Efratom Division

Time and Frequency Systems

OPERATION AND MAINTENANCE MANUAL

MODEL

M-100

RUBIDIUM OSCILLATOR

WARRANTY

"The seller warrants that each item furnished under this Order will at the time of shipment be free from defects in materials furnished and workmanship performed by the Seller. This warranty is limited to either granting credit or repairing or replacing at Seller's option with reasonable promptness after return to Seller any articles or materials which are disclosed to Seller's satisfaction to be defective, and only if said articles or materials are returned to the seller promptly after discovery of such defect and in no event later than 18 months from the date of delivery thereof. Normal transportation charges in connection with items returned shall be at the Seller's expense only if the Seller is responsible under the terms of this warranty. This warranty does not extend to any item which has been subject to misuse, neglect or accident, nor does it extend to anything which has been repaired or altered by other than the Seller. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, AND THE RIGHTS AND REMEDIES PROVIDED HEREIN ARE EXCLUSIVE AND IN LIEU OF ANY OTHER RIGHTS OR REMEDIES. IN NO EVENT SHALL SELLER BE LIABLE FOR CONSEQUENTIAL DAMAGES."

LIST OF EFFECTIVE PAGES

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NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line, in the outer margin of the column affected.

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SECTION 1
INTRODUCTION & SPECIFICATIONS

1. INTRODUCTION

1.1 DESCRIPTION

The Efratom Model M-100 Rubidium Frequency Standard (RFS), Part Number (P/N) 70502-1, is a sub-compact, light weight, atomic resonance-controlled oscillator. The unit provides a pure and stable 10 MHz sinusoidal signal from a 10 MHz voltage-controlled crystal oscillator (VCXO), which is referenced and locked to the hyperfine transition of Rubidium 87 (Rb^{87}). The reference element is an optically-pumped integrated rubidium vapor cell, contained within the physics package. For the standard Model M-100 this technique provides long-term stability of $\leq 6 \times 10^{-11}$/month ($\leq 3.6 \times 10^{-10}$ for first year) improving to $\leq 2 \times 10^{-10}$/yr starting with the second year; if ordered with the low-drift option the long-term stability is $\leq 1 \times 10^{-11}$. Short-term stability is rated at $\leq 3 \times 10^{-11}$ rms averaged over a one-second period.

The M-100 was designed to be used by the military as a Master oscillator in high-performance communication systems, frequency standard equipment, advanced navigation equipment, and all other systems which require extremely precise frequencies and time intervals. With the proper input power provided, and suitable cooling provisions, the M-100 can be used as a free-standing secondary frequency standard for laboratory and testing purposes.

1.2 MANUAL CONTENT

This manual contains all of the pertinent information concerning the operation and field maintenance for the Model M-100, Efratom P/N 70502-1. A Model M-100 with a Part Number other than 70502-1 is a modified unit. If a modified unit differs operationally from the standard unit an addendum will have been added. If an addendum has been added, it is important to read the addendum prior to reading this manual.

If an addendum has not been added for a particular Efratom P/N, it can be assumed that the unit modification did not affect the unit's operation. The Efratom P/N is located on the nameplate label, between the 10 MHz output connector J1 and the rectangular input/monitor connector J2.

1.3 CONNECTORS

All necessary connectors for inputs and output/monitoring signals are easily accessible from the cover of the M-100. The input power and signal monitor connections are to the rectangular connector J2, P/N M28748/7-D00F1A, which mates with rectangular connector P/N M28748-/8-D10LIA. The 10 MHz output is from the SMA-series coaxial connector J1, P/N M39012/61-3001, which mates with SMA-series coaxial connector P/N M39012/55-3006. Mating connectors for J1 and J2 are supplied with each unit.

1.4 ELECTRICAL PROTECTION

The electrical protection features of the M-100 include internal diodes to protect against reversed-polarity inputs and input-power transients (high amplitude). The 10 MHz output and all monitor signal outputs have short-circuit protection.

1.5 AVAILABLE OPTIONS

(a) Fast warm-up, $\leq$ 5 min to reach final frequency $\pm 2 \times 10^{-10}$ @ 25°C.

(b) Low-noise (5 MHz @ 1 vrms into 50 ohm load): $\geq$ 125 dB @ 10 Hz from carrier, $\geq$ 155 dB @ 300 Hz from carrier.

(c) Low-drift, $\leq 1 \times 10^{-11}$/month.

(d) Heat sink, Efratom P/N 70577

1.6 SPECIFICATIONS.

The pertinent performance specifications for Model M-100 are listed in Table 1.1.

TABLE 1.1. Model M-100 General Performance Specifications

OUTPUT CHARACTERISTICS

Frequency: 10 MHz Sine Wave, ($\pm$ 5×10^{-11} at shipment)

Amplitude: 0.5 vrms (-10% + 30%) into 50-ohm load

Phase Noise (SSB 1 Hz BW): > 120 dB at 100-Hz from carrier

(Signal-to-Noise) > 135 dB at 1000-Hz from carrier

Harmonic Distortion: 30 dB Down

Non-Harmonic Distortion: 80 dB Down

Warm-up: < 10 minutes to reach 10 MHz $\pm$ 2×10^{-10} at 25°C ambient

Peak current during warm-up: approx. 2.2 amps max. at 25°C with 26 vdc input.

INPUT

Voltage: 22.5 to 32 vdc (50 v, 50 ms transient).

Power: 10 watts max. at 25°C with 26 vdc input.

$< 1 \times 10^{-11}$ for $\pm$ 10 % input voltage change.

STABILITY

Long-Term Drift: $< 6 \times 10^{-11}$ for the first month after 14 days of continuous operation. $\leq 3.6 \times 10^{-10}$ for the first year, total period; $\leq 2 \times 10^{-10}$ for the second year.

Short-Term Stability: $\sigma y(\tau) = 3 \times 10^{-11} \times (\tau^{-\frac{1}{2}})$ for 1 sec $\leq \tau \leq$ 100 seconds

Magnetic Field: $< 3 \times 10^{-13}/AM^{-1}$ worst case orientation (2.4×10^{-11}/Gauss)

GENERAL

Frequency Trim Range Adjustment: $\geq 3 \times 10^{-9}$

Operating Temperature: $< 3 \times 10^{-10}$ from -55°C to +68°C

(-67°F to 155°F) at baseplate

Storage Temperature (non-operational): -62°C to +85°C (-80°F to 185°F)

Size (inches): 4.81 high x 3.90 wide x 3.94 deep (see Outline Dwg No. 70549-1)

Weight: 4 lb max. without heatsink

4.5 lb max. with standard heatsink attached.

SECTION 2
INSTALLATION

2. INTRODUCTION

CAUTION

THE UNIT'S OUTER COVER IS A SPECIALLY DESIGNED MAGNETIC SHIELD; DAMAGE TO THE OUTER COVER COULD CHANGE ITS SHIELDING CHARACTERISTICS.

2.1 RECEIVING AND INSPECTION

The M-100 is packaged and shipped in a foam-packed container. The unit was inspected mechanically and electrically prior to shipment. If the shipping carton is damaged, ask that the carrier's agent be present when the unit is unpacked. The unit should be inspected for external damage (i.e. scratches, dents, or broken connectors). If damage is discovered, or if the unit fails the Operational tests, notify the carrier, and Ball Corp., Efratom Division, 18851 Bardeen Ave., Irvine, CA 92715. Telephone (714) 752-2891; Telex 685-635. Retain the shipping carton and the foam-packing material for the carrier's inspection.

2.2 SHIPPING

If reshipment of the unit is necessary, the original container and packing should be used. If the original container is not available, a suitable container with foam-packing is recommended.

2.3 STORAGE

Temperatures during storage should be limited as follows:

(a) maximum temperature: +85°C (185°F)

(b) minimum temperature: -62°C (-79°F)

2.4 MOUNTING.

The unit's baseplate has been drilled and tapped to facilitate installation. Although the unit is shipped ready for installation, a heat sink and sufficient airflow must be provided to ensure that the unit baseplate temperature does not exceed 68°C (154°F) during operation.

The unit may be mounted with the aluminum thermal baseplate in contact with a flat metal surface using the supplied mounting screws, but the mounting screws should not be allowed to penetrate the baseplate more than 0.2 inches (5mm).

The heat transfer characteristics of the mounting surface must be adequate to limit the rise of the unit's baseplate to +68°C. The allowable environmental temperature (Ta) for this mounting is:

$Ta = +68°C - V_s, I_s, R_k$

Where: V_s = Supply Voltage in volts.

I_s = Supply Current in amperes.

R_k = Thermal Resistance between unit and ambient, (°C/watt).

2.5 POWER REQUIREMENTS.

The M-100 requires an external power source capable of providing between +22.5 vdc and +32 vdc, with a minimum output of 2.0 amp. The positive input voltage is to J2 pin L, the negative return voltage on J2 pin P.

In order to obtain optimum signal-to-noise ratio the maximum ac ripple voltage to the input of the unit must be less than 100 mV peak-to-peak during normal operation. During the warm-up period a higher ac ripple is acceptable, but at no time should the input voltage + ac ripple be higher/lower than the input power limits stated.

2.6 MONITORING SIGNAL OUTPUTS.

Figure 2.1 illustrates the pin connections for the Winchester connector J2, and presents a brief functional description of the connections.

J2 B. Rb LAMP VOLTAGE SIGNAL
F. XTAL CONT VOLTAGE SIGNAL
H. RESONANCE LOCK SIGNAL
L. +22.5 TO +32 VDC INPUT
P. GROUND (connected to enclosure)

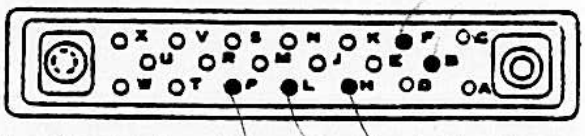


FIGURE 2.1. Winchester Connector and Pin Arrangement.

2.7 INSTALLATION CONSIDERATIONS.

Whether the unit is to be installed in a system, or used as a freestanding frequency standard, some consideration must be given to the operating location. If the signal-to-noise ratio and/or non-harmonic distortion are considerations, the unit should not be installed near equipment generating strong magnetic fields such as generators, transformers, etc.

SECTION 3
OPERATION AND FUNCTIONAL TESTS

3. INTRODUCTION

3.1 TEST EQUIPMENT

The test equipment required to perform functional tests is listed in Table 3.1. Test equipment other than those items listed may be used, provided that the performance equals or exceeds the MINIMUM USE CHARACTERISTICS as stated in Table 3.1.

TABLE 3.1 Functional Operation Test Equipment

ITEM	MINIMUM USE CHARACTERISTICS	TEST EQUIPMENT
3.1 DC Power Supply	Output Voltage: 0 To 30 vdc Output Current: 3.0 amp	Hewlett-Packard 6296A or 6433B
3.2 Digital Multimeter (DMM)	Voltage Range : 0 To 30 vdc Accuracy: $\pm$ 1.25% iv Resistance Range: 0 To 150 ohm Accuracy: N/A	Fluke 8000A or 8020A
3.3 Atomic Oscillator Test Set	Input Frequency: 10 MHz Accuracy: $\pm$ 1×10^{-11} Stability: parts in 10^{12}	Efratom TS-105A or TS-105
3.4 Resistive Load	Feed-thru type 50 ohm	Hewlett-Packard 10100C or Pomona Electric 4119-50
3.5 Timer	Capable of indicating 1 min to 15 min	Any wristwatch or wall clock

3.2 OPERATION

With the output connector J1 terminated with a 50—ohm resistive load, and the required input power applied to the pins L (+) & P (-) of connector J2, the unit will immediately begin producing a 10—MHz signal from the VCXO. Within 10 minutes after application of input power, the VCXO will be locked to the atomic reference frequency.

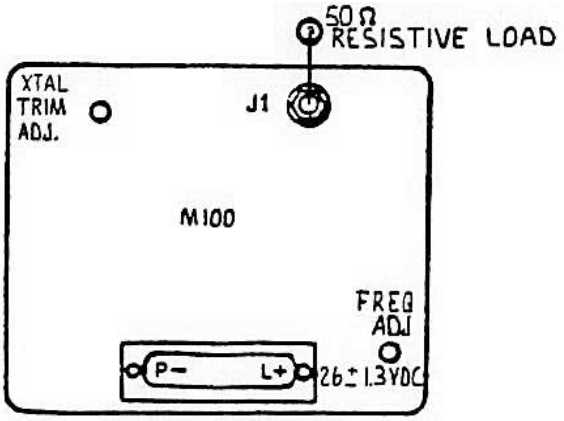


Figure 3.1. Connections for Normal Operation

NOTE

Throughout the test procedures, the Model M-100 may be referred to as the UUT (Unit Under Test). Also, all connections described or illustrated are for the standard configuration, SMA-type coaxial connector J1, and Winchester connector J2; if the UUT has a different connector arrangement, make the described connections to the appropriate pins as described in the pin diagram accompanying the UUT.

3.3 ATOMIC RESONANCE LOCK, AND VCXO CONTROL VOLTAGE TESTS.

3.3.1 Connect equipment as shown in Figure 3.2 with the 50 ohm feedthrough connected at the M-100 output connector J1. Do not make the dotted-line connection until instructed to do so.

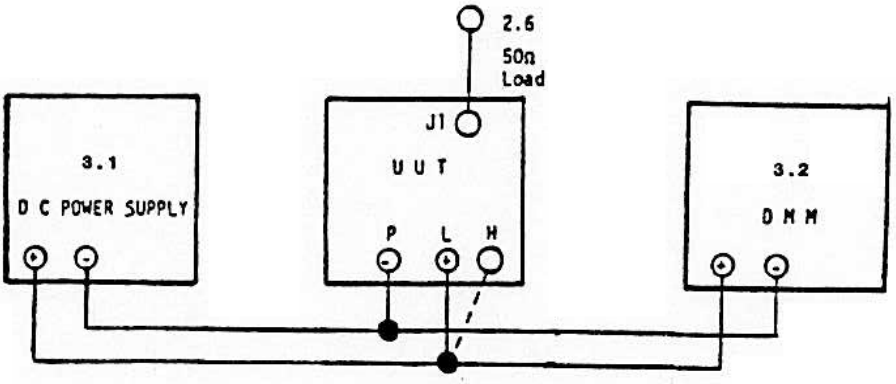


Figure 3.2 Test Setup for Atomic Resonance Lock Test

3.3.2 Adjust the dc power supply controls to obtain a 26 ± 1.3 vdc indication on the DMM. Note the time (item 2.5) input power is applied to the unit.

3.3.3 Disconnect the DMM positive lead connected to J2 pin L without disturbing the positive input voltage connection.

3.3.4 Set the DMM to measure resistance in the 200 ohm range. (Do not use the Auto Range for this test.)

3.3.5 Connect the DMM positive lead to J2 pin H (Figure 3.4 dotted-line connection). Monitor the DMM indication during warm-up.

NOTE

During warm-up the DMM will indicate overrange. Within 10 minutes after power application, the DMM should indicate approximately 150 ohm, indicating that the crystal oscillator has become locked to the atomic reference frequency.

3.3.6 Verify that atomic lock occurs $\leq$ 10 minutes after application of input power to the M-100.

3.3.7 After the atomic lock has been verified, remove the DMM positive lead from J2 pin H, and set the DMM controls to measure dc voltage in the 20 volt range.

3.3.8 Connect the DMM positive lead to J2 pin F, and verify that the DMM indication is between +3 and +17 vdc.

NOTE

If the DMM indication is not between +3 and +17 vdc refer to Section 5, Maintenance, paragraph 5.13 steps 5.13.1.1 through 5.13.1.9 or 5.13.1.1 through 5.13.4.4, as necessary, for the adjustment procedure.

3.4 OPERATIONAL FREQUENCY ACCURACY TEST

3.4.1 Connect the equipment as shown in Figure 3.4.

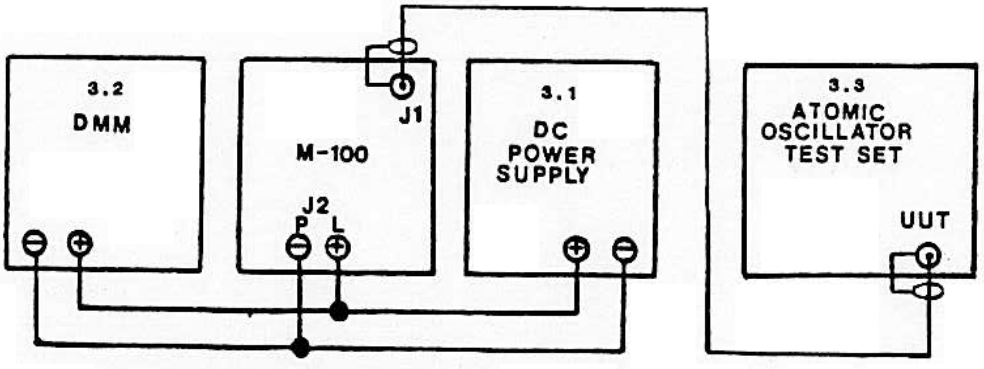


Figure 3.3 Operational Frequency Accuracy Test Setup.

3.4.2 Adjust the dc power supply controls to obtain a 26 $\pm$ 1.3 vdc indication on the DMM.

3.4.3 Allow sufficient time for equipment to stabilize.

NOTE

The UUT requires 10 minutes stabilization to obtain the following frequency accuracy: $\pm 2 \times 10^{-10}$ of the final frequency (calibrated frequency), or the frequency before the unit was turned off (if turnoff was within 24 hours). If the UUT was in storage, the worse-case error = $\pm 2 \times 10^{-10}$ warm-up +/- last calibration accuracy, or 5×10^{-11} factory setting at shipment (whichever is applicable) + * aging specification.

The UUT requires 1 hour stabilization time to obtain the following accuracy: $\pm 2 \times 10^{-11}$ of final frequency or frequency at turnoff (if turnoff was within 24 hours). If UUT was in storage, the worse case error = $\pm 2 \times 10^{-11}$ warm-up +/- last calibration accuracy, or 5×10^{-11} factory setting at shipment, whichever is applicable + * aging specification.

* Aging Specification:
Standard M-100: $\leq 6 \times 10^{-11}$/month; M-100 with high-stability option: $\leq 1 \times 10^{-11}$ /month (refer to the Table 1.1, Specifications).

3.4.4 If necessary, press the test set's ADVANCE switch to unblank the display, then press the RESET switch to obtain the READY message.

3.4.5 Perform all necessary menu option selections and bring the READY message back to the display. Ensure that "UUT 10 MHz" is part of the bottom-line message.

3.4.6 Press the test set's RESET push button to begin the test. Allow the test set sufficient time to obtain the UUT's FREQ OFFSET indication for the 100 sec AVR TIME, and the UUT's ALLAN VARIANCE indication for at least the 10 sec AVR TIME, (the 100 sec freq offset will have to update 10 times in order to obtain the 10 sec Allan Variance test results).

3.4.7 Allow sufficient time for the test set to indicate the UUT OFFSET for the data you require. Verify that the UUT frequency offset is within the tolerance stated in the NOTE following Step 3.4.3.

NOTE

If the UUT is not within the stated tolerance limits continue with the Frequency Adjustment procedure, paragraph 3.4.7.1 and 3.4.7.2.

3.4.7.1 Refer to Figure 3.4 to locate the M-100 frequency adjustment screw access hole.

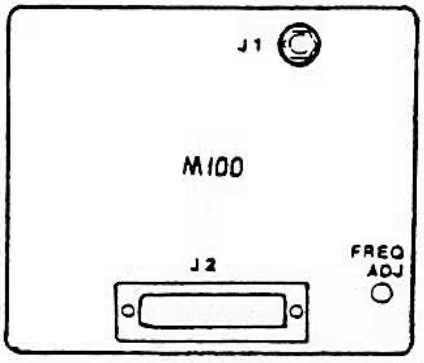


Figure 3.4 Location of M-100 Frequency Adjustment

3.4.7.2 Using the appropriate alignment tool and monitoring the test set indication, rotate the adjustment screw clockwise or counterclockwise as necessary, until the test set display indicates the M-100 is within the required tolerence (or $\pm$ 5×10^{-11}) for the three averaging times.

NOTE

If the unit has aged beyond the adjustment capability of the frequency adjust potentiometer, refer to the Maintenance, Section 5, Subsection 5.14 or 5.15, as necessary.

3.5 SHORT-TERM STABILITY TEST (ALLAN VARIANCE)

NOTE

If you have just completed 3.4 through 3.4.7, the Allan Variance (AV) indications on the test set are valid. If 3.4 was not performed, continue with 3.5.1.

3.5.1 Connect the equipment as illustrated in Figure 3.4.

3.5.2 Adjust the dc power supply controls to obtain a 26 ± 1.3 vdc indication on the DMM.

3.5.3 Allow sufficient time for equipment to stabilize. See Note following paragraph 3.4.3.

3.5.4 If necessary, press the test set's ADVANCE switch to unblank the display, then press the RESET switch to obtain the READY message.

3.5.5 Perform all necessary menu option selections and bring the READY message back to the display. Ensure that "UUT 10 MHz" is part of the bottom-line message.

3.5.6 Press the test set's RESET push button to begin the test. Allow the test set sufficient time to obtain the UUT's AV indication for at least the 10 sec AVR TIME. (The 100 sec FREQ OFFSET will have to update 10 times in order to obtain the 10 sec AV test results.)

3.5.7 Allow sufficient time for the test set to indicate the UUT AV, as required. Verify that the UUT AV is within the tolerance limits for short-term stability, as stated in Table 1.1.

SECTION 4
THEORY OF OPERATION

4. GENERAL

4.1 THEORY OF OPERATION

The Model M-100 Rubidium Frequency Standard utilizes the ground-state hyperfine transition of the rubidium atom, at approximately 6.8 GHz. In order to use this atomic transition, the oscillator incorporates a rubidium cell, a rubidium lamp, and servo electronics to control the frequency of a VCXO. The oscillator combines the performance of the basic quartz crystal with a frequency comparison scheme to an atomic resonance frequency, the hyperfine frequency. In this manner, the atomic standard behaves like a crystal oscillator for time periods shorter than the servo loop response time, and like an atomic oscillator for time periods greater than the loop response time. The inherently stable atomic resonance is therefore used to servo out the quartz crystal aging and a host of other environmental effects.

The rubidium atomic oscillator is a passive device, meaning that the atoms themselves do not produce a self-sustaining oscillation. The physics can be viewed in its simplest form as a series-resonant tank circuit that is resonant at the hyperfine frequency (approximately 6.8 GHz for rubidium atoms). The voltage source driving the tank is the microwave input coming from the modulator/synthesizer, and the LCR components are the rubidium atoms. The atomic resonance is detected by optical means and involves a process known as optical pumping, by which atoms are raised to a higher state through absorption of light energy coming from the rubidium lamp.

The crystal oscillator (VCXO) is locked to the rubidium atomic resonance at f_{Rb} = 6.834 682...GHz in the following manner. A microwave signal, having a frequency in the vicinity of f_{Rb}, is synthesized from the nominal 10 MHz VCXO output. This microwave signal is used to resonate rubidium atoms that are present in a sealed glass cell (the Rb resonance cell) in the form of a vapor that is placed inside a low Q microwave cavity. The frequency synthesis scheme is designed so that the VCXO frequency is exactly 10 MHz when the microwave frequency is exactly equal to f_{Rb}.

The frequency of the signal applied to the microwave cavity can be maintained equal to f_{Rb} by generating an error signal when the microwave frequency differs from f_{Rb} and using this error signal to servo the VCXO via its control voltage.

The error signal is generated in the optical package (physics package) as follows. Light from the rubidium lamp, produced by an rf excited plasma discharge, is passed though the rubidium resonance cell where it interacts with rubidium atoms in the vapor. After passing through the resonance cell, this light is incident upon a photocell. When the applied microwave frequency is equal to f_{Rb}, the rubidium atoms are resonated by the microwave field in the cavity, causing the light reaching the photocell to decrease, illustrated by the left, upper most curve in Figure 4.1. This decrease in light, when the microwave frequency is equal to the very-sharply-defined (Q_{Rb} 10^7) rubidium frequency, is then converted electronically to an error signal with amplitude and phase information that is used to steer the VCXO via its control voltage and to keep it on frequency at 10 MHz.

When the light from the rubidium spectral lamp strikes the photocell, a current proportional to the intensity of the light is generated. By modulating the rf signal injected into the resonator, the light striking the photocell will vary at the modulation rate, and the photocell output current will vary at the same rate.

The method of modulation used to locate the minimum photocell output current and thereby lock the VCXO to the atomic reference frequency is to frequency modulate the rf, at 127 Hz, prior to injecting the rf into the resonator. The 127 Hz modulation results in an alternating output from the photocell when the injected rf is not equal to f_{Rb}. When the rf is $<f_{Rb}$, the photocell current contains a component at 127 Hz ; likewise when rf is $>f_{Rb}$ a 127 Hz component is also present, but its phase is inverted. When the rf being injected is exactly equal to f_{Rb} the 127 Hz modulation varies the light signal around the null point of the photocell current (minimum light = minimum photocell current). When the light signal varies around the photo current null point the photocell output varies at twice the fundamental frequency, or 254 Hz, illustrated by the lower three curves and the center curve in Figure 4.1.

It is this 254 Hz signal which is used to generate the lock indicator signal, indicating that the unit is operating normally. If the rf signal drifts off frequency (rf $< >$ f_{Rb}) the photocell signal contains a 127 Hz component which for small offsets is proportional to the offset. The phase of the 127 Hz signal indicates if the rf is $<f_{Rb}$ or $>f_{Rb}$, and the phase information is used to servo the VCXO in the proper direction until the synthesized rf = f_{Rb}.

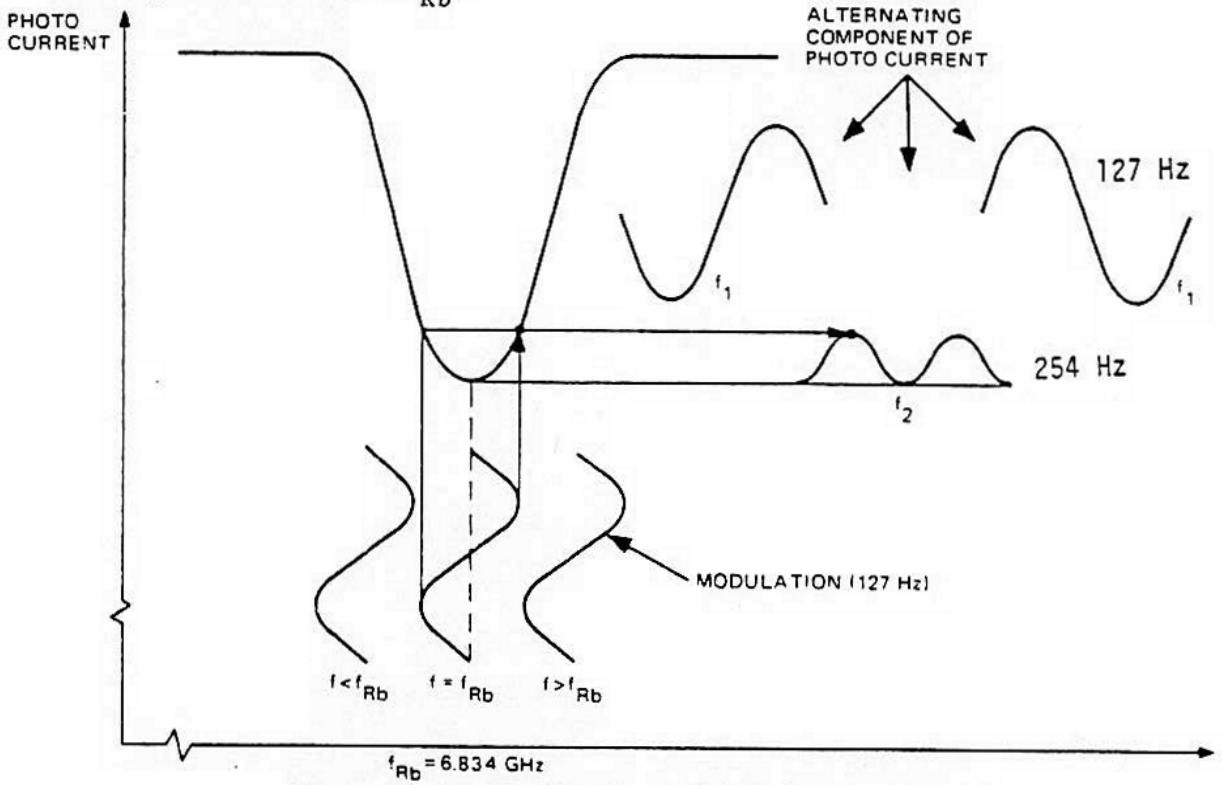


Figure 4.1. Derivation of Modulation Signal

4.2 BLOCK DIAGRAM ANALYSIS

As illustrated in the block diagram Figure 4.2, the Model M-100 contains the following five Assemblies:

(a) Servo board assembly A1.

(b) Physics package A2, (A2 includes the resonator, resonator thermostat board assembly A2A1, and the lamp board assembly A2A2).

(c) Power supply board assembly A3.

(d) Oscillator board assembly A4.

(e) Synthesizer board assembly A5.

In order to more easily understand the operation of the M-100, the following is written in the logical order-of-operation (with the exception of the power supply which is covered last), and not in the numeric order of the assemblies.

4.2.1 Oscillator Board Assembly A4.

The 10-MHz voltage-controlled crystal oscillator functions as the reference oscillator to provide a stable 10 MHz signal to the output connector and to the input of the frequency synthesizer assembly A5. A control voltage from the servo assembly is applied to a varactor diode to shift the frequency over a range of approximately 1.5×10^{-6} to maintain a 10 MHz output. The oscillator board contains a 10 MHz quartz crystal mounted in a thermal oven, the heater controller, an oscillator circuit, and output buffer amplifier.

The VCXO crystal is ovenized to improve its natural stability, and frequency locked to f_{Rb} primarily to improve its long-term stability. The temperature coefficient of the crystal is minimized by elevating its temperature to approximately 80°C, and holding that constant with the crystal heater controller circuitry. After atomic lock is obtained, the frequency of the oscillator is slaved to the atomic resonance of the rubidium atom via the VCXO control voltage from the servo assembly.

The output buffer amplifier provides isolation for the oscillator circuits. The buffered 10 MHz signals are transformer coupled to the output connector J1 and to the synthesizer assembly A5.

4.2.2 Synthesizer Assembly A5.

The synthesizer assembly produces the 6.834 682...GHz signal, from the VCXO 10 MHz output, which is compared to f_{Rb} within the physics package. The VCXO's control voltage is determined by the results of the comparison between the synthesized rf and the f_{Rb} signal developed in the physics package.

The 10 MHz signal from the VCXO is applied to both a tripler circuit and a sinewave to TTL conditioning circuit on the synthesizer assembly. The 10 MHz signal which was multiplied to 30 MHz by the tripler circuit is phase modulated at 127 Hz rate, and then applied to a doubler circuit which produces a 60 MHz signal, modulated at the 127 Hz.

The 10 MHz signal which was conditioned into a TTL signal is divided and recombined to produce a 5.3125 MHz TTL signal. This signal is combined with the phase-modulated 60 MHz signal and coupled by coaxial cable to a harmonic generator/step recovery diode within the physics package.

