

Technical Manual

iDEN

Enhanced Base Tranceiver System
(EBTS)

Volume 1 of 3
System Installation and Testing

68P80801E35-C

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RF SUB-SYSTEM

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System Installation and Testing

About This Volume

Volume 1 of the Enhanced Base Transceiver System (EBTS) manual, *System Installation and Testing*, provides the experienced service technician with an overview of the EBTS operation and functions, and contains information on installing and testing the 800 MHz, 900 MHz, and 1.5 GHz EBTSs and the Multi-Sector Expansion Rack (MSER).

The EBTS has three major components:

- ☐ Generation 3 Site Controller (Gen 3 SC) or integrated Site Controller (iSC)
- ☐ Base Radios (BRs)
- ☐ RF Distribution System (RFDS)

The BRs are described in Volume 2, *Base Radios*, and RFDS are described in Volume 3, *RF Distribution Systems (RFDS)*. Detailed information about the Gen 3 SC is contained in the *Gen 3 SC Supplement Manual, 68P880801E30 or iSC Supplement Manual 68P1098E05* (this manual is incomplete without the Gen 3 SC or iSC Supplement.)

The information in this manual is current as of the printing date. If changes to this manual occur after the printing date, they will be documented and issued as Schaumburg Manual Revisions (SMRs).

Target Audience

The target audience of this document includes field service technicians responsible for installing, maintaining, and troubleshooting the EBTS.

In keeping with Motorola's field replaceable unit (FRU) philosophy, this manual provides sufficient functional information to the FRU level. Please refer to the appropriate section of this manual for removal and replacement instructions.

Reference Materials (MSER)

Reference Materials (MSER)

In addition to this manual, the following technical manuals are related to the MSER and may be needed for installation or maintenance.

Publication	Title	Description
68P80801E30	Generation 3 Site Controller (Gen 3 SC) - System Manual	Provides detailed information about the Gen 3 SC including a description of major subsystems, components, installation, testing, troubleshooting, and other information
68P81098E05	Integrated Site Controller (iSC) System Manual	Provides detailed information about the iSC including a description of major subsystems, components, installation, testing, troubleshooting, and other information.
68P81089E50	Motorola Standards and Guidelines for Communications Sites	A useful reference for the installation of fixed network equipment. This manual provides guidelines and procedures to ensure the quality of Motorola radio equipment installation, integration, optimization, and maintenance. Field service personnel should be familiar with the guidelines and procedures contained in this publication.

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Maintenance Philosophy

The EBTS has been designed using a Field Replaceable Unit (FRU) maintenance concept. To minimize system down time, faulty FRUs may be quickly and easily replaced with replacement FRUs. This helps to restore normal system operation quickly.

Due to the high percentage of surface mount components and multi-layer circuit boards, field repair is discouraged. Faulty or suspect FRUs should be returned to the Motorola Customer Support Center for further troubleshooting and repair.

Each FRU has a bar code label attached to its front panel. This label identifies a sequential serial number for the FRU. Log this number whenever contacting the Motorola Customer Support Center. For complete information on ordering replacement FRUs, or instructions on how to return faulty FRUs for repair, contact:

**Nippon Motorola LTD. OR
Tokyo Service Center
044-366-8860**

**Motorola Customer Support Center
1311 East Algonquin Road
Schaumburg, Illinois 60196
(800) 448-3245 or (847) 576-7300**

Technical Support Service

Motorola provides technical support services for installation, optimization, and maintenance of its fixed network equipment. Before calling the Motorola Customer Support Center, please note the following information:

- ☐ Where the system is located
- ☐ The date the system was put into service
- ☐ A brief description of problem
- ☐ Any other unusual circumstances

Available Field Replaceable Units

Available Field Replaceable Units

The items listed in the following tables are available as FRUs. The listings are divided into the following FRU categories:

- ❑ **System General** – FRUs that can be used throughout any system
- ❑ **Single Channel Base Radio**- FRU used within a Single Channel Base Radio.
- ❑ **800 MHz QUAD Channel Base Radio**- FRU used within a QUAD Channel Base Radio.
- ❑ **900 MHz QUAD Channel Base Radio**- FRU used within a QUAD Channel Base Radio.
- ❑ **Generation 2 Base Radio**- FRU used within a Generation 2 Base Radio
- ❑ **Base Radio** – FRU used within a Base Radio
- ❑ **GEN 4 Duplexed RFDS** – FRUs used within, or exclusively used with, the following:
 - An RF Cabinet equipped with an 800 MHz GEN 4 Duplexed RFDS
 - An Expansion RF Cabinet utilizing GEN 4 Duplexed assemblies
 - A Single Rack, Redundant Controller (SRRC) and/or Single Rack, Single Controller (SRSC) EBTS and associated expansion cabinets
- ❑ **Cavity Combining RFDS** – FRUs used within, or exclusively used with, an 800 MHz Cavity Combining RFDS
- ❑ **900 MHz Duplexed RFDS** – FRUs used within, or exclusively used with, an 900 MHz Duplexed RFDS
- ❑ **900 MHz QUAD RFDS**- FRUs used within, or exclusively with, a 900 MHz QUAD RFDS
- ❑ **Hybrid Expansion RFDS** – FRUs used within a Hybrid Expansion RFDS
- ❑ **Site Controller Hardware** – FRUs used for site control and alarm monitoring

System General FRUs

P/N	Description
TLN3348	Open Rack - 43 Rack Units
TLN3349	Solid Door - 43 Rack Units
TLN3350	Door Louvered - 43 Rack Units
TLN3351	Cover Flat Top Louvered
TLN3352	Cover Base
TLN3353	Base Stationary
55-82097V01	Lock, Standard

Single Channel Base Radio FRUs

P/N	Description
CLN1282	Integrated Base Radio Chassis
CLN1283	Integrated Receiver Module, 800 MHz
TLF2020	Power Amplifier, 40 Watt, 800 MHz
TLN3334	Base Radio Controller
TLN3335	Power Amplifier, 70 Watt, 800 MHz
TLN3337	Exciter Module, 800 MHz
TLN3338	DC Power Supply Module
TLN3425	Base Radio Controller (DCMA), 1500 MHz
TLN3426	Power Amplifier, 40 Watt, 1500 MHz
TLN3427	Receiver Module, 1500 MHz
TLN3428	Exciter Module, 1500 MHz
TLN3429	AC Power Supply Module (DCMA)

Available Field Replaceable Units**Generation 2 FRUs**

P/N	Description
CLN1282	Integrated Base Radio Chassis
CLN1283	Integrated Receiver Module, 800 MHz
TLF2020	Power Amplifier, 40 Watt, 800 MHz
DLN6446	Enhanced Base Radio Controller
TLN3335	Power Amplifier, 70 Watt, 800 MHz
DLN1204	Low Noise Exciter
TLN3337	Exciter Module, 800 MHz
TLN3338	DC Power Supply Module
TLN3429	AC Power Supply Module (DCMA)

800 MHz QUAD Channel Base Radio FRUs

P/N	Description
CLN1496	800 MHz QUAD Receiver
CLN1497	800 MHz QUAD Exciter / Base Radio Controller
CLN1498	800 MHz QUAD DC Power Supply
CLN1499	800 MHz QUAD Power Amplifier
DLN1200	800 MHz QUAD Base Radio Chassis

900 MHz QUAD Channel Base Radio FRUs

P/N	Description
DLN1201	900 MHz QUAD Receiver
DLN1203	900 MHz QUAD Exciter / BR Controller
CLN1498	900 MHz QUAD DC Power Supply
DLN1202	900 MHz QUAD Power Amplifier
DLN1200	900 MHz QUAD Base Radio Chassis

GEN 4 Duplexed RFDS FRUs

800 MHz QUAD P/N	Description	900 MHz QUAD P/N
CLN1349	Power Supply	
CLN1350	Triple 2-Way Combiner Deck w / o Isolators	
CLN1351 (NOTE 1)	Triple 2-Way Combiner Deck w / o Isolators	
CLN1353	Dual 3-Way Combiner Deck w / Isolators	
CLN1362	4-Way Rx Low Noise Amplifier / Multicoupler Subassembly	DLN1206
CLN1363	6-Way Rx Low Noise Amplifier / Multicoupler Subassembly	
CLN1366A	Triple Through w / Isolators	
CLN1401	Alarm Board	
CLN1402	I/O Board	
CLN1403	Duplexed TTA Field Retrofit Kit	
CLN1405	Duplexed TTA Alarm Module	
CLN1481	Dual 2-Way Combiner Deck w / Isolators	
NOTES: 1. This item associated with expansion.		

Cavity Combining RFDS FRUs

P/N	Description
CKN1010	Rx Cavity Expansion Hardware: Main to Expansion Cabinet
TLF1900	Low Gain Amplifier Receiver Tray
TLF1980	Tx RF Transfer Switch for 800 MHz Cavity PCCH
TLG1002	Tx RF Transfer Switch for 1500 MHz Cavity PCCH
TLN3392	DC Low-Noise Amplifier Power Supply and Alarm Tray
TLN3393	DC Injector RF Distribution
TLN3394	Power Monitor Assembly
TTF1540	Isolator/Load Assembly
TTF1560	Cavity Combiner Channels 3 & 4
TTF1570	Cavity Combiner Channel 5

Available Field Replaceable Units**900 MHz QUAD Duplexed RFDS FRUs**

P/N	Description
See Note 1	Triple 2-Way Combiner Deck w/o Isolators
CLN1382	DC & Alarm Expansion Tray
DLN1205	RX Preselector
DLN1206	Three-Branch Rx Multicoupler Tray w/ 4-Way LNAs
See Note 1	900 MHz Duplexer
See Note 1	800/900 MHz Duplexer
NOTE: 1- Refer to iDEN Price Book for FRU details	

Hybrid Expansion RFDS

P/N	Description
CLN1285	Hybrid/Coupler Expansion Load Assembly
CLN1313	Duplexed Retrofit 3 Branch TTA, V03
CLN1314	Duplexed Retrofit 3 Branch TTA, V01
CLN1315	Duplexed Retrofit 3 Branch TTA, V06
CLN1325	Hybrid Expansion Receive Cabling, Primary Rack
TFF1090	Bandpass Transmit Filter
TLF1990	Primary Isolator
TLF2000	Secondary Isolator
TLN3358	Duplexed RF Expansion Tray (Non-5th Channel)
TLN3439	Duplexed RF Expansion Tray (5th Channel)

Site Control Hardware

P/N	Description
DLN1103	GEN 3 Site Controller
DLN1107	Environmental Alarm System
DPN1007	Gen3 SC Power Supply

General Safety Information

General Safety Information

The following general safety precautions must be observed during all phases of operation, service, and repair of the equipment described in this manual. The safety precautions listed below represent warnings of certain dangers of which we are aware. You should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.

Read and follow all warning notices and instructions marked on the product or included in this manual before installing, servicing or operating the equipment. Retain these safety instructions for future reference. Also, all applicable safety procedures, such as Occupational, Safety, and Health Administration (OSHA) requirements, National Electrical Code (NEC) requirements, local code requirements, safe working practices, and good judgement must be used by personnel.

Refer to appropriate section of the product service manual for additional pertinent safety information.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modifications of equipment.

Identify maintenance actions that require two people to perform the repair. Two people are required when:

- ✓ A repair has the risk of injury that would require one person to perform first aid or call for emergency support. An example would be work around high voltage sources. A second person may be required to remove power and call for emergency aid if an accident occurs to the first person.
- ✓ Use the National Institute of Occupational Safety and Health (NIOSH) listing equation to determine whether a one or two person lift is required when a system component must be removed and replaced in its rack.

If troubleshooting the equipment while power is applied, be aware of the live circuits.

DO NOT operate the transmitter of any radio unless all RF connectors are secure and all connectors are properly terminated.

All equipment must be properly grounded in accordance with *Motorola Standards and Guidelines for Communication Sites "R56" (6881089E50)* and specified installation instructions for safe operation. Slots and openings in the cabinet are provided for ventilation. To ensure reliable operation of the product and protect it from overheating, these slots and openings must not be blocked or covered.

Only a qualified technician familiar with similar electronic equipment should service equipment.

Some equipment components can become extremely hot during operation. Turn off all power to the equipment and wait until sufficiently cool before touching.

Human Exposure Compliance

This equipment is designed to generate and radiate radio frequency (RF) energy by means of an external antenna. When terminated into a non-radiating RF load, the base station equipment is certified to comply with Federal Communications Commission (FCC) regulations pertaining to human exposure to RF radiation in accordance with the FCC Rules Part 1 section 1.1310 as published in title 47 code of federal regulations and procedures established in TIA/EIA TSB92, Report on EME Evaluation for RF Cabinet Emissions Under FCC MPE Guidelines, Compliance to FCC regulations of the final installation should be assessed and take into account site specific characteristics such as type and location of antennas, as well as site accessibility of occupational personnel (controlled environment) and the general public (uncontrolled environment). This equipment should only be installed and maintained by trained technicians. Licensees of the FCC using this equipment are responsible for insuring that its installation and operation comply with FCC regulations Part 1 section 1.1310 as published in title 47 code of federal regulations.

Whether a given installation meets FCC limits for human exposure to radio frequency radiation may depend not only on this equipment but also on whether the “environments” being assessed are being affected by radio frequency fields from other equipment, the effects of which may add to the level of exposure. Accordingly, the overall exposure may be affected by radio frequency generating facilities that exist at the time the licensee’s equipment is being installed or even by equipment installed later. Therefore, the effects of any such facilities must be considered in site selection and in determining whether a particular installation meets the FCC requirements.

FCC OET Bulletin 65 provides materials to assist in making determinations if a given facility is compliant with the human exposure to RF radiation limits. Determining the compliance of transmitter sites of various complexities may be accomplished by means of computational methods. For more complex sites direct measurement of power density may be more expedient. Additional information on the topic of electromagnetic exposure is contained in the *Motorola Standards and Guidelines for Communications Sites* publication. Persons responsible for installation of this equipment are urged to consult the listed reference material to assist in determining whether a given installation complies with the applicable limits.

In general the following guidelines should be observed when working in or around radio transmitter sites:

- All personnel should have electromagnetic energy awareness training.
- All personnel entering the site must be authorized.
- Obey all posted signs.
- Assume all antennas are active.
- Before working on antennas, notify owners and disable appropriate transmitters.
- Maintain minimum 3 feet clearance from all antennas.
- Do not stop in front of antennas.
- Use personal RF monitors while working near antennas.
- Never operate transmitters without shields during normal operation.
- Do not operate base station antennas in equipment rooms.

General Safety Information

For installations outside of the U.S., consult with the applicable governing body and standards for RF energy human exposure requirements and take necessary steps for compliance with local regulations.

References:

TIA/EIA TSB92 "Report on EME Evaluation for RF Cabinet Emissions Under FCC MPE Guidelines", Global Engineering Documents: <http://global.ihs.com/>

FCC OET Bulletin 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields"; <http://www.fcc.gov/oet/rfsafety/>

Motorola Standards and Guidelines for Communications Sites, Motorola manual 68P81089E50

IEEE Recommended Practice for the Measure of Potentially Hazardous Electromagnetic Fields-- RF and Microwave, IEEE Std. C95.3-1991, Publication Sales, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331

IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE C95.1-1991, Publication Sales, 445 Hoes Lane, P.O. Box 1331

System Description

Overview

This section provides basic descriptions of the EBTS role within the iDEN system, the various EBTS configurations, and the EBTS major components. Topics covered in this section are listed in the following table.

Section	Page	Description
EBTS Site Description	2	Provides an overview of the EBTS within the iDEN system
EBTS Overall Functional Description	3	Provides a general description of the EBTS and identifies its major subsystems and components. Describes the role of the EBTS major components within the EBTS.
EBTS Cabinet Configurations	6	Provides an overview of the various available EBTS cabinet configurations
EBTS Component Descriptions	10	Describes the components that comprise the EBTS
EBTS Configuration Descriptions	26	Individually describes the various EBTS configurations. Describes the operation of each major component as specifically related to each of the individual configurations.

(See Figure 1.) The EBTS provides radio communication links between the land network and the mobile subscriber units in the integrated Dispatch Enhanced Network (iDEN) system.

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

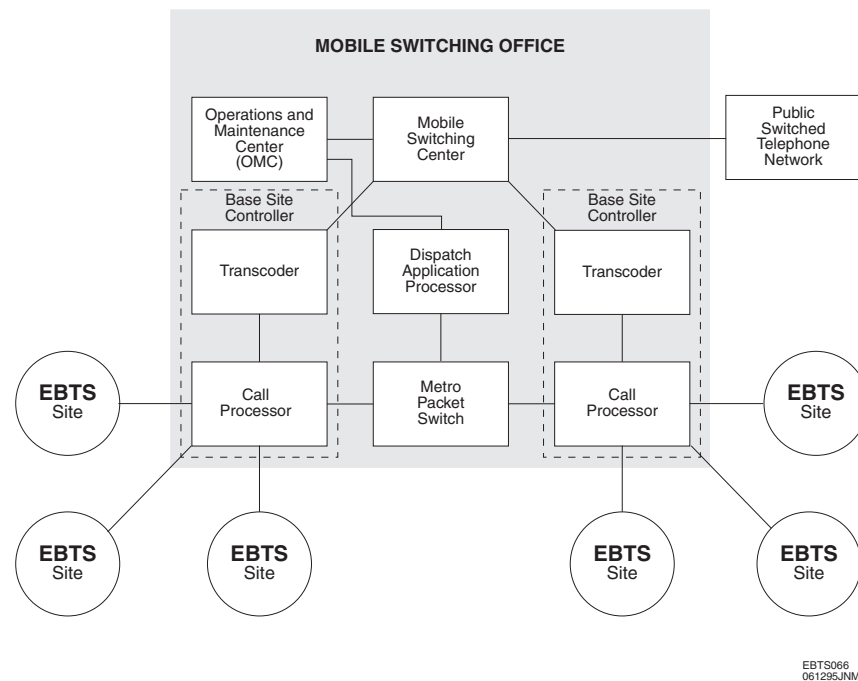


Figure 1 *integrated Dispatch Enhanced Network (iDEN) System*

EBTS Overall Functional Description

Figure 2 shows an overall simplified block diagram of a typical EBTS. The EBTS consists of three major components, as listed below:

- ❑ Generation 3 Site Controller or QUAD BR Controller/Exciter
- ❑ Base Radio(s)
- ❑ RF Distribution System

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

Generation 3 Site Controller (Gen 3 SC)

The Gen 3 SC assigns available frequencies and slots to the mobiles. It also communicates with the network via T1/E1 lines. There is at least one Gen 3 SC for each EBTS. The Gen 3 SC receives Global Positioning System (GPS) signals which it uses to develop high-precision system timing signals.

The Gen 3 SC interfaces with the Base Radios using the following interfaces:

- ❑ **5 MHz/1 PPS** – Via the received GPS signal, the Gen 3 SC 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** – 10Base2 Ethernet interface provides data and control interface between Gen 3 SC and Base Radios.

The Environmental Alarm System (EAS) is a component mounted above the Gen 3 SC, but is functionally considered a part of the Gen 3 SC. The EAS interfaces alarm signals from the EBTS to the Gen 3 SC. In turn, the Gen 3 SC can communicate EBTS alarms to the OMC via its T1/E1 link.

The EAS receives alarm signals from the Base Radios, RF Distribution System, and breaker status signals from the EBTS equipment cabinet circuit breakers.

The Gen 3 SC is described in detail in the supplement to this manual.

EBTS Overall Functional Description**Base Radio (BR)/Generation 2 Base Radio (Gen2 BR)**

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 with three time slots. The primary advantage of three time slots over six slots is better voice quality.

QUAD Base Radio

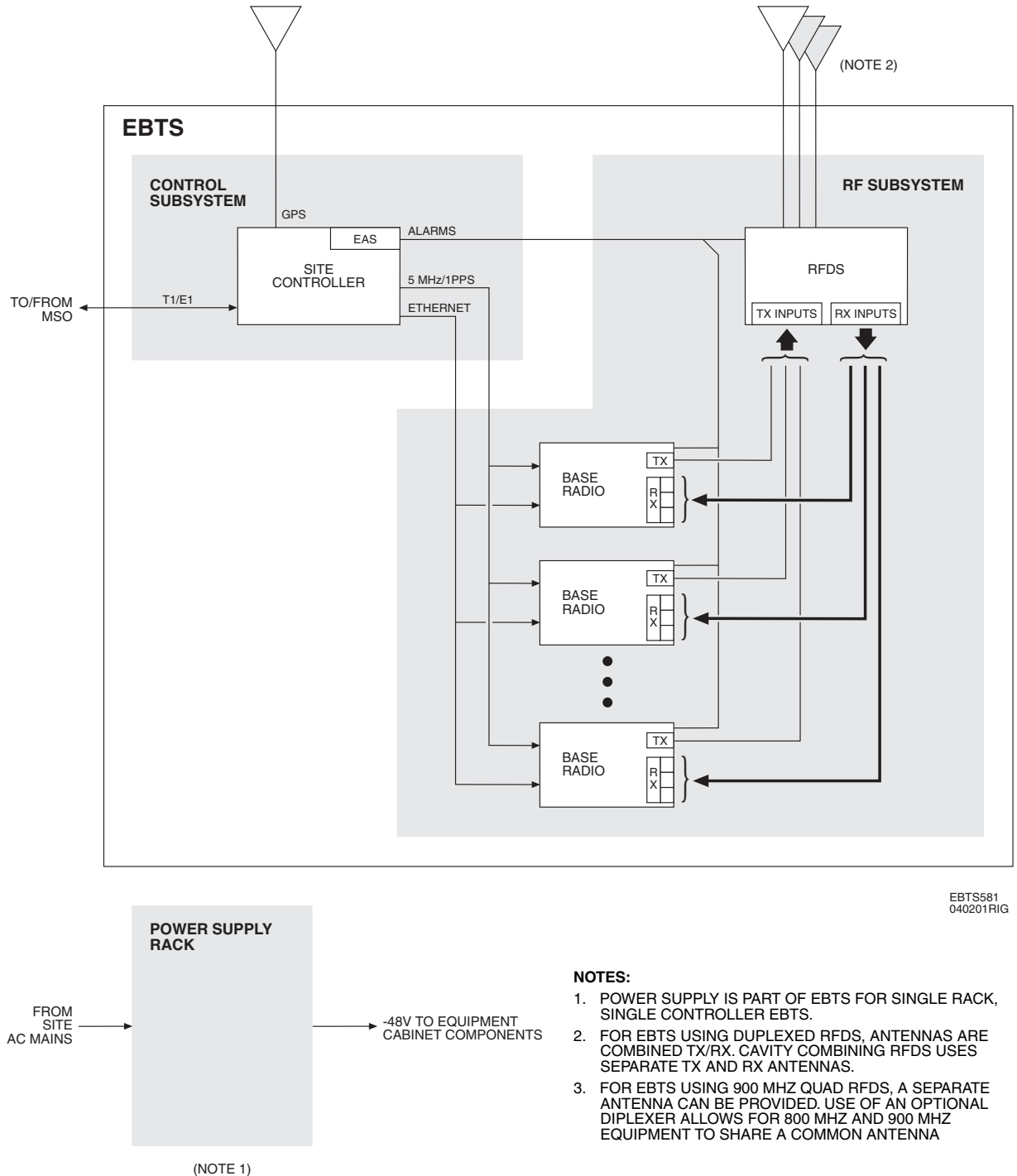
Each QUAD Channel Base Radio sends and receives control information and compressed voice data. Each Base Radio handles one to four 800 MHz channels that are 25 kHz wide and have six time slots each. This means that six voice or data signals are allowed for every 25 kHz signal. This is accomplished using 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.

RF Distribution System (RFDS)

The RFDS routes radio frequency signals from the site receive antennas, into the EBTS, 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.

Various types of RFDSs are available which use different methods of combining transmit signals onto a transmit antenna(s). The various types are discussed later in this section.

EBTS Overall Functional DescriptionFigure 2 **EBTS Overall Simplified Block Diagram**

EBTS Cabinet Configurations

Three different cabinet racking configurations are used for the EBTS: Stand-alone Control And RF Cabinet (SCRF configuration), Single-Rack, Redundant-Controller (SRRC), and Single Rack, Single Controller (SRSC). These configurations differ from each other primarily in the mounting location of the EBTS and ancillary components; the overall system functionality as well as the major components that comprise the systems are similar.

Figure 3 shows, in block form, the component complements that comprise the various EBTS cabinet configurations.

Stand-alone Control And RF Cabinet EBTS Configuration

The Stand-alone Control And RF Cabinet (SCRF) EBTS configuration consists of a separate Control Cabinet (which contains the Gen 3 SC) and one or more separate RF Cabinets (which contain the RFDS and the Base Radios). EBTSs using the GEN 4 Duplexed RFDS are available in the SCRF configuration, as well as the SRRC and SRSC configurations described below. EBTSs using any other type of RFDS are available only in the SCRF configuration.

The SCRF configuration requires a -48 VDC power source, supplied by an external power supply (rectifier) rack. (The rectifier rack used for an SCRF configuration is not part of the EBTS.)

NOTE

The 900 Mhz QUAD Duplexed RFDS Cabinet comes in three configurations: 3BR, 5BR plus Expansion Duplexers, and 5BR plus Combiner. Figure 4 shows, in block form, the component complements that comprises these three variations.

SRRC Configuration EBTS

The SRRC configuration combines the Control Cabinet and RF Cabinet functions in one cabinet. As such, the SRRC consists of a single cabinet containing an 800 MHz GEN 4 Duplexed RFDS and three Base Radios (baseline), along with a redundant (dual) Gen3 SCs.

The SRRC configuration requires a -48 VDC power source, supplied by an external power supply (rectifier) rack. (A rectifier rack used for an SRRC configuration is not part of the EBTS.)

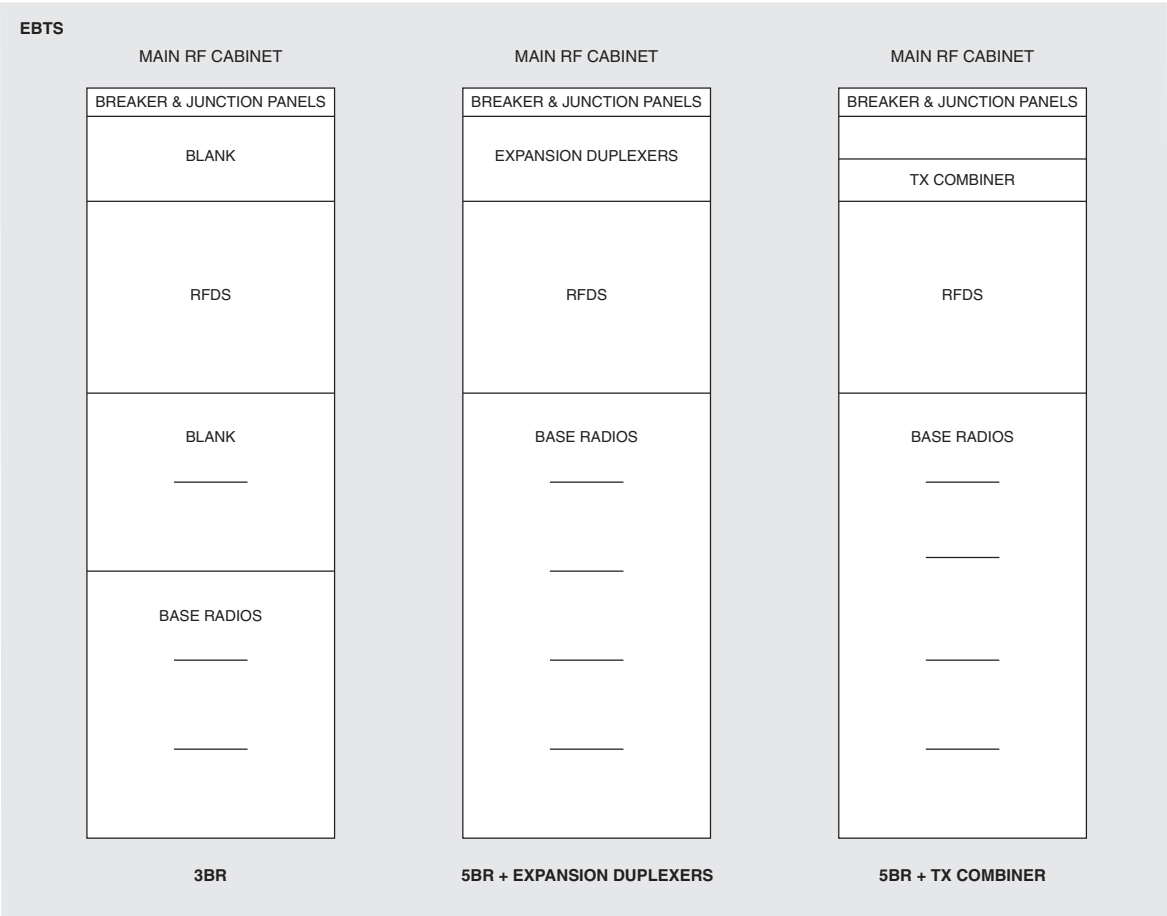
EBTS Cabinet Configurations



EBTS582
040201JNM

Figure 3 EBTS Equipment Complements For Various Cabinet Configurations

EBTS Cabinet Configurations



EBTS582_900
040201JNM

Figure 4 900 Mhz QUAD Duplexed RFDS Cabinet Configurations

SRSC Configuration EBTS

The SRSC configuration combines the Control Cabinet and RF Cabinet functions in one cabinet. As such, the SRSC consists of a single cabinet containing an 800 MHz GEN 4 Duplexed RFDS and three Base Radios, along with a single Gen 3 SC. Additionally, this configuration uses a self-contained rectifier system. This allows a complete EBTS installation compactly consisting of only one cabinet, and allows direct connection to the site AC mains.

Expansion RF Cabinets

All configurations (except the SRSC) can be *expanded* (have Base Radios added) by using a suitable Expansion RF Cabinet and interface items. Basically, an expansion cabinet consists of the added Base Radios, a breaker and junction panel, and an abbreviated RFDS that interfaces the expansion Base Radio Tx and Rx signals with those of the Main RF Cabinet Base RFDS.

Expansion RF Cabinets requires a -48 VDC power source, supplied by an external power supply (rectifier) rack.

Because expansion cabinet equipment complements vary greatly between the various RFDSs, the expansion cabinets are individually discussed in the applicable paragraphs that follow. Detailed information relating to specific expansion cabinets is provided in the respective RF Distribution sections of this manual.

EBTS Component Descriptions

EBTS Component Descriptions

The following paragraphs describe and show the major components of the EBTS. 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 EAS and GEN 3 SCs, refer to the supplement to this manual (68P80801E30) for detailed information.

Base Radio

The Base Radio (Figure) provides reliable digital communications capabilities by incorporating a compact software-controlled design. Increased channel capacity is achieved through voice compression techniques and time division multiplexing. Figure 7 shows a simplified block diagram of the Legacy and Generation 2 Base Radios. Figure 8 shows a simplified diagram of the QUAD Base Radio (800 and 900 MHz).

The Legacy 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

The Gen2 Base Radio consists of the following FRUs:

- ☐ Enhanced Base Radio Controller (EBRC) or the Base Radio Controller (BRC)- controls Gen2 Base Radio operation.
- ☐ Power Supply- supplied operating power for the other Base Radio FRUs
- ☐ Receiver- filters received RF and converts it to differential data
- ☐ Exciter or Low Noise Exciter- generates RF output
- ☐ Power Amplifier- amplifies Exciter output prior to transmission

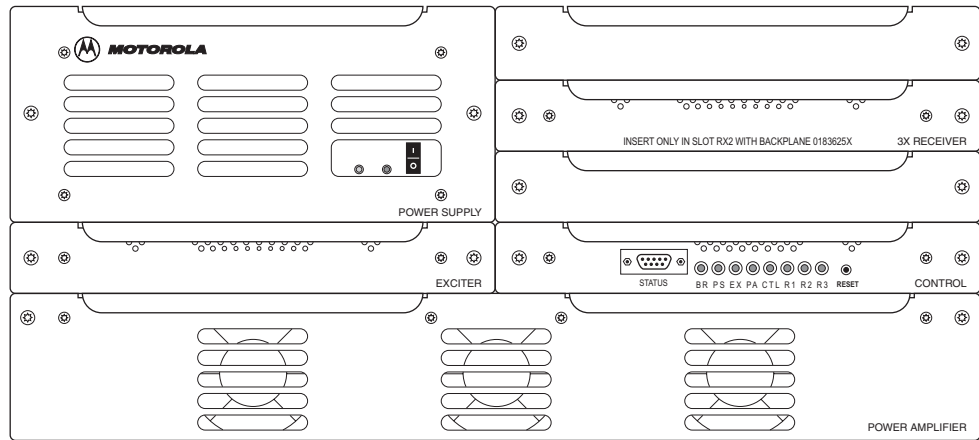
The QUAD Channel Base Radio (800/900 MHz) consists of the following FRUs:

- ❑ QUAD Channel Base Radio Controller (BRC) and Exciter- controls Base Radio operation and generates RF output
- ❑ Power Supply- provides operating power for the other Base Radio FRUs
- ❑ Receiver- filters received RF and converts it to differential data
- ❑ Power Amplifier- amplifies Exciter output before transmission

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

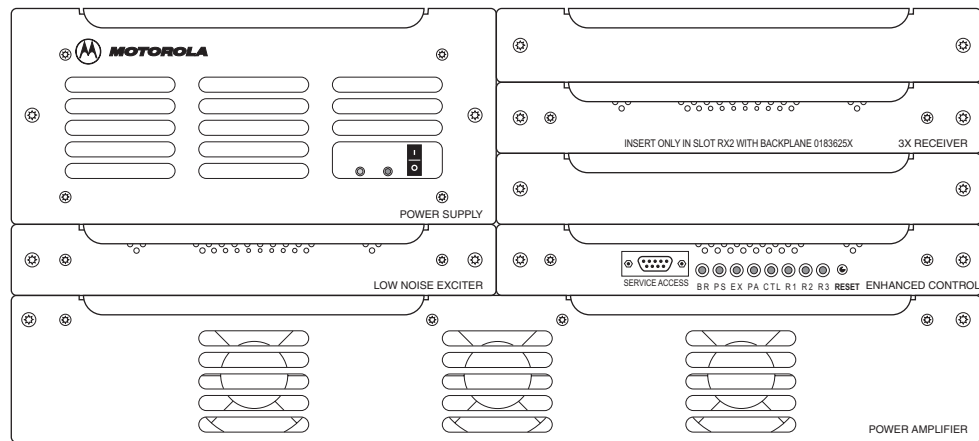
The Base Radio(s) are mounted below the RFDS (with one BR above the RFDS in 6-BR cabinets). In general, all cabinets designed for BR installation are pre-wired for the maximum BR capacity. The capacity number depends on the type of RFDS and whether the cabinet is a Main/primary or Expansion cabinet. In all cases, 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 each additional Base Radio is installed above the previous one.

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

EBTS Component Descriptions

EBTS282
080601JNM

Figure 5 **Base Radio (typical)**



EBTS282G
080601JNM

Figure 6 **Gen 2 Base Radio (typical)**

EBTS Component Descriptions

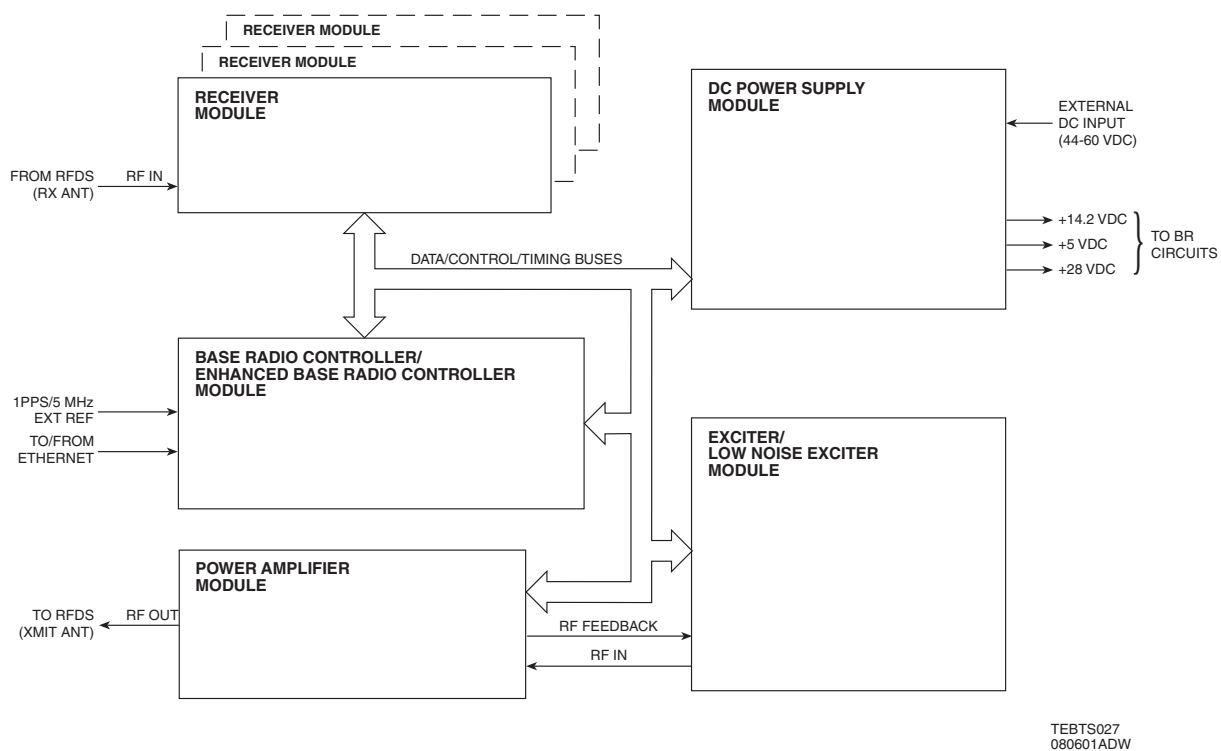
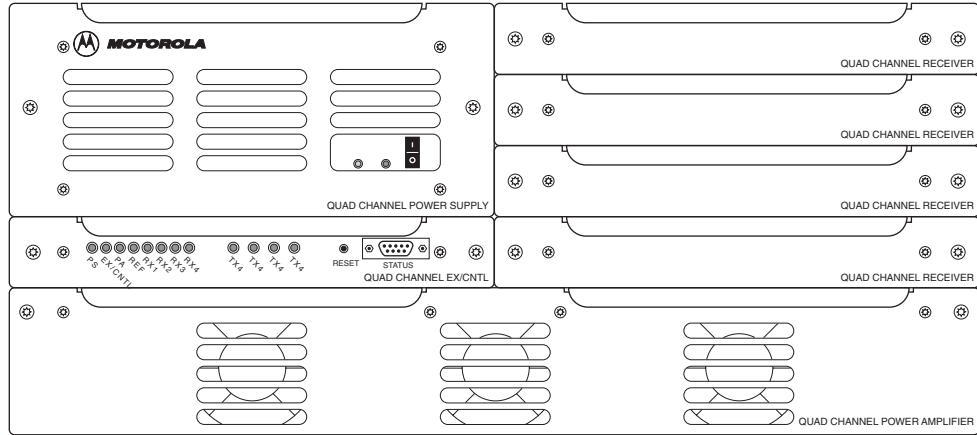
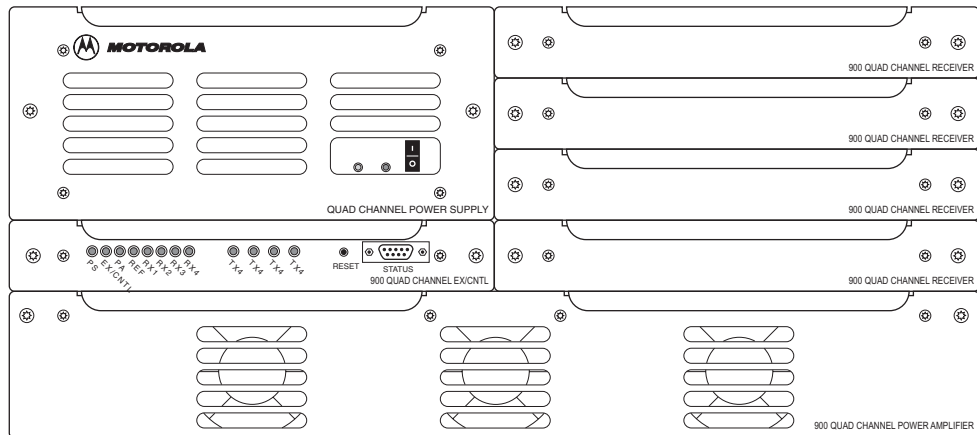


Figure 7 **Base Radio and Gen 2 Base Radio Simplified Block Diagram**

EBTS Component Descriptions

EBTS282Q
073001JNM

Figure 8 **QUAD Base Radio**



EBTS282Q_900
120501JNM

Figure 9 **900 MHz QUAD Base Radio**

EBTS Component Descriptions

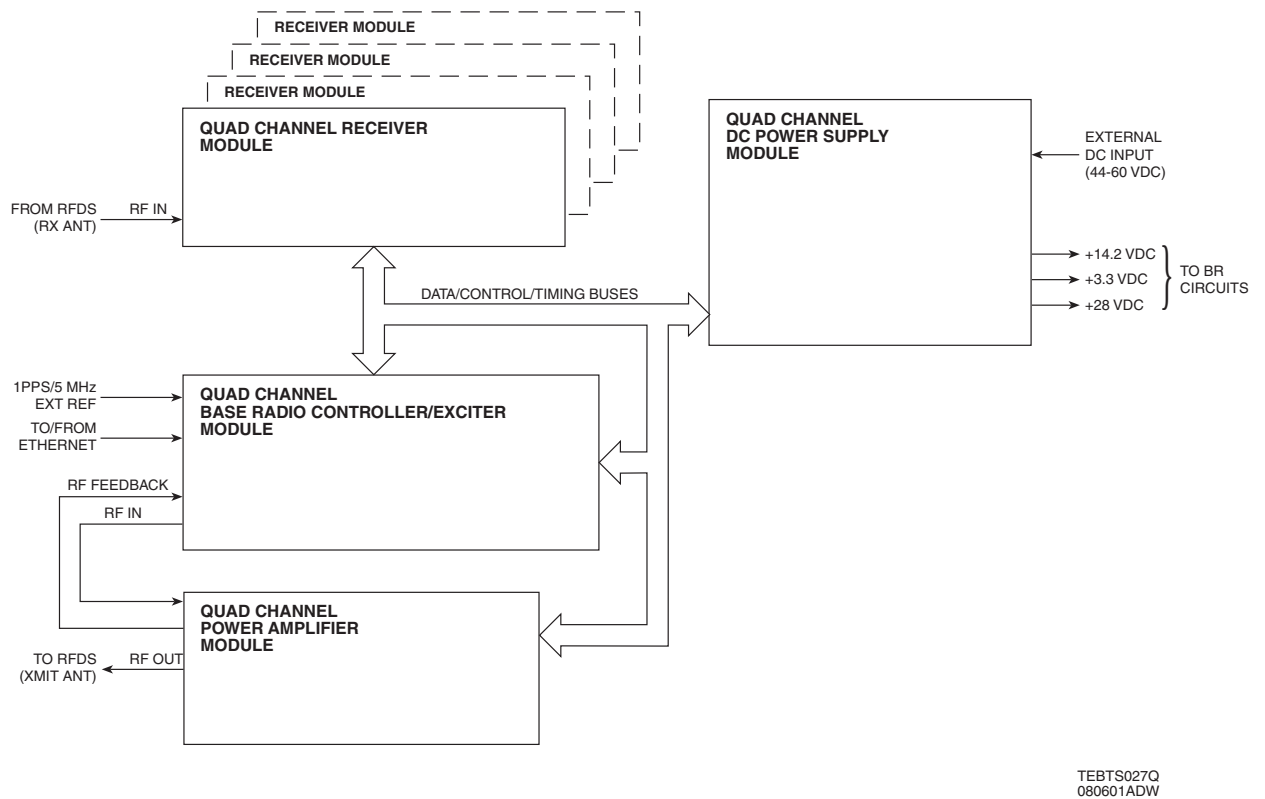


Figure 10 **QUAD Base Radio Simplified Block Diagram**

Gen 3 Site Controller

Gen 3 Site Controller

The Gen 3 SC is a rack-mounted unit that contains various equipment modules, shown in Figure 11. The Gen 3 SC performs all control functions for the EBTS. The Environmental Alarm System (EAS), which is a part of the Gen 3 SC, performs all alarm monitoring functions for the EBTS. The EAS is also shown in Figure 11.

Refer to the Supplement to this manual (68P80801E30) for detailed information on the Gen 3 SC.

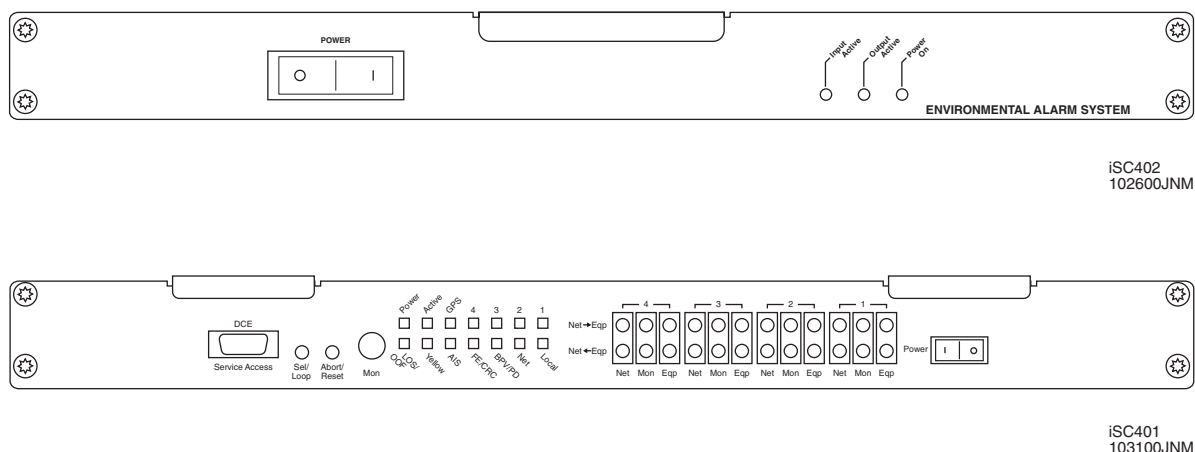


Figure 11 **Generation 3 Site Controller and EAS**

RF Distribution System

The RFDS is mounted near the top of the equipment cabinet. RF Distribution Systems fall into three basic categories:

- ☐ Duplexed
- ☐ Cavity Combining
- ☐ Diplexed

The duplexed RFDS combines both transmit and receive signals onto a single line which connects to a single transmit/receive antenna. Several duplexed RFDS systems exist, varying in design, channel capacity, and frequency coverage (800 or 900 MHz).

The cavity combining RFDS is an 800 MHz system consisting of separate transmit and receive subsystems. The cavity combining transmit subsystem combines several transmit signals onto one line which feeds a transmit-only antenna.

Signals from receive-only antennas are handled entirely separate from the transmit signals and are distributed to the receive inputs on the Base Radios.

The diplexed RFDS combines the 800 MHz system with the 900 MHz system onto a single transmit/receive antenna.

Duplexer Filter (Duplexed RFDS)

The duplexed RFDS accomplishes simultaneous use of a Tx/Rx antenna (duplexed antenna) using a duplexer filter for each antenna. The filter is tuned for transmit signal flow for a given, relatively narrow band of frequencies. Similarly, the receive path through the filter is also tuned for a given, relatively narrow band of frequencies that is appropriately spaced from the transmit band. Each duplexer filter has a common Tx/Rx antenna port, a transmit input port, and a receive output port.

Detailed information relating to specific duplexed RFDSs is provided in the respective RF Distribution sections of this manual.

Cavity Filter (Cavity Combining RFDS)

The cavity combining RFDS consists of a tuned cavity for each transmit input. Each cavity output is combined onto a common transmit output path which connects to a transmit-only antenna. As such, each cavity accepts and passes the transmit signal it is tuned for, while rejecting any reverse signal flow from an adjacent Base Radio of a frequency it is not tuned for.

The cavity combining RFDS is discussed as it applies to various systems later in this section. Detailed information relating to the cavity combining RFDS is provided in the *Cavity Combining RF Distribution* section of this manual.

Diplexed Filter (Diplexed RFDS)

The diplexed RFDS consists of two filters, operating in different frequency bands, which are combined to a common antenna. Each diplexer filter has a common dual band antenna port, an 800 MHz Tx/Rx port, and a 900 MHz Tx/Rx port. Detailed information relating to specific diplexed RFDS is provided in the appropriate RF Distribution sections of this manual.

Receive Multicoupler Assemblies

The various RF Distribution Systems are equipped with receive multicoupler assemblies. Basically, the receive multicouplers are used to distribute a single receive signal to multiple Base Radio receivers.

Because receive multicoupler assembly design varies greatly between the various RF distribution systems, these items are individually discussed in the EBTS Configuration Descriptions paragraph later in this section. Detailed information relating to specific receive multicoupler assemblies is provided in the respective RF Distribution sections of this manual.

Gen 3 Site Controller**DC Power Supply/Alarm Assemblies**

The various RF Distribution Systems are equipped with power supply / alarm circuit assemblies. Basically, the power supplies typically provide power for receive Low-Noise Amplifier/Multicoupler assemblies, transmit power monitors, Tower Top Amplifiers (where equipped), and fans (where equipped). Alarm functionality monitors the receive multicouplers and TTA circuits (where equipped) to provide alarms to the EAS in the event of a failure.

Because the power supply / alarm assembly design varies greatly between the various RF distribution systems, these items are individually discussed in the EBTS Configuration Descriptions paragraph later in this section. Detailed information relating to specific power supply / alarm assemblies is provided in the respective RF Distribution sections of this manual.

Cabinet Power Distribution And Interconnect Hardware

EBTS 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.

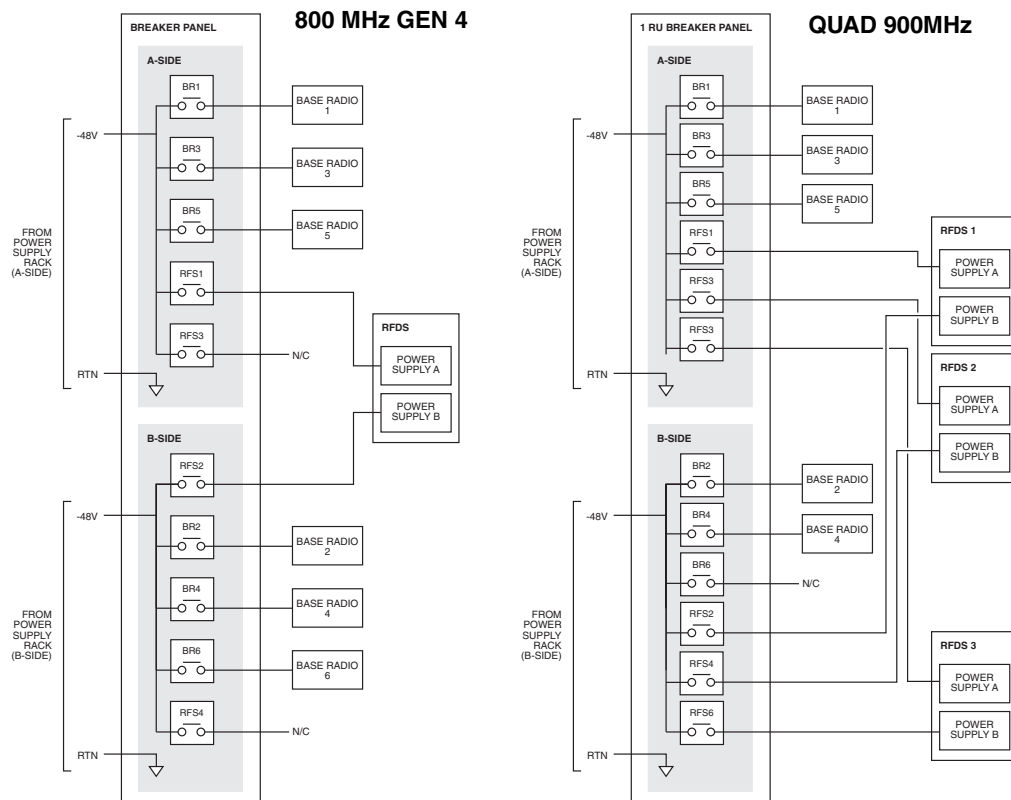
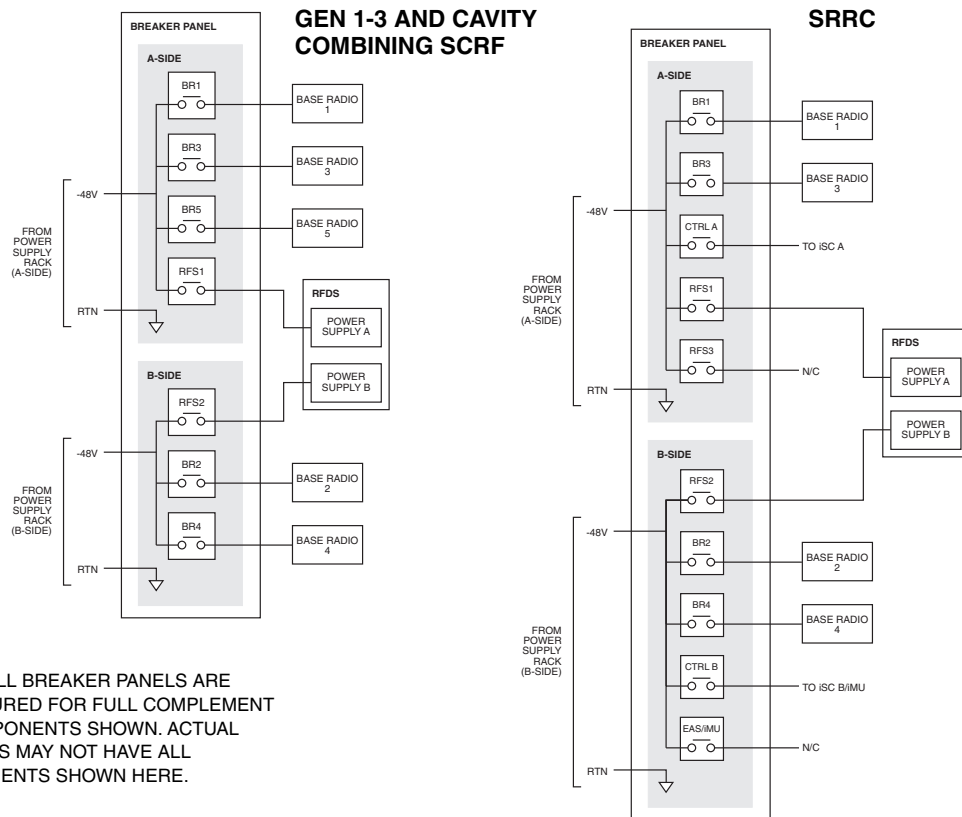
Breaker Panels

The Breaker Panel occupies the two uppermost rack units in cabinets using an external -48 VDC power source. (In the SRSC system, the breaker panel is integrated into the AC/DC Power System. In the 900 MHz QUAD systems, the breaker panel is one rack unit.) 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 (which may or may not be part of the cabinet). 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.

Different breaker panels are available to suit the equipment complements found in the various equipment cabinets. The different breaker panels are discussed below. Figure 12 shows, in simplified form, the distribution of the basic -48 VDC power to the EBTS major components.

Gen 3 Site Controller

EBTS583
073001JNM

Gen 3 Site Controller

Figure 12 DC Distribution Diagrams

RF Cabinet Breaker Panel (SCRF Configurations).

Two Rack Unit RF Cabinet Circuit Breaker Panel

A typical Two Rack Unit RF Cabinet Breaker Panel is shown in Figure 13.

