TECHNICAL INSTRUCTIONS

ND4000A-02x-xx0

1000 WATT
RADIOBEACON TRANSMITTER

(190kHz to 535kHz)

Original Issue .....01 October 2003
Change 1.....01 July 2004

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Simply the best engineered transmitters

LIST OF EFFECTIVE PAGES

The list of effective pages lists the status of all pages in this manual. Pages of the original issue are identified by a zero in the Change No. column. Pages subsequently changed are identified by the date of the change number. On a changed page, the text affected by the latest change is indicated by a vertical bar in the margin opposite the changed material.

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Change 1..... 01 July 2004

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ARTIFICIAL RESPIRATION (MOUTH-TO-MOUTH)

(a) START MOUTH-TO-MOUTH BREATHING IMMEDIATELY. SECONDS COUNT. Do not wait to loosen clothing, warm the casualty, or apply stimulants.

(b) ASSESS RESPONSIVENESS OF CASUALTY. Do not jar casualty or cause further physical injury (Figure 1)

(c) IF POSSIBLE, SEND A BYSTANDER TO GET MEDICAL HELP. Do not leave casualty unattended (Figure 2)

(d) CHECK CAROTID PULSE (Figure 3)

(e) LAY CASUALTY ON HIS/HER BACK and place any available jacket or blanket under his/her shoulders.

(f) TILT THE HEAD BACK AND LIFT THE CHIN to open the airway (Figure 4)

(g) PINCH CASUALTY'S NOSE AND EXHALE TWO SLOW BREATHS INTO CASUALTY (Figure 5)

(h) REMOVE YOUR MOUTH and check for breathing (Figure 6)

(i) CONTINUE GIVING ONE BREATH EVERY FIVE SECONDS without interruption. If any air is retained in the stomach after exhalation by casualty, press gently on stomach to expel air.

(j) IF CHEST DOES NOT RISE CHECK for obstruction in casualty's mouth: clear foreign material using your finger, tissues, etc. Use chin lift and recommence mouth-to-mouth breathing.

(k) WHILE MOUTH-TO-MOUTH BREATHING IS CONTINUED have someone else:
  (a) Loosen casualty's clothing.
  (b) Keep the casualty warm.

(l) DON'T GIVE UP. Continue without interruption until the casualty is revived, or until a doctor pronounces the casualty dead. Four hours or more may be required.

(m) DO NOT PROVIDE ANYTHING ORALLY while victim is unconscious.

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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 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.

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 that will flow through a victim's body. Very little current (as little as 10 milliamps) can result in severe shock or death.

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. Turn **OFF** the electrical source.
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.

TOXIC HAZARD WARNING

There are devices used in this equipment containing **BERYLLIUM OXIDE** ceramic, which is non-hazardous during normal device operation and under normal device failure conditions. These devices are specifically identified in the equipment manual's parts list(s).

DO NOT cut, crush or grind devices because the resulting dust may be **HAZARDOUS IF INHALED**. Unserviceable devices should be disposed of as harmful waste.

WARRANTY

Nautel 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 that 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.

ON-LINE PART QUOTES

Nautel provides an on-line website service (www.nautel.com/in-service.html) where requests for part quotes may be submitted. Requests will normally be responded to within one working day.

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 e-mail) 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:

U.S.A. customers use:	Nautel Maine Incorporated 201 Target Industrial Circle Bangor, Maine 04401	Telephone Facsimile	207-947-8200 (24 hours) 207-947-3693
All other customers use:	Nautel Limited 10089 Peggy's Cove Road, Nova Scotia, Canada B3Z 3J4	Telephone Facsimile E-Mail Web	902-823-3900 (24 hours) 902-823-3183 support@nautel.com www.nautel.com

MODULE EXCHANGE SERVICE

In order to provide Nautel customers with a fast and efficient service in the event of a problem, Nautel operates a factory rebuilt, module exchange service which takes full advantage of the high degree of module redundancy in Nautel equipment. This module exchange service is operated from Nautel's factory in Bangor, Maine and Hackett's Cove, Nova Scotia. These two locations allow us to provide a quick turn around service to keep our customers on the air. During the transmitter's warranty period, up to thirteen months from shipment, repair and exchange of modules is at no charge to the customer. When the warranty has expired, a charge of 80% of the list price for all exchanged modules is made. If the faulty module is returned to Nautel within 30 days, a credit is issued reducing this charge by one half to 40% of the list price. U.S.A. customers are required to contact our Bangor, Maine facility. Canadian and overseas customers should contact our Nova Scotia, Canada facility.

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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SECTION 1
GENERAL INFORMATION

INTRODUCTION

1.1 The ND4000A radiobeacon transmitter is a dual transmitter that operates in the LF/MF band at 1000 watts maximum (carrier) power. It transmits beacon identification signals at a repetition rate of eight seconds. Provision is made for standby codes to be transmitted when the primary exciter/keyer is switched to the secondary exciter/keyer or when commanded from an external source. Provision is also made for press-to-talk voice telephony. Tone identification and voice signals utilize amplitude modulation. Refer to table 1-2 for a technical summary.

PURPOSE AND SCOPE OF MANUAL

1.2 This manual provides the information necessary to install, operate and maintain the subject transmitter.

PURPOSE OF EQUIPMENT

1.3 When combined with an appropriate antenna system, the transmitter provides reliable facilities for airfield locator or aeronautical enroute requirements. It is ideally suited for remote or unmanned sites. To determine the configuration of a specific transmitter, obtain the complete part number from the transmitter's nameplate and then refer to figure 1-2.

FACTORY REPAIR SERVICE

1.4 Nautel provides a factory module repair service for users of Nautel's transmitters. Users who do not have repair facilities or who are not able to repair an assembly may utilize this service for a nominal fee. Refer to Warranty (page 2) for address of Nautel's repair facility and information to be supplied with returned parts.

MECHANICAL DESCRIPTION

1.5 The ND4000A radiobeacon transmitter is packaged in a single cabinet that weighs approximately 465 pounds (211 kilograms). Refer to figure MD-38 for dimensional information. The RF output coaxial cable connects to a connector on the top of the transmitter cabinet. External AC power and, if applicable, DC power cabling enter the cabinet through cable entry holes on the lower, left and right rear section of the cabinet. External input (audio and control) and output (status and alarm monitoring) cabling enter the cabinet through cable entry holes on the top section of transmitter cabinet.

1.5.1 TRANSMITTER CHASSIS (see figures MD-1 through MD-38): The subject transmitter chassis is a fabricated metal cabinet that accepts standard 19-inch rack mounted assemblies. The rear section of the transmitter is fitted with a lockable, full-depth hinged door. The cabinet is effectively divided into functional sections and the assemblies that are not plug-in or removable modules are fastened to support brackets. Side panels are removable to permit access to the interior during maintenance routines.

1.5.1.1 The cabinet contains the electrical components that are not installed in the plug-in modules and the mechanical positioning hardware to guide and align the plug-in modules. The connectors and the supporting hardware for the plug-in modules are integral parts of the cable wiring harness. Refer to figure MD-1 to determine the identity and location of the plug-in modules that form the subject transmitter. The control/monitor panel (A1) is mounted on a hinged door at the top, front section of the transmitter. Harmonic filter assembly (A9), monitor PWB (A10) and an optional battery panel (A11) are located immediately behind it. Access to these assemblies can be attained by opening the control/monitor panel's hinged door.

Table 1-1 Duplicated Modules/Assemblies

NAUTEL NOMENCLATURE NUMBER	DESCRIPTION	REFERENCE DESIGNATION	QTY
NAP13A/01	Modulator/Power Amplifier	A2 and A3	2
NAE45G/01	Exciter	A4 and A5	2
NAS25B/01 or NAS25B/02	Power Supply	A7 and A8	2

1.5.1.2 Modulator/power amplifier modules (A2/A3) are located below control monitor panel (A1). Exciter modules (A4/A5) are located directly below modulator/power amplifier modules (A2/A3). The power on/off panel (A6) is located directly below exciter modules (A4/A5). Power supply modules (A7/A8) are located at the bottom of the transmitter cabinet. All electrical connections to plug-in modules are made to connectors on the rear sections of the associated modules.

DUPLICATED MODULES/ASSEMBLIES

1.6 Table 1-1 (Duplicated Modules/Assemblies), lists the modules/assemblies which are duplicated to effectively form a dual transmitter. They are easily removed to accommodate maintenance.

TECHNICAL SUMMARY

1.7 Table 1-2 (Technical Summary), contains a detailed technical summary.

SPECIAL TOOLS AND TEST EQUIPMENT

1.8 There are no special tools required. Table 1-3 (Test Equipment), lists the test equipment that is required to operate and maintain the subject transmitters.

GLOSSARY OF TERMS

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

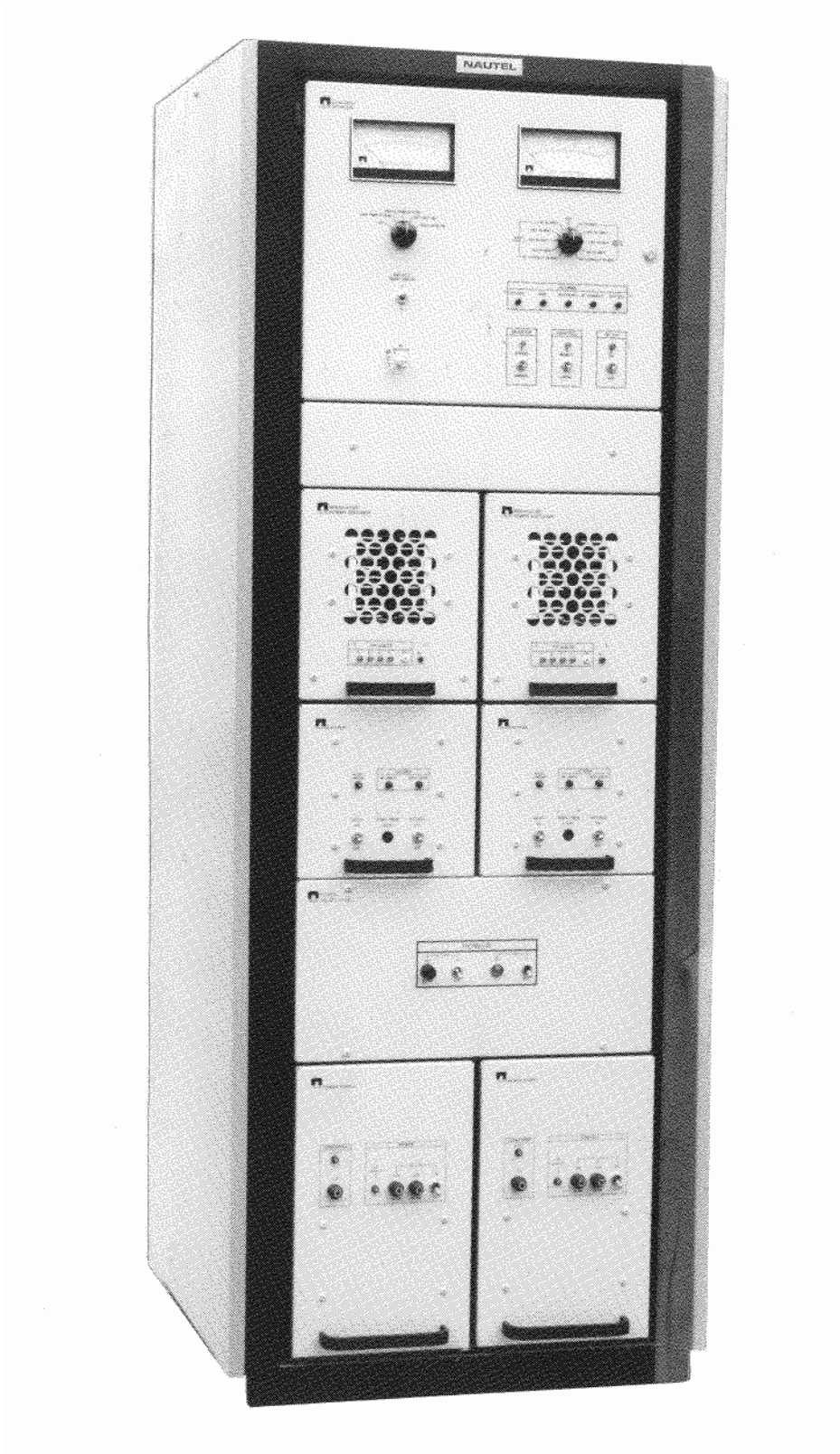


Figure 1-1 ND4000A Radiobeacon Transmitter

Table 1-2 Technical Summary

Equipment Name	LF/MF Radiobeacon Transmitter
Equipment Type Number	ND4000A
Frequency Range	190 to 535kHz
Frequency Control	
Standard	RF Synthesizer
Optional	Crystal Controlled Oscillator
Frequency Tolerance	±0.0003% (RF synthesizer) Over Full Environmental Range ±0.005% (crystal oscillator) Over Full Environmental Range
Type of Emission	
NON	(CW) Continuous Carrier
A2A	(MCW) Keyed Tone
A2A and A3E	(MCW) Simultaneous Telephony/Beacon
RF Carrier Output (one pre-set level)	
AC Power Source	200 Watts (Minimum) to 1000 Watts (Maximum)
DC Power Source	200 Watts (Minimum) to 1000 Watts (Maximum)
Peak Envelope Power	Maximum of 4000 Watts
Keyed Tone Frequency	400 or 1020Hz (±5%)
Modulation Level	0 to 95% (Adjustable)
Harmonics	Not exceeding -80dBs Relative to Carrier when Operating with Associated Antenna Tuning Unit
Level of Spurious Emissions (complies with)	
Canada	Radio Standards Specification 117
USA	FCC Rules and Regulations 87
ICAO	Annex 10
Audio Distortion	Less than 4% at up to 95% Modulation
Audio Response	±2dB from 300 to 3000Hz (A3E)
Noise and Hum Level	Not exceeding -46dB Relative to 1020Hz at 95% Modulation Level
External Audio Input Level	-20 to +20dBm Across 600 ohms (Balanced)
Power Requirements (as ordered by user)	
Voltage	180 to 250 Volts AC
Frequency	50 or 60Hz
Power	2200 VA maximum
External Battery (optional)	-72 Volts DC
Environmental Limits	
Temperature	-10°C to 55°C
Relative Humidity	0 to 95%

Table 1-2 Technical Summary (Continued)

Weight	Approximately 211 Kilograms (465 Pounds)
Dimensions	
Height	165 Centimetres (65 Inches)
Width	61 Centimetres (24 Inches)
Depth	61 Centimetres (24 Inches)
Airflow	Approximately 90 Cubic Feet/Minute
Heat Flushing (Maximum)	2200 BTU's/Hour
REMOTE MAINTENANCE MONITORING INPUTS/OUTPUTS	
(1)	Forward Power
(2)	Reflected Power
(3)	Modulation Percentage
(4)	Power Trim (A) and (B) Control
(5)	+24 Volts DC
(6)	+15 Volts DC
(7)	B- (A or B Side)
External Controls	
(1)	Remote System ON/OFF Control
(2)	Voice (Press-to-Talk) Control
(3)	Remote Standby Code Control
(4)	600 Ohm Balanced Audio Input
(5)	Standby Test
(6)	Battery Reset
External Alarms/Status Outputs:	
(1)	Changeover Alarm
(2)	Shutdown Alarm
(3)	SWR Alarm
(4)	Battery Alarm
(5)	Remote Audio Monitor
Transmitter Failure Threshold	Changeover to Standby Will Occur If:
(1)	Carrier Level Reduces More Than -3dB
(2)	Modulation Level Reduces More Than -4dB
(3)	Keying Ceases
Keyer Details	
Keying Rate	7 Words/Minute
Dot Element Length	0.125 Seconds
Dash Element Length	0.375 Seconds
Interval Between Elements	0.125 Seconds
Interval Between Characters	0.375 Seconds
Code Frame Length	8 Seconds
Code Content	1, 2 or 3 Characters (letters and/or numbers)
Non-coded Period (Option 1)	No tone after last character to end of frame
Non-coded Period (Option 2)	Continuous tone 0.375 seconds after last character to end of frame

Table 1-2 Technical Summary (Continued)

Standby Code 1 (Option A)	Interval of time between 1st character and 2nd Character increased from 0.375 to 0.875 seconds
Standby Code 1 (Option B)	Interval of time between 2nd character and 3rd Character increased from 0.375 to 0.875 seconds
Standby Code 1 (Option C)	Interval of time between last character and start of continuous tone increased from 0.375 to 0.875 seconds. Non-coded period must be continuous tone
Standby Code 2	0.125 second blip occurs 0.875 seconds before 1st character

NOTE: Technical specifications established at 500 watts RF power into a 50-ohm load unless otherwise specified.

Nautel's ND family of radiobeacon transmitters are identified by a multi-part identifier. This identifier is stamped on the transmitter's nameplate and identifies a specific configuration of radiobeacon in accordance with the following:

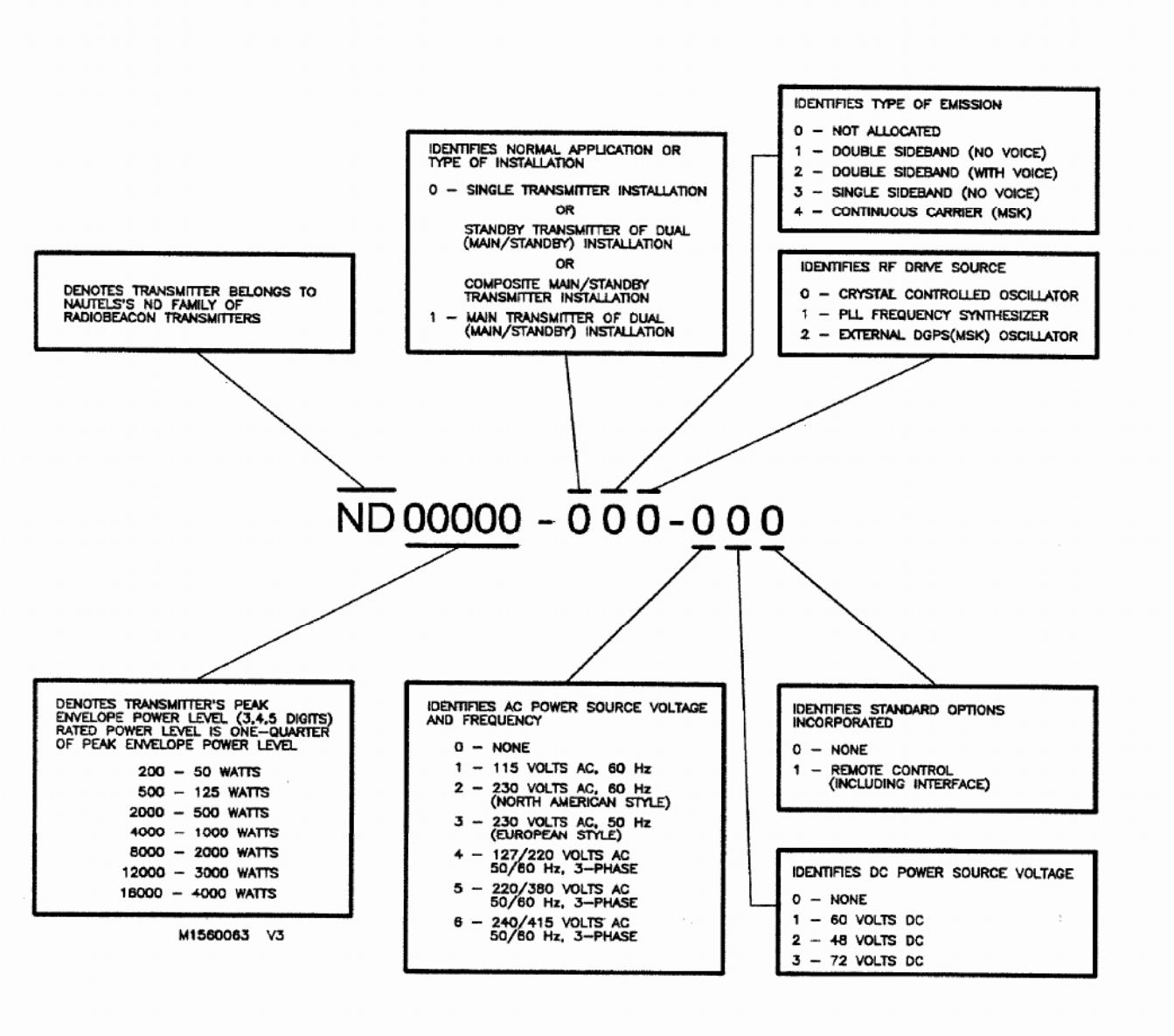


Figure 1-2 Nautel's Identification

Table 1-3 Test Equipment

NOMENCLATURE	PART, MODEL, OR TYPE NUMBER (EQUIVALENTS MAY BE USED)	APPLICATION
Dummy Load	Resistive 50-ohm dummy load rated at 2000 watts (twice the power rating of the transmitter)	Provides precise 50-ohm load during calibration and trouble shooting.
Digital Voltmeter	Any good quality 3 1/2 digit digital voltmeter	Measure voltages/resistances during trouble shooting procedures
AC Voltmeter	HP400E	Precise measurement of RF voltage across dummy load during calibration procedures
DC Ammeter	50 amperes measurement capability	Precise measurement of DC current consumption by power amplifiers during calibration
Oscilloscope	Any good quality oscilloscope with a calibrated time base	Monitor waveforms during testing and trouble shooting procedures
Audio Signal Generator	(600 ohm impedance)	Simulate voice audio during testing and calibration
Variable DC Power Supply	0-70 Volts DC	Vary DC voltages (B- and +15 Volts DC) during calibration
Stop Watch	Stop Watch	Monitor keyer timing of coded information during testing and calibration
Frequency Counter	Any good frequency counter with an accuracy of five parts per million up to 10MHz	Measure audio and RF frequency during testing and trouble shooting.
Variac	Variable Power Transformer	Vary 230 volt AC input during special calibration

Table 1-4 Glossary of Terms

TERM	DESCRIPTION
Bit	Basic timing increment derived from master clock in keying unit. Nominally 125 milliseconds long
Character	Letter or number in the beacon identification signal
Element	Smallest divisible part of a character. May be either a dot or a dash
Frame	Selected, fixed interval of time which is sufficiently long to accommodate the beacon identification signal and an interval of continuous tone. Normally set to 64 bits (eight seconds)
ICAO	International Civil Aviation Organization

SECTION 2
THEORY OF OPERATION

GENERAL

2.1 The theory of operation for the subject transmitter is presented in this section. The information is presented in detail using the electrical schematics as a reference.

TRANSMITTER DESCRIPTION (see figures SD-1 and SD-2)

2.2 The transmitter operates in the LF/MF band (190kHz to 535kHz) at 1000 watts maximum (carrier) power. It automatically transmits specific beacon identification signals at a repetition rate of 8.0 seconds. Standby codes may also be transmitted when commanded from an external source. Provision is made for local or remote operation of the transmitter. Emission is continuous carrier with double sideband amplitude modulation modes, A2A beacon-keyed identification tone and A2A and A3E, simultaneous beacon and voice. Provision is also made for automatic changeover from the selected main side of the transmitter to the standby side when the selected main side's critical parameters are not met.

Outputs, from tapped current shunt resistors R1/R4, provide **DC** current indication on **TEST-Volts/Current** meter that are representative of the current being consumed by side **A** or **B** of the transmitter. Current **A** Cal potentiometer R2 and Current **B** Cal potentiometer R3 provide adjustment for a precise DC current indications during special calibration procedures (side **A** or side **B**). Links between terminals 1/2 and 3/4 on TB3 are either connected or removed, dependent on the status (removed or installed) of optional battery panel A11.

CONTROL/MONITOR PANEL (A1) (see figure SD-3)

2.3 Control/monitor panel A1 contains switched metering circuits that monitor forward power, reflected power, modulation percentage, DC operating voltages and DC current of both sides of the transmitter. The monitor also contains alarm lamps, which turn on, when the following conditions exists; high RF current, high SWR, standby status and shutdown status. A battery alarm, when turned on, indicates the transmitter's B- operating voltage is being produced by an external DC power source (battery etc).

The RF monitor connector provides a BNC coaxial connection for external test equipment to monitor a sample of the RF output of the transmitter. Other switching controls included are; local or remote selection, monitor (changeover inhibit), RF on/off and a select **SELECT MAIN Tx** switch (side-**A** or side-**B** selection). Individual circuit descriptions are as follows:

2.3.1 LOCAL/REMOTE CONTROL: The local/remote switching circuit controls the electrical power for the transmitter when the RF switch is set to **ON**. During normal operation, the **CONTROL** switch is set to **REMOTE** and **REMOTE** lamp is turned on. Power trim A/B function and on/off switching facility can be controlled from a remote location. An external A/B main select (ground) on A1P4-11, when present, changes the selected main-side. When changeover occurs, remote and local standby alarm signals are generated. The **STANDBY-ALARM** lamp shall turn on.

2.3.2 NORMAL/BYPASS CONTROL: During normal operation the **MONITOR** switch will be set to **NORMAL**. When the **MONITOR** switch is set to **BYPASS**, the **BYPASS** lamp will turn on. A control signal (ground) will be passed through connector A1P4-10 and applied to the monitor PWB. The automatic changeover circuits (main to standby) within the monitor PWB will be inhibited. When the **MONITOR** switch is set to **NORMAL**, the **BYPASS** lamp will turn off and the changeover circuits will no longer be inhibited.

2.3.3 RF CONTROL SWITCH: The RF switch controls the **ON/OFF** function of the transmitter and resets the transmitter to the selected main-side when set to **OFF** then **ON** (if the transmitter is operating in the standby-side, transmitter will automatically be reset to the selected main-side). The **RF ON** status lamp will turn on when the RF switch is set to **ON**.

2.3.4 ALARM LAMPS: The following paragraphs explain each alarm lamp function:

2.3.4.1 Battery-Alarm Lamp: The **BATTERY-ALARM** lamp is normally turned off. When the B- operating voltage for the transmitter is produced by an external DC power source (battery etc), a battery control (+15V) signal will be applied through connector A1P4-1 and passed to the anode of **BATTERY-ALARM** lamp. The alarm-lamp will turn on.

2.3.4.2 RF Current-Alarm Lamp: The **RF CURRENT ALARM** lamp is normally turned off. When troughs of the modulation envelope, as sensed by the RF current probe at the harmonic filter's input, are exceeding the preset RF current threshold, +15 volts DC shall be applied thru connector A1P5-12 to the anode of the **RF CURRENT** lamp. The lamp will turn on. The RF current alarm lamp shall also turn on when the antenna impedance is less than 50 ohms at the sideband frequency and the antenna current is exceeding the current that would be present if the antenna impedance was 50 ohms.

2.3.4.3 SWR-Alarm Lamp: The **SWR-ALARM** lamp is normally turned off. When a reflected power ratio in excess of 2:1 has been sensed at the output of the harmonic filter, +15 volts DC shall be applied thru connector A1P4-9 and passed to the anode of the **SWR-ALARM** lamp. The alarm-lamp will turn on.

2.3.4.4 Standby-Alarm Lamp: The **STANDBY ALARM** lamp is normally off. When the selected main side turns off (caused by a fault on the selected main-side or a standby test control signal from a remote location), a B- control signal will be applied thru connector A1P3-5 and passed to the **STANDBY-ALARM** lamp. The alarm-lamp will turn on.

2.3.4.5 Shutdown-Alarm Lamp: The **SHUTDOWN ALARM** lamp is normally turned off. When the subject transmitter's main and standby sides have turned off, a B- control signal will be applied thru connector A1P4-12 and passed to the cathode of the **SHUTDOWN-ALARM** lamp. The alarm-lamp will turn on. The **STANDBY-ALARM** lamp shall normally be turned on prior to the **SHUTDOWN-ALARM** lamp turning on.

2.3.5 SELECT MAIN TX SWITCHING: The **SELECT MAIN TX** switch selects which side of the subject transmitter will be the main operating side **A** or **B**. When set to **A**, the **A** side will be the selected main-side and the **B** side will be the standby. Either side may be selected for the main-side. The B- operating voltage, from side **A** and side **B** of the transmitter are interfaced through the selected contacts of the switch and passed to their respective destinations.

2.3.6 SWITCHED METERING: The switched metering circuit contains a **TEST-Power/Mod** meter with an associated switch and a **TEST-Volts/Current** meter with its associated switch. The following is a description of the metering circuits:

2.3.6.1 Test-Power/Mod Meter/Switch: The **TEST-Power/Mod** meter provides an indication of the parameter (forward power, reflected power or modulation) selected by the **TEST-Power/Mod** switch. When it is set to **OFF**, the meter movement is shorted out. **SET 100% MOD** potentiometer (located on the monitor PWB) is adjusted for 100% modulation indication on the meter when the switch is set to **MOD SET**.

2.3.6.2 Test Volts/Current Meter/Test Switch: The **TEST-Volts/Current** meter provides an indication (for both sides of the transmitter) of the parameter (B-VDC, +24 VDC, +15 VDC, -15 VDC and DC current), as selected by the **TEST-Volts/Current TEST** switch. When it is set to **OFF**, the meter movement is shorted out. Potentiometer A1A1R2 is adjusted for a precise voltage indication on the meter when the switch is set to **B-V** (Side **A** or Side **B**).

MODULATOR/POWER AMPLIFIER MODULE

2.4 There are two identical modulator/power amplifier modules (A2 and A3) in the transmitter. Only one of them will be in use during operation. Modulator/power amplifier A2 will be selected when the **SELECT MAIN TX** switch is set to **A**, modulator/power amplifier A3 will be selected when it is set to **B**. See figure SD-4 for the electrical schematic and figure MD-4 through MD-9 for assembly detail.

A modulator/power amplifier can provide up to 4000 watts of peak envelope power or 1000 watts of continuous carrier power, over a frequency range of 190kHz to 535kHz. Each modulator/power amplifier contains four identical modulator assemblies (A1, A3, A5 and A7), four identical power amplifier assemblies (A2, A4, A6 and A8) and a display interface PWB (A9).

2.4.1 MODULATOR (A2A1) (see figure SD-4)**:** The description for the four modulators are identical. Only modulator A1 will be explained. Modulator PWB assembly A1A1, power MOSFET A1Q1 and their associated components form a switched regulator circuit that changes the logic level of the variable width modulator drive pulses from a ground reference to a B- voltage reference (logic 0).

2.4.1.1 The mod drive (0 to +15 VDC pulses) on J1-1 is applied to switching transistor A1A1Q1. A1A1Q1 will switch on/off as the 0 to +15 VDC pulses are applied to its emitter. The output on its collector will be passed to transistors A1A1Q2/Q3. The bases of A1A1Q2/Q3 will be switching between the B- level and a voltage that is 13 VDC less negative than the B-level.

Transistors A1A1Q2/Q3 and their associated components form a balanced drive for power MOSFET transistor A1Q1. Zener diode A1A1CR1 and resistor A1A1R2 establish a reference voltage which is 13 VDC less negative than the B- voltage, this reference is applied to the collector of transistor A1A1Q2. When the bases of transistors A1A1Q2/Q3 are at B- level, A1A1Q2 will be turned off and A1A1Q3 will be turned on. The voltage at the emitter junction of transistors A1A1Q2/A1Q3 will be at the B-level, MOSFET A1Q1 will be switched off. When the bases of transistors A1A1Q2/Q3 are 13 volts DC less negative than the B- level, A1A1Q2 will be turned on, A1A1Q3 will be turned off, MOSFET A1Q1 will be switched on. The output at the emitter of A1A1Q2/Q3 will be a rectangular waveform at the pulse width modulator switching frequency and shall be switching between the B-voltage and a level that is 13 VDC less negative.

2.4.1.2 Zener diode A1A1CR1 maintains the voltage on the collector of A1A1Q2 at 13.0 VDC (logic 1) more positive than the B- voltage (logic 0), regardless of the state of transistor A1A1Q2, this ensures the voltage across the gate/source junction of MOSFET A1Q1 does not exceed 13.0V. Transistors A1A1Q2/Q3 act as switches between a logic 1 and a logic 0 to charge and discharge the capacitive load presented by the gate of MOSFET A1Q1. MOSFET A1Q1 acts as a switch that connects it's load to the B- line when turned on and to ground when turned off.

2.4.1.2.1 When a logic 1 is applied to the base of transistors A1A1Q2/Q3, A1A1Q2 will be forward biased (turned on) and A1A1Q3 will be reverse biased (turned off). A logic 1 will be applied to the gate of MOSFET A1Q1 and it will turn on. When MOSFET A1Q1 is turned on, current will flow thru inductor A1L1.

2.4.1.2.2 When a logic 0 is applied to the bases of transistors A1A1Q2/Q3, A1A1Q2 will be reverse biased (turned off) and A1A1Q3 will be forward biased (turned on). A logic 0 will be applied to the gate of MOSFET A1Q1 and it will turn off. Current in inductor A1L1 will collapse thru free wheeling diodes A1CR1/CR2.

2.4.1.3 Inductors A1L1 and L1 and capacitors C2/C3 form a low pass filter which removes the switching frequency (70kHz) but allows audio information (300 to 3000Hz) to pass without attenuation. The resultant output of the low pass filter is a negative DC voltage that varies at the frequency and amplitude of the modulating audio being applied. The level of the negative voltage is the average of the fixed width pulses (from the modulator driver) required to produce the desired RF carrier output from the transmitter when there is no modulation present. The superimposed audio's frequency is determined by the rate the pulse width changes. The amplitude is determined by the amount the pulse width differs from the fixed width of the reference pulses.

2.4.1.4 The **PA VOLTS 1** lamp monitors the output of modulator A2A1. It will be full brilliance when the output power level is at maximum (250 watts). The average voltage of the four modulators may be monitored at test point TP1.

2.4.2 POWER AMPLIFIER (A2A2): The description for the four power amplifiers are identical. Only power amplifier A2A2 will be explained. The RF drive input on A2J1 is applied to the primary windings of 8:3 step-down transformer A2T1. The output of each secondary winding is applied across the gate and source terminals of a power MOSFET

transistor. When the gate of MOSFET A2Q1 is positive, the gate of MOSFET A2Q4 will be positive, the gates of MOSFETS A2Q2/Q3 will be negative. MOSFETS A2Q1/Q4 will be turned on, MOSFETS A2Q2/Q3 will be turned off. A hot carrier diode, placed across the source/drain junction of each MOSFET, ensures switching transients do not damage the MOSFET transistors.

2.4.2.1 The secondary windings of transformer A2T1 are configured to ensure the RF voltage applied to MOSFETS A2Q1/Q4 and MOSFETS A2Q2/Q3 are in phase. The voltage applied to A2Q1/Q4 is 180 degrees out of phase with the voltage applied to A2Q2/Q3. When A2Q1/Q4 are turned on, A2Q2/Q3 will be turned off. Current will flow from the modulation voltage thru the drain/source junction of MOSFET Q1, thru the primary windings of transformer T1, thru the drain/ source junction of Q4 to ground. During the next half cycle, A2Q1/Q4 are turned off, A2Q2/Q3 will be turned on. Current will flow from the modulation voltage thru the drain/source junction of A2Q3, in the reverse direction thru the primary windings of transformer T1, thru the drain/source junction of A2Q2 to ground. The resultant RF output (250 watts maximum) on the secondary of transformer T1 is essentially a square wave at the RF carrier frequency. This output is combined with output of the three associated power amplifiers (A4/A6/A8) and applied to connector J1 (1000 watts maximum).

2.4.2.2 When the temperature in a module reaches 82°C, thermal switch S1 opens and inhibits the mod drive input on TB1-3. Thermal switch S1 closes when the temperature falls below 82°C. The **B- DC SUPPLY** lamp shall turn on when the B- voltage is present.

EXCITER MODULE

2.5 There are two identical exciter modules (A4 and A5) in the transmitter. Only one will be used during operation. Exciter A4 will be selected when the **SELECT MAIN TX** switch is set to **A**, exciter A5 will be selected when it is set to **B**. An exciter module contains a keyer (A1) which provides the modulating audio; a modulator driver (A2) which produces a 70kHz, variable pulse width, mod drive output containing the carrier level and modulation information; an RF frequency generator (A3) which may be a fixed frequency, crystal-controlled RF oscillator or a DDS RF synthesizer; an RF drive amplifier (A4) which increases the RF drive to the power level required by the modulator/power amplifier stage and regulated +15V and -15V power supplies. See figure SD-5 for electrical schematic and figures MD-13 through MD-16 for assembly detail.

2.5.1 +15 VDC REGULATOR: The +15.0 VDC regulator contains regulator A4U1 and its associated components. If regulator A4U1's output exceeds +16.0 VDC, current will flow thru resistor A4R7 to the gate of thyristor A4Q1. Thyristor A4Q1 will turn on clamping the +24 volt DC input at A4J2-2 to ground. The regulated +15 VDC can be checked on the **TEST-Volts/Current** meter.

2.5.2 -15 VDC REGULATOR: The -15.0V circuit contains zener diode A4R1 and its associated components. When the RF switch is turned on, the B- voltage is applied through A4J2-1 to diode A4CR1. Zener diode A4CR1 ensures the -15.0V does not exceed the required limits. The regulated -15.0V can be checked on the **TEST-Volts/Current** meter.

2.5.3 KEYING/MOD SWITCH: Keying/mod switching circuit contains **KEYING** switch A4S1 and **MOD** switch A4S2. During normal operation, both two switches will be in their **ON** position. When the **KEYING** switch is set to **OFF**, a +15.0 VDC control signal will be applied to circuits within the keyer PWB. When the **KEYING** switch is set to **ON**, the +15.0 VDC control signal will be inhibited. When the **MOD** switch is set to **ON**, A +15.0 VDC control signal will be applied to modulator driver PWB A4A2. When the **MOD** switch is set to **OFF**, the +15.0 VDC control signal will be inhibited.

2.5.4 POWER TRIM: **POWER TRIM** potentiometer A4R5 provides a means of decreasing the carrier level of the transmitter while maintaining the modulation percentage. Adjustment of the **POWER TRIM** potentiometer may be performed without gaining access to the transmitter cabinet's interior. The power trim function may be controlled locally or remotely.

2.5.5 KEYER PWB (A4A1): (See figure SD-6) The keyer is a self-contained logic block that automatically generates keyed audio tone signals which are used to modulate the transmitter. This is accomplished by means of a 64-bit code cycle, or frame, which is eight seconds long. The beacon identification signal is programmed in the keyer and may contain up to three characters (letters or numbers) followed by either a long space or a long filler dash to the end of the code cycle or frame. The length of a dot is fixed at 125 milliseconds (one bit), while the length of the dash is fixed at 375 milliseconds (three bits). A tone oscillator circuit capable of generating a 400 or 1020Hz tone is also contained on the keyer together with an associated keying gate.

Two variations to the code may be selected thru external controls. These coding variations are referred to as standby '1' (A) and standby '2' (A) and may be used to transmit information such as; changeover from the selected main to the standby transmitter; changeover of the power source from, for instance AC supply to the (optional) battery backup or diesel backup.

The keyer also has the capability to generate whole frames of tones or spaces to meet particular customer coding requirements. If the transmitter is in the MCW operating mode, a keying override signal is applied to override the coded keying and actuate a continuous tone as the keyed tone output.

2.5.5.1 The timing oscillator contains operational amplifier U2A and its associated components and provides a free running clock circuit that produces a 64-pulse per second signal. The output of the timing oscillator may be monitored at test point TP1.

2.5.5.2 Counter U3 contains a 12-stage binary counter. Its 12 outputs labelled Q1 thru Q12 divide the timing oscillator signal by a factor of two to 4096 depending on which output is selected. Each output is a +15 volt square wave at the divided repetition rate (frequency).

2.5.5.3 The Q5 through Q8 outputs of 12-stage binary counter U3 are connected to the binary coded control inputs of code multiplexers U4 and U5. The control inputs determine (as a binary number clocking at 2.0Hz) which multiplexer gate of 16 in each multiplexer is to be switched on at a particular period of time. When a multiplexer gate is switched on, as determined by the state of the control input, the common input (pin 1) is shorted to the required output. Q9 output of 12-stage binary counter U3 and U2B determines which multiplexer, U4 or U5, will be enabled first. This, together with timing pulses from Q5 through Q8 outputs of binary counter U3, allows only one gate out of a possible 32 gates to be on (+15V) at a particular instant. The cycle starts at U4 gate '0' and ends at U5 gate 15, 32 steps and takes approximately eight seconds to complete, at which time it recycles and starts again. The outputs of multiplexers U4 and U5 are connected to code bus terminal boards TB1 and TB2 by straps programming the spaces and dash for the code.

2.5.5.4 The code bus, consisting of terminal blocks TB1 and TB2, is where the actual beacon identification code is programmed into the keyer. If there are no connections made on the code bus, the keyer output will be a continuous series of dots. Q4 output of the 12-stage binary counter which is a square wave at 4Hz turns keying output gate U1D on and off through resistor R15 and diode CR7. If there is a connection made from the code multiplexer to the dash portion of the code bus, program dash gate U1A will turn on, +15.0 volts DC will be applied throughout resistor R12, at the appropriate time which will turn keyer output gate U1D on thru diode CR7. Keying output gate U1D will be on only as long as any code multiplexer's output gate, which is connected to the dash bus, is on corresponding to the time for two bits at each gate output connected. If there is a connection made from the code multiplexer to the SPACE 1 portion of the code bus, program space, gate U1B will turn on at the appropriate time which will turn keyer output gate U1D off through gate U1B and diode CR7.

When programming the keyer, if a space is required during an interval, it is connected to the space bus. If a dash is required during an interval, it is connected to the dash bus. If a dot is required during an interval, there is no connection needed since the Q4 output of binary counter U3 provides continuous dots.

2.5.5.5 The X0, X1 and X2 outputs of code multiplexer U4 are always connected to the space bus; i.e., pre-programmed to ensure that a space period appears before the start of the beacon identification code. The X3 output of code multiplexer U4 is never connected because the first element of any letter or number of the beacon identification code is always a mark whether the character starts with a dot or a dash.

2.5.5.6 The Q10 through Q12 outputs of the 12-stage binary counter U3 are connected to the control inputs of frame selector U6. By connecting the output of U6 (X0 to X7) to the SPACE or MARK bus of code bus 2, the frame content can be selected. If a continuous space is required during the whole of a particular frame, link the appropriate output of U5 to the space bus in code bus 2. If a continuous mark is required during one whole of a particular frame, link the appropriate output of U5 to the mark bus of code bus 2. The outputs of frame selector U6 begin cycling at output X0 and continue in sequence to output X7. Each output corresponds to an individual 8.0 second frame which may consist of a tone (MARK), a SPACE, or the programmed beacon identification code. When a mark is selected during a frame, gate U1D is turned on for the entire frame thru diode CR8 which creates a tone period. When a space is selected during a frame, gate U1B is turned on which keys gate U1D off for an entire frame, which creates a space period.

2.5.5.7 Operational amplifiers U7A/U7B and their associated components form a stable, free running audio oscillator. Solder links *B* and *C* in the feedback network allow frequencies of 400Hz or 1020Hz to be used for the beacon tone (links *B* and *C* installed signifies a 1020Hz tone; links *B* and *C* removed signifies a 400Hz tone).

2.5.5.8 Each keyer contains two standby code capabilities (a total of four separate code variations, two for each side of the transmitter); a longer space period between the second and third characters of a three-character code and a blip before the start of the beacon identification code. The X15 output of code multiplexer U5 is connected to the SPACE 1 code bus thru resistor R11 and diode CR4 so that a space is normally generated. When a ground is placed on J1-4, standby 2 (*A*) and the count reaches gate X15 of U5, this count is inhibited which allows the output of the 12-stage binary counter U3 to turn on the keying output gate U1D through resistor R15 and diode CR7 to provide an additional dot in the code. Gate U1B is only off for as long as the count is at X15 of U5. This creates the blip before the start of the code. When a ground is connected to J1-2, standby 1 (*A*) and SPACE 2 portion of the code bus is wired to the space period between the second and third letters of a three-letter code, the space between these two letters will increase. When the count reaches the appropriate point of the code (between the second and third letters), gate U1C will turn on which will place a ground on the anode of diode CR1 of the timing oscillator. This ground will cause the timing oscillator to slow down to one-third of its rate automatically increasing time between the second and third letters. Similarly, an increased space can be programmed between first and second letters.

2.5.6 RF OSCILLATOR PWB (A4A3) (see figure SD-9)**:** The RF oscillator PWB is a dual purpose low level RF drive source for the exciter. It contains a crystal controlled oscillator circuit that can be connected as the RF drive generator and it contains a buffer/isolation amplifier that will accept and process an externally produced RF drive at the assigned carrier frequency. Links on the PWB are user connected to enable the integral crystal controlled oscillator and use it as the RF drive source or to enable the buffer/isolation amplifier when an external exciter is the RF drive source.

2.5.6.1 Crystal Oscillator: The crystal oscillator consists of transistor Q2, quartz crystal Y1, isolation amplifier Q3, frequency divider U1, buffer amplifiers Q4/Q5 and their associated components. When the crystal oscillator is to be the RF drive source, it must be enabled and the buffer amplifier must be inhibited. The crystal oscillator is enabled by linking pad **A** to pad **B**. Pad **D** must not be linked to any other pad to inhibit the buffer amplifier. The crystal oscillator operates within the frequency band of 2.0MHz and 4.0MHz. Its crystal (Y1) frequency must be 4 ($4fc$), 8 ($8fc$) or 16 ($16fc$) times the carrier frequency, whichever results in a frequency within the operating band. Variable capacitor C10 is adjusted to precisely set the oscillator to the desired frequency. The output of the oscillator is buffered by Q3 and applied to 12-bit binary counter U1, as its clock. Pad **E** is linked to the divider pad which will provide the assigned carrier

frequency (**/4** when *f*c is between 500kHz and 535kHz, **/8** when *f*c is between 250kHz and 500kHz or **/16** when *f*c is between 190kHz and 250kHz). Pad **F** must not be linked to pad **E**. Q4/Q5, which are connected as a balanced drive, current amplify the selected output of U1. The resultant *RF drive* at J1-4 will be a 15 volt peak-to-peak square wave at the carrier frequency (*f*c).

2.5.6.2 External RF Drive Input: Circuitry consisting of Q1, U2, U3, U4 and their associated components are not used in ND radiobeacons.

2.5.7 RF SYNTHESIZER PWB (A4A3) (see RF synthesizer PWB manual, following section 10 of this manual)**:** The RF synthesizer PWB uses direct digital synthesis (DDS) to generate the assigned carrier frequency within the radiobeacon broadcast band (190kHz to 535kHz). The output of a digital synthesizer integrated circuit with internal high-speed 12-bit digital to analog converter is low-pass filtered to provide a sinusoidal continuous output. The sine wave is digitized and divided by a factor of four to obtain the carrier frequency.

2.5.8 RF DRIVE AMPLIFIER (A4A4): The low level RF drive, a square wave switching between ground and 13.5 volts peak at the carrier frequency, is passed through connector A4A4J1 and applied to the primary winding of 1:1 coupling transformer A4T1. Transformer A4T1 has two identical sets of secondary windings, one wire of each set is connected to the gate and one wire of each set is connected to the source of power MOSFET transistors A4Q1/Q2. MOSFETS A4Q1/Q2 are connected in a push-pull configuration with the phasing of their inputs determining which one will be turned on.

2.5.8.1 When the gate of MOSFET A4Q1 is positive, the gate of MOSFET A4Q2 will be negative. A4Q1 will be on/A4Q2 will be off. The negative voltage *Tx on (B- VDC)* input at J2-1 will be applied thru A4L1 and A4Q1 to A4Q1/Q2's drain/source junction. During the next half cycle, the polarity on the gates of A4Q1 and A4Q2 will reverse. A4Q1 will be off/A4Q2 will be on. A ground will be applied to A4Q1/Q2's drain/source junction. The output at A4Q1/Q2's source/drain junction will be a square wave switching between ground and B- VDC, at the carrier frequency.

2.5.8.2 The output from A4Q1/Q2 is applied through A4C3/C4/R1 to A4J2 as a 48-52 volt peak-to-peak square wave *RF Drive* output for the RF power amplifiers. It is also peak detected by CR1 and applied to A4J3 as the *RF Drive Level* reference. This output is a DC voltage (between 12 and 16 VDC) that is proportional to the amplitude of the RF drive. Inductor A4L1 and capacitors A4C1/C2 provide decoupling for the *Tx On (B- VDC)* input. Diode A4CR2 provides protection against transient voltages in excess of 51 volts.

2.5.9 MODULATOR DRIVER PWB (A4A2) (see figures SD-7 and SD-8)**:** The modulator driver processes the *voice audio* input and passes it to an emission mode multiplexer where it is multiplexed with a *keyed tone* from the keyer, depending on the emission mode selected (keyed tone or keyed tone/ voice). The modulator driver produces a pulse width modulated *mod drive* that contains the carrier level and audio information. Logic circuits monitor RF drive level and modulation pulse width output. They turn on the appropriate **MOD DRIVE** and/or **RF DRIVE ALARM** lamp if a fault threshold is exceeded. The **AUDIO LIMITER** lamp will flash when audio peak/trough thresholds are exceeded.

2.5.9.1 Voice Audio Filter: The *voice audio* input on J1-4 is applied across varistor RV1 and **VOICE LEVEL** potentiometer R2 and passed to the non-inverting input of operational amplifier U1A. Varistor RV1 provides protection against high-level interference transients (e.g., lightning). Op amps U1A/U1B and their associated components form low and high pass four-pole filter circuits. The filters define the lower and upper limits of the audio bandwidth of the subject transmitter at 300 to 3000Hz respectively.

2.5.9.2 Voice Audio Amplifier/Limiter: Resistor R14 in series with the voice signal forms an attenuator with JFET Q1 which acts as an audio limiter and is turned on by unusually high peaks of the audio signal. This improves the voice power of the transmitter by compressing high voice peaks and preventing over-modulation on high peaks. Limiting of both positive and negative peaks of voice is provided since after amplification by operational amplifier U2A, the total signal is applied to inverting comparator U3B and non-inverting comparator U3A which turn on JFET Q1 when comparator thresholds are exceeded by voice signal peaks. Operation of either comparator

also switches U3D which will turn on the **AUDIO LIMITER** lamp, indicating the occurrence of a voice peak and limiter action. The voice signal is then applied thru **VOICE MOD %** potentiometer R21 and passed to emission mode multiplexer U4. Test point TP2 provides a monitoring point for the voice signal after filtering and limiting.

2.5.9.3 Emission Mode Multiplexer: The *voice audio* and/or the *keyed tone* are selected as the modulating audio output, for each emission mode, by emission mode multiplexer U4. The binary sum of the *mod enable* and *press-to-talk* inputs select the appropriate gate of U4 (0/1-no audio, 2-keyed tone and voice, 3-keyed tone only). The level of the keyed tone audio is adjusted by the setting of **TONE LEVEL** potentiometer R19 determines the keyed tone level when keyed tone only is selected. The setting of **TONE MOD %** potentiometer R20 determines its level when keyed tone and voice are selected. **VOICE MOD %** potentiometer R21 is adjusted for the voice modulation level. A ground potential *press-to-talk* command will apply a logic 0 to U4-A.

2.5.9.4 Line Volts Compensation/Power Trim Control: Line volts compensation and power trim control circuits contain wideband monolithic analog multiplier U6, operational amplifiers U5A, U5B and U2B and their associated components. The audio output of the emission mode multi-plexer, the *B-VDC* and *power trim* inputs are converted to current inputs and applied to U6-8/5/1 respectively. The output on U6-4 is applied to U5B and converted to a voltage on U5B's output. If the B- voltage decreases, the output voltage at U5B-7 will increase proportionally, similarly if the B- voltage increases, the voltage on U5B-7 will decrease proportionally. When the *power trim* control signal on J2-2 decreases, the output voltage on U5B-7 will decrease and visa-versa. Resultant modulation depth will remain constant regardless of B- voltage variations and power trim variations to -3dB.

2.5.9.5 PWM Square-Wave Generator: The pulse-width modulator square wave generator contains programmable timer U8 and its associated components. The oscillator frequency is adjusted to a nominal frequency of 70kHz by **FREQ** variable capacitor C22. The output of the generator will be a 15 volt square wave at the oscillator frequency and will be applied to the ramp integrator circuit.

2.5.9.6 Ramp Integrator: The ramp integrator circuit contains operational amplifier U9B plus its associated components. The 15 volt square wave from the PWM square wave generator is applied to the inverting input of U9B. Capacitor C26 and resistor R63, which are located in the feedback circuit of U9B, result in a linear sawtooth waveform being produced at the output of U9B. TP5 provides a convenient location to measure the waveform. **RAMP ADJUST** potentiometer R58 is adjusted to set the negative going peaks of the linear waveform to a DC reference potential of zero volts.

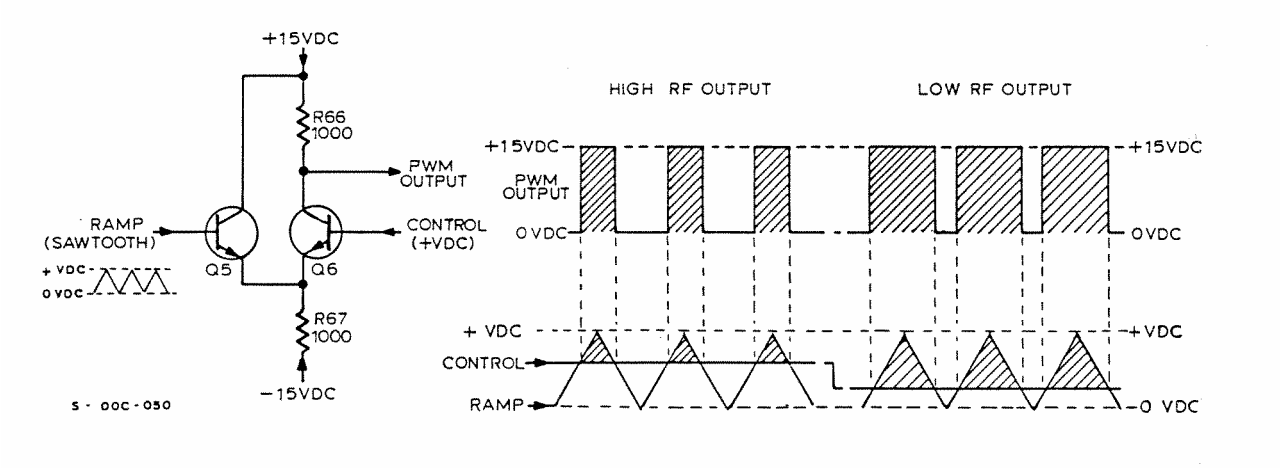


Figure 2-1 Simplified Schematic of Pulse-Width Differential Amplifier

2.5.9.7 Linear Attenuator: The linear attenuator circuit contains operational amplifier U7A, unity gain amplifier U7B, transistors Q2/Q4 and their associated components. U7A and Q4 form a diode to ground circuit which results in a bias voltage of approximately 0.6 volts DC being applied to the emitter of Q2. Normally the *VSWR cutback* input at J2-1, which is applied to U7B's non-inverting input, is 0 volts. U7B's output will be 0 volts and Q2 will be reverse biased (turned off). The linear attenuator circuit will present a high impedance between the audio signal and ground. When a positive voltage *VSWR cutback* input is applied, U7B's output will be positive and forward bias Q2 (turn it on). The impedance of the linear attenuator circuit will decrease in proportion to the current flow thru Q2. The attenuation factor will vary in proportion to the positive voltage level of the *VSWR cutback* input.

2.5.9.8 Variable Pulse-Width Generator: The variable pulse-width generator circuit is a differential amplifier that compares the linear sawtooth waveform from the ramp integrator with the linear attenuated audio and produces a nominal 70kHz rectangular waveform as its pulse-width modulation output. The circuit comprises operational amplifier U9A, transistors Q5, Q6 and their associated components. They are configured to form an emitter coupled differential amplifier. A portion of the audio and DC signal is applied to the non-inverting input of U9A from the wiper of **O/P POWER** potentiometer R48. Unity gain buffer amplifier applies this voltage to the base of Q6. The sawtooth waveform from U9A is applied to the base of Q5. Refer to figure 2-1 for a simplified schematic of the differential amplifier.

2.5.9.9 For explanation purposes, assume the audio signal is a DC reference voltage that does not contain an audio component. When the sawtooth waveform is less positive than the DC reference voltage, Q5 will be reverse biased and Q6 will be forward biased. When the sawtooth waveform is more positive than the DC reference voltage, Q6 will be reverse biased and Q5 will be forward biased. The output at the collector of Q6 will be approximately zero volts DC when Q6 is forward biased and +15 volts DC when it is reverse biased.

The forward/reverse bias ratio of Q6 is determined by the audio level. When audio is superimposed on the DC reference voltage, the input applied to the base of Q6 will go more or less positive at the audio rate. The magnitude of the change will be determined by the audio component's polarity and amplitude. When it is less positive, Q6 will be reverse biased for a longer portion of the sawtooth waveform. When it is more positive, Q6 will be reverse biased for a shorter portion of the sawtooth waveform. When audio is present, the resulting pulse-width modulated output, at the collector of Q6, is a varying width, rectangular waveform at the square wave generator's repetition rate (nominally 70kHz).

2.5.9.10 Balanced Drive: The balanced drive is a switching circuit that is driven by the variable pulse-width modulation output of the variable pulse-width generator. The circuit contains buffer amplifier U10A, transistors Q7 and Q8 and their associated components. The pulse-width modulated signal is inverted by buffer amplifier U10A. Transistors Q7 and Q8 turn on and off at the PWM switching frequency. The switching action of transistors Q7/Q8

ensures the leading and trailing edges of the rectangular waveform are sharp. The mod drive output at J2-6 is a low impedance pulse-width modulated signal switching between +15 volts DC and ground.

2.5.9.11 Pulse-Width Fault Detector: The pulse-width fault detector circuit monitors the pulse-width modulation signal for the presence of +15 VDC pulses. The circuit contains operational amplifier U11B, inverter U10D, relay K1 and their associated components. A two-pole low pass filter, comprising R68/R69 and C30/C31, continuously monitors the average on/off ratio of the variable pulse width mod drive signal. Normally the voltage on C31, which is applied to U11B's non-inverting input, will not exceed the reference threshold voltage being applied to its inverting input from the junction of R70/R71. U11B's output will be at near ground potential, resulting in the U10D's output being +15 VDC. A mod drive alarm signal will not be applied to J2-4.

If a dangerously high variable pulse width on/off ratio should occur, the voltage on capacitor C31 will exceed the reference threshold voltage applied to U11B's inverting input. U11B's output will be +15 VDC. Relay K1 will energize and remove the mod drive output from J2-6. U10D's output will be zero volts DC. A zero potential mod drive alarm signal will be applied through J2-4 to and turn on the **MOD DRIVE ALARM** lamp (A4DS3).

2.5.9.12 RF Drive Alarm Circuit: The RF drive alarm circuit contains operational amplifier U11A, inverter/buffers U10B/U10C, transistor Q3 and their associated components. When the transmitter is turned on, the voltage at the junction of C25/R60 will instantly rise to +15 VDC and decay slowly thru resistors R60/R61. Transistor Q3 will be forward biased (turned on) and U11A-3's non-inverting input will be at ground. Resistors R64/R65 establish the threshold voltage on U11A's inverting input.

The output on U11A-1 will be low and output on U10B-2 will be high, causing diode CR3 to be forward biased. The input on operational amplifier U10A-7 will be high and its output low.

The low output on U10A-6 will inhibit the mod drive. The output of U10C-4 will be low and applied to the RF drive alarm lamp on the exciter's front panel. The RF drive alarm lamp will turn on. After approximately five seconds the voltage being applied to the base of transistor Q3 will decay thru resistors R60/R61, transistor Q3 will be reversed biased, the output of U10B-2 will go low, diode CR3 will be reversed biased. The mod drive output on J2-6 will no longer be inhibited. The output of U10C-4 will go high and the RF drive alarm lamp on the exciter's front panel will turn off.

POWER ON/OFF PANEL ASSEMBLY (A6) (see figure SD-1)

2.6 The power on/off panel assembly contains the **POWER-AC LINE** and **POWER-BATTERY** switches. Under normal operating conditions both switches will be set to their **ON** position. AC power from the service entrance is applied thru terminals 1 and 2 on TB1 and passed to the contacts of the **POWER-AC LINE** switch. When it is set to **ON**, 230 volts AC will be passed to power supply modules A7 and A8. The DC power (battery) source is applied from TB2-2(-), thru fuse A6F1 and the contacts of the **POWER-BATTERY** switch to battery panel (optional) A11. If the optional battery panel is installed, DC power will be inhibited by switching circuits within the subject transmitter until AC power fails or decreases below a low AC voltage threshold.

POWER SUPPLY MODULES (see figure SD-10)

2.7 There are two identical power supply modules (A7 and A8) in the transmitter. Only one of the power supplies will be in use during operation. Power supply A7 will be selected when the **SELECT MAIN TX** switch is set to **A**, power supply A8 will be selected when it is set to **B**.

2.7.1 POWER SUPPLY CONTROL PWB (A7A1): 230 volt AC from the service entrance, at J1-1/2, is passed through the appropriate fuses (dependent if 50 or 60Hz) to the tapped primary

winding of power transformer T1. T1 contains two sets of centre-tapped secondary windings. One set provides a low level (17.5-0-17.5) AC for use as a phasing reference and as the voltage source for a 15 VDC regulated power supply. The other set provides a higher level AC as the voltage source for the B- VDC power supply. Varistors RV1/RV2 provide transient protection. Thyristors Q1/Q2, form a controlled full-wave rectifier for the B- VDC. The B- VDC output is maintained at the required level by controlling their gate voltage and therefore their on time for each half cycle of the AC voltage source.

2.7.1.1 Diodes A1CR1/CR2 full-wave rectify the AC voltage from T1's low level centre-tapped secondary and (T1-11/T1-12) and produce an unfiltered DC voltage (nominally 23 VDC) with a ripple frequency of twice the frequency of the AC power source. This voltage is applied thru diode A1CR3, filtered by A1C2 and applied to +15 VDC regulator A1U1. The output of A1U1 will be a regulated 15 VDC. Zener diode A1CR5 provides protection for A1U1 against transients in excess of 30 volts.

2.7.1.2 The unfiltered ripple DC from full-wave rectifier A1CR1/CR2 is also applied to the non-inverting input of zero crossing detector A1U2A. Zener diode A1CR4 and resistor A1R3 for a limiter to restrict the voltage being applied to A1U2A-3 to +10 volts. Resistors A1R6/R7 establish a low level on A1U2A's inverting input. This results in a narrow output pulse on A1U2A-1 when the zero crossing of the AC voltage occurs. At the zero crossing, A1U2A's output will be low, A1CR7 will be forward biased and A1C4 will quickly discharge to ground potential.

2.7.1.3 When the non-inverting input of A1U2A rises to a level more positive than the voltage on A1U2A's inverting input, diode A1CR7 will be reversed biased. Capacitor A1C4 will charge towards +15 VDC, thru A1R8, at an exponential rate. The input at A1U2D's non-inverting input will be a sawtooth waveform.

2.7.1.4 Operational amplifier A1U2C and its associated components provide a DC reference that is proportional to the B- VDC output at J1-3/4/5. A1R2/R4 form a voltage divider between +15 VDC and B- VDC. The resultant voltage at the junction of A1R2/R4 (+5.9 VDC when B- VDC is -70 VDC) is applied to the inverting input of A1U2C. An adjustable reference voltage is applied to A1U2C's non-inverting input (by A1R12's wiper) from the voltage divider formed by A1R11/R12/R13. A1R12 is adjusted for a DC voltage that will maintain A1U2C's output (dc reference voltage) at a level that will result in a B- VDC output of 70.0 VDC by controlling the on-time of thyristors Q1/Q2. If the B- VDC starts to go less negative. A1U2C's inverting input will go more positive and its DC reference voltage output will go less positive.

A1U2C's DC reference voltage is applied to A1U2D's inverting input where it is compared with the voltage of the sawtooth waveform on A1U2D's non-inverting input. At the start of each sawtooth waveform, A1U2D's inverting input will be more positive than its non-inverting input and its output will be a 0.0 VDC. When the sawtooth waveform's voltage is more positive than the DC reference voltage (A1U2D's inverting input is less positive than its non-inverting input) A1U2D's output will switch to +15 VDC for the balance of the sawtooth waveform's period. The more positive the DC reference voltage is, the shorter the period of time A1U2D's output will be 15 VDC.

A turn-on delay circuit, formed by A5A1C6/R20/ CR10/R19/CR11, applies +15 VDC to U2D's inverting input at the instant of turn-on. It ensures the sawtooth waveform's more positive periods are minimal during the initial charge period of the B- VDC storage capacitors in the modulator/power amplifier modules. The delay voltage decreases exponentially as C6 charges. When it goes less positive than the output of U2C, U2C's output will assume control and the delay circuit will have no further influence.

2.7.1.5 When A1U2D's output is +15 VDC, A1Q1 and A1Q2 will both be forward biased (turned on). Whichever thyristor (A1Q1 or A1Q2) has a positive voltage half cycle on its anode will be forward biased and turn on for the balance of the half-cycle. Capacitors C1 and C2 prevent the thyristors from false firing and diodes A1CR8/CR9 prevent reverse bias between the collectors and emitters of transistors A1Q1/Q2 when thyristors Q1/Q2 are turned off. Thyristors Q1/Q2 will be gated off each time zero crossover occurs on the full-wave waveform.

2.7.2 B- VDC To +24 VOLT DC CONVERTER PWB (A7A2): The B- voltage is applied thru fuse A7F1 and inductor A2L1 to the emitter of A2A1Q1. When B- VDC reaches approximately -52 volts dc, A2A1Q1 will be forward biased and turn on. The resultant output from the collector of A2A1Q1 will cause A2A1Q2 to be forward biased and turn on. The voltage at the junction of resistor A2A1R6 and the collector of A2A1Q2 will go to a nominal 13.0 VDC more positive than the B- voltage and be applied to timer A2A1U1. Resistors A2A1R7 thru A2A1R10, diode A2A1CR2 and capacitor A2A1C2 determine the switching frequency and duty cycle being generated by timer A2A1U1. The output of A2A1U1, an adjustable pulse width control signal, is passed to the gate of power MOSFET A2Q1.

2.7.2.1 Power MOSFET A2Q1, inductor A2L3, diode A2CR1 and capacitor A2C2 form a basic step-down flyback converter which inverts the polarity of the source voltage. When power MOSFET A2Q1 switches on, current from capacitor A2C2 will be applied to the load while current from power MOSFET A2Q1 will store energy in inductor A2L3. When power MOSFET A2Q1 switches off, the stored energy in inductor A2L3 will be applied through diode A2CR1 and capacitor A2C2 and applied to the load. This ensures that a constant current will be applied to the load when power MOSFET A2Q1 is switching on and off. Zener diode A2CR2 protects against excessive voltage on the output when the load is removed and resistor A2R3 limits the peak current thru power MOSFET A2Q1. The output from the converter circuit, a +24.0 volt DC control signal, is passed thru resistor A2R4 to +24V status lamp DS1. The lamp will turn on. The +24.0 volt DC control signal is also passed to A2TB1-5 for external use.

2.7.2.2 The -15 VDC generated by components A2L3, A2CR3 and A2C3 is not used in ND radiobeacons.

2.7.3 AC SUPPLY MONITOR (A7A3) ASSEMBLY: The AC supply monitor circuit contains transistors A3Q1/A3Q2/A3Q4, power MOSFET transistor A3Q3 and their associated components. Under normal operating conditions (ac power source), the breakdown threshold of zener diode A3CR3 will be exceeded, transistors A3Q1/A3Q4 and MOSFET A3Q3 will be forward biased (turned on). Transistor A3Q2 will be reverse biased (turned off). +15 volts DC will be passed to AC sense connectors J1-8 and J1-12. Diodes A3CR1/CR2 and capacitor A3C1 form a full-wave filtered rectifier for the input voltage to the AC supply monitor PWB. Resistors A3R1/R2 provide attenuation. If the breakdown threshold of zener diode A3CR3 is not exceeded, transistor A1Q1 will be reverse biased (turned off). When transistor A3Q1 turns off, transistor A3Q2 will be forward biased (turned on). MOSFET A3Q3 will be reverse biased (turned off) and transistor A3Q4 will be reverse biased (turned off). The AC sense outputs on connectors J1-8/J1-12 will be inhibited. The transmitter will either switch to the standby side, providing the fault is not generated from the AC power source of if already operating on the standby side, will switch to the DC power source (battery, if installed).

HARMONIC FILTER ASSEMBLY (A9)(see figure SD-11)

2.8 The harmonic filter assembly is a band pass filter that attenuates the harmonics of the square wave output being applied from the modulator/power amplifier circuits. The filter has a flat response characteristic over the operating bandwidth. The circuit also filters out the frequency on the lower side of the carrier frequency. Relay K1 or relay K2 will be energized depending on which side **A** or **B** of the subject transmitter has been selected. The harmonic filter assembly contains a forward/reflected power probe (A9A2) and an RF current probe (A9A1).

2.8.1 RF CURRENT PROBE (A9A1): The RF current probe contains transformer A1T1 and its associated components. The probe monitors the RF output power to detect excessive peak currents. The RF input from the contacts of relay K1 or K2 is passed across the primary winding of transformer A1T1 and applied to terminal '1' of inductor L1. A sample of the RF current is applied across transformer A1T1's secondary winding and passed through resistors A1R1 through A1R4 to connector A1J2. The current sample is passed to logic circuits within the monitor/interface panel.

2.8.2 FWD/REFL POWER PROBE (A9A2): Voltage transformer A2T1, current transformer A2T2 and their associated components provide voltage and current arms of a forward/reflected power bridge, which samples the RF output signal. Current transformer A2T3 and a secondary winding of transformer A2T1 provide voltage or current waveform outputs (as selected by **RF MON** switch) for monitoring purposes. The anti-phase voltages developed across A2T2's secondary are summed with the voltage from A2T1 to provide DC voltages at the cathodes of A2CR1/CR2 which are proportional to the forward/reflected power. A2R1 through A2R8 provide 50 ohm loading for their respective transformers.

2.8.2.1 RF MON Switching: **RF MON** switch A2S1 allows selection of either the voltage or the current waveform to be monitored on RF monitor BNC connector J1 on control/monitor A1's front panel. The following provides the necessary information for the setting of the **RF MON** switch.

2.8.2.2 The high capacitive reactance of the antenna is tuned at the carrier frequency by the ATU loading coils to produce a series resonant circuit. The resulting net antenna resistance is transformed to 50 ohms in a matching transformer to provide the load impedance required by the transmitter. When the antenna is very short, compared with the carrier frequency's wavelength, the series resonant circuit has an extremely high Q. Under these conditions, a perfect match may occur at the carrier frequency, but the sidebands may be mismatched, causing a standing wave on the feed cable at the sideband frequencies.

2.8.2.3 Depending upon the length of the feed cable, the impedance at the sideband frequencies may appear higher or lower than 50 ohms. If the sideband impedance appears low, the current waveform should be selected by **RF MON** switch to prevent excessive current overloading. If the sideband impedance appears high, the voltage waveform should be selected by **RF MON** switch to prevent excessive voltages occurring at the sideband frequency. The correct setting of **RF MON** switch is made by choosing the waveform which displays the greater modulation depth.

2.8.2.4 The use of an inefficient antenna produces a bandpass filter effect which reduces the modulation depth of the radiated signal.

2.8.2.5 Under no circumstances should the modulation level, as measured by the current or voltage probe, be adjusted beyond 95 percent in an effort to offset the sideband attenuation that occurs in the antenna. This will cause excessive dissipation and distortion to occur and would create spurious emissions which do not comply with national and/or international specifications.

MONITOR PWB (A10) (see figures SD-12 and SD-13)

2.9 The monitor PWB monitors critical parameters of the subject transmitter and produces control signals that turn on display lamps when these parameters are not met or a status condition of the transmitter is to be known. The PWB also produces and applies external alarm and status control signals to a remote location for the user's information. Test switches, located on the PWB, can be set to enable calibration/repair on one side of the transmitter while the other side is operating normally.

The monitor PWB provides adjustments for the carrier and modulation thresholds, sets the changeover time delay (seconds) and produces the unmetered +15 volt DC and -15 volt DC for the subject transmitter. The board also provides control signal outputs for the forward/reflected power (remote and local) and produces control signal outputs for the battery, SWR, shutdown, standby and RF current alarm circuits.

2.9.1 TEST SWITCH CONTROL: Under normal operating conditions **TEST B** switch S1 and **TEST A** switch S2 are set to **NORMAL**. When either is set to **TEST**, the RF output from that side **A** or **B** will be inhibited and it will be operating into an open circuit. The switches are normally set to **TEST** when performing maintenance procedures.

2.9.2 RELAY SWITCHING: The relay switching circuits contains remote on/off relay K1, shutdown relay K2, standby relay K3 and A/B main select relay K4. The following paragraphs describe each relay switching circuit:

2.9.2.1 Remote On/Off Relay: If the transmitter is set to local control, the remote on/off relay will have no influence. During normal operations, when remote is selected, relay K1 will be de-energized (transmitter turned on). When a remote ground

control signal is applied to 'remote off' input J4-1, relay K1 will energize, the B- operating voltage will be inhibited. A 'reset enable' (ground) control signal will be applied to circuitry on the monitor PWB The **STANDBY ALARM** and lamps will turn on. External shutdown and **SHUTDOWN-ALARM** standby alarm control signals will be generated.

2.9.2.2 A/B Main Select: The A/B main select relay (K2) is used to select which side of the transmitter (A or B) is the 'main' side. When the transmitter is set to local control, the relay is controlled by the select main **XMTR** switch (S3) on the control panel (A1). When the transmitter is set to remote control, the relay is controlled by an external input on the A/B main select remote line (J2-5). Relay K2 is de-energized to select side A as the main side.

2.9.2.3 Shutdown Relay: During normal operation, relay K2 will be energized. If the ground control input on K2-13 is removed, relay K2 will de-energize. The transmitter will turn off. A B- control signal will be applied thru J5-12 causing the **SHUTDOWN-ALARM** lamp to turn on and an external shutdown alarm control signal (ground) will be generated at J4-5.

2.9.2.4 Standby Relay: During normal operation, relay K3 will be energized. If the ground on K3-13 is removed, K3 will de-energize. The B- voltage will be applied thru J3-5. The **STANDBY-ALARM** lamp shall turn on and an external standby-alarm control signal (ground) will be generated and passed to standby alarm (remote) on J4-3. The transmitter's selected main side will shut down and the standby side will turn on.

2.9.3 MONITOR +15 VOLT DC REGULATOR: +24 VDC is applied thru J6-11 or J6-4 (from either the **A** or **B** side of the transmitter) and passed thru its associated diode to +15 VDC regulator U12-3. +24 VDC is applied to J6-12 for external use. The regulated +15 VDC is applied to J8-9 for external use and circuits within the transmitter for internal use. TP13 provides a convenient location to measure the +15 VDC.

2.9.4 MONITOR -15 VOLTS DC CIRCUIT: The B- voltage is applied across resistor R74 and zener diode CR16. The two components provide -15 VDC for the transmitter. TP9 provides a convenient location to measure the -15 volt DC. Transistors Q10/Q11 plus their associated components provide a sharp on/off transition for the -15 VDC. If the B- input is less negative than -30 VDC, zener diode CR13 will be reverse biased and turned off. Q10 will be reverse biased and turned off. When Q10 is turned off, Q11 will be forward biased and turned on. -15 VDC will be clamped to ground. When the B- VDC is turned off, the transmitter will reset (return to the main side) in a nominal five seconds.

2.9.5 MOD THRESHOLD CIRCUIT: The fwd pwr input on J6-1 a DC voltage representing the forward power of the transmitter with a super imposed AC voltage proportional to the modulation depth, is applied thru loading resistors R1/R2 and buffer amplifier U1a to the **MOD THRSH** potentiometer. **MOD THRSH** potentiometer is normally set for the desired minimum modulation level (normally to detect a -4.0dB drop on the intended modulation depth). The detected DC voltage (level of DC voltage will depend on setting of **MOD THRSH** potentiometer), from the wiper of R7, is applied thru Q1/Q2 to the junction of C7/R26.

2.9.5.1 Amplifiers U3B thru U3D form a buffered 'OR' circuit for the keyed tone input thus allowing provision for a keyed tone input to JFET Q3 from side **A** or side **B**. JFET Q3 and the 'OR' circuit form a synchronous detector which will only detect signals that are in phase with the keyed tone inputs to U3B or U3C. The detected DC voltage is applied to the non-inverting input of comparator U4A where it is compared to a bias voltage, established by resistors R28/31/33, being applied to the inverting input of U4A. When the inverting input is more positive than the bias voltage on the non-inverting input of operation amplifier U4A, U4A's output will be ground. The output of U4A will be a switched voltage that goes to ground each time the detected DC input (modulation) becomes more positive than the inverting input.

2.9.5.2 The output from operational amplifier U4A is applied across a differentiating circuit consisting of resistor R38 and capacitor C12. The differentiating circuit produces a positive pulse, during each transition, which is applied to the base of transistor Q6. If the positive pulse from U4A is not present (loss of keying or a decrease of 4.0dB on the intended modulation depth) on the base of transistor Q6 before

the changeover circuit's time delay has elapsed, transistor Q6 will remain turned off. This will cause the transmitter to change over to the standby side, indicated by a **STANDBY-ALARM** lamp turn on; or shutdown condition, indicated by a **SHUTDOWN-ALARM** lamp turning on, if the standby side was providing the RF drive.

2.9.6 CARRIER THRESHOLD CIRCUIT: The fwd pwr input on J6-1, a DC voltage representing the forward power of the transmitter with a super imposed AC voltage proportional to the modulation depth, is applied through loading resistors R1/R2 and buffer amplifier U1A to the **CARR THRSH** potentiometer R18. The **CARR THRSH** potentiometer is normally set for the desired minimum carrier level (normally to detect a -3.0dB drop on the intended carrier level). The detected DC voltage (level of DC voltage will depend on setting of the **CARR THRSH** potentiometer) from the wiper of potentiometer R18 is applied across capacitor C8.

2.9.6.1 Capacitor C8 filters out the modulation component of the RF carrier and charges to the mean DC level which is representative of the RF carrier level. This reference voltage is passed to the non-inverting input of comparator U3A and represents the carrier threshold level. It is compared to the voltage level, established by resistors R22/25, on the inverting input of comparator U3A. Normally, the output of comparator U3A will be a high impedance to ground and the circuit will have no influence. When the output of comparator U3A switches to a low impedance to ground, the positive pulses from modulation comparator U4A will be inhibited.

2.9.6.2 If the positive pulse from U4A is not present (modulation depth decrease of 4.0dB) on the base of Q6 before the changeover circuit's time delay has elapsed, Q6 will remain turned off. This will cause a change over to the standby exciter (**STANDBY-ALARM** lamp shall turn on) or a shutdown (**SHUTDOWN-ALARM** lamp shall turn on) if the standby exciter was providing the RF drive.

2.9.7 CHANGEOVER DELAY CIRCUIT: The changeover delay circuit can be adjusted for a changeover time delay of between 20 and 80 seconds. The time it takes for capacitors C15/C16 to exceed the voltage level established on the inverting input of comparator U5A will depend upon the setting of the **CHANGEOVER DELAY** potentiometer. With the potentiometer set for a maximum time delay (80 seconds), capacitors C15/C16 will take 80 seconds before the voltage level established on the non-inverting input of comparator U5A is more positive than the inverting input. When this occurs, comparator U5A's output will switch to a high impedance, a changeover control signal will be applied to the base of transistor Q8.

A high SWR status control signal being applied to diode CR8 will cause it to be forward biased and turn on. Q6 will be forward biased and ensure capacitor C15/C16 are held at ground potential. This results in the changeover circuits being inhibited during a high SWR condition.

2.9.8 STANDBY CIRCUIT: Under normal operating conditions transistor Q8 will be reversed biased and turned off. The changeover circuit will be inhibited. If a fault occurs resulting in transistor Q8 being turned on, a low control signal will be applied thru inverters U6A/U6B and applied thru resistor R61 to the base of transistor Q9. Q9 will be forward biased and turn on.

The input to U7-3 will be high and output on U7-1 will be high. The output on U7A-1 will be applied thru resistor R77 to the base of transistor Q13. Transistor Q13 will be reversed biased and turn off. A changeover control signal will be applied to K3 and turn on a standby-alarm lamp on the control/monitor panel. The transmitter will automatically switch to the standby side.

