R25	R F 82K 2% .250W		0757-0970				
R2 R29	R F 100K 2%.250W		0757-0972				
R1 R4	TRANSISTOR NPN S		1854-0003				
R2, R5,6	TRANSISTR 2N1701		1854-0020				
R8 R9,10,11	DIODE SIL 800PIV		1901-0030				
R2 R3,12	DIODE SIL 180WV		1901-0033				
R4 R5,6,7	DIODE SIL		1901-0039				

A13 BUFFER AMPLIFIER ASSY (05061-6030)
(P. C. BOARD IS 05061-6031)

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REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
C1 C2	C F 5000 PF		0160-2049	R8 R9,16,17,23	R F 510 OHM2%.2W		0757-0917
J1 J2	CONN BULKHEAD THRU 4		1250-0258	R3	R F 560 OHM2%.2W		0757-0918
	CHASSIS-BUFF		05061-0030	R18 R19	R F 910 OHM2%.2W		0757-0923
	COVER-BUFF-AMP		05061-0031	R11, R13	R F 1K 2% .250W		0757-0924
	PLATE-END		05061-2008	R7	R F 3.3K 2%.250W		0757-0936
	PLATE-END		05061-2009	R24 R25	R F 3.9K 2%.250W		0757-0938
	BD AY- BUFF AMP		05061-6031	Q1, Q2,3,4	TRANSISTOR 2N708		1854-0005
C8 C10	C FXD 260PF		0140-0223	CR2	DIODE SIL 30WV		1901-0040
C1 C2,3,5,6,7,8,11, 4,12,14	C F .01 MF 100V		0150-0093	CR1	DIODE BRKDN9.09V		1902-3149
C13	C F 2.2 MF 25V		0160-0128		SHIELD CAN MU ME		7100-0101
R14 R15	R F 22.1 OHM 1%		0757-0385	L1	COIL FXD 1000 UH		9140-0137
R22	R F 51 OHM2%.25W		0757-0893	T1 T2	TRANSFORMER 5MC		107A-65J-3A
R5 R6	R F 56 OHM2%.25W		0757-0894		PAD TOROID		107A-69A-27
R20 R21	R F 82 OHM2%.25W		0757-0898		BD-BLANK		05061-2031
R1 R2	R F 100 OHM2%.2W		0757-0900				
R10 R12	R F 200 OHM2%.2W		0757-0907				
*R4	R F 470 OHM2%.2W		0757-0916				

RFFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
09	C F .01 MF 100V		0150-0093	R16	R F 12K 2% .250W		0757-0950
019	C F .1 MF 50V		0150-0121	R33 R38	R F 13K 2% .250W		0757-0951
03 022,23	C F 1 MF 25V		0160-0127	R4 R67	R F 15K 2% .250W		0757-0952
14 15	C FXD .033 UF		0160-0180	R39 R46,53	R F 20K 2% .250W		0757-0955
5 12	C F .068 MF 50V		0170-0084	R21 R26,44,61,62,31	R F 33K 2% .250W		0757-0960
10 11,18,20	C F 4.7 MF 35V		0180-0100	R57 R43	R F 43K 2% .250W		0757-0963
6 7,8	C F 60 MF 50V		0180-0106	R6 R9,20,51	R F 51K 2% .250W		0757-0965
2 4,13	C F 100 MF 30V		0180-0113	R3 R5,47,49,60	R F 100K 2%.250W		0757-0972
1 17,21	C F 2.7 MF 35V		0180-0117	R7 R48	R F 150K 2%.250W		0757-0976
16	C F 1 MF 35V		0180-0291	Q7	TRANSISTOR 2N941		1853-0022
32	R F 1M 1% .125W		0698-3129	Q1 Q2,3,4,5,6,18, 20,21,22,23,24 14,15	TRANSISTOR NPN S		1854-0003
10	R F 38.3 OHM 1%		0698-3435	Q12 Q13,16,17,19	TRANSISTOR 2N708		1854-0005
18 19	R F 16.9K 1%.125W		0698-4308	Q8 Q23,9,10	TRANSISTOR NPN S		1854-0023
22	R F 8.665K 1%.12W		0698-5469	SCR1	SWTH SILI CONTRO		1884-0003
2 14,15,42	R F 100 OHM 2%.2W		0757-0900	CR2	DIODE SIL 180WV		1901-0033
35, 37	R F 470 OHM 2%.2W		0757-0916	CR3 CR4,5,6,14,15,16 17,18,19,20	DIODE SIL 30WV		1901-0040
24 29,30,63	R F 2K 2% .250W		0757-0931	CR12 CR7	DIODE BRKDN5.76V		1902-0034
54	R F 2.4K 2%.250W		0757-0933	CR13	DIODE BRKDN5.11V		1902-0041
25	R F 3K 2% .250W		0757-0935	CR10 CR11	DIODE BRKDN1.5V		1902-0067
36	R F 3.3K 2%.250W		0757-0936	CR1 CR9,8	DIODE BRKDN7.15V		1902-0074
55 56,58,64,66	R F 5.1K 2%.250W		0757-0941	R27	R V 1K 10% .5W		2100-1773
8 11,13,17,23,34, 1,45,52,59,65, 8,69,70,40	R F 10K 2% .250W		0757-0948	R12	R V 2K 10% .5W		2100-1774
28	R F 11K 2% .250W		0757-0949	R1	R V 5K 10% .5W		2100-1775
					BD-BLANK		05061-2016

A15 POWER REGULATOR ASSEMBLY
(05061-6018)

REFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
C13,	C F .1 MF 50V		0150-0121	R35	R F 3.3K 2%.250W		0757-0936
C2	C F .022 MF 200V		0160-0162	R7	R F 3.9K 2%.250W		0757-0938
C8	C F .47 MF 25V		0160-0174	R21 R29	R F 4.7K 2%.250W		0757-0940
C10	C F .1 MF 200V		0170-0019	R5 R3	R F 5.1K 2%.250W		0757-0941
C1	C F 1 MF 200V		0170-0072	R1 R2,23,25	R F 10K 2% .250W		0757-0948
C5 C7,9,11,12	C F 47 MF 35V		0180-0097	R20	R F 33K 2% .250W		0757-0960
C3 C4	C F 2.7 MF 35V		0180-0117	R19	R F 100K 2%.250W		0757-0972
C6	C F 22 MF 35V		0180-0160	R9	R F 400 OHM 5%3W		0767-0001
	TERMINAL SOLDR		0360-0065	R17	R F 660 OHM1% 1W		0811-0931
	TERMINAL .04 D		0360-0124	R10	R F .33 OHM 5%3W		0812-0019
R30*	R F 2M 1% .25W		0698-4345	Q12 Q18,19,21,9	TRANSISTOR PNP S		1853-0001
R16 R36	R F 20 OHM 1%.5W		0727-0012	Q5 Q3,7	TRANSISTOR2N3778		1853-0024
*R31,	R:F 265K 1%.50W		0727-0229	Q13 Q14,15,20,10,11, 6,8,1,2,16	TRANSISTOR NPN S		1854-0003
R32 R33	R F 221K 1%.125W		0757-0473	Q17 Q4	TRANSISTR 2N1701		1854-0020
R22	R F 475K 1%.125W		0757-0481	CR1 CR2,3,4,6,8	DIODE SIL IN4998		1901-0200
R24 R28,10	R F 51 OHM2%.25W		0757-0893	CR10	DIODE BRKDN 9V		1902-0071
R18	R F 56 OHM2%.25W		0757-0894	CR9 A,B	DIODE BRKDN PR		1902-0676
R26	R F 300 OHM2%.2W		0757-0911	CR5	DIODE BRKDN19.6V		1902-3234
R8	R F 510 OHM2%.2W		0757-0917	CR7	DIODE BRKDN21.5V		1902-3245
R14 R11	R F 1.3K 2%.250W		0757-0927		COIL FXD 5 UH		9100-0334
R4 R6,34	R F 1.5K 2%.250W		0757-0928		INSULATOR RECEPT		5020-0170
R15 R27,13	R F 2.2K 2%.250W		0757-0932		BD-BLANK		05061-2017

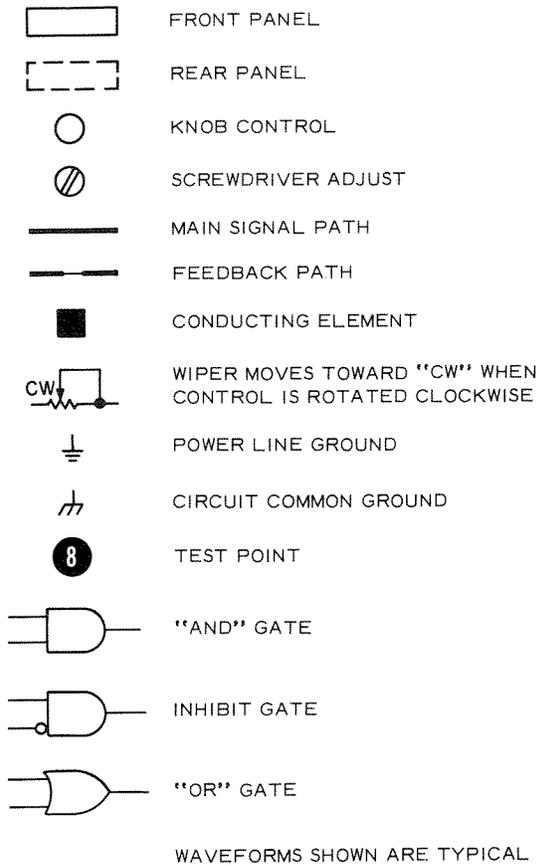
A17 TERMINAL BOARD ASSY
(05061-6018)

ACCESSORY KIT
(05061-6070)

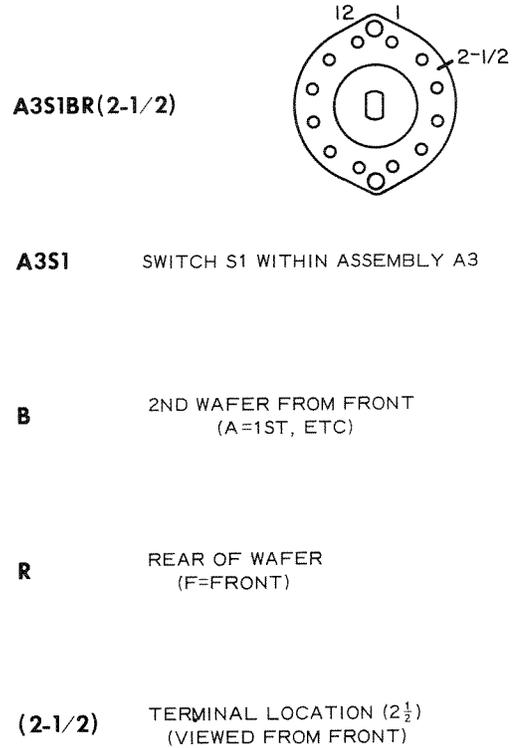
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EFD	DESCRIPTION	OPT	PART-NUMBER	REFD	DESCRIPTION	OPT	PART-NUMBER
	TERMINAL SOLDR		0360-0065		ADPTR MICON MALE		1250-0813
	TERMINAL .04 D		0360-0124		CUNN 5 PIN FEM		1251-0126
	TERMINAL SOLDR		0360-1467		SCREWDRIVER CERA		8710-0033
2*	R F 33.2K 1%.125W		0757-0454		WRENCH 4-SPLINE		8710-0055
7*	R F 332K 1%.125W		0757-0477		SCREWDRIVER		8730-0007
10*	R F 475K 1%.125W		0757-0481		BD ASSY-22 PIN		5060-7202
11*	R F 681K 1%.125W		0757-0485		CABLE ASSY TEST		05060-6116
1* 8*	R F 1K 2% .250W		0757-0924		LABEL-ACC KIT		05061-0036
3* 5*	R F 22K 2% .250W		0757-0956		BD-AY-EXTENDER		05061-6073
6*	R F 47K 2% .250W		0757-0964				
4*	R F 56K 2% .250W		0757-0966				
9*	R F 100K 2%.250W		0757-0972				
	BD-BLANK		05061-2018				

SYMBOLS



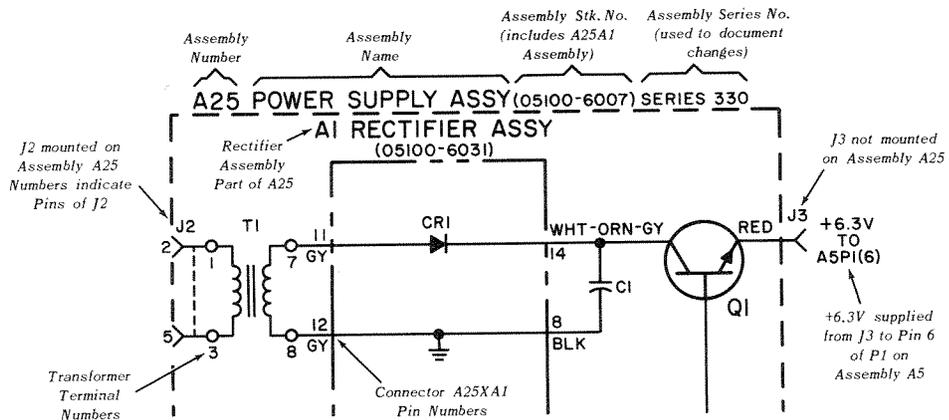
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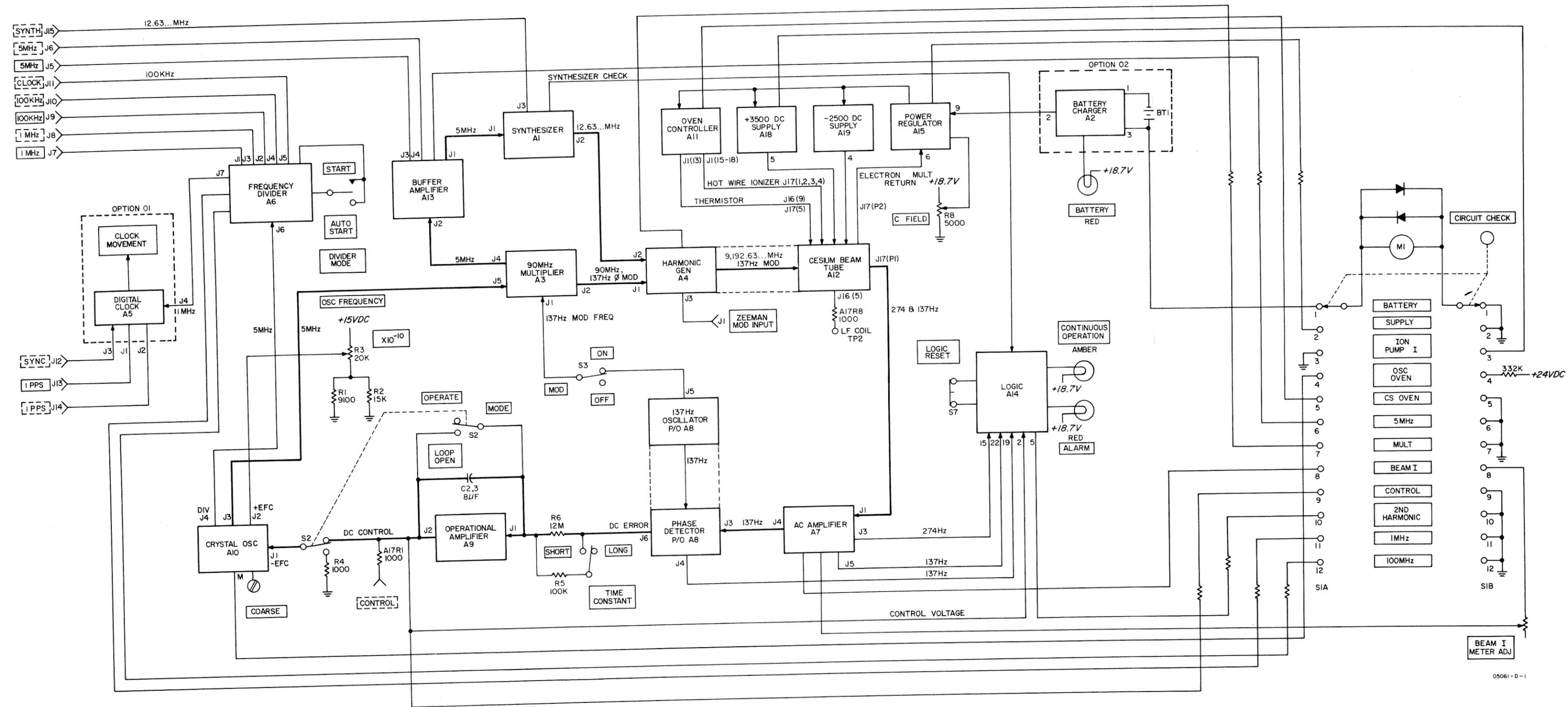