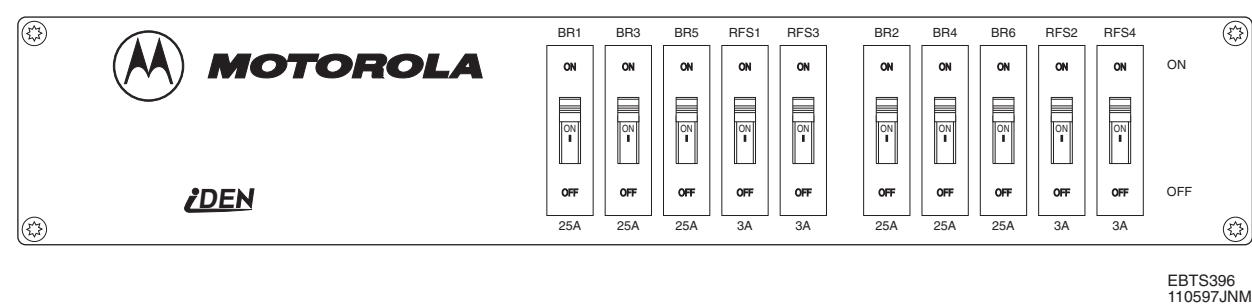


Figure 13 Two Rack Unit RF Cabinet Circuit Breaker Panel (Typical)

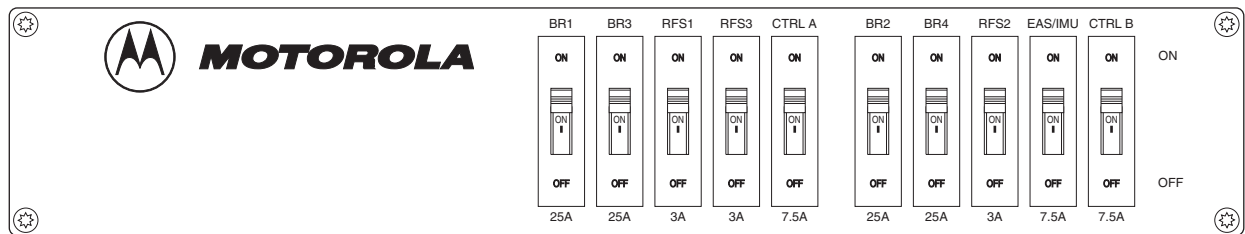
Each circuit breaker on the Breaker Panel is dedicated to a single module within the RF Cabinet. The circuit breakers provide on/off control for these modules. They also provide protection by automatically disconnecting the equipment in the event of an electrical overload. Each breaker and the equipment it controls is listed in the following table.

Label	Amp Rating	Use
BR1	25 A	Controls Base Radio #1
BR3	25 A	Controls Base Radio #3
BR5	25 A	Controls Base Radio #5
RFS1	3 A	Controls RFDS - System A
RFS3	3 A	Controls RFDS expansion assemblies - System A (NOTE)
BR2	25 A	Controls Base Radio #2
BR4	25 A	Controls Base Radio #4
BR6	25 A	Controls Base Radio #6 (NOTE)
RFS2	3 A	Controls RFDS - System B
RFS4	3 A	Controls RFDS expansion assemblies - System B (NOTE)
NOTE: These breakers appear only on systems where 6 BRs are used per cabinet.		

SRRC Breaker Panel.

A typical Breaker Panel as used in the SRRC configuration is shown in Figure 14.

Each circuit breaker on the Breaker Panel is dedicated to a single module within the equipment cabinet. The circuit breakers provide on/off control for these modules. 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.



iSC075
060796JNM

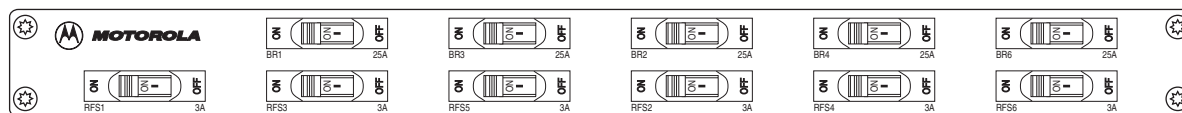
Figure 14 Two Rack Unit SRRC Primary Cabinet Circuit Breaker Panel

Label	Amp Rating	Use
BR1	25 A	Controls Base Radio #1
BR3	25 A	Controls Base Radio #3
RFS1	3 A	Controls RFDS - System A
RFS3	3 A	(reserved)
CTRL A	7.5 A	Controls Gen 3 SC A (main Gen 3 SC
BR2	25 A	Controls Base Radio #2
BR4	25 A	Controls Base Radio #4
RFS2	3 A	Controls RFDS - System B
EAS/IMU	7.5 A	Controls EAS
CTRL B	7.5 A	Controls Gen 3 SC B (redundant Gen 3 SC)

Gen 3 Site Controller

One Rack Unit RF Cabinet Breaker Panel

A typical one rack unit RF Cabinet Breaker Panel is show in Figure 15



EBTS703
120401JNM

Figure 15 **One Rack Unit RF Cabinet Circuit Breaker Panel (typical)**

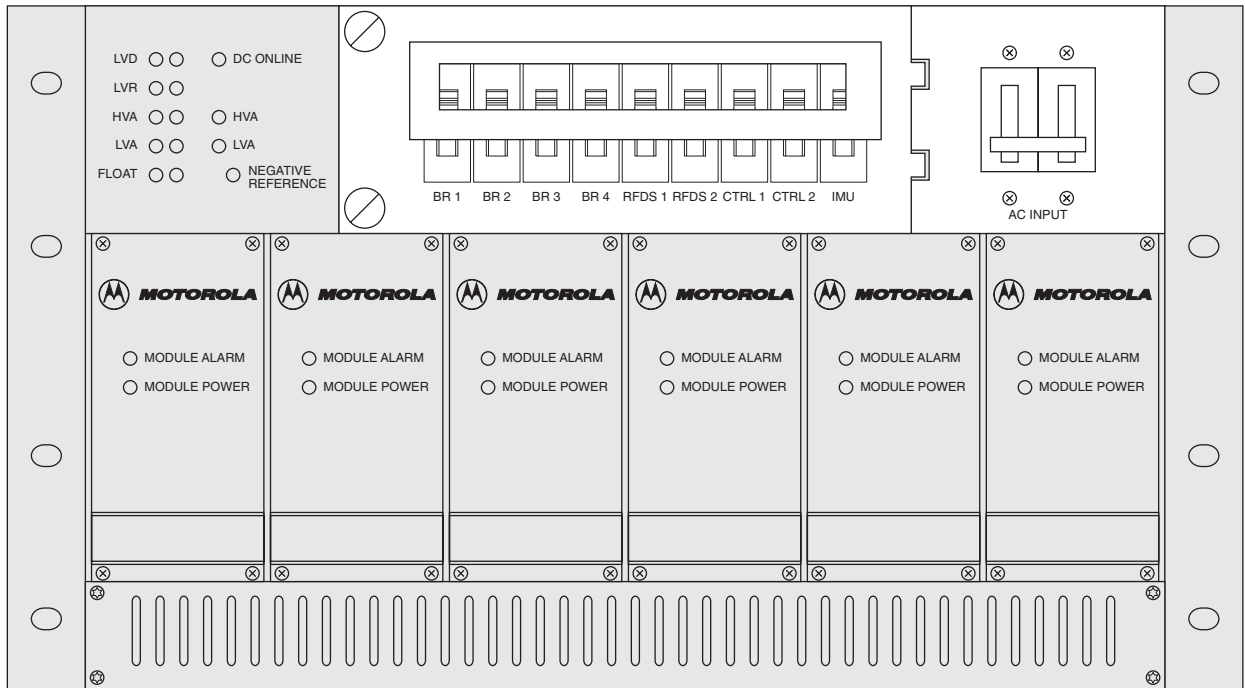
Label	Amp Rating	Use
BR1	25A	Controls Base Radio #1
BR2	25A	Controls Base Radio #2
BR3	25A	Controls Base Radio #3
BR4	25A	Controls Base Radio #4
BR5	25A	Controls Base Radio #5
RFS1	3A	Controls Multicoupler Tray Branch #1 - System A
RFS2	3A	Controls Multicoupler Tray Branch #1 - System B
RFS3	3A	Controls Multicoupler Tray Branch #2 - System A
RFS4	3A	Controls Multicoupler Tray Branch #2 - System B
RFS5	3A	Controls Multicoupler Tray Branch #3 - System A
RFS6	3A	Controls Multicoupler Tray Branch #3 - System B
STATUS	3A	Controls Multicoupler Alarms

SRSC Breaker Panel

The SRSC Breaker Panel (which is part of the AC/DC Power System) is shown in Figure 16.

Each circuit breaker on the Breaker Panel controls hardware within the equipment cabinet. The circuit breakers provide on/off control for these modules. 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.

Gen 3 Site Controller



EBTS590
060198JNM

Figure 16 **SRSC Circuit Breaker Panel**

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 Gen 3 SC
CTRL 2	(reserved)
IMU	Controls EAS
AC INPUT	Controls 240 VAC input to AC/DC Power System

Gen 3 Site Controller**Junction Panel**

The Junction Panel (shown in Figures 17 through 19) provides a central location for cabinet grounding and intercabinet cabling. Access to the Junction Panel is gained from the rear of the cabinet. There are three types of Junction Panels used in the equipment cabinets. One type is used for EBTS equipment cabinets, another is used in control cabinets and the other is used in some systems using RF expansion. The Junction Panel contains the following connectors:

- ☐ Ethernet (in/out) intercabinet connectors
- ☐ 5 MHz/1 PPS (in/out) intercabinet connectors
- ☐ Alarm intercabinet connection
- ☐ Transmit Out (some systems)
- ☐ Global Positioning Satellite (GPS) A and B connectors (used only in cabinets equipped with iSC)
- ☐ Receive 1, 2, and 3 antenna cable connections (some systems)

The Junction Panel is mounted at the rear of the equipment cabinet towards the top, below the breaker panel.

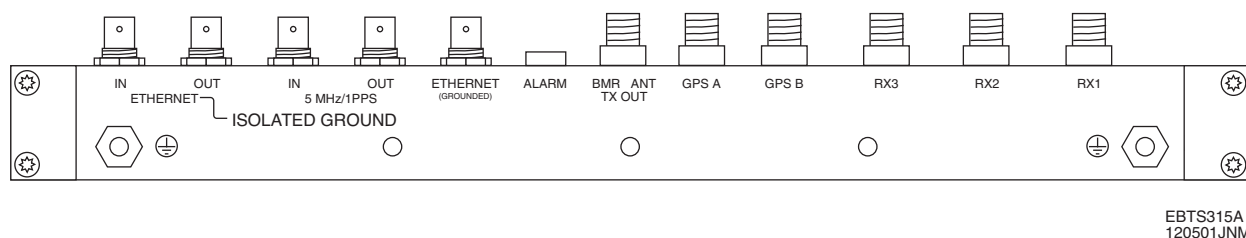


Figure 17 **Typical EBTS Junction Panel**



NOTE: Three additional ground studs are used for SRRC, SRSC, and 23" Racks.

EBTS315
032801JNM

Figure 18 **Typical Control Cabinet Junction Panel**

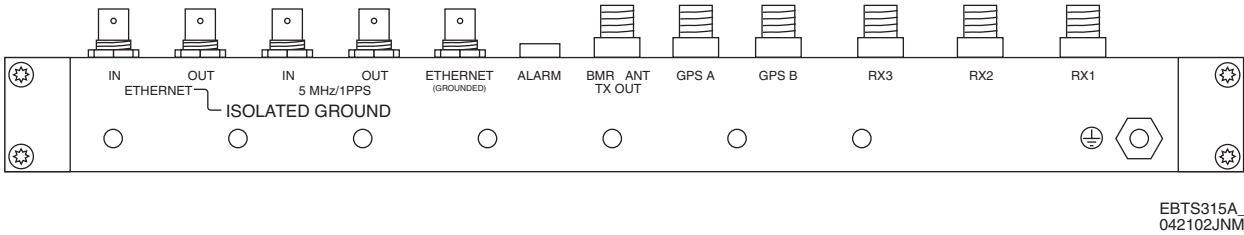


Figure 19 900 QUAD Junction Panel

The receive expansion junction panel (shown in Figure 20) is used in some systems to connect the Main RF Cabinet Rx expansion distribution ports to the Expansion RF Cabinet Rx antenna ports.

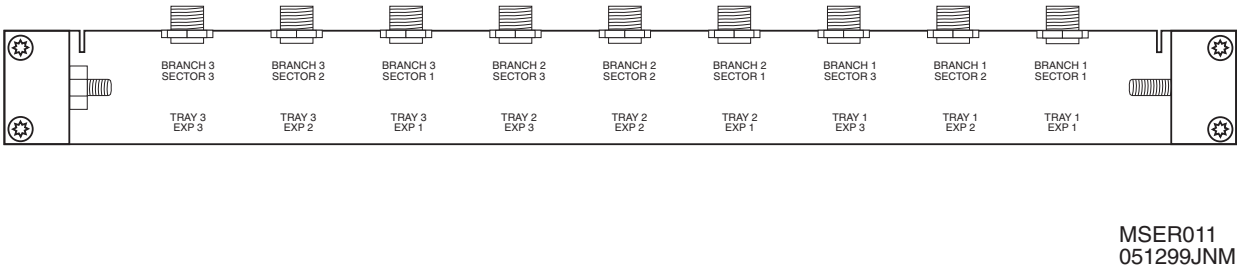


Figure 20 Typical RF Expansion Junction Panel (Main RF Cabinet)

EBTS Configuration Descriptions

EBTS Configuration Descriptions

The various EBTS configurations are primarily defined by four factors:

- ❑ **Cabinet configuration** – Stand-alone Control And RF Cabinet (SCRF) configuration or Single Cabinet configuration. SCRF configurations provide greatest Base Radio capacity. Single Cabinet configurations provide greatest degree of compactness.
- ❑ **Type of RF Distribution System** – Basically, two types are available; duplexed and cavity-combining. The 900 MHz RFDS is available only with duplexed RFDS.) The various RFDSs are described in further detail later.
- ❑ **Operating Frequency** – The systems covered in this manual use either 800 MHz channel assignments or 900 MHz channel assignment. (The channel frequencies are discussed in further detail in later sections of this manual, as applicable.)
- ❑ **Power Requirement** – The systems covered in this manual either require an external power supply (rectifier) system to convert site AC power into -48 VDC, or contain a built-in rectifier system to power the system directly from the site AC mains.

Various configurations have been designed incorporating different combinations of the factors listed above to suit particular site requirements.

The various configurations are listed in the table below. Each of the configurations listed below are individually described further in the following paragraphs.

EBTS Configuration Descriptions

Stand-alone Control And RF Cabinet (SCRF) Configurations			
Nomenclature	Expansion Compatibility	Maximum Base Radio Capacity	Power Requirement
GEN1 (through GEN3) 800 MHz Duplexed RFDS (also called "0182020V01, V03, and V06)", respectively) (NOTE)	Yes	5 (main RF cabinet w / expansion assemblies) 12 (main RF cabinet w / expansion assemblies, plus two expansion cabinets)	-48 VDC (external rectifiers required)
GEN4 800 MHz Duplexed RFDS	Yes	6 (main RF cabinet) 24 (main RF cabinet w expansion assemblies, plus three expansion cabinets)	-48 VDC (external rectifiers required)
800 MHz Cavity Combining RFDS	Yes	5 (main RF cabinet) 20 (main RF cabinet, plus three expansion cabinets)	-48 VDC (external rectifiers required)
NOTE: 800 MHz Duplexed RFDS, 0182020V06 (and prior) is no longer available. It has been replaced by the 800 MHz GEN 4 Duplexed RFDS. All information herein regarding 800 MHz Duplexed RFDS, 0182020V06 (and prior) is for reference only.			
Single Rack Configurations			
Nomenclature	Expansion Compatibility	Maximum Base Radio Capacity	Power Requirement
Single Rack, Redundant Controller 800 MHz GEN 4 Duplexed RFDS Configuration (SRRC Configuration)	Yes	4 (primary cabinet) 22 (primary cabinet w expansion assemblies, plus three expansion RF cabinets)	-48 VDC (external rectifiers required)
Single Rack, Single Controller 800 MHz GEN 4 Duplexed RFDS Configuration (SRSC Configuration)	No	3	240 VAC, 1-phase, 50/60 Hz (internal rectifier included)

EBTS Configuration Descriptions**SCRF EBTS Using 800 MHz
GEN 3 Duplexed RFDS (0182020V06 and prior)****NOTE**

800 MHz Duplexed RFDS (0182020V06 and prior) is no longer available. It has been replaced by the 800 MHz GEN 4 Duplexed RFDS.

All information herein regarding 800 MHz Duplexed RFDS (0182020V06 and prior) is for reference only.

Cabinet Components

The SCRF configuration using 800 MHz Duplexed RFDS (0182020V06 and prior) consists primarily of a Main RF Cabinet with a Breaker Panel at the top of the cabinet, an RFDS duplexer shelf below the Breaker Panel, an expansion area, followed by space for up to five Base Radios.

Duplexed RFDS Configurations

The duplexed RFDS allows a receive and transmit path to share a common antenna. This is accomplished through the use of three duplexers which serve three antennas. Figure 21 is a simplified block diagram showing the signal flow between the antennas, RFDS, and Base Radios in a three-branch duplexed system.

The Basic Duplexed Configuration shown in Figure 21 is the starting basis for the three-branch duplexed RFDS configurations. Each Base Radio transmit (Tx) signal is dedicated to its duplexer / antenna. However, the three receive signals (Rx1 through Rx3) from the three duplexer / antenna arrangements are applied to three respective receivers in each Base Radio, thereby providing receive diversity. The distribution of the individual Rx1-Rx3 signals from the duplexers / antennas to multiple Base Radios is provided by Receive Splitters. Each Receive Splitter takes its Rx signal from the antenna and provides multiple outputs which are then fed to respective Rx inputs of each Base Radio.

All duplexed RFDS configurations use the Receive Splitter arrangement shown in Figure 21 to provide the Rx1-Rx3 signals to each Base Radio.

The Expansion Configurations in Figure 21 show the Tx signal flow for various duplexed RFDS expansion configurations. Noting that the Rx signal distribution is identical to that discussed above, only the Tx signal paths are discussed. (Where used, an expansion cabinet will use additional Receive Splitters which are fed from outputs on the main RF cabinet Receive Splitter. The Receive Splitters used in the expansion RF cabinet distribute the Rx1-Rx3 signals in a manner identical to that shown for the Basic Duplexed Configuration.)

For the Tx signals, all expansion configurations make use of hybrid couplers (represented by circles in Figure 21) to combine Tx signals from two sources onto a single line. As shown, this arrangement can be cascaded to allow up to four Base Radio Tx signals to be combined onto a single line.

EBTS Configuration Descriptions

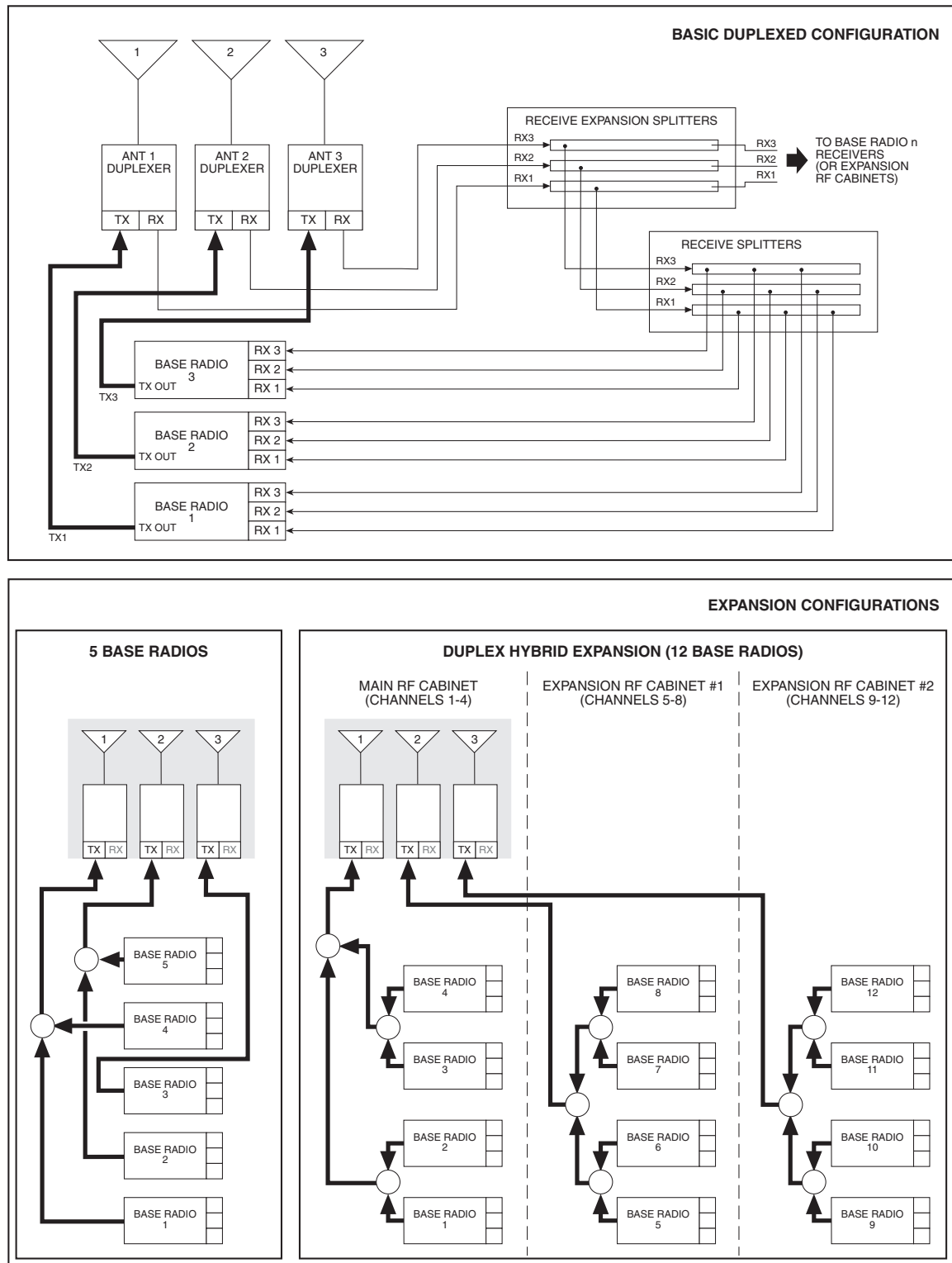
EBTS361
061097ADW

Figure 21 Simplified Block Diagram (800 MHz Duplexed RFDS 0182020V06 Configurations)

EBTS Configuration Descriptions**Duplexed RFDS RF Cabinet**

Figure 22 shows the front and rear views of the Main RF Cabinet with a duplexed RFDS and hybrid expansion assemblies installed.

Figure 23 shows the front and rear views of the duplexed RFDS main RF Cabinet with the coupler/load assembly and expansion junction panel installed.

The main duplexed RFDS cabinet consists of the following subassemblies:

- ☐ Three Multicoupler RF Amplifiers (Amp 1, Amp 2, and Amp 3)
- ☐ Redundant Power Supply Assembly
- ☐ Two 2-channel hybrid tray assemblies (optional)
- ☐ Coupler/Load Assembly (used only when hybrid expansion RFDS cabinet is used)
- ☐ Three Tx Isolator/Load Assemblies

Duplex Hybrid Expansion RFDS RF Cabinet

The Duplex Hybrid Expansion RFDS Cabinet is an expansion add-on to the Main Duplexed RFDS Cabinet. The duplex hybrid expansion RFDS enhances system channel capacity by combining up to four channels per duplexed branch, thereby providing a maximum of eight channels for a two-branch duplexed system, or 12 channels for a three-branch duplexed system. This is accomplished by adding the appropriate complement of expansion hybrid couplers and associated hardware.

Figure 24 shows the front and rear views of an expansion RF cabinet with the duplex hybrid expansion trays and associated combining hardware. The duplex hybrid expansion RFDS consists of the following subassemblies:

- ☐ Two Transmit Hybrid Expansion Tray Assemblies
- ☐ Transmit Bandpass Filters (used only in systems where the Main RF Cabinet has the earlier model PN 0182020V01 RFDS)
- ☐ Up to three Receiver Distribution Multicoupler (Splitter) Trays
- ☐ DC Power Supply Tray with two Power Supplies (PS1 and PS2)
- ☐ Coupler/Load Assembly
- ☐ Up to three 2-dB Receive Path Balance Attenuators

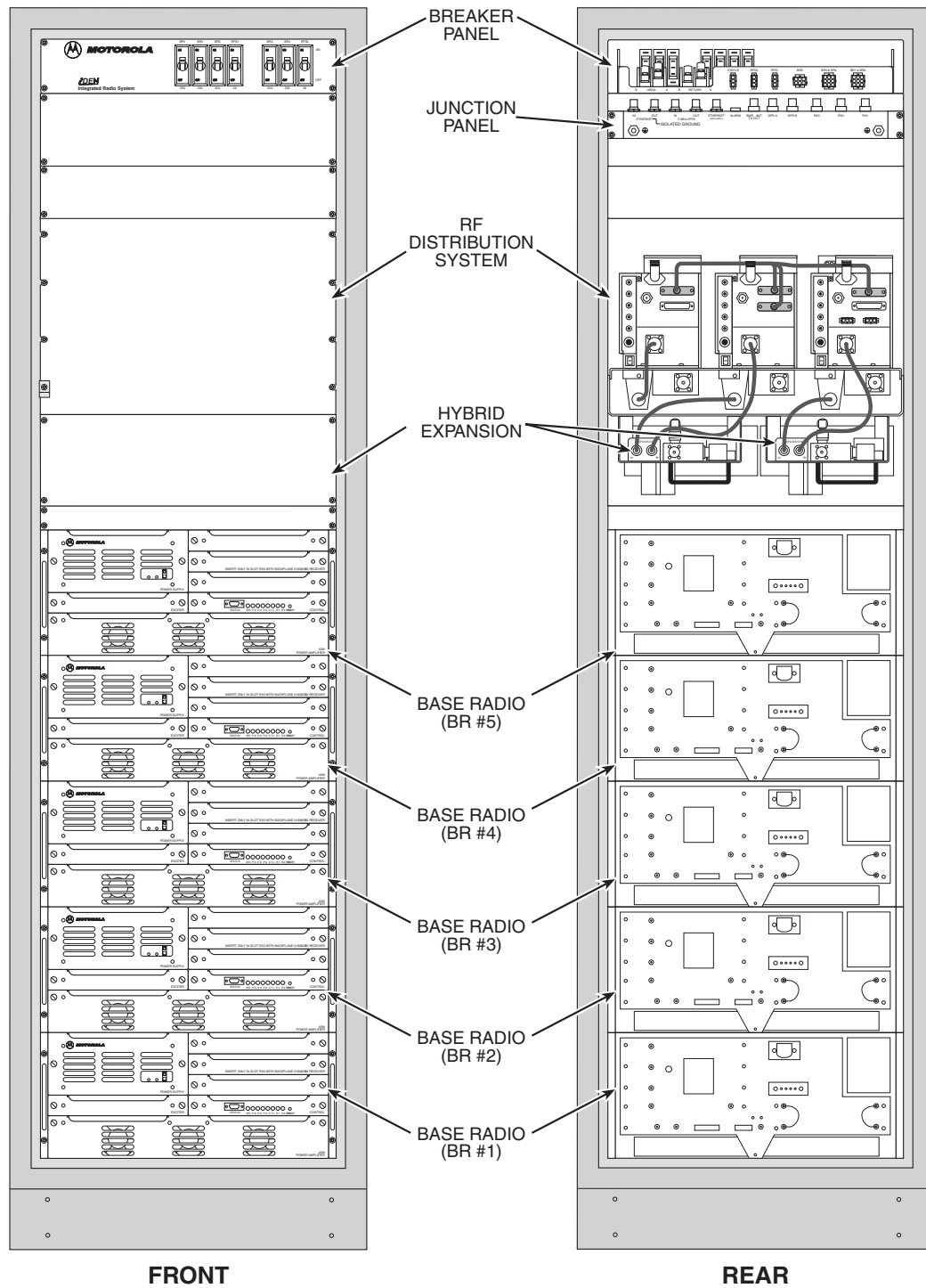
Duplexed Tower Top Amplifier Incorporation

Using the appropriate option kit, the Main Duplexed RF Cabinet may be fitted with FRUs and assemblies which allow the use of Tower Top Amplifiers (TTAs). These items, as installed in a typical Main RF Cabinet, are shown in Figure 25. (Different option kit part numbers are used for different RFDS version numbers.)

The Duplexed TTA FRUs and assemblies are as follows:

- ☐ DC Power Supply Tray
- ☐ DC Injectors – up to three used; one for each Tx/Rx branch

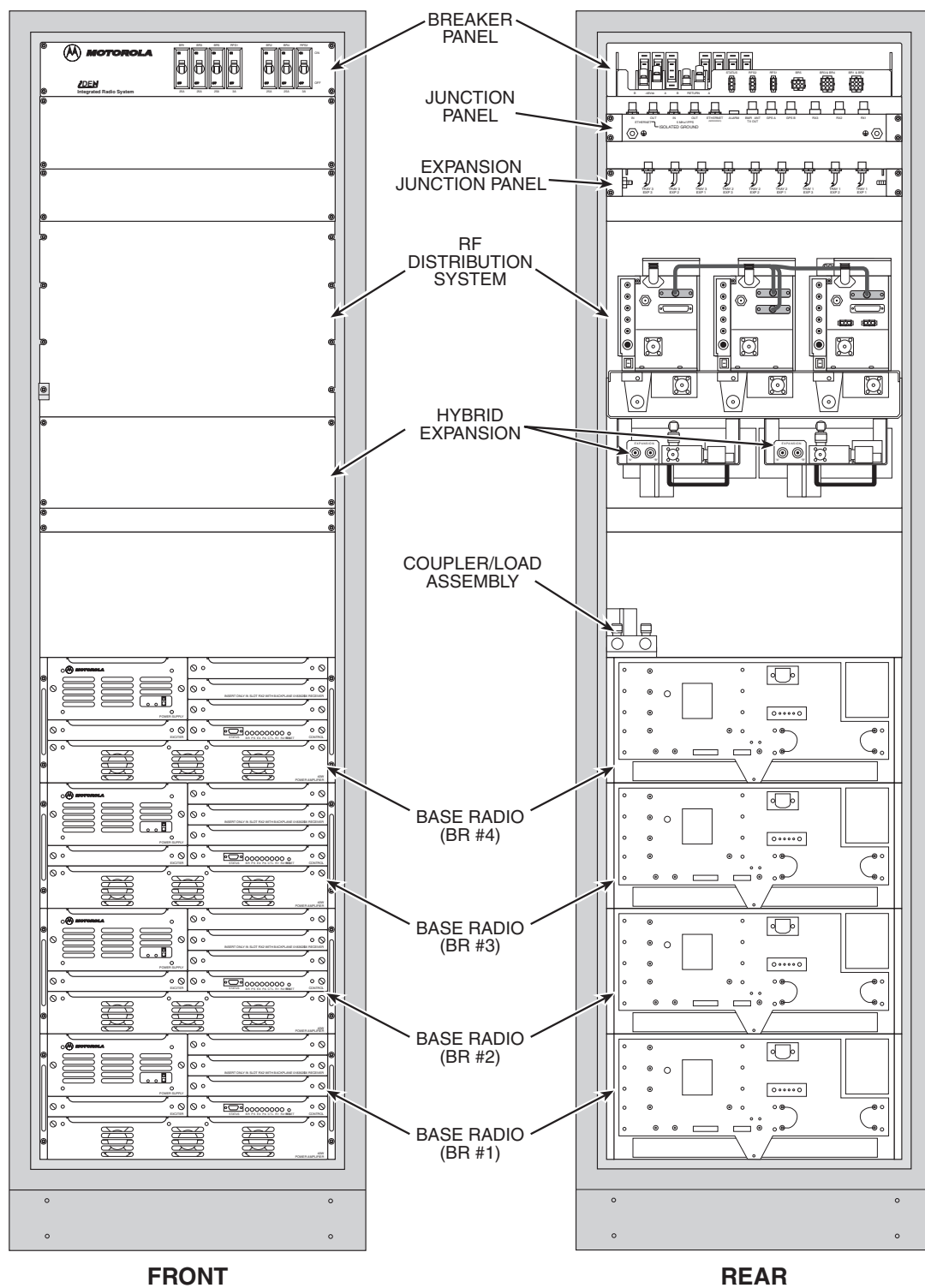
EBTS Configuration Descriptions



EBTS285
042597JNM

Figure 22 **Main Duplexed RF Cabinet (0182020V06 RFDS with Duplex Hybrid Expansion shown)**

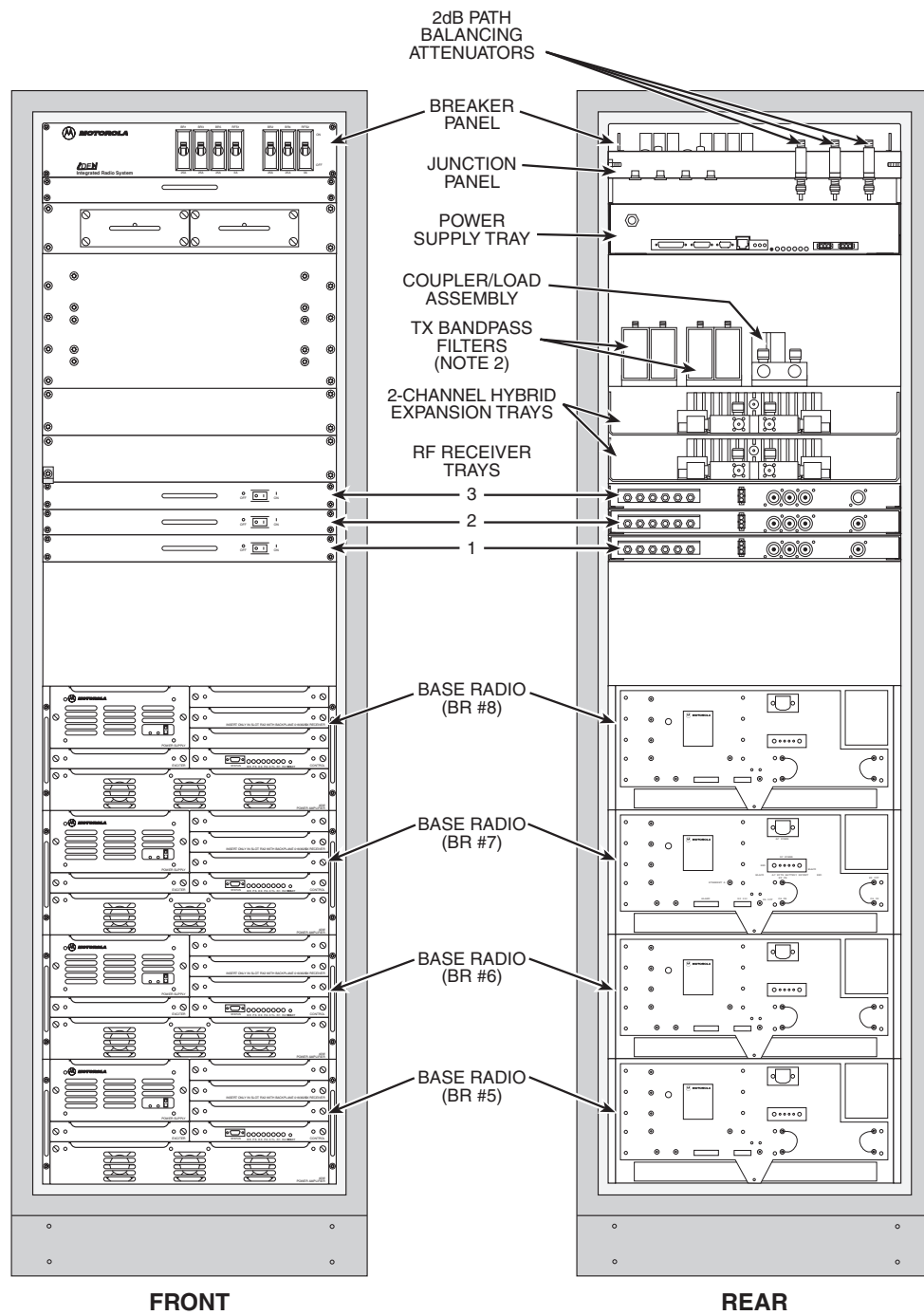
EBTS Configuration Descriptions



EBTS288
042597JNM

Figure 23 **Duplex RF Cabinet (with Hybrid Coupler/Load Assembly and Expansion Junction Panel)**

EBTS Configuration Descriptions



- NOTES:** 1. TWO RF EXPANSION CABINETS ARE REQUIRED FOR 9-12 CHANNEL SYSTEMS. (IN 9-12 CHANNEL EXPANSION RF CABINET, BASE RADIOS 5 THROUGH 8 ARE DENOTED AS BASE RADIOS 9 THROUGH 12, RESPECTIVELY.)
2. USED ONLY IN SYSTEMS USING 0182020V01 RFDS.

EBTS289
121896JNM

Figure 24 **Expansion Duplexed RF Cabinet (Duplex Hybrid Expansion)**

EBTS Configuration Descriptions

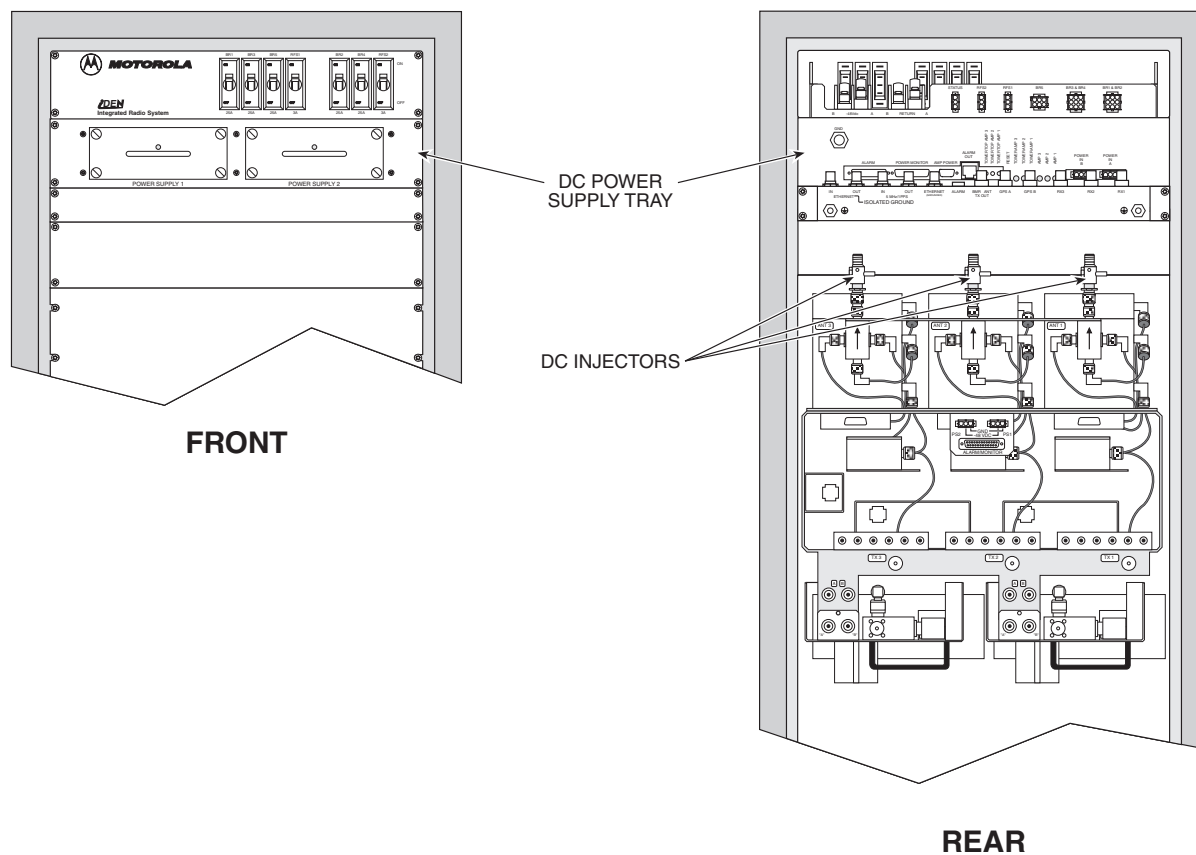
EBTS353
040297JNM

Figure 25 **Duplexed RFDS Tower Top Amplifier RF Cabinet
FRUs/Assemblies**

SCRF EBTS Using 800 MHz GEN 4 Duplexed RFDS

The 800 MHz GEN 4 Duplexed RFDS is a superseding replacement for earlier-version 800 MHz duplexed RFDSs. The GEN 4 RFDS allows a receive and transmit path to share a common antenna. This is accomplished through the use of up to three duplexers which serve three antennas. Although functionally similar to the older versions of the Duplexed RFDS discussed earlier, the 800 MHz GEN 4 Duplexed RFDS employs cascaded hybrid combining in a modularized, compact design. This modularization, along with a combining scheme based around this modularization, allows expansion with a minimum amount of added components. The extensive combining along with the compact design allows up to six Base Radios (BRs) per RF cabinet in an 800 MHz GEN 4 Duplexed RFDS system. This allows a maximum of 18 channels in a three-branch diversity site. (The configuration can be expanded to provide 24 channels by adding a fourth, TX-only antenna.)

Figure 26 is a simplified block diagram of the 800 MHz GEN 4 Duplexed RFDS. The Basic Configuration shown in Figure 26 is the starting basis for all 800 MHz GEN 4 Duplexed RFDS configurations.

Receive Description

The three receive signals (Rx1 through Rx3) from the three duplexer/antenna arrangements are applied to three respective receivers in each Base Radio, thereby providing receive diversity. The distribution of the individual Rx1-Rx3 signals from the duplexers/antennas to multiple Base Radios is provided by First Multicouplers (MC) and Expansion (local) MCs. Each First MC takes its Rx signal from the antenna (via the Duplexer Rx output) and provides multiple outputs which are available for use in the Main and Expansion RF Cabinet(s). In the Main or Expansion RF cabinets, a local Expansion MC takes the Rx1-Rx3 signals from the First MC and then provides multiple outputs of the Rx1-Rx3 signals. The multiple outputs are then fed to respective Rx1-Rx3 inputs of each Base Radio.

All configurations use the First MC/Expansion MC arrangement shown in Figure 26 to provide the Rx1-Rx3 signals to each Base Radio.

Transmit Description

In addition to three Duplexers, the Main RF Cabinet is baseline-equipped with a Dual 3-Way Combiner Deck that combines up to six Tx signals onto two lines to accommodate up to six BRs in the Main RF Cabinet. Combining points are represented by circles in Figure 26.

The basic configuration shown in Figure 26 uses six BRs. Note that while all three antenna/duplexers are used for receive, the basic configuration uses only two of the antenna/duplexers for transmitting.

In the four-BR basic configuration, the three Tx signals from BR1 through BR3 are fed to the first of two 3-way combiners in the Dual 3-Way Combiner Deck. The combined output is then fed to the Tx input port of Duplexer 1. The fourth BR is fed to the second of two 3-way combiners in the Dual 3-Way Combiner Deck. The BR4 Tx signal is then fed to the Tx input port of Duplexer 2 (the unused input ports of the second combiner need not be terminated).

EBTS Configuration Descriptions

From the basic configuration, the 800 MHz GEN 4 Duplexed system expansion configurations are modularly expanded at the following break points:

- ☐ 1-6 BR Expansion
- ☐ 1-9 BR Expansion
- ☐ 1-12 BR Expansion
- ☐ 1-18 BR Expansion
- ☐ 1-24 BR Expansion

In the 1-6 BR expansion, BR5 and BR6 are simply added and connected to the previously unused ports of the Dual 3-Way Tx Combiner Deck.

In the 1-9 BR expansion, one-half of a Dual 3-Way Combiner Deck in an Expansion RF Cabinet combine the three Tx signals from BR7 through BR9 onto one line. The combined signal is then directly applied to the Tx input port of Duplexer 3 in the Main RF Cabinet.

In the 1-12 BR and 1-18 BR expansions, a Triple 2-Way Combining Deck in the Main RF Cabinet is also used in conjunction with Dual 3-Way Combiner Decks in each RF cabinet. The Dual 3-Way Combiner Decks are cascaded with the Triple 2-Way Combining Deck to provide combining of up to six Tx signals per Duplexer.

In the 1-24 BR expansion, a third Expansion RF Cabinet equipped with a Duplexer, a Dual 3-Way Combiner Deck, and a Triple 2-Way Combiner Deck are connected to a fourth, TX-only antenna.

In these expansions, the pair of combined signals (each consisting of three Tx signals) from the Main RF Cabinet Dual 3-Way Combiner Deck are fed to the first of three 2-way combiners in the Triple 2-Way Combiner Deck. The cascaded combined signal from the 2-way combiner (consisting of the six BR1 through BR6 Tx signals) are fed to the Duplexer 1 Tx input. In an identical manner, the combined pair of Tx signals from BR7 through BR12 in Expansion RF Cabinet #1 are fed to the second 2-way combiner, which then applies its signal to the Duplexer 2 Tx input. The combined pair of Tx signals from BR13 through BR18 in Expansion RF Cabinet #2 are fed to the third 2-way combiner, which then applies its signal to the Duplexer 3 Tx input. (The combiner decks, along with the isolator function, are explained in greater detail in the *800 MHz GEN 4 Duplexed RFDS* section of this manual.)

Note that to go from the baseline four-BR configuration to any of the expansion configurations, only cabling additions and (in some cases) a Triple 2-Way Combiner Deck are required to implement the expansion. As such, expansion largely consists of simply adding BRs (or expansion cabinets) and intercabinet cabling.

EBTS Configuration Descriptions

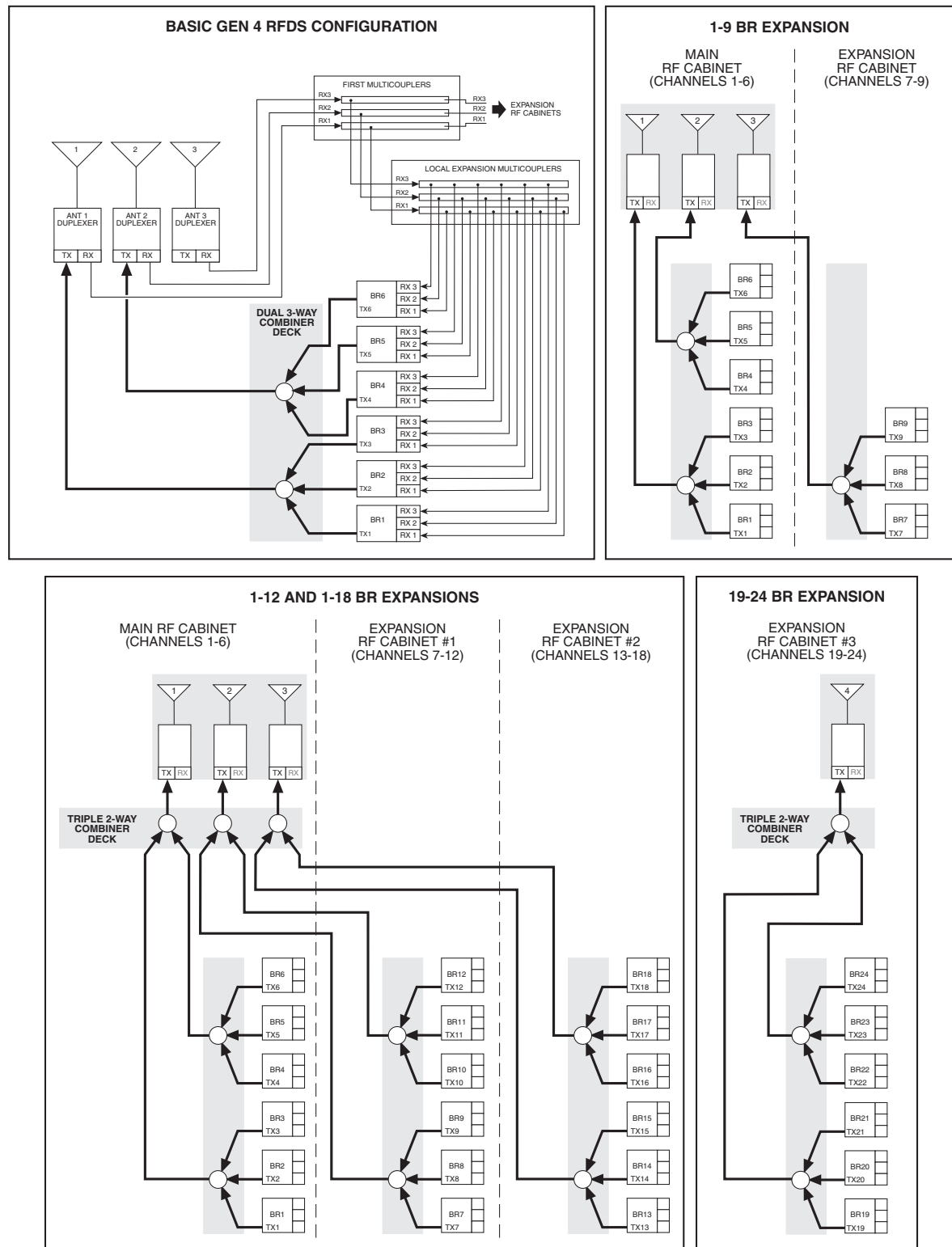
EBTS412
031098JNM

Figure 26 Simplified Block Diagram (800 MHz GEN 4 Duplexed RFDS Configurations)

EBTS Configuration Descriptions**SCRIF EBTS Using 900 MHz QUAD Duplexed RFDS RF Cabinet**

The 900 MHz QUAD Duplexed RFDS RF Cabinet is an extension add-on to an 800 MHz system. The 900 MHz QUAD cabinet supplements an existing 800 MHz system by providing an 800/900 MHz Dual Band feature.

800 MHz GEN 4 Duplexed RFDS Main RF Cabinet

Figure 27 shows the front and rear views of the 800 MHz GEN 4 Duplexed RFDS Main RF Cabinet. The Main RF Cabinet consists of the following subassemblies:

- ☐ Rx Tray – provides receive distribution, power supply, alarm, and power interconnect functions within the RFDS. It is equipped with:
 - three First Rx Multicouplers (4-way)
 - three Expansion (local) Rx Multicouplers (6-way)
 - two power supply boards
 - an alarm board
 - an I/O board
- ☐ Dual 3-Way Combiner Deck with Isolators
- ☐ Triple 2-Way Combiner Deck without Isolators (only in systems using more than 9 BRs)
- ☐ Duplexer Tray with three Duplexer Filters (Duplexers)
- ☐ Base Radios

800 MHz GEN 4 Duplexed RFDS Expansion RF Cabinet

Figure 28 shows the front and rear views of the 800 MHz GEN 4 Duplexed RFDS Expansion RF Cabinet. One or more Expansion RF Cabinets are used wherever a site uses more than six BRs. The Expansion RF Cabinet consists of the following subassemblies:

- ☐ Rx Tray (as above), equipped with three Expansion (local) Rx Multicouplers (6-way)
- ☐ Dual 3-Way Combiner Deck with Isolators
- ☐ Duplexer Tray with one Duplexer (only in 19-24 BR expansion systems)
- ☐ Triple 2-Way Combiner Deck without Isolators (only in 19-24 BR expansion systems)
- ☐ Up to three 2-dB Receive Path Balance Attenuators
- ☐ Base Radios

Duplexed Tower Top Amplifier Incorporation

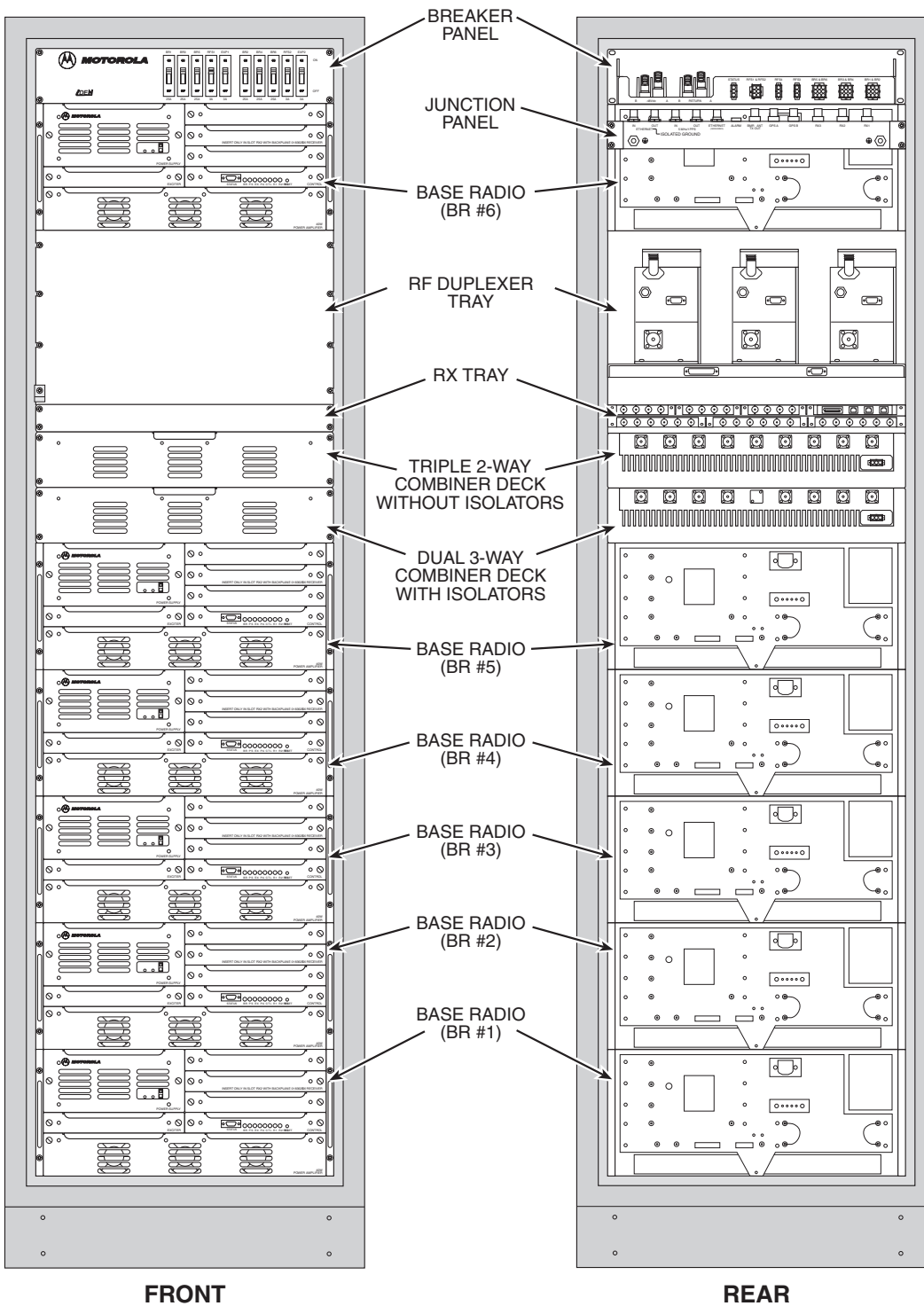
All systems using the GEN 4 Duplexed RFDS can be equipped with appropriate FRU and assemblies which allow the use of Duplexed Tower Top Amplifiers (DTTAs). These FRUs and assemblies are shown in Figure 29.

The GEN 4 Duplexed TTA FRUs and assemblies are as follows:

- ❑ TTA Alarm Tray, consisting of:
 - an interconnect/mounting tray
 - three TTA power/alarm interface units
- ❑ Rx Tray-to-TTA Alarm Tray wiring harness (not shown)
- ❑ Three DC Injectors (one for each Tx/Rx branch)
- ❑ DC Injector power cables (not shown)
- ❑ mounting and grounding hardware (not shown)

Unlike TTA incorporation kits for earlier RFDSs, the GEN 4 DTTA configuration does not require a separate DC power supply. DTTA power is received from the Rx Tray power supply.