In addition, the synthesizer assembly provides control over the strength of a magnetic field around the resonator cavity, called the C-field. The C-field is used as the fine tuning for the Rb output frequency. The C-field control is temperature-compensated as a function of the resonator temperature, reducing the temperature coefficient of the M-100.

4.2.3 Physics Package A2.

The function of the physics package is to provide the correct signal to the servo board in order to control the frequency of the VCXO. The physics package contains the components required to produce the atomic reference frequency (6.834 682 ... GHz) to which the 10 MHz VCXO output is referenced and locked. The physics package consists of the resonator cavity, the resonator thermostat board A2A1, the Rb lamp oscillator board A2A2, and the Rb lamp and lamp housing assembly.

The 60 MHz and 5.3125 MHz signals from the synthesizer board are applied to a harmonic generator/step recovery diode (CR1). When CR1 conducts it produces the harmonics of the 60 MHz and 5.3125 MHz signals. The fundamental frequency and the harmonic frequencies are fed to the resonator cavity (resonant cell) via a resonant loop. The resonant cell and loop are tuned to select the 114^{th} harmonic of 60 MHz minus 5.3125 MHz, which corresponds to the resonant frequency of the rubidium. The response of the atoms is detected by the photocell which supplies the correcting signal to the servo board from E13 and E14 located on the resonator thermostat board.

Resonator Cavity.

The resonator cavity contains the Rb cell, and a photocell (CR2). The Rb cell is a specially designed glass cell which contains a mixture of rubidium isotopes and various gases which are used to provide the reference frequency.

The photocell is a silicon photodetector. The photocell is placed behind the Rb cell, directly in the light path of the Rb spectral lamp. The photocell detects variations in the Rb light intensity which are $< 0.1\%$ of the overall intensity of the light. If the synthesized microwave signal is not exactly equal to f_{Rb} indicating that the VCXO output is not exactly 10 MHz, the photocell output signal is electronically converted into an error signal which is used to steer the VCXO to exactly 10 MHz.

The temperature of the cavity is elevated and maintained at approximately 75°C by two heater transistors and a thermistor mounted on the resonator, operating in conjunction with the circuits on the resonator thermostat board. A coil wrapped around the resonator cavity provides a magnetic field around the resonator cavity. This magnetic field is called the C-field. The adjustment of the C-field is used for fine-tuning the output frequency of the M-100.

Resonator Thermostat Board A2A1.

The resonator thermostat regulates the temperature of the resonator cavity by regulating the power to the heater elements mounted on the resonator cavity. A thermistor mounted on the resonator cavity acts as a temperature sensor and forms part of the feedback network for the thermal control circuit.

Lamp Oscillator Board A2A2.

The Rb lamp oscillator board consists of the lamp exciter circuits and lamp-housing heater circuits. The function of the lamp oscillator board is to ignite and maintain ignition of the Rb spectral lamp, and to provide control of the required heating necessary to maintain the lamp housing at approximately 115°C.

The lamp exciter circuit provides an rf excited plasma discharge which ignites and maintains ignition of the Rb spectral lamp. The lamp exciter circuit is a tunable oscillator, operating at approximately 80 MHz. The actual frequency of oscillation is determined by a tuned LC tank circuit, with the L component being a coil permanently mounted in the lamp housing.

Rb Lamp Assembly.

The Rb lamp assembly consists of the specially fabricated Rb spectral lamp, the Rb lamp oscillator coil, and the lamp heater and temperature sensor elements. The Rb spectral lamp produces light of the proper wavelength to interact with the rubidium atoms contained within the Rb resonant cell. The Rb lamp coil is permanently mounted within the Rb lamp housing in such a way that it surrounds the Rb lamp when the lamp is installed into the housing.

4.2.4 Servo Assembly A1.

The primary function of the servo assembly is to translate the photocell output signal into the correct control voltage for the VCXO in order to maintain the precise 10 MHz output frequency. The control voltage is derived by comparing the phase of the 127 Hz modulation signal with the phase of the photocell output signal. The 127 Hz modulation signal, a 127 Hz reference signal, and a 254 Hz reference signal originate in the servo assembly. The secondary function is to provide the monitoring signals for the Rb lamp operation, the atomic resonant lock circuit, and the VCXO control voltage monitor.

A CMOS oscillator/divider on the servo assembly provides the 127 Hz modulation signal for the synthesized rf introduced into the resonator. The oscillator frequency of 8.128 KHz is divided into the required 127 Hz and 254 Hz reference signals. The 127 Hz modulation signal is waveshaped into a sinewave on the servo assembly, and coupled to the synthesizer assembly to modulate the rf.

The photocell output from the physics package is routed to a dual stage current amplifier on the servo assembly. The photocell output signal is 254 Hz when the unit is in the locked mode of operation, or 127 Hz while the unit is obtaining lock. The first stage of amplification conditions the photocell signal, and provides the lamp voltage monitor signal available at the output connector J2 pin B. The output of the second stage of amplification is used for the phase comparison.

The phase detector is a triple two-channel CMOS analog switch which functions as a synchronous demodulator. The 127 and 254 Hz reference signals control the synchronous switching of the two switches, while the third switch is controlled by the level of signal from the lock monitor circuit.

4.2.5 Power Supply A3.

The internal power supply accepts +22 to +32 vdc input power and provides +20 vdc filtered and regulated power for the M-100 electronics, +21 vdc filtered, and floating power for the Rb lamp heaters; in addition to providing the unregulated, filtered voltages for the oscillator heater and resonator heaters. The input voltage line is fuse and diode protected against reverse-polarity inputs.

SECTION 5
MAINTENANCE

5. INTRODUCTION.

This section of the manual provides detailed procedures and instructions for performing all maintenance functions on the M-100, including incoming acceptance tests, performance tests, calibration, troubleshooting and repair. Throughout the test procedures the M-100 will be referred to as the UUT (Unit Under Test).

5.1 REQUIRED TEST EQUIPMENT.

The required test equipment to properly service the UUT is listed in Table 5.1. Test equipment other than the items listed may be used provided that they meet or exceed the Minimum Use Specification stated in Table 5.1. In the event that the required test equipment or a suitable substitute is not available it is recommended that the unit be returned to the factory for service.

Table 5.1 REQUIRED MAINTENANCE TEST EQUIPMENT

Item	Minimum Use Specification	Test Equipment
5.1 DC Power Supply	Voltage: 0 to 30 vdc Accuracy: Output monitored Current: 0 to 3 adc Accuracy: Output monitored	Hewlett Packard 6296A or 6433B
5.2 Digital Multimeter (DMM) (2 required)	Voltage: 0 to 30 vdc Accuracy: $\pm$ 1.25% iv Current: 0 to 3 adc Accuracy: $\pm$ 1% iv Resistance: 200 ohm range Accuracy: N/A	John Fluke 8600 opt 01
5.3 Reference Frequency Standard	Output: 10 MHz Accuracy: $\leq 1 \times 10^{-11}$/month, long-term drift	EFRATOM FRT-H
5.4 Linear Phase Recorder	Comparison range: 1 part in 10^7 to 1 part in 10^{11}	Tracor 888

Table 5.1 REQUIRED MAINTENANCE TEST EQUIPMENT (cont.)

Item	Minimum Use Specification	Test Equipment
5.5 True RMS Voltmeter	Range: 0 to 1 vrms Input Frequency: 10 MHz Accuracy: ± 3%	Hewlett Packard 3403C
5.6 Spectrum Analyzer	Range: 20 Hz to 100 MHz Bandwidth: 300 KHz	Hewlett Packard 141T Display with 8552 IF section and on 8553B RF section
5.7 Multifunction Counter	Perform time interval measurement using external time base. Periods Averaged: 1 to 10^5 Provide Data output	Fluke 1910A-02
5.8 Strip Chart recorder	Span Range: 1 mV to 1 V	Hewlett Packard 7132A or Texas Instruments PRIMA16AFR
5.9 Oscilloscope	Range: DC to 100 MHz	Tektronix 465 or 7704 MOD 129F with 7A26 Vert. P/I and 7B53A Time Base P/I
5.10 Resistive Load	Type: Feedthrough Impedance: 50 ohm Accuracy: ± 0.5 ohm	Pomona Electric 4119-50 or Hewlett Packard 10100A
5.11 Atomic Oscillator Test Set	Input: 10 MHz Accuracy: ± $1X10^{-11}$	Efratom TS-105A

5.2 TEST PROCEDURES.

The test procedures described in subsections 5.6 through 5.11 can be used to check performance for incoming inspection and periodic unit evaluation. These tests can be performed without removing the unit's outer cover.

5.3 CALIBRATION.

Calibration of the M-100 is accomplished by performing the tests described in Section 3, in addition to the tests in subsections 5.6 through 5.15 (as required).

5.4 TROUBLESHOOTING.

In the event that a major section or the complete unit is inoperative, troubleshooting will be necessary. Table 5.2 lists the most common malfunctions and the recommended checks. In general, internal adjustments have only a limited range and are designed to compensate for minor variations in circuit components; seldom, if ever, will an internal adjustment restore operation. The test procedures in subsection 5.6 through 5.13 will serve as an aid in further isolating a trouble to a specific circuit section.

Since the operation of some circuits is dependent on proper operation of other circuits, troubleshooting must be performed in the sequence given. If the trouble indicates a possible malfunction of a specific board, perform the troubleshooting procedure on that board. If the trouble cannot be found by any other means, perform the measurement tests described in Tables 5.3 through 5.7 in sequence until the trouble is located. If the problem is found to be in the physics package return the unit to the factory. The physics package is not field repairable.

5.5 EQUIPMENT HISTORY.

It is recommended that an Equipment History be maintained for each unit, and that the results of the performance tests be made a part of the permanent record for the Equipment History. A blank sample Performance Check List is included at the end of this section for your convenience. The blank sample check list may be reproduced as necessary to provide a permanent record.

NOTE

If the UUT has a heatsink attached, remove it prior to beginning the test sequence.

5.6 WARM-UP CURRENT, FREQUENCY ACCURACY AND INPUT POWER TESTS.

5.6.1 Connect the equipment as shown in Figure 5.1

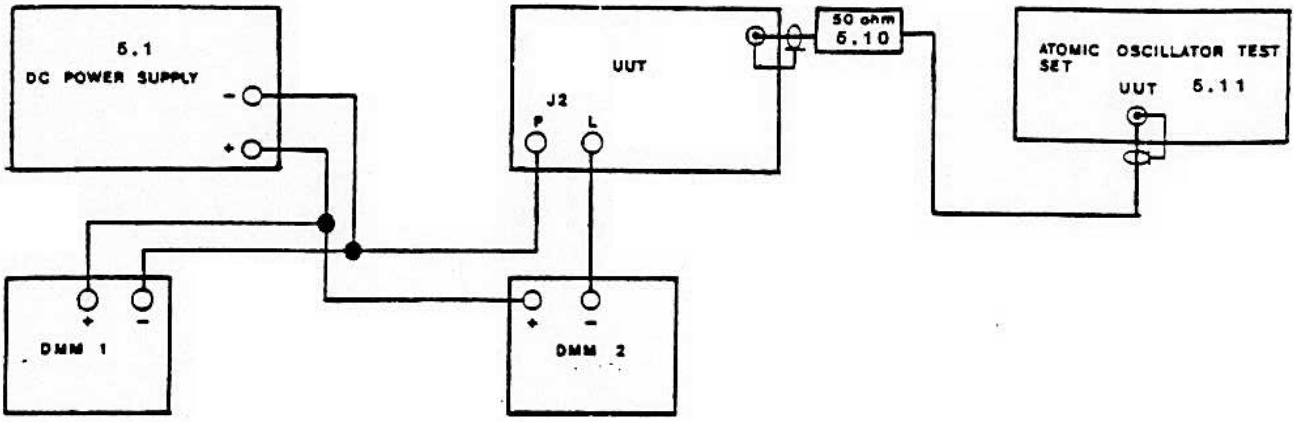


Figure 5.1. Warm-up Current, Frequency Accuracy, and Input Power Test Configuration.

5.6.1.1 Set the DMM #1 controls for voltage measurements in the 30 vdc range.

5.6.1.2 Set the DMM #2 controls for current measurements in the 3 adc range.

5.6.1.3 Ensure that all test equipment is operating and has had sufficient warm-up time.

5.6.2 Adjust the DC power supply controls to obtain a 26 $\pm$ 1.3 vdc indication on DMM #1. Note the exact indication; it will be required in step 5.6.6.

5.6.3 Allow the UUT to operate at ambient temperature for at least 5 hours.

NOTE

The maximum temperature fluctuation must not exceed $\pm$ 2°C. Also, continuous operation of the atomic oscillator test set is preferred over warm-up.

5.6.4 Ensure that the atomic oscillator test set has been operating at ambient temperature for at least 2 hours, press the RESET push button to begin the test.

5.6.5 Allow the atomic oscillator test set sufficient time to display the UUT Offset for the 100 seconds averaging time.

5.6.6 Record the UUT offset as indicated on the atomic oscillator test set. If the indicated offset is greater than $\pm 5 \times 10^{-11}$, adjust the UUT Frequency Trim potentiometer (as described in Section 3, steps 3.4.7.1 and 3.4.7.2) to obtain an in tolerance indication. If an in tolerance indication is not possible and the UUT frequency is too low, perform subsection 5.14; if the UUT frequency is too high, perform subsection 5.15.

5.6.7 Adjust the DC power supply for minimum output (0 vdc), and note the turn-off time. Allow a minimum of 2 hours before proceeding.

5.6.8 Monitor DMM#1 and DMM #2 while adjusting the DC power supply for the exact voltage noted in step 5.6.2, and note the turn-on time.

5.6.9 Record the DMM #2 maximum current indication during the UUT 10 minute warm-up period.

NOTE

The UUT current normally reaches maximum within 2 minutes after input power is applied.

5.6.10 Verify that the UUT maximum warm-up current is ≤ 2.2 adc.

5.6.11 At the end of the 10 minute warm-up, press the atomic oscillator test set RESET push button and record the UUT frequency offset for 100 seconds averaging times.

5.6.12 Verify that the UUT frequency offsets recorded for steps 5.6.6 and 5.6.11 differ by no more than $\pm 2 \times 10^{-10}$.

5.6.13 Allow the UUT to operate continuously for at least 1 hour.

5.6.14 Note the voltage indication on DMM #1 and the current indication on DMM #2.

5.6.15 Using the following formula and the data from step 5.6.14 determine the UUT power comsumption.

Power Formula: $P = I E$

Where: P = Power

I = Current

E = Input voltage

5.6.16 Verify that the UUT power consumption after > 1 hour operation is $\leq$ 18 watts.

5.6.17 If no other tests are required, adjust the DC power supply for minimum output and disconnect the test setup.

5.7 SHORT-TERM STABILITY (Allan Variance).

5.7.1 Ensure that the equipment is connected as shown in Figure 5.1, (DMM #2 is not required for this test).

5.7.2 Adjust the DC power supply controls to obtain a 26 $\pm$ 1.3 vdc indication of DMM #1.

5.7.3 Ensure that the UUT and the Atomic Oscillator Test Set have had sufficient stabilization time. (The UUT requires 1 hour stabilization).

NOTE

The maximum temperature fluctuation must not exceed $\pm$ 2°C.

5.7.4 Press the RESET push button on the Atomic Oscillator Test Set to begin the Allan Variance tests.

5.7.5 Allow the Atomic Oscillator Test Set sufficient time to display the Allan Variance for averaging time of 1 and 10 seconds.

5.7.6 Verify that the Allan Variance for 1 second averaging time is $\leq 3 \times 10^{-11}$, and that the Allan Variance for 10 seconds averaging time is $\leq 1 \times 10^{-11}$ as indicated on the atomic oscillator test set.

NOTE

If the UUT is not within the stated tolerance it may be necessary to continue the test in order to obtain a 100 second averaging time indication. If a 100 second averaging time indication is required the tolerance is $\leq 3 \times 10^{-12}$.

5.7.7 If no further tests are required, adjust the DC power supply for minimum output and disconnect the test setup.

5.8 TRIM RANGE TEST.

5.8.1 Ensure that the equipment is connected as shown in Figure 5.1, (DMM #2 is not required for this test).

5.8.2 Adjust the DC power supply controls to obtain a 26 $\pm$ 1.3 vdc indication of the DMM #1.

5.8.3 Ensure that the UUT and the atomic oscillator test set have had sufficient time to stabilize. (The UUT requires 1 hour to stabilize).

5.8.4 Determine the UUT nominal output frequency from the Atomic Oscillator Test Set Frequency Offset indication.

5.8.5 Locate the UUT frequency adjustment screw access hole (refer to Figure 3.4 if necessary).

5.8.6 Using the appropriate adjustment tool, rotate the UUT trim potentiomenter fully clockwise and verify that the frequency offset indication on the test set increases $\geq 1 \times 10^{-9}$ of the nominal output. Record the shift from the nominal.

5.8.7 Rotate the UUT trim potentiometer fully counter clockwise and verify that the frequency decreases $\geq 1X10^{-9}$ of the uut nominal output. Record the shift from nominal.

5.8.8 Using the following formula and the data recorded in steps 5.8.6 and 5.8.7, compute the UUT trim range.

Trim range ($\Delta f/f$ range) = $\Delta f/f$ Max + $\Delta f/f$ Min

Where: $\Delta f/f \text{ Max} = \frac{f \text{ max} - f \text{ (test set ref)}}{f \text{ (test set reference)}}$

$\Delta f/f \text{ Min} = \frac{f \text{ (test set ref)} - f \text{ min}}{f \text{ (test set reference)}}$

5.8.9 Verify that the UUT trim range is $\geq 3 \times 10^{-9}$.

5.8.10 Adjust the UUT trim potentiometer to a position which returns the UUT as close to 10 MHz as possible $\pm 5 \times 10^{-11}$.

5.9 OUTPUT LEVEL TEST.

5.9.1 Connect the equipment as shown in Figure 5.2.

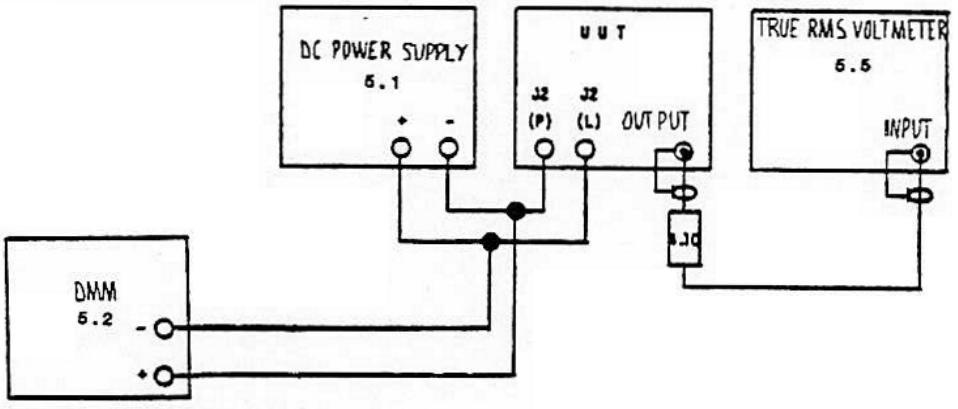


Figure 5.2. Output Level Test Configuration.

5.9.2 Adjust the DC power supply output controls to obtain a 26 $\pm$ 1.3 vdc indication on the DMM.

5.9.3 Allow a minimum of 10 minutes warm-up time for the UUT.

5.9.4 Verify that the UUT output level as indicated on the RMS voltmeter is between 0.45 and 0.65 vrms.

5.10 HARMONIC/NON-HARMONIC DISTORTION TESTS.

5.10.1 With the equipment connected as shown in Figure 5.2, disconnect the RMS voltmeter, and connect the uut output to the spectrum analyzer input, item 5.6.

5.10.2 Set the spectrum analyzer controls for 100 MHz sweep 300 KHz bandwidth.

5.10.3 Adjust the 10 MHz fundamental to REF on the spectrum analyzer display.

5.10.4 Measure the highest amplitude harmonic (in dB) below the REF.

5.10.5 Verify that the UUT Harmonic Distortion is at least 30 dB down from reference.

5.10.6 Measure the highest amplitude on Non-Harmonic signal up to 90 MHz.

5.10.7 Verify that the Non-Harmonic Distortion is at least 80 dB from the reference.

5.11 LONG-TERM STABILITY TEST.

Long-term stability refers to slow changes in the average frequency over time, due to secular changes in the UUT physics and/or electronic circuitry. Long-term stability is usually expressed as the ratio $\Delta f/f$, for a given period of time. A widely accepted method of measuring long-term stability uses a linear phase recorder to measuring long-term stability to plot the phase difference of the UUT versus that of a reference standard. The slope of the trace on the chart is the frequency offset between the UUT and the reference standard. The daily offsets can be plotted to show the long-term stability.

NOTE

Ensure that the UUT has been operating 14 days continuously prior to beginning this test.

5.11.1 Connect the equipment as shown in Figure 5.3.

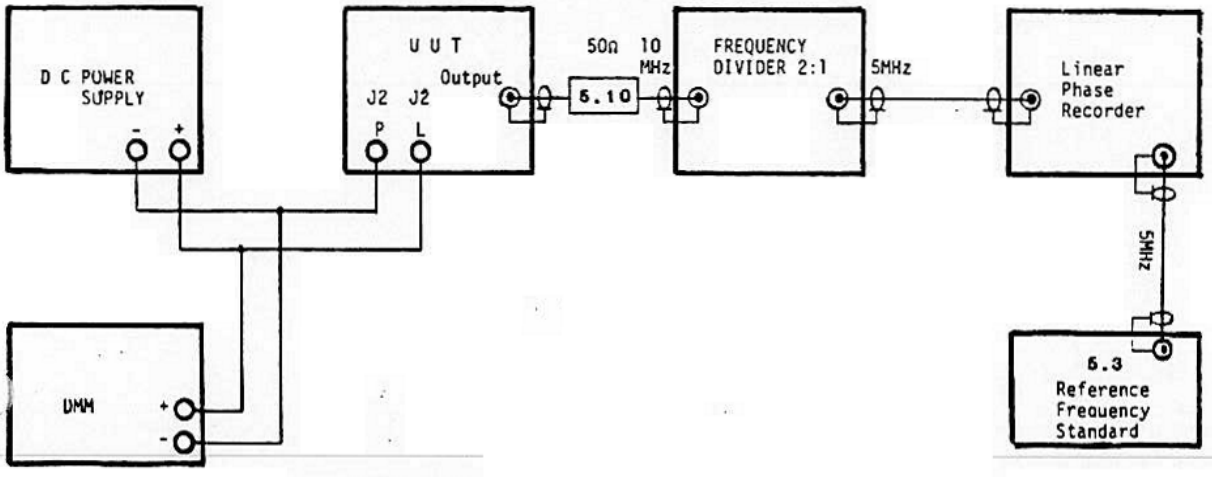


Figure 5.3. Long-Term Stability Test Setup.

5.11.2 Set the linear phase recorder controls as necessary to obtain a full scale chart width of 1 μsec (phase difference).

5.11.3 Using the following formula, compute and record the average fractional frequency offset every 24 hours over a period of at least 7 days.

$$\frac{\Delta f}{f} = \frac{\tau_1 - \tau_2}{T}$$

Where: $\Delta f/f$ = Average fractional frequency offset.

τ_1 = Initial phase difference indication.

τ_2 = Final phase difference indication.

T = Elapsed time between indications.

NOTE

It is recommended to plot the daily offset graphically and use this plot to estimate long term aging. If less than 30 indications are taken, the long term stability may be calculated for a 30 day period.

5.11.4 Based on the test results of step 5.11.3 verify that the long-term stability is $\leq 6 \times 10^{-11}$/month.

5.11.5 If no further tests are required, adjust the DC power supply for minimum output and disconnect the test setup.

5.12 VOLTAGE VARIATION TEST

5.12.1 Connect the equipment as shown in Figure 5.1.

NOTE

The ambient temperature should not vary more than $\pm$ 1°C during performance of this test.

5.12.2 Adjust the DC power supply controls to obtain a 26 $\pm$ 0.1 vdc.

5.12.3 Allow the UUT and the Atomic Oscillator Test Set sufficient time to stabilize (the UUT requires 1 hour min.).

5.12.4 At the end of the stabilization period, determine and record the UUT output frequency.

5.12.5 Adjust the DC power supply controls to obtain a 28.6 ± 0.1 vdc indication on the DMM. Allow the UUT to operate at this input voltage for at least 15 minutes.

5.12.6 Determine and record the UUT output frequency. Verify that it is within ± $1x10^{-11}$ of the reference frequency of step 5.12.10.

5.12.7 Adjust the DC power supply controls to obtain a 23.4 ± 0.1 vdc indication on the DMM. Allow the UUT to operate at this voltage for at least 15 minutes.

5.12.8 Determine and record the UUT output frequency and verify that it is within ± $1x10^{-11}$ of the reference frequency of step 5.12.10.

5.12.9 Adjust the DC power supply controls to obtain 26 ± 0.1 vdc indication on the DMM. Allow the UUT to operate at this input voltage for at least 15 minutes and record the UUT output frequency.

NOTE

The UUT average output frequency is the Referency Frequency for steps 5.12.6 and 5.12.8.

5.12.10 Determine and record the average UUT output frequency from the frequencies recorded in step 5.12.4 and 5.12.9.

5.13 CRYSTAL AGING COMPENSATION.

5.13.1 If the crystal control voltage approaches the end of the control range of +3 to +17 vdc, a correction of the crystal oscillator base frequency must be made.

5.13.1.1 Connect the equipment as shown in Figure 5.4, but do not make the dotted-line connection until instructed to do so.

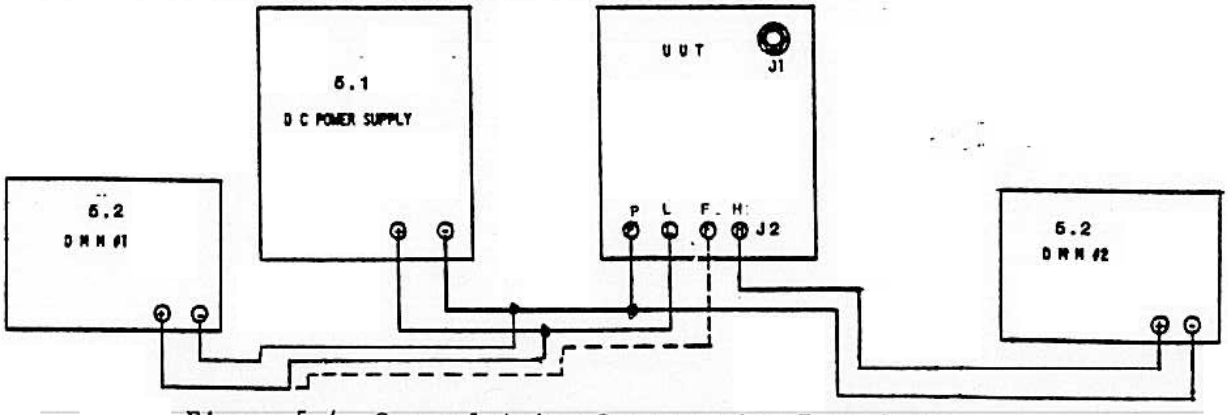


Figure 5.4. Crystal Aging Compensation Test Setup.

5.13.1.2 Set DMM #1 controls to measure dc voltage in the 30 vdc range, and DMM #2 to 200 ohm range. (Do not use auto range for this test).

5.13.1.3 Adjust the DC power supply output for a 26 $\pm$ 1.3 vdc indication on the DMM #1,

5.13.1.4 Disconnect the DMM #1 positive (+) lead connected to the DC power supply positive output connector. (Do not disturb the positive input to UUT).

5.13.1.5 Set the DMM #1 controls to measure DC voltage in the 20 volt range, and connect the positive lead to the UUT J2 pin F connection.

5.13.1.6 After the UUT has operated a minimum of 1 hour, ensure that DMM #2 indicates approximately 120 ohm and maintains this indication throughout the remainder of the test. (This indicates that the UUT has locked onto the atomic resonance frequency.)

5.13.1.7 Refer to Figure 5.5 to locate the UUT crystal trim adjustment (C5).

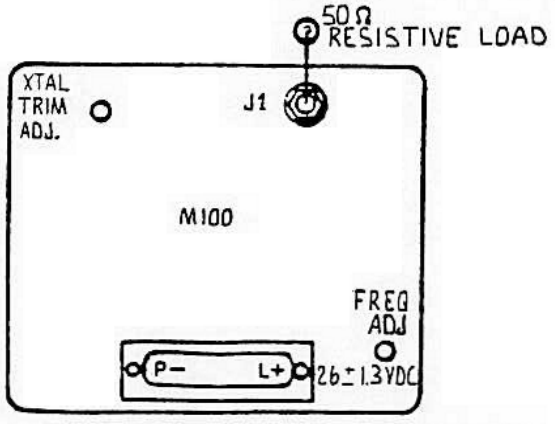


Figure 5.5. Crystal Trim Adjustment Location.

5.13.1.8 Using the proper adjustment tool or insulated screwdriver, slowly rotate the crystal trim adjustment to obtain a voltage indication, on DMM #2, of approximately +9 vdc. Clockwise rotation decreases the control voltage, counterclockwise rotation increases the control voltage.

5.13.1.9 If the crystal control voltage cannot be adjusted to +9 volts with the crystal trim adjustment proceed with step 5.13.2.

5.13.2 Remove the UUT outer cover by first removing the twelve (12) screws and related washers from the outer cover sides near the baseplate end of the UUT. Then remove the four (4) screws and related washers from the connector end of the outer cover. Carefully slide the UUT out of the outer cover.

NOTE

The UUT comes supplied with either one (1) or two (2) spare capacitors to be used as necessary to compensate for crystal aging. The number of capacitance value(s) has been determined by the preselected value of C6 on the oscillator board. The compensation capacitors are designated A4C6+ and A4C6- (if two (2) were necessary) and are located on the synthesizer board assembly A5. Refer to the final assembly drawing, Drawing No. 70500-1, top cut-away and Note (5) for further information and physical location. If the crystal control voltage was found to be too low (<+3 vdc) perform Subsection 5.13.3, if the crystal control voltage was found to be too high (>+17 vdc) DO NOT perform subsection 5.13.3, but perform subsection 5.13.4.

5.13.3 Locate C8 on the oscillator board assembly A4. Refer to Drawing No. 70512-2.

5.13.3.1 Locate and remove adjustment capacitor A4C6+ from the synthesizer board assembly.

5.13.3.2 Connect the adjustment capacitor in parallel to C8 on the oscillator board.

5.13.3.3 Ensure that the crystal trim adjustment C6 is set to approximately the center of its range.

5.13.3.4 Using the method described in steps 5.13.1.1 through 5.13.1.9 readjust the control voltage to approximately +9 vdc.

5.13.4 Locate C6 on the oscillator board assembly A4. Refer to Drawing No. 70512-2.

5.13.4.1 Locate and remove "adjustment capacitor A4C6- from the synthesizer board assembly.

5.13.4.2 Remove C8 from the oscillator board and connect A4C6- in its place.

5.13.4.3 Ensure that the crystal trim adjustment C6 is set to approximately the center of its range.

5.13.4.4 Using the method described in steps 5.13.1.1 through 5.13.1.9 readjust the control voltage to +9 vdc.

5.13.4.5 Secure the UUT outer cover by reinstalling all of the screws and washers removed in step 5.13.2.

NOTE

If during the performance of Section 3, Subsection 3.9, Operational Frequency Accuracy Test, or Subsection 5.6 Frequency Accuracy portion, it was found that the Frequency Adjust potentiometer (R35) did not have sufficient range to adjust the UUT output frequency within the required 5×10^{-11} it will be necessary to adjust the C-field current through the resonator coil.