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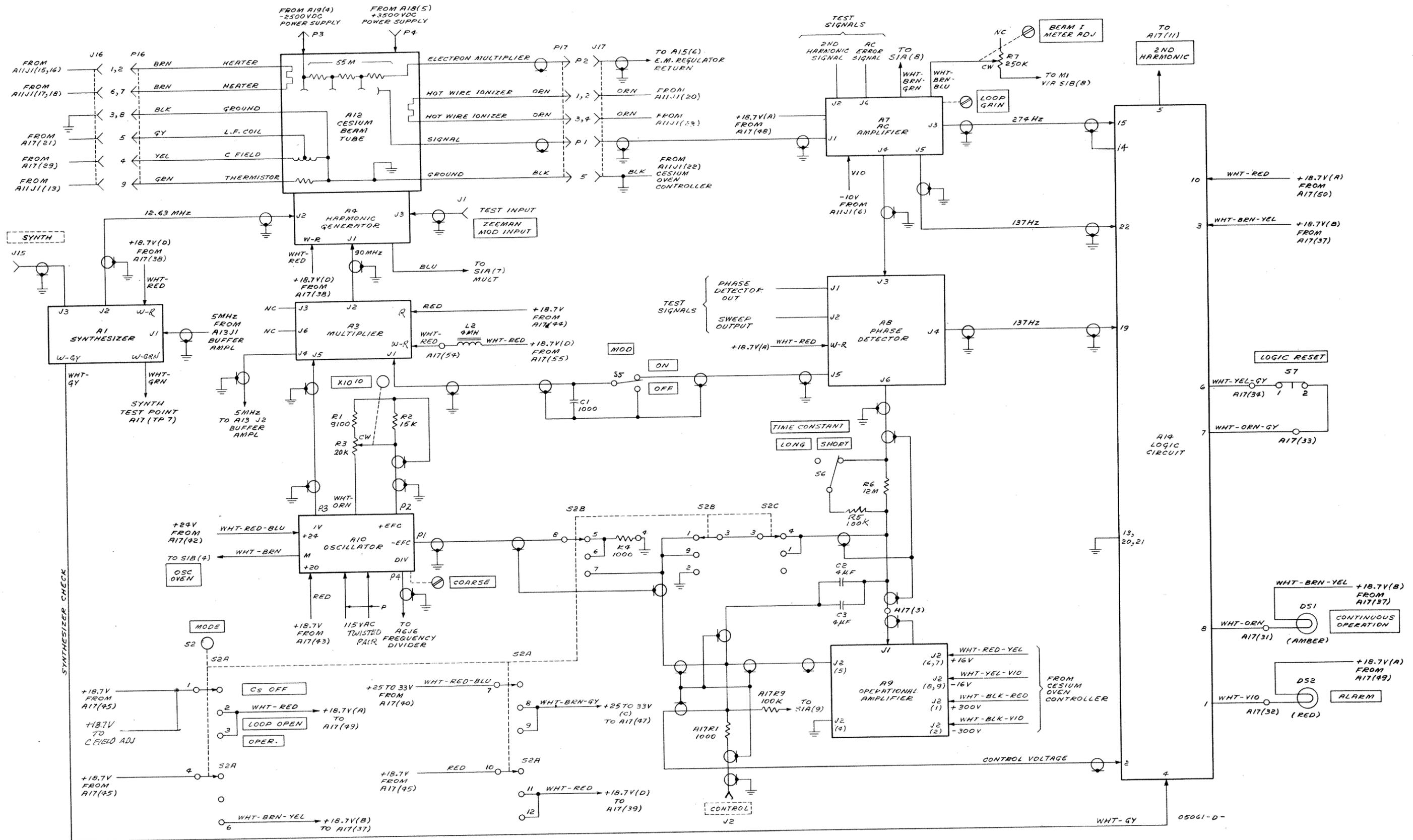
REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
*A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

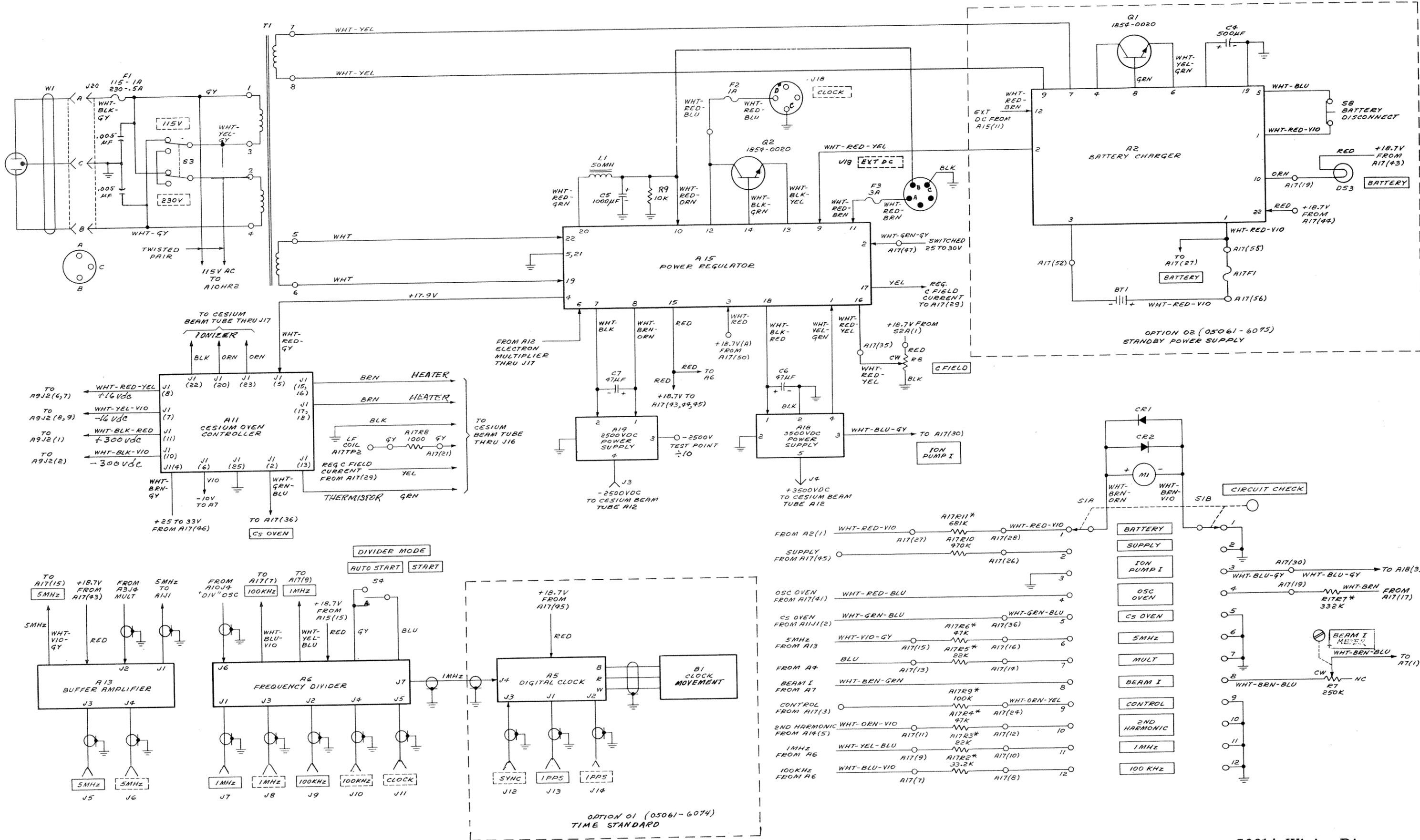




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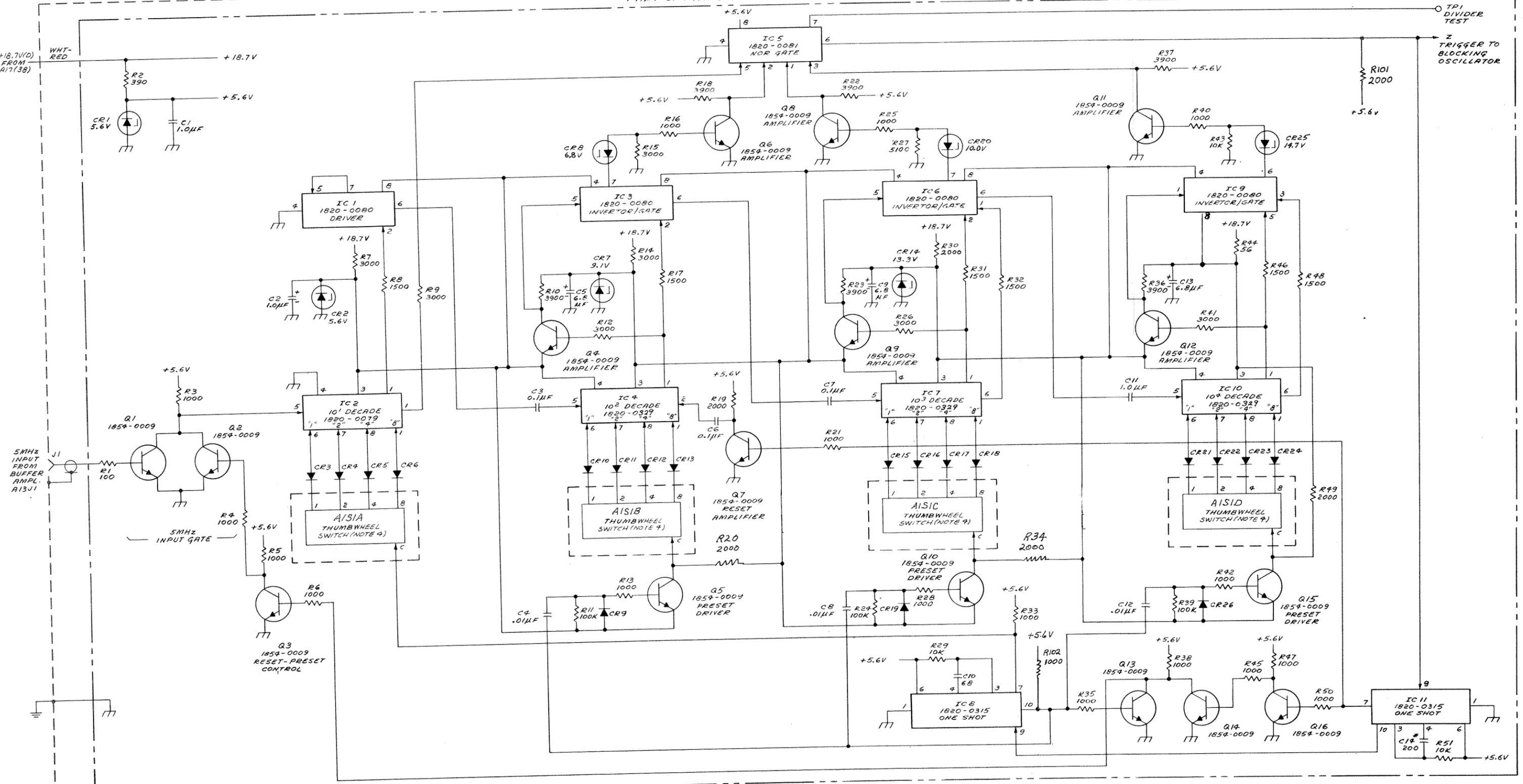


5061A Wiring Diagram
(Sheet 1 of 2)



5061A Wiring Diagram
(Sheet 2 of 2)

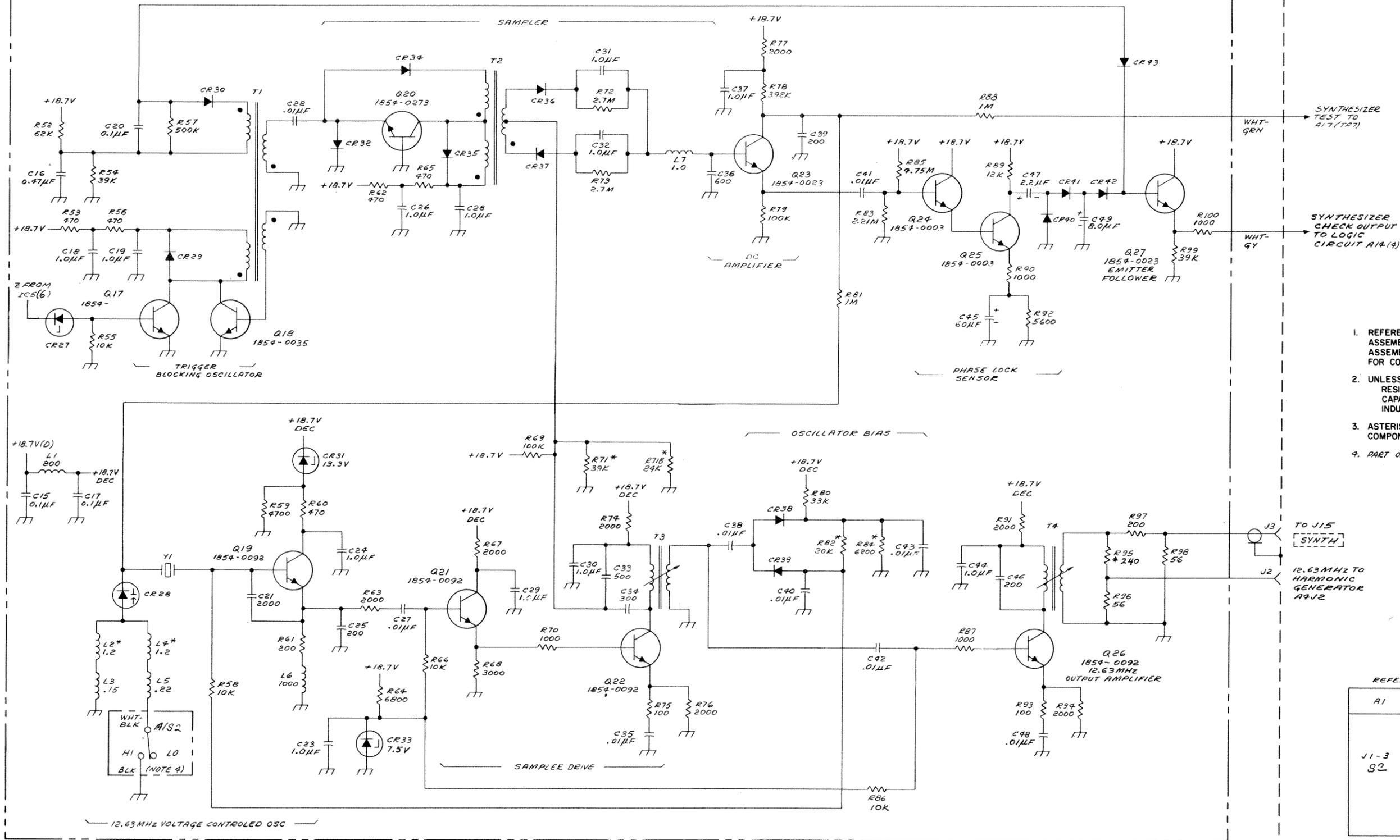
PART OF A1 SYNTHESIZER ASSEMBLY (05061-6001) (NOTE 1)
 PART OF A1A1 SYNTHESIZER P.C. BOARD ASSEMBLY (05061-6002)



