TECHNICAL MANUAL

DIRECT SUPPORT MAINTENANCE MANUAL
AMPLIFIER, PARAMETRIC
AM-6602/MSC-46(V)
(NSN 5895-00-100-4315)

H E A D Q U A R T E R S , D E P A R T M E N T O F T H E A R M Y

22 SEPTEMBER 1980

WARNING
HIGH VOLTAGE

High voltage is used in the operation of this equipment. DEATH CONTACT may result if personnel fail to observe safety precautions. Learn the areas containing high voltage in each piece of equipment. Be careful not to contact high-voltage connections when installing or operating this equipment. Before working inside the equipment, turn power off and ground points of high potential before touching them.

HIGH TEMPERATURE

Heaters are used in this equipment to maintain certain components at high temperature during operation. Before working inside a module that contains heated components, make sure that the power had been turned off long enough for the temperature to drop to a safe level.

CRYOGENIC TEMPERATURE AND HIGH VACUUM

One module of this equipment contains components at a cryogenic temperature within a vacuum. Before work can be performed the temperature must rise to room temperature. Before this module can be opened, the vacuum must be released after the temperature has normalized.

HIGH PRESSURE

Certain components are under high gas pressure. If it is necessary to open such a component, use precautions to release the pressure without damage.

TECHNICAL MANUAL No. 11-5820-801-30

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *22 September 1980*

DIRECT SUPPORT MAINTENANCE MANUAL
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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mall your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to: Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, New Jersey 07703.

In either case, a reply will be furnished direct to you.

LIST OF ILLUSTRATIONS

CHAPTER 1
INTRODUCTION

1-1. Scope

This manual contains information for direct support maintenance for Amplifier, Parametric AM-6602/-MSC-46(V), part of the AN/MSC-46 satellite communications terminal.

1-2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-3. Maintenance Forms, Records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those described by TM 38-750, The Army Maintenance Management System.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 735-11-2/NAVSUPINST 4440.127E/AFR 400-54/MCO 4430.3E and DSAR 4140.55.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/-NAVSUPINST 4610.33B/AFR 75-18/MCO P4610.19C and DLAR 4500.15.

1-4. Reporting Equipment Improvement Recommendations (EIR)

If your Amplifier, Parametric needs improvement, let us know. Send us an EIR. You, the user are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to us at U.S. Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. We'll send you a reply.

CHAPTER 2
FUNCTIONING OF EQUIPMENT

Section I. INTRODUCTION AND SIGNAL AMPLIFICATION

2-1. Introduction

a. Amplifier, Parametric AM-6602/MSC-46(V) is a two-stage RF preamplifier. The first stage is operated at a cryogenic temperature (about 18°K). The temperature is obtained by the use of Helium Refrigerator, Unit 4. Unit 4 is government supplied under another contract; therefore, the functioning and maintenance of Unit 4 is not described in this manual.

b. Functionally Amplifier, Parametric AM-6602/-MSC-46(V) can be divided into three parts: signal amplification, internal temperature control, and switching. Monitoring circuits with visual indicators are subcircuits in each of the functional circuits. Visual monitors include meters, panel and fuse lamps, and a temperature gage. The primary monitors are located on Local Control/Monitor Assembly, Unit 1, front panel (fig. 2-4) and on Remote Control/Monitor Assembly, 3A1, front panel (fig. 3-4). There are, in addition, three panel lamps, four fuse lamps, and a temperature gage on module panels in Frame Assembly, Unit 2 (fig. 3-14).

2-2. Block Diagram of Signal Amplification Circuit

Figure 2-1 is a block diagram of the signal amplification circuit. The circuit consists of two parametric amplifier stages (2A3 and 2A2) interconnected by band-pass filter 2A4. A klystron pump source (2A1) supplies both parametric amplifier stages. A power supply (1PS1) supplies the operating dc voltages. Monitors provide visual information on the dc voltages (VOLTAGE meter 1M4), the relative pump power (PUMP meter 1M5) and operating time (PARAMP ELAPSED TIME meter 1M3). Test points (FIRST STAGE and SECOND STAGE VARACTOR VOLTAGE TEST) provide convenient methods of sampling varactor bias voltages on Unit 1.

2-3. Vacuum Vessel Module 2A3 (First Stage Amplifier)

a. General. Vacuum Vessel Module 2A3 (first stage amplifier) consists of a ferrite paramp circulator (5 port, 3 junction), a paramp varactor diode in a suitable mount and a bandpass pump filter through which the pump power (from 2A1) enters the paramp varactor (fig. 2-1). To minimize resistive noise generation, the first stage components (paramp circulator, paramp varactor and pump filter) are operated at an ambient temperature of about 18°K, cooled by means of Refrigerator Unit Assembly 4A3, part of Unit 4. The first stage amplifier typically operates at a center frequency of 7.5 GHz, has a bandwidth of 0.50 GHz and produces a net gain of 15.2 dB.

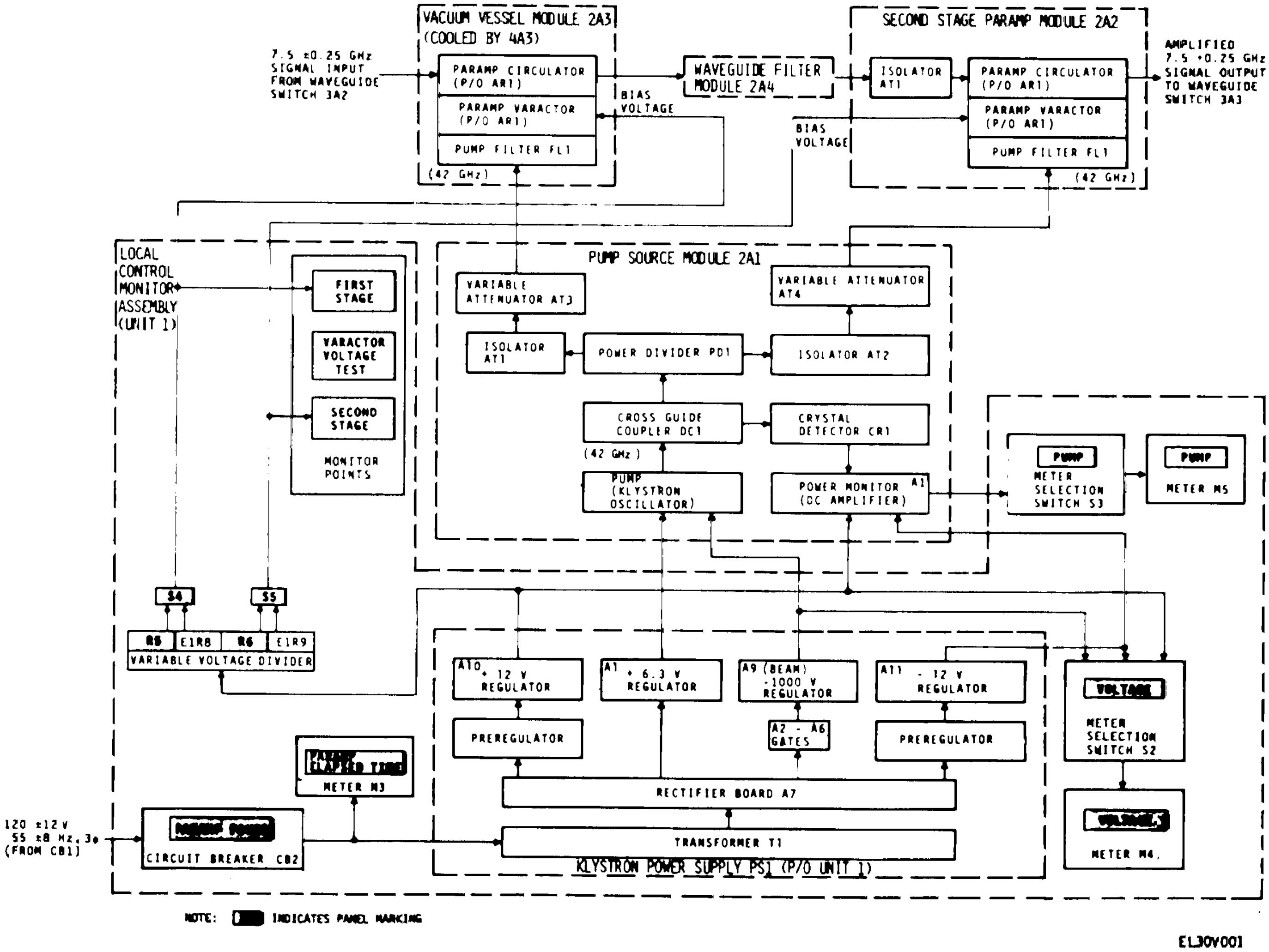


Figure 2-1. Block Diagram of Signal Amplification Circuit, AM-6602/MSC-46(V).

b. Paramp Circulator. A typical paramp circulator provides low loss for RF power flowing in one direction between two ports and a high loss for power flowing in the opposite direction; the power flow is either aided or impeded by a strong magnetic field. The input signal from Waveguide Switch 3A2 (at 7.5 ± 0.25 GHz) entering the input port of the paramp circulator (P/O AR1) (fig. 2-1) flows to the paramp varactor port with a loss of about 0.6 dB. Power flow in the same frequency band in the opposite direction (toward the paramp circulator input port from the paramp varactor port) experiences high loss. The signal is amplified in the paramp varactor (P/O AR1) and the amplified signal appears at the same paramp varactor port. The amplified signal flows to the paramp circulator output port with a loss of about 0.3 dB. Power flow in the opposite direction (toward the paramp varactor port from the paramp circulator output port) experiences high loss The paramp circulator separates the input and output signals, isolates the paramp varactor from the input and output circuits, and provides low VSWR and good impedance matches at the input, output, and paramp varactor ports.

c. Paramp Varactor. Interaction of low input signal power (at 7.5 ± 0.25 GHz), and high pump signal power (at 42 GHz), in a varactor diode results in an output signal (at input signal frequency) at a much higher power level than that of the input signal. The varactor diode mounted in a suitable structure is called the paramp varactor (P/O AR1) (fig. 2-1). The physical dimensions and arrangement of the paramp varactor provide, in general, for tuned circuits at three frequencies: the signal frequency (7.5 ± 0.25 GHz), the pump frequency (42.00 GHz), and the idler frequency (34.5 ± 0.25 GHz). Careful parts arrangement (and a pump filter FL1) prevents the idler frequency from propagating through the paramp circulator (signal) or pump (Pump Source Module 2A1) circuits. The paramp varactor (fig. 2-1) is called a one-port parametric amplifier stage because both the input and output signals (at 7.5 ± 0.25 GHz) appear at the same paramp varactor port simultaneously. They are separated by the circulator *(b* above). Amplifier gain is controlled principally by controlling the amount of pump power (generated in Pump Source Module 2A1) at the paramp varactor whereas the center operating frequency and instantaneous bandwidth are controlled principally by the amplitude of the bias voltage (3 ± 3 V) (adjusted in Unit 1) applied to the paramp varactor diode.

d. Pump Filter FL1. To prevent sum (49.5 GHz) and difference (34.5 GHz) frequencies (42 ± 7.5 GHz) from entering the pump circuits (Pump Source Module 2A1), passband pump filter FL1 (fig. 2-1) is used at the 2A3 pump input port. The filter, with an insertion loss of 0.2 dB at 42-GIIz center frequency, provides at least 15-dB attenuation at the sum and difference frequencies.

2-4. Waveguide Filter Module 2A4

Waveguide Filter Module 2A4 (a bandpass filter) is used to interconnect the two (2A3 and 2A2) amplifier stages (fig. 2-1). Insertion loss within the signal band (7.5 ± 0.25 GHz) is about 0.2 dB. From 7.9 to 8.4 GHz the filter provides more than 20-dB attenuation. The filter is symmetrical so that at frequencies less than 7.1 GHz the attenuation is also 20 dB or more.

2-5. Second Stage Paramp Module 2A2 (Second Stage Amplifier)

The two stages of amplification (2A3 and 2A2) are functionally similar, except that in Second Stage Paramp Module 2A2 (second stage) an isolator (AT1) and a four-port circulator (P/O AR1) are used in tandem to provide a circuit that is equivalent to the first-stage (2A3) five-port circulator (fig. 2-1). Because gain of a parametric amplifier is temperature sensitive it is necessary to protect against ambient temperature changes. The operating temperature of the second stage (2A2) is maintained at 135°F (330°K) by controlled heaters within 2A2. The gain of the second stage is approximately 15 dB. The overall gain of the two-stage amplifier is 30 dB [15.2 dB (2A3) -0.2 dB (2A4) + 15 dB (2A2)1].

2-6. Pump Source Module 2A1

(fig. 2-1)

a. Klystron Oscillator V1. The parametric amplifier pump located in Pump Source Module 2A1 is basically a klystron oscillator (V1). Its operating frequency is 42.00 ±0.025 GHz and is tunable over the 50-MHz range. To match the paramp varactor; however, the frequency must be set at 42 GHz. The output power of a typical klystron oscillator (V1) is approximately 500 mW, although some klystron oscillators may produce only 350 mW, the minimum specified value for V1. The minimum power level at which the operation of V1 is adequate depends upon the particular paramp varactors with which it is used, although never less than 300 mW. The operating temperature of VI is 195°F and is maintained by controlled heaters on the front and back flanges of V1 (para 2-11).

b. Crossguide Coupler DC1. The pump power from klystron oscillator V1 is sampled by an 18-dB crossguide coupler DC1. The insertion loss of the coupler is 0.2 dB. The main power flow is from klystron oscillator V1 to power divider PD1.

(1) *Crystal Detector CR1.* The sampled pump power (18 dB below the main power level) from DC1 is rectified in a crystal detector CR1 that uses a crystal diode suitable for this frequency range and power level.

(2) *DC Amplifier A1.* The output of crystal detector CR1 is supplied to a dc amplifier (Power Monitor A1) mounted on a printed circuit card. This amplifier uses an integrated circuit (IC) operational amplifier that requires + 12 V and - 12 V for operation. The detected signal input to A1 is usually about 0.5 V but may vary from about 0.2 V to about 4 V. The output of A1 drives the 1-mA PUMP meter (1M5) on the Unit 1 front panel. The meter circuit is adjusted so that 1M5 indicates 4 to 6 (green part of the scale) when the pump power is within its specified tolerance limits.

c. Power Divider PD1. The pump power from crossguide coupler DC1 is split into two channels by means of a waveguide power divider PD1. The divider has an insertion loss of about 0.1 dB.

d. Isolators AT1 and AT2. Each pump channel (output channels of PD1) has an isolator (insertion loss 0.15 dB) to provide adequate channel isolation (20 dB) This helps prevent "crosstalk" between the two amplifier stages.

e. Variable Attenuators AT3 and AT4. The gain, and to some extent the bandwidth, of amplifier stages 2A3 and 2A2 is affected by the pump power level at the paramp varactor diode. To adjust the power level in each amplifier stage, a variable waveguide attenuator (AT3, AT4) is used in each pump powerline. A lossy card (100 ohms per square inch) is inserted into the variable waveguide by a screw adjustment and is set during gain-band-width alignment procedures (para 3-7). Attenuation is variable from 0 dB to more than 20 dB, insertion loss is about 0.1 dB. Attenuation variation is not directly translated into gain variation. Operating temperature of AT3 and AT4 is maintained at about 135°F by controlled heaters in a heat sink adjacent to the attenuators (para 2-11).

2-7. Klystron Power Supply 1PS1

(fig. 2-1)

a. General. Klystron Power Supply 1PS1 contains four regulated power supplies receiving their input power through a single transformer (T1) that accepts the three-phase 120 ± 12 V, 55 ± 8 Hz primary power. Four three-phase outputs of T1 are connected to rectifier board A7, which supplies power to a -1000 V regulator (A9) for the klystron oscillator beam voltage, to a 6.3-V regulator (A1) for the klystron oscillator filament voltage, to a + 12 V regulator (A10) for the varactor bias voltage and the dc amplifiers, and to a - 12 V regulator (A11) for the dc amplifiers. Each 12-V regulator is separated from rectifier board A7 by a preregulator.

b. Klystron Power. The outputs of - 1000 V regulator A9 and 6.3-V regulator A1 are supplied directly to klystron oscillator 2A1V1. The beam voltage (- 1000 V) is variable ± 50 V via a trimpot on A9. The correct beam voltage is that which provides the most pump power and is originally set by the manufacturer during initial alignment procedures. The high side output line of A1 is connected to the high side (- 1000 V) output line of A9. Thus the filament voltage is floating on top of the beam voltage and from a chassis ground point of view, the filament voltage is - 1000 V on the high side of A1 output and - 1006 V on the low side of A1 output.

c. Paramp Varactor Bias Voltage. Bias voltages for the paramp varactor diodes in 2A3 and 2A2 are derived from the + 12 V regulator (A 10) output. The bias voltage for each amplifier stage is passed through a voltage divider (1R5, 1E1R8 for first stage; 1R6, 1E1R9 for second stage) network in Unit 1 having a trimpot 1R5, 1R6 as half the divider. The bias voltage is taken off the wiper arm of the trimpot and is therefore adjustable over a 0 to 6V range. Manually operated switches (54 for the first stage and 55 for the second stage) permit the operator to connect either bias voltage line to the midpoint of the divider (instead of the wiper arm) thereby providing a 6-V bias. This effectively "turns off" (bypasses) the amplifier stage by biasing it out of operating frequency range and at the same time provides minimum insertion loss for that stage. The correct bias voltage for each amplifier stage is determined during a gain-bandwidth alignment (para 3-7).

d. DC Amplifier Voltage. DC amplifiers in 2A1 (2A1 Power Monitor, fig. 2-1) and Unit 1 (1A1 Temperature Monitor, fig. 2-2) contain an IC operational amplifier (U1) (fig. 2-9, 2-14) that requires + 12V and - 12 V for operation. These voltages are obtained directly from A10 and A11, the + 12 volt and - 12 volt regulators, respectively. The two regulators are identical. In this power supply the positive end of A11 is connected to the negative end of A10 thereby providing a common ± 12 V return line. A trimpot on each 12-V regulator permits some adjustment of the output voltage. The trimpot is preset before installation to provide a 12 ± 0 12V output.

2-8. Monitors in Signal Amplification Circuits

a. VOLTAGE Meter 1M4. By means of a VOLTAGE selection switch (1S2) on the front panel of Unit 1 the operator can select 1PS1 output voltages to be displayed on VOLTAGE meter 1M4 (fig. 2-1) VOLTAGE meter 1M4 provides a direct measurement of the output of 1PS1A10 and 1PS1A11, the ± 12 V regulators. The negative voltage from A1 is reversed at the meter terminals so that a positive deflection is obtained Beam voltage (-1000 V from A9) is sampled at 0.01 amplitude (by means of a voltage divider in Unit 1) so that VOLTAGE meter 1M4 indicates 10 ± 0.5 when the beam voltage is - 1000 ± 50 V The output of A1, the 6.3-V regulator, is not monitored.

b. PUMP Meter 1M5. The output of (Power Monitor) dc amplifier 2A1A1 (para 2-6*b*(2)) can be displayed on 1M5, PUMP meter, by use of PUMP selection switch 1S3 (fig. 2-1). Because the output voltage of crystal detectors (2A1CR1, fig. 2-1) varies over a wide range a meter adjustment (PUMP POWER METER ADJ R7 on rear panel of Unit 1, fig. 3-3) is provided to align PUMP meter 1M5 to indicate in the green area of the scale (4 to 6) when pump power (para 2-6a) is adequate. The manufacturer aligns 1M5 to operate with the 2A1 module with which it is shipped Interchanging Unit 1's or 2A1 modules may necessitate realignment of PUMP meter 1M5. Replacement of piece parts or subassemblies in either the 2A1 portion or Unit 1 portion of the pump power monitoring (and generation) circuit may also necessitate realignment.

c. PARAMP ELAPSED) TIME Meter IM3. PARAMP ELAPSED TIME meter 1M3 is a time totalizing meter operating on 120 ± 12 V, 55 ± 8 Hz. The meter indicates total hours and tenths of hours that primary voltage has been applied to 1PS1 (fig. 2-1). The meter dial has a digital movement; that is, the 0.1-hour indicator moves once in 6 minutes and the hour indicator advances one unit each hour. Klystron oscillator 2A1V1 is a limited life item (5000 hours, minimum). The purpose of 1M3 is to indicate when 2A1V1 is approaching its expected life limit.

d. VARACTOR VOLTAGE TEST Points. Two monitor points, VARACTOR VOLTAGE TEST FIRST STAGE and SECOND STAGE, on the front panel of Unit 1 permit measurement of the bias voltages to the 2A3 paramp varactor and the 2A2 paramp varactor (fig. 2-1). The voltage will be in the range 3 ± 3 V. The precise value is not important (para 2-7*c).* These monitor points permit maintenance personnel to determine easily whether bias voltage is present in Unit 1 and therefore (assuming circuit continuity) at the paramp varactors in Modules 2A2 and 2A3. The presence or absence of bias voltages is an important maintenance factor.

Section II. INTERNAL TEMPERATURE CONTROLS

2-9. Vacuum Vessel Module 2A3 Temperature

a. General. The interior of Vacuum Vessel Module 2A3 is operated at an ambient temperature of about 18°K (- 427°F). This is accomplished by use of a closed cycle Helium Refrigerator, Unit 4, of which Refrigeration Unit Assembly 4A3 is inserted into 2A3. A vacuum is used to insulate the cold parts of 2A3 (and 4A3). Because the cryogenic temperature is well below the freezing point of air, the temperature helps maintain the vacuum at a much lower pressure than that initially obtained by operating the vacuum pump during preliminary adjustment procedures. Thus a hard vacuum indicates suitably low temperature and unsatisfactorily high temperature results in a soft vacuum. Unit 1 monitors are used to indicate the internal cryogenic temperature (CRYOGENIC TEMP meter 1M1) and pressure (VACUUM meter 1M2) in 2A3 (fig. 2-2).

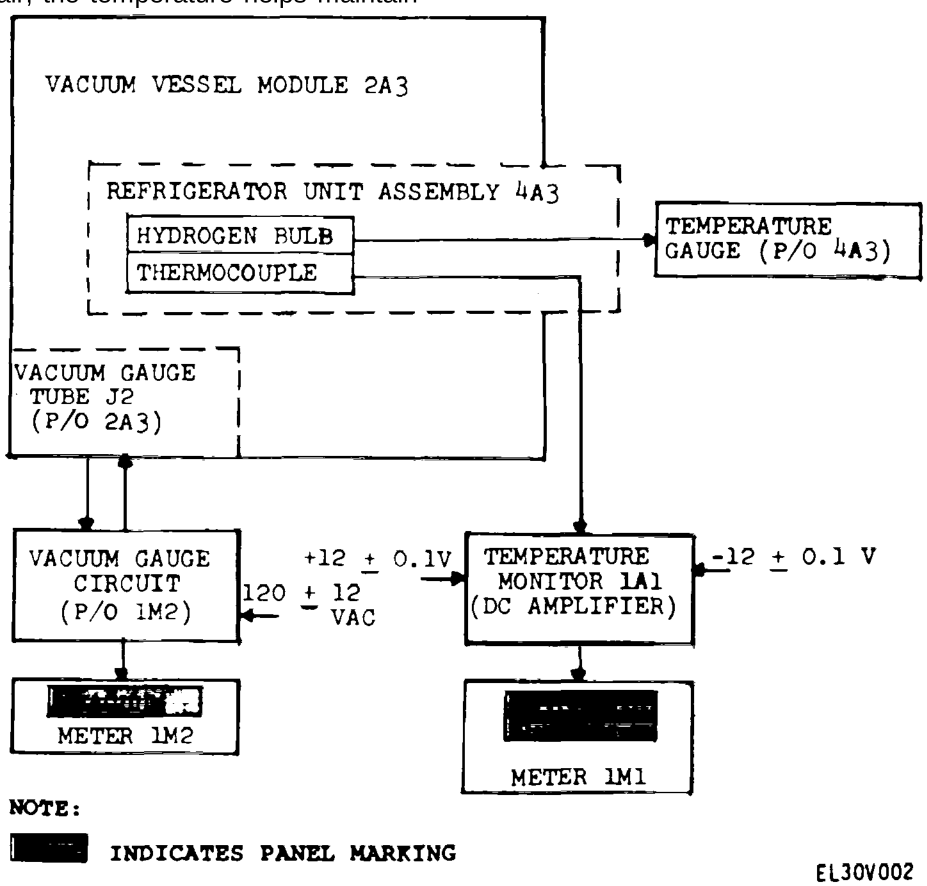


Figure 2-2. Block Diagram of Module 2A3 Temperature and Pressure Sensors.

b. CRYOGENIC TEMP Meter 1M1. Refrigerator Unit Assembly 4A3 (fig. 2-2) has two independent temperature sensors. One is a hydrogen bulb that operates a hydrogen pressure gage (temperature gage) mounted on

4A3. When the temperature is below 26°K (60 psia on gage) the hydrogen pressure gage is an accurate temperature gage and is so calibrated. A second sensor is a thermocouple mounted at the same cold station of 4A3 as is the hydrogen bulb. The voltage on the thermocouple leads is brought out to a connector (2A3J1). The voltage is then applied through cable connections to Temperature Monitor 1A1 (a dc amplifier) located in Unit 1. The thermocouple voltage is amplified sufficiently in 1A1 to drive CRYOGENIC TEMP meter 1M1. Temperature Monitor 1A1 utilizes an IC operational amplifier (para 2-7*d*) that requires + 12 volts and -12 volts for operation. The amplification is adjusted so that CRYOGENIC TEMP meter 1M1 indicates 20°K when the temperature gage on 4A3 also indicates 20°K. The two temperature indicators may not track precisely at other temperatures (20° ± 5°K) but the 4A3 temperature gage is the more accurate of the two.

c. VACUUM Meter IM2. The vacuum sensor consists of a thermopile bridge tube (J2, fig. 2-2) that is inserted into 2A3. The sensor uses 0.20 Vac to heat the hot junc- tions of the thermopile; the cold junctions are held at ambient vessel (2A3) temperature. The temperature differential between the hot and cold junctions is about 10°C at atmospheric pressure but rises to perhaps 400°C in a hard vacuum. The thermopile (vacuum sensor) then generates an increasing voltage as the pressure decreases. The thermopile voltage is applied to a vacuum gage circuit that drives VACUUM meter 1M2. The complete sensor (thermopile tube 2A3J2 and VACUUM meter 1M2 with its associated circuit) is a pre-calibrated part. Either section (1M2 or 2A3J2) can be separately replaced, but not repaired.

2-10. Second Stage Paramp Module 2A2 Temperature

To maintain constant amplifier stage gain the temperature of the second-stage (2A2) paramp circulator and paramp varactor is held constant at 135°F (fig. 2-1). This is accomplished by use of three 100-watt heaters and a temperature controller circuit that operates from the 120 ± 12 Vac as shown in block diagram, figure 2-3. The temperature controller employs a sense detecting circuit mounted on a circuit card assembly, a thermistor mounted on the part whose temperature is being regulated and a high-current thyristor (triac) also mounted on the circuit card assembly. The operating temperature is set by adjusting a potentiometer in the sense detecting circuit. The thermistor senses a change in temperature and produces a change in voltage in the sense detecting circuit. The change in voltage drives a low power switch that, in turn, drives a high power switch (triac) that switches power to the heaters. A thermostat is used in series with the heaters to prevent uncontolled heating if the control circuit fails. The thermostat opens the power line circuit when the temperature reaches 150°F and closes the circuit when the temperature drops below 150°F. A panel indicator lamp (2A2DS1, fig. 3-14), across the thermostat terminals, lights when the thermostat is open, thereby indicating a malfunction in the temperature controller circuit.

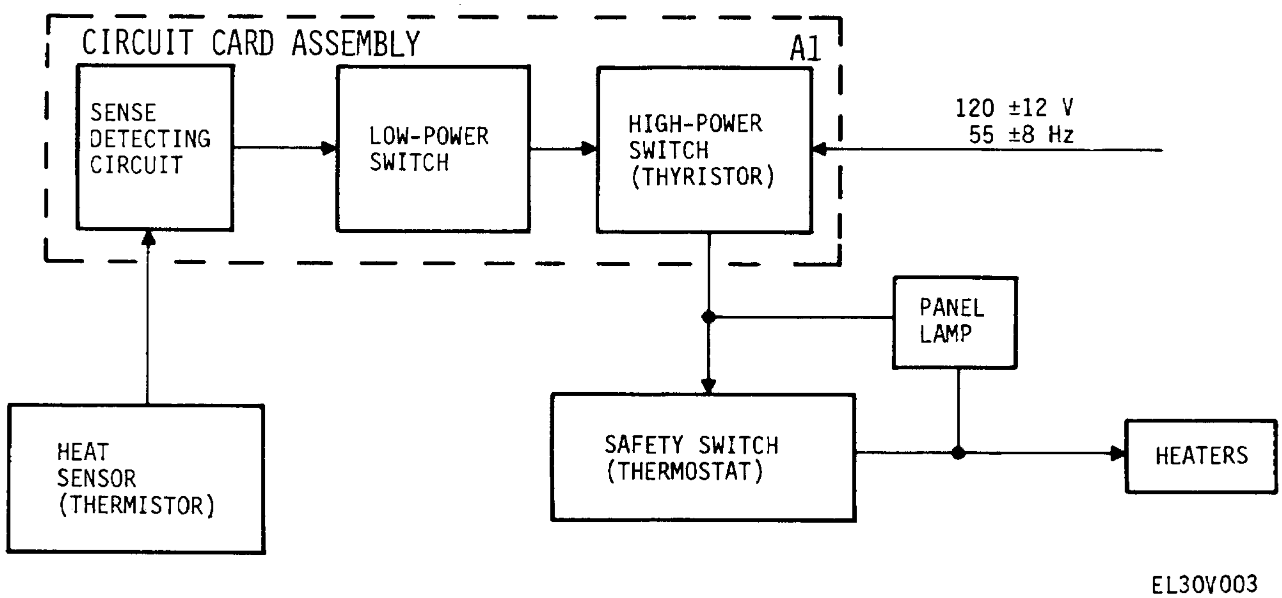


Figure 2-3. Block Diagram of Temperature Controller Circuit.

2-11. Pump Source Module 2A1 Temperature

For efficient operation and long life of klystron oscillator 2A1V1, it is necessary to operate V1 at about 195°F (fig. 2-1). For consistent operation of the pump waveguide components, they are maintained at a constant temperature. The interior of the Pump Source Module 2A1 is maintained at about 135° by means of two 50-watt heaters and a fan to circulate the hot air The back flange of V1 has two 100-watt heaters and the front flange, a 100-watt heater. The temperature controller cards for these heater banks are electrically identical to the card (2A2A1) used in the Second Stage Paramp Module 2A2 (para 2-10, fig 2-3). Only their temperature settings are different. Thermostats to protect against uncontrolled temperature rise are used with each heater bank. Panel indicator lamps are placed across the terminals of S2 and S4, the thermostats in the back flange and front flange heater circuits, respectively. The lamps light when the thermostats are open, thereby indicating malfunctions in the temperature control circuits for klystron oscillator V1.

Section III. SWITCHING

2-12. General

Redundantly installed Parametric Amplifier system AM-6602/MSC-46(V) contains two Waveguide Switches, 3A2 and 3A3, and switches on Unit 1, Module 2A1, and Remote Control/Monitor Assembly 3A1 Unit 1 (fig 2-4) contains three power switches:

MAIN POWER circuit breaker CB1
PARAMP POWER circuit breaker CB2
REFRIG POWER switch S1,

two meter switches:

VOLTAGE meter selection switch S2
PUMP meter selection switch S3,

and two amplifier stage switches:

first stage switch S4 (fig. 3-3)
second stage switch S5 (fig. 3-3).

These switches are described in paragraphs 2-7 and 2-8*a* and *b*. Remote Control/Monitor Assembly Serial No. 001 contains a NOISE DIODE switch (S2, fig. 3-5) used to switch 28 Vdc to Noise Diode Assembly 3A13. Switch 2A1S1 is a safety interlock. Waveguide switches 3A2, 3A3 and CHANNEL SELECT pushbutton switch 3A1S1 comprise the channel switching system. The safety interlock and channel switching are described in paragraphs 2-13 and 2-14, respectively. Noise signal generation is discussed in paragraphs 2-20*c* and 2-14*c*.

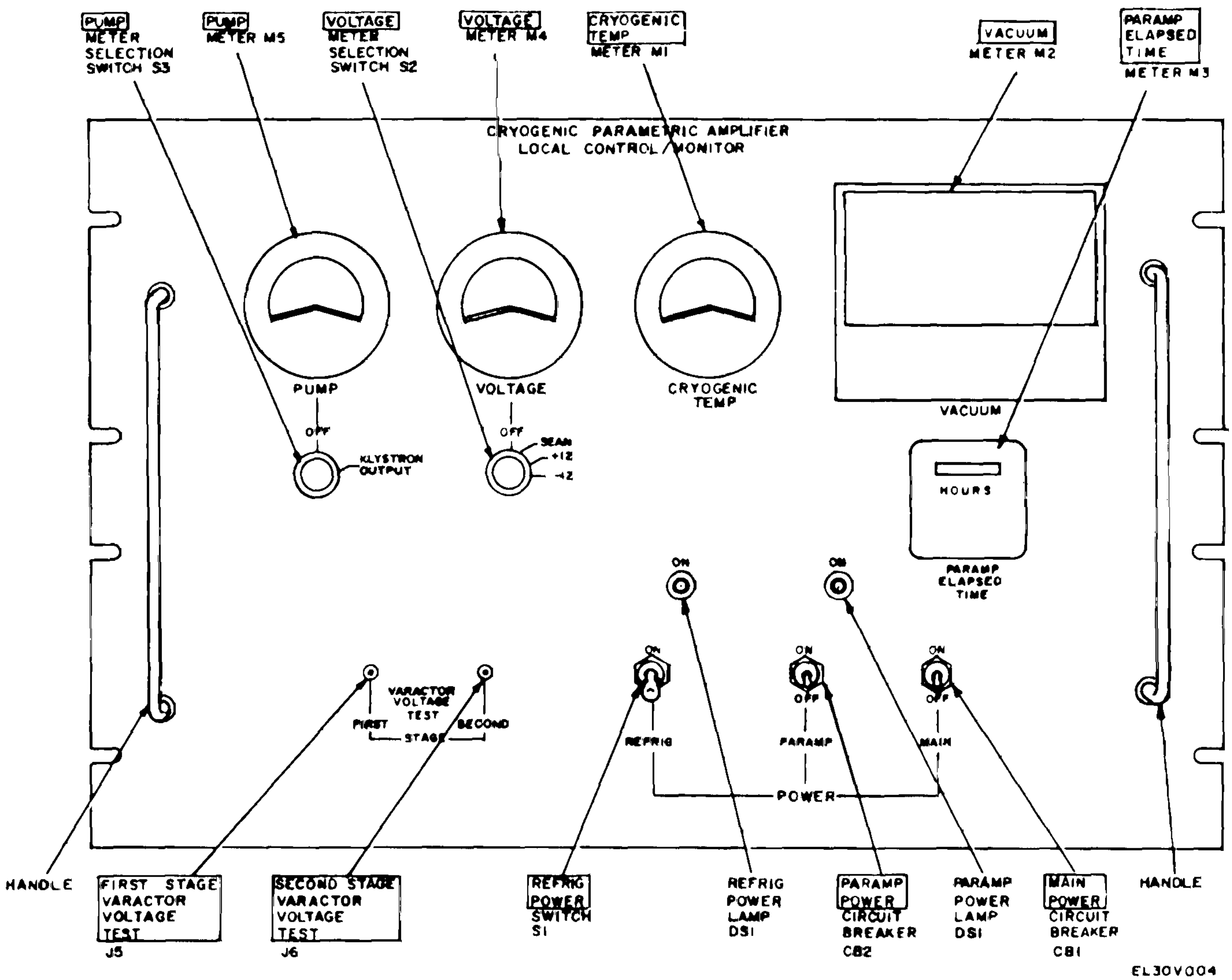


Figure 2-4. Front Panel View of Local Control/Monitor Assembly Unit 1.