An increase in C-field current will increase the UUT output frequency, whereas decreasing the C-field current will decrease the output frequency. Refer to synthesizer assembly Drawing No. 70515 and synthesizer schematic Drawing No. 70516 as required to facilitate the correction compensation. If the UUT output frequency was found to be too low after adjusting the UUT frequency adjust potentiometer R35 fully clockwise, perform the required steps in subsection 5.14 and omit subsection 5.15. If the UUT output frequency was found to be too high after adjusting R35 fully counterclockwise, omit subsection 5.14 but perform subsection 5.15.

5.14 UUT OUTPUT FREQUENCY LOW COMPENSATION.

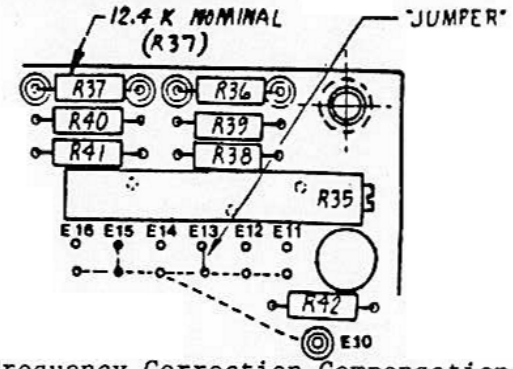


Figure 5.6. Location of Frequency Correction Compensation Jumpers on Synthesizer Board Assembly.

5.14.1 Remove the UUT from its outer cover by removing the twelve (12) screws and related washers from the outer cover sides near the baseplate end of the UUT. Then remove the four (4) screws and related washers on the connector end and carefully slide the UUT out of the outer cover.

NOTE

The C-field current is adjusted by changing pre-selected jumper wires on the synthesizer board assembly. Refer to Figure 5.6.

5.14.2 Locate the compensation jumper connections on the synthesizer board.

NOTE

Terminal E15 is normally jumpered to E10 at the factory, (dotted-line connections in Figure 5.6). On some UUT's the jumper was not required. If the UUT does not have a jumper between E10 and either E16, E15, or E14, perform subsection 5.14.3. If a jumper is connected between E10 and either E16 or E15 omit subsection 5.14.3 but perform 5.14.4. If E10 is jumpered to E14, omit subsections 5.14.3 and 5.14.4 but perform subsection 5.14.5.

5.14.3 Using a 35 to 40 watt soldering iron and SN63WRMAP3 solder, (Federal Specification QQ-S-571E), perform the following:

5.14.3.1 Locate terminal E16 and the corresponding E10 connection on the synthesizer board, refer to Figure 5.6, as necessary.

5.14.3.2 Select a piece of uninsulated 24 gauge wire approximately 1/8 inch long.

5.14.3.3 Lay the jumper across the E16 and corresponding E10 terminals, and carefully solder the jumper in place.

5.14.3.4 Replace the UUT outer cover and secure with two (2) screws and washers removed in step 5.14.1.

5.14.3.5 Perform the steps in subsection 3.9 to adjust and verify that the UUT output frequency is 10 MHz $\pm$ 5×10^{-11}.

5.14.3.6 Secure the UUT outer cover by reinstalling all of the screws and washers removed in step 5.14.1.

5.14.4 Using a 35 to 40 watt soldering iron and SN63WRMAP3 solder (Federal Specification QQ-S-571E), perform the following:

5.14.4.1 Remove the existing jumper between E10 and either E16 or E15 terminals.

NOTE

Moving the jumper from E10/E16 to E10/E15 or E10/E15 to E10/E14 will increase the UUT output frequency by approximately 1×10^{-9}.

5.14.4.2 Select a piece of uninsulated 24 gauge wire approximately 1/8 inch long.

5.14.4.3 Lay the jumper across the E10/E15 or E10/E14 terminals as illustrated in Figure 5.7 and carefully solder the jumper in place.

5.14.4.4 Replace the UUT outer cover with two (2) of the screws and washers removed in step 5.14.1.

5.14.4.5 Perform the necessary steps in subsection 3.9 to adjust and verify that the UUT output frequency is 10 MHz $\pm$ 5×10^{-11}.

5.14.4.6 Secure the UUT outer cover by reinstalling all of the screws and washers removed in step 5.14.1.

5.14.5 If it was found that the E10/E14 terminals have a jumper installed it will be necessary to recalculate the value of R37 and replace the old R37 with a resistor of the new calculated value. Proceed as follows:

5.14.5.1 Locate and determine the value of R37 on the synthesizer board assembly. Refer to Appendix B, Drawing No. 70515.

5.14.5.2 Calculate the new required value for R37 using the following formula:

$$R37new = \frac{40}{\frac{\Delta f}{f} + \frac{40}{R37}} \text{ Original}$$

Where: $\frac{\Delta f}{f}$ = Anticipated positive frequency increase in parts of 10^{-9}.

R37 = K Ohms

5.14.5.3 Using a 35 to 40 watt soldering iron and SN63WRMAP3 solder (Federal Specification QQ-S-571E), remove resistor R37 and the jumper across E10/E14.

5.14.5.4 Replace R37 with a resistor of the calculated value from step 5.14.5.2.

5.14.5.5 Replace the UUT outer cover and secure with two (2) of the screws and washers removed in step 4.15.1.

5.14.5.6 Perform the necessary steps in subsection 3.9 to adjust and verify that the UUT output frequency is 10 MHz $\pm$ 5×10^{-11}.

5.14.5.7 Secure the UUT outer cover by reinstalling all of the screws and washers removed in step 5.14.1.

5.15 UUT OUTPUT FREQUENCY HIGH COMPENSATION.

5.15.1 Remove the UUT from its outer cover by removing the twelve (12) screws and washers from the outer cover sides located near the baseplate end of the UUT. Then remove the four (4) screws and related washers on the connector end and carefully slide the UUT out of the outer cover. The "C-field" current is adjusted by changing pre-selected jumper wires or recalculating the required value of R37 and replacing R37 if necessary. Locate the compensation jumper connections on the synthesizer board. Refer to Figure 5.7.

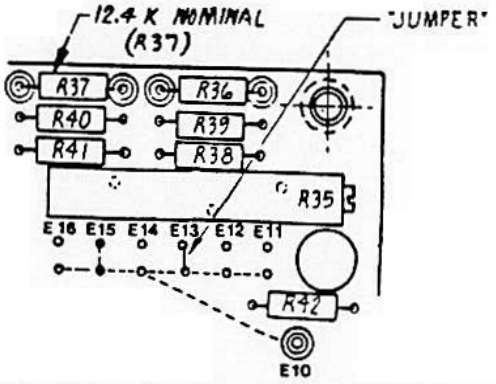


Figure 5.7 Location of Frequency Correction Compensation Jumper on Synthesizer Board Assembly.

NOTE

Terminal E15 is normally jumpered to E10 at the factory, (dotted-line connections in Figure 5.7). If a jumper is installed between E10 and either E14 or E15 perform subsection 5.15.3 and omit subsection 5.15.4. If a jumper is installed between E10 and E16 omit subsection 5.15.3 but perform 5.15.4. It may be also necessary to perform 5.15.5). If E10 is not jumpered to either E14, E15, or E16 omit subsection 5.15.3 and 5.15.4 but perform subsection 5.15.5.

5.15.3 Using a 35 to 40 watt soldering iron and SN63WRMAP3 solder (Federal Specification QQ-S-571E) perform the following:

5.15.3.1 Select a piece of uninsulated 24 gauge wire approximately 1/8 inch long.

5.15.3.2 If E10/E14 are jumpered, remove the existing jumper and lay the new jumper wire across the E15 and corresponding E10 terminals. If E10/E15 are jumpered, remove the existing jumper and lay the new jumper wire across the E16 and corresponding E10 terminals.

5.15.3.3 Carefully solder the jumper wire in place.

5.15.3.4 Replace the UUT outer cover and secure with two (2) of the screws and washers removed in step 5.15.1.

5.15.3.5 Perform the necessary steps in subsection 3.9 to adjust and verify that the UUT output frequency is 10 MHz $\pm$ 5×10^{-11}.

5.15.3.6 Secure the UUT outer cover by reinstalling all of the screws removed in step 5.15.1.

5.15.4 If it was found that the E10/E16 terminals have a jumper installed, perform the following steps.

5.15.4.1 Using a 35 to 40 watt soldering iron, remove the jumper across the E10/E16 terminal.

5.15.4.2 Replace the UUT outer cover and secure with two (2) of the screws and washers removed in step 5.15.1.

5.15.4.3 Perform the required steps in subsection 3.9 to adjust and verify that the UUT output frequency is 10 MHz $\pm$ 5×10^{-11}.

5.15.4.4 Secure the UUT outer cover by reinstalling all of the screws and washers removed in step 5.15.1.

5.15.5 If no jumper exists between E10 and E14, E15, or E16 it will be necessary to replace R37 with a recalculated valued resistor. To recalculate and replace R37 perform the following steps.

5.15.5.1 Calculate the required increased resistance value for R37 using the following formula:

$$\text{R37 new} = \frac{40}{\frac{\Delta f}{f} + \frac{40}{\text{R37 Original}}}$$

Where: $\frac{\Delta f}{f}$ = Anticipated negative frequency shift in parts of 10^{-9}.

R37 = K ohms

5.15.5.2 Using a 35 to 40 watt soldering iron and SN63WRMAP3 solder (Federal Specification QQ-S-571E) remove the existing R37 resistor and install a new R37 resistor with the resistance value calculated in step 5.15.5.1.

5.15.5.3 Replace the UUT outer cover and secure with two (2) of the screws and washers removed in step 5.15.1.

5.15.5.4 Perform the required steps in subsection 3.9 to adjust and verify that the UUT output frequency is 10 MHz $\pm$ 5×10^{-11}.

5.15.5.5 Secure the UUT outer cover by reinstalling all of the screws and washer removed in step 5.15.1.

5.16 SOLDERING TECHINQUES.

SN63WRMAP3 solder, per QQ-S-571, and a 35 to 40 watt soldering iron should be used to accomplish the majority of the soldering done on the M-100. If a higher wattage soldering iron is used, excessive heat can cause the etched circuit wiring to separate from the board material. If it becomes necessary to solder in the general area of any of the high frequency contacts in the unit, clean the contacts immediately upon completion of the soldering.

Table 5.2 Troubleshooting Guide

Malfunction	Suggested Checks
1. Unit completely inoperative (no 10 MHz output, VCXO = 0 Vdc).	a. Verify input Voltage = 22.5 to 32 Vdc b. Check connections at J2. c. Check A3 power supply for +20 Vdc at the collector of Q9 (mounted on frame assembly, see drawing 70570. Use standard circuit tracing techniques to isolate trouble to a specific stage or component.
2. Weak 10 MHz output or no output.	a. Check J1 connections to A4. b. Check oscillator circuit (schematic 70513).
3. No atomic resonance locked operation.	a. Check lamp for correct ignition voltage. A1TP1 4.5-11Vdc (when lamp is ignited) A1TP1 2.1 Vdc (before lamp ignition) Ignition in the wrong mode (indication is similar to a hot lamp). Restore to normal mode by turning input power off and then on. b. Check +20V input current to lamp. 135-155 ma is normal and can be adjusted with A2A2C5 (drawing 70507). c. Check Synthesizer circuit (schematic 70516). E3 10 MHz 2.2V nom. (Check Oscillator circuit per schematic 70513). E5 127 Hz 300-500mV p-p (Check Servo-circuit per schematic 705-138). TP9 5.3125 MHz. E7-E8 60 MHz 15-25V p-p. d. Check Servo circuit (schematic 705-138). TP1 4.5-11 Vdc (Check Optical Path per Physics Package schematic 70519). E8 127Hz ± 1 Hz 300-500mV p-p. U3 pin 7 15 Vdc. U7 pin 7 12 Vdc. E6 2.5 to 16.5 Volts, 8 Volts nominal. e. Verify resonator operation at A5E6,E7 with 10KΩ in series with DVM. 1.5-2.8 normal (see drawing 70519).

Table 5.3 Servo Board A1 Test Measurements

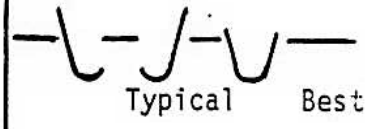
Test Point To Ground	Test Parameters	Frequency Range	Typical Waveform
E1	+20 ± 0.2 Vdc		
E2	Ground		
TP1	4.5-11 Vdc		
TP2	250 mV p-p min.	254 ± 2 Hz	Sine Wave
TP3	2.5 V p-p	254 ± 2 Hz	
TP4	2.0 V p-p	127 ± 1 Hz	
TP5	2.0 Vdc for return sweep 7.0 Vdc for normal sweep		
TP6	4.0 V p-p	254 ± 2 Hz	Sine Wave
TP7	4.0 V p-p	254 ± 2 Hz	
E6	2.5 - 16.5 Vdc 9V Nominal		
E7	< 1KΩ to Gnd		Atomic Locked operation only
E8	300-500 mV p-p	127 ± 1 Hz	Sine Wave

Table 5.4 Synthesizer A5 Test Measurements

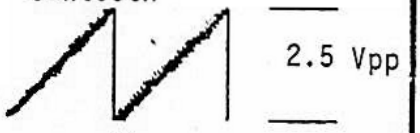
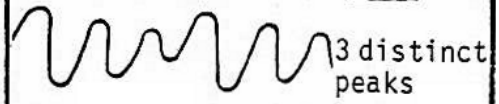
Test Point	Test Parameters	Frequency Range	Typical Waveform
E1	+20 ± 0.2 Vdc		
E2	Ground		
E3	2.0V p-p min.	10 MHz	Sine Wave
E5	300-500 mV p-p	127 ± 1 Hz	Sine Wave
TP1	2.5 V p-p nom.	10 MHz	Sawtooth 
TP3	6.0 V p-p	30 MHz	
TP4	2.0 V p-p	30 MHz	Sine Wave
TP5	4 V p-p nom.	60 MHz	Sine Wave
TP6	8.0 V p-p	60 MHz	Sine Wave
TP8	15 V p-p nom.	60 MHz	Sine Wave
TP9	800 mV p-p nom.		
U1, Pin 14	4.7-5.3 Vdc		
U1, Pin 5 & 13	3.0 V p-p	5 MHz	Square Wave
U1, Pin 1, 2, 4	3.0 V p-p	312.5 KHz	Square Wave
U1, Pin 8	3.0 V p-p	5.3125 MHz	Square Wave

Table 5.5 Oscillator Board A4
Test Measurements

Test Point	Test Parameters
E1	20 ± 0.2 VDC
E2	Gnd
E3 22.5-32Vdc	Specified nominal input voltage
E4	2.5-16.5 VDC
TP2	100-200 mv p-p
TP3	1-10 VDC
TP4	1.2 V p-p
TP5	1.2 V p-p
E5-E6	2.0 V p-p min.
E7-E8	0.5Vrms +30% -10% Into 50Ω load

Table 5.6 Power Supply A3
Test Measurements

Test Point	Test Parameters
E1	24 ± 1.2 VDC (5%)
E16 22.5-32Vdc	26 ± 1.3 VDC (5%) (Fast warm-up only)
Q9C	20 ±0.1 VDC
U1-2 6.2 ± 0.2Vdc	6.5 ± 0.2 VDC
U1-6	10 ± 1 VDC (Dependent on load and input supply)
Q1C	< 0.6 V normal load
Q1C	≈ 1.7 V minimal overload
E15	18.0 - 28.3V
CR4 Anode	19 ± 1 VDC

Table 5.7 Lamp Board A2A2
Test Measurements

Test Point	Test Parameters
E1	+20 ± 0.2 Vdc
E3	18.0-28.3 Vdc (dependent on Input Voltage at A3E1
E1	135-155 ma Input current (Adj C5)
CR1 Anode	1.0-1.9 Vdc
Temp at Base of lamp	112-116°C(Note: RF affects reading on most meters).

5.17 SAMPLE TEST DATA SHEETS.

Model: Efratom M-100 Rubidium Frequency Standard

Serial No: Date:

Manual Para No. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL (6)	Tolerance Limits (7)
3.3	Atomic Resonance Lock-on					
3.3.2	Time Input Power Applied					Note Time:
3.3.6	Time to Lock-on	≤ 10 min				≤ 10 min.
3.3.8	Control Voltage	3 to 17vdc				> 3 < 17 vdc
3.4	Operational Freq. Accuracy					
3.4.7	Frequency Offset	10 MHz				$\pm 5 \times 10^{-11}$
3.5	Short-Term Stability					
3.5.6	1 Second Averaging	10 MHz				$\pm 3 \times 10^{-11}$
	10 Second Averaging	10 MHz				$\pm 1 \times 10^{-11}$
5.6	Warm-up Current, Frequency Accuracy and Input Power Tests					
5.6.2	DMM #1 Indication					Note exact DMM#1 Ind.
5.6.6	UUT Frequency Offset					Record Offset
5.6.7	Turn-off Time					Note Turn-off Time
5.6.8	Turn-on Time	> 2 hr				Note Turn-on Time
5.6.9	DMM #2 Ind. at 10 min					Record
5.6.10	UUT Max. Warm-up Current	≤ 2.2 Adc				
5.6.11	UUT Frequency Offset					Record Offset
5.6.12	Offset Difference					$\pm 2 \times 10^{-10}$
5.6.14	DMM #1					Note Indication
5.6.14	DMM #2					Note Indication
5.6.16	> 1 hr operation power	< 18 W				
5.7	Short-Term Stability					
5.7.6	1 Second Averaging	10 MHz				$\pm 3 \times 10^{-11}$
	10 Second Averaging	10 MHz				$\pm 1 \times 10^{-11}$
5.8	Trim Range Test					
5.8.6	Trim Pot Fully CW	Increase				$\geq 1 \times 10^{-9}$
5.8.7	Trim Pot Fully CCW	Decrease				$\geq 1 \times 10^{-9}$
5.8.9	Trim Range	3×10^{-9}				$\geq 3 \times 10^{-9}$
5.9.6	Output Level Test					
5.9.4	Output	0.5 Vrms				0.45 to 0.65 Vrms
5.10	Harmonic/Non Harmonic Distortion Tests					
5.10	Harmonic Distortion					> 30 dB Down
5.10	Non Harmonic Distortion					> 80 dB Down

Model: Efratom M-100 Rubidium Frequency Standard

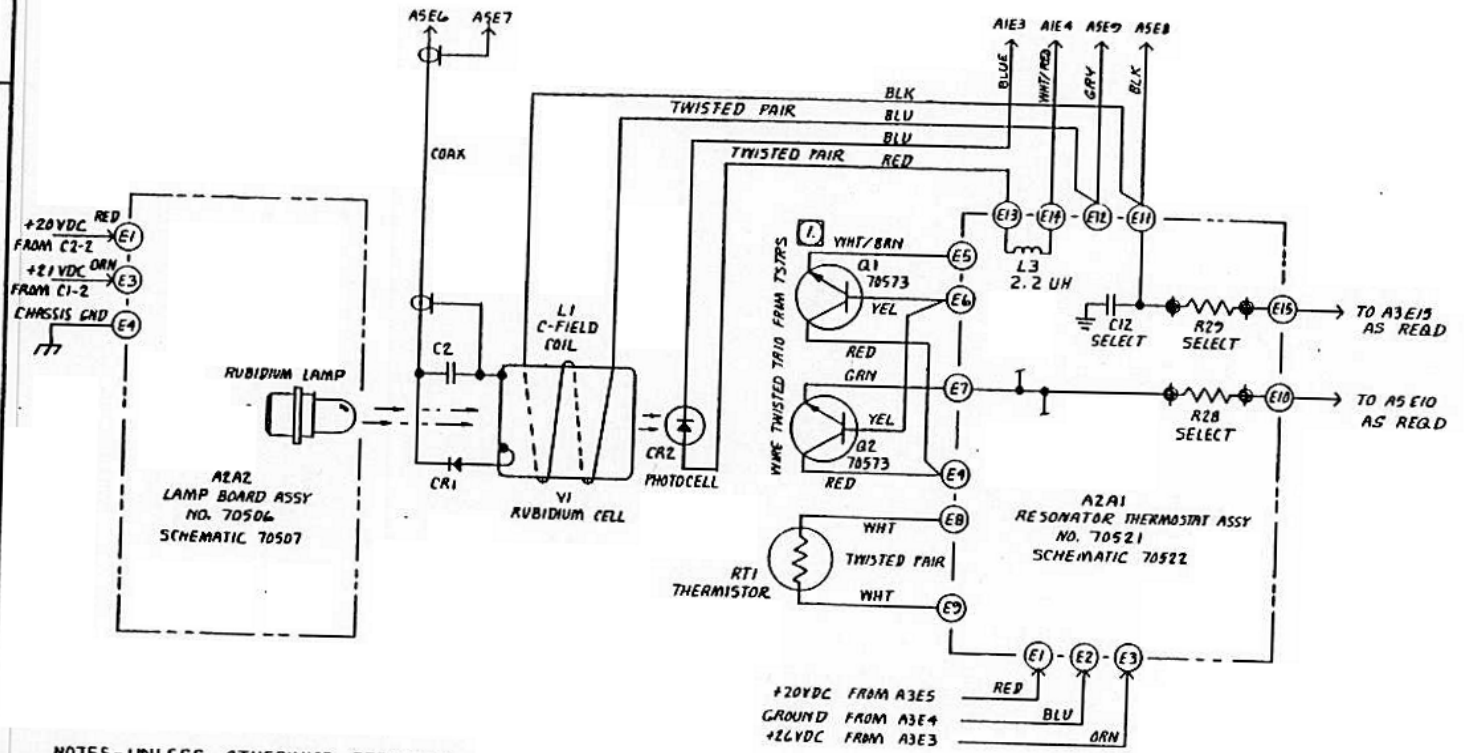
Serial No: Date:

Manual Para No. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL (6)	Tolerance Limits (7)
5.11	Long-Term Stability					
5.11.4		10 MHz				< ± 6 x 10^{-11}
5.12	Voltage Variation Test					
5.12.4	26 ± 0.1 vdc Input	Record UUT Freq				
5.12.6	28.6 ± 0.1 vdc Input	Record UUT Freq				± 1x10^{-11} of Ref. Step 5.12.10
5.12.8	23.4 ± 0.1 vdc Input	Record UUT Freq				± 1x10^{-11} of Ref. Step 5.12.10
5.12.9	26 ± 0.1 vdc Input	Record UUT Freq				
5.12.10	Average Frequency of Steps	5.12.4	and 5.12.9			Use as Ref.

APPENDIX A

SCHEMATIC DIAGRAMS

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	RELEASED PER ECO 711-122	6-20-79	
	B	REV. PER ECO 711-302	5-12-80	
	C	REV. PER ECO 450	8-7-81	



NOTES-UNLESS OTHERWISE SPECIFIED

1. THE THERMISTOR (RT1) IS PHYSICALLY LOCATED AND MOUNTED NEXT TO (Q1).

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN Whitmore	6-20-79
CHECKED	6-21-79
	6/21/79

EFRATOM

SCHEMATIC - PHYSICS PACKAGE A2

SIZE	CODE IDENT NO.	DRAWING NO	
C	55761	70519	C

SCALE NONE | SHEET 1 OF 1

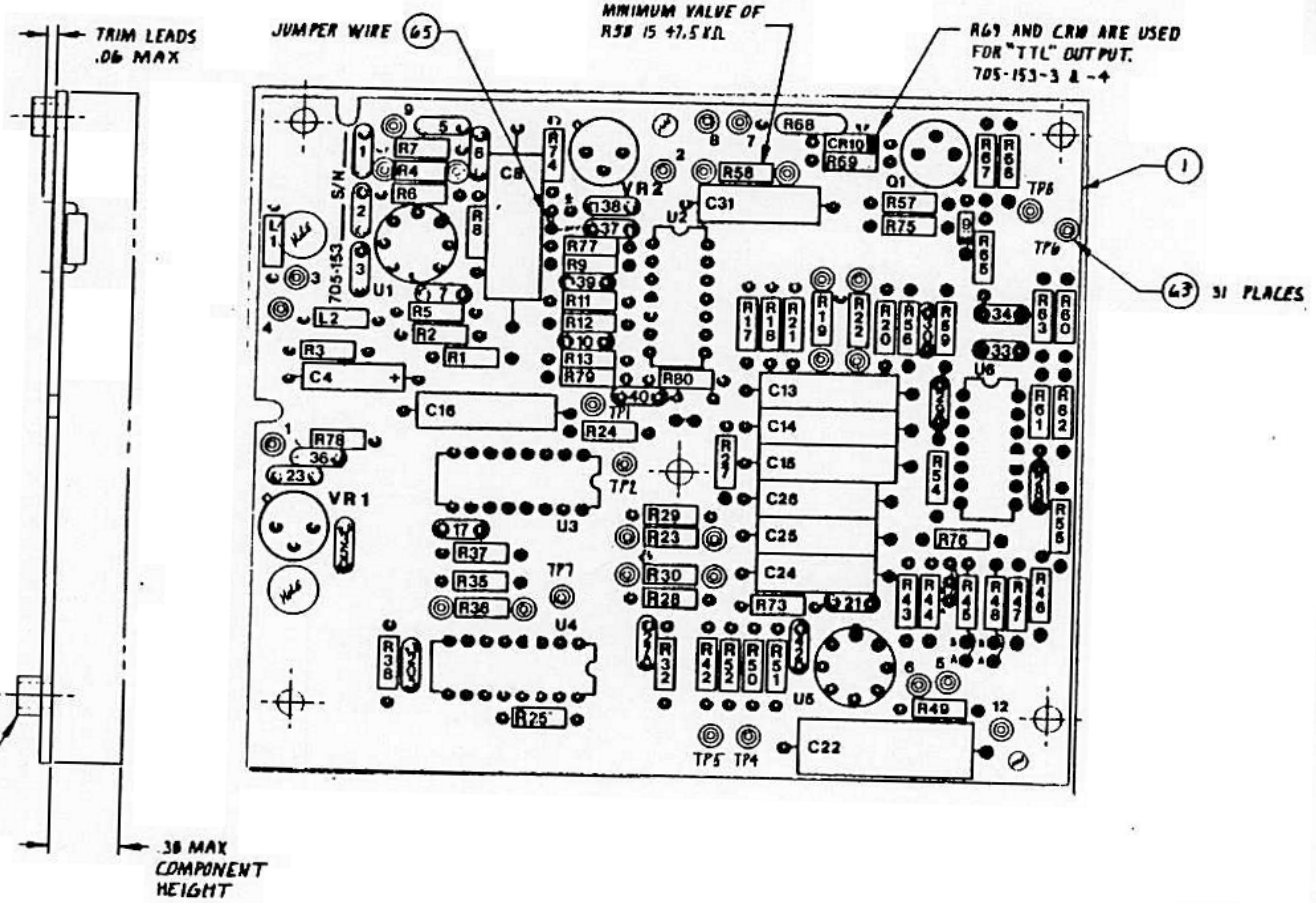
M-100	
NEXT ASSY	USED ON
APPLICATION	

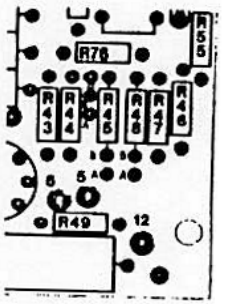
70519 - C

APPENDIX B

ASSEMBLY DRAWINGS
AND
PARTS LISTS

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	RELEASED	5-19-83	JW
	B	REVISED PER ED 583A	8-3-83	





"LN" ASSY
705-153-2, 705-153-3

NOTES: UNLESS OTHERWISE SPECIFIED.

1. FOR SCHEMATIC DIAGRAM SEE DWG NO. 705-154.
2. REFERENCE DESIGNATORS ARE FOR REFERENCE ONLY AND MAY NOT APPEAR ON THE COMPONENT PART.
3. INSTALL COMPONENTS PER MIL-STD-275.
4. SOLDER PER REQT 5 OF MIL-STD-454.
5. CONFORMAL COAT BOTH SIDES PER MIL-I-46058, TYPE UR. MASK OFF ALL SOLDER TERMINALS AND MOUNTING HOLES.
6. MARK PART NO. AND REV LETTER PER MIL-STD-130.
7. BOND COMPONENTS C4, 8, 13-16, 22, 24-26, 31 USING TRABOND 2112. CURE 55 MINUTES MIN AT 60 TO 70°C.

