MOTOROLA

iDEN™

Outdoor Single Rack, Single Controller

Installation & Reference Guide

68P80800F15-O

COPYRIGHT

NOTICE

The Motorola products described in this manual contain one or more computer programs. The use of these computer programs is governed by the terms and conditions of a corresponding license agreement with Motorola, Inc. In addition, these computer programs are protected by copyright law and international treaties. Unauthorized reproduction, modification, or distribution of these programs, or any part thereof, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. U.S. and international patents pending.

TRADEMARKS

, Motorola, and iDEN are trademarks or registered trademarks of Motorola, Inc. in the United States and other countries.

Sun, Sun Microsystems, the Sun Logo, Ultra, and Ultra Enterprise are trademarks or registered trademarks of Sun Microsystems, Inc. in the United States and other countries. All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. in the United States and other countries. Products bearing SPARC trademarks are based upon an architecture developed by Sun Microsystems, Inc.

UNIX is a trademark of Novell, Inc. in the United States and other countries.

Open Software Foundation, OSF and Motif are trademarks of Open Software Foundation, Inc. in the United States and other countries.

X Window System is a trademark of the Massachusetts Institute of Technology in the United States and other countries.

Wingz is a trademark of Informix Software, Inc. in the United States and other countries.

LIABILITY

While reasonable efforts have been made to assure the accuracy of this document, Motorola, Inc. assumes no liability resulting from any omissions in this document, or from use of the information obtained herein. The information in this document has been carefully checked and is believed to be entirely reliable. However, no responsibility is assumed for inaccuracies. Motorola, Inc. reserves the right to make changes to any products described herein to improve reliability, function, or design, and reserves the right to revise this document and to make changes from time to time in content hereof with no obligation to notify any person of revisions or changes. Motorola, Inc. does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey license under its patent rights or the rights of others.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MOTOROLA

Contents

Chapter 7
System Troubleshooting

Chapter 8
Software Commands

Chapter 9
Base Radio

Chapter 10
800 MHz GEN 4 Duplexed RF Distribution System

Chapter 11
AC / DC Power System

List of Figures

Chapter 1
About This Manual

Chapter 2
System Description

Chapter 3
Pre-Installation

Chapter 4
Installation

This Page Intentionally

Left Blank

List of Tables

Chapter 9
Base Radio

Chapter 10
800 MHz GEN 4 Duplexed RF Distribution System

Chapter 11
AC / DC Power System

This Page Intentionally

Left Blank

MOTOROLA

Chapter 1
About This Manual

Purpose

The purpose of this manual is two-fold: to provide instructions for installing and powering up the Outdoor SRSC equipment, and to provide information that will aid in maintaining the equipment.

Target Audience

This manual is intended for use by technicians experienced with similar types of equipment. In keeping with the philosophy of Field Replaceable Units (FRUs), this manual contains functional information sufficient to give service personnel an operational understanding of the FRU modules, allowing faulty modules to be identified and replaced with known FRU replacement modules.

Related Manuals

The following manuals may be required to supplement the information contained in this manual:

- ❐ Quality Standards-Fixed Network Equipment (FNE) Installation Manual (R56)
- ❐ integrated Site Controller System Manual (68P81098E05)
- ❐ Enhanced Base Transceiver System (68P81099E10)

Organization of the Manual

- System Description - This section describes the major components of Outdoor Single Rack Single Controller (SRSC), and its role within the iDEN system. A quick reference for cabling among these components is also provided.
- Pre-Installation - This section provides pre-installation information for the preparation of an Outdoor SRSC site. Every subject discussed in this section must be considered prior to performing the installtion of the Outdiir SRSC.
- Installtion - The section provides procedures required to permanently install the Outdoor SRSC at the selected site.
- Final Checkout - This section describes the final checkout/power-up procedures after installtion of the Outdoor SRSC is complete. The procedures in the section provide an orderly system power-up sequence and ensure proper basic operation of the Outdoor SRSC.
- System Testing - This section provides testing procedures for the Base Radios and the RFDS.
- System Troubleshooting - This chapter provides troubleshooting procedure for the Base Radios and RFDS.
- Software Commands - This section provides definitions for the Man-Machine-Interface (MMI) commands. MMI commands are used to test and configure the Outdoor SRSC equipment via a service computer.
- Base Radio - This section provides technical information for the Base Radio (BR).
- 800 MHz GEN 4 Duplexed RF Distribution System - This sections provides technical information for the 800 MHz GEN 4 Duplexed RF Distribution System, as used in the Outdoor SRSC.
- AC/DC Power System - This section provides technical information for the AC/DC Power System used in the Outdoor SRSC.

Error and Concern Reporting

Any errors or concerns about this manual or its contents should be reported via the survey form provided at the beginning of this manual. Please be sure to add your name and phone number so we can follow up with you.

Chapter 2
System Description

Overview

This section describes the major components of Outdoor Single Rack Single Controller (SRSC), and its role within the iDEN system. A quick reference for cabling among these components is also provided.

The topics of this section are listed in the following table.

Section	Page	Description
SRSC's Function Within The iDEN System	2-2	Describes the SRSC system
Outdoor SRSC Component Descriptions	2-3	Provides performance specifications for the SRSC system
Cabling Information	2-14	Provides information on how to connect all cabling required for the proper operation of the Outdoor SRSC system.

SRSC's Function Within The iDEN System

The Outdoor SRSC provides radio communication links between the land network and the mobile subscriber units in the integrated Dispatch Enhanced Network (iDEN) system.

Each SRSC interfaces with the Mobile Switching Office (MSO) via a standard telephone T1 interface (domestic) or E1 interface (international). Via the interface, communication between the SRSC and MSO is facilitated. This link also provides a means to send any alarm conditions from the SRSC back to the Operations and Maintenance Center (OMC). Similarly, the OMC can control and configure SRSC operation via this link.

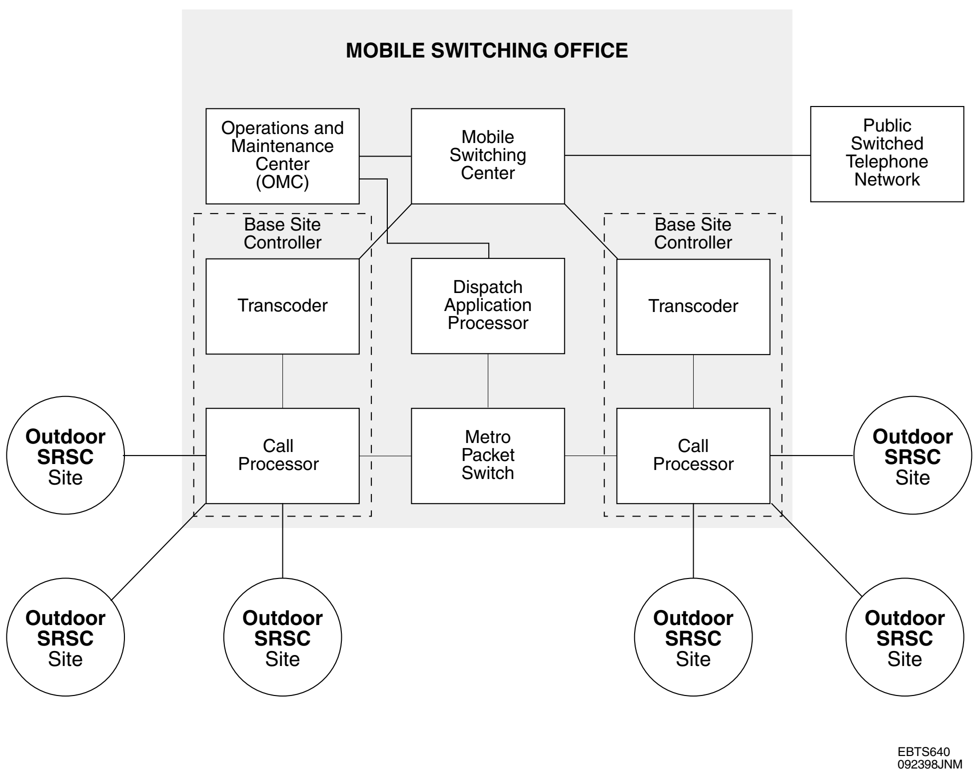


Figure 2-1 ***integrated Dispatch Enhanced Network (iDEN) System***

Outdoor SRSC Component Descriptions

The following paragraphs describe and show the major components of the Outdoor SRSC. For a complete description of the various types of RFDS and the Base Radios, refer to the appropriate section of this manual. Each section contains an overview, a description of controls and indicators, performance specifications, and theory of operation. The descriptions for Junction and Breaker Panels are provided below.

Troubleshooting and removal / replacement procedures are also included for modules containing FRUs, such as the Base Radio and RFDS.

For a complete description of the iMU and iSCs, refer to the supplement to this manual (68P81098E05) for detailed information.

The SRSC combines the GEN 4 Control and RF Equipment Cabinet, and AC / DC power supply functions into one cabinet. The SRSC consists of a single cabinet (shown in Figure 2-2) which contains an 800 MHz GEN 4 Duplexed RF Distribution System (RFDS) and three Base Radios (BRs), along with an integrated Site Controller (iSC), and an AC / DC Power System. The SRSC is a single cabinet, stand-alone, non-expandable system which can be directly connected to the site antennas, T1 / E1 interface, and AC mains.

Outdoor SRSC Component Descriptions

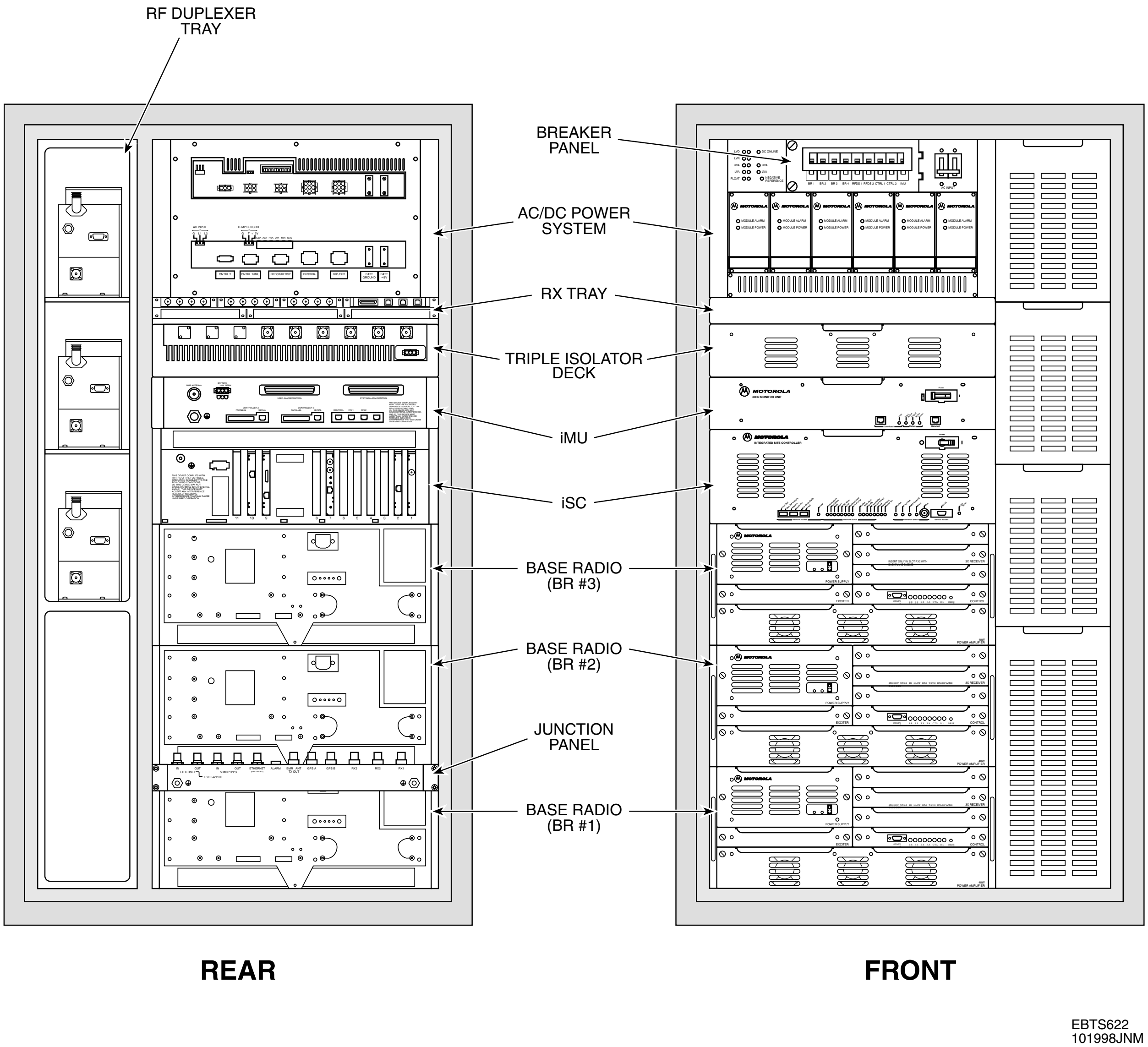


Figure 2-2 ***SRSC Cabinet***

The AC / DC Power System, iSC, and RFDS subsystems used in the SRSC cabinet are functionally similar to those used in a Stand-alone Control and RF Cabinet system. These subsystems are individually discussed below.

Figure 2-3 shows an overall simplified block diagram of a typical Outdoor SRSC. It consists of four major components, as listed below:

- ❒ integrated Site Controller
- ❒ Base Radio(s)
- ❒ RF Distribution System
- ❒ AC / DC Power System

These components, and their overall functions within the Outdoor SRSC, are individually discussed below.

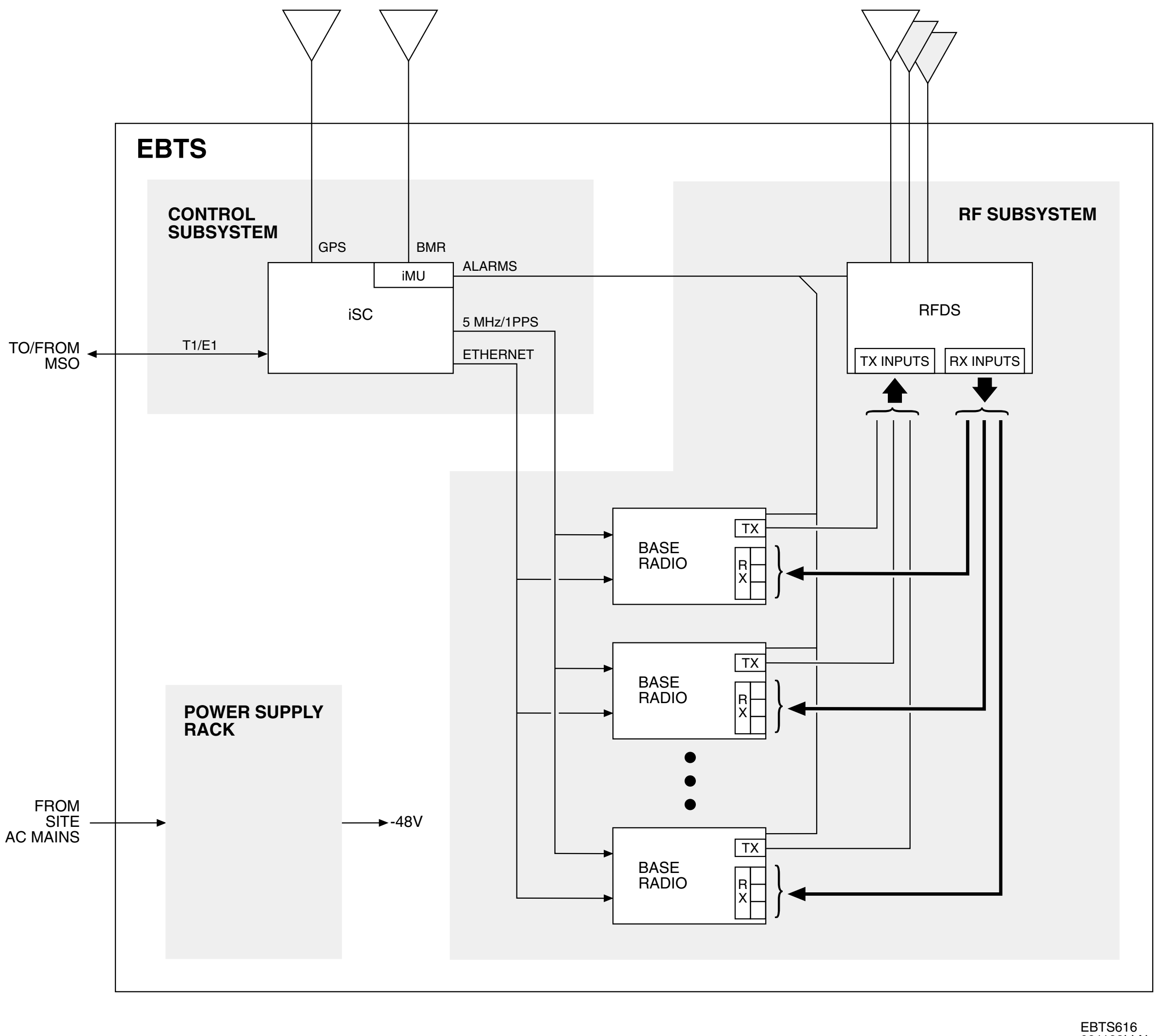


Figure 2-3 ***Outdoor SRSC Simplified Block Diagram***

integrated Site Controller

The iSC, shown in Figure 2-4, provides the interface between the Base Radios and the telco network, as well as providing a common interface point for all system alarms.

The iSC assigns available frequencies and time slots to the mobiles. It also communicates with the network via T1/E1 lines. The iSC receives Global Positioning System (GPS) signals which it uses to develop high-precision system timing signals.

The iSC interfaces with the Base Radios using the following interfaces:

❒ **5 MHz/1 PPS** – Via the received GPS signal, the iSC sends a high-precision 5 MHz signal (at 1 pulse-per second repetition rate) to the Base Radios. Via synthesis circuitry in the Base Radios, the 5MHz/1 PPS signal establishes timing functions and transmit/receive frequencies for the Base Radios.

❒ **Ethernet –** 10BaseT Ethernet interface provides data and control interface between iSC and Base Radios.

The iDEN Monitor Unit (iMU), also shown in Figure 2-4, is a component mounted above the iSC, but is functionally considered a part of the iSC. The iMU interfaces alarm signals from the SRSC to the iSC. In turn, the iSC can communicate SRSC alarms to the OMC via its T1/E1 link.

The iMU receives alarm signals from the Base Radios, RF Distribution System, and breaker status signals from the SRSC equipment cabinet circuit breakers. The iMU also contains a Base Monitor Receiver (BMR) which, via a separate receive antenna, verifies actual over-the-air communications.

Refer to the integrated Site Controller System Manual (68P81098E05) supplement of this manual for more information on the iSC.

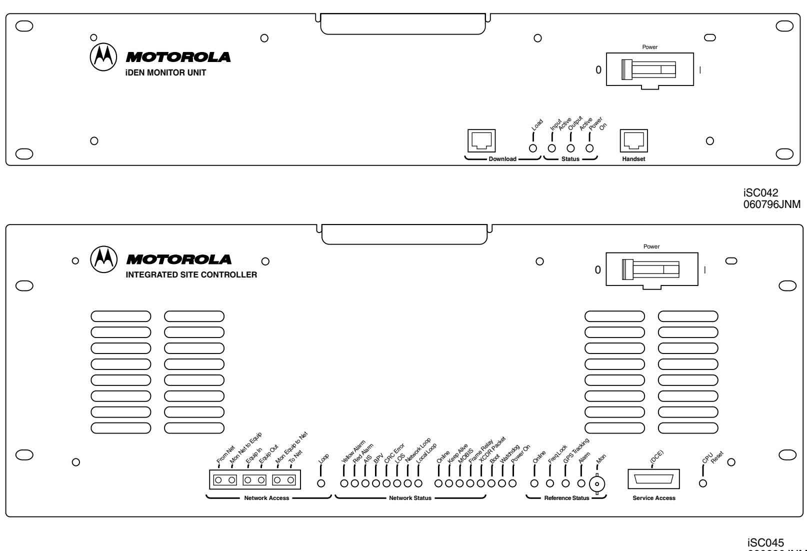


Figure 2-4 ***Integrated Site Controller and iDEN Monitor Unit***

Base Radio

Each Base Radio sends and receives control information and compressed voice data. Each Base Radio handles one 800 MHz channel that is 25 kHz wide and has six time slots. This means that six voice or data signals are allowed for every 25 kHz signal. This is accomplished using voice compression or encoding techniques. Inbound control slots are used by the mobiles for channel requests and other call control. Outbound control slots are for paging the mobiles from the network and call assignments.

The Base Radio is also capable of handling one 25 kHz, 800 MHz channel (or 900 MHz channel) with three time slots. The primary advantage of three time slots over six slots is better voice quality.

Figure 2-6 shows a simplified block diagram of the Base Radio. The Base Radio consists of the following FRUs:

- ❐ Base Radio Controller (BRC) – controls Base Radio operation
- ❐ Power Supply – provides operating power for the other Base Radio FRUs
- ❐ Receiver – filters Received RF and converts it to differential data
- ❐ Exciter – generates RF output
- ❐ Power Amplifier – amplifies exciter output prior to transmission

Each FRU is described in detail in the *Base Radio* section of this manual.

The Base Radio(s) are mounted below the RFDS . In general, all cabinets designed for BR installation are pre-wired for the maximum BR capacity. The first Base Radio (or lowest-numbered Base Radio in an expansion cabinet) is installed at the bottom of the cabinet. The next Base Radio is installed above the first and the third is installed above the previous one.

Refer to the *Base Radio* section of this manual for more information on the BR.

Outdoor SRSC Component Descriptions

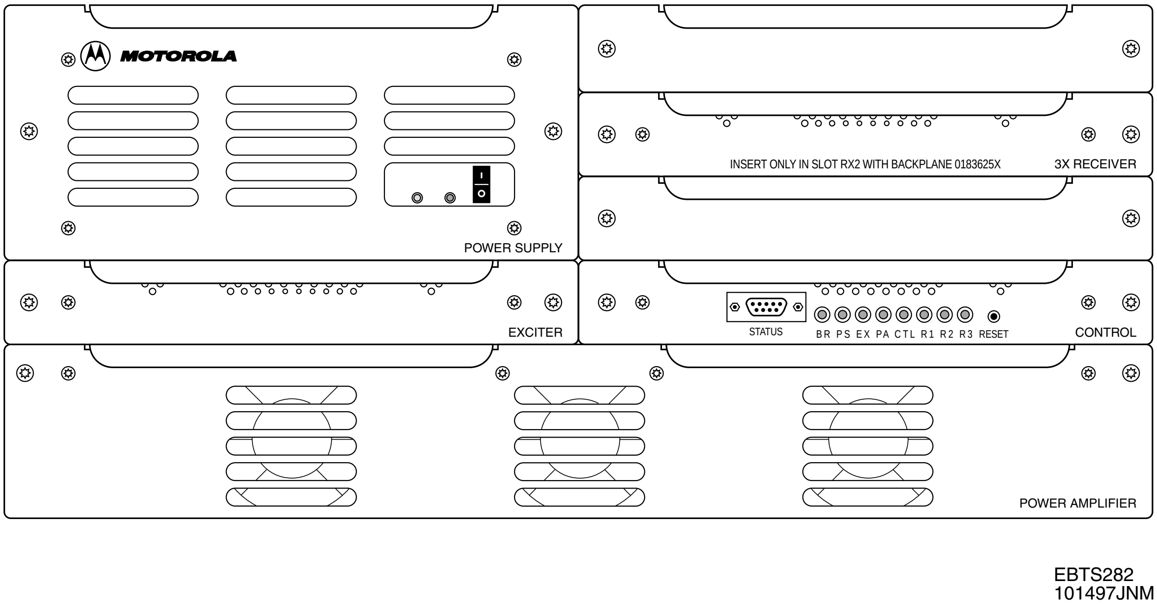


Figure 2-5 ***Base Radio***

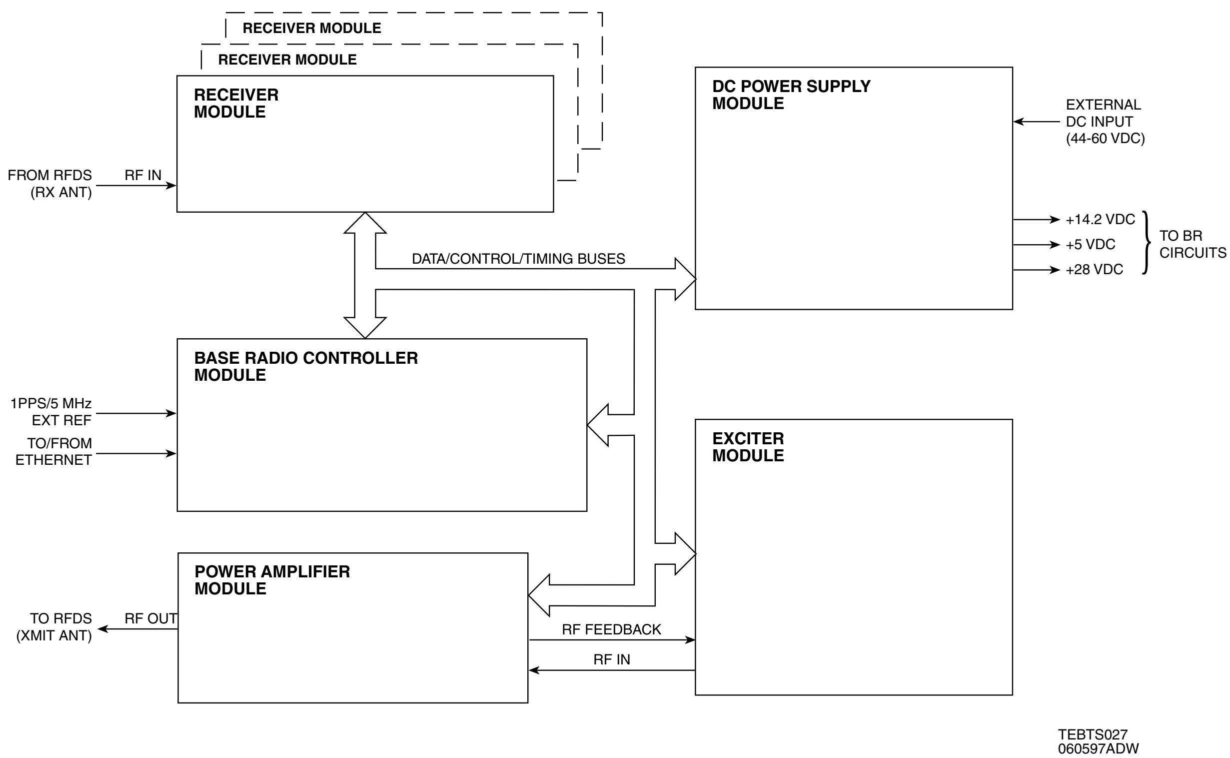


Figure 2-6 ***Base Radio Simplified Block Diagram***

RF Distribution System (RFDS)

The RFDS routes radio frequency signals from the site receive antennas, into the SRSC, and back out to the site antennas for transmission.

The RFDS combines several transmit signals from several Base radios onto one line, which is applied to an antenna. Similarly, a receive signal from an antenna is distributed to several Base Radios via the RFDS.

The SRSC system uses a GEN 4 Duplexed RFDS, which is an 800 MHz duplexing and receiver multicoupler system that accommodates three BRs. Duplexers allow a transmit (Tx) and a receive (Rx) path to share a common antenna. Figure 2-7 shows the GEN 4 Duplexed RFDS used within the SRSC system.

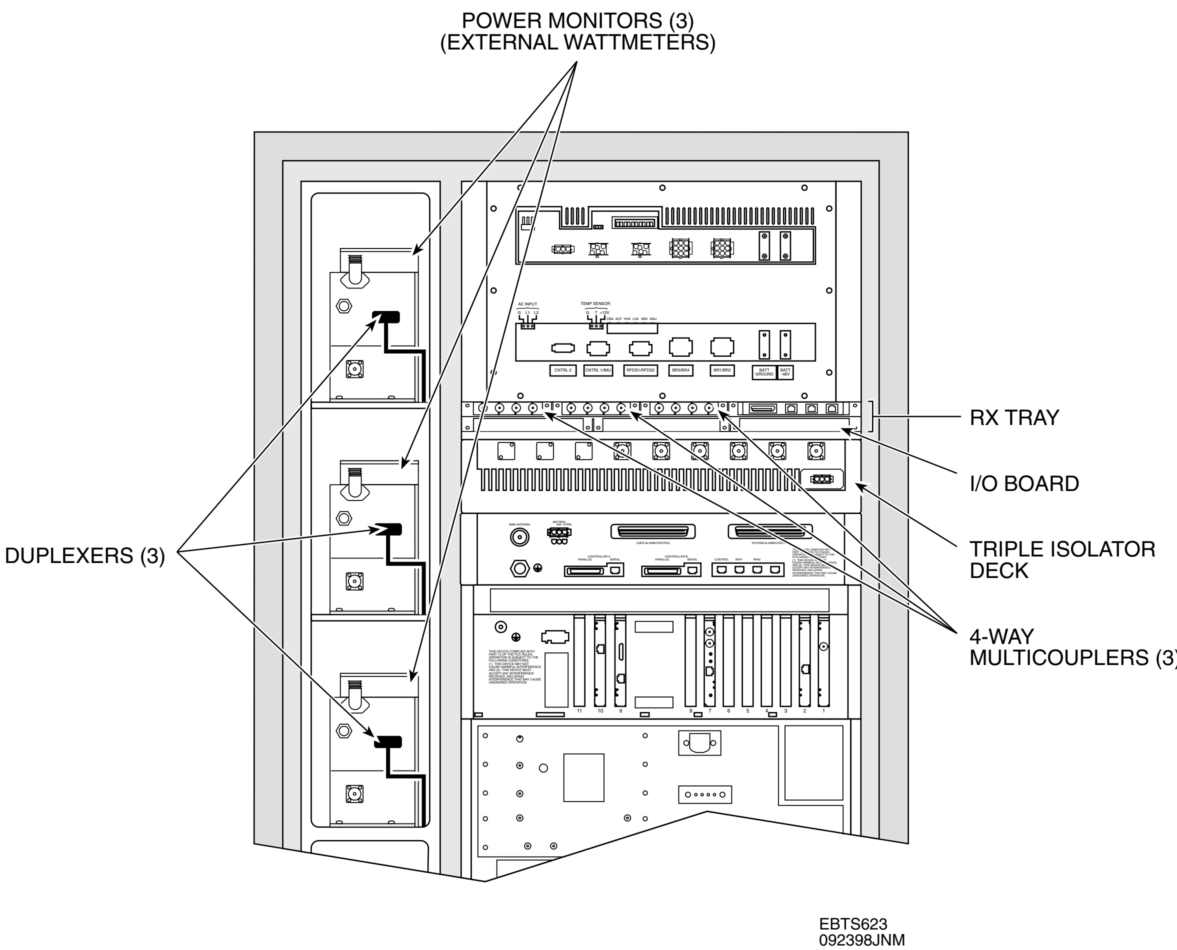


Figure 2-7 ***SRSC GEN 4 Duplexed RF Distribution System***

The SRSC version of the GEN 4 Duplexed RFDS contains several Field Replaceable Units (FRUs), including:

- An Rx LNA / Multicoupler Tray (Rx Tray), consisting of the following FRUs:
  - Three, 4-Way Multicoupler / Amplifier assemblies
  - Two Power Supplies
  - Alarm Board
  - Input / Output Interface Board (I / O Board)
- A Triple Isolator Deck
- A Tower-Top Amplifier (TTA) Alarm Tray (optional), which contains three TTA alarm interface modules

The Triple Isolator Deck provides isolation and a signal conditioning interface between the Duplexers and the Base Radio transmit signals.

The deck utilizes a microstrip / groundplane design to facilitate transmission line properties that provide functions such as harmonic filters. Due to the compact, high-density design of the deck, a coldplate and forced-air cooling is used instead of the simple radiational / convective cooling used in the other RFDSs. The coldplate is a casting with integral heat sinks which conducts heat away from the circuitry. Additionally, fans provide concentrated cooling air flow across the assembly. The fans are not thermostatically controlled and operate continuously while power is applied to the cabinet.

An Rx Tray is used for Rx signal distribution. Corresponding to the three Rx diversity branches, the Rx Tray contains three, 4-Way Multicouplers (MCs). Each MC contains an amplifier / 4-way multicoupler that accepts a single Rx signal from the Duplexer Rx output and then provides four outputs which are applied to the three BRs in the SRSC cabinet (the fourth output is not used and terminated).

The Rx Tray also contains a dual-redundant power supply, an I / O board, an alarm diagnostics board, and a power / signal backplane ("midplane" board). The power supplies provide operating power for the Rx Tray receive multicouplers, as well as the isolator deck fans, tower top amplifiers, and the duplexer power monitor assemblies. The I / O board provides a power and alarm interconnect between various RFDS assemblies. The alarm diagnostics board detects and routes RFDS failure status information to the iDEN Monitor Unit (iMU) via the I / O board alarm interconnect.

AC/DC Power System

The AC / DC Power System (shown in Figure 2-8) receives 240 Vac, 1-phase, 50 / 60 Hz power from the site AC mains and provides several -48 Vdc outputs for use by various SRSC components within the SRSC cabinet. Figure 2-8 shows the AC / DC Power System used within the SRSC cabinet.

The AC / DC Power System uses six identical, front-panel accessible rectifier module Field Replaceable Units (FRUs). The module FRUs convert the AC mains power into the -48 Vdc (nominal) required by the cabinet components. The multiple modules provide (N+1) redundancy should any module fail.

Each rectifier module is equipped with MODULE POWER and MODULE ALARM indicators which, at a glance, show the operational status of each module. The AC / DC Power System is designed to allow “hot pull” of a defective module, thereby circumventing a system power-down to replace a defective module. In addition to the front panel indications, the AC / DC Power System interfaces alarm status signals to the iMU and, in turn, to the OMC should a malfunction occur.

The AC / DC Power System front panel contains test points (along with corresponding trimmer adjustments) for conveniently setting up and checking various power system parameters. System status indicators are also provided.

The AC / DC Power System is equipped with an integral breaker panel which provides an AC mains breaker, as well as individual DC output breakers for each cabinet component that receives power from the AC / DC Power System.

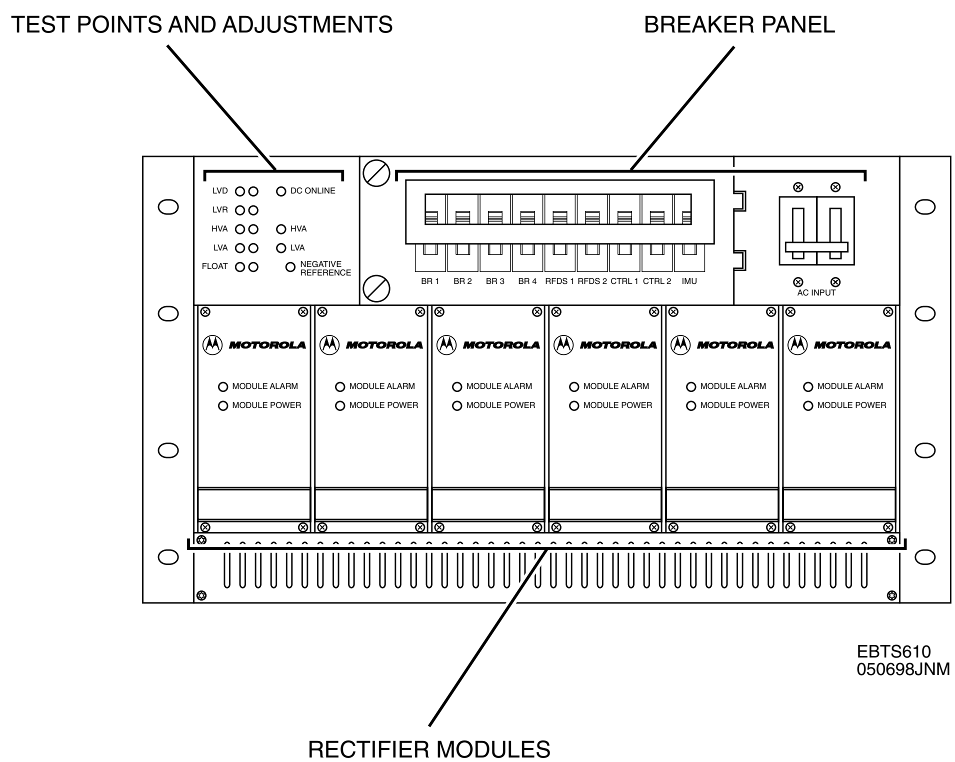


Figure 2-8 ***AC/DC Power System***

Cabinet Power Distribution And Interconnect Hardware

SRSC Equipment Cabinets are equipped with hardware that provides DC distribution / overload protection and signal interconnection for the system. Each of these items is discussed below.

Breaker Panel

The breaker panel (shown in Figure 2-8) is integrated into the AC / DC Power System. The Breaker Panel is the central location for power distribution and overload protection for the equipment cabinet.

All systems receive -48 Vdc from a power supply (rectifier) system. The power supply system provides two identical -48 Vdc feeds: A and B. The A-side feed and B-side feeds are correspondingly applied to A- and B-sides of the cabinet Breaker Panel.

Figure 2-9 shows, in simplified form, the distribution of the basic -48 Vdc power to the SRSC major components.

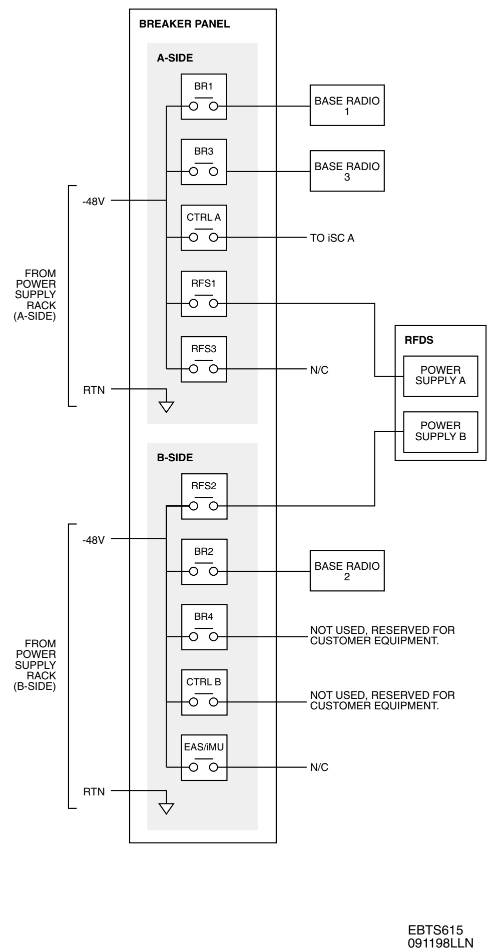


Figure 2-9 ***DC Distribution Diagram***

Junction Panel

The Junction Panel (shown in Figure 2-10) provides a central location for cabinet grounding and intercabinet cabling. Access to the Junction Panel is gained from the rear of the cabinet. The Junction Panel contains the following connectors:

- ❐ Ethernet (in / out) intercabinet connectors
- ❐ Global Positioning Satellite (GPS) A and B connectors (used only in cabinets equipped with an iSC)

The Junction Panel is mounted at the rear of the equipment cabinet towards the bottom, between Base Radios 2 and 1.

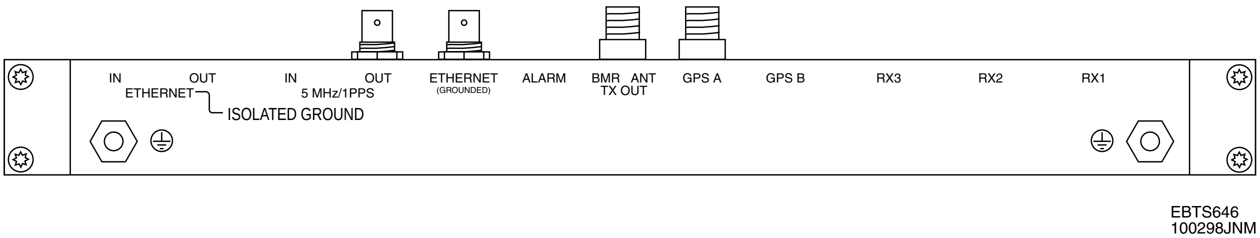


Figure 2-10 ***Typical Junction Panel***

Cabling Information

The illustrations and corresponding tables within this section identify cabling part numbers and point-to-point connections. The illustrations show the location and connections of the cables. Each cable is identified by an index number. The corresponding tables identify the point-to-point connection, function, and part number of the cables. Connections appearing in **bold** are labeled accordingly on the equipment.

The cabling diagrams included in this section are listed in the following table.

Section	Page	Description
Duplexer-To-Rx Tray Cabling	2-15	Provides cabling information for the receive connections between the Duplexers and the Rx Tray
Receiver Cabling	2-17	Provides cabling information for the Rx Tray-to-Base Radio Rx input connections
Chassis Grounding	2-18	Provides chassis ground connection information for components within the SRSC cabinet
5 MHz / 1 PPS Cabling	2-20	Provides information for the 5 MHz / 1 PPS cabling connections within the SRSC cabinet
Ethernet Cabling	2-22	Provides information for the Ethernet connections within the SRSC cabinet
iSC / iMU Interconnections	2-24	Provides information for the connections between the iSC and iMU within the SRSC cabinet
Power Cabling	2-25	Provides information for the cabling between the AC / DC Power System power distribution panel and the components within the SRSC cabinet
Cabinet Alarm / Power Monitor Harness Connections	2-28	Provides information for alarm and power monitor interconnection for various components within the SRSC cabinet
AC / DC Power System Alarm Connections	2-29	Provides information for AC / DC Power System alarm connections to the iMU within the SRSC cabinet
Transmit Power Out Cabling	2-31	Provides cabling information for the Base Radio transmit output connections to the RFDS within the SRSC cabinet
Duplexed TTA Cabling	2-32	Provides information for cabling between the Rx Tray, TTA Alarm Tray, and DC injectors within the SRSC cabinet for systems equipped to operate with TTAs

Duplexer-To-Rx Tray Cabling

NOTE

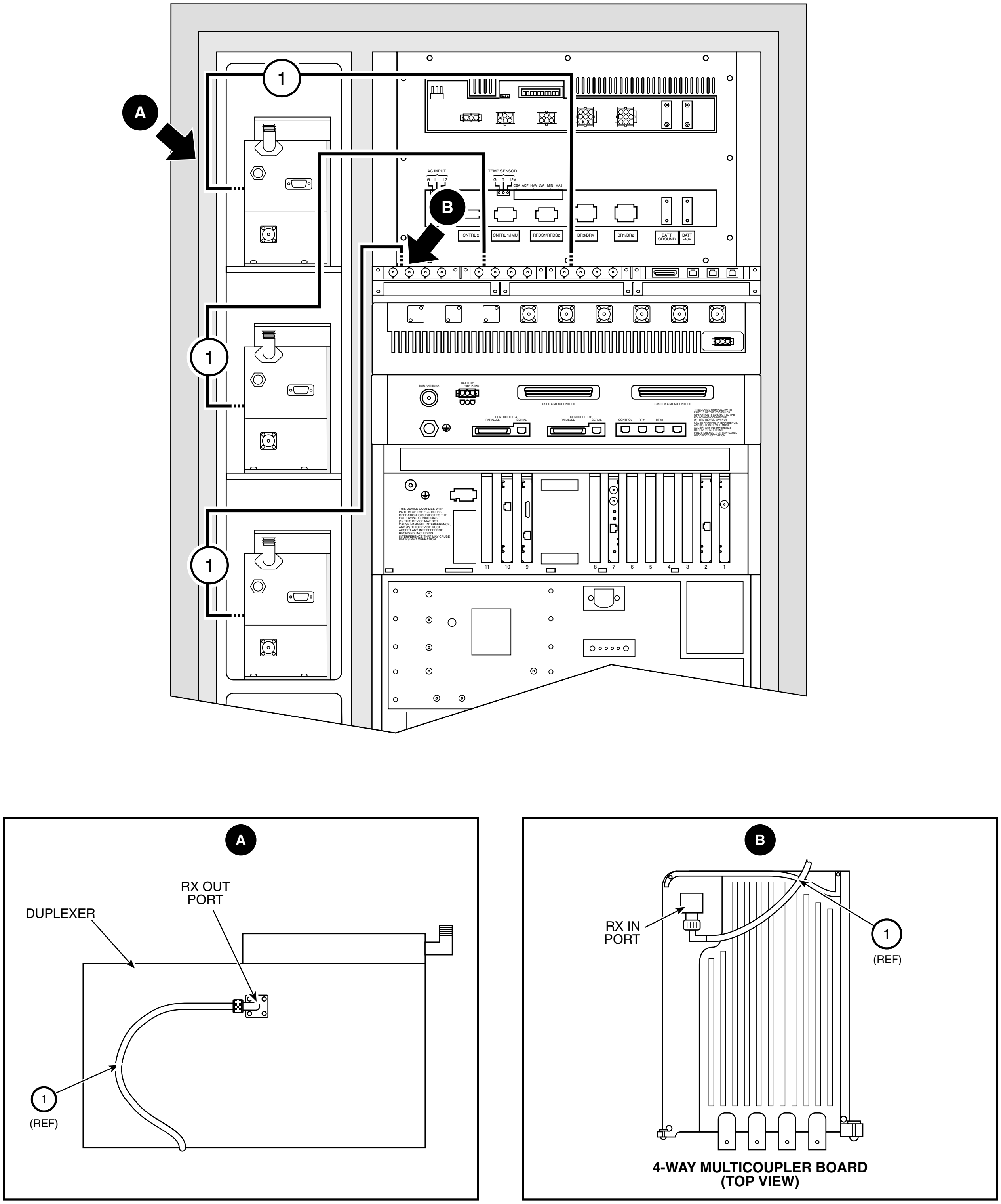
Duplexer-to-Rx Tray cabling is factory configured. This information is provided as a reference for performing maintenance.

Duplexer-to-Rx Tray cabling routes the Rx output from the Duplexers to the 4-way multicouplers in the SRSC cabinet Rx Tray. Table 2-1 identifies and Figure 2-11 shows the Duplexer cabling and connecting points.

Table 2-1 ***Duplexer-To-Rx Tray Cabling***

Index	Part Number	From	To	Notes
1	3012028G17	Duplexer Rx output port (see detail A in Fig. 2-11)	Input port on 4-Way Multicoupler Board (see detail B in Fig. 2-11)	

Cabling Information



EBTS625
092398JNM

Figure 2-11 ***Duplexer-To-Rx Tray Cabling***

Receiver Cabling

Receiver cabling refers to the cabling within the cabinet from the Rx Tray to the Base Radios.

Table 2-2 lists receiver cabling information and Figure 2-12 shows the receiver cabling connections.

Table 2-2 ***Receiver Cabling (SRSC System)***

Index	Part Number	From	To
1	0112004Y15	**R1** connector on 4-Way Multicoupler Board	RX connector on BR1
2	0112004Y15	**R2** connector on 4-Way Multicoupler Board	RX connector on BR2
3	0112004Y12	**R3** connector on 4-Way Multicoupler Board	RX connector on BR3
4	0909906D01	—	50Ω termination connected to **R4** connectors on Rx1, Rx 2, and Rx3 4-Way Multicoupler Boards. (3 total terminations used)

Cabling Information

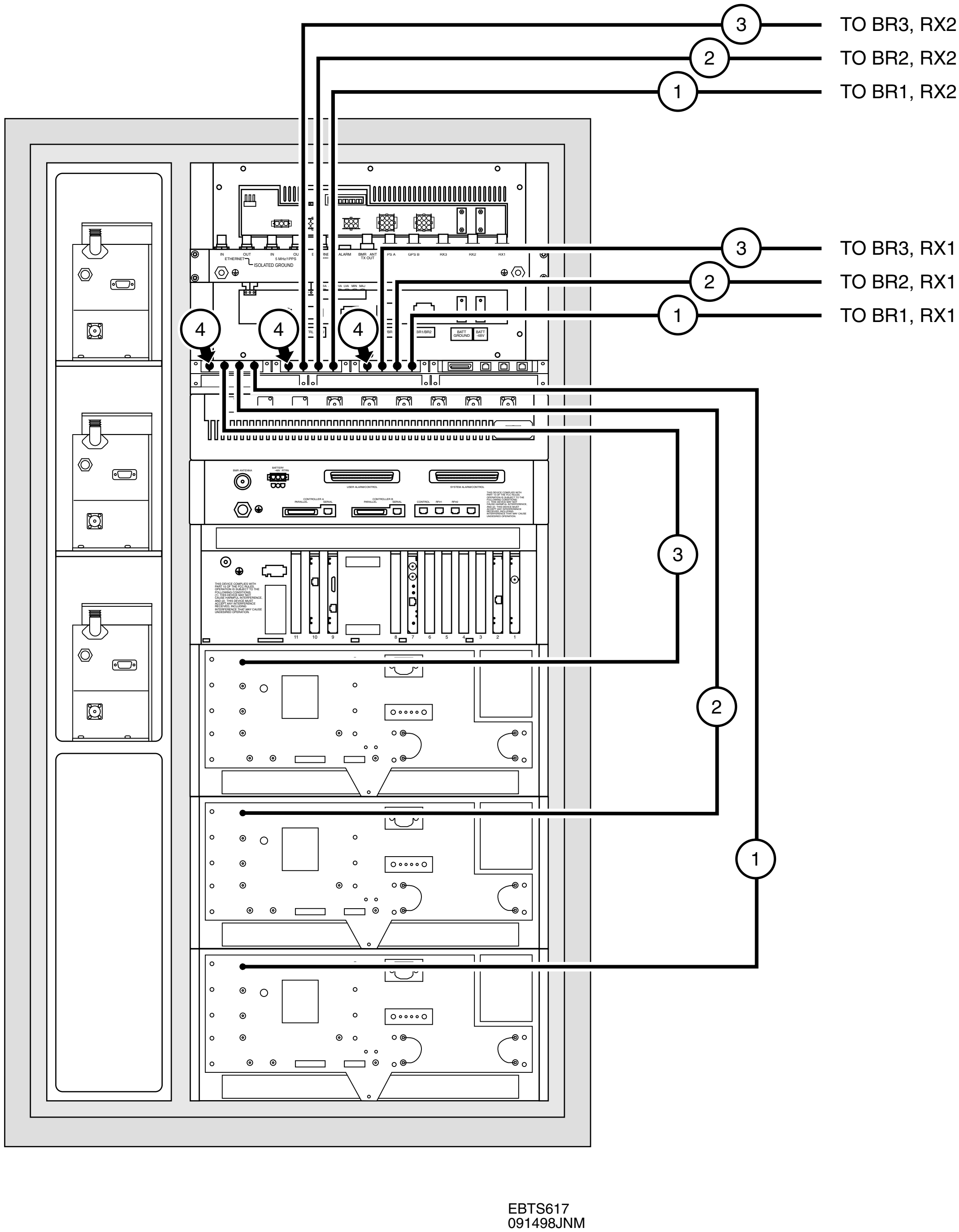


Figure 2-12 ***Receiver Cabling***

Chassis Grounding

Chassis grounding refers to the ground cable connections between the equipment modules within the equipment cabinet and the cabinet frame. Chassis grounds help prevent interference and damage to equipment in the event of a lightning strike.

Table 2-3 identifies and Figure 2-13 shows the SRSC cabinet ground cabling.

Table 2-3 **Ground Straps (SRSC System)**

Index	Part Number	From	To
1	308200X04	Ground stud on equipment cabinet	**GROUND** stud on Base Radio 1
2	308200X04	Ground stud on equipment cabinet	**GROUND** stud on Base Radio 2
3	308200X04	Ground stud on equipment cabinet	**GROUND** stud on Base Radio 3
4	308200X04	Ground stud on equipment cabinet	**GROUND** stud on iSC
5	308200X04	Ground stud on equipment cabinet	**GROUND** stud on iMU
6	308200X02	Ground stud on equipment cabinet	ground lug on Rx Tray
7	308200X04	Ground stud on equipment cabinet	ground stud on Antenna 1 Duplexer
8	308200X04	Ground stud on equipment cabinet	ground stud on Antenna 2 Duplexer
9	308200X04	Ground stud on equipment cabinet	ground stud on Antenna 3 Duplexer

Cabling Information

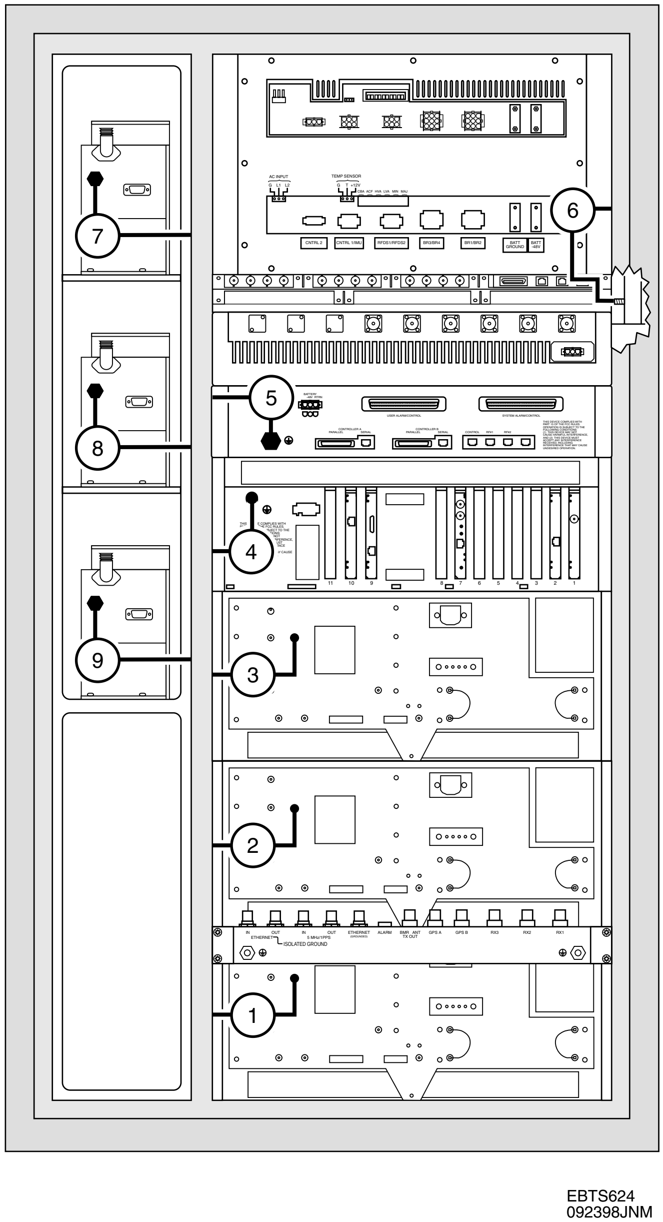


Figure 2-13 ***Chassis Grounding Diagram***

5 MHz/1 PPS Cabling

5 MHz / 1 PPS cabling routes the time frequency reference signal between the iSC and each Base Radio.

Table 2-4 identifies and Figure 2-14 shows the 5 MHz / 1 PPS cabling.

Table 2-4 ***5 MHz/1 PPS Cabling (SRSC System)***

Index	Part Number	From	To
1	0909906D01	—	**5 MHz/1 PPS OUT** connector on Junction Panel (50Ω termination)
2	3082004X03	Underside of **5 MHZ/1 PPS OUT** connector on Junction Panel	BNC T-adapter on Base Radio 1
3	0112004Z17	BNC T-adapter on Base Radio 1	BNC T-adapter on Base Radio 2 BNC T-adapter on Base Radio 3
4	0112004Z17	BNC T-adapter on Base Radio 3	**OUT 1** connector on iSC SRI card
5	0909906D01	—	**OUT 2** connector on iSC SRI card (50 Ω termination)
6	3083415X02	Underside of **GPS A** connector on Junction Panel	**GPS ANT** connector on iSC SRI card

NOTES:

1. Cables are connected between BNC T-adapters (P/N 0909907D01), which are connected to the appropriate BR connector.
2. Cabinet is equipped with cables (index no. 3) and T-adapters for connection to three BRs regardless of BR complement. Unused T-adapters are left unconnected.

Cabling Information

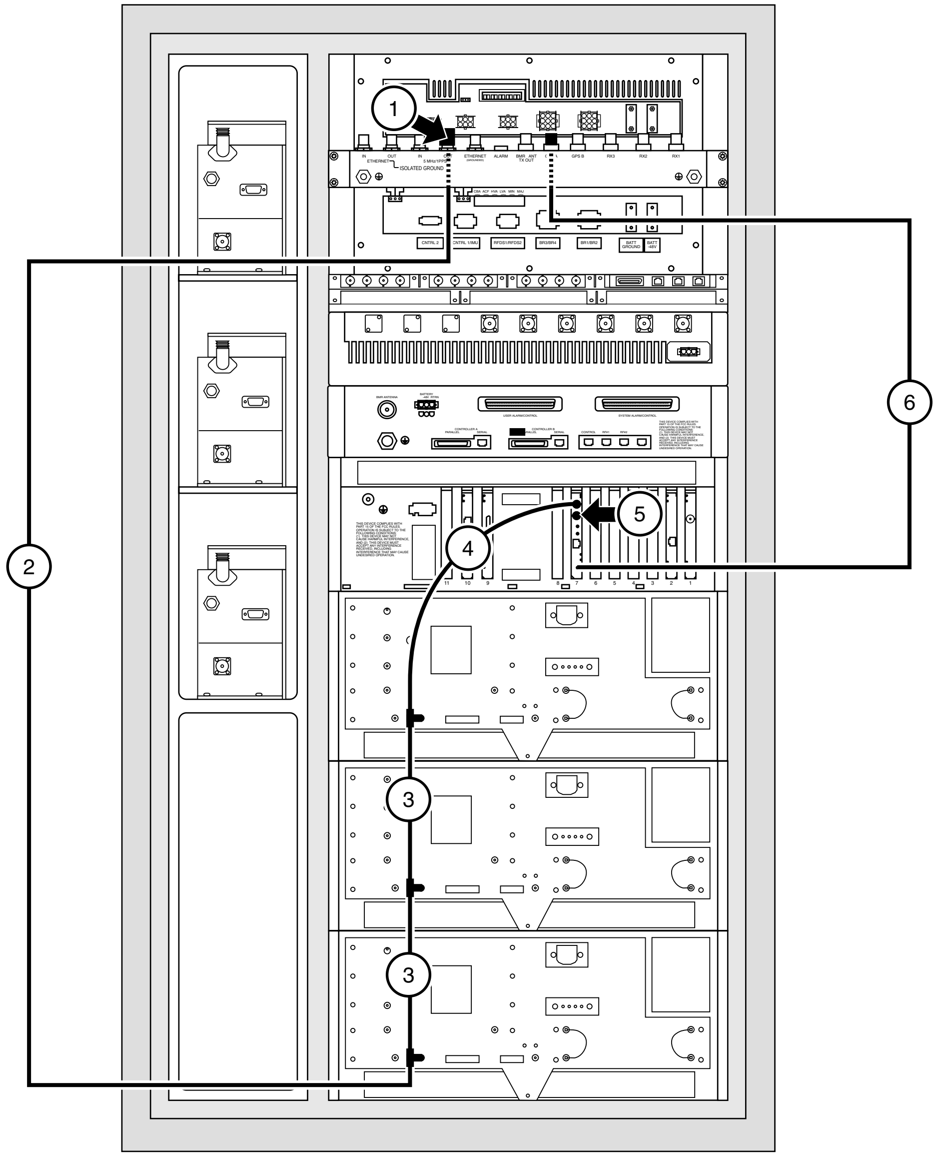


Figure 2-14 ***5 MHz/1 PPS Cabling***

Ethernet Cabling

Ethernet cabling routes the Ethernet network between the Junction Panel and each Base Radio.

Table 2-5 identifies and Figure 2-15 shows the Ethernet cabling.

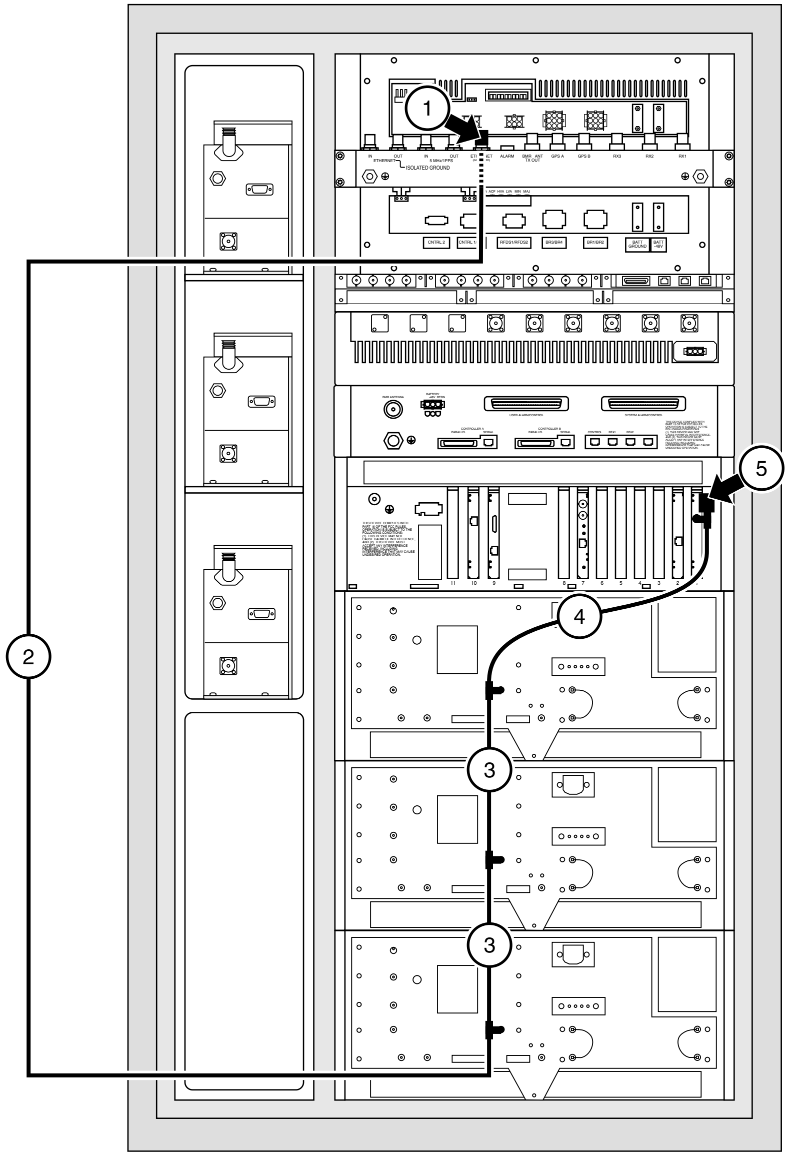
Table 2-5 ***Ethernet Cabling (SRSC System)***

Index	Part Number	From	To
1	0909906D01	—	**ETHERNET (GROUNDED)** connector on Junction Panel
2	3082004X03	Underside of **ETHERNET (GROUNDED)** connector on Junction Panel	BNC T-adapter on Base Radio 1
3	0112004Z17	BNC T-adapter on Base Radio 1	BNC T-adapter on Base Radio 2 BNC T-adapter on Base Radio 3
4	0112004Z17	BNC T-adapter on Base Radio 3	BNC T-adapter on **10 Mb/s** connector on iSC ELP card
5	0909906D01	—	50Ω termination

NOTES:

1. Cables are connected between BNC T-adapters (P/N 0909907D01), which are connected to the appropriate BR connector.
2. Cabinet is equipped with cables (index no. 3) and T-adapters for connection to three BRs regardless of BR complement. Unused T-adapters are left unconnected.

Cabling Information



EBTS619
091498JNM

Figure 2-15 ***Ethernet Cabling***

iSC/iMU Interconnections

iSC / iMU interconnections refer to the connections between the iSC and the iMU.

Table 2-6 identifies and Figure 2-16 shows the iSC-to-iMU connections.

Table 2-6 ***iSC/iMU Interconnections***

Index	Part Number	From	To
1	3012028P31	**BMR ANTENNA** connector on iMU	Underside of **BMR ANT** connector on Junction Panel (not shown)
2	3083499X01	**CONTROLLER A PARALLEL** connector on iMU	**PARALLEL** connector on iSC Transient Protection (S/P) card.
3	3084225N48	**CONTROLLER A SERIAL** connector on iMU	**SERIAL** connector on iSC Transient Protection (S/P) card.

NOTES:

1. Refer to iSC Supplement to this manual, 68P81098E05, for iSC-to-network (T1/E1) cabling.
2. Refer to iSC Supplement to this manual, 68P81098E05, for iMU USER ALARM connections.

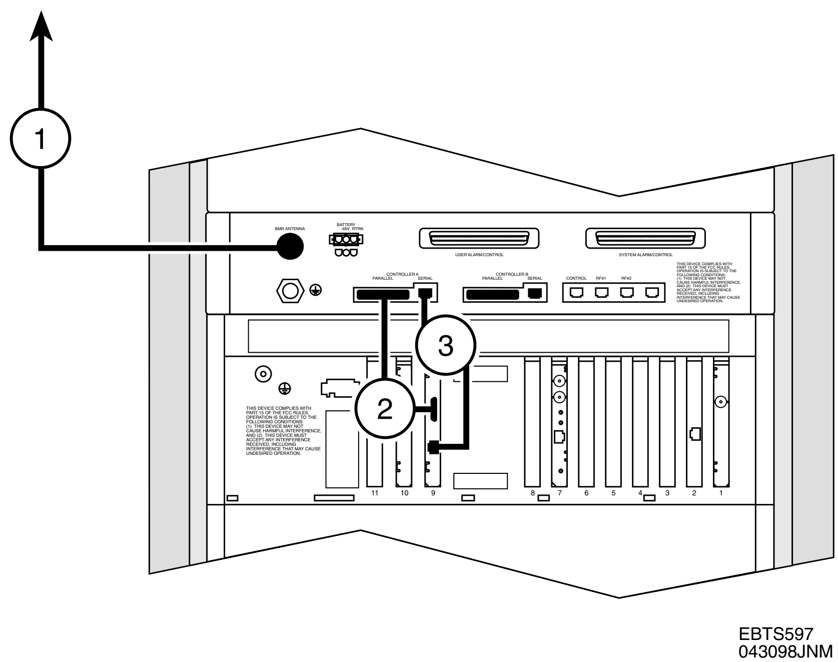


Figure 2-16 ***iSC/iMU Interconnections***

Power Cabling

Power cabling refers to the AC mains power connection, and the DC power connections between the power distribution panel on the AC/DC Power System and the components within the cabinet. Table 2-7 identifies and Figure 2-17 shows the power connections.

! WARNING !

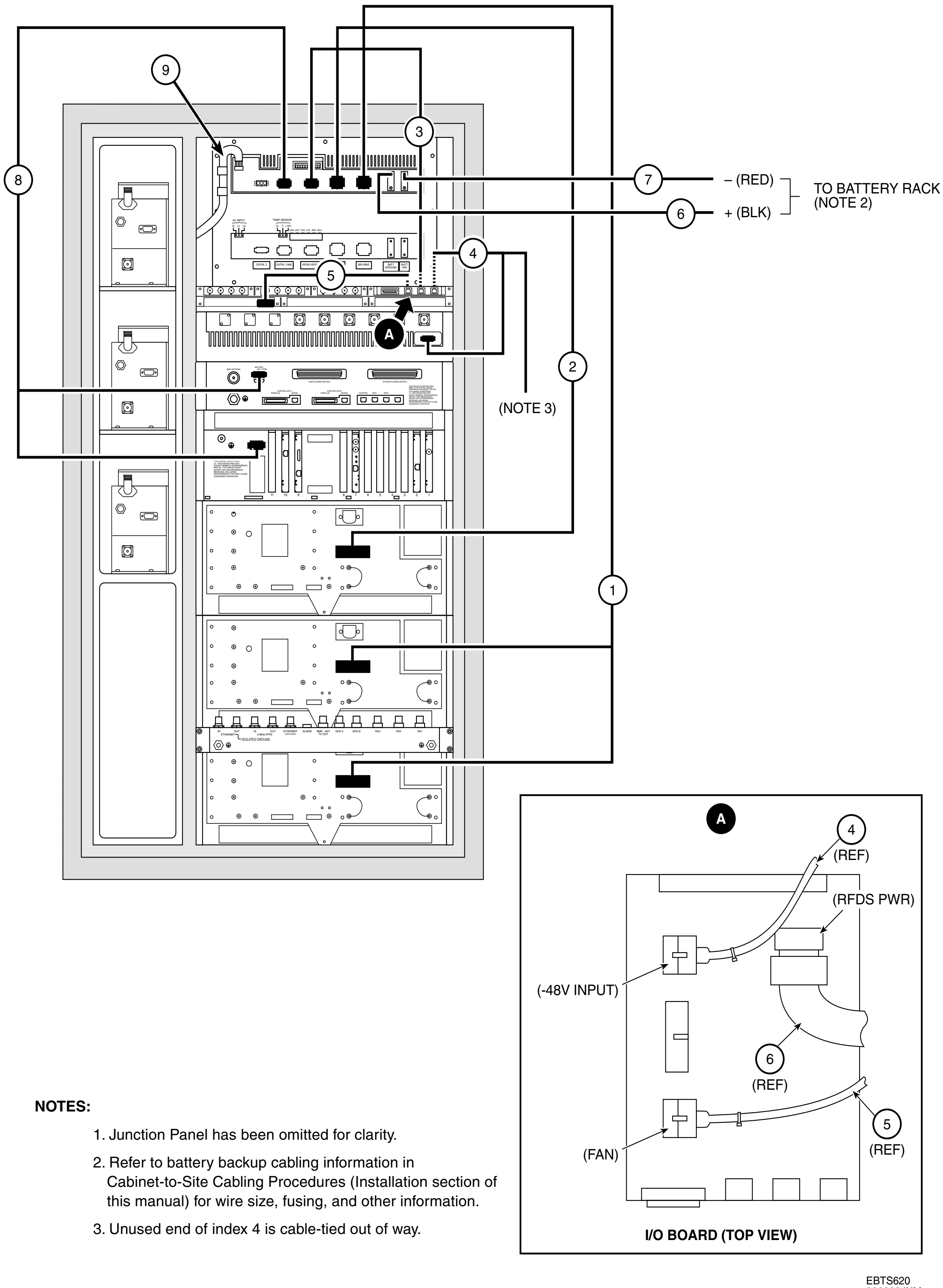
TYPICAL BATTERY INSTALLATION UTILIZES A SPECIAL BATTERY RACK. IF BATTERIES ARE INSTALLED IN SRSC CABINET, THE CONSIDERATIONS SPECIFIED IN ‘QUALITY STANDARDS – FIXED NETWORK EQUIPMENT INSTALLATIONS’ (MOTOROLA STANDARD R56) MUST BE OBSERVED.
FAILURE TO PROPERLY INSTALL BATTERY SYSTEM CAN RESULT IN AN EXPLOSION HAZARD TO PERSONNEL AND SITE, AND POSSIBLE EQUIPMENT DAMAGE DUE TO ELECTROLYTE LEAKAGE AND/OR OUTGASSING.

