Errata

Title & Document Type: 5061A Preliminary Operation and Schematics

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HP References in this Manual

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Agilent Technologies

TEMPORARY OPERATING MANUAL

HEWLETT-PACKARD MODEL 5061A

CESIUM BEAM FREQUENCY STANDARD

All Serials

02475-1

March, 1968

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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.

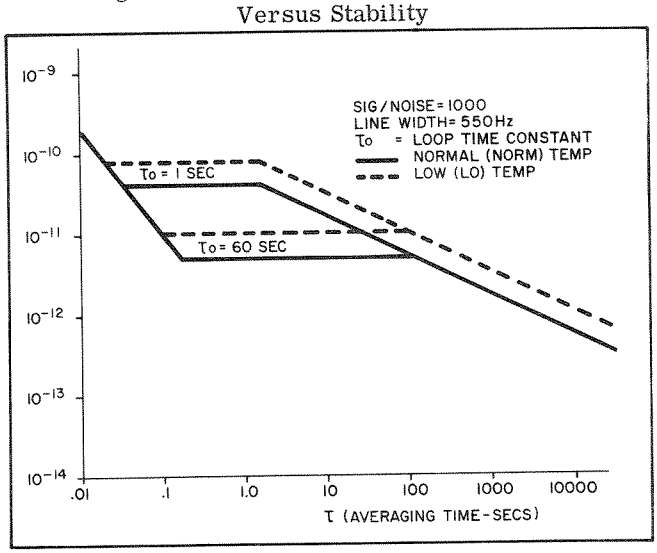
1-4. In the beam tube, a state-selected beam of Cesium 133 atoms passes through a microwave cavity. When the frequency of the applied microwave magnetic field, derived by multiplying the quartz crystal oscillator frequency, is near the hyperfine transition frequency of Cesium 133 (9, 192, 631, 770. 0 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

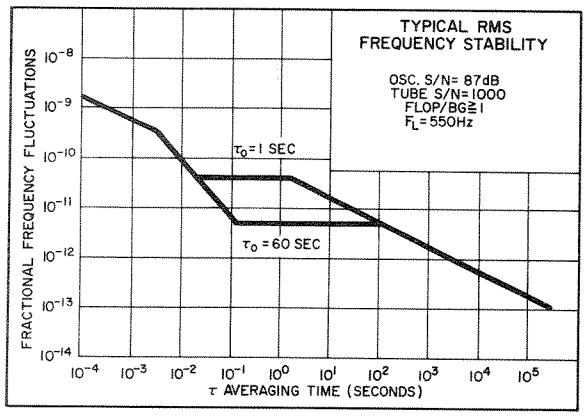
5061A CESIUM BEAM STANDARD

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 x 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. 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.

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 10^{10} 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 10^8 range, with dial reading parts in 10^{10}.

Coarse Adjustment: 1 part in 10^6, screwdriver adjustment at front panel.

Stability:
As a Function of Ambient Temperature: < 2. 5 x10^{-10} total from 0° to +50°C.

As a Function of Load: < $\pm 2 \times 10^{-11}$ for open circuit to short, and 50 ohm R, L, C load change.

As a Function of Supply Voltage: < $\pm 5 \times 10^{-11}$ for 22 to 30 V dc, or for 115/230 V ac, ± 10%.

Table 1-1. Specifications (cont'd)

GENERAL

Environmental

Temperature:
Operating, 0-50°C. Typical stability better than ± 5 x 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 x 10^{-12}.

Vibration: Passed MIL-STD-167.

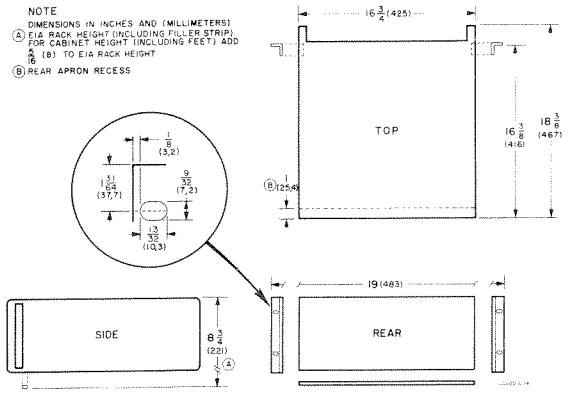
Shock: Passed MIL-T-21200, Class 1.

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

Power:
115 or 230V ac ±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 μs minimum
Rise Time: < 50 ns
Fall Time: < 1 μs
Jitter: < 20 ns.

All specs are with 50-ohm load.

Synchronization: 10 μs (±1 μs) 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

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	Offset	8730-0007
Board 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 (±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

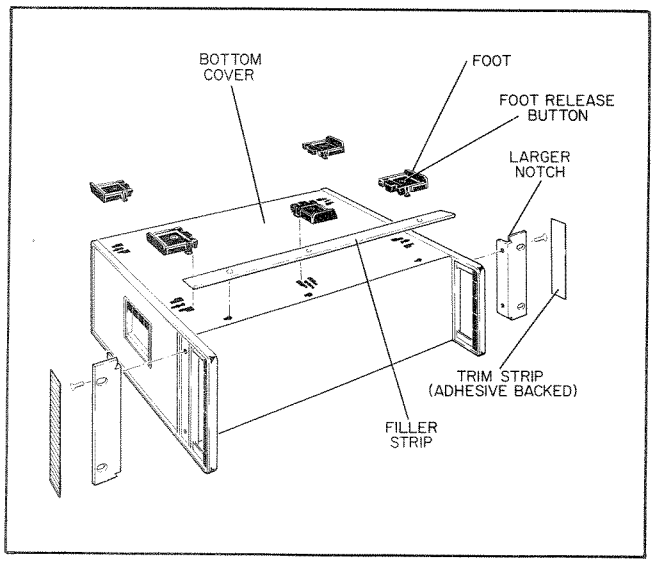
Connector Description	Connector HP Part No.	Mating Connector HP Part No.	Mating Connector Description
BNC female jacks (J2, 6, 8, 10, 11, 12, 14 & 15)	1250-0140	1250-0061*	BNC male plug, UG88/U
ZEEMAN MOD INPUT, female jack (J1)	1250-0102	1250-0061*	BNC male plug, UG88/U
EXT DC, 5-pin male jack (J19)	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 1251-1979 1251-1981	1251-1977 1251-1978 1251-1980	Hood Connector receptacle Lock Spring
+3500V, 1-pin male jack (J4)	1251-1977 1251-1979 1251-1980	1251-1977 1251-1978 1251-1980	Hood Connector receptacle Lock spring

*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:

Figure 2-1. Conversion for Rack Mounting



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

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

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

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

2-15. INSTALLATION LOCATION

2-16. The cesium beam tube installed in the Model 5061A is slightly sensitive to external magnetic fields. Avoid installing the instrument near large motors, generators, transformers, or other equipment which radiates strong fields of 2 Gauss or more. Also avoid placing a strong permanent magnet near the beam tube. These devices can radiate magnetic fields which are strong enough to permanently affect the magnetic shielding within the beam tube. The front-panel C FIELD control compensates for small magnetic field effects such as the earth's magnetic field with respect to the instrument location. For maximum accuracy, check the C FIELD adjustment when the instrument is relocated (See Paragraph 3-8, 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

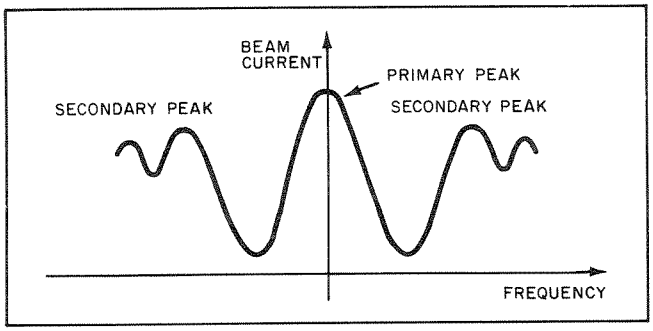


Table 3-1. Operating Checks

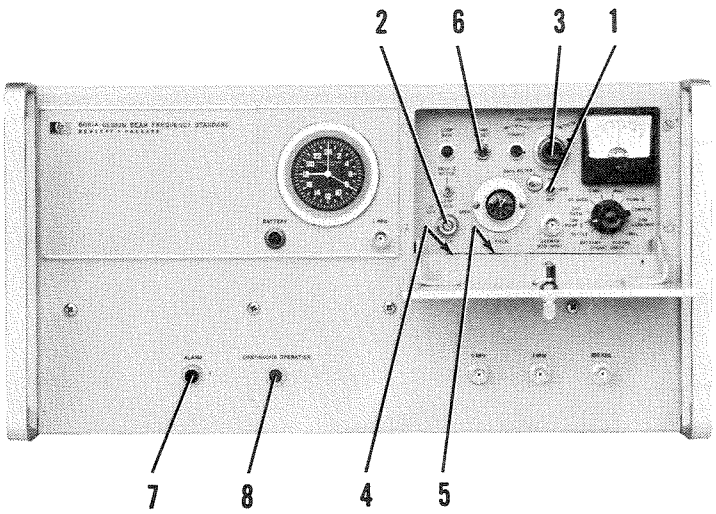
CIRCUIT CHECK		
Switch Position	Meter Indication	Description
BATTERY	0 (40 with Option 02)	Indicates battery voltage
SUPPLY	38-42	Indicates +18.7 volts regulated supply voltage
ION PUMP I	*0	Indicates vacuum in cesium beam tube by monitoring ion pump current. Fail-safe circuit removes power to cesium beam tube if current exceeds 40 μa.
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 ± 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

*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.

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). Note CS OFF used for test purposes and storage.

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.
6. Wait 30 seconds, press LOGIC RESET button.
7. ALARM light should be off.
8. 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.
9. 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	50.18kHz
-400	12632139.8 Hz	4567	HI	49.20kHz
-450	12632185.9 Hz	4634	HI	51.17kHz
-500	12632231.4 Hz	0736	HI	45.14kHz
-550	12632277.6 Hz	7274	HI	48.48kHz
-600	12632322.2 Hz	5257	HI	43.86kHz
-650	12632369.5 Hz	7337	HI	47.78kHz
-700	12632415.2 Hz	8617	HI	45.10kHz

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.

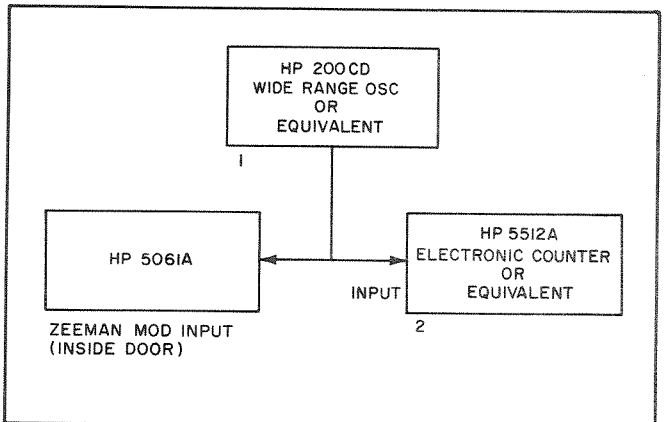
j. The hyperfine transition frequency is slightly sensitive to the earth's magnet field and local magnetic fields. The "C" field within the cesium beam tube compensates for these minor variations and should be adjusted when the instrument is moved or relocated.

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



1. SET OUTPUT LEVEL TO APPROXIMATELY 1Vrms AND FREQUENCY TO ZEEMAN FREQUENCY.
2. SET COUNTER FOR BEST RESOLUTION OF ZEEMAN FREQUENCY.

(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.

l. 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.

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 μsec to 1 sec with respect to an external reference. The 0-1 μsec TIME DELAY screwdriver adjustment (A5C2) allows fine adjustment over any 1 μsec portion of the thumbwheel settings. The TIME DELAY switches and the 0-1 μsec 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 μsec, proceed as follows:

a. Remove the top cover.

b. Using the knob on back of clock movement, set hours and minutes.

c. Replace the top cover and open the access door in the top cover.

d. Using the FAST pushbutton to speed up the clock tick, or STOP pushbutton to stop the clock (release the pushbutton to start clock tick), set the clock to the nearest second.

e. Set the 6 thumbwheel switch to 0 0 0 0 0 0, and 0-1 μsec TIME DELAY control maximum clockwise (do not over-tighten).

f. Connect a reference pulse to the 5061A rear-panel SYNC INPUT jack. The reference input pulse must be greater than +5V, with a rise time of less than 0. 05 μsec.

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

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

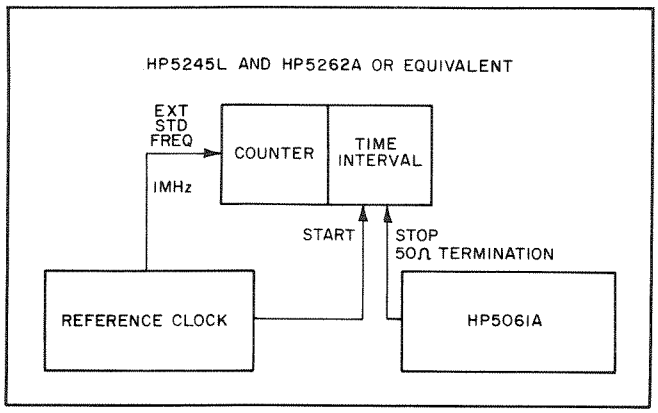
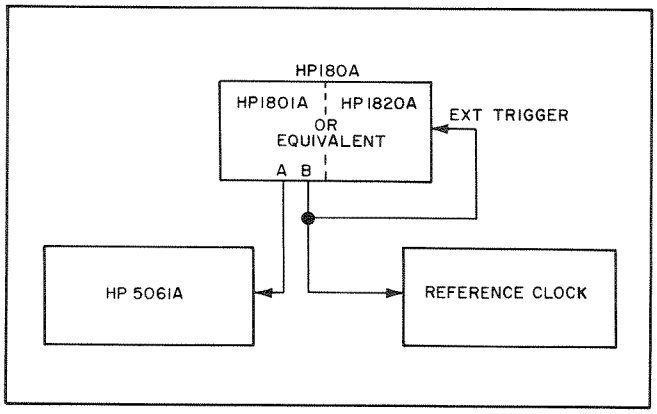


Figure 3-8. Clock Offset Test Setup, Example 2



3-22. Manual Synchronization

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

a. Perform Paragraph 3-20, steps a, b, c, and d.

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

c. Connect circuit shown in Figure 3-7.

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.

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

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

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

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

a. Perform Paragraph 3-20, steps a, b, c, and d.

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

c. Connect circuit shown in Figure 3-8. No 50-ohm termination is required for this test setup.

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

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

3-25. 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 _____				
Zeeman Frequency _____ kHz				
CIRCUIT	METER READINGS			
BATTERY				
SUPPLY				
ION PUMP I				
OSC. OVEN				
CS. OVEN				
5 MHz				
DATE				

Time Scale: Atomic ☐ UT2 ☐				
UT2 Offset _____ x 10^{-10}				
CIRCUIT	METER READINGS			
MULT				
BEAM I				
CONTROL				
2ND HARMONIC				
1 MHz				
100 kHz				
DATE				

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

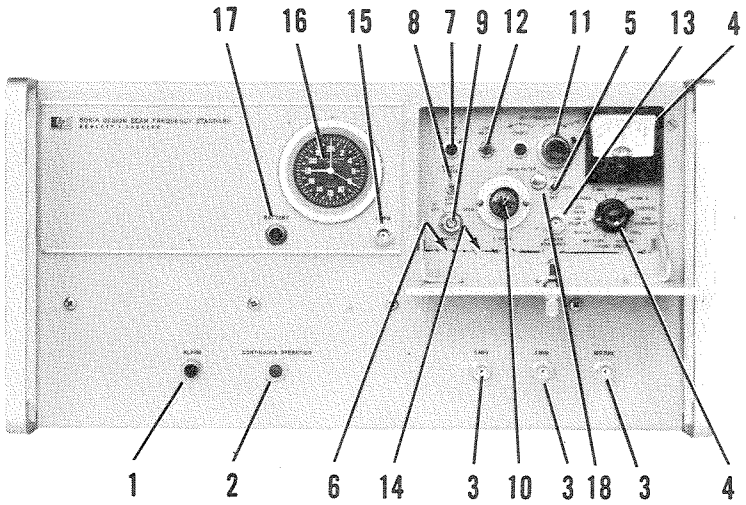
The front-panel MODE switch should not be set to CS OFF when Internal Standby Battery Option 02 is installed. The battery charge circuits will not function properly when the MODE switch is returned to LOOP OPEN or OPER position.

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.

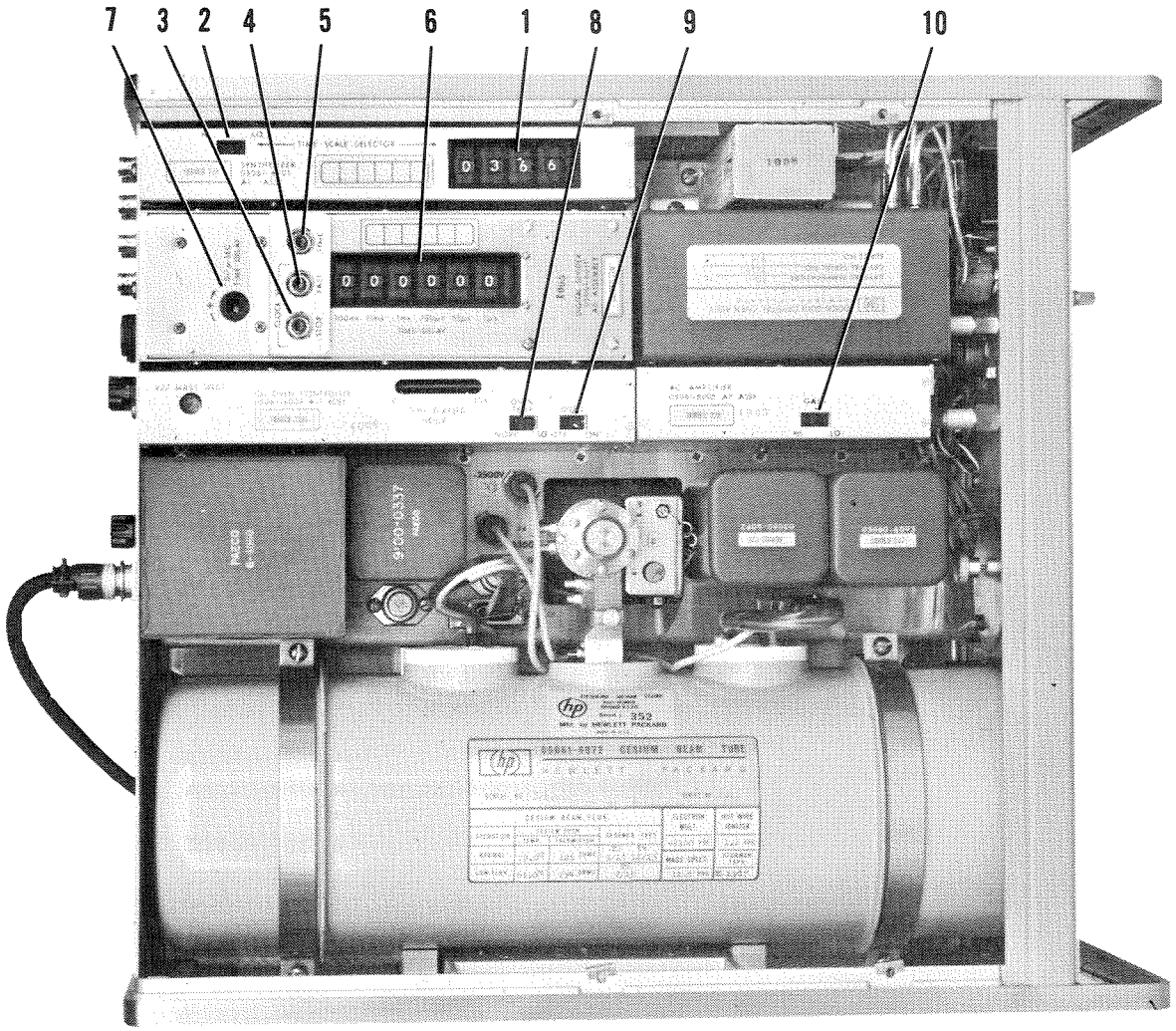
15. 1 PPS jack (Option 01 only): provides 10 volt, 20 μs, 1 pps into 50 ohms from digital clock.

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 μs to 1 sec.

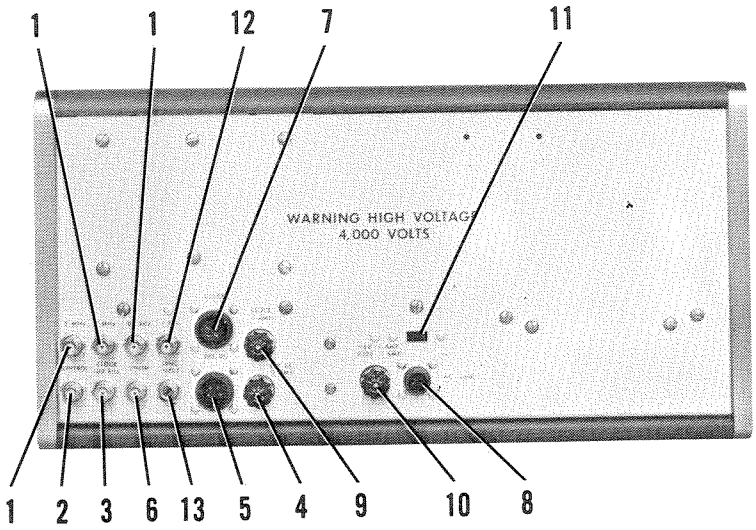
7. 0-1 μSEC TIME DELAY control (Option 01 only): Allows continuous adjustment of clock pulse delay over any 1 μsec range.

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, 100 kHz: BNC jacks paralleled with front-panel outputs to provide these standard frequencies.

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

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 μsec 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.