TABULATION

ASSEMBLY NO.	R44	R45	R46	R47	JUMPER POSITION	R42	"TTL"
705-153-1	100K	82.5K	33.2K	39.2K	"A"	47.5K	NO
705-153-2 (LN)	47.5K	221K	15K	22.1K	"B"	10K	NO
705-153-3 TTL(LN)	47.5K	221K	15K	22.1K	"B"	10K	YES
705-153-4 TTL	100K	82.5K	33.2K	39.2K	"A"	47.5K	YES

SEE SEPARATE PARTS LIST NO. PL 705-153

QTY REQD	ITEM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
			PARTS LIST	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±	CONTRACT NO.	EFRATOM	
MATERIAL	APPROVALS / DRAWN / CHECKED / ISSUED	DATE 5-19-83	ASSY- SERVO BD.
FINISH			SIZE C · FSCM NO. · DWG. NO. 705-153-728 · REV B
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	SCALE 2/1 · MIBD · SHEET 1
APPLICATION			

APPLICATION	
NEXT ASSY	USED ON
70500-1	M-100

REVISION

LTR	DESCRIPTION	DATE	APPROVAL
A	RELEASED PER DRN 71138	4-16-79	HW
B	REVISED PER ECO 71167	5-24-79	HW
C	REVISED PER ECO 711107	6-7-79	HW
D	REVISED PER ECO 711-127	6-20-79	HW
E	REVISED PER ECO 711-133, 711-138	7-5-79	D.L.
F	REVISED PER ECO 711-152	7-27-79	D.L.
G	REVISED PER S/N 002 & ECO 711-188	9-17-79	HW
H	ADDED ITEM 33 & 34	9-21-79	HW
J	REVISED PER ECO 711-226, -209	11-16-79	D.L.
K	REVISED PER ECO 711-243. USED WITH ASSY 70500-1 REV D & UP FOR S/N 025 & UP.	12-13-79	HW
L	REV. PER ECO 711-309	5-15-80	HW
M	REV PER ECO-350	8-5-80	HW
N	REV PER ECO-361	9-18-80	DE
P	REV PER ECO 434	4-3-81	HW
R	REV PER ECO-411	6-11-81	HW
T	REV PER ECO 464, 411-B	8-7-81	HW
U	REVISED PER ECO 471, 491	3-10-82	HW
V	REVISED PER EO 583A	8-8-83	HW

REV STATUS OF SHEETS	
REV	V K P
SHEET	1 2 3

CONTRACT NO.	
APPROVALS	DATE
ORIGN Whitmore	4-11-79
CHK Oridenan	4-17-79
APVD	
APVD	

EFRATOM

PARTS LIST -
FINAL ASSEMBLY

SIZE	CODE IDENT NO.	DRAWING NO.	REV
A	55761	PL 70500-1	V

M-100 SHEET 1 OF 3

FORM NO. 005 6/77

EFRATOM 18851 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70500-1
LIST TITLE: FINAL ASSEMBLY M-100		CONTRACT NO.	SHEET 2 OF 3

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
1	1		705-153-1	SERVO ASSY	A1
2	1		70518-3	PHYSICS PACKAGE ASSY	A2
3	1		70509-1	POWER SUPPLY ASSY	A3
4	1		70512-2	OSCILLATOR ASSY	A4
5	1		70515-2	SYNTHESIZER ASSY	A5
6	1		70570-1	FRAME ASSY	
7	1		70525	SHIELD, OUTER COVER	
8	1		70526	SHIELD, OUTER LID	
9	1		70571-1	BASEPLATE ASSY	
10	1		70535-1	NAMEPLATE LABEL	
11	REF		70549-1	OUTLINE DWG	
12	REF		70548-3	WIRING DIAGRAM	
13	REF		70501-1	SCHEMATIC DIAGRAM	
14	REF		70502-1	SPECIFICATION	
15	1		70569	SUPPORT, LAMP HOLDER	
16	2		70425-3	SCREW, M2x6	
17	6		70414-4	WASHER, FLAT, M2	
18	6		70414-13	WASHER, LOCK, M2	
19			NOT USED		
20	39		70425-8	SCREW M2.5x5	
21	8		70425-9	SCREW M2.5x6	
22	4		70425-11	SCREW M2.5x10	
23	4		70426-34	SCREW, BRASS M4x8	
24	55		70414-6	WASHER, FLAT M2.5	
25	4		70414-9	WASHER, FLAT, BRASS M4	
26	55		70414-14	WASHER, LOCK M2.5	
27	4		70425-4	SCREW M2x8	
28	4		70588	BLOCK NUT	
29	AR		MIL-W-16878,TYPE E	WIRE, 24 AWG, STRANDED	
30	AR		SN63WRMAP3	SOLDER	
31	REF		ATP 70500	TEST PROCEDURE	

EFRATOM 18851 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70500-1
LIST TITLE: FINAL ASSEMBLY M-100		CONTRACT NO.	SHEET 3 OF 3

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
32	AR		70424-3	POLYURETHANE FOAM	
33	4		70425-12	SCREW M2.5 x 12	
34	1		M39012/55-3006	CONNECTOR COAX (MATING PLUG)	P1
35	1		M28748/8DIOL1A	CONNECTOR (MATING PLUG)	P2
36	AR		70424-9	FOAM, POLYESTER	
37	1		CCR05CH6R8DR	CAPACITOR, 6.8PF	A4C6+
38	AR		CCR05CXXXXXR	CAPACITOR, SELECT VALUE	A4C6-
39	AR		70424-5	EPOXY	
40	1		M39014/01-1572	CAPACITOR 6800 PF	C3
41			NOT USED		
42	1		MS35431-1	LUG, SOLDER	
43	AR		M17/93-RG178	CABLE, COAX	
44	AR		70422-2	TUBING, SHRINK, 1/8	
45	AR		70422-3	TUBING, SHRINK, 1/4	
46	AR		70414-24	WASHER, INSULATING, FLAT	
47	2		70414-25	WASHER, E.T. LOCK	
48			NOT USED		
49			NOT USED		
50			NOT USED		
51			NOT USED		
52	1		70593	FOAM SEAL - RESONATOR	
53	1		70595	INSULATOR, FOAM - OSCILLATOR	
54	AR		M39014/01-1572	CAPACITOR 6800PF	
55	AR		LOCKTITE NO. 222	ADHESIVE SEALANT (PURPLE)	MIL-S-46163 TYPEII, GRADE M

APPLICATION		REVISION			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVAL
		A	RELEASED EO-583A	5-20-83	
		B	REVISED EO-598	10-31-83	
		C	REVISED PER EO 637A	12-12-83	

REV																																
SHEET																																
REV STATUS OF SHEETS	REV	C	C	B	A																											
	SHEET	1	2	3	4																											

CONTRACT NO.	
APPROVALS	DATE
ORIGN Rothrock	5-20-83
CHK	
APVD	
APVD	

EFRATOM

PARTS LIST-
STANDARD SERVO ASSY

SIZE	CODE IDENT NO.	DRAWING NO.
A	55761	PL 705-153-1

SHEET 1 OF 4

FORM NO. 005 6/77

EFRATOM
18851 BARDEEN AVE
IRVINE, CAL., 92715

PARTS LIST

FSCM NO. 55761

PL 705-153-1

LIST TITLE: SERVO ASSEMBLY

CONTRACT NO.

SHEET 2 OF 4

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
1	1		705-155	PRINTED WIRING BOARD	
2	1		CCR05CG101JR	CAPACITOR 100 PF	C17
3	1		M39014/01-1353	CAPACITOR 560 PF	C10
4	2		M39014/01-1357	CAPACITOR 1000 PF	C5,7
5	5		M39014/01-1572	CAPACITOR 6800 PF	C1,2,3,20,21
6	1		M39014/01-1575	CAPACITOR .01 UF	C30
7	1		M39014/02-1356	CAPACITOR .22 UF	C33
8	12		M39014/01-1593	CAPACITOR .1 UF	C6,23,27-29,35-40,42
9	1		M39014/02-1419	CAPACITOR 1 UF	C34
10	1		M39003/1-3006	CAPACITOR 10 UF	C4
11	4		M83421/01-1142S	CAPACITOR .047 UF	C24,25,26,31
12	4		M83421/01-1171S	CAPACITOR .1 UF	C13,14,15,16
13	2		M83421/01-1252S	CAPACITOR 1 UF	C8,22
14	3		RCR07G220JS	RESISTOR 22Ω ¼ W	R54,73,74
15			NOT USED		
16	2		RCR07G3331JS	RESISTOR 330Ω ¼ W	R77,78
17	1		RCR07G915JS	RESISTOR 9.1 MEG ¼ W	R63
18	5		RCR07G105JS	RESISTOR 1 MEG ¼ W	R37,50,51,56,61
19	2		RCR07G475JS	RESISTOR 4.7 MEG ¼ W	R65,76
20	1		RNC55H2740FS	RESISTOR 274Ω 1/10 W	R5
21	1		RNC55H4640FS	RESISTOR 464Ω 1/10 W	R67
22	1		RNC55H4990FS	RESISTOR 499Ω 1/10 W	R2
23	1		RNC55H6810FS	RESISTOR 681Ω 1/10 W	R6
24	2		RNC55H1001FS	RESISTOR 1K 1/10W	R8,49
25	1		RNC55H2211FS	RESISTOR 2.21K 1/10W	R75
26			NOT USED		
27	1		RNC55H3011FS	RESISTOR 3.01K 1/10W	R3
28	2		RNC55H3481FS	RESISTOR 3.48 K 1/10 W	R20,66
29	1		RNC55H3571FS	RESISTOR 3.57 K 1/10W	R28
30	2		RNC55H9091FS	RESISTOR 9.09K 1/10W	R21,29
31	4		RNC55H1002FS	RESISTOR 10K 1/10W	R24,60,13,52

EFRATOM
18851 BARDEEN AVE
IRVINE, CAL., 92715

PARTS LIST

FSCM NO. 55761

PL 705-153-1

LIST TITLE: SERVO ASSEMBLY

CONTRACT NO.

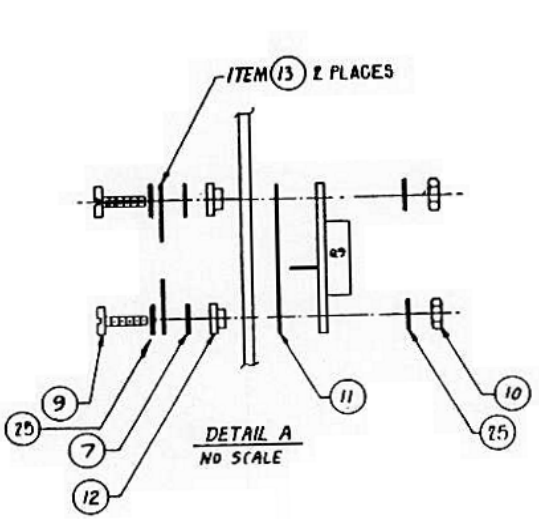
SHEET 3 OF 4

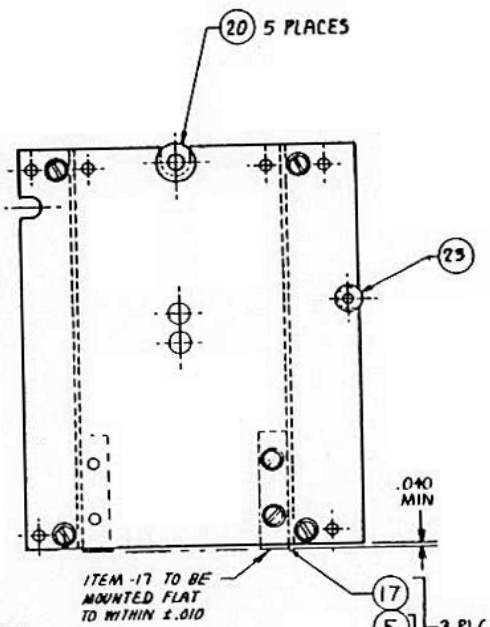
ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
32	1		RNC55H1502FS	RESISTOR 15K	R4
33	1		RNC55H1872FS	RESISTOR 18.7K	R1
34	1		RNC55H2743FS	RESISTOR 274K	R62
35	1		RNC55H2742FS	RESISTOR 27.4K	R48
36	2		RNC55H3322FS	RESISTOR 33.2K	R17,46
37	1		RNC55H3922FS	RESISTOR 39.2K	R47
38	1		RNC55H4752FS	RESISTOR 47.5K	R42
39	2		RNC55H5622FS	RESISTOR 56.2K (R58 NOMINAL)	R18,58
40	3		RNC55H8252FS	RESISTOR 82.5K	R27,57,45
41	10		RNC55H1003FS	RESISTOR 100K	R7,9,11,25,32,38,43,79,44,8
42			NOT USED		
43	1		RNC55H3323FS	RESISTOR 332K	R55
44	1		RNC55H4223FS	RESISTOR 422K	R35
45	1		RNC55H1004FS	RESISTOR 1MEG	R59
46	1		RNC55H2004FS	RESISTOR 2MEG	R12
47	5		RNC55HXXXXFS	RESISTOR SELECT VALUE	R19,22,23,30,36
48	1		RWR80S1000FS	RESISTOR 100Ω 2W	R68
49			NOT USED		
50			NOT USED		
51	1		JANTXIN4153	DIODE	CR9
52	2		70412-2	INDUCTOR 2.2UH	L1,2
53			NOT USED		
54	1		JANTX2N5662	TRANSISTOR	Q1
55	2		M38510-10703BXC	VOLTAGE REGULATOR	VR1, VR2
56	1		70495-1	INTEGRATED CIRCUIT (883/4053BC)	U4
57	1		70496-1	INTEGRATED CIRCUIT (μA725HMWB)	U1
58			NOT USED		
59			NOT USED		
60	1		M38510-10104BGX	INTEGRATED CIRCUIT	U5
61	2		M38510-11005BCX	INTEGRATED CIRCUIT (LM124J/883B)	U6, U2
62	1		CD4060BD/3	INTEGRATED CIRCUIT	U3

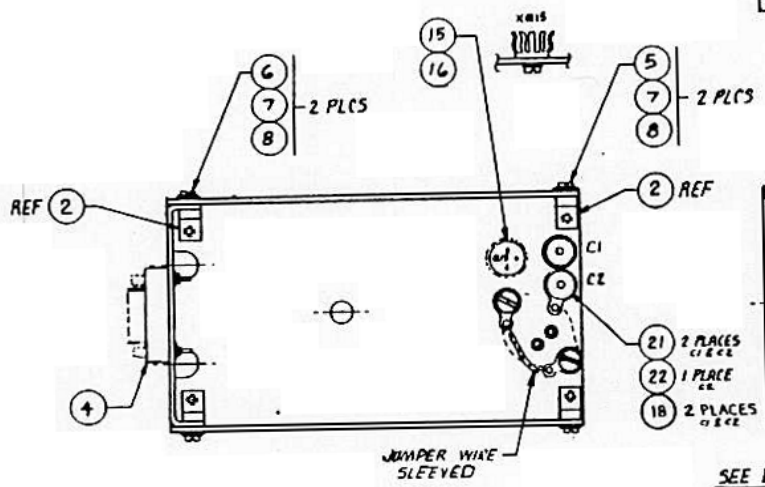
EFRATOM 18851 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 705-153-1
LIST TITLE: SERVO ASSEMBLY		CONTRACT NO.	SHEET 4 OF 4

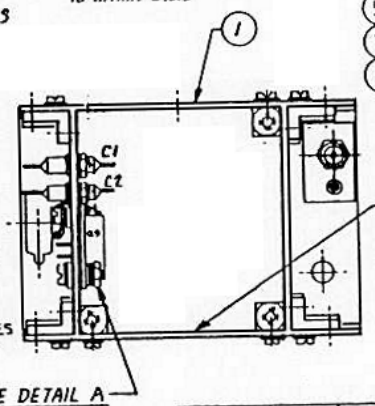
ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
63	31		SE16XC02	TERMINAL-TURRET	
64	1		70418-1	MOUNTING PAD	XQ1
65	AR		QQ-W-343, TYPE S	WIRE,TINNED COPPER 24 AWG	
66	2		M38527/4-03N	MOUNTING PAD	XU1,XU5
67			NOT USED		
68	4		70417-1	STANDOFF-PEM	
-	REF		705-154	SCHEMATIC	

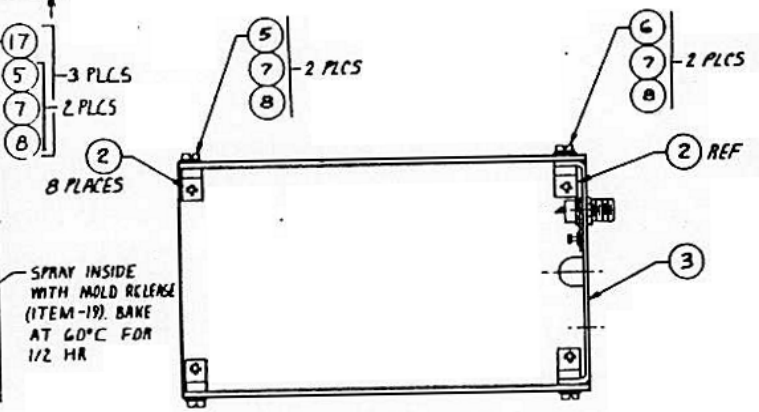
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	RELEASED PER DRN 71108	3-22-79	
	B	REVISED PER ECO 71176	6-7-79	
	C	REV PER ECO 711-209	12-12-79	
	D	REVISED PER ECO 357	8-26-80	
	E	REVISED ITEM-16 ECO-376	9.30.80	
	F	REVISED PER ECO'S 464, 469	8-7-81	
	G	REV. CONNECTOR SCREW POSITIONS ECO 557	2 17 82	
	H	REVISED PER ECO-500-A	4-14-82	
	J	REVISED PER ECO-398A	5-21-82	
	K	REVISED PER ECO-529, 527	3-10-83	
	L	ADDED TABULATION ECO-648	3-16-84	











SEE SEPARATE PARTS LIST NO. 70570-TAB

TABULATION	
PART NO.	DESCRIPTION
70570-1	USE CONN PLATE ASSY 70598-1
70570-2	USE CONN PLATE ASSY 70598-2

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
			PARTS LIST

70500	M100
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN Whitmore	3-20-79
CHECKED J. Whitmore	3-22-79

EFRATOM SYSTEMS CORP

FRAME ASSEMBLY

SIZE	CODE IDENT NO	DRAWING NO.	REV
C	55761	70570-TAB	L

SCALE 1/1 SHEET 1 OF 1

70570-TAB

APPLICATION		REVISION			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVAL
70500	M100	A	RELEASED PER DRN 71108	3-22 79	HW
		B	REVISED PER ECO 71176	5-24-79	HW
		C	REVISED PER ECO 711-132 711-139	7-5-79	HW
		D	REVISED PER ECO 711-203, 711-241	11-16-79	
		E	REVISED PER ECO 357	3-27-80	HW
		F	REVISED ITEM-16 ECO 376	3,30,80	HW
		G	REVISED PER ECO 764, 769	1-81	HW
		H	ADDED 70400 NDS ITEM 16,19	3-3-81	
		J	REVISED PER ECO-ECO-A	4-15-82	HW
		K	REVISED PER ECO-524, 527	3-10-83	HW

REV																															
SHEET																															
REV STATUS OF SHEETS	REV	K	J																												
	SHEET	1	2																												

CONTRACT NO.	
APPROVALS	DATE
ORIGN HW	3-22-79
CHK HW	3-22-79
APVD [illegible]	3-22-79
APVD	

EFRATOM

PARTS LIST — FRAME ASSEMBLY

SIZE	CODE IDENT NO.	DRAWING NO.	
A	55761	PL 70570-1	K

SHEET 1 OF 2

FORM NO. 005 6/77

EFRATOM 18851 BARDEEN AVE IRVINE, CAL. 92715	PARTS LIST	FSCM NO 55761	PL 70570-1
LIST TITLE FRAME ASSEMBLY		CONTRACT NO	SHEET 2 OF 2

ITEM NO	QTY REQD	FSCM NO	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
1	1		70524	FRAME, ALUMINUM	
2	8		70531	BLOCK, ANGLE	
3	1		70538	CONNECTOR PLATE ASSY	
4	1		70598-1	PLATE, MTG WINCHESTER CONN, ASSY	
5	10		70425-8	SCREW 2.5 mm	
6	4		70425-9	SCREW 2.5 mm	
7	14		70414-6	WASHER, FLAT 2.5 mm	
8	14		70414-14	WASHER, LOCK 2.5 mm	
9	2		70425-11	SCREW 2.5 mm	
10	2		70415-8	NUT 2.5 mm	
11	1		M38527/8-23P	INSULATOR	
12	2		70414-2	WASHER, SHOULDER	
13	2		MS35431-1	LUG, SOLDER	
14	1		JANTX2N3740	TRANSISTOR (MAY USE JANTX2N3741)	Q9
15	1		JANTX2N5662	TRANSISTOR	Q15
16	1		70420-5	HEAT SINK (WITH HARDWARE)	XQ15
17	3		70529	BLOCK, MTG	
18	2		70414-23	WASHER-FLAT	
19	AR		70424-11	MOLD RELEASE (TFE-20)	
20	5		MS35489-4	GROMMET	
21	2		70410	CAPACITOR, FEED-THRU, 1500PF	C1, C2
22	1		70421-4	LUG, SOLDER	
23	1		MS35489-1	GROMMET	
24	AR		70411	THERMAL JOINT COMPOUND	
25	4		70414-25	WASHER, LOCKING TOOTH	

REVISION STATUS OF THIS SHEET

LETTER	A	B	C	D	E	F	G	H	J		
DATE	5 24 [illegible]	[illegible]	[illegible]	8-21-[illegible]	9-30-83	[illegible]	[illegible]	[illegible]	3-10-83		
ECO NO.	[illegible]	[illegible]	[illegible]	351	376	[illegible]	[illegible]	[illegible]	524 527		

APPLICATION	
NEXT ASSY	USED ON
70500	M100

REVISION			
LTR	DESCRIPTION	DATE	APPROVAL
A	RELEASED PER ECO 711-127	6-20-79	HW
B	REV PER ECO 711-189, 711-193, 711-195	9-10-79	HW
C	REV PER ECO 711-199	9-26-79	HW
D	REV. PER ECO 711-281	11-16-79	[illegible]
E	REV PER ECO 711-260	1-29-80	CC
F	REV PER ECO 711-262	2-19-80	HW
G	REV. PER ECO 711-269	4-18-80	HW
H	REV PER ECO 383	10-1-80	HW
J	REVISED PER ECO 419	1-29-81	HW
K	REVISED PER ECO 461, 468, 442	8-10-81	HW
L	ADDED PL TABULATION REV PER ED-541A	62-83	HW

TABULATION

PARTS LIST	R7	R35	
PL 70515-1	2.74K	RTR12DY102R	
PL 70515-2	2.74K	RJ12FY202	10 MHZ UNIT
PL 70515-3	4.99K	RJ12FY202	5 MHZ UNIT

REV																															
SHEET																															
REV STATUS OF SHEETS	REV	L	D	L	J																										
	SHEET	1	2	3	4																										

CONTRACT NO.

APPROVALS	DATE
ORIGN Whitmore	3-13-79
CHK D. Weidemann	3-14-79
APVD	
APVD	

EFRATOM

PARTS LIST
SYNTHESIZER ASSY
BD 5

SIZE	CODE IDENT NO.	DRAWING NO.	
A	55761	PL 70515-TAB	L
	M100	SHEET 1 OF 4	

FORM NO. 005 6/77

EFRATOM
18651 BARDEEN AVE
IRVINE, CAL., 92715

PARTS LIST

FSCM NO. 55761

PL 70515- TAB

LIST TITLE: SYNTHESIZER ASSEMBLY

CONTRACT NO.

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
1	1		70517	PRINTED WIRING BOARD	EFRATOM
2	1		CCR05CH4R7DR	CAPACITOR 4.7PF	C13
3	1		CCR05CH120JR	CAPACITOR 12PF	C10
4	1		CCR05CG150JR	CAPACITOR 15PF	C21
5	2		CCR05CG220JR	CAPACITOR 22PF (C27 NOMINAL)	C19, C27
6	1		CCR05CG330JR	CAPACITOR 33PF	C23
7	1		CCR05CG390JR	CAPACITOR 39PF	C17
8	1		CCR05CG470JR	CAPACITOR 47PF	C18
9	1		CCR05CG750JR	CAPACITOR 75PF	C9
10	2		CCR05CG101JR	CAPACITOR 100PF (C28 NOMINAL)	C14,C28
11	1		CCR05CGXXXJR	CAPACITOR SELECT (47-120PF)	C29
12	1		CCR05CG272JR	CAPACITOR 2700PF	C30
13	1		M39014/01-1340	CAPACITOR 100PF	C16
14	16		M39014/01-1572	CAPACITOR 6800PF	C1,C3-8,11,15
—	—		———		C32,20,22,24,25,26,31
15	2		M83421/01-1142S	CAPACITOR .047UF	C2,C12
16	5		JANTX1N4148-1	DIODE	CR1-CR5
17	1		JANTX1N5146A	DIODE, VARACTOR	CR6
18	2		70412-1	INDUCTOR .15UH (MS75083-3)	L6,L10
19	1		70412-2	INDUCTOR 2.2UH (MS75084-4)	L1
20	5		70412-4	INDUCTOR 6.8UH (MS75084-10)	L4,7,9,12,13
21	1		70412-5	INDUCTOR 18UH (MS75084-15)	L2
22	2		70406-3	INDUCTOR VARIABLE (RED-YEL)	L5,L8
23	2		70406-4	INDUCTOR VARIABLE (GRN-YEL)	L3,L11
24	1		JANTX2N2219A	TRANSISTOR	Q1
25	5		JANTX2N2369A	TRANSISTOR	Q2-6
26	2		JANTX2N3553	TRANSISTOR	Q7-8
27	2		RNC55H56R2FS	RESISTOR 56.2Ω	R24,28
28	2		RNC55H1000FS	RESISTOR 100Ω	R14,19
29	1		RNC55H1500FS	RESISTOR 150Ω	R13
30	1		RNC55H4750FS	RESISTOR 475Ω	R27

EFRATOM 18851 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70515-TAB
LIST TITLE: SYNTHESIZER ASSEMBLY		CONTRACT NO.	SHEET 3 OF 4

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
31	1		RNC55H6810FS	RESISTOR 681Ω	R2
32	3		RNC55H1001FS	RESISTOR 1KΩ	R5, 40,30
33	1		RNC55H1871FS	RESISTOR 1.87KΩ	R16
34	6		RNC55H3401FS	RESISTOR 3.4KΩ	R8, 11,12,18,23,41
35	1		RNC55H5231FS	RESISTOR 5.23KΩ	R9
36	1		RNC55H5621FS	RESISTOR 5.62KΩ	R10
37	1		RNC55H6191FS	RESISTOR 6.19KΩ	R17
38	1		RNC55H1002FS	RESISTOR 10KΩ	R6
39	1		RNC55H1003FS	RESISTOR 100KΩ	R3
40	4		RNC55HXXXXFS	RESISTOR SELECT (100Ω-12KΩ)	R31,34,37,33
41	1		RNC65H1330FS	RESISTOR 133Ω	R29
42	2		RNC65H1001FS	RESISTOR 1KΩ	R21,22
43	1		RNC65H1501FS	RESISTOR 1.5KΩ	R26
44	1		RNC65H1871FS	RESISTOR 1.87KΩ	R15
45	1		RNC65H2741FS	RESISTOR 2.74KΩ	R1
46	1		RNC70H4750FS	RESISTOR 475Ω	R25
47	1		RNC70H6810FS	RESISTOR 681Ω	R20
48	1		RWR81S2740FS	RESISTOR 274Ω	R4
49	1		70406-7	TRANSFORMER (6-PIN)	T1
50	1		JM38510/30001/BCX	INTEGRATED CIRCUIT	U1
51	1		70494-1	INTEGRATED CIRCUIT	U2
52	1		JM38510/00201/BCX	INTEGRATED CIRCUIT	U3
53	4		70416-3	TERMINAL, SOLDER (BIFURCATED)	
54	1		70420-1	HEAT SINK	
55	2		70418-1	MOUNTING PAD (TO-5)	XQ1,7
56	5		M38527/3-02N	MOUNTING PAD (TO-18)	XQ2-6
57	AR		SN63WRMAP3	SOLDER	QQ-S-571
58	1		70561	WASHER,MYLAR	XQ8
59					
60	AR		MIL-I-46058 TYPE UR	POLYURETHANE (CONFORMAL COAT)	
61	1		RNC55H2740FS	RESISTOR 274Ω	R42

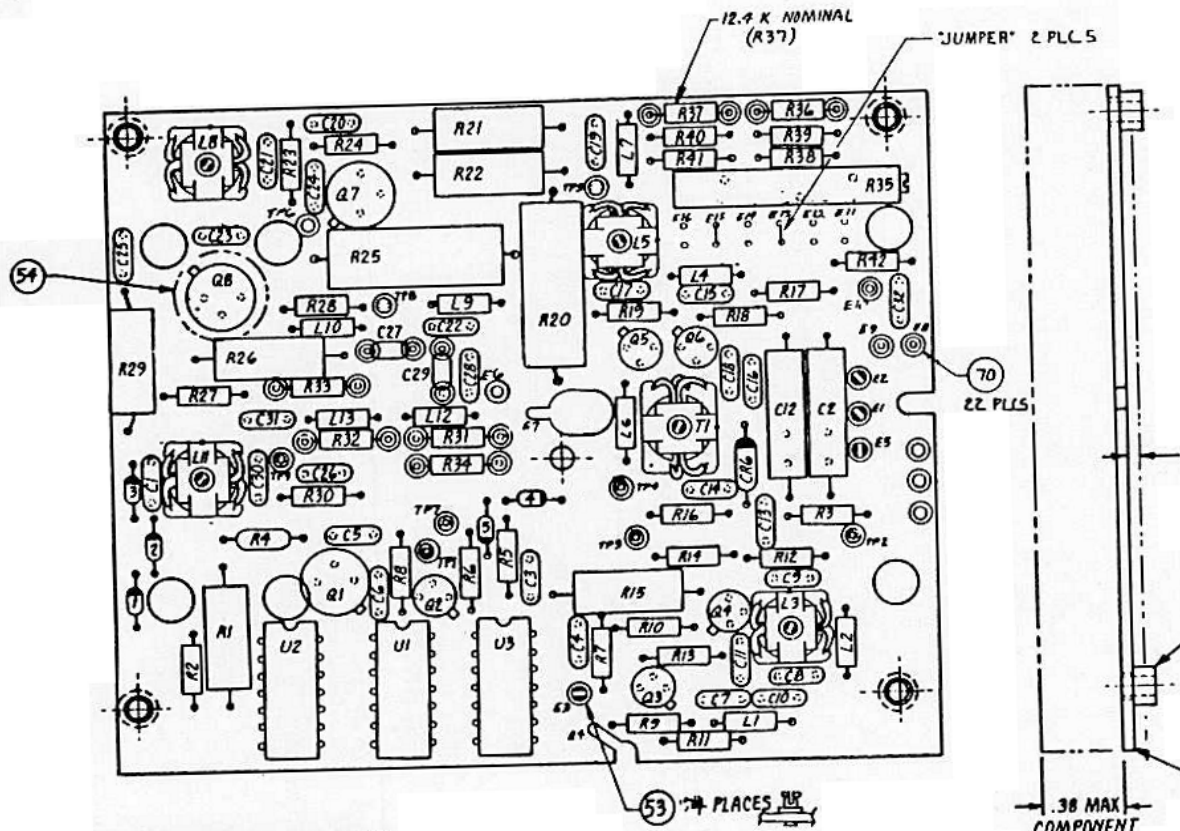
(1)

EFRATOM 18851 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70515-TAB
LIST TITLE: SYNTHESIZER ASSY		CONTRACT NO.	SHEET 4 OF 4

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
62	1		RJ12FY202	POTENTIOMETER 2KΩ	R35 (70515-2 70515-3)
63	4		70417-1	STANDOFF	
64	REF		70516	SCHEMATIC	
65			NOT USED		
66	1		RNC55H3321FS	RESISTOR 3.32K NOMINAL	R36
67	1		RNC55H1301FS	RESISTOR 1.30K	R38
68	1		RNC55H2211FS	RESISTOR 2.21K	R39
69	1		RNC55H8450FS	RESISTOR 845Ω	R32
70	31		SE16XC02	TERMINAL, SOLDER	
71	1		RNC55H2741FS	RESISTOR 2.74 K	R7 (70515-2)
72	1		RNC55H4991FS	RESISTOR 4.99 K	R7 (70515-3)

(1) ACTUAL PART MAY VARY DUE TO AVAILABILITY. SEE ECO 711-260 FOR ALTERNATE VALUES

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	RELEASED PER DRN 71110	3-13-79	
	B	REVISED PER ECO 71112	3-15-79	
	C	REVISED PER ECO 711100	6-6-79	
	D	REVISED PER ECO 711-127	6-20-79	
	E	REVISED PER ECO 711-189	9-18-79	
	F	ADDED NOTE -8	9-21-79	
	G	REVISED TERMINALS PER ECO 303	10-1-80	
	H	REVISED PER ECO = 419	1-29-81	
	J	REVISED PER PWB REV "D1"	3-31-81	
	K	ADDED NOTE -9 & TABULATION -3 PER EO-591A	6-2-83	



TABULATION		
PART NO.	DESCRIPTION	R7
70515-1	USES WIRE WOUND POT R35 (1K)	2.74K
70515-2	USES CERMET POT R35 (2K)	2.74K
70515-3	USES CERMET POT R35 (2K)	4.99K (9)

NOTES-UNLESS OTHERWISE SPECIFIED

1. FOR SCHEMATIC DIAGRAM SEE DWG NO. 70516.
2. REFERENCE DESIGNATORS ARE FOR REFERENCE ONLY AND MAY NOT APPEAR ON THE COMPONENT PART.
3. INSTALL COMPONENTS PER MIL-STD-275, INCLUDES SWAGING OF SOLDER TERMINALS.
4. SOLDER PER REQT 5 OF MIL-STD-454.
5. CONFORMAL COAT BOTH SIDES PER MIL-I-46058, TYPE UR. MASK OFF ALL SOLDER TERMINALS AND MOUNTING HOLES.
6. TEST PER EFRATOM TP 70515.
7. MARK "55761 ASSY 70515 REV __" PER MIL-STD-130.
8. BOND COMPONENTS C2, C12, R1, 22, 21, 15, 25, 26, 29, 35, 20, USING TRABOND 2112. CURE 35 MINUTES MINIMUM AT 60 TO 70 °C.