Table 2-7 ***Power Cabling***

Index	Part Number	From	To	Notes
1	3082050X02	**BR1/BR2** connector on AC / DC Power System	**DC POWER** connector on Base Radio 1 and 2	Y-cable assembly
2	3082050X01	**BR3/BR4** connector on AC / DC Power System	**DC POWER** connector on Base Radio 3	
3	3082129X04	**RFDS1/RFDS2** connector on AC / DC Power System	**–48 Vdc** Mate-N-Lok input connector on Rx Tray I / O board	See detail A in Fig. 2-17
4	3082129X02	**FAN POWER** output Mate-N-Lok connector on Rx Tray I / O board	Mate-N-Lok input connector on Triple Isolator Deck (NOTE 3)	Y-cable assembly see detail A in Fig. 2-17
5	3082056X03	RFDS power output Mate-N-Lok connector on Rx Tray I / O board	9-pin subminі D connector (P5) on RFDS duplexer shelf	See detail A in Fig. 2-17
6	—	**BATT GROUND** terminal lug on AC / DC Power System	Backup battery rack (NOTE 2)	
7	—	**BATT -48V** terminal lug on AC / DC Power System	Backup battery rack (NOTE 2)	
8	3083609X01	**CTRL 1/IMU** connector on AC / DC Power System	• **BATTERY** connector on iMU • **BATTERY** connector on iSC	Y-cable assembly
9	—	Site 240 VAC, 30 A receptacle	AC / DC Power System AC input	Power cord is part of AC / DC Power System.

NOTES:

1. In Fig. 2-17, Junction Panel is omitted for clarity.
2. Refer to battery backup cabling information in Cabinet-to-Site Cabling Procedures (Installation section of this manual) for wire size, fusing, and other information.
3. Unused end of index 4 is cable-tied out of way.
4. Cabinet is equipped with full 3-BR power cabling.



NOTES:

1. Junction Panel has been omitted for clarity.
2. Refer to battery backup cabling information in Cabinet-to-Site Cabling Procedures (Installation section of this manual) for wire size, fusing, and other information.
3. Unused end of index 4 is cable-tied out of way.

EBTS620
092298JNM

Figure 2-17 ***Power Cabling***

Cabinet Alarm/Power Monitor Harness Connections

The cabinet alarm connections use a multi-connector wiring harness assembly that provides for daisy-chain connection of the various components.

Table 2-8 identifies and Figure 2-18 shows the harness connecting points.

Table 2-8 ***Cabinet Alarm/Power Monitor Harness Connections***

Index	Part Number	From	To
1	3082053X01	25-pin submini-D connector (P4) on RFDS duplexer shelf	Power monitor multi-connector harness. From top-to-bottom, connects to: • 25-pin **ALARM** connector on Base Radio 3 • 25-pin **ALARM** connector on Base Radio 2 • 25-pin **ALARM** connector on Base Radio 1
2	3082733X02	—	Shorting plug. Connects to **CONTROL** connector on iMU. **CAUTION: If shorting plug is not used, false alarms will result.**
3	3084225N48	RJ45 STANDARD alarm connector on I/O board	**RF#1** connector on iMU
4	3082733X02	—	Shorting plug. Connects to RJ45 BREAKER STATUS ALARM connector on I/O board. **CAUTION: If shorting plug is not used, false alarms will result.**

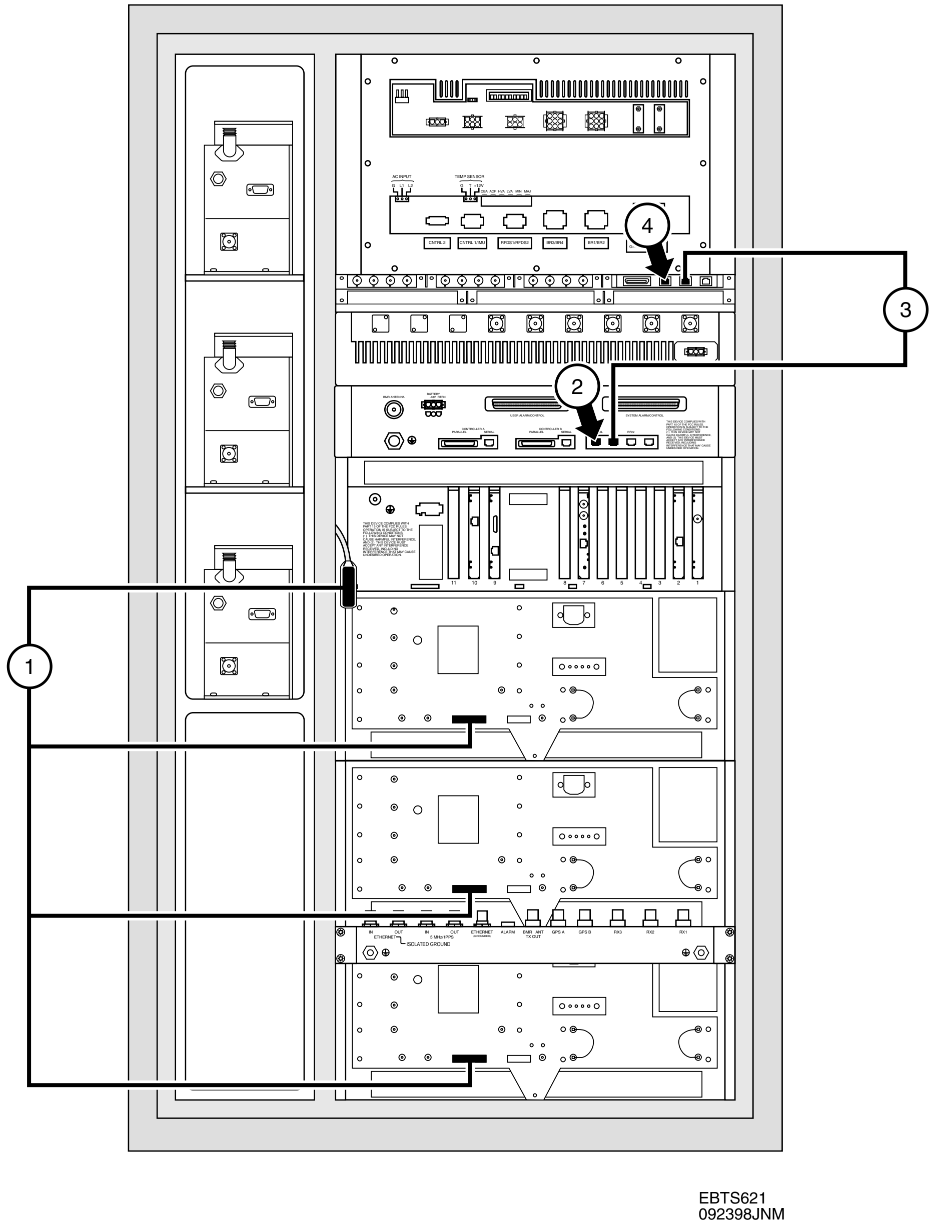


Figure 2-18 ***Cabinet Alarm/Power Monitor Harness Connections***

AC/DC Power System Alarm Connections

Wiring for six power supply alarm contact pairs is connected from the AC / DC Power System to the iMU SYSTEM ALARM punchblock.

Table 2-9 identifies and Figure 2-19 shows the harness connecting points.

NOTE

Refer to Alarm Wiring in *iSC Supplement 68P81098E05 (Chapter 3 – Pre-Installation)* for punchblock details.

Table 2-9 ***AC/DC Power System Alarm Connections***

Index	From	To	Function
1	**TEMP SENSOR** connector on AC / DC Power System	Battery temperature sensor probe	Battery temperature monitoring. **NOTE:** Battery temperature sensor probe and cable are part of AC/DC Power System.
2	**CBA** terminal block pair on AC / DC Power System	Punchblock pair 15, 40	Circuit Breaker Alarm (indicates breaker has tripped)
3	**ACF** terminal block pair on AC / DC Power System	Punchblock pair 12, 37	AC Failure Alarm (loss of AC mains)
4	**HVA** terminal block pair on AC / DC Power System	Punchblock pair 14, 39	High DC Voltage Alarm (upper threshold limit of -48Vdc output exceeded)
5	**LVA** terminal block pair on AC / DC Power System	Punchblock pair 13, 38	Low DC Voltage Alarm (lower threshold limit of -48 Vdc output exceeded)
6	**MIN** terminal block pair on AC / DC Power System	Punchblock pair 16, 41	Minor rectifier module failure
7	**MAJ** terminal block pair on AC / DC Power System	Punchblock pair 17, 42	Major rectifier failure

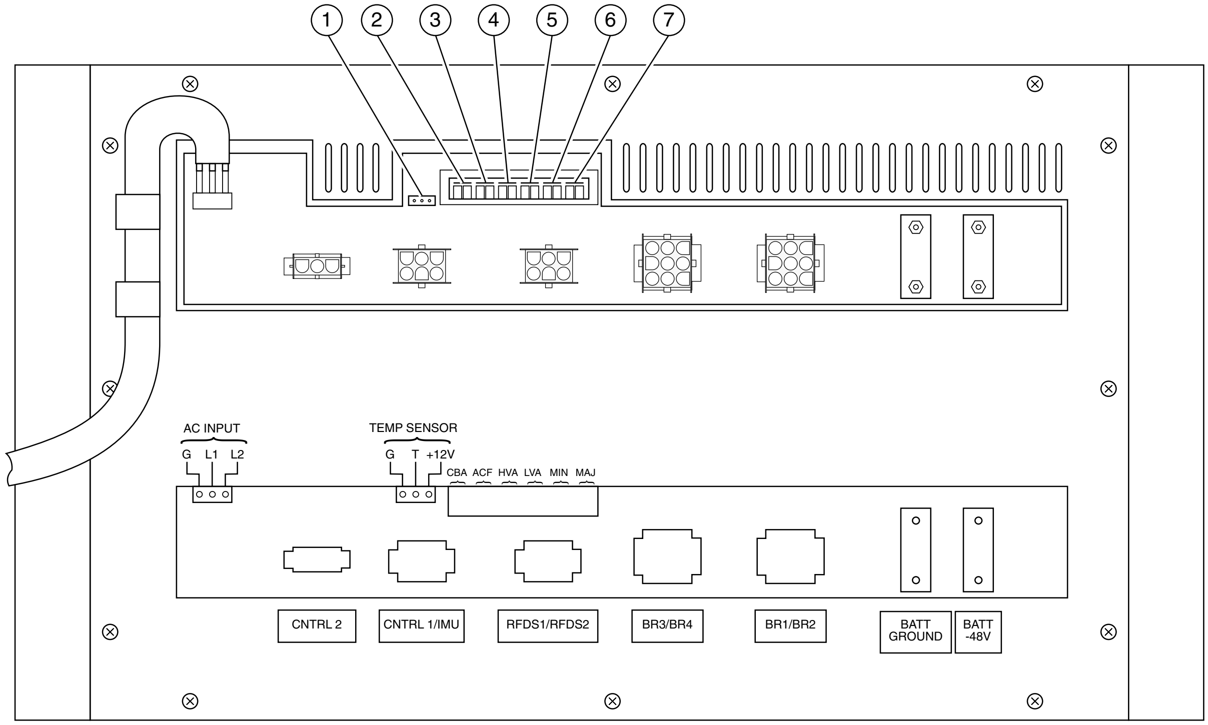


Figure 2-19 ***AC/DC Power System Alarm Connections***

Transmit Power Out Cabling

Transmit power output cabling routes the Base Radio RF output to the transmit inputs on the RFDS.

Table 2-10 identifies and Figure 2-20 shows the SRSC Tx cabling.

Table 2-10 ***Transmit Power Out Cabling***

Index	Part Number	From	To
1	0112004K14	**PA OUT** connector on BR 1	Triple Isolator Deck **T2** (IN) port
2	0112004K14	**PA OUT** connector on BR 2	Triple Isolator Deck **T4** (IN) port
3	0112004K14	**PA OUT** connector on BR 3	Triple Isolator Deck **T6** (IN) port
4	0112004B03	**T1** (OUT) port on Triple Isolator Deck	Antenna 1 Duplexer Tx input port
5	0112004B03	**T3** (OUT) port on Triple Isolator Deck	Antenna 2 Duplexer Tx input port
6	0112004B03	**T5** (OUT) port on Triple Isolator Deck	Antenna 3 Duplexer Tx input port

Cabling Information

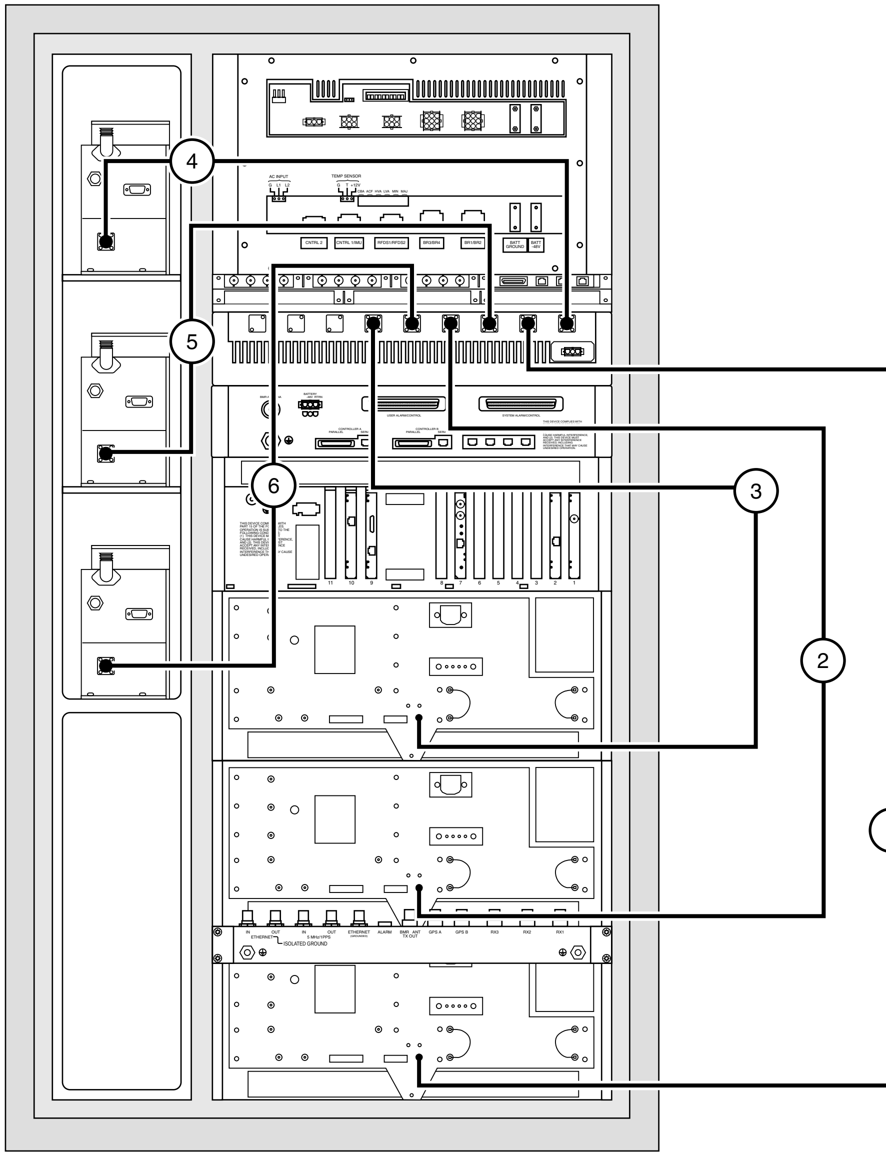


Figure 2-20 ***Transmit Power Out Cabling***

Duplexed TTA Cabling

Table 2-11 lists and Figure 2-21 shows the cabling for the TTA Alarm Tray and DC Injectors within the SRSC cabinet.

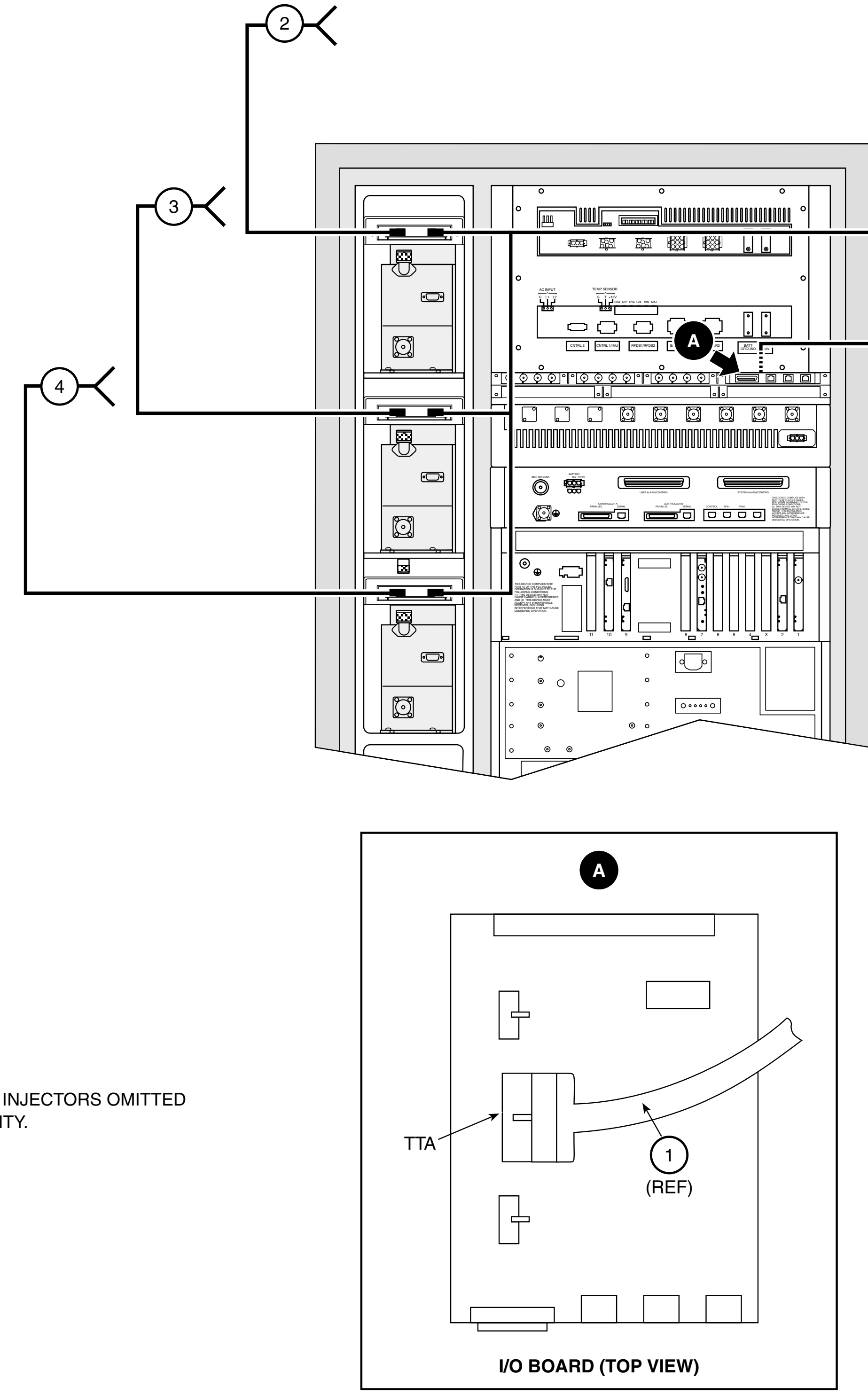
Table 2-11 ***Duplexed TTA Cabling***

Index	Part Number	From	To	Notes
1	3082136X02	TTA Mate-N-Lok connector on Rx Tray I / O Board (See detail A in Fig. 2-21.)	Right-side connector on rear of TTA power / alarm interface card (3 places, as shown)	Multi-branch wiring harness
2	—	Duplexer 1 DC injector	Left-side connector on rear of TTA #1 power / alarm interface card	Cable is integral part of DC Injector P / N 8082223Y01
3	—	Duplexer 2 DC injector	Left-side connector on rear of TTA #2 power / alarm interface card	Cable is integral part of DC Injector P / N 8082223Y01
4	—	Duplexer 3 DC injector	Left-side connector on rear of TTA #3 power / alarm interface card	Cable is integral part of DC Injector P / N 8082223Y01

NOTE

Index 1 and index 2 (and respective connectors on TTA power / alarm interface cards) are identically keyed. However, if connections are interposed TTA will not function.

Cabling Information



NOTE: DC INJECTORS OMITTED FOR CLARITY.

EBTS627
092498JNM

Figure 2-21 ***Duplexed TTA Cabling***

MOTOROLA

Chapter 3
Pre-Installation

Overview

This section provides pre-installation information for the preparation of an Outdoor SRSC site. A pre-installation site review and evaluation helps prevent potential equipment installation problems. Every subject discussed in this section must be considered prior to performing the installation of the Outdoor SRSC.

The topics included are listed in the following table.

Foundation (Site Pad) Planning

Motorola recommends the following considerations:

- ❒ A reinforced concrete pad (minimum size: 5' x 7' x 6"), capable of supporting the weight of the Outdoor SRSC (approximately 1400 lbs.), level to within 1/8" is required.
- ❒ Locate the pad to minimize dust and sand entering the Equipment Cabinet while the doors are open for servicing.
- ❒ Ensure sufficient soil grading and drainage to prevent water from accumulating in the vicinity of the site foundation.
- ❒ Soil resistivity should be measured prior to pouring the pad; the resulting holes can then be sleeved to facilitate later installation of grounding rods for the Utility Pedestal and Equipment Cabinet.
- ❒ The telco service entrance to the Outdoor SRSC is located at the bottom of the Utility Pedestal, as shown in Figure 3-1. A PVC pipe should be installed in the site pad to allow the telco conduit to enter the Utility Pedestal through its bottom entry port. Pad design/location should also accommodate plans to bring transmission lines and electrical conductors into the Utility Pedestal.

Rooftop Sites

- ❒ Because the weight of the hardware is nearly 1400 pounds, structural and seismic analysis of the rooftop may be required to determine proper placement, as well as needs for reinforcement.

Widely Varying Temperature Conditions

- ❒ A larger, thicker pad may be required in areas that experience extremely cold temperatures to compensate for ground frost upheaval.
- ❒ Locate the pad to minimize snow accumulation against cabinet doors. This eases winter access and decreases the likelihood that water from melting snow will enter cabinets during servicing.

Cabinet Footprint

Outdoor SRSC equipment has a footprint as shown in Figure 3-1. The height for both the Utility Pedestal and Equipment Cabinet is 72 inches.

At least 2’ of free space is required in front and behind each cabinet. Additional free space is recommended at the front and back of the Outdoor SRSC to allow service personnel easy access to the equipment.

The National Electrical Code (NEC) requires a 36” clearance for electrical service access to all fuse panels, breaker panels, etc.

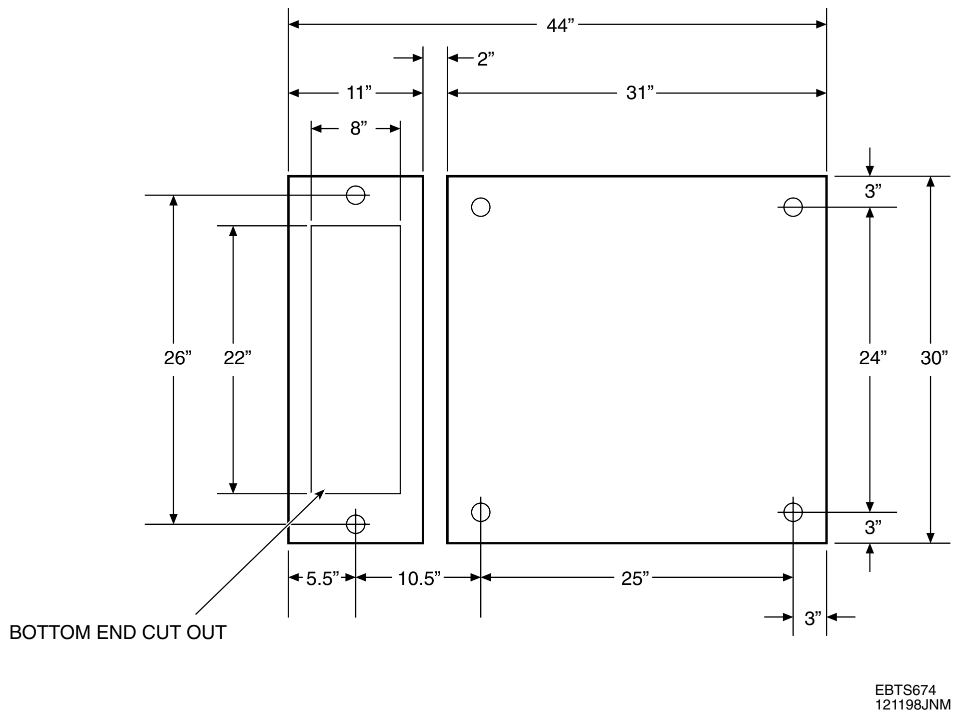


Figure 3-1 ***Equipment Cabinet Footprint***

NOTE

For additional dimension details, refer to the cabinet manufacturer drawings supplied with the Outdoor SRSC.

Electrical Requirements

All electrical wiring for the Outdoor SRSC site must meet the requirements of NEC and all applicable local codes.

AC Service

The DC power system operates from a 240 V, single-phase, 50 / 60 Hz service. 200 Amp service is recommended.

The DC power system has normal loads and start-up loads, as does the HVAC. Both of these loads are dependent upon the number of BRs in the site and the size and condition of the battery system. The normal and start-up load of the Motorola offered power system, using a one-hour backup, is provided in Table 3-1. These loads may differ for customer designed power systems.

Table 3-1 ***Typical AC Power Loads (Imposed by DC Power System) (70 W BR)***

Configuration (Total BRs on Site)	AC Amps (nominal)	AC Amps (start-up)	Heat † (BTU) (NOTE 2)
SRSC (combined iSC / RF equipment / rectifier; 3 BR)	15 (NOTE 3)	19 (NOTE 4)	11,270

NOTES:

1. The values contained in this table are to be used for planning purposes only. These values are typical and are not guaranteed equipment specifications.
2. BTU values listed in the Heat column are approximate and based on nominal AC Amps. Includes the heat generated by rectifiers and iDEN equipment.
3. SRSC operating at full equipment load; 220 VAC nominal line voltage.
4. SRSC battery charging at full capacity; 220 VAC nominal line voltage.

Meter Baseplate

A special mounting plate has been provided on the outside of the Utility Pedestal for locating the meter baseplate. See Figure 3-2.

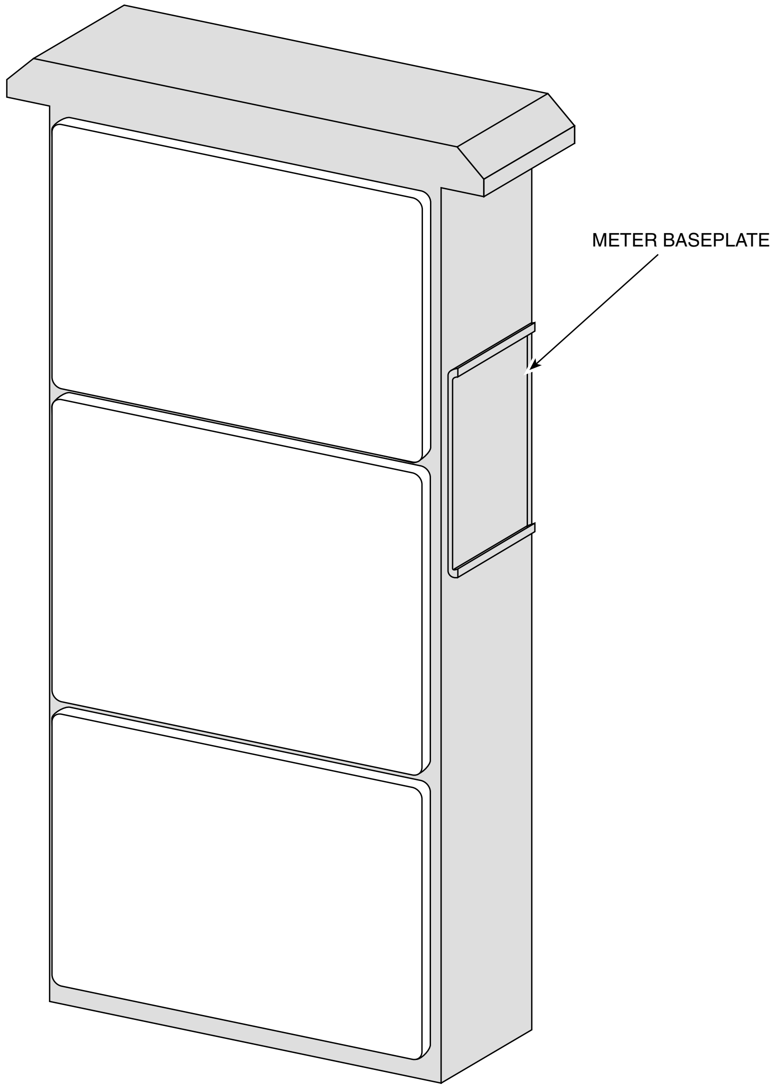


Figure 3-2 ***Mounting Plate for Electric Meter***

Power Panel

All Outdoor SRSC sites use a standardized power panel including circuit breaker layout, see Table 3-2.

Table 3-2 ***Power Panel Layout***

No.	Amps	Circuit Breaker Label	No.	Amps	Circuit Breaker Label
1	30	Equipment Power	2	100	Surge Arrestor
3			4		
5	15	HVAC	6	20	Lamps, Smoke Detector
7			8	15	Battery Heater
NOTE: The Equipment Power, HVAC, and surge arrestors are 2-pole breakers.					

48 Vdc Power System

DC Power Reference

The Outdoor SRSC equipment operates from positive ground, -48 Vdc power. Reference is made throughout this manual to the -48 Vdc (supply / hot) and the DC return power leads. The hot and return leads are kept isolated from chassis grounds in the equipment. The positive (+) return lead is grounded at a single point on the rectifier load return bus. Table 3-3 shows the color coding for these wires.

Table 3-3 ***-48Vdc Power Bus Color Coding***

Description	Battery Connection	Wire Color
-48 Vdc (nominal)	Negative (-)	Red
DC Return	Positive (+)	Black
NOTE: The hot/supply side is negative polarity (-) in the 48 Vdc system power bus and the ground side is positive polarity (+).		

Power Supply Rack

The battery system provides 1hour of backup power to the SRSC equipment.

NOTE

The HVAC system is not part of the battery backup circuit and thus will shut down when AC power is lost. Since the SRSC will continue to generate heat, it will probably experience thermal shutdown after about 30 minutes of running on battery backup power.

Grounding Requirements

The Outdoor SRSC site must meet certain specifications for adequate protection from lightning induced transients. Proper ground installation methods are outlined in the *Quality Standards-Fixed Network Equipment (FNE) Installation Manual (R56)*. Refer to the Manual Overview for information on obtaining the R56 manual.

Ground Rings

Separate ground rings should surround the site pad and antenna tower. Ground rods (8') should be driven into the ground at the four corners of the pad, and at each tower support post. The two ground rings should be bonded together with one wire, buried at least 18" underground, or below frost level.

These ground rings are referred to as the exterior primary ground and must be at least #2 AWG solid, bare, tinned copper wire. All connections to the rings should be made by exothermic welding. All exothermic welded connections should be treated with cold galvanizing spray.

Inspection wells should be provided, for access to the buried ground system to allow verification of ground resistance. The ground resistance should be less than 5Ω.

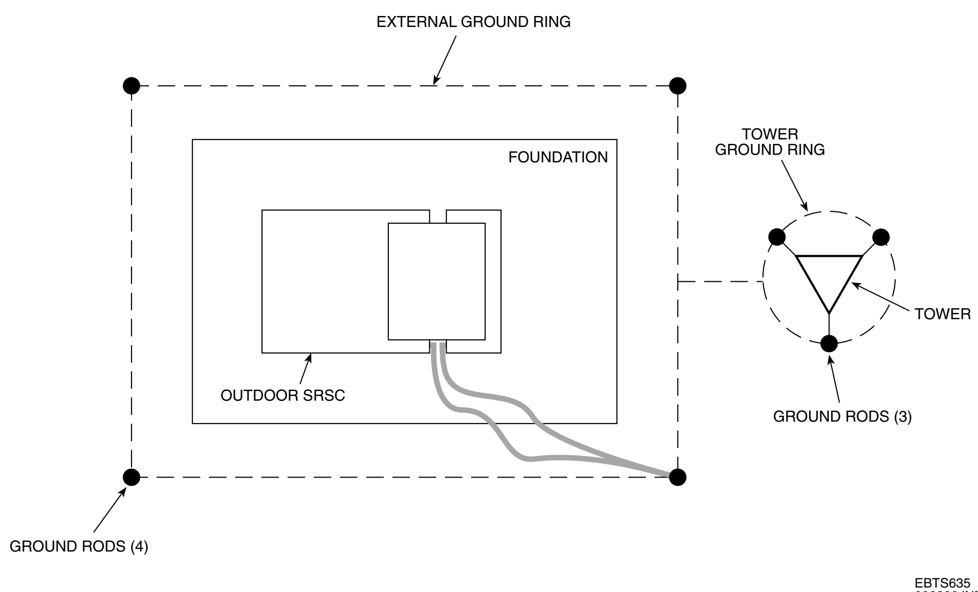


Figure 3-3 ***Typical Ground Ring Installation for Outdoor SRSC Site***

Tower Grounding

Ground each leg of the antenna tower with an 8’ ground rod driven near each leg. All ground connections to the antenna tower must be exothermically welded. Do not weld directly on tower structural members; weld only to provided tower grounding tabs or to tower feet.

NOTE

Make sure that welding ground connections to the antenna tower does not void the warranty of the tower.

Metal monopole towers require a minimum of three 8’ long ground rods to be driven into the ground, spaced approximately 10’ apart. These ground rods may be exothermically welded to the bottom portion of the mast itself, to the monopole footing, or to the provided grounding connection tabs.

CAUTION

Do not mount antennas on wooden poles. Such installations render the path through the antenna transmission line the shortest to Ground. Refer to *Quality Standards Fixed Network Equipment* - *Installation Manual (R56)*. for approved antenna installation methods.

Master Ground Bar

The Master Ground Bar (MGB) is located on the inside of the bottom bay of the Utility Pedestal. It is used to ground the following equipment:

- ❐ Telco board
- ❐ RF surge arrestors
- ❐ electrical system.

Antenna Installation

CAUTION

Do not mount antennas on wooden poles. Such installations render the path through the antenna transmission line the shortest to Ground. Refer to *Quality Standards Fixed Network Equipment - Installation Manual (R56)*. for approved antenna installation methods.

Antenna Feed Line Requirements

Eight bulkhead-style cable entrance ports are provided on the Utility Pedestal for antenna transmission lines. These lines may also enter the Utility Pedestal via the large, rectangular bottom port. Either way, transmission lines must be grounded using manufacturer approved grounding kits.

To reduce interference (intermodulation) problems, connectors on the transmit antenna lines must be gold or silver plated. The plating on the male/female connector combination must match on both connectors. For example, a male connector containing a gold plated center pin and silver plated outer conductor must match the female connector with a gold plated center pin and silver plated outer conductor.

Connectors at the antenna feed line entrance are Type N, except for the transmission connectors which are 5/16 DIN. Connector types at the antenna end may vary depending upon the antenna and jumper combinations selected by the customer. Contact your iDEN System Manager for additional information.

Antenna Surge Protection

All antenna feed lines must be protected with a suitable surge arrestor as they enter the lower bay of the Utility Pedestal. Six (6) bulkhead-mount surge protectors are provided:

- 3 transmit/receive
- 1 BMR
- 1 GPS
- 1 test port.

Figure 3-4 shows the layout of the bulkhead. Surge arrestors for bottom-entry applications are available; contact your Motorola representative for more information. Figures 3-5 and 3-6 show the schematic layout of the surge protectors as Motorola recommends they should be installed.

Antenna Installation

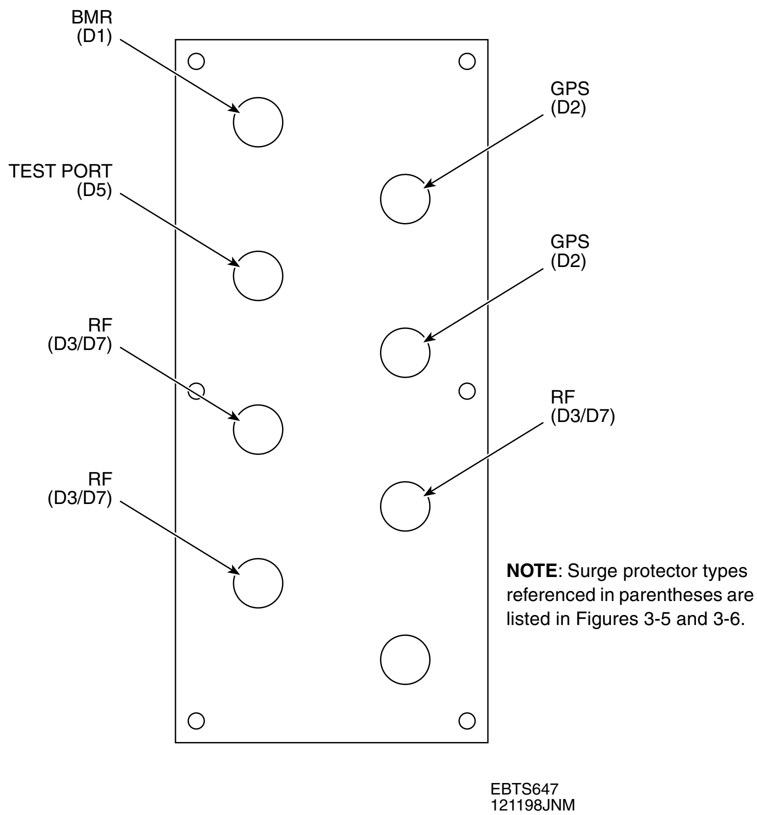
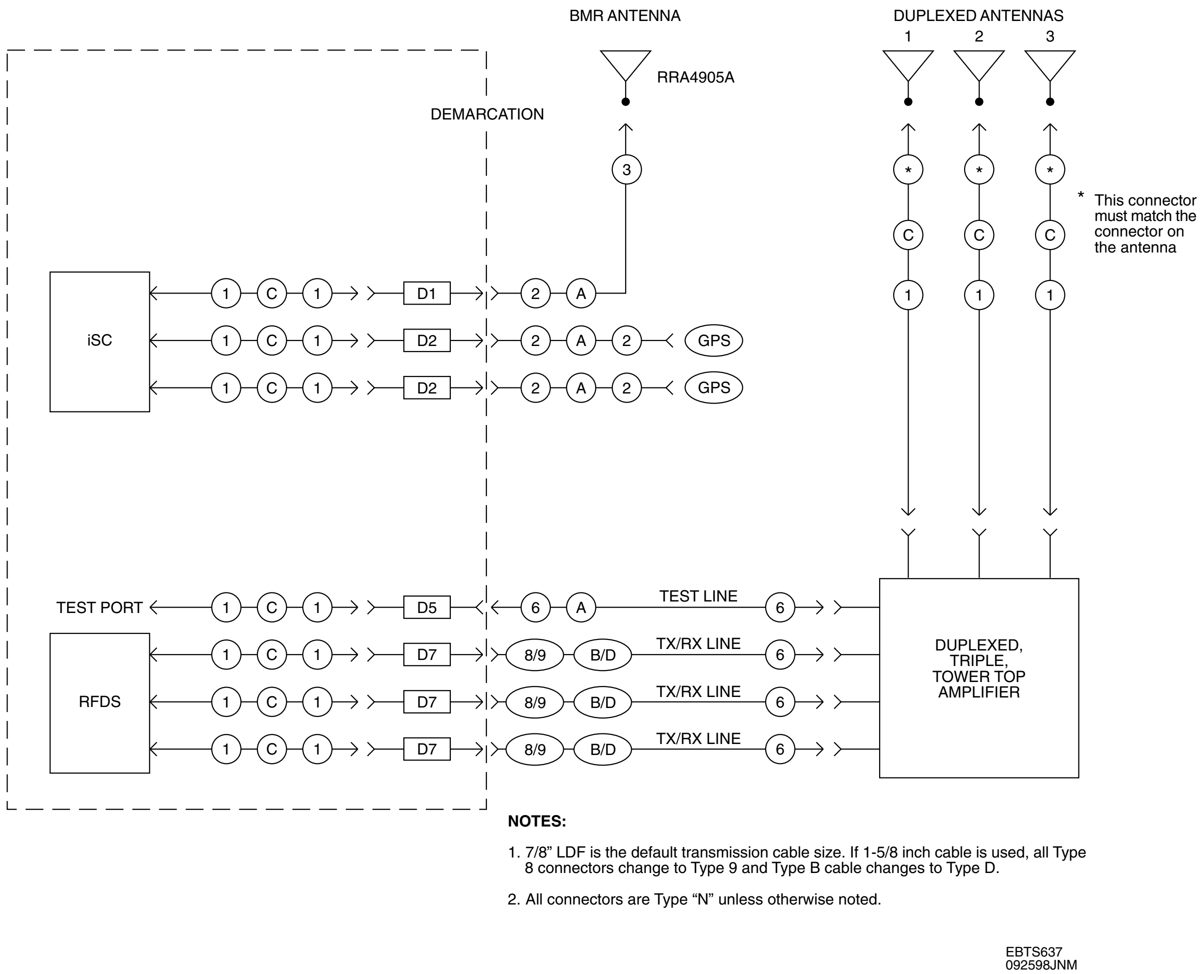


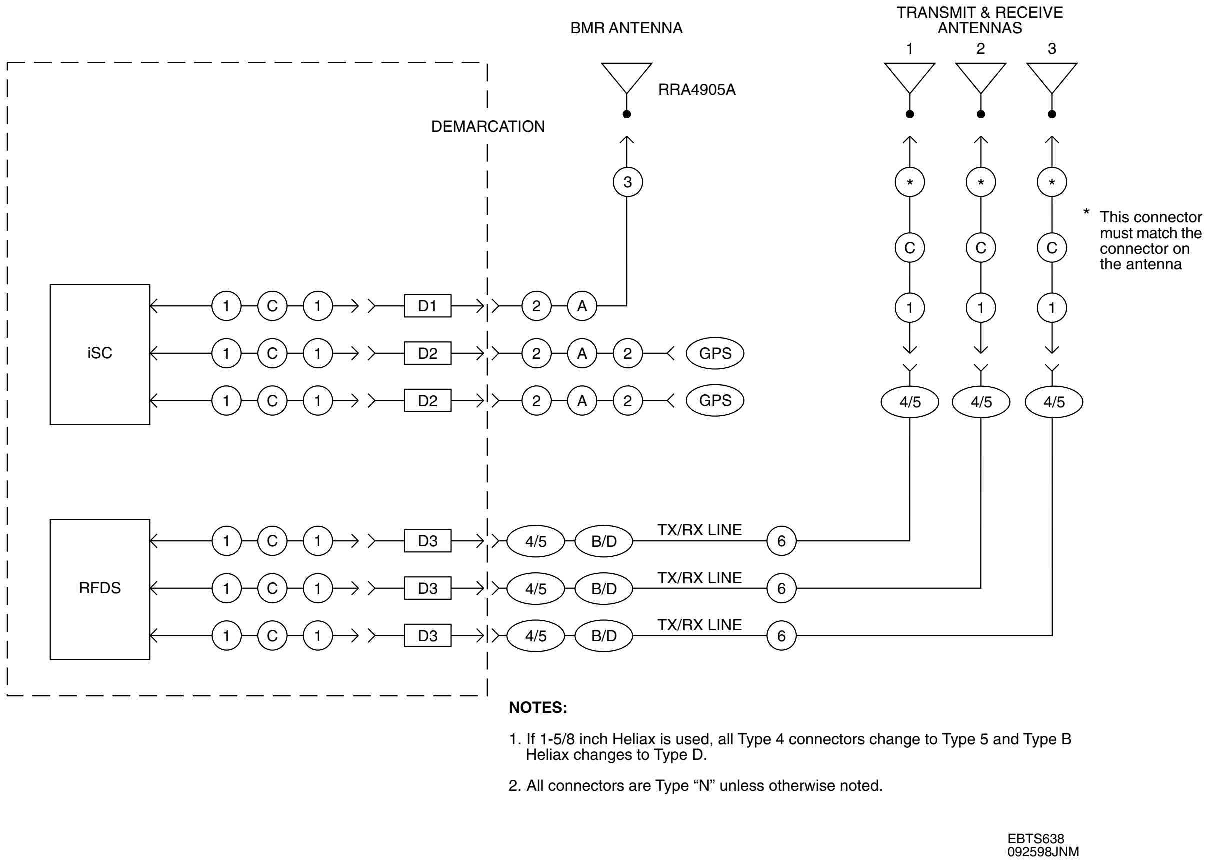
Figure 3-4 ***Bulkhead Connector Layout***



smission Line Key	Connector Key		Surge Protector Key (bottom port)		Surge Protector Key (bulk-head)	
1/2" LDF 4-50A	1	F4PNM	D1	IS-50NX-C2-MA	D1	DQ3407.17.0028
7/8" LDF 5-50A	2	L4PNF	D2	092-820T-A	D2	DQ3403.17.0019
1/2" FSJ4-50B	3	L44P - Type "UHF"	D5	IS-50NX-C2	D5	DQ3408.17.0007
1-5/8" LDF 7-50A	4	L5PNF	D7	097-031G-A.2	D7	DQ3409.41.0001
	5	L7PNF				
	6	L4PNM				
	7	F4PDM-C 7/16" DIN				
	8	L4PDF 7/16" DIN				
	9	L7PDF 7/16" DIN				

Figure 3-5 ***Surge Protection Schematic for Outdoor SRSC with Duplexed RF Antennas***

Antenna Installation



Transmission Line Key		Connector Key		Surge Protector Key (bottom port)		Surge Protector Key (bulk-head)	
A	1/2" LDF 4-50A	1	F4PNM	D1	IS-50NX-C2-MA	D1	DQ3407.17.0028
B	7/8" LDF 5-50A	2	L4PNF	D2	092-820T-A	D2	DQ3403.17.0019
C	1/2" FSJ4-50B	3	L44P - Type "UHF"	D3	IS-CT50HN-MA	D3	DQ3407.41.0001
D	1-5/8" LDF 7-50A	4	L5PNF				
		5	L7PNF				

Figure 3-6 ***Surge Protection Schematic for Outdoor SRSC with Non-duplexed RF Antennas***

Antenna Feed Line Identification

All antenna feed lines should be marked appropriately to simplify connections to the proper Outdoor SRSC equipment. Colored vinyl tape is recommended for use in identifying the antenna feed lines. Use 3M colored outdoor marking tape or a permanent, color-fast equivalent.

NOTE

The color coding schemes identified within this manual are a recommendation only. The purpose for identifying specific colors is an attempt to obtain uniformity between Outdoor SRSC sites. Other color schemes may be used.

Table 3-4 shows how to identify the antenna feed lines for a typical duplexed RFDS.

Table 3-4 ***Duplexed RFDS Antenna Identification (Typical)***

Color	Description
Red	Base Radio Antenna 1 (receive / transmit)
Blue	Base Radio Antenna 2 (receive / transmit)
Green	Base Radio Antenna 3 (receive / transmit)
Brown	Base Radio Antenna 4 (NOT USED)
Yellow	Global Positioning System (GPS) Antenna
White	Base Monitor Radio (BMR) Antenna
Orange	Tower Top Amplifier Test Cable

RF Antenna Planning

Antenna Identification

NOTE

The color coding schemes identified within this manual are a recommendation only. The purpose for identifying specific colors is an attempt to obtain uniformity between Outdoor SRSC sites. Other color schemes may be used.

An antenna array can contain up to three receive antennas. In a duplexed RFDS site, the transmit signals are present on the same receive antennas. By referencing the antenna array with respect to a direct front view, these are:

- ❐ *RED* represents the left-most antenna (#1)
- ❐ *BLUE* represents the middle antenna (#2)
- ❐ *GREEN* represents the right-most antenna (#3)
- ❐ *BROWN* represents the transmit antenna (#4), if used
- ❐ *ORANGE* represents the test port on the tower top amp (#5), if used

GPS Antenna Planning

The iSC within the Outdoor SRSC obtains precise timing information from the Global Positioning System (GPS). This system permits all Outdoor SRSC sites in the area to synchronize to a common timing reference. The Outdoor SRSC cannot operate properly without the use of the tracking satellites. The site planner must evaluate the proposed site antenna locations prior to the installation of the Outdoor SRSC.

GPS Antenna Evaluation

The Site Reference Industry (SRI) Standard Architecture card mounted within the iSC contains a GPS receiver that must locate and track at least four satellites during initial power-up. The four satellites are used to establish a three-dimensional fix (latitude, longitude, and altitude) for the site. This process takes approximately 13 to 25 minutes to complete.

Once the position of the site has been established, the corresponding data is stored in memory and normal operation resumes.

GPS Tracking Criteria

To allow an Outdoor SRSC to successfully initialize, the Position Dilution Of Precision (PDOP) must be less than 10.0. A PDOP greater than 10 in a site that has been reset will delay the start-up of the Outdoor SRSC. To minimize the potential for the delay, Motorola recommends not having the PDOP greater than 10 for periods greater than 15 minutes.

Once an Outdoor SRSC is operating and the BRs have been keyed, a PDOP greater than 10 will not affect site performance, as long as at least one satellite is being tracked. However, to maintain maximum reliability, three satellites should be tracked at all times.

The Outdoor SRSC must be capable of the following:

❒ Tracking a minimum of four satellites during initial start-up or after loss of power to the SRI.

❒ Tracking three satellites continuously for maximum reliability.

❒ To allow the site to restart in the event the SRI is inadvertently reset, periods where the PDOP is greater than 10.0 should be minimized.

GPS Evaluation Kit

The Motorola GPS evaluation kit can be used to evaluate the site and antenna mounting location prior to site acceptance. Although many GPS receivers are available, the Motorola GPS evaluation kit includes the same receiver and antenna used in the Outdoor SRSC. The data reported by this kit is the same as that used by the Outdoor SRSC, if the antennas were installed in the test locations.

Refer to Appendix B - Parts and Suppliers for information on obtaining the Motorola GPS evaluation kit. The evaluation kit includes software programs and the instructions necessary to collect the necessary data in order to evaluate the site. The necessary data includes:

❒ Dilution Of Precision (DOP)

❒ DOP Type (Position or Horizontal)

❒ Number of visible satellites

❒ Number of satellites being tracked

GPS Antenna Mounting Requirements

The Global Positioning System (GPS) antenna should be mounted with an unrestricted aerial view to within 10° of the horizon in all directions. The antenna must be mounted high enough to clear the peak of the Outdoor SRSC site roof.

If the antenna is mounted on a tower, care should be taken to minimize the amount of sky blanking caused by the tower. In the northern hemisphere it is preferable to mount the antenna on a southern face of the tower, with the tower shadow to the north, while in the southern hemisphere the antenna should be on a northern face with the tower shadow to the south.

At latitudes greater than 50°N, greater care is required to minimize obstruction to the south. Conversely, at greater than 50°S greater care is required to minimize obstruction to the north.

Isolate the GPS antenna not less that 12 inches or 12 wave lengths horizontally distant, which ever is greater, from any RF radiating antenna or device. Fluorescent lights and high pressure sodium vapor lights can generate very broad spectrum RF noise; therefore a GPS antenna should not be located close to these types of devices.

Adjacent buildings and trees create a large RF shadow that blocks the sky view and require consideration when selecting a suitable GPS antenna location. Towers and antennas in the general vicinity of the GPS antenna location normally create a minimum shadow and therefore generally do not impact the GPS signal.

NOTE

The GPS antenna should be disconnected if the S/N ratio of the transmission line is to be tested with sweeper. In this case, install a 5 Ω load in place of the GPS antenna.

GPS Antenna Line Loss

The maximum allowable line attenuation between the antenna and the SRI in the iSC is 6 dB. This includes a 4 dB foliage margin. Installations in which the antenna has an unobstructed view of the sky may have a maximum line attenuation of 10 dB. In a typical Outdoor SRSC installation using 1/2” low density foam coaxial cable, the length of the cable run should never exceed 150’. This is sufficient for most installations.

When considering the use of larger cables, calculate the cable lengths allowing 4.5 dB of loss at 1.5 GHz. The remaining 1.5 dB of attenuation is provided by interior site cabling and connectors.

Another option is the use of in-line amplifiers to overcome excessive line loss. The in-line amplifiers are powered by the 5 Vdc supplied by the GPS receiver and are inserted between the GPS antenna and the SRI, preferably near the antenna. Either the connector on the coaxial line must be changed to fit the amplifiers, or a short jumper cable field fabricated. Refer to Appendix B - Parts and Suppliers for information on the approved GPS in-line amplifiers.

BMR Antenna Planning

The Base Monitor Radio (BMR) antenna must be designed to provide an adequate RF link with the co-located site without introducing overload/desense/intermodulation.

A fixed attenuator attached to the BMR antenna port may be necessary. Attenuator values will vary with each site. The proper combination of antenna mounting location, antenna type and gain, and attenuators must be chosen to allow the BMR to function as desired within the system.

BMR Antenna Type and Gain

An omni-directional, narrow vertical beamwidth antenna, with an operating range suitable for the specific system, is recommended for the BMR. This type of antenna provides an adequate signal to/from the BMR while helping to achieve the necessary local isolation.

BMR Antenna Mounting Location

To avoid possible overload/de-sense/intermodulation at the co-located site, the antenna should be mounted so the maximum possible isolation exists between the BMR and the co-located antennas. Trial and error may be necessary to achieve an optimum mounting location.

BMR Transmission Line Attenuators

The BMR antenna connection is compatible with N-type RF connectors, similar to the GPS modules. Refer to Appendix B - Parts and Suppliers for recommended BMR attenuators.

Telephone Company (Telco) Line Interface

Telco Backboard

A wall-mounted AC grade fire-rated plywood backboard (1/2”x4’x4’) is provided within the top bay of the Utility Pedestal.

Telco Device Grounding

A grounded 4-position termination block has been provided in the upper bay of the Utility Pedestal for use with the various devices that may be mounted to the telco backboard.

Telco Service Entrance

The telco service entrance is located at the bottom of the Utility Pedestal. The telco conduit should be connected to factory-installed conduit at the top of the Utility Pedestal’s lower bay.

Telco Surge Arrestor

A surge arrestor designed for operation with a T1/E1 telephone circuit has been provided and must be installed on the T1/E1 telco backboard. It should be wired per manufacturer instructions.

Special Considerations

Disabled Personnel

The customer is responsible for determining the applicable Americans with Disabilities Act (ADA) requirements that apply to the Outdoor SRSC site. The ADA requires certain clearances for handicapped personnel.

Hazardous Materials and Equipment

NOTE

The following information is provided as an aid for the planning of an Outdoor SRSC site. Compliance with all local, state, and federal regulations concerning the handling and use of hazardous materials and equipment is the sole responsibility of the customer and associated agents.

The standard battery system uses valve-regulated batteries designed for telecommunication applications. These batteries are also referred to as sealed or low maintenance lead-acid batteries. Motorola recommends that these batteries be stored, transported, and installed by a certified hazardous material handler. Many regulatory agencies classify batteries as hazardous material. Special permits and safety equipment may be needed.

Environmental Considerations

Temperature Regulation

The environment in which the Outdoor SRSC operates is an important consideration. The temperature inside the Equipment Cabinet is regulated with a thermostatically controlled, closed loop Heating / Ventilation / Air-Conditioning (HVAC) system.

The pre-wired heater pad need only be properly strapped around the battery cells to maintain their temperature between 60-75 °F.

Damp and Wet Conditions

In areas of high humidity, to avoid water condensation on electronic assemblies when the door to the Equipment Cabinet is opened, the thermostat may need to be altered from its factory setting.

HVAC Hazardous Waste

Where local regulations prohibit discharge of condensate directly on the ground, the condensate will probably need to be routed to a legal sewer system or approved facility drain. Additional plumbing and an electric condensate pump may be needed in these cases.

Receipt of Equipment

Unpacking the Equipment

The Outdoor SRSC is packed with all modules intact.

Equipment Inspection

Inspection of the Outdoor SRSC equipment must be performed as soon as all equipment is unpacked.

NOTE

If obvious damage has occurred to the shipping containers before unpacking, contact the shipping agent and ask that a representative of their company be present while the equipment is unpacked.

Observe guidelines for safe handling of electrostatic sensitive devices or equipment to prevent electrostatic discharge damage. An anti-static wrist strap is provided with the Outdoor SRSC and should always be worn when handling any electrical component. Refer to the guidelines in the Manual Overview for additional information.

Inspect the following upon receipt of the Outdoor SRSC:

❐ Check for loose or damaged equipment.

❐ Check all sides of each cabinet for dents, scratches, or other damage.

❐ Check all cabinet wiring to insure connections are in place.

❐ Check modules and boards for physical damage to controls or connectors.

❐ Verify that ground straps are secure.

If any equipment is damaged, contact the shipping company immediately, then contact your Motorola representative.

Recommended Tools, Equipment, and Parts

Tables 3-5 through 3-7 list the tools, test equipment, and locally procured parts required to install the Outdoor SRSC. The model numbers listed are recommended, but equivalent tools and equipment made by other manufacturers are acceptable. Refer to Appendix B - Parts and Suppliers for recommended tools, test equipment, and spare parts.

NOTE

When selecting tools and equipment, always choose those which have insulated grips and handles. This helps prevent potential injury resulting from electrical shock.

Recommended Tools

Table 3-5 lists the tools recommended for installation. These are not included as part of the Outdoor SRSC shipment and must be procured locally. All model numbers are Motorola part numbers, unless noted otherwise.

Table 3-5 ***Recommended Tools for Installation***

Tool	Model/Type	Supplier	Description
Banding cutter	n/a	Locally Procured	n/a
Cable Crimp Tool	TBM5 S	Thomas & Betts	Crimping lugs on power cables
Calculator	n/a	Locally Procured	n/a
Cart, Two-wheeled (luggage type)	6680387A47	Motorola	Transportation of tools and test equipment
Cartridge Fuse Puller	34-002	Ideal	Removing and installing cartridge-type fuses.
Circuit Cooler Spray	0180334B46	Motorola	Low temperature alarm testing
Cellular tool kit	RPX4286A	Motorola	Miscellaneous tools
Crimping Tool	8-pin modular cable	Locally Procured	Customizing T1 connections
Digital Level	24" w/module	Pro Smartlevel	Antenna downtilt measurements

Table 3-5 ***Recommended Tools for Installation (Continued)***

Tool	Model/Type	Supplier	Description
Driver Tools	2” hex to hex extension (2)	Locally Procured	n/a
	6” hex to hex extension (2)		n/a
	T10 TORX™ bit (APEX)		n/a
	Long T10 TORX bit		n/a
	T15 TORX bit (APEX)		n/a
	T20 TORX bit (APEX)		n/a
	T25 TORX bit (APEX)		n/a
	T30 TORX bit (APEX)		n/a
Electric Drill	0180371B44	Motorola	Drilling holes
Electric Screwdriver (only 1 required)	RLN4053A / heavy duty	Motorola	Tightening screws / nuts
	RLN4051A / heavy duty (variable speed)	Motorola	Tightening screws / nuts
	0180320B28 / light duty	Motorola	Tightening screws / nuts
Flashlight, small	n/a	Locally Procured	n/a
Hammer Drill	RLN4315A	Motorola	Drilling concrete floor for mounting studs
Heat Gun	0180320B51	Motorola	High temperature alarm testing
Hole Punch	1”	Locally Procured	Wiring 240 VAC to power supply cabinet
ISO T BNC	n/a	Locally Procured	Used for tower top amp sensitivity testing
Knife, utility	n/a	Locally Procured	n/a
Markers (2)	n/a	Locally Procured	n/a
Nut driver, 3/16”	n/a	Locally Procured	n/a
Nut driver, 10 mm	n/a	Locally Procured	n/a
Pliers	n/a	Locally Procured	n/a
Pliers, connector	n/a	Snap-on	n/a
Pliers, needle nose	n/a	Locally Procured	n/a
Screw driver, torque hand tool	5 in-lbs	Ind Pneumatic	n/a

Recommended Tools, Equipment, and Parts

Table 3-5 ***Recommended Tools for Installation (Continued)***

Tool	Model/Type	Supplier	Description
Drives for torque screwdriver	1/4" drive, 7/16" deep socket	Ind Pneumatic	n/a
	1/4" drive, 5/16" deep socket		n/a
	1/4" drive, 3/16" socket		n/a
	1/4" drive, 1" blade screwdriver		n/a
	1/4" hex to 1/4" hex drive		n/a
Screwdrivers	#0 Phillips	Locally Procured	n/a
	#2 Phillips		n/a
	3/16" blade		n/a
	#1 blade		n/a
	1/4" blade		n/a
Step Ladder	7'	Locally Procured	To gain access to cable tray assembly
Tarpaulin	Approximately 8' x 10'	Locally Procured	Protect equipment during installation
Tie wrap gun	n/a	Locally Procured	n/a
Tool Box	n/a	Locally Procured	n/a
Torque wrenches	6680388A27	Motorola	Tightening battery lug nuts
	5/16" breaking type, 5 in-lbs	Locally Procured	For SMA connectors
Drives for 5/16" torque wrench	6" extension, 3/8" drive	Snap-on	n/a
	1" deep 6 point socket, 3/8" drive		n/a
	5/8" deep socket, 3/8" drive	Ind Pneumatic	n/a
	9/16" deep socket, 3/8" drive		n/a
	1" deep socket, 3/8" drive		n/a
	1/4" hex to 3/8" hex drive		n/a

Table 3-5 ***Recommended Tools for Installation (Continued)***

Tool	Model/Type	Supplier	Description
TORX driver with bits (handle storage)	n/a	Locally Procured	n/a
Tweezers	n/a	Locally Procured	n/a
Vacuum cleaner	0180382A11	Motorola	General clean-up
Wire Cutters	n/a	Locally Procured	Cutting power cables (#6 AWG to 250 MCM)
Wrenches, open end	3/8”	Locally Procured	n/a
	1-1/16”		n/a
Wrist strap	n/a	Locally Procured	n/a

Recommended Test Equipment

Table 3-6 lists the recommended test equipment for installation. These are not included as part of the Outdoor SRSC shipment and must be procured locally. All model numbers are Motorola part numbers, unless noted otherwise.

Table 3-6 ***Recommended Test Equipment for Installation***

Test Equipment	Model/Type	Supplier	Description
Communication Software	Procomm Plus (or equivalent)	DataStorm	Host communication
Digital Multimeter	Fluke 77	Fluke	DC measurements
	R1037A	Motorola	DC measurements
	R1073A	Motorola	DC measurements
File Compression Software	PKUnzip	PKWare	Compress/decompress files
Ground Resistance Ohmmeter	AEMC 3700 clamp-on ground tester	Locally Procured	Measure for adequate ground
RF Attenuators	Refer to Appendix B		Protection for R2660 Analyzer and used with the Outdoor SRSC equipment for RF attenuation
Service Computer	Refer to Appendix B		Local service terminal

Table 3-6 ***Recommended Test Equipment for Installation (Continued)***

Test Equipment	Model/Type	Supplier	Description
Communication Cable Between PC Service Computer and Outdoor SRSC Equipment	n/a	n/a	DB9 male / RS232 male used with RS232 female / DB9 male Pinouts from DB9 to DB9 must be straight through
Communication Cable Between Macintosh Service Computer and Outdoor SRSC Equipment	n/a	n/a	Din 8 male / DB9 male (refer to Figure 3-7)
Service Monitor	R2660 w/iDEN	Motorola	Station alignment
Test Cable used with R2660 Analyzer	n/a	n/a	12' of typhlon cable type N male both ends
T1 Tester/Protocol Analyzer	209A T	T-Berd	Testing T1 lines

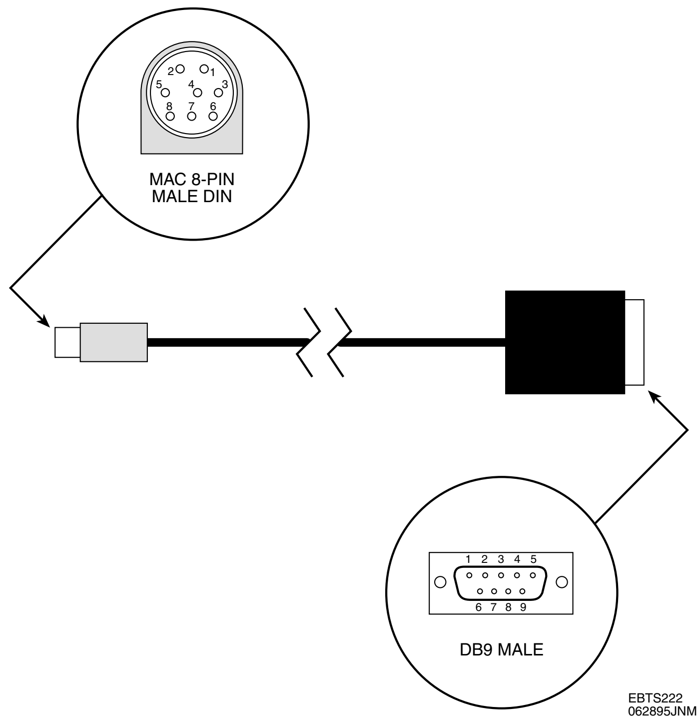


Figure 3-7 ***MAC 8-pin Male DIN to DB9 Male Connector***

Recommended Parts

Table 3-7 lists the recommended parts for installation. These are not included as part of the Outdoor SRSC shipment and must be locally procured. All model numbers are Motorola part numbers, unless noted otherwise.

Table 3-7 ***Recommended Parts for Installation***

Part	Type/Size	Supplier	Where Used
Anchor Kit	#02100-13	Hendry	Outdoor SRSC cabinet floor anchors
Colored Vinyl Tape	red, black, green, brown, yellow, and white	Locally Procured	Wire identification
Grease	anti-oxidant	Locally Procured	Battery terminal corrosion control
Lockwashers	split - 3/8”	Locally Procured	Breaker panel, Power Supply rack
	split - 1/4”	Locally Procured	DC return bus, Power Supply rack
Lugs	2 hole 1" center various sizes	Locally Procured	Battery connection; 3/8” bolt, 4/0 Cu
Lugs	2 hole 1" center	Locally Procured	DC return connection; 1/4” bolt, #6 Cu
Power Cables	#6 AWG stranded Cu (red and black)	Locally Procured	Power supply wiring
	4/0 stranded Cu (red and black)	Locally Procured	Power supply wiring
Ground Cables	#2 AWG stranded Cu (green)	Locally Procured	Cabinet grounding
	#6 AWG stranded Cu (green)	Locally Procured	Cabinet grounding

This Page Intentionally

Left Blank

MOTOROLA

Chapter 4
Installation

Overview

This section provides procedures required to permanently install the Outdoor SRSC at the selected site.

The section topics are listed in the following table.

Introduction

The procedures described in this section assume the field technician or installer has knowledge of the installation techniques contained in the *Quality Standards Fixed Network Equipment - Installation Manual (R56)*.

NOTE

Prior to performing the installation procedures, prepare the site with all associated antennas, phone lines, and other related site equipment. This information is covered in the *Pre-Installation* section of this manual.

In an Outdoor SRSC site, the term *Equipment Cabinet* is used to refer to Fixed Network Equipment (FNE) mounted in a standard equipment rack. The term *Utility Pedestal* refers to the enclosure adjacent to the Equipment Cabinet which serves as the demarcation point for antenna transmission lines, and electric company and Telco equipment.

The Outdoor SRSC may be shipped in one of two configurations:

❐ with the Utility Pedestal pre-wired to the Equipment Cabinet

❐ with the Utility Pedestal separated from the Equipment Cabinet.

While the first configuration allows a somewhat more simple receiving and installation process, the second allows added flexibility for coordinating the connection of outside equipment (i.e., telephone, AC, etc.). The methods for installing the two configurations are outlined here:

Install Pre-wired Outdoor SRSC

1. Lay foundation
(refer to the section on *Foundation (Site Pad) Planning* in Chapter 3)

2. Place and secure Outdoor SCRC
(refer to Hennessy *Enclosure Installation and Owners Manual*)

CAUTION

To lift pre-wired Outdoor SRSC cabinets, use only the four (4) lifting eyes mounted on top of the Equipment Cabinet. Attempting to use the two lifting eyes above the Utility Pedestal will result in damage to the equipment and could cause injury to personnel.

3. Ground Equipment Cabinet and Utility Pedestal
(see *Enclosure Ground Connections* on page 4-6)

4. Install / connect batteries, and set up battery heater
(see *Battery Backup Connections* on page 4-7)

5. Hook up telephone company-, electric company-, and Antenna equipment
(refer to the appropriate sections in Chapter 3, *Pre-Installation*).

CAUTION

Do not mount antennas on wooden poles. Such installations render the path through the antenna transmission line the shortest to Ground. Refer to *Quality Standards Fixed Network Equipment - Installation Manual (R56)*. for approved antenna installation methods.

6. Perform Check-out procedure
(refer to Chapter 5, *Final Checkout*)

Install Separately Shipped Utility Pedestal and Equipment Cabinet

1. Lay foundation
   (refer to the section on *Foundation (Site Pad) Planning* in Chapter 3)
2. Place and secure Utility Pedestal
   (refer to Hennessy *Enclosure Installation and Owners Manual*)
3. Ground Utility Pedestal
   (see *Enclosure Ground Connections* on page 4-6)
4. Hook up telephone company-, electric company-, and Antenna equipment
   (refer to the appropriate sections in Chapter 3, *Pre-Installation*).