2-13. Safety Interlock

High voltage (-1000 V) is used to operate klystron oscillator 2A1V1 (para 2-7*b).* To protect personnel, a safety interlock is installed on the 2A1 chassis. When the 2A1 chassis cover is removed the interlock switch opens and deenergizes Klystron Power Supply 1PS1, the source of high voltage (fig. 2-5). Interlock switch 2A1S1 is in series with the energizing coil of latching relay 1K1 (K1, fig 3-3). When 2A1S1 is open 1K1 contacts cannot close. The three-phase primary power (120 ± 12 V, *55 ± 8* Hz) passes through the 1K1 contacts to 1PS1. Single-phase primary power (120 ± 12 V, 55 ± 8 Hz) however, is not interrupted by the interlock switch. This single-phase primary power operates the temperature control circuits in 2A1 (para 2-11) and in 2A2 (para 2-10), vacuum gage tube 2A3J2 and VACUUM meter 1M2 (para 2-9c).

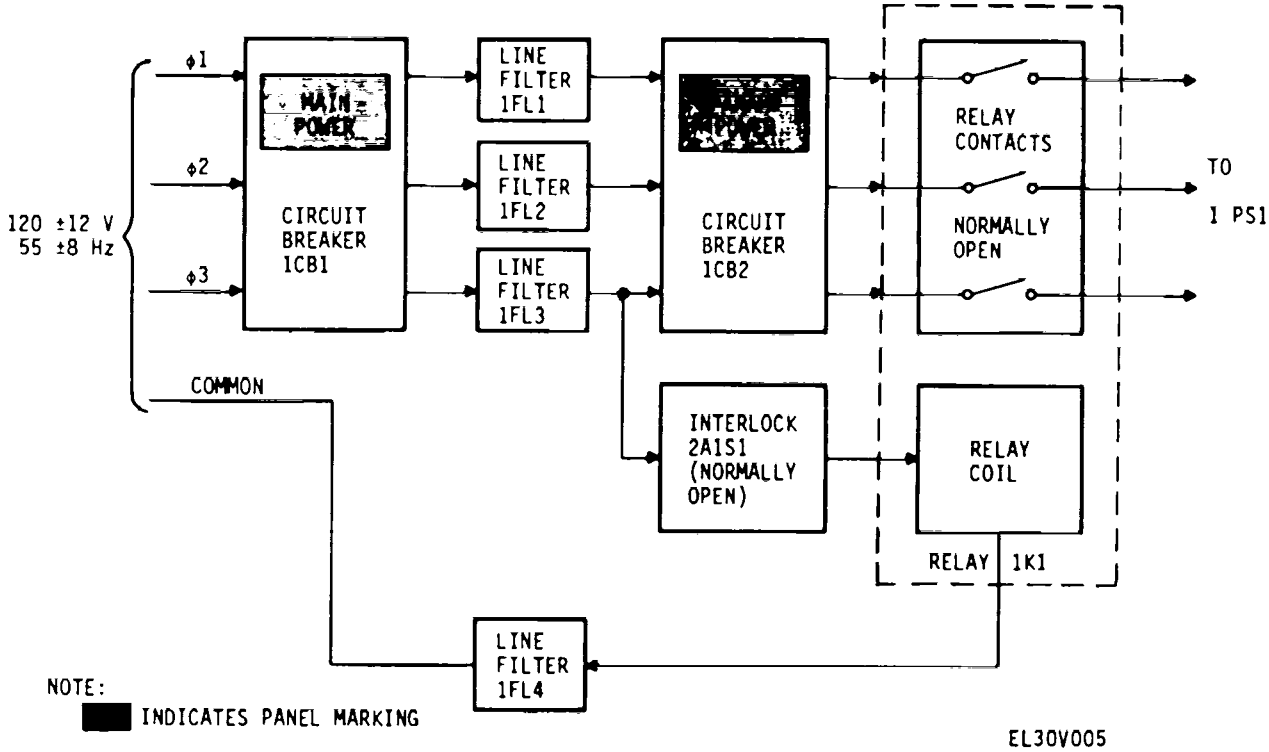


Figure 2-5. Block Diagram of Safety Interlock Circuit.

2-14. Channel Switching

a. A four-port waveguide latching transfer switch (3A2/3A3) is used both at the signal input and at the signal output ports of the redundant parametric amplifier system. The drive motors for the waveguide switches require 28 Vdc. This is supplied through split CHANNEL SELECT pushbutton switch 3A1S1 on Remote Control/-Monitor Assembly 3A1 panel (S1, fig. 3-4). The input (3A2) and output (3A3) waveguide switch drives are connected in parallel and the waveguide switch position indicators are connected in series (fig. 2-6). Thus, when the operator selects Channel 2 by pressing the right side of 3A1S1, both the input (3A2) and the output (3A3) Waveguide Switches are switched simultaneously to Channel 2 and the switch position indicators will cause the 2 half of CHANNEL SELECT pushbutton switch 3A1S1 to light (DS2, DS4, fig. 3-4). If a failure occurs in either waveguide switch drive (or indicator) the panel lamps, which are a part of the 3A1S1 assembly, will fail to light. A hand (mechanical) switching knob on the top of each waveguide switch permits manual setting to the desired channel.

b. The Waveguide Switches latch in either position Channel 1 (port 1 connected to port 2 of the switch) (fig. 2-7) or position Channel 2 (port 1 connected to port 4 of the switch); there is no OFF position. In each position port 3 of Waveguide Switch 3A2 is available for a test signal input (to the standby channel) and port 3 of Waveguide Switch 3A3 is available to monitor the signal output of the standby channel. Therefore, in waveguide switch position 1; port 3 is connected to port 4 (Channel 2 standby), and in position 2, to port 2 (Channel 1 standby). The position of CHANNEL SELECT pushbutton switch 3A1S1 does not affect the specific operation of the Amplifier, Parametric AM-6602/MSC-46(V) except that the switch position determines the source of the RF input signal, operational or test, to each channel.

c. In Serial No. 001, the noise diode assembly (3A13) is mounted on 3A2 port 3. A switch (NOISE DIODE) on Serial No. 001, 3A1, permits the operator to activate the noise diode by switching on + 28 V (S2, fig. 3-5). A noise signal is then supplied via the decoupled port of directional coupler 3A13A1 to the standby channel and can be monitored at 3A3 port 3.

d. In all systems during gain-bandwidth test and alignment procedures, the RF output of a sweep generator is connected to 3A2 port 3 and the amplified signal is monitored by test equipment attached to 3A3 port 3 (fig. 3-8). In Serial No. 001, the sweep generator is connected to 3A2 port 3 via the main port of directional coupler 3A13A1.

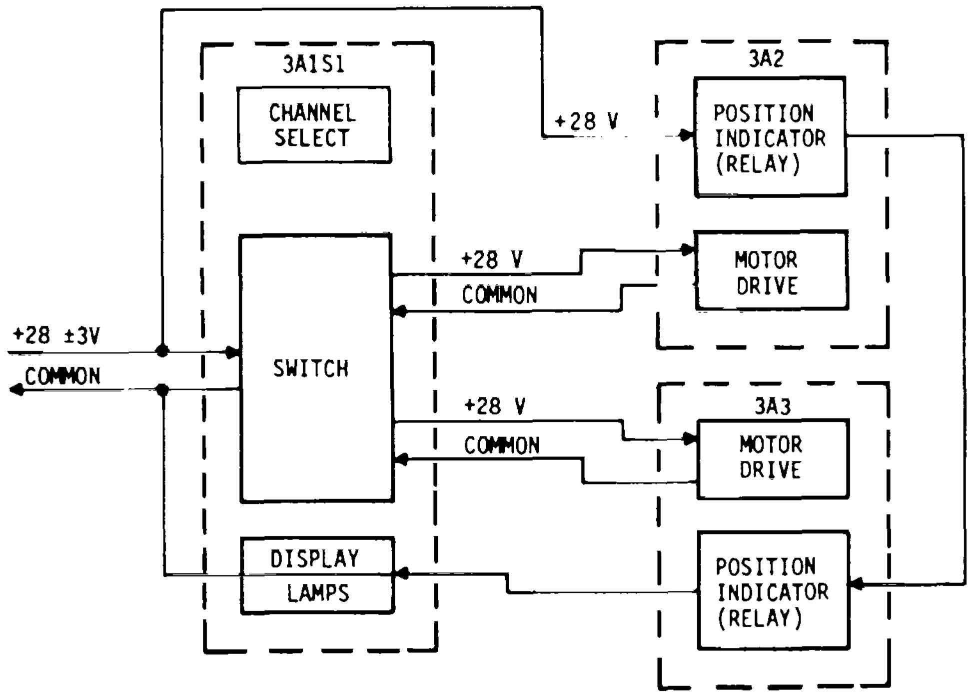


Figure 2-6. Block Diagram of Channel Switching, +28 V Control and Display Indicator Circuits.

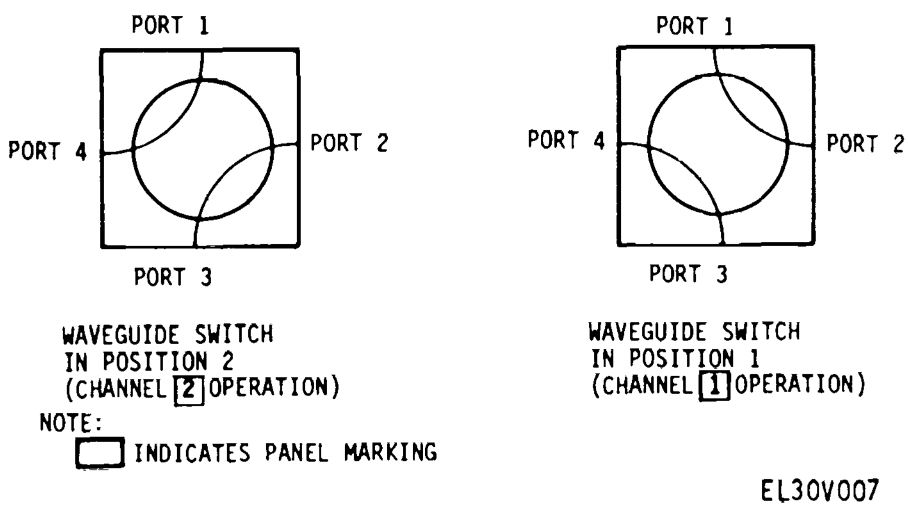


Figure 2-7. Block Diagram of Channel Switching, RF Switch Positions.

Section IV. CIRCUIT DESCRIPTIONS

2-15. First Stage Amplifier Circuits

a. Vacuum Vessel Module 2A3 (fig. 2-8).

(1) The first stage of the parametric amplifier (Module 2A3) consists of an RF circuit that is operated at a cryogenic temperature. Module 2A3 is operating satisfactorily when an RF input signal in the range 7250 to 7750 MHz at a power level of - 50 dBm or less has a gain of about 15 dB at the RF output terminal when the module is at the specified cryogenic temperature. The operator cannot adjust any part of the internal RF circuits; pump filter FL1 and mount circulator AR1 (consisting of a paramp varactor and paramp circulator) (fig. 2-1).

(2) The cryogenic temperature is measured by a gold-iron thermocouple, which is part of Unit 4. The voltage output of the thermocouple is connected to J1 terminals 1 and 2. At operating temperature (18 ± 2°K) the voltage is in the range 2.5 to 7.5 mV. This voltage is amplified in Unit 1 sufficiently to drive the CRYOGENIC TEMP meter 1M1.

(3) Vacuum gage tube (J2) can be operated only in conjunction with the VACUUM meter (1M2) circuit in Unit 1, where test points are available for measurement purposes (para 2-9*c*).

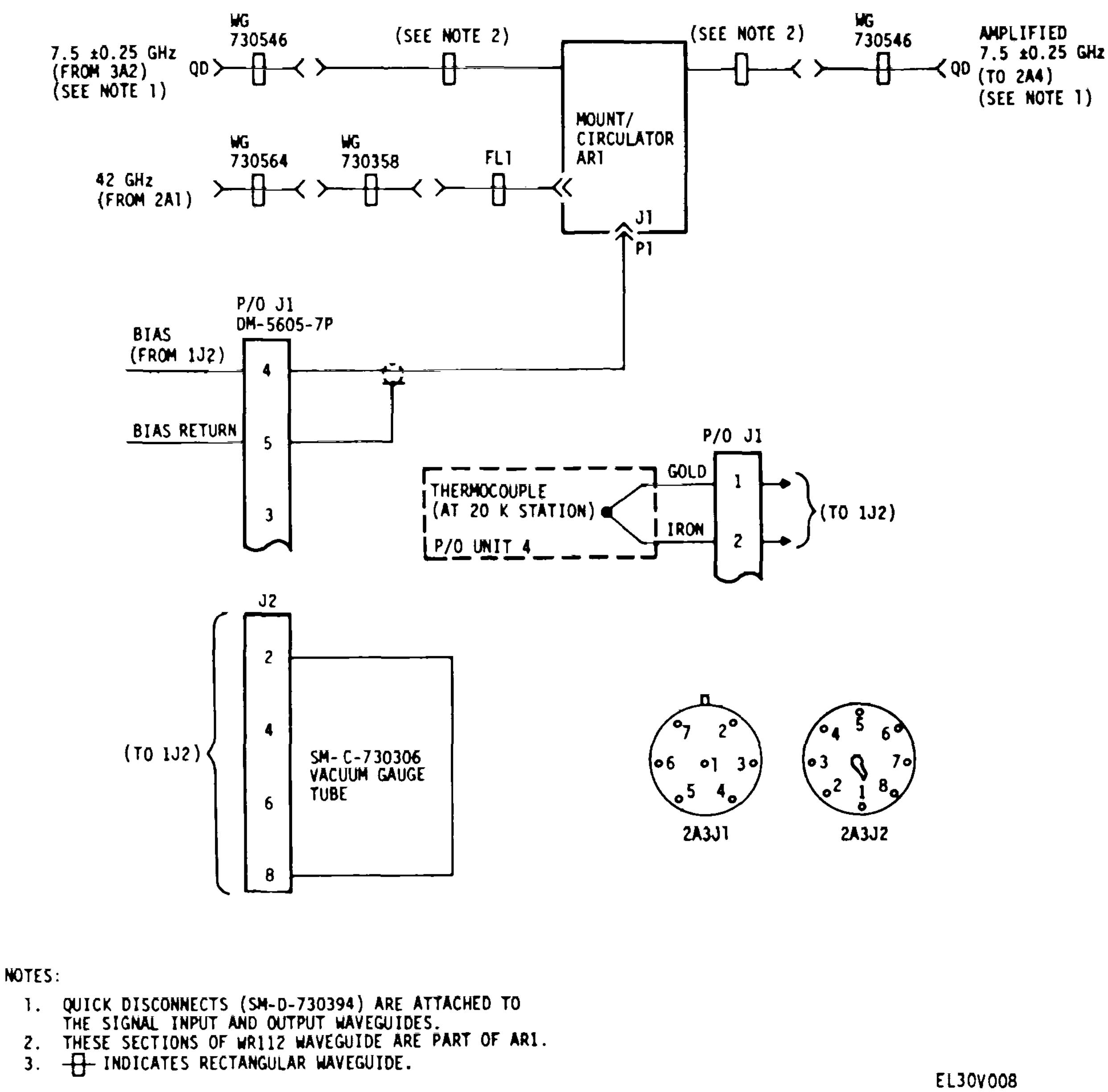


Figure 2-8. Vacuum Vessel Module 2A3, Schematic Diagram.

(4) The varactor bias voltage (J1 terminals 4 and 5) is set in Unit 1 during gain-bandwidth alignment. The presence of the voltage, not its value, is the important factor. Because the bias circuit cannot tolerate any appreciable dc current (10 microamp, maximum) no impedance measurements can be made. Current will cause irreparable damage to the varactor diode mounted within the paramp varactor. The varactor diode is the device that provides parametric amplification. Bias voltage can be measured on Unit 1 at 1J5, FIRST STAGE VARACTOR VOLTAGE TEST.

b. Temperature Monitor 1A1 (fig. 2-9). Circuit card assembly 1A1, Temperature Monitor, is a dc amplifier used to amplify the thermocouple output voltage (a above) to a level sufficient to drive a 1-mil meter, CRYOGENIC TEMP meter 1M1. An integrated circuit operational amplifier (U1) is used as the active element. This operational amplifier requires + 12 V on terminal 7 and - 12 V on terminal 4, supplied through card (P1) terminals C and E, respectively. The input signal (2.5 to 7.5 mV) is applied to U1 terminals 2 and 3 via P1 terminals F and B, respectively. A bridge circuit (R1, R2, R7, R8, R6) is used to balance the input voltage with respect to circuit ground and center the output meter. Variable resistor R12 is a feedback resistor used to set the overall gain of the amplifier. Meter 1M1 is connected directly across P1 terminals J and H. R4, in the meter circuit, is a limiting resistor used to protect the meter. Assembly 1A1 provides a gain of about 13 dB.

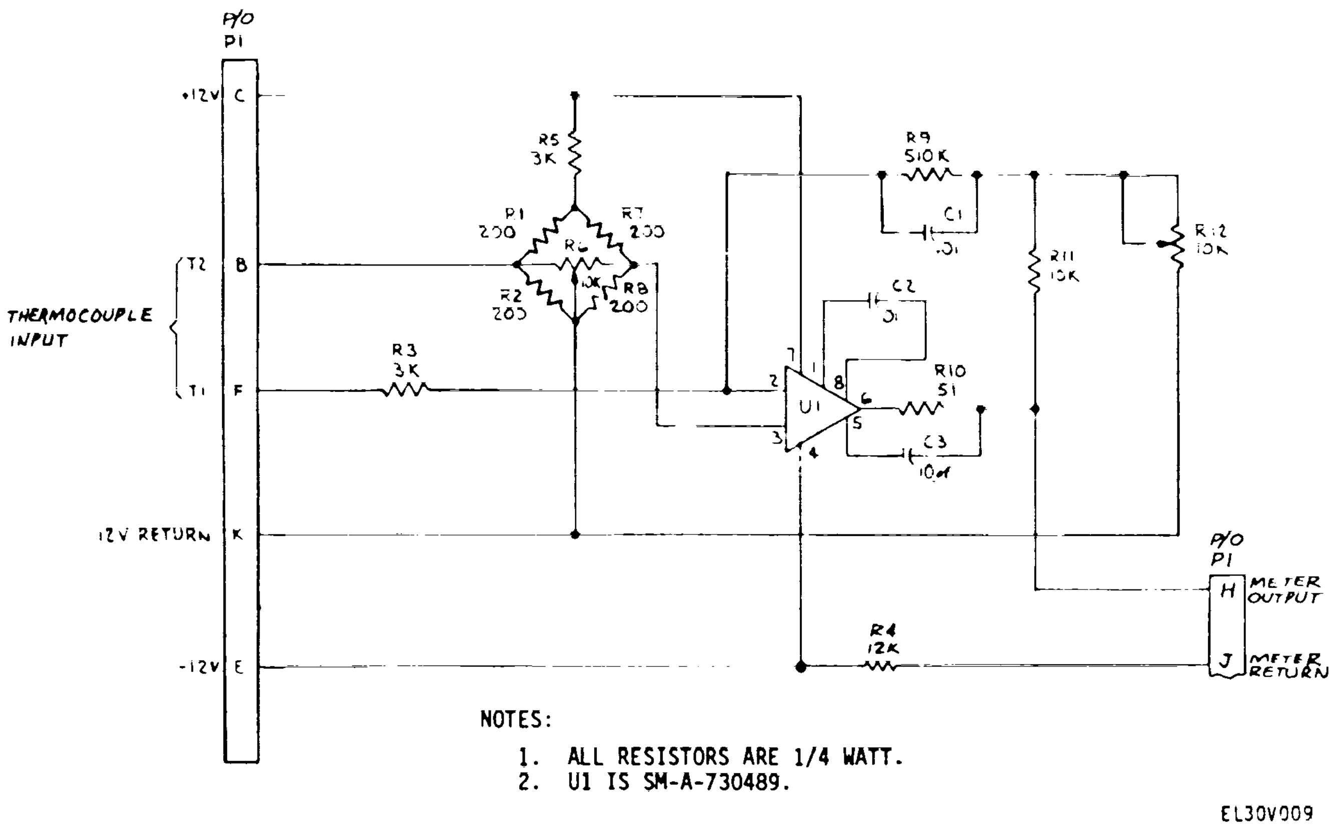


Figure 2-9. Temperature Monitor Card 1A1 (Sheet 1 of 2).

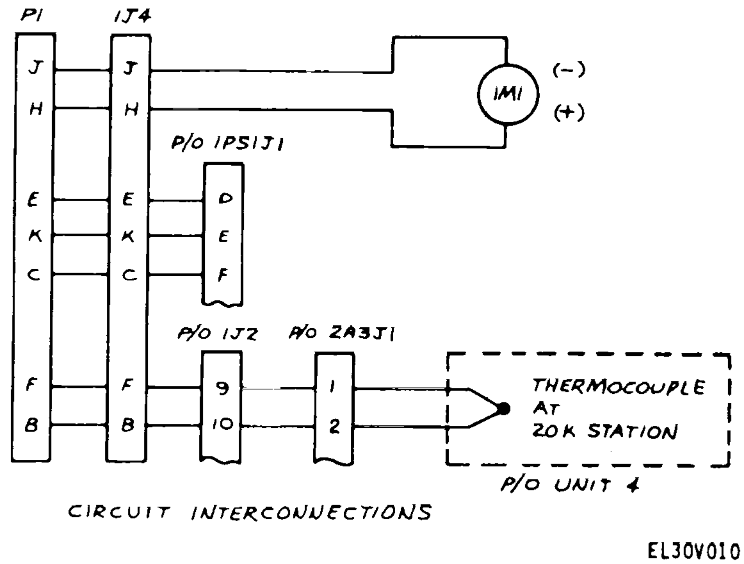


Figure 2-9. Temperature Monitor Card 1A1 (Sheet 2 of 2).

c. Vacuum Measurement Circuit. The vacuum (pressure) is sampled in Module 2A3 by means of vacuum gage tube 2A3J2, a thermopile (para 2-9*c*). The measurement circuit is contained within VACUUM meter 1M2 and 2A3J2. Interconnection of 2A3J2 and 1M2 is accomplished on terminal board 1E1 at terminals 1E1-16 through 1E1-22, where operational voltages can be measured (fig. 2-10). The circuit is energized whenever MAIN POWER circuit breaker 1CB1 is set to ON. Primary power (120 ± 12 Vac) can be measured at 1E1-17 and 1E1-18. Voltages on terminals 1E1-19 through 1E1-22 are a function of the pressure (vacuum) in Module 2A3. Terminal board 1E1 provides the only convenient measurement points for the vacuum measurement circuit. Both VACUUM meter 1M2 and vacuum gage tube 2A3J2 are precalibrated sealed subassemblies.

2-16. Second Stage Amplifier Circuits

a. Second Stage Paramp Module 2A2 (fig. 2-11).

(1) The second stage of the parametric amplifier (Module 2A2) consists of an RF circuit that is operated at a controlled temperature of about 140°F. Module 2A2 is operating satisfactorily when an RF input signal in the range 7250 to 7750 MHz at a power level of -40 dBm or less has a gain of about 15 dB at the RF output terminal when the module is at the specified temperature. The operator cannot adjust any part of the internal RF circuits: pump filter FL1, isolator AT1 and Mount Circulator AR1 (consisting of a paramp varactor and a paramp circulator) (fig. 2-11).

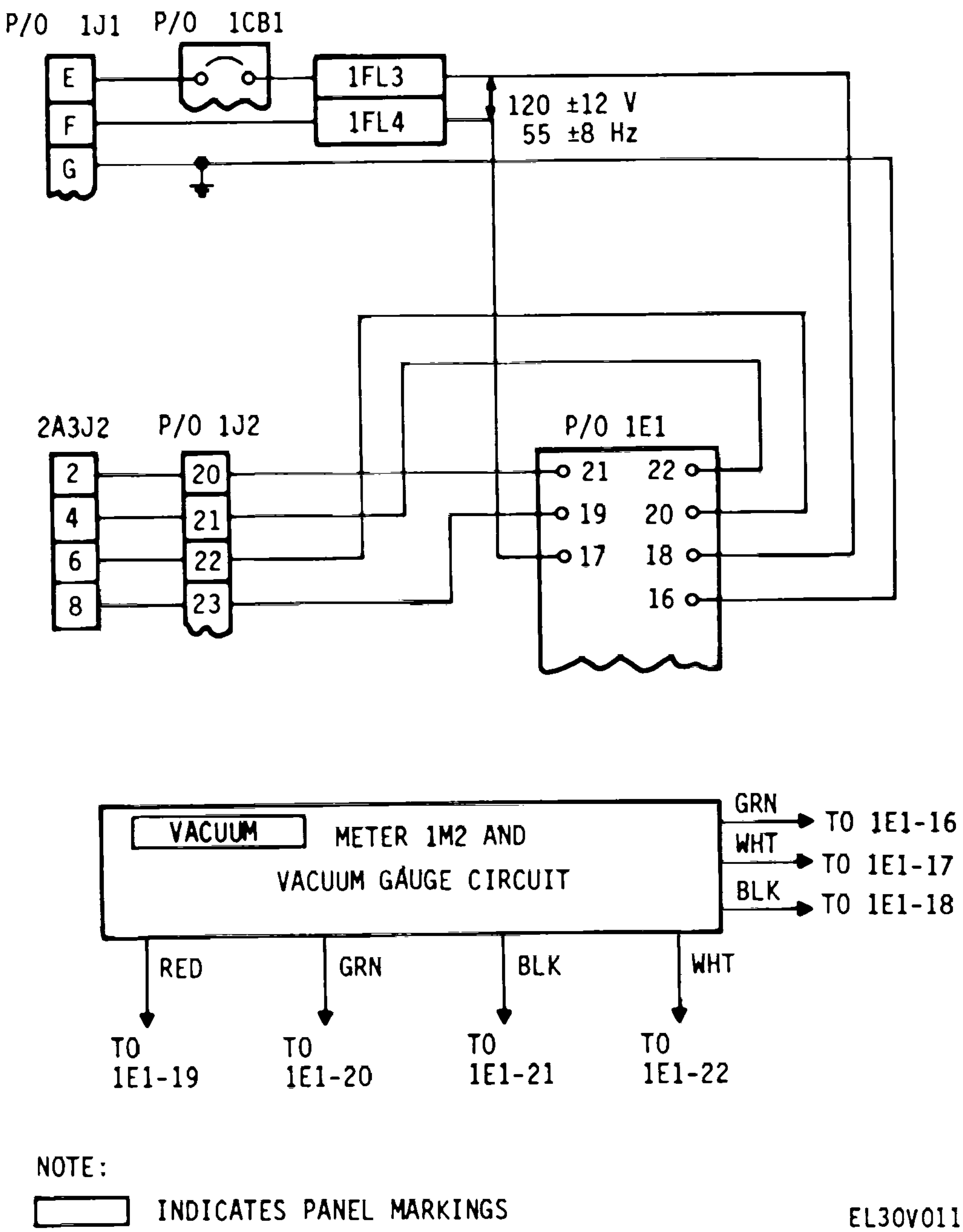


Figure 2-10. Vacuum Measurement Circuit, P/O Unit 1.

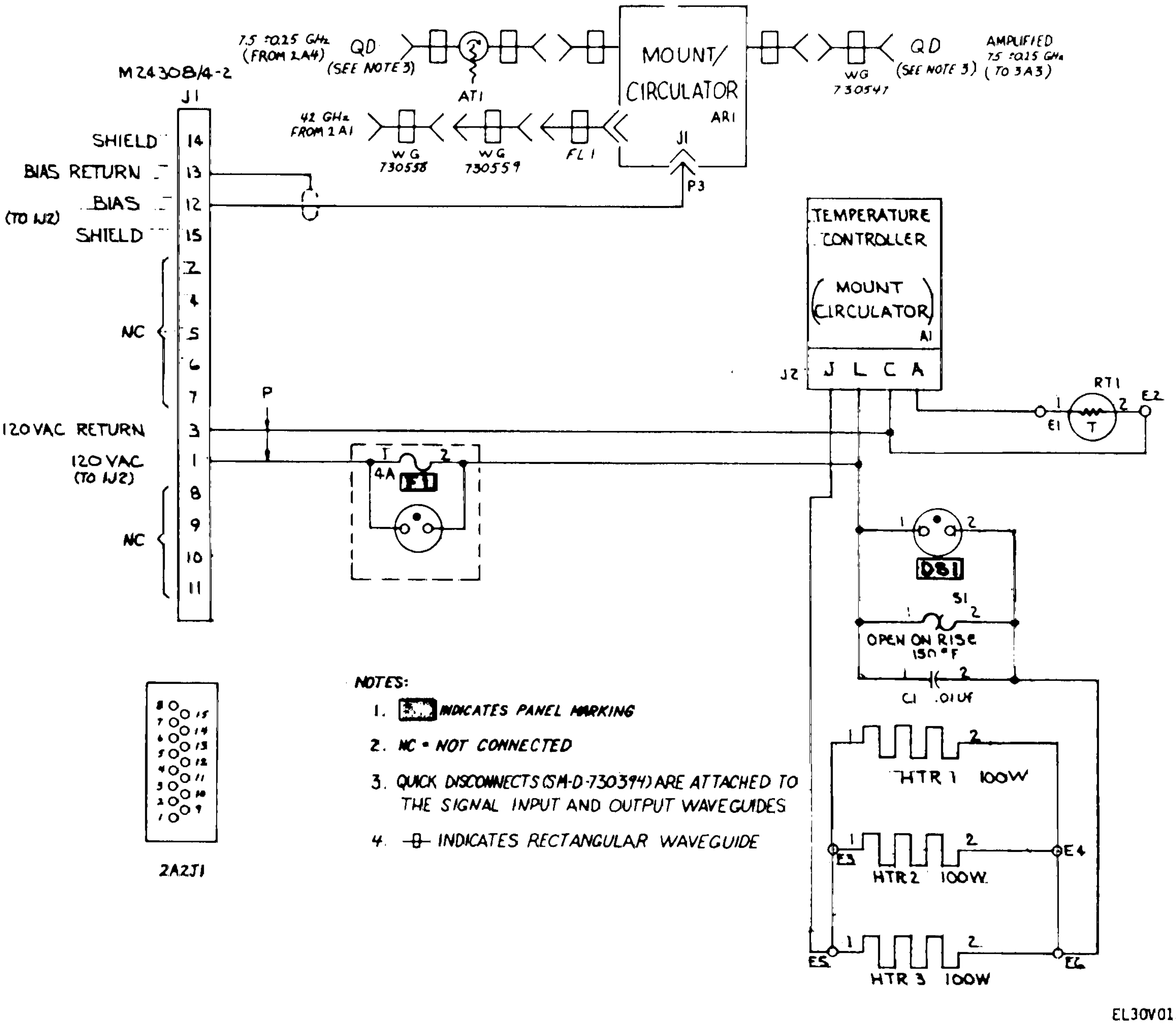


Figure 2-11. Second Stage Paramp Module 2A2, Schematic Diagram.

(2) The varactor bias voltage (J1 terminals 12 and 13) is set in Unit 1 during gain-bandwidth alignment. The presence of the voltage, not its value, is the important factor. Because the bias circuit cannot tolerate any appreciable dc current (10 microamp, maximum) no impedance measurements can be made. Current will cause irreparable damage to the varactor diode mounted within the paramp varactor. The varactor diode is the device that provides parametric amplification. Bias voltage can be measured on Unit 1 at 1J6, SECOND STAGE VARACTOR VOLTAGE TEST.

(3) The temperature of Module 2A2 is maintained by controlling power to three 100-W heaters located in heat sinks adjacent to AR1. The heaters are wired in parallel with a thermostat in series with the heaters. The thermostat is normally closed but will open if the temperature reaches 150°F. This is a safety device to prevent overheating. Capacitor C1 across the thermostat terminals is used to suppress transients when the thermostat switches. Thermistor RT1 senses a change in temperature of the heat sink on which it is located and is the controlling device for temperature controller A1. Temperature controller A1, in response to AT1 resistance variations, switches on and off power (120 ± 12 Vac) to the heaters to maintain the temperature at 140 ± 4°F. Primary power to the heaters enters through J1 terminals 1 and 3. This power comes from the output side of Unit 1 line filters 1 FL2 and 1 FL4 and is present whenever MAIN POWER circuit breaker 1CB1 is set to ON (fig. 2-17). An indicating fuse, F1, in the 120-V power line is mounted on the panel of Module 2A2.

b. Temperature Controller Circuit (fig. 2-12). U1 is an integrated circuit zero-voltage switch. Q1 is a thyristor that, when triggered on, conducts current for the heater circuits. The function of U1 is to trigger on Q1 when heat is needed. The pulse output to Q1 is at U1 terminal 4. This pulse is produced when the ac voltage crosses zero voltage line. The thyristor then conducts until the voltage again returns to the zero line (a half cycle). The process is repeated until the heat produced is at the preset level. The thermistor RT1 (a negative temperature coefficient resistor) is connected across card terminals C and A and U1 terminals 7 and 13. On U1, terminal 7 is the common terminal. The pulsing of Q1 occurs when the resistance of RT1 is greater than the resistance of R2 plus R3. Resistor R2 is variable and is preset to provide the required temperature. As the heat sink on which RT1 is mounted becomes warmer, the resistance of RT1 decreases and when it matches that of R1 + R2 U1 does not produce a pulse and the thyristor is not pulsed on; hence, no current flows through the heaters. R2 is a series limiting resistor used to protect U1. C1 is an input capacitor and C2 is an output capacitor, both for U1. Because of the nature of U1 and Q1, impedance measurements are not practical. Voltage measurements (120 ± 12 Vac) can be made be- tween card terminals L and C (power input) and J and L (load-heater circuit). Under normal operating conditions, the J-L voltage is intermittent. One temperature controller is used in Module 2A2 and three, in Module 2A1. The circuits are identical; the settings of the variable resistor R2 differ in each to provide a different control temperature.

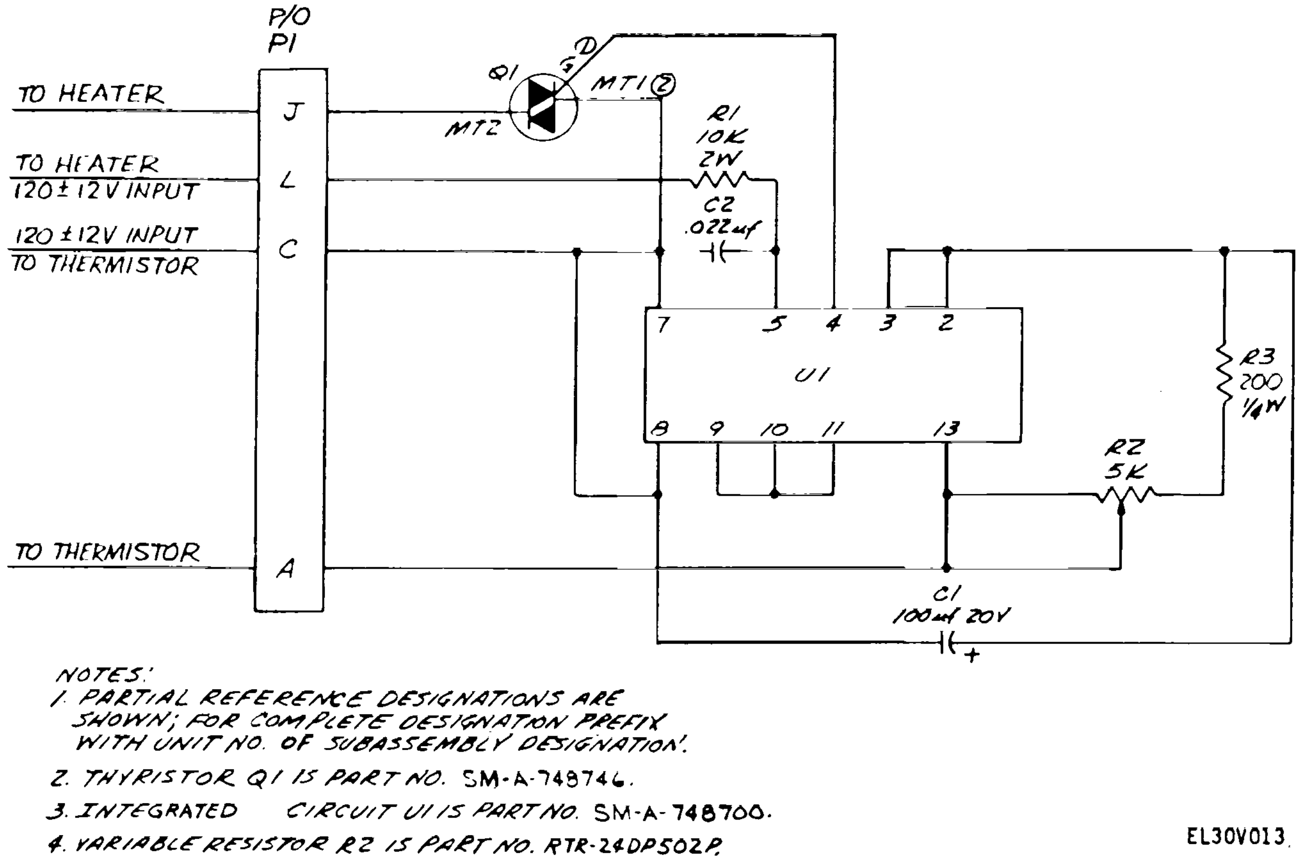


Figure 2-12. Temperature Controller; 2A2A1, 2A1A2, 2A1A3, 2A1A4, Schematic Diagram.