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PART OF A1 SYNTHESIZER ASSEMBLY (05061-6001) (NOTE 1)
 PART OF AIR1 SYNTHESIZER P.C. BOARD ASSEMBLY (05061-6002)



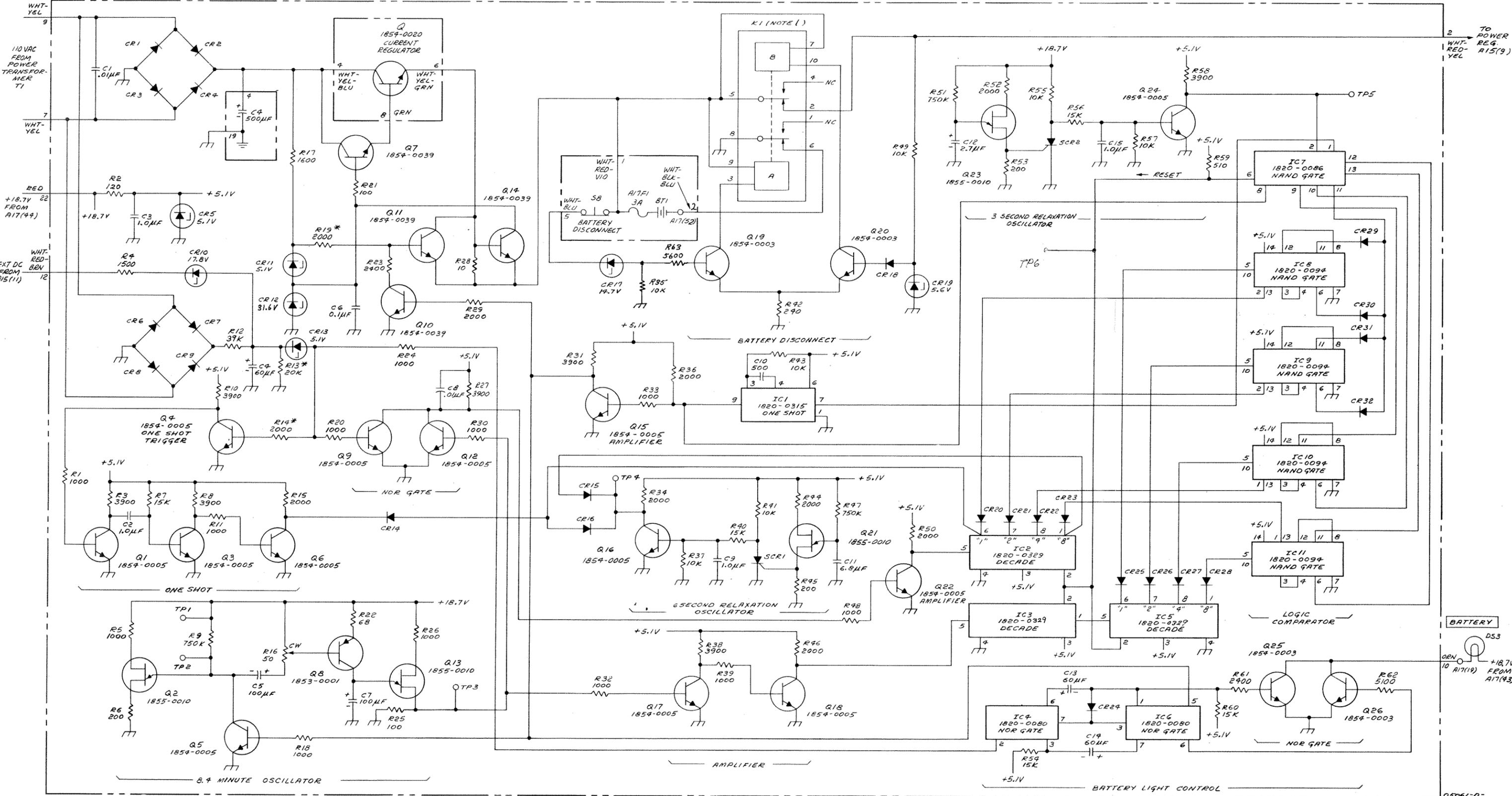
NOTES

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

AI	AIA1	AIA2
	C1-49	
	CR1-43	
	IC1-11	
J1-3	L1-7	
S2	Q1-27	
	R1-102	
	T1-4	
	Y1	
	Y1	

A2 BATTERY CHARGER ASSEMBLY (05061-6019) OPTION 02



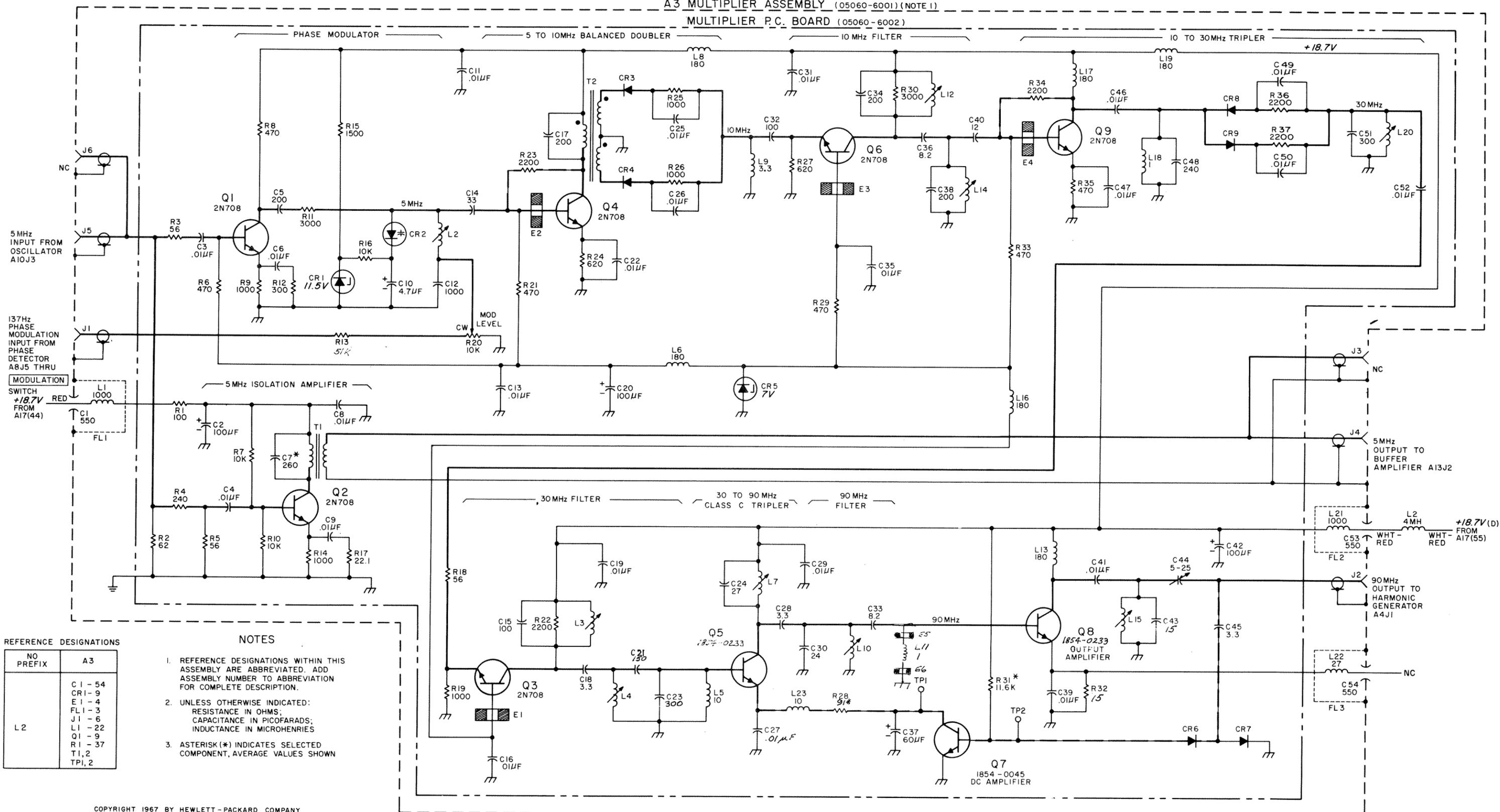
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NOTE 1 - PROTECTIVE RELAY K1 OPENS IF BATTERY VOLTAGE DECREASES BELOW 42.1 Vdc

A2 Battery Charger (Option 02)

A3 MULTIPLIER ASSEMBLY (05060-6001) (NOTE 1)

MULTIPLIER P.C. BOARD (05060-6002)

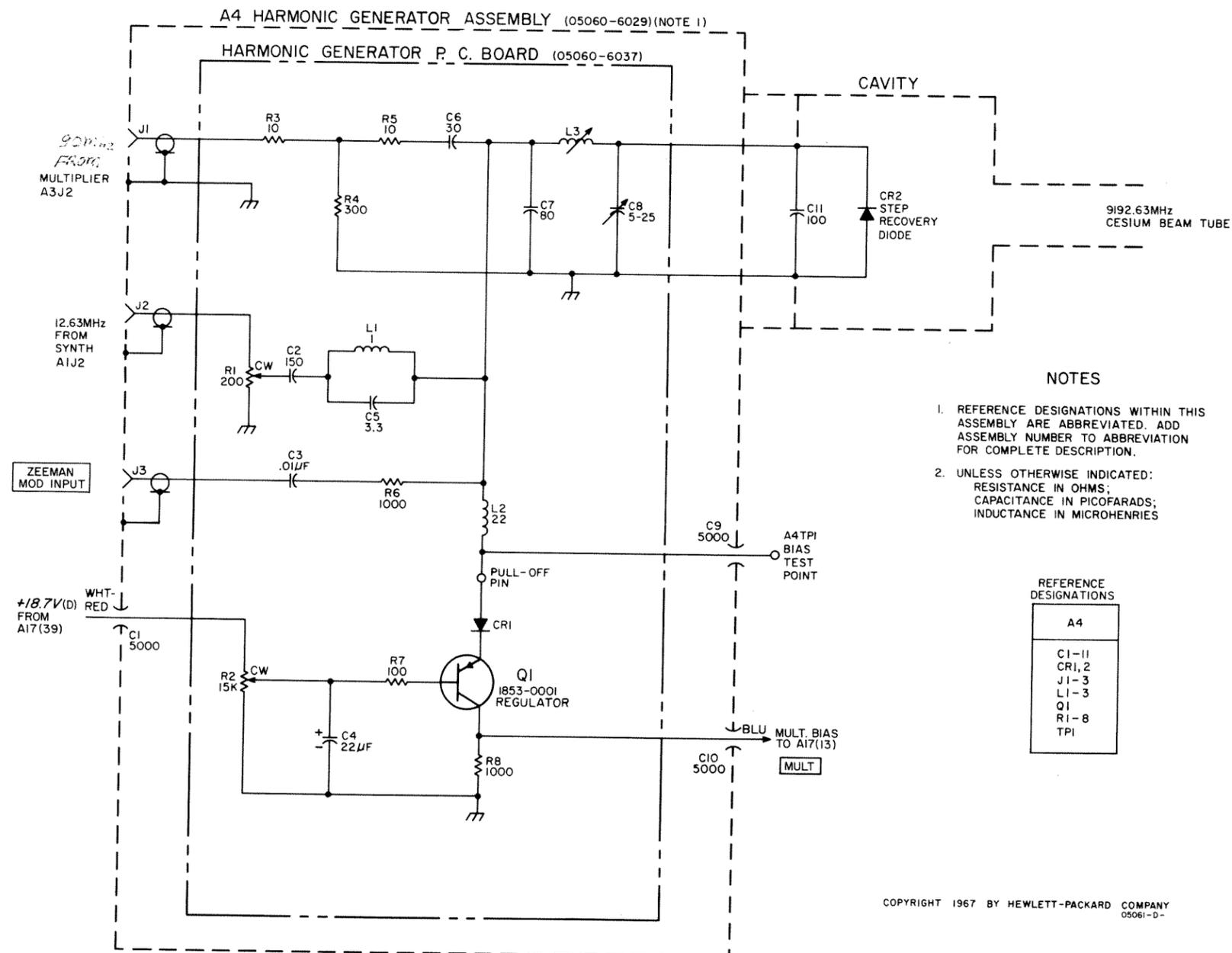


REFERENCE DESIGNATIONS

NO PREFIX	A3
	C1 - 54
	CR1 - 9
	E1 - 4
	FL1 - 3
	J1 - 6
	L1 - 22
	Q1 - 9
	R1 - 37
	T1, 2
L2	TP1, 2

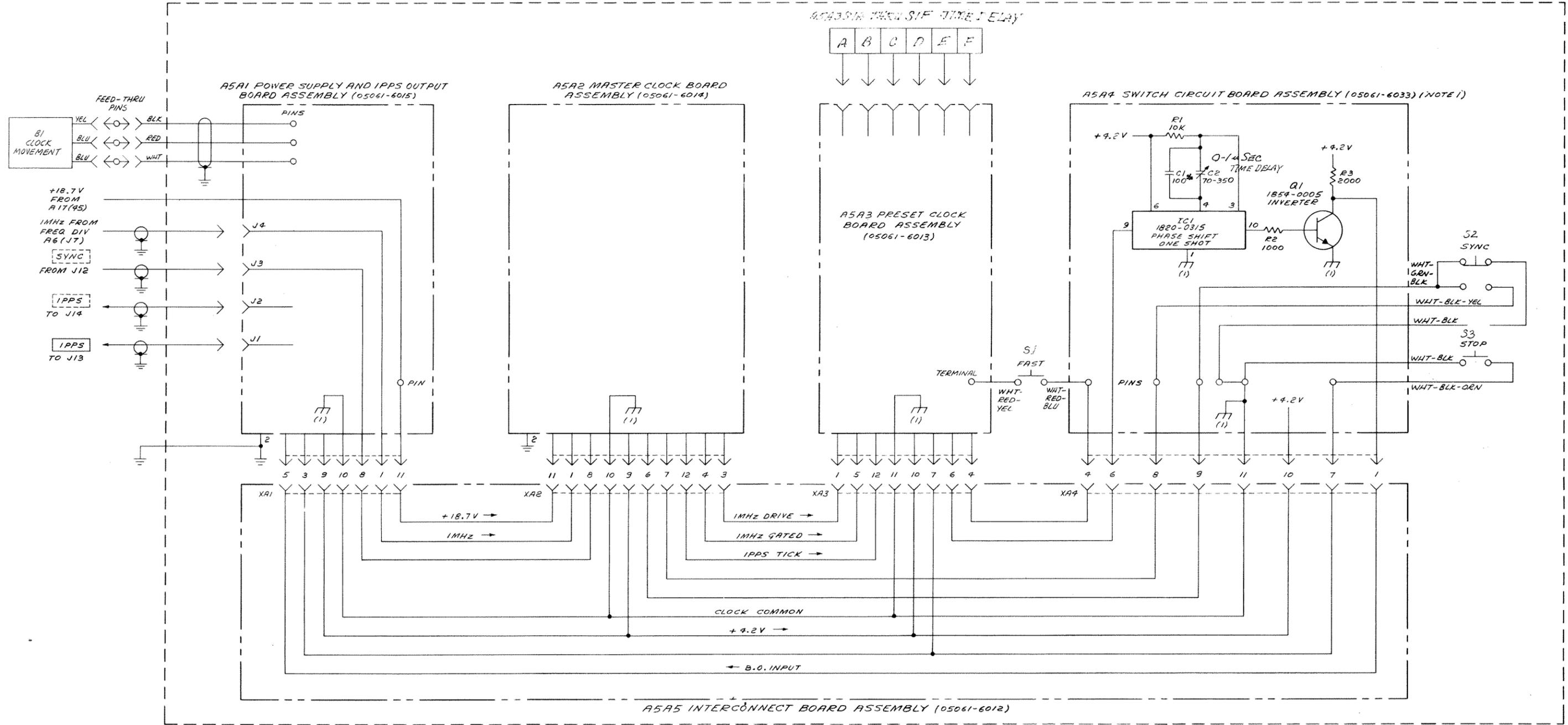
NOTES

- REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
- UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICO FARADS; INDUCTANCE IN MICROHENRIES
- ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN