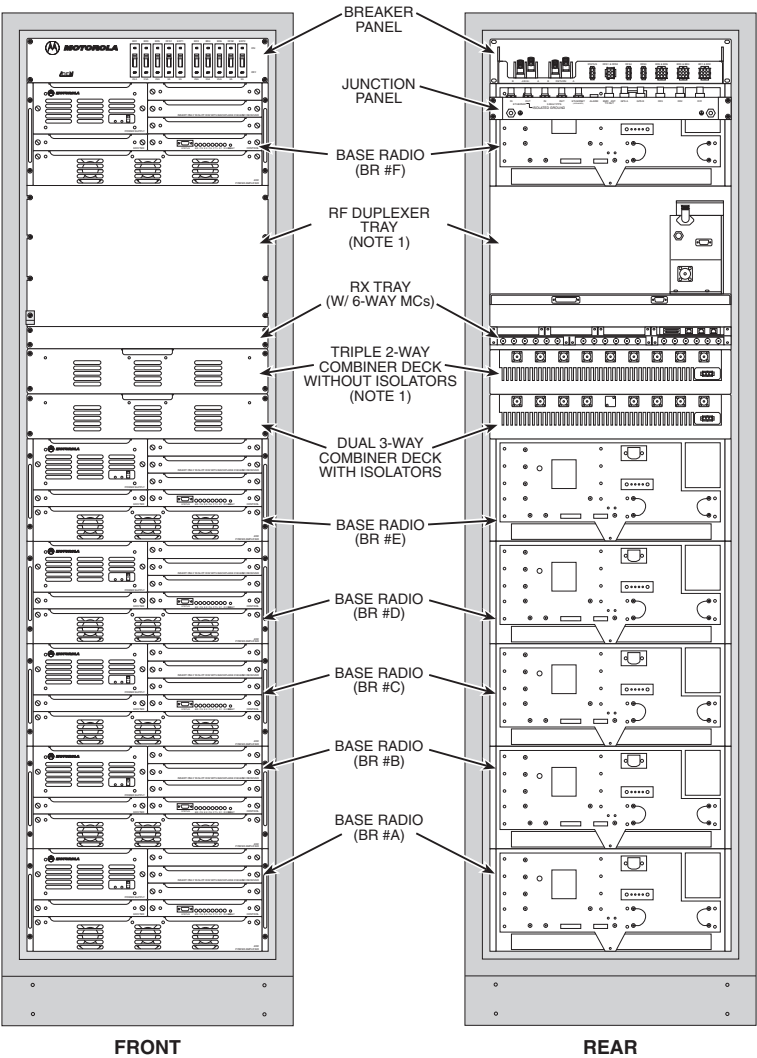
EBTS Configuration Descriptions



EBTS445
122997JNM

Figure 27 **Main RF Cabinet (800 MHz GEN 4 Duplexed RFDS)**

EBTS Configuration Descriptions

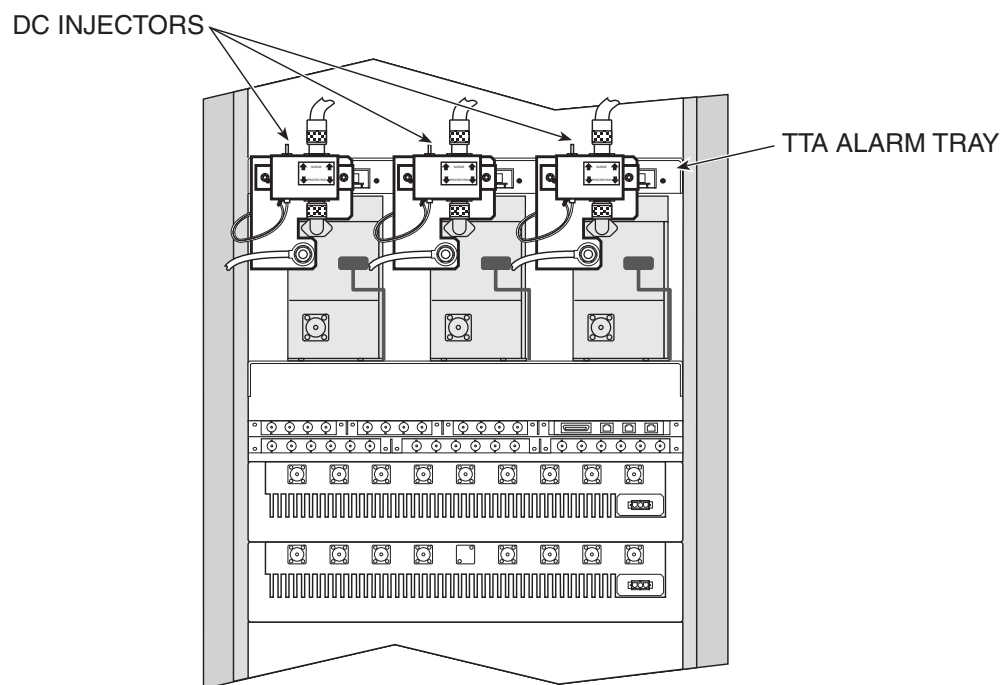


EBTS455
051998LLN

- 1. THESE ITEMS USED ONLY IN EXPANSION RF CABINET #3.
- 2. BASE RADIO DESIGNATION DEPENDS ON TYPE OF SYSTEM AND POSITION WITHIN SYSTEM, AS FOLLOWS:

Expansion Cabinet Base Radio Position	SCRF GEN 4 BR Designation			SRRG GEN 4 BR Designation		
	Exp. RFC #1	Exp. RFC #2	Exp. RFC #3	Exp. RFC #1	Exp. RFC #2	Exp. RFC #3
F	12	18	24	9	16	22
E	11	17	23	8	15	21
D	10	16	22	7	14	20
C	9	15	21	6	13	19
B	8	14	20	5	12	18
A	7	13	19	4	11	17

Figure 28 Expansion RF Cabinet (800 MHz GEN 4 Duplexed RFDS)

EBTS Configuration Descriptions

EBTS514
032698JNM

Figure 29 **GEN 4 Duplexed RFDS Tower Top Amplifier FRUs/Assemblies**

SRRC EBTS Using 800 MHz GEN 4 Duplexed RFDS

The SRRC is functionally similar to SCRF configurations. However, in the SRRC a portion of Base Radio space is used instead for the controller subsystem consisting of Gen 3 SCs and an EAS. (Refer to the EBTS Overall Functional Description and EBTS Component Descriptions paragraphs earlier in this section for block diagram interface and functional descriptions of the Gen 3 SC and EAS.)

Figure 30 shows a simplified block diagram of the GEN 4 RFDS used in the SRRC configuration. The SRRC configuration uses the same assemblies as the 800 MHz GEN 4 Duplexed RFDS as described earlier for the SCRF configuration. As such, the SRRC GEN4 configuration is functionally similar to the GEN 4 SCRF configuration, except as follows:

- ❑ The baseline configuration is equipped with three BRs. The space for BR4 and BR5 are replaced instead with an EAS and two Gen 3 SCs (one main, one redundant). In the baseline configuration, the fourth BR position (located at the top of the rack) is not installed; however, the cabinet is pre-cabled to accept a total of four BRs.
- ❑ A special breaker panel is used to accommodate both the RF components and the Control components.

For expansion, the SRRC configuration uses standard GEN 4 Expansion RF Cabinets fitted with up to six BRs. As such, the SRRC configuration allows a maximum of 16 channels in a three-branch diversity site. (The configuration can be expanded to provide 22 channels by adding a third Expansion RF Cabinet equipped with a Duplexer and the appropriate RF distribution hardware to support six more BRs. (This cabinet is connected to a fourth, TX-only antenna.)

Receive Description

Receive operation for the SRRC configuration is identical to that used in the GEN 4 SCRF configuration, except that three of the six Local Expansion Multicoupler Rx outputs for the Rx1-Rx3 signals are terminated, thereby feeding three outputs for each diversity branch to three Base Radios. Refer to Receive Description in the SCRF EBTS Using 800 MHz GEN 4 Duplexed RFDS paragraph earlier in this section for more information.

Transmit Description

Transmit operation for the SRRC configuration is identical to that used in the SCRF configuration, except that the Dual Three-Way Combiner Deck inputs normally connected to BR5 and BR6 are left unconnected. Combining points are represented by circles in Figure 30.

Note in Figure 30 that while all three antenna/duplexers are used for receive, the basic configuration uses only one of the antenna/duplexers for transmitting.

In the three-BR basic configuration, the three Tx signals from BR1 through BR3 are fed to the first of two 3-way combiners in the Dual 3-Way Combiner Deck. The combined output is then fed to the Tx input port of Duplexer 1.

EBTS Configuration Descriptions

From the basic configuration, the SRRC expansion configurations are modularly expanded at the following break points:

- ☐ 1-9 BR Expansion
- ☐ 1-10 BR Expansion
- ☐ 1-16 BR Expansion
- ☐ 1-22 BR Expansion

In the 1-9 BR expansion, no additional hardware or modifications are required for the SRRC primary cabinet. One-half of a Dual 3-Way Combiner Deck in an Expansion RF Cabinet combines the three Tx signals from BR4 through BR6 onto one line. The combined signal is then directly applied to the Tx input port of Duplexer 2 in the SRRC primary cabinet. Similarly, the second-half of the Dual 3-Way Combiner Deck in the Expansion RF Cabinet combines the three Tx signals from BR7 through BR9 onto one line. This combined signal is then directly applied to the Tx input port of Duplexer 3 in the SRRC primary cabinet.

In the 1-10 BR and 1-16 BR expansions, a Triple 2-Way Combining Deck in the SRRC primary cabinet is added and used in conjunction with the Dual 3-Way Combiner Decks in the SRRC primary cabinet and the Expansion RF Cabinets. The Dual 3-Way Combiner Decks are cascaded with the Triple 2-Way Combining Deck to provide combining of up to six Tx signals per Duplexer.

A fourth BR is added in the SRRC primary cabinet. The transmit output of BR10 is simply connected to one of the previously unused ports of the primary cabinet Dual 3-Way Combiner Deck.

In the 1-10 and 1-16 BR expansions, the combined pair of signals (each consisting of three Tx signals) from the SRRC primary cabinet Dual 3-Way Combiner Deck are fed to the first of three 2-way combiners in the Triple 2-Way Combiner Deck. The cascaded combined signal from the 2-way combiner (consisting of the four BR1 - BR3 and BR10 Tx signals) are fed to the Duplexer 1 Tx input. In an identical manner, the combined pair of Tx signals from BR4 through BR9 in Expansion RF Cabinet #1 are fed to the second 2-way combiner, which then applies its signal to the Duplexer 2 Tx input. The combined pair of Tx signals from BR11 through BR16 in Expansion RF Cabinet #2 are fed to the third 2-way combiner, which then applies its signal to the Duplexer 3 Tx input. (The combiner decks, along with the isolator function, are explained in greater detail in the *Single-Rack, Redundant-Controller System* section of this manual.)

NOTE

Although the normal expansion progression is from 9-BR (without a Triple 2-Way Combiner Deck) to 10-BR (with an added BR4, Triple 2-Way Combiner Deck, and an Expansion RF Cabinet), the SRRC is available as a primary cabinet equipped with four BRs, a Dual 3-Way Combiner Deck, and a Triple 2-Way Combiner Deck.

This configuration utilizes the signal flow as shown for BR1 through BR4 in the “1-10 and 1-16 BR Expansions” shown in Figure 30.

Note that to go from the baseline three-BR configuration to any of the expansion configurations, only cabling additions and (in some cases) a Triple 2-Way Combiner Deck are required to implement the expansion. As such, expansion largely consists of simply adding BRs (or expansion cabinets) and intercabinet cabling.

EBTS Configuration Descriptions

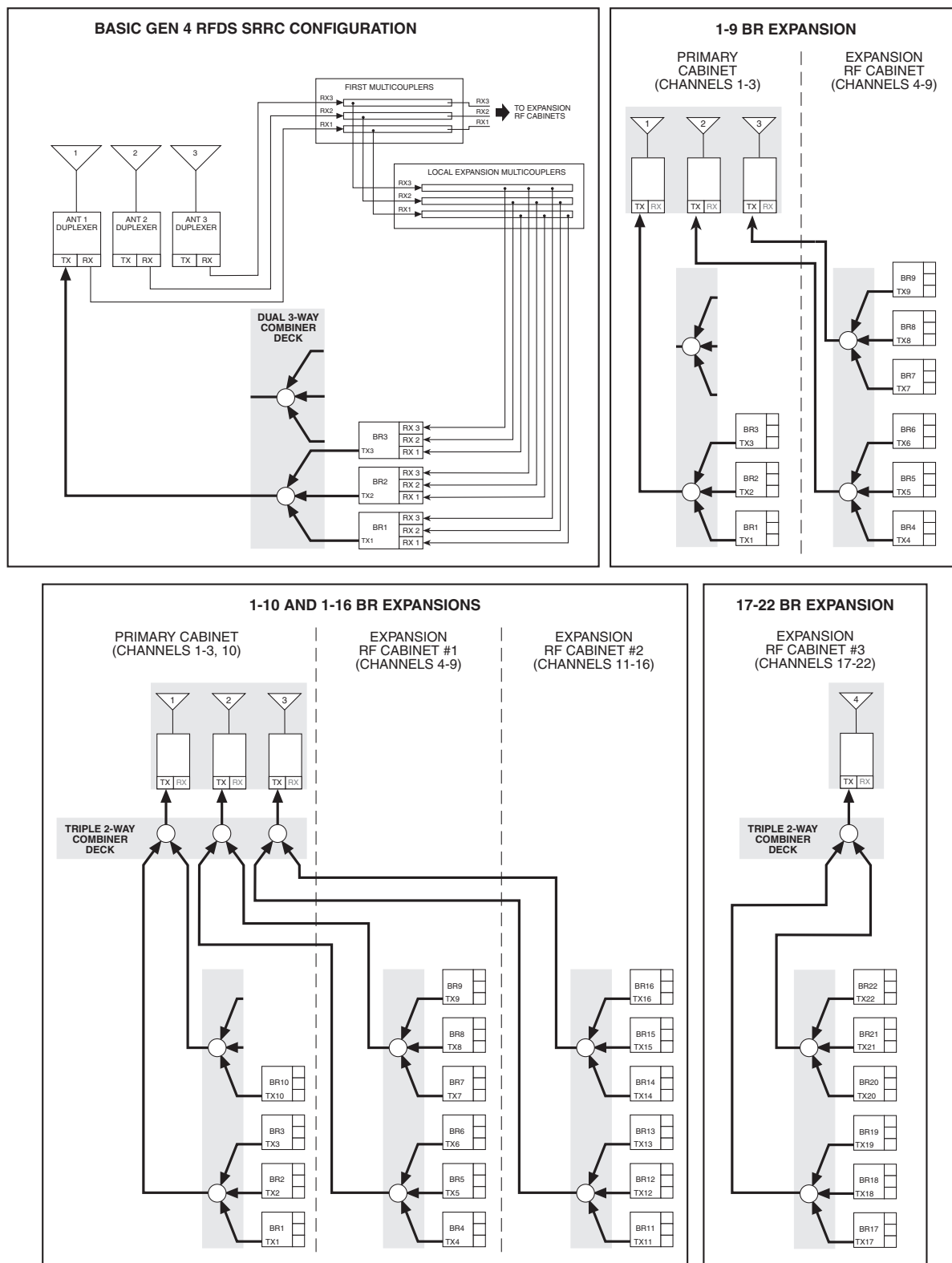


Figure 30 Simplified Block Diagram (SRRC With 800 MHz GEN 4 Duplexed RFDS)

SRRC Primary Cabinet

Figure 31 shows the front and rear views of the SRRC primary cabinet. The SRRC primary cabinet consists of the following components and subassemblies:

- ☐ Two Gen 3 SCs and one EAS
- ☐ Rx Tray – provides receive distribution, power supply, alarm, and power interconnect functions within the RFDS. It is equipped with:
 - three First Rx Multicouplers (4-way)
 - three Expansion (local) Rx Multicouplers (6-way)
 - two power supply boards
 - an alarm board
 - an I/O board
- ☐ Dual 3-Way Combiner Deck with Isolators
- ☐ Triple 2-Way Combiner Deck without Isolators (only in systems using more than 9 BRs; or system with primary cabinet equipped with four BRs)
- ☐ Duplexer Tray with three Duplexer Filters (Duplexers)
- ☐ Base Radios

SRRC Expansion RF Cabinet

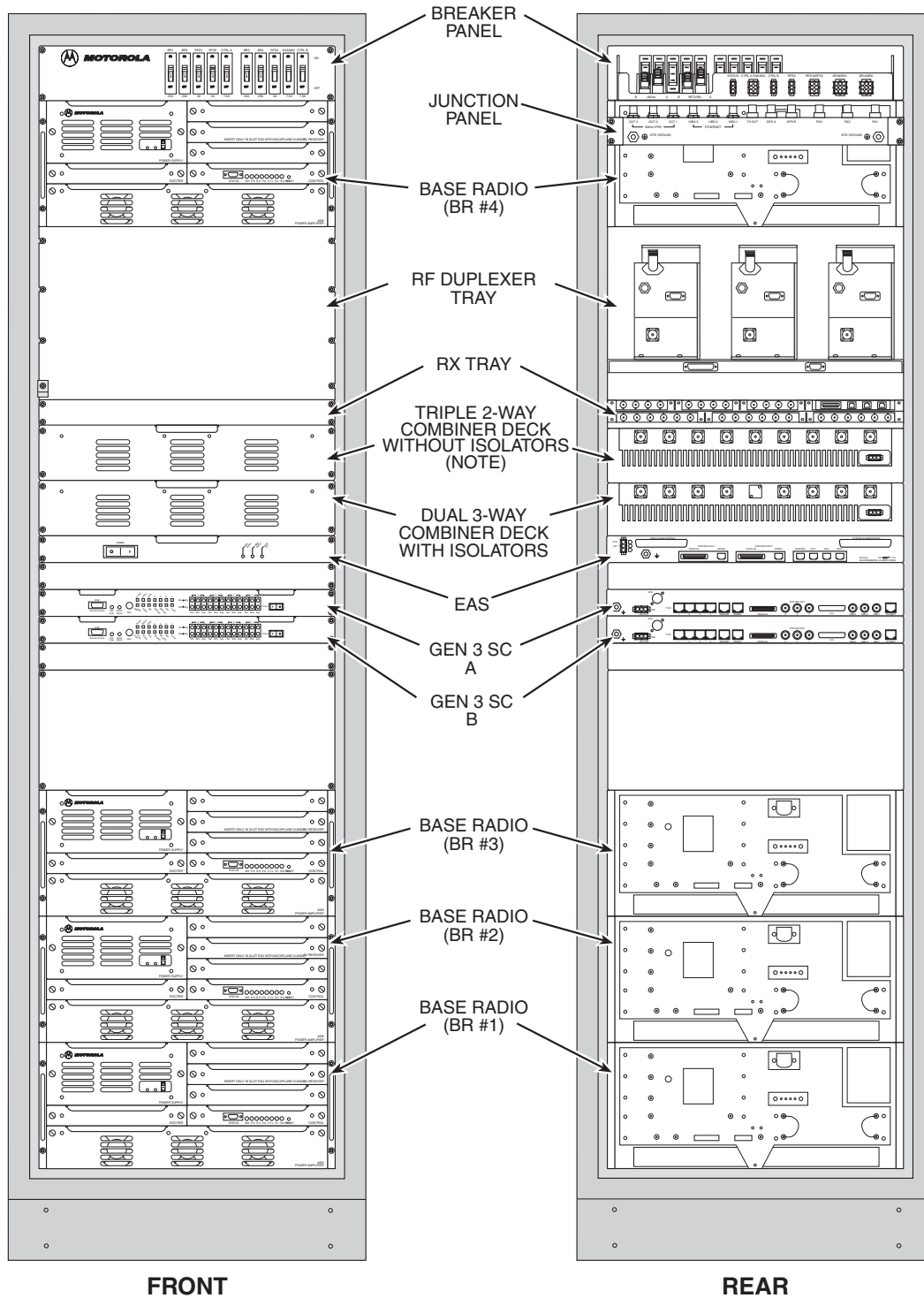
Expansion RF Cabinets used in conjunction with the SRRC primary cabinet are identical to the 800 MHz GEN 4 Duplexed RFDS Expansion RF Cabinet described earlier and shown in Figure 28. One or more Expansion RF Cabinets are used wherever an SRRC site uses more than four BRs. The Expansion RF Cabinet consists of the following subassemblies:

- ☐ Rx Tray (as above), equipped with three Expansion (local) Rx Multicouplers (6-way)
- ☐ Dual 3-Way Combiner Deck with Isolators
- ☐ Duplexer Tray with one Duplexer (only in 17-22 BR expansion systems)
- ☐ Triple 2-Way Combiner Deck without Isolators (only in 17-22 BR expansion systems)
- ☐ Base Radios

Duplexed Tower Top Amplifier Incorporation

Duplexed Tower Top Amplifier (DTTA) incorporation into the SRRC configuration is identical to that of the SCRF 800 MHz GEN 4 RFDS. Refer to the Duplexed Tower Top Amplifier Incorporation discussion in the earlier SCRF EBTS Using 800 MHz GEN 4 Duplexed RFDS paragraph earlier in this section for information.

EBTS Configuration Descriptions



EBTS512
040201JNM

NOTE: BASELINE CONFIGURATION USES BR1 THRU BR3. BR4 IS EXPANSION ITEM.

Figure 31 **SRRC Primary Cabinet**

SRSC EBTS Using 800 MHz GEN 4 Duplexed RFDS

The SRSC is functionally similar to the SCRF GEN 4 configurations. However, in the SRSC a portion of Base Radio space is used instead for the controller subsystem consisting of a Gen 3 SC and an EAS, and an AC/DC Power System (which is not part of the EBTS for all other configurations). (Refer to the EBTS Overall Functional Description and EBTS Component Descriptions paragraphs earlier in this section for block diagram interface and functional descriptions of the Gen 3 SC and EAS.)

As such, the SRSC EBTS is a single cabinet, stand-alone, non-expandable 3-BR EBTS which can simply be directly connected to the site antennas, T1/E1 interface, and AC mains.

Figure 32 shows a simplified block diagram of the GEN 4 RFDS used in the SRSC configuration. The SRSC configuration uses some of the same assemblies as the 800 MHz GEN 4 Duplexed RFDS, as described earlier for the SCRF configuration. As such, the SRSC is functionally similar to the GEN 4 SCRF configuration, except as follows:

- ❑ The configuration is equipped with three BRs (maximum). The space for BR4 and BR5 are replaced instead with an EAS and a Gen 3 SC.
- ❑ Because the SRSC configuration is limited to three BRs, transmit combining and receive expansion is not required. A Triple Isolator Deck is used to couple the three BR TX outputs to the three duplexers. In the Rx Tray, the First (4-Way) Multicouplers directly feed the three BRs (The Expansion (6-Way) Multicouplers are not used.)
- ❑ The fourth BR position (located at the top of the rack) is not installed. In its place, an AC/DC Power System is installed.
- ❑ A special breaker panel is used to accommodate both the RF components and the Control components.

Receive Description

The three receive signals (Rx1 through Rx3) from the three duplexer/antenna arrangements are applied to three respective receivers in each Base Radio, thereby providing receive diversity. The distribution of the individual Rx1-Rx3 signals from the duplexers/antennas to multiple Base Radios is provided by First Multicouplers (MCs). Each First MC takes its Rx signal from the antenna (via the Duplexer Rx output) and provides four outputs which are available for use by the Base Radios. Three of the four outputs of each MC are fed to respective Rx1-Rx3 inputs of each Base Radio (the fourth output of each MC is not used and is terminated).

Transmit Description

In addition to three Duplexers, the SRSC is equipped with a Triple Isolator Deck. The three Tx signals from BR1 through BR3 are respectively fed through the three isolators in the deck and then applied to the duplexer Tx inputs. (The isolator function is explained in greater detail in the *Single Rack, Single Controller GEN 4 EBTS* section later in this manual.)

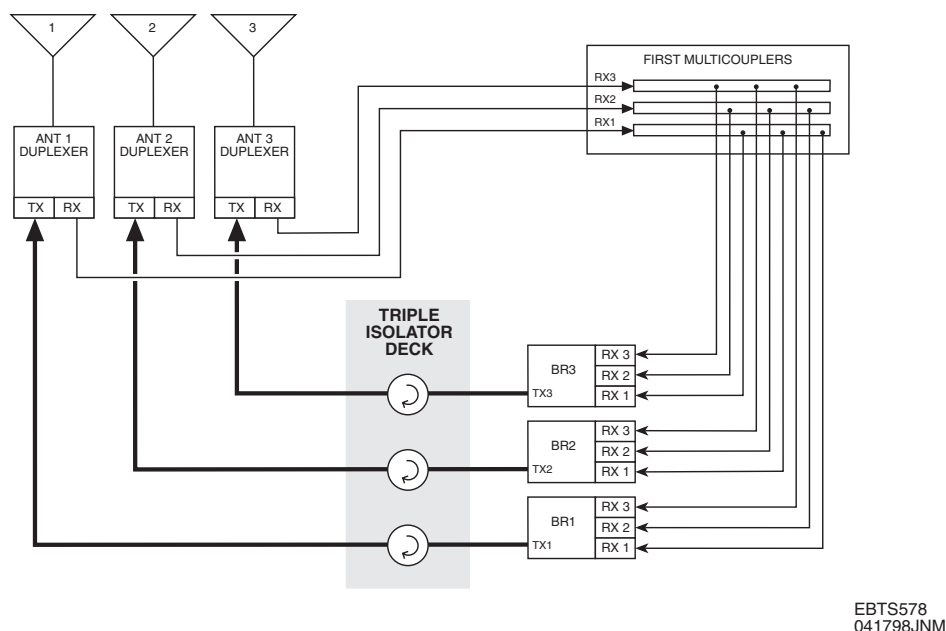
EBTS Configuration Descriptions

Figure 32 **Simplified Block Diagram (SRSC With 800 MHz GEN 4 Duplexed RFDS)**

SRSC Cabinet

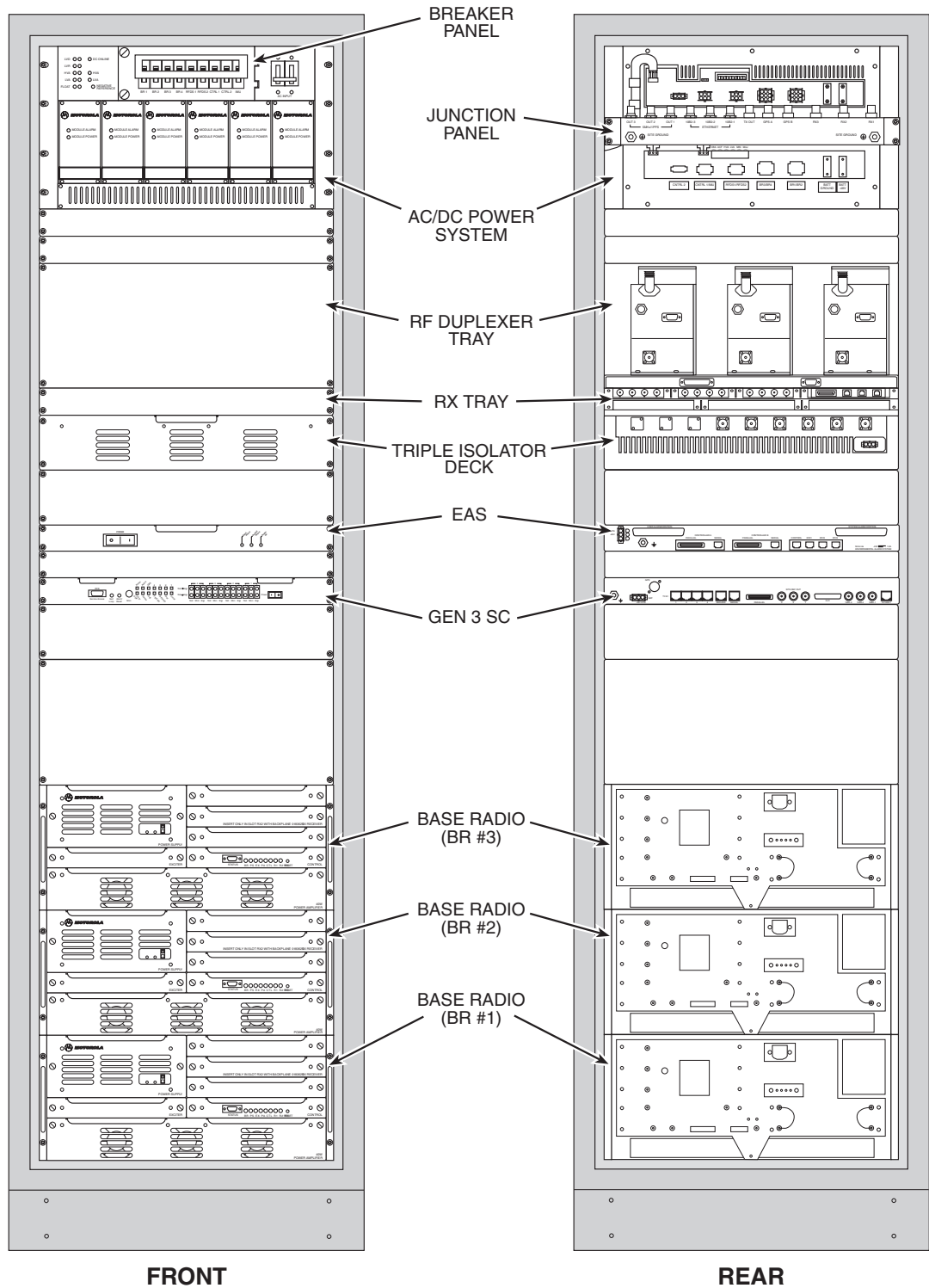
Figure 33 shows the front and rear views of the SRSC cabinet. The SRSC primary cabinet consists of the following components and subassemblies:

- ☐ AC/DC Power System
- ☐ Gen 3 SC and EAS
- ☐ Rx Tray – provides receive distribution, power supply, alarm, and power interconnect functions within the RFDS. It is equipped with:
 - ☐ three First Rx Multicouplers (4-way)
 - ☐ two power supply boards
 - ☐ an alarm board
 - ☐ an I/O board
- ☐ Triple Isolator Deck
- ☐ Duplexer Tray with three Duplexer Filters (Duplexers)
- ☐ Base Radios

Duplexed Tower Top Amplifier Incorporation

Duplexed Tower Top Amplifier (DTTA) incorporation into the SRSC configuration is identical to that of the SCRF 800 MHz GEN 4 RFDS. Refer to the Duplexed Tower Top Amplifier Incorporation discussion in the earlier SCRF EBTS Using 800 MHz GEN 4 Duplexed RFDS paragraph earlier in this section for information.

EBTS Configuration Descriptions



EBTS701
072001JNM

Figure 33 **SRSC Cabinet**

EBTS Configuration Descriptions**Cavity Combining RFDS****Cavity Combining RFDS Configurations**

The cavity combining RFDS is a 800 MHz, non-duplexed RF combining system. This RFDS uses up to three receive antennas. For each cavity combiner, a single transmit antenna is used. Figure 34 is a simplified block diagram showing the signal flow between the antennas, RFDS, and Base Radios in a three-branch cavity combining system.

The Basic Cavity Combining Configuration shown in Figure 34 is the starting basis for all three-branch cavity combining RFDS configurations. Each Base Radio transmit (Tx) signal is fed to an individual cavity input of the RFDS. These inputs are combined by the RFDS and applied to a common Tx antenna. However, the three receive signals (Rx1 through Rx3) from the three Rx antennas are applied to three respective receivers in each Base Radio, thereby providing receive diversity. The distribution of the individual Rx1-Rx3 signals from the Rx antennas to multiple Base Radios is provided by Receive Splitters. Each Receive Splitter takes its Rx signal from the antenna and provides multiple outputs which are then fed to respective Rx inputs of each Base Radio.

All cavity combining RFDS configurations use the Receive Splitter arrangement shown in Figure 34 to provide the Rx1-Rx3 signals to each Base Radio.

The Expansion Configurations shown in Figure 34 show the Tx signal flow for various cavity combining configurations. Noting that the Rx signal distribution is identical to that discussed above, only the Tx signal paths are discussed. (Where used, an expansion cabinet will use additional Receive Splitters which are fed from outputs on the main RF cabinet Receive Splitter. The Receive Splitters used in the expansion RF cabinet distribute the Rx1-Rx3 signals in a manner identical to that shown for the Basic Cavity Combining Configuration.)

For the Tx signals, all expansion configurations make use of a phasing harness (represented by circles in Figure 34) to combine Tx signals from two cavity combiners onto a single Tx antenna feed. As shown, this arrangement allows symmetrical doubling of the number of Base Radios and, therefore, the number of channels. Up to 10 channels can be accommodated per combiner pair/phasing harness. A functional duplication of the 1-10 channel expansion results in the 20-channel expansion system. (Note that this system requires two separate Tx antennas.)

EBTS Configuration Descriptions

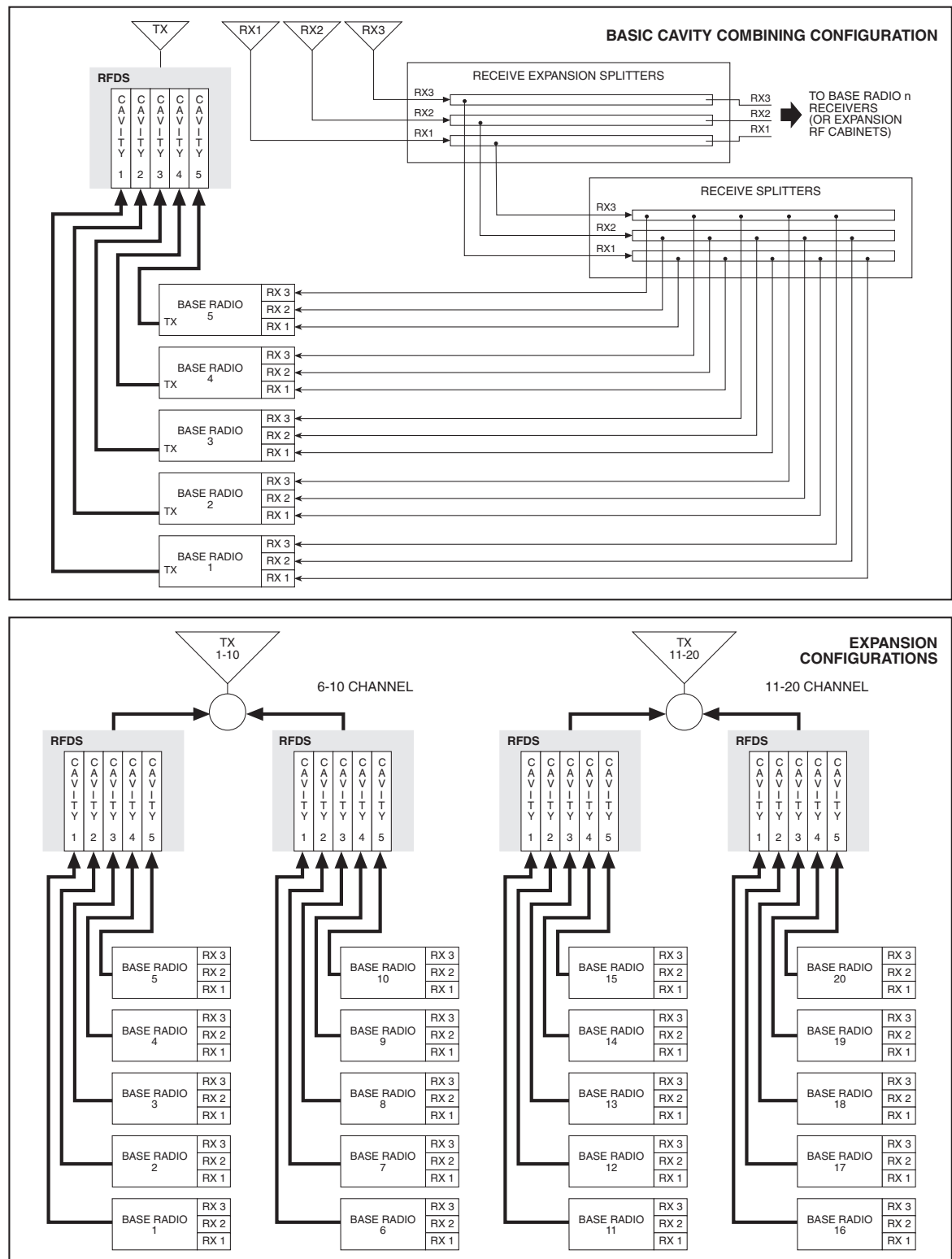
EBTS364
061097LLN

Figure 34 Simplified Block Diagram (Cavity Combining RFDS Configurations)

EBTS Configuration Descriptions**Cavity Combining RFDS Main Cabinet**

Figure 35 shows the front and rear views of the RF Cabinet with a cavity combining RFDS installed.

The main cabinet of the cavity combining RFDS consists of the following FRUs/assemblies:

- ☐ TLN3392 DC Power Distribution and Alarm Tray with two Power Supplies (PS1 and PS2) – provides DC power and alarm monitoring for the amplifiers in the Tower Top Amplifiers and /or the receive amplifiers in the Receiver Distribution Trays.
- ☐ Up to three Receiver Distribution Multicoupler (Splitter) Trays
- ☐ RF Distribution DC Injector
- ☐ Power Monitor Assembly
- ☐ Up to five Cavities
- ☐ Up to five Isolator/Load Assemblies
- ☐ Base Radios

Cavity Combining RFDS Expansion Cabinets

As stated earlier, the cavity combining system can be expanded to 20 channels. Depending on the channels covered by an expansion cabinet, the expansion cabinet is equipped as described below. Cavity expansion cabinets use some additional assemblies as used in the main cavity combining RFDS cabinet to provide expansion.

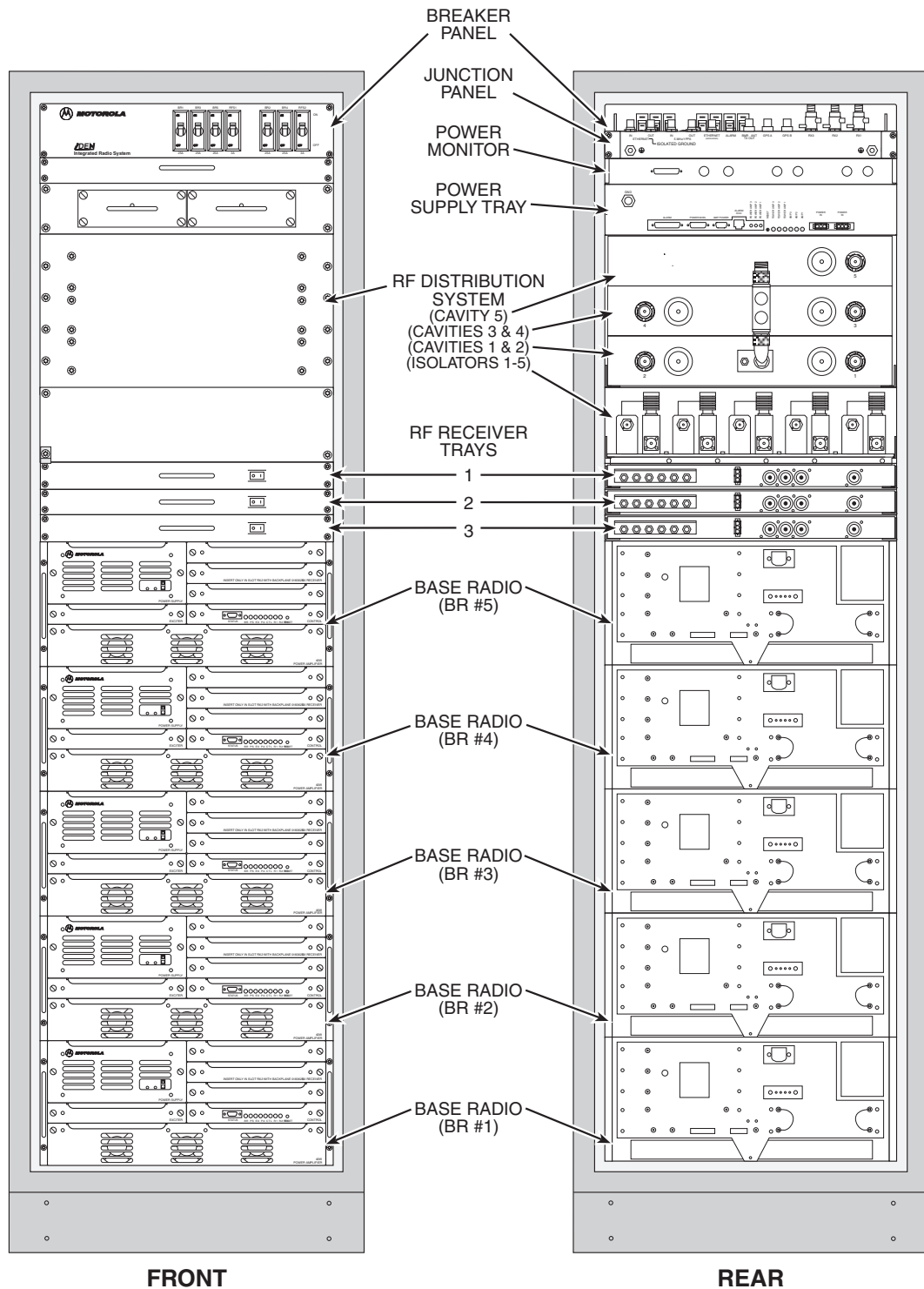
The cavity expansion RFDS cabinet used for channels 6-10 and channels 16-20 consists of the following subassemblies:

- ☐ Up to five Cavities
- ☐ Up to five Isolator/Load Assemblies
- ☐ Up to three Receiver Distribution Multicoupler (Splitter) Trays
- ☐ DC Power Distribution and Alarm Tray with two Power Supplies (PS1 and PS2)
- ☐ Base Radios

The cavity expansion RFDS cabinet used for channels 11-15 consists of the following subassemblies:

- ☐ DC Power Distribution and Alarm Tray with two Power Supplies (PS1 and PS2)
- ☐ Up to three Receiver Distribution Multicoupler (Splitter) Trays
- ☐ Power Monitor Assembly
- ☐ Up to five Cavities
- ☐ Up to five Isolator/Load Assemblies
- ☐ Base Radios

EBTS Configuration Descriptions



EBTS287
042597JNM

Figure 35 **Main RF Cabinet (Cavity RFDS)**

EBTS Configuration Descriptions**900 MHz QUAD Duplexed RFDS**

The 900 MHz QUAD Duplexed RFDS is a hybrid duplexed, expansion-enhanced duplexed RFDS that allows a receive and transmit path to share a common antenna. This is accomplished through the use of up to three duplexers which serve three antennas. The 900 MHz QUAD Duplexed RFDS employs hybrid combining in a modularized, compact design. The compact design of the combining assembly allows up to six Base Radios (BRs) per RF cabinet in an 900 MHz QUAD Duplexed RFDS system. An expansion is available which adds an additional 6 channels (channels 7-12) using an added expansion RF cabinet and additional antennas.

Figure 36 shows simplified block diagrams of various 900 MHz QUAD Duplexed RFDS configurations. The Basic 900 MHz QUAD Duplexed RFDS Configuration shown in Figure 36 is the starting basis for all 900 MHz QUAD Duplexed RFDS configurations.

Receive Description

The three receive signals (Rx1 through Rx3) from the three duplexer/antenna arrangements are applied to three respective receivers in each Base Radio, thereby providing receive diversity. The distribution of the individual Rx1-Rx3 signals from the duplexers/antennas to multiple Base Radios is provided by Receive Multicouplers (RMCs). Each RMC takes its Rx signal from the antenna (via the Duplexer Rx output) and provides multiple outputs which are available for the respective Rx1-Rx3 inputs of each Base Radio.

In a 1-6 BR system, the Main RF Cabinet Receive Multicouplers provide the six distribution outputs of each Rx branch for the six Base Radios. However, in the 1-12 BR expansion system, the six outputs of the main cabinet multicoupler do not directly drive the Base Radios. Instead, a distribution output for each branch is fed to the input of a second group of multicouplers located in an Rx Tray. The Rx Tray multicouplers, in turn, now provide the Rx signals for the six Base Radios in the Main RF Cabinet.

Similar to the Rx Tray arrangement used in the Main RF Cabinet, an Rx Tray located in the Expansion RF Cabinet receives the three branch diversity Rx signals from the main cabinet Receive Multicouplers. The expansion cabinet Rx Tray multicouplers provide the Rx signals for the six Base Radios in the Expansion RF Cabinet.

Transmit Description

The Basic duplexed configuration shown in Figure 36 is the starting basis for all three-branch duplexed RFDS configurations. In this configuration, the three Base Radio transmit (Tx) signals are respectively applied to a dedicated duplexer/antenna.

In expansion configurations, (1-6 BR and 1-12 BR), the Main RF Cabinet is equipped with a Triple 2-Way Combiner Deck that combines up to six Tx signals onto three lines to accommodate up to six BRs in the Main RF Cabinet. Combining points are represented by circles in Figure 36.

In the 6-BR configuration, the two Tx signals from BR1 and BR4 are fed to the first of three 2-way combiners in the Triple 2-Way Combiner Deck. The combined output is then fed to the Tx input port of Duplexer 1. Similarly, the two Tx signals from BR2 and BR5 are fed to the second of three 2-way combiners in the combiner deck. The combined Tx signal is then fed to the Tx input port of Duplexer 2. The two TX signals from BR3 and BR6 are similarly applied to the Tx input port of Duplexer 3.

In the 1-12 BR system expansion, Triple 2-Way Combining Decks in the Expansion RF Cabinet are used to accommodate the Tx signals from Base Radios 7 through 12. The Tx system for BRs 7-12 are completely independent from that used for BRs 1-6 in the Main RF Cabinet.

In the expansion cabinet, three pairs of Tx signals (TX7/TX8, TX9/TX10, and TX11/TX12) are combined into three lines by a Triple 2-Way Combiner Deck identical to that used in the Main RF Cabinet. The first two combined signals, in turn, are again applied to a Dual 2-Way Combiner Deck without Isolators. The TX7/TX8 combined signal is combined with the TX9/TX10 signal; the TX7-10 cascade combined signal is applied to Tx-only antenna ANT4 via a transmit filter. The TX11/TX12 combined signal is fed through the second combiner deck and applied to Tx-only antenna ANT5 via a transmit filter. The Dual 2-Way Combiner Deck is not equipped with isolators, since it does not accept signals directly from the Base Radio. (The combiner decks, along with the isolator function, are explained in greater detail in the *900 MHz QUAD Duplexed RF Distribution System* section of this manual.)

EBTS Configuration Descriptions

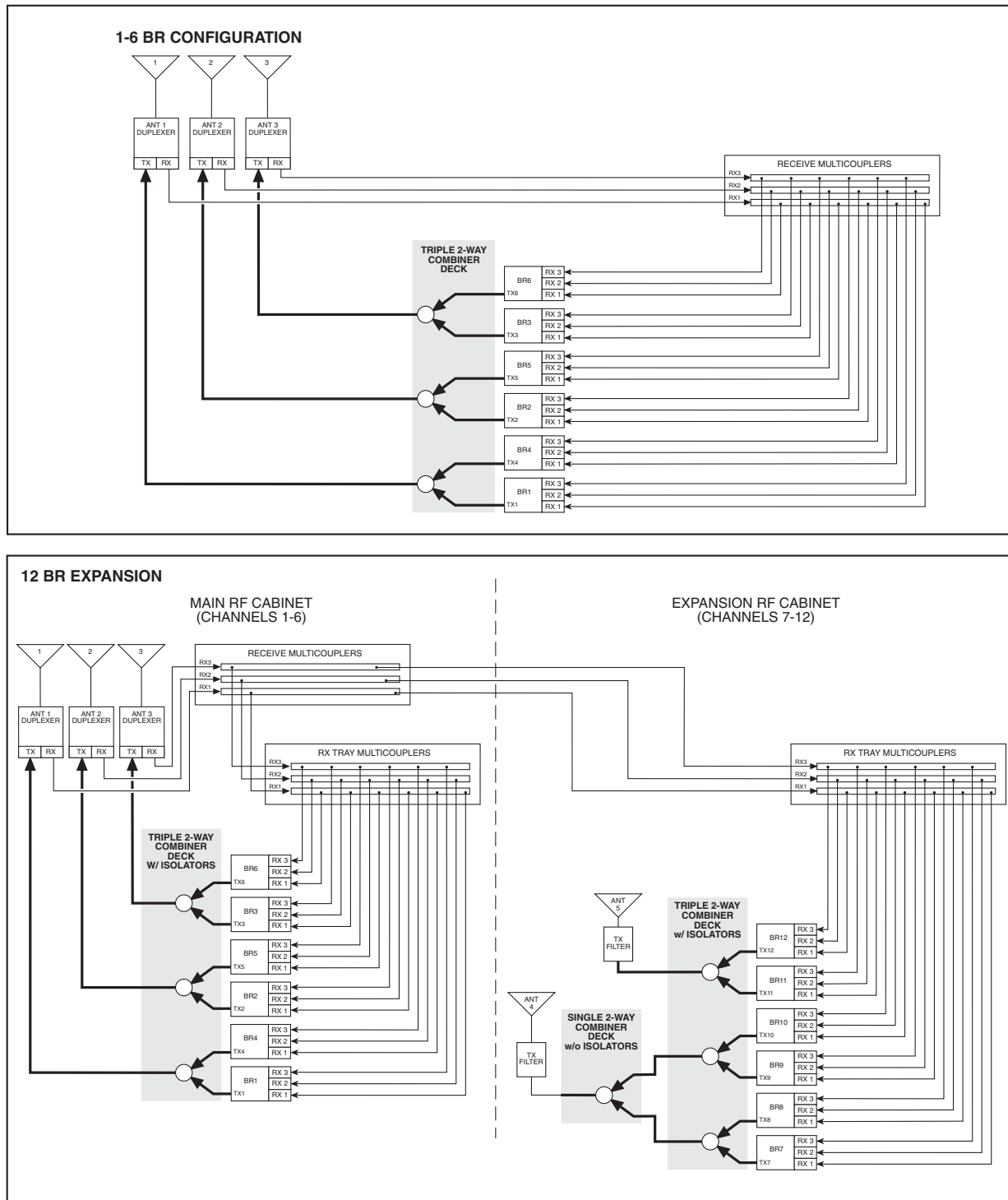
EBTS460
012098JNM

Figure 36 Simplified Block Diagram (900 MHz QUAD Duplexerd RFDS)

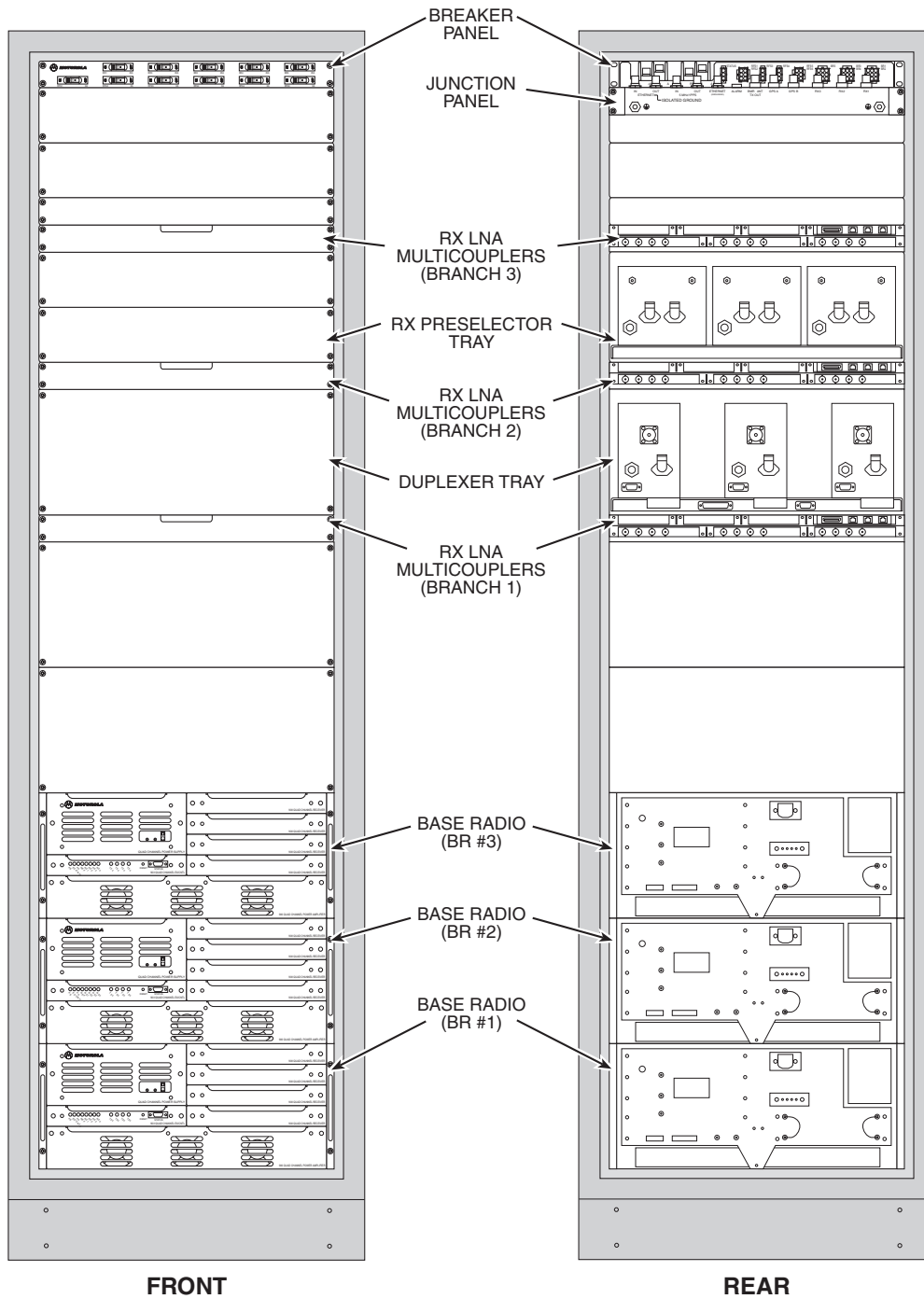
900 MHz QUAD RFDS Main RF Cabinet

Figures 37 through 39 shows the front and rear views of the 900 MHz QUAD RFDS Main RF Cabinet.