2-17. RF Pump Circuits

a. Pump Source Module 2A1 (fig. 2-13).

(1) The primary subassembly of Module 2A1 is the klystron oscillator V1. This tube operates with -1000 V beam voltage and +6.3 V (with respect to the beam voltage) filament voltage. These voltages are generated in 1PS1 and supplied to Module 2A1 through terminals J, K, and H of J1. The output power of V1 is at 42.00 GHz. The RF power is divided into two channels in power divider PD1, one channel for each stage of the parametric amplifier. The RF power control is the variable attenuator (AT3 in fist stage channel and AT4 in second stage channel). The variable attenuators are mounted behind a cover plate on the panel of Module 2A1. The required adjustments can be made when the cover plate is removed. Each variable attenuator is set during gain-bandwidth alignment. A crossguide coupler (DC1) is inserted between V1 and PD1 so that the output power of V1 can be sampled. The decoupled power is rectified in crystal detector CR1 and the dc output is supplied to a dc amplifier, Power Monitor A1, where it is amplified sufficiently to operate meter 1M5, PUMP meter on Unit 1.

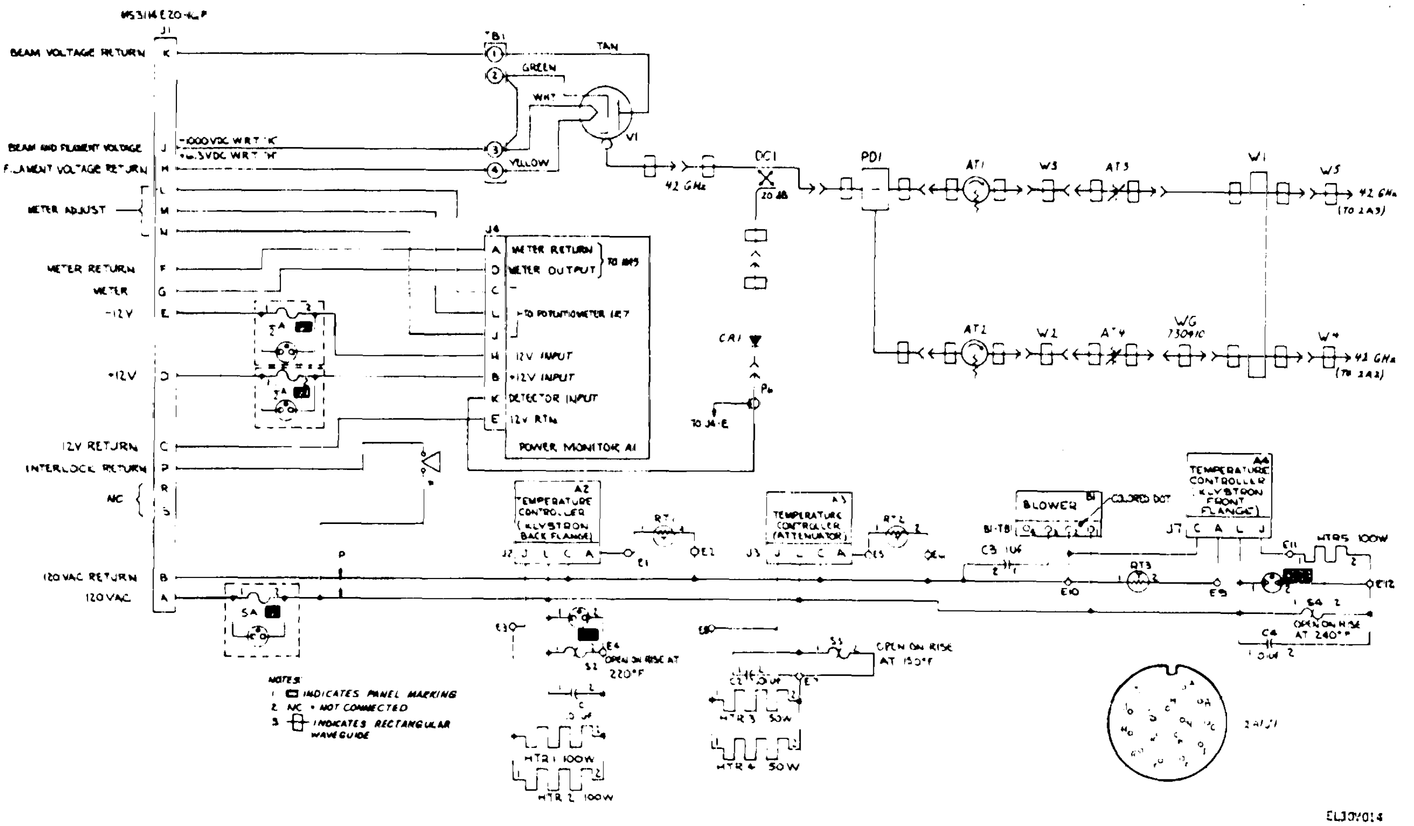


Figure 2-13. Pump Source Module 2A1, Schematic Diagram.

(2) Module 2A1 uses three temperature control circuits and a fan for precise temperature control. Temperature controllers A2, A3 and A4 are identical to 2A2A1 except for the setting of the control resistor R2 (fig. 2-12). The thermostats mounted on the heat sink for V1, S2 and S4, have panel lamps, DS1 and DS2, respectively, across their terminals. These lamps, mounted on Module 2A1 panel, light when the thermostats are open thereby indicating malfunctions in the temperature control circuits. (Refer to para 2-11.) Capacitors to suppress transients are placed across the terminals of all three thermostats (S2, S3, S4). Primary power (120 ± 12 V) to the heaters enters through J1 terminals A and B. This power comes from the output sides of Unit 1 line filters 1 FL3 and 1 FL4 and is present whenever MAIN POWER circuit breaker 1CB1 is set to ON (fig. 2-17). An indicating fuse, F1, in the 120-v powerline, is mounted on the panel of Module 2A1.

(3) Safety switch S1 is described in paragraph 2-13 (fig. 2-5). Because S1 is connected to the 120-V line behind fuse F1, the interlock relay (1K1) will not close when F1 is open as well as when S1 is open. This prevents the applicator of dc power to Module 2A1 when all of the temperature control circuits are disabled.

(4) The dc amplifier, Power Monitor A1, requires +12 V and -12 V for operation. These lines are protected by indicating fuses F2 and F3, respectively. The fuses are mounted on the panel of Module 2A1.

b. Power Monitor 2A1A1 (fig. 2-14). Circuit card assembly 2A1A1, Power Monitor, is a dc amplifier used to amplify the detected pump power voltage to a level sufficient to drive a 1-mil meter, PUMP meter 1M5. An integrated circuit operational amplifier (U1) is used as the active element. This operational amplifier is identical to that used in 1A1, Temperature Monitor, dc amplifier (para 2-15*b).* This operational amplifier requires +12 V on terminal 7 and -12 V on terminal 4, supplied through card (P1) terminals B and H, respectively. The input signal from 2A1CR1 (0.2 to 4 V) is applied to U1 terminal 2 via card terminal K. PUMP meter selection switch 1S3 is connected across card terminals D and A. When 1S3 is set to KLYSTRON OUTPUT, PUMP meter 1M5 is connected across these terminals; when 1S3 is set to OFF the circuit is open. A variable resistor (potentiometer) mounted in Unit 1 (R7 PUMP POWER METER ADJ) is connected across card terminals C, L and J. Terminal L is connected to the wiper arm of 1R7, which is adjusted (screwdriver adjustment) to center the meter (1M5) deflection. Variable resistor R5 in the feedback circuit permits adjustment of the gain of the dc amplifier. Whenever the gain is changed the meter deflection may require adjustment via 1R7. The required gain depends on the detected voltage from the particular crystal detector (2A1CR1) with which it is used. The input RF power to the crystal detector depends on the particular klystron oscillator (2A1V1) with which it is used.

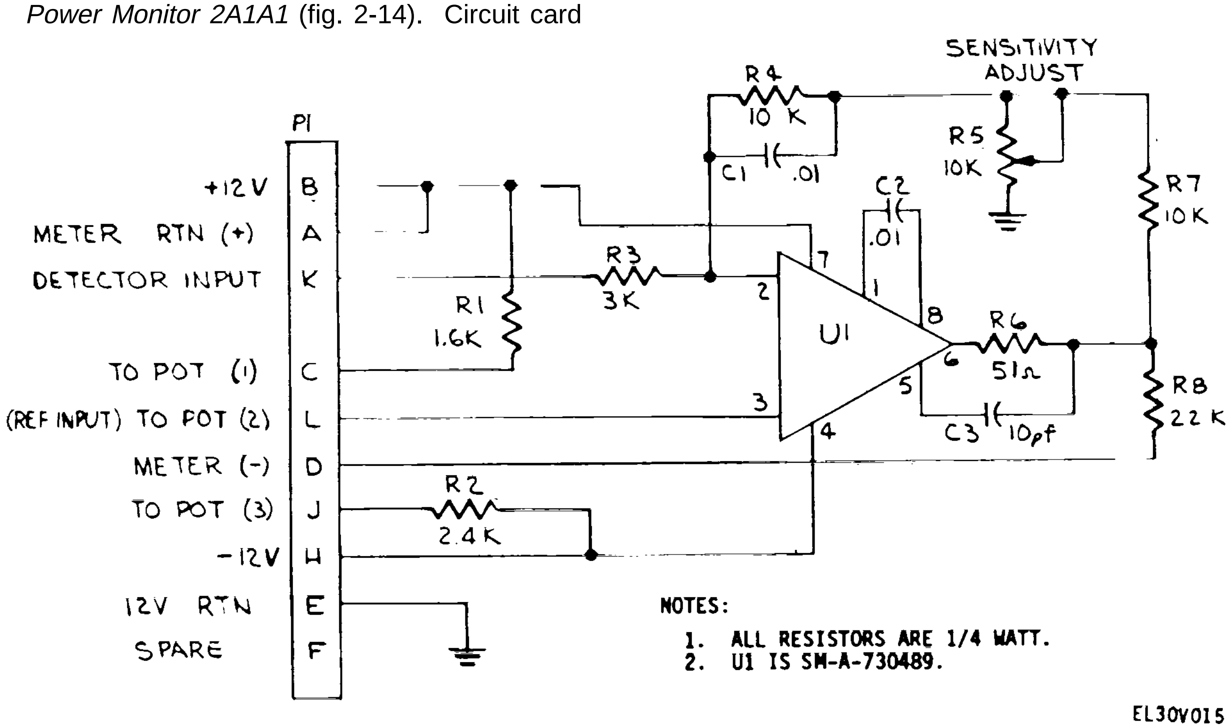


Figure 2-14. Pump Source Power Monitor 2A1A1, Schematic Diagram.

2-18. Local Control and Monitoring Circuits

a. Varactor Bias Voltage Circuit (fig. 2-15). The source of the varactor bias voltage is the + 12 volt regulator in Regulated Power Supply 1PS1. A voltage divider consisting of a 1-kilohm fixed resistor (E1R8 or E1R9) and a 1-kilohm variable resistor (R5 or R6) is connected across the + 12 volt regulator output. The bias voltage is taken off the low side of the divider (12-volt return line) and either the wiper arm of the variable resistor or the center of the voltage divider. The bias voltage can therefore be varied from 0 to +6 V. The wiper arm line and the line to the voltage divider midpoint are connected to two poles of a single throw switch (S4 or S5). The common terminal of the switch (S4-2 or S5-2) is connected to the panel test jack J5 or J6) and to the varactor diode in the parametric amplifier stage (2A3, first stage or 2A2, second stage). The varactor diode, then, always has a bias voltage applied: either from the wiper arm of the variable resistor (normal operation) or from the midpoint (+6 V) of the voltage divider (BYPASS operation). E1R8 and E1R9 are mounted on terminal board 1E1; R5 and R6, S4 and S5 are mounted on the rear panel of Unit 1 (fig. 3-2).

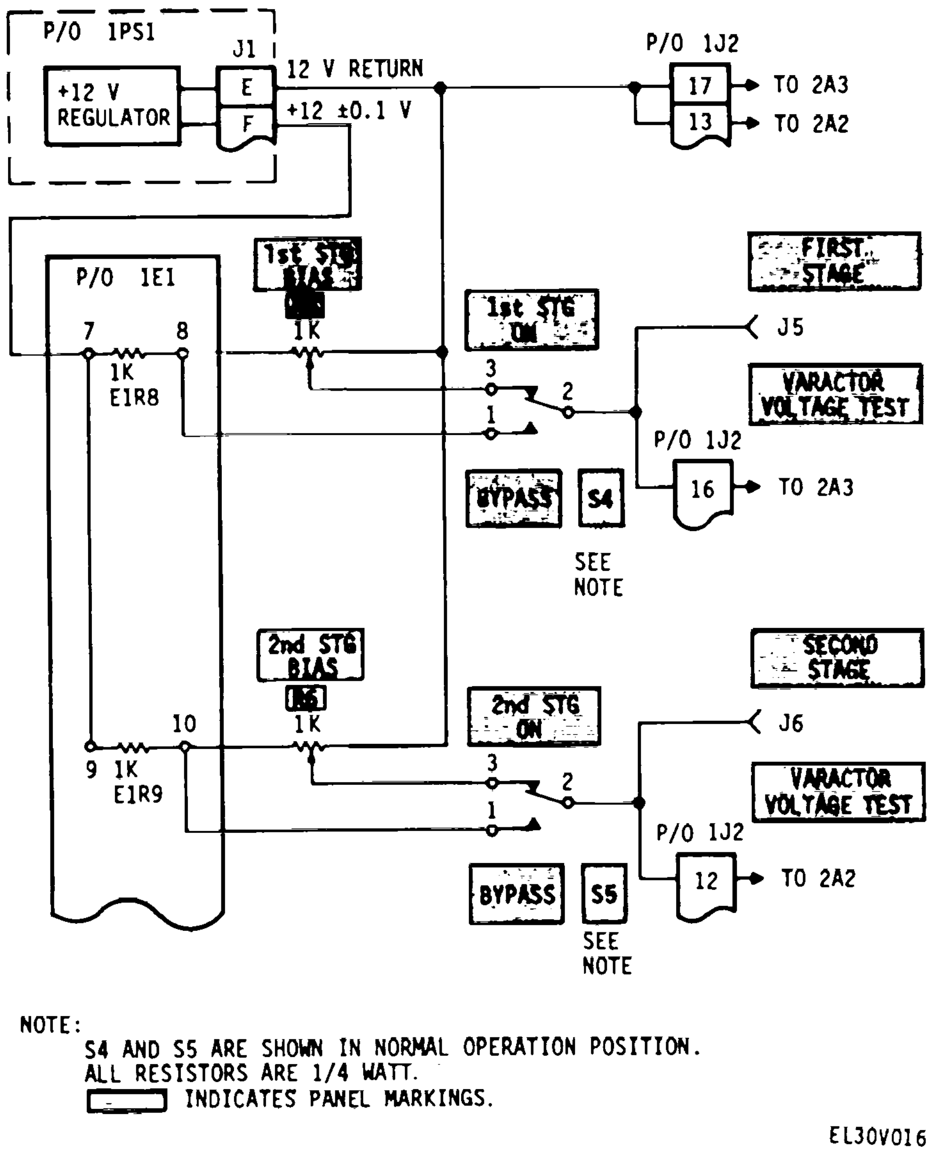


Figure 2-15. Varactor Bias Voltage Circuit , P/O Unit 1.

b. Voltage Measurement Circuit (fig. 2-16). During normal operation selection switch S2 for VOLTAGE meter M4 is set to OFF, in which condition the M4 circuit is open. When S2 is set to BEAM the voltage drop across

E1R1 is measured, this is 0.01 of the total beam voltage. The other two voltages, + 12 V and -12 V, are measured directly The measured voltages are the outputs of Klystron Power Supply PS1 (except the + 6.3 V voltage for the klystron oscillator filament, which is not monitored).

c. Local Control Monitor Assembly, Unit 1, Schematic Diagram. Various monitor and control sections of Unit 1 have been described along with the functional circuits to which they belong (para 2- 15*b* and *c*, 2-17*b*, and *a* and *b* above). Figure 2-17 shows the complete schematic diagram Klystron Power Supply PS1 circuits are described in paragraph 2-19.

2-19. DC Power Supply Circuits

a. Klystron Power Supply (fig. 2-18).

(1) Primary power (120 ± 12 V, 3 phase, 55 ± 8 Hz) is supplied to Klystron Power Supply PS1 through connector 1J1 terminals A, L, E, G, circuit breaker 1CB1, line filters 1FL1, 1FL2, 1FL3, circuit breaker 1CB2, and latching relay 1K1 contacts A1, B1, and C1 (fig 2-17). Output power from PS1 is provided at four voltage levels: -1000 V, +6.3 V, +12 V, and -12 V. Each voltage is obtained from an independent voltage regulator circuit A9, A1, A10 and A11, respectively. A common transformer (T1) and rectifier board (A7) are used to provide the inputs to the voltage regulators.

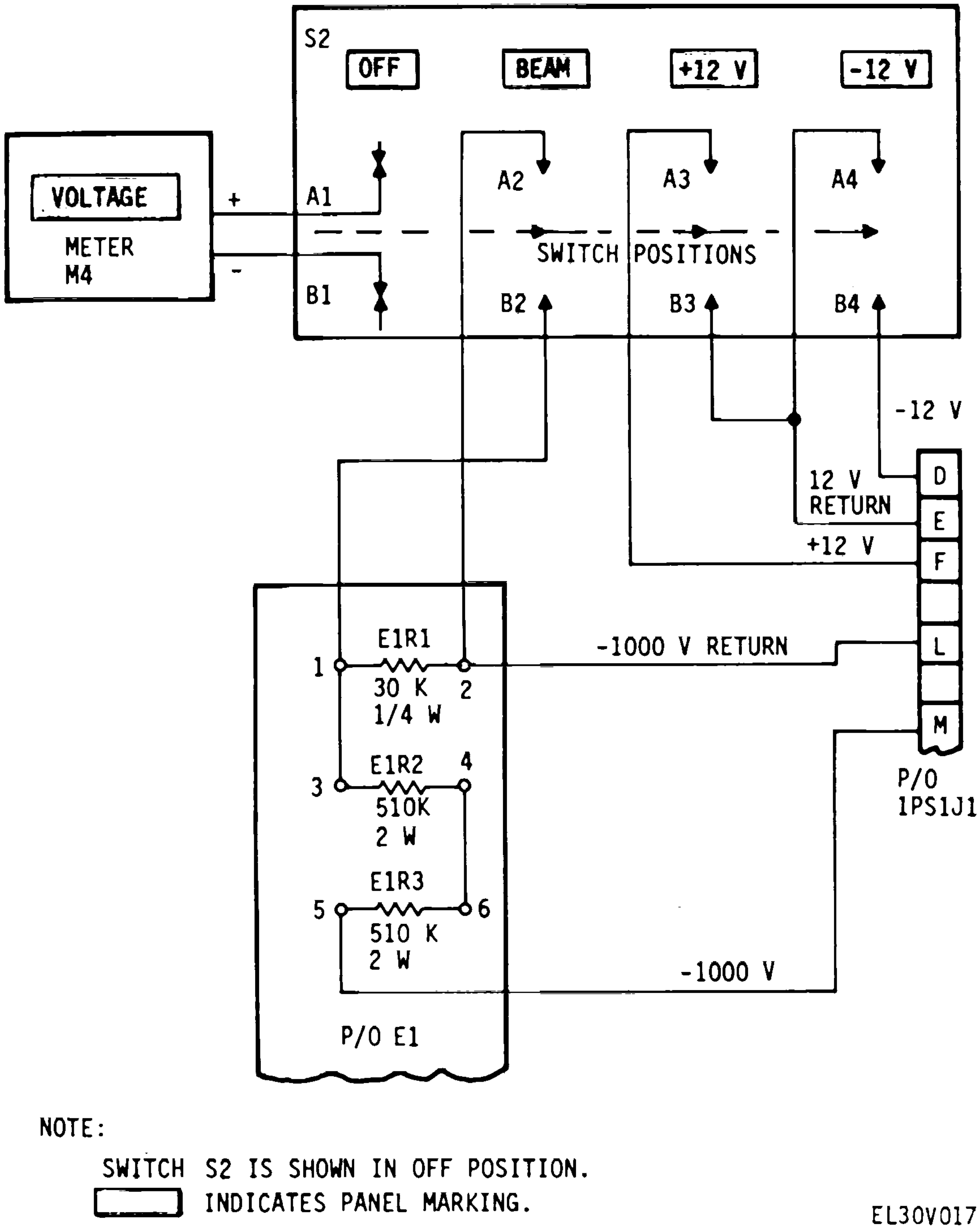


Figure 2-16. Voltage Measurement Circuits, P/O Unit 1.

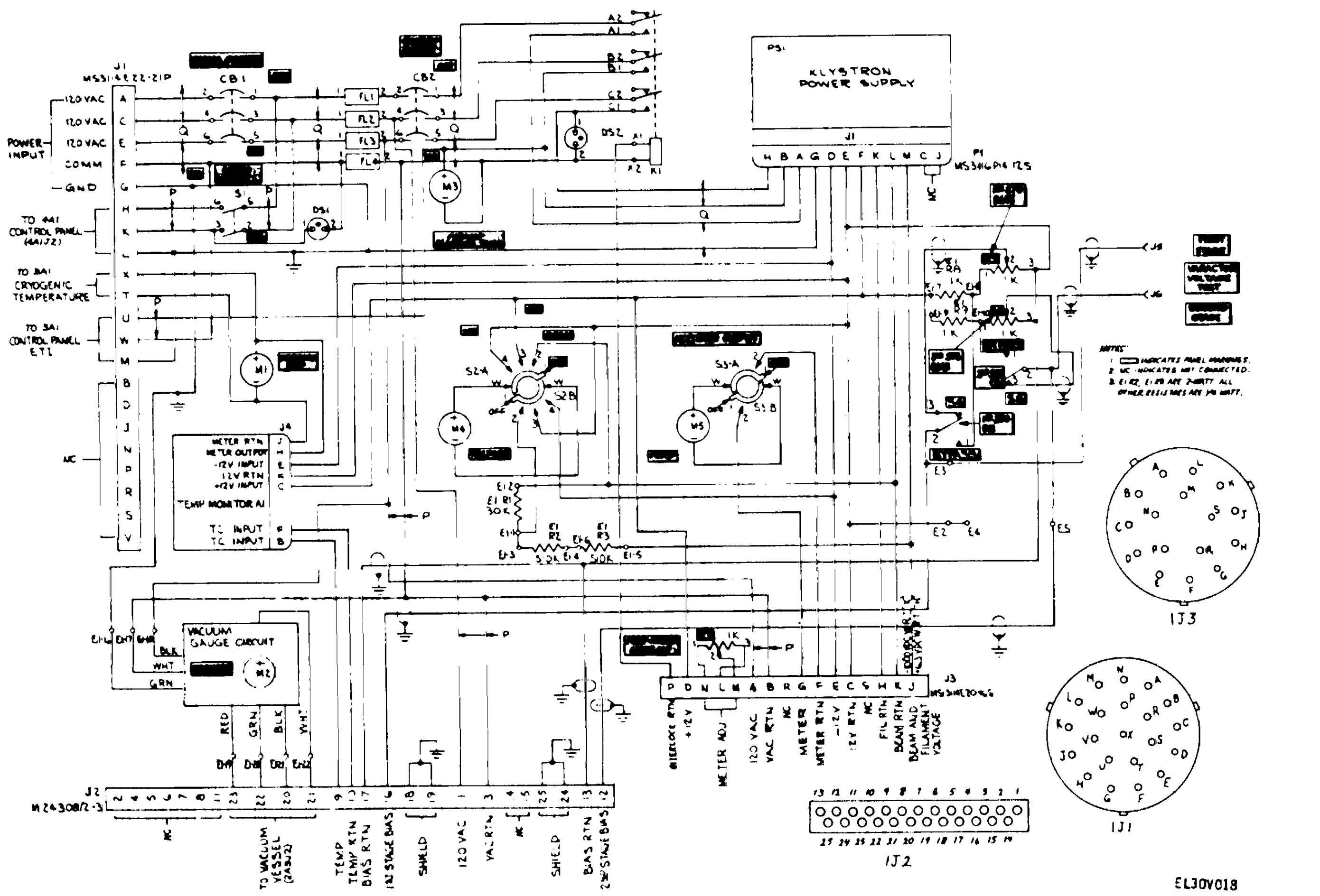


Figure 2-17. Local Control/Monitor Assembly Unit 1, Schematic Diagram.

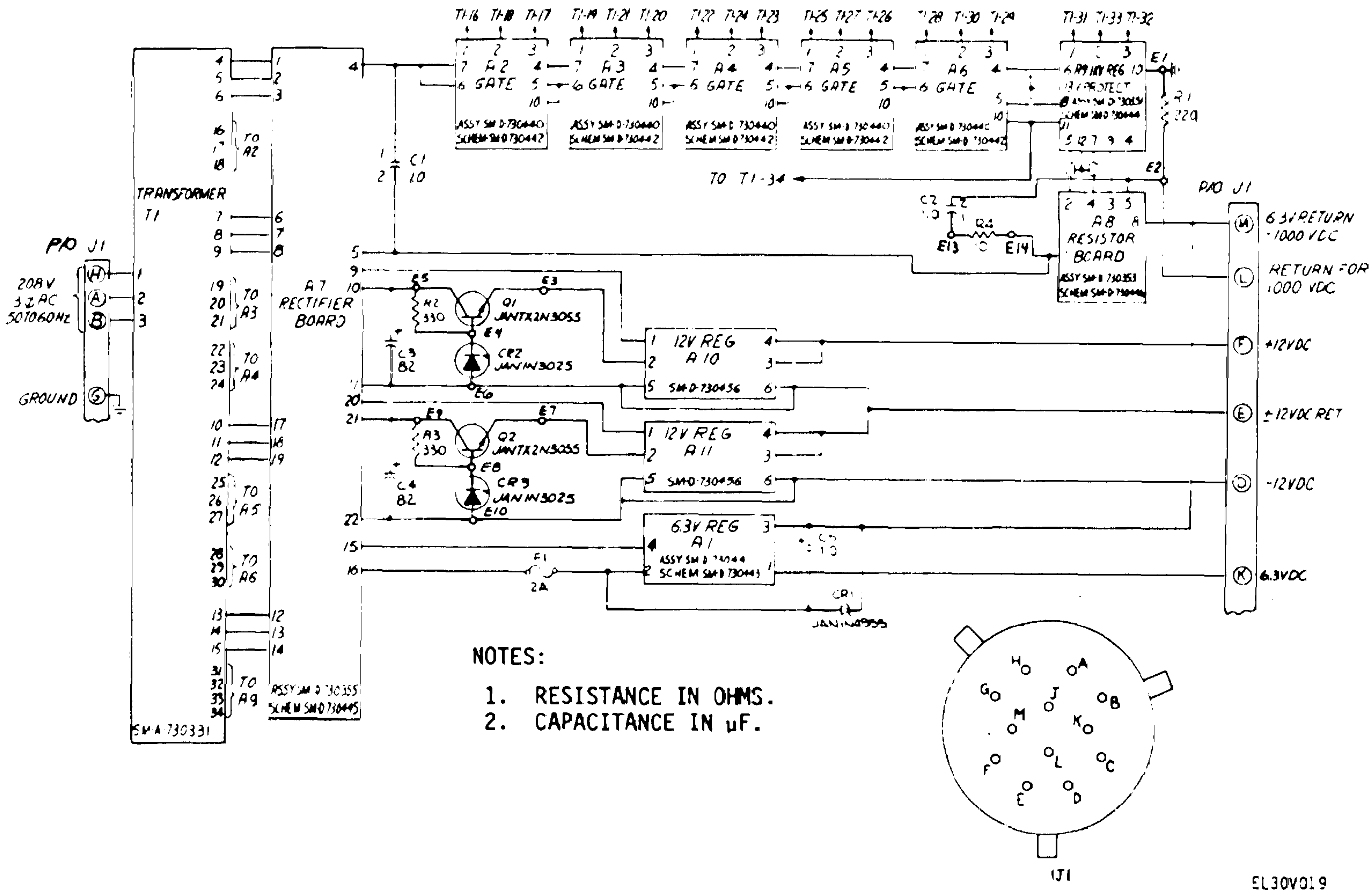


Figure 2-18. Klystron Power Supply 1PS1, Schematic Diagram.

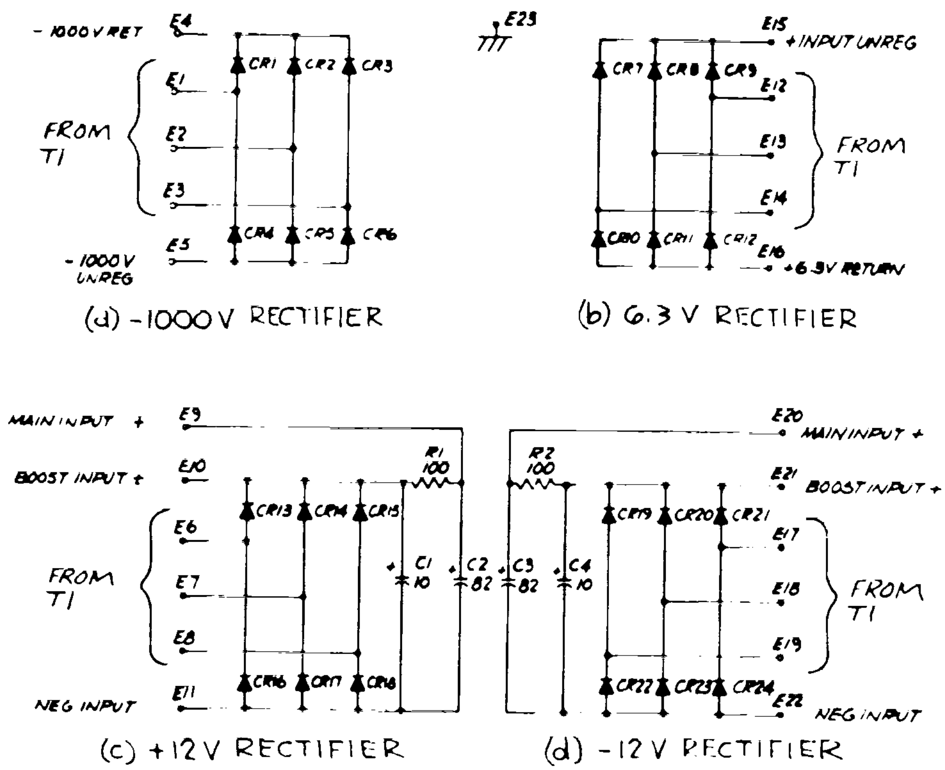
(2) Transformer TI has four three-phase secondary windings, one for each voltage regulator, and six singlephase secondary windings that supply the internal bias voltage (when rectified in the individual circuits) to the five gate circuits (A2, A3, A4, A5, A6) and to the 1000 V regulator A9.

(3) Capacitor C1 is across the high voltage output of the rectifier board and capacitor C2 is across the high voltage (-1000 V) output of PSI A small (10-ohm) resistor is in series with C2. Circuit ground of the high voltage supply is separated from chassis ground by RI (220 ohms). This is a safety device to ensure that the chassis never rises more than 30 V above ground, regardless of internal circuit failures such as ground short of a high voltage circuit (1000 V regulator or 6.3 V regulator).

(4) Because the drift, ripple, and regulation of the 12-V regulators (A10, A 1) are very stringent, preregulators are employed between the regulators (A10, A 11) and rectifier board A7. These preregulators utilize a filter capacitor (C3, C4), a 7Zener diode (CR2, CR3), and a power transistor emitter follower (Q1, Q2) to provide low ripple input to the 12-V regulators The 12-V regulators are identical and, because they are potted in epoxy, they are nonreparable They are capable of producing several times the power required in this system. The regulated voltage is constant within ± 0. I V. The low side of the + 12 V output and the high side of the 12 V output are tied together to provide a common ± 12 V return line

b. Rectifier Board A 7 (fig. 2-19). Rectifier Board A7 contains four three-phase full-wave bridge rectifiers. The + 12 V and 12 V rectifiers have an RC filter in the output circuit. These two bridge rectifiers are identical and supply the 12-V preregulators. They employ 1N4245 diodes. The -1000 V bridge rectifier utilizes 1N3647 diodes and the +6.3 V bridge rectifier, IN5550 diodes

c. +6.3 V Regulator A1 (fig. 2-20). The input voltage to power transistor Q1 is unregulated 12 V at terminals E2 and E4. The output voltage of Q1 is 6.3 V at terminals E1 and E3. Transistors Q2 and Q3 supply the drive to Q1 and U1, an integrated circuit voltage regulator, drives Q2 and Q3. Resistor R4 produces a voltage drop proportional to output current. When this drop reaches about 0.6 V the drive current to Q2 and Q3 is depleted. Variable resistor R6 (a trimpot) permits adjustment of the output voltage to 6.3 V. If the output is shorted the regulator will produce about 2.5 amps which will, in time, cause Q1 to overheat and fail Short duration shorts, however, will not cause failure. To prevent cold turn-on surges from causing damage the input line (E2) has a 2-amp fuse (F1) and the circuit is bridged by Zener diode CR1 and capacitor C1 (fig 2-18).



NOTES:

1. CR1 - CR6 ARE 1N3647.
2. CR7 - CR12 ARE 1N5550.
3. CR13 - CR24 ARE 1N4245.
4. RESISTANCES ARE IN OHMS.
5. CAPACITANCES ARE IN μF.

EL30V020

Figure 2-19. Rectifier Board 1PS1A7, Schematic Diagram.