2.9.9 SHUTDOWN CIRCUIT: Normally, the control signal applied to flip-flop device U7-11 will be low and the shutdown circuit will be inhibited. If a fault occurs when the standby side of the transmitter has been selected, the collector of transistor Q9 will switch to a ground level.

After a nominal delay (ten seconds), caused by resistor R67 and capacitors C24/C27, the input on flip-flop device U7-11 will go high. The output on U7B-13 will be high and applied through R75 to the

base of transistor Q12. Transistor Q12 will be reverse biased and turn off. A shutdown control signal will be applied to relay K2 and to a shutdown-alarm lamp on the control/monitor's front panel. The lamp will turn on. Both sides of the subject transmitter will be shutdown.

2.9.10 FORWARD POWER CAL: The fwd pwr input on connector J6-1, a DC voltage representing the forward power of the transmitter with a super imposed AC voltage proportional to the modulation depth, is applied through loading resistors R1/R2 and applied to the non-inverting input of buffer amplifier U1B. Capacitor C6 filters the modulation component while charging to a DC level that is representative of the carrier level. The output of buffer amplifier U1B is applied through resistor R78 and the **FWD PWR CAL** potentiometer and passed through connector J5-3 to **TEST** meter M1 on control/monitor A1's front panel. The **FWD PWR CAL** potentiometer provides a calibration adjustment for the forward power indication on the **TEST** meter.

The DC voltage representing the transmitters RF carrier level is also passed through operational amplifier U1C. Operational amplifier U1C plus its associated components provide a gain of five at the output of U1C-8 which is applied across diodes CR5/6 to fwd pwr (remote) connector J6-3 for external use.

2.9.11 AUDIO MONITOR CIRCUIT: The fwd pwr input on connector J6-1, a DC voltage representing the forward power of the transmitter with a super imposed AC voltage proportional to the modulation depth, is applied through loading resistors R1/R2 and passed to the non-inverting input of audio amplifier U2A. The output on U2A-1 is coupled through capacitor C23 and passed to audio monitor connector J10.

2.9.11.1 Speaker Control: Normally the **SPEAKER** switch will be set to **OFF**. When it is set to **ON**, an audible signal will be passed through the **SPEAKER VOLUME** potentiometer and passed to **SPEAKER** LS1.

2.9.12 RF CURRENT CIRCUIT: A sample of the RF current is applied through RF current sample connector J8-12 and passed to a detector circuit consisting of diode CR1 and capacitor C3. The detected signal is passed across resistor R6 and a limiting circuit consisting of diode CR3 and resistor R12. The limiting circuit maintains the input on operational amplifier U8A inverting input to +15 V. Resistor R20 and **OVERMOD CAL** potentiometer establish the reference threshold on the non-inverting input of operational amplifier U8A-3. Under normal operation the output of U8A-1 will be low, transistor Q4 will be reverse biased and turned off.

If the voltage being applied to U8A-2 becomes less positive than the reference voltage at U8A-3, the output on U8A-1 will go high. Transistor Q4 will be forward biased and turn on. Capacitor C13 will discharge causing the input on U8B-6 to become more positive than the reference voltage on U8B-5. The output on U8B-7 will go high. The **RF CURRENT-ALARM** lamp shall turn on.

2.9.13 SWR CUTBACK THRESHOLD CIRCUIT: Under normal operating conditions (no reflected power), comparator U10A's output will be low (ground). The circuit will have no influence. If the voltage level (DC voltage representing the reflected power) on U10A's non-inverting input becomes more positive than U10A's inverting input (established by resistors R94/96 and the **SWR CUTBACK THRESHOLD** potentiometer), U10A-1 output will go high. The voltage level, on U10A-1 output, will depend on the level of the DC voltage representing the reflected power sample on J8-4. Capacitor C43 shapes the transient response time providing a lower gain by connecting resistor R100 in parallel with resistor R101 to protect against unwanted fluctuations.

The output on U10A-1 is passed to SWR cutback connector J8-10 and applied to a linear attenuator circuit within the mod driver PWB. When U10A's output is high, comparator U10B's non-inverting input will be more positive than U10B's inverting input (approximately 0.6 V), established by resistor R103 and diode CR31. The output on U10B-7 will go high. This output will be passed to four separate circuits.

One portion of U10B's output will be applied to the base of transistor Q14. It will be forward biased and turn on. Q14's collector (ground) will be passed to connector J6-9 for external use. The output on U10B-7 is also passed thru inverter U6C to the cathode of diode CR39. When U6C's output is low (SWR present), diode CR39 will be forward biased and turn on. A ground will be passed to SWR standby connector J9-8 for internal use.

The control signal, representing a high SWR condition, on the output of U10B-7 will also be applied thru buffer U4B and resistor R112 and passed to the changeover circuits to inhibit the subject transmitter from changing over when a high SWR condition is present. A fourth portion of the high SWR condition on the output U10B-7 will be applied thru resistor R111 and passed thru **SWR alarm** connector J5-9 and applied to a **SWR-alarm** lamp on the control/monitor's front panel. The **SWR-alarm** lamp will turn on when a high SWR condition is present.

2.9.14 POWER TRIM INTERFACE CONTROL CIRCUIT: Operational amplifiers U4C/D, U11A/B and their associated components form the power trim interface control circuit for sides A and B. Amplifiers U11A/B limit the output of U4C/D to a level that will not exceed the intended RF carrier output of either side (set by the respective **O/P POWER** potentiometers on the mod drive PWBs). The outputs of amplifiers U11A/B are applied thru pwr trim connectors J6-10/5.

2.9.15 REFLECTED POWER/REFL PWR CAL CIRCUIT: A DC voltage representing the reflected power of the transmitter is passed through refl pwr connector J8-4 and applied through load resistors R90/91 to the inverting input of buffer amplifier U9D. Capacitor C37 will charge through resistor R92 to an average value representing the reflected power. The output of U9D is applied through resistor R104 and the **REFL PWR CAL** potentiometer and passed to refl pwr connector J5-2 for internal use. The **REFL PWR CAL** potentiometer provides adjustment during calibration for the reflected power indication being provided by **TEST** meter M1 on control/monitor panel A1. The reflected power control signal from the output of U9D is also applied through buffer U1D and passed to refl pwr (remote) connector J8-1 for external use.

2.9.16 MOD% CONTROL CIRCUIT: Operational amplifier U9A and its associated components form a one-pole active low-pass filter/ attenuator. The input on J6-6, a DC voltage proportional to the intended carrier level, is applied thru the filter/attenuator where the RF carrier frequency will be removed but the audio information will be passed.

One output of U9A is applied to U9B's non-inverting input. A second output is applied thru R27 and the **SET 100% MOD** potentiometer to A7-8. A peak detector, comprising CR4, R40 and C10, detects the peak output on U9A. The detected signal is applied thru buffer U9C to J7-7. When the **TEST** switch is set to **MOD-READ**, the meter will be placed between the mod meter adjust line on J7-8 and the mod% on J7-7. For 100% adjustment on the test meter, **TEST** switch on the control/monitor panel is set to mod-set, the output on U9C will be double the output of U9A to compensate for the return line thru the meter from the output of U9A.

2.9.17 AC POWER MONITOR CIRCUIT (DC Option Installed): The AC power monitor circuit controls the status of the local and remote battery alarm indications when the DC power source option is installed.

When the AC power is satisfactory, a +15 VDC AC sense input will be on J8-8/7. U6E output will be low and control/monitor panel's **BATTERY-ALARM** lamp will be off. The output of inverter/buffer U6D will be maintained at a low (zero VDC) and transistor Q15 will be reverse biased (turned off). An open collector will be applied to J6-8 as the remote battery alarm output.

When the AC power fails, the AC sense input on J8-8/7 will be 10K ohms to ground. U6E-12 will be high and the control/monitor panel's **BATTERY-ALARM** lamp will turn on. The output of inverter/buffer U6D will be high (+15 VDC) and transistor Q15 will be forward biased (turned on). A current sink to ground will be applied to J6-8 as the remote battery alarm output.

2.9.18 AC POWER MONITOR CIRCUIT (DC Option Not Installed)**:** When the DC power source option is not installed, the output of the AC power monitor circuit is paralleled with the output of the SWR cutback circuit.

When the AC power is satisfactory, a +15VDC AC sense input will be present on J8-8/7 and the output of inverter/buffer U6D will be maintained at a low (zero VDC). Diode CR29 will be reverse biased and the monitor circuit will have no influence on the SWR cutback output.

When the AC power falls fifteen percent below its normal level, the AC sense input on J8-8/7 will be 10K ohms to ground and the output of inverter/ buffer U6D will be held high (+15V). Diode CR29 will be forward biased and the monitor circuit will apply +15 VDC to U10B-5 and to J8-10. The +15 VDC SWR cutback output will cause the RF output to cutback to a minimal level and the SWR cutback circuit will respond as if a high SWR is being detected (see paragraph 2.9.3.15). The A/B changeover circuit will be inhibited, the control/ monitor panel's **SWR-ALARM** lamp will turn on, a current sink to ground will be applied to J6-9 as the remote SWR alarm output and a low (zero VDC) will be applied to J9-8 as the SWR standby output. This status will be maintained until the AC power is within 10 percent of its normal nominal level and the AC sense input returns to +15V.

2.9.19 MONITOR BYPASS CIRCUIT: Under normal operating conditions the monitor bypass input on J5-10 will be an open circuit. The bypass circuit will have no influence. If a monitor bypass high (+15 VDC) control signal is applied to the base of Q16, transistor Q8's base will be held at ground potential regardless of the output from comparator U5A. The changeover circuit will be inhibited and the transmitter will remain operating in the selected side **A** or **B**.

BATTERY CONTROL PANEL (A11) ASSEMBLY (see figure SD-14)

2.10 Battery control panel assembly contains sensing circuits which automatically switch the external power source from AC to DC (battery) if the AC voltage falls below the required limits or if both the main-side and standby-side power supply modules fail. Once the transmitter has switched to the DC power source (battery), sensing circuits monitor the battery voltage and will inhibit the DC power source (battery) input if the B- falls below the desired low battery threshold level. The transmitter will shut down.

2.10.1 BATTERY CONTROL PWB (A11A1): The battery control PWB contains transistors A1Q1/ A1Q2 and associated components. During normal operation (AC power source), transistors A1Q1/Q2 will be reverse biased (turned off) and relays K2/K3 will be de-energized. The battery input on connector J1-1/2/3 will be inhibited. The AC sense (*A*) and AC sense (*B*) inputs (+15.0 volts DC) are applied through connectors P1-7/P1-5 and passed to the bases of transistors A1Q1/Q2. The B- VDC (*A*)/ B- VDC (*B*) inputs are applied through connector P1-8 and P1-4, across zener diodes A1CR3/CR4 and to the bases of transistors A1Q1/A1Q2. A positive voltage will be developed on the bases of transistors A1Q1/Q2. A1Q1/Q2 will be reverse biased and turned off. If one AC sense input (A or B) is removed, the remaining AC sense input (A or B) will maintain the turned off status of transistors A1Q1/A1Q2. Relays K2/K3 shall remain de-energized.

If the selected main-side **A** or **B** of the transmitter fails, due to a failure of the associated power supply, the respective transistor (A1Q1-side A or A1Q2-side B) will remain turned off. The relay (K2 or K3) associated with transistor A1Q1 or A1Q2 will also remain de-energized. The transmitter will changeover and the B- VDC and AC sense inputs shall be provided from the standby-side power supply. If the standby side of the transmitter's B- VDC power source fails (loss of both power supplies), transistors A1Q1/Q2 shall turn on and relays K2/K3 will energize. The battery will automatically provide the transmitter with the B- operating voltage (a momentarily dip in output power may occur). If the AC power source fails, the same result will occur that was explained for the loss of both power supplies.

2.10.1.1 Low Battery Voltage Monitor: When operating from an external DC power source (battery), the AC sense inputs on P1-7 and P1-5 are removed. Transistors A1Q1/A1Q2 are turned on and relays K2/K3 energized. If the battery voltage discharges below the desired ***Low Battery Threshold*** (nominally –62V), transistors A1Q1/Q2 shall turn off. Relays K2/K3 shall de-energize and the transmitter will shut down. Potentiometers A1R7/R8 set the bias level on transistors A1Q1/Q2 and therefore establish the desired ***Low Battery Threshold*** (adjusted at the factory when –62V is present on the anodes of zener diodes A1CR3/ A1CR4).

2.10.1.1.1 Recharging of the DC power source (battery) will not result in the transmitter automatically turning on.

2.10.1.1.2 **BATTERY RESET** switch S1 must be momentarily closed (ground) for a nominal three to five seconds. When **BATTERY RESET** switch S1 is momentarily closed, relay K1 will momentarily energize and the associated modulator's storage capacitors will begin to charge through limiting resistors R2/R3 towards the battery voltage. The B- VDC (*B*) and B- VDC (*A*) output on connectors J1-12/J1-10 are inhibited by the contacts of relay K1. When the B- VDC levels on connectors P1-8/P1-4 reach the desired level (greater than -62 volts DC), transistors A1Q1/A1Q2 will be forward biased (turned on). Relays K2/K3 will energize and the transmitter will resume normal operation on the selected main-side (A or B, dependent on the position of the **SELECT MAIN TX** switch) using the DC power source as the transmitter's B- supply.

SECTION 3
INSTALLATION AND PREPARATION FOR USE

GENERAL

3.1 This section contains the information required to prepare the equipment site to receive the subject transmitter and the information required to unpack, install and prepare the transmitter for use.

3.1.1 VISUAL INSPECTION: It is recommended that a visual inspection be performed on the subject transmitter, removable modules and associated printed wiring boards prior to installation and applying power. Inspect for the following:

(a) Inspect all electrical components for evidence of overheating or physical damage.

(b) Verify all fuses are the correct value and are not defective.

(c) Inspect all solder connections for good mechanical bond and adequate solder.

(d) Verify all wiring insulation is not pinched, frayed, broken or otherwise damaged.

(e) Verify wire strands of wiring conductors are not broken or otherwise damaged.

(f) Verify the chassis and printed wiring boards are free from solder slivers and other conductive foreign objects.

(g) Verify all integrated circuit devices are installed and firmly seated in their sockets.

TEST EQUIPMENT

3.2 The test equipment required for initial installation is listed in table 1-3.

SITE REQUIREMENTS

3.3 The transmitter should be installed in a building that provides a minimum clearance on all sides of at least four feet.

3.3.1 LIGHTNING/SAFETY GROUND: The transmitter site must contain a lightning/safety ground system to protect the transmitter from lightning-induced voltage transients. Refer to the *Recommendations for Transmitter Site Preparation* booklet.

3.3.2 ANTENNA SYSTEM: The antenna system must present a 50 ohm unbalanced load to the transmitter's RF output, with a maximum SWR of 2:1. Provision to protect the transmitter from lightning-induced voltage transients must be incorporated. Refer to the *Recommendations for Transmitter Site Preparation* booklet.

3.3.3 ELECTRICAL POWER: The transmitter will operate from an AC or DC power source.

3.3.3.1 AC Power Requirements: The transmitter will operate from a 180 to 250 volts RMS, 50Hz, (line-to-neutral) or 180 to 250 volts RMS, 60Hz (line-to-line) AC power source, provided the mean voltage does not vary by more than ten percent. The AC power source must be rated at a minimum of 2200 volt-amperes. Provision must be made to protect the transmitter from lightning-induced voltage transients. Refer to the *Recommendations for Transmitter Site Preparation* booklet.

3.3.3.2 DC Power Requirements: If used, the DC power source must be a battery bank that provides a nominal -72.0V with a constant current capacity of 25A. The no-load voltage of the DC power source must be in excess of -62.0V for the transmitter to turn on initially. The capacity of the DC battery bank, in conjunction with the ***Low Battery Voltage Threshold*** setting, shall dictate the length of time the transmitter will operate. When the battery bank voltage has decayed to below the low battery voltage threshold (–62.0V, factory setting), the transmitter will turn off and prevent the batteries from fully discharging. It is recommended that the DC power source be separately fused. Provision must be made to protect the transmitter from lightning-induced voltage transients.

3.3.4 ELECTRICAL POWER CABLING: The AC power cable must be provided by the user. A DC power cable, (if applicable) must also be provided for the user. The AC power cable enters the cabinet through a cable entry hole in its lower, rear, right-hand side and terminates at terminal board TB1. If applicable, the DC power cable enters the cabinet through a cable entry hole in its lower, rear, left-hand side and terminates at terminal board TB2 (see figure MD-38).

3.3.5 RF FEED CABLE: The RF feed cable must be a 50 ohm coaxial cable that is terminated by a type *N* coaxial connector. The RF output connector of the transmitter is located on the outer, top section of the transmitter cabinet.

3.3.6 CONTROL/MONITOR CABLING: The control/monitoring cable enters the cabinet through a cable entry hole on the top of the transmitter cabinet (left or right side), are passed through a ferrite toroid and terminate on terminal boards TB3 and TB4. The ferrite toroids are available at either end of the interface panel assembly (see figure MD-29) and provide protection for the transmitter from lightning induced voltage transients. Terminal boards TB3/ TB4 are accessible from the rear of the transmitter cabinet. Refer to figure MD-38 for information to assist in determining cable length.

3.3.7 VENTILATION: The interior of the transmitter enclosure must contain a ventilation system that will ensure the inside temperature does not exceed +55°C.

3.3.8 HEATING: The interior of the transmitter enclosure must contain a heating system that will ensure the inside temperature does not go below -10°C.

3.3.9 WORK AREA: It is recommended that a suitable work area be provided adjacent to the transmitter to permit bench inspection/repair of removable assemblies.

EXTERNAL INPUT/OUTPUT CIRCUIT REQUIREMENTS (see figure 3-3):

3.4 The external input (audio and control) and output (status and alarm monitoring) circuits must comply with the following:

3.4.1 EXTERNAL AUDIO SOURCE: An external audio source must be provided. The impedance of the audio source must be a balanced 600 ohms. The audio signal applied to the transmitter must be between -20dBm and +20dBm. The user determined limits are between 0 to 95 percent modulation.

3.4.2 REMOTE CONTROL CIRCUITS: The transmitter's on/off status and its RF output level can be controlled remotely. There is also provision to remotely switch from main to standby, as a test function, to verify the standby transmitter is serviceable and to activate the standby '1' and standby '2' code variations. When these remote controls are used, the following must be observed:

3.4.2.1 Standby '1' and Standby '2' Controls: The stby 1 and stby 2 (side **A** and side **B**) switching circuits should be the equivalent of normally open, single pole, single throw switches. When in the closed position, each switch should apply a ground to the appropriate terminal of barrier strip TB3 (see figure 3-3).

3.4.2.2 Battery Reset Control: When required, the battery reset switch should be a normally open, single pole, single throw, spring-loaded switch. When held in its closed position, it shall apply a ground to TB3-17.

3.4.2.3 Power Trim 'A' and 'B' Controls: The **A** and **B** power trim control inputs are intended to be provided by a remote maintenance monitoring (RMM) system. It shall provide +15 volts DC to TB4-10 for side **A** and to TB4-11 for side **B** when the intended carrier level is desired. If an RMM system is not used, connect TB4-10 and TB4-11 to +15 volts DC.

3.4.2.4 Remote Off Control: The RMT off control switching circuit should be the equivalent of a normally open, single pole, single throw switch. When set to its closed position (RF off), it shall apply a ground to TB3-19.

3.4.2.5 A/B Main Select Control: The A/B main select switching circuit should be the equivalent of a normally open, single pole, single throw switch. When set to its closed position, it shall apply a ground to TB3-18.

3.4.2.6 Press-To-Talk Control: The press-to-talk switching circuit should be the equivalent of a normally open, single pole, single throw switch. When set to its closed position (press-to-talk), it shall apply a ground to TB4-19. If the press-to-talk information is phantom fed on the audio input, this switching circuit will not be required (see note on figure SD-2).

3.4.3 EXTERNAL STATUS MONITORING: Outputs that may be used to identify or verify the status of remotely controlled functions are available on terminals of TB3 and TB4. These outputs include forward power, reflected power, modulation percentage, audio monitor, internal standby and SWR standby.

3.4.3.1 External Forward Power Monitoring: The external forward power output is intended to be monitored by a remote maintenance monitoring (RMM) system. A buffered DC voltage that is representative of the forward power level is provided at TB4-14. This voltage is a non-linear function of the forward power level and will be 7.8 ±10% volts DC at 1000 watts. Any other terminating device must have an input impedance of not less than 100K ohms.

3.4.3.2 External Reflected Power Monitoring: The external reflected power output is intended to be monitored by a remote maintenance monitoring (RMM) system. A buffered DC voltage that is representative of the reflected power level is provided at TB4-15. This voltage is a non-linear function of the reflected power level and will be 8.6 ±10% volts DC at 1000 watts. Any other terminating device must have an input impedance of not less than 100K ohms.

3.4.3.3 External Modulation Percentage Monitoring: The external modulation percentage output is intended to be monitored by a remote maintenance monitoring (RMM) system. A buffered DC voltage that is representative of the modulation percentage is provided at TB4-16. When operating in CW, at 1000 watts RF output, 4.3 ±10% volts DC will be applied to TB4-16. When operating in MCW, at 1000 watts carrier power and 95% modulation, 8.2 ±10% volts DC will be applied to TB4-16.

3.4.3.4 Audio Monitor: A transformer coupled 600 ohm audio output is provided between TB3-22 and TB3-23 for external monitoring.

3.4.3.5 Internal Standby Monitoring: The internal standby output is the normally closed contact of a relay. The relay is held energized when the selected side (main transmitter) is operating and an open circuit is applied to TB3-9. When the main transmitter has been shut down and the standby transmitter has been enabled, the relay will de-energize and apply a ground to TB3-9.

3.4.3.6 SWR Standby Monitoring: The SWR standby output is provided by a CMOS inverter that is protected from negative voltages by a series diode. When the reflected power is satisfactory, an open collector is applied to TB3-10. When the reflected power is excessive and causing the carrier level to be cutback (reduced), a current sink-to-ground is applied to TB3-10.

3.4.4 EXTERNAL ALARM MONITORING CIRCUITS (see figure SD-1)**:** Alarm signals that identify malfunctions or conditions that require response from a maintainer are provided.

3.4.4.1 Standby-Alarm: A standby alarm output is provided by the normally closed contact of a relay. The relay is held energized when the selected side (main transmitter) is operating and an open circuit is applied to TB3-15 as the standby alarm status. When the selected side has shut down and the standby side has been enabled, the relay will de-energize and apply a ground to TB3-15 as the standby alarm status.

3.4.4.2 Shutdown-Alarm: A shutdown-alarm output is provided by the normally closed contact of a relay. The relay is held energized when either side (main or standby transmitter) is operating and an open circuit is applied to TB3-16 as the shutdown alarm status. When both sides have been shut down and the transmitter is off-the-air, the relay will de-energize and apply a ground to TB3-16 as the shutdown alarm status.

3.4.4.3 SWR-Alarm: The emitter/collector impedance of a switching transistor to ground is applied to TB3-13 as the SWR-alarm output. When the reflected power is satisfactory, the transistor will be reverse biased and apply an open collector to TB3-

13 as the SWR alarm output. When the reflected power is excessive and causing the carrier level to be cutback (reduced), the transistor will be forward biased and a current sink-to-ground will be applied to TB3-13 as the SWR alarm output.

3.4.4.4 Battery Alarm: The emitter/collector impedance of a switching transistor to ground is applied to TB3-14 as the 'remote battery alarm' output. When AC power is being used as the transmitter's power source, the transistor will be reverse biased and apply an open collector to TB3-14 as the 'remote battery alarm' output. When the ac power fails or is turned off and an external DC power source (battery) is the transmitter's power source, the transistor will be forward biased and a current sink-to-ground will be applied to TB3-14 as the 'remote battery alarm' output.

NOTE

Current flow through a current sink (switching transistor) must not exceed 200 milliamperes. Zener diodes are connected between the output and ground to ensure voltage transients, induced in the external wiring, are not coupled to the transmitter's logic circuits. The external alarm monitoring circuits must operate from a positive DC voltage power source. An external DC power supply may be used or +15V from TB4-12 may be used as the voltage source. If the +15V from TB4-12 is used, it must be remembered that this voltage is turned off if the transmitter is shut down.

UNPACKING:

3.5 The transmitter is packed in wooden crates for shipment. A packing list(s) provides a detailed listing of crate contents.

Crates should be inspected for transit damage prior to shipment acceptance and/or uncrating.

3.5.1 TRANSMITTER CABINET CRATE: The transmitter is packed partially disassembled in a wooden crate that is approximately 178 cm (70 inches) x 74 cm (29 inches) x 76 cm (30 inches). Shipping weight is approximately 150 kilograms (330 pounds). Open crate and remove the transmitter cabinet as follows:

(a) Locate crate in an upright position, as marked, in a clear area that will permit extraction of the transmitter without risk of damage to the unit or injury to personnel.

(b) Remove the panel identified as the top from the crate by carefully prying it open using a small pry bar or other suitable tool.

(c) Remove the two wooden braces securing the transmitter and carefully remove the transmitter cabinet.

(d) Perform a visual inspection of the transmitter cabinet and its assemblies as detailed in paragraph 3.1.1.

3.5.2 POWER SUPPLY MODULE CRATE: The power supply modules are packed fully assembled in a wooden crate that is approximately 65 cm (25 inches) x 72 cm (28 inches) x 43 cm (17 inches). Shipping weight is approximately 122 kilograms (270 pounds). Open crate and remove modules as follows:

(a) Locate the crate in an upright position, as marked on the crate, in a clear area that will permit extraction of the power supply modules without risk of damage to the unit or injury to personnel.

(b) Remove the panel identified as the top from the crate by carefully prying it open using a small pry bar or other suitable tool.

(c) Carefully remove the two power supply modules and place at a location near the transmitter cabinet.

(d) Perform a visual inspection of power supply modules as detailed in paragraph 3.1.1.

(e) Do not install power supply modules in transmitter cabinet at this time.

3.5.3 EXCITER AND MODULATOR/ POWER AMPLIFIER MODULE CRATE: The exciter and modulator/power amplifier modules are packed fully assembled in a wooden crate that is approximately 114 cm (45 inches) x 58 cm (23 inches) x 35.5 cm (14 inches). Shipping weight is approximately 52.3 kilograms (115 pounds). Open crate and remove the modules as follows:

(a) Locate crate in an upright position, as marked on crate, in a clear area that will permit extraction of modules without risk of damage to unit or injury to personnel.

(b) Remove the panel identified as the top from the crate by carefully prying it open using a small pry bar or other suitable tool.

(c) Carefully remove the two modulator/power amplifier modules and two exciter modules. Place modules at a location near the transmitter cabinet.

(d) Perform a visual inspection of the subject modules as detailed in paragraph 3.1.1.

(e) Do not install subject modules in transmitter cabinet at this time.

ANCILLARY PARTS

3.6 An ancillary parts list is provided with each transmitter. These parts include commonly used installation materials and hardware. The ancillary parts are not intended to be long term maintenance spares and are provided only to assist in the initial installation. An itemized listing of the ancillary parts kit contents is included in its packing list.

USER ASSIGNED INFORMATION

3.7 The final configuration of each transmitter is determined by the user's requirements and applications. The following user assigned information must be obtained prior to final assembly and installation of the transmitter.

3.7.1 CARRIER FREQUENCY: Determine the transmitter's assigned carrier frequency and record frequency in the ***Established Reference*** section of table 5-2.

3.7.2 TONE FREQUENCY: Determine which keyed tone frequency (400Hz, 1020Hz) is to be used and record frequency in the ***Established Reference*** section of table 5.2.

3.7.3 IDENTIFICATION CODE: Determine the identification code that has been assigned to the transmitter and record code in the ***Established Reference*** section of table 5.2.

3.7.4 STANDBY CODES: Determine the standby codes as follows:

3.7.4.1 Standby 1 (A) Code: Determine the standby 1 (A) code variation to be transmitter and record code in the ***Established Reference*** section of table 5.2.

3.7.4.2 Standby 2 (A) Code: Determine the standby 2 (A) code and record code in the ***Established Reference*** section of table 5.2.

3.7.4.3 Standby 1 (B) Code: Determine the standby 1 (B) code variation and record code in the ***Established Reference*** section of table 5.2.

3.7.4.4 Standby 2 (B) Code: Determine the standby 2 (B) code and record code in the ***Established Reference*** section of table 5.2.

3.7.5 MEAN LEVEL OF AC POWER SOURCE: Determine the mean RMS voltage level of the AC power source that will be applied to the transmitter.

Table 3-1 Crystal Operating Frequencies

FREQUENCY (kHz)	MULTIPLY BY	CRYSTAL FREQUENCY (kHz)
190 - 250	16	3040 to 4000
251 - 500	8	2000 to 4000
501 - 535	4	2000 to 2140

PARTS REQUIRED BUT NOT SUPPLIED

3.8 Some parts required to complete the subject transmitter's installation are not supplied with the transmitter. The user must supply these parts. A specific installation will dictate the parts required and will normally include the following:

(a) A suitable 50 ohm RF output coaxial cable, terminated by a type 'N' coaxial connector at the transmitter end, is required.

(b) All external control/monitor wiring must be provided by the user.

(c) All external AC and, if applicable, DC power cabling must be provided by the user.

3.8.1 OSCILLATOR CRYSTALS: Two oscillator crystals are required if the RF drive is generated by the crystal controlled oscillator on the RF oscillator PWBs. If the assigned carrier frequency is identified by the user and the oscillator crystals are ordered during manufacture, the crystals will be installed in the transmitter. If oscillator crystals are not ordered prior to shipment, they must be obtained by the user. The crystals must be fundamental, AT cut; with undercut pins for installation in a standard HC-6 holder. They must operate in a parallel resonant circuit, with a load capacitance of 50pF. Crystal frequency must be between 2.0MHz and 4.0MHz (4, 8 or 16 times assigned carrier frequency - see table 3-1), with an initial frequency tolerance of ±10 parts per million at 25°C and a frequency stability of ±2 parts per million over an operating temperature range of 0°C to 50°C.

NOTE

It is recommended that at least one spare oscillator crystal be obtained as a replacement for maintenance purposes.

PRE-INSTALLATION PROCEDURES

3.9 Assembly of the transmitter must be completed and the following pre-installation procedures completed prior to applying power.

3.9.1 DISASSEMBLY REQUIRED: Disassemble the transmitter to the extent required to gain access to its major assemblies and complete the pre-installation procedures as follows:

(a) Set or verify the **TEST** meter indications are set to zero.

(b) Verify battery links are connected if optional battery panel (A11) is not installed or removed if the battery panel is installed (see note on figure SD-1).

3.9.2 EXCITER MODULE PRE-INSTALLATION (see figure MD-14)**:** Determine if the exciter modules contain an RF synthesizer PWB or an RF oscillator PWB [when RF drive is generated by an integral oscillator], then proceed as follows:

3.9.2.1 RF Synthesizer PWB Pre-Installation: If an RF synthesizer PWB has been installed as A3 in the exciter module, perform the pre-installation procedures completing the *Preparation for Use* section of the RF synthesizer PWB service instruction manual.

3.9.2.2 RF Oscillator PWB: (see figure MD-19) If an RF oscillator PWB has been installed as A3 in the exciter module, complete the following requirements or verify they are being met:

(a) An oscillator crystal that meets the requirements of paragraph 3.8.1 must be installed in crystal socket XY1.

(b) A link must be connected between printed wiring pad **A** and pad **B** (enables crystal controlled oscillator).

(c) A link must not be connected between printed wiring pad **D** and any other pad (disables buffer/isolation amplifier).

(d) A link must not be connected between printed wiring pad **F** and any other pad.

(e) A link must be connected between printed wiring pad **E** and the appropriate divide-by pad (**/4**, **/8** or **/16**). Enter table 3-1 with carrier frequency to determine divider.

3.9.3 KEYER PWB PRE-INSTALLATION (see figure MD-17)**:** Complete the pre-installation procedures on keyer PWBs as follows:

3.9.3.1 Identification Code: Connect the identification code selection terminals of TB1 and TB2 to the appropriate code bus as follows:

NOTE

A dot is one bit, a dash is three bits, the space between elements of a character is one bit and the space between characters is three bits.

If continuous tone is required after the identification code, leave a space of three segments (bits) and fill in the remaining programmable segments.

Identified terminals of TB1 and TB2 are assigned two segments. In a properly completed lattice, the right-hand segment will be filled in if the left-hand segment is filled in. The left-hand segment will not be filled in if the right-hand segment is not filled in.

(a) Refer to figure 3-1 and fill in the blank lattice using the Morse code representation of the assigned identification code, noting that each segment of the lattice represents one bit; the first bit of the first element of the first character is pre-assigned and there are fifty programmable bits.

(b) When both segments for a terminal (in the completed lattice) are filled in, connect that terminal to TB2-14 (dash bus).

(c) When only the right-hand segment for a terminal (in the completed lattice) is filled in, do not connect that terminal.

(d) When both segments for a terminal (in the completed lattice) are not filled in, connect that terminal to TB1-1 (space 1) with one exception: If segments represent the space between characters that will be expanded when a standby '1' command is applied, connect that terminal to TB2-13 (space 2).

3.9.3.2 Frame Content: Connect the frame content selection terminals of TB3 to the appropriate frame content code bus as follows:

NOTE

A frame consists of 64 bits (8 seconds). It can be continuous tone (MCW), continuous no-tone (CW) or it can contain one identification code and its attendant space or long dash. The frame content selector is a cyclic octal sequencer that allows the user to choose the contents of each frame in a continuously repeated eight frame sequence.

TB3-3 through TB3-10 represent the eight frames of each cycle. They are assigned sequentially, with TB3-3 representing the first frame.

(a) Terminals of TB3 that represent frames which are to contain an identification code shall not be connected to TB3-1 (MARK bus) or TB3-2 (SPACE bus).

(b) Terminals of TB3 that represent frames which are to be continuous tone (MCW) shall be connected to TB3-1 (MARK bus).

(c) Terminals of TB3 that represent frames which are to be continuous no-tone (CW) shall be connected to TB2-1 (SPACE bus).

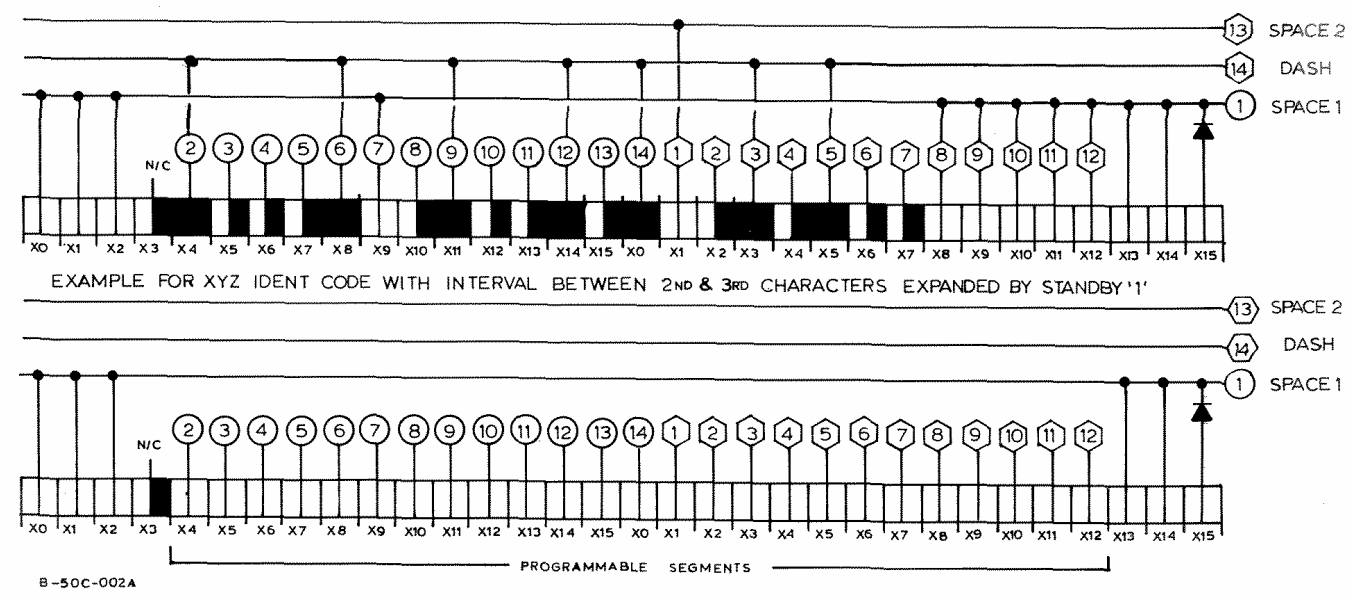


Figure 3-1 Identification of Code Selection Lattice

Table 3-2 Selecting Primary Winding Taps for Power Transformers A7T1/A8T1

AC SUPPLY VOLTAGE (RMS)	TRANSFORMER TAPS	
	(WIRE 5)	(WIRE 6)
180 - 189	4	2
190 - 199	4	1
200 - 209	5	2
210 - 219	5	1
220 - 229	6	2
230 - 239	6	1
240 - 249	7	2
250 - 259	7	1

3.9.3.3 Keyed Tone Frequency: If the keyed tone frequency is to be 1020Hz, as determined in paragraph 3.7.2, install or verify links *B* and *C* are installed. If the keyed tone frequency is to be 400 Hz, remove or verify links *B* and *C* are removed.

3.9.3.4 Keyed Tone Source: If the keyed tone signal is to be supplied by the internal tone oscillator, verify link *A* is installed. Remove link *A* if it is supplied from an external source.

3.9.4 POWER TRANSFORMERS A7T1 and A8T1 PRIMARY TAP SELECTION (see figure MD-24)**:** Connect the primary winding taps of power transformers A7T1 and A8T1 as follows:

(a) Refer to table 3-2 and determine which primary winding taps of transformer A7T1 should be connected for the mean RMS voltage of the AC power source (previously determined in paragraph 3.7.5).

(b) Gain access to power transformer A7T1's primary winding taps. Transformer is located on inner front portion of module with its taps facing the module's front panel.

(c) Locate and, if necessary, remove tyraps from wires identified in table 3-2. Wires #5 (grey) and #6 (grey) are located on the inner section of the front panel of the power supply module.

(d) Connect wires, located in step (c), to the primary winding taps of power transformer A7T1's, as identified in table 3-2 and depicted in figure MD-24.

(e) Ensure all hardware securing electrical connections is firmly tightened.

(f) Repeat steps (a) through (e) for power transformer A8T1, noting that the primary winding taps selected for power transformer A8T1 should be the same as the primary winding taps selected for power transformer A7T1.

Table 3-3 Selecting Frequency Band Links on Harmonic Filter A12

FREQUENCY BAND (kHz)		SERIES INDUCTORS	PARALLEL INDUCTORS		SERIES CAPACITORS (C1/C2/C3/C4) (QUANTITY)	PARALLEL CAPACITORS (C5/C6/C7/C8) (QUANTITY)
FROM	TO		L3-1	L4-1		
190.0	198.4	L1-6 to L2-6	L4-6	L3-6	4	4
198.4	216.2	L1-5 to L2-6	L4-6	L3-5	4	4
216.2	233.9	L1-5 to L2-5	L4-5	L3-5	4	4
233.9	251.2	L1-4 to L2-5	L4-5	L3-4	4	4
251.2	269.9	L1-4 to L2-4	L4-4	L3-4	4	4
269.9	289.9	L1-4 to L2-5	L4-5	L3-4	3	3
289.9	316.1	L1-4 to L2-4	L4-4	L3-4	3	3
316.1	349.7	L1-3 to L2-4	L4-4	L3-3	3	3
349.7	386.9	L1-4 to L2-4	L4-4	L3-4	2	2
386.9	428.1	L1-3 to L2-4	L4-4	L3-3	2	2
428.1	470.1	L1-3 to L2-3	L4-3	L3-3	2	2
470.1	512.4	L1-2 to L2-3	L4-3	L3-2	2	2
512.4	535.0	L1-2 to L2-2	L4-2	L3-2	2	2

3.9.5 HARMONIC FILTER PRE-INSTALLATION: Complete the pre-installation procedures on harmonic filter assembly A9 as follows (refer to figure SD-12 to locate harmonic filter assembly A9 and to figures MD-30 through MD-33 for its assembly detail):

Ensure all attaching hardware on capacitor selector plates A9E1/A9E2, taps on inductors A9L1 through A9L4 and the harmonic filter's cover is securely fastened when the requirements of paragraph 3.9.5 have been completed. Failure to do so may result in a hazardous condition or unreliable adjustment.

(a) Gain access to rear panel of harmonic filter assembly A9 by opening rear hinged door of transmitter cabinet.

(b) Remove rear cover from the filter assembly by removing ten screws and ten washers.

NOTE

The number of in-circuit capacitors is determined by the position of selector plates E1 and E2. Refer to table 3-3 to determine number of in-circuit capacitors for a specific frequency and to figure 3-2 for examples of selector plate positioning. A minimum of two capacitors will be linked by E1 and by E2. All selected capacitors are the same value; therefore, it does not matter which groupings are selected.

Tap selection of series inductors L1 and L2 and parallel inductors L3 and L4 is frequency dependent. Refer to table 3-3 to determine tap connections for a specific frequency. Refer to the electrical schematic depicted in Figure SD-12 as an aid to understanding the function of the band links in harmonic filter A9.

(c) Enter table 3-3 with the assigned carrier frequency and determine the following:

- From the ***Series Inductor*** column of table 3-3, determine the taps of inductors A9L1 and A9L2 that are to be interconnected.

- From the ***Parallel Inductor*** column of table 3-3, determine the tap of L4 that is to be connected to L3-1 and the tap of L3 that is to be connected to L4-1.

- From the ***Series Capacitors*** column of table 3-3, determine the number of capacitors that are to be placed in-circuit by capacitor selector plate E1.

- From the ***Parallel Capacitors*** column of table 3-3, determine the number of capacitors that are to be placed in-circuit by capacitor selector plate E2.

(d) Interconnect the taps of series inductors L1 and L2 as identified in step (c).

(e) Interconnect the taps of parallel inductors L3 and L4 as identified in step (c).

(f) Position series capacitor selector plate E1 over capacitors C1, C2, C3 and C4 so it places, in-circuit, the number of capacitors identified in step (c).

CAUTION

Change position of capacitor selector plates by removing any screws attaching plate to a capacitor, loosen nut in centre of plate and then carefully rotate plate to the desired orientation. An insulating pad is located directly under selector plates E1 and E2. Ensure pad is correctly positioned and then secure plate to each in-circuit capacitor. Tighten bolt in centre of selector plate.

(g) Position parallel capacitor selector plate E2 over capacitors C5, C6, C7 and C8 so it places, in circuit, the number of capacitors identified in step (c).

(h) Reinstall rear panel on harmonic filter assembly removed in step (b). Ensure hardware is fastened securely.

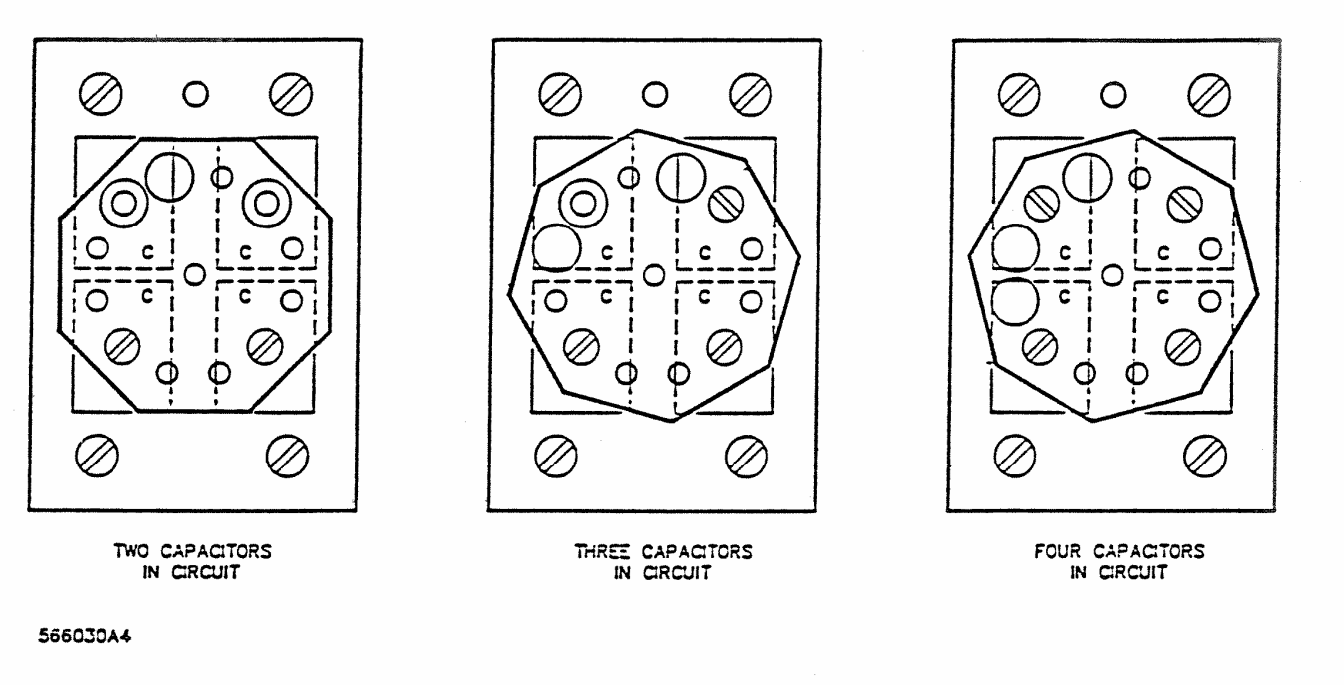


Figure 3-2 Positioning of Selector Plates E1 and E2

INSTALLATION PROCEDURES

3.10 The following procedures must be performed while installing the transmitter:

3.10.1 TRANSMITTER MODULE INSTALLATION: Install the modulator/power amplifier modules, power supply modules and exciter modules as follows:

3.10.1.1 Power Supply Modules A7/A8 (see figures MD-1 and MD-23)**:** Install power supply modules A7/A8 as follows:

(a) Verify the pre-installation requirements of paragraph 3.9 have been completed.

(b) Verify screws securing modulator assemblies A1, A3, A5, A7 and power amplifier assemblies A2, A4, A5, A6 to terminals 1, 2 and 3 of terminal blocks TB1 through TB8 are firmly tightened.

(c) Position the power supply modules adjacent to their respective supports at the front of the transmitter cabinet.

(d) Carefully lift power supply modules and slide into cabinet.

(e) Connect cableform floating connector P2 to connector A7J1.

(f) Connect cableform floating connector P3 to connector A8J1.

(g) Firmly secure attaching hardware to retaining bolt on rear of module A7.

(h) Firmly secure attaching hardware to retaining bolt on rear of module A8.

(i) Install 1-inch blanking plugs, provided as ancillary parts into unused cable entry holes.

3.10.1.2 Modulator/Power Amplifier Modules (see figures MD-1 and MD-4)**:** Install RF power modules A2/A3 as follows:

(a) Verify the pre-installation requirements of paragraph 3.9 have been completed.

(b) Locate modulator/power amplifier module tray openings on the front of the transmitter cabinet.

(c) Install the two modulator/power amplifier modules into their respective trays.

(d) Firmly secure attaching hardware to retaining bolt on rear of modules.

(e) Mate BNC coaxial connector P9, which terminates coaxial cable from exciter module A4, with BNC coaxial connector J2 of modulator/power amplifier module A2.

(f) Mate connector P10, which terminates a cableform flying lead, with connector J1 of modulator/power amplifier module A2.

(g) Mate connector P11, which terminates a cableform flying lead, with connector J1 of modulator/power amplifier module A3.

(h) Mate BNC coaxial connector P12, which terminates coaxial cable from exciter module A5, with BNC coaxial connector J2 of modulator/power amplifier module A3.

3.10.1.3 Exciter Modules (see figures MD-1 and MD-13)**:** Install exciter modules A4/A5 as follows:

(a) Verify the pre-installation requirements of paragraph 3.9 have been completed.

(b) Locate exciter module tray openings on the front of the transmitter cabinet.

(c) Install the two exciter modules into their respective trays.

(d) Do not secure attaching hardware to retaining bolt on rear of modules at this time.

(e) Mate connector P5, which terminates a cableform flying lead, with connector J2 of exciter module A4.

(f) Mate connector P6, which terminates a cableform flying lead, with connector J1 of exciter module A4.

(g) Mate connector P7, which terminates a cableform flying lead, with connector J2 of exciter module A5.

(h) Mate connector P8, which terminates a cableform flying lead, with connector J1 of exciter module A5.

(i) Mate BNC coaxial connector P19, which terminates coaxial cable from modulator/ power amplifier module A2, with BNC coaxial connector A4J2 of exciter module A4.

(j) Mate BNC coaxial connector P20, which terminates coaxial cable from modulator/ power amplifier module A2, with BNC coaxial connector A4J2 of exciter module A5.

3.10.2 EXTERNAL INPUT/OUTPUT INTERFACE CONNECTIONS: Connect the external input/output wiring to the transmitter as depicted in figure 3-3, observing the following: see figure MD-1 to locate the terminal boards and to figure MD-29 for additional detail.

NOTE

The external control/monitoring cable must be strain-relieved by clamping at cabinet entrance, using a suitable cable clamp. Install blanking plugs in all unused cable entry holes.

(a) Route the external input/output interface cable(s), through the most appropriate cable entry hole (top of cabinet), through the appropriate ferrite ring(s) and terminate on their respective terminals on interface panel barrier strips TB3 and TB4, (barrier strips TB3/TB4 are accessible through the rear section of the transmitter cabinet).

(b) Using figure 3-3 to determine the final destination of each conductor, cut each conductor to its required length.

(c) Remove approximately 0.5 inches of insulation from the end of each conductor. Terminate each conductor with an appropriate terminal lug for a #6 screw.

(d) Connect the input/output conductors to the appropriate terminals of barrier strips TB3 and TB4 using figure 3-3 as a guide.

3.10.3 RF OUTPUT CABLE CONNECTION: Install the RF output coaxial cable as follows:

(a) Route the RF output coaxial cable to type *N* coaxial connector J1, which is located on the top cover of the transmitter cabinet.

(b) Cut the RF output coaxial cable to the required length. Install a type *N* coaxial connector on the cable and connect the coaxial cable to RF output connector J1.

3.10.4 LIGHTNING/SAFETY GROUND CONNECTION: Connect a continuous, insulated 4 AWG copper wire or one-inch copper braid, from the station lightning/safety ground system, directly to the safety ground connection at the top of the transmitter. Ensure the conductor wire does not contact any other metal surface of the chassis or cabinet.

3.10.5 AC AND DC POWER CONNECTION (see figure MD-38): Connect the AC power cabling, and if applicable, the DC power cabling as follows:

NOTE

The AC and DC power source cables must be strain-relieved by clamping at cabinet entrance, using appropriate cable clamps.

(a) Switch off transmitter's ac power source at service entrance.

(b) Remove appropriate (smaller) knockout from lower, right-hand, cable-entry.

(c) Install cable clamp provided in ancillary parts kit in cable-entry hole.

(d) Route wiring from AC power source through cable clamp, installed in step (c), to vicinity of barrier strip TB1.

(e) Connect AC power source conductors to barrier strip TB1 as follows:

North American Type Supply
230 VAC (line-to-line)

TB1-1	Line A (115 VAC)
TB1-2	Line B (115 VAC)
TB1-3	Neutral (Not Connected)
TB1-4	Ground

European Type Supply
230 VAC (line-to-neutral)

TB1-1	Line (230 VAC)
TB1-2	Neutral
TB1-3	No Connection
TB1-4	Ground

(f) Remove appropriate (smaller) knockout from lower, left-hand, cable-entry hole.

(g) Install cable clamp provided in ancillary parts kit in cable-entry hole.

(h) Route wiring from DC power source through cable clamp, installed in step (g), to vicinity of barrier strip TB2.

(i) Connect DC power source conductors to barrier strip TB2 as follows:

- Positive conductor to TB2-1
- Negative conductor to TB2-2

(j) Firmly tighten cable clamps, ensuring wiring is not pinched.

FIRST STAGE (INITIAL START-UP)

3.11 The first stage of the initial start-up is to perform a visual inspection and then perform a complete functional test/adjustment procedure as detailed in paragraph 5.3. On completion of the functional test/adjustment procedures, perform the second stage procedures as detailed in paragraph 3.12.

NOTE

The transmitter was fully tested during manufacture and subjected to an extensive burn-in period.

SECOND STAGE (INITIAL START-UP)

3.12 The second stage of initial start-up is to connect the transmitter's output to its antenna system, interfaced by a suitable antenna tuning arrangement and to adjust the antenna tuning unit in accordance with the instructions in its instruction manual. The transmitter is used as the 50-ohm, RF signal source and the following should be observed:

WARNING

Do not turn on transmitter until requested to do so by personnel at the antenna site. Extremely high, potentially lethal, RF voltages are present in antenna tuning unit when an RF signal of any level is being applied.

(a) Verify the requirements of paragraph 3.11 have been satisfactorily completed.

(b) Set switches to positions tabulated for *Test Setting* in table 4-1.

(c) Connect an antenna system, interfaced by a suitable antenna tuning arrangement, to RF output coaxial connector J1, using a suitable 50 ohm coaxial cable.

(d) Set or verify **O/P POWER** potentiometer A4A2R48 is set fully counter clockwise.

(e) Set the **TEST-Power/Mod** switch to **FWD PWR**.

(f) When requested by personnel at antenna tuning unit site, set **RF** switch to **ON** and adjust **O/P POWER** potentiometer A4A2R48 clockwise for an initial **FWD PWR** indication of 50 watts on the **TEST-Power/Mod** meter.

(g) Continuously monitor the forward power indication on the **TEST-Power/Mod** meter and adjust **O/P POWER** potentiometer A4A2R48 (side A) to control the RF output level during adjustment of the antenna tuning unit as requested by personnel at the antenna tuning unit site. Do not permit the forward power indication on the **TEST-Power/Mod** meter to exceed 1000 watts (the maximum rated carrier power of the transmitter).

(h) Adjust or verify antenna tuning unit is adjusted (by personnel at antenna tuning unit site) in accordance with instructions in the ATU instruction manual.

(i) On completion of antenna tuning unit adjustment, set the **TEST-Power/Mod** switch to **REFL PWR** and verify the reflected power indication on the **TEST-Power/Mod** meter is less than five percent of the forward power reading (50 watts maximum).

(j) Repeat procedures detailed in paragraph 3.12 for the standby (side B) side of the subject transmitter.

THIRD STAGE (INITIAL START-UP)

3.13 The third stage of initial start-up is to establish the RF output level (intended carrier level) that will provide the desired field strength at the required distance from the antenna, the correct setting (**CUR** or **VOLT**) of **RF MON** switch A9A2S1 and the optimum modulation percentage intended modulation depth for the antenna system in use; by operating a transmitter, that has met the requirements of the first stage of initial start-up (successfully completed the functional test/adjustment procedures detailed in paragraph 5.3), into an antenna system that has met the requirements of the second stage of initial start-up.

3.13.1 INTENDED CARRIER LEVEL: The intended carrier level is the unmodulated RF output that will provide the desired field strength at the required distance from the antenna. Once established, the intended carrier level should be recorded in the ***Established Reference*** section of table 5-2 and should be used in all subsequent functional test/ adjustment procedures. Using procedures detailed in paragraph 5.5.4, adjust **O/P POWER** potentiometer A4A2R48 when side **A** is selected until the desired field strength at the required distance from the antenna is attained. Ensure the unmodulated RF output does not exceed 1000 watts.

When the intended carrier level has been determined, set the **SELECT MAIN TX** switch to **B** and adjust **O/P POWER** potentiometer A5A2R48 for the intended carrier level.

NOTE

If the intended carrier level is less than 1000 watts, it will be necessary to adjust the carrier level fault threshold level, while operating into the antenna system, as detailed in paragraph 5.3.15.2.

3.13.2 RF MONITOR SIGNAL SOURCE SELECTION: The source of the RF output information available on **RF MON** connector A9A2J3 is determined by the setting of **RF MON** switch A9A2S1. When **RF MON** switch A9A2S1 is set to **CUR**, a sample of the RF output current waveform is provided. When **RF MON** switch A9A2S1 is set to **VOLT**, a sample of the RF output voltage waveform is provided. The correct setting for this switch is the setting which provides the waveform with the greatest modulation depth (percentage). Once established, the setting of **RF MON** switch A9A2S1 should be recorded in the ***Established Reference*** section of table 5-2 and **RF MON** switch A9A2S1 should be set to the recorded setting.

3.13.3 INTENDED MODULATION DEPTH: The intended modulation depth is the optimum modulation depth that can be attained (as close as possible to 95%) with the antenna system in use. Once established, the intended modulation depth should be recorded in the ***Established Reference*** section of table 5-2 and should be used in all subsequent test/adjustment procedures.

CAUTION

Reduce modulation percentage immediately if the* RF CURRENT *lamp turns on. Failure to observe this precaution may result in excessive current flow in the power amplifier stage and cause failure of solid state devices.

- If **RF CURRENT** lamp turns on, the RF stress current threshold is being exceeded. Reduce mod depth immediately to a level that results in **RF CURRENT** lamp turning off.

- If **SWR ALARM** lamp turns on, the carrier level will be cutback and it will not be possible to maintain the intended carrier level. Reduce mod depth until **SWR ALARM** lamp turns off.

NOTE

If the intended modulation depth is less than 95%, it will be necessary to adjust the modulation depth fault threshold level, while operating into the antenna system, as detailed in paragraph 5.3.15.3 and the combined voice/tone (A3E mode) modulation depth as detailed in paragraph 5.3.12.

3.13.3.1 Set RF output's modulation envelope to the intended modulation depth as follows:

(a) Verify the intended carrier level has been determined as detailed in paragraph 3.13.1 and the transmitter's unmodulated RF output is the intended carrier level.

(b) Verify setting of **RF MON** switch A9A2S1 has been determined as detailed in paragraph 3.13.2 and it is set to the established setting.

(c) Set switches as tabulated for ***Test Setting*** in table 4-1.

(d) Set **TONE LEVEL** potentiometers A4A2R19 and A5A2R19 fully counter clockwise.

(e) Set the **RF** switch to **ON**.

(f) Set **MOD** switch A4S2 (A5S2) to **ON**.

(g) Monitor oscilloscope waveform and slowly increase modulation depth by adjusting **TONE LEVEL** potentiometer A4A2R19 clockwise until 95% modulation is attained or the **SWR-ALARM** lamp turns on or until modulation envelope is excessively distorted.

(h) Set **TONE LEVEL** potentiometer to the setting that will provide 95% modulation or the best compromise of depth and distortion when the **SWR-ALARM** lamp is not turned on.

(i) Set **TEST-Power/Mod** switch to **MOD-SET**.

(j) Adjust the **SET 100 % MOD** potentiometer for 100% indication on the lower scale of the **TEST-Power/Mod** meter.

(k) Set the **TEST-Power/Mod** switch to **MOD-READ**.

(l) Record **TEST-Power/Mod** meter's lower scale indication as the intended modulation depth in ***Established References*** section of table 5-2.

(m) Set **TEST-Power/Mod** switch to **REFL PWR.**

(n) **TEST-Power/Mod** meter's reflected power indication shall be less than 50W.

(o) **SWR-ALARM** lamp shall be off.

(p) Set **SELECT MAIN TX** switch to **B**.

(q) Verify the transmitter's unmodulated RF output is the intended carrier level.

(r) Set **TEST-Power/Mod** switch to **MOD-SET.**

(s) Adjust **SET 100 % MOD** potentiometer for 100% indication on the lower scale of the **TEST-Power/Mod** meter.

(t) Set **TEST-Power/Mod** switch to **MOD-READ**.

(u) Adjust **TONE LEVEL** potentiometer A5A2R19 for modulation depth recorded in step (l).

(v) Set **TEST-Power/Mod** switch to **REFL PWR**.

(w) **TEST-Power/Mod** meter's reflected power indication shall be less than 50W.

(x) **SWR-ALARM** lamp shall be off.

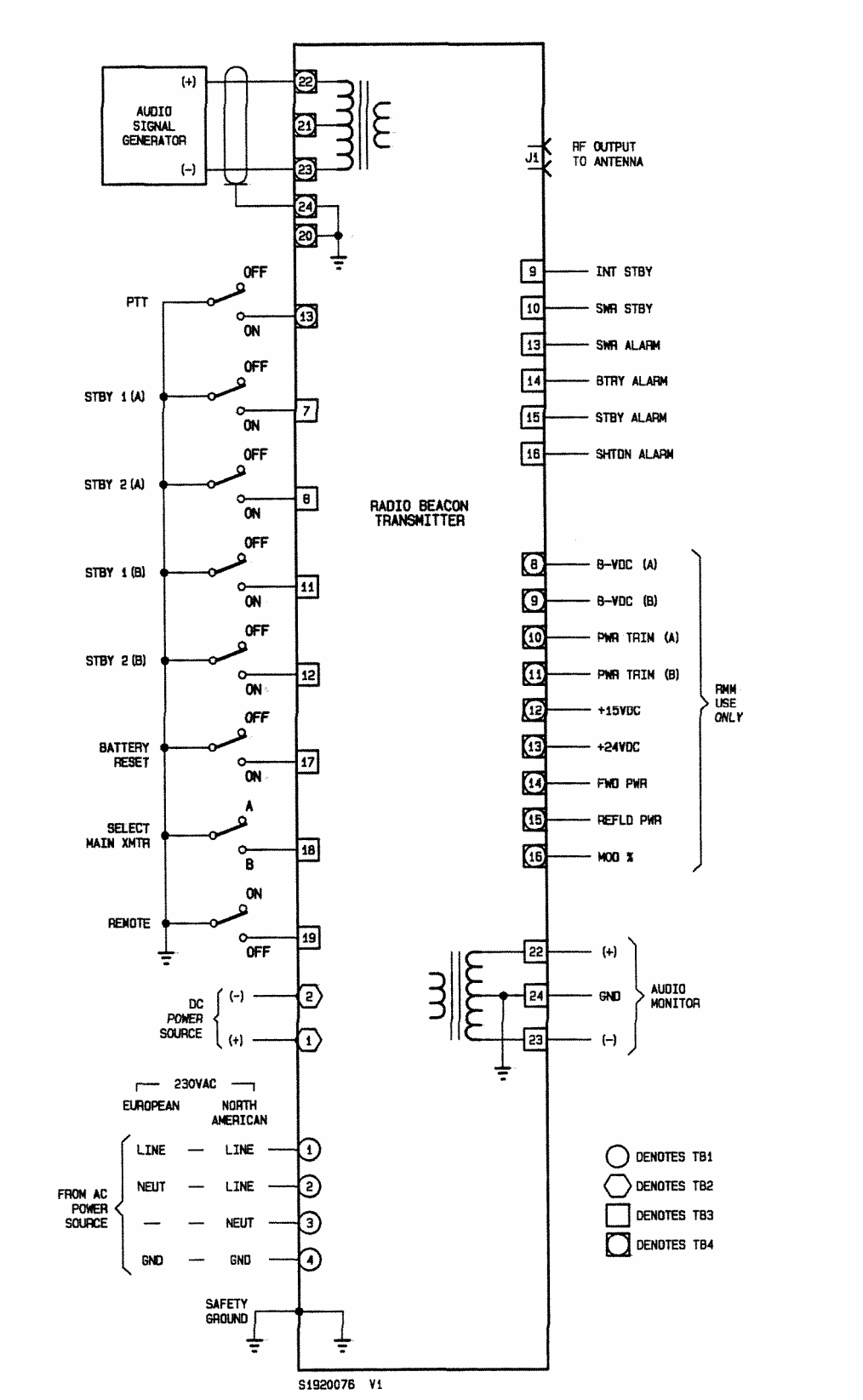


Figure 3-3 External Input/Output Interface

SECTION 4
OPERATING INSTRUCTIONS

GENERAL

4.1 This section provides the information required to place the subject transmitter in operation. Normally, the transmitter will not be attended during use.

EMERGENCY SHUTDOWN PROCEDURE

4.2 There are no special precautions to be taken if an emergency shutdown is required. Switch off AC power by placing **POWER - AC LINE** switch A6S1 to its **OFF** position or turn off AC power source at the service entrance. If a battery is being used as the transmitter's DC power source, set **POWER - BATTERY** switch A6S2 to its **OFF** position.

CONTROLS AND INDICATORS

4.3 The following paragraphs list assemblies that contain controls and indicators, identify illustrations that depict their location and markings and reference tables that describe their purpose and function.

4.3.1 CONTROL/MONITOR PANEL CONTROLS AND INDICATORS: Figures MD-2 and MD-3 depict the controls and indicators on control/monitor panel A1. Table 4-2 is keyed to the reference designation assigned to the controls/ indicators and explains their function.

NOTE

TEST-Power/Mod *meter's RF Kilowatts scale is a square law scale. Resulting non-linearity makes it difficult to read less than 100 watts. Any reading that is less than fifty percent of the 100-watt mark is less than 25 watts.*

4.3.2 RF POWER MODULE CONTROLS AND INDICATORS: Figures MD-4 through MD-12 depict the controls and indicators on RF power modules A2/A3 and their associated assemblies. Table 4-3 is keyed to the reference designation assigned to the controls/indicators and explains their function.

4.3.3 EXCITER MODULE CONTROLS AND INDICATORS: Figures MD-13 through MD-21 depict the controls and indicators on exciter modules A4/A5 and their associated printed wiring boards/assemblies. Table 4-4 is keyed to the reference designation assigned to the controls/ indicators and explains their functions.

4.3.4 POWER ON/OFF PANEL CONTROLS AND INDICATORS: Figure MD-22 depicts the controls and indicators on power on/off panel A6. Table 4-5 is keyed to the reference designation assigned to the controls/indicators and explains their functions.

4.3.5 POWER SUPPLY MODULE CONTROLS AND INDICATORS: Figure MD-23 through MD-28 depict the controls and indicators on power supply modules A7/A8. Table 4-6 is keyed to the reference designation assigned to the controls/ indicators and explains their function.

4.3.6 HARMONIC FILTER CONTROLS: Figures MD-30 through MD-33 depict the controls of harmonic filter assembly A9. Table 4-7 is keyed to the reference designation assigned each control and explains their function.

4.3.7 MONITOR PWB CONTROLS AND INDICATORS: Figures MD-34 and MD-35 depict the controls and indicators on the monitor/PWB A10. Table 4-8 is keyed to the reference designation assigned to the controls/indicators and explains their function.

4.3.8 BATTERY PANEL CONTROLS AND INDICATORS: Figure MD-36 depicts the controls and indicators on battery panel assembly A11. Table 4-9 is keyed to the reference designation assigned to the controls/indicators and explains their function.

4.3.9 MISCELLANEOUS (CABINET/ INTERFACE PANEL) CONTROLS AND INDICATORS: Figure MD-1 depicts the controls on the transmitter cabinet and figure MD-29 depicts the controls on the interface panel assembly. Table 4-10 is keyed to the reference numbers assigned to the controls and explains their function.

PRESTART-UP CHECKS

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

(a) Verify the pre-installation requirements described in paragraphs 3.9.1 through 3.9.5 have been completed.

(b) Verify the transmitter modules have been properly installed in the cabinet and all panels are installed and securely fastened.

(c) Verify interconnecting wiring has been connected as shown in figures SD-1 and SD-2.

(d) Verify the transmitter's RF output connector J1 is terminated into a 50-ohm load.

- An antenna that is interfaced by a tuned antenna tuning unit for normal adjustment, testing and operating procedures.

- A 50 ohm, resistive, dummy load with a wattage rating of twice the rated carrier power of the transmitter for harmonic filter procedures and for specified special adjustment.

(e) Verify the voltage of the input power source is between 180 and 250 (230 nominal) volts AC, at the appropriate frequency and power rating for the transmitter (2200 volt-amperes).

TURNING ON TRANSMITTER

4.5 Turn on transmitter as described in paragraph 5.3.2 for initial startup and after repairs that may have affected the adjustment accuracy, at other times, set the switches to position tabulated for ***Test Setting*** in table 4-1 initially and then to settings tabulated for ***Operating Setting***.

RESETTING TRANSMITTER

4.6 Transmitters that have been transferred to the standby side or that have shutdown, may be reset by momentarily switching the transmitter **off** and then back to **on**. This action may be taken locally by using the **RF** switch or remotely using remote on/off control. Transmitters that have been reset will always go to the selected main side of the subject transmitter (original state).

MODULATION DEPTH WHEN USING A HIGH 'Q' ANTENNA:

4.7 A typical radiobeacon antenna is relatively inefficient, since it is very short when compared with the wavelength of the carrier frequency. The high capacitive reactance of a typical antenna is tuned to the carrier frequency, by an antenna tuning unit's (ATU) loading coils, to produce a series resonant circuit. The resulting net antenna system resistance is then transformed to 50 ohms by a matching transformer. When the antenna is very short compared with the wavelength of the carrier frequency, the resonant circuit has an extremely high 'Q'. Under these conditions, the antenna system may present a 50-ohm load to the transmitter at the carrier frequency but a different impedance at the sideband frequencies. The mismatch at the sideband frequencies will cause a standing wave on the feed cable. Depending upon the length of the feed cable, the sideband impedance of the antenna system will appear to be more or less than 50 ohms. When the transmitter is connected to a high 'Q' antenna system, the difference between the carrier impedance and the sideband impedance may cause RF stress current limits to be exceeded, as described in paragraph 4.7.1, or reflected power thresholds to be exceeded, as described in paragraph 4.7.2. When RF stress current limits are exceeded, instant remedial action must be taken.

4.7.1 RF CURRENT ALARM INDICATION: A current probe in the input to harmonic filter A10 provides an RF current sample that is representative of the RF current in the active modulator/power amplifier module. This sample is applied to a logic circuit, is peak detected and causes the **RF CURRENT ALARM** lamp to turn on or flash when stress current thresholds are exceeded. The stress current threshold is established during adjustment, when the transmitter's RF output is being applied to a precision, 50-ohm, resistive dummy load, and the load impedance is precisely 50 ohms at the carrier and sideband frequencies. This threshold represents the peak RF current when the RF carrier's forward power level is 1000 watts, the modulation depth is 95 percent and the carrier/sideband impedance is 50 ohms. If this current is exceeded for any reason, the **RF CURRENT ALARM** lamp will turn on or flash. When the **RF CURRENT ALARM** lamp is on or flashing, remedial action must be taken by adjusting the appropriate potentiometers on modulator driver PWB boards A4A2 and A5A2.

4.7.2 SWR-ALARM INDICATION: A voltage probe at the output of harmonic filter A10 provides a voltage sample that is representative of the sensed reflected power. This sample is applied to a logic circuit, is peak detected and causes the carrier level to be cutback (reduced) and **SWR-ALARM** lamp to turn on when the peak reflected power exceeds a nominal 115 watts. If there is no reflected power when an unmodulated carrier (CW) is applied to the antenna system, but there is reflected power when the carrier is modulated (MCW), the sideband limitations of the antenna system may dictate a reduction in modulation depth to maintain the carrier level at its intended level. If the **SWR-ALARM** lamp is not on during CW emissions but turns on during MCW emissions, the modulation depth (percentage) is too high for the antenna in use and the carrier level will be cutback when **SWR-ALARM** lamp is on. If reflected sideband power is causing the **SWR-ALARM** lamp to turn on, remedial action must be taken by adjusting the appropriate potentiometers on modulator driver printed wiring boards A4A2 and A5A2.

4.7.3 REMEDIAL ACTION IN BEACON MODE: When operating in beacon (no voice) mode, the modulation depth should be reduced by adjusting **TONE LEVEL** potentiometer (R19) counter clockwise until **RF CURRENT ALARM** lamp A1A1DS4 just turns off. The resultant modulation depth is the maximum obtainable with that particular antenna system.

4.7.4 REMEDIAL ACTION IN VOICE AND BEACON MODE: When operating in voice and beacon mode, the modulation depth should be reduced by adjusting both **TONE MOD %** potentiometer (R20) and **VOICE MOD %** potentiometer (R21) counter clockwise, when tone and voice audio are both present, until **RF CURRENT ALARM** lamp A1A1DS4 just turns off. The 35/60 ratio of tone percentage to voice percentage should be maintained when adjustments are completed.

Table 4-1 Preliminary Switch Settings

NOMENCLATURE USED IN TEXT	REF DES	INITIAL SETTING	TEST SETTING	OPERATING SETTING
SPEAKER	A10S3	**OFF**	**OFF**	**OFF**
MONITOR	A1S4	**BYPASS**	**BYPASS**	**NORMAL**
TEST-Volts/Current	A1S5	**OFF**	**OFF**	**OFF**
SELECT MAIN TX	A1S3	**A**	**A**	**A** or **B**
RF	A1S1	**OFF**	**OFF**	**ON**
TEST-Power/Mod	A1S6	**OFF**	**OFF**	**OFF**
CONTROL	A1S2	**LOCAL**	**LOCAL**	**LOCAL** or **REMOTE**
KEYING	A4S1	**OFF**	**OFF**	**ON**
KEYING	A5S1	**OFF**	**OFF**	**ON**
MOD	A4S2	**OFF**	**OFF**	**ON**
MOD	A5S2	**OFF**	**OFF**	**ON**
POWER-AC LINE	A6S1	**OFF**	**ON**	**ON**
POWER-BATTERY	A6S2	**OFF**	**OFF**	**ON**
POWER-AC LINE	A7S1	**OFF**	**ON**	**ON**
POWER AC LINE	A8S1	**OFF**	**ON**	**ON**
RF MON	A9A2S1	**VOL** or **CUR**	As Determined	As Determined
Side 'A' Status	A10S2	**NORMAL**	**NORMAL**	**NORMAL**
Side 'B' Status	A10S1	**NORMAL**	**NORMAL**	**NORMAL**

MODULATION PERCENTAGE INDICATION

4.8 Current and voltage transformers in the forward/reflected power probe, which is in the output of harmonic filter A10, provide samples that are representative of the RF output current and voltage waveforms. When the transmitter's RF output is being applied to a precision, 50-ohm, resistive dummy load and the load impedance is precisely 50 ohms at the carrier and sideband frequencies, the waveforms provided by both transformers will be identical. When the transmitter's RF output is being applied to an antenna system, the sideband impedance will be high or lower than 50 ohms. If the sideband impedance is less than 50 ohms, the current transformer's waveform is selected as the source for the RF monitor sample. If the sideband impedance is greater than 50 ohms, the voltage transformer's waveform is selected as the source for the RF monitor sample. The RF monitor sample is applied to the **RF MONITOR** connector for external monitoring and to a modulation detector circuit. The output of the modulation detector circuit is displayed on the **TEST-Power/Mod** meter as a modulation percentage indication.

Table 4-2 Control/Monitor Panel Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A1A1DS1	MD-2	**STANDBY-ALARM**	When turned on, indicates the transmitter has switched from the selected main-side to standby-side.
A1A1DS2	MD-2	**SWR-ALARM**	When turned on, indicates a reflected power in excess of 120 watts has been sensed at the output of the harmonic filter. When the DC option is not installed, it may indicate the AC power is more than 10% low.
A1A1DS3	MD-2	**SHUTDOWN ALARM**	Turns on when the transmitter has shut down.
A1A1DS4	MD-2	**RF CURRENT ALARM**	When turned on, indicates troughs of modulation envelope, as sensed by an RF current probe at the harmonic filter's input are exceeding the preset overmod threshold. Normally turns on when the antenna impedance is less than 50 ohms at the sideband frequency and the antenna current is exceeding the current that would be present if the antenna impedance was 50 ohms.
A1A1DS5	MD-2	**BATTERY-ALARM**	When turned on, indicates transmitter's B- voltage is being provided by an external DC power source (battery).
A1A1DS6	MD-2	**RF ON**	When turned on, indicates operating voltage for the subject transmitter is being supplied by the AC power or DC power source.
A1A1DS7	MD-2	**CONTROL-REMOTE**	Turns on when the **CONTROL** switch is set to **REMOTE** and the on/off switching facility has been extended to a remote site.
A1A1DS8	MD-2	**MONITOR - BYPASS**	When turned on, indicates **MONITOR** switch is set to **BYPASS** and changeover is inhibited.
A1M1	MD-2	**TEST-Power/Mod**	Displays parameter selected by the **TEST-Power/Mod** switch. Forward and reflected power readings are obtained from the upper scale. Modulation percentage readings are obtained from the lower scale.
A1M2	MD-2	**TEST-Volts/Current**	Displays parameter selected by the **TEST-Volts/Current** switch. Voltage readings are obtained from the upper scale. Current readings are obtained from lower scale.

Table 4-2 Control/Monitor Panel Controls and Indicators (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A1S1	MD-2	**RF**	Turns the transmitter **ON** or **OFF**. Resets the transmitter to its original state when set to **OFF** and then returned to **ON**. (If operating in the standby mode, transmitter will reset to main).
A1S2	MD-2	**CONTROL**	Extends **ON/OFF** switching facility to a remote site when set to **REMOTE**.
A1S3	MD-2	**SELECT MAIN TX**	Selects either side **A** or side **B** to provide the RF output for the subject transmitter.
A1S4	MD-2	**MONITOR**	Inhibits changeover circuits when set to **BYPASS**. Allows maintainer to work on a circuit without concern for the parameters that would normally cause a changeover.
A1S5	MD-2	**TEST-Volts/Current**	Test switch that selects parameter, **DC CURRENT +15V, -15V, +24V** or **B-V** for the main or standby transmitter to be displayed on **TEST** meter M2. Shorts out meter movement when set to **OFF.**
A1S6	MD-2	**TEST-Power/Mod**	Test switch that selects parameter **FWD PWR, MOD SET, REFL PWR** or **MOD READ** to be displayed on **TEST** meter M1. Shorts out meter movement when set to **OFF**.
A1A1R2	MD-3	**Meter Cal**	Adjusted for a precise B- VDC indication on **TEST** meter A1M2 during test/adjustment procedures.

Table 4-3 Modulator/Power Amplifier Module Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
*A9DS1	MD-4	**B-**	Indicates the B- voltage is being applied when on.
*A9DS2	MD-4	**PA VOLTS - 4**	Indicates modulator *A7 is functioning and is applying a modulated B- voltage to power amplifier *A8 when on.
*A9DS3	MD-4	**PA VOLTS - 3**	Indicates modulator *A5 is functioning and is applying a modulated B- voltage to power amplifier *A6 when on.
*A9DS4	MD-4	**PA VOLTS - 2**	Indicates modulator *A3 is functioning and is applying a modulated B- voltage to power amplifier *A4 when on.
*A9DS5	MD-4	**PA VOLTS - 1**	Indicates modulator *A1 is functioning and is applying a modulated B- voltage to power amplifier *A2 when on.
*F1	MD-9	**7A SLOW**	Fuses B- voltage to modulator *A1 at 7.0 amperes.
*F2	MD-9	**7A SLOW**	Fuses B- voltage to modulator *A3 at 7.0 amperes.
*F3	MD-9	**7A SLOW**	Fuses B- voltage to modulator *A5 at 7.0 amperes.
*F4	MD-9	**7A SLOW**	Fuses B- voltage to modulator *A7 at 7.0 amperes.
*S1	MD-5	**Thermal**	Normally closed thermal switch. Opens and removes PWM from the associated modulators when temperature exceeds 82 degrees Celsius.
TP1	MD-4	**PA VOLTS**	Provides a test point to monitor the average output voltage (modulated B- VDC) from the modulators.

* Denotes partial reference designation shown. For complete reference designation, prefix with A2 or A3 as appropriate.

Table 4-4 Exciter Module Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A1TB1	MD-17	**TB1**	Provides selection points for the first twelve bits of a keying frame that contains ident code information. Refer to para 3.9.3.1 for interconnect information.
A1TB2	MD-17	**TB2**	Provides selection points for the last thirteen bits of a keying frame that contains ident code information. Refer to para 3.9.3.1 for interconnect information.
A1TB3	MD-17	**TB3**	Provides frame content selection points for each frame in the octal frame sequencer. Refer to para 3.9.3.2 for interconnect information.
A1	MD-17	**Link 'A'**	Installed when tone oscillator is used as keyed tone audio source.
A1	MD-17	**Link 'B'**	Used in conjunction with link *C*. Sets frequency of tone oscillator to 1020Hz when both links are installed. Sets tone oscillator frequency to 400Hz when removed.
A1	MD-17	**Link 'C'**	Used in conjunction with link *B*. Sets frequency of tone oscillator to 1020 Hz when both links are installed. Sets tone oscillator frequency to 400Hz when removed.
A2C22	MD-18	**PWM Freq**	Adjusted to set the frequency of the PWM squarewave (ramp) generator to the optimum frequency (nominally 70kHz) for the assigned carrier frequency.
A2R2	MD-18	**VOICE LEVEL**	Adjusts audio level to the voice modulation amplifier.
A2R19	MD-18	**TONE LEVEL**	Adjusted to set the amplitude of the tone signal to the level that will provide the desired modulation percentage when operating in keyed or continuous MCW mode (press-to-talk input not being applied).
A2R20	MD-18	**TONE MOD %**	Adjusted to set the amplitude of the tone signal to the level that will provide the desired modulation percentage when a press-to-talk input is being applied (normally 35% of modulation percentage present when press-to-talk input is being applied).