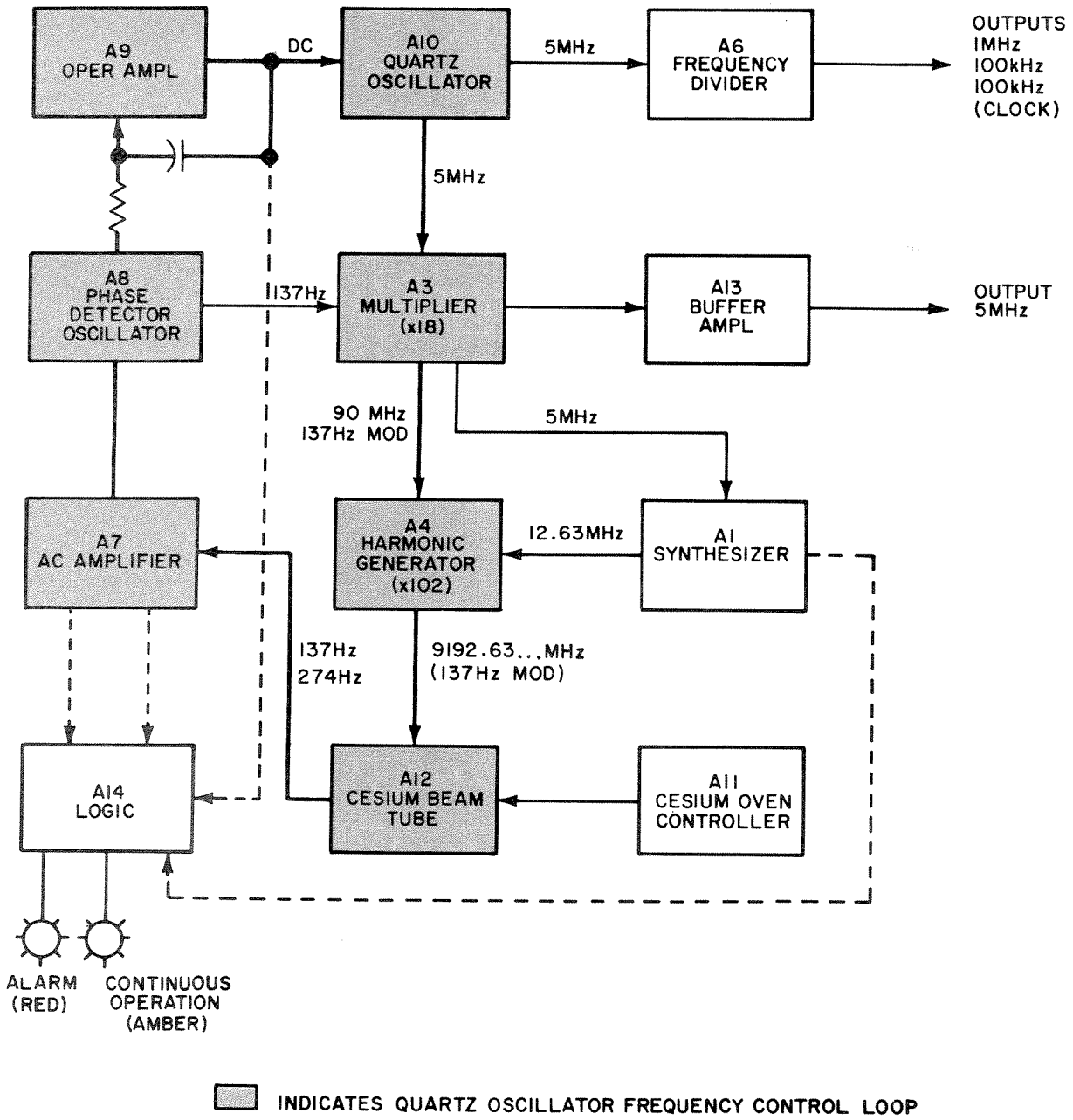


Figure 4-1. Simplified Block Diagram

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_o, the hyperfine transition frequency, the output beam current varies at twice the modulation frequency. If the carrier lies above f_o, as shown by the plot labelled f_{c1}, output current varies at the same rate as the modulation but has been shifted by 180° with respect to it; when the carrier lies below f_o, 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.

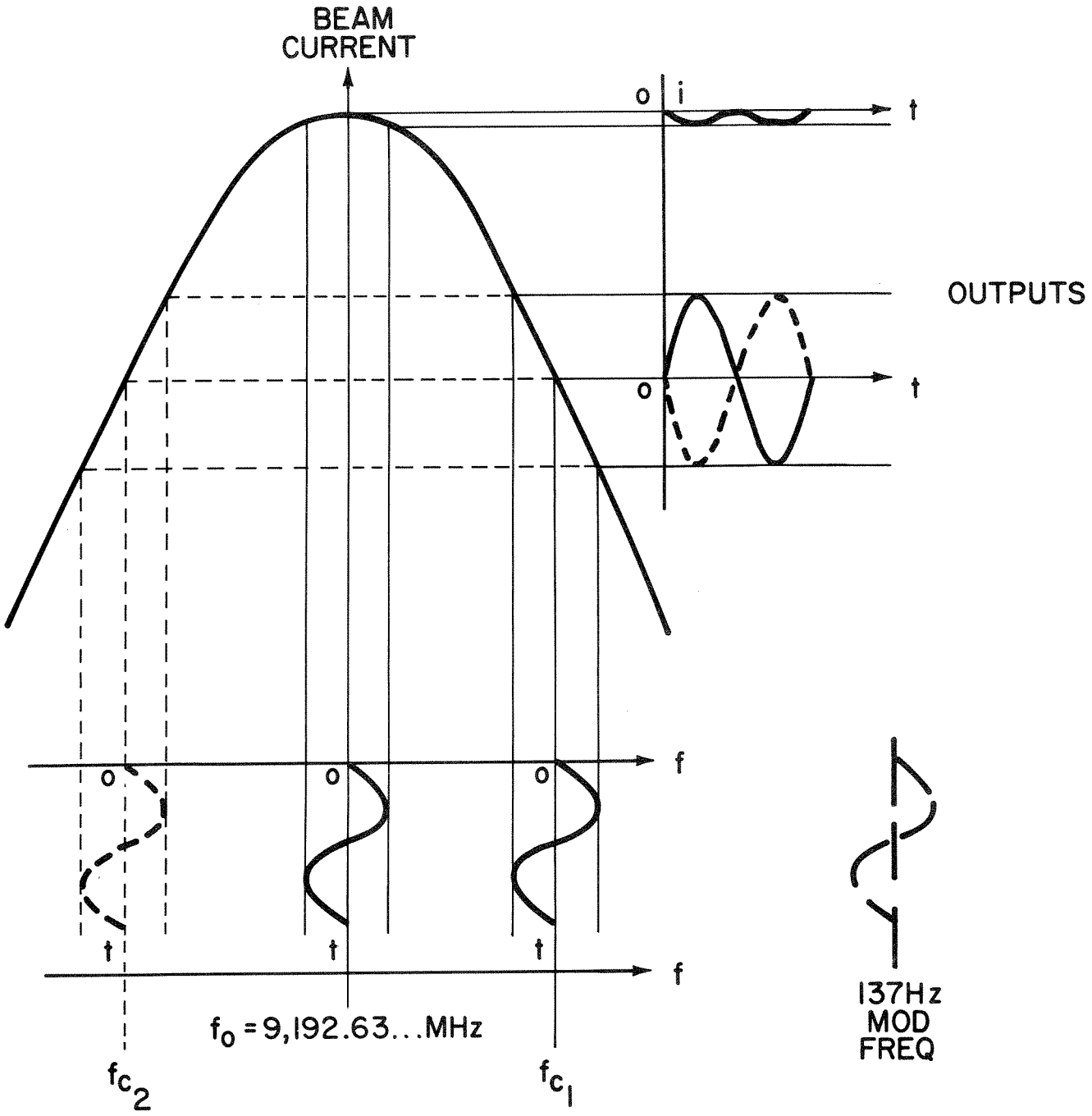


Figure 4-2. Discriminator Action of Cesium Beam Tube

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

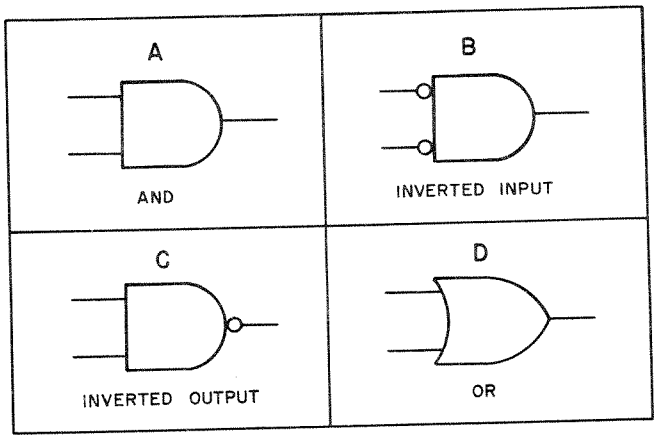
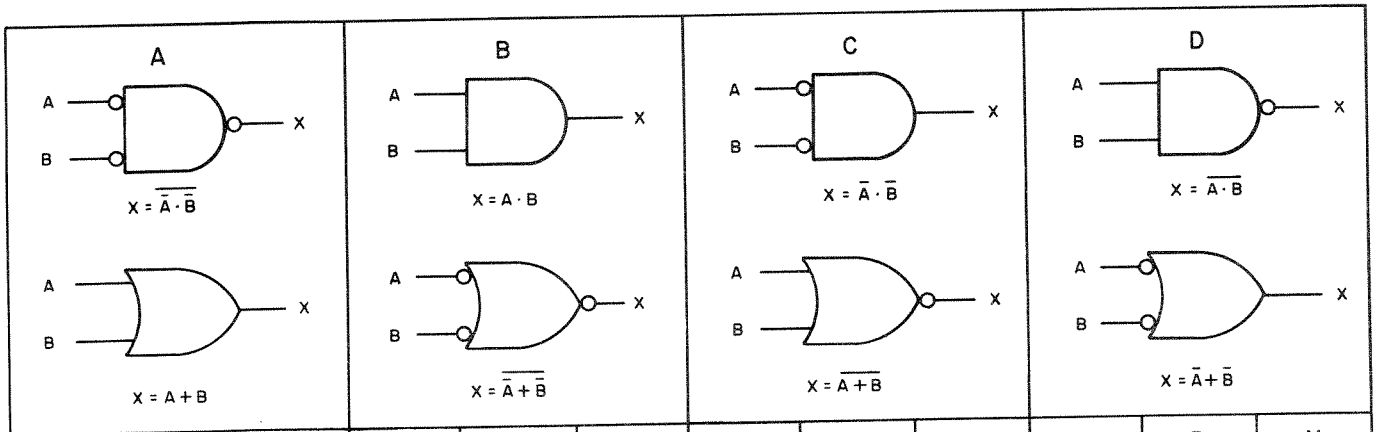


Figure 4-4. Logic Function Comparison



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

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 ($\cdot$) 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 plut 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 hould 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 transistion 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.

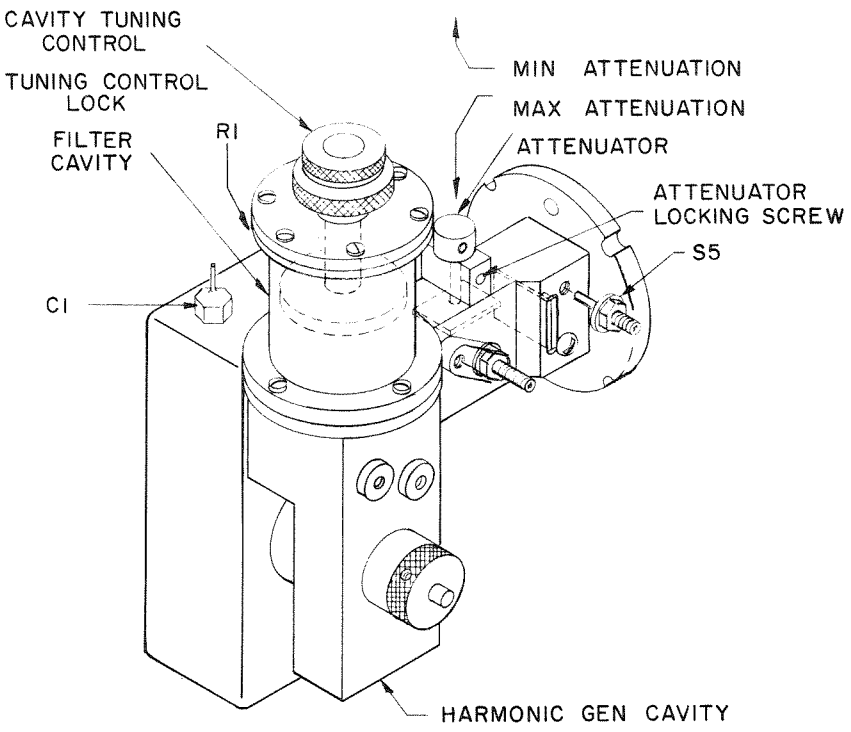


Figure 5-1. Harmonic Generator Assembly

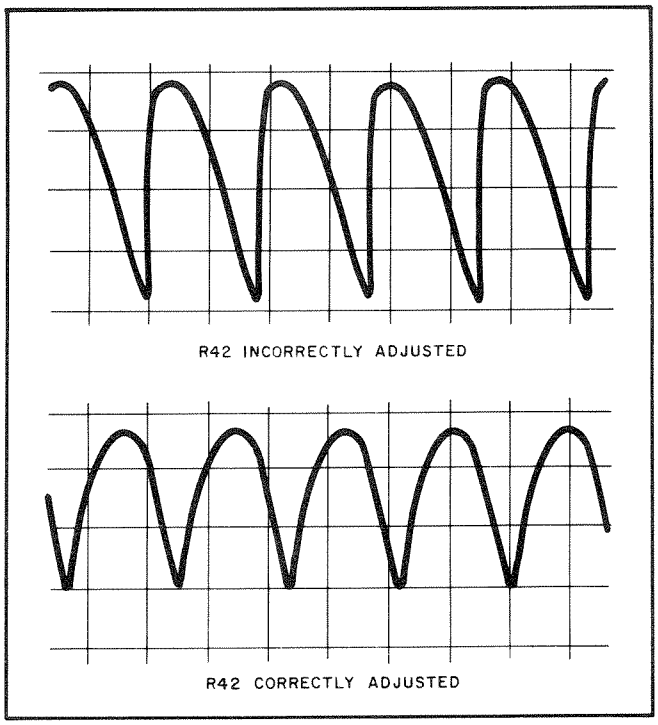


Figure 5-2. A8R42 Adjustment

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,

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

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 ± 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 X10^{-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 X10^{-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 X10^{-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
C1	C F .001 MF 75V		0160-0975
C2 C3	C F 4 MF 30V		0160-2048
	C F .005 MF 250V		0160-3043
C5	C F 1000 MF 50V		0180-0090
C6 C7	C F 47 MF 35V		0180-0097
	TRMINAL FEEDTHRU		0340-0038
	BUSH INSULATOR		0340-0039
	INSUL FEED THRU		0340-0119
	CAP WIRE TERMIN		0362-0187
	KNOB BAR .625D		0370-0104
	TAPE FOAM 1.25 W 18"		0460-0114
	FASTNER		0510-0182
	SHAFT LOCK NUT		0590-0035
R6	R F 12M 1% 1W		0730-0145
R4	R F 1K 2% .250W		0757-0924
R1	R F 6.2K 2%.250W		0757-0946
R9	R F 10K 2% .250W		0757-0948
R2	R F 15K 2% .250W		0757-0952
R5	R F 100K 2%.250W		0757-0972
	TUBING HS BLU 2 1/2"		0890-0878

REFD	DESCRIPTION	OPT	PART-NUMBE
M1	METER 50-0-50 UA		1120-1472
	DIAL TURNS COUNT		1140-0014
	TRANSISTOR INSUL		1200-0076
	CLAMP TRANSISTOR		1200-0087
	BUSHNG TRANSISTR		1200-0092
J5 J7,9,1	RECEPT BNC		1250-0102
J6 J8,10,11,12,14, 15,2	CONN RF		1250-0140
J19	CONN 5PIN MALE		1251-0111
J18	CONN 4PIN FEMALE		1251-0128
J20	CONN 3PIN MALE		1251-0146
	INSERT COAX PLUG		1251-0179
P17	CONN 5 PIN 2COAX		1251-0182
	RETAIN CONN		1251-0215
P16	CONNECTOR 9 PIN		1251-0216
	CONN HOOD		1251-0217
	LOCK POSTS		1251-0218
	CONN RET 15PIN		1251-0220
	CONNECTOR HOOD		1251-0222
	HOOD R&P CONN HX		1251-1977
J3 P4	CONN R&P HEX		1251-1978
P3 J4	CONN R&P HEX		1251-1979

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

REFD	DESCRIPTION	OPT	PART-NUMBER
	CONN RING R&P HX		1251-1981
F1 F2,3	FUSEHOLDER		1400-0084
	BUSHING POT EXT		1410-0052
DS2	LIGHT RED		1450-0113
DS1	LIGHT AMBER		1450-0114
	PIN DOWEL.125 D		1480-0017
	PIN ROLL		1480-0059
Q2	TRANSISTR 2N1701		1854-0020
CR1 CR2	DIODE SIL 30WV		1901-0040
R8	R V 5K 5% .75W		2100-1414
R3	R VAR 20K3%5TURN		2100-2425
	R VAR MTG BRACKT		2100-2427
R7	R VAR 250K 20%		2100-2429
F2	FUSE LAMP 115V		2110-0001
F3	FUSE 3A		2110-0003
F1	FUSE 230V 1 AMP		2110-0007
	LAMP INCD		2140-0025
	NUT HEX		2950-0040
S1	SWTCH 2SEC12POS		3100-0893
S2	SWTCH 3SEC 3POS		3100-0894
S3	SWITCH SLIDE		3101-0033
S6	SWITCH SLIDE		3101-0045
S7	SWITCH P-BUTTON		3101-0124
S5	SWITCH TOGGLE		3101-0163
S4	SWITCH TOGGLE		3101-1155
	PLATE IDENT		7120-1255
	PLATE SERIAL		7122-0082
	LABEL IDENT		7124-0960
L1	CHOKE FILTER50MH		9100-0337
L2	COIL FXD 5 UH		9100-0339
T1	TRANSFORMER		9100-2449
	CT 18.38X17X9.25		9211-1126
	CT 22.25X21X15.4		9211-1128
	BAG POLYETHYL		9220-0012
	PAD-TOP-BOTTOM		9220-1304
	POST POLY 6X6		9220-1347
	PLATE FLUTED AL		5000-0053
	SIDE COVER		5000-0747
	GUIDE BOARD PC		5040-4528
	FRAME AY 8X16 FM		5060-0736
	BUTT COVER ASSY		5060-0755
	HNDLE ASSY SIDE		5060-0763
	RTNR HNDLE ASSY		5060-0765
	FT AY-FULL MOD		5060-0767
	KIT-8H RACK MT		5060-0777
	APPLICATION-NOTE 52		5951-0052

REFD	DESCRIPTION	OPT	PART-NUMBER
W24	CABLE-AY TERM		05061-6058
W25	CBL AY-OPER AMP		05061-6059
	CBL AY-MAIN		05061-6060
W29	CBL AY-OSC		05061-6064
W30	CBL AY-BUFF SYNT		05061-6065
	CBL AY-PANEL		05061-6066
	CBL AY-PANEL		05061-6067
W32	CBL AY-DIG DIV		05061-6069
	KIT-ACCESSORY		05061-6070
	OPT 1 AY-CLOCK	01	05061-6074
	OPT 2 AY-BAT	02	05061-6075
	OPT 3 AY-CLK BAT	03	05061-6076

REFD	DESCRIPTION	OPT	PART-NUMBER
A17	BD AY-TERMINAL		05061-6018
A13	MOD AY-BUFF AMP		05061-6030
W1	CABLE-AY FRONT		05061-6035
W2	CBL-AY BUFF REAR		05061-6036
W3	CBL-AY SYNTH		05061-6037
W4	CABLE AY-MULT		05061-6038
W5	CABLE AY-OSC		05061-6039
W6	CABLE AY-OSC		05061-6040
W7	CBL-AY 2ND HAR		05061-6041
W8	CABLE AY-E TO LO		05061-6042
W9	CBL-AY PHASE DET		05061-6043
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
	INSUL FEED THRU		0340-0119
J1 J2,3	CONN BULKHEAD		1250-0258
S1	SWITCH THUMBWHEL		3100-2063
	LABEL MARKING		7124-0845
	CHASSIS-SYNTH		05061-0001
	COVER-SYNTH		05061-0002
	PLATE-END		05061-2003
	PLATE-END		05061-2005
	BD AY-SYNTH		05061-6002

REFD	DESCRIPTION	OPT	PART-NUMBER
CR28	C V VAR 39PF 30V		0122-0013
C21	C F 2000 PF 300V		0140-0180
C10	C F 68 PF 300V		0140-0192
C14 25,39,46	C F 200 PF 300V		0140-0220
C34	C F 300 PF 300V		0140-0225
C33	C F 500 PF 300V		0140-0234
C4 8,12,22,27,35, 38,40,41,42,43, 48	C F .01 MF 100V		0150-0093
C3 6,7,15,17,20	C F .1 MF 50V		0150-0121
 23,24,26,28,29, 30,31,32,44 C11	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
Q23 27	TRANSISTOR NPN S		1854-0023
Q18	TRANSISTOR NPN S		1854-0035
Q19, 21,22,26,	TRANSISTOR2N3563		1854-0092
Q20	TRANSISTOR NPN S		1854-0273
CR9, 19,26,30,38,39, 40,41,42,43,	DIODE SIL 30WV		1901-0040
CR29 32,34,35	DIODE SIL 75WV		1901-0050
CR36 CR37	DIODE SIL 35WIV		1901-0146
CR20	DIODE BRKDN 10V		1902-0025
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
L3	COIL F RF		9140-0187
L5	COIL:F .22UH		9140-0190
L1	COIL CHOKE 200UH		9140-0237
	BD-BLANK		05061-2002
T1	XFMER BLK OSC		05061-8001
T2	XFMER BLK OSC		05061-8002
T3	XFMER SAMPLER-DR		05061-8003
T4	XFMER MHZ OUTPUT		05061-8004

REFD	DESCRIPTION	OPT	PART-NUMBER
R83	R F 2.21M1%.125W		0698-3126
R85	R F 4.75M2%.125W		0698-3127
R81 R88	R F 1M 1% .125W		0698-3129
R72 R73	R F 2.7M 1%.125W		0698-3130
R2	R:F 390 OHM5% 2W		0698-3633
R57	R F 500K 1%.125W		0721-0011
R78	R F 392K 1%.125W		0757-0479
R44 96,98	R F 56 OHM2%.25W		0757-0894
R1 75,93	R F 100 OHM2%.2W		0757-0900
R61 R97	R F 200 OHM2%.2W		0757-0907
R95*	R F 240 OHM2%.2W		0757-0909
R53 60,62,65,56	R F 470 OHM2%.2W		0757-0916
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
R8 17,31,32,46,48	R F 1.5K 2%.250W		0757-0928
R19 20,30,34,49,63, 67,74,76,77,91, 94,101	R F 2K 2% .250W		0757-0931
R7 9,12,14,15,26, 41,68	R F 3K 2% .250W		0757-0935
R10 18,22,23,36,37	R F 3.9K 2%.250W		0757-0938
R59	R F 4.7K 2%.250W		0757-0940
R27	R F 5.1K 2%.250W		0757-0941
R92	R F 5.6K 2%.250W		0757-0942
R84*	R F 6.2K 2%.250W		0757-0943
R64	R F 6.8K 2%.250W		0757-0944
R29 43,51,55,58,66, 86	R F 10K 2% .250W		0757-0948
R89	R F 12K 2% .250W		0757-0950
R82*	R F 20K 2% .250W		0757-0955
R80	R F 33K 2% .250W		0757-0960
R54* 71,99	R F 39K 2% .250W		0757-0962
R52	R F 62K 2% .250W		0757-0967
R11 24,34,69,79	R F 100K 2%.250W		0757-0972
	CRYSTAL SOC HC6U		1200-0758
IC2	INTEGRATED CIRC		1820-0079
IC1 3,6,9	INTEGRATED CIRC		1820-0080
IC5	INTEGRATED CIRC		1820-0081
IC8 11	INTEGRATED CIRC		1820-0315
IC4 7,10	INTEGRATED CIRC		1820-0329
Q24 25	TRANSISTOR NPN S		1854-0003
Q17	TRANSISTOR 2N708		1854-0009
Q1 Q2 THRU 16	TRANSISTOR 2N709		1854-0009