The 900 MHz QUAD RFDS Main RF Cabinet consists of the following FRUs and assemblies:

- ☐ Three Receive Multicoupler/RF Amplifiers (4-way)
- ☐ Preselector Tray with 3 Preselectors
- ☐ Duplexer Tray with 3 Duplexers
- ☐ Base Radios
- ☐ Either of the following trays:
 - Duplexer Tray with 3 Duplexers
 - Triple 2-Way Combiner Deck w/o Isolators

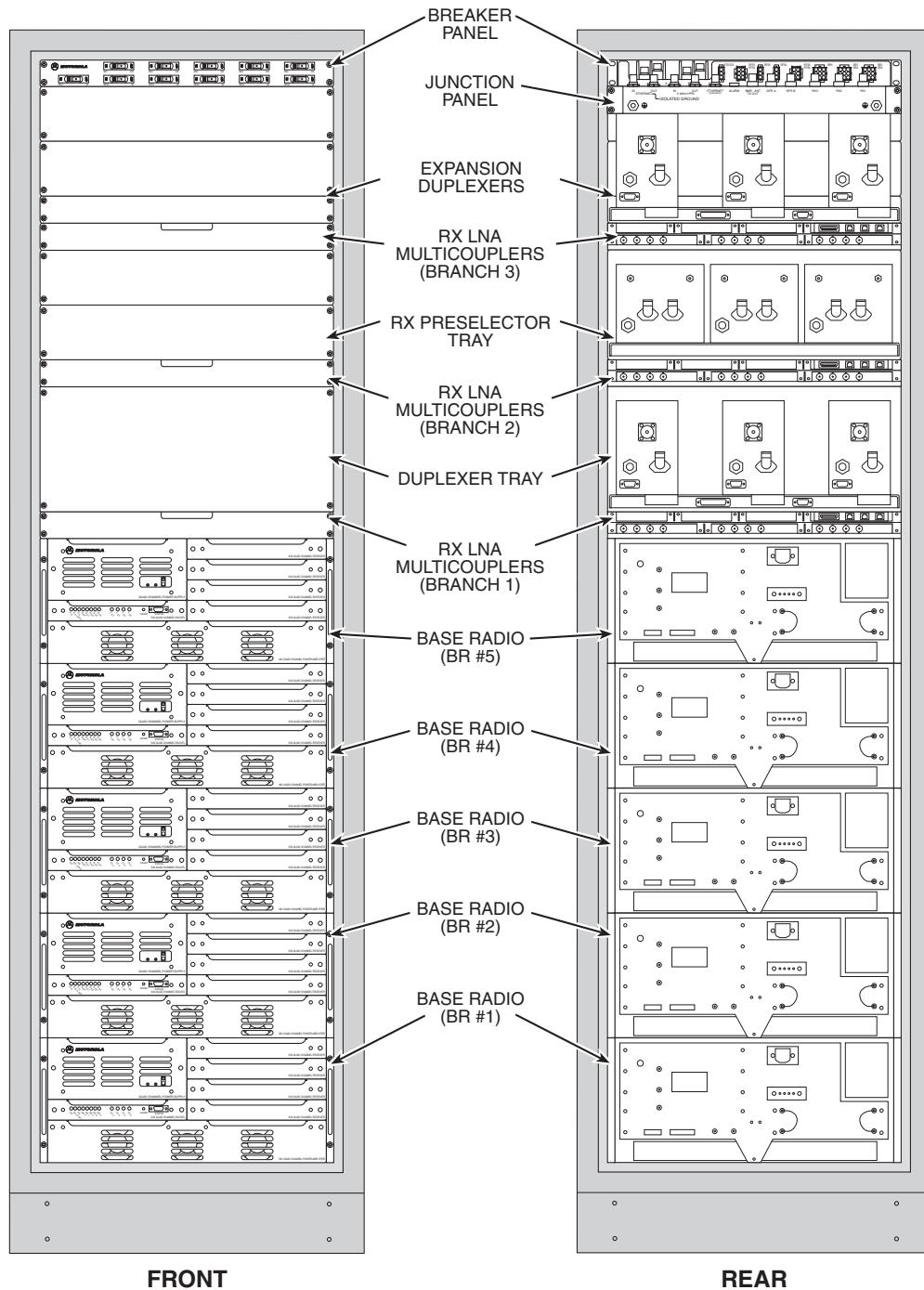
EBTS Configuration Descriptions



EBTS900
042302JNM

Figure 37 Main RF Cabinet (900 MHz QUAD Duplexerd RFDS)

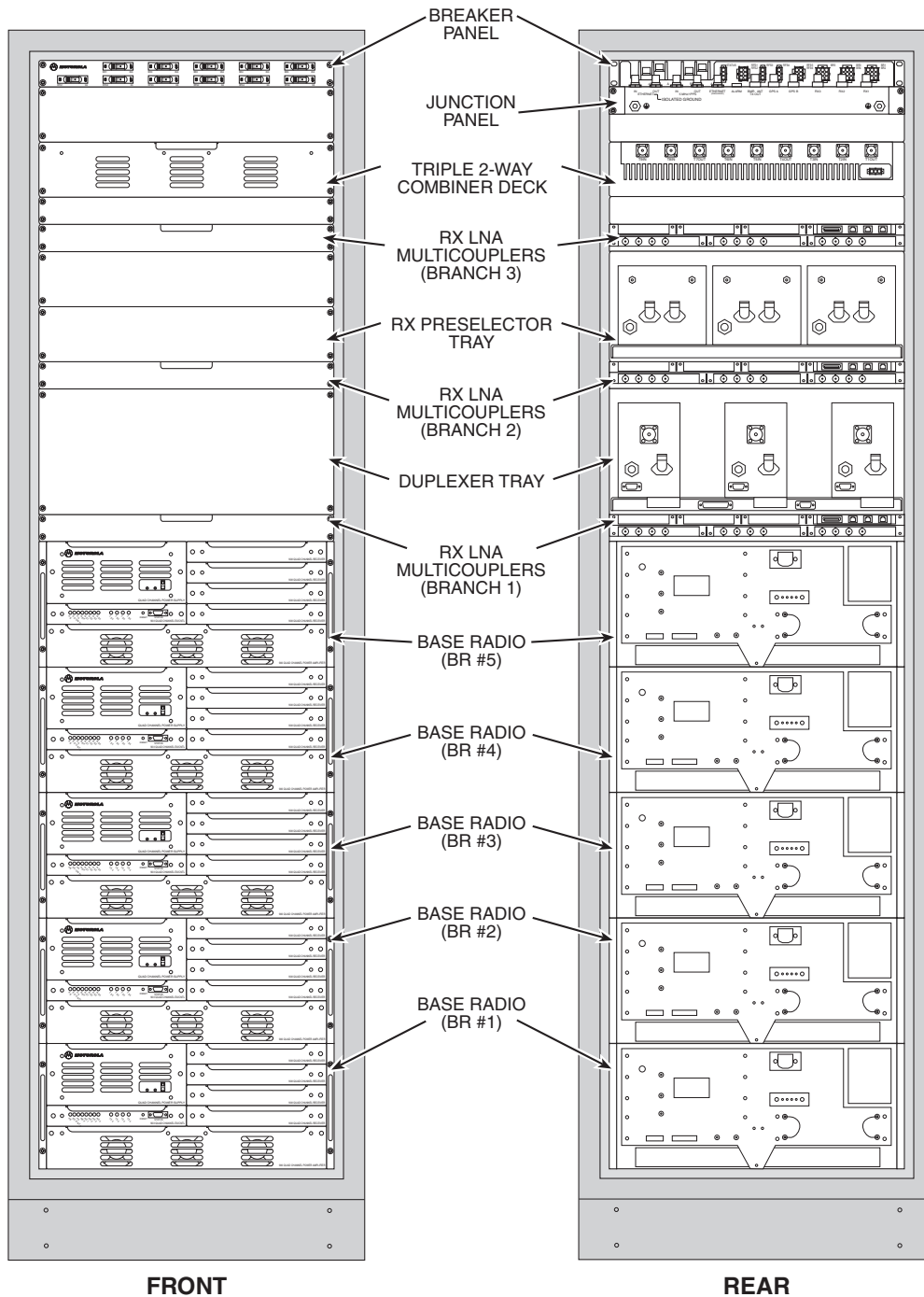
EBTS Configuration Descriptions



EBTS901
042302JNM

Figure 38 **Main RF Cabinet (900 MHz QUAD Duplexer RFDS with Expansion Duplexers)**

EBTS Configuration Descriptions



EBTS902
042302JNM

Figure 39 **Main RF Cabinet (900 MHz QUAD Duplexer RFDS with TX Combiner)**

Pre-Installation

Overview

This section provides pre-installation information for the preparation of an EBTS 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 EBTS.

The topics included are listed in the following table.

Section	Page	Description
Site Planning	3	Covers site considerations relating to the building grounds, space, weights, floor loading, cabinet arrangements, Telco interface, environmental considerations, and other special considerations.
Lifting Equipment Rack	11	Describes the manner in which racks should be lifted into place and explains necessary precautions.
Receipt of Equipment	15	Describes unpacking procedures, equipment inventory, and equipment inspection.
Electrical Requirements	16	Defines the requirements for transfer switch, breaker panel configuration, surge arrestors, cabinet power, and an optional back-up generator.
Grounding Requirements	21	Defines the grounding standards, installation of ground rings, antenna tower grounding, site grounding, and equipment grounding.
Antenna Installation	27	Describes Base Radio, BMR, and GPS antenna considerations, color coding and identification, and surge suppression.
Alarm Wiring	33	Describes the connection of smoke detectors, burglar alarms, and temperature sensors.
Recommended Tools, Equipment, and Parts	34	Shows the recommended tools, equipment, and parts required for installation.

NOTE

Unless otherwise noted, all data in this section applies equally to Stand-alone Control and RF Cabinet (SCRF), Single Rack, Redundant Controller (SRRC), and Single Rack, Single Controller (SRSC) EBTS configurations. Where differences exist, they are noted.

Site Planning

Licensing and availability of space help to determine a site selection. On a Motorola owned or controlled site, field engineering and program management plan the system and site layouts. Planning helps to prevent potential on-site and off-site interference from other RF systems. Site layouts should always be planned to minimize the inter-cabling lengths between RF equipment.

Site Considerations

The EBTS site building should not contain windows and must be able to resist extreme weather conditions. It should be designed to meet the requirements of the American National Standards, *Building Code Requirements for Minimum Design Loads in Buildings and Other Structures*.

Motorola recommends the following considerations when selecting a site:

- ☐ A minimum floor space of at least 200 square feet is recommended to allow enough space for front and rear access to the equipment cabinets.
- ☐ The minimum ceiling height of at least 8'-6" above a finished floor is required to allow enough space for the height of the equipment cabinets and cable access at the top of the cabinets.
- ☐ The ceiling structure should be able to support a cable tray assembly for routing the intercabinet cabling and other site cabling. The cable tray assembly is mounted to the site ceiling and walls per site plan and should be at least 7'-6" from the site floor to allow for the height of the equipment cabinets.
- ☐ The minimum door dimensions should be at least 3' wide and 6'-8" high.
- ☐ All exterior doors should have tamper proof locks installed for security purposes.
- ☐ The interior site environment should be maintained at a constant 78° F (25.6° C). The site should be capable of maintaining this temperature in an outside ambient temperature range of -10 to +105° F (-23.4 to +40.6° C). iDEN equipment is not approved or recommended for outdoor use.
- ☐ Proper surge protection is required for all antennas and power inputs to prevent potential damage to the site equipment.
- ☐ The site floor should be level to within 1/8" and able to support the weight of the site equipment. Refer to the floor loading information provided in this section.

Site Planning

Cabinets and Racks

Cabinet and Rack Dimensions

Table 1 lists the dimensions for the equipment cabinets (Control Cabinet or RF Cabinet), power supply rack, and battery rack.

Table 1 **Cabinet and Rack Dimensions**

Configurations	Width (inches)	Depth (inches)	Height (inches)
Battery Rack (typical)	25	22	84
EBTS Equipment Cabinets*	23.625	23.625	85†
NOTE: † The loading eyelets on top of the cabinets are 1.75" high. With the eyelets, the total cabinet height is 86.75". NOTE: * The Gen 3 SC and EAS can be mounted in a rack with other equipment if desired.			

Cabinet Footprint

EBTS equipment cabinets have a footprint as shown in Figure 1 (two cabinets side-by-side are shown). The height for both non-wheeled and wheeled cabinets is 85" high.

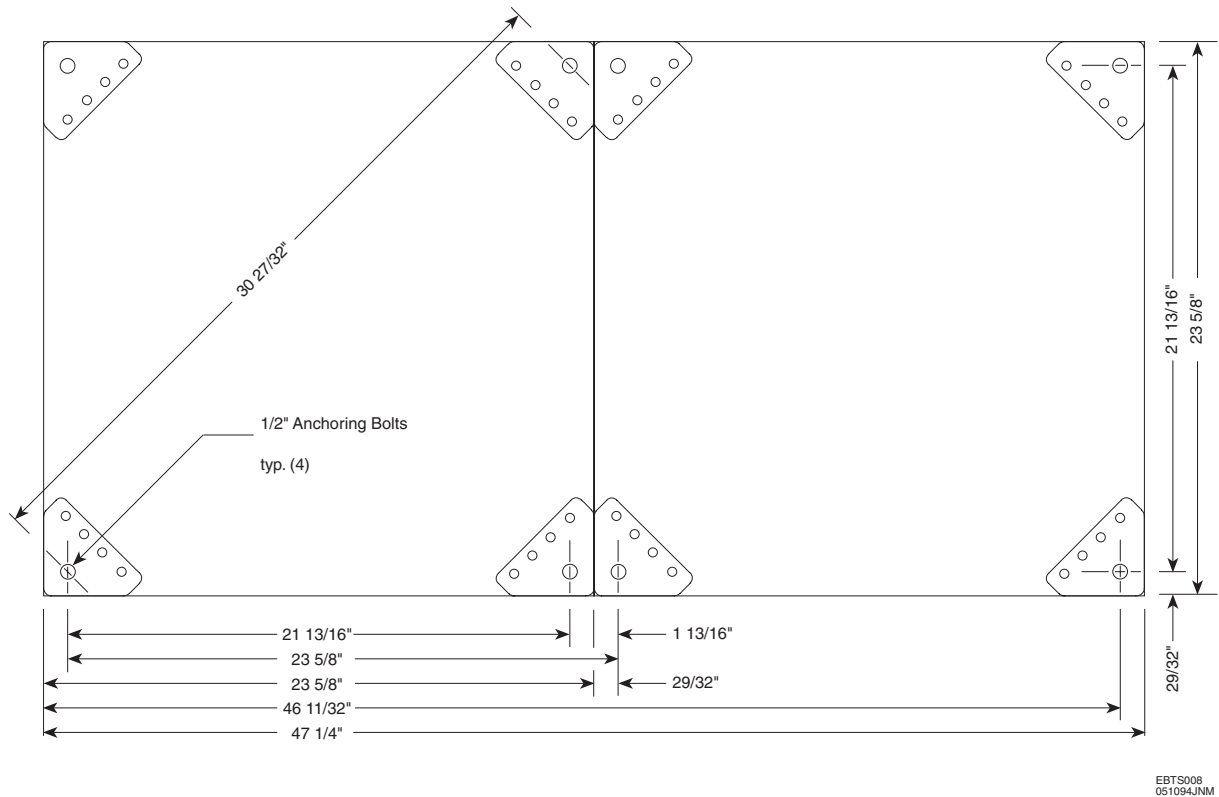


Figure 1 **Equipment Cabinet Footprint**

For Stand-alone Control And RF Cabinet systems, the Site Control and RF equipment cabinets may be installed adjacent to each other or to other equipment. Figure 2 shows the cabinet layout within a typical site. 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 each cabinet to allow service personnel easy access to the equipment.

NOTE

Not all equipment cabinets are shipped with doors, wheels or side panels. Cabinet positions and installation procedures vary with the style of cabinet.

Site Planning

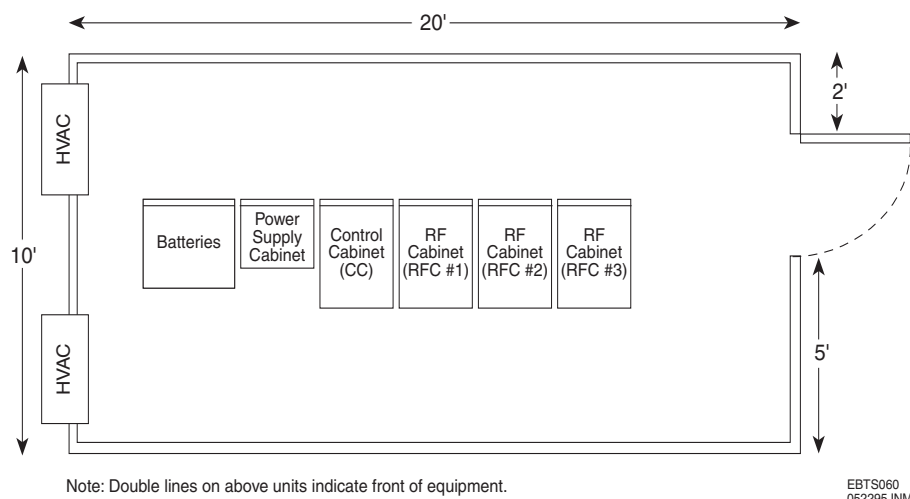
Figure 2 **Typical Cabinet Layout****Cabinet Floor Loading**

Table 2 lists typical weight and floor loading information for various configurations of equipment cabinets.

Table 2 **Equipment Cabinet Weight and Floor Loading**

Configuration	Weight (lbs)	Floor Loading (lbs/sq. ft.)
Control Cabinet	269	69
RF Cabinet with 1 BR	380	98
RF Cabinet with 2 BRs	468	121
RF Cabinet with 3 BRs	556	143
RF Cabinet with 4 BRs	644	166
RF Cabinet with 5 BRs	732	189
RF Cabinet with 6 BRs	820	211
RF Cabinet with 7 BRs	908	234
RF Cabinet with 8 BRs	996	257
Single Rack, Redundant Controller (SRRC) (combined control/RF cabinet)	606	156
Single Rack, Single Controller (SRSC) (combined control/RF/rectifier cabinet)	672	173
Cabinet Doors (each)	25	6
NOTE: There is a maximum of four doors per cabinet. The information in this table is typical and is not a guaranteed specification.		

NOTE

Maximum internal loading capacity of the supplied EBTS cabinet (Schroff part number 22191-483) is 890 lbs.

Battery Rack Floor Loading

Table 3 lists typical weight and floor loading information for various configurations of the Battery rack.

Table 3 **Battery Rack Weight and Floor Loading**

Configuration	Weight (lbs)	Floor Loading (lbs/sq. ft.)
Battery Rack with 1 tray	463	121
Battery Rack with 2 trays	876	229
Battery Rack with 3 trays	1289	337
Battery Rack with 4 trays	1707	447
NOTE: One tray contains four individual batteries. The information in this table is typical and is not a guaranteed specification.		

Special Considerations**Breaker Panel Access**

The National Electrical Code (NEC) requires a 36" clearance for electrical service access to all fuse panels, breaker panels, etc., and requires that all doors to this equipment open to at least 90°.

Disabled Personnel

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

One ADA requirement that should be considered is a 36" wide aisle for wheelchair-bound personnel. The aisle must include an adjacent "T" shaped area to allow room for maneuvering a wheelchair.

Site Planning**Hazardous Materials and Equipment****NOTE**

The following information is provided as an aid for the planning of an EBTS 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 proposed site must not have imminent hazards present in the form of hazardous materials (stored or spilled), harmful or dangerous conditions, or exposure to RF energy levels in excess of ANSI Occupational Guidelines.

If asbestos removal is required, it must be removed by a certified asbestos remover from the site improvement area or from places where it would be disturbed during site construction.

Floors containing asbestos may be left intact. However, drilling or penetration of the floor must be done in accordance with federal and state clean air guidelines. It is recommended that drilling be performed by a certified asbestos remover.

After any removal of asbestos, a certificate of air cleanliness for the site must be obtained from the contractor.

The standard battery system uses valve-regulated batteries designed for telecommunication applications. These batteries are also referred to as sealed or maintenance-free 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.

Seismically Active Areas

EBTS sites that are in seismically active areas may require additional bracing of the equipment cabinets. This manual does not contain specific procedures related to seismic bracing.

Telephone Company (Telco) Line Interface**Telco Surge Arrestor**

A surge arrestor must be installed at the T1/E1 service entrance. The arrestor must be designed for operation with a T1/E1 telephone circuit. The arrestor must only be installed on the customer side of the T1/E1 service entrance. It should be wired per manufacturer instructions. Refer to Appendix B - Parts and Suppliers for the recommended surge arrestors.

Telco Service Entrance

A rigid conduit sleeve must be installed to provide the service entrance into the site building. The conduit must be 2" in diameter and a PVC elbow should be attached (pointing down) on the outside end of the conduit. The conduit must be grounded in accordance with the *Motorola Standards and Guidelines for Communications Sites (68P81089E50)*. Refer to the Manual Overview for information on obtaining this manual.

Telco Backboard

A wall-mounted AC grade fire-rated plywood backboard (1/2"x4'x4') must be provided within the site. Reserve a two square foot area on the Telco backboard for dedicated EBTS use.

A 120 VAC dual receptacle grounded outlet should be installed on or adjacent to the Telco backboard. This outlet can be used for accessories such as modems and other AC-powered devices. This may also be used as a general service outlet.

Environmental Considerations

Temperature Control

The environment in which the EBTS operates is an important consideration. The temperature should be regulated to ensure trouble-free operation. Lower temperatures will reduce battery capacity, but prolong life. Excessive temperatures result in generated heat that may reduce the lifespan of electronic equipment, and could cause permanent damage.

To prevent temperature problems, a Heating/Ventilation/ Air-Conditioning (HVAC) system must be used. All HVAC systems should be thermostatically controlled. To prolong equipment life, the internal temperature of the EBTS site should be maintained at 78° F $\pm$ 10° F (25.6° C $\pm$ 5.5° C). The environmental equipment must be rated such that it is able to maintain the environment to meet the equipment heat dissipation values, which are given in British Thermal Units (BTUs).

BTUs can be figured by multiplying the power rating of the equipment by a factor of 3.414. For example; a Control Cabinet dissipates 300 Watts, which is equivalent to 1024.2 BTUs ($300 \times 3.414 = 1024.2$). Refer to Table 4 for additional BTU information.

The EBTS equipment operates on a -48 VDC power system that typically includes a battery backup system. Should AC power be lost, the DC power system continues to supply the EBTS equipment with the necessary power. Because the EBTS remains operational during loss of AC power, heat is still generated by the equipment. Unless the site HVAC is on a backup system, the generated heat will affect the operation of the EBTS equipment. The operation of the EBTS equipment degrades when temperatures exceed 120° F (48.9° C).

Site Planning

For sites containing more than one-hour battery backup, the effect of generated heat should be considered. The HVAC system design should be evaluated to insure the proper operating environment is maintained in the event of AC power loss.

Redundant HVAC Systems

A redundant HVAC system may be installed, if necessary. It must be wired on a delayed circuit to prevent both HVAC systems from starting up simultaneously. The HVAC system should be capable of automatically switching between the heating and cooling modes in response to the thermostat. The controls must ensure that both modes never operate simultaneously.

Existing HVAC Systems

Existing building HVAC systems may be programmed to turn off during non-occupied hours. This type of HVAC system must be evaluated to insure that the site temperature is maintained within the range suitable for EBTS operation.

Humidity Control and Air Cleanliness

The relative humidity within the site should be less than 95% non-condensing. The site should also be a relatively dust-free environment. Proper measures should be taken to ensure the cleanliness of the site and that it remains relatively dust-free.

Lifting Equipment Rack

WARNING

CRUSH HAZARD COULD RESULT IN DEATH,
PERSONAL INJURY OR EQUIPMENT DAMAGE.
EQUIPMENT RACKS CAN WEIGH UP TO 545 KG (1,200
LBS.). FOLLOW INSTRUCTIONS BELOW FOR PROPER
LIFTING PROCEDURES.

Equipment racks should only be lifted without the use of lifting equipment when there are sufficient personnel available to ensure that regulations covering Health and Safety are not breached.

Motorola recommends the use of appropriate powered mechanical lifting apparatus for moving and lifting the equipment racks.

In addition to these points, refer to and comply with any local regulations that govern the use of lifting equipment.

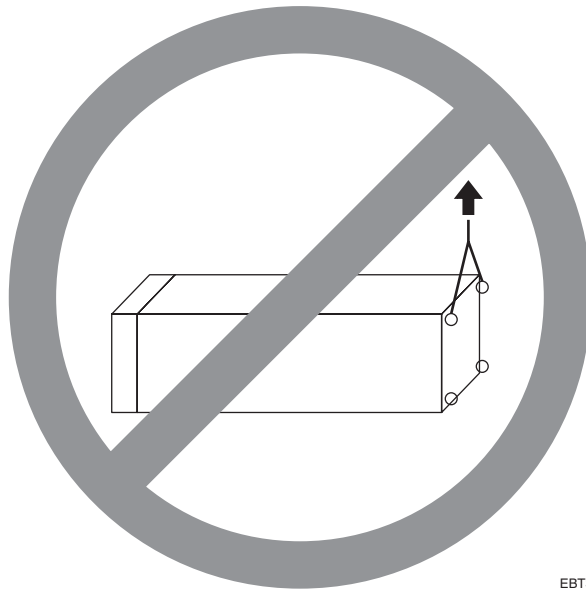
Lifting Equipment Racks From Horizontal

In some cases the equipment racks are laid down horizontal to facilitate the shipping process. Use appropriate lifting apparatus to lift the racks upright complying with all applicable health and safety regulations and any other regulations applicable to lifting heavy equipment.

WARNING

CRUSH HAZARD COULD RESULT IN DEATH,
PERSONAL INJURY OR EQUIPMENT DAMAGE. DO NOT
USE EYENUTS TO LIFT THE RACK UPRIGHT FROM THE
HORIZONTAL POSITION. EYENUTS COULD FAIL
RESULTING IN THE EQUIPMENT DROPPING.

Do NOT use the eyenuts mounted on top of the rack to lift the equipment upright from a horizontal position. The eyenuts are NOT designed to lift in this direction and could fail resulting in the equipment dropping.

Lifting Equipment RackEBTS720
072601JNM**Lifting Equipment Racks Vertically**

If it is necessary to lift the equipment rack vertically, four (4) M10 eyenuts are provided mounted to the top of the rack. Before attempting to use, visually check the eyenuts and associated rack hardware for damage that may have occurred during transit. If any damage is apparent, **DO NOT USE**; contact Motorola for replacement.

ALL four (4) eyenuts **MUST** be used when lifting the equipment rack. When lifting from a center point, the distance from each eyenut to the lifting point must be minimum 40 inches (1 meter) to ensure the proper lifting angle is maintained. See Figure 4 Using a length shorter than that specified could cause the eyenuts to fail.

If eyenuts are removed or become loose, they must be properly installed before they are used to lift the equipment rack. Eyenuts must be aligned to point towards the center lifting point of the cabinet (see Figure 3) and tightened to between 130-150 in-lbs torque. This can be accomplished by hand tightening the eyenut and bolt assembly and tightening the bolt (turning clockwise) an additional 45 degrees. Correct eyenut tightness and alignment are crucial to ensure the eyenut assembly will perform to its intended lifting capacity.

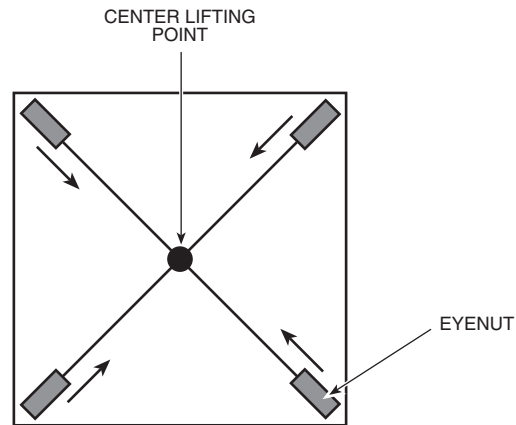
EBTS722
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Figure 3 **Top View of Equipment Rack "Eyenut Alignment"**

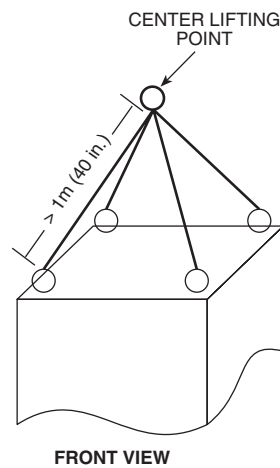
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072601JNM

Figure 4 **Minimum Distance Eyenut to Lifting Point**

Unpacking the Equipment

The EBTS equipment cabinets are packed with all modules intact. The shipping labels of the RF cabinets are numbered to identify their sector affiliation. This information is required when connecting the antennas on multiple sector sites. Save the labels from the protecting plastic wrap. Improper identification of the RF cabinet will result in frequencies being assigned to the wrong sectors.

Lifting Equipment Rack **WARNING**

SOME POWER SUPPLY RACKS ARE NOT DESIGNED TO STAND UNSECURED. IF THE RACK IS LEFT UNATTENDED IN THE UPRIGHT POSITION, IT MAY TIP CAUSING DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL. DO NOT UNPACK THE POWER SUPPLY RACK UNTIL IT IS READY FOR INSTALLATION.

Receipt of Equipment

Equipment Inspection

Inspection of the EBTS 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 EBTS 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 EBTS:

- ☐ 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.

Equipment Inventory

Check the EBTS equipment against the itemized packing list to insure that all equipment was received. If available, check the sales order with the packing list to account for all equipment ordered. Contact your Motorola representative to report missing items and for additional information.

Electrical Requirements

Electrical Requirements

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

AC Service

A typical DC power system operates from a 50-60 Hz AC service as listed below. Since Motorola no longer supplies such modules, the following is for planning purposes:

- ☐ 240/120 V single-phase, 3-wire
- ☐ 208/120 V three-phase, 4-wire

Equipment rooms constructed inside existing buildings that use higher voltage systems require a step-down transformer. A main disconnect switch located within the EBTS is recommended.

Service Amperage

When the HVAC is powered from the same panel or sub-panel as the DC power supply, 200 Amp service is recommended. When the HVAC is powered from a separate panel or sub-panel, 100 Amp service is recommended for the EBTS equipment. In stand-alone buildings or equipment shelters, a 200 Amp service entrance panel is also 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 is provided in Table 4 for several common EBTS configurations, using a two hour backup. These loads may differ for customer designed power systems.

Emergency Generator and Transfer Switch

Some sites may contain permanently installed emergency generators, however, most sites are equipped with connections for portable generators. Sites with permanently installed generators usually have an automatic transfer switch that transfers the AC service from the utility power to the generator after the generator has started. Sites with connections for a portable generator require a manual transfer switch and external connector. Refer to Parts and Suppliers for the recommended external connectors and wiring diagrams.

Generators and transfer switches must be capable of supporting the maximum load for the customer-defined service area of the generator. Start-up loads that include the HVAC and rectifiers must also be taken into consideration when selecting a generator size. Motorola offers several different generators for the EBTS site.

Electrical Requirements

Table 4 **Typical AC Power Loads (Imposed by DC Power System) (70 W BR)**

Configuration (Total BRs on Site)	DC Load (Watts)	Rectifiers Required	AC Amps (nominal)	AC Amps (start-up)	Heat † (BTU) (NOTE 2)
1 Sector - 2 Base Radios	1600	1	8	18	6,560
1 Sector - 5 Base Radios	3475	2	16	36	13,120
2 Sector - 4 Base Radios	2900	2	14	36	11,650
2 Sector - 10 Base Radios	6650	4	31	72	25,400
3 Sector - 6 Base Radios	4200	3	20	54	19,280
3 Sector - 12 Base Radios	7950	4	38	72	36,630
3 Sector - 24 Base Radios	15,450	8	75	140	71,200
SRRC (combined SC/ RF equipment; 4 BR)	3200	2	16	36	13,120
SRSC (combined SC/ RF equipment/ rectifier; 3 BR)	N/A	N/A	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.					

In a shared site with multiple emergency power switches installed, each switch should be labeled with the associated system name with a weatherproof placard attached to or mounted next to the switch.

The EBTS site contains an Environmental Alarm System (EAS) that has eight dry contact closure outputs and 48 customer-defined inputs. The relay closures are controlled from the Operations and Maintenance Center (OMC) and one may be used as a remote start for permanent generators, if desired. The customer-defined inputs may be used to monitor permanent generator operation if desired. Refer to the Gen 3 SC Supplement to this manual for detailed information on alarm wiring.

Electrical Requirements

Surge Arrestors

A Motorola approved surge arrestor must be installed adjacent to the AC power panel. Very short wire lengths between the arrestor and the power panel are required for proper operation. Refer to Appendix B - Parts and Suppliers for the recommended surge arrestors.

For sites using a transfer switch, the arrestor must be installed on the panel side of the transfer switch. Additional arrestors may also be installed at the customer's option on the line or generator side of the switch.

Motorola has developed a functional specification that is used to help select various surge arrestors. This specification is available to all customers and can be obtained by contacting your iDEN System Manager.

Power Panel

Motorola recommends that all EBTS sites use a standardized power panel including circuit breaker layout. Table 5 shows the layout recommended by Motorola. Vacant space should be left to accommodate future requirements.

Table 5 Recommended Power Panel Layout

No.	Amps	Circuit Breaker Label	No.	Amps	Circuit Breaker Label
1	20	Receptacle 1 (inside)	2	20	Receptacle 2 (inside)
3	20	Ceiling Light	4	40	HVAC
5	20	Smoke Detector	6		
7	20	Outside GFI	8	30	Rectifier 3
9	30	Rectifier 1	10		
11			12	30	Rectifier 4
13	30	Rectifier 2	14		
15			16	60	Surge Arrestor
17	20	Spare	18		
NOTE: The rectifiers, HVAC, and surge arrestors are 2-pole breakers.					

48 VDC Power System (SCRF and SRRC Configurations)

The EBTS equipment operates on a DC power system that includes a -48 VDC battery system. Motorola offers a DC power system to complement the EBTS equipment. All references to the DC power system within this manual assume the use of the Motorola offered power system, however other systems may be used.

This manual only provides procedures for the -48 VDC battery system. If other DC power systems are used, then consult the manufacturer's documentation supplied with the equipment.

DC Power Reference

The EBTS equipment operates from positive ground, 48 VDC power. Reference is made throughout this manual to the -48 VDC (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 6 shows the color coding for these wires.

Table 6 **48VDC Power Bus Color Coding**

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

Power Supply Rack

The Motorola-offered Power Supply rack is field expandable from 50 to 300 Amps DC output in 50 Amp increments. Expansion can be accomplished without disrupting the operation of the EBTS. Customers may initially order the necessary amperage for the present site configuration, and if desired expand later as the need warrants. Contact your iDEN System Manager for information on expansion kits. The rectifier system also includes the necessary complement of circuit breakers and alarm wiring for the EBTS equipment.

The standard battery system utilizes from one to four trays of valve regulated, absorbed glass mat, lead-acid batteries in a 7' relay rack. Battery capacity is increased by adding additional trays of batteries when and if needed. The single rack is designed to hold enough batteries for one-hour backup of all site configurations, and two-hour backup for up to nine BRs. Sites with extended battery backup times may require a different battery system. Contact your iDEN System Manager for additional information.

Sites with extended battery backup hours may require including the HVAC equipment on the battery back-up circuit, as well. Otherwise, an alternate method for maintaining site temperature must be used. iDEN equipment continues to generate heat when operating on battery backup which must somehow be dissipated.

Electrical Requirements**Cabinet Requirements (SCRF and SRRC Configurations)**

Proper sizing of the rectifiers and batteries is accomplished by the iDEN System Manager when the EBTS is ordered. The information in Table 7 is provided for customers that prefer to design a unique DC power system. This table lists the power system requirements of the Control and RF Cabinets.

Table 7 Typical Cabinet Power System Requirements

Configurations	Requirement
DC Power System: †	
Minimum	-41 VDC
Maximum	-60 VDC
Control Cabinet:	
with standby Gen 3 SC	300 Watts
without standby Gen 3 SC	200 Watts
SCRF RF Cabinet/SRRC Cabinet:	
without BRs	50 Watts
each additional BR (70 W P.A.)	625 Watts
† Voltage is measured at circuit breaker panel input of the equipment cabinets	

Grounding Requirements

The EBTS site must meet certain specifications for adequate protection from lightning induced transients. Proper ground installation methods are outlined in the *Motorola Standards and Guidelines for Communication Sites "R56" (6881089E50)*. Refer to the Manual Overview for information on obtaining the *Motorola Standards and Guidelines for Communication Sites "R56" (6881089E50)* manual.

Ground Rings

Separate ground rings should surround the site building and antenna tower. Ground rods (8') should be driven into the ground at 10' intervals for average soil. 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 tinned copper wire, solid or stranded. 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.

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.

Grounding Requirements

Site Building and Equipment Grounding

On stand-alone site buildings, a PVC (typically 3/4") conduit must be provided for the interior ground wire to exit the building. For site buildings with floors at ground level, the conduit must exit a side wall at a 45° angle or less. For buildings with space below the floors for a ground connection, the conduit may exit through the floor. In both cases, the location of the opening should be close to the master ground bar inside the building.

Use of metal conduit is discouraged as the conduit provides inductance to a surge, raising the impedance of the ground. If metal conduit is required by local building codes, both ends of the conduit must be bonded to the ground wire through the use of grounding clips or other suitable means to eliminate the inductance of the conduit.

Cabinet Grounding

Within the EBTS site, ground the cabinets with a single dedicated connection between each cabinet and the master ground bar. The connecting wire must be a #2 AWG green-insulated copper wire.

Use two-hole mounting lugs (and split ring lock washers when possible) with an anti-oxidant grease applied for interior grounding connections and exterior secondary grounding connections. If lock washers are used, they should be placed between the nut and the lug to ensure the mechanical integrity of the connection. The washer must not be secured between the lug and the surface to which it is connected. Painted connections must be scraped clean before applying the anti-oxidant grease and lug.

WARNING

NEVER USE A BARE OR DAMAGED WIRE FOR THE CONNECTION OF CHASSIS GROUND OR OTHER ELECTRICAL WIRING TO PREVENT DAMAGE TO EQUIPMENT OR POTENTIAL INJURY TO PERSONNEL.

NOTE

Each EBTS cabinet frame must be connected to the site ground using a single dedicated ground wire, except for RF Cabinets containing cavity combining systems.

Grounding Requirements

The site ground wire should drop into the top of each cabinet and be connected to a single designated grounding stud. Single hole lugs (1/2" diameter) are used for these grounding connections. Connect the ground wires as follows:

- ❑ On the Gen 3 SC Control Cabinet, the ground wire is mounted to one of the ground studs on the Junction Panel (rear of cabinet).
- ❑ On equipment cabinets containing a duplexed RFDS, the ground wire is mounted to the studs located on each of the duplexers or to one of the ground studs on the Junction Panel (rear of cabinet).
- ❑ On equipment cabinets containing a cavity combining RFDS, two separate ground wires are required. One ground wire is connected to the cavity ground plate for cabinet grounding. Another ground wire is connected to one of the ground studs on the Junction Panel. This protects the tower top receive system.

 WARNING

DO NOT DAISY-CHAIN MULTIPLE EQUIPMENT CABINET GROUNDS USING A SINGLE GROUND WIRE. DOING SO INCREASES THE OVERALL INDUCTANCE OF THE GROUND WIRE WHICH CAN DISTRIBUTE SURGE ENERGY AMONG THE CABINETS INSTEAD OF TO THE MASTER GROUND BAR.

The EBTS equipment cabinets are classified as surge producers due to external coaxial cable connections. Surges from outside the site can enter the site grounding system via the coaxial cables. To prevent damage to the equipment, each cabinet must be connected to chassis ground through a minimum wire size of at least #2 AWG. Green insulated wire must be used to identify all ground wiring.

Cable Tray Grounding

The cable tray assembly must be designed and installed so that it does not come into contact with metal conduits, pipes, or other metal objects. The cable tray assembly must also be connected to the master ground bar through the use of a single dedicated wire. The connecting wire shall be a minimum size of #6 AWG green-insulated copper wire.

Any metal-to-metal joints on the cable tray assembly must be bonded together with a wire jumper to prevent electrical discontinuity, unless the tray connectors are specifically designed to insure continuity. Painted surfaces on the cable tray assembly must be scraped clean at the point where the jumper wire is attached to ensure a good electrical connection. Repaint cable tray assembly surfaces, if necessary.

Grounding Requirements

Electrical System Grounding

The site electrical system should be connected to the internal ground bar by a single connection. This should be from the panel/sub-panel in the equipment room with a #2 AWG stranded green insulated wire. For sites with sub-panels, the utility green Multi-Grounded Neutral (MGN) wire may not be present. In this situation, an electrician may need to be consulted to extend the MGN from the service entrance to the sub-panel. If this is done in metal conduit, then grounding clips should be used at both ends of the conduit to minimize inductance.

If metal conduit is used for the electrical system, all connections must be bonded together through conduit compression or screw fitting designed for such purposes. The metal conduit system must not be in contact with other metal on the site including cable ladder or equipment cabinets to minimize ground loops and sharing of surge energy. Small pieces of rubber or other insulating material may be used on conduit clamps to eliminate any inadvertent connections.

WARNING

NEC PROHIBITS GROUNDING THE AC POWER SYSTEM NEUTRAL (WHITE WIRE) ANYWHERE OTHER THAN AT THE SERVICE ENTRANCE PANEL. HOWEVER, GROUNDING OF THE MGN (GREEN WIRE) AT MULTIPLE LOCATIONS IS ALLOWED.

ENSURE A GOOD CONNECTION BETWEEN THE ELECTRICAL SYSTEM GROUND AND SITE GROUND TO PREVENT EXCESSIVE VOLTAGE POTENTIAL BETWEEN THE TWO GROUND SYSTEMS DURING LIGHTNING STRIKES.

Power Supply and Battery Racks

The Power Supply rack (SCRF and SRRC configurations) and battery system rack should each be individually connected to the internal ground bar. Motorola recommends connecting the ground wire to one of the screws on the blank panel of the rack. Make sure that all paint is removed around the contact area to allow a good contact. Use a #2 AWG insulated grounding wire with a single hole lug to make the connections. The section on Installation provides a detailed procedure for grounding the Power Supply rack.

DC Power System Grounding

The DC power system is grounded only at a single point to prevent return current flow through ground connections and ground loops. A #6 AWG (or larger) insulated ground wire (green) with a double hole lug should be attached in one of

the locations on the DC return bus of the Power Supply rack. This ground wire is also connected to the Master Ground Bar.

NOTE

The return bus on the Power Supply rack may be supported by red insulators. The color red in these insulators has no significance.

Telco Device Grounding

A single #6 AWG (or larger) insulated ground wire should be terminated on the Telco board for use by the various devices mounted to the board.

Miscellaneous Site Grounding

A #6 AWG, insulated ground wire may be installed within the site to connect the miscellaneous metal items (such as the door, door frame, HVAC grilles, etc.) that are not likely to be the source of electrical surges. All ground wiring should be routed near the ceiling, if possible.

One end of the ground wire must be connected to the Master Ground Bar. This connection bonds the remaining metal (conductive) items in the room with the ground system.

Site Ground Bars

There are two types of ground bars used in the EBTS site. Both ground bars should be mounted immediately below the antenna entry plate on both the inside and outside of the shelter wall. The ground bars must have direct wire connections to the site ground system.

Exterior Ground Bar

The Exterior Ground Bar (EGB) provides a convenient location to terminate coaxial grounding straps and grounding wires from exterior metal surfaces as they enter the site, including:

- ☐ antenna feed line entrance plate
- ☐ cable support
- ☐ air conditioner housing

Master Ground Bar

The Master Ground Bar (MGB) is located inside the equipment room preferably underneath or near the cable entrance. Various metal structures within the site connect to the MGB, including the ground wires from:

Grounding Requirements

- ☐ EBTS equipment cabinets
- ☐ power supply rack
- ☐ battery system rack
- ☐ DC power system return
- ☐ Telco board
- ☐ RF surge arrestors
- ☐ electrical system
- ☐ cable ladder/ceiling support system
- ☐ other miscellaneous metal items and structures (door, louvers, etc.)

Motorola recommends the use of 1/4" thick copper ground bars with hole patterns to accept a minimum of 15 double hole lug connections (3/8" holes on 1" center). The ground lead from the ground bars to the ground rod system should be a minimum of #2 AWG. Both the internal and external ground bars must be connected together. This usually occurs when the internal ground wire exits the building and is tied into the ground rings with the external ground wire.

For sites which are part of an existing building, a connection to the building steel may be made in lieu of an underground ring. All other aspects of site interior grounding remain the same.

Antenna Installation

Antenna Feed Line Requirements

The transmission line entry for all antennas should be installed with a metal antenna entry plate external to the site building. All antenna feed line entry ports must be covered to prevent small animals or objects from entering. Transmission lines must be grounded to the exterior ground bar below the antenna feed line entry port 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.

All connectors at the antenna feed line entrance are Type N. 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 Feed Line Identification

All antenna feed lines should be marked appropriately to simplify connections to the proper EBTS 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 EBTS sites. Other color schemes may be used.

Table 8 shows how to identify the antenna feed lines for a typical duplexed RFDS. Table 9 shows how to identify the antenna feed lines for a typical cavity combining RFDS.

Be sure to identify the tower top amplifier test cable(s) in systems utilizing tower top amplifiers. Depending on the receive configuration, there could be as many as three individual test cables for the tower top amplifiers. Make sure that a unique color coding is used to identify these test cables.

Antenna Installation**Table 8 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 (transmit; BR19/BR20)
Yellow	Global Positioning System (GPS) Antenna
Orange	Tower Top Amplifier Test Cables †
† The color of the tower top amplifier test cables are user defined. The routing of these test cables and the number of test cables installed are site dependent.	

Table 9 Cavity Combining RFDS Antenna Identification (Typical)

Color	Description
Red	Base Radio Antenna 1 (receive)
Blue	Base Radio Antenna 2 (receive)
Green	Base Radio Antenna 3 (receive)
Brown	Base Radio Antenna 4 (transmit)
Yellow	Global Positioning System (GPS) Antenna
Orange	Tower Top Amplifier Test Cables †
† The color of the tower top amplifier test cables are user defined. The routing of these test cables and the number of test cables installed are site dependent.	

Antenna Surge Arrestors

All antenna feed lines should terminate with a suitable surge arrestor within 12" inside of the entry window. Each arrestor must connect to the master ground bar located below the entry plate. It is recommended that the arrestors be mounted to a mounting bracket to simplify grounding cable and installation. Refer to Appendix B - Parts and Suppliers for recommended surge arrestors and mounting brackets.

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 EBTS sites. Other color schemes may be used.

Within each sector is an antenna array containing up to three receive antennas. In a duplexed RFDS site, the transmit signals are present on the same receive antennas. In a cavity combining RFDS site, a separate transmit antenna is added to each sector. 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

NOTE

Sectors containing two antennas typically have a left and right but no middle antenna.

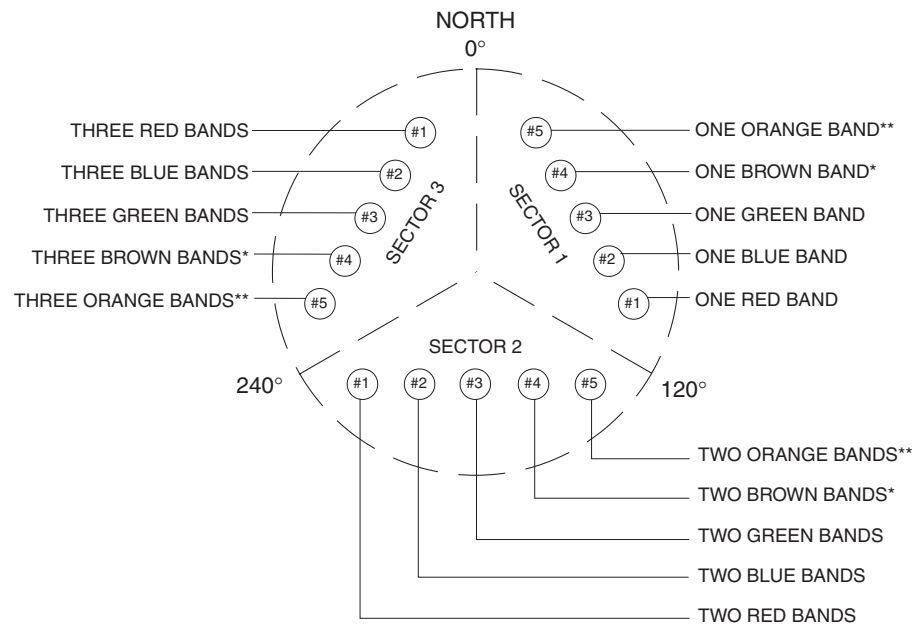
Sector Identification

Typically, sectors are numbered 1, 2, or 3 in a clockwise manner with Sector 1 being the first sector from true north, 0 degrees. Figure 5 shows the recommended sector color coding. Table 10 identifies each of the antenna sectors. For example, a cable with three red bands indicates an antenna lead from Antenna 1 (left-most) within Sector 3.

Table 10 **Sector Identification**

Bands	Description	Coverage †
One band	Sector 1	0° to 120°
Two bands - same color	Sector 2	120° to 240°
Three bands - same color	Sector 3	240° to 0°
† Sector coverage assumes reference to true North, which is 0°.		

Antenna Installation



* Antenna 4 is the transmit antenna when using a cavity combining RFDS.
 ** Antenna 5 is the test port antenna when using a cavity combining RFDS.

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Figure 5 **Recommended Sector Color Coding**

Single sector sites often use omnidirectional antennas in a triangular pattern. In this situation red identifies Antenna 1, the northernmost antenna in the triangle. Blue is Antenna 2, which is the next antenna clockwise (viewed from the top) in the triangle. Green is Antenna 3, which is the last antenna in the triangle, if present. Brown is Antenna 4, which is the transmit antenna for systems using a cavity combining RFDS. Antenna 4 is not used in duplexed sites. Orange is Antenna 5, which is the test port antenna for systems using a cavity combining RFDS. Antenna 5 is not used in duplexed sites.

GPS Antenna Planning

The Gen 3 SC within the EBTS obtains precise timing information from the Global Positioning System (GPS). This system permits all EBTS sites in the area to synchronize to a common timing reference. The EBTS 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 EBTS.

GPS Antenna Evaluation

The Site Controller 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 EBTS to successfully initialize, four satellites must be tracked

Once an EBTS is operating and the BRs have been keyed, site synchronization is maintained as long as at least one satellite is being tracked. However, to maintain maximum reliability, three satellites should be tracked at all times.

The EBTS must be capable of the following:

- ☐ Tracking a minimum of four satellites during initial start-up or after loss of power to the Gen3 SC.
- ☐ Tracking three satellites continuously for maximum reliability.

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 EBTS. The data reported by this kit is the same as that used by the EBTS, 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:

- ☐ Number of visible satellites
- ☐ Number of satellites being tracked

GPS Antenna Requirements

The two Global Positioning System (GPS) antennas should be mounted at least 10' apart with an unrestricted aerial down view to within 10° of the horizon in all directions. This provides a degree of redundancy in case the antennas are damaged by falling objects or inadvertent shadowing.

The antennas must be mounted high enough to clear the peak of the EBTS site roof. For systems in the northern hemisphere, GPS antennas should be mounted so that a clear view of the southern sky is maintained. For systems in the southern hemisphere, GPS antennas should be mounted so that a clear view of the northern sky is maintained.

Antenna Installation

Isolate the GPS antennas from RF interference by mounting the antennas at least 12' horizontally from other transmitting antennas.

Adjacent structures, such as trees or buildings, are obstructions due to their wide, solid profiles. Mount the GPS antennas to clear these obstructions and provide a clear path. Adjacent antenna towers at the RF site which protrude into the required view have a minimal effect on GPS satellite reception and are not obstructions.

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 EBTS sites. Other color schemes may be used.

As mentioned in the RF Antenna Installation section, GPS antennas are color coded yellow. The same identification technique used for RF antennas is also used to identify the GPS antennas, refer to Table 11. Antenna 1 should always be the northern-most antenna.

Table 11 **GPS Antenna Identification**

Band	Description
One yellow band	GPS Antenna 1 (northern-most)
Two yellow bands	GPS Antenna 2

GPS Antenna Line Loss

The maximum allowable line attenuation between the antenna and the Gen 3 SC 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 EBTS 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.

Alarm Wiring

Various alarms or sensors are installed within the EBTS site building. All alarm wiring terminates at the Environmental Alarm System (EAS) located within the Site Control Cabinet. The electrical contacts for the alarms must be dry contacts and remain normally closed (open on alarm). Refer to the Gen 3 SC Supplement to this manual for detailed alarm interconnect information.

Motorola recommends site installation of the following alarms:

- ☐ Smoke detector (120 VAC)
- ☐ Intrusion alarm
- ☐ High temperature sensor
- ☐ Low temperature sensor

The high temperature sensor should be capable of monitoring temperatures above 80° F (26.7° C). The low temperature sensor should be capable of monitoring temperatures below 70° F (21.1° C). Temperature sensors should be mounted to the Telco wiring board at a convenient height to facilitate the setting and inspection of the trigger points. Refer to Appendix B - Parts and Suppliers for recommended alarms.

Local codes may require an additional contact closure to deactivate the HVAC system and prevent circulation of smoke in the event of a fire. An additional smoke detector may be used to provide this contact. It can also be configured to trigger an external alarm, if required.

If a second alarm closure is used, it must be completely isolated from the dedicated EBTS smoke alarm circuit. Parallel connection of the HVAC controller through these contacts may damage the HVAC and EBTS equipment. This is because the HVAC low voltage controller typically has 5 VDC negative ground, which opposes the -48 VDC EBTS supply.

If specialized automatic fire suppression systems are installed within the site, water flow alarms or Halon release alarms may also be required. These systems may also have to be remotely monitored for unattended facilities. Check your local codes for additional information and requirements.

NOTE

The use of Halon within the United States of America is now prohibited. However, if a Halon fire suppression system is currently in use, there may be alarm requirements that have to be satisfied.

Recommended Tools, Equipment, and Parts

Recommended Tools, Equipment, and Parts

Tables 12 through 14 list the tools, test equipment, and locally procured parts required to install the EBTS. 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 12 lists the tools recommended for installation. These are not included as part of the EBTS shipment and must be procured locally. All model numbers are Motorola part numbers, unless noted otherwise.

Table 12 **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

Recommended Tools, Equipment, and Parts

Table 12 **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 12 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

Recommended Tools, Equipment, and Parts**Table 12 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 13 lists the recommended test equipment for installation. These are not included as part of the EBTS shipment and must be procured locally. All model numbers are Motorola part numbers, unless noted otherwise.

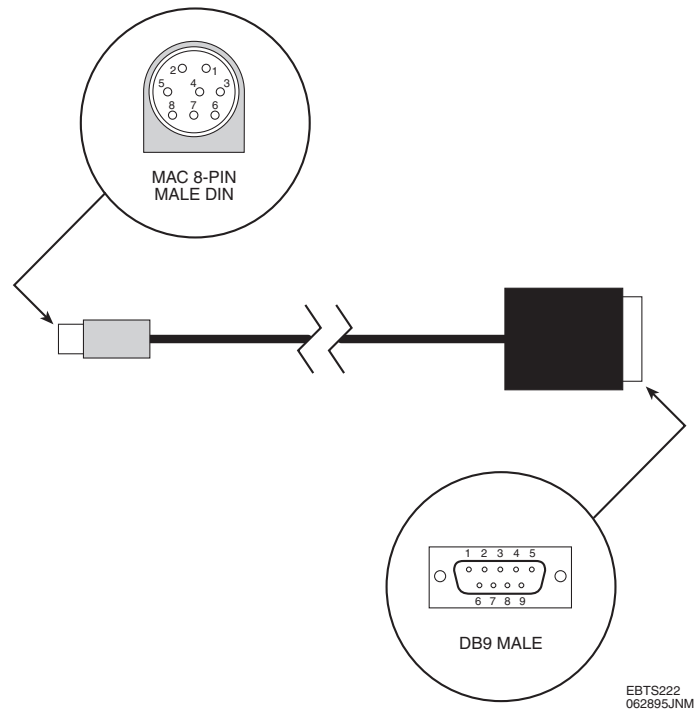
Table 13 Recommended Test Equipment for Installation

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 EBTS equipment for RF attenuation
Service Computer	Refer to Parts and Suppliers		Local service terminal
Communication Cable Between PC Service Computer and EBTS 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 EBTS Equipment	n/a	n/a	Din 8 male / DB9 male (refer to Figure 6)
Service Monitor	R2660 w/iDEN	Motorola	Station alignment

Recommended Tools, Equipment, and Parts

Table 13 **Recommended Test Equipment for Installation (Continued)**

Test Equipment	Model/Type	Supplier	Description
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 6 **MAC 8-pin Male DIN to DB9 Male Connector**

Recommended Tools, Equipment, and Parts**Recommended Parts**

Table 14 lists the recommended parts for installation. These are not included as part of the EBTS shipment and must be locally procured. All model numbers are Motorola part numbers, unless noted otherwise.

Table 14 **Recommended Parts for Installation**

Part	Type/Size	Supplier	Where Used
Anchor Kit	#02100-13	Hendry	EBTS 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
Refer to Appendix B - Parts and Suppliers for other cable sizes needed where equipment cabinets are not next to each other.			

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Overview

This section provides procedures required to permanently install the EBTS at the selected site. The section topics are listed in the following table.