CAUTION

Do not mount antennas on wooden poles. Such installations render the path through the antenna transmission line the shortest to Ground. Refer to *Quality Standards Fixed Network Equipment - Installation Manual (R56)*. for approved antenna installation methods.

5. Place and secure Equipment Cabinet
   (refer to Hennessy *Enclosure Installation and Owners Manual*)
6. Attach Equipment Cabinet to Utility Pedestal with Seismic Plate
7. Install PVC duct work between Equipment Cabinet and Utility Pedestal.
8. Ground Equipment Cabinet
   (see *Enclosure Ground Connections* on page 4-6)
9. Install / connect batteries, and set up battery heater
   (see *Battery Backup Connections* on page 4-7)
10. Wire up Utility Pedestal to Equipment Cabinet
    (see *Rewiring Utility Pedestal to Equipment Cabinet* on page 4-10)
11. Perform checkout procedure.
    (refer to Chapter 5, *Final Checkout*)

Cabinet-to-Site Cabling Procedures

Cabinet-to-site cabling describes the cabling to be installed between the Outdoor SRSC and the site for all systems. Perform each of the individual cabling procedures listed in the table below (as applicable) for the particular system being installed.

Procedure	Page	Description
Enclosure Ground Connections	4-6	Connection of Equipment Cabinet and Utility Pedestal grounds
Battery Backup Connections	4-7	Connection of SRSC to battery backup system
Rewiring Utility Pedestal to Equipment Cabinet	4-10	Electrical connection of Equipment Cabinet to Utility Pedestal
Base Radio Antenna Connections	4-16	Connection of site Base Radio antennas to Outdoor SRSC
GPS Antenna Connections	4-18	Connection of site GPS antenna(s) to Outdoor SRSC
BMR Antenna Connection	4-18	Connection of site BMR antenna Outdoor SRSC
T1/E1 Cabling	4-18	Connection of site T1/E1 line to Outdoor SRSC

Enclosure Ground Connections

Wiring must be installed to connect each enclosure to the external ground ring. Figure 4-1 illustrates where these connections should be made. Refer to the *Pre-Installation* section of this manual for more information about the external ground ring.

NOTE

Single-point ground method (in which the Equipment Cabinet and the Utility Pedestal will each be grounded using its own ground wire) shall be used. Ground wire shall consist of green-insulation #2 AWG or larger.

During installation of cabinet ground wires, be sure to check any factory-installed internal ground connections for tightness.

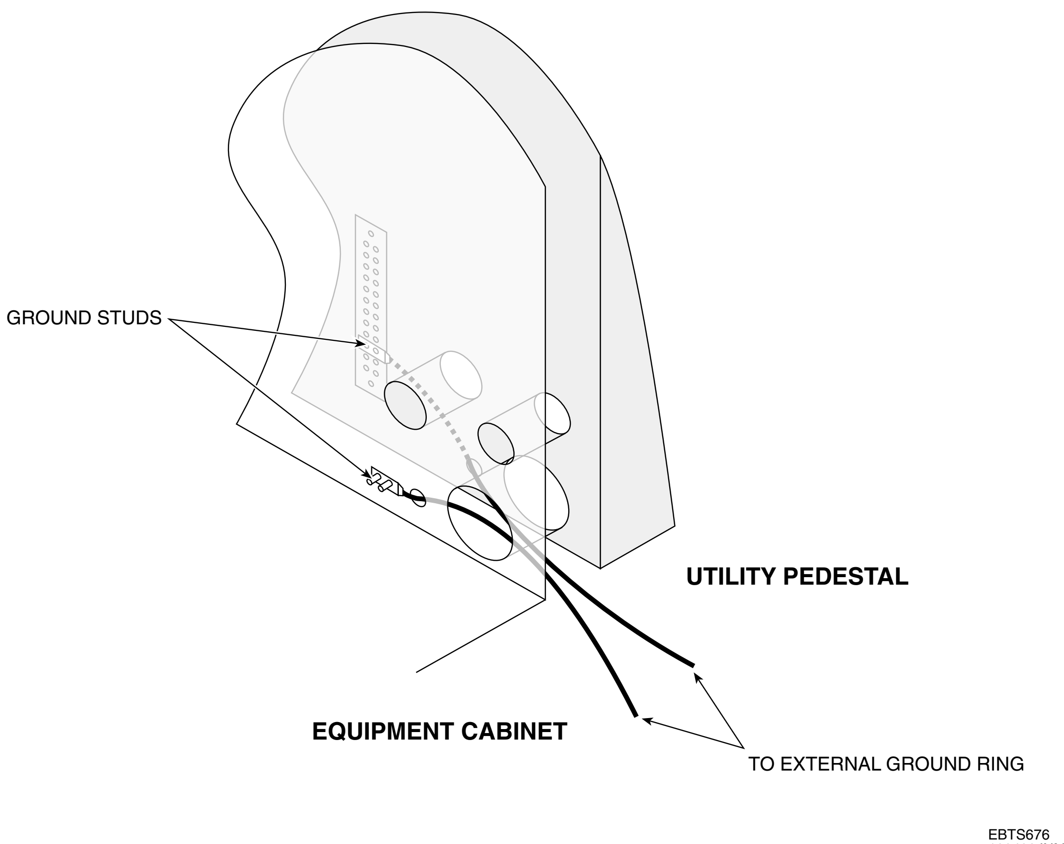


Figure 4-1 ***Connections to External Ground Ring***

Battery Backup Connections

Connect AC / DC Power System to battery rack observing the following guidelines and using the following procedure.

CAUTION

The AC / DC Power System is to be connected to a battery system that is in accordance with any and all applicable electrical codes for the end-use country (for example, the National Electrical Code ANSI / NFPA 70 in USA).

Connecting Details

The battery backup system consists of four 12-volt, valve-regulated, lead-acid batteries connected in series. They are to be installed in a drawer at the bottom of the Equipment Cabinet. A -48V (hot) and ground connection is made between the rear panel **BATT -48V** and **BATT GROUND** terminal lugs on the AC / DC Power System and the battery rack. Connecting details are shown in Figure 4-3.

! WARNING !

THE CONSIDERATIONS SPECIFIED IN ‘QUALITY STANDARDS – FIXED NETWORK EQUIPMENT INSTALLATIONS’ (MOTOROLA STANDARD R56) MUST BE OBSERVED.

FAILURE TO PROPERLY INSTALL BATTERY SYSTEM CAN RESULT IN AN EXPLOSION HAZARD TO PERSONNEL AND SITE, AND POSSIBLE EQUIPMENT DAMAGE DUE TO ELECTROLYTE LEAKAGE AND/OR OUTGASSING.

! WARNING !

MAKE SURE ALL BREAKERS ON AC/DC POWER SUPPLY ARE SET TO OFF BEFORE PERFORMING CONNECTIONS. FAILURE TO OBSERVE THIS WARNING MAY RESULT IN INJURY TO PERSONNEL.

1. Place the four battery cells on the heater pad in the battery tray so that their terminals are at the front of the battery compartment.
2. Using the black plastic dust caps and the sheet metal terminal connectors as shown in Figure 4-2, connect the negative terminal of the left-most battery to the positive terminal of the adjacent battery, and continue like so until only the positive terminal of the left-most battery and negative terminal of the right-most battery remain empty.
3. Strap the heater pad over the top of the battery cells so that the temperature sensor contacts the surface of the right-most cell.

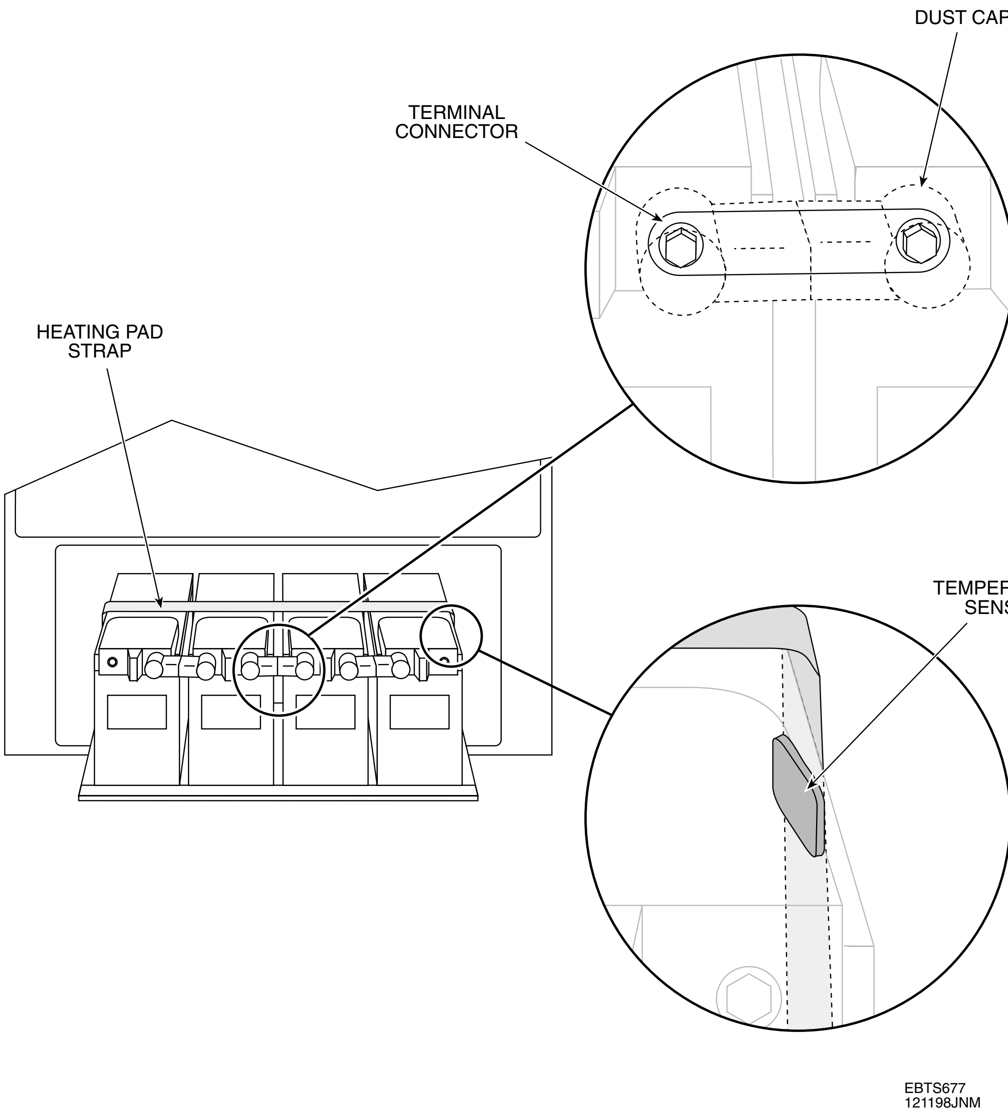


Figure 4-2 ***Battery Terminal Connections***

4. Using the remaining two black plastic dust caps, connect the battery cables provided in the shipping carton as shown in Figure 4-3, routing the cables up through one of the cable boots at the rear of the battery compartment. Fill the boot with a self-sealing foam once the cable is connected.

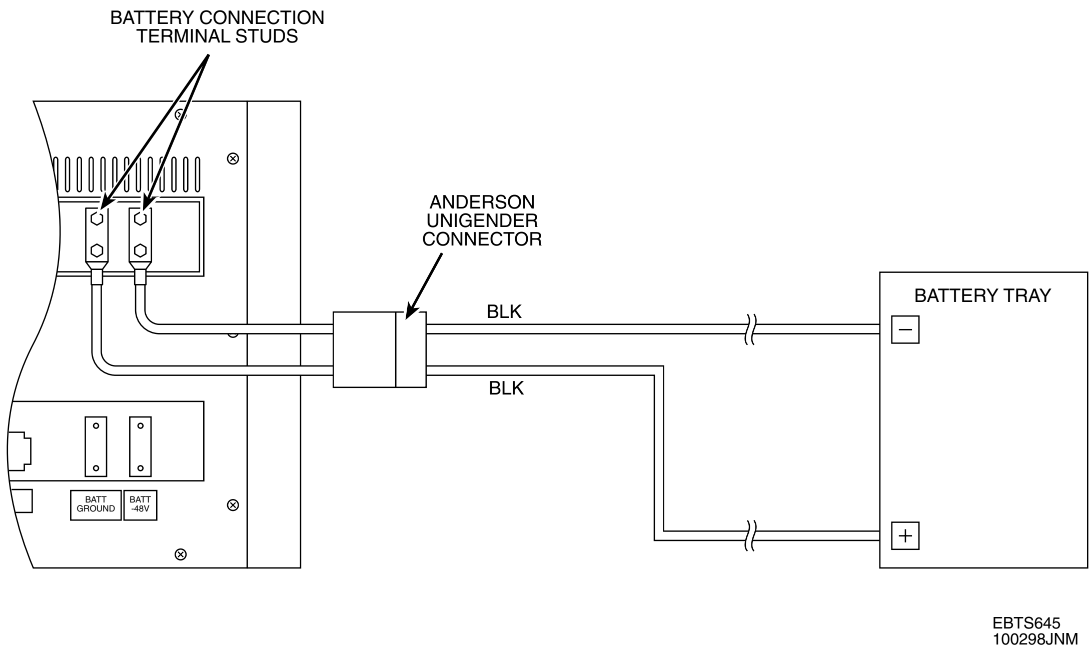


Figure 4-3 ***SRSC Battery Backup Connections***

Rewiring Utility Pedestal to Equipment Cabinet

In most cases, the AC / DC Power System within the Equipment Cabinet is prewired to the circuit breaker panel in the middle bay of the Utility Pedestal. To power up the equipment after securing the Outdoor SRSC to its foundation requires only the task of requesting that the electric company hook up a meter and bring power to the Utility Pedestal.

If the Utility Pedestal has been shipped separated from the Equipment Cabinet, then an extra wiring task is required. The following procedure assumes that the Utility Pedestal and Equipment Cabinet have been reconnected with the Seismic Plate, and that the duct work between the two enclosures has been fitted.

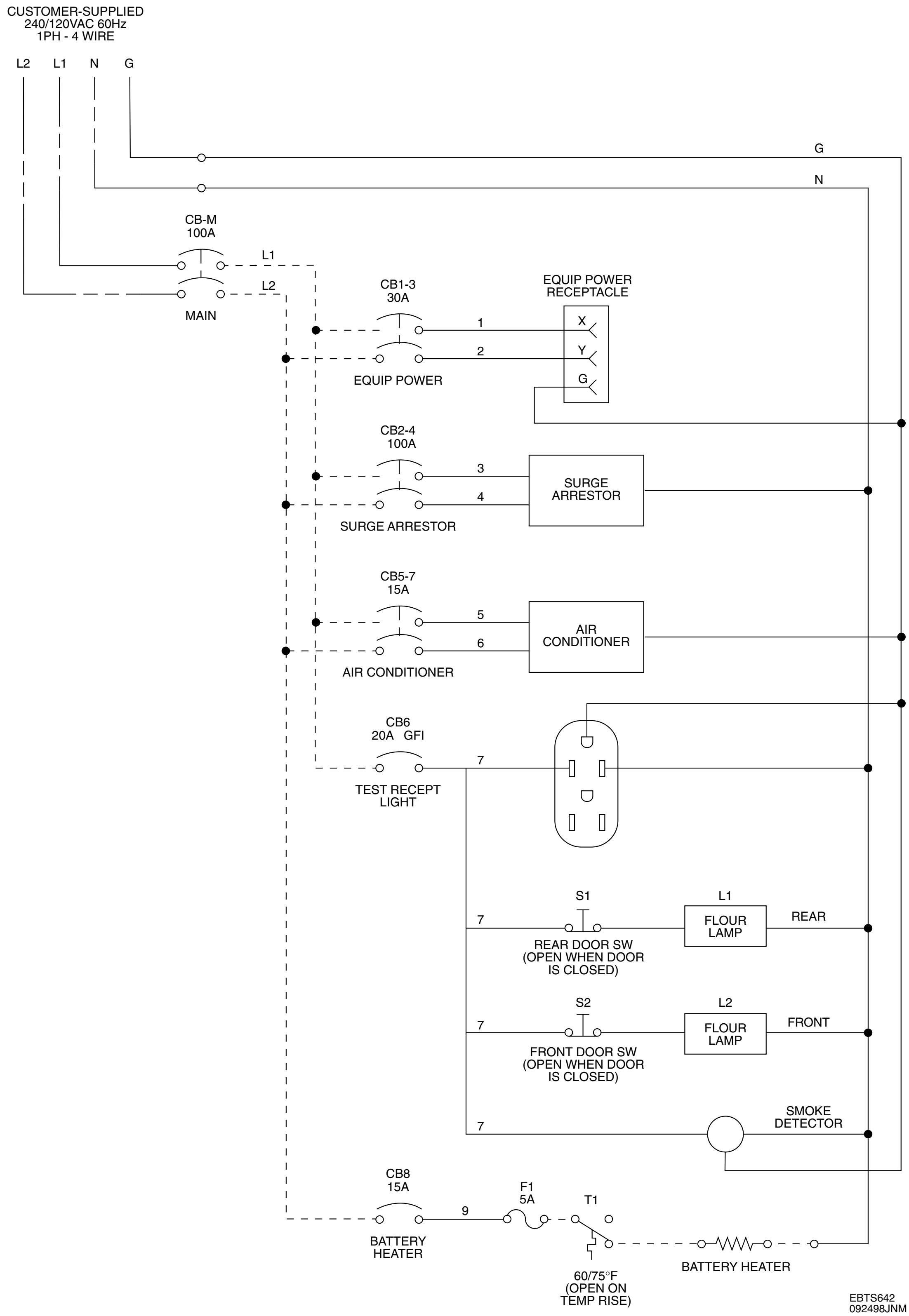


Figure 4-4 ***AC Electrical System Schematic***

Cabinet-to-Site Cabling Procedures

1. With the raceway cover off, feed the wiring harness through the 2-inch PVC duct up through the top of the raceway and into the middle bay of the Utility Pedestal, as shown in Figure 4-5.

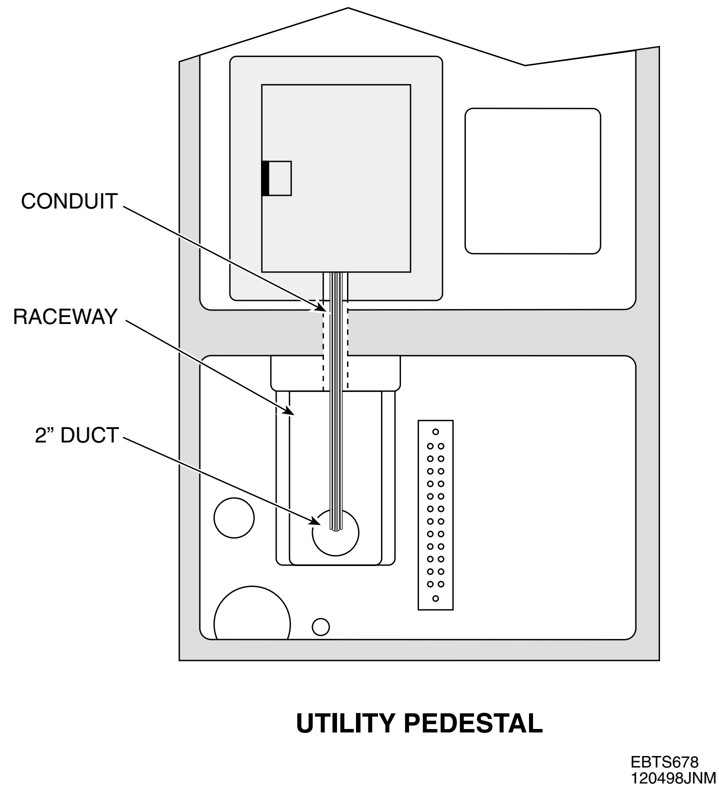


Figure 4-5 ***Routing of Wiring Harness into Utility Pedestal***

2. Connect the four green wires to the grounding strip as shown in Figure 4-6.

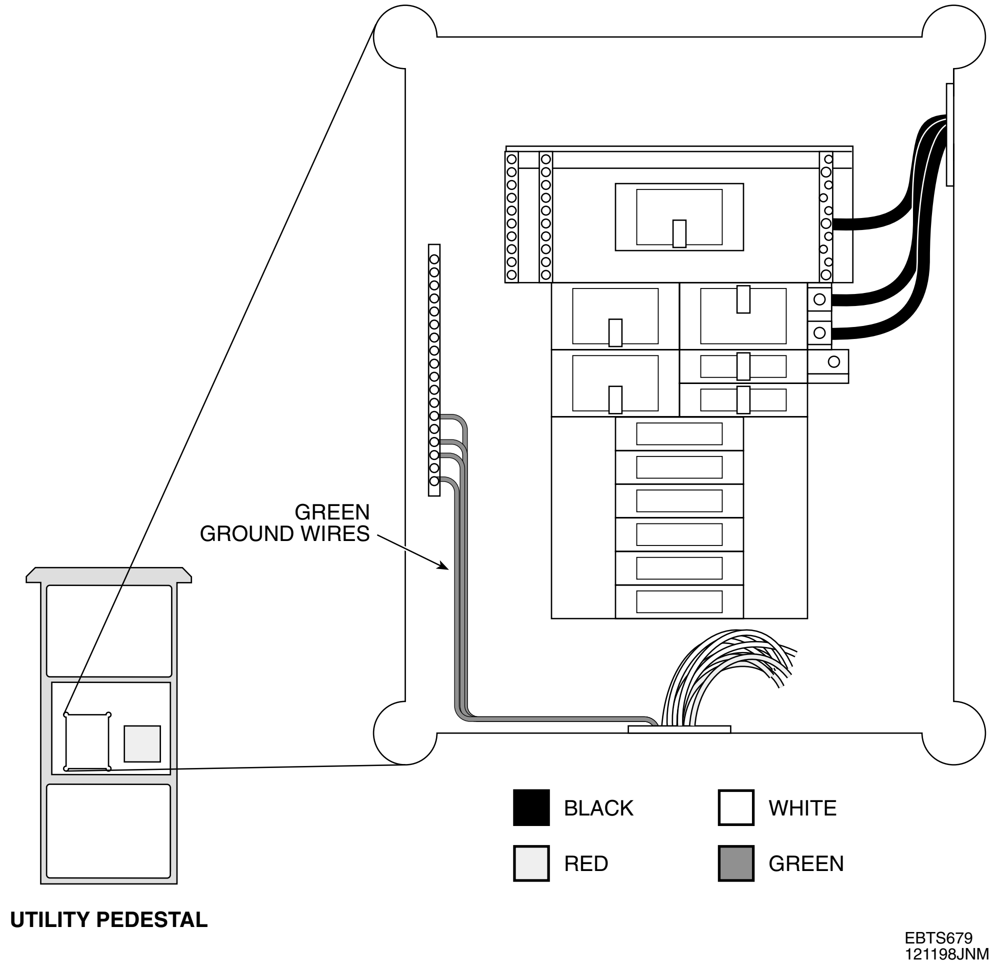


Figure 4-6 ***Electrical System Grounding Diagram***

3. Connect the wires labeled 1, 2, 5, 6, 7, and 9 as shown in Figure 4-7.

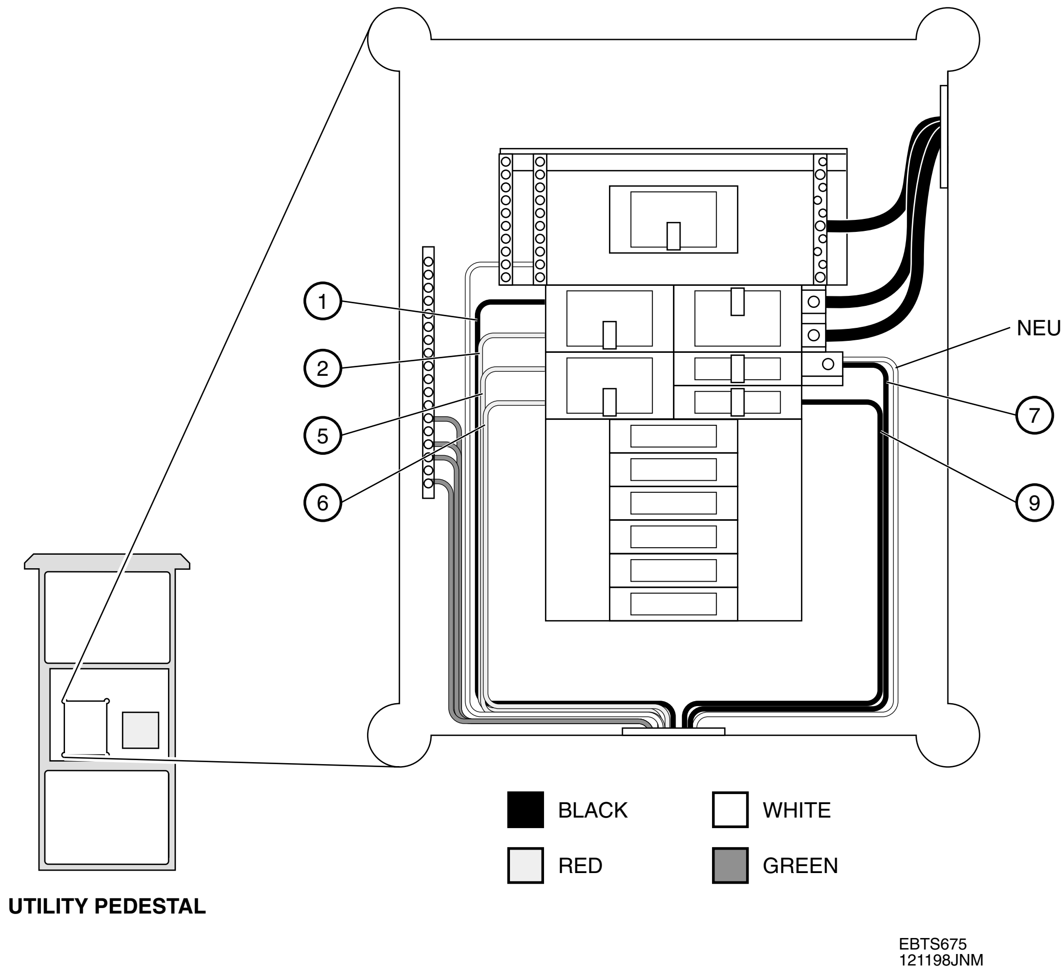


Figure 4-7 ***Load Center Wiring Diagram***

4. Connect the AC power system neutral wire (white wire labeled "NEU") to the back of the 20A breaker as shown in Figure 4-7.

CAUTION

NEC prohibits grounding the AC power system neutral (white wire) anywhere other than at the service entrance panel.

5. Connect the remaining white wire to the equipment-side of the Main circuit breaker, as shown in Figure 4-7.

6. At the rear of the battery compartment, mate the connectors of the alarm wiring harness, bringing it through the 4-inch duct, as shown in Figure 4-8.

Fill the cable boot, through which the alarm wiring harness is routed up into the Equipment Cabinet, with a self-sealing foam after making the connection.

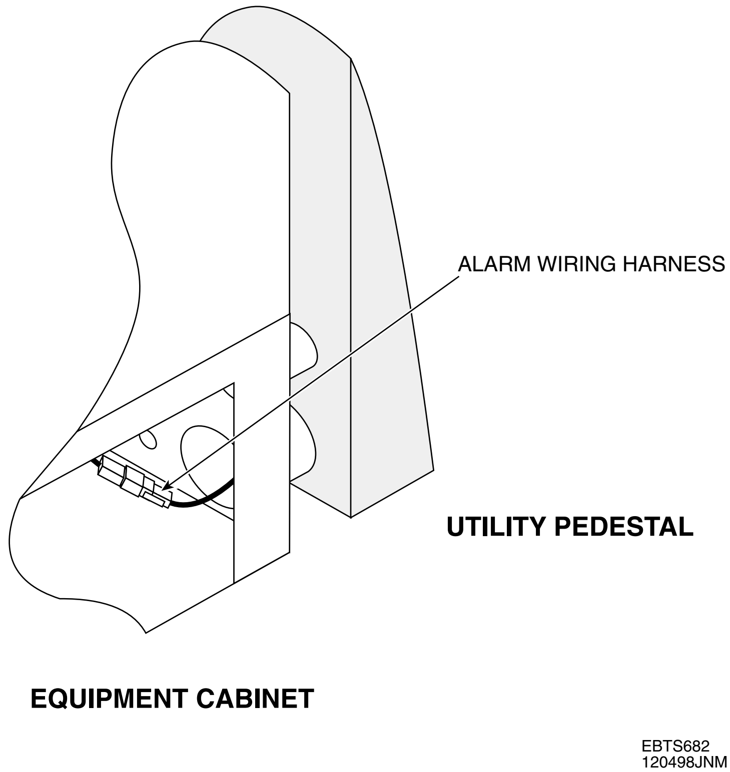


Figure 4-8 ***Alarm Wiring Harness Connection***

7. Replace the raceway cover and fasten with flatwashers, lockwashers and machine screws.

Base Radio Antenna Connections

This sub-section assumes the Base Radio antennas have been previously installed and their transmission (feed) lines have proper surge protection as they enter the Utility Pedestal.

Make sure the antenna cables are properly marked. Observe the direction of corresponding antennas while correlating the azimuth to the tagged antenna cable. Be sure to document this information for future use.

NOTE

The RFDS uses female N-type or 7/16” DIN connectors on the antenna ports. The N-type connectors have gold plated center conductors and silver plated outer shells. The 7/16” DIN connectors have silver plated inner conductors and silver plated outer conductors. Motorola recommends using material matching connectors on all antenna connections.

The following procedure applies to all configurations using the 800 MHz GEN 4 RFDS. Perform cabling as follows:

1. Identify and tag each antenna cable. Refer to Antenna Installation in the *Pre-Installation* section for the recommended color coding to tag the antennas.

2. Route antenna cables through the 4-inch PVC duct and up into the rear of the Equipment Cabinet through one of the cable boots at the rear of the battery compartment. Fill the boot with "Stuff-It" once the antenna cables are connected

   Extension cables for the antenna feedlines must be procured locally. Superflex™ 1/2-inch cable is the recommended extension cable.

3. Connect each of the tagged antenna cables to the N-type connectors on the RFDS as follows:

   - **Duplexed RFDS without Tower Top Amplifier compatibility** – Connect antenna cables to RFDS duplexer antenna ports as shown in Figure 4-9.
   - **Duplexed RFDS with Tower Top Amplifier (TTAs) compatibility** – Connect antenna cables to DC injector on each duplexer antenna port as shown in Figure 4-10.

Cabinet-to-Site Cabling Procedures

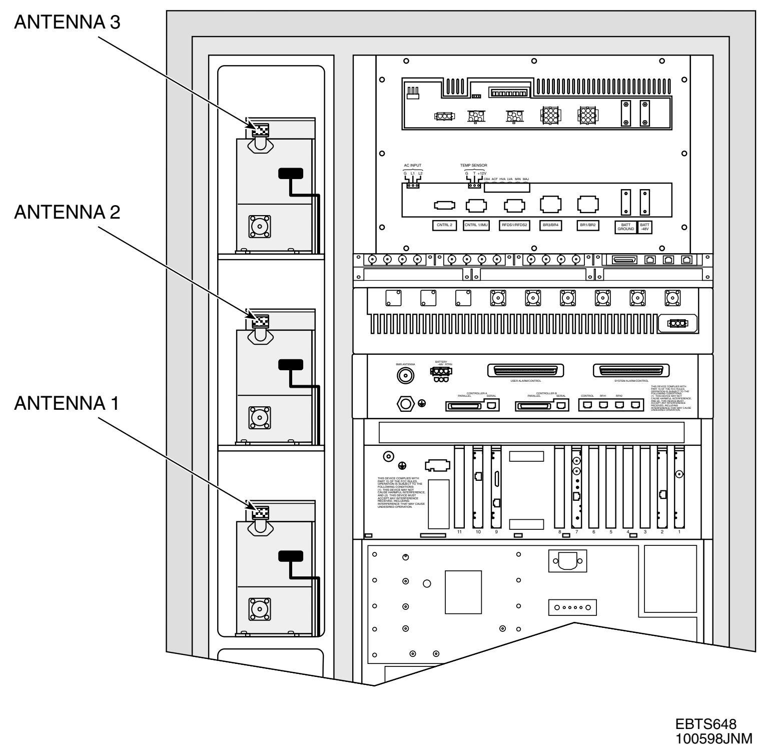


Figure 4-9 ***800 MHz GEN 4 Duplexed RFDS Antenna Connections, Non-TTA (Rear View)***

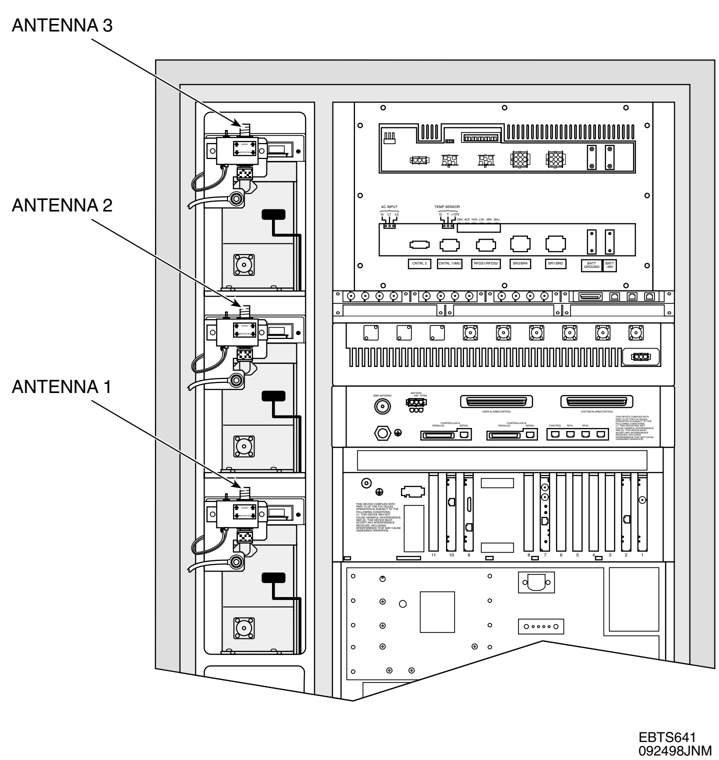


Figure 4-10 ***800 MHz GEN 4 Duplexed RFDS Antenna Connections, TTA (Rear View)***

GPS Antenna Connections

The Global Positioning System (GPS) receiver is located on the SRI card the iSC. Refer to the iSC Supplement for detailed information on the GPS antenna installation requirements.

Junction Panel

The transmission line is routed through a Junction Panel, as shown in Figure 4-11, at the rear of the Equipment Cabinet. The connector for the GPS cable has been installed and connected to the GPS Receiver by the factory.

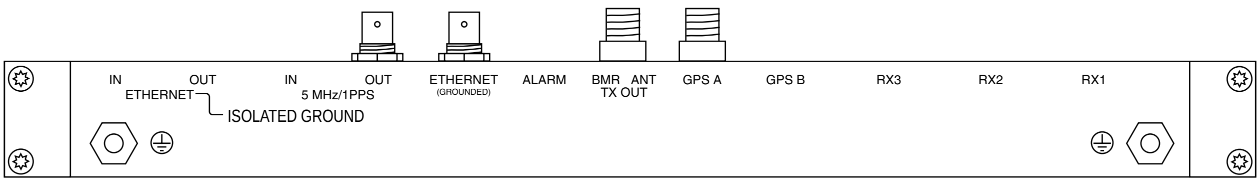


Figure 4-11 ***Typical Junction Panel (Rear View)***

BMR Antenna Connection

The Base Monitor Radio (BMR) is located in the iMU. Refer to the iSC Supplement for detailed information on the BMR antenna installation requirements.

Junction Panel

The transmission line is routed through a Junction Panel, as shown in Figure 4-11, at the rear of the Equipment Cabinet. The connector for the BMR cable has been installed and connected to the Base Monitor Radio by the factory.

T1/E1 Cabling

The local telephone company installs the T1 line, which terminates in an 8-pin modular plug. This demarcation (demarc) point connects to the iSC through a surge arrestor. Refer to the iSC Supplement of this manual for detailed information on the T1 line installation requirements.

Chapter 5
Final Checkout

Overview

This section describes the final checkout / power-up procedures after installation of the Outdoor SRSC is complete. Perform the following procedures after the Outdoor SRSC has been installed. The procedures in this section provide an orderly system power-up sequence and ensure proper basic operation of the Outdoor SRSC.

This section consists of the following procedures:

Procedure	Page	Description
Final Checkout Setup	5-2	Describes how to prepare the Outdoor SRSC for the final checkout
Powering the Power Supply System	5-3	Describes how to activate and check the Power Supply Rack
Applying Power to Components Within Equipment Cabinets	5-8	Describes how to apply power to the modules within the cabinets

Final Checkout Setup

The procedures below make certain the Outdoor SRSC equipment is set to OFF before power is applied, thereby ensuring an orderly power-up sequence.

Checkout Setup

On the AC / DC Power System breaker panel (Figure 5-1), set all circuit breakers to the OFF position.

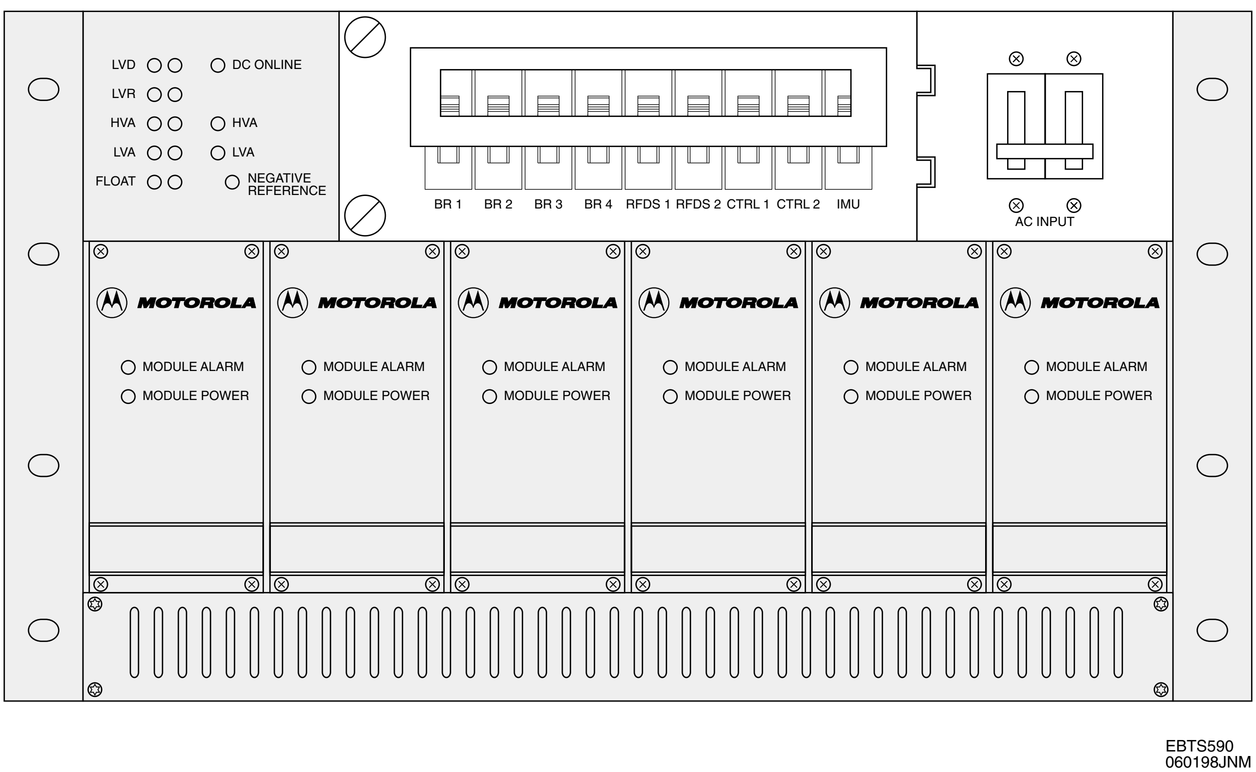


Figure 5-1 ***SRSC Breaker Panel***

Powering the Power Supply System

The following procedures verify that the power supply equipment is correctly connected and capable of producing the correct output voltages to power the Outdoor SRSC equipment.

Battery Float/Equalize Verification

If the Power Supply rack and battery system were previously installed and are operational, perform the following procedures to check the float and equalize voltages.

1. Using a digital voltmeter (DVM), measure the voltage at the system voltage and ground connections on the SSC module.

   Verify the proper float voltage is read on the DVM.

2. On the SSC, set the FLOAT / EQUALIZE switch to EQUALIZE.

   Verify all rectifier modules go into equalize mode and share the load properly.

3. On the SSC, set the FLOAT / EQUALIZE switch to FLOAT.

   Verify all rectifier modules return to float.

NOTE

Immediately after setting the FLOAT / EQUALIZE switch to FLOAT, a “No load” indication may appear because the batteries are not drawing any current. This condition should clear after several minutes.

4. On the battery disconnect panel, set the DISCONNECT / CONNECT breaker to DISCONNECT.

5. On the power supply chassis, set the FLOAT / EQUALIZE switch to EQUALIZE.

   Verify the system voltage is properly set for equalize.

6. On the power supply chassis, set the FLOAT / EQUALIZE switch to FLOAT.

7. On the battery disconnect panel, set the DISCONNECT / CONNECT breaker to CONNECT.

8. Turn on all AC and DC breakers for every installed rectifier.

   Verify the battery system is charging by verifying an increase in rectifier current.

NOTE

In systems with multiple rectifiers and charged batteries, it is a normal indication for only one rectifier to indicate a low current flow. However, a single rectifier should never carry more than 20% of the load over the other rectifiers. If this occurs, perform the Battery Float / Equalize Adjustment.

Battery Float/Equalize Adjustment

1. On the Power Supply chassis, set FLOAT / EQUALIZE switch to FLOAT.
2. Using a digital voltmeter (DVM), measure the voltage at the system voltage and ground connections on the SSC module.

   If necessary, adjust the float setting for the appropriate rectifier until the desired voltage is read on the DVM.
3. On the Power Supply chassis, set the FLOAT / EQUALIZE switch to EQUALIZE.
4. Using a digital voltmeter (DVM), measure the voltage at the system voltage and ground connections on the SSC module.

   If necessary, adjust the float setting for the appropriate rectifier until the desired voltage is read on the DVM.
5. On the power supply chassis, set the AC breaker for rectifier #1 to OFF.

   If no additional rectifiers are installed, proceed to step 9.
6. On the power supply chassis, set the DC breaker for the next rectifier to ON.
7. On the power supply chassis, set the AC breaker for the same rectifier as in step 6 to ON.

   Verify that the fan start and the voltage on the system voltmeter reads approximately 54 volts. If necessary, adjust the rectifier float and equalize voltages by repeating steps 1 through 7 again.

! WARNING !

IN THE FOLLOWING STEP, TURN ON DC CIRCUIT BREAKERS FOR THE INSTALLED RECTIFIER MODULES *ONLY.* SHOCK HAZARD CAN RESULT IF EMPTY RECTIFIER SLOT HAS POWER APPLIED.

8. Turn on all AC and DC breakers for every installed rectifier.

   Verify that all rectifiers are on line and that the proper system voltage is present.

9. Set the battery disconnect switch to CONNECT.

   The batteries should begin charging. Verify that all rectifier modules are sharing the load.

Power Supply System Power-Up (SRSC System)

This procedure verifies that the AC / DC Power System is correctly connected and capable of producing the correct output voltages to power the Outdoor SRSC equipment. Figure 5-2 shows the front view of the AC / DC Power Supply System.

1. On rear panel of AC / DC Power System, verify that all connections are secure.

! WARNING !

LOADS MUST BE SET TO OFF BEFORE REMOVING OR INSERTING A CARTRIDGE TYPE FUSE INTO FUSEHOLDER.

CARTRIDGE TYPE FUSE SHOULD NEVER BE REMOVED OR INSERTED BY HAND OR SCREWDRIVER. USE APPROPRIATE INSULATED FUSE PULLER TOOL (IDEAL P/N 34-002 OR EQUIVALENT) TO REMOVE AND INSTALL FUSE.

2. If backup battery rack is used, disconnect battery system from AC / DC Power System via backup rack fuse or disconnect switch (as applicable).

3. On AC / DC Power System, set AC INPUT breaker to ON.

   Verify the following indications on AC / DC Power System:

Name	Indication
DC ONLINE	illuminated
MODULE POWER (all six)	all illuminated
MODULE ALARM (all six)	all extinguished

Powering the Power Supply System

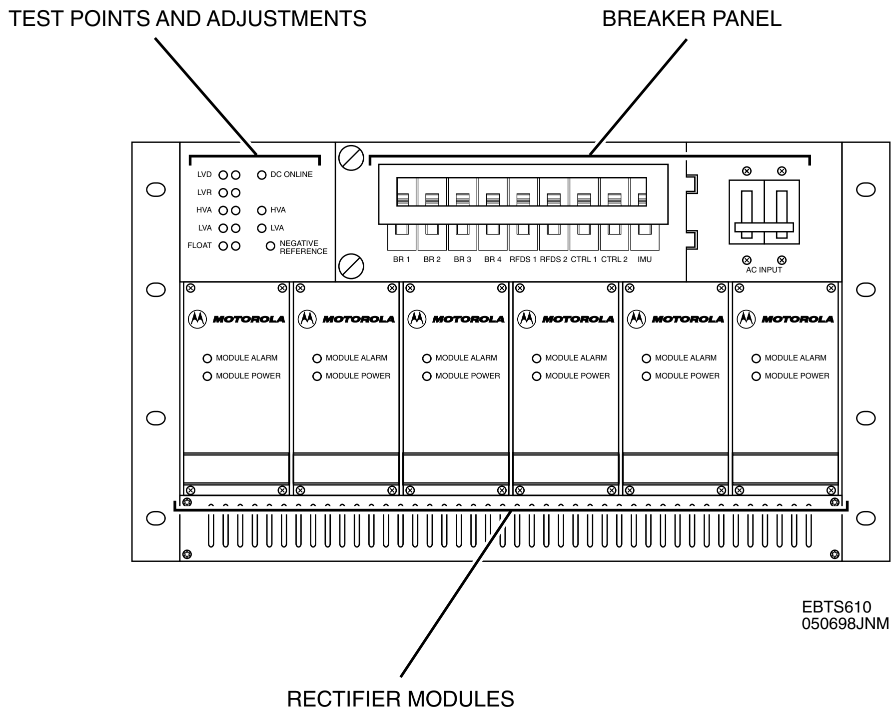


Figure 5-2 ***AC/DC Power System (Front View)***

4. Using a Digital Voltmeter (DVM), verify the power system voltages specified below. For each measurement, connect DVM test leads to NEGATIVE REFERENCE test point and opposite test point specified below.

If required, adjust parameter reading using corresponding trimmer adjustment adjacent to test point.

Test Point	Parameter	Factory Value (Acceptable Range)
LVD	low voltage disconnect	4.2 V (4 - 5 V)
LVR	low voltage reconnect	4.81 V (4.5 - 5.5 V)
HVA	voltage alarm; high threshold	5.4 V (5.1 - 6 V)
LVA	voltage alarm; low threshold	4.3 V (4 - 5 V)
FLOAT	system float (nominal bus) voltage	5.4 V (5.15 - 5.62 V)

NOTES:

1. Values listed are scaled at 1/10 actual bus value. Actual voltages and tolerances at -48V bus are 10X test point values.
2. Values listed are recommended factory cal points. Corresponding ranges (in parentheses) indicates allowable deviation from factory spec, and/or acceptable range of accommodation for customer-preferred differences.

5. If system uses backup battery rack, perform steps 5.1 through 5.3 below. (If backup battery rack is not used, go to step 6.)

5.1 On AC / DC Power System, set AC INPUT breaker to OFF.

5.2 Reconnect battery backup system to AC / DC Power System via battery rack switch or fuse (as applicable).

! WARNING !

LOADS MUST BE SET TO OFF BEFORE REMOVING OR INSERTING A CARTRIDGE TYPE FUSE INTO FUSEHOLDER. INSERTING OR REMOVING FUSE WITH LOADS SET TO ON CAN RESULT IN ARCING WHEN FUSE IS INSERTED OR REMOVED.

CARTRIDGE TYPE FUSE SHOULD NEVER BE REMOVED OR INSERTED BY HAND OR SCREWDRIVER. USE APPROPRIATE INSULATED FUSE PULLER TOOL (IDEAL P/N 34-002 OR EQUIVALENT) TO REMOVE AND INSTALL FUSE.

5.3 On AC / DC Power System, set AC INPUT breaker to ON.

5.4 Again verify the system normal indications shown in step 3, and the parameters listed in step 4.

6. Go to Applying Power to Components Within Equipment Cabinets procedure.

Applying Power to Components Within Equipment Cabinets

The following procedures provide an orderly power-up sequence of the components within the equipment cabinet(s).

Depending on the type of system, perform the applicable procedure below.

SRSC System

NOTE

Breaker panels are always shipped fully configured whether the equipment the circuit breaker controls is installed or not. Perform all steps in this procedure to prevent unwanted alarm indications from occurring.

1. On the AC / DC Power System breaker panel, set the **CTRL 1** breaker to ON.

   Verify that the **Power On** LED on the Controller is lit.

NOTE

The Site Reference ISA card within the Controller requires 13 to 20 minutes to start up for the first time. During this delay, the GPS receiver locates and fixes on satellites. Also, the HSO requires 20 minutes for frequency stabilization.

2. Set the **IMU** breaker to ON.

   Verify that the **Power On** LED on the iMU is lit.

3. Set the **CTRL 2** breaker to ON.

4. Set the **BR 1** breaker to ON.

   Verify the following LED conditions on the Base Radio 1 Base Radio Controller:

   - All BRC LEDs flash three times upon initial power-up.
   - BR LED flashes quickly while the Base Radio is waiting for code to be downloaded from the iSC.

5. Set the **BR 3** breaker to ON.

   If Base Radio 3 is installed within the cabinet, verify the LED conditions are as defined in step 4.

6. Set the **BR 2** breaker to ON.

   If Base Radio 2 is installed within the cabinet, verify the LED conditions are as defined in step 4.

7. Set the **RFDS 1** breaker to ON.

   Verify that the fans in the Triple Isolator Deck turn on.

8. Set the **RFDS 2** breaker to ON.

This Page Intentionally

Left Blank

Chapter 6
System Testing

Overview

This section provides testing procedures for the Base Radios and RFDS. Software downloading and complete test procedures for the iSC are provided in the iSC supplement to this manual.

Perform the iSC Verification procedures provided in the Supplement prior to performing the Base Radio and RFDS Verification procedures contained herein. The topics of this section are listed in the following table.

Testing Overview

The testing procedures covered in this section are intended to be used in conjunction with the information provided in the iSC Supplement to this manual as well as the System Troubleshooting section of this manual. Together, the troubleshooting information and testing procedures provide the necessary information to isolate failures to a Field Replaceable Unit (FRU). This helps to keep system down-time to a minimum by quickly returning the site to normal operation.

NOTE

All suspected faulty FRUs should be shipped to a Motorola depot facility for servicing or repair.

MMI Commands

Service technicians can communicate with the Outdoor SRSC through the use of Man Machine Interface (MMI) commands and a service computer. MMI commands provide testing capabilities with access to alarm log files and various diagnostic tests. MMI commands also provide a means to configure the iSC and RF Cabinet for various system tests.

Two different command sets, iSC and Base Radio, allow testing of the Outdoor SRSC. These command sets are downloaded from the service computer via the Interface Panel. Downloading may also be accomplished directly through an available service port on the iSC.

A select number of MMI commands are used in the procedures within this chapter. The complete set of Base Radio MMI commands are included in the Software Commands section of this manual. The complete set of iSC MMI commands are included in the iSC Supplement to this manual.

Testing Procedures

The procedures in this section test the functionality of the Outdoor SRSC and help isolate failures to the FRU level. If a failure cannot be isolated after performing these tests, refer to the System Troubleshooting section of this manual, as well as the System Testing chapter in the iSC Supplement to this manual for further information. Testing procedures are divided into two sections:

- iSC Verification - refer to the iSC System Manual, 68P81098E05 (Supplement to this manual)
- Base Radio and RFDS Verification - procedures contained herein.

iSC Verification

The iSC test procedures are included in the System Testing chapter of the iSC Supplement to this manual. Perform the iSC verification procedures prior to performing the Base Radio and RFDS verification procedures. iSC test procedures consist of downloading the test software and verifying the operation of the iSC and iMU. A summary of the iSC Verification procedures is provided in the following table.

iSC Manual Section	Description
Serial download	Describes how to download application code to the service computer and the iSC via the serial port.
Ethernet download	Describes how to download the application code to the service computer and iSC via the Ethernet port.
Loading the Base Radios	Describes how to download the application code to each Base Radio.
Standby iSC Status	Describes how to check the status of the standby iSC System.
Base Radio Registration and Status	Describes how to check the registration and status of each Base Radio within the system.
T1 Connection Test	Describes how to locally manufacture a T1 test cable, set-up, and perform a loop-back test on the T1 line.
iMU alarm checkout	Describes how to verify that all site alarms monitored by the iMU are working properly.
SRI status	Describes how to check the alarm, GPS, and on-line status of the SRI.

Base Radio and RFDS Verification

These procedures verify the operation of the RFDS and Base Radios. The Base Radio and RFDS Verification consists of:

Test Equipment

Commercial Test Equipment

Table 6-1 lists the recommended test equipment for these procedures. Equivalent equipment is acceptable, unless otherwise noted.

Table 6-1 ***Test Equipment for RF Cabinet Testing***

Equipment	Model/Type	Manufacturer	Description
Service Computer †	80286 or better	IBM, IBM compatible, or Macintosh	Local service computer
Application Code	n/a	Motorola	Compressed application code for iSC and BRC
Communication Software	ProComm Plus	DataStorm	Host communication
RS-232 Cable	n/a	Locally Procured	Straight through connecting cable with DB9 connector for BRC port
RF Attenuator, 250W, 10dB	01-80301E72	Motorola	Used to attenuate receive signals for testing
RF Power Meter††	HP438A	Hewlett-Packard	Used to perform relative calibration and linearity checks of signal source
Low-Power Sensor Head	HP8481D	Hewlett-Packard	Used in conjunction with Power Meter
Rubidium Frequency Standard	PRFS	Ball/Efratom	Used as a frequency standard for receive test
iDEN Test Set	R2660	Motorola	Used for checking receive operation

† Either a DOS-based computer or Macintosh computer may be used for the service computer. Contact your iDEN System Manager for additional information.

†† Do not substitute analog power meter (such as HP435A). Analog power meter averaging time is not long enough to accurately read pulsed iDEN signal.

Calibrating a Test Cable For Field Use

The BER sensitivity portion of the following procedure requires a calibrated iDEN test set-to-SRSC signal cable. The calibrated cable used as described in certain portions of the BER Floor And Sensitivity Verification procedure is **mandatory** in providing an accurate, known signal level **at the SRSC antenna port**. Accurate BER sensitivity field testing is assured only if this method is used.

The steps in calibrating a cable should be **done in the shop using certified calibrated equipment**. Following calibration, the cable is tagged as being calibrated, and then becomes part of your other field test equipment assortment.

At least twice a year, the cable calibration should be rechecked and retagged, as applicable. Discard the cable if gross deviations from tagged value or visible physical damage to cable is noticed.

Select and calibrate the test cable as follows:

1. Obtain an RG-58/U (equivalent or better) N(M)-to-N(M) cable assembly of adequate length to reach from an iDEN Test Set to the RFDS equipment.

2. Connect Power Meter Sensor Head HP8481D, along with Power Meter HP438A, to the R2660 Test Set **RF IN/OUT** connector.

3. Turn on the R2660. Set R2660 for a continuous unmodulated carrier.

4. Adjust R2660 output level until a reading of –55 dBm is displayed on the power meter. Disconnect the power meter sensor head from R2660.

5. Connect one end of the cable being calibrated to the R2660 **RF IN/OUT** connector.

6. Connect the power meter sensor head to the other end of the cable.

7. Observe the reading on the power meter.

8. Solving for loss, calculate the cable loss as follows:

(meter reading) – (55 dBm)= Calibrated cable loss

EXAMPLE:
(56.7) – (55 dBm)= 1.7 dB cable loss

9. Apply a permanent tag to the cable, noting its calibrated loss. (This calibration value will be required in subsequent field measurement procedures.)

   The calibration tag should also include calibration date and your name.

NOTE

The calibrated cable should be treated with care to prevent degrading of calibration. Pack cable separately in protected box or bag, making certain cable is not coiled excessively tight or bent.

If available, plastic end caps for connectors are recommended.

Base Radio Start-up Sequence

The following procedure assumes that the software has been downloaded to the Base Radio from the iSC. Refer to Loading the Base Radios in the iSC Supplement to this manual for additional information.

1. Connect an RS-232 cable from the service computer to the STATUS connector located on the front of BRC, in sector 1.

2. Apply power, if the system has been shut down between procedures. (The Base Radios should have power already applied from the System Checkout procedure.)

NOTE

When servicing Base Radios (BRs), in situations where the Control Board or the entire BR is replaced, the integrated Site Controller (iSC) will automatically reboot the serviced BR given that the BR has been off-line for a period not less than that stipulated by the "Replacement BRC Accept Timer" (default is 3 minutes). If the BR is turned on prior to the expiration of the "Replacement BRC Accept Timer", power the BR back down and wait the minimum timer length before turning the BR back on.

3. On the BRC, verify the condition of the LEDs for each Base Radio, as listed in Table 6-2.

Table 6-2 ***Base Radio LED Indications***

LED	Color	Normal Indication
BR	Green	Flashing
PS	Red	Off
EX	Red	Off
PA	Red	Off
CTL	Red	Off
R1	Red	Off
R2	Red	Off
R3	Red	Off
NOTE: Refer to the Base Radio section of this manual for conditions relating to the LEDs listed above.		

Verify the following LED conditions on the BRC:

- All BRC LEDs flash 3 times upon initial power-up.
- BR LED flashes quickly when BR is waiting for code to be downloaded from iSC.
- All BRC LEDs scroll during code downloading process.
- BR LED flashes slowly when BR is de-keyed.
- BR LED is solid when BR is keyed.

4. On the Power Supply module of the Base Radio, verify that the green LED is lit.

Selecting Base Radio Position and Receiver Complement

During equipment setup or when a Base Radio is to be added, MMI is used to:

- Set the position of the Base Radio within the Equipment Cabinet.
- Select a particular Base Radio. This is required when assigning transmit and receive frequencies to a particular Base Radio.
- Select a receiver complement for a particular Base Radio.

These operations are described below. Refer to the “Software Commands” section of this manual for detailed information on using the MMI commands.

Setting And Accessing Base Radio Position

The **set position** command programs the position number of where a Base Radio is mounted within the Equipment Cabinet.

Base Radio designation starts from the bottom of the cabinet, with the lowest Base Radio being designated as “1”.

The **set position** command would also be used in accessing a particular Base Radio for further MMI actions.

Selecting A Receiver Complement For A Base Radio

The **set rx_fru_config** command sets which receivers should be present in a selected Base Radio. The command has provision for all possible complements of three receivers.

The **set rx_mode** command selectively enables any combination of individual receivers within a selected Base Radio, while disabling any receiver that was not specifically selected.

Displaying Base Radio Alarms

In the iSC procedures, the Base Radios were connected to the iSC and received downloaded test software via the BR-iSC Ethernet link. If necessary, reset the Base Radio to initiate the code download from the iSC.

1. When prompted, type the proper password.

After entering the correct password, the BRC> prompt is displayed on the service computer.

The default password is **motorola**.

```
Enter login password:

BRC>
```

NOTE

Motorola recommends changing the default password once proper operation of the equipment has been verified. To change the password, contact the Operations and Maintenance Center (OMC) operator on duty.

2. At the BRC> prompt, type: **set alarm_reports off**

This command disables synchronous alarm reporting.

```
BRC> set alarm_reports off
set ALARM REPORTS TRACE to OFF in RAM
```

3. Type: **get alarms**

This command displays any outstanding alarm conditions. If any alarms are discovered, they are displayed on the service computer as shown in the example:

```
BRC> get alarms
[brc fru warning]
[external reference failure]
[gps failure]
```

If no alarms are present during normal operation, this message is displayed:

```
BRC> get alarms
NO ALARM CONDITIONS DETECTED
```

Setting Rx and Tx Frequencies

Base Radio frequencies are factory set to a default receive frequency of 806.000 MHz and a default transmit frequency of 851.000 MHz.

CAUTION

Do not transmit to an antenna under any circumstance unless those frequencies are licensed.

Perform the following procedure if you know the actual frequencies required. Otherwise, use the default frequencies.

1. At the BRC> prompt, type: **dekey**

   This command stops all RF transmission.

```
BRC> dekey
XMIT OFF INITIATED
```

2. Type: **set rx_freq 806.00000** to set the receive frequency.
3. Type **set tx_freq 851.00000** to set the transmit frequency.
4. Proceed to Checking Receive Operation.

! WARNING !

BE SURE THE DEKEY COMMAND HAS BEEN ISSUED TO ALL BASE RADIOS IN THE CABINET TO PREVENT INJURY WHILE DISCONNECTING AND CONNECTING ANTENNAS.

Checking Receive Operation

Receive operation test procedures must be performed on each Base Radio in the Equipment Cabinet. For each receiver within each Base Radio, perform Bit Error Rate (BER) verification as described in the BER Floor And Sensitivity Verification procedures below.

The test requires the R2660 iDEN Test Set as a signal source, and a calibrated coaxial cable for connecting the R2660 to the antenna ports in the Equipment Cabinet.

NOTE

The following procedure requires the use of a calibrated test set-to-SRSC signal cable. Refer to Calibrating a Test Cable For Field Use instructions earlier in this section for information.

NOTE

Throughout the procedures, calculations solving for losses are used. The convention used is that of solving for losses rather than gain. As such, losses are handled as positive numbers and gain as a negative number (“negative” loss). Therefore, signs (+, –) associated with a reading or value are in some cases dropped. For each calculation required, examples are also provided.

BER Floor And Sensitivity Verification (General Instructions)

BER Floor testing verifies basic receiver functionality by verifying the receivers’ ability to achieve a specified minimum BER at a high signal level. BER Sensitivity testing verifies the receivers’ performance by verifying the receivers’ ability to achieve low BER with a low-level signal.

Perform verification as follows:

1. Connect the service computer to the local service port (STATUS connector) of the Base Radio and log on.

   The service port connector is located on the front of the BRC module. The default password is **motorola**.

NOTE

Motorola recommends changing the default password once proper operation of the equipment has been verified. To change the password, contact the Operations and Maintenance Center (OMC) operator on duty.

2. Press the RESET button on the BRC.

3. At the BRC> prompt, type: **dekey**

This command stops all RF transmission.

```
BRC> dekey
XMIT OFF INITIATED
```

! WARNING !

BE SURE THE **DEKEY** COMMAND HAS BEEN ISSUED TO ALL BASE RADIOS IN THE CABINET TO PREVENT INJURY OR DAMAGE TO EQUIPMENT WHILE DISCONNECTING AND CONNECTING ANTENNAS.

4. Remove power from the R2660 and connect the Rubidium Frequency Standard 10 MHZ OUTPUT to a 10 dB attenuator.

5. Connect the other end of the 10 dB attenuator to the 10 MHZ REFERENCE OSCILLATOR IN / OUT connector on the R2660.

6. Put the R2660 in EXT REF mode.

7. Apply power to the R2660.

NOTE

Refer to the equipment manual provided with the R2660 for further information regarding mode configuration of the unit (Motorola Part No. 68P80309F16).

8. At the BRC> prompt, type: **set alarm_reports off**
This command disables alarm reporting.

9. At the BRC> prompt, type: **get alarms**
Verify a report of “no alarms reported”.

10. At the BRC> prompt, type: **set sgc off**

This command disables the software gain control routine within the Base Radio. Repeat this step for all Base Radios within the Equipment Cabinet.

11. Connect the service computer to the bottom Base Radio (BR1) in the Equipment Cabinet.

12. At the BRC> prompt, type: **get rx_freq**

    This command displays the receive frequency for the current Base Radio. The message appears as:

```
BRC> get rx_freq
RECEIVE FREQUENCY is 806.00000 MHz
```

13. Set the R2660 to the receive frequency determined in the previous step.

    All receivers within a Base Radio have the same receive frequency.

CAUTION

If cabinet uses tower-top amplifier DC injectors, make certain injector DC power is disconnected or disabled before proceeding. Damage to R2660 can occur if DC power is not disabled.

NOTE

If system uses DC injectors, test signal connection is to be made through DC injectors.

14. Connect R2660 to cabinet Rx1 antenna input as follows:

14.1 Disconnect the antenna cable from the duplexer 1 antenna port on the EBTS Main RF Cabinet.

14.2 (See Figure 6-1.) Using the Calibrated Test cable, connect the R2660 **RF IN/OUT** connector to the duplexer 1 antenna port. (On 900 MHz systems, connect a calibrated DC block between the test cable and antenna port.)

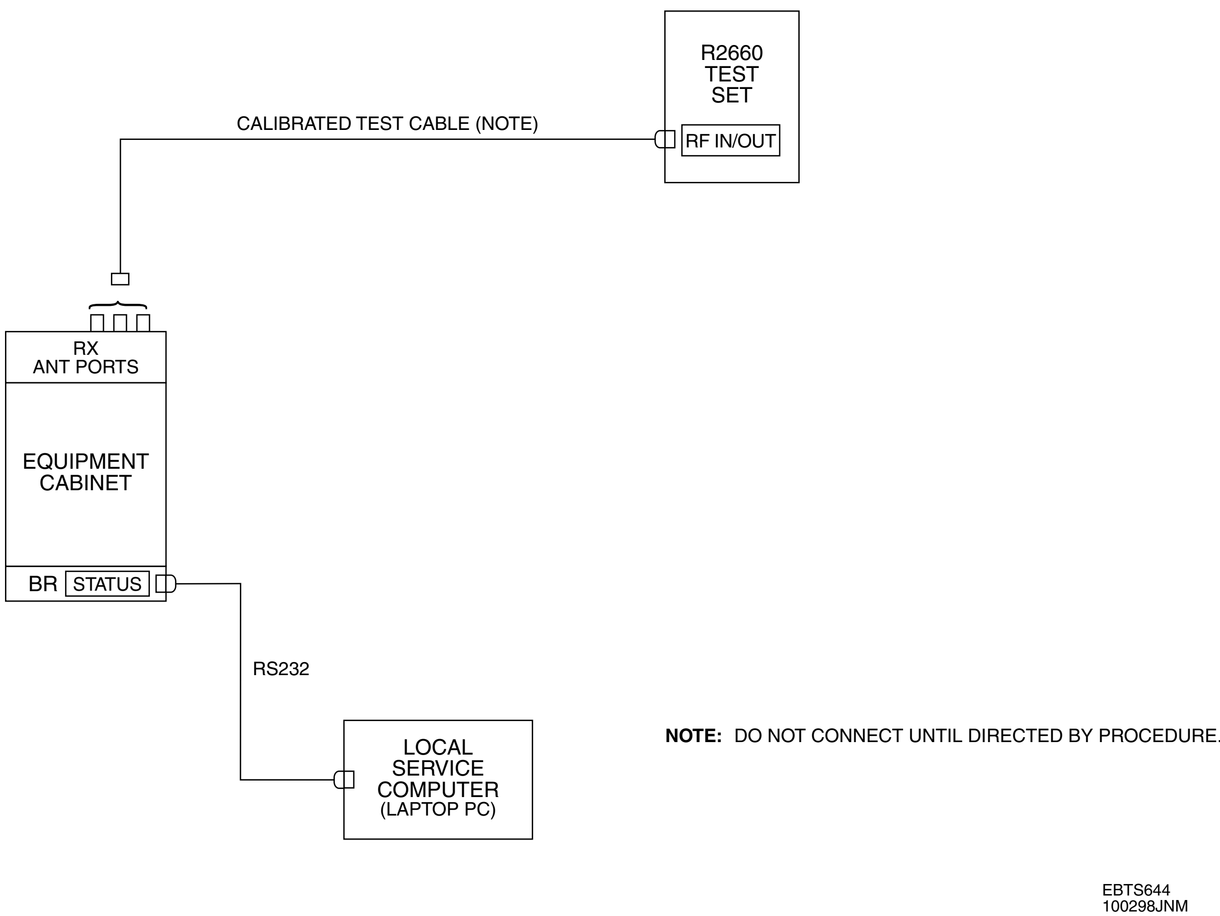


Figure 6-1 ***EBTS BER Verification Setup***

15. At the BRC> prompt, type: **set rx_mode 1**

    This command enables only antenna / receiver 1 while disabling the remaining antenna / receivers. Repeat this step for all Base Radios within the Equipment Cabinet.

```
BRC>set rx_mode 1
set RECEIVER 1 to ENABLED in RAM
set RECEIVER 2 to DISABLED in RAM
set RECEIVER 3 to DISABLED in RAM
```

NOTE

For the following tests, make sure the R2660 is set to the same frequency as displayed by the **get rx_freq** command.

16. Set the R2660 to generate the 6 / 1 iDEN test signal.

17. At the BRC> prompt, type: **get rssi 1 1000**

    This commands returns the receive signal strength indication. To pass the BER floor test, the Bit Error Rate must be **less than 0.01% (1.0e-02%)** for the displayed results.

```
BRC> get rssi 1 1000
Starting RSSI monitor for 1 repetitions averaged each 1000 reports.

Line  RSSI1   RSSI2  RSSI3   SGC    CI      BER        OffsetSyncMiss
       dBm     dBm    dBm     dB   dBmdBm %            Hz%
----   ------  ------  ------  ----  --------------------  -------   ---------
1      -80.0  -131.5  -131.5    0   -79.2  -121.90.000e+00-5.4.000e+00
```

18. Verify that the RSSI dBm signal strength, for the receiver under test, is -80.0 dBm ± 1.0 dBm. Adjust the R2660 signal output level to get the appropriate RSSI dBm level. **The BER floor % value is valid only if the RSSI signal strength is within the limits of -81.0 dBm to -79.0 dBm.**

19. Adjust R2660 output level for an output level **at the end of the cable feeding the SRSC** as follows:

System Type	Required Level at cable end
800 MHz Duplexed RFDS	–113.5 dBm

19.1 Note the tagged calibrated loss value of the Calibrated Test Cable.

19.2 Calculate the required R2660 output level to produce the required SRSC signal level as follows:

800 MHz Duplexed RFDS:
(–113.5 dBm) + Calibrated cable loss= Required R2660 Output Level
EXAMPLE: **(–113.5) + (1.7)= –111.8 dBm**

19.3 While observing R2660 Output Level display, set the R2660 for an output level as determined above.

20. At the BRC> prompt, type: **get rssi 2 100**

This will generate two lines of printout showing the Bit Error Rate (BER) averaged over 100 readings. Depending on system type, proceed as follows:

The Base Radio BER readings **must be less than 8% (8.0e - 00%)** on each line of the displayed results.