REFD	DESCRIPTION OPT (Option 02 = 05021-6075)	PART-NUMBER
	C F 500 MF 75V	0180-0047
	R F 10K 2% .250W	0757-0948
	TRANSISTOR INSUL	1200-0076
	CLAMP TRANSISTOR	1200-0087
	BUSHNG TRANSISTR	1200-0092
	BATTERY 24V2.3A	1420-0053
	LIGHT RED	1450-0113
	TRANSISTR 2N1701	1854-0020
	FUSE 3A RADIAL	2110-0274
	LAMP INCD	2140-0025
	SWITCH P-BUTTON	3101-0124
	BRACKET-CAP	05061-0014
	PANEL-LEFT	05061-0021
	BRACKET-BATT	05061-0026
	GASKET-BATT	05061-0027
	BD AY-BATT CHARG	05061-6019

REFD	DESCRIPTION OPT (Option 03 = 05061-6076)	PART-NUMBER
	C F 500 MF 75V	0180-0047
	R F 10K 2% .250W	0757-0948
	CLOCK 24 HR	1010-0021
	RING THRD CLOCK	1010-0022
	BEZEL AND WINDOW	1010-0023
	TRANSISTOR INSUL	1200-0076
	CLAMP TRANSISTOR	1200-0087
	BUSHNG TRANSISTR	1200-0092
	RECEPT BNC	1250-0102
	BALL -STUD RECVR	1390-0143
	BALL STUD FASTNR	1390-0144
	BATTERY 24V2.3A	1420-0053
	LIGHT RED	1450-0113
	TRANSISTR 2N1701	1854-0020
	FUSE 3A RADIAL	2110-0274
	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

REFD	DESCRIPTION OPT (Option 03 = 05061-6076)	PART-NUMBER
	BRACKET-BATT	05061-0026
	GASKET-BATT	05061-0027
	KNOB-CLOCK	05061-2011
	PLATE-CENTER	05061-2022
	PLATE-LEFT	05061-2023
	MOD AY-DIG DIV	05061-6011
	BD AY-BATT CHARG	05061-6019
	COVER-AY TOP	05061-6034
	CBL AY-FREQ DIV	05061-6061
	CBL AY-DIG DIV	05061-6062
	CBL AY-DIG DIV	05061-6068
	CBL AY-CLOCK	05061-6071

REFD	DESCRIPTION OPT (Battery Charger Board = 05061-6019)	PART-NUMBER
C10	C F 500 PF 300V	0140-0234
C1 C8	C F .01 MF 100V	0150-0093
C6	C F .1 MF 50V	0150-0121
C2 C3,9,15	C F 1 MF 25V	0160-0127
C4 C13,14	C F 60 MF 6V	0180-0106
C5 C7	C F 100 MF 30V	0180-0113
C11	C F 6.8 MF 35V	0180-0116
C12	C F 2.7 MF 35V	0180-0117
	TERMINAL SOLDR	0360-0065
	TERMINAL .04 D	0360-0124
	RELAY DPDT 28V2A	0490-0475
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

REFD	DESCRIPTION	OPT	PART-NUMBER
R1 R5,11,18,20,24, 26,30,32,33,39 48	R F 1K 2% .250W		0757-0924
R4	R F 1.5K 2%.250W		0757-0928
R14* 15,19*,29,34,36, 44,46,50,52	R F 2K 2% .250W		0757-0931
R23 R61	R F 2.4K 2%.250W		0757-0933
R3 R8,10,27,31,38, 58	R F 3.9K 2%.250W		0757-0938
R62	R F 5.1K 2%.250W		0757-0941
R63	R F 5.6K 2%.250W		0757-0942
R35 37,41,43,49,55, 57	R F 10K 2% .250W		0757-0948
R7 40,54,56,60	R F 15K 2% .250W		0757-0952
*R13,	R F 20K 2% .250W		0757-0955
R12	R F 39K 2% .250W		0757-0962
R17	R F 1.6K 5% .5W		0758-0063
C4 C6	INTEGRATED CIRC		1820-0080
C7	INTEGRATED CIRC		1820-0086
C8 ,10,11	INTEGRATED CIRC		1820-0094
C1	INTEGRATED CIRC		1820-0315
C2 ,5	INTEGRATED CIRC		1820-0329
Q	TRANSISTOR PNP S		1853-0001
Q19 20,26,25	TRANSISTOR NPN S		1854-0003
Q1 3,4,5,6,12,9,15, 16,17,18,22,24	TRANSISTOR 2N708		1854-0005
Q7 10,11,14	TRANSISTOR2N3053		1854-0039
Q2 21,23,13	TRANSISTOR2N2646		1855-0010
SCR1 SCR2	SWTH SILI CONTRO		1884-0003
CR1 CR2 THRU 4 CR6 THRU 9	DIODE SIL 600PIV		1901-0029
CR18 29,30,31,32	DIODE SIL 30WV		1901-0040
CR5 CR11,13	DIODE BRKDN5.11V		1902-0041
CR19	DIODE BRKDN5.62V		1902-3104
CR17	DIODE BRKDN14.7V		1902-3203
CR10	DIODE BRKDN17.8V		1902-3224
CR12	DIODE BRKDN31.6V		1902-3290
CR14, 15,16,20,21,22, 23,25,26,27,28, 24,	DIODE GERM 60WIV		1910-0016
R15	R V 50 OHM 10%		2100-1769
	BD-BLANK		05061-2019

A5 DIGITAL CLOCK MODULE (05061-6011)

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

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

(05061-6014)

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

REFD	DESCRIPTION	OPT	PART-NUMBER
C2	C F 56 PF 300V		0140-0191
C1 C3	C F 150 PF 300V		0140-0196
	TERMINAL SOLDR		0360-0065
R42 R50,54	R F 510 OHM2%.2W		0757-0917
R39 R44,45,47,48,49, R51,52,53,55,56, R58,61,62	R F 1K 2% .250W		0757-0924
R3 R4,9,10,15,16, R21,22,27,28,33, R34	R F 1.5K 2%.250W		0757-0928
R1 R2,6,7,8,12,13, R4,18,19,20,24, R5,26,30,31,32, R5,36,37,38,40, R1,60	R F 2K 2% .250W		0757-0931
R5 R1,17,23,29	R F 3K 2% .250W		0757-0935
R59	R F 3.9K 2%.250W		0757-0938
R43 R6,57	R F 10K 2% .250W		0757-0948
C9 C10,11,17	INTEGRATED CIRC		1820-0080
C12	INTEGRATED CIRC		1820-0086
C1 C2	INTEGRATED CIRC		1820-0094
C13 C15,16	INTEGRATED CIRC		1820-0315
C3 C4,5,6,7,8	INTEGRATED CIRC		1820-0329
Q14	TRANSISTOR NPN S		1854-0003
Q1 Q2 THRU Q13,15	TRANSISTOR 2N709		1854-0009
CR17 CR18	DIODE SIL 30WV		1901-0040
CR19, THRU CR26,	DIODE GERM 60WIV		1910-0016
S14, S1A, S1B,C,D,F,	SWITCH THUMBWHEL		3100-2061
	BD-BLANK		05061-2013
	CONNECTOR-6 PIN		05061-2024

A5A4 SWITCH BOARD ASSY (05061-6033)

REFD	DESCRIPTION	OPT	PART-NUMBER
C2,	C VAR 70-350PF		0131-0006
*C1,	C F 100 PF 300V		0140-0176
	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

A5A5 INTERCONNECT BOARD ASSY (05061-6012)

REFD	DESCRIPTION	OPT	PART-NUMBER
	BD-BLANK		05061-2012
	CONNECTOR-12 PIN		05061-2025

REFD	DESCRIPTION	OPT	PART-NUMBER
	INSUL FEED THRU		0340-0119
J1 J2 THRU 7	CONN BULKHEAD		1250-0258
	SCREW 4-40X.250		2230-0024
	CABLE 1 COND 23"		8120-0106
	BRAID MONEL RF 13"		8160-0035
FL2 FL3	FLTR FEEDTHRU		00106-6059
	SHIELD DIVIDER		05060-0012
FL1	FLTR A FEED THRU		05060-6061
	COVER-BOTTOM		05061-0003
	COVER-TOP		05061-0004
	PLATE-END		05061-2028
	PLATE-END		05061-2029
	BD AY-FREQ DIV		05061-6004

REFD	DESCRIPTION	OPT	PART-NUMBER
C22	C VAR 9-35 PF		0121-0046
C20	C F 1300 PF 500V		0140-0154
C25	C F 3000 PF 300V		0140-0159
C36 C46	C F 5600 PF 300V		0140-0170
C11	C F 100 PF 300V		0140-0176
C5	C F 560 PF 300V		0140-0178
C13 C23	C F 1000 PF 300V		0140-0179
C27 C31	C F 2000 PF 300V		0140-0180
C51 C52	C F 8200 PF 100V		0140-0184
C21	C F 47 PF 500 V		0140-0204
C12	C F 680 PF 300V		0140-0208
C40	C F 200 PF 300V		0140-0220
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

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

REFD	DESCRIPTION	OPT	PART-NUMBER
R17	R F 27K 2% .250W		0757-0958
R13	R F 43K 2% .250W		0757-0963
R49	R F 51K 2% .250W		0757-0965
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
T6	TRANSF RF 100KC		107A-9C
.12	COIL ASSY 5.5MH		107A-9F
	BD-BLANK		05061-2004
T2 T4	TRANS-1MHZ-4MHZ		05061-8005

REFD	DESCRIPTION	OPT	PART-NUMBER
T1	TRANS-5MHZ IN		05061-8006
T3	TRANS-1MHZ OUT		05061-8007
T5	XFER-9MHZ MULTI		05061-8008

REFD	DESCRIPTION	OPT	PART-NUMBER
	INSUL FEED THRU		0340-0119
J1 J2 THRU 6	CONN BULKHEAD		1250-0258
R17	R:VAR 10K 20%		2100-2428
	TIP-INPUT		00105-2010
	CHASSIS-AC-AMP		05061-0005
	COVER-AC-AMP		05061-0006
	PLATE-END		05061-2001
	PLATE-END		05061-2007
	SHAFT		05061-2039
	BD AY- AC AMP		05061-6006

REFD	DESCRIPTION	OPT	PART-NUMBE
C2	C F 300 PF 300V		0140-0225
C16	C F .0047 MF500V		0150-0086
C5	C F .01 MF 100V		0150-0093
C6	C F 1 MF 25V		0160-0127
C12	C F 2.2 MF 25V		0160-0128
C1	C F .0082 MF200V		0160-0160
C7 C10	C FXD .033 UF		0160-0180
C18	C F .01 MF 50V		0170-0082
C8	C F .068 MF 50V		0170-0084
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
4	R F 3.3M 1%.125W		0698-3131
25 28	R F 16.9K1%.125W		0698-4308
27	R F 8.665K1%.12W		0698-5469
3	R F 10M 1% 1W		0730-0168
49	R F 47.5K1%.125W		0757-0457
40	R F 56 OHM2%.25W		0757-0894
34	R F 68 OHM2%.25W		0757-0896
52	R F 100 OHM2%.2W		0757-0900
41 44	R F 200 OHM2%.2W		0757-0907
1 45	R F 1K 2% .250W		0757-0924
19	R F 1.6K 2%.250W		0757-0929
39 36,35	R F 2K 2% .250W		0757-0931
43	R F 3K 2% .250W		0757-0935
29 37,38	R F 4.7K 2%.250W		0757-0940
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
R15	R F 30K 2% .250W		0757-0959
R7	R F 39K 2% .250W		0757-0962
R2 R6	R F 56K 2% .250W		0757-0966
R22	R F 82K 2% .250W		0757-0970
R12 R13	R F 100K 2%.250W		0757-0972
R23	R F 150K 2%.250W		0757-0976
Q2 Q3,7,8,9,10,11, 12,13,14	TRANSISTOR NPN S		1854-0003
Q1 Q5,6	TRANSISTOR NPN S		1854-0023
Q4A Q4B	TRANSISTOR DUAL		1855-0049
CR1 CR2,5	DIODE SIL 180WV		1901-0033
CR3	DIODE BRKDN 6.8V		1902-0245
CR4	DIODE BRKDN 11V		1902-0246
R18	R V 500 OHM 10%		2100-1772
	BD-BLANK		05061-2006

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

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

A8	05061-6007	ASSY:PHASE DETECTOR
	05060-6011	ASSY.- PHASE DETECTOR P.C. BOARD
	05060-2015	BOARD BLANK P.C.
A8C1	0170-0091	C:FXD POLY 0.01213UF 2% 50VDCW
A8C2	0180-0117	C:FXD ELECT TA 2.7UF 10% 35VDCW
A8C3	0170-0090	C:FXD POLY 0.0252UF 1% 50VDCW
A8C4	0180-0116	C:FXD ELECT TA 6.8 UF 10% 35VDCW
A8C5	0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW
A8C6	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW
A8C7	0140-0176	C:FXD MICA 100 PF 2% 300 VDCW
A8C8	0140-0225	C:FXD MICA 300PF 1% 300VDCW
A8C9	0180-0113	C:FXD ELECT TA 100UF +20-15% 30VDCW
A8C10	0180-0113	C:FXD ELECT TA 100UF +20-15% 30VDCW
A8C11	0140-0176	C:FXD MICA 100 PF 2% 300 VDCW
A8C12	0140-0175	C:FXD MICA 39 PF 2% 300 VDCW
A8C13	0150-0093	C:FXD CER 0.01UF +80-20% 100VDCW
A8C14	0140-0175	C:FXD MICA 39 PF 2% 300 VDCW
A8C15	0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW
A8C16	0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW

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
A8R7	0757-0450	R:FXD MET FLM 22.1K OHM 1% 1/8W	
A8R8	0757-0894	R:FXD MET FLM 56 OHM 2% 1/8W	
A8R9	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
A8R10	2100-0806	R:VAR WW 5K OHM 5%	
A8R11	0757-0945	R:FXD MET FLM 7.5K OHM 2% 1/8W	
A8R12	0757-0972	R:FXD MET FLM 100K OHM 2% 1/8W	
A8R13	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
A8R14	0757-0972	R:FXD MET FLM 100K OHM 2% 1/8W	
A8R15	0757-0914	R:FXD MET FLM 395 OHM 2% 1/8W	
A8R16	0757-0957	R:FXD MET FLM 24K OHM 2% 1/8W	
A8R17	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
A8R18	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
A8R19	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
A8R20	0757-0907	R:FXD MET FLM 200 OHM 2% 1/8W	
A8R21	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
A8R22	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
A8R23	0757-0273	R:FXD MET FLM 3.01K OHM 1% 1/8W	
A8R24	0757-0964	R:FXD MET FLM 47K OHM 2% 1/8W	
A8R25	0757-0958	R:FXD MET FLM 27K OHM 2% 1/8W	
A8R26	0757-0914	R:FXD MET FLM 395 OHM 2% 1/8W	
A8R27	0757-0958	R:FXD MET FLM 27K OHM 2% 1/8W	
A8R28	0757-0964	R:FXD MET FLM 47K OHM 2% 1/8W	
A8R29	0757-0273	R:FXD MET FLM 3.01K OHM 1% 1/2W	
A8R30	0757-0427	R:FXD MET FLM 1.50K OHM 1% 1/8W	
A8R31	0757-0427	R:FXD MET FLM 1.50K OHM 1% 1/8W	
A8R32	0757-0427	R:FXD MET FLM 1.50K OHM 1% 1/8W	
A8R33	0757-0427	R:FXD MET FLM 1.50K OHM 1% 1/8W	
A8R34	0757-0952	R:FXD MET FLM 15K OHM 2% 1/8W	
A8R35	0757-0952	R:FXD MET FLM 15K OHM 2% 1/8W	
A8R36	0757-0965	R:FXD MET FLM 51K OHM 2% 1/8W	
A8R37	0757-0976	R:FXD MET FLM 150K OHM 2% 1/8W	
A8R38	0727-0013	R:FXD DEPC 24.3 OHM 1% 1/2W	
A8R39	2100-1437	R:VAR WW 20K OHM 5% 1W	
A8R40	0757-0952	R:FXD MET FLM 15K OHM 2% 1/8W	
A8R41	0757-0964	R:FXD MET FLM 47K OHM 2% 1/8W	
A8R42	2100-1437	R:VAR WW 20K OHM 5% 1W	
A8R43	0757-0964	R:FXD MET FLM 47K OHM 2% 1/8W	
A8R44	0757-0952	R:FXD MET FLM 15K OHM 2% 1/8W	
A8R45	0757-0955	R:FXD MET FLM 20K OHM 2% 1/8W	
A8R46	0757-0964	R:FXD MET FLM 47K OHM 2% 1/8W	
A8R47	0727-0013	R:FXD DEPC 24.3 OHM 1% 1/2W	
A8R48	0757-0965	R:FXD MET FLM 51K OHM 2% 1/8W	
A8R49	0727-0002	R:FXD DEPC 3.0 OHM 1% 1/2W	
A8R50	0757-0965	R:FXD MET FLM 51K OHM 2% 1/8W	
A8R51	0757-0935	R:FXD MET FLM 3.0K OHM 2% 1/8W	
A8R52	0757-0935	R:FXD MET FLM 3.0K OHM 2% 1/8W	
A8R53	0757-0972	R:FXD MET FLM 100K OHM 2% 1/8W	
A8R54	0757-0972	R:FXD MET FLM 100K OHM 2% 1/8W	
A8T1	9100-0340	TRANSFORMER	
	A8 MISC.		
	8160-0035	BRAID:WIRE SHIELDING MONEL 3/32 OD	
	0340-0039	INSULATOR:BUSHING	
	8120-0229	CABLE:COAXIAL 50 OHM RG-188A/U	
	5020-0176	INSULATOR FOR SNAP-ON PINS	
	0340-0037	TERMINAL:STUDS	

Reference Designation	℗ Stock No.	Description	Note
A9	05061-6008	ASSY: OPERATIONAL AMPLIFIER	
	05060-6076	ASSY: OPERATIONAL AMPLIFIER P.C. BD	
	05060-2056	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		N.S.R. PART OF CHOPPER ASSY G1	
A9DS2		N.S.R. PART OF CHOPPER ASSY G1	
A9G1	1990-0028	CHOPPER:PHOTOELECTRIC	
A9J1	1250-0258	JACK:COAXIAL 50-OHM SUB-MINAT CHASSIS	
A9J2	1251-0216	CONNECTOR:MALE 9-CONTACT TYPE D	
A9L1	9140-0082	COIL:RF FXD 15 UH	
A9L2	9140-0040	COIL:FXD RF 42 UH	
A9Q1	1854-0023	TRANSISTOR:SILICON NPN	
A9Q2	1854-0003	TRANSISTOR:NPN SILICON	
A9Q3	1854-0003	TRANSISTOR:NPN SILICON	
A9Q4	1853-0010	TRANSISTOR:SILICON PNP	
A9Q5	1854-0023	TRANSISTOR:SILICON NPN	
A9Q6	1854-0023	TRANSISTOR:SILICON NPN	
A9Q7	1854-0023	TRANSISTOR:SILICON NPN	
A9Q8	1854-0023	TRANSISTOR:SILICON NPN	
A9Q9	1854-0023	TRANSISTOR:SILICON NPN	
A9Q10	1853-0010	TRANSISTOR:SILICON PNP	
A9Q11	1853-0010	TRANSISTOR:SILICON PNP	
A9Q12	1854-0003	TRANSISTOR:NPN SILICON	
A9Q13	1854-0003	TRANSISTOR:NPN SILICON	
A9Q14	1853-0001	TRANSISTOR:PNP SILICON 30V 900MW	
A9R1		N.S.R. PART OF CHOPPER ASSY G1	
A9R2		N.S.R. PART OF CHOPPER ASSY G1	
A9R3	0757-0475	R:FXD MET FLM 274K OHM 1% 1/8W	
A9R4	0757-0918	R:FXD MET FLM 560 OHM 2% 1/8W	
A9R5	0757-0914	R:FXD MET FLM 393 OHM 2% 1/8W	
A9R6	0698-3124	R:FXD DEPC 1.30 MEGOHM 1% 1/8W	
A9R7	0757-0968	R:FXD MET FLM 68K OHM 2% 1/8W	
A9R8	0698-3125	R:FXD DEPC 1.50 MEGOHM 1% 1/8W	
A9R9	0757-0922	R:FXD MET FLM 820 OHM 2% 1/8W	
A9R10	0698-3116	R:FXD DEPC 562K OHM 1% 1/8W	
A9R11	0757-0926	R:FXD MET FLM 1.2K OHM 2% 1/8W	
A9R12	0757-0481	R:FXD MET FLM 475K OHM 1% 1/8W	
A9R13	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/8W	
A9R14	0757-0910	R:FXD MET FLM 270 OHM 2% 1/8W	
A9R15	0757-0471	R:FXD MET FLM 182K OHM 1% 1/8W	
A9R16	0757-0930	R:FXD MET FLM 1.8K OHM 2% 1/8W	
A9R17	0757-0946	R:FXD MET FLM 8.2K OHM 2% 1/8W	
A9R18	0757-0948	R:FXD MET FLM 10K OHM 2% 1/8W	
A9R19	0757-0898	R:FXD MET FLM 82 OHM 2% 1/8W	
A9R20	0757-0904	R:FXD MET FLM 150 OHM 2% 1/8W	
A9R21	0757-0972	R:FXD MET FLM 100K OHM 2% 1/8W	
A9R22	0757-0479	R:FXD MET FLM 392K OHM 1% 1/8W	
A9R23	0757-0946	R:FXD MET FLM 8.2K OHM 2% 1/8W	
A9R24	0757-0482	R:FXD MET FLM 511K OHM 1% 1/8W	
A9R25	0757-0972	R:FXD MET FLM 100K OHM 2% 1/8W	
A9R26	0757-0481	R:FXD MET FLM 475K OHM 1% 1/8W	
A9R27	0757-0948	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 RECEPT 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	