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A5 DIGITAL CLOCK ASSEMBLY (05061-6011)



NOTES

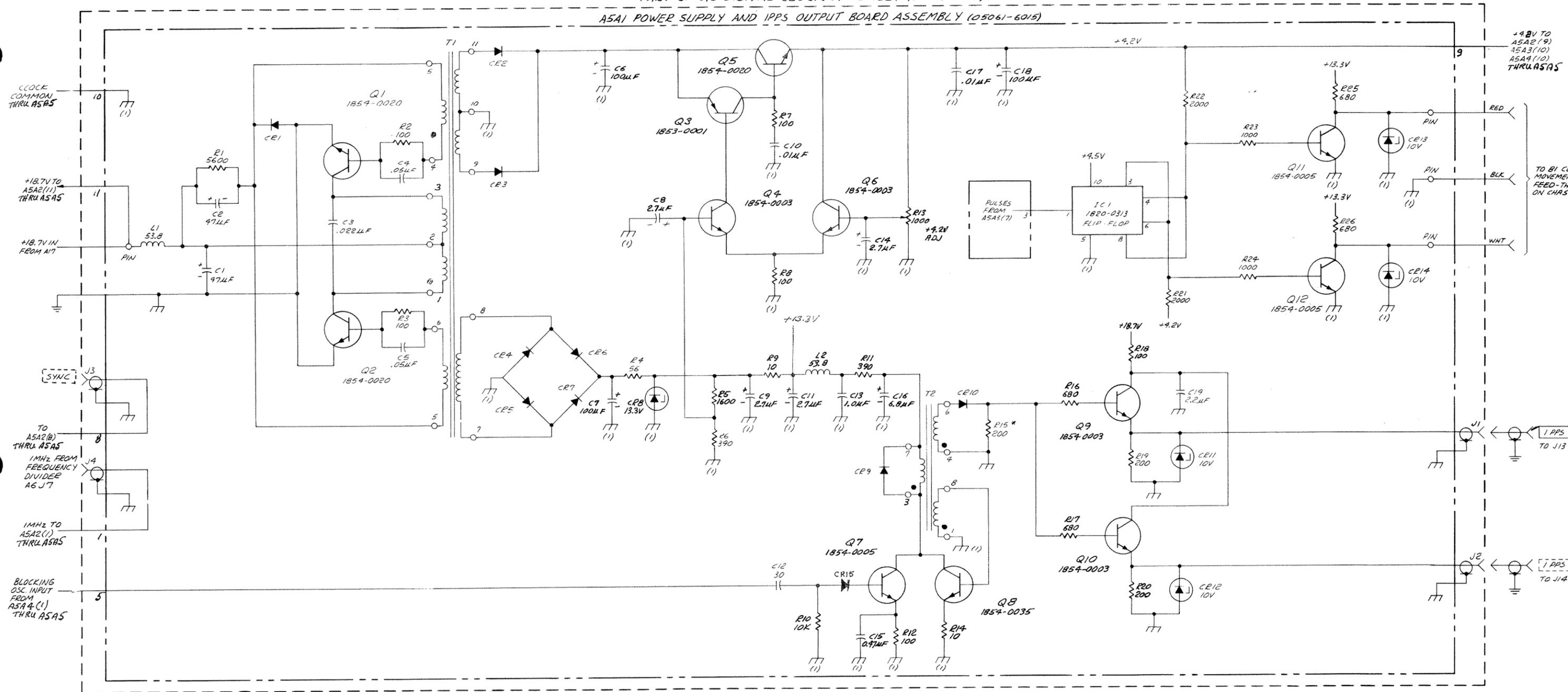
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;

REFERENCE DESIGNATIONS

A5A4
C1,2
IC1
Q1
R1-3

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PART OF A5 DIGITAL CLOCK ASSEMBLY (05061-6011)
 A5A1 POWER SUPPLY AND 1PPS OUTPUT BOARD ASSEMBLY (05061-6015)



NOTES

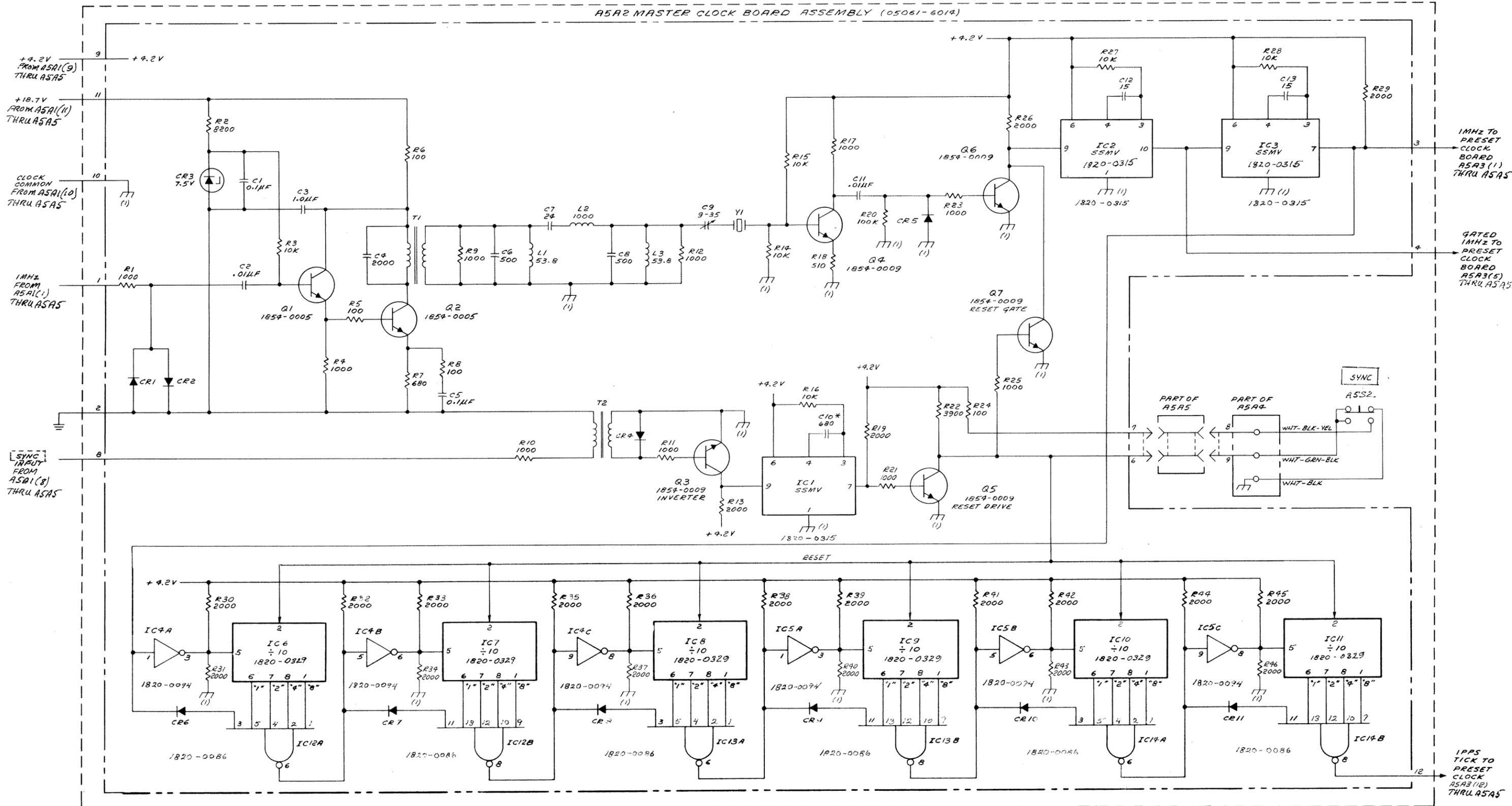
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICO FARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A5	A5A1
		C1-19 CR1-15
	J1-4	L1, L2 Q1-12 R1-26 T1, T2

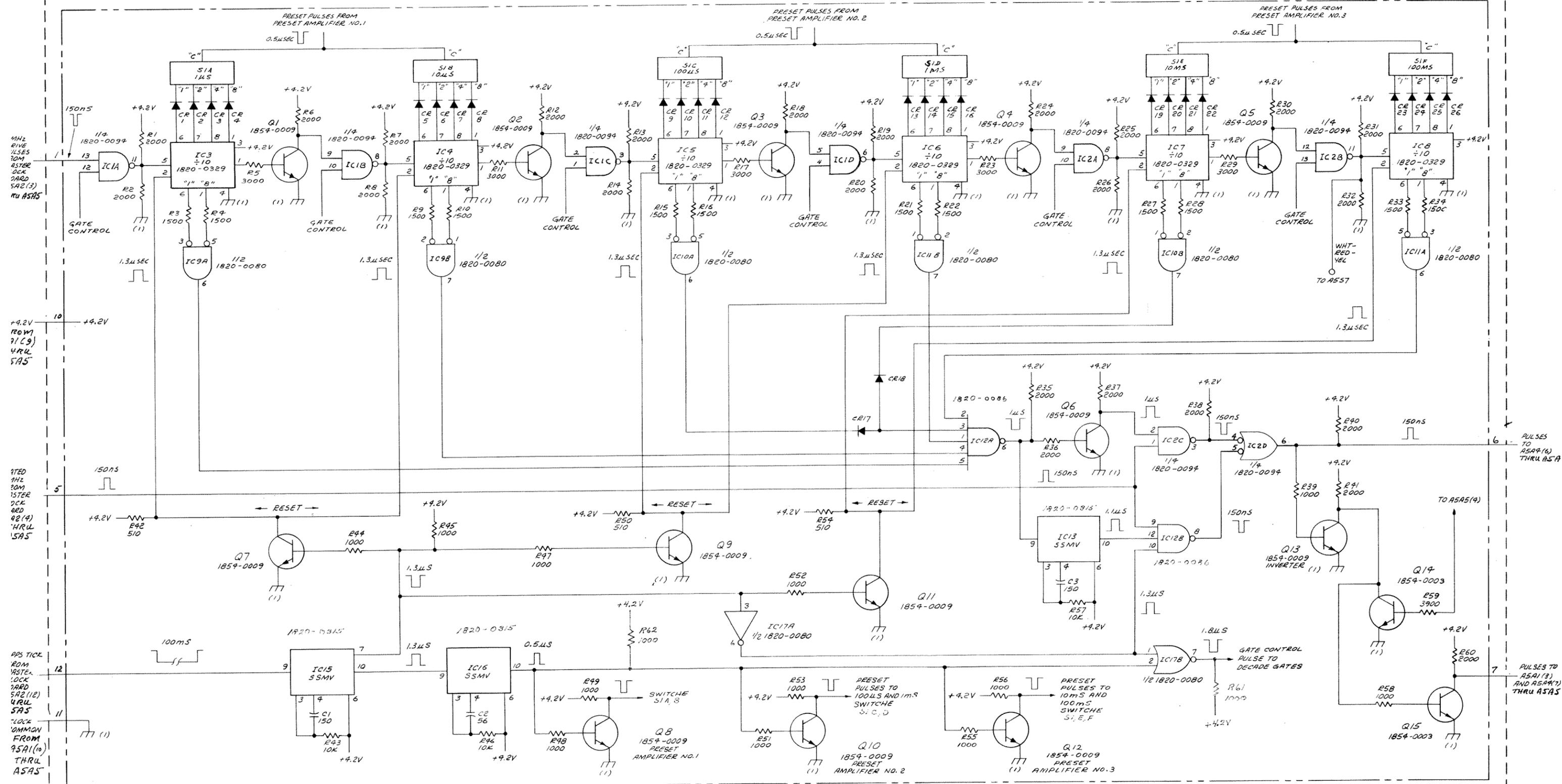
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PART OF A5 DIGITAL CLOCK ASSEMBLY (05061-6011) (NOTE 1)
 A5A2 MASTER CLOCK BOARD ASSEMBLY (05061-6014)