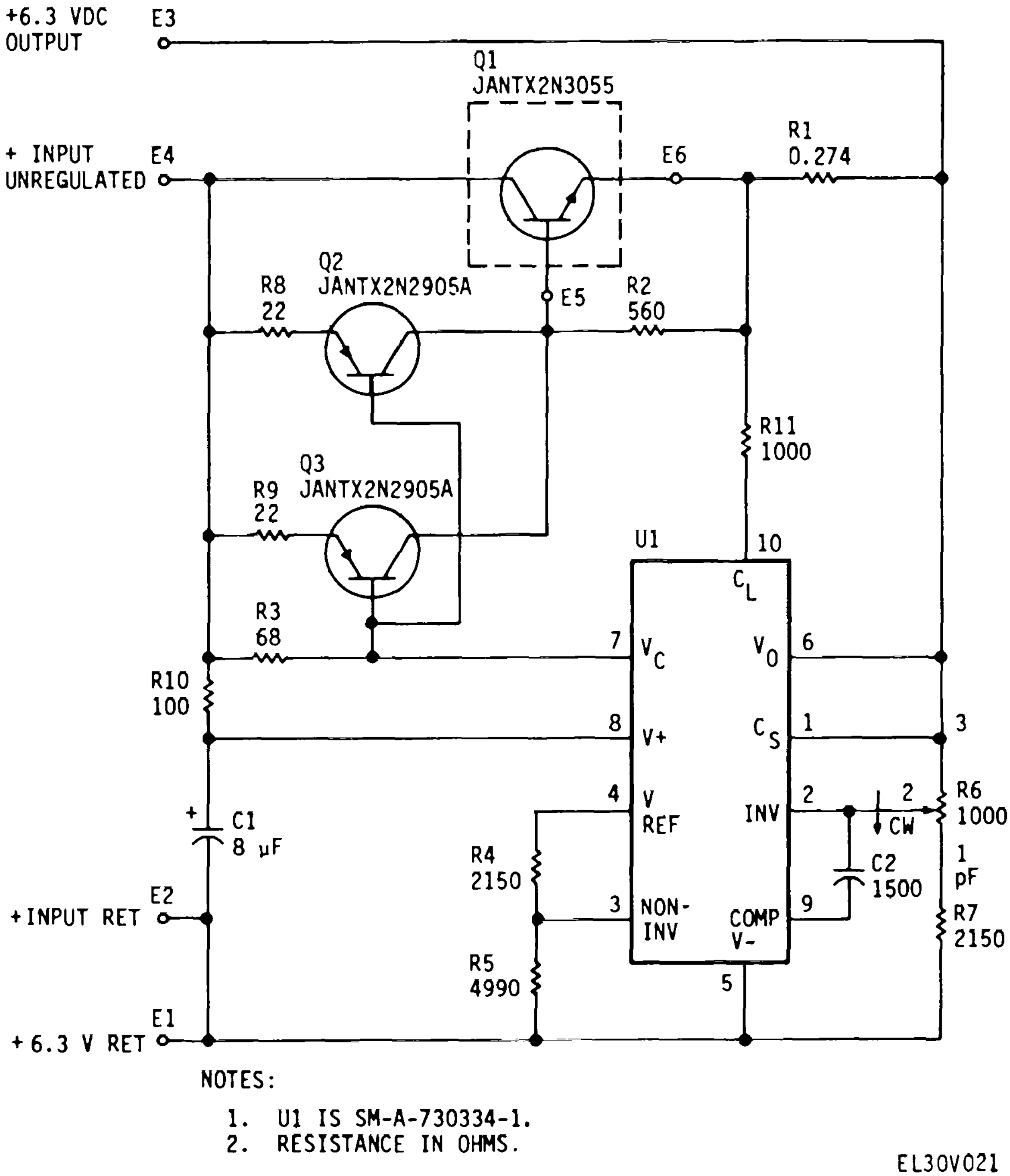
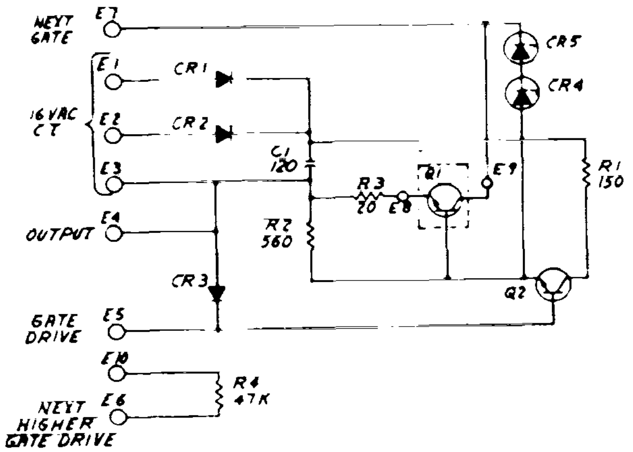


Figure 2-20. +6.3 V regulator 1PS1A1, Schematic Diagram

d. Gate Assemblies (fig. 2-21). Five gate assemblies (A2, A3, A4, A5, A6) are used between the high voltage bridge rectifier (on A7) and the 1000 V regulator A9. Each gate consists of a series pass transistor Q1 and an emitter follower driver Q2. Maximum gate voltage (360 V) is set by Zener diodes CR4 and CR5. Diodes CR1 and CR2 and capacitor C1 provide the bias voltage (about 10 V) for the gate. Resistor R4 is connected in series from gate to gate so that equal voltage drop per gate Is provided from the bridge rectifier to the 1000 V regulator (A2R4 is connected to A7E4 and A6R4 is connected to A9E1 I1, the return line of the 1000 V regulator). Normally this voltage drop is about 60 V per gate but during breakdown (short on 1000 V line) the voltage drop may be as high as 300 V per gate. This is why five gates are used.



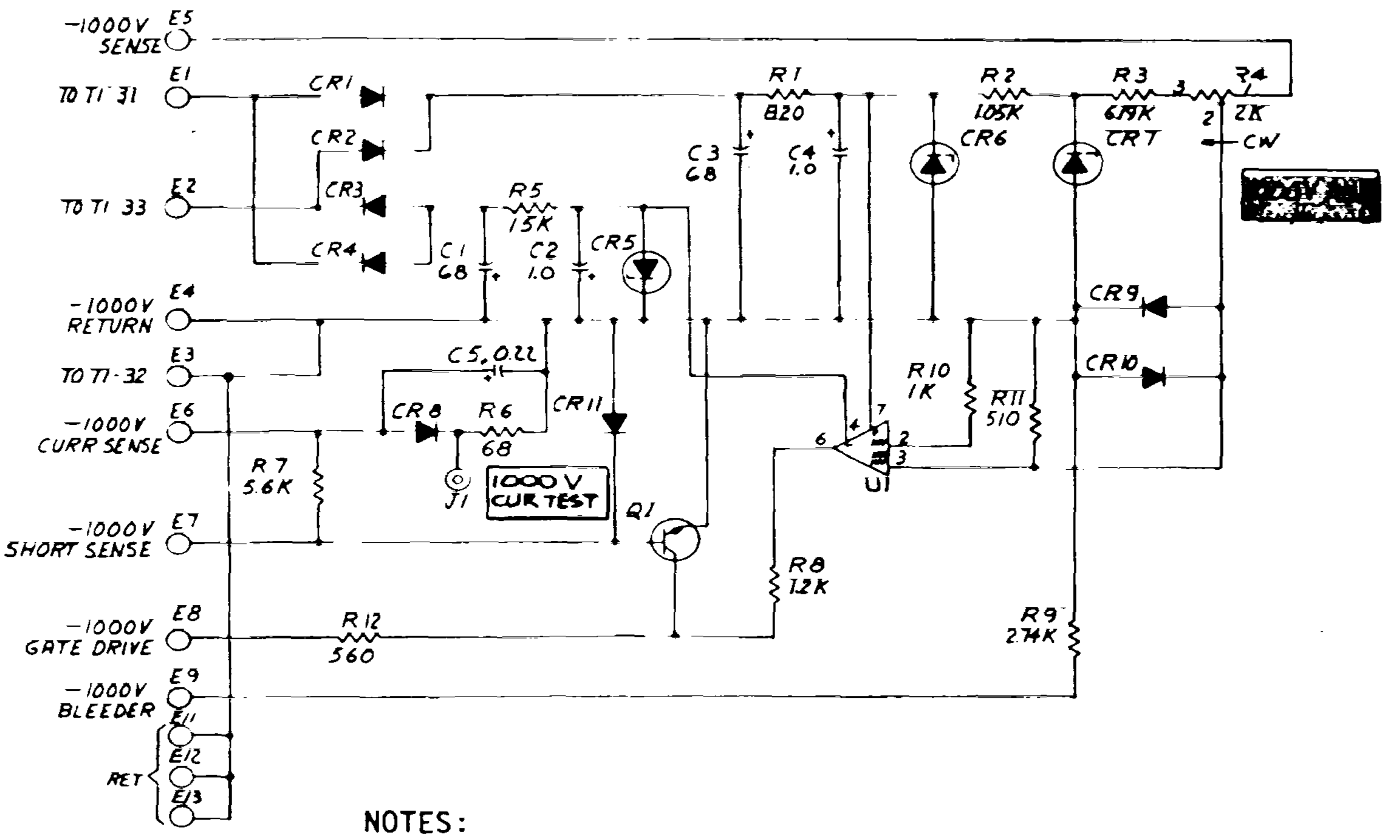
NOTES:

1. CR1, CR2, CR3 ARE 1N4245.
2. CR4, CR5 ARE 1N3050B.
3. Q1 IS 2N5159.
4. Q2 IS 2N2219A.
5. RESISTANCE IS IN OHMS.
6. CAPACITANCE IS IN μF.

EL30V022

Figure 2-21. Gate Assembly 1PS1A2-A6, Schematic Diagram

e. - 1000 V Regulator and Protect Circuit IPSIA9 (fig. 2-22). The voltage from T1 at E1 and E2 of A9 is about 48 Vac (center tapped at E3). The rectified voltage is about 30 V. Zener diodes CR5 and CR6 reduce this voltage to 15 V and + 15 V, the operating voltage required by integrated circuit operational amplifier Z1. Zener diode CR7 reduces the voltage to 6.2 V, the reference voltage. Diodes CR9 and CR 10 protect Z1 from excessive voltage. Capacitor C5 and diode CR8 compensate for drift in the base voltage at transistor Q1. A small fraction of the output voltage (1000 $\pm$ 50 V) is sensed across variable resistor R4 (1000 V ADJ). The voltage across R4 varies from about + I V at one end to about I V at the other end. The wiper arm (1000 V AD1) is set the null point. The positive end of R4 is connected to the 6.2 V reference voltage through resistor R3. The wiper arm of R4 is connected to the noninverting input of Z1 while the inverting input is connected to ground, the 1000 V return line. Any error voltage is amplified in Z1, which has a gain of 50 dB or more. The output of Z1 drives the lowest potential gate, IA6, through A9 terminal E8 to A6 terminal ES, to correct the output voltage to the desired value (wiper arm at voltage null). If the output current becomes excessive (about 125 ma) the output drive (at E8) to gate A6 is reduced because Q1 starts conducting and removes drive power. Thereafter the output current is limited to about 20 ma. This protects the power supply under sustained short circuit in the high voltage line.



NOTES:

1. ▭ INDICATES PANEL MARKINGS.
2. RESISTANCE IS IN OHMS, CAPACITANCE IS IN µF.
3. CR1 - CR4, CR8 ARE 1N4245.
4. CR5, CR6 ARE 1N956B.
5. CR7 IS 1N827.
6. CR9 - CR11 ARE 1N4184.
7. Q1 IS 2N2219A.
8. U1 IS SM-A-730333.

EL30V023

Figure 2-22. - 1000 V Regulator and Protect Circuit 1PS1A9, Schematic Diagram.

f: Resistor Board A8 (fig. 2-23). Resistor board A8 is a convenient mounting board for resistors required by A9 circuits. The high voltage terminals are on AS. Terminals El/E8 of A8 are the 1000 V output to J1, terminal M (fig. 2-18). Resistors R1, R2, R3, and R4 provide part of the voltage divider for the -1000 V output from which the error voltage (A9R4, 1000 V ADJ) is picked off. Resistors R5, R6, R7, and R8 are bleeder resistors to discharge capacitors when power is turned off. These resistors are in series with A9R9. The voltage drop across R9 is 0.01 that of the output voltage. Resistors R9, R10, and R11 provide a bias voltage at the base of A9Q1 in the current sense circuit. Resistor R12 and capacitor R5 feed back any ripple voltage to the error sense circuit of A9R4. This has the effect of canceling ripple voltage.

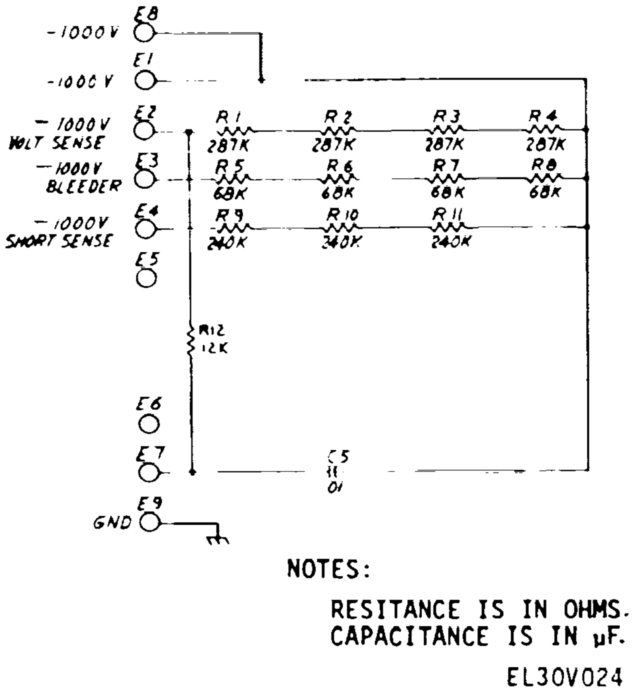


Figure 2-23. Resistor Board 1PS1A8, Schematic Diagram.

2-20. Remote Control and Monitoring Circuits

a. Remote Control/Monitor Assembly 3A1 (fig. 2-24). Remote Control/Monitor Assembly 3A1 consists of two meters (M1, M3) operated in parallel with CRYOGENIC TEMP meter 1M1 (one for each channel), two meters (M2, M4) operated in parallel with PARAMP ELAPSED TIME meter 1M3 (one for each channel), and a split pushbutton switch (S1) assembly (CHIANNEL SELECT) that permits the operator to switch control voltage (28 ± 3 Vdc) to Waveguide Switches 3A2 and 3A3 and contains indicating lamps that identify the circuit (Channel I or Channel 2) in use. Serial No. 001, in addition, contains a toggle switch (S2) (NOISE DIODE) that permits the operator to switch 28 V to a diode noise generator in assembly 3A13 (used in Serial No. 001 only), thereby generating a noise signal that is supplied to the standby channel through Waveguide Switch 3A2 port 3. All meters and switches are panel mounted. Primary power to Assembly 3A1 is 28 d 3 Vdc, which is supplied from an external source, not part of the AM-6602/MSC-46(V) system.

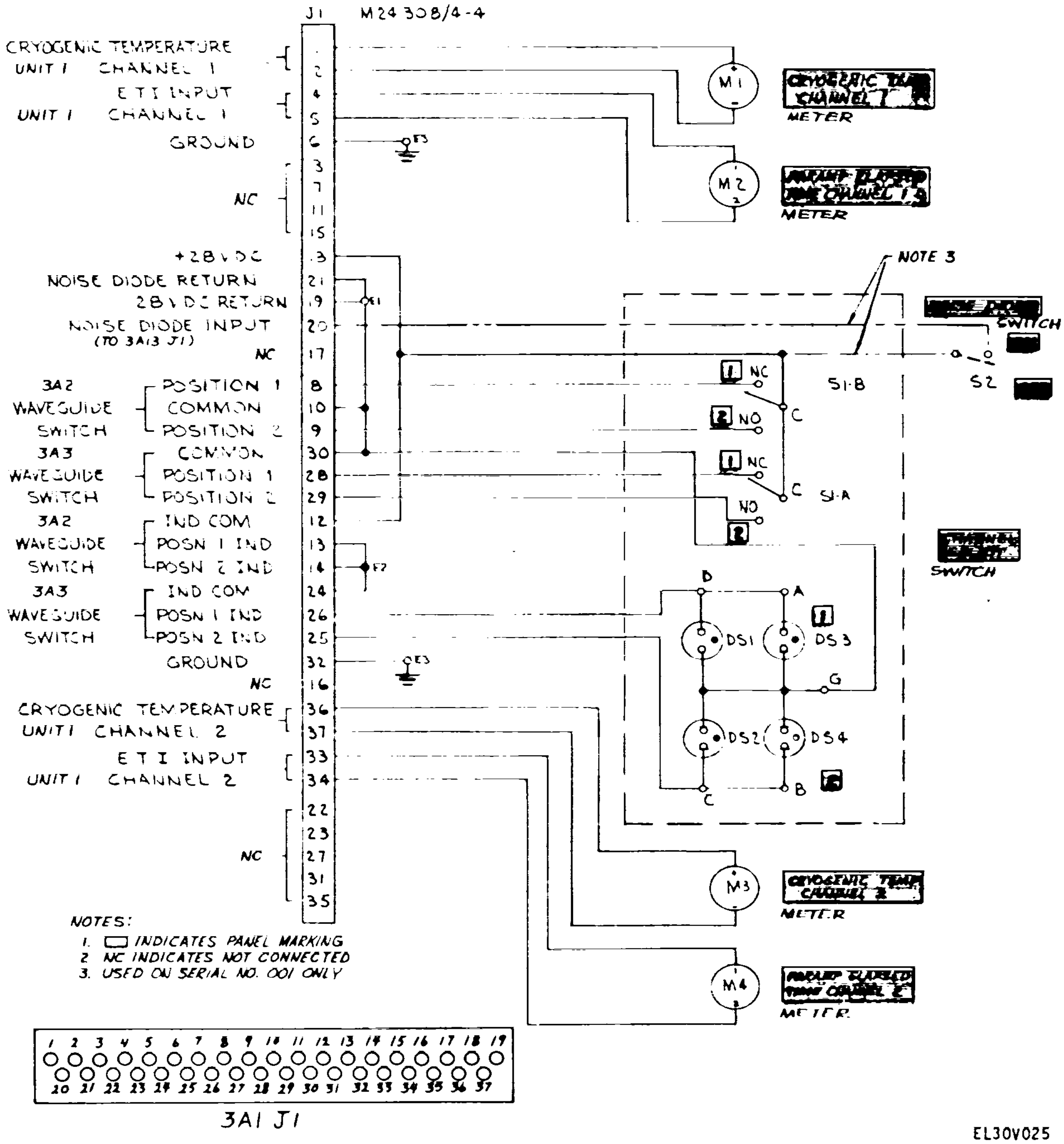


Figure 2-24. Remote Control/Monitor Assembly 3A1, Schematic Diagram.

b. Waveguide Channel Switching and Monitoring (fig. 2-25). Waveguide switching *is* accomplished by the use of 28-V drive motors in Waveguide Switches 3A2 and 3A3. To prevent the generation of RF noise by hysteresis or other means, the drive voltage (28 V) is removed from the motors when the switching is complete; that is, when the Waveguide Switches have latched into position. There is no neutral position; the Waveguide Switches are in either position I[(Channel 1 operation) or position [i (Channel 2 operation). The indicating circuit, however, is continuously energized since this circuit does not contain a component capable of generating RF noise.

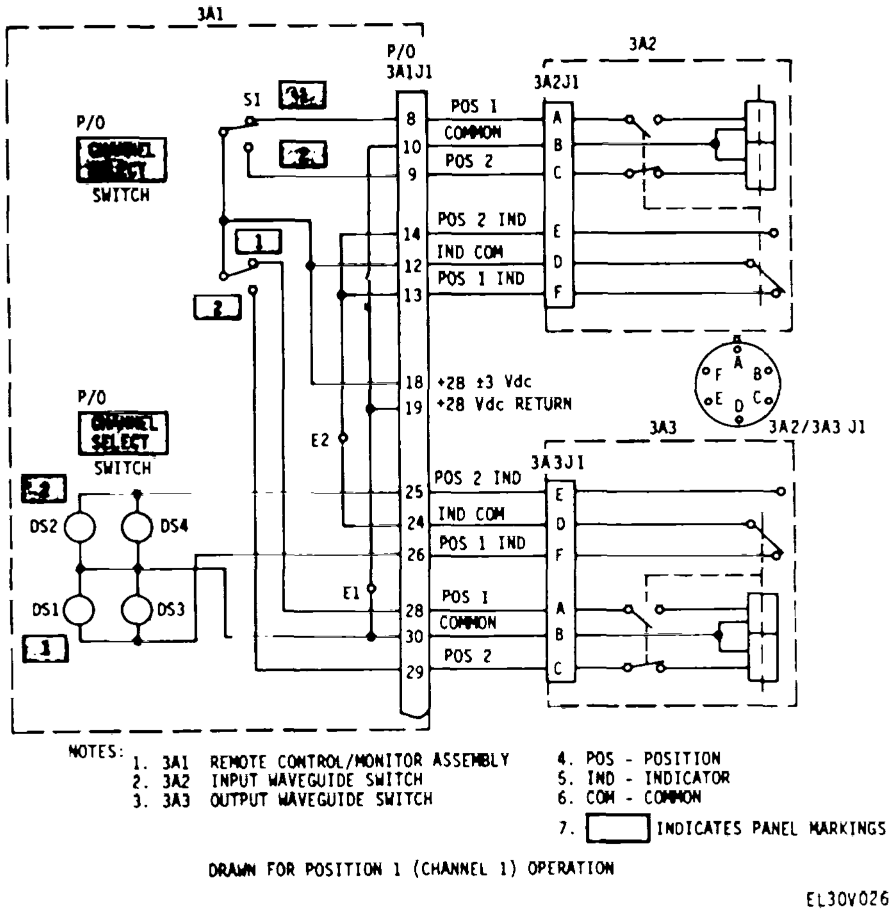


Figure 2-25. Waveguide switching Circuit, Schematic Diagram.

c. Noise Signal Generation. Noise signal generation equipment, 3A13, is included with Serial No. 001, Remote Control/Monitor Assembly 3A I. Assembly 3A13 is divided into three subassemblies:

3 A 13 AI directional coupler (WR 112 size)

3A13A2 coax-to-waveguide transition

3A13A3 solid-state noise generator

The directional coupler (3A13A1) is mounted on port 3 of Waveguide Switch 3A2. The solid-state generator (3A13A3) is a diode mounted in a coaxial structure. The transition (3A13A2) is used to connect 3A13A3 to 3A13A1 at the decoupled port. The "thru port" of 3A13A1 is available for connection to other waveguide test equipment. When the diode is activated by the application of 28 ± 3 Vdc, a noise spectrum covering the frequency passband of AM-6602/MSC-46(V) is generated and supplied to the standby channel. NOISE DIODE switch 3A1S2 on Serial No. 001, Remote Control/Monitor Assembly 3AI (fig. 3-5) controls the 28-V power to 3A13A3.

CHAPTER 3
DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

Section I. GENERAL

3-1. Introduction

a. Direct Support Maintenance Requirements. Direct support personnel shall isolate faults in Amplifier, Parametric AM-6602/MSC-46(V) (in dual channel installation) to a replaceable module or part in Units 1, 2 and 3 and shall remove and replace the faulty item. In Unit 1, faulty parts shall be removed and replaced except for circuit card assembly 1A1 (Temperature Monitor) and Klystron Power Supply I PS I, which shall be removed and replaced as subassemblies. In Unit 2, Modules 2A1, 2A2, 2A3, and 2A4 shall be removed and replaced, if faulty. In Unit 3, faulty parts of 3A1 shall be removed and replaced; all other Unit 3 subassemblies-3A2, 3A3, 3A4, 3A5, 3A6, 3A7, 3A8, 3A9, 3A10, 3A11, 3A12-shall be removed and replaced as necessary. In addition, an apparent fault in AM-6602/MSC-46(V) may be isolated to a fault in Unit 4 or to a fault in primary power input. Correction of these two types of faults is not discussed in this manual.

b. Outline of CHAPTER 3 Material Voltage and resistance measurements for Unit I are given in paragraph 3-2, and for subassembly 3A1, in paragraph 3-3 Tools and test equipment are listed in paragraphs 3-4 and 3-5, respectively. Fault isolation to a replaceable module or part is described in paragraph 3-6. A diagnostic chart is provided as the principal aid in troubleshooting. Gain and bandwidth RF test procedures are described in paragraph 3-7. RF tests of waveguide assemblies are given in paragraph 3-8. Pump frequency and power RF tests are given in paragraph 3-9. Main power failure troubleshooting is discussed in paragraph 3-10 Removal and replacement of Modules 2AI, 2A2, 2A3, 2A4, subassembly IPSI and Unit 3 waveguide assemblies (3A2 through 3A12) are described in paragraph 3-1 1. System interconnections (cable) are illustrated in paragraph 3-12.

3-2. Unit 1 Voltage and Resistance Measurements

a. Introduction. Faults in Unit I can be isolated to a replaceable part or subassembly by the use of system monitors and a multimeter to measure voltages and resistances. The diagnostic troubleshooting chart (para 3-6) is a principal aid in isolating faults to Unit I part level. The chart requires that some voltage checks be made in addition to those provided by the system monitors. When a fault is apparently located, either a voltage check or a resistance check of the suspected part will confirm its operability. Always check the part to ensure that it is faulty before removal. Voltage checks are made with all cables connected (to J1, J2, J3) and the POWER switch and circuit breakers (REFRIG, PARAMP, MAIN) set to ON; that is, with normal operating power. Resistance checks are made with all cables removed (from J1, J2, J3) and Klystron Power Supply connector P1 disconnected.

b. Parts Identification. Unit I parts layout is shown in figures 3-1, 3-2 and 3-3. Principal areas for separate voltage-resistance checking are the five E1 resistors (RI, R2, R3, R8, R9) connected to tie points E1-1 through E1-10, on terminal board E1, the vacuum gage circuit for M2 connected to tie points E1-16 through E1-22, circuit card assembly Al including socket connector labeled j4 (fig. 2-17), and circuit breakers CBI and CB2. The system monitors (meters M1, M2, M3, M4, MS, switches S2, S3, panel lamps DSI, DS2, test points J5, J6) are used to check the remainder of the circuit.

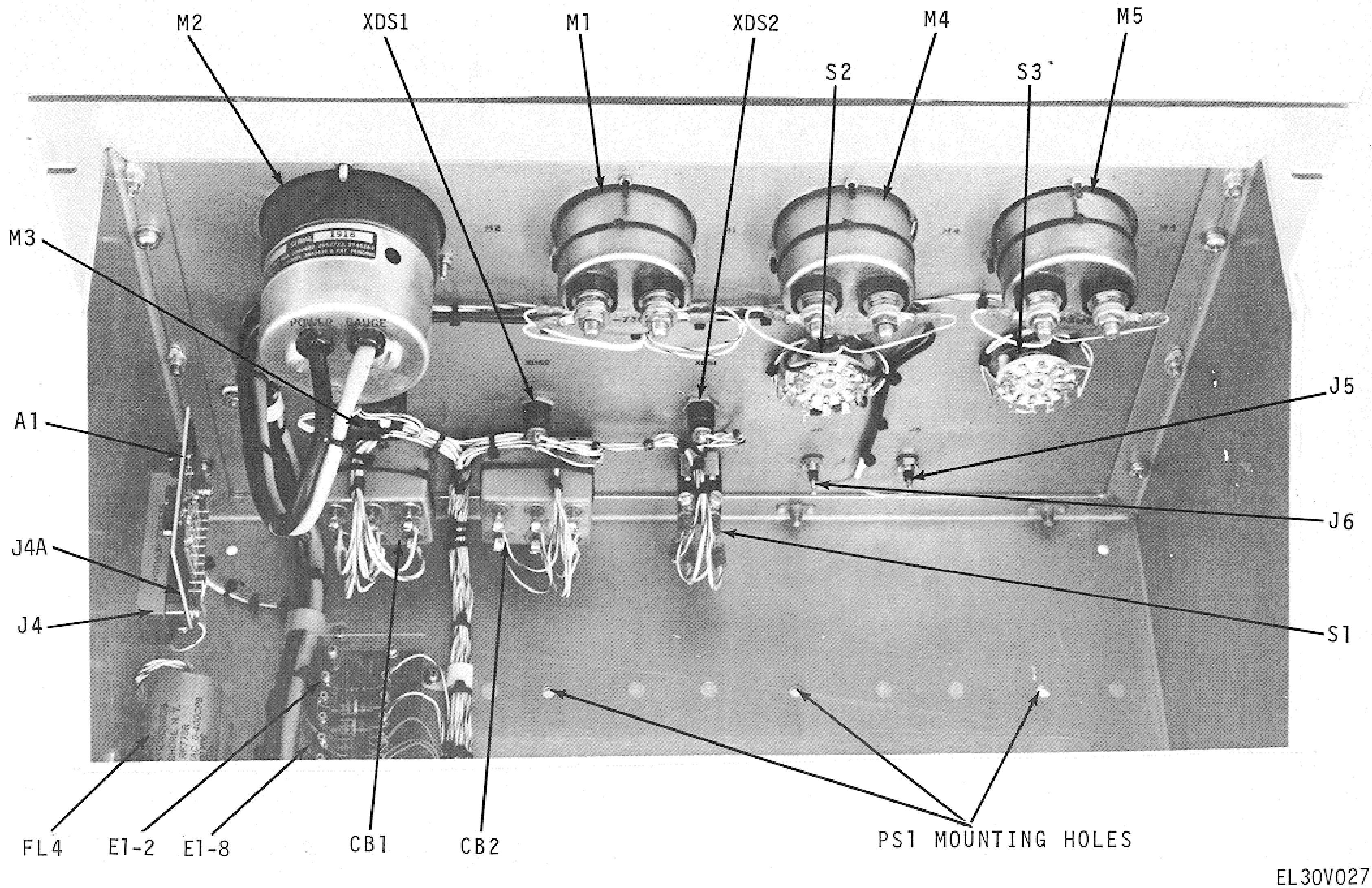


Figure 3-1. Unit 1 Parts Layout, Rear of Front Panel View.

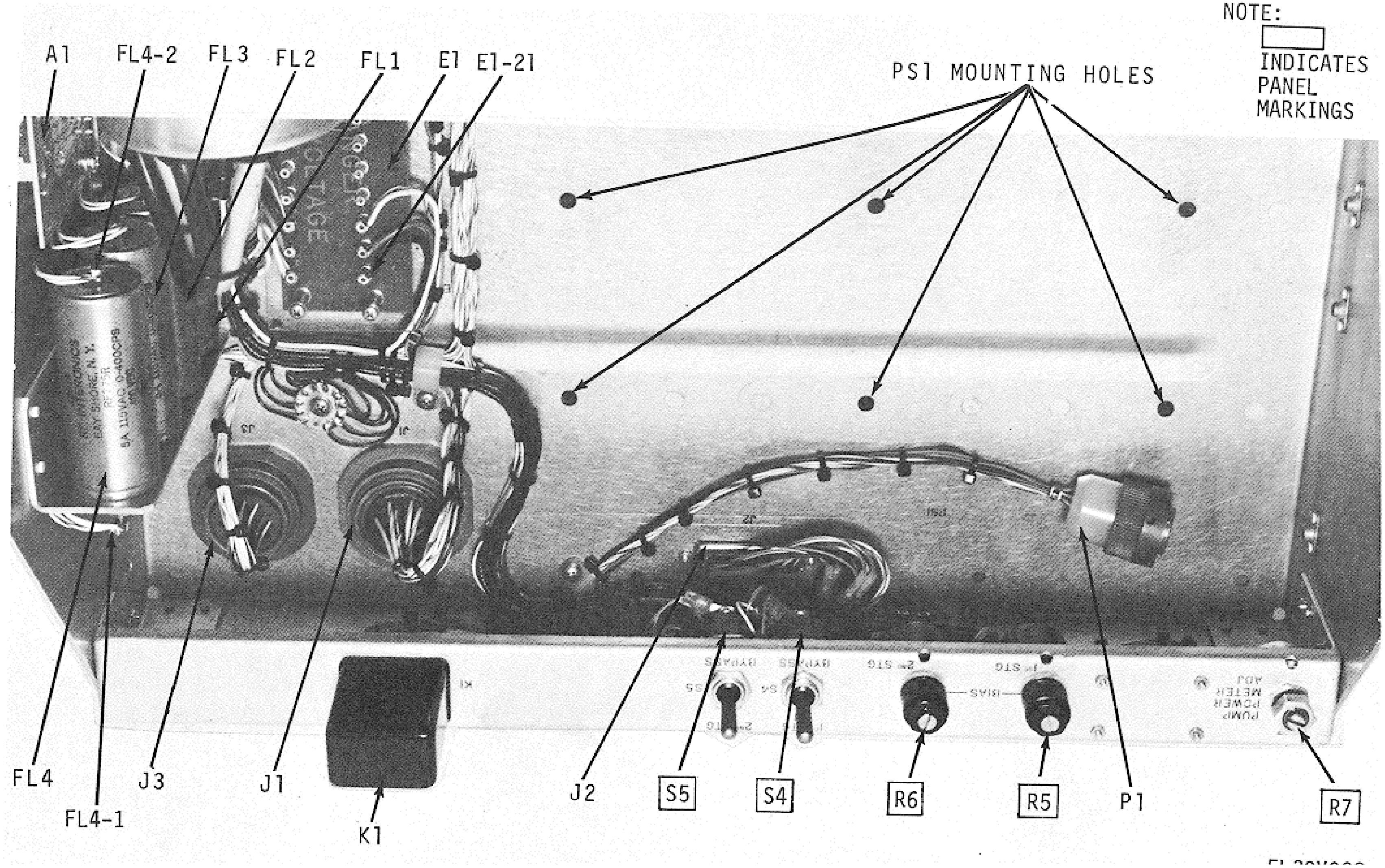


Figure 3-2. Unit 1 Parts Layout, rear of Chassis View.

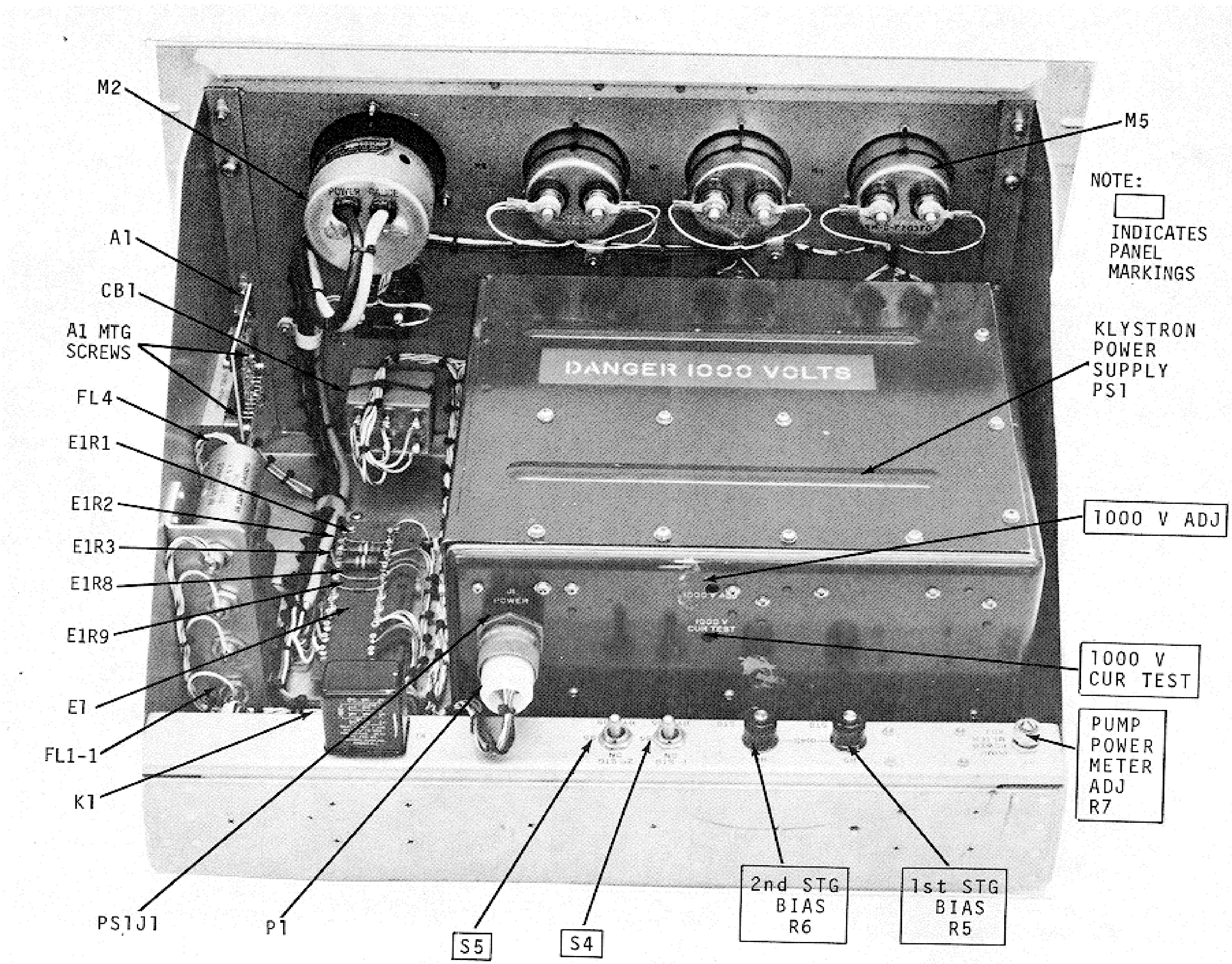


Figure 3-3. Unit 1 Parts Layout, Overall View.

c. Terminal Board El.