800 MHz Duplexed RFDS Example:

```
BRC> get rssi 2 100
Starting RSSI monitor for 2 repetitions averaged each 100 reports.

  Line   RSSI1  RSSI2  RSSI3   SGC  DIVBER          SyncMiss
          dBm    dBm    dBm     dB  dBm%            %
  ----   -----  -----  -----  ----  --------------  ---------
   100  -113.5                 0.0  1.942e+00       0.000e+00
   200  -113.5                 0.0  1.068e+00       0.000e+00
```

21. Note and record the BER obtained.

NOTE

If the BER obtained in the above step is equal to or greater than the specified limit, a problem is indicated. Continue with tests in this procedure; the results of the remaining tests will be used in fault-isolating the BER problem.

22. At the BRC > prompt, type: **get alarms**

This command returns all active alarms of the Base Radio.

```
BRC> get alarms
NO ALARM CONDITIONS DETECTED
```

NOTE

If the **get alarms** command displays alarms, refer to the System Troubleshooting section for corrective actions.

23. At the BRC> prompt, type: **get rx1_kit_no**

This command returns the kit number of the receiver.

```
BRC> get rx1_kit_no
RECEIVER 1 KIT NUMBER IS CRF6010A
```

NOTE

If the kit number is CRF6010 or CRF6030, continue to step 24. If the kit number is TRF6560, proceed to step 26.

Prompt displays **kit** numbers (which should not be confused with **FRU** numbers). Refer to Base Radio FRUs (Foreword) for correlation between receiver kit numbers and corresponding FRU numbers.

---

24. At the BRC> prompt, type: **get rx_fru_config**

This command lists the receivers active for diversity.

```
BRC> get rx_fru_config
RECEIVER CONFIGURATION {RX1 RX2 RX3}
```

NOTE

If the antenna configuration does not match the receiver configuration, use the **set rx_fru_config** MMI command to properly set the parameter.

---

25. Move the service computer to the next Base Radio and repeat steps 17 through 24 of this procedure.

Remember to verify the correct receive frequency for each Base Radio.

26. Reconnect antenna connections as follows:

26.1 Disconnect the Calibrated Test Cable from the antenna 1 duplexer.

26.2 Reconnect the antenna cable to the duplexer 1 antenna port.

27. Proceed to BER Verification (Receiver 2) procedure.

BER Verification (Receiver 2)

The following procedure describes enabling receiver 2 for BER floor and sensitivity testing. Perform this procedure for two branch and three branch diversity sites.

1. Connect R2660 to cabinet Rx2 antenna input as follows:

1.1 Disconnect the antenna cable from the duplexer 2 antenna port in the Equipment Cabinet.

1.2 Using the Calibrated Test cable, connect the R2660 **RF IN/OUT** connector to the duplexer 2 antenna port. (On 900 MHz systems, connect a calibrated DC block between the test cable and antenna port.)

2. Connect the service computer to the bottom Base Radio (BR1) STATUS connector in the Equipment Cabinet.

3. At the BRC> prompt, type: **set rx_mode 2**

   This command enables only antenna / receiver 2 while disabling the remaining antenna / receivers. Repeat this step for all Base Radios within all RF cabinets at the site.

```
BRC>set rx_mode 2
set RECEIVER 1 to DISABLED in RAM
set RECEIVER 2 to ENABLED in RAM
set RECEIVER 3 to DISABLED in RAM
```

4. Again connect the service computer to the bottom Base Radio (BR1).

   Repeat steps 17 through 25 of the BER Floor And Sensitivity Verification (General Instructions) procedure for each Base Radio at the site.

5. Reconnect antenna connections as follows:

   5.1 Disconnect the Calibrated Test Cable from the antenna 2 duplexer.

   5.2 Reconnect the antenna cable to the duplexer 2 antenna port.

6. Depending on site receiver diversity, proceed as follows:

   - If testing a two branch diversity site, continue with step 7.
   - If testing a three branch diversity site, proceed to BER Verification (Receiver 3) procedure.

7. Connect the service computer to the bottom Base Radio (BR1) in the Equipment Cabinet.

8. At the BRC> prompt, type: **set rx_mode 12**

   This command enables receivers 1 and 2 in the Base Radio.

```
BRC>set rx_mode 12
set RECEIVER 1 to ENABLED in RAM
set RECEIVER 2 to ENABLED in RAM
set RECEIVER 3 to DISABLED in RAM
```

9. At the BRC> prompt, type: **set sgc on**

   This command enables the software gain control routine within the Base Radio.

```
BRC> set sgc on
set SOFTWARE GAIN CONTROL to ENABLED in RAM
```

10. Connect the service computer to the next Base Radio and repeat steps 8 and 9 for each Base Radio in the Equipment Cabinet.

11. Disconnect the service computer from the last Base Radio when complete.

12. Noting the recorded BER sensitivity readings obtained in step 21 of the BER Floor And Sensitivity Verification (General Instructions) procedure for each receiver and each Base Radio, proceed as follows:

    - If **all** BER readings were **less than limit specified above**, receiver system is OK. Turn off test setup. Disconnect test setup and reconnect any disconnected system antenna cabling.
      Proceed to Checking Transmit Operation.
    - If **any** BER reading **equalled or exceeded the limit specified above**, receiver system needs fault isolation.

      Proceed to Excessive BER Fault Isolation procedure in the System Troubleshooting section of this manual.

BER Verification (Receiver 3)

The following procedure describes enabling receiver 3 for BER floor and sensitivity testing. This test applies only to three-branch diversity sites.

1. Connect R2660 to cabinet Rx3 antenna input as follows:

   1.1 Disconnect the antenna cable from the duplexer 3 antenna port on the EBTS Main RF Cabinet.

   1.2 Using the Calibrated Test cable, connect the R2660 **RF IN/OUT** connector to the duplexer 3 antenna port. (On 900 MHz systems, connect a calibrated DC block between the test cable and antenna port.)

2. Connect the service computer to the bottom Base Radio (BR1) STATUS connector in the Equipment Cabinet.

3. At the BRC> prompt, type: **set rx_mode 3**

   This command enables only antenna / receiver 3 while disabling the remaining antenna / receivers. Repeat this step for each Base Radio at the site.

```
BRC>set rx_mode 3
set RECEIVER 1 to DISABLED in RAM
set RECEIVER 2 to DISABLED in RAM
set RECEIVER 3 to ENABLED in RAM
```

4. Again connect the service computer to the bottom Base Radio (BR1).

   Repeat steps 17 through 25 of the BER Floor And Sensitivity Verification (General Instructions) procedure for each Base Radio at the site.

5. Reconnect antenna connections as follows:

   5.1 Disconnect the Calibrated Test Cable from the antenna 3 duplexer.

   5.2 Reconnect the antenna cable to the duplexer 3 antenna port.

6. Connect the service computer to the bottom Base Radio (BR1) in the Equipment Cabinet.

7. At the BRC> prompt, type: **set rx_mode 123**

   This command enables all antennas / receivers in the Base Radio.

```
BRC>set rx_mode 123
set RECEIVER 1 to ENABLED in RAM
set RECEIVER 2 to ENABLED in RAM
set RECEIVER 3 to ENABLED in RAM
```

8. At the BRC> prompt, type: **set sgc on**

   This command enables the software gain control routine within the Base Radio.

```
BRC> set sgc on
set SOFTWARE GAIN CONTROL to ENABLED in RAM
```

9. Connect the service computer to the next Base Radio and repeat steps 7 and 8 for each Base Radio at the site.

10. Noting the recorded BER sensitivity readings obtained in step 21 of the BER Floor And Sensitivity Verification (General Instructions) procedure for each receiver and each Base Radio, proceed as follows:

- If **all** BER readings were **less than limit specified above**, receiver system is OK. Turn off test setup. Disconnect test setup and reconnect any disconnected system antenna cabling.
  Proceed to Checking Transmit Operation.
- If **any** BER reading **equalled or exceeded the limit specified above**, the receiver system needs fault isolation.

  Proceed to Excessive BER Fault Isolation procedure in the System Troubleshooting section of this manual.

Checking Transmit Operation

The following procedures verify transmission from the system antennas.

CAUTION

Do not transmit to an antenna under any circumstance unless those frequencies are licensed.

NOTE

The following steps describe the transmit verification of a 70 W Power Amplifier. If the Base Radio under test contains a 40W Power Amplifier, substitute 40 instead of 70 in the following steps.

1. Connect the service computer into the local service port of the bottom Base Radio (BR1) within the Equipment Cabinet and log on.
2. At the BRC> prompt, type: **dekey**

   This command stops all RF transmission.

```
BRC> dekey
completed successfully
```

CAUTION

This command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into a dummy load.

Attempting to key a 40W station to an output power greater than 40W will damage the Power Amplifier.

3. At the BRC> prompt, type: **set tx_power 70**

This command sets the transmitter output to 70 Watts.

```
BRC> set tx_power 70
setting transmitter power to 70 watts

TXLIN ATTENUATION is 5.000000


TARGET POWER is 70.00 watts [48.45 dbm]
ACTUAL POWER is 56.70 watts [47.54 dbm]
POWER WINDOW is 66.85 -> 73.30 watts [48.25 -> 48.65 dbm]
TXLIN LEVEL REGISTER REDUCED 83 STEPS [ -3.32 db].
TXLIN LEVEL is 0x55

completed successfully
```

4. At the BRC> prompt, type: **get fwd_pwr**

This command returns the current value of forward power as measured from the RF Power Amplifier.

```
BRC> get fwd_pwr
FORWARD POWER is 67 watts [48.3 dbm]
```

Verify that the returned value meets the specifications listed in Table 6-3.

5. At the BRC> prompt, type: **get ref_pwr**

This command returns the reflected power value as measured from the RF Power Amplifier.

```
BRC> get ref_pwr
REFLECTED POWER is 2 watts [31.9 dbm]
```

Verify that the returned value meets the specifications listed in Table 6-3.

6. At the BRC> prompt, type: **get vswr**

   This command returns the current Voltage Standing Wave Ratio (VSWR) at the RF Power Amplifier.

```
BRC> get vswr
VSWR is 1.4:1
```

   Verify that the returned value meets the specifications listed in Table 6-3.

NOTE

The **get wattmeter** command is valid only for Base Radios connected to Power Monitor harness (**ALARM** connector on rear of Base Radio.

For more information, refer to “Cabinet Alarm / Power Monitor Harness Connections” (Cabling Information) in the System Description chapter.

7. At the BRC> prompt, type: **get wattmeter**

   This command returns the current forward and reverse power readings, and calculates the VSWR from the external wattmeter located in the RFDS.

```
BRC> get wattmeter
FORWARD POWER AT WATTMETER is 38 Watts
REFLECTED POWER AT WATTMETER is 0 Watts
WATTMETER VSWR is 1.1:1
```

   Verify that the returned value meets the specifications listed in Table 6-3.

Table 6-3 ***Transmit Level Specifications (Duplexed RFDS)***

Function	Tolerance	
	70 W, 800 MHz PA	**40 W, 800 MHz PA**
Forward Power	Greater than 66 W	Greater than 38 W
Reflected Power	Less than 7 W	Less than 6.3 W
VSWR	Less than 2.4:1	Less than 2.4:1

Table 6-3 ***Transmit Level Specifications (Duplexed RFDS) (Continued)***

Function	Tolerance	
	70 W, 800 MHz PA	40 W, 800 MHz PA
Wattmeter Forward Power (NOTE 1)		
800 MHz GEN 4 Duplexed RFDS; 1 BR per antenna	Greater than 33 W	Greater than 19 W
800 MHz GEN 4 Duplexed RFDS; 3 BRs per antenna	Greater than 9.5 W	Greater than 5.5 W
Wattmeter Reflected Power	Less than 0.9 W	—

NOTES:

1. External wattmeter (power monitor) readings assume Tx signals within 854-866 MHz range. Within 851-854 MHz Tx range, reading may be up to 1.5 dB lower.

8. At the BRC> prompt, type: **get alarms**

This command returns all active alarms of the Base Radio.

```
BRC> get alarms
NO ALARM CONDITIONS DETECTED
```

NOTE

If the get alarms command displays alarms, refer to the System Troubleshooting section of this manual for corrective actions.

9. At the BRC> prompt, type: **dekey**

This command stops all RF transmission.

```
BRC> dekey
completed successfully
```

10. Repeat this procedure for each Base Radio at the site.

11. Disconnect all test equipment at the completion of the procedure.

Viewing the Transmit Spectrum (optional)

The transmit spectrum can be viewed on the R2660 service monitor. Perform the following procedure to view the transmitted signal spectrum.

NOTE

The following procedure assumes the use of a 70 W Power Amplifier. If the Base Radio under test contains a 40 W Power Amplifier, substitute 40 instead of 70 in the following examples.

1. Set the R2660 to the Spectrum Analyzer Mode.
2. Connect a whip antenna to the RF IN / OUT connector on the R2660.

CAUTION

This command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into a dummy load.

Attempting to key a 40W station to an output power greater than 40W will damage the Power Amplifier.

3. At the BRC> prompt, type: **set tx_power 70**

   This command sets the transmitter output to 70 Watts.

```
BRC> set tx_power 70
setting transmitter power to 70 watts

TXLIN ATTENUATION: 5.000000


TARGET POWER: 70.00 watts [48.45 dbm]
ACTUAL POWER: 56.70 watts [47.54 dbm]
POWER WINDOW: 66.85 -> 73.30 watts [48.25 -> 48.65 dbm]
TXLIN LEVEL REGISTER REDUCED 83 STEPS [ -3.32 db].
TXLIN LEVEL: 0x55

completed successfully
```

Figure 6-2 shows the transmitted signal on the Spectrum Analyzer.

4. At the BRC> prompt, type: **dekey**

This command stops all RF transmission.

```
BRC> dekey
XMIT OFF INITIATED
```

5. Repeat this procedure for each Base Radio.

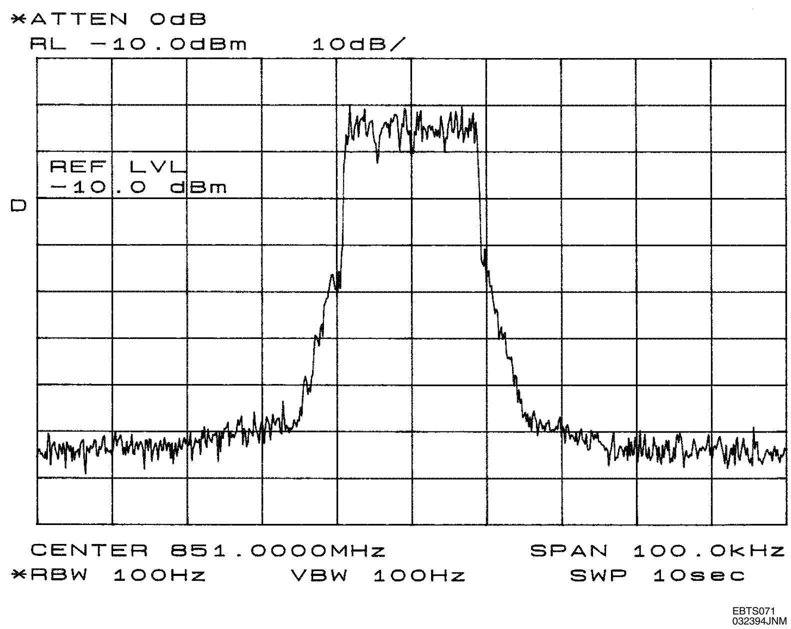


Figure 6-2 ***Spectrum Analyzer Display of Transmitted Signal (800 MHz Base Radio)***

This Page Intentionally

Left Blank

MOTOROLA

Chapter 7 System Troubleshooting

Overview

This chapter provides troubleshooting procedures for the Base Radio and RFDS of the Outdoor SRSC.

The topics of this chapter are listed in the following table.

Troubleshooting

The fault indications identified in this chapter provide a guide for isolating failures to a Field Replaceable Unit (FRU).

Perform troubleshooting whenever a failure occurs during normal operation that cannot be resolved by the Operations and Maintenance Center (OMC).

Base Radio Fault Indications

The built-in system troubleshooting intelligence is mainly accessed through the Base Radio(s) LED and Man-Machine Interface (MMI) status and fault indications.

In the event of a failure, the Base Radio indications should always be checked first, in the order set forth in this chapter.

Some indications list several possible failures along with corresponding corrective actions. If a failure is isolated to the FRU level, the suspected module should be replaced with a new one. This restores the system to normal operation as quickly as possible.

Suspected FRUs should be shipped to the appropriate Motorola repair depot for repair.

Base Radio Receiver System Troubleshooting

This section provide procedures for fault-isolating receiver BER faults detected during the “BER Floor and Sensitivity Verification” procedure in the *System Testing* section of this manual. The procedures in this section can fault-isolate the problem to either a receiver module FRU or other causes within the RFDS.

RF Distribution System Troubleshooting

This section provide procedures for fault-isolating RFDS power failures and alarm indications.

Miscellaneous Troubleshooting

The Miscellaneous Troubleshooting instructions provide a quick reference for solving nonspecific system problems.

Base Radio Fault Indications/ Isolation

NOTE

MMI commands listed here are Base Radio MMI commands, unless otherwise noted.

NOTE

When servicing Base Radios (BRs), in situations where the Control Board or the entire BR is replaced, the integrated Site Controller (iSC) will automatically reboot the serviced BR given that the BR has been off-line for a period not less than that stipulated by the "Replacement BRC Accept Timer" (default is 3 minutes). If the BR is turned on prior to the expiration of the "Replacement BRC Accept Timer", power the BR back down and wait the minimum timer length before turning the BR back on.

Indication	Possible Failure	Corrective Action
BR LED (green) is not lit	Base Radio (BR) Power Supply module power switch is off	Set power switch to ON position
	No power to BR	• Verify appropriate breaker is on • Verify Power Supply switch is on • Verify power cabling from breaker panel to BR • Verify power (voltage and polarity) to BR • Check if Power Amp fans are on • Check if other LEDs are lit • Check LEDs on Power Supply • Check for other alarm conditions by executing **get_alarms** MMI command • Replace BR Power Supply module

Base Radio Fault Indications/Isolation

Indication	Possible Failure	Corrective Action
BR LED (green) is not lit (continued)	BR waiting for registration	• Verify Ethernet cabling to iSC • Verify Ethernet properly terminated • Verify iSC successfully downloaded • Verify proper Ethernet address by executing **get enet_id** MMI command • Verify proper cabinet and position settings by executing **get_cabinet and get_position** MMI command • Check for other alarm conditions by executing **get_alarms** MMI command • Reset BR • Replace BRC module
	BRC / display board failure	• Verify communication through local port • Check for other alarm conditions by executing **get_alarms** MMI command • Reset BR and verify if LEDs initially blink 3 times • Check ribbon cable between display board and BRC board • Replace BRC module
	BR out of service	• Check if other LEDs are lit • Check for other alarm conditions by executing **get_alarms** MMI command • Correct service affecting problem
PS LED (red) is lit	Major BR Power Supply alarm	• Identify alarm condition by executing **get_alarms** BR MMI command • Verify stability and presence of input power • Verify 28.6 Vdc by executing **get ps_ad0** MMI command • Verify 14.2 Vdc by executing **get ps_ad1** MMI command • Verify 5.1 Vdc by executing **get ps_ad2** MMI command • Replace BR Power Supply module
	BRC / display board failure	• Verify communication through local port • Check for other alarm conditions by executing **get_alarms** MMI command • Reset BR and verify all LEDs flash 3 times upon power-up • Check ribbon cable between display board and BRC board • Replace BRC module
	Short circuit on another module	• Check for other alarm conditions by executing **get_alarms** MMI command • Isolate short circuit by removing other FRUs • Replace faulty FRU

Indication	Possible Failure	Corrective Action
PS LED (red) is flashing	Minor BR Power Supply alarm	• Identify alarm condition by executing **get_alarms** MMI command • Verify stability and presence of input power • Replace BR Power Supply module, as required
EX LED (red) is lit	Major Exciter alarm	• Identify alarm condition by executing **get_alarms** MMI command • Verify proper 5 MHz / 1 PPS cabling • Verify 5 MHz / 1 PPS properly terminated • Verify correct transmit frequency by executing **get tx _freq** MMI command • Verify proper Exciter / PA feedback cabling • Replace Exciter module
	BRC / display board failure	• Verify communication through local port • Check for other alarm conditions by executing **get_alarms** MMI command • Reset BR and verify if LEDs initially blink 3 times • Check ribbon cable between display board and BRC board • Check BR DSP by executing **get tx_sanity** MMI command • Replace BRC module
	Receiver module(s) failure	• Check if other LEDs are lit • Check for other alarm conditions by executing **get_alarms** MMI command • Verify correct receive frequency by executing **get rx_freq** MMI command • Replace Receiver module
	Power Amplifier failure	• Remove PA and turn on BR • Check for other (non-PA) alarm conditions • Replace Power Amplifier module
	SRI failure	• Verify proper 5 MHz/1 PPS cabling • Verify 5 MHz/1 PPS is properly terminated
EX LED (red) is flashing	Minor Exciter alarm	• Identify alarm condition by executing **get_alarms** MMI command • Reset the BR • Replace Exciter module, as required

Base Radio Fault Indications/Isolation

Indication	Possible Failure	Corrective Action
PA LED (red) is lit	Major Power Amplifier alarm	• Identify alarm condition by executing **get_alarms** MMI command • Verify output is properly terminated • Verify all PA fans are operational • Verify output cabling integrity • Replace Power Amplifier module
	BRC / display board failure	• Verify communication through local port • Check for other alarm conditions by executing **get_alarms** MMI command • Reset BR and verify if LEDs initially blink 3 times • Check ribbon cable between display board and BRC board • Replace BRC module
PA LED (red) is flashing	Minor Power Amplifier alarm	• Identify alarm condition by executing **get_alarms** MMI command • PA is in a rollback condition • Verify proper site environmental conditions • Verify proper air flow to PA module • Reset the BR • Replace the PA, as required
CTL LED (red) is lit	Major BRC alarm	• Verify communication through local port • Identify alarm condition by executing **get_alarms** MMI command • Verify all external station connections • Reset the BR and view self test results • Replace BRC module
	BRC display board failure	• Verify communication through local port • Check for other alarm conditions by executing **get_alarms** MMI command • Reset BR and verify if LEDs initially blink 3 times • Check ribbon cable between display board and BRC board • Replace BRC module
CTL LED (red) is flashing	Minor BRC alarm	• Identify alarm condition by executing **get_alarms** MMI command • Verify all external station connections • Verify all external station cabling integrity • Verify 5 MHz / 1 PPS properly terminated • Verify presence of 5 MHz / 1 PPS • Replace BRC module, as required

Indication	Possible Failure	Corrective Action
R1, R2, or R3 LED (red) is lit	Major Receiver alarm	• Identify alarm condition by executing **get_alarms** MMI command • Verify proper 5 MHz / 1 PPS cabling • Verify 5 MHz / 1 PPS properly terminated • Verify correct receive frequency by executing **get rx_freq** MMI command • Verify proper antenna cabling to receiver • Verify input antenna cabling integrity • Verify antenna integrity • Verify RFDS breakers are ON • Check for RFDS alarms by executing **status_eas** MMI command • Reset RFDS fuse(s) • Replace Receiver module
	BRC / display board failure	• Verify communication through local port • Check for other alarm conditions by executing **get_alarms** MMI command • Reset BR and verify if LEDs initially blink 3 times • Check ribbon cable between display board and BRC board • Check BR DSP by executing **get rx_sanity** MMI command • Replace BRC module
R1, R2, or R3 LED (red) is flashing	Minor Receiver alarm	• Identify alarm condition by executing **get_alarms** MMI command • Reset the BR • Replace 3X Receiver module, as required

Excessive BER Fault Isolation

The following procedures fault isolate excessive BER readings between a Base Radio or other receiver system problems. In this manner, the element causing an excessive BER can be isolated through elimination.

Except where noted, this procedure uses the same test setup as shown in Figure 1 in the *System Testing* section of this manual.

As a general rule, compare the failed BER tests to look for a common failure cause.

❒ If one or more RX branches consistently fail on **more than one BR,** the problem is **most likely** related to a common Rx element such as the multicoupler / LNA or cabling common to that particular path. Perform the following:

  ❍ Check cabling and replace as required.

  ❍ Check multicoupler / LNA and replace as required.

❒ If excessive BER reading(s) in **any** number of receivers appear with **no common pattern**, the fault may be directly related to the corresponding receivers, or to some other element within the receiver system; further testing as provided below is required.

Field Procedure

The procedure below verifies acceptable Base Radio receiver BER and sensitivity. On receiver paths where excessive BER was noted, perform the following procedure.

NOTE

Following any repair or module replacement, the Base Radio and RFDS Verification procedures (*System Testing* section of this manual) should be repeated.

1. On receiver where excessive BER was noted, disconnect the Rx cable from the corresponding rear panel **RX** connector.
2. Connect the Calibrated Test Cable to the **RX** connector on Base Radio.
3. Connect the service computer to the local service port of the Base Radio and log on.

4. Adjust R2660 output level for an output level **at the end of the cable feeding the Base Radio** as follows:

Base Radio	Required Level at cable end
800 MHz	–108.0 dBm

4.1 Note the tagged calibrated loss value of the Calibrated Test Cable.

4.2 Calculate the required R2660 output level to produce the required Base Radio signal level as follows:

800 MHz Base Radio:
(–108.0 dBm) + Calibrated cable loss= Required R2660 Output Level
EXAMPLE: **(–108.0) + (1.7)= –106.3 dBm**

4.3 While observing R2660 Output Level display, set the R2660 for an output level as determined above.

5. At the BRC> prompt, type: **get rssi 2 100**

This will generate two lines of printout showing the Bit Error Rate (BER) averaged over 100 readings.

- If BER is **greater than 8% (8.0e - 00%)**, proceed to step 6.
- If BER is **8% (8.0e - 00%) or less**, proceed to step 9.

```
BRC> get rssi 2 100
Starting RSSI monitor for 2 repetitions averaged each 100 reports.

 Line  RSSI1  RSSI2  RSSI3  SGC  DIVBER          SyncMiss
        dBm    dBm    dBm    dB  dBm%            %
 ----  -----  -----  -----  ---- --------------  ---------
 100   -108.0                0.0 1.942e+00       0.000e+00
 200   -108.0                0.0 1.068e+00       0.000e+00
```

6. Increase the R2260 output level by 2 dB.

7. At the BRC> prompt, again type: **get rssi 2 100**

8. Observe BER results and proceed as follows:
   - If BER is still **greater than 8% (8.0e - 00%)**, Base Radio **receiver module is defective**. Return module to depot for repair.
   - If BER is now **8% (8.0e - 00%) or less**, field measurement cannot positively resolve BER failure condition within EBTS equipment. Proceed to Resolving Unclear BER Pass/Fail Indications instructions below.
9. Reconnect the Rx cabinet cable to Base Radio **RX** input. Reconnect the Calibrated Test Cable to the antenna port that feeds the receiver being tested.
10. Adjust R2660 output level for an output level **at the end of the cable feeding the EBTS** as follows:

Base Radio	Required Level at cable end
800 MHz	–111.5 dBm

800 MHz Duplexed RFDS:
(–111.5 dBm) + Calibrated cable loss= Required R2660 Output Level
EXAMPLE: **(–111.5) + (1.7)= –109.8 dBm**

11. At the BRC> prompt, again type: **`get rssi 2 100`**
12. Observe BER results and proceed as follows:
   - If BER is still **8% (8.0e - 00%) or less**, field measurement cannot positively resolve BER failure condition within EBTS equipment. Proceed to Resolving Unclear BER Pass/Fail Indications instructions below.
   - If BER is now **greater than 8% (8.0e - 00%), while other receivers pass without requiring the level increase in step 10 above,** cabling to the Base Radio RX input should be checked and replaced, as required.

Resolving Unclear BER Pass/Fail Indications

In cases where an unclear or marginal pass/fail indications appears (failing at the initial cabinet test signal level, then passing with a small signal level increase), this indicates a functional receive system that is being pulled close to unacceptable BER by one or more reasons. These reasons include:

- ❒ Several elements within the receive system (RFDS, cabling, and / or receiver module) are within their lower operational pass limits. The cumulative effect of this sometimes results in marginal BER readings, thereby requiring critical test precision and accuracy to rule out testing error as an erroneous cause for rejection.
- ❒ A problem specific to a site, such as interference.

As in any field situation, the foremost concern is getting the Base Radio up and operational. Perform the following steps to provide immediate corrective action at the field level:

1. Replace the receiver module FRU.
2. Repeat the BER Floor and Sensitivity Verification procedure (*System Testing* section of this manual).
3. Depending on the test results, proceed as follows:
    - If receive path BER is now OK, no further field actions are required. See Dispositioning of Receiver Modules instructions below.
    - If receive path BER still indicates unclear pass / fail indications or failure, the problem is **not related to receiver module**. Replace the receiver module with the original module and return the second module to spares. Refer to Miscellaneous Troubleshooting instructions in this section.

Dispositioning of Receiver Modules

Before a receiver module is to be returned as “defective”, it is recommended that higher-precision shop testing be performed on the receiver module in accordance with Appendix C – Optional High Precision Receiver BER Testing. The tests in this appendix can positively resolve whether or not a Base Radio receiver module meets factory BER / sensitivity specifications.

This test is also useful in determining the cause of unclear pass / fail indications, as it can positively determine whether or not a receiver module is contributing to a failure.

RF Distribution System Fault Isolation

! WARNING !

ON GEN 4 DUPLEXED RFDS, COMBINER AND/OR ISOLATOR DECK SURFACES ARE HOT. CONTACT CAN CAUSE BURNS. ALLOW DECK SURFACE TO COOL BEFORE TOUCHING.

Indication	Possible Failure	Corrective Action
RFDS circuit breaker alarm	Breaker in RFDS tripped or in OFF position	• Verify that ALL breakers in RFDS are in the ON position • Identify any tripped breakers and replace faulty FRU, if necessary • Verify correct breaker panel cabling
	Faulty alarm cable	• Identify other RFDS alarms by executing **display_eas** MMI command • Verify correct alarm cabling • Verify cabling integrity • Replace alarm cable, if appropriate
	No power to breaker panel	• Verify power cabling to the breaker panel • Verify power (level and polarity) to breaker panel
	Breaker panel failure	• Verify that ALL breakers in RFDS are in the ON position • Identify any tripped breakers and replace faulty FRU, if necessary • Verify correct breaker panel cabling • Verify power cabling to the breaker panel • Verify power (level and polarity) to breaker panel • Replace breaker panel

Indication	Possible Failure	Corrective Action
RFDS multicoupler amplifier alarm	No power to RFDS	• Verify that both breakers for RFS are ON • Verify either LED on RFDS Power Supply FRU is lit (On GEN 4 and 900 MHz RFDS, verify RFDS power by checking that fans in combiner or isolator deck are operating.) • Verify power cabling to RFDS
	Low noise (multicoupler) amplifier failure	• Check the resettable fuse, reset if necessary • Replace the low noise amplifier FRU
	Tripped or faulty resettable fuse	• Check the resettable fuse, reset if necessary • Replace RFDS, if appropriate
	Faulty alarm cable	• Identify other RFDS alarms by executing **display_eas** MMI command • Verify correct alarm cabling • Verify cabling integrity • Replace alarm cable, if appropriate
RFDS multicoupler power supply alarm	RFDS Power Supply FRU failure	• Verify that both breakers for RFS are ON • Verify if Power Supply LEDs are lit. (On GEN 4 and 900 MHz RFDS, verify RFDS power by checking that fans in combiner or isolator deck are operating.) • Replace RFDS Power Supply FRU
	No power to RFDS	• Verify that both breakers for RFS are ON • Verify either green LED on RFDS Power Supply FRU is lit. (On GEN 4 and 900 MHz RFDS, verify RFDS power by checking that fans in combiner or isolator deck are operating.) • Verify power cabling to RFDS
	Faulty alarm cable	• Identify other RFDS alarms by executing **display_eas** MMI command • Verify correct alarm cabling • Verify cabling integrity • Replace alarm cable, if appropriate

RF Distribution System Fault Isolation

Indication	Possible Failure	Corrective Action
RFDS tower top amplifier alarm	No power to RFDS	• Verify that both breakers for RFS are ON
		• Verify either LED on RFDS Power Supply FRU is lit. (On GEN 4 and 900 MHz RFDS, verify RFDS power by checking that fans in combiner or isolator deck are operating.)
		• Verify power cabling to RFDS
	Tower top amplifier failure	• Verify power to tower top amplifier
		• On RFDS Power Supply Tray equipped with Reset switch, actuate Reset switch
		• Test functionality of tower top amplifier through test port connection
		• Replace tower top amplifier
	No power to tower top amplifier	• Verify that both breakers for RFS are ON
		• Verify either LED on RFDS Power Supply FRU is lit. (On GEN 4 and 900 MHz RFDS, verify RFDS power by checking that fans in combiner or isolator deck are operating.)
		• Verify Tower Amp cabling to DC injector
		• Verify DC power to Tower Amplifier from the Power Supply Tray
		• On RFDS Power Supply Tray equipped with Reset switch, actuate Reset switch
		• Verify RF cabling to tower top amplifier
	Faulty alarm cable	• Identify other RFDS alarms by executing **display_eas** MMI command
		• Verify correct alarm cabling
		• Verify cabling integrity
		• Replace alarm cable, if appropriate
	DC injector failure	• Check all DC injectors for short between DC injection port and ground. Replace as required. (This failure is especially evident following a lightning strike.)

Miscellaneous Troubleshooting

Indication	Possible Failure	Corrective Action
No communication from OMC	Open or disconnected T1 line	• Check for open or disconnected T1 line
No over-the-air communication	Open Ethernet cable, or missing termination of Ethernet cable	• Verify no open or damaged Ethernet cable, or missing termination
	iSC failure	• Refer to iSC Supplement manual
	Open or damaged BR antenna, lead-in, or surge arrestor	• Verify no open or damaged BR antenna, lead-in or surge arrestor
No internal site communication (Ethernet)	Open Ethernet cable, missing termination of Ethernet cable	• Verify no open or damage to Ethernet cable, or missing termination
	iSC failure	• Refer to iSC Supplement manual.
Transmissions bad or unusable	Open or damaged BR antenna, lead-in, or surge arrestor	• Verify no open or damaged BR antenna, lead-in, or surge arrestor
Marginal receiver system BER	• EBTS receive system degradation	• Check RFDS receive hardware (through tests and / or substitution) and replace, as required **NOTE:** If problem is common to a certain Rx branch, Rx items in that path should be highly suspected. Check items and replace, as required.
	• Base Radio problem	• If, through substitution and process of elimination, repeated receiver module replacement on a Base Radio does not solve problem, Base Radio may need repair.
	• Interference / spurious response conditions caused by ambient high-level EMI sources (such as radio transmitters or telephony repeaters).	• Analyze field space RF spectrum within site. Correct as required.
Bad VSWR reported	Open or damaged BR antenna, lead-in, or surge arrestor	• Verify no open or damage to BR antenna, lead-in, or surge arrestor
Entire site off air after several hours	AC Power failure	• Verify AC input
Site power supply system alarms	Defective rectifier module	• Check for illuminated MODULE ALARM indication on Rectifier Module(s). Replace modules as required.
	Improper power supply system threshold settings	• Measure power supply system float and threshold parameters. Adjust as required. (Refer to *Final Checkout* section of this manual for power supply system checkout and setup.) **NOTE:** Refer to "Replacement of AC/DC Power System FRUs" (*AC / DC Power System* section of this manual) for maintenance instructions.

This Page Intentionally

Left Blank

MOTOROLA

Chapter 8
Software Commands

Overview

This section provides definitions for the Man-Machine-Interface (MMI) commands. MMI commands are used to test and configure the EBTS equipment via a service computer. Two command sets are used to accomplish this; the integrated Site Controller (iSC) command set and Base Radio (BR) command set.

The iSC command set is described in detail in the iSC Supplement to this manual. Base radio commands are described herein.

The following table lists the chapter topics.

MMI Commands

This section describes all MMI commands pertaining to the Base Radios. All valid commands are described, along with the syntax, definitions, and examples.

MMI commands are input from a service computer to the system RS-232 serial port (19200 bps, 8 data bits, 1 stop bit, no parity). The RS-232 is accessed from the iSC, or from the front of each BRC in the RF Cabinet.

The test procedure for the Base Radio uses these commands to test and configure the system. Refer to the Base Radio section of this manual for the Base Radio test procedures.

This section covers Base Radio MMI commands only; refer to the iSC Supplement to this manual for a complete description of all MMI commands pertaining to the iSC.

Access Level

The Base Radio commands are available through the use of the password: **motorola**. This password allows the service technician access to a subset of the MMI command set. This subset is used for field service and does not allow permanent configuration of the Base Radio.

NOTE

The **motorola** password is a default password that is programmed during manufacturing. The password may be changed by the Operations and Maintenance Center (OMC).

Most of the commands are valid only while the Base Radio is in the test mode. The configuration data is temporarily stored in RAM until the Base Radio is taken out of the test mode. Most MMI commands do not allow the configuration data to be permanently stored in EEPROM, although a limited number do. Commands that allow configuration data to be changed are noted.

Conventions

All Base Radio MMI commands are presented in alphabetical order. The command syntax is case sensitive. The syntax for each command is presented as follows:

- plain text shows the actual text to be typed to invoke a command or action
- *italic* text shows where a parameter or value is to be substituted
- text enclosed in brackets [ ] indicates an optional value that may be entered.

- ❐ Where items are separated by vertical bars | , the items are the applicable choices that may be entered
- ❐ text enclosed in braces { } indicates a corresponding selection or parameter that **must** be entered for the command to execute
- ❐ A series of dots ... indicates one or more occurrences of a preceding parameter

The syntax for the BR commands is case sensitive. Each example is shown in the format that should be entered by the operator.

Some commands require the use of parameters. If input parameters are not entered, a response is returned identifying the proper syntax for the command.

A definition describes in detail each command's purpose and function. Where helpful, the definition is followed by an example of the commands response. Typical values have been used whenever possible.

Some commands return varying responses (such as available, not available, unknown, o.k., and alarm). Only one of the possible responses is listed in each example.

Base Radio Commands

DEKEY

Syntax:

dekey

The **dekey** command stops all RF transmission.

After the command is entered, an indication of a successful transmission stop is returned.

Example:

```
BRC> dekey
XMIT OFF INITIATED
```

GET ALARMS

Syntax:

get alarms

The **get alarms** command returns Base Radio alarm conditions.

Example:

If alarm conditions exist, all active alarms are returned.

```
BRC> get alarms
[brc fru warning]
[external reference failure]
[gps failure]
```

If no alarm conditions exist, a message is returned indicating alarms have not been detected.

```
BRC> get alarms
NO ALARM CONDITIONS DETECTED.
```

GET ALARM_MASK

Syntax:

get alarm_mask

The **get alarm_mask** command returns twelve, 1-byte hexadecimal fields. These bytes represent which alarms are enabled or disabled.

ff indicates that all alarms covered by that byte are enabled.

Example:

```
BRC> get alarm_mask
 ALARM MASK is |ff|ff|ff|ff|ff|ff|ff|ff|ff|ff|ff|ff|ff|ff|ff|ff|
```

GET ALARM_REPORTS

Syntax:

get alarm_reports

The **get alarm_reports** command returns the enabled / disabled status of the alarm reports.

Example:

```
BRC> get alarm_reports
 ALARM REPORTS: TRACE is ENABLED
```

GET BRC_KIT_NO

Syntax:

get brc_kit_no

The **get brc_kit_no** command returns the kit number of the Base Radio Controller (BRC) module.

Example:

```
BRC> get brc_kit_no
BRC KIT NUMBER is TRN7515A
```

GET BRC_REV_NO

Syntax:

get brc_rev_no

The **get brc_rev_no** command returns the hardware revision number of the BRC module.

Example:

```
BRC> get brc_rev_no
BRC REVISION NUMBER is RXX.XX.XX
```

GET BRC_SCRATCH

Syntax:

get brc_scratch

The **get brc_scratch** command reads the allocated EEPROM field reserved for a scratch pad on the BRC module.

Example:

```
BRC> get brc_scratch
BRC SCRATCH is Motorola, Inc.
```

GET CABINET

Syntax:

get cabinet

The **get cabinet** command returns the cabinet in which the current Base Radio resides.

Example:

```
BRC> get cabinet
CABINET is 1
```

GET DEFAULT_TX_POWER

Syntax:

get default_tx_power

The **get default_tx_power** command returns the default transmit operating power level. The value is returned in Watts and dBm.

Example:

```
BRC> get default_tx_power
DEFAULT TRANSMITTER POWER is 50.00 watts (46.99 dBm)
```

GET ENET_ID

Syntax:

get enet_id

The **get enet_id** command returns the Ethernet address for the current BRC.

Example:

```
BRC> get enet_id
BRC ETHERNET ADDRESS is 08 00 3E C0 02 C8
```

GET EXCITER_SCALING_FACTOR

Syntax:

get exciter_scaling_factor {*port: 0->11*}

The **get exciter_scaling_factor** command returns the scaling factor for a specified Exciter module A/D port.

Example:

```
BRC> get exciter_scaling_factor 1
EXCITER SCALING FACTOR 1 is 1.000000
```

GET EXT_REF

Syntax:

get ext_ref

The **get ext_ref** command returns the current enabled / disabled state of phase locking circuit on the BRC.

Example:

```
BRC> get ext_ref
EXTERNAL REFERENCE is ENABLED
```

GET EX_AD

Syntax:

get ex_ad [*port: 0 -> 11*]

The **get ex_ad** command returns the current hexadecimal value of all A / D ports on the Exciter module with their interpreted voltages.

If the variable for the port number is not entered, the current value of all ports are returned.

Example:

```
BRC> get ex_ad
EXCITER A->D PORT[0] = 0x6c   [14.24v].
EXCITER A->D PORT[1] = 0x0    [0.00v].
EXCITER A->D PORT[2] = 0xa7   [10.21v].
EXCITER A->D PORT[3] = 0xff   [4.98v].
EXCITER A->D PORT[4] = 0x7c   [4.84v].
EXCITER A->D PORT[5] = 0x39   [1.04v].
EXCITER A->D PORT[6] = 0x52   [1.58v].
EXCITER A->D PORT[7] = 0x78   [6.42v].
EXCITER A->D PORT[8] = 0x81   [5.04v].
EXCITER A->D PORT[9] = 0x0    [0.00v].
EXCITER A->D PORT[10] = 0x0   [0.00v].
```

GET EX_KIT_NO

Syntax:

get ex_kit_no

The **get ex_kit_no** command returns the kit number of the Exciter module.

Example:

```
BRC> get ex_kit_no
EXCITER KIT NUMBER is TLF7000A
```

GET EX_REV_NO

Syntax:

get ex_rev_no

The **get ex_rev_no** command returns the hardware revision number of the Exciter module.

Example:

```
BRC> get ex_rev_no
EXCITER REVISION NUMBER is Rxx.xx.xx
```

GET EX_SCRATCH

Syntax:

get ex_scratch

The **get ex_scratch** command reads the allocated EEPROM field reserved for the scratch pad on the Exciter module.

Example:

```
BRC> get ex_scratch
EXCITER SCRATCH is Motorola, Inc.
```

GET FWD_PWR

Syntax:

get fwd_pwr

The **get fwd_pwr** command returns the current value of forward power. This reading is taken from the built-in power meter of the RF Power Amplifier module. The results are returned in Watts and dBm.

This command should be used only when the transmitter is keyed to obtain accurate results.

Example:

```
BRC> get fwd_pwr
FORWARD POWER is 66.32 watts [48.22 dbm]
```

GET FWD_WATTMETER_SCALING_FACTOR

Syntax:

get fwd_wattmeter_scaling_factor

The **get fwd_wattmeter_scaling_factor** command returns the linear multiplier used to derive the forward power level from the external wattmeter located in the RFDS, if applicable.

Example:

```
BRC> get fwd_wattmeter_scaling_factor
FORWARD POWER WATTMETER SCALING FACTOR is 52.00
```

GET K_FACTOR

Syntax:

get k_factor

The **get k_factor** command returns the current operational k_factor value.

Example:

```
BRC> get k_factor
K FACTOR is 0.85000000
```

GET MAX_VSWR

Syntax:

get max_vswr

The **get max_vswr** command returns the maximum Voltage Standing Wave Ratio (VSWR) before an alarm is triggered, as measured by the external wattmeter located in the RFDS, if applicable.

Example:

```
BRC>get max_vswr
MAXIMUM VSWR is 4.00:1
```

GET MAX_WATTMETER_VSWR

Syntax:

get max_wattmeter_vswr

The **get max_wattmeter_vswr** command returns the maximum VSWR before an alarm is triggered, as measured by the built-in power meters of the RF Power Amplifier module.

Example:

```
BRC>get max_wattmeter_vswr
MAXIMUM VSWR AT WATTMETER: 4.00:1
```

GET PA_AD

Syntax:

get pa_ad [*port: 0 -> 11*]

The **get pa_ad** command returns the current hexadecimal value of all A/D ports on the Power Amplifier module with their interpreted voltages.

If the variable for the port number is not entered, the current value of all ports are returned.

Example:

```
BRC> get pa_ad
PA A->D PORT[0] = 0x0        [0.00v].
PA A->D PORT[1] = 0x0        [0.00v].
PA A->D PORT[2] = 0x2        [0.04v].
PA A->D PORT[3] = 0x7b       [2.40v].
PA A->D PORT[4] = 0xb        [0.21v].
PA A->D PORT[5] = 0xb        [0.21v].
PA A->D PORT[6] = 0x6        [0.06v].
PA A->D PORT[7] = 0x8        [0.06v].
PA A->D PORT[8] = 0xb        [0.21v].
PA A->D PORT[9] = 0x80       [2.50v].
PA A->D PORT[10] = 0x8       [0.06v].
```

GET PA_COEF

Syntax:

get pa_coef

The **get pa_coef** command returns the Power Amplifier coefficients. These values are determined and programmed during manufacturing.

Example:

```
BRC> get pa_coef
***AT AND BELOW 858.500 MHz***
PA COEFFICIENT FACTOR A: 0.04900
PA COEFFICIENT FACTOR B: 3.04000
PA COEFFICIENT FACTOR C: 3.66000

***ABOVE 858.500 MHz***
PA COEFFICIENT FACTOR D: 0.00300
PA COEFFICIENT FACTOR E: 3.37000
PA COEFFICIENT FACTOR F: 3.73000
```

GET PA_KIT_NO

Syntax:

get pa_kit_no

The **get pa_kit_no** command returns the kit number of the Power Amplifier module.

Example:

```
BRC> get pa_kit_no
POWER AMPLIFIER KIT NUMBER is TRN7713A
```

GET PA_REV_NO

Syntax:

get pa_rev_no

The **get pa_rev_no** command returns the hardware revision number of the Power Amplifier module.

Example:

```
BRC> get pa_rev_no
POWER AMPLIFIER REVISION NUMBER is RXX.XX.XX
```

GET PA_SCALING_FACTOR

Syntax:

get pa_scaling_factor *{port: 0->11}*

The **get pa_scaling_factor** command returns the scaling factor for a specified Power Amplifier module A/D port.

Example:

```
BRC> get pa_scaling_factor 1
POWER AMPLIFIER SCALING FACTOR 1 is 1.000000
```

GET PA_SCRATCH

Syntax:

get pa_scratch

The **get pa_scratch** command reads the allocated EEPROM field reserved for the scratch pad on the Power Amplifier module.

Example:

```
BRC> get pa_scratch
POWER AMPLIFIER SCRATCH PAD is Motorola, Inc.
```

GET PCTRL

Syntax:

get pctrl

The **get pctrl** command returns the current enabled / disabled state of the power leveling functionality of the Base Radio.

Example:

```
BRC> get pctrl
POWER CONTROL is ENABLED
```

GET PEND

Syntax:

get pend

The **get pend** command returns the current warp value setting and the internal temperature of the pendulum IC.

Example:

```
BRC> get pend
PENDULUM WARP is 0x94
PENDULUM TEMPERATURE is +33 C
```

GET PEND_LOCK

Syntax:

get pend_lock

The **get pend_lock** command returns the current locked / unlocked status of the pendulum lock bit.

Example:

```
BRC> get pend_lock
PENDULUM is LOCKED
```

GET POSITION

Syntax:

get position

The **get position** command returns the position number of where the current Base Radio is mounted within a selected cabinet. This *does not* represent the cabinet in which the Base Radio resides.

Example:

```
BRC> get position
POSITION is 2
```

GET PS_AD

Syntax:

get ps_ad [*port: 0* -> *11*]

The **get ps_ad** command returns the current hexadecimal value of all A/D ports on the Power Supply module with their interpreted voltages.

If the variable for the port number is not entered, the current value of all ports are returned.

Example:

```
BRC> get ps_ad
PWR SUPPLY A->D PORT[0] = 0xed          [28.28v].
PWR SUPPLY A->D PORT[1] = 0xe3          [14.23v].
PWR SUPPLY A->D PORT[2] = 0xd6          [5.08v].
PWR SUPPLY A->D PORT[3] = 0xea          [4.57v].
PWR SUPPLY A->D PORT[4] = 0x5           [0.10v].
PWR SUPPLY A->D PORT[5] = 0xde          [4.34v].
PWR SUPPLY A->D PORT[6] = 0x92          [2.83v].
PWR SUPPLY A->D PORT[7] = 0xff          [4.98v].
PWR SUPPLY A->D PORT[8] = 0xfe          [4.90v].
PWR SUPPLY A->D PORT[9] = 0xff          [4.98v].
PWR SUPPLY A->D PORT[10] = 0x0          [0.00v].
```

GET REF_PWR

Syntax:

get ref_pwr

The **get ref_pwr** command returns the current value of reflected power. This reading is taken from the built-in power meter of the RF Power Amplifier module. The results are returned in Watts and dBm.

This command should only be used when the transmitter is keyed to obtain accurate results.

Example:

```
BRC> get ref_pwr
REFLECTED POWER is 1.50 watts [31.75 dbm]
```

GET REF_WATTMETER_SCALING_FACTOR

Syntax:

get ref_wattmeter_scaling_factor

The **get ref_wattmeter_scaling_factor** command returns the linear multiplier used to derive the reflected power level from the external wattmeter located in the RFDS, if applicable.

Example:

```
BRC> get ref_wattmeter_scaling_factor
REFLECTED POWER WATTMETER SCALING FACTOR is 52.00
```

GET ROM_VER

Syntax:

get rom_ver

The **get rom_ver** command returns the current software version stored in firmware on the BRC module.

Example:

```
BRC> get rom_ver
BRC ROM VERSION is RXX.XX.XX
```

GET RPTR_STATUS

Syntax:

get rptr_status

The **get rptr_status** command returns the overall status of the repeater.

Example:

```
BRC> get rptr_status
BRC HOST CODE VERSION is Rxx.xx.xx
BRC FIRMWARE VERSION is Rxx.xx.xx

BRC REVISION is Rxx.xx.xx
EXCITER REVISION is Rxx.xx.xx
POWER AMPLIFIER REVISION is Rxx.xx.xx
RECEIVER 1 REVISION is Rxx.xx.xx
RECEIVER 2 REVISION is Rxx.xx.xx
RECEIVER 3 REVISION is Rxx.xx.xx

RECEIVER 1 is PRESENT
RECEIVER 2 is PRESENT
RECEIVER 3 is PRESENT

PENDULUM WARP is 0x94
PENDULUM TEMPERATURE is +33 C
PENDULUM is LOCKED

RECEIVE FREQUENCY is 815.00000 MHz
TRANSMIT FREQUENCY is 859.00000 MHz
TRANSMIT INTERMEDIATE FREQUENCY is 118.50000 MHz.

WINDOW CLIPPING LEVEL is 5.5 db
WINDOW CLIPPING SATURATION LEVEL is 15 db
WINDOW CLIPPING MODE is ENABLED

SOFTWARE GAIN CONTROL is ENABLED
SOFTWARE GAIN CONTROL DELAY is 246 units (2.050000 msec)
EXTERNAL REFERENCE is ENABLED

PERIODIC TRAINING is ENABLED
PERIODIC TRAINING INTERVAL is 30000 units (5 sec)

POWER CONTROL is ENABLED
POWER CONTROL INTERVAL is 90000 units (15 sec)

POWER WATCHDOG is ENABLED

POWER REPORTS TRACE is DISABLED
ALARM REPORTS TRACE is DISABLED
INITILIZATION TRACE is DISABLED
```

GET RSSI

Syntax:

get rssi {*no. of reports*} {*no. of samples*}

The **get rssi** command allows examination of the received RF signal quality of the Base Radio. A performance report is returned including Bit Error Rate (BER), Received Signal Strength Indication (RSSI), frequency offset, and the sync miss rate.

RSSI data is calculated for the specified number of samples. Each sample is averaged over the specified number of reports specified. A report is generated once every 90 msec.

Example:

```
BRC> get rssi 2 100
Starting RSSI monitor for 2 repetitions averaged each 100 reports.

Line  RSSI1   RSSI2   RSSI3  SGC    DIVBER   SyncMiss
       dBm     dBm     dBm    dB    dBm%        %
----  -----   -----   -----  ----   -------------- ---------
  1   -109.1  -127.0  -127.0  0.0   -109.02.942e+000.000e+00
  2   -108.7  -127.0  -127.0  0.0   -109.02.874e+000.000e+00
```

GET RX*(n)*_AD

Syntax:

get rx1_ad [*port: 0 -> 11*]

get rx2_ad [*port: 0 -> 11*]

get rx3_ad [*port: 0 -> 11*]

The **get rx*(n)*_ad** command returns the current hexadecimal value of all A/D ports on the Receiver module with their interpreted voltages.

If the variable for the port number is not entered, the current value of all ports are returned.

Example:

```
BRC> get rx1_ad
RX1 A->D PORT[0] = 0xe0        [9.71v].
RX1 A->D PORT[1] = 0x87        [5.27v].
RX1 A->D PORT[2] = 0xe2        [9.80v].
RX1 A->D PORT[3] = 0xff        [4.98v].
RX1 A->D PORT[4] = 0x7d        [4.88v].
RX1 A->D PORT[5] = 0xe6        [4.49v].
RX1 A->D PORT[6] = 0x57        [1.70v].
RX1 A->D PORT[7] = 0x67        [2.01v].
RX1 A->D PORT[8] = 0x7d        [4.88v].
RX1 A->D PORT[9] = 0xd0        [8.13v].
```

GET RX*(n)*_DELTA

Syntax:

get rx1_delta

get rx2_delta

get rx3_delta

The **get rx(n)_delta** command returns the contents of the RSSI offset value in dBm for a selected receiver. This is a calibrated value that is set during manufacturing.

Example:

```
BRC> get rx1_delta
RECEIVER 1 RECEIVE SIGNAL STRENGTH DELTA is 0.0
```

GET RX*(n)*_KIT_NO

Syntax:

get rx1_kit_no

get rx2_kit_no

get rx3_kit_no

The **get rx*(n)*_kit_no** command returns the kit number of a selected Receiver module.

Example:

```
BRC> get rx1_kit_no
RECEIVER 1 KIT NUMBER is CRF6010A
```

GET RX*(n)*_REV_NO

Syntax:

get rx1_rev_no

get rx2_rev_no

get rx3_rev_no

The **get rx*(n)*_rev_no** command returns the hardware revision number of the specified Receiver module.

Example:

```
BRC> get rx1_rev_no
RECEIVER 1 REVISION NUMBER is RXX.XX.XX
```

GET RX*(n)*_SCALING_FACTOR

Syntax:

get rx1_scaling_factor {*port: 0* -> *11*}

get rx2_scaling_factor {*port: 0* -> *11*}

get rx3_scaling_factor {*port: 0* -> *11*}

The **get rx*(n)*_scaling_factor** command returns the scaling factor for a specified Receiver module A/D port.

Example:

```
BRC> get rx1_scaling_factor 1
RECEIVER 1 SCALING FACTOR 1 is 2.000000
```

GET RX*(n)*_SCRATCH

Syntax:

get rx1_scratch

get rx2_scratch

get rx3_scratch

The **get rx*(n)*_scratch** command reads the allocated EEPROM field reserved for the scratch pad on the specified Receiver module.

Example:

```
BRC> get rx1_scratch
RECEIVER 1 SCRATCH is Motorola, Inc.
```

GET RX_FREQ

Syntax:

get rx_freq

The **get rx_freq** command returns the programmed receiver frequency for the current Base Radio.

Example:

```
BRC>get rx_freq
The RX FREQUENCY is: 806.00000 MHz
```

GET RX_FRU_CONFIG

Syntax:

get rx_fru_config

The **get rx_fru_config** displays the current receiver diversity configuration of a Base Radio.

Example:

```
BRC> get rx_fru_config
RECEIVER CONFIGURATION {RX1 RX2 RX3}
```

GET RX_INJ

Syntax:

get rx_inj

The **get rx_inj** command returns the high/low side injection status of the second Local Oscillator (LO) for all receivers.

Example:

```
BRC> get rx_inj
RECEIVER INJECTION is LOW
```

GET RX_MODE

Syntax:

get rx_mode

The **get rx_mode** command returns the enabled / disabled status of the receiver.

Example:

```
BRC>get rx_mode
RECEIVER 1 is ENABLED
RECEIVER 2 is ENABLED
RECEIVER 3 is ENABLED
```

GET RX_QSIGN

Syntax:

get rx_qsign

The **get rx_qsign** command returns the current Q sign status of the receivers.

Example:

```
BRC> get rx_qsign
RECEIVER Q SIGN is NON-INVERTED
```

GET RX_SANITY

Syntax:

get rx_sanity

The **get rx_sanity** command returns the receive Digital Signal Processor (DSP) operational condition as either passed or failed.

Example:

```
BRC> get rx_sanity
RECEIVE DSP SANITY TEST passed
```

GET RX_STATUS

Syntax:

get rx_status

The **get rx_status** command returns status information of the receivers.

Example:

```
BRC> get rx_status
RECEIVER INJECTION is LOW
BER STATUS is LOCKED
RECEIVER Q SIGN is NON-INVERTED
RECEIVER 1 is ENABLED
RECEIVER 2 is ENABLED
RECEIVER 3 is ENABLED
```

GET RX_VERSION

Syntax:

get rx_version

The **get rx_version** command returns the current RX Digital Signal Processor (DSP) software version.

Example:

```
BRC> get rx_version
RECEIVE DSP VERSION is 251.235
```

GET SGC

Syntax:

get sgc

The **get sgc** command returns the enabled / disabled status of the Software Gain Control (SGC) routine.

Example:

```
BRC> get sgc
SOFTWARE GAIN CONTROL is ENABLED
```

GET SGC_ATTEN

Syntax:

get sgc_atten {*no. of repetitions: 1->10,000*}

The **get sgc_atten** command returns the attenuator values as reported from the Digital Signal Processor (DSP) to the screen for the number of repetitions specified.

Example:

```
BRC> get sgc_atten 10
Starting SGC monitor for 10 repetitions
displays hex number of 2-dB attenuation steps
     0     0     0     0     0     0
     0     0     0     0     0     0
     0     0     0     0     0     0
     0     0     0     0     0     0
     0     0     0     0     0     0
     0     0     0     0     0     0
     0     0     0     0     0     0
     0     0     0     0     0     0
     0     0     0     0     0     0
```

GET SGC_DELAY

Syntax:

get sgc_delay

The **get sgc_delay** command returns the current setting of the delay used by the software gain control routine.

Example:

```
BRC> get sgc_delay
SOFTWARE GAIN CONTROL is 246 UNITS (2.050000 msec)
```

GET SYS_GAIN

Syntax:

get sys_gain

The **get sys_gain** command returns the enabled / disabled status of the system gain factor.

Example:

```
BRC> get sys_gain
SYSTEM GAIN is ENABLED
```

GET TRAINING_INTERVAL

Syntax:

get training_interval

The **get training_interval** command returns the number of timer ticks between training operations.

Example:

```
BRC> get training_interval
TRAINING INTERVAL: is 30000 ticks (5 min)
```

GET TXLIN

Syntax:

get txlin [*register: 0x00 -> 0x1a*]

The **get txlin** command returns the corresponding byte of the tranlin register as mapped into memory.

Example:

```
BRC> get txlin
TXLIN[0x00]: 0x56      TXLIN[0x01]: 0x08TXLIN[0x02]: 0x16
TXLIN[0x03]: 0x29      TXLIN[0x04]: 0xF1TXLIN[0x05]: 0x1E
TXLIN[0x06]: 0x2C      TXLIN[0x07]: 0x00TXLIN[0x08]: 0x3A
TXLIN[0x09]: 0xBB      TXLIN[0x0A]: 0x53TXLIN[0x0B]: 0x80
TXLIN[0x0C]: 0xA3      TXLIN[0x0D]: 0x40TXLIN[0x0E]: 0x20
TXLIN[0x0F]: 0x80      TXLIN[0x10]: 0x38TXLIN[0x11]: 0x4D
TXLIN[0x12]: 0x00      TXLIN[0x13]: 0x1FTXLIN[0x14]: 0x7F
TXLIN[0x15]: 0x13      TXLIN[0x16]: 0xFFTXLIN[0x17]: 0x00
```

GET TXLIN_STAT

Syntax:

get txlin_stat

The **get txlin_stat** command returns the tranlin operational status. The unassigned internal registers with dummy data are polled.

Example:

```
BRC> get txlin_stat
Checksum: 1880
Test Register: 0x1e
Clip Detect Bit OFF
Local Osc. Locked
I - Channel Software Offset Bit set.
Q - Channel Software Offset Bit set.
Level Set  : 0xff
Sine Value : 0x0
Cosine Value: 0x7d
```

GET TX_FREQ

Syntax:

get tx_freq

The **get tx_freq** command returns the programmed transmitter frequency for the current Base Radio.

Example:

```
BRC> get tx_freq
TRANSMIT FREQUENCY is 851.00000MHz
```

GET TX_IF

Syntax:

get tx_if

The **get tx_if** command returns the current programmed transmit IF frequency.

Example:

```
BRC> get tx_if
TRANSMIT INTERMEDIATE FREQUENCY is 118.50000 MHz
```

GET TX_MODE

Syntax:

get tx_mode

The **get tx_mode** command returns the current transmit mode.

Example:

```
BRC> get tx_mode
TRANSMIT MODE is DC
```

GET TX_SANITY

Syntax:

get tx_sanity

The **get tx_sanity** command returns the Tx Digital Signal Processor (DSP) operational condition as either passed or failed.

Example:

```
BRC> get tx_sanity
TRANSMIT DSP SANITY TEST passed
```

GET TX_VERSION

Syntax:

get tx_version

The **get tx_version** command returns the current TX Digital Signal Processor (DSP) software version.

Example:

```
BRC> get tx_version
TRANSMIT DSP VERSION is 251.237
```

GET VSWR

Syntax:

get vswr

The **get vswr** command calculates the current Voltage Standing Wave Ratio (VSWR), as measured by the built-in power meters of the RF Power Amplifier module. This command should only be used when the transmitter is keyed to obtain accurate results.

Example:

```
BRC> get vswr
VSWR is 1.35:1
```

GET WATTMETER

Syntax:

get wattmeter

The **get wattmeter** command returns the forward and reverse power readings and calculates the VSWR from the external wattmeter which is connected to the antenna port. The output power readings are calibrated and returned in Watts.

This command should only be used when the transmitter is keyed to obtain accurate results.

Example:

```
BRC> get wattmeter
FORWARD POWER AT WATTMETER is 27.42 Watts(44.38 dBm)
REFLECTED POWER AT WATTMETER is 1.20 Watts (30.79 dBm)
WATTMETER VSWR is 1.53
```

GET WINDOW_CLIPPING_PARAMETERS

Syntax:

get window_clipping_parameters

The **get window_clipping_parameters** command returns the current variables in the window clipping algorithm.

Example:

```
BRC> get window_clipping_parameters
WINDOW CLIPPING THRESHOLD is 5.5000000
WINDOW SATURATION THRESHOLD is 15.000000
```

HELP

Syntax:

help

The **help** command returns all commands available for the Base Radio software. The display is dependent on the given access level. This command will return the subset of commands available for field personnel.

Example:

```
BRC> help
                    dekey
get                 alarms
get/set             alarm_mask
get/set             alarm_reports
get                 brc_kit_no
get                 brc_rev_no
get/set             brc_scratch
get/set             cabinet
get                 default_tx_power
get                 enet_id
get/set             exciter_scaling_factor
get                 ext_ref
get                 ex_ad
get                 ex_kit_no
get                 ex_rev_no
get/set             ex_scratch
get                 fwd_pwr
get/set             fwd_wattmeter_scaling_factor
                    help
get/set             k_factor
get/set             max_vswr
get/set             max_wattmeter_vswr
get                 pa_ad
get                 pa_coef
get                 pa_kit_no
get                 pa_rev_no
get/set             pa_scaling_factor
get/set             pa_scratch
get/set             pctrl
get                 pend
get                 pend_lock
get/set             position
```

get/set	ref_wattmeter_scaling_factor
	reset
get	rom_ver
get	rptr_status
get	rssi
get	rx(n)_ad
get/set	rx(n)_delta
get	rx(n)_kit_no
get	rx(n)_rev_no
get/set	rx(n)_scaling_factor
get/set	rx(n)_scratch
get/set	rx_freq
get/set	rx_inj
get/set	rx_mode
get/set	rx_qsign
get	rx_sanity
get	rx_status
get	rx_version
get/set	sgc
get	sgc_atten
get/set	sgc_delay
get/set	sys_gain
set	tone
set/set	training_interval
get/set	txlin
get	txlin_stat
get/set	tx_freq
get/set	tx_if
get/set	tx_mode
set	tx_power
get	tx_sanity
get	tx_version
get	vswr
get	wattmeter
set	window_clipping

RESET

Syntax:

reset

The **reset** command performs a software reset of the Base Radio. All parameters entered from the service computer will be lost.

Example:

```
BRC> reset
Base Radio Controller
Firmware Version Rxx.xx.xx
Copyright © 1998
Motorola, Inc. All rights reserved.

DRAM TEST: passed
SRAM TEST: passed
ENET TEST: passed
```

SET ALARM_MASK

Syntax:

set alarm_mask {*byte: 0->11*} {*data: 0x00->0xff*}

The **set alarm_mask** command enables / disables alarms from being acknowledged by the Base Radio. The input parameters are the byte number and the data (or mask).

Example:

The following example enables all alarms in byte 1.

```
BRC> set alarm_mask 1ff
set ALARM MASK 1 to 0xFF in RAM
```

SET ALARM_REPORTS

Syntax:

set alarm_reports {on | off}

The **set alarm_reports** command enables / disables asynchronous alarm reporting. Alarms are not reported to the local terminal if they occur when the alarm reports are disabled.

Example:

```
BRC>set alarm_reports on
set ALARM REPORTS TRACE to ENABLED in RAM
```

SET BRC_SCRATCH

Syntax:

set brc_scratch [*scratch text; 40 char limit*]

NOTE

This command permanently stores the data in EEPROM and is not lost when you exit test mode.

The **set brc_scratch** command writes to the allocated EEPROM field reserved for the scratch pad of the Base Radio Controller module. This space is overwritten whenever the set brc_scratch command is issued. A maximum of 40 characters may be entered into the scratch pad.

Example:

```
BRC> set brc_scratch abcdef
set BRC SCRATCH to abcdef in RAM and EEPROM
```

SET CABINET

Syntax:

set cabinet {1 | 2 | 3 | 4 | 5 | 6 | 7 | 8}

NOTE

This command permanently stores the data in EEPROM and is not lost when you exit test mode.

The **set cabinet** command sets the cabinet number of the Base Radio.

Example:

```
BRC> set cabinet 1
set CABINET to 1 in RAM and EEPROM
```

SET EXCITER_SCALING_FACTOR

Syntax:

set exciter_scaling_factor {*port: 0->11*} {*scaling factor*}

The **set exciter_scaling_factor** command changes the multiplier on the corresponding Exciter module A / D port. These values should not be trained, they are calibrated during manufacturing.

Example:

```
BRC> set exciter_scaling_factor 1 1
set EXCITER SCALING FACTOR 1 to 1 in RAM
```

SET EX_SCRATCH

Syntax:

set ex_scratch [*scratch text; 40 char limit*]

NOTE

This command permanently stores the data in EEPROM and is not lost when you exit test mode.

The **set ex_scratch** command writes to the allocated EEPROM field reserved for the scratch pad of the Exciter module. This space is overwritten whenever the set ex_scratch command is issued. A maximum of 40 characters may be entered into the scratch pad.

Example:

```
BRC> set ex_scratch xyz123
set EXCITER SCRATCH to xyz123 in RAM and EEPROM
```

SET FWD_WATTMETER_SCALING_FACTOR

Syntax:

set fwd_wattmeter_scaling_factor {*1.0* -> *1000.0*}

The **set fwd_wattmeter_scaling_factor** command changes the linear multiplier used to derive the forward power level from the external wattmeter located in the RFDS, if applicable.

Example:

```
BRC> set fwd_wattmeter_scaling_factor 52.00
set FORWARD POWER WATTMETER SCALING FACTOR to 52.00 in RAM
```

SET K_FACTOR

Syntax:

set k_factor {*-.99< k_factor < .99*}

The **set k_factor** command alters the TX Digital Signal Processor (DSP) k-factor. The k-factor changes average power.

Example:

```
BRC> set k_factor 0.85
set K FACTOR to 0.85000000 in RAM
```

SET MAX_VSWR

Syntax:

set max_vswr {*1.1 -> 4.0*}

The **set max_vswr** command sets the maximum Voltage Standing Wave Ratio (VSWR) for the internal Base Radio power monitor. The power is reduced if this value is reached.

