

TECHNICAL INSTRUCTIONS

®AMPFET ND1
AM BROADCAST TRANSMITTER
1000 WATT
(THREE PRESET POWER LEVELS)

C-QUAM AM STEREO

or

MONAURAL

(Capable of AM STEREO with externally generated RF drive)

Original Issue01 August 1994
Change 1..... 15 March 1995

AMPFET is a registered Trade Mark

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ISO 9002 REGISTERED



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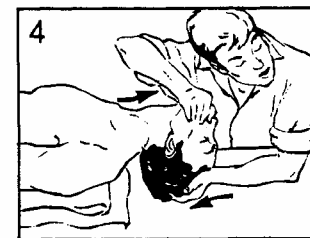
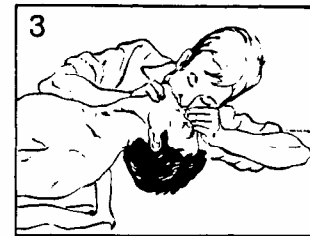
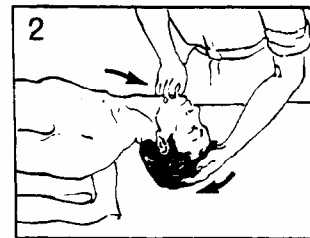
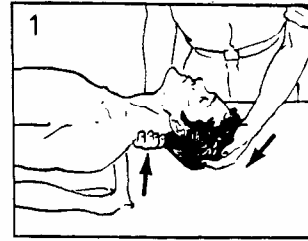
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ARTIFICIAL RESPIRATION (MOUTH-TO-MOUTH)

1. START MOUTH TO MOUTH BREATHING IMMEDIATELY, SECONDS COUNT. Do not wait to, loosen clothing, warm the casualty, or apply stimulants.
2. LAY CASUALTY ON HIS BACK and place any available jacket or blanket under his shoulders.
3. LIFT THE NECK. (Fig. 1)
4. MOVE FOREHEAD BACK as far as possible and open mouth by lifting jaw forward. (Fig. 2)
5. TAKE A DEEP BREATH and open your mouth widely.
6. PINCH CASUALTY'S NOSE and blow into casualty until you see the chest rise. (Fig. 3)
7. REMOVE YOUR MOUTH and let casualty's chest deflate. (Fig. 4)
8. CONTINUE MOUTH-TO-MOUTH BREATHING without interruption at the rate of 10 to 12 breaths a minute. If any air retained in the stomach after exhalation by casualty, press gently on stomach to expel air.
9. IF CHEST DOES NOT RISE CHECK for obstruction in casualty's mouth: Clear foreign material by turning the head to one side and using finger, tissues, etc. Check neck extension and recommence mouth-to-mouth breathing.
10. WHILE MOUTH-TO-MOUTH BREATHING IS CONTINUED have someone else:
 - (a) Loosen casualty's clothing
 - (b) Summon medical aid.
 - (c) Keep the casualty warm.
11. DON'T GIVE UP. Continue without interruption until the casualty is revived, or until a doctor pronounces the casualty is dead. Four hours or more may be required.
12. DO NOT LEAVE CASUALTY when he revives. Be ready to resume artificial respiration if necessary.
13. DO NOT give liquids while victim is unconscious.



GENERAL RULES FOR TREATMENT FOR BURNS, BLEEDING, AND SHOCK

1. After casualty has revived, treat for injuries and shock.
2. Reassure casualty.
3. Try to make him comfortable.
4. Keep him reasonably warm but do not apply heat.
5. If thirsty, liquids may be given but no alcohol (no liquids should be given in cases of severe burns).
6. Treat burns or wounds. Infection danger in treating burns or wounds is very great so ensure hands are clean and do not handle affected areas more than necessary.
7. Do not apply salves, grease, etc. to burns.
8. Do not remove burned clothing which adheres to the skin or break blisters.
9. Cover the burn with a dry sterile dressing, piece of sheeting, etc.
10. Bandage lightly over blisters where care must be taken to cover and not to break.
11. If severe bleeding of wound, elevate affected area, except in the case of a fracture.
12. Expose wound, remove visible foreign bodies and apply pressure.
13. Apply dressing, pad and bandage.
14. For burns and bleeding, immobilize injured part using splints if necessary and keep patient in restful position during removal to hospital or expert medical attention.
15. In all cases, send for medical aid immediately.

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ELECTRIC SHOCK - RESCUE METHODS

Electricity can damage the body in a number of ways. It may interfere with the proper functioning of the nervous system and the heart action, it can subject the body to extreme heat and can cause severe muscular contractions. The path that the current of electricity takes through the body is important. Currents which pass from hand to hand or from hand to foot may pass directly through the heart and upset its normal functioning. This threat to life is related to the amount of current or amperage which will flow through a victim's body. Very little current (as little as 10 milliamps) can result in severe shock.

Speed in the application of first aid measures is absolutely essential in cases of electrical injury. As soon as the victim is freed safely from the source of the electrical current, if breathing has stopped, artificial respiration should be commenced immediately. If the carotid pulse cannot be felt, external cardiac massage should be commenced simultaneously. Resuscitation should be continued until the patient is breathing on his own or until medical aid arrives. Survival rates can be quite high if cardio-pulmonary resuscitation is started within 3 to 4 minutes of the injury being received.

ACT AT ONCE - DELAY OR INDECISION MAY BE FATAL

1. Remove source or casualty from electrical contact.
2. Commence artificial respiration immediately.
3. Treat for burns, bleeding and shock.

REMOVING A CASUALTY FROM ELECTRICAL CONTACT

LOW VOLTAGE - 0 to 240 volts (household use)

Switch off the current, if possible and time permits. If the switch cannot be located immediately and the supply is through a flexible cord or cable, the current may be shut off by removing the plug or even breaking the cable or wrenching free. Never attempt to shut off current by cutting cord with a knife or scissors.

If the current cannot be shut off, the greatest care is necessary in removing the casualty. Household rubber gloves, rubber or plastic hose (if there is no water in them), a dry unpainted stick or a clean dry rope can be used to free victim.

HIGH VOLTAGE - 240 volts and up (industrial machines and power lines)

Do not touch any person or equipment in contact with a wire.

Use a dry unpainted pole, clean dry rope, dry rubber or plastic water hose to separate the casualty from the contact.

Keep as far away as possible.

Do not touch the casualty until he is free.

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WARRANTY

Nautical Electronic Laboratories Limited/Nautel Maine Incorporated, hereinafter referred to as Nautel, guarantees all mechanical and electrical parts of the equipment for a period of thirteen months from date of shipment.

- 1.A "Part Failure" shall be deemed to have occurred when the part has become defective, or does not have the characteristics required for the specified equipment performance:
 - (a) When the equipment is operated within the design parameters, and
 - (b)When the equipment is installed and adjusted according to Nautel's prescribed procedures as stated in the instruction manual.
2. Nautel shall provide replacements for all "Parts" at no cost to the Customer when they become defective during the warranty period, and upon the return of the defective part.
3. In the event that a "Part" fails during the warranty period and causes damage to a sub-assembly which cannot be readily repaired in the field, the entire sub-assembly so damaged may be returned to Nautel for repair. The repairs will be made without charge to the Customer.
4. Where warranty replacements or repair are provided under items 2 or 3, Nautel will pay that part of the shipping costs incurred in returning the part/assembly to the Customer.
5. Warranty replacement parts and repair, which are provided under items 2 or 3, shall be guaranteed for a period of ninety days from date of shipment or until the end of the original warranty period, whichever occurs later.
6. Nautel will not assume responsibility for any charges incurred by other than Nautel employees.
7. Nautel shall have the privilege of investigating whether failures have been caused by factors beyond its control.
8. Nautel shall in no event be liable for any consequential damages arising from the use of this equipment.
9. When requesting a warranty repair/replacement, please provide complete and accurate information. Observe the instructions regarding 'Equipment Being Returned to Nautel' on page two of this warranty and provide the information requested.
10. When ordering spare/replacement parts; please provide complete and accurate information. Refer to the parts list of this manual for ordering information. Provide as much of the information requested for 'Equipment Being Returned to Nautel' on page two of this warranty as is practical. The information identified by an asterisk is the minimum required.

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FACTORY SUPPORT

TECHNICAL ASSISTANCE

Nautel's field service department provides telephone technical assistance on a 24 hour, seven days a week basis. Requests by other media (facsimile or telex) will be responded to the next working day if received after Nautel's normal working hours. Contact the appropriate field service centre from the following:

United States of America customers use: Nautel Maine Incorporated
201 Target Industrial Circle
Bangor, Maine 04401

Telephone 207-947-8200 (24 hours)
Facsimile 207-947-3693

All other customers use: Nautical Electronic Laboratories Limited
Hackett's Cove, RR#1 Tantallon
Halifax County, Nova Scotia, Canada
B0J 3J0

Telephone 902-823-3900 (24 hours)
Facsimile 902-823-3183
Telex 019-22552

EQUIPMENT BEING RETURNED TO NAUTEL

All equipment being returned to Nautel and all requests for repairs or replacements should be marked 'field return' and addressed to the appropriate Nautel facility.

Complete and accurate information regarding the equipment being returned will ensure prompt attention and will expedite the dispatch of replacements. Refer to the nameplate on the transmitter and/or the appropriate module/assembly to obtain name, type, part and serial number information. Refer to the parts list of this manual or the appropriate service instruction manual for additional ordering information.

The following information should accompany each request:

- * Model of Equipment
- * Serial number of Equipment
- * Name of Part/Assembly
Serial number of Part/Assembly
- * Complete reference designation of Part/Assembly
- * Nautel's part number of Part/Assembly
- * OEM's part number of Part/Assembly
Number of hours in Use
Nature of defect
- * Return shipping address

* Denotes minimum information required to order spare/replacement parts

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1000 WATT AM BROADCAST TRANSMITTER
AMPFET ND1

SECTION 1
GENERAL INFORMATION

INTRODUCTION

1.1 The AMPFET ND1 AM broadcast transmitter is a totally solid state, medium wave, amplitude modulated, broadcast transmitter. It may be operated as a monaural or an AM stereo transmitter. The exciter panel contains the RF drive PWB, modulator driver PWB, RF drive amplifier and exciter power supply. The transmitter contains one RF power module and an AC/DC power supply. It operates at one preset frequency, in the AM broadcast frequency band, into a nominal 50 ohm, unbalanced, transmission line. Typically the transmitter will operate continuously at 125 percent positive peak program modulation at 1100 watts. Remote control interfacing is a standard feature.

FACTORY SUPPORT

1.2 Nautel provides after sales factory support. Technical assistance is available on a 24 hour, seven days a week basis. A factory service facility for repair of modules/assemblies is also available. Refer to the *Factory Support* portion of the *Warranty* pages at the front of this manual for additional information.

PURPOSE AND SCOPE OF MANUAL

1.3 This *Technical Instruction Manual* provides the information required to install, operate and maintain the transmitter. Detailed information for modules/assemblies, which are normally removed from the transmitter for servicing, is not included. *Service Instruction Manual* appendices provide information for troubleshooting and maintaining bench-repairable modules/assemblies used in the transmitter.

1.3.1 FAMILY TREE: The family trees for this transmitter are depicted in figures 7-1 and 7-2. They identify the major assemblies and shows their hierarchical assembly relationship. They also identify the reference designation assigned to each assembly and where their parts list is located.

PURPOSE OF EQUIPMENT

1.4 AMPFET ND1 1000 watt AM broadcast transmitters are intended to be used in conventional AM broadcasting stations. Remote control facilities are incorporated to allow unattended operation at a transmitter site, remotely located from station studios.

MECHANICAL DESCRIPTION

1.5 The AMPFET ND1 transmitter's modules/assemblies are housed in one cabinet. Figures MD-1 thru MD-13 provide assembly detail and identify the location of all electrical parts. The mechanical drawings are presented in order of the reference designation assigned to their assemblies. Refer to the list of drawings in table 10-1 to locate a specific illustration.

NOTE

Some modules/assemblies may have an alpha suffix on their designator (A, B, C, etc.). The suffix is assigned alphabetically and indicates the module contains minor component or circuit variations. Since a change that merits an alpha suffix change will normally enhance the operation of the affected module/assembly or compliment the operation of an external circuit, it is not recommended that later versions be interchanged with earlier versions. All earlier versions can be replaced by later versions.

TECHNICAL SUMMARY

1.6 Table 1-1 - Technical Summary, contains a detailed technical summary.

SPECIAL TOOLS AND TEST EQUIPMENT

1.7 Table 1-3 lists the special tools required. Table 1-2 - Test Equipment, lists the test equipment that is required to operate and maintain the AMPFET ND1 transmitter.

GLOSSARY OF TERMS

1.8 Table 1-4 - Glossary of Terms, provides a list of all unique terms, abbreviations and acronyms used in this publication.

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AMPFET ND1

Table 1-1 Technical Summary

Nautel Model Number	AMPFET ND1
Configuration	
(1)	One RF power module (Consists of 3 modulator/PA assemblies)
RF Output Power	
(1)	Rated - 1000 watts (capable 1100 watts)
(2)	Operating Range - 100 to 1100 watts
(3)	Three preset levels, selected locally or remotely
RF Frequency Range (supplied to one frequency as ordered)	530kHz to 1710kHz
RF Terminating Impedance	50 ohms, unbalanced
RF Terminating Device	7/8 inch EIA Flange
RF Frequency Stability	± 5 Hz or ± 5 ppm whichever is greater
RF Carrier Shift (100% Modulation).....	1%, or less
Type of Modulation	
Standard.....	Monaural
Optional.....	C-QUAM AM Stereo
Audio Input Impedance	
Monaural	600 ohms balanced
C-QUAM AM Stereo	Left and Right channels (Both 600 ohms balanced)
Audio Frequency Response	
Monaural	Within 1.0 dB from 30Hz to 10,000Hz
C-QUAM AM Stereo	Within 1.0 dB from 50Hz to 10,000Hz
Audio Input Level (Monaural).....	0dBm to +12dBm (+10dBm preferred)
Audio Input Level (C-QUAM AM Stereo)	
Left Channel.....	+10dBm to produce 50% envelope modulation (Right channel off)
Right Channel	+10dBm to produce 50% envelope modulation (Left channel off)
Audio Frequency Distortion	
Monaural	Better than 0.8% (THD) at 95% modulation 30-10,000Hz
C-QUAM AM Stereo	Less than 1.5% at 50% single channel modulation (50Hz - 10,000Hz) Reduced antenna bandwidth may degrade specification
Audio Intermodulation Distortion.....	1.0% or less, 60/7000Hz 1:1 ratio

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AMPFET ND1

Table 1-1 Technical Summary (Continued)

Modulation Capability	
Monaural	125% positive peak modulation
C-QUAM AM Stereo (L+R Envelope)	125% positive peak modulation
Incidental Phase Modulation (IPM)	
Monaural	Better than -36dB relative to 95% modulation at 1000Hz
C-QUAM AM Stereo	L-R modulation better than -36dB relative to 100%, when L+R envelope modulation is 95% at 1000Hz
RF Harmonics/Spurious Outputs	
	-77 dB or better relative to carrier Meets or exceeds FCC, DOC and CCIR requirements, when preceded by external NRSC compatible audio filtering
Noise and Hum (Unweighted)	
Monaural	-60 dB or better relative to 100% modulation
C-QUAM AM Stereo	-60 dB or better relative to 100% (L+R) modulation
Metering	
(1)	Forward/reflected output power
(2)	Total DC input current/voltage to RF power modules
Remote Control	
(1)	RF power stage on/off
(2)	1 of 3 preset RF output power levels
(3)	External interlock
(4)	RF output power trim
(5)	Instantaneous RF power off/on
Remote Monitoring	
(1)	Forward power level
(2)	Reflected power level
(3)	RF Monitor output (station modulation monitor)
(4)	RF power stage ON/OFF status
(5)	Local/remote control status
(6)	Power level status
(7)	RF Ready status
(8)	RF Drive level alarm
(9)	High B- alarm
(10)	High AC alarm
(11)	Low AC alarm
(12)	RF Drive Tuning alarm
(13)	SWR Shutback (RF power off) alarm
(14)	SWR Cutback (RF power reduced) alarm
(15)	RF Current alarm
(16)	Interlock Open alarm
(17)	Frequency Monitor (RF drive)

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Table 1-1 Technical Summary (Continued)

AC Power Source	
(1)	230 volts, line-to-line (North American style), 60Hz, 4-wire
(2)	230 volts, line-to-neutral (European style), 50Hz, 3-wire
Permissible Power Supply Variations	
Voltage	+10/-5%
Frequency	±5%
Power Consumption	
0% modulation	1430 watts
100% modulation	2140 watts
Power Factor	0.82 or better
Overall Efficiency	Better than 70%
Environmental Limits	
Temperature (derate 3°C per 500m/2°C per 1000 ft above sea level)	-10°C to +50°C
Relative Humidity	0 to 95%
Altitude	0 to 13,000 feet (0 to 4000m)
Transmitter Dimensions	
Height	65.0 inches (165 cm)
Width	22.5 inches (61 cm)
Depth	24.0 Inches (61 cm)
Weight	425 pounds (193 kg)

NOTE: Technical specifications established at 1000 watts RF output power into a 50 ohm load.

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AMPFET ND1

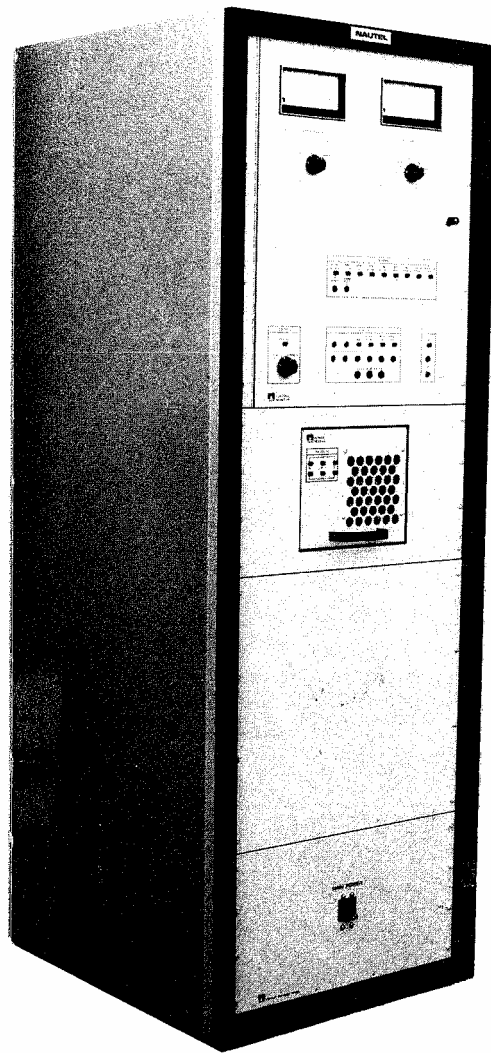


Figure 1-1 AMPFET ND1 - 1000 Watt AM Broadcast Transmitter

1000 WATT AM BROADCAST TRANSMITTER
AMPFET ND1

Table 1-2 Test Equipment

NOMENCLATURE	PART, MODEL, OR TYPE NUMBER (EQUIVALENTS MAY BE USED)	APPLICATION
Dummy Load	50 ohms, 2400 Watts (minimum) VSWR 1.1	'off-air' testing
Digital Multimeter	3 1/2 digit, AC and DC volts (10M ohms input), ohms and amps, $\pm 0.5\%$ accuracy, Beckman 3010	testing and maintenance
Frequency Counter	5ppm up to 10MHz Fluke Model 1900A	measure carrier frequency
Oscilloscope	Tektronix Model T922	testing and maintenance
RF Drive Tuning Adapter	Nautel P/N 165-1031-01	Used to tune RF drive shunt inductor in RF power modules.
Modulation Monitor	-100% to +125% TFT Model 375	to set up audio level
OR		
Modulation Monitor (AM Stereo)	50-ohm input impedance -100% to +125% modulation Motorola Model 1410	to set up audio level
Audio Signal Generator	10Hz to 10kHz, 600 ohms, 0 to +12dBm Hewlett Packard model 651B	simulates modulating audio input during testing and maintenance
Distortion Analyzer	20Hz to 20kHz Marconi Model TF231	measures audio distortion during testing and maintenance
Function Generator	sine, square and triangular waveform with DC offset Hewlett Packard model 3310A	signal source for module
15VDC Power Supply	15 volts, 1 amp	DC power source for module tests
24VDC Power Supply	24 volts, 1 amp	DC power source for module tests
100VDC Power Supply	0-100 volts, 0.5 amp	DC power source for module tests

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Table 1-3 Special Tools

NOMENCLATURE	PART, MODEL, OR TYPE NUMBER (EQUIVALENTS MAY BE USED)	APPLICATION
Tuning Tool	HAG38*	Setting carrier frequency. Adjust output levels.
Torque Wrench	Capable of torquing to five inch-pounds (0.665 Newton-Meters)	Installing power MOSFETS

* - Manufactured by, or available from, Nautel

Table 1-4 Glossary of Terms

TERM	DESCRIPTION
AMPFET	NAUTEL's nomenclature for this fully solid-state series of broadcast transmitters.
Integral Modular Reserve (IMR)	Identical modules operating in an overall system design such that failure of individual modules results in a power reduction only and not a complete system shutdown.
Modular Redundancy	Identical modules operating in an overall system design such that failure of one module does not affect the output of the system.
PWM	Pulse width modulation.
Power Level Cutback Cycle	A cycle within the internal control of the system, which, when activated, results in the modulator drive being reduced to effectively zero until the fault has been removed following which the level returns to normal.

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SECTION 2
THEORY OF OPERATION

GENERAL

2.1 The theory of operation for the subject transmitter is presented in this section. Unique circuits are explained.

TRANSMITTER DESCRIPTION (see figure SD-1)

2.2 The transmitter operates at one fixed frequency between 530kHz and 1710kHz and provides up to 1100 watts RF output power. It may be operated locally when co-located with the studio, or remotely when the studio is at a different site. For technical performance details, refer to Table 1-1 - Technical Summary. The transmitter comprises four functional blocks; control/monitor function, exciter stage, RF power stage (consists of the RF power module and the RF output filter) and the AC/DC power stage.

CONTROL/MONITOR FUNCTION

2.3 The control/monitor function comprises the control/monitor panel, control interface PWB and remote interface PWB.

2.3.1 CONTROL/MONITOR PANEL (see figure SD-2): The control/monitor panel provides local controls and analog meters to display RF power and critical DC voltage/current levels. It contains three printed wiring boards; the control interface PWB and a meter calibration PWB for each meter. The control interface PWB is mounted on the rear of the panel. Its routinely monitored indicators/switches protrude through and are accessible/viewed from the panel front. The control/monitor panel also contains a local/remote **CONTROL** switch, which determines if control of the transmitter is local or from a remote location.

2.3.1.1 DC Supply Meter: DC supply meter monitors DC power supply parameters. It consists of **DC SUPPLY** meter M1, **DC SUPPLY** switch S1 and meter calibration PWBA2. *Current (+ve)* (P8-H) and *current (-ve)* (P8-C) inputs from a precision current shunt resistor in the AC/DC power supply are applied to the meter when the **DC SUPPLY** switch is set to **B-AMPS**. Alternate settings of the **DC SUPPLY** switch

allow measurement of PA volts (from RF power module) and +15, -15, +24 and B- DC power supply voltages. The meter cal PWB contains electrical adjustments for voltage and current scales.

2.3.1.2 Output Power Meter: The output power meter circuit monitors transmitter output power. It consists of **OUTPUT POWER** meter M2, **OUTPUT POWER** switch S3, **READ LOWER SCALE** switch S4 and meter cal PWB A3. When the **OUTPUT POWER** switch is set to **FORWARD POWER**, the DC voltage *forward power* input (P8-J), from the forward/reflected power probe, is applied to the **OUTPUT POWER** meter. When the **OUTPUT POWER** switch is set to **REFLECTED POWER**, the *reflected power* input (P5-12), which is also a DC voltage from the forward/reflected power probe, is applied to the meter. The **READ LOWER SCALE** switch increases the power reading by a factor of four when it is held depressed. Meter cal PWB assembly A3 provides electrical accuracy adjustments for both upper and lower scales of the meter.

2.3.2 CONTROL INTERFACE PWB (see figure SD-2): The control interface PWB controls the RF drive, modulator drive and RF power amplifier stages. Refer to its service instruction manual for detailed circuit information. Its primary functions are:

- Produces a DC voltage *gain control* output that ultimately determines the forward power (RF carrier) level of the RF output. This voltage is the reference voltage for a variable pulse width modulation (PWM) generator.
- Monitors critical parameters and causes the *gain control* voltage to be turned off (shutback) or reduced (cutback) when defined fault threshold limits are exceeded
- Identifies the out-of-tolerance parameter, when the carrier level is shutback/cutback by providing a visual indication for local monitoring or an electrical status output for remote monitoring.
- Determines on/off status of RF power stage.

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2.3.2.1 Supply Voltage Monitor: The *24 VDC ref* input (P3-3) is an unregulated DC voltage which is proportional to the AC power source voltage. It is compared to fault thresholds that provide an operating window (normally plus or minus ten percent). If the voltage is not maintained within this window, the *gain control* output will be clamped to 0.0 VDC and a 15.0 VDC *shutback* output (P4-1) will be applied to the exciter stage and inhibit the modulator drive. The transmitter's RF output will be turned off (shutback) and will remain off until the AC power voltage is restored to a voltage within the operating window.

2.3.2.1.1 When the *24 VDC ref* input falls to the low AC threshold, the **LOW AC PWR ALARM** lamp will turn on and a 15 VDC *low AC alarm* (P3-8) output will be applied to the remote interface PWB for external monitoring. When normal operation is resumed, the *low AC alarm* output will return to an open collector but the **LOW AC PWR ALARM** lamp will remain on as a maintenance aid. It will remain on until the **ALARM RESET** switch is activated.

2.3.2.1.2 When the *24 VDC ref* input exceeds the high AC threshold, the **HIGH AC PWR ALARM** lamp will turn on and a 15 VDC *high AC alarm* (P3-7) output will be applied to the remote interface PWB for external monitoring. When normal operation is resumed, the *high AC alarm* output will return to an open collector but the **HIGH AC PWR ALARM** lamp will remain on as a maintenance aid. It will remain on until the **ALARM RESET** switch is activated.

2.3.2.2 B- VDC Monitor: The *B- VDC* input (P3-9) is representative of the negative DC voltage applied to the RF power amplifiers as their high current voltage source. When it is more negative than -82.0 VDC, the *gain control* output will be clamped to 0.0 VDC and a 15.0 VDC *shutback* output (P4-1) will be applied to the exciter stage and inhibit the modulator drive. The transmitter's RF output will be instantly shutback (turned off). The **HIGH B- ALARM** lamp will turn on and a 15 VDC *high B- VDC alarm* (P3-6) output will be applied to the remote interface PWB for external monitoring. When the B- DC voltage is restored to a level that is less negative than -82.0 VDC, normal operation will resume. The *high B- VDC alarm* output will return to an open collector but the **HIGH B- ALARM** lamp will remain on as a maintenance aid. It will remain on until the **ALARM RESET** switch is activated.

2.3.2.3 RF Drive Level Monitor: The *RF drive level* input (P3-10) is a DC voltage that is representative of the amplitude of the RF drive being applied to the RF power amplifiers. When the *RF drive level* input falls below 36.0 VDC, the *gain control* output will be clamped to 0.0 VDC and a 15.0VDC *shutback* output (P4-1) will be applied to the exciter stage to inhibit the modulator drive. The transmitter's RF output will be instantly shutback (turned off). The **LOW RF DRIVE ALARM** lamp will turn on and a 15 VDC *low RF drive alarm* (P3-5) output will be applied to the remote interface PWB for external monitoring. When the RF drive is restored, normal operation will resume. The *low RF drive alarm* output will return to an open collector but the **LOW RF DRIVE ALARM** lamp will remain on as a maintenance aid. It will remain on until the **ALARM RESET** switch is activated.

2.3.2.4 Reflected Power Monitor: The *reflected power* input (P6) is a DC voltage which is proportional to the reflected power sensed at the transmitter's output. When the reflected power exceeds 175 watts, the *reflected power* input will be more than 2.7 VDC and it will exceed the high SWR fault threshold. The *gain control* output will be clamped to 0.0 VDC and a 15.0 VDC *shutback* output (P4-1) will be applied to the exciter stage to inhibit the modulator drive. A clock pulse (maximum of one per second) will also be applied to an alarm count/cutback circuit. The RF output will be instantly shutback (turned off). The **SWR SHUTBACK ALARM** lamp will turn on and a 15 VDC *SWR shutback alarm* (P3-4) output will be applied to remote interface PWB for external monitoring.

2.3.2.4.1 Turning off the RF output will result in the *reflected power* input being reduced to 0.0 VDC. The *gain control* output will be restored to its pre-shutback level, the *shutback* output will return to an open collector and the RF output will be restored at an exponential rate over a 250 milli-second period. If the high SWR fault threshold is exceeded before the preset power level is reached, the shutback cycle will be repeated.

2.3.2.4.2 If four or more shutback cycle clock pulses are applied within any 20 second period, the **SWR CUTBACK ALARM** lamp will turn on and a 15 VDC *cutback alarm* (P4-10) output will be applied to the remote interface PWB for external monitoring. The

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gain control output will be cutback (reduced) by one increment (approx 10%) for each count in excess of three until the carrier level is cutback (reduced) to a level that results in an acceptable reflected power. The alarm count/cutback counter will automatically reset 20 seconds after the first clock count, provided a count of nine has not been attained. When it is reset, the *SWR cutback alarm* output will return to an open collector but the **SWR CUTBACK ALARM** lamp will remain on as a maintenance aid. At the ninth clock pulse, the *gain control* output will be clamped to 0.0 VDC and a 15.0 VDC *shutback* output will be applied to the exciter stage to inhibit the modulator drive. The RF output will be shutback (turned off) until the counter is reset by the application of an alarm reset command (locally or remotely).

2.3.2.4.3 When the *reflected power* input returns to or is maintained at a level which is less than the high reflected power fault threshold, the *SWR shutback alarm* output will return to an open collector but the **SWR SHUTBACK ALARM** lamp will remain on as a maintenance aid. It will remain on until the **ALARM RESET** switch is activated.

2.3.2.5 RF Current Monitor: The *RF current sample* input (P7) is an RF voltage that is proportional to the total RF current being applied to the RF output filter by the RF power amplifiers. When it exceeds a high RF current fault threshold, the *gain control* output will be clamped to 0.0 VDC and a 15.0 VDC *shutback* output (P4-1) is applied to the exciter stage to inhibit the modulator drive. A clock pulse will also be applied to the alarm count/cutback circuit. The RF output will be instantly shutback (turned off). The **HIGH RF CURRENT ALARM** lamp will turn on and a 15 VDC *high RF current alarm* (P3-1) output will be applied to the remote interface PWB for external monitoring.

2.3.2.5.1 Turning off the RF output will result in the *RF current sample* input being reduced to 0.0 VDC. The *gain control* output will be restored to its pre-shutback level, the *shutback* output will return to an open collector and the transmitter's RF output will be restored at an exponential rate over a 250 millisecond period. If the high RF current fault threshold is exceeded before the preset power level is reached, the shutback cycle will be repeated. If more than three shutback cycles are initiated in any twenty second period, the alarm count/cutback circuit will affect the RF output as described in paragraph 2.3.2.4.2.

2.3.2.5.2 When the *RF current sample* input returns to a level that is less than the high RF current fault threshold, the *high RF current alarm* output will return to an open collector but **HIGH RF CURRENT ALARM** lamp will remain on as a maintenance aid. It will remain on until the **ALARM RESET** switch is activated.

2.3.2.6 RF Drive Control: An RF drive control circuit provides a 24 VDC *RF drive enable* output to turn on the RF drive amplifier in the exciter stage.

2.3.2.6.1 The application of an open collector *RF inhibit* input (P2-2), a positive voltage *tune alarm* input (P1-2) or the presence of a high B- VDC alarm will cause the *RF drive enable* output to change to an open collector, turn off the RF drive amplifier and inhibit its RF drive output.

2.3.2.6.2 If the RF drive was turned off because of a positive voltage *tune alarm* input, the RF drive will be inhibited, the **RF DRIVE DETUNE ALARM** lamp will turn on and a 15 VDC *detuned RF drive* (P4-11) output will be applied to the remote interface PWB for external monitoring. The RF drive will be inhibited, the **RF DRIVE DETUNE ALARM** lamp will remain on and the *detuned RF drive* output (P4-11) will be 15 VDC until the RF drive control circuit is manually reset by actuating the **RF TUNING RESET** switch on the control interface PWB.

- An open collector *RF inhibit* signal is produced by the exciter stage's RF drive PWB when its RF drive output is inadequate.
- A positive voltage in excess of 1.0 VDC is produced as the *tune alarm* signal, by the exciter stage's RF drive amplifier when the RF drive output impedance is not correct.

2.3.2.7 RF On/RF Off Select: A bistable relay (K1) controls distribution of the AC/DC power supply's unregulated 24 VDC. When the relay is latched in its 'on' state, the **RF ON** lamp will be turned on and 24 VDC will be applied thru P5-1 to the interlock circuit as the *24 VDC (RF on)* output. When the relay is latched 'off', the **RF ON** lamp will be off and the *24 VDC (RF on)* output will be an open circuit (0.0 VDC). The control source for the relay's 'on' state is dependent on the control/monitor panel's **CONTROL** switch setting. Its 'off' state can be selected locally or remotely when the **CONTROL** switch is set to **REMOTE**.

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2.3.2.8 Preset Power Level Select: Two bistable relays (K3/K4), that have their contacts connected as binary counters, determine which one of four preset power levels are selected.

2.3.2.10.1 The resultant binary number causes:

- one of four voltages to be selected as the source voltage for the *gain control* (P1-10) output.
- the **OUTPUT POWER** lamp (**HIGH, LOW 1, LOW 2** or **AUTO**) that is associated with the selected voltage source to turn on.
- 15 VDC to be applied to the appropriate *power status* [*high* (P2-1), *low 1* (P2-4), *low 2* (P2-8) or *auto* (P2-9)] output for remote monitoring.

2.3.2.8.2 The voltage sources for the **High, Low 1** and **Low 2** selections are provided by precisely adjusted voltage dividers on the control interface PWB. The voltage source for the auto selection is provided by an optional power level controller. An optional power level controller can not be used, therefore auto power cannot be selected if the optional C-QUAM AM stereo PWB is installed as the RF drive source.

2.3.2.9 RF Power Level Trim: The *power increase* (P1-4) and *power decrease* (P1-3) inputs control a sixteen bit binary up/down counter that causes the voltage of the *gain control* output (P1-10) to change approximately 0.15 VDC at each count change. The counter is preset to a count of eight when the RF power stage is turned on. This value is used when setting the preset forward power levels. Any count change will increase or decrease this preset level and will cause the RF power level to increase or decrease proportionally.

2.3.2.10 Battery Backup for Local Alarm Latches: A 9 volt battery provides backup power for the *high B- VDC, high AC, low AC, low RF drive, SWR shutback, SWR cutback* and *high RF current* alarm latching circuits. In the event of a power failure, the battery voltage will ensure any alarm that was latched, prior to the failure, will still be latched when power is restored. The local **ALARM** lamps will not be on during a failure since the battery does not provide backup power for them.

2.3.3 SAFETY INTERLOCK: The 24 VDC (*RF on*) output at P5-1, is applied through the remote interface PWB, through the normally closed external interlock switches, through the remote interface PWB (P6-9); where it emerges as the 24 VDC (*RF on*) output. If all external interlock switches are closed, 24 VDC will be applied to the control interface PWB (P5-3) and to the RF power modules in the RF power stage. If any interlock switch is open, the 24 VDC (*RF on*) output will be an open circuit and will not provide 24 VDC. The **INTERLOCK OPEN ALARM** lamp will be on and 24 VDC will be applied to the remote interface PWB as the *interlock open alarm* (P5-4) output.

2.3.4 REMOTE INTERFACE PWB (see figure SD-3): The remote interface PWB contains the customer interface connections for remote control and remote alarm/status monitoring. RFI filtering is provided on all input/output lines to ensure transmitter operation is not interrupted due to RF pick-up on control lines. The current sinks for remote monitoring are also on the remote interface PWB. Refer to the remote interface PWB service instruction manual for detailed information.

2.3.5 MODULATION MONITOR PWB (see figure SD-4): The *RF sample* input is applied to the contacts of a relay switching circuit. The DC voltage level on *gain control* input energizes the appropriate relay(s) to provide 6.0 \pm 2.0 volts RMS into a 1000 ohm load as the *modulation monitor* output, when the RF output is between 100 watts and 1100 watts. Refer to the modulation monitor service instruction manual for detailed information.

EXCITER STAGE (see figure SD-4)

2.4 The exciter stage provides the *RF drive (fc)* and the variable pulse width *mod drive (fpwm)* for the RF power stage. It is controlled by commands from the control/monitor function, the AC/DC power stage and the RF power stage. It also contains monitoring circuits that provide control signals for protection circuits in the control/ monitor function. They include an *RF inhibit* which is present when there is no RF drive, a *tune alarm* which is present when the output of the RF drive amplifier is mistuned and an *RF drive level* which is a DC voltage that is proportional to the peak- to-peak amplitude of the RF drive being applied to the RF power stage.

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2.4.1 MONAURAL/THIRD PARTY AM STEREO (see figure SD-4) An exciter stage which is configured for monaural or third party AM stereo operation contains; one low voltage power supply (A2A2), one monaural RF drive PWB (A2A3), one modulator driver PWB (A2A4) and one RF drive amplifier (A2A5). It does not contain the optional C-QUAM AM stereo exciter PWB (A2A7). The setting of the **STEREO ENABLE** switch and the resultant status of relays A2K1/A2K2 will determine if the RF drive PWB is enabled and connected as the RF drive and $2fc/N$ source. The **STEREO ENABLE** switch must be set to **OFF** and relays A2K1/A2K2 must be de-energized.

2.4.2 C-QUAM AM STEREO (see figure SD-4): An exciter stage configured for C-QUAM AM stereo operation contains; one low voltage power supply (A2A2), one modulator driver PWB (A2A4), one RF drive amplifier (A2A5) and one C-QUAM AM stereo exciter PWB (A2A7). It does not contain the monaural RF drive PWB (A2A3). The setting of the **STEREO ENABLE** switch and the resultant status of relays A2K1/A2K2 will determine if the C-QUAM AM stereo exciter PWB is enabled and connected as the RF drive and $2fc/N$ source. The **STEREO ENABLE** switch must be set to **ON** and relays A2K1/A2K2 must be energized.

2.4.3 LOW VOLTAGE POWER SUPPLY (see figure SD-4): The low voltage power supply contains the transmitter's unregulated +24 VDC, regulated +15 VDC and regulated -15 VDC power supplies. 17.5-0-17.5 volts AC is applied to P18-1/2/3 from a set of centre-tapped secondary windings of the main power transformer. This voltage is full-wave rectified and converted to unregulated +24 VDC and -24 VDC outputs. Refer to the low voltage power supply's service instruction manual for additional information.

2.4.3.1 The unregulated +24 VDC output (P18-3) is applied to the transmitter's control circuits and is switched by the safety interlock circuitry (see paragraph 2.3.3). It is returned as the 24 VDC(RF on) input to P18-4 and is applied to a +15 VDC regulator. The resultant regulated +15 VDC (P18-9) is applied to the transmitters logic circuits.

2.4.3.2 The full-wave rectifier's unregulated -24 VDC output is applied to a -15 VDC regulator. The resultant regulated -15 VDC (P18-8) is applied to the transmitters logic circuits.

2.4.4 MODULATOR DRIVER PWB (see figure SD-4): The modulator driver PWB accepts and processes the *600 ohms balanced audio* input (J2-6, 7 and 8) when a monaural RF drive PWB is the RF drive source or an unbalanced L+R audio when a C-QUAM AM stereo exciter PWB is the RF drive source. The *B- VDC* and *gain control* inputs are applied to an analog multiplier, where they are combined with the processed (low pass filtered) audio to produce a DC reference voltage. The DC reference is proportional to the RF output's carrier level and it varies at the rate and amplitude of the audio. The variable pulse width generator compares the PWM ramp integrator circuit's triangular output, generated by the RF drive PWB at the $2fc/N$ input (J3), with the carrier reference/audio signal from the multiplier circuit and produces a rectangular waveform switching between zero and 15.0VDC as the *mod drive* output (J1-9). When a peak of the *mod envelope* input (J2-3) exceeds preset amplitude/ duration limits, the remaining portion of that half cycle of audio input will be inhibited. A protection circuit, within the variable pulse width generator's circuit, monitors the width of the mod drive pulses and inhibits the *mod drive* output when the width exceeds its safe limits. A 15.0 VDC *shutback* input (J1-5) will cause *mod drive* output to be clamped to ground. Refer to modulator driver PWB service instruction manual for detailed information.

2.4.5 C-QUAM AM STEREO EXCITER PWB (see figure SD-4): When a C-QUAM AM stereo exciter PWB is installed, it is the low level RF drive source. It also provides a $2fc/N$ output (see table 3-4 for frequency) that determines the frequency (*fpwm*) of the exciter's variable pulse width *mod drive* and it processes the balanced left and right audio inputs. The processed audio results in a L+R audio, which is applied to the modulator PWB as an unbalanced audio for amplitude modulation, and a L-R audio, which is combined with a 25Hz pilot frequency as the carrier frequency's quadrature phase modulating source. It also produces an *RF inhibit* output to control the RF drive amplifier's on/off state. This output is a current sink to ground when the RF drive level is satisfactory or an open collector when it is not.

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2.4.5.1 A stereo on/off switch provides a choice for the RF drive output. The RF drive may be a conventional (monaural) unmodulated carrier (switch set to off) or it may be a quadrature phase modulated (AM stereo) carrier that contains the L-R audio and pilot frequency information (switch set to on). In both cases, the RF drive frequency is the assigned carrier frequency (f_c), which is a derivative of an integral crystal controlled oscillator that operates at four times the carrier frequency ($4f_c$). Calibration adjustment/selections provide the delays, symmetry and balancing required for optimum AM stereo performance. The *PA volts* input; which is a sample of the B-VDC, complete with modulating audio, being applied to the final RF power amplifiers; is used by the calibration circuits to minimize incidental phase modulation introduced by the RF power amplifier stages.

Refer to the C-QUAM AM stereo exciter PWB's service instruction manual for detailed information.

2.4.6 RF DRIVE PWB (see figure SD-4): The RF drive PWB produces an internally generated RF drive source for the transmitter or accepts an externally generated RF drive source. Incidental phase modulation (IPM) adjustment and a programmable pulse width modulation (PWM) divider are also contained within the RF driver's circuits. The *PA (power amplifier) volts* input (J1-7) is monitored by the IPM correction circuit, which compensates for any incidental phase modulation caused by the RF power stages. The *RF drive* output (J1-2), when present, is a 15.0 VDC peak-to-peak square wave at the carrier frequency (f_c). When the *RF drive* output is present, the *RF inhibit* output will be a current sink to ground. When no *RF drive* output is present, the *RF inhibit* output will be an open collector. The N divider circuit accepts an RF signal at twice the carrier frequency ($2f_c$) and generates a zero to 15.0 VDC $2f_c/N$ output (J2). Refer to the RF drive PWB service instruction manual for detailed information.

2.4.7 RF DRIVE AMPLIFIER (see figure SD-4): The RF drive amplifier buffers the *RF drive* signal and provides an amplified RF drive for the RF power modules. Monitoring circuits generate a *tune alarm*, nominally 1.0 VDC, when the RF drive signal is being operated into a load that is not properly tuned. Refer to the RF drive amplifier service instruction manual for detailed information.

2.4.6.1 The RF drive amplifier's *RF drive* output is series tuned by its ***RF Drive Tuning*** inductor A5L1 and the appropriate capacitor(s) on the RF drive control PWB. The resultant sine wave signal is then applied to the RF power modules in the RF power stage, as their *RF drive*. A peak detector provides a positive DC voltage as the *RF drive level* output (approximately 39VDC when the *RF drive* is 84 volts peak-to-peak). It is applied to a protection circuit on the control interface PWB. When the *RF drive level* output falls below 36 VDC, an RF shutback command is generated. The RF output is instantly turned off and local/remote alarms are turned on (refer to paragraph 2.3.2.3).

RF POWER STAGE (see figure SD-1)

2.5 The RF power stage consists of one RF power module (A2) and the RF output filter (A6).

2.5.1 RF POWER MODULE: The RF power module contains three wideband, modulator/power amplifier assemblies that provide up to 1100 watts of unmodulated, RF carrier power to an AMPFET ND1's RF output, when they are all contributing equally. The RF output requires a fifty ohm terminating impedance. The *RF drive* input circuit, which is common to all of the modulator/power amplifiers, is precisely tuned to the carrier frequency. In addition to the RF output, *PA volts* and *B-VDC sample* outputs are provided.

2.5.1.1 The *PA volts* output, which is a sample of the B-VDC, with superimposed modulation envelope, drive voltage to the power amplifiers; is applied to an IPM correction circuit in the exciter stage and to the voltage metering circuit on the control/monitor panel. The IPM correction circuit minimizes any incidental phase modulation (IPM) introduced by the RF power amplifiers.

2.5.1.2 The *B-VDC sample* output is the B-VDC voltage source for the exciter stage's RF drive amplifier. It is also applied to the voltage metering circuit on the control/monitor panel. Refer to the RF power module's service instruction manual for detailed information.

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2.5.2 RF OUTPUT FILTER (see figure SD-6): The RF output filter is a three-pole band pass filter with a series trap tuned to the carrier frequency's third harmonic. Its nominal input and output impedance is 50 ohms and it has a loaded Q of '2'. The filter removes unwanted harmonics from the RF output of the RF power module, which is applied to the filter's input, and provides the transmitter's final *RF output*. The filter also contains an RF current probe and a forward/reflected power probe. These probes monitor the RF and provide outputs that are monitored by protection circuits.

2.5.2.1 RF Current Probe: The RF current probe monitors the RF current flow at the filter's input and provides a current sample that is proportional to the total RF current as the *RF current sample* (A1J2) and the *mod envelope* output (A1J1).

2.5.2.1.1 The *RF current sample* is applied to the control interface PWB's RF current monitor circuit. If the RF current approaches the maximum stress current threshold of the RF power module, the *RF current sample* will exceed a preset fault threshold and cause the RF output to be shutback (turned off) and result in a **HIGH RF CURRENT** alarm to be generated (refer to paragraph 2.3.2.5).

2.5.2.1.2 The *mod envelope* output is applied to a mod level detector/comparator circuit in the exciter stage's modulator driver PWB. This circuit ensures the RF power module's RF stress current thresholds are not exceeded during high or long (low frequency) modulation peaks (refer to paragraph 2.4.4).

2.5.2.2 Forward/Reflected Power Probe: The forward/reflected power probe contains an RF current transformer (A2T1) and an RF voltage transformer (A2T2). These transformers form the current and voltage arms of a forward/reflected power bridge, which samples the RF output.

2.5.2.2.1 The voltage (RF current waveform) on the RF current transformer's secondary is applied to the centre-tapped secondary of the RF voltage transformer, where it is summed with the RF voltage waveform's anti-phase voltages. When the RF output impedance is precisely 50-ohms, the RF current waveform will be in-phase and of equal amplitude to the RF voltage waveform on one half of the centre-tapped secondary and 180° out-of-phase but of equal amplitude to the other half.

2.5.2.2.2 The in-phase voltages are summed, rectified by CR1, filtered by L1/C1/L2, resulting in a DC voltage being applied to A2J2 as the *forward power* output. This voltage is proportional to the RF output's forward power level.

2.5.2.2.3 The out-of-phase voltages are summed, rectified by CR3, filtered by L3/C2/L4, resulting in a DC voltage being applied to A2J3 as the *reflected power* output. This voltage is proportional to the RF output's reflected power level.

2.5.2.2.4 The RF voltage transformer contains an additional secondary winding, which provides a true sample of the RF output's voltage waveform as the *RF sample* output at A2J1. This output is intended for monitoring by a modulation monitor and for test equipment during maintenance.

AC/DC POWER STAGE

2.6 See figure SD-5. The AC/DC power stage converts the AC power source voltage to the negative DC voltage (B- VDC) required by the transmitter's RF power stage. It consists of an AC line filter (A3U1), a power transformer (A5T1), a full-wave rectifier (A7A1), a power supply control PWB (A5A1), an inductor (A5L1), a current shunt resistor (A7R1) and large storage capacitors which are located in the RF power module.

2.6.1. AC/DC POWER SUPPLY: The nominal 230 VAC power source is applied to the primary windings of the step-down power transformer thru circuit breaker A3CB1 and AC line filter A3U1. Primary winding taps accommodate variations in the mean level of the AC voltage.

2.6.1.1. The power transformer has two sets of centre-tapped secondary windings. One set provides a centre-tapped 178 VAC (89-0-89) for the B- VDC power supply. The other set provides a centre-tapped 35 VAC (17.5-0-17.5) for the power supply control PWB, which controls the B- VDC power supply and for the exciter stage's low voltage power supply, which provides the DC voltages for the rest of the transmitter.

2.6.1.2 Current shunt resistor A7R1 provides a DC voltage, between its *current (+ve)* and *current (-ve)* outputs, which represents the total current being drawn by the RF power modules. These outputs are applied to control/monitor panel A1.

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2.6.1.3 Inductor A5L1, in conjunction with the storage capacitors in the RF power modules, smooths and filters the 120Hz ripple on the *B- VDC* outputs. Free wheeling diode A7A1CR1 maintains current flow in the inductor during the 'off' time of the rectifier's thyristors.

2.6.2 B- VDC FULL-WAVE RECTIFIER: Rectifier assembly thyristors A7A1U1A/A7A1U1B form a switched full-wave rectifier for the *B- VDC* voltage power supply. The on period of each thyristor, which is determined by the current requirements of the transmitter's modulator/power amplifier stages, is controlled by a gate switching circuit in power supply control PWB A5A1. When transistor A5A1Q1 or A5A1Q2 (connected between the anode and gate of a thyristor), turns on while the anode of that thyristor is positive, the thyristor will turn on for the balance of that positive voltage half cycle. Refer to figure 2-1 for timing information.

2.6.3 THYRISTOR TURN-ON CONTROL: Power supply control PWB A5A1's circuits monitor the *B- VDC* voltage and produce thyristor turn-on control pulses that control the turn-on time of the switched full-wave rectifier thyristors in the *B- VDC* power supply. The controlled turn on regulates the *B- VDC* output voltage by replenishing the current being consumed, from the storage capacitors in the RF power modules, by the modulator/RF power amplifiers.

2.6.3.1 Amplifier U2C is connected as a comparator/amplifier, and provides regulation on the *B-* line. Resistors A5A2R2 and A5A1R4/R20 and capacitor A5A2C1 provide a level shifted sample of the *B- VDC* voltage. Resistors A5A1R3/R7 produce a gain of ten to the reduction of ten caused by resistors A5A2R2 and A5A1R4. U2C compares the level shifted sample of the *B- VDC* voltage, which is applied to its inverting input, to an adjustable threshold voltage, which is applied to its non-inverting input. Resistors A5A1R6/R9 and **B- Adjust** potentiometer A5A1R8 establish this threshold voltage. The voltage on U2C's inverting input will be a nominal 7.5 VDC when *B- VDC* is -74.0 VDC. This voltage will increase when *B- VDC* becomes more positive than -74 VDC and it will decrease when *B- VDC* becomes less positive than -74 VDC. **B- Adjust** potentiometer A5A1R8 is adjusted during testing to set the adjustable threshold voltage for the level required to maintain *B- VDC* at -74.0 VDC when

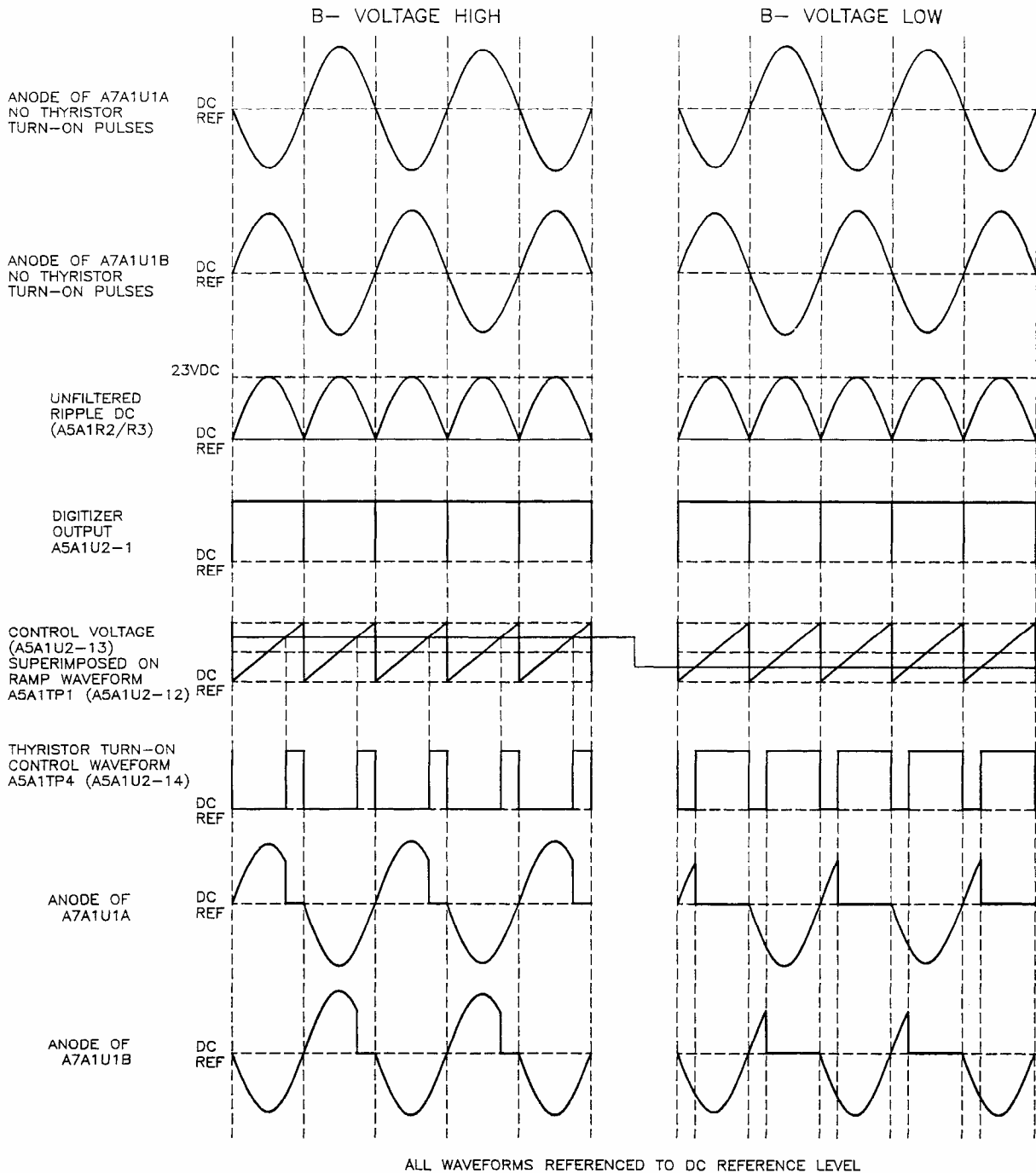
the unmodulated RF output is 1000 watts. The threshold voltage will be more positive than the reference voltage. U2C's output is such that it provides the correct bias when the *B- VDC* voltage varies.

2.6.3.2 Diodes A5A1CR1/CR2 are connected as a full-wave rectifier. The resultant unfiltered, unregulated DC voltage, which has a ripple frequency that is twice the frequency of the AC power source, is applied to the regulated 15 VDC power supply formed by regulator U1 and its associated components. It is also applied to the non-inverting input of operational amplifier U2A.

2.6.3.3 Amplifier U2A is connected as a comparator/digitizer. It compares the ripple DC voltage applied to its non-inverting input to the 0.31 VDC bias applied to its inverting input from the voltage divider A5A1R10/R11. When ripple voltage is more positive than the reference voltage, the output of U2A will be 15 VDC. When the ripple voltage is less positive than the reference voltage, U2A's output will switch to 0.0 VDC. Since the periods of time the ripple voltage is less positive than the threshold voltage corresponds to the zero volt crossover of the AC power source, a ground potential pulse is produced as U2C's output at each zero volt crossover of the AC power source voltage.

2.6.3.4 Since the inverting input of U2A is clamped to a nominal 0.31 VDC, U2A's output will be 0.0 VDC for a relatively short period of each ripple cycle (at zero voltage crossover points) and will be 15 VDC for remaining period. When U2A's output switches to 15 VDC, diode A5A1CR6 will be reverse biased and capacitor A5A1C3 will charge exponentially towards 15 VDC through A5A1R14. When U2A's output switches to 0.0 VDC, capacitor A5A1C3 will quickly discharge through diode A5A1CR6. The resultant is a sawtooth waveform that returns to 0.0 volts each time a zero voltage crossover occurs.

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Figure 2-1 Timing Information

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2.6.3.5 Operational amplifier U2D is connected as a comparator, with the control reference voltage from U2C applied to its inverting input and the sawtooth waveform from U2A applied to its non-inverting input. When the sawtooth waveform is less positive than the control reference voltage, U2D's output will be 0.0 VDC. When the sawtooth waveform is more positive than control reference waveform, U2D's output will be 15 VDC. When B- VDC varies, the 'time' that the sawtooth waveform remains more positive or less positive than the control reference waveform also varies. This results in an increase or decrease in duration of the positive pulses at U2D's output.

2.6.3.6 The positive pulses on U2D's output are applied through resistors A5A1R15/R16 to the bases of transistors A5A1Q1/Q2. Transistors A5A1Q1/Q2 will be forward biased and turn on. Emitters of transistors Q1/Q2 are applied to gates of thyristors A7A1U1A and A7A1U1B, and thyristors will be gated on. Diodes A7A1CR8/ CR9 prevent reverse bias between collector and emitter of transistors A5A1Q1/Q2 when thyristors A7A1U1A/U1B are turned off. Thyristors A7A1U1A/U1B will be gated off each time zero crossover occurs on the full-wave waveform.

SECTION 3 INSTALLATION AND PREPARATION FOR USE

PLANNING AND SITE PREPARATION

3.1 Transmitter sites should be prepared to receive the transmitter prior to its delivery and/or installation. The following must be taken into consideration when preparing new sites. They should be used as the evaluating criteria at existing sites. It is recommended that all requirements be incorporated to ensure optimum reliability and performance is obtained.

NOTE

Frequent reference is made to terminals on the remote interface PWB (A4A1). It is located on the exciter panel which is behind the control/monitor panel. Refer to figure MD-5 to locate the remote interface PWB and then to its service instruction manual for its assembly detail.