REFD	DESCRIPTION	OPT	PART-NUMBER
	TERMINAL SOLDR L		0360-0353
	ELAPS TIME INDIC		1010-0005
J1	CONN 25 PIN PLUG		1251-0063
	RET CONN SUBMIN		1251-1042
	CHASSIS-CESIUM O		05061-0009
	COVER-CESIUM O		05061-0010
	PLATE-END		05061-2001
	PLATE-END		05061-2003
	BD AY-CS OVEN CT		05061-6010

REFD	DESCRIPTION	OPT	PART-NUMBER
C6 C7,21,22	C F .05 MF 100V		0150-0096
C2 C18	C F 2.2 MF 25V		0160-0128
C19	C F .022 MF 200V		0160-0162
C8	C F .22 MF 400V		0160-0845
C16	C F .22 MF 50V		0170-0086
C9	C F 3.9 MF 35V		0180-0022
C1 C3,14,15	C F 47 MF 35V		0180-0097
C4 C11	C F 60 MF 6V		0180-0106
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 OHM1%.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 OHM2%.2W		0757-0900
R11	R F 160 OHM2%.2W		0757-0905
R15	R F 180 OHM2%.2W		0757-0906

REFD	DESCRIPTION	OPT	PART-NUMBER
R16	R F 200 OHM2%.2W		0757-0907
R12	R F 330 OHM2%.2W		0757-0912
R7	R F 1.8K 2%.250W		0757-0930
R20	R F 2.2K 2%.250W		0757-0932
R32	R F 3.9K 2%.250W		0757-0938
R8	R F 4.7K 2%.250W		0757-0940
R5	R F 5.6K 2%.250W		0757-0942
R6	R F 6.2K 2%.250W		0757-0943
R4	R F 6.8K 2%.250W		0757-0944
R17	R F 8.2K 2%.250W		0757-0946
R22 R23	R F 10K 2% .250W		0757-0948
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
Q1 Q4	TRANSISTOR NPN S		1854-0003
Q2, Q5,6	TRANSISTR 2N1701		1854-0020
CR8 CR9,10,11	DIODE SIL 800PIV		1901-0030
CR2 CR3,12	DIODE SIL 180WV		1901-0033
CR4 CR5,6,7	DIODE SIL		1901-0039

REFD	DESCRIPTION	OPT	PART-NUMBER
CR1	DIODE SIL 30WV		1901-0040
CR13	DIODE BRKDN 10V		1902-0025
R27	R:VAR 10K 10%.5W		2100-1761
T2	TRANSFORMER		9100-0333
T1	TRANSFORMER		9100-0335
T3	TRANSFORMER		9100-0336
T4	TRANSFORMER AUTO		9100-2234
	DISC INSULATING		05060-0051
L1	COIL A 27UH FLTR		05060-6034
L2	COIL A 350UH FLT		05060-6073
	BD BLANK		05061-2010

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

REFD	DESCRIPTION	OPT	PART-NUMBER
C9	C F .01 MF 100V		0150-0093
C19	C F .1 MF 50V		0150-0121
C3 C22,23	C F 1 MF 25V		0160-0127
C14 C15	C FXD .033 UF		0160-0180
C5 C12	C F .068 MF 50V		0170-0084
C10 C11,18,20	C F 4.7 MF 35V		0180-0100
C6 C7,8	C F 60 MF 6V		0180-0106
C2 C4,13	C F 100 MF 30V		0180-0113
C1 C17,21	C F 2.7 MF 35V		0180-0117
C16	C F 1 MF 35V		0180-0291
R32	R F 1M 1% .125W		0698-3129
R10	R F 38.3 OHM 1%		0698-3435
R18 R19	R F 16.9K1%.125W		0698-4308
R22	R F 8.665K1%.12W		0698-5469
R2 R14,15,42	R F 100 OHM2%.2W		0757-0900
R35, R37	R F 470 OHM2%.2W		0757-0916
R24 R29,30,63	R F 2K 2% .250W		0757-0931
R54	R F 2.4K 2%.250W		0757-0933
R25	R F 3K 2% .250W		0757-0935
R36	R F 3.3K 2%.250W		0757-0936
R55 R56,58,64,66	R F 5.1K 2%.250W		0757-0941
R8 R11,13,17,23,34, 1,45,52,59,65, 8,69,70,40	R F 10K 2% .250W		0757-0948
R28	R F 11K 2% .250W		0757-0949
R16	R F 12K 2% .250W		0757-0950
R33 R38	R F 13K 2% .250W		0757-0951
R4 R67	R F 15K 2% .250W		0757-0952
R39 R46,53	R F 20K 2% .250W		0757-0955
R21 R26,44,61,62,31	R F 33K 2% .250W		0757-0960
R57 R43	R F 43K 2% .250W		0757-0963
R6 R9,20,51	R F 51K 2% .250W		0757-0965
R3 R5,47,49,60	R F 100K 2%.250W		0757-0972
R7 R48	R F 150K 2%.250W		0757-0976
Q7	TRANSISTOR 2N941		1853-0022
Q1 Q2,3,4,5,6,18, 20,21,22,23,24 14,15	TRANSISTOR NPN S		1854-0003
Q12 Q13,16,17,19	TRANSISTOR 2N708		1854-0005
Q8 Q23,9,10	TRANSISTOR NPN S		1854-0023
SCR1	SWTN SILI CONTRO		1884-0003
CR2	DIODE SIL 180WV		1901-0033
CR3 CR4,5,6,14,15,16 17,18,19,20	DIODE SIL 30WV		1901-0040
CR12 CR7	DIODE BRKDN5.76V		1902-0034
CR13	DIODE BRKDN5.11V		1902-0041
CR10 CR11	DIODE BRKDN11.5V		1902-0067
CR1 CR9,8	DIODE BRKDN7.15V		1902-0074
R27	R V 1K 10% .5W		2100-1773
R12	R V 2K 10% .5W		2100-1774
R1	R V 5K 10% .5W		2100-1775
	BD-BLANK		05061-2016

REFD	DESCRIPTION	OPT	PART-NUMBER
C13,	C F .1 MF 50V		0150-0121
C2	C F .022 MF 200V		0160-0162
C8	C F .47 MF 25V		0160-0174
C10	C F .1 MF 200V		0170-0019
C1	C F 1 MF 200V		0170-0072
C5 C7,9,11,12	C F 47 MF 35V		0180-0097
C3 C4	C F 2.7 MF 35V		0180-0117
C6	C F 22 MF 35V		0180-0160
	TERMINAL SOLDR		0360-0065
	TERMINAL .04 D		0360-0124
R30*	R F 2M 1% .25W		0698-4345
R16 R36	R F 20 OHM 1%.5W		0727-0012
*R31,	R:F 265K 1%.50W		0727-0229
R32 R33	R F 221K 1%.125W		0757-0473
R22	R F 475K 1%.125W		0757-0481
R24 R28,10	R F 51 OHM2%.25W		0757-0893
R18	R F 56 OHM2%.25W		0757-0894
R26	R F 300 OHM2%.2W		0757-0911
R8	R F 510 OHM2%.2W		0757-0917
R14 R11	R F 1.3K 2%.250W		0757-0927
R4 R6,34	R F 1.5K 2%.250W		0757-0928
R15 R27,13	R F 2.2K 2%.250W		0757-0932
R35	R F 3.3K 2%.250W		0757-0936
R7	R F 3.9K 2%.250W		0757-0938
R21 R29	R F 4.7K 2%.250W		0757-0940
R5 R3	R F 5.1K 2%.250W		0757-0941
R1 R2,23,25	R F 10K 2% .250W		0757-0948
R20	R F 33K 2% .250W		0757-0960
R19	R F 100K 2%.250W		0757-0972
R9	R F 400 OHM 5%3W		0767-0001
R17	R F 660 OHM1% 1W		0811-0931
R10	R F .33 OHM 5%3W		0812-0019
Q12 Q18,19,21,9	TRANSISTOR PNP S		1853-0001
Q5 Q3,7	TRANSISTOR2N3778		1853-0024
Q13 Q14,15,20,10,11, 6,8,1,2,16	TRANSISTOR NPN S		1854-0003
Q17 Q4	TRANSISTR 2N1701		1854-0020
CR1 CR2,3,4,6,8	DIODE SIL IN4998		1901-0200
CR10	DIODE BRKDN 9V		1902-0071
CR9 A,B	DIODE BRKDWN PR		1902-0676
CR5	DIODE BRKDN19.6V		1902-3234
CR7	DIODE BRKDN21.5V		1902-3245
	COIL FXD 5 UH		9100-0335
	INSULATOR RECEPT		5020-0176
	BD-BLANK		05061-2017

EFD	DESCRIPTION	OPT	PART-NUMBER
	TERMINAL SOLDR		0360-0065
	TERMINAL .04 D		0360-0124
	TERMINAL SOLDR		0360-1467
2*	R F 33.2K1%.125W		0757-0454
7*	R F 332K 1%.125W		0757-0477
10*	R F 475K 1%.125W		0757-0481
11*	R F 681K 1%.125W		0757-0485
1* 8*	R F 1K 2% .250W		0757-0924
3* 5*	R F 22K 2% .250W		0757-0956
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

REFD	DESCRIPTION	OPT	PART-NUMBER
	ADPTR MICON MALE		1250-0813
	CONN 5 PIN FEM		1251-0126
	SCREWDRIVER CERA		8710-0033
	WRENCH 4-SPLINE		8710-0055
	SCREWDRIVER		8730-0007
	BD ASSY-22 PIN		5060-7202
	CABLE ASSY TEST		05060-6116
	LABEL-ACC KIT		05061-0036
	BD-AY-EXTENDER		05061-6073

SYMBOLS

FRONT PANEL

REAR PANEL

KNOB CONTROL

SCREWDRIVER ADJUST

MAIN SIGNAL PATH

FEEDBACK PATH

CONDUCTING ELEMENT

CW — WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE

POWER LINE GROUND

CIRCUIT COMMON GROUND

8 — TEST POINT

"AND" GATE

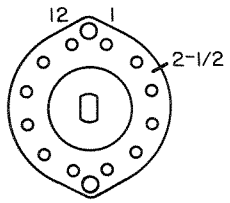
INHIBIT GATE

"OR" GATE

WAVEFORMS SHOWN ARE TYPICAL

SWITCH DESIGNATIONS

A3S1BR(2-1/2)



A3S1 — SWITCH S1 WITHIN ASSEMBLY A3

B — 2ND WAFER FROM FRONT (A=1ST, ETC)

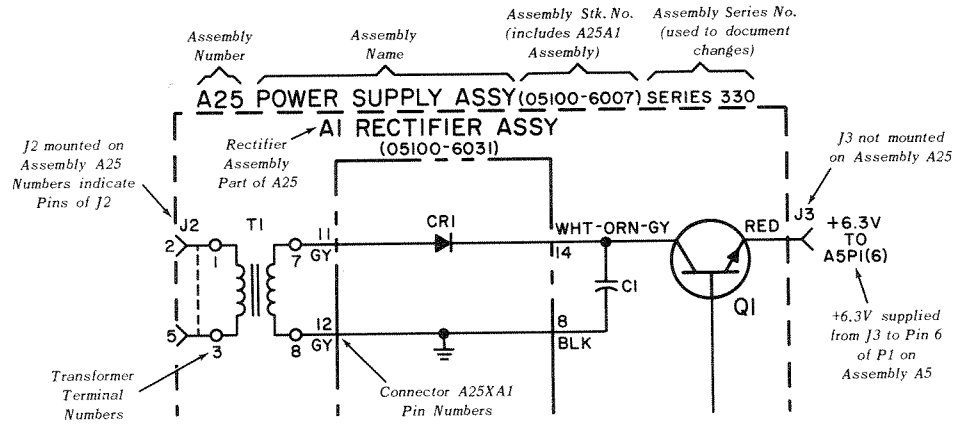
R — REAR OF WAFER (F=FRONT)

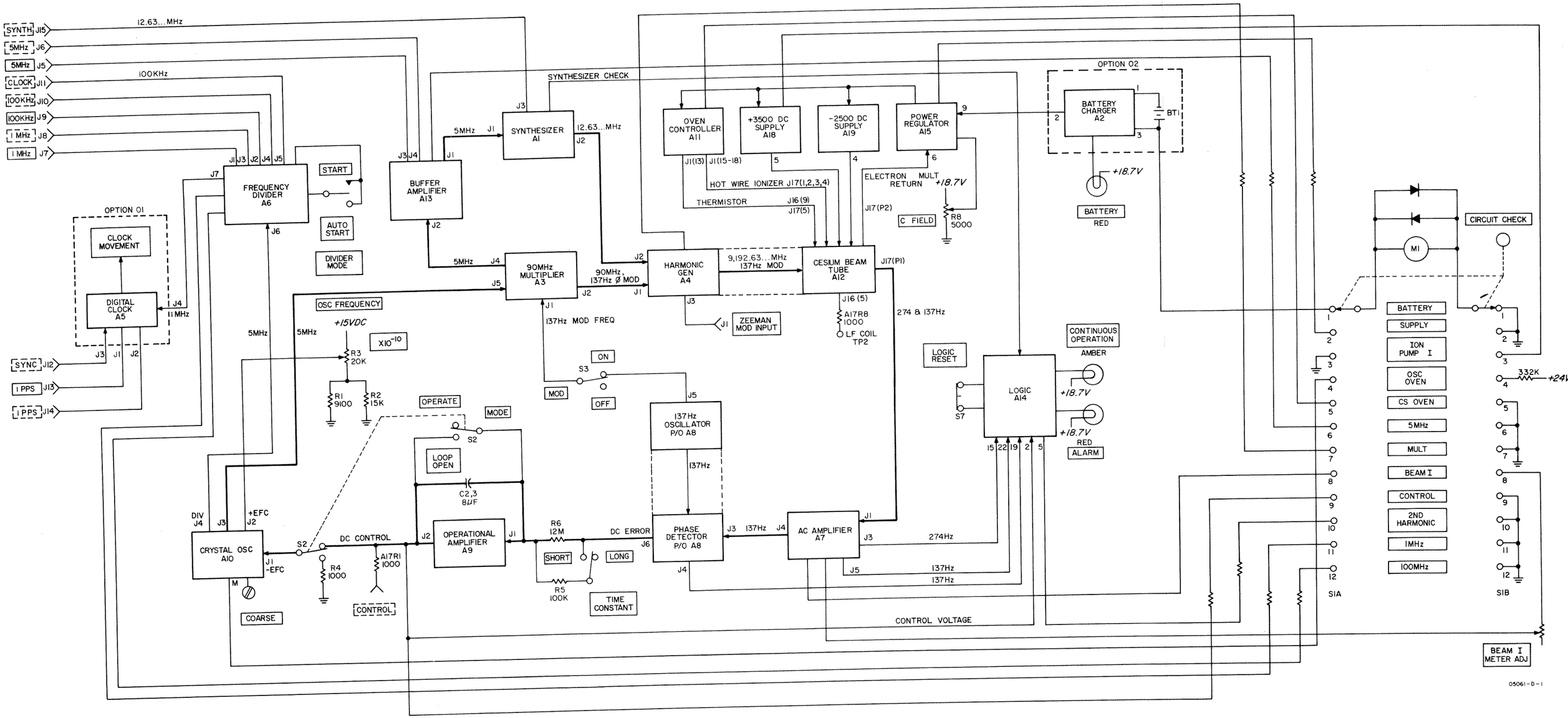
(2-1/2) — TERMINAL LOCATION ($2\frac{1}{2}$) (VIEWED FROM FRONT)

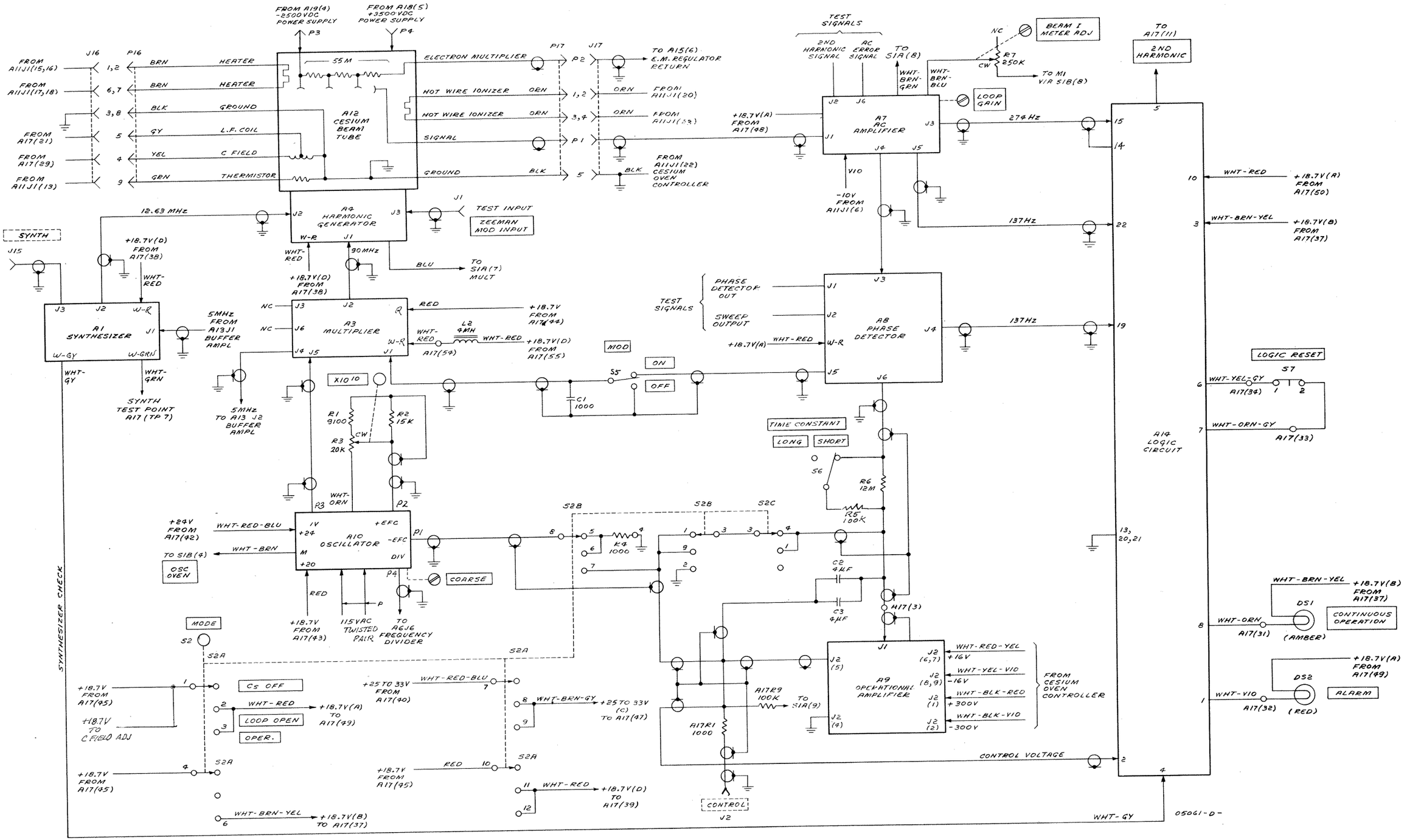
REFERENCE DESIGNATIONS

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

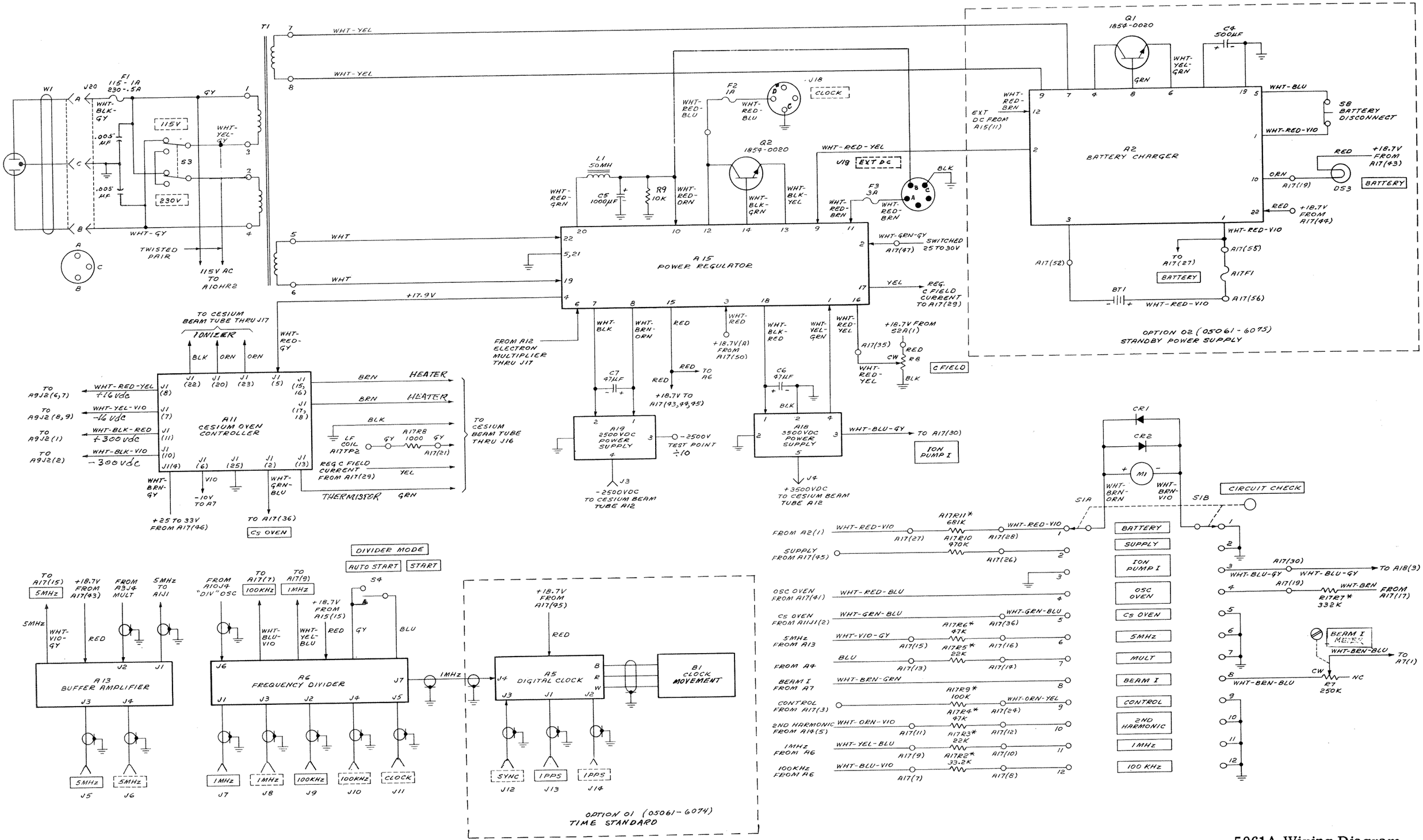
ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
*A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3