WARNING

Voltages dangerous to life exist in Unit 1.

(1) For convenience 22 tie points-(fig. 2-17) are mounted on terminal board El that is mounted to the chassis on standoffs (fig. 3-3). A clear plastic card is mounted on standoffs above the terminal board to protect personnel Seventeen of the 22 tie points on E1 are used **(**fig. 2-10, 2-15, 2-16). Tie points E1-1 through E1-10 are used to mount resistors EIRI, EIR2, EIR3, E1R8, and E1R9 respectively, as shown in figures 2-10, 2-15 and 2-16. Tie points E1-16 through E1-22 are used as connecting points for VACUUM meter M2 circuits.

(2) The ac voltages listed in the chart below can be measured at tie points EI-16 through El-22. Normal operating voltages shall be applied to Unit 1 (para 3-2a). Be careful to avoid contact with dangerous voltages. Measurements are given for three conditions: normal operational voltages, voltages that occur when Vacuum Vessel Module 2A3 is at atmospheric pressure (no vacuum), and voltages that occur when an open circuit exists between VACUUM meter M2 and the vacuum gage circuit 2A3J2 (cable open-WIP4 not connected to 2A3J2).

El Tie Points	Normal Operation volts, ac	Atmospheric Pressure in Module 2A3 volts, ac	Open Circuit (WIP4 Removed from 2A3J2) volts, ac
20-22	0	0	0
20-21	0.2 ± 0.02	1.2 ± 0 1	0
21-22	0.2 ± 0.02	1.2 ± 0 1	1 2 ± 0 I
19-22	0.2 ± 0.02	1.2 ± 0 1	0
19-21	0	0	0
19-20	0.2 ± 0.02	1.2 ± 0 1	1 2 ± 0 1
17-18	120 ± 12	120 ± 12	120 ± 12
16-18	120 ± 12	120 ± 12	120 ± 12
16-17	0	0	0

(3) At tie points E1-1 through E1-10, the voltage and resistance in the chart below can be measured. For voltage measurements, normal operating voltages shall be applied (para 3-2a). Exercise care to avoid contact wit} dangerous voltages. For resistance measurements, first disconnect all cables to Unit 1 and disconnect P1 from PS1J1.

NOTES

1. Voltages at E1 tie points 3-4 and 5-6 increase about 10 V when S2 is set at BEAM. Listed voltages are for S2 set at OFF.
2. Listed voltage is for S2 set to BEAM. When S2 is set to OFF voltage is 27.5 ± 3 V.
3. Listed resistance is for S2 set to OFF. When S2 is set to BEAM, resistance is 11 ± -1 kilohms.
4. With S4 and S5 set to BYPASS, measure 1 ± 0.1 kilohms from J4, pin K to E1-8 (R5 measurement) and to E1-10 (R6 measurement).

E1 Tie Points	Voltage volts, dc-	Resistance 4 kilohms
9-10	6 ± 0 1	0 75 ± 0 1
7-8	6 ± 0 1	0 75 ± 0 1
5-6	500 ± 50[1]	510 ± 35
3-4	500 ± 50[1]	510 ± 35
1-2	10 ± 0.5[2]	30 ± 1.5[3]

d. Temperature Monitor Card A 1.

WARNING

Voltages dangerous to life exist in Unit 1.

(1) Voltage measurement on A1 shall be made with A1 inserted in its socket J4 and normal power applied to Unit 1 (para 3-2a). Connector pins on the card feed through the card connector so that voltage probes can be inserted into the desired pins (from the top of the chassis) while the card is mounted in J4 (fig. 3-1). When A1 is mounted in J4, pin L is the pin closest to the front panel. Al (and J4) pin layout is as follows: | L | K | J | H | | F | E | D | C | B | A | With a multimeter measure the following voltages:

Pin terminals	K-E	K-C	BF	J-H
volts, dc	-12 ± 0.5	+12 ± 0.5	0 005 ± 0.002	0.07 ± 0 03

(2) Resistance measurements can be made on A1 if A1 is removed from Unit 1. The card is firmly fastened in its socket (J4) by two nylon screws through the pin connector into the socket (fig. 3-3). Remove the screws and pull out the card. The card, if faulty, shall be replaced, not repaired. Measure the following resistance:

Terminals	(kilohms	Terminals	(kilohms)
B-C	3.1 + 0.3	E-J	12 + 2
B-F1	30 + 3	F-H1	500 + 50
B-K	0.08 + 0.08	F-K1	500 + 50
C-F	12 + 2	H-K	8 + 3
C-K	3.1 + 0.3		

Pin Resistance Pin Resistance

CAUTION

The card is aligned to drive CRYOGENIC TEMP meter MI Do not change the settings of A1R6 or A1R12 (fig. 2-9).

e. Meters M1, M4. M5. Meters M1, M4, and M5 can be checked for open circuits or short circuit if diagnostic procedures (para 3-6) indicate a faulty meter. With all power off (para 3-2a) remove leads to one terminal of the suspect meter. With ohmmeter (multimeter) set on X1000 scale, check resistance across meter terminals. If the ohmmeter indicates infinite resistance the meter circuit is open; if it indicates zero resistance, the meter circuit is shorted; if it indicates a small resistance (order of 100 ohms) the meter circuit is likely in satisfactory operating condition.

f *Power Switches.* The diagnostic procedure (para 3-6) requires voltage measurements at the terminals of CB1 (MAIN POWER circuit breaker), CB2 (PARAMP POWER circuit breaker) and S1(REFRIG POWER switch). Terminal layouts are sketched here so that the appropriate terminal (fig. 31) can be easily located. The terminal layout for CB1and CB2 is as follows:

1•	3•	5•
2•	4•	6•

The terminal layout for S1is as follows-

2•	5•
3•	6•

When all power is removed from Unit 1 (para 3-2a) (cable to J1 disconnected) the following resistance checks can be made on CB1, CB2, and SI.

(1) CB1, CB2 Resistance Measurements

Measure across terminals	1-2 (ohms)	3-4 (ohms)	5-6 (ohms)
CB1, CB2 set to ON	O	O	O
CB1, CB2 set to OFF	Infinite	infinite	infinite

(2) S1Resistance Measurements:

Measure across terminals	2-3 (ohms)	5-6 (ohms)
S1 set to ON	0	0
S1 set to OFF	infinite	infinite

(3) CB1 CB2 S2 Voltage Measurements.

WARNING

Voltages dangerous to life exist in Unit I

With power cable connected to J1 the following ac voltages can be measured with a multimeter:

From		To	
FL4-1 (fig 3-21	CBI-2 120 ± 12	CBI-4 120 ± 12	CBI-6 120 ± 12
FtL4-1 CB1 set to OFF CB1 set to ON	CBI-l 0 120 ± 12	CBI-3 O 120 ± 12	CBI-5 O 120 ± 12
FL4-1 CBI set to ON	CB2-2 120 ± 12	CB2-4 120 ± 12	CB2-6 120 ± 12
FL4-1 CB2 set to OFF	CB2-1 O	CB2-3 O	CB2-5 0
FL4-1 CB1/CB2 set to ON	CB2-1 120 ± 12	CB2-32 120 ± 12	CB2-5[1] 120 ± 12

[1]CB2-5 to FL4-1 also measures voltage across DS2-1 to DS2-2
[2]CB2-3 to FL4-1 also measures voltage across M3.

With CB1set to ON and S1 set to OFF measure from
S1-2 to S1-5: 208 ± 21 V
S1-3 to S1-6: O

With CB1set to ON and S1set to ON measure from
S1-3 to 51-6: 208 ± 21 V
S13 to FL4-1: 120 ± 12 V (this is equivalent to measuring DS1Ito DS1-2)

g. Switches S4 and S5. Switch S4 (fig. 3-2) and switch S5 can be checked when all cables to Unit 1(at J1, J2, J3) are disconnected and P1 is disconnected from PSIJI. Make the following resistance checks:

Measure from	S4 **Set to**	S5 Set to	Resistance (ohms)
J5 to E1-8	BYPASS	-	
J5 to E1-8	IST STG ON	-	600 ± 600
J6 to EI-10	-	BYPASS	O
J6 to EI-10	-	2ND STG ON	600 ± 600

CAUTION

Do not change the settings of R5 (BIAS 1ST STG) and R6 (BIAS 2ND STG). If R5 or R6 is reset, then a gain-bandwidth realignment must be performed.

h. Line Filter Voltage Measurements.

WARNING

Voltages dangerous to life exist in Unit 1. The voltage across line filters FL1 FL2, FL3 and FL4 can be measured between terminals I and 2 of each filter (fig. 3-2, 3-3). When CBI is set to OFF the voltage is zero. When CBI is set to ON the (ac) voltage drop will be less than 5 V per filter.

3-3. Remote Control/Monitor Assembly 3A1 Voltage and Resistance Measurements

WARNING

When 1 CB1 and 1CB2 are set to ON this assembly contains dangerous voltages.

a. Display Meters. The meters used in 3A1 to display temperature (M1 and M3) are identical to 1M1 (para *3-2e* and para 2-9*b*) The time totalizing meters (NM2 and M4) are identical to 1M3 (para 2-8c) These 3A1 meters are connected in parallel with the corresponding Unit 1 meters so that indications on Unit 1 front panel and 3A1 front panel are identical When the 3A1 meters do not track the Unit 1 meters then check the 3A1 subassembly. CRYOGENIC TEMP CHANNEL 1 meter M1 and CRYOGENIC TEMP CIIANNEL 2 meter M3 can be checked in the same manner that 1M1 is checked. If the time totalizing meters--1M3, 3A1M2, 3A1M4-do not operate when 120 ± 12 V, 55 ± 8 Hz is applied across their terminals (normal operating voltages when 1CB1 and 1CB2 are set to ON) they should be replaced (para 3-6 and fig 3-6)

b. Parts Layout and CHANNEL SELECT Switch S1. Parts layout of Remote Control/Monitor Assembly 3A1 is shown in figures 3-4 and 3-5. Serial No 001 is shown because it has a toggle switch (S2, fig. 3-5) to switch + 28 Vdc to noise generator 3A13A3 used in Serial No. 001 installation only (para 2-20c). Tie points E1 and E3 are on the bracket mount for connector J1. Subassembly S1 contains several parts including a split pushbutton switch and four indicator lamps DS1, DS2, DS3, DS4. The panel lamps can be separately replaced, when faulty. A defective switch, however, requires replacement of the complete subassembly. With W5P1 connected to J1 and normal operating voltages applied (para *3-2a)* make voltage checks on CHANNEL SELECT pushbutton switch S1 as shown below and **in** figure 3-4: (Also refer to figure 2-24.)

S1 in Position 1 Measure		S1 In Position o Measure	
C to E1:	28 ± 3V	C to E1:	28t 3 v
NO to E1:	0V	NO to E1:	281 3 V
NC to E1:	283V	NC to E1:	OV
G to A:	2873V	G to B:	28t3V
G to B:	OV	G to A:	OV

With cable removed from JI measure the following resistance.

	S1 Terminals	
SI Position	C-NC (ohms)	C-NO (ohms)
1	0	infinite
2	infinite	0

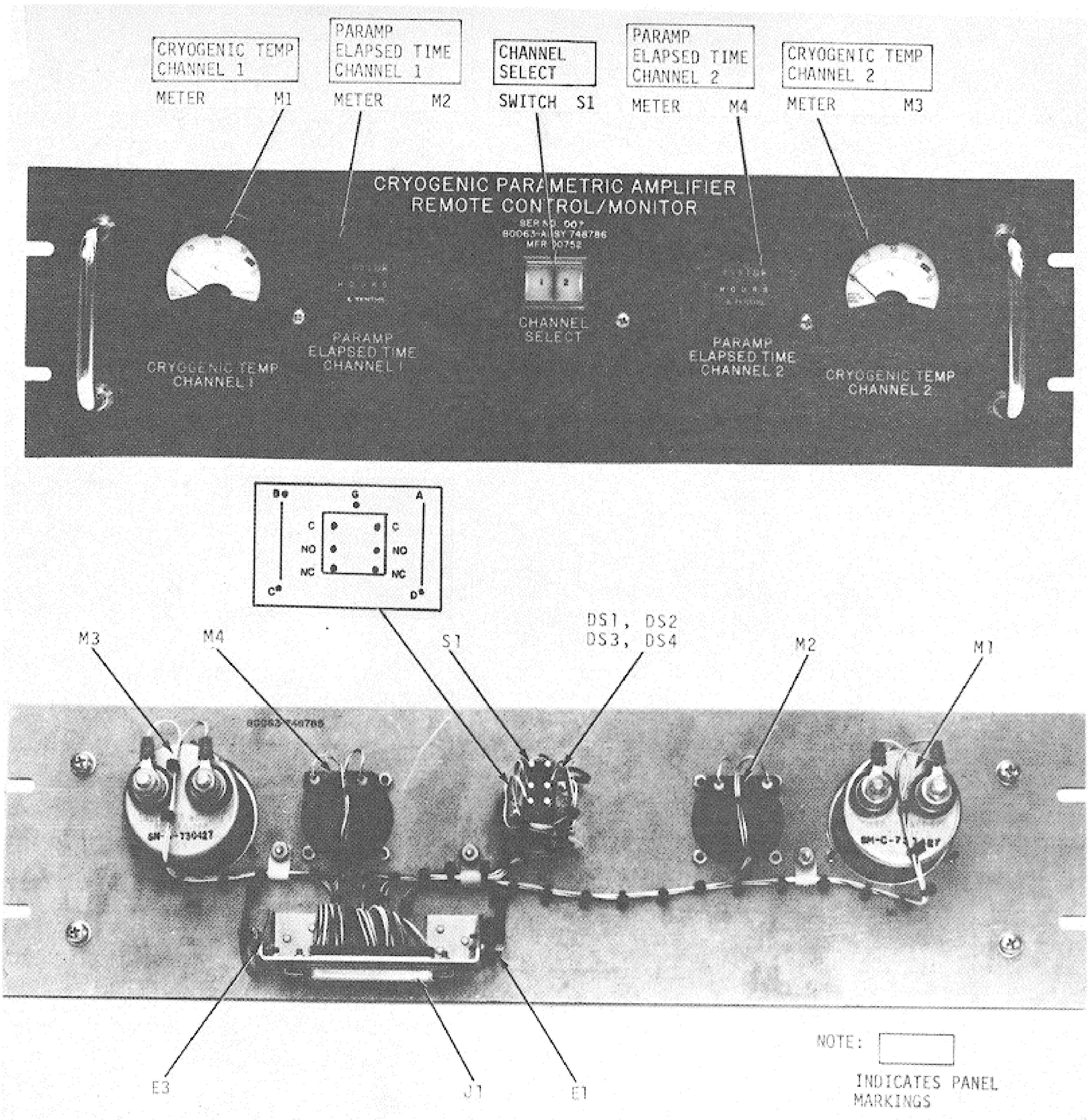


Figure 3-4. Remote Control/Monitor Assembly 3A1 3-8

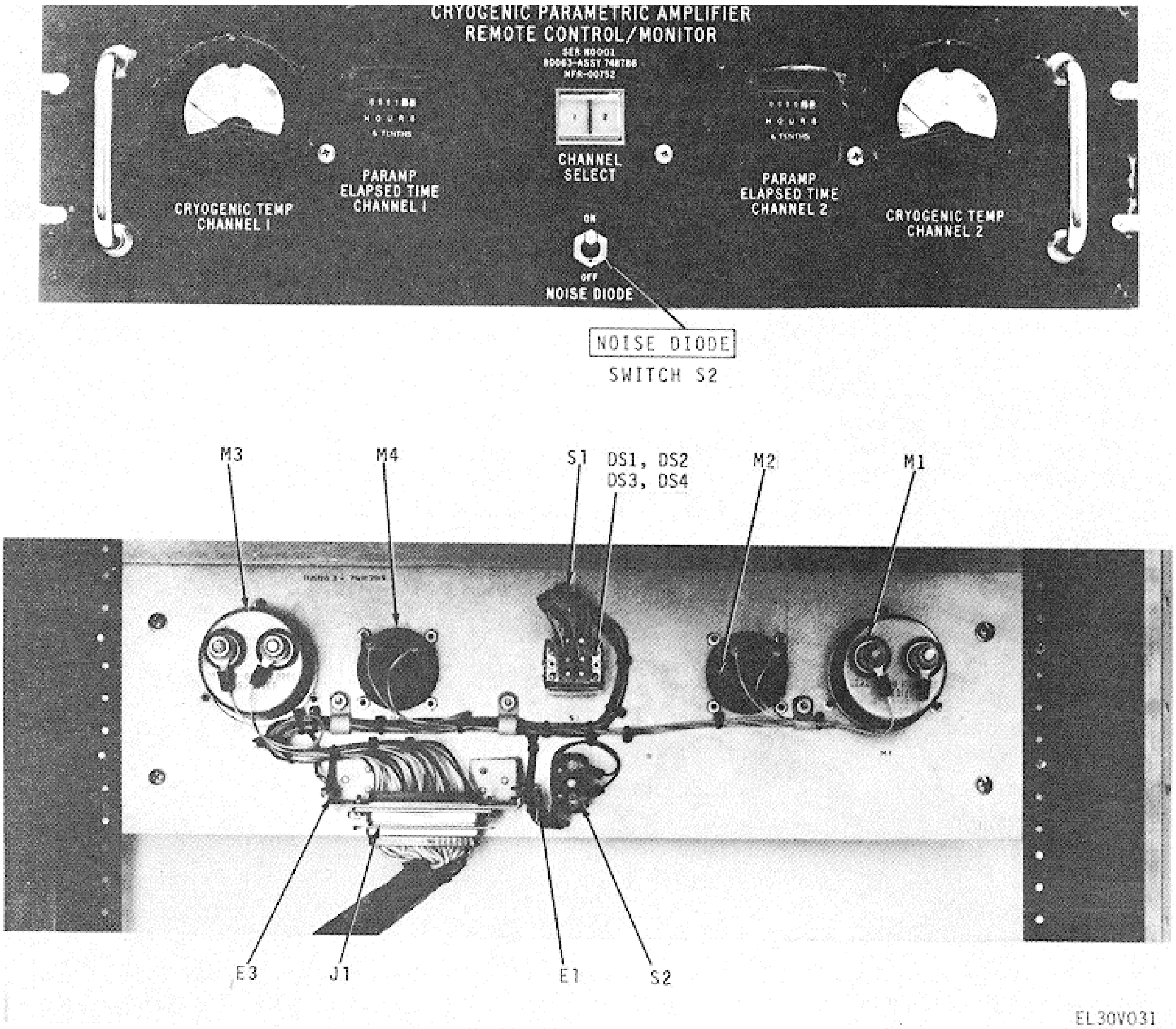


Figure 3-5. Remote Control/Monitor Assembly 3A1, Serial No. 001

Section II. TOOLS AND TEST EQUIPMENT

3-4. Tools

The following tools, as listed in the maintenance allocation chart (MAC) for Amplifier, Parametric AM-6602/- MSC-46(V) and TM 1-5820-801-30P, Direct Support Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts) for Amplifier, Parametric AM-6602/MSC-46(V) (NSN 5895-00-100-4315) are required for direct support maintenance:

Name	Mfr/Model
Operator, valve	80063/SM-C-730301
Pump, vacuum	64484/ 1402
Rubber Tubing, vacuum	11273/18240 size No 11
Kit, Tool, Electronic Equipment TK-100/-G	
Adapter, evacuating and charging,	75629/
Unit 4 Kit, tool, Unit 4	75629/

3-5. Test Equipment

The following test equipments, as listed in MAC, are required for direct support maintenance of Amplifier, Parametric AM-6602/MSC-46(V):

Name	Type Designation	Mfr/Model
Adapter, coax to wave-guide	VG-1054/U	28480OH281A
Attenuator, 20 dB		28480/8491 A
Attenuator, variable	CN-1367/U	28480/H382A
Bridge, power	AN/USM-260	28480/431C
Coupler, 20 dB		*80063/SM-D-748724*
Detector, crystal		28480/420A
Generator, sweep		28480/H01-694C
Meter, frequency	FR-194/U	28480/H532A
Meter, frequency		14059/B551
Mount, bolometer		28480/R486A
Multimeter		60741/630NA
Oscilloscope	**AN/USM-273**	**80009/453**
Termination, RF		14059/B580

Section III. TROUBLESHOOTING

3-6. Fault Isolation

a. Circuits Covered in Diagnostic Flow Charts. Troubleshooting procedures as detailed in the diagnostic flow charts (fig 3-6 and 3-7) are designed to locate and isolate a fault to a replaceable module, subassembly, or component in the signal amplification circuits and the temperature and pressure (vacuum) monitor and control circuits. The faulty item shall be removed from the system and replaced with a spare These circuits comprise Amplifier, Parametric AM-6602/MSC-46(V). The redundancy kit, Unit 3, is not included

b. Unit 3 Subassembles. The redundancy kit, Unit 3, is not directly involved in the troubleshooting procedure because it does not affect the normal operation of the parametric amplifier If, however, a fault is isolated to IMI or IM3, the corresponding 3AI meters (para 3-3a) may be faulty because 3A1 meters are operated in parallel with the Unit I meters. When a IMI or IM3 fault is indicated, remove the cable at 3AIJI. If the fault remains, it is in Unit I. If the fault clears, it is in 3AI, then refer to paragraph 3-3a for procedure. Waveguide assemblies 3A2, 3A3, 3A4, 3A5, 3A6, 3A7, 3A8, 3A9, 3A10, 3AII and 3 A 12 are highly unlikely to cause RF faults unless waveguide interconnections are not tight or unless the waveguides have become physically deformed Refer to organizational maintenance checks and services for interconnection information. Waveguide assemblies or waveguide runs (3A2, 3A4, 3A5, 3A6; 3A2, 3A9, 3A5, 3A10; 3A3, 3A8, 3A5, 3A7, 3A3, 3A12, 3A5, 3AI I) can be measured for insertion loss by the procedure given in paragraph 3-8. Insertion loss per assembly shall be 0. I1 dB or less If a failure occurs in the drive motor or indicator section of Waveguide Switch 3A2 or 3A3, 3AI indicator DSI, DS3, or DS2, DS4 (fig 2-25 and 3-4) will not switch when the unlit half of the 3 A I S I pushbutton switch (CIIANNEL SELECT) is depressed Remove and replace 3A2 or 3A3 Refer to paragraph 3-3h for checkout of 3AISI.

c Diagnostic Flow Charts (fig 3-6 and 3-7)

(1) Initial Conditions. Diagnostic flow charts are presented for two sets of initial conditions: normal (fig. 3-6) and initial start-up (fig. 3-7). Figure 3-6 applies when the system is in operation (one channel operating and one channel in standby) as will normally be the case For this condition the two Unit 1 circuit breakers and power switches (MAIN, PARAMP and REFRIG POWER) are set to ON and Module 2A3 is (or had been) at its ambient environmental conditions internal temperature of 20° $\pm$ 2°K and internal pressure of 40 millitorr or less. Modules 2A2 and 2Ai will be at their normal elevated temperatures. Figure 3-7 applies when Module 2A3 is at room temperature and room pressure and the two circuit breakers and switch (MAIN, PARAMP, REFRIG POWER) are set to OFF. This condition can occur when Module 2A3 has been replaced, or Unit 4 has been out of operation, or when primary power has been shut off for an hour or more. Figure 3-7 could be used also during preliminary adjustment at initial installation The two charts differ in monitor checking procedures because of time delays encountered in start-up procedures while vacuum and temperature equilibriums are being established The time required for Modules 2AI and 2A2 to reach their operating temperatures is less than that required for Module 2A3 to reach its environmental conditions, therefore, when Module 2A3 is ready to operate the other two modules are also ready to operate

(2) Chart Sections. The diagnostic procedure is conveniently divided into two sections the first section utili7es system monitors and a multimeter for fault isolation, the second section utilizes RF signal generation and detection equipment for evaluating system operation and for isolating faults RF tests should not be made until the monitors have been checked Since the two charts differ only in the monitor checking procedures but are the same for RF test procedures, figure 3-7 refers to figure 3-6 for RF test procedures.

(3) Systematic Troubleshooting. The direct-support maintenance technician should always use a diagnostic flow chart for troubleshooting so that a systematic method of fault isolation is maintained. Spot checking at random of the several circuits may or may not isolate the cause of trouble and is therefore not recommended

(4) Chart Use. The diagnostic flow charts (fig 3-6 and 3-7) are designed to test a module, subassembly, or component sufficiently to verify that the item is faulty before it is removed and replaced The charts assume that only one fault has occurred and provide the method of isolating and correcting the fault The technician enters the chart at the upper left comer START and reads from left to right along the top line only, verifying the monitor indications or performing the required test until a fault (no-go condition) is encountered If a fault is discovered he reads down the branch line (top to bottom) performing the tests as indicated until he isolates and corrects the fault This is usually the removal and replacement (R/R) of a component, subassembly, or module but may be a voltage or attenuator adjustment. lie then returns to the top line where he discovered the fault and continues to read and check from left to right If no faults are encountered along the top line of the flow chart, the equipment is satisfactory and no further testing shall be made. No branch (down) line of the flow chart shall be checked unless a no-go condition has been indicated in the top line The primary requirement of the system is to provide 29.5 $\pm$ 1 dB gain over the 7.5 $\pm$ 0.25 GHz frequency range. All other requirements are secondary.

(5) Items Not Checked By Chart. The diagnostic flow charts assume that any malfunction is in a replaceable

part, subassembly, or module and not in the cables or harnesses used for interconnection The charts do not cover point-to-point wiring or interconnection cables, plugs, and connectors. Ordinarily, visual observation for abrasion will indicate possible shorts or opens in the wiring Chassis harnesses can be checked from the schematic diagrams. Refer to paragraph 3-12 for cable interconnections If necessary, perform continuity checks with all power off, that is, with cable W5 not connected to the power sources but interconnected with Amplifier, Parametric AM-6602/MSC-46(V) and all other interconnecting cables (W1, W2, W3, W4) connected.

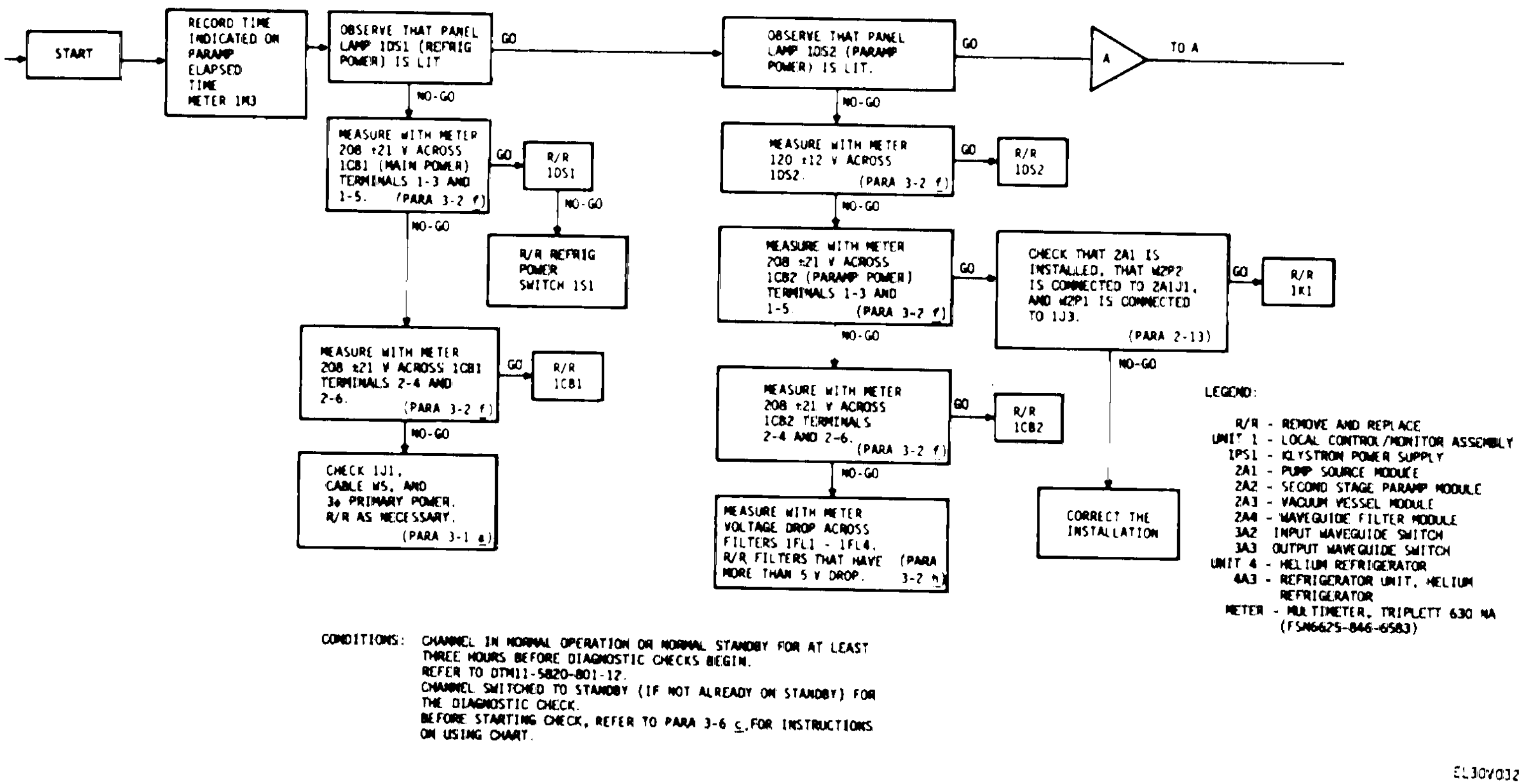


Figure 3-6. Diagnostic Flow Chart for Amplifier, Parametric AM-6602/MSC-46(V) (Sheet 1 of 7).

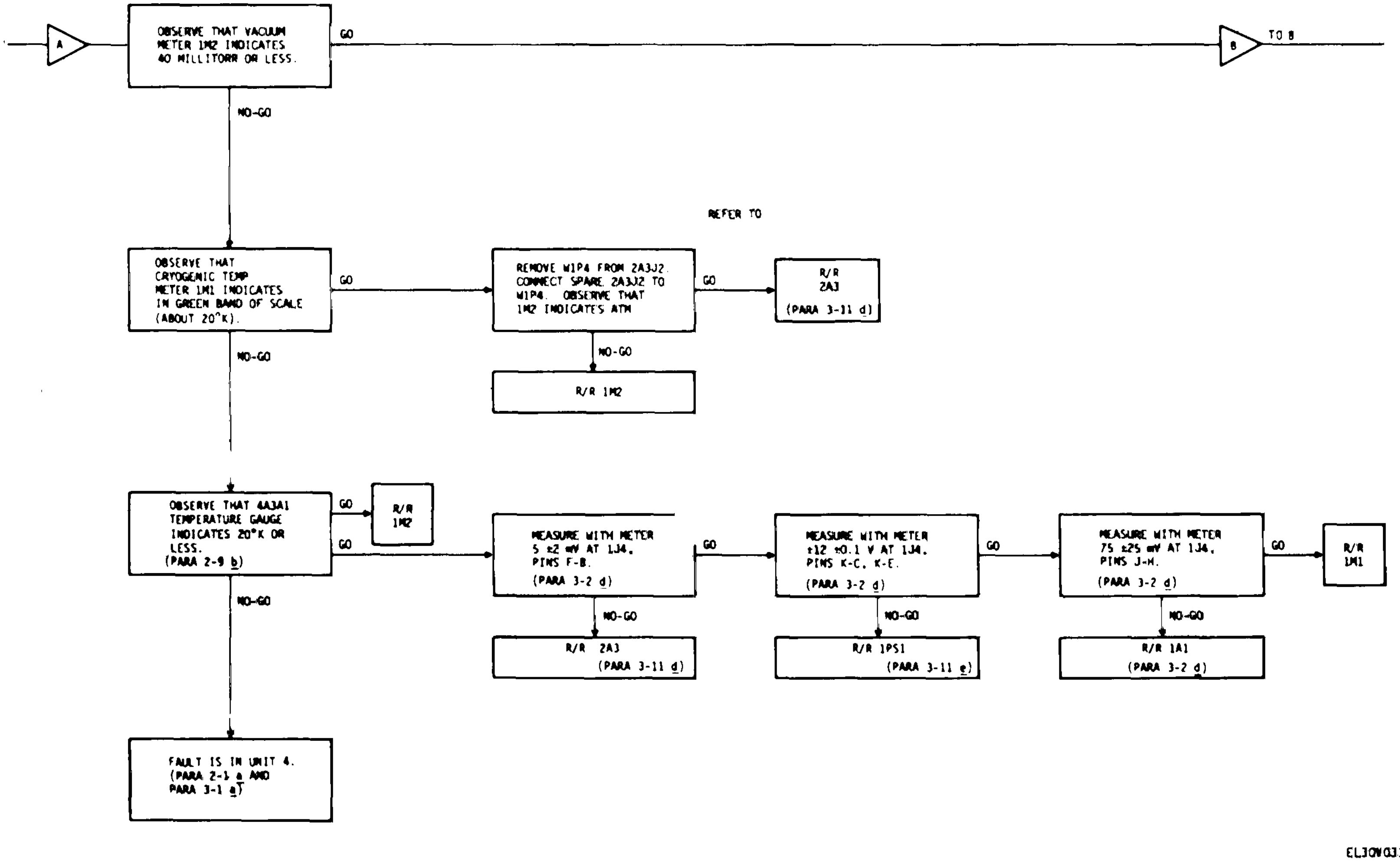


Figure 3-6. Diagnostic Flow Chart for Amplifier, Parametric AM-6602/MSC-46(V) (Sheet 2 of 7).

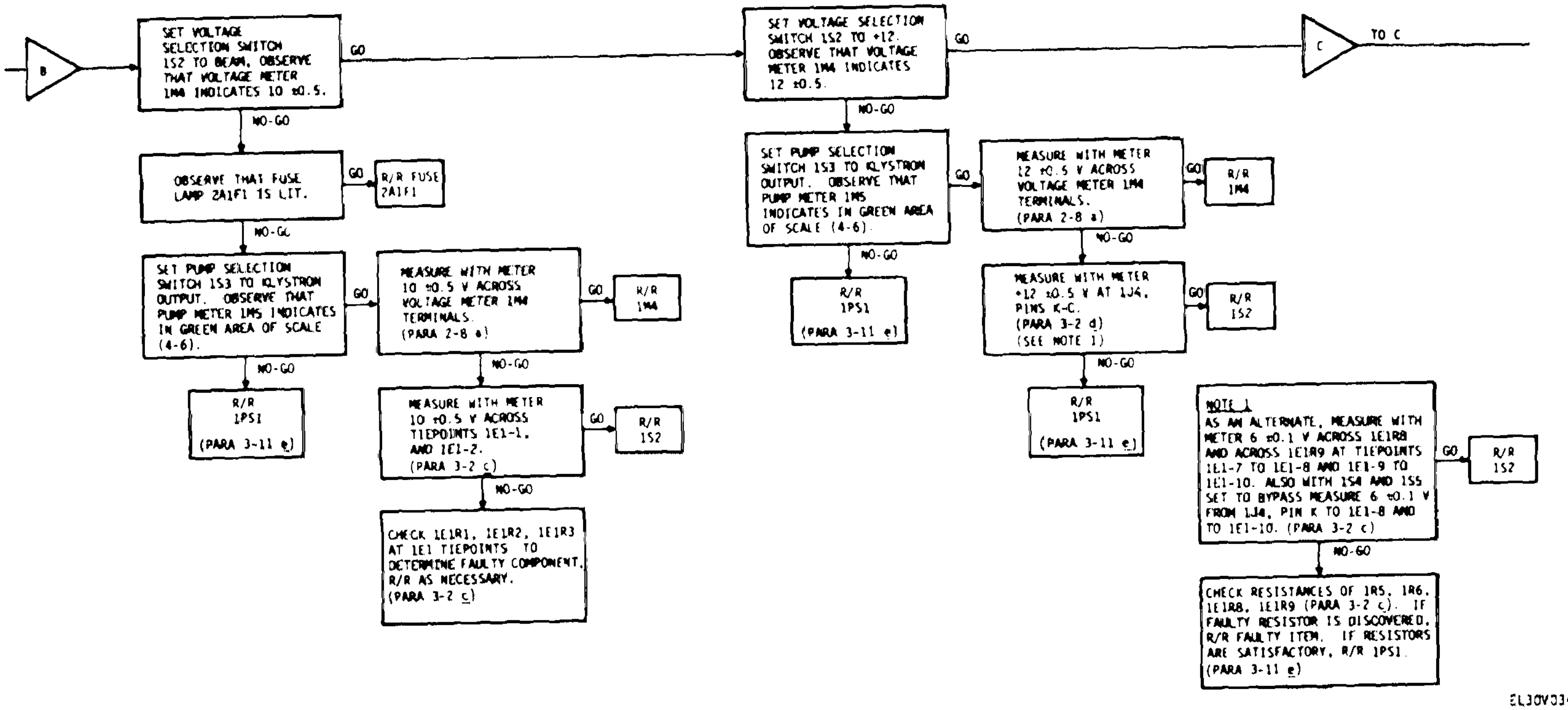


Figure 3-6. Diagnostic Flow Chart for Amplifier, Parametric AM-6602/MSC-46(V) (Sheet 3 of 7).