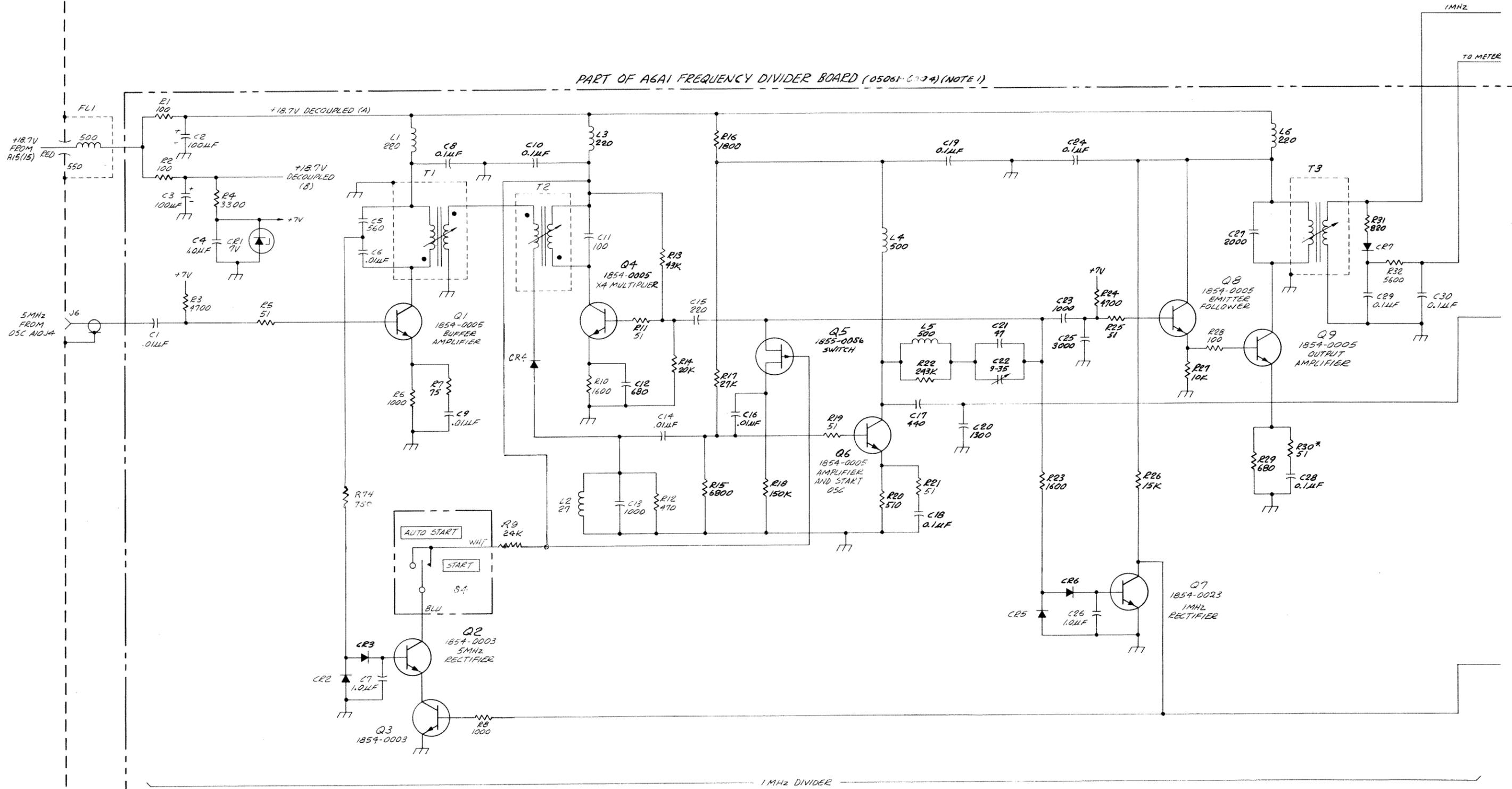
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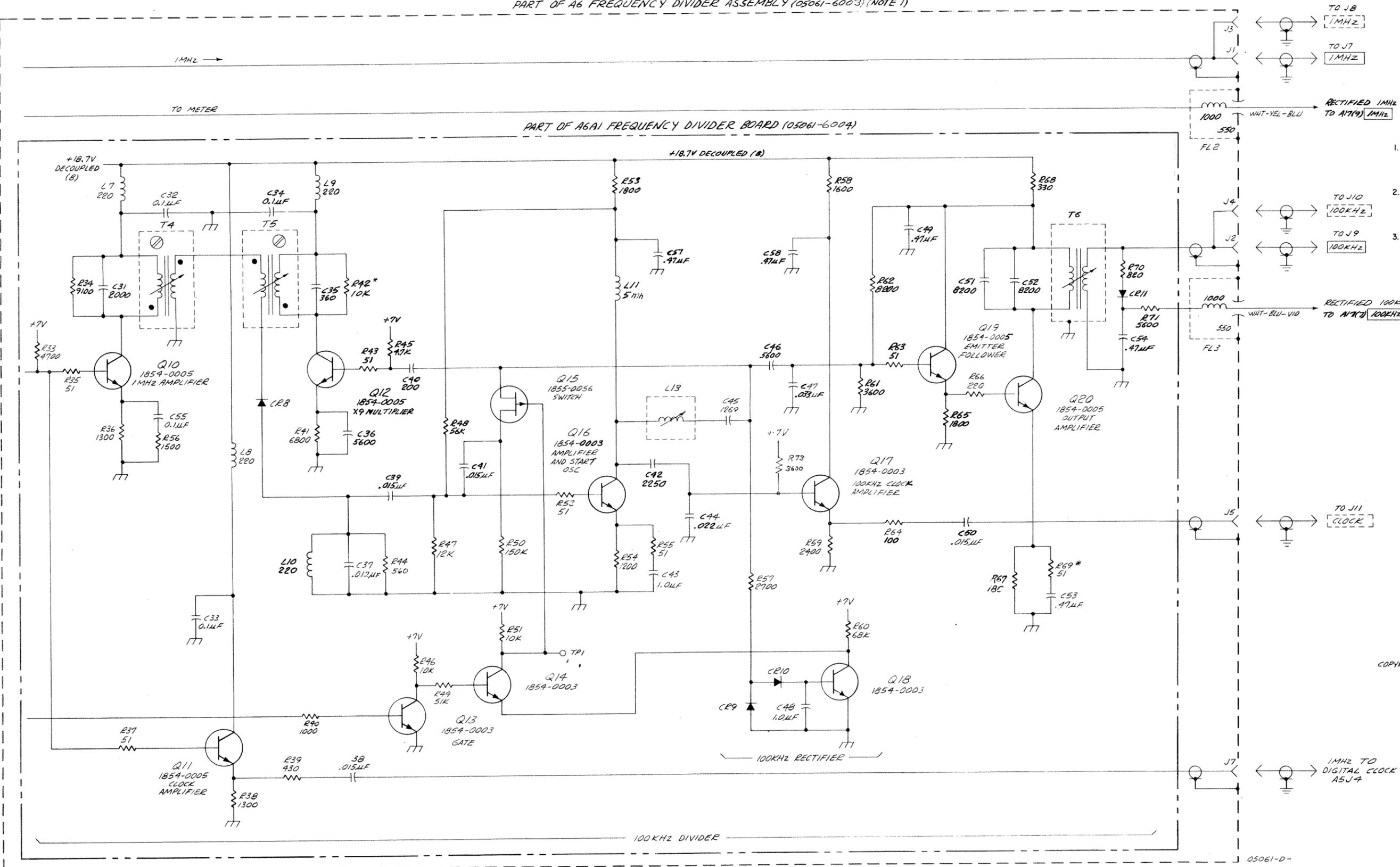


PART OF A6 FREQUENCY DIVIDER ASSEMBLY (05061-6003)

PART OF A6A1 FREQUENCY DIVIDER BOARD (05061-6004) (NOTE 1)



05061-0-



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

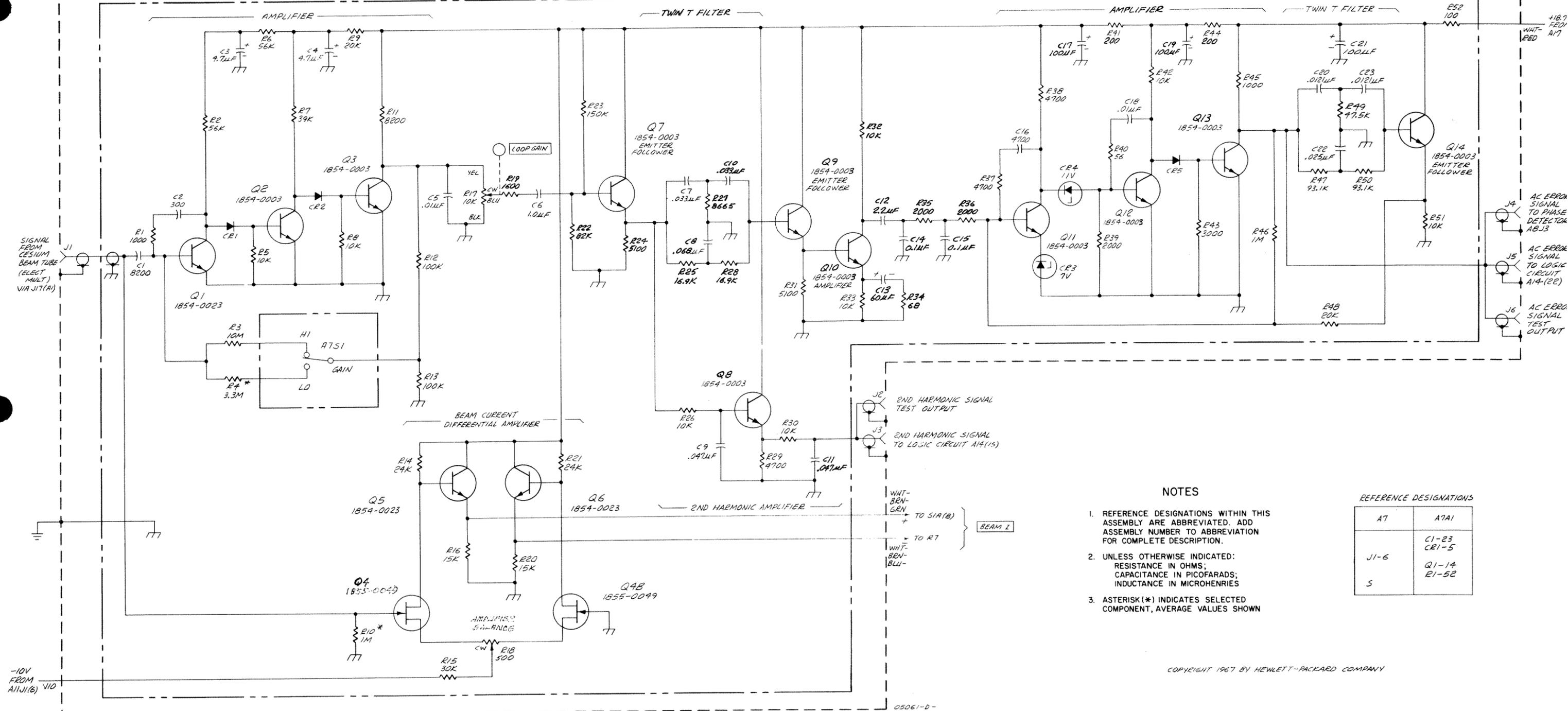
A6	A6A1
FL1-3	C1-60
J1-5,7	CR1-11
	L1-12
	Q1-20
	R1-71
	T1-6
	TP1

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A7 AC AMPLIFIER ASSEMBLY (05061-6005)

A7A1 AC AMPLIFIER BOARD (05061-6006) (NOTE 1)



NOTES

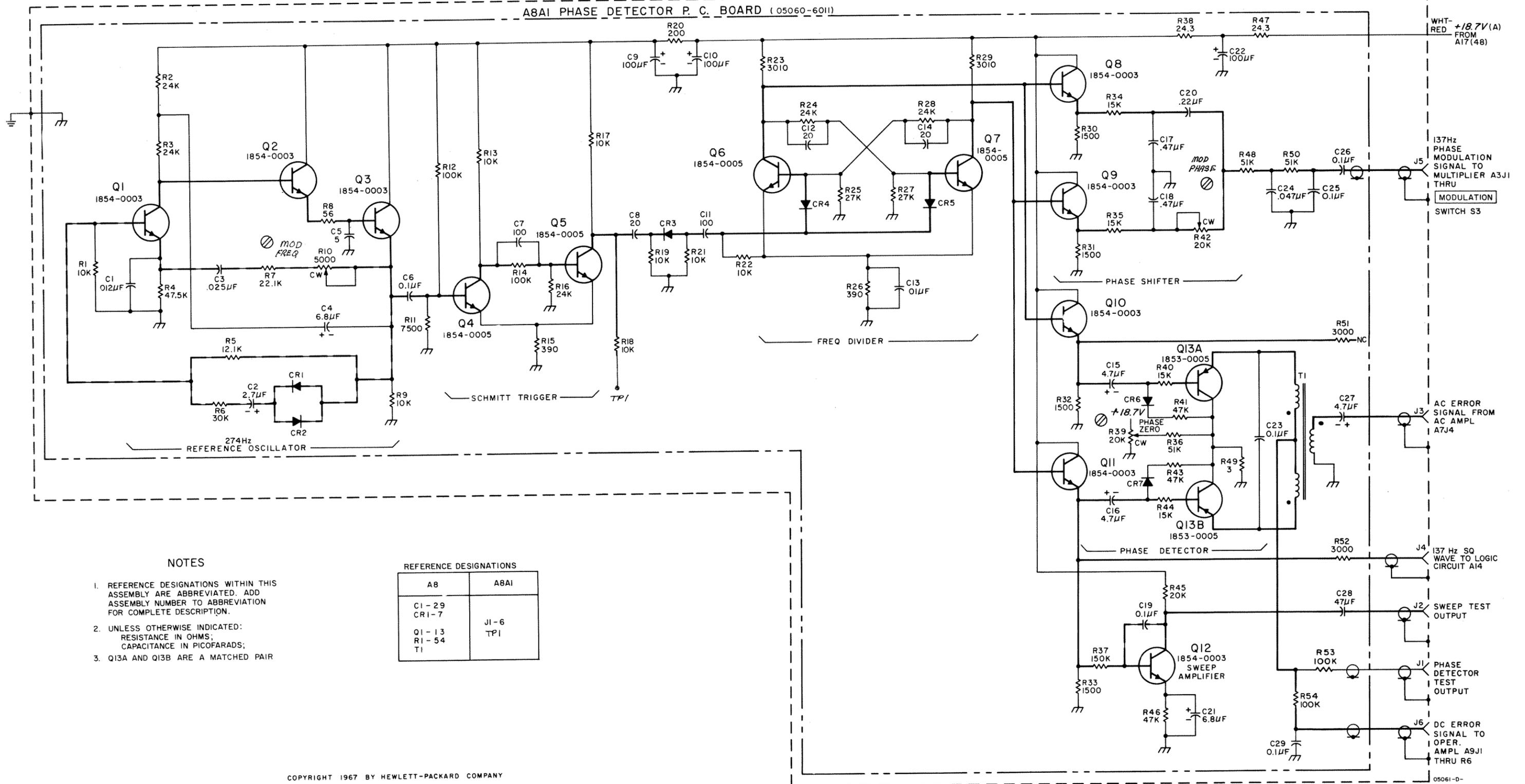
- REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
- UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
- ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

A7	A7A1
J1-6	C1-23 C21-5
S	Q1-14 R1-52

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A8 PHASE DETECTOR ASSEMBLY (05061-6007) (NOTE 1)
 A8A1 PHASE DETECTOR P. C. BOARD (05060-6011)



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 PICO FARADS;
3. Q13A AND Q13B ARE A MATCHED PAIR

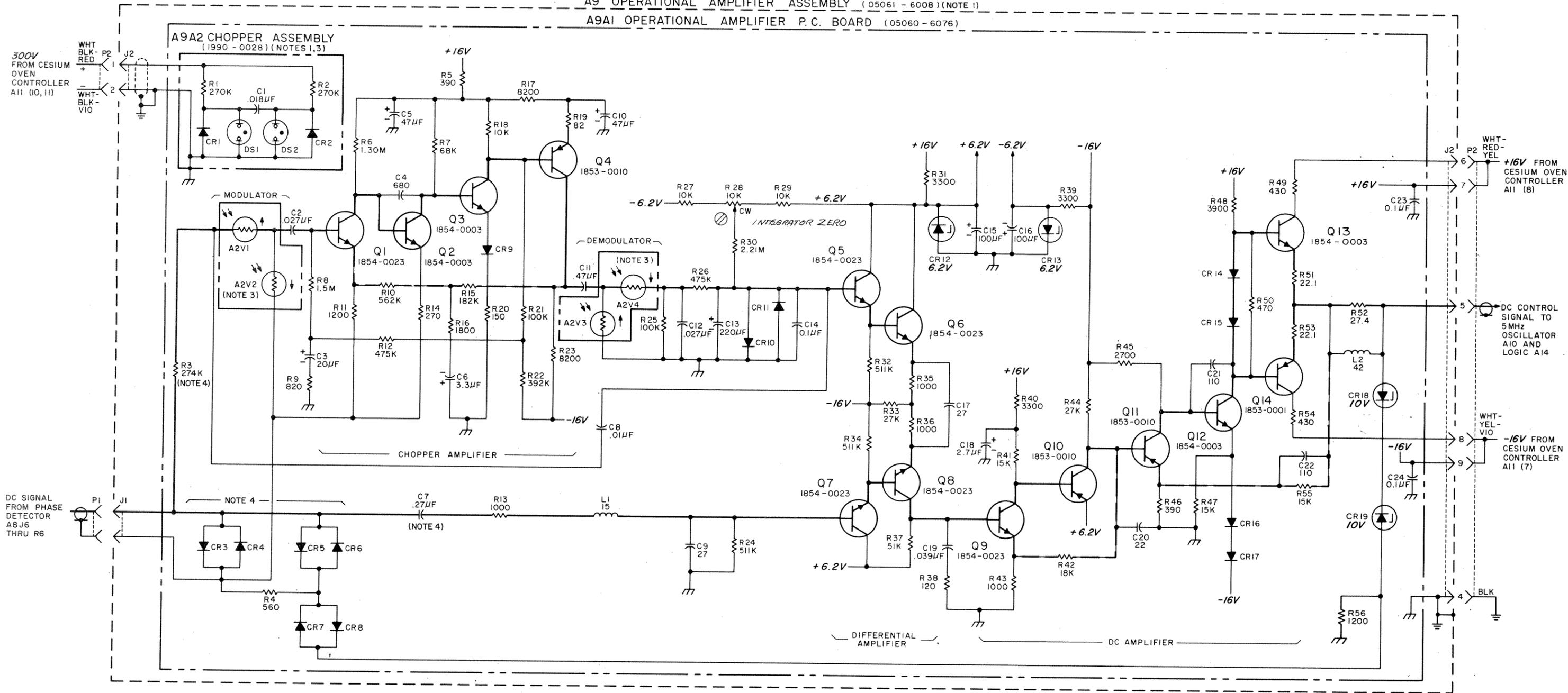
REFERENCE DESIGNATIONS

A8	A8A1
C1 - 29	J1 - 6
CR1 - 7	TP1
Q1 - 13	
R1 - 54	
T1	

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A9 OPERATIONAL AMPLIFIER ASSEMBLY (05061 - 6008) (NOTE 1)