(9) RESISTOR VALUE OF R7 IS 4.99K ON LNO "LOW NOISE OSCILLATORS" ASSY 70515-3.

SEE SEPARATE PARTS LIST NO. 70515-TAB.

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
		PARTS LIST	

70500	M100
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN	3-2-79
CHECKED	3-14-79

EFRATOM

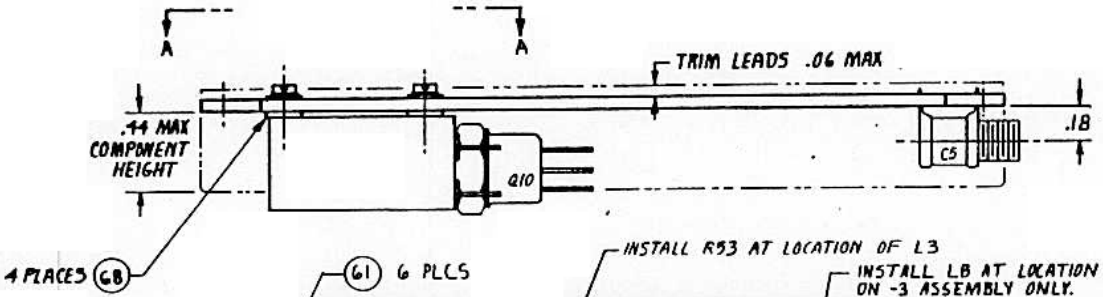
SYNTHESIZER ASSEMBLY

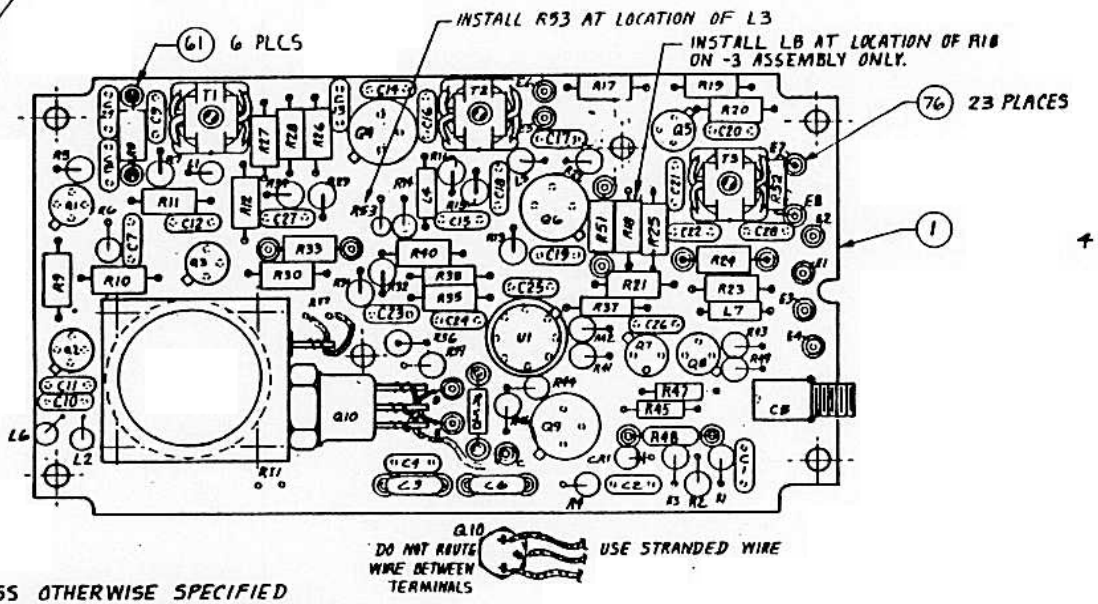
SIZE	CODE IDENT NO	DRAWING NO.	REV
C	55761	70515 (SEE TAB)	K

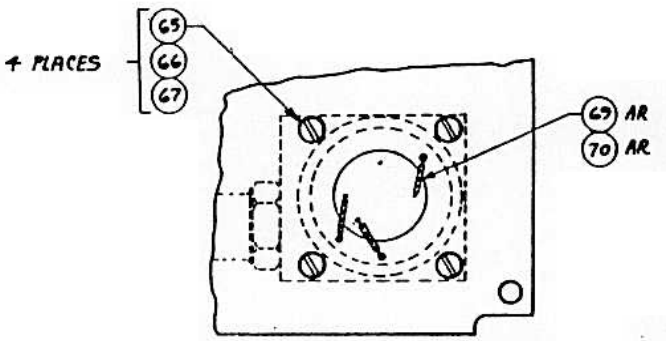
SCALE 2/1 | M-100 | SHEET 1 OF 1

70515 K

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	RELEASED PER DRN 71108	3-5-79	
	B	REVISED PER ECO 71197	6-6-79	
	C	REV. PER ECO 711-263	4 MAR 80	
	D	REVISED PER ECO-372, 383	9-30-80	
	E	REVISED ECO 419	1-29-81	
	F	REVISED PER ECO 452	8-6-81	
	G	REVISED PER ECO-471	8-12-81	
	H	REV PER ECO-475	3-11-82	
	J	REV PER ECO-594	8-8-83	







WHEN USING THE CRYSTAL WITH WIRE LEADS, THE LEADS ARE TO BE SLEEVED AND LAYED DOWN FLAT AGAINST THE BOARD

VIEW A-A
ROTATED 180°

NOTES-UNLESS OTHERWISE SPECIFIED

1. FOR SCHEMATIC DIAGRAM SEE DWG NO. 70513.
2. REFERENCE DESIGNATORS ARE FOR REFERENCE ONLY AND MAY NOT APPEAR ON THE COMPONENT PART.
3. INSTALL COMPONENTS PER MIL-STD-275, INCLUDES SWAGING OF SOLDER TERMINALS.
4. SOLDER PER REQT 5 OF MIL-STD-454.
5. CONFORMAL COAT BOTH SIDES PER MIL-I-46058, TYPE UR. MASK OFF ALL SOLDER TERMINALS AND MOUNTING HOLES.
6. TEST PER EFRATOM TP 70512.
7. MARK "55761 ASSY 70512-__ REV __" PER MIL-STD-130.

TABULATION				
ASSEMBLY	L8	R18	R19	R51
70512-2 (Vo=5V)	—	243Ω	562Ω	200Ω
70512-3 (Vo=12V)	6.8UH	—	243Ω	649Ω

SEE SEPARATE PARTS LIST NO. 70512-2,-3

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ±.02 .XXX ±.010 ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN Hutchinson	3-5-79
CHECKED [illegible]	3-6-79

EFRATOM

OSCILLATOR BOARD ASSEMBLY

SIZE	CODE IDENT NO	DRAWING NO.	REV
C	55761	70512-(TAB)	J

SCALE 2/1 | M-100 | SHEET 1 OF 1

NEXT ASSY	USED ON
70500	M100

APPLICATION

70512-TAB J

APPLICATION	
NEXT ASSY	USED ON
70500	M100

REVISION			
LTR	DESCRIPTION	DATE	APPROVAL
A	RELEASED PER DRN 71108	3-6-79	HW
B	REVISED PER ECO 71164, 71185	5-24-79	HW
C	REVISED PER ECO 711103	6-6-79	HW
D	REVISED PER ECO 711-141	7-10-79	DL
E	REVISED PER ECO 711-162, 176, 193, 195	9-10-79	HW
F	REV PER ECO 711-199	9-26-79	HW
G	REV PER ECO 711-212, -213	10-31-79	HW
H	REV. PER ECO 711-230	11-16-79	HW
I	REV PER ECO 711-258 711-260	1-28-80	CC
J	REV PER ECO 711-263	2-19-80	HW
K	REV. PER ECO 711-269	4-18-80	HW
L	REV. PER ECO 711-345	7-15-80	HW
M	REV. PER ECO 711-368	9-22-80	JE
N	REVISED PER ECO 372, 383	9-30-80	HW
P	REVISED ECO 419	1-29-81	HW
R	REV PER ECO-447, -453	6-11-81	HW
T	REV PER ECO 466, 414	8-10-81	HW
U	Released -2 ECO -475 -481 -482 -471	2-26-81	HW
V	REV PER ECO-533	3-10-83	HW
W	REV PER EO 625	12-6-83	JH

REV																																					
SHEET																																						
REV STATUS OF SHEETS	REV	W	K	S	E																																	
	SHEET	1	2	3	4																																	

CONTRACT NO.	
APPROVALS	DATE
ORIGN Whitmore	3-6-79
CHK J. Dickerson	3-22-79
APVD	
APVD	

EFRATOM

PARTS LIST -
OSCILLATOR BOARD ASSEMBLY
(A4) (BOARD 4)

SIZE	CODE IDENT NO.	DRAWING NO.	
A	55761	PL 70512-2	W
	M100	SHEET 1 OF 4	

FORM NO. 005 6/77

EFRATOM 18651 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70512-2
LIST TITLE: OSCILLATOR BOARD ASSEMBLY (A4)		CONTRACT NO.	SHEET 2 OF 4

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
1	1		70514	PRINTED WIRING BOARD	
2	1		70572	CRYSTAL THERMOSTAT ASSY	
3	1		CCR05CH5R6DR	CAPACITOR 5.6 PF (NOMINAL)	C29
4	1		CCR05CG620JR	CAPACITOR 62PF	C9
5	2		CCR05CG181JR	CAPACITOR 180PF	C16,C21
6	2		CCR05CG511JR	CAPACITOR 510PF	C11,C10
7	-		NOT USED		
8	3		CCR05CGXXXJR	CAPACITOR SELECT VALUE	C3,C6,C4
9	1		M39014/01-1340	CAPACITOR 100PF	C25
10	1		M39014/01-1357	CAPACITOR 1000PF	C17
11	13		M39014/01-1572	CAPACITOR 6800PF	C1,2,7,13,14,15,18,19
—	—		—	—	20,23,24,27,28
12	1		M39014/01-1575	CAPACITOR .01UF	C8
13	1		M39014/01-1587	CAPACITOR .047UF	C26
14	2		M39014/01-1593	CAPACITOR .1UF	C12,C22
15	1		PC26J140	CAPACITOR, VAIRABLE 1-14PF	C5
16	1		JANTX1N5148A	DIODE, VARACTOR	CR1
17	1		70412-2	INDUCTOR 2.2UH (MS75084-4)	L2
18			NOT USED		
19	1		70412-4	INDUCTOR 6.8UH (MS75084-10)	L6
20	4		70412-6	INDUCTOR 180UH (MS75085-10)	L1,4,5,7
21	3		JANTX2N2484	TRANSISTOR	Q1,2,3
22	2		JANTX2N2219A	TRANSISTOR	Q9
23	3		JANTX2N2222A	TRANSISTOR	Q5,7,8
24	1		JANTX2N3635	TRANSISTOR	Q6
25	1		RNC55H2000FS	RESISTOR 200 Ω (NOM. SELECT)	R51
26	3		RNC55H56R2FS	RESISTOR 56.2Ω	R17,19,25
27	1		RNC55H90R9FS	RESISTOR 90.9Ω	R15
28	6		RNC55H1000FS	RESISTOR 100Ω (R32 NOMINAL)	R32,7,9,12,22,50
29	2		RNC55H2430FS	RESISTOR 243Ω (R18 SELECT)	R26, R18
30	1		RNC55H3320FS	RESISTOR 332Ω	R16

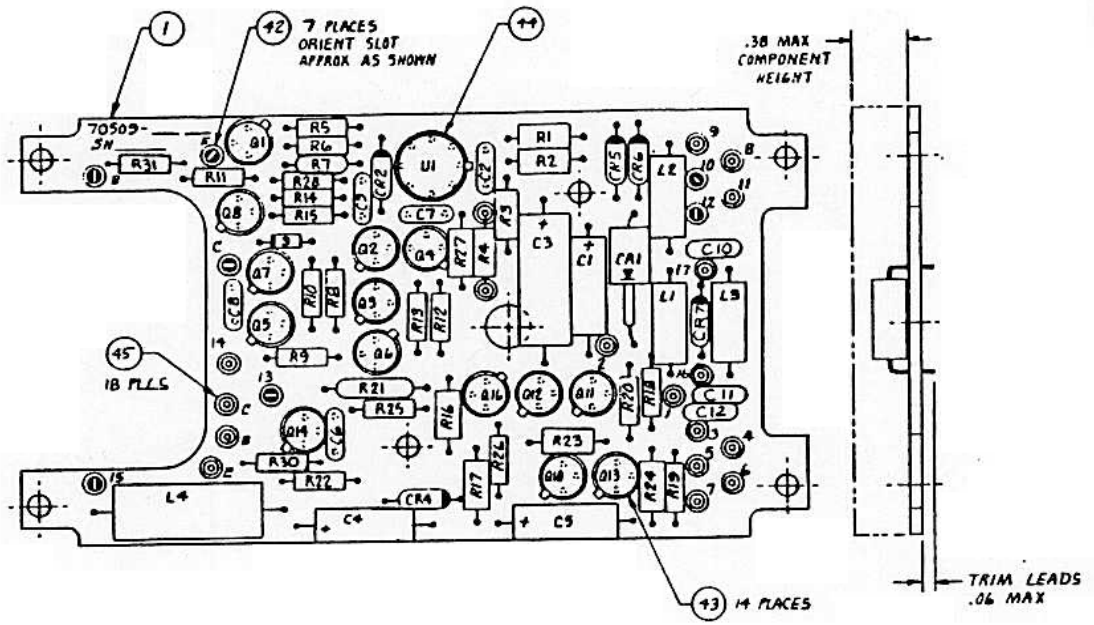
EFRATOM 18851 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70512-2
LIST TITLE: OSCILLATOR BOARD ASSEMBLY (A4)		CONTRACT NO.	SHEET 3 OF 4

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
31	1		RNC55H3920FS	RESISTOR 392Ω	R28
32	-		NOT USED	RESISTOR	
33	2		RNC55H6810FS	RESISTOR 681Ω	R20,R53
34	-		NOT USED	RESISTOR	
35	-		NOT USED	RESISTOR	
36	1		RNC55H1181FS	RESISTOR 1.18KΩ	R34
37	1		RNC55H1871FS	RESISTOR 1.87KΩ	R21
38	1		RNC55H2001FS	RESISTOR 2.00KΩ	R13
39	2		RNC55H4321FS	RESISTOR 4.32KΩ	R27,40
40	4		RNC55H5621FS	RESISTOR 5.62KΩ	R1,5,6,14
41	1		RNC55H1242FS	RESISTOR 12.4KΩ	R30
42	1		RNC55H1652FS	RESISTOR 16.5KΩ	R31
43	1		RNC55H4022FS	RESISTOR 40.2KΩ	R29
44	3		RNC55H4752FS	RESISTOR 47.5KΩ	R35,R36,38
45	1		RNC55H5622FS	RESISTOR 56.2KΩ	R11
46	3		RNC55H1003FS	RESISTOR 100KΩ	R3,4,39
47	2		RNC55HXXXXFS	RESISTOR SELECT VALUE	R2,33
48	1		RCR07G101JS	RESISTOR 100Ω	R47
49	2		RCR07G241JS	RESISTOR 240Ω	R37,43
50	2		RCR07G471JS	RESISTOR 470Ω	R45,23
51	1		RCR07G132JS	RESISTOR 1.3KΩ	R42
52	1		RCR07G272JS	RESISTOR 2.7KΩ	R41
53	2		RCR07G103JS	RESISTOR 10KΩ	R44,49
54	1		RNC55H3323FS	RESISTOR 332KΩ	R10
55	1		RNC55H4991FS	RESISTOR 4.99K NOMINAL	R8
(1) 56	1		RNR81S1R82FS	RESISTOR 1.82Ω 1W	R48
(1) 57	1		RWR81S5110FS	RESISTOR 511Ω 1W	R46
58	2		70406-5	TRANSFORMER (RED-GRN-BLU-WHT)	T2,T3
59	1		70406-6	TRANSFORMER (GRN-RED-WHT-YEL)	T1
60	1		M38510/10103BGX	INTEGRATED CIRCUIT, OP-AMP	U1
61	6		70416-3	TERMINAL, SOLDER (BIFURCATED)	

EFRATOM 18851 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70512-2
LIST TITLE: OSCILLATOR BOARD ASSEMBLY (A4)		CONTRACT NO.	SHEET 4 OF 4

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
62	2		70418-1	MOUNTING PAD (TO-5)	XQ6,9
63	7		M38527/3-02N	MOUNTING PAD (TO-18)	XQ1-5,7,8
64	1		M38527/4-03N	MOUNTING PAD (8-PIN)	XU1
65	4		70425-3	SCREW	
66	4		70414-18	WASHER, SPRING	
67	4		70414-4	WASHER, FLAT	
68	4		70414-1	WASHER, FIBER	
69	AR		QQ-w-343,TYPE S	WIRE, TINNED COPPER, 30 AWG	
70	AR		MIL-I-22129	SLEEVING, TEFLON, 30 AWG	
71	AR		SN63WRMAP3	SOLDER	
72	AR		MIL-I-46058, TYPE UR	POLYURETHANE, CONFORMAL COAT	
73	REF		70513	SCHEMATIC DIAGRAM	
74	REF		TP 70512	TEST PROCEDURE	
75	AR		MIL-W-16878,TYPE E	WIRE, STRANDED, 30AWG, TEFLON	
76	27		SE16XC02	SOLDER TERMINAL (TURRET)	
77	1		RNC55H1780FS	RESISTOR 178Ω NOMINAL	R24
78	1		RNC55H82R5FS	RESISTOR 82.5Ω NOMINAL	R52
(1)	ACTUAL PART MAY VARY DUE TO AVAILABILITY. SEE ECO 711-260 FOR ALTERNATE VALUES.				

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	REVISED PER ECO 71199	6-4-79	[illegible]
	C	REV PER ECO 711-173	9-11-79	[illegible]
	D	ADDED NOTE -8	9-21-79	[illegible]
	E	REV PER ECO 711-251	12-3-79	[illegible]
	F	REV PER ECO 377	9-11-80	[illegible]
	G	REVISED ECO 419	1-29-81	[illegible]



TABULATION	
PART NO.	DESCRIPTION
370509-1	ADD JUMPER BETWEEN "E1" & "E16"
370509-2	NO JUMPER AT "E16"

NOTES - UNLESS OTHERWISE SPECIFIED

1. FOR SCHEMATIC DIAGRAM SEE DWG NO. 370510.
2. REFERENCE DESIGNATORS ARE FOR REFERENCE ONLY AND MAY NOT APPEAR ON THE COMPONENT PART.
3. INSTALL COMPONENTS PER MIL-STD-275.
4. SOLDER PER REQT 5 OF MIL-STD-454.
5. CONFORMAL COAT BOTH SIDES PER MIL-I-46058, TYPE UR. MASK OFF ALL SOLDER TERMINALS AND MOUNTING HOLES.
6. MARK PART NO. AND REV LETTER PER MIL-STD-130.
7. BOND COMPONENTS C1, 3, 4, 5, CR1; L1, 2, 3, 4, USING TRABOND 2112. CURE 35 MINUTES MINIMUM AT 60 TO 70°C.
8. SLEEVE CR1 TO PREVENT THE BODY FROM TOUCHING THE GROUND CIRCUIT.

SEE SEPARATE PARTS LIST NO. 370509-1

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS XX ± XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN Whitmore	6-4-79
CHECKED [illegible]	6-4-79
[illegible]	6-6-79
[illegible]	6/11/79

EFRATOM

POWER SUPPLY ASSEMBLY

SIZE	CODE IDENT NO.	DRAWING NO	
C	55761	370509-TAB	G

SCALE 2/1 SHEET 1 OF 1

70500	HM-100
NEXT ASSY	USED ON

APPLICATION

370509-TAB G

APPLICATION	
NEXT ASSY	USED ON

REVISION

LTR	DESCRIPTION	DATE	APPROVAL
E	REDRAWN NO CHANGE	7-18-79	D.L.
F	REV PER ECO 711-173, 711-193	9-10-79	HW
G	REV. PER ECO 711-229	11-16-79	[illegible]
H	REV PER ECO 711-258 711-260	1-28-80	CC
J	REV PER ECO 711-251 + 234	2-12-80	CC
K	REV. PER ECO 711-269; 271	4-18-80	HW
L	REV. PER ECO 711-327	7-14-80	HW
M	REV PER ECO 347	9-22-80	HW
N	REVISED ECO 419	1-29-81	HW
P	REVISED ECO-481	3-18-82	HW
R	REV PER ECO-513	3-10-83	HW

REV STATUS OF SHEETS				
REV	R	K	R
SHEET	1	2	3

CONTRACT NO.

APPROVALS		DATE
ORIGN	HW	4-18-80
CHK	HW	4-18-80
APVD		
APVD		

EFRATOM

PARTS LIST - POWER SUPPLY ASSY

SIZE	CODE IDENT NO.	DRAWING NO.	REV
A	55761	PL 70509-1	R

SHEET 1 OF 3

FORM NO. 005 6/77

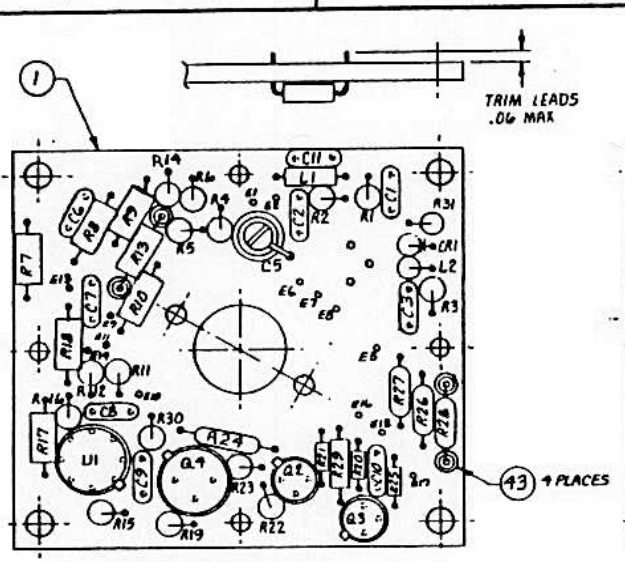
EFRATOM 18851 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70509-1
LIST TITLE: POWER SUPPLY ASSY A3		CONTRACT NO.	SHEET 2 OF 3

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
1	1		70511	PRINTED WIRING BOARD	
2	1		M39014/01-1330	CAPACITOR 33PF	C2
3	6		M39014/01-1572	CAPACITOR 6800PF	C7,8,9,10,11,12
4	1		M39014/01-1593	CAPACITOR .1UF	C6
5	2		M39003/01-2951	CAPACITOR 2.2UF	C1,C5
6	1		M39003/01-2848	CAPACITOR 4.7UF	C4
7	1		M39003/01-3026	CAPACITOR 22UF	C3
8	1		70428	DIODE (IN5650A)	CR1
9	1		JANTX1N825	DIODE	CR2
10	1		JANTX1N4150-1	DIODE	CR3
11	1		JANTX1N5301	DIODE	CR4
12	3		JANTX1N5807	DIODE	CR5-7
13	2		70412-8	INDUCTOR 4.7UH (MS75101-3)	L1,L2
14	1		70412-7	INDUCTOR 3.3UH (MS75101-1)	L3
15	1		70412-9	INDUCTOR 4.7UH (MS91189-21)	L4
16	8		JANTX2N2222A	TRANSISTOR Q2,	4,6,7,8,10,13,14
17	6		JANTX2N2907A	TRANSISTOR	Q1,3,5,11,12,16
18			NOT USED		
19			NOT USED		
20			NOT USED		
21	1		RNC55H1000FS	RESISTOR 100Ω	R27
22	1		RNC55H1540FS	RESISTOR 154Ω (NOMINAL)	R4
23	1		RNC55H1301FS	RESISTOR 1.30KΩ	R3
24			NOT USED		
25	1		RNC55H3241FS	RESISTOR 3.24KΩ	R2
26	2		RNC55H4321FS	RESISTOR 4.32KΩ	R16,17
27	1		RNC55H2211FS	RESISTOR 2.21KΩ	R23
28	1		RNC55H3012FS	RESISTOR 30.1KΩ	R24
29	4		RCR07G100JS	RESISTOR 10Ω	R18,20,30,31
30	2		RCR07G270JS	RESISTOR 27Ω	R8,10
31	3		RCR07G101JS	RESISTOR 100Ω	R5,25,28

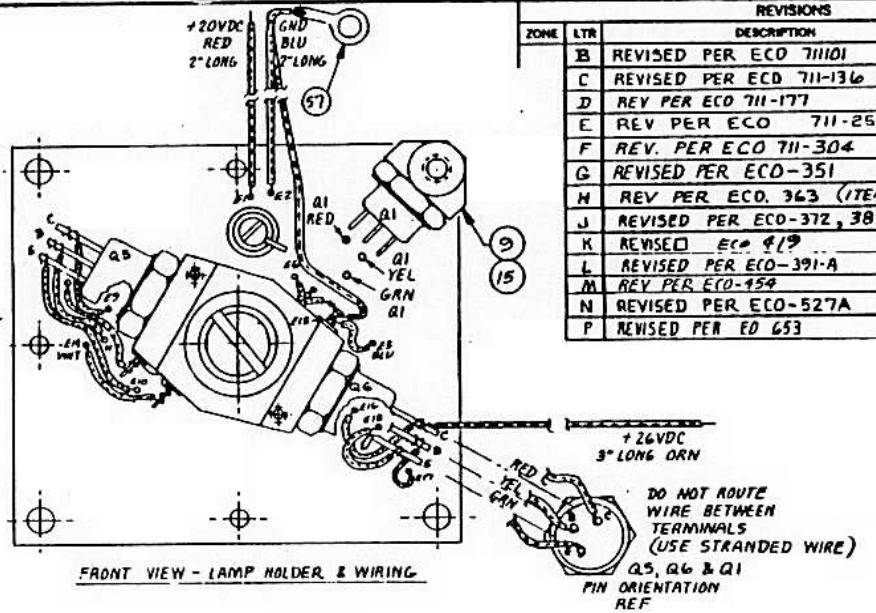
EFRATOM 18851 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70509-1
LIST TITLE: POWER SUPPLY ASSY A3		CONTRACT NO.	SHEET 3 OF 3

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
32	1		RCR07G821JS	RESISTOR 820	R6
33	2		RCR07G182JS	RESISTOR 1.8K	R26, R1
34	1		RCR07G222JS	RESISTOR 2.2K	R9
35	2		RCR07G472JS	RESISTOR 4.7K	R12,13
36	1		RCR07G682JS	RESISTOR 6.8K	R19
37	3		RCR07G103JS	RESISTOR 10K	R11,15,22
38	1		RCR07G183JS	RESISTOR 18K	R14
[1] 39	1		RWR81S1R00FS	RESISTOR 1.0 1W	R7
[1] 40	1		RWR80S1R30FS	RESISTOR 1.30Ω. 2 W	R21
41	1		M38510/10103BGX	OP AMP	U1
42	7		70416-3	TERMINAL, SOLDER (BIFURCATED)	
43	14		M38527/3-02N	MOUNTING PAD (TO-18)	
44	1		M38527/4-03N	MOUNTING PAD (8 PIN)	
45	18		SE16XC02	TERMINAL, SOLDER (TURRET)	
[1]	ACTUAL PART MAY VARY DUE TO AVAILABILITY. SEE ECO 711-260 FOR ALTERNATE VALUES.				
REF			70510	SCHEMATIC	

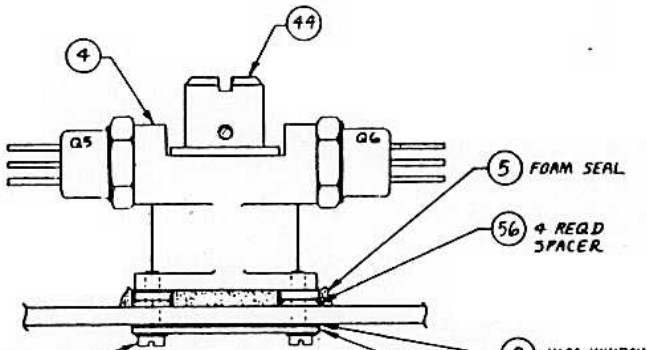
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	REVISED PER ECO 711101	6-5-79	
	C	REVISED PER ECO 711-136	7-18-79	
	D	REV PER ECO 711-177	9-11-79	
	E	REV PER ECO 711-250	12-3-79	CC
	F	REV. PER ECO 711-304	5-12-80	
	G	REVISED PER ECO-351	8-5-80	
	H	REV PER ECO. 363 (ITEM-57)	9-22-80	
	J	REVISED PER ECO-372, 382	9-30-80	
	K	REVISED ECO 419	1-29-81	
	L	REVISED PER ECO-391-A	3-26-81	
	M	REV PER ECO-454	6-10-81	
	N	REVISED PER ECO-527A	3-10-83	
	P	REVISED PER ED 653	6-19-89	



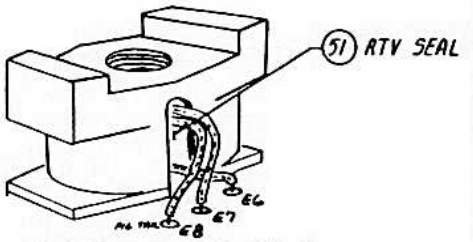
FRONT VIEW - COMPONENT LAYOUT



FRONT VIEW - LAMP HOLDER & WIRING



SIDE VIEW ROTATED 90° CCW



WIRING VIEW OF E6, E7, E8

NO SCALE

NOTES - UNLESS OTHERWISE SPECIFIED

1. FOR SCHEMATIC DIAGRAM SEE DWG NO. 70507.
2. REFERENCE DESIGNATORS ARE FOR REFERENCE ONLY AND MAY NOT APPEAR ON THE COMPONENT PART.
3. INSTALL COMPONENTS PER MIL-STD-275.
4. SOLDER PER REQT 5 OF MIL-STD-454.
5. TEST PER EFRATOM TP 70506.
6. MARK PART NO. AND REV LETTER PER MIL-STD-130.
7. DURING THE ASSEMBLY AGING PERIOD USE A FLAT WASHER IN PLACE OF ITEM 42, SPRING WASHER. AT FINAL ASSEMBLY, INSTALL SPRING WASHER AND PUT LOCTITE, ITEM 45, ON SCREW THREADS.