Section	Page	Description
Introduction	2	Provides general information for the installation procedures
EBTS Cabinet Installation	5	Describes installing wheeled and non-wheeled EBTS equipment cabinets
Power Supply Rack Installation	8	Provides general information regarding Power Supply Rack installation
Cabinet And Site Connections	9	Describes and lists general cabling procedures required in installing the EBTS
Intercabinet Cabling Procedures	12	Provides step-by-step procedures and diagrams for installing cabling between cabinets for systems using multiple cabinets
Cabinet-to-Site Cabling Procedures	39	Provides step-by-step procedures and diagrams for installing cabling between the EBTS and the site
Diplexer Hardware Installation	62	Provides step-by-step procedures and diagrams for installing the 800/900 Mhz Diplexer

NOTE

Unless otherwise noted, all data in this section applies equally to Stand-alone Control and RF Cabinet (SCRF), Single Rack, Redundant Controller (SRR), and Single Rack, Single Controller (SRSC) EBTS configurations. Where differences exist, they are noted.

In this section, “equipment cabinet” similarly denotes an RF Cabinet (SCRF systems) or an SRR or SRSC cabinet (unless specifically stated otherwise).

Introduction

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 (Motorola Standards and Guidelines for Communication Sites "R56" (6881089E50))*.

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 EBTS site, the term *cabinet* is used to refer to Fixed Network Equipment (FNE) mounted in different types of frames. It does not refer in any way to building electrical cabinets, outdoor utility cabinets, or some types of equipment shelters commonly known as cabinets.

The Site Control and equipment cabinets consist of Euroracks. These are shipped standard as an open frame with four corner posts with top and bottom assemblies to tie the posts together. Optional side panels and doors are available. The components of the Power Supply rack are shipped pre-assembled in open relay racks. The battery systems may be in a 7' open rack or a custom designed enclosure.

Two terms are used interchangeably when discussing site configurations: cell and sector sites. Sector is commonly used when discussing antenna radiation patterns. Cell is commonly used when discussing configuration files. In an iDEN system, the two are synonymous. EBTS sites may be configured with one, two, or three sectors (cells). In this section of the manual, the term sector is used.

Single sector sites usually provide omni-directional RF coverage and are referred to as omni sites. Two or three sectored sites have different coverage patterns for the sectors and are referred to as sector sites. Each EBTS site requires a Gen 3 SC, whether in a separate stand-alone cabinet, or in the same cabinet as the Base Radios (single-cabinet system). Every sector within the EBTS site requires an RF Cabinet. For example, a three sector site contains a single Gen 3 SC and three RF Cabinets.

For a typical SCRF EBTS, a Site Control Cabinet and several RF Cabinets may be installed, depending on the configuration. An SRRC omni expansion EBTS may also use several cabinets. Table 1 lists the cabinet complements required for various systems that may use multiple cabinets.

Installation procedures (or appropriate references) for the Power Supply rack, batteries, and all associated cabling are also provided.

Table 1 **Cabinet Complements For Various Systems**

System/Site Type	Cabinet Configuration
800 MHz GEN 4 DUPLEXED RFDS (STAND-ALONE CONTROL AND RF CABINET SYSTEM)	
1-6 Channel Omni Expansion	• one Gen Site Control Cabinet • one Main GEN 4 Duplexed RF Cabinet
7-12 Channel Omni Expansion	• one Site Control Cabinet • one Main GEN 4 Duplexed RF Cabinet • one Expansion Main GEN 4 Duplexed RF Cabinet
13-20 Channel Omni Expansion	• one Site Control Cabinet • one Main GEN 4 Duplexed RF Cabinet • two Expansion Main GEN 4 Duplexed RF Cabinets
19-24 Channel Omni Expansion	• one Site Control Cabinet • one Main GEN 4 Duplexed RF Cabinet • two Expansion Main GEN 4 Duplexed RF Cabinets • one 19-24 Channel Expansion RF Cabinet
800 MHz GEN 4 DUPLEXED RFDS (SINGLE-RACK, REDUNDANT CONTROLLER (SRRC) SYSTEM)	
1-10 Channel Omni Expansion	• one SRRC primary cabinet • one Expansion GEN 4 Duplexed RF Cabinet
11-16 Channel Omni Expansion	• one SRRC primary cabinet • two Expansion GEN 4 Duplexed RF Cabinet
17-22 Channel Omni Expansion	• one SRRC primary cabinet • two Expansion GEN 4 Duplexed RF Cabinet • one 17-22 Channel Expansion RF Cabinet
900 MHz QUAD DUPLEXED RFDS	
1-6 Channel Expansion	• one Site Control Cabinet • one Main RF Cabinet

Introduction

Table 1 **Cabinet Complements For Various Systems (Continued)**

System/Site Type	Cabinet Configuration
800 MHz CAVITY COMBINING RFDS	
1-5 Channel Omni Expansion	• one Site Control Cabinet • one Main Cavity RF Cabinet
6-10 Channel Omni Expansion	• one Site Control Cabinet • one Main Cavity RF Cabinet • one Expansion Cavity RF Cabinet (without power monitor tray)
11-15 Channel Omni Expansion	• one Site Control Cabinet • one Main Cavity RF Cabinet • one Expansion Cavity RF Cabinet (with power monitor tray) • two Expansion Cavity RF Cabinet (without power monitor tray)
16-20 Channel Omni Expansion	• one Site Control Cabinet • one Main Cavity RF Cabinet • one Expansion Cavity RF Cabinet (with power monitor tray) • one Expansion Cavity RF Cabinet (without power monitor tray)
Sectored	• one Site Control Cabinet • three Main RF Cabinets
800 MHz DUPLEXED RFDS (0182020V06 and prior)	
NOTE: 800 MHz Duplexed RFDS (0182020V06 and prior) is no longer available. It has been replaced by the 800 MHz GEN 4 Duplexed RFDS. All information herein regarding 800 MHz Duplexed RFDS (0182020V06 and prior) is for reference only.	
1-4 Channel Duplex Hybrid Expansion	• one Site Control Cabinet • one Main Duplexed RF Cabinet
5-8 Channel Duplex Hybrid Expansion	• one Site Control Cabinet • one Main Duplexed RF Cabinet • one Expansion Duplexed RF Cabinet
9-12 Channel Duplex Hybrid Expansion	• one Site Control Cabinet • one Main Duplexed RF Cabinet • two Expansion Duplexed RF Cabinets
Sectored	• one Site Control Cabinet • three Main Duplexed RF Cabinets

EBTS Cabinet Installation

This sub-section provides procedures for permanently mounting the EBTS equipment cabinets within a site.

Refer to the manufacturer's installation manual for installation information for the power supply rack and battery rack.

Cabinet Bracing Considerations

EBTS cabinets are self-supporting structures. The cabinets require additional bracing during shipment of prefabricated sites.

In areas subject to seismic activity, additional bracing of the cabinet may be required to prevent it from tipping. However, the bracing hardware must be locally procured. There are no specific procedures within this manual for bracing cabinets in active seismic areas.

WARNING

EQUIPMENT CABINETS ARE HEAVY AND MAY TIP. USE EXTREME CAUTION WHEN MOVING. LIFT FROM TOP EYE BOLTS WITH APPROPRIATE APPARATUS OR SECURE CABINET FROM TIPPING IF LIFTING FROM BOTTOM. FAILURE TO DO SO COULD RESULT IN DEATH OR SERIOUS INJURY OR EQUIPMENT DAMAGE.

Cabling Considerations

On installations consisting of multiple cabinets, intercabinet cables used in the EBTS installation are manufactured in predetermined lengths. The length of the cables restricts the height of the site cable tray to no more than 6" above the cabinets. This also restricts the spacing between cabinets to no more than 5".

The intercabinet cabling requires a cabinet layout configuration similar to Figure 1. If the site cannot accommodate one of these layouts, the intercabinet cables shipped with the EBTS may not be long enough. Refer to Appendix B - Parts and Suppliers for information on manufacturing custom cables.

EBTS Cabinet Installation

Access Considerations

Allow at least 2' of floor space in front and behind the cabinets to permit access during installation. Although most maintenance is performed from the front of the equipment cabinets, access to the rear is required for expansion, cabling, and antenna connections.

Cabinet Position Considerations

Sector Identification

The location of each base radio within the RF Cabinets is identified in the software. The identification includes the RF cabinet the BR is located in, and the BR's position within the RF Cabinet. This is an important consideration for installation and cabling.

Typically, the BRs in RF Cabinet 1 are programmed with information relating to a sector 1. Each sector is dedicated to a specific RF Cabinet. Antennas from each sector must be connected to the appropriate RF Cabinet.

The RF Cabinet number is identified on the RF Cabinet shipping label. Make sure that all cabinets are positioned properly before performing the following procedures so that the cabinet and sector numbers match. Figure 1 shows a typical cabinet layout.

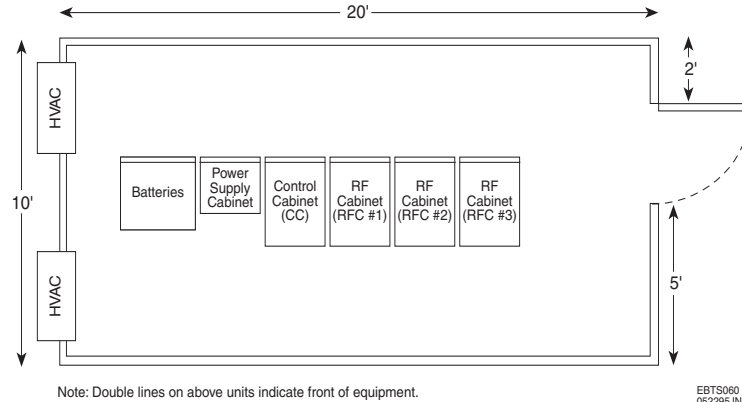


Figure 1 **Typical EBTS Cabinet Layout**

Cabinets

The following procedures describe how to mount cabinets in an EBTS site building. Read all of the procedures carefully to ensure a quality installation.

EBTS cabinets must be secured to the floor for optimum stability. This includes the Power Supply rack. Since the cabinets are quite heavy, this procedure is written so that each cabinet is moved only once.

Motorola recommends installing the first cabinet at the far end of the row, and then installing adjacent cabinets until the row is completed. If the Power Supply rack and batteries have been previously installed, mount the Site Control Cabinet first, followed by the RF Cabinet(s) in the same manner.

Perform the following steps to properly install the EBTS cabinets within the site building:

1. Measure the mounting location for the first cabinet in the row.

Refer to the cabinet footprint(s) located in the *Pre-Installation* section of this manual.

2. Carefully mark the mounting holes with a pencil, as indicated on the appropriate cabinet footprint.
3. Drill the marked mounting holes to the appropriate depth of the mounting hardware with a hammer drill and bit.

Refer to Parts and Suppliers for recommended mounting hardware.

4. Insert an anchor into the drilled hole.

If necessary, tap the anchor into place using a hammer.

5. Remove the four screws securing the bottom kick panel to the front and back of the cabinet.

Remove the kick panel and set aside during installation.

WARNING

EQUIPMENT CABINETS ARE HEAVY AND MAY TIP. USE EXTREME CAUTION WHEN MOVING. LIFT FROM TOP EYE BOLTS WITH APPROPRIATE APPARATUS OR SECURE CABINET FROM TIPPING IF LIFTING FROM BOTTOM. FAILURE TO DO SO COULD RESULT IN DEATH OR SERIOUS INJURY OR EQUIPMENT DAMAGE.

6. Carefully move the cabinet into the position indicated by the holes in the floor.

Adjust and level the cabinet as necessary to position the cabinet mounting holes with the pre-drilled holes.

7. Secure the cabinet to the site floor with the locally procured mounting hardware.
8. If required, connect adjacent cabinets to each other using the ganging hardware (kit no. THN6718A).

Power Supply Rack Installation

Power Supply Rack Installation

SCRF and SRRC systems require installation of a power supply rack, which is separate from the EBTS.

For detailed instructions on installing the iDEN Power Supply rack, please refer to the manual supplied with the Power Supply rack.

Cabinet And Site Connections

Cabinet and site connections consist of the cabling to be installed between cabinets (intercabinet cabling) and cabling to be installed between the EBTS and the site (cabinet-to-site cabling).

EBTS Junction Panels

Most of the intercabinet and site-to-cabinet cabling is connected via the Junction Panel located at the top rear of each equipment cabinet. Figures 2 and 4 show the different types of junction panels.

The Junction Panel is accessed from the rear of the cabinet. All intercabinet cabling runs up and out the top of each cable tray assembly. The OUT connection for each cable has been connected by the factory. Installation of intercabinet cabling is completed by connecting the free end of the cable to the appropriate IN connector on adjacent cabinets.

Cabling connections utilizing connecting points other than the Junction Panel are described as applicable in the various procedures that follow.

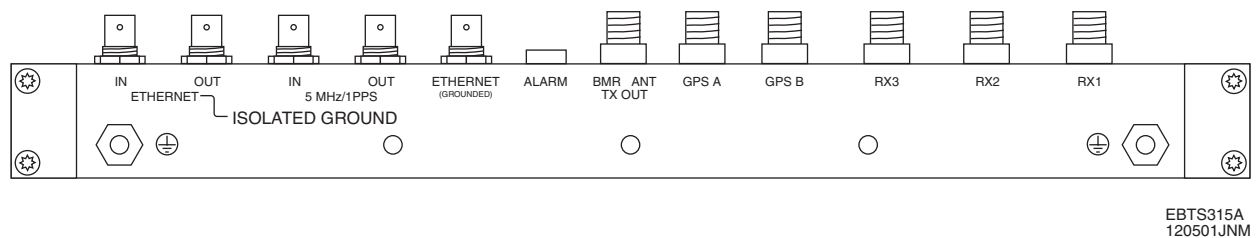
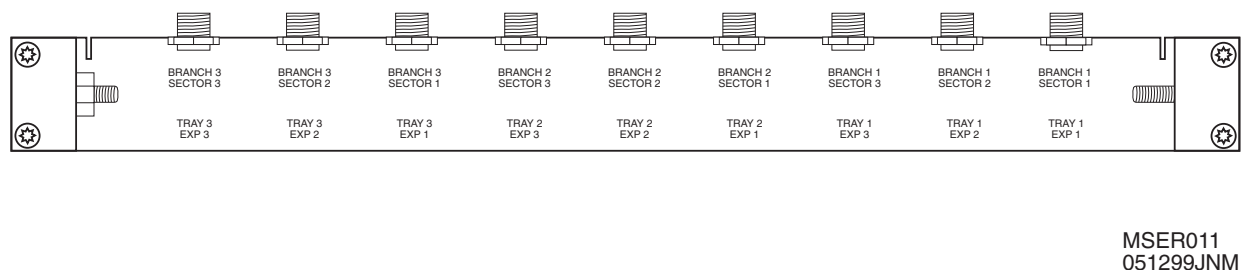


Figure 2 Typical Junction Panel (Rear View)



NOTE: THE EXPANSION JUNCTION PANEL IS NOT USED IN GEN 4 SYSTEMS.

Figure 3 Typical Junction Panel for Expansion RF Systems (Rear View)

Cabinet And Site Connections



NOTE: Three additional ground studs are used for SRRC, SRSC, and 23" Racks.

EBTS315
032801JNM

Figure 4 **Typical Junction Panel for Control Cabinets**

Cabling Part Numbers And Quantities

The required cabling part numbers and quantities are specified in the procedures that follow, or in the section of this manual that individually covers the particular type of system being installed, as applicable.

Procedure	Page	Description
5 MHz / 1 PPS Intercabinet Cabling	12	Connection of the system 5 MHz / 1 PPS timing reference signal provided by the Gen 3 SC for the Base Radios
Ethernet Intercabinet Cabling	20	Connection of EBTS Ethernet between cabinets
Alarm Intercabinet Cabling	25	Connection of cabinet alarm connections between cabinets
Primary Control Channel Redundancy Intercabinet Cabling	33	Connection of the Primary Control Channel redundancy control cable from the Gen 3 SC to the RF Cabinet
Power Supply Rack-to-EBTS Power (-48 VDC) Connections	34	Connection of -48 VDC power wiring from Power Supply rack to equipment cabinets

Intercabinet Cabling

Intercabinet cabling describes the cabling to be installed between equipment cabinets and the power supply rack in SCRF and SRRC systems. Perform each of the individual intercabinet cabling procedures listed in the table below (as applicable) for the particular system being installed.

When all applicable intercabinet cabling procedures have been performed, proceed to Cabinet-to-Site Cabling Procedures.

NOTE

Since the SRSC system uses only one cabinet, intercabinet cabling is not required for an SRSC system. Omit Intercabinet Cabling Procedures and proceed directly to Cabinet-to-Site Cabling Procedures.

Cabinet-to-Site Cabling

Cabinet-to-site cabling describes the cabling to be installed between the EBTS equipment cabinet(s) 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
Battery Backup Connections (SRSC Systems Only)	39	Connection of SRSC cabinet to battery backup rack
Equipment Cabinet Ground Connections	42	Connection of equipment cabinet grounds
Base Radio Antenna Connections	50	Connection of site Base Radio antennas to EBTS
GPS Antenna Connections	61	Connection of site GPS antenna(s) to EBTS (reference to procedure)
Alarm Intercabinet Cabling	25	Connection of site and Power Supply rack alarm connections to the EBTS (reference to procedure)
T1 / E1 Cabling	61	Connection of site T1 / E1 line to the EBTS (reference to procedure)

Intercabinet Cabling Procedures

NOTE

Since the SRSC system uses only one cabinet, intercabinet cabling is not required for an SRSC system. Omit Intercabinet Cabling Procedures and proceed directly to Cabinet-to-Site Cabling Procedures.

Perform the following intercabinet cabling procedures (as applicable) for the system being installed.

5 MHz/1 PPS Intercabinet Cabling

NOTE

A powered-down BR connected to the 5 MHz/1 PPS system can degrade the 5 MHz/1 PPS signal for the other BRs, possibly causing malfunctions.

Before powering-down a BR, always first disconnect the BR from the 5 MHz/1 PPS system. Make certain powered-down BRs are not connected to the 5 MHz/1 PPS system. (5 MHz/1 PPS "T" connections at a powered-down BR can be left open; termination at these points is not required.)

5 MHz/1 PPS intercabling is the 5 MHz/1 PPS cabling from the cabinet containing the site controller to the RF Cabinet(s). Figures 6 through 13 show the required intercabling for various EBTS site configurations. Table 2 correlates the specific types of systems and sites to Figures 6 through 13.

Intercabinet Connections

The 5 MHz/1 PPS signal originates in the site controller. All 5 MHz/1 PPS connections between the Site Controller and the RF Cabinet(s) are made on the junction panel of the Site Control and RF Cabinets.

The site controller has three identical buffered outputs available at connectors **SITE REF OUT 1**, **SITE REF OUT 2** and **SITE REF OUT 3**.

The **SITE REF OUT** connectors should be utilized in a manner that distributes the BR load evenly between the three outputs.

To properly distribute the BR load and ensure site reliability in the event of a failure, follow the general guidelines specified below:

- ☐ Distribute the load as evenly as possible between the three **SITE REF OUT** output connectors.
- ☐ As with all 5 MHz/1 PPS cabling, the far-end of each daisy-chain must be terminated with the specified 50Ω load.
- ☐ In sectorized sites with multiple RF Cabinets serving a single sector, do not drive all cabinets within a single sector from the same output.

The following examples illustrate possible RF Cabinet 5 MHz/1 PPS intercabling that balances the BR load and provides site reference output redundancy within a sector.

Example 1 - Assume a 24-BR, three-sector site consisting of the following arrangement:

- ☐ 12 BRs in Sector 1
- ☐ 8 BRs in Sector 2
- ☐ 4 BRs in Sector 3

The table below shows a proper distribution of the site reference outputs to the RF Cabinets (RFCs).

Site Ref Output	Sector 1 (12 BRs)	Sector 2 (8 BRs)	Sector 3 (4 BRs)
1	RFC 1 (4 BRs)	RFC 4 (4 BRs)	
2	RFC 2 (4 BRs)		RFC 6 (4 BRs)
3	RFC 3 (4 BRs)	RFC 5 (4 BRs)	

Note that in the above example, each output drives 8 BRs, while utilizing all three outputs within sector 1.

Example 2 - Assume a 16-BR, two-sector site with the following arrangement:

- ☐ 8 BRs in Sector 1
- ☐ 8 BRs in Sector 2

The table below shows a proper distribution of the site reference outputs to the RFCs.

Site Ref Output	Sector 1 (8 BRs)	Sector 2 (8 BRs)
1	RFC 1 (4 BRs)	RFC 3 (4 BRs)
2	RFC 2 (4 BRs)	RFC 4 (4 BRs)

Note that in the above example, each output drives eight BRs, while utilizing two different outputs within a given sector.

Intercabinet Cabling Procedures

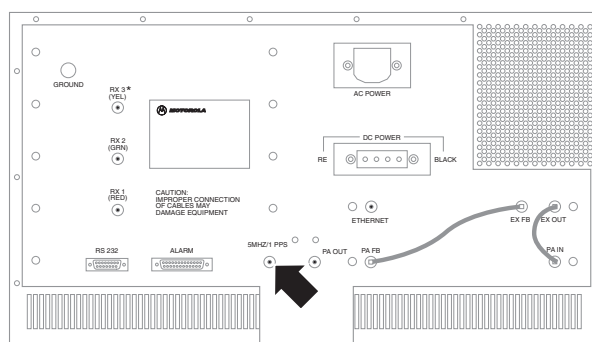
Example 3 - Assume a 20-BR omni site with four RFCs, each containing five BRs. The table below shows a proper distribution of the site reference outputs to the RFCs.

Output	Omni 20
1	RFC 1 (5 BRs) RFC 2 (5 BRs)
2	RFC 3 (5 BRs) RFC 4 (5 BRs)

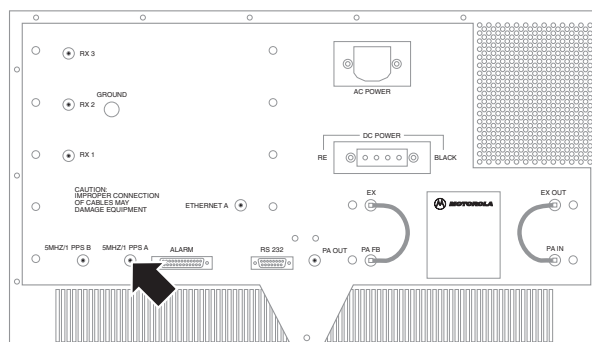
- ❑ Note that in the above example, each output drives 10 BRs.

▲ CAUTION

Improper connection of 5 MHz / Ethernet cables may damage equipment. See Figure 5 below for details of the 5 MHz and Ethernet connector locations.



QUAD BASE RADIO



SINGLE CHANNEL BASE RADIO

EBTS800
120501JNM

Figure 5 **Locations of Legacy Single Channel BR and QUAD BR w5 MHz connectors (rear view)**

5 MHz/1 PPS Cabling Procedure

Noting the general guidelines discussed above, perform 5 MHz/1 PPS cabling between cabinets as follows:

1. On the cabinet that contains the site controller, connect cable (PN 0112004Z29) to the **5 MHz/1 PPS OUT 1** connector on the junction panel. For sites with more than 15 channels, connect an additional cable (PN 0112004Z29) to the **5 MHz/1 PPS OUT 2** connector on the junction panel.
Connect free end of cable(s) to **5 MHz/1 PPS IN** connector on RF Cabinet(s).
2. Starting at the first RF Cabinet, daisy-chain connect cables (PN 0112004Z29) from the **5 MHz/1 PPS OUT** connectors to the **5 MHz/1 PPS IN** connectors on each cabinet junction panel in accordance with Table 2 and Figures 6 through 13, as applicable.
3. Connect a 50 Ω BNC Terminator (PN 0909906D01) to the **5 MHz/1 PPS OUT** connector on the last RF Cabinet of each daisy-chain in the configuration. (Systems using **both** the OUT 1 and OUT 2 site reference outputs will have **two** 50 Ω end terminations.)
4. Proceed to Ethernet Intercabinet Cabling.

Table 2 **5 MHz/1 PPS Intercabinet Cabling**

System/Site Type	Cabinet Configuration	Perform Cabling As Shown In:
800 MHz GEN 4 DUPLEXED (STAND-ALONE CONTROL AND RF CABINET) / 900 MHz RFDS		
1-6 Channel Omni	1 Main RF Cabinet	Figure 6
7-12 Channel Omni Expansion	1 Main RF Cabinet 1 Expansion RF Cabinet	Figure 7
13-20 Channel Omni Expansion*	1 Main RF Cabinet 2 Expansion RF Cabinets	Figure 7 or Figure 9
19-24 Channel Omni Expansion*	1 Main RF Cabinet 3 Expansion RF Cabinets	Figure 9
800 MHz GEN 4 RFDS SRRC EXPANSION SYSTEMS		
4-10 Channel Omni Expansion	1 SRRC Primary Cabinet 1 Expansion RF Cabinet	Figure 11
11-16 Channel Omni Expansion*	1 SRRC Primary Cabinet 2 Expansion RF Cabinet	Figure 12 or Figure 13
17-22 Channel Omni Expansion*	1 SRRC Primary Cabinet 3 Expansion RF Cabinet	Figure 13
CAVITY COMBINING RFDS		
1-5 Channel Omni	1 Main RF Cabinet	Figure 6

Intercabinet Cabling Procedures**Table 2 5 MHz/1 PPS Intercabinet Cabling (Continued)**

System/Site Type	Cabinet Configuration	Perform Cabling As Shown In:
6-10 Channel Omni Expansion	1 Main RF Cabinet 1 Expansion RF Cabinet	Figure 7
11-15 Channel Omni Expansion	1 Main RF Cabinet 2 Expansion RF Cabinets	Figure 8
16-20 Channel Omni Expansion*	1 Main RF Cabinet 3 Expansion RF Cabinets	Figure 9
Sectored	3 Main RF Cabinets	Figure 10
* Systems using more than 15 channels require High-Capacity Cabinet utilizing dual SRI outputs OUT1 and OUT2.		
800 MHz DUPLEXED RFDS (0182020V06 and prior)		
NOTE: 800 MHz Duplexed RFDS (0182020V06 and prior) is no longer available. It has been replaced by the 800 MHz GEN 4 Duplexed RFDS.		
All information herein regarding 800 MHz Duplexed RFDS (0182020V06 and prior) is for reference only.		
1-5 Channel Duplex Hybrid Expansion	1 Site Control Cabinet 1 Main Duplexed RF Cabinet	Figure 6
5-8 Channel Duplex Hybrid Expansion	1 Site Control Cabinet 1 Main Duplexed RF Cabinet 1 Expansion Duplexed RF Cabinet	Figure 7
9-12 Channel Duplex Hybrid Expansion	1 Site Control Cabinet 1 Main Duplexed RF Cabinet 2 Expansion Duplexed RF Cabinets	Figure 8
Sectored	1 Site Control Cabinet 3 Main Duplexed RF Cabinets	Figure 10
* Systems using more than 15 channels require High-Capacity Cabinet utilizing dual SRI outputs OUT1 and OUT2.		

Intercabinet Cabling Procedures

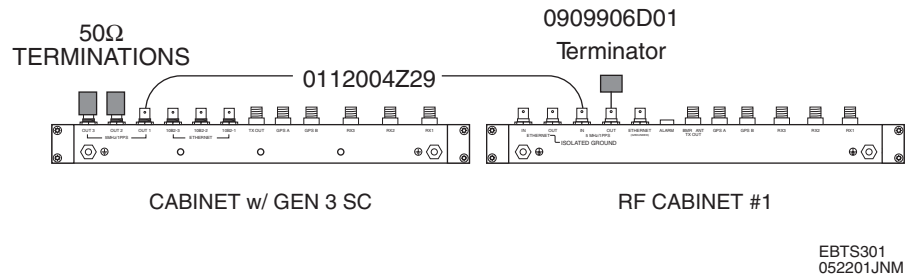


Figure 6 **5 MHz/1 PPS Connections for Single RF Cabinet Omni Sites**

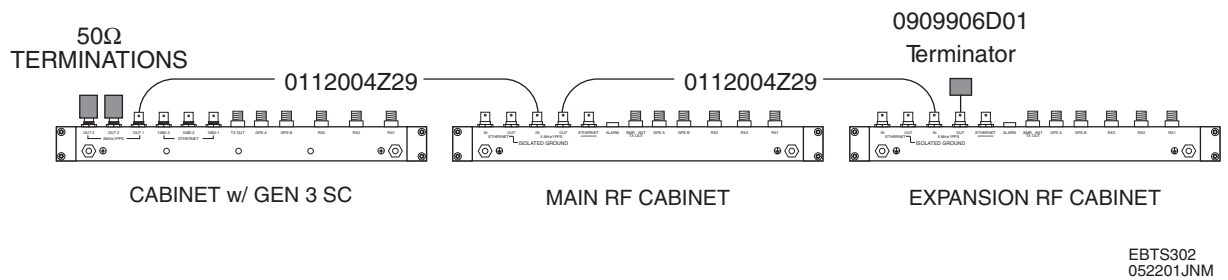


Figure 7 **5 MHz/ 1PPS Connections for 2 RF Cabinet Omni Expansion Sites**

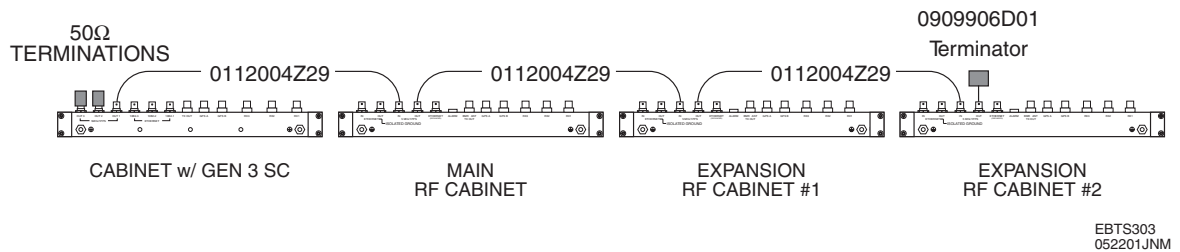


Figure 8 **5 MHz/1 PPS Connections for 3 RF Cabinet Omni Expansion Sites (15 or fewer Channels)**

Intercabinet Cabling Procedures

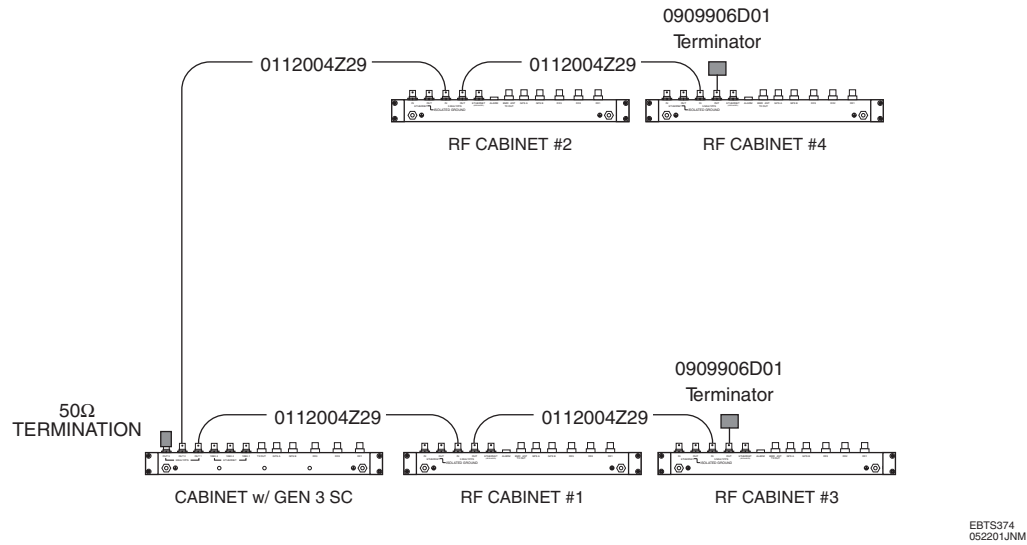


Figure 9 **5 MHz/1PPS Connections for Omni Sites Using More Than 15 Channels**

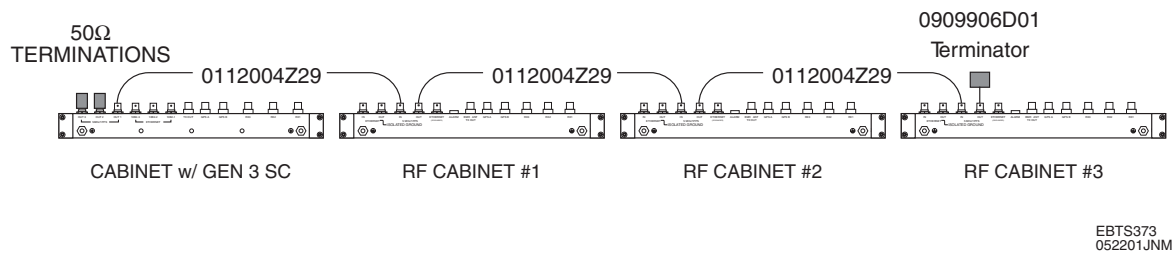


Figure 10 **5 MHz/1 PPS Connections for Sected Sites**

Intercabinet Cabling Procedures

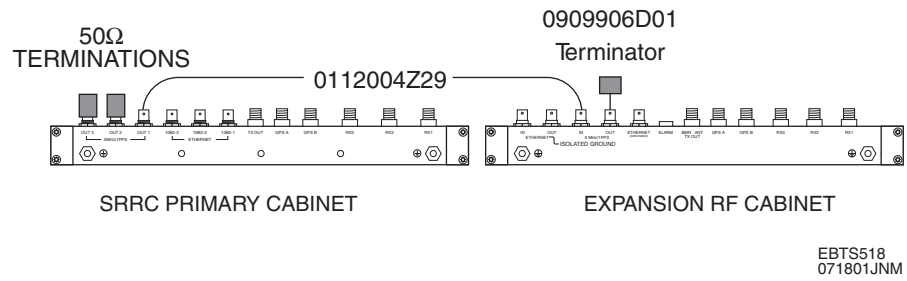


Figure 11 5 MHz/1 PPS Connections for SRRC Omni Site with One Expansion RF Cabinet

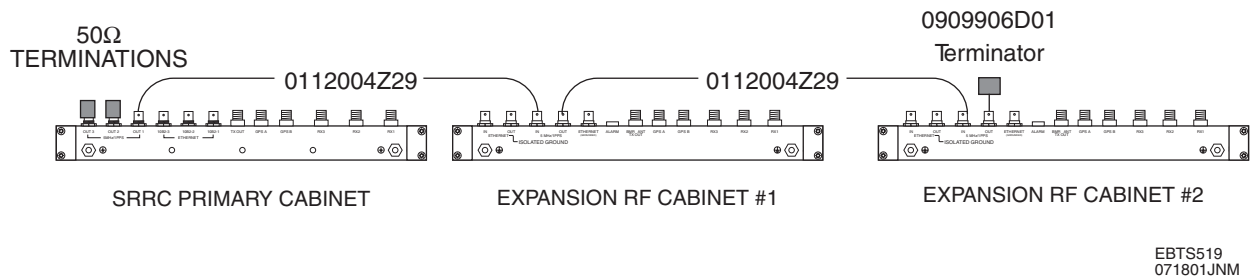


Figure 12 5 MHz/1 PPS Connections for SRRC Omni Site with One Expansion RF Cabinet

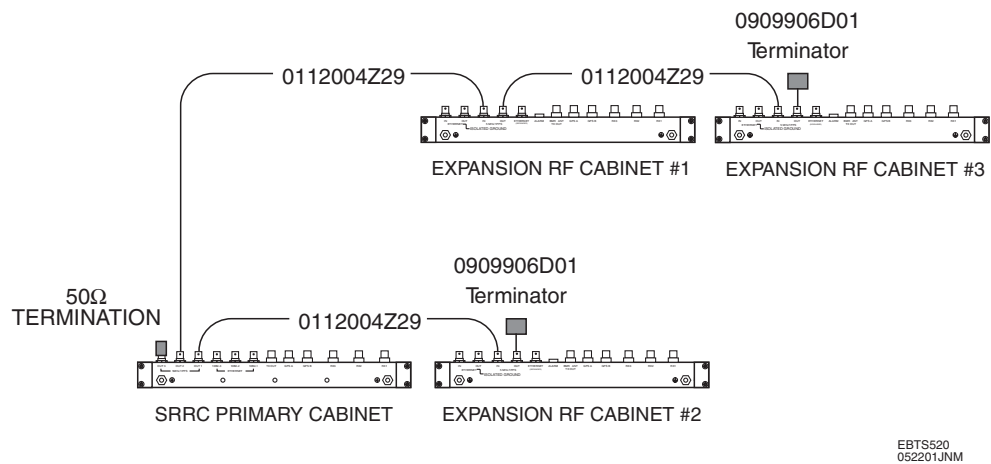


Figure 13 5 MHz/ 1PPS Connections for SRRC Omni Site with Multiple Expansion RF Cabinets (more than 15 channels)

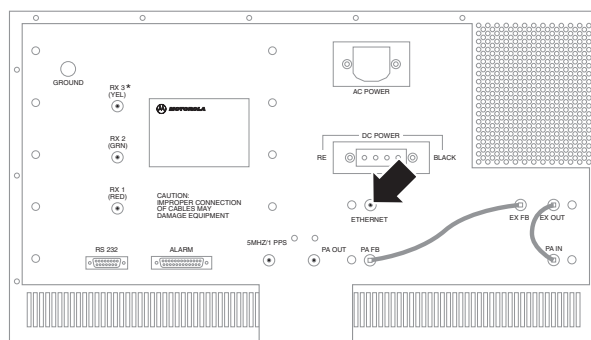
Intercabinet Cabling Procedures

Ethernet Intercabinet Cabling

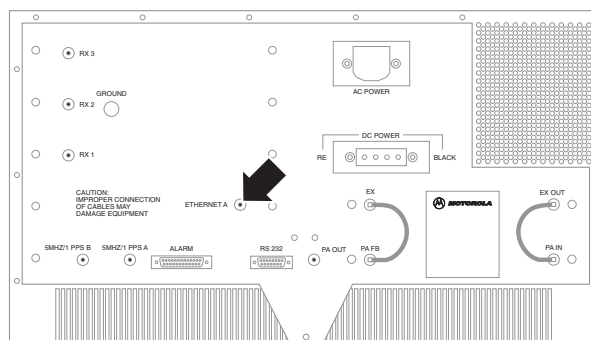
Ethernet intercabinet cabling is the Ethernet cabling from the cabinet containing the Gen 3 SC to the RF Cabinet(s). Figures 15 through 18 show the required intercabinet cabling for various **Stand-alone Control And RF Cabinet** EBTS site configurations. Figures 19 through 21 show the required intercabinet cabling for various **SRRC** EBTS site configurations utilizing Expansion RF Cabinets. (For an SRRC system utilizing only the primary cabinet, Ethernet intercabinet cabling is not required.) Table 3 correlates the specific types of systems and sites to Figures 15 through 21.

▲ CAUTION

Improper connection of 5 MHz / Ethernet cables may damage equipment. See Figure 14 below for details of the locations of the Base Radio 5 MHz and Ethernet locations.



QUAD BASE RADIO



SINGLE CHANNEL BASE RADIO

EBTS801
120401JNM

Figure 14 **Location of Legacy Single Channel BR and QUAD BR Ethernet connectors (rear view)**

Ethernet Cabling Procedure

Perform Ethernet cabling between cabinets as follows:

1. On the cabinet containing the Gen 3 SC, locate the free end of the cable (PN 0112004Z29) connected to the **ETHERNET 10B2-1** connector on the junction panel.
Connect free end of cable to **ETHERNET IN** connector on RF Cabinet(s).
2. Starting at the first RF Cabinet, daisy-chain connect cables (PN 0112004Z29) from the **ETHERNET OUT** connectors to the **ETHERNET IN** connectors on each cabinet Junction Panel in accordance with Table 3 and Figures 15 through 21, as applicable.
3. Connect a 50Ω BNC Termination (PN 0909906D01) to the **ETHERNET OUT** connector on the last RF Cabinet in the configuration.
4. Proceed to Alarm Intercabinet Cabling.

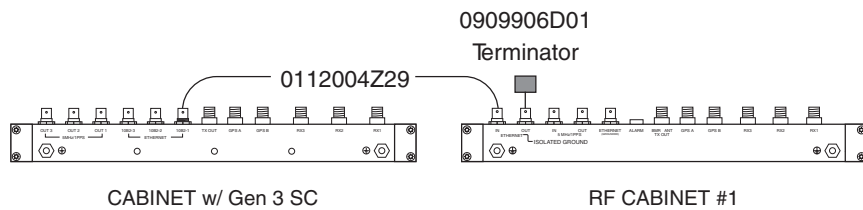
Table 3 **Ethernet Intercabinet Cabling**

System/Site Type	Cabinet Configuration	Perform Cabling As Shown In:
800 MHz GEN 4 DUPLEXED / 900 MHz RFDS		
1-6 Channel Omni	1 Main RF Cabinet	Figure 15
7-12 Channel Omni Expansion	1 Main RF Cabinet 1 Expansion RF Cabinet	Figure 16
13-20 Channel Omni Expansion	1 Main RF Cabinet 2 Expansion RF Cabinets	Figure 17
19-24 Channel Omni Expansion	1 Main RF Cabinet 3 Expansion RF Cabinets	Figure 17
800 MHz GEN 4 RFDS SRRC EXPANSION SYSTEMS		
4-10 Channel Omni Expansion	1 SRRC Primary Cabinet 1 Expansion RF Cabinet	Figure 19
11-16 Channel Omni Expansion	1 SRRC Primary Cabinet 2 Expansion RF Cabinet	Figure 20
17-22 Channel Omni Expansion	1 SRRC Primary Cabinet 3 Expansion RF Cabinet	Figure 21

Intercabinet Cabling Procedures

Table 3 *Ethernet Intercabinet Cabling (Continued)*

System/Site Type	Cabinet Configuration	Perform Cabling As Shown In:
CAVITY COMBINING RFDS		
1-5 Channel Omni	1 Main RF Cabinet	Figure 15
6-10 Channel Omni Expansion	1 Main RF Cabinet 1 Expansion RF Cabinet	Figure 16
11-15 Channel Omni Expansion	1 Main RF Cabinet 2 Expansion RF Cabinets	Figure 17
16-20 Channel Omni Expansion	1 Main RF Cabinet 3 Expansion RF Cabinets	Figure 17
Sectored	3 Main RF Cabinets	Figure 18
800 MHz DUPLEXED RFDS (0182020V06 and prior)		
NOTE: 800 MHz Duplexed RFDS (0182020V06 and prior) is no longer available. It has been replaced by the 800 MHz GEN 4 Duplexed RFDS. All information herein regarding 800 MHz Duplexed RFDS (0182020V06 and prior) is for reference only.		
1-5 Channel Omni	1 Main RF Cabinet	Figure 15
5-8 Channel Duplex Hybrid Expansion	1 Main RF Cabinet 1 Expansion RF Cabinet	Figure 16
9-12 Channel Duplex Hybrid Expansion	1 Main RF Cabinet 2 Expansion RF Cabinets	Figure 17
Sectored	3 Main RF Cabinets	Figure 18



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Figure 15 *Ethernet Connections for Single RF Cabinet Omni Site*

Intercabinet Cabling Procedures

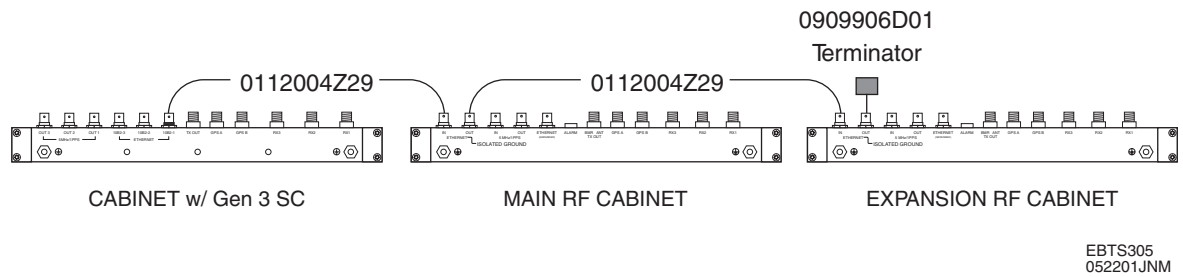


Figure 16 **Ethernet Connections for 2 RF Cabinet Omni Expansion Sites**

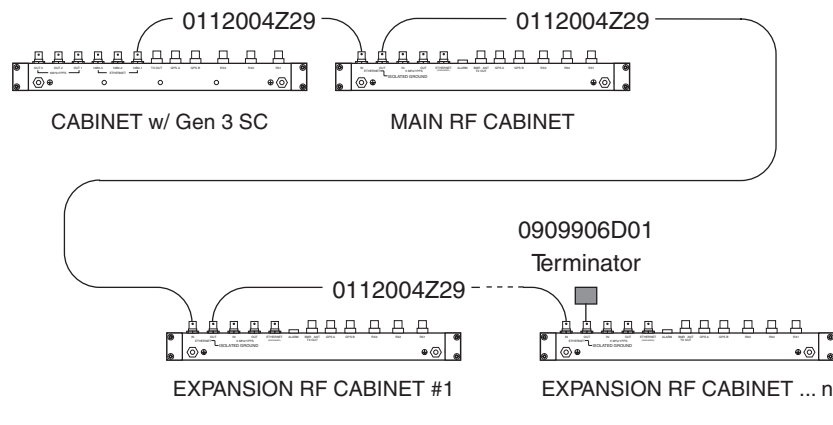


Figure 17 **Ethernet Connections for Sites Using 3 or More RF Cabinets**

Intercabinet Cabling Procedures

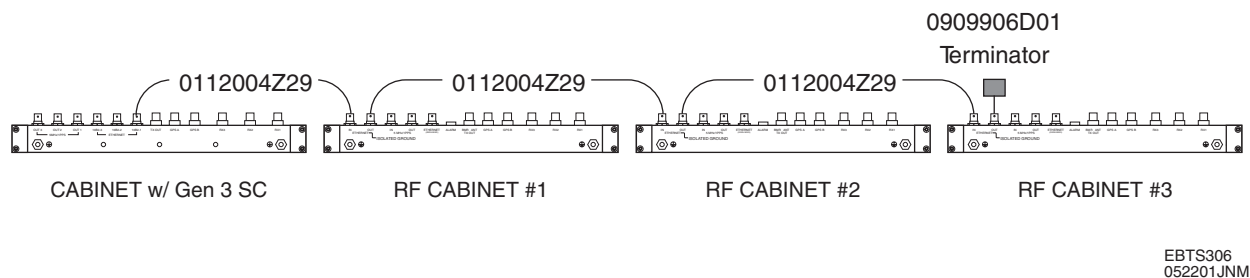


Figure 18 Ethernet Connections for Sectored Sites

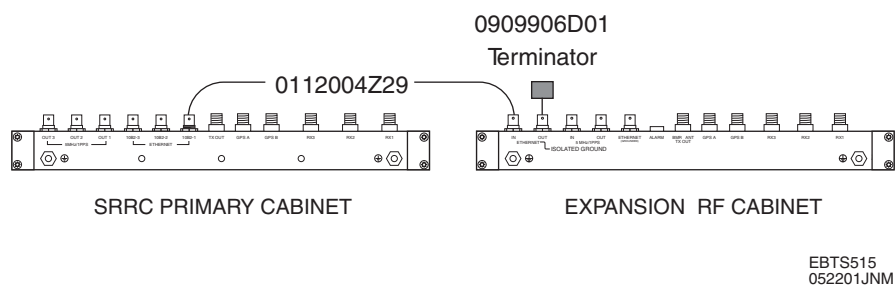


Figure 19 Ethernet Connections for SRRC Omni Site with One Expansion RF Cabinet

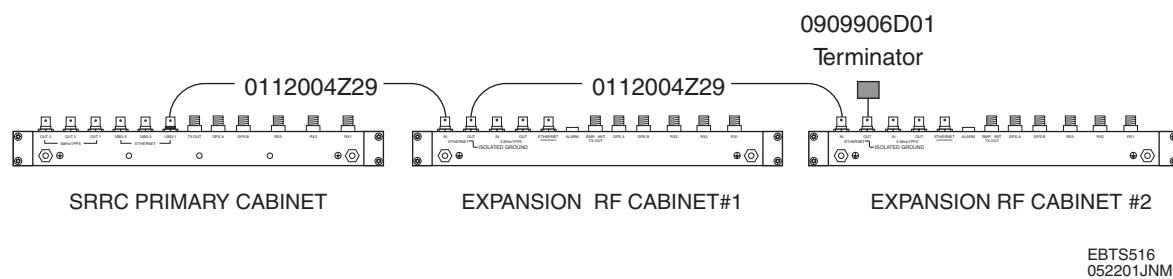


Figure 20 Ethernet Connections for SRRC Omni Site with Two Expansion RF Cabinets

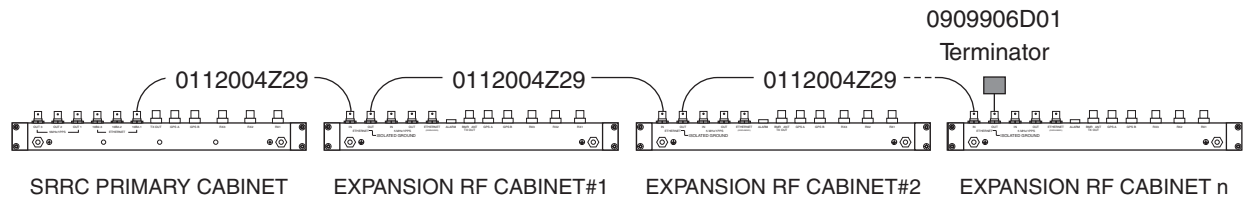
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Figure 21 **Ethernet Connections for SRRC Site with Three or More Expansion RF Cabinets**

Alarm Intercabinet Cabling

NOTE

The following information describes alarm cabling **between** cabinets. For alarm cabling **within** an equipment cabinet, refer to the applicable RFDS or system section in this manual.

Cabinet alarm connections are made between the Environment Alarm System (EAS) and the RF Cabinets. The location of the alarm connection for the RF Cabinet depends on the type of RFDS being used.

- ❑ **800 MHz GEN 4 Duplexed RFDS and 900 MHz QUAD Duplexed RFDS** — The alarm connection on the Main RF Cabinet and expansion cabinet(s) is located on the Rx Tray on each cabinet.
- ❑ **800 MHz GEN 4 SRRC System** — Alarm inter-cabinet cabling is not required for an SRRC utilizing only the SRRC primary cabinet. For expansion cabinets, the alarm connection on the expansion cabinet(s) is located on the Rx Tray on each cabinet.
- ❑ **Cavity Combining RFDS** — The alarm connection is located on the RFDS Power Supply / Alarm Tray and is labeled **ALARM**.
- ❑ **800 MHz Duplexed and Duplex Hybrid Expansion RFDS (0182020V06 and prior)** — The alarm connection on the Main RF Cabinet is on the Junction Panel and is labeled **ALARM**. The alarm connection on each Expansion RF Cabinet is located on the RFDS Power Supply / Alarm Tray.

Intercabinet Cabling Procedures**Alarm Intercabinet Cabling Procedure (General)**

Perform alarm cabling from the EAS to RF cabinets (RFCs) as follows:

1. Make certain an adequate quantity of RJ45-to-RJ45 cables (P/N 3084225N42) is available. Each RF cabinet requires one cable.
2. Refer to Table 4. Noting the type of system being cabled, proceed as directed in Table 4.
3. When all alarm cabling for system has been installed, proceed to Power Supply Rack-to-EBTS Power (-48 VDC) Connections.

Alarm Intercabinet Cabling Procedure (For Systems Using More Than 3 RF Cabinets)

Alarm wiring for the Main RF Cabinet and Expansion RF Cabinets #1 and #2 terminate directly to the EAS rear panel as described above.

Alarm interface for Expansion RF Cabinet #3 is facilitated by Modular Adapter (PN 2882174W03), which breaks-out various signal pairs from EAS punch block 2 (**USER ALARM/CONTROL**) into six modular connectors.

Connect the alarm cable from Expansion RF Cabinet #3 to the modular connector designated as "EXPANSION RF CABINET #3", as shown in Figure 28.