SYNTH J15
5MHz J6
5MHz J5
CLOCK J11
100KHz J10
100KHz J9
1 MHz J8
1 MHz J7
12.63...MHz
100KHz
SYNTHESIZER CHECK
FREQUENCY DIVIDER A6
START
AUTO START
DIVIDER MODE
BUFFER AMPLIFIER A13
SYNTHESIZER A1
OVEN CONTROLLER A11
+3500 DC SUPPLY A18
-2500 DC SUPPLY A19
POWER REGULATOR A15
OPTION 02
BATTERY CHARGER A2
BT1
+18.7V
BATTERY
RED
OPTION 01
CLOCK MOVEMENT
DIGITAL CLOCK A5
1 MHz
SYNC J12
1 PPS J13
1 PPS J14
THERMISTOR
HOT WIRE IONIZER J17(1,2,3,4)
ELECTRON MULT RETURN
C FIELD
R8 5000
90MHz MULTIPLIER A3
HARMONIC GEN A4
9,192,63...MHz 137Hz MOD
CESIUM BEAM TUBE A12
J17(P1)
274 & 137Hz
ZEEMAN MOD INPUT
A17R8 1000
LF COIL TP2
CIRCUIT CHECK
MI
BATTERY
SUPPLY
ION PUMP I
OSC OVEN
CS OVEN
5MHz
MULT
BEAM I
CONTROL
2ND HARMONIC
1MHz
100MHz
332K
+24VDC
SIA
SIB
OSC FREQUENCY
+15VDC
X10
R3 20K
R1 9100
R2 15K
137Hz MOD FREQ
ON
S3
MOD
OFF
137Hz OSCILLATOR P/O A8
LOGIC RESET
S7
LOGIC A14
CONTINUOUS OPERATION
AMBER
ALARM
RED
OPERATE
MODE
S2
LOOP OPEN
C2,3 8μF
DIV J4
+EFC
CRYSTAL OSC A10
-EFC
COARSE
DC CONTROL
R4 1000
A17R1 1000
CONTROL
OPERATIONAL AMPLIFIER A9
R6 12M
SHORT
LONG
R5 100K
TIME CONSTANT
DC ERROR
PHASE DETECTOR P/O A8
137Hz
AC AMPLIFIER A7
274Hz
CONTROL VOLTAGE
BEAM I METER ADJ
05061-D-1



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)

+18.7V(D) FROM A17(3B)

WHT-RED

+18.7V

+5.6V

R2 390

CR1 5.6V

C1 1.0μF

IC 5 1820-0081 NOR GATE

TP1 DIVIDER TEST

Z TRIGGER TO BLOCKING OSCILLATOR

R101 2000

R18 3900

R22 3900

R37 3900

Q8 1854-0009 AMPLIFIER

Q11 1854-0009 AMPLIFIER

R16 1000

R25 1000

R40 1000

CR8 6.8V

R15 3000

Q6 1854-0009 AMPLIFIER

R27 5100

CR20 10.0V

R43 10K

CR25 14.7V

IC 1 1820-0080 DRIVER

IC 3 1820-0080 INVERTOR/GATE

IC 6 1820-0080 INVERTOR/GATE

IC 9 1820-0080 INVERTOR/GATE

R7 3000

R8 1500

R9 3000

C2 1.0μF

CR2 5.6V

CR7 9.1V

R14 3000

R17 1500

R10 3900

C5 6.8 μF

R12 3000

Q4 1854-0009 AMPLIFIER

CR14 13.3V

R30 2000

R31 1500

R32 1500

R23 3900

C9 6.8 μF

R26 3000

Q9 1854-0009 AMPLIFIER

R44 56

R46 1500

R48 1500

R36 3900

C13 6.8μF

R41 3000

Q12 1854-0009 AMPLIFIER

R3 1000

IC 2 10¹ DECADE 1820-0079

IC 4 10² DECADE 1820-0329

IC 7 10³ DECADE 1820-0329

IC 10 10⁴ DECADE 1820-0329

C3 0.1μF

R19 2000

C6 0.1μF

C7 0.1μF

C11 1.0μF

Q1 1854-0009

Q2 1854-0009

5MHz INPUT FROM BUFFER AMPL. A13J1

J1

R1 100

CR3 CR4 CR5 CR6

CR10 CR11 CR12 CR13

CR15 CR16 CR17 CR18

CR21 CR22 CR23 CR24

R21 1000

A1S1A THUMBWHEEL SWITCH (NOTE 4)

A1S1B THUMBWHEEL SWITCH (NOTE 4)

A1S1C THUMBWHEEL SWITCH (NOTE 4)

A1S1D THUMBWHEEL SWITCH (NOTE 4)

R49 2000

R4 1000

5MHz INPUT GATE

R5 1000

R6 1000

Q3 1854-0009 RESET-PRESET CONTROL

Q7 1854-0009 RESET AMPLIFIER

R20 2000

R34 2000

R13 1000

R11 100K

CR9

Q5 1854-0009 PRESET DRIVER

C4 .01μF

Q10 1854-0009 PRESET DRIVER

C8 .01μF

R24 100K

CR19

R28 1000

R33 1000

R42 1000

R39 100K

CR26

Q15 1854-0009 PRESET DRIVER

C12 .01μF

R29 10K

C10 68

IC 8 1820-0315 ONE SHOT

R102 1000

R35 1000

Q13 1854-0009

R38 1000

R45 1000

R47 1000

Q14 1854-0009

Q16 1854-0009

R50 1000

IC 11 1820-0315 ONE SHOT

C14 * 200

R51 10K

05061-0-

A1 Synthesizer Assembly (Sheet 1 of 2)

PART OF A1 SYNTHESIZER ASSEMBLY (05061-6001) (NOTE 1)

PART OF A1A1 SYNTHESIZER P.C. BOARD ASSEMBLY (05061-6002)

SAMPLER

+18.7V
R77 2000
R78 392K
C37 1.0µF
CR43
R88 1M
SYNTHESIZER TEST TO A17(TP7)
WHT-GRN
C39 200
C31 1.0µF
R72 2.7M
C32 1.0µF
R73 2.7M
CR34
CR36
CR37
T2
CR30
T1
C22 .01µF
Q20 1854-0273
CR32
CR35
R65 470
C26 1.0µF
C28 1.0µF
R62 470
+18.7V
R52 62K
C20 0.1µF
R57 500K
C16 0.47µF
R54 39K
R53 470
R56 470
C18 1.0µF
C19 1.0µF
CR29
Z FROM IC5(6)
Q17 1854-
CR27
R55 10K
Q18 1854-0035
TRIGGER BLOCKING OSCILLATOR
L7 1.0
C36 600
Q23 1854-0023
R79 100K
DC AMPLIFIER
C41 .01µF
R83 2.21M
R85 9.75M
Q24 1854-0003
R89 12K
C47 2.2µF
CR41
CR42
CR40
C49 8.0µF
Q25 1854-0003
R90 1000
C45 60µF
R92 5600
Q27 1854-0023 EMITTER FOLLOWER
R100 1000
R99 39K
WHT-GY
SYNTHESIZER CHECK OUTPUT TO LOGIC CIRCUIT A17(4)
R81 1M
PHASE LOCK SENSOR

OSCILLATOR BIAS

+18.7V(D)
L1 200
C15 0.1µF
C17 0.1µF
+18.7V DEC
+18.7V DEC
CR31 13.3V
R59 4700
R60 470
Y1
CR28
Q19 1854-0092
C24 1.0µF
C21 2000
R63 2000
C27 .01µF
C25 200
R61 200
L6 1000
L2* 1.2
L4* 1.2
L3 .15
L5 .22
WHT-BLK
A1S2
HI
LO
BLK (NOTE 4)
R58 10K
+18.7V
R64 6800
C23 1.0µF
CR33 7.5V
+18.7V DEC
R67 2000
C29 1.0µF
Q21 1854-0092
R66 10K
R68 3000
R70 1000
Q22 1854-0092
R75 100
R76 2000
C35 .01µF
SAMPLER DRIVE
R69 100K
+18.7V
R71* 39K
R71B 24K
+18.7V DEC
R74 2000
C30 1.0µF
C33 500
C34 300
T3
C38 .01µF
CR38
CR39
C40 .01µF
R82* 30K
R84* 6200
C43 .01µF
+18.7V DEC
R80 33K
+18.7V DEC
R91 2000
C94 1.0µF
C96 200
T4
R97 200
R95* 240
R96 56
R98 56
J3
J2
TO J15 SYNTH
12.63 MHz TO HARMONIC GENERATOR A9J2
R87 1000
Q26 1854-0092 12.63 MHz OUTPUT AMPLIFIER
R93 100
R94 2000
C98 .01µF
R86 10K
12.63 MHz VOLTAGE CONTROLED OSC

NOTES

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

REFERENCE DESIGNATIONS

A1	A1A1	A1A2
J1-3 S2	C1-49 CR1-43 IC1-11 L1-7 Q1-27 R1-102 T1-4 TP1 Y1 S1	

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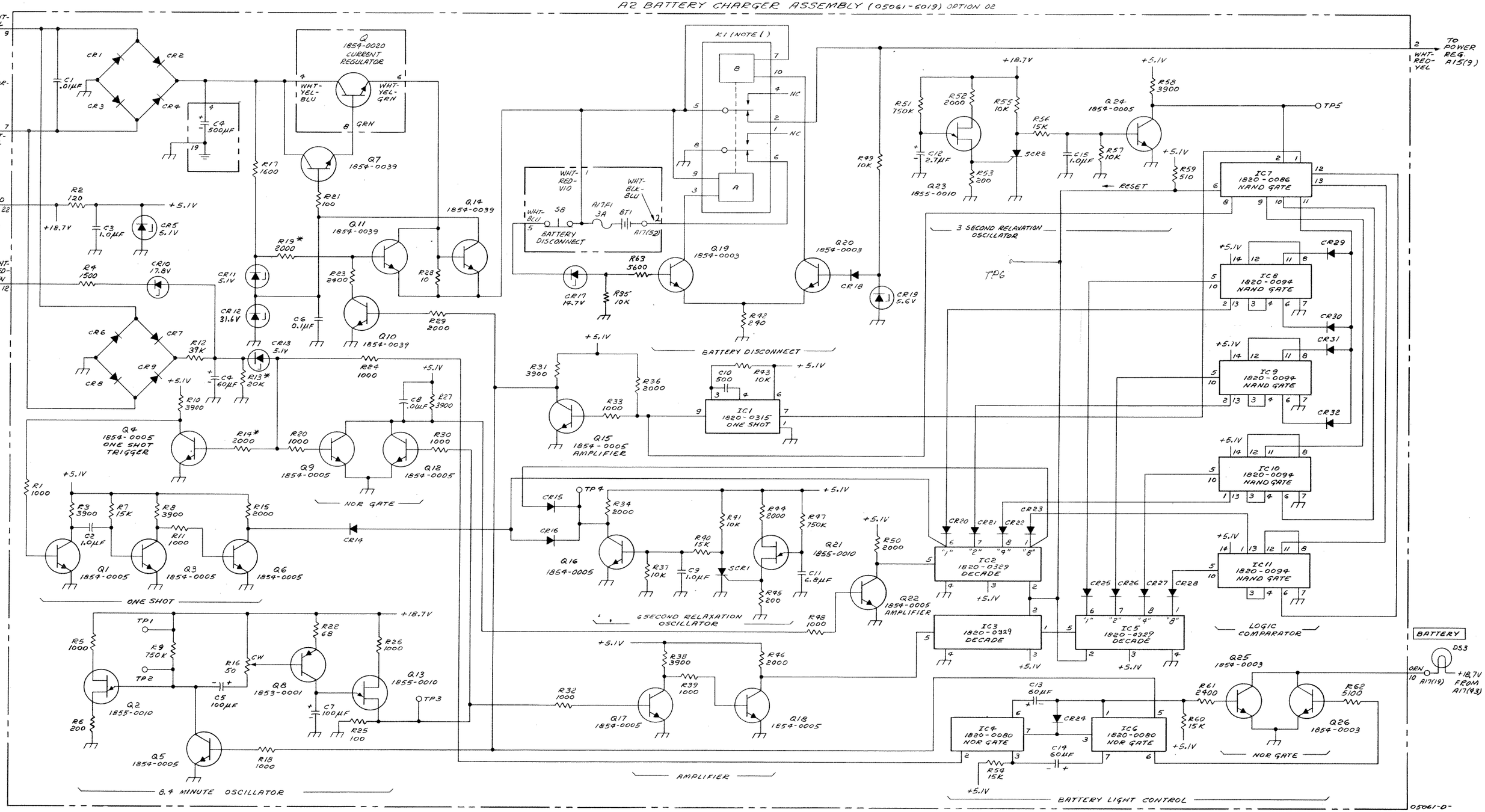
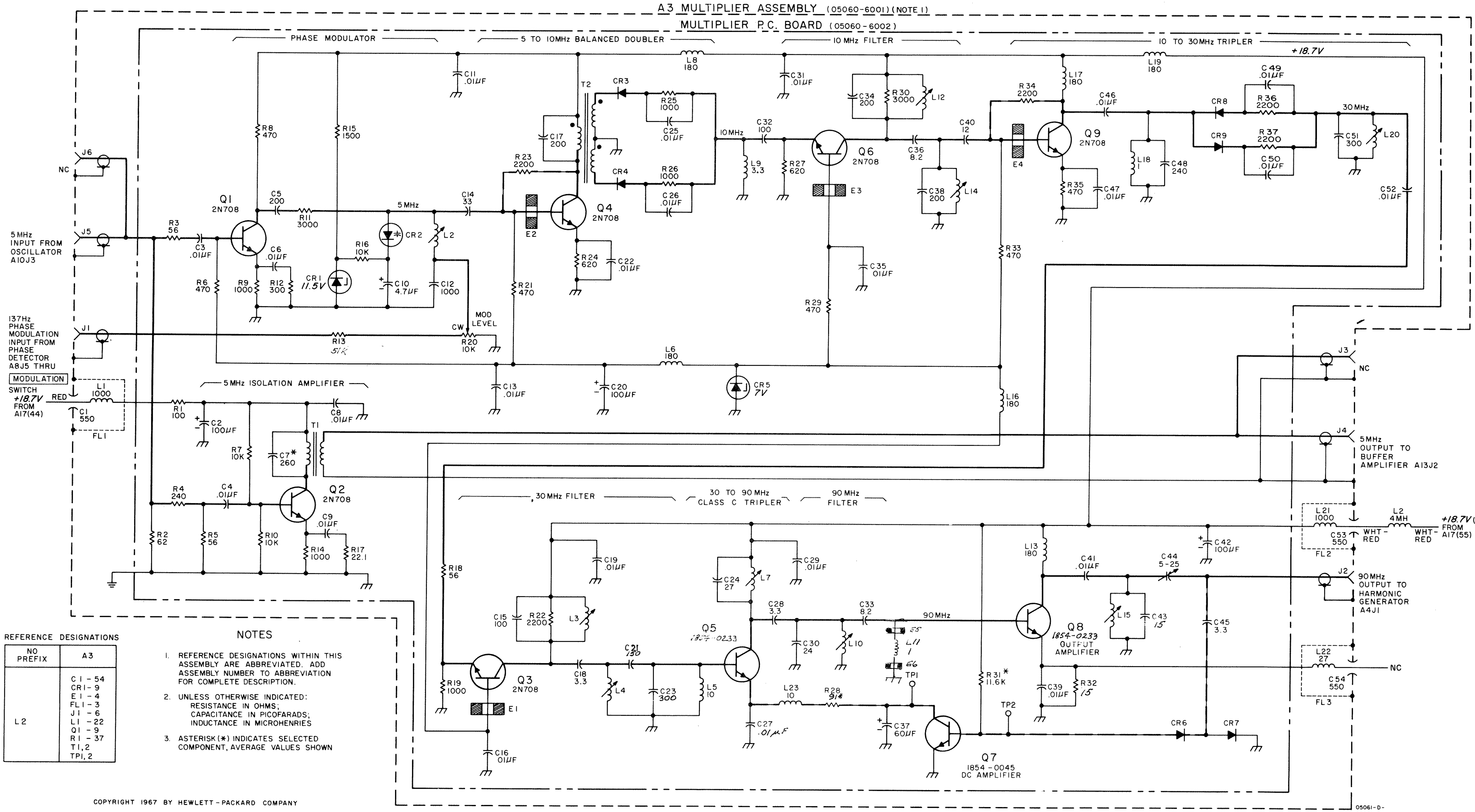
A2 BATTERY CHARGER ASSEMBLY (05061-6019) OPTION 02



NOTE! — PROTECTIVE RELAY K1 OPENS IF BATTERY VOLTAGE DECREASES BELOW 42.1 VDC



REFERENCE DESIGNATIONS

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

NOTES

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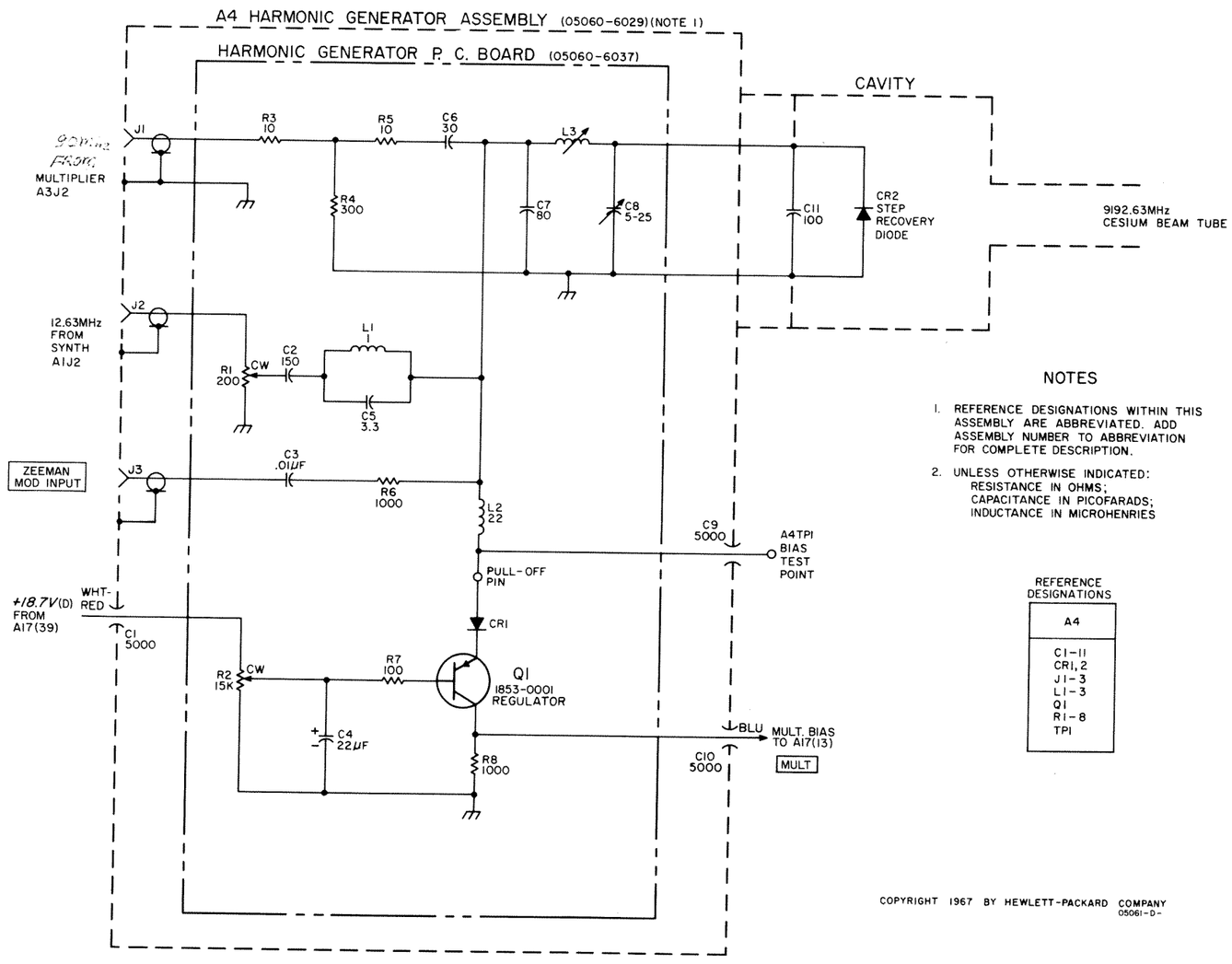
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN



NOTES

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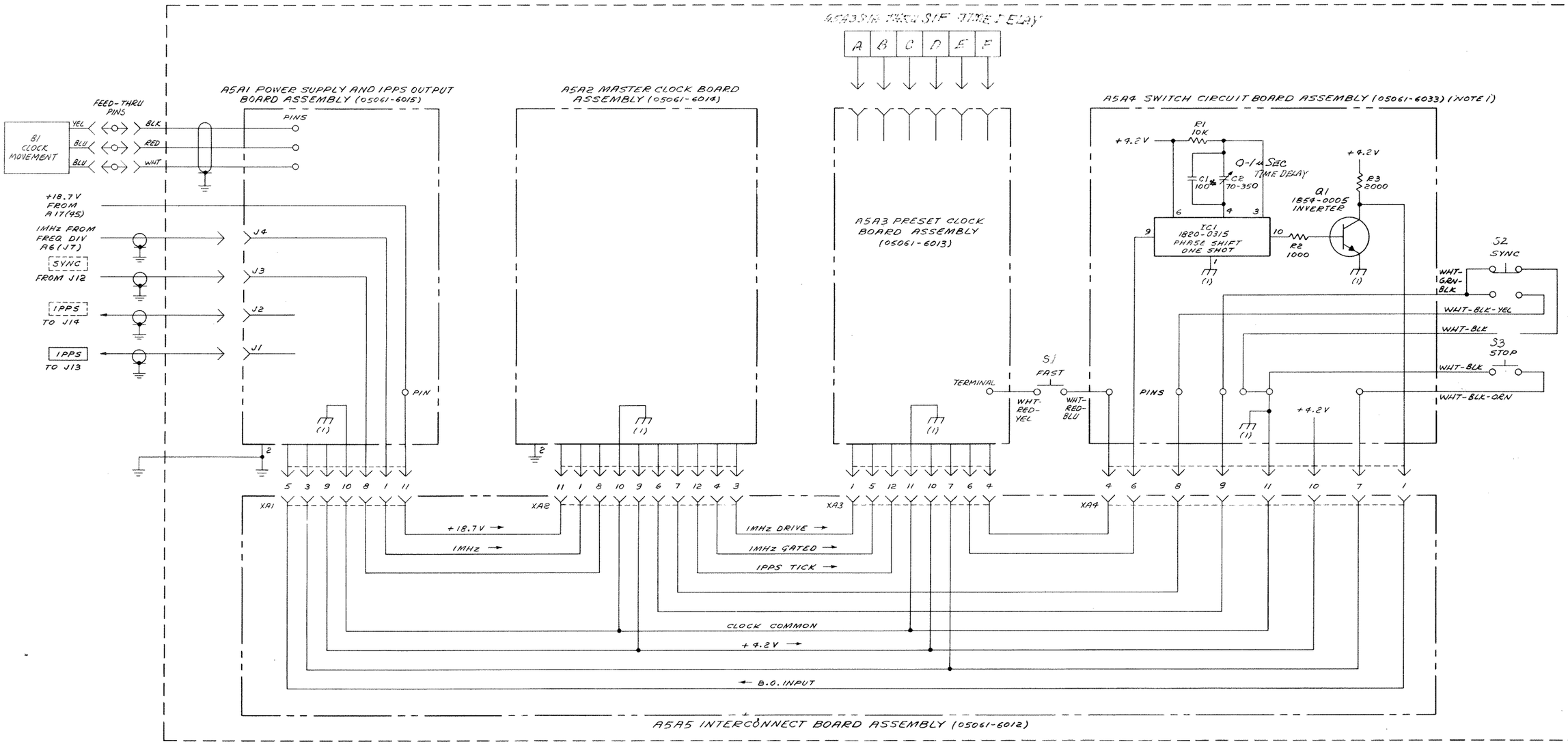
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES

REFERENCE DESIGNATIONS
A4
C1-11 CR1, 2 J1-3 L1-3 Q1 R1-8 TP1



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;

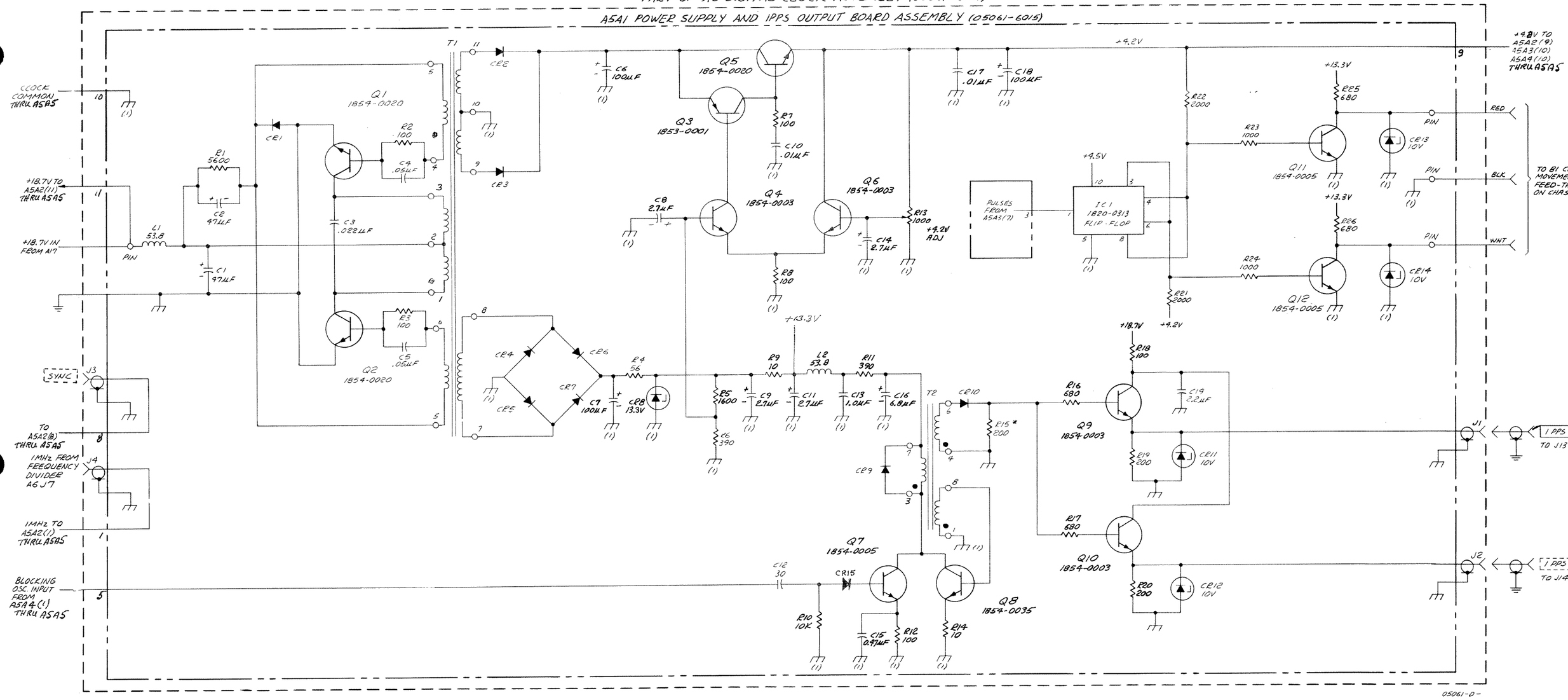
REFERENCE DESIGNATIONS

A5A4
C1,2 IC1 Q1 R1-3

A5 Digital Clock
A5A4 Switch Circuit
(Sheet 1 of 4) (Option 01)

PART OF A5 DIGITAL CLOCK ASSEMBLY (05061-6011)

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



NOTES

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2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

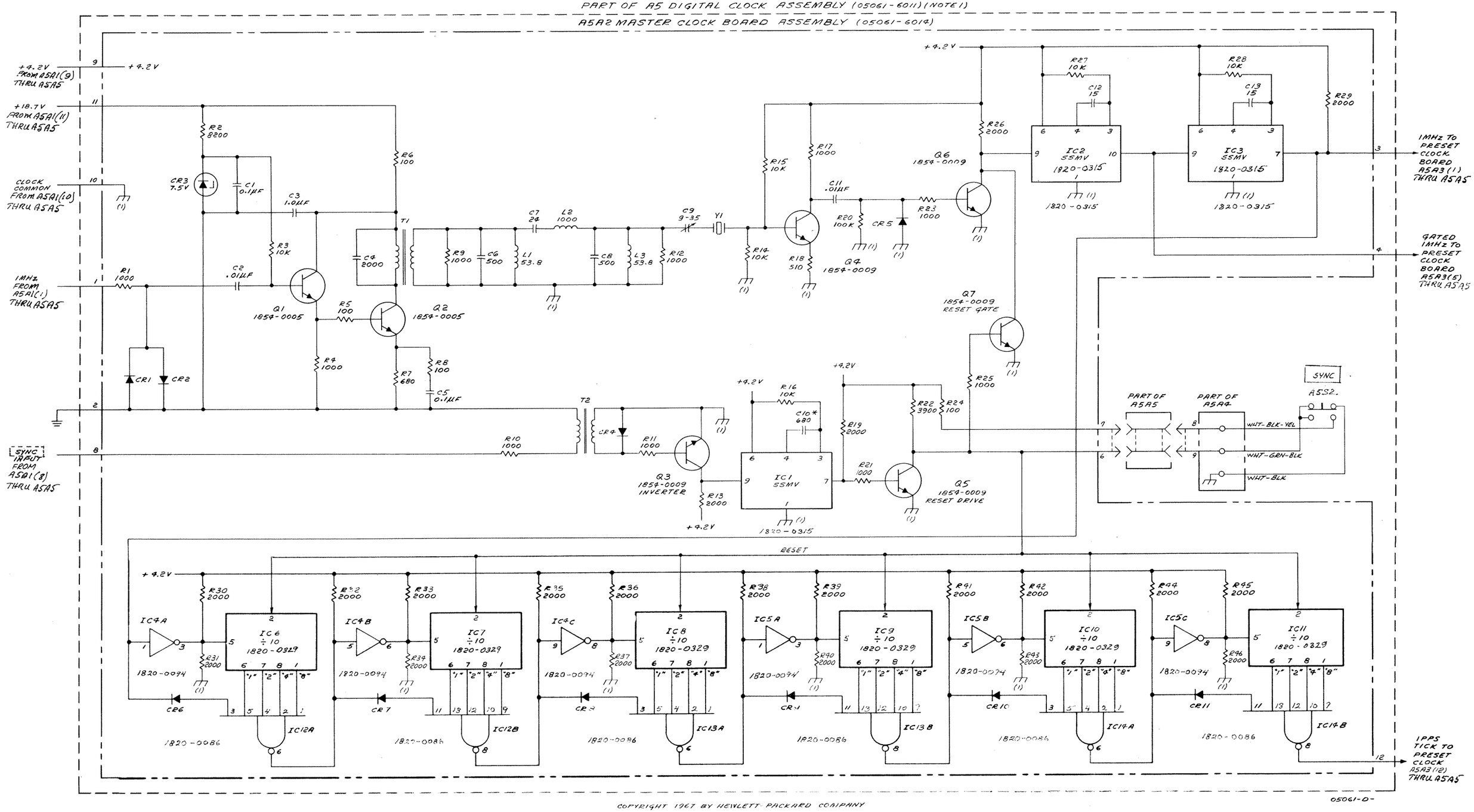
REFERENCE DESIGNATIONS

W/O PREFIX	A5	A5A1
	J1-4	C1-19 CR1-15 IC1 L1,2 Q1-12 R1-26 T1,2

A5A1 Power Supply (Sheet 2 of 4)

PART OF A5 DIGITAL CLOCK ASSEMBLY (05061-6011) (NOTE 1)

A5A2 MASTER CLOCK BOARD ASSEMBLY (05061-6014)



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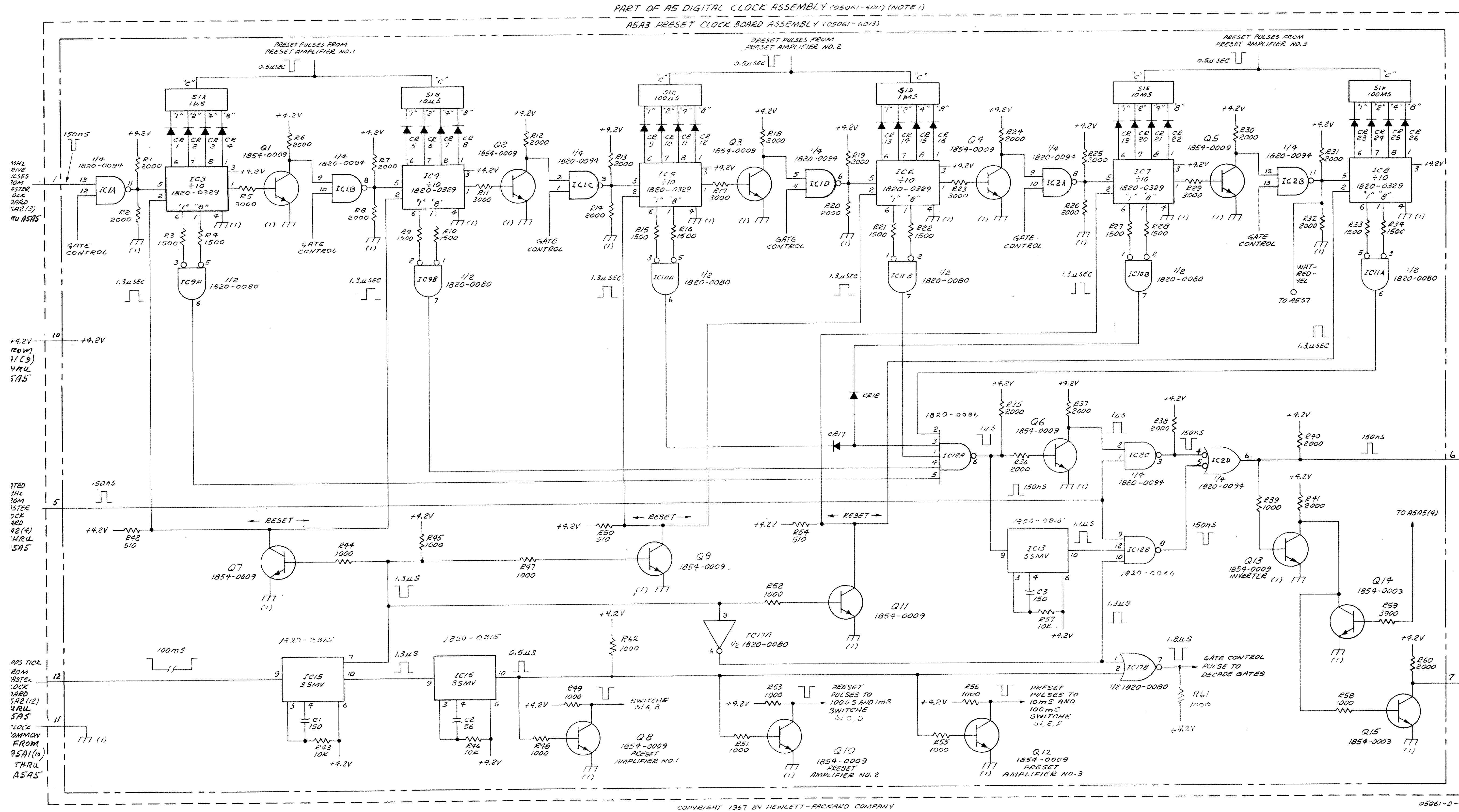
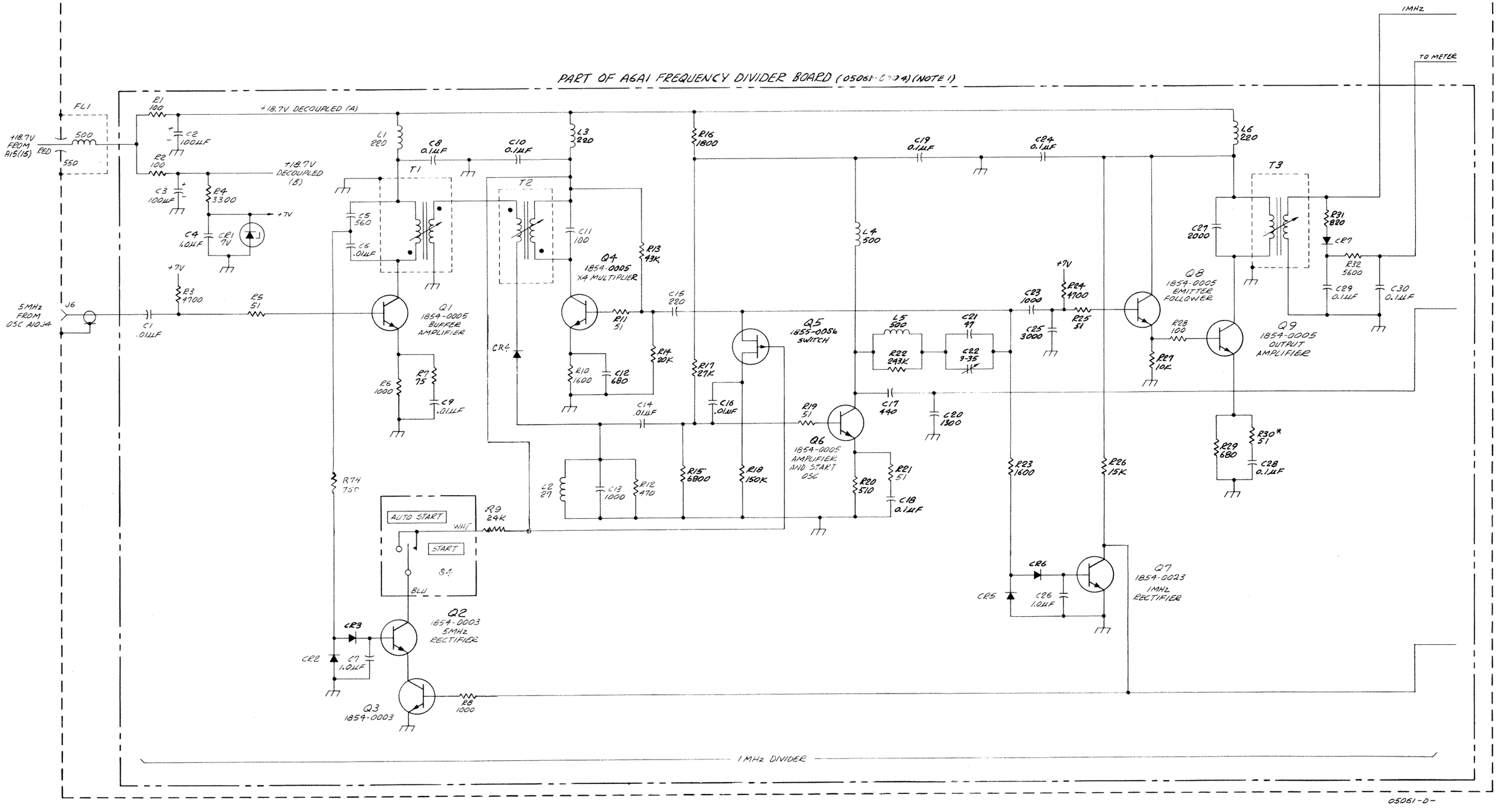
A5A2 Master Clock
(Sheet 3 of 4)



A5A3 Preset Clock
(Sheet 4 of 4)

PART OF A6 FREQUENCY DIVIDER ASSEMBLY (05061-6003)

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



A6 Frequency Divider
(Sheet 1 of 2)

PART OF A6 FREQUENCY DIVIDER ASSEMBLY (05061-6003) (NOTE 1)

1MHz →

TO METER

PART OF A6A1 FREQUENCY DIVIDER BOARD (05061-6004)

+18.7V DECOUPLED (B)

+18.7V DECOUPLED (B)

L7 220 · C32 0.1μF · T4 · C34 0.1μF · T5 · L9 220

R34 9100 · C31 2000 · C35 360 · R42* 10K

+7V · R33 4700 · R35 51 · Q10 1854-0005 1MHz AMPLIFIER · R36 1300 · C55 0.1μF · R56 1500

CR8 · L8 220 · C39 .015μF

R43 51 · R45 4.7K · C40 200 · Q12 1854-0005 X9 MULTIPLIER · R41 6800 · C36 5600

R48 56K · C41 .015μF · Q15 1855-0056 SWITCH

R53 1800 · C57 .47μF · L11 5mh · Q16 1854-0003 AMPLIFIER AND START OSC · R52 51 · C42 2250 · C44 .022μF · R54 100 · R55 51 · C43 1.0μF

L10 220 · C37 .013μF · R44 560 · R47 12K · R50 150K

C33 0.1μF

+7V · R51 10K · TP1 · R46 10K · R49 51K · Q14 1854-0003 · Q13 1854-0003 GATE

R37 51 · R40 1000 · Q11 1854-0005 CLOCK AMPLIFIER · R39 430 · 38 .015μF · R38 1300

100KHz DIVIDER

L13 · C45 1069

R58 1600 · C58 .47μF · C46 5600 · C47 .033μF · R61 3600

+7V · R73 3600 · Q17 1854-0003 100KHz CLOCK AMPLIFIER · R64 100 · C50 .015μF · R59 2400 · R57 2700

100KHz RECTIFIER

CR10 · CR9 · C48 1.0μF · Q18 1854-0003 · +7V · R60 68K

R68 330 · C49 .47μF · R62 8800 · R63 51 · Q19 1854-0005 EMITTER FOLLOWER · R66 220 · R65 1800 · Q20 1854-0005 OUTPUT AMPLIFIER

T6 · C51 8200 · C52 8200 · R70 820 · CR11 · R71 5600 · C54 .47μF

1000 · 350 · FL3 · WHT-BLU-VIO · RECTIFIED 100KHz TO A17(9) 100KHz

1000 · 550 · FL2 · WHT-YEL-BLU · RECTIFIED 1MHz TO A17(9) 1MHz

J3 · J1 · TO J8 1MHz · TO J7 1MHz

J4 · J2 · TO J10 100KHz · TO J9 100KHz

J5 · TO J11 CLOCK

J7 · 1MHz TO DIGITAL CLOCK A5J4

R67 180 · R69* 51 · C53 .47μF

05061-D-

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

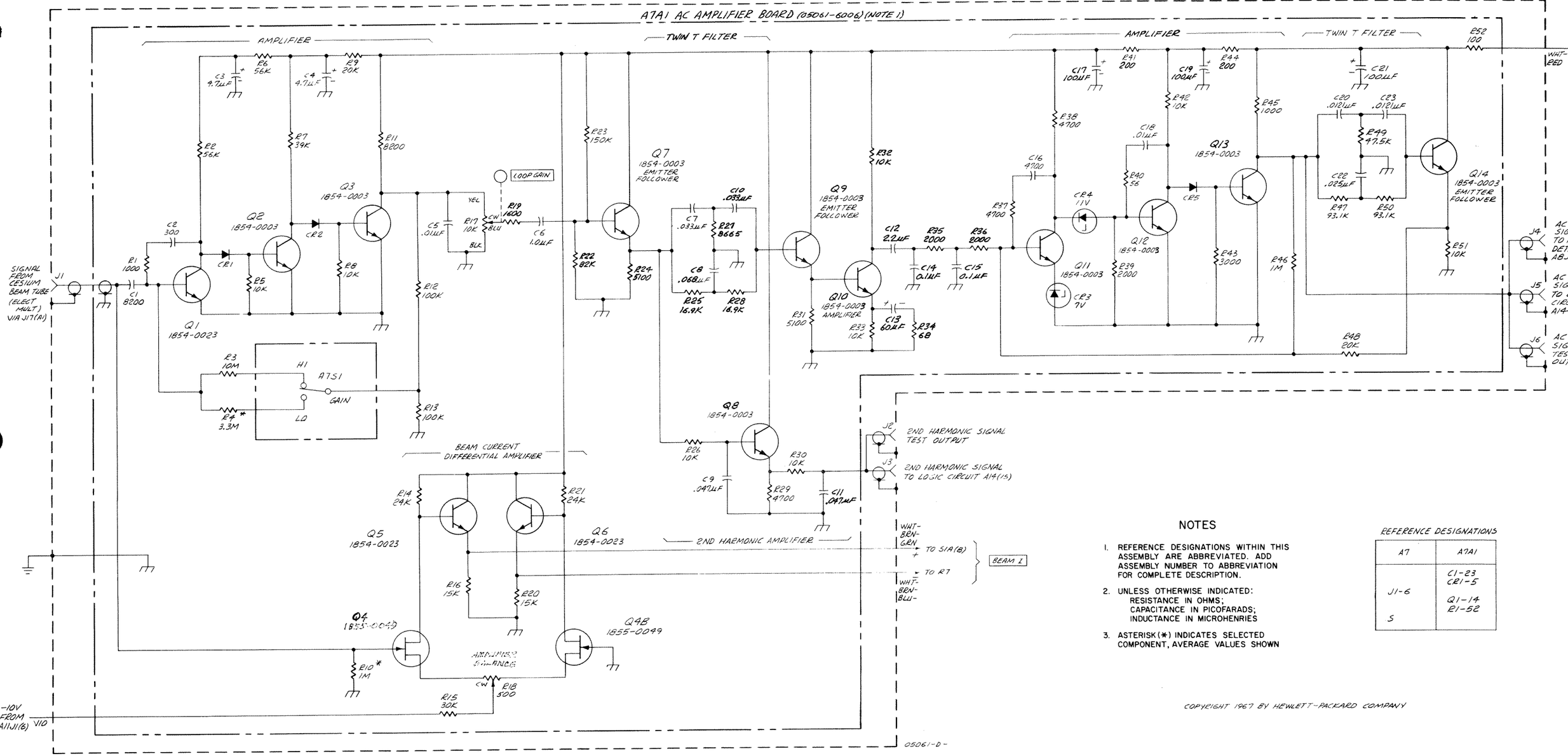
REFERENCE DESIGNATIONS

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

A6 Frequency Divider (Sheet 2 of 2)