3.1.1 TRANSMITTER ROOM REQUIREMENTS: The following transmitter room requirements must be addressed when the transmitter site is being finalized.

3.1.1.1 Transmitter Dimensions: Refer to figure MD-13 for transmitter dimensions. These dimensions identify floor space requirements and will assist in determining cable lengths and routing.

3.1.1.2 Maintenance Access Clearance: It is recommended a clearance of at least four feet be maintained on all sides of the transmitter.

3.1.1.3 Air Flushing: A fan in the RF power module draws cooling air through louvres in the cabinet's rear door; circulates it through the module and exhausts it as a horizontal, low velocity stream through openings in the module's front panel. A room air exchange rate of 100 CFM should achieve an acceptable intake/exhaust temperature rise.

3.1.1.4 Cooling: The transmitter room's ambient air temperature must not exceed 50°C. For air conditioning requirements, it can be assumed that 75% of the power being consumed, from the AC power source, is applied to the antenna system as the RF output and 25% is converted to waste heat.

NOTE

A simple method of determining waste heat being generated is to determine the average RF output power, divide the average RF output power (in watts) by three and then convert the quotient to British thermal units (BTU's) by multiplying it by 3.413.

As an example: At 1000 watts carrier power with 50% modulation, average power output is 1125 watts.

This represents an average long term output power based on typical processed program material. At 75% overall efficiency, the waste heat generated is 375 watts, which equals 1280 BTU's per hour.

3.1.1.5 Heating: The transmitter room must contain a heating system that will ensure its ambient air temperature does not go below 0°C.

3.1.1.6 Work Area: It is recommended that a suitable work area with an adequate table surface be provided adjacent to the transmitter to permit bench adjustment/repair of modules.

3.1.2 LIGHTNING PROTECTION: Extremely high voltage/current transients are produced when a lightning strike occurs. These transients, which are probably the most significant hazard to any solid state transmitter, may be passed to the transmitter through the wiring connecting it to its power source and its antenna system. It is imperative that all practical precautions be taken to protect the transmitter from this phenomenon. Refer to Nautel's **Lightning Protection for Radio Transmitter Stations** booklet for recommendations and for specific protection techniques. The following requirements are considered to be essential.

3.1.2.1 Station Reference Ground: The site must contain a station reference ground, as defined in Nautel's **Lightning Protection for Radio Transmitter Stations** booklet. This ground must provide a continuous, low impedance path to the earth. The transmitter cabinet's designated reference ground point, the shield of the coaxial feed cable and the ground connection of the power source's surge protection devices must be connected directly to the station reference ground.

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3.1.2.2 AC Power Source: All conductors from the AC power source should be protected by bi-directional surge protection devices that are connected between each conductor and the station reference ground. A surge protector panel, that contains suitably rated varistors is available from Nautel for this purpose. In addition, the AC power conductors should pass through a ferrite toroid. The inductance formed by this toroid will be transparent to the AC voltages, but will present an impedance to transients originating in the power source. If used, the surge protector panel should be installed in close proximity to the station reference ground.

NOTE

The AC power source usually presents the lowest impedance path to ground potential and will normally carry most of the lightning induced current away from the transmitter site.

When lightning hits the power source, a significant amount of induced current may flow towards the transmitter. In this instance, the objective is to route the current around the transmitter, instead of through it, to the best ground available.

3.1.2.3 Antenna Feed Cable: The shield of the antenna feed's coaxial cable should be connected directly to the station reference ground where it enters the building. In addition, the centre conductor and the shield of the feed cable should pass through a ferrite toroid which is positioned between the shield ground, at the building entrance and the shield termination, at the transmitter reference ground. This toroid will be transparent to the RF signal, but will present an impedance to transients originating in the antenna.

3.1.2.4 Antenna/RF Output Disconnect: A switching circuit that disconnects the antenna from the transmitter's RF output when the transmitter is turned off should be incorporated into the RF feed/ antenna design. This switching circuit will prevent lightning induced transients from entering the transmitter when its solid state devices are most susceptible to electrostatic failure.

3.1.2.5 Antenna Tower: The antenna tower is the most likely target for lightning strikes. It is imperative that it contain lightning protection devices, such as air-gap spark balls, as the first line of defense against lightning strikes.

3.1.2.6 Control/Monitor Wiring: All external/control wiring, that may carry lightning induced transients, should be interfaced to the station reference ground by surge protection devices, where they enter the building. All conductors and their shields should pass through a ferrite toroid, located between its surge protection device and the transmitter. This toroid will be transparent to control/ monitor signals, but will present an impedance to lightning induced transients.

3.1.3 ELECTRICAL POWER: The transmitter is configured during manufacture to operate from a 230 volt, 50/60Hz, AC power source (European style or North American style); as ordered by the purchaser. The AC power source must meet all of the following requirements:

3.1.3.1 Nominal Voltage: The primary winding of the main AC power transformer contains eight tap options to accommodate voltages that differ from the ideal voltage of the power source. These taps represent five percent (10.0 volt) increments and are selected during installation to provide the optimum nominal voltage for the transmitter.

3.1.3.2 Voltage Stability: The AC power source's nominal voltage must be stable to within plus or minus five percent under all loading conditions. The transmitter contains circuitry that maintains the RF output at the preset carrier level for voltage variations within this range.

3.1.3.3 Power Consumption: When the transmitter is operating at 1000 watts and is being modulated at 100% by a continuous sine wave, power consumption is 2.14 kilowatts. When the transmitter is operating at 1000 watts and it is not being modulated, consumption is 1.43 kilowatts. Actual power consumption for a specific station will depend on the programming format and the level of audio processing. It is recommended that the AC power source have a twenty-five percent over capacity to ensure adequate regulation.

3.1.3.4 External Switching: It is recommended that all voltage carrying conductors from the AC power source be controlled by an external switching box that is located in close proximity to the transmitter. This switch box should be clearly marked **TRANSMITTER EMERGENCY ON/OFF SWITCH.**

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3.1.4 ANTENNA SYSTEM: It is recommended that the antenna system meets (as a minimum) the standards specified in EIA Standard TR-101-A, paragraph 8(b) with a normal impedance of $50 \pm j0$ ohms at the carrier frequency. The transmitter will function while operating into a maximum VSWR of 1.5:1, or with sideband VSWR's of up to 2:1 when the carrier frequency impedance is $50 \pm j0$ ohms, but overall system performance will be degraded.

3.1.4.1 RF Feed Cable: The feed cable interconnecting the transmitter and the antenna system should be a suitably rated coaxial cable. Unless otherwise requested, the transmitter's RF output connector is a 7/8 inch EIA flange. The RF feed cable's transmitter end must be terminated by an appropriate mating connector.

3.1.4.2 Static Drain Choke: A static drain choke having a reactance of 2000 ohms or greater at the carrier frequency should be connected between the conductor of the RF feed cable and ground. This choke is necessary to drain DC voltages which may build up on the antenna tower system (ie: static electricity).

3.1.5 RF DRIVE SOURCE: The RF drive can be derived from one of four sources.

3.1.5.1 Internal Monaural RF Drive PWB: When the exciter is configured for an internally produced, monaural RF drive; the integral crystal oscillator of its associated RF drive PWB is the RF drive source. Refer to the RF drive PWB's service instruction manual and paragraphs 3.3.2 and 3.3.4 of this manual for additional information.

3.1.5.2 External Monaural RF Generator: When the exciter is configured for an externally produced, monaural RF drive, the integral crystal oscillator of its associated RF drive PWB is replaced by an external monaural RF generator as the originating source of the RF drive. Refer to the RF drive PWB's service instruction manual and paragraphs 3.3.2 and 3.3.4 of this manual for additional information. The external RF generator must provide:

- Carrier frequency of ± 5 Hz or 5 parts per million (ppm) whichever is greater, when it is not being modulated.

- RF drive level of between 5.0 and 12.0 volts peak-to-peak (sine wave or square wave).
- 50-ohm impedance matching at the carrier frequency.

3.1.5.3 Third Party AM Stereo Exciter: When the exciter is configured for an externally produced, AM stereo RF drive, the crystal oscillator in its associated RF drive PWB is replaced by an external monaural RF generator as the originating source of the RF drive. Refer to the RF drive PWB's service instruction manual and paragraphs 3.3.2 and 3.3.4 of this manual for additional information. The external AM stereo generator must provide:

- Carrier frequency of ± 5 Hz or 5 parts per million (ppm) whichever is greater, when it is not being modulated.
- RF drive level of between 5.0 and 12.0 volts peak-to-peak (sine wave or square wave).
- 50-ohm impedance matching at the carrier frequency.
- Phase-modulated RF signal, containing the left minus right channel information.

3.1.5.4 Nautel's C-QUAM AM Stereo Exciter: When the exciter is configured to use the RF drive produced by Nautel's C-QUAM AM stereo exciter PWB, the optional C-QUAM AM exciter PWB is installed, on the exciter panel, and the standard RF drive PWB is removed. This RF drive source is normally configured for AM stereo but it can produce a monaural RF drive if desired. Refer to the C-QUAM AM stereo exciter PWB's service instruction manual for detailed information.

3.1.6 MODULATING AUDIO: Modulating audio must be applied from an external source. The transmitter does not have any audio processing capability, therefore, any processing must be completed before the modulating audio is applied, noting the audio may be processed to provide a higher percentage of positive modulation than negative modulation. Electrical inter-connection should be made using suitably rated twisted shielded pair(s) of conductors.

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3.1.6.1 Monaural Audio: Modulating audio for monaural RF drives (internal or external) is connected between TB1-15 (**AUDIO +**), TB1-17 (**AUDIO -**) and TB1-16 (shield) of the remote interface PWB. The monaural audio must provide:

- Balanced 600 ohms.
- Output level between 0dB and +12dB (factory set to 10dB) for 100% modulation.

3.1.6.2 External AM Stereo Audio: Modulating audio for third party (external) AM stereo RF drives is applied to the AM stereo generator and the resultant left plus right (L+R) audio is connected between the TB1-15 (**AUDIO +**), TB1-17 (**AUDIO -**) and TB1-16 (shield) of the remote interface PWB. The L+R audio must provide:

- Balanced 600 ohms.
- Output level between 0dB and +12dB (factory set to 10dB) for 100% modulation.

3.1.6.3 Nautel's C-QUAM AM Stereo Audio: Modulating audio for Nautel's AM stereo exciter must be left and right audio channels. Both channels must have identical characteristics to obtain best AM stereo performance. Electrical connection is made directly to terminals of TB1 on the C-QUAM AM stereo exciter PWB. The left channel connects to TB1-3(+), TB1-5(-) and TB1-4(shield). The right channel connects to TB1-10(+), TB1-8(-) and TB1-9(shield).

3.1.6.3.1 Refer to the C-QUAM AM stereo exciter PWB's service instruction manual for detailed information.

3.1.6.3.2 The left and right audio channels must provide:

- Balanced 600 ohms.
- When left audio only is applied (right audio inhibited), its level must be precisely 10dBm when a modulation depth of 50% is expected.
- When right audio only is applied (left audio inhibited), its level must be precisely 10dBm when a modulation depth of 50% is expected.

3.1.7 SAFETY INTERLOCK: The external safety interlock circuit is connected between TB1-13 and TB1-14 of the remote interface PWB. It must present a short circuit (low impedance) between the terminals when the interlock circuit is intact and it is safe to enable the RF output. It must present an open circuit when one or more of the interlock switches have been activated and the RF output is required to be inhibited. Any number of serial interlock switches may be installed, provided an open circuit is presented if any interlock switch is activated.

NOTE

The interlock circuit provides the path for the master on/off circuit's 24 VDC power source. If wiring for the interlock circuit is lengthy, unwanted transients may be induced on this voltage. When this occurs, a user supplied relay, that has its energized/de-energized state controlled by the external interlock switches, should be installed in close proximity to the remote interface PWB. The relay should be connected as a fail-safe relay (energized when the interlock circuit is intact, de-energized when it is opened) with its normally open contacts interconnecting the two interlock terminals.

The transmitter's RF stage may be inhibited for approximately one second after the integrity of the external interlock has been restored.

3.1.8 REMOTE CONTROL CIRCUITS: The on/off status, RF power module on/off selection, preset RF power level and alarm reset can be controlled from a remote location, using switching circuits that comply with the following.

NOTE

*Remote controls must apply a DC return from the **REMOTE COMMON** terminals (TB1-19/TB2-19) on the remote interface PWB. Since this DC return is not present when the **CONTROL** switch is set to **LOCAL**, the remote controls only have influence when it is set to **REMOTE**. Electrical remote control connections are made to TB1.*

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3.1.8.1 On/Off Control: The remote on/off control circuit must be the equivalent of a single pole, three position (on/off/on) switch. Each on position must be spring-loaded to return to off when the toggle is released. It must be connected to apply a remote common (from TB1-19/TB2-19), from one on-position, to the **RF ON** terminal (TB1-1) when the transmitter is to be turned on and from the other on position to the **RF OFF** terminal (TB1-2) when it is to be turned off.

3.1.8.2 Preset Power Level Select: The remote preset power level select circuit should be the equivalent of three (four if optional remote power level control is used) normally open/held closed spring-loaded switches. They must be connected to apply remote common (TB1-19/TB2-19) to the appropriate **POWER SELECT** terminal [**HIGH** (TB1-5), **LOW 1** (TB1-6), **LOW 2** (TB1-7) or **AUTO** (TB1-8)].

3.1.8.3 Alarm Reset: The external alarm reset circuit must be the equivalent of a normally open/held closed spring-loaded switch. It must be connected to apply a remote common potential (from TB1-19/TB2-19) to the **ALARM RESET** terminal (TB1-12) when alarm retention circuits and/or the SWR protection circuit's counter are to be reset.

3.1.9 OTHER REMOTE CONTROLS: Additional controlling inputs can be connected, at the user's discretion. Since the DC return for these control inputs is the main chassis ground, they will influence the transmitter's RF output regardless of the transmitter's **CONTROL** switch setting. The controlling electrical connections are made to a terminal of TB1 on the remote interface PWB.

3.1.9.1 RF Power Trim: This circuit must be the equivalent of a single pole, three position (on/off/on) switch. Each on position must be spring-loaded to return to off, when the toggle is released. It must apply a ground potential, from one on-position, to the remote interface PWB's **POWER INCR** terminal (TB1-9) when an incremental increase in RF power is required or to its **POWER DECR** terminal (TB1-10), from the second on-position, when a decrease is required.

NOTE

When the remote power trim is reset (set to the centre of its range), it has a $\pm 10\%$ control of the preset RF carrier level, in 1.4% increments.

3.1.9.2 PWM Inhibit Control: The external PWM (pulse width modulation) inhibit switching circuit must be the equivalent of a single pole, single throw (on/off) switch. It must be connected to apply a ground potential, from its on-position, to the **PWM INHIBIT** terminal (TB1-11) when the transmitter's RF output, is to be inhibited.

NOTE

*The external PWM inhibit input is intended to be used in conjunction with antenna switching circuitry, to ensure RF output current is not flowing during opening/closing of contacts in the transmitter's RF output feed cable. The antenna switching circuits must apply a ground to the **PWM INHIBIT** terminal prior to contact opening (disconnecting the RF load) and must maintain this ground until contact closure has occurred and an appropriate impedance has been connected to the transmitter's RF output. A residual RF leak of approximately 1.0 watts is present when the RF output is inhibited. The RF output will be instantly restored to its original level when the ground potential is removed from the **PWM INHIBIT** terminal.*

3.1.10 RF PERFORMANCE MONITORING: The transmitter provides outputs that are representative of the RF drive, forward power level, the reflected power level and the RF output for external monitoring. These outputs are available on the remote interface PWB (the forward and reflected power level outputs from terminals of TB2 and the RF drive/RF monitor outputs from coaxial BNC connectors).

3.1.10.1 Forward Power Level: A buffered dc voltage that is representative of the forward power level is available at the **BFRD FWD PWR** terminal (TB2-16). This voltage is a non-linear (square law) function of the forward power level and will be 5.82 ± 0.5 volts DC at 1000 watts.

3.1.10.2 Reflected Power Level: A buffered DC voltage that is representative of the reflected power level is available at the **BFRD REFL PWR** terminal (TB2-18). This voltage is a non-linear (square law) function of the reflected power level and will be 2.6 ± 0.5 volts dc at 200 watts.

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3.1.10.3 RF Drive Sample: A sample of the RF drive is provided at the **FREQUENCY MONITOR** BNC coaxial connector (J9). The *Freq Monitor* output is intended to be used during maintenance, to monitor the frequency of the RF drive. It should be a nominal 1.0 ± 0.5 volts RMS, into a 50 ohm load.

3.1.10.4 RF Monitor Sample: A true sample of the RF output, including its modulation envelope, is provided at the remote interface PWB's **RF MONITOR** BNC coaxial connector (J4). The *RF Monitor* output is intended to be applied to a modulation monitor with a 1000-ohm input impedance. It may also be monitored by an oscilloscope during maintenance procedures. When the RF output is varied from 100 watts to 1100 watts, the relay selections provide 15 operating windows. The *RF Monitor* voltage's nominal value at the centre of each window should be 14 peak-to-peak volts (6.0 volts RMS). The average value across the range of each window should be between 4.0 and 8.0 volts rms. When the *RF Monitor* voltage and the RF output are plotted on an X/Y chart (see paragraph 5.3.9.5), the maximum and minimum voltage of any window shall not differ from the average value by more than 10%.

3.1.11 REMOTE ALARM INDICATIONS:

Outputs that indicate stress thresholds for critical parameters have been exceeded are available on terminals of the remote interface PWB. These outputs are provided for external monitoring. Each alarm output contains a switching transistor that provides an open collector during normal operation (non-alarm condition) and a current-sink-to-ground when an alarm condition exists. Each external monitoring circuit must present an impedance, between the switching transistor and a positive dc voltage source, that will result in not more than 40 milliamperes flowing through the transistor when it is turned on. Each alarm circuit's positive voltage source must not exceed 24 VDC. Each of the alarm outputs is protected against transients and/or overvoltage by a 56 volt zener diode.

NOTE

In most cases the RF output is shutback (turned off) when an alarm condition is sensed. When the cause of the alarm has been removed, the RF output will be restored at an exponential rate, over a nominal 200 millisecond period.

3.1.11.1 RF Stress Current Alarm: The *High RF Current Alarm* output is applied to **ALARM - RF CUR** terminal TB2-7. During non-alarm conditions, it is an open collector. When the RF current exceeds a factory set threshold, which represents the maximum current the RF power module can provide without being over-stressed, the *High RF Current Alarm* output will be a current-sink-to-ground. The RF output will be shutback (turned off).

3.1.11.2 High AC Power Source Voltage Alarm: The *High AC Alarm* output is applied to **ALARM - HIGH AC** terminal TB2-8. During non-alarm conditions, it is an open collector. When the AC power source's voltage is more than 10% above its normal, nominal voltage, the *High AC Alarm* output will be a current-sink-to-ground. The RF output will be shutback (turned off).

3.1.11.3 Low AC Power Source Voltage Alarm: The *Low AC Alarm* output is applied to **ALARM - LOW AC** terminal TB2-9. During non-alarm conditions, it is an open collector. When the AC power source's voltage is more than 10% below its normal, nominal voltage, the *Low AC Alarm* output will be a current-sink-to-ground. The RF output will be shutback (turned off).

3.1.11.4 High B- Voltage Alarm: The *High B- Alarm* output is applied to **ALARM - HIGH B-** terminal TB2-10. During non-alarm conditions, it is an open collector. When the B- voltage goes more negative than a nominal -82.0 VDC, the *High B- Alarm* output will be a current-sink-to-ground. The RF output will be shutback (turned off).

3.1.11.5 RF Drive Level Alarm: The *Low RF Drive Alarm* output is applied to **ALARM - DRIVE LEVEL** terminal TB2-11. During non-alarm conditions, it is an open collector. When the RF drive level falls below a preset failure threshold (nominally 77 volts peak-to-peak), the *Low RF Drive Alarm* will be a current-sink-to-ground. The RF output will be shutback (turned off).

3.1.11.6 RF Drive Tuning Alarm: The *Detuned RF Drive Alarm* output is applied to **ALARM - DRIVE TUNING** terminal TB2-12. A non-alarm condition is an open collector. When the RF drive is detuned by a change in the RF drive frequency or a detuning of tuned RF drive circuits, the *Detuned RF Drive Alarm* output will be a current-sink-to-ground. The RF output will be shutback (turned off).

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3.1.11.7 SWR Shutback Alarm: The *SWR Shutback Alarm* output is applied to **ALARM - SWR SHUTBACK** terminal TB2-13. During non-alarm conditions, it is an open collector. When the reflected power exceeds 175 watts (1.5:1 relative to 1100 watts at 100% modulation or 14dB return loss), the *SWR Shutback Alarm* output will be a current-sink-to-ground. The RF output will be shutback (turned off).

3.1.11.8 SWR Cutback Alarm: The *SWR Cutback Alarm* output is applied to **ALARM - SWR CUTBACK** terminal TB2-14. During non-alarm conditions, the output is an open collector. When the alarm counter, which counts SWR shutbacks (see paragraph 3.1.11.7) and high RF current shutbacks (see paragraph 3.1.11.1), has exceeded three counts, the *SWR Cutback Alarm* output will be a current-sink-to-ground. The RF output will be cutback (reduced) by an amount that is proportional to the amount the alarm counter's count exceeds three. The RF output will be shutback (turned off) when the count is nine.

3.1.11.9 Interlock Open Alarm: The *Interlock Open Alarm* output is applied to **INTLK OPEN ALARM** terminal TB2-21. When the interlock circuit is intact (non-alarm condition), the output is an open collector. When the interlock is open, the *Interlock Open Alarm* output will be a current-sink-to-ground. The RF output will be turned off by removing 24 VDC from transmitter's control circuits.

3.1.12 REMOTE STATUS INDICATIONS: Outputs that indicate the status of operator controlled circuits are available for external monitoring at terminals of TB2 on the remote interface PWB. Each status output contains a switching transistor that provides an open collector when its circuit is passive (not-true condition) and a current-sink-to-ground when a true (circuit active) condition exists. Each monitoring circuit must present an impedance, between the transistor and a positive DC voltage source, that will result in not more than 40 milliamperes flowing through the transistor when it is turned on. The positive voltage source must not exceed 24 VDC. Each of the status outputs is protected against transients and/or overvoltage by a 56 volt zener diode.

3.1.12.1 Remote Status: The *Remote Status* output is applied to **REMOTE STATUS** terminal TB2-15. When the transmitter's **CONTROL** switch is set to **LOCAL** and the remote control functions have no influence on the transmitter's on/off status, or preset RF power levels, the *Remote Status* output is an open collector. When the transmitter's **CONTROL** switch is set to **REMOTE** and the remote control functions are controlling transmitter operation, the *Remote Status* output is a current sink to ground.

3.1.12.2 RF On Status: The *RF On Status* output is applied to **STATUS - RF ON** terminal TB2-1. When the transmitter is turned off, the *RF On Status* output is an open collector. When the transmitter is turned on, but not necessarily producing an RF output, the *RF On Status* output is a current sink to ground.

3.1.12.3 Exciter B Status: The *Exciter B Status* output, which is applied to **STATUS - EXCTR B** terminal TB2-2 is not used in this transmitter, as there is no B exciter.

3.1.12.4 Power Level Status: The *Pwr Level Status* outputs are applied to **STATUS - POWER** terminals [**HIGH**(TB2-3), **LOW 1**(TB2-4), **LOW 2** (TB2-5) and **AUTO** (TB2-6)]. When a power level is not selected, its *Pwr Level Status* output is an open collector. When selected, a *Pwr Level Status* output is a current sink to ground.

3.1.12.5 RF Ready Status: The *RF Ready Status* output is applied to **RF READY** terminal TB2-20. When the AC/DC power supply is not producing an unregulated 24 VDC, and the transmitter control functions are not operable, the *RF Ready Status* output is an open collector. When the AC/DC power supply is producing an unregulated 24 VDC, and the transmitter control functions are operable (locally or remotely as appropriate), the *RF Ready Status* output is a current sink to ground.

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3.1.13 PARTS SUPPLIED BY NAUTEL: The following parts/materials are supplied by or are available from Nautel.

3.1.13.1 Parts Removed During Disassembly For Shipment: All the parts that were removed during disassembly for shipment and are required to reassemble the transmitter are provided. An itemized listing of the parts is not provided in this manual, as the extent of disassembly is determined by the method of shipment. Detailed packing lists will be included with each transmitter shipment.

3.1.13.2 Ancillary Parts: An ancillary parts kit is provided with each transmitter. These parts are provided to ensure initial installation is not delayed because of lost or damaged hardware. They are not intended to be maintenance spares. Detailed information about these parts is not included in this manual. The ancillary parts kit contents is itemized in its packing list.

3.1.14 PARTS REQUIRED BUT NOT SUPPLIED BY NAUTEL: Some parts and materials required to complete an installation are not supplied with the transmitter or are not provided by Nautel. The user must supply these parts. Each installation will dictate the parts required, and will normally include the following:

- A suitable 50-ohm RF output coaxial cable, terminated by a 7/8 inch EIA connector at the transmitter end, is required.
- All external control/monitor wiring, including their associated terminating devices and conduit clamps must be provided by the user.
- All electrical power cables, including conduit, terminating devices and conduit clamps must be provided by the user.

3.1.14.1 Surge Protector Panel: A surge protector panel, that is rated for the AC power source to be applied to the transmitter, is available from Nautel. The surge protector panel will help protect the transmitter against lightning induced voltage transients on the AC power source and/or the antenna system.

3.1.15 TEST EQUIPMENT AND SPECIAL TOOLS: The test equipment required to install and maintain the transmitter is listed in table 1-2 and the special tools are listed in table 1-3.

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NON-TECHNICAL PRE-COMMISSIONING

3.2 On delivery of the transmitter, the following non-technical procedures should be observed and completed.

NOTE

Non-technical procedures are defined as being those procedures that do not require technical knowledge of transmitter circuits or their operation to complete.

3.2.1 ACCEPTANCE OF SHIPMENT: All shipments should be inspected for transit damage prior to acceptance.



Sufficient manpower or mechanical assistance should be on hand prior to removing the transmitter cabinet from its packing crate. The crate may weigh in excess of 200 kilograms (440 pounds)

3.2.2 UNPACKING INSTRUCTIONS: The degree of unpacking is dictated by the method of packaging for shipment. Transmitters that are not shipped by electronic equipment moving specialists may be packed in wooden crates, with the number of crates determined by the extent of disassembly for shipment. Instructions accompany any crate that requires special unpacking information. Packing lists provide detailed listings of shipment contents.

NOTE

Normally, the transmitter will be partially disassembled for shipment. As a minimum, the RF power module will be removed. The extent of any additional disassembly will be dictated by the shipping method, site information provided by the user and the handling equipment of the mover.

3.2.3 ASSEMBLY/INSTALLATION: When required, assembly instructions, which are specific to the level of disassembly for shipment, is included with the transmitter documentation. They may be appended to this instruction manual or provided separately.

NOTE

Partially disassembled transmitters should be placed in their final location prior to completing assembly.

3.2.4 INSTALLATION OF EXTERNAL CONTROL/MONITOR WIRING: Connect wiring from the modulating audio source, remote control/monitoring devices, and when used, the external RF drive source; to terminating points on the exciter panel's remote interface PWB, as follows:

NOTE

Monaural audio, remote control/monitor wiring terminates on the remote interface PWB. AM stereo audio wiring terminates on the C-QUAM AM stereo exciter PWB. Refer to figure MD-5 as an aid to locating these PWB's and then to their service instruction manual(s) to locate the terminals.

- (a) Route monaural audio, control and monitor wires; thru a convenient cable entry hole in the cabinet, to the vicinity of the remote interface PWB. If applicable, route AM stereo left and right audio wires to the vicinity of the C-QUAM AM stereo exciter PWB. Ensure all wires, including their shields pass thru a ferrite toroid (a minimum of two turns). There are two toroids located immediately above the remote interface PWB.

NOTE

The user must knock out an appropriate sized cable entry hole where the control/monitor cables enter. Two dual-diameter (0.50/0.75 inch) knockouts are provided at the top front of the cabinet to accommodate top entry. See figure MD-13 as a guide to locating the knockouts.

Where practical, it is recommended all external wiring be installed in a metal conduit and the metal conduit be rigidly attached to the cabinet.

- (b) Using figure 3-1 as a guide, determine the specific destination of each wire.
- (c) Coaxial cables that terminate at J1 (**STEREO**), J4 (**RF MONITOR**) and J9 (**FREQUENCY MONITOR**), of the remote interface PWB; should be cut to the required length and terminated by a BNC coaxial connector.
- (d) Wires that will be connected to a terminal on the interface PWB should be cut to the required length and terminated by a terminal lug that will accept a #6 screw and is the appropriate size for the conductor.

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NOTE

Open, uninsulated, #6-screw, crimp lugs, for installation on 18 to 22 AWG conductors; are provided in the ancillary parts kit.

- (e) If the monaural audio input provides 125% positive/100% negative modulation, connect the positive input to TB1-15 and the negative input to TB1-17 of the remote interface PWB.

NOTE

Connection of the audio cable's shield is dependent on the presence or absence of ground loops. In some installations, it may be necessary to connect the shield at one end only. In these cases, connect the end that provides the best results.

- (f) If Nautel's AM stereo option is installed, connect the left and right audio to TB1 of the C-QUAM AM stereo exciter PWB. The phase relationship of the left and right audio is crucial to C-QUAM AM stereo operation. The correct polarization must be maintained:
 - Connect left audio's positive input to TB1-5, negative input to TB1-3 and shield to TB1-4.
 - Connect right audio's positive input to TB1-10, negative input to TB1-8 and shield to TB1-9.
- (g) Connect remaining control/monitor wiring to the terminals of TB1 and TB2 on the remote interface PWB as identified in figure 3-1. Ensure securing screws are firmly tightened.

NOTE

DC return for remote control circuits connected to TB1-1 thru TB1-8 and TB1-12 must be obtained from TB1-19 or TB2-19.

DC return for remote circuits connected to A8TB1-1 thru A8TB1-4 must be connected to A8TB1-5.

DC return for control circuits connected to TB1-9 thru TB1-11 must be obtained from TB2-17 or by connecting to any convenient chassis ground.

The DC return (-ve) for remote monitoring circuit's dc power source must be obtained from TB2-17 or by connecting to any convenient chassis ground.

3.2.5 INSTALLATION OF AC POWER

SOURCE WIRING: Connect wiring from AC power source to terminals of AC/DC power supply A5's AC power terminal board (TB1). Access to the AC/DC power supply is gained via the rear door. Refer to figure MD-6 as an aid in locating the terminal board.

NOTE

The following procedures assume the AC power is 230 VAC (North American style line-neutral-line or European Style line-neutral).

The user must knock out the appropriate sized cable entry hole where the AC power cable enters the cabinet. Three dual-diameter (0.50/0.75 inch) knockouts are provided. One on the right-hand side of the cabinet's lower, rear, cross member to accommodate floor level entry and two at the top rear of the cabinet to accommodate top entry. See figure MD-13 as a guide to locating the knockouts.

It is recommended the AC power source wiring be installed in a metal conduit and the conduit be rigidly attached to the cabinet at the entry hole.

- (a) Route the AC power source wires through the selected cable entry hole to the vicinity of AC/DC power supply A5's AC power terminal board (TB1). Refer to figure MD-6 as an aid in locating the terminal board.
- (b) When the AC power source is single-phase, 230 VAC, three wire (line-to-line North American style) plus ground; cut each conductor to the required length and insert them in the terminals of A5TB1 as follows:

A5TB1-1	-Line (φ) 1
A5TB1-3	-Ground
A5TB1-2	-Line (φ) 2
A5TB1-4	-Neutral

- (c) When the AC power source is single phase, 230 VAC, two wire (line-to-neutral European style) plus ground; cut each conductor to the required length and insert them in the terminals of A5TB1 as follows:

A5TB1-1	-Line (φ) 1
A5TB1-3	-Ground
A5TB1-2	-Neutral
A5TB1-4	- N/C

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- (d) Ensure all of the terminal board's terminal securing screws are firmly tightened.

NOTE

Final selection of the power transformer's primary winding taps is completed during the technical pre-commissioning procedures (paragraph 3.3)

3.2.6 INSTALLATION OF RF FEED

CABLE: Connect an RF feed coaxial cable, that has been cut to required length, to the transmitter's RF output; noting the RF feed cable termination point is located at the top of the RF output filter (refer to figure MD-13 for location and dimensional information). When the transmitter's RF output termination device is a 7/8 inch EIA flange connector, connect the feed cable as detailed in paragraph 3.2.6.1.

NOTE

The transmitter's RF output should be applied to a dummy load during the commissioning procedure's initial turn-on. If the RF feed cable is not connected to a switching circuit that permits antenna/dummy load selection, ensure the RF feed cable for the dummy load is connected to the transmitter's RF output connection until otherwise specified during the commissioning procedures.

3.2.6.1 Connection of 7/8 Inch EIA Flange

Connector: When the transmitter's RF output connection is a 7/8 inch EIA flange connector, connect the RF feed cable as follows:

- (a) Verify RF feed cable is the required length and has been terminated by a 7/8 inch EIA flange connector, with an inner connector.
- (b) Locate and remove three 1/4-20 nuts and three 1/4 inch washers from the 7/8 inch EIA flange mounting studs on the top of the RF output filter.
- (c) Gain access to the interior of the RF output filter, by removing its rear cover, noting it is secured by sixteen 6-32 x 0.5 inch screws and sixteen external tooth lock washers. Retain screws and washers for reuse during assembly.

- (d) Install the RF feed cable's 7/8 inch EIA flange connector on the RF output filter's flange mounting studs and secure using attaching hardware retained in step (b). Ensure nuts are firmly tightened.

- (e) In the RF output filter, locate the RF output wire which originates from capacitor C3 and is terminated by a lug. Mate the lug to the inner connector of the RF feed cable's 7/8 inch EIA flange connector.



Ensure RF output filter A6's access panel retaining screws are firmly tightened. If they are not, eddy currents, that may affect filter tuning and that will generate excessive heat, will result.

- (f) Visually inspect the interior of the RF output filter, and then install its rear cover, using sixteen 6-32 x 0.5 inch screws and external tooth lock washers retained in step (c).

3.2.7 REFERENCE GROUND INTER-CONNECTION:

Connect a continuous, low-impedance conductor (0 AWG copper wire, two-inch copper strap or equivalent), as described in Nautel's 'Lightning Protection for Radio Transmitter Stations' booklet, between the station reference ground and one of the transmitter's reference ground bolts, noting there are two reference ground connection points on the transmitter. The bottom entry reference ground connection is located at the bottom, left side of the cabinet (see figure MD-2). The top entry reference ground connection is located adjacent to the RF output termination point on the RF output filter (see figure MD-8).

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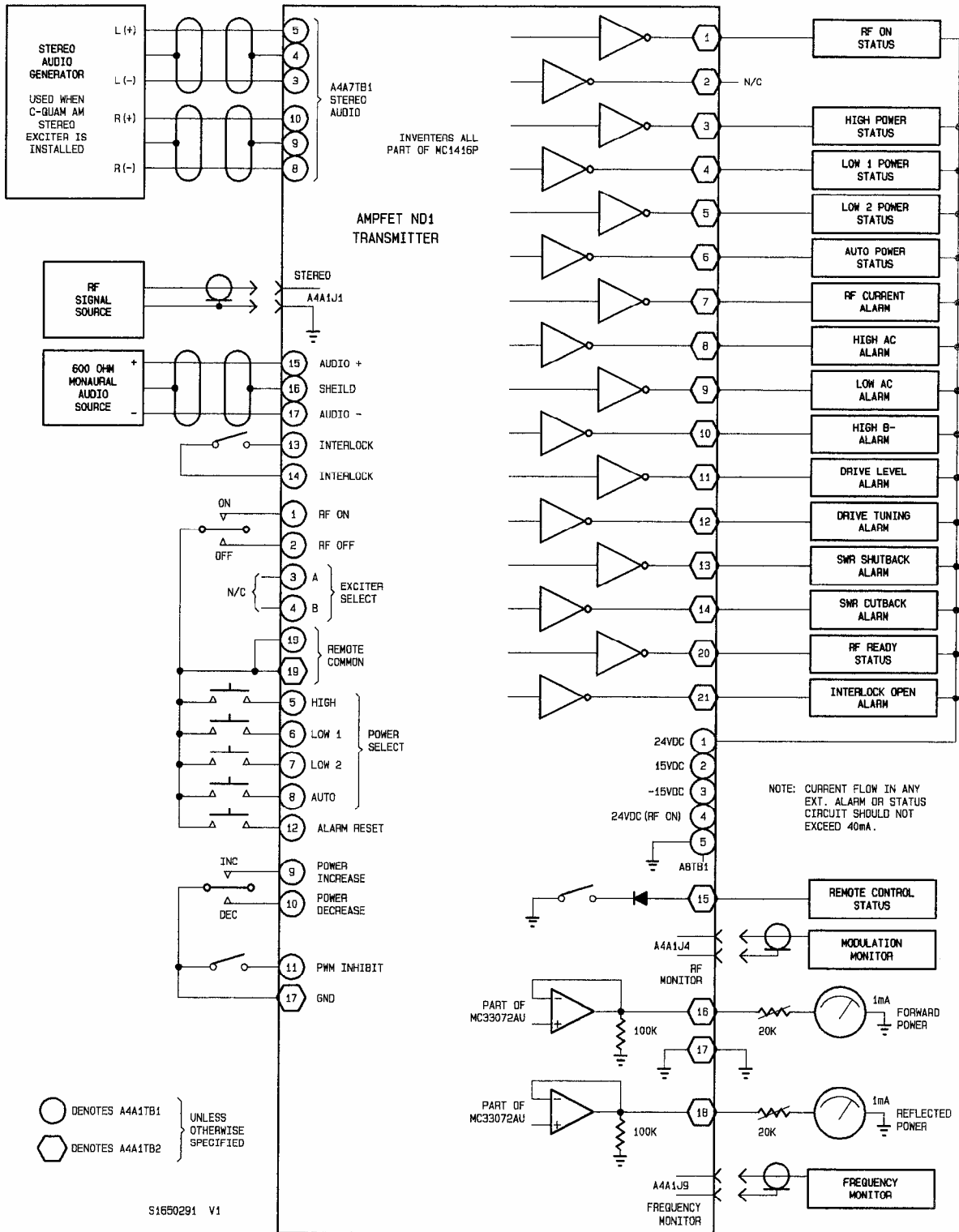


Figure 3-1 External Input/Output Interface

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TECHNICAL PRE-COMMISSIONING

3.3 Prior to applying AC power and turning on transmitter, some circuits must be customized to the station's power source and operating requirements. The following should be completed.

NOTE

Technical pre-commissioning procedures require technical decisions and customization of electrical circuits. They should be incorporated by the station engineer or a competent electronic technician.

Reference is made to an RF drive PWB (A4A3) and a modulator driver PWB (A4A4) in the following procedures. These printed wiring boards are located on the exciter panel. Refer to figure MD-1 to locate the exciter panel, to figure MD-6 to locate the specified PWB and then to the appropriate PWB service instruction manual for its assembly detail.

3.3.1 SELECTING PWR TRANSFORMER'S PRIMARY WINDING TAPS: Connect the AC power wiring, from **MAIN POWER** circuit breaker/AC line filter, to the appropriate primary winding taps of power transformer A5T1, as follows:

WARNING

Ensure AC power source is switched off at the service entrance. If this precaution is not observed, voltages that may cause serious injury or death will be present on circuit breaker and transformer terminals.

- (a) Determine fully loaded, mean, RMS, line-to-line voltage of the AC power source and record this voltage for future reference.
- (b) Verify the power transformer is rated for the voltage determined in step (a) by noting voltage rating on its nameplate.
- (c) Enter the appropriate nominal AC voltage column of table 3-1 with the mean, RMS, line-to-line voltage obtained in step (a) and determine which power transformer primary winding taps should be used.
- (d) Gain access to transformer's primary winding taps by removing screws securing circuit breaker panel A3 to the cabinet. Carefully lift away panel and swing it to one side.
- (e) Connect one of the moveable wires (#4) to the power transformer's input terminal identified in table 3-1.
- (f) Connect the remaining moveable wire (#5) to the power transformer's input terminal identified in table 3-1.
- (g) Re-install the circuit breaker panel on the front of the cabinet, using attaching hardware removed in step (d).

Table 3-1 Primary Winding Tap Selection for 230 VAC Power Transformer A5T1

NOMINAL AC VOLTAGE (RMS - LINE-TO-LINE)	WIRE #5 TO TRANSFORMER TAP	WIRE #4 TO TRANSFORMER TAP
176 - 185	2 (0 V)	4 (180 V)
186 - 195	1 (10 V)	4 (180 V)
196 - 205	2 (0 V)	5 (200 V)
206 - 215	1 (10 V)	5 (200 V)
216 - 225	2 (0 V)	6 (220 V)
226 - 235	1 (10 V)	6 (220 V)
236 - 245	2 (0 V)	7 (240 V)
246 - 255	1 (10 V)	7 (240 V)

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Table 3-2 Low-Pass Filter Selector Switch Settings

HIGH FREQUENCY ROLL-OFF (-1.0 dB)	FILTER SELECTOR SWITCH SETTINGS	
RF DRIVE PWB	S1-1	S1-2
16.5kHz	OPEN	OPEN
10.0kHz	OPEN	CLOSED
6.6kHz	CLOSED	OPEN
5.5kHz	CLOSED	CLOSED

3.3.2 INTERNAL/EXTERNAL RF DRIVE:

Connect or verify the RF drive source link on RF drive PWB installed on the exciter panel is connected as desired.

NOTE

If a C-QUAM AM stereo PWB is installed, as the RF drive source, RF drive PWB A3 will not be installed.

NOTE

Do not remove oscillator crystal from an RF drive PWB that is configured for external RF drive. The oscillator's output is used to obtain the $2f_c/N$ output which ultimately determines the pulse width modulation frequency (f_{pwm})

- (a) On RF drive PWB's that utilize an external RF drive (monaural or AM stereo) source, link or verify terminal **C** is linked to terminal **A**.
- (b) On RF drive PWB's that utilize the integral crystal oscillator as the RF drive source, link or verify terminal **C** is linked to terminal **B**.
- (c) Record RF drive source link connection for the exciter's RF drive PWB.

3.3.3 MODULATING AUDIO PASS BAND SELECTION:

The low-pass filter switch, on the exciter panel's modulator driver PWB, is set during manufacture, for a -1.0dB roll-off at highest frequency listed in table 3-2. This selection will be adequate for most installations.

NOTE

A 3-pole Butterworth filter that can be altered towards a pseudo-Bessel response is used as the low-pass filter.

The decision to select a lower roll-off frequency will be dictated by complex factors. They may include; an antenna with sideband limitations, square wave overshoot, and the processing the audio is subjected to. In some instances, AM Stereo stations may wish to reduce/eliminate pass band influence. Nautel's field service department will provide advice and recommendations based on the installation.

- (a) Set or verify the low-pass filter selector switch, on the modulator driver PWB, has been set to provide desired high-frequency roll off.
- (b) Refer to table 3-2 to determine the roll-off frequencies that can be selected and the settings of the low-pass filter selector switch that are required to obtain them. Record the roll-off frequency and the filter selector switch settings for future reference.

3.3.4 f_c DEPENDENT SELECTIONS (RF DRIVE PWB):

Verify the carrier frequency (f_c) dependent link connections and switch settings of the exciter panel's RF drive PWB have been properly connected/set as follows:

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Table 3-3 RF Drive PWB's Carrier Frequency Dependent Switch Settings and Link Connections

f_c (kHz)	÷ LINKS		N	SELECT N SWITCH SETTINGS				$2f_c/N$ (kHz)	
	CONNECT F TO	CONNECT J TO		S1-4 (8)	S1-3 (4)	S1-2 (2)	S1-1 (1)	MIN	MAX
531 - 559	D (/4)	H (/4)	6 (0110)	0	1	1	0	177.00	186.33
560 - 749	D (/4)	H (/4)	8 (1000)	1	0	0	0	140.00	187.25
750 - 909	D (/4)	H (/4)	10 (1010)	1	0	1	0	150.00	181.80
910 - 999	D (/4)	H (/4)	12 (1100)	1	1	0	0	151.67	166.50
1000 - 1099	E (/2)	G (/2)	12 (1100)	1	1	0	0	166.67	183.17
1100 - 1279	E (/2)	G (/2)	14 (1110)	1	1	1	0	157.14	182.71
1280 - 1439	E (/2)	G (/2)	8 (1000)	1	0	0	0	320.00	359.75
1440 - 1710	E (/2)	G (/2)	10 (1010)	1	0	1	0	288.00	342.00

0 = switch open
1 = switch closed

3.3.4.1 Carrier Oscillator Crystal: Verify an appropriate oscillator crystal has been installed, noting the crystal frequency must be between 2.0Mhz and 4.0Mhz. Use the following criteria to determine the frequency of the oscillator crystal.

- When f_c is less than 1000 kHz, the oscillator crystal frequency should be precisely four times the carrier frequency ($4f_c$).
- When f_c is 1000 kHz or higher, the oscillator crystal frequency should be precisely twice the carrier frequency ($2f_c$).

3.3.4.2 Frequency Divider Links: Connect or verify the appropriate divide-by (\div) links are connected. Determine interconnection as follows:

- (a) Enter table 3-3 with f_c and refer to the \div **Links** column to determine which terminals (/2 or /4) should be linked to terminals **F** and **J**, noting:
 - Divide-by-four links (/4) are connected when f_c is less than 1000kHz.

- Divide-by-two links (/2) are connected when f_c is 1000kHz or higher.

- (c) When oscillator frequency must be divided by four to obtain f_c ; terminals **F** and **D** must be linked and terminals **J** and **H** must be linked. Terminals **E** and **G** must not be connected.

- (d) When oscillator frequency must be divided by two to obtain f_c ; terminals **F** and **E** must be linked and terminals **J** and **G** must be linked. Terminals **D** and **H** must not be connected.

3.3.4.3 Divide-by-N Switch Settings: Verify the **divide-by-N** switch settings are set to provide a $2f_c/N$ that, in conjunction with divider links in the modulator driver PWB, will ultimately produce the required variable pulse width modulation frequency (f_{pwm}). $2f_c/N$ should be within the frequency range specified in the $2f_c/N$ (kHz) column of table 3-3.

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NOTE

The optimum variable pulse width modulation frequency (f_{pwm}) was selected during factory tests. Refer to the transmitter configuration sheet, provided with the factory test results, to determine the switch settings that were established to obtain this frequency. These settings should be used unless the assigned carrier frequency is changed.

In rare cases, the factory established f_{pwm} for a specific transmitter may not be as tabulated in table 3-3. For these transmitter's, the information in table 3-3 is not valid. The divide-by-N switches must be set and the resultant $2f_c/N$ frequency must be as recorded on the transmitter configuration sheet.

Refer to the RF drive PWB's service instruction manual to select the appropriate f_{pwm} after a frequency change and to identify how the switch settings/link connections are normally determined.

3.3.5 f_c DEPENDENT SELECTIONS (C-QUAM AM STEREO EXCITER PWB): If the C-QUAM AM stereo exciter PWB is installed, Verify it is the appropriate variation, the appropriate oscillator crystal is installed and the divide-by-N switch has been properly set:

NOTE

C-QUAM AM stereo exciter PWBs contain frequency dependent parts. There are eleven variations, with each one for a specific frequency band. Refer to the C-QUAM AM stereo exciter PWB's service instruction manual to determine the variation that should be installed for the assigned carrier frequency.

3.3.5.1 Carrier Oscillator Crystal: Verify an appropriate oscillator crystal has been installed, noting the crystal frequency must be four times the assigned carrier frequency ($4f_c$).

3.3.5.2 Divide-by-N Switch Settings: Verify the *divide-by-N* switch settings are set to provide a $2f_c/N$ that, in conjunction with divider links in the modulator driver PWB, will ultimately produce the required variable pulse width modulation frequency (f_{pwm}). $2f_c/N$ should be within the frequency range specified in the **$2f_c/N$ (kHz)** column of table 3-4.

NOTE

The optimum variable pulse width modulation frequency (f_{pwm}) was selected during factory tests. Refer to the transmitter configuration sheet, provided with the factory test results, to determine the switch settings that were established to obtain this frequency. These settings should be used unless the assigned carrier frequency is changed.

In rare cases, the factory established f_{pwm} for a specific transmitter may not be as tabulated in table 3-4. For these transmitter's, the information in table 3-4 is not valid. The divide-by-N switches must be set and the resultant $2f_c/N$ frequency must be as recorded on the transmitter configuration sheet.

Refer to the C-QUAM AM stereo exciter PWB's service instruction manual to select the appropriate f_{pwm} after a frequency change and to identify how the switch settings are normally determined.

3.3.6 MODULATOR DRIVER PWB'S $2f_c/N$ DIVIDER LINKS: Connect or verify the appropriate $2f_c/N$ frequency divider links have been connected, on the modulator driver PWB in the exciter panel, as recorded on the transmitter configuration sheet.

3.3.6.1 If factory link connection information is not available or if a frequency change is being implemented, enter table 3-3 or table 3-4 with carrier frequency (f_c) and determine $2f_c/N$.

NOTE

Unless otherwise specified, $2f_c/N$ frequency divider links are connected to provide a variable pulse width modulation frequency (f_{pwm}) that is between 70.00kHz and 93.63kHz.

- (a) If $2f_c/N$ is between 140.00 and 187.25kHz:
 - Connect terminal **A** to associated /2 terminal.
 - Connect terminal **B** to associated /2 terminal.
- (b) If $2f_c/N$ is between 288.00 and 359.75 kHz:
 - Connect terminal **A** to associated /4 terminal.
 - Connect terminal **B** to associated /4 terminal.

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Table 3-4 C-QUAM AM Stereo Exciter PWB's Carrier Frequency Dependent Switch Settings

fc (kHz)	N	SELECT N SWITCH SETTINGS				2fc/N (kHz)	
		S4-4 (8)	S4-3 (4)	S4-2 (2)	S4-1 (1)	MIN	MAX
531 - 559	6 (0110)	0	1	1	0	177.00	186.33
560 - 749	8 (1000)	1	0	0	0	140.00	187.25
750 - 909	10 (1010)	1	0	1	0	150.00	181.80
910 - 999	12 (1100)	1	1	0	0	151.67	166.50
1000 - 1099	12 (1100)	1	1	0	0	166.67	183.17
1100 - 1279	14 (1110)	1	1	1	0	157.14	182.71
1280 - 1439	8 (1000)	1	0	0	0	320.00	359.75
1440 - 1710	10 (1010)	1	0	1	0	288.00	342.00

0 = switch open
1 = switch closed

3.3.7 CONTROL INTERFACE BATTERY: If battery BT1 is not already installed in its battery holder on the control interface PWB, locate the 9.0 volt battery supplied in the ancillary parts kit and install it. Ensure the mating connector is connected and fully engaged.

NOTE

The control interface PWB is located on the rear of the control/monitor panel. Refer to figure MD-3 as an aid in locating the control interface PWB and then, if additional information is necessary, to its service instruction manual

3.3.8 REMOVAL OF METER SHORTING CLIPS: Remove or verify in-transit meter shorting clips have been removed from terminals of both meters (**DC SUPPLY** and **OUTPUT POWER**) on the control/monitor panel. Ensure nuts securing wiring to meter terminals are firmly tightened.

NOTE

The in-transit meter shorting clips are factory installed to prevent damage to the meter movements when the transmitter is in transit. These clips must be removed for a meter to function properly.

3.3.9 LOAD RESISTANCE CHECK FOR B-VOLTAGE POWER SUPPLY: Check the B-voltage power supply's load resistance as follows:

- (a) Measure the load resistance for the B- voltage power supply by connecting an ohmmeter between the choke strap assembly (A5A2), which is located on the power supply choke and chassis ground. Refer to figure MD-6 to locate the strap assembly.
- (b) Resistance reading obtained in step (a) should be an open circuit.

NOTE

There are large storage capacitors in the RF power module. Resistance readings will not be accurate until they are fully charged to the voltage being applied by the ohmmeter.

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COMMISSIONING PROCEDURES

3.4 These procedures are in a step-by-step format. They will permit a person who is not familiar with the transmitter to perform the checks. They should be completed in sequence, as each procedure establishes settings and contains prerequisites for subsequent procedures.

NOTE

The transmitter was precisely calibrated and subjected to a burn-in during manufacture. It should not be necessary to change any adjustment, other than the ones specified. If the tests associated with a procedure indicate that the preset adjustments are not optimum, perform the appropriate adjustment procedure as detailed in section 5 prior to proceeding with additional tests.

An optional C-QUAM AM stereo exciter PWB (A4A7) may be installed on the exciter panel as the exciter's RF drive source. When this option is included, the exciter panel's RF drive PWB (A4A3) will not be installed.

Exciter Modules/Assemblies

DC Power Supply.....	A4A2
RF Drive PWB	A4A3
or	
C-QUAM AM Stereo Exciter PWB	A4A7
Modulator Driver PWB.....	A4A4
RF Drive Amplifier	A4A5

3.4.1 PRECAUTIONS TO BE OBSERVED:

This transmitter contains many solid state devices, which may be damaged if subjected to excessive heat or high voltage transients. Every effort must be taken to ensure circuits are not overdriven and they are not disconnected from their loads while turned on. Precautionary information included in the operating instructions of section four should be read and fully understood prior to applying power and must be observed during operation.

3.4.2 PRELIMINARY SETTINGS: Verify the transmitter is ready to turn on as follows:

- (a) Verify pre-commissioning requirements of paragraph 3.2 and 3.3 have been completed.
- (b) Set all switches and circuit breakers as tabulated in table 3-5.

- (c) Terminate the transmitter's RF output into a precision 50 ohm dummy load rated at a minimum of 2000 watts.

WARNING

If a jumper is placed between the interlock inputs (TB1-13/TB1-14) on the remote interface PWB, safety features controlled by the external interlocks will be disabled. It is recommended a fail safe method of alerting personnel to this fact be implemented. Voltages which are dangerous to life will be present on RF output stages and the antenna system if the transmitter is turned on.

- (d) Close all external interlocks or temporarily connect a jumper wire between TB1-13 and TB1-14 of the remote interface PWB.
- (e) Turn off the audio input at its source.
- (f) Set control/monitor panel's (control interface PWB) **ADJUST-LOW 1**, **ADJUST-LOW 2** and **ADJUST-HIGH** potentiometers fully counter clockwise (minimum of four turns)
- (g) If the optional C-QUAM AM stereo exciter PWB is installed on the exciter panel as the exciter's RF drive source:
 - Disable the AM stereo feature and select monaural operation by setting its **STEREO ENABLE** switch to **MONO**.
 - Inhibit the 25Hz pilot frequency by setting its **PILOT** switch to **OFF**.
 - Turn it **STEREO ENABLE** on by setting the exciter panel's switch to **ON**.
- (h) Open-circuit the modulator drive to the RF power module by removing the mod drive enable relay (K1) from its socket on modulator driver PWB A4A4.

NOTE

Modulator driver PWB A4A4 is located on the exciter panel. Refer to figure MD-1 to locate exciter panel and then to figure MD-5 to locate the modulator driver PWB. For assembly detail of modulator driver PWB, refer to its service instruction manual.

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Table 3-5 Reference Switch Settings for Initial Turn-on

WHERE SWITCH IS LOCATED	REF DES	PANEL MARKING/ NOMENCLATURE USED IN TEXT	SETTING
Circuit Breaker Panel	A3CB1	MAIN POWER	OFF
Exciter Panel	A4S1	STEREO ENABLE	*
Control/Monitor Panel	A1S1	DC SUPPLY	+24VDC
	A1S2	CONTROL	LOCAL
	A1S3	OUTPUT POWER	FORWARD

* Denotes - set to **OFF** when monaural RF drive PWB is the RF drive source.
set to **ON** when C-QUAM AM stereo exciter PWB is the RF drive source

3.4.3 INITIAL TURN-ON: Switch on AC power at service entrance. Turn on transmitter and observe its alarm/status indicators as follows:



Do not change the setting of any adjustment on a C-QUAM AM stereo exciter (if installed) unless specifically directed to do so and then only if test results are not within specified tolerances. Improper adjustment may result in emission level test results being out of tolerance and will probably cause a badly distorted or otherwise unacceptable AM stereo output.

NOTE

If the optional C-QUAM AM stereo exciter PWB is installed as the RF drive source, it is recommended that it be set for monaural operation as specified in step (g) of paragraph 3.4.2 for routine tests, unless the tests require AM stereo operation.

- (a) Verify the requirements of paragraph 3.4.2 have been completed.
- (b) Set the **MAIN POWER** circuit breaker to **ON**.
- (c) The circuit breaker panel's **B-VDC** lamp shall turn on.

NOTE

Control switches and indicator lamps are located on the control interface PWB. They are oriented to be accessible/visible through openings in the front of control/monitor panel. They are considered to be on the control/monitor panel in the following.

NOTE (Continued)

Unless otherwise stated, all referenced controls and indicators, are located on or accessible from the control/monitor panel in the following.

- (d) Preset the control interface PWB's local control switches. Press and release the following switches, noting they are all located on the control/monitor panel:
 - **ALARM RESET** switch
 - **RF-OFF** switch
 - **SELECT OUTPUT POWER-LOW 2** switch.
- (e) The control/monitor panel's **OUTPUT POWER-LOW 2** lamp shall turn on.
- (f) The **B- VDC** lamp on the rear of the RF power module shall be on.
- (g) All remaining lamps shall be off.
- (h) Turn on the RF power stage (press/release the **RF-ON** switch and verify the **RF-ON** lamp turns on).
- (i) The RF power module's cooling air fan shall turn on.
- (j) The RF power module's **MOD FAIL ALARM** lamps may turn on.

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3.4.4 DC POWER SUPPLY CHECKS: Check the outputs of the various DC voltage power supplies, as follows:

NOTE

The output voltage of the unregulated 24 VDC power supply and the B- VDC power supply is dependent on the voltage of the AC power source and the power transformer's primary winding tap selection.

- (a) Set control/monitor panel's **DC SUPPLY** switch to **+24 VDC** and record the **DC SUPPLY** meter's indication. Reading shall be between 22.0 and 26.5 VDC.

NOTE

The output of the 24 VDC power supply is unregulated and is directly proportional to the voltage transformed to the secondary windings of the power transformer. If voltage in step (a) is not within specified limits, the most probable cause is the power transformer primary winding tap selection.