Intercabinet Cabling Procedures

Table 4 **Alarm Intercabinet Cabling**

System/Site Type	Intercabinet Cabling Connections	Perform Cabling As Shown In:
800 MHz GEN 4 DUPLEXED RFDS (STAND-ALONE CONTROL AND RF CABINET SYSTEM)		
1-6 Channel Omni	EAS RF#1 to Main RFC alarm connector on Rx Tray	Figure 24
7-12 Channel Omni Expansion	- EAS RF#1 to Main RFC alarm connector on Rx Tray - EAS RF#2 to Expansion RFC alarm connector on Rx Tray	Figure 24
13-18 Channel Omni Expansion	- EAS RF#1 to Main RFC alarm connector on Rx Tray - EAS RF#2 to Expansion RFC #1 alarm connector on Rx Tray - EAS RF#3 to Expansion RFC #2 alarm connector on Rx Tray	Figure 24
19-24 Channel Omni Expansion	- EAS RF#1 to Main RFC alarm connector on Rx Tray - EAS RF#2 to Expansion RFC #1 alarm connector on Rx Tray - EAS RF#3 to Expansion RFC #2 alarm connector on Rx Tray - EAS High-Capacity connections to Expansion RFC #3 alarm connector on Rx Tray	Figure 24 Figure 28
800 MHz GEN 4 DUPLEXED RFDS (SRRS SYSTEM)		
4-10 Channel Omni Expansion	EAS RF#2 to Expansion RFC alarm connector on Rx Tray	Figure 27
11-15 Channel Omni Expansion	- EAS RF#2 to Expansion RFC #1 alarm connector on Rx Tray - EAS RF#3 to Expansion RFC #2 alarm connector on Rx Tray	Figure 27
17-22 Channel Omni Expansion	- EAS RF#2 to Expansion RFC #1 alarm connector on Rx Tray - EAS RF#3 to Expansion RFC #2 alarm connector on Rx Tray - EAS High-Capacity connections to Expansion RFC #3 alarm connector on Rx Tray	Figure 27 Figure 28
900 MHz QUAD DUPLEXED RFDS		
1-6 Channel Omni	EAS RF#1 to Main RFC alarm connector on Rx Tray	Figure 24
800 MHz CAVITY COMBINING RFDS		
1-5 Channel Omni	EAS RF#1 to Main RFC ALARM connector on Power Supply Tray	Figure 25
6-10 Channel Omni Expansion	- EAS RF#1 to Main RFC ALARM connector on Power Supply Tray - EAS RF#2 to Expansion RFC ALARM connector on Power Supply Tray	Figure 25

Intercabinet Cabling Procedures**Table 4 Alarm Intercabinet Cabling (Continued)**

System/Site Type	Intercabinet Cabling Connections	Perform Cabling As Shown In:
11-15 Channel Omni Expansion	- EAS RF#1 to Main RFC ALARM connector on Power Supply Tray - EAS RF#2 to Expansion RFC #1 ALARM connector on Power Supply Tray - EAS RF#3 to Expansion RFC #2 ALARM connector on Power Supply Tray	Figure 25
16-20 Channel Omni Expansion	- EAS RF#1 to Main RFC ALARM connector on Power Supply Tray - EAS RF#2 to Expansion RFC #1 ALARM connector on Power Supply Tray - EAS RF#3 to Expansion RFC #2 ALARM connector on Power Supply Tray - High-Capacity EAS connection to Expansion RFC #3 ALARM connector on Power Supply Tray	Figure 25 Figure 28
Sectored	- EAS RF#1 to Main RFC #1 ALARM connector on Power Supply Tray - EAS RF#2 to Main RFC #2 ALARM connector on Power Supply Tray - EAS RF#3 to Main RFC #3 ALARM connector on Power Supply Tray	Figure 26
800 MHz DUPLEXED RFDS (0182020V06 and prior)		
NOTE: 800 MHz Duplexed RFDS (0182020V06 and prior) is no longer available. It has been replaced by the 800 MHz GEN 4 Duplexed RFDS. All information herein regarding 800 MHz Duplexed RFDS (0182020V06 and prior) is for reference only.		
1-5 Channel Omni	EAS RF#1 to Main RFC ALARM connector	Figure 22
5-8 Channel Duplex Hybrid Expansion	- EAS RF#1 to Main RFC ALARM connector - EAS RF#2 to Expansion RFC ALARM connector on Power Supply Tray	Figure 22
9-12 Channel Duplex Hybrid Expansion	- EAS RF#1 to Main RFC ALARM connector - EAS RF#2 to Expansion RFC #1 ALARM connector on Power Supply Tray - EAS RF#3 to Expansion RF Cabinet #2 ALARM connector on Power Supply Tray	Figure 22
Sectored	- EAS RF#1 to Main RFC #1 ALARM connector - EAS RF#2 to Main RFC #2 ALARM connector - EAS RF#3 to Main RFC #3 ALARM connector	Figure 23

Intercabinet Cabling Procedures

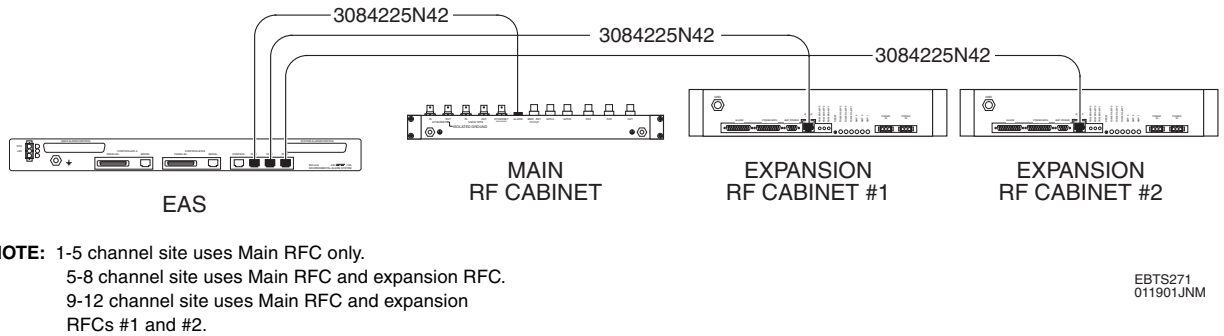


Figure 22 **Alarm Connections for 800 MHz Duplexed RFDS (0182020V06 or earlier) Omni Sites**

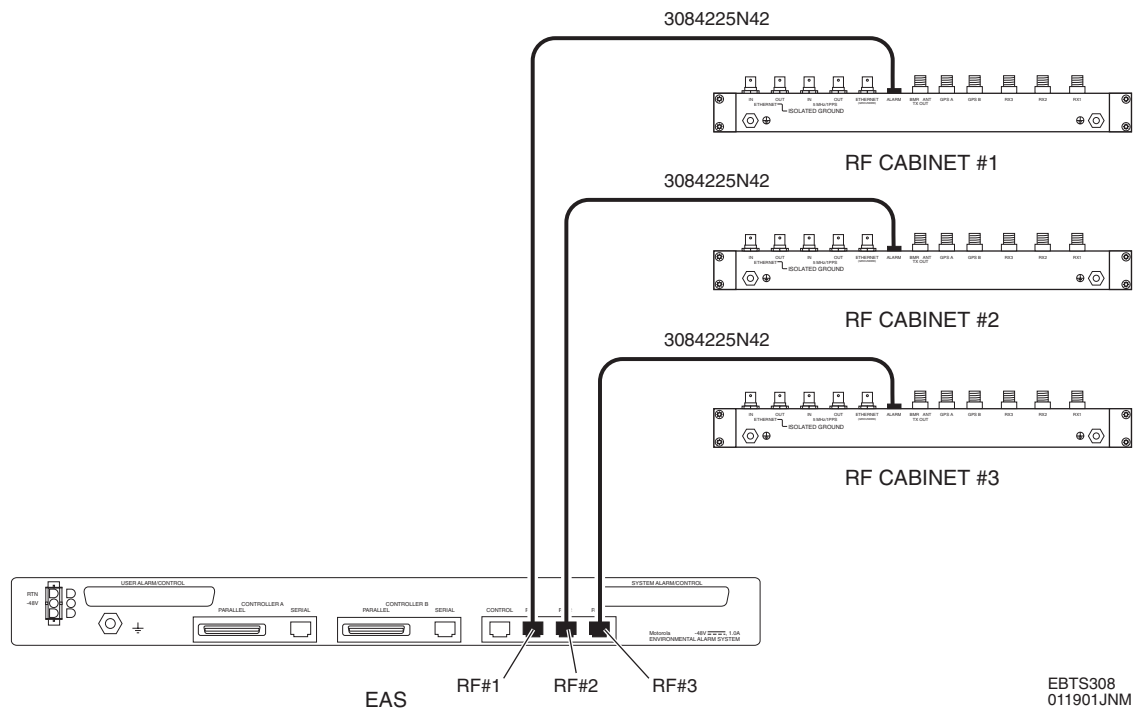
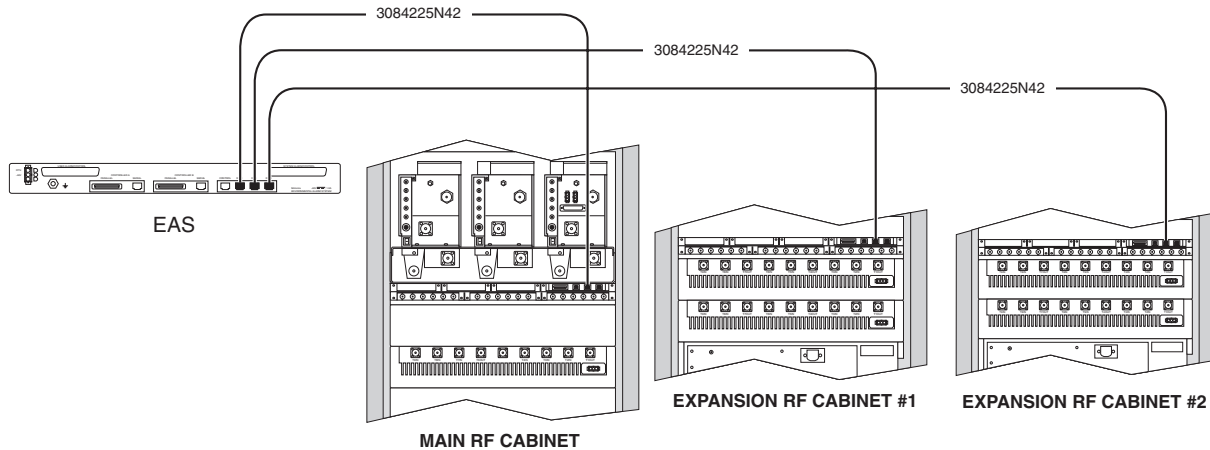


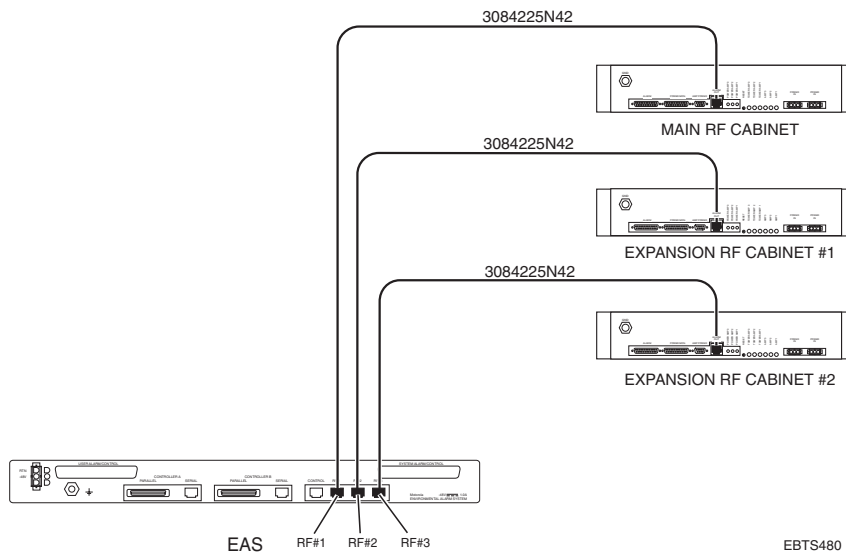
Figure 23 **Alarm Connections for 800 MHz Duplexed RFDS (0182020V06 and earlier) Sectorized Sites**

Intercabinet Cabling Procedures

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011901JNM

- NOTES:**
1. For systems using more than 2 Expansion RFCs, additional EAS connections are as shown in Figure 28, Alarm Connections (High Capacity Systems).
 2. Rx Tray using CTF6220A version I/O Board requires extra cable between cable 3084225N42 and I/O RJ-45 connector (as shown by dashed lines). (This applies to main and/or expansion RF cabinets.) Refer to 800 MHz GEN 4 Duplexed RFDS section of manual for more information.

Figure 24 **Alarm Connections for 800 MHz GEN 4 Duplexed RFDS / 900 MHz QUAD Duplexed RFDS Sites (Stand-alone Control And RF Cabinet configuration)**

EBTS480
011901JNM

- NOTE:**
- 1-5 channel site uses Main RFC only.
 - 6-10 channel site uses Main RFC and expansion RFC.
 - 11-15 channel site uses Main RFC and two expansion RFCs.
 - 16-20 channel site uses Main RFC and three expansion RFCs. For systems using more than 3 RFCs, additional EAS connections are as shown in Figure 28, Alarm Connections (High Capacity Systems).

Figure 25 **Alarm Connections for Cavity Combining RFDS Omni Sites**

Intercabinet Cabling Procedures

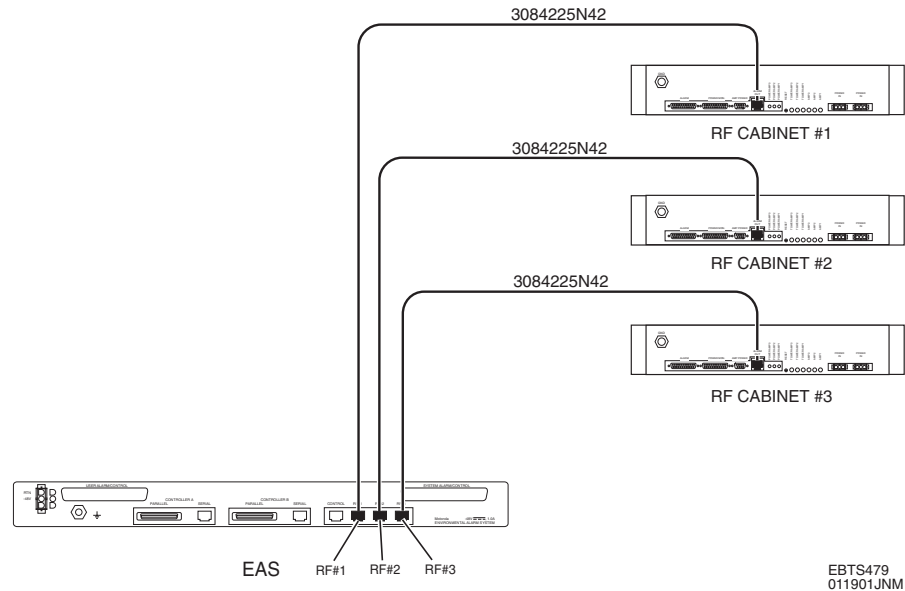
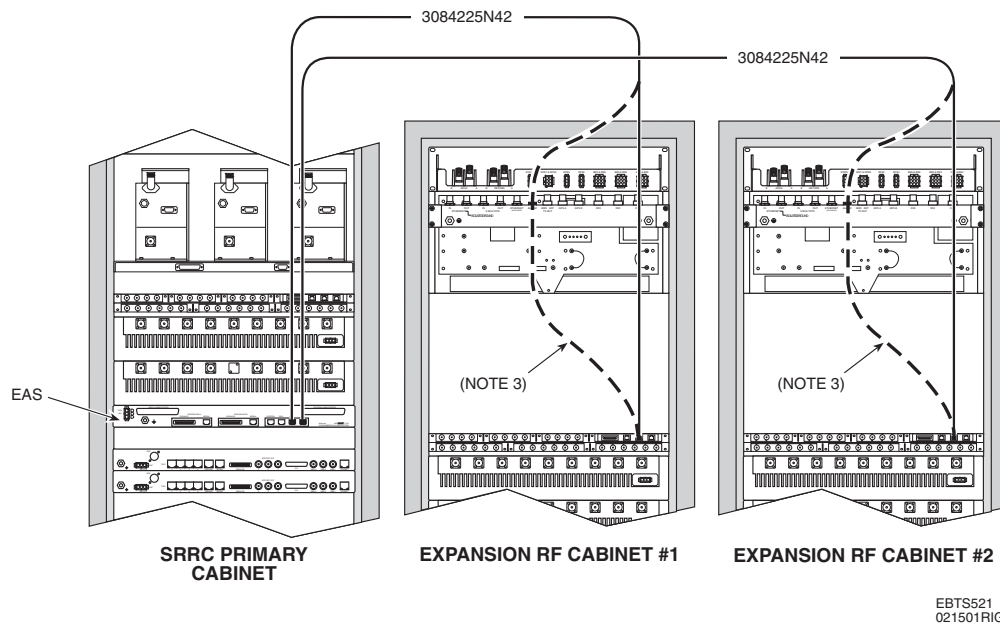


Figure 26 Alarm Connections for Cavity Combining RFDS Sected Sites



- NOTES:**
1. For systems using more than 2 Expansion RFCs, additional EAS connections are as shown in Figure 28, Alarm Connections (High Capacity Systems).
 2. Only alarm cabling to expansion cabinets shown. For alarm cabling within SRRC primary cabinet, refer to Single Rack, Redundant Controller GEN 4 EBTS section in this manual.
 3. Rx Tray using CTF6220A version I/O Board requires extra cable between cable 3084225N42 and I/O RJ-45 connector (as shown by dashed lines). (This applies to primary and/or expansion RF cabinets.) Refer to Single Rack, Redundant Controller GEN 4 EBTS section of manual for more information.

Figure 27 Alarm Connections for SRRC Expansion Sites

Intercabinet Cabling Procedures

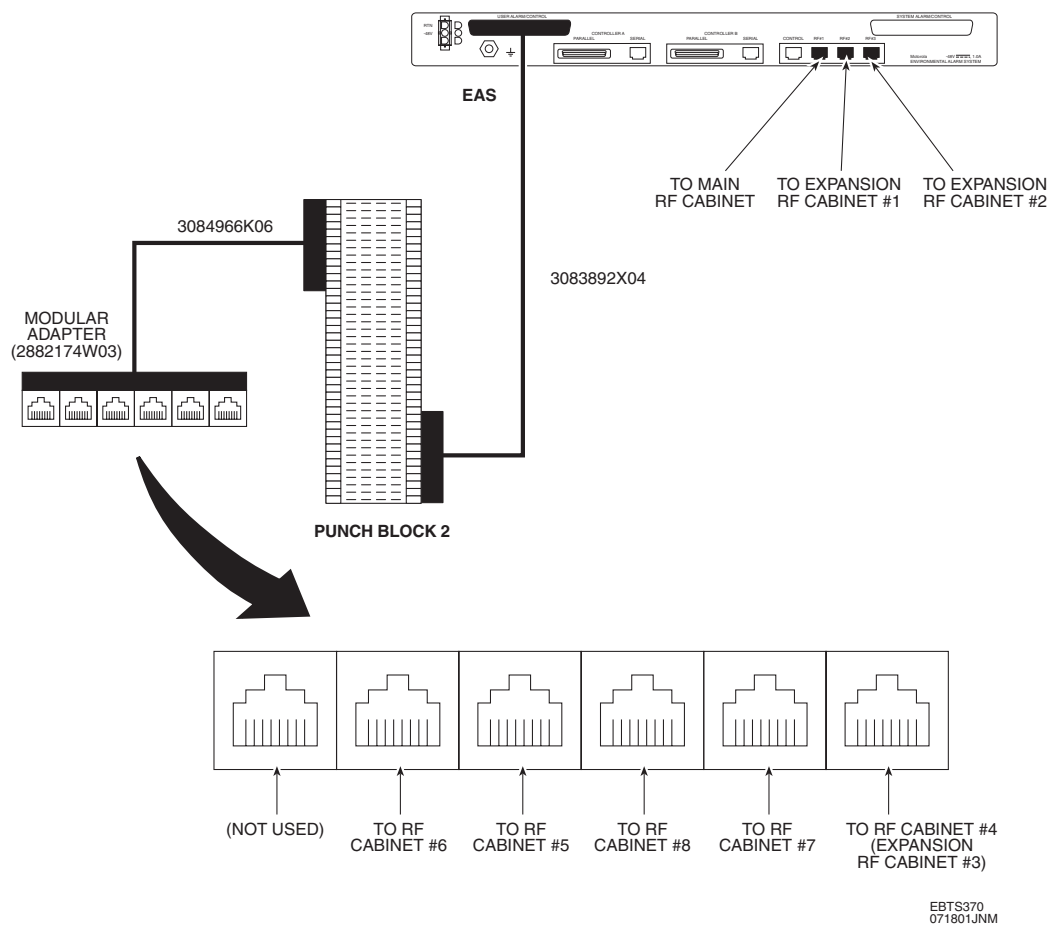


Figure 28 **Alarm Connections (High Capacity Systems)**

Primary Control Channel Redundancy Intercabinet Cabling

NOTE

The following procedure applies only to Cavity Combining systems using multiple RF Cabinets.

On a cavity combining RFDS, additional signalling connections must be made for Primary Control Channel (PCCH) redundancy. There is a PCCH redundancy control cable for each RF Cabinet used in the system.

The red wire is routed to RF Cabinet 1, the blue wire is routed to RF Cabinet 2, and the green wire is routed to RF Cabinet 3. RF Cabinets 2 and 3 are only used in sectorized sites. All of the PCCH redundancy control wires (red, blue, and green) branch from the Control Cabinet modular cable connection on the rear of the EAS.

1. On the EAS, locate the modular cable that is plugged into the Control Cabinet connector.

The end of this cable contains three separate branched wires that are colored red, blue, and green.

2. Locate the Mate-N-Lok connector at the end of a colored wire.

This is a PCCH redundancy control connection for a specific RF Cabinet. Refer to the paragraph at the beginning of this procedure for definitions of wire colors.

NOTE

Make sure that each wire is routed to the appropriate RF Cabinet. Red is for RF Cabinet 1, blue is for RF Cabinet 2, and green is for RF Cabinet 3.

3. Route the colored cable to the appropriate RF Cabinet.
4. In the RF Cabinet, locate the loose cable containing another Mate-N-Lok connector.

This cable is connected to the antenna relay on the rear of the RF Cabinet and to the Auxiliary connector on the BR backplane.

5. Connect the two Mate-N-Lok connectors from the Control Cabinet and RF Cabinet together.
6. Repeat this procedure for additional RF Cabinets, if necessary.
7. Proceed to Power Supply Rack-to-EBTS Power (-48 VDC) Connections.

Power Supply Rack-to-EBTS Power (-48 VDC) Connections

⚠ WARNING

MAKE SURE ALL POWER TO THE POWER SUPPLY RACK IS OFF TO PREVENT INJURY TO PERSONNEL.

All -48 VDC (hot) power supply connections are made between the Power Supply rack and the equipment cabinet.

The Power Supply breaker panel should be divided into two sections: A and B. Both sides are connected to the same power source and have the same potential. Figure 30 shows a typical breaker panel layout.

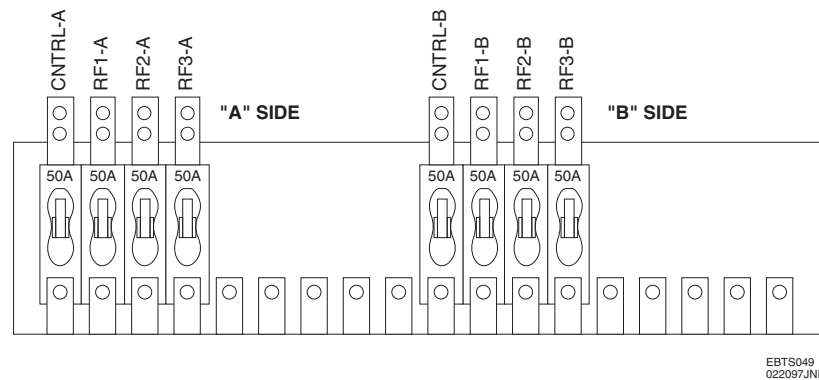


Figure 29 **Typical Equipment Cabinet Power Distribution Panel (Rear View)**

The Power Supply circuit breakers are typically located on the front of the Power Supply rack. When viewed from the front of the Power Supply rack, the A-side circuit breakers are on the left. The B-side breakers are on the right.

The equipment cabinet requires two power feeds to provide the operating power to the A and B sides of the cabinet. Two -48 VDC (hot) wires from individual breakers on the power supply are connected to the A and B sides of the -48 VDC EBTS breaker panel. Two DC return wires from the power supply are connected to the A and B sides of each return EBTS breaker panel. This provides two separate power feeds to the equipment cabinet. Figure 30 shows a rear view of the equipment cabinet Power Distribution Panel.

The equipment cabinet distributes the -48 VDC (hot) through individual power circuits for each module in the cabinet. These circuits are wired from the circuit breaker panel in the cabinet.

Power wiring for circuit breakers in the equipment cabinet is accessed from the rear of the cabinet on the breaker panel. The breaker panel layout is similar to that of the Power Supply rack. The A-side is on the left and the B-side is on the right, when viewed from the front.

Intercabinet Cabling Procedures

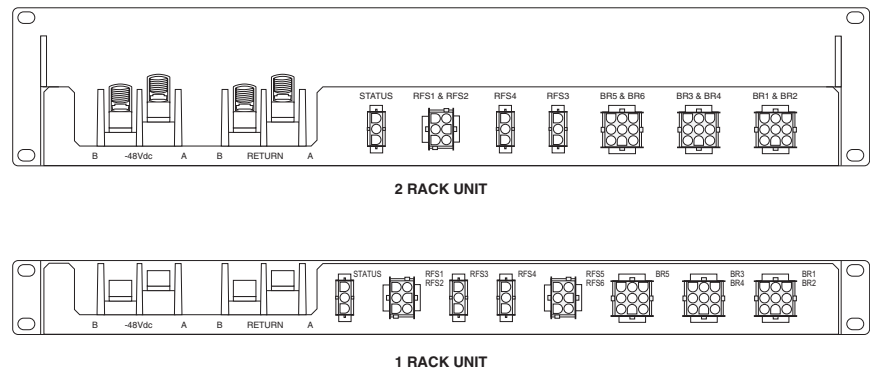
EBTS397
120401JNM

Figure 30 **Typical Equipment Cabinet Power Distribution Panel (Rear View)**

Connections to the Power Supply rack are made from the front. Other EBTS connections are made from the rear of the cabinet.

Connecting Power to the EBTS Rack

The EBTS rack requires a -48 VDC, which is provided by the DC Power Distribution. Figure 31 shows the typical connections for power to the EBTS.

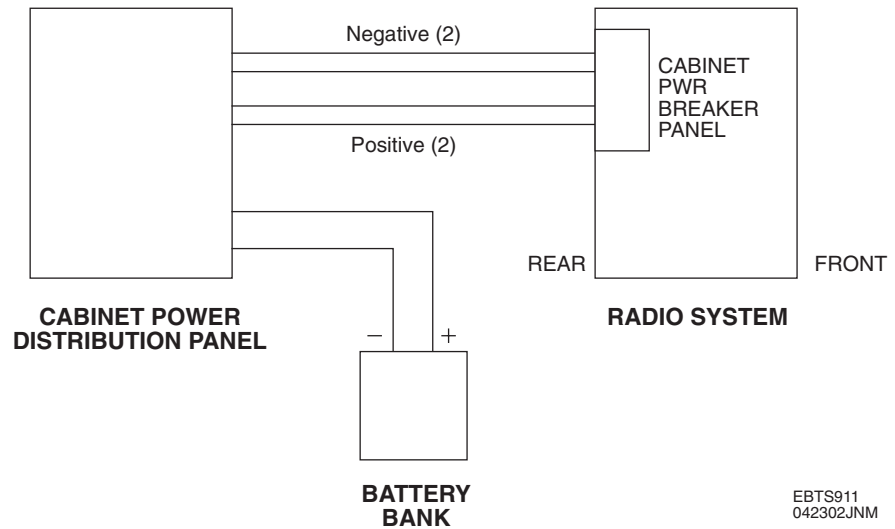
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Figure 31 **Typical Power Connections for the EBTS Rack**

Intercabinet Cabling Procedures**Determining Power Connection Wire Gauge**

Table 5 lists the required wire gauges for various installations. The “loop length” refers to the combined length of the -48 VDC (hot) lead and the DC return lead. For example, a cabinet that needs 16 feet of wire to reach the Power Supply rack has a total loop length of 32 feet. For a standard installation, the equipment cabinet is located adjacent to the Power Supply rack with a cable loop length less than 35 feet.

Table 5 **Power Connection Wire Gauge**

Loop Length	Wire Gauge	Maximum Outer Diameter of Cable
50 feet or less	#6 AWG	0.40 in. (10.2 mm)
50 to 80 feet	#4 AWG	0.40 in. (10.2 mm)
80 to 120 feet	#2 AWG	0.40 in. (10.2 mm)

NOTE

Wire used for the cabinet power connection to the breaker panel shall not be smaller than #6 AWG. Total cable loop (from the power supply rack breakers to the EBTS breakers) voltage drop shall not exceed 500 mV for cabling of the -48 VDC (hot) and DC return leads.

Some sites may require certain size (larger than noted below) cable to meet local codes. When larger cable is used in a run from the power source, the cable shall be “tapped down” to a smaller size for connection to the EBTS breaker panel. In accordance with local code requirements, a properly sized electrical box mounted on top of the EBTS cabinet or commercial tap cover, is where this cable size transition should take place. Because every site is unique and different, the site planner/designer will specify these details.

When a “tapped down” connection is used, the total voltage drop of the “tapped down” section and the main loop should be designed to maintain a voltage drop not to exceed 500 mV.

The screws that connect the power cables to the Power Supply rack are not provided and must be locally procured. Power Supply rack breaker panel screw size is 3/8-16 x 3/4.

Equipment Cabinet -48 VDC Power Connections

Each equipment cabinet requires two wires for -48 VDC power (hot). Perform -48 VDC (hot) power source-to-equipment cabinet wiring as described below.

WARNING

MAKE SURE ALL POWER TO THE POWER SUPPLY RACK IS OFF TO PREVENT INJURY TO PERSONNEL.

1. For each equipment cabinet, route two runs of appropriate-gauge bulk wiring between -48 VDC (hot) A and B side connections on equipment cabinet and Power Supply rack. Make certain wire runs are properly routed through cabinets and cable tray assembly, allowing adequate slack.
2. Depending on wire gauge used, terminate the wire ends at the Power Supply rack using appropriate double-hole crimp lugs.
3. Connect the first power wire lug to breaker 2A (RF1-A) of the Power Supply rack. (See Figure 30.)
4. On the equipment cabinet power distribution panel, strip and insert free end of wire coming from power supply RF1-A into **-48 VDC** terminal block **A** on power distribution panel. (See Figure 30.) Securely tighten connection.
5. Connect the second power wire lug to breaker 2B (RF1-B) of the Power Supply rack. (See Figure 30.)
6. On equipment cabinet power distribution panel, strip and insert free end of wire coming from power supply RF1-B into **-48 VDC** terminal block **B** on power distribution panel. (See Figure 30.) Securely tighten connection.
7. If additional RF cabinets (RFCs) are used, repeat steps 1 through 6 for RFC #2 and RFC #3) using power supply breakers RF2-(A, B) and RF3-(A, B), as applicable.

Equipment Cabinet -48 VDC Return Connections

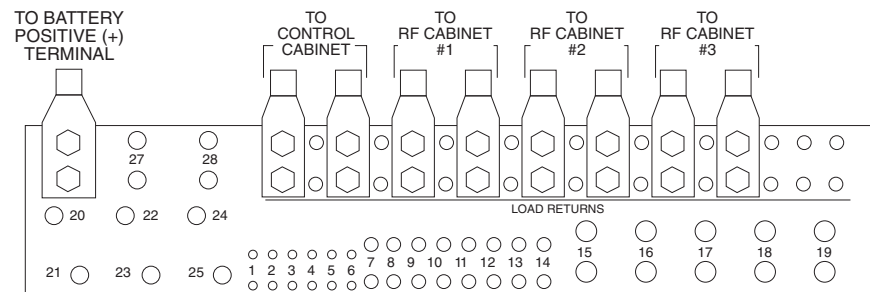
Each equipment cabinet requires two -48 VDC return wires. Perform -48 VDC return power source-to-equipment cabinet wiring as described below.

Intercabinet Cabling Procedures

! WARNING

MAKE SURE ALL POWER TO THE POWER SUPPLY RACK IS OFF TO PREVENT POSSIBLE INJURY TO PERSONNEL.

1. On the Power Supply rack, access the ground bus. Refer to the Power Supply manual supplied with the Power Supply cabinet for the location and access information for the ground bus.



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Figure 32 **Typical Power Supply Rack DC Return Bus (Front View)**

2. Using appropriate gauge wire, route two runs of bulk wiring between **A** and **B** side **RETURN** connections on equipment cabinet and Power Supply rack **RETURN** connections. Make certain wire runs are properly routed through cabinets and cable tray assembly, allowing adequate slack.
3. Depending on wire gauge used, terminate the two wire ends at the Power Supply rack using appropriate double-hole crimp lugs.
4. Connect the first DC return wire lug to the DC return bus bar on the Power Supply rack. (See Figure 32.)
5. On equipment cabinet power distribution panel, strip and insert free end of wire coming from power supply A-side return into **RETURN** terminal block **A**. (See Figure 30.) Securely tighten connection.
6. Connect the second DC return wire lug to the DC return bus bar on the Power Supply rack. (See Figure 32.)
7. On equipment cabinet power distribution panel, strip and insert free end of wire coming from power supply B-side return into **RETURN** terminal block **B**. (See Figure 30.) Securely tighten connection.
8. Proceed to Cabinet-to-Site Cabling Procedures.

Site Controller Cabinet Power Connections

For SCRF systems, refer to the Gen 3 SC Supplement to this manual for information on connecting the Gen 3 SC control cabinet to the power supply rack.

Cabinet-to-Site Cabling Procedures

Perform the following cabinet-to-site cabling procedures as applicable to the system being installed.

NOTE

Unless otherwise noted, all cabling procedures herein apply to and shall be performed for all EBTS configurations. Where differences or exceptions exist, they are noted.

Battery Backup Connections (SRSC Systems Only)

The DC Power System within the SRSC cabinet is equipped to directly accommodate a -48V lead-acid battery backup system. Connect DC Power System to battery rack observing the guidelines below.

▲ CAUTION

The battery backup system cables should be sized appropriately for the battery charging capacity of the DC Power System, the load requirements of the SRSC cabinet, and the applicable electrical codes. Refer to the *Motorola iDEN -48V DC Power System Installation, Operation and Maintenance Manual* p/n 0-SY001026-1 for power system charging capacity. The SRSC cabinet maximum load requirement is approximately 55 Amps @ 42VDC.

▲ CAUTION

The SRSC DC Power System is intended for use with valve-regulated, lead-acid batteries ONLY. Make sure that the DC Power System float voltage is set to 54VDC.

Cabinet-to-Site Cabling Procedures **CAUTION**

Use a minimum battery backup system capacity of 66 ampere-hours with the SRSC DC Power System.

 CAUTION

If mounting batteries in the rack, a suitable battery support shelf must be used. The shelf must be capable of supporting the entire battery weight and must be capable of containing electrolyte leakage.

 CAUTION

Installation, maintenance and servicing of batteries should only be performed by trained personnel. Consult the battery supplier for further technical information and assistance.

 CAUTION

The DC Power System must be connected to a battery system meeting all applicable electrical codes applicable in the user's customer's country (for example, the National Electrical Code ANSI/NFPA 70 in USA).

 WARNING

BATTERY TERMINALS CAN SUPPLY HIGH CURRENT. AVOID CONTACT WITH CONDUCTIVE OBJECTS. TURN OFF POWER TO THE POWER SUPPLY SYSTEM AND DISCONNECT BATTERY BACKUP SYSTEM BEFORE SERVICING TO AVOID INJURY TO PERSONNEL.

 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.

CONNECTION SHALL INCLUDE A FUSE INSTALLED ON HOT SIDE OF WIRING.

Connecting Details

A -48V (hot) and ground connection is made between the rear panel **BATT -48V** and **BATT GROUND** terminal lugs on the DC Power System and the battery rack (terminal lugs on power system are copper plated studs which accept 10-32 nuts). Connecting details are shown in Figure 33.

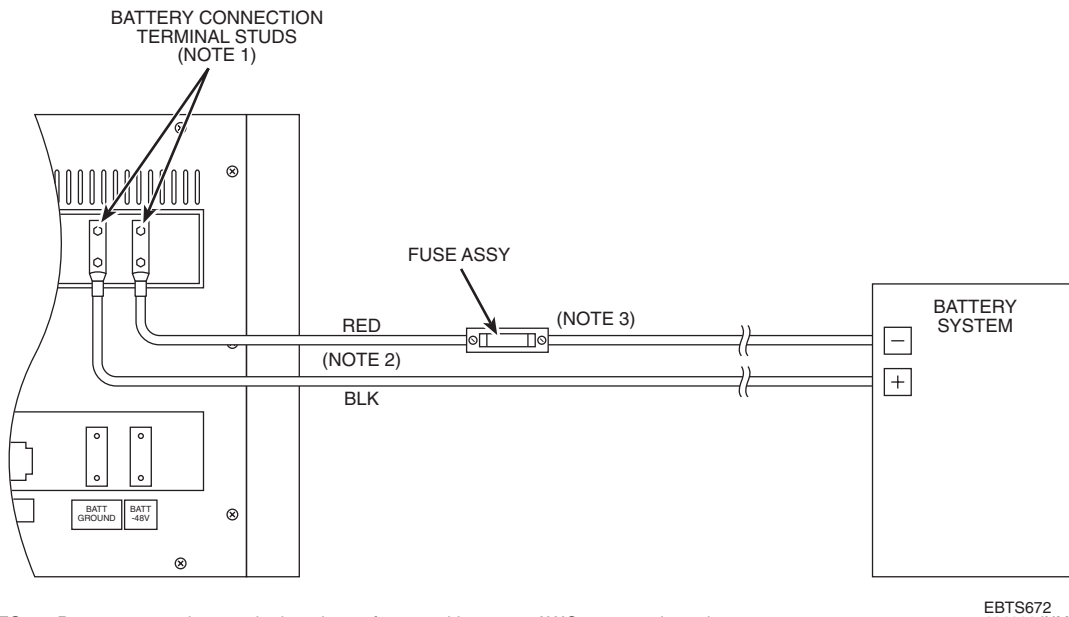
As shown, a fuse shall be used on the “hot” side of the circuit.

 WARNING

TYPICAL BATTERY INSTALLATION UTILIZES A SPECIAL BATTERY RACK. IF BATTERIES ARE INSTALLED IN SRSC CABINET, THE CONSIDERATIONS SPECIFIED IN MOTOROLA STANDARDS AND GUIDELINES FOR COMMUNICATIONS SITES “R56” (6881089E50) 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.

Cabinet-to-Site Cabling Procedures



- NOTES:**
1. Battery connection terminal studs are for use with #12-#1 AWG copper wire only.
 2. Refer to battery system manufacturer's instructions for connections to battery system and required wire gauge.
 3. -48V (hot) lead between battery system and DC Power System shall be fused using inline fuseholder (Buss P/N G30060-1CR, or equivalent) and 60A time delay cartridge fuse (Buss P/N SC-60, or equivalent).

Figure 33 **SRSC Battery Backup Connections**

Equipment Cabinet Ground Connections

Cabinet grounding wires may have been installed prior to cabinet installation. If so, follow the instructions below. If grounding wires have not yet been installed, refer to the Grounding Requirements in the *Pre-Installation* section of this manual.

Perform the procedure below that applies to the particular system being installed.

NOTE

Single-point ground method (where each cabinet or rack is grounded to master ground using its own ground wire) shall be used. Equipment cabinet shall use green-insulation #2 AWG (or larger) for ground wire.

NOTE

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

**RF Cabinet Grounding For 800 MHz Duplexed RFDS
(0182020V06 Duplexed RFDS)****NOTE**

800 MHz Duplexed RFDS (0182020V06 and prior) is no longer available. It has been replaced by the 800 MHz GEN 4 Duplexed RFDS.

All information herein regarding 800 MHz Duplexed RFDS (0182020V06 and prior) is for reference only.

On RF Cabinets using a 0182020V06 Duplexed RFDS, the ground cable connects to the ground studs on each Duplexer chassis. Figure 34 shows the ground connections for the duplexed RFDS.

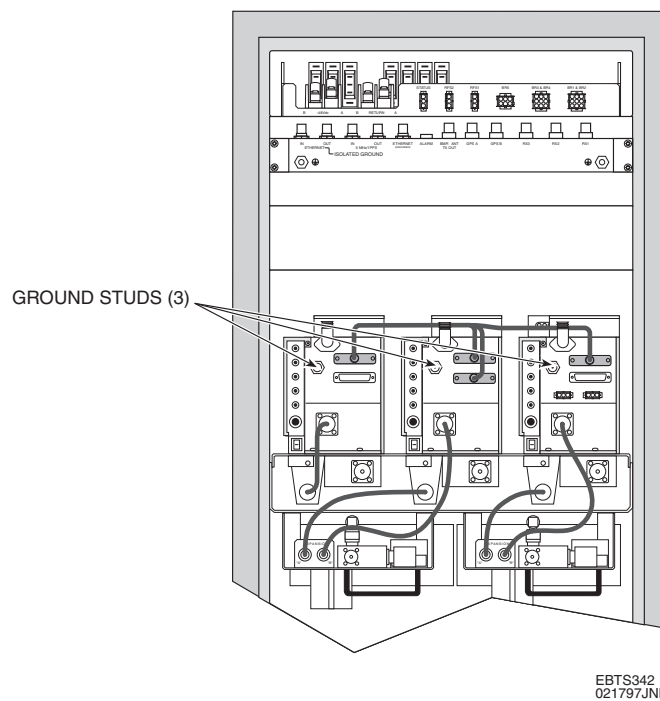
Cabinet-to-Site Cabling Procedures

Figure 34 **Ground Connection for 800 MHz (0182020V06) Duplexed RFDS (Rear View)**

Cabinet Grounding (SCRF, SRRC, and SRSC Using 800 MHz GEN 4 Duplexed RFDS)

On any cabinet using an 800 MHz GEN 4 Duplexed RFDS, a ground cable connects to the ground stud on each Duplexer chassis. On the Rx Tray, a ground cable is connected to the stud on the bracket assembly. Figure 35 shows the ground connections for the 800 MHz GEN 4 Duplexed RFDS.

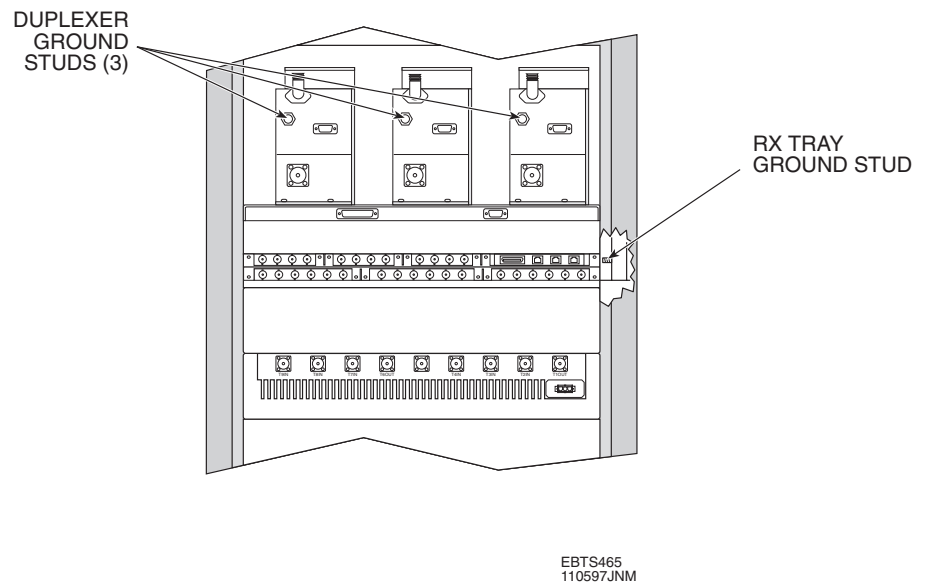
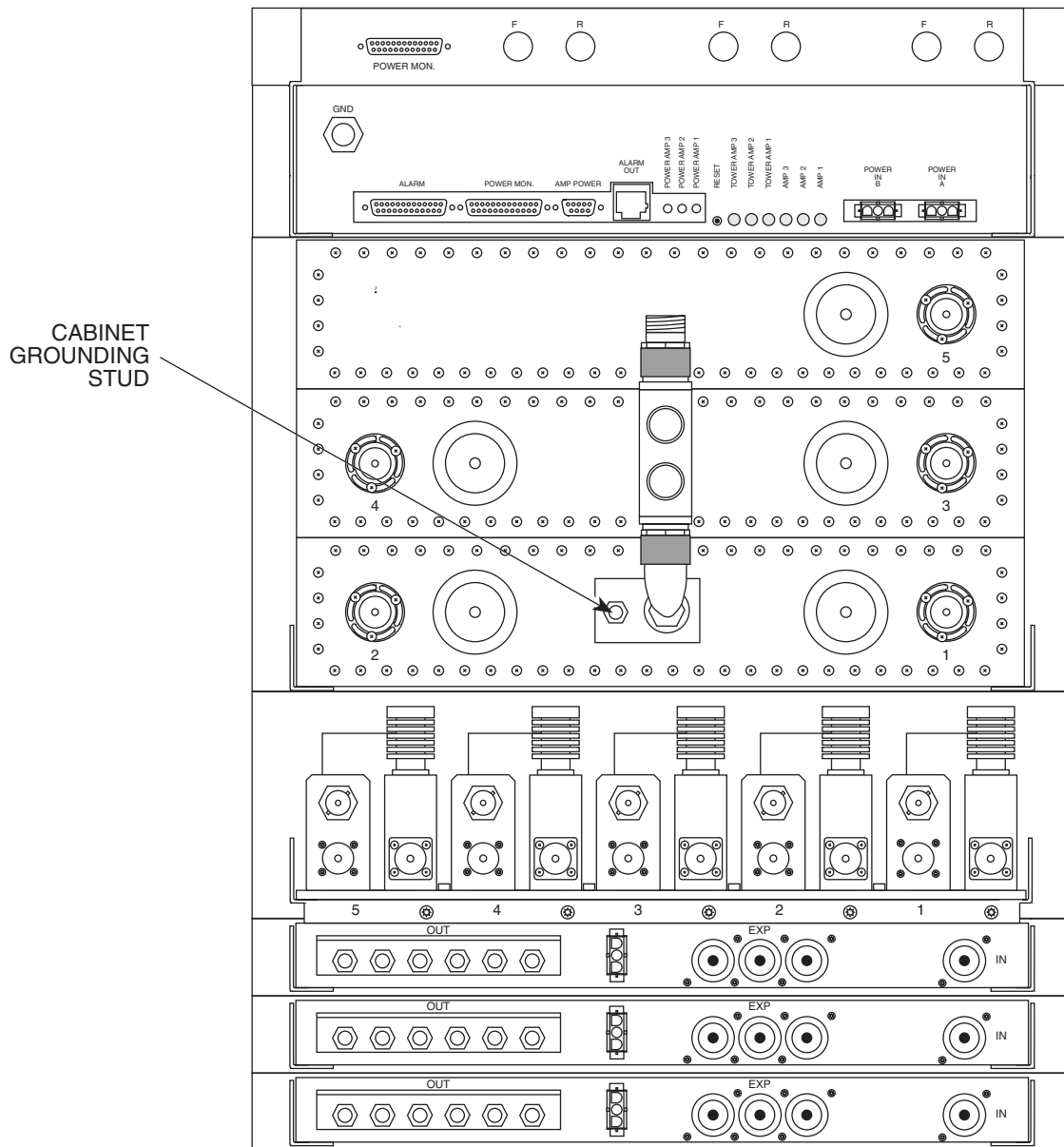


Figure 35 **Ground Connection for 800 MHz GEN 4 Duplexed RFDS (Rear View)**

Cabinet-to-Site Cabling Procedures

RF Cabinet Grounding (Cavity Combining RFDS)

On RF Cabinets using a cavity combining RFDS, the ground wire connects to the output port antenna stud on the RFDS ground plate. Figure 36 shows the ground connection for the cavity combining RF Cabinet.



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Figure 36 **Ground Connection for Cavity Combining RFDS (Rear View)**

RF Cabinet Grounding (900 MHz QUAD Duplexed RFDS)

On 900 MHz RF Cabinets, a ground cable connects to the ground stud on each Duplexer chassis. On the Rx Tray, a ground cable is connected to the stud on the bracket assembly. Figures 37 through 39 shows the ground connections for the 900 MHz RFDS.

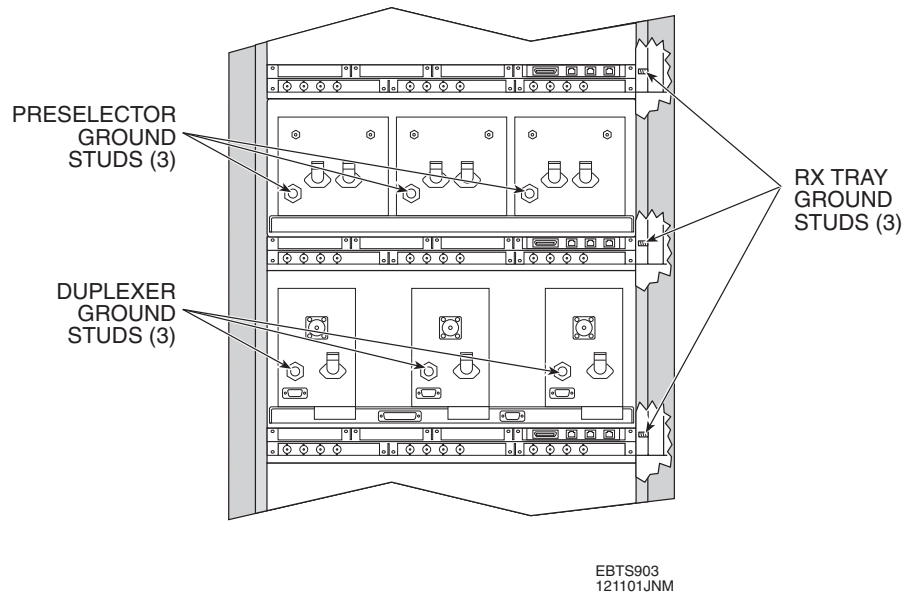


Figure 37 **Ground Connection for 900 MHz QUAD RFDS (Rear View)**

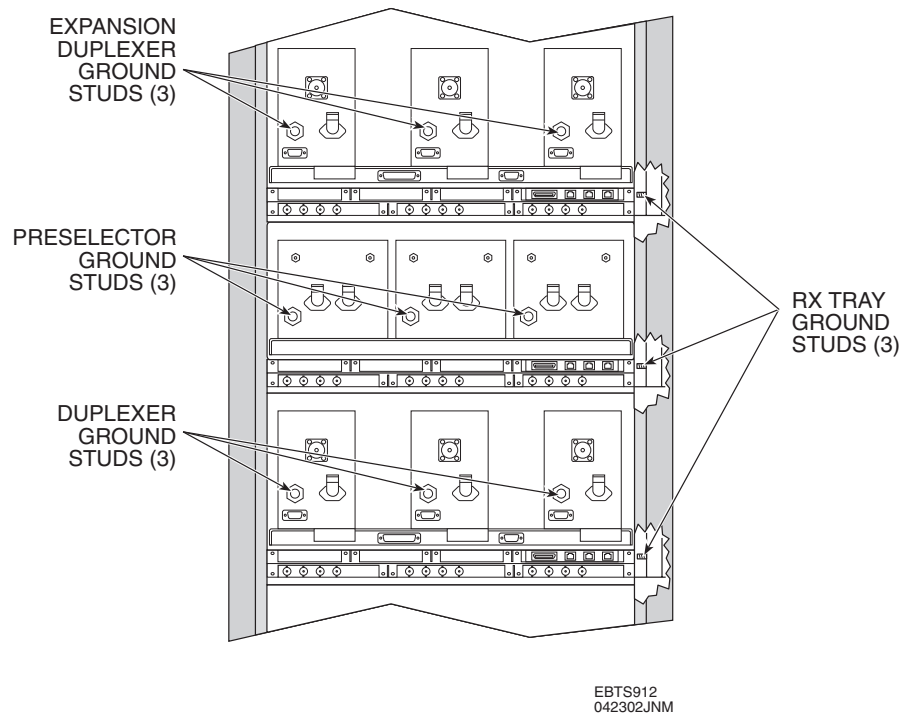


Figure 38 **Ground Connection for 900 MHz QUAD RFDS with Expansion Duplexer option (Rear View)**

Cabinet-to-Site Cabling Procedures

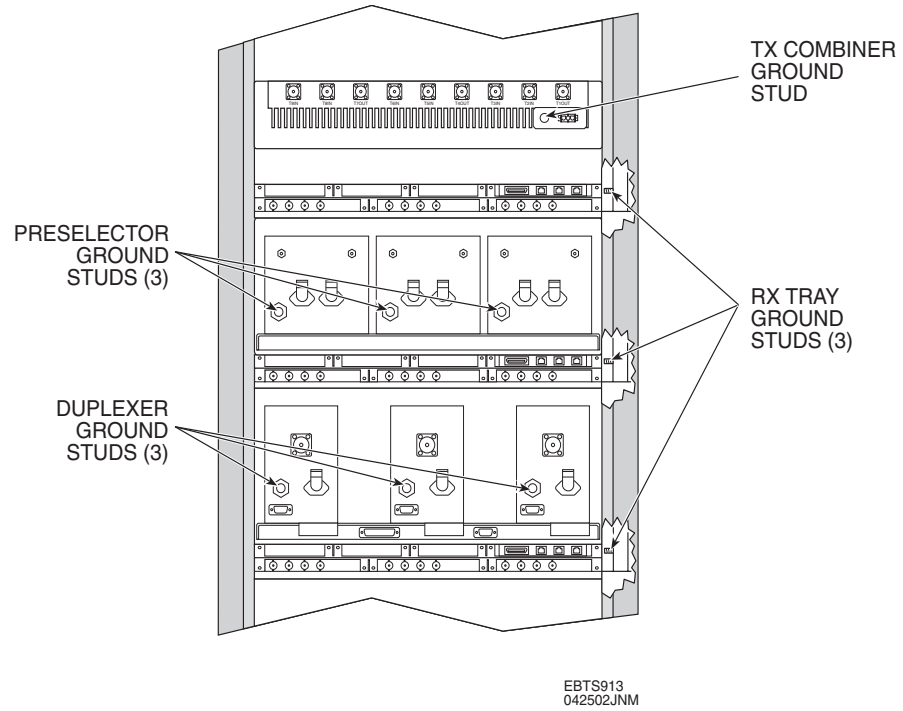


Figure 39 **Ground Connection for 900 MHz QUAD RFDS with TX Combiner option (Rear View)**

Equipment Cabinet Grounding to Site Master Ground Bar

On the Equipment Cabinet, ground connects to either of the two ground studs on the Junction Panel.

Perform the following steps to ground the chassis of the cabinet to the site master ground bar (MGB).

NOTE

A hex nut is secured to the Junction Panel of each cabinet during manufacturing. This nut is used to make ground connections on the Junction Panel. It may also be removed from the Junction Panel and used for the ground connections on the RF Distribution System.

1. Remove the nut and star washer from the ground stud on the Junction Panel and set it aside.
2. Strip the end of the wire to be connected to the cabinet ground.
3. Using appropriate tool, attach a crimp lug onto the cabinet ground wire. Make certain lug is securely fastened to wire.
4. Route the cabinet ground wire through the top of the cabinet.
5. Place the lug over the ground stud and secure it with the nut removed in step 1.
6. Make sure that the other end of the cabinet ground wire is routed to the site master ground bar (MGB).
7. Strip the end of the wire for connection to the master ground bar.
8. Using appropriate tool, attach a dual-hole crimp lug onto the wire. Make certain lug is securely fastened to wire.

NOTE

If necessary, refer to Appendix B - Parts and Suppliers for recommended crimp lugs.

9. Secure the ground wire lug to the site master ground bar (MGB) using the appropriate tools and hardware.

Cabinet-to-Site Cabling Procedures**Base Radio Antenna Connections**

This sub-section assumes the Base Radio antennas have been previously installed. The antenna leads should be dropped above the EBTS cabinets as per the site plan.

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.

Perform the procedure below that applies to the particular system being installed.

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.

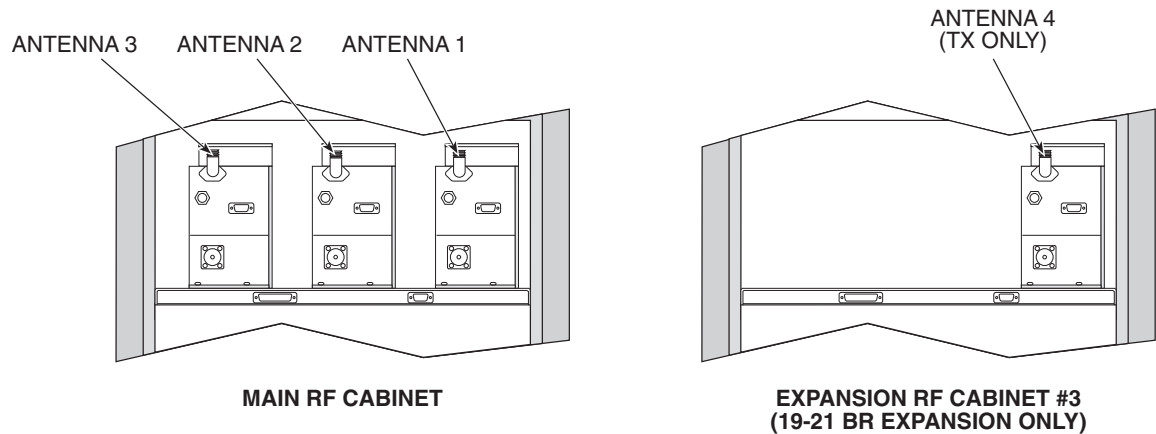
800 MHz GEN 4 Duplexed RFDS Antenna Connections (SCRF, SRRC, and SRSC Using 800 MHz GEN 4 Duplexed RFDS)

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

1. Identify all antenna cables designated for the RF Cabinets.
All antenna cables must enter through the top of the cabinets. Extension cables for the antenna feedlines must be procured locally. Superflex™ 1/2" cable is the recommended extension cable.
2. Tag each of the antenna cables to identify the Sector number (where applicable) and the RF Cabinet number (where applicable).
3. Where applicable, sectors and RF Cabinets are marked 1 through 3. Refer to Antenna Installation in the *Pre-Installation* section for the recommended color coding to tag the antennas.
4. 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 40.
 - **Duplexed RFDS with Tower Top Amplifier (TTAs) compatibility** – Connect antenna cables to DC injector on each duplexer antenna port as shown in Figure 41.