Example:

```
BRC> set max_vswr 4
set MAX VSWR to 4 in RAM
```

SET MAX_WATTMETER_VSWR

Syntax:

set max_wattmeter_vswr {*1.1 -> 4.0*}

The **set max_wattmeter_vswr** command sets the maximum Voltage Standing Wave Ratio (VSWR) for the external wattmeter located in the RFDS, if applicable. The power is rolled back if this value is reached.

Example:

```
BRC>set max_wattmeter_vswr
set MAX WATTMETER VSWR to 4 in RAM
```

SET PA_SCALING_FACTOR

Syntax:

set pa_scaling_factor {*port: 0->11*} {*scaling factor*}

The **set pa_scaling_factor** command changes the multiplier on the corresponding Power Amplifier module A/D port. These values should not be changed; they are calibrated during manufacturing.

Example:

```
BRC> set pa_scaling_factor 1 1
set POWER AMPLIFIER SCALING FACTOR 1 to 1.000000 in RAM
```

SET PA_SCRATCH

Syntax:

set pa_scratch [*scratch text; 40 char limit*]

NOTE

This command permanently stores the data in EEPROM and is not lost when you exit test mode.

The **set pa_scratch** command writes to the allocated EEPROM field reserved for the scratch pad of the Power Amplifier module. This space is overwritten whenever the set pa_scratch command is issued. A maximum of 40 characters may be entered into the scratch pad.

Example:

```
BRC> set pa_scratch xyz123
set PA SCRATCH to xyz123 in RAM and EEPROM
```

SET PCTRL

Syntax:

set pctrl {on | off}

The **set pctrl** command enables / disables the power leveling functionality of the Base Radio. The output indicates and verifies the changes.

Example:

```
BRC> set pctrl on
set POWER CONTROL to ENABLED in RAM
```

SET POSITION

Syntax:

set position {1 | 2 | 3 | 4 | 5 | 6}

NOTE

This command permanently stores the data in EEPROM and is not lost when you exit test mode.

The **set position** command programs the position number of where the current Base Radio is mounted within a selected cabinet. This *does not* represent the cabinet in which the Base Radio resides.

Example:

```
BRC> set position 2
set POSITION to 2 in RAM and EEPROM
```

SET REF_WATTMETER_SCALING_FACTOR

Syntax:

set ref_wattmeter_scaling_factor {*1.0 -> 1000.0*}

The **set ref_wattmeter_scaling_factor** command changes the linear multiplier used to derive the reflected power level from the external wattmeter located in the RFDS, if applicable.

Example:

```
BRC> set ref_wattmeter_scaling_factor 52
set REFLECTED POWER WATTMETER SCALING FACTOR to 52.00 in
RAM
```

SET RX*(n)*_DELTA

Syntax:

set rx1_delta {>*-100.0 -> +100.0 dBm*}

set rx2_delta {>*-100.0 -> +100.0 dBm*}

set rx3_delta {>*-100.0 -> +100.0 dBm*}

The **set rx*(n)*_delta** command defines the contents of the RSSI offset value for a selected receiver.

Example:

```
BRC> set rx1_delta 0.98
set RECEIVER 1 RECEIVE SIGNAL STRENGTH DELTA to 0.98 in RAM
```

SET RX*(n)*_SCALING_FACTOR

Syntax:

set rx1_scaling_factor {*port: 0-> 11*} {*scaling factor*}

set rx2_scaling_factor {*port: 0 -> 11*} {*scaling factor*}

set rx3_scaling_factor {*port: 0 -> 11*} {*scaling factor*}

The **set rx*(n)*_sclaing_factor** command changes the value of the multiplier on the specified A/D port for a selected receiver. These values should not be changed, they are calibrated during manufacturing.

Example:

```
BRC> set rx1_scaling_factor 1 2
set RECEIVER 1 SCALING FACTOR 1 to 2 in RAM
```

SET RX*(n)*_SCRATCH

Syntax:

set rx(n)_scratch [*scratch text; 40 char limit*]

NOTE

This command permanently stores the data in EEPROM and is not lost when you exit test mode.

The **set rx*(n)*_scratch** command writes to the allocated EEPROM field reserved for the scratch pad of a selected Receiver module. This space is overwritten whenever the rx(n)_scratch command is issued. A maximum of 40 characters may be entered into the scratch pad.

Example:

```
BRC> set rx1_scratch abc899
set RECEIVER 1 SCRATCH to abc899 in RAM and EEPROM
```

SET RX_FREQ

Syntax:

set rx_freq {*806.000 - 821.000*}

The **set rx_freq** command programs the receiver frequency in the 800 MHz band. The receive frequency for each receiver within a selected Base Radio are programmed at the same time with this command.

The programmed receiver frequency must be in the range of 806.000 MHz to 821.000 MHz in 6.25 kHz increments.

Example:

```
BRC>set rx_freq 806.00000
set RECEIVE FREQUENCY to 806.0000 MHz in RAM
```

SET RX_FRU_CONFIG

NOTE

This command permanently stores the data in EEPROM and is not lost when you exit test mode.

Syntax:

set rx_fru_config {1| |12 | 123}

The **set rx_fru_config** command sets which receivers should be present in a Base Radio for the intended receive diversity. It is stored in the BRC EEPROM.

Example:

```
BRC>set rx_fru_config 123
RECEIVER CONFIGURATION {RX1 RX2 RX3}
```

SET RX_INJ

Syntax:

set rx_inj {high | low}

The **set rx_inj** command sets the current second Local Oscillator (LO) injection setting to achieve high/low side injection.

Example:

```
BRC> set rx_inj low
set RECEIVER INJECTION to LOW in RAM
```

SET RX_MODE

Syntax:

set rx_mode {1 | 2 | 3 | 12 | 13 | 23 | 123}

The **set rx_mode** command enables/disables any of the individual receivers of the current Base Radio. If a receiver is disabled using this command, it is not used in calculations for BER, RSSI, etc.

Example:

```
BRC>set rx_mode 12
set RECEIVER 1 to ENABLED in RAM
set RECEIVER 2 to ENABLED in RAM
set RECEIVER 3 to DISABLED in RAM
```

SET RX_QSIGN

Syntax:

set rx_qsign {inverted | non-inverted}

The **set rx_qsign** command sets the Rx q_sign to inverted or non-inverted.

Example:

```
BRC> set rx_qsign non-inverted
set RECEIVER Q SIGN to NON-INVERTED in RAM
```

SET SGC

Syntax:

set sgc {on | off}

The **set sgc** command enables / disables the Software Gain Control (SGC).

Example:

```
BRC> set sgc on
set SOFTWARE GAIN CONTROL to ENABLED in RAM
```

SET SGC_DELAY

Syntax:

set sgc_delay {*0 - 1000*}

The **set sgc_delay** command sets the delay used by the software gain control routine.

Example:

```
BRC> set sgc_delay 246
set SOFTWARE GAIN CONTROL DELAY to 246 in RAM
```

SET SYS_GAIN

Syntax:

set sys_gain {on | off}

The **set sys_gain** command enables / disables the system gain factor from being used.

Example:

```
BRC> set sys_gain on
set SOFTWARE GAIN to ENABLED in RAM
```

SET TONE

Syntax:

set tone {*-18000 Hz -> 18000 Hz*}

CAUTION

This command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into a dummy load.

The **set tone** command initializes a continuous single tone transmission. The only way to discontinue this feature is via the **dekey** command.

Example:

```
BRC> set tone 1000
set TONE to 1000 in RAM
```

SET TRAINING_INTERVAL

Syntax:

set training_interval {*no. of ticks*}

The **set training_interval** command sets the period between tranlin training cycles.

Example:

```
BRC> set training_interval 30000
set TRAINING INTERVAL to 30000 in RAM
```

SET TXLIN

Syntax:

set txlin {*register: 0x00 -> 0x1a*} {*hex byte: 0x00 -> 0xff*}

The **set txlin** command writes one specific hexadecimal byte to the specified tranlin register and update the codeplug shadow registers.

Example:

```
BRC> set txlin 1 08
set TXLIN 1 to 0x08 in RAM
```

SET TX_FREQ

Syntax:

set tx_freq {*851.000 - 866.000*}

The **set tx_freq** command programs the transmit frequency in the 800 MHz band. When this command is entered, the transmitter frequency is programmed into the Base Radio Controller.

The transmit frequency is specified in 6.25 kHz increments. The programmed transmitter frequency must be in the range of 851.00000 MHz to 866.00000 MHz in 6.25 kHz increments.

Example:

```
BRC>set tx_freq 851.00000
The TRANSMIT FREQUENCY to 851.00000MHz in RAM
```

SET TX_IF

Syntax:

set tx_if {*frequency in MHz*}

The **set tx_if** command sets the transmitter IF frequency.

Example:

```
BRC> set tx_if 118.35
set TRANSMIT INTERMEDIATE FREQUENCY to 118.5000 MHz in RAM
```

SET TX_MODE

Syntax:

set txmode {outbound | dc | inbound | 6tone}

The **set tx_mode** command sets the transmit mode.

Example:

```
BRC> set tx_mode outbound
set TRANSMIT MODE to OUTBOUND in RAM
```

SET TX_POWER

Syntax:

set tx_power {*value in Watts*}

CAUTION

This command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into a dummy load.

The **set tx_power** command keys the transmitter to a specified power without altering any programmed parameters. In test mode, the current default transmit mode setting (default_tx_mode) indicates the mode of the transmitter.

The range of allowable settings is dependent upon the Power Amplifier used (70W or 40W). A message is returned indicating transmitter activity.

Example:

```
BRC> set tx_power 40

    WORKING...
    TRANSMITTER KEYED: 40.12 watts

BRC>
```

SET WINDOW_CLIPPING

Syntax:

set window_clipping {on | off}

The **set window_clipping** command enables/disables the window clipping algorithm.

Example:

```
BRC> set window_clipping on
set WINDOW CLIPPING to ENABLED in RAM
```

VER

Syntax:

ver

The **ver** command returns the current version of the BR software.

Example:

```
BRC>ver
BRC SOFTWARE VERSION is Rxx.xx.xx
```

MOTOROLA

Chapter 9
Base Radio

Overview

This section provides technical information for the Base Radio (BR). The topics covered are listed in the following table.

Base Radio Overview

The BR provides reliable digital BR capabilities in a compact software-controlled design. Increased channel capacity is provided through voice compression techniques and Time Division Multiplexing (TDM).

The BR contains the five FRUs listed below:

❒ Base Radio Controller (BRC)

❒ Exciter

❒ Power Amplifier

❒ Power Supply (AC/DC)

❒ Receiver

The modular design of the BR also offers increased shielding and provides easy handling. All FRUs connect to the backplane through blindmate connectors. Figure 9-1 shows the front view of the BR.

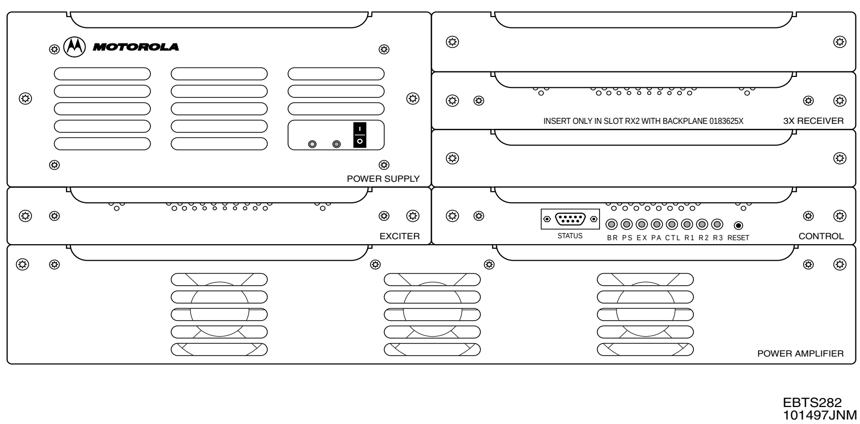


Figure 9-1 ***Base Radio (Typical)***

Controls and Indicators

The Power Supply and BRC contain controls and indicators that provide a means for monitoring various status and operating conditions of the BR, and also aid in fault isolation. The controls and indicators for both modules are discussed in the Power Supply and BRC sections of this chapter.

The Power Supply contains two front panel indicators; the BRC contains eight front panel indicators. The Power Supply contains a power switch used to apply power to the BR. The BRC contains a RESET switch used to reset the BR.

Performance Specifications

General Specifications

General specifications for the BR are listed in Table 9-1.

Table 9-1 ***BR General Specifications***

Specification	Value or Range
Dimensions: Height Width Depth	 5 EIA Rack Units (RU) 19" (482.6 mm) 16.75" (425 mm)
Operating Temperature	32˚ to 104˚ F (0˚ to 40˚ C)
Storage Temperature	-22˚ to 140˚ F (-30˚ to 60˚ C)
Rx Frequency Range: 800 MHz iDEN	 806 - 821 MHz
Tx Frequency Range: 800 MHz iDEN	 851 - 866 MHz
Tx – Rx Spacing: 800 MHz iDEN	 45 MHz
Channel Spacing	25 kHz
Frequency Generation	Synthesized
Digital Modulation	M-16QAM
Power Supply Inputs: Vac (option) Vdc	 90 - 140 / 180 - 230 Vac (@ 47 - 63 Hz) -48 Vdc (41 - 60 Vdc)
Diversity Branches	Up to 3

Transmit Specifications

The BR transmit specifications are listed in Table 9-2.

Table 9-2 ***Transmit Specifications***

Specification	Value or Range
Average Power Output: (800 MHz) 40 W PA (800 MHz) 70 W PA	 2 - 40 W 4 - 70 W
Transmit Bit Error Rate (BER)	0.01%
Occupied Bandwidth	18.5 kHz
Frequency Stability *	1.5 ppm
RF Input Impedance	50 Ω (nom.)
FCC Designation (FCC Rule Part 90): (800 MHz) 40 W PA (800 MHz) 70 W PA	 ABZ89FC5772 ABZ89FC5763
* Stability without site reference connected to station.	

Receive Specifications

The receive specifications are listed in Table 9-3.

Table 9-3 ***Receive Specifications***

Specification	Value or Range
Static Sensitivity †: 800 MHz BR (BER = 8%)	 -108 dBm
BER Floor (BER = 0.01%)	≥ -80 dBm
IF Frequencies	73.35 MHz (1st) 450 kHz (2nd)
Frequency Stability *	1.5 ppm
RF Input Impedance	50 Ω (nom.)
FCC Designation (FCC Rule Part 15): 800 MHz BR	 ABZ89FR5762

† Measurement referenced from single receiver input port of BR.

* Stability without site reference connected to station.

NOTE

FCC Compliance Notice: The BR is FCC Compliant only when used in conjunction with Motorola supplied RF Distribution Systems. Motorola does not recommend that this BR be used without a Motorola approved RF Distribution System. It is the customer's responsibility to file for FCC approval if the BR is used with a non-Motorola supplied RF Distribution System.

Theory of Operation

The BR operates in conjunction with other site controllers and equipment that are properly terminated. The following description assumes such a configuration. shows an overall block diagram of the BR.

Power is applied to the AC Power or DC Power inputs located on the BR backplane. The DC Power input is connected if -48 Vdc or batteries are used in the site. The AC Power input is used when 120/240 Vac service is used as a power source within the site.

Power is applied to the BR by setting the Power Supply power switch to the on position. Upon power-up, the BR performs self-diagnostic tests to ensure the integrity of the unit. These tests are primarily confined to the BRC and include memory and Ethernet verification routines.

After the self-diagnostic tests are complete, the BR reports any alarm conditions present on any of its modules to the site controller via Ethernet. Alarm conditions may also be verified locally using service computer and the STATUS port located on the front of the BRC.

The software resident in EPROM on the BRC registers the BR with the site controller via Ethernet. Once registered, the BR software is downloaded via Ethernet and is executed from RAM. Operating parameters for the BR are included in this download. This software allows the BR to perform call processing functions.

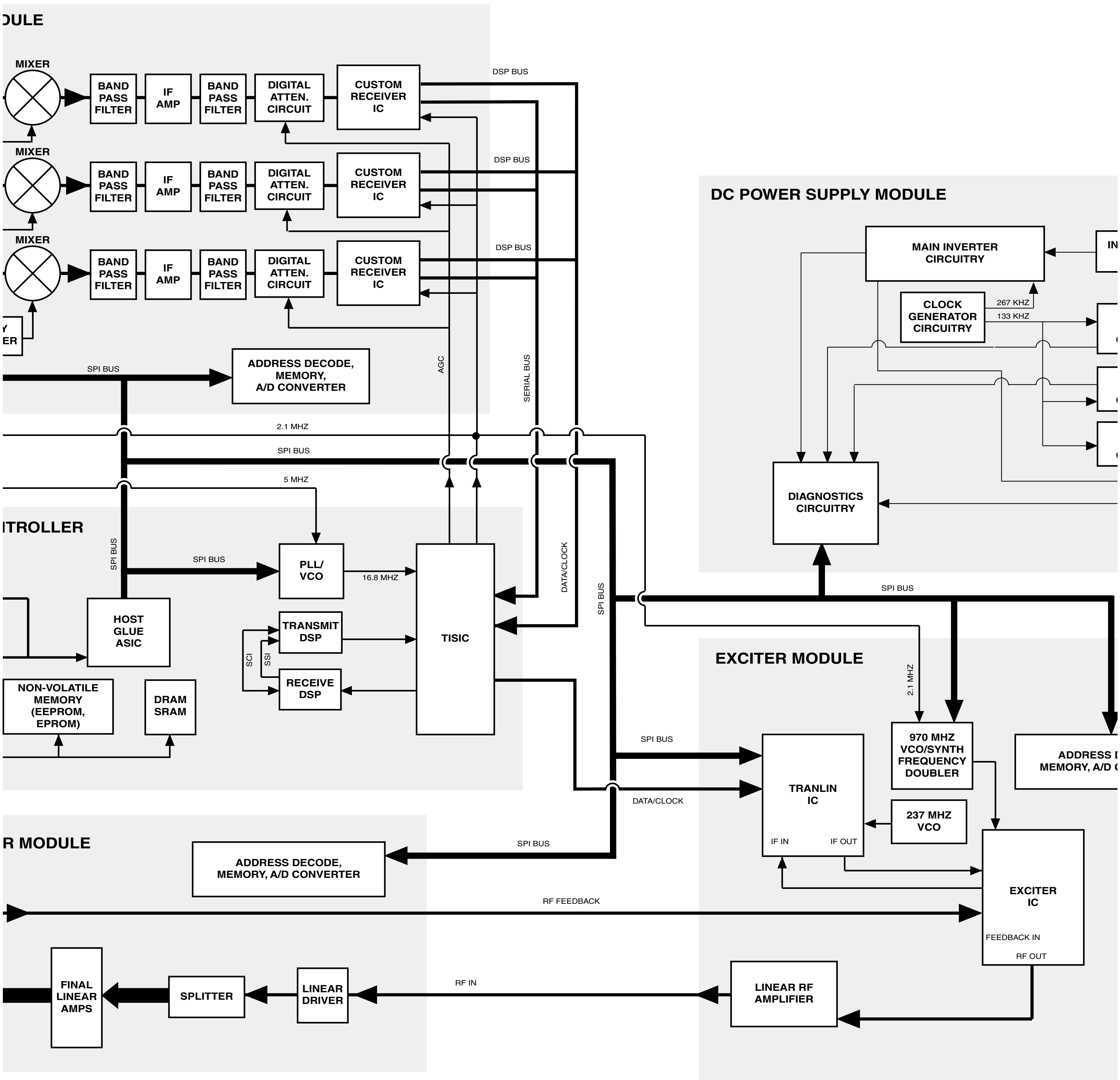
The BR operates in a TDMA (Time Division Multiple Access) mode. This mode, combined with voice compression techniques, provides an increased channel capacity ratio of as much as 6 to 1. Both the receive and transmit signals of the BR are divided into 6 individual time slots. Each receive slot has a corresponding transmit slot; this pair of slots comprises a logical RF channel.

The BR uses diversity reception for increased coverage area and improved quality. The Receiver module within the BR contains three receivers. Two Receivers are used with two-branch diversity sites, and three Receivers are used with three-branch diversity sites.

All Receivers within a given BR are programmed to the same receive frequency. The signals from each receiver are fed to the BRC where a diversity combining algorithm is performed on the signals. The resultant signal is processed for error correction and then sent to the site controller via Ethernet with the appropriate control information regarding its destination.

The transmit section of the BR is comprised of two separate FRUs, the Exciter and Power Amplifier (PA). Several PA FRUs are available, covering different applications and power levels; these are individually discussed as applicable in later subsections.

The Exciter processes the information to transmit from the BRC in the proper modulation format. This low level signal is sent to the PA where it is amplified to the desired output power level. The PA is a continuous keyed linear amplifier. A power control routine monitors the output power of the BR and adjusts it as necessary to maintain the proper output level.



have a 50Ω load (P/N 5882106P03) installed on Antenna Port #3.
FIG parameter as follows:
s: 12
s: 123

Figure 9-2 **Base**

This Page Intentionally

Left Blank

Base Radio Controller

Overview

The Base Radio Controller (BRC) serves as the main controller for the Base Radio. The BRC provides signal processing and operational control for other Base Radio modules. Figure 9-3 shows a top view of the BRC with the cover removed. The BRC module consists of two printed circuit boards (BRC board and LED / display board), a slide-in housing, and associated hardware.

The operating software and codeplug are contained within the BRC memory. The software defines operating parameters for the BR, such as output power and operating frequency.

The BRC interconnects to the Base Radio backplane using one 96-pin DIN connector and one blindmate RF connector. The BRC is secured in the Base Radio chassis using two Torx screws.

NOTE

BRC Modules with board level kit number CLN6989 must be used with System Software Release version SR 3.3 or higher. If used with System Software versions older than 3.3, a PENDULUM lock error will result and the Base Radio will not function.

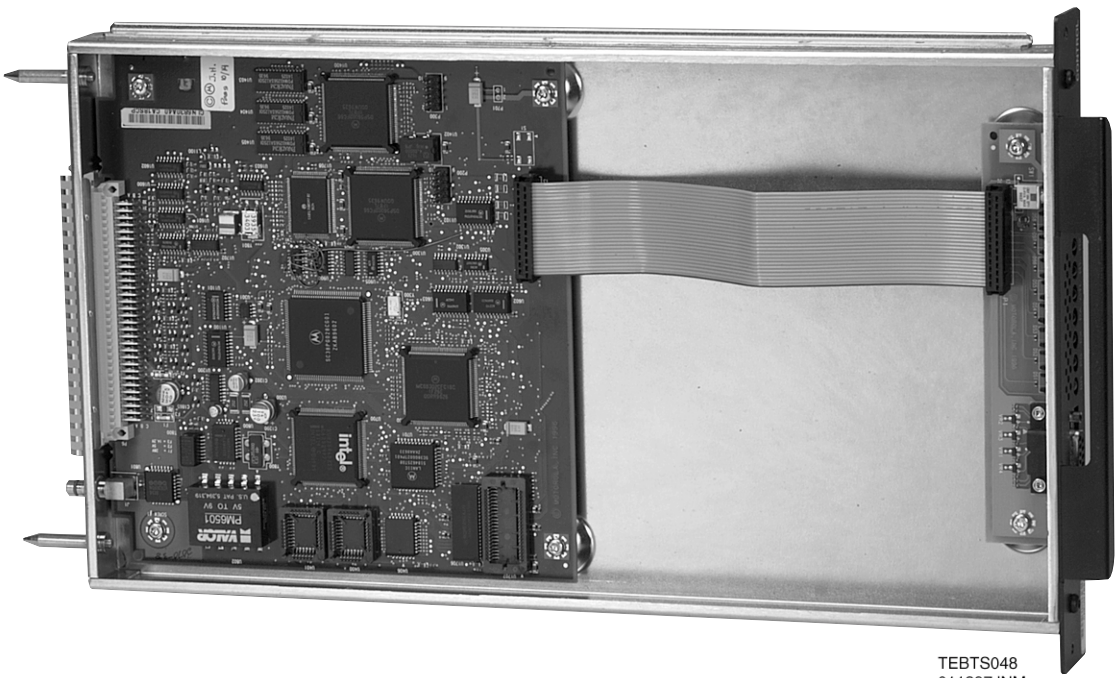


Figure 9-3 ***BRC, version CLN6989 (with cover removed)***

Controls and Indicators

The BRC monitors the functions of other Base Radio modules. The LEDs on the front panel indicate the status of the modules monitored by the BRC. All LEDs on the BRC front panel normally flash on / off three times upon initial power-up. A RESET switch is provided to allow a manual reset of the Base Radio. Figure 9-4 shows the front panel of the BRC.

Indicators

Table 9-4 lists and describes the BRC LEDs.

Controls

Table 9-5 lists the controls and descriptions.

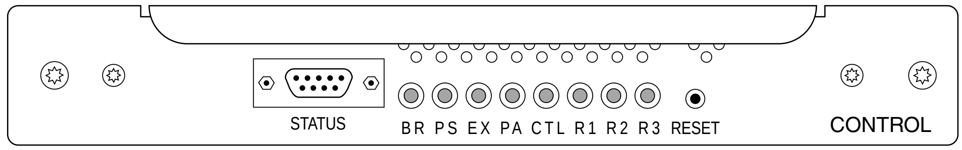


Figure 9-4 ***BR Controller (Front View)***

Table 9-4 ***BR Controller Indicators***

LED	Color	Module Monitored	Condition	Indications
BR	Green	BR	Solid (on)	Station is keyed
			Flashing (on)	Station is not keyed
			Off	Station is out of service or power is removed
PS	Red	Power Supply	Solid (on)	FRU failure indication - Power Supply has a major alarm and is out of service
			Flashing (on)	Power Supply has a minor alarm and may be operating at reduced performance
			Off	Power Supply under normal operation (no alarms)
EX	Red	Exciter	Solid (on)	FRU failure indication - Exciter has a major alarm and is out of service
			Flashing (on)	Exciter has a minor alarm and may be operating at reduced performance
			Off	Exciter under normal operation (no alarms)
PA	Red	Power Amplifier	Solid (on)	FRU failure indication - PA has a major alarm and is out of service
			Flashing (on)	PA has a minor alarm and may be operating at reduced performance
			Off	PA under normal operation (no alarms)
CTL	Red	Controller	Solid (on)	FRU failure indication - BRC has a major alarm and is out of service
			Flashing (on)	BRC has a minor alarm and may be operating at reduced performance
			Off	BRC under normal operation (no alarms)
R1 R2 R3	Red	Receiver #1, #2, or #3	Solid (on)	FRU failure indication - Receiver (#1, #2, or #3) has a major alarm and is out of service
			Flashing (on)	Receiver (#1, #2, or #3) has a minor alarm and may be operating at reduced performance
			Off	Receiver (#1, #2, or #3) under normal operation (no alarms)

Table 9-5 ***BR Controller Controls***

Control	Description
RESET Switch	A push-button switch used to manually reset the BR.
STATUS connector	A 9-pin connector used for connection of a service computer, providing a convenient means for testing and configuring.

Theory of Operation

Table 9-6 briefly describes the BRC circuitry. Figure 9-5 is a functional block diagram of the BRC.

Table 9-6 ***BR Controller Circuitry***

Circuit	Description
Host Microprocessor and Host Glue ASIC	Contains two integrated circuits that comprise the central controller of the BRC and station
Non-Volatile Memory	Consists of: • EPROMs containing the station operating software • one EEPROM containing the station codeplug data
Volatile Memory	Contains DRAM to store station software used to execute commands. Contains SRAM for general data space used by the host microprocessor
Ethernet Interface	Provides the BRC with a 10Base2 Ethernet communication port to network both control and compressed voice data
RS-232 Interface	Provides the BRC with two independent RS-232 serial interfaces
Digital Signal Processors and TISIC	Performs high-speed modulation / demodulation of compressed audio and signaling data
Station Reference Circuitry	Generates the 16.8 MHz and 2.1 MHz reference signal used throughout the station
Input Ports	Contains two 16-line input buses that receive miscellaneous inputs from the BR
Output Ports	Contains three 16-line output buses providing a path for sending miscellaneous control signals to various circuits throughout the BR
Remote Station Shutdown	Provides software control to cycle power on the BR

Host Microprocessor

The host microprocessor serves as the main controller for the BR. It operates at a clock speed of 16.5 MHz that is supplied from the Host Glue ASIC. The processor controls the operation of the Base Radio as determined by the station software contained in non-volatile memory. The station software is contained in two EPROMs. The station codeplug is stored in EEPROM.

Serial Communication Buses

The microprocessor provides two general-purpose serial communications buses (SCC2 and SCC3).

The SCC2 serial communications bus is an asynchronous RS-232 interface. A 9-pin D-type connector on the BRC front panel provides a port for service personnel to connect a service computer. A service computer allows the downloading of application code or diagnostic software. Service personnel can perform programming and maintenance tasks via Man Machine Interface (MMI) commands. The interface between the SCC2 port and the front panel STATUS connector is via EIA-232 Bus Receivers / Drivers.

The SCC3 serial communications bus is an RS-232 interface with synchronous or asychronous capabilities. It can interface remotely to a synchronous modem. The SCC3 port connects via EIA-232 Bus Receivers / Drivers to RS232 connector located on the backplane of the BR. This port is provided for future use and is not normally enabled.

Address and Data Bus

The microprocessor is equipped with a 23-line address bus used to access the non-volatile memory, DRAM memory, and provide control via memory mapping for other circuitry in the BRC.

A 16-line data bus transfers data to / from the BRC memory, as well as other BRC circuitry. This data bus is buffered for transfers to and from the non-volatile and DRAM memory.

Host Glue ASIC

The Host Microprocessor controls the operations of the Host Glue ASIC which performs the functions described Table 9-7.

Table 9-7 ***Host Glue ASIC Functions***

Function	Description
SPI Bus	Serves as a general-purpose serial communications bus providing communications between the Host Microprocessor and other Base Radio modules
DRAM Controller	Provides signals necessary to access and refresh the DRAM memory
System Reset	Generates a BRC Reset upon power up
Host Microprocessor Clock	Buffers the 33 MHz crystal outputs, performs a divide-by-2, and outputs a clock signal for the Host Microprocessor at 16.5 MHz
Address Decoding	Provides decoding of addressing from Host Microprocessor and generates corresponding chip select signals for various BRC devices, such as DRAM, EPROM, I / O Ports, DSPs, and internal Host Glue ASIC registers
Interrupt Controller	Accepts interrupt signals from various BRC circuits (such as the DSPs), prioritizes the interrupts based on hardware-defined priority ranking, and sends interrupt and priority level information to Host Microprocessor (via IPL lines 1-3)

Non-Volatile Memory

The Base Radio software resides in two 512K x 8 EPROMs. These EPROMs are accessed by the Host Microprocessor via the 19 lines of the 23-line host address bus and the 16-line host data bus.

The data determining the station personality resides in an 8K x 8 codeplug EEPROM. The EEPROM is accessed by the microprocessor via 15 lines of the 23-line host address bus and the 16-line data bus.

Stations are manufactured with default data programmed into the codeplug. Field programming information is downloaded from the network/site controllers. This data includes operating frequencies and output power level. Many of the station parameters may be adjusted but will not be stored within the station. Refer to the Software Commands section of this manual for additional information.

Volatile Memory

Each BRC contains 2MB of DRAM. The BRC downloads the station software code into DRAM for the station to use. Data is lost upon loss of power or reset since the DRAM is volatile memory.

The DRAM also provides short-term storage for data generated and required during normal operation. Read and write operations are performed via the Host Address and Data buses in conjunction with column and row select lines that are controlled by the Host Glue ASIC. DRAM memory locations are sequentially refreshed by the address bus and column row signals from the Host Glue ASIC during normal operation.

Two 32K x 8 fast Static RAM (SRAM) ICs are also provided on the BRC. The SRAM is accessed by the Microprocessor via 15 lines of the 23-line Host Address Bus and the 16-line Data Bus.

Ethernet Interface

The Local Area Network (LAN) Controller for the Ethernet Interface is provided by a 32-bit address, 16-bit data LAN coprocessor. The LAN coprocessor implements the CSMA/CD access method which supports the IEEE 802.3 10Base2 standard. The LAN coprocessor communicates to the Host Microprocessor via DRAM. Of the LAN coprocessor’s 32 address lines, 22 are used for the Ethernet interface.

The LAN coprocessor supports all IEEE 802.3 Medium Access Control, including the following:

❐ framing
❐ preamble generation
❐ stripping
❐ source address generation
❐ destination address checking

The LAN coprocessor receives commands from the CPU by reading a specified block in memory. Internal FIFOs of the LAN Controller optimize the microprocessor bus performance.

In addition, the on-chip Direct Memory Access (DMA) controller of the LAN coprocessor transfers data blocks (buffers and frames) from Ethernet to DRAM. This automatic transfer of data by the LAN coprocessor relieves the host CPU of byte transfer overhead.

The Ethernet Serial Interface works directly with the LAN coprocessor to perform the following major functions:

- ❐ 10 MHz transmit clock generation (obtained by dividing the 20 MHz signal provided by on board crystal)
- ❐ Manchester encoding / decoding of frames
- ❐ electrical interface to the Ethernet transceiver

An isolation transformer provides high voltage protection and isolates the Ethernet Serial Interface (ESI) and the transceiver. The pulse transformer has the following characteristics:

- ❐ Minimum inductance of 75 µH
- ❐ 2000 V isolation between primary and secondary windings
- ❐ 1:1 Pulse Transformer

The Coaxial Transceiver Interface (CTI) is a coaxial cable line driver / receiver for the Ethernet. CTI provides a 10Base2 connection via a coaxial connector on the board. This device minimizes the number of external components necessary for Ethernet operations.

A DC / DC converter provides a constant voltage of -9 Vdc for the CTI from a 5 Vdc source.

The CTI performs the following functions:

- ❐ Receives and transmits data to the Ethernet coaxial connection
- ❐ Reports any collision detected on the coaxial
- ❐ Disables the transmitter when packets are longer than the legal length (Jabber Timer)

Digital Signal Processors

The Receive Digital Signal Processor (RXDSP), Transmit Digital Signal Processor (TXDSP), and related circuitry process the station transmit and receive compressed audio / data. This circuitry includes the RXDSP and TXDSP, the TDMA Infrastructure Support IC (TISIC), and the TISIC Interface Circuitry. All signals input to or output from the DSP are in digitized format.

The inputs are digitized receive signals from the Receivers. The outputs are digitized voice audio / data (modulation signals) that are sent from the DSP to the Exciter. The DSPs communicate with the Microprocessor via an 8-bit host data bus on the Host Processor side. Communication is interrupt driven for all DSPs.

The RXDSP operates from a 40 MHz clock provided by an on-board crystal. The RXDSP accepts redigitized signal from the receivers. The RXDSP provides address and data buses to receive digitized audio from the TISIC.

The RXDSP also accesses its DSP program and signal processing algorithms contained in three 32K x 8 SRAM ICs. The RXDSP communicates with the host bus via an 8-bit interface.

Additionally, there is a serial data path to the TXDSP via the Synchronous Serial Interface (SSI) port. A serial control path is also provided from the TXDSP via the Serial Communications Interface (SCI) port.

The TXDSP also operates at a clock speed of 40 MHz, provided by a clock oscillator. The TXDSP sends the digitized signal to the TISIC where it is then passed to the Exciter.

The TXDSP contains its own address and data bus to access its DSP program and signal processing algorithms contained in local memory. The TXDSP memory consists of six 32K x 8 SRAM ICs. The TXDSP communicates with the host bus via an 8-bit interface.

TISIC

The TISIC controls all internal DSP operations. This circuit provides a number of functions, including the following:

- ❒ Interfaces with the DSPs via the DSP address and data buses.
- ❒ Accepts a 16.8 MHz signal and a 1 PPS signal from Station Reference Circuitry.
- ❒ Outputs a 2.1 MHz reference signal used by the Exciter and Receivers.
- ❒ Outputs a 4.8 MHz reference signal used by the Exciter to clock data into the TRANLIN IC.
- ❒ Accepts differential data from Receiver (RX1 through RX3) via interface circuitry.
- ❒ Accepts and sends serial data from the Receiver (RX1 through RX3) via serial data bus.
- ❒ Accepts and formats differential data from the TXDSP for transmission to the Exciter via interface circuitry.
- ❒ Generates 15 ms and 7.5 ms ticks. These are synchronized to the 1 PPS time mark from the iSC for routing to the TXDSP and RXDSP, respectively.
- ❒ Generates the Receive SSI (RXSSI) frame sync interrupt for the RXDSP.

Station Reference Circuitry

The Station Reference Circuitry is a phase-locked loop consisting of a high-stability Voltage Controlled Crystal Oscillator (VCXO) and a Phase Locked Loop IC. The GPS output from the iSC is connected to the 5 MHz / 1 PPS A BNC connector on the EBTS junction panel. In this mode, the PLL compares the reference frequency to the 16.8 MHz VCXO output and generates a DC correction voltage. The control voltage enable switch is closed. This allows the control voltage from the PLL to adjust the high-stability VCXO frequency to a stability equivalent to that of the external 5 MHz frequency reference.

The VXCO is continually frequency-controlled by the control voltage from the PLL and outputs a 16.8 MHz clock signal which is applied to the TISIC.

The TISIC divides the 16.8 MHz signal by 8 and outputs a 2.1 MHz signal. This signal is separated and buffered by a splitter. The output signal is then sent to the Exciter and Receivers as a 2.1 MHz reference via the backplane.

The 4.8 MHz reference signal generated by the TISIC is applied to the Exciter module, where it is used to clock data into and out of the TRANLIN IC.

Input Ports

Two general purpose, 16-line input ports provide for various input signals from the BRC and station circuitry. These inputs are sent to the Host Microprocessor.

Input Port P0 In and Port P1 In each consist of 16 lines from circuitry in the BRC, as well as other modules in the station via the backplane. The buses communicate with the buffers to make data available to the Host Microprocessor via the Host Data Bus. The DIP switch and the Station Reference Circuitry are typical inputs for these ports.

Output Ports

Three general purpose 16-line output ports provide various control signals from the Host Microprocessor to the BRC and station circuitry via the backplane.

The three output ports, Port P0 Out through Port P2 Out, each consist of 16 lines from the Host Data Bus via latches.

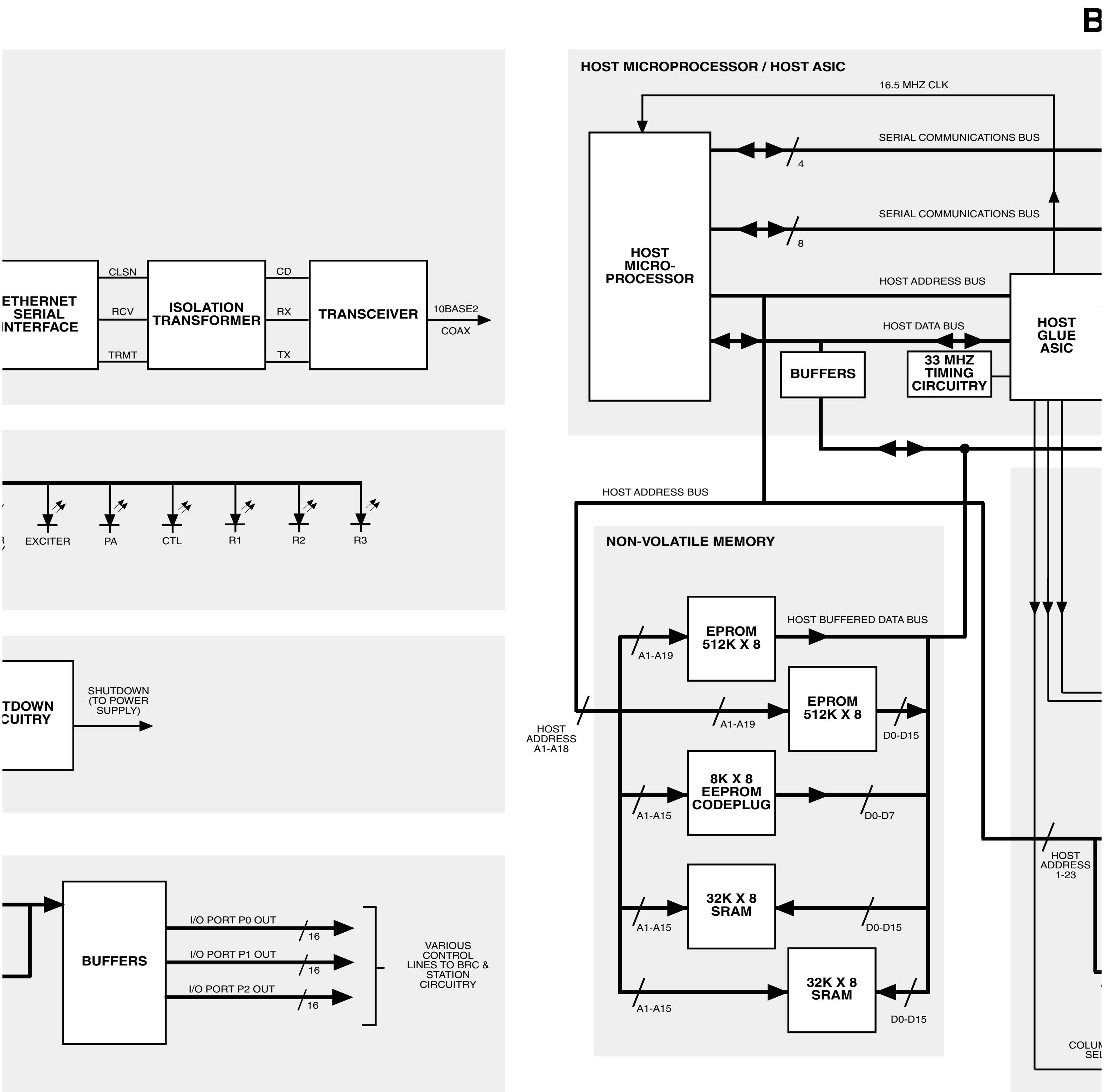
Typical control signals from these output ports vary from the control signals for the eight front panel LEDs and the address select lines for SPI peripherals.

Remote Station Shutdown

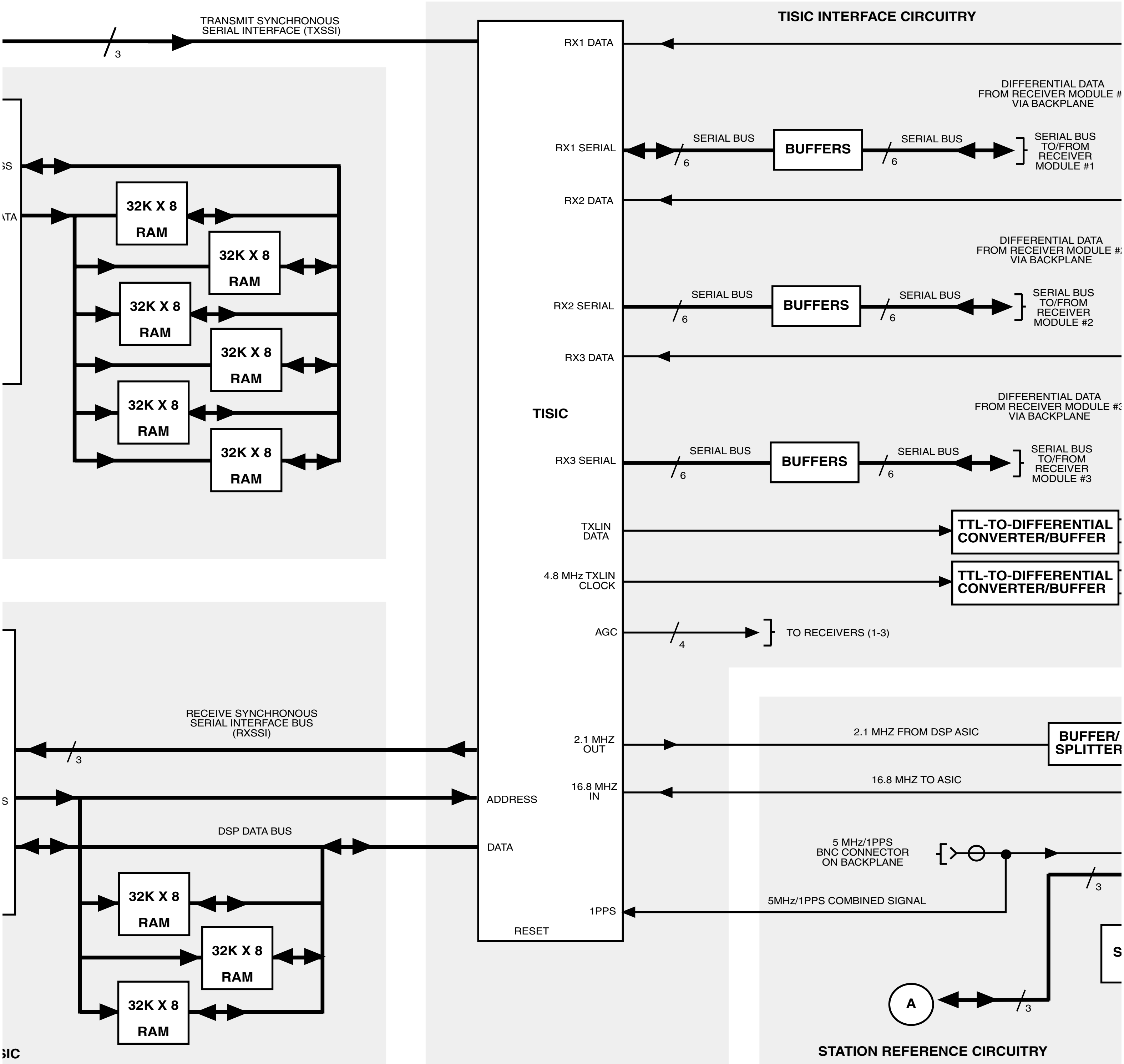
The BRC contains circuitry to send a shutdown pulse to the Base Radio Power Supply. After receiving this pulse, the power supply cycles the power for the BR, including the 5.1 Vdc, 28.6 Vdc and 14.2 Vdc distributed through the BR. The BRC generates the shutdown pulse through software control. A remote site uses the shutdown function to perform a hard reset of all modules in the BR.

This Page Intentionally

Left Blank



B
HOST MICROPROCESSOR / HOST ASIC
16.5 MHZ CLK
SERIAL COMMUNICATIONS BUS
4
SERIAL COMMUNICATIONS BUS
8
HOST MICRO-PROCESSOR
HOST ADDRESS BUS
HOST DATA BUS
HOST GLUE ASIC
BUFFERS
33 MHZ TIMING CIRCUITRY
ETHERNET SERIAL INTERFACE
CLSN
RCV
TRMT
ISOLATION TRANSFORMER
CD
RX
TX
TRANSCEIVER
10BASE2
COAX
EXCITER
PA
CTL
R1
R2
R3
HOST ADDRESS BUS
NON-VOLATILE MEMORY
EPROM 512K X 8
HOST BUFFERED DATA BUS
A1-A19
EPROM 512K X 8
A1-A19
D0-D15
HOST ADDRESS A1-A18
8K X 8 EEPROM CODEPLUG
A1-A15
D0-D7
32K X 8 SRAM
A1-A15
D0-D15
32K X 8 SRAM
A1-A15
D0-D15
HOST ADDRESS 1-23
TDOWN CUITRY
SHUTDOWN (TO POWER SUPPLY)
BUFFERS
I/O PORT P0 OUT
16
I/O PORT P1 OUT
16
I/O PORT P2 OUT
16
VARIOUS CONTROL LINES TO BRC & STATION CIRCUITRY


TRANSMIT SYNCHRONOUS SERIAL INTERFACE (TXSSI)
3
TISIC INTERFACE CIRCUITRY
RX1 DATA
DIFFERENTIAL DATA FROM RECEIVER MODULE # VIA BACKPLANE
RX1 SERIAL
SERIAL BUS
6
BUFFERS
SERIAL BUS
6
SERIAL BUS TO/FROM RECEIVER MODULE #1
RX2 DATA
DIFFERENTIAL DATA FROM RECEIVER MODULE # VIA BACKPLANE
RX2 SERIAL
SERIAL BUS
BUFFERS
SERIAL BUS
SERIAL BUS TO/FROM RECEIVER MODULE #2
RX3 DATA
DIFFERENTIAL DATA FROM RECEIVER MODULE # VIA BACKPLANE
TISIC
RX3 SERIAL
SERIAL BUS
BUFFERS
SERIAL BUS
SERIAL BUS TO/FROM RECEIVER MODULE #3
32K X 8 RAM
TXLIN DATA
TTL-TO-DIFFERENTIAL CONVERTER/BUFFER
4.8 MHz TXLIN CLOCK
TTL-TO-DIFFERENTIAL CONVERTER/BUFFER
AGC
4
TO RECEIVERS (1-3)
RECEIVE SYNCHRONOUS SERIAL INTERFACE BUS (RXSSI)
2.1 MHZ OUT
2.1 MHZ FROM DSP ASIC
BUFFER/ SPLITTER
ADDRESS
16.8 MHZ IN
16.8 MHZ TO ASIC
DSP DATA BUS
DATA
5 MHz/1PPS BNC CONNECTOR ON BACKPLANE
1PPS
5MHz/1PPS COMBINED SIGNAL
RESET
A
STATION REFERENCE CIRCUITRY

ock Diagram

Exciter

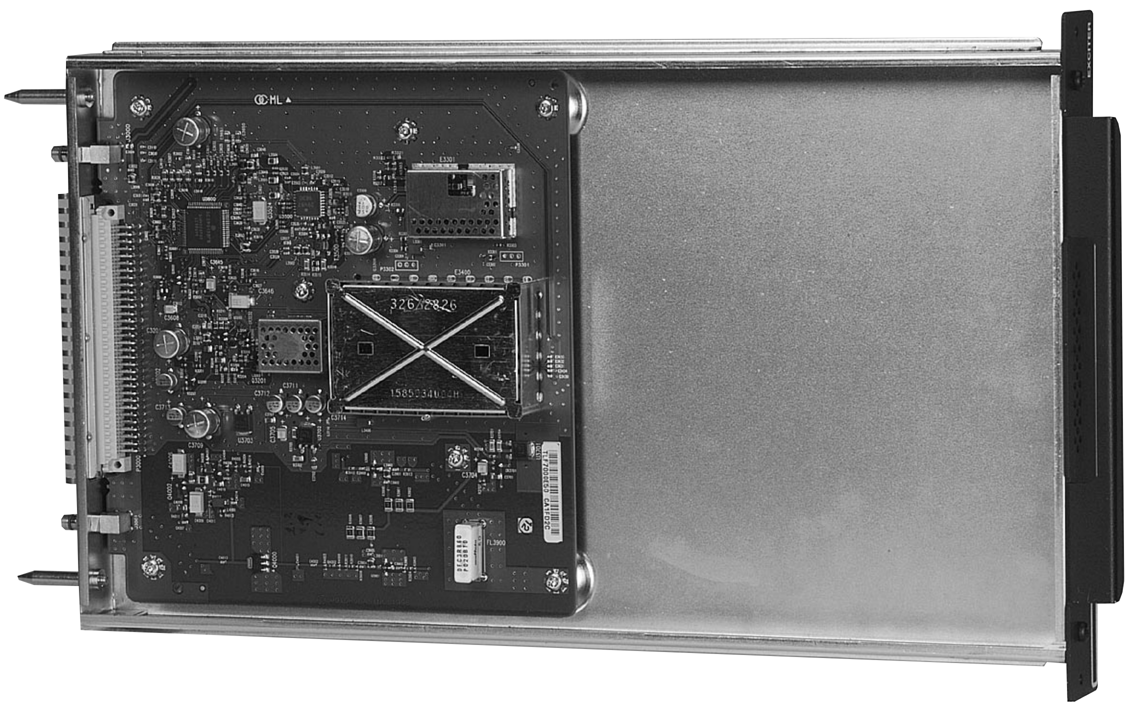
Exciter Overview

The Exciter, in conjunction with the Power Amplifier (PA), provides the transmitter functions for the Base Radio. The Exciter module consists of a printed circuit board, a slide in housing, and associated hardware.

The Exciter interconnects to the Base Radio backplane using a 96-pin DIN connector and two blindmate RF connectors. Two Torx screws on the front of the Exciter hold it in the chassis.

There are no controls or indicators on the Exciter. Specifications of the transmitter circuitry, including the Exciter and PAs, are provided in the Base Radio section of the manual.

Figure 9-6 shows the Exciter with the cover removed.



EBTS330
012197JNM

Figure 9-6 ***Exciter (with cover removed)***

Theory of Operation

Table 9-8 lists and describes the basic circuitry of the Exciter. Figure 9-7 shows the functional block diagram of the Exciter.

Table 9-8 ***Exciter Circuitry***

Circuit	Description
Tranlin IC	Performs the following functions: • up-converts the baseband data to the first IF • down-converts the IF feedback signal to baseband • uses a baseband Cartesian feedback loop system, necessary to obtain linearity from the transmitter and avoid splattering power into adjacent channels • performs training functions for proper linearization of the transmitter
Exciter IC	Interfaces with Tranlin IC to perform: • up-conversion from first IF to the transmit operating frequency • down-conversion to IF of PA output feedback signal for input to Tranlin IC
Address Decode, Memory, & A / D Converter	Serves as the main interface between the synthesizer, Tranlin IC, A / D, and EEPROM on the Exciter and the BRC via the SPI bus
Frequency Synthesizer Circuitry	Consists of a phase-locked loop and VCO to provide a LO signal to the Exciter IC for the second up-conversion and for the first down-conversion of the feedback signal from the PA
970 MHz VCO (800 MHz BR)	Provides a LO signal to the Exciter IC for the second up-conversion to the transmit frequency
237 MHz VCO (800 MHz BR)	Provides a LO signal to Tranlin IC for the first up-conversion and for the second down-conversion of the feedback signal. The synthesizer and divide by 2 circuitry within the Tranlin IC set the first IF to 118.5 MHz
Regulator Circuitry	Provides a regulated voltage to various ICs and RF devices located on the Exciter
Linear RF amplifier Stages	Amplifies the RF signal from the Exciter IC to an appropriate level for input to the PA

Address Decode Circuitry

The address decode circuitry enables the BRC to use the address bus to control Exciter circuitry. The BRC can select a specific device on the Exciter via the SPI bus for control or data communication purposes.

If the board select circuitry decodes address lines A2 through A5 as the Exciter address, it enables the chip select circuitry. The chip select circuitry then decodes address lines A0 and A1 to generate the chip select signals for the EEPROM, A / D converter, Tranlin IC, and PLL IC. Once selected, the BRC uses the SPI bus to send and receive data to and from the device.

Memory Circuitry

The memory circuitry consists of an EEPROM located on the Exciter. The BRC performs all memory read and write operations via the SPI bus. Information stored in this memory device includes the kit number, revision number, module specific scaling and correction factors, and free form information (scratch pad).

A/D Converter Circuitry

Analog signals from various areas throughout the Exciter board are fed to the A / D converter. These analog signals are converted to a digital signal and are output to the BRC via the SPI lines upon request of the BRC. All signals are periodically monitored and controlled by the BRC.

Some of the signals monitored include the regulated voltages, the external wattmeter (optional), the PLL circuit, and other internal signals.

Tranlin IC Circuitry

The Tranlin IC is a main interface between the Exciter and BRC. Digitized signals (baseband data) are sent via the DSP data bus from the Digital Signal Processors (DSP) of the BRC to the Exciter. These data signals are clocked via the DSP clock signal provided by the Receiver.

The differential data clock signal also serves as a 4.8 MHz reference signal to the internal synthesizer circuit of the Tranlin IC. The Tranlin compares the reference signal with the output of the 237 MHz Voltage Controlled Oscillator (VCO). If the VCO output is out of phase or differs in frequency, correction pulses are sent to the Oscillator and the VCO output is adjusted.

The Tranlin IC up-converts the baseband data received from the BRC to the first IF of 118.5 MHz . It also down-converts an IF feedback signal from the Exciter IC to baseband data for summing.

The Serial Peripheral Interface (SPI) bus is used to communicate with the Tranlin IC. The SPI bus serves as a general purpose bi-directional serial link between the BRC and other modules of the Base Radio, including the Exciter. The SPI bus is used to send control and operational data signals to and from the various circuits of the Exciter.

Exciter IC Circuitry

The Exciter IC interfaces directly with the Tranlin IC to perform up-conversion from the first IF to the programmed transmit operating frequency. The first IF signal is passed through a band-pass filter before it reaches the Exciter IC.

The Exciter IC also down-converts the RF feedback signal from the PA to its IF signal. The IF signal is then input to the Tranlin IC for conversion to baseband data that computes the Cartesian feedback.

Synthesizer Circuitry

The synthesizer circuitry consists of the Phase-Locked Loop (PLL) IC and associated circuitry. The output of this circuit is combined with the 970 MHz VCO to supply a Local Oscillator (LO) signal to the Exciter IC for the second up-conversion of the programmed transmit frequency. This signal is also used for the first down-conversion of the feedback signal from the PA.

An internal phase detector generates a logic pulse in proportion to the difference in phase or frequency between the reference frequency and loop pulse signal.

If the reference frequency is faster than the VCO feedback frequency, an up signal is output from the PLL IC. If the reference frequency is slower than the VCO feedback frequency, a down signal is output from the PLL IC. These pulses are used as correction signals and are fed to a charge pump circuit.

The charge pump circuit consists of five transistors and its associated biasing components. This circuit generates the correction signal and causes it to move up or down in response to the phase detector output pulses. The correction signal is passed through the low-pass loop filter to the 970 MHz Voltage Controlled Oscillator (VCO) circuit .

970 MHz Voltage Controlled Oscillator (VCO)

The 970 MHz VCO generates the second injection frequency for the Exciter IC.

The VCO requires a very low-noise DC supply voltage of +10 Vdc for proper operation. The oscillator is driven by a Super Filter that contains an ultra low-pass filter. The Super Filter obtains the required low-noise output voltage for the oscillator.

The output of the oscillator is tapped and sent to the VCO Feedback Filter. This feedback signal is supplied to the Synthesizer circuitry for the generation of correction pulses.

The untapped output of the 970 MHz VCO is sent to the second LO injection circuitry.

237 MHz Voltage Controlled Oscillator (VCO)

The 237 MHz VCO provides a LO signal to Tranlin IC for the first up-conversion and for the second down-conversion of the feedback signal. The synthesizer and divide by 2 circuitry within the Tranlin IC set the first IF to 118.5 MHz .

Regulator Circuity

This circuit generates three regulated voltages of +5 Vdc, +10 Vdc, and +11.8 Vdc. All voltages are obtained from the +14.2 Vdc backplane voltage. These voltages are used to power various ICs and RF devices of the Exciter.

Linear RF Amplifier Stages

This circuitry is used to amplify the RF signal from the Exciter IC to an appropriate level for input to the PA.

This Page Intentionally

Left Blank

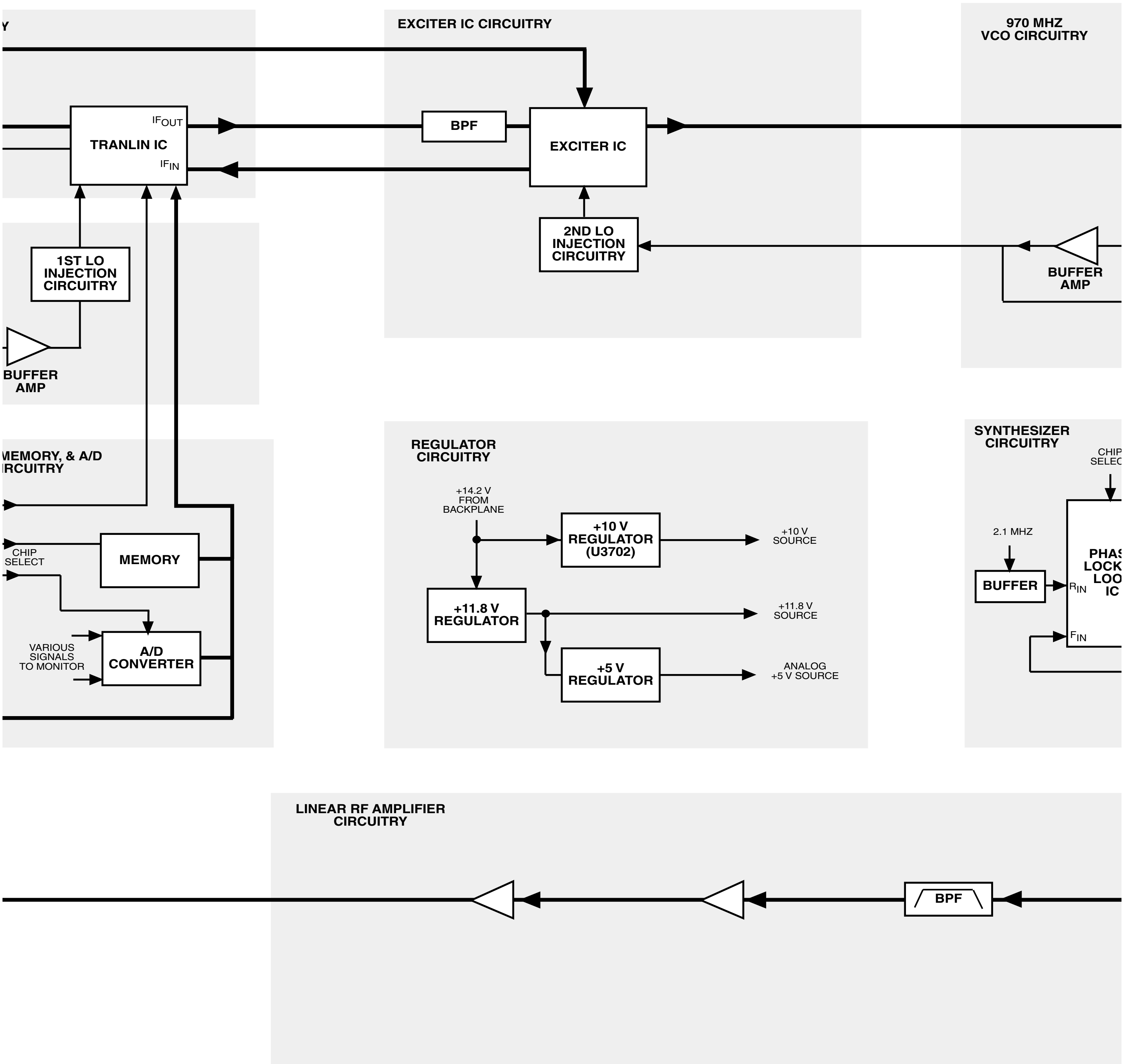


Figure 9-7 ***Excite***

This Page Intentionally
Left Blank

40W, 800 MHz Power Amplifier – TLF2020 (TTF1580B); 70W, 800 MHz Power Amplifier – TLN3335 (CTF1040)

PA Overview

The Power Amplifier (PA), in conjunction with the Exciter, provides the transmitter functions for the Base Radio. The PA accepts the low-level modulated RF signal from the Exciter and amplifies the signal for transmission via the RF output connector.

The 800 MHz Base Radio can be equipped with either 40 Watt PA, TLF2020 (version TTF1580B) or 70 Watt PA, TLN3335 (version CTF1040), hereinafter referred to as the 40W PA and 70W PA, respectively. This subsection describes both PAs; where differences exist, they are noted throughout.

The 40W PA contains five hybrid modules, four pc boards, and a module heatsink / housing assembly. The 70W PA contains eight hybrid modules, four pc boards, and a module heatsink / housing assembly.

The PA connects to the chassis backplane using a 96-pin DIN connector and three blindmate RF connectors. Two Torx screws located on the front of the PA hold it in the chassis.

Specifications of the transmitter circuitry, including the Exciter and PAs, are provided in Base Radio Overview section. Figure 9-8 shows the 70W PA with the cover removed.

Theory of Operation

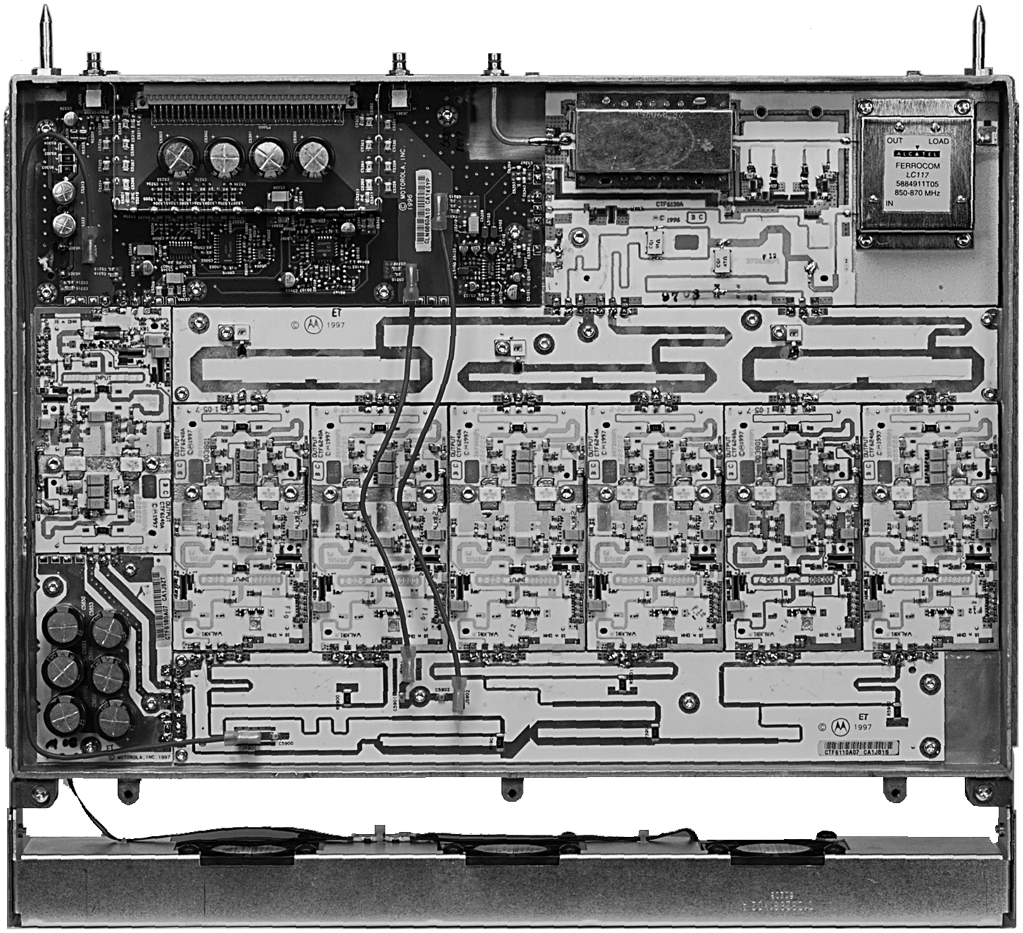
Table 9-9 describes the basic functions of the PA circuitry. Figures 9-9 and 9-10 show the functional block diagrams of 40W PA, TLF2020 (version TTF1580B) and 70W PA, TLN3335 (version CTF1040), respectively.

DC/Metering Board

The DC / Metering Board provides the interface between the PA and the Base Radio backplane. The preamplified / modulated RF signal is input directly from the Exciter via the Base Radio backplane.

The RF input signal is applied to the input of the Linear Driver Module (LDM). The RF feedback signal is fed back to the Exciter, where it is monitored for errors.

40W, 800 MHz Power Amplifier – TLF2020 (TTF1580B); 70W, 800 MHz Power Amplifier – TLN3335 (CTF1040)



EBTS469
111197JNM

NOTE: 70W PA shown. 40W PA is similar.

Figure 9-8 ***70 Watt PA – TLN3335 (version CTF1040; with cover removed)***

Table 9-9 ***Power Amplifier Circuitry; TLF2020 (version TTF1580B) and TLN3335 (version CTF1040)***

Circuit	Description
DC / Metering Board	• Serves as the main interface between the PA and the backplane board • Accepts RF input from the Exciter via a blindmate RF connector • Routes the RF input via a 50 Ω stripline to the Linear Driver Module RF amplifier • Routes the RF feedback from the RF Combiner / Peripheral Module to the Exciter via a blindmate RF connector • Provides digital alarm and metering information of the PA to the BRC via the SPI bus • Routes DC power to the fans and PA
Linear Driver Module (LDM)	• Contains one Class AB stage which, in turn, drives a parallel Class AB stage • Amplifies the low-level RF signal (~25 mW average power) from the Exciter via the DC / Metering Board • Provides an output of ~10 W average power

Circuit	Description
Interconnect Board	• Provides RF interconnection from the LDM to the RF Splitter board • Provides DC supply filtering
RF Splitter / DC board	• Interfaces with the DC / Metering Board to route DC power to the LFMs • 40W PA – Contains splitter circuits that split the RF output signal of the LDM into three outputs for the three Linear Final Modules • 70W PA – Contains splitter circuits that split the RF output signal of the LDM into six outputs for the six Linear Final Modules
Linear Final Module (LFM)	• 40W PA – Each module contains two Class AB amplifiers in parallel. Each module amplifies one of three RF signals (~ 8 W average power) from the LDM (via the Splitter / DC board). Three LFMs provide a sum RF output of approximately 48 W average power. • 70W PA – Each module contains two Class AB amplifiers in parallel. Each module amplifies one of six RF signals (~ 8 W average power) from the LDM (via the Splitter / DC board). Six LFMs provide a sum RF output of approximately 97 W average power.
RF Interconnect Board (40W PA only)	• Contains three transmission lines that interconnect the LFMs to the RF Combiner / Peripheral Module
Combiner Board (70W PA only)	• Contains three separate Quadrature combiner circuits that respectively combine the six RF outputs from the LFMs into three signals. These three signals, in turn, are applied to the RF Combiner / Peripheral Module.
RF Combiner / Peripheral Module	• Contains a combiner circuit that combines the three RF signals from the RF Interconnect Board (40W PA) or the Combiner Board (70W PA). It routes the combined RF signal through a circulator and a Low Pass Filter. The final output signal is routed to the blindmate RF connector • Contains an RF coupler that provides an RF feedback signal to the Exciter via a blindmate RF connector. Also contains a forward and reverse power detector for alarm and power monitoring purposes
Fan Assembly	• Consists of three fans used to keep the PA within predetermined operating temperatures

The primary function of the DC / Metering Boards is to monitor proper operation of the PA. This information is forwarded to the Base Radio Controller (BRC) via the SPI bus. The alarms diagnostic points monitored by the BRC on the PA include the following:

- ❐ Forward power
- ❐ Reflected power
- ❐ PA temperature sense

Linear Driver Module

The Linear Driver Module (LDM) amplifies the low-level RF signal from the Exciter. The LDM consists of a two-stage cascaded amplifier.