Table 4-4 Exciter Module Controls and Indicators (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A2R21	MD-18	**VOICE MOD %**	Adjusted to set the amplitude of the voice audio to the level that will provide the desired modulation percentage when a press-to-talk input is being applied (normally 60% of modulation percentage present when press-to-talk input is being applied).
A2R48	MD-18	**O/P POWER**	Adjusted to set the on/off ratio of the mod drive to the ratio that will produce the desired RF output power level.
A2R58	MD-18	RAMP ADJ	Adjusted for the reference voltage that will position the negative going peaks of PWM ramp integrator's triangular waveform output, measured at TP5, at zero volts DC (ground).
#A3E1/E2/ E4	MD-♦	**RF Drive Internal/External**	Shunt posts that select the source of the RF drive signal. Refer to the RF synthesizer PWB's service instruction manual for further detail.
#A3E3	MD-♦	**PDM Selection**	Not used in NDB transmitters.
#A3E5	MD-♦	**Balanced Drive Matching**	7-position shunt post that allows matching of the balanced drive signal. Set to E5:A for NDB transmitters.
#A3R32	MD-♦	**SYMMETRY**	Not used in NDB transmitters.
#A3R41	MD-♦	**IPM BAL**	Not used in NDB transmitters.
#A3S1	MD-♦	**X 1000**	Rotary 10-position BCD switch that selects the carrier frequency's thousands digit (either '0' or '1'), in kHz.
#A3S2	MD-♦	**X 100**	Rotary 10-position BCD switch that selects the carrier frequency's hundreds digit, in kHz.
#A3S3	MD-♦	**X 10**	Rotary 10-position BCD switch that selects the carrier frequency's tens digit, in kHz.
#A3S4	MD-♦	**X 1**	Rotary 10-position BCD switch that selects the carrier frequency's units digit, in kHz.
#A3S5	MD-♦	**X 0.1**	Rotary 10-position BCD switch that selects the carrier frequency's tenths digit, in kHz.

Table 4-4 Exciter Module Controls and Indicators (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
#A3S6:1/2/3	MD-♦	**IPM Correction Capacitance**	Not used in NDB transmitters.
#A3S6:4	MD-♦	**IPM Correction Enable/Disable**	Set to closed (disabled) for NDB transmitters.
*A3C10	MD-19	**Osc Freq**	Adjusted to fine tune the carrier oscillator to the frequency that will provide the desired RF carrier frequency.
*A3-	MD-19	**Freq Divider Links**	Connects PWB pad 'E' to appropriate output of frequency divider (4, 8 or 16). Refer to paragraph 3.9.2.1 for interconnection information.
*A3-	MD-19	**'A' to 'B' Link**	Installed when crystal oscillator provides the RF carrier frequency of the transmitter ('C' to 'D' link not installed).
*A3-	MD-19	**'C' to 'D' Link**	Not Used
*A3-	MD-19	**'E' to 'F' Link**	Not Used
DS1	MD-13	**AUDIO LIMITER**	Indicates amplitude of input voice audio is exceeding the pre-set threshold level that represents the maximum desired modulation depth and the voice audio is being attenuated to this level when on.
DS2	MD-13	**RF DRIVE ALARM**	Indicates the RF drive level has fallen below the minimum RF drive threshold when on.
DS3	MD-13	**MOD DRIVE ALARM**	Indicates the on/off radio of the mod drive signal's variable pulse width is incorrect and the mod drive output is being inhibited when on.
F1	MD-16	**1A SLOW**	Fuses B- voltage to exciter assembly at 1.0 ampere.
R5	MD-13	**PWR TRIM-LOCAL**	Provides a local adjustment to reduce the carrier level while maintaining the modulation percentage during testing. Normally set fully clockwise.
S1	MD-13	**KEYING**	Determines status of associated keyer PWB. Keying is inhibited when set to **OFF**.

Table 4-4 Exciter Module Controls and Indicators (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
S2	MD-13	**MOD**	Determines status of associated modulator driver PWB's modulating audio. The modulating audio is inhibited when set to **OFF**.

Partial reference designation shown. For complete reference designation, prefix with A4 or A5 as appropriate. Refer to Figure MD-14 to locate A1 and A3 and to Figure MD-15 to locate A2 and A4.

- Denotes used only when RF synthesizer PWB is installed as A3.
* - Denotes used only when RF (crystal) oscillator is installed as A3.
♦ - Refer to the RF synthesizer PWB's service instruction manual to locate referenced item.

Table 4-5 Power On/Off Panel Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A6DS1	MD-22	**Power - AC Line**	Indicates AC voltage present at power supply modules A7 and A8.
A6F1	MD-22	**BATTERY**	Fuses the transmitter's external DC power source (battery) at 30 amperes.
A6S1	MD-22	**POWER-AC LINE**	Switches the AC power source being supplied to power supply modules A7 and A8 **ON** or **OFF**.
A6S2	MD-22	**POWER-BATTERY**	Switches the external DC power source being supplied to the optional battery panel A11 **ON** or **OFF**.

Table 4-6 Power Supply Module Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
*DS1	MD-23	**CONVERTER-+24V**	Indicates B- VDC to +24 VDC converter is providing 24 volts DC when on.
*DS2	MD-23	**POWER-DC SUPPLY**	Indicates the B- voltage is present when on.
*F1	MD-23	**CONVERTER**	Fuses B- DC voltage being applied to B- VDC to +24 VDC converter at 1.0 amperes.
*F2	MD-23	**POWER-AC LINE**	Fuses line side of the 230 VAC power being applied to the power transformer (line *A* when AC power source is North American style split phase) at 30 amperes.
*F3	MD-23	**POWER-AC LINE**	Fuses line *B* side of the 230 VAC power being applied to the power transformer (when AC power source is North American style split phase) at 30 amperes. Bypassed when AC power source is European style (line-neutral).
*S1	MD-23	**POWER-AC LINE**	Switches the AC power source, being applied to the power transformer within the power supply module, **ON** or **OFF** when **POWER-AC LINE** switch A6S1 is set to **ON**.
*A1R12	MD-26	**B-Level**	Adjusted to set the B- VDC output of the associated power supply to precisely -70 volts dc.
*A2A1R10	MD-27A	**+24 VAC Level**	Adjusted to set the 24 VDC output of the associated power supply's B- VDC to +24 VDC converter to precisely +24.0 volts DC.
*A3R3	MD-27B	**Low AC Voltage Threshold**	Adjusted to provide a **Battery-Alarm** lamp indication when the AC power source decreases by fifteen percent.
*TP1	MD-25	**B- Volts**	Provides a test point to monitor the B- VDC from associated power supply (-70 VDC).

* Denotes partial reference designation shown. For complete reference designation, prefix with A7 or A8 as appropriate.

Refer to Figure MD-24 to locate A2 and to Figure MD-25 to locate A1 and A3.

Table 4-7 Harmonic Filter Assembly Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A9A2S1	MD-29	**RF MON**	Determines the source of the RF output waveform for **TEST** meter M1's modulation readings and for the monitoring sample provided at the **RF MONITOR** output connector. Sample provided by current transformer A9A2T3 is the source when **CUR** is selected. Sample provided by voltage transformer A9A2T1 is the source when **VOLT** is selected.
A9E1	MD-30	**Capacitor Selector Plate**	Determines the number of in-circuit capacitors in the output filter's series tuned L/C circuit. Orientation permits selection of 2, 3 or 4 capacitors. Refer to figure 3-2 for examples.
A9E2	MD-30	**Capacitor Selector Plate**	Determines the number of in-circuit capacitors in the output filter's parallel tuned L/C circuit. Orientation permits selection of 2, 3 or 4 capacitor. Refer to Figure 3-2 for examples.

Table 4-8 Monitor/PWB Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A10DS1	MD-34	**SET THRSH**	Flashes between tone periods during keyed MCW operation. Continuously on when RF carrier level falls below pre-set carrier fault threshold (normally -3.0dB) or when modulation level falls below pre-set modulation fault threshold (normally -4.0dB) or keying fails.
A10LS1	MD-34	**SPEAKER**	Provides an audible signal for local monitoring of the detected modulation.
A10R7	MD-34	**MOD THRSH**	Adjusted to produce a modulation fault signal when modulation level falls below the desired percentage (must be at least 1.0dB below the carrier fault threshold). Ultimately will cause the transmitter to shut down if the modulation percentage does not exceed this minimum threshold level within the time delay period of the shutdown circuit.
A10R18	MD-34	**CARR THRSH**	Adjusted to produce a carrier fault signal when the carrier level falls below the desired level (usually -3.0dB). Ultimately will cause transmitter shut down if the carrier level does not exceed this minimum threshold level within the time delay period of the shutdown circuit.
A10R23	MD-34	**RF CURRENT**	Adjusted, when operating into a 50.0-ohm resistive load, for a modulation threshold (normally 95%) that represents the maximum permissible before peak RF current thresholds are exceeded. When the modulation envelope exceeds 95%, the peak detected RF current sample will cause the **RF CURRENT ALARM** lamp to turn on.
A10R48	MD-34	**CHANGEOVER DELAY**	Adjusted for a delay of between 20 and 80 seconds before transmitter changeover/shutdown occurs.
A10R79	MD-34	**FWD PWR CAL**	Adjusted, during adjustment procedures, to precisely set the forward power indication on the **TEST** meter, when the **TEST** switch is set to **FWD PWR**.
A10R95	MD-34	**SWR CUTBACK THRESHOLD**	Adjusted for **SWR** fault threshold that represents the maximum acceptable reflected power before an **SWR** cutback output will be produced. When an **SWR** cutback output is produced, the RF output will be cutback to a level that will ensure the reflected power does not exceed the threshold level.

Table 4-8 Monitor/PWB Controls and Indicators (Continued)

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A10R107	MD-34	**REFL PWR CAL**	Adjusted to precisely set the reflected power indication on the **TEST** meter, when the **TEST** switch is set to **REFL PWR**, during test/adjustment.
A01R114	MD-34	**SET 100 % MOD**	Adjusted for 100 % modulation indication on the **TEST** meter when **TEST** switch S6 is set to **MOD-SET** and transmitter is operating in CW mode.
A10R115	MD-34	**SPEAKER VOLUME**	Adjusts the loudness output of **SPEAKER** LS1.
A10F1	MD-34	**Monitor B-V**	Fuses the B- voltage to monitor PWB A10.
A10S1	MD-34	**Side 'B' Test**	When set to **TEST,** inhibits the RF input to the harmonic filter assembly and enables the user to perform adjustment/repair procedures on the **B** side (side **B** will be operating into an open circuit).
A10S2	MD-34	**Side 'A' Test**	When set to **TEST,** inhibits the RF input to the harmonic filter assembly and enables the user to perform adjustment/repair procedures on the **A** side (side **A** will be operating into an open circuit).
A10S3	MD-34	**SPEAKER**	Switches an audible signal to **SPEAKER** LS1 for local monitoring of the detected modulation.

Do not change setting of Side* A *Test switch or Side* B *Test switch when transmitter is turned on. Always set* RF *switch to* OFF *before changing settings.

Table 4-9 Battery Panel Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
A11S1	MD-36	**BATTERY RESET**	Resets transmitter's low battery voltage shutdown circuit, utilizing a slow charge circuit, when discharged batteries are replaced by charged batteries. Used only when AC power is not being applied.
A11A1R7	MD-36	**Side 'A'-Low Battery Threshold**	Adjusted during special test to set the ***Low Battery Threshold*** to the desired level for side **A** of the transmitter (set when DC power source is a nominal -62 volts DC).
A11A1R8	MD-36	**Side 'B'-Low Battery Threshold**	Adjusted during special test to set the ***Low Battery Threshold*** to the desired level for side **B** of the transmitter (set when DC power source is a nominal -62 volts DC).

Table 4-10 Miscellaneous (Cabinet/Interface Panel) Controls and Indicators

REF DES	FIG NO.	PANEL MARKING/ NOMENCLATURE USED IN TEXT	FUNCTION
F1	MD-29	0.25A	Fuses B- VDC (A) applied to TB4-8, for external monitoring, at 0.25 amperes.
F2	MD-29	0.25A	Fuses B- VDC (B) applied to TB4-9, for external monitoring, at 0.25 amperes.
F3	MD-29	3.0A	Fuses B- VDC (A) input to monitor/interface panel A10, exciter A4, control/monitor panel A1 and battery panel A11 (optional).
F4	MD-29	0.25A	Fuses +15 volt DC output from monitor/interface panel A10.
F5	MD-29	0.25A	Fuses +24 volt DC output from monitor/interface panel A10.
F6	MD-29	3.0A	Fuses B- VDC (B) input to monitor/interface panel A10, exciter A4, control/monitor panel A1 and battery panel A11 (optional).
R2	MD-1	**Current 'A' Cal**	Adjusted for **DC CURRENT** (**A**) indication on the **TEST** meter that is representative of the current being consumed by transmitter side **A**.
R3	MD-1	**Current 'B' Cal**	Adjusted for **DC CURRENT** (**B**) indication on the **TEST** meter that is representative of the current being consumed by transmitter side **B**.

SECTION 5
TESTING AND ADJUSTMENTS

GENERAL

5.1 This section contains adjustment procedures that are performed in conjunction with functional tests. Special and operational adjustments procedures are also included in this section.

NOTE

Instructions are presented in a step-by-step format. 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 the order presented. It is recommended instructions be followed sequentially during initial start-up and after major repairs.

OPERATION OF EQUIPMENT

5.2 Observe the instructions presented in section 4 when turning the system on or off. Detailed control and indicator information is presented in tables 4-2 through 4-10.

NOTE

TEST-Power/Mod *meter's forward/reflected power scale is a square law scale. Resulting non-linearity makes it difficult to read less than 100 watts. Any reading that is less than fifty percent of the 100 watt mark is less than 25 watts.*

The carrier portion of the RF output is referred to as the intended carrier level in the following procedures. This level is normally determined by flight/range tests during initial installation (refer to paragraph 3.13). The intended carrier level must not exceed 1000 watts or be less than 200 watts. Once established, the RF output power that provides the desired field strength at the specified range shall be used as the intended carrier level. Use 1000 watts as the intended carrier level if flight/range tests have not been completed.

The depth of the modulation envelope is referred to as the intended modulation depth in the following. The modulation depth is normally dictated by the 'Q' of the antenna system and is determined during initial installation (refer to paragraphs 4.7 and 3.13). The intended modulation depth should be as close to 95 percent as is possible. Once determined, the optimum modulation percentage that can be attained from a specific transmitter/antenna system shall be used as the intended modulation depth. Use ninety-five percent as the intended modulation depth, if no other value has been established.

TEST/ADJUSTMENT PROCEDURES

5.3 Functional test/adjustment procedures shall 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. The adjustment procedures, performed in conjunction with the functional tests, consist of adjusting appropriate electrical components to bring specific operating parameters of a fully assembled transmitter into the desired limits. The functional test/adjustment procedures are carried out with the transmitter's RF output connected to a precision, 50-ohm, resistive dummy load.

NOTE

Functional test/adjustment procedures are presented in a sequence that will accommodate a complete functional test and/or alignment of transmitter.

Printed wiring board mounted potentiometers are four-turn potentiometers 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.

5.3.1 TEST/ ADJUSTMENT TEST EQUIPMENT: The following test equipment is required to perform the functional test/adjustment procedures. Refer to table 1-3 for additional information regarding test equipment identification and/or specifications.

- Precision, 50-ohm, resistive, dummy load, rated at 2000 watts
- Digital multimeter
- Audio signal generator
- Frequency counter
- Variable DC power supply
- Oscilloscope
- Stopwatch
- Variac

5.3.2 TEST/ ADJUSTMENT PRE-REQUISITES: The following pre-requisites must be completed prior to performing any of the following procedures:

(a) Verify the AC power voltage is within five percent of the voltage used to select the primary winding taps of power transformers A7T1 and A8T1.

(b) If the RF drive source is generated by a fixed frequency crystal oscillator PWBs A4A3 and A5A3, verify the PWBs have been set up as detailed in paragraph 3.9.2.1.

(c) If the RF drive source is generated by a frequency synthesizer printed wiring boards (A4A3 and A5A3), verify their switch settings have been set to provide the desired frequency as detailed in paragraph 3.9.2.2.

(d) Verify the links on keyer printed wiring boards A4A1 and A5A1, that determine the identification code information, have been appropriately connected as detailed in paragraph 3.9.3.

(e) Verify the appropriate primary winding taps of power transformers A7T1 and A8T1 have been selected and connected as detailed in paragraph 3.9.4.

(f) Verify harmonic filter A9's inductor taps and in-circuit capacitors have been selected and connected, for the assigned carrier frequency, as detailed in paragraph 3.9.5.

(g) Connect the transmitter's RF output 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 2000 watts.

(h) Extend exciter modules A4 and A5, from the transmitter cabinet, to a position that allows access to **O/P POWER** potentiometer A4A2R48 and A5A2R48.

(i) Set **O/P POWER** potentiometers A4A2R48 and A5A2R48 fully counter clockwise.

NOTE

RF CURRENT ALARM *lamp should be on when the transmitter is turned on and the RF output is cutback to zero watts (***O/P POWER** *potentiometer A4A2R48/ A5A2R48 set fully counter clockwise).*

(j) Set **PWR TRIM - LOCAL** potentiometers A4R5 and A5R5 fully clockwise.

(k) Set switches as tabulated for ***Initial Settings*** in table 4-1.

5.3.3 TRANSMITTER TURN-ON: Apply AC power to the subject transmitter and verify the indicator indications are normal as follows:

NOTE

The transmitter has duplicated exciter/RF power amplifier stages ('A and 'B'). When any of the following procedures are for the active stage ('A' or 'B') only, the reference designation for side 'A' will be identified and the reference designation for side 'B' will be in parenthesis.

The following modules have been duplicated:

REF DES 'A'	REF DES 'B'	DESCRIPTION
A2	A3	Modulator/Power Amplifier Module
A4	A5	Exciter Module
A7	A8	Power Supply Module

(a) Verify the requirements of paragraph 5.3.2 have been completed and are being met.

(b) Verify AC power source voltage is within five percent of voltage used to select the primary winding taps of power transformers A7T1 and A8T1 (see paragraph 3.9.4).

(c) Verify AC power is turned on at the service entrance and is being applied to transmitter.

(d) Set **POWER-AC LINE** switch A6S1 to **ON**.

(e) All lamps shall be off.

(f) Set power supply module *A*'s **POWER-AC LINE** switch (A7S1) to **ON**.

(g) **DC SUPPLY** lamp A7DS2 and B- lamp A2A9DS1 shall turn on.

(h) Set power supply module *B*'s **POWER-AC LINE** switch (A8S1) to **ON**.

(i) **DC SUPPLY** lamp A8DS2 and B- lamp A3A9DS1 shall turn on.

(j) All other lamps shall be off.

5.3.4 DC VOLTAGE CHECKS: Check the B- voltage (no load) and logic/control DC voltages as follows:

5.3.4.1 B- Voltage (No Load) Check: Check the no load B- voltage level as follows:

(a) Verify switches are set as tabulated for ***Test Settings*** in table 4-1.

(b) Verify **O/P POWER** potentiometers A4A2R48 (A5A2R48) are set fully counter clockwise.

(c) Connect a multimeter between test point A7A1TP1 (A8A1TP1) and ground.

(d) Indication on multimeter should be precisely -72.0 VDC.

(e) If necessary, adjust **B- Level** potentiometer A7A1R12 (A8A1R12) for a multimeter indication of precisely -72.0 VDC.

(f) Set **TEST-Volts/Current** switch to **B-V - SIDE A** (**B**).

(g) **TEST-Volts/Current** meter indication shall be between -71.0 and -73.0V

NOTE

Adjustment of **Meter Cal** *potentiometer affects* **TEST-Volts/Current** *meter's +24, +15 and -15 indications.*

(h) If necessary, adjust **Meter Cal** potentiometer A1A1R2 for a **TEST-Volts/Current** meter indication of -72.0V.

5.3.4.2 Logic/Control DC Voltage Checks: Check the logic/control DC voltages as follows:

(a) Verify requirements of paragraphs 5.3.2 and 5.3.3 are completed and being met.

(b) Set **RF** switch to **ON**.

(c) **RF CURRENT-ALARM** lamp, **RF ON** lamp, **MONITOR-BYPASS** lamp and **CONVERTER +24V** lamp A7DS1 (A8DS1) shall turn **ON**.

(d) **AUDIO LIMITER** lamp A4DS1 (A5DS1) and **RF DRIVE-ALARM** lamp A4DS2 (A5DS2) will turn on initially. After a delay of approximately five seconds, they shall both turn off.

(e) Blower fan A2B1 (A3B1) shall turn on and circulate cooling air.

(f) Set **TEST-Volts/Current** switch to **+24V - SIDE A** (**B**).

(g) Connect a multimeter between meter M2 (+) and ground.

(h) Multimeter's indication shall be between 23.8 and 24.2 VDC.

(i) If necessary, adjust **24 VDC Level** potentiometer A2A1R10 on power supply A7 (A8), for a multimeter indication of 24.0 ±0.2 VDC.

(j) **TEST-Volts/Current** meter's indication shall be within ten percent of the reading in step (h).

(k) Record difference between reading obtained in step (h) and reading obtained in step (j) as **TEST-Volts/Current** meter's correction factor for **+24 VOLTS** in ***Established References*** section of table 5-2.

(l) Set **TEST-Volts/Current** switch to **+15V - SIDE A (B)**.

(m) Verify multimeter is connected between meter M2 (+) and ground.

(n) Multimeter's indication shall be between 14.7 and 15.3V.

(o) **TEST-Volts/Current** meter's indication shall be within ten percent of the reading in step (n).

(p) Record difference between reading obtained in step (n) and reading obtained in step (o) as **TEST-Volts/Current** meter's correction factor for **+15 VOLTS** in ***Established References*** section of table 5-2.

(q) Set **TEST-Volts/Current** switch to **-15V - SIDE A (B)**.

(r) Connect multimeter between meter M2 (-) and ground.

(s) Multimeter's indication shall be between -14.25 and -15.75V.

(t) **TEST-Volts/Current** meter's indication shall be within ten percent of the reading in step (s).

(u) Record difference between reading obtained in step (t) and reading obtained in step (s) as **TEST-Volts/Current** meter's correction factor for **-15 VOLTS** in ***Established References*** section of table 5-2.

(v) Connect multimeter between test point A10TP13 and ground.

(w) Multimeter's indication shall be between 14.5 and 15.5V.

(x) Connect a multimeter between test point A7A1TP2 (A8A1TP2) and ground.

(y) Multimeter's indication shall be between 14.5 and 15.5V.

(z) Connect a multimeter between test point A10TP7 and ground.

(aa) Multimeter's indication shall be between -14.5 and -15.5V.

5.3.5 CARRIER FREQUENCY CHECK: Check the carrier (RF drive) frequency as follows:

5.3.5.1 RF Synthesizer Check: If the RF drive is provided by RF synthesizer PWBs (A4A3 and A5A3), check the RF drive frequency and level, as follows:

(a) Verify switches are set as tabulated for ***Test Setting*** in table 4-1.

(b) Disconnect connector A4P2 (A5P2) from its mating connector A4A4J1 (A5A4J1).

(c) Set **RF** switch to **ON**. **RF DRIVE ALARM** lamp A4DS2 (A5DS2) shall turn on.

(d) Connect a frequency counter between test point A4A3TP7 (A5A3TP7) and ground.

(e) Frequency counter indication should be within 0.0005 percent of assigned RF carrier frequency. If necessary, set switches S1 through S5 on the RF synthesizer PWB.

(f) Connect an oscilloscope between test point A4A3TP7 (A5A3TP7) and ground.

(g) Oscilloscope waveform indication shall be similar to the waveform depicted in figure 6-4, with a peak-to-peak voltage between 12.1 and 14.9 volts.

(h) Set **RF** switch to **OFF**.

(i) Connect connector A4P2 (A5P2) to its mating connector A4A4J1 (A5A4J1).

5.3.5.2 RF Oscillator Check: If the RF drive is provided by fixed frequency, RF oscillator printed wiring boards (A4A3 and A5A3), check the RF drive frequency and level, as follows:

(a) Verify switches are set as tabulated for ***Test Setting*** in table 4-1.

(b) Verify the appropriate oscillator crystal, for the assigned carrier frequency, is installed in crystal holder A4A3XY1 (A5A3XY1).

(c) Verify the appropriate link is installed on RF oscillator A4A3 (A5A3) (PWB pad 'E' connected to PWB pad ÷4, 8 or 16; PWB pad 'A' connected to PWB pad 'B') for the assigned carrier frequency.

(d) Disconnect connector A4P2 (A5P2) from its mating connector A4A4J1 (A5A4J1).

(e) Set **RF** switch to **ON**. **RF DRIVE ALARM** lamp A4DS2 (A5DS2) shall turn **ON**.

(f) Connect a frequency counter between test point A4A3TP3 (A5A3TP3) and ground.

(g) Frequency counter indication shall be the assigned carrier frequency ±0.004 percent.

(h) If necessary, adjust **Osc Freq** trimmer capacitor A4A3C5 (A5A3C5) until the frequency counter's indication is the assigned carrier frequency ±0.004 percent.

(i) Connect an oscilloscope between test point A4A3TP3 (A5A3TP3) and ground.

(j) Oscilloscope waveform indication shall be similar to the waveform depicted in figure 6-2, with a peak-to-peak voltage between 11.7 and 14.3 volts.

(k) Set **RF** switch to **OFF**.

(l) Connect connector A4P2 (A5P2) to its mating connector A4A4J1 (A5A4J1).

5.3.6 RF DRIVE OUTPUT LEVEL CHECK: Check the RF drive output level from RF drive amplifier A4A4 (A5A4) as follows:

(a) Set or verify switches are set as tabulated for ***Test Setting*** in table 4-1.

(b) Set **RF** switch to **ON**.

(c) Connect an oscilloscope between center conductor of A4A4J2 (A5A4J2) and ground.

(d) Oscilloscope waveform indication shall be similar to the waveform depicted in figure 6-5, with a peak-to-peak voltage between 66.0 and 74.0 volts.

(e) Connect a multimeter between connector A4A4J3 (A5A4J3) and ground.

(f) Multimeter indication shall be between 12.0 an 14.0V.

(g) Disconnect multimeter and oscilloscope.

5.3.7 PULSE WIDTH MODULATION DRIVE CHECK: Check the frequency and ramp waveform of the variable pulse width modulation (PWM) mod drive circuit, as follows:

(a) Set or verify switches are set as tabulated for ***Test Setting*** in table 4-1.

(b) Verify **O/P POWER** potentiometer A4A2R48 (A5A2R48) is set fully counter clockwise.

(c) Verify **PWR TRIM - LOCAL** potentiometer A4R5 (A5R5) is set fully clockwise.

(d) Set **RF** switch to **ON**.

(e) Connect a frequency counter between test point A4A2TP5 (A5A2TP5) and ground.

(f) Frequency counter's indication shall be between 69.86kHz and 70.14kHz.

(g) If necessary, adjust **PWM Freq** trimmer capacitor A4A2C22 (A5A2C22) until frequency counter's indication is between 69.86kHz and 70.14kHz.

(h) Connect an oscilloscope between test point A4A2TP6 (A5A2TP6) and ground.

(i) Oscilloscope waveform indication shall be a DC trace (no pulses).

(j) If necessary, adjust **RAMP ADJUST** potentiometer A4A2R58 (A5A2R58) until there are pulses on the oscilloscope trace and then adjust **RAMP ADJUST** potentiometer A4A2R58 (A5A2R58) until the pulses just disappear.

(k) Connect oscilloscope between test point A4A2TP5 (A5A2TP5) and ground.

(l) Oscilloscope waveform indication shall be similar to the waveform depicted in figure 6-9, with the negative going peaks at or slightly below the zero volt reference line.

5.3.8 RF CARRIER CHECK: Check that the power amplifier and tuned RF circuits are functioning within the required limits and verify the RF output can be adjusted to the rated carrier level (maximum of 1000 watts), as follows:

(a) Verify requirements of paragraph 5.3.2 thru 5.3.7 are completed and are being met.

(b) Verify **O/P POWER** potentiometer A4A2R48 (A5A2R48) is fully counter clockwise.

(c) Verify **PWR TRIM - LOCAL** potentiometer A4R5 (A5R5) is fully clockwise.

(d) Set switches as tabulated for ***Test Setting*** in table 4-1.

(e) Set **RF** switch to **ON**.

Discontinue adjusting* O/P POWER *potentiometer A4A2R48 (A5A2R48) if reading on* TEST-Power/Mod *meter exceeds 50 watts.

(f) Monitor reflected power indication on **TEST-Power/Mod** meter and adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for a forward power indication of precisely 1000 watts on the dummy load's power indicator.

(g) Forward power level shall linearly increase, from near zero watts to 1000 watts, as **O/P POWER** potentiometer A4A2R48 (A5A2R48) is adjusted in step (f).

(h) **RF CURRENT-ALARM** lamp shall turn off and **TEST-Power/Mod** meter's reflected power indication shall be near zero watts.

(i) Set **TEST-Power/Mod** switch to **FWD PWR**.

(j) **TEST-Power/Mod** meter's forward power indication should be 1000 watts.

(k) If necessary, adjust **FWD PWR CAL** potentiometer A10R79 until **TEST-Power/Mod** meter's forward power indication is precisely 1000 watts.

(l) Set **TEST-Volts/Current** switch to **DC CURRENT - SIDE A** (**B**).

(m) **TEST-Volts/Current** meter's indication shall be between 15.3 and 19.7 amperes.

(n) Set **TEST-Volts/Current** switch to **B-V - SIDE A** (**B**).

(o) **TEST-Volts/Current** meter's indication shall be between -66.8 and -71.4V.

(p) Connect an oscilloscope to **RF MONITOR** connector.

(q) Oscilloscope waveform indication shall be similar to the waveform depicted in figure 6-15, with a peak-to-peak voltage between 18.0 and 22.0 volts.

(r) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for the intended carrier level as indicated on dummy load's forward power indicator.

(s) Repeat steps (1) through (q) with the RF output set to the intended carrier level.

5.3.9 MODULATION DEPTH (MCW) CHECK: Check the modulation depth with the transmitter operating in the MCW mode as follows:

NOTE

The intended modulation depth was determined at initial installation. It is the modulation depth a specific antenna system will accommodate before excessive reflected sideband power and/or distortion is produced. It should be as close to 95 percent as possible. If an intended modulation depth has not been established, set it to 95 percent.

(a) Set switches as tabulated for ***Test Setting*** in table 4-1.

(b) Verify **RF MON** switch A9A2S1 is set to the position (**VOLT** or **CUR**) determined during initial installation (see paragraph 3.13).

NOTE

When reading modulation percentage on **TEST-Power/Mod** *meter, always set* **TEST-Power/Mod** *switch to* **MOD-SET** *and adjust* **SET 100% MOD** *potentiometer for a 100% indication before taking a modulation depth reading.*

(c) Set **MOD** switch A4S2 (A5S2) to **ON**.

(d) Connect an oscilloscope to **RF MONITOR** connector.

(e) Set **RF** switch to **ON**.

(f) Verify the transmitter's RF output is the intended carrier level, as indicated by the dummy load's forward power indication.

(g) If necessary, adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) to set transmitter's RF output to the intended carrier level.

(h) Set **TEST-Power/Mod** switch to **MOD-SET**.

(i) Adjust **SET 100% MOD** potentiometer for a 100% modulation depth indication on **TEST-Power/Mod** meter.

(j) Set **TEST-Power/Mod** switch to **MOD-READ**.

(k) Adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) until **TEST-Power/Mod** meter's modulation percentage indication is 100%.

(l) Oscilloscope waveform shall be similar to the waveform depicted in figure 6-14. Modulation depth shall be 100% and waveform shall be free from clipping and/or distortion.

(m) If necessary, adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for a **TEST Power/Mod** meter's indication of 95 percent or the intended modulation depth.

(n) Oscilloscope waveform shall be similar to the one depicted in figure 6-14. Modulation envelope shall be 95 percent or the intended modulation depth and waveform shall be free from clipping and distortion.

5.3.10 B- VOLTAGE (MCW) CHECK: Check the B- voltage with the transmitter's RF output set to the intended carrier level and the intended modulation depth; as follows:

(a) Set or verify switches are set as tabulated for ***Test Setting*** in table 4-1.

(b) Set **RF** switch to **ON**.

(c) Verify the transmitter's RF output is the intended carrier level, as indicated by the dummy load's forward power indication.

(d) If necessary, adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) to set transmitter's RF output to the intended carrier level.

(e) Set **MOD** switch A4S2 (A5S2) to **ON**.

(f) **Test-Power/Mod** meter's indication should be 95% or the intended modulation depth.

(g) If necessary, adjust modulation depth as detailed in paragraph 5.3.9.

(h) Set **TEST-Volts/Current** switch to **B- SIDE A** (**B**).

(i) Connect a multimeter between test point A7A1TP1 (A8A1TP1) and ground.

(j) Multimeter's indication shall be precisely -70.0 VDC.

(k) If necessary, adjust **B- Adj** potentiometer A7A1R12 (A8A1R12) until multimeter's indication is precisely -70.0 VDC.

(l) **Test-Volts/Current** meter's indication shall be between -68.6 and -71.4 VDC.

(m) Record difference between reading obtained in step (l) and reading obtained in step (j) as **TEST-Volts/Current** meter's correction factor for B- volts (MCW) in ***Established References*** section of table 5-2.

5.3.11 AUDIO LIMITER BALANCE CHECK: Check the audio limiter circuits as follows:

(a) Set switches as tabulated for ***Test Setting*** in table 4-1.

(b) Connect a shorting jumper between TB4-19 (press-to-talk) and ground.

(c) Connect an audio signal generator between TB4-22 and TB4-23 with shield if applicable to TB4-24 (see figure 3-3).

(d) Set audio signal generator to 1000Hz and its output level to 0dBm (0.77 Volt RMS).

(e) Set **RF** switch and **MOD** switch A4S2 (A5S2) to **ON**.

(f) Set **TONE MOD%** potentiometer A4A2R20 (A5A2R20) fully counter clockwise.

(g) Verify the transmitter's RF output is the intended carrier level, as indicated by the dummy load's forward power indication.

(h) **AUDIO LIMITER** lamp A4DS1 (A5DS1) shall be on.

(i) Connect an oscilloscope to **RF MONITOR** connector.

(j) Simultaneously monitor oscilloscope waveform and increase output level of audio signal generator to 1.0dBm.

(k) Oscilloscope waveform indication in step (j) shall not vary more than five percent while increasing output level of audio signal generator.

(l) If the requirements of step (k) are not met, set the output of the audio signal generator to 1000Hz at 0dBm (0.77 Vrms) and then slowly adjust **VOICE LEVEL** potentiometer A4A2R2 (A5A2R2) clockwise until **AUDIO LIMITER** lamp A4DS1 (A5DS1) just turns on.

NOTE

Adjust **VOICE LEVEL** *potentiometer A4A2R2 (A5A2R2) very slowly. A five second time delay is built into the audio voice limiter circuit.*

(m) Repeat steps (j) and (k).

5.3.12 MODULATION DEPTH (A3E MODE) CHECK: Check the modulation depth when voice and tone (A3E mode) are simultaneously transmitted as follows:

NOTE

The intended modulation depth is determined at initial installation. It is the modulation depth a specific antenna system will accommodate before excessive reflected sideband power and/or distortion is produced. The voice/tone must be maintained at a 60/35 percent ratio, relative to the intended modulation depth.

(a) Set switches as tabulated for ***Test Setting*** in table 4-1.

(b) Verify a shorting jumper (press-to-talk) is connected between TB4-19 and ground.

(c) Verify an audio signal generator (voice audio input) is connected between TB4-22 and TB4-23 with shield if applicable to TB4-24 (see figure 3-3).

(d) Set audio signal generator to 1000Hz and its output level to 0dBm (0.77 Volt RMS).

(e) Connect an oscilloscope to **RF MONITOR** connector.

(f) Set **RF** switch to **ON**.

(g) Verify the transmitter's RF output is the intended carrier level, as indicated by the dummy load's forward power indication.

(h) If necessary, adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) to set transmitter's RF output to the intended carrier level.

(i) Set **MOD** switch A4S2 (A5S2) to **ON**.

(j) Oscilloscope waveform's modulation envelope shall be the composite of the external voice audio and the tone audio (A3E). Maximum modulation peaks shall not exceed the intended modulation depth.

(k) If the requirements of step (j) are not met, set **TONE MOD %** potentiometer A4A2R20 (A5A2R20) fully counter clockwise.

(l) Oscilloscope waveform's modulation envelope (external voice audio) shall be 60% of intended modulation depth.

(m) If necessary, adjust **VOICE MOD %** potentiometer A4A2R21 (A5A2R21) until oscilloscope waveform's modulation envelope is 60 percent of intended modulation depth.

(n) Switch off signal generator's output.

(o) Oscilloscope waveform's modulation envelope (tone audio) should be 35 percent of intended modulation depth.

(p) If necessary, adjust **TONE MOD%** potentiometer A4A2R20 (A5A2R20) until oscilloscope waveform's modulation envelope is 35 percent of intended modulation depth.

(q) Switch on audio signal generator and set its output to 1000Hz at 0dB (0.77 Vrms).

(r) Oscilloscope waveform's modulation envelope shall be the composite of the external voice audio and the tone audio (A3E). Maximum modulation peaks shall not exceed the intended modulation depth.

(s) Disconnect audio signal generator.

(t) Remove shorting jumper from TB4-19.

5.3.13 IDENTIFICATION CODE CHECK: Check station identification code as follows:

(a) Set switches as tabulated for ***Test Setting*** in table 4-1.

(b) Set **RF** switch to **ON**.

(c) Set **MOD** switch A4S2 (A5S2) to **ON**.

(d) Verify the RF carrier and modulation depth are set to their intended levels.

(e) Set **KEYING** switch A4S1 (A5S1) to **ON**.

(f) Set **SPEAKER** switch to **ON**.

(g) Adjust **SPEAKER VOLUME** potentiometer for a clear audible keyed beacon identification tone.

(h) The deciphered coded portion of the identification message shall be the station identification characters as assigned in paragraph 3.9.3.1.

(i) Using a stopwatch, measure and record the time for one frame length (from the start of the code of one frame to the start of the code of the next frame).

(j) The time recorded in step (i) shall be between 7.2 and 8.8 seconds.

5.3.14 STANDBY '1' AND STANDBY '2' CODE CHECKS: Check for generation of the standby 1 and standby 2 code variations as follows:

(a) Verify requirements of paragraphs 5.3.2 through 5.3.12 have been completed and are met.

(b) Set switches as tabulated for ***Test Settings*** in table 4-1.

(c) Set **RF** switch to **ON**.

(d) Set **MOD** switch A4S2 (A5S2) to **ON**.

(e) Verify the RF carrier output and modulation depth are set to their intended levels.

(f) Set **KEYING** switch A4S1 (A5S1) to **ON**.

(g) Set **SPEAKER** switch to **ON** and verify an audible keyed beacon tone can be heard from the speaker.

(h) Connect a shorting jumper (standby 1) between TB3-7 (TB3-11) and ground.

(i) Standby 1 code variation, as assigned in paragraph 3.9.3.1 and recorded in table 5-2, shall be included in the identification portion of the ident code.

(j) Disconnect jumper from TB3-7 (TB3-11).

(k) Connect a shorting jumper (standby 2) between TB3-8 (TB3-12) and ground.

(l) Standby 2 code variation, which is a 0.125 second blip that occurs 0.875 seconds before the first ident character, shall be detected in the ident code.

(m) Disconnect shorting jumper from TB3-8 (TB3-12).

5.3.15 FAULT THRESHOLDS/CHANGE-OVER CHECK: Check that the carrier level and modulation depth fault thresholds are set to the desired levels that will result in a main to standby transmitter changeover occurring when RF output falls below a predetermined minimum carrier level; when the modulation envelope falls below a predetermined percentage or keying is not present, for a predetermined period of time; as follows:

5.3.15.1 Preliminary Changeover Procedures: Verify the previous functional test/adjustment prerequisites have been completed and then check that the associated potentiometers and switches have been set to the settings required to start the changeover procedures as follows:

(a) Verify carrier level checks of paragraph 5.3.8 have been completed and are being met.

(b) Verify modulation depth requirements (tone only) of paragraph 5.3.9 have been completed and are being met.

(c) Connect an oscilloscope to **RF MONITOR** connector.

(d) Set switches as tabulated for ***Test Setting*** in table 4-1.

(e) Set **TEST-Power/Mod** switch to **FWD PWR**.

(f) Set **RF** switch to **ON**.

(g) Verify the transmitter's RF output is the intended carrier level, as indicated by **TEST-Power/Mod** meter's forward power indication.

(h) If necessary, adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) to set transmitter's RF output to the intended carrier level.

(i) Set **MOD** switch A4S2 (A5S2) to **ON**.

(j) Oscilloscope waveform's modulation envelope shall be the intended modulation depth.

(k) If necessary, adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) until the modulation envelope on the oscilloscope waveform is the intended modulation depth.

(l) Set **KEYING** switch A4S1 (A5S1) to **ON**.

(m) **SET THRSH** lamp A10DS1 shall be flashing on and off, provided the keying frame contains identification code.

NOTE

Refer to figure MD-34 to locate monitor PWB A10 and **SET THRSH** *lamp A10DS1.*

5.3.15.2 Carrier Level Fault Threshold Check: Verify the carrier level fault threshold is set to initiate a changeover from the selected side (main transmitter) to the other side (standby transmitter) when the carrier level has decreased by 3.0 dB from the intended carrier level or to a user determined minimum level, as follows:

NOTE

*International Civil Aviation Organization (ICAO) standards dictate the transmitter to be turned off or a warning alarm be generated when the RF output has decreased by 3.0dB or more from the intended carrier level. The following procedures use -3.0dB as the carrier level fault threshold. If the user decides to select a different threshold level, the user selected threshold level shall be inserted where -3.0 dB is referenced. The desired carrier fault threshold level shall be recorded in '**Established References** section of table 5-2.*

(a) Verify requirements of paragraph 5.3.15.1 have been completed and are being met.

(b) Verify **TEST-Power/Mod** switch is set to **FWD PWR**.

(c) Simultaneously monitor forward power indication on **TEST-Power/Mod** meter and of **SET THRSH** lamp A10DS1, while decreasing RF carrier level by adjusting **O/P POWER** potentiometer A4A2R48 (A5A2R48) counter clockwise until **SET THRSH** lamp just turns full on and remains on or forward power indication has decreased by more than -3.0dB.

(d) **TEST-Power/Mod** meter's forward power indication should be -3.0dB from the intended carrier level.

(e) If requirement of step (d) is met, go to step (k); if not, complete steps (f) through (j).

(f) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for a forward power indication on **TEST-Power/Mod** meter that is 3.0 dB less than the intended carrier level.

(g) If **SET THRSH** lamp A10DS1 is full on (not flashing), adjust **CARR THRSH** potentiometer A10R18 until **SET THRSH** lamp A10DS1 is flashing.

(h) Adjust **CARR THRSH** potentiometer A10R18 until **SET THRSH** lamp A10DS1 just turns full on and remains on.

(i) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for the intended carrier level, as indicated by **TEST-Power/Mod** meter.

(j) Repeat steps (b) through (d).

(k) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for the intended carrier level, as indicated by **TEST-Power/Mod** meter.

(l) **SET THRSH** lamp A10DS1 shall be flashing on and off.

5.3.15.3 Modulation Depth Fault Threshold Check: Check that the modulation depth fault threshold is set to initiate a changeover from main to standby transmitter when the modulation depth has decreased by 4.0dB or to a user determined decrease, as follows:

NOTE

The modulation depth fault threshold (normally -4.0dB) must be not less than -1.0dB greater than the carrier level fault threshold.

(a) Verify the instructions detailed in paragraphs 5.3.15.1 and 5.3.15.2 have been completed and their requirements are being met.

(b) Determine the minimum modulation depth (normally -4.0dB when the carrier level fault threshold is -3.0dB) that is acceptable before transmitter changeover occurs. Record this level as the Modulation Depth Fault Threshold in ***Established References*** section of table 5-2.

NOTE

If difference between intended modulation depth and modulation depth fault threshold is specified in dB's, refer to table 5-1 and determine power multiplication factor for specified dB reduction. Multiply intended modulation depth by power multiplication factor to determine modulation depth fault threshold.

(c) Set switches as tabulated for ***Test Settings*** in table 4-1.

(d) Set **MOD** switch A4S2 (A5S2) to **ON**.

(e) Verify an oscilloscope is connected to **RF MONITOR** connector.

(f) Set **RF** switch to **ON**.

(g) Verify the RF output is the intended carrier level, as indicated by **TEST-Power/Mod** meter.

(h) Verify oscilloscope waveform's modulation envelope is the intended modulation depth.

(i) Set **KEYING** switch A4S1 (A5S1) to **ON**.

(j) **SET THRSH** lamp A10DS1 shall be flashing on and off.

(k) Simultaneously monitor oscilloscope waveform's modulation envelope (when modulation is present) and **SET THRSH** lamp, while decreasing the modulation depth. Adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) until **SET THRSH** lamp just turns full on or the mod depth is less than the fault threshold determined in step (b).

(l) Set **KEYING** switch A4S1 (A5S1) to **OFF**.

(m) Oscilloscope waveform's modulation envelope should be the modulation depth for the modulation depth fault threshold determined in step (b).

(n) If requirement of step (m) is met, go to step (v); if not, complete steps (o) through (u).

(o) Adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for a modulation envelope, on oscilloscope waveform, that is precisely the modulation depth for the modulation depth fault threshold determined in step (b).

(p) Set **KEYING** switch A4S1 (A5S1) to **ON**.

(q) If **SET THRSH** lamp A10DS1 is full on (not flashing), adjust **MOD THRSH** potentiometer A10R7 until **SET THRSH** lamp A10DS1 is flashing.

(r) Adjust **MOD THRSH** potentiometer A10R7 until **SET THRSH** lamp A10DS1 just turns full on and remains on.

(s) Set **KEYING** switch A4S1 (A5S1) to **OFF**.

(t) Adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for a modulation envelope, on oscilloscope waveform, that is the intended modulation depth.

(u) Repeat steps (i) thru (m).

(v) Adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for a modulation envelope, on oscilloscope waveform, that is the intended modulation depth.

(w) Set **KEYING** switch A4S1 (A5S1) to **ON**.

(x) **SET THRSH** lamp A10DS1 shall be flashing on and off.

5.3.15.4 Changeover/Shutdown Check: Check auto changeover from side **A** to side **B** and/or the shutdown of the transmitter when; the RF output falls below a predetermined minimum carrier level; modulation envelope falls below a predetermined percentage or when keying is not present; for a predetermined period of time, as follows:

NOTE

The changeover delay period, once set, is applicable to both sides of the transmitter. If either side 'A' or 'B' of the transmitter shuts down, the pre-selected delay will occur before **STANDBY ALARM** *lamp or, if applicable,* **SHUTDOWN ALARM** *lamp turns on.*

(a) Verify requirements of paragraphs 5.3.15.1 and 5.3.15.3 are completed and being met.

(b) Set switches as tabulated for ***Test Setting*** in table 4-1.

(c) Refer to table 5-2 and determine the time recorded as the changeover time delay in ***Established References*** section.

NOTE

If a changeover time delay has not been established or is to be changed, determine the delay to be used and record this time as the changeover time delay in ***Established References*** *section of table 5-2.*

(d) Set **MOD** switch A4S2 (A5S2) to **ON**.

(e) Set **RF** switch to **ON**.

(f) Verify transmitter is operating at the intended carrier level and the intended modulation depth.

(g) Set **KEYING** switch A4S1 (A5S1) to **ON**.

(h) Set **MONITOR** switch to **NORMAL**.

(i) **MONITOR-BYPASS** lamp A1A1DS8 shall turn off and selected side **A** or **B** shall remain on.

(j) Simultaneously start stopwatch, monitor **STANDBY ALARM** lamp and set **KEYING** switch A4S1 (A5S1) to **OFF**.

(k) After the delay determined in step (c), the selected side (main) transmitter will turn off and **STANDBY-ALARM** lamp shall turn on.

NOTE

RF CURRENT-ALARM *lamp,* **RF DRIVE-ALARM** *lamp A5DS2 (A4DS2) and* **AUDIO LIMITER** *lamp A5DS1 (A4DS1) shall also turn on. After a nominal five second delay, these lamps shall turn off and the standby transmitter shall turn on; provided it is switched on and is serviceable.*

Table 5-1 dB to Power/Voltage Conversion

VOLTAGE	-dB	POWER	VOLTAGE	-dB	POWER	VOLTAGE	-dB	POWER
1.0000	0.0	1.0000	0.6310	4.0	0.3981	0.3981	8.0	0.1585
0.9886	0.1	0.9772	0.6237	4.1	0.3890	0.3936	8.1	0.1549
0.9772	0.2	0.9550	0.6166	4.2	0.3802	0.3890	8.2	0.1514
0.9661	0.3	0.9333	0.6095	4.3	0.3715	0.3846	8.3	0.1479
0.9550	0.4	0.9120	0.6026	4.4	0.3631	0.3802	8.4	0.1445
0.9441	0.5	0.8913	0.5957	4.5	0.3548	0.3758	8.5	0.1413
0.9333	0.6	0.8710	0.5888	4.6	0.3467	0.3715	8.6	0.1380
0.9226	0.7	0.8511	0.5821	4.7	0.3388	0.3673	8.7	0.1349
0.9120	0.8	0.8318	0.5754	4.8	0.3311	0.3631	8.8	0.1318
0.9016	0.9	0.8128	0.5689	4.9	0.3236	0.3589	8.9	0.1288
0.8913	1.0	0.7943	0.5623	5.0	0.3162	0.3548	9.0	0.1259
0.8810	1.1	0.7762	0.5559	5.1	0.3090	0.3508	9.1	0.1230
0.8710	1.2	0.7586	0.5495	5.2	0.3020	0.3467	9.2	0.1202
0.8610	1.3	0.7413	0.5433	5.3	0.2951	0.3428	9.3	0.1175
0.8511	1.4	0.7244	0.5370	5.4	0.2884	0.3388	9.4	0.1148
0.8414	1.5	0.7079	0.5309	5.5	0.2818	0.3350	9.5	0.1122
0.8318	1.6	0.6918	0.5248	5.6	0.2754	0.3311	9.6	0.1096
0.8222	1.7	0.6761	0.5188	5.7	0.2692	0.3273	9.7	0.1072
0.8128	1.8	0.6607	0.5129	5.8	0.2630	0.3236	9.8	0.1047
0.8035	1.9	0.6457	0.5070	5.9	0.2570	0.3199	9.9	0.1023
0.7943	2.0	0.6310	0.5012	6.0	0.2512	0.3162	10.0	0.1000
0.7852	2.1	0.6166	0.4955	6.1	0.2455	0.3126	10.1	0.09972
0.7762	2.2	0.6026	0.4898	6.2	0.2399	0.3090	10.2	0.09550
0.7674	2.3	0.5888	0.4842	6.3	0.2344	0.3055	10.3	0.09333
0.7586	2.4	0.5754	0.4786	6.4	0.2291	0.3020	10.4	0.09120
0.7499	2.5	0.5623	0.4732	6.5	0.2239	0.2985	10.5	0.08913
0.7413	2.6	0.5495	0.4677	6.6	0.2188	0.2951	10.6	0.08710
0.7328	2.7	0.5370	0.4624	6.7	0.2138	0.2917	10.7	0.08511
0.7244	2.8	0.5248	0.4571	6.8	0.2089	0.2884	10.8	0.08318
0.7161	2.9	0.5129	0.4519	6.9	0.2042	0.2851	10.9	0.08128
0.7079	3.0	0.5012	0.4467	7.0	0.1995	0.2818	11.0	0.07943
0.6998	3.1	0.4898	0.4416	7.1	0.1950	0.2786	11.1	0.07762
0.6918	3.2	0.4786	0.4365	7.2	0.1905	0.2754	11.2	0.07586
0.6839	3.3	0.4677	0.4315	7.3	0.1862	0.2723	11.3	0.07413
0.6761	3.4	0.4571	0.4266	7.4	0.1820	0.2692	11.4	0.07244
0.6683	3.5	0.4467	0.4217	7.5	0.1778	0.2661	11.5	0.07079
0.6607	3.6	0.4365	0.4169	7.6	0.1738	0.2630	11.6	0.06918
0.6531	3.7	0.4266	0.4121	7.7	0.1698	0.2600	11.7	0.06761
0.6457	3.8	0.4169	0.4074	7.8	0.1660	0.2570	11.8	0.06607
0.6383	3.9	0.4074	0.4027	7.9	0.1622	0.2541	11.9	0.06457

(l) If the changeover delay time in step (k) is satisfactory, go to step (p); if not, complete steps (m) through (o).

(m) Set **RF** switch to **OFF** and **MONITOR** switch to **BYPASS**.

(n) Adjust **CHANGEOVER DELAY** potentiometer A10R48 in the direction required to produce the desired changeover time delay.

NOTE

CHANGEOVER DELAY *potentiometer A10R48 can be adjusted for a changeover time delay that is between 20 and 80 seconds. Clockwise adjustment increases the time and counter clockwise adjustment decreases the time.*

(o) Repeat steps (e) through (n) until the requirements of step (k) are met without further adjustment of **CHANGEOVER DELAY** potentiometer A10R48.

(p) Set **RF** switch to **OFF** and **MONITOR** switch to **BYPASS.**

(q) Set **KEYING** switch A4S1 (A5S1) to **ON**.

(r) Set **RF** switch to **ON**.

(s) **SET THRSH** lamp A10DS1 shall be flashing on and off.

(t) Monitor **SET THRSH** lamp A10DS1 and decrease carrier level by adjusting **O/P POWER** potentiometer A4A2R48 (A5A2R48) counter clockwise until **SET THRSH** lamp A10DS1 just turns full on.

(u) **TEST-Power/Mod** meter's forward power indication shall be the level recorded for carrier fault threshold level in ***Established References*** section of table 5-2.

(v) Simultaneously start stopwatch, monitor **STANDBY ALARM** lamp and set **MONITOR** switch to **NORMAL.**

(w) **MONITOR-BYPASS** lamp A1A1DS8 shall turn off and selected side **A** or **B** shall remain on.

(x) After the delay determined in step (c), the selected side (main) transmitter will turn off and **STANDBY-ALARM** lamp shall turn on [(see note after step (k)].

(y) Set **RF** switch to **OFF** and **MONITOR** switch to **BYPASS**.

(z) Set **RF** switch to **ON**.

(aa) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for the intended carrier level, as indicated by **TEST-Power/Mod** meter.

(ab) Verify **KEYING** switch A4S1 (A5S1) is set to **ON**.

(ac) **SET THRSH** lamp A10DS1 shall be flashing on and off.

(ad) Monitor **SET THRSH** lamp and decrease mod depth by adjusting **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) counter clockwise until **SET THRSH** lamp just turns full on.

(ae) Set **KEYING** switch A4S1 (A5S1) to **OFF**.

(af) Set **TEST-Power/Mod** switch to **MOD-SET**.

(ag) Adjust **SET 100 % MOD** potentiometer for a 100% modulation depth indication on **TEST-Power/Mod** meter.

(ah) Set **TEST-Power/Mod** switch to **MOD-READ**.

NOTE

When reading modulation percentage on **TEST-Power/Mod** *meter, always set* **TEST-Power/Mod** *switch to* **MOD-SET** *and adjust* **SET 100 %** *potentiometer for a 100% indication before taking a modulation depth reading.*

(ai) **TEST-Power/Mod** meter's modulation indication shall be percentage recorded for mod fault threshold level in ***Established References*** section of table 5-2.

(aj) Set **KEYING** switch A4S1 (A5S1) to **ON**.

(ak) Simultaneously start stopwatch, monitor **STANDBY ALARM** lamp and set **MONITOR** switch to **NORMAL**.

(al) **MONITOR-BYPASS** lamp A1A1DS8 shall turn off and selected side **A** or **B** shall remain on.

(am) After the delay determined in step (c), the selected side (main) transmitter will turn off and **STANDBY-ALARM** lamp shall turn on (see note after step (k).

(an) Set **RF** switch to **OFF** and **MONITOR** switch to **BYPASS**.

(ao) Set **KEYING** switch A4S1 (A5S1) to **OFF**.

(ap) Set **RF** switch to **ON**.

(aq) Adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for the intended modulation depth, as indicated by **TEST-Power/Mod** meter.

5.3.16 SWR CUTBACK THRESHOLD CHECK: Check that SWR cutback threshold level represents a reflected power of 115 watts, as follows:

(a) Set switches as tabulated for *Test Setting* in table 4-1.

(b) Set **O/P POWER** potentiometer A4A2R48 (A5A2R48) fully counter clockwise.

(c) Verify **RF** switch is set to **OFF**.

(d) Disconnect connector P13 from A9A2J1 and P14 from A9A2J2 (refer to figure MD-30 to locate fwd/refl power probe A9A2).

(e) Install connector P14 on connector A9A2J1.

(f) Connect a shorting clip across resistor A4A2R44 (A5A2R44).

(g) Set **RF** switch to **ON**.

(h) Simultaneously monitor dummy load's power indicator and **SWR-ALARM** lamp while slowly adjusting **O/P POWER** potentiometer A4A2R48 (A5A2R48) clockwise until **SWR ALARM** lamp just turns on.

Discontinue adjusting* O/P POWER *potentiometer A4A2R48 (A5A2R48) when dummy load's forward power indication exceeds 120 watts.

(i) Dummy load's forward power indication should be 115 watts.

(j) If requirement of step (i) is not met, adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for precisely 115 watts as indicated by dummy load's forward power indication.

(k) Set **TEST-Power/Mod** switch to **REFL PWR**.

(l) **TEST-Power/Mod** meter's indication shall be 115 ±5.0 watts.

(m) Adjust **SWR CUTBACK THRESHOLD** potentiometer A10R95 until **SWR-ALARM** lamp just turns on.

(n) Connect a multimeter, which has been set to measure resistance between TB3-13 and ground.

(o) Multimeter indication (**SWR Alarm**) shall be zero ohms.

(p) Connect a multimeter, that has been set to measure resistance, between TB3-10 and ground.

(q) Multimeter indication (**SWR Standby**) shall be zero ohms.

(r) Set **O/P POWER** potentiometer A4A2R48 (A5A2R48) fully counter clockwise.

(s) **SWR-ALARM** lamp shall turn off.

(t) Remove shorting clip from resistor A4A2R44 (A5A2R44).

(u) Slowly adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) clockwise until **SWR-ALARM** lamp just turns on.

(v) Simultaneously monitor **TEST-Power/Mod** meter's reflected power indication and continue to adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) clockwise.

(w) Reflected power indication on **TEST-Power/Mod** meter shall not increase significantly beyond 115 watts as **O/P POWER** potentiometer A4A2R48 (A5A2R48) is adjusted clockwise.

(x) Set **O/P POWER** potentiometer A4A2R48 (A5A2R48) fully counter clockwise.

(y) Set **RF** switch to **OFF**.

(z) Disconnect connector P14 from A9A2J1 and install it on A9A2J2.

(aa) Install connector P13 to A9A2J1.

(ab) Set **RF** switch to **ON**.

(ac) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for the intended carrier level as indicated by dummy load's forward power probe indication.

5.3.17 RF CURRENT THRESHOLD CHECK: Verify the modulation peak detector circuit will cause **RF CURRENT-ALARM** lamp to turn on when the absolute maximum modulation peaks (1000 watts carrier level with modulation peaks of 100%) are exceeded, as follows:

NOTE

The modulation peak detector (RF current) circuit has no influence on the radiated RF output. Its sole purpose is to alert a maintainer that the modulation envelope is exceeding 100% when the RF output is set to the intended carrier level.

(a) Set switches as tabulated for Test Setting in table 4-1.

(b) Set **RF** switch to **ON**.

(c) Set **MOD** switch A4S2 (A5S2) to **ON**.

(d) Verify the RF output is the intended carrier level and it is being modulated by the intended modulation depth.

(e) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for precisely 1000 watts, as indicated by dummy load's forward power indication.

(f) Set **TEST-Power/Mod** switch to **MOD-SET**.

(g) Adjust **SET 100 % MOD** potentiometer for 100% modulation depth indication on **TEST-Power/ Mod** meter.

(h) Set **TEST-Power/Mod** switch to **MOD-READ**.

(i) Simultaneously monitor **TEST-Power/Mod** meter while adjusting **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for 100% modulation depth indication.

(j) **RF CURRENT-ALARM** lamp shall turn on.

(k) If necessary, adjust **RF CURRENT CAL** potentiometer A10R23 until **RF CURRENT-ALARM** lamp just turns on.

(l) Connect an oscilloscope between test point A10TP14 and ground.

(m) Oscilloscope waveform indication shall be similar to the waveform depicted in figure 6-13.

(n) Simultaneously monitor **TEST-Power/Mod** meter while adjusting **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for an indication that is slightly below 100% modulation.

(o) **RF CURRENT-ALARM** lamp shall turn off.

(p) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for the intended carrier level, as indicated by dummy load's forward power indication.

(q) Adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for the intended modulation depth, as indicated by **TEST-Power/Mod** meter.

5.3.18 ALARM SYSTEMS CHECK: Verify the following alarm lamps turn on when the transmitter's parameters are not met:

5.3.18.1 RF Current-Alarm Check: **RF CURRENT-ALARM** lamp was checked in paragraph 5.3.17.

5.3.18.2 SWR-Alarm Check: **SWR-ALARM** lamp was checked in paragraph 5.3.16.

5.3.18.3 Shutdown-Alarm Check: Check **SHUTDOWN-ALARM** lamp as follows:

(a) Set switches as tabulated for ***Test Setting*** in table 4-1.

(b) Set **RF** switch to **ON**.

(c) Set **MOD** switch A4S2 (A5S2) to **ON**.

(d) Verify the RF output is the intended carrier level and it is being modulated by the intended modulation depth.

(e) Set **KEYING** switch A4S1 (A5S1) to **ON**.

(f) Set **MONITOR** switch to **NORMAL**.

(g) Verify **MONITOR-BYPASS** lamp is turned off.
(h) Set **KEYING** switch A4S1 (A5S1) to **OFF**.

(i) After the changeover time delay recorded in ***Established References*** section of table 5-2 (between 20 and 80 seconds), the selected side (main transmitter) will shut down and **STANDBY-ALARM** lamp will turn on.

NOTE

When changeover occurs and the standby transmitter fails to turn on, an additional 20 to 80 second delay will occur plus a nominal five second delay before a shutdown-alarm control signal is generated.

(j) After an additional changeover time delay period (between 20 and 80 seconds), **SHUTDOWN-ALARM** lamp will turn on.

(k) Set **RF** switch to **OFF**.

(l) Set **KEYING** switch A4S1 (A5S1) to **ON**.

(m) Set **MONITOR** switch to **BYPASS**.

(n) Set **RF** switch to **ON**.

(o) **MONITOR-BYPASS** lamp shall turn on, **STANDBY-ALARM** lamp and **SHUTDOWN-ALARM** lamp shall turn off.

(p) The selected side (main transmitter) shall turn on and resume normal operation.

5.3.18.4 Standby-Alarm Check: The standby changeover and indicator circuits are checked in paragraphs 5.3.18.3.

5.3.18.5 Battery-Alarm Check: When the DC option is installed, **BATTERY-ALARM** lamp function is checked in paragraph 5.3.19. When the DC option is not installed, **BATTERY-ALARM** lamp function is checked in paragraph 5.4.3.

5.3.18.6 Mod Drive-Alarm Check: Check mod drive fault monitoring/indicating circuits as follows:

NOTE

Completion of these checks will alter PWM ramp integrator circuit. On completion, the ramp integrator circuit must be readjusted in accordance with paragraph 5.3.7.

(a) Set switches as tabulated for ***Test Setting*** in table 4-1.

(b) Set **POWER TRIM** potentiometer A4R5 (A5R5) and **RAMP ADJUST** potentiometer A4A2R58 (A5A2R58) fully clockwise.

(c) Set **O/P POWER** potentiometer A4A2R48 (A5A2R48) fully counter clockwise.

(d) Connect a shorting clip across resistor A4A2R59 (A5A2R59).

(e) Connect an oscilloscope between test point A4A2TP6 (A5A2TP6) and ground.

(f) Disconnect connector P6 from A4J1 (A5J1).

(g) Set **RF** switch to **ON**.

(h) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) clockwise until **MOD DRIVE-ALARM** lamp A4DS3 (A5DS3) turns on.

(i) Measure and record oscilloscope mod drive waveform's on/off duty cycle, noting off period is zero volts and on period is ±15 volts.

(j) The on time recorded in step (i) shall be between 59 and 65 percent.

(k) Oscilloscope waveform indication shall be similar to the waveform depicted in figure 6-11.

(l) Set **RF** switch to **OFF**.

(m) Install connector P6 on A4J1 (A5J1).

(n) Remove shorting clip from resistor A4A2R59 (A5A2R59).

(o) Adjust PWM ramp integrator circuit as detailed in paragraph 5.3.7.

5.3.18.7 RF Drive-Alarm Check: Check **RF DRIVE-ALARM** lamp A4DS2 (A5DS2) function as follows:

(a) Set or verify switches are set as tabulated for Test Setting in table 4-1.

(b) Disconnect P6 (P8) from A4J1 (A5J1).

(c) Disconnect P19 (P20) from A4A4J2 (A5A4J2).

(d) Disconnect A4P4 (A5P4) from A4A4J3 (A5A4J3).

(e) Connect output from a variable (0 to 50 volts) DC power supply between connector A4P4 (A5P4) and ground, ensuring positive lead is connected to A4P4 (A5P4).

(f) Set output of variable DC power supply to 15.0V.

(g) Set **RF** switch to **ON**.

(h) Reduce output of DC power supply until **RF DRIVE-ALARM** lamp A4DS2 (A5DS2) just turns on.

(i) DC power supply's output voltage shall be between 9.8 and 10.5V.

(j) Set **RF** switch to **OFF**.

(k) Disconnect DC power supply from A4P4 (A5P4).

(l) Install A4P4 (A5P4) on A4A4J3 (A5A4J3).

(m) Install P6 (P8) on A4J1 (A5J1).

(n) Install P19 (P20) on A4A4J2 (A5A4J2).

5.3.19 LOW AC POWER CHECK: The low AC power check is not performed during functional test/ adjustment procedures. The low AC power check will be performed in the special adjustment procedures (refer to paragraph 5.4.3).

5.3.20 LOW BATTERY VOLTAGE MONITOR: When applicable, verify transmitter shuts down when external DC power source voltage decreases to -62.0 VDC, as follows:

NOTE

The low battery threshold level is set to -62.0 VDC at the factory. When the battery voltage falls below this level, a shutdown-alarm lamp shall turn on and the transmitter shall turn off. Users have the option of setting the low battery voltage threshold at a lower level (see paragraph 5.4.4).

(a) Verify battery panel related links are removed from between the terminals of TB3-1/TB3-2 and TB3-3/TB3-4 on TB3 (see note on figure SD-1).

(b) Set switches as tabulated for ***Test Setting*** in table 4-1.

(c) Set **POWER-BATTERY** switch A6S2 to **ON**.

(d) Set **RF** switch to **ON**.

(e) Set **MOD** switch A4S2 (A5S2) to **ON**.

(f) Verify transmitter is operating at the intended carrier level and the intended modulation depth.

(g) Set **POWER-AC LINE** switch A6S1 to **OFF**.

(h) **BATTERY ALARM** lamp shall turn on and a remote battery alarm control signal (ground) will be applied to TB3-14.

(i) Verify transmitter is operating at the intended carrier level (1000 watts maximum) and the intended modulation depth.

(j) Connect a multimeter between TB2-1(+) and TB2-2(-).

(k) Indication on multimeter, just prior to **SHUTDOWN-ALARM** lamp turning on, shall be a nominal -62.0V.

(l) When battery voltage decreases below the nominal -62.0V, **SHUTDOWN ALARM** lamp shall turn on. The transmitter will shut down.

(m) Set **POWER-BATTERY** switch A6S2 to **OFF**.

(n) Remove discharged batteries and reinstall charged batteries (nominal -72.0V) to the appropriate terminals on TB2).

(o) Set **POWER-BATTERY** switch to **ON**.

(p) Momentarily depress (three to five seconds) **BATTERY RESET** switch.

(q) Verify transmitter turns on and is operating at the intended carrier level and the intended modulation depth.

(r) Remove multimeter.

(s) Set **POWER-AC LINE** switch A6S1 to **ON**.

(t) **BATTERY-ALARM** lamp shall turn off and the remote battery alarm control signal (ground) shall be removed from TB3-14.

(u) Verify transmitter is operating at the intended carrier level and the intended modulation depth.

5.3.21 TEST/ADJUSTMENT OF SIDE B: Complete a functional test and if necessary adjust side **B** of the transmitter as follows:

(a) Set **SELECT MAIN TX** switch to **B**.

(b) Repeat paragraphs 5.3.2 through 5.3.20 using reference designations and transmitter side identification in parenthesis for modules that are duplicated in sides **A** and **B**.

NOTE

SELECT MAIN TX *switch must be set to* **B** *when instructed to set switches as tabulated for* ***Test Settings*** *in table 4-1.*

SPECIAL ADJUSTMENT PROCEDURES

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

High voltages that may cause serious injury or death are present inside the transmitter cabinet. Use extreme caution when AC power is applied.

NOTE

When an adjustment procedure is for a module or component that is duplicated for sides **A** *and* **B***, the reference designation that is applicable to the side 'B' module is shown in parenthesis (see note after paragraph 5.3.3).*

5.4.1 CURRENT SHUNT RESISTOR ADJUSTMENT (see figure SD-1): Adjust current shunt resistor R1 (R4) as follows:

(a) Set switches, except **POWER-AC LINE** switch as tabulated for ***Test Settings*** in table 4-1.

(b) Set **POWER-AC LINE** switch A6S1 to **OFF**.

(c) Remove left (right) side panel from transmitter cabinet.

(d) Set **TEST-Volts/Current** switch to **DC CURRENT-SIDE A** (**B**).

(e) Set **O/P POWER** potentiometer A4A2R48 (A5A2R48) fully counter clockwise.

(f) Using a clip-on DC current meter, clip current meter over wire going to current shunt resistor R1-5 (R4-5).

(g) Set **POWER-AC LINE** switch A6S1 to **ON**.

(h) Verify **DC SUPPLY** lamp A7DS2 (A8DS2) and B- lamp A2A9DS1 (A3A9DS1) are on.

(i) Set **RF** switch to **ON**.

(j) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for a 15.0 ampere indication on the clip-on DC current meter.

(k) **TEST-Volts/Current** meter's indication shall be 15.0 amperes.

(l) If necessary, adjust **Current Cal** potentiometer R2 (R3) for a 15.0 indication on **TEST-Volts/ Current** meter.

(m) Remove clip-on DC current meter.

(n) Set **TEST-Power/Mod** switch to **FWD PWR**.

(o) Set **O/P POWER** potentiometer A4A2R48 (A5A2R48) for 1000 watts of forward power, as indicated by **TEST-Power/Mod** meter.

(p) **TEST-Volts/Current** meter's indication shall be between 15.3 and 19.3 amperes.

(q) Set **MOD** switch A4S2 (A5S2) to **ON** and note **TEST-Power/Mod** meter's modulation depth (percentage) reading.

NOTE

When using **TEST-Power/Mod** *meter for an indication of the RF outputs modulation percentage, always set* **TEST-Power/Mod** *switch to* **MOD-SET** *and adjust* **SET 100 %** *potentiometer for a 100% modulation depth indication on* **TEST-Power/Mod** *meter. Set switch to* **MOD-READ** *for actual reading.*

(r) If necessary, adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for a 95% modulation depth indication on **TEST-Power/Mod** meter.

(s) DC current indication on **TEST-Volts/Current** meter shall be 25.6 ±2.0 amperes.

(t) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for the intended carrier level, as indicated on **TEST-Power/Mod** meter.

(u) Adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for the intended modulation depth as indicated on **TEST-Power/Mod** meter.

(v) Record **TEST-Volts/Current** meter's current indication, when the RF output is the intended carrier level at the intended modulation depth, for comparison with future test results.

(w) Set **POWER-AC LINE** switch A6S1 to **OFF**.

(x) Install panel on transmitter upon completion of tests.

5.4.2 TEST METER ADJUSTMENT: Check the accuracy of the forward power and reflected power indications of **TEST-Power/Mod** meter and if necessary, adjust as follows:

NOTE

Test-Power/Mod *meter's accuracy was set during manufacture. Its accuracy will affect the quality of routine adjustments; therefore, it should not be disturbed unless its accuracy is suspect or repairs dictate that adjustments are necessary.*

5.4.2.1 Forward Power Reading: Check the accuracy of the forward power indication of **TEST-Power/Mod** meter as follows:

(a) Set switches as tabulated for Test Setting in table 4-1.

(b) Verify dummy load has provision to accurately measure the power output of the transmitter to within two percent.

(c) Set **RF** switch to **ON**.

(d) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for precisely 1000 watts (by dummy load's forward power indication).

(e) Set **TEST-Power/Mod** switch to **REFL PWR**.

(f) Indication on **TEST-Power/Mod** meter shall be near zero.

(g) Set **O/P POWER** potentiometer A4(A5) A2R48 for the intended carrier level, as displayed by dummy load's forward power indication.

(h) Set **TEST-Power/Mod** switch to **FWD PWR**.

(i) **TEST-Power/Mod** meter's forward power indication shall be the intended carrier level.

(j) If necessary, adjust **FWD PWR CAL** potentiometer A10R79 until **TEST-Power/Mod** meter's forward power indication is precisely the intended carrier level.

5.4.2.2 Reflected Power Reading: Check the accuracy of the reflected power indication of **TEST-Power/Mod** meter as follows:

(a) Set switches as tabulated for ***Test Setting*** in table 4-1.

(b) Set **RF** switch to **ON**.

(c) Set **TEST-Power/Mod** switch to **FWD PWR.**

(d) Verify the RF output's forward power is the intended carrier level, as indicated by **TEST-Power/Mod** meter's forward power indication.

(e) Set **RF** switch to **OFF**.

(f) Disconnect connector P13 from A9A2J1.

(g) Disconnect connector P14 from A9A2J2.

(h) Install connector P14 on A9A2J1.

(i) Connect a shorting clip across resistor A4A2R44 (A5A2R44).

(j) Set **RF** switch to **ON**.

(k) Set **TEST-Power/Mod** switch to **REFL PWR**.

(l) **Test-Power/Mod** meter's indication shall be the intended carrier level.

(m) If necessary, adjust **REFL PWR CAL** potentiometer A10R107 until **TEST-Power/ Mod** meter's forward power indication is precisely the intended carrier level.

(n) Set **RF** switch to **OFF**.

(o) Disconnect connector P14 from A9A2J1 and install it on A9A2J2.

(p) Remove shorting clip from resistor A4A2R44 (A5A2R44).

(q) Install connector P13 on A9A2J1.

5.4.3 LOW AC VOLTAGE THRESHOLD ADJUSTMENT: Adjust the low AC voltage threshold circuit as follows:

NOTE

When DC option is installed and the AC power source voltage falls below the low AC voltage threshold, ***BATTERY-ALARM*** *lamp will turn on. The transmitter's RF output will remain at the intended carrier level.*

When DC option is not installed and the AC power source voltage falls below the low AC voltage threshold, **SWR-ALARM** *lamp will turn on. The RF output will cutback to approximately 115 watts.*

(a) Switch off the AC power source at the service entrance.

(b) Connect the output of a variable power transformer (variac) as the transmitter's AC power source.

(c) Connect an AC voltmeter across the output terminals of the variac.

(d) Verify the transmitter's output is terminated into a 50-ohm load (properly matched antenna system or a dummy load).

(e) Adjust variac's output for an AC voltmeter indication that is the low AC supply voltage (RMS) end for power transformer taps selected in paragraph 3.9.4.

(f) Set switches as tabulated for ***Test Setting*** in table 4-1.

(g) Set **POWER-AC LINE** switch A8S1 (A7S1) of power supply module **B** (**A**) to **OFF**.

(h) Set **RF** switch to **ON**.

(i) Verify the transmitter's RF output is the intended carrier level, as indicated by the dummy load's forward power indication.

(j) If necessary, adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) to set transmitter's RF output to the intended carrier level.

(k) Set **MOD** switch A4S2 (A5S2) to **ON**.

(l) Set **Test-Power/Mod** switch to **MOD-SET**.

(m) Adjust **SET 100 % MOD** potentiometer for a 100% modulation depth indication on **TEST-Power/Mod** meter.

(n) Set **TEST-Power/Mod** switch to **MOD-READ**.

(o) Adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for the intended modulation depth, as indicated by **TEST-Power/Mod** meter.

(p) Slowly decrease variac's output until **BATTERY-ALARM** lamp just turns on when DC option is installed or **SWR-ALARM** lamp just turns on when DC option is not installed.

(q) AC voltmeter's indication shall be 15.5 ±0.5 percent (10.5 ±0.5 percent if low end of AC supply voltage is 180 volts RMS) less than the voltage determined in step (e).

(r) If necessary, slowly adjust **Low AC Voltage Threshold** potentiometer A7A3R3 (A8A3R3) until the appropriate **ALARM** lamp (**BATTERY** or **SWR**) just turns on.

(s) Slowly increase variac's output until the **ALARM** lamp (**BATTERY** or **SWR**) just turns off.

(t) Ac voltmeter's indication shall be 10.5 ±0.5 percent (5.5 ±0.5 percent if low end of AC supply voltage is 180 volts RMS) less than the voltage determined in step (e).

(u) Repeat steps (p) through (t) until their requirements are met without further adjustment of **Low AC Voltage Threshold** potentiometer A7A3R3 (A8A3R3).

(v) Disconnect variac and connect transmitter directly to the AC power supply source.

5.4.4 LOW BATTERY VOLTAGE THRESHOLD ADJUSTMENT (DC OPTION INSTALLED): Verify the low battery voltage threshold is set to the level that will initiate a transmitter shutdown when the battery bank has discharged to the battery manufacturer's recommended discharge cut-off voltage, as follows:

NOTE

The low battery threshold level is set to -62.0V during factory tests. If the battery manufacturer's recommended discharge cut-off voltage is less negative than -62.0V, the recommended cut-off voltage may be used to determine the low battery voltage threshold level. The low battery threshold level must not be more negative than -62.0V.

5.4.4.1 Low Battery Voltage Threshold Adjustment Pre-requisites: Complete the following pre-requisites prior to attempting to determine the low battery voltage threshold or finalizing the adjustment.

(a) Verify battery panel related links are removed from between terminals TB3-1/TB3-2 and TB3-3/TB3-4 (see note on figure SD-1).

(b) Set **Low Battery Threshold** potentiometers A11A1R7 side **A** and A11A1R8 side **B** fully clockwise.

(c) Set switches as tabulated for ***Test Setting*** in table 4-1.

(d) Set **POWER - BATTERY** switch A6S2 to **ON**.

(e) Set **RF** switch to **ON**.

(f) Set **MOD** switch A4S2 (A5S2) to **ON**.

(g) Verify transmitter's RF output is the intended carrier level and its modulation envelope is the intended modulation depth.

(h) Set **POWER-AC LINE** switch A6S1 to **OFF**.

(i) **BATTERY ALARM** lamp shall turn on.

(j) Verify the transmitter's RF output is the intended carrier level and its modulation envelope is the intended modulation depth.

5.4.4.2 Determination of Low Voltage Battery Threshold: If the low battery voltage threshold is not known, calculate its level as follows:

(a) Determine the battery manufacturer's recommended discharge cut-off voltage.