- (b) If the voltage reading in step (a) is less than 22.0 VDC, switch off AC power source at the service entrance, then select new primary winding taps as detailed in paragraph 3.3.1, using the taps tabulated for the next lower voltage range in table 3-1. Verify requirements of step (a) are being met.
- (c) If voltage reading in step (a) is more than 26.5 VDC, switch off AC power source at the service entrance, then select new primary winding taps as detailed in paragraph 3.3.1, using taps tabulated for next higher voltage range in table 3-1. Verify requirements of step (a) are being met.
- (d) Set **DC SUPPLY** switch to **+15 VDC** and record **DC SUPPLY** meter's indication. Reading shall be between 14.0 and 16.0 VDC.
- (e) Set **DC SUPPLY** switch to **-15 VDC** and record **DC SUPPLY** meter's indication. Reading shall be between -14.0 and -16.0 VDC.
- (f) Set **DC SUPPLY** switch to **B- VDC**.
- (g) The **DC SUPPLY** meter's indication should be between -72.0 and -75.0 VDC..

- (h) If necessary adjust the power supply control PWB's **B- VDC Adjust** potentiometer for a **DC SUPPLY** meter indication of -72.0 VDC.
- (i) Set the **DC SUPPLY** switch to **B- AMPS**.
- (j) The **DC SUPPLY** meter's indication shall be near zero amperes.

3.4.5 RF DRIVE FREQUENCY/ PREAMPLIFIER CHECKS: Check frequency and level of the RF drive being produced by the exciter's RF drive source, as follows:

NOTE

There are two standard factory configured RF drive options. They are:

Transmitters that are not factory configured for C-QUAM AM stereo operation have one monaural RF drive PWB (A4A3).

Transmitters that are factory configured for C-QUAM AM stereo operation do not have a monaural RF drive PWB (A4A3). They have one C-QUAM AM stereo exciter PWB (A4A7).

If required, refer to figure MD-5 to locate the monaural RF drive PWB or the C-QUAM AM stereo exciter PWB. For assembly detail, refer to the appropriate service instruction manual.

- (a) Verify **Low 2** is the selected preset power level (**OUTPUT POWER-LOW 2** lamp is on).
- (b) Verify the **ADJUST-LOW 1**, **ADJUST-LOW 2** and **ADJUST-HIGH** potentiometers, are fully counter clockwise.
- (c) Connect a frequency counter to the remote interface PWB's **FREQUENCY MONITOR** connector (J9), using a suitable coaxial cable.
- (d) Determine exciter's RF drive source, noting:
 - When a C-QUAM AM stereo exciter PWB is providing the RF drive, its integral crystal oscillator is the RF drive source.
 - When a monaural RF drive PWB is providing the RF drive and it has a link connected between its **B** and **C** terminals, its integral crystal oscillator is the RF drive source.

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- When a monaural RF drive PWB is providing the RF drive and it has a link connected between its **A** and **C** terminals, an external RF generator is the RF drive source.
- (e) If a monaural RF drive PWB is providing the RF drive, check the RF drive as detailed in paragraph 3.4.5.1 or 3.4.5.2.
- (f) If a C-QUAM AM stereo exciter PWB is providing the RF drive, check the RF drive as detailed in paragraph 3.4.5.3.

3.4.5.1 Internal RF Drive Source: If the RF drive source is being produced internally, check the RF drive as follows:

- (a) Verify a link is connected between terminals **B** and **C** on selected RF drive PWB.
- (b) Frequency counter indication shall be the assigned carrier frequency ± 5.0 Hz or five parts per million (ppm) whichever is greater.
- (c) If the requirement of step (b) is not met, adjust RF drive PWB's **FREQ ADJUST** trimming capacitor (C14), until the frequency counter's indication is the assigned carrier frequency.
- (d) Connect an oscilloscope between TP2 of the RF drive PWB and ground.
- (e) Oscilloscope indication should be similar to example depicted in figure 5-1 [symmetrical (50% duty cycle) square wave with a nominal peak-to-peak amplitude of 15.0 volts].
- (f) If necessary, adjust the RF drive PWB's **SLICER BIAS** potentiometer (R4) to obtain a symmetrical square wave.
- (g) Disconnect oscilloscope.

3.4.5.2 External RF Drive Source: If the RF drive is being provided from an external source, check the RF drive as follows: :



Ensure peak-to-peak amplitude of external rf drive does not exceed 12.0 volts. Voltages in excess of 12.0 volts will over stress rf drive input components and cause them to overheat.

- (a) Verify a link is connected between terminals **A** and **C** on rf drive pwb.
- (b) Verify an external rf drive is being applied to the remote interface pwb's **STEREO** connector (J1).
- (c) Verify the external rf drive input is the assigned carrier frequency, is unmodulated and its amplitude is between 5.0 and 12.0 volts peak-to-peak (sine or square wave).
- (d) Frequency counter indication shall be the assigned carrier frequency ± 5.0 Hz or five parts per million (ppm) whichever is greater.
- (e) If the requirement of step (d) is not met, adjust carrier frequency of external rf source, until the frequency counter's indication is the assigned carrier frequency.
- (f) Connect an oscilloscope between terminal **C**, of rf drive pwb and ground.
- (g) Oscilloscope indication should be a symmetrical (50% duty cycle) waveform (sine or square) with a nominal peak-to-peak amplitude that is between 5.0 and 12.0 volts.
- (h) Connect an oscilloscope between TP2 of the rf drive pwb and ground.
- (i) Oscilloscope indication should be similar to example depicted in figure 5-1 (symmetrical (50% duty cycle) square wave with a nominal peak-to-peak amplitude of 15.0 volts].
- (j) If necessary, adjust the rf drive pwb's **SLICER BIAS** potentiometer (R4) to obtain a symmetrical square wave.
- (k) Disconnect oscilloscope.

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3.4.5.3 AM Stereo Rf Drive Source: If the rf drive source is being produced by a C-QUAM AM stereo exciter pwb, check the rf drive as follows:

- (a) Verify the exciter panel's **STEREO ENABLE** switch is set to **ON** and the C-QUAM AM stereo exciter pwb's **STEREO ENABLE** switch is set to **MONO**.
- (b) Frequency counter indication shall be the assigned carrier frequency ± 5.0 Hz or five parts per million (ppm) whichever is greater.
- (c) If the requirement of step (b) is not met, adjust the C-QUAM AM stereo exciter pwb's **4fc** trimming capacitor (C49), until the frequency counter's indication is the assigned carrier frequency.
- (d) Connect an oscilloscope between TP12 of the C-QUAM AM stereo exciter pwb and ground (TP17).
- (e) Oscilloscope indication should be similar to the example depicted in figure 5-1 [symmetrical (50% duty cycle) square wave with a nominal peak-to-peak amplitude of 15.0 volts].
- (f) If necessary, adjust the C-QUAM AM stereo exciter pwb's **SLICER BIAS** potentiometer (R154) to obtain a symmetrical square wave.
- (g) Disconnect oscilloscope.

3.4.6 RF DRIVE AMPLIFIER CHECKS: Check the amplitude of the rf drive being applied to the rf power amplifier stages, as follows:

NOTE

The rf drive amplifier (A4A5) is located on the exciter panel. Refer to figure MD-1 to locate the exciter panel and then to figure MD-5 to locate the rf drive amplifier. For assembly detail of the rf drive amplifier, refer to its service instruction manual.

- (a) Verify **Low 2** is the selected preset power level (**OUTPUT POWER-LOW 2** lamp is on).



Use extreme care when connecting/disconnecting the oscilloscope probe in the following procedures. Do not allow the probe to short the rf drive to ground.

- (b) Connect an oscilloscope to monitor the rf drive amplifier's rf drive input. Connect it between the centre conductor of J2 on the rf drive amplifier and ground.
- (c) Oscilloscope indication shall be similar to the example in figure 5-2. Waveform's peak-to-peak amplitude should be a nominal 20 volts.

WARNING

Voltages which are dangerous to life are present on exposed terminals of the power transformer when the side panel is removed. Extreme caution must be exercised when the panel is removed.

- (d) Connect an oscilloscope between TB1-2, of rf power module A2 and ground, noting access is gained by removing the side panel.
- (e) Oscilloscope indication shall be similar to the example in figure 5-3. Waveform's peak-to-peak amplitude shall be between 80.0 and 88.0 volts, peak-to-peak.

3.4.6.1 Rf Drive Level Detector Check: Check the amplitude of the rf drive control pwb's *rf drive level* output, noting it is monitored by the low rf drive alarm circuit, as follows:

NOTE

The rf drive control pwb is located on the rf drive amplifier. Refer to the rf drive amplifier's service instruction manual for additional information.

- (a) Connect a digital multimeter, that is preset to measure dc volts, between the cathode of CR3 on the rf drive control pwb and ground.
- (b) The digital multimeter's indication should be between 38.0 and 40.0 vdc.

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3.4.7 MOD DRIVE CHECKS: Check critical parameters of the variable pulse width modulation drive signal, as follows:

NOTE

Modulator driver pwb A4A4 is located on the exciter panel. Refer to figure MD-1 to locate exciter panel and then to figure MD-5 to locate the modulator driver pwb. For assembly detail of modulator driver pwb, refer to its service instruction manual.

- (a) Verify the rf power stage is turned on and **low 2** preset rf level is selected (**RF ON** and **OUTPUT POWER-LOW 2** lamps are turned on).
- (b) Verify the mod drive input to the rf power module is inhibited (relay K1 has been removed from the modulator driver pwb).
- (c) Verify control/monitor panel's, **ADJUST-LOW 1**, **ADJUST-LOW 2** and **ADJUST-HIGH** potentiometers, are fully counter clockwise.
- (d) Set the **DC SUPPLY** switch to **B- AMPS**.
- (e) The **DC SUPPLY** meter's indication shall be near zero amperes, indicating current being consumed by the rf power module is near zero amperes.
- (f) Connect an oscilloscope between th/2 terminal associated with terminal **B** of the modulator driver pwb and ground.
- (g) Oscilloscope indication should be similar to example depicted in figure 5-4. Waveform should be positive going $2fc/N$ pulses. Refer to commissioning records for recorded value of $2fc/N$ (see paragraph 3.3.4.3 or 3.3.5.2).
- (h) Connect a frequency counter between **TP4** of modulator driver pwb and ground.
- (i) Frequency counter's indication shall be the pulse width modulation frequency ($fpwm$). It should be between 70.0 and 96.63 kHz. Refer to commissioning records for recorded value (see paragraph 3.3.6).

NOTE

The factory determined PWM frequency ($fpwm$) for a transmitter may be outside the tolerance specified in step (i). See paragraph 3.3.4.3 or 3.3.5.2.

- (j) Connect the oscilloscope between **TP4** of the modulator driver pwb and ground.

NOTE

When preset $fpwm$ is unknown, enter table 3-3 and determine 'N' for assigned carrier frequency (fc). If fc is less than 1280 kHz, divide it by the number tabulated as 'N'. If fc is 1280 kHz or more, divide it by twice the number tabulated as 'N'.

- (k) Oscilloscope indication should be similar to example depicted in figure 5-5. Waveform should be a square wave with a nominal peak-to-peak amplitude of 15.0 volts at the $fpwm$ frequency
- (l) Connect an oscilloscope between **TP6** of the modulator driver pwb and ground.
- (m) Oscilloscope indication should be similar to example depicted in figure 5-6. It should be a triangular waveform with a nominal peak-to-peak amplitude of 4.0 volts. Its negative going peaks should just touch zero volts dc. Its frequency should be the $fpwm$.
- (n) Connect the oscilloscope between **TP10** of the modulator driver pwb and ground.
- (o) Oscilloscope waveform indication should basically be a zero volt dc trace with nominal +15 vdc spikes at $fpwm$.
- (p) Monitor oscilloscope and turn **ADJUST-LOW 2** potentiometer clockwise until a rectangular waveform with an on (positive peak)/off (negative peak) ratio of 40/60 (40% duty cycle) is attained.
- (q) Oscilloscope waveform shall increase linearly and continuously from a 0/100 ratio (zero volts dc trace) to a rectangular waveform with a 40/60 ratio (40% at 15vdc/60% at 0vdc), as the **ADJUST-LOW 2** potentiometer is adjusted. Final waveform shall be similar to the example in figure 5-7.

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- (r) Set the **ADJUST-LOW 2** potentiometer fully counterclockwise.
- (s) Select low 1 power level (press/release the **SELECT OUTPUT POWER-LOW 1** switch and verify the **OUTPUT POWER-LOW 1** lamp turns on).
- (t) Repeat steps (l) thru (r), substituting **ADJUST-LOW 1** potentiometer where **ADJUST-LOW 2** potentiometer is specified.
- (u) Select high power level (press/release the **SELECT OUTPUT POWER-HIGH** switch and verify the **OUTPUT POWER-HIGH** lamp turns on).
- (v) Verify oscilloscope is connected between **TP10** of modulator driver pwb and ground.
- (w) Oscilloscope waveform indication should be a rectangular waveform with an on (positive peak)/off (negative peak) ratio of 25/75 (25% duty cycle).
- (x) Monitor oscilloscope and turn **ADJUST-HIGH** potentiometer clockwise until a waveform with an on (positive peak)/off (negative peak) ratio of 40/60 (40% duty cycle) is attained.
- (y) Waveform's on/off ratio shall increase linearly and continuously from a 25/75 ratio to a 40/60 ratio (40% at 15vdc/60% at 0vdc), as **ADJUST-HIGH** potentiometer is adjusted. Final waveform shall be similar to the example in figure 5-7.
- (z) Set the **ADJUST-HIGH** potentiometer fully counter clockwise.
- (aa) Return to low 2 power level (press/release the **SELECT OUTPUT POWER-LOW 2** switch and verify **OUTPUT POWER-LOW 2** lamp turns on).

3.4.8 INITIAL PRODUCTION OF RF POWER:

Reconnect the mod drive to the rf power module and slowly increase the rf output while monitoring the appropriate meters and alarm lamps for signs of a malfunction, as follows:

NOTE

Refer to figure MD-1 to locate the rf power module. For assembly detail of the rf power module, refer to its service instruction manual.

- (a) Verify requirements of paragraphs 3.4.2 thru 3.4.7 have been successfully completed.
- (b) Turn off the transmitter by setting its **MAIN POWER** circuit breaker to **OFF**.
- (c) Complete the modulator drive circuit to the rf power module by installing the mod drive enable relay (K1) which was removed in step (h) of paragraph 3.4.2
- (d) Verify the **ADJUST-LOW 1**, **ADJUST-LOW 2** and **ADJUST-HIGH** potentiometers, are fully counter clockwise.
- (e) Turn on the transmitter by setting its **MAIN POWER** circuit breaker to **ON** (circuit breaker panel's **B- VDC** lamp shall turn on).
- (f) Verify the rf power stage is turned on and **low 2** preset rf level is selected (**RF ON** and **OUTPUT POWER-LOW 2** lamps are turned on).
- (g) Verify the rf power module's cooling air fan is operating, noting the fan is located on the rear of the module.
- (h) Set the **DC SUPPLY** switch to **B- VDC**.
- (i) The **DC SUPPLY** meter indication shall be between -72.0 and -75.0 vdc.
- (j) Set the **DC SUPPLY** switch to **B- AMPS**.
- (k) The **DC SUPPLY** meter indication shall be near zero amperes, indicating the current being consumed by the rf power module is a nominal zero amperes.



Discontinue increasing rf output power if DC SUPPLY meter's current indication exceeds 10 amperes before an output of 400 watts is attained.

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- (l) Monitor the **DC SUPPLY** meter while slowly adjusting the **ADJUST-LOW 2** potentiometer clockwise for an rf output of 400 watts, as indicated by the **OUTPUT POWER** meter.

If the voltage cannot be adjusted to -72.0 vdc in step (r), the most probable cause is a reduction in AC power source voltage, as the result of loading. Refer to paragraph 3.4.9.

NOTE

*To obtain a more accurate reading when rf output is less than 350 W, press **READ LOWER SCALE** switch and read **FORWARD POWER** meter's lower scale.*

- (m) All **ALARM** lamps, including **ALARM** lamps of the rf power module, shall be off.
- (n) The **DC SUPPLY** meter indication should be less than 10.0 amperes.
- (o) Continue to monitor B- vdc current reading on the **DC SUPPLY** meter while adjusting the **ADJUST-LOW 2** potentiometer for an rf output of 1000 watts, as indicated by the **OUTPUT POWER** meter.
- (p) The **DC SUPPLY** meter indication shall be between 17.0 and 19.0 amperes. Record reading for future reference.

- (s) Set the **DC SUPPLY** switch to **B- VDC**.
- (t) The **DC SUPPLY** meter indication shall be within 1.0 vdc of voltage reading in step (r).
- (u) Set the **OUTPUT POWER** switch to **REFLECTED**.
- (v) The **REFLECTED POWER** meter indication should be near zero watts.

NOTE

The reflected power indication is dependent on the impedance of the transmitter's rf output terminating load. The reflected power level should be near zero watts when the load impedance is precisely 50 ohms at the carrier frequency.

NOTE

*Indication on **DC SUPPLY** meter is the current being drawn from B- voltage power supply. Maximum current range specified in step (p) is applicable when the B- vdc is -71.0 vdc. Minimum current range is applicable when the B- vdc is -73.0 vdc.*

- (q) Connect a digital multimeter that has been preset to measure dc volts, between ac/dc power supply A5's **B-VDC** test point TP1 (-) and chassis ground.

3.4.9 UNREGULATED 24 VDC CHECK - FULL LOAD: Verify the AC power source voltage can maintain the output voltage of the B- vdc power supply at a nominal -72.0 vdc, when the rf output is set to 1000 watts, by monitoring the output of the unregulated 24 vdc power supply:

- (a) Verify the requirements of paragraph 3.4.8 have been completed and the rf output is 1000 watts of unmodulated rf carrier.
- (b) Set **DC SUPPLY** switch to **+24VDC** and record the **DC SUPPLY** meter's indication. Reading recorded shall be between 22.0 and 26.5 vdc.

NOTE

*Refer to figure MD-1 to locate ac/dc power supply and then to figure MD-6 to locate **B-VDC** test point.*

- (r) The digital multimeter indication shall be between -71.0 and -73.0 vdc. If necessary, adjust the power supply control pwb's **B- Vdc Adjust** potentiometer for -72.0 vdc.

NOTE

The output of the 24 vdc power supply is unregulated and is directly proportional to the voltage transformed to the secondary windings of the power transformer. If voltage in step (b) is not within specified limits, the most probable cause is a reduction in the voltage of the AC power source under full load condition (when the transmitter's rf output is maximum).

NOTE

*The power supply control pwb is on ac/dc power supply A5. Refer to figure MD-7 to locate the **B- Vdc Adjust** potentiometer.*

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- (c) If the voltage reading in step (b) is less than 22.0 vdc, switch off AC power source at the service entrance, then select new primary winding taps as detailed in paragraph 3.3.1, using the taps tabulated for the next lower voltage range in table 3-1.
- (d) Verify requirements of step (b) are being met.
- (e) Connect a digital multimeter that has been preset to measure dc volts, between ac/dc power supply A5's **B-VDC** test point TP1 (-) and chassis ground.
- (f) Adjust power supply control pwb's **B- Vdc Adjust** potentiometer for -72.0 vdc.
- (g) Set the **DC SUPPLY** switch to **B- VDC**.
- (h) The **DC SUPPLY** meter indication shall be between -71.0 and -73.0 vdc.

FUNCTIONAL TESTS/FINAL ADJUSTMENTS

3.5 Perform the final adjustments; to provide the desired rf output power levels; the desired audio characteristics and modulation envelope; and then perform a functional test as detailed in section 5.

SECTION 4 OPERATING INSTRUCTIONS

GENERAL

4.1 The following instructions are primarily intended for persons involved in testing or maintenance of the equipment.

EMERGENCY SHUTDOWN PROCEDURE

4.2 There are no special precautions to be taken if an emergency shutdown is required, but the type of shutdown will be dictated by the reason for the shutdown. There are two types of shutdown, the first turns off the rf output by inhibiting the exciter and power amplifier stages. The second turns off the rf output and disables all of the internal power supplies by disconnecting the ac power source.

4.2.1 TURN-OFF OF RF OUTPUT: When the cause of the emergency shutdown is external to the transmitter or is in the rf output portion of the transmitter, the following will inhibit the exciter and power amplifier stages:

WARNING

The following will not turn off the B- voltage power source. If the reason for an emergency shutdown requires the B- dc voltage to be turned off, proceed directly to paragraph 4.2.2.

- (a) If in remote control, select **RF OFF** at the remote control site.
- (b) If the front of the transmitter is accessible, press and release the control/monitor panel's **RF OFF** switch (local or remote control).
- (c) Open any external interlock switch.

4.2.2 COMPLETE SHUTDOWN: When the cause of the emergency shutdown dictates the need for a complete shutdown of the transmitter, open (turn off) the circuit breaker panel's **MAIN POWER** circuit breaker or switch off the ac power source at the service entrance.

CONTROLS AND INDICATORS

4.3 A table is referenced for each module/assembly that contains controls and/or indicators. Each table identifies the panel marking, or when there is no marking, the nomenclature used in text, the reference designation assigned to each item and a description of each control/indicator's purpose/function.

4.3.1 CONTROL/MONITOR PANEL CONTROLS AND INDICATORS: Table 4-1 lists the control/monitor panel's controls and indicators. Refer to figure MD-1 to locate it, noting its reference designation is A1, and then refer to figures MD-3 for its assembly detail.

4.3.2 RF POWER MODULE CONTROLS AND INDICATORS: Table 4-2 lists the rf power module's controls and indicators. Refer to figure MD-1 to locate the rf power module, noting its reference designation is A2. The rf power module has its own service manual. Refer to this manual for its assembly detail.

4.3.3 EXCITER PANEL CONTROLS AND INDICATORS: Table 4-3 lists the exciter panel's controls and indicators (4-3A for monaural rf drive and 4-3B for C-QUAM AM stereo rf drive). Refer to figure MD-1 to locate the exciter panel, noting its reference designation is A4. Refer to figure MD-5 for its assembly detail. Each of the exciter panel's pwb/assemblies have their own service manuals. Refer to the appropriate manual for the assembly detail of a specific pwb/assembly.

4.3.4 AC/DC POWER STAGE CONTROLS AND INDICATORS: Table 4-4 lists the ac/dc power stage's controls and indicators. The ac/dc power stage consists of circuit breaker panel A3, ac/dc power supply A5, rectifier assembly A7 and external dc interface panel A8. Refer to figures MD-1 and MD-2 to locate the ac/dc power supply stage's assemblies. For a specific assembly detail; refer to figure MD-4 for the circuit breaker panel, figure MD-6 for the ac/dc power supply, figure MD-11 for the rectifier assembly and figure MD-12 for the external dc interface panel.

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PRE-STARTUP CHECKS

4.4 Prior to applying input power to the transmitter, observe the following:

- (a) Verify all assemblies/modules are installed and mating connectors are fully engaged.
- (b) Verify the external input/output wiring is connected as detailed in paragraph 3.2.
- (c) Visually inspect the internal electrical wiring for defects such as; damaged insulation, broken wires, wrong connections and/or loose connections.
- (d) Verify all panels/covers are installed and their attaching hardware is firmly secured.
- (e) Verify the transmitter rf output is terminated into a 50 ohm load - an antenna that is interfaced by an appropriate matching system for normal operation, or a 50 ohm resistive dummy that is rated at 2400 watts for adjustment and testing procedures.
- (f) Verify appropriate primary winding taps of the power transformer have been selected to match the voltage of the input power source (refer to paragraph 3.3).
- (g) Verify the power source has a minimum rating of 2500 VA.

TURNING ON THE TRANSMITTER

4.5 Turn on the transmitter as described in paragraph 3.4 for initial startup and after repairs that may have affected the tuning of frequency sensitive circuits. At other times, set the switches to their appropriate positions.

MODULATION LEVELS

4.6 The modulating audio's gain control is factory set for a 100 percent modulation envelope when the input audio is a pure sine wave and its amplitude is +10dBm at 600 ohms. If necessary, the gain control can be adjusted to obtain this modulation envelope when the amplitude of the input audio is between 0.0 dBm and +12 dBm at 600 ohms. If the station's audio processing equipment can produce a

more positive than negative audio waveform, the gain control can be set to provide a modulation envelope with 125 percent positive peaks, provided the negative valleys do not exceed 100 percent, when the carrier level is 1100 watts.

NOTE

Once the gain of the modulating audio stage has been established, the amplitude of the input audio must be controlled by the station audio processing equipment. Circuits that monitor the positive modulation peaks, will limit their on time when rf current stress limits are exceeded. If this occurs or the negative valleys exceed 100 percent, distortion will be present in the demodulated audio.

VERIFICATION OF PA FAILURE ALARMS

4.7 Transients may occasionally trigger the failure detection circuit in a modulator/power amplifier assembly and cause one or more of the rf power module's **ALARM** lamps to turn on. The transmitter should be momentarily switched off and then on to reset the alarm circuits.

- If the offending **ALARM** lamp does not turn on when rf power is restored, the fault was a false alarm triggered by a transient.
- If the offending **ALARM** lamp turns on when rf power is restored, a fault exists in one or more modulator/power amplifiers in the rf power module.

REMOVAL OF RF POWER MODULE

4.8 The large B- vdc, electrolytic, capacitors in the rf power module must be discharged prior to disconnecting its connectors and removing it from the transmitter. Turn off the B-vdc power supply, to discharge the storage capacitors, by switching off the ac power. This is accomplished by opening (turning off) the circuit breaker panel's **MAIN POWER** circuit breaker or switching off the ac power source at the service entrance.

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NOTE

When the circuit breaker panel's B- VDC lamp is on, ac power is being applied to the power transformer and the B- vdc power supply is producing a potentially high current negative voltage.

The B- lamp on the rear of the rf power module indicates the charge status of its storage capacitors. When it is not fully off, the storage capacitor contains a charge and it is not permissible to disconnect its mating connectors.

OPERATION WITH DEFECTIVE MODULATOR/POWER AMPLIFIER:

4.9 Operation with one or more defective modulator/power amplifiers will not cause any additional harm to the transmitter. The consequence of operation will be a considerable decrease in the rf output's carrier level (50% with one defective modulator/power amplifier) and modulation distortion that exceeds recognized standards, at the higher audio frequencies. It is recommended corrective action be taken as soon as it is convenient.



Do not attempt to compensate for any rf power reduction, caused by modulator/power amplifier failures, by adjusting rf power level controls.

OPERATING PRECAUTIONS

4.10 The subject transmitter contains many solid state devices that may be damaged if subjected to excessive heat or high voltage transients. Every effort must be taken to ensure the circuits are not overdriven and they are not disconnected from their loads while turned on. The following should be routinely observed.

4.10.1 The transmitter's rf output must be applied to a 50-ohm load (antenna or resistive dummy load). The load must not be disconnected from or connected to the transmitter when an rf output is being produced. The rf output must be turned off prior to changing the load. Operation into an open circuit is not recommended.

4.10.2 The dc current being consumed by the rf power module(s) must not exceed prescribed maximums for specific carrier levels (modulated or unmodulated). The control/monitor panel's **DC SUPPLY** meter provides an indication of the current being drawn from the B- dc power supply by the rf power stage when the **DC SUPPLY** switch is set to **B-AMPS**. This current consumption, which is representative of the rf current being produced, is referred to as the *dc supply current*. It is recommended the *dc supply current* be routinely monitored, especially when the carrier level or modulation depth are changed.

4.10.3 The graph in figure 4-1 plots the *dc supply current* reading versus the rf carrier's forward power level to determine if the *dc supply current* is within prescribed limits. The results are only valid if all modulator/power amplifiers in the rf power module are contributing their full share to the rf output. The graph depicts maximums for:

- rf carrier only (no mod) when B- vdc is -71.0.
- rf carrier only (no mod) when B- vdc is -73.0.
- carrier being modulated by normal programming material.
- carrier being modulated at 100 percent by a continuous sine wave.

READING OUTPUT POWER METER

4.11 The output parameter displayed on the **OUTPUT POWER** meter is determined by the setting of the **OUTPUT POWER** switch (**FORWARD** or **REFLECTED**). The meter display has two scales. The upper scale is normally in-circuit. When the power level is less than 350 watts, a more precise reading can be obtained by depressing the **READ LOWER SCALE** switch and reading the lower scale.

NOTE

The OUTPUT POWER meter has square law scales. Resulting non-linearity makes it difficult to read less than 200 watts on the upper scale and 50 watts on the lower scale.

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REMOTE OPERATION

4.12 Preset power level and the transmitter's on/off status can be controlled remotely. When the control/monitor panel's **CONTROL** switch is set to **REMOTE**, these functions are controlled from a remote location. When the **CONTROL** switch is set to **LOCAL** the remote controls have no influence. The remote alarm/status monitoring is independent of and is not affected by the *local/remote* selection.

ELECTROSTATIC PROTECTION

4.13 The transmitter's assemblies contain semiconductor devices that are susceptible to damage from electrostatic discharge. Prior to removing an assembly from the transmitter, and while servicing an assembly, the following precautions must be observed:

NOTE

Electrostatic energy is produced when two insulating materials are rubbed together. A person wearing rubber-soled shoes, walking across a nylon carpet or a waxed floor, can generate an extremely large electrostatic charge. This effect is magnified during periods of low humidity.

Components such as integrated circuits, field-effect transistors, thyristors, and Schottky diodes may be damaged by this high voltage unless adequate precautions are taken.

4.13.1 PERSONAL DISCHARGING:

Maintainers should be electrically discharged by a suitable grounding system (anti-static mats, grounding straps) during removal of an assembly from the transmitter and while handling the assembly for maintenance procedures.

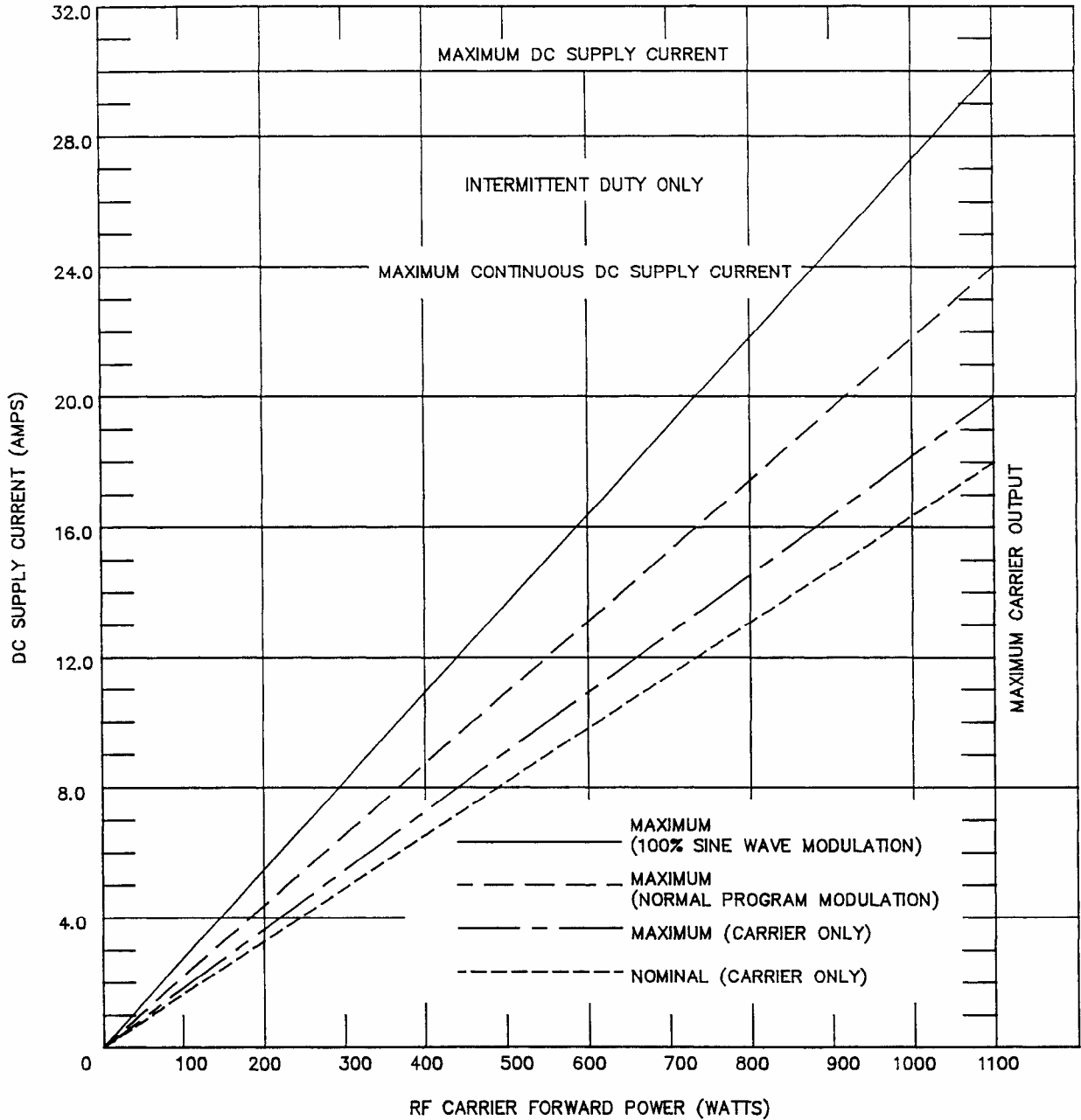
4.13.2 HANDLING/STORAGE: The assembly should be placed in an anti-static bag when it is not installed in a host transmitter or when it is not being subjected to maintenance procedures. Electronic components should be stored in anti-static materials.

4.13.3 TOOLS/TEST EQUIPMENT: Testing and maintenance equipment, including soldering and unsoldering tools, should be suitable for contact with static sensitive semiconductor devices.

4.13.4 STRESS CURRENT PROTECTION: Every precaution should be taken to ensure the static sensitive semiconductor devices are protected from unnecessary stress current. This is achieved by ensuring:

- current is not flowing when an electrical connection is broken.
- voltages are not present on external control/monitoring circuits when they are connected.

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Figure 4-1 Dc Input Current Versus Rf Carrier Forward Power

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Table 4-1 Control/Monitor Panel Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A1BT1	MD-3	Battery	Acts as an uninterruptible power supply for alarm display circuits. Provides 9.0 vdc, when ac power source is inadvertently turned off or when a power failure occurs, that permits the active alarm information to be retained.
A1DS1	MD-3	INTERLOCK OPEN ALARM	When turned on, indicates the exciter stages and power amplifier stages have been inhibited (rf output turned off) because an external interlock switch is open. Normal operation is restored and the INTERLOCK OPEN ALARM lamp will turn off when all interlock switches are closed.
A1DS2	MD-3	DETUNED RF DRIVE ALARM	When turned on, indicates the rf output is shutback (turned off) because the load for the rf drive amplifier is not tuned to the carrier frequency. The lamp will not turn off and normal operation will not be restored until DETUNED RF DRIVE RESET switch is activated, after the cause of the alarm has been removed.
A1DS3	-	Not Used	
A1DS4	MD-3	RF - ON	When turned on, indicates the exciter stages and the rf power amplifiers are enabled.
A1DS5	MD-3	HIGH B-VDC ALARM	When turned on, indicates the rf output has been shutback (turned off), since the alarm circuits were reset, because output voltage of the B- vdc power supply has exceeded the high B- vdc threshold (more negative than -82.0 vdc). If cause of alarm is removed, normal operation is restored, but HIGH B-VDC ALARM lamp shall remain on.
A1DS6	MD-3	HIGH AC PWR ALARM	When turned on, indicates the rf output has been shutback (turned off), since the alarm circuits were reset, because the voltage of the ac power source was excessive and caused the output of the unregulated 24 vdc power supply to exceed the high ac power threshold (more than 5% above nominal). If cause of alarm is removed, normal operation is restored, but HIGH AC PWR ALARM lamp shall remain on.

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Table 4-1 Control/Monitor Panel Controls and Indicators (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A1DS7	MD-3	LOW AC PWR ALARM	When turned on, indicates the rf output has been shutback (turned off), since the alarm circuits were reset, because the ac power source voltage was low and caused the unregulated 24 vdc power supply's output to fall below the low ac power threshold (more than 10% below nominal). If cause of alarm is removed, normal operation is restored, but LOW AC PWR ALARM lamp shall remain on.
A1DS8	MD-3	LOW RF DRIVE ALARM	When turned on, indicates the rf output has been shutback (turned off), since the alarm circuits were reset, because the amplitude of the rf drive was less than the low rf drive threshold (less than 67.5 volts peak-to-peak). If cause of alarm is removed, normal operation is restored, but LOW RF DRIVE ALARM lamp shall remain on.
A1DS9	MD-3	SWR SHUTBACK ALARM	When turned on, indicates the rf output has been shutback (turned off), since the alarm circuits were reset, because the reflected power exceeded the reflected power threshold (175 ±25 watts). If cause of alarm is removed, normal operation is restored, but SWR SHUTBACK ALARM lamp shall remain on.
A1DS10	MD-3	HIGH RF CURRENT ALARM	When turned on, indicates the rf output has been shutback (turned off), since the alarm circuits were reset, because the rf current flowing in the rf output filter exceeded the rf power modules' stress current threshold. If cause of alarm is removed, normal operation is restored, but HIGH RF CURRENT ALARM lamp shall remain on.
A1DS11	-	Not Used	
A1DS12	MD-3	SWR CUTBACK ALARM	When turned on, indicates the rf output is being cutback (reduced) because it was shutback (turned off) four times or more, by the SWR shutback circuit (reflected power in excess of 175 watts) or the high rf current shutback circuit, in any 20 second period, since the alarm circuit was reset. Each additional SWR or High Rf Current shutback cycle, beyond four, will incrementally increase the reduction until the rf output is shutback at a count of nine.

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Table 4-1 Control/Monitor Panel Controls and Indicators (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A1DS13	MD-3	OUTPUT POWER-HIGH	When turned on, indicates the high power level circuitry is enabled and the transmitter's rf output will be the preset high power level.
A1DS14	MD-3	OUTPUT POWER-LOW 1	When turned on, indicates the low 1 power level circuitry is enabled and the transmitter's rf output will be the preset low 1 power level.
A1DS15	MD-3	OUTPUT POWER-LOW 2	When turned on, indicates the low 2 power level circuitry is enabled and the transmitter's rf output will be the preset low 2 power level.
A1DS16	MD-3	OUTPUT POWER-AUTO STATUS	When turned on, indicates the reference voltage that determines the carrier level of the rf output is being provided by an optional auxiliary power control pwb or by an external micro processor based rf power level controller.
A1DS17	-	Not Used	
A1DS18	◆	BAT OK	When turned on, indicates the charge state of the 9.0 volt battery on the control interface pwb is adequate to maintain the fault alarm memory if ac power is lost.
A1R10	◆	B-VDC THRSILD	Adjusted to set high B-vdc threshold to -82.0 vdc. Establishes reference point that causes rf output to be shutback and HIGH B-VDC ALARM to be activated.
A1R95	◆	POWER LIMIT	Adjusted to limit the unmodulated rf output to 1100 watts when any power level ADJUST potentiometer (HIGH , LOW 1 or LOW 2) is set for maximum output (fully clockwise).
A1R100	MD-3	LOW 2 ADJUST	Adjusted to set carrier portion of the rf output to desired level when Low 2 power level is selected.
A1R103	MD-3	HIGH ADJUST	Adjusted to set carrier portion of the rf output to desired level when High power level is selected and both rf power modules are contributing to the rf output (600 watts min/1100 watts max).
A1R105	MD-3	LOW 1 ADJUST	Adjusted to set the carrier portion of the rf output to the level desired when Low 1 power level is selected.

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Table 4-1 Control/Monitor Panel Controls and Indicators (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A1R111	◆	CURRENT THRESHOLD	Adjusted to set the high rf current threshold to a level that represents the stress current limits of the rf power module. Limit cannot be precisely defined as it includes complex factors such as peak current, average current and the rise/fall time of the modulating audio. Establishes the reference point that causes the rf output to be shutback and HIGH RF CURRENT ALARM to be activated.
A1S1	-	Not Used	
A1S2	-	Not Used	
A1S3	MD-3	RF - OFF	Sets the on/off latching relay to its <i>off</i> position when pressed and released. Effectively opens the interlock circuit and turns off the rf output by inhibiting the exciter stage and the rf power amplifier. This switch is in-circuit regardless of CONTROL switch setting.
A1S4	MD-3	RF - ON	Sets the on/off latching relay to its <i>on</i> position when pressed and released, provided the CONTROL switch is set to LOCAL . Completes the interlock circuit's 24 vdc source circuit and enables the exciter stage and rf power amplifier. This switch is disabled and has no influence when the CONTROL switch is set to REMOTE .
A1S5	MD-3	ALARM RESET	Resets ALARM lamp circuits that latch in turned on state when alarm condition is sensed. This switch is in-circuit regardless of CONTROL switch setting.
A1S6	MD-3	SELECT OUTPUT POWER-HIGH	Sets the power level latching relays to the high power level configuration, provided the CONTROL switch is set to LOCAL . Sets rf output to the preset <i>high</i> power level. Switch is disabled and has no influence when CONTROL switch is set to REMOTE .
A1S7	MD-3	SELECT OUTPUT POWER-AUTO	Sets the power level latching relays to the auto power level configuration, provided the CONTROL switch is set to LOCAL . The rf output level is determined by an optional auxiliary power control pwb or by an external micro processor based power controller. Switch is disabled and has no influence when CONTROL switch is set to REMOTE .

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Table 4-1 Control/Monitor Panel Controls and Indicators (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A1S8	MD-3	SELECT OUTPUT POWER-LOW 2	Sets the power level latching relays to the low 2 power level configuration, provided the CONTROL switch is set to LOCAL . Sets rf output to the preset <i>low 2</i> power level. Switch is disabled and has no influence when CONTROL switch is set to REMOTE .
A1S9	MD-3	SELECT OUTPUT POWER-LOW 1	Sets the power level latching relays to the low 1 power level configuration, provided the CONTROL switch is set to LOCAL . Sets rf output to the preset <i>low 1</i> power level. Switch is disabled and has no influence when CONTROL switch is set to REMOTE .
A1S10	MD-3	DETUNED RF DRIVE RESET	Resets the latching feature of the detuned rf drive detector circuit. Restores the operational status of the transmitter and turns off the DETUNED RF DRIVE ALARM lamp, provided the cause of the detuned rf drive alarm has been removed.
A1S11	-	Not Used	
A2R1		CURRENT CAL	Adjusted to accurately set the current reading on the lower scale of the DC SUPPLY meter, when the DC SUPPLY switch is set to B- AMPS .
A2R2		VOLTAGE CAL	Adjusted to accurately set the voltage reading on the upper scale of the DC SUPPLY meter, when the DC SUPPLY switch is set to B- VDC .
A3R2	MD-3	HIGH PWR CAL	Adjusted to accurately set the output power reading on the upper scale of the OUTPUT POWER meter. Normally when the OUTPUT POWER switch is set to FORWARD and the rf output is 1000 watts.
A3R4	MD-3	LOW PWR CAL	Adjusted to accurately set the output power reading on the lower scale of the OUTPUT POWER meter. Normally when the OUTPUT POWER switch is set to FORWARD , the READ LOWER SCALE switch is held depressed and the rf output is 250 watts.
DS1	MD-3	REMOTE	When turned on, indicates the CONTROL switch is set to REMOTE and the transmitter's on/off and preset power level selections are being controlled from a remote location.

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Table 4-1 Control/Monitor Panel Controls and Indicators (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
M1	MD-3	DC SUPPLY	Indicates parameter - voltage (upper scale) or current (lower scale) selected by DC SUPPLY switch.
M2	MD-3	OUTPUT POWER	Indicates the output power parameter (in kilowatts) selected by OUTPUT POWER switch. Upper scale is normally in-circuit. For a more accurate reading when forward/reflected power is less than 350 watts, press and hold READ LOWER SCALE switch.
S1	MD-3	DC SUPPLY	Determines dc power supply information to be displayed on DC SUPPLY meter (B- VDC, B- AMPS, +24VDC, +15VDC, -15VDC and PA VOLTS). Shorts out the meter terminals when set to OFF .
S2	MD-3	CONTROL	Determines whether the on/off function and the preset rf power level selection is controlled locally or remotely. Switches on the control/monitor panel are placed in-circuit when switch is set to LOCAL .
S3	MD-3	OUTPUT POWER	Determines rf output parameter to be displayed on OUTPUT POWER meter. Applies forward power when set to FORWARD , reflected power when set to REFLECTED . Shorts out the meter terminals when set to OFF .
S4	MD-3	READ LOWER SCALE	Increases sensitivity of OUTPUT POWER meter by a factor of four when held depressed. OUTPUT POWER meter's lower scale to be read.

NOTE: Partial reference designation shown. Prefix with A1 for full reference designation.

- ◆ - Denotes item is located on control interface pwb A1 and is not specifically identified in figure MD-3. Refer to the control interface pwb's assembly detail drawing in its service instruction manual to locate these items.

Items prefixed with A1, that are identified as being in figure MD-3, are located on control interface pwb A1. They are visible or accessible from the front of the control/monitor panel.

Refer to figure MD-3 to locate control interface pwb A1.

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Table 4-2 Rf Power Module Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
DS1	-	B-	<p>Indicates charge state of large, electrolytic storage capacitors connected across B- vdc input to the rf power module.</p> <p>When fully turned on (maximum brightness), indicates large, electrolytic storage capacitors are charged to the B-vdc (nominally -72 vdc).</p> <p>When partially turned on, indicates storage capacitors are charging or not fully discharged.</p> <p>When turned off, indicates storage capacitors are fully discharged.</p>
L1	-	Rf Drive Tune	<p>Adjusted to precisely tune the rf drive input's parallel L/C circuit; formed by L1 and the sum of the reflected capacitance, from power MOSFETs in the modulator/power amplifier's, for minimum rf drive current at the carrier frequency (f_c).</p>
A4DS1	-	PA FAIL ALARM - A	<p>When turned on, indicates modulator/power amplifier A1 has failed and is not contributing to the rf power module's output. Normally caused by the failure of one or more power MOSFET's, in A1's power amplifier stage, being sensed by its rf drive current imbalance detector.</p>
A4DS2	-	PA FAIL ALARM - B	<p>When turned on, indicates modulator/power amplifier A2 has failed and is not contributing to the rf power module's output. Normally caused by the failure of one or more power MOSFET's, in A2's power amplifier stage, being sensed by its rf drive current imbalance detector.</p>
A4DS3	-	PA FAIL ALARM - C	<p>When turned on, indicates modulator/power amplifier A3 has failed and is not contributing to the rf power module's output. Normally caused by the failure of one or more power MOSFET's, in A3's power amplifier stage, being sensed by its rf drive current imbalance detector.</p>

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Table 4-2 Rf Power Module Controls and Indicators (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A4DS4	-	MOD FAIL ALARM - A	When turned on, indicates the PA volts output of modulator/amplifier A1 is less negative than the average PA volts of all three modulator/power amplifiers, as the result of a modulator failure.
A4DS5	-	MOD FAIL ALARM - B	When turned on, indicates the PA volts output of modulator/amplifier A2 is less negative than the average PA volts of all three modulator/power amplifiers, as the result of a modulator failure.
A4DS6	-	MOD FAIL ALARM - C	When turned on, indicates the PA volts output of modulator/amplifier A3 is less negative than the average PA volts of all three modulator/power amplifiers, as the result of a modulator failure.

NOTE: Partial reference designation shown. Prefix with A2 for full reference designation.

Figures MD-1 and MD-2 depict the location of the rf power module, but do not show the detail of its controls and indicators. Refer to the rf power module's service instruction manual for its assembly detail.

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Table 4-3A Exciter Panel Controls and Indicators (Monaural Rf Drive)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A1F1	MD-5 ♣	External Rf Drive	Fuses external rf drive at 200 milliamperes.
A3C14	MD-5 ♦	FREQ ADJ	Precisely sets carrier frequency (f_c), by adjusting the crystal oscillator to twice the carrier frequency ($2f_c$) when f_c is less than 1000 kHz, or four times ($4f_c$) when f_c is 1000 kHz or more.
A3R4	MD-5 ♦	SLICER BIAS	Adjusted to obtain a symmetrical square wave at the input to the rf drive's balanced amplifier.
A3R18	MD-5 ♦	IPM BALance	Set during initial installation to offset the incidental phase modulation introduced by rf power amplifier stage and obtain optimum left/right channel separation during external AM stereo operation.
A3S1	MD-5 ♦	Select N	Preset to set the 'N' divider for a frequency ($2f_c/N$) that will result in the optimum pulse width modulation frequency (f_{pwm}).
A4DS1	MD-5 ♥	Audio Limiting	When turned on or flashing, indicates some portion of the positive going audio half-cycles (modulation peak) are exceeding a threshold that represents the rf power amplifier's stress current threshold and the balance of that half cycle is being amplitude limited.
A4R6	MD-5 ♥	SET THRESHOLD	Adjusted to set the maximum amplitude threshold for the positive going half-cycles of the modulating audio, before the stress current threshold of the rf power amplifier stage is exceeded.
A4R17	MD-5 ♥	COMMON MODE BALANCE	Adjusted to cancel (minimize) noise introduced on the audio input wiring.
A4R34	MD-5 ♥	AUDIO	Adjusted to set modulation depth. Can be adjusted for 100% when the 600 ohm audio input is between 0dBm and +12dBm. Normally set for 100% with a +10dBm input, during manufacture.
A4R37	MD-5 ♥	CAR LVL	Adjusted for identical rf carrier levels during main or standby operation in transmitters that have a main/standby exciter. Set fully clockwise in transmitters that do not have main/standby exciter stages.

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Table 4-3A Exciter Panel Controls and Indicators (Monaural Rf Drive) (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A4S1	MD-5 ♡	Low Pass Filter	Determines the modulating audio pass band by selecting the desired -1.0dB high frequency roll-off from one of four fixed frequencies (5.5 kHz, 6.6 kHz, 10.0 kHz or 16.5 kHz).
A5L1	MD-5 ♠	Rf Drive Tuning	Adjusted to series tune the rf drive amplifier output (in conjunction with in-circuit capacitors A5A1C1/C2/C3) to the carrier frequency (<i>f_c</i>).
A6R3	MD-5 ■	SET THRESHold	Adjusted to set a threshold that is compared to the <i>gain control</i> dc voltage (forward power reference level). Setting determines switching point for one of 15 autotransformer turn ratios. Ensures the <i>rf monitor</i> output is maintained between 4.0 and 8.0 volts rms as forward power reference level varies from minimum (100W) to maximum (1100W).
DS1	MD-5	STEREO ENABLE	Indicates status of STEREO ENABLE switch and therefore the operating status of the rf drive pwb. Must be off when monaural rf drive pwb A3 is the rf drive and <i>2f_c/N</i> source for the transmitter.
S1	MD-5	STEREO ENABLE	Determines operating status of the rf drive pwb. Must be set to OFF when monaural rf drive pwb A3 is the rf drive and <i>2f_c/N</i> source for the transmitter.

NOTE: Partial reference designation shown. Prefix with A4 for full reference designation.

Figure MD-5 depicts the assembly detail of the exciter panel and identifies its major assemblies. Refer to the appropriate service instruction manual for the assembly detail of these assemblies.

- ♣ -Denotes item is located on remote interface pwb A1. If necessary, refer to its service instruction manual to locate its controls/indicators.
- ♦ -Denotes item is located on rf drive pwb A3. If necessary, refer to its service instruction manual to locate its controls/indicators.
- ♡ -Denotes item is located on modulator driver pwb A4. If necessary, refer to its service instruction manual to locate its controls/indicators.
- ♠ -Denotes item is located on rf drive amplifier assembly A5. If necessary, refer to its service instruction manual to locate its controls/indicators.
- -Denotes item is located on modulation monitor pwb A6. If necessary, refer to its service instruction manual to locate its controls/indicators.

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Table 4-3B Exciter Panel Controls and Indicators (C-QUAM AM Stereo Rf Drive)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A1F1	MD-5 ♣	External Rf Drive	Fuses external rf drive at 200 milliamperes.
A4DS1	MD-5 ♥	Audio Limiting	When turned on/flashing, indicates some portion of positive going audio half-cycles (modulation peaks) are exceeding the rf power amplifier's stress current threshold and the balance of that half cycle is being amplitude limited.
A4R6	MD-5 ♥	SET THRESHOLD	Adjusted to set a threshold that represents the maximum amplitude for the positive going half-cycles of the modulating audio, before the rf power amplifier's stress current threshold is exceeded.
A4R17	MD-5 ♥	COMMON MODE BALANCE	Adjusted to cancel (minimize) noise introduced on the audio input wiring.
A4R34	MD-5 ♥	AUDIO	Adjusted to set modulation depth at 100% when the left and right audio inputs are precisely 180 degrees out-of-phase and they are both of equal amplitude (+10dB).
A4R37	MD-5 ♥	CAR LVL	Adjusted for identical main/standby rf carrier levels in transmitters that have main/standby exciters. Set to centre of its operating range in transmitters that do not have main/standby exciter stages.
A4S1	MD-5 ♥	Low Pass Filter	Determines the modulating audio pass band by selecting the desired -1.0dB high frequency roll-off from one of four fixed frequencies (5.5 kHz, 6.6 kHz, 10.0 kHz or 16.5 kHz).
A5L1	MD-5 ♠	Rf Drive Tuning	Adjusted to series tune the rf drive amplifier output (in conjunction with in-circuit capacitors A5A1C1/C2/C3) to the carrier frequency (f_c).
A6R3	MD-5 ■	SET THRESHold	Adjusted to set a threshold that is compared to the <i>gain control</i> dc voltage (forward power reference level). Setting determines switching point for one of 15 autotransformer turn ratios. Ensures the <i>rf monitor</i> output is maintained between 4.0 and 8.0 volts rms as forward power reference level varies from minimum (100W) to maximum (1100W).

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Table 4-3B Exciter Panel Controls and Indicators (C-QUAM AM Stereo Rf Drive) (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A7C49	MD-5 ♦	FREQ ADJ (4fc)	Adjusted to set C-QUAM AM stereo exciter pwb's crystal oscillator to assigned rf carrier frequency.
A7R154	MD-5 ♦	SLICER BIAS	Adjusted to obtain an rf drive waveform that is a symmetrical square wave.
A7S3	MD-5 ♦	STEREO ENABLE	Enables AM stereo operation when set to STEREO . Inhibits AM stereo operation and converts to a monaural exciter when set to MONO .
A7S5	MD-5 ♦	PILOT	Enables the 25Hz pilot tone when set to ON . Disables pilot tone for testing or monaural operation when set to OFF .
DS1	MD-5	STEREO ENABLE	Indicates status of STEREO ENABLE switch and therefore operating status of C-QUAM AM stereo exciter pwb A7. Must be on when the C-QUAM AM stereo exciter pwb is the rf drive, 2fc/N and audio source for the transmitter.
S1	MD-5	STEREO ENABLE	Determines operating status of C-QUAM AM stereo exciter pwb A7. Must be set to ON when a C-QUAM AM stereo exciter pwb is the rf drive, 2fc/N and audio source for the transmitter.

NOTE: Partial reference designation shown. Prefix with A4 for full reference designation.

Figure MD-5 depicts the assembly detail of the exciter panel and identifies its major assemblies. Refer to the appropriate service instruction manual for the assembly detail of these assemblies.

- ♣ - Denotes item is located on remote interface pwb A1.
- ♥ - Denotes item is located on modulator driver pwb A4.
- ♠ - Denotes item is located on rf drive amplifier assembly A5.
- - Denotes item is located on modulation monitor pwb A6.
- ♦ - Denotes item is located on C-QUAM AM stereo exciter pwb A7.

The C-QUAM AM stereo exciter pwb contains a number of controls and adjustments that are not identified in this listing. They are part of the complex and time intensive AM stereo adjustments and are not routinely adjusted. Refer to its service instruction manual for a complete listing

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Table 4-4 Ac/Dc Power Stage Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A3CB1	MD-4	MAIN POWER	Controls application of ac power source to the power transformer and protect wiring from excessive current.
A3DS1	MD-4	B-VDC	Indicates ac power is being applied to the power transformer and the B- vdc power supply is producing a nominal -72 vdc.
A3F1	MD-4	17.5 Vac (1)	Fuses one of the 17.5 vac inputs to the unregulated +24 vdc power supply's full-wave rectifier (from one side of the power transformer's 17.5-0-17.5 vac secondary winding), at 3.0 amperes.
A3F2	MD-4	17.5 Vac (2)	Fuses the other 17.5 vac input to the unregulated +24 vdc power supply's full-wave rectifier (from one side of the power transformer's 17.5-0-17.5 vac secondary winding), at 3.3 amperes.
A5A1F1	MD-7	Thyristor Control (1)	Fuses the B- dc voltage in one of the thyristor gate switching circuits, of the B- vdc power supply's switched full-wave rectifier circuit, at 0.5 amperes.
A5A1F2	MD-7	Thyristor Control (2)	Fuses the B- dc voltage in the other thyristor gate switching circuit, of the B- vdc power supply's switched full-wave rectifier circuit, at 0.5 amperes.
A5A1R8	MD-7	B-VDC ADJust	Adjusted to set output voltage of the B- vdc power supply to -72.0 vdc when the transmitter's rf output is its maximum rated carrier level (1100 watts).
A5A2F1	MD-6	B-Vdc Control	Fuses the low-current B-vdc output, used by the monitoring and control circuits, at 3.0 amperes.
A8F1	MD-12	Ext +24 Vdc	Fuses unregulated +24 vdc output, available at TB1-1 of external dc interface panel A8, at 0.5 amperes.
A8F2	MD-12	Ext +15 Vdc	Fuses regulated +15 vdc output, available at TB1-2 of external dc interface panel A8, at 0.5 amperes.
A8F3	MD-12	Ext -15 Vdc	Fuses regulated -15 vdc output, available at TB1-3 of external dc interface panel A8, at 0.5 amperes.
A8F4	MD-12	Ext +24 Vdc (Tx On)	Fuses 24 vdc (Tx On) output, available at TB1-4 of external dc interface panel A8, at 0.5 amperes.

SECTION 5 TESTING AND ADJUSTMENT

GENERAL

5.1 This section contains a step-by-step functional test procedure for the subject transmitter, using integral meters and precision test/monitoring equipment. The test procedures contain routine adjustment instructions to bring the parameter being tested within defined limits, where appropriate. Special adjustment procedures are also included in this section. These adjustments are defined as being the adjustments that require a significant amount of disassembly and/or test equipment that will not normally be available at a transmitter site.

NOTE

It is recommended that personnel who are not familiar with detailed circuit theory or do not realize what impact a specific adjustment will have on other steps, follow instructions in order presented. It is recommended they be followed sequentially during initial turn-on and after major repairs.

OPERATING PRECAUTIONS

5.2 The transmitter contains protection circuits that monitor critical parameters. When the defined limits of any of these parameters are exceeded, one or more **ALARM** lamps will turn on. When the out-of-tolerance condition could result in excessive power amplifier stress current, the modulator drive to the power amplifiers will effectively be reduced or turned off, as long as the cause of the out-of-tolerance condition exists. Maintainers should read and fully understand operating instructions provided in section 4. Pay particular attention to paragraph 4.10.