SEE SEPARATE PARTS LIST NO. PL 70506-2

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN Whitmore	6-5-79
CHECKED	6-5-79
	6-6-79
	6/8/79

EFRATOM
A DIVISION OF ... CORP

LAMP BOARD ASSEMBLY
A2A2
(BOARD 2)

SIZE	CODE IDENT NO.	DRAWING NO	
C	55761	70506-2	P

SCALE 2/1 | M100 | SHEET 1 OF 1

70518-3	M-100
NEXT ASSY	USED ON
APPLICATION	

70506 P

APPLICATION		REVISION			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVAL
70518-3	M100	AC	REVISED ITEM 42 & 45, ED 653,640	2-20-84	sc

REV																															
SHEET																															
REV STATUS OF SHEETS	REV	AC	M	W																											
	SHEET	1	2	3																											

CONTRACT NO.

APPROVALS	DATE
ORIGN Whitmore	3-19-79
CHK [illegible]	3-19-79
APVD L Pearson	7/27/79
APVD	

EFRATOM

PART LIST -
LAMP BOARD ASSEMBLY

SIZE	CODE IDENT NO.	DRAWING NO.	
A	55761	PL 70506-2	AC
M100		SHEET 1 OF 3	

FORM NO. 005 6/77

EFRATOM
18851 BARDEEN AVE
IRVINE, CAL., 92715

PARTS LIST

FSCM NO 55761

PL 70506-2

LIST TITLE: LAMP BOARD ASSEMBLY

CONTRACT NO.

SHEET 2 OF 3

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
1	1		70508	PRINTED WIRING BOARD	
2	1		70596	WINDOW, MICA	
3	1	MOTOR	705-154	TRANSISTOR, CUT OFF (JANTX2N3375)	Q1
4	1		70576	THERMOSTAT ASSY	
5	1		70597	SEAL FOAM	
6	2		CCR05CG332JR	CAPACITOR 3300PF , 50V	C3,8
7	1		M39014/01-1340	CAPACITOR 100PF	C9
8	4		M39014/01-1572	CAPACITOR 6800PF	C1, ,6,7,11
9	1		705-141	POST, TRANSISTOR MOUNT	
10	1		M39014/01-1587	CAPACITOR .047UF	C10
11	1		70403	CAPACITOR, VARIABLE, 1.5-14PF	C5
12	1		JANTX1N4148-1	DIODE	CR1
13	1		70412-2	INDUCTOR 2.2UH (MS75084-4)	L1
14	1		70412-1	.15UH (MS75083-3)	L2
15	1		70425-15	SCREW, METRIC, M3X6	
16	2		JANTX2N2222A	TRANSISTOR	Q2,3
17	1		JANTX2N2219A	TRANSISTOR	Q4
18	1		RNC55H1000FS	RESISTOR 100Ω 1/10W	R30
19	1		RNC55H2430FS	RESISTOR 243Ω 1/10W	R4
20	2		RNC55H3920FS	RESISTOR 392Ω 1/10W (R14, NOMINAL)	R8,14
21	1		RNC55H1051FS	RESISTOR 1.05KΩ 1/10W	R9
22	2		RNC55H4321FS	RESISTOR 4.32KΩ 1/10W	R7,18
23	1		RNC55H5111FS	RESISTOR 5.11KΩ 1/10W	R6
24	2		RNC55H1652FS	RESISTOR 16.5KΩ 1/10W	R5,10
25	2		RNC55H4752FS	RESISTOR 47.5KΩ 1/10W	R11,12
26	2		RNC55H1003FS	RESISTOR 100KΩ 1/10W	R16,17
27	1		RNC55HXXXXFS	RESISTOR SELECT 1/10W	R13
28	1		RCR05G101JS	RESISTOR 100Ω 1/8W	R25
29	2		RCR05G241JS	RESISTOR 240Ω 1/8W	R15,21
30	1		RCR05G471JS	RESISTOR 470Ω 1/8W	R23
31	1		RCR05G132JS	RESISTOR 1.3KΩ 1/8W	R20

EFRATOM 18651 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70506-2
LIST TITLE: LAMP BOARD ASSEMBLY		CONTRACT NO.	SHEET 3 OF 3

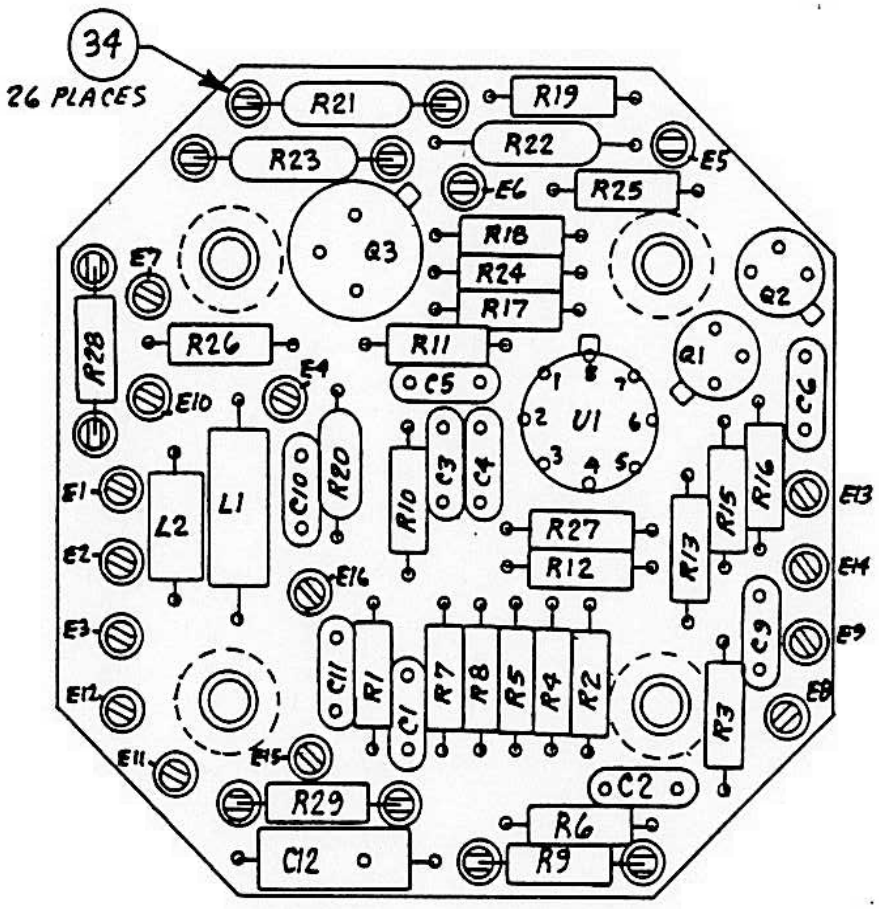
ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
32	1		RCR05G272JS	RESISTOR 2.7KΩ 1/8W	R19
33	1		RCR05G103JS	RESISTOR 10K 1/8W	R22
34	1		RCR07G103JS	RESISTOR 10K 1/4W	R29
(1) 35	2		RWR81S1R00FS	RESISTOR 1.00Ω	R26,27
(1) 36	1		RWR81SR806FS	RESISTOR .806 Ω	R28
(1) 37	2		RWR81S19R6FS	RESISTOR 19.6 Ω	R2,3
(1) 38	1		RWR80S5110FS	RESISTOR 511 Ω	R24
(1) 39	1		RWR80S1501FS	RESISTOR 1.5KΩ	R1
40	1		M38510/10103BGX	INTEGRATED CIRCUIT	U1
41	2		70425-4	SCREW (M2 x 8mm LG. S.S.)	
42	2		70414-19	WASHER, SPRING	
43	4		SE16XC02	TERMINAL, SOLDER	
44	1		705-110	RUBIDIUM LAMP ASSEMBLY	
45	AR		LOCTITE #222	ADHESIVE SEALANT (PURPLE)	MIL-S-46163 TYPE II, GR.M
46	1		RNC55H2000FS	RESISTOR, 200Ω 1%W	R31
47	1		70418-1	MOUNTING PAD	XQ4
48	2		M38527/3-02N	MOUNTING PAD	XQ2,3
49	1		M38527/4-03N	MOUNTING PAD	XU1
50	AR		MIL-W-16878, TYPE E	WIRE, 24 AWG, STRANDED	
51	AR		70424-7	SILICONE RUBBER-RTV	
52	AR		SN63W-RMAP-3	SOLDER	
53	REF		70507	SCHEMATIC	
54	—		NOT USED	—	
55	2		70573	TRANSISTOR (JANTX2N3997)	Q5,6
56	4		70414-1	WASHER, FIBRE	
57	1		70421-1	LUG	
58	1		70559	INSULATOR	
59	AR		70411	THERMAL JOINT COMPOUND	
60	1		CCR05CG102JR	CAPACITOR, 1000 PF, 100V	C2

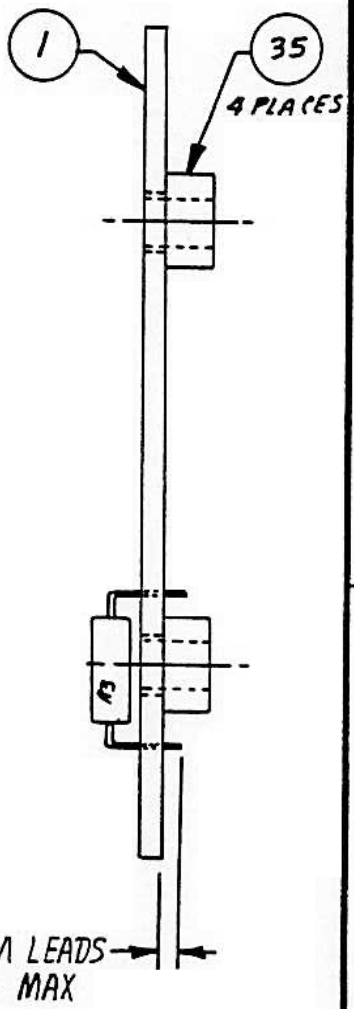
(1) ACTUAL PART MAY VARY DUE TO AVAILIBILITY. SEE ECO 711-260 FOR ALTERNATE VALUES.

APPLICATION	
NEXT ASSY	USED ON

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	RELEASED PER ECO 711-224	11-12-79	HW
B	REV. PER E.O. 711-272	4-14-80	HW
C	REV PER ECO-492	3-11-82	HW

REV. C
SH 1
DWG. NO. 70521-2





SEE SEPARATE PARTS LIST NO. PL 70521-2

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±	CONTRACT NO.	EFRATOM	
MATERIAL ~	APPROVALS / DRAWN Whitmore	DATE 11-12-79	RESONATOR THERMOSTAT ASSY
FINISH ~	CHECKED D. Davidson	11-13-79	SIZE A / FSCM NO. 55761 / DWG. NO. 70521-2 / REV. C
DO NOT SCALE DRAWING	ISSUED		SCALE 2/1 / SHEET

BISHOP GRAPHICS, INC. REORDER NO. 20507

APPLICATION		REVISION			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVAL
		A	RELEASED PER ECO 711-224	1H2-79	HW
		B	REV PER ECO'S 711-257,258,260	1-28-80	CL
		C	REV. PER ECO 711-269,-295	4.18.80	HW
		D	REV PER ECO 466	8-11-81	HW
		E	REV PER ECO-477, -492	3-11-82	HW
		F	REV "R28" PER EO-569	6-3-83	HW

REV																																	
SHEET																																	
REV STATUS OF SHEETS	REV	F	C	D																													
	SHEET	1	2	3																													

CONTRACT NO.

APPROVALS	DATE
ORIGN whitmore	1H2-79
CHK J. Nicholson	11/13/79
APVD L Shaw	11/13/79
APVD	

EFRATOM

PARTS LIST - RESONATOR THERMOSTAT ASSY

SIZE	CODE IDENT NO.	DRAWING NO.	
A	55761	PL 70521-2	F

SHEET 1 OF 3

FORM NO. 005 6/77

EFRATOM 18851 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70521-2
LIST TITLE: RESONATOR THERMOSTAT ASSY		CONTRACT NO.	SHEET 2 OF 3

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
1	1		70587	PRINTED WIRING BOARD	
2	1		M38510/10104BGX	OP AMP	U1
3	2		M39014/01-1340	CAPACITOR 100PF	C4,C5
4	5		M39014/01-1572	CAPACITOR 6800PF	C1,2,9,10,11
5			NOT USED		
6	1		M39014/01-1587	CAPACITOR .047UF	C6
7	1		705-129	CAPACITOR 1UF	C3
8	2		JANTX2N2222A	TRANSISTOR	Q1,Q2
9	1		JANTX2N2219A	TRANSISTOR	Q3
10			NOT USED		
11	1		RNC55H2430FS	RESISTOR 243Ω	R1
12	1		RNC55H3920FS	RESISTOR 392Ω	R5
13	1		RNC55H1181FS	RESISTOR 1.18KΩ	R6
14	1		RNC55H4321FS	RESISTOR 4.32KΩ	R4
15	1		RNC55H1542FS	RESISTOR 15.4KΩ	R3
16	1		RNC55H1652FS	RESISTOR 16.5KΩ	R7
17	1		RNC55H4992FS	RESISTOR 49.9KΩ	R2
18			NOT USED	RESISTOR	
19	1		RNC55H7503FS	RESISTOR 750KΩ	R13
20	1		RCR07G206JS	RESISTOR 20 MEGΩ	R12
21	2		RCR07G101JS	RESISTOR 100Ω	R19,R26
22	2		RCR07G241JS	RESISTOR 240Ω	R11,R17
23	1		RCR07G471JS	RESISTOR 470Ω	R24
24	1		RCR07G272JS	RESISTOR 2.7KΩ	R16
25	1		RCR07G562JS	RESISTOR 5.6KΩ	R15
26	2		RCR07G103JS	RESISTOR 10KΩ	R18,R25
(1) 27	1		RWR80SR806FS	RESISTOR .806 Ω 2W	R21
(1) 28	1		RWR81S3480FS	RESISTOR 348Ω 1W	R20
29			NOT USED		
30	1		70412-7	INDUCTOR 3.3UH (MS75101-1)	L1
31	1		70412-4	INDUCTOR 6.8UH (MS75084-10)	L2

EFRATOM 18651 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO. 55761	PL 70521-2
LIST TITLE: RESONATOR THERMOSTAT ASSY		CONTRACT NO.	SHEET 3 OF 3

ITEM NO.	QTY REQD	FSCM NO.	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
32	1		RNC55H4021FS	RESISTOR, NOMINAL VALUE 4.02K	R28
33	1		RNC55H2000FS	RESISTOR, NOMINAL VALUE 200Ω	R8
34	26		70416-3	TERMINAL, SOLDER	
35	4		70417-1	STANDOFF, SELF CLINCHING	
36	2		RNC55 or RCR07	RESISTOR, SELECT (FS or JS)	R9, R29
37	-		NOT USED		
38	-		NOT USED		
39	1		70418-1	MOUNTING PAD	XQ3
40	2		M38527/3-02N	MOUNTING PAD	XQ1, XQ2
41	1		M38527/4-03N	MOUNTING PAD	XU1
42	AR		SN63WRMAP3	SOLDER	
43	AR		MIL-I-46058, TYPE UR	CONFORMAL COAT	
44	2		RNC55H1503FS	RESISTOR 150K	R10, R27
45	1		RWR80S1R82FS	RESISTOR 1.82Ω 2W	R22
46	1		RWR80S1R00FS	RESISTOR, NOMINAL VALUE, 2W (1Ωmin)	R23
47	1		M39014/01-1593	CAPACITOR .1UF "SELECT"	C12
48	1		M39003/01-2848	CAPACITOR 4.7UF "SELECT"	C12
REF	-		TP70521	TEST PROCEDURE	
REF	-		70522	SCHEMATIC	

(1) ACTUAL PART MAY VARY DUE TO AVAILABILITY. SEE ECO 711-260 FOR ALTERNATE VALUES

APPLICATION		REVISION			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVAL
		A	RELEASED PER ECO 711-237	11-21-79	HW
		B	REV. PER E.C.C. 711-279	4-16-80	HW
		C	REV. PER ECO 711-332	7-01-80	HW
		D	REV PER ECO 360	8-26-80	HW
		E	REVISED PER ECO 375	9-30-80	HW
		F	REVISED PER ECO 428	4-3-81	HW
		G	ADDED 70414-11 TO ITEM-45	8-12-81	HW
		H	ADDED ITEM-49 PER. ECO-491 REV ITEM-7 PER ECO-477	3-11-82	HW
		J	REVISED PER ECO-529	5-4-83	HW

REV																																	
SHEET																																	
REV STATUS OF SHEETS	REV	J	D	E																													
	SHEET	1	2	3																													

CONTRACT NO.	
APPROVALS	DATE
ORIGN Whitmore	11-21-79
CHK	
APVD	
APVD	

EFRATOM

PARTS LIST –
PHYSICS PACKAGE ASSY

SIZE	CODE IDENT NO.	DRAWING NO.	
A	55761	PL 70518-3	J

SHEET 1 OF 3

FORM NO. 005 6/77

ERATOM 18651 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO 55761	PL 70518-3
LIST TITLE PHYSICS PACKAGE ASSEMBLY (A2)		CONTRACT NO	SHEET 2 OF 3

ITEM NO	QTY REQD	FSCM NO	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
1	1		70599	MOUNTING PLATE ASSY	
2	1		70527	SHIELD, INNER, MU-METAL CAN	
3	1		70528	SHIELD, INNER, MU-METAL LID	
4	1		70550-1	RESONATOR CAVITY ASSY	
5	1		70560-1	CONDENSER ASSY	
6	3		70568	NUT, INSULATING	
7	2		70573	TRANSISTOR (JANTX 2N3997)	Q1,Q2
8	8		70425-3	SCREW, SS 2MM x 6MM	
9	3		70566	NUT, HEX, CONE HEAD	
10	12		70414-13	WASHER, LOCK 2 mm	
11	–		NOT USED	—	
12	AR		70424-14	POLYETHER FOAM (3500 H)	
13	AR		70424-3	POLYURETHANE FOAM	
14	AR		SN63WRMAP3	SOLDER	
15	AR		MIL-W-16878, TYPE E	WIRE, 24 AWG, STRANDED	
16	1		70402	DIODE	CR1
17	1		70246	SCREW, ADJ, DIODE	
18	REF		70519	SCHEMATIC	
19	–		—	—	
20	1		70506-2	LAMP BOARD ASSY	A2A2
21	REF		70529	BLOCK, LITE	
22	—		NOT USED	—	
23	4		70425-5	SCREW 2 mm x 10mm	
24	15		70414-4	WASHER, FLAT 2 mm	
25	4		70426-28	SCREW 3 mm X 16 mm	
26	4		70414-7	WASHER, FLAT 3 mm	
27	4		70414-15	WASHER, LOCK 3 mm	
28	4		70425-11	SCREW 2.5mm x 10mm	
29	4		70414-6	WASHER, FLAT, 2.5 mm	
30	1		70521-2	THERMOSTAT BD ASSY	A2A1
31	4		70414-14	WASHER, LOCK, 2.5 mm	

REVISION STATUS OF THIS SHEET

LETTER	A	B	C	D					
DATE	5-	4-		5-3-83					
ECO NO.	--	-1-2		529					

EFRATOM 18851 BARDEEN AVE IRVINE, CAL., 92715	PARTS LIST	FSCM NO 55761	PL 70518-3
LIST TITLE PHYSICS PACKAGE ASSEMBLY (A2)		CONTRACT NO	SHEET 3 OF 3

ITEM NO	QTY REQD	FSCM NO	PART OR IDENT NUMBER	DESCRIPTION	REFERENCE
32	3		MS35489-1	GROMMET	
33	-		NOT USED	-	
34	-		NOT USED	-	
35	4		70414-1	WASHER, FIBRE	
36	-		NOT USED	-	
37	4		70417-2	SPACER, FIBRE (.115 I.D.)	
38	4		70417-3	SPACER, FIBRE (.140 I.D.)	
39	AR		70424-1	EPOXY ADHESIVE	
40	AR		70411	THERMAL JOINT COMPOUND	
41	-		NOT USED	-	
42	-		NOT USED	-	
43	-		NOT USED	-	
44	AR		70424-7	SILICONE RUBBER	
45	1		70590	SPACER	
46	1		70592	GASKET	
47	1		70412-2	INDUCTOR 2.2 UH (MS75084-4)	L3
48	AR		70424-11	MOLD RELEASE (TFE-20)	
[illegible]	AR		LOCKTITE NO. 222	[illegible]	[illegible]

REVISION STATUS OF THIS SHEET

LETTER	[illegible]	[illegible]	C	D	E				
DATE	[illegible]	[illegible]	9-30-80	[illegible]	[illegible]				
ECO NO	[illegible]	[illegible]	375	[illegible]	[illegible]				

APPENDIX C

M-100 SPECIFICATIONS

APPLICATION		REVISIONS			
NEXT ASSY	USED ON	REV.	DESCRIPTION	DATE	APPROVED
70500-1	M100-1	L	REVISED PER ECO-549	4-18-83	HW

** NOTE: Changes from previous issue. The margins of this document are marked with an asterisk to indicate where changes from the previous issue have been made.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±	CONTRACT NO.	EFRATOM A DIVISION OF Ball CORP	
MATERIAL —	APPROVALS / DRAWN W.P.	DATE 4-18-83	SPECIFICATION — RUBIDIUM FREQUENCY STANDARD MODEL M100
FINISH —	CHECKED H. Whitmore	4-18-83	SIZE A / FSCM NO. 55761 / DWG. NO. 70502-1 / REV. L
DO NOT SCALE DRAWING	ISSUED		SCALE / SHEET 1 OF 6

RUBIDIUM FREQUENCY STANDARD

1.0 SCOPE

1.1 Purpose This specifcation establishes the general requirements for a full military rubidium frequency standard.

2.0 APPLICABLE DOCUMENTS

2.1 Issue of Documents The following documents of the issue in effect when the order is placed from a part of this specification to the extent specified herein.

MIL-E-5400---Electronic Equipment, Airborne, General Specification for, (used as guide)

MIL-E-14072--Finishes for Ground Electronic Equipment

MIL-I-45208--Inspection System Requirements

MIL STD-130--Identification Marking

MIL-STD-202--Test Methods for Electronic Component Parts

MIL-STD-454--Standard General Requirements for Electronic Equipment

MIL-STD-461--Electromagnetic Interference Characteristics Requirements for Equipment

MIL-STD-810--Environmental Test Methods

MIL-HDBK-217-Reliability Prediction of Electronic Equipment

3.0 PERFORMANCE CHARACTERISTICS

3.1 Output 10 MHz Sine Wave, $0.5\ ^{+30}_{-10}$ % VRMS, 50 ohms output impedance; frequency set at 10 MHz $\pm 5 \times 10^{-11}$ at shipment. (5 MHz Low Noise Option available)

3.2 Signal to Noise (SSB 1 Hz BW)

> 120 dB at 100 Hz and > 135 dB at 1 KHz from carrier;

> 95 dB at 1 Hz and ∿155 dB at 300 Hz from carrier (Low Noise Option)

3.3 Harmonic/Non-Harmonic 30 dB down, 80 dB down.

3.4 Power On/Off Cycling Retrace within parts 10^{-11}.

3.5 Input Power +22.5 to +32 VDC (50 V, 50ms transient)

18W max. at 25°C ambient and +26 VDC.

3.6 Warm-up Characteristics < 10 minutes to reach 2×10^{-10} at +25°C ambient. < 25 minutes to reach 2×10^{-10} at -55°C ambient. Peak current during warm-up, ∿ 2A at +26 VDC, +25°C ambient. (Five minute warm-up option available, peak current during warm-up, ∿ 4A at +26 VDC, +25°C ambient).

** 3.7 Long-Term Drift 6×10^{-11} for the first month after 14 days of continuous operation. 3.6×10^{-10} for the first year; 2×10^{-10} per year, starting with 2nd year. (1×10^{-11} per month option available).

** 3.8 Short Term Stability $\sigma y(\tau) = 3\times10^{-11}$ $(\tau^{-\frac{1}{2}})$

1 sec $\leq \tau \leq$ 100 sec

3.9 Trim Range Adjustment 3×10^{-9} frequency standard.

3.10 Voltage Variation < 1×10^{-11} for ± 10% input voltage change.

** 3.11 Operating Temperature < 3×10^{-10} from -55°C (ambient) to +68°C (baseplate) (Meets MIL-E-5400, CLASS I; parts in 10^{-9} offset at +71°C).

** 3.12 Storage Temperature (Non-Ops) -62°C to +85°C. (Meets MIL-E-5400, Class I).

** 3.13 Magnetic Field < 3×10^{-13} /AM^{-1} worst case orientation.

(2.4×10^{-11}/GAUSS)

3.14 Altitude (-) < 7×10^{-11} from sea level to 12,000m (40,000 ft.).< 1×10^{-13} /mbar.

** 3.15 Humidity 100% relative humidity.

3.16 Acceleration $< 4 \times 10^{-12}$ /g worst case orientation.

** 3.17 Vibration (Ops) $0.02 g^2/Hz$, 20 to 500Hz; Allan Variance $\sim 1 \times 10^{-10}$ for $\tau = 1$ sec; < 0.2 μsec/hr error. (Improved vibration performance options available).

** 3.18 Reliability Level B QPL or Equivalent parts, derated to 60% stress level, calculated at +68°C baseplate. Per MIL-HDBK-217B

> 34,000 hours, ground, stationary environment.
> 19,000 hours, airborne, inhabited transport environment.
> 11,000 hours, ground, mobile environment.

3.19 Size See Outline Drawing No. 70549-1 (∿ 4x4x5 inches).

3.20 Weight Four pounds maximum; 4.5 pounds maximum with standard heatsink.

3.21 Electrical Protection An internal diode protects against reversed polarity; 10 MHz output short circuit protected.

3.22 Radiation Hardening Hardness level information supplied at request. (Hardened to a ground tactical environment).

3.23 EMI Compatibility MIL-STD-461, Notice 3, data supplied at request.

4.0 PARTS SCREENING/QUAL LEVEL

MIL-M-38510-------QPL, INTEGRATED CIRCUITS

MIL-STD-202-------PASSIVE COMPONENTS, MIL-ER-LEVEL

MIL-STD-750-------TRANSISTORS & DIODES, TX LEVEL

MIL-STD-883-------INTEGRATED CIRCUITS, LEVEL B

MIL-STD-19500-----QPL, TRANSISTORS, DIODES, TX LEVEL

MIL-C-39012-------CONNECTORS, COAX

MIL-C-28748-------CONNECTORS, RACK AND PANEL

IN-HOUSE SPECS FOR NON-QPL PARTS SCREENED TO ABOVE LEVELS

5.0 ACCEPTANCE TESTS CONDUCTED (Each Unit)

5.1 Warm-up and Lock Test

5.2 Output Level Test

5.3 Short-Term Stability Test

5.4 Frequency Variation vs Temperature (-55°C ambient to +68°C baseplate).

5.5 Trim Range Test

5.6 Temperature Cycling (Non-Ops)

(-55 C to +70 C ambient, 1-hour dwell, 10 cycles).

5.7 Burn-In and Long-Term Drift Test (7 days at ambient).

6.0 QUALIFICATION TESTS (Qual Unit Only)

6.1 Vibration-Sine

6.1.1 Sine, Test #1 (Non-Ops)

MIL-STD-202E, Method 204C, Test Condition-A, (10g peak 0.3* inch double ampl; 10 Hz to 200*Hz; 12 cycles. Three axis, total of 36 times).

6.1.2 Sine, Test #2 (Non-Ops)

(10g peak, 0.005 inch double ampl; 200 Hz to 500 Hz, 1 cycle, 3 axis, total of 3 times).

6.2 Vibration-Random

6.2.1 Random Test #3 (Operational)

$0.02g^2/Hz$, 20 to 50 Hz falling linearly to $0.001g^2/Hz$ at 500Hz (Vertical plane only).

SHORT TERM STABILITY SPEC WAIVED.

6.3 Shock

6.3.1 Shock Test #1 (Non-Ops)

MIL-STD-202E, Method 213B, Test Condition-J (30g peak 11 msec, 1/2 Sine, 6.8 ft/sec, 3 shocks, 3 axis, 18 shocks).

6.3.2 Shock Test #2 (Non-Ops)

(10g peak, 16 msec, 1/2 Sine, 3.28 ft/sec, 4000 shocks).

6.4 Altitude MIL-STD-810C, Method 500, Procedure I (Expanded to a soak of 15,000m (50,000 ft)*; then 3,000m (10,000 ft) and operate unit; return to ambient non-ops).

6.5 Hi-Temp MIL-STD-810C, Method 501, Procedure II (Expanded to 49°C*, *68°C ambient, 49°C*, three 12-hour cycles, non-ops; stabilized 68°C operational test).

6.6 Low Temp MIL-STD-810C, Method 502, Procedure I (Soak at -60°C ambient* or -18°C baseplate*, whichever is colder; then -40°C ambient*; operate during last 2 hours).

** 6.7 Humidity MIL-STD-810C, Method 507.1, Procedure II (Dry at -54°C, then +23°C ambient, 50% humidity; then cycle with dwells between 0°C and +49°C total of five 48-hour cycles; at last cycle operate unit).*

6.8 Magnetic Field Subjected to field strengths of 50 to 250 A/M in a Helmholtz coil, from which an average frequency deviation is determined.

6.9 Toppling Test (Tip to each of the four sides).

6.10 EMI MIL-STD-461A (test data available upon request). Tested to 461A, Notice 3, CE01, 02, 03, 04, CS01, 02, 06, RE02, RS01, 02, 03.

7.0 DOCUMENTATION CONTROL

FOR ASSEMBLY DRAWINGS, SCHEMATICS AND DETAIL PARTS OF THIS UNIT, SEE EFRATOM MASTER DRAWING LIST MDL 70500-1. DRAWINGS ARE PREPARED IN ACCORDANCE WITH MIL-D-1000, FORM 2, CAT E. (DOD-D-1000, LEVEL 2).

*Alteration to methods or procedures called out in referred-to specification.

PIN	Color	Function
B	White	Rb Lamp Signal
F	Brown	Xtal Cont Voltage Signal
H	Green	Resonance Lock Signal
L	Red	+22.5 to +32 VDC Input power
P	Black	Ground (connected to Enclosure)

CORBY DAWSON ELECTRONICS-SPECIALIZING IN REPAIR AND CALIBRATION OF
CESIUM AND RUBIDIUM FREQUENCY STANDARDS
1204 PRIMROSE CT. LOMPOC, CA. 93436 805-736-0288

M100

The following notes will answer some of the most common questions regarding the care and feeding of the M100 rubidium unit.

-The unit should be mounted on a metal chassis to provide heat sinking.

-Initial current draw is no greater than 1.9 amps @ 26VDC dropping down to <800ma after approx. 10 minutes.

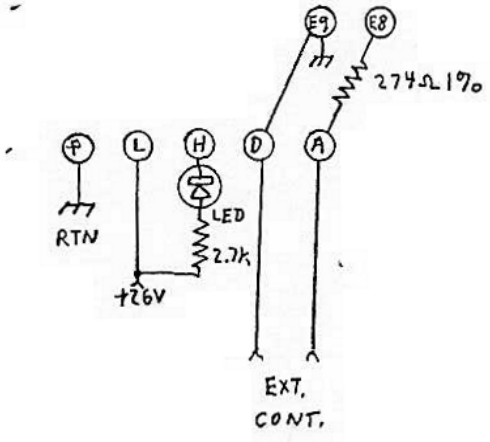
-I recommend running the unit on 24 to 28 VDC

-The lock pin (H) can be tied thru an LED and 2.7K resistor to the + supply volts providing a visual indication when the unit is locked.