(b) Record battery discharge cut-off voltage determined in step (a) as V_{bco}.

(c) Measure battery voltage at battery bank's output terminals.

(d) Record battery bank's output voltage determined in step (c) as V_b.

(e) Set **TEST-Volts/Current** switch to DC **CURR** - Side **A**.

(f) Record **TEST-Volts/Current** meter's current indication as I_b.

(g) Measure battery control panel voltage between A11A1CR3-anode and ground.

(h) Record control panel voltage determined in step (g) as V_{cp}.

(i) Calculate power consumption from batteries (P_b) by multiplying battery voltage recorded as V_b in step (d) and battery current recorded as I_b in step (f) [$P_b = V_b \times I_b$].

(j) Record battery power consumption determined in step (i) as P_b.

(k) Calculate voltage drop in wiring from battery bank to battery control panel A11 (V_d) by subtracting control panel voltage recorded as V_{cp} in step (h) from battery voltage recorded as V_b in step (d) [$V_d = V_b - V_{cp}$].

(l) Record wiring voltage drop determined in step (k) as V_d.

(m) Calculate the resistance of the wiring from battery bank to battery control panel A11 (R_w) by dividing the voltage drop recorded as V_d in step (l) by the battery current recorded as I_b in step (f) [$R_w = V_d/I_b$].

(n) Record wiring resistance determined in step (m) as R_w.

(o) Calculate the current drain from the battery bank (I_{bd}), when its output voltage is at the battery cut-off voltage level (V_{bco}), by dividing battery power consumption recorded as P_b in step (j) by the battery cut-off voltage recorded as V_{bco} in step (b) [$I_{bd} = P_b/V_{bco}$].

(p) Record current drain, at the battery cut-off voltage, determined in step (o) as I_{bd}.

(q) Calculate the voltage drop in the wiring from the battery bank to battery control panel A11 (V_{dw}), when the battery bank's output voltage is at the battery cut-off voltage level (V_{bco}) by multiplying the current drain recorded as I_{bd} in step (p) and the wiring resistance recorded as R_w in step (n) [$V_{dw} = I_{bd} \times R_w$].

(r) Record wiring voltage drop, at the battery cut-off voltage, determined in step (q) as V_{dw}.

(s) Calculate the low battery threshold voltage (V_{thresh}) by subtracting wiring voltage drop recorded as V_{dw} in step (r) from the battery cut-off voltage recorded as V_{bco} in step (b) [$V_{thresh} = V_{bco} - V_w$].

(t) Record low battery threshold voltage obtained in step (s) as the Low Battery Threshold in ***Established References*** section of table 5-2.

NOTE

The 'low battery voltage threshold' recorded in step (t) will not change unless the wiring between the battery bank and the transmitter is changed or a different manufacturer's batteries are used.

5.4.4.3 Finalization of Low Battery Voltage Threshold Adjustment: Finalize the low battery voltage threshold adjustment as follows:

(a) Verify the requirements of paragraph 5.4.4.1 have been completed and are being met.

(b) Determine DC voltage recorded as the low battery voltage threshold level in step (t) of paragraph 5.4.4.2.

NOTE

If the low battery voltage threshold level has not been calculated, refer to paragraph 5.4.4.2 for the procedure to perform this calculation.

(c) Set **POWER - BATTERY** switch A6S2 to **OFF**.

(d) Disconnect P18 from A11J1 on the battery control panel.

(e) Connect test leads of a variable DC power supply between chassis of battery control panel A11 (+) and A11A1CR3-anode (A11A1CR4-anode), ensuring positive voltage lead is connected to the chassis.

(f) Connect a jumper wire (negative voltage from variable DC power supply) between A11A1CR3-anode (A11A1CR4-anode) and A11K2-A (A11K3-B).

NOTE

Disconnect wiring quick-disconnect terminal from relay A11K2 (A11K3) terminal for easy access.

(g) Turn on variable DC power supply and set its output voltage to 72 VDC.

(h) Relay A11K2 (A11K3) shall energize.

(i) Slowly decrease voltage output of variable DC power supply until relay A11K2 (A11K3) just de-energizes or until the variable DC power supply's output voltage is less negative than the 'low battery voltage threshold' level determined in step (b).

(j) Relay A11K2 (A11K3) shall de-energize when the variable DC power supply's output voltage is precisely the low battery voltage threshold level determined in step (b).

(k) If required, set variable DC power supply's output voltage to precisely the low battery voltage threshold level and then adjust **Low Battery Threshold** potentiometer A11A1R7 (A11A1R8) until relay A11K2 (A11K3) just de-energizes.

(l) Repeat steps (g) through (k) until the requirement of step (j) is met without further adjustment of **Low Battery Threshold** potentiometer A11A1R7 (A11A1R8).

(m) Repeat steps (e) through (l) using reference designations in parenthesis.

(n) Remove DC power supply and jumper wire connected in steps (e) and (f), ensuring wiring quick-disconnect is installed on relay A11K2-A and A11K3-B.

OPERATIONAL ADJUSTMENT PROCEDURES

5.5 Operational adjustments are those procedures that are routinely performed by maintenance personnel when the transmitter's RF output is connected to its antenna system after successful completion of a minimum performance test and when emission levels/quality are being confirmed. It is assumed the antenna system has been properly tuned and is presenting a 50-ohm load at the carrier frequency.

NOTE

The operational adjustment procedures must be completed for side **A** *and side* **B**. *Where applicable, the reference designation for side* **B** *is shown in parenthesis. Complete the full operational test procedure for one side before attempting the other.*

Reference is made to intended carrier level and intended modulation depth in these instructions. Refer to notes on page 5-1 for an explanation.

5.5.1 OPERATIONAL ADJUSTMENT TEST EQUIPMENT: The following test equipment is required for operational adjustment procedures (see table 1-3 for more detailed specifications):

(a) A frequency counter with suitable test probes (Coaxial cable with a BNC connector at one end and clip-on probes at the other end).

(b) An oscilloscope, with suitable test probes (Coaxial cable with a BNC connector at one end and clip-on probes at the other end).

(c) A multimeter, with appropriate test leads.

(d) An audio signal generator, with appropriate clip-on test leads.

5.5.2 OPERATIONAL ADJUSTMENT PRE-REQUISITES: The following pre-requisites must be completed before attempting operational adjustments:

(a) Verify functional test/adjustment procedures, detailed in paragraph 5.3.2 through 5.3.20, have been successfully completed.

(b) Connect or verify the transmitter's RF output (J1) is connected to a properly tuned 50-ohm antenna system rated at 2000 watts.

(c) Verify AC power source's voltage is within five percent of mean RMS voltage used to select primary winding taps of power transformers A7T1/A8T1 in paragraph 3.9.4 and it has a minimum power rating of 2200 volt-amperes.

(d) Verify the test equipment identified in paragraph 5.5.1 is available.

(e) Set **POWER-AC LINE** switch A6S1 to **OFF**.

(f) Set remaining switches to positions tabulated for ***Test Setting*** in table 4-1.

(g) Set **O/P POWER** potentiometer A4A2R48 (A5A2R48) fully counter clockwise.

(h) Set **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) fully counter clockwise.

(i) Verify **RF MON** switch A9A2S1 is set to position (**VOLT** or **CURR**) recorded in the ***Established References*** section of table 5-2.

5.5.3 TRANSMITTER TURN-ON: Apply AC power to the transmitter and verify the indicator indications are normal at initial turn-on, as follows:

(a) Verify the requirements of paragraph 5.5.2 have been completed.

(b) Turn on AC power at the service entrance.

(c) Set **POWER-AC LINE** switch A6S1 to **ON**.

(d) **DC SUPPLY** lamp A7DS2, **B-** lamp A2A9DS1, **DC SUPPLY** lamp A8DS2, **B-** lamp A3A9DS1 shall turn on.

(e) Set **RF** switch to **ON**.

(f) **RF CURRENT-ALARM** lamp, **TX ON** lamp, **MONITOR-BYPASS** lamp and **CONVERTER +24V** lamp A7DS1 shall turn on.

(g) **AUDIO LIMITER** lamp A4DS1 (A5DS1), **RF DRIVE-ALARM** lamp A4DS2 (A5DS2) shall turn on initially. After a delay of approximately five seconds, lamps should turn off.

(h) **REMOTE CONTROL**, **MOD DRIVE-ALARM** A4DS3 (A5DS3), **SWR-ALARM**, **STANDBY-ALARM** and **SHUTDOWN-ALARM** lamps shall be off.

5.5.4 CARRIER LEVEL ADJUSTMENT: Set the unmodulated RF output to the intended carrier level as follows:

(a) Verify the requirements of paragraphs 5.5.2 through 5.5.3 have been completed.

(b) Set switches as tabulated for ***Test Setting*** in table 4-1.

(c) Set **TEST-Power/Mod** switch to **FWD PWR**.

(d) Set **RF** switch to **ON**.

(e) Adjust **O/P POWER** potentiometer A4A2R48 (A5A2R48) for a forward power indication, on **TEST-Power/Mod** meter, that is the intended carrier level.

(f) **RF Current Alarm** lamp shall turn off.

(g) Set **TEST-Power/Mod** switch to **REFL PWR**.

(h) Reflected power indication on **TEST-Power/Mod** meter shall be near zero watts.

(i) **SWR-ALARM** lamp shall remain off.

5.5.5 MODULATION DEPTH ADJUSTMENT: Set the RF outputs modulation envelope to the intended modulation depth as follows:

(a) Verify the requirements of paragraphs 5.5.2 through 5.5.4 have been completed and the transmitter's unmodulated RF output is the intended carrier level.

(b) Set switches as tabulated for ***Test Setting*** in table 4-1.

(c) Set **TEST-Power/Mod** switch to **MOD-SET** and **TX** switch to **ON**.

(d) Set **MOD** switch A4S2 (A5S2) to **ON**.

(e) Set **TEST-Power/Mod** switch to **MOD-SET**.

(f) Adjust **SET 100 % MOD** potentiometer for 100% indication on the lower scale of **TEST-Power/ Mod** meter.

(g) Set **TEST-Power/Mod** switch to **MOD-READ**.

Discontinue adjusting* TONE LEVEL *potentiometer A4A2R19 (A5A2R19) in an increasing mod depth direction, if RF* CURRENT-ALARM *lamp turns on before the desired mod depth is obtained. If an attempt is made to increase the mod depth beyond this percentage, RF stress current threshold levels may be exceeded.

(h) Adjust **TONE LEVEL** potentiometer A4A2R19 (A5A2R19) for the 'intended modulation depth' as indicated on **TEST-Power/Mod** meter's lower scale.

(i) Set **TEST-Power/Mod** switch to **REFL PWR**.

(j) Reflected power indication on **TEST-Power/Mod** meter shall be less than 50 watts.

(k) **SWR-ALARM** lamp shall remain off.

POST OPERATIONAL ADJUSTMENT PROCEDURES

5.6 When the operational adjustment procedures have been successfully completed, set all switches to the setting tabulated for ***Operating Setting*** in table 4–1.

Table 5-2 Functional Test/Adjustment Check List

ESTABLISHED REFERENCES

VOLT READING B- VOLTS VDC +24 VOLTS VDC +15 VOLTS VDC
CORRECTION FACTORS: -15 VOLTS VDC

Carrier Frequency	kHz	Station Identification Code	
Intended Carrier Level	Watts	Intended Modulation Depth (MCW) ...	%
Modulation Depths (A2A/A3E)		Keyed Tone Frequency	Hz
- Tone Percentage	%	Changeover Time Delay	Seconds
- Voice Percentage.....	%	Tone Frequency	Hz
Carrier Fault Threshold Level	Watts	Mod Fault Threshold Level.....	%
External Standby 1 Side A		External Standby 2 Side A	
External Standby 1 Side B		External Standby 2 Side B	
Low Battery Threshold	VDC	Monitor Switch (**VOLTS** or **CURR**).....	

FUNCTIONAL TEST RESULTS

NOTE

Functional test/adjustment checks are the same for both sides of the transmitter (A and B). In most instances, the following check list will be applicable to either side.

PARA		FUNCTION OBSERVED	TEST RESULTS		TOLERANCES
5.3.3	(g)	Lamp status	Accept ☐	Reject ☐	Specified lamps on
	(i)	Lamp status	Accept ☐	Reject ☐	Specified lamps on
5.3.4.1	(d)	B- VDC (Unloaded)	A VDC	B VDC	-72.0 VDC
5.3.4.2	(c)	Lamps status	Accept ☐	Reject ☐	Specified lamps on
	(d)	Lamps status	Accept ☐	Reject ☐	Specified lamps off
	(e)	Blower fans A2B1 (A3B1)	Accept ☐	Reject ☐	Both sides operating
	(h)	+24 volts DC	A VDC	B VDC	+23.8 to +24.2 VDC
	(n)	+15 volts DC	A VDC	B VDC	+14.7 to +15.3 VDC
	(s)	-15 volts DC	A VDC	B VDC	-14.25 to -15.75 VDC
	(w)	+15 volts DC (Monitor)	A VDC	B VDC	+14.5 to +15.5 VDC
	(y)	+15 volts DC (Pwr/Sup)	Accept ☐	Reject ☐	+14.5 to +15.5 VDC
	(aa)	-15 volts DC (Monitor)	Accept ☐	Reject ☐	-14.5 to -15.5 VDC

Table 5-2 Functional Test Check List (Continued)

PARA		FUNCTION OBSERVED	TEST RESULTS				TOLERANCES
5.3.5.1	(g)	Carrier Freq (RF Osc)	A	kHz	B	kHz	Within ±0.004% of fc
	(j)	RF Drive Level	A	Volts	B	Volts	11.7 to 14.3 V(peak-peak)
5.3.5.2	(e)	Carrier Freq (Freq Syn)	A	kHz	B	kHz	Within ±0.004% of fc
	(g)	Low Level RF Drive	A	Volts	B	Volts	12.1 and 14.9 V(peak-peak)
5.3.6	(d)	RF Drive	A	Volts	B	Volts	66.0 to 74.0 V(peak-peak)
	(f)	RF Drive Level	A	VDC	B	VDC	+12.0 to +14.0 VDC
5.3.7	(f)	PWM Osc Frequency	A	kHz	B	kHz	69.86 to 70.14 kHz
	(l)	PWM Waveform	Accept ☐		Reject ☐		Triangular waveform with positive portion of waveform at
			A		B		or near ground level
5.3.8	(g)	Forward Power (CW)	Accept ☐		Reject ☐		Linear increase to 1000 watts
	(h)	RF Current-Alarm Lamp	Accept ☐		Reject ☐		Specified lamp off
	(h)	Reflected Power (CW)	A	Watts	B	Watts	Near zero watts
	(j)	Forward Power (CW)	A	Watts	B	Watts	1000 watts
	(m)	Dcv Current (CW-1000W)	A	Amps	B	Amps	15.3 to 19.7 amperes
	(o)	B- (CW)	A	VDC	B	VDC	-66.8 to -71.4 VDC
	(q)	RF Carrier Level (CW-1000W)	A	Volts	B	Volts	18.0 to 22.0 V(peak-peak)
5.3.9	(i)	Modulation Depth	A	%	B	%	100% maximum
	(l)	Modulation Depth (100%)	Accept ☐		Reject ☐		Free from clipping/distortion at 100% modulation
	(n)	Modulation Depth	A	%	B	%	Free from clipping/distortion at 95%/intended modulation
			Accept ☐		Reject ☐		
5.3.10	(j)	B- VDC (MCW)	A	VDC	B	VDC	-70.0 VDC
	(l)	B- VDC (MCW)	A	VDC	B	VDC	-68.6 to -71.4 VDC
5.3.11	(k)	Audio Limiter	Accept ☐		Reject ☐		Specified lamp shall turn on and mod depth shall not vary by more than five percent

Table 5-2 Functional Test Check List (Continued)

PARA		FUNCTION OBSERVED	TEST RESULTS	TOLERANCES
5.3.12	(l)	Modulation Depth (A3E Mode)	A % B %	60% of intended modulation depth
	(o)	Modulation Depth (Tone-A3E Mode)	A % B %	35% of intended modulation depth
5.3.13	(h)	Identification Code	Accept ☐ Reject ☐	Assigned Indent
	(j)	Frame Length	A B	7.2 to 8.8 seconds
5.3.14	(i)	Stby code '1'	Accept ☐ Reject ☐	See 'Established References'
	(l)	Stby code '2'	Accept ☐ Reject ☐	See 'Established References'
5.3.15.2	(c)	Carrier Fault Threshold	A B	See 'Established References'
	(c)	Set Threshold Lamp (Within limits)	Accept ☐ Reject ☐	Lamp flashing on and off
	(c)	Set Threshold Lamp (Threshold exceeded)	Accept ☐ Reject ☐	Lamp turns on and remains on
5.3.15.3	(k)	Modulation Fault Threshold Level	A B	No less than -1dB greater than carrier threshold level
	(k)	Set Threshold Lamp (Within limits)	Accept ☐ Reject ☐	Lamp flashing on and off
	(k)	Set Threshold Lamp (Threshold exceeded)	Accept ☐ Reject ☐	Lamp turns on and remains on
5.3.15.4	(k)	Changeover/Shutdown (Loss of keying)	Accept ☐ Reject ☐	See 'Established References' (20 to 80 seconds)
	(x)	Changeover/Shutdown (Low carrier level)	Accept ☐ Reject ☐	See 'Established References' (20 to 80 seconds)
	(am)	Changeover/Shutdown (Low modulation depth)	Accept ☐ Reject ☐	See 'Established References' (20 to 80 seconds)
5.3.16	(i)	SWR Cutback Threshold	Accept ☐ Reject ☐	Between 110 and 120 watts
	(w)	SWR Cutback Threshold	Accept ☐ Reject ☐	No Increase in forward pwr
5.3.17	(i)	Overmod Threshold (100% Modulation)	Accept ☐ Reject ☐	Specified lamp on

Table 5-2 Functional Test Check List (Continued)

PARA	FUNCTION OBSERVED	TEST RESULTS		TOLERANCES
5.3.18.1	RF Current Alarm	Accept ☐	Reject ☐	See para 5.3.17 (j)
5.3.18.2	SWR-Alarm	Accept ☐	Reject ☐	See para 5.3.16 (h)
5.3.18.3 (i)	Standby-Alarm	Accept ☐	Reject ☐	Specified lamp on
(j)	Shutdown-Alarm	Accept ☐	Reject ☐	Specified lamp on
5.3.18.4	Standby Alarm	Accept ☐	Reject ☐	See para 5.3.18.3 (i)
5.3.18.5	Battery Alarm	Accept ☐	Reject ☐	See para 5.3.19 (h)
5.3.18.6 (h)	Mod Drive-Alarm	A	B	Specified lamp on
(j)		Accept ☐	Reject ☐	Rectangular waveform with positive portion 62 ±3.0% of time
5.3.18.7 (h)	RF Drive-Alarm Lamp	A	B	Specified lamp on
(i)	RF Drive-Alarm	A VDC	B VDC	Between 9.8 and 10.5 volts DC
5.3.20 (h)	Battery-Alarm Lamp	Accept ☐	Reject ☐	Specified lamps on
(i)	Carrier Level (DC power source)	A kHz	B kHz	Intended Level Carrier
(k)	Low Battery Threshold	Accept ☐	Reject ☐	Nominal -62.0 volts DC
(t)	Battery-Alarm Lamp	Accept ☐	Reject ☐	Specified lamp off

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. This section also contains wiring data information for each hard wired assembly.

ELECTRICAL SCHEMATICS/ LOGIC DIAGRAMS

6.2 An electrical schematic for each electrical assembly in the ND4000A radiobeacon transmitter is provided.

6.2.1 COMPONENT VALUES: Unless otherwise specified on the schematic:

- All resistor values are shown in ohms (K = 1000 and M = 1 000 000).
- All capacitor values are shown in microfarads (uF).
- Unidentified diodes are part number 1N4938.

6.2.2 GRAPHIC SYMBOLS: The graphic symbols used on the electrical schematics are in accordance with American National Standard ANSI Y32.2-1975 - Graphic Symbols for Electrical and Electronic Diagrams.

6.2.3 LOGIC SYMBOLS: 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.

6.2.4 REFERENCE DESIGNATIONS: Reference designations have been 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.

WIRING INFORMATION

6.3 Point to point wiring information is provided in tables 8-1 through 8-12.

6.3.1 TRANSMITTER CABINET WIRING: Table 8-1 provides a tabular wiring list for the transmitter cabinet.

6.3.2 CONTROL/ MONITOR PANEL WIRING: Table 8-2 provides a tabular wiring list for control/monitor panel A1.

6.3.3 MODULATOR/POWER AMPLIFIER MODULE WIRING: Table 8-3 provides a tabular wiring list for modulator/power amplifier modules A2 and A3.

6.3.4 EXCITER MODULE WIRING: Table 8-4 provides a tabular wiring list for exciter modules A4 and A5.

6.3.5 POWER ON/OFF PANEL WIRING: Table 8-5 provides a tabular wiring list for power on/off panel A6.

6.3.6 POWER SUPPLY MODULE WIRING: Table 8-6 provides a tabular wiring list for power supply modules A7 and A8.

6.3.7 B- VDC TO +24 VDC CONVERTER WIRING: Table 8-7 provides a tabular wiring list for B- VDC to +24 VDC converter A7A2 and A8A2.

6.3.8 HARMONIC FILTER ASSEMBLY WIRING: Table 8-8 provides a tabular wiring list for harmonic filter assembly A9.

6.3.9 FWD/REFL POWER PROBE WIRING: Table 8-9 provides a tabular wiring list for fwd/refl power probe A9A1.

6.3.10 BATTERY CONTROL PANEL ASSEMBLY WIRING: Table 8-11 provides a tabular wiring list for battery control panel assembly A11.

6.3.11 INTERFACE PANEL ASSEMBLY WIRING: Table 8-12 provides a tabular wiring list for the interface panel assembly.

MECHANICAL DRAWINGS

6.4 Mechanical drawings, shown in figures MD-1 through MD-38, are illustrations that depict the assembly detail for and show the location of most electrical components. The illustrations are presented in their order on the reference designation hierarchy.

SCHEDULED MAINTENANCE

6.5 Scheduled maintenance is restricted to performing a visual inspection and a functional test/ calibration procedure (see paragraph 5.3) at scheduled intervals. The recommended 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

6.6 Corrective maintenance procedures comprise identifying and correcting defects or deficiencies that arise during operation and/or testing of the transmitter. The transmitter will switch to the standby side and/or shut down automatically if the carrier level or modulation depth fall below preset thresholds or if the identification code keying is lost. A functional test and where appropriate an attempted calibration procedure should be the first step in taking corrective action. Figure 6-1 thru 6-15 provides waveform indications for use in fault isolation.

ISOLATION OF DEFECTIVE POWER MOSFETs

6.7 Isolate defective power MOSFET devices using a digital multimeter that can measure a diode's forward/reverse resistance, as follows:

Power MOSFET transistors are susceptible to damage from static electricity. Observe static protection procedures when handling the devices and the assemblies containing devices. As a minimum grounded conductive, bench mats and wrists straps should be used.

NOTE

The following procedures require the power MOSFET under test to be turned on by the application of a DC voltage (minimum of 4.0 volts DC to a maximum of 9.0 volts DC) between its gate and source. Some digital multimeters have sufficient DC voltage on their test leads when they are set to diode or resistance test positions.

If the digital 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 volts DC must be obtained.

6.7.1 ISOLATION OF DEFECTIVE POWER MOSFET's IN A POWER AMPLIFIER: Isolate defective power MOSFETs in a power amplifier assembly as follows:

NOTE

*Previously recorded alarm/status indications (***PA VOLTS** *1 through 4 lamps) will indicate which power amplifier assembly is suspected of having a defective power MOSFET(s). Refer to figure SD-4.*

(a) Locate the power amplifier assembly that is suspected of having defective power MOSFETs. (Refer to figure MD-7 to identify a specific power amplifier assembly and to figure MD-11 for its assembly detail).

(b) Remove suspect power amplifier assembly as follows:

- Disconnect coaxial cable connector from J1 (BNC) of power amplifier assembly.

- Disconnect three screws/washers securing assembly to associated terminal board.

- Disconnect four screws/washers securing assembly to the mounting rails.

- Carefully lift away power amplifier assembly.

(c) On the suspect power amplifier assembly, unsolder and disconnect wiring from gate terminal of power MOSFET's Q1 thru Q4.

(d) Ensure power MOSFETs to be tested are turned off, by momentarily connecting a shorting jumper between the gate and source terminals of each device.

(e) Measure source/drain resistance, of power MOSFET being tested, in both directions.

(f) Resistance measurements in step (e) shall be an open circuit in the reverse bias direction and a diode pedestal in the forward bias direction. If requirements of this step are met, proceed to step (h).

NOTE

If multimeter in use does not have diode measuring capability, the resistance of the forward bias direction will be an open circuit.

(g) Disconnect wiring and component leads from the source and drain terminals of MOSFET's that do not meet the requirements of step (f) and repeat (d) thru (f).

(h) Turn on power MOSFET being tested by momentarily applying a DC voltage (4.0 to 9.0 volts DC) between its gate (+) and source (-) terminals.

(i) Measure source/drain resistance, of power MOSFET(s) turned on in step (h), in both (forward and reverse) directions.

(j) Resistance measurements in step (i) shall be a short circuit in both (forward and reverse) directions.

(k) Turn off MOSFET(s) being tested by momentarily connecting a shorting jumper between its gate and source terminals.

(l) Measure drain/ground resistance of power MOSFETs Q1 and Q3 in both (forward and reverse) directions.

(m) Resistance measurement in step (l) shall be a high impedance (open circuit) in one direction and a diode pedestal in the other direction.

(n) If requirements of steps (f), (j) and (m) are met, the power MOSFET being tested and it's associated insulating washer may be assumed to be serviceable.

(o) If requirements of steps (f) and (j) are not met, the power MOSFET being tested may be assumed to be defective. If requirements of step (m) are not met, the associated insulating washer may be assumed to be defective. Replace the defective power MOSFET as detailed in paragraph 6.8.1.

NOTE

It is recommended that power MOSFET Q1 in the associated modulator assembly be tested in conjunction with the suspect power amplifier assembly. Refer to paragraph 6.7.2.

(p) On completion of testing/repair:

- Install power amplifier assembly in modulator/ power amplifier module, ensuring it is oriented as depicted in Figure MD-7, using screws/ washers removed in step (b). Connect appropriate coaxial cable connector to J1.

6.7.2 CHECK OF POWER MOSFET IN MODULATOR ASSEMBLY: Check power MOSFET Q1 in a modulator assembly as follows:

(a) If associated power amplifier assembly has been removed for testing, it is not necessary to remove modulator assembly to be tested.

(b) If associated power amplifier is installed, remove modulator assembly as follows. (Refer to figure MD-6 to identify a specific modulator assembly and to figure MD-10 for its assembly detail).

- Disconnect three screws/washers securing assembly to associated terminal board.

- Disconnect four screws/washers securing assembly to the mounting rails.

- Carefully lift away modulator assembly.

(c) Disconnect printed wiring board A1 from modulator assembly to be tested, by removing its four securing screws/washers and carefully lifting away the printed wiring board.

(d) Verify power MOSFET Q1 is turned off, by momentarily connecting a shorting jumper between its gate and source terminals.

(e) Measure source/drain resistance, of power MOSFET Q1, in both directions.

(f) Resistance measurements in step (e) shall be an open circuit in the reverse bias direction and a diode pedestal in the forward bias direction. If requirements of this step are met, proceed to step (h).

NOTE

If multimeter in use does not have diode measuring capability, the resistance of the forward bias direction will be an open circuit.

(g) If requirements in step (f) are not met, unsolder and disconnect wiring from the source and drain terminals of MOSFET Q1 and repeat steps (d) through (f).

(h) Turn on power MOSFET Q1 by momentarily applying a DC voltage (4.0 to 9.0 volts DC) between its gate (+) and source (-) terminals.

(i) Measure source/drain resistance, of power MOSFET Q1, in both directions.

(j) Resistance measurements in step (i) shall be a short circuit in both directions.

(k) Turn off power MOSFET Q1 by momentarily connecting a shorting jumper between its gate and source terminals.

(l) Measure resistance between power MOSFET Q1's drain (case) terminal and ground.

(m) Resistance measured in step (l) shall be an open circuit in one direction and a diode pedestal in the other direction.

(n) If requirements of steps (f), (j) and (m) are met, power MOSFET Q1 and it's associated insulating washer may be assumed to be serviceable.

(o) If requirements of steps (f) and (j) are not met, power MOSFET Q1 may be assumed to be defective. If requirements of step (m) are not met, the insulating washer may be assumed to be defective. Replace power MOSFET Q1 as detailed in paragraph 6.8.2.

NOTE

If power MOSFET Q1 of a modulator assembly is defective, transistors A1Q2 and A1Q3, on its printed wiring board, may also be defective and should be checked.

(p) On completion of testing/repair:

- Install printed wiring board A1 on modulator assembly, ensuring it is oriented as depicted in Figure MD-10, using four screws/washers removed in step (c).

- Install modulator assembly in modulator/ power amplifier module, ensuring it is oriented as depicted in figure MD-6, using screws/washers removed in step (b).

6.7.3 ISOLATION OF DEFECTIVE POWER MOSFET's IN RF DRIVE AMPLIFIER ASSEMBLY: Isolate defective power MOSFETs in a RF drive amplifier. Refer to figure SD-5.

(a) Locate the RF drive amplifier that is suspected of having defective power MOSFETs. (Refer to figure MD-15 to identify the RF drive amplifier and to figure MD-21 for its assembly detail).

(b) Remove suspect RF drive power amplifier assembly as follows:

- Disconnect coaxial cable connectors from J1 and J2 (BNC) of RF drive amplifier assembly.

- Remove wire #16 connected to terminal 1 of the RF drive amplifier.

- Disconnect four screws/washers securing assembly to the RF power module.
- Carefully lift away RF drive amplifier assembly.

(c) On the suspect RF drive amplifier assembly, unsolder and disconnect wiring from gate terminal of power MOSFET's Q1 and Q2.

(d) Ensure power MOSFETs to be tested are turned off, by momentarily connecting a shorting jumper between the gate and source terminals of each device.

(e) Measure source/drain resistance, of power MOSFET being tested, in both directions.

(f) Resistance measurements in step (e) shall be an open circuit in the reverse bias direction and a diode pedestal in the forward bias direction. If requirements of this step are met, proceed to step (h).

NOTE

If multimeter in use does not have diode measuring capability, the resistance of the forward bias direction will be an open circuit.

(g) Disconnect wiring and component leads from the source and drain terminals of MOSFET's that do not meet the requirements of step (f) and repeat (d) thru (f).

(h) Turn on power MOSFET being tested by momentarily applying a DC voltage (4.0 to 9.0 volts DC) between its gate (+) and source (-) terminals.

(i) Measure source/drain resistance, of power MOSFET(s) turned on in step (h), in both (forward and reverse) directions.

(j) Resistance measurements in step (i) shall be a short circuit in both (forward and reverse) directions.

(k) Turn off MOSFET(s) being tested by momentarily connecting a shorting jumper between its gate and source terminals.

(l) Measure drain/ground resistance of power MOSFET Q1 in both (forward and reverse) directions.

(m) Resistance measurement in step (l) shall be a high impedance (open circuit) in one direction and a diode pedestal in the other direction.

(n) If requirements of steps (f), (j) and (m) are met, the power MOSFET being tested and it's associated insulating washer may be assumed to be serviceable.

(o) If requirements of steps (f) and (j) are not met, the power MOSFET being tested may be assumed to be defective. If requirements of step (m) are not met, the associated insulating washer may be assumed to be defective. Replace the defective power MOSFET as detailed in paragraph 6.8.3.

(p) On completion of testing/repair:

- Install RF drive amplifier assembly in exciter module, ensuring it is oriented as depicted in Figure MD-15, using screws/washers removed in step (b). Connect appropriate coaxial cable connectors to J1 and J2.

6.7.4 CHECK OF POWER MOSFET IN DC-DC CONVERTER ASSEMBLY: Check power MOSFET Q1 in a DC-DC converter assembly as follows. (Refer to figures SD-10 and MD-24 to identify the DC-DC converter assembly and to figure MD-27 for its assembly detail.

(a) Remove DC-DC converter as follows:

- Disconnect the five wires connected to terminal block TB1.
- Disconnect four screws/washers securing assembly to the associated power supply module.
- Carefully lift away DC-DC Converter assembly.

(b) Verify power MOSFET Q1 is turned off, by momentarily connecting a shorting jumper between its gate and source terminals.

(c) Measure source/drain resistance, of power MOSFET Q1, in both directions.

(d) Resistance measurements in step (c) shall be an open circuit in the reverse bias direction and a diode pedestal in the forward bias direction. If requirements of this step are met, proceed to step (h).

NOTE

If multimeter in use does not have diode measuring capability, the resistance of the forward bias direction will be an open circuit.

(e) If requirements in step (d) are not met, unsolder and disconnect wiring from the source and drain terminals of MOSFET Q1 and repeat steps (b) through (d).

(f) Unsolder jumper wire connected to terminal 2 on PWB.

(g) Turn on power MOSFET Q1 by momentarily applying a DC voltage (4.0 to 9.0 volts DC) between its gate (+) and source (-) terminals.

(h) Measure source/drain resistance, of power MOSFET Q1, in both directions.

(i) Resistance measurements in step (h) shall be a short circuit in both directions.

(j) Turn off power MOSFET Q1 by momentarily connecting a shorting jumper between its gate and source terminals.

(k) Measure resistance between power MOSFET Q1's drain (case) terminal and ground.

(l) Resistance measured in step (k) shall be an open circuit in one direction and a diode pedestal in the other direction.

(m) If requirements of steps (d), (i) and (l) are met, power MOSFET Q1 and it's associated insulating washer may be assumed to be serviceable.

(n) If requirements of steps (d) and (i) are not met, power MOSFET Q1 may be assumed to be defective. If requirements of step (l) are not met, the insulating washer may be assumed to be defective. Replace power MOSFET Q1 as detailed in paragraph 6.8.4.

(o) On completion of testing/repair:

- Solder jumper wire removed at terminal 2 on PWB.

- Install DC-DC converter assembly in power supply module, ensuring it is oriented as depicted in Figure MD-24, using screws/ washers removed in step (a).

- Install wiring to TB1 of the DC-DC converter as follows:

Wire	#28	to	TB1-1
	#29	to	TB1-2
	#17	to	TB1-3
	#26	to	TB1-4
	#27	to	TB1-5

POWER MOSFET REPLACEMENT

6.8 Replace power MOSFET's as follows:

6.8.1 POWER MOSFET REPLACEMENT ON POWER AMPLIFIER ASSEMBLIES: Replace defective power MOSFET(s) on a power amplifier assembly as follows: (Refer to Figure MD-11 for assembly detail).

(a) Disconnect or verify wire is disconnected from gate terminal.

(b) Remove device mounting hardware.

(c) Unsolder and remove diode and wire from source terminal.

(d) Unsolder gate, source and drain terminals from printed wiring board, using a solder removal system and then remove power MOSFET. Ensure solder is not splattered on the chassis.

NOTE

There is an insulating washer between the metal chassis and power MOSFETs Q1 and Q3. These insulators must be retained for use when installing new power MOSFET.

CAUTION

Ensure hole in metal chassis and the chassis surface under an insulating washer are free from burrs or any sharp projection that could damage the insulating washer.

(e) For power MOSFETs Q1 and Q3, position the original (or an identical) insulating washer on chassis where power MOSFET will be installed; ensuring hole in insulating washer is aligned with mounting hole in printed wiring board.

(f) Bend the ends of the leads of new power MOSFET to fit into printed wiring board pads. Ensure leads do not touch printed wiring pattern at other than designated points.

(g) Install power MOSFET and secure using hardware removed in step (b), noting the cathode end of a diode is installed on the drain terminal on the printed wiring board as depicted in figure MD-11. Torque nuts to five inch pounds (0.57 Newton meters or 0.58 kilogram meters).

(h) Perform a functional test as described in paragraph 6.7.1.

(i) Solder anode lead of associated diode to source terminal and the appropriate wires to the gate and source terminals. Refer to wiring table shown in figure MD-11 to determine identity of wires connected to gate and source terminals.

6.8.2 POWER MOSFET REPLACEMENT ON MODULATOR ASSEMBLIES: Replace defective power MOSFET Q1 on a modulator assembly as follows: (Refer to figure MD-10 for assembly detail).

(a) Disconnect or verify capacitor lead is disconnected from source terminal.

(b) Remove nuts securing diodes CR1 and CR2 to power MOSFET mounting hardware and chassis mounted standoffs, and then carefully lift off diodes.

(c) Loosen hardware securing pillar connected to the source terminal.

(d) Unsolder gate, source and drain terminals from printed wiring board, using a solder removal system, and then remove power MOSFET. Ensure solder is not splattered on chassis.

NOTE

There is an insulating washer between the metal chassis and power MOSFET Q1. This insulator must be retained for use when installing new power MOSFET.

CAUTION

Ensure hole in metal chassis and the chassis surface under insulating washer is free from burrs or any sharp projection that could damage the insulating washer.

(e) Bend the ends of the leads of new power MOSFET to fit into printed wiring board pads. Ensure leads do not touch printed wiring pattern at other than designated points.

(f) Position the original (or an identical) insulating washer on chassis where power MOSFET will be installed; ensuring hole in insulating washer is aligned with mounting hole in printed wiring board.

(g) Install power MOSFET and secure using hardware removed in step (b). Torque nuts to five inch pounds (0.57 Newton meters or 0.58 kilogram meters).

(h) Perform a functional test as described in paragraph 6.7.2.

(i) Solder lead of capacitor C2 to source terminal.

(j) Install diodes CR1 and CR2 using attaching hardware removed in step (b). Ensure anode end of both diodes is installed on device mounting terminal.

(k) Tighten hardware securing pillar connected to the source terminal.

6.8.3 POWER MOSFET REPLACEMENT ON RF DRIVE AMPLIFIER ASSEMBLIES: Replace defective power MOSFET(s) on a RF drive amplifier assembly as follows: (Refer to figure MD-21 for assembly detail).

(a) Remove hardware securing the power MOSFET to the chassis.

NOTE

There is an insulating washer and an insulating pad between the metal chassis and power MOSFET Q1. These insulators must be retained for use when installing new power MOSFET.

(b) Loosen hardware securing the adapter PWB to the chassis.

(c) Unsolder gate, source and drain terminals from the adapter PWB, using a solder removal system and then remove power MOSFET. Ensure solder is not splattered on the chassis or between the pads on the adapter PWB.

(d) Remove and retain the insulating sleeve on the drain terminal of the power MOSFET just removed.

Ensure hole in metal chassis surface under an insulating washer and an insulating pad is free from burrs or any sharp projection that could damage the insulating washing or insulating pad.

(e) Secure hardware securing the adapter PWB to the chassis.

(f) Measure, using an ohmmeter, resistance between each of the adapter PWB's three printed wiring terminals and ground. Resistance measured should be an open circuit for each situation.

(g) If the resistance measured in step (f) is not an open circuit, adjust the position of the adapter PWB to obtain an open circuit between all three terminals and ground.

(h) For power MOSFET Q1, position the original (or an identical) insulating washer on chassis where power MOSFET will be installed; ensuring hole in insulating washer is aligned with mounting hole on the metal chassis.

(i) Install power MOSFET using hardware removed in step (a). Do not fully tighten the hardware.

(j) Solder the gate and source leads to the appropriate adapter PWB terminals. Trim the power MOSFET's leads to prevent shorting to the drain terminal.

(k) Install the insulating sleeve removed in step (d) to the drain lead on the power MOSFET.

(l) Loosen hardware securing the adapter PWB to the chassis.

(m) Solder the drain lead to the appropriate adapter PWB terminal.

(n) Torque hardware to five inch pounds (0.57 Newton meters or 0.58 kilogram meters).

(o) Perform a function test as described in paragraph 6.7.3.

6.8.4 POWER MOSFET REPLACEMENT ON DC-DC CONVERTER ASSEMBLIES: Replace defective power MOSFET on a DC-DC converter assembly as follows: (Refer to figure MD-27 for assembly detail)

(a) Remove hardware securing the power MOSFET to the chassis.

NOTE

There is an insulating washer and an insulating pad between the metal chassis and power MOSFET. These insulators must be retained for use when installing new power MOSFET.

(b) Loosen hardware securing the adapter PWB to the chassis.

(c) Unsolder gate, source and drain leads from the adapter PWB, using a solder removal system and then remove power MOSFET. Ensure solder is not splattered on the chassis or between the terminals on the adapter PWB.

(d) Remove and retain the insulating sleeve on the drain lead of the power MOSFET just removed.

Ensure hole in metal chassis surface under an insulating washer and an insulating pad is free from burrs or any sharp projection that could damage the insulating washing or insulating pad.

(e) Secure hardware securing the adapter PWB to the chassis.

(f) Measure, using an ohmmeter, resistance between each of the adapter PWB's three printed wiring terminals and ground. Resistance measured should be an open circuit for each situation.

(g) If the resistance measured in step (f) is not an open circuit, adjust the position of the adapter PWB to obtain an open circuit between all three terminals and ground.

(h) Position the original (or an identical) insulating washer on chassis where power MOSFET will be installed; ensuring hole in insulating washer is aligned with mounting hole on the metal chassis.

(i) Install power MOSFET using hardware removed in step (a). Do not fully tighten the hardware.

(j) Solder the gate and source leads to the appropriate adapter PWB terminals. Trim the power MOSFET's leads to prevent shorting to the drain terminal.

(k) Install the insulating sleeve removed in step (d) to the drain lead on the power MOSFET.

(l) Loosen hardware securing the adapter PWB to the chassis.

(m) Solder the drain lead to the appropriate adapter PWB pad.

(n) Torque hardware to five inch pounds (0.57 Newton meters or 0.58 kilogram meters).

(o) Perform a function test as described in paragraph 6.7.4.

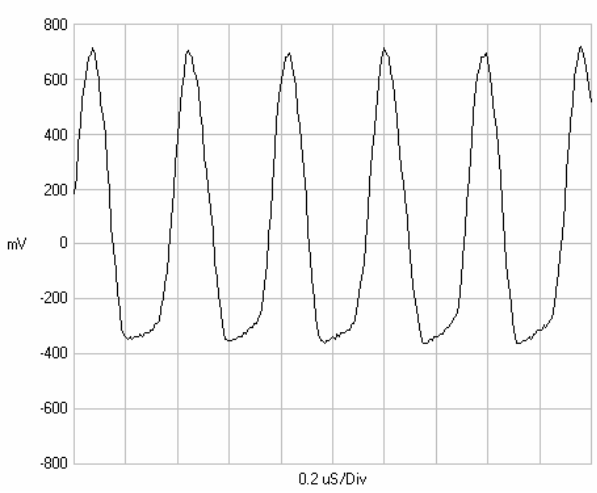


Fig 6-1 Carrier Oscillator Frequency - CW
$f$osc=2.64MHz, Connector P2 Disconnected
RF Oscillator PWB - A4A3TP1 (DC Coupled)

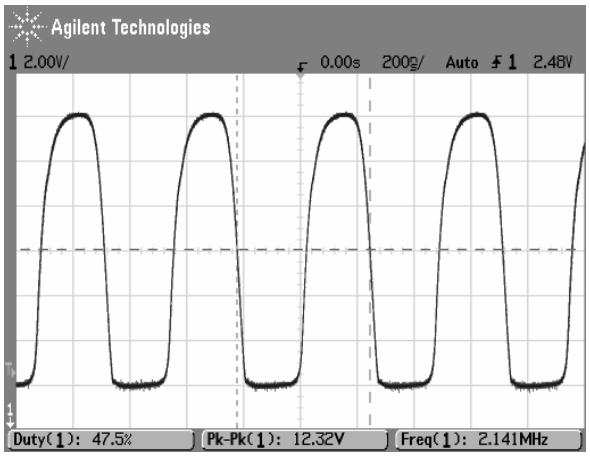


Fig 6-3 Carrier Oscillator - CW
$f$osc = 2.141MHz, Connector P2 Disconnected
RF Synthesizer PWB - Test Point A9R28 (RHS)
(DC Coupled)

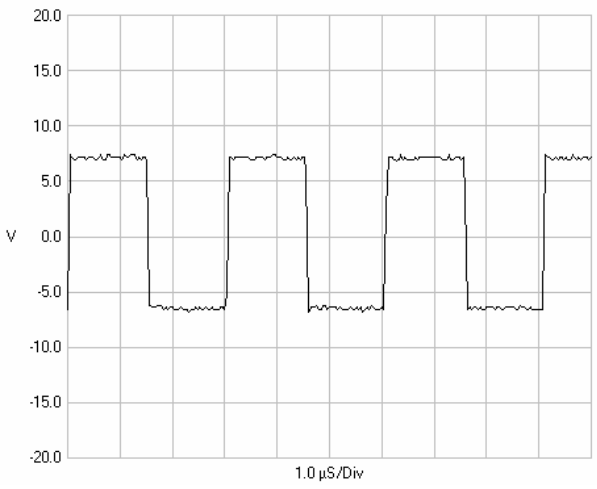


Fig 6-2 Balanced Drive Output - CW
fc = 330kHz, Connector P2 Disconnected
RF Oscillator PWB - A4A3TP3 (DC Coupled)

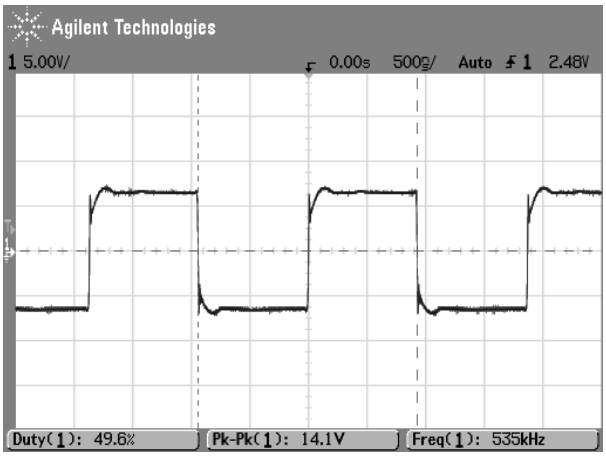


Fig 6-4 Balanced Drive Output - CW
fc = 535kHz, Connector P2 Disconnected
RF Synthesizer PWB - A4A3TP7 (DC Coupled)

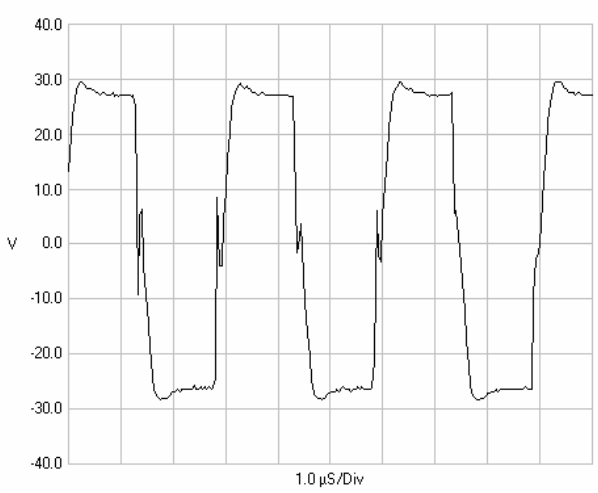


Fig 6-5 RF Drive Output (B- = 50 VDC)
*f*c = 330kHz, Connector P4 Connected
RF Drive Amplifier - A4A4J2 (DC Coupled)
(When B- = 70 VDC, p-p Voltage
should be 75V)

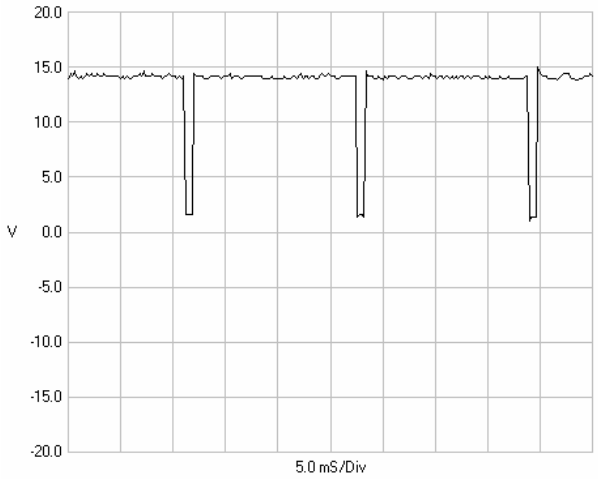


Fig 6-6 Keyer Timing Oscillator - CW
Keyer PWB - A4A1TP1 (DC Coupled)

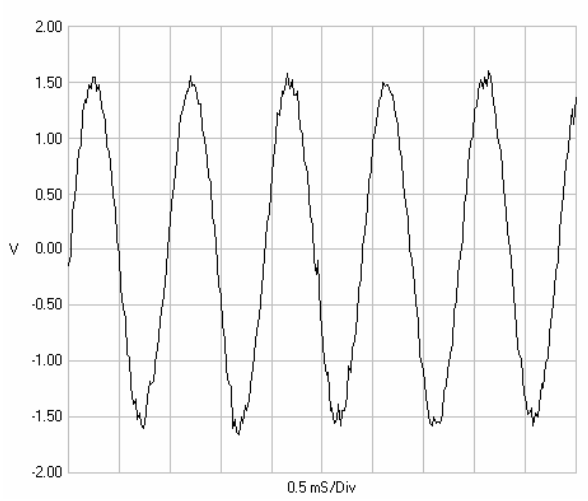


Fig 6-7 Tone Oscillator - CW
*f*tone = 1020Hz, Connector P5 Connected
Keyer PWB - A4A1TP2 (AC Coupled)

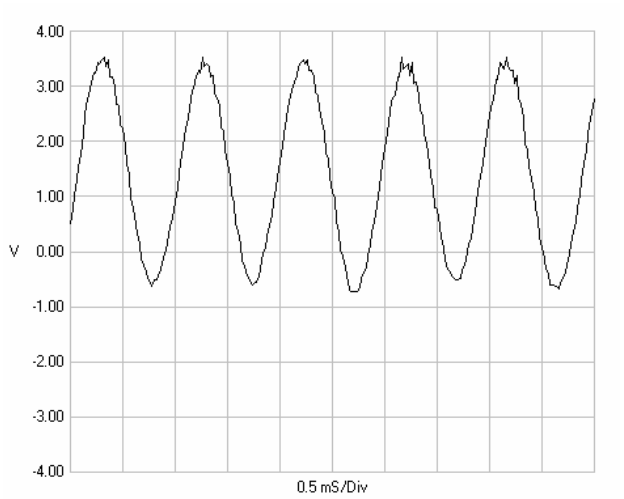


Fig 6-8 Audio/Keyed Tone - MCW
*f*tone = 1020Hz
Modulator Driver PWB-A4A2TP3 (DC Coupled)

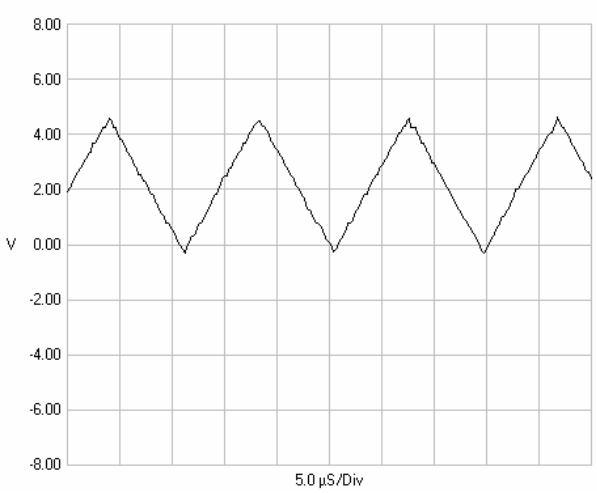


Fig 6-9 PWM Ramp Integrator Output - CW
*f*pwm = 70kHz, Zero Watt RF Output
Modulator Driver PWB-A4A2TP5 (DC Coupled)

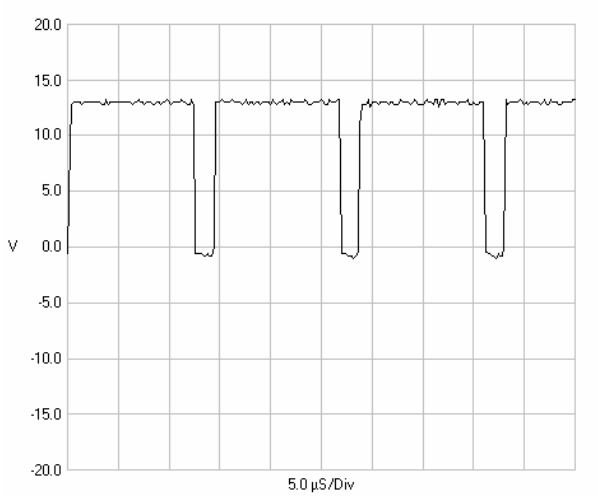


Fig 6-11 Mod Drive Alarm Condition
*f*pwm = 70kHz, Connector P6 Disconnected
Modulator Driver PWB-A4A2TP6 (DC Coupled)

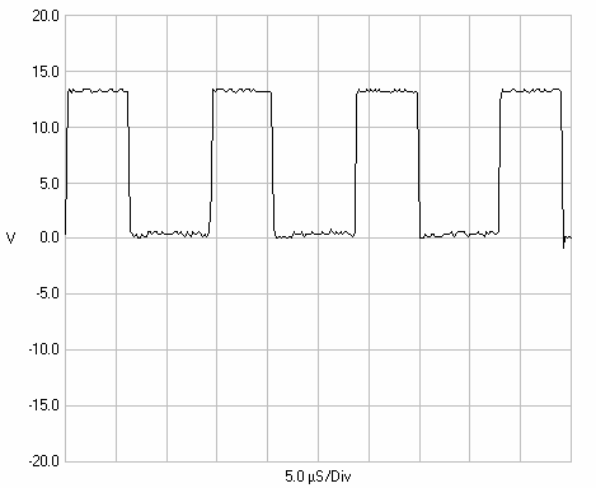


Fig 6-10 Mod Drive (PWM Output) - CW
*f*pwm = 70kHz, 1000 Watts RF Output
Modulator Driver PWB-A4A2TP6 (DC Coupled)

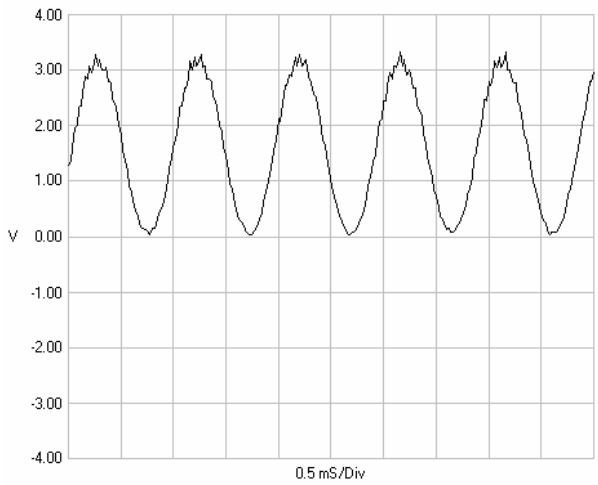


Fig 6-12 FWD Power Sample - MCW
*f*osc = 1020Hz, 1000 Watts, 95% Modulation
Monitor PWB - A10TP1 (DC Coupled)

Waveforms - Off Air Troubleshooting (Sheet 3 of 4)

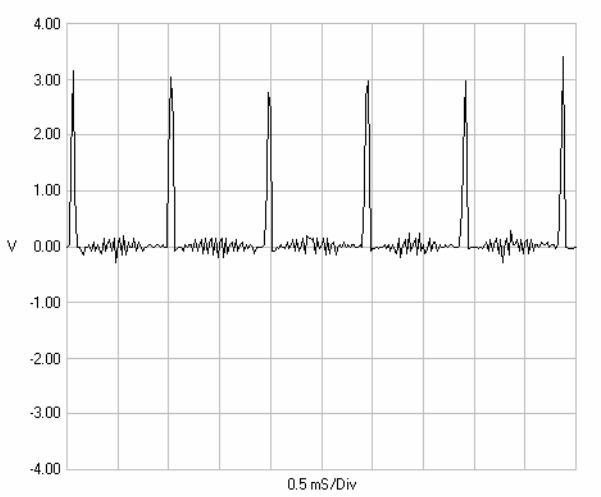


Fig 6-13 RF Current Status (**RF Current** lamp on)
f = 1020Hz, 100% Modulation
Monitor PWB - A10TP4 (DC Coupled)

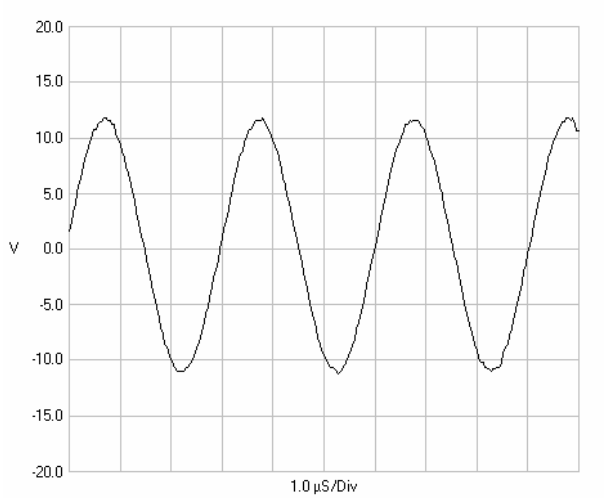


Fig 6-15 RF Monitor
*f*c = 330kHz, 1000 Watts - CW
Control/Monitor Panel - A1J1 (DC Coupled)

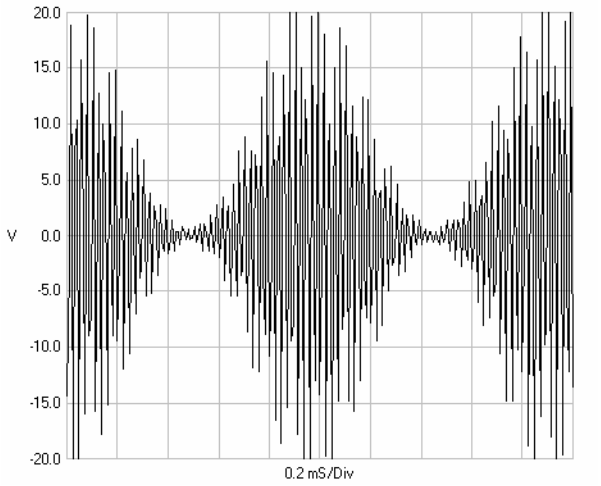


Fig 6-14 RF Monitor
*f*c = 330kHz, 1000 Watts, 95% Modulation
Control/Monitor Panel - A1J1 (DC Coupled)

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 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.

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 X/Y GRID COLUMN: Ref Des Indexes for printed wiring boards with a high parts density have an X/Y grid column. This column contains an alpha/numeric grouping that is keyed to an X/Y grid on the item's assembly detail drawing. This information is provided as an aid to locating parts on printed wiring boards.

7.6.7 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.

NOTE

OEM code 37338 is listed for parts manufactured by Nautel or to a Nautel control drawing. United States of America customers should refer all replacement part orders to Nautel Maine Incorporated (OEM code 57655).

Table 7-1 Manufacturers' Code to Address Index

00779	AMP Incorporated, 2800 Fulling Mill, P O Box 3608, Harrisburg, Pennsylvania 17105
00809	Croven, 500 Beech Street, Whitby, Ontario, Canada L1N 5S5
00853	Sangamo Weston Incorporated, Sangamo Capacitor Division, PO Box 128, Route 3, Sangamo Road, Pickens, South Carolina 29671
01121	Allen-Bradley Company, 1201 South 2nd Street, Milwaukee, Wisconsin 53204
01295	Texas Instruments Incorporated, US Semiconductor Group, PO Box 225012, M/S 49, 13500 North Central Expressway, Dallas, Texas 75265
02111	Spectrol Electronics Corporation, 17070 East Gale Avenue, City of Industry, California 91749
02660	Bunker Ramo Corporation, Amphenol Connector Division, 2801 South 25th Avenue, Broadview, Illinois 60153
04713	Motorola Incorporated, Semiconductor Products Group, 5005 East McDowell Road, Phoenix, Arizona 85008
07263	Fairchild Camera and Instrument Corporation, Semiconductor Division, 10400 Ridgeview Crescent, Cupertino, California 95014
08372	Cutler-Hammer Canada Limited, 45 Progress Avenue, Scarsborough, Ontario, Canada M1P 2T6 USA Customers Use - 55459
9482	AMP of Canada Limited, 20 Esna Park Drive, Markham, Ontario, Canada L3R 1E1 USA customers use - 00779
09675	Raytheon Canada Limited, 400 Phillips Street, PO Box 1619, Waterloo, Ontario, Canada N2J 4K6
0GP12	Radial Incorporated 150 Long Beach Blvd, Stratford, Connecticut 06497
13150	Vernitron Electronic Components, Beau Products Division, PO Box 10, Laconia, New Hampshire 03246
14552	Microsemi Corporation, 2830 South Fairview Street, Santa Ana, California 92704
14604	Elmwood Sensors Incorporated, 500 Narragansett Park Drive, PO Box 2325, Pawtucket, Rhode Island 02861
14655	Cornell Dubilier Electronics Division, Federal Pacific Electric Company, 150 Avenue L, Newark, New Jersey 07101
14674	Corning Glass Works, Electronic Products Division, Houghton Park, Corning, New York 14830
15513	Data Display Products, P O Box 91072, 5428 West 104th St., Los Angeles, California 90009
17856	Siliconix Incorporated, 2201 Laurelwood Road, Santa Clara, California 95054

Table 7-1 Manufacturers' Code to Address Index (Continued)

1W902	SEMTECH Corpus Christie Corp, 121 International Drive, Corpus Christie, Texas 78406
24444	General Semiconductor Industry Inc., Susidiary of Square D Compamy, 2001 W Temple Pl., Temple, Arizona 85281
27014	National Semiconductor Corp, 2900 Semiconductor Drive, Santa Clara, California 95051
33062	Ferronics Incorporated, 60 North Lincoln Road, East Rochester, New York 14445 Temple, Arizona 85281
34361	Omron Electronics Incorporated, 432 Toyama Road, Sunnyvale, California 94086
35005	Dale Electronics Canada Limited, 18 Howden Road, Scarsborough, Ontario, Canada M1R 3E6 USA customers use - 91637
35403	Electrovert Limited, 3285 Cavendish Boulevard, PO Box 1200 NDG, Montreal, Quebec, Canada H3C 2Y9
37338	Nautical Limited 10089 Peggy's Cove Road Hackett's Cove, Nova Scotia, Canada B3Z 3J4 USA Customers Use - 57655
37903	Siemens Electric Ltd., 7300 Trans Canada Highway, Pointe Clare, Quebec, Canada H9R 107 USA Customers Use - 66842
44655	Ohmite Manufacturing Co., 3601 West Howard Street, Skokie, Illinois 60076
45496	Digital Systems 1850 Centennial Park Drive Suite 300 Reston, Virginia 22091
46897	Phillips Manufacturing Company, 7334 North Clark Street, Chicago, Illinois 60626
50088	SGS-Thomson Micro Electronics Inc 1310 Electronics Drive Carrolton, Texas 75006-6905
50434	Hewlett Packard Company, 640 Page Mill Road, Palo Alto, California 94304
54590	RCA Corporation, Distribution and Special Products, Building 206-2, Cherry Hill Offices, Cherry Hill, New Jersey 08002
55459	Eaton Corporation, Aerospace & Commercial Controls Div., JBT Products, 300 8th Avenue, Arab, Alabama 35016
56289	Sprague Electric Company, 87 Marshall Street, North Adams, Massachusetts 01247
56699	Mepco/Centralab Incorporated, 6071 St Andrews Road, Columbia, South Carolina 29210
57655	Nautel Maine Incorporated, 201 Target Industrial Circle Bangor, Maine 04401
58756	CTS Corporation, Electromechanical Division, 1142 W Beardsley Avenue, Elkhart, Indiana 46154
59124	KOA Speer Electronics Incorporated, Bolivar Drive, PO Box 547, Bradford, Pennsylvania 16701

Table 7-1 Manufacturers' Code to Address Index (Continued)

59474	Jeffers Electronics Incorporated, Grand Plaza, 945 Grand Avenue, PO Box 730, Nogales, Arizona 85621
66842	Siemens Energy & Automation Inc, I-T-E Circuit Protection, Division 811 N Main Street, Bellefontaine, Ohio 43311
71400	Bussman Manufacturing Division, McGraw-Edison Company, 502 Earth City Plaza, Earth City, Missouri 63045
71785	TRW Incorporated, TRW Cinch Connectors, 1501 Morse Avenue, Elk Grove Village, Illinois 60007
72982	Erie Technological Products Inc, 644 West 12th Street, Erie, Pennsylvania 16512
73631	Curtis Instruments Inc., Helipot Division. 2500 Harbour Blvd., Fullerton, California 92634
73831	Hammond Mfg Company Limited, 394 Edinburgh Road North, Guelph, Ontario, Canada N1H 1E5
73899	JFD Electronics Components Corp, 112 Mott Street, Oceanside, New York 11572
73949	Guardian Electric Mfg Company, 1550 W Carroll Avenue, Chicago, Illinois 60607
74199	Quam Nichols Company, 218 E Marquette Road, Chicago, Illinois 60637
74970	E F Johnson, 299 10th Avenue SW, Waseca, Minnesota 56093
75042	TRW Electronic Components, IRC Fixed Resistor Division, 401 North Broad Street, Philadelphia, Pennsylvania 19108
75915	Littlefuse Incorporated, 800 East Northwest Highway, Des Plaines, Illinois 60016
77342	AMF Incorporated, Potter and Brumfield Division, 200 Richland Creek Drive, Princeton, Indiana 47670
80294	Bourns Incorporated, Instrument Division, 6135 Magnolia Avenue, Riverside, California 92506
81073	Grayhill Incorporated PO Box 373 561 Hillgrove Avenue La Grange, Illinois 60525
81483	International Rectifier, 9220 Sunset Boulevard, Box 2321, Terminal Annex, Los Angeles, California 90054
82877	Rotron Incorporated, Custom Division, 7 Hasbrouck Lane, Woodstock, New York 12498
89473	General Electric Distributing Corp., 1 River Road, Schenactady, New York 12305
90201	P R Mallory and Company Inc, Mallory Capacitor Division, PO Box 372, 4760 Kentucky Avenue, Indianapolis, Indiana 46206
91506	Augat Incorporated, PO Box 779, 633 Perry Avenue, Attleboro, Massachusetts 02703

Table 7-1 Manufacturers' Code to Address Index (Continued)

91637	Dale Electronics Incorporated, 2064 12th Avenue, Columbus, Nebraska 68601
91833	Keystone Electronics Corporation, 49 Bleeker Street, New York, New York 10012
91929	Honeywell Incorporated, Microswitch Division, 11 West Spring Street, Freeport, Illinois 61032
94696	Magnecraft Electric Company, 5575 North Lynch Avenue, Chicago, Illinois 60630
96095	AVX Ceramics, Division of AVX Corporation, Seneca Avenue, Olean, New York 14760
99800	American Precision Industries, Delevan Division, 270 Quaker Road, East Aurora, New York 14052
MIDWE	Midwec, PO Box 417, Scott's Bluff, Nebraska 69361

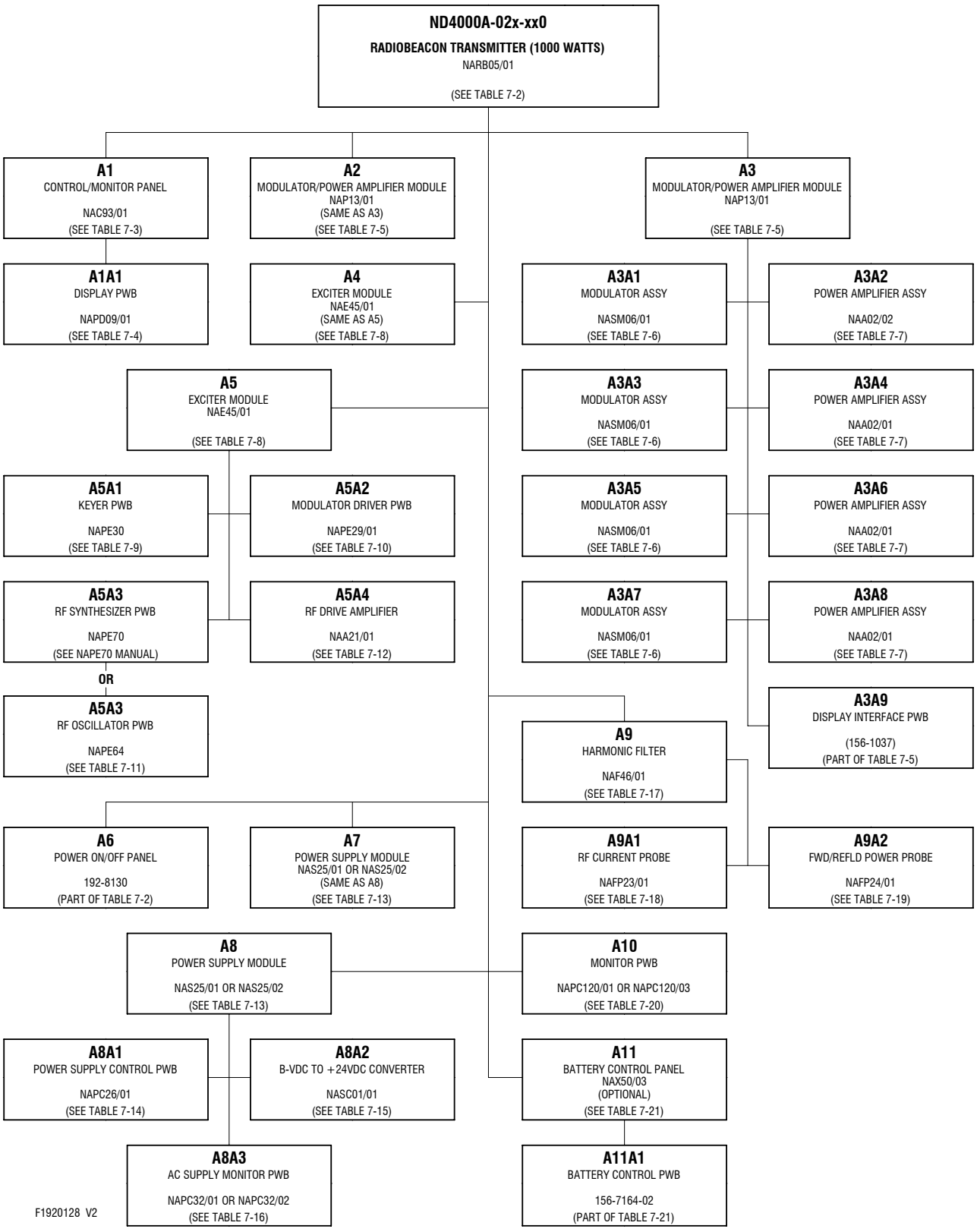


Figure 7-1 Family Tree - ND4000A 1000 Watt Radiobeacon Transmitter

Table 7-2 Ref Des Index for ND4000A-0xx-xx0 (1000 Watt) Radiobeacon Transmitter

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
• ♦ ♣	-	Transmitter, Radiobeacon, 1000W, DSB	-	ND4000A-020-200	37338
• ♦ □	-	Transmitter, Radiobeacon, 1000W, DSB	-	ND4000A-020-230	37338
• ♠ ♣	-	Transmitter, Radiobeacon, 1000W, DSB	-	ND4000A-020-300	37338
• ♠ □	-	Transmitter, Radiobeacon, 1000W, DSB	-	ND4000A-020-330	37338
■ ♦ ♣	-	Transmitter, Radiobeacon, 1000W, DSB	-	ND4000A-021-200	37338
■ ♦ □	-	Transmitter, Radiobeacon, 1000W, DSB	-	ND4000A-021-230	37338
■ ♠ ♣	-	Transmitter, Radiobeacon, 1000W, DSB	-	ND4000A-021-300	37338
■ ♠ □	-	Transmitter, Radiobeacon, 1000W, DSB	-	ND4000A-021-330	37338
	A1	Control/Monitor Panel	NAC93/01	See Table 7-3	37338
	A2	Modulator/Power Amplifier Module	NAP13A/01	See Table 7-5	37338
	A3	Modulator/Power Amplifier Module	NAP13A/01	See Table 7-5	37338
	A4	Exciter Module	NAE45G/01	See Table 7-8	37338
	A5	Exciter Module	NAE45G/01	See Table 7-8	37338
	A6	Power ON/OFF Panel, Ac/Dc	192-8130	192-8130	37338
	A6DS1	Lamp, Neon, 250 VAC, Amber	BAP42	35R2113T	95263
	A6F1	Fuse, 30A, 125V, Time Delay, Type MDA	FB42	MDA30	71400
	A6P1	Connector, Size 17-14, 14 Pin-Contacts	182-5012	182-5012	37338
	A6S1	Switch, Toggle, 2PST, 250 VAC, 10A	SC42	5222L	08372
	A6S2	Switch, Toggle, 1PST,	SCP15	7361K5	08372
	A6XF1	Fuseholder, Panel, Type MDA Fuse	BAP27	HKP	71400
♦	A7	Power Supply Module, 230 VAC, 60Hz	NAS25B/01	See Table 7-13	37338
♠	A7	Power Supply Module, 230 VAC 50Hz	NAS25B/02	See Table 7-13	37338
♦	A8	Power Supply Module, 230 VAC, 60Hz	NAS25B/01	See Table 7-13	37338
♠	A8	Power Supply Module, 230 VAC, 50Hz	NAS25B/02	See Table 7-13	37338
	A9	Harmonic Filter	NAF46C/01	See Table 7-17	37338
□	A10	Monitor PWB (AC/Battery Backup)	NAPC120/01	See Table 7-20	37338
♣	A10	Monitor PWB (AC Only)	NAPC120/03	See Table 7-20	37338
□	A11	Battery Control Panel	NAX50A/03	See Table 7-21	37338
♣	A11	Not Used			
	C1	Capacitor, Plastic, 1.0uF 10%, 250V	CS11	52003105K	37903
	C2	Capacitor, Plastic, 0.68uF 20%, 250 Vac	CAP22	33044684	46897
	C3	Capacitor, Plastic, 0.68uF 20%, 250 Vac	CAP22	33044684	46897
	CR1	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	01295
	CR2	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	01295
	CR3	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	01295
	CR4	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	01295
	F1	Fuse, 0.25A, 250V, Slo-Blo, Type 3AG	FA03	313.250	75915
	F2	Fuse, 0.25A, 250V, Slo-Blo, Type 3AG	FA03	313.250	75915
	F3	Fuse, 3.0A, 250V, Slo-Blo, Type 3AG	FA10	313003	75915
	F4	Fuse, 0.25A, 250V, Slo-Blo, Type 3AG	FA03	313.250	75915
	F5	Fuse, 0.25A, 250V, Slo-Blo, Type 3AG	FA03	313.250	75915
	F6	Fuse, 3.0A, 250V, Slo-Blo, Type 3AG	FA10	313003	75915
	J1	Connector, Coaxial, BNC, 50Ω, Panel	JDP21	UG58/U	02660
	P1	Connector, Size 17-14, 14 Socket-Contacts	182-5012-02	182-5012-02	37338
	P2	Connector, Size 17-16, 16 Socket-Contacts	182-5013	182-5013	37338
	P3	Connector, Size 17-16, 16 Socket-Contacts	182-5013	182-5013	37338
	P4	Connector, MTA, Closed End, 12 Pin, 22AWG	JU03	1-640433-2	09482

Table 7-2 Ref Des Index for ND4000A-0xx-xx0 (1000 Watt) Radiobeacon Transmitter (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	P5	Connector, Size 17-16, 16 Socket-Contacts	182-5013	182-5013	37338
	P6	Connector, Size 11-4, 4 Pin-Contacts	182-5010-01	182-5010-01	37338
	P7	Connector, Size 17-16, 16 Socket-Contacts	182-5013	182-5013	37338
	P8	Connector, Size 11-4, 4 Pin-Contacts	182-5010-01	182-5010-01	37338
	P9	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P10	Connector, Size 17-16, 16 Socket-Contacts	182-5013	182-5013	37338
	P11	Connector, Size 17-16, 16 Socket-Contacts	182-5013	182-5013	37338
	P12	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P13	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P14	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P15	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P16	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P17	Connector, MTA, Closed End, 12-Pin, 22AWG	JU03	1-640433-2	09482
	P18	Connector, Size 17-16, 16 Socket-Contacts	182-5013	182-5013	37338
	P19	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P20	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P21	Connector, MTA, Closed End, 12-Pin, 22AWG	JU03	1-640433-2	09482
	P22	Connector, MTA, Closed End, 12-Pin, 22AWG	JU03	1-640433-2	09482
	P23	Connector, MTA, Closed End, 8-Pin, 22AWG	JU06	640433-8	09482
	R1	Resistor, Current Shunt	156-7063-01	156-7063-01	37338
	R2	Resistor, Variable, 200 Ohms, 1W	RW12	70L201T000	02111
	R3	Resistor, Variable, 200 Ohms, 1W	RW12	70L201T000	02111
	R4	Resistor, Current Shunt	156-7063-01	156-7063-01	37338
	R5	Resistor, Metal Film, 22K Ohms, 2% 1/2W	RD11	RL20S223G	35005
	R6	Resistor, Metal Film, 68K Ohms, 2% 1/2W	RD17	RL20S683G	35005
	T1	Transformer, Audio	TA28	140Q	73831
	T2	Transformer, Audio	TA28	140Q	73831
	TB1	Terminal Block, Barrier, 4-terminal	JC41	4-150	71785
	TB2	Terminal Block, Barrier, 4-terminal	JC41	4-150	71785
	TB3	Terminal Block, Barrier, 24-terminal	JR19	GFT-24	73631
	TB4	Terminal Block, Barrier, 24-terminal	JR19	GFT-24	73631
	XF1	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
	XF2	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
	XF3	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
	XF4	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
	XF5	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
	XF6	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915

USE CODE EXPLANATION

- ♦ - Denotes used when AC power source is 230 VAC RMS (line-to-line), 60Hz.
- ♠ - Denotes used when AC power source is 230 VAC RMS (line-to-Neutral), 50/60Hz
- ☐ - Denotes used when battery option installed.
- ♣ - Denotes used when battery option is not installed.
- • - Denotes used when crystal controlled oscillator is RF drive source.
- ■ - Denotes used when RF synthesizer is RF drive source.