NOTE

*The **OUTPUT POWER** meter has two scales. The upper scale is normally in-circuit and should be read when the rf power level being monitored is more than 350 watts. When the indicated power level is less than 350 watts, a more precise reading can be obtained by depressing the **READ LOWER SCALE** switch and reading the lower scale.*

WARNING

*Ac voltages that can cause serious personal injury or death are present on circuit breaker terminals and primary winding taps of the main power transformer. These voltages are present when ac power is being applied and the **MAIN POWER** circuit breaker is closed, regardless of the transmitter's rf on/off status. In addition to the ac voltage, the output of the B- dc power supply (nominally -72 volts dc) will be present when ac power is applied to the main power transformer's primary windings.*

FUNCTIONAL TESTS

5.3 Successful completion of the following tests will verify the transmitter circuits are within factory specifications. When a routine adjustment will correct an out-of-tolerance condition, the adjustment procedure is included.

NOTE

If an in-tolerance condition cannot be attained with the specified routine adjustment, discontinue testing until the problem causing the out-of-tolerance condition has been corrected.

5.3.1 GENERAL: The functional tests should be performed and the results recorded for comparison with past and future test results, as a routine part of scheduled maintenance checks and as the first step in troubleshooting procedures.

5.3.1.1 The functional test procedures are provided in a step-by-step format. This method of presentation will permit a person who is unfamiliar with the transmitter to perform the functional tests in a logical sequence. It is recommended the procedures be completed in sequence, as each procedure establishes switch settings and contains prerequisites for subsequent procedures.

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5.3.1.2 The following assume the commissioning procedures described in paragraph 3.4 have been completed during initial installation or after major repairs that warrant the initial start-up procedure be repeated.

5.3.1.3 The modules/assemblies that make up the exciter stage are located on the exciter panel, which is located directly behind the control/ monitor panel. Refer to figure MD-5 for the exciter panel's assembly detail and as an aid in locating and identifying the modules/assemblies.

NOTE

An optional C-QUAM AM stereo exciter pwb (A4A7) may be installed on the exciter panel as the rf drive source. When this option is included, the monaural rf drive pwb (A4A3) will not be installed.

Exciter Modules/Assemblies

Low Voltage Power Supply	A4A2
Rf Drive Pwb.....	A4A3
or	
C-QUAM AM Stereo Exciter Pwb	A4A7
Modulator Driver Pwb.....	A4A4
Rf Drive Amplifier.....	A4A5

5.3.1.4 When the specified adjustment is on a printed wiring board of the exciter panel, the hinged control/monitor panel must be opened to gain access to the adjustments.

5.3.1.5 Printed wiring board mounted potentiometers are multi-turn devices that have a clutch at either extreme of their adjustment. Their wipers must be turned a minimum of four turns in one direction to ensure they have been set fully clockwise or fully counter clockwise.

NOTE

The majority of the controls/indicators are on the control interface pwb (A1A1). They are oriented to be accessible/visible through openings in the front of the control/monitor panel. They are considered to be on the control/monitor panel in the following.

Unless otherwise stated, all referenced controls and indicators, are located on or accessible from the control/monitor panel in the following.

5.3.2 TEST EQUIPMENT REQUIRED: The following test equipment is required to perform the functional test procedures.

Digital multimeter	Oscilloscope
Distortion analyzer	Functional generator
Audio signal generator	DC ammeter
15 vdc power supply	24 vdc power supply
Modulation monitor	Frequency counter
0 - 100 vdc pwr supply	50-ohm dummy load
Rf Drive Tuning Adapter	

5.3.3 TEST PREREQUISITES: The following prerequisites must be completed prior to performing any of the functional test procedures:

CAUTION

Do not change the setting of any adjustment on the optional C-QUAM AM stereo exciter (if installed) unless specifically directed to do so and then only if the test results are not within the specified tolerances. Improper adjustment may cause some of paragraph 5.3.10's emission level test results to be out of tolerance and will probably cause a badly distorted or otherwise unacceptable AM stereo output.

NOTE

If the optional C-QUAM AM stereo exciter pwb is installed as the rf drive source, it is recommended that it be set for monaural operation as specified in step (e), unless tests require AM stereo operation.

- (a) Verify nothing that would affect the rf drive or modulator to the power amplifier stage has been changed or altered since the transmitter was commissioned or since the last time the initial start-up procedure described in paragraph 3.4 were completed.
- (b) Set all switches/circuit breakers, except **MAIN POWER** circuit breaker, as tabulated in table 5-1. Set **MAIN POWER** circuit breaker to **OFF**.
- (c) Connect or verify the transmitter's rf output is connected to a precision 50 ohm, resistive dummy load that has provision to accurately display the rf power being applied to it and is rated at a minimum of 2.0 kilowatts.

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Table 5-1 Reference Switch Settings for Functional Test

WHERE SWITCH IS LOCATED	REF DES	PANEL MARKING/ NOMENCLATURE USED IN TEXT	SETTING
Circuit Breaker Panel	A3CB1	MAIN POWER	ON
Exciter Panel	A4S1	STEREO ENABLE	*
Control/Monitor Panel	A1S1	DC SUPPLY	+24VDC
	A1S2	CONTROL	LOCAL
	A1S3	OUTPUT POWER	FORWARD

* Denotes - set to OFF when monaural rf drive pwb is the rf drive source.
set to ON when C-QUAM AM stereo exciter pwb is the rf drive source

WARNING

If a jumper is placed between the interlock inputs (TB1-13 and TB1-14) on the remote interface pwb, safety features provided by the external interlocks will be disabled. It is recommended that a fail safe method of alerting personnel to this fact be implemented. Voltages which are dangerous to life will be present on rf output stages and the antenna system if the transmitter is turned on.

- (d) Close all external interlocks or temporarily connect a jumper wire between TB1-13 and TB1-14 of the remote interface pwb.

NOTE

The remote interface pwb is on the exciter panel, which is located directly behind the control/monitor panel. Refer to the exciter panel's assembly detail (figure MD-5) to locate the remote interface pwb. If necessary, refer to the remote interface pwb's service instruction manual for its assembly detail.

- (e) If the optional C-QUAM AM stereo exciter pwb is installed on the exciter panel as the exciter's rf drive source:
 - Disable the AM stereo feature and select monaural operation by setting its **STEREO ENABLE** switch to **MONO**.
 - Inhibit the 25Hz pilot frequency by setting its **PILOT** switch to **OFF**.
 - Turn it on by setting the exciter panel's **STEREO ENABLE** switch to **ON**.

- (f) For transmitters that utilize a C-QUAM AM stereo exciter pwb as the rf drive source, connect a test audio switching circuit, as depicted in its service instruction manual, in lieu of normal station programming.
- (g) For transmitters that utilize a monaural rf drive pwb as the rf drive source, connect an audio generator [preset to 1000 Hz at a zero output level (off)], between TB1-15(+) and TB1-17(-) of the remote interface pwb, in lieu of normal station programming.

CAUTION

Ensure the peak-to-peak amplitude of the external rf drive does not exceed 12.0 volts. Voltages in excess of 12.0 volts will over stress rf drive input components and cause them to overheat.

- (h) If an externally generated rf drive is being applied as the rf drive source, verify it is not being modulated and its frequency is the assigned carrier frequency plus/minus 5.0 Hz.
- (i) Connect a modulation monitor to remote interface pwb's **RF MONITOR** connector (J4).
- (j) Set **ADJUST-LOW 1**, **ADJUST-LOW 2** and **ADJUST-HIGH** potentiometers fully counter clockwise (minimum of four turns).
- (k) Open-circuit the modulator drive to the rf power module by removing the mod drive enable relay (K1) from its socket on the modulator driver pwb.

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NOTE

The modulator driver pwb is located on exciter panel A4, which is immediately behind the control/ onitor panel. Refer to the exciter panel's assembly detail (figure MD-5) to locate the modulator driver pwb. If necessary, refer to modulator driver pwb's service instruction manual for its assembly detail.

5.3.4 INITIAL TURN-ON: Apply ac power to the transmitter and observe the alarm and status indicators as follows:

- (a) Verify the requirements of paragraph 5.3.3 have been completed.
- (b) Switch on or verify the ac power source is switched on at the service entrance.
- (c) Set the **MAIN POWER** circuit breaker to **ON**.
- (d) The circuit breaker panel's **B- VDC** lamp shall turn on.
- (e) Preset the control interface pwb's local control switches. Press and release the following switches, noting they are all located on the control/monitor panel:
 - **ALARM RESET** switch
 - **RF-OFF** switch
 - **SELECT OUTPUT POWER-LOW 2** switch.
- (f) The **OUTPUT POWER-LOW 2** lamp shall turn on.
- (g) The **B- VDC** lamp on the rear of the rf power module shall be on.
- (h) All remaining lamps shall be off.
- (i) The remote **Rf Ready status** output on the remote interface pwb's **RF READY** terminal (TB2-20) shall be a current sink to ground.
- (j) Turn on the exciter stage. Press/release **RF-ON** switch and verify **RF-ON** lamp turns on.
- (k) The rf power module's cooling air fan shall turn on.
- (l) One or more of the rf power module's **MOD FAIL ALARM** lamps may turn on.

Table 5-2 Dc Voltages

DC SUPPLY SWITCH SETTING	METER READING (VDC)	
	MIN	MAX
+24VDC	+22.0	+26.5
+15VDC	+14.0	+16.0
-15VDC	-14.0	-16.0
B-VDC	-72.0	-75.0

5.3.5 DC POWER SUPPLY CHECKS: Check the outputs of the various dc voltage power supplies, as follows:

NOTE

The output voltage of the unregulated 24vdc power supply is dependent on the ac power source voltage and the transformer's primary winding tap selection.

If voltage is not within specified limits, but it was previously, the most probable cause is a change in source voltage. If the change is long term, primary winding tap selection may have to be changed.

- (a) Sequentially set **DC SUPPLY** switch to each of the settings tabulated in table 5-2 and verify the **DC SUPPLY** meter readings are within the tolerance specified.
- (b) If the +24vdc reading is less than 22.0 vdc, switch off ac power and select new primary winding taps as detailed in paragraph 3.3.1, using the taps tabulated for the next lower voltage range in table 3-1. Repeat step (a).
- (c) If the +24vdc reading is more than 26.5 vdc, switch off ac power and select new primary winding taps as detailed in paragraph 3.3.1, using the taps tabulated for the next higher voltage range in table 3-1. Repeat step (a).
- (d) If B-vdc reading is not within specified tolerance, adjust the power supply control pwb's **B- VDC Adjust** potentiometer for a **DC SUPPLY** meter indication of -72.0 vdc.
- (e) Verify the rf power module is not drawing any current from B-vdc power supply. Set **DC SUPPLY** switch to **B- AMPS** and note **DC SUPPLY** meter's indication is zero amperes.

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**5.3.6 RF DRIVE FREQUENCY/
PREAMPLIFIER CHECKS:** Check frequency and level of the rf drive being produced by the exciter's rf drive source, as follows:

NOTE

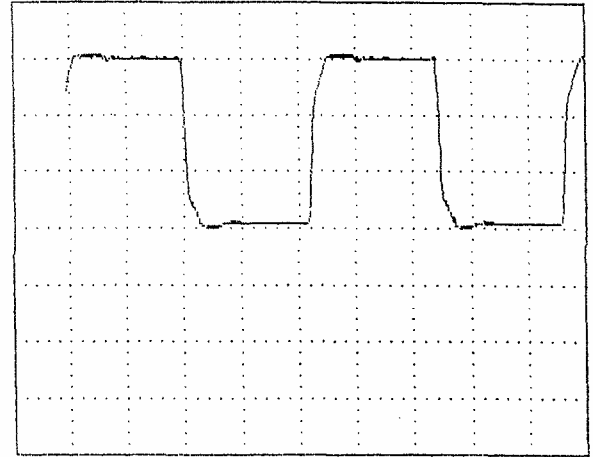
There are two standard factory configured rf drive options. They are:

Monaural or externally generated AM stereo operation. These transmitters have one monaural rf drive pwb (A4A3), they do not have a C-QUAM AM stereo exciter pwb (A4A7).

C-QUAM AM stereo operation. These transmitters have one C-QUAM AM stereo exciter pwb (A4A7), they do not have a monaural rf drive pwb (A4A3).

If required, refer to figure MD-5 to locate the monaural rf drive pwb or the C-QUAM AM stereo exciter pwb. For assembly detail, refer to the appropriate service instruction manual.

- (a) Determine the exciter's rf drive source:
 - When a C-QUAM AM stereo exciter pwb is installed, its integral crystal oscillator is the rf drive source.
 - When an rf drive pwb is installed and it has a link connecting its **B** and **C** terminals, its crystal oscillator is the rf drive source.
 - When an rf drive pwb is installed and it has a link connecting its **A** and **C** terminals, an external rf generator is the rf drive source.
- (b) Verify **Low 2** is the selected preset power level (**OUTPUT POWER-LOW 2** lamp is on).
- (c) Verify the **ADJUST-LOW 1**, **-LOW 2** and **-HIGH** potentiometers, are fully counter clockwise.
- (d) Connect a frequency counter to the remote interface pwb's **FREQUENCY MONITOR** connector (J9), using a suitable coaxial cable.
- (e) If an rf drive pwb is installed, check the rf drive as detailed in para 5.3.6.1 or 5.3.6.2.
- (f) If a C-QUAM AM stereo exciter pwb is installed, check the rf drive as detailed in paragraph 5.3.6.3.



$f_c = 1134 \text{ kHz (Dc Coupled)}$
0.2 $\mu\text{s/div}$, 5.0 V/div, Scale Centre = 0.0 vdc
Figure 5-1 Balanced Drive Input Waveform

5.3.6.1 Internal Rf Drive Source: If the rf drive source is the integral oscillator of an rf drive pwb, check the rf drive as follows:

- (a) Verify a link is connected between terminals **B** and **C** of rf drive pwb.
- (b) Frequency counter indication shall be the assigned carrier frequency $\pm 5.0 \text{ Hz}$ or five parts per million (ppm) whichever is greater.
- (c) If the requirement of step (b) is not met, adjust rf drive pwb's **FREQ ADJUST** trimming capacitor (C14), until the frequency counter's indication is the assigned carrier frequency.
- (d) Connect an oscilloscope between **TP2** of the rf drive pwb and ground.
- (e) Oscilloscope indication should be similar to example depicted in figure 5-1 [symmetrical (50% duty cycle) square wave with a nominal peak-to-peak amplitude of 15.0 volts].
- (f) If necessary, adjust the rf drive pwb's **SLICER BIAS** potentiometer (R4) for a symmetrical square wave.
- (g) Disconnect oscilloscope.

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5.3.6.2 External Rf Drive Source: If the rf drive is being provided from an external source, check the rf drive as follows:

CAUTION

Ensure peak-to-peak amplitude of external rf drive does not exceed 12.0 volts. Voltages in excess of 12.0 volts will over stress rf drive input components and cause them to overheat.

- (a) Verify a link is connected between terminals **A** and **C** of the rf drive pwb.
- (b) Verify an rf drive is being applied to remote interface pwb's **STEREO** connector (J1).
- (c) Verify the external rf drive input is the assigned carrier frequency, is unmodulated and its amplitude is between 5.0 and 12.0 volts peak-to-peak (sine or square wave).
- (d) Frequency counter indication shall be the assigned carrier frequency ± 5.0 Hz or five parts per million (ppm) whichever is greater.
- (e) If the requirement of step (d) is not met, adjust carrier frequency of external rf drive source, until frequency counter's indication is the assigned carrier frequency.
- (f) Connect an oscilloscope between terminal **C**, of the rf drive pwb and ground.
- (g) Oscilloscope indication should be a symmetrical (50% duty cycle) waveform (sine or square) with a nominal peak-to-peak amplitude that is between 5.0 and 12.0 volts.
- (h) Connect an oscilloscope between TP2 of the rf drive pwb and ground.
- (i) Oscilloscope indication should be similar to example depicted in figure 5-1 (symmetrical (50% duty cycle) square wave with a nominal peak-to-peak amplitude of 15.0 volts).
- (j) If necessary, adjust the active rf drive pwb's **SLICER BIAS** potentiometer (R4) to obtain a symmetrical square wave.
- (k) Disconnect oscilloscope.

5.3.6.3 AM Stereo Rf Drive Source: If the rf drive source is being produced by a C-QUAM AM stereo exciter pwb, check the rf drive as follows:

- (a) Verify exciter panel's **STEREO ENABLE** switch is set to **ON** and C-QUAM AM stereo exciter pwb's **STEREO ENABLE** switch is set to **MONO**.
- (b) Frequency counter indication shall be the assigned carrier frequency ± 5.0 Hz or five parts per million (ppm) whichever is greater.
- (c) If requirement of step (b) is not met, adjust C-QUAM AM stereo exciter's **4fc** trimming capacitor (C49), until the frequency counter's indication is the assigned carrier frequency.
- (d) Connect an oscilloscope between TP12 of the C-QUAM AM stereo exciter pwb and ground (TP17).
- (e) Oscilloscope indication should similar to the example depicted in figure 5-1 [symmetrical (50% duty cycle) square wave with a nominal peak-to-peak amplitude of 15.0 volts].
- (f) If necessary, adjust the C-QUAM AM stereo exciter pwb's **SLICER BIAS** potentiometer (R154) to obtain a symmetrical square wave.
- (g) Disconnect oscilloscope.

5.3.7 RF DRIVE AMPLIFIER CHECKS: Check the amplitude of the rf drive being applied to the rf power amplifier stages, as follows:

NOTE

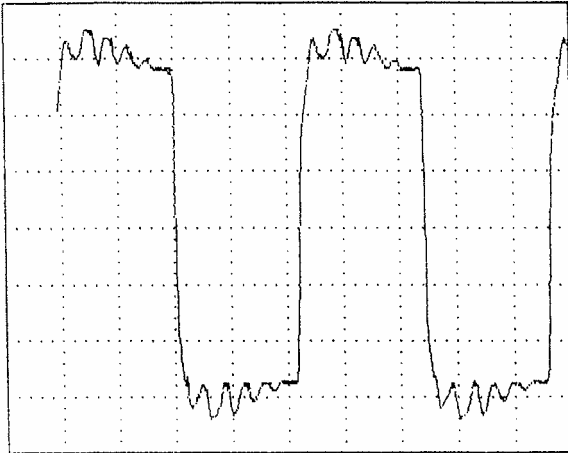
The rf drive amplifier is located on the exciter panel. Refer to figure MD-5 to locate the rf drive amplifier. For assembly detail of the rf drive amplifier, refer to its service instruction manual.

- (a) Verify **Low 2** is the selected preset power level (**OUTPUT POWER-LOW 2** lamp is on).

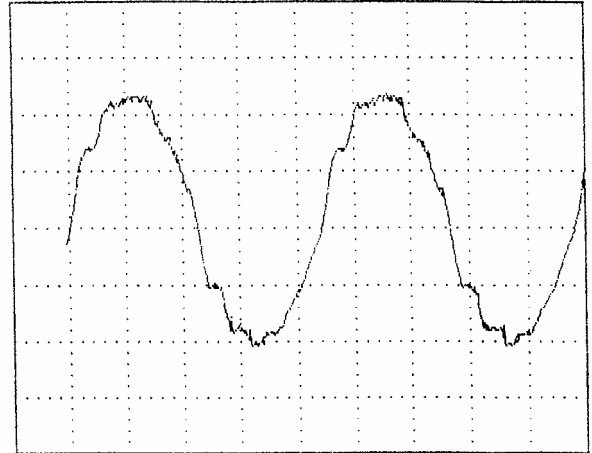
CAUTION

Use extreme care when connecting/disconnecting the oscilloscope probe in the following procedures. Do not allow the probe to short the rf drive to ground.

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$f_c = 1134 \text{ kHz}$ (Ac Coupled)
0.2 $\mu\text{s}/\text{div}$, 2.0 V/div, Scale Centre = 0.0 vdc
Figure 5-2 Rf Drive Amplifier Input Waveform



$f_c = 1134 \text{ kHz}$ (Ac Coupled)
0.2 $\mu\text{s}/\text{div}$, 20.0 V/div, Scale Centre = 0.0 vdc
Figure 5-3 Rf Drive Output Waveform

- (b) Connect an oscilloscope to monitor the rf drive amplifier's rf drive input. Connect it between the centre conductor of J2 on the rf drive amplifier and ground
- (c) Oscilloscope indication shall be similar to the example in figure 5-2. Waveform's peak-to-peak amplitude should be a nominal 20 volts.

WARNING

Voltages which are dangerous to life are present on exposed terminals of the power transformer when the side panel is removed. Extreme caution must be exercised when the panel is removed.

- (d) Connect an oscilloscope between TB1-2, of the rf power module and ground, noting access is gained by removing the side panel.
- (e) Oscilloscope indication shall be similar to the example in figure 5-3. Waveform's peak-to-peak amplitude shall be between 80.0 and 88.0 volts, peak-to-peak.

5.3.7.1 Rf Drive Level Detector Check: Check the rf drive reference level, noting it is monitored by the low rf drive alarm circuit, as follows:

NOTE

The rf drive control pwb is located on the rf drive amplifier. Refer to the rf drive amplifier's service instruction manual for its assembly detail.

- (a) Connect a digital multimeter, preset to measure dc volts, between the cathode of CR3 on the rf drive control pwb and ground.
- (b) The digital multimeter's indication should be between 38.0 and 40.0 vdc.

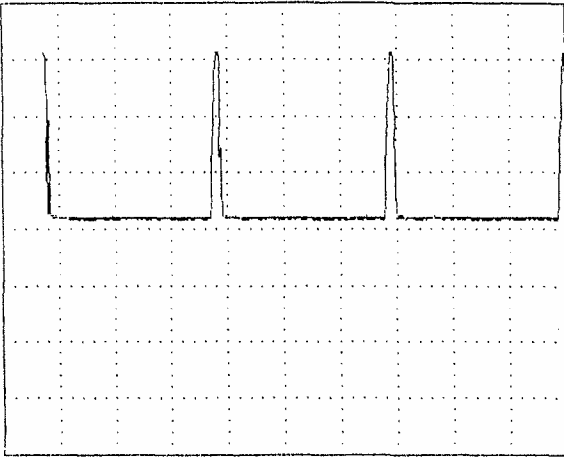
5.3.8 MOD DRIVE CHECKS: Check critical parameters of the variable pulse width modulation drive signal, as follows:

NOTE

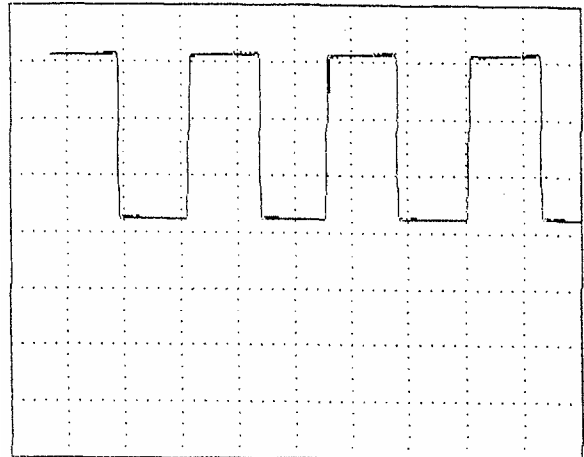
Modulator driver pwb A4A4 is located on the exciter panel. Refer to figure MD-1 to locate exciter panel and then to figure MD-5 to locate the modulator driver pwb. For assembly detail of modulator driver pwb, refer to its service instruction manual.

- (a) Verify the rf power stage is turned on and **low 2** preset rf level is selected (**RF ON** and **OUTPUT POWER-LOW 2** lamps are turned on).
- (b) Verify the mod drive input to the rf power module is inhibited (relay K1 has been removed from the modulator driver pwb).

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$2fc/N = 174.5$ kHz (Dc Coupled)
2.0 μ s/div, 5.0 V/div, Scale Centre = 0.0 vdc
Figure 5-4 $2fc/N$ Frequency Waveform



$fpwm = 87.23$ kHz (Dc Coupled)
5.0 μ s/div, 5.0 V/div, Scale Centre = 0.0 vdc
Figure 5-5 PWM Frequency Waveform

- (c) Verify **ADJUST-LOW 1**, **-LOW 2** and **-HIGH** potentiometers, are fully counter clockwise.
- (d) Set the modulator driver pwb's **CAR LVL** potentiometer (R37) fully clockwise.

NOTE

The **CAR LVL** potentiometer provides a means of balancing the mod drive output of two modulator driver pwb's when the transmitter contains a main/standby exciter. It is set fully clockwise in single exciter transmitters to ensure inadvertent adjustment does not allow the rf output to exceed the transmitter's maximum rating (1100 watts in AMPFET ND1 transmitters).

- (e) Set the **DC SUPPLY** switch to **B-AMPS**.
- (f) The **DC SUPPLY** meter's indication shall be near zero amperes, indicating current consumption of the rf power module is near zero amperes.
- (g) Connect an oscilloscope between the **I2** terminal associated with terminal **B** of the modulator driver pwb and ground.
- (h) Oscilloscope indication should be similar to example depicted in figure 5-4. Waveform should be positive going $2fc/N$ pulses. Refer to commissioning records for recorded value of $2fc/N$ (see paragraph 3.3.4.3 or 3.3.5.2)

- (i) Connect a frequency counter between **TP4** of modulator driver pwb and ground.
- (j) Frequency counter's indication shall be the pulse width modulation frequency ($fpwm$). It should be between 70.0 and 96.63 kHz. Refer to commissioning records for recorded value (see paragraph 3.3.6).

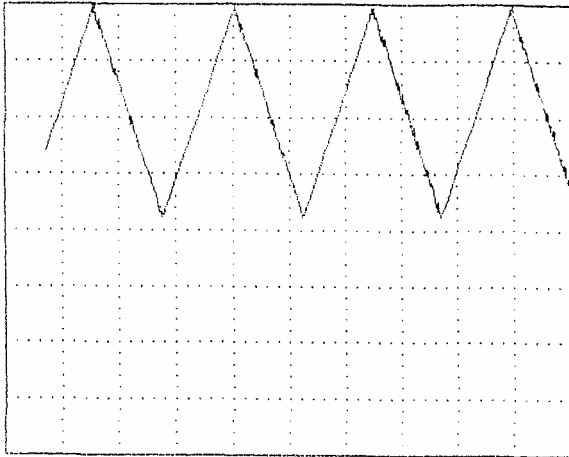
NOTE

The factory determined PWM frequency ($fpwm$) for a transmitter may be outside the tolerance specified in step (j). See paragraph 3.3.4.3 or 3.3.5.2.

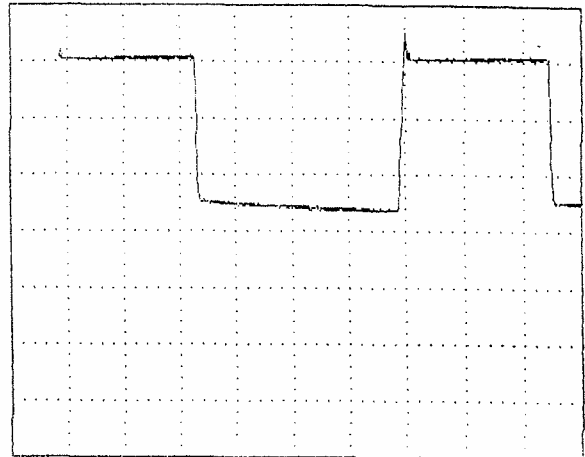
When preset $fpwm$ is unknown, enter table 3-3 and determine 'N' for assigned carrier frequency (fc). If fc is less than 1280 kHz, divide it by the number tabulated as 'N'. If fc is 1280 kHz or more, divide it by twice the number tabulated as 'N'.

- (k) Connect the oscilloscope between **TP4** of the modulator driver pwb and ground.
- (l) Oscilloscope indication should be similar to example depicted in figure 5-5. Waveform should be a square wave with a nominal peak-to-peak amplitude of 15.0 volts at the $fpwm$ frequency
- (m) Connect an oscilloscope between **TP6** of the modulator driver pwb and ground.

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$f_{pwm} = 87.23 \text{ kHz}$ (Dc Coupled)
5.0 $\mu\text{s}/\text{div}$, 1.0 V/div, Scale Centre = 0.0 vdc
Figure 5-6 PWM Ramp Integrator Waveform



$f_{pwm} = 87.23 \text{ kHz}$ (Dc Coupled)
5.0 $\mu\text{s}/\text{div}$, 5.0 V/div, Scale Centre = 0.0 vdc
Figure 5-7 Mod Drive Output Waveform

- (n) Oscilloscope indication should be similar to example depicted in figure 5-6. It should be a triangular waveform with a nominal peak-to-peak amplitude of 4.0 volts. Its negative going peaks should just touch zero volts dc. Its frequency should be the f_{pwm} .
- (o) Connect the oscilloscope between **TP10** of the modulator driver pwb and ground.
- (p) Oscilloscope waveform indication should basically be a zero volt dc trace with nominal +15 vdc spikes at f_{pwm} .
- (q) Monitor oscilloscope and slowly adjust **ADJUST-LOW 2** potentiometer fully clockwise (minimum of four turns).
- (r) Waveform observed on oscilloscope shall increase linearly and continuously from a 0/100 ratio (zero vdc trace) to a rectangular waveform with a 40/60 ratio (40% at 15vdc/ 60% at 0vdc), as the **ADJUST-LOW 2** potentiometer is adjusted. Final waveform shall be similar to the example in figure 5-7.
- (s) If requirement of step (r) is not met, set **ADJUST-LOW 2** potentiometer fully clockwise (minimum of four turns) and adjust the control interface pcb's **POWER LIMIT** potentiometer (R95) for the 40/60 on/off ratio specified in step (r).

NOTE

*A 40/60 on/off ratio will produce an rf carrier level of 1100 watts, with 125% positive modulation peaks, when all power amplifiers are contributing to the rf output. The **POWER LIMIT** potentiometer is adjusted to limit the rf carrier level to 1100 watts (rated power level of the transmitter) when **ADJUST -HIGH, -LOW 1** or **-LOW 2** potentiometers are set for maximum power (fully clockwise).*

- (t) Set the **ADJUST-LOW 2** potentiometer fully counterclockwise.
- (u) Select low 1 power level (press/release the **SELECT OUTPUT POWER-LOW 1** switch and verify the **OUTPUT POWER-LOW 1** lamp turns on).
- (v) Repeat steps (m) thru (t), substituting **ADJUST-LOW 1** potentiometer where **ADJUST-LOW 2** potentiometer is specified.
- (w) Select high power level (press/release the **SELECT OUTPUT POWER-HIGH** switch and verify the **OUTPUT POWER-HIGH** lamp turns on).
- (x) Verify oscilloscope is connected between **TP10** of modulator driver pwb and ground.
- (y) Oscilloscope waveform should be rectangular with an on (positive peak)/off (negative peak) ratio of 25/75 (25% duty cycle).

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- (z) Monitor oscilloscope and slowly adjust **ADJUST-HIGH** potentiometer fully clockwise minimum of four turns.
 - (aa) Waveform's on/off ratio shall increase linearly and continuously from a 25/75 ratio to a 40/60 ratio (40% at 15vdc/60% at 0vdc), as **ADJUST-HIGH** potentiometer is adjusted. Final waveform shall be similar to the example in figure 5-7.
 - (ab) Set the **ADJUST-HIGH** potentiometer fully counter clockwise.
 - (ac) Return to low 2 power level (press/release the **SELECT OUTPUT POWER-LOW 2** switch and verify **OUTPUT POWER-LOW 2** lamp turns on.
 - (ad) Inhibit exciter panel's dc power source by turning transmitter off (press/release **RF-OFF** switch and verify the **RF-ON** lamp turns off).
 - (ae) Install the relay (K1) which was removed from its socket on the modulator driver pwb.
 - (af) Verify the **ADJUST-LOW 1**, **-LOW 2** and **-HIGH** potentiometers, are fully counter clockwise.
 - (ag) Activate exciter panel's dc power source by turning transmitter on (press/release **RF-ON** switch and verify the **RF-ON** lamp turns on).
- (f) Forward power reading, as indicated by **OUTPUT POWER** meter, should be zero watts.
 - (g) Set the **DC SUPPLY** switch to **B-VDC**.
 - (h) B- vdc reading, as indicated by **DC SUPPLY** meter should be between -72.0 and -75.0 vdc.
 - (i) Set the **DC SUPPLY** switch to **B-AMPS**.
 - (j) The **DC SUPPLY** meter's reading shall be near zero amperes, indicating the current being consumed by rf power module is minimal.

5.3.9.1 Forward Power Limiting: Preset the rf power level control circuits to limit the maximum, unmodulated rf output to 1100 watts as follows:

- (a) Set the control interface pwb's **POWER LIMIT** potentiometer fully counter clockwise.

CAUTION

*Discontinue clockwise adjustment of **ADJUST-LOW 2** potentiometer if forward power exceeds 800 watts or if B- vdc current exceeds 15 amperes when **POWER LIMIT** potentiometer is fully counter clockwise.*

5.3.9 RF OUTPUT CHECKS: Check the forward/reflected power and the modulator input current levels as follows:

- (a) Verify the requirements of paragraphs 5.3.3 thru 5.3.8 have been successfully completed.
- (b) Verify **ADJUST-LOW 1**, **-LOW 2** and **-HIGH** potentiometers, are fully counter clockwise.
- (c) Verify the rf power stage is turned on and *low 2* preset rf level is selected (**RF ON** and **OUTPUT POWER-LOW 2** lamps are turned on).
- (d) Verify the rf power module's cooling air fan is operating, noting the fan is located on the rear of the module.
- (e) Set the **OUTPUT POWER** switch to **FORWARD**.
- (b) Monitor dummy load's forward power reading and the **DC SUPPLY** meter's current indication, while slowly adjusting the **ADJUST-LOW 2** potentiometer fully clockwise.
- (c) Dummy load's forward power indication should be less than 800 watts. Record reading as *forward power*.
- (d) B- current reading, as indicated by **DC SUPPLY** meter shall be less than 15 amperes. Record reading as *B-Vdc Current*.
- (e) Set the **DC SUPPLY** switch to **B-VDC**.
- (f) The **DC SUPPLY** meter's indication should be between -71.0 and -73.0 vdc.
- (g) Set the **OUTPUT POWER** switch to **REFLECTED**.
- (h) The **OUTPUT POWER** meter's reflected power indication should be near zero watts.

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- (i) Enter figure 4-1 with *forward power* reading from step (c), *B- Vdc Current* reading from step (d) and plot intersection point on graph.
- (j) Intersection point in step (i) must be below the line representing *maximum (carrier only)*.
- (k) Set the **OUTPUT POWER** switch to **FORWARD** and verify the **OUTPUT POWER** meter's forward power indication is the same as forward power reading recorded in step (c).
- (l) Adjust control interface pwb's **POWER LIMIT** potentiometer for an rf output of precisely 1100 watts, as indicated by dummy load's forward power indicator.

CAUTION

Do not change POWER LIMIT potentiometer setting once it has been established in step (l). If setting is changed in a clockwise direction, it will be possible to set forward power to more than 1100 W. If setting is changed in a counter clockwise direction, it will not be possible to set the forward power to 1100 W.

- (m) Set the **DC SUPPLY** switch to **B- AMPS**.
- (n) B- current reading, as indicated by **DC SUPPLY** meter shall be not more than 20 amperes. Record reading as *B-Vdc Current (1100 watts)*.
- (o) Set the **DC SUPPLY** switch to **B- VDC**.
- (p) B- vdc reading, as indicated by **DC SUPPLY** meter, shall be between -72.0 and -75.0 vdc. If reading is unsatisfactory, adjust output of B-vdc power supply (refer to paragraph 5.3.9.2) and then repeat paragraph 5.3.9.1.
- (q) Enter figure 4-1 with *forward power* reading of 1100 watts and the *B-vdc Current (1100 watts)* reading recorded in step (n) and then plot intersection point on the graph.
- (r) Intersection point must be below the line representing *maximum (carrier only)*.
- (s) The **OUTPUT POWER** meter's forward power indication should be 1100 watts. If reading is not satisfactory, calibrate the meter accuracy as detailed in paragraph 5.3.9.3.

5.3.9.2 B-Vdc Adjustment: Adjust the B-vdc power supply for an output of between -71.0 and -73.0 vdc when the forward power level is 1100 watts, as follows:

- (a) Set **DC SUPPLY** switch to **+24VDC** and verify the **DC SUPPLY** meter's indication is between 22.0 and 26.5 vdc.

NOTE

The 24 vdc power supply is unregulated and its output is proportional to the voltage transformed to the power transformer's secondary windings. If the 24 vdc power supply's output is not between 22.0 and 26.5 vdc, the most probable cause is a change in the voltage of the ac power source. If this is the case and the change is caused by the loading of the power source, the power transformer's primary winding tap selection may have to be changed.

- (b) Set the **DC SUPPLY** switch to **B- VDC**.
- (c) Measure the voltage between the ac/dc power supply's **B-VDC** test point (-) and ground using a digital multimeter.

NOTE

The B-VDC test point is located on the ac/dc power supply's J1 connector bracket. Refer to figure MD-6 as an aid in locating this test point.

- (d) The digital multimeter's indication should be between -71.0 and -73.0 vdc.
- (e) Adjust the power supply control pwb's **B- Vdc Adjust** potentiometer for a digital multimeter indication of -72.0 vdc.

NOTE

*The power supply control pwb is on the ac/dc power supply. Refer to figure MD-6 to locate the pwb then if necessary, to figure MD-7 to locate the **B- Vdc Adjust** potentiometer.*

- (f) The **DC SUPPLY** meter's indication shall be between -71.0 and -73.0 vdc.
- (g) If necessary, adjust meter calibration pwb's **VOLTAGE CAL** potentiometer (R2) for a **DC SUPPLY** meter indication of -72.0 vdc, noting the meter calibration pwb is fastened to the **DC SUPPLY** meter terminals.

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5.3.9.3 OUTPUT POWER Meter Accuracy:

Verify the readings provided by the **OUTPUT POWER** meter are reliable, as follows:

- (a) Verify requirements of paragraph 5.3.9.1 and 5.3.9.2 have been completed and the rf output's forward power level, as indicated by the dummy load's forward power indicator, is precisely 1100 watts.
- (b) Set the **OUTPUT POWER** switch to **FORWARD**.
- (c) The **OUTPUT POWER** meter's forward power indication should be 1100 watts.
- (d) If necessary, adjust meter calibration pwb's **HIGH PWR CAL** potentiometer for an **OUTPUT POWER** meter indication of 1100 watts, noting meter calibration pwb is fastened to the **OUTPUT POWER** meter terminals.
- (e) Adjust **ADJUST-LOW 2** potentiometer for an rf output of precisely 250 watts, as indicated by dummy load's forward power indicator.
- (f) Press and hold **READ LOWER SCALE** switch.
- (g) The forward power, as read on the **OUTPUT POWER** meter's lower scale, should be 250 watts.
- (h) If necessary, adjust meter calibration pwb's **LOW PWR CAL** potentiometer for an **OUTPUT POWER** meter indication of 250 watts, noting meter calibration pwb is fastened to the **OUTPUT POWER** meter terminals.
- (i) Release **READ LOWER SCALE** switch.

5.3.9.4 Setting Preset Power Levels: Set the preset rf power level control circuits to produce the desired rf output levels, as follows:

- (a) Verify control interface pwb's **POWER LIMIT** potentiometer has been preset to limit the forward power level at 1100 watts, as detailed in paragraph 5.3.9.1.
- (b) Set the **OUTPUT POWER** switch to **FORWARD**.
- (c) Select preset **High** rf power level. Press/release **SELECT OUTPUT POWER-HIGH** switch and verify the **OUTPUT POWER-HIGH** lamp turns on.

- (d) Set **ADJUST-HIGH** potentiometer for the desired preset **High** forward power level, as indicated by dummy load's forward power indicator (650 watts min/1100 watts max).
- (e) The **OUTPUT POWER** meter's indication shall be the same as the dummy load's forward power indication. Record reading as the **High** preset forward power level.
- (f) Select **Low 1** preset rf power level. Press/release **SELECT OUTPUT POWER-LOW 1** switch and verify **OUTPUT POWER-LOW 1** lamp turns on.
- (g) Set **ADJUST-LOW 1** potentiometer for the desired preset **low 1** forward power level, as indicated by dummy load's forward power indicator (100 watts min/1100 watts max).
- (h) The **OUTPUT POWER** meter's indication shall be the same as the dummy load's forward power indication. Record reading as the **Low 1** preset forward power level.
- (i) Select **Low 2** preset rf power level. Press/release **SELECT OUTPUT POWER-LOW 2** switch and verify **OUTPUT POWER-LOW 2** lamp turns on.
- (j) Set **ADJUST-LOW 2** potentiometer for the desired preset **low 2** forward power level, as indicated by dummy load's forward power indicator (100 watts min/1100 watts max).
- (k) The **OUTPUT POWER** meter's indication shall be the same as the dummy load's forward power indication. Record reading as the **Low 2** preset forward power level.
- (l) If used, verify the optional power level controller controls the rf power level. Press/release **SELECT OUTPUT POWER-AUTO** switch and verify **OUTPUT POWER-AUTO** lamp turns on.
- (m) The rf output, as indicated by dummy load's forward power indicator, shall be the carrier level demanded by power level controller.
- (n) The **OUTPUT POWER** meter's indication shall be the same as the dummy load's forward power indication. Record reading(s) as the **Auto** preset forward power level(s).

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5.3.9.5 Check of Rf Monitor Levels: Verify the average amplitude of the *rf monitor* output is between 4.0 and 8.0 volts rms when a 1000 ohm load is applied to the remote interface pwb's **RF MONITOR** connector (J4) and it is maintained within 10 percent of the average value by the modulation monitor's auto transformer switching circuits as the demanded output power is varied from 100 watts to 1100 watts:

NOTE

The modulation monitor pwb is located on exciter panel. Refer to the exciter panel's assembly detail (figure MD-5) to locate modulation monitor pwb. If necessary, refer to the modulation monitor pwb's service instruction manual for its assembly detail.

- (a) Verify the preset power levels have been set as detailed in paragraph 5.3.9.4.
- (b) Verify the voltage at the junction of R4/R5, on the modulation monitor pwb, is between 6.8 and 7.2 vdc (use a digital multimeter). If necessary, adjust modulation monitor pwb's **SET THRESHold** potentiometer for a digital multimeter reading of 7.0 vdc.
- (c) Set the **OUTPUT POWER** switch to **FORWARD**.
- (d) Connect an ac voltmeter, that has a 1000 ohm resistor connected across its input, to the remote interface pwb's **RF MONITOR** connector (J4).
- (e) Select **Low 2** preset rf power level. Press/release **SELECT OUTPUT POWER-LOW 2** switch and verify **OUTPUT POWER-LOW 2** lamp turns on.
- (f) Set the **ADJUST-LOW 2** potentiometer for an rf output of 1100 watts.
- (g) The ac voltmeter's indication should be between 4.0 and 8.0 volts rms.
- (h) Monitor the ac voltmeter's indication while slowly decreasing the rf output from 1100 watts to 100 watts by adjusting the **ADJUST-LOW 2** potentiometer counter clockwise.
- (i) Plot an X/Y graph using the ac voltmeter's readings (in rms volts) as the X scale and the rf output in watts as the Y scale.

- (j) The graph plotted in step (i) should be a series of 15 sawtooth excursions over the rf output range. The maximum and minimum excursions should be between 4.0 and 8.0 volts rms. In addition the maximum and minimum excursions should not differ from the average value by more than 10 percent. Retain plot for future reference.
- (k) Adjust **ADJUST-LOW 2** potentiometer for an rf output, as indicated by dummy load's forward power indicator, of the desired **Low 2** preset power level.
- (l) Disconnect the ac voltmeter.

5.3.10 MODULATION ENVELOPE/EMISSION LEVEL CHECKS: Verify modulation envelope, radiated sidebands and hum/noise levels are within their acceptable limits, as follows:

CAUTION

*When a C-QUAM AM stereo exciter pwb is the rf drive source, the modulator driver pwb's **AUDIO** potentiometer should not be adjusted during routine testing. Any change in the setting of this potentiometer will change the modulation depth and will affect the left/right audio separation. This will probably cause a badly distorted or otherwise unacceptable AM stereo output. It may also cause some of the emission level test results to be out of tolerance. Refer to the C-QUAM AM stereo exciter pwb's service instruction manual for modulation envelope checks.*

5.3.10.1 Modulation Envelope/Emission Level Check Prerequisites: The following prerequisites must be completed for each of the modulation envelope/emission level checks.

- (a) Verify the requirements of paragraphs 5.3.3 thru 5.3.9 have been successfully completed.
- (b) Connect a modulation monitor to remote interface pwb's **RF MONITOR** connector (J4).
- (c) Verify an audio generator is connected as the modulating audio source, noting it should be routed through a test audio switching circuit (see C-QUAM AM stereo exciter pwb's manual) when a C-QUAM AM stereo exciter pwb is the rf drive source.

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- (d) Verify transmitter's rf output is connected to a precision, 50 ohm, resistive, 2400 watt, dummy load that has provision to accurately display the rf power being applied to it.

5.3.10.2 Check of Audio Balance: Verify the gain of the modulator driver pwb's balance/ unbalance amplifier is set to minimize spurious noise introduced by external wiring and ensures an undistorted reproduction of the input audio is processed by the audio circuits, as follows:

NOTE

*This test is not applicable when the C-QUAM AM stereo exciter pwb is the rf drive source. Its L+R audio output is unbalanced and the balance/ unbalance amplifier has minimal effect. The modulator driver pwb's **COMMON MODE BALANCE** potentiometer should be set to the centre of its travel (approximately two turns from either extreme).*

- (a) Verify the prerequisites of paragraph 5.3.10.1 have been completed and are being met.
- (b) Verify **Low 2** is the selected preset rf power level (**OUTPUT POWER-LOW 2** lamp is on).
- (c) Set **ADJUST-LOW 2** potentiometer fully counter clockwise (rf output shall be zero watts).
- (d) Connect output of audio generator between TB1-15 and TB1-16 on the control/monitor panel's remote interface pwb. Interconnect TB1-15 and TB1-17 using a jumper wire.
- (e) Connect an oscilloscope between **TP3** of the modulator driver pwb and ground.
- (f) Set audio generator for a +10 dBm output.
- (g) Oscilloscope indication should be a null (dc trace).
- (h) If necessary adjust modulator driver pwb's **COMMON MODE BALANCE** potentiometer (R17) for a null.
- (i) Turn off the audio generator.
- (j) Disconnect jumper from TB1-15/TB1-17. Restore audio generator output to its original connections (between TB1-15 and TB1-17) on the remote interface pwb.

5.3.10.3 Audio Gain/Modulation Control: Verify modulating audio is being processed by the modulator driver and modulation depth can be set to 100% over the full audio pass band, as follows:

NOTE

The following tests provide the option of checking the audio stage's gain, to ensure it can be adjusted to provide 100% modulation, when the audio input level is between 0.0 and +12 dBm, or just verifying the audio stage is functioning without disrupting the setting established for normal station programming.

*Complete steps (a) thru (e) only, when a C-QUAM AM stereo exciter pwb is the rf drive source. Any change in the modulator driver pwb's **AUDIO** potentiometer setting will affect AM stereo quality.*

- (a) Verify prerequisites of paragraphs 5.3.10.1 and 5.3.10.2 have been completed and are being met.
- (b) Set **ADJUST-LOW 2** potentiometer for an rf output, as indicated by dummy load's forward power indicator, of precisely 1000 watts.

NOTE

*The gain of the audio amplifier stage can be adjusted to accommodate an audio input of 0 dBm to +12 dBm for a modulation depth of 100%. The modulator driver pwb's **AUDIO** potentiometer is preset during manufacture to provide 100% modulation when the audio input level is +10 dBm.*

- (c) Adjust audio generator's output for a 100% modulation depth indication on modulation monitor. The audio generator's output shall be between 0 dBm and +12 dBm (10 dBm when C-QUAM AM stereo exciter pwb is the rf drive source).
- (d) If the audio gain has previously been established for 100% modulation when the station programming audio is a specific level, record audio generator's output level.
- (e) Verify the audio input level recorded in step (d) is the previously established station programming reference level.

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NOTE

If a full audio gain check is required, proceed to step (f). If completion of steps (a) thru (e) satisfies testing requirements, proceed to paragraph 5.3.10.4.

- (f) Turn off the audio generator.
- (g) Set the modulator driver pwb's **AUDIO** potentiometer fully clockwise.
- (h) Turn on the audio generator and adjust its output level for a 100% modulation depth indication on the modulation monitor.
- (i) The audio generator's output level indication shall be 0 dBm or less.
- (j) Set the modulator driver pwb's **AUDIO** potentiometer fully counter clockwise.
- (k) Set the audio generator's output to +12 dBm.
- (l) Verify modulator driver pwb's **AUDIO** potentiometer can be adjusted for a 100% modulation depth indication on the modulation monitor.
- (m) Set audio generator's output to the level recorded in step (d).
- (n) Adjust the modulator driver pwb's **AUDIO** potentiometer for a 100% mod depth indication on modulation monitor.
- (o) Set audio generator's output to zero (off).

5.3.10.4 Audio Frequency Response: Check the audio frequency response as follows:

- (a) Verify the prerequisites of paragraphs 5.3.10.1 thru 5.3.10.3 have been completed and are being met.
- (b) Adjust audio generator's output for a 25% modulation depth, on modulation monitor.
- (c) Record audio generator's output level.
- (d) Repeat steps (b) and (c) with the audio generator's frequency set to 10kHz, 7500Hz, 5000Hz, 400Hz and 50Hz.

- (e) Audio generator's output should be within 1.0 dB of level recorded in step (c) for all frequencies in step (d). The difference between the highest and lowest output should not exceed 1.0 dB.
- (f) Set audio generator's frequency to 1000 Hz.
- (g) Check frequency response when modulation depth is 50%, 85% and 95%, by repeating steps (b) thru (c) and substituting the appropriate percentage in step (b).
- (h) Set audio generator output to zero (turned off).

5.3.10.5 Signal-To-Noise Ratio: Check the signal-to-noise ratio as follows:

NOTE

*An unacceptable signal-to-noise ratio may be obtained when the rf sample is obtained from the remote interface pwb's **RF MONITOR** connector. This is caused by monitoring circuit ground loops. It may be necessary to use a current probe, inserted at the rf output connector, as the rf sample source for the modulation monitor in the following tests.*

- (a) Verify the prerequisites of paragraphs 5.3.10.1 thru 5.3.10.3 have been completed and are being met.
- (b) Connect a distortion analyzer with a nominal 25 kHz bandwidth to the demodulated audio output of the modulation monitor.
- (c) Adjust the audio generator's output for a 100% modulation depth indication on the modulation monitor.
- (d) Record signal level on distortion analyzer.
- (e) Set output level of audio generator to zero (turned off).
- (f) Record combined noise and hum level indication on distortion analyzer.
- (g) The combined noise and hum level recorded in step (f) shall be a minimum of 60 dB below the signal level recorded in step (d).

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5.3.10.6 Audio Distortion: Check the demodulated audio for distortion as follows:

- (a) Verify the prerequisites of paragraphs 5.3.10.1 thru 5.3.10.3 have been completed and are being met.
- (b) Connect a distortion analyzer with a nominal 25 kHz bandwidth to the demodulated audio output of the modulation monitor.
- (c) Adjust audio generator for a 25% mod depth indication on the modulation monitor.
- (d) Distortion analyzer's audio distortion level indication shall not exceed one percent.
- (e) Repeat steps (c) and (d) with audio generator's frequency set to 10 000 Hz, 7500 Hz, 5000 Hz, 400 Hz and 50 Hz.
- (f) Distortion analyzer's audio distortion level indication shall be a maximum of 1.0% for all frequencies listed in step (e).
- (g) Set audio generator's frequency to 1000 Hz.
- (h) Check audio distortion level when modulation depth is 50%, 85% and 95%, by repeating steps (c) thru (g) and substituting the appropriate percentage in step (c).
- (i) Disconnect the distortion analyzer from the modulation monitor.

5.3.10.7 Carrier Shift: Check the carrier shift with 1000 Hz modulation as follows:

- (a) Verify prerequisites of paragraphs 5.3.10.1 and 5.3.10.2 have been completed and are being met.
- (b) Record carrier level indication on the modulation monitor.
- (c) Adjust output of audio generator for a 95% modulation depth indication on the modulation monitor.
- (d) Record carrier level indication on the modulation monitor.

- (e) Carrier level recorded in step (d) shall not differ from carrier level indication recorded in step (b) by more than one percent.
- (f) Set audio generator's frequency to 1000 Hz and its output level to zero.

5.3.10.8 Completion of Modulation Envelope/Emission Level Checks: On completion of the modulation envelope/emission level checks, adjust **ADJUST-LOW 2** potentiometer for an rf output, as indicated by dummy load's forward power indicator, of precisely the carrier level to be transmitted when **Low 2** power level is selected (see paragraph 5.3.9.4).

5.3.11 REMOTE CONTROL CHECK: Check the remote control circuits as follows:

5.3.11.1 Remote Control Prerequisites: Complete the following for each check.

- (a) Connect or verify transmitter's rf output is connected to a precision, 50 ohm, resistive, 2400 watt, dummy load that has provision to accurately display rf power being applied.
- (b) Connect or verify an audio generator, that has been preset to 1000 Hz at a zero output level (turned off), is connected as the modulating audio source.
- (c) Verify the preset power levels have been preset as detailed in paragraph 5.3.9.4.
- (d) Set the **OUTPUT POWER** switch to **FORWARD**.
- (e) Select **Low 2** preset rf power level (press/release **SELECT OUTPUT POWER-LOW 2** switch and verify **OUTPUT POWER-LOW 2** lamp is on).
- (f) Verify the rf output is the preset **Low 2** forward power level.
- (g) Set the **CONTROL** switch to **REMOTE** and verify the **REMOTE** lamp turns on.
- (h) All other status lamps shall remain the same.
- (i) The *remote status* output, on the remote interface pwb's **REMOTE STATUS** terminal (TB2-15), shall be a current sink to ground.

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5.3.11.2 Remote On/Off Control: Verify the transmitter's rf output (rf power amplifier stage) on/off function can be controlled from a remote location as follows:

- (a) Verify the prerequisites of paragraph 5.3.11.1 have been completed and are being met.
- (b) At remote control site, set the remote *on/off* switch to *off* [momentary application of a ground to remote interface pwb's **RF OFF** terminal (TB1-2)].
- (c) The rf output shall immediately go to zero watts, indicating the rf power stage has been turned off.
- (d) The **RF ON** lamp shall turn off.
- (e) The rf power modules' cooling air fan shall turn off.
- (f) The remote *rf on status* output, on the remote interface pwb's **RF ON STATUS** terminal (TB2-1), shall be an open collector.
- (g) Remaining indicator lamps shall remain as they were before turn-off.
- (h) At remote control site, set the remote *on/off* switch to *on* [momentary application of a ground to remote interface pwb's **RF ON** terminal (TB1-1)].
- (i) The **RF ON** lamp shall turn on.
- (j) The rf output shall be restored to the preset Low 2 power level.
- (k) The rf power modules' cooling air fan shall turn on.
- (l) The remote *rf on status* output, on the remote interface pwb's **RF ON STATUS** terminal, shall be a current sink to ground.

5.3.11.3 Remote Power Level Controls: Verify the three preset levels and optional auto power (when used) level can be selected from a remote location as follows:

- (a) Verify the prerequisites of paragraph 5.3.11.1 have been completed and are being met.
- (b) At the remote control site, set the remote *Power Level Selector* switch to *High* [application of a ground to remote interface pwb's **POWER SELECT - HIGH** terminal (TB1-5)].
- (c) The **OUTPUT POWER-HIGH** lamp shall turn on, indicating *High* preset power level is selected.
- (d) The rf output shall be the preset *high* forward power level.
- (e) The remote *High power level status* output, on the remote interface pwb's **HIGH POWER STATUS** terminal (TB2-3), shall be a current sink to ground.
- (f) The remaining *power level status* outputs, on the remote interface pwb's **POWER STATUS** terminals (TB2-4, TB2-5, TB2-6), shall be an open collector.
- (g) At the remote control site, set the remote *Power Level Selector* switch to *Low 1* [momentary application of a ground to remote interface pwb's **POWER SELECT - LOW 1** terminal (TB1-6)].
- (h) The **OUTPUT POWER-LOW 1** lamp shall turn on, indicating *Low 1* preset power level is selected.
- (i) The rf output shall be the preset *Low 1* forward power level.
- (j) The remote *Low 1 power level status* output, on the remote interface pwb's **LOW 1 POWER STATUS** terminal (TB2-4), shall be a current sink to ground.
- (k) The remaining *power level status* outputs, on the remote interface pwb's **POWER STATUS** terminals (TB2-3, TB2-5, TB2-6), shall be an open collector.

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- (l) At the remote control site, set the remote **Power Level Selector** switch to **Low 2** [momentary application of a ground to remote interface pwb's **POWER SELECT - LOW 2** terminal (TB1-7)].
 - (m) The **OUTPUT POWER-LOW 2** lamp shall turn on, indicating **Low 2** preset power level is selected.
 - (n) The rf output shall be the preset **Low 2** forward power level.
 - (o) The remote **Low 2 power level status** output, on the remote interface pwb's **LOW 2 POWER STATUS** terminal (TB2-5), shall be a current sink to ground.
 - (p) The remaining *power level status* outputs, on the remote interface pwb's **POWER STATUS** terminals (TB2-3, TB2-4, TB2-6), shall be an open collector.
 - (q) If used, set the remote **Power Level Selector** switch to **Auto** [momentary application of a ground to remote interface pwb's **POWER SELECT - AUTO** terminal (TB1-8)].
 - (r) The **OUTPUT POWER-AUTO** lamp shall turn on, indicating **Auto** power level is selected.
 - (s) The rf output shall be the level commanded by the optional power level controller. It will be zero if the optional controller is not used.
 - (t) The remote **Auto power level status** output, on the remote interface pwb's **AUTO POWER STATUS** terminal (TB2-6), shall be a current sink to ground.
 - (u) The remaining *power level status* outputs, on the remote interface pwb's **POWER STATUS** terminals (TB2-3, TB2-4, TB2-5), shall be an open collector.
- 5.3.11.4 Remote Power Trim Control:** Verify the rf output power can be trimmed from a remote location as follows:
- (a) Verify the low 2 preset rf power level is selected (**OUTPUT POWER-LOW 2** lamp is on and the rf output is the preset **Low 2** forward power level).
 - (b) Verify the remaining prerequisites of paragraph 5.3.11.1 are being met.
 - (c) Set remote **Power Trim** switch to its **Increase** position [application of a ground to remote interface pwb's **POWER INCR** terminal (TB1-9)] a minimum of seven times.
 - (d) The rf output shall increase one increment each time the switch is closed, for the first seven switch closures.
 - (e) The rf output shall not change on the eighth and subsequent switch closures.
 - (f) Final rf output shall be a minimum of ten percent higher than the rf output noted in step (a).
 - (g) Set remote **Power Trim** switch to its **Decrease** position [application of a ground to remote interface pwb's **POWER DECR** terminal (TB1-10)] a minimum of fifteen times.
 - (h) The rf output shall decrease one increment each time the switch is closed, for the first fifteen switch closures.
 - (i) The rf output shall not change on the sixteenth and subsequent switch closures.
 - (j) Final rf output shall be a minimum of ten percent lower than the rf output noted in step (a).
 - (k) The power trim circuit can be reset to its mid-range setting by momentarily turning off the rf drive stage (press/release **RF-OFF** switch and then press/release **RF-ON** switch). It can also be reset by setting remote **Power Trim** switch, in its **Increase** or **Decrease** position, a minimum of fifteen times and then setting the switch seven times in its other position.
 - (l) The rf output shall be restored to the preset **Low 2** power level, as noted in step (a).