A9A1 OPERATIONAL AMPLIFIER P.C. BOARD (05060 - 6076)



NOTES

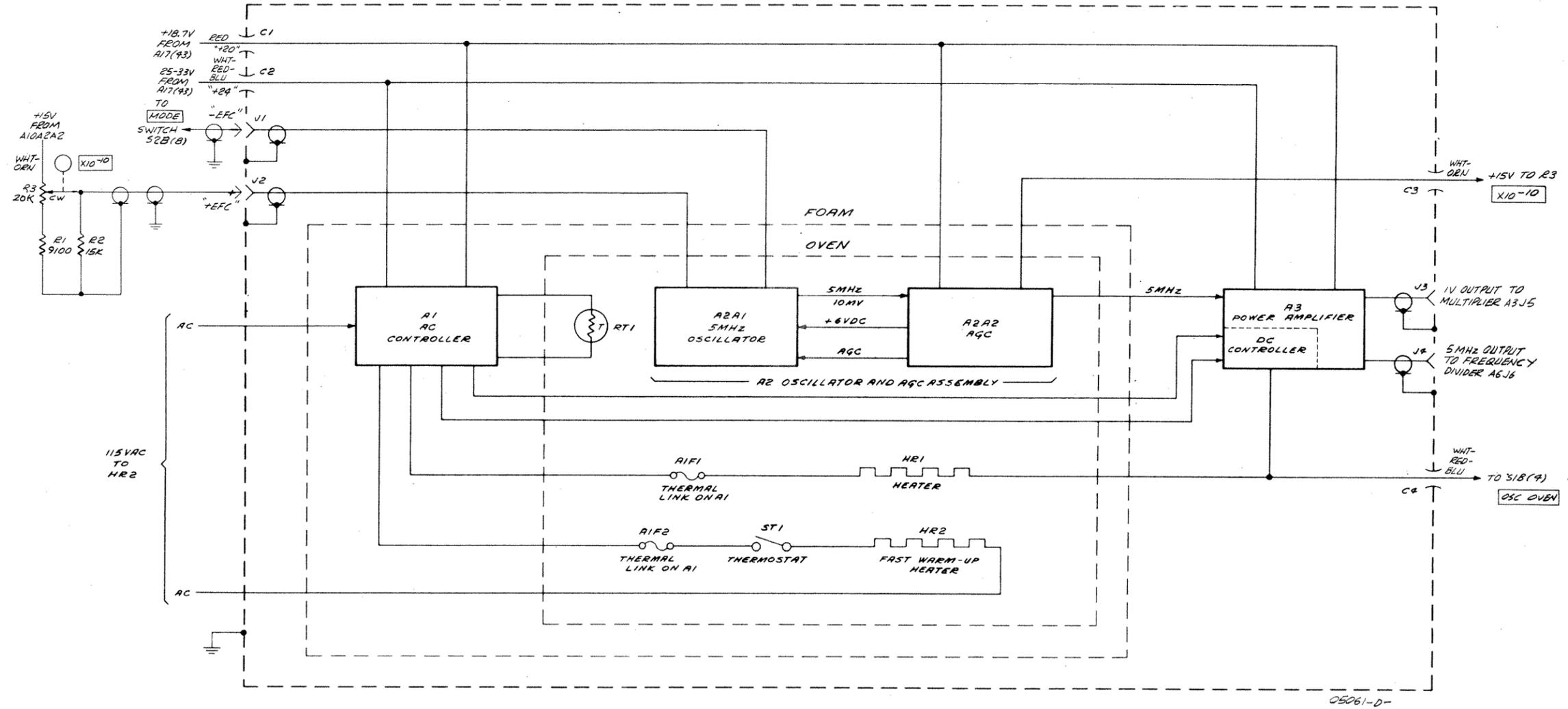
- REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
- UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS;
INDUCTANCE IN MICROHENRIES
- A9A2 CHOPPER ASSEMBLY ALSO CONTAINS V1-V4. NEON DSI ENERGIZES V1, V3 AND DS2 ENERGIZES V2, V4.
- USE GLOVES WHEN CHANGING CONNECTIONS TO C7, CR3-6 AND R3. THIS IS A VERY HIGH IMPEDANCE AREA.

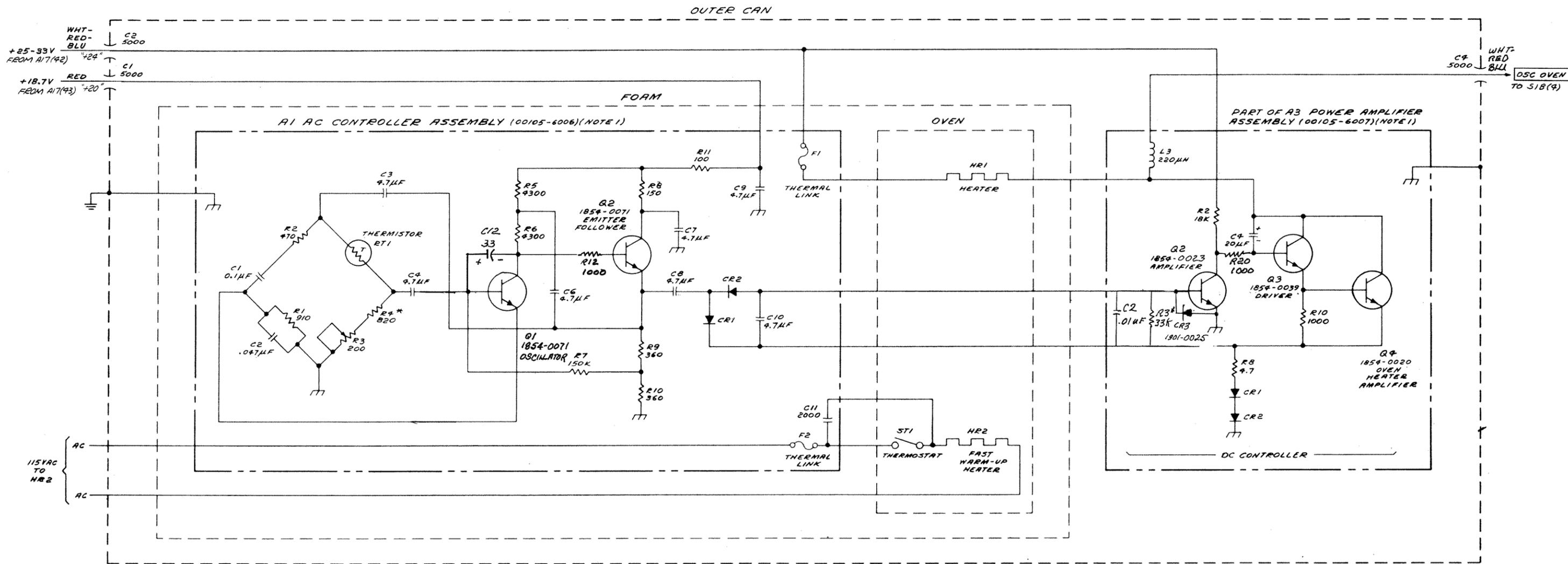
REFERENCE DESIGNATIONS

NO PREFIX	A9	A9A1	A9A2
		C2-24 CR3-19	C1 CR1,2 DS1,2
P1,2	J1,2	L1,2 Q1-14 R3-56	R1,2 V1-4

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A10 OSCILLATOR ASSEMBLY (00105-5013)
OUTER CAN





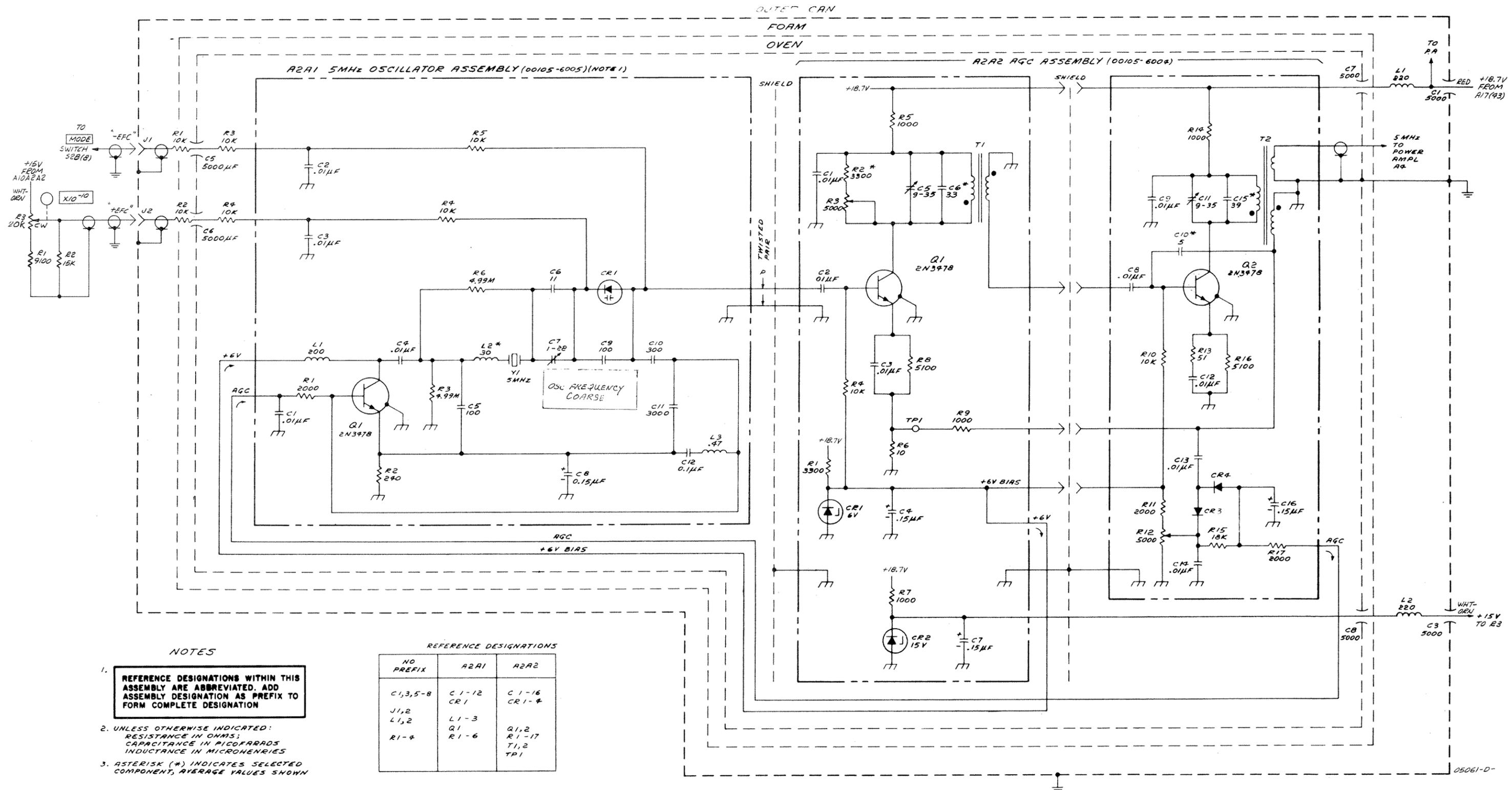
NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A1	A3
C1,2,4	C1-11 CR1,2 F1,2	C2,4 CR1,2
HR1,2	Q1,2 R1-11 RT1	L3 Q2-4 R2,3,8,10
ST1		

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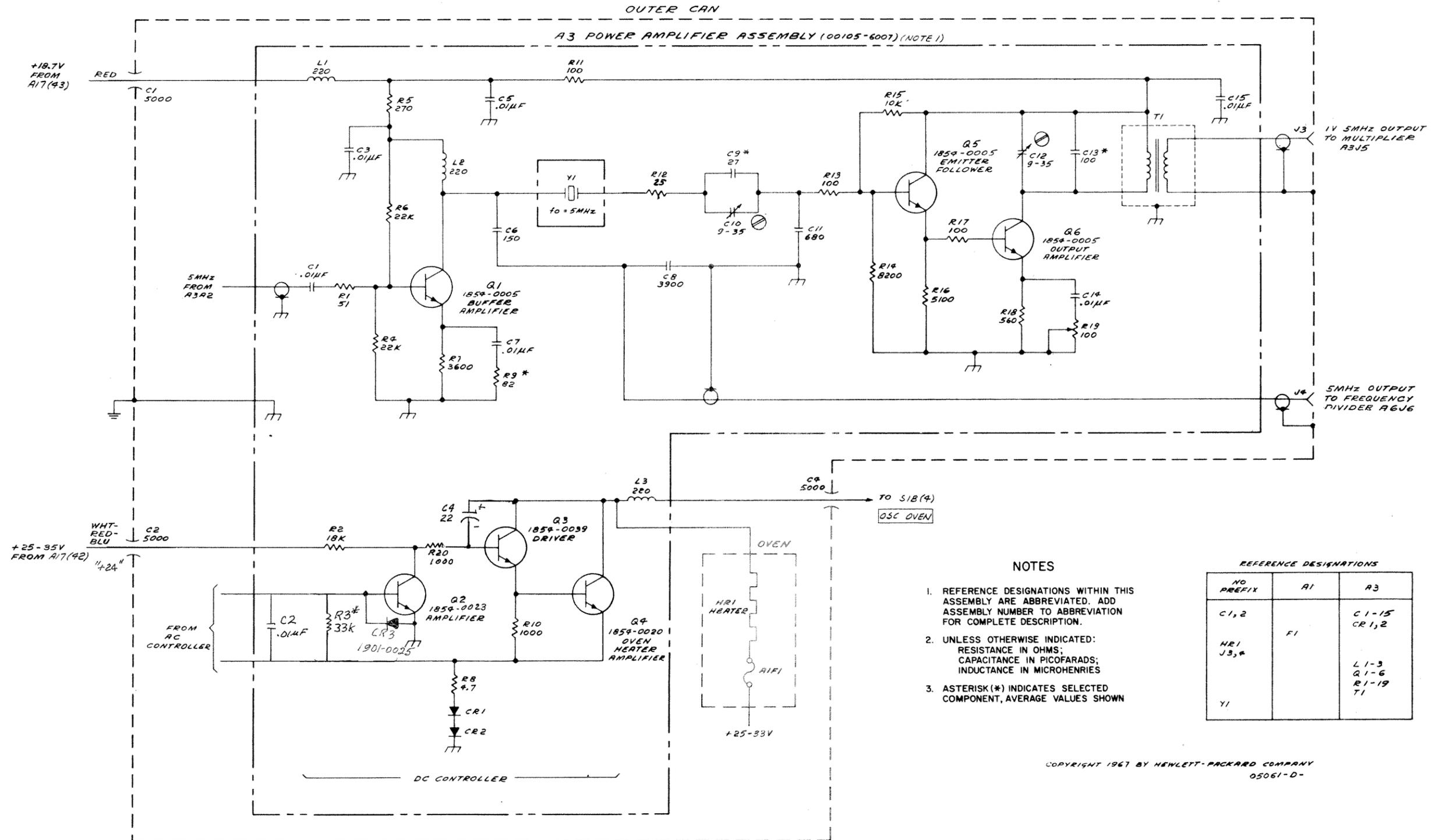
NOTES

- REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION
- UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
- ASTERISK (*) INDICATES SELECTED COMPONENT; AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

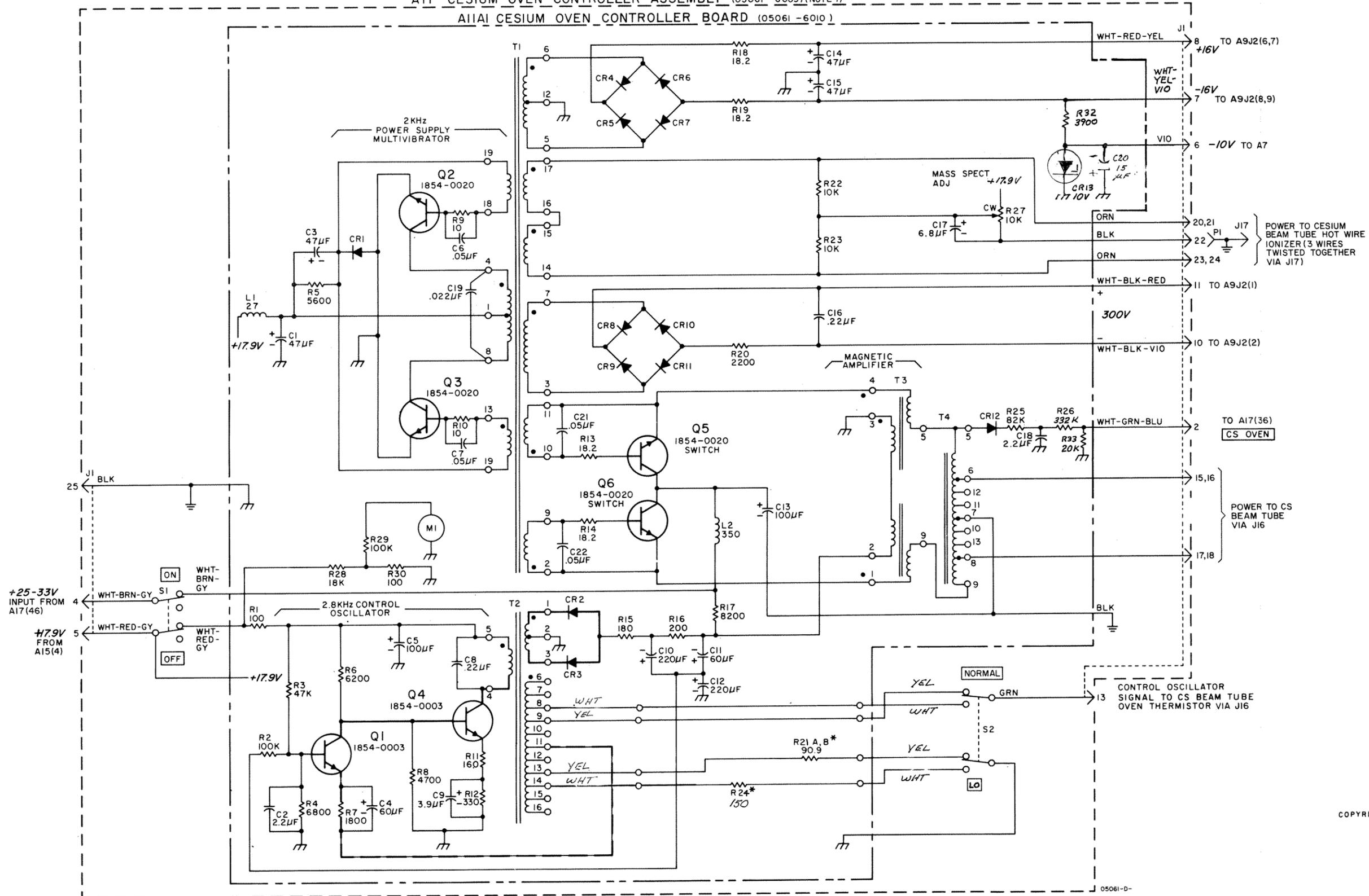
NO PREFIX	A2A1	A2A2
C1,3,5-8	C1-12	C1-16
J1,2	CR1	CR1-4
L1,2	L1-3	
R1-4	Q1	Q1,2
	R1-6	R1-17
		T1,2
		TP1

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A11 CESIUM OVEN CONTROLLER ASSEMBLY (05061 -6009) (NOTE 1)

A11A1 CESIUM OVEN CONTROLLER BOARD (05061 -6010)



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	A11	A11A1
J17	C20 CR13 J1	C1-19, 21, 22 CR1-12 L1, 2 M1
P1	R32 S1, 2	Q1-6 R1-31 T1-4

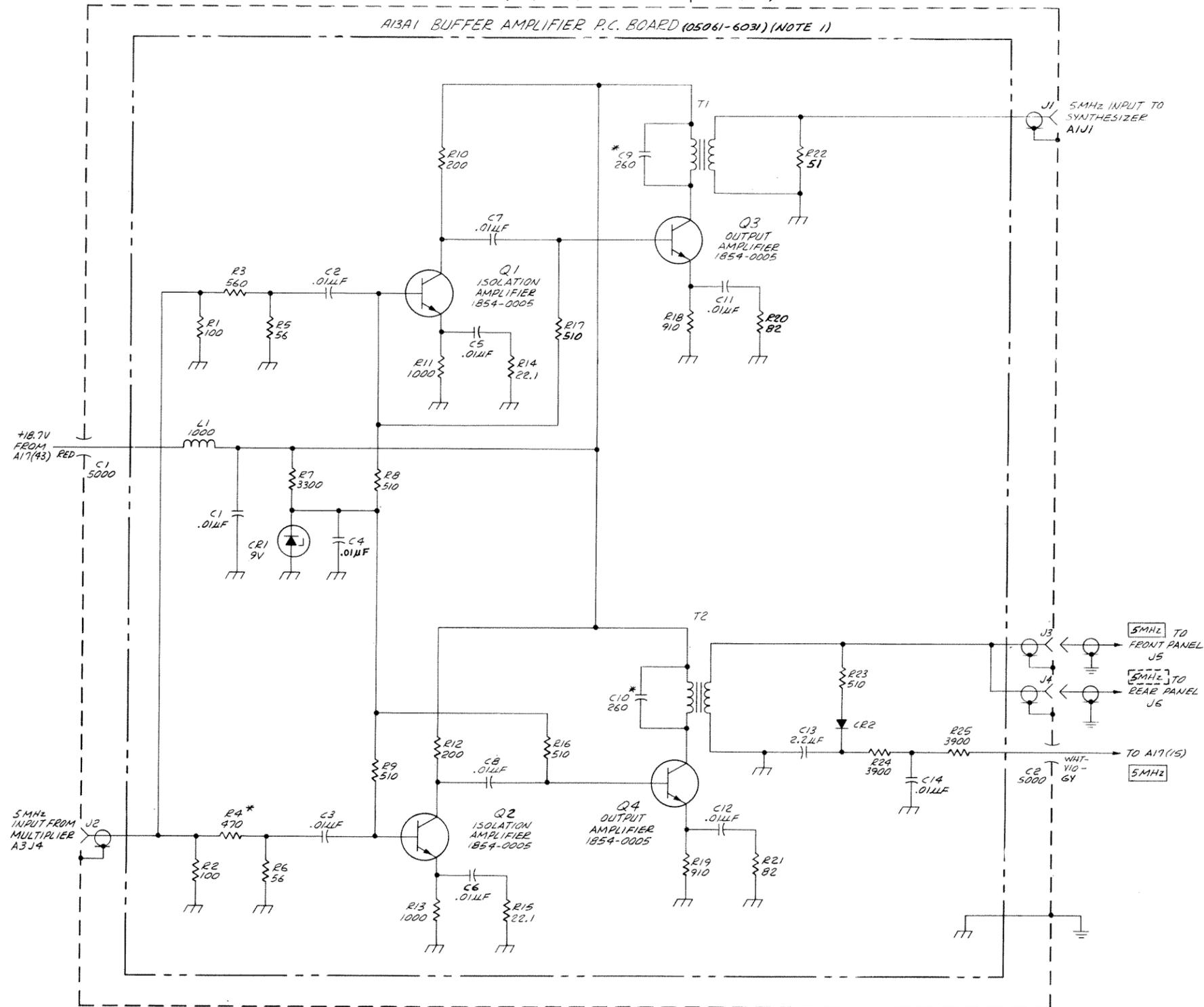
TAPS USED ON THERMISTOR SECONDARY OF T2	
THERMISTOR RESISTANCE AT DESIRED TEMP	TRANSFORMER TAPS
60 - 87 Ω	10, 12
87 - 126 Ω	9, 13
126 - 180 Ω	8, 14
180 - 250 Ω	7, 15
250 - 365 Ω	6, 16

TAPS USED ON HOT WIRE IONIZER SECONDARY OF T1		
HOT WIRE IONIZER VOLTAGE	OUTPUT TAPS	STRAP TAPS
< +1.2V	15, 17	14, 16
+1.2 - 1.6V	16, 17	
> +1.6V	14, 17	15, 16

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A13 BUFFER AMPLIFIER ASSEMBLY (05061-6090)

A13A1 BUFFER AMPLIFIER P.C. BOARD (05061-6031) (NOTE 1)



NOTES

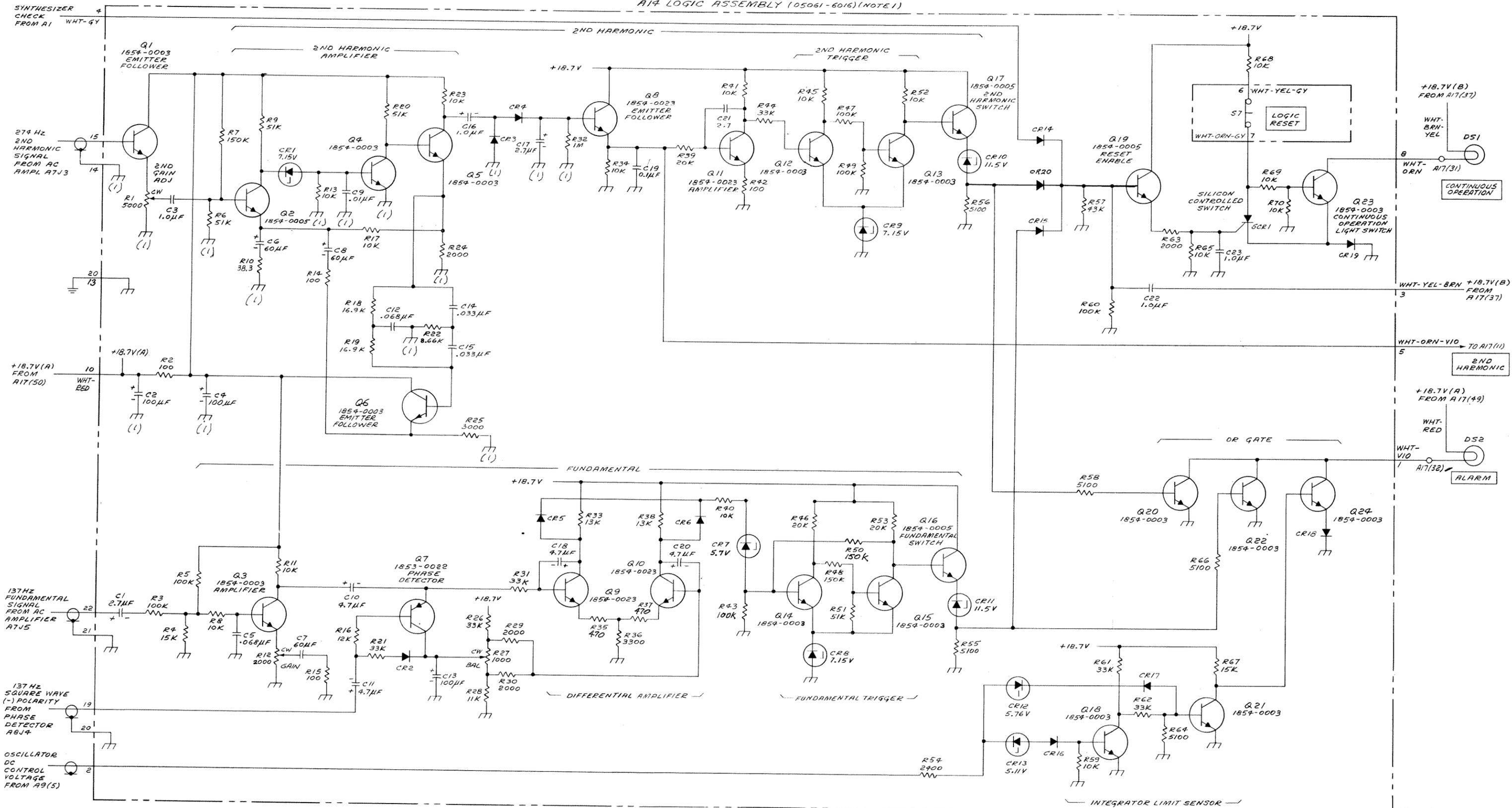
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICO FARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

A13	A13A1
C1,2	C1-14 CR1,2
J1-4	L1 Q1-4 R1-25 T1,2

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A14 LOGIC ASSEMBLY (05061-6016) (NOTE 1)

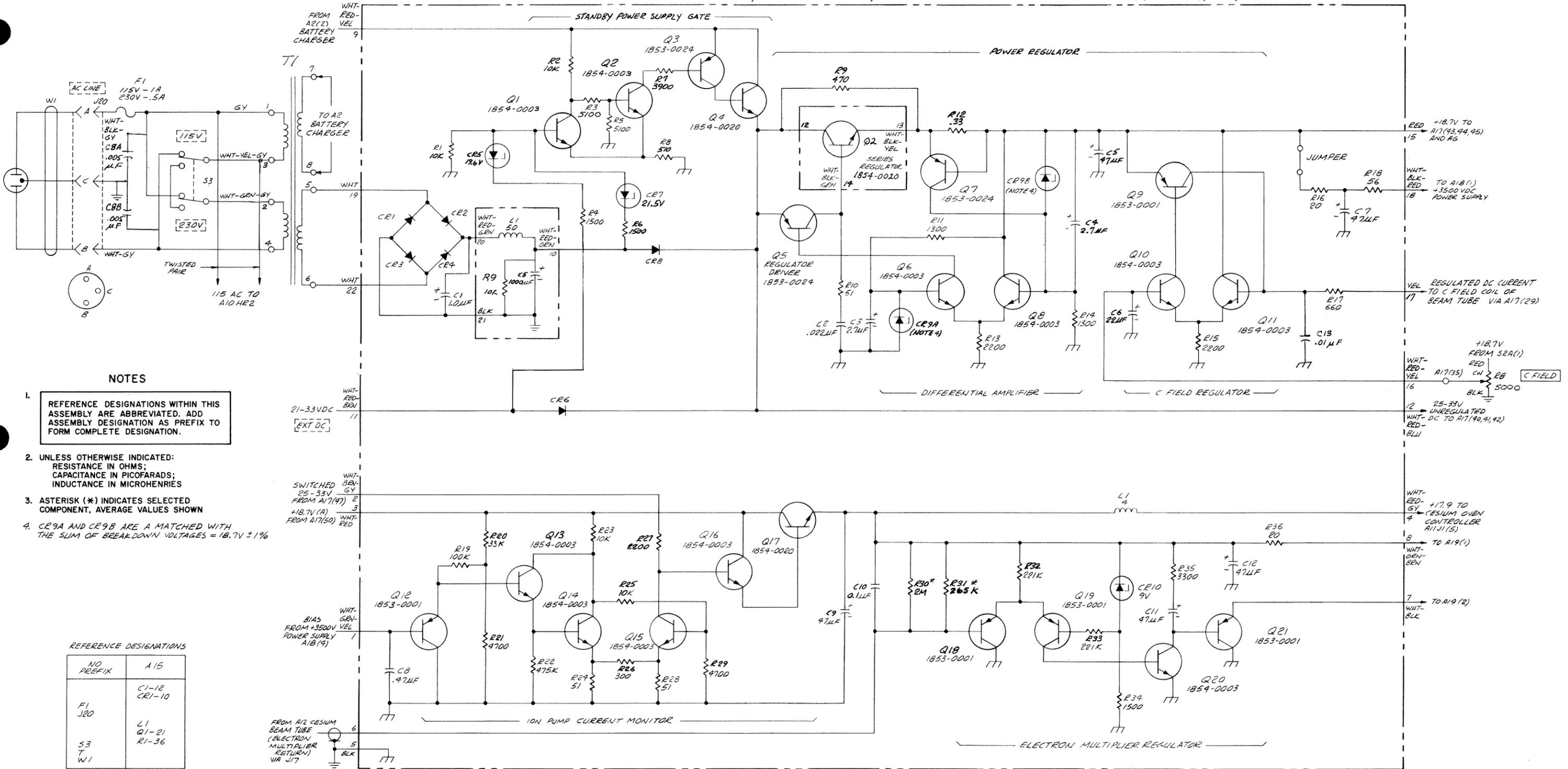


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REFERENCE DESIGNATIONS

NO. PREFIX	A14
DS1-2	C1-23
57	CR1-19
	Q1-24
	R1-70

A15 RECTIFIER/POWER REGULATOR/ELECTRON MULTIPLIER REGULATOR ASSEMBLY (05061-607) (NOTE 1)