Table 7-3 Ref Des Index - NAC93/01 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	NAC93/01	192-2000-01	37338
	A1	Display PWB	NAPD09/01	See table 7-4	37338
	J1	Connector, Coaxial, BNC, 50Ω, Bulkhead	JDP26	227715-3	00779
	M1	Meter, 0-2kW/0-100%	MD22	156-2012	37338
	M2	Meter, 0-100 VDC/0-40 ADC	MD21	156-2011	37338
	P1	Connector, MTA, Closed End, 12-Pin, 22AWG	JU03	1-640433-2	09482
	P2	Connector, MTA, Closed End, 12-Pin, 22AWG	JU03	1-640433-2	09482
	P3	Connector, MTA, Closed End, 12-Pin, 22AWG	JU03	1-640433-2	09482
	P4	Connector, MTA, Closed End, 12-Pin, 22AWG	JU03	1-640433-2	09482
	P5	Connector, MTA, Closed End, 12-Pin, 22AWG	JU03	1-640433-2	09482
	S1	Switch, Toggle, 4PDT	SA23	8B4011	91929
	S2	Switch, Toggle, 4PDT	SA23	8B4011	91929
	S3	Switch, Toggle, 2PDT	SCP03	8373K107	08372
	S4	Switch, Toggle, 2PDT	SCP03	8373K107	08372
	S5	Switch, Rotary, Non-shorting 2P12T	SA27	212-N112-B2	58756
	S6	Switch, Rotary, Non-shorting 2P6T	SA32	212-N206-A1	58756

NOTE: Partial reference designation shown. Prefix with A1 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-4 Ref Des Index - NAPD09/01 Display PWB

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	X/Y GRID	OEM CODE
	-	Display PWB (-70 VDC)	NAPD09/01	192-2020-01	F/2	37338
	DS1	Diode, Light Emitting, Red	QK13	HLMP-3351	F/3	50434
	DS2	Diode, Light Emitting, Red	QK13	HLMP-3351	E/3	50434
	DS3	Diode, Light Emitting, Red	QK13	HLMP-3351	D/3	50434
	DS4	Diode, Light Emitting, Red	QK13	HLMP-3351	C/3	50434
	DS5	Diode, Light Emitting, Red	QK13	HLMP-3351	A/3	50434
	DS6	Diode, Light Emitting, Green	QK12	HLMP-3554	B/1	50434
	DS7	Diode, Light Emitting, Amber	QK14	HLMP-3451	D/1	50434
	DS8	Diode, Light Emitting, Amber	QK14	HLMP-3451	F/1	50434
	J1	Header, MTA, 12 Square Posts, 0.156 Centre	JU21	1-640383-2	G/3	09482
	R1	Resistor, Variable, Film, 100K Ohms, 1/2W	RW01	3339P-1-104	F/2	80294
	R2	Resistor, Metal Film, 475K Ohms, 1% 1/4W	RAC09	MF55D4753F	F/2	59124
	R3	Resistor, Metal Film, 2210 Ohms, 1% 1/4W	RAB29	MF55D2211F	A/1	59124
	R4	Resistor, Metal Film, 22K Ohms, 2% 1/2W	RD11	RL20S223G	D/1	35005
	R5	Resistor, Metal Film, 22K Ohms, 2% 1/2W	RD11	RL20S223G	D/1	35005
	R6	Resistor, Metal Film, 2210 Ohms, 1% 1/4W	RAB29	MF55D2211F	F/1	59124

NOTE: Partial reference designation shown. Prefix with A1A1 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-5 Ref Des Index - NAP13A/01 Modulator/Power Amplifier Module

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	Modulator/Power Amplifier Module	NAP13A/01	170-1000-04	37338
	A1	Modulator Assembly	NASM06/01	See Table 7-6	37338
	A2	Power Amplifier	NAA02/01	See Table 7-7	37338
	A3	Modulator Assembly	NASM06/01	See Table 7-6	37338
	A4	Power Amplifier	NAA02/01	See Table 7-7	37338
	A5	Modulator Assembly	NASM06/01	See Table 7-6	37338
	A6	Power Amplifier	NAA02/01	See Table 7-7	37338
	A7	Modulator Assembly	NASM06/01	See Table 7-6	37338
	A8	Power Amplifier	NAA02/01	See Table 7-7	37338
	A9	Display Interface PWB	156-1037	156-1037	37338
	A9DS1	Diode, Light Emitting, Green	QK12	HLMP-3554	50434
	A9DS2	Diode, Light Emitting, Amber	QK14	HLMP-3451	50434
	A9DS3	Diode, Light Emitting, Amber	QK14	HLMP-3451	50434
	A9DS4	Diode, Light Emitting, Amber	QK14	HLMP-3451	50434
	A9DS5	Diode, Light Emitting, Amber	QK14	HLMP-3451	50434
	A9R1	Resistor, Metal Film, 4700 Ohms, 5% 2W	RBP17	GS-3, 4700 Ohms	75042
	A9R2	Resistor, Metal Film, 3300 Ohms, 5% 2W	RBP16	GS-3, 3300 Ohms	75042
	A9R3	Resistor, Metal Film, 3300 Ohms, 5% 2W	RBP16	GS-3, 3300 Ohms	75042
	A9R4	Resistor, Metal Film, 3300 Ohms, 5% 2W	RBP16	GS-3, 3300 Ohms	75042
	A9R5	Resistor, Metal Film, 3300 Ohms, 5% 2W	RBP16	GS-3, 3300 Ohms	75042
	A9R6	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	A9R7	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	A9R8	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	A9R9	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	B1	Fan, 24 VDC	ZA27	MD24B2	82877
	C1	Capacitor, Plastic, 0.1uF 10%, 250V	CS05	52001104K	37903
	C2	Capacitor, Plastic, 1.8uF 10%, 250V	CNP34	730P185X9250	56289
	C3	Capacitor, Plastic, 1.8uF 10%, 250V	CNP34	730P185X9250	56289
	C4	Capacitor, Plastic, 0.1uF 10%, 250V	CS05	52001104K	37903
	C5	Capacitor, Plastic, 1.8uF 10%, 250V	CNP34	730P185X9250	56289
	C6	Capacitor, Plastic, 1.8uF 10%, 250V	CNP34	730P185X9250	56289
	C7	Capacitor, Plastic, 0.1uF 10%, 250V	CS05	52001104K	37903
	C8	Capacitor, Plastic, 1.8uF 10%, 250V	CNP34	730P185X9250	56289
	C9	Capacitor, Plastic, 1.8uF 10%, 250V	CNP34	730P185X9250	56289
	C10	Capacitor, Plastic, 0.1uF 10%, 250V	CS05	52001104K	37903
	C11	Capacitor, Plastic, 1.8uF 10%, 250V	CNP34	730P185X9250	56289
	C12	Capacitor, Plastic, 1.8uF 10%, 250V	CNP34	730P185X9250	56289
	F1	Fuse, 7.0A, 250V, Slo-Blo, Type 3AG	FA18	313007	75915
	F2	Fuse, 7.0A, 250V, Slo-Blo, Type 3AG	FA18	313007	75915
	F3	Fuse, 7.0A, 250V, Slo-Blo, Type 3AG	FA18	313007	75915
	F4	Fuse, 7.0A, 250V, Slo-Blo, Type 3AG	FA18	313007	75915
	J1	Connector, Size 17-16, 16 Pin-Contacts	JQ07	206036-1	09482
	J2	Connector, Coaxial, BNC, 50Ω, Bulkhead	JDP26	UG1094/U	02660
	L1	Inductor	158-1007	158-1007	37338
	L2	Inductor	158-1007	158-1007	37338
	L3	Inductor	158-1007	158-1007	37338
	L4	Inductor	158-1007	158-1007	37338

Table 7-5 Ref Des Index - NAP13A/01 Modulator/Power Amplifier Module (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	P1	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P2	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P3	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P4	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P5	Cord and Connector	ZA40	571064	82877
	S1	Switch, Thermal, 1PST-NC, 82°C	SCP32	3100U-003-1445	14604
	T1	Transformer	156-1022	156-1022	37338
	T2	Transformer	156-1022	156-1022	37338
	T3	Transformer	156-1022	156-1022	37338
	T4	Transformer	156-1022	156-1022	37338
	TB1	Terminal Block, Barrier, 3-Terminal	JR40	13003	13150
	TB2	Terminal Block, Barrier, 3-Terminal	JR40	13003	13150
	TB3	Terminal Block, Barrier, 3-Terminal	JR40	13003	13150
	TB4	Terminal Block, Barrier, 3-Terminal	JR40	13003	13150
	TB5	Terminal Block, Barrier, 3-Terminal	JR40	13003	13150
	TB6	Terminal Block, Barrier, 3-Terminal	JR40	13003	13150
	TB7	Terminal Block, Barrier, 3-Terminal	JR40	13003	13150
	TB8	Terminal Block, Barrier, 3-Terminal	JR40	13003	13150
	TP1	Jack, Tip, White	JN16	105-0201-200	74970
	XF1	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
	XF2	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
	XF3	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
	XF4	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915

NOTE: Partial reference designation shown. Prefix with A2 or A3 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-6 Ref Des Index - NASM06/01 Modulator Assembly

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	Modulator Assembly	NASM06/01	166-1030-01	37338
	A1	FET-Driver PWB	170-1025	170-1025	37338
	A1C1	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
	A1CR1	Diode, Zener, 13V, 1.5W, 5%	QK31	1N5928B	04713
	A1Q1	Transistor, PNP, Power, High Voltage	QE38	2N5415	50088
	A1Q2	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	04713
	A1Q3	Transistor, PNP, Switch/Amplifier	QA29	2N2907A	04713
	A1R1	Resistor, Metal Film, 1200 Ohms, 2% 1/2W	RC38	RL20S122G	35005
	A1R2	Resistor, Metal Film, 6800 Ohms, 5% 2W	RBP18	GS-3, 6800 Ohms	75042
	A1R3	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	A1R4	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	A1R5	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	35005
	C1	Capacitor, Electrolytic, 6200uF, 100V	CCD26	3188EG622T100ALA1	56699
	C2	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	CR1	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
	CR2	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
	L1	Inductor	158-1007	158-1007	37338
	Q1	Transistor, Field Effect, N Channel	QAP38	IRFP140	81483

NOTE: Partial reference designation shown. Prefix with A2A1, A2A3, A2A5, A2A7, A3A1, A3A3, A3A5 or A3A7 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-7 Ref Des Index - NAA02/01 Power Amplifier

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	Power Amplifier	NAA02/01	166-1020-01	37338
	C1	Capacitor, Plastic, 0.47uF 10%, 250V	CNP15	52003474K	37903
	C2	Capacitor, Plastic, 0.47uF 10%, 250V	CNP15	52003474K	37903
	C3	Capacitor, Plastic, 0.47uF 10%, 250V	CNP15	52003474K	37903
	C4	Capacitor, Plastic, 0.47uF 10%, 250V	CNP15	52003474K	37903
	CR1	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
	CR2	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
	CR3	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
	CR4	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
	J1	Connector, Coaxial, BNC, 50Ω, Bulkhead	JDP26	UG1094/U	02660
	Q1	Transistor, Field Effect, N Channel	QAP38	IRFP140	81483
	Q2	Transistor, Field Effect, N Channel	QAP38	IRFP140	81483
	Q3	Transistor, Field Effect, N Channel	QAP38	IRFP140	81483
	Q4	Transistor, Field Effect, N Channel	QAP38	IRFP140	81483
	T1	Transformer, Driver	156-1046	156-1046	37338

NOTE: Partial reference designation shown. Prefix with A2A2, A2A4, A2A6, A2A8, A3A2, A3A4, A3A6 or A3A8 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-8 Ref Des Index - NAE45G/01 Exciter Module

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	Exciter Module	NAE45G/01	156-3000-25	37338
	A1	Keyer PWB	NAPE30	See Table 7-9	37338
	A2	Modulator Driver PWB	NAPE29C/01	See Table 7-10	37338
•	A3	RF Oscillator (Optional DGPS Input) PWB	NAPE64A	See Table 7-11	37338
■	A3	RF Synthesizer PWB	NAPE70	See NAPE70 Manual	37338
	A4	RF Drive Amplifier	NAA21A/01	See Table 7-12	37338
	C1	Capacitor, Ceramic, 0.47uF 10%, 50V	CCG09	CKR06BX474KL	56289
	C2	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
	C3	Capacitor, Tantalum, 22uF 10%, 35V	CCP20	CSR13F226KM	56289
	C4	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	C5	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
	CR1	Diode, Zener, 15V, 1.5W, 5%	QK34	1N5929B	04713
	CR2	Diode, Zener, 16V, 1.5W 2%	QL23	1N5930C	04713
	DS1	Diode, Light Emitting, Amber	QK14	HLMP-3451	50434
	DS2	Diode, Light Emitting, Red	QK13	HLMP-3351	50434
	DS3	Diode, Light Emitting, Red	QK13	HLMP-3351	50434
	F1	Fuse, 1.0A, 250V, Slo-Blo, Type 3AG	FA08	313.001	75915
	J1	Connector, Size 11-4, 4 Socket-Contacts	JQ01	206430-1	09482
	J2	Connector, Size 17-16, 16 Pin-Contacts	JQ07	206036-1	09482
	L1	Toroid, Ferrite, 6mm	LY09	11-122-B	33062
	P1	Connector, D-Sub, 25-Pin, HDP-20	JR39	205208-1	09482
	P2	Connector, Coaxial, BNC, 50Ω, Clamp	JDP25	69475	02660
	P3	Not Used			
	P4	Connector, Tip, White	JN14	105-0301-001	74970
	P5	Connector, MTA, Keyed, 8-Pin, 22AWG	JU28	644463-8	09482
	P6	Connector, MTA, Keyed, 12-Pin, 22AWG	JU26	1-644463-2	09482
	P7	Connector, MTA, Keyed, 8-Pin, 22AWG	JU28	644463-8	09482
	P8	Connector, MTA, Keyed, 8-Pin, 22AWG	JU28	644463-8	09482
	Q1	Thyristor, Power	QA12	2N3228	54590
	R1	Resistor, Wirewound, 820 Ohms, 5% 10W	RN26	RW68V821	35005
	R2	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	R3	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	R4	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	R5	Resistor, Variable, Comp, 10K Ohms, 2W	RV25	RV4LAYSA103A	44655
	R6	Resistor, Metal Film, 3300 Ohms, 2% 1/2W	RAP11	RL20S332G	35005
	R7	Resistor, Metal Film, 100 Ohms, 2% 1/2W	RAP05	RL20S101G	35005
	S1	Switch, Toggle, 1PST	SCP01	8381K108	08372
	S2	Switch, Toggle, 1PST	SCP01	8381K108	08372
	U1	IC, Voltage Regulator, +15V, 3A, Plastic	UX20	CM1059, 1073, 1074	04713
•	W1	Cable Assembly	156-3068	156-3068	37338
•	W1J1	Connector, Socket, D-Sub, 25-Pin, HDP-20	JR38	205207-1	09482
•	W1P1	Connector, MTA, Keyed, 4-Pin, 22AWG	JU27	644463-4	09482
•	W1P2	Connector, MTA, Keyed, 8-Pin, 22AWG	JU28	644463-8	09482
	XDS1	Socket, Light Emitting Diode	QK25	PS-200-B	15513
	XDS2	Socket, Light Emitting Diode	QK25	PS-200-B	15513
	XDS3	Socket, Light Emitting Diode	QK25	PS-200-B	15513
	XF1	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915

USE CODE EXPLANATION

- • - Denotes used when crystal controlled oscillator is RF drive source.
- ■ - Denotes used when RF synthesizer is RF drive source.

NOTE: Partial reference designation shown. Prefix with A4 or A5 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-9 Ref Des Index - NAPE30 Keyer PWB

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	Keyer PWB	NAPE30	156-3029	37338
	C1	Capacitor, Ceramic, 0.47uF 10%, 50V	CCG09	CKR06BX474KL	56289
	C2	Capacitor, Plastic, 0.1uF 2%, 100V	CCD05	Type 6	MIDWE
	C3	Capacitor, Mica, Dipped, 680pF 2%, 500V	CB35	CM06FD681G03	14655
	C4	Capacitor, Plastic, 0.1uF 2%, 100V	CCD05	Type 6	MIDWE
	C5	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
	CR1	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR2	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR3	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR4	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR5	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR6	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR7	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR8	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	J1	Header, MTA, 8 Square Posts, 0.156 Centre	JU08	640383-8	09482
	L1	Bead, Ferrite, 5.8mm	LY37	21-129-B	33062
	R1	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R2	Resistor, Metal Film, 330K Ohms, 2% 1/2W	RAP19	RL20S334G	35005
	R3	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R4	Resistor, Composition, 1.0M Ohms, 5% 1/2W	RF31	RC20GF105J	01121
	R5	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R6	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R7	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R8	Resistor, Metal Film, 1800 Ohms, 2% 1/2W	RAP10	RL20S182G	35005
	R9	Resistor, Metal Film, 1800 Ohms, 2% 1/2W	RAP10	RL20S182G	35005
	R10	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R11	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R12	Resistor, Metal Film, 3300 Ohms, 2% 1/2W	RAP11	RL20S332G	35005
	R13	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R14	Resistor, Metal Film, 330K Ohms, 2% 1/2W	RAP19	RL20S334G	35005
	R15	Resistor, Metal Film, 33K Ohms, 2% 1/2W	RAP15	RL20S333G	35005
	R16	Resistor, Metal Film, 28.7K Ohms, 1% 1/4W	RY21	RN60D2872F	35005
	R17	Resistor, Metal Film, 18.7K Ohms, 1% 1/4W	RY17	RN60D1872F	35005
	R18	Resistor, Metal Film, 560 Ohms, 2% 1/2W	RAP08	RL20S561G	35005
	R19	Resistor, Metal Film, 28.7K Ohms, 1% 1/4W	RY21	RN60D2872F	35005
	R20	Resistor, Metal Film, 18.7K Ohms, 1% 1/4W	RY17	RN60D1872F	35005
	R21	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R22	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R23	Resistor, Metal Film, 3300 Ohms, 2% 1/2W	RAP11	RL20S332G	35005
	R24	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	35005
	R25	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R26	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R27	Resistor, Metal Film, 330K Ohms, 2% 1/2W	RAP19	RL20S334G	35005
	TB1	Terminal Strip, 14-Pin, 8281/14, PWB Mount	JK21	25.104.1453	35403
	TB2	Terminal Strip, 14-Pin, 8281/14, PWB Mount	JK21	25.104.1453	35403
	TB3	Terminal Strip, 10-Pin, 8281/10, PWB Mount	JK20	25.104.1053	35403

Table 7-9 Ref Des Index - NAPE30 Keyer PWB (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	U1	IC, CMOS, Analog Switch, Quad	UB10	MC14066BCP	04713
	U2	IC, Operational Amplifier, Dual	UA39	TL082MJG	04713
	U3	IC, CMOS, Counter, Binary, 12-bit	UB13	MC14040BCP	04713
	U4	IC, CMOS, 16-Channel Analog Multiplexer	UD03	MC14067BCP	04713
	U5	IC, CMOS, 16-Channel Analog Multiplexer	UD03	MC14067BCP	04713
	U6	IC, CMOS, 8-Channel Analog Multiplexer	UB42	MC14051BCP	04713
	U7	IC, Operational Amplifier, Dual	UA39	TL082MJG	04713
	XU1	Socket, DIP, 14 Socket Contacts	UD41	1814AG111D	91506
	XU2	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	91506
	XU3	Socket, DIP, 16 Socket Contacts	UD40	1816AG111D	91506
	XU4	Socket, DIP, 24 Socket Contacts	UD39	1824AG111D	91506
	XU5	Socket, DIP, 24 Socket Contacts	UD39	1824AG111D	91506
	XU6	Socket, DIP, 16 Socket Contacts	UD40	1816AG111D	91506
	XU7	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	91506

NOTE: Partial reference designation shown. Prefix with A4A1 or A5A1 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-10 Ref Des Index - NAPE29C/01 Modulator Driver PWB

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	Modulator Driver PWB	NAPE29C/01	156-3015-10	37338
	C1	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
	C2	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
	C3	Capacitor, Mica, Dipped, 3300pF 2%, 500V	CCD18	CM06FD332G03	14655
	C4	Capacitor, Mica, Dipped, 3300pF 2%, 500V	CCD18	CM06FD332G03	14655
	C5	Capacitor, Mica, Dipped, 3300pF 2%, 500V	CCD18	CM06FD332G03	14655
	C6	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
	C7	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
	C8	Capacitor, Mica, Dipped, 390pF 2%, 500V	CB32	CM05FD391G03	14655
	C9	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
	C10	Capacitor, Mica, Dipped, 390pF 2%, 500V	CB32	CM05FD391G03	14655
	C11	Capacitor, Mica, Dipped, 91pF 2%, 500V	CZ02	CM04FD910G03	14655
	C12	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	C13	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	C14	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
	C15	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
	C16	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	C17	Capacitor, Ceramic, 1.0uF 10%, 50V	CCG10	CKR06BX105KL	56289
	C18	Capacitor, Ceramic, 1.0uF 10%, 50V	CCG10	CKR06BX105KL	56289
	C19	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	C20	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	C21	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
	C22	Capacitor, Variable, 7-25pF, 350V	CY23	DV11PS25D	72982
	C23	Capacitor, Mica, Dipped, 100pF 2%, 500V	CB25	CM05FD101G03	14655
	C24	Capacitor, Ceramic, 0.0047uF 10%, 100V	CCG03	CKR05BX472KL	56289
	C25	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
	C26	Capacitor, Mica, Dipped, 220pF 2%, 500V	CB29	CM05FD221G03	14655
	C27	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
	C28	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	C29	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
	C30	Capacitor, Ceramic, 0.022uF 10%, 100V	CCG05	CKR06BX223KL	56289
	C31	Capacitor, Ceramic, 0.022uF 10%, 100V	CCG05	CKR06BX223KL	56289
	C32	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
	C33	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
	C34	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	C35	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
	C36	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	C37	Capacitor, Ceramic, 0.0047uF 10%, 100V	CCG03	CKR05BX472KL	56289
	C38	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	C39	Capacitor, Mica, Dipped, 470pF 2%, 500V	CB32	CD15FD471G03	14655
	CR1	Not Used			
	CR2	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR3	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR4	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR5	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR6	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263

Table 7-10 Ref Des Index - NAPE29C/01 Modulator Driver PWB (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	J1	Header, MTA, 12 Square Posts, 0.156 Centre	JU21	1-640383-2	09482
	J2	Header, MTA, 8 Square Posts, 0.156 Centre	JU08	640383-8	09482
	K1	Relay, DIP Reed, 12V, 1PST, NC, 1/4A	KAP23	JWD171-14	77342
	L1	Bead, Ferrite, 5.8mm	LY37	21-129-B	33062
	L2	Bead, Ferrite, 5.8mm	LY37	21-129-B	33062
	L3	Bead, Ferrite, 5.8mm	LY37	21-129-B	33062
	L4	Bead, Ferrite, 5.8mm	LY37	21-129-B	33062
	Q1	Transistor, Field Effect, P Channel	QM21	2N5116	17856
	Q2	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	04713
	Q3	Transistor, NPN, High Gain, Low Noise	QA31	2N930A	04713
	Q4	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	04713
	Q5	Transistor, NPN, Switch	QN26	2N2369A	04713
	Q6	Transistor, NPN, Switch	QN26	2N2369A	04713
	Q7	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	04713
	Q8	Transistor, PNP, Switch/Amplifier	QA29	2N2907A	04713
	R1	Not Used			
	R2	Resistor, Variable, Film, 1000 Ohms, 1/2W	RV06	3339P-1-102	80294
	R3	Resistor, Metal Film, 150K Ohms, 2% 1/2W	RD21	RL20S154G	35005
	R4	Resistor, Metal Film, 150K Ohms, 2% 1/2W	RD21	RL20S154G	35005
	R5	Resistor, Metal Film, 560K Ohms, 2% 1/2W	RD28	RL20S564G	14674
	R6	Resistor, Metal Film, 82 Ohms, 2% 1/2W	RC24	RL20S820G	35005
	R7	Resistor, Metal Film, 33K Ohms, 2% 1/2W	RAP15	RL20S333G	35005
	R8	Resistor, Metal Film, 150K Ohms, 2% 1/2W	RD21	RL20S154G	35005
	R9	Resistor, Metal Film, 150K Ohms, 2% 1/2W	RD21	RL20S154G	35005
	R10	Resistor, Metal Film, 150K Ohms, 2% 1/2W	RD21	RL20S154G	35005
	R11	Resistor, Metal Film, 3300 Ohms, 2% 1/2W	RAP11	RL20S332G	35005
	R12	Resistor, Metal Film, 27K Ohms, 2% 1/2W	RD12	RL20S273G	35005
	R13	Resistor, Metal Film, 3300 Ohms, 2% 1/2W	RAP11	RL20S332G	35005
	R14	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R15	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R16	Resistor, Composition, 1.8M Ohms, 5% 1/2W	RF34	RC20GF185J	01121
	R17	Resistor, Metal Film, 560K Ohms, 2% 1/2W	RD28	RL20S564G	14674
	R18	Resistor, Composition, 1.8M Ohms, 5% 1/2W	RF34	RC20GF185J	01121
	R19	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	80294
	R20	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	80294
	R21	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	80294
	R22	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R23	Resistor, Metal Film, 82K Ohms, 2% 1/2W	RD18	RL20S823G	35005
	R24	Resistor, Metal Film, 82K Ohms, 2% 1/2W	RD18	RL20S823G	35005
	R25	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R26	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R27	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	R28	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	R29	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R30	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R31	Resistor, Metal Film, 1800 Ohms, 2% 1/2W	RAP10	RL20S182G	35005
	R32	Resistor, Metal Film, 560K Ohms, 2% 1/2W	RD28	RL20S564G	14674

Table 7-10 Ref Des Index - NAPE29C/01 Modulator Driver PWB (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	R33	Resistor, Metal Film, 390K Ohms, 2% 1/2W	RD26	RL20S394G	35005
	R34	Resistor, Metal Film, 220K Ohms, 2% 1/2W	RD23	RL20S224G	35005
	R35	Resistor, Metal Film, 33K Ohms, 2% 1/2W	RAP15	RL20S333G	35005
	R36	Resistor, Metal Film, 33K Ohms, 2% 1/2W	RAP15	RL20S333G	35005
	R37	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	R38	Resistor, Metal Film, 330 Ohms, 2% 1/2W	RAP07	RL20S331G	35005
	R39	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R40	Resistor, Metal Film, 56K Ohms, 2% 1/2W	RAP16	RL20S563G	35005
	R41	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R42	Resistor, Metal Film, 180K Ohms, 2% 1/2W	RAP18	RL20S184G	35005
	R43	Resistor, Composition, 3.3M Ohms, 5% 1/2W	RF37	RC20GF335J	01121
	R44	Resistor, Metal Film, 82K Ohms, 2% 1/2W	RD18	RL20S823G	35005
	R45	Resistor, Metal Film, 28.7K Ohms, 1% 1/4W	RY21	RN60D2872F	35005
	R46	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	R47	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R48	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	80294
	R49	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	R50	Resistor, Metal Film, 150K Ohms, 2% 1/2W	RD21	RL20S154G	35005
	R51	Resistor, Metal Film, 33K Ohms, 2% 1/2W	RAP15	RL20S333G	35005
	R52	Resistor, Metal Film, 33K Ohms, 2% 1/2W	RAP15	RL20S333G	35005
	R53	Resistor, Metal Film, 22K Ohms, 2% 1/2W	RD11	RL20S223G	35005
	R54	Resistor, Metal Film, 56K Ohms, 2% 1/2W	RAP16	RL20S563G	35005
	R55	Resistor, Metal Film, 47K Ohms, 2% 1/2W	RD15	RL20S473G	35005
	R56	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R57	Resistor, Metal Film, 15K Ohms, 2% 1/2W	RD09	RL20S153G	35005
	R58	Resistor, Variable, Film, 1000 Ohms, 1/2W	RV06	3339P-1-102	80294
	R59	Resistor, Metal Film, 2700 Ohms, 2% 1/2W	RC42	RL20S272G	35005
	R60	Resistor, Metal Film, 330K Ohms, 2% 1/2W	RAP19	RL20S334G	35005
	R61	Resistor, Metal Film, 330K Ohms, 2% 1/2W	RAP19	RL20S334G	35005
	R62	Resistor, Metal Film, 33K Ohms, 2% 1/2W	RAP15	RL20S333G	35005
	R63	Resistor, Composition, 680K Ohms, 5% 1/2W	RF29	RC20GF684J	01121
	R64	Resistor, Metal Film, 3900 Ohms, 2% 1/2W	RD02	RL20S392G	35005
	R65	Resistor, Metal Film, 8200 Ohms, 2% 1/2W	RD06	RL20S822G	35005
	R66	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	R67	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	R68	Resistor, Metal Film, 39K Ohms, 2% 1/2W	RD14	RL20S393G	35005
	R69	Resistor, Metal Film, 39K Ohms, 2% 1/2W	RD14	RL20S393G	35005
	R70	Resistor, Metal Film, 33K Ohms, 2% 1/2W	RAP15	RL20S333G	35005
	R71	Resistor, Metal Film, 56K Ohms, 2% 1/2W	RAP16	RL20S563G	35005
	R72	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	RV1	Varistor, 4V RMS, 0.4 Joules	QI20	V8ZA1	89473
	U1	IC, Operational Amplifier, Dual	UA39	TL082MJG	04713
	U2	IC, Operational Amplifier, Dual	UA39	TL082MJG	04713
	U3	IC, Comparator, Quad	UL02	MC3302L	04713
	U4	IC, CMOS, Dual, 4-Ch Analog Multiplex	UL17	MC14052BAL	04713
	U5	IC, Operational Amplifier, Dual	UA39	TL082MJG	04713
	U6	IC, Analog Multiplier	UC41	RM4200ADE	09675

Table 7-10 Ref Des Index - NAPE29C/01 Modulator Driver PWB (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	U7	IC, Operational Amplifier, Dual	UA39	TL082MJG	04713
	U8	IC, CMOS, Programmable Timer	UL42	MC14536BCP	04713
	U9	IC, Operational Amplifier, Dual	UA39	TL082MJG	04713
	U10	IC, CMOS, Inverter/Buffer, Hex	UL41	MC14049UBCP	04713
	U11	IC, Operational Amplifier, Dual	UD02	LM258J	04713
	XK1	Socket, DIP, 14 Socket Contacts	UD41	1814AG111D	91506
	XU1	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	91506
	XU2	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	91506
	XU3	Socket, DIP, 14 Socket Contacts	UD41	1814AG111D	91506
	XU4	Socket, DIP, 16 Socket Contacts	UD40	1816AG111D	91506
	XU5	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	91506
	XU6	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	91506
	XU7	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	91506
	XU8	Socket, DIP, 16 Socket Contacts	UD40	1816AG111D	91506
	XU9	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	91506
	XU10	Socket, DIP, 16 Socket Contacts	UD40	1816AG111D	91506
	XU11	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	91506

NOTE: Partial reference designation shown. Prefix with A4A2 or A5A2 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-11 Ref Des Index - NAPE64A RF Oscillator (Optional DGPS Input) PWB

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	X/Y GRID	OEM CODE
	-	RF Oscillator (Optional DGPS Input) PWB	NAPE64A	156-3050-01	-	37338
	C1	Capacitor, Ceramic, 0.001uF 10%, 200V	CCG01	CKR05BX102KRV	A/2	56289
	C2	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	F/4	56289
	C3	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	B/5	56289
	C4	Capacitor, Ceramic, 0.001uF 10%, 200V	CCG01	CKR05BX102KRV	B/3	56289
	C5	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	A/4	56289
	C6	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	B/4	56289
	C7	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	A/3	56289
	C8	Capacitor, Mica, Dipped, 180pF 2%, 500V	CB28	CM05FD181G03	E/4	14655
	C9	Capacitor, Mica, Dipped, 51pF 2%, 500V	CZ42	CM05ED510G03	E/4	14655
	C10	Capacitor, Variable, 0.8-23pF, 750V	CY18	PC51H230	E/5	73899
	C11	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	A/2	56289
	C12	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	B/2	56289
	C13	Capacitor, Mica, Dipped, 1000pF 2%, 500V	CB37	CM06FD102G03	D/3	14655
	C14	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	E/3	56289
	C15	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	B/1	56289
	C16	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	C/2	56289
	C17	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	D/2	56289
	C18	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	C/3	56289
	C19	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	C/2	56289
	C20	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	D/2	56289
	C21	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	D/2	56289
	C22	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	F/2	56289
	C23	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	A/1	56289
	C24	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	B/4	56289
	C25	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	C/2	56289
	C26	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	B/3	56289
	CR1	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	B/2	27014
	CR2	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	A/4	27014
	CR3	Diode, Hot Carrier	QK09	1N5711	F/3	50434
	CR4	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	D/3	27014
	CR5	Not Used	-		C/4	
	CR6	Not Used	-		C/4	
	CR7	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	B/3	27014
	CR8	Diode, Zener, 56V, 1W, 5%	QM23	1N4758A	/	04713
	DS1	Diode, Light Emitting, Red	QK13	HLMP-3351	C/4	50434
	J1	Header, MTA, 4 Square Posts, 0.156 Centre	JU20	640383-4	E/5	09482
	J2	Connector, Coaxial, BNC, 90°, PWB Mount	JS21	R141665161	A/5	0GP12
	J3	Header, MTA, 8 Square Posts, 0.156 Centre	JU08	640383-8	B/5	09482
	L1	Inductor, Moulded, Shielded, 1000uH	LAP39	IMS-51000uH±10%	E/3	35005
	L2	Bead, Ferrite, 5.8mm	LY37	21-129-B	E/2	33062
	L3	Bead, Ferrite, 5.8mm	LY37	21-129-B	/	33062
	Q1	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	A/3	04713
	Q2	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	F/3	04713
	Q3	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	E/3	04713
	Q4	Transistor, NPN, General Purpose	QAP04	2N2219A	D/2	04713
	Q5	Transistor, PNP, Switch/Amplifier	QA23	2N2905A	D/2	04713

Table 7-11 Ref Des Index - NAPE64A RF Oscillator (Optional DGPS Input) PWB

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	X/Y GRID	OEM CODE
	Q6	Transistor, NPN, 300V, 0.5A, c/w Mtg Kit	200-5012	200-5012	C/5	04713
	R1	Resistor, Metal Film, 100 Ohms, 2% 1/2W	RAP05	RL20S101G	A/5	35005
	R2	Resistor, Metal Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	A/2	35005
	R3	Not Used	-		B/5	
	R4	Resistor, Metal Film, 100 Ohms, 2% 1/2W	RAP05	RL20S101G	A/4	35005
	R5	Resistor, Metal Film, 100 Ohms, 2% 1/2W	RAP05	RL20S101G	E/4	35005
	R6	Resistor, Metal Film, 1800 Ohms, 2% 1/2W	RAP10	RL20S182G	E/4	35005
	R7	Resistor, Metal Film, 8200 Ohms, 2% 1/2W	RD06	RL20S822G	F/4	35005
	R8	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	E/4	35005
	R9	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	B/3	35005
	R10	Resistor, Metal Film, 15K Ohms, 2% 1/2W	RD09	RL20S153G	A/4	35005
	R11	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	A/4	35005
	R12	Resistor, Metal Film, 560 Ohms, 2% 1/2W	RAP08	RL20S561G	A/3	35005
	R13	Resistor, Metal Film, 100 Ohms, 2% 1/2W	RAP05	RL20S101G	A/3	35005
	R14	Resistor, Metal Film, 120 Ohms, 2% 1/2W	RC26	RL20S121G	E/3	35005
	R15	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	B/5	80294
	R16	Resistor, Metal Film, 220 Ohms, 5% 2W	RK31	GS-3, 220 ohms	B/4	75042
	R17	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	A/2	35005
	R18	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	B/2	35005
	R19	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	C/1	35005
	R20	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	C/1	35005
	R21	Resistor, Metal Film, 27K Ohms, 2% 1/2W	RD12	RL20S273G	E/3	35005
	R22	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	D/3	35005
	R23	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	B/1	35005
	R24	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	B/1	35005
	R25	Resistor, Metal Film, 1800 Ohms, 2% 1/2W	RAP10	RL20S182G	E/2	35005
	R26	Resistor, Metal Film, 100 Ohms, 2% 1/2W	RAP05	RL20S101G	D/3	35005
	R27	Resistor, Metal Film, 2200 Ohms, 2% 1/2W	RC41	RL20S222G	C/3	35005
	R28	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	C/1	35005
	R29	Not Used	-		C/3	
	R30	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	C/2	80294
	R31	Resistor, Metal Film, 390 Ohms, 2% 1/2W	RC32	RL20S391G	C/2	35005
	R32	Resistor, Metal Film, 8200 Ohms, 2% 1/2W	RD06	RL20S822G	C/3	35005
	R33	Not Used	-		C/4	
	R34	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	C/3	35005
	R35	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	C/3	35005
	R36	Resistor, Metal Film, 2200 Ohms, 2% 1/2W	RC41	RL20S222G	C/5	35005
	R37	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	C/5	35005
	R38	Resistor, Metal Film, 15K Ohms, 2% 1/2W	RD09	RL20S153G	B/3	35005
	R39	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	A/2	35005
	R40	Resistor, Metal Film, 270 Ohms, 5%, 2W	RS36	GS-3, 270 OHMS	/	75042
	U1	IC, CMOS, Counter, Binary, 12-bit	UB13	MC14040BCP	F/2	04713
	U2	IC, Comparator, Quad	UL02	MC3302L	B/4	04713
	U3	IC, CMOS, Schmitt Trigger, Hex	UM23	MC14584BCP	A/2	04713
	U4	IC, Operational Amplifier, Precision	UX42	OP177GP	B/2	45496
	XU1	Socket, DIP, 16 Socket Contacts	UD40	1816AG111D	/	91506
	XU2	Socket, DIP, 14 Socket Contacts	UD41	1814AG111D	/	91506

Table 7-11 Ref Des Index - NAPE64A RF Oscillator (Optional DGPS Input) PWB

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	X/Y GRID	OEM CODE
	XU3	Socket, DIP, 14 Socket Contacts	UD41	1814AG111D	/	91506
	XU4	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	/	91506
	XY1	Socket, Crystal, Teflon, PWB Mount	BAP39	8000-DG4	/	91506
	Y1	Crystal, Fundamental, Parallel, Resonant	XA19	A067DXA-50	D/4	00809

NOTE: Partial reference designation shown. Prefix with A4A3 or A5A3 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-12 Ref Des Index - NAA21A/01 RF Drive Amplifier

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	RF Drive Amplifier	NAA21A/01	156-3026-07	37338
	C1	Capacitor, Plastic, 0.47uF 10%, 250V	CNP15	52003474K	37903
	C2	Capacitor, Plastic, 0.47uF 10%, 250V	CNP15	52003474K	37903
	C3	Capacitor, Plastic, 0.47uF 10%, 250V	CNP15	52003474K	37903
	C4	Capacitor, Plastic, 0.47uF 10%, 250V	CNP15	52003474K	37903
	C5	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
	CR1	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR2	Diode, Zener Transient Supressor, 51V	QI27	1.5KE51CA	24444
	J1	Connector, Coaxial, BNC, 50Ω, Bulkhead	JDP26	UG1094/U	02660
	J2	Connector, Coaxial, BNC, 50Ω, Bulkhead	JDP26	UG1094/U	02660
	J3	Jack, Tip, White	JN16	105-0201-200	74970
	L1	Toroid, Ferrite, Coated, 9.5mm, B Mtl	LX14	11-720-B	33062
	Q1	Transistor, Field Effect, N Channel, 100V, 14A	QN31	IRF530	81483
	Q2	Transistor, Field Effect, N Channel, 100V, 14A	QN31	IRF530	81483
	R1	Resistor, Wirewound, 15 ohms, 5% 25W	RWP16	NHL-25-06Z 15 Ohms	35005
	R2	Resistor, Metal Film, 68K Ohms, 2% 1/2W	RD17	RL20S683G	35005
	R3	Resistor, Metal Film, 82K Ohms, 2% 1/2W	RD18	RL20S823G	35005
	T1	Transformer	156-3010	156-3010	37338

NOTE: Partial reference designation shown. Prefix with A4A4 or A5A4 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-13 Ref Des Index - NAS25B/01 and NAS25B/02 Power Supply Module

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
♦	-	Power Supply Module, 230 VAC, 60Hz	NAS25B/01	156-7157-11	37338
♠	-	Power Supply Module, 230 VAC, 50Hz	NAS25B/02	156-7157-12	37338
	A1	Power Supply Control PWB	NAPC26/01	See Table 7-14	37338
	A2	B- VDC to +24 VDC Converter	NASC01/01	See Table 7-15	37338
□	A3	AC Supply/Battery Monitor PWB	NAPC32A/01	See Table 7-16	37338
♣	A3	AC Supply Monitor PWB	NAPC32A/02	See Table 7-16	37338
	C1	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
	C2	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
	CR1	Diode, Power Rectifier, 400V, 12A	QL06	MR1124	04713
	DS1	Diode, Light Emitting, Green	QK12	HLMP-3554	50434
	DS2	Diode, Light Emitting, Green	QK12	HLMP-3554	50434
	F1	Fuse, 1.0A, 250V, Slow, 3AG	FA08	313.001	75915
	F2	Fuse, 30A, 125V, Time Delay, Type MDA	FB42	MDA30	71400
	F3	Fuse, 30A, 125V, Time Delay, Type MDA	FB42	MDA30	71400
	J1	Connector, Size 17-16, 16 Pin-Contacts	JQ07	206036-1	09482
	L1	Inductor, Choke, 5mH, 30ADC	TZ06	195G30	73831
	P1	Connector, MTA, Closed End, 8-Pin, 22AWG	JU06	640433-8	09482
	P2	Connector, MTA, Closed End, 4-Pin, 22AWG	JU01	640433-4	09482
	P3	Connector, MTA, Closed End, 4-Pin, 22AWG	JU01	640433-4	09482
	Q1	Thyristor, Power, Insulated Stud, 400V, 40A	QM28	SIPS440	04713
	Q2	Thyristor, Power, Insulated Stud, 400V, 40A	QM28	SIPS440	04713
	R1	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	RV1	Varistor, 95V RMS, 30 Joules	QI33	V150ZA8	89473
	RV2	Varistor, 95V RMS, 30 Joules	QI33	V150ZA8	89473
	S1	Switch, Toggle, 2PST, 250 VAC, 10A	SC42	5222L	08372
	T1	Transformer, Pwr, 1-Ph, 230V, 2200VA	TD32A	156-7148	37338
	TP1	Jack, Tip, White	JN16	105-0201-200	74970
	XDS1	Socket, Light Emitting Diode	QK25	PS-200-B	15513
	XDS2	Socket, Light Emitting Diode	QK25	PS-200-B	15513
	XF1	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
	XF2	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915
	XF3	Fuseholder, Panel, Type 3AG Fuse	BAP30	342012A	75915

USE CODE EXPLANATION:

♦ - Denotes used when AC power source is 230 VAC RMS (line-to-line), 60Hz.
♠ - Denotes used when AC power source is 230 VAC RMS (line-to-Neutral), 50/60Hz
□ - Denotes used when battery option installed.
♣ - Denotes used when battery option is not installed.

NOTE: Partial reference designation shown. Prefix with A7 or A8 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-14 Ref Des Index - NAPC26C/01 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	NAPC26C/01	156-7026-17	37338
	C1	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
	C2	Capacitor, Tantalum, 47uF 10%, 35V	CCP21	CSR13F476KM	56289
	C3	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
	C4	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
	C5	Capacitor, Ceramic, 0.001uF 10%, 200V	CCG01	CKR05BX102KL	56289
	C6	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
	CR1	Diode, General Purpose, 600V, 1A	QM31	1N4005	04713
	CR2	Diode, General Purpose, 600V, 1A	QM31	1N4005	04713
	CR3	Diode, General Purpose, 600V, 1A	QM31	1N4005	04713
	CR4	Diode, Zener, 10.0V, 400mW, 10%	QG03	1N758	04713
	CR5	Diode, Zener, 30V, 5W 5%	QL28	1N6282A	04713
	CR6	Not Used			
	CR7	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR8	Diode, General Purpose, 600V, 1A	QM31	1N4005	04713
	CR9	Diode, General Purpose, 600V, 1A	QM31	1N4005	04713
	CR10	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR11	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	DS1	Diode, Light Emitting, Green	QK12	HLMP-3554	50434
	J1	Header, MTA, 8 Square Posts, 0.156 Centre	JU08	640383-8	09482
	L1	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	33062
	Q1	Transistor, NPN, Power, High Voltage	QE02	2N3439	04713
	Q2	Transistor, NPN, Power, High Voltage	QE02	2N3439	04713
	R1	Resistor, Metal Film, 3300 Ohms, 2% 1/2W	RAP11	RL20S332G	35005
	R2	Resistor, Metal Film, 33K Ohms, 2% 1/2W	RAP15	RL20S333G	35005
	R3	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R4	Resistor, Metal Film, 3300 Ohms, 2% 1/2W	RAP11	RL20S332G	35005
	R5	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	35005
	R6	Resistor, Metal Film, 1000 Ohms, 2% 1/2W	RAP09	RL20S102G	35005
	R7	Resistor, Metal Film, 47K Ohms, 2% 1/2W	RD15	RL20S473G	35005
	R8	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R9	Resistor, Metal Film, 56K Ohms, 2% 1/2W	RAP16	RL20S563G	35005
	R10	Resistor, Metal Film, 560K Ohms, 2% 1/2W	RD28	RL20S564G	14674
	R11	Resistor, Metal Film, 18K Ohms, 2% 1/2W	RAP14	RL20S183G	35005
	R12	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	80294
	R13	Resistor, Metal Film, 18K Ohms, 2% 1/2W	RAP14	RL20S183G	35005
	R14	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R15	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R16	Resistor, Metal Film, 3300 Ohms, 2% 1/2W	RAP11	RL20S332G	35005
	R17	Resistor, Metal Film, 3300 Ohms, 2% 1/2W	RAP11	RL20S332G	35005
	R18	Resistor, Metal Film, 330K Ohms, 2% 1/2W	RAP19	RL20S334G	35005
	R19	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R20	Resistor, Metal Film, 33K Ohms, 2% 1/2W	RAP15	RL20S333G	35005
	R21	Resistor, Metal Film, 1820 Ohms, 1% 1/4W	RAB28	MF55D1821F	59124
	RT1	Thermistor, PTC, 0.39 Ohms, 1.13A Trip	RX13	RXE075	4G927
	RT2	Thermistor, PTC, 0.39 Ohms, 1.13A Trip	RX13	RXE075	4G927
	U1	IC, Voltage Regulator, +15 Volt	UT19	MC78M15CT	04713
	U2	IC, Operational Amplifier, Quad	UC15	MC3403L	04713
	XU1	Not Used			
	XU2	Socket, DIP, 14 Socket Contacts	UD41	1814AG111D	91506

Table 7-14 Ref Des Index - NAPC26C/01 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

NOTE: Partial reference designation shown. Prefix with A7A1 or A8A1 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-15 Ref Des Index - NASC01/01 B- VDC to +24 VDC Converter

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	B- VDC to +24 VDC Converter	NASC01/01	192-7075-01	37338
	A1	Converter PWB	156-7033-05	156-7033-05	37338
	A1C1	Capacitor, Tantalum, 22uF 10%, 35V	CCP20	CSR13F226KM	56289
	A1C2	Capacitor, Mica, Dipped, 390pF 2%, 500V	CB32	CM05FD391G03	14655
	A1C3	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	56289
	A1CR1	Diode, Zener, 13V, 1.5W, 5%	QK31	1N5928B	14552
	A1CR2	Diode, Hot Carrier	QK09	1N5711	50434
	A1Q1	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	04713
	A1Q2	Transistor, PNP, Switch/Amplifier	QA29	2N2907A	04713
	A1R1	Resistor, Metal Film, 3300 Ohms, 5% 2W	RBP16	GS-3, 3300 Ohms	75042
	A1R2	Resistor, Metal Film, 47 Ohms, 2% 1/2W	RC21	RL20S470G	35005
	A1R3	Resistor, Metal Film, 27K Ohms, 2%1/2W	RD12	RL20S273G	35005
	A1R4	Resistor, Metal Film, 15K Ohms, 2% 1/2W	RD09	RL20S153G	35005
	A1R5	Resistor, Metal Film, 1800 Ohms, 2% 1/2W	RAP10	RL20S182G	35005
	A1R6	Resistor, Metal Film, 27K Ohms, 2%1/2W	RD12	RL20S273G	35005
	A1R7	Resistor, Metal Film, 27K Ohms, 2%1/2W	RD12	RL20S273G	35005
	A1R8	Resistor, Metal Film, 680 Ohms, 2% 1/2W	RC35	RL20S681G	35005
	A1R9	Resistor, Metal Film, 68K Ohms, 2%1/2W	RD17	RL20S683G	35005
	A1R10	Resistor, Variable, Film, 5000 Ohms, 1/2W	RV10	3339P-1-502	80294
	A1U1	IC, Timer	UD04	SE555JG	01295
	A1XU1	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	91506
	C1	Capacitor, Plastic, 3.0uF 10% 250V	CNP36	730P305X9250	56289
	C2	Capacitor, Electrolytic, 1100uF, 75V	CYP01	500112U075AA2B	00853
	C3	Capacitor, Electrolytic, 100uF, 25V	CCD32	031-36101	46897
	CR1	Diode, Power Rectifier, 200V, 3A	QL05	MR852	04713
	CR2	Diode, Zener, 33V, 5W	QL35	1N6283A	04713
	CR3	Diode, Power Rectifier, 1A, UltraFast	QN33	MUR160	04713
	L1	Inductor, Moulded, 39uH	LAP07	MS75103-4	99800
	L2	Bead, Ferrite, 3.5mm	LXP20	21-030-B	33062
	L3	Inductor	156-7044-01	156-7044-01	37338
	Q1	Transistor, Field Effect, N Channel, 100V, 14A	QN31	IRF530	81483
	R1	Resistor, Metal Film, 6800 Ohms, 5% 2W	RBP18	GS-3, 6800 Ohms	75042
	R2	Resistor, Metal Film, 3300 Ohms, 2% 1/2W	RAP11	RL20S332G	5005
	R3	Resistor, Wirewound, 6 Ohms, 5% 10W	RS37	HLM-10-10Z-6 OHMS-5%	35005
	R4	Resistor, Metal Film, 2200 Ohms, 2% 1/2W	RC41	RL20S222G	35005
	TB1	Terminal Block, 6-Single Terminals, 15A	JB07	14306	13150

NOTE: Partial reference designation shown. Prefix with A7A2 or A8A2 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-16 Ref Des Index - NAPC32A/01 and NAPC32A/02 AC Supply Monitor PWB

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
☐	-	AC Supply/Battery Monitor PWB	NAPC32A/01	156-7155-04	37338
♣	-	AC Supply Monitor PWB	NAPC32A/02	156-7155-05	37338
	C1	Capacitor, Electrolytic, 150uF, 40V	CCD31	3073GE151T040JPA	56699
	C2	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KLV	56289
	CR1	Diode, Power Rectifier, 200V, 3A	QG31	1N5624	89473
	CR2	Diode, Power Rectifier, 200V, 3A	QG31	1N5624	89473
	CR3	Diode, Zener, 16V, 1.5W, 5%	QN20	1N5930B	04713
	J1	Header, MTA, 4 Square Posts, 0.156 Centre	JU20	640383-4	09482
	J2	Header, MTA, 4 Square Posts, 0.156 Centre	JU20	640383-4	09482
	L1	Toroid, Ferrite, 6mm	LY09	11-122-B	33062
	Q1	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	04713
	Q2	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	04713
	Q3	Transistor, Field Effect, N Channel	QE19	MPF6661	04713
	Q4	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	04713
	R1	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	35005
	R2	Resistor, Metal Film, 5600 Ohms, 2% 1/2W	RAP12	RL20S562G	35005
	R3	Resistor, Variable, Film, 5000 Ohms, 1/2W	RV10	3339P-1-502	80294
	R4	Resistor, Metal Film, 330K Ohms, 2% 1/2W	RAP19	RL20S334G	35005
	R5	Resistor, Metal Film, 12K Ohms, 2% 1/2W	RD08	RL20S123G	35005
/1	R6	Resistor, Metal Film, 68K Ohms, 2% 1/2W	RD17	RL20S683G	35005
/2	R6	Resistor, Metal Film, 100K Ohms, 2% 1/2W	RAP17	RL20S104G	35005
	R7	Resistor, Metal Film, 820 Ohms, 2% 1/2W	RC36	RL20S821G	35005
	R8	Resistor, Metal Film, 10K Ohms, 2% 1/2W	RAP13	RL20S103G	35005
	R9	Resistor, Metal Film, 33K Ohms, 2% 1/2W	RAP15	RL20S333G	35005

USE CODE EXPLANATION: ☐ - Denotes used when battery option installed.
♣ - Denotes used when battery option is not installed.
/1 - Denotes used only on NAPC32A/01 Variation
/2 - Denotes used only on NAPC32A/02 Variation

NOTE: Partial reference designation shown. Prefix with A7A3 or A8A3 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-17 Ref Des Index - NAF46C/01 Harmonic Filter

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	Harmonic Filter	NAF46C/01	156-6000-10	37338
	A1	RF Current Probe	NAFP23/01	See Table 7-18	37338
	A2	Forward/Reflected Power Probe	NAFP24A/01	See Table 7-19	37338
	C1	Capacitor, Mica, 1800pF 5%, 3000V	CF41	27130B182J02	00853
	C2	Capacitor, Mica, 1800pF 5%, 3000V	CF41	27130B182J02	00853
	C3	Capacitor, Mica, 1800pF 5%, 3000V	CF41	27130B182J02	00853
	C4	Capacitor, Mica, 1800pF 5%, 3000V	CF41	27130B182J02	00853
	C5	Capacitor, Mica, 6800pF 5%, 2000V	CF42	27120B682J02	00853
	C6	Capacitor, Mica, 6800pF 5%, 2000V	CF42	27120B682J02	00853
	C7	Capacitor, Mica, 6800pF 5%, 2000V	CF42	27120B682J02	00853
	C8	Capacitor, Mica, 6800pF 5%, 2000V	CF42	27120B682J02	00853
	C9	Capacitor, Mica, 82pF 2%, 500V	CB24	CM05ED820G03	14655
	C10	Capacitor, Mica, 82pF 2%, 500V	CB24	CM05ED820G03	14655
	C11	Capacitor, Mica, 82pF 2%, 500V	CB24	CM05ED820G03	14655
	C12	Capacitor, Mica, 82pF 2%, 500V	CB24	CM05ED820G03	14655
	C13	Capacitor, Mica, 82pF 2%, 500V	CB24	CM05ED820G03	14655
	C14	Capacitor, Mica, 82pF 2%, 500V	CB24	CM05ED820G03	14655
	C15	Capacitor, Mica, 82pF 2%, 500V	CB24	CM05ED820G03	14655
	C16	Capacitor, Mica, 82pF 2%, 500V	CB24	CM05ED820G03	14655
	CR1	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	01295
	CR2	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	01295
	K1	Relay, 24 VDC Coil, SPST-NO-DM, 13A	KC02	W389DCX-3	94696
	K2	Relay, 24 VDC Coil, SPST-NO-DM, 13A	KC02	W389DCX-3	94696
	L1	Inductor	156-6014	156-6014	37338
	L2	Inductor	156-6014-01	156-6014-01	37338
	L3	Inductor	156-6014-02	156-6014-02	37338
	L4	Inductor	156-6014-03	156-6014-03	37338
	P1	Connector, Coaxial, Type N, 50 Ohm, Crimp	JDP22	82-5375	02660
	R1	Resistor, Wirewound, 680 Ohms, 5% 5W	RWP17	CW5-680 Ohms 5%	35005
	R2	Resistor, Wirewound, 680 Ohms, 5% 5W	RWP17	CW5-680 Ohms 5%	35005
	R3	Resistor, Wirewound, 400 Ohms, 1% 50W	RN30	RE75G4000F	35005
	TB1	Terminal Block, 2 Single Terminals	JK09	159-1032-01	37338
	TB2	Terminal Board	156-6039	156-6039	37338

NOTE: Partial reference designation shown. Prefix with A9 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-18 Ref Des Index - NAFP23/01 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	NAFP23/01	156-6021-01	37338
	J1	Connector, Coaxial, BNC, 50Ω, Panel	JDP21	UG58/U	02660
	J2	Connector, Coaxial, BNC, 50Ω, Bulkhead	JDP26	UG1094/U	02660
	R1	Resistor, Metal Film, 200 Ohms, 1% 1/4W	RY02	RN60D2000F	35005
	R2	Resistor, Metal Film, 200 Ohms, 1% 1/4W	RY02	RN60D2000F	35005
	R3	Resistor, Metal Film, 200 Ohms, 1% 1/4W	RY02	RN60D2000F	35005
	R4	Resistor, Metal Film, 200 Ohms, 1% 1/4W	RY02	RN60D2000F	35005
	T1	Transformer, RF Current	156-6023	156-6023	37338

NOTE: Partial reference designation shown. Prefix with A9A1 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-19 Ref Des Index - NAFP24A/01 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	NAFP24A/01	156-6016-04	37338
	C1	Capacitor, Mica, Dipped, 680pF 2%, 500V	CB35	CM06FD681G03	14655
	C2	Capacitor, Mica, Dipped, 680pF 2%, 500V	CB35	CM06FD681G03	14655
	CR1	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	CR2	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	J1	Connector, Coaxial, BNC, 50Ω, Bulkhead	JDP26	UG1094/U	02660
	J2	Connector, Coaxial, BNC, 50Ω, Bulkhead	JDP26	UG1094/U	02660
	J3	Connector, Coaxial, BNC, 50Ω, Bulkhead	JDP26	UG1094/U	02660
	R1	Resistor, Metal Film, 200 Ohms, 1% 1/4W	RY02	RN60D2000F	35005
	R2	Resistor, Metal Film, 200 Ohms, 1% 1/4W	RY02	RN60D2000F	35005
	R3	Resistor, Metal Film, 200 Ohms, 1% 1/4W	RY02	RN60D2000F	35005
	R4	Resistor, Metal Film, 200 Ohms, 1% 1/4W	RY02	RN60D2000F	35005
	R5	Resistor, Metal Film, 220 Ohms, 2% 1/2W	RC29	RL20S221G	35005
	R6	Resistor, Metal Film, 220 Ohms, 2% 1/2W	RC29	RL20S221G	35005
	R7	Resistor, Metal Film, 220 Ohms, 2% 1/2W	RC29	RL20S221G	35005
	R8	Resistor, Metal Film, 220 Ohms, 2% 1/2W	RC29	RL20S221G	35005
	R9	Resistor, Metal Film, 47 Ohms, 2% 1/2W	RC21	RL20S470G	35005
	S1	Switch, Toggle, 2PDT	SCP03	8373K107	08372
	T1	Transformer, RF Voltage	156-6026	156-6026	37338
	T2	Transformer, RF Current	156-6023	156-6023	37338
	T3	Transformer, RF Current	156-6023	156-6023	37338
	TB1	Terminal Block, 6 Single Terminals, 30A	JC23	21303	13150

NOTE: Partial reference designation shown. Prefix with A9A2 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-20 Ref Des Index - NAPC120/01 and NAPC120/03 Monitor PWB

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	X/Y GRID	OEM CODE
☐	-	Monitor PWB (AC/Battery Backup)	NAPC120/01	192-2030-01	K/3	37338
♣	-	Monitor PWB (AC Only)	NAPC120/03	192-2030-03	K/3	37338
	C1	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	F/4	56289
	C2	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	F/4	56289
	C3	Capacitor, Ceramic, 0.001uF 10%, 200V	CCG01	CKR05BX102KRV	G/1	56289
	C4	Capacitor, Ceramic, 0.001uF 10%, 200V	CCG01	CKR05BX102KRV	E/2	56289
	C5	Capacitor, Plastic, 0.47uF 10%, 250V	CNP15	B32232-A3474K	J/9	37903
	C6	Capacitor, Ceramic, 0.022uF 10%, 100V	CCG05	CKR06BX223KRV	H/5	56289
	C7	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	F/5	56289
	C8	Capacitor, Ceramic, 1.0uF 10%, 50V	CCG10	CKR06BX105KRV	G/6	56289
	C9	Capacitor, Ceramic, 0.47uF 10%, 50V	CCG09	CKR06BX474KRV	H/2	56289
	C10	Capacitor, Ceramic, 0.22uF 10%, 50V	CCG08	CKR06BX224KRV	F/2	56289
	C11	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	H/4	56289
	C12	Capacitor, Tantalum, Dipped, 10uF, 35V	CCP36	TAP106K035G	G/4	96095
	C13	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	I/2	56289
	C14	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	G/2	56289
	C15	Capacitor, Tantalum, Dipped, 10uF, 35V	CCP36	TAP106K035G	I/7	96095
	C16	Capacitor, Tantalum, Dipped, 10uF, 35V	CCP36	TAP106K035G	I/7	96095
	C17	Capacitor, Ceramic, 0.47uF 10%, 50V	CCG09	CKR06BX474KRV	H/5	56289
	C18	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	H/6	56289
	C19	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	D/4	56289
	C20	Capacitor, Ceramic, 1.0uF 10%, 50V	CCG10	CKR06BX105KRV	J/7	56289
	C21	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	G/6	56289
	C22	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	E/4	56289
	C23	Capacitor, Tantalum, Dipped, 10uF, 35V	CCP36	TAP106K035G	D/5	96095
	C24	Capacitor, Tantalum, Dipped, 10uF, 35V	CCP36	TAP106K035G	G/7	96095
	C25	Capacitor, Tantalum, Dipped, 10uF, 35V	CCP36	TAP106K035G	E/7	96095
	C26	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	F/6	56289
	C27	Capacitor, Tantalum, Dipped, 10uF, 35V	CCP36	TAP106K035G	G/7	96095
	C28	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	J/5	56289
	C29	Capacitor, Tantalum, Dipped, 10uF, 35V	CCP36	TAP106K035G	E/7	96095
	C30	Capacitor, Tantalum, Dipped, 10uF, 35V	CCP36	TAP106K035G	D/7	96095
	C31	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	D/7	56289
	C32	Capacitor, Plastic, 0.1uF 10%, 250V	CS05	B32232-1.0-10-400	B/7	37903
	C33	Capacitor, Plastic, 0.1uF 10%, 250V	CS05	B32232-1.0-10-400	C/7	37903
	C34	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	H/2	56289
	C35	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	H/4	56289
	C36	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	K/3	56289
	C37	Capacitor, Mica, Dipped, 330pF 2%, 500V	CB31	CM05FD331G03	K/1	14655
	C38	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	J/4	56289
	C39	Not Used	-		K/3	37338
	C40	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	K/5	56289
	C41	Capacitor, Tantalum, Dipped, 10uF, 35V	CCP36	TAP106K035G	K/5	96095
	C42	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KRV	K/2	56289
	C43	Capacitor, Ceramic, 0.001uF 10%, 200V	CCG01	CKR05BX102KRV	G/3	56289
	C44	Capacitor, Tantalum, Dipped, 10uF, 35V	CCP36	TAP106K035G	K/5	96095
	C45	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	G/1	56289

Table 7-20 Ref Des Index - NAPC120/01 and NAPC120/03 Monitor PWB (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	X/Y GRID	OEM CODE
	C46	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	K/7	56289
	C47	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	J/1	56289
	C48	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KRV	C/5	56289
	CR1	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	G/1	27014
	CR2	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	E/2	27014
	CR3	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	G/1	27014
	CR4	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	F/2	27014
	CR5	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	H/4	27014
	CR6	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	I/4	27014
	CR7	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	H/4	27014
	CR8	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	H/5	27014
	CR9	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	H/5	27014
	CR10	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	G/2	27014
	CR11	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	F/2	27014
	CR12	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	I/7	27014
	CR13	Diode, Zener, 43V, 1.5W, 5%	QG38	1N5940B	D/5	91929
	CR14	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	G/7	27014
	CR15	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	E/7	27014
	CR16	Diode, Zener, 15V, 1.5W, 5%	QK34	1N5929B	D/7	14552
	CR17	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	F/7	27014
	CR18	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	E/6	27014
	CR19	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	F/7	27014
	CR20	Diode, Power Rectifier, 200V, 3A	QG31	1N5624	D/9	89473
	CR21	Diode, Power Rectifier, 200V, 3A	QG31	1N5624	E/9	89473
	CR22	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	E/8	27014
	CR23	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	I/8	27014
	CR24	Diode, Power Rectifier, 200V, 3A	QG31	1N5624	K/3	89473
	CR25	Diode, Power Rectifier, 200V, 3A	QG31	1N5624	K/4	89473
	CR26	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	J/3	27014
	CR27	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	J/3	27014
	CR28	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	E/3	27014
/1	CR29	Not Used				
/3	CR29	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	F/4	27014
	CR30	Diode, Zener, 12.0V, 400mW, 5%	QG08	1N759A	I/3	04713
	CR31	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	F/2	27014
	CR32	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	K/2	27014
	CR33	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	K/2	27014
	CR34	Not Used				
	CR35	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	J/2	27014
	CR36	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	J/2	27014
	CR37	Diode, Zener, 56V, 1W 5%	QM23	1N4758A	H/2	04713
	CR38	Diode, Zener, 56V, 1W 5%	QM23	1N4758A	K/5	04713
	CR39	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	J/4	27014
	CR40	Diode, General Purpose, 400V, 1A	QE28	1N4004	K/4	04713
	DS1	Diode, Light Emitting, Amber	QK14	HLMP-3451	F/4	50434
	F1	Fuse, 0.5A, 250V, Slo-Blo, 3AG	FA05	313.500	H/7	75915
	J1	Header, MTA, 12 Square Posts, 0.156 Centre	JU21	1-640383-2	A/8	09482

Table 7-20 Ref Des Index - NAPC120/01 and NAPC120/03 Monitor PWB (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	X/Y GRID	OEM CODE
	J2	Header, MTA, 12 Square Posts, 0.156 Centre	JU21	1-640383-2	L/10	09482
	J3	Header, MTA, 12 Square Posts, 0.156 Centre	JU21	1-640383-2	A/6	09482
	J4	Header, MTA, 12 Square Posts, 0.156 Centre	JU21	1-640383-2	L/8	09482
	J5	Header, MTA, 12 Square Posts, 0.156 Centre	JU21	1-640383-2	A/3	09482
	J6	Header, MTA, 12 Square Posts, 0.156 Centre	JU21	1-640383-2	L/5	09482
	J7	Header, MTA, 12 Square Posts, 0.156 Centre	JU21	1-640383-2	A/1	09482
	J8	Header, MTA, 12 Square Posts, 0.156 Centre	JU21	1-640383-2	L/3	09482
	J9	Header, MTA, 8 Square Posts. 0.156 Centre	JU08	640383-8	K/1	09482
	J10	Connector, Coaxial, BNC, PWB Mount	JF35	R141426161	/	0GP12
	K1	Relay, 48 VDC Coil, 4PDT, 5A	KA10	1315-4C-48D	E/9	73949
	K2	Relay, 48 VDC Coil, 4PDT, 5A	KA10	1315-4C-48D	G/9	73949
	K3	Relay, 48 VDC Coil, 4PDT, 5A	KA10	1315-4C-48D	H/9	73949
	K4	Relay, 48 VDC Coil, 4PDT, 5A	KA10	1315-4C-48D	J/9	73949
	L1	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	I/9	33062
	L2	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	I/6	33062
	L3	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	E/5	33062
	L4	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	G/6	33062
	L5	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	G/6	33062
	L6	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	C/5	33062
	L7	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	J/6	33062
	L8	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	K/3	33062
	L9	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	J/3	33062
	L10	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	F/1	33062
	L11	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	K/7	33062
	L12	Inductor, Choke, 2.5 Turns, J Material	LA16	82-152-J	J/2	33062
	Q1	Transistor, PNP, Switch/Amplifier	QA29	2N2907A	H/7	04713
	Q2	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	F/5	04713
	Q3	Transistor, Field Effect, P Channel	QM21	2N5116	E/6	17856
	Q4	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	I/2	04713
	Q5	Transistor, NPN, High Gain, Low Noise	QA31	2N930A	E/5	04713
	Q6	Transistor, NPN, High Gain, Low Noise	QA31	2N930A	I/6	04713
	Q7	Transistor, NPN, High Gain, Low Noise	QA31	2N930A	E/5	04713
	Q8	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	I/5	04713
	Q9	Transistor, PNP, Switch/Amplifier	QA29	2N2907A	I/4	04713
	Q10	Transistor, PNP, Switch/Amplifier	QA29	2N2907A	D/5	04713
	Q11	Transistor, PNP, Switch/Amplifier	QA29	2N2907A	D/6	04713
	Q12	Transistor, PNP, Power, High Voltage	QE38	2N5415	E/6	50088
	Q13	Transistor, PNP, Power, High Voltage	QE38	2N5415	F/7	50088
	Q14	Transistor, NPN, High Voltage, 300V, .5A	QS17	MPSA42	G/2	04713
	Q15	Transistor, NPN, High Voltage, 300V, .5A	QS17	MPSA42	K/6	04713
	Q16	Transistor, NPN, Switch/Amplifier	QA03	2N2222A	J/7	04713
	R1	Resistor, Metal Film, 33.2K Ohms, 1% 1/4W	RAB43	MF55D3322F	K/6	59124
	R2	Resistor, Metal Film, 3320 Ohms, 1% 1/4W	RAB31	MF55D3321F	K/6	59124
	R3	Resistor, Metal Film, 100K Ohms, 1% 1/4W	RAC01	MF55D1003F	F/4	59124
	R4	Resistor, Metal Film, 100K Ohms, 1% 1/4W	RAC01	MF55D1003F	E/2	59124
	R5	Resistor, Metal Film, 100K Ohms, 1% 1/4W	RAC01	MF55D1003F	F/4	59124
	R6	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	G/1	59124

Table 7-20 Ref Des Index - NAPC120/01 and NAPC120/03 Monitor PWB (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	X/Y GRID	OEM CODE
	R7	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	H/6	80294
	R8	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	F/4	59124
	R9	Resistor, Metal Film, 121 Ohms, 1% 1/4W	RAB14	MF55D1210F	F/4	59124
	R10	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	F/3	59124
	R11	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	H/7	59124
	R12	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	G/1	59124
	R13	Resistor, Metal Film, 182K Ohms, 1% 1/4W	RAC04	MF55D1823F	E/2	59124
	R14	Resistor, Metal Film, 150K Ohms, 1% 1/4W	RAC03	MF55D1503F	E/2	59124
	R15	Resistor, Metal Film, 5620 Ohms, 1% 1/4W	RAB34	MF55D5621F	F/5	59124
	R16	Resistor, Metal Film, 1000 Ohms, 1% 1/4W	RAB25	MF55D1001F	F/6	59124
	R17	Resistor, Metal Film, 150K Ohms, 1% 1/4W	RAC03	MF55D1503F	H/5	59124
	R18	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	G/6	80294
	R19	Resistor, Metal Film, 18.2K Ohms, 1% 1/4W	RAB40	MF55D1822F	F/6	59124
	R20	Resistor, Metal Film, 18.2K Ohms, 1% 1/4W	RAB40	MF55D1822F	I/1	59124
	R21	Resistor, Metal Film, 100K Ohms, 1% 1/4W	RAC01	MF55D1003F	H/6	59124
	R22	Resistor, Metal Film, 15K Ohms, 1% 1/4W	RAB39	MF55D1502F	F/4	59124
	R23	Resistor, Variable, Film, 1000 Ohms, 1/2W	RV06	3339P-1-102	H/1	80294
	R24	Resistor, Metal Film, 15 Ohms, 1% 1/4W	RAB03	MF55D15R0F	H/1	59124
	R25	Resistor, Metal Film, 274 Ohms, 1% 1/4W	RAB18	MF55D2740F	G/4	59124
	R26	Resistor, Metal Film, 47.5K Ohms, 1% 1/4W	RAB45	MF55D4752F	G/2	59124
	R27	Resistor, Metal Film, 5620 Ohms, 1% 1/4W	RAB34	MF55D5621F	E/2	59124
	R28	Resistor, Metal Film, 150K Ohms, 1% 1/4W	RAC03	MF55D1503F	H/3	59124
	R29	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	I/5	59124
	R30	Resistor, Metal Film, 100K Ohms, 1% 1/4W	RAC01	MF55D1003F	G/4	59124
	R31	Resistor, Metal Film, 1000 Ohms, 1% 1/4W	RAB25	MF55D1001F	G/3	59124
	R32	Resistor, Metal Film, 18.2K Ohms, 1% 1/4W	RAB40	MF55D1822F	F/6	59124
	R33	Resistor, Metal Film, 100K Ohms, 1% 1/4W	RAC01	MF55D1003F	G/3	59124
	R34	Resistor, Metal Film, 39.2K Ohms, 1% 1/4W	RAB44	MF55D3922F	H/4	59124
	R35	Resistor, Metal Film, 100K Ohms, 1% 1/4W	RAC01	MF55D1003F	E/6	59124
	R36	Resistor, Metal Film, 3320 Ohms, 1% 1/4W	RAB31	MF55D3321F	H/2	59124
	R37	Resistor, Metal Film, 1.0M Ohms, 1% 1/4W	RAC13	MF55D1004F	I/2	59124
	R38	Resistor, Metal Film, 18.2K Ohms, 1% 1/4W	RAB40	MF55D1822F	H/3	59124
	R39	Resistor, Metal Film, 332K Ohms, 1% 1/4W	RAC07	MF55D3323F	H/4	59124
	R40	Resistor, Metal Film, 332K Ohms, 1% 1/4W	RAC07	MF55D3323F	F/2	59124
	R41	Resistor, Metal Film, 100K Ohms, 1% 1/4W	RAC01	MF55D1003F	H/4	59124
	R42	Resistor, Metal Film, 15K Ohms, 1% 1/4W	RAB39	MF55D1502F	F/5	59124
	R43	Resistor, Metal Film, 15K Ohms, 1% 1/4W	RAB39	MF55D1502F	G/4	59124
	R44	Resistor, Metal Film, 33.2K Ohms, 1% 1/4W	RAB43	MF55D3322F	I/2	59124
	R45	Resistor, Metal Film, 33.2K Ohms, 1% 1/4W	RAB43	MF55D3322F	I/1	59124
	R46	Resistor, Metal Film, 3920 Ohms, 1% 1/4W	RAB32	MF55D3921F	I/5	59124
	R47	Resistor, Metal Film, 33.2K Ohms, 1% 1/4W	RAB43	MF55D3322F	F/5	59124
	R48	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	I/6	80294
	R49	Resistor, Metal Film, 121 Ohms, 1% 1/4W	RAB14	MF55D1210F	I/5	59124
	R50	Resistor, Metal Film, 1000 Ohms, 1% 1/4W	RAB25	MF55D1001F	I/5	59124
	R51	Resistor, Metal Film, 2210 Ohms, 1% 1/4W	RAB29	MF55D2211F	F/4	59124
	R52	Resistor, Metal Film, 1.0M Ohms, 1% 1/4W	RAC13	MF55D1004F	I/6	59124
	R53	Resistor, Metal Film, 100K Ohms, 1% 1/4W	RAC01	MF55D1003F	I/6	59124

Table 7-20 Ref Des Index - NAPC120/01 and NAPC120/03 Monitor PWB (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	X/Y GRID	OEM CODE
	R54	Resistor, Metal Film, 1210 Ohms, 1% 1/4W	RAB26	MF55D1211F	I/2	59124
	R55	Resistor, Metal Film, 100 Ohms, 1% 1/4W	RAB13	MF55D1000F	H/5	59124
	R56	Resistor, Metal Film, 121K Ohms, 1% 1/4W	RAC02	MF55D1213F	G/6	59124
	R57	Resistor, Metal Film, 100K Ohms, 1% 1/4W	RAC01	MF55D1003F	H/6	59124
	R58	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	J/6	59124
	R59	Resistor, Metal Film, 562 Ohms, 1% 1/4W	RAB22	MF55D5620F	J/6	59124
	R60	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	I/5	59124
	R61	Resistor, Metal Film, 27.4K Ohms, 1% 1/4W	RAB42	MF55D2742F	I/4	59124
	R62	Resistor, Metal Film, 47.5K Ohms, 1% 1/4W	RAB45	MF55D4752F	E/4	59124
	R63	Resistor, Metal Film, 33.2K Ohms, 1% 1/4W	RAB43	MF55D3322F	I/4	59124
	R64	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	E/7	59124
	R65	Resistor, Metal Film, 182K Ohms, 1% 1/4W	RAC04	MF55D1823F	E/4	59124
	R66	Resistor, Metal Film, 82.5K Ohms, 1% 1/4W	RAB48	MF55D8252F	E/4	59124
	R67	Resistor, Metal Film, 1.0M Ohms, 1% 1/4W	RAC13	MF55D1004F	G/7	59124
	R68	Resistor, Metal Film, 1.0M Ohms, 1% 1/4W	RAC13	MF55D1004F	E/7	59124
	R69	Resistor, Metal Film, 15K Ohms, 1% 1/4W	RAB39	MF55D1502F	D/5	59124
	R70	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	D/5	59124
	R71	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	D/5	59124
	R72	Resistor, Metal Film, 33.2K Ohms, 1% 1/4W	RAB43	MF55D3322F	D/6	59124
	R73	Resistor, Metal Film, 15K Ohms, 1% 1/4W	RAB39	MF55D1502F	D/6	59124
	R74	Resistor, Wirewound, 1200 Ohms, 5%5W	RN19	R5J1K2	G/7	44655
	R75	Resistor, Metal Film, 8250 Ohms, 1% 1/4W	RAB36	MF55D8251F	E/7	59124
	R76	Resistor, Metal Film, 1.0M Ohms, 1% 1/4W	RAC13	MF55D1004F	F/7	59124
	R77	Resistor, Metal Film, 8250 Ohms, 1% 1/4W	RAB36	MF55D8251F	F/7	59124
	R78	Resistor, Metal Film, 8250 Ohms, 1% 1/4W	RAB36	MF55D8251F	H/5	59124
	R79	Resistor, Variable, Film, 5000 Ohms, 1/2W	RV10	3339P-1-502	H/4	80294
	R80	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	B/7	35005
	R81	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	C/7	35005
	R82	Resistor, Metal Film, 1000 Ohms, 5% 2W	RBP13	GS-3, 1000 Ohms	E/9	75042
	R83	Resistor, Metal Film, 1000 Ohms, 5% 2W	RBP13	GS-3, 1000 Ohms	G/9	75042
	R84	Resistor, Metal Film, 4700 Ohms, 5% 2W	RBP17	GS-3, 4700 Ohms	G/9	75042
	R85	Resistor, Metal Film, 1000 Ohms, 5% 2W	RBP13	GS-3, 1000 Ohms	H/9	75042
	R86	Resistor, Metal Film, 4700 Ohms, 5% 2W	RBP17	GS-3, 4700 Ohms	H/9	75042
	R87	Resistor, Metal Film, 1000 Ohms, 5% 2W	RBP13	GS-3, 1000 Ohms	I/9	75042
	R88	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	H/2	59124
	R89	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	H/4	59124
	R90	Resistor, Metal Film, 18.2K Ohms, 1% 1/4W	RAB40	MF55D1822F	K/2	59124
	R91	Resistor, Metal Film, 18.2K Ohms, 1% 1/4W	RAB40	MF55D1822F	K/2	59124
	R92	Resistor, Metal Film, 150K Ohms, 1% 1/4W	RAC03	MF55D1503F	K/2	59124
	R93	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	J/4	59124
	R94	Resistor, Metal Film, 68.1K Ohms, 1% 1/4W	RAB47	MF55D6812F	F/3	59124
	R95	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	F/3	80294
	R96	Resistor, Metal Film, 3920 Ohms, 1% 1/4W	RAB32	MF55D3921F	F/3	59124
	R97	Resistor, Metal Film, 3320 Ohms, 1% 1/4W	RAB31	MF55D3321F	J/2	59124
	R98	Resistor, Metal Film, 3320 Ohms, 1% 1/4W	RAB31	MF55D3321F	J/2	59124
	R99	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	F/4	59124
	R100	Resistor, Metal Film, 82.5K Ohms, 1% 1/4W	RAB48	MF55D8252F	F/3	59124

Table 7-20 Ref Des Index - NAPC120/01 and NAPC120/03 Monitor PWB (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	X/Y GRID	OEM CODE
	R101	Resistor, Metal Film, 82.5K Ohms, 1% 1/4W	RAB48	MF55D8252F	F/3	59124
	R102	Resistor, Metal Film, 332 Ohms, 1% 1/4W	RAB19	MF55D3320F	I/2	59124
	R103	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	F/2	59124
	R104	Resistor, Metal Film, 56.2K Ohms, 1% 1/4W	RAB46	MF55D5622F	E/3	59124
	R105	Not Used				
	R106	Not Used				
	R107	Resistor, Variable, Film, 10K Ohms, 1/2W	RW09	3339P-1-103	E/3	80294
	R108	Resistor, Metal Film, 8250 Ohms, 1% 1/4W	RAB36	MF55D8251F	H/2	59124
	R109	Resistor, Metal Film, 8250 Ohms, 1% 1/4W	RAB36	MF55D8251F	K/6	59124
	R110	Resistor, Metal Film, 2210 Ohms, 1% 1/4W	RAB29	MF55D2211F	J/4	59124
	R111	Resistor, Metal Film, 1210 Ohms, 1% 1/4W	RAB26	MF55D1211F	I/4	59124
	R112	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	H/2	59124
	R113	Resistor, Metal Film, 6.81 Ohms, 1% 1/2W	RC11	MF60D6R81F	K/1	59124
	R114	Resistor, Variable, Comp, 25K Ohms, 2W	RV35	RV4NAYSD253A	C/5	44655
	R115	Resistor, Variable, Comp, 1000 Ohms, 2W	RV18	RV4NAYSD102A	A/5	44655
	R116	Resistor, Metal Film, 121 Ohms, 1% 1/4W	RAB14	MF55D1210F	K/5	59124
	R117	Resistor, Metal Film, 1000 Ohms, 1% 1/4W	RAB25	MF55D1001F	K/5	59124
	R118	Resistor, Metal Film, 332 Ohms, 1% 1/4W	RAB19	MF55D3320F	K/5	59124
	R119	Resistor, Metal Film, 10K Ohms, 1% 1/4W	RAB37	MF55D1002F	J/7	59124
	S1	Switch, Toggle, 2PDT	SCP03	8373K107	B/9	08372
	S2	Switch, Toggle, 2PDT	SCP03	8373K107	D/9	08372
	S3	Switch, Toggle, 1PST	SCP01	8381K108	B/5	08372
	U1	IC, Operational Amplifier, Quad	UD08	LM224J	H/6	04713
	U2	IC, Operational Amplifier, Dual	UD02	LM258J	D/4	04713
	U3	IC, Comparator, Quad	UL02	MC3302L	F/5	04713
	U4	IC, Operational Amplifier, Quad	UD08	LM224J	H/3	04713
	U5	IC, Operational Amplifier, Dual	UA39	TL082MJG	J/6	04713
	U6	IC, CMOS, Inverter/Buffer, Hex	UL41	MC14049UBCP	J/5	04713
	U7	IC, CMOS, D Flip Flop, Dual	UB15	MC14013BCP	F/6	04713
	U8	IC, Operational Amplifier, Dual	UD02	LM258J	H/2	04713
	U9	IC, Operational Amplifier, Quad	UD08	LM224J	F/2	04713
	U10	IC, Operational Amplifier, Dual	UD02	LM258J	F/3	04713
	U11	IC, Operational Amplifier, Dual	UD02	LM258J	J/3	04713
	U12	Voltage Regulator, Adjustable Voltage, 3A	UT36	LM350T	K/4	27014
	U13	Speaker, 45 Ohm, 2W	LP07	30A05Z45	/	74199
	XF1	Fuseholder, PWB Mount, Type 3AG Fuse	FA31	4245	/	91833
	XK1	Socket, Relay, PWB Mount	KC19	1310-PC	/	73949
	XK2	Socket, Relay, PWB Mount	KC19	1310-PC	/	73949
	XK3	Socket, Relay, PWB Mount	KC19	1310-PC	/	73949
	XK4	Socket, Relay, PWB Mount	KC19	1310-PC	/	73949
	XU1	Socket, DIP, 14 Socket Contacts	UD41	1814AG111D	/	91506
	XU2	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	/	91506
	XU3	Socket, DIP, 14 Socket Contacts	UD41	1814AG111D	/	91506
	XU4	Socket, DIP, 14 Socket Contacts	UD41	1814AG111D	/	91506
	XU5	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	/	91506
	XU6	Socket, DIP, 16 Socket Contacts	UD40	1816AG111D	/	91506
	XU7	Socket, DIP, 14 Socket Contacts	UD41	1814AG111D	/	91506

Table 7-20 Ref Des Index - NAPC120/01 and NAPC120/03 Monitor PWB (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	X/Y GRID	OEM CODE
	XU8	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	/	91506
	XU9	Socket, DIP, 14 Socket Contacts	UD41	1814AG111D	/	91506
	XU10	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	/	91506
	XU11	Socket, DIP, 8 Socket Contacts	UD42	1808AG111D	/	91506

USE CODE EXPLANATION: ☐ - Denotes used when battery option installed.
♣ - Denotes used when battery option is not installed.
/1 - Denotes used only on NAPC120/01 Variation
/3 - Denotes used only on NAPC120/03 Variation

NOTE: Partial reference designation shown. Prefix with A10 (composite ref des prefix, including all higher assemblies) to obtain complete reference designation.