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5.3.11.5 Remote PWM Inhibit Control: Verify the variable pulse width modulator (PWM) drive, and therefore the rf output, can be inhibited from a remote location; as follows:

- (a) Verify the prerequisites of paragraph 5.3.11.1 have been completed and are being met.
- (b) Verify the low 2 preset rf power level is selected (**OUTPUT POWER-LOW 2** lamp is on) and the rf output is the preset **Low 2** forward power level.
- (c) Monitor the **OUTPUT POWER** meter's indication and simulate a **PWM Inhibit** input by applying a ground to the remote interface pwb's **PWM INHIBIT** terminal (TB1-11).
- (d) The rf output shall instantly go to zero watts, indicating the modulator (PWM) drive has been inhibited.
- (e) Monitor **OUTPUT POWER** meter's indication and remove ground from remote interface pwb's **PWM INHIBIT** terminal (TB1-11).
- (f) The rf output shall instantly be restored to the preset **Low 2** power level, as noted in step (b).
- (g) Set the **CONTROL** switch to **REMOTE**.

5.3.12 PROTECTION CIRCUIT CHECKS: Verify the fault detector circuits, that monitor critical parameters of the transmitter and protect the rf power amplifier stages, are functioning within their design limits as follows:

NOTE

There is no practical way of controlling the ac power source voltage. It is also not practical to detune rf drive circuits or simulate faults in the rf output stages without risk to the solid state devices in the rf power amplifier stages. The following are go/no go test of fault detection circuits that monitor voltages which represent critical parameters.

5.3.12.1 Protection Circuit Check Prerequisites: Ensure the following prerequisites have been completed and are being met before starting each protection circuit check.

- (a) Verify transmitter's rf output is connected to a precision, 50 ohm, resistive, 2400 watt, dummy load that has provision to accurately display rf power being applied.
- (b) Verify an audio generator, that has been preset to 1000 Hz at a zero output level (turned off), is connected as the modulating audio source.
- (c) Verify the preset power levels have been preset as detailed in paragraph 5.3.9.4.
- (d) Verify the transmitter is operational and there are no **ALARM** lamps turned on.
- (e) Verify the **CONTROL** switch is set to **LOCAL**.
- (f) Verify the low 2 preset rf power level is selected (**OUTPUT POWER-LOW 2** lamp is on) and the rf output is the preset **Low 2** forward power level.

5.3.12.2 High B- Vdc Detector: Verify the rf output is shutback (turned off) and a high B- alarm is produced when the output of the B- vdc power supply exceeds -82 vdc, as follows:

- (a) Verify requirements of paragraph 5.3.12.1 are being met.
- (b) Simulate a high B-vdc by temporarily connecting a 100K ohm resistor in parallel with resistor R6 on control interface pwb.

NOTE

Connecting a 100K ohm resistor in parallel with resistor R6 simulates a B- voltage that is more negative than -82 volts dc. Refer to figure MD-3 to locate the control interface pwb and then to its service instruction manual to locate R6.

If a more precise check of the high B- vdc threshold is required or if the calibration of the high B- vdc alarm threshold is suspect, perform the adjustment procedures detailed in paragraph 5.4.3.

- (c) The rf output shall be instantly shutback to a near zero watts reading.
- (d) The **HIGH B-VDC ALARM** and **LOW RF DRIVE ALARM** lamps shall turn on.

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- (e) The *High B- alarm* output, on remote interface pwb's **HIGH B- ALARM** terminal (TB2-10), shall be a current sink to ground.
- (f) The *Drive Level Alarm* output, on remote interface pwb's **DRIVE LEVEL ALARM** terminal (TB2-11), shall be a current sink to ground.
- (g) Remove the 100K ohm resistor which was temporarily installed across R6 on the control interface pwb.
- (h) The rf output shall return to the preset **Low 2** forward power level.
- (i) The *High B- alarm* output, on the remote interface pwb's **HIGH B- ALARM** terminal shall be an open collector.
- (j) The *Drive Level alarm* output, on the remote interface pwb's **DRIVE LEVEL ALARM** terminal shall be an open collector.
- (k) The **HIGH B-VDC ALARM** and **LOW RF DRIVE ALARM** lamps shall remain on.
- (l) Reset alarm circuit (press/release the control interface pwb's **ALARM RESET** switch S5).
- (m) The **HIGH B-VDC ALARM** and **LOW RF DRIVE ALARM** lamps shall turn off.

5.3.12.3 High Ac Voltage Detector: Verify the rf output is shutback (turned off) and a high Ac alarm is produced when the voltage of the ac power source is more than 5% above its nominal value, as follows:

NOTE

The output voltage of unregulated 24 vdc power supply is monitored, by the high ac voltage detector circuit, since it is directly proportional to the ac power source voltage.

- (a) Verify requirements of paragraph 5.3.12.1 are being met.
- (b) Simulate a high ac voltage by temporarily connecting a 47K ohm resistor in parallel with resistor R7 on control interface pwb.

NOTE

Connecting a 47K ohm resistor in parallel with resistor R7 simulates a voltage that is more than 5% above the nominal output of the unregulated 24 vdc power supply. Refer to figure MD-3 to locate the control interface pwb and then to its service instruction manual to locate R7.

- (c) The rf output shall be instantly shutback to a near zero watts reading.
- (d) The **HIGH AC PWR ALARM** lamp shall turn on.
- (e) The *High Ac alarm* output, on the remote interface pwb's **HIGH AC ALARM** terminal (TB2-8), shall be a current sink to ground.
- (f) Remove the 47K ohm resistor which was temporarily installed across R7 on the control interface pwb.
- (g) The rf output shall return to the preset **Low 2** forward power level.
- (h) The remote *high Ac alarm* output, on the remote interface pwb's **HIGH AC ALARM** terminal shall be an open collector.
- (i) The **HIGH AC PWR ALARM** lamp shall remain on.
- (j) Reset the alarm circuit (press/release control interface pwb's **ALARM RESET** switch S5).
- (k) The **HIGH AC PWR ALARM** lamp shall turn off.

5.3.12.4 Low Ac Voltage Detector: Verify the rf output is shutback (turned off) and a low Ac alarm is produced when ac power source voltage is more than 5% below its nominal value, as follows:

NOTE

The output voltage of the unregulated 24 vdc power supply is monitored, since it is directly proportional to the ac power source voltage.

- (a) Verify requirements of paragraph 5.3.12.1 are being met.
- (b) Simulate a low ac voltage by temporarily connecting a 15K ohm resistor in parallel with capacitor C4 on control interface pwb.

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NOTE

Connecting a 15K ohm resistor in parallel with capacitor C4 simulates a voltage that is more than 5% below the nominal output of the unregulated 24 vdc power supply. Refer to figure MD-3 to locate the control interface pwb and then to its service instruction manual to locate C4.

- (c) The rf output shall be instantly shutback to a near zero watts reading.
- (d) The **LOW AC PWR ALARM** lamp shall turn on.
- (e) The *low Ac alarm* output, on the remote interface pwb's **LOW AC ALARM** terminal (TB2-9), shall be a current sink to ground.
- (f) Remove the 15K ohm resistor which was temporarily installed across C4 of the control interface pwb.
- (g) The rf output shall return to the preset **Low 2** forward power level.
- (h) The *low Ac alarm* output, on the remote interface pwb's **LOW AC ALARM** terminal shall be an open collector.
- (i) The **LOW AC PWR ALARM** lamp shall remain on.
- (j) Reset the alarm circuit (press/release control interface pwb's **ALARM RESET** switch S5).
- (k) The **LOW AC PWR ALARM** lamp shall turn off.

5.3.12.5 Low RF Drive Level Detector: Verify the rf output is shutback (turned off) and a low rf drive alarm is produced when amplitude of the rf drive, to the rf power amplifier stages, falls below its fault threshold, as follows:

NOTE

The rf drive is peak detected by a half-wave rectifier circuit in the exciter panel's rf drive amplifier. When the rf drive is acceptable, the output voltage of this circuit will be more than 35.0 vdc.

- (a) Verify requirements of paragraph 5.3.12.1 are being met.

- (b) Simulate a low rf drive condition by temporarily connecting a 100K ohm resistor in parallel with resistor R2 on the control interface pwb.

NOTE

Connecting a 100K ohm resistor in parallel with resistor R2 simulates an rf drive level voltage of less than 35.0 vdc. Refer to figure MD-3 to locate the control interface pwb and then to its service instruction manual to locate R2.

- (c) The rf output shall be instantly shutback to a near zero watts reading.
- (d) The **LOW RF DRIVE ALARM** lamp shall turn on.
- (e) The *low rf drive alarm* output, on the remote interface pwb's **DRIVE LEVEL ALARM** terminal (TB2-11), shall be a current sink to ground.
- (f) Remove the 100K ohm resistor which was temporarily installed across R2 of the control interface pwb.
- (g) The rf output shall return to the preset **Low 2** forward power level.
- (h) The *low rf drive alarm* output, on the remote interface pwb's **DRIVE LEVEL ALARM** terminal shall be an open collector.
- (i) **LOW RF DRIVE ALARM** lamp shall remain on.
- (j) Reset the alarm circuit (press/release control interface pwb's **ALARM RESET** switch S5).
- (k) The control/monitor panel's **LOW RF DRIVE ALARM** lamp shall turn off.

5.3.12.6 Detuned Rf Drive Detector: Verify the rf output is shutback (turned off) and a detuned rf drive alarm is produced when the rf drive tuned circuits are detuned enough to apply a nominal 1.0 vdc tune alarm to the detuned rf drive detection circuit, as follows:

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NOTE

The rf drive output of the rf drive amplifier is monitored by a circuit that compares the phase of current and voltage. When the rf drive output's tuned circuits are detuned, current and voltage waveforms will be out of phase by an amount proportional to the degree of detuning. The monitoring circuit's output will be a dc voltage proportional to current/voltage phase difference. When tuned circuits are acceptable, this ac voltage will be less than 1.0 vdc.

- (a) Verify requirements of paragraph 5.3.12.1 are being met.
- (b) Connect a variable dc power source that has been preset to 0.0 vdc between the J1-2 side of resistor R107 (+) and TP2 (ground) on the control interface pwb.

NOTE

Refer to figure MD-3 to locate the control interface pwb and then to its service instruction manual to locate R107.

- (c) Monitor the **OUTPUT POWER** meter indication and slowly increase output of variable dc power supply until the **DETUNED RF DRIVE ALARM** lamp just turns on.
- (d) The variable dc power supply's output shall be between 0.5 and 1.0 vdc.
- (e) The rf output shall be instantly shutback to a near zero watts reading.
- (f) **LOW RF DRIVE ALARM** lamp shall also turn on.
- (g) *Detuned rf drive alarm* output, on the remote interface pwb's **DRIVE TUNING ALARM** terminal (TB2-12), shall be a current sink to ground.
- (h) The *low rf drive alarm* output, on the remote interface pwb's **DRIVE LEVEL ALARM** terminal (TB2-11), shall also be a current sink to ground.
- (i) Set variable dc power supply to 0.0 vdc.
- (j) **DETUNED RF DRIVE ALARM** lamp shall remain on and the conditions of steps (e) thru (h) shall be maintained.

- (k) Reset the rf drive detuned detector circuit (press/release the control interface pwb's **RF TUNING RESET** switch S10).
- (l) **DETUNED RF DRIVE ALARM** lamp shall turn off.
- (m) The rf output shall return to the preset **Low 2** forward power level.
- (m) The *detuned rf drive alarm* output, on the remote interface pwb's **DRIVE TUNING ALARM** terminal, shall be an open collector.
- (n) The *low rf drive alarm* output, on the remote interface pwb's **DRIVE LEVEL ALARM** terminal shall be an open collector.
- (o) **LOW RF DRIVE ALARM** lamp shall remain on.
- (p) Reset the alarm circuit (press/release control interface pwb's **ALARM RESET** switch S5).
- (q) **LOW RF DRIVE ALARM** lamp shall turn off.
- (r) Disconnect the variable dc power supply.

5.3.12.7 High Rf Current Detector: Verify the rf output is shutback (turned off) and a high rf current alarm is produced when rf power amplifier stress current limits are approached, as follows:

NOTE

A current probe in the rf output filter provides an rf voltage that is representative of the rf output current.

The high rf current detector forms part of a dynamic servo that turns off the rf output (shutback) when the high rf current fault threshold is exceeded. When this occurs, the rf current will fall to zero, the rf shutback signal will be removed and then the rf output will be exponentially restored over a 250 millisecond period. If a high rf current is still detected, the shutback/turn on cycle will be repeated.

Each shutback causes an alarm count/power cutback circuit to advance one count. If more than three counts occur in any twenty second period, the rf output will be reduced (cutback) in increments until the rf current is acceptable or until shutdown occurs at a count of nine.

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NOTE (Continued)

The alarm count/power cutback circuit resets 20 seconds after the first count if a count of nine has not been attained (shutdown has not occurred). If shutdown has occurred, a manually initiated alarm reset command must be applied to reset the counter.

The cutback feature is difficult to check because of test circuit limitations. The counter/cutback function is tested in high SWR tests of paragraph 5.3.12.8, therefore it is not tested in this procedure.

CAUTION

The protection provided by the high rf current detection circuit is disabled, by disconnecting the output of the rf current probe from its input, during the following tests. Restore circuit integrity as soon as possible after completion of testing.

- (a) Verify requirements of paragraph 5.3.12.1 are being met.
- (b) Remove *rf current sample* input from the control interface pwb. Disconnect coaxial cable (P7) from its **RF CURRENT SAMPLE** BNC connector (J7).

NOTE

Refer to figure MD-3 to locate control interface pwb and to its service instruction manual to locate J7.

- (c) Connect a function generator that is preset to provide a 100 Hz square wave at a peak-to-peak amplitude of 0.0 volts (referenced to ground potential) to the control interface pwb's **RF CURRENT SAMPLE** connector (J7).
- (d) Simulate an increasing rf current by slowly increasing the function generator's peak-to-peak amplitude (referenced to ground potential) until the **HIGH RF CURRENT ALARM** lamp just turns on.

NOTE

*The **SWR CUTBACK ALARM** lamp will also turn on because the dynamic servo has been disabled and the 100Hz input will cause the alarm counter to shift past a count of three to a count of nine very rapidly. The rf output will be shutback to and remain at zero watts.*

- (e) Function generator's peak-to-peak amplitude shall be between 4.2 and 4.6 volts, noting the negative going peak must be at ground potential.
- (f) If requirements of steps (d) and (e) are met, proceed to step (m).
- (g) If requirements of steps (d) and (e) are not met, set the control interface pwb's **CURRENT THRESHOLD** potentiometer (R111) fully clockwise.

NOTE

*Refer to the control interface pwb's service instruction manual to locate **CURRENT THRESHOLD** potentiometer R111.*

- (h) Set the peak-to-peak amplitude of the function generator's output to 4.4 volts
- (i) If the **HIGH RF CURRENT ALARM** lamp is on, reset the alarm circuit (press/release control interface pwb's **ALARM RESET** switch).
- (j) Slowly adjust the control interface pwb's **CURRENT THRESHOLD** potentiometer counter clockwise until the **HIGH RF CURRENT ALARM** lamp just turns on.
- (k) The rf output shall be instantly shutback to a near zero watts reading.
- (l) The *high rf current alarm* output, on remote interface pwb's **RF CUR ALARM** terminal (TB2-7), shall be a current sink to ground.
- (m) Set peak-to-peak amplitude of the function generator's output to 0.0 volts.
- (n) The rf output shall remain shutback at near zero watts, the **HIGH RF CURRENT ALARM** and **SWR CUTBACK ALARM** lamps shall remain on.
- (o) The *high rf current alarm* output, on the remote interface pwb's **RF CUR ALARM** terminal, shall switch to an open collector.
- (p) Reset the alarm circuit (press/release the control interface pwb's **ALARM RESET** switch).

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- (q) The rf output shall be restored to the preset **Low 2** forward power level.
- (r) The **HIGH RF CURRENT ALARM** and **SWR CUTBACK ALARM** lamps shall turn off.
- (s) Disconnect function generator and restore the high rf current detector circuit integrity by connecting rf current sample coaxial cable (P7) to control interface pwb's **RF CURRENT SAMPLE** input connector (J7).

5.3.12.8 High SWR Detector: Verify the rf output is shutback (turned off) and a high SWR alarm is produced when the reflected power exceeds 175 watts, as follows:

NOTE

A forward/reflected power probe in the rf output filter provides a dc voltage that is proportional to the reflected power sensed at the filter's output. This dc voltage will be a nominal 2.7 vdc when the reflected power is 175 watts.

The high SWR detector is part of a dynamic servo that inhibits the rf output (shutback) when the high reflected power fault threshold is exceeded. When this occurs, the reflected power will fall to zero, the rf shutback signal will be removed and then the rf output will be exponentially restored over a 250 millisecond period. If a high reflected power is still detected, the shutback/turn on cycle will be repeated.

Each shutback causes an alarm count/power cutback circuit to advance one count. If more than three counts occur in any 20 second period, the rf output will be reduced (cutback) in increments until the reflected power is acceptable or until shutdown occurs at a count of '9'.

The alarm count/power cutback circuit resets 20 seconds after the first count if a count of '9' has not been attained (shutdown has not occurred). If shutdown has occurred, a manually initiated alarm reset command must be applied to reset the counter and restore normal operation.

A one-shot multivibrator in the SWR alarm circuit restricts the clocking of the alarm counter, by SWR alarms, to a maximum of one clock per second. Additional SWR alarms will be disregarded and have no influence on the count.

CAUTION

The protection provided by the high SWR detection circuit is disabled, by disconnecting the output of the forward/reflected power probe from its input, during the following tests. Restore circuit integrity as soon as possible after completion of testing.

- (a) Verify requirements of paragraph 5.3.12.1 are being met.
- (b) Remove the reflected power input from the control interface pwb. Disconnect coaxial cable (P6) from its **REFLECTED POWER** BNC connector (J6).

NOTE

Refer to figure MD-3 to locate the control interface pwb and then to its service instruction manual to locate J6.

- (c) Connect a variable dc power supply, that has been preset to 0.0 vdc, to control interface pwb's **REFLECTED POWER** connector (J6) using a suitable coaxial cable.
- (d) Simulate an increasing reflected power by slowly increasing the output voltage of the variable dc power supply until the **SWR SHUTBACK ALARM** lamp just turns on.

NOTE

*Steps (e) thru (l) must be completed within twenty seconds after the **SWR SHUTBACK ALARM** lamp turns on in step (d).*

- (e) The variable dc power supply's output shall be between 2.56 and 2.83 vdc.
- (f) The rf output shall be instantly shutback to a near zero watts reading.
- (g) **SWR Shutback Alarm** output, on the remote interface pwb's **SWR SHUTBACK ALARM** terminal (TB2-13), shall be a current sink to ground.
- (h) Set variable dc power supply's output to 3.0 vdc and then switch off its output.
- (i) The rf output shall be restored to the preset **Low 2** forward power level.

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- (j) *SWR Shutback Alarm* output, on the remote interface pwb's **SWR SHUTBACK ALARM** terminal (TB2-13), shall switch to an open collector.
- (k) The **SWR SHUTBACK ALARM** lamp shall stay on.
- (l) Reset the alarm circuit (press/release the control interface pwb's **ALARM RESET** switch).
- (m) The **SWR SHUTBACK ALARM** lamp shall turn off.

NOTE

*Steps (n) thru (z) must be completed within twenty seconds, after the **SWR SHUTBACK ALARM** lamp turns on in step (o).*

- (n) Switch the variable dc power supply's output on (3.0 vdc) and then off three times at a maximum repetition rate of one on/off cycle per second, noting the time of first turn-on.

NOTE

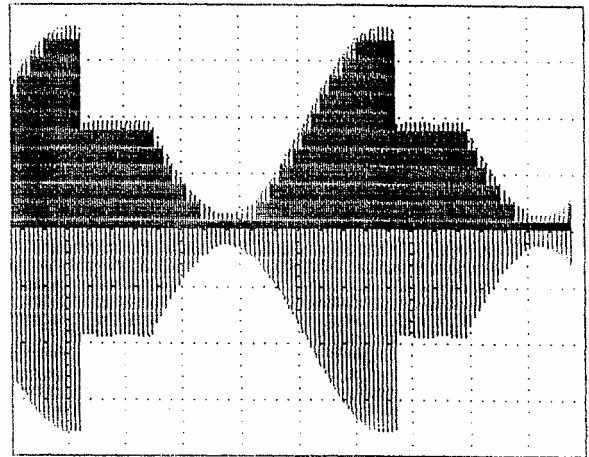
*A one-shot multivibrator in the *SWR* alarm circuit restricts the clocking of the alarm counter, by *SWR* alarms, to a maximum of one clock per second. Spurious or additional *SWR* alarms will be disregarded and have no influence on the count.*

- (o) The **SWR SHUTBACK ALARM** lamp shall turn on the first time the power supply is switched on and it shall stay on for steps (p) thru (x).
- (p) The rf output shall be reduced to zero watts when the power supply is on and it shall be restored to the preset **Low 2** forward power level when the power supply is switched off.
- (q) Switch the variable dc power supply's output on and then off one more (fourth) time.
- (r) The **SWR CUTBACK ALARM** lamp shall turn on.
- (s) The rf output shall be reduced to zero watts when the power supply is on and it shall return to a slightly lower level than the preset **Low 2** forward power level, when the power supply is switched off.
- (t) *SWR cutback alarm* output, on the remote interface pwb's **SWR CUTBACK ALARM** terminal (TB2-14), shall be a current sink to ground.

- (u) Switch the variable dc power supply's output on and then off four (fifth thru eighth) times at a maximum repetition rate of one on/off cycle per second.
- (v) The rf output shall be reduced to zero watts when the power supply is on and it shall increment to a lower forward power each time the power supply is switched off.
- (w) Approximately 20 seconds after time noted in step (n) (first turn-on of power supply), the rf output shall be restored to the preset **Low 2** forward power level, indicating the alarm counter has been reset to '0'.
- (x) *SWR cutback alarm* output, on the remote interface pwb's **SWR CUTBACK ALARM** terminal, shall switch to an open collector.
- (y) **SWR CUTBACK ALARM** and **SWR SHUTBACK ALARM** lamps shall remain on.
- (z) Reset the alarm circuit (press/release the control interface pwb's **ALARM RESET** switch).
- (aa) The **SWR CUTBACK ALARM** and **SWR SHUTBACK ALARM** lamps shall both turn off.
- (ab) Switch the variable dc power supply's output on and then off a minimum of nine times, within 20 seconds, at a maximum repetition rate of one on/off cycle per second. Ensure dc power supply is off on completion.
- (ac) **SWR SHUTBACK ALARM** and **SWR CUTBACK ALARM** lamps shall both turn on.
- (ad) The rf output shall be shutback (zero watts).
- (ae) *SWR shutback alarm* output, on the remote interface pwb's **SWR SHUTBACK ALARM** terminal (TB2-13), shall be an open collector.
- (af) *SWR cutback alarm* output, on the remote interface pwb's **SWR CUTBACK ALARM** terminal (TB2-14), shall be a current sink to ground.
- (ag) The requirements of steps (ac), (ad), (ae) and (af) shall be maintained indefinitely, indicating the alarm counter's 20-second reset clock has been inhibited.

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- (ah) Reset the alarm circuit (press/release the control interface pwb's **ALARM RESET** switch).
- (ai) The rf output shall be restored to the preset **Low 2** forward power level.
- (aj) **SWR CUTBACK ALARM** and **SWR SHUTBACK ALARM** lamps shall both turn off.
- (ak) *SWR cutback alarm* output, on the remote interface pwb's **SWR CUTBACK ALARM** terminal (TB2-14), shall switch to an open collector.
- (al) Disconnect variable dc power supply and restore the high SWR detector circuit's integrity. Connect reflected power coaxial cable (P6) to the control interface pwb's **REFLECTED POWER** connector (J6).



Modulated at 95% by 30 Hz sine Wave
5.0 ms/div, 5.0 V/div, Scale Centre = 0.0 vdc
Figure 5-8 Rf Output with Positive Peak Clipping

5.3.12.9 Modulation Peak Limiting: Verify the modulation peaks are limited, to reduce rf power amplifier stress current, when the rf output's modulation envelope contains low frequency (long duration), high amplitude peaks, as follows:

- (a) Verify requirements of paragraph 5.3.12.1 are being met.
- (b) Connect an oscilloscope to the remote interface pwb's **RF MONITOR** connector (J4).
- (c) Verify an audio generator is connected as the modulating audio source.
- (d) Preset audio generator to provide a 30 Hz sine wave at a zero output level (turned off).
- (e) Select **High** preset rf power level (press/ release **SELECT OUTPUT POWER-HIGH** switch and verify the **OUTPUT POWER-HIGH** lamp turns on).
- (f) Adjust **ADJUST-HIGH** potentiometer for an rf output, as indicated by dummy load's forward power indicator, of precisely 1000 watts.
- (g) Monitor oscilloscope and adjust the audio generator's output for 95% modulation as indicated by modulation envelope waveform.

- (h) Monitor oscilloscope and adjust the modulator driver pwb's **SET THRESHOLD** potentiometer until trailing edge of each 30 Hz cycle is just being clipped as depicted in figure 5.8 and then adjust **SET THRESHOLD** potentiometer for a setting that is on the edge of the clipping threshold (no clipping).
- (i) Set **ADJUST-HIGH** potentiometer for the preset **High** forward power level, as indicated by dummy load's forward power indicator.
- (j) Select **Low 2** preset rf power level (press/ release **SELECT OUTPUT POWER-LOW 2** switch and verify **OUTPUT POWER-LOW 2** lamp turns on).

5.3.12.10 Check of Safety Interlock: Verify the rf output is shutback (turned off) and an interlock open alarm is produced when the integrity of the interlock circuit is interrupted, as follows:

- (a) Verify requirements of paragraph 5.3.12.1 are being met.
- (b) Open an external interlock switch.

NOTE

The transmitter control circuit's 24 vdc power source is applied from A2TB1-14 to A2TB1-13 by the external interlock circuit, when it is intact.

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- (c) The rf output shall fall to near zero reading, indicating the rf power has been turned off.
- (d) **INTERLOCK OPEN ALARM** lamp shall turn on.
- (e) The **RF ON** lamp shall remain on.
- (f) The rf power module's fan shall turn off.
- (g) The remote *interlock open alarm* output, on the remote interface pwb's **INTLK OPEN ALARM** terminal (TB2-21), shall be a current sink to ground.
- (h) The remote *rf on status* output, on the remote interface pwb's **RF ON STATUS** terminal (TB2-1), shall remain as a current sink to ground.
- (i) Remaining indicator lamps shall remain as they were before turn-off.
- (j) Restore the integrity of the interlock circuit.
- (k) The rf output shall be restored to the preset **Low 2** power level.
- (l) **INTERLOCK OPEN ALARM** lamp shall turn off.
- (m) The rf power module's fan shall turn on.
- (n) The *interlock open alarm* output, on the remote interface pwb's **INTLK OPEN ALARM** terminal, shall be an open collector.

5.3.13 REMOTE FORWARD POWER MONITOR: When connected, remote forward power indicator's reading shall be the same as the **OUTPUT POWER** meter's forward power reading when the **OUTPUT POWER** switch is set to **FORWARD**.

5.3.14 REMOTE REFLECTED POWER MONITOR When connected, remote reflected power indicator's reading shall be the same as the **OUTPUT POWER** meter's forward power reading when the **OUTPUT POWER** switch is set to **REFLECTED**.

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SPECIAL ADJUSTMENT PROCEDURES

5.4 Procedures referred to as special adjustment procedures contain adjustments that should not have to be altered once they have been established. Adjustments have been precisely set at factory prior to shipment and should not require further adjustment. Settings will affect accuracy of the adjustment; therefore, they should not be disturbed unless their accuracy is suspect and then only if the specified test equipment is available.

5.4.1 INCIDENTAL PHASE MODULATION (EXTERNAL AM STEREO RF DRIVE): Adjust for minimum incidental phase modulation (IPM) when an external AM stereo generator is the rf drive source for an rf drive pwb in the exciter drawer, as follows:

NOTE

If Nautel's optional C-QUAM AM stereo exciter pwb is installed as the rf drive source, do not use these procedures. Use procedures detailed in C-QUAM AM stereo exciter pwb's service instruction manual.

*An unacceptable incidental phase modulation (IPM) level may be obtained when the modulation monitor's rf sample is obtained from the remote interface pwb's **RF MONITOR** connector (J4), as the result of monitoring circuit ground loops. It may be necessary to use a current probe, that is inserted at the rf output connector, as the rf sample source for the modulation monitor in the following tests.*

- (a) Set all switches as tabulated in table 5-1.
- (b) Verify the rf output is connected to a precision, 50 ohm, resistive, 2400 watt, dummy load.
- (c) Verify the transmitter is operational and the **Low 2** preset power level is selected:
 - **RF ON** and **OUTPUT POWER-LOW 2** lamps are on.
 - Rf output is the preset **Low 2** forward power level.
 - There are no **ALARM** lamps on.
- (d) Connect an AM stereo modulation monitor to the remote interface pwb's **RF MONITOR** connector (J4).

- (e) Connect an audio signal generator, that has been set to 1000 Hz and its output level to zero (turned off), to the left and right input terminals of the station's stereo exciter, in lieu of normal station programming.

NOTE

*If the left plus right audio from the AM stereo exciter was disconnected from the remote interface pwb's **AUDIO** terminals, to connect an audio generator for other test procedures, ensure audio generator has been disconnected and audio from the AM stereo exciter has been reconnected.*

- (f) Adjust output of audio generator for a 90 percent modulation depth indication on the left plus right (L + R) channel of the station's stereo modulation monitor. Ensure the left and right signals are equal.
- (g) Adjust rf drive pwb's **IPM BALANCE** potentiometer (R18) for minimum left/right separation, as indicated on the station's stereo modulation monitor.
- (h) Set audio generator's output to zero (turned off).

5.4.2 RF DRIVE TUNING: Tune the rf drive series tuning inductor on rf amplifier A4A5 and the shunt tuning (parallel) inductor of the rf power module as follows:

NOTE

The rf drive amplifier is located on the exciter panel. Refer to figure MD-5 to locate the rf drive amplifier. Refer to the rf drive amplifier's service instruction manual for its assembly detail.

5.4.2.1 Series Tuning: Tune rf drive series tuning inductor A4A5L1 as follows:

- (a) Ensure the rf power stage is off (press/ release the **RF OFF** switch) and then set the **MAIN POWER** circuit breaker to **OFF**.
- (b) Disconnect mating connectors (P3) from J1 on rear of rf power module.

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Table 5-3 Rf Drive Series Tuning

LINKS INSTALLED			IN-CIRCUIT CAPACITORS			CAPACITY (pF)
-	A-C	-	-	C2	-	1200
A-B	-	-	C1	-	-	2700
A-B	A-C	-	C1	C2	-	3900
-	-	A-D	-	-	C3	5600
-	A-C	A-D	-	C2	C3	6800
A-B	-	A-D	C1	-	C3	8300
A-C	B-C	D-C	C1	C2	C3	9500

- (c) Terminate the rf drive into a short circuit by installing a shorting jumper between pins 13 and 16 of connector P3 removed in step (b).
- (d) Connect a function generator, that has been preset to provide a sinusoidal rf output at the carrier frequency across diode CR2 (between the source and drain of Q2).
- (e) Connect an oscilloscope across the function generator's output.
- (f) Adjust rf drive series tuning inductor A4A5L1 for a minimum amplitude (null) rf drive waveform on the oscilloscope.
- (g) If a definite null is not obtained in step (f), set tuning coil A4A5L1 slug to its fully inserted position (maximum inductance) and then determine the resonant frequency of the series circuit by adjusting the frequency of the function generator.
- (h) If resonant frequency is below the required carrier frequency, change the link selection (A to B, C, D) to select less capacitance, and repeat from step (d). Refer to table 5-3 to determine link/capacitance selection.
- (i) If resonant frequency is above the required carrier frequency, change the link selection (A to B, C, D) to select more capacitance, and repeat from step (d). Refer to table 5-3 to determine link/capacitance selection.
- (j) Disconnect the oscilloscope and function generator.
- (k) Remove shorting jumper installed in step (c) from connector P3.
- (l) Connect wiring harness connector P3 to mating connector (J1) on the rear of the rf power module.

5.4.2.2 Parallel Tuning: Tune the shunt (parallel) tuning inductor in the rf drive input of the rf power module as follows:

NOTE

If an rf power module has been serviced or if it has not previously been fine tuned in the transmitter, verify it was coarse tuned (while removed from the transmitter) to the carrier frequency. Refer to the rf power module's service instruction manual for bench tuning procedures.

- (a) Verify the requirements of paragraph 5.4.2.1 have been completed and are being met.
- (b) Set the **MAIN POWER** circuit breaker to **OFF**.
- (c) Terminate or verify the rf output is terminated into a precision 50 ohm, resistive, 2400 watt, dummy load.
- (d) Turn off or verify the modulating audio source is turned off.
- (e) Set the **ADJUST-LOW 2** potentiometer fully counter clockwise (minimum of four turns).
- (f) Turn on the transmitter by setting the **MAIN POWER** circuit breaker to **ON**.
- (g) Select the Low 2 preset power level (press/release **SELECT OUTPUT POWER-LOW 2** switch and verify the **OUTPUT POWER-LOW 2** lamp is on).
- (h) Turn on the rf power stage (press/release the **RF ON** switch and verify the **RF ON** lamp is on).
- (i) The rf output shall be near zero watts.
- (j) Set **DC SUPPLY** switch to **PA** volts.
- (k) Adjust **ADJUST-LOW 2** potentiometer for a **PA VOLTS** indication of -9.0 vdc.

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- (l) The rf output should be approximately 55 watts.
- (m) Precisely tune rf drive shunt tuning inductor (L1) in the rf power module, to the carrier frequency as detailed in steps (o) thru (z).
- (n) Switch off B- Vdc to the rf power module (set **MAIN POWER** circuit breaker to **OFF**).
- (o) Wait for rf power module storage capacitors to discharge. The rf power module's **B- Vdc** lamp (DS1) will be fully turned off.
- (p) Insert an rf drive tuning adapter (Nautel part number NAX106) in the rf drive input circuit of the rf power module by:
- disconnecting the rf drive connector from J1.
 - connecting the rf drive tuning adapter to J1.
 - connecting rf drive connector, which was disconnected from J1, to the input connector of the rf drive tuning adapter.
- (q) Connect a digital multimeter (preset to measure dc volts) between the (+) and (-) terminals of rf drive tuning adapter's pwb.
- (r) Switch on B- Vdc to the rf power module (set **MAIN POWER** circuit breaker to **ON**).
- (s) The rf output shall return to the reading noted in step (l).
- (t) Using a 3/8 inch nut driver, adjust rf drive shunt tuning inductor on rf power module, for a null (minimum) reading on the digital multimeter.
- (u) Switch off B- Vdc to the rf power module (set **MAIN POWER** circuit breaker to **OFF**).
- (v) Wait for rf power module's storage capacitors to discharge. Rf power module's **B- VDC** lamp (DS1) will be fully turned off when the capacitors are discharged.
- (w) Disconnect rf drive tuning adapter.
- (x) Restore rf drive circuit. Mate the wiring harness connector disconnected in step (p) with J1 of the tuned rf power module.
- (y) Switch on B- Vdc to the rf power module (set **MAIN POWER** circuit breaker to **ON**).
- (z) The rf output shall return to the reading noted in step (l).
- (aa) On completion of tuning, set **ADJUST-LOW 2** potentiometer for an rf output of precisely the carrier level to be transmitted for the preset Low 2 forward power level.

5.4.3 HIGH B-VDC THRESHOLD: Set High B- vdc alarm threshold, on the control interface pwb, to initiate an rf shutback (turn off of rf output) and generate a high B-vdc alarm when the B-vdc exceeds -82.0vdc; as follows:

- (a) Set the **MAIN POWER** circuit breaker to **OFF**.
- (b) Set the control interface pwb's **B-VDC THRSILD** potentiometer (R10) fully clockwise.

NOTE

The control interface pwb is located on the rear of the control/monitor panel (see figure MD-3). Refer to the control interface pwb's service instruction manual for its assembly detail.

- (c) Disconnect the mating connector (P3) from J3 of the control interface pwb.

NOTE

Disconnecting J3's mating connector removes the B-vdc (ref) input from the control interface pwb. It also removes the 24 vdc (ref), 15 vdc (ref) and the rf drive level inputs.

- (d) Temporarily interconnect the 15vdc input at J4-9 of the control interface pwb to its 15vdc (ref) input by installing a jumper between TP7 and the positive (+) terminal of C15.
- (e) Connect a 0-100 volt variable dc power supply as the B-vdc ref input. Connect its negative lead to CR1's cathode and connect its positive lead to TP2.
- (f) Set the output of the variable dc power supply to -82.0 volts dc.
- (g) Turn on the transmitter by setting the **MAIN POWER** circuit breaker to **ON**.

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- (h) Turn on the rf power stage (press/release the **RF ON** switch and verify the **RF ON** lamp is on).
- (i) Select Low 2 preset power level (press/ release **SELECT OUTPUT POWER-LOW 2** switch and verify the **OUTPUT POWER-LOW 2** lamp is on)
- (j) The **LOW AC PWR** and **RF DRIVE ALARM** lamps shall be on.
- (k) The remaining control/monitor panel **ALARM** lamps should be off. If not, reset the alarm circuits (press/release **ALARM RESET** switch).

NOTE

The alarm lamps identified as being on in step (j) will be on as the result of P3 being disconnected from J3 of the control interface pwb.

- (l) The rf output shall be near zero watts.
- (m) Slowly adjust the control interface pwb's **B-VDC THRSILD** potentiometer counter clockwise until the **HIGH B-VDC ALARM** lamp just turns on.
- (n) Set the output of the variable dc power supply to -72.0 volts dc.
- (o) Reset the alarm circuits (press/release the **ALARM RESET** switch).
- (p) The **HIGH B-VDC ALARM** lamp shall turn off.
- (q) Slowly increase the output voltage of the variable dc power supply until the **HIGH B-VDC ALARM** lamp just turns on.
- (r) The output voltage of the variable dc power supply shall be between -81.5 and -82.5 vdc.
- (s) Restore the transmitter protection circuits to their operational status by:
 - turning off the transmitter (set the **MAIN POWER** circuit breaker to **OFF**).
 - disconnecting the variable dc power supply from the control interface pwb.
 - removing the jumper wire from between TP7 and C15 on the control interface pwb.

- Connect wiring harness connector P3 to J3 of the control interface pwb [disconnected in step (c)].

5.4.4 HIGH/LOW AC VOLTS

THRESHOLD: Set high/low ac voltage alarm thresholds for an operating window that allows a voltage variation of $\pm 5\%$ from the ideal (nominal centre) voltage for the power transformer's selected primary winding taps. If the applied ac voltage is not within this window, an rf shutback will be initiated and an **AC PWR** alarm will be generated.

NOTE

The ac alarm threshold adjustments are on the control interface pwb, which is on the rear of the control/monitor panel. Refer to the control interface pwb's instruction manual for its assembly detail.

5.4.4.1 Pre-Requisites for Ac Alarm Thresholds:

Establish transmitter operating criteria and determine the nominal voltage of the unregulated 24 vdc power supply, as follows:

- (a) Set all switches as tabulated in table 5-1.
- (b) Verify the rf power stage is enabled and **Low 2** is the selected preset power level (**RF ON** and **OUTPUT POWER-LOW 2** lamps are on)
- (c) Verify the rf output is the preset low 2 forward power level.
- (d) From transmitter records, determine which of the power transformer's primary winding taps are connected.
- (e) Using a digital voltmeter, measure the dc voltage between TP5 of the control interface pwb and chassis ground.
- (f) Voltage reading in step (e) should be between 21.5 and 26.5 vdc. Record reading as the **actual unregulated 24 vdc**.
- (g) Determine average rms voltage being applied to the power transformer. Record measured value as the **applied ac voltage**.

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NOTE

Unless there is a significant voltage drop in the wiring between the service entrance and the transmitter's power transformer, the voltage can be measured at the service entrance, noting it should be loaded by the transmitter during this measurement.

- (h) Determine the optimum ac voltage for the power transformer's connected primary winding taps by entering table 3-1 with tap connections determined in step (d). Calculate centre voltage of the tabulated voltage range for that tap selection. Record calculated value as the **ideal ac voltage**.
- (i) Calculate the unregulated 24 vdc's nominal voltage by multiplying the **actual unregulated 24 vdc** recorded in step (e) by the **ideal ac voltage** recorded in step (h) and then dividing the product by the **applied ac voltage** recorded in step (g).
- (j) The resultant in step (i) should be between 21.5 and 26.5 vdc. Record this value as the **nominal unregulated 24 vdc**.
- (k) Determine high ac alarm threshold. Multiply the **nominal unregulated 24 vdc** recorded in step (j) by 1.075. Record the resultant as the **high ac alarm threshold reference voltage**.
- (l) Determine low ac alarm threshold. Multiply the **nominal unregulated 24 vdc** recorded in step (j) by 0.925. Record the resultant as the **low ac alarm threshold reference voltage**.
- (m) Turn off the transmitter (set the **MAIN POWER** circuit breaker to **OFF**).
- (n) Set the control interface pwb's **HIGH AC THRESHOLD** potentiometer (R17) fully counter clockwise (minimum of four turns).
- (o) Set the control interface pwb's **LOW AC THRESHOLD** potentiometer (R149) fully clockwise (minimum of four turns).
- (p) Disconnect the mating connector (P3) from J3 of the control interface pwb.

NOTE

Disconnecting J3's mating connector removes the 24 Vdc (Ref), B- Vdc (Ref), 15 Vdc (Ref) and rf drive level inputs from the control interface pwb.

- (q) Temporarily simulate the control interface pwb's 15 vdc (ref) input by installing a jumper between TP7 and C18's positive (+) terminal on the control interface pwb.
- (r) Simulate the 24 vdc (ref) input by connecting the output of a 0-30 volt variable dc power supply between TP5(+) and TP13(-) on the control interface pwb.
- (s) Set variable dc power supply to the voltage recorded as the **nominal unregulated 24 vdc** in step (j).
- (t) Turn on the transmitter (set the **MAIN POWER** circuit breaker to **ON**).
- (u) Verify **RF ON** and **OUTPUT POWER-LOW 2** lamps are on, indicating rf power stage is enabled and **Low 2** is the selected preset power level.
- (v) The **LOW RF DRIVE** alarm lamp shall be on.

NOTE

*The **RF DRIVE ALARM** lamp will be on as a result of P3 being disconnected from J3 of the control interface pwb.*

- (w) The **LOW AC PWR** alarm lamp may also be on. If so, reset the alarm retention circuits (press/release **ALARM RESET** switch).
- (x) The rf output shall be near zero watts.

5.4.4.2 High Ac Voltage Alarm Threshold: Set the high ac voltage alarm threshold to initiate an rf shutback (turn off of rf output) and generate a **high ac alarm** when the applied ac voltage exceeds the ideal ac voltage by more than 5%, as follows:

- (a) Verify the pre-requisites of paragraph 5.4.4.1 have been completed and are being met.
- (b) Verify the control interface pwb's **HIGH AC THRESHOLD** potentiometer (R17) is set fully counter clockwise (minimum of four turns).

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- (c) Set the output of the variable dc power supply to the precise voltage recorded as the **high ac alarm threshold reference voltage** recorded in step (k) of paragraph 5.4.4.1.
 - (d) Slowly adjust the control interface pwb's **HIGH AC THRESHOLD** potentiometer clockwise until the **HIGH AC PWR ALARM** lamp just turns on.
 - (e) Set output of the variable dc power supply to the **nominal unregulated 24 vdc** value recorded in step (j) of paragraph 5.4.4.1.
 - (f) Reset the alarm retention circuits (press/ release the **ALARM RESET** switch).
 - (g) The **HIGH AC PWR ALARM** lamp shall turn off.
 - (h) Slowly increase the output voltage of the variable dc power supply until the **HIGH AC PWR ALARM** lamp just turns on.
 - (i) The output voltage of the variable dc power supply shall be within 0.1 vdc of the **high ac alarm threshold reference voltage** recorded in step (k) of paragraph 5.4.4.1.
 - (j) Restore the high ac alarm circuit to its pre adjustment status by repeating steps (e), (f) and (g).
- (d) Slowly adjust the control interface pwb's **LOW AC THRESHOLD** potentiometer counter clockwise until the **LOW AC PWR ALARM** lamp just turns on.
 - (e) Set output of the variable dc power supply to the **nominal unregulated 24 vdc** value recorded in step (j) of paragraph 5.4.4.1.
 - (f) Reset the alarm retention circuits (press/ release the control interface pwb's **ALARM RESET** switch).
 - (g) The **LOW AC PWR ALARM** lamp shall turn off.
 - (h) Slowly decrease the output voltage of the variable dc power supply until the **LOW AC PWR ALARM** lamp just turns on.
 - (i) The output voltage of the variable dc power supply shall be within 0.1 vdc of the **low ac alarm threshold reference voltage** recorded in step (l) of paragraph 5.4.4.1.
 - (j) Restore the low ac alarm circuit to its pre-adjustment status by repeating steps (e), (f) and (g).

5.4.4.3 Low Ac Voltage Alarm Threshold: Set the low ac voltage alarm threshold to initiate an rf shutback and generate a *low ac alarm* when the applied ac voltage falls below the ideal ac voltage by more than 5%, as follows:

- (a) Verify the pre-requisites of paragraph 5.4.4.1 have been completed and are being met.
- (b) Verify the control interface pwb's **LOW AC THRESHOLD** potentiometer (R149) is set fully clockwise (minimum of four turns).
- (c) Set the output of the variable dc power supply to the precise voltage recorded as the **low ac alarm threshold reference voltage** recorded in step (l) of paragraph 5.4.4.1.

5.4.4.4 Completion of Ac Voltage Tests: On completion of the ac voltage alarm threshold checks and adjustments, restore the transmitter to an operational status, as follows;

- (a) Turn off the transmitter (set the **MAIN POWER** circuit breaker to **OFF**).
- (b) Turn off the variable dc power supply and disconnect its test leads from the control interface pwb.
- (c) Remove the jumper wire from between TP7 and C18 on the control interface pwb.
- (d) Locate connector P3 of the wiring harness that was disconnected in step (p) of paragraph 5.4.4.1 and mate it with connector J3 of the control interface pwb.
- (e) Turn on the transmitter (set the **MAIN POWER** circuit breaker to **ON**).
- (f) Reset the alarm retention circuits (press/ release the **ALARM RESET** switch).

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- (g) The **RF ON** and **OUTPUT POWER-LOW 2** lamps should be on, indicating the rf power stage is enabled and **Low 2** is the selected preset power level.
- (h) The rf output should be the preset **low 2** forward power level.
- (i) All **ALARM** lamps should be off.

5.4.5 RF CURRENT LEVEL: Select or verify the resistance value of R52 on the control interface pwb has been selected to provide between 1.65 and 1.69 vdc at the anode of CR9, on the control interface pwb, when the rf output is an unmodulated 1100 watts and it is terminated by a precision 50-ohm load; as follows:

NOTE

The value of resistor R52 was selected during manufacture. It should not be necessary to change/select its value, unless the control interface pwb is replaced or tuning of the rf output filter is changed.

- (a) Set all switches/circuit breakers, except the **MAIN POWER** circuit breaker, as tabulated in table 5-1. Set the **MAIN POWER** circuit breaker to **OFF**.
- (b) Terminate or verify the rf output is terminated into a precision 50 ohm, resistive, 2400 watt, dummy load.
- (c) Verify modulating audio source is turned off.

NOTE

The control interface pwb is located on the rear of the control/monitor panel (see figure MD-3). Refer to the control interface pwb's service instruction manual for its assembly detail.

- (d) If a replacement control interface pwb is being installed and the value of R52 in the original control interface pwb is known, install a resistor of this value as R52.
- (e) If a replacement control interface pwb is being installed and the value of R52 is not known, temporarily install a 1000 ohm, 0.5 watt resistor as R52

- (f) On the control interface pwb, connect a digital multimeter (preset to measure dc volts) between anode of CR9 (+) and TP13.
- (g) Turn on the transmitter (set the **MAIN POWER** circuit breaker to **ON**).
- (h) Turn on the rf power stage (press/release the **RF ON** switch and verify the **RF ON** lamp is on).
- (i) Select Low 2 preset power level (press/ release **SELECT OUTPUT POWER-LOW 2** switch and verify the **OUTPUT POWER-LOW 2** lamp is on)
- (j) Adjust **ADJUST-LOW 2** potentiometer for an rf output of 1100 watts.
- (k) All **ALARM** lamps on the control/monitor panel should be off. If not reset the alarm circuits. (press/release **ALARM RESET** switch).
- (l) The digital multimeter's indication should be between 1.65 and 1.69 volts dc.
- (m) If requirement of step (l) is met, the value of R52 is satisfactory.
- (n) If requirement of step (l) is not met, replace R52 with a different resistor value, until requirement is met, noting an increase in resistance will increase the voltage level.

NOTE

If, after completion of tests, resistor R52 is not properly installed on the control interface pwb; turn off the transmitter, remove the control interface pwb, solder R52 in position, re-install the control interface pwb and repeat the tests.

- (o) On completion of test, set **ADJUST-LOW 2** potentiometer for an rf output of precisely the desired low 2 preset forward power level

5.4.6 DC SUPPLY METER'S B- AMPS READING ACCURACY: Verify the current reading provided by the DC SUPPLY meter is reliable when B- AMPS is selected by the dc supply switch, as follows:

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NOTE

*Reference is made to the DC Volts Control Assembly.
Refer to figure MD-2 to locate the DC Volts Control assembly.*

- (a) Turn off the transmitter (set the **MAIN POWER** circuit breaker to **OFF**).
- (b) Turn off the ac power source at the service entrance.
- (c) Locate current shunt resistor A7R1 on the rectifier assembly (see figure MD-11).
- (d) Disconnect the black 6AWG wire from position 5 of current shunt resistor A7R1.
- (e) Connect the positive lead of a dc ammeter to position 5 of the current shunt resistor.

NOTE

The ammeter must be able to measure up to 20 amperes dc.

- (f) Connect the negative lead of the ammeter to black 6AWG wire disconnected in step (d).
- (g) Turn on the ac power source at the service entrance.
- (h) Turn off or verify the modulating audio source is turned off.
- (i) Set the **ADJUST - LOW 2** potentiometer fully counter clockwise (minimum of four turns).
- (j) Turn on the transmitter (set the **MAIN POWER** circuit breaker to **ON**).
- (k) Turn on the rf power stage (press/release the **RF ON** switch and verify the **RF ON** lamp is on).
- (l) Select Low 2 preset power level (press/ release **SELECT OUTPUT POWER-LOW 2** switch and verify the **OUTPUT POWER-LOW 2** lamp is on)
- (m) The rf output shall be near zero watts.
- (n) Set the **DC SUPPLY** switch to B- Amps.
- (o) Set the **ADJUST - LOW 2** potentiometer for reading of 15 amps on the ammeter.

- (p) The rf output should not exceed 1100 watts.
- (q) If necessary, adjust meter calibration pwb's **CURRENT CAL** potentiometer (R1) for a dc supply meter indication of 15 amps, noting the meter calibration pwb is fastened to the **DC SUPPLY** meter terminals.
- (r) Set the **ADJUST - LOW 2** potentiometer fully counter clockwise (minimum of four turns).
- (s) Turn off the transmitter (set the **MAIN POWER** circuit breaker to **OFF**).
- (t) Turn off the ac power source at the service entrance.
- (u) Disconnect the ammeter.
- (v) Connect the black 6AWG wire to position 5 of current shunt resistor A7R1.
- (w) Turn on the ac power source at the service entrance.
- (x) Turn on the transmitter (set the **MAIN POWER** circuit breaker to **ON**).
- (y) The **RF ON** and **OUTPUT POWER - LOW 2** lamps shall be on, indicating **LOW 2** preset power level is selected and the rf power stages are enabled.
- (z) The rf output shall be near zero watts.
- (aa) See **ADJUST - LOW 2** potentiometer for an rf output of precisely the carrier level to be transmitted for the **LOW 2** power level.

5.4.7 DC SUPPLY METER'S PA VOLTS READING ACCURACY: Verify the reading provided by the **DC SUPPLY** meter is accurate when it is displaying **PA VOLTS** as follows:

- (a) Turn off the transmitter (set the **MAIN POWER** circuit breaker to **OFF**).
- (b) Wait for the rf power module's storage capacitors to discharge. The rf power module's **B- VDC** lamp will be fully turned off when the capacitors are discharged.

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- (c) Disconnect connectors P3 and A6P1 from the rear of the rf power module.
- (d) Remove the rf power module, as detailed in paragraph 6.5.1.
- (e) Remove one modulator/power amplifier from the rf power module as detailed in the rf power module's service instruction manual.
- (f) Locate power thyristor Q11, noting it is adjacent to modulator pwb A1. Refer to figure MD-6 in the rf power module's service instruction manual as an aid in locating Q11.
- (g) Connect an insulated wire (approximately four inches long) to the cathode of Q11 (negative terminal of capacitor C3).
- (h) Install the modulator/power amplifier in the rf power module as detailed in the rf power module's service instruction manual, ensuring the wire added in step (g) passes thru an air vent hole in front of the rf power module.
- (i) Turn on the transmitter (set the **MAIN POWER** circuit breaker to **ON**).
- (j) The **B- VDC** lamp on the rear of the rf power module shall turn on, indicating its storage capacitors have charged to B- Vdc.
- (k) Turn on the rf power stage (press/release the **RF ON** switch and verify the **RF ON** lamp is on).
- (l) Select Low 2 preset power level (press/ release **SELECT OUTPUT POWER-LOW 2** switch and verify the **OUTPUT POWER-LOW 2** lamp is on)
- (m) Set the **DC SUPPLY** switch to **PA VOLTS**.
- (n) Adjust the **ADJUST-LOW 2** potentiometer for a voltmeter reading of 25 volts dc.
- (o) The **DC SUPPLY** meter's reading should be 25 volts dc.
- (p) If necessary, replace resistor R4B, which is located on switch S1 of the control/monitor panel and with a resistor value that provides a **DC SUPPLY** meter reading of 25 volts dc.
- (q) Set the **ADJUST - LOW 2** potentiometer fully counter clockwise (minimum of four turns).
- (r) Turn off the transmitter (set the **MAIN POWER** circuit breaker to **OFF**).
- (s) Wait for the rf power module storage capacitors to discharge. The rf power module's **B- VDC** lamp will be fully turned off when the capacitors are discharged.
- (t) Repeat steps (c) thru (f).
- (u) Remove wire installed in step (g).
- (v) Repeat steps (h), (i), (l) thru (r).
- (w) Set the **ADJUST - LOW 2** potentiometer for an rf output of precisely the carrier level to be transmitted for the **LOW 2** power level.

CAUTION

Ensure wire installed in step (g) does not short to ground. Serious damage to the modulator/power amplifier could result.

- (i) Replace the rf power module as detailed in paragraph 6.5.2
- (j) Connect the negative lead of a dc voltmeter to the wire added to the rf power module.
- (k) Connect the positive lead of the voltmeter to chassis ground on the rf power module.
- (l) Connect wiring harness connector P3 to J1 of the rf power module.
- (m) Connect A6P1 to J2 of the rf power module.
- (n) Set the **ADJUST-LOW 2** potentiometer fully counter clockwise (minimum of four turns).

SECTION 6 MAINTENANCE

GENERAL

6.1 This section contains scheduled and corrective maintenance information for the subject transmitter. Fault symptoms should be analyzed to determine the corrective action required. Normally a recalibration will resolve the apparent problem. In any event, the most practical way to isolate a fault is to perform a functional test in conjunction with the calibration procedures.

CAUTION

The AMPFET ND2.5 transmitter contains many solid state devices that may be damaged if subjected to excessive heat or high voltage transients. Every effort must be taken to ensure circuits are not overdriven or disconnected from their loads while turned on.

SCHEDULED MAINTENANCE

6.2 Scheduled maintenance consists of performing a visual inspection of the transmitter in conjunction with a functional test/adjustment test procedure at scheduled intervals (see section 5). The recommended minimum time between scheduled maintenance visits is three months. Local operating and environmental conditions may dictate more frequent visits and in the case of remote sites, less frequent visits may be acceptable. Experience and system reliability will determine the most practical schedule for a specific installation.

CORRECTIVE MAINTENANCE

6.3 Corrective maintenance procedures consist of identifying and correcting defects or deficiencies that arise during operation and/or functional check/calibration test procedures of the subject transmitter. Local and remote alarm signals will be generated when a malfunction occurs. If the alarm condition was caused by a malfunction in the power amplifier stages, the integral modular reserve (IMR) features will maintain operation at a reduced rf output level. The nature of the fault and station policy will dictate whether immediate maintenance response is necessary. Fault analysis and rectification may be conducted from three different levels with a different technical competence level required for each.

6.3.1 ON-AIR TROUBLESHOOTING: On-air trouble shooting can be performed from a remote location or locally at the transmitter site.

6.3.1.1 Remote Trouble Shooting: Remote on-air troubleshooting consists of monitoring the transmitter's radiated signal using an on-air monitor and observing the status of remote fault alarm indicators. The information obtained from these sources should enable an operator to decide if response may be deferred to a more convenient time, if immediate corrective action must be taken and/or whether the standby transmitter must be enabled (if one is available). It is recommended the significance of remote indications and the appropriate responses be incorporated into a station's standard operating procedures.

6.3.1.2 Local Trouble Shooting: Local on-air trouble shooting consists of monitoring the transmitter's integral meters and fault alarm indicators. Analysis of their status will normally identify the nature of the malfunction and in most cases will determine what corrective action must be taken.