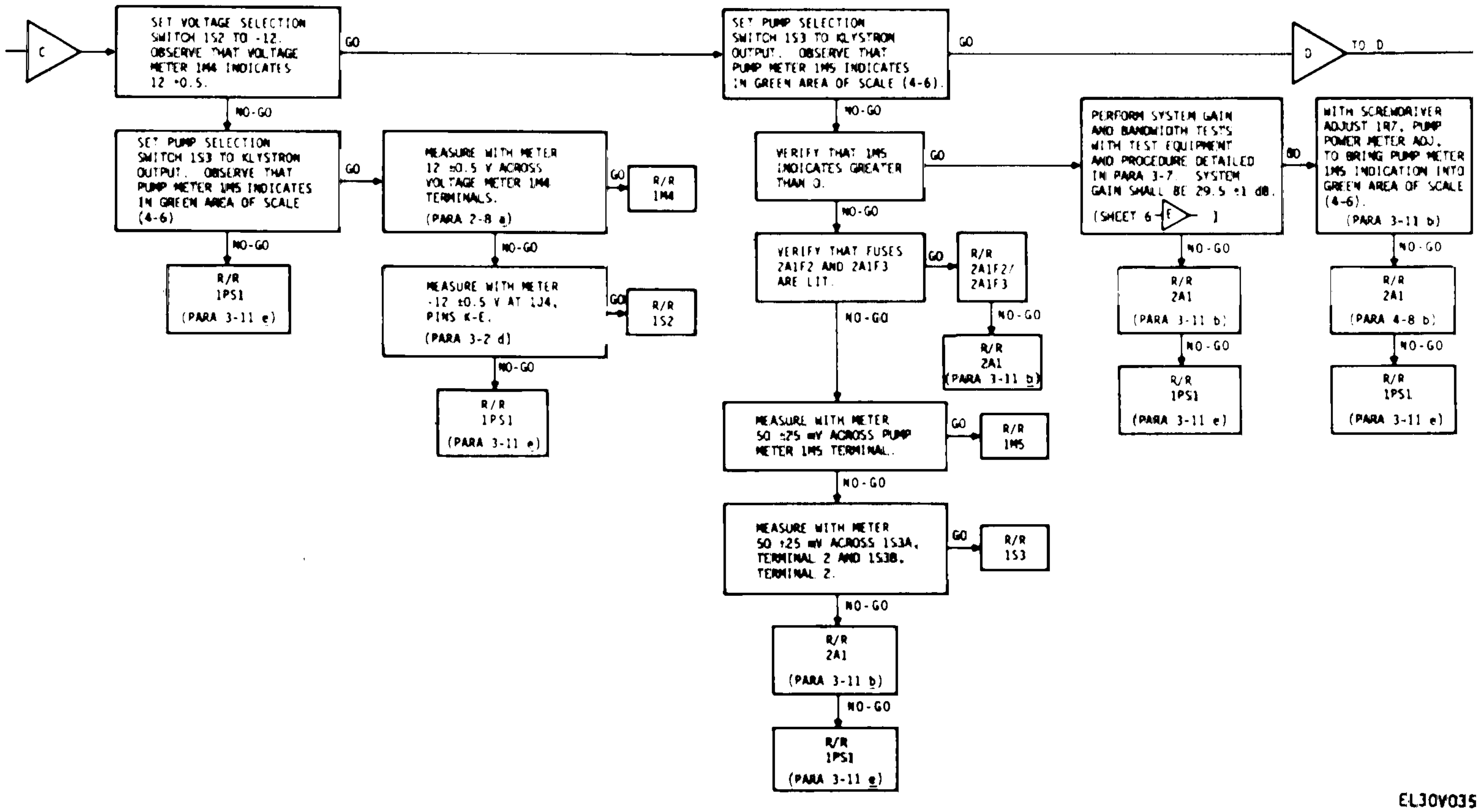


Figure 3-6. Diagnostic Flow Chart for Amplifier, Parametric AM-6602/MSC-46(V) (Sheet 4 of 7).

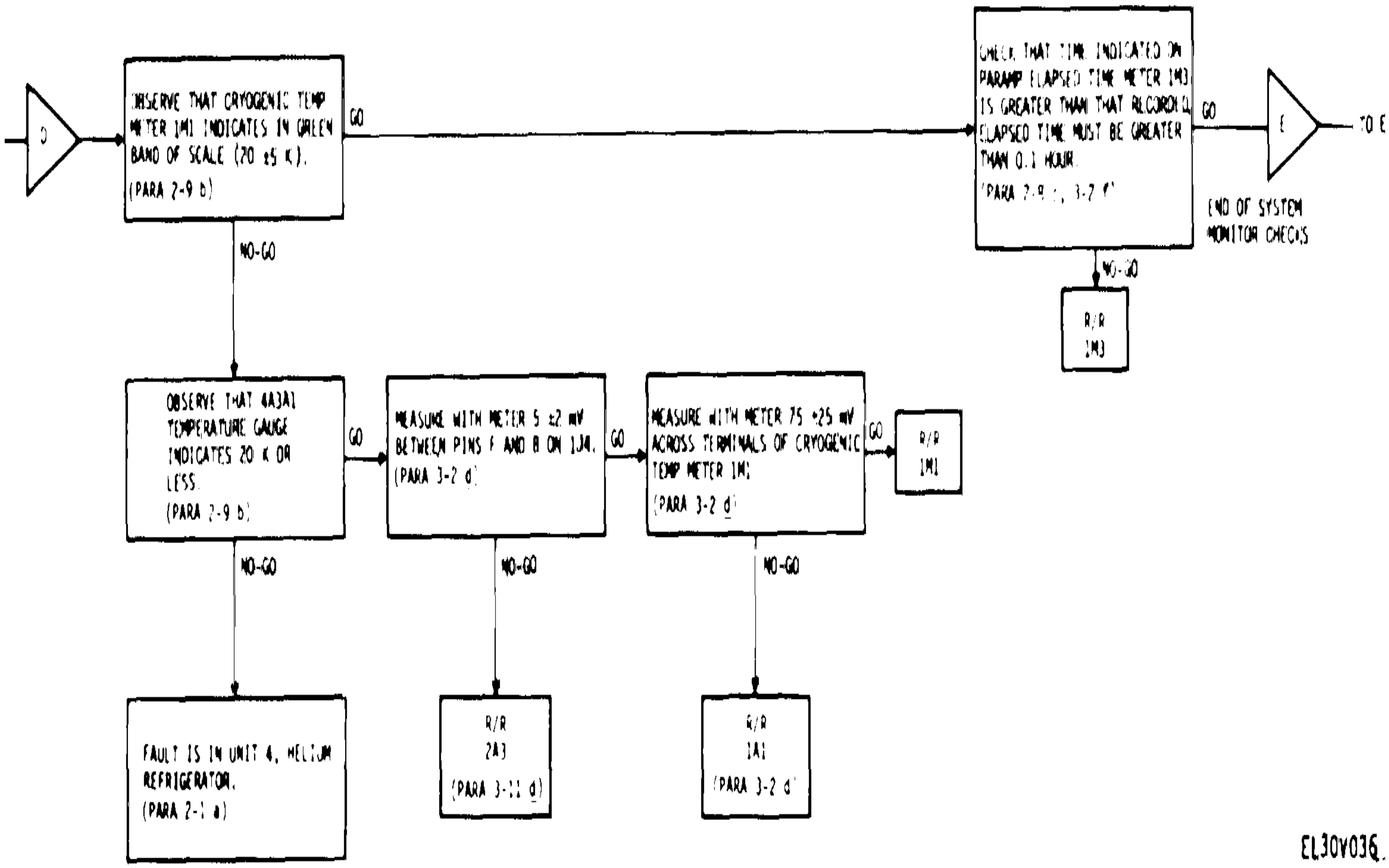


Figure 3-6. Diagnostic Flow Chart for Amplifier, Parametric AM-6602/MSC-46(V) (Sheet 5 of 7).

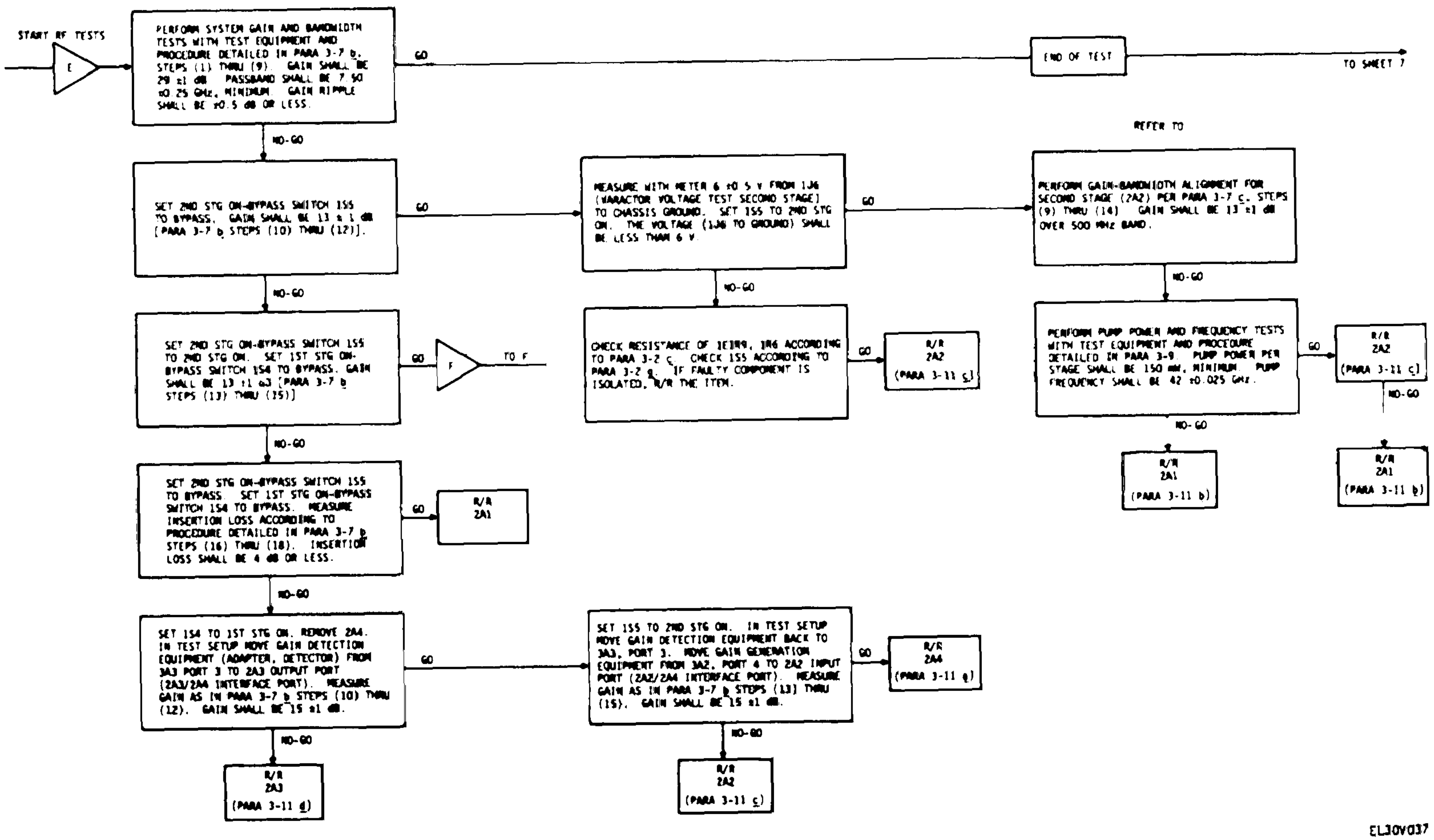


Figure 3-6. Diagnostic Flow Chart for Amplifier, Parametric AM-6602/MSC-46(V) (Sheet 6 of 7).

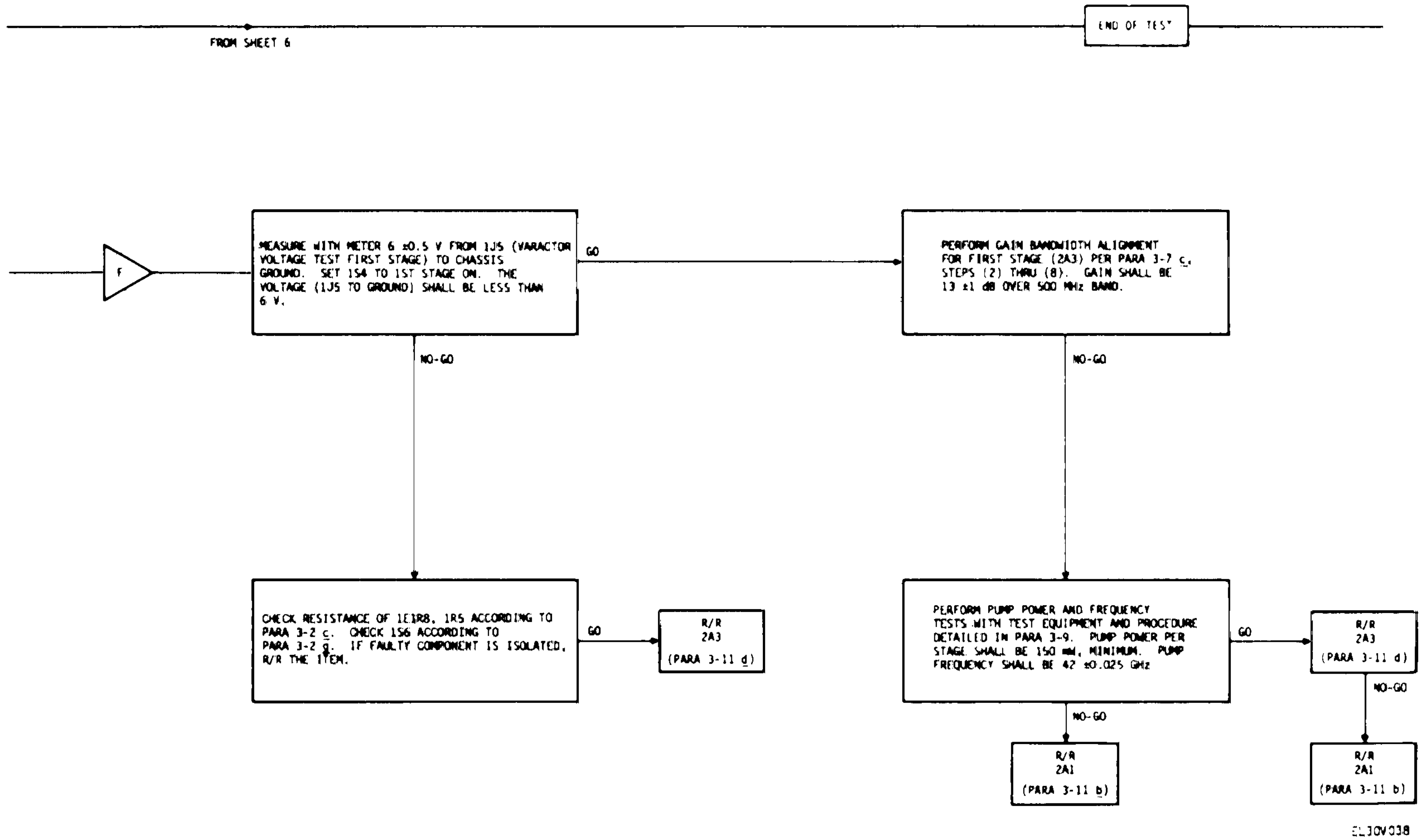


Figure 3-6. Diagnostic Flow Chart for Amplifier, Parametric AM-6602/MSC-46(V) (Sheet 7 of 7).

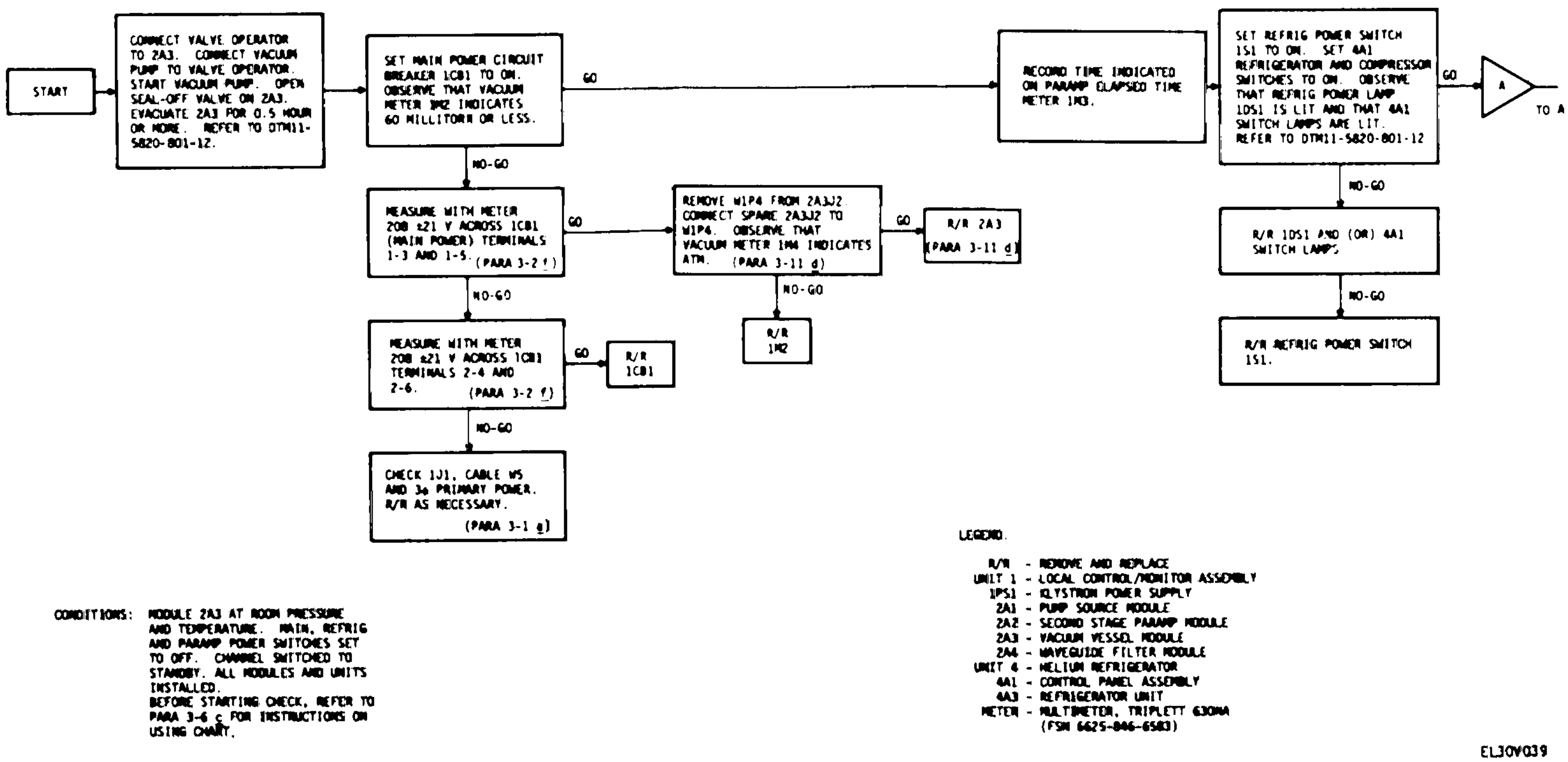


Figure 3-7. Diagnostic Flow Chart for Amplifier, Parametric AM-6602/MSC-46(V) (Sheet 1 of 4).

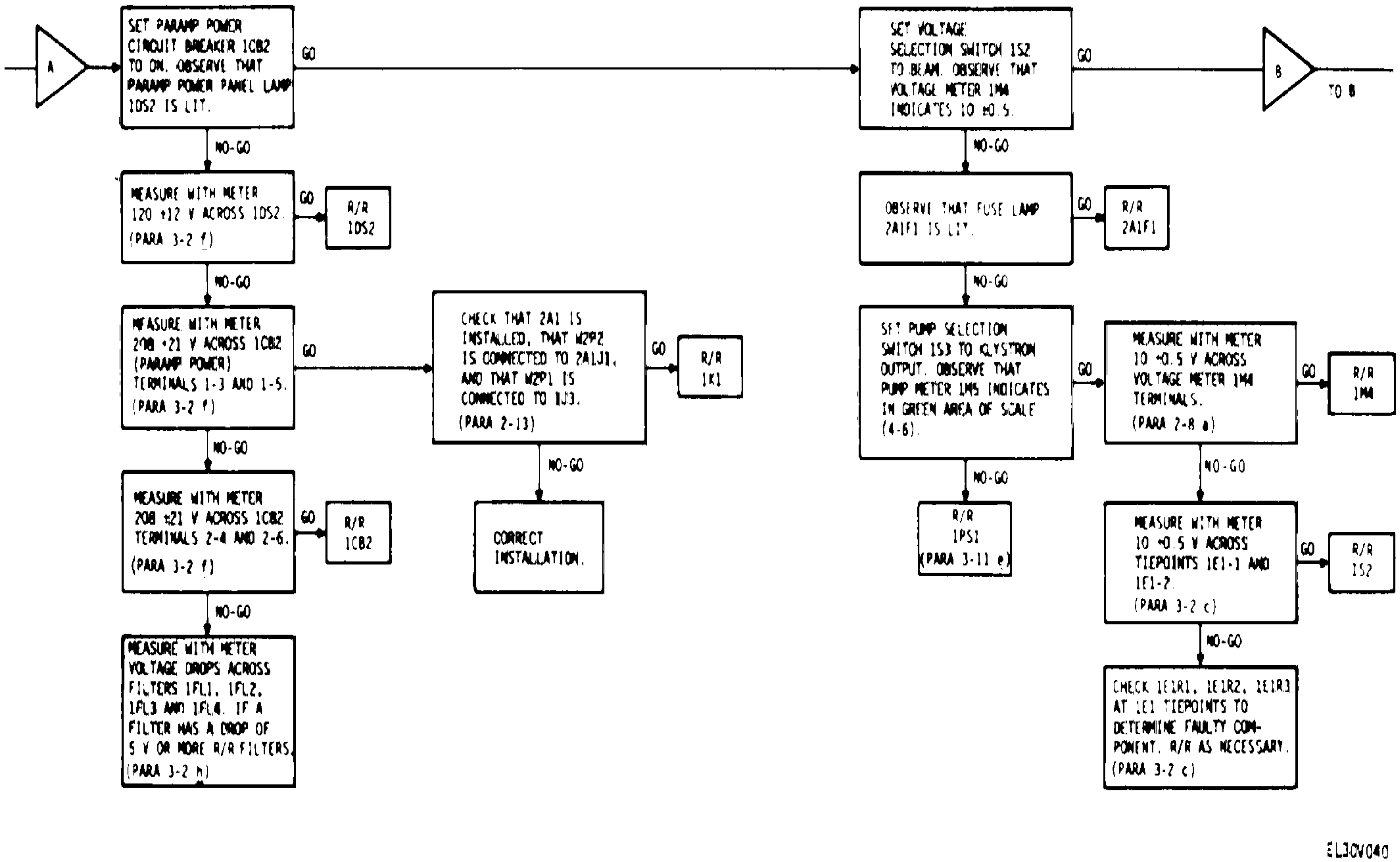


Figure 3-7. Diagnostic Flow Chart for Amplifier, Parametric AM-6602/MSC-46(V) (Sheet 2 of 4).

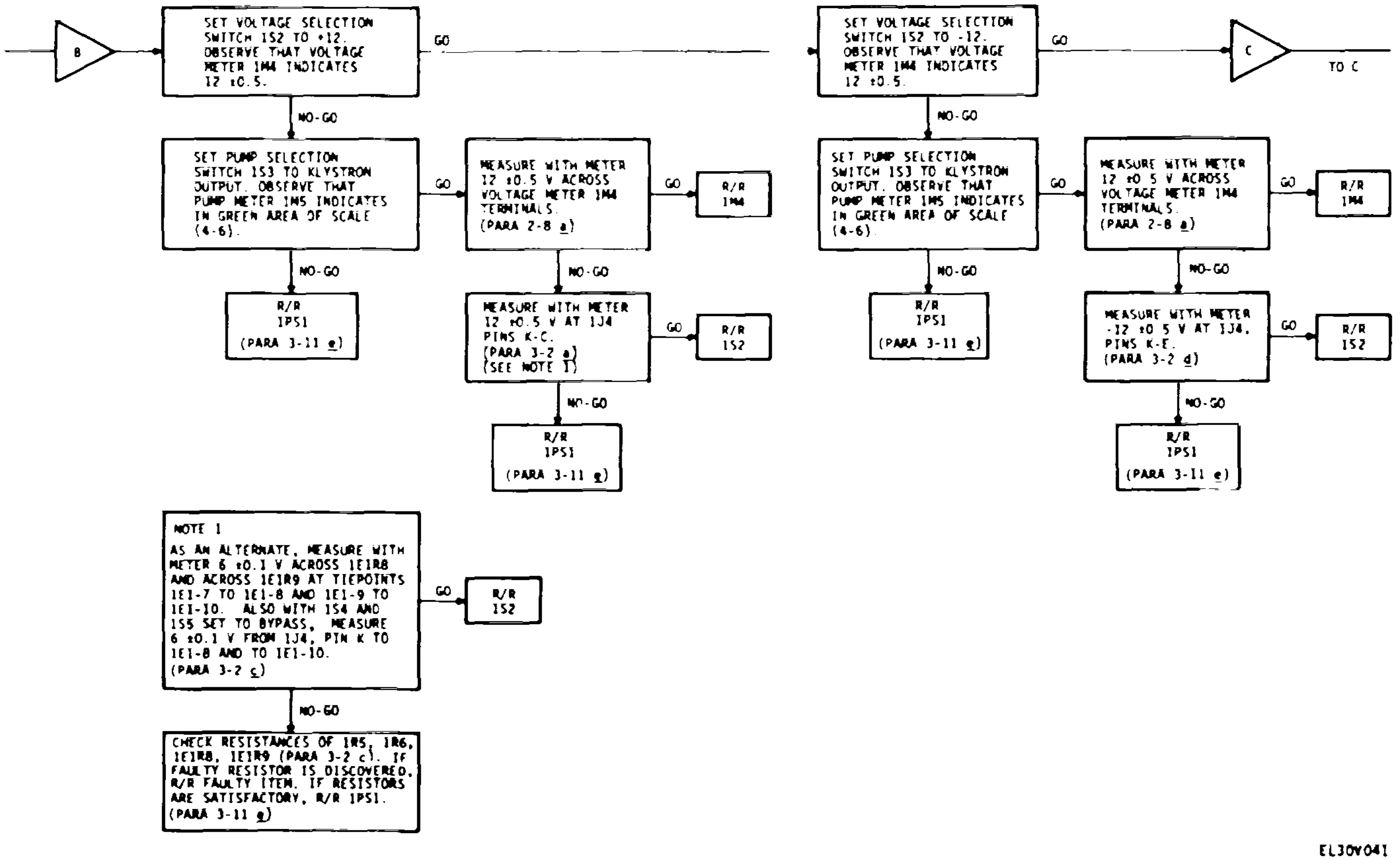
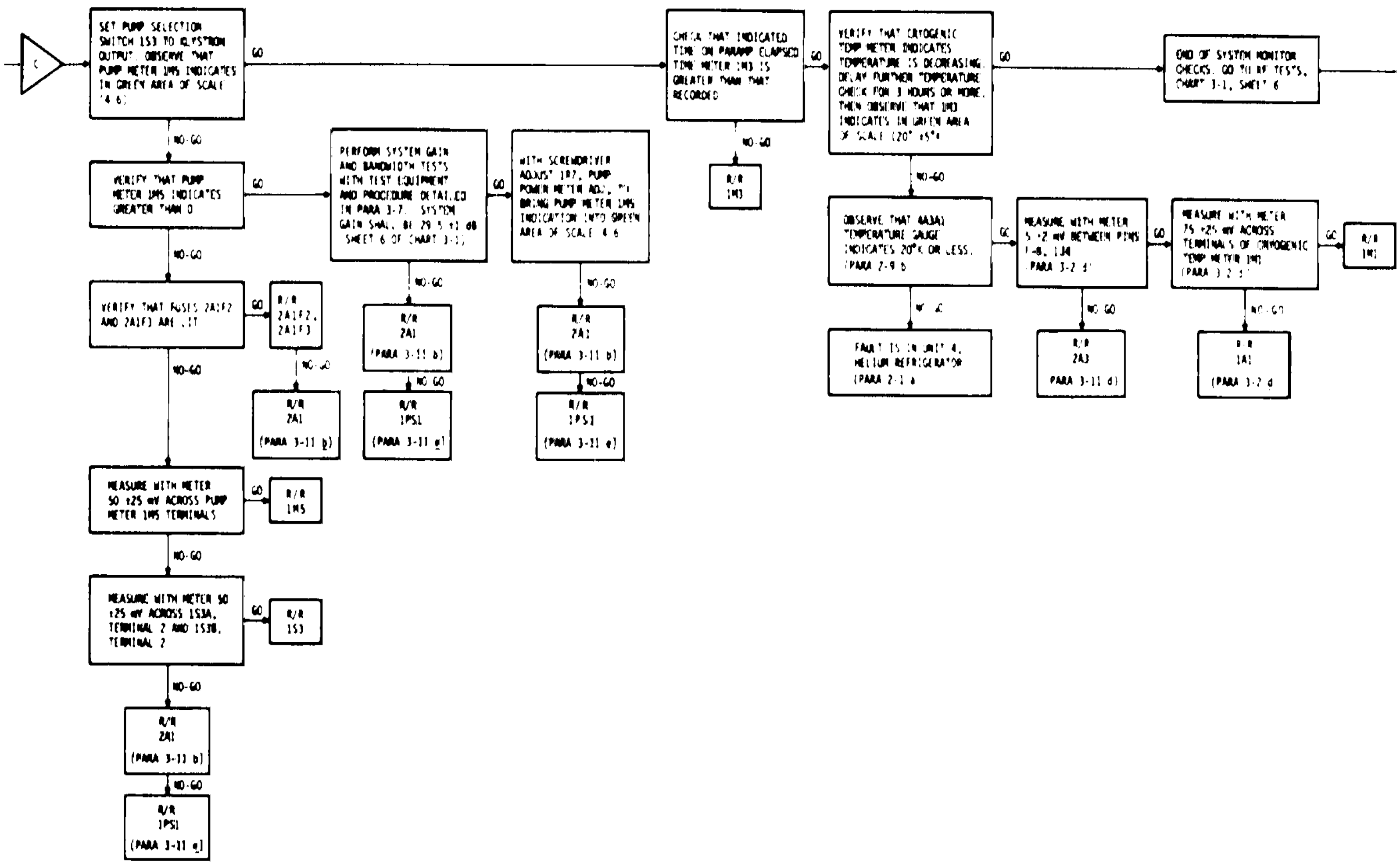


Figure 3-7. Diagnostic Flow Chart for Amplifier, Parametric AM-6602/MSC-46(V) (Sheet 3 of 4).



EL3OV042

Figure 3-7. Diagnostic Flow Chart for Amplifier, Parametric AM-6602/MSC-46(V) (Sheet 4 of 4).

3-7. RF Gain and Bandwidth Measurements

a Introduction.

(1) *Types of Measurements.* Gain-bandwidth measurements are divided into two parts: test and alignment The technician first tests the channel (Amplifier, Parametric AM-6602/MSC-46(V)) to determine if a fault exists, and, if so, which stage (2A3 or 2A2) is at fault A fault is defined as gain not within specified limits (29 5 t I dB) or bandwidth less than 500 MIDz (7250 to 7750 MITz) After a fault has been isolated to the first stage (2A3) or the second stage (2A2), the technician then performs an alignment procedure to correct the fault. If realignment does not eliminate the fault, then module removal and replacement is necessary (para 3-11) The steps are outlined on sheets 6 and 7 of figure 3-6.

(2) Initial Conditions. The channel to be tested shall be in normal standby condition (Refer to IM 11-5895-539-12). This implies that CRYOGENIC TEMP meter 1M1 indicates 20°±5°K, that VACUUM meter 1M2 indicates 20 millitorr or less, that MAIN (ICBI) and PARAMP (1CB2) circuit breakers and REFRIG (1S1) switch have been set to ON for at least 15 minutes (fig. 2-4). CHANNEL SELECT pushbutton switch 3A1S1 (fig 3-4) shall indicate that the channel is in standby, that is, the channel not under test shall be illuminated on the 3A1SI display A diagnostic check of the monitoring system according to figure 3-6, sheets 1, 2, 3, 4, and 5, shall have been completed.