-If you are wanting to control the frequency externally you must modify the unit as follows. The original frequency adjust pot is still in circuit and adjustable.

1. Remove the cover
2. Identify connections E8 and E9 on the synth. Board
3. Connect a wire from the inside solder pin D of the J2 multipin connector to E9 on the synth. board
4. Connect a 274 ohm 1% resistor between two short lengths of wire and cover with heat shrink tubing.
5. Insert the resistor/wire between inside solder pin A on J2 and E8 on the synth board
6. Replace cover

The unit can now be externally controlled in frequency by application of a control voltage between pins A and D



DWG NO	SH	REV
70579	1	B

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
	B	REVISED AND REDRAW	6-26-80	

26 VDC TO 21 VDC LAMP HTR. REG
26V DISTR
20V REG.
PWR SUPPLY BOARD A3
J2-R
J2-L
J2-P
+26 VDC NOMINAL INPUT (22.5 TO 32 VDC)
+20V DISTR.
LAMP OSCILLATOR BOARD A2A2
LAMP OSCILLATOR ≈ 7.7 MHZ
LAMP HEATER
CONTROLLER ≈ 113°C
RUBIDIUM LAMP
+20 VDC
+20VDC
C-FIELD WINDING
RESONATOR CAVITY
PHOTO CELL
R_b CELL
LAMP OSCILLATOR COIL
R_b LAMP HEATER
≈ 6.8GHZ
PHOTO CELL OUTPUT
RESONATOR THERMOSTAT A2A1
≈ 76°C
RESONATOR HEATER
CONTROLLER
+26VDC
+20VDC
SNAP DIODE
C-FIELD CURRENT
+20VDC
J1 OUTPUT 10 MHz STD
BUFFER AMP.
VCXO
CRYSTAL OVEN ≈ 78°C
CONTROLLER
CRYSTAL HEATER
+26 VDC
LAMP VOLTAGE MONITOR J2-B
TRIM RANGE ADJ
10 MHZ OSCILLATOR A4
10MHZ TO SYNTHESIZER
100K
100K
J2-F
CRYTAL CONTROL VOLT
PHOTOCELL CURRENT AMP.
SWEEP CIRCUIT ≈ 30 SECOND
VCXO CONTROL VOLTAGE INTEGRATER
SERVO BOARD A1
RND AMPL
254 HZ AMPL
PHASE DETECTOR
RESONANCE LOCK AMPL
+20VDC
LOCK
100Ω
LOCK MONITOR
J2-H
LOCK SIG
127 HZ NOTCH FILTER
508 HZ OSCILLATOR
DEVIDER 254/127 HZ
127 HZ OUTPUT AMPL
127HZ
60 MHZ +5.3125 MHZ
OUTPUT NETWORK
AMPL
AMPL
60MHZ
DOUBLER
PHASE MODULATOR
30MHZ
TRIPPLER
10MHZ
TEMP COMP.
C-FIELD CONTROL
5.3125 MHZ
5.3125 MHZ SYNTHIZER
OUTPUT FREQ. ADJ. (EXT. OR INT POT.)
+20VDC
+20 VDC
SYNTHESIZER A5

Figure 4.2 Block Diagram

QTY REQD	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
.XX ±
.XXX ±

MATERIAL

FINISH

NEXT ASSY	USED ON
	10500

CONTRACT NO

APPROVALS	DATE
DRAWN Ralph Nguyen	6-26-80
CHECKED W. Thomas	7-15-80
ISSUED	

EFRATOM

M100
BLOCK DIAGRAM

SIZE	FSCM NO	DWG NO	REV
D	55761	70579	B

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	N	REVISED PER ED 625	12-6-83	
	P	REVISED VALUES IN TAB PER ED 695	10 02 84	
	A	RELEASED PER ECO 711-122	6-18-79	
	B	REV PER ECO 711-162, -176	9 10 79	
	C	REV PER ECO 711-212	12-18-79	
	D	REV PER ECR 711-263	2-19-80	
	E	REV. PER ECO 711-321	5-15-80	
	F	REV PER ECO 711-345	7-16-80	
	G	REV PER ECO-368	10-2-80	
	H	E8 WAS SHOWN GROUNDED BUT ISN'T	10-2-80	
	J	REV PER ECO'S 447, 453, 466, 479	8-8-81	
	K	REV PER ECO'S 471, 475, 481, 492	3 11 82	
	L	REV PER ECO-533	3-10-83	
	M	REV PER ED-694A	8-8-83	

OSCILLATOR CONTROL VOLTAGE INPUT
TO A1E6 (E4)

+26VDC INPUT
TO A3E9 (E3)

+20VDC INPUT
TO A3E10 (E1)

GND INPUT (E2)
TO A3E8

TO A3E3 (E5)
10 MHZ OUTPUT
TO SYNTHESIZER BD

TO A3E4 (E6)

TO J1 (E7)
10 MHZ OUTPUT

THERMOSTAT ASSEMBLY FOR CRYSTAL (Y1)

TABULATION				
ASSEMBLY	L8	R18	R19	R51
70512-2 (V₀=5V)	—	249Ω	562Ω	698Ω
70512-3 V₀=1.8V	6.8UH	—	100Ω	698Ω

NOTES - UNLESS OTHERWISE SPECIFIED

1. CAPACITOR VALUES ARE IN MICROFARADS (UF) OR PICOFARADS (PF). THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ±10%.
   MIL-C-20, STYLE CKR05 (TEMP COMP CERAMIC).
   MIL-C-39014, STYLE CKR05 (CERAMIC)
   MIL-C-19978, STYLE PC26 (CERAMIC TRIMMER CAPACITOR).
   CAPACITOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE CKR05.
2. RESISTOR VALUES ARE IN OHMS (Ω). THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ±1%.
   MIL-R-55182, STYLE RNC55 (METAL FILM) ⅛ W.
   MIL-R-39008, STYLE RCR07 (COMPOSITION) ¼ W.
   MIL-R-39007, STYLE RWR81 (WIRE WOUND) 1 W.
   RESISTOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE RNC55.

NOTES - CONTINUED

3. OTHER COMPONENTS ARE AS SPECIFIED OR CONTROLLED BY THE FOLLOWING SPECIFICATIONS.
   MIL-S-19500, DIODES AND TRANSISTORS (JANTX).
   MIL-M-38510, INTEGRATED CIRCUITS.
   MIL-C-15305, INDUCTORS
4. SYMBOL ◆ INDICATES SOLDER TERMINALS. "E" POINTS AND "TEST POINTS" ARE SOLDER TERMINALS WITH THE EXCEPTION OF (E9, E10, E16).
5. FOR ASSEMBLY DRAWING SEE 70512-2 OR 70512-3.

⚠ FOR COMPONENT VALUES SEE TABULATION.

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
			PARTS LIST

70500	M-100
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN	4-15-79
CHECKED	4/19/79

EFRATOM

SCHEMATIC - OSCILLATOR A4

SIZE	CODE IDENT NO	DRAWING NO	REV
D	55761	70513	P

SCALE NONE | BOARD NO 4 | SHEET 1 OF 1

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	RELEASED PER ECO 711-122	6-15-79	HW
	B	REVISED PER ECO 711-127	6-20-79	HW
	C	REV PER ECR 711-212	12-18-79	CC
	D	REV PER ECO 711-262	2-19-80	CC
	E	REV. PER E.C.O. 711-321	5-12-80	HW
	F	REV PER ECO #442	9-5-81	HW
	G	REV "A7" PER EO-541A	6-2-83	HW

REVISIONS

NOTES - UNLESS OTHERWISE SPECIFIED

1. CAPACITOR VALUES ARE IN MICROFARADS (UF) OR PICOFARADS (PF). THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ± 10%.
   MIL-C-20, STYLE CCR05, (TEMP COMP CERAMIC)
   MIL-C-39014, STYLE CKR05 (CERAMIC)
   MIL-M-83421, STYLE CRH01 (METALLIZED FILM)
   CAPACITOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE CKR05.
2. RESISTOR VALUES ARE IN OHMS (Ω). THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ±1%.
   MIL-R-55182, STYLE RNC55 (METAL FILM) 1/10 W.
   STYLE RNC65 (METAL FILM) 1/4 W.
   STYLE RNC70 (METAL FILM) 1/2 W.
   MIL-R-39007, STYLE RWR81, (WIRE WOUND) 1 W.
   [6] MIL-R-39015, STYLE RTR12, VARIABLE (WIRE WOUND) 3/4 W.
   MIL-R-22097, STYLE RJ12, VARIABLE (CERMET) 1 W.

NOTES - CONTINUED

2. CONTINUED
   RESISTOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE RNC55.
3. OTHER COMPONENTS ARE AS SPECIFIED OR CONTROLLED BY THE FOLLOWING SPECIFICATIONS.
   MIL-S-19500, DIODES AND TRANSISTORS (JANTX)
   MIL-M-38510, INTEGRATED CIRCUITS
   MIL-C-15305, INDUCTORS
4. SYMBOL ◆ INDICATES SOLDER TERMINALS, "E" POINTS AND "TEST POINTS" ARE SOLDER TERMINALS.
5. FOR ASSEMBLY DRAWING SEE NO. 70515.
[6] SEE ASSEMBLY DRAWING AND PARTS LIST FOR POTENTIOMETER USED.

NOTES - CONTINUED

[7] RESISTOR VALUE OF R7 IS 4.99K ON LNO "LOW NOISE OSCILLATORS" ASSY 70515-3.

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

PARTS LIST

70500	M-100
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS ±, DECIMALS .XX ±, .XXX ±, ANGLES ±. MATERIAL. FINISH. DO NOT SCALE DRAWING.

CONTRACT NO

APPROVALS	DATE
DRAWN	6-15-79
CHECKED	6/19/79
MFG	6/19/79
	6/19/79

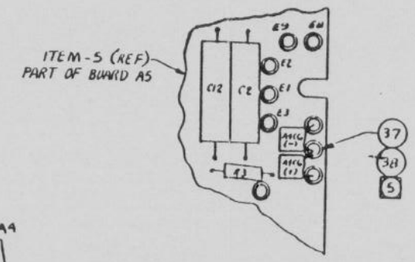
◆ EFRATOM

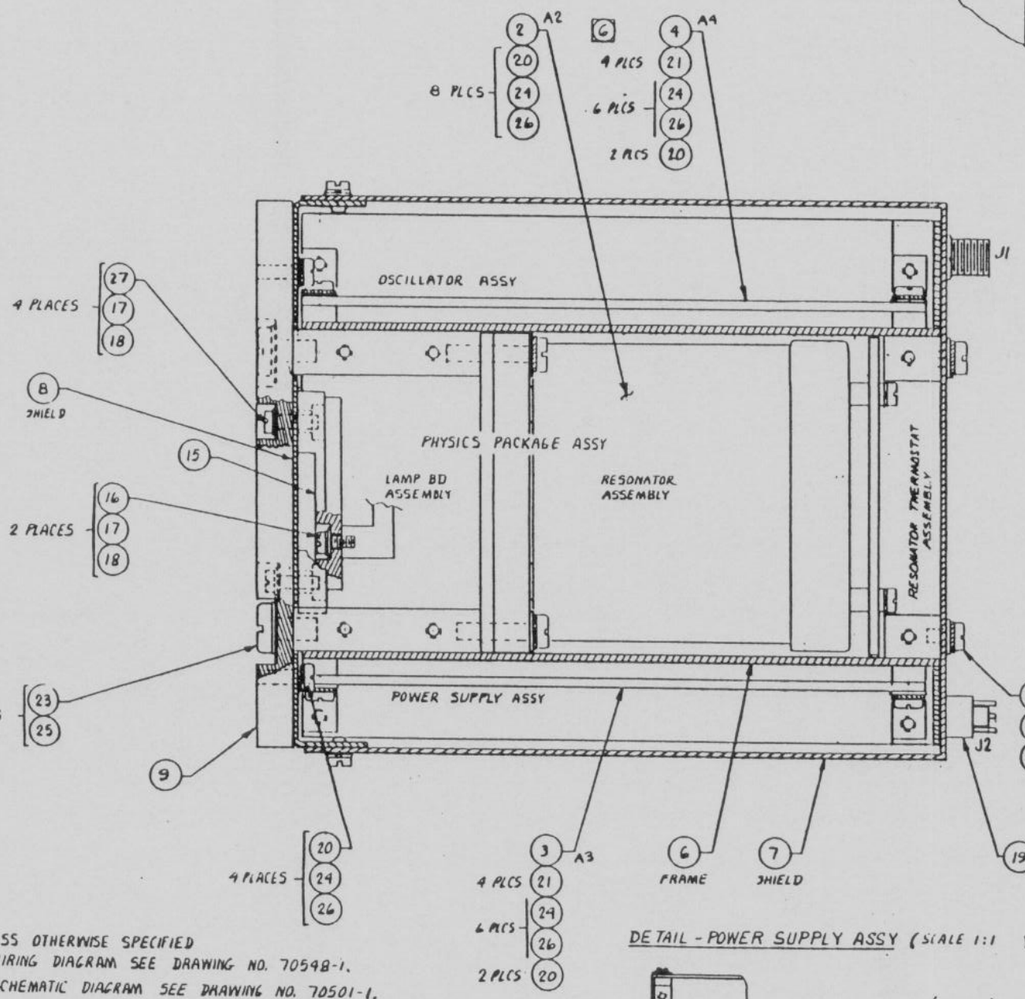
SCHEMATIC - SYNTHESIZER A5

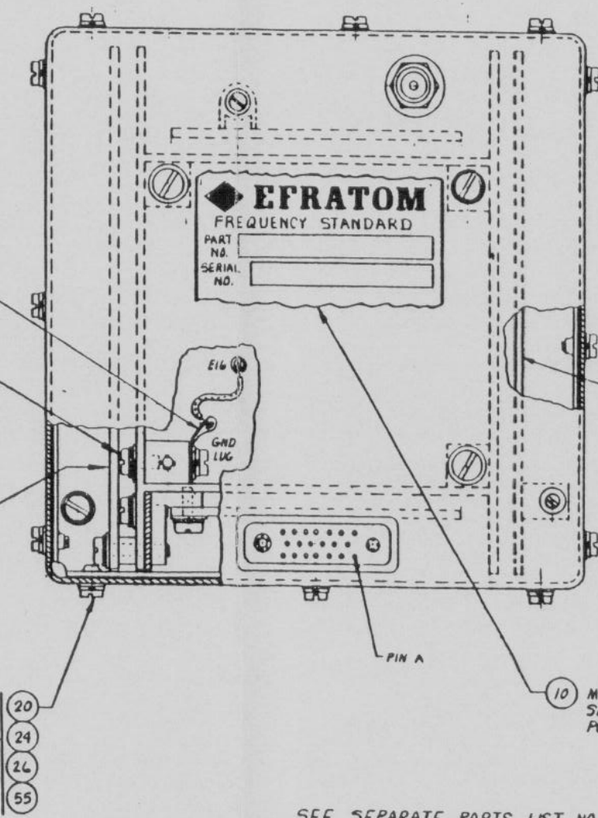
SIZE	CODE IDENT NO	DRAWING NO	REV
D	55761	70516	G

SCALE — BOARD NO 5 SHEET 1 OF 1

ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED
	A	RELEASED PER DRN 71138	8/6-79	
	B	REVISED PER ECO 711107	6-7-79	
	C	REVISED PER S/N 002 & ECO 711-188	9-17-79	
	D	REV PER ECR 711-243	12-3-79	CC
	E	REV PER ECO 711-209	12-12-79	CC
	F	REV PER ECO 711-309	5-13-79	
	G	REV PER ECO 411-8	8-11-81	
	H	REV PER ECO-971	3-11-82	



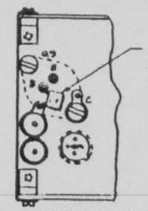




NOTES-UNLESS OTHERWISE SPECIFIED

1. FOR WIRING DIAGRAM SEE DRAWING NO. 70548-1.
2. FOR SCHEMATIC DIAGRAM SEE DRAWING NO. 70501-1.
3. FOR SPECIFICATION AND OUTLINE SEE DRAWING NO. 70502-1.
4. FOR TEST PROCEDURE SEE ATP 70500
5. STORAGE LOCATION FOR "A9C6" CAPACITORS. THE VALUE OF "A9C6+" IS 6.8 PF. THE VALUE OF "A9C6-" IS SELECTED TO BE 6 TO 8 PF LESS THAN THE VALUE OF THE "A9C6" WHICH IS INSTALLED ON "A4". THE "A9C6-" MAY BE 2 CAPACITORS AS REQD TO MAKE THE VALUE.
6. SEAL PHYSICS PACKAGE WITH ECCOFOAM.

DETAIL - POWER SUPPLY ASSY (SCALE 1:1)



ADD CAPACITOR, C3 (6800 PF.) BETWEEN Q9-B AND GROUND LUG. SLEEVE LEADS AND "RTV" CAPACITOR TO FRAME.

7. INSTALL E.T. LOCK WASHER AT POINTS OF GROUND PLANE WHICH REQUIRE GROUNDING.

SEE SEPARATE PARTS LIST NO. 70500-1

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION
			PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN	4-10-79
CHECKED	4-12-79

NEXT ASSY | USED ON | APPLICATION: M-100

EFRATOM

FINAL ASSEMBLY - FREQUENCY STANDARD MODEL M-100

SIZE	CODE IDENT NO	DRAWING NO	
D	55761	70500-1	H

SCALE 2/1 SHEET 1 OF 1

WIRE LIST		
FROM	TO	FUNCTION
CR2 - BLU		PHOTOCELL
CR2 RED	E13	PHOTOCELL
RT1-1 (WHT)	E9	THERMISTOR
RT1-2 (WHT)	E8	THERMISTOR
Q1-B (YEL)	E6	HTR TRANSISTOR
Q1-E (WHT/BRN)	E5	HTR TRANSISTOR
Q1 C (RED)	E4	HTR TRANSISTOR
Q2 B (YEL)	E6	HTR TRANSISTOR
Q2-E (GRN)	E7	HTR TRANSISTOR
Q2-C (RED)	E4	HTR TRANSISTOR
L1-BLK	E11	"C" FIELD
L1-BLU	E12	"C" FIELD
	E16	CHASSIS GND
E14-WHT/RED		PHOTOCELL

DWG. NO.	SH	REV
70518-TAB	1	R

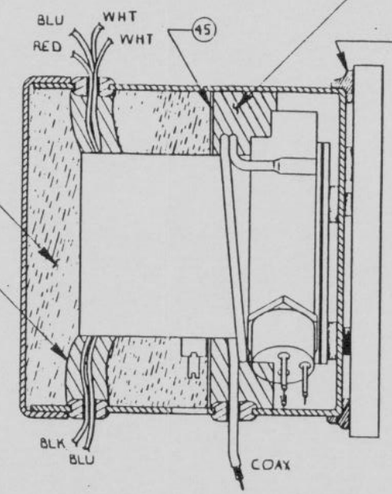
REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	K	REDRAWN eco 332, 360	8-26-80	HW
	L	REVISED PER ECO 365, 450	8-7-81	HW
	M	REVISED PER ECO-491	3-11-82	HW
	N	REV PER ECO-527	3-10-83	HW
	P	ADDED TABULATION PER EO# 676	9-5-84	HW
	R	ADDED -5	8-29-85	DH

(12) CUT STRIP AND WRAP AROUND RESONATOR FORMING A SEAL TO PREVENT ECCOFOAM FROM COMING IN CONTACT WITH CONDENSER AREA.

(44) APPLY RTV AROUND CAN TO FORM SEAL TO PREVENT ECCOFOAM FROM ENTERING AREA IN NEXT ASSY.

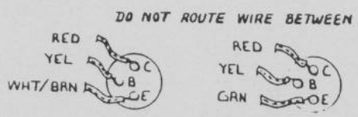
FILL WITH ECCOFOAM BETWEEN ITEM-45 AND THE LID. MASK OFF VIEWING PORT HOLE. (13)

ITEM-12 REF WRAP AROUND WIRING (2 PLCS)



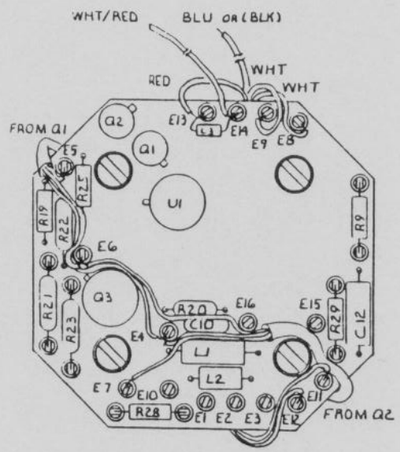
SECTION VIEW

DO NOT ROUTE WIRE BETWEEN TERMINALS

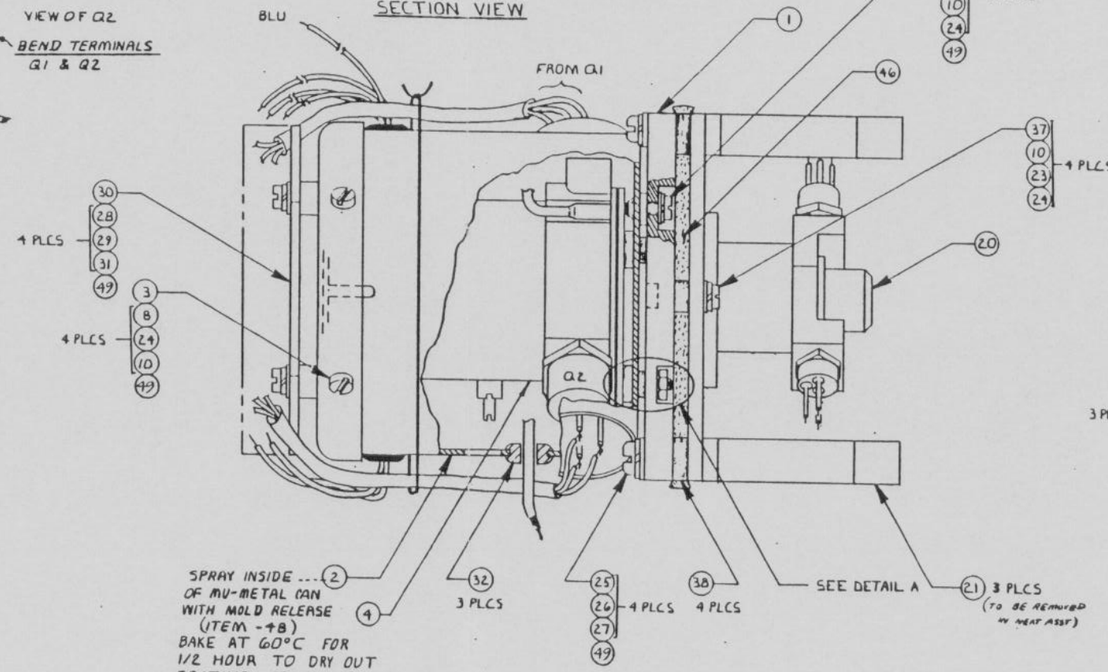


VIEW OF Q1 VIEW OF Q2

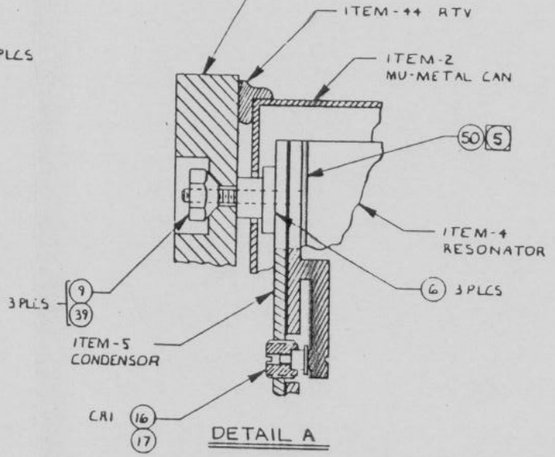
BEND TERMINALS Q1 & Q2



MOST COMPONENTS NOT SHOWN SEE DWG 70521-2 FOR DETAIL



SPRAY INSIDE ... (2) OF MU-METAL CAN WITH MOLD RELEASE (ITEM -48) BAKE AT 60°C FOR 1/2 HOUR TO DRY OUT COATING. IT WILL TURN A CHALKY WHITE COLOR WHEN DRY.



DETAIL A

TABULATION	
PART NO	DESCRIPTION
70518-3	STANDARD CELL
70518-4	HOT CELL
70518-5	FAST WARM-UP

NOTES: UNLESS OTHERWISE SPECIFIED

1. FOR SCHEMATIC DIAGRAM SEE DWG 70519
2. FOR TEST PROCEDURE SEE TP 70518
3. REFERENCE DESIGNATORS ARE FOR REFERENCE ONLY AND MAY NOT APPEAR ON THE COMPONENT PART
4. SOLDER PER REQT 5 OF MIL-STD-454.

[5] ITEM 50 USED AS REQ'D ON "-4" CONFIG ONLY

SEE SEPARATE PARTS LIST NO PL 70518-TAB

QTY REQD	FSCM NO	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

70500-1	M100
NEXT ASSY	USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
.XX ±
.XXX ±

MATERIAL

FINISH

CONTRACT NO.

APPROVALS	DATE
DRAWN	8-26-80
CHECKED	9-2-80
ISSUED	

EFRATOM

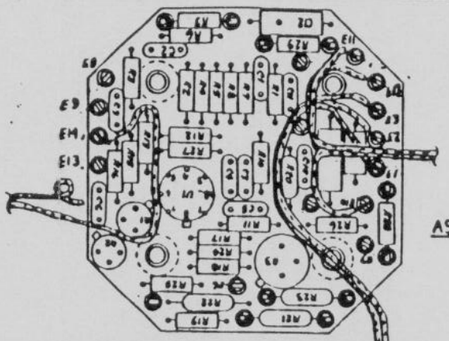
PHYSICS PACKAGE ASSY

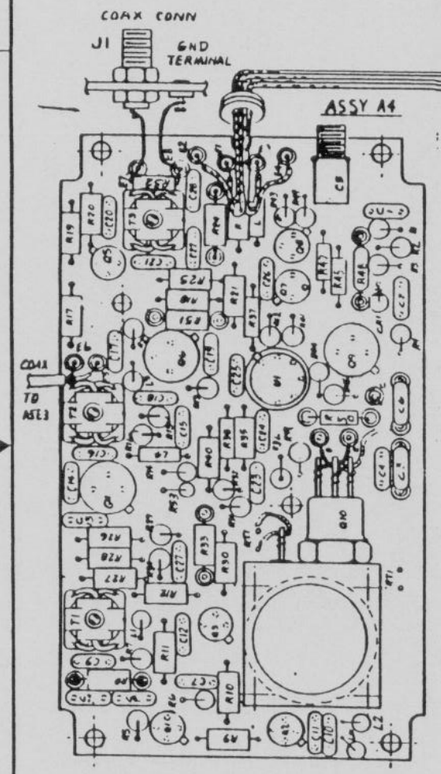
SIZE D | FSCM NO. | DWG. NO. | REV.

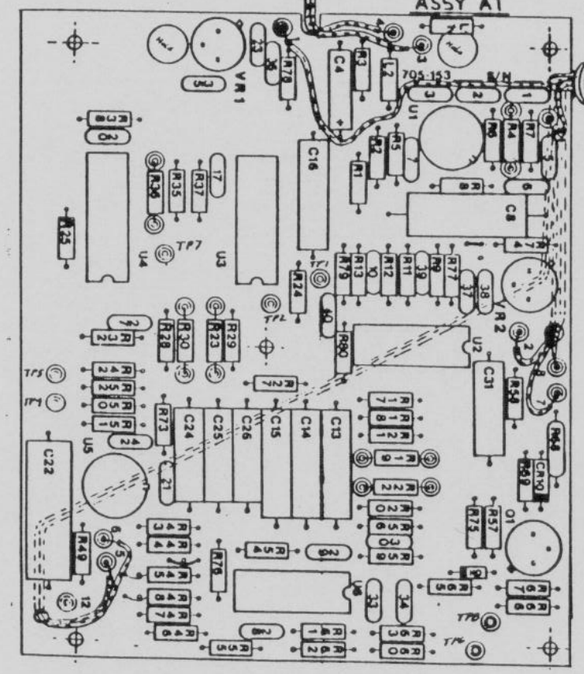
NOTES: UNLESS OTHERWISE SPECIFIED
1. SLEEVE ALL WIRES RUNNING UNDER BOARD ASSY A1 WITH 1/8" DIA SLEEVING TYPE RNF-100
2. STAKE WIRES NEATLY TO BOARDS AS NECESSARY TO PREVENT DAMAGE BY FLEXING USING RTV-108 CLEAR SILICONE RUBBER ADHESIVE.