A7 AC AMPLIFIER ASSEMBLY (05061-6005)

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



NOTES

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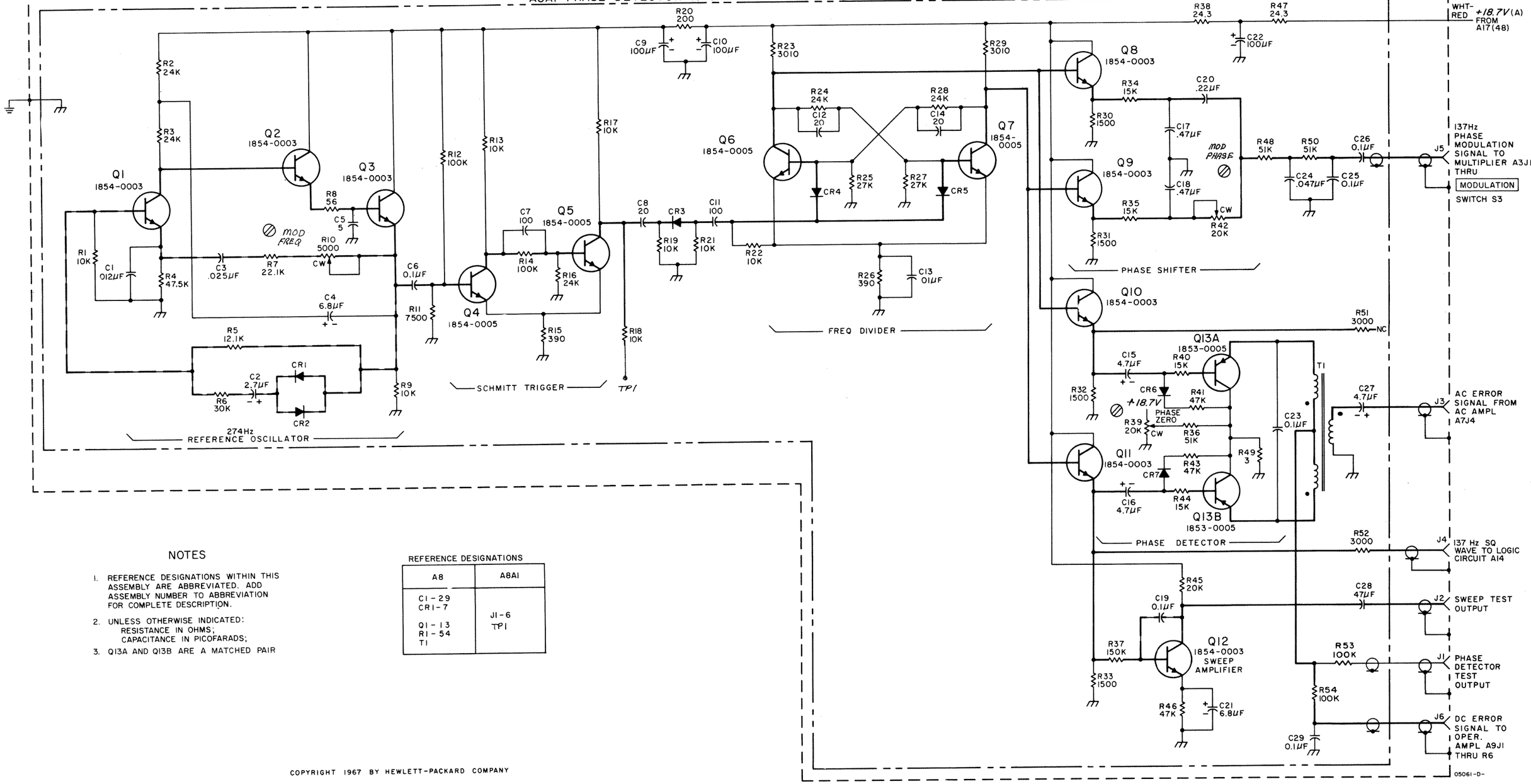
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

A7	A7A1
J1-6	C1-23 CR1-5 Q1-14 R1-52
S	

A8 PHASE DETECTOR ASSEMBLY (05061-6007) (NOTE 1)

A8A1 PHASE DETECTOR P. C. BOARD (05060-6011)

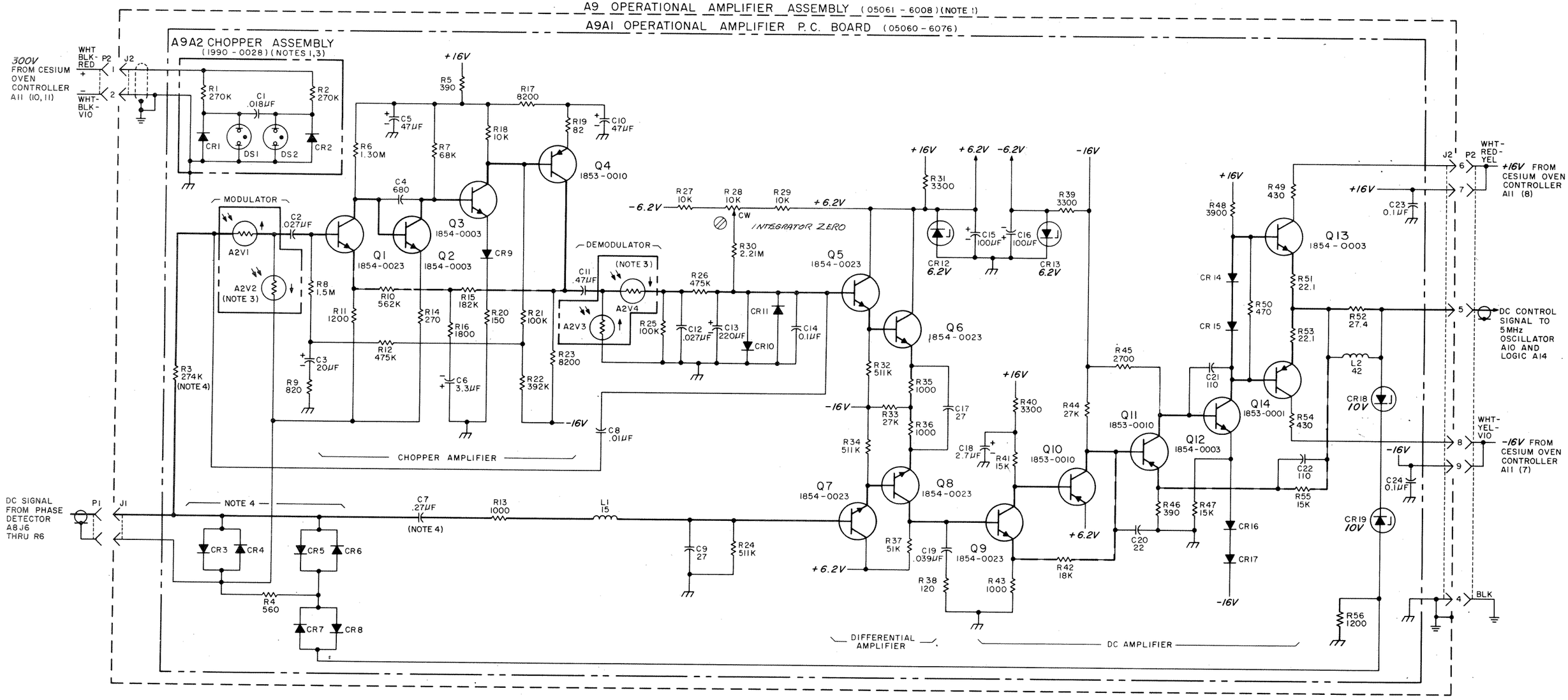


NOTES

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 PICOFARADS;
3. Q13A AND Q13B ARE A MATCHED PAIR

REFERENCE DESIGNATIONS

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

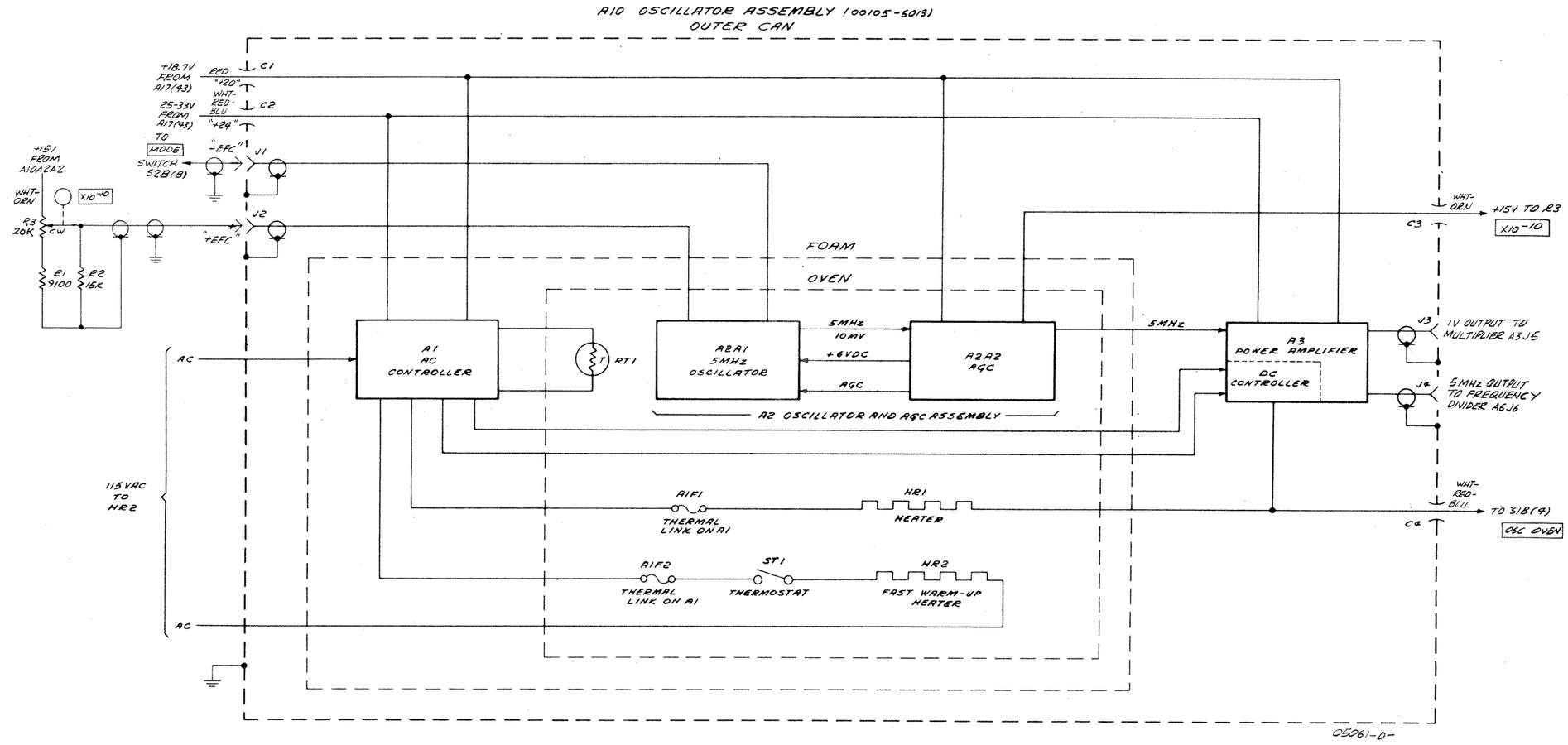


NOTES

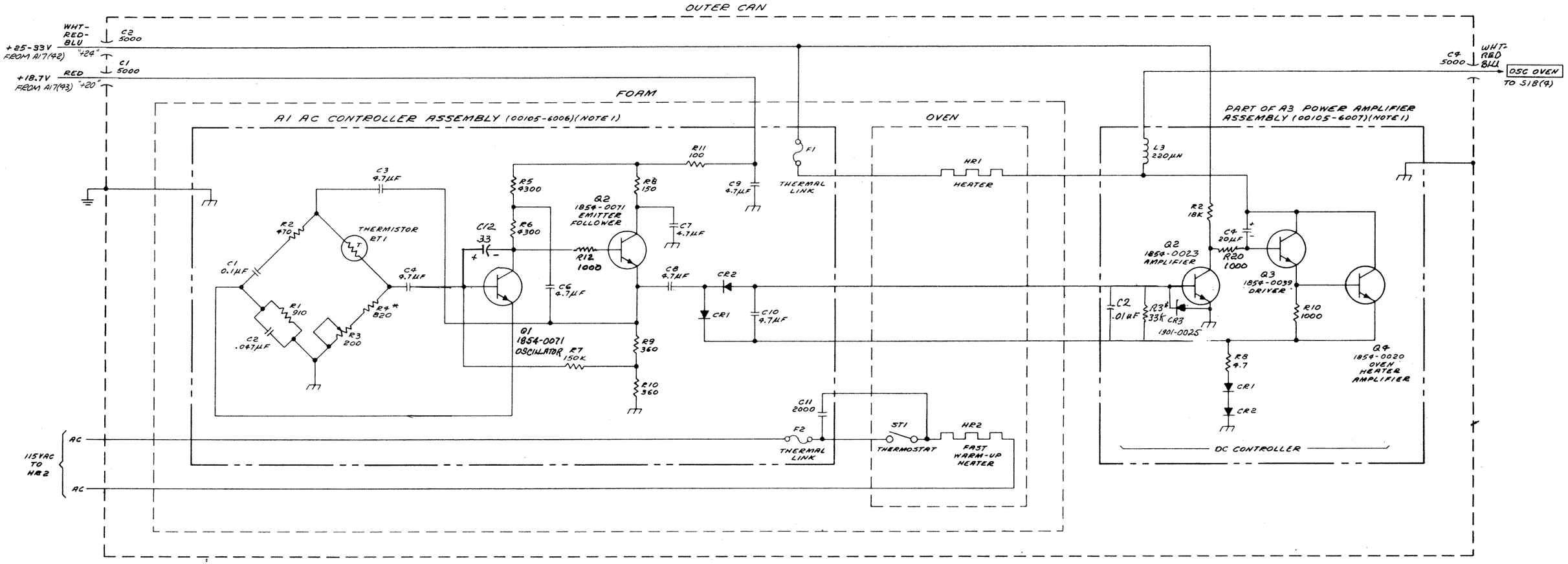
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. A9A2 CHOPPER ASSEMBLY ALSO CONTAINS V1-V4. NEON DS1 ENERGIZES V1, V3 AND DS2 ENERGIZES V2, V4.
4. 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	C1
		CR3-19	CR1,2
			DS1,2
	J1,2		
		L1,2	
		Q1-14	
P1,2		R3-56	R1,2
			V1-4



A10 Oscillator
(Sheet 1 of 4)

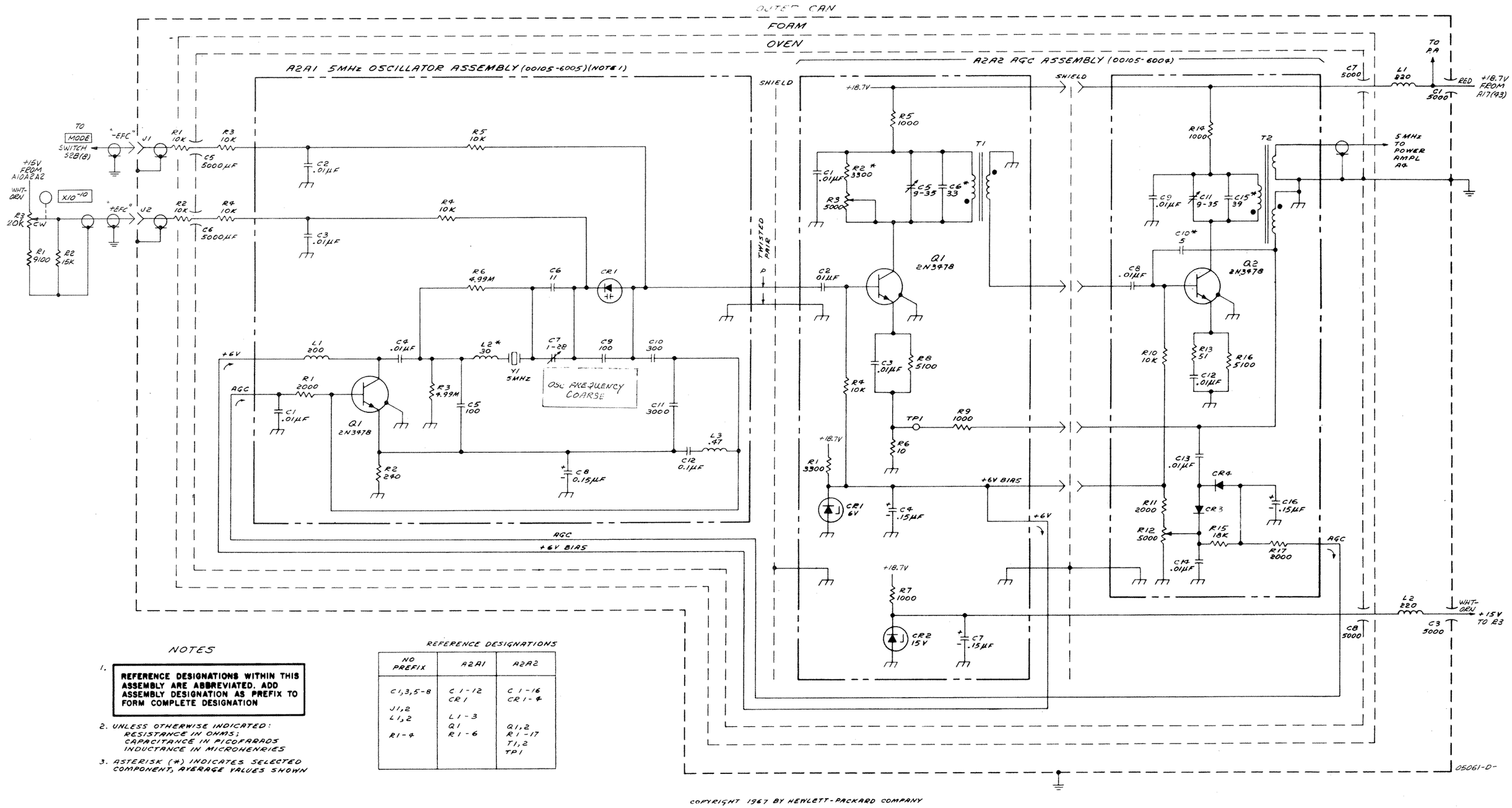


NOTES

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 MICROFARADS
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

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



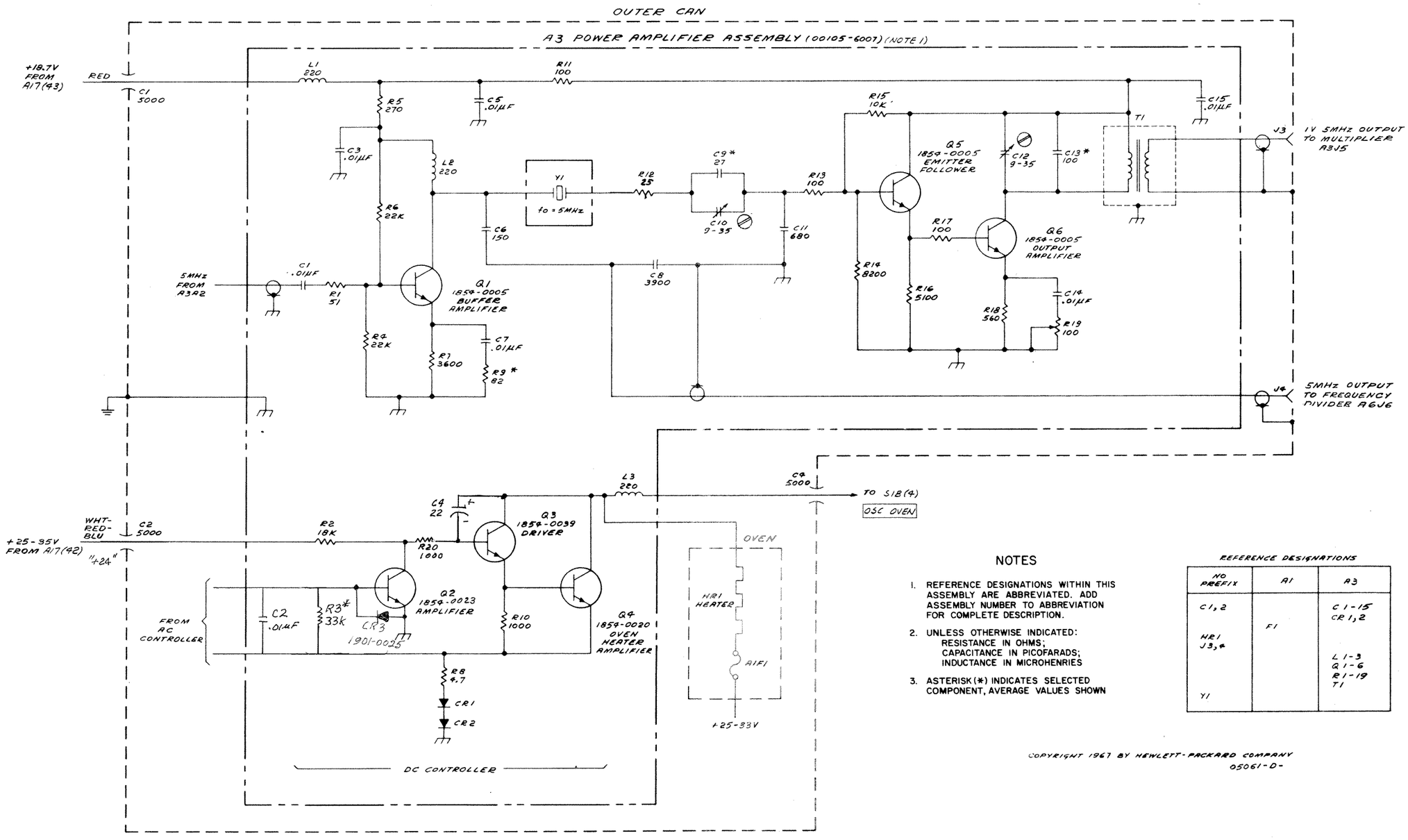
NOTES

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

REFERENCE DESIGNATIONS

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

A10A2A1 5 MHz Oscillator
A10A2A2 AGC Assembly
(Sheet 3 of 4)