6.3.1.2.1 The power amplifier stages contain an integral modular reserve (IMR) feature. This feature permits the transmitter to operate at a reduced rf output level when a malfunction occurs in one or more of its rf power modules. Station operating procedures will dictate if the reduced rf output level is acceptable. When the reduced rf output level can be tolerated, replacement of the defective rf power module(s) may be deferred to a more convenient time. Defective rf power modules may be removed from the transmitter for servicing, while the transmitter is operating at a reduced rf output level, provided the removal instructions detailed in paragraph 6.5 have been met. Refer to paragraph 6.5 for rf power module removal/replacement instructions.

CAUTION

*If the transmitter is operated with an rf power module(s) removed for servicing, the appropriate **ENABLE POWER MODULE** switch (located on the rear of the dc volts control panel) must be set to **OFF**.*

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6.3.2 OFF-AIR TROUBLESHOOTING:

Off-air troubleshooting must be performed when selection of the reserve (standby) exciter assemblies, replacement of defective rf power module(s) or routine on-air calibration adjustments will not restore operation. It is recommended the output be connected to a precision 50-ohm resistive dummy load (rated at a minimum of 5 kW) for off-air troubleshooting procedures. If an appropriate dummy load is not available, troubleshooting for a majority of faults can be performed with the power amplifier stages turned off. The transmitter may remain connected to its antenna system for these procedures. It is recommended the rf output level be reduced to a minimal value when the rf output is connected to the antenna system and it is necessary to troubleshoot faults in the power amplifier stage.

RF POWER MODULE FAULT ISOLATION

6.4 Determine if an rf power module is defective and subsequently determine which modulator/power amplifier(s) caused an alarm condition to be generated, as follows:

NOTE

A defective rf power module can be removed for repair, without turning off the transmitter as described in paragraph 6.5. The transmitter can be operated at a reduced output power level up to 1250 watts with an rf power module removed. Refer to paragraph 4.10 for procedures to be observed prior to and after removal of an rf power module.

- (a) Check status of the three **PA FAIL** and the three **MOD FAIL** lamps on the front of each rf power module (see figure MD-1).

NOTE

Rf power modules that have one or more PA FAIL or MOD FAIL lamps turned on, may contain one or more defective modulator/power amplifiers. Confirm a legitimate failure has occurred by verifying the PA failure alarms as detailed in paragraph 4.8.

- (b) Record which rf power module is defective (**PA FAIL** and/or **MOD FAIL** lamps turned on), noting rf power module 'A' is the left hand module (A4) and rf power module 'B' is the right hand module (A5); when the transmitter is viewed from the front (see figure MD-1).

- (c) Record which **PA FAIL** and/or **MOD FAIL** lamps are turned on for each rf power module recorded in step (b).
- (d) Replace rf power modules recorded in step (b) as detailed in paragraph 6.5.

REPLACEMENT PROCEDURES FOR RF POWER MODULE

6.5 Replace rf power module as follows:

CAUTION

Rf power modules contain solid state devices that may be damaged if they are subjected to excessive heat or high voltage transients. Every effort must be taken to ensure circuits are not overdriven and they are not disconnected from their loads while turned on.

CAUTION

The power module to be removed must be turned off and the B- Vdc lamp on its rear panel must be 'off' prior to disengaging its connectors.

- (a) Gain access to the rf power module control panel (see figure MD-2) and the rear of the rf power module to be removed, by opening the rear door of the transmitter cabinet.
- (b) Turn off the rf power module to be removed by momentarily pressing and releasing the appropriate **POWER MODULE ENABLE - OFF** switch on the rf power module control panel
- (c) The associated **POWER MODULE ENABLE** lamp on the circuit breaker panel shall turn off, indicating the affected power module has been turned off and the rf output circuits have been reconfigured to convert the transmitter to a 1250 watt (maximum) transmitter.
- (d) The **B- Vdc** lamp on the rear of the rf power module to be removed shall turn off within a nominal 12 seconds, indicating the large storage capacitors have discharged.

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6.5.1 RF POWER MODULE REMOVAL:

Remove defective rf power module as follows:

- (a) Verify requirements of paragraph 6.5 have been completed and are being met.
- (b) Verify **B- Vdc** lamp, on the rear of the rf power module, is off or wait until it turns off.
- (c) Disconnect mating connectors from J1 and J2 on the rf power module.
- (d) Remove attaching hardware (hexagon lock nut and washer) from rear retaining stud of rf power module to be removed.
- (e) Carefully withdraw rf power module from the front of the transmitter cabinet.

NOTE

If a serviceable rf power module is available, install module as detailed in paragraph 6.5.2. If a serviceable rf power module is not available, the transmitter may be operated at half power with one rf power module removed.

- (f) Service defective rf power module using instructions detailed in the rf power module's service instruction booklet.

6.5.2 RF POWER MODULE INSTALLATION: Install an rf power module as follows:

- (a) Verify requirements of paragraph 6.5 have been completed and are being met.
- (b) Verify the circuit breaker panel's **POWER MODULE ENABLE** lamp, for the rf power module to be installed, is off.

- (c) Slide rf power module into its support tray, from the front of the transmitter cabinet, ensuring the retaining stud at rear of the module passes through the slotted mounting hole in the support tray.
- (d) Secure the rf power module to its support tray, by installing a 10-24 hex nut and a #10 flat washer on its retaining stud.

NOTE

Ensure nut is firmly tightened as the retaining stud provides a secondary ground for the module.

- (e) Connect interconnecting mating connectors to J1 and J2 of the rf power module.
- (f) Turn on the newly installed rf power module by momentarily pressing and releasing the appropriate **POWER MODULE ENABLE - ON** switch on the rf power module control panel
- (g) The associated **POWER MODULE ENABLE** lamp on the circuit breaker panel shall turn on, indicating the affected power module has been turned on and the rf output circuits have been reconfigured to restore the transmitter to a 2500 watt transmitter, provided the other rf power module is also turned on and contributing to the rf output.

NOTE

When the second rf power module is turned on, the rf output will be significantly reduced by the reconfiguring of the rf output circuits, until its storage capacitor is charged and it is contributing to the rf output

- (h) The **B- Vdc** lamp on the rear of the rf power module shall turn on within a nominal six seconds, indicating the large storage capacitors have charged to B- vdc.

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**REPLACEMENT PROCEDURES FOR
EXCITER PANEL PWB'S**

6.6 The following procedures must be observed when replacing exciter panel assemblies:

CAUTION

The exciter panel's assemblies contain many solid state devices that may be damaged if subjected to excessive heat or high voltage transients. Every effort must be taken to ensure circuits are not overdriven and not disconnected from their loads while turned on. MAIN POWER circuit breaker must be set to off.

- (a) Turn off the transmitter by setting the **MAIN POWER** circuit breaker off.
- (b) To gain access to the exciter panel's assemblies, turn the control/monitor panel's fastening screws 1/4 turn counter clockwise.
- (c) Locate assemblies on the exciter panel suspected of having a fault (see figure MD-4 to identify the exciter panel's assemblies).
- (d) Remove attaching hardware and cable connectors from assemblies identified in step (c) and remove assemblies.
- (e) Ensure cable connectors and other conductive material of the wiring harness are isolated from exposed terminals.
- (f) Repair defective assemblies removed in step (d), as per instructions detailed in the appropriate bench repair instructions.

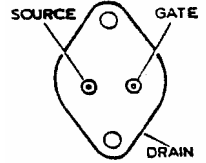
ISOLATION OF DEFECTIVE MOSFETS

6.7 Isolate defective power MOSFET, using a digital multimeter that is capable of measuring the forward/reverse resistance of a diode, as follows:

CAUTION

Precautions must be observed when handling or maintaining circuits which contain electrical or electrostatic sensitive parts and/or devices. A means should be provided to keep electrostatic voltage below the sensitivity level of the electrostatic part/device.

- (a) Unsolder and disconnect wiring from gate of power MOSFET to be tested.
- (b) Verify all power MOSFETs are turned off, by momentarily connecting a jumper between their gate and source terminals.



NOTE

The following procedures require power MOSFET under test to be turned on by the application of a dc voltage (between 4.0 and 9.0 volts dc) between its gate and source. Some digital multimeters have sufficient dc voltage on their test leads when set to 'diode' or 'resistance' test positions. If multimeter to be used falls in this category, it may be used as the voltage source. If it does not, a dc voltage source that is between 4.0 and 9.0 vdc must be obtained.

NOTE

Because paired MOSFETs are connected in parallel, all MOSFETs must be turned off prior to testing to prevent interaction between the MOSFET under test and MOSFETs not being tested.

- (c) Measure source/drain resistance, of power MOSFET being tested, in both directions.
- (d) Resistance measurement in step (c) shall be an open circuit in reverse bias direction and a diode pedestal in forward bias direction.
- (e) If the requirements in step (d) are not met, unsolder and disconnect wiring from the source of MOSFET that is suspected of being defective and repeat steps (b) thru (d).
- (f) If requirements of step (d) are still not met, assume the MOSFET being tested is defective. Replace the defective power MOSFET as detailed in paragraph 6.8.
- (g) Turn on power MOSFET to be tested by momentarily applying a dc voltage (4.0 volts dc to 9.0 volts dc) between its gate (+) and source (-) leads.
- (h) Measure source/drain resistance, of power MOSFET being tested, in both directions.

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- (i) Resistance measurements in step (h) shall be a short circuit in both directions.
- (j) If the requirements of step (i) are met, power MOSFET being tested may be assumed to be serviceable.
- (k) If requirements of step (i) are not met, power MOSFET being tested or, where applicable, its insulating washer may be assumed to be defective. Replace defective power MOSFET as detailed in paragraph 6.8.
- (e) Set replacement power MOSFET in the appropriate position on chassis (heat sink) ensuring insulator, if applicable, is installed between the chassis and power MOSFET.
- (f) Position insulating spacers in the mounting holes of power MOSFET mentioned in step (e) from under the chassis (heat sink).

CAUTION

When replacing defective power MOSFET ensure that the mounting holes and mounting surface are free from burrs or any sharp projection that could damage the insulating pads and/or plastic sleeves.

MOSFET REPLACEMENT

6.8 Replace defective power MOSFET as follows:

- (a) Unsolder the applicable leads of power MOSFET to be replaced, ensure solder is not splattered on the chassis.

CAUTION

When removing power MOSFET and, if installed, note color and/or type of insulator pad between the power MOSFET and chassis (heat sink) ensuring the 'same' type is used when reinstalling. If a thermo compound and mica insulator is being used in lieu of an insulator pad, ensure thermo compound is clean (free of slivers) and mica insulator is not damaged prior to reinstalling MOSFET.

- (b) Remove attaching hardware from the power MOSFET to be replaced and remove MOSFET. If installed, note type of insulator between chassis (heat sink) and MOSFET.
- (c) Remove insulating sleeve from gate and source lead of removed power MOSFET and install them on replacement device.
- (d) If applicable, position correct insulator on chassis (heat sink) where power MOSFET will be installed, ensuring lead and mounting holes are properly aligned. See *caution* following step (a).
- (g) Reinstall screws of power MOSFET ensuring that screws with *Belville* washers are torqued to five inch pounds (0.665 Newton meters or 0.58 kilogram meters).
- (h) Resolder the appropriate leads to the source terminals of the power MOSFET.
- (i) Verify terminals of power MOSFET which protrude through the chassis (heat sink) are not shorting to the chassis (heat sink) and protective plastic sleeve over gate or source leads are present and not damaged.
- (j) Verify the chassis is free from solder slivers and other conductive foreign objects, pay special attention to holes in the chassis (heat sink) containing MOSFET terminals and the area around the insulated, conductive circuit board. See caution following step (f).
- (k) Perform a resistance measurement as detailed in paragraph 6.7.
- (l) Resolder leads to gate terminals of power MOSFETs that have been replaced and perform a visual inspection.

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VENTILATION FAN FILTERS

6.9 The air filters covering the air intakes for the cooling air fans should be inspected and cleaned periodically. There are two cooling air fans in an AMPFET ND2.5 transmitter. One in each rf power module.

6.9.1 RF POWER MODULE AIR FILTERS:

The air filter element (media) can be removed from an rf power module without disrupting its operation. Carefully remove the outer retainer and then extract the media. Wash the media using soap and warm water. When it is clean and dry, position the media in the fan guard and secure it in place by re-installing the outer retainer. The filter element is a 30 PPI (pores per inch) media. Replacement filter, which include the guard, the filter element and the retainer are available from Nautel (Nautel P/N HAS47).

SECTION 7 PARTS LIST

INTRODUCTION

7.1 This section contains reference designation indexes which provide descriptive and provisioning information for all electrical and mechanical parts that have been assigned a reference designation and form a part of the subject equipment.

FAMILY TREE

7.2 Figure 7-1 depicts the family tree for the subject equipment. It is based on the descending order of the reference designation hierarchy and identifies all assemblies that have been assigned a Nautel configuration control number.

MANUFACTURER'S INDEX

7.3 Table 7-1 provides a cross reference from the original equipment manufacturers (OEM) codes to the manufacturer's name and address. The listing is sorted alpha/numerically by the manufacturers' codes.

HOW TO LOCATE INFORMATION FOR A SPECIFIC PART

7.4 To locate the information for a specific part, the user must know the reference designation assigned to the part. In addition, the user must know the Nautel configuration control number assigned to the assembly that contains the part or the full reference designation, which includes the reference designation of all higher assemblies.

7.4.1 WHEN NAUTEL CONFIGURATION CONTROL NUMBER IS KNOWN: Locate the information for a part when the Nautel configuration control number is known, as follows:

Refer to the table of contents (list of tables), for this manual and identify which table is the reference designation index for that assembly.

Locate the part's reference designation in the identified table.

7.4.2 WHEN REF DES IS KNOWN: Locate the information for a part when the full reference designation is known, as follows:

Enter the family tree depicted in figure 7-1 with the full reference designation.

Follow the family tree branches to the block that represents the lowest level assembly assigned a Nautel configuration control number. Delete the reference designation and then go to the table specified in the block with the balance of the reference designation.

Locate the part's reference designation in the specified table.

REFERENCE DESIGNATION INDEXES

7.5 Individual reference designation indexes are provided for all assemblies that have been assigned a Nautel configuration control number. To obtain the full reference designation for a specific part, the tabulated designation must be prefixed with the reference designation of the assembly that contains the part and the reference designation of all higher level assemblies. Notes at the end of each table identify possible higher level assemblies. The reference designation indexes are divided into six columns to aid in locating specific information.

COLUMN CONTENT EXPLANATION

7.6 The following paragraphs provide an explanation of the purpose and contents of each column in the reference designation indexes.

7.6.1 USE CODE COLUMN: This column contains a symbol/letter code which is part of a configuration control management system. When there is more than one variation of an assembly, each variation will be assigned a code in this column and the parts that are unique to a variation will be assigned the same code. Parts that are common to all variations will not have an entry in this column. Notes at the end of each table explain the code's significance.

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7.6.2 REF DES COLUMN: The ref des column contains the reference designation for a specific part. These designations are assigned in accordance with the requirements of American National Standard Specification ANSI Y32.16. Each reference designation index is sorted and listed alpha/numerically according to the reference designations in this column.

7.6.3 NAME OF PART AND DESCRIPTION COLUMN: This column contains the name and descriptive information for each part. The key word or noun is presented first, followed by the adjective identifiers.

7.6.4 NAUTEL'S PART NO. COLUMN: This column contains the Nautel part number assigned to each part. This number is Nautel's drawing number for Nautel manufactured parts, Nautel's configuration control number for assemblies that are under configuration control management or Nautel's inventory management number for purchased parts.

7.6.5 JAN/MIL/OEM PART NO. COLUMN: This column contains an original equipment manufacturer's part number for a part. A single part number is listed for each part, even though there may be more than one known manufacturer. The listed number is Nautel's usual or preferred choice. A JAN/MIL number has been assigned as the manufacturer's part number, where practical, to assist the user in finding a suitable replacement part. The use of this number does not restrict Nautel from selecting and using commercial equivalents, where their use will not degrade circuit operation or reliability, during manufacture.

7.6.6 OEM CODE COLUMN: This column contains a five digit coded group as the original equipment manufacturer's (OEM) identifier. The code was extracted from Cataloging Handbook H4/H8 - Commercial and Government Entity (Cage) Code. Manufacturers that were not listed in the catalog when this listing was compiled have been assigned a unique five letter code. This code is assigned arbitrarily and has no other significance. The manufacturers identified for parts that have JAN or MIL part numbers are Nautel's normal supply source for that part.

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Table 7-1 Manufacturers' Code to Address Index

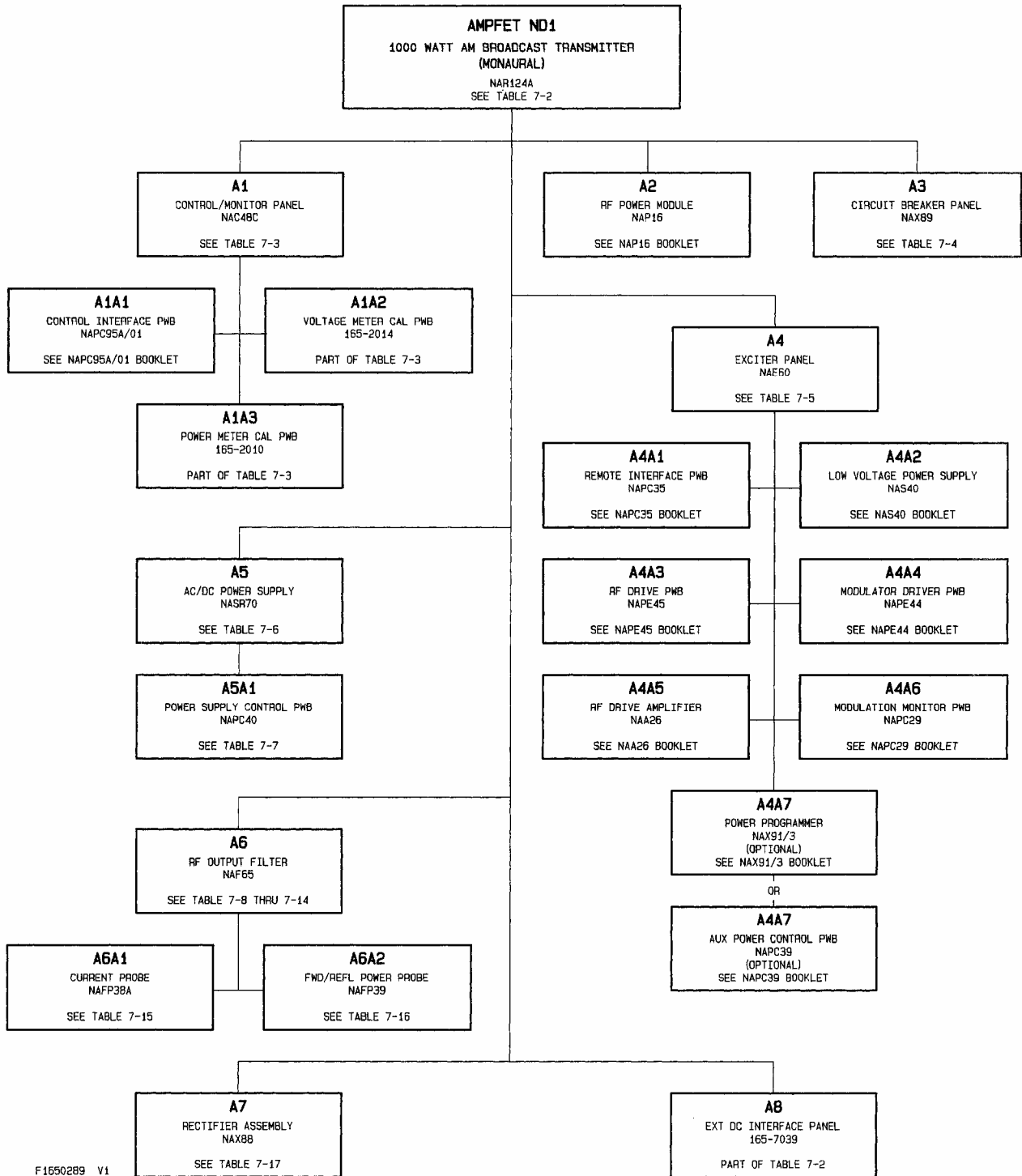
00779	AMP Incorporated, 2800 Fulling Mill, P O Box 3608, Harrisburg, Pennsylvania 17105	09482	AMP of Canada Limited, 20 Esna Park Drive, Markham, Ontario, Canada L3R 1E1 USA customers use - 00779
00853	Sangamo Weston Incorporated, Sangamo Capacitor Division, PO Box 128, Route 3, Sangamo Road, Pickens, South Carolina 29671	1C532	EEV Canada Limited, 67 Westmore Drive, Rexdale, Ontario, Canada M9V 3Y6
01121	Allen-Bradley Company, 1201 South 2nd Street, Milwaukee, Wisconsin 53204	12969	Unitrode Corporation, 5 Forbes Road, Lexington, Massachusetts 02173
02111	Spectrol Electronics Corporation, 17070 East Gale Avenue, City of Industry, California 91745	13150	Vernitron Electronic Components, Beau Products Division, PO Box 10, Laconia, New Hampshire 03246
02660	Bunker Ramo Corporation, Amphenol Connector Division, 2801 South 25th Avenue, Broadview, Illinois 60153	14655	Cornell Dubilier Electronics Division, Federal Pacific Electric Company, 150 Avenue L, Newark, New Jersey 07101
04713	Motorola Incorporated, Semiconductor Products Group, 5005 East McDowell Road, Phoenix, Arizona 85008	14674	Corning Glass Works, Electronic Products Division, Houghton Park, Corning, New York 14830
05245	CORCOM Incorporated 1600 Winchester Road Libertyville, Illinois 60048	15513	Data Display Products, P O Box 91072, 5428 West 104th St., Los Angeles, California 90009
07263	Fairchild Camera and Instrument Corporation, Semiconductor Division, 10400 Ridgeview Crescent, Cupertino, California 95014	33062	Ferronics Incorporated, 60 North Lincoln Road, East Rochester, New York 14445
08372	Cutler-Hammer Canada Limited, 45 Progress Avenue, Scarsborough, Ontario, Canada M1P 2T6 USA customers use - 68592	34361	Omron Electronics Inc., 432 Toyama Road, Sunnyvale, California 94086
09353	C & K Components Incorporated 15 Riverdale Avenue Newton, Massachusetts 02158	35005	Dale Electronics Canada Limited, 18 Howden Road, Scarborough, Ontario, Canada M1R 3E6 USA customers use - 91637

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Table 7-1 Manufacturers' Code to Address Index (Continued)

37338	Nautical Electronic Laboratories Ltd, Hackett's Cove, Halifax County, Nova Scotia, Canada B0J 3J0 USA customers use - 57655	73949	Guardian Electric Mfg. Co., 1550 W Carroll Avenue, Chicago, Illinois 60607
37903	Siemens Electric Ltd., 7300 Trans Canada Highway, Pointe Clare, Quebec, Canada H9R 107 USA customers use - 66842	74193	Heinemann Electric Company, 2600 Brunswick Pike Rt 1, PO Box 6800, Lawrenceville, New Jersey 08648
50434	Hewlett Packard Company, 640 Page Mill Road, Palo Alto, California 94304	74970E	F Johnson, 299 10th Avenue SW, Waseca, Minnesota 56093
56289	Sprague Electric Company, 87 Marshall Street, North Adams, Massachusetts 01247	75042	TRW Electronic Components, IRC Fixed Resistor Division, 401 North Broad Street, Philadelphia, Pennsylvania 19108
57655	Nautel Maine Incorporated, 201 Target Industrial Circle Bangor, Maine 04401	75378	CTS Knights Incorporated, 400 Reimann Avenue, Sandwich, Illinois 60548
59474	Jeffers Electronics Incorporated, Grand Plaza, 945 Grand Avenue, PO Box 730, Nogales, Arizona 85621	75915	Littlefuse Incorporated, 800 East Northwest Highway, Des Plaines, Illinois 60016
66842	Siemens Energy & Automation I-T-E Circuit Protection Division 811 N. Main Street Bellefontaine, Ohio 43311	80294	Bourns Incorporated, Instrument Division, 6135 Magnolia Avenue, Riverside, California 92506
68592	EATON Corporation, Cutler-Hammer Products Route 1, Box 1-A Arden, North Carolina 28704	81483	International Rectifier, 9220 Sunset Boulevard, Box 2321, Terminal Annex, Los Angeles, California 90054
71785	TRW Incorporated, 1501 Morse Avenue, Elk Grove Village, Illinois 60007	89473	General Electric Distributing Corp., 1 River Road, Schenactady, New York 12305
73831	Hammond Manufacturing Co. Ltd, 394 Edinburgh Road North, Guelph, Ontario, Canada M1H 1E5	91506	Augat Incorporated, PO Box 779, 633 Perry Avenue, Attleboro, Massachusetts 02703
		91637	Dale Electronics Incorporated, 2064 12th Avenue, Columbus, Nebraska 68601

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F1650289 V1

Figure 7-1 Family Tree - AMPFET ND1 (Monaural)

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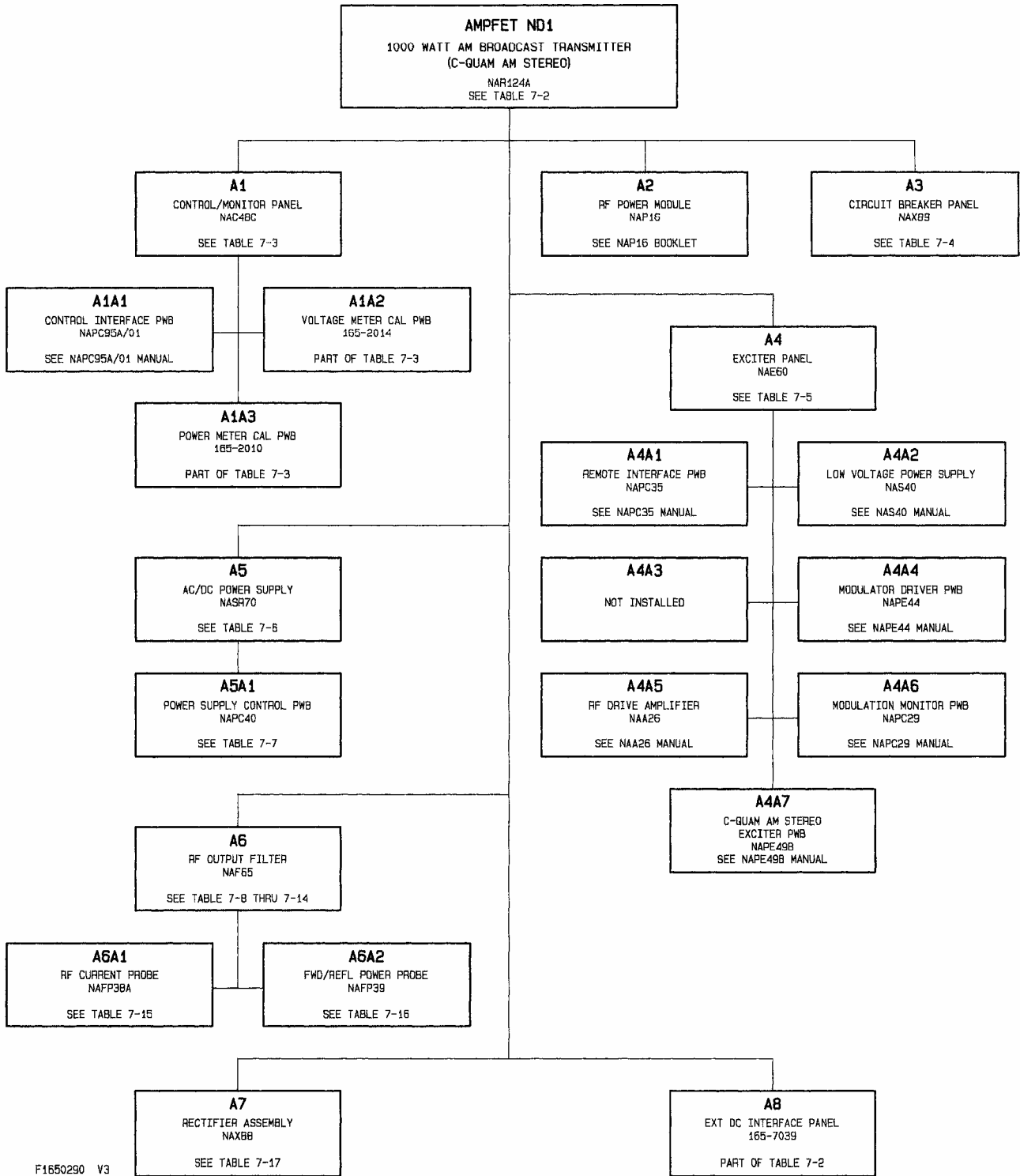


Figure 7-2 Family Tree - AMPFET ND1 (C-QUAM AM Stereo)

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AMPFET ND1

Table 7-2 Ref Des Index - AMPFET ND1 1kW AM Broadcast Transmitter

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	AM Broadcast Transmitter, 1kW	AMPFET ND1	165-7000-01	37338
	A1	Control/Monitor Panel, 1kW	NAC48C	See Table 7-3	37338
	A2	Rf Power Module	NAP16	See NAP16 Manual	37338
	A3	Circuit Breaker Panel	NAX89	See Table 7-4	37338
	A4	Exciter Panel	NAE60	See Table 7-5	37338
	A5	Ac/Dc Power Supply	NASR70A	See Table 7-6	37338
<i>fc</i>	A6	Rf Output Filter, 1kW (530 - 633 kHz)	NAF65/01	See Table 7-8	37338
<i>fc</i>	A6	Rf Output Filter, 1kW (634 - 775 kHz)	NAF65/02	See Table 7-9	37338
<i>fc</i>	A6	Rf Output Filter, 1kW (776 - 962 kHz)	NAF65/03	See Table 7-10	37338
<i>fc</i>	A6	Rf Output Filter, 1kW (963 - 1159 kHz)	NAF65/04	See Table 7-11	37338
<i>fc</i>	A6	Rf Output Filter, 1kW (1160 - 1386 kHz)	NAF65/05	See Table 7-12	37338
<i>fc</i>	A6	Rf Output Filter, 1kW (1387 - 1610 kHz)	NAF65/06	See Table 7-13	37338
<i>fc</i>	A6	Rf Output Filter, 1kW (1611 - 1700 kHz)	NAF65/07	See Table 7-14	37338
	A7	Rectifier Assembly	NAX88	See Table 7-17	37338
	A8	External Dc Interface Panel	165-7039	165-7039	37338
	A8C1	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
	A8C2	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
	A8C3	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
	A8C4	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
	A8F1	Fuse, 0.5A, 250V, Slow, 3AG	FA05	313.500	75915
	A8F2	Fuse, 0.5A, 250V, Slow, 3AG	FA05	313.500	75915
	A8F3	Fuse, 0.5A, 250V, Slow, 3AG	FA05	313.500	75915
	A8F4	Fuse, 0.5A, 250V, Slow, 3AG	FA05	313.500	75915
	A8L1	Bead, Ferrite, 5.8mm	LY37	21-129-B	33062
	A8L2	Bead, Ferrite, 5.8mm	LY37	21-129-B	33062
	A8L3	Bead, Ferrite, 5.8mm	LY37	21-129-B	33062
	A8L4	Bead, Ferrite, 5.8mm	LY37	21-129-B	33062
	A8TB1	Terminal Block, 6-pos, Double, 15A	JC01	14006	13150
	A8XF1	Fuse Block, 2 Pole	FA25	357002	75915
	A8XF2	Included in A8XF1			
	A8XF3	Fuse Block, 2 Pole	FA25	357002	75915
	A8XF4	Included in A8XF3			
	P1	Connector, 7 Socket Contacts	165-7030	165-7030	37338
	P2	Connector, 29 Bisexual Contacts	165-7032	165-7032	37338
	P3	Connector, 14 Socket Contacts	165-8136	165-8136	37338
	P4	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	P5	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	P6	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	P7	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	P8	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482

NOTE: Duplicated reference designation indicates an option exists for that item. Refer to use code to determine which item is applicable.

USE CODE EXPLANATION: *fc* - Denotes item is frequency dependent or contains frequency dependent components. Description identifies variation to be used for a specific frequency or band of frequencies.

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Table 7-3 Ref Des Index - NAC48C 1kW Control/Monitor Panel

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Control/Monitor Panel, 1kW	NAC48C	165-2000-03	37338
A1		Control Interface Pwb	NAPC95A/01	See NAPC95A/01 Manual	37338
A2		Voltage Meter Calibration Pwb	165-2014	165-2014	37338
A2R1		Resistor, Variable, Film, 200 ohms, 1/2W	RA12	64Y201T000	02111
A2R2		Resistor, Variable, Film, 100K ohms, 1/2W	RW01	3339P-1-104	80294
A2R3		Resistor, Film, 470K ohms, 2% 1/2W	RD27	RL20S474G	35005
A3		Power Meter Calibration Pwb	165-2010	165-2010	37338
A3R1		Resistor, Film, 6800 ohms, 2% 1/2W	RD05	RL20S682G	35005
A3R2		Resistor, Variable, Film, 2K ohms, 1/2W	RW31	3339P-1-202	80294
A3R3		Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	35005
A3R4		Resistor, Variable, Film, 2K ohms, 1/2W	RW31	3339P-1-202	80294
A3R5		Resistor, Film, 4700 ohms, 2% 1/2W	RD03	RL20S472G	35005
CR1		Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
DS1		Diode, Light Emitting, Amber	QK14	HLMP-3451	50434
M1		Meter, 0-100Vdc/0-40Adc	MD21	156-2011	37338
M2		Meter, 0-1.4kW, 0-0.35kW, 1mA FSD	MD15	159-2053	37338
P1		MTA, Closed End Housing, 12-pin, 22 AWG	JU03	1-640433-2	09482
P2		MTA, Closed End Housing, 12-pin, 22 AWG	JU03	1-640433-2	09482
P3		MTA, Closed End Housing, 12-pin, 22 AWG	JU03	1-640433-2	09482
P4		MTA, Closed End Housing, 12-pin, 22 AWG	JU03	1-640433-2	09482
P5		MTA, Closed End Housing, 12-pin, 22 AWG	JU03	1-640433-2	09482
P6		Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
P7		Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
P8		Connector, 52 Bisexual Contacts	165-2020	165-2020	37338
R1		Resistor, Film, 2200 ohms, 2% 1/2W	RC41	RL20S222G	35005
R2		Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	35005
R3		Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	35005
R4		Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	35005
R5A		Resistor, Film, 270K ohms, 2% 1/2W	RD24	RL20S274G	35005
R5B		Resistor, Film, (value selected at test)	-	-	35005
S1		Switch, Rotary, Non-shorting 2P12T	SA27	T215	75378
S2		Switch, Rotary, Non-shorting 2P6T	SA32	T206	75042
S3		Switch, Rotary, Non-shorting 4P6T	SA02	T216	75042
S4		Switch, Pushbutton, Momentary, SPST, NO	SCP26	8531TCQ	09353

NOTE: Partial reference designation shown. Prefix with A1 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

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Table 7-4 Ref Des Index - NAX89 Circuit Breaker Panel

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Circuit Breaker Panel	NAX89	165-7130	37338
CB1		Circuit Breaker, 2-pole, 20A 250V 60Hz	SB01	AM2-A3-20-2	74193
DS1		Diode, Light Emitting, Amber	QK14	HLMP-3451	50434
F1		Fuse, 3A, 250V, Slow, 3AG	FA10	313003	75915
F2		Fuse, 3A, 250V, Slow, 3AG	FA10	313003	75915
P1		Connector, 10 Socket Contacts	165-7129	165-7129	37338
U1		Filter, Ac Line, 20 Amp, 250Vac, 50/60Hz	UC37	20VK6	05245
XDS1		Socket, LED	QK25	PS-200-B	15513
XF1		Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
XF2		Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915

NOTE: Partial reference designation shown. Prefix with A3 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

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Table 7-5 Ref Des Index - NAE60 Exciter Panel

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	Exciter Panel	NAE60	165-3040	37338
	A1	Remote Interface Pwb	NAPC35	See NAPC35 Manual	37338
	A2	Low Voltage Power Supply	NAS40	See NAS40 Manual	37338
◆	A3	Rf Drive Pwb	NAPE45	See NAPE45 Manual	37338
	A4	Modulator Driver Pwb	NAPE44	See NAPE44 Manual	37338
	A5	Rf Drive Amplifier	NAA26	See NAA26 Manual	37338
	A6	Modulation Monitor Pwb	NAPC29	See NAPC29 Manual	37338
♣	A7	C-QUAM AM Stereo Exciter Pwb	NAPE49	See NAPE49 Manual	37338
♥	A7	Power Programmer	NAX91/3	See NAX91/3 Manual	37338
♥	A7	Auxiliary Power Control Pwb	NAPC39	See NAPC39 Manual	37338
	C1	Capacitor, Dipped Mica, 2200pF 2%, 500V	CB41	CM06FD222G03	14655
	C2	Capacitor, Dipped Mica, 2200pF 2%, 500V	CB41	CM06FD222G03	14655
	CR1	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR2	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	DS1	Diode, Light Emitting, Green	QK12	HLMP-3554	50434
	J1	Connector, 29 Bisexual Contacts	165-3007	165-3007	37338
	J2	Connector, 52 Bisexual Contacts	165-3008	165-3008	37338
	K1	Relay, 24Vdc Coil, 4PDT, 5A	KC14	MY4-DC24	34361
	K2	Relay, 24Vdc Coil, 4PDT, 5A	KC14	MY4-DC24	34361
	P1	Connector, Coaxial, BNC, 50 ohm, Clamp	JDP25	69475	02660
	P2	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	P3	MTA, Closed End Housing, 12-pin, 22 AWG	JU03	1-640433-2	09482
	P4	MTA, Closed End Housing, 12-pin, 22 AWG	JU03	1-640433-2	09482
	P5	MTA, Closed End Housing, 12-pin, 22 AWG	JU03	1-640433-2	09482
	P6	MTA, Closed End Housing, 12-pin, 22 AWG	JU03	1-640433-2	09482
	P7	MTA, Closed End Housing, 12-pin, 22 AWG	JU03	1-640433-2	09482
	P8	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	P9	MTA, Closed End Housing, 12-pin, 22 AWG	JU03	1-640433-2	09482
	P10	MTA, Closed End Housing, 8-pin, 22 AWG	JU06	640433-8	09482
	P11	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	P12	MTA, Closed End Housing, 8-pin, 22 AWG	JU06	640433-8	09482
	P13	Connector, Coaxial, BNC, 50 ohm, Clamp	JDP25	69475	02660
	P14	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	P15	MTA, Closed End Housing, 4-pin, 22 AWG	JU01	640433-4	09482
	P16	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	P17	MTA, Closed End Housing, 8-pin, 22 AWG	JU06	640433-8	09482
	P18	Connector, 8 Socket Contacts	165-7119	165-7119	37338
	P19	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	P20	MTA, Closed End Housing, 4-pin, 22 AWG	JU01	640433-4	09482
	P21	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	P22	Connector, Coaxial, BNC, 50 ohm, Crimp	JDP24	225395-7	09482
	R1	Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	35005
	R2	Not Used			
	R3	Resistor, Film, 2200 ohms, 2% 1/2W	RC41	RL20S222G	35005
	S1	Switch, Toggle, 1PST	SCP01	8381K108	08372
	XDS1	Socket, Light Emitting Diode	QK25	PS-200-B	15513
	XK1	Socket, Relay	KA19	1310-1ST	73949
	XK2	Socket, Relay	KA19	1310-1ST	73949

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Table 7-5 Ref Des Index - NAE60 Exciter Panel (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
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NOTE: Duplicated reference designations indicate an option exists for that component. Refer to description to determine which component is required for a specific installation.

Partial reference designation shown. Prefix with A4 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

USE CODE EXPLANATION:

- ♣ - Denotes item installed when C-QUAM AM stereo exciter pwb (A7) option is incorporated.
- ◆ - Denotes item not normally installed when C-QUAM AM stereo exciter pwb (A7) option is incorporated.
- ♥ - Denotes optional item. Not available and therefore not installed when C-QUAM AM stereo exciter pwb (A7) option is incorporated.

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Table 7-6 Ref Des Index - NASR70 Ac/Dc Power Supply

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
A	-	Ac/Dc Power Supply, 208/240 Vac	NASR70A	165-7100-01	37338
B	-	Ac/Dc Power Supply, 208/240 Vac	NASR70B	165-7100-02	37338
	A1	Power Supply Control Pwb	NAPC40B	See Table 7-7	37338
	A2	Choke Strap Assembly	165-7107-01	165-7107-01	37338
	A2C1	Capacitor, Plastic, 1.0uF 10%, 250V	CS11	52003105K	37903
	A2F1	Fuse, 3A, 250V, Slow, 3AG	FA10	313003	75915
	A2R1	Resistor, Comp, 6800 ohms, 5% 2W	RJ05	RC42GF682J	01121
	A2R2	Resistor, Film, 33K ohms, 2% 1/2W	RAP15	RL20S333G	35005
	A2R3	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	35005
	A2XF1	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
	J1	Connector, 7 Pin Contacts	165-7117	165-7117	37338
	J2	Connector, 10 Pin Contacts	165-7118	165-7118	37338
A	L1	Inductor, Choke, 20mH, 30Adc	TB26	TB26	37338
B	L1	Inductor, Choke, 20mH, 30Adc	TZ11	195M30	73831
	P1	MTA, Closed End Housing, 8-pin, 22 AWG	JU06	640433-8	09482
	RV1	Varistor, 95V rms, 30 Joules	QI33	V150ZA8	89473
	RV2	Varistor, 95V rms, 30 Joules	QI33	V150ZA8	89473
	T1	Transformer, Power, 1-Ph, 230V, 2.2KVA	TD32	156-7148	37338
	TB1	Terminal Block, 4-pos, Double, 40A	JC41	4-150	71785
	TP1	Jack, Tip, White	JN16	105-0201-200	74970

NOTE: Partial reference designation shown. Prefix with A5 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

USE CODE EXPLANATION: A -Denotes used when nomenclature number has an A suffix (NASR70A).
 B -Denotes used when nomenclature number has a B suffix (NASR70B).

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Table 7-7 Ref Des Index - NAPC40B Power Supply Control Pwb

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Power Supply Control Pwb	NAPC40B	165-7115-02	37338
C1		Capacitor, Tantalum, 47uF 10%, 35V	CCP21	CSR13F476KM	56289
C2		Capacitor, Ceramic, 0.001uF 10%, 200V	CCG01	CKR05BX102KL	56289
C3		Capacitor, Ceramic, 0.22uF 10%, 50V	CCG08	CKR06BX224KL	56289
C4		Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
C5		Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
C6		Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
C7		Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
C8		Not Used			
C9		Capacitor, Ceramic, 0.22uF 10%, 50V	CCG08	CKR06BX224KL	56289
CR1		Diode, Power Rectifier, 600V, 1A	QL07	1N4247	12969
CR2		Diode, Power Rectifier, 600V, 1A	QL07	1N4247	12969
CR3		Diode, Power Rectifier, 600V, 1A	QL07	1N4247	12969
CR4		Diode, Zener, 10.0V, 400mW, 10%	QG03	1N758	04713
CR5		Diode, Zener, 30V, 5W 5%	QL28	1N6282A	04713
CR6		Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
CR7		Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
CR8		Diode, Power Rectifier, 600V, 1A	QL07	1N4247	12969
CR9		Diode, Power Rectifier, 600V, 1A	QL07	1N4247	12969
CR10		Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
F1		Fuse, 0.50A, 125V, Fast, PICO II	FC18	251.500	75915
F2		Fuse, 0.50A, 125V, Fast, PICO II	FC18	251.500	75915
J1		MTA, Square Post Header Assembly, 8-Pin	JU08	640383-8	09482
Q1		Transistor, NPN, Power, High Voltage	QE02	2N3439	04713
Q2		Transistor, NPN, Power, High Voltage	QE02	2N3439	04713
R1		Resistor, Film, 33 ohms, 2% 1/2W	RAP03	RL20S330G	35005
R2		Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	35005
R3		Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	35005
R4		Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	35005
R5		Resistor, Film, 56K ohms, 2% 1/2W	RAP16	RL20S563G	35005
R6		Resistor, Film, 18K ohms, 2% 1/2W	RAP14	RL20S183G	35005
R7		Resistor, Film, 560K ohms, 2% 1/2W	RD28	RL20S564G	14674
R8		Resistor, Variable, Film, 10K ohms, 1/2W	RW09	3339P-1-103	80294
R9		Resistor, Film, 18K ohms, 2% 1/2W	RAP14	RL20S183G	35005
R10		Resistor, Film, 47K ohms, 2% 1/2W	RD15	RL20S473G	35005
R11		Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	35005
R12		Resistor, Film, 330K ohms, 2% 1/2W	RAP19	RL20S334G	35005
R13		Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	35005
R14		Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	35005
R15		Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	35005
R16		Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	35005
R17		Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	35005
R18		Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	35005
R19		Resistor, Film, 33K ohms, 2% 1/2W	RAP15	RL20S333G	35005

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Table 7-7 Ref Des Index - NAPC40B Power Supply Control Pwb (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	R20	Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	35005
	R21	Resistor, Film, 180K ohms, 2% 1/2W	RAP18	RL20S184G	35005
	U1	IC, Voltage Regulator, +15 Volt	UB31	MC78M15CG	04713
	U2	IC, Operational Amplifiers, Quad	UC15	MC3403L	04713
	XU1	Not Used			
	XU2	Socket, Integrated Circuit, 14-Pin	UD41	1814AG111D	91506

NOTE: Partial reference designation shown. Prefix with A5A1 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

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Table 7-8 Ref Des Index - NAF65/01 1kW Rf Output Filter (530 - 633 kHz)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Rf Output Filter, 1kW (530 - 633 kHz)	NAF65/01	165-6000-01	37338
A1		Rf Current Probe, 1kW	NAFP38A	See Table 7-15	37338
A2		Forward/Reflected Power Probe, 1kW	NAFP39	See Table 7-16	37338
C1		Capacitor, Cast Mica, 2400pF, 5%, 5000V	CC23	27250B242J00	00853
C2		Capacitor, Cast Mica, 18000pF, 5%, 3000V	CC16	29230B183J00	00853
C3		Capacitor, Cast Mica, 2400pF, 5%, 5000V	CC23	27250B242J00	00853
E1		Surge Arrester, 2800Vdc 10%	UM34	GHX28	1C532
J1		Connector Ass'y, Rf Output, Type LC	165-6040-01	165-6040-01	37338
J1		Connector Ass'y, Rf Output, Type N, Straight	165-6040-02	165-6040-02	37338
J1		Connector Ass'y, Rf Output, 0.25 inch Stud	165-6040-03	165-6040-03	37338
J1		Connector Ass'y, Rf Output, 7/8 inch EIA	165-6040-04	165-6040-04	37338
J1		Connector Ass'y, Rf Output, Type N, 90°	165-6040-05	165-6040-05	37338
L1		Inductor, 27 CW turns, #12 TCW, Former	165-6026	165-6026	37338
L2		Inductor, 3 CCW turns, #6 TCW, Former	165-6031	165-6031	37338
L3		Inductor, 8 CW turns, 1/4" TCW, Former	165-6026-07	165-6026-07	37338
L4		Inductor, 27 CW turns, #12 TCW, Former	165-6026	165-6026	37338
P1		Connector, 2 Pin Contacts	165-6039	165-6039	37338

NOTE: Duplicated reference designations indicate an option exists for that component. Refer to description to determine which component is required for a specific installation.

Partial reference designation shown. Prefix with A6 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

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Table 7-9 Ref Des Index - NAF65/02 1kW Rf Output Filter (634 - 775 kHz)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Rf Output Filter, 1kW (634 - 775 kHz)	NAF65/02	165-6000-02	37338
A1		Rf Current Probe, 1kW	NAFP38A	See Table 7-15	37338
A2		Forward/Reflected Power Probe, 1kW	NAFP39	See Table 7-16	37338
C1		Capacitor, Cast Mica, 2000pF, 5%, 5000V	CC22	27250B202J00	00853
C2		Capacitor, Cast Mica, 15000pF, 5%, 4000V	CC17	29240B153J00	00853
C3		Capacitor, Cast Mica, 2000pF, 5%, 5000V	CC22	27250B202J00	00853
E1		Surge Arrester, 2800Vdc 10%	UM34	GHX28	1C532
J1		Connector Ass'y, Rf Output, Type LC	165-6040-01	165-6040-01	37338
J1		Connector Ass'y, Rf Output, Type N, Straight	165-6040-02	165-6040-02	37338
J1		Connector Ass'y, Rf Output, 0.25 inch Stud	165-6040-03	165-6040-03	37338
J1		Connector Ass'y, Rf Output, 7/8 inch EIA	165-6040-04	165-6040-04	37338
J1		Connector Ass'y, Rf Output, Type N, 90°	165-6040-05	165-6040-05	37338
L1		Inductor, 22 CW turns, #12 TCW, Former	165-6026-01	165-6026-01	37338
L2		Inductor, 3 CCW turns, #6 TCW, Former	165-6031	165-6031	37338
L3		Inductor, 8 CW turns, 1/4" TCW, Former	165-6026-07	165-6026-07	37338
L4		Inductor, 22 CW turns, #12 TCW, Former	165-6026-01	165-6026-01	37338
P1		Connector, 2 Pin Contacts	165-6039	165-6039	37338

NOTE: Duplicated reference designations indicate an option exists for that component. Refer to description to determine which component is required for a specific installation.

Partial reference designation shown. Prefix with A6 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

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Table 7-10 Ref Des Index - NAF65/03 1kW Rf Output Filter (776 - 962 kHz)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Rf Output Filter, 1kW (776 - 962 kHz)	NAF65/03	165-6000-03	37338
A1		Rf Current Probe, 1kW	NAFP38A	See Table 7-15	37338
A2		Forward/Reflected Power Probe, 1kW	NAFP39	See Table 7-16	37338
C1		Capacitor, Cast Mica, 1600pF, 5%, 5000V	CC21	27250B162J00	00853
C2		Capacitor, Cast Mica, 12000pF 5%, 4000V	CC01	29240B123J02	00853
C3		Capacitor, Cast Mica, 1600pF, 5%, 5000V	CC21	27250B162J00	00853
E1		Surge Arrester, 2800Vdc 10%	UM34	GHX28	1C532
J1		Connector Ass'y, Rf Output, Type LC	165-6040-01	165-6040-01	37338
J1		Connector Ass'y, Rf Output, Type N, Straight	165-6040-02	165-6040-02	37338
J1		Connector Ass'y, Rf Output, 0.25 inch Stud	165-6040-03	165-6040-03	37338
J1		Connector Ass'y, Rf Output, 7/8 inch EIA	165-6040-04	165-6040-04	37338
J1		Connector Ass'y, Rf Output, Type N, 90°	165-6040-05	165-6040-05	37338
L1		Inductor, 21 CW turns, #10 TCW, Former	165-6026-02	165-6026-02	37338
L2		Inductor, 3 CCW turns, #6 TCW, Former	165-6031	165-6031	37338
L3		Inductor, 8 CW turns, 1/4" TCW, Former	165-6026-07	165-6026-07	37338
L4		Inductor, 21 CW turns, #10 TCW, Former	165-6026-02	165-6026-02	37338
P1		Connector, 2 Pin Contacts	165-6039	165-6039	37338

NOTE: Duplicated reference designations indicate an option exists for that component. Refer to description to determine which component is required for a specific installation.

Partial reference designation shown. Prefix with A6 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

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Table 7-11 Ref Des Index - NAF65/04 1kW Rf Output Filter (963 - 1159 kHz)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Rf Output Filter, 1kW (963 - 1159 kHz)	NAF65/04	165-6000-04	37338
A1		Rf Current Probe, 1kW	NAFP38A	See Table 7-15	37338
A2		Forward/Reflected Power Probe, 1kW	NAFP39	See Table 7-16	37338
C1		Capacitor, Cast Mica, 1300pF, 5%, 5000V	CC20	27250B132J00	00853
C2		Capacitor, Cast Mica, 10000pF 5%, 5000V	CC02	29250B103J02	00853
C3		Capacitor, Cast Mica, 1300pF, 5%, 5000V	CC20	27250B132J00	00853
E1		Surge Arrester, 2800Vdc 10%	UM34	GHX28	1C532
J1		Connector Ass'y, Rf Output, Type LC	165-6040-01	165-6040-01	37338
J1		Connector Ass'y, Rf Output, Type N, Straight	165-6040-02	165-6040-02	37338
J1		Connector Ass'y, Rf Output, 0.25 inch Stud	165-6040-03	165-6040-03	37338
J1		Connector Ass'y, Rf Output, 7/8 inch EIA	165-6040-04	165-6040-04	37338
J1		Connector Ass'y, Rf Output, Type N, 90°	165-6040-05	165-6040-05	37338
L1		Inductor, 20 CW turns, #10 TCW, Former	165-6026-03	165-6026-03	37338
L2		Inductor, 3 CCW turns, #6 TCW, Former	165-6031	165-6031	37338
L3		Inductor, 6 CW turns, 5/16" TCW, Former	165-6026-06	165-6026-06	37338
L4		Inductor, 20 CW turns, #10 TCW, Former	165-6026-03	165-6026-03	37338
P1		Connector, 2 Pin Contacts	165-6039	165-6039	37338

NOTE: Duplicated reference designations indicate an option exists for that component. Refer to description to determine which component is required for a specific installation.

Partial reference designation shown. Prefix with A6 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

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Table 7-12 Ref Des Index - NAF65/05 1kW Rf Output Filter (1160 - 1386 kHz)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Rf Output Filter, 1kW (1160 - 1386 kHz)	NAF65/05	165-6000-05	37338
A1		Rf Current Probe, 1kW	NAFP38A	See Table 7-15	37338
A2		Forward/Reflected Power Probe, 1kW	NAFP39	See Table 7-16	37338
C1		Capacitor, Cast Mica, 1100pF, 5%, 5000V	CC19	27250B112J00	00853
C2		Capacitor, Cast Mica, 8200pF 5%, 5000V	CC03	29250B822J02	00853
C3		Capacitor, Cast Mica, 1100pF, 5%, 5000V	CC19	27250B112J00	00853
E1		Surge Arrester, 2800Vdc 10%	UM34	GHX28	1C532
J1		Connector Ass'y, Rf Output, Type LC	165-6040-01	165-6040-01	37338
J1		Connector Ass'y, Rf Output, Type N, Straight	165-6040-02	165-6040-02	37338
J1		Connector Ass'y, Rf Output, 0.25 inch Stud	165-6040-03	165-6040-03	37338
J1		Connector Ass'y, Rf Output, 7/8 inch EIA	165-6040-04	165-6040-04	37338
J1		Connector Ass'y, Rf Output, Type N, 90°	165-6040-05	165-6040-05	37338
L1		Inductor, 15 CW turns, #10 TCW, Former	165-6026-04	165-6026-04	37338
L2		Inductor, 3 CCW turns, #6 TCW, Former	165-6031	165-6031	37338
L3		Inductor, 6 CW turns, 5/16" TCW, Former	165-6026-06	165-6026-06	37338
L4		Inductor, 15 CW turns, #10 TCW, Former	165-6026-04	165-6026-04	37338
P1		Connector, 2 Pin Contacts	165-6039	165-6039	37338

NOTE: Duplicated reference designations indicate an option exists for that component. Refer to description to determine which component is required for a specific installation.

Partial reference designation shown. Prefix with A6 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

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Table 7-13 Ref Des Index - NAF65/06 1kW Rf Output Filter (1387 - 1610 kHz)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Rf Output Filter, 1kW (1387 - 1610 kHz)	NAF65/06	165-6000-06	37338
A1		Rf Current Probe, 1kW	NAFP38A	See Table 7-15	37338
A2		Forward/Reflected Power Probe, 1kW	NAFP39	See Table 7-16	37338
C1		Capacitor, Cast Mica, 910pF, 5%, 5000V	CC18	27250B911J00	00853
C2		Capacitor, Cast Mica, 6800pF 5%, 5000V	CC04	29250B682J02	00853
C3		Capacitor, Cast Mica, 910pF, 5%, 5000V	CC18	27250B911J00	00853
E1		Surge Arrester, 2800Vdc 10%	UM34	GHX28	1C532
J1		Connector Ass'y, Rf Output, Type LC	165-6040-01	165-6040-01	37338
J1		Connector Ass'y, Rf Output, Type N, Straight	165-6040-02	165-6040-02	37338
J1		Connector Ass'y, Rf Output, 0.25 inch Stud	165-6040-03	165-6040-03	37338
J1		Connector Ass'y, Rf Output, 7/8 inch EIA	165-6040-04	165-6040-04	37338
J1		Connector Ass'y, Rf Output, Type N, 90°	165-6040-05	165-6040-05	37338
L1		Inductor, 15 CW turns, #8 TCW, Former	165-6026-05	165-6026-05	37338
L2		Inductor, 3 CCW turns, #6 TCW, Former	165-6031	165-6031	37338
L3		Inductor, 6 CW turns, 5/16" TCW, Former	165-6026-06	165-6026-06	37338
L4		Inductor, 15 CW turns, #8 TCW, Former	165-6026-05	165-6026-05	37338
P1		Connector, 2 Pin Contacts	165-6039	165-6039	37338

NOTE: Duplicated reference designations indicate an option exists for that component. Refer to description to determine which component is required for a specific installation.

Partial reference designation shown. Prefix with A6 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

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Table 7-14 Ref Des Index - NAF65/07 1kW Rf Output Filter (1611 - 1700 kHz)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Rf Output Filter, 1kW (1611 - 1700 kHz)	NAF65/07	165-6000-07	37338
A1		Rf Current Probe, 1kW	NAFP38A	See Table 7-15	37338
A2		Forward/Reflected Power Probe, 1kW	NAFP39	See Table 7-16	37338
C1		Capacitor, Cast Mica, 820pF 5%, 5000V	CYP38	27250B821J01	00853
C2		Capacitor, Cast Mica, 6800pF 5%, 5000V	CC04	29250B682J02	00853
C3		Capacitor, Cast Mica, 820pF 5%, 5000V	CYP38	27250B821J01	00853
E1		Surge Arrester, 2800Vdc 10%	UM34	GHX28	1C532
J1		Connector Ass'y, Rf Output, Type LC	165-6040-01	165-6040-01	37338
J1		Connector Ass'y, Rf Output, Type N, Straight	165-6040-02	165-6040-02	37338
J1		Connector Ass'y, Rf Output, 0.25 inch Stud	165-6040-03	165-6040-03	37338
J1		Connector Ass'y, Rf Output, 7/8 inch EIA	165-6040-04	165-6040-04	37338
J1		Connector Ass'y, Rf Output, Type N, 90°	165-6040-05	165-6040-05	37338
L1		Inductor, 15 CW turns, #8 TCW, Former	165-6026-05	165-6026-05	37338
L2		Inductor, 3 CCW turns, #6 TCW, Former	165-6031	165-6031	37338
L3		Inductor, 6 CW turns, 5/16" TCW, Former	165-6026-06	165-6026-06	37338
L4		Inductor, 15 CW turns, #8 TCW, Former	165-6026-05	165-6026-05	37338
P1		Connector, 2 Pin Contacts	165-6039	165-6039	37338

NOTE: Duplicated reference designations indicate an option exists for that component. Refer to description to determine which component is required for a specific installation.