The RF input signal applied to the LDM has an average power level of approximately 25 mW. The LDM amplifies this signal to an average output level of approximately 10 Watts. The LDM output is fed to the RF Splitter / DC Distribution Board via an Interconnect Board.

Interconnect Board

The output of the LDM is applied to the Interconnect Board, which provides an RF connection to the RF Splitter / DC Distribution Board. As a separate function, area on the Interconnect Board serves as a convenient mounting location for electrolytic capacitors used for filtering the +28 VDC supply.

RF Splitter/DC Distribution Board

The RF Splitter portion of this board accepts the amplified signal from the LDM (via the Interconnect Board). The primary function of this circuit is to split the RF signal into drive signals for the LFMs.

In the 40W PA, this circuit splits the drive signal into three separate paths to be applied to the three LFMs, where the signals will be amplified further. In the 70W PA, this circuit splits the drive signal into six separate paths to be applied to the six LFMs, where the signals will be amplified further.

The DC Distribution portion of this board interfaces directly with the DC / Metering Board to route DC power to the LFMs.

Linear Final Modules

The RF Splitter output signals are applied directly into the LFMs for final amplification. Each LFM contains parallel PAs that amplify the RF signals.

In the 40W PA, the parallel LFMs amplify the input signals to a sum output level of approximately 48 Watts average power. The amplified signal is then sent directly to the RF Interconnect Board. In the 70W PA, the parallel LFMs amplify the input signals to a sum output level of approximately 97 Watts average power. The amplified signal is then sent directly to the Combiner Board.

RF Interconnect Board (40W PA Only)

The RF Interconnect Board consists of transmission line paths which route the three output signals from the LFMs to the three inputs of the RF Combiner / Peripheral Module.

Combiner Board (70W PA Only)

The Combiner Board combines pairs of signals into single signals, thereby combining the six signals from the LDMs into three signals. The resulting three signals are applied to the RF Combiner / Peripheral Module.

RF Combiner/Peripheral Module

This module consists of two portions: an RF combiner and a peripheral module. The RF Combiner portion of the module combines the three RF signals from the RF Interconnect Board (40W PA) or the Combiner Board (70W PA) into a single signal using a Wilkinson coupler arrangement.

Following the combiner circuit, the single combined RF signal is then passed through a directional coupler which derives a signal sample of the LFM RF power output. Via the coupler, a sample of the RF output signal is fed to the Exciter as a feedback signal. Following the coupler, the power output signal is passed through a circulator, which protects the PA in the event of high reflected power.

The peripheral portion of the module provides a power monitor circuit that monitors the forward and reflected power of the output signal. This circuit furnishes the A / D converter on the DC / Metering Board with input signals representative of the forward and reflected power levels.

For forward power, a signal representative of the measured value is sent to the BRC via the SPI bus. The BRC determines if this level is within tolerance of the programmed forward power level. If the level is not within parameters, the BRC will issue a warning to the site controller which, in turn, will shut down the Exciter if required.

Reflected power is monitored in the same manner. The BRC uses the reflected power to calculate the voltage standing wave ratio (VSWR). If the VSWR is determined to be excessive, the forward power is rolled back. If it is extremely excessive, the BRC issues a shut-down command to the Exciter.

A thermistor is located on the RF Combiner / Peripheral module to monitor the operating temperature of the PA. The thermistor signal indicating excessive temperature is applied to the A / D converter and then sent to the BRC. The BRC rolls back forward power if the monitored temperature is excessive.

Fan Module

The PA contains a fan assembly to maintain normal operating temperature through the use of a cool air intake. The fan assembly consists of three individual fans in which airflow is directed across the PA heatsink.

The current draw of the fans is monitored by the DC / Metering Board. A voltage representative of the current draw is monitored by the BRC. The BRC flags the iSC if an alarm is triggered. The PA LED on the front panel of the BRC also lights, however the PA does not shut down.

This Page Intentionally
Left Blank

40W, 800 MHz Power Amplifier - TLI

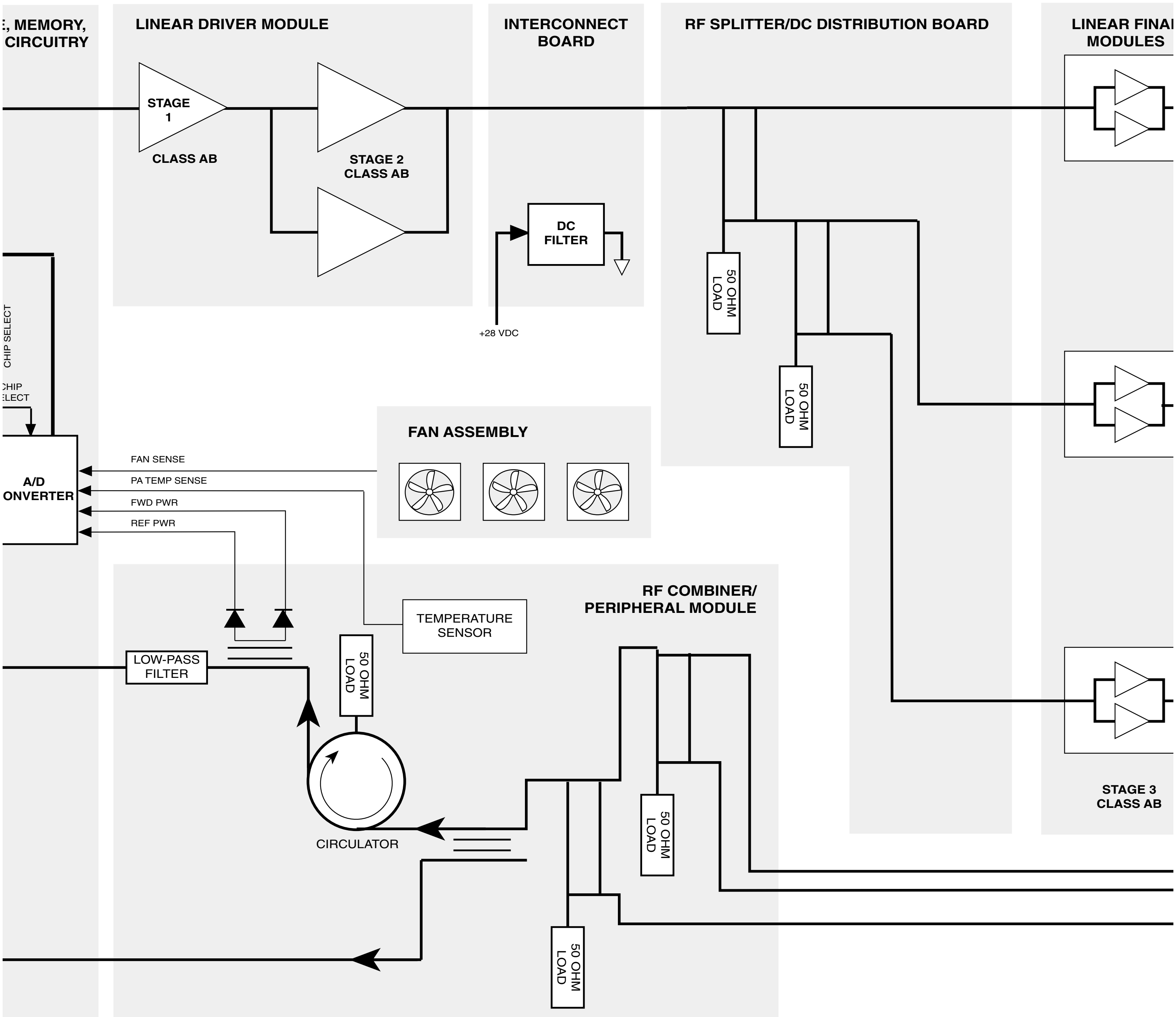
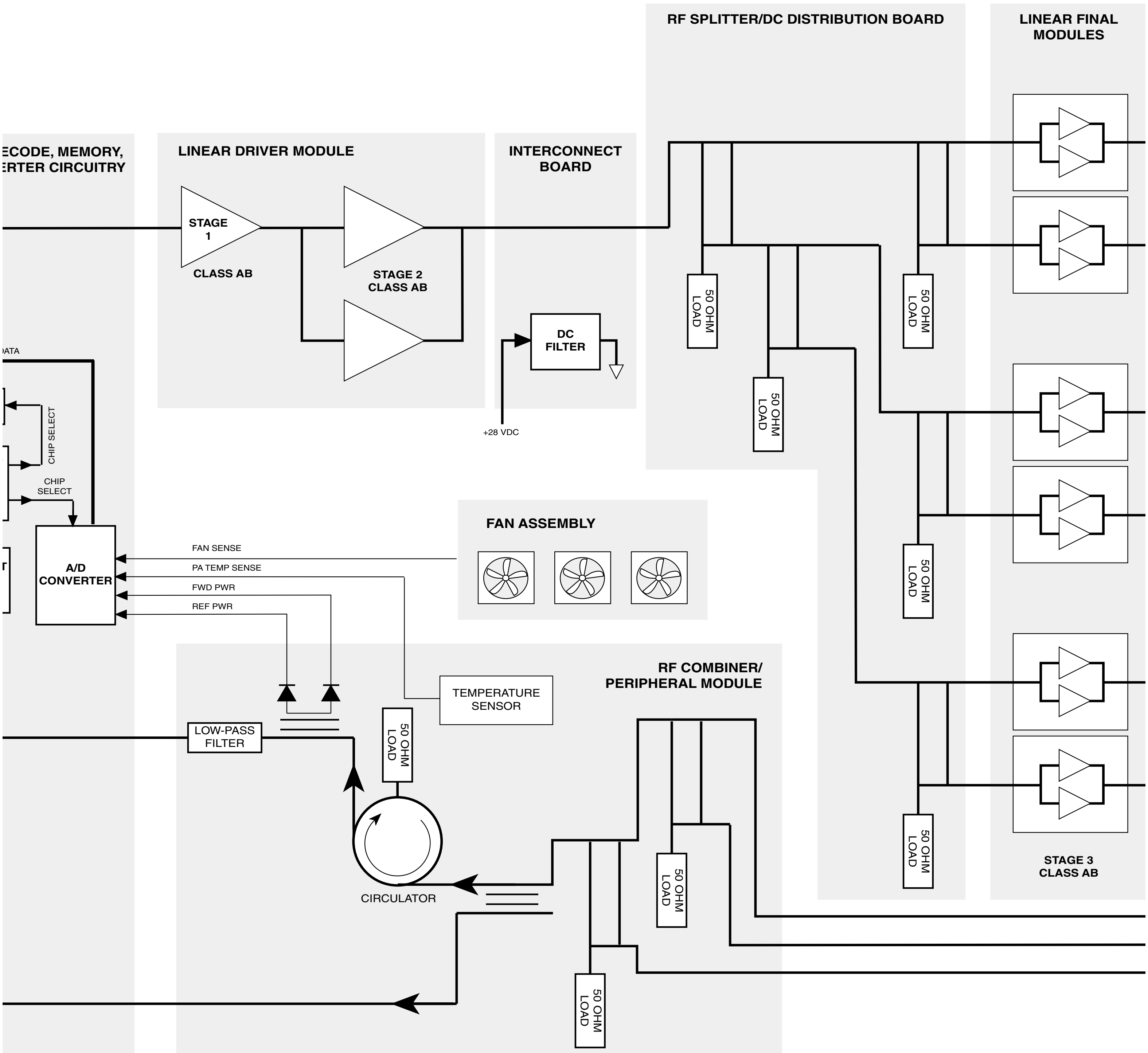


Figure 9-9 ***TLF2020 (TTF158***
Functional Block

Power Amplifier – TLN3335 (CTF1040)
gram



N3335 (CTF1040) 70 W, 800 MHz Power Amplifier Functional Block Diagram

DC Power Supply

DC Power Supply Overview

The DC Power Supply provides DC operating voltages to the Base Radio FRUs. It accepts input voltage sources from 41Vdc to 60Vdc. This input source may be either positively or negatively grounded.

On initial start up, the supply requires a nominal 43 Vdc. If the voltage drops below 41 V, the DC Power Supply reverts to a quiescent mode and does not supply any output power.

The DC Power Supply is designed for sites with an available source of DC voltage. Output voltages supplied from the DC Power Supply are 28.6 Vdc, 14.2 Vdc and 5.1 Vdc with reference to output ground. The supply is rated for 575 Watts of continuous output power with up to 113˚ F (45˚ C) inlet air. At 140˚ F (60˚ C), the 28.6 Vdc output is reduced to 80% of maximum power.

The DC Power Supply consists of the Power Supply and front panel hardware. The DC Power Supply interconnects to the chassis backplane using a edgecard style connector. The DC power supply is secured in the chassis with two Torx screws located on the front panel.

Figure 9-11 shows the DC Power Supply with the cover removed.

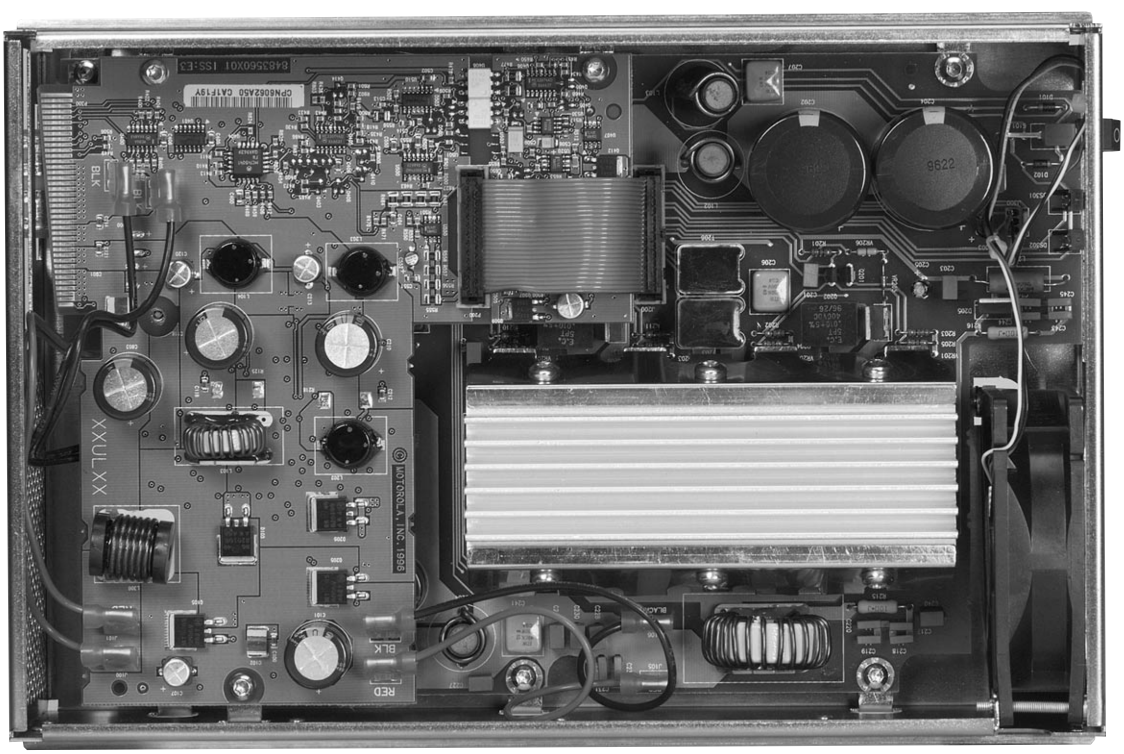


Figure 9-11 ***DC ower Supply***

Controls and Indicators

Table 9-10 summarizes the LED indicators on the DC Power Supply during normal operation. The ON / OFF switch located behind the front panel turns the DC power supply on and off.

Table 9-10 ***DC Power Supply Indicators***

LED	Condition	Indications
Green	Solid (on)	Power Supply is on and operating under normal conditions with no alarms
	Off	Power Supply is turned off or required power is not available
Red	Solid (on)	Power Supply fault or load fault on any output, or input voltage is out of range
	Off	Power Supply is under normal operation with no alarms

Performance Specifications

Table 9-11 lists the specifications for the DC Power Supply.

Table 9-11 ***DC Power Supply Specifications***

Description	Value or Range	
Operating Temperature	0° to +40° C (no derating) +41° to +60° C (derating)	
Input Voltage	41 to 60 Vdc	
Input Polarity	Positive (+) ground system	
Start-up Voltage	43 Vdc (minimum)	
Input Current	15.6 A (maximum) @ 41 Vdc	
Steady State Output Voltages	28.6 Vdc ±5% 14.2 Vdc ±5% 5.1 Vdc ±5%	
Total Output Power Rating	575 W (no derating) 485 W (derating)	
Output Ripple	All outputs 50mV p-p (measured with 20 MHz BW oscilloscope at 25°C) High Frequency individual harmonic voltage limits (10kHz to 100MHz) are:	
	28.6 Vdc	1.5 mV p-p
	14.2 Vdc	3.0 mV p-p
	5.1 Vdc	5.0 mV p-p
Short Circuit Current	0.5 A average (maximum)	

Theory of Operation

Table 9-12 briefly describes the basic DC Power Supply circuitry. Figure 9-12 shows the functional block diagrams for the DC Power Supply.

Table 9-12 **DC Power Supply Circuitry**

Circuit	Description
Input Circuit	Routes input current from the DC power input cable through the high current printed circuit edge connector, EMI filter, panel mounted combination circuit breaker, and on/off switch
Start-up Inverter Circuitry	Provides Vdc for power supply circuitry during initial power-up
Main Inverter Circuitry	Consists of a switching-type power supply to generate the +28.6 Vdc supply voltage
Temperature Protection	The Power Supply contains a built-in cooling fan that runs whenever the supply is powered on. The supply shuts down if temperature exceeds a preset threshold
+14.2 Vdc Secondary Converter Circuitry	Consists of a switching-type power supply to generate the +14.2 Vdc supply voltage
+5 Vdc Secondary Converter Circuitry	Consists of a switching-type power supply to generate the +5.1 Vdc supply voltage
Clock Generator Circuitry	Generates the 267 kHz and 133 kHz clock signals used by the pulse width modulators in the four inverter circuits
Address Decode, Memory, & A/D Converter	Serves as the main interface between A/D on the Power Supply and the BRC via the SPI bus

This Page Intentionally

Left Blank

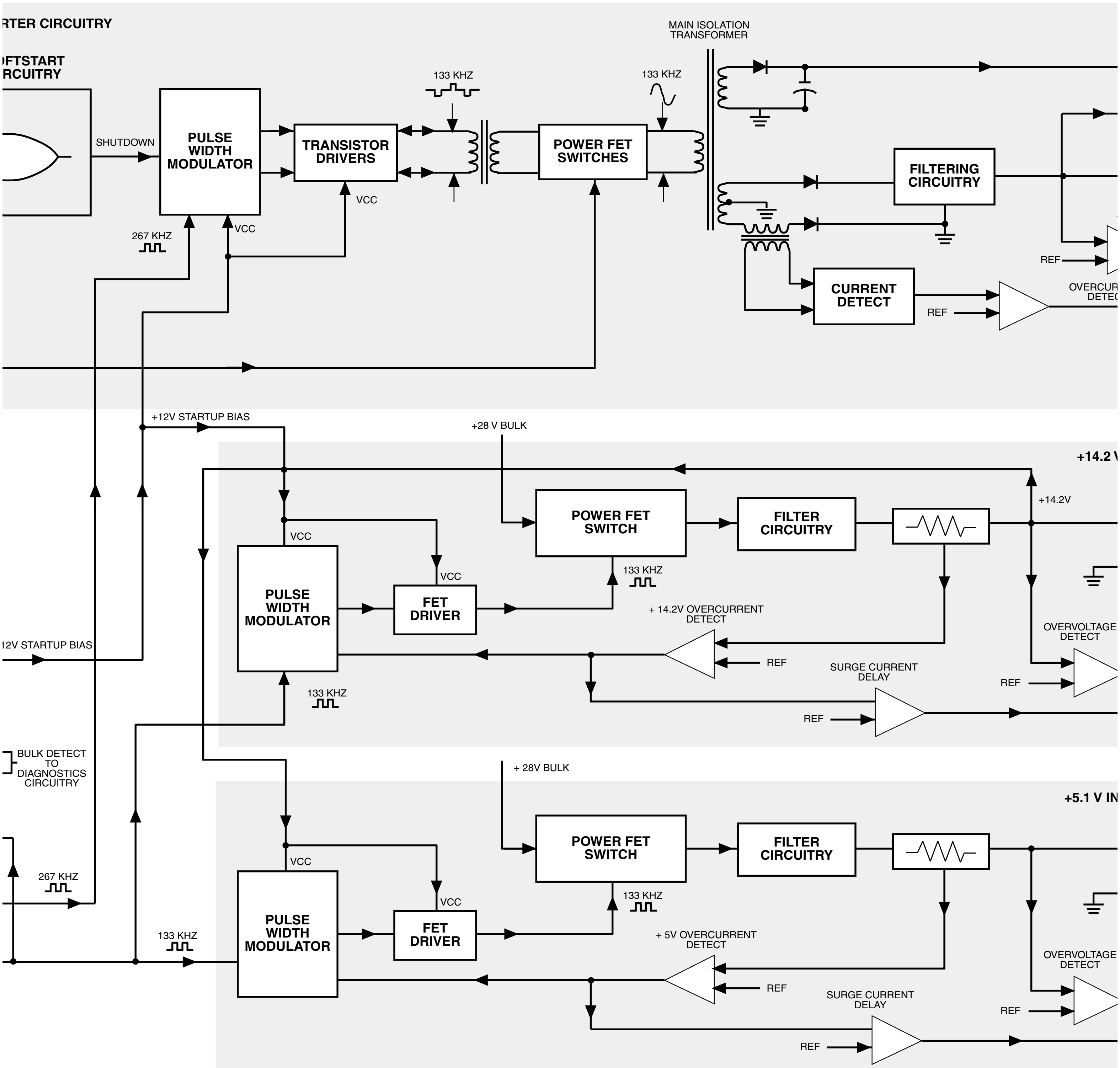
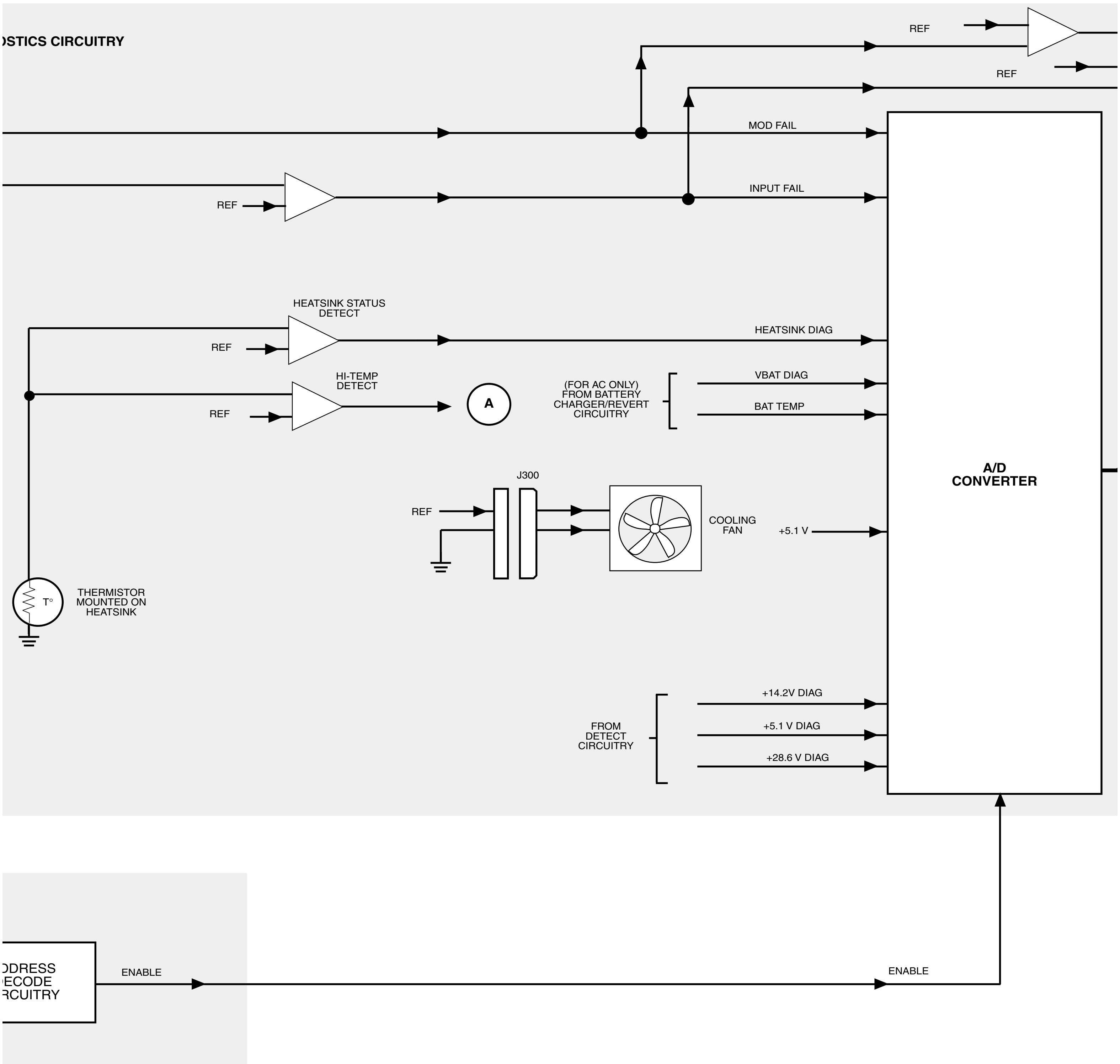


Figure 9-12 ***DC Power Supply Functional Blo***



r Diagram (Sheet 2 of 2)

AC Power Supply

AC Power Supply Overview

The AC Power Supply provides DC operating voltages for the Base Radio FRUs. The AC Power Supply accepts an AC input (90 to 280 Vac @ 47 to 63 Hz) to generate three output voltages: 28.6 Vdc, 14.2 Vdc and 5.1 Vdc with reference to output ground. The AC Power Supply automatically adjusts to the AC input ranges and supplies a steady output.

The AC Power Supply contains several switching-type power supply circuits, power factor correction circuitry, battery charger / revert circuitry, diagnostics and monitoring circuitry.

The battery charging / revert circuitry charges an external storage battery and automatically reverts to battery power in case of an AC power failure.

The Power Supply interconnects to the chassis backplane using an edgecard connector. Two Torx screws on the front panel of the AC Power Supply secure it in the chassis.

Figure 9-13 shows the front view of the AC Power Supply.

Figure 9-13 ***AC Power Supply (front view)***

Controls and Indicators

Table 9-13 lists and describes the indicators of the AC Power Supply. The power ON / OFF switch is used to turn the power supply on and off.

Table 9-13 ***AC Power Supply Indicators***

LED	Condition	Indications
Green	Solid (on)	Power Supply under normal operation with no alarms (the red LED is normally off when this LED is lit)
	Off	Power Supply is turned off or required power is not available
Red	Solid (on)	In battery revert mode, Power Supply fault, or load fault on any output
	Off	The Power Supply is under normal operation with no alarms

Performance Specifications

Table 9-14 lists the specifications for the AC Power Supply.

Table 9-14 ***AC Power Supply Specifications***

Description	Value or Range	
Operating Temperature	-30° to +45° C (no derating) -30° to +60° C (derating)	
Input Voltage	90 to 280 Vac	
Input Frequency Range	47 to 63 Hz	
Input Current	8.5 A (maximum)	
Steady State Output Voltages	28.6 Vdc ±5% 14.2 Vdc ±5% 5.1 Vdc ±5%	
Total Output Power Rating	625 W (no derating)* 595 W (derating)*	
Battery Charging Voltage Range	26 to 32.5 Vdc	
Output Ripple	All outputs 50 mV p-p (measured with 20 MHz BW oscilloscope at 25°C) High Frequency individual harmonic voltage limits (10 kHz to 100 MHz) are:	
	28.6 Vdc	1.5 mV p-p
	14.2 Vdc	3 mV p-p
	5.1 Vdc	5 mV p-p
Short Circuit Current	0.5 A average (maximum)	

* Includes 50 W for the battery charger.

Theory of Operation

Table 9-15 briefly describes the basic AC Power Supply circuitry. Figure 9-14 shows the functional block diagrams for the AC Power Supply.

Table 9-15 ***AC Power Supply Circuitry***

Circuit	Description
Input Conditioning Circuitry	Consists of ac line transient protection, EMI filtering, rectifier, power factor correction circuitry, and filtering
Start-up Inverter Circuitry	Provides Vcc for power supply circuitry during initial power-up
Main Inverter Circuitry	Consists of a switching-type power supply to generate the +28.6Vdc supply voltage
Temperature Protection	Contains a built-in thermostatically controlled cooling fan. The Power Supply shuts down if temperature exceeds a preset threshold
+14.2 Vdc Secondary Converter Circuitry	Consists of a switching-type power supply to generate the +14.2 Vdc supply voltage
+5 Vdc Secondary Converter Circuitry	Consists of a switching-type power supply to generate the +5 Vdc supply voltage
Clock Generator Circuitry	Generates 267 kHz and 133 kHz clock signals for the pulse width modulators in the four inverter circuits
Diagnostics Circuitry	Converts analog status signals to digital format for transfer to BRC
Address Decode, Memory, & A / D Converter	Serves as the main interface between A / D and D / A on the Power Supply and the BRC via the SPI bus
Battery Charging / Revert Circuitry	Offers features such as output short circuit protection, reversed battery protection, ambient battery temperature monitoring, and immediate revert to battery backup leaving no interruption of station operation In the event of an AC power failure, a battery revert relay is energized which places the storage battery on the +28 V bus which maintains station operation under backup power. An SCR in parallel with the relay contacts provides instant battery revert and protection for the relay contacts against arcing

This Page Intentionally

Left Blank

AC Powe

Functional Bl

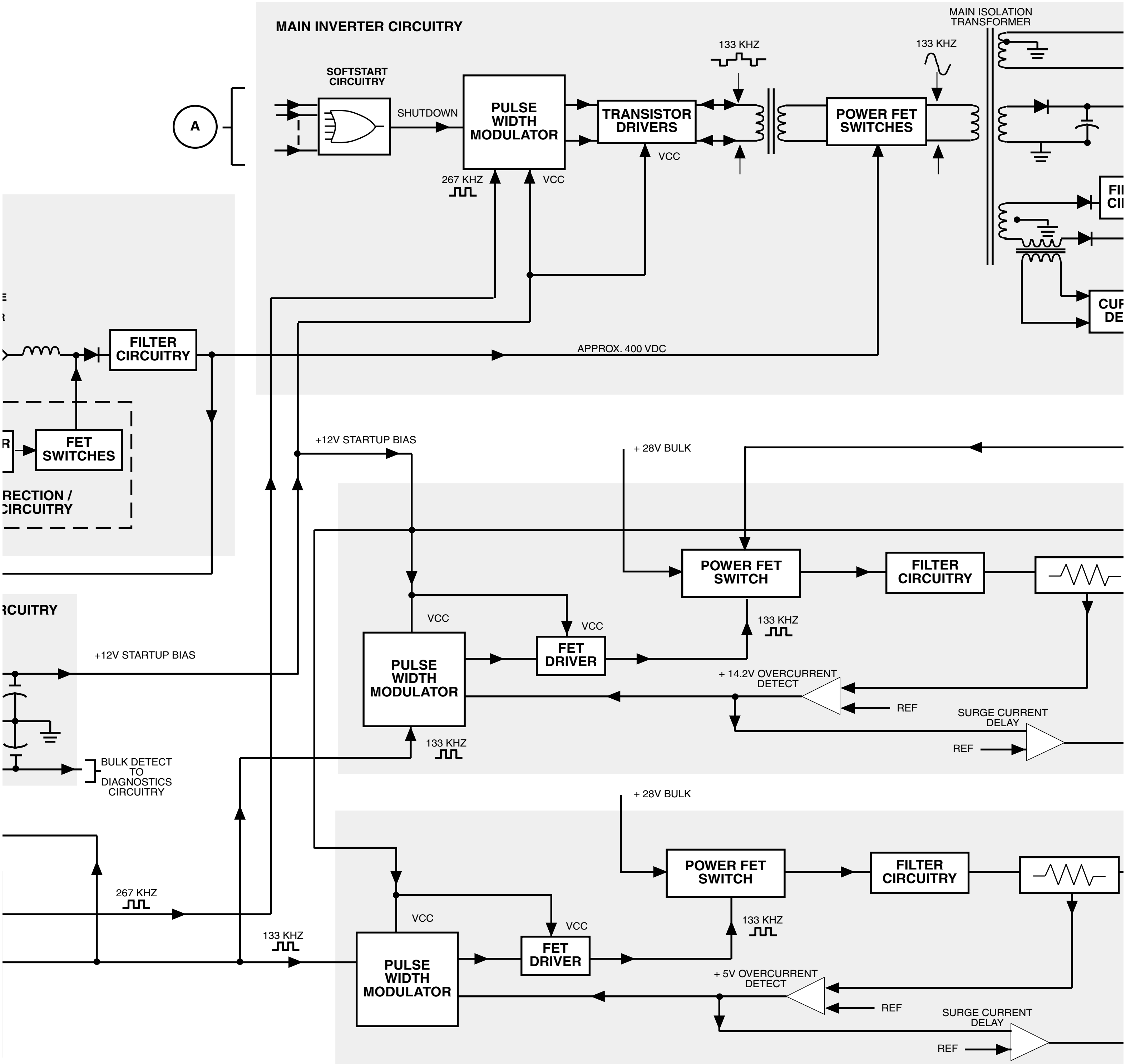
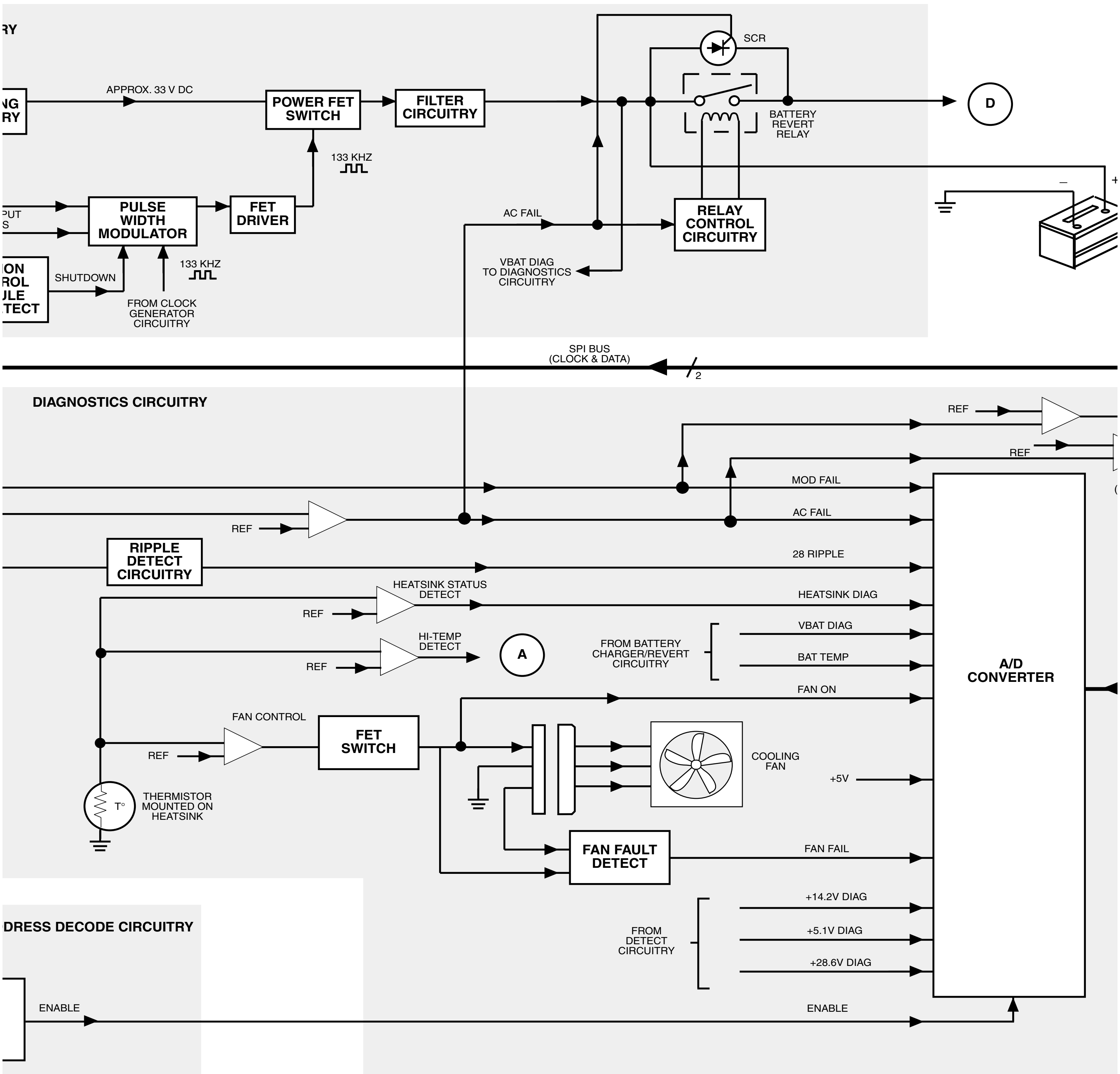


Figure 9-14 ***AC Power Sup***



iagram (Sheet 2 of 2)

800 MHz 3X Receiver – CLN1283

Overview

The 3X Receiver provides the receiver functions for the Base Radio. It consists of a receiver board, a slide-in housing, and associated hardware. The 3X Receiver incorporates one to three diversity branches on a single module. Figure 9-15 shows a top view of the Receiver with the cover removed.

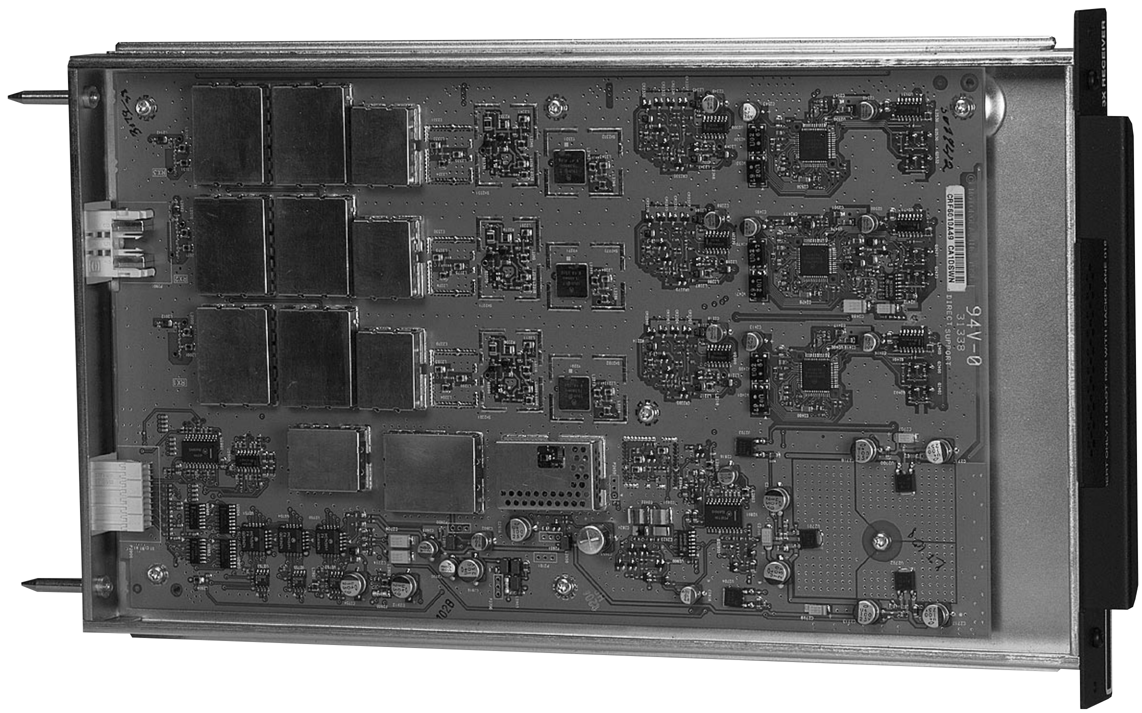


Figure 9-15 ***3X Receiver (with cover removed)***

Definition and Identification

The 3X receiver kit contains three receivers on a single board. This allows a single module to provide three-branch diversity BR functionality. To identify 3X receiver boards in the EBTS, use the MMI command **get_rx1_kit_no**. This command can be used on all receiver models, and reports the kit number from the receiver's EEPROM. The 3X receiver can also be identified by visual inspection of the front panel. Because the 3X receiver can only be inserted into the middle receiver slot, the front panel of a 3X receiver reads **INSERT ONLY IN SLOT RX2 WITH BACKPLANE 0183625X 3X RECEIVER**.

The two remaining receiver slots are covered with blank panels. A summary of the Receiver FRUs available for the Base Radio is provided in the chart below.

Table 9-16 ***Receiver FRUs***

Receiver FRUs		Chassis FRUs	
3X Receiver: 800 MHz	CLN1283	With 3x Receiver Backplane: 800 MHz	CLN1282
Single Receiver: 800 MHz	TLN3336	With Single Receiver Backplane: 800 MHz	TLN3333

Replacement Compatibility

The 3X Receiver board (CRF6010 or CRF6030) can only be used in receive slot 2 (middle receiver slot) with backplane 0183625X. The backplane connector is different than the TRF6560 version of the receiver board. This is why there is a need for a new backplane. The receiver will function only when it is installed in slot 2. The TRF6560 receiver will not make electrical connection in any slot of the new backplane. Compatibility between the new and old receiver boards is summarized in Table 9-17.

Table 9-17 ***800 MHz Base Radio Receiver Board/BR Backplane Compatibility***

	CRF6101 3X Receiver	TRF6560 Receiver
New backplane 0183265X--	Compatible	Not compatible
Old backplane 0182416W--	Not compatible	Compatible

Diversity Configuration

There is a new software parameter used for diversity purposes with the CLN1283 and CLN1356 3X Receivers. The parameter is the **rx_fru_config** parameter. The diversity issues to consider are described in the following paragraph. This parameter can be accessed through the MMI commands using the Motorola password. ROMs prior to version R06.06.17 do not support the **rx_fru_config** parameter. The ROM version in a base repeater can be checked using the MMI command **ver**. If a repeater contains the CRF6010 or CRF6030 receiver, the BRC board must be populated with a compatible version of ROM. Table 9-18 lists the ROM compatibilities.

Table 9-18 ***Receiver ROM Compatibility***

	CRF6010/CRF6030	TRF6560
ROM version R06.03.40	Not compatible	Compatible
ROM version R06.06.09	Not compatible	Compatible
ROM version R06.06.17	Not compatible	Compatible
ROM versions newer than R06.06.17	Compatible	Compatible

NOTE

When replacing FRUs, ensure that the ROM version on the BRC installed in the base radio is compatible with the ROM version on the Receiver.

NOTE

If downloaded code is used, then the downloaded code can be used to change the needed parameter (the **rx_fru_config** parameter).

Diversity Uses and Cautions

The 3X receiver board can be used in one, two, or three branch diversity systems. The number of active receivers is determined by the **rx_fru_config** parameter stored on the Base Radio Control (BRC) board. The **rx_fru_config** parameter is only valid, and must be set properly for, systems utilizing the CRF6010 or CRF6030 3X Receiver board. The **rx_fru_config** parameter is ignored by Base Radios that have ROM older than version R06.06.17 installed on the Base Radio Controller board.

To view the **rx_fru_config** parameter, use the MMI command **get rx_fru_config**. The configuration of each repeater can be changed in the field to match the number of receivers connected to antennas. To change the rx_fru_config parameter, use the command set **rx_fru_config yyy**, where yyy is the active receiver (yyy is 1 for one branch, 12 for two branch, and 123 for three branch diversity. For the iDEN system to work optimally, the **rx_fru_config** parameter must match the number of receivers connected to antennas.

CAUTION

There will be significant system degradation if the **rx_fru_config** parameter is not properly set in systems with the CLN1283 or CLN1356 3X receiver kit.

Modifying Base Radios from Three Branch to Two Branch Diversity

NOTE

This procedure is applicable only to Base Radios equipped with the CRF6010 or CRF6030 3X Receiver Board.

When modifying a three branch Base Radio to a two branch Base Radio, it is important to observe all precautionary statements in the previous paragraph.

To modify a three branch Base Radio to a two branch Base Radio:

1. Disconnect the RF cable from the RX3 connector on the Base Radio.
2. Connect an SMA male load (Motorola part number 5882106P03) to the RX3 connector on the Base Radio.

   The SMA male load is required to limit the amount of radiated emissions.
3. Verify that the **rx_fru_config** parameter is set properly as described in the Diversity Uses and Cautions paragraph.

Modifying Base Radios from Two Branch to Three Branch Diversity

1. Remove the SMA male load from the RX3 connector of the Base Radio you wish to convert from two branch diversity to three branch diversity.
2. Connect the Receive Antenna #3 RF cable to the RX3 connector on the Base Radio.
3. Verify that the **rx_fru_config** parameter is set properly as described in the Diversity Uses and Cautions paragraph.

Theory of Operation

The Receiver performs highly selective bandpass filtering and dual down conversion of the station receive RF signal. A custom Receiver IC outputs the baseband information in a differential data format and sends it to the BRC.

Table 9-19 lists the Receiver circuitry and Figure 9-16 shows a functional block diagram for the Receiver.

Table 9-19 ***Receiver Circuitry***

Circuit	Description
Frequency Synthesizer Circuitry	Consists of a phase-locked loop and VCO. It generates the 1st LO injection signal for all three receivers.
Receiver Front-End Circuitry	Provides filtering, amplification, and the 1st down conversion of the receive RF signal. Digital step attenuators at the 1st IF are included in this block.
Custom Receiver IC Circuitry	Consists of a custom IC to perform the 2nd down conversion, filtering, amplification, and conversion of the receive signal. This block outputs the receive signal as differential data to the BRC.
Address Decode, A / D Converter, & Memory Circuitry	Performs address decoding for board and chip select signal, converts analog status signals to digital format for use by the BRC. A memory device holds module specific information.
Local Power Supply Regulation	Accepts +14.2 Vdc input from the backplane interconnect board and generates two +10 Vdc, a +11.5 Vdc, and two +5 Vdc signals for the receiver.

Frequency Synthesizer and VCO Circuitry

The synthesizer and VCO circuitry generate the RF signal used to produce the 1st LO injection signal for the first mixer in all the Receiver front end circuits. Functional operation of these circuits involves a Phase-Locked Loop (PLL) and VCO.

The PLL IC receives frequency selection data from the BRC module microprocessor via the SPI bus. Once programmed, the PLL IC compares a 2.1 MHz reference signal from the BRC with a feedback sample of the VCO output from its feedback buffer.

Correction pulses are generated by the PLL IC, depending on whether the feedback signal is higher or lower in frequency than the 2.1 MHz reference. The width of these pulses is dependent on the amount of difference between the 2.1 MHz reference and the VCO feedback.

The up / down pulses are fed to a charge pump circuit that outputs a DC voltage proportional to the pulse widths. This DC voltage is low-pass filtered and fed to the VCO circuit as the control voltage. The control voltage is between +2.5 Vdc and +7.5 Vdc.

The DC control voltage from the synthesizer is fed to the VCO, which generates the RF signal used to produce the 1st LO injection signal. The VCO responds to the DC control voltage by generating the appropriate RF signal. This signal is fed through a buffer to the 1st LO injection amplifier. A sample of this signal is returned to the PLL IC through a buffer to close the VCO feedback loop.

Receiver Front End Circuitry

The station receive RF signal enters the Receiver through the RF-type connector located on the back of the Receiver board. This signal is low-pass filtered and amplified. The amplified output is image filtered before being input to the 1st mixer. The signal mixes with the 1st LO injection signal to produce a 73.35 MHz 1st IF signal.

The 1st IF signal is sent through a 4-pole bandpass filter and fed to a buffer amplifier. The buffer amplifier output signal is 4-pole bandpass filtered again and the resultant signal is then passed through a digital attenuator. This attenuation is determined by the BRC. The resulting signal is then fed to the RF input of the custom receive IC.

Custom Receiver IC Circuitry

The custom Receiver IC provides additional amplification, filtering, and a second down-conversion. The 2nd IF signal is converted to a digital signal and is output via differential driver circuitry to the BRC. This data signal contains the necessary I and Q information, AGC information, and other data transfer information required by the BRC to process the receive signal.

The remainder of the custom Receiver IC circuitry consists of timing and tank circuits to support the internal oscillator, 2nd LO synthesizer circuitry, and 2nd IF circuitry.

A serial bus provides data communications between the custom Receiver IC and the DSP Glue ASIC (DGA) located on the BRC. This bus enables the DGA to control various current and gain settings, establish the data bus clock rate, program the 2nd LO, and perform other control functions.

Address Decode Circuitry

The address decode circuitry enables the BRC to use the SPI bus to select a specific device on a specific Receiver for control or data communication purposes.

If the board select circuitry decodes address lines A2 through A5 as the Receiver address, it enables the chip select circuitry. The chip select circuitry then decodes address lines A0 and A1 to generate the chip select signals for the EEPROM, A/D converter, and PLL IC.

Memory Circuitry

The memory circuitry consists of three EEPROMs located on the Receiver. The BRC performs all memory read and write operations via the SPI bus. Information stored in this memory device includes the kit number, revision number, module specific scaling and correction factors, and free form module information (scratch pad).

A/D Converter Circuitry

Analog signals from various strategic operating points throughout the Receiver board are fed to the A / D converter. These analog signals are converted to a digital signal and are output to the BRC via the SPI lines upon request of the BRC.

Voltage Regulator Circuitry

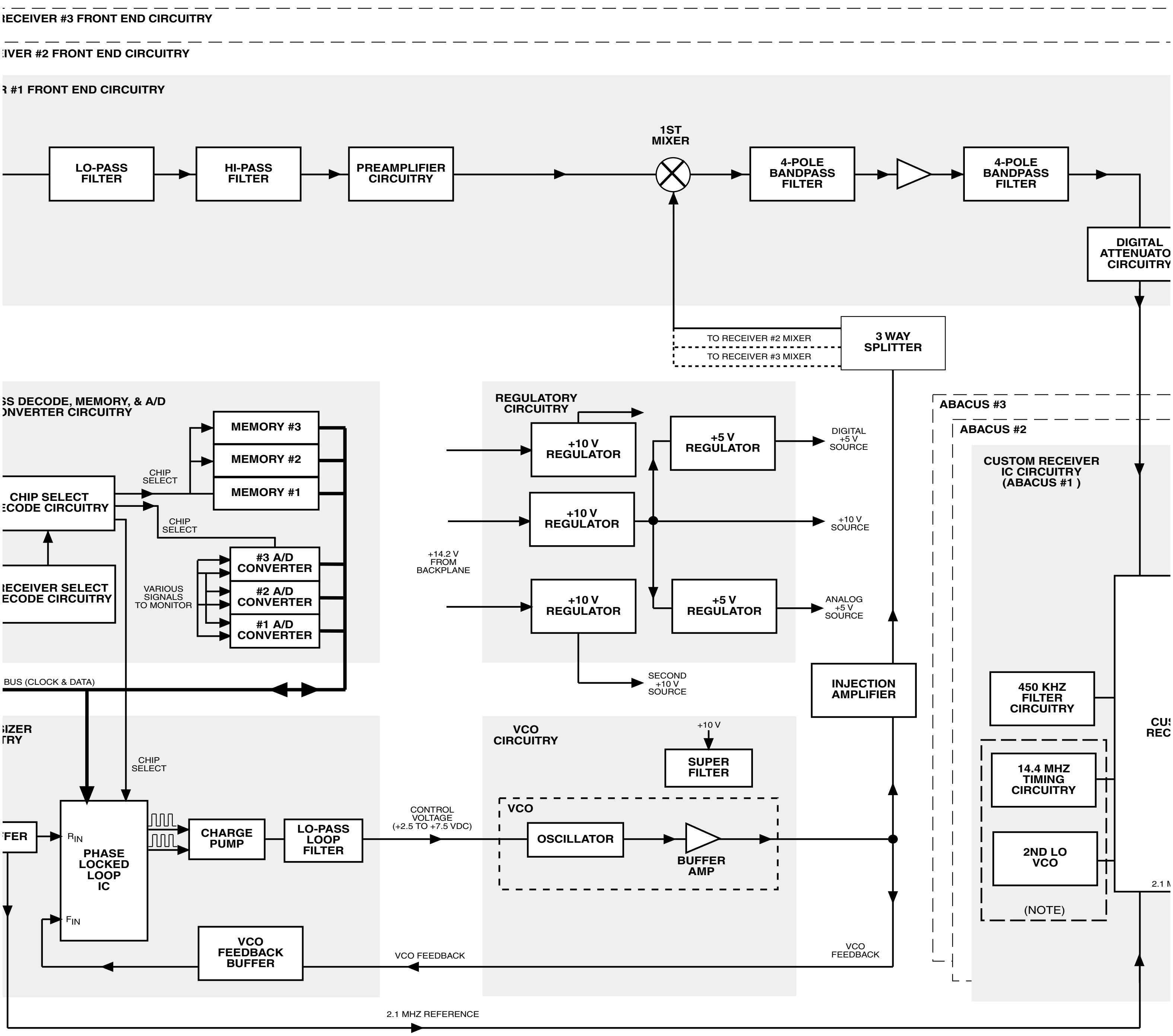
The voltage regulator circuitry consists of two +10 Vdc, a +10.8 Vdc, and two +5 Vdc regulators. The two +10 Vdc and the +10.8 Vdc regulators accept the +14.2 Vdc input from the backplane interconnect board and generate the operating voltages for the Receiver circuitry.

The +10 Vdc regulators each feed a +5 Vdc regulator, one of which outputs Analog +5 Vdc, and the other Digital +5 Vdc operating voltages for use by the custom Receiver IC.

A +5.1 Vdc operating voltage is also available from the backplane interconnect board to supply +5.1 Vdc to the remainder of the Receiver circuitry.

This Page Intentionally

Left Blank



4 MHz TIMING CIRCUITRY AND 2ND LO VCO PRESENT ONLY ON ABACUS #2.
NCTIONS ARE SHARED FOR ALL THREE ABACUS SECTIONS.

Figure 9-16 ***3X Receiver Functio***

This Page Intentionally

Left Blank

Troubleshooting

Overview

This subsection serves as a guide for isolating Base Radio failures to the FRU level. It contains procedures for:

- Troubleshooting
- Verification / Station Operation

The maintenance philosophy for the Base Radio is to repair by replacing defective FRUs with new FRUs. This maintenance method limits down-time and quickly restores the Base Radio to normal operation.

Two troubleshooting procedures for the Base Radio are included. Each procedure is designed to quickly identify faulty FRUs.

Ship defective FRUs to a Motorola repair depot for repair.

Recommended Test Equipment

Table 9-20 lists the recommended test equipment necessary for performing the Base Radio troubleshooting / verification procedures.

Table 9-20 ***Recomme33nded Test Equipment***

Test Equipment	Model Number	Use
Communications Analyzer	R2660 w / iDEN option	Used for checking receive and transmit operation (iDEN signaling capability) and station alignment
Dummy Load (50 Ω, 150 W)	none	Used to terminate output
Service Computer	IBM or clone, 80286 or better	Local service terminal
Portable Rubidium Frequency Standard	Ball Efratom	Frequency standard for R2660, netting TFR
Power Meter	none	Used to measure reflected and forward power
RF Attenuator, 250 W, 10 dB	Motorola 0180301E72	Protection for R2660
Software:		
Communication	Procomm Plus	Local service computer
File Compression	PKZip	Compress / Decompress data

Troubleshooting Procedures

Many of the troubleshooting and station operation procedures require Man-Machine Interface (MMI) commands. These commands are used to communicate station level commands to the Base Radio via the RS-232 communications port located on the front of the BRC.

Routine Checkout

Procedure 1 is a quick, non-intrusive test performed during a routine site visit. Use this procedure to verify proper station operation without taking the station out of service. Figure 9-17 shows the Procedure 1 Troubleshooting Flowchart.

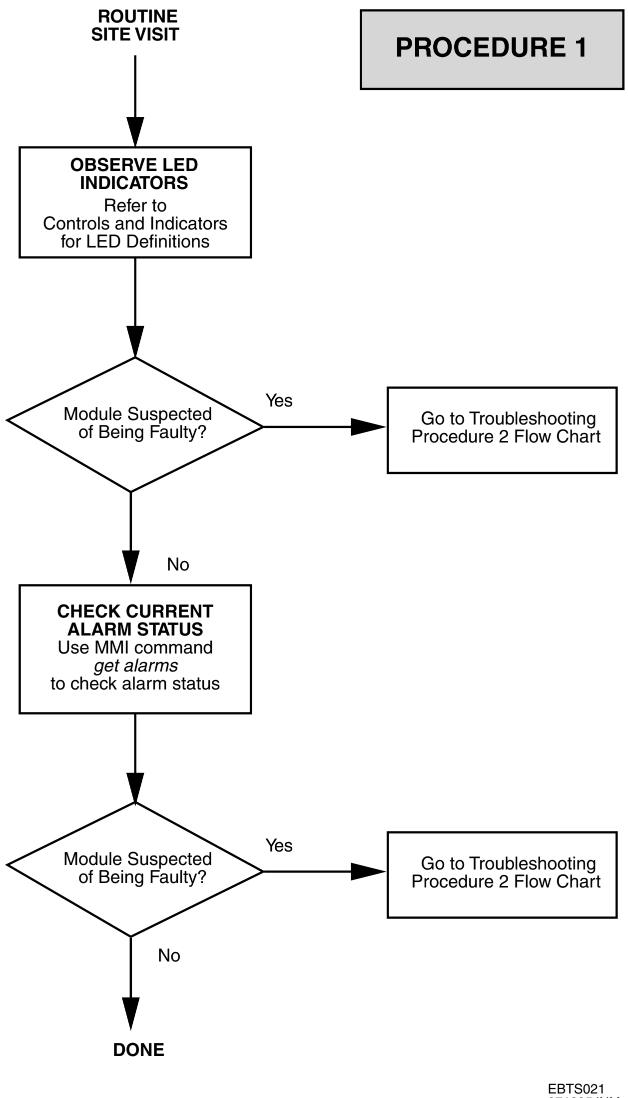


Figure 9-17 ***Procedure 1 Troubleshooting Flowchart***

Reported/Suspected Problem

Use Procedure 2 to troubleshoot reported or suspected equipment malfunctions. Perform this procedure with equipment in service (non-intrusive) and with equipment taken temporarily out of service (intrusive).

Figure 9-18 shows the Procedure 2 Troubleshooting Flowchart.

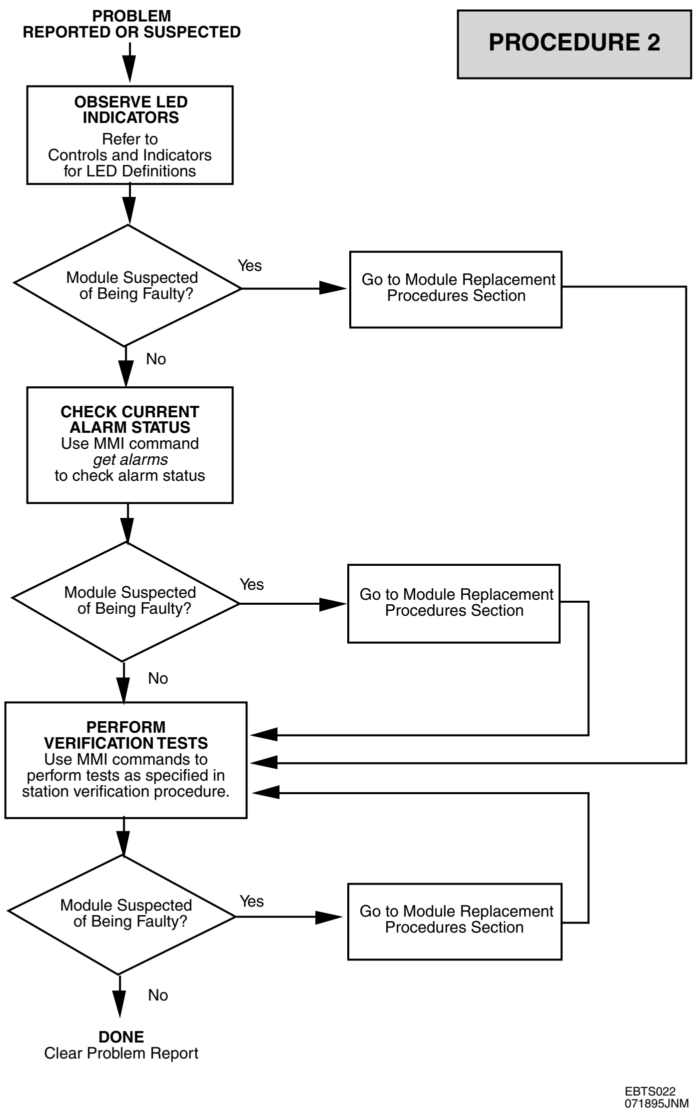


Figure 9-18 ***Procedure 2 Troubleshooting Flowchart***

Base Radio/Base Radio FRU Replacement Procedures

Replace suspected station modules with known non-defective modules to restore the station to proper operation. The following procedures provide FRU replacement instructions and post-replacement adjustments and/or verification instructions.

Base Radio Replacement Procedure

NOTE

The Base Radio removal and installation procedures are included for reference or buildout purposes. Field maintenance of Base Radios typically consists of replacement of FRUs within the Base Radio. Perform Base Radio FRU replacement in accordance with “Base Radio FRU Replacement Procedure” below.

Perform Base Radio (BR) replacement as described in the following paragraphs.

Removal

Remove BR from Equipment Cabinet as follows:

1. Remove power from the Base Radio by setting the Power Supply ON/OFF switch to the OFF position.
2. Tag and disconnect the cabling from the BR rear panel connectors.
3. Remove the four M6 TORX screws which secure the BR front panel to the Equipment Cabinet mounting rails.

! WARNING !

BR WEIGHT EXCEEDS 60 LBS (27 KG). USE TWO-PERSON LIFT WHEN REMOVING BR FROM EQUIPMENT CABINET. MAKE CERTAIN BR IS FULLY SUPPORTED WHEN BR IS FREE FROM MOUNTING RAILS.

4. While supporting the BR, carefully remove the BR from the Equipment Cabinet by sliding the BR from the front of cabinet.

Installation

Install BR in Equipment Cabinet as follows:

1. If adding a BR, install side rails in the appropriate BR mounting position in the rack.

! WARNING !

BR WEIGHT EXCEEDS 60 LBS (27 KG). USE TWO-PERSON LIFT WHEN INSTALLING BR IN EQUIPMENT CABINET. MAKE CERTAIN BR IS FULLY SUPPORTED UNTIL BR IS FULLY PLACED IN MOUNTING POSITION.

2. While supporting the BR, carefully lift and slide the BR in the Equipment Cabinet mounting position.
3. Secure the BR to the Equipment Cabinet mounting rails using four M6 TORX screws. Tighten the screws to 40 in-lb (4.5 Nm).
4. Connect the cabling to the BR rear panel connectors as tagged during the BR removal. If adding a BR, perform the required cabling in accordance with the Cabling Information subsection of the RFDS section applicable to the system.
5. Perform BR activation in accordance with Station Verification Procedures below.

Anti-Static Precautions

CAUTION

The Base Radio contains static-sensitive devices. when replacing Base Radio FRUs, always wear a grounded wrist strap and observe proper anti-static procedures to prevent electrostatic discharge damage to Base Radio modules.

Motorola publication 68P81106E84 provides complete static protection information. This publication is available through Motorola National Parts.

Observe the following additional precautions:

- ❒ Wear a wrist strap (Motorola Part No. 4280385A59 or equivalent) at all times when servicing the Base Radio to minimize static build-up.
- ❒ A grounding clip is provided with each EBTS cabinet. If not available, use another appropriate grounding point.
- ❒ DO NOT insert or remove modules with power applied to the Base Radio. ALWAYS turn the power OFF using the Power Supply rocker switch on the front of the Power Supply module.
- ❒ Keep spare modules in factory packaging for transporting. When shipping modules, always pack in original packaging.

FRU Replacement Procedure

Perform the following steps to replace any of the Base Radio FRUs:

NOTE

When servicing Base Radios (BRs), in situations where the Control Board or the entire BR is replaced, the integrated Site Controller (iSC) will automatically reboot the serviced BR given that the BR has been off-line for a period not less than that stipulated by the “Replacement BRC Accept Timer” (default is 3 minutes). If the BR is turned on prior to the expiration of the “Replacement BRC Accept Timer”, power the BR back down and wait the minimum timer length before turning the BR back on.

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.

2. Loosen the front panel fasteners. These are located on each side of the module being replaced.
3. Pull out the module.
4. Insert the non-defective replacement module by aligning the module side rails with the appropriate rail guides inside the Base Radio chassis.
5. Gently push the replacement module completely into the Base Radio chassis assembly using the module handle(s).

CAUTION

DO NOT slam or force the module into the chassis assembly. This will damage the connectors or backplane.

6. Secure the replacement module by tightening the front panel fasteners to the specified torque of 5 in-lbs.
7. Apply power to the Base Radio by setting the switch to the ON position.
8. Perform the Station Verification Procedure provided below.

Station Verification Procedures

Perform the Station Verification Procedures whenever you replace a FRU. The procedures verify transmit and receive operations. Each procedure also contains the equipment set-up.

Replacement FRU Verification

All module specific information is programmed in the factory prior to shipment. Base Radio specific information (e.g. receive and transmit frequencies) is downloaded to the Base Radio from the network / site controller.

Replacement FRU alignment is not required for the Base Radio.

Base Repeater FRU Hardware Revision Verification

NOTE

The following procedure requires the Base Radio to be out of service. Unless the Base Radio is currently out of service, Motorola recommends performing this procedure during off-peak hours. This minimizes or eliminates disruption of service to system users.

1. Connect one end of the RS-232 cable to the service computer.
2. Connect the other end of the RS-232 cable to the STATUS port, located on the front panel of the BRC.
3. Using the field password, login to the BR.
4. Collect revision numbers from the station by typing the following commands:

```
>dekey
>test_mode
>get brc_rev_no
>get rx1_rev_no
>get rx2_rev_no
>get rx3_rev_no          (if BR is 3 branch)
>get pa_rev_no
>get ex_rev_no
```

5. If all modules return revision numbers of the format “Rxx.xx.xx”, then all revision numbers are present and no further action is required. Log out and repeat steps 1 through 4 for each additional BR.

   If revision numbers were returned as blank or not in the format “Rxx.xx.xx”, contact your local Motorola representative or Technical Support.

6. When all BRs have been checked, log out.

Transmitter Verification

The transmitter verification procedure verifies the transmitter operation and the integrity of the transmit path. This verification procedure is recommended after replacing an Exciter, Power Amplifier, BRC, or Power Supply module.

NOTE

The following procedure requires the Base Radio to be out of service. Unless the Base Radio is currently out of service, Motorola recommends performing this procedure during off-peak hours. This minimizes or eliminates disruption of service to system users.

Equipment Setup

To set up the equipment, use the following procedure:

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.

2. Connect one end of the RS-232 cable to the service computer.

3. Connect the other end of the RS-232 cable to the STATUS port located on the front panel of the BRC.

4. Disconnect the existing cable from the connector labeled PA OUT.

   This connector is located on the backplane of the Base Radio.

5. Connect a test cable to the PA OUT connector.

6. Connect a 10 dB attenuator on the other end of the test cable.

7. From the attenuator, connect a cable to the RF IN / OUT connector on the R2660 Communications Analyzer.

8. Remove power from the R2660 and connect the Rubidium Frequency Standard 10MHZ OUTPUT to a 10 dB attenuator.

9. Connect the other end of the 10 dB attenuator to the 10MHZ REFERENCE OSCILLATOR IN / OUT connector on the R2660.

NOTE

Refer to the equipment manual provided with the R2660 for further information regarding mode configuration of the unit (Motorola Part No. 68P80386B72).

10. Set the R2660 to the EXT REF mode.
11. Apply power to the R2660.
12. Set the R2660 to the SPECTRUM ANALYZER mode with the center frequency set to the transmit frequency of the Base Radio under test.
13. Perform the appropriate transmitter verification procedure below for the particular Power Amplifier used in the Base Radio.

Transmitter Verification Procedure (40W, 800 MHz Power Amplifier – TLF2020)

This procedure provides commands and responses to verify proper operation of the transmit path for 800 MHz Base Radios using a 40 Watt Power Amplifier.

1. Apply power to the Base Radio by setting the switch to the 1 position.

   The following message displays on the service computer during power-up.

```
Base Radio
firmware revision RXX.XX.XX
Copyright © 1998
Motorola, Inc. All rights reserved.

Unauthorized access prohibited

Enter login password:
```

2. Enter the proper password. After entering the correct password, the BRC> prompt is displayed on the service computer.

   The default password is **motorola**

NOTE

Motorola recommends that you change the default password once proper operation of the equipment is verified.

3. At the BRC> prompt, type: **dekey**

This command verifies that there is no RF power being transmitted.

```
BRC> dekey
XMIT OFF INITIATED
```

CAUTION

The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into a RF load.

4. At the BRC> prompt, type: **set tx_power 40**

This command sets the transmitter output to 40 Watts.

```
BRC> set tx_power 40
setting transmitter power to 40 watts

TXLIN ATTENUATION: 5.000000


TARGET POWER: 40.00 watts [46.02 dBm]
ACTUAL POWER: 37.77 watts [45.07 dBm]
POWER WINDOW: 38.20-> 41.89 watts [45.82 -> 46.22 dBm]
TXLIN LEVEL REGISTER REDUCED 59 STEPS [-2.30 dB].
TXLIN LEVEL: 0x6f

completed successfully
```

After keying the Base Radio, verify the forward and reflected powers of the station along with the station VSWR with the parameters listed in Table 9-21.