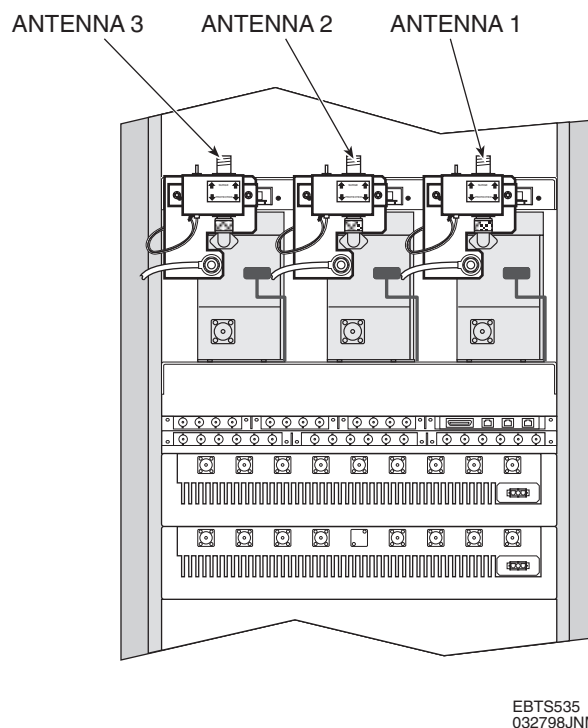
Cabinet-to-Site Cabling Procedures

5. On system using Expansion RF Cabinet #3 (19-24 channel expansion in Stand-alone Control And RF Cabinet system or 17-22 channel expansion in SRRC system), connect transmit-only (fourth) antenna to Expansion RF Cabinet #3. (Antenna connection is similar to that shown in Figure 40.)
6. To continue, perform one of the following:
 - **Multi-sectored site** – Repeat steps 1 through 3 for RF Cabinet #2 and RF Cabinet #3, as necessary.
 - **Omni sites** – Proceed to GPS Antenna Connections.



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Figure 40 **800 MHz GEN 4 Duplexed RFDS Antenna Connections, Non-TTA (Rear View)**



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Figure 41 **800 MHz GEN 4 Duplexed RFDS Antenna Connections, TTA (Rear View)**

Cabinet-to-Site Cabling Procedures

900 MHz QUAD Duplexed RFDS Antenna Connections

1. Identify all antenna cables designated for the RF Cabinets.
All antenna cabling must enter through the top of the cabinets. Extension cables for the antenna feedlines must be procured locally. Superflex™ 1/2" cable is the recommended extension cable.
2. Tag each of the antenna cables to identify the Sector number (where applicable) and the RF Cabinet number.
3. Where applicable, sectors and RF Cabinets are marked 1 through 3. Refer to Antenna Installation in the *Pre-Installation* section for the recommended color coding to tag the antennas.
4. Connect each of the tagged antenna cables to the N-type connectors on the RFDS duplexer antenna ports or Tx filter (as applicable) as shown in Figure 42.
5. To continue, perform one of the following:
 - **Multi-sectored site** – Repeat steps 1 through 3 for RF Cabinet #2 and RF Cabinet #3, as necessary.
 - **Omni site** – Proceed to GPS Antenna Connections.

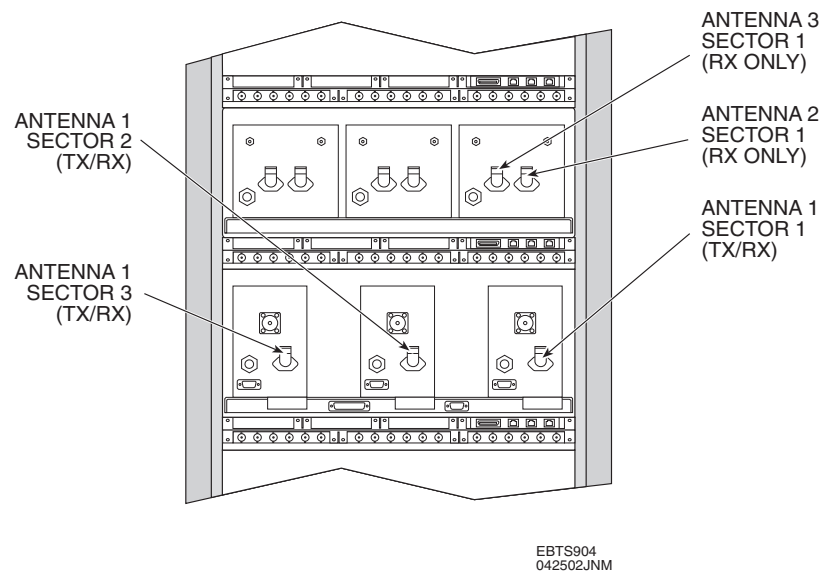


Figure 42 900 MHz QUAD Duplexed RFDS Antenna Connections (Rear View)

Cabinet-to-Site Cabling Procedures

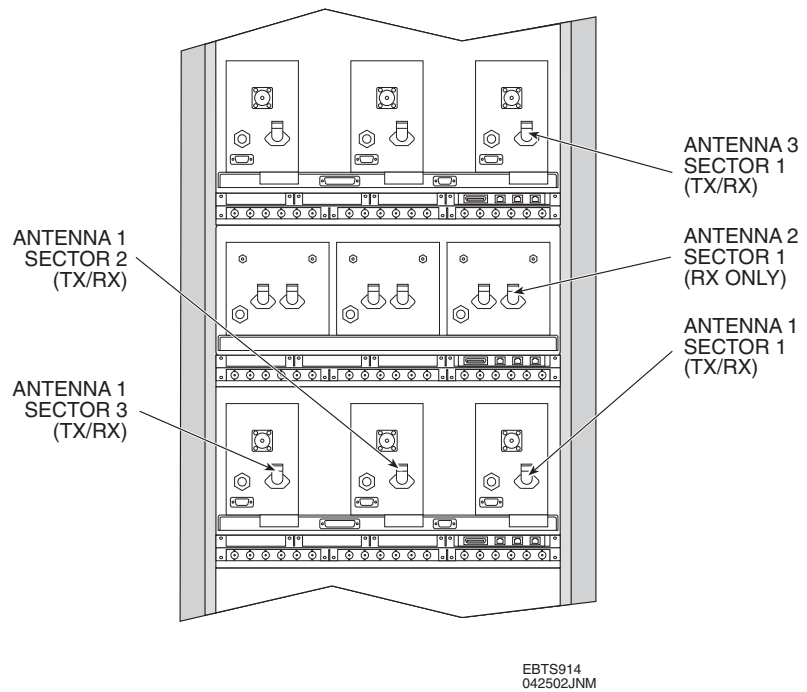


Figure 43 **900 MHz QUAD Duplexed RFDS with Expansion Duplexer option Antenna Connections (Rear View)**

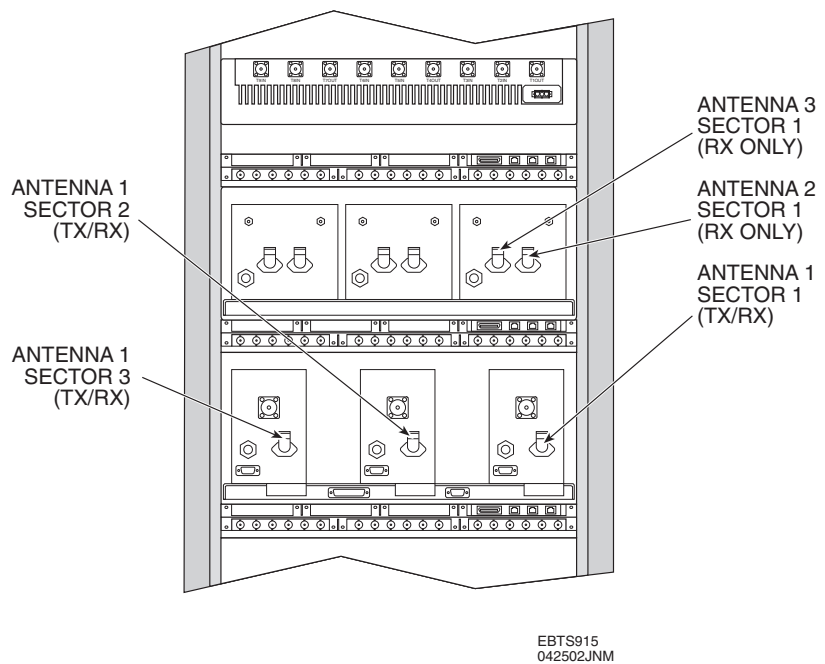


Figure 44 **900 MHz QUAD Duplexed RFDS with TX Combiner option Antenna Connections (Rear View)**

Cabinet-to-Site Cabling Procedures**1-5 Channel Cavity Combined RFDS Antenna Connections**

Refer to Figure 45 for the proper connecting points to the RFDS.

1. Identify all antenna cables designated for the RF Cabinets. Three branch diversity sites will have three receive antennas and one transmit antenna while two branch diversity sites will have two receive antennas and one transmit antenna per RF cabinet.

All antenna cabling must enter through the top of the cabinets. Extension cables for the antenna feedlines must be procured locally. Superflex™ 1/2" cable is the recommended extension cable.

2. Tag each of the antenna cables to identify the Sector number and the RF Cabinet number.

Sectors and RF Cabinets are marked 1 through 3. Refer to Antenna Installation in the *Pre-Installation* section of this manual for the recommended color coding to tag the antennas.

3. Connect each of the tagged receive antenna cables to the N-type connectors on the ground plate inside the RF Cabinet.
4. Connect the tagged transmit antenna cables to the DIN-type connectors on the cavity combiner inside the RF Cabinet.
5. To continue, perform one of the following:
 - **Multi-sectored site** – Repeat steps 1 through 4 for RF Cabinet #2 and RF Cabinet #3, as necessary.
 - **Omni site** – Proceed to GPS Antenna Connections.

6-10 Channel Cavity Combined Antenna Connections

Refer to Figure 46 for 6-10 channel omni site cabling.

1. Identify all antenna cables designated for the RF Cabinets.

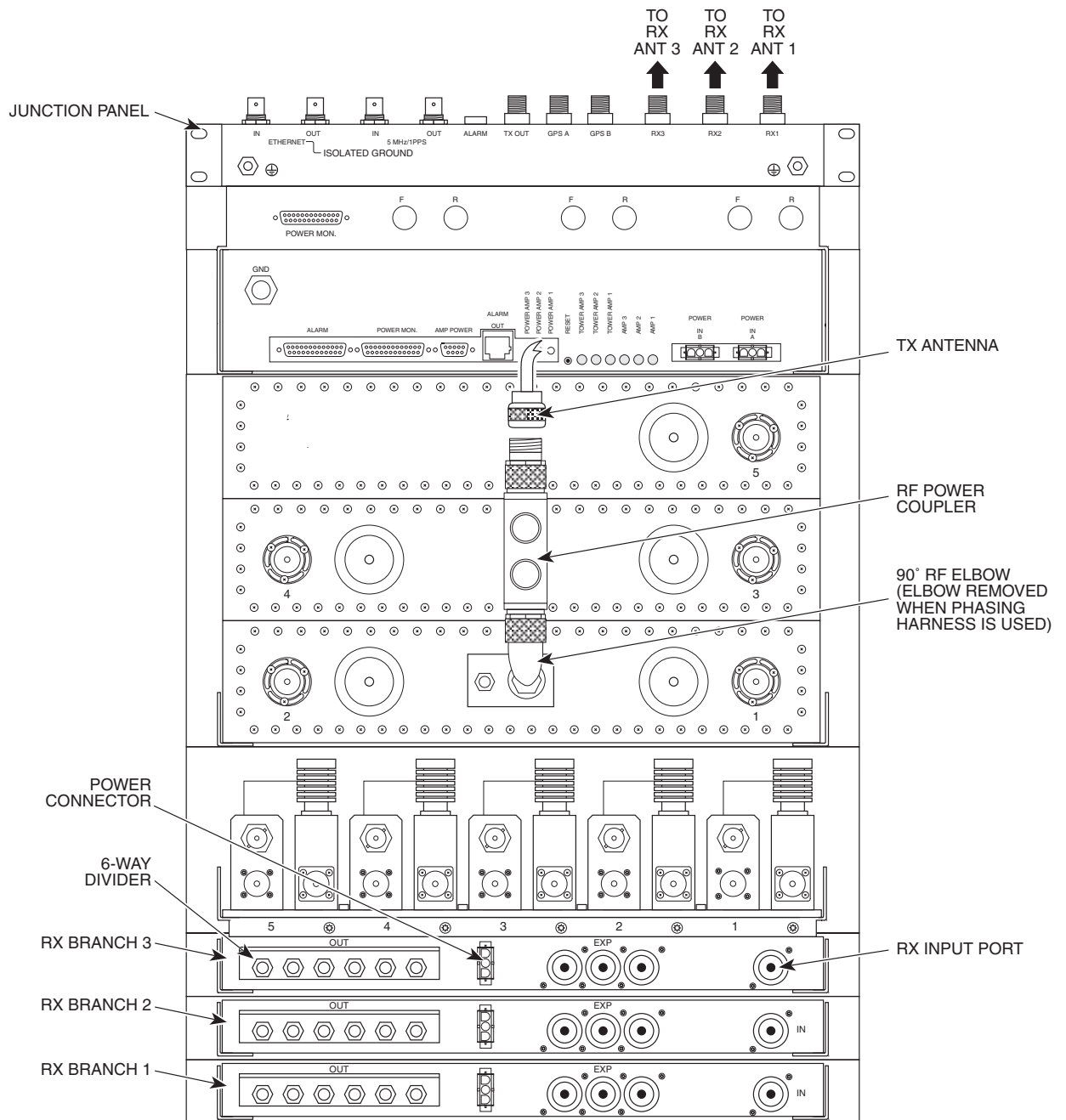
All antenna cabling must enter through the top of the cabinets. Extension cables for the antenna feedlines must be procured locally. Superflex™ 1/2" cable is the recommended extension cable.

2. Tag each of the antenna cables to identify TX and RX drops.

Refer to Antenna Installation in the *Pre-Installation* section for the recommended color coding to tag the antennas.

3. Remove the RF Power Coupler from the Main RF Cabinet and install it to the Phasing Harness on the Expansion RF Cabinet. Refer to Figure 46 for placement.

Cabinet-to-Site Cabling Procedures



NOTE:

RX Branch 3 is only used in three branch diversity connections.

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Figure 45 Cavity Combining RFDS Connections (Rear View)

Cabinet-to-Site Cabling Procedures**NOTE**

The RF Power Coupler (shipped with the Main RF Cabinet) needs to be disconnected and installed on the Phasing Harness (shipped with the Expansion RF Cabinet) of the Expansion RF Cabinet.

4. Connect the RF Power Coupler forward and reverse monitor ports to the Power Monitor of the Main RF Cabinet.
5. Connect the Phasing Harness to the Cavity Combiner output, 7/16" DIN connector, of the Main RF Cabinet.
6. Connect each of the tagged receive antenna cables to the N-type connectors on the junction panel of the Main RF Cabinet.
7. Connect the receiver antenna expansion cables from the RX Expansion junction panel inside the Main RF Cabinet to the N-type connectors on the junction panel inside the Expansion RF Cabinet.

RX Expansion cables are shipped with the Expansion RF Cabinet.

NOTE

Refer to Cabling Diagrams sub-section of *Cavity Combining RF Distribution System* section of this manual for connecting points and cable part numbers.

8. Connect the transmit antenna drop to the output of the Power Coupler attached to the Phasing Harness.
9. Proceed to GPS Antenna Connections.

11-20 Channel Cavity Combined Antenna Connections

Refer to Figure 46 for 11-20 channel omni site cabling.

1. Perform cabling and setup as described in 6-10 Channel Cavity Combined Antenna Connections procedure above.
2. Install RF Power Coupler as follows:
 - **11-15 Channel Expansion** – Leave RF Power Coupler installed on RF Expansion Cabinet #2.
 - **16-20 Channel Expansion** – Remove the RF Power Coupler supplied with Expansion RF Cabinet #2. Install the RF Power Coupler to the Phasing Harness, as shown in Figure 46.

3. Connect the RF Power Coupler forward and reverse monitor ports to the Power Monitor of Expansion RF Cabinet #2.
4. (16-20 Channel Expansion only) Connect the Phasing Harness to the Cavity Combiner output, 7/16" DIN connector, of Expansion RF Cabinet #2.
5. Connect the receiver antenna expansion cables from the RX Expansion junction panel inside the Main RF Cabinet to the N-type connectors on the junction panel inside the Expansion RF Cabinets.

RX Expansion cables are shipped with the Expansion RF Cabinets.

NOTE

Refer to Cabling Diagrams sub-section of *Cavity Combining RF Distribution System* section of this manual for connecting points and cable part numbers.

6. Connect the transmit antenna drop to the output of the Power Coupler attached to the Phasing Harness.
7. Proceed to GPS Antenna Connections.

Cabinet-to-Site Cabling Procedures

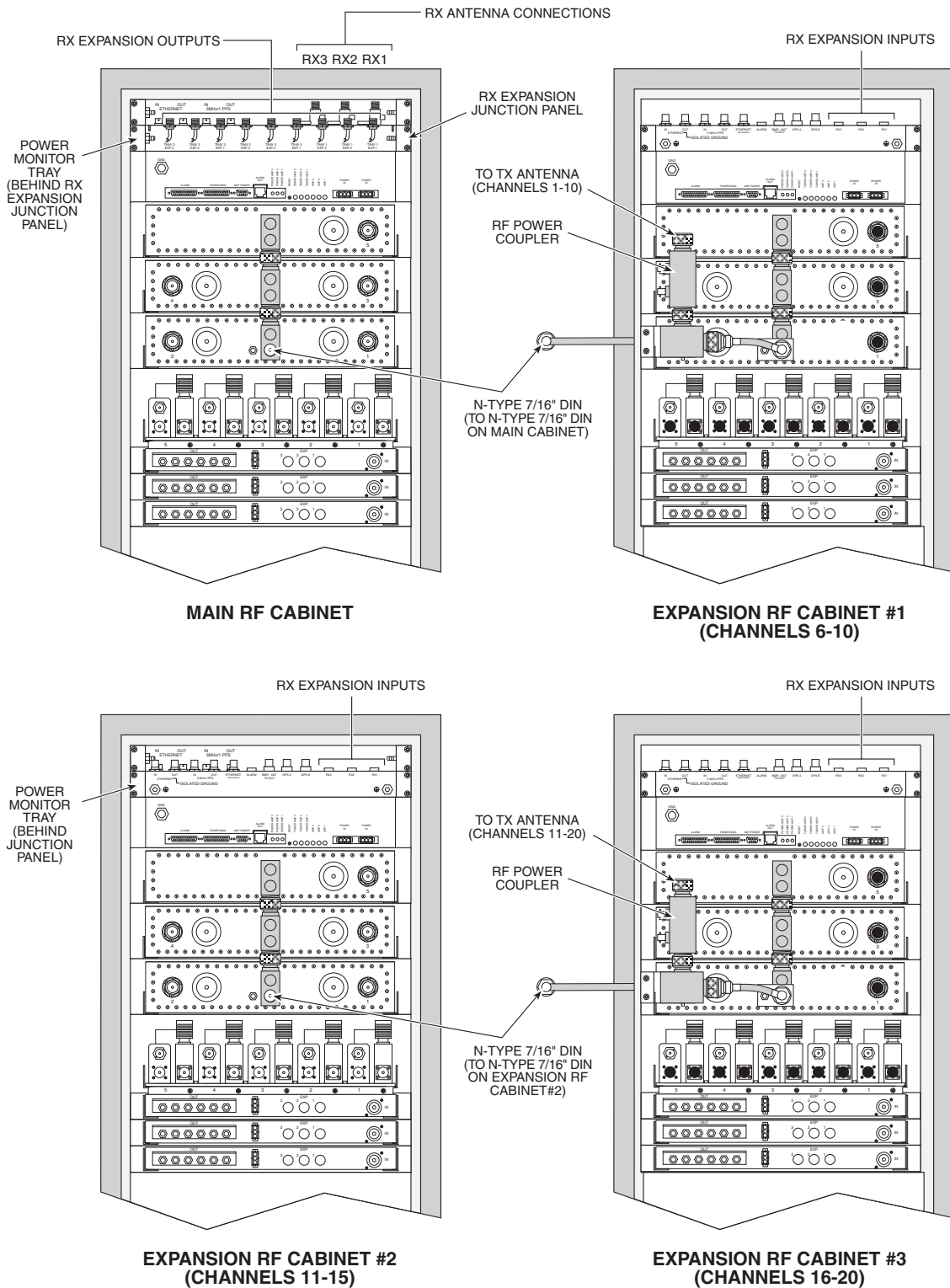
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Figure 46 6-10 Channel and 11-20 Channel Cavity RFDS Connections

800 MHz Duplexed RFDS And Duplex Hybrid Expansion Antenna Connections (0182020V06 Duplexed RFDS)

NOTE

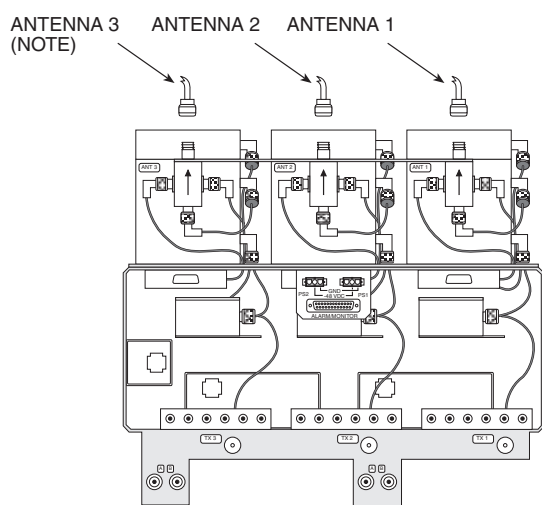
800 MHz Duplexed RFDS (0182020V06 and prior) is no longer available. It has been replaced by the 800 MHz GEN 4 Duplexed RFDS.

All information herein regarding 800 MHz Duplexed RFDS (0182020V06 and prior) is for reference only.

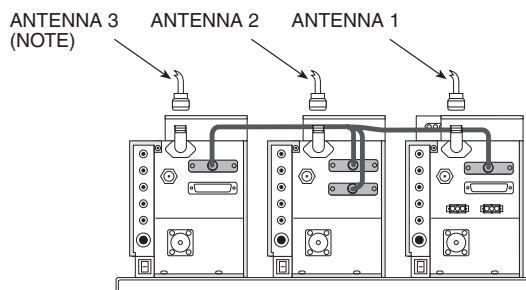
1. Identify all antenna cables designated for the RF Cabinets. Three branch diversity sites will have three antennas and two branch diversity sites will have two antennas per RF cabinet.

All antenna cabling must enter through the top of the cabinets. Extension cables for the antenna feedlines must be procured locally. Superflex™ 1/2" cable is the recommended extension cable.
2. Tag each of the antenna cables to identify the Sector number (where applicable) and the RF Cabinet number.
3. Where applicable, sectors and RF Cabinets are marked 1 through 3. Refer to Antenna Installation in the *Pre-Installation* section for the recommended color coding to tag the antennas.
4. 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 47.
 - **Duplexed RFDS with Tower Top Amplifier (TTAs) compatibility** – Connect antenna cables to DC injector on each duplexer antenna port as shown in Figure 48.
5. To continue, perform one of the following:
 - **Multi-sectored site** – Repeat steps 1 through 3 for RF Cabinet #2 and RF Cabinet #3, as necessary.
 - **Omni sites** – Proceed to GPS Antenna Connections.

Cabinet-to-Site Cabling Procedures



RFDS PN0182020V03

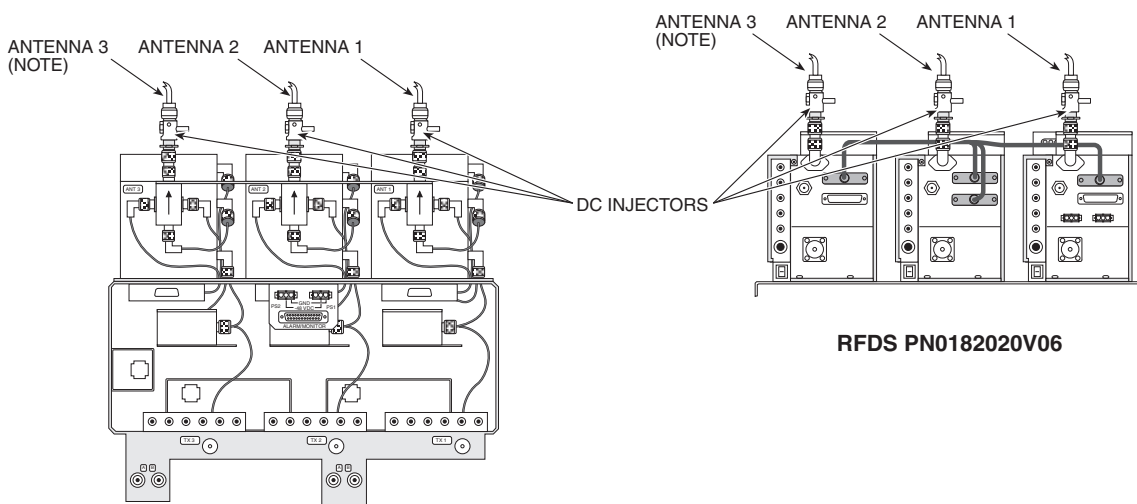


RFDS PN0182020V06

NOTE: Antenna 3 used only with three-branch diversity systems.

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Figure 47 **Duplexed RFDS (0182020V06 and prior)**
Antenna Connections, Non-TTA (Rear View)



RFDS PN0182020V03

RFDS PN0182020V06

NOTE: Antenna 3 used only with three-branch diversity systems.

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Figure 48 **Duplexed RFDS (0182020V06 and prior)**
Antenna Connections, TTA (Rear View)

GPS Antenna Connections

The Global Positioning System (GPS) receiver is located in the Gen 3 SC. Refer to the Gen 3 SC Supplement for detailed information on the GPS antenna installation requirements.

Alarm System Cabling

The Environment Alarm System (EAS), located above the Gen 3 SC, handles all alarms for the site. Refer to the Gen 3 SC Supplement for detailed information on the alarm wiring.

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 Gen 3 SC through a surge arrestor. Refer to the Gen 3 SC Supplement of this manual for detailed information on the T1 line installation requirements.

Diplexer Hardware Installation

Diplexer Hardware Installation

Hardware is available to allow for installation of the 800/900 MHz Diplexers into the Motorola offered 800 MHz Enhanced Base Transceiver Site equipment cabinet. The diplexer tray can be mounted horizontally within the cabinet or vertically on the cabinet's rear rails. It is recommended that the diplexer tray be installed in the horizontal configuration. The vertical configuration is to be left as an alternative when space is limited.

NOTE

Only a trained technician who is familiar with the installation of electronic infrastructure or similar type equipment should perform the procedures listed below.

The items needed to perform the installation are listed below:

Table 6 Installation Hardware

Item	Kit Qty	Motorola Part Number	Part description	
1	10	0285504U01	M6 Standard Cage Nut	
2	1	0782086Y03	Diplexer Support Tray	
3	10	0310917A36	M6x1x20 Torx Steel Zinc Screw	T30 TORX bit and driver
4	3	0182452V12	800/900 Diplexer Filter	
5	9	0310907C70	M4x0.7x10 Torx Steel Zinc Screw	T20 TORX bit and driver
6	1	0783362Y01	Diplexer Grounding Panel	
7	3	3082000X04	11" Ground Cable	
8	4	0212022A06	M10 Nutlock	17mm deep well socket driver
9	3	0212022A04	M6 Nutlock	10mm deep well socket driver
10	2	0783334Y01	Tab Bracket	

Since equipment location varies between sites the customer is responsible for providing the appropriate RF interconnect cables between the 800 MHz and 900 MHz equipment and the diplexers. RF cables of the necessary length and connector types (N and DIN 7/16) should be fabricated, tested and available before diplexer installation is begun. The customer should also fabricate an AWG #2 ring lugged ground cable of appropriate length to attach between the "Site Ground" (the Master Ground Bus Bar (MGB) of the site or equipment area) and one of the M10 ground studs found on the diplexer ground panel. The customer should also provide the necessary tools required for performing the installation.

Recommended: Horizontal mount within cabinet

Horizontal mounting of the diplexer tray requires a 5 rack unit (8.75 inches / 22.2 cm) opening within the cabinet. Hardware items 1 through 9 are needed for this assembly. Figure 49 is provided to depict a 5 rack unit opening within the cabinet and will be used to reference the relative position for mounting the specified hardware items. The following steps detail the installation procedure.

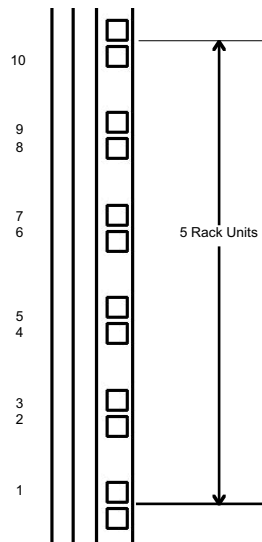


Figure 49 5 Rack Unit Index

1. Remove power to the cabinet. Verify that the appropriate all breaker switches feeding power to the cabinet are in the "OFF" position.

CAUTION

Cabinets have two independent power sources (A and B). Disconnect BOTH power sources before servicing.

2. Remove any existing slide rails and cage nuts within the 5 rack unit opening.
3. Install cage nuts for diplexer support tray. Install M6 cage nuts (item 1) to the front and rear SIDE rails of the cabinet on location 3 per Figure 49 (4 places). The cage nuts should be installed from the outside of the cabinet and oriented such that the engagement flanges lie in a vertical position (see Figure 50).

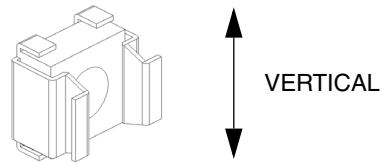
Diplexer Hardware Installation

Figure 50 **Proper Cage Nut Orientation**

4. Install cage nuts for diplexer grounding panel. Install M6 cage nuts (item 1) to the left and right REAR rails of the cabinet on locations 9 and 10 per Figure 49 (4 places). It may be necessary to clip and relocate new race cable ties in order to install the cage nuts. The cage nuts should be installed from the inside of the cabinet and oriented such that the engagement flanges lie in a vertical position (see Figure 50).
5. Orient the tray such that the slotted form points towards the front of the cabinet and the two side forms point towards the top of the cabinet (see Figure 51). The tray will need to be inserted in a rolled angle and rotated back to a horizontal position once the entire tray clears the front rails. Care should be taken to not pinch any cables that are routed within the rack channel guides. Match the TOP holes of the tray side forms to the cage nuts installed in step 3. Secure the tray to the inside of the cabinet rails with the M6 steel zinc screws (item 3) provided (4 places). Tighten the screws to 40 in-lb.

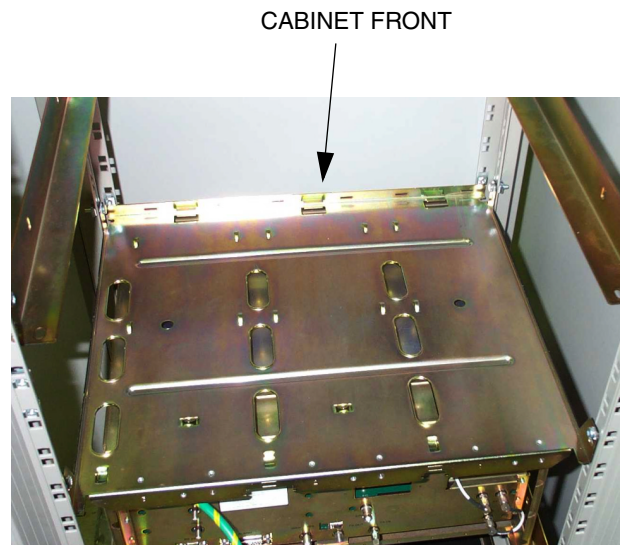


Figure 51 **Diplexer Tray – Horizontal Mount**

Diplexer Hardware Installation

6. Insert each diplexer filter (item 4) into the rear of the cabinet and onto the tray (3 places). Orient the filter with the RF connectors facing away from the rear of the cabinet (see Figure 52). Slide each filter towards the slotted form on the tray, ensuring that the filter's front bracket engages underneath its corresponding tab on the tray. Also ensure that the filter's rear angled bracket is flush against the form on the rear of the tray. Match the top and rear holes of each angled bracket to their corresponding holes on the tray. Secure the filter bracket onto the tray with the M4 steel zinc screws (item 5) provided (3 places, each filter). Tighten the screws to 15 in-lb.



Figure 52 **Finished Horizontal Mount Assembly – Rear View**

7. Secure the diplexer grounding panel (item 6), with the grounding studs nearer the bottom of the cabinet, to the REAR cabinet rails with the M6 steel zinc screws (item 3) provided (4 places). Orient the grounding panel such that the ground studs point away from the cabinet (see Figure 52). Match the holes of the panel to the cage nuts installed in step 4. Tighten the screws to 40 in-lb.
8. Secure a ground cable (item 7) to each M10 ground stud found on the diplexer filters (item 4) with an M10 nut (item 8) provided (1 place, each filter). Tighten the nuts to 40 in-lb. Secure each free end of the ground cables to a single M6 grounding stud found on the diplexer grounding panel (item 6) with an M6 nut (item 9) provided (3 places). Attach only ONE ground cable to each ground stud (see Figure 52). Tighten the nuts to 40 in-lb.
9. The installer is responsible for properly grounding the equipment in compliance with Motorola Standards and Guidelines for Communication Sites "R56" (6881089E50). This can be achieved by attaching a single dedicated #2 AWG ground cable from the Site Ground to one of the M10 ground studs found on the diplexer ground panel (item 6). Secure the ground cable with the M10 nut (item 8) provided. Tighten the nut to 40 in-lb.

Diplexer Hardware Installation

10. Connect RF cables. Verify that all DC power is OFF at the 800 MHz rack and there is no RF power present before attaching or removing RF cables. The “800” N-type port on the diplexer (item 4) connects to the 800MHz RFDS Antenna Port. The “ANT-OUT” 7/16-type port on the diplexer (item 4) connects to the Site Antenna.

 CAUTION

If connecting 900 MHz RF cables to the diplexer while the 800 MHz rack is in operation, DO NOT disconnect the RF cable from the diplexer “800” port. Personal injury or equipment damage could result from RF arcing.

11. If the 900 MHz RFDS equipment has previously been installed verify that all DC power is OFF at the 900 MHz rack and there is no RF power present before attaching or removing RF cables. The “900” N-type port on the diplexer (item 4) connects to the 900 MHz RFDS Antenna Port. If the 900 MHz RFDS is not available for immediate connection it is permissible to leave the “900” N-type port on the diplexer unterminated.

When attaching the 900 MHz RFDS to the diplexer at a later date verify that all DC power is OFF at the 900 MHz rack and there is no RF power present before attaching or removing RF cables. It is acceptable to leave the 800 MHz rack powered up and operational while attaching the 900 MHz RFDS to the “900” N-type port on the diplexer.

NOTE

Verify that all ground connections are in place and tight for safe and proper operation of the equipment.

Diplexer Hardware Installation

12. Apply power to the cabinet by turning all appropriate breakers to the "ON" position.

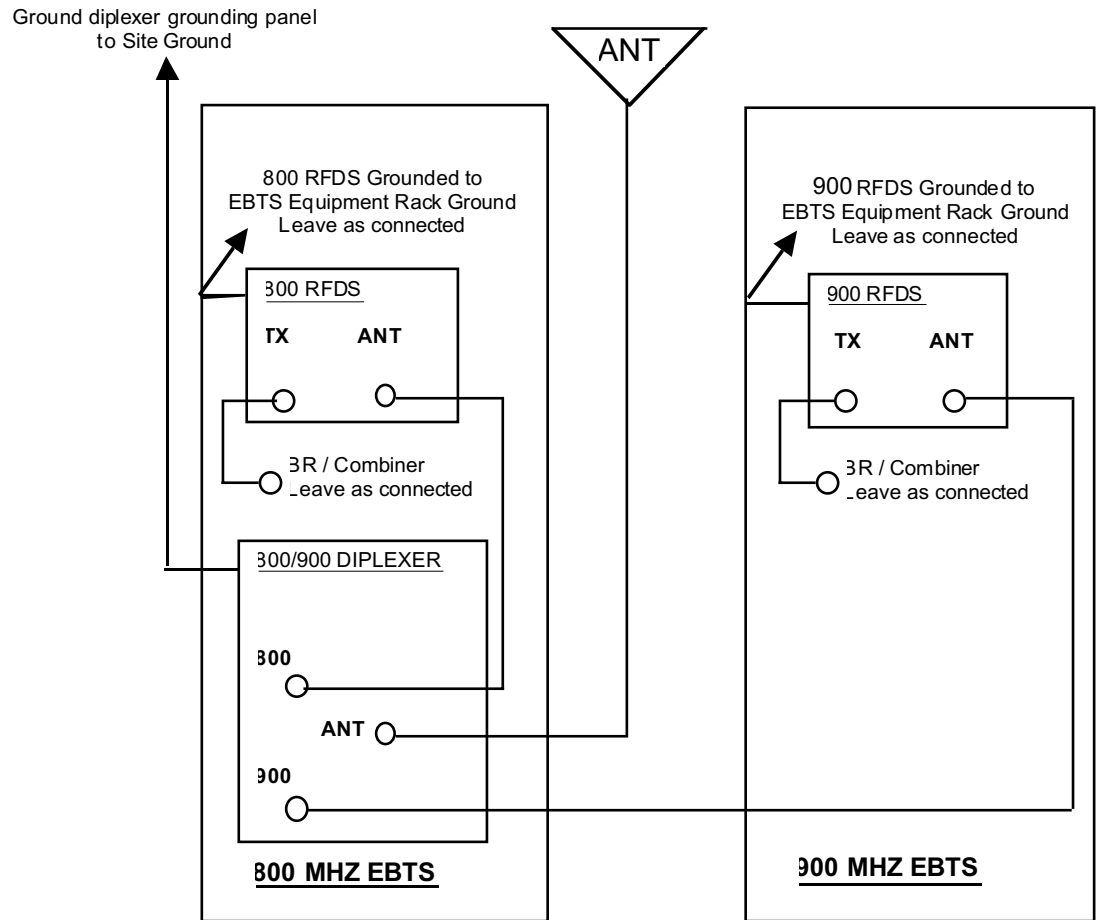


Figure 53 **Diplexer RF and Ground Connections (One Sector, TX antenna)**

Alternate: Vertical mount on rear cabinet rails

Vertical mounting of the diplexer tray requires a 13 rack unit (22.75 inch / 57.8 cm) clearance on the rear cabinet rails. This clearance can be found in the rear of most cabinet configurations between rail hole locations 13 through 37 (counting from the bottom hole towards the top of the cabinet) as shown in Figure 54. Hardware items 1 through 10 are needed for this assembly. The following steps detail the installation procedure.

1. Remove power to the cabinet. Verify that all breaker switches feeding power to the cabinet are in the "OFF" position.

Diplexer Hardware Installation**NOTE**

Cabinets have two independent power sources (A and B). Disconnect BOTH power sources before servicing.

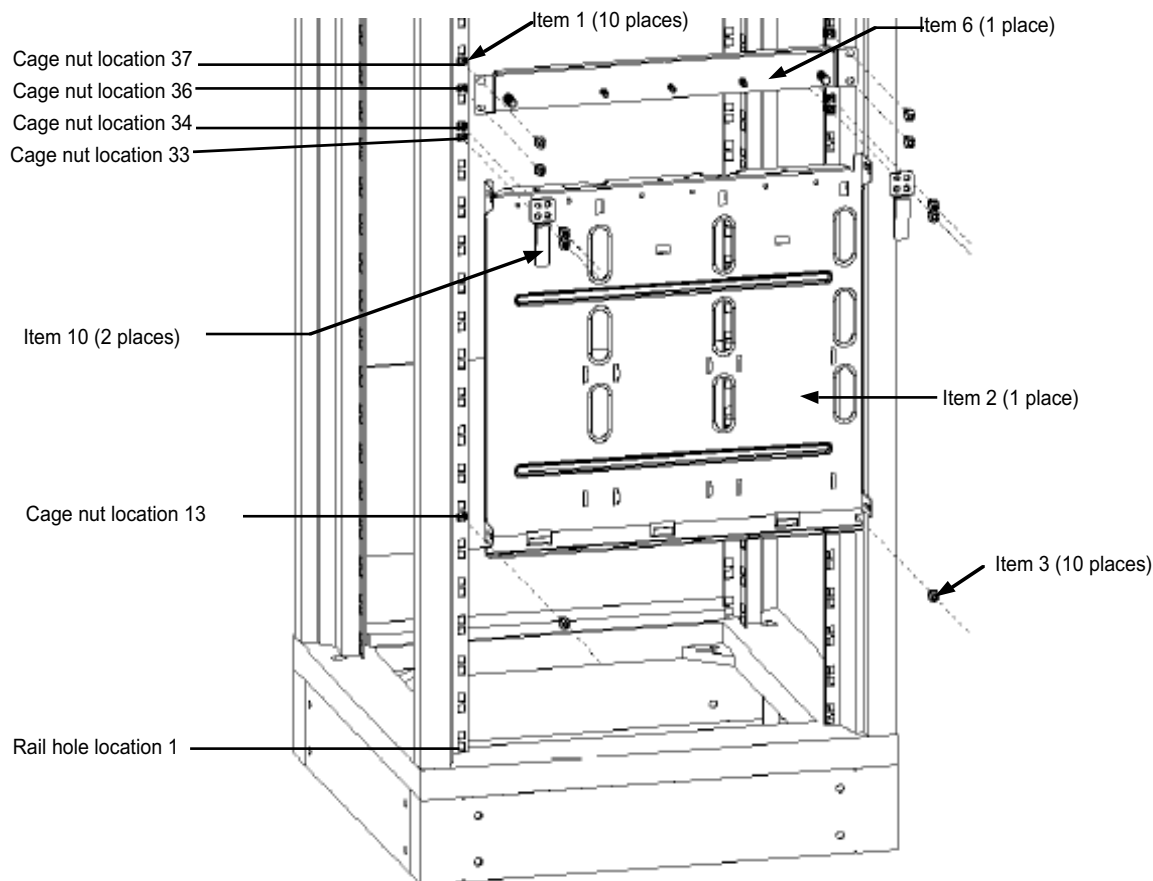


Figure 54 **Diplexer Vertical Hardware Mount**

2. Detach the base radio grounding cable from the grounding cage nut found in the left REAR rail location 33. Do not discard the M6 steel zinc screw as the base radio grounding cable will be reattached in step 6. Relocate the cage nut to the left REAR rail position 35. The grounding cage nut should be installed from the inside of the cabinet and oriented such that the engagement flanges lie in a vertical position (see Figure 50).

Diplexer Hardware Installation

3. Install cage nuts (item 1) to the left and right REAR rails of the cabinet on locations 13, 33, 34, 36, and 37 per Figure 54 (10 places). The cage nuts should be installed from the inside of the cabinet and oriented such that the engagement flanges lie in a vertical position (see Figure 50).
4. Secure the diplexer support tray (item 2) to the rear rails. Orient the tray such that the slotted form points towards the bottom of the cabinet and the two side forms point away from the rear of the cabinet (see Figure 55). Match the two obround openings found on the rear bottom of the tray to the location 13 cage nuts installed in step 3. Attach the tray to cabinet rails with the M6 steel zinc screws (item 3) provided (2 places). Tighten the screws to 40 in-lb.

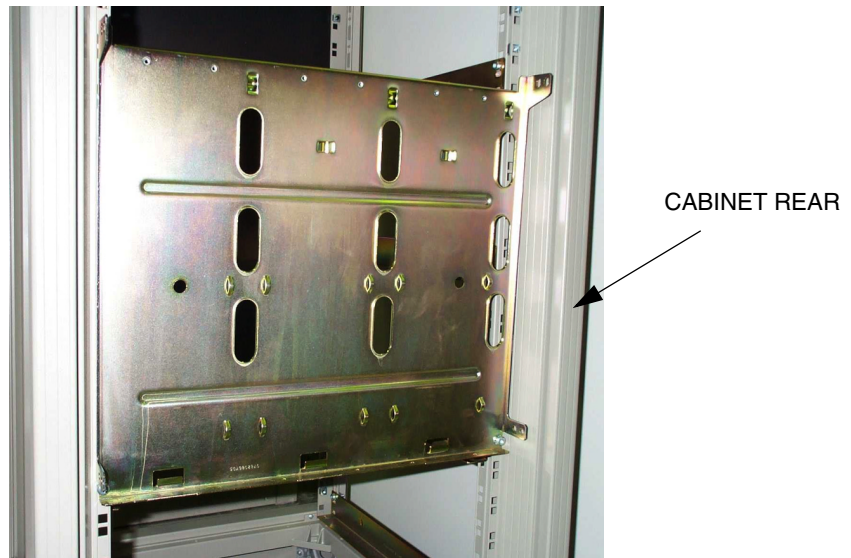


Figure 55 **Diplexer Tray – Vertical Mount**

5. Attach the tab brackets (item 10) to the REAR cabinet rails. Orient the brackets such that the holes are on top and the offset form points away from the cabinet (see Figure 56). Match the tab bracket holes to the cage nuts installed on locations 33 and 34 in step 3. Use the left holes of the tab when mounting to the left rail; use the right holes of the tab when mounting to the right rail. Secure the tab bracket with the M6 steel zinc screws (item 3)

Diplexer Hardware Installation

provided (4 places). Tighten the screws to 40 in-lb. Ensure the tab brackets apply a spring pressure to the support tray in this position.

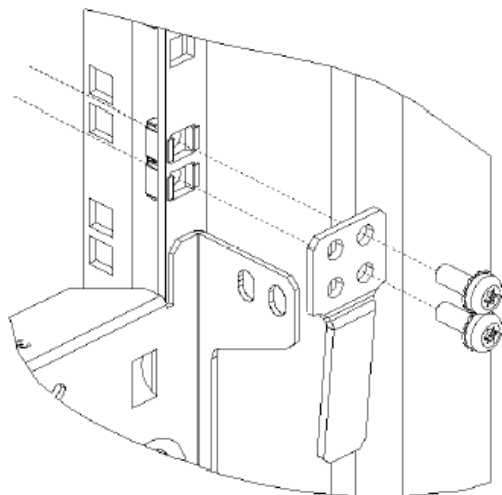


Figure 56 **Tab Bracket Assembly Detail**

NOTE

Secure the base radio ground cable, removed in step 2, under one of the heads of the M6 steel zinc screws installed in step 5 to the grounding cage nut located in rail hole location 35 using an M6 steel zinc screw..

6. Insert each diplexer filter (item 4) onto the diplexer support tray (3 places). Orient the filters with the connectors facing toward the top of the cabinet (see Figure 57). Slide each filter down towards the slotted form on the tray. Ensure that each filter's front bracket engages underneath its corresponding tab on the tray. Also ensure that the filter's rear angled bracket is flush against the form on the rear top of the tray. Match the top and rear holes of each angled bracket to their corresponding holes on the tray. Secure the filter bracket onto the tray with the M4 steel zinc screws (item 5) provided (3 places, each filter). Tighten the screws to 15 in-lb.

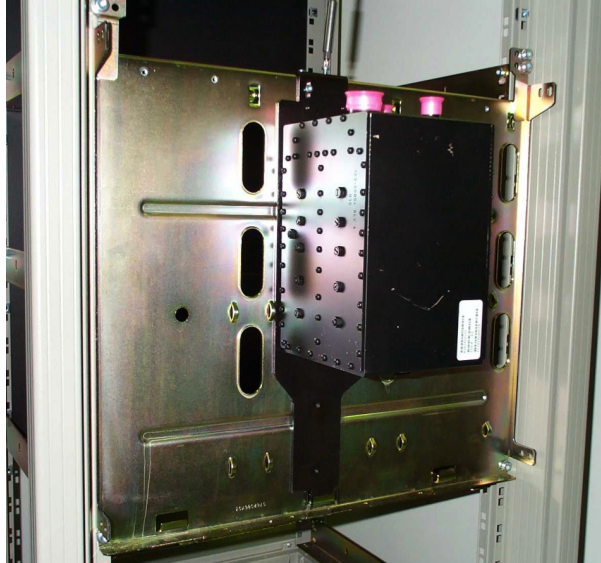


Figure 57 **Diplexer – Single Vertical Mount**

7. Secure the diplexer grounding panel (item 6) to the REAR cabinet rails with the M6 steel zinc screws (item 3) provided (4 places). Orient the grounding panel such that the ground studs point away from the cabinet (see Figure 58). Match the holes of the panel to the location 36 and 37 cage nuts installed in step 3. Tighten the screws to 40 in-lb.
8. Secure a ground cable (item 7) to each M10 ground stud found on the diplexer filters (item 4) with an M10 nut (item 8) provided (1 place, each filter). Tighten the nuts to 40 in-lb. Secure each free end of the ground cables to a single M6 grounding stud found on the diplexer grounding panel (item 6) with an M6 nut (item 9) provided (3 places). Attach only ONE ground cable to each ground stud (see Figure 58). Tighten the nuts to 40 in-lb.

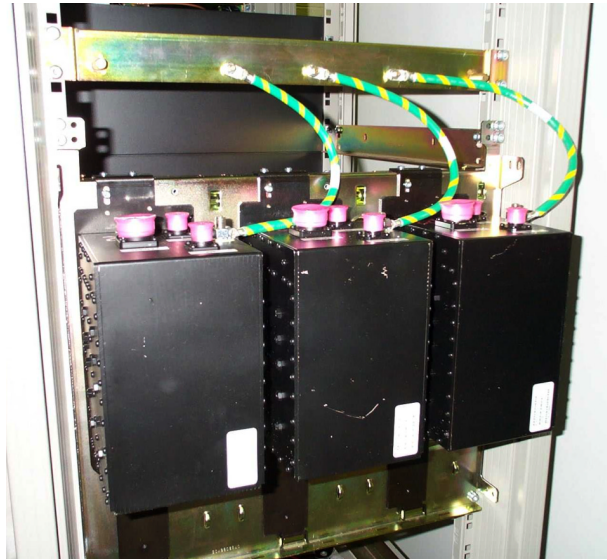
Diplexer Hardware Installation

Figure 58 Finished Vertical Mount Assembly – Rear View

9. The installer is responsible for properly grounding the equipment in compliance with Motorola Standards and Guidelines for Communication Sites “R56” (6881089E50). This can be achieved by attaching a single dedicated #2 AWG ground cable from the Site Ground to one of the M10 ground studs found on the diplexer ground panel (item 6). Secure the ground cable with the M10 nut (item 8) provided. Tighten the nut to 40 in-lb.
10. Connect RF cables. Verify that all DC power is OFF at the 800 MHz rack and there is no RF power present before attaching or removing RF cables. The “800” N-type port on the diplexer (item 4) connects to the 800MHz RFDS Antenna Port. The “ANT-OUT” 7/16-type port on the diplexer (item 4) connects to the Site Antenna.

CAUTION

If connecting 900 MHz RF cables to the diplexer while the 800 MHz rack is in operation, DO NOT disconnect the RF cable from the diplexer “800” port. Personal injury or equipment damage could result from RF arcing.

11. If the 900 MHz RFDS equipment has previously been installed verify that all DC power is OFF at the 900 MHz rack and there is no RF power present before attaching or removing RF cables. The “900” N-type port on the diplexer (item 4) connects to the 900 MHz RFDS Antenna Port. If the 900

MHz RFDS is not available for immediate connection it is permissible to leave the “900” N-type port on the diplexer unterminated.

When attaching the 900 MHz RFDS to the diplexer at a later date verify that all DC power is OFF at the 900 MHz rack and there is no RF power present before attaching or removing RF cables. It is acceptable to leave the 800 MHz rack powered up and operational while attaching the 900 MHz RFDS to the “900” N-type port on the diplexer.

NOTE

Verify that all ground connections are in place and tight for safe and proper operation of the equipment.

12. Apply power to the cabinet by turning all appropriate breakers to the “ON” position.

Table 7 and Table 8 show 800 Mhz and 900 MHz diplexer specifications.

Table 7 Diplexer 800 MHz Port to Antenna Port

Specification	Value or Range (Typical)
Insertion Loss, 806 to 870 MHz	0.25 dB
Port Impedance	50Ω
Power Input:	
RMS	100 watts
Peak Envelope	1500 watts
Peak Instantaneous	3000 watts

Table 8 Diplexer 900 MHz Port to Antenna Port

Specification	Value or Range (Typical)
Insertion Loss, 896 to 940 MHz	0.25 dB
Port Impedance	50Ω
Power Input:	
RMS	50 watts
Peak Envelope	750 watts
Peak Instantaneous	1500 watts

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Final Checkout

Overview

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

This section consists of the following procedures:

Procedure	Page	Description
Checkout Procedures Required Based On System Configuration	2	Detailed information on procedures necessary to carry out the final check on various system configurations
Final Checkout Setup	3	Describes how to prepare the EBTS for the final checkout
Powering the Power Supply System	6	Describes how to activate and check the Power Supply Rack
Applying Power to the Equipment Cabinets	14	Describes how to apply power to the Equipment Cabinet
Applying Power to Components Within Equipment Cabinets	16	Describes how to apply power to the modules within the cabinets

Checkout Procedures Required Based On System Configuration

Checkout Procedures Required Based On System Configuration

The procedures in this section vary significantly for the various system configurations. Briefly, the configurations are:

- ❑ **Stand-alone Control And RF Cabinet (SCRF) System** – Power system located in separate rack. The Gen 3 SC is located in a separate Control Cabinet; Base Radios are located in an RF Cabinet
- ❑ **Single Rack, Redundant Controller (SRRRC) System** – Power system located in separate rack. The Gen 3 SC and Base Radios are located in the same cabinet.
- ❑ **Single Rack, Single Controller (SRSC) System** – Power System, Gen 3 SC, and Base Radios are all located in the same cabinet.

NOTE

Refer to the *System Description* section of this manual for more details on system configurations.

The table below lists the procedures that are to be performed in this section for the system configuration being installed.

Procedure	Page	System Configuration		
		SCRF	SRRRC	SRSC
Final Checkout Setup	3			
Checkout Setup (SCRF System)		✓		
Checkout Setup (SRRRC System)			✓	
Checkout Setup (SRSC System)				✓
Powering the Power Supply System	6			
Power Supply Rack Power-Up (SCRF and SRRRC Systems)		✓	✓	
Power Supply System Power-Up (SRSC System)				✓
Applying Power to the Equipment Cabinets	14			
SCRF System		✓		
SRRRC System			✓	
Applying Power to Components Within Equipment Cabinets	16			
SCRF System		✓		
SRRRC System			✓	
SRSC System				✓

Final Checkout Setup

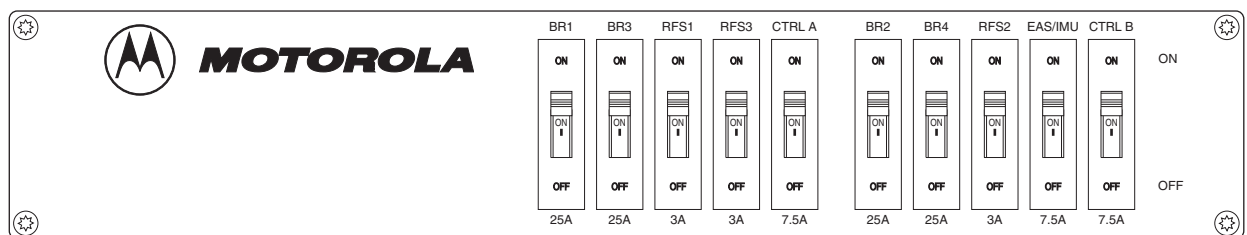
The procedures below make certain the EBTS equipment is set to OFF before power is applied, thereby ensuring an orderly power-up sequence. Perform the procedure below that applies to the system being installed.

Checkout Setup (SCRF System)

1. On the Gen 3 SC (control) cabinet circuit breaker panel (Figure 1), set all circuit breakers to the OFF position.
2. On the RF Cabinet circuit breaker panel (Figure 2), set all circuit breakers to the OFF position.
3. Set all Power Supply rack circuit breakers (Figure 3) to the OFF position. (Refer to the manufacturer's manual for additional information on the Power Supply rack.)