Partial reference designation shown. Prefix with A6 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

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Table 7-15 Ref Des Index - NAFP38A 1kW Rf Current Probe

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Rf Current Probe, 1kW	NAFP38A	165-6020-01	37338
J1		Connector, Coaxial, BNC, Bulkhead, 50-ohm	JDP26	UG1094/U	02660
J2		Connector, Coaxial, BNC, Bulkhead, 50-ohm	JDP26	UG1094/U	02660
R1		Resistor, Film, 10 ohms, 2% 1/2W	RAP01	RL20S100G	35005
R2		Resistor, Film, 39 ohms, 2% 1/2W	RC20	RL20S390G	35005
R3		Resistor, Film, 39 ohms, 2% 1/2W	RC20	RL20S390G	35005
R4		Resistor, Film, 330 ohms, 2% 1/2W	RAP07	RL20S331G	35005
T1		Transformer, Current, Rf	165-6022	165-6022	37338

NOTE: Partial reference designation shown. Prefix with A6A1 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

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Table 7-16 Ref Des Index - NAFP39 1kW Forward/Reflected Power Probe

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
*	-	Forward/Reflected Power Probe, 1kW	NAFP39	165-6015	37338
A	-	Forward/Reflected Power Probe, 1kW	NAFP39A	165-6015-01	37338
*	A1	Final Power Probe Pwb	139-6111	139-6111	37338
A	A1	Final Power Probe Pwb	139-6111-01	139-6111-01	37338
	A1C1	Capacitor, Dipped Mica, 1800pF 2%, 500V	CB40	CM06FD182G03	14655
	A1C2	Capacitor, Dipped Mica, 1800pF 2%, 500V	CB40	CM06FD182G03	14655
*	A1CR1	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
A	A1CR1	Diode, Power Rectifier, 200V, 1.0A	QN38	MUR120	04713
*	A1CR2	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
A	A1CR2	Diode, Power Rectifier, 200V, 1.0A	QN38	MUR120	04713
*	A1CR3	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
A	A1CR3	Diode, Power Rectifier, 200V, 1.0A	QN38	MUR120	04713
*	A1CR4	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
A	A1CR4	Diode, Power Rectifier, 200V, 1.0A	QN38	MUR120	04713
	A1L1	Inductor, Moulded, Shielded, 10000uH	LAP41	15S103K	59474
	A1L2	Inductor, Moulded, Shielded, 10000uH	LAP41	15S103K	59474
	A1L3	Inductor, Moulded, Shielded, 10000uH	LAP41	15S103K	59474
	A1L4	Inductor, Moulded, Shielded, 10000uH	LAP41	15S103K	59474
	A1R1	Resistor, Film, 100 ohms, 2% 1/2W	RAP05	RL20S101G	35005
	A1R2	Resistor, Film, 100 ohms, 2% 1/2W	RAP05	RL20S101G	35005
	A1R3	Resistor, Film, 100 ohms, 2% 1/2W	RAP05	RL20S101G	35005
	A1R4	Resistor, Film, 100 ohms, 2% 1/2W	RAP05	RL20S101G	35005
	A1R5	Resistor, Film, 100 ohms, 2% 1/2W	RAP05	RL20S101G	35005
	A1R6	Resistor, Film, 100 ohms, 2% 1/2W	RAP05	RL20S101G	35005
	A1R7	Resistor, Film, 100 ohms, 2% 1/2W	RAP05	RL20S101G	35005
	A1R8	Resistor, Film, 100 ohms, 2% 1/2W	RAP05	RL20S101G	35005
	J1	Connector, Coaxial, BNC, Bulkhead, 50-ohm	JDP26	UG1094/U	02660
	J2	Connector, Coaxial, BNC, Bulkhead, 50-ohm	JDP26	UG1094/U	02660
	J3	Connector, Coaxial, BNC, Bulkhead, 50-ohm	JDP26	UG1094/U	02660
	T1	Transformer, Current, Rf	139-6116	139-6116	37338
	T2	Transformer, Voltage, Rf	165-6018	165-6018	37338
	TB1	Terminal Block, 4-pos, Single, Ins Tur, 20A	JR11	74204	13150

NOTE: Partial reference designation shown. Prefix with A6A2 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Duplicated reference designations indicate an option exists for that item. Refer to description to determine which item/variation is required for a specific installation.

USE CODE EXPLANATION: * - Denotes used when basic nomenclature number has no suffix (NAFP39).
A - Denotes used when basic nomenclature number has an A suffix (NAFP39A).

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Table 7-17 Ref Des Index - NAX88 Rectifier Assembly

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
-		Rectifier Assembly, Full-Wave	NAX88	165-7135	37338
A1		Rectifier Assembly, 1-Phase, 400V, 71A	UM30	C03-1346	81483
A1CR1		Diode, Power Rectifier, 400V, 70A	QAP36	IRKE71-04	81483
A1RV1		Varistor, 200V rms, 75 Joules	QI15	Z21L331	81483
A1RV2		Varistor, 200V rms, 75 Joules	QI15	Z21L331	81483
A1U1		Rectifier, Dual Thyristor	UM31	IRKU71-04	81483
R1		Resistor, Current Shunt	156-7063-01	156-7063-01	37338

NOTE: Partial reference designation shown. Prefix with A7 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

SECTION 8
WIRING INFORMATION

INTRODUCTION

8.1 This section contains wiring information for hard-wired assemblies of the subject unit. Refer to table 8-1 for an itemized listing of assemblies that have wiring lists.

WIRING LISTS NOT PROVIDED

8.2 Separate wiring lists are not provided for some assemblies. These assemblies include:

8.2.1 Assemblies that have separate maintenance manuals are not provided. Refer to the associated maintenance manual for detailed wiring information of these assemblies.

8.2.2 Assemblies that have their wiring information adequately depicted/tabulated on their assembly detail drawings are not provided. Refer to the associated assembly detail drawing for detailed wiring information of these assemblies.

PRINTED WIRING PATTERNS

8.3 The need for printed wiring pattern information is beyond the scope of this manual, therefore, detailed printed wiring patterns for printed circuit boards are not included.

WIRE COLORS

8.4 Every effort is made to manufacture the assemblies using wire that is the color tabulated in the 'Code' column of the wiring list tables. In some instances, a white wire will be substituted. In this case identification must be determined by locating the assigned identification number.

WIRING LISTS PROVIDED

8.5 The wiring lists tabulated in table 8-1 are provided. These lists provide, non-printed wiring pattern, point-to-point (source/destination) interconnecting information.

Table 8-1 Wiring Lists Provided

Table 8-2	Wiring List - AMPFET ND1 (NAR124A) Cabinet Cable Harness
Table 8-3	Wiring List - NAC48C Control/Monitor Panel
Table 8-4	Wiring List - NAE60 Exciter Panel
Table 8-5	Wiring List - NASR70 Ac/Dc Power Supply
Table 8-6	Wiring List - NAX89 Circuit Breaker Panel
Table 8-7	Wiring List - NAF65 Rf Output Filter
Table 8-8	Wiring List - NAFP39 Forward/Reflected Power Probe
Table 8-9	Connector Mating Information - Sorted by Floating Connector
Table 8-10	Connector Mating Information - Sorted by Fixed Connector

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Table 8-2 Wiring List - AMPFET ND1 (NAR124A) Cabinet Wiring Harness

*	SOURCE	DESTINATION	CODE	SIZE	REMARKS
	P2-A	P1-1	1 White	22	3- Conductor Shielded
	P2-B	P1-2	2 Red	22	
	P2-C	P1-3	3 Black	22	
	P2-D	Not Connected	- Shield	-	
	P2-R	P1-4	4 White	20	
	P3-1	P1-5	5 White	14	
	P3-2	P1-6	6 White	14	
	P3-3	P1-7	7 White	14	
	A7R1-4	P2-F	8 White	18	
	A7R1-3	P2-E	9 White	18	
	A7R1-1	Ground	10 Black	14	
	A7R1-1	Ground	11 Black	14	
	A7R1-1	Ground	12 Black	14	
	P3-8	P2-H	13 White	22	
	P3-8	A8XF3-3	14 White	22	
	P3-11	P2-S	15 White	20	
	P3-16	P2-N	16 White	22	1-Conductor
	P3-13	P2-P	- Shield	-	Shielded
	P3-9	P2-L	17 Core	RG188A/U	Coaxial Cable
	P3-6	P2-M	- Shield	-	
	P3-5	Ground	18 Black	20	
	P3-10	P2-J	19 White	22	1-Conductor
	Not Connected	P2-K	- Shield	-	Shielded
	P4-Centre	P2-JJ	20 Core	RG188A/U	Coaxial Cable
	P4-Body	P2-KK	- Shield	-	
	P5-Centre	P2-LL	21 Core	RG188A/U	Coaxial Cable
	P5-Body	P2-MM	- Shield	-	
	P6-Centre	P2-PP	22 Core	RG188A/U	Coaxial Cable
	P6-Body	P2-RR	- Shield	-	
	P7-Centre	P2-DD	23 Core	RG188A/U	Coaxial Cable
	P7-Body	P2-EE	- Shield-	-	
	P8-Centre	P2-FF	24 Core	RG188A/U	Coaxial Cable
	P8-Body	P2-HH	- Shield	-	
	P2-Z	A8XF1-1	25 White	20	
	P2-AA	A8XF1-3	26 White	20	
	P2-BB	A8XF3-1	27 White	20	
	P2-CC	A8TB1-5	28 Black	20	
	P3-4	Ground A	29 Black	14	
	P3-7	Ground A	30 Black	14	
	P3-14	Ground A	31 Black	14	
	A7A1-Gnd(+)	A7R1-5	- White	10	
	A6E6 (Ref Gnd)	E1 (Safety Gnd)	- Black	2	
	A5TB1-3	E1 (Safety Gnd)	- Black	14	
	A5-Ground	A6E6 (Ref Gnd)	- Black	14	
	A1-Ground	Cabinet Gnd	- Black	14	
	A1-Ground	Cabinet Gnd	- Black	14	
	A5-Ground	Ground B	- Black	14	
	A1-Hinge	Cabinet Ground	- Black	14	

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Table 8-3 Wiring List - NAC48C Control/Monitor Panel

*	SOURCE	DESTINATION	CODE	SIZE	REMARKS
	S2-12 (Anode)	S2-2	Diode	1N4938	CR1
	S2-9 (Anode)	S2-10	LED	Amber	DS1
	S2-10	S2-12	Resistor	2200 Ohms	R1
	S3A-3	S3A-5	Resistor	3300 Ohms	R2
	S3A-7	S3A-5	Resistor	3300 Ohms	R3
	S3A-W2	S3B-W2	Resistor	10K Ohms	R4
	S1B-7	S1B-9	Resistor	270K Ohms	R5A
	S1B-7	S1B-9	Resistor	Selected	R5B
	P8-AL	S1A-7	1 White	22	1-Conductor
	P8-AK	Not Connected	- Shield	-	Shielded
	P8-B	S1A-6	2 White	22	
	P8-C	S1A-3	3 White	22	
	P8-D	P3-9	4 White	22	
	P3-9	S1A-2	5 White	22	
	P8-E	P1-6	6 White	22	
	P1-6	P3-3	7 White	22	
	P3-3	S1B-4	8 White	22	
	P8-F	P3-11	9 White	22	
	P3-11	P4-9	10 White	22	
	P4-9	S1B-5	11 White	22	
	P8-H	A2-6	12 White	22	
	P8-J	S3A-W1	13 White	22	1-Conductor
	P8-K	Not Connected	- Shield	-	Shielded
	P8-L	P6-Centre	14 Core	RG188A/U	Coaxial Cable
	P8-M	P6-Body	- Shield	-	
	P8-N	P7-Centre	15 Core	RG188A/U	Coaxial Cable
	P8-P	P7-Body	- Shield		
	P8-R	P5-7	16 White	22	
	P8-S	P5-3	17 White	22	
	P8-T	P5-2	18 White	22	
	P8-U	P4-12	19 White	22	
	P8-V	P4-2	20 White	22	
	P8-W	P3-10	21 White	22	
	P8-X	P2-12	22 White	22	
	P8-Y	P2-10	23 White	22	
	P8-AA	P2-7	24 White	22	
	P8-AB	P2-3	25 White	22	1-Conductor
	P8-AC	Ground near P8	- Shield	-	Shielded
	P8-AD	P2-2	26 White	22	
	P8-DB	P1-4	27 White	22	
	P8-DA	P1-3	28 White	22	
	P8-CZ	P1-2	29 White	22	
	S2-2	P8-CY	30 White	22	
	S2-1	P8-CX	31 White	22	
	S2-8	P8-CW	32 White	22	
	P5-4	P8-CV	33 White	22	
	P5-1	P8-CU	34 White	22	
	P4-11	P8-CT	35 White	22	

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Table 8-3 Wiring List - NAC48C Control/Monitor Panel (Continued)

*	SOURCE	DESTINATION	CODE	SIZE	REMARKS
	P4-10	P8-CS	36 White	22	
	P4-1	P8-CR	37 White	22	
	P3-8	P8-CP	38 White	22	
	P3-7	P8-CN	39 White	22	
	P3-6	P8-CM	40 White	22	
	P3-5	P8-CL	41 White	22	
	P3-4	P8-CK	42 White	22	
	P3-1	P8-CJ	43 White	22	
	P2-9	P8-CH	44 White	22	
	P2-8	P8-CF	45 White	22	
	S1B-4	S2-9	46 White	22	
	P2-6	P8-CE	47 White	22	1-Conductor
	Ground near P2	P8-CD	- Shield	-	Shielded
	P2-4	P8-CC	48 White	22	
	P2-1	P8-CB	49 White	22	
	P1-10	P8-CA	50 White	22	1-Conductor
	P1-11	P8-BZ	- Shield	-	Shielded
	P1-1	P8-BY	51 White	22	
	P5-12	S3A-W2	52 White	22	1-Conductor
	P5-11	Not Connected	- Shield	22	Shielded
	S1A-4	A2-2	53 White	22	
	S1A-W1	A2-3	54 White	22	
	S1B-W1	A2-1	55 White	22	
	S1B-3	A2-5	56 White	22	
	S2-7	P2-11	57 White	22	
	S3A-2	S4-1	58 White	22	
	S4-1	A3-1	59 White	22	
	S4-2	A3-4	60 White	22	
	S3B-7	A3-2	61 White	22	
	S1B-9	A2-4	62 Black	22	
	S3B-W2	A3-3	63 Black	22	
	A2-4	Ground	64 Black	22	
	A3-3	Ground	65 Black	22	
	P8-AH	P5-6	66 White	22	
	S2-W1	Ground	67 Black	22	
	S3A-5	S3B-W2	- Black	22	
	S1A-4	S1A-5	Tinned Copper Wire	24	
	S3A-8	S3A-7	Tinned Copper Wire	24	
	S1A-5	S1B-2	Tinned Copper Wire	24	Sleeved
	S1B-2	S1B-6	Tinned Copper Wire	24	Sleeved
	S1A-1	S1B-1	Tinned Copper Wire	24	Sleeved
	S2-W1	S2-W2	Tinned Copper Wire	24	Sleeved
	S3A-1	S3A-3	Tinned Copper Wire	24	Sleeved
	S3A-2	S3A-9	Tinned Copper Wire	24	Sleeved

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Table 8-4 Wiring List - NAE60 Exciter Panel

*	SOURCE	DESTINATION	CODE	SIZE	REMARKS
	TT-2	Ground	Capacitor	2200 pF	C1
	TT-1	Ground	Capacitor	2200 pF	C2
	XK1-13 Cathode	XK1-14	Diode	1N4935	CR1
	XK2-13 Cathode	XK2-14	Diode	1N4935	CR2
	TT-1	TT-2	Resistor	3300 Ohms	R1
	TT-6	TT-7	Resistor	2200 Ohms	R3
	J1-A	P18-1	1 White	22	3-Conductor
	J1-B	P18-2	2 Red	22	Shielded
	J1-C	P18-6	3 Black	22	
	Gnd.	Not Connected	- Shield	-	
	J1-D	Gnd.	4 Black	22	
	J1-E	J2-C	5 White	18	
	J1-F	J2-H	6 White	18	
	J1-H	P15-1	7 Orange	22	
	J1-J	XK2-11	8 White	22	1-Conductor
	J1-K	TT14	- Shield	-	Shielded
	J1-L	P9-9	9 White	22	1-Conductor
	J1-M	P9-10	- Shield	-	Shielded
	J1-N	P13-Centre	10 White	22	1-Conductor
	J1-P	P13-Body	- Shield	-	Shielded
	J1-R	P12-1	11 White	22	
	J1-S	TT-1	12 White	22	
	J1-Z	P18-3	13 Orange	22	
	J1-AA	P15-3	14 Red	22	
	J1-BB	P9-4	15 Blue	22	
	J1-CC	P18-7	16 Black	20	
	J1-DD	P4-7	17 White	22	1-Conductor
	J1-EE	P4-8	- Shield	-	Shielded
	J1-FF	P4-6	18 White	22	1-Conductor
	J1-HH	P4-5	- Shield	-	Shielded
	J1-JJ	P10-3	19 White	22	1-Conductor
	J1-KK	P10-4	- Shield	-	Shielded
	J1-LL	J2-N	20 Core	RG188A/U	Coaxial Cable
	J1-MM	J2-P	- Shield	-	
	J1-PP	P14-Centre	21 Core	RG188A/U	Coaxial Cable
	J1-RR	P14-Body	- Shield	-	
	P12-1	J2-D	22 White	22	
	P18-3	P6-3	23 Orange	22	
	P6-3	J2-E	24 Orange	22	
	P18-9	TT8	25 Red	22	
	P18-9	TT4	26 Red	22	
	TT4	P9-7	27 Red	22	
	P9-7	P10-5	28 Red	22	
	P10-5	P4-1	29 Red	22	
	P4-1	P5-7	30 Red	22	
	TT4	J2-F	31 Red	22	
	TT4	P13-3	32 Red	22	
	P7-5	XK1-3	33 Red	22	

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Table 8-4 Wiring List - NAE60 Exciter Panel (Continued)

*	SOURCE	DESTINATION	CODE	SIZE	REMARKS
	P18-8	TT10	34 Blue	22	
	P18-8	TT-3	35 Blue	22	
	TT-3	P9-4	36 Blue	22	
	TT-3	J2-B	37 Blue	22	
	P6-9	P15-1	38 Orange	22	
	P6-9	P18-4	39 Orange	22	
	P17-8	TT6	40 Orange	22	
	P17-8	J2-S	41 Orange	22	
	TT-2	P9-3	42 White	22	
	P4-7	J2-J	43 White	22	1-Conductor
	P4-8	J2-K	- Shield	-	Shielded
	P4-6	J2-L	44 White	22	1-Conductor
	P4-5	J2-M	- Shield	-	Shielded
	P1-Centre	P7-11	45 White	22	1-Conductor
	P1-Body	P7-10	- Shield	-	Shielded
	P2-Centre	P16-Centre	46 Core	RG188A/U	Coaxial Cable
	P2-Body	P16-Body	- Shield	-	
	P3-3	J2-T	47 White	22	
	P3-5	J2-X	48 White	22	
	P3-6	J2-R	49 White	22	
	P3-8	J2-Y	50 White	22	
	P3-9	J2-AA	51 White	22	
	P3-11	J2-CM	52 White	22	
	P3-12	J2-CP	53 White	22	
	P4-3	P12-7	54 White	22	1-Conductor
	P4-2	P12-8	- Shield	-	Shielded
	P4-4	J2-CW	55 White	22	
	P4-9	J2-CY	56 White	22	
	P4-10	J2-CS	57 White	22	
	P4-11	J2-CK	58 White	22	
	P4-12	J2-CT	59 White	22	
	P5-1	J2-CN	60 White	22	
	P5-2	J2-CJ	61 White	22	
	P5-4	J2-CH	62 White	22	
	P5-4	P17-7	63 White	22	
	P5-5	J2-CF	64 White	22	
	P5-9	J2-CB	65 White	22	
	P5-10	J2-CC	66 White	22	
	P6-1	J2-CL	67 White	22	
	P6-2	J2-CV	68 White	22	
	P6-4	J2-DB	69 White	22	
	P6-5	J2-DA	70 White	22	
	P6-6	J2-V	71 White	22	
	P6-7	J2-U	72 White	22	
	P6-8	J2-CU	73 Orange	22	
	P6-10	XK1-1	74 White	22	2-Conductor
	P6-11	XK1-2	75 Black	22	Shielded
	P6-12	TT15	- Shield	-	

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Table 8-4 Wiring List - NAE60 Exciter Panel (Continued)

*	SOURCE	DESTINATION	CODE	SIZE	REMARKS
	P7-2	XK2-2	76 White	22	1-Conductor
	P7-3	TT13	- Shield	-	Shielded
	P8-Centre	XK2-1	77 Core	RG188A/U	Coaxial Cable
	P8-Body	TT13	- Shield	-	
	P9-1	P15-2	78 White	22	1-Conductor
	P9-2	P15-4	- Shield	-	Shielded
	J2-W	P12-5	79 White	22	
	J2-AB	P17-4	80 White	22	1-Conductor
	J2-AC	P17-5	- Shield	-	Shielded
	J2-AD	XK2-12	81 White	22	1-Conductor
	TT16	Not Connected	- Shield	-	Shielded
	J2-BY	P12-4	82 White	22	
	J2-CA	P9-1	83 White	22	1-Conductor
	J2-BZ	P9-2	- Shield	-	Shielded
	J2-CE	P17-6	84 White	22	1-Conductor
	J2-CD	P17-5	- Shield	-	Shielded
	J2-CR	P9-5	85 White	22	
	J2-CX	P17-3	86 White	22	
	J2-CZ	P12-6	87 White	22	
	J2-AH	P3-10	88 White	22	
	P21-Center	XK2-6	89 Core	RG188A/U	Coaxial Cable
	P21-Shell	-	- Shield	-	
	P11-Center	XK2-10	90 Core	RG188A/U	Coaxial Cable
	P11-Shell	TT12	- Shield	-	
	P22-Center	XK2-5	91 Core	RG188A/U	Coaxial Cable
	P22-Shell	TT13	- Shield	-	
	P19-Center	XK2-9	92 Core	RG188A/U	Coaxial Cable
	P19-Shell	TT13	- Shield	-	
	P7-4	XK2-4	93 White	22	1-Conductor
	P7-1	TT16	- Shield	-	Shielded
	P20-4	XK2-8	94 White	22	1-Conductor
	P20-3	TT16	- Shield	-	Shielded
	P7-7	XK2-3	95 White	22	1-Conductor
	P7-8	TT14	- Shield	-	Shielded
	P20-1	XK2-7	96 White	22	1-Conductor
	P20-2	TT14	- Shield	-	Shielded
	J2-AL	XK2-11	97 White	22	1-Conductor
	J2-AK	-	- Shield	-	Shielded
	A7TB1-2	XK1-5	98 White	22	1-Conductor
	A7TB1-1	TT15	- Shield	-	Shielded
	P10-8	XK1-9	99 White	22	2-Conductor
	P10-6	XK1-10	100 Black	22	Shielded
	P10-7	TT15	- Shield	-	
	XK1-11	TT8	101 Red	22	
	XK1-7	TT9	102 Red	22	
	P17-1	TT9	103 Red	22	
	XK1-12	TT10	104 Blue	22	
	XK1-8	TT11	105 Blue	22	

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Table 8-4 Wiring List - NAE60 Exciter Panel (Continued)

*	SOURCE	DESTINATION	CODE	SIZE	REMARKS
	P17-2	TT11	106 Blue	22	
	XK1-13	TT6	107 Orange	22	
	P18-4	TT6	108 Orange	22	
	XK2-13	XK1-13	109 Orange	22	
	XK2-14	XK1-14	110 White	22	
	XDS1-Cathode	XK1-14	111 White	22	
	XDS1-Cathode	S1-1	- White	22	
	TT7	XDS1-Anode	- White	22	
	S1-2	Gnd	- Black	20	

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Table 8-5 Wiring List - NASR70 Ac/Dc Power Supply Assembly

*	SOURCE	DESTINATION	CODE	SIZE	REMARKS
	T1-8	T1-9	Varistor	95V/35J	RV1
	T1-10	T1-9	Varistor	95V/35J	RV2
	L1-2	A2-Chassis	- -	-	Secured by Bolt
	J2-1	TB1-1	1 Grey	14	
	J2-2	TB1-2	2 Grey	14	
	J2-3	E1 (Ground)	3 Black	14	
◆	J2-4	T1-4, 5, 6 or 7	4 Grey	14	
◆	J2-5	T1-1 or 2	5 Grey	14	
	J2-6	T1-11	6 Grey	14	
	J2-7	T1-13	7 Grey	14	
	T1-12	Ground at J1	8 Black	14	
	J1-3	T1-12	9 Black	22	
	J2-10	A2-4	11 White	22	
♣	T1-8	A7A1U1-A(-)	12 White	10	
	T1-8	P1-5	13 Grey	22	
♣	T1-10	A7A1U1-B(-)	14 White	10	
	T1-10	P1-7	15 Grey	22	
♣	T1-9	A7A1CR1-()	16 White	10	
	T1-9	L1-1	17 White	10	
	J2-8	P1-1	18 Grey	22	
	J2-9	P1-2	19 Grey	22	
	P1-1	J1-1	20 Grey	22	
	P1-2	J1-2	21 Grey	22	
	A2-1	P1-3	22 White	22	
♣	P1-6	A7A1U1-G2(G)	23 White	22	
♣	P1-8	A7A1U1-G1(G)	24 White	22	
	J1-4	A2XF1-Side	25 White	20	
	L1-2	J1-5	26 White	14	
	L1-2	J1-6	27 White	14	
	L1-2	J1-7	28 White	14	
	A2-3	TP1	29 White	22	

NOTE Wiring list is applicable to NASR70A and NASR70B

◆ - Denotes destination determined by mean rms voltage of ac power source.
Selected during installation.

♣ - Denotes destination connected when installed in cabinet.

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Table 8-6 Wiring List - NAX89 Circuit Breaker Panel

*	SOURCE	DESTINATION	CODE	SIZE	REMARKS
	P1-1	CB1A-1	1 Grey	14	
	P1-2	CB1B-1	2 Grey	14	
	P1-3	U1-Gnd	3 Black	14	
	CB1A-2	U1-4	4 Grey	14	
	CB1B-2	U1-3	5 Grey	14	
	P1-4	U1-1	6 Grey	14	
	P1-5	U1-2	7 Grey	14	
	P1-6	XF1-Center	8 Grey	14	
	P1-7	XF2-Center	9 Grey	14	
	P1-8	XF1-Side	10 Grey	20	
	P1-9	XF2-Side	11 Grey	20	
	P1-10	XDS1-Cathode	12 White	22	
	XDS1-Anode	Ground	- Black	22	

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Table 8-7 Wiring List - NAF65 Rf Output Filter Assembly

*	SOURCE	DESTINATION	CODE	SIZE	REMARKS
♣	P1-1	L1-Bottom	1 White	14	
	P1-4	Ground at A1	2 White	14	
♦	C1-Top	L1-Tap	- White	14 x 2	Twisted Pair
♦	E3	L3-Top Tap	- White	14 x 2	Twisted Pair
♦	E6 (Ref Gnd)	L3-Bottom Tap	- White	14 x 2	Twisted Pair
♦	E2	L4-Bottom Tap	- White	14 x 2	Twisted Pair
♦	A2TB1-1	L4-Top Tap	- White	14 x 2	Twisted Pair
	A2TB1-3	E5	- White	14 x 2	Twisted Pair
	C3-Top	J1-Center	- White	14 x 2	Twisted Pair
	C3-Top	A2TB1-4	- White	14	
	E3	L2-Tap	- White	14 x 2	Twisted Pair

NOTE: ♣ - Denotes wire passes thru centre of rf current transformer A1T1

♦ - Denotes location of tap is dependent on carrier frequency. Location is determined at initial calibration during manufacture/after frequency change.

All wires are teflon insulated.

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Table 8-8 Wiring List - NAFP39 Forward/Reflected Power Probe

*	SOURCE	DESTINATION	CODE	SIZE	REMARKS
♣	TB1-1	TB1-3	- White	14	1-Conductor Shielded
	Ground at TB1	Not Connected	- Shield	-	
	A1-7	J2-Center	- White	22	
	A1-8	J3-Center	- White	22	
	A1-2	Ground at A1	Tinned Copper	Wire	24
	T1-1	A1-2	- -	-	Lead of T1
	T1-2	A1-1	- -	-	Lead of T1
	T2-1	TB1-4	- -	-	Lead of T2
	T2-2	Ground at TB1	- -	-	Lead of T2
	T2-3	A1-1	- -	-	Lead of T2
	T2-4	A1-3	- -	-	Lead of T2
	T2-5	A1-4	- -	-	Lead of T2
	T2-6	A1-1	- -	-	Lead of T2
	T2-7	J1-Center	- -	-	Lead of T2
	T2-8	Ground at J1	- -	-	Lead of T2

NOTE: ♣ - Denotes wire passes thru centre of rf current transformer T1

T1-1 and T1-2 are twisted together.
T2-1 and T2-2 are twisted together.
T2-7 and T2-8 are twisted together.

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Table 8-9 Connector Mating Information - Sorted by Floating Connector

FLOATING CONNECTOR		FIXED CONNECTOR	
REF DES	DESCRIPTION	REF DES	DESCRIPTION
P1	7 Socket-Contacts	A5J1	7 Pin-Contacts
P2	29 Bisexual-Contacts	A4J1	29 Bisexual-Contacts
P3	11 Socket-Contacts	A2J1	11 Pin-Contacts
P4	BNC	A6A1J1	BNC
P5	BNC	A6A1J2	BNC
P6	BNC	A6A2J1	BNC
P7	BNC	A6A2J2	BNC
P8	BNC	A6A2J3	BNC
A1P1	MTA, 12 Socket-Contacts	A1A1J1	MTA, 12 Pin-Contacts
A1P2	MTA, 12 Socket-Contacts	A1A1J2	MTA, 12 Pin-Contacts
A1P3	MTA, 12 Socket-Contacts	A1A1J3	MTA, 12 Pin-Contacts
A1P4	MTA, 12 Socket-Contacts	A1A1J4	MTA, 12 Pin-Contacts
A1P5	MTA, 12 Socket-Contacts	A1A1J5	MTA, 12 Pin-Contacts
A1P6	BNC	A1A1J6	BNC
A1P7	BNC	A1A1J7	BNC
A1P8	52 Bisexual-Contacts	A4J2	52 Bisexual-Contacts
A3P1	10 Socket-Contacts	A5J2	10 Pin-Contacts
A4P1	BNC	A4A1J2	BNC
A4P2	BNC	A4A1J3	BNC
A4P3	MTA, 12 Socket-Contacts	A4A1J5	MTA, 12 Pin-Contacts
A4P4	MTA, 12 Socket-Contacts	A4A1J6	MTA, 12 Pin-Contacts
A4P5	MTA, 12 Socket-Contacts	A4A1J7	MTA, 12 Pin-Contacts
A4P6	MTA, 12 Socket-Contacts	A4A1J8	MTA, 12 Pin-Contacts
A4P7	MTA, 12 Socket-Contacts	A4A3J1	MTA, 12 Pin-Contacts
A4P8	BNC	A4A3J2	BNC
A4P9	MTA, 12 Socket-Contacts	A4A4J1	MTA, 12 Pin-Contacts
A4P10	MTA, 8 Socket-Contacts	A4A4J2	MTA, 8 Pin-Contacts
A4P11	BNC	A4A5J1	BNC
A4P12	MTA, 8 Socket-Contacts	A4A5J3	MTA, 8 Pin-Contacts
A4P13	BNC	A4A5J2	BNC
A4P14	BNC	A4A6J1	BNC
A4P15	MTA, 4 Socket-Contacts	A4A6J2	MTA, 4 Pin-Contacts
A4P16	BNC	A4A6J3	BNC
A4P17	MTA, 8 Socket-Contacts	A4A7J1	MTA, 8 Pin-Contacts
A4P18	8 Socket-Contacts	A4A2J1	8 Pin-Contacts
A4P19	BNC	A4A4J3	BNC
A4P20	MTA, 4 Socket-Contacts	A4A7J2	MTA, 4 Pin-Contacts
A4P21	BNC	A4A7J3	BNC
A4P22	BNC	A4A7J4	BNC
A5P1	MTA, 8 Socket-Contacts	A5A1J1	MTA, 8 Pin-Contacts
A6P1	2 Pin-Contacts	A2J2	2 Socket-Contacts

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Table 8-10 Connector Mating Information - Sorted by Fixed Connector

FIXED CONNECTOR		FLOATING CONNECTOR	
REF DES	DESCRIPTION	REF DES	DESCRIPTION
A1A1J1	MTA, 12 Pin-Contacts	A1P1	MTA, 12 Socket-Contacts
A1A1J2	MTA, 12 Pin-Contacts	A1P2	MTA, 12 Socket-Contacts
A1A1J3	MTA, 12 Pin-Contacts	A1P3	MTA, 12 Socket-Contacts
A1A1J4	MTA, 12 Pin-Contacts	A1P4	MTA, 12 Socket-Contacts
A1A1J5	MTA, 12 Pin-Contacts	A1P5	MTA, 12 Socket-Contacts
A1A1J6	BNC	A1P6	BNC
A1A1J7	BNC	A1P7	BNC
A2J1	11 Pin-Contacts	P3	11 Socket-Contacts
A2J2	2 Socket-Contacts	A6P1	2 Pin-Contacts
A4A1J1	BNC	External	BNC
A4A1J2	BNC	A4P1	BNC
A4A1J3	BNC	A4P2	BNC
A4A1J4	BNC	External	BNC
A4A1J5	MTA, 12 Pin-Contacts	A4P3	MTA, 12 Socket-Contacts
A4A1J6	MTA, 12 Pin-Contacts	A4P4	MTA, 12 Socket-Contacts
A4A1J7	MTA, 12 Pin-Contacts	A4P5	MTA, 12 Socket-Contacts
A4A1J8	MTA, 12 Pin-Contacts	A4P6	MTA, 12 Socket-Contacts
A4A1J9	BNC	External	BNC
A4A2J1	8 Pin-Contacts	A4P18	8 Socket-Contacts
A4A3J1	MTA, 12 Pin-Contacts	A4P7	MTA, 12 Socket-Contacts
A4A3J2	BNC	A4P8	BNC
A4A4J1	MTA, 12 Pin-Contacts	A4P9	MTA, 12 Socket-Contacts
A4A4J2	MTA, 8 Pin-Contacts	A4P10	MTA, 8 Socket-Contacts
A4A4J3	BNC	A4P19	BNC
A4A5J1	BNC	A4P11	BNC
A4A5J2	BNC	A4P13	BNC
A4A5J3	MTA, 8 Pin-Contacts	A4P12	MTA, 8 Socket-Contacts
A4A6J1	BNC	A4P14	BNC
A4A6J2	MTA, 4 Pin-Contacts	A4P15	MTA, 4 Socket-Contacts
A4A6J3	BNC	A4P16	BNC
A4A7J1	MTA, 8 Pin-Contacts	A4P17	MTA, 8 Socket-Contacts
A4A7J2	MTA, 4 Pin-Contacts	A4P20	MTA, 4 Socket-Contacts
A4A7J3	BNC	A4P21	BNC
A4A7J4	BNC	A4P22	BNC
A4J1	29 Bisexual-Contacts	P2	29 Bisexual-Contacts
A4J2	52 Bisexual-Contacts	A1P8	52 Bisexual-Contacts
A5A1J1	MTA, 8 Pin-Contacts	A5P1	MTA, 8 Socket-Contacts
A5J1	7 Pin-Contacts	P1	7 Socket-Contacts
A5J2	10 Pin-Contacts	A3P1	10 Socket-Contacts
A6A1J1	BNC	P4	BNC
A6A1J2	BNC	P5	BNC
A6A2J1	BNC	P6	BNC
A6A2J2	BNC	P7	BNC
A6A2J3	BNC	P8	BNC

SECTION 9 ELECTRICAL SCHEMATICS

INTRODUCTION

9.1 This section contains electrical schematics\ logic diagrams for the subject equipment. Block diagrams, simplified electrical schematics and/or logic diagrams may be included. Refer to table 9-1 for an itemized listing.

COMPONENT VALUES

9.2 Unless otherwise specified on the logic/schematic diagram:

- Resistor values are shown in ohms.
(K = 1 000 and M = 1 000 000).
- Capacitor values are shown in microfarads (uF).
- Unidentified diodes are part number 1N4938.

GRAPHIC SYMBOLS

9.3 The graphic symbols used on electrical schematics are in accordance with American National Standard ANSI Y32.2-1975 - Graphic Symbols for Electrical and Electronic Diagrams.

LOGIC SYMBOLS

9.4 The logic symbols used on electrical schematics and logic diagrams are in accordance with American National Standard ANSI Y32.14-1975 - Graphic Symbols for Logic Diagrams.

REFERENCE DESIGNATIONS

9.5 Reference designations were assigned in accordance with American National Standard ANSI Y32.16-1975 - Reference Designations for Electrical and Electronic Parts and Equipments. Each electrical symbol has been identified with its basic reference designation. To obtain the full reference designation for a specific part, this basic identifier must be prefixed with the reference designation assigned to all higher assemblies.

IDENTIFICATION OF SCHEMATIC DIAGRAMS

9.6 Each illustration in this section is identified by a number that is both the figure number and the page number. The numbers are assigned sequentially and are prefixed by the letters 'SD-'. The electrical schematics/logic diagrams included in this section are listed in table 9-1.

STRUCTURE OF SCHEMATICS

9.7 The electrical schematics have been structured in a hierarchical format that is based on function and signal flow. Wherever practical, the signal flow is from left to right. Inputs will normally originate on the left-hand side and outputs will be extended to the right-hand side. Exceptions will be indicated by an arrow indicating the direction of signal flow.

NOTE

The physical location of a part/assembly was not necessarily a factor when a schematic was drawn. The full reference designation assigned to a part/assembly, in conjunction with the family tree in figure 7-1 and the assembly detail drawings in section 10, will identify its location.

9.7.1 Figure SD-1 identifies the major functional blocks and their detailed interconnection. Figures SD-2 thru SD-6 further expand the functional breakdown of each block and contain cross references that identify which block is the signal source for inputs or the destination for outputs.

9.7.2 When a sub-function is treated as a block in figures SD-2 thru SD-5, its detailed circuit information will be included in its own schematic drawing(s). These schematics may be included in this section or in an appended service instruction manual(s).

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LOCATING A PART/ASSEMBLY IDENTIFIED ON A SCHEMATIC

9.8 The full reference designation assigned to a part/assembly is the key to physically locating that part/assembly.

NOTE

Full reference designations contain the assembly hierarchical coding.

When the end item is divided into units (cabinets) the first coding is a unit number (1, 2, 3, etc).

When the end item is divided into assemblies, the first coding is an assembly number (A1, A2, A3, etc).

If a unit or an assembly is divided into sub-assemblies, assembly codings that identify assembly relationship (1A1, A2A1, A2A1A1, etc) are added

9.8.1 Enter the family tree depicted in figure 7-1 with the full reference designation and follow the family tree branches to the appropriate block, noting the name and Nautel nomenclature number of all higher assemblies in the path.

NOTE

The drawings in section 10 depict the assembly detail of the transmitter and any of its modules/ assemblies that are not the subject of their own service instruction manual. If the block in the family tree references a manual that is keyed to a Nautel nomenclature number, the assembly detail for that assembly will be included in the referenced service instruction manual.

9.8.2 Enter table 10-1 with the name and Nautel nomenclature number of each family tree block in the path, starting at the highest assembly (normally figure MD-1) and determine the figure number(s) for that assembly. Refer to the referenced figure and locate the next lower level assembly. Repeat this procedure until the location of the required part/assembly has been identified.

LOCATING THE SCHEMATIC DIAGRAM(S) FOR A FUNCTIONAL BLOCK

9.9 The text inside a functional block, provides the key to locating its schematic diagram(s).

9.9.1 WHEN FIGURE NUMBER IDENTIFIED: In some instances the figure number of the schematic will be identified. These schematics will be included in this section.

9.9.2 WHEN REFERENCE DESIGNATION ASSIGNED TO BLOCK: When a functional block has been assigned a reference designation, enter the family tree depicted in figure 7-1 and follow the family tree branches to the block that contains the reference designation.

9.9.2.1 If the family tree's block references a service instruction manual that is keyed to a Nautel nomenclature number, the schematic will be included in the referenced manual.

9.9.2.2 If the family tree's block references a table in section 7 of this manual, the schematic will be in this section. Enter table 9-1 to with the Nautel nomenclature number and/or the description to identify the appropriate figure number(s).

9.9.3 TITLE OF BLOCK: When a functional block has not been assigned a reference designation and a figure number has not been referenced, the schematic is included in this section. Enter table 9-1 with the name of the functional block to identify the appropriate figure number(s).

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Table 9-1 List of Electrical Schematics

Figure SD-1	Electrical Schematic - AMPFET ND1 1kW AM Broadcast Transmitter
Figure SD-2	Electrical Schematic - 1kW Control/Monitor Panel (NAC48C)
Figure SD-3	Electrical Schematic - Exciter Panel (NAE60) (Sheet 1 of 2)
Figure SD-4	Electrical Schematic - Exciter Panel (NAE60) (Sheet 2 of 2)
Figure SD-5	Electrical Schematic - Ac/Dc Power Stage (NASR70A/NASR70B)
Figure SD-6	Electrical Schematic - 1kW Rf Output Filter (NAF65)

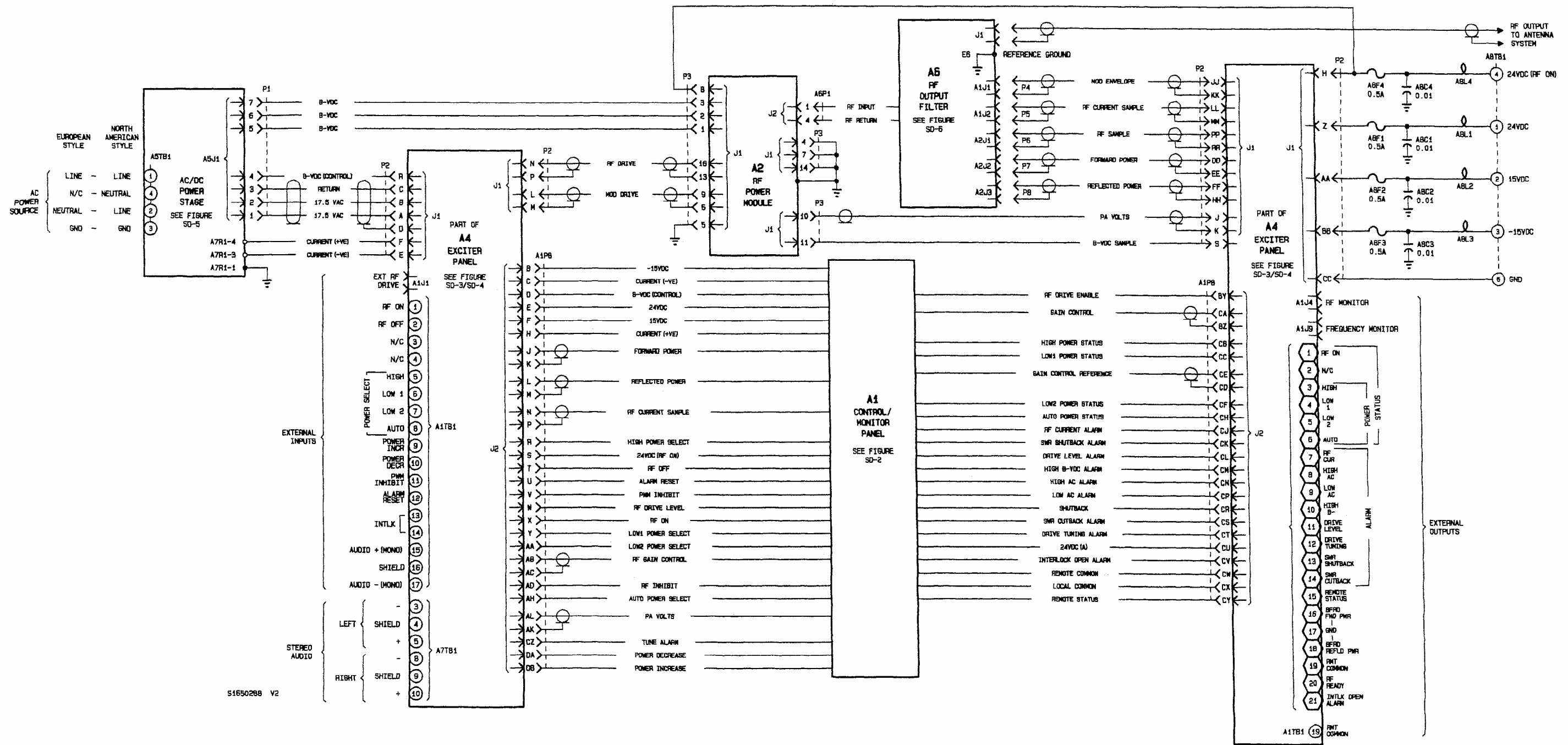


Figure SD-1 Electrical Schematic - AMPFET ND1 1kW AM Broadcast Transmitter

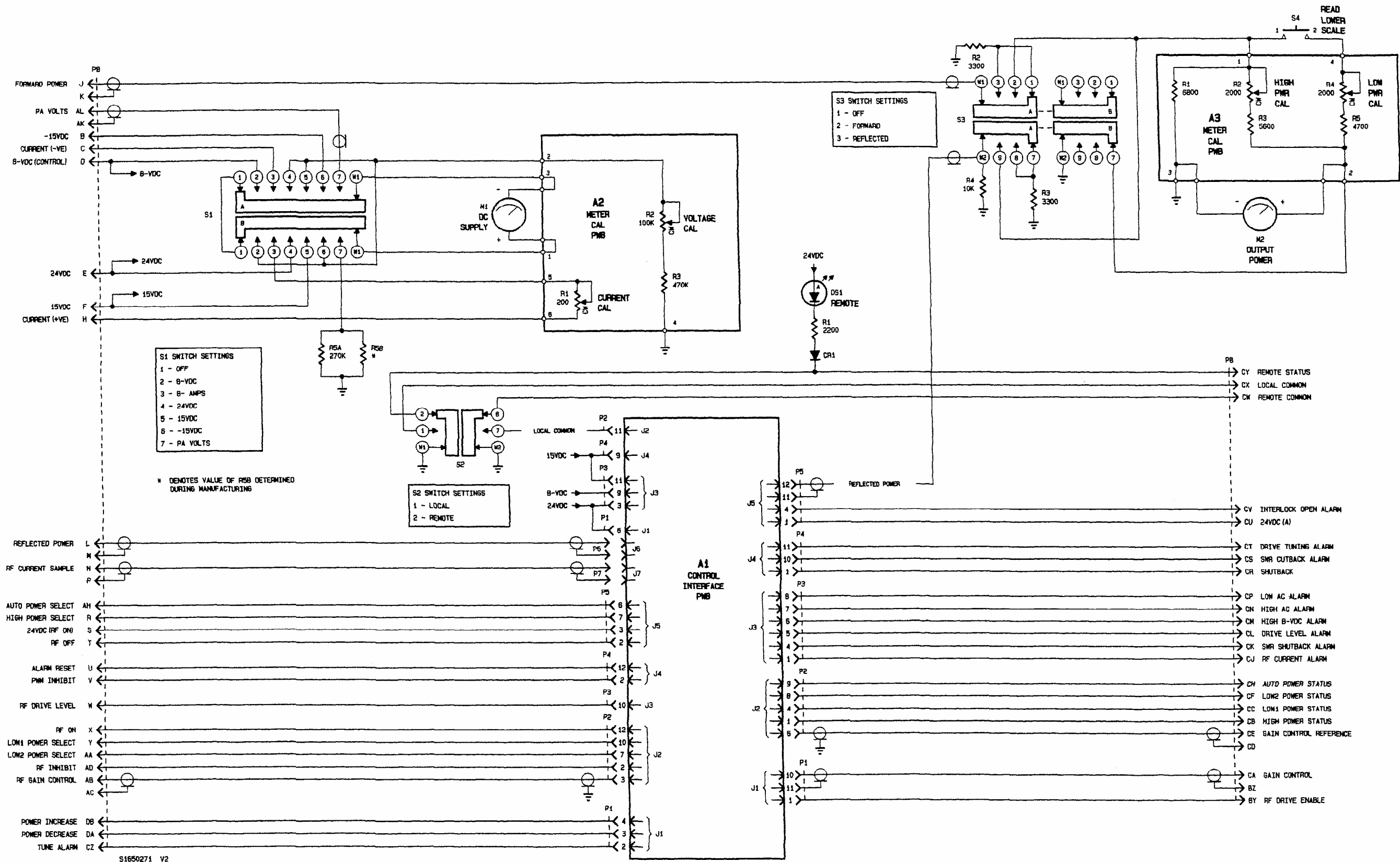


Figure SD-2 Electrical Schematic - 1kW Control/Monitor Panel (NAC48C)

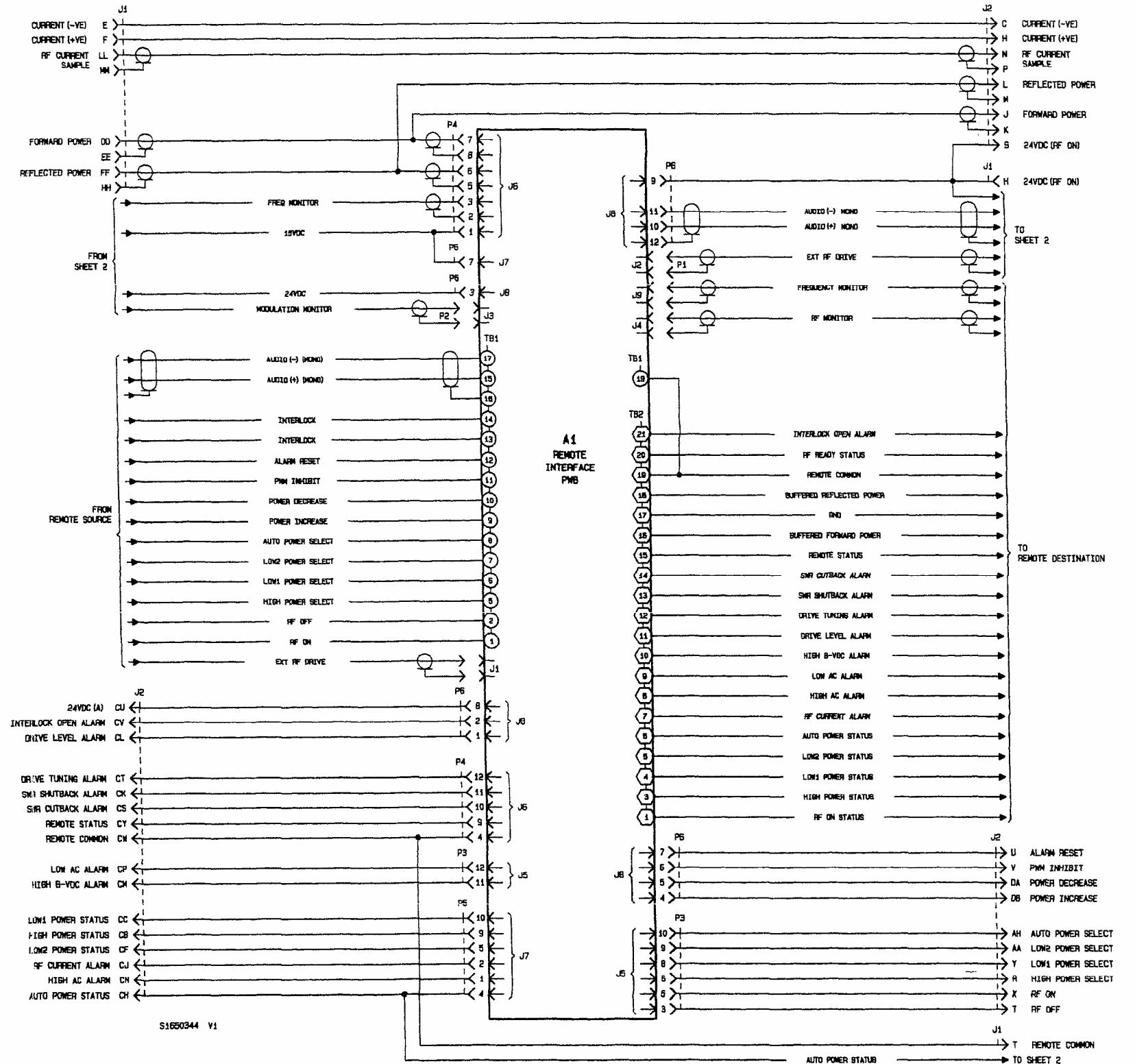


Figure SD-3 Electrical Schematic - Exciter Panel (NAE60) (Sheet 1 of 2)

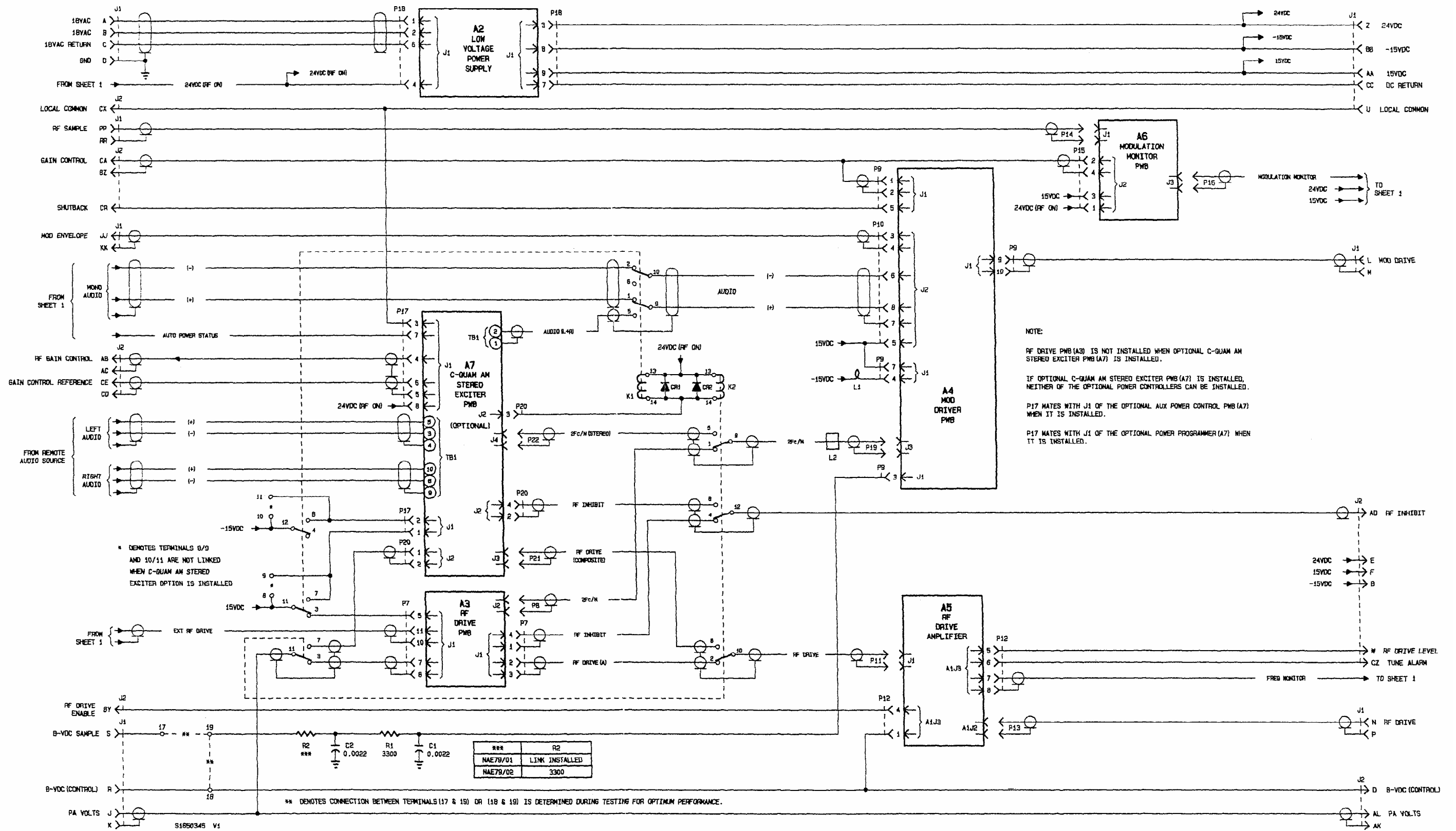
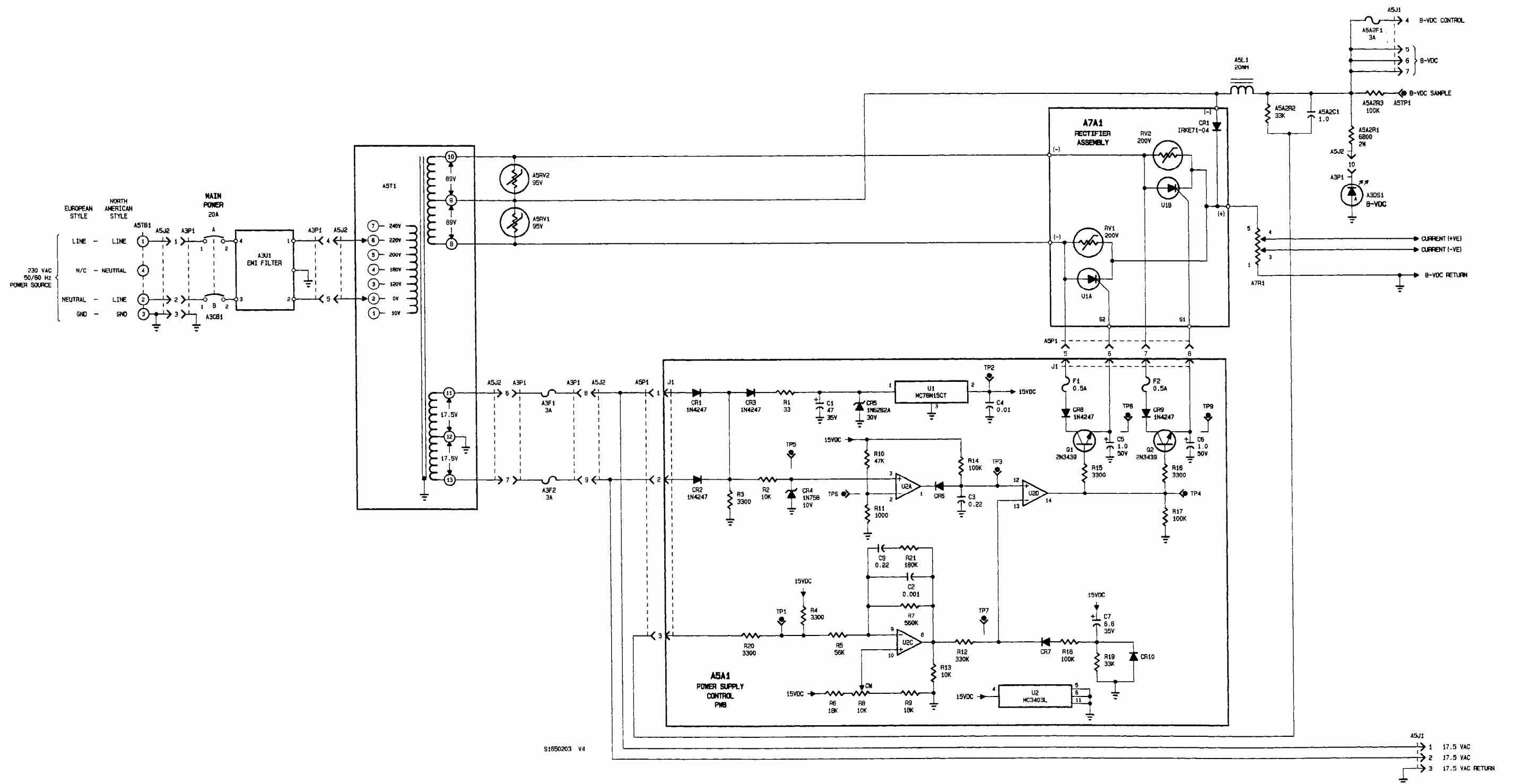


Figure SD-4 Electrical Schematic - Exciter Panel (NAE60) (Sheet 2 of 2)



S1650203 V4

Figure SD-5 Electrical Schematic - Ac/Dc Power Stage (NASR70A/NASR70B)

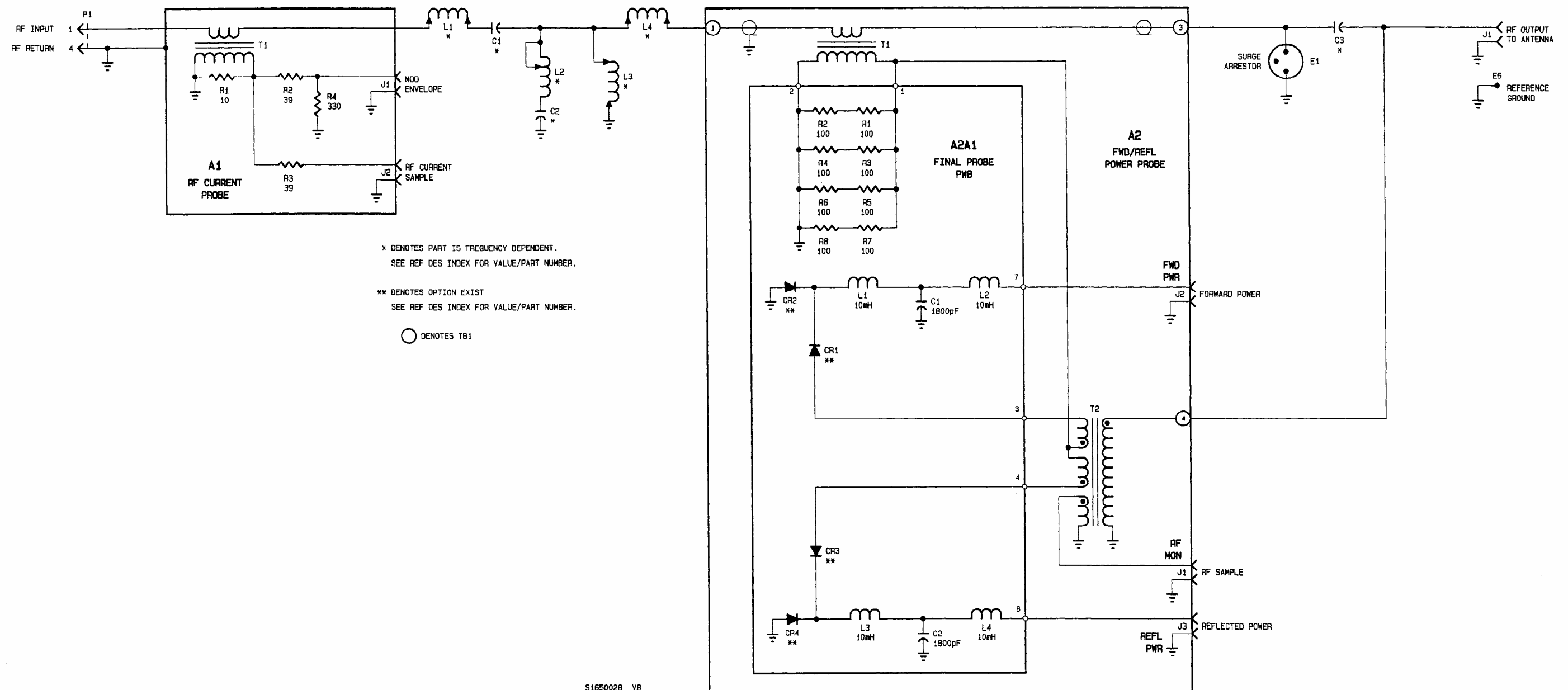


Figure SD-6 Electrical Schematic - 1kW Rf Output Filter (NAF65)

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SECTION 10
MECHANICAL DRAWINGS

INTRODUCTION

10.1 This section contains mechanical drawings for assemblies of the subject equipment. Dimensional drawings may be included. Refer to table 10-1 for an itemized listing. Assembly detail drawings for assemblies/modules that have separate maintenance manuals are not included. Refer to the appropriate maintenance manual for the assembly detail of these assemblies.