(3) *Test Setup.* One test setup is used for both gain bandwidth test and alignment procedures. The two procedures are continuous. If during system gain-band- width test a fault is indicated, the technician continues with the test to isolate the fault and then with the alignment to eliminate the fault. No change in test equipment or test setup is required. Initially use the Test Reference Connection (CN-1367/U connected to VG-1054/U), which is used to calibrate the test equipment After the test equipment is calibrated, the equipment to be tested is connected. Using the test equipment in the chart below, make the test setup illustrated in figure 3-8:

Item	Reference
Adapter. VG-1054/U (2)	HP H281A
Attenuator, 20 dB	HP 8491 A
Attenuator, Variable	HP 1t382A
CN- 1 367/U	
Detector, Crystal	HP 420A
Generator, Signal, Sweep	HP 1O01-694C
Meter, Frequency FR-194/U	HP If523A
Oscilloscope AN/USM-273	Tek 453

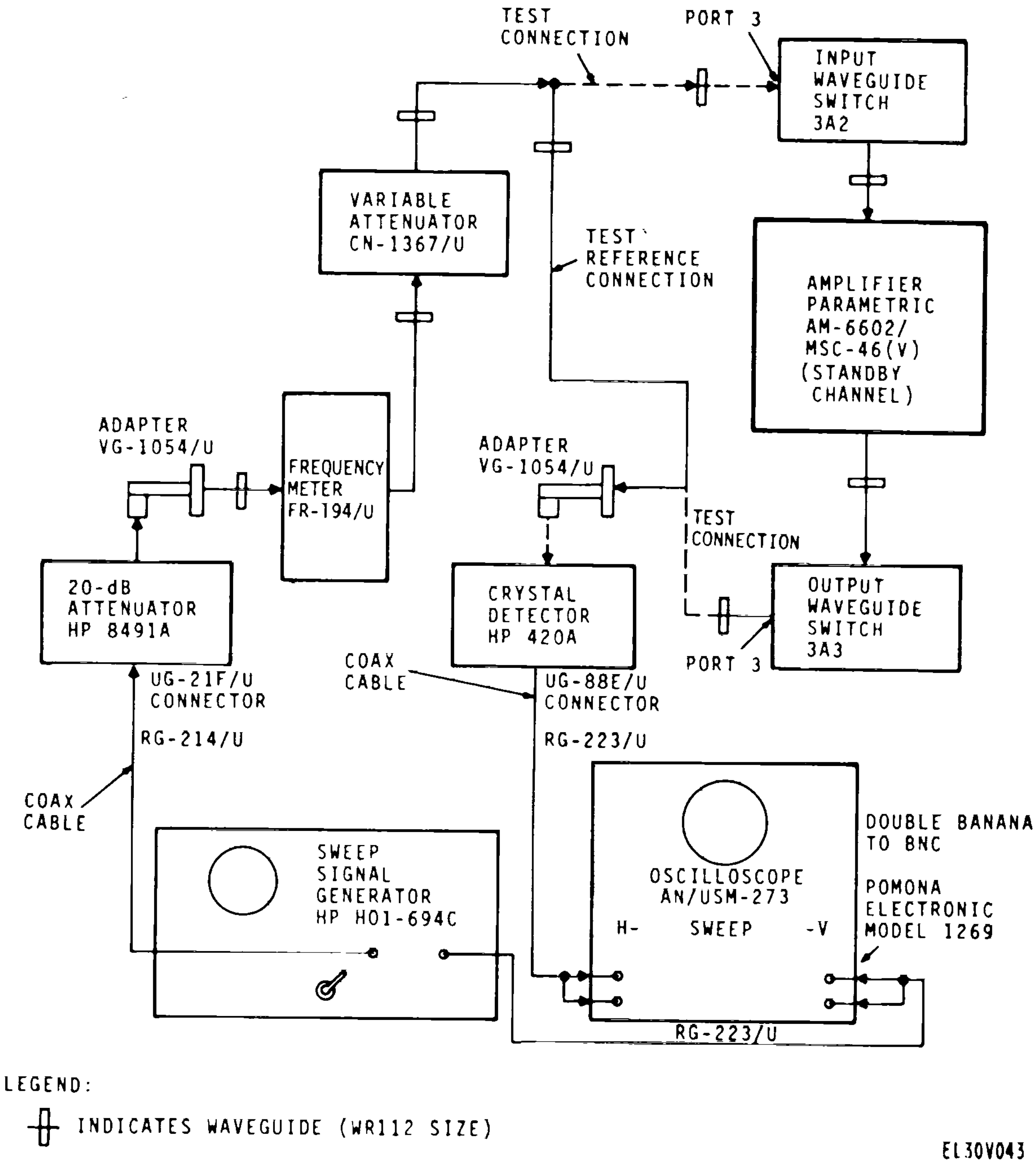


Figure 3-8. Channel Gain-Bandwidth Test Setup.

b RF Gain-Bandwidth Test Procedure.

(1) After the test setup is made using Test Reference Connection (para 3-7a) (fig. 3-8) energize test equipment (sweep generator and oscilloscope) and permit a 15- minute warmup period.

(2) Set the sweep generator to sweep the frequency band 7.20 to 7.80 GHz. Set frequency markers at 7.25 and 7.75 GItz. Check marker frequencies with FR-194/U.

(3) Set CN-1367/U at 10 dB.

(4) Set AN/USM-273 for maximum sensitivity and obtain a convenient reference trace on the oscilloscope face. Mark the trace with a grease pencil. This is the upper reference level.

(5) Increase the attenuation 2 dB (CN-1367/U set to 12 dB) and mark this trace also on the oscilloscope face.

This is the lower reference level. The test equipment is now calibrated.

(6) Remove the Test Reference Connection and make the Test Connections. Connect CN- 1367/U to Port 3 of input Waveguide Switch 3A2 and connect VG-1054/U to Port 3 of output Waveguide Switch 3A3.

(7) Increase the attenuation in CN-1367/U until the oscilloscope trace is at approximately the upper reference level but does not go above the upper reference level. (Refer to fig. 3-9.) The CN-1367/U dial indication minus 10 is the system gain in dB.

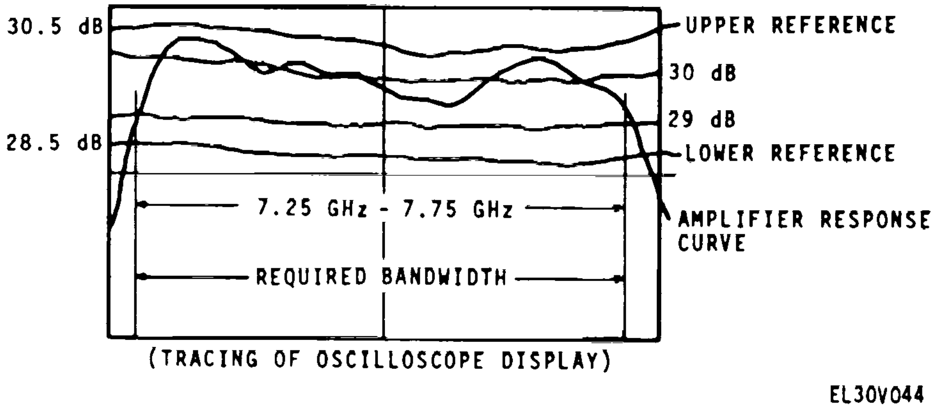


Figure 3-9. Typical Gain-Bandwidth Response of AM-6602/MSC-46(V).

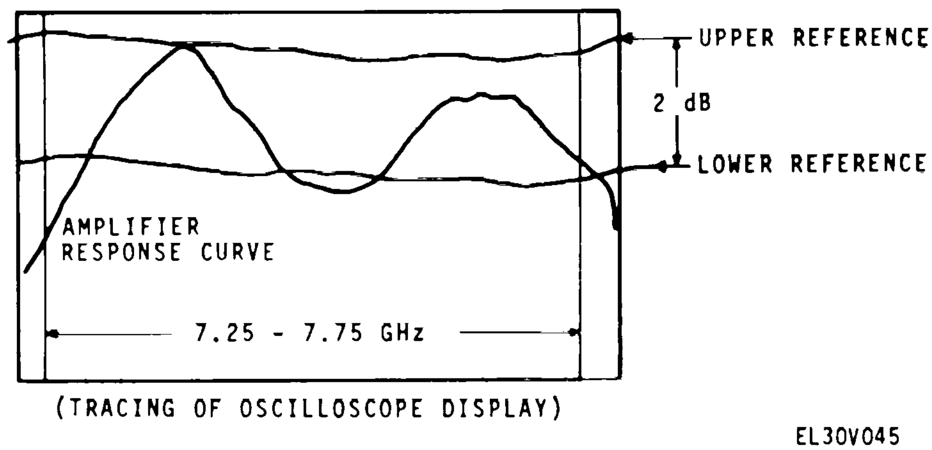


Figure 3-10. Out-of-Tolerance Gain-Bandwidth Response.

(8) Measure the bandwidth between the oscilloscope reference traces with FR-194/U.

(9) For acceptable performance, the measurements taken in steps (7) and (8) shall indicate a gain of 29.5 ±1 dB over the frequency band 7250 to 7750 MHz. For comparison, a typical gain-bandwidth measurement as displayed on an oscilloscope is sketched in figure 3-9. If channel gain and bandwidth are acceptable, terminate test here. Continue only if channel measurements are out of tolerance.

(10) To measure the response of the first stage (2A3) of the amplifier continue as follows. Set toggle switch ISS5 to BYPASS (fig. 3-3).

(11) Decrease the attenuation (from that set in step
(7) until the oscilloscope trace approaches the upper reference level (fig. 3-9). The CN- 1367/U dial indication minus 10 is the first stage (2A3) gain in dB less the second stage (2A2) insertion loss of 1.5 ±0.5 dB.

(12) The measured gain in step (11) shall be between 12.5 dB and 14.5 dB and the bandwidth shall be 500 MHz minimum.

(13) To measure the response of the second stage (2A2) of the amplifier continue as follows. Set toggle switch 1S5 to 2ND STG ON and set toggle switch 154 to BYPASS (fig. 3-3).

(14) Vary the attenuation (from that in (10) above) until the oscilloscope trace approaches the upper reference level (fig. 3-9). The CN-1367/U dial indication minus 10 is the second stage (2A2) gain in dB less the first stage (2A3) insertion loss of 2.0 : 0.5 dB.

(15) The measured gain in (14) above shall be between 12.5 dB and 14.5 dB and the bandwidth shall be 500 MHz minimum.

(16) To measure system insertion loss, continue as follows. Set both IS4 and ISS to BYPASS (fig. 3-3).

(a) Reduce the attenuation until the oscilloscope trace approaches the upper reference level (fig. 3-9). The CN-1367/U dial indication minus 10 is the cold insertion loss of Amplifier, Parametric AM-6602/MSC-46(V) It shall be 4 dB or less and is assumed to be 0.5 dB greater in the first stage (2A3) than in the second stage (2A2) (for gain computation purposes).

(b) Reset toggle switches 1S4 and IS5 to 1ST STG ON and 2ND STG ON, respectively.

c. Gain-Bandwlth .Alignment Procedure.

(1) Gain-bandwidth alignment shall be made after the gain-bandwidth tests indicate that either the first stage (2A3) (*b*(l), (11), and (12) above) or the second stage (2A2) *(b(13),* (14), and (16) above) gain-bandwidth characteristics are out of tolerance Maintain the test setup of figure 3-8 (b(6) above).

(2) If the first stage (2A3) characteristics are out of tolerance proceed as follows. Set toggle switch 1S5 to BYPASS (fig. 3-3) Display the gain-bandwidth response curve on AN/USM-273 as in b(l 1) above An example of an out-of-tolerance gain-bandwidth response is shown in figure 3-10

(3) On Pump Source Module 2A1 front panel, remove the cover plate by removing four Phillips head screws, thereby exposing attenuator controls AT3 and AT4 (fig 3-11).

(4) Unlock 2A1AT3 attenuator control by loosening the lock thumbscrew (right angles to the attenuator control) Then, with a hex wrench, turn AT3 attenuator control while observing the oscilloscope Adjust for optimum gain (approximately that shown in figure 3-9).

(5) Turn the IST STG BIAS IR5 adjustment control (fig 3-3) with a screwdriver while observing the oscilloscope Adjust for optimum bandwidth (approximately that shown in figure 3-9).

(6) Because the effects of the 2A1AT3 and 1R5 adjustments react on each other to some extent it may be necessary to repeat (4) and (5) above one or more times to obtain the optimum gain-bandwidth response Stage gain shall be 13.5 ± 1 dB over 500 .MHz band Refer to *b(12)* above.

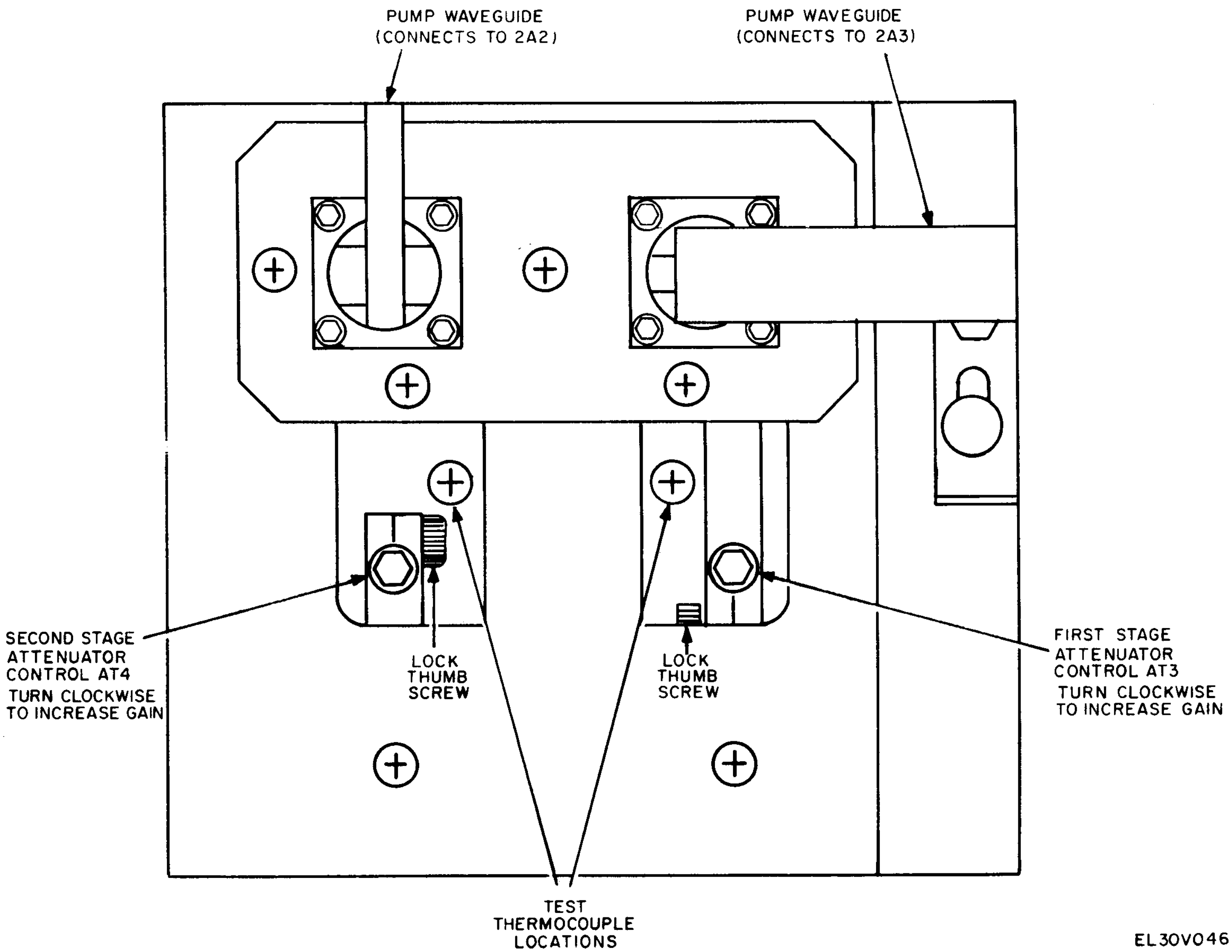


Figure 3-11. Location of Pump Attenuator Controls, Pump Source Module 2A1

(7) When the optimum gain-bandwidth response has been obtained, carefully relock the AT3 attenuator control with the lock thumbscrew while observing the oscilloscope to make certain that the locking procedure does not change the control settings and, therefore, the amplifier response.

(8) Reset toggle switch 1S5 to 2ND STG ON (fig. 3-3) Check the channel gain-bandwidth response per *b(7),* (8), and (9) above If the response is not completely satisfactory, make minor adjustments by means of the second stage controls while observing the channel response on the oscilloscope. Second stage controls are de scribed in (9) through (13) below. Operational requirement is for adequate channel response. How this response is divided between the two stages of amplification is irrelevant.

(9) If the second stage (2A2) characteristics are out of tolerance, set toggle switch 1S4 to BYPASS and display the gain-bandwidth response curve on AN/USM-273 as in *b(14)* above (fig. 3-10).

(10) Perform (3) above (Remove cover plate over attenuator controls) (fig. 3-11).

(11) Unlock 2A1AT4 attenuator control and adjust the gain as in (4) above, using the AT4 adjustment.

(12) Adjust 2ND STG BIAS control 1R6 (fig. 3-3) using the procedure in (5) above.

(13) Continue the alignment procedure as given in (6) and (7) above, but using 2A1AT4 and 1R6 adjustments. Stage gain shall be 13.5±dB over 500 MHz band Refer to b(15) above.

(14) Reset toggle switch 1S4 to 1ST STG ON. Check the channel gain-bandwidth response as per *b(7),* (8), and (9) above. Minor adjustments of this first stage controls ((4) through (7) above) may be necessary for optimum channel response.

(15) Remove the test equipment and replace the cover plate (with four Phillips head screws removed in (3) above) on the Pump Source Module 2A1 front panel.

3-8. Waveguide Assembly RF Tests

a. Assemblies That Can Be Tested. RF insertion loss over the amplifier passband (7.5 *i* 0.25 GHz) can be measured on any waveguide assembly that can readily be removed from the system. Waveguide Switches 3A2 and 3A3 can be tested in place, if necessary. Other Unit 3 waveguide assemblies (3A4, 3A5, 3A6, 3A7, 3A8, 3A9, 3A10, 3AI 1, 3A12) can be removed and tested individually or tested in sections. Refer to paragraph 3-6b. The procedure given here is specifically for Waveguide Filter Module 2A4. Any other waveguide assembly (WR 112 size) can be measured by the same procedures c(l) through (7) below. The additional steps in c below are for out-of-band signal rejection tests of the filter.

b. Test Setup. The test equipment and test setup shown in figure 3-8 shall be used except that the item under test is Waveguide Filter Module 2A4 instead of Amplifier, Parametric AM-6602/MSC-46(V). The test setup can be made at any convenient location. Remove 2A4 from 2A2 and 2A3 by flipping open the waveguide quick disconnects (para 3-11a) (fig. 3-14) and lifting out 2A4 The initial test setup shall contain the item under test (2A4) connected to the test equipment, that is, use the Test Connection of figure 3-8 first, connecting 2A4 between CN-1367/U and V'G- 1054/U.

c. Test Procedure

(1) After the test setup is made using Test Connection (fig. 3-8), energize the test equipment (sweep generator and oscilloscope) and permit 15-minute warmup period.

(2) Set the sweep generator to sweep the frequency band 7.20 to 7 80 GHz. Set frequency markers at 7.25 and 7.75 GHz Check to see that marker frequencies are correct with FR-194/U.

(3) Set CN-1367/U at 1.0 dB.

(4) Set AN/USM-273 for maximum sensitivity and obtain a convenient reference trace on the oscilloscope face. Mark the trace with a grease pencil.

(5) Remove 2A4 from the test setup and make the Test Reference Connection, that is, connect CN-I 367/U to VG- 1054/U.

(6) Decrease the attenuation to return the oscilloscope trace to the reference trace level.

(7) The difference in CN-1367/U settings of (4) above and (6) above is the insertion loss of Waveguide Filter Module 2A4. The loss shall be between 0.0 dB and 0 3 dB.

(8) Remove the grease pencil trace marks from the oscilloscope scope face.

(9) Set CN-1 367/U at 25 dB. Obtain a trace on the oscilloscope and mark the trace with a grease pencil.

(10) Set the sweep generator to sweep the frequency band 7.0 to 8.4 GHz. Set frequency markers at 7.1 and 7.9 GHz.

(11) Insert Module 2A4 in the test setup, that is, between CN-1367/U and VG-1054/U.

(12) Set CN-1367/U to 5 dB. ((9) setting minus step in (12) above setting = 20 dB.)

(13) Observe the oscilloscope for responses in the frequency bands 7.0 to 7.1 GHz and 7.9 to 8.4 GHz. No response shall reach the reference trace levels set in (9) above. The specified filter rejection is 20 dB or more in these two frequency bands.

(14) Remove Module 2A4 from the test setup and reconnect it in Frame Assembly Unit 2 to Modules 2A2 and 2A3.

3-9. Pump Frequency and Power Tests

WARNING

Module 2A1 contains a 1000-V line and a 120- V line Do not open the chassis cover.

CAUTION

Do not perform these tests unless gain-band- width tests (para 3-7) provide unsatisfactory results and the apparent cause is inadequate pump power. Refer to figure 3-6, sheets 6 and 7.

a. RF Tests.

(1) Remove Pump Source Module 2A1 from Unit 2 as follows.

(*a*) Remove the four cap screws in each of the two pump waveguide interface flanges at the interfaces with 2A2 and 2A3 pump waveguides Refer to figure 3-12.

(b) Slide open the four mounting slide clips on 2A1 (fig. 3-12) and lift Module 2A1 out of Support Frame 2A5.

(c) Place 2A1 in a convenient position to connect test equipment to the pump waveguide flanges.

(*d*) Do not remove W2P2 from 2A1JI.

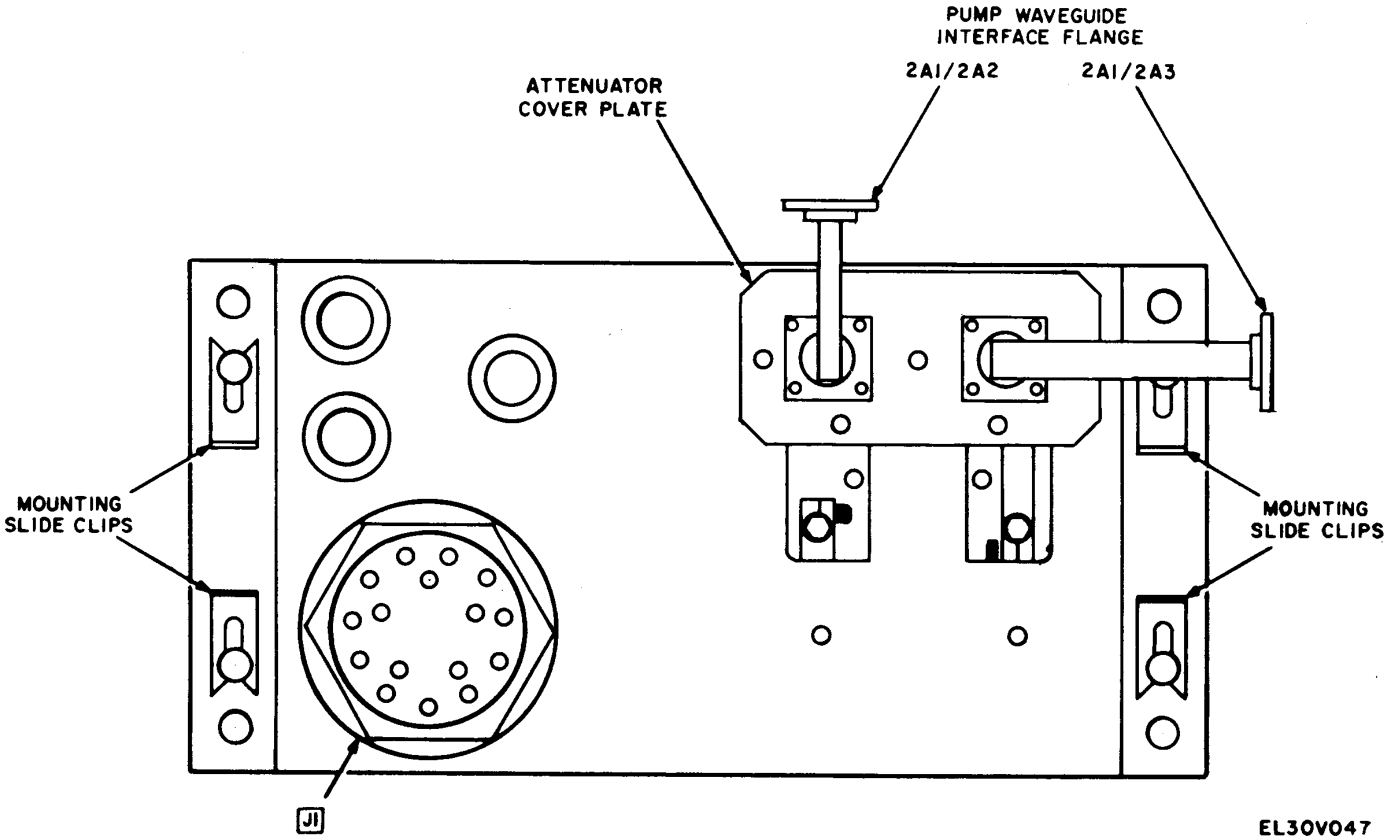


Figure 3-12. Pump Source Module 2A1.

(2) With the following test equipment listed in the chart below, make the test setup illustrated in figure 3-13. Two successive test setups shall be made one with the 20- dB coupler connected to the 2A3 pump waveguide interface (with the other pump waveguide (2A1/2A2 inter- face) terminated) and a second with the 20-dB coupler connected to the 2A1/2A2 waveguide interface (with the other pump waveguide (2A 1/2A3 interface) terminated). There is no preference in test order. The channel under test shall be in normal standby condition. Refer to para- graph 3-7*a*(2).

(3) Make sure that the MAIN (1CB1) and PAR- AMP (ICB2) POWER circuit breakers are set to ON. Energize power bridge; allow 30 minutes for test equipment warmup.

(4) The power bridge (AN/USM-260) shall indicate 150 mW or more (per channel). With the 20-dB coupler in the measurement line, the bridge actually measures 0.01 times the total power; that is, 1.5 mW (or more).

Item	Reference
Bridge, Power AN/IUSM-260	SIP 431C
Coupler, 20-dB	SM-D-748724
Mount, Bolometer	HP R486A

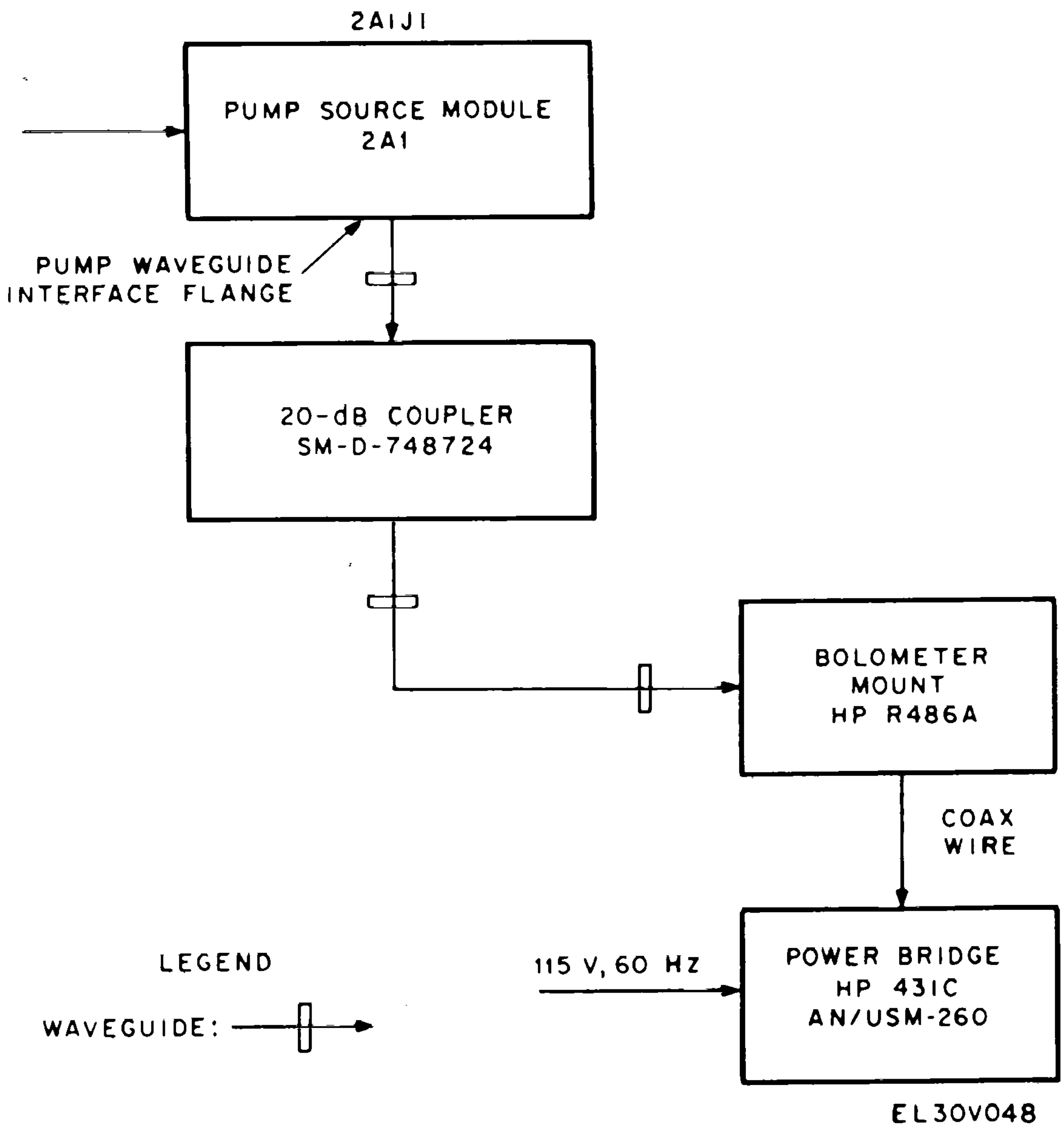


Figure 3-13. Klystron Oscillator Test Setup.

(5) If the power is below 150 mW, adjust the klystron ocsillator beam voltage by means of the screwdriver adjustment on the rear of 1PS1 (1000 V ADJ) (fig. 3-3). Turn the control to obtain maximum

pump power as indicated on the power bridge.

CAUTION

Do not perform this step if the channel gain bandwidth response is satisfactory per test of paragraph 3-*7b.*

(6) If step (5) is accomplished then (after 2A1 is re- mounted in 2A5) a gain-bandwidth alignment must be made per paragraph 3-7(The prime operational criterion is for adequate channel gain-bandwidth response. The precise power and frequency of 2A1NVI, the klystron oscillator, is incidental if that criterion is met.

(7) If steps (5) and (6) above do not give adequate results, replace Module 2A1 (para 3-1 1 *b.).* If they provide satisfactory operation, disconnect the test equipment, replace 2A1 in 2A5, slide shut the four mounting slide clips., and replace the eight cap screws removed in (1) *(a)* above.

b. Beam Voltage Adjustment.

(1) A direct test of pump frequency and power is de scribed in a above Another test and adjustment described here is useful under certain conditions Over the life of the klystron oscillator 2A1NV1 (pump) (rated at 5000 hours) its output power as measured on the PUMP meter 1M5 may drop toward the minimum tolerance level This may be caused by a small change in the beam voltage requirements of the klystron oscillator Regular weekly preventive maintenance checks of the pump power (as indicated by meter 1M5) will provide information as to power decrease which, in turn, will indicate the need for remedial action There are two causes for reduced PUMP meter indications- klystron oscillator 2A1V1 output power had dropped or the pump power measurement circuit has deteriorated The pump power measurement circuit condition is covered in the diagnostic flow charts by the 1R7, PUMP POWER ADJ procedure (fig. 3-6, sheet 4). Also refer to paragraph 2-17b. The procedure here is valid only when output power of klystron oscillator 2A1VI has decreased Proceed as follows.

(2) Set PUMP selection switch 1S3 (fig 2-4) to KLYSTRON OUTPUT

(3) Record PUMP meter 1M5 indication.

(4) Compare indication with that recorded during the previous weekly check.

(5) If the output power has decreased 0 5 to 1.0 unit (on meter scale) and the cause is pump power, insert screwdriver into hole marked 1000 V ADJ on 1PS1 (fig. 3-3).

(6) While observing PUMP meter 1M5, slowly turn adjustment to increase meter indication. The turn direction that increases power can be either clockwise or counterclockwise. Adjust for maximum pump power.

(7) Set PUMP selection switch 1S3 to OFF and per form a gain-bandwidth test and alignment according to the procedures of paragraph 3-7*b* and *c.*

3-10. Main Power Failure *a. General Description.* Protection against primary power (120 Vac) overload (shorts) is obtained by means of MAIN POWER circuit breaker 1CB2 (fig 2-4) All power to Units 1, 2, and 4 is controlled by 1CB1 Power to 1PS1 and PARAMP ELAPSED TIME meters 1M3, 3A1M2, 3A1M4 is controlled by 1CB2. When an overload exists the circuit breaker cannot be set to ON.

b. MAIN POWER 1CRB1 Overload. If 1CB2 and 1S1 are set to OFF and if 1CB1 cannot be set to ON the failure can be isolated by successively removing cable plugs as follows:

Fault clears on removal of plug	From	Fault is in Module
W2P1	2A1J1	2A1
W1P2	2A2J1	2A2
W1P4	2A3J2	2A3

If a fault is located in one of the above modules, remove and replace the module (para 3-11*b.*, *c* and *d.* If the fault remains after the three plugs are removed, the fault is in Unit 1. Remove W5P2/W5P3 from 1J1 and make continuity checks from 1J11 terminals A, C, F, F to terminal 2 of line filters 1FL1, 1FL2, 1FL3, 1FL4, respectively, with 1CB1 both ON and OFF Refer to figure 3-2 and paragraph 3-2 Replace fault)' items as necessary.

c. Paramp Power 1C82 Overloaod If PARAMP POWER circuit breaker 1CB2 cannot be set to ON (but 1CB1 operates normally) the fault is likely in 1PS1. Remove 1P1 from 1PS1J1 and if the fault clears, remove and replace 1PS1 (para 3-11*e*,). If the fault does not clear remove W5P1 from 3A1J1. If the fault clears, meter 3A1M2 or 3A1M4 is at fault. Remove and replace the faulty meter. If the fault does not clear remove WUP2/- W5P3 from 1J1. Make continuity checks from 1CB2 to 1PS1 to isolate the fault. Make the necessary repairs.

d. REFRIG POUEFR 1S1 Overload. If 1CB1 operates normally but trips when 1S1 is set to ON, remove W5P4/W5P5 from 4A1J2. If the fault clears the fault is in Unit 4. Refer to paragraph 2-1a . If the fault remains, remove W5P2/W5P3 from 1J1 and continuity check from 1CB1 terminals 1and 3 to 1S1 terminals 6 and 3, respectively Refer to paragraph *3-2f'* Make necessary repairs.

3-11. Module Removal and Replacement

a.. Waveguide Filter 2A4. Refer to figures 3-14 and 3-15.

(1) Snap open the waveguide quick disconnects at the 2A4/2A2 and the 2A4/2A3 interfaces

(2) Lift out Waveguide Filter Module 2A4.

(3) To reinstall 2A4, place the module on the quick disconnects and snap shut the connectors.

h. Pump Source .Module. Refer to figures 3-14 and 3-12

(1) Remove four cap screws from the pump wave- guide interface flange that interfaces 2A1 and 2A2

(2) Remove four cap screws from the pump wave- guide interface flange that interfaces 2A1 and 2A3.

(3) Remove cable plug W2P2 from 2A1J1.

(4) Slide open the four mounting slide clips that hold 2A1 in 2A5.

(5) Lift out Pump Source Module 2A1.

(6) To reinstall 2A1, place the module in 2A5. Slide closed the four mounting slide clips, reconnect W2P2 to 2A1J1 and replace the eight cap screws in the two pump waveguide interface flanges removed in (1) and (2) above.

c. Second Stage Paramp Module 2A 2. Refer to figures 3-14 and 3-15.

(1) Remove Waveguide Filter Module 2A4 (a above).