Table 7-21 Ref Des Index - NAX50A/03 Battery Control Panel

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	-	Battery Control Panel	NAX50A/03	156-7108-06	37338
	A1	Battery Control PWB	156-7164-02	156-7164-02	37338
	A1C1	Capacitor, Electrolytic, 150uF, 150V	CA08	TC495	90201
	A1C2	Capacitor, Electrolytic, 150uF, 150V	CA08	TC495	90201
	A1CR1	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	27014
	A1CR2	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	27014
	A1CR3	Diode, Zener, 56V, 1.5W, 2%	QG36	1N5943C	04713
	A1CR4	Diode, Zener, 56V, 1.5W, 2%	QG36	1N5943C	04713
	A1CR7	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	27014
	A1CR8	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	27014
	A1J1	Header, MTA, 8 Square Posts, 0.156 Centre	JU08	640383-8	09482
	A1Q1	Transistor, PNP, Power, High Voltage	QE38	2N5415	50088
	A1Q2	Transistor, PNP, Power, High Voltage	QE38	2N5415	50088
	A1R1	Resistor, Metal Film, 1800 Ohms, 2% 1/2W	RAP10	RL20S182G	35005
	A1R2	Resistor, Metal Film, 1800 Ohms, 2% 1/2W	RAP10	RL20S182G	35005
	A1R3	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	35005
	A1R4	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	35005
	A1R5	Resistor, Metal Film, 1800 Ohms, 2% 1/2W	RAP10	RL20S182G	35005
	A1R6	Resistor, Metal Film, 1800 Ohms, 2% 1/2W	RAP10	RL20S182G	35005
	A1R7	Resistor, Variable, Film, 500 Ohms, 1/2W	RW36	3339P-1-501	80294
	A1R8	Resistor, Variable, Film, 500 Ohms, 1/2W	RW36	3339P-1-501	80294
	C1	Capacitor, Plastic, 0.1uF 10%, 250V	CS05	52003104K	37903
	C2	Capacitor, Plastic, 0.1uF 10%, 250V	CS05	52003104K	37903
	C3	Capacitor, Plastic, 0.1uF 10%, 250V	CS05	52003104K	37903
	C4	Capacitor, Plastic, 0.1uF 10%, 250V	CS05	52003104K	37903
	CR1	Diode, General Purpose, 200V, 0.1A	QAP29	1N4938	07263
	J1	Connector, Size 17-16, 16 Pin-Contacts	JQ07	206036-1	09482
	K1	Relay, 24 VDC Coil, 4PDT, 5A	KC14	MY4-DC24	34361
	K2	Relay, 24 VDC Coil, SPST-NO-DM, 13A	KC02	W389DCX-3	94696
	K3	Relay, 24 VDC Coil, SPST-NO-DM, 13A	KC02	W389DCX-3	94696
	P1	Connector, MTA, Closed End, 8-Pin, 22AWG	JU06	640433-8	09482
	R1	Resistor, Wirewound, 1000 Ohms, 5% 5W	RWP10	RS5-1000 Ohms-5%	35005
	R2	Resistor, Wirewound, 15 Ohms, 5% 20W	RN31	HLM20-15 Ohms - 5%	35005
	R3	Resistor, Wirewound, 15 Ohms, 5% 20W	RN31	HLM20-15 Ohms - 5%	35005
	R4	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	35005
	R5	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	35005
	R6	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	35005
	R7	Resistor, Metal Film, 10 Ohms, 2% 1/2W	RAP01	RL20S100G	35005
	R8	Resistor, Wirewound, 560 Ohms, 5% 5W	RWP09	RS5-560 Ohms-5%	35005
	R9	Resistor, Wirewound, 560 Ohms, 5% 5W	RWP09	RS5-560 Ohms-5%	35005
	S1	Switch, Push Button Mom, 1PDT, Red	156-7185	156-7185	37338
	XK1	Socket, Relay	KA19	1310-1ST	73949

NOTE: Partial reference designation shown. Prefix with A11 (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 wiring boards are not provided:

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 - ND4000A Transmitter Cabinet
Table 8-3	Wiring List - NAC93/01 Control/Monitor Panel
Table 8-4	Wiring List - NAP13A/01 Modulator/Power Amplifier Module
Table 8-5	Wiring List - NAE45G/01 Exciter Module
Table 8-6	Wiring List - Power On/Off Panel (192-8130)
Table 8-7	Wiring List - NAS25B/01 and NAS25B/02 Power Supply Modules
Table 8-8	Wiring List - NASC01/01 B- VDC to +24 VDC Converter
Table 8-9	Wiring List - NAF46C/01 Harmonic Filter
Table 8-10	Wiring List - NAFP24A/01 Forward/Reflected Power Probe
Table 8-11	Wiring List - NAX50A/03 Battery Control Panel
Table 8-12	Wiring List - Interface Panel Assembly (192-8110)
Table 8-13	Connector Mating Information - Sorted By Floating Connector

Table 8-2 Wiring List - ND4000A Transmitter Cabinet

SOURCE	DESTINATION	CODE		SIZE	REMARKS
TB1-1	TB1-3		Capacitor		C2 Leads Sleeved
TB1-2	TB1-4		Capacitor		C3 Leads Sleeved
TB1-1	P1-1	1	Grey	14	
TB1-2	P1-2	2	Grey	14	
TB2-2	P1-3	3	White	14	
TB2-3	P1-4	4	White	14	
TB2-4	P1-5	5	White	14	
P1-6	P2-1	6	Grey	14	
P1-7	P2-2	7	Grey	14	
P1-11	P3-1	8	Grey	14	
P1-12	P3-2	9	Grey	14	
P2-3	R1-1	10	White	14	
P2-4	R1-1	11	White	14	
P2-5	R1-1	12	White	14	
P17-12	P5-1	13	White	22	
P2-6	P5-1	14	White	22	
P2-7	P21-11	15	White	22	
P2-7	P5-2	16	White	22	
P10-3	P5-2	17	White	22	
P3-3	R4-1	18	White	14	
P3-4	R4-1	19	White	14	
P3-5	R4-1	20	White	14	
P17-10	P7-1	21	White	22	
P3-6	P7-1	22	White	22	
P3-7	P21-4	23	White	22	
P3-7	P7-2	24	White	22	
P11-3	P7-2	25	White	22	
R1-5	P10-4	26	White	14	
R1-5	P10-5	27	White	14	
R1-5	P10-6	28	White	14	
R1-5	P10-7	29	White	14	
R1-5	XF3-Centre	30	White	14	
R4-5	P11-4	31	White	14	
R4-5	P11-5	32	White	14	
R4-5	P11-6	33	White	14	
R4-5	P11-7	34	White	14	
R4-5	XF6-Centre	35	White	14	
XF3-Side	P4-6	36	White	22	
XF6-Side	P17-8	37	White	22	
TT1	P4-10	38	White	22	
TT2	P4-2	39	White	22	
R1-2 or 3	P4-9	40	White	22	
R4-2 or 3	P4-1	41	White	22	
P21-10	P5-12	42	White	22	
P22-10	P5-11	43	White	22	
P7-11	P5-11	44	White	22	
P21-5	P7-12	45	White	22	
P5-7	P22-2	46	Conductor	22	1-Conductor
P5-8	P22-3	46	Shield	-	Shielded
P5-14	P4-12	47	White	22	

Table 8-2 Wiring List - ND4000A Transmitter Cabinet (Continued)

SOURCE	DESTINATION	CODE		SIZE	REMARKS
P5-5	P4-8	48	White	22	
P5-6	P4-7	49	White	22	
P7-7	P23-5	50	Conductor	22	1-Conductor
P7-8	P23-6	50	Shield	-	Shielded
P7-14	P4-4	51	White	22	
P7-5	P17-6	52	White	22	
P7-6	P17-7	53	White	22	
P6-1	P10-1	54	Core	RG188A/U	Coaxial Cable
P6-2	P10-2	54	Shield		
P8-1	P11-1	55	Core	RG188A/U	Coaxial Cable
P8-2	P11-2	55	Shield		
P19-Centre	P9-Centre	56	Conductor	22	1-Conductor
P19-Body	P9-Body	56	Shield	-	Shielded
P20-Centre	P12-Centre	57	Conductor	22	1-Conductor
P20-Body	P12-Body	57	Shield	-	Shielded
P10-8	A9K1-4	58	Core	RG58A/U	Coaxial Cable
P10-9	A9-Ground Bolt	58	Shield	-	
P11-8	A9K2-6	59	Core	RG58A/U	Coaxial Cable
P11-9	A9 Ground Bolt	59	Shield	-	
P17-9	A9TT-1	60	White	22	
P17-11	A9TT-2	61	White	22	
P21-1	P13-Centre	62	Conductor	22	1-Conductor
P21-2	P13-Body	62	Shield	-	Shielded
P22-4	P14-Centre	63	Conductor	22	1-Conductor
P22-5	P14-Body	63	Shield	-	Shielded
P21-6	P15-Centre	64	Conductor	22	1-Conductor
P21-7	P15-Body	64	Shield	-	Shielded
P22-12	P16-Centre	65	Conductor	22	1-Conductor
P22-11	P16-Body	65	Shield	-	Shielded
TT-5	P5-9	66	White	20	
TT-6	P5-10	67	White	20	
TB3-10	P23-8	68	White	22	
TT-7	P7-9	69	White	22	
TT-8	P7-10	70	White	22	
TB3-13	P21-9	71	White	22	
TB3-14	P21-8	72	White	22	
TB3-15	P17-3	73	White	22	
TB3-16	P17-5	74	White	22	
TB4-14	P21-3	75	White	22	
TB4-15	P22-1	76	White	22	
TB4-16	P23-7	77	White	22	
TB3-20	P23-2	78	Conductor	22	1-Conductor
TB3-Ground	Not Connected	78	Shield	-	Shielded
TB3-18	P4-5	79	White	22	
TB3-19	P17-1	80	White	22	
TB4-10	P4-11	81	White	22	
TB4-11	P4-3	82	White	22	
TB3-2	P17-2	83	White	22	
TB3-4	P17-4	84	White	22	
TB4-18	P5-3	85	Conductor	22	1-Conductor

Table 8-2 Wiring List - ND4000A Transmitter Cabinet (Continued)

SOURCE	DESTINATION	CODE		SIZE	REMARKS
TB4-17	P5-4	85	Shield	-	Shielded
TB4-18	P7-3	86	Conductor	22	1-Conductor
TB4-17	P7-4	86	Shield	-	Shielded
TB4-19	P5-13	87	White	20	
TB4-19	P7-13	88	White	20	
P21-12	XF5-Centre	89	White	22	
P22-9	XF4-Centre	90	White	22	
P5-15	Ground	91	Black	18	
P7-15	Ground	92	Black	18	
P10-10	Ground	93	Black	14	
P10-11	Ground	94	Black	14	
P10-12	Ground	95	Black	14	
P10-13	Ground	96	Black	14	
P11-10	Ground	97	Black	14	
P11-11	Ground	98	Black	14	
P11-12	Ground	99	Black	14	
P11-13	Ground	100	Black	14	
P2-8	P22-8	101	White	22	
P2-12	P18-16	102	White	22	
P3-8	P22-7	103	White	22	
P3-12	P18-15	104	White	22	
P1-8	P18-1	105	White	14	
P1-9	P18-2	106	White	14	
P1-10	P18-3	107	White	14	
P18-4	R1-1	108	White	14	
P18-5	R1-1	109	White	14	
P18-6	R1-1	110	White	14	
P18-7	R4-1	111	White	14	
P18-8	R4-1	112	White	14	
P18-9	R4-1	113	White	14	
TB3-1	P18-10	114	White	20	
TB3-3	P18-12	115	White	20	
TB3-2	P18-11	116	White	20	
TB3-4	P18-13	117	White	20	
TB3-17	P18-14	118	White	20	
TB3-1	P5-16	119	White	20	
TB3-3	P7-16	120	White	20	
P2-9	Ground	121	Black	14	
P2-10	Ground	122	Black	14	
P2-11	Ground	123	Black	14	
P3-9	Ground	124	Black	14	
P3-10	Ground	125	Black	14	
P3-11	Ground	126	Black	14	
P2-13	Rack Angle	127	Black	14	
P3-13	Rack Angle	128	Black	14	
		129	Not Used		
			to		
		199	Not Used		
LH Side Panel	Ground	200	Black	14	
RH Side Panel	Ground	201	Black	14	

Table 8-2 Wiring List - ND4000A Transmitter Cabinet (Continued)

SOURCE	DESTINATION	CODE		SIZE	REMARKS
Rear Door	Ground	202	Black	14	
Cabinet	Ground	203	Black	14	
Power On/Off Pnl	Ground	204	Black	14	
Safety Ground	Ground	205	Black	8	
Safety Ground	Ground	206	Black	8	
Safety Ground	Ground	207	Black	14	
R2-Yellow	TT-1	-	-	-	Leads of R2
R2-Red	TT-1	-	-	-	Leads of R2
R2-Green	R1-4	-	-	-	Leads of R2
R3-Yellow	TT2	-	-	-	Leads of R3
R3-Red	TT2	-	-	-	Leads of R3
R3-Green	R4-4	-	-	-	Leads of R3
A9A2TB1-1	J1-Centre	-	Core	RG58A/U	Coaxial Cable
A9A2TB1-2	J1-Ground	-	Shield	-	
TB2-1	Ground	-	White	10	
TB2-3	TB2-2	-	White	14	
TB2-4	TB2-2	-	White	14	
TB1-3	TB1-4	-	Black	14	

Table 8-3 Wiring List - NAC93/01 Control/Monitor Panel

SOURCE	DESTINATION	CODE		SIZE	REMARKS
P1-1	P3-5	1	White	22	
P1-2	P4-9	2	White	22	
P1-3	P4-12	3	White	22	
P1-4	P5-12	4	White	22	
P1-5	P4-1	5	White	22	
P1-6	Ground	6	Black	22	
P1-7	S5A-9	7	White	22	
P1-7	S5B-10	8	White	22	
P1-10	P4-6	9	White	22	
P1-10	S4-4	10	White	22	
P1-11	S4-2	11	White	22	
P1-12	P3-6	12	White	22	
P1-12	S2-5	13	White	22	
P2-1	S2-3	14	White	22	
P2-2	S2-11	15	White	22	
P2-3	S5B-1	16	White	22	
P2-4	S5A-1	17	White	22	
P2-5	S5B-3	18	White	22	
P2-6	S5A-2	19	White	22	
P2-7	S5A-5	20	White	22	
P2-8	S2-10	21	White	22	
P2-9	S2-4	22	White	22	
P2-10	S2-12	23	White	22	
P2-11	S5B-11	24	White	22	
P2-12	S5A-11	25	White	22	
P3-1	S1-3	26	White	22	
P3-11	S1-6	27	White	22	
P3-11	P3-9	-	White	22	
P3-12	S1-5	28	White	22	
P3-12	P3-10	-	White	22	
P3-4	S5B-9	29	White	22	
P3-7	S5A-7	30	White	22	
P3-8	S5A-10	31	White	22	
P3-2	S1-10	32	White	22	
P3-3	S1-9	33	White	22	
P4-2	S6-9	34	White	22	
P4-3	S6-8	35	White	22	
P4-5	J1-Centre	36	Core	RG188A/U	Coaxial Cable
P4-4	J1-Ground	36	Shield		
P4-7	S2-8	37	White	22	
P4-8	S2-7	38	White	22	
P4-10	S4-3	39	White	22	
P4-11	S2-6	40	White	22	
P5-4	S5B-4	41	White	22	
P5-5	S5B-8	42	White	22	
P5-7	S6-11	43	White	22	
P5-8	S6-10	44	White	22	
P5-10	S2-9	45	White	22	
P5-11	Ground	46	Black	22	
S1-7	Ground	47	Black	22	

Table 8-3 Wiring List - NAC93/01 Control/Monitor Panel (Continued)

SOURCE	DESTINATION	CODE	SIZE	REMARKS
S2-2	S3-5	48 White	22	
S3-3	Ground	49 Black	22	
S4-1	S4-4	Tinned Copper Wire	24	
S5A-3	S5A-4	Tinned Copper Wire	24	
S5A-4	S5A-8	Tinned Copper Wire	24	Sleeved
S5A-8	S5A-9	Tinned Copper Wire	24	
S5A-6	S5B-6	Tinned Copper Wire	24	Sleeved
S5B-2	S5B-5	Tinned Copper Wire	24	Sleeved
S5B-5	S5B-7	Tinned Copper Wire	24	Sleeved
S5B-7	S5B-10	Tinned Copper Wire	24	Sleeved
S5A-W	M2 (-)	50 White	22	
S5B-W	M2 (+)	51 White	22	
S6-1	S6-7	Tinned Copper Wire	24	Sleeved
S6-2	S6-3	Tinned Copper Wire	24	
S6-3	S6-4	Tinned Copper Wire	24	
S6-4	Ground	52 Black	22	
S6-5	S6-10	Tinned Copper Wire	24	Sleeved
S6-W1	M1 (-)	53 White	22	
S6-W2	M1 (+)	54 White	22	

Table 8-4 Wiring List - NAP13A/01 Modulator/Power Amplifier Module

SOURCE	DESTINATION	CODE		SIZE	REMARKS
TT2	TT3		Capacitor	0.1 F	C1
TT3	Ground		Capacitor	1.8 F	C2
TT4	TT5		Capacitor	1.8 F	C3
TT7	TT8		Capacitor	0.1 F	C4
TT8	Ground		Capacitor	1.8 F	C5
TT9	TT10		Capacitor	1.8 F	C6
TT12	TT13		Capacitor	0.1 F	C7
TT13	Ground		Capacitor	1.8 F	C8
TT14	TT15		Capacitor	1.8 F	C9
TT17	TT18		Capacitor	0.1 F	C10
TT18	Ground		Capacitor	1.8 F	C11
TT19	TT20		Capacitor	1.8 F	C12
J1-1	S1-2	1	Core	RG188A/U	Coaxial Cable
J1-2	Ground	-	Shield	-	
J1-4	XF1-Centre	2	White	14	
J1-5	XF2-Centre	3	White	14	
J1-6	XF3-Centre	4	White	14	
J1-7	XF4-Centre	5	White	14	
XF1-Side	TB1-1	6	White	14	
XF2-Side	TB3-1	7	White	14	
XF3-Side	TB5-1	8	White	14	
XF4-Side	TB7-1	9	White	14	
J1-8	TT21	10	Core	RG58A/U	Coaxial Cable
J1-9	TT20	-	Shield	-	
J2-Centre	P1-Centre	11	White	22	1-Conductor
Ground	P1-Shell	-	Shield	-	Shielded
J2-Centre	P2-Centre	12	White	22	1-Conductor
Ground	P2-Shell	-	Shield	-	Shielded
J2-Centre	P3-Centre	13	White	22	1-Conductor
Ground	P3-Shell	-	Shield	-	Shielded
J2-Centre	P4-Centre	14	White	22	1-Conductor
Ground	P4-Shell	-	Shield	-	Shielded
A9-1	TB1-1	15	White	22	
A9-2	TB8-3	16	White	22	
A9-3	TB6-3	17	White	22	
A9-4	TB4-3	18	White	22	
A9-5	TB2-3	19	White	22	
J1-10	Ground	-	Black	14	
J1-11	Ground	-	Black	14	
J1-12	Ground	-	Black	14	
J1-13	Ground	-	Black	14	
A9-6	TP1	Tinned Copper Wire		24	
P5-1	J1-3	Fan Cord Assembly		-	B1
P5-2	Ground	-	-	-	B1
L1-1	TB1-2	-	-	-	Leads of L1
L1-2	TT-2	-	-	-	Leads of L1
L2-1	TB3-2	-	-	-	Leads of L2
L2-2	TT-7	-	-	-	Leads of L2

Table 8-4 Wiring List - NAP13A/01 Modulator/Power Amplifier Module (Continued)

SOURCE	DESTINATION	CODE		SIZE	REMARKS
L3-1	TB5-2	-	-	-	Leads of L3
L3-2	TT-12	-	-	-	Leads of L3
L4-1	TB7-2	-	-	-	Leads of L4
L4-2	TT-17	-	-	-	Leads of L4
T1-1	TB2-1	-	-	-	Leads of T1
T1-3	TB2-1	-	-	-	Leads of T1
T1-2	TB2-2	-	-	-	Leads of T1
T1-4	TB2-2	-	-	-	Leads of T1
T1-5	TT-1	-	-	-	Leads of T1
T1-6	TT-6	-	-	-	Leads of T1
T2-1	TB4-1	-	-	-	Leads of T2
T2-3	TB4-1	-	-	-	Leads of T2
T2-2	TB4-2	-	-	-	Leads of T2
T2-4	TB4-2	-	-	-	Leads of T2
T2-5	TT-6	-	-	-	Leads of T2
T2-6	TT-11	-	-	-	Leads of T2
T3-1	TB6-1	-	-	-	Leads of T3
T3-3	TB6-1	-	-	-	Leads of T3
T3-2	TB6-2	-	-	-	Leads of T3
T3-4	TB6-2	-	-	-	Leads of T3
T3-5	TT-11	-	-	-	Leads of T3
T3-6	TT-16	-	-	-	Leads of T3
T4-1	TB8-1	-	-	-	Leads of T4
T4-3	TB8-1	-	-	-	Leads of T4
T4-2	TB8-2	-	-	-	Leads of T4
T4-4	TB8-2	-	-	-	Leads of T4
T4-5	TT-16	-	-	-	Leads of T4
T4-6	TT-21	-	-	-	Leads of T4
TT-3	TT-4	Tinned Copper Wire		16	
TT-8	TT-9	Tinned Copper Wire		16	
TT-13	TT-14	Tinned Copper Wire		16	
TT-18	TT-19	Tinned Copper Wire		16	
TT-2	TB2-3	-	White	16	
TT-7	TB4-3	-	White	16	
TT-12	TB6-3	-	White	16	
TT-17	TB8-3	-	White	16	
TB1-2	TT-3	-			
TB3-3	TB1-3	-	Core	RG188A/U	Coaxial Cable
TB3-Ground	TB1-Ground	-	Shield		

Table 8-5 Wiring List - NAE45G/01 Exciter Module

	SOURCE	DESTINATION	CODE		SIZE	REMARKS
	U1-1	Ground		Capacitor	0.47uF	C1
	U1-2	Ground		Capacitor	6.8uF	C2
	TT3	Ground		Capacitor	22.0uF	C3
	U1-2	Ground		Capacitor	0.1uF	C4
	TT6	Ground		Capacitor	1.0uF	C5
	TT3 (Anode)	Ground		Diode, Zener	15V	CR1
	TT4 (Cathode)	TT5		Diode, Zener	16V	CR2
	TT1	TT2		Resistor	820 Ohms	R1
	R5-1	Ground		Resistor	4700 Ohms	R6
	TT5	Ground		Resistor	100 Ohms	R7
	J2-1	XF1-Centre	1	White	22	
	J2-2	U1-1	2	White	22	
	J2-3	P6-4	3	White	22	1-Conductor
	J2-4	P6-3	-	Shield	-	Shielded
	J2-5	S2-1	4	Red	22	
	J2-6	TT1	5	Blue	22	
	J2-7	P5-1	6	White	22	1-Conductor
	J2-8	P5-6	-	Shield	-	Shielded
	J2-9	P5-2	7	White	22	
	J2-10	P5-4	8	White	22	
%	J2-11	P7-1	9	White	22	
	J2-12	P7-2	10	White	22	
	J2-13	P6-9	11	White	22	
	J2-14	R5-2	12	White	22	
	J1-1	P7-6	13	White	22	1-Conductor
	J1-2	P7-7	-	Shield	-	Shielded
	-	-	14	Not Used	-	
	XF1-Side	TT2	15	White	22	
	XF1-Side	A4-1	16	White	22	
	J2-16	P6-5	17	White	22	
	TT3	P6-6	18	White	22	
	TT4	R4-2	19	White	22	
	S2-1	R2-2	20	White	22	
	S2-1	R5-3	21	White	22	
	R5-3	S1-1	22	White	22	
	TT7	P6-8	23	White	22	
	TT7	P5-5	24	White	22	
	U1-2	P1-4	25	White	22	
	P1-12	P2-Centre	26	White	22	1-Conductor
	P1-14	P2-Shell	-	Shield	-	Shielded
	P4	P7-5	27	White	22	
	P5-1	P6-11	28	White	22	1-Conductor
	P5-6	P6-7	-	Shield	-	Shielded
	P5-3	S1-2	29	White	22	
	P6-10	S2-2	30	White	22	
	P6-12	XDS1-Cathode	31	White	22	
	P7-3	XDS2-Cathode	32	White	22	
	P7-4	XDS3-Cathode	33	White	22	
	R2-1	XDS1-Anode	34	White	22	
	R4-1	XDS2-Anode	35	White	22	
	R3-1	XDS3-Anode	36	White	22	

Table 8-5 Wiring List - NAE45G/01 Exciter Module (Continued)

	SOURCE	DESTINATION	CODE	SIZE	REMARKS
	P1-18	P7-5	37 White	22	
	P1-19	J1-4	38 White	22	
	Q1-Cathode	Ground	- Black	22	
	J2-15	Ground	- Black	18	
	TT4	U1-2	- White	22	
	Q1-Anode	U1-1	- White	22	
	TT4	TT7	- White	22	
	Q1-Gate	TT5	Tinned Copper Wire	24	
	TT1	TT3	Tinned Copper Wire	24	
	TT5	TT6	Tinned Copper Wire	24	
*	W1J1-12	W1P1-4	- White	22	1-Conductor
*	W1J1-14	W1P1-3	- Shield	-	Shielded
*	W1J1-4	W1P1-2	- White	22	
*	W1J1-18	W1P8-1	- White	22	
*	W1J1-19	W1P8-2	- White	22	

% Denotes through LY09 ferrite toroid (two turns) to form L1.

* Denotes used only when RF oscillator PWB is used as RF drive source.

Table 8-6 Wiring List - Power On/Off Panel (192-8130)

SOURCE	DESTINATION	CODE		SIZE	REMARKS
P1-1	S1-1	1	Grey	14	
P1-2	S1-2	2	Grey	14	
P1-3	XF1-Centre	3	White	16	
P1-4	XF1-Centre	4	White	16	
P1-5	XF1-Centre	5	White	16	
P1-6	S1-3	6	Grey	16	
P1-7	S1-4	7	Grey	16	
P1-11	S1-3	8	Grey	16	
P1-12	S1-4	9	Grey	16	
P1-8	S2-2	10	White	14	
P1-9	S2-2	11	White	14	
P1-10	S2-2	12	White	14	
XF1-Side	S2-1	-	White	12	
S1-3	DS1-1	-	Grey	20	
S1-4	DS1-2	-	Grey	20	

Table 8-7 Wiring List - NAS25B/01 and NAS25B/02 Power Supply Modules

	SOURCE	DESTINATION	CODE		SIZE	REMARKS
	Q1-Gate (+)	Q1-Cathode (-)		Capacitor	1.0uF	C1
	Q2-Gate (+)	Q2-Cathode (-)		Capacitor	1.0uF	C2
	TT1	TP1		Resistor	100K Ohms	R1
	T1-8	T1-9		Varistor	95V RMS	RV1
	T1-10	T1-9		Varistor	95V RMS	RV2
	J1-1	S1-1	1	Grey	14	
	J1-2	S1-2	2	Grey	14	
	S1-3	XF2-Centre	3	Grey	14	
	S1-4	XF3-Centre	4	Grey	14	
	XF2-Side	T1-4/5/6 or 7	5	Grey	14	
	XF3-Side	T1-1 or 2	6	Grey	14	
	T1-8	Q2-Anode	7	Grey	12	
	T1-8	P1-7	8	Grey	22	
	T1-10	Q1-Anode	9	Grey	12	
	T1-10	P1-5	10	Grey	22	
	Q1-Cathode	Ground	11	Black	12	
	Q2-Cathode	Ground	12	Black	12	
	Q1-Gate	P1-6	13	White	22	
	Q2-Gate	P1-8	14	White	22	
	L1-2	J1-3	15	White	14	
	L1-2	J1-4	16	White	14	
	L1-2	A2TB1-3	17	White	22	
	L1-2	TT1	18	White	22	
	L1-2	P1-3	19	White	22	
	L1-2	J1-5	20	White	14	
	T1-11	P1-1	21	Grey	22	
	T1-13	P1-2	22	Grey	22	
	T1-12	Ground	23	Black	22	
	P1-4	P3-4	24	White	22	
	J1-6	XF1-Centre	25	White	20	
	XF1-Side	A2TB1-4	26	White	20	
	A2TB1-5	J1-7	27	White	20	
	A2TB1-1	XDS1-Anode	28	White	22	
	A2TB1-2	XDS2-Cathode	29	White	22	
	T1-9	CR1-Anode	30	White	14	
	J1-9	Ground	31	Black	14	
	J1-10	Ground	32	Black	14	
	J1-11	Ground	33	Black	14	
	T1-11	P2-1	34	Grey	22	
	T1-13	P2-2	35	Grey	22	
	P3-3	J1-8	36	White	22	
	P3-1	J1-12	37	White	22	
	J1-15	S1-1	38	Grey	14	
	J1-16	S1-2	39	Grey	14	
	J1-14	A2TB1-6	40	White	20	
	J1-13	Ground	41	Black	14	
	T1-9	L1-1	-	White	12	
%	S1-4	T1-1 or T1-2	-	Grey	14	
	XDS1-Cathode	Ground	-	-	-	Lead of XDS1
	XDS1-Anode	Ground	-	-	-	Lead of XDS1

Table 8-7 Wiring List - NAS25B/01 and NAS25B/02 Power Supply Modules (Continued)

	SOURCE	DESTINATION	CODE	SIZE	REMARKS

Denotes final destination (taps) determined by the AC line voltage source

% Denotes used only on the NAS25B/04 power supply

Table 8-8 Wiring List - NASC01/01 B- VDC to +24 VDC Converter

SOURCE	DESTINATION	CODE	SIZE	REMARKS
T1-11	Ground	- -	-	C1
T1-13 (-)	Ground (+)	- -	-	C3
C2 (+)	Q1-Drain (Anode)	- -	-	CR1
TT-7	Ground (Anode)	- -	-	CR2
TT-12	TT-13 (Anode)	- -	-	CR3
TT-1	TT-8	- -	-	L1
TT-4	TT-5	- -	-	R1
TT-2	Ground	- -	-	R2
TT-3	TT-6	- -	-	R4
TB1-1	TT-3	- White	22	
TB1-2	TT-5	- White	22	
TB1-3	TT-4	- White	22	
TB1-4	TT-1	- White	22	
TB1-5	TT-10	- White	22	
TB1-5	TT-6	- White	22	
TB1-6	TT-13	- White	22	
TT-8	TT-11	Tinned Copper Wire	20	Sleeved
TT-8	A1-1	Tinned Copper Wire	20	Sleeved
TT-8	R3-1	Tinned Copper Wire	20	Sleeved
R3-2	TT-9	Tinned Copper Wire	20	Sleeved
TT-9	Q1-Source	Tinned Copper Wire	20	Sleeved
A1-2	Q1-Gate	Tinned Copper Wire	20	Sleeved
C2 (+)	TT-10	Tinned Copper Wire	20	Sleeved
TT-2	TT-5	Tinned Copper Wire	20	Sleeved
TT-6	TT-7	Tinned Copper Wire	20	Sleeved
L3-4	Ground	- -	-	Leads of L3
L3-1	Q1-Drain	- -	-	Leads of L3
L3-2/3	TT-12	- -	-	Leads of L3

Table 8-9 Wiring List - NAF46C/01 Harmonic Filter

SOURCE	DESTINATION	CODE	SIZE	REMARKS
TT3 (Anode)	Ground	Diode	-	CR1
TT4 (Anode)	Ground	Diode	-	CR2
TT1	TT3	Resistor	470 Ohms	R1
TT2	TT4	Resistor	470 Ohms	R2
TT3	K1-A	- White	22	
TT4	K2-A	- White	22	
K1-B	Ground Bolt	- Black	22	
K2-B	Ground Bolt	- Black	22	
K1-6	TB1-1	- White	14	Teflon
K2-4	TB1-1	- White	14	Teflon
TB1-2	P1-Centre	- Core	RG58A/U	Coaxial Cable
Ground Bolt	P1-Shell	- Shield	-	
TB1-1	TB1-2	- White	12	Teflon
L1-1	A1J1-Centre	- White	12	Teflon
L1-2/3/4/5 or 6	L-2/2/3/4/5 or 6	- White	12	Teflon
L2-1	C1-C4 Bottom	- White	12	Teflon
E1	E2	- White	12	Teflon
E2	A2TB1-3	- Core	RG58A/U	Coaxial Cable
C5-C8 Bottom	A2TB1-2	- Shield	-	
E2	L4-1	- White	12	Teflon
L4-1	L3-2/3/4/5 or 6	- White	12	Teflon
Ground	L3-1	- White	12	Teflon
C5-C8 Bottom	L4-2/3/4/5 or 6	- White	12	Teflon
TB2-2	TB1-1	- White	18	Teflon
TB2-1	R3-2	- White	18	Teflon
R3-1	Ground	- White	14	

Table 8-10 Wiring List - NAFP24A/01 Forward/Reflected Power Probe

SOURCE	DESTINATION	CODE	SIZE	REMARKS
TT13	Ground	- -	-	C1
TT14	Ground	- -	-	C2
TT10 (Anode)	TT13	- -	-	CR1
TT11 (Anode)	TT14	- -	-	CR2
TT5	Ground	- -	-	R1
TT6	Ground	- -	-	R2
TT7	Ground	- -	-	R3
TT8	Ground	- -	-	R4
TT1	Ground	- -	-	R5
TT2	Ground	- -	-	R6
TT3	Ground	- -	-	R7
TT4	Ground	- -	-	R8
TT9	TT12	- -	-	R9
TB1-1	TB1-3	- Conductor	-	165-6034-03
TB1-Ground	-	- Shield		
TT1	S1-2	- White	22	
S1-4	J3-Centre	- White	22	
S1-6	TT-12	- White	22	
TT13	J1-Centre	- White	22	
TT14	J2-Centre	- White	22	
T1-1	TB1-3	- -	-	Lead of T1
T1-2	Ground	- -	-	Lead of T1
T1-3	TT10	- -	-	Lead of T1
T1-4	TT5	- -	-	Lead of T1
T1-5	TT11	- -	-	Lead of T1
T1-6	TT5	- -	-	Lead of T1
T1-7	TT9	- -	-	Lead of T1
T1-8	Ground	- -	-	Lead of T1
T2-1	Ground	- -	-	Lead of T2
T2-2	TT6	- -	-	Lead of T2
T3-1	Ground	- -	-	Lead of T3
T3-2	TT1	- -	-	Lead of T3
TT1	TT2	Tinned Copper Wire	24	
TT2	TT3	Tinned Copper Wire	24	
TT3	TT4	Tinned Copper Wire	24	
TT5	TT6	Tinned Copper Wire	24	
TT6	TT7	Tinned Copper Wire	24	
TT7	TT8	Tinned Copper Wire	24	

Table 8-11 Wiring List - NAX50A/03 Battery Control Panel

SOURCE	DESTINATION	CODE		SIZE	REMARKS
TT16	TT7		Capacitor	0.1uF	C1
TT17	TT10		Capacitor	0.1uF	C2
TT15	TT8		Capacitor	0.1uF	C3
TT18	TT11		Capacitor	0.1uF	C4
XK1-13	XK1-14(Anode)		Diode	-	CR1
TT5	TT13		Resistor	680 Ohms	R1
TT3	TT9		Resistor	10 Ohms	R4
TT4	TT10		Resistor	10 Ohms	R5
TT1	TT8		Resistor	10 Ohms	R6
TT7	TT11		Resistor	10 Ohms	R7
TT6	TT14		Resistor	390 Ohms	R8
TT2	TT12		Resistor	390 Ohms	R9
J1-1	K2-4	1	White	16	
J1-2	K2-4	2	White	16	
J1-3	K2-4	3	White	16	
K2-A	K2-4	4	White	20	
K2-4	K3-6	5	White	16	
K2-4	K3-6	6	White	16	
K2-4	K3-6	7	White	16	
K2-4	TT-13	8	White	20	
K3-B	K3-6	9	White	20	
J1-4	K2-6	10	White	16	
J1-5	K2-6	11	White	16	
J1-6	K2-6	12	White	16	
TT18	K2-6	13	White	20	
J1-7	K3-4	14	White	16	
J1-8	K3-4	15	White	16	
J1-9	K3-4	16	White	16	
TT15	K3-4	17	White	20	
J1-10	XK1-10	18	White	20	
J1-11	TT17	19	White	20	
J1-12	XK1-11	20	White	20	
J1-13	TT16	21	White	20	
J1-14	XK1-13	22	White	22	
J1-15	P1-5	23	White	22	
J1-16	P1-7	24	White	22	
TT4	XK1-10	25	White	20	
TT3	XK1-11	26	White	20	
TT4	P1-8	27	White	22	
TT3	P1-4	28	White	22	
K2-B	TT6	29	White	20	
K3-A	TT2	30	White	20	
TT14	P1-1	31	White	22	
TT12	P1-2	32	White	22	
R2-1	TT1	33	White	20	
R3-1	TT7	34	White	20	
TT1	XK1-9	35	White	20	
TT7	XK1-12	36	White	20	
TT5	XK1-14	37	White	20	

Table 8-11 Wiring List - NAX50A/03 Battery Control Panel (Continued)

SOURCE	DESTINATION	CODE		SIZE	REMARKS
TT16	XK1-3	38	White	20	
TT17	XK1-2	39	White	20	
TT15	XK1-5	40	White	20	
TT18	XK1-8	41	White	20	
XK1-13	S1-3	42	White	22	
TT13	R2-2	43	White	20	
TT13	R3-2	44	White	20	
S1-2	Ground	-	Black	22	

Table 8-12 Wiring List - Interface Panel Assembly (192-8110)

SOURCE	DESTINATION	CODE	SIZE	REMARKS
TB4-21	TB4-Ground	Capacitor	1.0uF	C1
TB3-7	TT5 (Anode)	Diode	-	CR1
TB3-8	TT6 (Anode)	Diode	-	CR2
TB3-11	TT7 (Anode)	Diode	-	CR3
TB3-12	TT8 (Anode)	Diode	-	CR4
TB4-19	TT3	Resistor	22K Ohms	R5
TB4-21	TB4-Ground	Resistor	68K Ohms	R6
XF1-Side	TB4-8	1 Blue	20	
XF2-Side	TB4-9	2 Blue	20	
XF1-Centre	TB3-1	3 Blue	20	
XF2-Centre	TB3-3	4 Blue	20	
XF4-Side	TB4-12	5 Red	20	
XF5-Side	TB4-13	6 Orange	20	
XF3-Side	XF1-Centre	- Blue	20	
XF6-Side	XF2-Centre	- Blue	20	
TB3-9	TB3-15	- White	22	
TB4-20	TB4-24	- Black	20	
TB4-24	TB4-Ground	Tinned Copper Wire	24	
TB3-24	TB3-Ground	Tinned Copper Wire	24	
T1-Red	TB4-21	- -	-	Lead of T1
T1-Brown	TB4-22	- -	-	Lead of T1
T1-Blue	TB4-23	- -	-	Lead of T1
T1-Green	TB4-17	- -	-	Lead of T1
T1-Yellow	TB4-18	- -	-	Lead of T1
T1-Black	TT4	- -	-	Lead of T1
T2-Red	TB3-24	- -	-	Lead of T2
T2-Brown	TB3-23	- -	-	Lead of T2
T2-Blue	TB3-22	- -	-	Lead of T2
T2-Green	TB3-20	- -	-	Lead of T2
T2-Yellow	TB3-24	- -	-	Lead of T2
T2-Black	TB3-21	- -	-	Lead of T2

Table 8-13 Connector Mating Information - Sorted by Floating Connector

	FLOATING CONNECTOR		FIXED CONNECTOR	
	REF DES	DESCRIPTION	REF DES	DESCRIPTION
	-	Type N (RF Feed Cable)	J1	Type N (RF Output Connector)
	-	BNC (External RF Monitor)	A1J1	BNC
	-	BNC (External Audio Monitor)	A10J10	BNC
	P1	14 Socket-Contacts	A6P1	14 Pin-Contacts
	P2	16 Sockets-Contacts	A7J1	16 Pin-Contacts
	P3	16 Sockets-Contacts	A8J1	16 Pin-Contacts
	P4	MTA, 12 Socket-Contacts	A10J2	MTA, 12 Pin-Contacts
	P5	16 Sockets-Contacts	A4J2	16 Pin-Contacts
	P6	4 Pin-Contacts	A4J1	4 Socket-Contacts
	P7	16 Sockets-Contacts	A5J2	16 Pin-Contacts
	P8	4 Pin-Contacts	A5J1	4 Socket-Contacts
	P9	BNC	A2J2	BNC
	P10	16 Socket-Contacts	A2J1	16 Pin-Contacts
	P11	16 Socket-Contacts	A3J1	16 Pin-Contacts
	P12	BNC	A3J2	BNC
	P13	BNC	A9A2J1	BNC
	P14	BNC	A9A2J2	BNC
	P15	BNC	A9A2J3	BNC
	P16	BNC	A9A1J2	BNC
	P17	MTA, 12 Socket-Contacts	A10J4	MTA, 12 Pin-Contacts
	P18	16 Socket-Contacts	A11J1	16 Pin-Contacts
	P19	BNC	A4A4J2	BNC
	P20	BNC	A5A4J2	BNC
	P21	MTA, 12 Socket-Contacts	A10J6	MTA, 12 Pin-Contacts
	P22	MTA, 12 Socket-Contacts	A10J8	MTA, 12 Pin-Contacts
	P23	MTA, 8 Socket-Contacts	A10J9	MTA, 8 Pin-Contacts
	A1P1	MTA, 12 Socket-Contacts	A1A1J1	MTA, 12 Pin-Contacts
	A1P2	MTA, 12 Socket-Contacts	A10J1	MTA, 12 Pin-Contacts
	A1P3	MTA, 12 Socket-Contacts	A10J3	MTA, 12 Pin-Contacts
	A1P4	MTA, 12 Socket-Contacts	A10J5	MTA, 12 Pin-Contacts
	A1P5	MTA, 12 Socket-Contacts	A10J7	MTA, 12 Pin-Contacts
	A2P1	BNC	A2A2J1	BNC
	A2P2	BNC	A2A4J1	BNC
	A2P3	BNC	A2A6J1	BNC
	A2P4	BNC	A2A8J1	BNC
	A2P5	2 Socket-Contacts	A2B1	2 Pin-Contacts
	A3P1	BNC	A3A2J1	BNC
	A3P2	BNC	A3A4J1	BNC
	A3P3	BNC	A3A6J1	BNC
	A3P4	BNC	A3A8J1	BNC
	A3P5	2 Socket-Contacts	A3B1	2 Pin-Contacts
	A4P1	D-Sub, 25 Socket-Contacts	A4A3J1	D-Sub, 25 Pin-Contacts
*	A4P1	D-Sub, 25 Pin-Contacts	A4W1J1	D-Sub, 25 Socket-Contacts
	A4P2	BNC	A4A4J1	BNC
	A4P3	Not Used	-	
	A4P4	Tip Plug	A4A4J3	Tip Jack
	A4P5	MTA, 8 Socket-Contacts	A4A1J1	MTA, 8 Pin-Contacts

Table 8-13 Connector Mating Information - Sorted by Floating Connector

	FLOATING CONNECTOR		FIXED CONNECTOR	
	REF DES	DESCRIPTION	REF DES	DESCRIPTION
	A4P6	MTA, 12 Socket-Contacts	A4A2J1	MTA, 12 Pin-Contacts
	A4P7	MTA, 8 Socket-Contacts	A4A2J2	MTA, 8 Pin-Contacts
	A4P8	MTA, 8 Socket Contacts	No Connection	
*	A4W1P1	MTA, 4 Socket-Contacts	A4A3J1	MTA, 4 Pin-Contacts
*	A4W1P8	MTA, 8 Socket-Contacts	A4A3J3	MTA, 8 Pin-Contacts
	A5P1	MTA, 4 Socket-Contacts	A5A3J1	MTA, 4 Pin-Contacts
	A5P2	BNC	A5A4J1	BNC
	A5P3	Not Used	-	
	A5P4	Tip Plug	A5A4J3	Tip Jack
	A5P5	MTA, 8 Socket-Contacts	A5A1J1	MTA, 8 Pin-Contacts
	A5P6	MTA, 12 Socket-Contacts	A5A2J1	MTA, 12 Pin-Contacts
	A5P7	MTA, 8 Socket-Contacts	A5A2J2	MTA, 8 Pin-Contacts
	A5P8	MTA, 8 Socket-Contacts	A5A3J3	MTA, 8 Pin-Contacts
	A7P1	MTA, 8 Socket-Contacts	A7A1J1	MTA, 8 Pin-Contacts
	A7P2	MTA, 4 Socket-Contacts	A7A3J1	MTA, 4 Pin-Contacts
	A7P3	MTA, 4 Socket-Contacts	A7A3J2	MTA, 4 Pin-Contacts
	A8P1	MTA, 8 Socket-Contacts	A8A1J1	MTA, 8 Pin-Contacts
	A8P2	MTA, 4 Socket-Contacts	A8A3J1	MTA, 4 Pin-Contacts
	A8P3	MTA, 4 Socket-Contacts	A8A3J2	MTA, 4 Pin-Contacts
	A9P1	BNC	A9A1J1	BNC
	A11P1	MTA, 8 Socket-Contacts	A11A1J1	MTA, 8 Pin-Contacts

Denotes used only when RF synthesizer PWB is used as the RF drive source.

* Denotes used only when RF oscillator PWB is used as the RF drive source.

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.

UNIQUE SYMBOLOGY

9.6 Nautel utilizes unique symbology on electrical schematics to describe two-state (logic) inputs/outputs which differ from those inputs/outputs having only one distinct state or multiple states (analog).

9.6.1 TYPE OF INPUTS/OUTPUTS: On electrical schematics, names used to describe two-state (logic) inputs/outputs are prefixed by a '#'. Those inputs/outputs representing a one-state or analog signal will have no prefix.

9.6.2 LOGIC LEVEL/CONVENTION: The '#' prefix identifies an input/output that has two distinct states - 'high' and 'low'. A suffix, '+' or '-', identifies the active (true) state of the input/ output. The 'high' (+) will be the more positive of the two levels used to represent the logic states. The 'low' (-) will be the less positive of the two levels used to represent the logic states. Two types of logic, positive and negative, may be represented on a particular schematic. In positive logic, a 'high' represents the active (true) state and a 'low' represents the inactive (false) state. In negative logic, a 'low' represents the active state and a 'high' represents the inactive state.

IDENTIFICATION OF SCHEMATIC DIAGRAMS

9.7 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

9.8 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 the Mechanical Drawing section (10), will identify its location.

9.8.1 Figure SD-1 identifies the major functional blocks and their detailed interconnection. Figures SD-2 thru SD-16 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.

9.8.2 When a sub-function is treated as a block in figures SD-2, SD-3, SD-5, SD-6, SD-7 and SD-10, 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).

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 the parts list section of this manual, the schematic will be in this section. Enter table 9-1 with the Nautel nomenclature number and/or the description to identify the 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).

LOCATING A PART/ASSEMBLY IDENTIFIED ON A SCHEMATIC

9.10 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.

9.10.1 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

Drawings in the mechanical drawing 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.

9.10.2 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.

Table 9-1 List of Electrical Schematics

Figure SD-1	Electrical Schematic - ND4000A 1000W Radiobeacon Transmitter (Sheet 1 of 2)
Figure SD-2	Electrical Schematic - ND4000A 1000W Radiobeacon Transmitter (Sheet 2 of 2)
Figure SD-3	Electrical Schematic - NAC93/01 Control/Monitor Panel
Figure SD-4	Electrical Schematic - NAP13A/01 Modulator/Power Amplifier Module
Figure SD-5	Electrical Schematic - NAE45G/01 Exciter Module
Figure SD-6	Electrical Schematic - NAPE30 Keyer PWB
Figure SD-7	Electrical Schematic - NAPE29C/01 Modulator Driver PWB (Sheet 1 of 2)
Figure SD-8	Electrical Schematic - NAPE29C/01 Modulator Driver PWB (Sheet 2 of 2)
Figure SD-9	Electrical Schematic - NAPE64A RF Oscillator (Optional DGPS Input) PWB
Figure SD-10	Electrical Schematic - NAS25B/01 & NAS25B/02 (NAPC26C/01) Power Supply Module
Figure SD-11	Electrical Schematic - NAF46C/01 Harmonic Filter
Figure SD-12	Electrical Schematic - NAPC120/01 & NAPC120/03 Monitor PWB (Sheet 1 of 2)
Figure SD-13	Electrical Schematic - NAPC120/01 & NAPC120/03 Monitor PWB (Sheet 2 of 2)
Figure SD-14	Electrical Schematic - NAX50A/03 Battery Control Panel

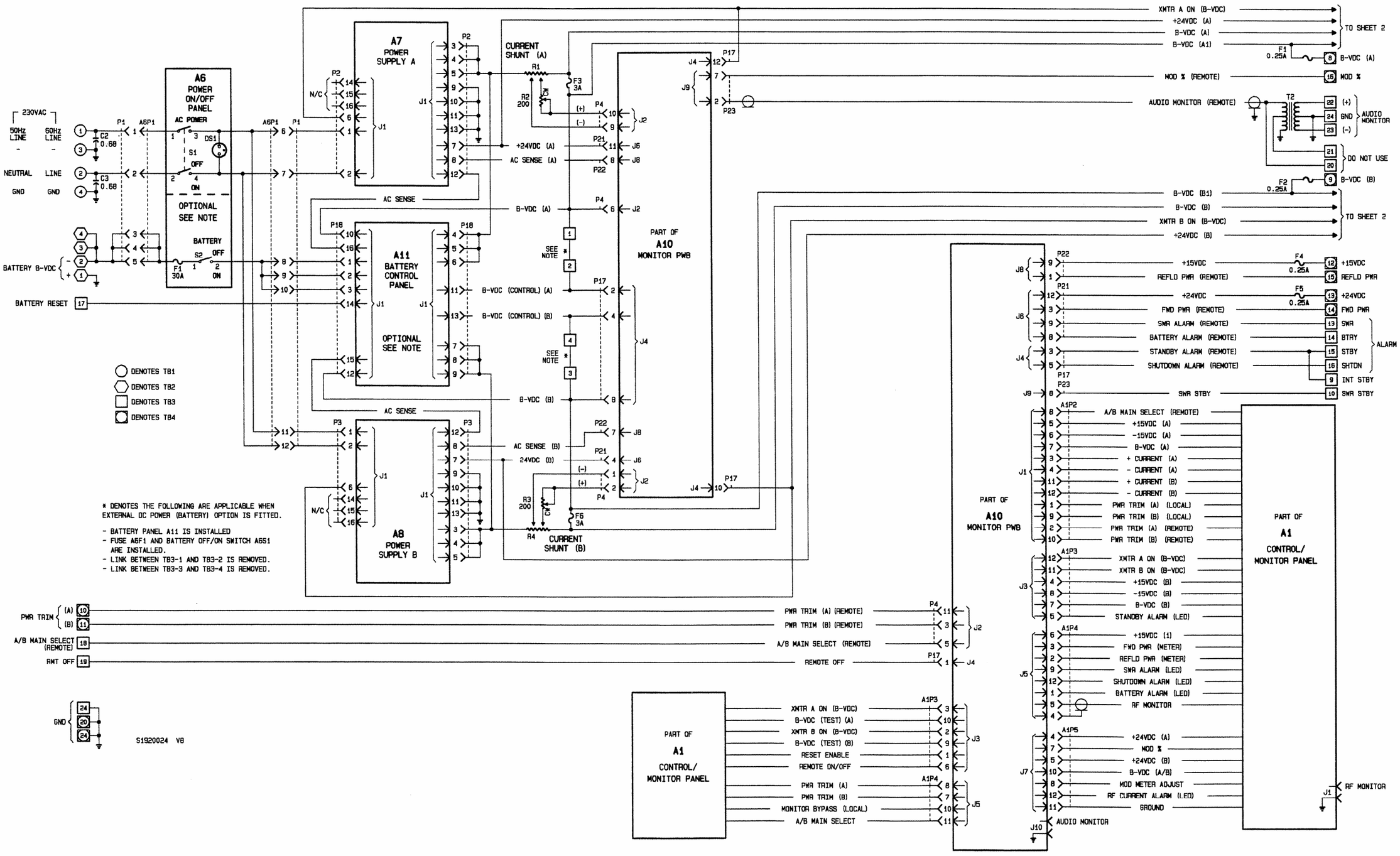


Figure SD-1 Electrical Schematic - ND4000A 1000W Radiobeacon Transmitter (Sheet 1 of 2)

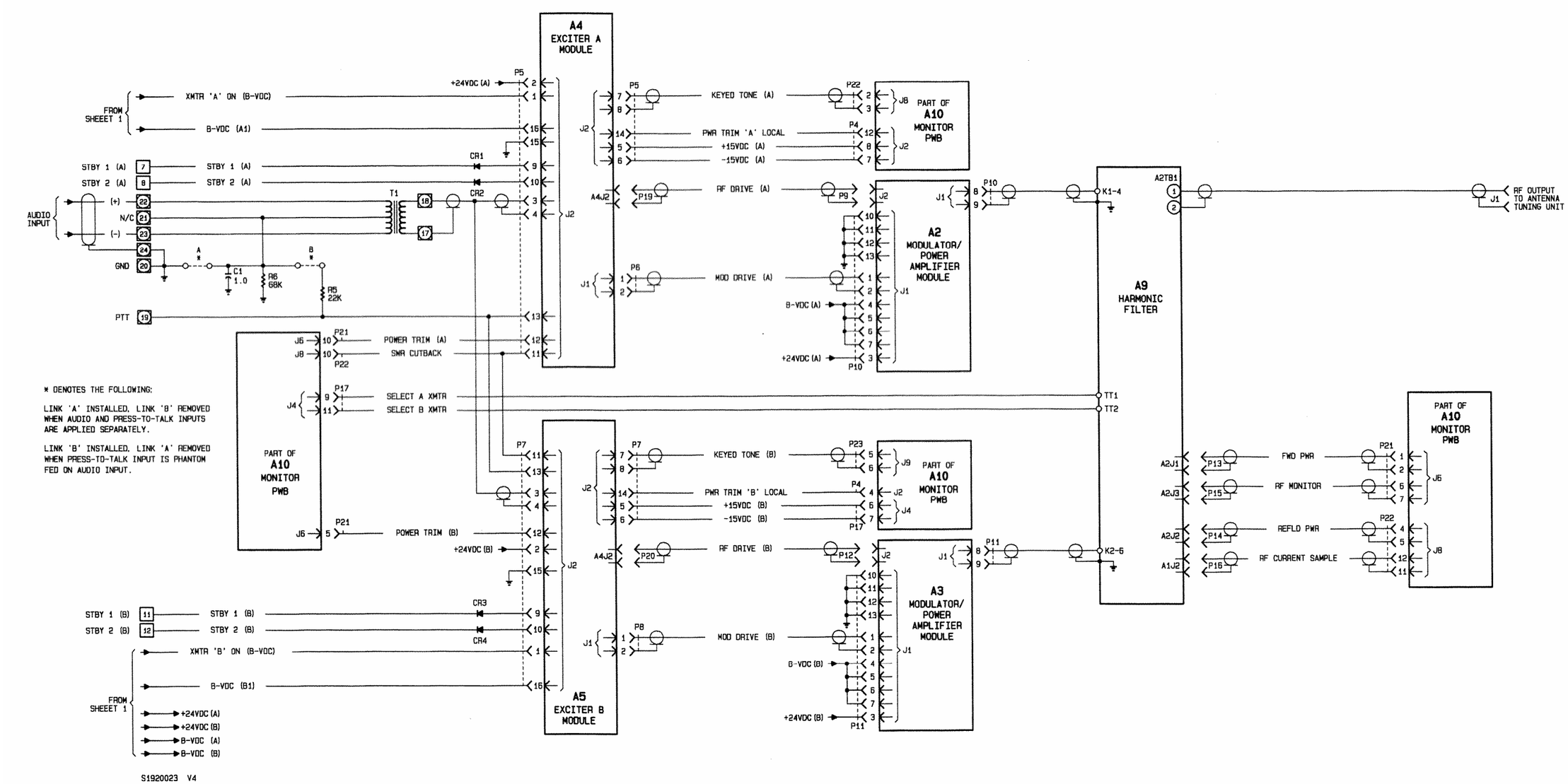


Figure SD-2 Electrical Schematic - ND4000A 1000W Radiobeacon Transmitter (Sheet 2 of 2)

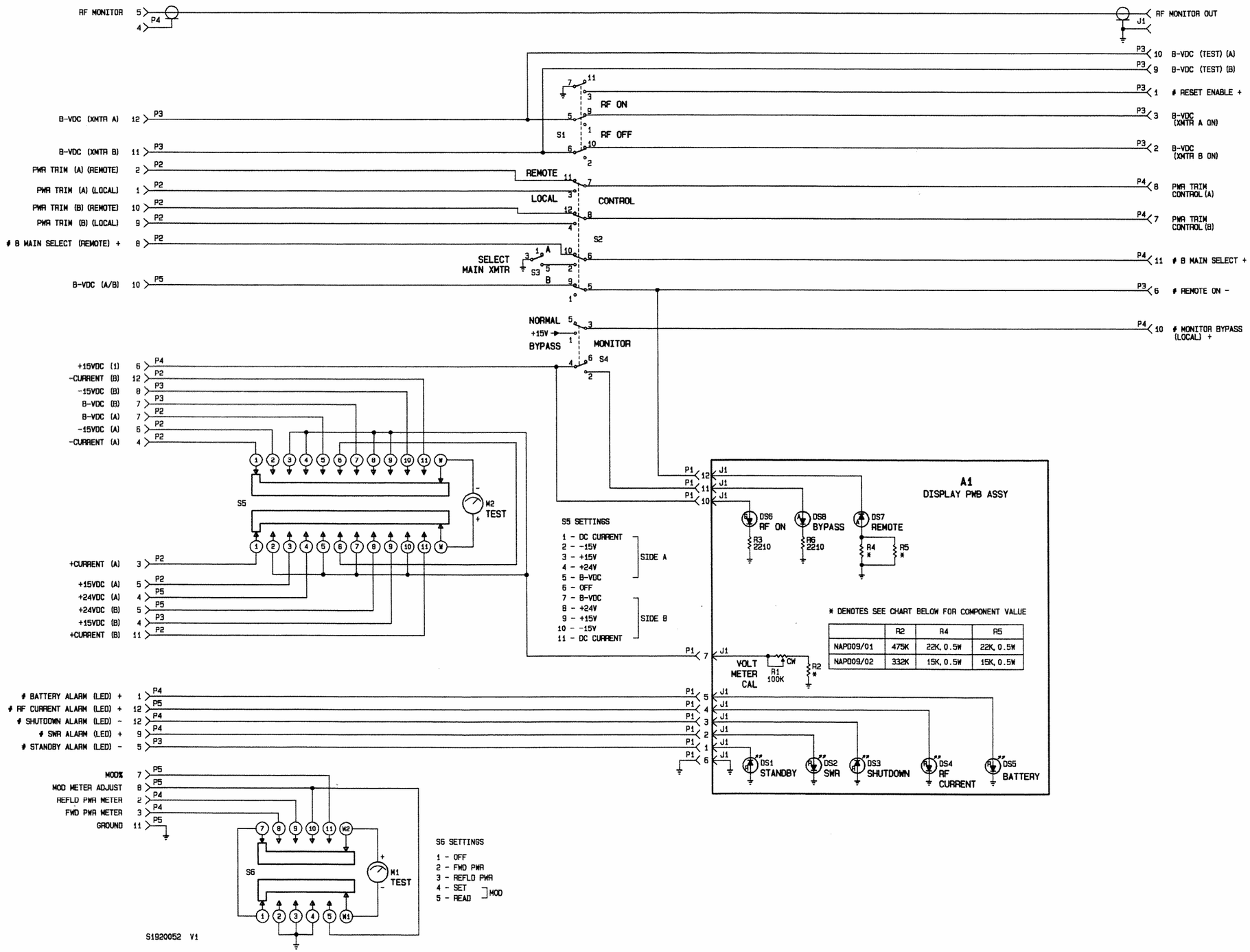
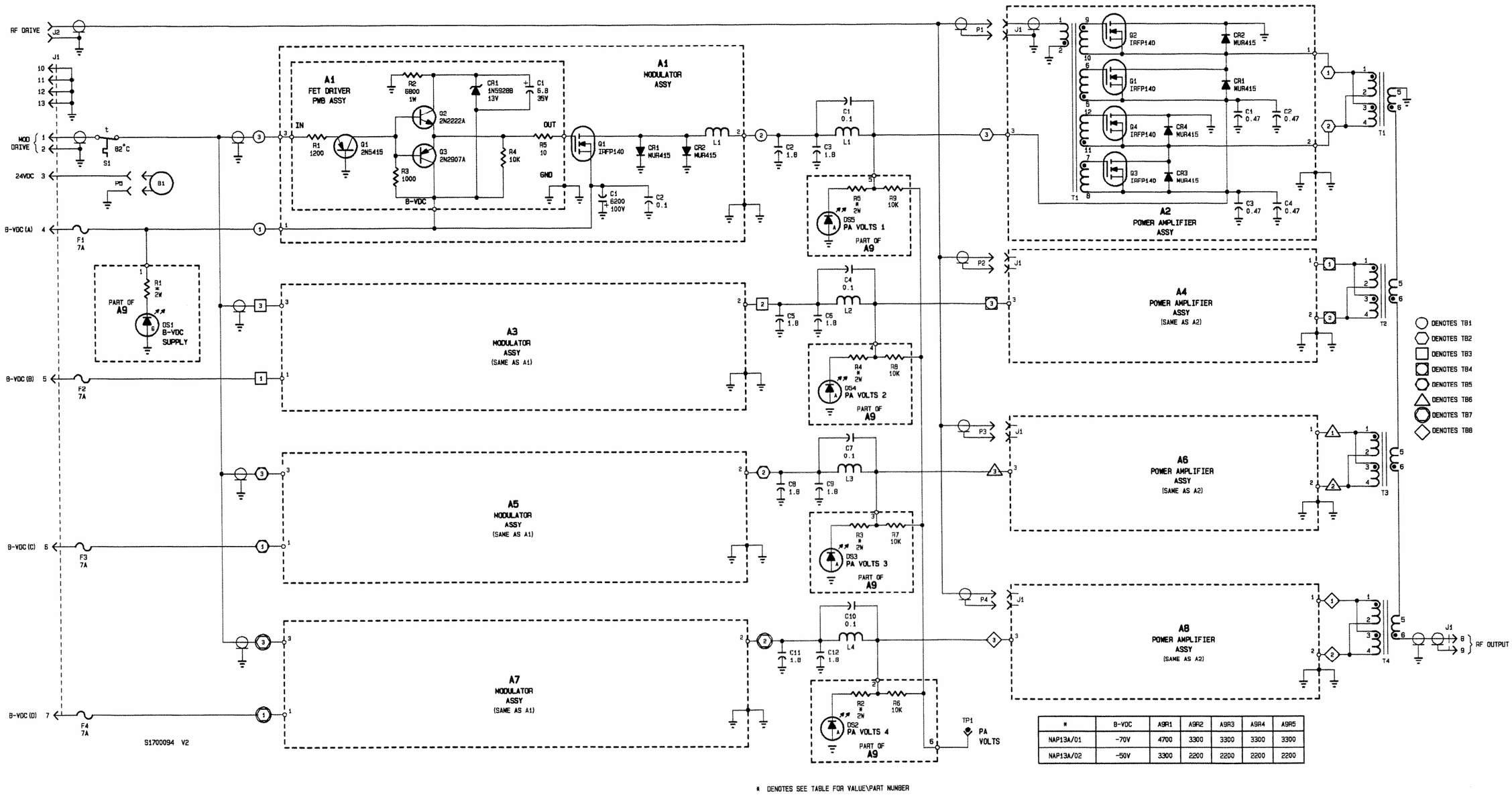
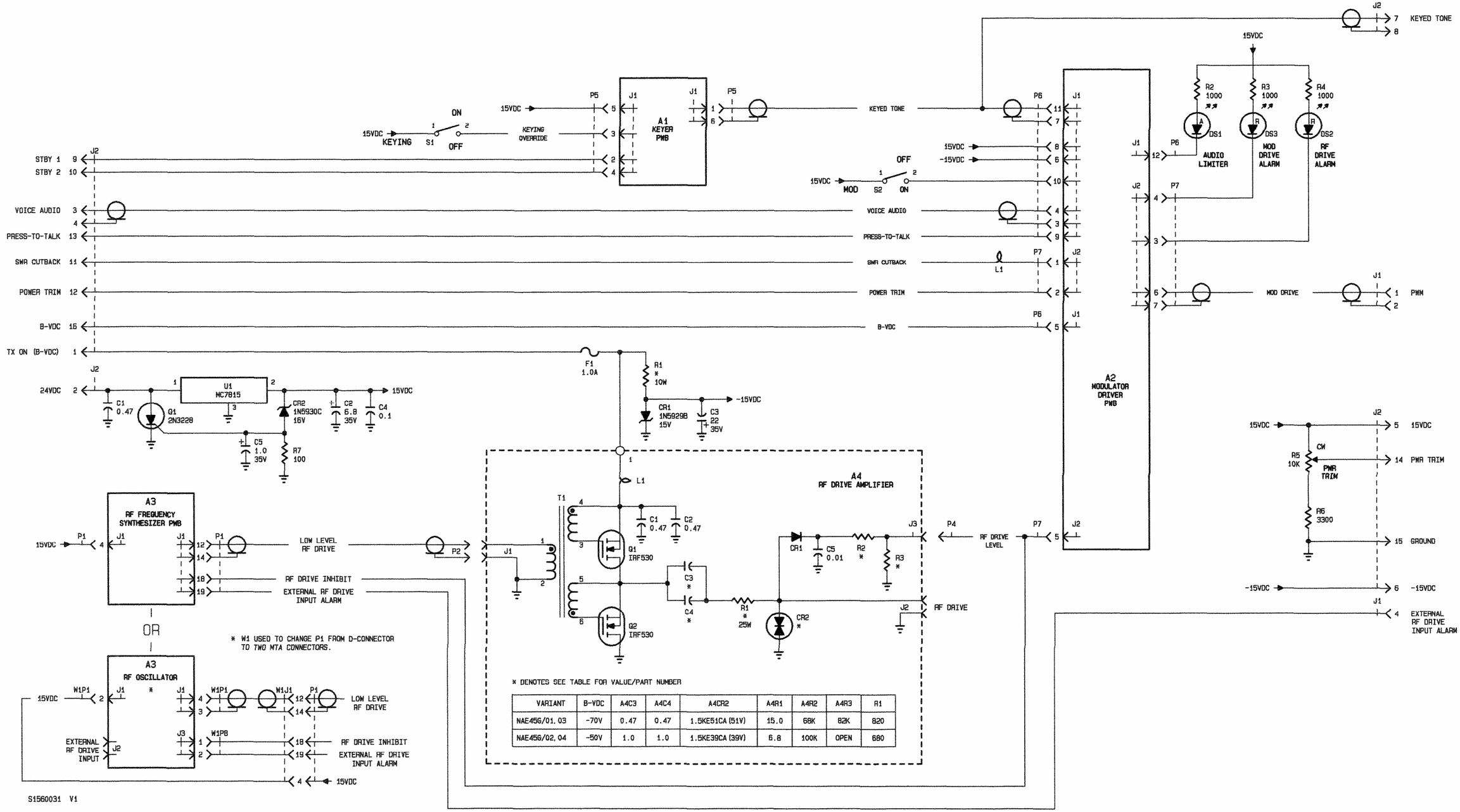


Figure SD-3 Electrical Schematic - NAC93/01 Control/Monitor Panel



*	B-VDC	A9R1	A9R2	A9R3	A9R4	A9R5
NAP13A/01	-70V	4700	3300	3300	3300	3300
NAP13A/02	-50V	3300	2200	2200	2200	2200

Figure SD-4 Electrical Schematic - NAP13A/01 Modulator/Power Amplifier Module



VARIANT	B-VDC	A4C3	A4C4	A4CR2	A4R1	A4R2	A4R3	R1
NAE45G/01, 03	-70V	0.47	0.47	1.5KE51CA (51V)	15.0	68K	82K	820
NAE45G/02, 04	-50V	1.0	1.0	1.5KE39CA (39V)	6.8	100K	OPEN	680

Figure SD-5 Electrical Schematic - NAE45G/01 Exciter Module

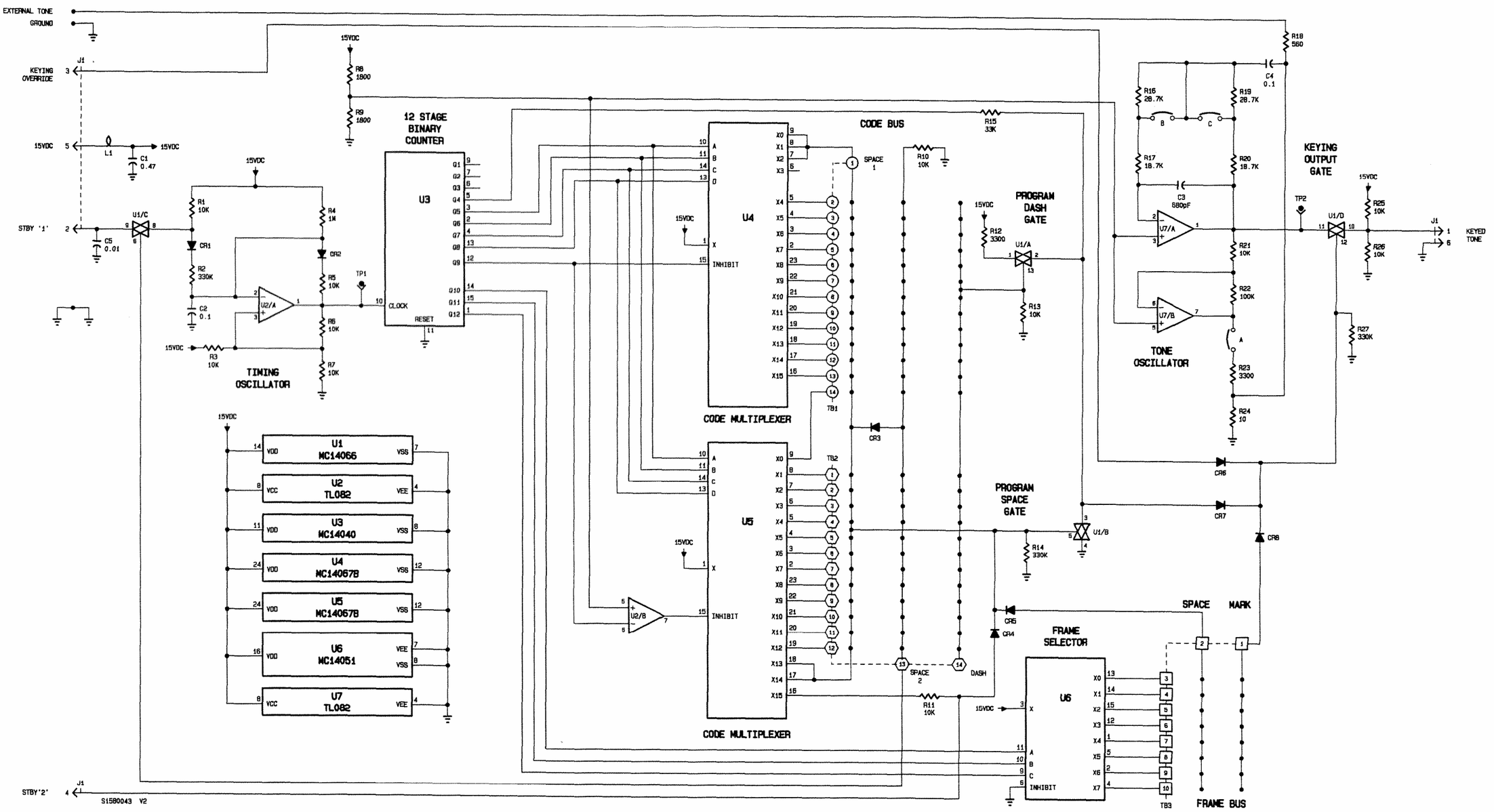


Figure SD-6 Electrical Schematic - NAPE30 Keyer PWB

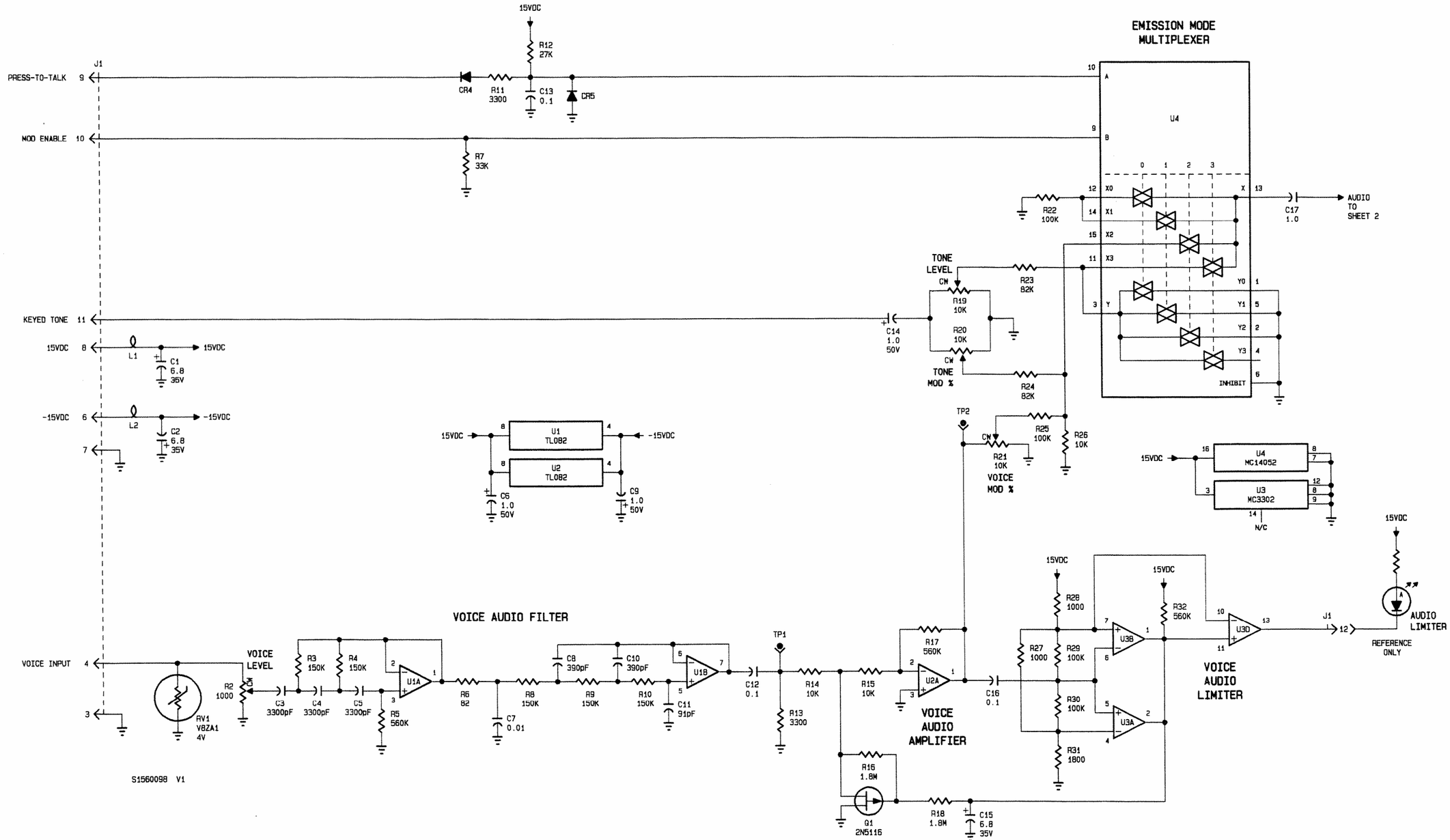
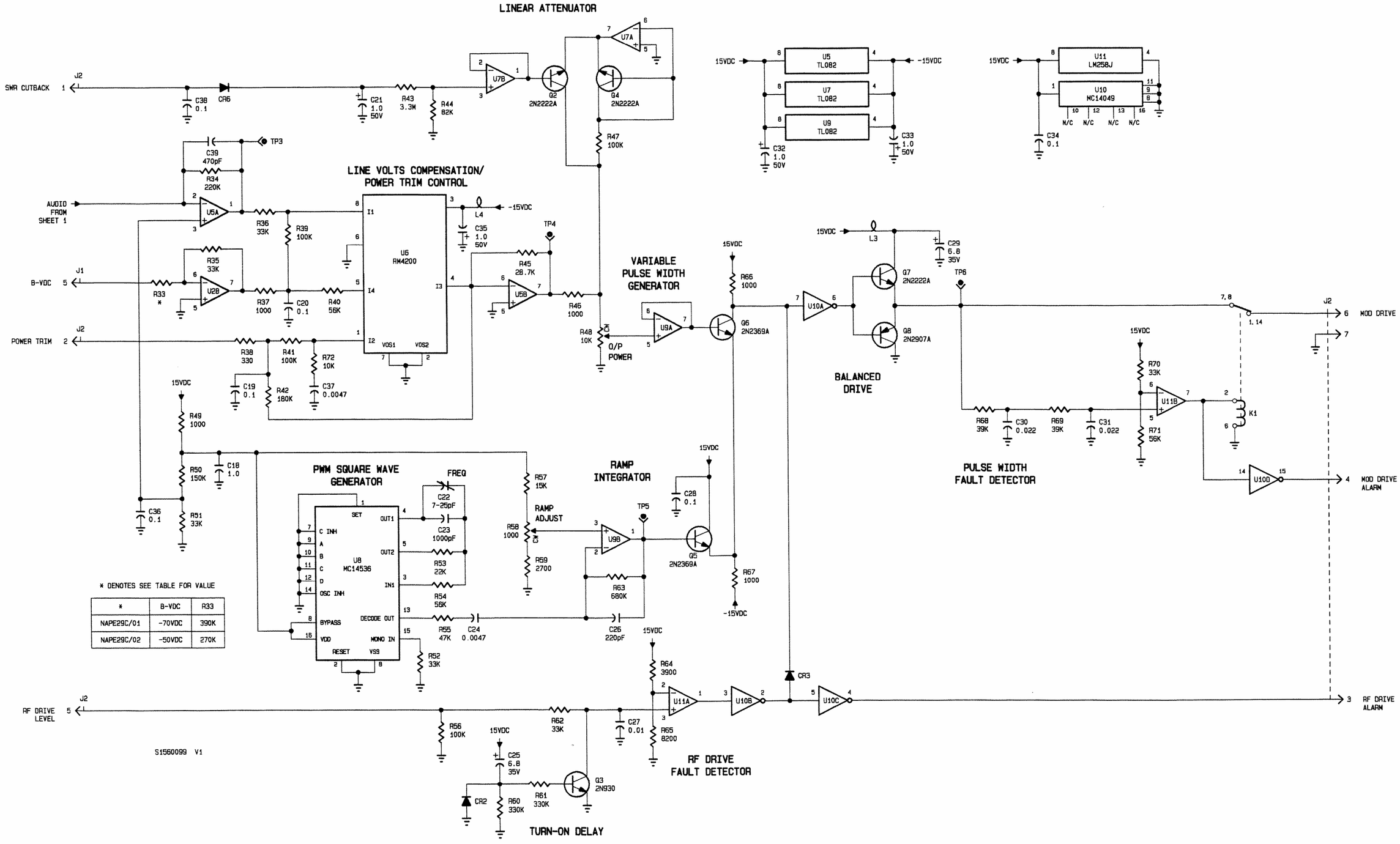