Table 9-21 ***40W, 800 MHz PA Transmitter Parameters***

Parameter	Value or Range
Forward Power	Greater than 38.0 Watts
Reflected Power	Less than 4.0 Watts
VSWR	Less than 2:1

5. At the BRC> prompt, type: **get fwd_pwr**

   This command returns the current value of forward power from the RF Power Amplifier.

```
BRC> get fwd_pwr
FORWARD POWER is 39.13 watts [45.92 dBm]
```

6. At the BRC> prompt, type: **get ref_pwr**

   This command returns the current value of reflected power from the RF Power Amplifier.

```
BRC> get ref_pwr
REFLECTED POWER is 0.27 watts [24.28 dBm]
```

7. At the BRC> prompt, type: **get vswr**

   This command calculates the current Voltage Standing Wave Ratio (VSWR) from the RF Power Amplifier.

```
BRC> get vswr
VSWR is 1.17:1
```

8. At the BRC> prompt, type: **get alarms**

   This command returns all active alarms of the Base Radio.

```
BRC> get alarms
NO ALARM CONDITIONS DETECTED
```

NOTE

If the **get alarms** command displays alarms, refer to the *System Troubleshooting* section of this manual for corrective actions.

9. View the spectrum of the transmitted signal on the R2660 Communications Analyzer in the Spectrum Analyzer mode. Figure 9-19 shows a sample of the spectrum.

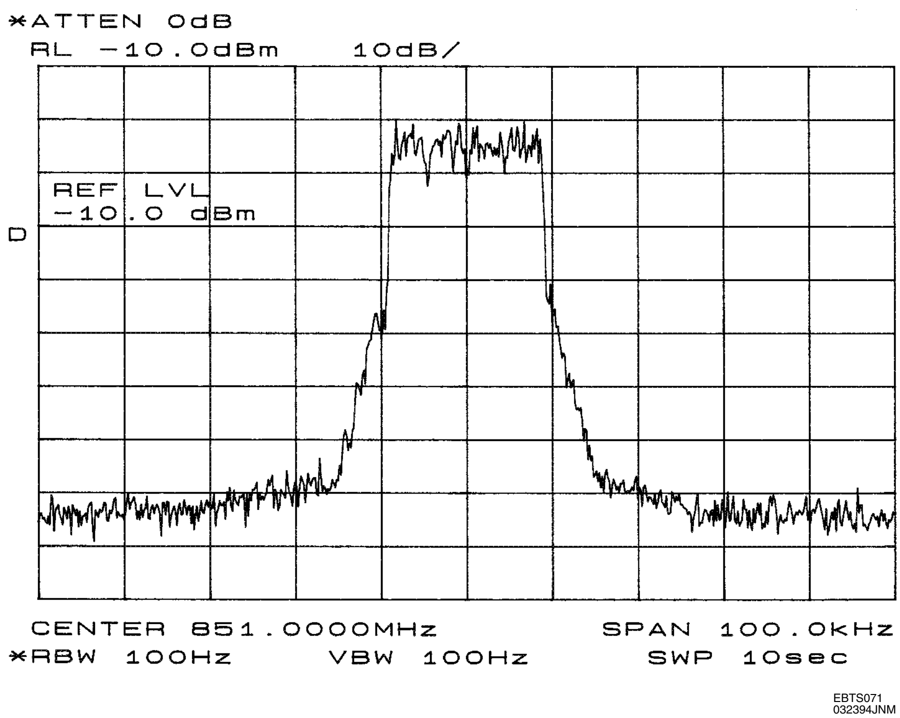


Figure 9-19 ***Transmitted Signal Spectrum (800 MHz BR)***

10. At the BRC> prompt, type: **dekey**

This command stops all transmitter activity.

```
BRC> dekey
XMIT OFF INITIATED
```

Transmitter Verification Procedure (70W, 800 MHz Power Amplifiers)

This procedure provides commands and responses to verify proper operation of the transmit path for 800 MHz Base Radios using a 70 Watt Power Amplifier.

1. Apply power to the Base Radio by setting the switch to the 1 position.

The following message displays on the service computer during power-up.

```
Base Radio
firmware revision RXX.XX.XX
Copyright © 1998
Motorola, Inc. All rights reserved.

Unauthorized access prohibited

Enter login password:
```

2. Enter the proper password. After entering the correct password, the BRC> prompt is displayed on the service computer.

The default password is **motorola**

NOTE

Motorola recommends that you change the default password once proper operation of the equipment is verified.

3. At the BRC> prompt, type: **dekey**

This command verifies that there is no RF power being transmitted.

```
BRC> dekey
XMIT OFF INITIATED
```

CAUTION

The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into an RF load.

4. At the BRC> prompt, type: **set tx_power 70**

This command sets the transmitter output to 70 Watts.

```
BRC> set tx_power 70
setting transmitter power to 70 watts

TXLIN ATTENUATION: 5.000000


TARGET POWER: 70.00 watts [48.45 dBm]
ACTUAL POWER: 56.70 watts [47.54 dBm]
POWER WINDOW: 66.85 -> 73.30 watts [48.25 -> 48.65 dBm]
TXLIN LEVEL REGISTER REDUCED 85 STEPS [-3.32 dB].
TXLIN LEVEL: 0x55

completed successfully
```

After keying the Base Radio, verify the forward and reflected powers of the station along with the station VSWR with the parameters listed in Table 9-22.

Table 9-22 ***70W, 800 MHz PA Transmitter Parameters***

Parameter	Value or Range
Forward Power	Greater than 66.5 Watts
Reflected Power	Less than 7.0 Watts
VSWR	Less than 2:1

5. At the BRC> prompt, type: **get fwd_pwr**

This command returns the current value of forward power from the RF Power Amplifier.

```
BRC> get fwd_pwr
FORWARD POWER is 68.55 watts [48.36 dBm]
```

6. At the BRC> prompt, type: **get ref_pwr**

   This command returns the current value of reflected power from the RF Power Amplifier.

```
BRC> get ref_pwr
REFLECTED POWER is 2.10 watts [33.22 dBm]
```

7. At the BRC> prompt, type: **get vswr**

   This command calculates the current Voltage Standing Wave Ratio (VSWR) from the RF Power Amplifier.

```
BRC> get vswr
VSWR is 1.42:1
```

8. At the BRC> prompt, type: **get alarms**

   This command returns all active alarms of the Base Radio.

```
BRC> get alarms
NO ALARM CONDITIONS DETECTED
```

NOTE

If the **get alarms** command displays alarms, refer to the *System Troubleshooting* section of this manual for corrective actions.

9. View the spectrum of the transmitted signal on the R2660 Communications Analyzer in the Spectrum Analyzer mode. Figure 9-20 shows a sample of the spectrum.

10. At the BRC> prompt, type: **dekey**

    This command stops all transmitter activity.

```
BRC> dekey
XMIT OFF INITIATED
```

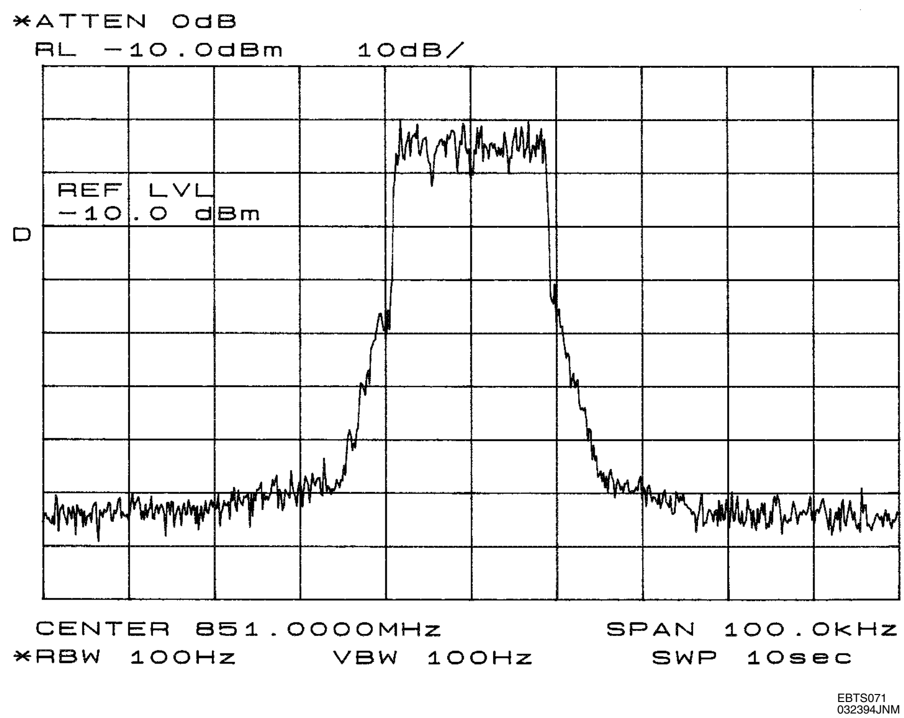


Figure 9-20 ***Transmitted Signal Spectrum (800 MHz BR)***

Equipment Disconnection

Use the following steps to disconnect equipment after verifying the transmitter.

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.

2. Disconnect the RS-232 cable from the connector on the service computer.

3. Disconnect the other end of the RS-232 cable from the RS-232 connector located on the front panel of the BRC.

4. Disconnect the test cable from the PA OUT connector located on the backplane of the Base Radio.

5. Connect the standard equipment cable to the PA OUT connector.

6. Disconnect the 10 dB attenuator from the other end of the test cable.

7. From the attenuator, disconnect the cable to the R2660 Communications Analyzer.

8. Restore power to the Base Radio by setting the Power Supply rocker switch to the ON (1) position.

If necessary, continue with the Receiver Verification Procedure.

Receiver Verification

The receiver verification procedure sends a known test signal to the Base Radio to verify the receive path. This verification procedure is recommended after replacing a Receiver, BRC, or Power Supply module.

NOTE

The following procedure requires the Base Radio to be out of service. Unless the Base Radio is currently out of service, Motorola recommends performing this procedure during off-peak hours. This minimizes or eliminates disruption of service to system users.

Equipment Setup

Set up the equipment for the receiver verification procedure as follows:

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.
2. Connect one end of the RS-232 cable to the service computer.
3. Connect the other end of the RS-232 cable to the STATUS port located on the front panel of the BRC.
4. Disconnect the existing cable from the connector labeled RX1 (or the connector corresponding to the receiver under test).

   This connector is located on the backplane of the Base Radio.
5. Connect a test cable to the RX 1 connector.
6. Connect the other end of the test cable to the RF IN / OUT connector on the R2660 Communications Analyzer.
7. Remove power from the R2660 and connect the Rubidium Frequency Standard 10MHZ OUTPUT to a 10 dB attenuator.
8. Connect the other end of the 10 dB attenuator to the 10MHZ REFERENCE OSCILLATOR IN / OUT connector on the R2660.
9. Set the R2660 to the EXT REF mode.
10. Apply power to the R2660.

NOTE

Refer to the equipment manual provided with the R2660 for further information regarding mode configuration of the unit (Motorola Part No. 68P80386B72).

11. Set the R2660 to the receive frequency of the Base Radio under test.

All receivers within a single Base Radio have the same receive frequency.

12. Set the R2660 to generate the test signal at an output level of -80dBm.

Receiver Verification Procedure

This procedure provides commands and responses to verify proper operation of the Base Radio receive path. Perform the procedure on all three receivers in each Base Radio in the EBTS.

The Bit Error Rate (BER) measurement meets specifications at less than 0.01% (1.0e-02%) to pass the process.

Before you begin the verification procedure, put the Base Radio into the test mode of operation to take it out of service. Enable the desired receiver under test and disable the other receiver(s). In this case the receiver under test is receiver #1.

In the following procedures, enter the software commands as they appear after the prompt. These commands are in bold letters.

For example, BRC> **get rx_freq**

13. Restore power to the Base Radio by setting the Power Supply rocker switch to the ON (1) position.

The following message displays on the service computer during power-up.

```
Base Radio
firmware revision RXX.XX.XX
Copyright © 1998
Motorola, Inc. All rights reserved.

Unauthorized access prohibited

Enter login password:
```

14. Enter the proper password. After entering the correct password, the BRC> prompt is displayed on the service computer.

The default password is **motorola**

NOTE

Motorola recommends that you change the default password once proper operation of the equipment is verified.

15. At the BRC> prompt, type: **get rx_freq**

This command displays the receive frequency for the current Base Radio:

800 MHz BR:

```
BRC> get rx_freq
The RX FREQUENCY is: 806.00000
```

16. Verify that the R2660 transmit frequency is set to the frequency determined in the previous step.

17. At the BRC> prompt, type: **set rx_mode 1**

This command is used to enable the antenna/receiver under test.

```
BRC>set rx_mode 1
set RECEIVER 1 to ENABLED in RAM
set RECEIVER 2 to DISABLED in RAM
set RECEIVER 3 to DISABLED in RAM
```

18. At the BRC> prompt, type: **get rssi 1 1000**

This commands returns the receive signal strength indication. To pass the BER floor test, the Bit Error Rate must be less than 0.01% (1.0e-02%) for the displayed results.

```
BRC> get rssi 1 1000
Starting RSSI monitor for 1 repetitions averaged each 1000 reports.

Line  RSSI1   RSSI2  RSSI3   SGC    CI     BER        OffsetSyncMiss
       dBm     dBm    dBm     dB   dBmdBm %           Hz%
----   ------  ------  ------  ----  --------------------  -------  ---------
0      -80.0  -131.5  -131.5    0   -79.2  -121.90.000e+00-5.4.000e+00
```

19. Verify that the RSSI dBm signal strength, for the receiver under test, is -80.0 dBm ± 1.0 dBm. Adjust the R2660 signal output level to get the appropriate RSSI dBm level. The BER floor % value is valid only if the RSSI signal strength is within the limits of -81.0 dBm to -79.0 dBm.

20. At the BRC > prompt, type: **get alarms**

This command returns all active alarms of the Base Radio.

```
BRC> get alarms
NO ALARM CONDITIONS DETECTED
```

NOTE

If the **get alarms** command displays alarms, refer to the System Troubleshooting section for corrective actions.

21. At the BRC> prompt, type: **get rx1_kit_no**

As shown below, this command returns the kit number of the receiver.

800 MHz BR:

```
BRC> get rx1_kit_no
RECEIVER 1 KIT NUMBER IS CRF6010A
```

NOTE

If the kit number is CRF6010, continue to step 22. If the kit number is TRF6560, proceed to Equipment Disconnection.

22. At the BRC> prompt, type: **get rx_fru_config**

This command lists the receivers active for diversity.

```
BRC> get rx_fru_config
RECEIVER CONFIGURATION {RX1 RX2 RX3}
```

NOTE

If the antenna configuration does not match the receiver configuration, use the **set rx_fru_config** MMI command to properly set the parameter.

Equipment Disconnection

Disconnect equipment after verifying the receiver as follows:

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.
2. Disconnect the RS-232 cable from the connector on the service computer.
3. Disconnect the other end of the RS-232 cable from the RS-232 connector on the front panel of the BRC.
4. Disconnect the test cable from the RX 1 connector located on the backplane of the Base Radio.
5. Connect the standard equipment cable to the RX 1 connector.
6. Disconnect the cable to the R2660 Communications Analyzer.
7. Restore power to the Base Radio by setting the Power Supply rocker switch to the ON (1) position.

   This completes the Receiver Verification Procedure for the receiver under test.

Repeat the Receiver Verification Procedure for each receiver in every Base Radio in the Outdoor SRSC.

Backplane

Backplane Connectors

All external equipment connections are made on the Base Radio backplane. Table 9-23 lists and describes each of the connectors on the backplane.

Table 9-23 ***Base Radio Backplane Connectors***

Connector	Description	Type
RX 1 through RX 3	Provides the input path for the received signal to the Base Radio. Each receiver has an input for one of these signals. Connect these ports to a multicoupler distribution system and surge protection circuitry before connecting them to the receive antennas.	RF-type connector in Table 9-25
EX OUT / EX FB PA IN / PA FB	Connects the exciter and PAs together to form the transmitter for the Base Radio. These connections are usually made at the factory These four ports close the feedback loop between these two modules by connecting EX OUT to the PA IN and the EX FB to the PA FB	RF-type connectors in Table 9-35 and Table 9-36
PA OUT	Transmits the RF output of the Base Radio. Connect this port to a combiner or duplexer before connecting to the transmit antenna	RF-type connector in Table 9-36
ETHERNET A (or labeled ETHERNET on some production units)	Provides Ethernet connectivity to the Base Radio from the site controller. This Ethernet port connects directly to the BRC	BNC-type connector in Table 9-32
5MHZ / 1 PPS-A (or labeled SPARE on some production units)	Serves as both the timing and frequency reference port for the Base Radio This port is connected to the site timing / frequency reference.	BNC-type connector in Table 9-34
RS-232	This is a DTE RS-232 interface provided for future use and is not currently enabled	DB-9-type connectors in Table 9-31
ALARM	Provides the connection for external calibrated power monitors to the Base Radio This connector also provides station DC voltages and programming lines (SPI) for monitoring / potential future expansion	DB-25-type connector
AC POWER	Provides connection to AC power supply, if the Base Radio is equipped with an AC power supply	Line cord connector
DC POWER	Provides DC power connection, if the Base Radio is equipped with a DC power supply or an AC power supply to support the battery revert feature	Card edge connector
GROUND	Connects the station to ground. A ground stud and a ground braid on the back of the Base Radio connect the station to a site ground, such as an appropriately grounded cabinet This ground provides increased transient / surge protection for the station	Ground stud

Figure 9-21 shows the locations of the Base Radio external connections.

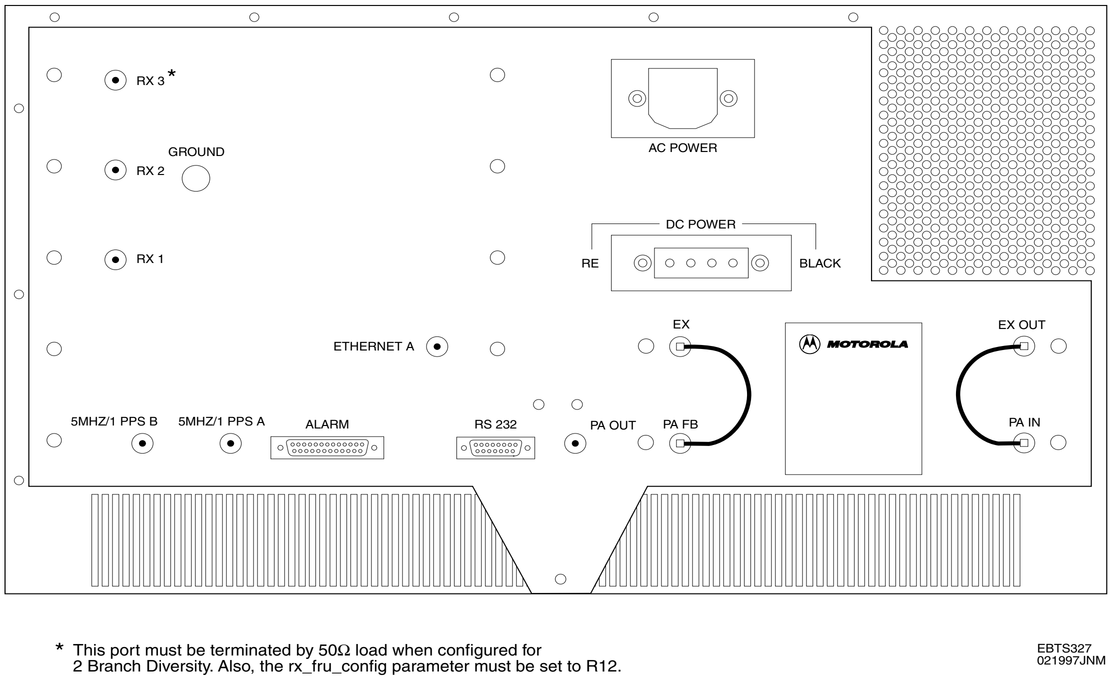


Figure 9-21 ***Base Radio Backplane Connectors***

Backplane RF Connections

When Base Radios are shipped from the factory as FRUs, each connection on the back of a repeater has a designated color dot beside it as listed in Table 9-24. To find where a cable should be connected, match the label wrapped around the cable to the dot on the back of the repeater.

Table 9-24 ***Color Codes for RF Connections on Rear of Base Radio***

Connectors	Color Dot Code
TX	Orange
RX 1	Red
RX 2	Green
RX 3	Yellow
Ethernet	White
5 MHz/1 pps A or Spare	Gray

Backplane Connector Pinouts

Table 9-25 lists the pin-outs for the 96-pin P1 connector of the Base Radio Controller board.

Table 9-25 **P1 Connector Pin-outs**

Pin No.	Row A	Row B	Row C
1	AGC3	14.2V	AGC1
2	AGC4	14.2V	AGC2
3	GND	GND	GND
4	RESET	GND	GND
5	BATT_STAT	GND	GND
6	CTS	GND	GND
7	RTS	5V	5V
8	5V	5V	5V
9	5V	5V	5V
10	SHUTDOWN	5V	
11	RCLK	5V	DATA1
12	ODC_1	5V	DATA1*
13	TCLK	GND	DATA3
14	ODC_3	GND	DATA3*
15	RXD	GND	DATA2
16	ODC_2		DATA2*
17	TXD		
18	SSI		SBI_1
19	SSI*		SBI_3
20	BRG	GND	SBI_2
21	CLK		
22	CLK*	GND	A4
23	GND		A3
24	A5	GND	A2
25	A0	GND	A1
26	CD	GND	5MHZ / SPARE
27	METER_STAT	GND	SPI_MISO
28	WP*	GND	SPI_CLK
29	GND	GND	SPI_MOSI
30	GND	GND	GD
31	1PPS_GPS	GND	2.1MHZ_TX
32	GND	GND	2.1MHZ_RX
NOTE: * = enabled low			

Table 9-26 lists the pin-outs for the 48-pin P2 connector of the 3X Receiver.

Table 9-26 **P2 Connector Pin-outs**

Pin No.	Row A	Row B	Row C	Row D
1	GND	AGC4	AGC3	GND
2	GND	AGC2	AGC1	A0
3	GND	RX1_DATA	RX1_DATA	A1
4	GND	RX1_SBI	RX1_ODC	A2
5	GND	RX2_DATA	RX2_DATA	A3
6	5V	RX2_SBI	RX2_ODC	A4
7	GND	RX3_DATA	RX3_DATA	A5
8	GND	RX3_SBI	RX3_ODC	WP*
9	14.2V	SCLK	MOSI	MISO
10	14.2V	GND	GND	GND
11	14.2V	GND	REF	GND
12	GND	GND	GND	GND
NOTE: Row A is make first, break last.				

Table 9-27 lists the pin-outs for the 16-pin P3 connector of the 3X Receiver.

Table 9-27 **P3 Connector Pin-outs**

Pin No.	Row A	Row B	Row C	Row D	Row E
1	GND		GND		GND
2		RX1			
3	GND		GND		GND
4					
5					
6					
7	GND		GND		GND
8		RX2		RX3	
9	GND		GND		GND

Table 9-28 lists the pin-outs for the 96-pin P5 connector of the Exciter.

Table 9-28 ***P5 Connector Pin-outs***

Pin No.	Row A	Row B	Row C
1	28V	28V	28V
2	28V	28V	28V
3	14.2V	14.2V	14.2V
4	14.2V	14.2V	14.2V
5	5V	5V	5V
6	5V	5V	5V
7	GND	GND	EXT_VFWD
8	GND	GND	EXT_VREF
9			
10	GND	GND	GND
11	GND	GND	VBLIN
12	GND	GND	RESET
13			
14	GND	GND	GND
15	GND	GND	SPI_MISO
16	A0	GND	GND
17	GND	GND	SPI_CLK
18	A1	GND	WP*
19	GND	GND	GND
20	A5	GND	SPI_MOSI
21	GND	GND	GND
22	A4	GND	GND
23	GND	GND	CLK*
24	A3	GND	GND
25	GND	GND	CLK
26	GND	GND	GND
27	GND	GND	SSI*
28	GND	GND	GND
29	GND	GND	SSI
30	GND	GND	GND
31	GND	GND	2.1MHz_TX
32	GND	GND	GND
NOTE: * = enabled low			

Table 9-29 lists the pin-outs for the 96-pin P6 connector of the Power Amplifier.

Table 9-29 ***P6 Connector Pin-outs***

Pin No.	Row A	Row B	Row C
1	VBLIN	GND	28V
2	GND	GND	28V
3	A0	GND	28V
4	GND	GND	28V
5	A1	GND	28V
6	GND	GND	28V
7	A2	GND	28V
8	GND	GND	28V
9	A3	GND	28V
10	GND	GND	28V
11	SPI_MISO	GND	28V
12	GND	GND	28V
13	SPI_MOSI	GND	28V
14	GND	GND	28V
15	SPI_CLK	GND	28V
16	GND	GND	28V
17	WP*	GND	28V
18	GND	GND	28V
19	GND	GND	28V
20	GND	GND	28V
21	GND	GND	28V
22	GND	GND	28V
23	GND	GND	28V
24	GND	GND	28V
25	GND	5V	28V
26	GND	5V	28V
27	GND	14.2V	28V
28	GND	14.2V	28V
29	GND	14.2V	28V
30	GND	14.2V	28V
31	GND	28V	28V
32	GND	28V	28V
NOTE: * = enabled low			

Table 9-30 lists the pin-outs for the 25-pin P7 Alarm connector.

Table 9-30 ***P7 Connector Pin-outs***

Pin No.	Signal
1	SPI_MISO
2	SPI_MOSI
3	SPI_CLK
4	A0
5	A1
6	A2
7	A3
8	A4
9	A5
10	GND
11	28V
12	14.2V
13	14.2V
14	WP*
15	5V
16	GND
17	BATT_STAT
18	MTR_STAT
19	EXT_VFWD
20	EXT_VREF
21	GND
22	GND
23	BAT_TEMP
24	VAT_TEMP
25	GND
NOTE: * = enabled low	

Table 9-31 lists the pin-outs for the 9-pin P8 RS-232 connector.

Table 9-32 lists the pin-outs for P13. Tables 9-33 through 9-36 list the pin-outs for the SMA and blindmate connectors for Receivers 1- 3, BRC, Exciter and PA.

Table 9-37 lists the pin-outs for 78-pin P9 connector of the Power Supply.

Table 9-31 ***P8 Connector Pin-outs***

Pin No.	Signal
1	CD
2	RxD
3	TxD
4	RCLK
5	GND
6	TCLK
7	RTS
8	CTS
9	BRG

Table 9-32 ***P13 Connector Pin-outs***

Connector	Signal
1	ETHERNET - A (or 5MHZ IN*)
* May appear as indicated in parenthesis on some production units.	

Table 9-33 ***SMA Connectors- Receivers***

Connector	Signal
P19	RCV ONE RF IN
P20	RCV TWO RF IN
P21	RCV THREE RF IN

Table 9-34 ***Blind Mates - BRC***

Connector	Signal
P10	SPARE* (or 5MHZ / 1 PPS - A)
P11	ETHERNET* (or ETHERNET - A)
*May appear as indicated in parenthesis on some production units.	

Table 9-35 ***Blind Mates - Exciter***

Connector	Signal
P14	EXCITER OUT
P15	EXCITER FEEDBACK

Table 9-36 **Blind Mates - PA**

Connector	Signal
P16	PA FEEDBACK
P17	PA IN
P18	PA RF OUT

Table 9-37 **P9 Connector Pin-outs**

Pin No.	Signal
1	GND
2	GND
3	28V
4	28V
5	28V
6	28V
7	28V
8	28V
9	28V
10	28V
11	28V
12	28V
13	28V
14	28V
15	28V
16	14.2V
17	14.2V
18	14.2V
19	14.2V
20	14.2V
21	14.2V
22	14.2V
23	14.2V
24	5V
25	5V
26	5V
27	5V
28	5V
29	5V
30	5V
31	5V

Table 9-37 **P9 Connector Pin-outs (Continued)**

Pin No.	Signal
32	GND
33	GND
34	GND
35	GND
36	GND
37	GND
38	GND
39	GND
40	GND
41	GND
42	GND
43	GND
44	GND
45	GND
46	GND
47	GND
48	GND
49	GND
50	GND
51	GND
52	GND
53	GND
54	SCR_SHUT
55	SCR_THRESH
56	RELAY_ENABLE
57	SHUTDOWN
58	28V_AVG
59	BATT_TEMP
60	SPI_MISO
61	SPI_MOSI
62	SPI_CLK
63	
64	
65	
66	
67	A0(CS1)
68	A1(CS2)

Table 9-37 ***P9 Connector Pin-outs (Continued)***

Pin No.	Signal
69	A5
70	
71	A4
72	
73	A3
74	GND
75	A2
76	GND
77	GND
78	GND

Base Radio Signals

Table 9-38 lists and describes the Base Radio signals.

Table 9-38 ***Base Radio Signal Descriptions***

Signal Name	Signal Description
GND	Station ground
28V	28VDC
14.2V	14.2VDC
5.1V	5.1 VDC
A0,A1,A2,A3,A4,A5	The BRC uses these lines to address station modules and devices on those modules
SPI_MOSI	Serial Processor Interface - Master out slave in Data
SPI_MISO	Serial Processor Interface - Master in slave out Data
SPI_CLK	Serial Processor Interface - Clock signal (100 KHz - 1 MHz)
AGC1, AGC2, AGC3, AGC4	BRC uses these lines to set the digital attenuator's on the receiver(s) for SGC functionality
2.1MHz_RX	2.1MHz generated on the BRC and used as a reference by the Receiver(s)
2.1MHz_TX	2.1MHz generated on the BRC and used as a reference by the Exciter
DATA1, DATA1*	This differential pair carries receiver 1 data to the Base Radio Controller
DATA2 DATA2*	This differential pair carries receiver 2 data to the Base Radio Controller
DATA3, DATA3*	This differential pair carries receiver 3 data to the Base Radio Controller
ODC_1, ODC_2, ODC_3	Clocks used to clock differential receive data from each respective receiver to the BRC
SBI_1, SBI_2, SBI_3	Serial Bus Interface - These lines are used to program the custom receiver IC on each receiver
SSI, SSI*	Differential transmit data from the Exciter to the BRC
CLK, CLK*	Differential Data clock used to clock transmit data from the BRC to the Exciter
VBLIN	Programmable bias voltage generated on the Exciter and used to bias the Power amplifier devices
RESET	Output from BRC to Exciter (currently not used)
EXT_VFWD	DC voltage representing the forward power at the antenna as measured by the external wattmeter
EXT_VREF	DC voltage representing the reflected power at the antenna as measured by the external wattmeter
WP*	Write protect line used by the BRC to write to serial EEPROMs located on each module
BAT_STAT	Binary flag used to signal BRC to monitor the External battery supply alarm
METER_STAT	Binary flag used by the BRC to indicate to the BRC it should monitor

Table 9-38 ***Base Radio Signal Descriptions (Continued)***

Signal Name	Signal Description
1PPS	Global Positioning System - 1 pulse per second (this may be combined with 5MHz at the site frequency reference
RCLK	RS-232 - Receive clock
TCLK	RS-232 - Transmit clock
CTS	RS-232 - Clear to send
RTS	RS-232 - Request to send
CD	RS-232 - Carrier detect
RXD	RS-232 - Receive data
TXD	RS-232 - Transmit data
BRG	RS-232 - Baud rate generator
5MHz / Spare	signal currently not used
EXCITER_OUT	Forward transmit path QQAM at approximately a 11dBm level
EXCITER_FEEDBACK	Signal comes from the PA at approximately a 16dBm. Used to close the cartesian RF_LOOP
PA_IN	4 dBm QQAM forward path of the transmitter
PA_FEEDBACK	Signal to the Exciter at approximately 16dBm. Used to close the cartesian RF_LOOP
RX1_IN	RF into Receiver 1
RX2_IN	RF into Receiver 2
RX3_IN	RF into Receiver 3
5MHZ REFERENCE	5MHz station / site reference. Signal comes from the redundant site frequency reference and usually is multiplexed with the 1PPS signal from the global positioning satellite input to the site frequency reference
ETHERNET	Interface between the BRC and the ACG. This connects the Base to the 10 MHz LAN
SCR_SHUT	Signal currently not used
SCR_THRESH	Signal currently not used
RELAY ENABLE	Signal currently not used
SHUTDOWN	Input signal from the BRC to the Power supply. Used to exercise a station "hard start"
28V_AVG	Signal currently not used
BATT_TEMP	DC voltage from the external batteries used to represent the temperature of the batteries. Signal used only with AC power supplies
NOTE: * = enabled low	

This Page Intentionally

Left Blank

MOTOROLA

Chapter 10
800 MHz GEN 4 Duplexed RF Distribution System

Overview

This section provides technical information for the 800 MHz GEN 4 Duplexed RF Distribution System, as it used in the Outdoor SCRC.

The topics of this section are listed in the following table.

Section	Page	Description
RFDS Specifications	10-2	Provides performance specifications for the GEN 4 Duplexed RFDS.
RFDS Theory of Operation	10-4	Describes the transmit and receive path of the RFDS.
Removal/Replacement Procedures	10-16	Provides instructions for replacing components o the GEN 4 Duplexed RFDS.
Field Retrofit of Duplexed TTA Interface (CLN1403)	10-27	Provides instructions for field installation to retrofit the SRSC cabinet with DTTA kits
Duplexed TTA Receive Branch Equalization	10-32	For systems using Duplexed TTAs, provides reference to receive branch equalization requirements and procedures.

RFDS Specifications

GEN 4 Duplexed RFDS General Specifications

Table 10-1 lists the general specifications for the GEN 4 Duplexed RFDS.

Table 10-1 ***GEN 4 Duplexed RFDS General Specifications***

Specification	Value or Range
Rack Space Requirement	6 EIA Rack Units (RU)
Storage Temperature Range	-40˚ to +203˚ F (-40 to +95° C)
Operating Temperature Range	+32˚ to +104˚ F (0 to +40° C)
Cooling (Isolator Deck)	Coldplate with continuous forced-air cooling
Frequency Range: Receive Transmit	 806 to 821 MHz 851 to 866 MHz
Tx - Rx Spacing	45 MHz
Channel Spacing	25 kHz (min.)
Port Impedance	50 Ω (nom.)
Input Supply Voltage; RFDS	-40 Vdc to -65 Vdc (-48 Vdc nom.)
Input Current; RFDS	2.25 A (steady-state max.)
Input Supply Voltage; Fan Array	12 Vdc

Antenna to Receiver Specifications

Table 10-2 lists the GEN 4 Duplexed RFDS antenna port-to-receiver port specifications for a single receive branch.

Table 10-2 ***Duplexer Antenna Port-to-Receiver Port Specifications***

Specification	Value or Range
Gain (806 to 821 MHz): T_A = 77˚ F (25° C) ambient temperature	 10.0 dB

Transmitter to Antenna Specifications

Table 10-3 lists the GEN 4 Duplexed RFDS path loss from Base Radio transmitter port-to-antenna port specifications.

Table 10-3 ***Base Radio Transmitter Port-to-Antenna Port Specifications***

Specification	Value or Range	
	Maximum	**Typical**
Insertion Loss; Passband*	3.0 dB	2.0 dB
* Includes deck and associated cabling losses over 854-866 MHz range. (Losses are higher in the 851-854 MHz range.)		

RFDS Theory of Operation

Figure 10-1 shows a block diagram for the GEN 4 Duplexed RFDS used within the SRSC system.

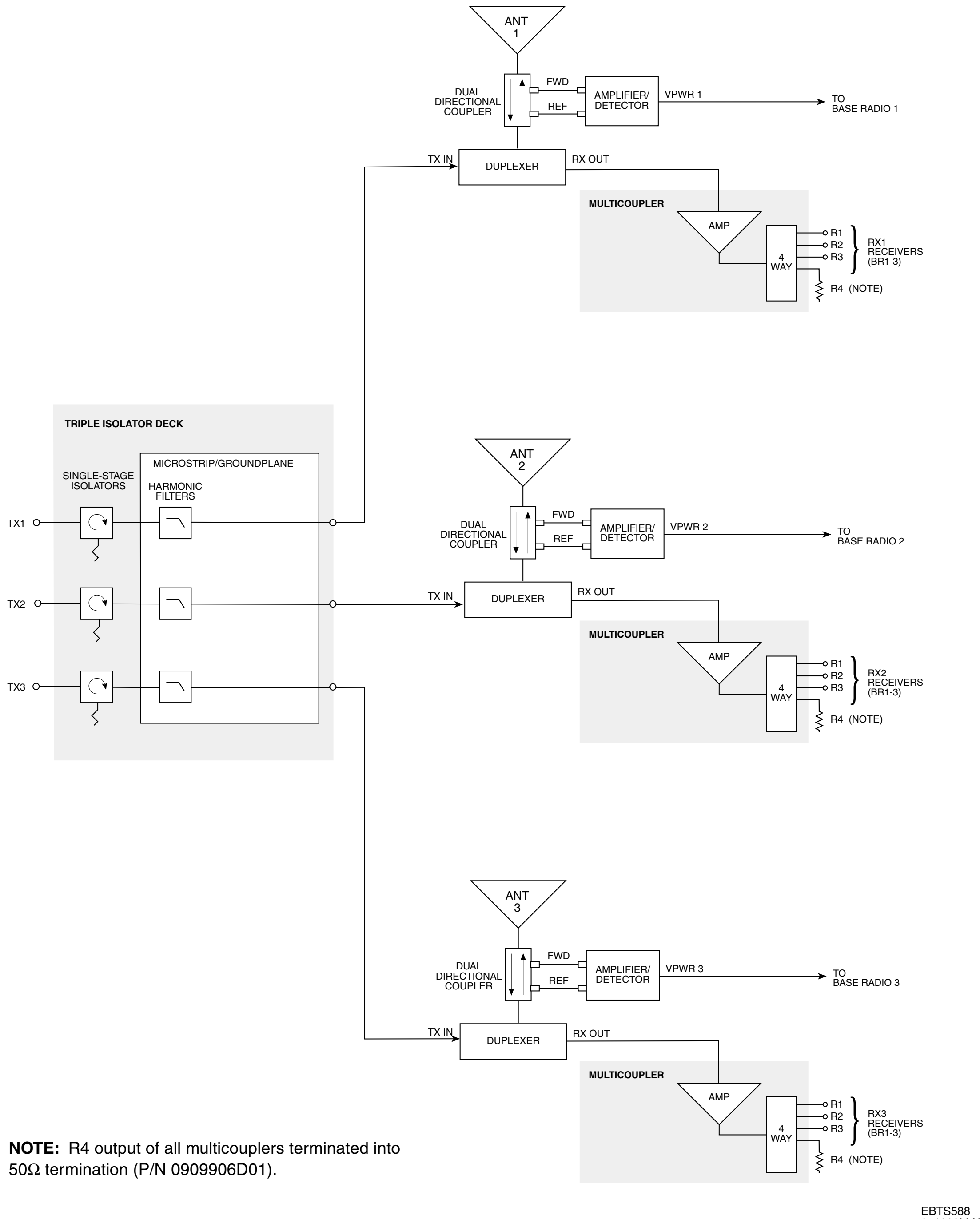


Figure 10-1 ***SRSC GEN 4 Duplexed RFDS Block Diagram***

Duplexer Operation

Three Duplexers accommodate three Transmit / Receive (Tx / Rx) antennas, ANT 1 through ANT 3. Each Duplexer is tuned to accept a transmit input (TX IN 1 through TX IN 3) in the 851-866 MHz range.

The respective Rx outputs furnished by the three Duplexers (RX OUT 1 through RX OUT 3) provide triple-diversity Rx signals for individual Base Radio receivers operating in the 806 - 821 MHz range. The RX OUT1 through RX OUT3 signals are applied to the Base Radio receivers through multicouplers, which are discussed later.

Transmit Operation

A Triple Isolator Deck provides isolation and filtering of the TX signals from the Base Radios. The deck consists of three microstrip / groundplane printed circuits which provide the filtering function. Each circuit card also contains a discrete isolator device.

Base Radios 1 through 3 transmit signals TX1 through TX3 are respectively applied to the three sections of the Triple Isolator Deck. Each section of the deck applies a Tx input through a single-stage isolator. From the isolator, each signal is passed through a harmonic filter. The output of the filter is then fed to the TX input of its respective Duplexer. TX1 through TX3 are respectively applied to Duplexers ANT1 through ANT3.

Harmonic filters are used in each Tx signal path to prevent undesired intermodulation products due to simultaneous Tx signals.

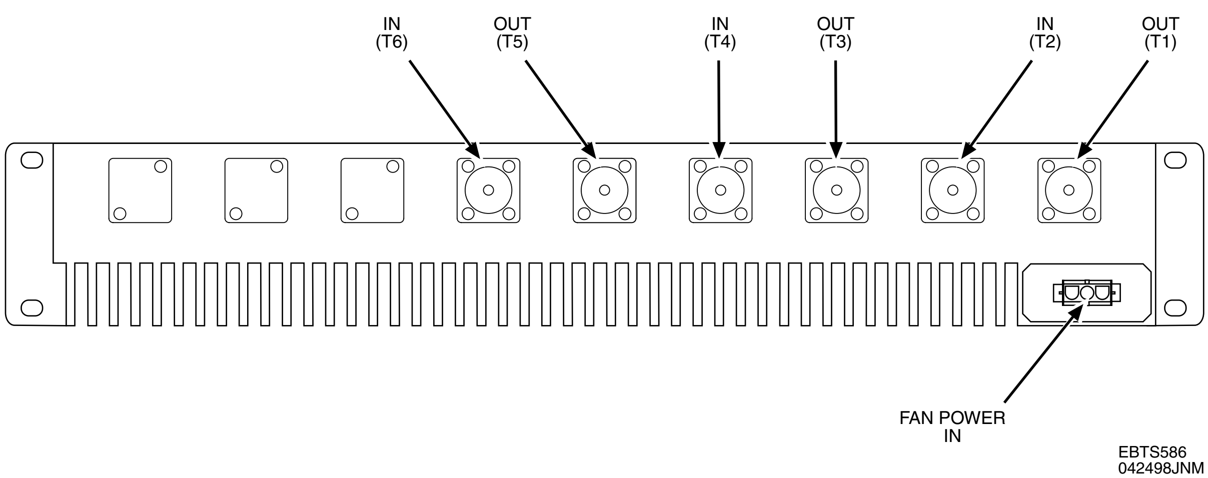


Figure 10-2 ***Triple Isolator Deck***

Receive Operation

Each receive branch of the GEN 4 Duplexed RFDS uses a 4-Way Multicoupler (MC). The MC uses a Multicoupler / Amplifier (MC / Amp) which converts a single receive signal into multiple buffered receive signals. All three Rx branches function identically; therefore, only the RX1 is discussed here.

The MC consists of a low-noise amplifier and a four-way multicoupler (splitter) which takes the RX OUT signal from the ANT 1 Duplexer and provides four outputs. Three outputs (R1 through R3) respectively provide RX1 signal feeds for the RX1 receivers of Base Radios 1 through 3. (The R4 output is not used and is terminated into 50Ω load, P/N 0909906D01.)

Power Monitoring

A dual-directional coupler is installed on each Duplexer antenna port. The couplers are in-line and provide forward and reflected RF signal samples. These signal samples are fed to power monitors that, in turn, read the forward and reflected power readings from the antenna.

The power monitors measure the power readings by converting forward-power signal sample FWD and reflected-power signal sample REF into DC voltages. These DC voltages (VPWR1 through VPWR3) are proportional to the forward and reflected power readings. VPWR1 through VPWR3 are sent to Base Radios 1 through 3, respectively, where they are used to determine the forward and reflected power readings. They are also used to calculate the VSWR at a particular antenna port.

GEN 4 Duplexed RFDS Alarm Circuit

Two opto-isolator outputs send alarm closure signals to the Environmental Alarm System (EAS) in the iMU: One diagnostic alarm output is provided for both of the power supplies; the other alarm is provided for each of the MC/Amps in the MCs. The alarms operate as normally closed loops. As such, when either (or both) of the power supplies experiences a failure, an alarm is generated. Similarly, when any combination of amplifiers experiences a failure, an alarm is generated. Upon detection of an alarm condition, the respective alarm will open to generate an alarm signal. The alarm signals are routed to the iMU by way of the Alarm output telco connector on the Rx Tray I/O board.

Duplexed Tower Top Amplifier Interface

The SRSC can be equipped with DC injectors installed on each duplexer, and a Tower Top Amplifier (TTA) interface tray. The TTA Alarm Tray and DC injectors, as installed on the duplexers, are shown in Figure 10-3. The DC injectors allow the RFDS to work with Duplexed (DTTAs). The DC injectors also provide a low-impedance path to ground in cases of a lightning strike. Typically, a TTA assembly itself is mounted on the antenna mast structure; the assembly contains three identical subassemblies for the respective three branches of the antenna system. The DTTAs augment system coverage of an EBTS by providing increased receive gain.

TTA Alarm Tray

The TTA Alarm Tray consists of three TTA power/alarm interface modules. These three modules provide the TTA power interface from the power supplies (located in the Rx Tray) to the TTAs. The power / alarm interface modules control application of power to the TTAs, and monitor the TTA interface for alarm conditions.

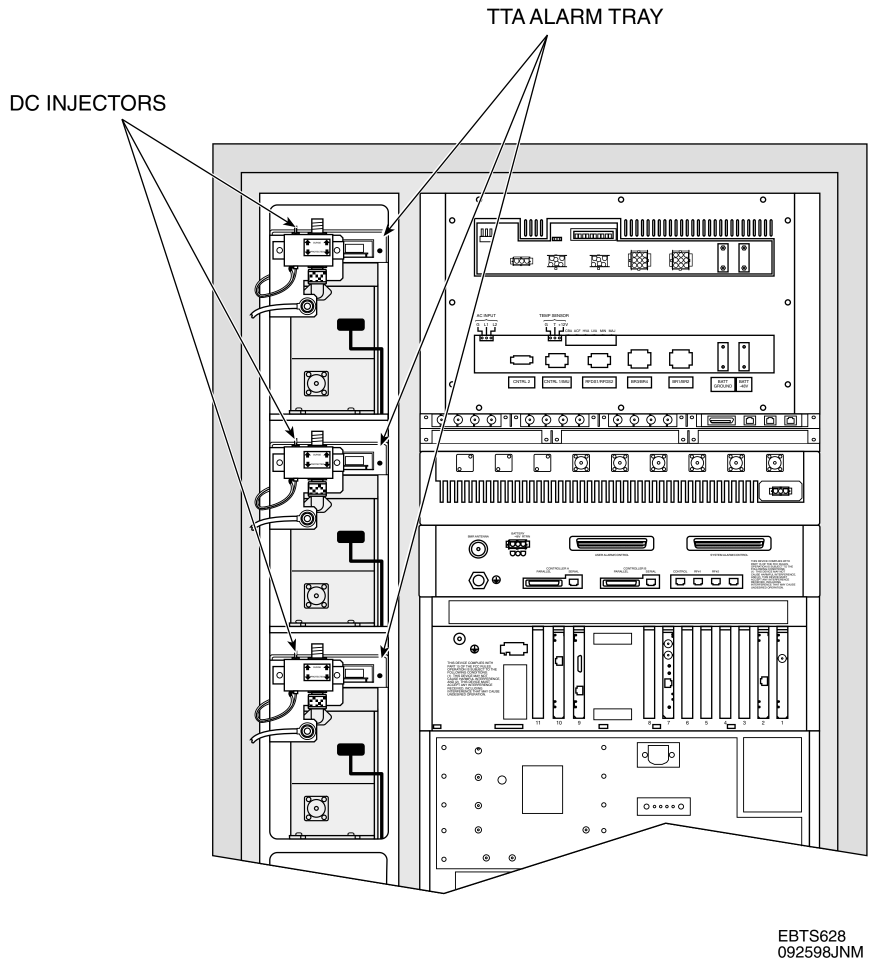


Figure 10-3 ***Duplexed TTA FRUs/Assemblies***

Tx/Rx Signal Flow

Figure 10-4 shows the incorporation of the Duplexed TTAs into the Tx / Rx signal flow path of a 800 MHz Duplexed RFDS. For each Tx / Rx antenna branch, a Duplexed TTA is inserted into the Tx / Rx path. DC injectors receive +24V power from the power supplies in the Rx Tray. Using the DC injectors, the existing Tx / Rx coaxial cables carry the Tx / Rx signals, along with the injected +24V operating power, to the Duplexed TTAs.

The tower-mounted Duplexed TTA assembly consist of the following:

- ❒ Three Low-Noise Amplifiers (LNAs) which increase receive path gain
- ❒ A test port which allows calibration signal injection into the LNA input
- ❒ Three duplexing devices which isolate the LNA s from the Tx signals

The Duplexed TTA assembly contains duplexers which provide isolation of the TX and Rx signals. The Tx signal is coupled directly to the antenna. However, the Rx signal is diverted by the duplexer and then fed to an LNA before being recoupled to the main RF Tx/Rx cable that connects to the RFDS. The duplexed TTA TEST PORT allows for the injection of a calibration reference signal into the receive path. The reference signal is applied to a four-way splitter; three of the splitter outputs serve as inputs to the LNAs. The reference signal is used in calculating the EBTS receive path gain.

DC Injectors

The DC injectors are two-port devices with an additional DC injection terminal. The antenna-side port (labeled “SURGE”) allows injection of the DC power onto the coaxial connection. This port is also capable of discharging to ground a high-energy pulse received over the antenna connection (as in the case of a lightning strike). The opposite port (labeled “PROTECTED”), which is connected to the RFDS, is isolated from the injected DC as well as any high-energy entering through the SURGE (antenna) port.

TTA Alarm Interface

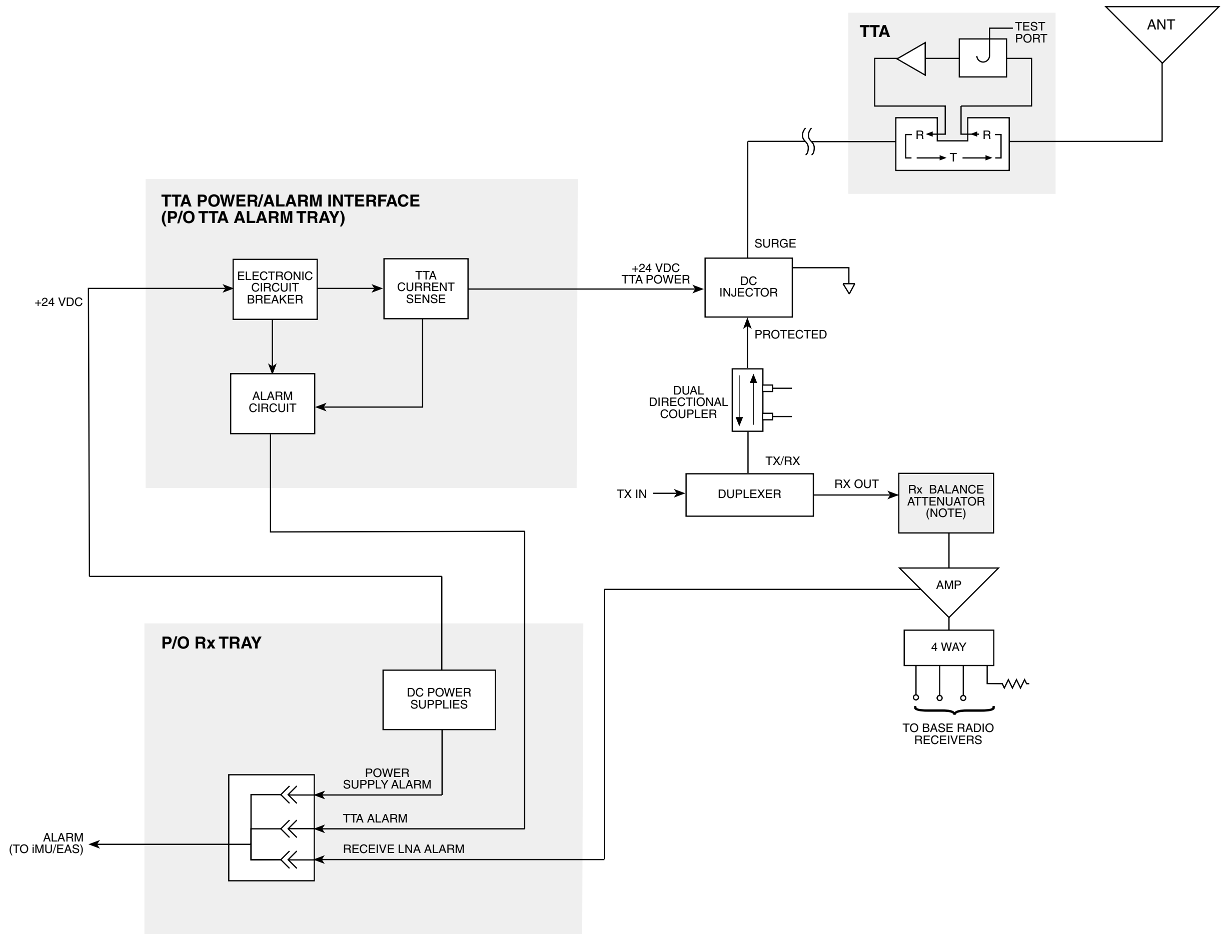
The TTA power/alarm interface modules contain circuitry which monitors the operation of the TTAs for both TTA current draw and surge-protect tripping of a DC injector.

The TTA power/alarm interface module monitors the current draw of the TTA. If the current draw exceeds or dips below a pre-defined threshold window, an alarm is generated.

In the case of a high-energy discharge through a DC injector, the DC injector dumps the energy to ground. Unfortunately, this mode also momentarily shorts the injected DC power to ground, in turn shorting the TTA power feed from the Rx Tray power supply. To handle this condition, the TTA power/alarm interface module is equipped with an electronic circuit breaker which detects this condition.

Upon detection of a short-circuit, the electronic circuit breaker opens to remove the power supply from the short circuit imposed by the DC injector. The electronic circuit breaker waits an ample amount of time, at which point the high-energy event is expected to have ceased and the DC injector should have recovered (i.e., no short circuit). At this point, the electronic circuit breaker re-applies RFDS power to the DC injector. The electronic breaker repeats this cycle indefinitely until the DC injector recovers. If a DC injector will not recover, the repeated cycling will manifest itself as a persistent alarm, thereby indicating a shorted DC injector at the site.

The TTA power/alarm interface module alarm circuits are wired such that when any combination of TTA amplifiers experience an over/under current failure, or the electronic breaker indicates failure to properly reset, an alarm is sent to the Rx Tray I/O board. In turn, the alarm is then forwarded to the iDEN Monitor Unit.



NOTE: Balance attenuator value is determined using field equalization procedure. Attenuators are field-procured and not supplied with TTA FRUs.

Figure 10-4 ***Duplexed TTA Block Diagram***

Power Supplies

The RFDS uses two Power Supply boards (power supply A and power supply B) in a dual-redundant arrangement. The Power Supply boards are located in the Rx Tray. The power supplies convert the -48 Vdc (hot) site power to +12 Vdc and +24 Vdc. The +12 Vdc is used for the Rx Tray receive multicouplers, and the isolator deck fan assemblies. The +24 Vdc is used for the Duplexer power monitors and (where applicable) tower top amplifiers.

Each Power Supply board is equipped with green and red LED indicators which indicate when the board is receiving power and properly functioning. The RFS1 and RFS2 circuit breakers on the AC / DC Power System breaker panel control the application of -48 Vdc power to the A and B Power Supply boards.

Connectors, Pinouts, and Wiring

Power Monitor Wiring Harness

(See Figure 10-5.) The GEN 4 Duplexed RFDS contains 25-pin power monitor connector (P4) that interconnects the Power Monitor (sometimes called "external wattmeter") FWD and REF signals to BR1 through BR3.

The GEN 4 Duplexed RFDS also contains monitor power connector P5 that interconnects the power monitors on each duplexer with DC power from the Rx Tray assembly. The power monitors interconnect with connectors P4 and P5 through duplexer connectors P1 through P3,which respectively connect to the ANT1 through ANT3 duplexers.

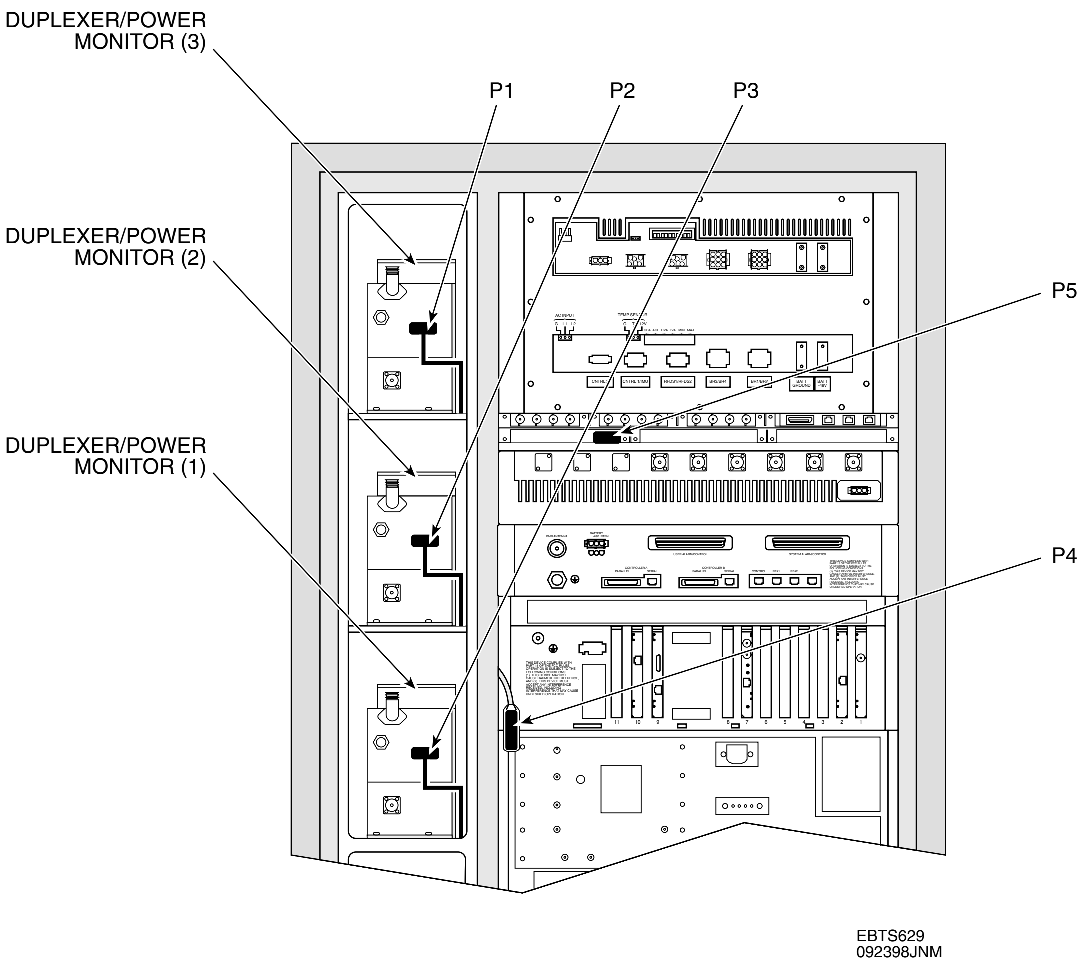


Figure 10-5 ***GEN 4 RFDS Alarm/Monitor Connections***

Table 10-4 is a wire-run list that correlates the connections from connectors P4 and P5 to the P1 through P3 duplexer connectors.

Table 10-4 ***GEN 4 Duplexed RFDS Alarm/Monitor Harness Wire Run List***

From	To	Function
P4-1	—	no connection
P4-2	—	no connection
P4-3	—	no connection
P4-4	P1-3	GND
P4-5	P1-5	ANT A (antenna 1) FWD power monitor
P4-6	P1-1	Antenna A REF power monitor
P4-7	P2-3	GND
P4-8	P2-5	ANT B (antenna 2) FWD power monitor
P4-9	P2-1	ANT B (antenna 2) REF power monitor
P4-10	P3-3	GND
P4-11	P3-5	ANT C (antenna 3) FWD power monitor
P4-12	P3-1	ANT C (antenna 3) REF power monitor
P4-13	—	no connection
P4-14	—	no connection
P4-15	—	no connection
P4-16	—	no connection
P4-17	—	no connection
P4-18	P1-4	GND (power monitor return)
P4-19	P2-4	GND (power monitor return)
P4-20	P3-4	GND (power monitor return)
P4-21	—	no connection
P4-22	—	no connection
P4-23	—	no connection
P4-24	—	no connection
P4-25	—	no connection
P5-1	P1-2	+24 VDC (monitor 1)
P5-2	P1-7	GND (monitor 1)
P5-3	P1-9	no connection
P5-4	P2-2	+24 VDC (monitor 2)
P5-5	P2-7	GND (monitor 2)
P5-6	P2-9	no connection
P5-7	P3-2	+24 VDC (monitor 3)
P5-8	P3-7	GND (monitor 3)
P5-9	P3-9	no connection

I/O Board Version

Two versions of the I/O Board currently exist: CTF6220A and CTF6220B. The two versions are functionally identical, but do use different pinouts for the RJ-45 ALARM STANDARD connector that connects the cabinet alarms to the iMU.

The SRSC is shipped using version CTF6220B, which eliminates the need for an extra, second cable to be connected between the I/O Board and the iMU. However, if the I/O Board is replaced with an A-version, the cabling must be considered. Refer to I/O Board Alarm Output Cabling in the *800 MHz GEN RF Distribution System* section of this manual for more information.

NOTE

The CTF6220A and CTF6220B I/O boards are totally interchangeable. However, appropriate cabling must be used for the version being used. If cabling does not correspond to version, false alarms will result.

I/O Board Rear Panel Connector Pinouts

The I/O Board rear panel connectors provide the cabinet alarm interface to the I/O board and a diagnostics connector. The connectors are as follows:

- ❐ **Diagnostics** – 36-pin SCSI-style connector (reserved for future use)
- ❐ **Breaker Status (Alarm Expansion)** – Not used in the SRSC system. Breaker status is sent directly from the AC/DC Power System to the iMU.
- ❐ **Alarm Standard** – RJ-45 connector sends cabinet alarm status to the iMU.
- ❐ **Alarm Auxiliary** – RJ-45 connector receives additional, auxiliary alarm signals (reserved).

Table 10-5 lists the connector pinout for I/O Board CTF6220B.

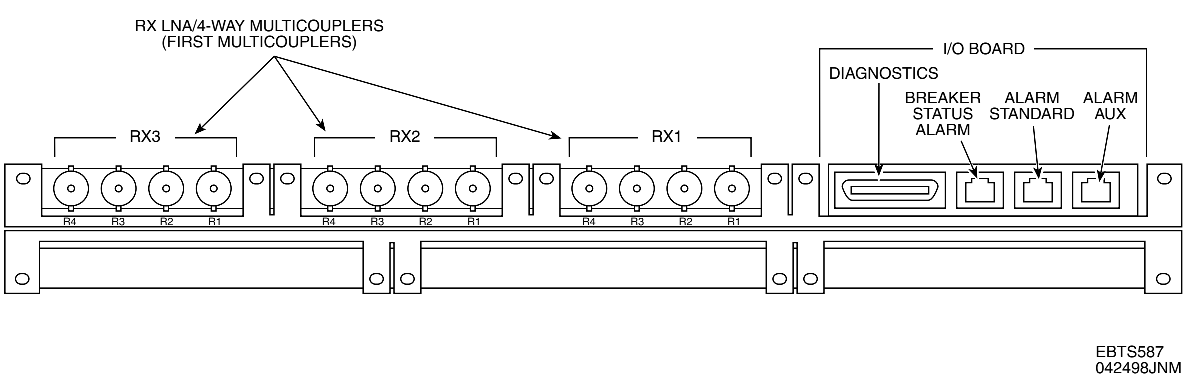


Figure 10-6 ***SRSC Rx Tray***

Table 10-5 ***I/O Board Rear Panel Connector Pinouts (I/O Board CTF6220B)***

Pin	Function/Connector			
	Diagnostics	Breaker Status Alarm	Alarm Standard	Alarm Auxiliary
1	MC #2 Alarm	Breaker	RFDS Power Supply Alarm return	Fan Alarm return
2	MC #3 Alarm	Breaker return	RFDS TTA Alarm return	not used
3	not used	RFDS MC Alarm	RFDS Multicoupler Alarm return	MC Alarm return
4	not used	RFDS TTA Alarm	RFDS Power Supply Alarm	Fan Alarm
5	not used	RFDS PS Alarm	RFDS TTA Alarm	not used
6	not used	RFDS MC Alarm return	RFDS Multicoupler Alarm	MC Alarm
7	TTA #1 Alarm	RFDS TTA Alarm return	Breaker Alarm return	PS Alarm Expansion return
8	TTA #2 Alarm	RFDS PS Alarm return	Breaker Alarm	PS Alarm Expansion
9	TTA #3 Alarm			
10	TTA Alarm Expansion			
11	Fans #1 Alarm			
12	Fans #2 Alarm			
13	PS#1 +12VDC Alarm			
14	PS#1 +24VDC Alarm			
15	PS#2 +12VDC Alarm			
16	PS#2 +24VDC Alarm			
17	PS Alarm Expansion			
18	N/C			
19	MC #1 Alarm			
20	GND			
21	GND			
22	GND			
23	GND			
24	GND			
25	N/C			

Table 10-5 ***I/O Board Rear Panel Connector Pinouts (I/O Board CTF6220B) (Continued)***

Pin	Function/Connector			
	Diagnostics	Breaker Status Alarm	Alarm Standard	Alarm Auxiliary
26	N/C			
27	+24 VDC			
28	+24 VDC			
29	+24 VDC			
30	+24 VDC			
31	N/C			
32	N/C			
33	+12 VDC			
34	+12 VDC			
35	+12 VDC			
36	+12 VDC			

I/O Board Power Connectors

The I/O Board power connectors provide the I/O board power interface from the AC/DC Power System -48 Vdc power feed to the RFDS and isolator deck fans. (The I/O Board power connectors are mounted on the printed circuit board surface and are identified in Figure 10-7.) The connectors are as follows:

- ❒ **-48 Vdc input** – 8-pin Mate-N-Lok header connector P1008. Receives -48 Vdc feed from RFS1 & RFS2 connector on the breaker panel.
- ❒ **Fan Power output** – 8-pin Mate-N-Lok header connector P1007. Sends +12 Vdc to the isolator deck fans.
- ❒ **RFDS Power output (power monitor interface)** – Mate-N-Lok header connector which terminates to 9-pin submini-D connector P5 (located on the duplexer shelf). Refer to Table 10-4 for pinout and signal functions.
- ❒ **TTA Power output/Alarm input** – 16-pin Mini Mate-N-Lok header connector P1006. Only used on systems with TTA interface. Sends +24 Vdc to TTA Alarm Tray. Receives alarm signals from TTA Alarm Tray.

Table 10-6 lists the power connector pinouts for the I/O Board.

Table 10-6 ***I/O Board Power Connector Pinouts***

Pin	Function/Connector		
	TTA Power/Alarm Interface P1006	**-48 Vdc Input P1008**	**Fan Power P1007**
1	TTA #1 +24 Vdc	-48 Vdc (‘A’ side)	N / C
2	TTA #1 GND	Return (‘A’ side)	Return (‘A’ side)
3	TTA #1 alarm enable	N / C	Alarm enable (‘A’ side)
4	TTA #1 alarm	N / C	+12 Vdc (‘A’ side)
5	TTA #1 alarm return	-48 Vdc (‘B’ side)	N / C
6	TTA #2 +24 Vdc	Return (‘B’ side)	Return (‘B’ side)
7	TTA #2 GND	N / C	Alarm enable (‘B’ side)
8	TTA #2 alarm enable	N / C	+12 Vdc (‘B’ side)
9	TTA #2 alarm		
10	TTA #2 alarm return		
11	TTA #3 +24 Vdc		
12	TTA #3 GND		
13	TTA #3 alarm enable		
14	TTA #3 alarm		
15	TTA #3 alarm return		
16	N / C		

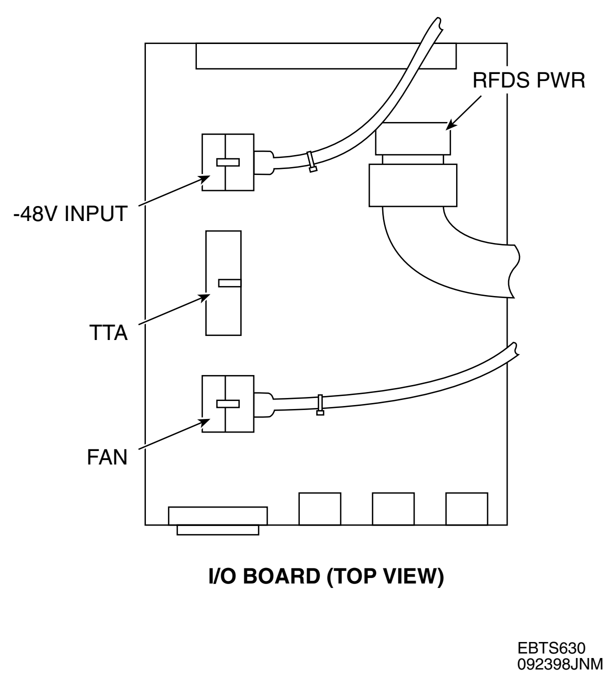


Figure 10-7 ***I/O Board Power Connectors***

Removal/Replacement Procedures

Instructions are provided below for replacing FRUs within the GEN 4 Duplexed RFDS. Figure 10-8 identifies the GEN 4 Duplexed RFDS assemblies and FRUs. Figure 10-9 identifies the Rx Tray assemblies and attaching hardware.

Replace suspected FRUs with known non-defective FRUs to restore the RFDS to proper operation.

CAUTION

The RFDS contains static-sensitive modules. Take precautionary measures to prevent static discharge damage when servicing the RFDS.