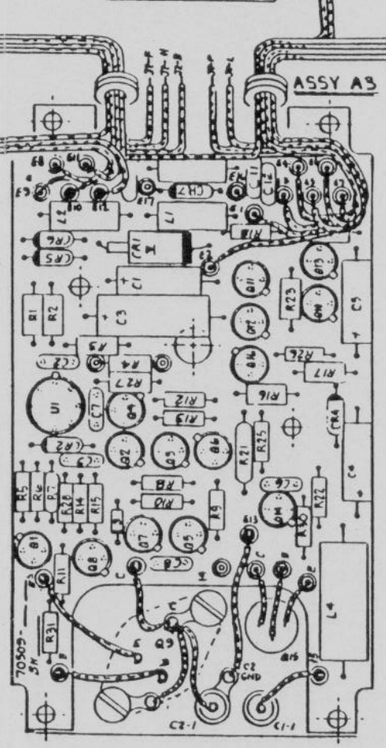
DWG NO	REV
70548-3	K

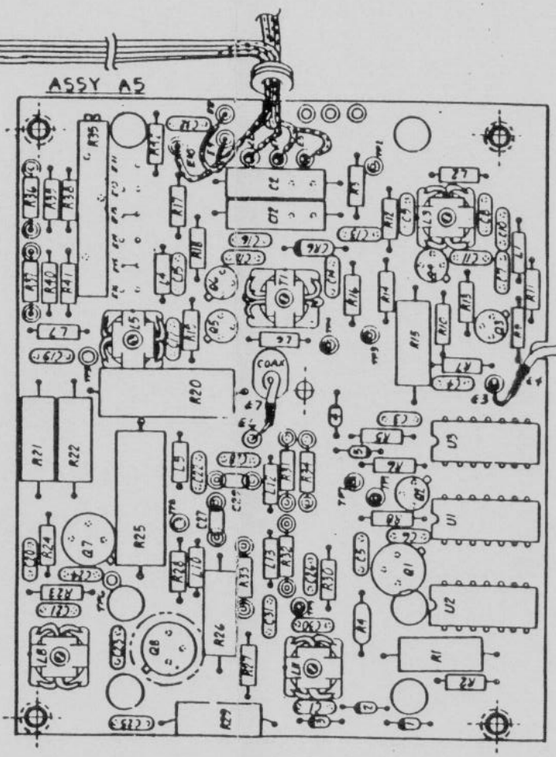
REVISIONS			
ZONE	REV	DESCRIPTION	DATE	APPROVED
	K	REVISED PER ED 583A	8-19-83	





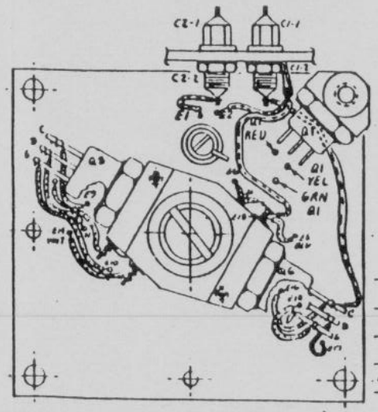






SINGLE ENTRY WIRE LIST

NO.	FROM	TO	COLOR
1	A1E1	A3E12	RED
2	A1E2	A3E11	BLU
3	A1E3	A2	BLU
4	A1E4	A2A1E19	WHT/RED
5	A1E5	J2 F	GRN
6	A1E6	A4E4	YEL
7	A1E7	J2-H	WHT
8	A1E8	A5E5	WHT/GRN
9	A1E9	J2-B	WHT/BLK
10	A2A1E1	A3E5	RED
11	A2A1E2	A3E4	BLU
12	A2A1E3	A3E3	ORN
13	A2A1E1	C2-2	RED
14	A2A1E2	C1 GND LUG	BLU
15	A2A1E15	C1 GND LUG	BLU
16	—	—	—
17	A2A1E16	C1-2	ORN
18	A3E1	J2 L	ORN
19	A3E2	J2-P	BLU
20	A3E13	C2-GND	BLU
21	A3E15	C1-1	ORN
22	A3Q9E	Q9E	GRN
23	A3Q9B	Q9B	YEL
24	A3Q9C	Q9C	RED
25	A3Q15E	Q15E	GRN
26	A3Q15B	Q15B	YEL
27	A3Q15C	Q15C	RED
28	Q9C	Q9C	JUMPER
29	Q9C	C2-1	RED
30	A4E1	A3E10	RED
31	A4E2	A3E8	BLU
32	A4E3	A3E9	ORN
33	A4E5	A5E3	COAX
34	A4E6	A5E4	SHIELD
—	A4E7	J1 GND TERM	BUS
35	A4E8		BUS
36	A5E1	A3E7	RED
37	A5E2	A3E6	BLU
38	A5E6	RESONATOR	COAX
1	A5E7	RESONATOR	SHIELD
39	A5E8	A2A1E11	BLK
40	A5E9	A2A1E12	GRY
41	A5E10	A2A1E10	WHT/RED



ASSY A2A2

QTY PER GP	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
			PARTS LIST	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
.XX
.XXX
MATERIAL
FINISH
NEXT ASSY USED ON
APPLICATION
DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN Kirkham	9-12-83
CHECKED	
ISSUED	

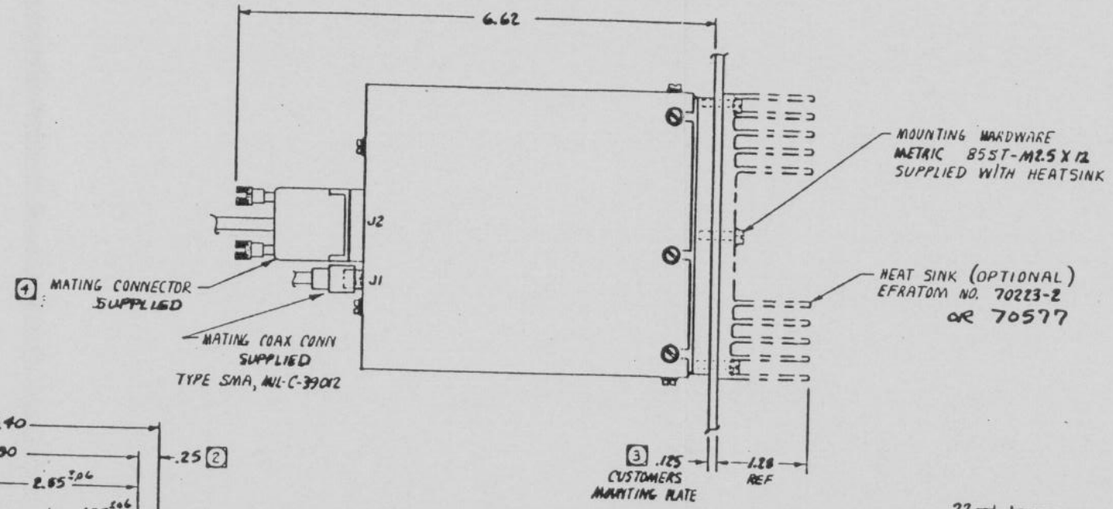
EGG EGRATOM
A Division of EG&G

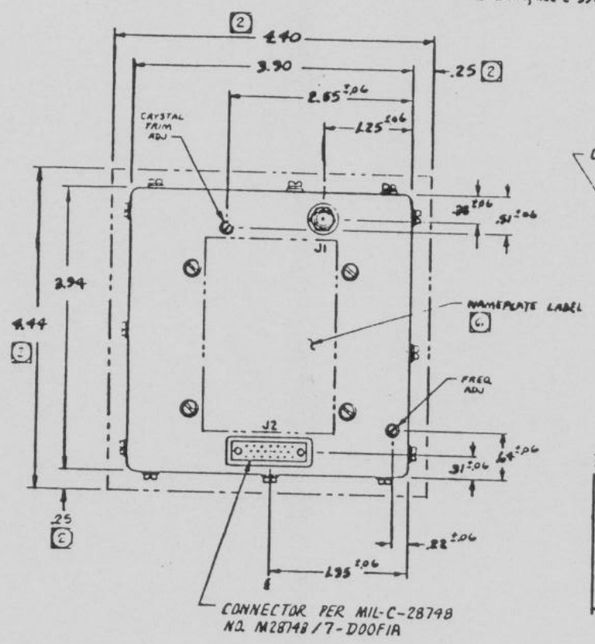
WIRING DIAGRAM — RUBIDIUM OSCILLATOR

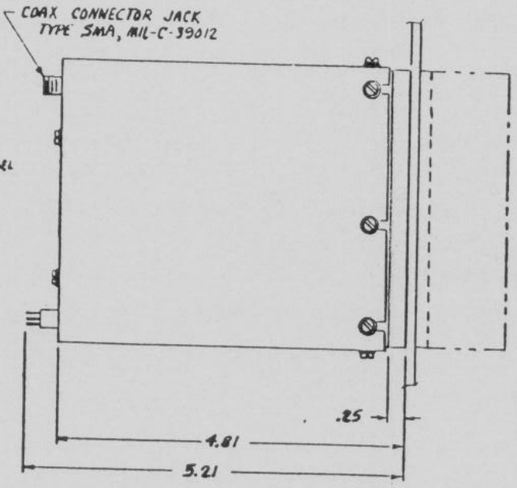
SIZE	FSCM NO	DWG NO	REV
D	55761	70548-3	K

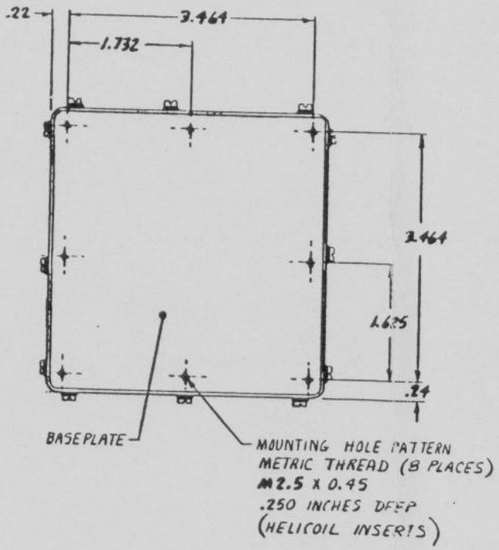
SCALE FX SHEET 1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	RELEASED PER ECO 711-148	1-31-79	WCJ
	B	REV PER ECO 711-268	2-20-80	L.J









NOTES - UNLESS OTHERWISE SPECIFIED

1. FOR SPECIFICATIONS SEE DRAWING NO. 70502-1.
2. PREFERRED CLEARANCE AROUND UNIT FOR SHOCK AND VIBRATION.
3. PREFERRED THICKNESS OF MOUNTING SURFACE.
4. CONNECTOR WIRING DATA:
   - J1 ___ 10MHz OUTPUT
   - J2-L ___ +22.5 TO +32 VDC INPUT
   - J2-P ___ GROUND
   - J2-F ___ CRYSTAL CONTROL VOLTAGE SIGNAL
   - J2-H ___ RESONANCE LOCK SIGNAL
   - J2-B ___ Rb LAMP VOLTAGE SIGNAL

NOTES - CONTINUED

5. FOR ASSEMBLY DRAWINGS, SCHEMATICS, AND DETAIL PARTS OF THIS UNIT, SEE EFRATOM MASTER DRAWING LIST NO. MDL 70500-1.
6. THE NAMEPLATE LABEL IS MARKED WITH EFRATOM PART NO. AND SERIAL NO. UNLESS OTHERWISE SPECIFIED.

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

NEXT ASSY	70500-1
APPLICATION	USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS ± DECIMALS .XX ±.03 .XXX ±.010 ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN	7-31-79
CHECKED	7-31-79
	7/31/79
	7/31/79

EFRATOM

OUTLINE AND MOUNTING - RUBIDIUM FREQUENCY STANDARD MODEL M-100

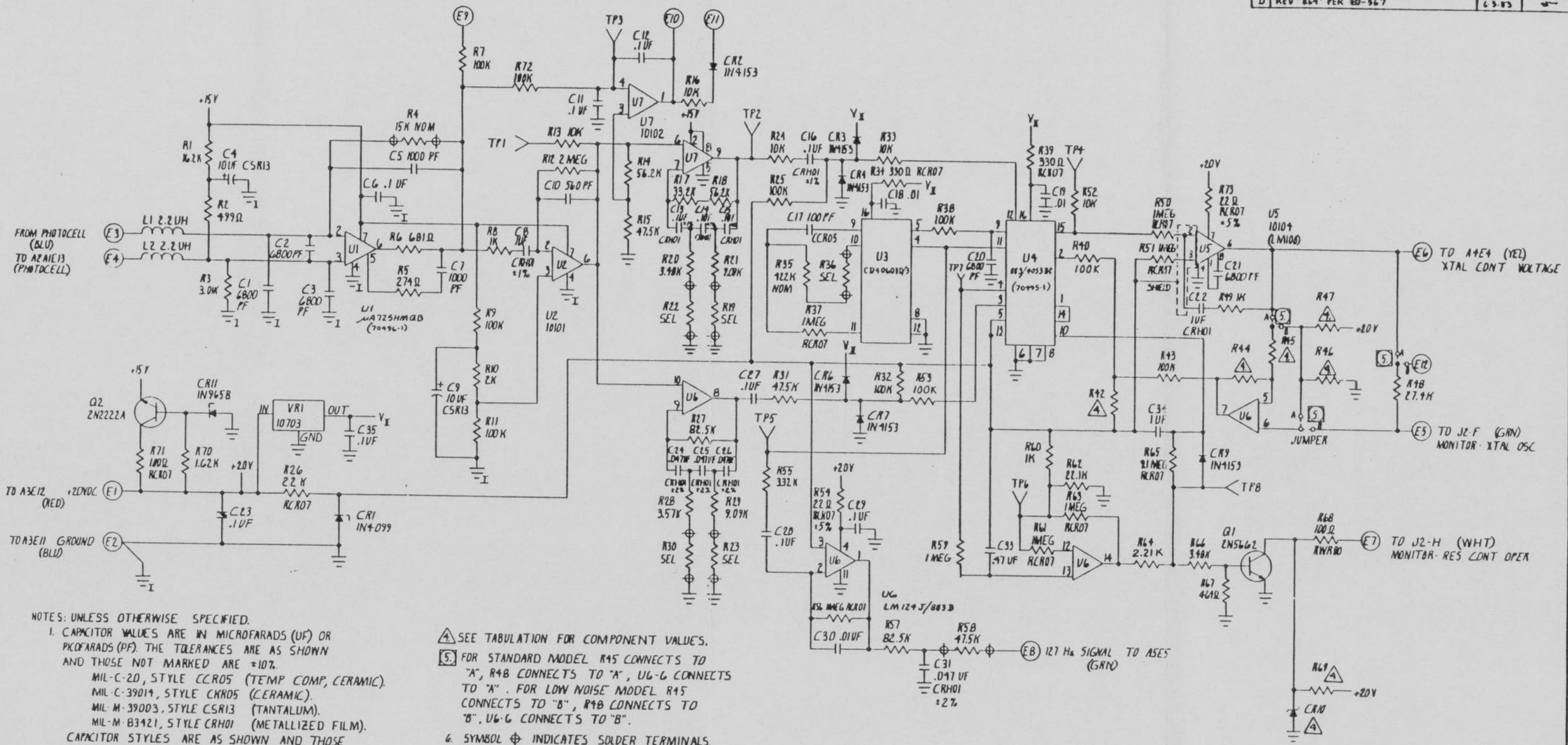
SIZE	CODE IDENT NO	DRAWING NO	
D	55761	70549-1	B

SCALE 1/1 SHEET 1 OF 1

DWG NO	SH	REV
705-138	1	D

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	RELEASED ECO-525	11-30-82	
	B	REVISED TERMINALS AT R19,R22	2-9-83	
	C	REVISED PER ECO-534 ECO-537	2-25-83	
	D	REV "B&C" PER ECO-567	6-3-83	



NOTES: UNLESS OTHERWISE SPECIFIED.

1. CAPACITOR VALUES ARE IN MICROFARADS (UF) OR PICOFARADS (PF). THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ±10%.
   MIL-C-20, STYLE CCR05 (TEMP COMP, CERAMIC).
   MIL-C-39014, STYLE CKR05 (CERAMIC).
   MIL-M-39003, STYLE CSR13 (TANTALUM).
   MIL-M-83421, STYLE CRH01 (METALLIZED FILM).
   CAPACITOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE CKR05.
2. RESISTOR VALUES ARE IN OHMS (Ω). THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ±1%.
   MIL-R-39007, STYLE RWR80 (WIRE WOUND) 2 W.
   MIL-R-39008, STYLE RCR07 (COMPOSITION) 1/4 W.
   MIL-R-55182, STYLE RNC55 (METAL FILM) 1/10 W.
   RESISTOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE RNC55.
3. OTHER COMPONENTS ARE AS SPECIFIED OR CONTROLLED BY THE FOLLOWING SPECIFICATIONS.
   MIL-S-19500, DIODES AND TRANSISTORS (JANTX).
   MIL-M-38510, INTEGRATED CIRCUITS.
   MIL-C-15305, INDUCTORS.

4. SEE TABULATION FOR COMPONENT VALUES.
5. FOR STANDARD MODEL R45 CONNECTS TO "A", R48 CONNECTS TO "A", U6-6 CONNECTS TO "A". FOR LOW NOISE MODEL R45 CONNECTS TO "B", R48 CONNECTS TO "B", U6-6 CONNECTS TO "B".
6. SYMBOL ⊕ INDICATES SOLDER TERMINALS. "E" POINTS AND "TEST POINTS" ARE SOLDER TERMINALS.
7. FOR ASSEMBLY DRAWING SEE DWG NO. 705-137.

TABULATION

DESCRIPTION	ASSEMBLY NO.	R44	R45	R46	R47	JUMPER POSITION	R42	R69	CR10
SERVO	705-137-1	100K	82.5K	33.2K	39.2K	"A"	47.5K	NOT USED	NOT USED
"LN" SERVO	705-137-2	47.5K	221K	15K	22.1K	"B"	10K	NOT USED	NOT USED
"LN" SERVO "TTL"	705-137-3	47.5K	221K	15K	22.1K	"B"	10K	10K	IN4625
SERVO "TTL"	705-137-4	100K	82.5K	33.2K	39.2K	"A"	47.5K	10K	IN4625

70500	M160
NEXT ASSY	USED ON
APPLICATION	DO NOT SCALE DRAWING

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS ±1/64 DECIMALS .XX ±.01 .XXX ANGLES

CONTRACT NO

APPROVALS	DATE
DRAWN	1-30-82
CHECKED	4-2-82
ISSUED	

MATERIAL

FINISH

EFRATOM

SCHEMATIC - SERVO

A1

SIZE	FSCM NO	DWG NO	REV
D	55761	705-138	D

SCALE M160 SHEET 1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	C	REVISED AND REDRAWN PER ECO 711-122	6-18-79	
	D	REV PER ECO 711-183	9-10-79	
	E	REV PER ECO 711-233A	12-12-79	
	F	REV. PER ECO 711-304	5-8-80	
	G	REV PER ECO-466	8-19-81	
	H	REV (C2 WAS 3300 PF) ED-615	10-31-83	

L1 2.2UH
R1 1.5KΩ RWR82
C11 6800 PF
R2 20Ω RWR81
C2 1000 PF ±5% CCR05
Q1 JANTX 2N3375
HEAT SINK
L2 .15UH
R3 20Ω RWR81
C3 3300 PF ±5% CCR05
CR1 IN9198-1
C1 6800 PF
R31 140 Ω
C5 1.5-14 PF 70903
L3
RUBIDIUM LAMP
E15
HEAT SINK CABLE Q1
E15
E5
CHASSIS GND E9
E2
GROUNDED AT C1
+21 VDC INPUT (E3) FROM C1-2
+20 VDC INPUT (E1) FROM C2-2
R4 243Ω
C6 6800 PF
R5 16.5K
R7 4.32K
R10 16.5K
R11 47.5K
R12 47.5K
C8 3300 PF ±5% CCR05
U1 (10103) (LM101)
C9 100PF ±20% CKR05
R15 240Ω ±5% RCR05
R16 100K
R17 100K
R18 4.32K
R13 SELECT
R14 392Ω NOMINAL
R6 5.11K
R8 332Ω
R9 1.05K
C7 6800 PF
R19 2.7K ±5% RCR05
R20 1.3K ±5% RCR05
C10 .047 UF
Q2 2N2222A
R21 240Ω ±5% RCR05
R22 10K ±5% RCR05
Q3 2N2222A
R24 511Ω RWR82
Q4 2N2219A
R23 470Ω ±5% RCR05
R29 10K ±5% RCR07
R25 100Ω ±5% RCR05
R30 100Ω
R26 1Ω RWR81
R27 1Ω RWR81
R28 .806Ω RWR81
Q5 70573
Q6 70573
THERMOSTAT ASSEMBLY
E8
E6
E7
E13
E14
RT1

NOTES - UNLESS OTHERWISE SPECIFIED

1. CAPACITOR VALUES ARE IN MICROFARADS (UF) OR PICOFARADS (PF). THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ±10%.
   MIL-C-20, STYLE CCR05, (TEMP COMP CERAMIC).
   MIL-C-39014, STYLE CKR05, (CERAMIC).
   CAPACITOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE CKR05.
2. RESISTOR VALUES ARE IN OHMS (Ω). THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ±1%.
   MIL-R-55182, STYLE RNC55 (METAL FILM) 1/4 W.
   MIL-R-39008, STYLE RCR05 (COMPOSITION) 1/8 W.
   STYLE RCR07 (COMPOSITION) 1/4 W.
   MIL-R-39007, STYLE RWR81 (WIRE WOUND) 1 W.
   STYLE RWR82 (WIRE WOUND) 1½ W.
   RESISTOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE RNC55.
3. OTHER COMPONENTS ARE AS SPECIFIED OR CONTROLLED BY THE FOLLOWING SPECIFICATIONS.
   MIL-S-19500, DIODES AND TRANSISTORS ('JANTX).
   MIL-M-38510, INTEGRATED CIRCUITS
   MIL-C-15305, INDUCTORS
4. SYMBOL ◆ INDICATES SOLDER TERMINALS.
5. FOR ASSEMBLY DRAWING SEE 70506.

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

PARTS LIST

70500	M100
NEXT ASSY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE
FRACTIONS ± DECIMALS XX ± XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO

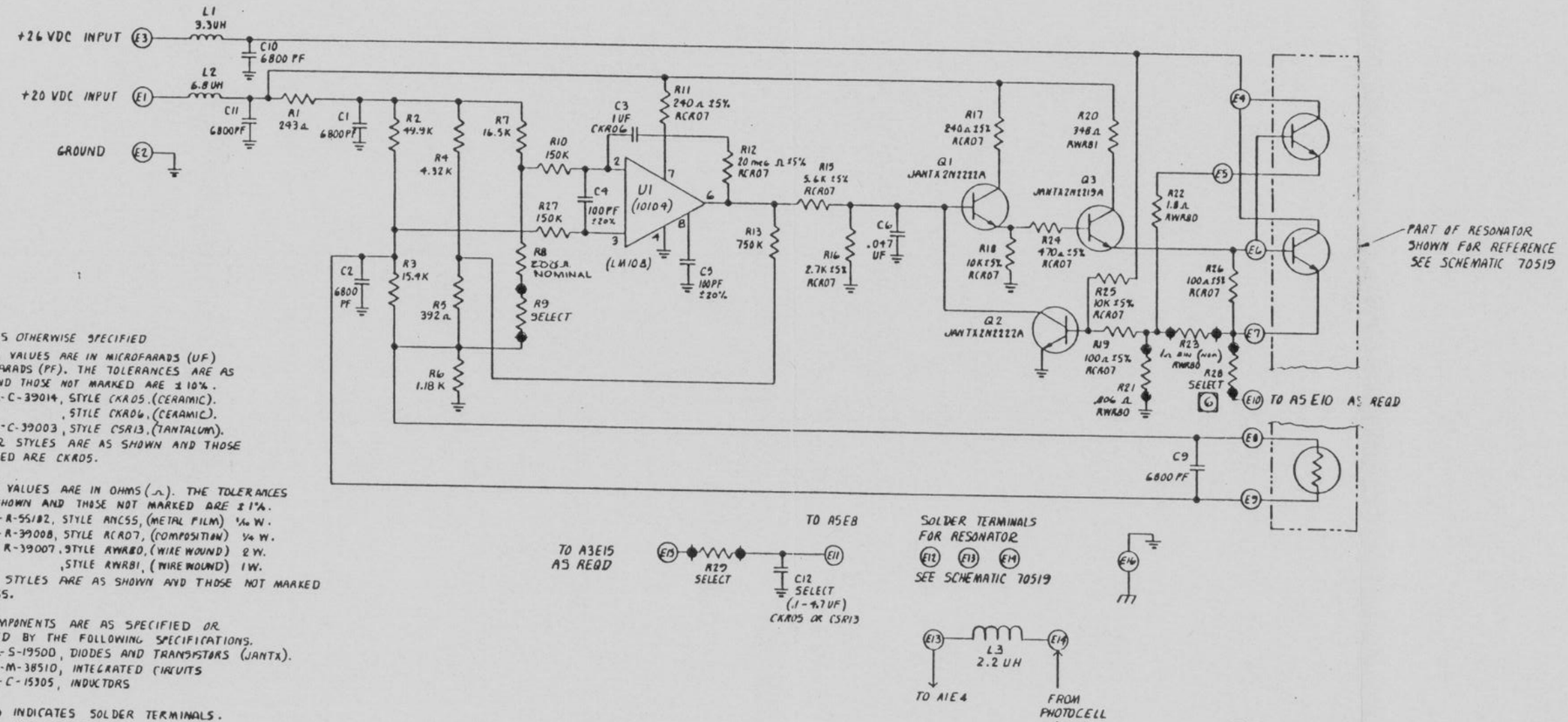
APPROVALS	DATE
DRAWN	6-18-79
CHECKED	6/18/79
	6/19/79
	6/19/79

EFRATOM

SCHEMATIC - LAMP BOARD A2A2

SIZE	CODE IDENT NO	DRAWING NO	REV
D	55761	70507	H

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	RELEASED PER ECO 711-122	7-16-79	
	B	REV PER ECO 711-213	12-18 79	
	C	REV PER ECO 711-257	1-28-80	
	D	REV. PER E.C.O 711-295	4-18-80	
	E	REV PER E.C.O. 711-302	5.09.80	
	F	REV PER ECO-466	9-19-87	
	G	REV PER ECO-477	3-11-82	
	H	REV "R28" PER EO-569	6-3-83	



NOTES - UNLESS OTHERWISE SPECIFIED

1. CAPACITOR VALUES ARE IN MICROFARADS (UF) OR PICOFARADS (PF). THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ± 10%.
   MIL-C-39014, STYLE CKR05, (CERAMIC).
   , STYLE CKR06, (CERAMIC).
   MIL-C-39003, STYLE CSR13, (TANTALUM).
   CAPACITOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE CKR05.

2. RESISTOR VALUES ARE IN OHMS (Ω). THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ± 1%.
   MIL-R-55182, STYLE RNC55, (METAL FILM) 1/8 W.
   MIL-R-39008, STYLE RCR07, (COMPOSITION) 1/4 W.
   MIL-R-39007, STYLE RWR80, (WIRE WOUND) 2 W.
   , STYLE RWR81, (WIRE WOUND) 1 W.
   RESISTOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE RNC55.

3. OTHER COMPONENTS ARE AS SPECIFIED OR CONTROLLED BY THE FOLLOWING SPECIFICATIONS.
   MIL-S-19500, DIODES AND TRANSISTORS (JANTX).
   MIL-M-38510, INTEGRATED CIRCUITS
   MIL-C-15305, INDUCTORS

4. SYMBOL ◆ INDICATES SOLDER TERMINALS. "E" POINTS ARE ALSO SOLDER TERMINALS.

5. FOR ASSEMBLY DRAWING SEE 70521.

6. RESISTOR R28 MINIMUM VALUE IS 4.02K FOR STANDARD UNITS, 2.43 K FOR "FAST WARM-UP" UNITS.

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

PARTS LIST

NEXT ASSY	M-100
USED ON	
APPLICATION	
DO NOT SCALE DRAWING	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±
MATERIAL
FINISH

CONTRACT NO

APPROVALS	DATE
DRAWN	7-6-79
CHECKED	7-12-79
	7/27/79
	7/27/79

EFRATOM

SCHEMATIC - RESONATOR THERMOSTAT A2 A1

SIZE	CODE IDENT NO	DRAWING NO	
D	55761	70522-2	H

SCALE — BOARD NO. 6 SHEET — OF —

ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED
	A	RELEASED PER ECO 711-122	7-18-79	
	B	REV PER ECO 711-172	9-11-79	
	C	Rev PER ECO 711-251 & 254	2-12-80	CC
	D	REV PER ECO 711-284	4-14-80	
	E	REV. PER ECO 711-321	5-12-80	
	F	REV. PER ECO 711-327	7-14-80	
	G	REV PER ECO-481	3 11 82	

HTR PWR INP +26VDC TO J2-R

+26 VDC TO J2-L

L1 4.7UH

C12 6800PF

CR5 IN5807

R5 100Ω ±5% RCR07

R7 1.0Ω RWR81

Q1 2N2907A

R8 27Ω ±5% RCR07

R10 27Ω ±5% RCR07

R11 10K ±5% RCR07

Q3 2N2907A

Q5 2N2907A

Q9 2N3740 PART OF FRAME ASSY DWG 70571

R31 10Ω RCR07

C8 6800 PF

Q8 2N2222A

TO C2-1 +20 VDC TO LAMP BD A2A2E1

+20VDC TERMINALS

E5 TO A2A1E1

E7 TO A5E1

E10 TO A4E1

E12 TO A1E1

E14 NOT USED

R1 1.8K ±5% RCR07

R2 3.24K

R28 100Ω ±5% RCR07

R27 100Ω

R6 820Ω ±5% RCR07

C7 6800 PF

C9 6800 PF

U1 (10103)

C2 33PF (LM101)

CR1 IN5650A

C1 2.2UF CSR13

CR6 IN5807

R3 1.30K

CR2 IN825

R4 SELECT 154Ω NOM

Q4 2N2222A

Q6 2N2222A

CR3 IN4150-1

R12 4.7K ±5% RCR07

R14 18K ±5% RCR07

R9 2.2K ±5% RCR07

R13 4.7K ±5% RCR07

R15 10K ±5% RCR07

C3 22 UF CSR13

Q2 2N2222A

Q7 2N2222A

GROUND TO J2-P

E17

CR7 IN5807

C11 6800PF

C10 6800 PF

R16 9.32K

R18 10Ω ±5% RCR07

R20 10Ω ±5% RCR07

Q11 2N 2907A

Q12 2N 2907A

R21 1.30Ω RWR80

L2 4.7UH TO A4E3

L3 3.3UH TO A2A1E3

C6 .1UF

R29 100Ω ±5% RCR07

Q16 2N2907A

Q19 2N2222A

R26 1.8K ±5% RCR07

Q15 2N5662 PART OF FRAME ASSY DWG 70571

R30 10Ω RCR07

R22 10K ±5% RCR07

C4 4.7UF CSR13

L4 4.7UH TO C1-1 +21 VDC (TO A2A1E3 AS REQD) TO LAMP BD A2A2E3

R23 2.21K

R17 9.32K

Q10 2N 2222A

Q13 2N 2222A

R19 6.8K ±5% RCR07

R24 30.1K

CR4 IN5301

C5 8.2UF CSR13

GROUND TERMINALS

E4 TO A2A1E2

E6 TO A5E2

E8 TO A4E2

E11 TO A1E2

E15 CHASSIS

NOTES - UNLESS OTHERWISE SPECIFIED

1. CAPACITOR VALUES ARE IN MICROFARADS (UF) OR PICOFARADS (PF). THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ±10%.
   MIL-C-39014, STYLE CKR05, (CERAMIC).
   MIL-C-39003, STYLE CSR13, (TANTALUM).
   CAPACITOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE CKR05.

2. RESISTOR VALUES ARE IN OHMS (Ω) THE TOLERANCES ARE AS SHOWN AND THOSE NOT MARKED ARE ±1%.
   MIL-R-55182, STYLE RNC55, (METAL FILM) 1/8 W.
   MIL-R-39008, STYLE RCR07, (COMPOSITION) 1/4 W.
   MIL-R-39007, STYLE RWR80, (WIRE WOUND) 2 W.
   STYLE RWR81, (WIRE WOUND) 1 W.
   RESISTOR STYLES ARE AS SHOWN AND THOSE NOT MARKED ARE RNC55.

NOTES - CONTINUED

3. OTHER COMPONENTS ARE AS SPECIFIED OR CONTROLLED BY THE FOLLOWING SPECIFICATIONS.
   MIL-S-19500, DIODES AND TRANSISTORS, (JANTX)
   MIL-M-38510, INTEGRATED CIRCUITS
   MIL-C-15305, INDUCTORS

4. SYMBOL ◆ INDICATES SOLDER TERMINALS. "E" POINTS ARE ALSO SOLDER TERMINALS

5. FOR ASSEMBLY DRAWING SEE 70509.

6. THE "HEATER POWER INPUT" IS NOT USED IN ALL APPLICATIONS. WHEN "J2-R" IS NOT USED, A JUMPER WIRE WILL BE ADDED BETWEEN "E1" AND "E16".

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN	7/10/79
CHECKED	7/12/79
	7/17/79
	7/18/79

NEXT ASSY — USED ON M-100

APPLICATION

EFRATOM

SCHEMATIC - POWER SUPPLY A3

SIZE	CODE IDENT NO	DRAWING NO	
D	55761	70510	G

SCALE — BOARD NO. 3 SHEET — OF —