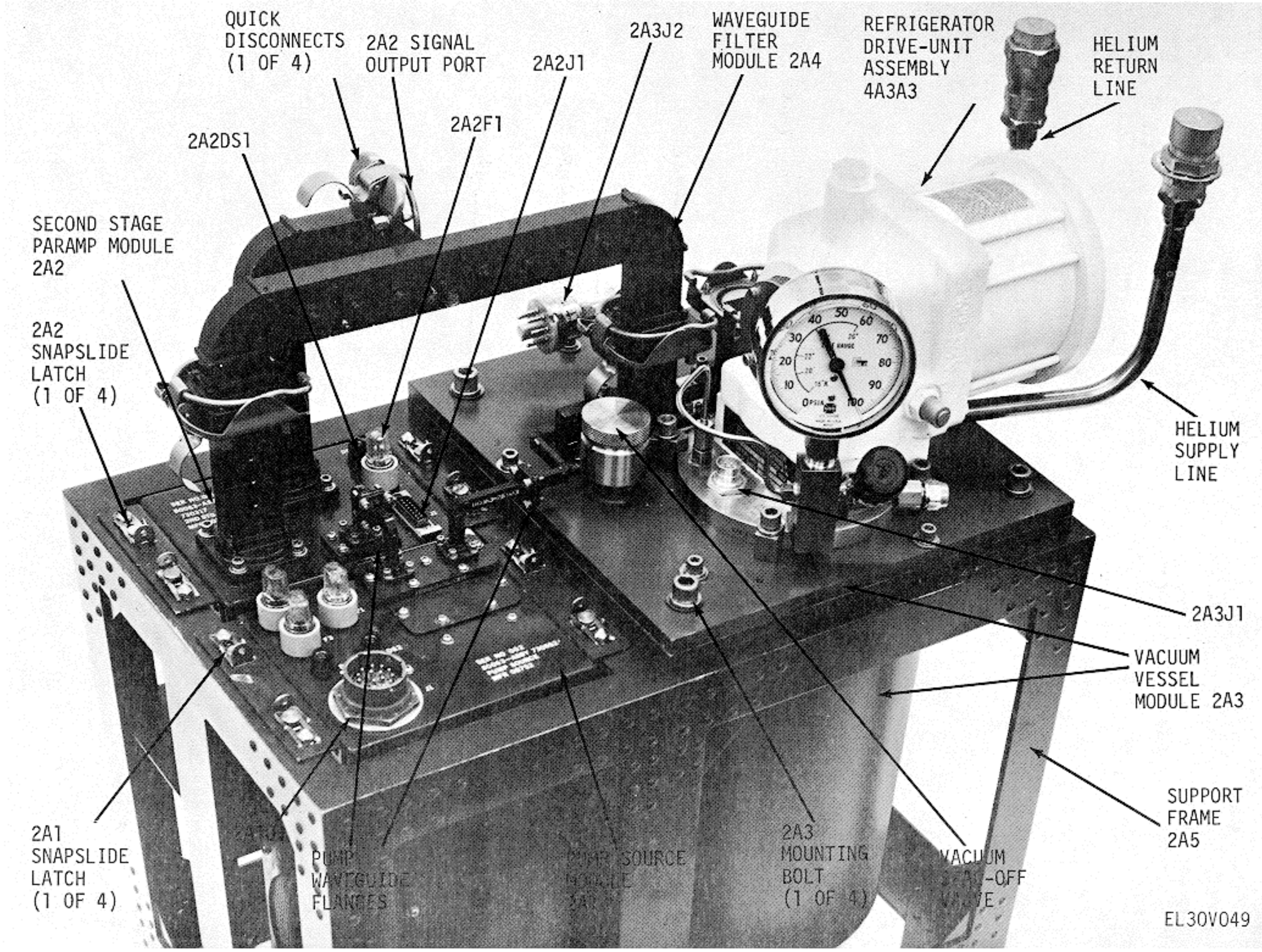


Figure 3-14. Frame Assembly Unit 2, 2A4, 2A1, 2A2 Module Removal.

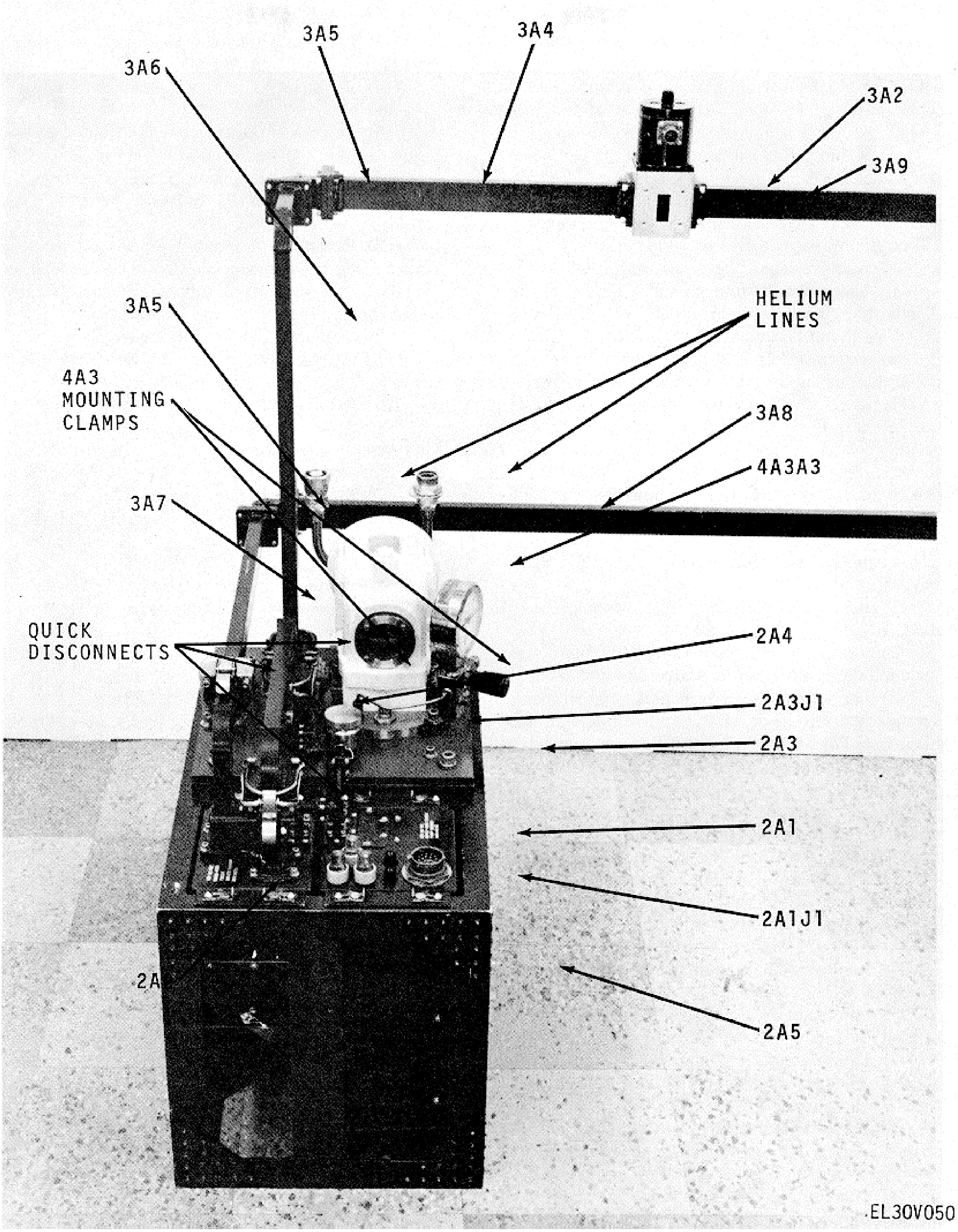


Figure 3-15. Frame assembly Unit 2, 2A2, 2A3 Module Removal

(2) For a Channel 1 installation, remove four cap screws at waveguide bend 3A5 interface with waveguide 3A7 For a Channel 2 installation, remove four cap screws at waveguide bend 3A5 interface with waveguide 3A11.

(3) Remove four cap screws from the pump wave guide interface flange that interfaces 2A2 and 2A1.

(4) Snap open the quick disconnects at the 2A2 signal output port thereby freeing 3A7 or 3A11 waveguide. Lift out the waveguide 3A7 or 3A11.

(5) Remove cable plug WIP2 from 2A2J1.

(6) Slide open the four mounting slide clips (snap slide latch on figure 3-14) that hold 2A2 in 2A5.

(7) Lift out Second Stage Paramp Module 2A2.

(8) To reinstall 2A2, place the module in 2A5, slide closed the four mounting slide clips, reconnect W1P2 to 2A2J1, place 3A7/3A11 waveguide on the quick disconnects at the 2A2 signal output port, snap closed the connector, replace the four cap screws removed in step (2) above, in the flange that connects 3A5 to 3A7/3A11 and replace the four cap screws in the pump waveguide inter face flange 2A2/2A1 removed in (3) above. Reinstall Module 2A4 (*a* above).

d. Vacuum Vessel (Module 2A3. Refer to figures 3-14 and 3-15.

(1) Remove Waveguide Filter Module 2A4 *(a* above).

(2) Remove four cap screws from the pump wave guide interface flange that interfaces 2A3 and 2A1.

(3) For a Channel 1 installation, remove four cap screws at the waveguide bend 3A5 interface with wave guide 3A6 For a Channel 2 installation, remove four cap screws at the waveguide bend 3A5 interface with wave guide 3A10.

(4) Snap open the quick disconnects at the 2A3 signal input port thereby freeing the 3A6 or 3A10 wave guide Lift out the 3A6 or 3A10 waveguide.

(5) Disconnect the helium lines to Refrigerator Unit Assembly 4A3.

(6) Remove W1P3 from 2A3J1, W1P4 from 2A3J2, and W3P2 from 4A3A3J6.

(7) Remove four mounting bolts (cap screws) at corners of 2A3 front panel.

(8) Lift Vacuum Vessel Module 2A3 and Refrigerator Unit Assembly 4A3 out of Frame Assembly 2A5.

(9) To remove 4A3A2 and 4A3A3 from 2A3, attach evacuating and charging adapter (para 3-4) to 4A3A3 helium lines.

(10) Open vacuum valve on the evacuating and charging adapter (90" turn) to release the helium pressure in Refrigerator Unit Assembly 4A3.

(11) Loosen two bolts (cap screws) on each of the two mounting clamps that mount 4A3A3 to 4A3A1. Remove the clamps.

(12) Lift out the Refrigerator Unit Drive Unit As sembly 4A3A3 and Displacer Assembly 4A3A2.

(13) Reinstall Refrigerator Unit Displacer Assembly 4A3A2 and Drive Unit Assembly 4A3A3.

(14) Refasten the mounting clamps removed in (11) above.

(15) To reinstall 2A3 place the module in 2A5 and fasten the four bolts removed in (7) above.

(16) Make the refrigerator piping connections.

(17) Reconnect WIP3 to 2A3J1, W1P4 to 2A3J2 and W3P2 to 4A3A3J6.

(18) Reconnect waveguide 3A6 or 3A10 to the signal input port quick disconnect. Connect waveguide bend 3A5 flange to 3A6 or 3A 10 with four cap screws removed in (2) above.

(19) Reconnect pump waveguide flange at the 2A2/2A1 interface with four cap screws removed in (3) above.

(20) Remount Module 2A4 *(a* above).

(21) If it is unnecessary to remove the Refrigerator Unit Assembly 4A3 from Module 2A3, omit (9) through (14) above.

e. Klystron Power Supply 1PS1 Refer to figure 3-3.

(1) Remove W5P2/W5P3 from 1J1, W1P1 from 1J2, and W2P1 from 1J3.

(2) Disconnect 1P1 from 1PS1J1.

(3) Remove Unit 1 from its rack by removing eight mounting screws from the front panel and place it upside down on a bench.

(4) Remove nine bolts from bottom of Unit 1 chassis.

(5) Carefully lift Unit 1 off of 1PS1.

(6) To reinstall 1PS1, place 1PS1 on a bench with the side stenciled "DANGER 1000 VOLTS" down.

(7) Align the Unit 1 chassis (turned upside down) over 1PS1 so that 1PS1J1 is at the rear of the chassis Lower Unit 1 over 1PS1.

(8) Align the nine mounting holes and replace the nine bolts removed in (4) above.

(9) Rack mount Unit 1 with the eight mounting screws removed in step (3) above.

(10) Reconnect 1P1 to 1PS1J1.

(11) Reconnect W1P1 to 1J2, W2P1 to 1J3, and W5P2/W5P3 to 1J1.

f. Waveguide Switch 3A2. Refer to figure 3-15.

(1) Remove W5P6 from 3A2J1.

(2) Remove four cap screws at 3A2/3A4 interface (Port 2 of 3A2).

(3) Remove four cap screws at 3A2/3A9 interface (Port 4 of 3A2).

(4) Remove four cap screws at 3A2 Port 1 interface and remove 3A2.

(5) To replace 3A2, connect the antenna waveguide to Port 1 of 3A2 with four cap screws removed in (4) above, connect 3A9 to Port 4 with four cap screws removed in (3) above and connect 3A4 to Port 2 with four cap screws removed in (2) above Reconnect W5P6 and 3A2J1.

g. Waveguide Switch 3A 3.

(1) Remove W5P8 from 3A3J1.

(2) Remove four cap screws at the 3A3/3A8 inter face (Port 2 of 3A3).

(3) Remove four cap screws at the 3A3/3A 12 inter face (Port 4 of 3A3).

(4) Remove four cap screws at 3A3 Port 1 interface and remove 3A3.

(5) To replace 3A3, connect the output waveguide to 3A3 Port 1 with four cap screws removed in (4) above, connect 3A12 to Port 4 of 3A3 with four cap screws removed in (3) above, and connect 3A8 to Port 2 of 3A3 with four cap screws removed in (2) above. Reconnect W5P8 and 3A3J1.

h. Other Unit 3 Waveguide Assembles. To remove other Unit 3 waveguide assemblies (3A4, 3A6, 3A7, 3A8, 3A9, 3A10, 3A11, 3A12) start by disconnecting at the waveguide bend 3A5 (fig. 3-15) Then release the other end of the assembly, as necessary.

3-12. System Interconnections

Local Control/Monitor Assembly, Unit 1, is connected by cable to Modules 2A1, 2A2, 2A3, 3A1 and 4A1 and to the primary input power (3 phase, 120 ± 12 V, 55 ± 8 Hz). Remote Control/Monitor Assembly 3A1I is connected by cable to Unit 1, Modules 3A2, 3A3 and to + 28 V primary power. Four cables (W1, W2, W3, W4) are used per channel and one cable (W5) interconnects both channels. (W3 and W4 provide Unit 4 interconnections.) Four illustrations show the cable interconnections from Unit 1 (1J1, fig. 3-16; 1J2, fig. 3-17, 1J3, fig. 3-18) and from 3A1 (3A1J1, fig. 3-19). Two illustrations show the cable wiring (W1, W2, fig. 3-20 and W3, W4, W5, fig 3-21). These illustrations are presented as aids in system continuity checking, should such become necessary. These illustrations along with the appropriate schematic diagrams (fig. 2-17, 2-24, 2-8, 2-11, 2-13) show all system cable interconnections and facilitate checking from one unit or module to another. Continuity checking is accomplished with primary power disconnected (W5 not connected to 120 V and 28 V sources).

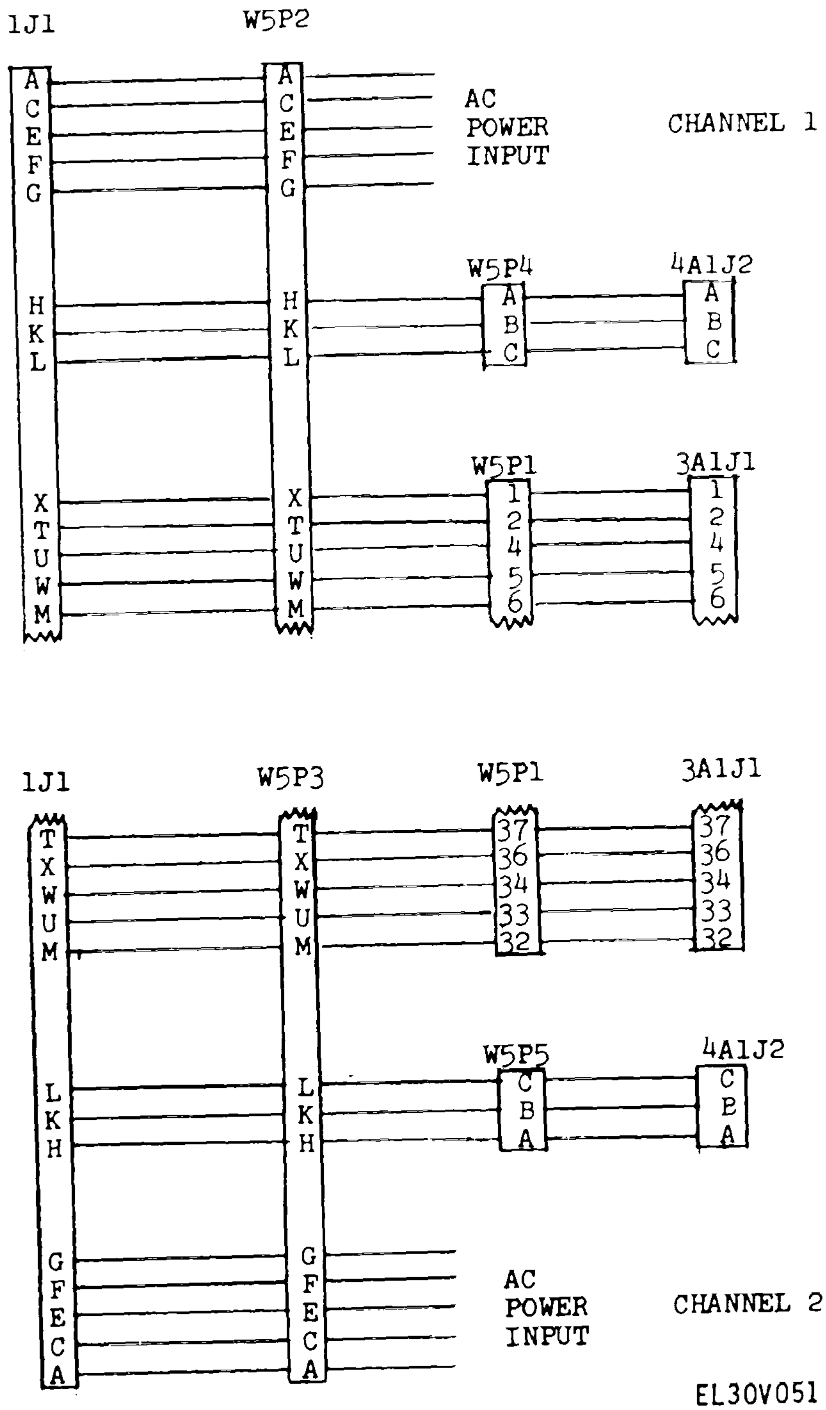


Figure 3-16. Interconnections to 1J1

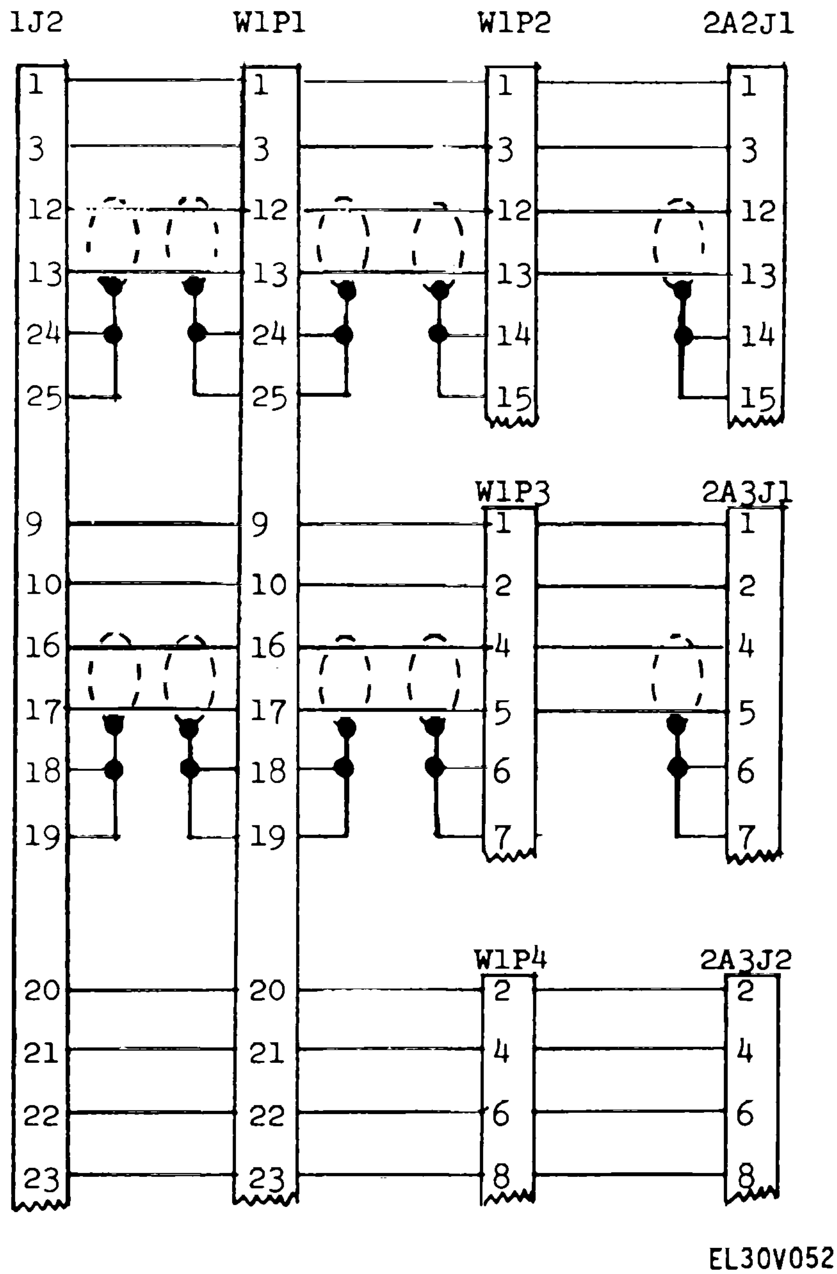


Figure 3-17. Interconnections to 1J2.

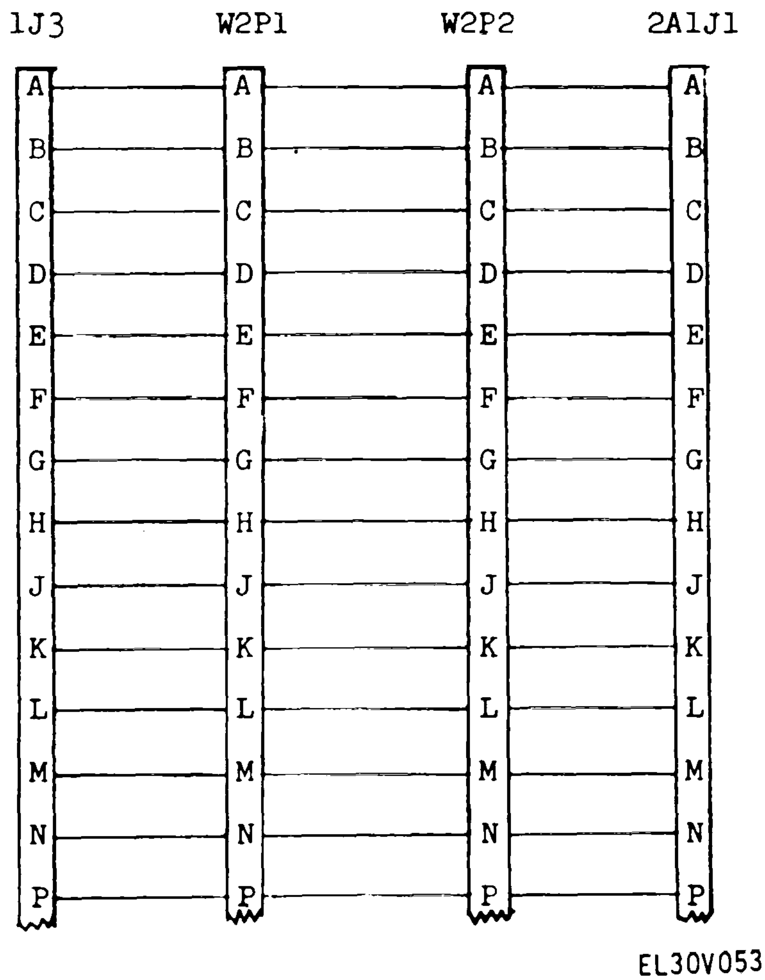


Figure 3-18. Interconnections to 1J3

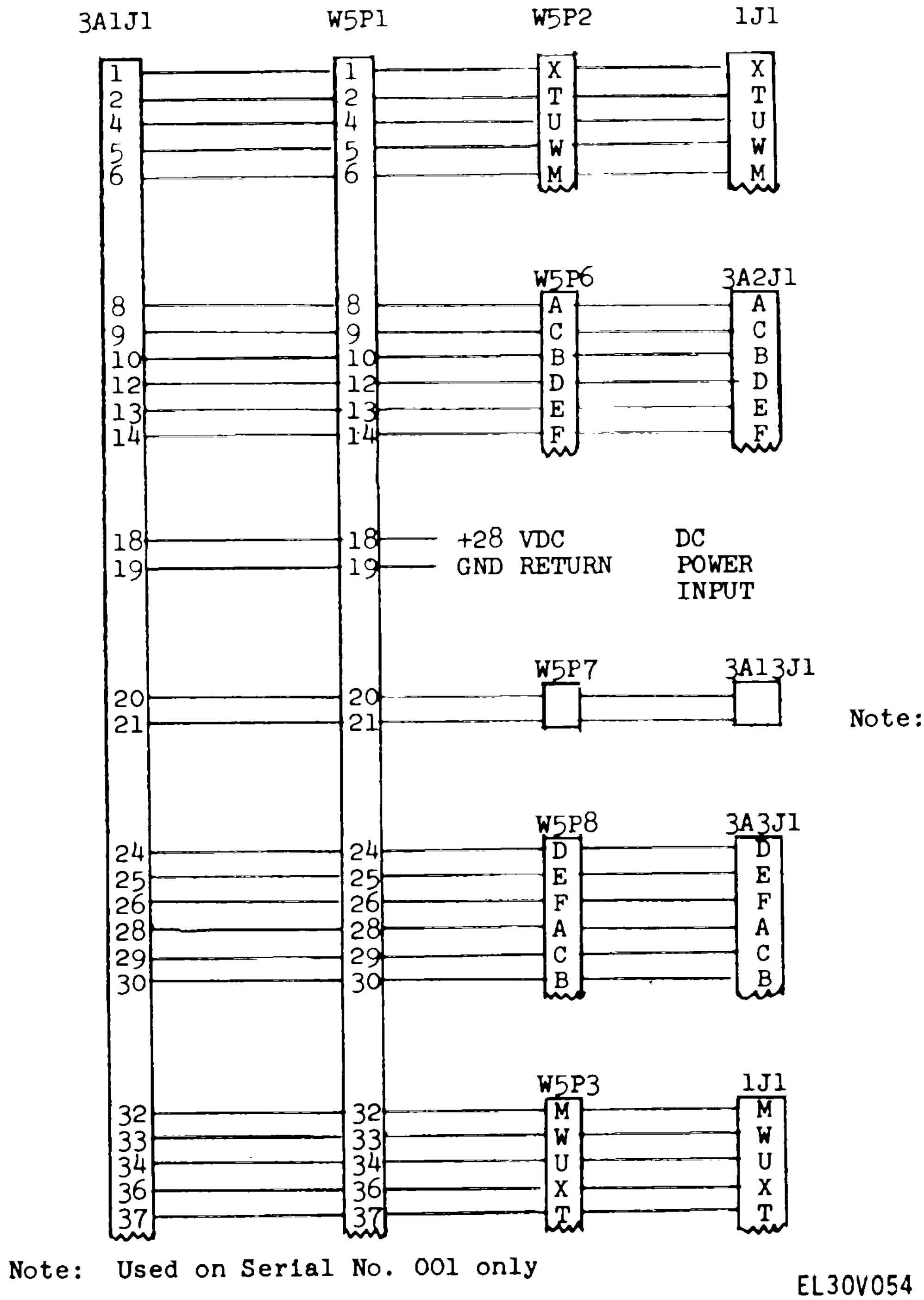
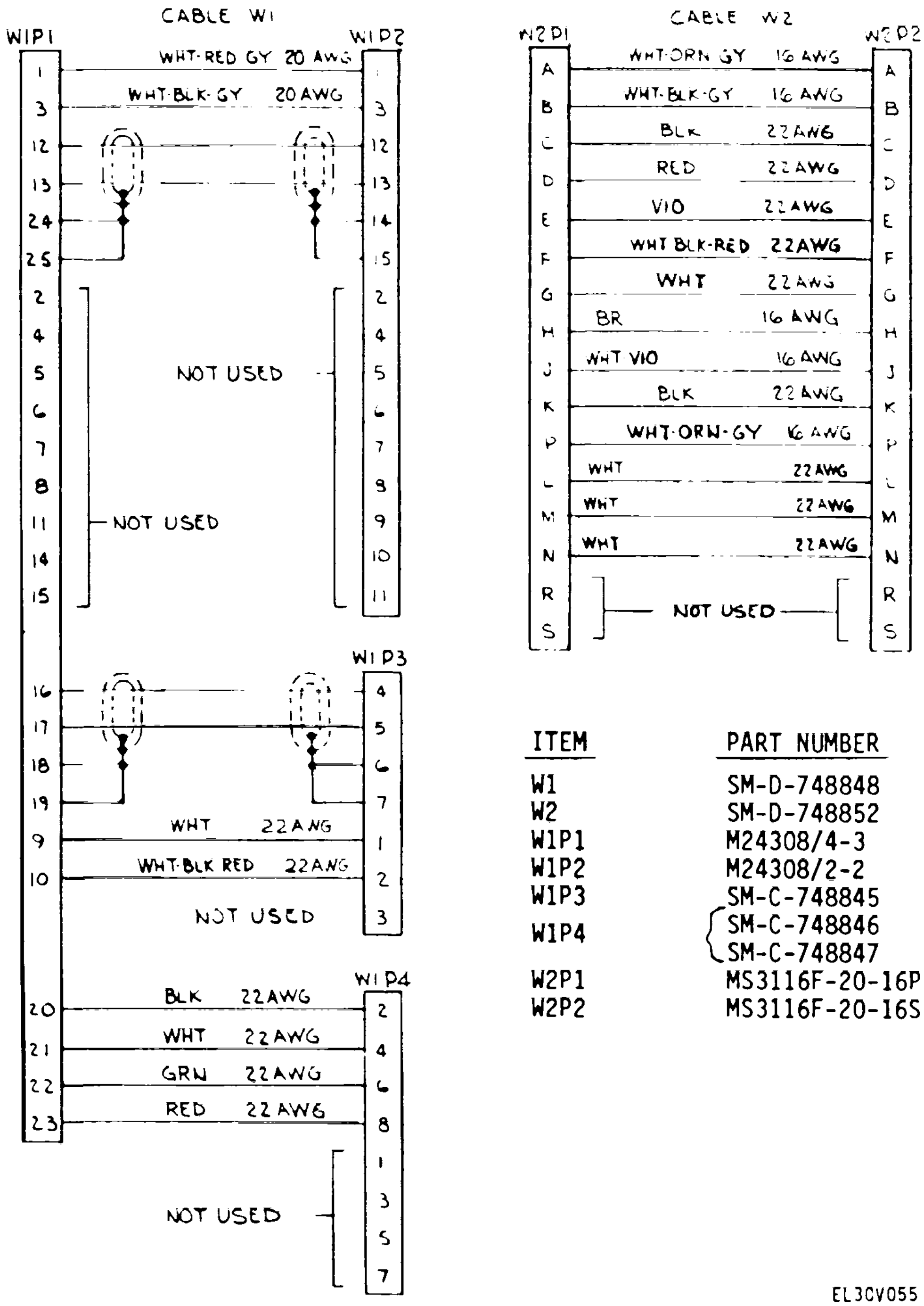


Figure 3-19. Interconnections to 3A1J1.



ITEM	PART NUMBER
W1	SM-D-748848
W2	SM-D-748852
W1P1	M24308/4-3
W1P2	M24308/2-2
W1P3	SM-C-748845
W1P4	SM-C-748846 SM-C-748847
W2P1	MS3116F-20-16P
W2P2	MS3116F-20-16S

Figure 3-20. Interconnection Cables W1 and W2.

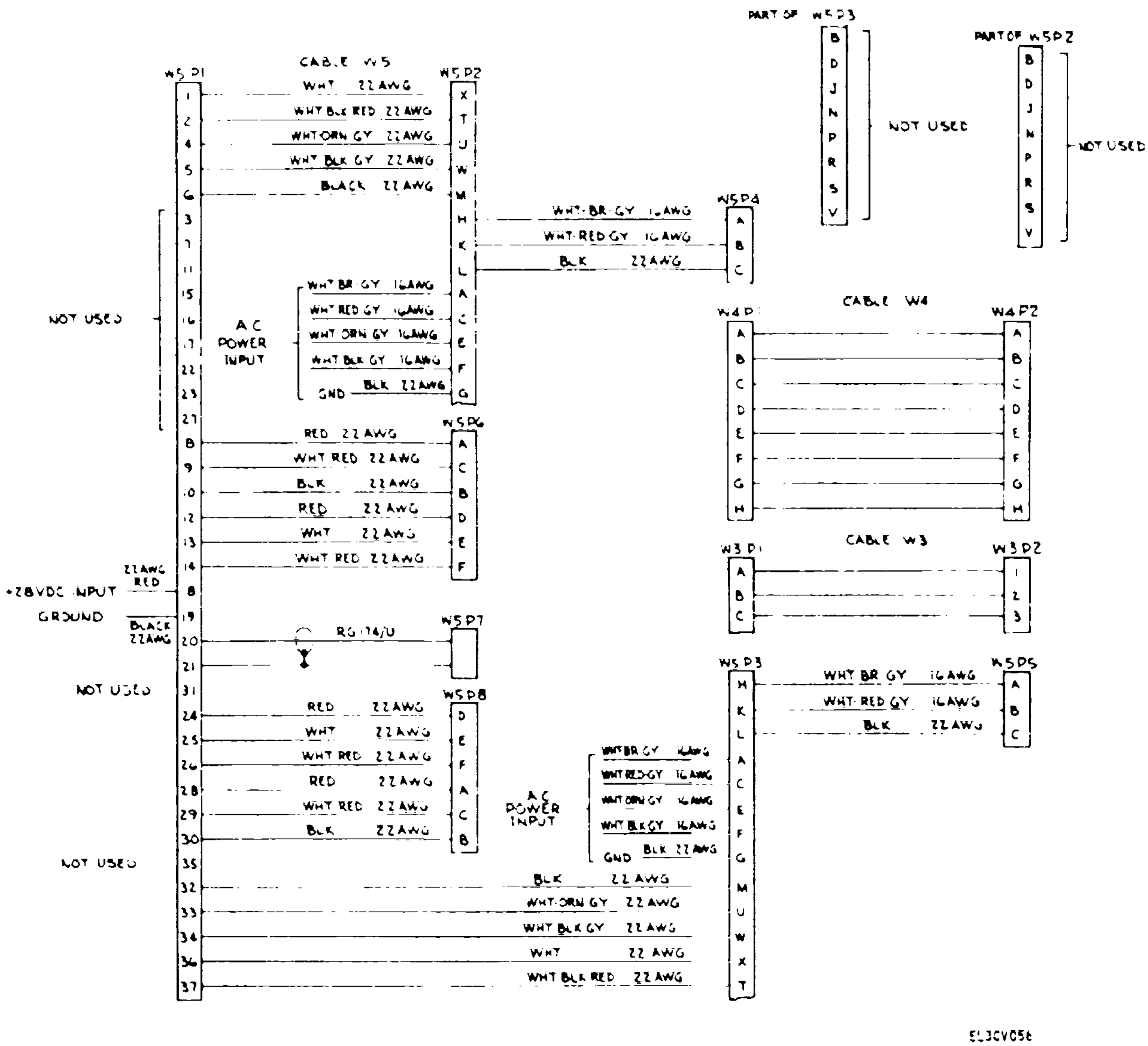


Figure 3-21. Interconnection Cables W3, W4, and W5.

APPENDIX A
REFERENCES

The following publications contain information applicable to the maintenance of Amplifier, Parametric AM-6602/MSC-46 (V) .

DA Pam 310-4	Index of Technical Publications: Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	US Army Equipment Index of Modification Work Orders.
TM 11-5820-801-30P	Direct Support Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts) for Amplifier, Parametric AM-6602/MSC-46(V).
TM 38-750	The Army Maintenance Management System (TAMMS).

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USA Dep (1)
Sig Sec USA Dep (1)
Ft Richardson (CERCOM Ofc) (2)
Units org under fol TOE:
29-207 (2)
29-610 (2)

NG: None
USAR: None
For explanation of abbreviations used, see AR 310-50.

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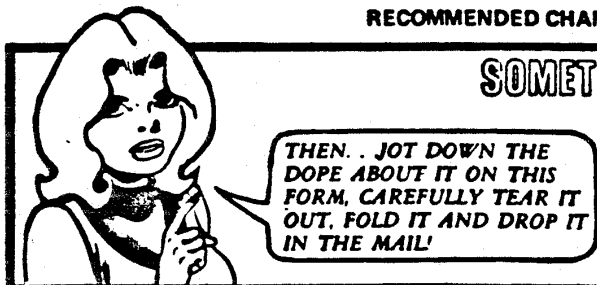

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