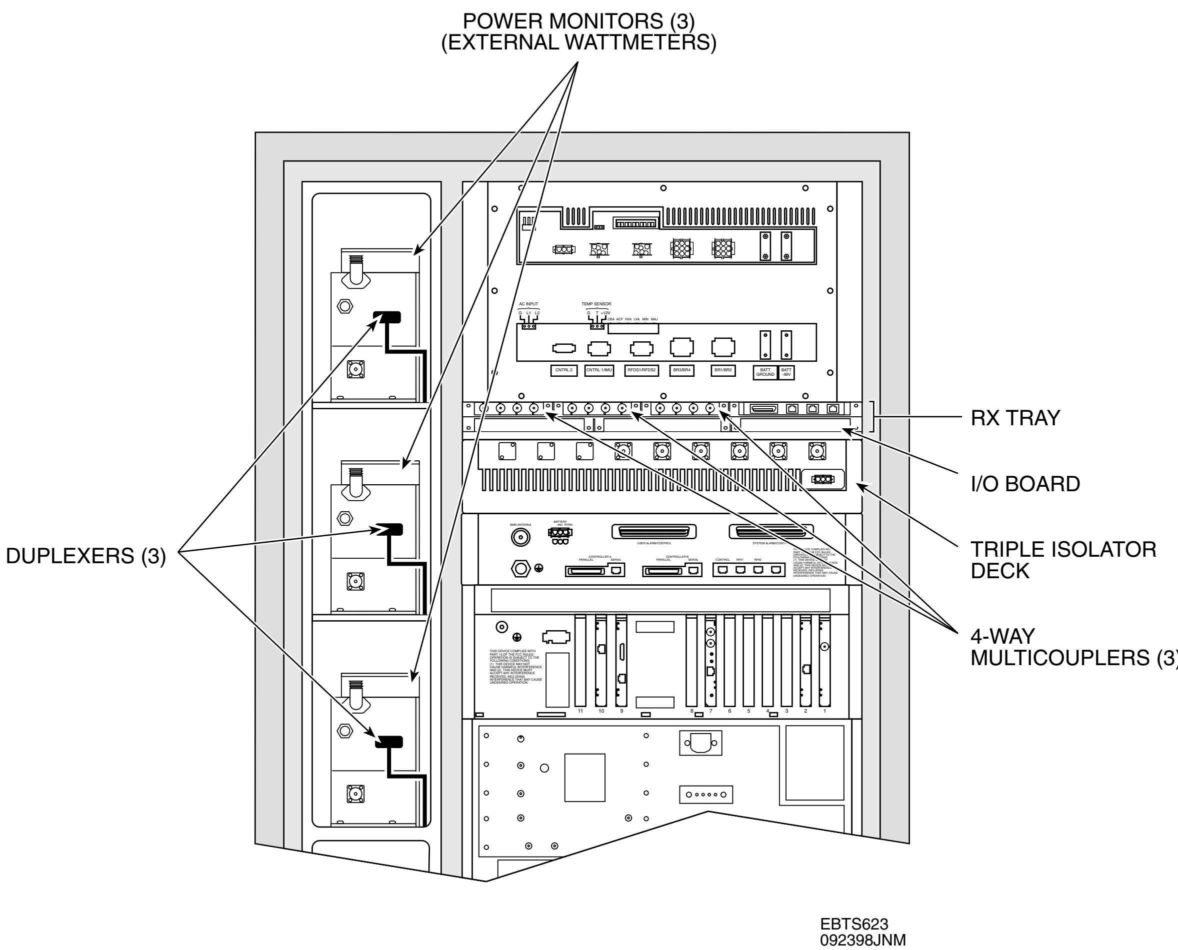


Figure 10-8 ***FRUs within the SRSC GEN 4 Duplexed RF Distribution System***

4-Way Multicoupler Board Replacement Procedure

Perform the following steps to replace a 4-Way Multicoupler Board.

Removal

(See Figure 10-9.) Remove 4-Way Multicoupler Board as follows:

1. Tag and remove all BNC connections at the **R1** through **R3** BNC connectors on the 4-Way Multicoupler Board, and remove the 50Ω termination from the **R4** BNC connector. Save 50Ω termination for reuse.

2. Remove two M3.5 TORX screws (1, Figure 10-9) which secure board assembly to Rx Tray chassis (one screw on each side of board). Save screws for reuse.

3. Partially draw board assembly out of Rx Tray until blindmate connector at front of board is disengaged.

4. Remove board from slot enough to gain access to input port SMA cable termination on top of board. Disconnect SMA cable from board connector.

5. Remove board fully from Rx Tray slot.

Installation

(See Figure 10-9.) Install 4-Way Multicoupler Board as follows:

1. Align 4-Way Multicoupler Board with Rx Tray board slot. Partially slide board into slot enough to allow Rx input SMA cable to mate with SMA connector on top of board.

2. Connect SMA cable to SMA connector on top of board. Using a breaking-type 5/16” torque wrench, torque the SMA connector to 5 in-lb.

3. Carefully slide board fully into slot, making certain blindmate connection at front of board is fully mated to Rx Tray chassis midplane connector.

4. Install two M3.5 TORX screws (1, Figure 10-9), one on each side of assembly, (saved during removal) which secure board assembly to Rx Tray chassis.

5. Connect cabling to the **R1** through **R3** BNC connectors on the 4-Way Multicoupler Board as tagged during removal. Connect the 50Ω termination (saved during removal) to the **R4** BNC connector.

Removal/Replacement Procedures

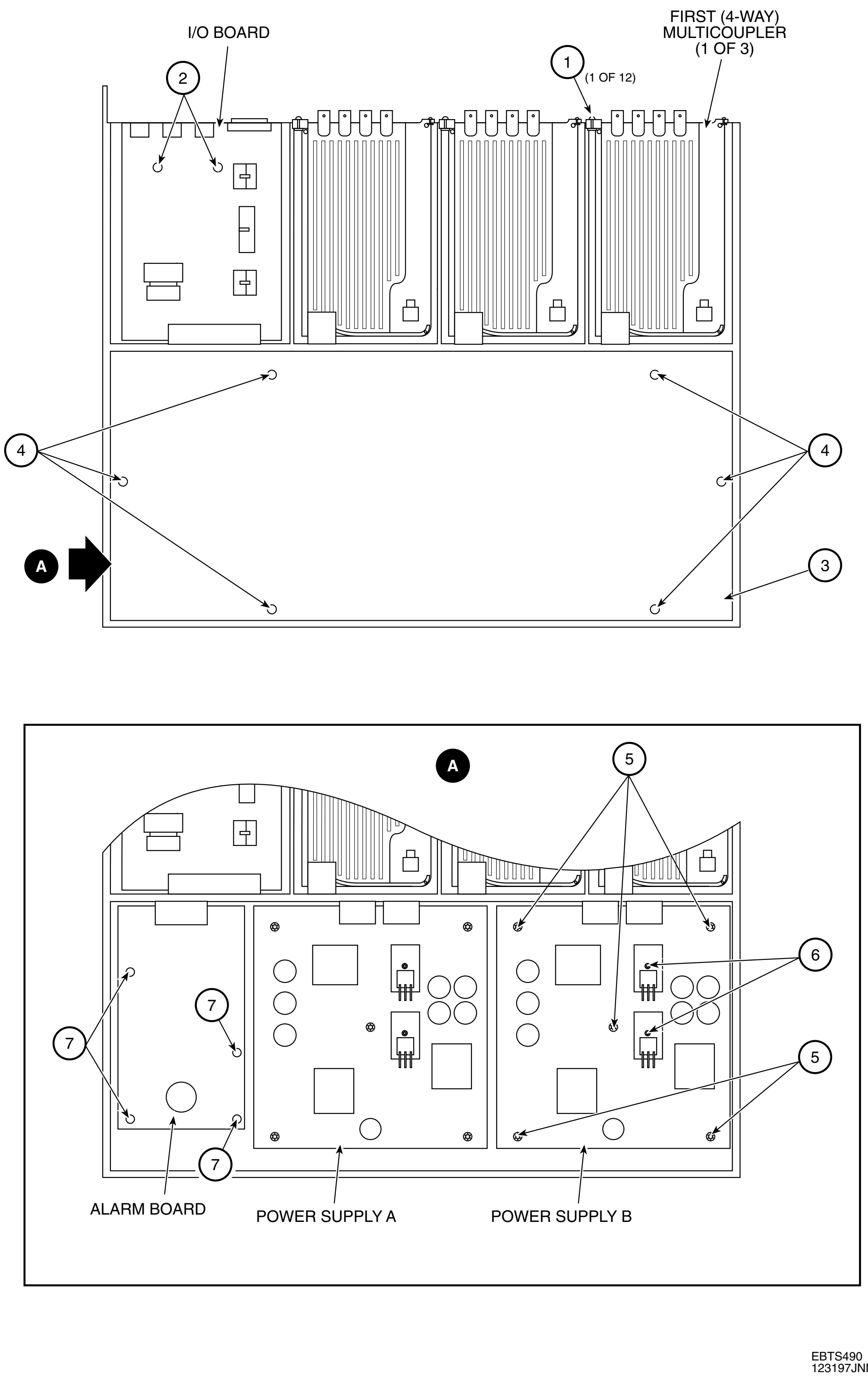


Figure 10-9 ***Rx Tray FRU/Assembly Replacement***

I/O Board Replacement Procedure

Perform the following steps to replace an I/O Board.

NOTE

During I/O Board replacement, the site will become inoperative due to loss of alarm and certain power functions. When followed as written, this procedure keeps the amount of downtime to a minimum.

It is recommended to perform this procedure during off-peak periods.

To prevent alarm reports while the replacement procedure is performed, the site should be taken down via the Operations and Maintenance Center (OMC).

Removal

(See Figure 10-9.) Remove I/O Board as follows:

1. Remove four M3.5 TORX screws which secure Rx Tray chassis to front panel. (Do not remove the four M6 TORX screws which secure front panel to equipment cabinet.) Save screws for reuse.
2. From rear of cabinet, carefully slide Rx Tray chassis from cabinet enough to access two M3.5 TORX screws (2, Figure 10-9) that secure I/O Board to Rx Tray chassis.
3. Remove two M3.5 TORX screws that secure I/O Board to Rx Tray chassis. Save screws for reuse.
4. Slide I/O Board away from Rx Tray midplane until connector at front of board is disengaged.
5. With board still connected to RJ45 alarm and Mate-N-Lok power connectors, tag wiring connections. Position board aside with all connections intact.

Installation

(See Figure 10-9.) Install I/O Board as follows:

1. Disconnect connection on board being replaced. Connect harness to replacement I/O Board noting tagged position.
2. Place new I/O Board in mounting position.

3. Align connector at front of board with mating connector on Rx Tray chassis midplane. Gently slide board toward front of Rx Tray chassis until connectors are fully mated.

4. Secure board using two M3.5 TORX screws (2, Figure 10-9) saved during removal.

5. Carefully slide Rx Tray chassis toward front panel until chassis is flush with front panel. Make certain no wiring is pinched between Rx Tray chassis and front panel.

6. Start four M3.5 TORX screws that secure Rx Tray chassis to Rx Tray front panel. Tighten all four screws evenly.

7. Reactivate site via OMC.

Power Supply Board Replacement Procedure

The Rx Tray Power Supply boards are located in the Rx Tray as shown in Figure 10-9. Because two Power Supply boards are used in a redundant arrangement, a defective power supply board can be replaced without taking the system out of operation.

CAUTION

Power Supply board opposite to board being replaced remains energized. When replacing board, use care to prevent accidental contact of tools with components and / or surfaces of energized board. Failure to adhere to caution may result in damage to equipment.

Removal

(See Figure 10-9.) Perform the following steps to determine and replace a defective Power Supply board.

1. Remove the four M6 TORX screws which secure the Rx Tray front panel to the Equipment Cabinet mounting rails. Save screws for reuse.

2. From front of cabinet, gradually slide the Rx Tray from cabinet enough to gain access to cover (3, Figure 10-9).

3. Remove six M3.5 TORX screws (4) that secure cover to Rx Tray chassis (save screws for reuse.) Remove cover.

4. Determine which Power Supply board has failed by observing the green and red LED indicators on each board. (On properly functioning supply, green LED is lit and red LED is off.)

5. Noting the Power Supply board that has failed, on AC/DC Power System breaker panel turn off power for the defective power supply as follows:

Power Supply Board	AC/DC Power System Circuit Breaker
A (left board as viewed from front)	RFDS 1
B (right board as viewed from front)	RFDS 2

6. On failed board, remove five M3.5 TORX screws (5) that secure board to Rx Tray chassis. Save screws for reuse.

7. Remove two M3 TORX screws (6) that secure board, along with D120 and D122 TO-220 devices, to Rx Tray chassis.

NOTE

Observe if TO-220 devices use plastic insulator collars along with each screw. If collars are used, save screws and collars for possible reuse. Plastic insulating collars and insulator pads are not needed when replacing newer-version power supply that uses plastic-encased TO-220 devices.

8. Slide board towards front of Rx Tray chassis until connector at rear of board disengages mating connector on Rx Tray chassis midplane. Remove board from chassis.

Installation

(See Figure 10-9.) Install Power Supply Board as follows:

1. Place Power Supply Board in mounting position on Rx Tray chassis floor.

2. Align connector at rear of board with mating connector on Rx Tray chassis midplane. Gently slide board toward rear of chassis until connectors are fully mated.

3. Start (but do not tighten) five M3.5 TORX screws (5, Figure 10-9) that secure board to Rx Tray chassis.

CAUTION

In following step, if TO-220 devices on replacement Power Supply Board have **metal tabs**, plastic insulator collar and insulator pad must be used with retaining screws. If TO-220 devices on replacement power supply are **plastic encased** (encapsulated TO-220), collars are not used.

Failure to use insulator collars on metal-tab device will result in damage to replacement power supply.

4. Note the TO-220 devices (D120 and D122) on the board, each secured by a screw (6) in the device mounting tabs. If devices have a metal mounting tab, make certain that a plastic insulator collar (saved during removal) is properly installed in each mounting tab on TO-220 devices, D120 and D122.
5. Start (but do not tighten) two M3 TORX screws (6) that secure board, along with D120 and D122 TO-220 devices, to Rx Tray chassis.
6. Tighten five screws (5) and two screws (6) evenly.
7. Apply power to board being replaced by resetting appropriate breaker on AC / DC Power System breaker panel. Verify proper operation by observing green LED indicator on board.
8. Place cover (3) in mounting position, making certain any adjacent wiring is not pinched under cover.
9. Secure cover using six M3.5 TORX screws (4).
10. Carefully slide Rx Tray fully into cabinet.
11. Secure the Rx Tray to the Equipment Cabinet mounting rails using four M6 TORX screws. Tighten the screws to 40 in-lb (4.5 Nm).

Alarm Board Replacement Procedure

Perform the following steps to replace an Alarm Board.

NOTE

During Alarm Board replacement, the site will become inoperative due to loss of alarm functions. When followed as written, this procedure keeps the amount of downtime to a minimum.

It is recommended to perform this procedure during off-peak periods.

To prevent alarm reports while the replacement procedure is performed, the site should be taken down via the Operations and Maintenance Center (OMC).

Removal

(See Figure 10-9.) Remove Alarm Board as follows:

1. Remove the four M6 TORX screws which secure the Rx Tray front panel to the Equipment Cabinet mounting rails. Save screws for reuse.
2. From front of cabinet, gradually slide the Rx Tray from cabinet enough to gain access to cover (3, Figure 10-9).
3. Remove six M3.5 TORX screws (4) that secure cover to Rx Tray chassis (save screws for reuse.) Remove cover.
4. Remove four M3.5 TORX screws (7) that secure Alarm Board to Rx Tray chassis. Save screws for reuse.
5. Using the finger hole in the Alarm Board, place finger in hole and pull board forward until connector at rear of board disengages mating connector on Rx Tray chassis midplane. Remove board from chassis.

Installation

(See Figure 10-9.) Install Alarm Board as follows:

1. Place Alarm Board in mounting position on Rx Tray chassis floor.
2. Align connector at rear of board with mating connector on Rx Tray chassis midplane.
3. Using finger hole in board, gently slide board toward rear of Rx Tray chassis until connector is fully mated.
4. Secure board using four M3.5 TORX screws (7, Figure 10-9) saved during removal.

5. Place cover (3) in mounting position, making certain any adjacent wiring is not pinched under cover.
6. Secure cover using six M3.5 TORX screws (4) saved during removal.
7. Carefully slide Rx Tray fully into cabinet.
8. Secure the Rx Tray to the Equipment Cabinet mounting rails using four M6 TORX screws. Tighten the screws to 40 in-lb (4.5 Nm).
9. Reactivate site via OMC.

Triple Isolator Deck Replacement Procedure

Perform the following steps to replace a Triple Isolator Deck.

! WARNING !

TRIPLE ISOLATOR DECK SURFACES ARE HOT. CONTACT CAN CAUSE BURNS. ALLOW DECK SURFACES TO COOL BEFORE PROCEEDING TO PREVENT INJURY.

! WARNING !

BE SURE THE **DEKEY** COMMAND HAS BEEN ISSUED TO ALL BASE RADIOS THAT CONNECT TO THE ISOLATOR DECK TO PREVENT INJURY OR DAMAGE TO EQUIPMENT WHILE DISCONNECTING OR CONNECTING TRANSMIT CABLING.

NOTE

During Triple Isolator Deck replacement the site will become inoperative.

Removal

Remove Triple Isolator Deck as follows:

1. Make certain the **dekey** command has been issued to all base radios that connect to the Triple Isolator Deck being removed.
2. At rear of Triple Isolator Deck, disconnect Mate-N-Lok fan power connector.
3. Tag and disconnect N-connector RF cables from Triple Isolator Deck rear panel connectors.
4. Remove the four M6 TORX screws which secure the Triple Isolator Deck front panel to the Equipment Cabinet mounting rails. Save screws for reuse.
5. While supporting the Triple Isolator Deck, carefully remove the Triple Isolator Deck from the Equipment Cabinet by sliding it from the front of cabinet.

Installation

Install Triple Isolator Deck as follows:

1. While supporting the Triple Isolator Deck, carefully lift and slide the Triple Isolator Deck into the pre-installed side rails in the Equipment Cabinet mounting position.
2. Secure the Triple Isolator Deck to the Equipment Cabinet mounting rails using four M6 TORX screws. Tighten the screws to 40 in-lb (4.5 Nm).
3. Connect cabling to the Triple Isolator Deck rear panel connectors as tagged during removal.
4. Reactivate system as follows:
    - On an up-and-running system which was deactivated with a **dekey** command, reset the Base Radio Controller on Base Radios where the command was issued.
    - On a system that was completely shut down, perform activation in accordance with the System Testing section of this manual.

TTA Alarm Module Replacement

The location of the Duplexed TTA FRUs are shown in Figure 10-10. Perform the following steps to replace a TTA Alarm Module.

NOTE

During TTA Alarm Module replacement, the site will become inoperative due to loss of TTA functions. When followed as written, this procedure keeps the amount of downtime to a minimum.

It is recommended to perform this procedure during off-peak periods.

To prevent alarm reports while the replacement procedure is performed, the site should be taken down via the Operations and Maintenance Center (OMC).

Removal

Remove TTA Alarm Module as follows:

1. On front of TTA Alarm Tray, remove the two TORX screws which secure TTA Alarm Module being removed to tray. Save screws for reuse.
2. Draw TTA Alarm Module away from front panel enough to access cabling at rear of module.
3. At rear of TTA Alarm Module, tag and disconnect the two harnesses which connect to module.
4. Remove TTA Alarm Module from front of tray.

Installation

Install TTA Alarm Module as follows:

1. From front of TTA Alarm Tray, position the TTA Alarm Module for installation into tray.
2. Noting tagged wiring positions, connect two wiring harnesses to replacement TTA Alarm Module.
3. Place replacement TTA Alarm Module in mounting position and start two TORX screws (removed during removal) which secure module to tray.
4. Tighten two TORX screws to 8 in-lb.
5. Reactivate site via OMC.

Field Retrofit of Duplexed TTA Interface (CLN1403)

NOTE

During field retrofit, the site will become inoperative. When followed as written, this procedure keeps the amount of downtime to a minimum.

It is recommended to perform this procedure during off-peak periods.

To prevent alarm reports while the retrofit procedures are being performed, the site should be taken down via the Operations and Maintenance Center (OMC).

Figures 10-10 and 10-11 show the Duplexed TTA interface FRUs. Field retrofit of the CLN1403 Duplexed TTA interface consists of installing the following TTA hardware:

- ❒ TTA Alarm Tray
- ❒ DC Injectors (3 used)
- ❒ DC Injector Mounting Hardware
- ❒ TTA Tray Cabling

When all of the field retrofit procedures have been completed, perform receive branch equalization in accordance with the “Duplexed TTA Receive Branch Equalization” procedure in the *800 MHz GEN 4 Duplexed RF Distribution System* section of this manual.

NOTE

The tower-mounted TTA assemblies themselves are not part of the FRU described herein. The tower-mounted TTA assemblies are drop-shipped to the customer site.

TTA Alarm Tray Installation

The TTA Alarm Tray interfaces alarm monitoring and operating power for the Duplexed TTAs via the DC injectors. The TTA Alarm Tray occupies one rack unit above the RFDS front panel.

(See Figure 10-10.) Install TTA Alarm Tray as follows:

1. Unpack the TTA Alarm Tray and record the bar code number in the site records.
2. On equipment cabinet, remove the 1-RU blank panel directly above the RFDS front panel blank. Save screws for reuse.
3. Insert the TTA Alarm Tray into the rack in the location shown in Figure 10-10.
4. Secure the TTA Alarm Tray to the front of the cabinet using four TORX screws. Torque the screws to 40 in.-lbs.
5. Proceed to DC Injector Installation procedure below.

DC Injector Installation

The DC injectors allow the Duplexed TTA +24V operating power to be fed to the Duplexed TTA LNAs via the Tx/Rx coaxial feed cable. A DC injector must be installed at the antenna port of each duplexer.

(See Figure 10-11.) Install DC injectors as follows:

1. On Antenna 1 duplexer antenna port, disconnect antenna cable.
2. On Antenna 1 duplexer, remove nut that secures ground cable to duplexer. Disconnect cable and position aside.
3. Place DC injector mounting bracket over duplexer ground stud.
4. Place ground cable over stud. Start (but do not tighten) hex nut that secures ground cable along with bracket.

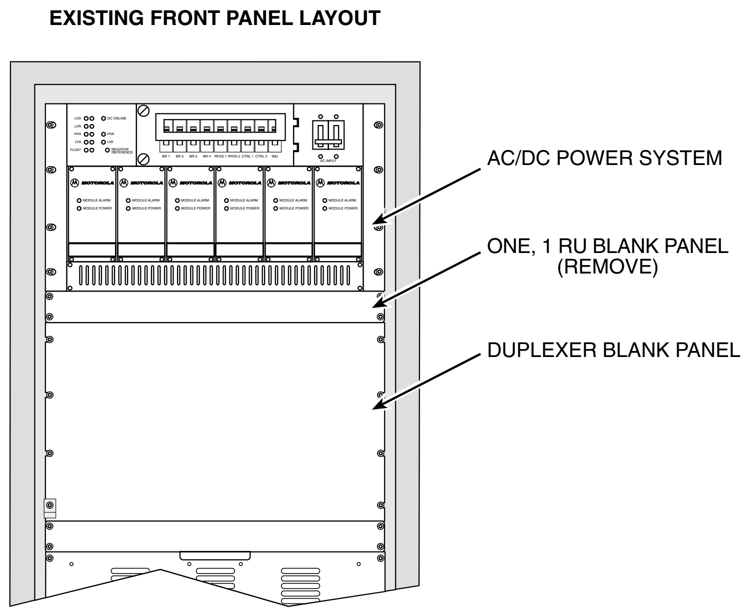
NOTE

In next step, DC Injector must be oriented properly.

5. Orientate DC Injector such that port labeled “PROTECTED” is facing duplexer port. Connect PROTECTED port on DC Injector to duplexer port.
6. Align mounting holes in bracket with mounting holes on DC injector. Secure DC injector to bracket using two M4 screws.
7. Fully tighten ground cable hex nut.

8. Connect the antenna cable to DC injector port labeled “SURGE”.
9. Repeat steps 1 through 8 for antenna branch 2 and branch 3.
10. Perform cabling in accordance with Duplexed TTA Cabling (provided in Cabling Information later in this section).
11. Reactivate site via OMC.
12. Proceed to Duplexed TTA Receive Branch Equalization procedure later in this section.

Field Retrofit of Duplexed TTA Interface (CLN1403)



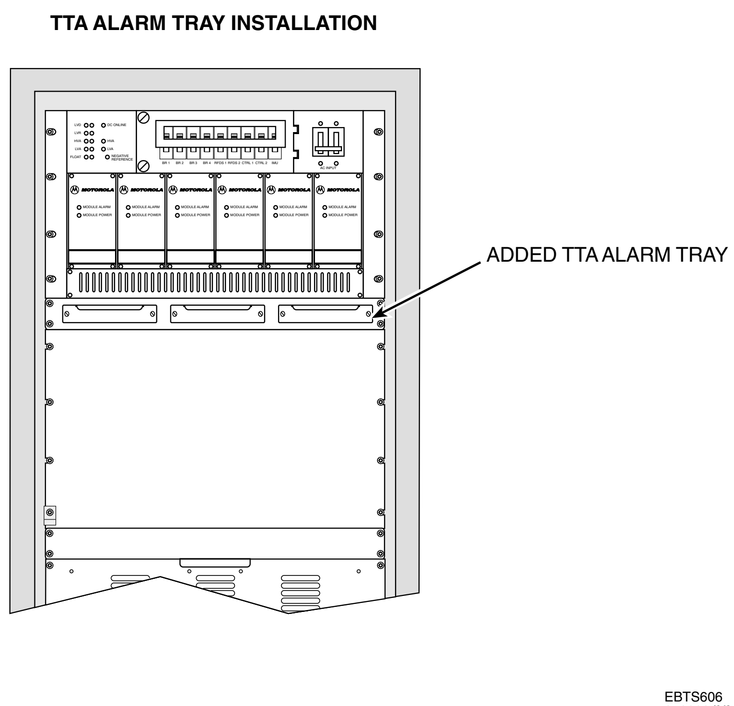


Figure 10-10 ***TTA Alarm Tray Installation***

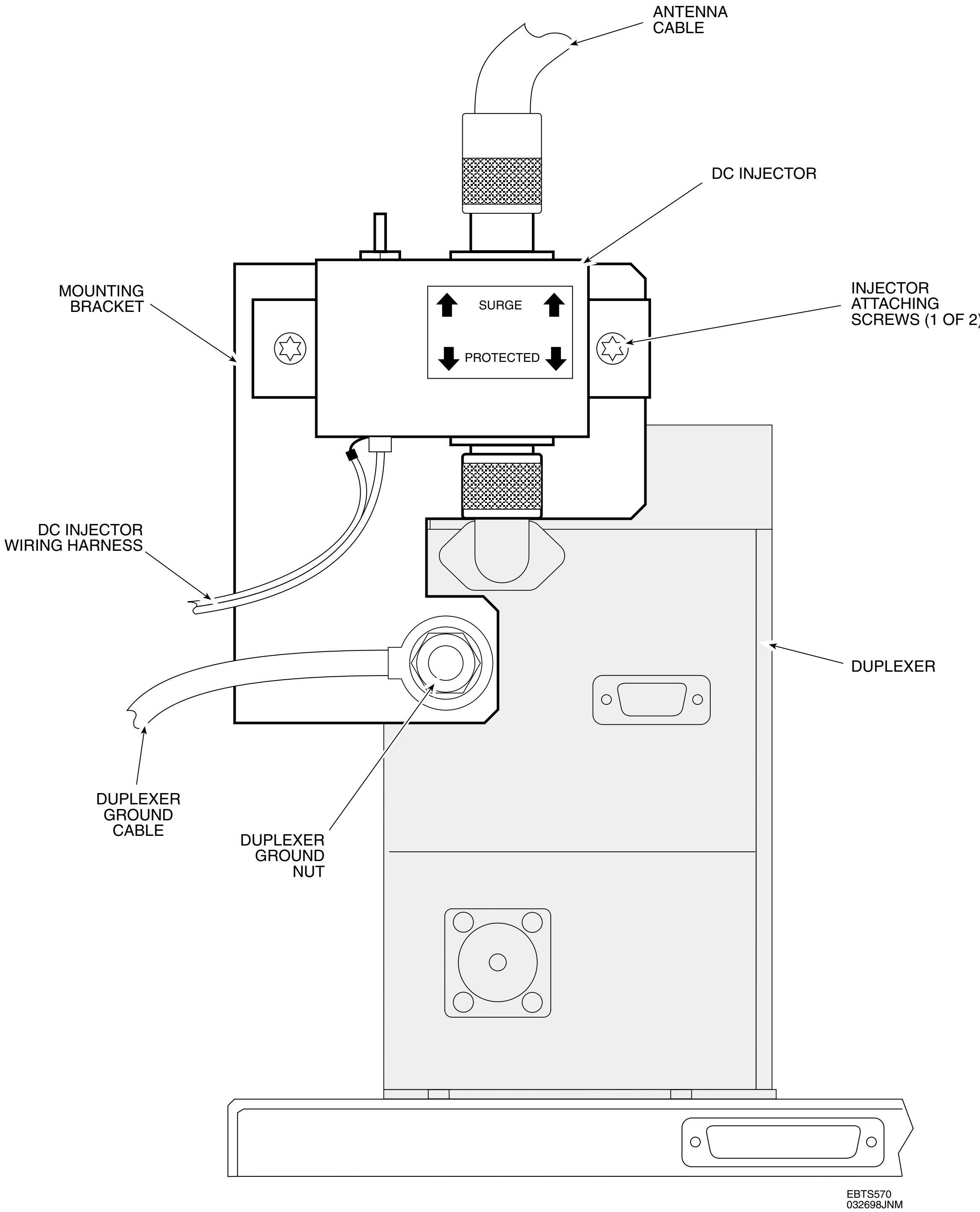


Figure 10-11 ***DC Injector Installation***

Duplexed TTA Receive Branch Equalization

NOTE

The procedures described in this section apply only to systems using the Duplexed TTA option.

Reason For Receive Branch Equalization

The required gain of all branches of the receiver system is 8.5 dB ±0.5 dB. This gain is measured through the receiver antenna system including the Duplexed TTA and the RFDS to the receiver input port of the Base Radio. However, due to variables such as cable run length and other factors, the loss value from antenna to Base Radio Rx input cannot be assumed to be a given value.

The following procedure equalizes the system gain for all receiver branches to a specified value. In performing this procedure, the value of a required inline attenuator is calculated which balances the gain to the required 8.5 dB ±0.5 dB value.

As shipped, each duplexer Rx output is directly cabled to its respective receive LNA input. In performing the following procedures, the inline attenuator discussed above will be inserted between the duplexer Rx output and its respective receive LNA input; this will be required for each duplexer branch.

As mentioned earlier, the value of the attenuators will be determined in the following procedures. SMA inline attenuators shall be used; these are not part of the TTA FRUs and are locally procured. The recommended attenuator type is as follows:

Mini-Circuits

Model SAT-__

(where _ is value in dB)

Equalization Methods Available

Two methods of determining the balance attenuator value are available. Either method may be used. The two methods are as follows:

- ❒ Using the procedures in this section. These procedures are listed below.
    - ❍ Test Equipment Considerations
    - ❍ Equipment Set-up
    - ❍ Equalization Procedure

  These procedures use the iDEN Analyzer as a signal source and Base Radio Received Signal Strength Indicator (RSSI) command as a precision signal strength measurement tool.

- ❒ Using the iDEN Branch Attenuator Calculator, which is a software package that runs on the service computer. The package calculates required attenuator values by determining the receive budget based on cabling run lengths.

  Contact the iDEN Customer Response Center to obtain this software.

  Regardless of the method used for receive equalization, install the required attenuators as described in the Inline Attenuator Installation procedure at the end of this section.

Test Equipment Considerations

An R2600-series analyzer is used in the equalization procedure. The output level of the R2660 analyzers is specified with an output accuracy of ±2 dB relative to the front panel reading. Since this procedure requires a precision of ±0.5 dB, only relative measurements referenced to a normalized setting will be made using the analyzer. Therefore, it is very important to follow the procedure exactly so the equalization results are within the specified ±0.5 dB tolerance.

NOTE

The equalization procedure requires the R2660 analyzers. The R2600 analyzers with the iDEN modulation can also be used for the test. The same procedure is used for both instruments.

Definitions

This paragraph defines the data required to perform the equalization procedure and associated calculations.

Receive branch calibration data

The tower top amplifier is equipped with a test port and is supplied with calibration data. The following calibration data is required for each receive branch:

- ❒ Antenna Port to Output Port Gain (GAO)
- ❒ Test Port to Output Port Gain (GTO)

Analyzer cable

The analyzer cable used with the R2660 analyzer (Figure 10-12) must be long enough to reach the primary cabinet junction panel. The loss of this cable is not required for the calculations. The analyzer cable is used in all of the test procedures and signal level is referenced to the end of the cable instead of to the output of the R2660 analyzer.

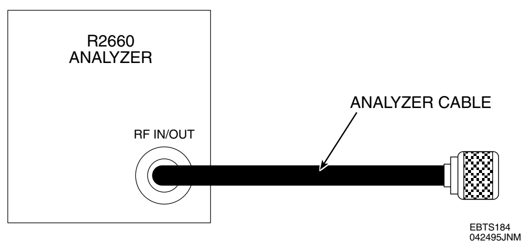


Figure 10-12 ***R2660 Analyzer and Cable***

Test cable

Each site should be equipped with a Test Cable connected from an accessible area to the test port of the tower amplifiers as shown in Figure 10-13. This cable should be of known length and attenuation which should be supplied by the customer. If the attenuation of the cable is not available, the attenuation can be calculated given the cable length. This cable is referred to as the Test Cable, and its loss is referred to as TCL (dB). The TCL (dB) value should include the loss of the main Test Port transmission line, tower top jumper cable, tower bottom jumper cable, and lightning surge arrestor. All cables and jumpers shown in Figure 10-13 are considered part of the test cable.

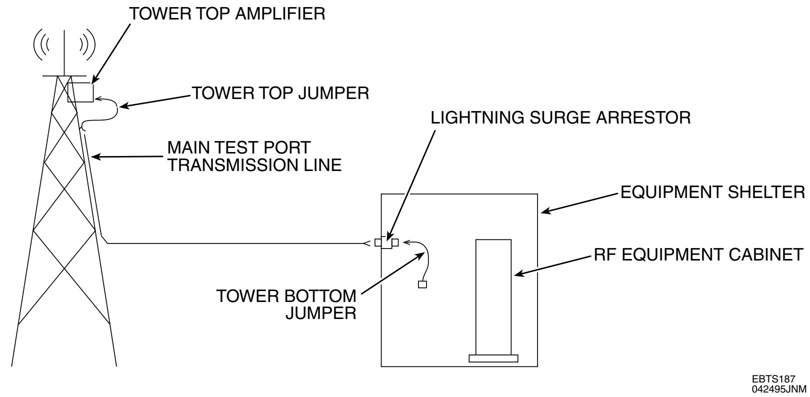


Figure 10-13 ***EBTS Tower Top Amplifier Configuration***

Receive antenna branch gain

GBA is the Receive Antenna Branch Gain of the RFDS. Use 9.0 dB for all entries in the procedure where GBA is requested.

Equipment Set-up

Set up the equipment using the following procedure. Base Radio 1 will be used during the equalization procedure.

1. Connect one end of the RS-232 cable to the service computer.

2. Connect the other end of the RS-232 cable to the Status port located on the front panel of the BRC of Base Radio 1 (the bottom Base Radio in the primary cabinet). It is important to use the bottom Base Radio.

3. Be sure the Test Cable is connected to the tower top amplifier Test Port.

4. Connect the Analyzer Cable to the other end of the Test Cable as shown in Figure 10-14. All other connections remain connected. All cables and jumpers shown in Figure 10-14 except the analyzer cable are considered part of the test cable.

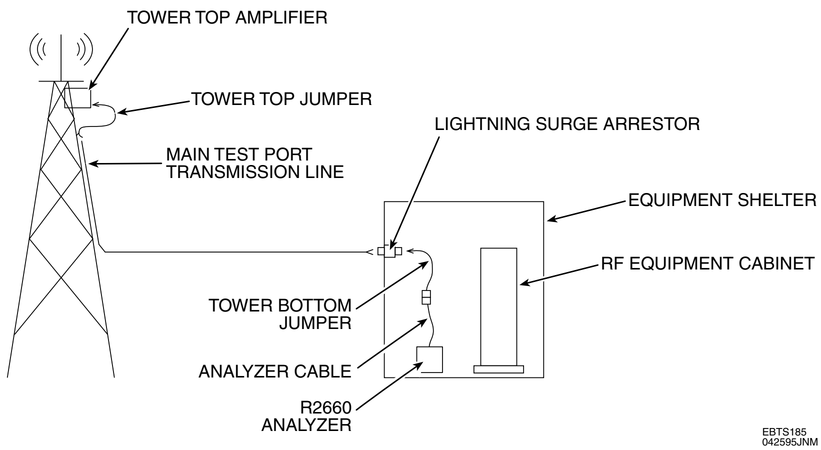


Figure 10-14 ***Analyzer Cable/Test Cable Connection***

5. Remove power from the R2660 and connect the Rubidium Frequency Standard 10 MHz Output to a 10 dB attenuator.
6. Connect the other end of the 10 dB attenuator to the 10 MHz Reference Oscillator In / Out connector in the R2660.
7. Set the R2660 to the EXT REF mode.
8. Apply power to the R2660 running the iDEN modulation.

NOTE

Refer to the equipment manual provided with the R2660 for further information regarding mode configuration of the unit (Motorola P / N 68P80309F16).

9. Set the R2660 to the frequency at which the tower top amplifier calibration data was taken (typically 815 MHz).
10. Set the R2660 to generate the test signal at an output level of -80 dBm.

Equalization Procedure

Perform the following procedure to equalize the receive gain for each branch.

1. Set up the service computer to communicate to the station through the RS-232 port.

2. Log on. The default password is **motorola**.

CAUTION
Make certain all Base Radios are dekeyed. Execute **dekey** command on service computer.

3. Set the receive frequency of the Base Radio to the frequency which the tower top amplifier calibration data was taken. This should be the same frequency that the R2660 was set during step 9 of equipment set-up.

   At the BRC> prompt type: **set rx_freq XXX.XXXXX** to set the receive frequency.

   XXX.XXXXX represents the desired 800 MHz frequency.

```
BRC> set rx_freq XXX.XXXXX
set RECEIVE FREQUENCY to XXX.XXXXX MHz in RAM
```

4. At the BRC> prompt, type: **set rx_mode 123**

   This command enables all antennas / receivers in the Base Radio.

```
BRC>set rx_mode 123
set RECEIVER 1 to ENABLED in RAM
set RECEIVER 2 to ENABLED in RAM
set RECEIVER 3 to ENABLED in RAM
```

5. At the BRC> prompt type: **set sgc off**

   This command disables the software gain control routine within the Base Radio.

```
BRC> set sgc off
set SOFTWARE GAIN CONTROL to DISABLED in RAM
```

6. At the BRC> prompt type: **set sys_gain on**

   This command enables the system gain for proper readout of the RSSI.

```
BRC> set sys_gain on
set SOFTWARE GAIN to ENABLED in RAM
```

7. At the BRC> prompt type: **get rssi 1 100**

   This command returns several fields that indicate the receiver performance. The data includes The Received Signal Strength Indicator (RSSI) and Bit Error Rate (BER).

```
BRC> get rssi 1 100
Starting RSSI monitor for 1 repetitions averaged each 100 reports.

Line  RSSI1   RSSI2  RSSI3   SGC    CI    BER       OffsetSyncMiss
       dBm     dBm    dBm     dB     dBmdBm%        Hz%
----   ------  ------  ------  ----   ------------ --------- ------- ---------
1     -101.3  -100.9 -102.0   0.0    -100.3-124.70.000e+00-5.10.000e+00
```

8. Adjust the output level from the R2660 and repeat step 6 until the RSSI for receiver 1 (RSSI1) is approximately -100 dBm.

NOTE

Once the level of the R2660 is set in step 8, the level should **NOT** be changed again for any other receiver or any other step in the calibration procedure. This level serves as the normalized value to which other relative measurements will be referenced.

9. Log the received signal strengths for all of the receivers present (i.e. RSSI 1, RSSI 2, and RSSI 3).

   These values will be referred to as #RSSI1, #RSSI2, and #RSSI3 respectively and are required in the following steps.

10. Disconnect the Analyzer Cable from the Test Cable.

11. (See Figure 10-15.) At the duplexer 1 antenna port, disconnect the antenna feed cable.

12. Connect the Analyzer Cable to the duplexer antenna port just disconnected in the previous step.

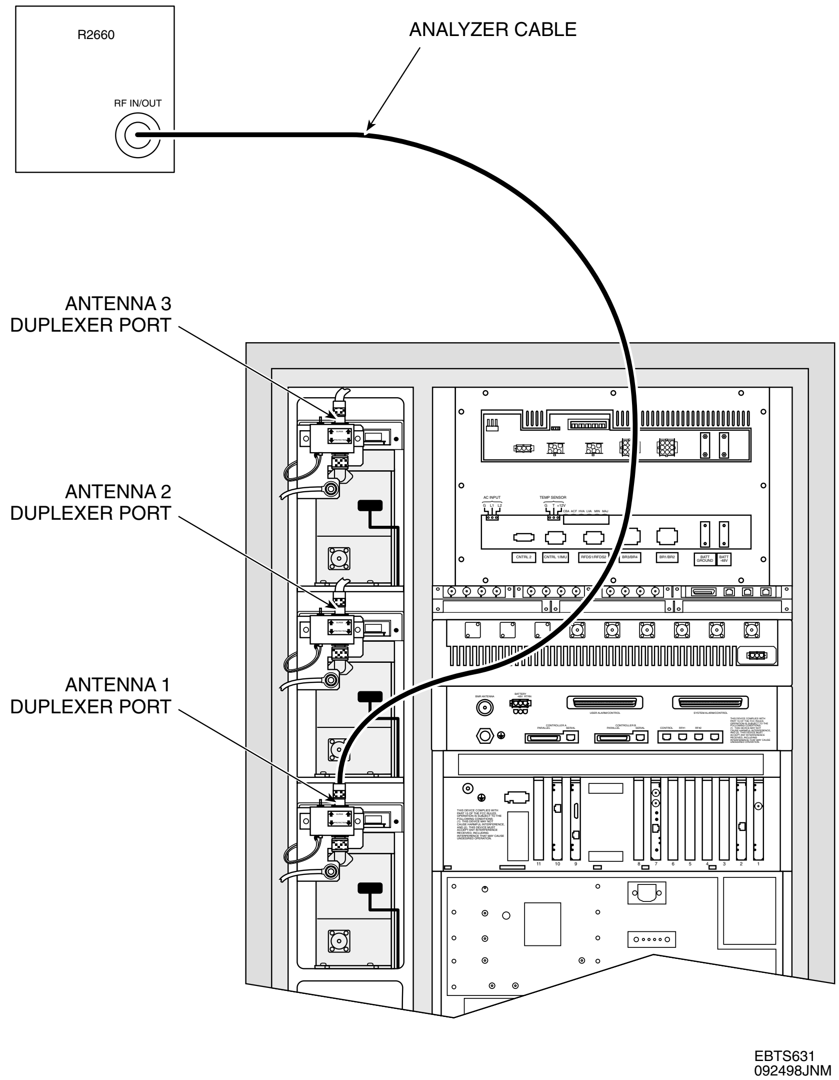


Figure 10-15 ***Analyzer Cable to Duplexer Antenna Port Connection (Typical)***

13. At the BRC> prompt type: **get rssi 1 100**

This command returns several fields that indicate the receiver performance. The data includes The Received Signal Strength Indicator (RSSI) and Bit Error Rate (BER).

```
BRC> get rssi 1 100
Starting RSSI monitor for 1 repetitions averaged each 100 reports.

Line  RSSI1   RSSI2   RSSI3   SGC    CI     BER        OffsetSyncMiss
       dBm     dBm     dBm     dB     dBmdBm%         Hz%
----  ------  ------  ------  ----   ------------ --------- ------- ---------
1     -101.3  -100.9  -102.0  0.0    -100.3-124.70.000e+00-5.10.000e+00
```

14. Log the received signal strengths for the present receiver.

    This value will be referred to as $RSSI1.

15. Disconnect the Analyzer Cable from the duplexer antenna port and reconnect the antenna feed cable to the antenna port.

16. Repeat steps 11 through 15 for the antenna 2 receive path and log the received signal strength for the Rx2 path as $RSSI2.

17. Repeat steps 11 through 15 for the antenna 3 receive path and log the received signal strength for the Rx3 path as $RSSI3.

18. Calculate the value of the inline attenuator required to equalize each receive branch using the appropriate RSSI value for the given branch. Use the following equation to determine this value.

    Attenuator = (GAO1-GTO) + (#RSSI1 - $RSSI1) + TCL + (GBA1-0.85)-8.5

    The above equation describes the attenuation required to obtain the required system path gain of 8.5 dB. As such, gain is represented as negative attenuation (negative numbers) and losses are represented as positive attenuation (positive numbers). In summary:

    - GAO is the Antenna Port to Output Port gain in dB given on the Tower Top Amplifier (this is a positive number).
    - GTO is the Test Port to Output Port gain in dB given on the Tower Top Amplifier (this is a negative number).
    - #RSSI is the reading in dBm given by the station in step 9 (this is a negative number).
    - $RSSI is the reading in dBm given by the station in step 14 (this is a negative number).
    - TCL is the Test Cable Loss in dB either given by the customer or calculated given the length of the cable (this number is a positive number in dB).
    - GBA is the Receive Gain constant of 9.0 dB.
    - 0.85 dB is the loss of the cable that connects the Rx Multicoupler to the receiver in Base Radio 1.
    - 8.5 dB is the expected gain for the entire path.

Example

Variable	Value
GAO1	16.8 dB
GTO	-9.7 dB
#RSSI1	-100 dBm
$RSSI1	-85.45 dBm
TCL	-2.7 dB

Attenuator = (GAO1-GTO) + (#RSSI1 - $RSSI1) + TCL + (GBA1-0.85)-8.5

= (16.8 - (-9.7)) + (-100 - (-85.45)) + (2.7) + (9.0 - 0.85) - 8.5

= (26.5) + (-14.55) + (2.7) + (8.15) - 8.5

= 14.3 dB

Therefore, choose a 14 dB attenuator for path 1.

19. On Rx1 receive path, install an inline attenuator of value determined in the previous step as described in “Inline Attenuator Installation” procedure below.

20. Repeat the calculation for the remaining receive branches replacing the appropriate values for paths 2 and 3.

21. Using an attenuator of the value determined in step 18 for the branch being equalized, install an inline attenuator as described in “Inline Attenuator Installation” procedure below. This is to be done for each branch.

22. Reconnect the Analyzer Cable to the Test Cable.

23. At the BRC> prompt type: **get rssi 1 100**

This command returns several fields that indicate the receiver performance. The data includes The Received Signal Strength Indicator (RSSI) and Bit Error Rate (BER).

```
BRC> get rssi 1 100
Starting RSSI monitor for 1 repetitions averaged each 100 reports.

Line  RSSI1   RSSI2   RSSI3   SGC    CI     BER       OffsetSyncMiss
       dBm     dBm     dBm     dB     dBmdBm%         Hz%
----   ------  ------  ------  ----   ------------ --------- ------- ---------
1     -101.3  -100.9  -102.0   0.0   -100.3-124.70.000e+00-5.10.000e+00
```

24. The reported RSSI numbers for Receivers 1, 2, and 3 should all be with ±0.5 dB of each other. If not, repeat the procedure.

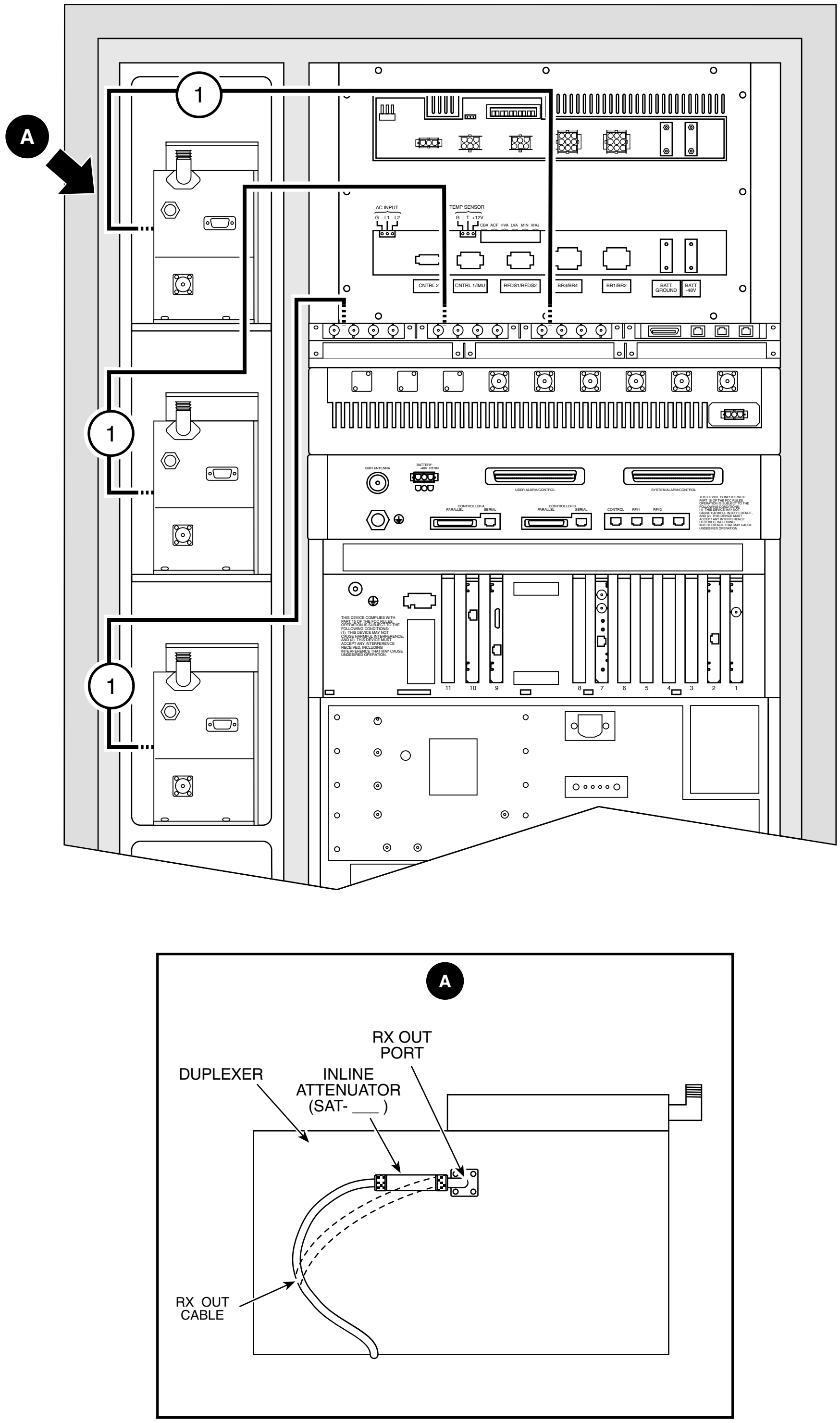
NOTE

Once the cabinet is equalized for Base Radio 1, all the other Base Radios in the cabinet (as well as any expansion cabinets) are also equalized. No other checks or tests need to be done for the other radios.

Inline Attenuator Installation

(See Figure 10-16.) Install inline attenuators as follows:

1. On side of ANT 1 duplexer, disconnect the Rx output cable from the SMA connector on duplexer side.
2. Connect inline attenuator to SMA connector on duplexer side.
3. Connect free end of cable disconnected above to inline attenuator.
4. Repeat steps 1 though 3 for each additional branch, using attenuator values determined in previous procedure.



EBTS632
092398JNM

Figure 10-16 ***Inline Attenuator Installation***

This Page Intentionally

Left Blank

MOTOROLA

Chapter 11 AC / DC Power System

Overview

This section provides technical information for the AC / DC Power System used in the Outdoor SRSC.

The topics of this section are listed in the following table.

Section	Page	Description
AC / DC Power System Specifications	11-2	Provides performance specifications for the power system used in the Outdoor SRSC.
AC / DC Power System Theory Of Operation	11-3	Provides theory of operation for the AC / DC Power System, as used in the SRSC system
Removal / Replacement Procedures	11-9	Provides instructions for replacing Power System FRUs.

AC/DC Power System Specifications

Table 11-1 lists the AC / DC Power System specifications.

Table 11-1 ***AC/DC Power System Specifications***

Specification	Value or Range
Rack Space Requirement	6 EIA Rack Units (RU)
Storage Temperature Range (NOTE 1)	-40˚ to +185˚ F (-40 to +85° C)
Operating Temperature Range (NOTE 1)	+32˚ to +122˚ F (0 to +50° C)
AC mains service	240 V, 30 A, 45-60 Hz, 1-phase
AC Line Input Range maximum: minimum:	 264.5 V 172.0 V
DC Rated Output (total)	54 V @ 50 A
Regulation (at rated output) Line: Load:	 0.5% max 2% max
Ripple and Noise (at rated output)	200 mV max
Front Panel Adjustment Cal Levels (NOTES 2, 3) LVD (low voltage disconnect): LVR (low voltage reconnect): HVA (voltage alarm; high threshold): LVA: (voltage alarm; low threshold): FLOAT:	 4.2 V (4 - 5 V) 4.81 V (4.5 - 5.5 V) 5.4 V (5.1 - 6 V) 4.3 V (4 - 5 V) 5.4 V (5.15 - 5.62 V)

NOTES:

1. Temperature ranges specified at 5-95% relative humidity (non-condensing)
2. Values listed are applicable to front panel test points, which are scaled at 1/10 bus value. Actual voltages and tolerances at -48V bus are 10X test point values.
3. Values listed are recommended factory cal points. Corresponding ranges (in parentheses) indicates allowable deviation from factory spec, and/or acceptable range of accommodation for customer-preferred differences.

AC/DC Power System Theory Of Operation

Figure 11-1 illustrates the layout while Figure 11-2 shows a block diagram of the AC / DC Power System used within the SRSC system. The AC / DC Power System receives 240 Vac, 1-phase, 50 / 60 Hz power from the site AC mains and provides several -48 Vdc outputs for use by various EBTS components within the SRSC cabinet. Its functional elements are as follows:

- ❐ Six Rectifier Modules
- ❐ Control / Calibration Circuitry
- ❐ Alarm Circuitry
- ❐ Low Voltage Disconnect (LVD) Contactor
- ❐ Breaker Panel, consisting of nine circuit breakers

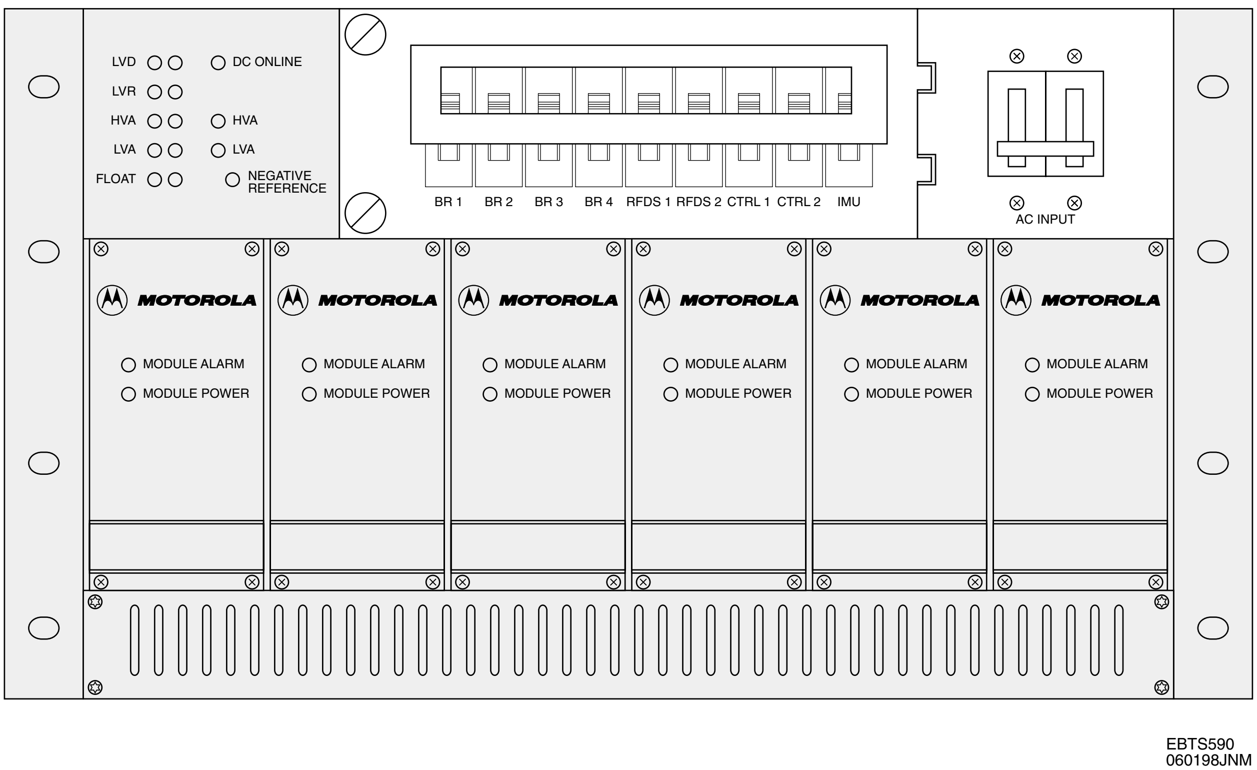
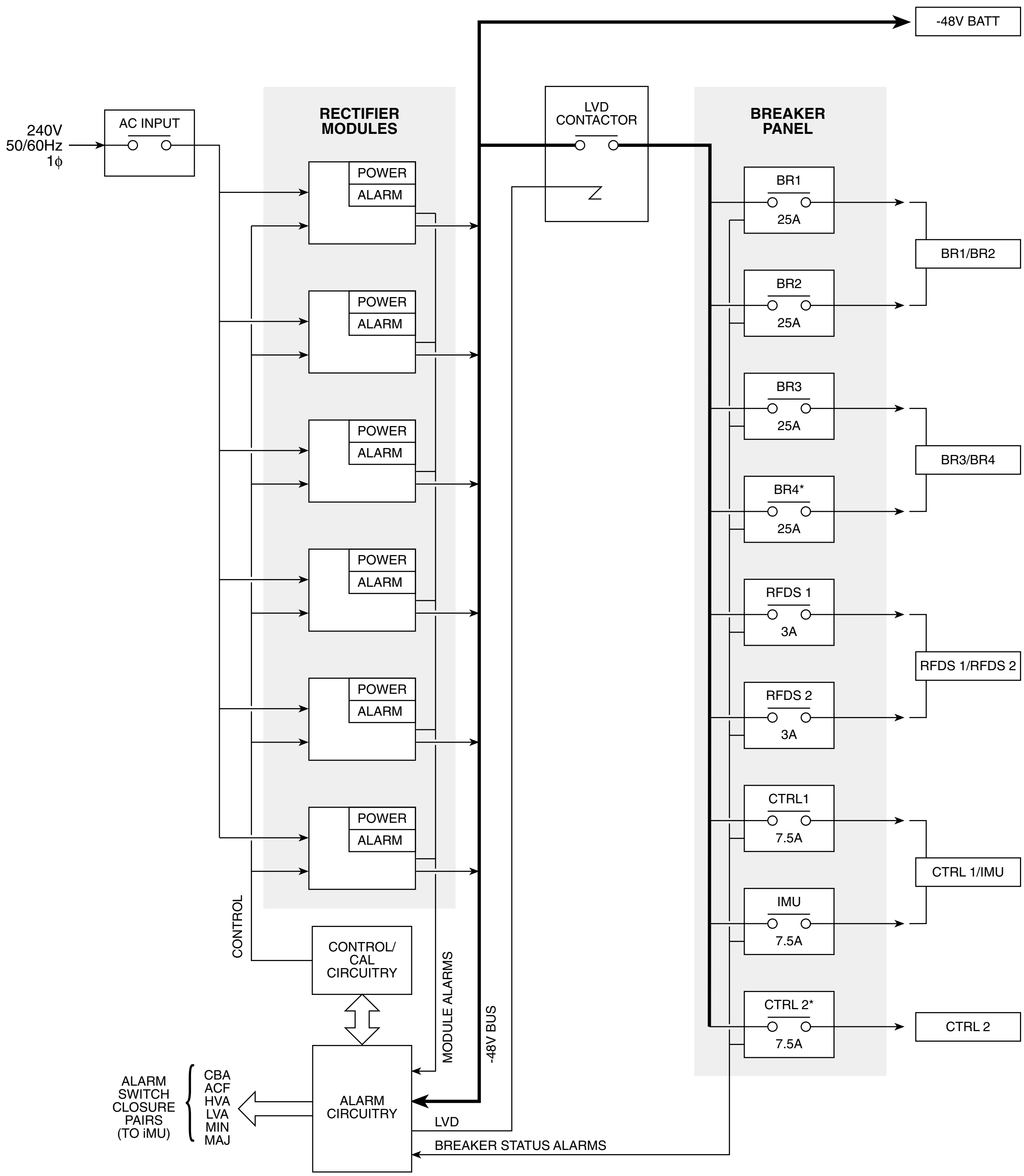


Figure 11-1 ***AC/DC Power System***

AC/DC Power System Theory Of Operation



* BR4 and CTRL2 Outputs are not used on SRSC System, but are reserved for customer equipment, e.g., Microwave.

EBTS614
091198LLN

Figure 11-2 ***AC/DC Power System Block Diagram***

Rectifier Modules

Six identical switching power supply modules (Rectifier Modules) provide *n+1* redundant, parallel conversion of AC mains power to cabinet -48 Vdc power. (At any given time, a minimum of five modules must be operational to assure proper power capacity to the cabinet.) The modules receive AC power from the AC input breaker. Each module applies its -48 Vdc output over the -48V bus.

Each Rectifier Module is equipped with the following indicators:

Indicator	Function
MODULE POWER	green LED indicator which shows module is receiving mains power and properly providing -48 Vdc output
MODULE ALARM	red LED indicator which shows module is not operating properly and requires replacement

In addition to the front panel visual status indications described above, each module sends alarm status signals to the alarm circuitry discussed below. Each module receives control and calibration for various parameters from the control / calibration circuitry, which is also discussed below.

Alarm Circuitry

The alarm circuitry within the AC / DC Power System sends alarm signals to the iMU. The iMU, in turn, communicates these alarms to the Operations and Maintenance Center. (Refer to the iSC supplement of this manual for more information on the iMU.)

The alarm circuitry monitors various power system parameters. Under normal conditions, the alarm circuitry sends alarm switch closures to the iMU. However, if any of the monitored signals indicate a fault within the AC / DC Power System the respective alarm switch closure opens to indicate the alarm.

For some alarms which involve voltage thresholds, the alarm circuitry works in conjunction with the control / calibration circuitry. The control / calibration circuitry sets the trip points at which various parameters are considered out of acceptable range. (The control / calibration circuitry is discussed below.)

The alarms and their conditions are described as follows:

Alarm	Description
CBA	Circuit Breaker Alarm – Via BREAKER STATUS ALARM interface, alarm circuitry detects tripped circuit breaker.
ACF	AC Failure – Alarm circuitry detects loss of AC mains power.
HVA	High Voltage Alarm – Via -48V bus and control / calibration circuitry, alarm circuitry detects voltage on -48V bus exceeding bus high threshold set by control / calibration circuitry.
LVA	Low Voltage Alarm – Via -48V bus and control / calibration circuitry, alarm circuitry detects voltage on -48V bus exceeding bus low threshold set by control / calibration circuitry.
MIN	Minor rectifier failure – Via MODULE ALARMS interface, alarm circuitry detects a failed module.
MAJ	Major rectifier failure – Via MODULE ALARMS interface, alarm circuitry detects that two or more modules have failed.

In addition to the alarm signals discussed above, the alarm circuitry also sends low voltage disconnect signal LVD to the load LVD contactor should the bus voltage fall below the minimum trip point.

Load LVD Contactor

The load LVD contactor (high-current relay) is used to disconnect the equipment cabinet components should the bus voltage fall below a preset minimum trip point. An LVD trip point is specified at a point where reliable operation of the various cabinet components can no longer be assured. Note that by positioning the contactor at the load (i.e., breaker panel connecting the components to the power system), low voltage disconnect for any condition leading to excessively low bus voltage is assured. As such, in addition to site shutdown, the LVD protects the backup batteries from damage due to deep depletion by disconnecting the batteries from the load when an excessive low bus voltage condition occurs.

Reconnection of the load (LVD disable) occurs when the LVR threshold is crossed. This value is somewhat higher than the LVD trip point to add hysteresis between the LVD and LVR trip points. Also, the higher LVR provides a margin of assurance that the backup batteries have received a deep enough charge to prevent repeated LVR cycling.

Control/Calibration Circuitry

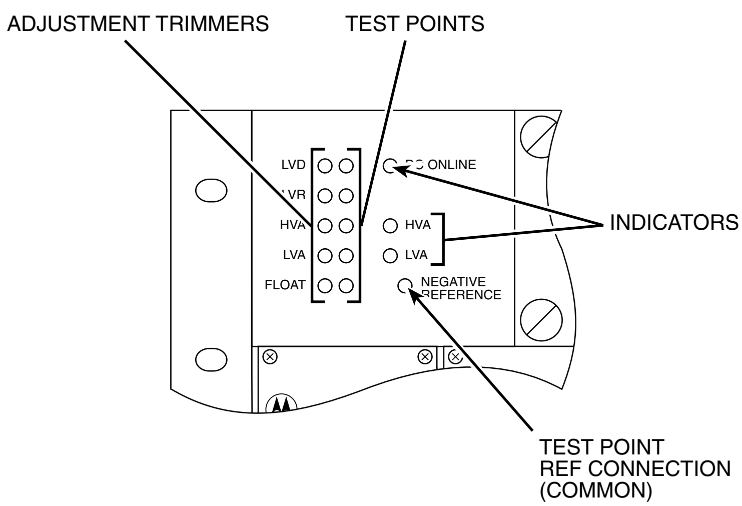
The control / calibration circuitry sets the thresholds of the various level-sensitive alarms discussed above, as well as setting the nominal (float) -48V bus voltage. The circuitry also allows front panel measurement and adjustment of the various parameters and thresholds.

For each parameter, a front panel adjustment and corresponding test point is provided. The adjustments / test points are described below:

Adjustment/ Test Point	Description
LVD	Low Voltage Disconnect – sets the voltage trip point for the -48V bus at which a bus voltage equal to or less than the LVD setting will result in a forced site shutdown. (Refer to Load LVD Contactor paragraph above for explanation of LVD operation.)
LVR	Low Voltage Reconnect – following a LVD trip, sets the voltage trip point for the -48V bus at which a bus voltage equal to or greater than the LVR setting will result in resumed site operation. (Refer to Load LVD Contactor paragraph above for explanation of LVD operation.)
HVA	High Voltage Alarm – sets the voltage trip point for the -48V bus at which a bus voltage equal to or greater than the HVA setting will result in a "-48V bus voltage too high" site alarm.
LVA	Low Voltage Alarm – sets the voltage trip point for the -48V bus at which a bus voltage equal to or less than the LVA setting will result in a "-48V bus voltage too low" site alarm.
FLOAT	Sets the nominal (float) voltage of the -48V bus.
NOTE: Adjustment values and ranges for the parameters above are specified in Table 11-1. AC/DC Power System Specifications.	

Figure 11-3 shows the AC / DC Power System adjustments, test points, and system indicators. The test points accept a standard multimeter probe. The multimeter common probe is inserted into the NEGATIVE REFERENCE test point, and the + probe is inserted into one of five test points corresponding to the parameter to be measured. Adjustment trimmers corresponding to the five test points are adjacent to the test points. The adjustment trimmers use slotted screws and accept a small flat blade (1/8") screwdriver or alignment tool.

A green DC ONLINE indicator shows if the -48V bus is energized. Red HVA and LVA indicators respectively show if an HVA or LVA condition is occurring on the -48V bus.



NOTE: Measurements at front panel test points are scaled at 1/10 bus value. Actual voltages and tolerances at -48V bus are 10X test point values.

EBTS609
050698JNM

Figure 11-3 ***AC/DC Power System Adjustments, Test Points, and Indicators***

Breaker Panel

The breaker panel (shown in Figure 11-1) consists of nine load circuit breakers which connect the -48V bus to the various Mate-N-Lok component connectors on the AC / DC Power System rear panel. The circuit breaker complement and ratings are shown in Figure 11-2.

Each breaker is equipped with a second, contact monitor SPST contact pair which sends notification to the alarm circuitry anytime one of the nine breakers open. The alarm circuitry, in turn, sends a CBA (breaker alarm) to the iMU.

Each circuit breaker on the Breaker Panel provide on / off control for hardware within the equipment cabinet. They also provide protection by automatically disconnecting the equipment in the event of an electrical overload. Each breaker and the equipment it controls is listed in the following table.

Label	Use
BR 1	Controls Base Radio #1
BR 2	Controls Base Radio #2
BR 3	Controls Base Radio #3
BR 4	(reserved)
RFDS 1	Controls RFDS - System A
RFDS 2	Controls RFDS - System B
CTRL 1	Controls iSC
CTRL 2	(reserved)
IMU	Controls iMU
AC INPUT	Controls 240 Vac input to AC / DC Power System

Removal/Replacement Procedures

Replacement of AC/DC Power System FRUs

Field maintenance of the AC / DC Power System is limited to replacement of failed Rectifier Module(s). A Rectifier Module failure is indicated by an illuminated red MODULE ALARM indicator and / or an extinguished green MODULE POWER indicator.

Instructions are provided below for replacing a Rectifier Module. Replace suspected FRUs with known non-defective FRUs to restore the power system to proper operation.

NOTE

In cases of minor power system alarm (MIN alarm) Rectifier Modules are designed for “hot pull” replacement. There is no need to shut down any equipment for field replacement of Rectifier Modules.

Where multiple modules indicate alarms, remove and replace only one module at a time.

Removal

Remove Rectifier Module as follows:

1. Remove the four Phillips-head screws which secure Rectifier Module to power system chassis. Save screws for reuse.
2. Grasp handle on Rectifier Module and slide module from power system chassis.

Installation

Install Rectifier Module as follows:

1. Align Rectifier Module with mating slot in power system chassis.
2. Gradually slide Rectifier Module into chassis until module front panel is flush with adjacent modules.
3. Check indicators on Rectifier Module just installed. Green indicator should be lit, and red indicator should be unlit.

NOTE

If Rectifier Module indications are not OK with known-good module, another problem exists. AC / DC Power System will require replacement (along with site shutdown) at earliest convenient time.

4. Secure Rectifier Module to power system chassis using four screws (saved during removal).

Numerics

A

B

I

J

L

M

P

R

This Page Intentionally

Left Blank