NOTES

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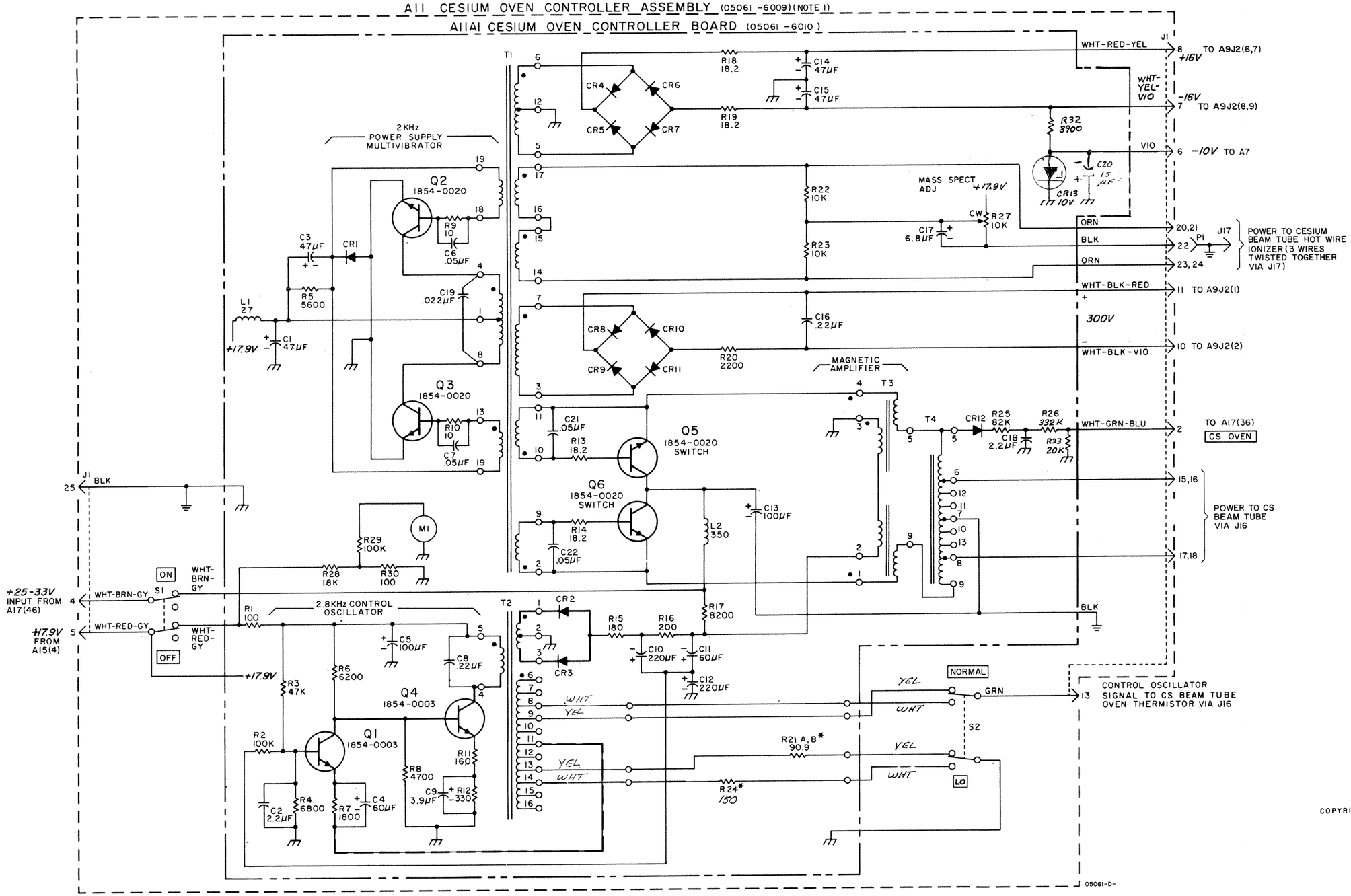
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A1	A3
C1, 2		C1-15
		CR1, 2
	F1	
HR1		
J3, 4		
		L1-3
		Q1-6
		R1-19
		T1
Y1		

05061-D-



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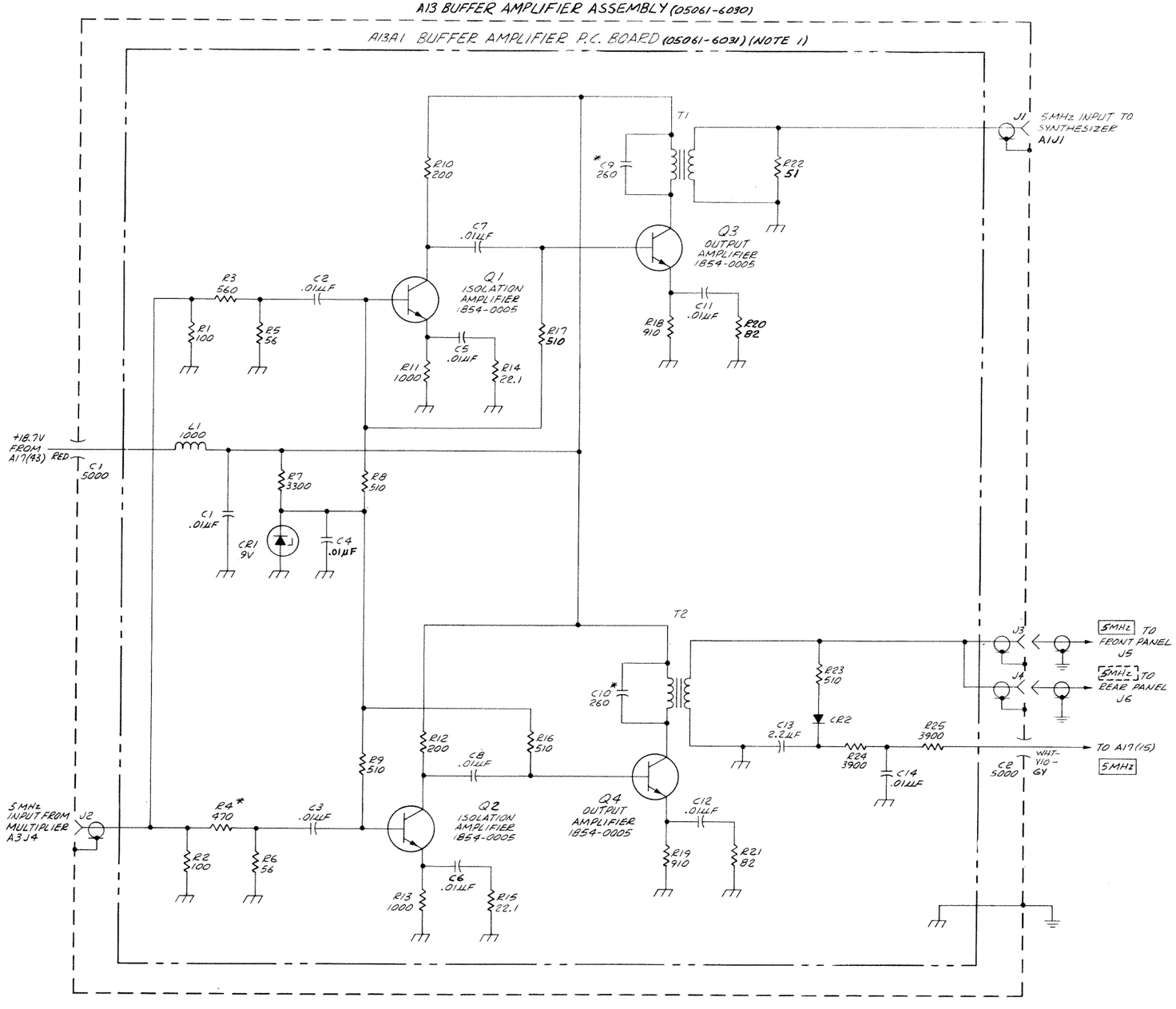
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A11	A11A1
	C20	C1-19, 21, 22
	CR13	CR1-12
J17	J1	
		L1, 2
P1		M1
		Q1-6
	R32	R1-31
	S1, 2	T1-4

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

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

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

SYNTHESIZER CHECK FROM A1 — 4 — WHT-GY

2ND HARMONIC

2ND HARMONIC AMPLIFIER

Q1 1854-0003 EMITTER FOLLOWER

274 Hz 2ND HARMONIC SIGNAL FROM AC AMPL A7J3 — 15 — 14

2ND GAIN ADJ R1 5000 CW

C3 1.0µF

R7 150K

R9 51K

CR1 7.15V

Q4 1854-0003

R13 10K

C9 .01µF

R80 51K

R23 10K

C16 1.0µF

CR4

CR3

C17 2.7µF

Q5 1854-0003

R6 51K

Q2 1854-0005

C6 60µF

R10 38.3

C8 60µF

R14 100

R17 10K

R24 2000

20 — 13

R18 16.9K

C12 .068µF

R19 16.9K

R22 8.66K

C14 .033µF

C15 .033µF

+18.7V(A) FROM A17(50) — 10 — WHT-RED

+18.7V(A)

R2 100

C2 100µF

C4 100µF

Q6 1854-0003 EMITTER FOLLOWER

R25 3000

2ND HARMONIC TRIGGER

+18.7V

Q8 1854-0023 EMITTER FOLLOWER

R32 1M

R34 10K

C19 0.1µF

R39 20K

R91 10K

C21 2.7

Q11 1854-0023 AMPLIFIER

R42 100

R44 33K

Q12 1854-0003

R45 10K

R47 100K

R49 100K

CR9 7.15V

R52 10K

Q13 1854-0003

Q17 1854-0005 2ND HARMONIC SWITCH

CR10 11.5V

R56 5100

CR14

OR20

CR15

R57 43K

R60 100K

C22 1.0µF

Q19 1854-0005 RESET ENABLE

+18.7V

R68 10K

6 — WHT-YEL-GY

S7 LOGIC RESET

WHT-ORN-GY — 7

SILICON CONTROLLED SWITCH

R63 2000

R65 10K

C23 1.0µF

R69 10K

R70 10K

SCR1

Q23 1854-0003 CONTINUOUS OPERATION LIGHT SWITCH

CR19

+18.7V(B) FROM A17(37) — WHT-BRN-YEL — DS1

8 — WHT-ORN — A17(31) — CONTINUOUS OPERATION

WHT-YEL-BRN — 3 — +18.7V(B) FROM A17(37)

WHT-ORN-V10 — 5 — TO A17(11) — 2ND HARMONIC

FUNDAMENTAL

+18.7V

CR5

R33 13K

R38 13K

CR6

R40 10K

C18 4.7µF

C20 4.7µF

Q10 1854-0023

Q9 1854-0023

R37 470

R35 470

R36 3300

CR7 5.7V

R43 100K

R46 20K

R53 20K

Q16 1854-0005 FUNDAMENTAL SWITCH

R50 150K

R48 150K

Q14 1854-0003

R51 51K

Q15 1854-0003

CR11 11.5V

R55 5100

CR8 7.15V

137 Hz FUNDAMENTAL SIGNAL FROM AC AMPLIFIER A7J5 — 22 — 21

C1 2.7µF

R3 100K

R4 15K

R5 100K

R8 10K

Q3 1854-0003 AMPLIFIER

C5 .068µF

R12 2000 CW GAIN

C7 60µF

R15 100

R11 10K

C10 4.7µF

Q7 1853-0022 PHASE DETECTOR

R16 12K

R21 33K

CR2

C13 100µF

C11 4.7µF

+18.7V

R26 33K

R29 2000

R27 1000 CW BAL

R30 2000

R28 11K

R31 33K

DIFFERENTIAL AMPLIFIER

FUNDAMENTAL TRIGGER

137 Hz SQUARE WAVE (-) POLARITY FROM PHASE DETECTOR A8J4 — 19 — 20

OSCILLATOR DC CONTROL VOLTAGE FROM A9(5) — 2

OR GATE

R58 5100

Q20 1854-0003

Q22 1854-0003

Q24 1854-0003

CR18

R66 5100

+18.7V

R61 33K

CR17

R62 33K

R64 5100

R67 15K

Q21 1854-0003

CR12 5.76V

CR13 5.11V

CR16

Q18 1854-0003

R59 10K

R54 2400

+18.7V(A) FROM A17(49) — WHT-RED — DS2

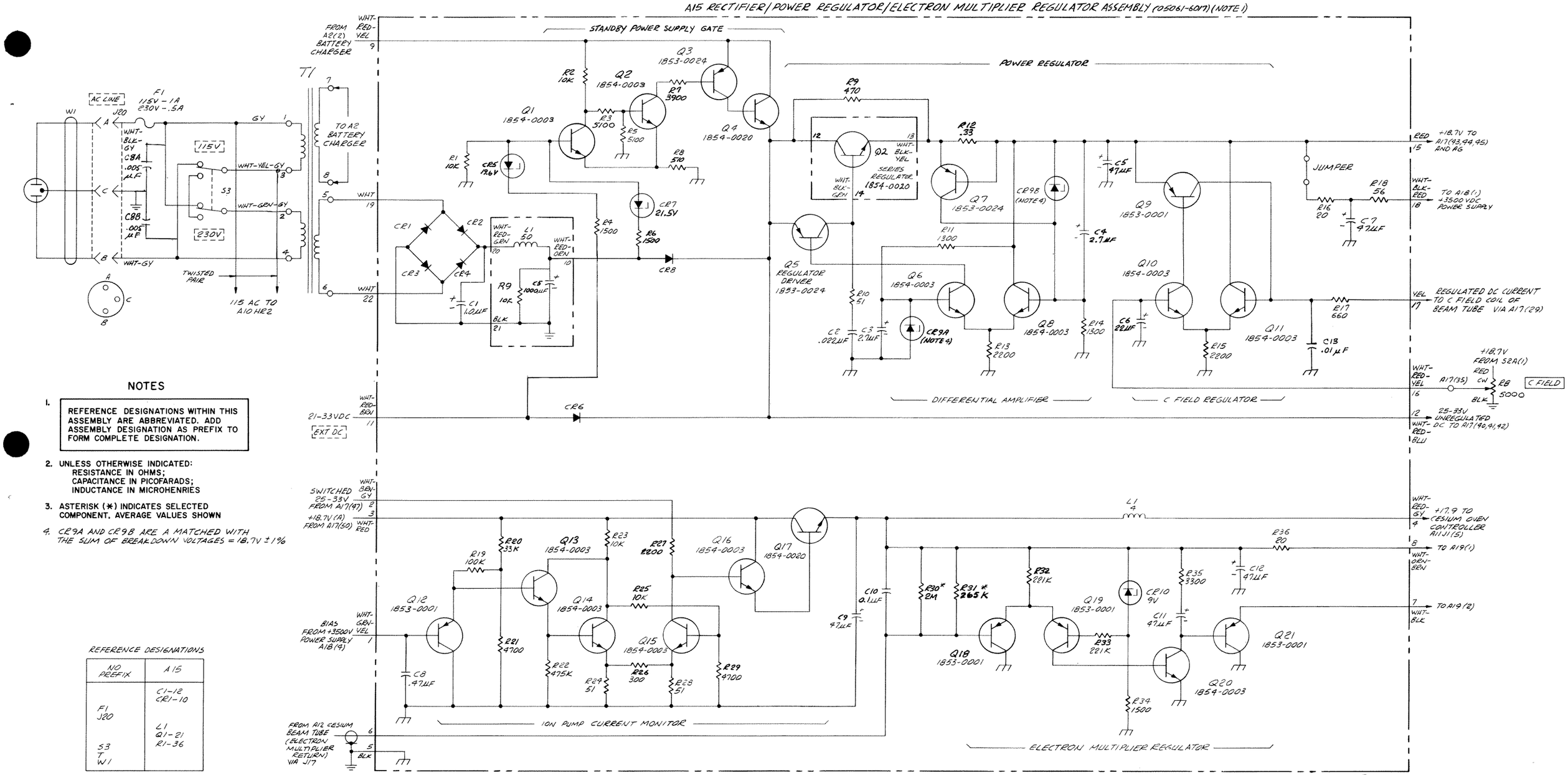
WHT-V10 — 1 — A17(32) — ALARM

INTEGRATOR LIMIT SENSOR

05061-D-

REFERENCE DESIGNATIONS

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



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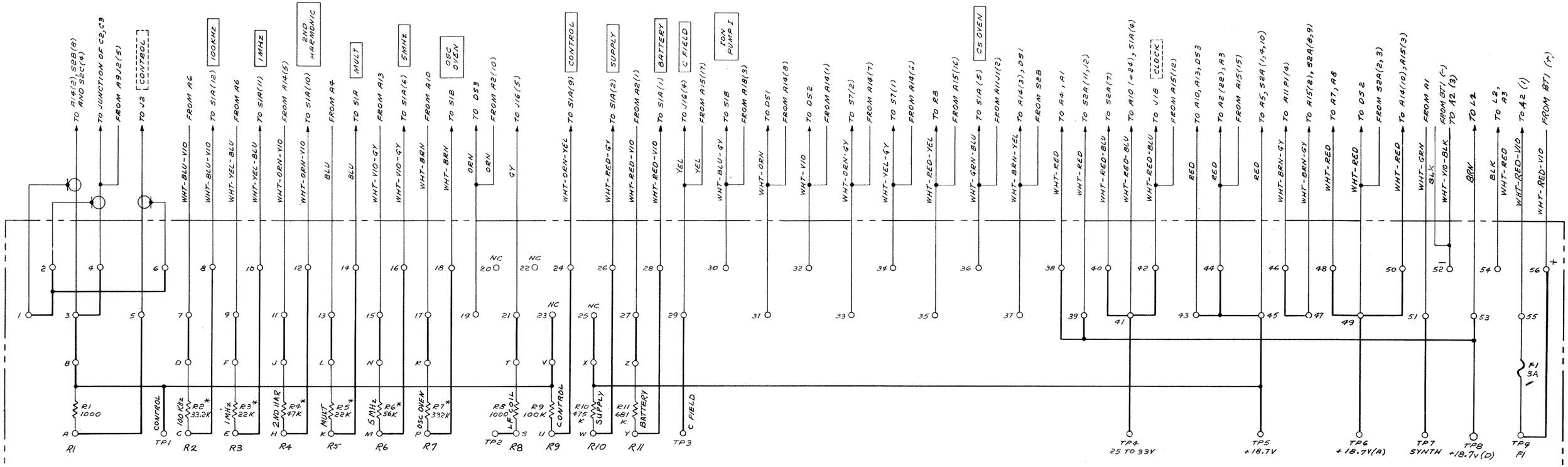
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN
4. CR9A AND CR9B ARE A MATCHED WITH THE SUM OF BREAKDOWN VOLTAGES = 18.7V ±1%

REFERENCE DESIGNATIONS

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



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

NOTES

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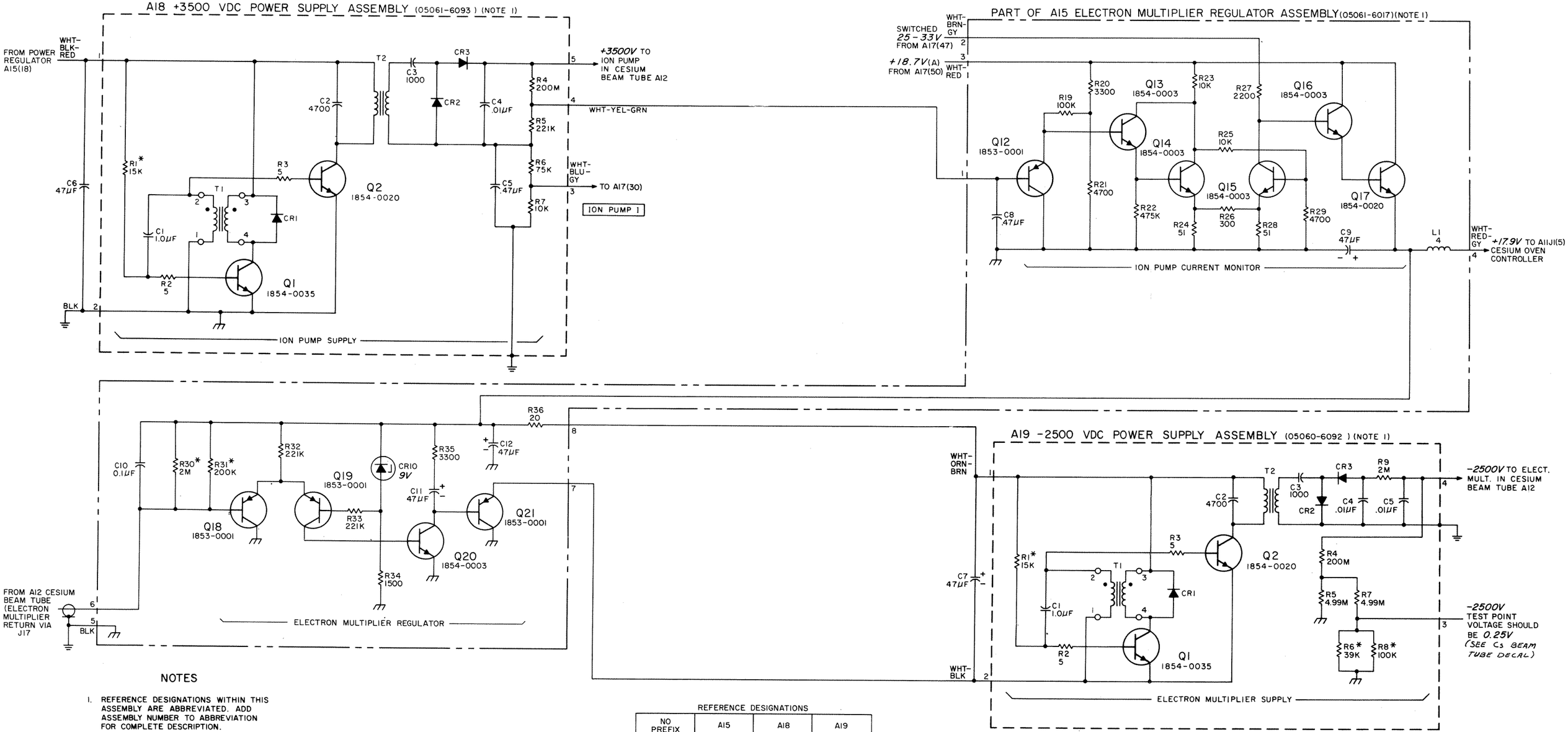
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS;
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

A17
F1 R1-11 TP1-9



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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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