NOTES

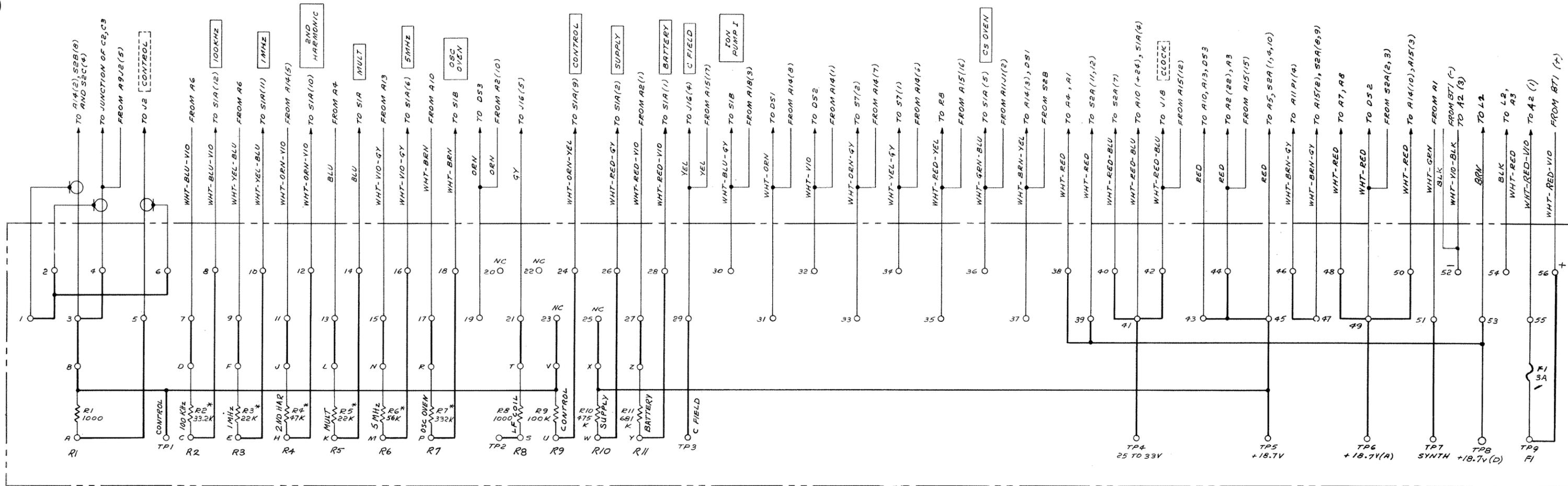
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN
4. CR9A AND CR9B ARE A MATCHED WITH THE SUM OF BREAKDOWN VOLTAGES = 18.7V ± 1%

REFERENCE DESIGNATIONS

NO PREFIX	A15
F1	C1-12 CR1-10
J20	L1 Q1-21 R1-36
S3	
T	
W1	

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A17 TERMINAL BOARD ASSEMBLY (05061-6018) (NOTE 1)

NOTES

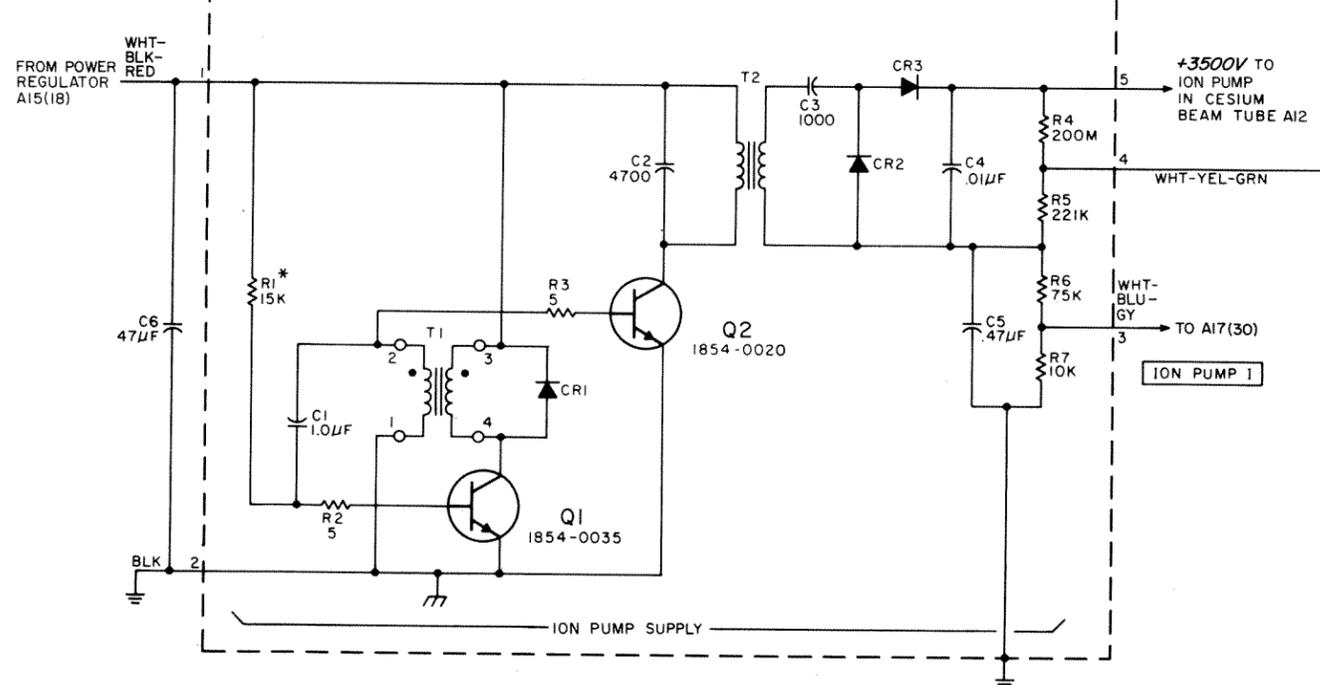
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS;
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

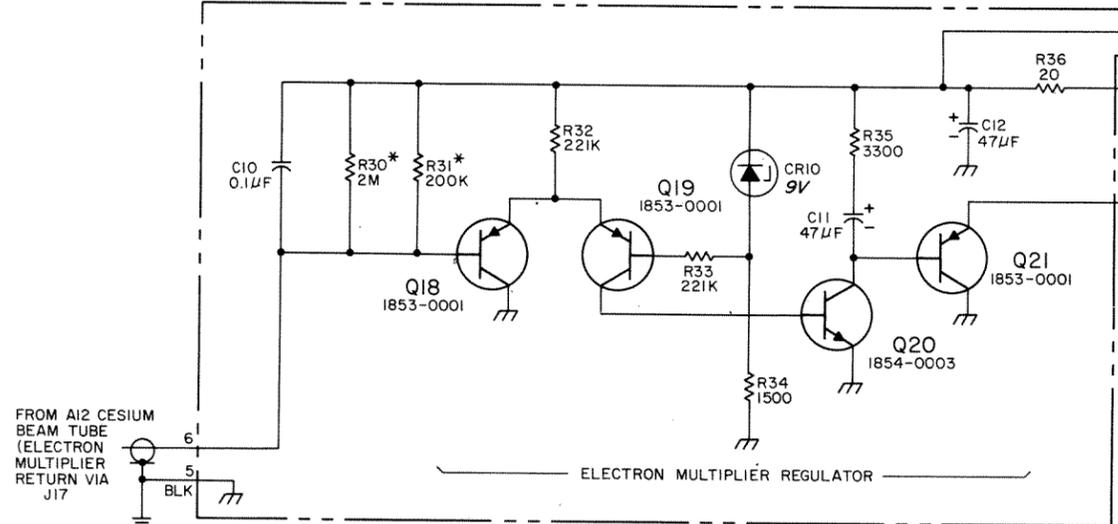
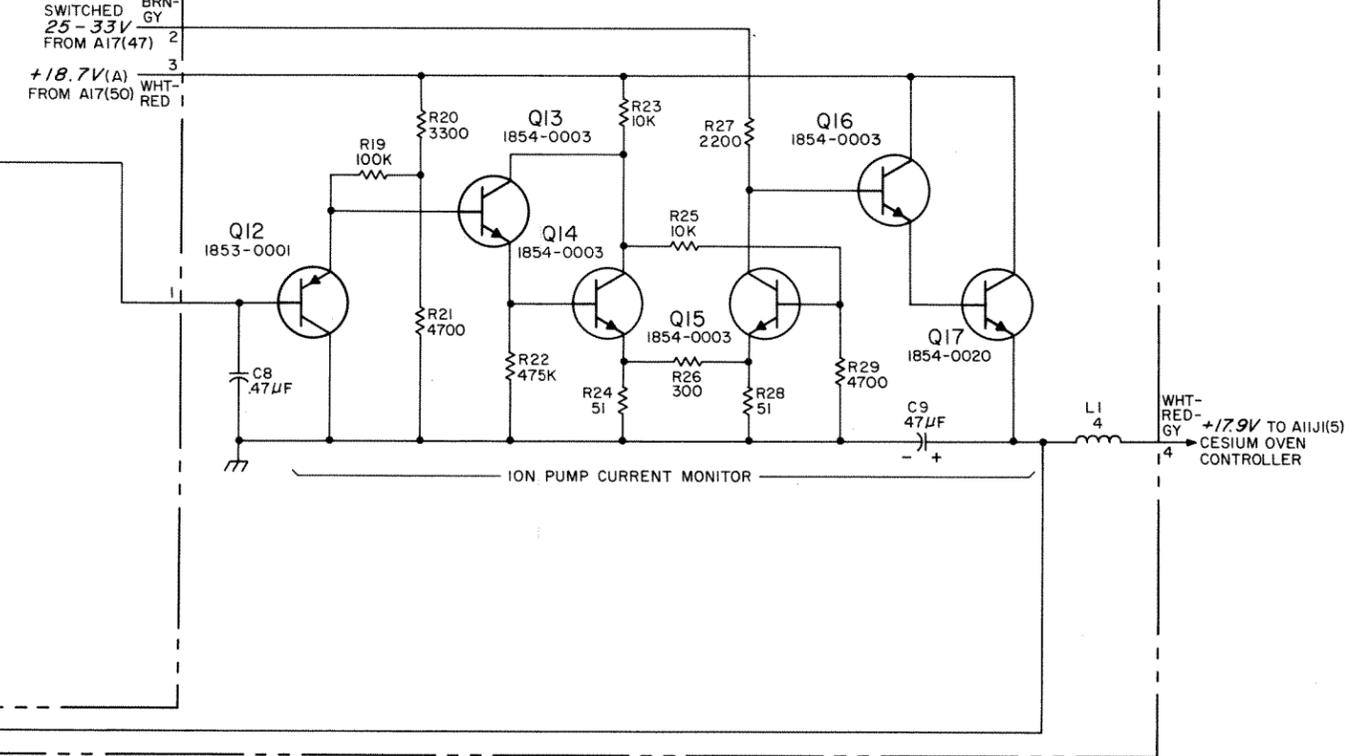
A17
F1
R1-11
TP1-9

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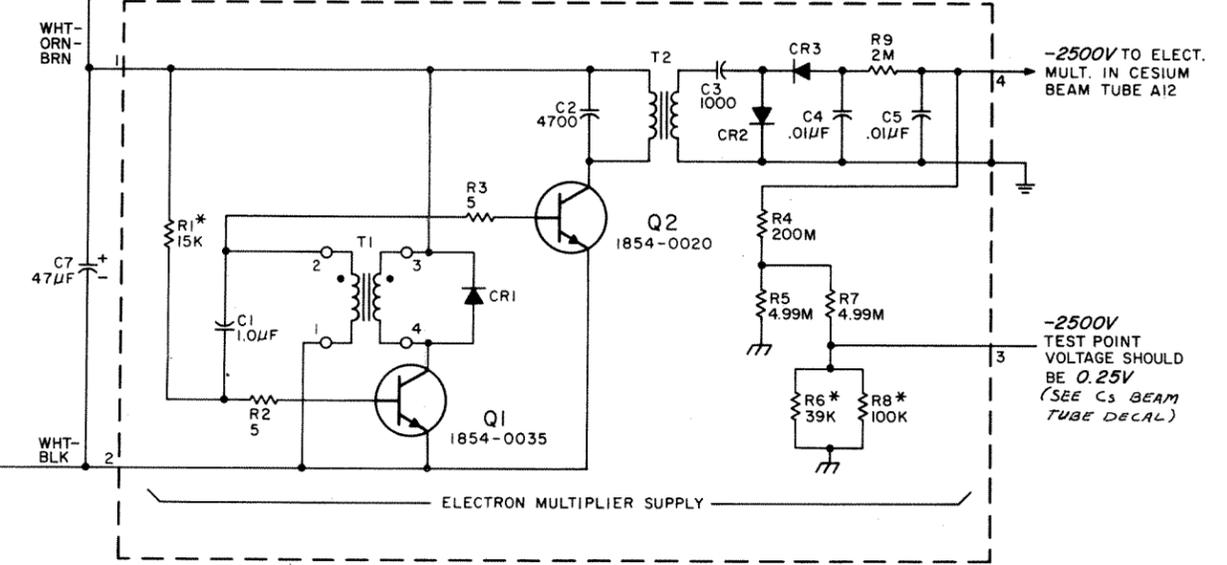
A18 +3500 VDC POWER SUPPLY ASSEMBLY (05061-6093) (NOTE 1)



PART OF A15 ELECTRON MULTIPLIER REGULATOR ASSEMBLY (05061-6017) (NOTE 1)



A19 -2500 VDC POWER SUPPLY ASSEMBLY (05060-6092) (NOTE 1)



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 PICO FARADS;
INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A15	A18	A19
C6,7	C8-12 CR10 L1 Q12-21 R19-36	C1-5 CR1-3 Q1,2 R1-7 T1,2	C1-5 CR1-3 Q1,2 R1-9 T1,2

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A18 +3500 VDC Power Supply
A19 -2500 VDC Power Supply