Figure SD-7 Electrical Schematic - NAPE29C/01 Modulator Driver PWB (Sheet 1 of 2)



*	B-VDC	R33
NAPE29C/01	-70VDC	390K
NAPE29C/02	-50VDC	270K

Figure SD-8 Electrical Schematic - NAPE29C/01 Modulator Driver PWB (Sheet 2 of 2)

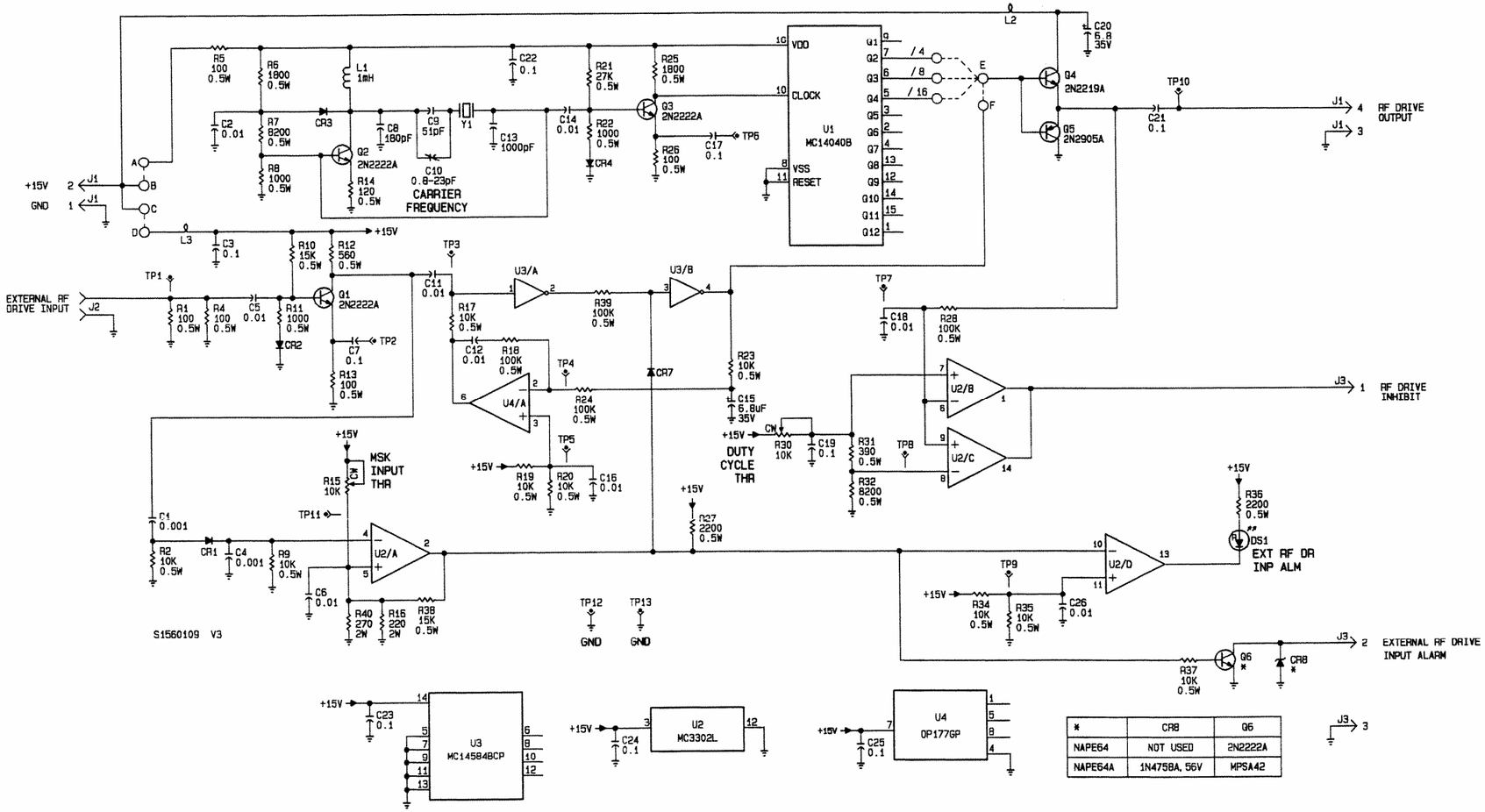


Figure SD-9 Electrical Schematic - NAPE64A RF Oscillator (Optional DGPS Input) PWB

*	A3 (NO BATTERY)	A3 (BATTERY)	F3
NAS25B/01	NAPC32A/02	NAPC32A/01	NORMAL
NAS25B/02	NAPC32A/02	NAPC32A/01	SHORTED

**	R6
NAPC32A/01	68K
NAPC32A/02	120K

S1920073 V1

Figure SD-10 Electrical Schematic - NAS25B/01 & NAS25B/02 (NAPC26C/01) Power Supply Module

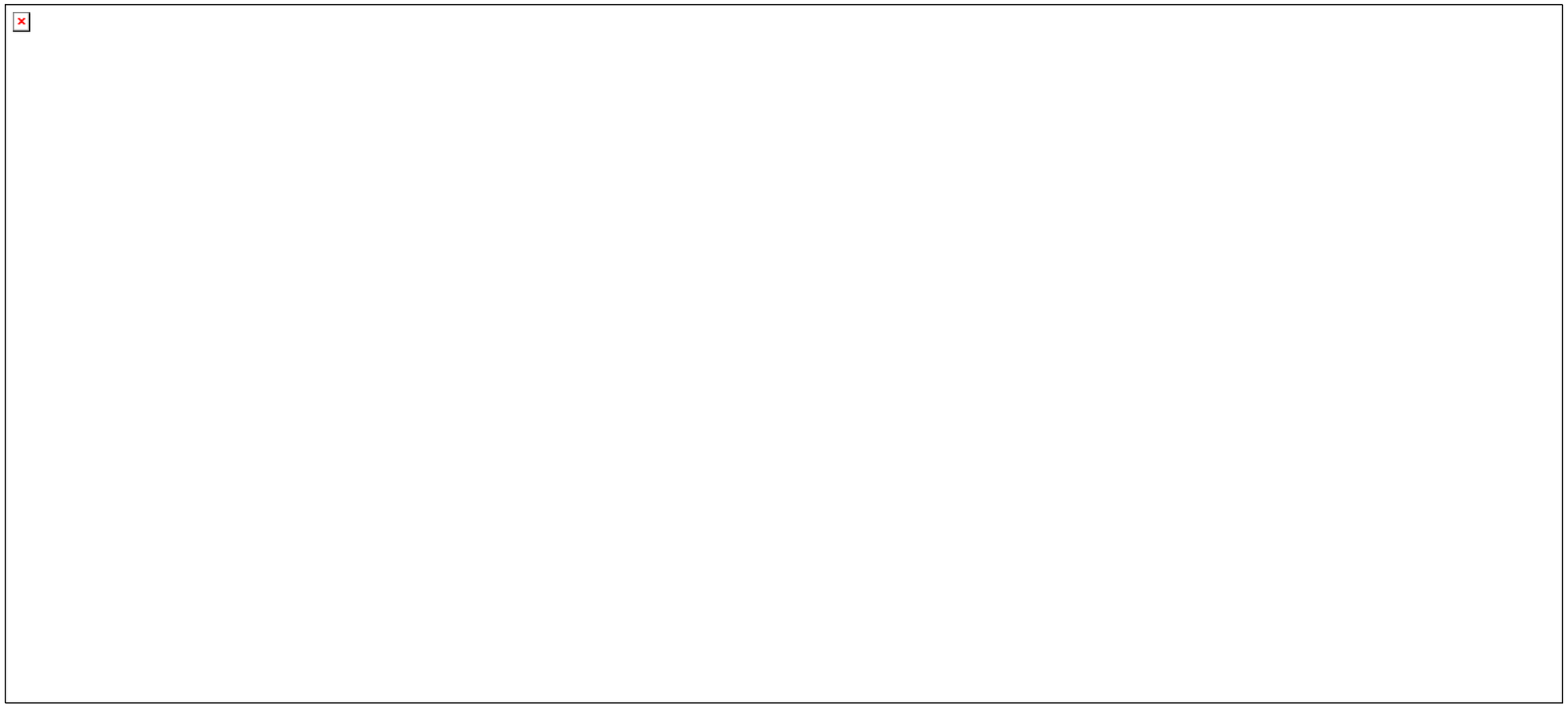


Figure SD-11 Electrical Schematic - NAF46C/01 Harmonic Filter

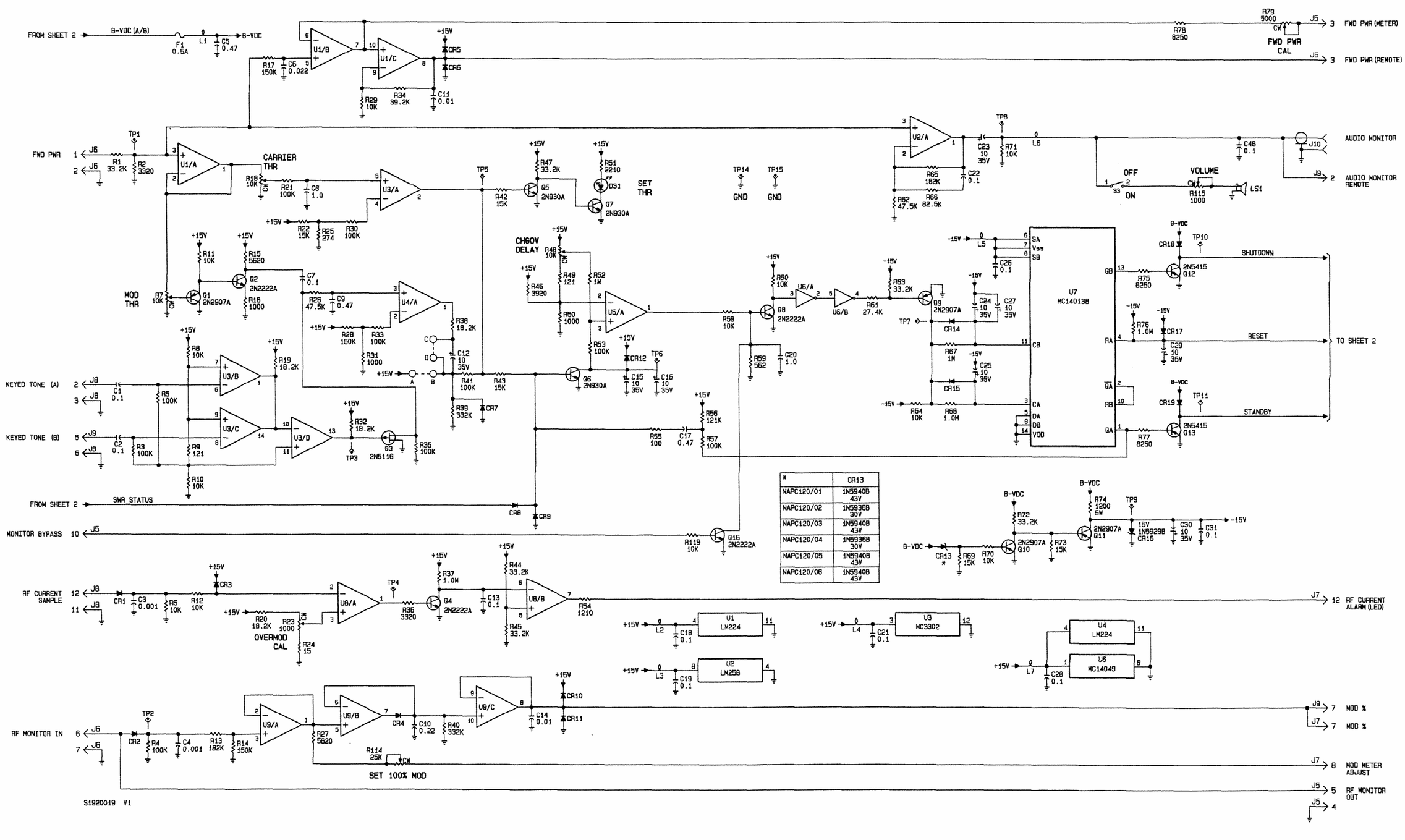
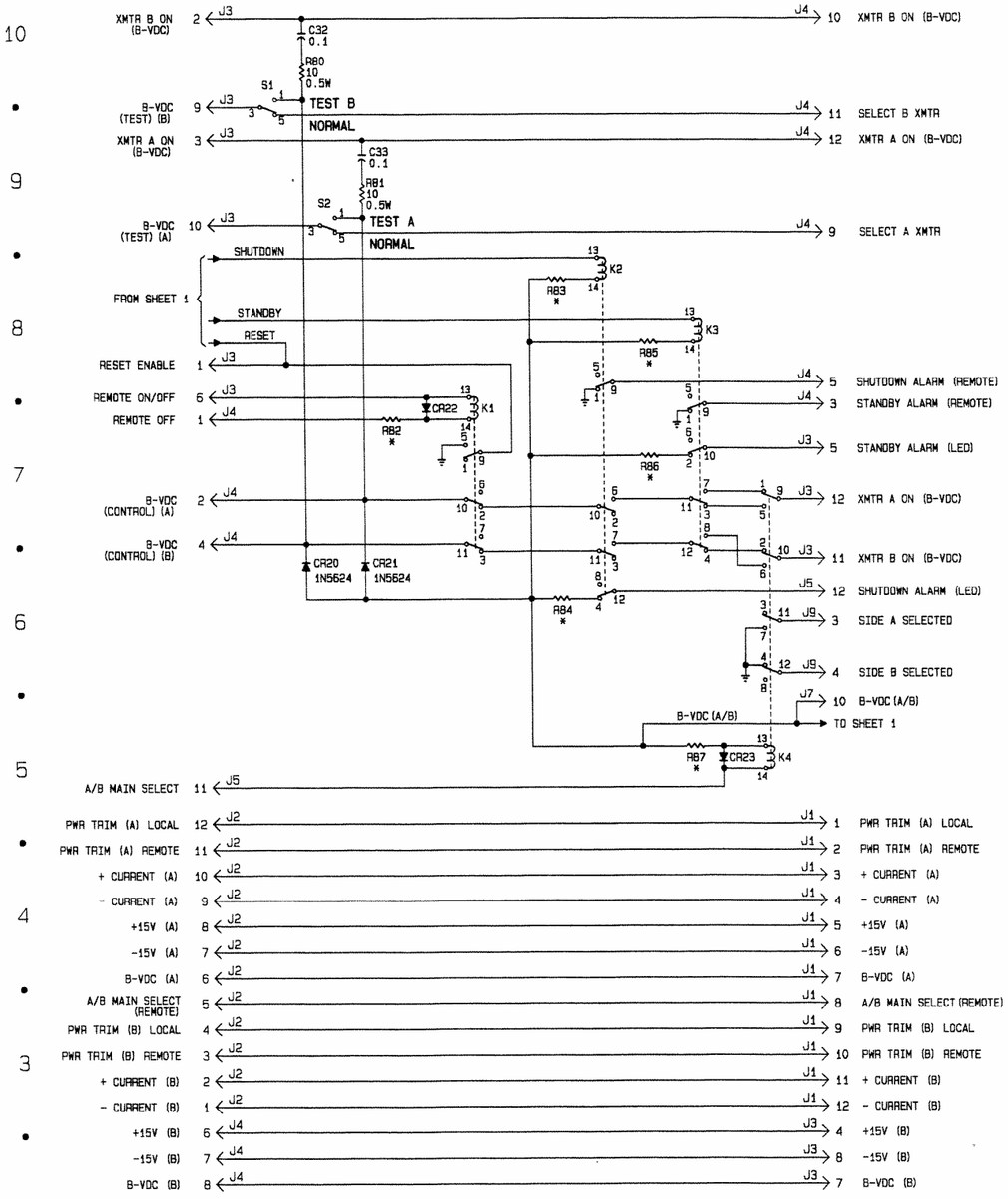


Figure SD-12 Electrical Schematic - NAPC120/01 & NAPC120/03 Monitor PWB (Sheet 1 of 2)



S1920020 V2

*	C39	CR29	R82	R83	R84	R85	R86	R87	R94
NAPC120/01	NOT USED	NOT USED	1000, 2W	1000, 2W	4700, 2W	1000, 2W	4700, 2W	1000, 2W	68.1K
NAPC120/02	NOT USED	NOT USED	LINK	LINK	3300, 2W	LINK	3300, 2W	LINK	68.1K
NAPC120/03	NOT USED	1N4938	1000, 2W	1000, 2W	4700, 2W	1000, 2W	4700, 2W	1000, 2W	68.1K
NAPC120/04	NOT USED	1N4938	LINK	LINK	3300, 2W	LINK	3300, 2W	LINK	68.1K
NAPC120/05	150uF, 40V	1N4938	1000, 2W	1000, 2W	4700, 2W	1000, 2W	4700, 2W	1000, 2W	68.1K
NAPC120/06	150uF, 40V	1N4938	1000, 2W	1000, 2W	4700, 2W	1000, 2W	4700, 2W	1000, 2W	10K

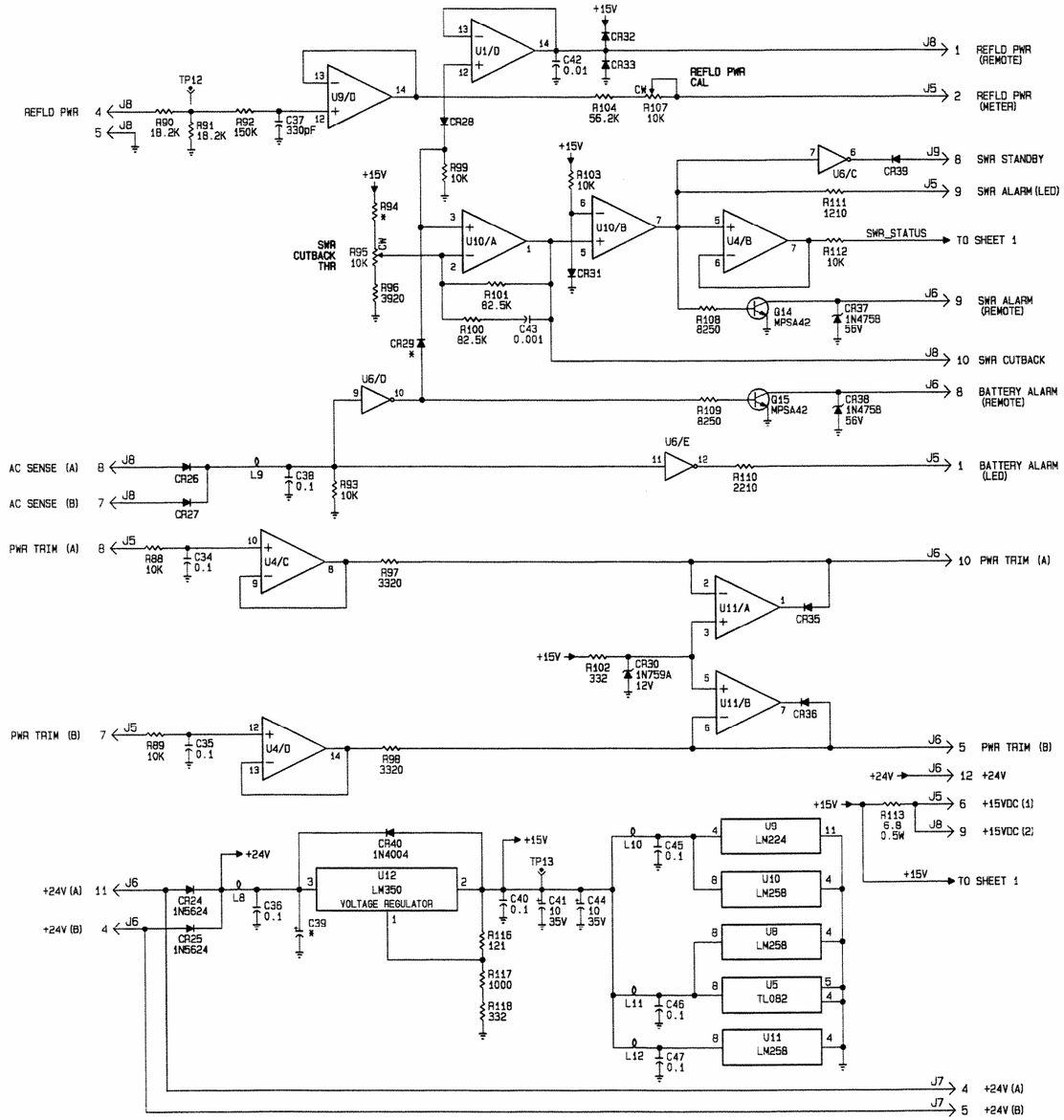


Figure SD-13 Electrical Schematic - NAPC120/01 & NAPC120/03 Monitor PWB (Sheet 2 of 2)

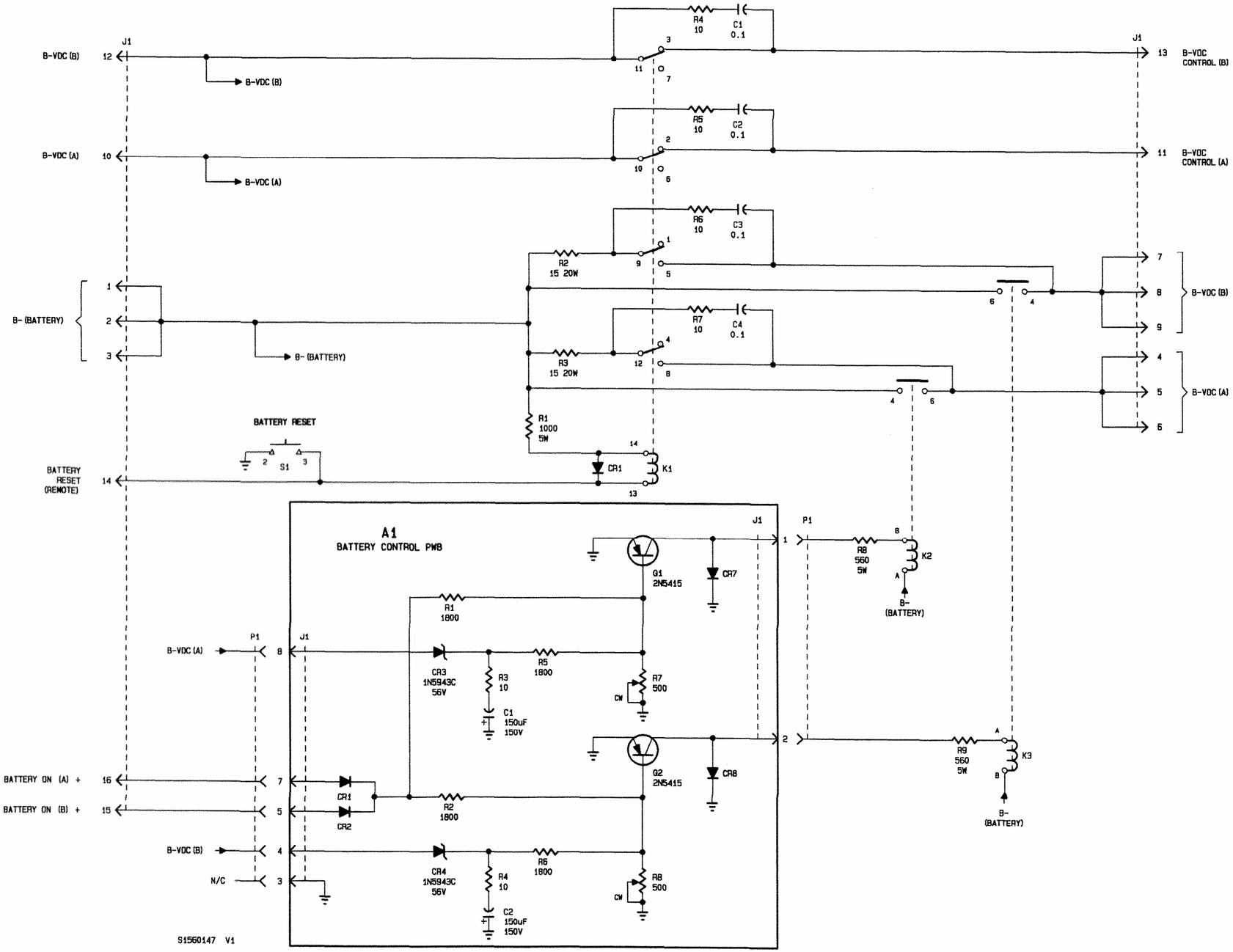


Figure SD-14 Electrical Schematic - NAX50A/03 Battery Control Panel

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.

X/Y CO-ORDINATES ON PWB DRAWINGS

10.4 Assembly detail drawings for printed wiring boards with a high parts density contain X/Y co-ordinates to assist in locating components. When the reference designation of a component is known, but it can not be easily located:

- Refer to the associated parts list (Ref Des index) and note the X/Y co-ordinates in its ***X/Y Grid Column*** for that reference designation.

- Return to the assembly drawing and look for the component within the rectangle formed by the X/Y coordinates obtained from the ref des index.

Table 10-1 List of Mechanical Drawings

Figure MD-1	Assembly Detail - ND4000A 1000W Radiobeacon Transmitter
Figure MD-2	Assembly Detail - NAC93/01 Control/Monitor Panel (Front View)
Figure MD-3A	Assembly Detail - NAC93/01 Control/Monitor Panel (Rear View)
Figure MD-3B	Assembly Detail - NAPD09/01 Display PWB
Figure MD-4	Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Front View)
Figure MD-5	Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Top View)
Figure MD-6	Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Left Side)
Figure MD-7	Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Right Side)
Figure MD-8	Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Bottom View)
Figure MD-9	Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Rear View)
Figure MD-10	Assembly Detail - NASM06/01 Modulator Assembly
Figure MD-11	Assembly Detail - NAA02/01 Power Amplifier
Figure MD-12	Assembly Detail - Display Interface PWB (P/N 156-1037)
Figure MD-13	Assembly Detail - NAE45G/01 Exciter Module (Front View)
Figure MD-14	Assembly Detail - NAE45G/01 Exciter Module (Left Side View)
Figure MD-15	Assembly Detail - NAE45G/01 Exciter Module (Right Side View)
Figure MD-16	Assembly Detail - NAE45G/01 Exciter Module (Rear View)
Figure MD-17	Assembly Detail - NAPE30 Keyer PWB
Figure MD-18	Assembly Detail - NAPE29C/01 Modulator Driver PWB
Figure MD-19	Assembly Detail - NAPE64A RF Oscillator (Optional DGPS Input) PWB
Figure MD-20	Not Used
Figure MD-21	Assembly Detail - NAA21A/01 RF Drive Amplifier
Figure MD-22	Assembly Detail - Power On/Off Panel (192-8130)
Figure MD-23	Assembly Detail - NAS25B/01 & NAS25B/02 Power Supply Module (Front View)
Figure MD-24	Assembly Detail - NAS25B/01 & NAS25B/02 Power Supply Module (Top View)
Figure MD-25	Assembly Detail - NAS25B/01 & NAS25B/02 Power Supply Module (Rear View)
Figure MD-26	Assembly Detail - NAPC26C/01 Power Supply Control PWB
Figure MD-27	Assembly Detail - NASC01/01 B- VDC To +24 VDC Converter
Figure MD-28	Assembly Detail - NAPC32A/01 & NAPC32A/02 Ac Supply Monitor PWB
Figure MD-29	Assembly Detail - Interface Panel (P/N 192-8110)
Figure MD-30	Assembly Detail - NAF46C/01 Harmonic Filter (Front View)
Figure MD-31	Assembly Detail - NAF46C/01 Harmonic Filter (Rear View)
Figure MD-32	Assembly Detail - NAFP23/01 RF Current Probe
Figure MD-33	Assembly Detail - NAFP24A/01 Forward/Reflected Power Probe
Figure MD-34	Assembly Detail - NAPC120/01 Monitor PWB
Figure MD-35	Assembly Detail - NAPC120/03 Monitor PWB
Figure MD-36	Assembly Detail - NAX50A/03 Battery Control Panel
Figure MD-37	Assembly Detail - Battery Control PWB (P/N 156-7164-02)
Figure MD-38	Dimensional Information - ND4000A 1000W Radiobeacon Transmitter

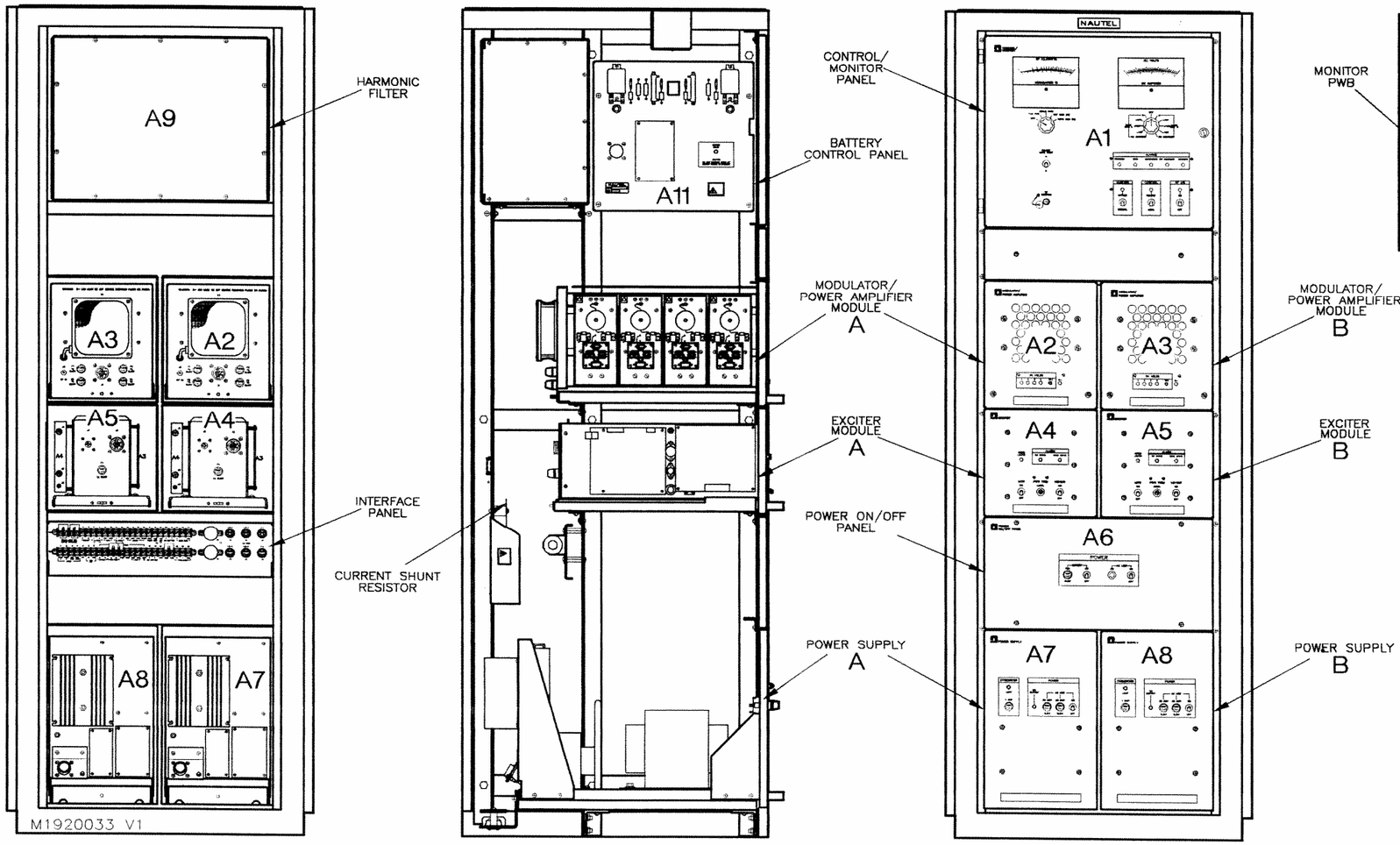


Figure MD-1 Assembly Detail - ND4000A 1000W Radiobeacon Transmitter

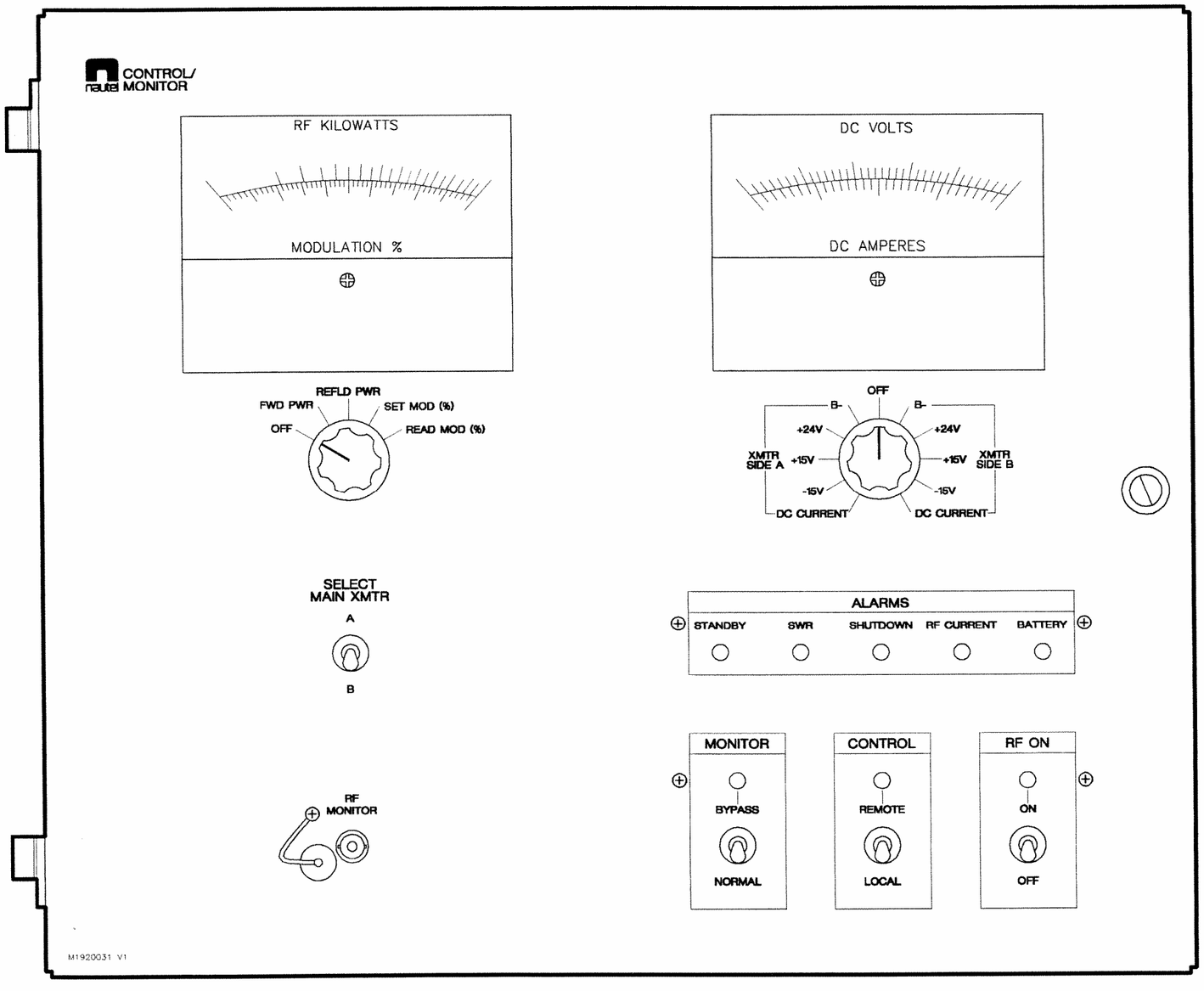


Figure MD-2 Assembly Detail - NAC93/01 Control/Monitor Panel (Front View)

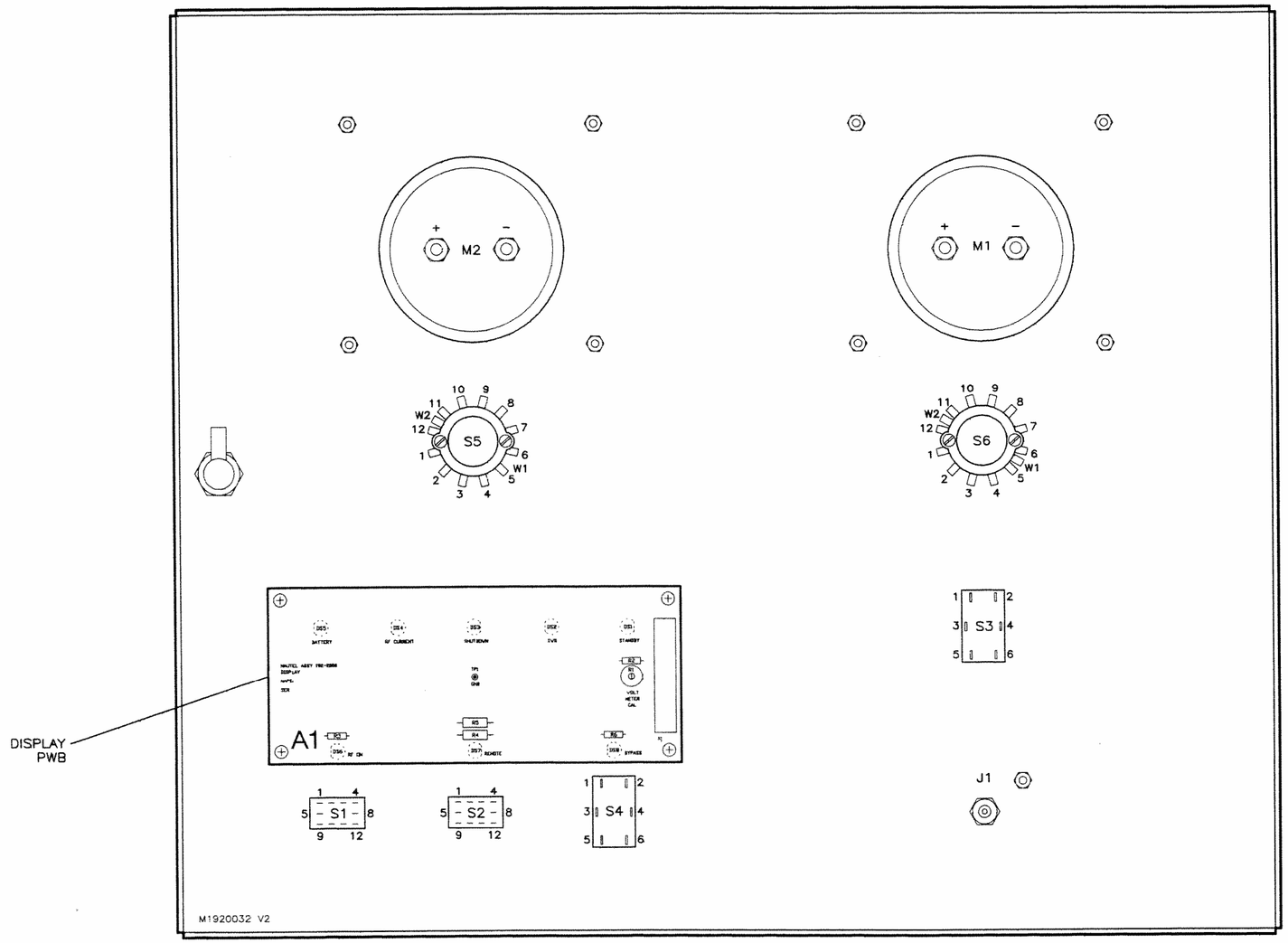
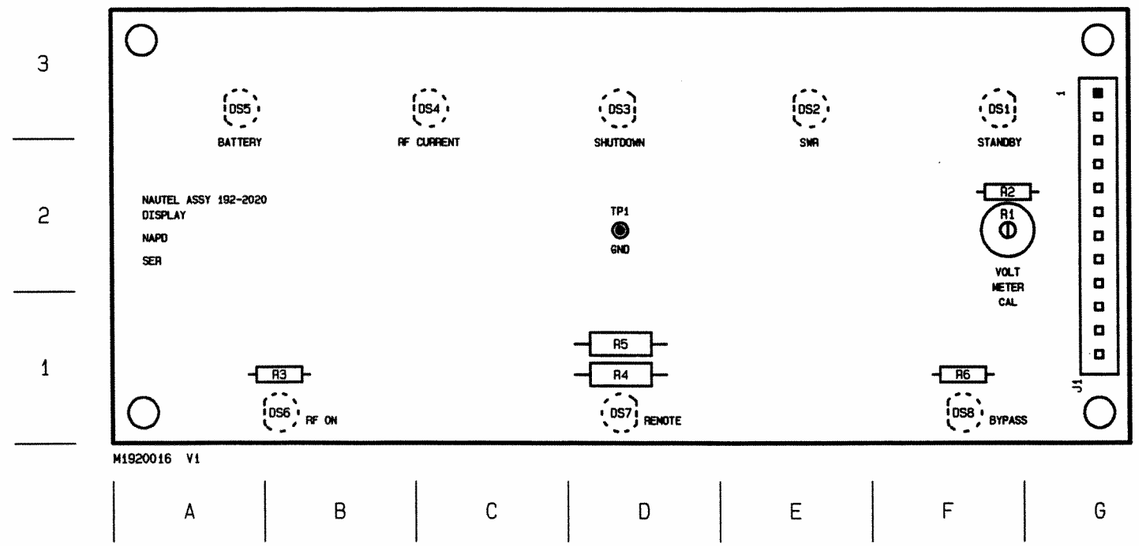


Figure MD-3A Assembly Detail - NAC93/01 Control/Monitor Panel (Rear View)



ALL LEDs LOCATED ON REVERSE SIDE

Figure MD-3B Assembly Detail - NAPD09/01 Display PWB

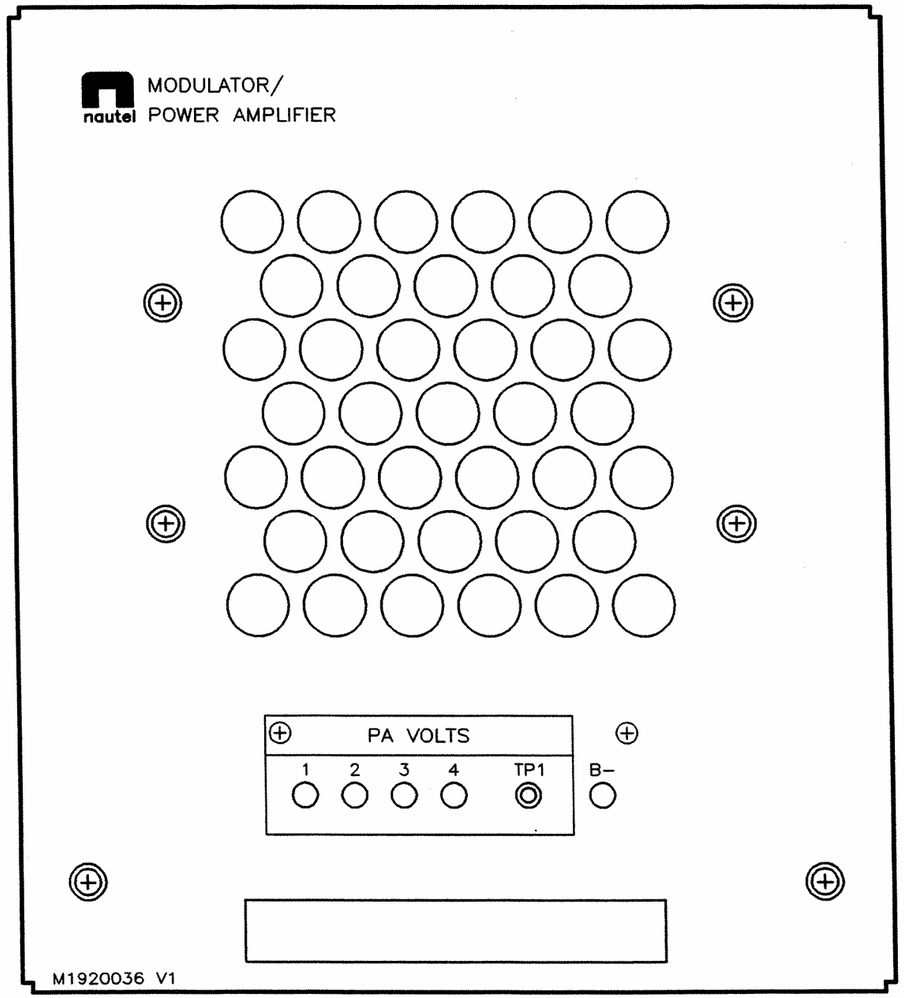


Figure MD-4 Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Front View)

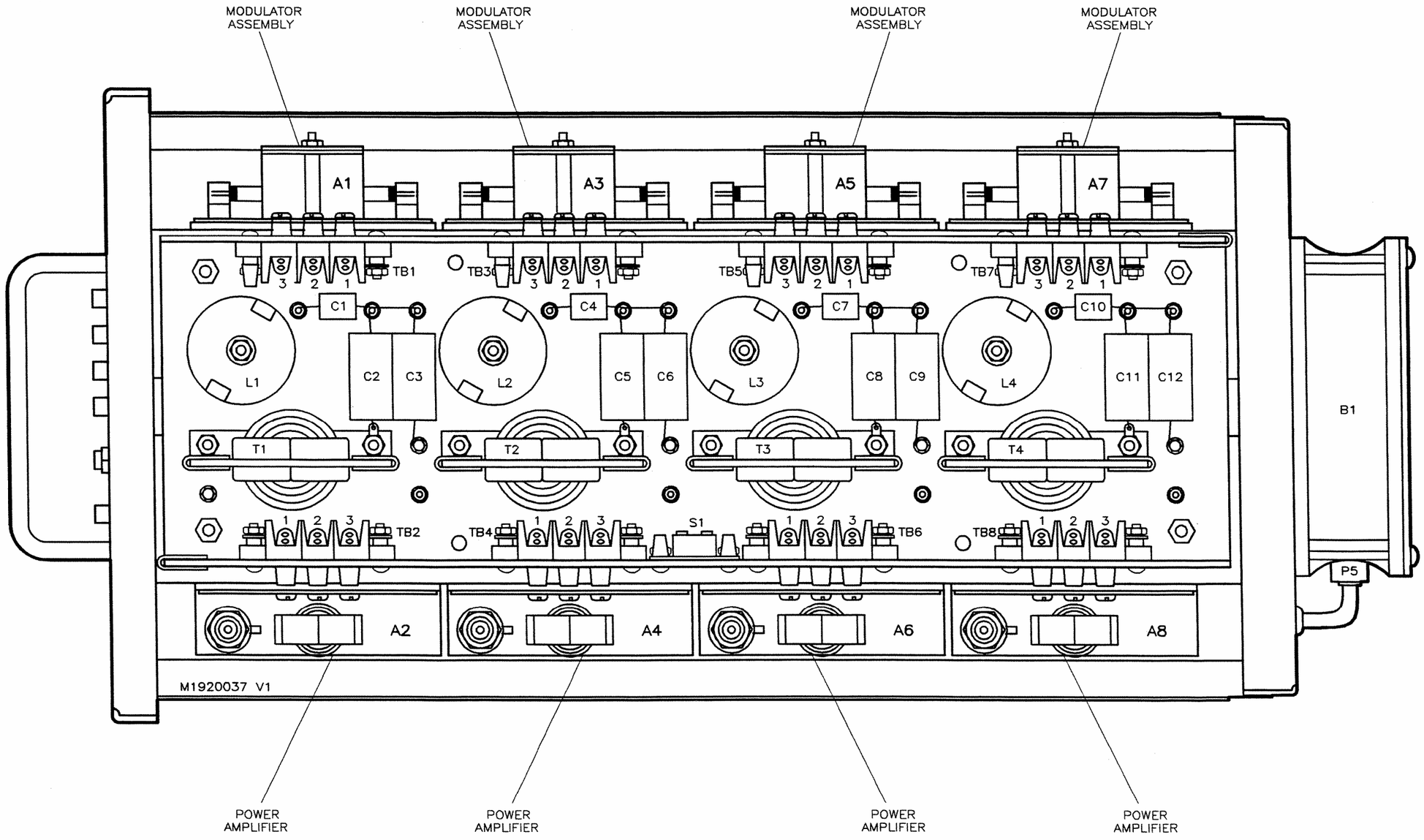


Figure MD-5 Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Top View)

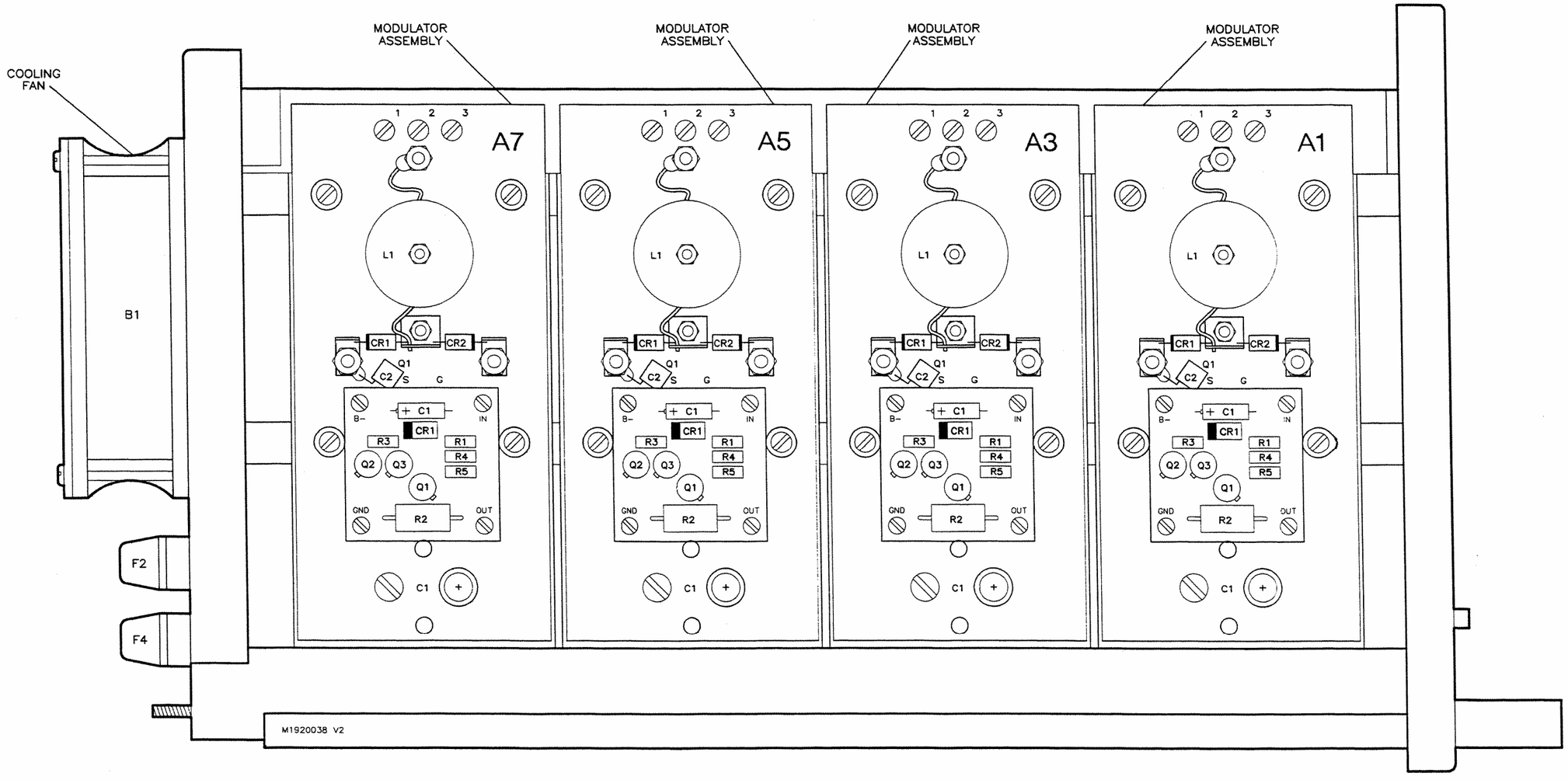


Figure MD-6 Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Left Side View)

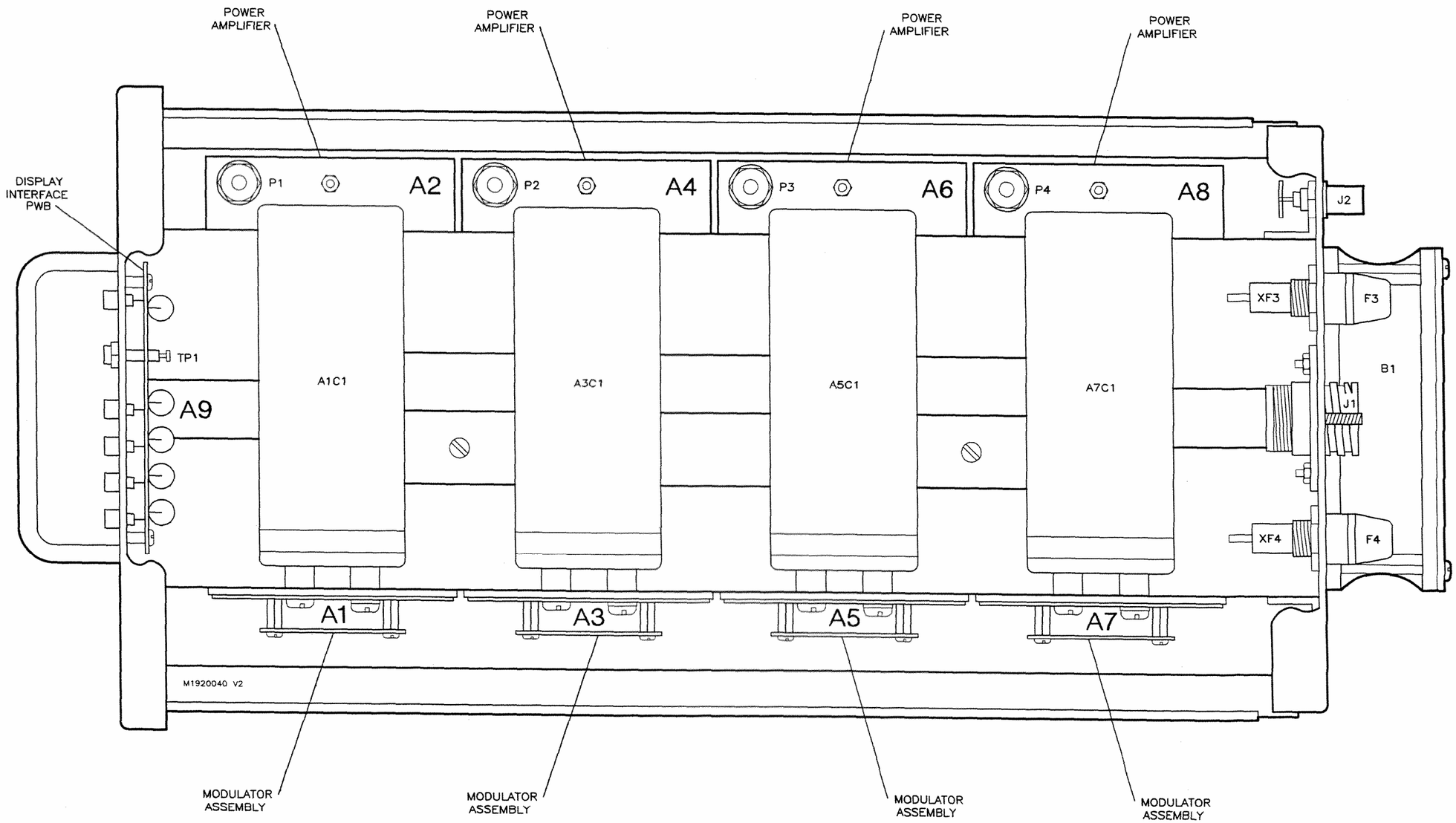


Figure MD-7 Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Right Side View)

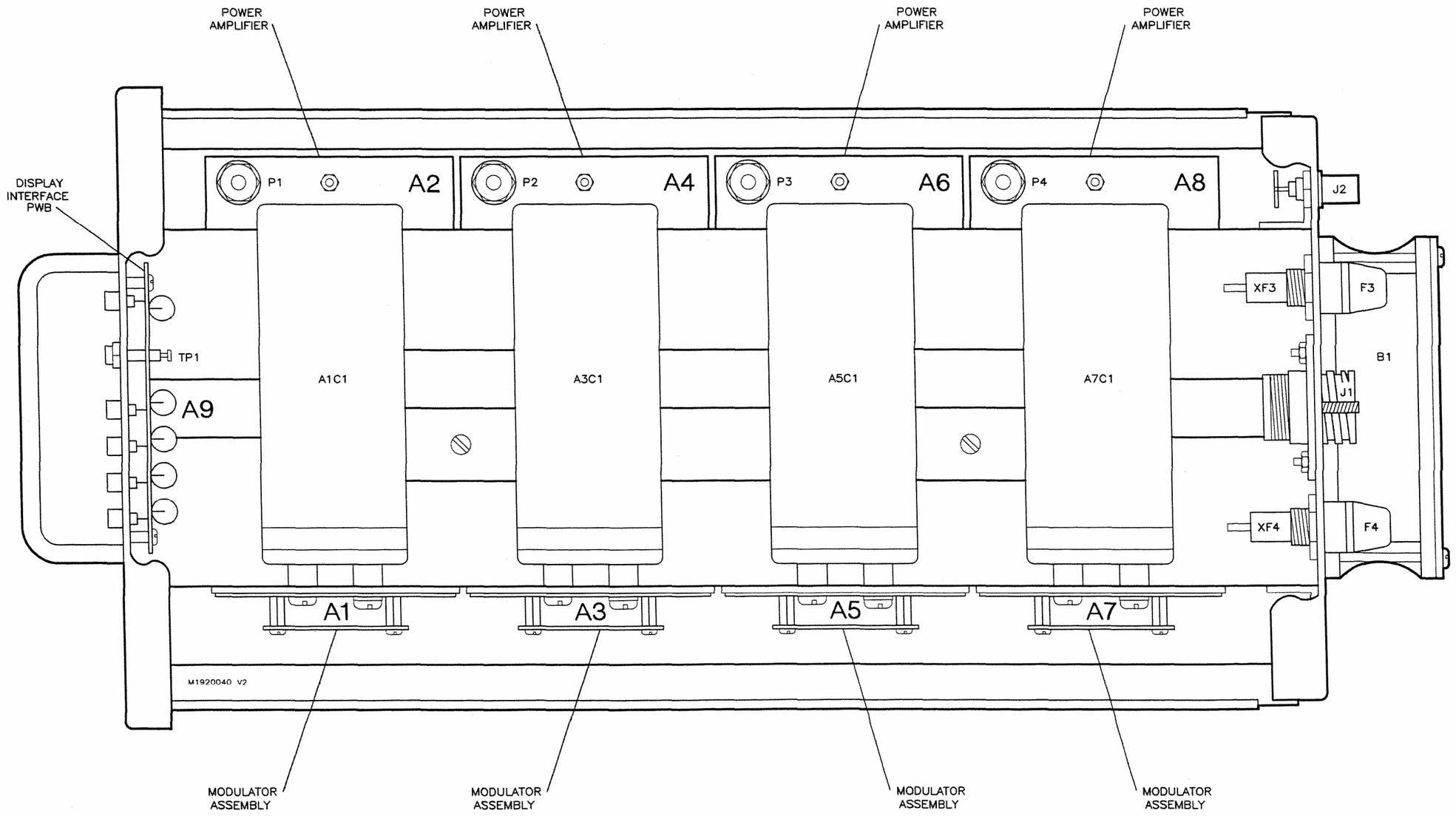


Figure MD-8 Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Bottom View)

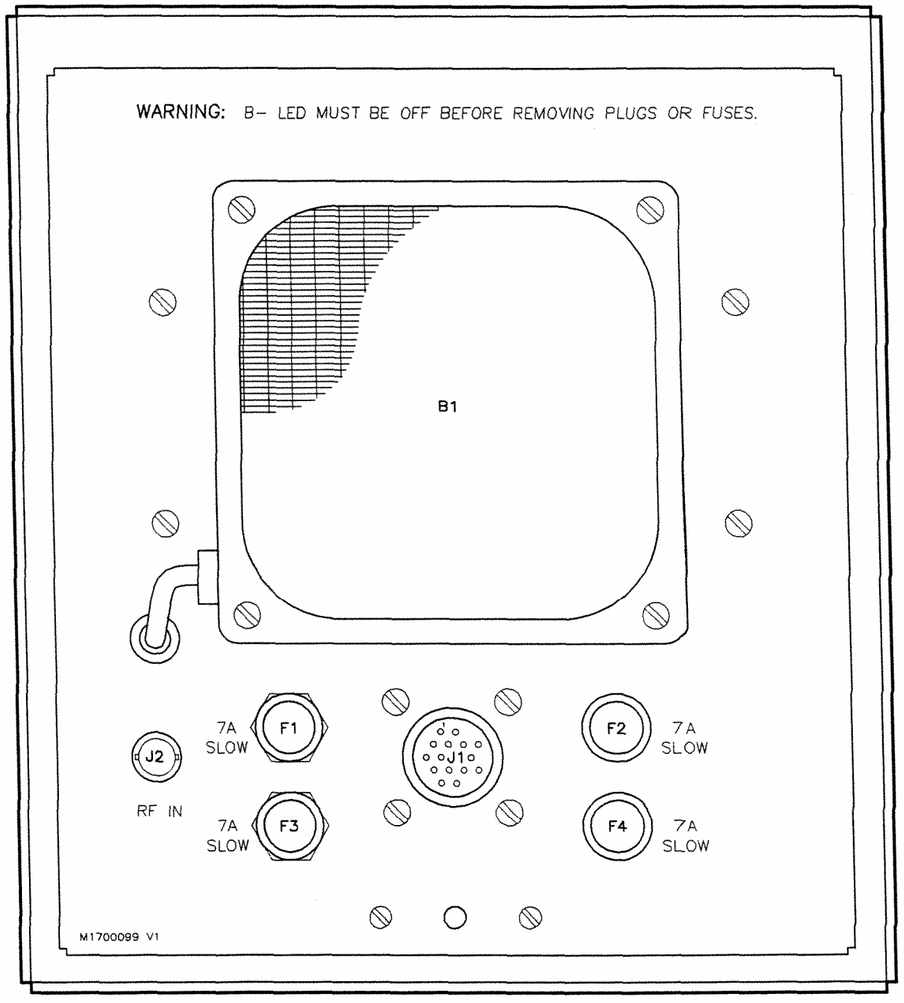
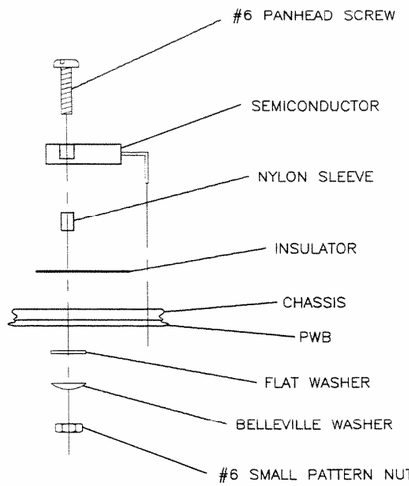


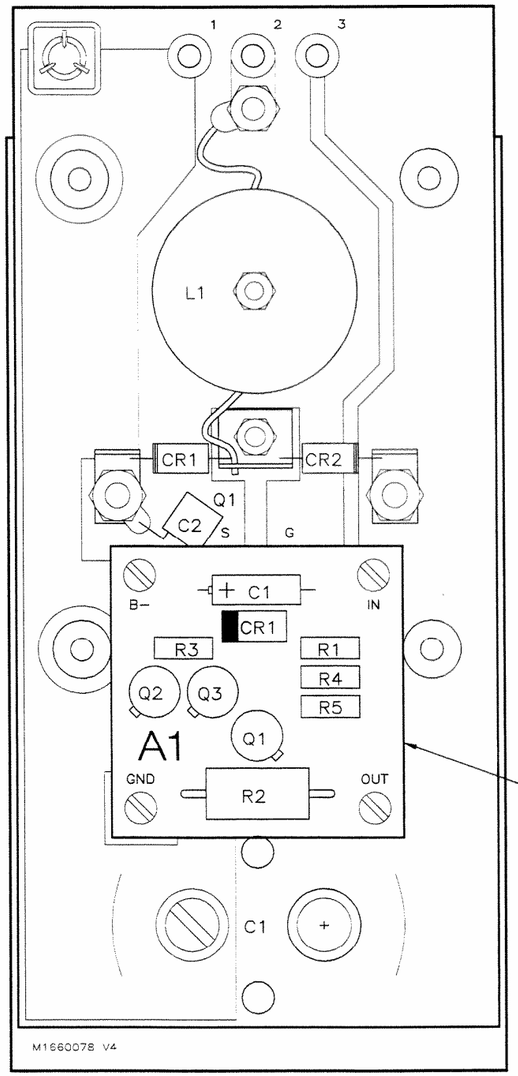
Figure MD-9 Assembly Detail - NAP13A/01 Modulator/Power Amplifier Module (Rear View)



Q1 MOUNTING DETAIL

TORQUE ATTACHED HARDWARE TO
5 in/lbs (.566 NEWTON METRES)

ENSURE SEMICONDUCTOR LEADS DO NOT CONTACT
PRINTED WIRING PATTERNS AT OTHER THAN DESIGNATED POINTS



FET DRIVER PWB

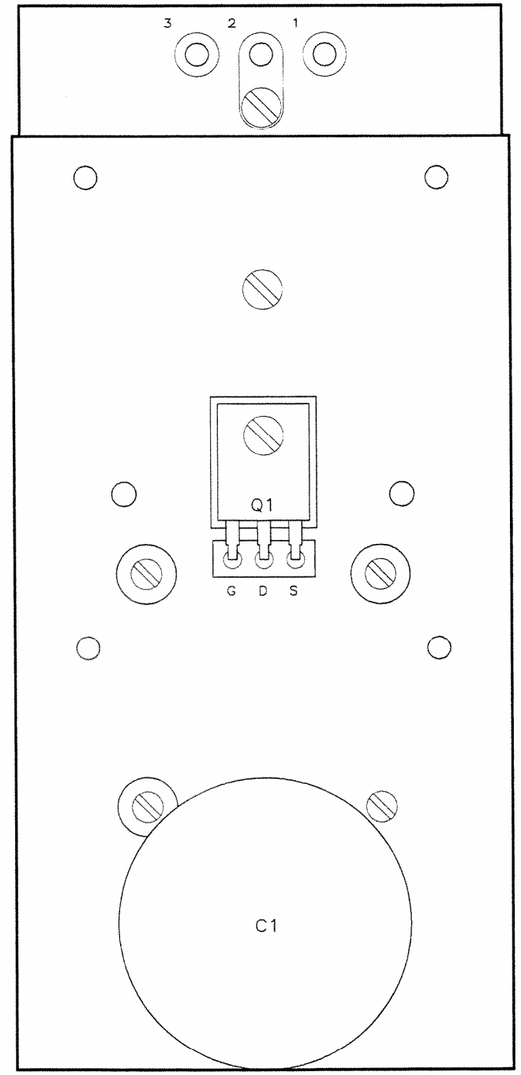
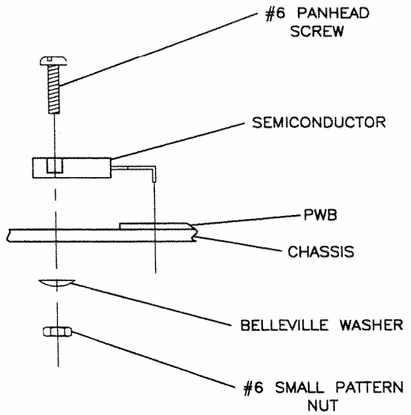
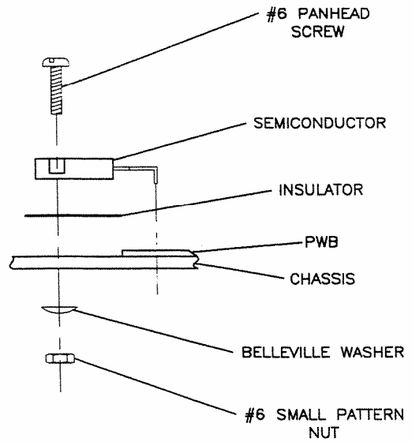


Figure MD-10 Assembly Detail - NASM06/01 Modulator Assembly



Q2 & Q4 MOUNTING DETAIL

TORQUE ATTACHED HARDWARE TO 5 in/lbs (.566 NEWTON METRES)



Q1 & Q3 MOUNTING DETAIL

TORQUE ATTACHED HARDWARE TO 5 in/lbs (.566 NEWTON METRES)

SOURCE	DESTINATION
T1–1	J1–CENTRE
T1–2	GROUND (AT J1)
T1–5	Q1–SOURCE (5)
T1–6	Q1–GATE (6)
T1–7	Q3–GATE (7)
T1–8	Q3–SOURCE (8)
T1–9	Q2–GATE (9)
T1–10	Q2–SOURCE (10)
T1–11	Q4–SOURCE (11)
T1–12	Q4–GATE (12)

ENSURE SEMICONDUCTOR LEADS DO NOT CONTACT PRINTED WIRING PATTERNS AT OTHER THAN DESIGNATED POINTS

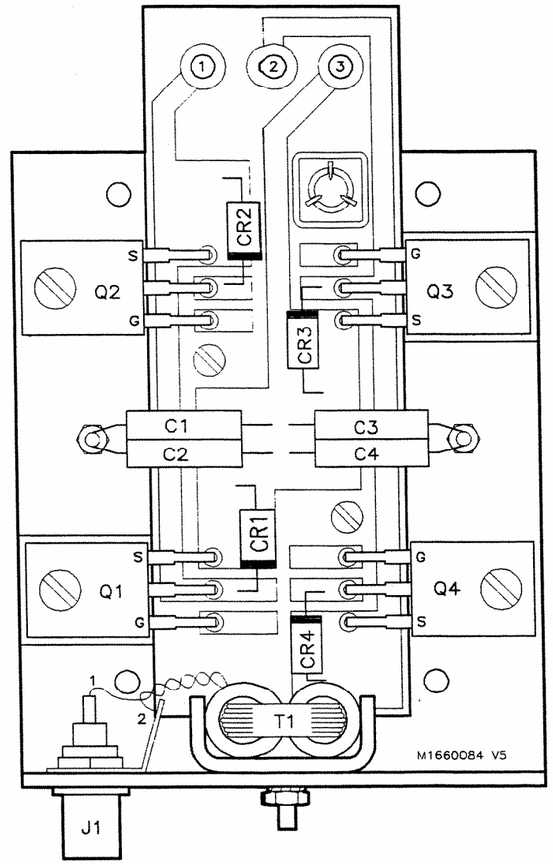


Figure MD-11 Assembly Detail - NAA02/01 Power Amplifier

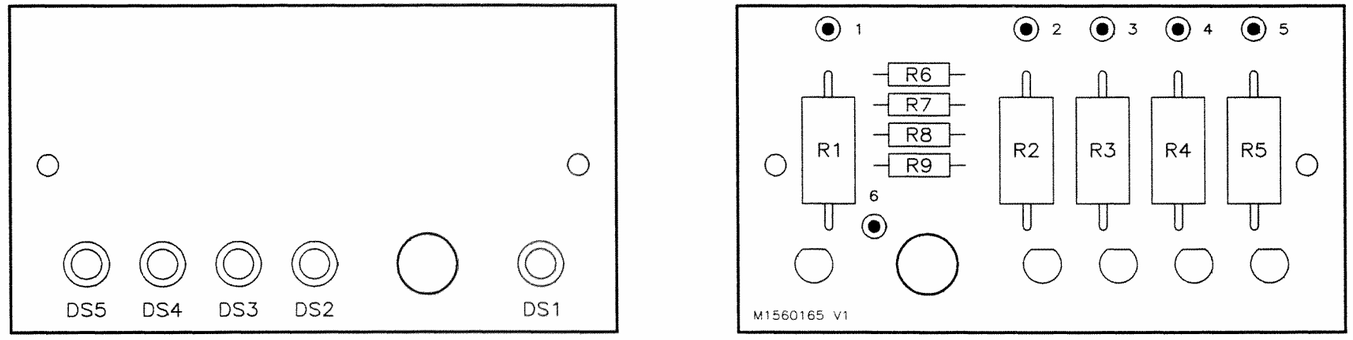


Figure MD-12 Assembly Detail - Display Interface PWB (P/N 156-1037)

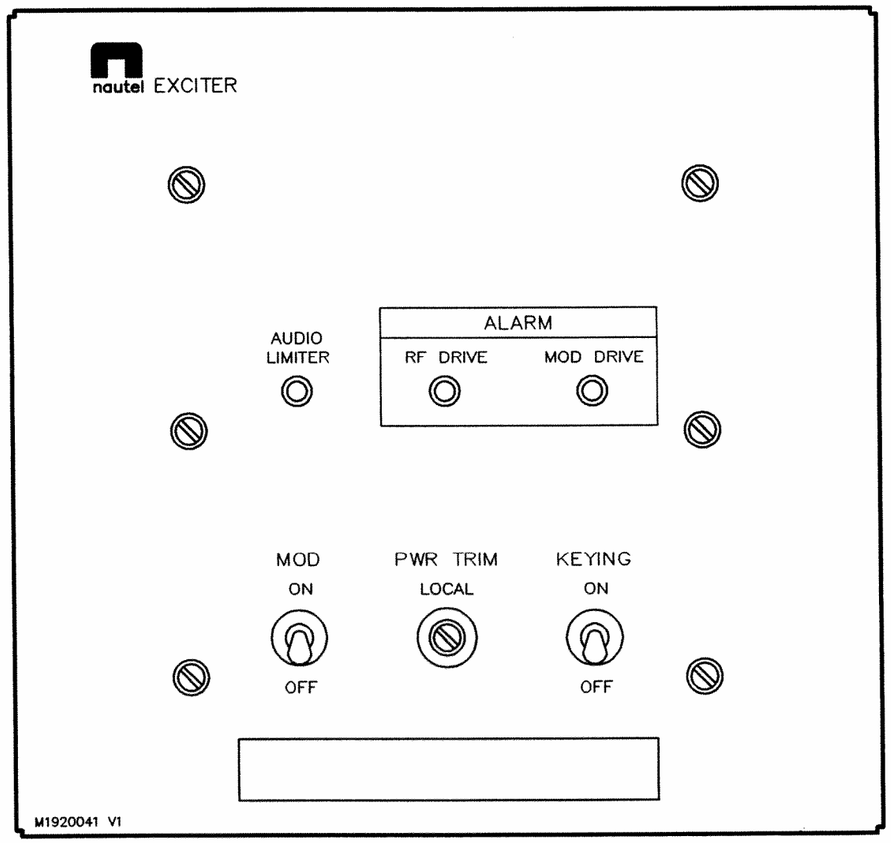


Figure MD-13 Assembly Detail - NAE45G/01 Exciter Module (Front View)

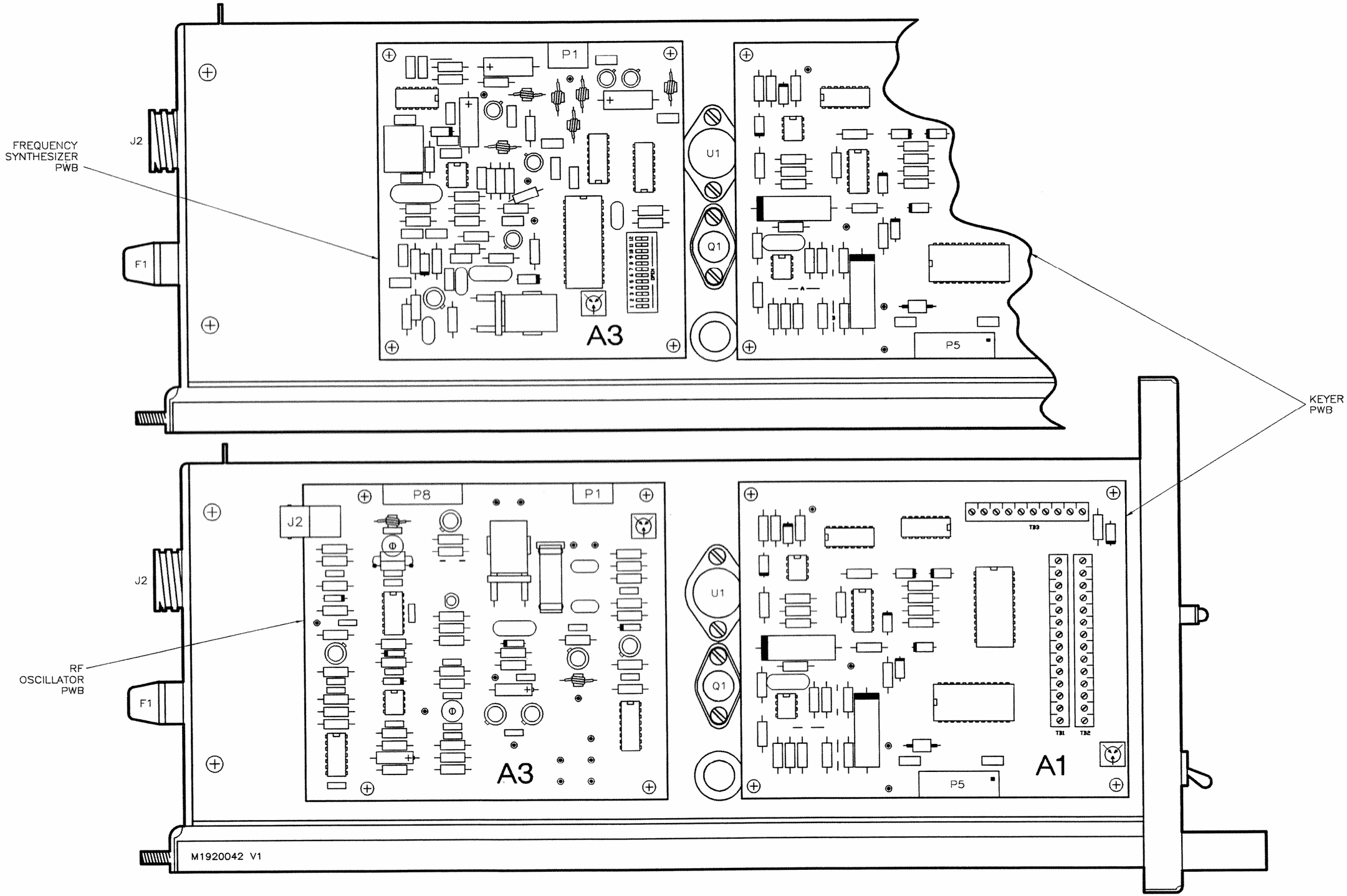


Figure MD-14 Assembly Detail - NAE45G/01 Exciter Module (Left Side View)

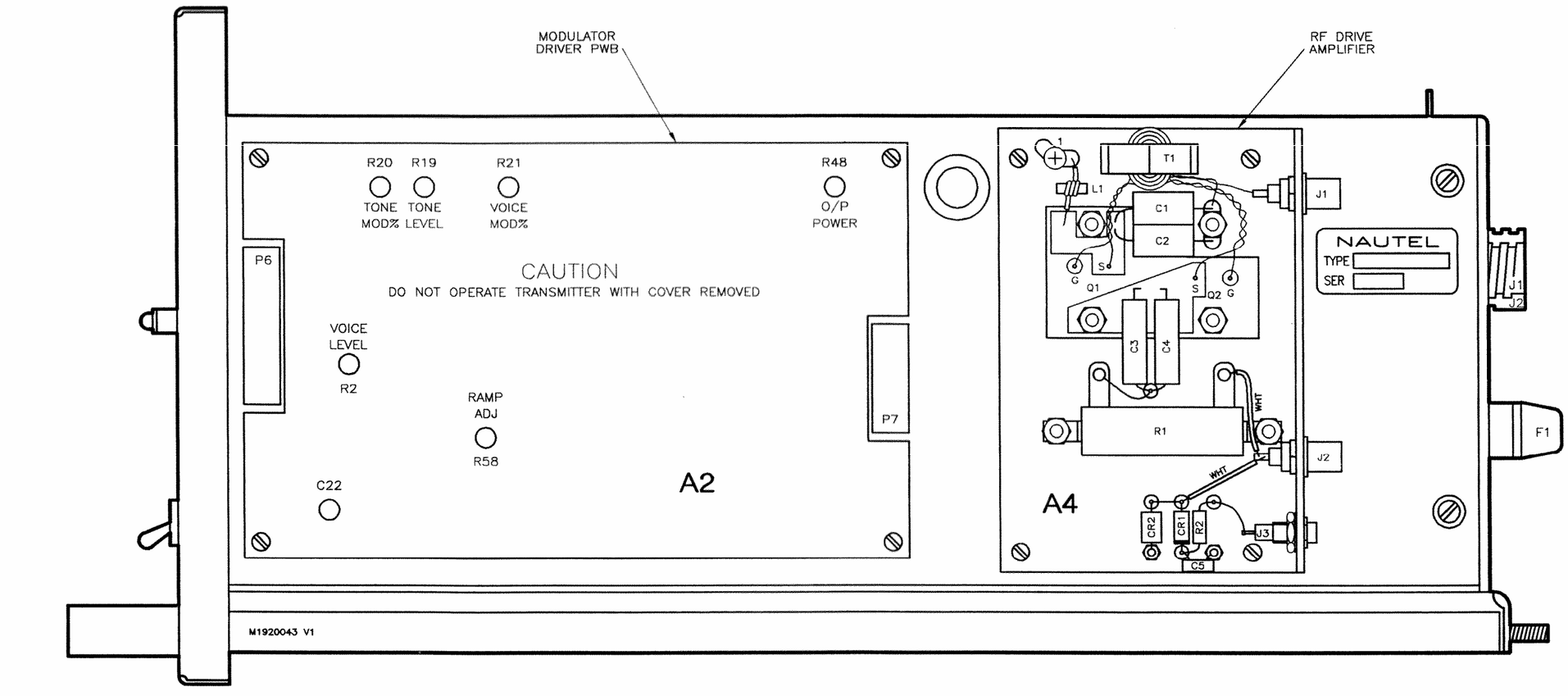


Figure MD-15 Assembly Detail - NAE45G/01 Exciter Module (Right Side View)

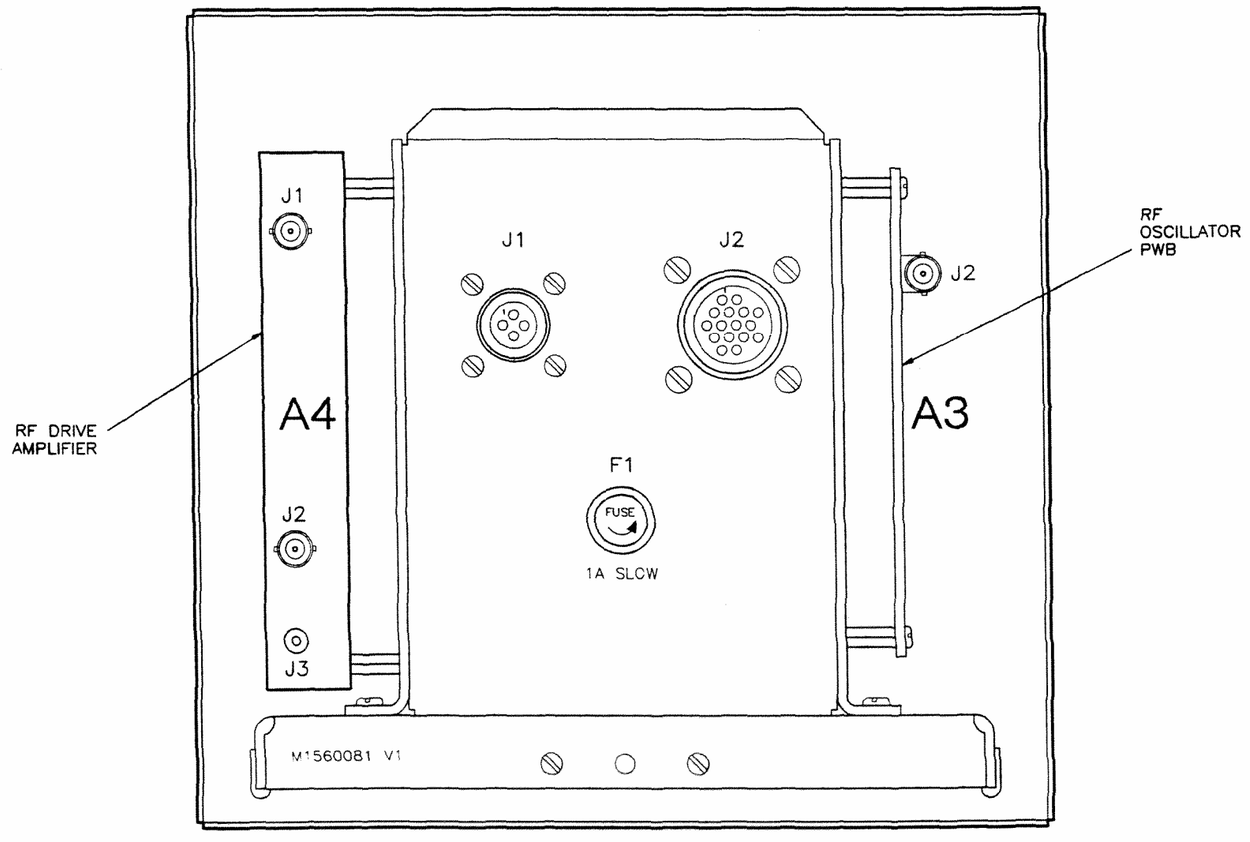
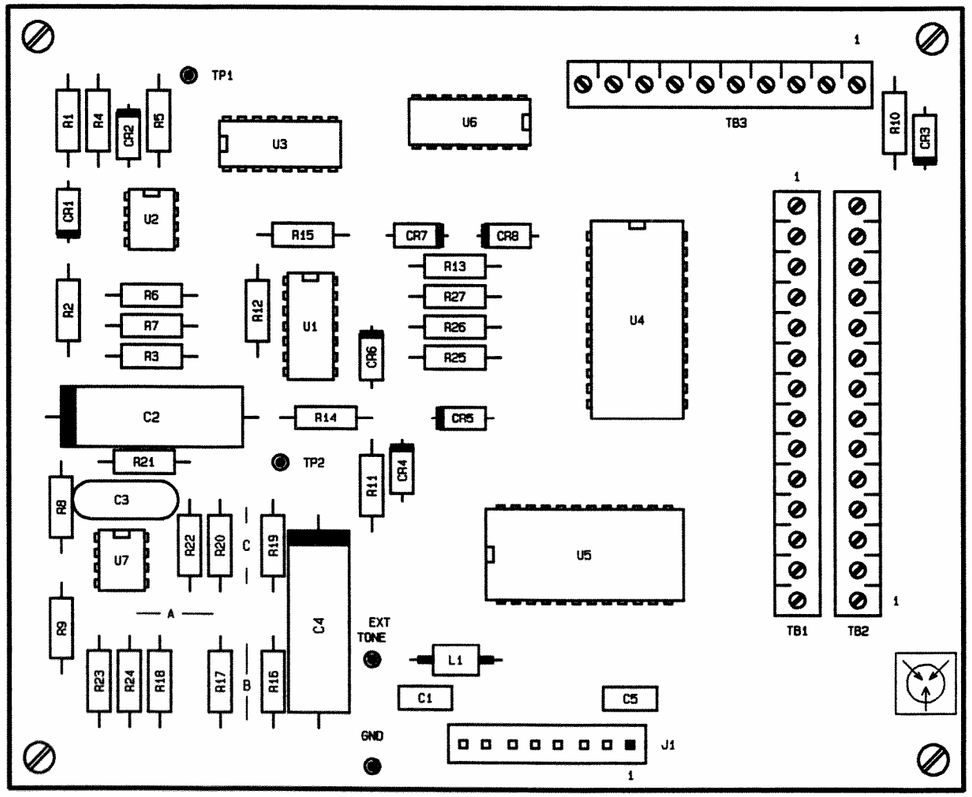


Figure MD-16 Assembly Detail - NAE45G/01 Exciter Module (Rear View)



M1560167 V1

Figure MD-17 Assembly Detail - NAPE30 Keyer PWB

NOTE: C39 (INSTALLED IN PARALLEL WITH R34) USED ON NAPE29C/01 AND NAPE29C/02 VARIATIONS ONLY.