LOCATING ASSEMBLY DETAIL DRAWINGS

10.2 Each illustration in this section is identified by a number that is both the figure number and the page number. The numbers are assigned sequentially and are prefixed by the letters 'MD-'. Drawings in this section are listed in table 10-1.

CONTENT OF MECHANICAL DRAWINGS

10.3 Mechanical drawings are illustrations that depict the location of electrical components and show assembly outline detail. Where appropriate, dimensional information will be included.

10.3.1 When a module/assembly is the subject of its own assembly detail drawing and it is also shown in a higher level assembly, the detail depicted in the higher level assembly may have minor differences from the module/assembly actually installed. In this case, always refer to the assembly detail drawing for the module/assembly for detailed information.

Table 10-1 List of Mechanical Drawings

Figure MD-1	Assembly Detail - AMPFET ND1 1kW AM Broadcast Transmitter - Front View
Figure MD-2	Assembly Detail - AMPFET ND1 1kW AM Broadcast Transmitter - Side/Rear Views
Figure MD-3	Assembly Detail - 1kW Control/Monitor Panel (NAC48C)
Figure MD-4	Assembly Detail - Circuit Breaker Panel (NAX89)
Figure MD-5	Assembly Detail - Exciter Panel (NAE60)
Figure MD-6	Assembly Detail - Ac/Dc Power supply (NASR70A/NASR70B)
Figure MD-7	Assembly Detail - Power Supply Control Pwb (NAPC40B)
Figure MD-8	Assembly Detail - 1kW Rf Output Filter (NAF65)
Figure MD-9	Assembly Detail - 1kW Rf Current Probe (NAFP38A)
Figure MD-10	Assembly Detail - 1kW Forward/Reflected Power Probe (NAFP39)
Figure MD-11	Assembly Detail - Rectifier Assembly (NAX88)
Figure MD-12	Assembly Detail - External Dc Interface Panel (P/N 165-7039)
Figure MD-13	Dimensional Information - AMPFET ND1 1kW AM Broadcast Transmitter

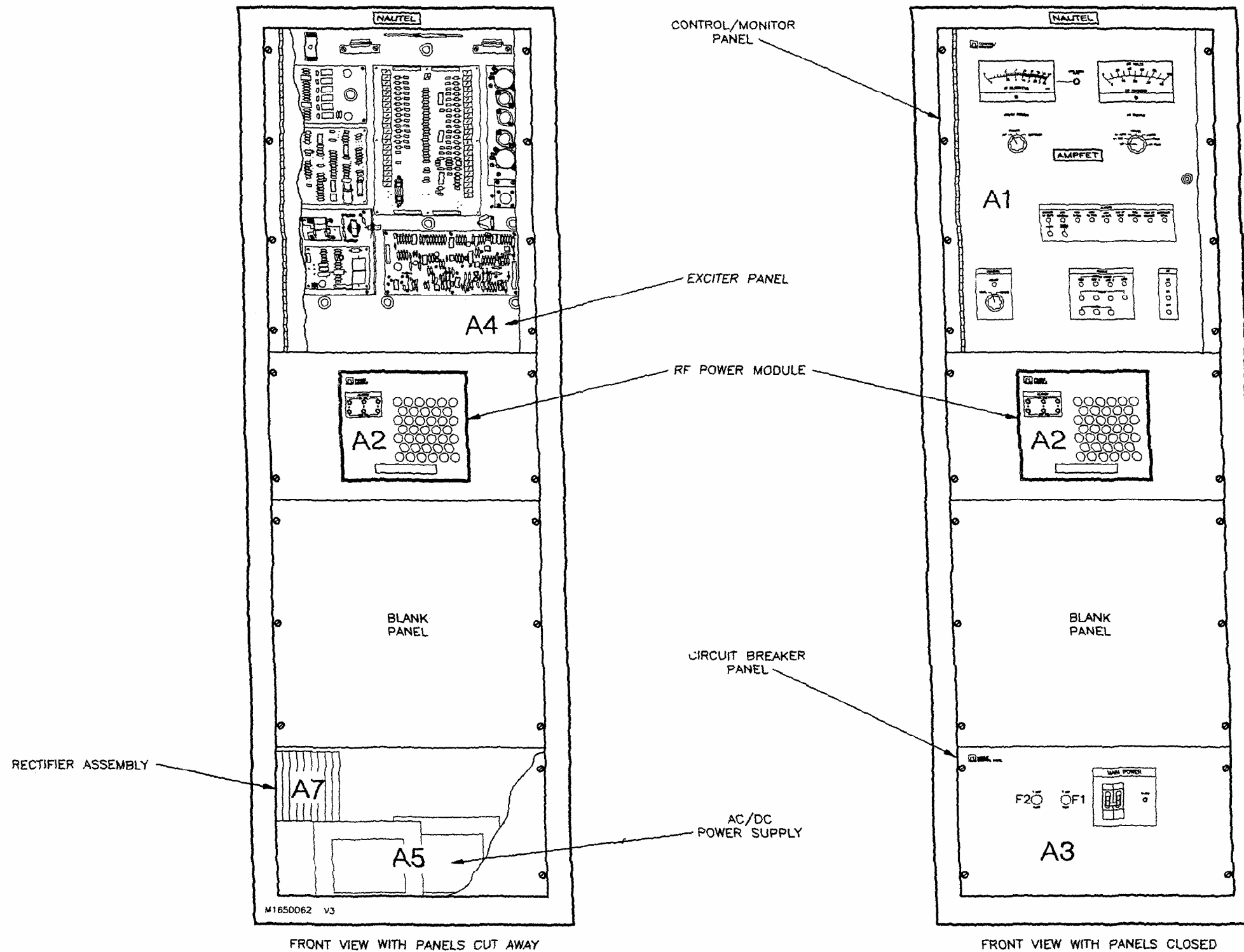


Figure MD-1 Assembly Detail - AMPFET ND1 1kW AM Broadcast Transmitter - Front View

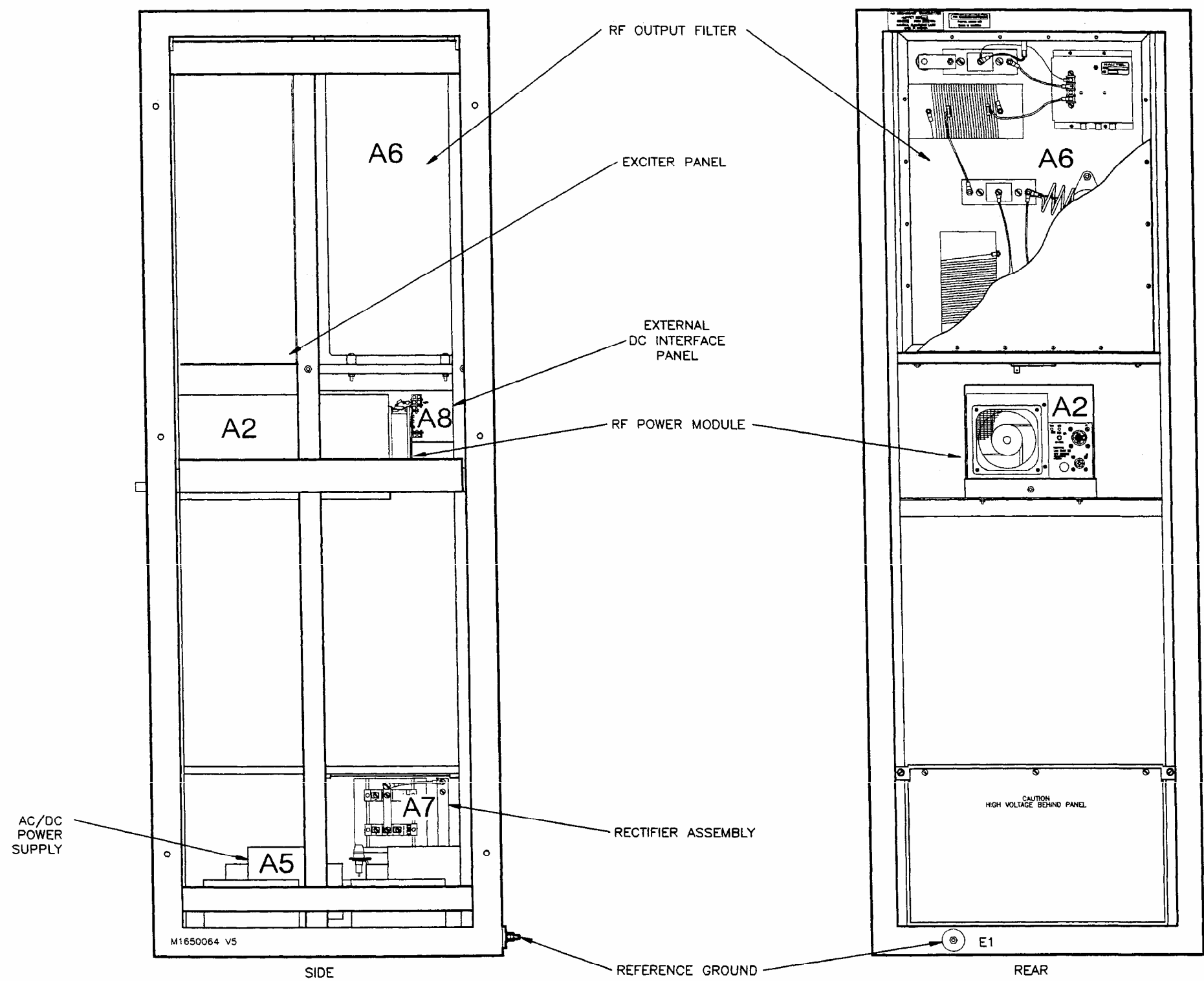


Figure MD-2 Assembly Detail - AMPFET ND1 1kW AM Broadcast Transmitter - Side/Rear Views

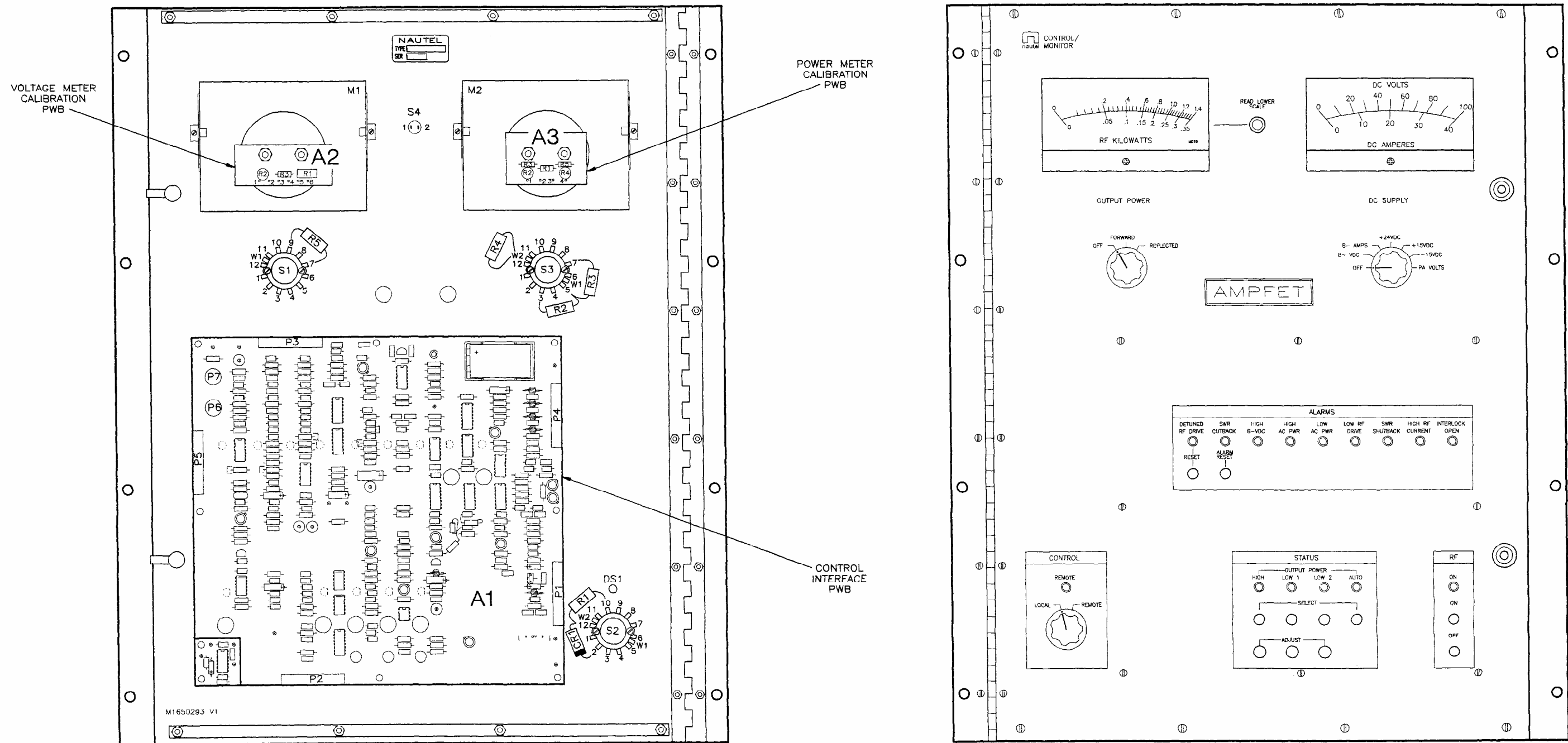


Figure MD-3 Assembly Detail - 1kW Control/Monitor Panel (NAC48C)

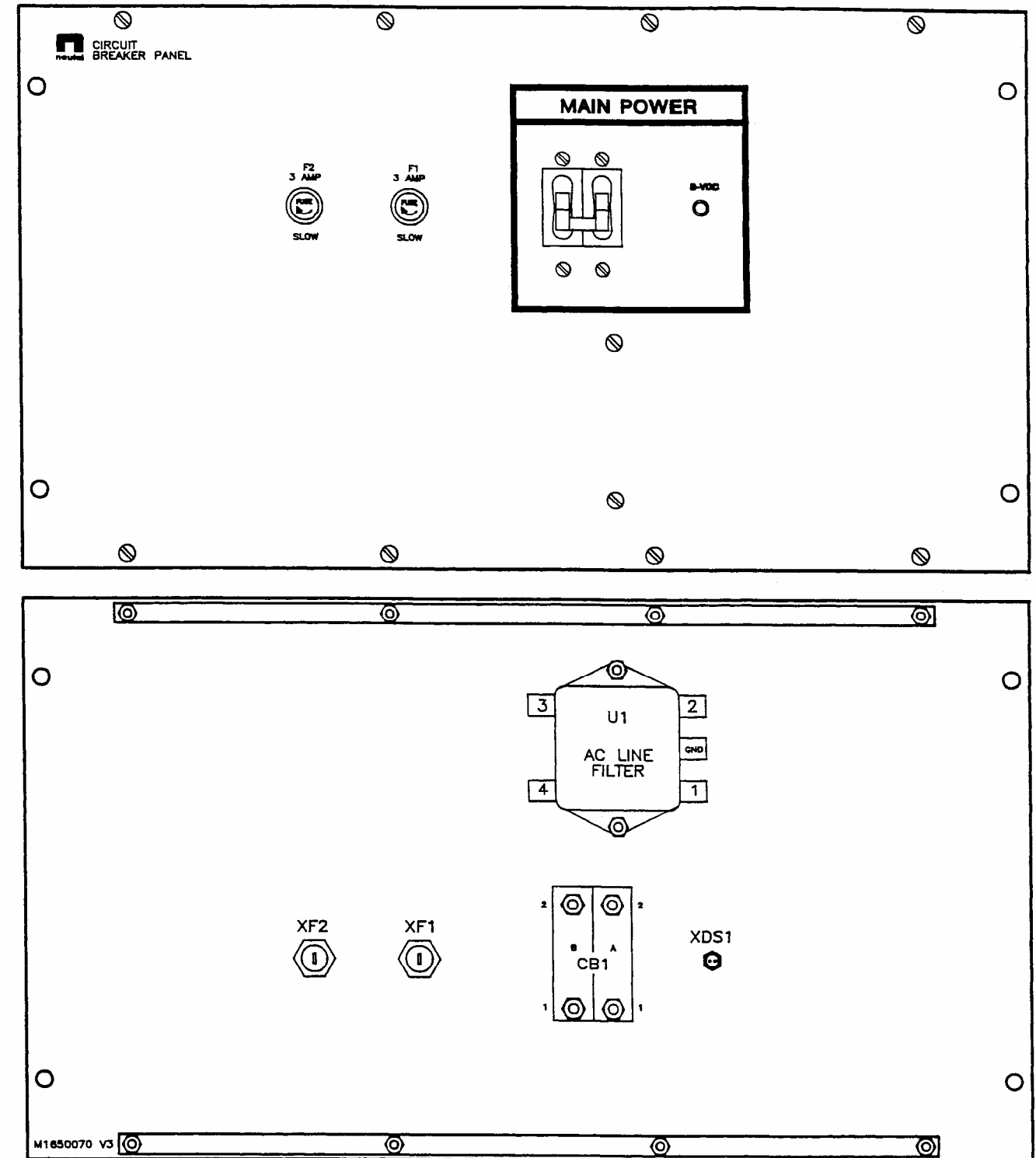


Figure MD-4 Assembly Detail - Circuit Breaker Panel (NAX89)

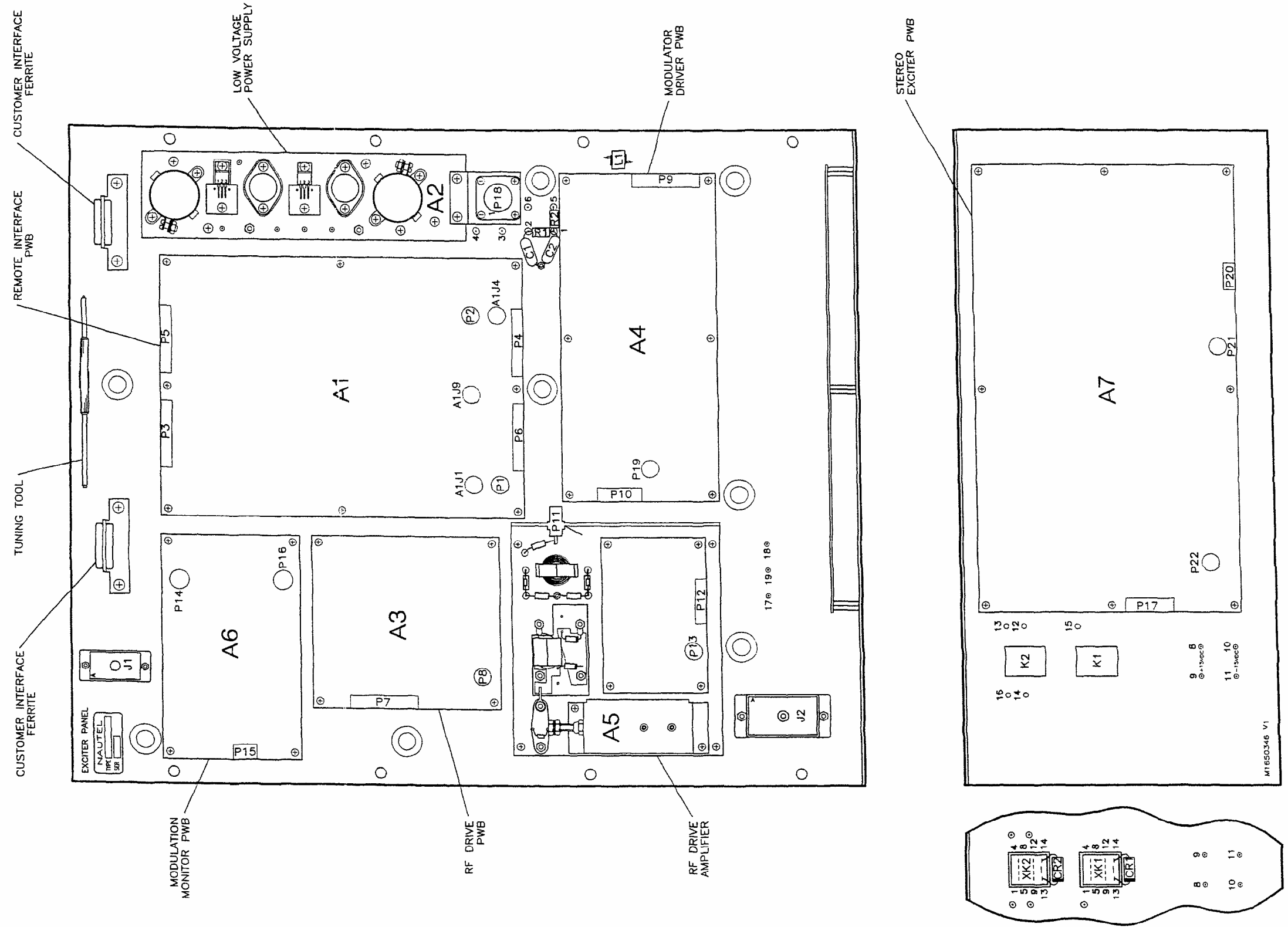


Figure MD-5 Assembly Detail - Exciter Panel (NAE60)

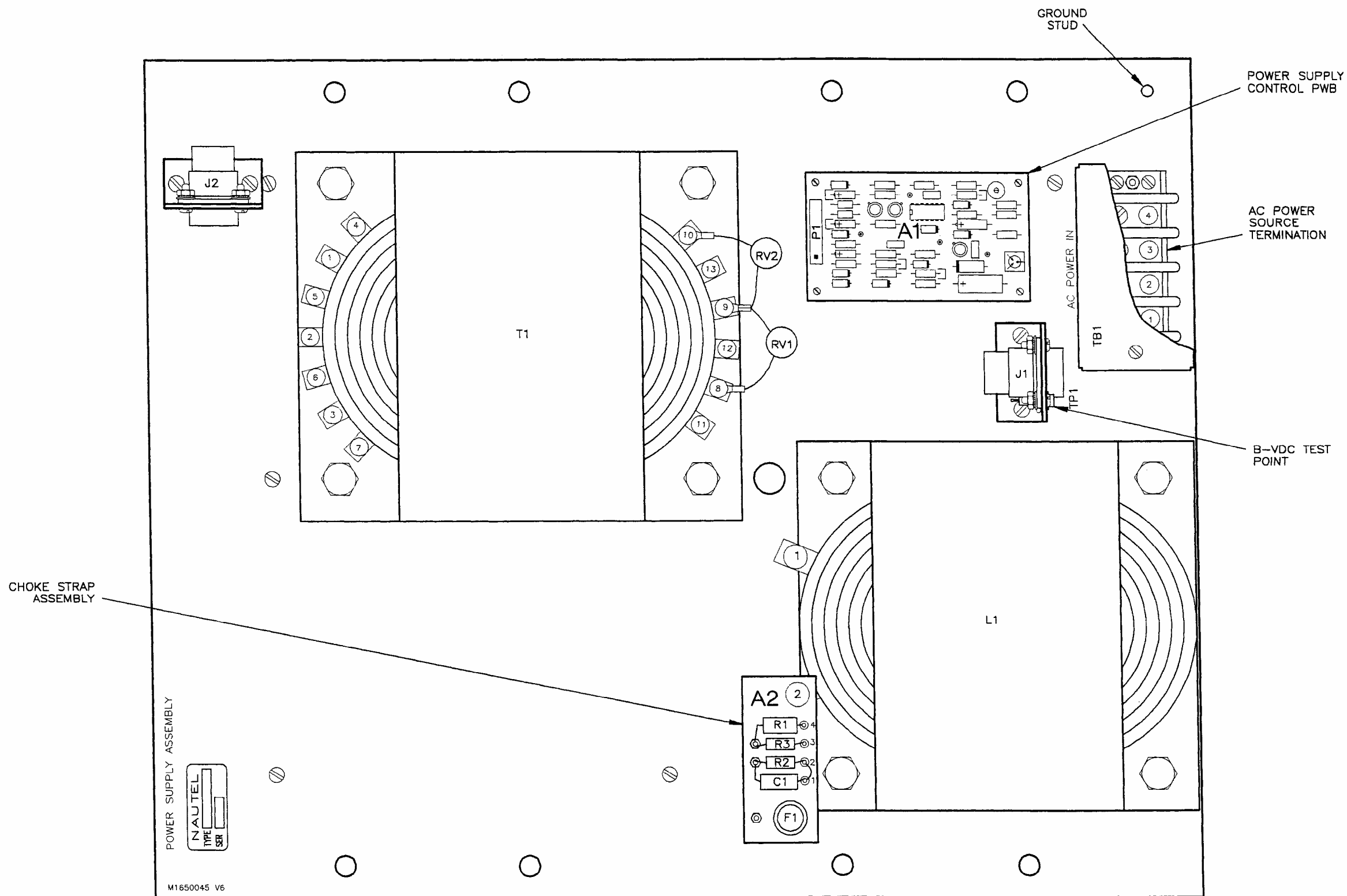
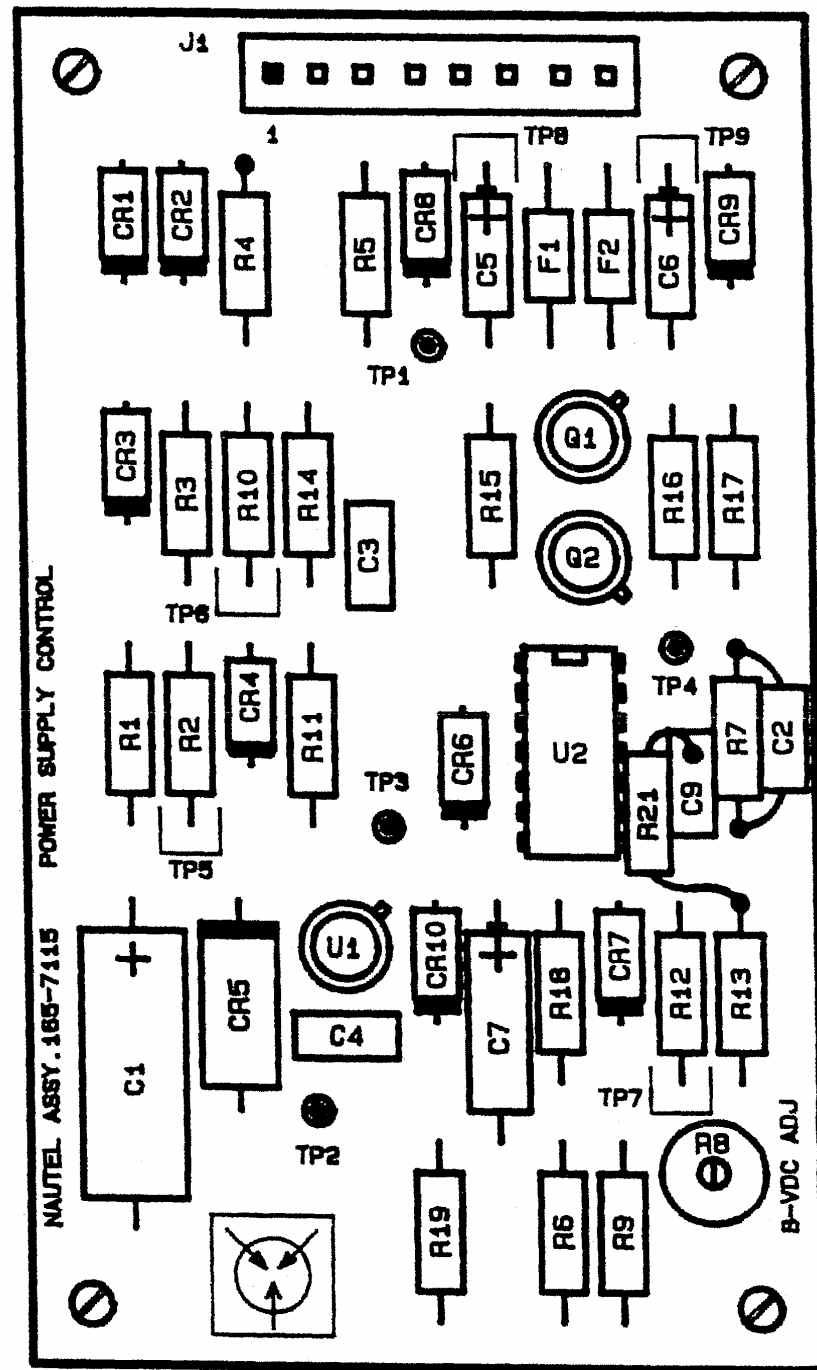
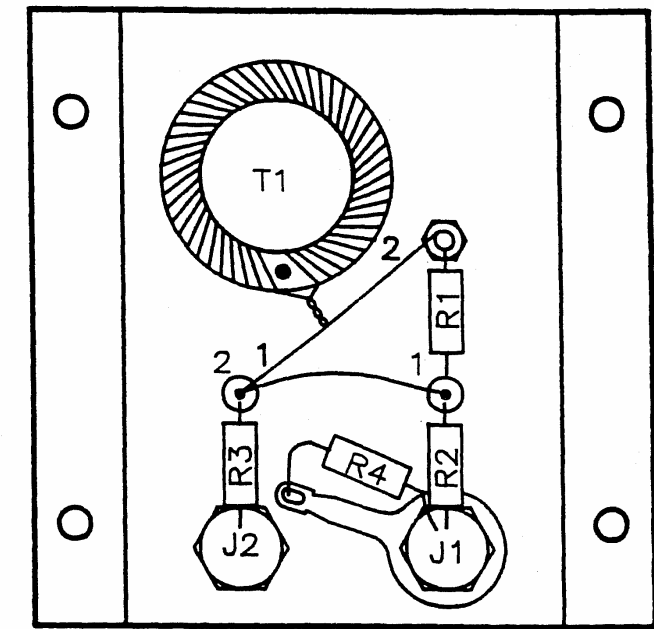
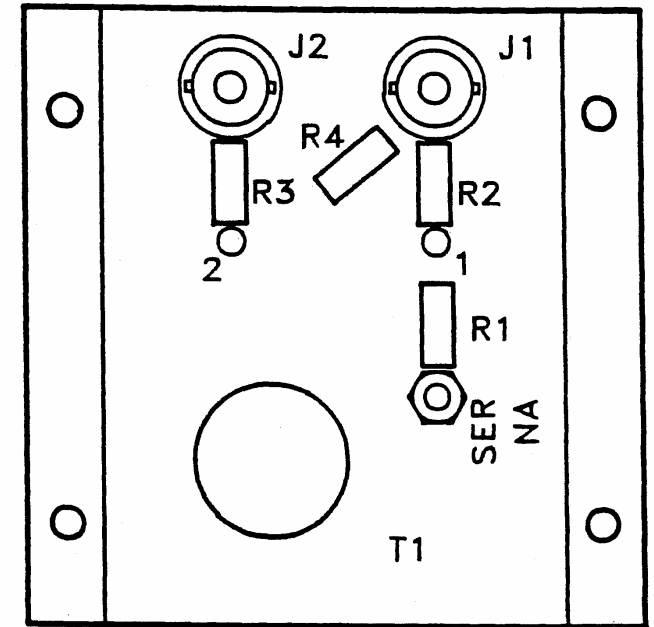


Figure MD-6 Assembly Detail - Ac/Dc Power Supply (NASR70A/NASR70B)



M1650112 V1

Figure MD-7 Assembly Detail - Power Supply Control Pwb (NAPC40B)



M1650128 V3

Figure MD-9 Assembly Detail - 1kW Rf Current Probe (NAFP38A)

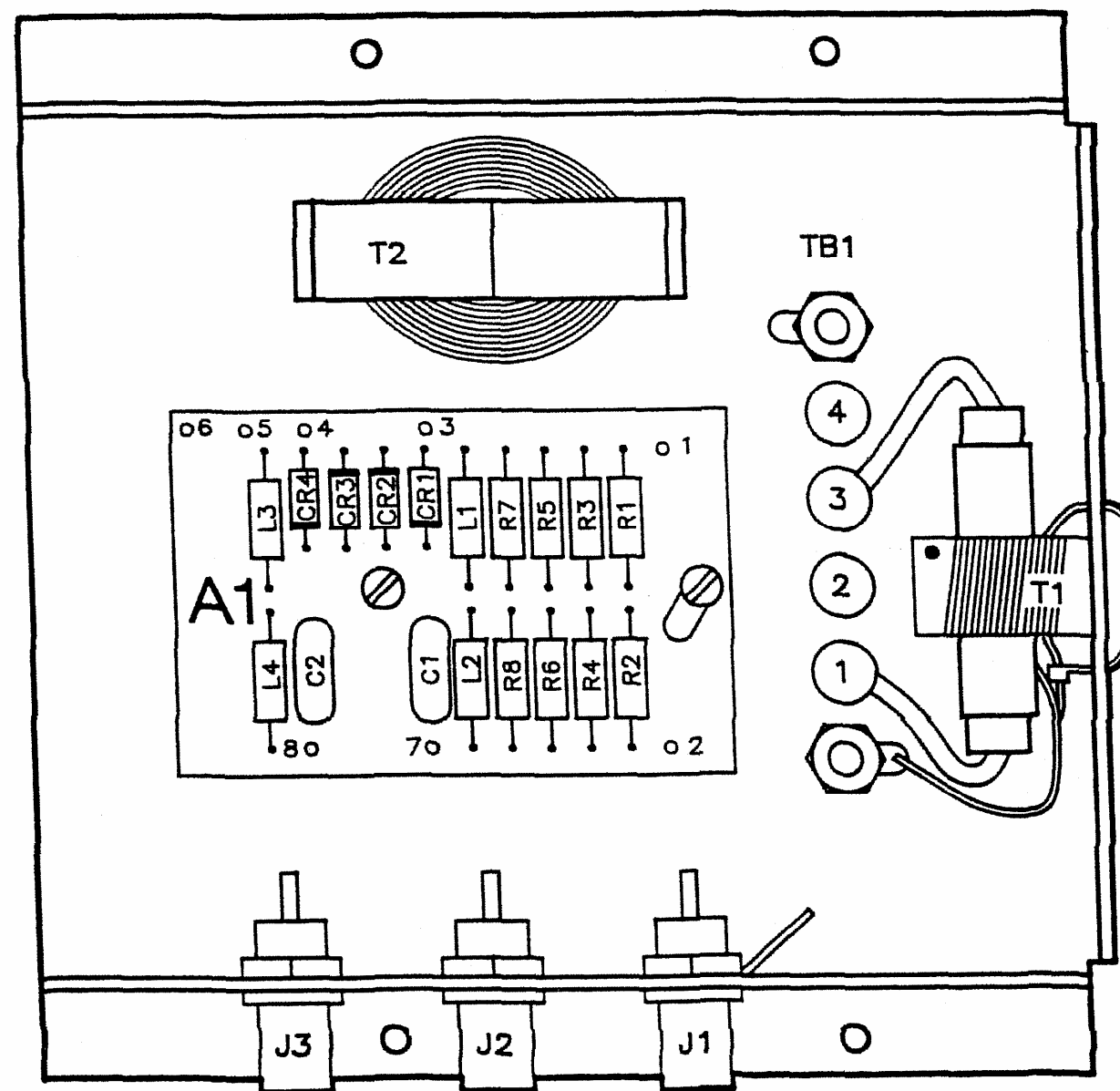
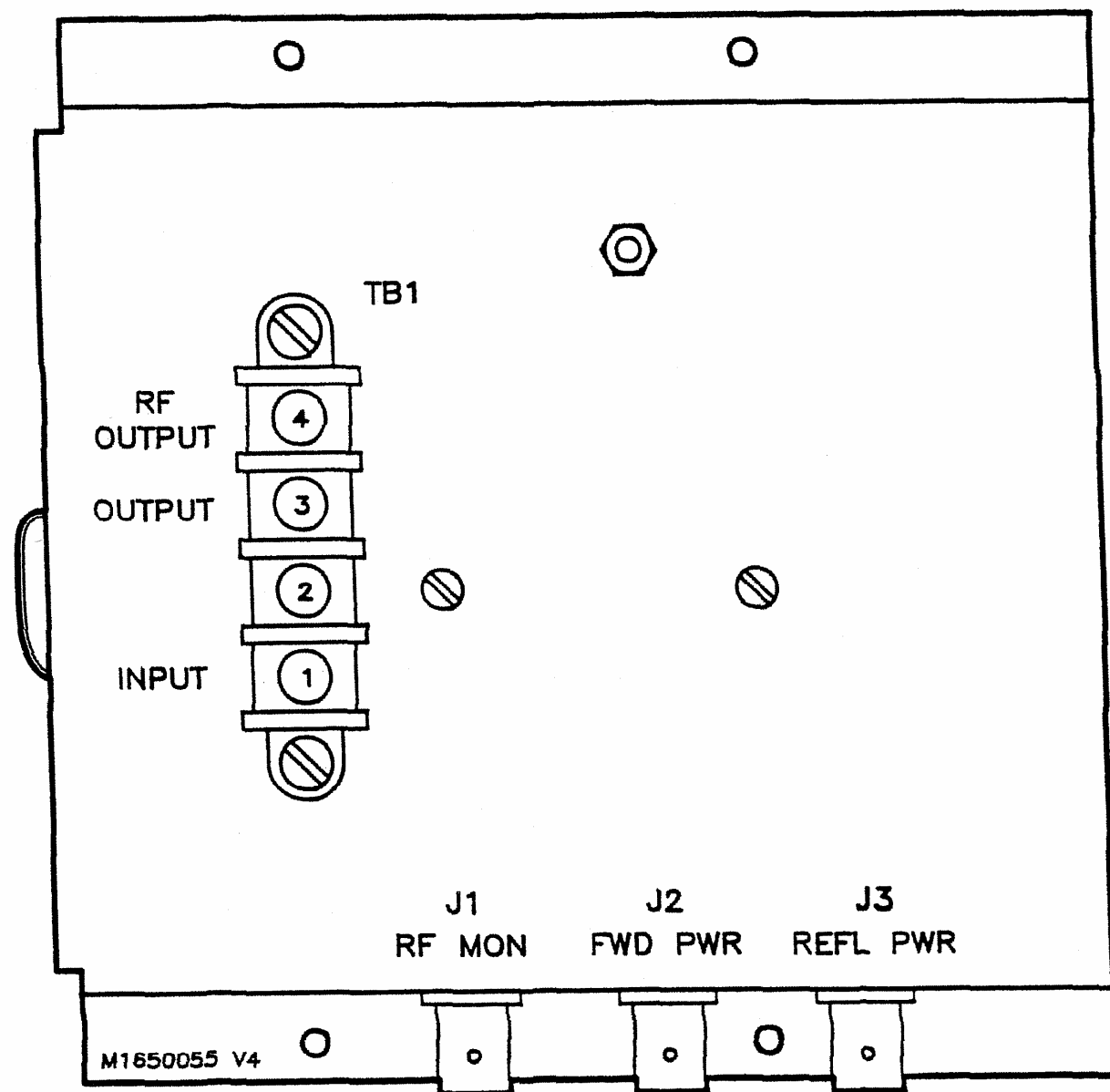


Figure MD-10 Assembly Detail - 1kW Forward/Reflected Power Probe (NAFP39)

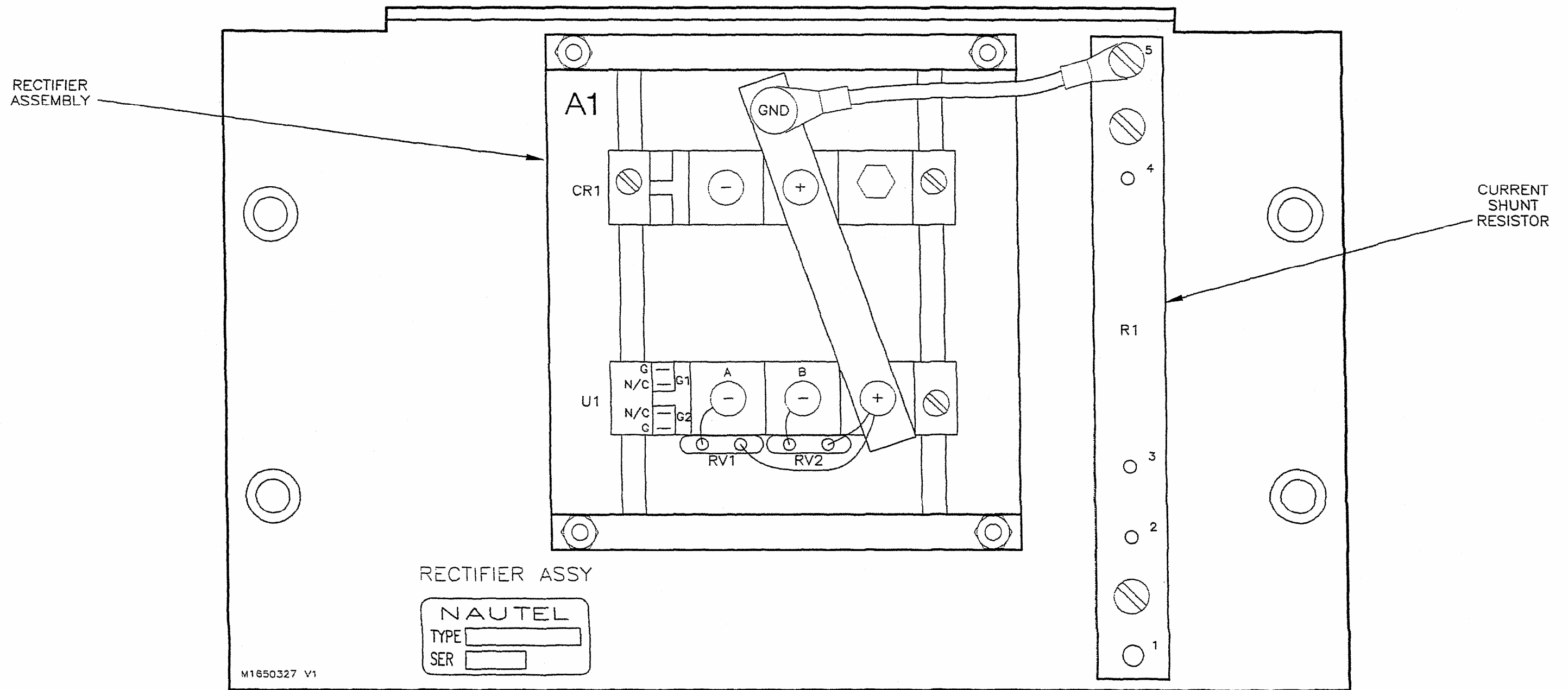
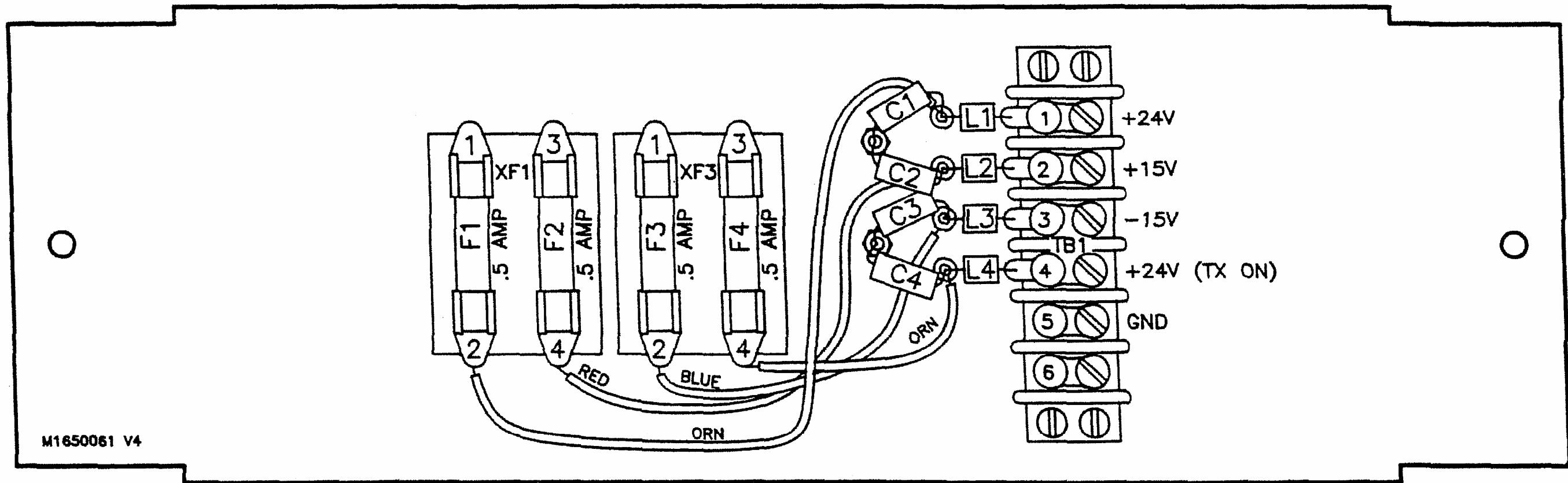


Figure MD-11 Assembly Detail - Rectifier Assembly (NAX88)



M1650061 V4

Figure MD-12 Assembly Detail - External Dc Interface Panel (P/N 165-7039)

NOTE: ALL CABLE ENTRY HOLE
KNOCKOUTS PROVIDE
FOR TWO HOLE SIZES:
= .50
.75

ADDITIONAL AC PWR
CABLE ENTRY HOLES
ARE LOCATED IN THE
BASE AT THE SAME
LOCATION AND IN THE
LOWER RIGHT HAND
CORNER AT THE BASE
OF THE TRANSMITTER

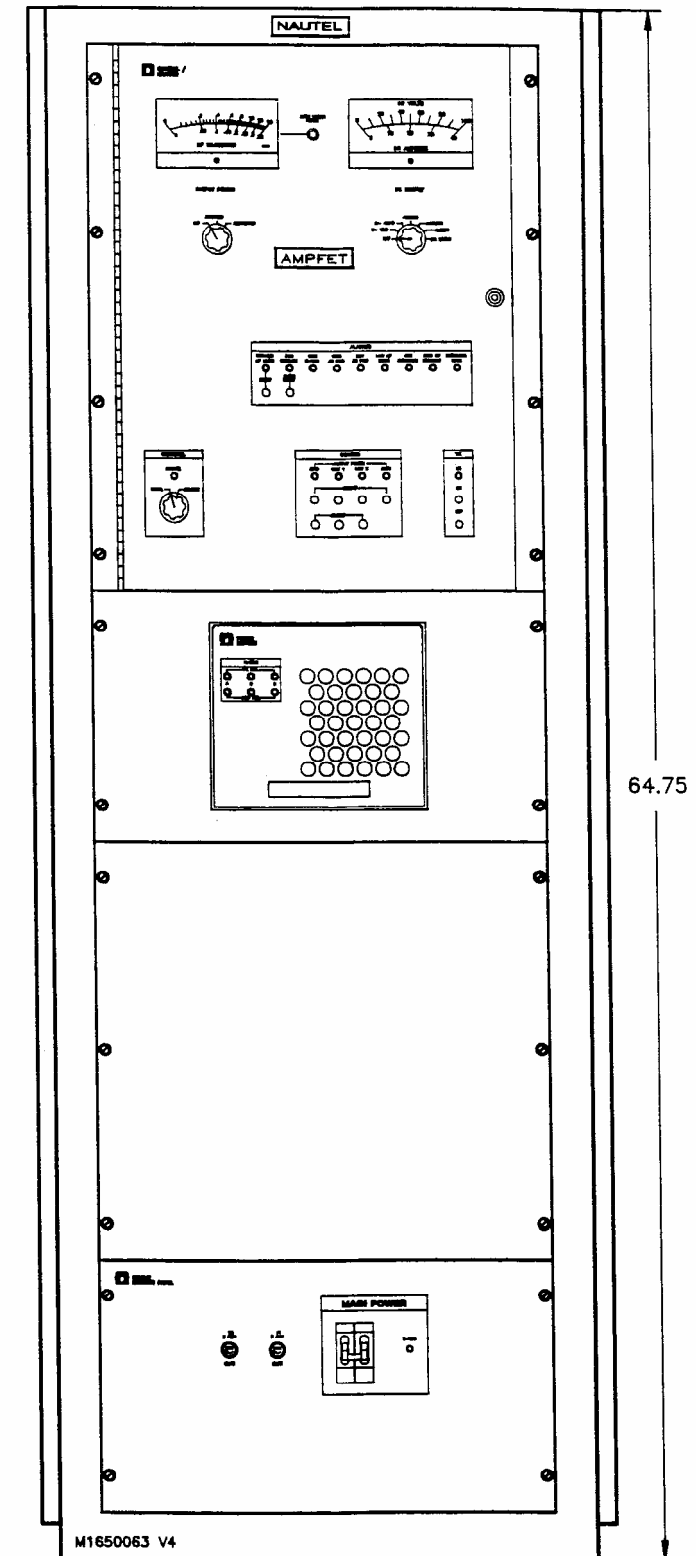
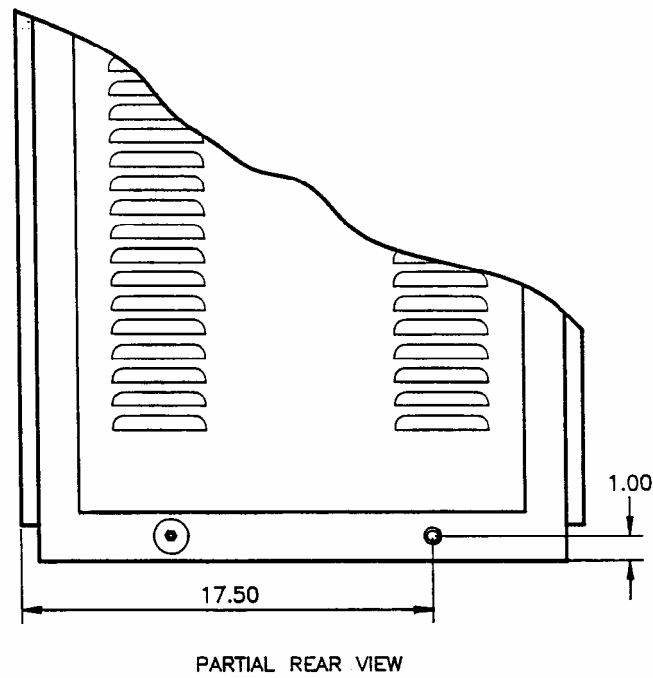
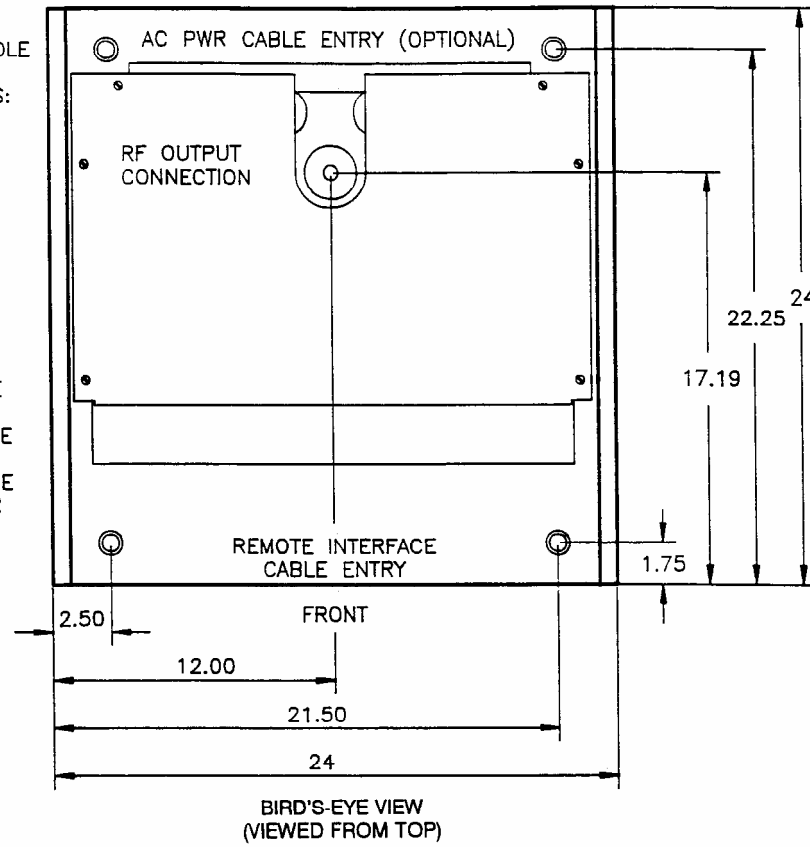


Figure MD-13 Dimensional Information - AMPFET ND1 1kW AM Broadcast Transmitter