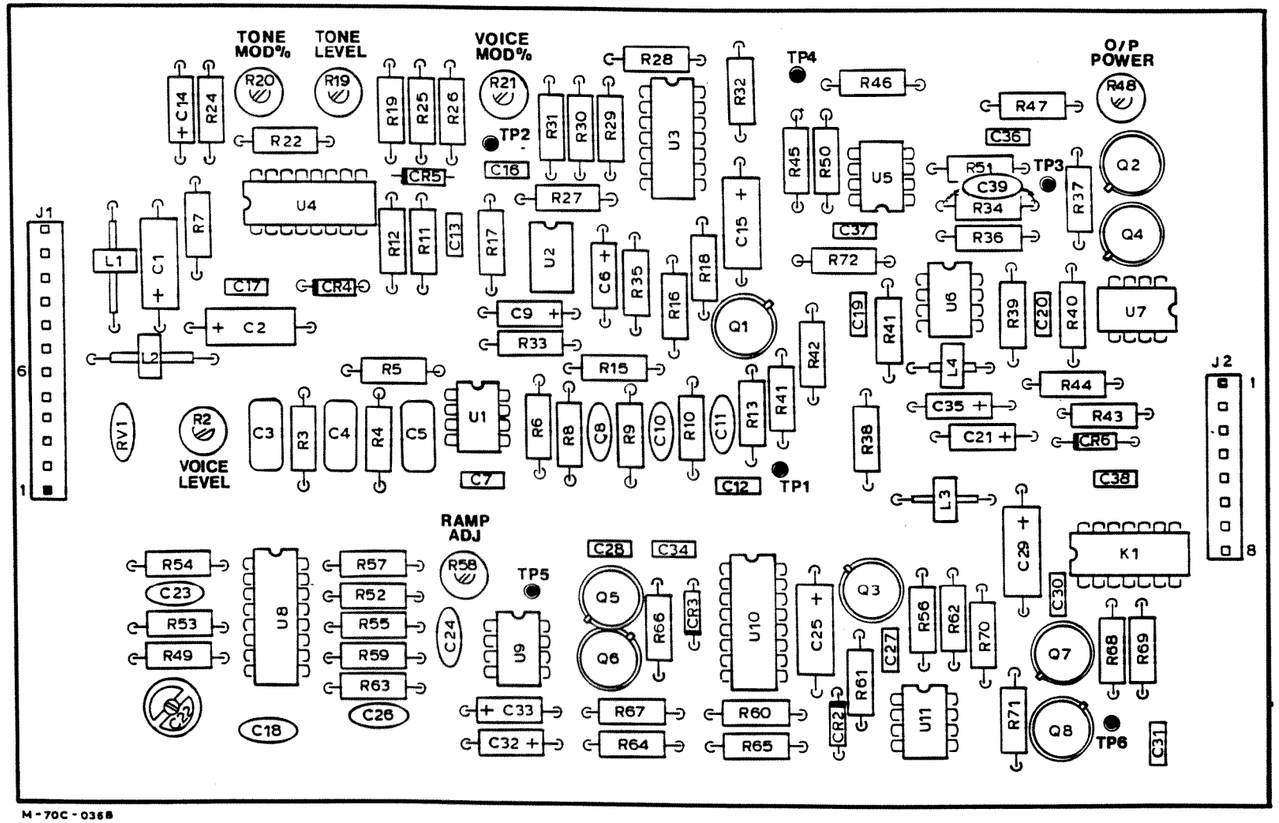
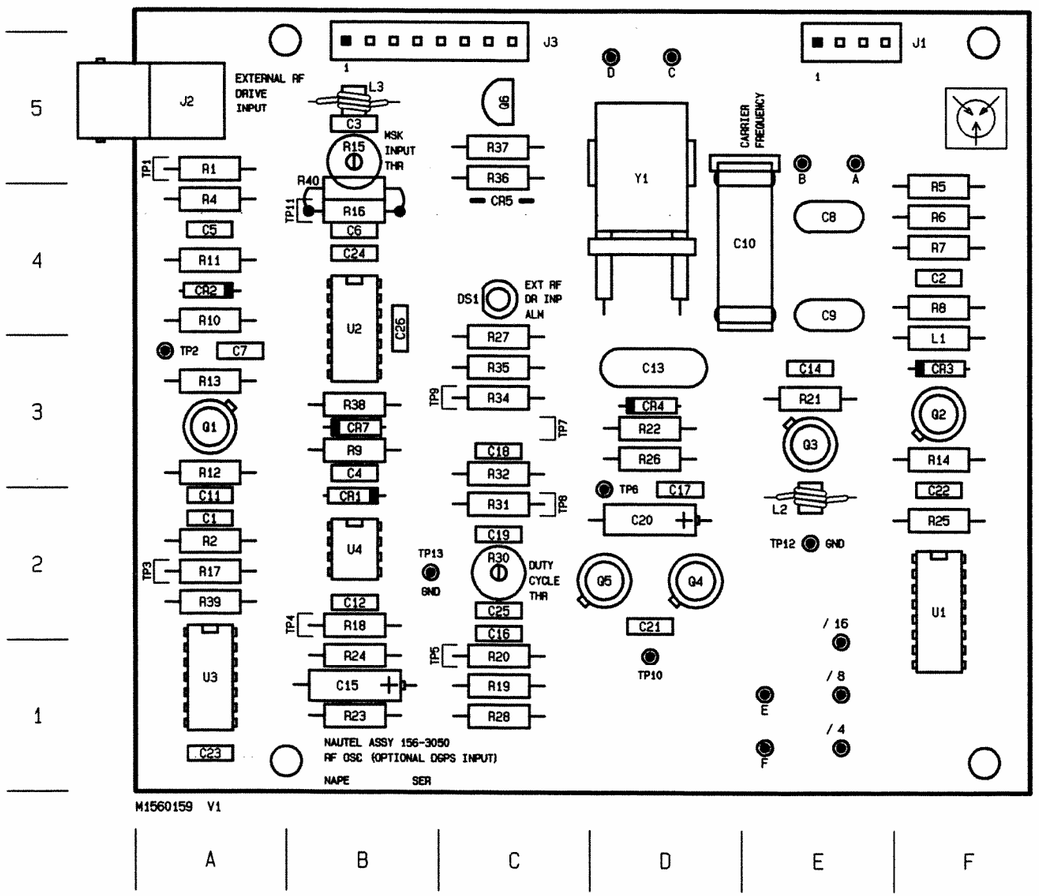
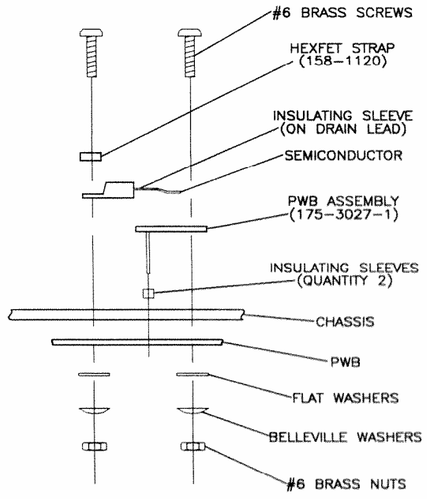


Figure MD-18 Assembly Detail - NAPE29C/01 Modulator Driver PWB



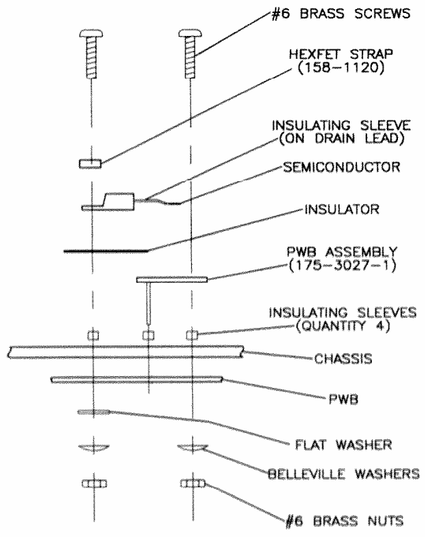
CR8 LOCATED ON REVERSE SIDE

Figure MD-19 Assembly Detail - NAPE64A RF Oscillator (Optional DGPS Input) PWB



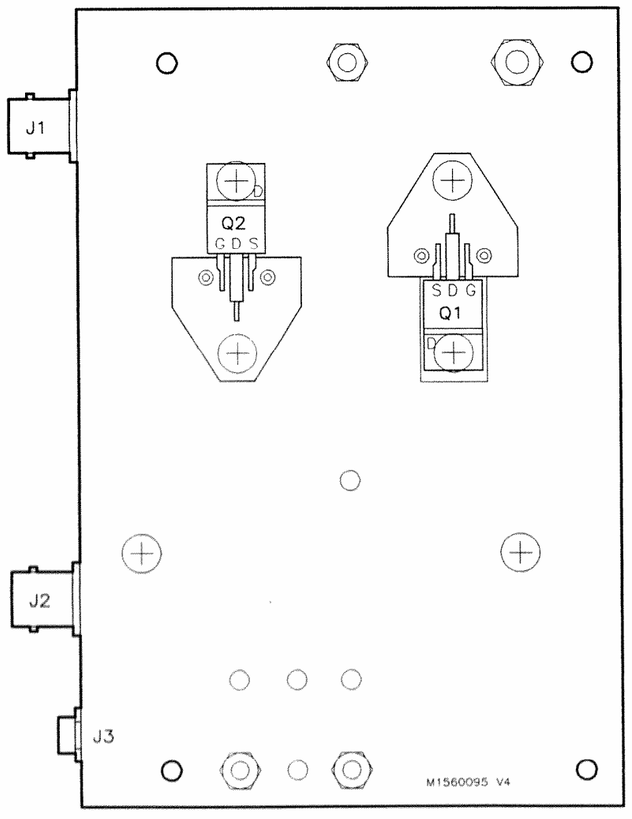
Q2 MOUNTING DETAIL

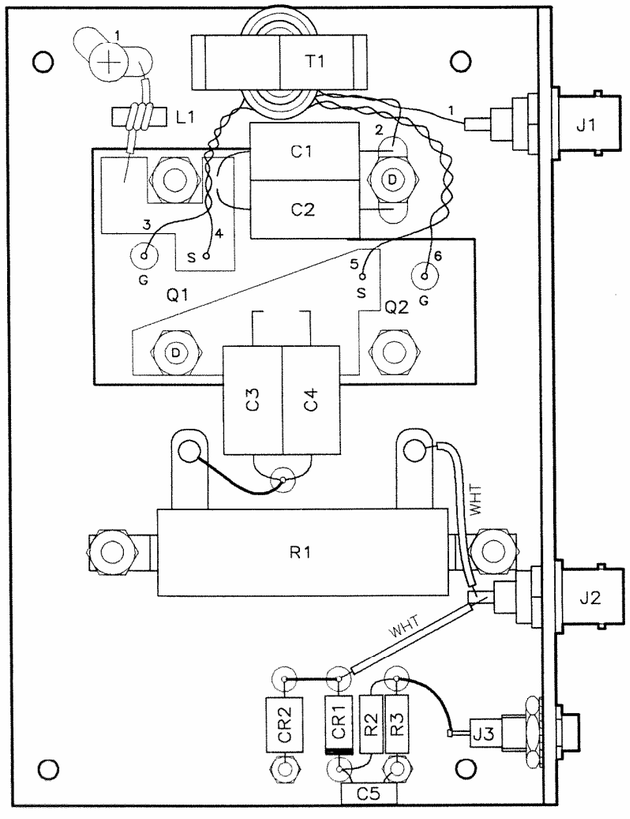
TORQUE ATTACHED HARDWARE TO 5 in/lbs (0.566 NEWTON METRES)



Q1 MOUNTING DETAIL

TORQUE ATTACHED HARDWARE TO 5 in/lbs (0.566 NEWTON METRES)





NAA21A/01 VARIATION SHOWN
R3 NOT USED ON NAA21A/02

Figure MD-21 Assembly Detail - NAA21A/01 RF Drive Amplifier

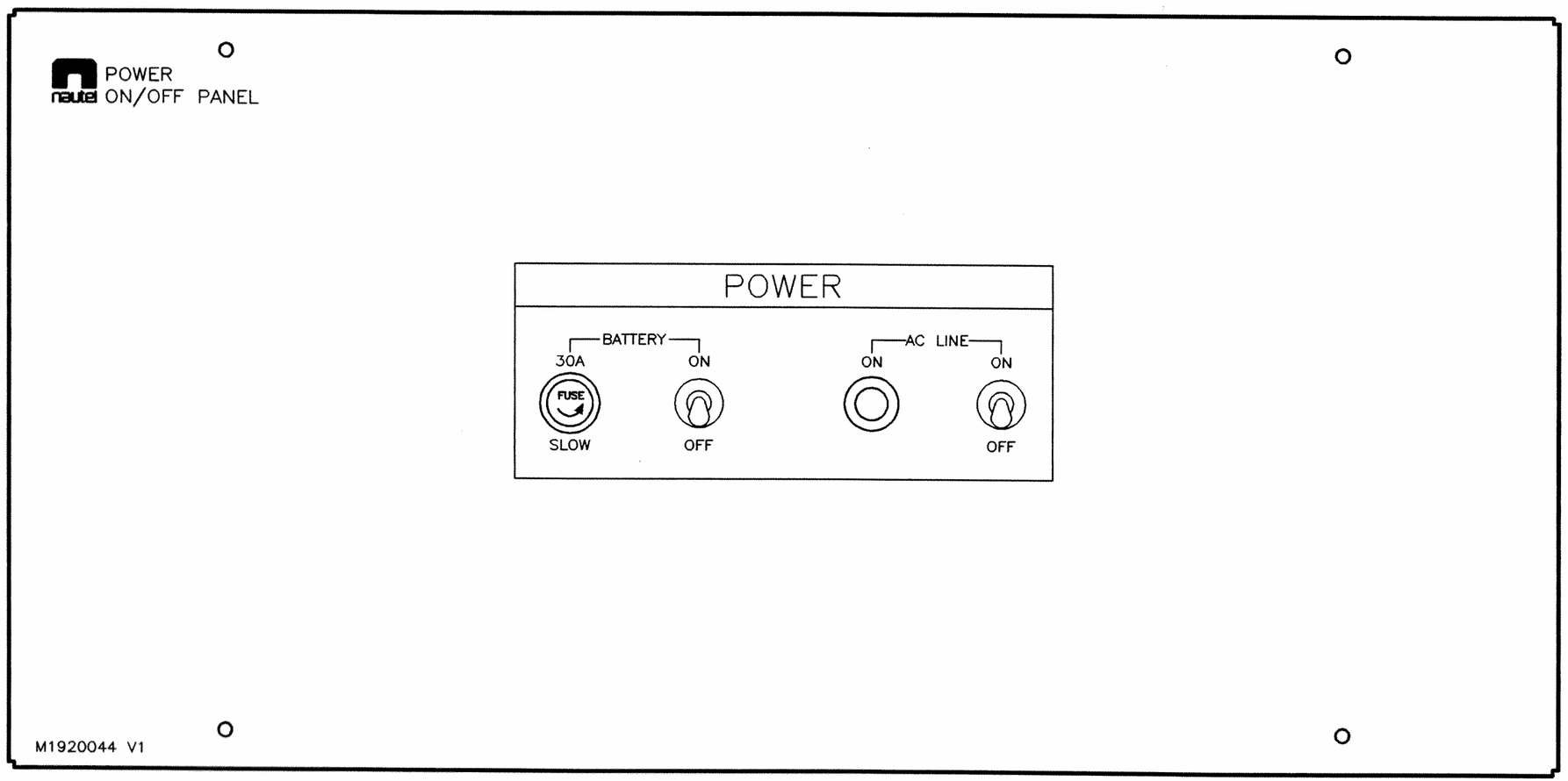


Figure MD-22 Assembly Detail - Power On/Off Panel (192-8130)

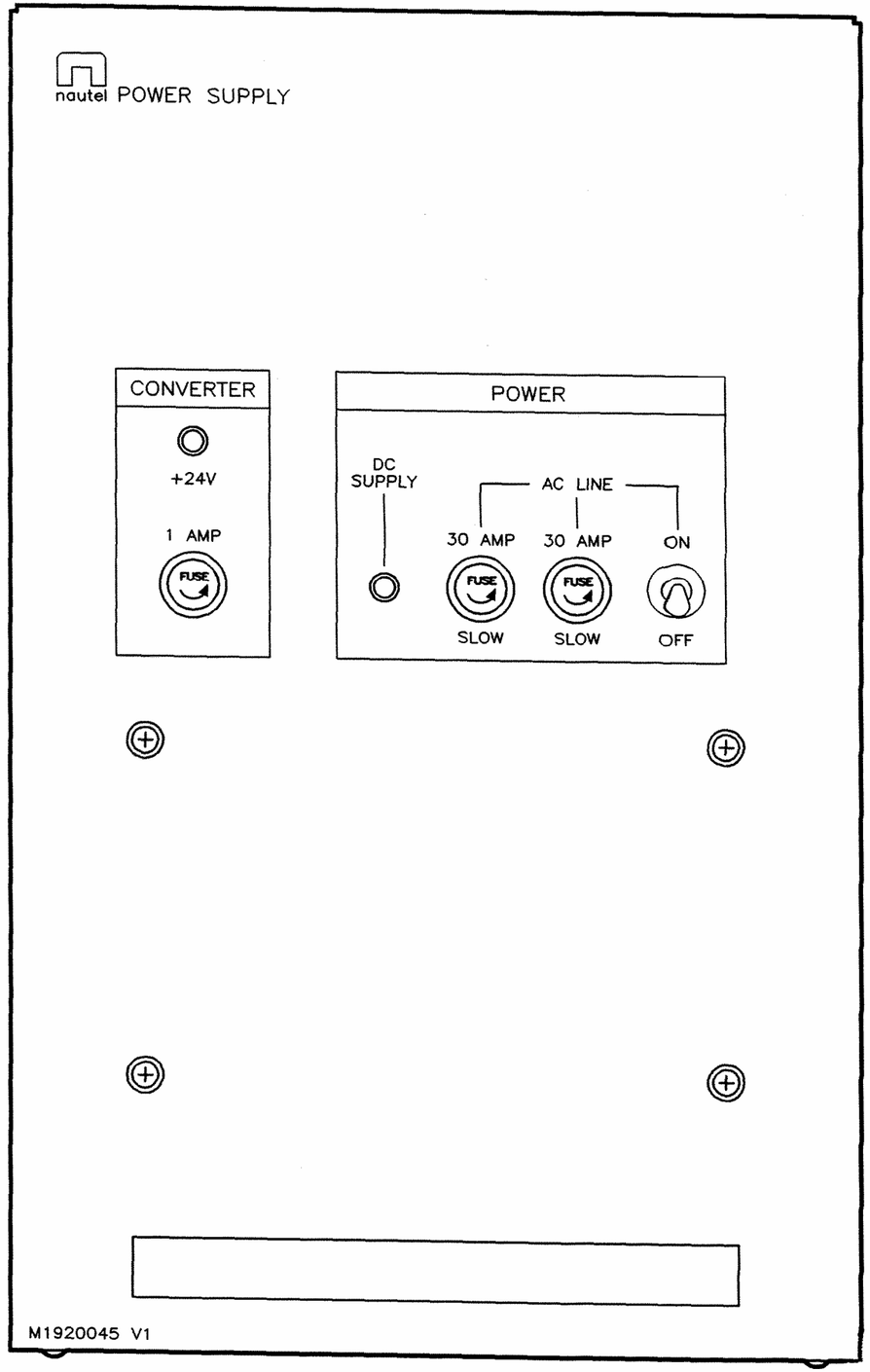


Figure MD-23 Assembly Detail - NAS25B/01 & NAS25B/02 Power Supply Module (Front View)

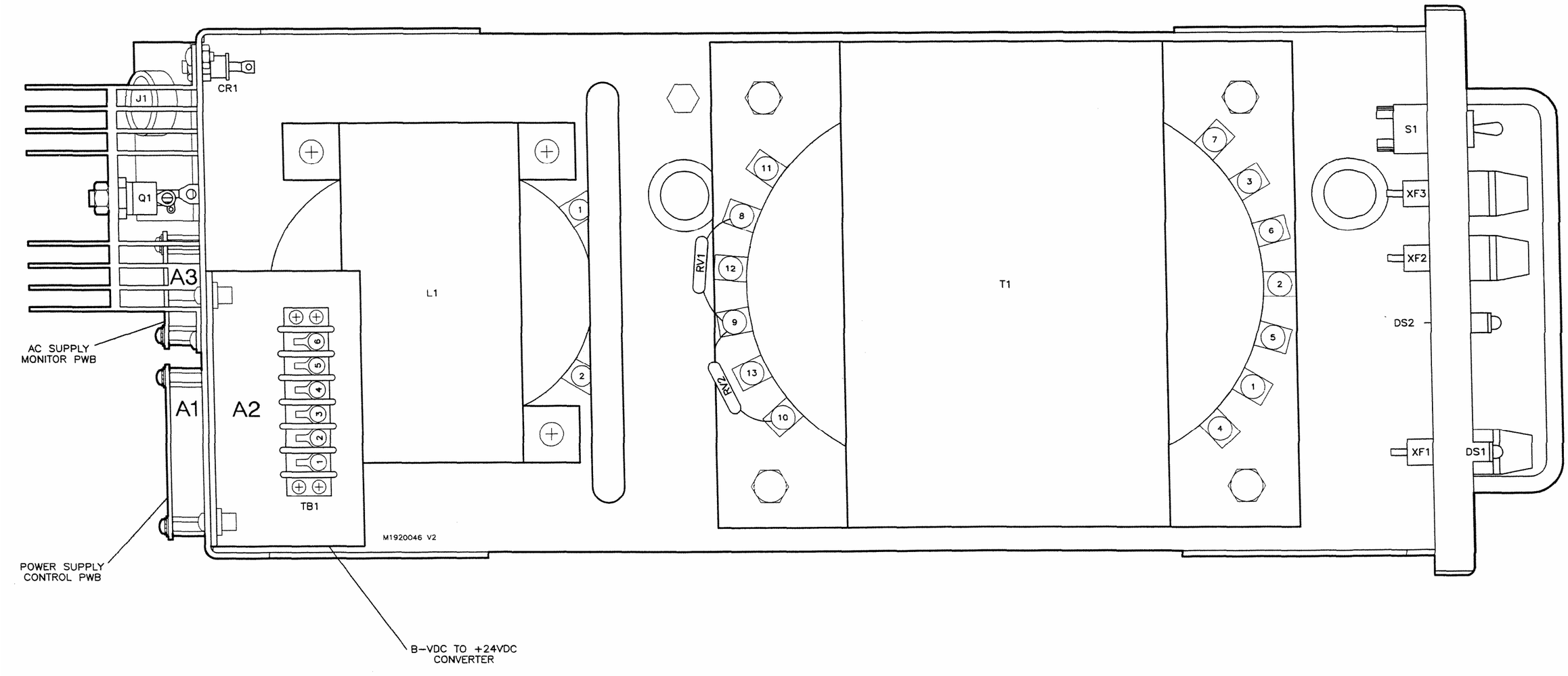


Figure MD-24 Assembly Detail - NAS25B/01 & NAS25B/02 Power Supply Module (Top View)

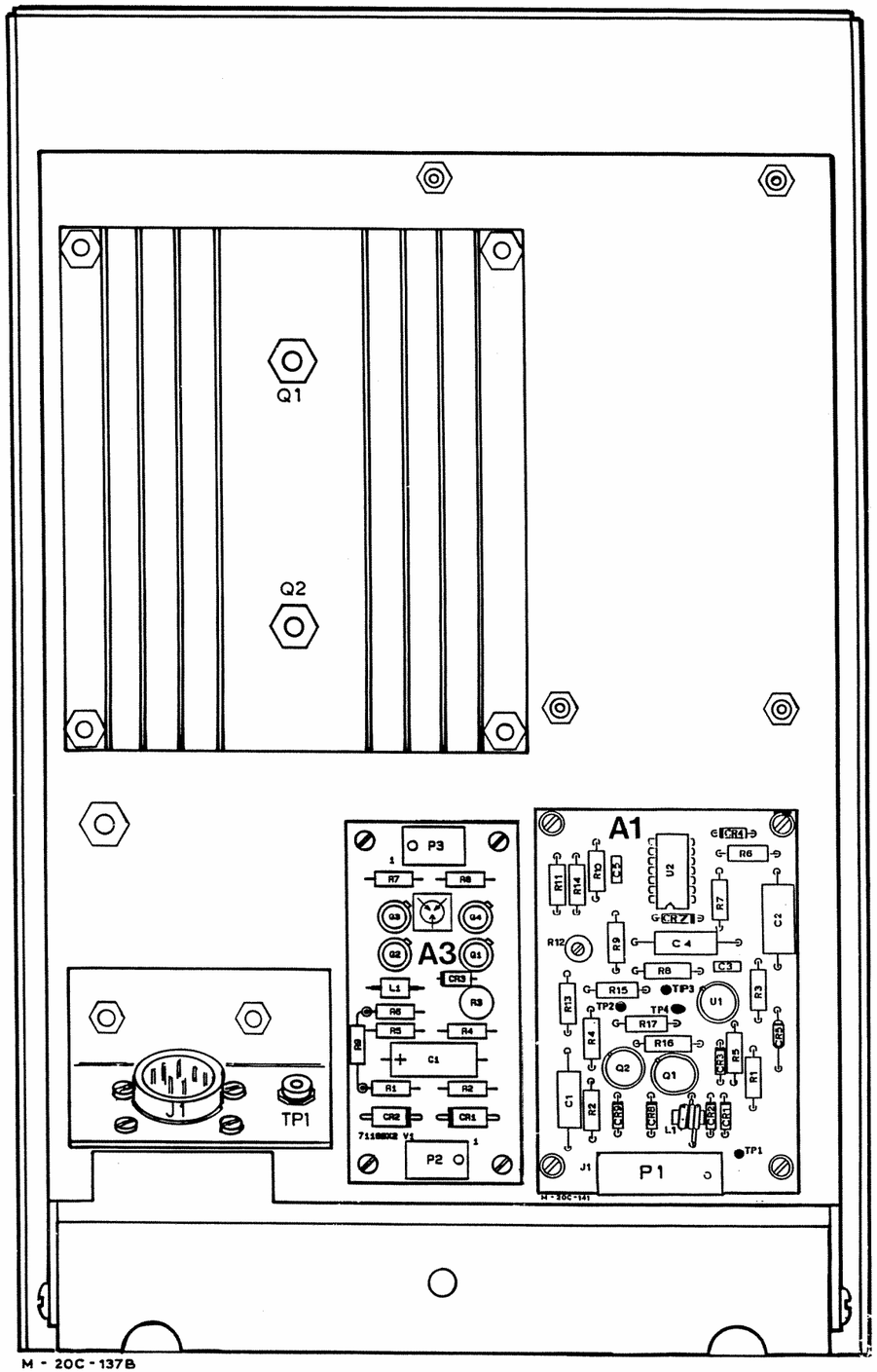


Figure MD-25 Assembly Detail - NAS25B/01 & NAS25B/02 Power Supply Module (Rear View)

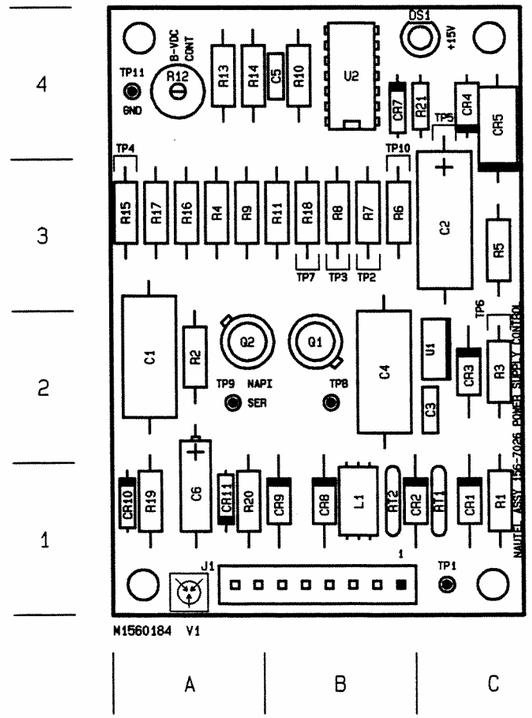
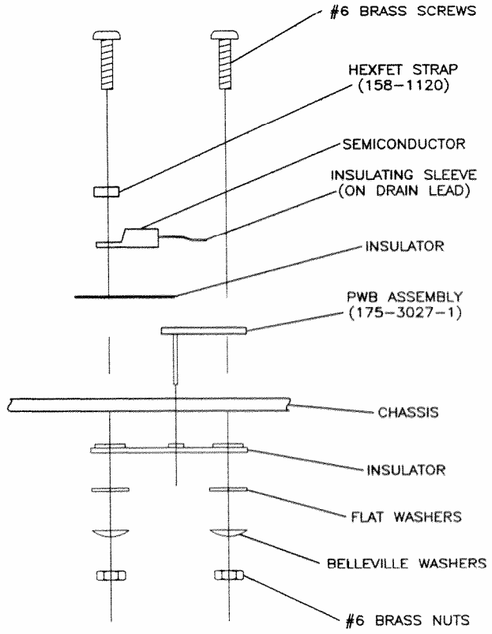
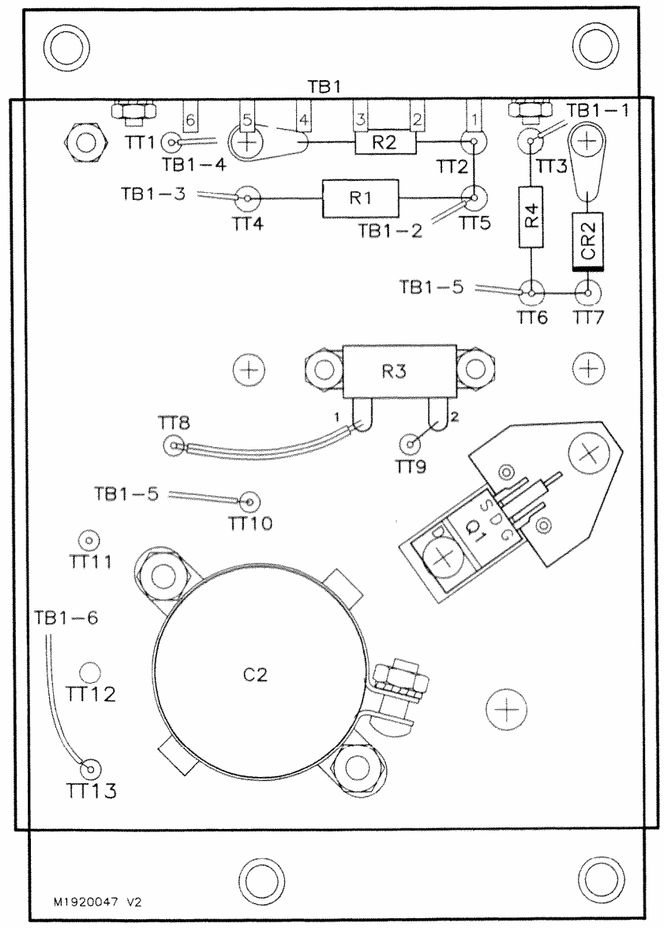


Figure MD-26 Assembly Detail - NAPC26C/01 Power Supply Control PWB



Q1 MOUNTING DETAIL

TORQUE ATTACHED HARDWARE TO
5 in/lbs (0.566 NEWTON METRES)



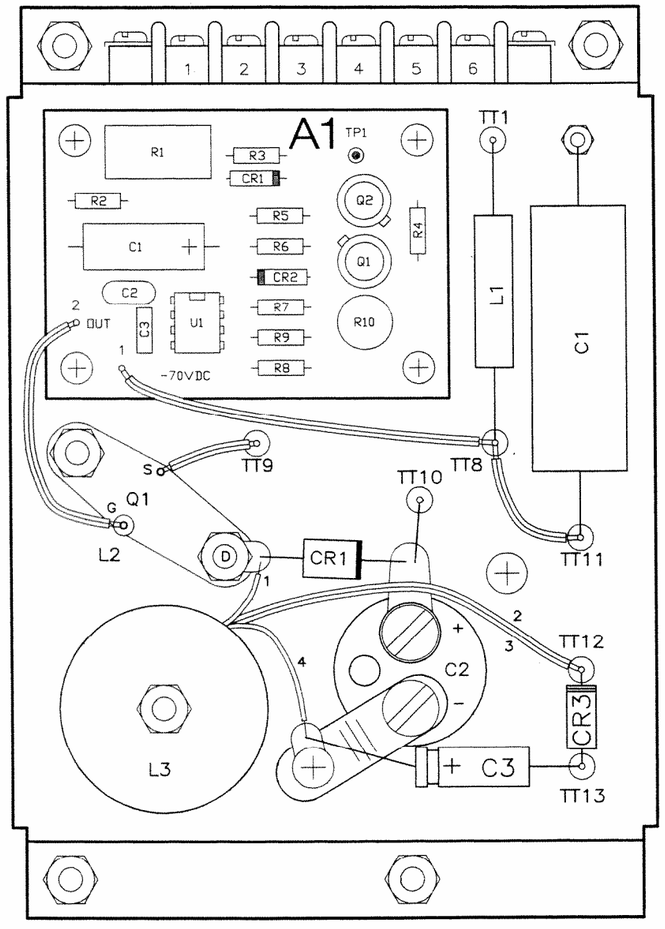


Figure MD-27 Assembly Detail - NASC01/01 B- VDC To +24 VDC Converter

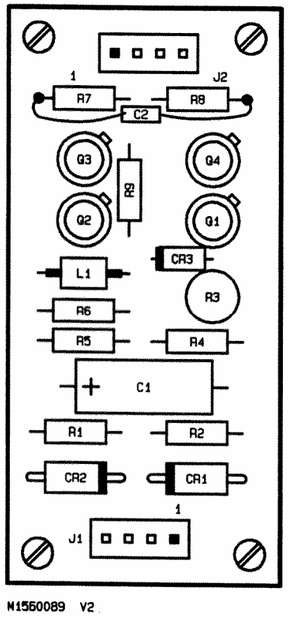
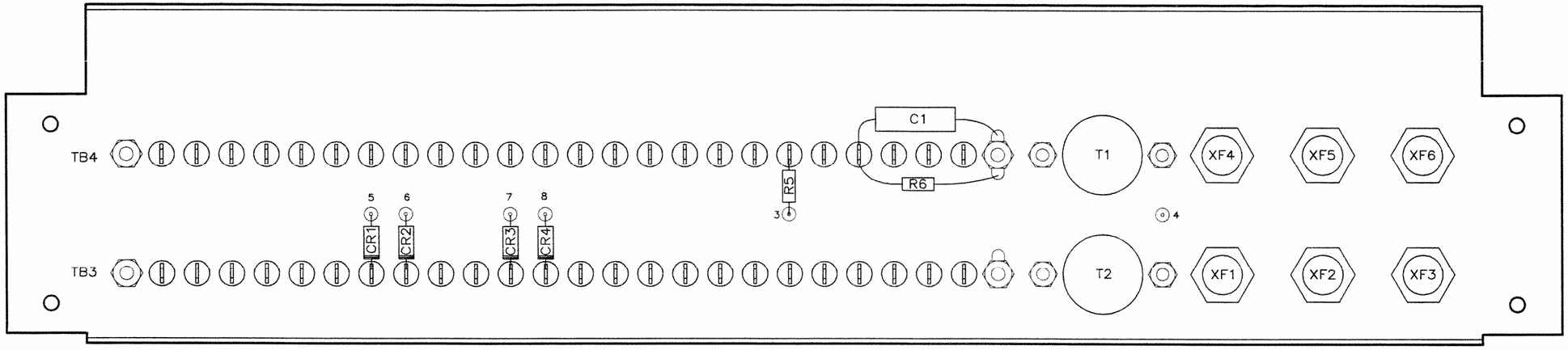


Figure MD-28 Assembly Detail - NAPC32A/01 & NAPC32A/02 AC Supply Monitor PWB



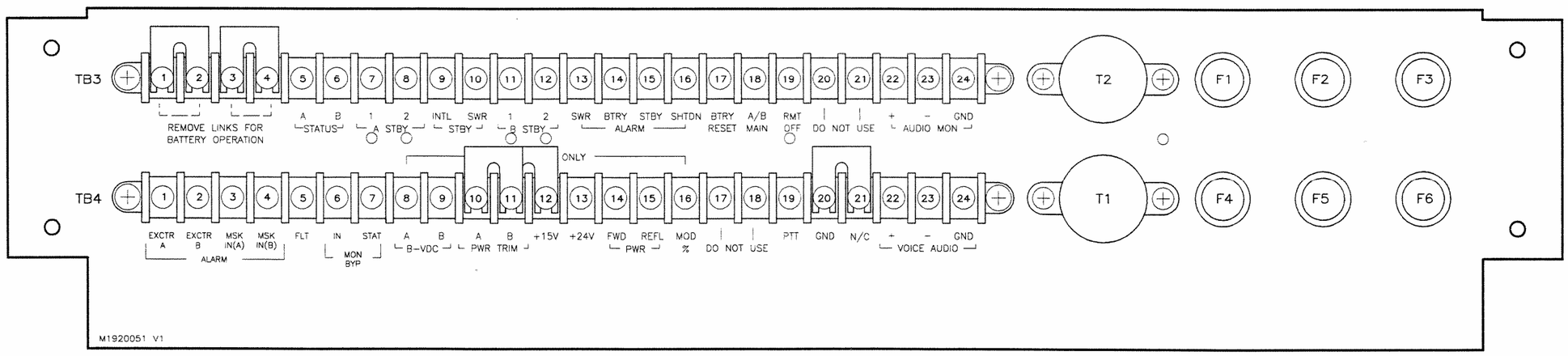


Figure MD-29 Assembly Detail - Interface Panel (P/N 192-8110)

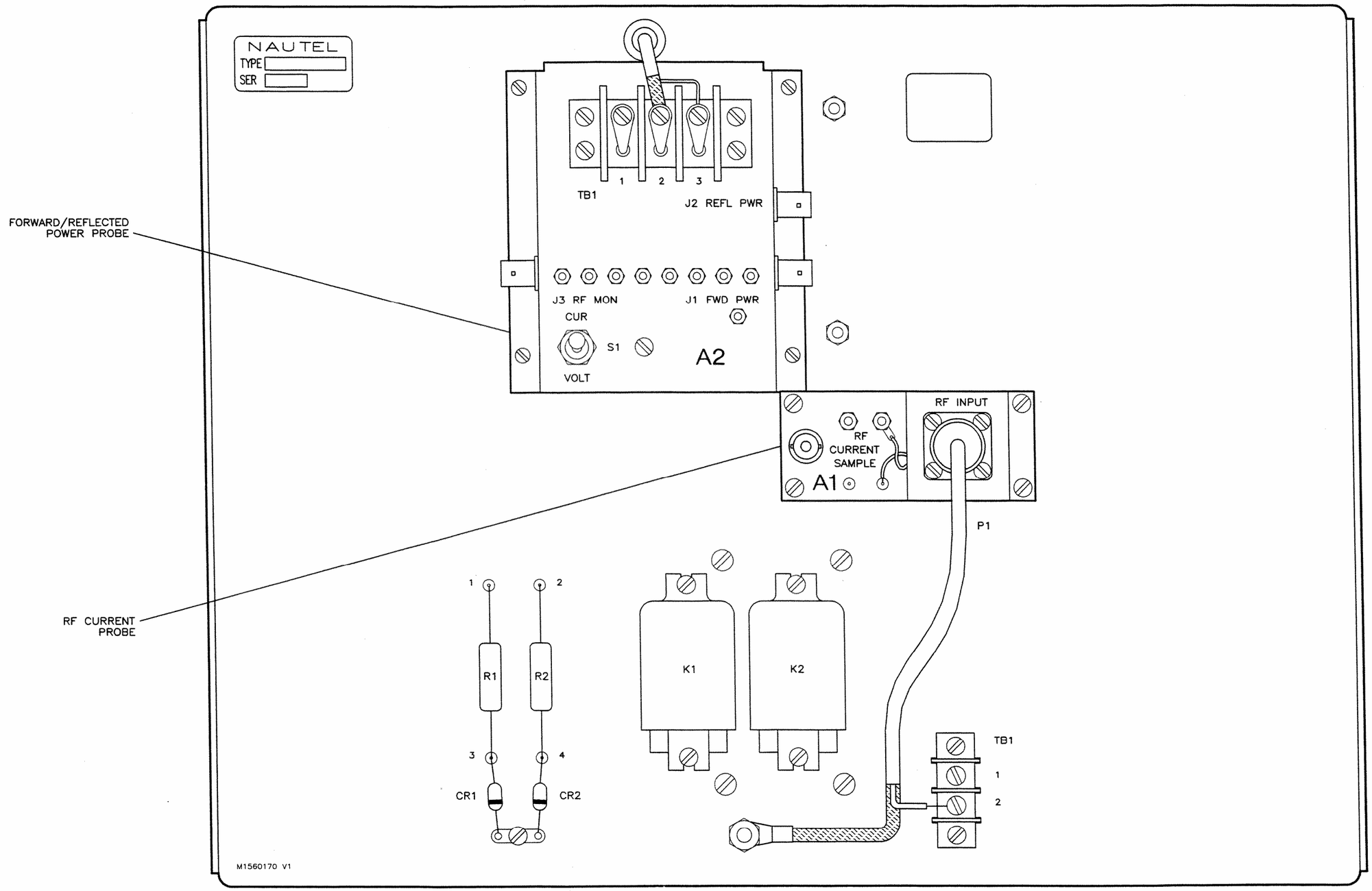
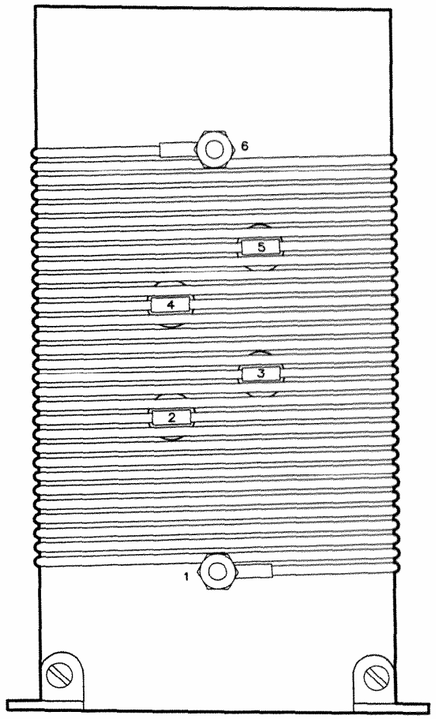


Figure MD-30 Assembly Detail - NAF46C/01 Harmonic Filter (Front View)



REPRESENTATIVE OF INDUCTORS L1, L2 AND L4. TERMINAL '1' OF INDUCTOR L3 ON OPPOSITE SIDE.

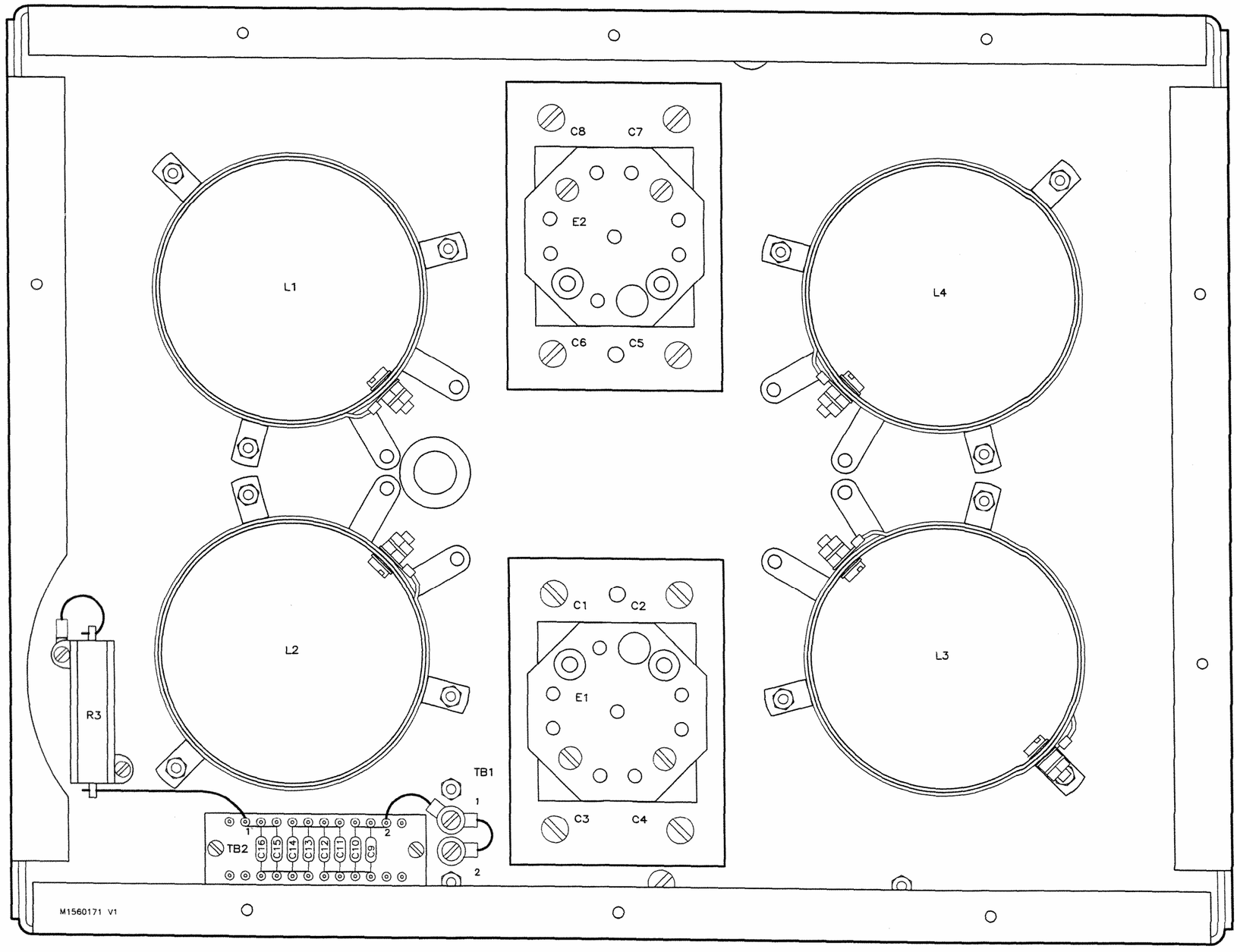


Figure MD-31 Assembly Detail - NAF46C/01 Harmonic Filter (Rear View)

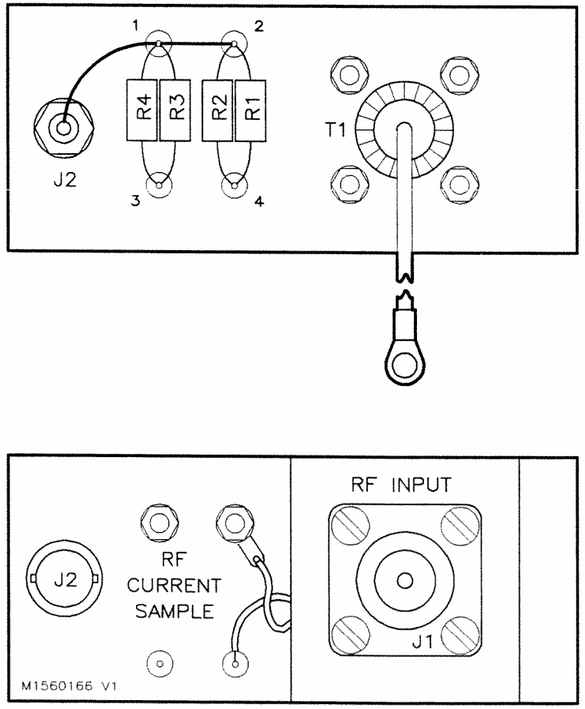
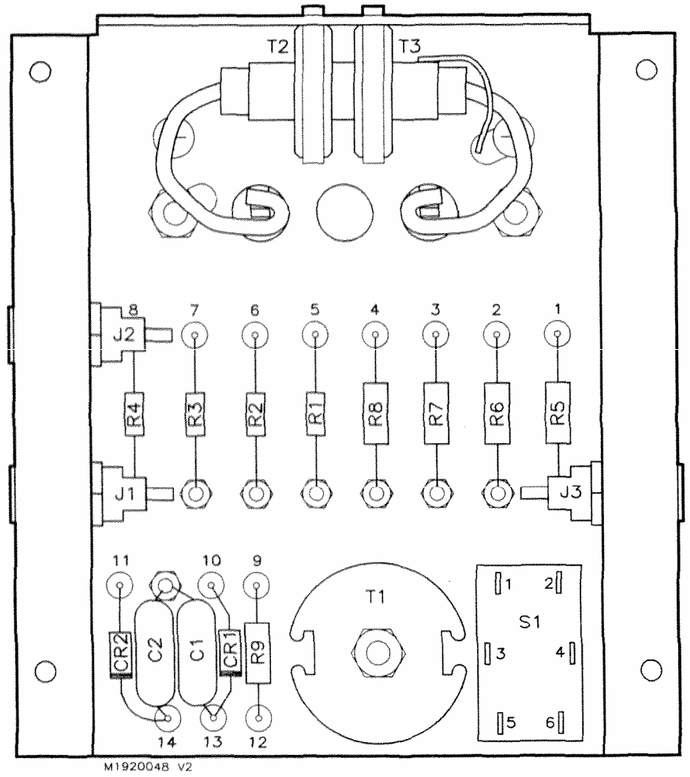


Figure MD-32 Assembly Detail - NAFP23/01 RF Current Probe



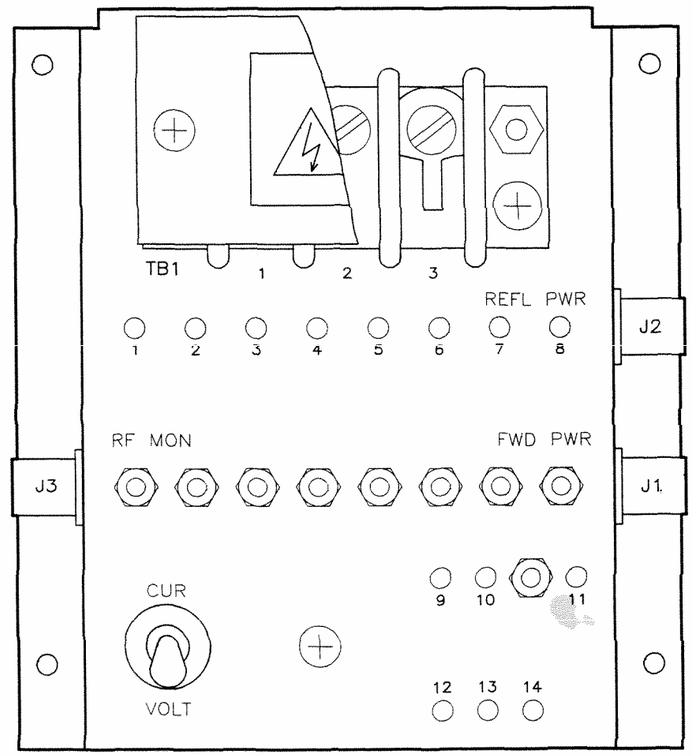


Figure MD-33 Assembly Detail - NAFP24A/01 Forward/Reflected Power Probe

S1, S2, S3, LS1, R114 & R115
INSTALLED ON REVERSE SIDE

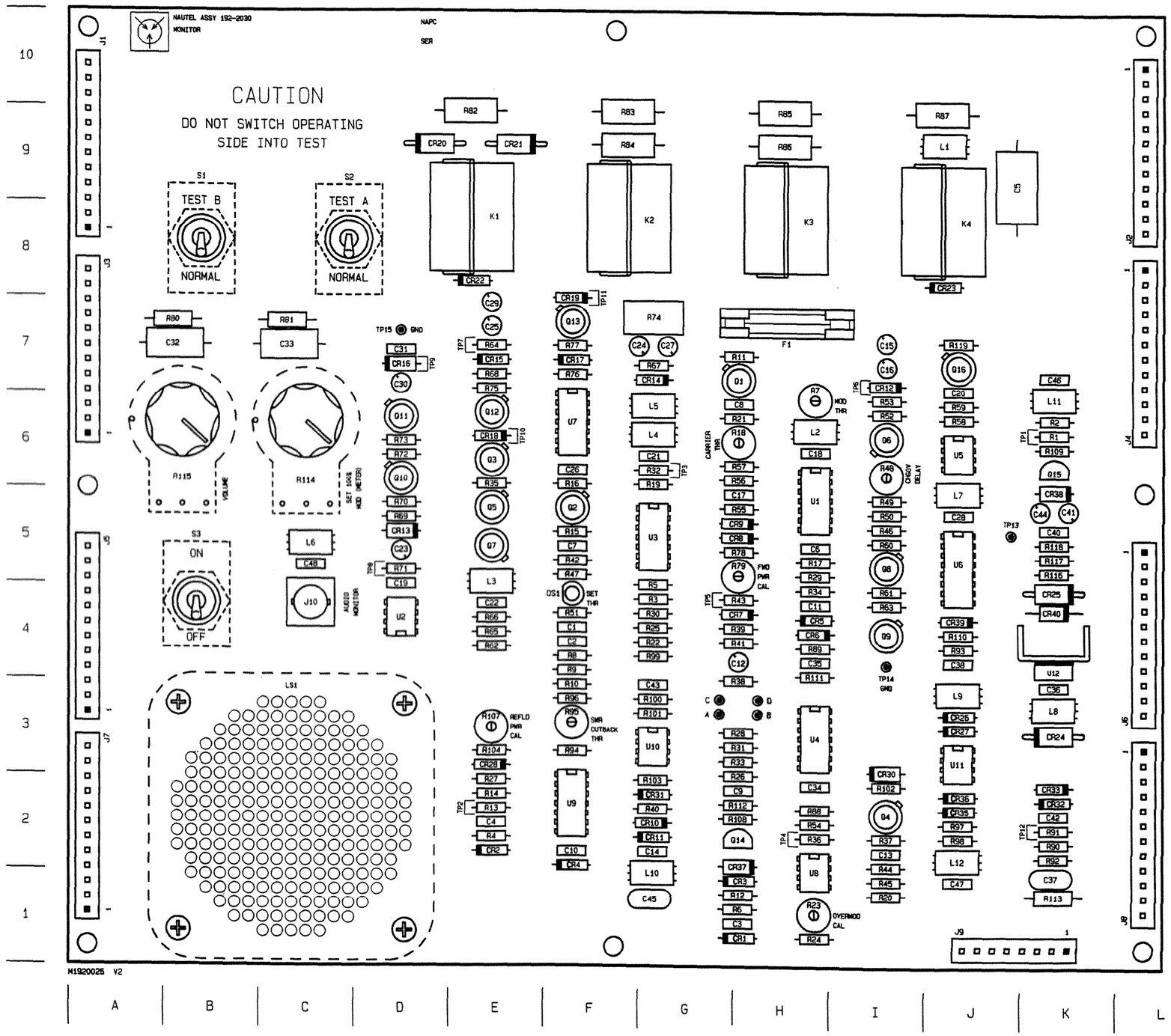


Figure MD-34 Assembly Detail - NAPC120/01 Monitor PWB

S1, S2, S3, LS1, R114 & R115
INSTALLED ON REVERSE SIDE

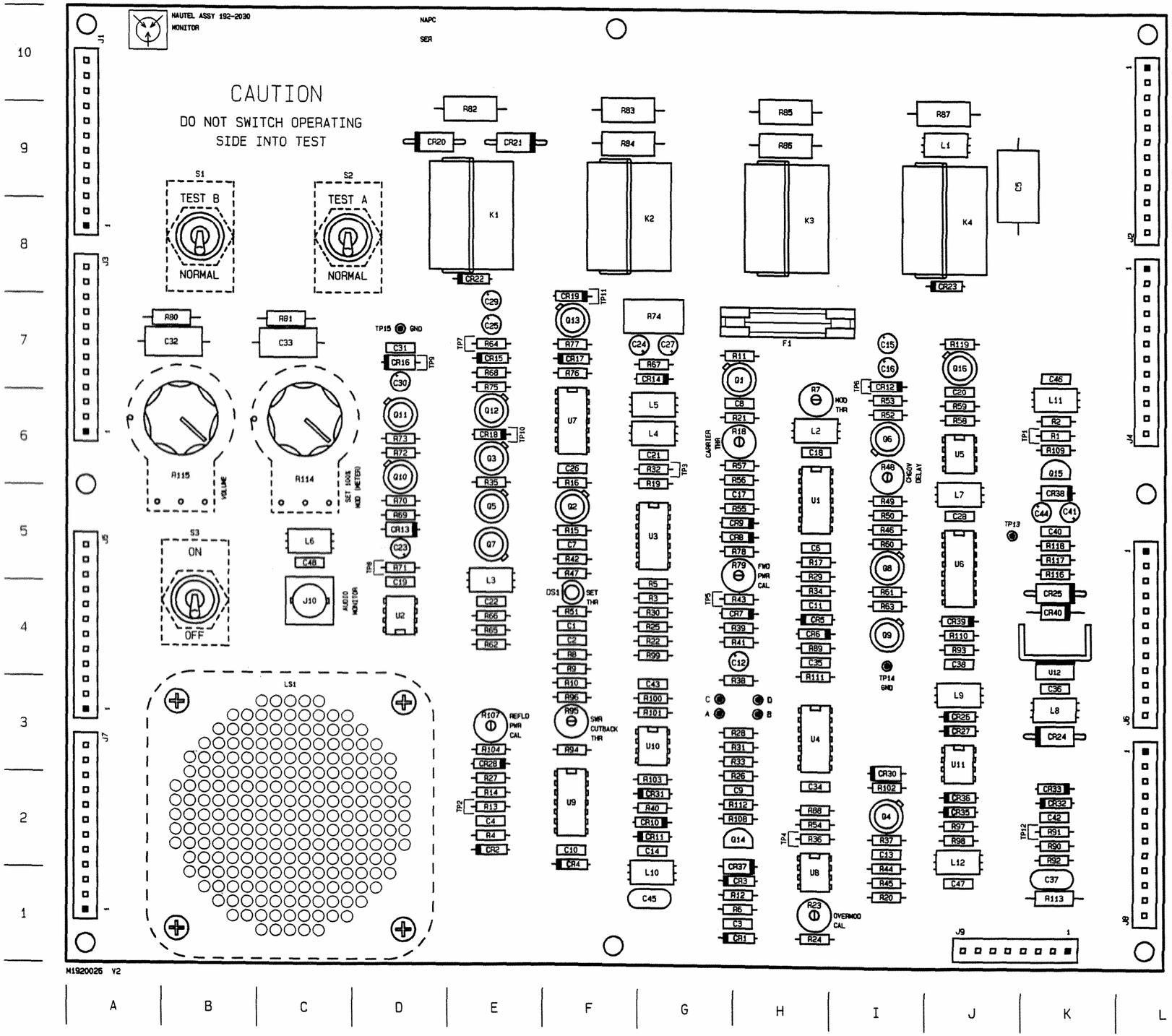


Figure MD-35 Assembly Detail - NAPC120/03 Monitor PWB

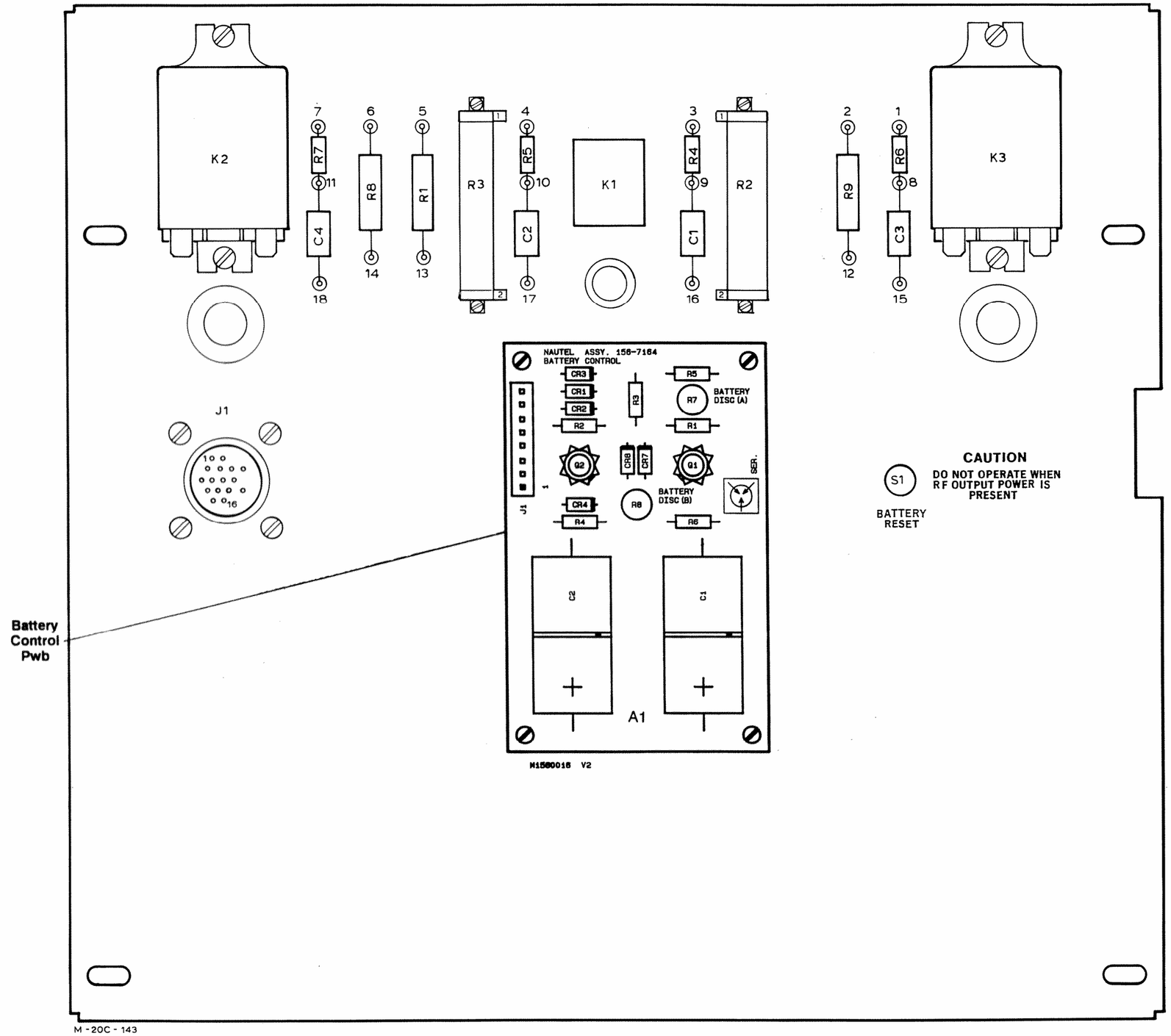


Figure MD-36 Assembly Detail - NAX50A/03 Battery Control Panel

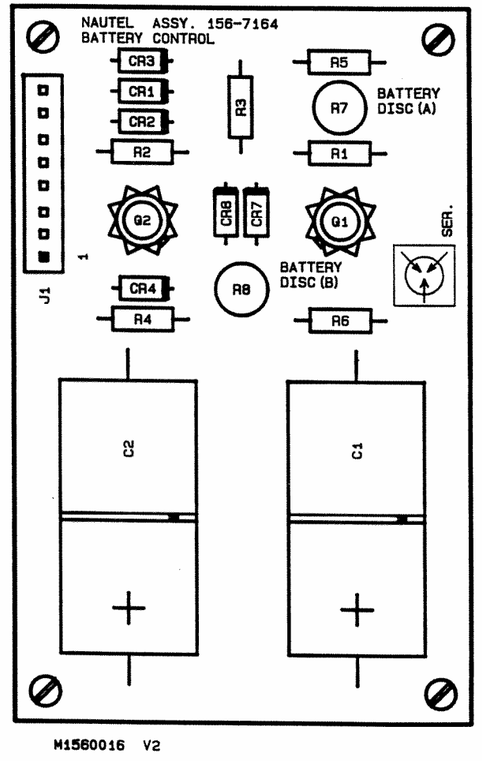
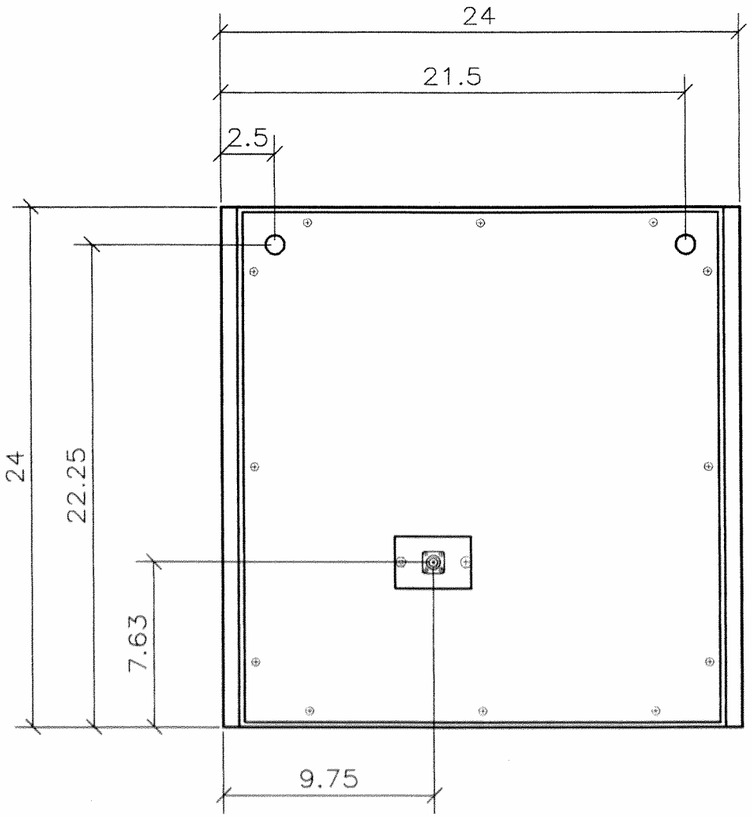


Figure MD-37 Assembly Detail - Battery Control PWB (P/N 156-7164-02)



ALL DIMENSIONS ARE IN INCHES

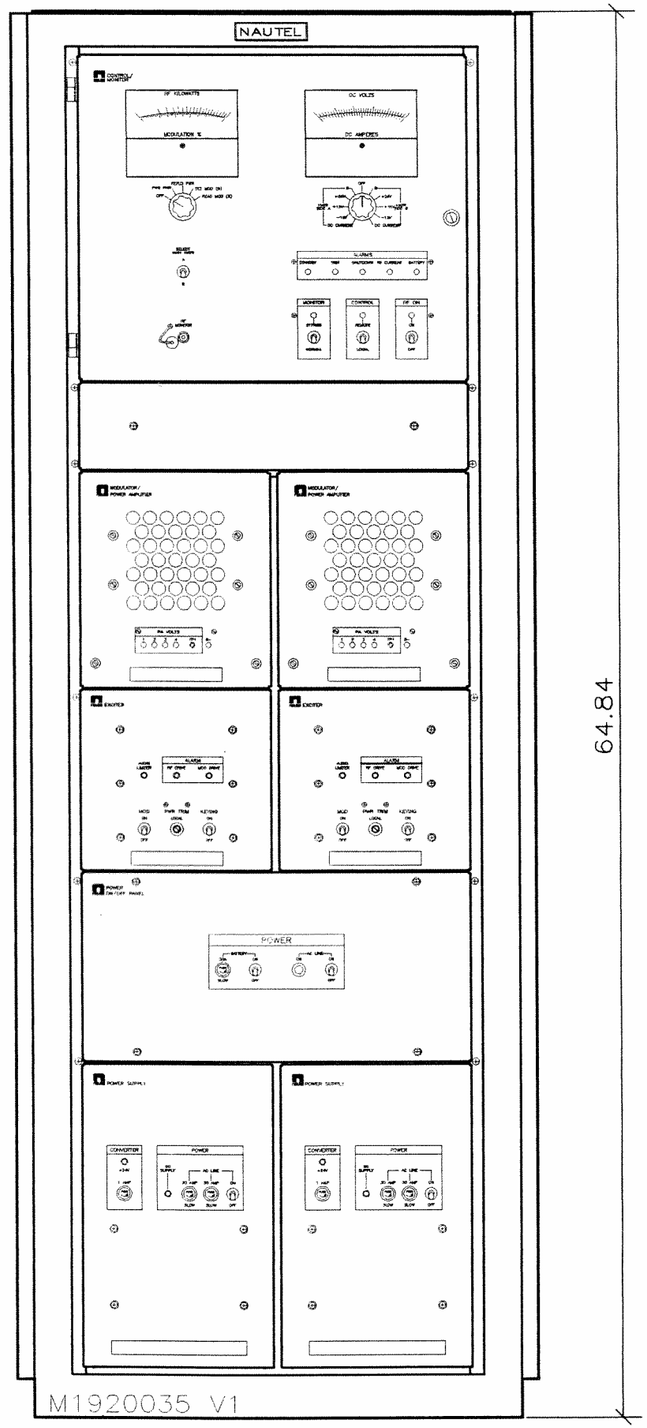


Figure MD-38 Dimensional Information - ND4000A 1000W Radiobeacon Transmitter