Checkout Setup (SRRC System)

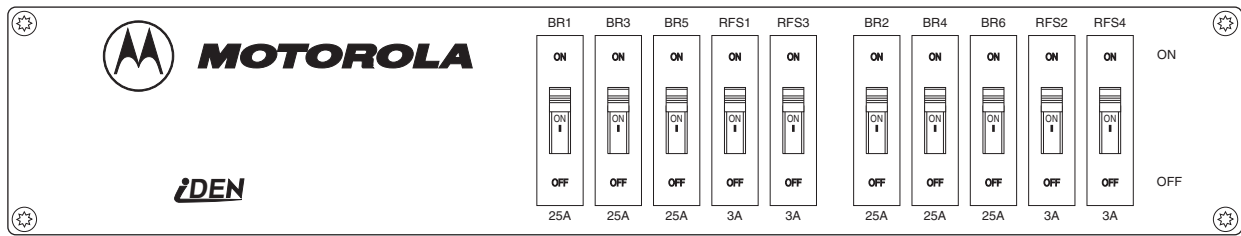
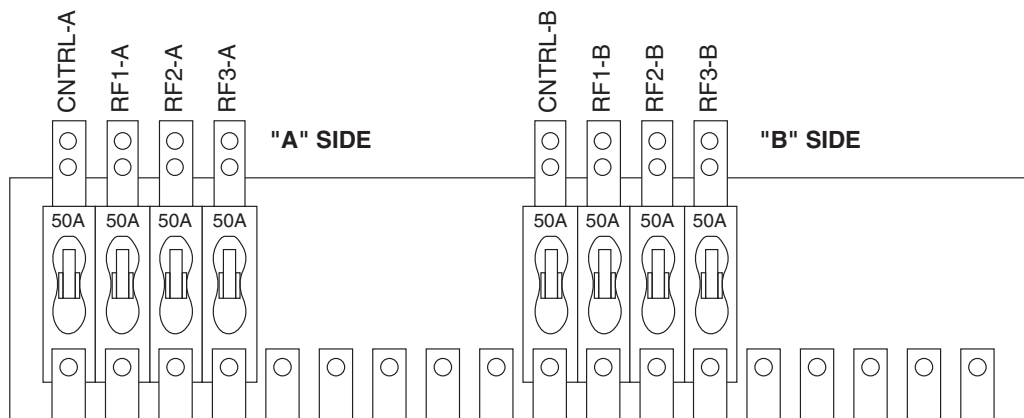
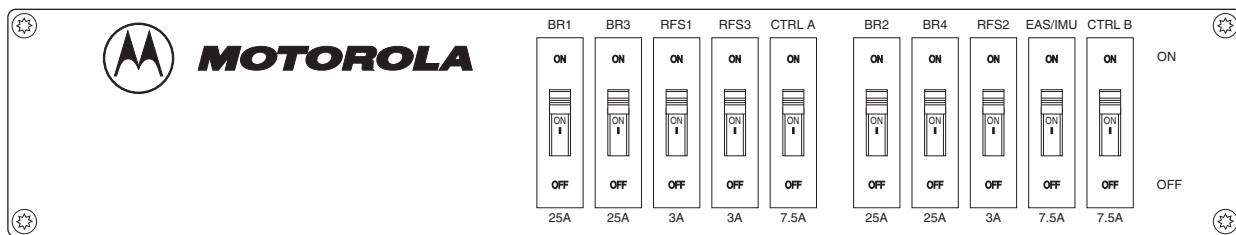
1. On the SRRC primary cabinet circuit breaker panel (Figure 4), set all circuit breakers to the OFF position.
2. Set all Power Supply rack circuit breakers (Figure 3) to the OFF position. (Refer to the manufacturer's manual for additional information on the Power Supply rack.)



iSC075
060796JNM

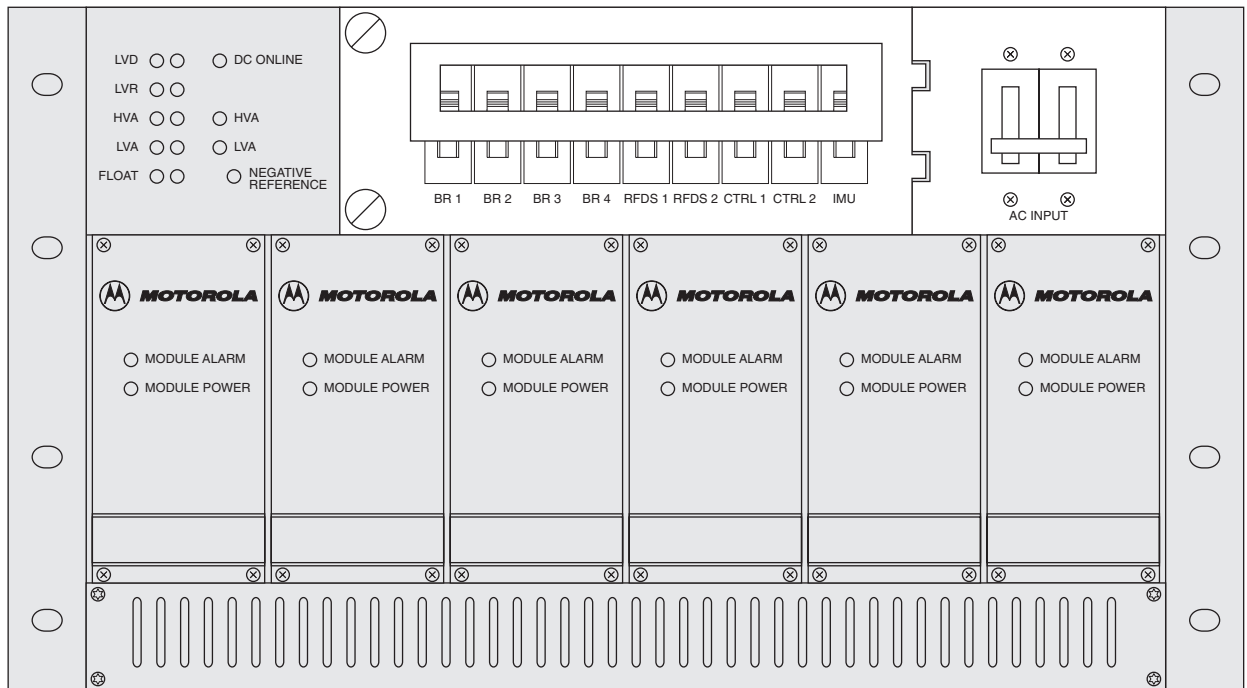
Figure 1 **Control Cabinet Breaker Panel (SCRF Systems)**

Final Checkout Setup

EBTS396
110597JNMFigure 2 **Typical RF Cabinet Breaker Panel (SCRF Systems)**EBTS049
022097JNMFigure 3 **Typical Power Supply Rack Breaker Panel (SCRF and SRRC Systems)**iSC075
060796JNMFigure 4 **SRRC Primary Cabinet Breaker Panel**

Checkout Setup (SRSC System)

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



EBTS590
060198JNM

Figure 5 **SRSC Breaker Panel**

Powering the Power Supply System

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 EBTS equipment.

Depending on the system configuration (SCRF, SRRC, or SRSC), perform the applicable procedure below.

Power Supply Rack Power-Up (SCRF and SRRC Systems)

This generic procedure verifies that the typical Power Supply rack is correctly connected and capable of producing the correct output voltages to power the EBTS equipment. Use this procedure to apply power to the Power Supply rack. Figure 6 shows the front view of a typical Power Supply rack.

1. On Power Supply rack, open front cover of -48V breaker distribution panel.
Verify that all connections are secure and make good contact. Make any necessary adjustments, then close the cover.
2. On System Status and Control (SSC) Panel, set the FLOAT/EQUALIZE switch to FLOAT.

NOTE

If Power Supply rack and battery system were installed prior to the EBTS equipment, the Power Supply may already be operational. Motorola recommends performing the Battery Float/Equalize Adjustment to verify these settings.

3. On Power Supply chassis, set all AC and DC circuit breakers to OFF.
4. On battery disconnect panel, set DISCONNECT/CONNECT breaker to DISCONNECT.

Powering the Power Supply System

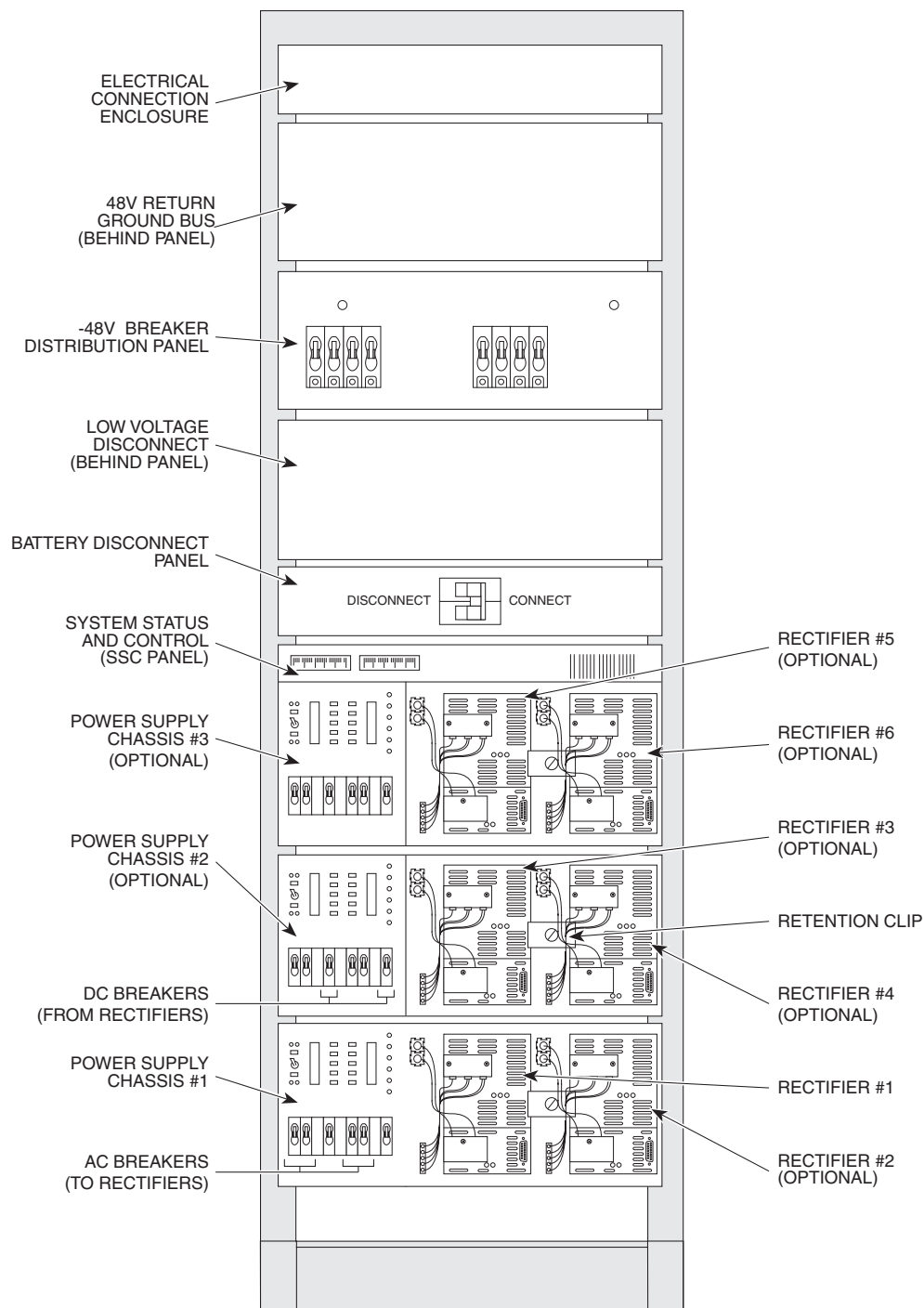
5. On EBTS site AC circuit breaker panel, verify that all circuit breakers for the Power Supply rack are set to ON.
6. On Power Supply chassis, set DC breaker for rectifier #1 to ON.
7. On Power Supply chassis, set AC breaker for rectifier #1 to ON.

Verify that the fan starts and that the system voltmeter reads approximately 54 volts. If necessary, adjust rectifier float and equalize voltages by performing the Battery Float/Equalize Adjustment.

NOTE

The float and equalize voltages for the DC power system are dependent upon the battery system being used. The factory-set voltages are proper for the JCI Dynasty battery system. They will require adjustment when used with the GNB or other batteries. Alarm and other settings are determined by the system engineering. Check with the system manager for proper system voltages and settings.

Powering the Power Supply System

EBTS039
071195JNMFigure 6 **Typical Power Supply Rack (Front View)**

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.

Powering the Power Supply System**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.

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 EBTS equipment. Figure 7 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.

WARNING

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

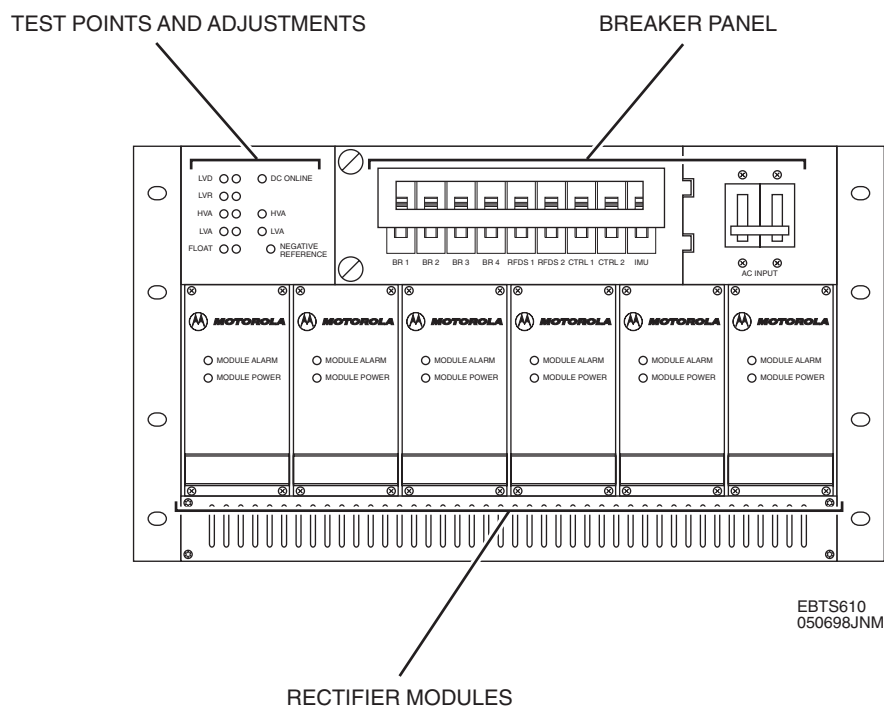


Figure 7 AC/DC Power System (Front View)

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.		

Powering the Power Supply System

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.

 WARNING

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 the Equipment Cabinets

Applying Power to the Equipment Cabinets

The following procedures apply Power Supply rack power to the SCRF or SRRC equipment cabinets. Depending on the type of system, perform the applicable procedure below.

NOTE

Omit this procedure for an SRSC system.

SCRF System

1. On the Power Supply rack breaker panel, set the **CNTRL A** and **CNTRL B** breakers to ON.

This supplies power to Controllers A and B.
2. Verify a voltage level between -43 VDC and -60 VDC at the -48 VDC (hot) terminals on the breaker panel in the cabinet containing the Gen 3.
3. Verify a voltage level of less than 1.0 V between the DC return and chassis ground of the cabinet containing the Gen 3.
4. On the Power Supply rack breaker panel, set the RFC #1 breaker **1A** and **1B** to the ON position.

This supplies power to the A and B sides of the first RF Cabinet.
5. Verify a voltage level of between -43 VDC and -60 VDC at the -48 VDC (hot) terminals A and B at the power distribution panel in the first RF Cabinet.
6. Verify a voltage level of less than 1.0 V between the DC return and chassis ground of the RF Cabinet.
7. If additional RF Cabinets are installed, repeat steps 4 through 6 to turn on the Power Supply rack breakers for RFC #2 (**2A** and **2B**) and RFC #3 (**3A** and **3B**).

SRRC System

1. On the Power Supply rack breaker panel, set the **CNTRL A** and **CNTRL B** breakers to the ON position.

This supplies power to the A and B sides of the SRRC primary cabinet.
2. Verify a voltage level of between -43 VDC and -60 VDC at the -48 VDC (hot) terminals A and B at the power distribution panel in the SRRC primary cabinet.

Applying Power to the Equipment Cabinets

3. Verify a voltage level of less than 1.0 V between the DC return and chassis ground of the cabinet.
4. If Expansion RF Cabinets are installed, repeat steps 1 through 3 to turn on the Power Supply rack breakers for RFC #1 (**1A** and **1B**) through RFC #3 (**3A** and **3B**), as applicable.

Applying Power to Components Within Equipment Cabinets

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.

SCRF 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 Gen 3 SC (control) cabinet breaker panel, set the **EAS/iMU** breaker to ON.

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

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

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

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

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

NOTE

The Site Reference circuit within the Controller requires 13 to 20 minutes to stabilize when initially powered up for the first time. During this time period, the GPS receiver locates and fixes on satellites. Also, the HSO requires 20 minutes for frequency stabilization.

4. On the RF Cabinet breaker panel, set the **BR1** breaker to ON.

Legacy Single Channel BR

Verify the following LED conditions on the BR1 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 Gen 3 SC.

Applying Power to Components Within Equipment Cabinets**QUAD Channel and Generation 2 Single Channel BRs:**

Verify the following LED conditions on the BR1 Base Radio Controller:

- All BRC LEDs remain off during the initial power-up.
 - BR LED remains off while the Base Radio is waiting for code to be downloaded from the Controller. As code downloads, the other LEDs will repeatedly light sequentially until the download is complete.
5. Set the **BR3** breaker to ON.

If Base Radio 3 is installed within the RF Cabinet, verify the LED conditions are as defined in step 4.
 6. Set the **BR5** breaker to ON.

If Base Radio 5 is installed within the RF Cabinet, verify the LED conditions are as defined in step 4.
 7. Set the **RFS1** breaker to ON.

Verify (where applicable) that the corresponding unlabeled LED (green) on the RFDS Power Supply is lit.
 8. Set the **BR2** breaker to ON.

If Base Radio 2 is installed within the RF Cabinet, verify the LED conditions are as defined in step 4.
 9. Set the **BR4** breaker to ON.

If Base Radio 4 is installed within the RF Cabinet, verify the LED conditions are as defined in step 4.
 10. Set the **BR6** breaker to ON (if cabinet is equipped with BR6 breaker).

If Base Radio 6 is installed within the RF Cabinet, verify the LED conditions are as defined in step 4.
 11. Set the **RFS2** breaker to ON.

Verify (where applicable) that the corresponding unlabeled LED (green) on the RFDS Power Supply is lit.
 12. Set the **RFS3** breaker to ON.

(900 MHz Duplexed RFDS only) Verify that the corresponding unlabeled LED (green) on the RFDS Power Supply is lit.
 13. Set the **RFS4** breaker to ON.

(900 MHz Duplexed RFDS only) Verify that the corresponding unlabeled LED (green) on the RFDS Power Supply is lit.
 14. Repeat steps 1 through 13 for additional RF Cabinets (RFC #2 and RFC #3), if necessary.

Applying Power to Components Within Equipment Cabinets**SRRC 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 primary cabinet breaker panel, set the **EAS/iMU** breaker to ON.
Verify that the **Power On** LED on the EAS is lit.
2. Set the **CTRL A** breaker to ON.
Verify that the **Power On** LED on Controller A is lit.
3. Set the **CTRL B** breaker to ON.
Verify that the **Power On** LED on Controller B is lit.

NOTE

The Site Reference circuit card within the Controller requires 13 to 20 minutes to stabilize when initially powered up for the first time. During this time period, the GPS receiver locates and fixes on satellites. Also, the HSO requires 20 minutes for frequency stabilization.

4. Set the **BR1** breaker to ON.

Legacy Single Channel BR

Verify the following LED conditions on the BR1 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 Gen 3 SC.

QUAD Channel and Generation 2 Single Channel BRs:

Verify the following LED conditions on the BR1 Base Radio Controller:

- All BRC LEDs remain off during initial power-up.
- BR LED remains off while the Base Radio is waiting for code to be downloaded from the Gen 3 SC.

Applying Power to Components Within Equipment Cabinets

5. Set the **BR3** 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 **RFS1** breaker to ON.

Verify that the fans in the Dual 3-Way Combiner Deck turn on.

7. Set the **RFS2** breaker to ON.

8. Set the **BR2** breaker to ON.

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

9. Set the **BR4** breaker to ON.

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

10. Set the **RFS3** breaker to ON.

11. Set the **RFS4** breaker to ON.

12. Repeat steps 1 through 11 for additional equipment cabinets, as applicable.

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 circuit card within the Controller requires 13 to 20 minutes to stabilize when initially powered up for the first time. During this time period, the GPS receiver locates and fixes on satellites. Also, the HSO requires 20 minutes for frequency stabilization.

Applying Power to Components Within Equipment Cabinets

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

Single Channel BR

Verify the following LED conditions on the BR1 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 Gen 3 SC.

QUAD Channel and Generation 2 BRs:

Verify the following LED conditions on the BR1 Base Radio Controller:

- All BRC LEDs remain off during initial power-up.
- BR LED remains off while the Base Radio is waiting for code to be downloaded from the Gen 3 SC.

4. 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 3.

5. 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 3.

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

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.

System Testing

Overview

NOTE

In this section, “RF Cabinet” similarly denotes a stand-alone RF cabinet (Stand-Alone Control and RF Cabinet systems) or the RF subsystem of a Single Rack system (Single Rack, Redundant Controller or Single Rack, Single Controller system).

Refer to “EBTS Cabinet Configurations” (*System Description* section of this manual) for more information about system types and cabinet configurations.

This section provides testing procedures for the RF Cabinet. Software downloading and complete test procedures for the Gen 3 SC and iSC are provided in the Gen 3 SC or iSC supplements to this manual.

Perform the Site Control Verification procedures provided in the Supplement prior to performing the RF Cabinet Verification procedures contained herein. The topics of this section are listed in the following table.

Section	Page	Description
Testing Overview	2	Describes the requirements for MMI commands and testing procedures
Site Control(Gen3 SC)/iSC Verification	3	Refer to the <i>Gen 3 SC System Manual, 68P80801E30</i> (Supplement to the EBTS System Manual)
RF Cabinet Verification	4	Testing procedures for components of the RF Cabinet
RF Cabinet Verification - QUAD Carrier	34	Testing procedures for components of the QUAD BR RF Cabinet
QUAD BR Channel Mapping	76	Describes how Carrier Channels are mapped
RF Cabinet Verification - Generation 2 BR	81	Describes procedures for Generation 2 BR RF Cabinet

Testing Overview

The testing procedures covered in this section are intended to be used in conjunction with the information provided in the Gen 3 SC or 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 EBTS 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 Site Control and RF Cabinets for various system tests.

Two different command sets, Gen 3 SC or iSC and Base Radio, allow testing of the EBTS. 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 Gen 3 SC or 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 Gen 3 SC or iSC MMI commands are included in the Gen 3 SC or iSC Supplement to this manual.

Testing Procedures

The procedures in this section test the functionality of the EBTS 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 Gen 3 SC Supplement to this manual for further information. Testing procedures are divided into two sections:

- ❑ Site Control(Gen3 SC)/iSC Verification - refer to the Gen 3 SC System Manual, 68P80801E30 (Supplement to this manual)
- ❑ RF Cabinet Verification - procedures contained herein.

Site Control(Gen3 SC)/iSC Verification

The Gen 3 SC or iSC test procedures are included in the System Testing chapter of the Gen 3 SC or iSC Supplement to this manual. Perform the Site Control (Gen3 SC/iSC) verification procedures prior to performing the RF Cabinet verification procedures. Site Control (Gen3 SC/iSC) test procedures consist of downloading the test software and verifying the operation of the Gen 3 SC/iSC and EAS/iMU. A summary of the Site Control (Gen3 SC/iSC) Verification procedure is provided in the following table.

Gen3 SC /iSC Manual Section	Description
Serial download	Describes how to download application code to the service computer and the Gen 3 SC/iSC via the serial port
Ethernet download	Describes how to download the application code to the service computer and Gen 3 SC/iSC via the Ethernet port
Loading the Base Radios	Describes how to download the application code to each Base Radio
Standby Gen 3 SC/iSC Status	Describes how to check the status of the standby Gen 3 SC/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
EAS/iMU alarm checkout	Describes how to verify that all site alarms monitored by the EAS/iMU are working properly
GPS/SRI status	Describes how to check the alarm, add GPS, and check status

RF Cabinet Verification

RF Cabinet Verification

These procedures verify the operation of the RF Cabinet and Base Radios. The RF Cabinet Verification consists of:

Section	Page	Description
RF Cabinet Test Equipment	4	Identifies all recommended test equipment for the RF Cabinet Verification
Base Radio Start-up Sequence	6	Describes how to connect the service computer and start-up the Base Radio
Displaying Base Radio Alarms	8	Describes how to verify the alarm conditions of the Base Radio
Setting Rx and Tx Frequencies	11	Describes how to program the Base Radio with the desired receive and transmit frequencies
Checking Receive Operation	12	Describes how to verify proper receive operation of the Base Radios
Checking Transmit Operation	26	Describes how to verify proper transmit operation of the Base Radios
Viewing the Transmit Spectrum (optional)	31	Describes how to verify transmit operation through the use of a spectrum display analyzer

RF Cabinet Test Equipment

Commercial Test Equipment

Table 1 lists the recommended test equipment for the RF Cabinet procedures. Equivalent equipment is acceptable, unless otherwise noted.

Table 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 Gen 3 SC 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-EBTS 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 EBTS 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 top of an EBTS RF Cabinet.

RF Cabinet Verification

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:

$$(55 \text{ dBm}) - (\text{meter reading}) = \text{Calibrated cable loss}$$

EXAMPLE:

$$(55 \text{ dBm}) - (56.7 \text{ dBm}) = 1.7 \text{ dB cable loss}$$

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 Gen 3 SC or iSC. Refer to Loading the Base Radios in the Gen 3 SC or 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 Generation 3 Site Controller (Gen 3 SC) 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 2.

Table 2 **Single Carrier 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:

- For Legacy Base Radios- All BRC LEDs flash 3 times upon initial power-up.
- For Gen2 Base Radios: CTL LED momentarily flashes on initial power-up
- BR LED flashes quickly when BR is waiting for code to be downloaded from Gen 3 SC or 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.

RF Cabinet Verification

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 RF 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 a selected RF 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 Gen 3 SC /iSC procedures, the Base Radios were connected to the Gen 3 SC/iSC and received downloaded test software via the BR-Gen 3 SC /iSC Ethernet link. If necessary, reset the Base Radio to initiate the code download from the Gen 3 SC/iSC.

1. When prompted, type the proper password.

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

The default factory set field password is **motorola**.

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

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.

RF Cabinet Verification

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 (800 MHz Base Radio) and a default transmit frequency of 851.000 MHz (800 MHz Base Radio).

ATTENTION

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 XXX.XXXXX** to set the receive frequency.
XXX.XXXXX represents the desired 800 MHz frequency.

800 MHz BR Example:

```
BRC> set rx_freq 806.00000
set RECEIVE FREQUENCY to 806.00000 MHz in RAM
```

3. Type **set tx_freq XXX.XXXXX** to set the transmit frequency.
XXX.XXXXX represents the desired 800 MHz frequency.

800 MHz BR Example:

```
BRC> set tx_freq 851.00000
set TRANSMIT FREQUENCY to 851.00000 MHz in RAM
```

4. Proceed to Checking Receive Operation.

RF Cabinet Verification**CAUTION**

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 Main and Expansion (if used) RF Cabinets. 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 on the EBTS RF Cabinet.

NOTE

(800 MHz Cavity Combining RFDS only)
Prior to performing this procedure, perform the receiver equalization procedure described in the Cavity Combining RFDS section of this manual.

NOTE

The following procedure requires the use of a calibrated test set-to-EBTS 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/Single Channel BR 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 default factory set field password is Motorola.

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

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
```

RF Cabinet Verification **CAUTION**

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 each of the RF Cabinets at this site.
11. Connect the service computer to the bottom Base Radio (BR1) in the RF 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:

800 MHz BR Example:

```
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

(800 MHz systems only) 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:

800 MHz Duplexed RFDS:

- 14.1 Disconnect the antenna cable from the duplexer 1 antenna port on the EBTS Main RF Cabinet.
- 14.2 (See Figure 1.) Using the Calibrated Test cable, connect the R2660 **RF IN/OUT** connector to the duplexer 1 antenna port.

800 MHz Cavity Combining RFDS:

- 14.1 Disconnect the antenna cable from the **RX1** antenna port (or top of DC injector, if so equipped) on the EBTS Main RF Cabinet.
- 14.2 (See Figure 1.) Using the Calibrated Test cable, connect the R2660 **RF IN/OUT** connector to the **RX1** antenna port (or top of DC injector, if so equipped).

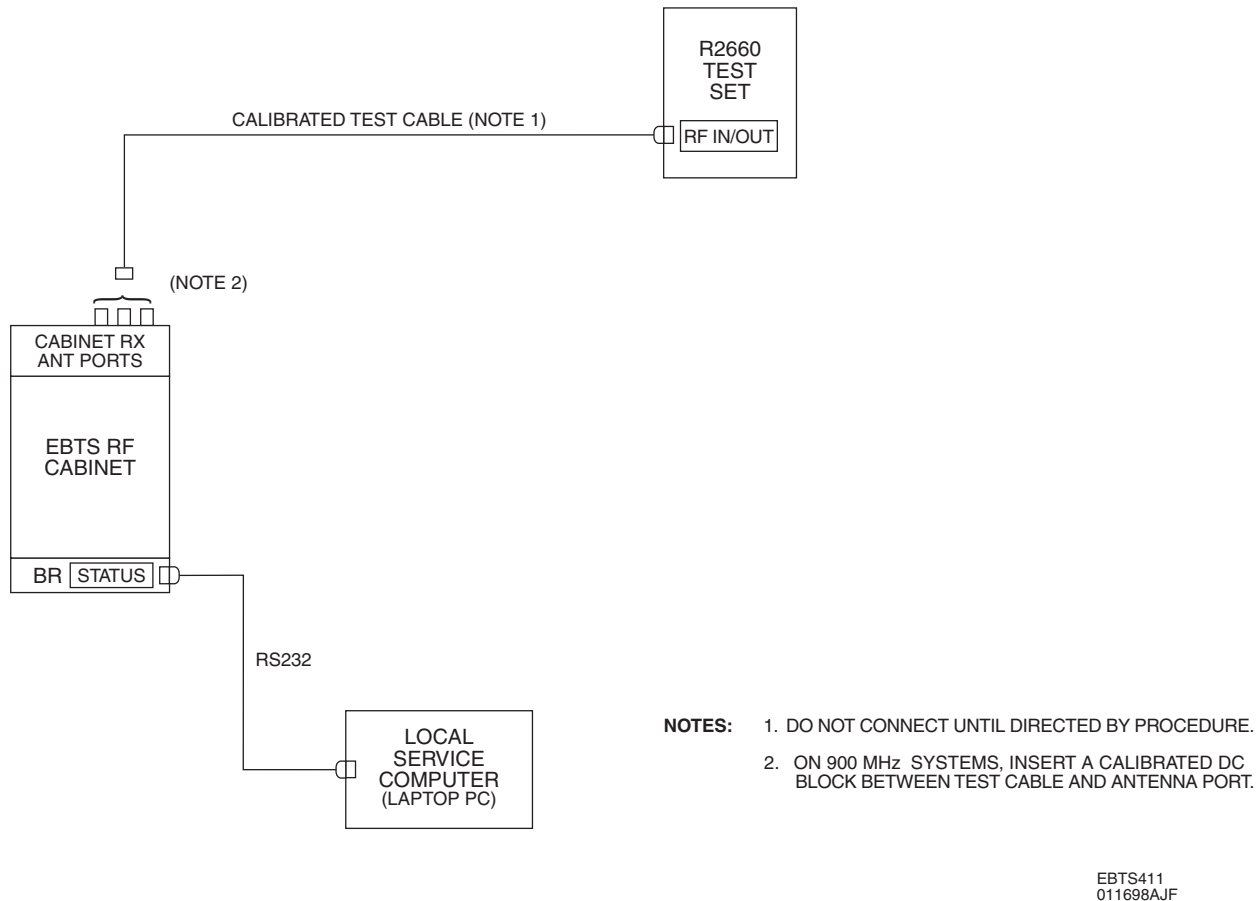
RF Cabinet Verification

Figure 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 each RF Cabinet at the site.

```
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 dBm	RSSI2 dBm	RSSI3 dBm	SGC dB	CI dBm	BER dBm%	OffsetSyncMiss 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 $\pm$ 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 between -81.0 dBm to -79.0 dBm.**

RF Cabinet Verification

19. Depending on the system type being tested, adjust R2660 output level for an output level **at the end of the cable feeding the EBTS** as follows:

System Type	Required Level at cable end
800 MHz Duplexed RFDS	-113.5 dBm
900 MHz Duplexed RFDS	-114.5 dBm
800 MHz Cavity Combining RFDS	-107.5 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 EBTS signal level as follows:

800 MHz Duplexed RFDS:
$(-113.5 \text{ dBm}) + \text{Calibrated cable loss} = \text{Required R2660 Output Level}$
EXAMPLE: $(-113.5) + (1.7) = -111.8 \text{ dBm}$

800 MHz Cavity Combining RFDS:
$(-107.5 \text{ dBm}) + \text{Calibrated cable loss} = \text{Required R2660 Output Level}$
EXAMPLE: $(-107.5) + (1.7) = -105.8 \text{ dBm}$

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:

For 800 MHz Systems, 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 dBm	RSSI2 dBm	RSSI3 dBm	SGC dB	DIVBER dBm%	SyncMiss %
----	-----	-----	-----	----	-----	-----
100	-113.5			0.0	1.942e+00	0.000e+00
200	-113.5			0.0	1.068e+00	0.000e+00

800 MHz Cavity Combining RFDS Example:

BRC> **get rssi 2 100**

Starting RSSI monitor for 2 repetitions averaged each 100 reports.

Line	RSSI1 dBm	RSSI2 dBm	RSSI3 dBm	SGC dB	DIVBER dBm%	SyncMiss %
----	-----	-----	-----	----	-----	-----
100	-107.5			0.0	1.942e+00	0.000e+00
200	-107.5			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

RF Cabinet Verification**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.

800 MHz BR:

```
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.

NOTE

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:

800 MHz MHz Duplexed RFDS:

- 26.1 Disconnect the Calibrated Test Cable from the antenna 1 duplexer.
- 26.2 Reconnect the antenna cable to the duplexer 1 antenna port.

800 MHz Cavity Combining RFDS:

- 26.1 Disconnect the Calibrated Test Cable from the **RX1** antenna port (or top of DC injector, if so equipped).
- 26.2 Reconnect the antenna cable to the **RX1** antenna port (or top of DC injector, if so equipped).

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:

800 MHz MHz Duplexed RFDS:

- 1.1 Disconnect the antenna cable from the duplexer 2 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 2 antenna port.

800 MHz Cavity Combining RFDS:

- 1.1 Disconnect the antenna cable from the **RX2** antenna port (or top of DC injector, if so equipped) on the EBTS Main RF Cabinet.
- 1.2 Using the Calibrated Test cable, connect the R2660 **RF IN/OUT** connector to the **RX2** antenna port (or top of DC injector, if so equipped).

RF Cabinet Verification

2. Connect the service computer to the bottom Base Radio (BR1) STATUS connector in the Main RF 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 in all cabinets at the site.

5. Reconnect antenna connections as follows:

800 MHz Duplexed RFDS:

- 5.1 Disconnect the Calibrated Test Cable from the antenna 2 duplexer.
- 5.2 Reconnect the antenna cable to the duplexer 2 antenna port.

800 MHz Cavity Combining RFDS:

- 5.1 Disconnect the Calibrated Test Cable from the **RX2** antenna port (or top of DC injector, if so equipped).
- 5.2 Reconnect the antenna cable to the **RX2** antenna port (or top of DC injector, if so equipped).

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 Main RF 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 Main and Expansion RF Cabinets.
11. Disconnect the service computer from the last Base Radio when complete.

RF Cabinet Verification

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:

800 MHz Duplexed RFDS:

- 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.

800 MHz Cavity Combining RFDS:

- 1.1 Disconnect the antenna cable from the **RX3** antenna port (or top of DC injector, if so equipped) on the EBTS Main RF Cabinet.
- 1.2 Using the Calibrated Test cable, connect the R2660 **RF IN/OUT** connector to the **RX3** antenna port (or top of DC injector, if so equipped).

2. Connect the service computer to the bottom Base Radio (BR1) STATUS connector in the Main RF 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 all Base Radios within all RF cabinets 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 in all cabinets at the site.

5. Reconnect antenna connections as follows:

800 MHz Duplexed RFDS:

- 5.1 Disconnect the Calibrated Test Cable from the antenna 3 duplexer.
- 5.2 Reconnect the antenna cable to the duplexer 3 antenna port.

800 MHz Cavity Combining RFDS:

- 5.1 Disconnect the Calibrated Test Cable from the **RX3** antenna port (or top of DC injector, if so equipped).
- 5.2 Reconnect the antenna cable to the **RX3** antenna port (or top of DC injector, if so equipped).

6. Connect the service computer to the bottom Base Radio (BR1) in the Main RF 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 in all the RF Cabinets at the site.

RF Cabinet Verification

10. Noting the recorded BER sensitivity readings obtained in step 21 of the BER/Single Channel BR 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.

ATTENTION

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

NOTE

(Cavity Combining RFDS only)
Prior to performing this procedure, perform the cavity tuning procedure described in the Cavity Combining RFDS section of this manual.

NOTE

The following steps describe the transmit verification of a 70 W Power Amplifier. If the Base Radio under test contains a 40W or 60W Power Amplifier, substitute 40 or 60 (as applicable) 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 RF Cabinet and log on.

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

This command stops all RF transmission.

```
BRC> dekey
completed successfully
```

ATTENTION

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

CAUTION

Attempting to key a 40W (or 60W) station to an output power greater than 40W (or 60W) 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
```

RF Cabinet Verification**NOTE**

(Cavity Combining RFDS only)

The **get wattmeter** command functions only on Base Radios located in the Main RF Cabinet. The **get fwd_pwr**, **get ref_pwr**, and **get vswr** commands are valid for all Base Radios at the site.

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 3 or 4 (as applicable).

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 3 or 4 (as applicable).

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 3 or 4 (as applicable).

NOTE

(Duplexed RFDS only)

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 “RF Cabinet Alarm/ Power Monitor Harness Connections” (Cabling Information) in the RF Distribution System section of this manual that applies to the system being tested.

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 3 or 4 (as applicable).

Table 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
Wattmeter Forward Power:		
800 MHz Duplexed RFDS 0182020V06	Greater than 28.5W (w/ combiner 13 W)	Greater than 16 W (w/ combiner 7.5 W)
Wattmeter Reflected Power	Less than 4.8 W (w/ combiner 2.2 W)	Less than 2.7 W (w/ combiner 1.3 W)

RF Cabinet Verification

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

Function	Tolerance	
	70 W, 800 MHz PA	40 W, 800 MHz PA
Wattmeter Forward Power (Expansion Configurations): (NOTE 1)		
800 MHz Duplexed RFDS 0182020V06 (NOTE 2)	Greater than 5 W	—
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
800 MHz GEN 4 Duplexed RFDS; 6 BRs per antenna (cascaded combining)	Greater than 3.5 W	Greater than 2 W
Wattmeter Reflected Power (Expansion Configurations)	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. 2. 800 MHz Duplexed RFDS (0182020V06 and prior) is no longer available. It has been replaced by the 800 MHz GEN 4 Duplexed RFDS. All information herein regarding 800 MHz Duplexed RFDS (0182020V06 and prior) is for reference only.		

Table 4 **Transmit Level Specifications (Cavity Combining RFDS)**

Function	Tolerance	
	70 Watt PA	40 Watt PA
Forward Power	Greater than 66 Watts	Greater than 38 Watts
Reflected Power	Less than 7 Watts	Less than 6.3 Watts
VSWR	Less than 2.4:1	Less than 2.4:1
Wattmeter Forward Power †	Greater than 21 Watts	Greater than 12 Watts
Wattmeter Reflected Power †	Less than 3.5 Watts	Less than 2 Watts
† Typical numbers based on the insertion loss of a two channel combiner.		

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 within each of the RF Cabinets 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 or 60 W Power Amplifier, substitute 40 or 60 (as applicable) 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.

RF Cabinet Verification

ATTENTION

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

Attempting to key a 40W (or 60W) station to an output power greater than 40W (or 60W) 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 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.

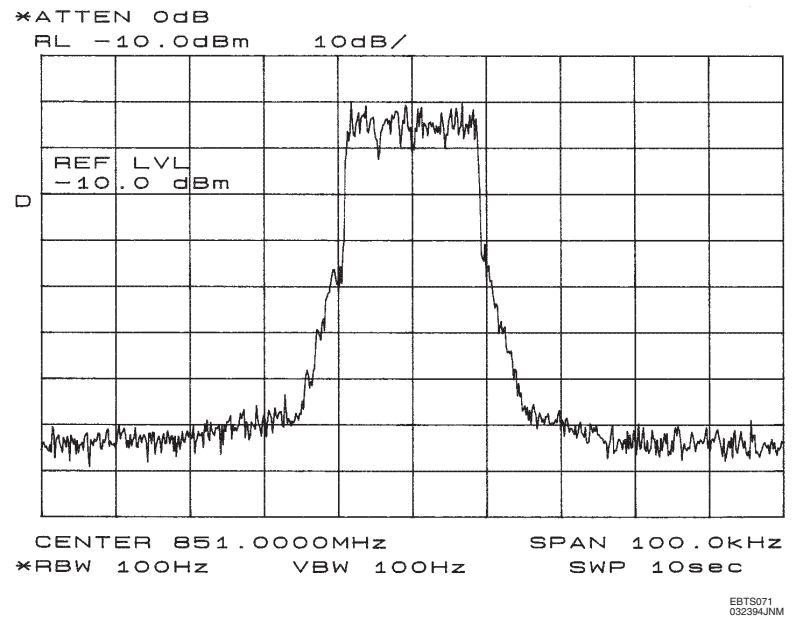


Figure 2 **Spectrum Analyzer Display of Transmitted Signal (800 MHz Base Radio)**

RF Cabinet Verification - QUAD Carrier

RF Cabinet Verification - QUAD Carrier

These procedures verify the operation of the QUAD Carrier RF Cabinet and Base Radios. The QUAD Carrier RF Cabinet Verification consists of:

Section	Page	Description
QUAD QUAD RF Cabinet Test Equipment	34	Identifies all recommended test equipment for the RF Cabinet Verification.
QUAD Channel Base Radio Start-up Sequence	35	Describes how to connect the service computer and start-up the quad carrier Base Radio.
Selecting QUAD Base Radio Position and Receiver Complement	38	Describes how to select Base Radio. position and Receiver complement
Displaying QUAD Channel Base Radio Alarms	39	Describes how to verify the alarm conditions of the Base Radio.
Checking QUAD BR Receive Operation	40	Describes how to verify proper receive operation of the Base Radios.
QUAD Channel BR -- Checking Transmit Operation	68	Describes how to verify proper transmit operation of the Base Radios.
QUAD BR Channel Mapping	76	Describes how Carrier Channels are mapped

QUAD RF Cabinet Test Equipment**Commercial Test Equipment**

Table 5 lists the recommended test equipment for the RF Cabinet procedures. Equivalent equipment is acceptable, unless otherwise noted.

Table 5 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 Attenuator, 10dB		Motorola	Used to attenuate signal from Rubidium Reference

Table 5 **Test Equipment for RF Cabinet Testing**

Equipment	Model/Type	Manufacturer	Description
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.			

QUAD Channel Base Radio Start-up Sequence

NOTE

The first time a 900 MHz QUAD BR is powered on-site, it will boot to the test mode. Once the cabinet and position IDs are set, you must perform a front panel reset to enter the test mode.

NOTE

The QUAD BR must be in test mode in order to activate the BR installation software. This is done by performing a diagnostic reset. Press the reset button located on the BR front panel and follow the on-screen instructions. The QUAD BR Test and Application software is resident on the Base Radio and need not be downloaded from the iSC/Gen 3 SC.

1. Find the STATUS connector on the front of EX / CNTL, in sector 1. Connect an RS-232 cable between the service computer and the STATUS connector.
2. If someone shut down the system between procedures, apply power. (QUAD Channel Base Radios should still be under power, due to the System Checkout procedure.)
3. After the BR is powered up using the front switch on the Power Supply Module, press the reset button on the Control Module front panel. At the

RF Cabinet Verification - QUAD Carrier

prompt, hit a Carriage Return on the service computer to enter the test application mode. Using the field password, log in to the BR.

To enter field mode, at the > prompt type **login -ufield**.

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

The default factory set field password is **motorola**.

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

```
>login -ufield  
password:<login password>  
  
field>
```

4. On the BRC, verify LED conditions for each QUAD Channel Base Radio. Refer to Table 2.

Table 6 **QUAD Channel Base Radio LED Indications**

LED	Color	Normal Indication
PS	Red	Off
EX / CNTL	Red	Off
PA	Red	Off
REF	Red	Off
RX1	Red	Off
RX2	Red	Off
RX3	Red	Off
RX4	Red	Off
TX1	Green	Flashing while keyed or Solid when dekeyed
TX2	Green	Flashing while keyed or Solid when dekeyed
TX3	Green	Flashing while keyed or Solid when dekeyed
TX4	Green	Flashing while keyed or Solid when dekeyed
NOTE: For conditions related to indications above, refer to this manual's QUAD Channel Base Radio section.		

The following LED operation is normal for the QUAD Channel BR:

- Loading of a file to RAM.
 - An LED pattern walks slowly in a series from right to left, and then repeats.
 - Loading a file to NVM (FLASH).
 - An LED pattern walks slowly in a series from both ends towards the middle, and then repeats.
 - Memory Testing.
 - A continuous LED pattern sweeps slowly in a series from left to right, and then right to left.
5. On the Base Radio's Power Supply module, verify that the green LED is lit.

Selecting QUAD 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 RF 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 QUAD Channel Base Radio Position

The pi -oplatform command programs the position number of where a Base Radio is mounted within a selected RF Cabinet. Usage is below:

```
pi -oplatform -pX
where X is the position value
```

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

The ci -oplatform command programs the cabinet number of where a Base Radio is mounted. Usage is below:

```
ci -oplatform -cX
where X is the cabinet value
```

Selecting A Receiver Complement For A QUAD Channel Base Radio

The diversity command sets which receivers should be present in a selected Base Radio. The command has provision for all possible complements of receivers. Usage is below:

```
diversity -orx_all -dX
```

where X is enables the diversity configuration as below:

diversity -orx_all -d0	#Turn all branches off
diversity -orx_all -d1	#enable branch 1; 2 & 3 are off
diversity -orx_all -d10	#enable branch 2; 1 & 3 are off
diversity -orx_all -d11	#enable branch 1 & 2; 3 is off
diversity -orx_all -d100	#enable branch 3; 1 & 2 are off
diversity -orx_all -d101	#enable branch 3 & 1; 2 is off
diversity -orx_all -d110	#enable branch 3 & 2; 1 is off
diversity -orx_all -d111	# enable 1, 2 and 3

Displaying QUAD Channel Base Radio Alarms

NOTE

The QUAD BR must be in test mode in order to activate the BR installation software. This is done by performing a diagnostic reset. Press the reset button located on the BR front panel and follow the on-screen instructions. The QUAD BR Test and Application software is resident on the Base Radio and need not be downloaded from the iSC/Gen 3 SC.

1. At the > prompt, initiate login to the QUAD Channel BR.

To enter field mode, at the > prompt type **login -ufield**.

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

The default factory set field password is **motorola**.

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

```
>login -ufield
password:<login password>

field>
```

RF Cabinet Verification - QUAD Carrier**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. Type: alarms -ofault_hndlr

The ALARMS command returns the active 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:

```
field> alarms -ofault_hndlr

ACTIVE_FAULT_ID=RX_LO1_LOCK

field>
```

Checking QUAD BR Receive Operation

Receive operation test procedures must be performed on each Base Radio in the Main and Expansion (if used) RF Cabinets. 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 on the EBTS RF Cabinet.

NOTE

(800 MHz Cavity Combining RFDS only)
Prior to performing this procedure, perform the receiver equalization procedure described in the Cavity Combining RFDS section of this manual.

NOTE

The following procedure requires the use of a calibrated test set-to-EBTS signal cable. Refer to the 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.

QUAD Channel BR: 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.

QUAD BR Receiver Verification: Base Radio with RFDS (Measurement at the top of Rack)

The receiver verification procedure sends a known test signal into the Base Radio via the antenna ports at the top of the rack 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 services to system users.

RF Cabinet Verification - QUAD Carrier**Equipment Setup**

Set up equipment for the receiver verification 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 cables from the connectors labeled RX1, RX2, and RX3 at the top of the EBTS rack. If the radio is configured for 2 Branch diversity, disconnect the RX1 and RX2 cables.

NOTE

Connecting the R2660 to the EBTS rack antenna ports will introduce extra system gain into the measurement, which must be accounted for. This must be accounted for in the calibration procedure. (See "Calibration of the R2660 output level" on page 50.).

5. Connect test cables from each of the RX1, RX2, and RX3 connectors (Cables A,B,C in Figure 3) to the input ports of the 3-way splitter. For 2 Branch diversity tests, load the RX3 cable with an appropriate 50ohm load or connect it to the RX3 antenna port on the radio.

6. Connect an additional test cable (Cable D in Figure 3) from the summed port of the 3-way splitter to the RF IN/OUT connector on the R2660 Communications Analyzer.

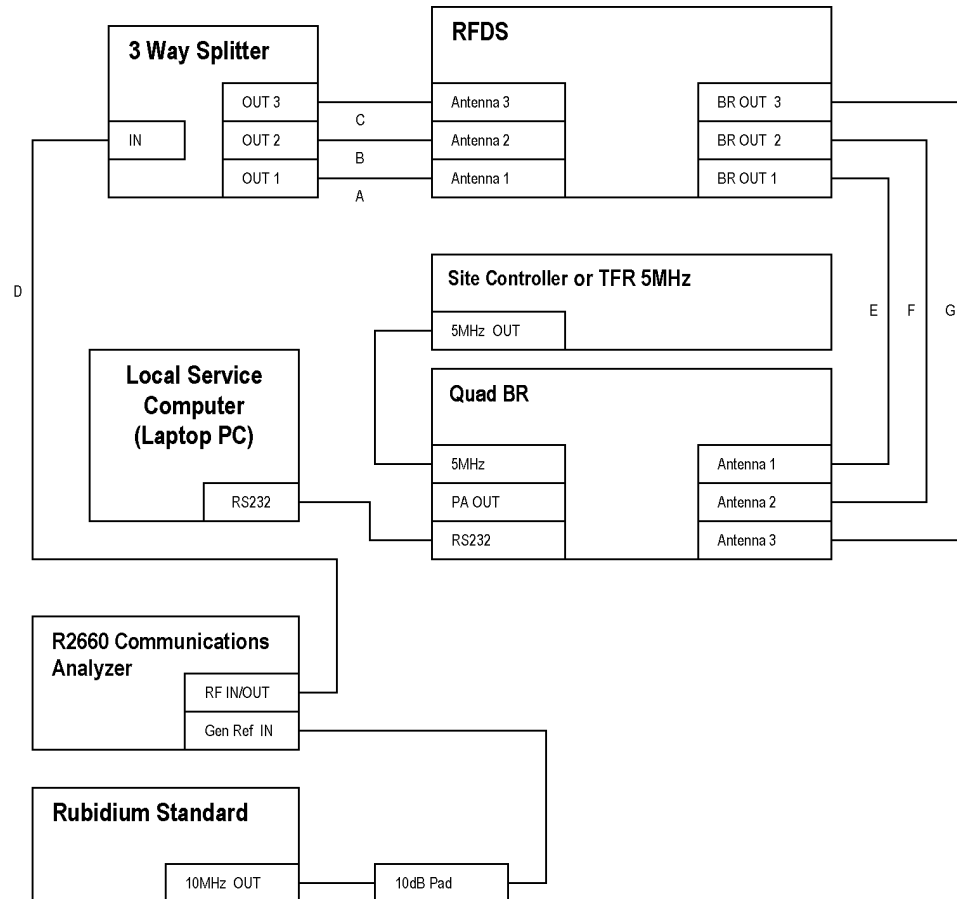


Figure 3 **QUAD BR w/ RFDS Verification Test Setup**

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.

RF Cabinet Verification - QUAD Carrier**NOTE**

Refer to the equipment manual provided with the R2660 for further information regarding mode configuration of the unit (Motorola Part No. 68P80386B72).

9. Set the R2660 to the EXT REF mode.
10. Apply power to the R2660.

NOTE

Due to the nature of the Quad BR configuration, Antenna 2 MUST be connected to the R2660 for synchronization (This is not required for SR9.6 and above). All three RX inputs on the back of the EBTS must be connected to the R2660 and calibrated such that EACH input receives the calibrated RF signal. (See "Calibration of the R2660 output level" on page 50.) If all RX inputs are not connected, some receive paths will not receive properly.

QUAD BR Receiver Verification Procedure: Base Radio with RFDS

This procedure provides commands and responses to verify proper operation of the Base Radio receiver paths. Perform the procedure on all four channels in each Base Radio in the EBTS.

1. Power on the BR using the front switch on the Power Supply Module. Press the reset button on the front of the EX/BRC module. Using the terminal program on the service computer, log onto the BR. Bold type indicates user input commands.

To enter field mode, at the > prompt type **login -ufield**.

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

The default factory set field password is **motorola**.

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

```
>login -ufield  
password:<login password>  
  
field>
```

2. Set the Frequency of the R2660 to 810 MHz (898 MHz for 900 MHz QUAD BR). R2660 power out should be set to -80 dBm.

NOTE

Replace **810** with **898** for 900 MHz QUAD BR in the following MMI command sessions.

RF Cabinet Verification - QUAD Carrier

3. Set all channel frequencies.

```
field> freq -orxch1 -f810  
field> freq -orxch2 -f810  
field> freq -orxch3 -f810  
field> freq -orxch4 -f810
```

4. Verify the R2660 signal level:

```
field> enable -orxch1 -dbr1 -son  
field> ppc -orxch1 -mchn -s1  
field> ppr -orxch1 -r1 -a100
```

5. The resulting output will look similar to this:

```
field> ppr -orxch1 -r1 -a100  
  
SGC Atten.(dBm)=0.000000  
Freq. Offset=-15.059323  
Sync. Attempts=1.000000  
Sync. Successes=1.000000  
BER%=0.000000  
RX Path1 RSSI=-80.934021  
RX Path2 RSSI=-127.012520  
RX Path3 RSSI=-127.012520  
Chn sig. strength=-57.098698  
Chn intf. strength=-91.696739  
  
field>
```

NOTE

RX Path1 RSSI must read -80dBm $\pm$ 1dB for the BER Floor verification to be accurate. Adjust the output level of the R2660 to compensate for loss in the test cables and three-way splitter.

QUAD BER Floor Measurement: Base Radio with RFDS

1. Verify that the R2660 is set to 810MHz (898 MHz for 900 QUAD BR) and is producing a power level of -80dBm. (See "QUAD BR Receiver Verification Procedure: Base Radio with RFDS" on page 44.)
2. Using the MMI commands below, issue the command to put the BR into single branch mode. If the resulting bit error rate for receiver branches 1, 2, and 3 is less than 0.01%, the receiver has passed the test.
3. Check Receiver 1. At the field> prompt, type (inputs are in **bold**, comments are in *italics*):

NOTE

Replace **810** with **898** for 900 MHz QUAD BR in the following MMI command sessions

RF Cabinet Verification - QUAD Carrier

```
field> freq -orxch1 -f810
field> enable -orxch1 -soff
field> enable -orxch1 -dbr1 -son
field> ppc -orxch1 -mchn -s1
field> ppr -orxch1 -a1000 -r1

field> enable -orxch1 -soff
field> enable -orxch1 -dbr2 -son
field> ppc -orxch1 -mchn -s1
field> ppr -orxch1 -a1000 -r1

field> enable -orxch1 -soff
field> enable -orxch1 -dbr3 -son
field> ppc -orxch1 -mchn -s1
field> ppr -orxch1 -a1000 -r1
```

Check Receiver 2:

```
field> freq -orxch2 -f810
field> enable -orxch2 -soff
field> enable -orxch2 -dbr1 -son
field> ppc -orxch2 -mchn -s1
field> ppr -orxch2 -a1000 -r1

field> enable -orxch2 -soff
field> enable -orxch2 -dbr2 -son
field> ppc -orxch2 -mchn -s1
field> ppr -orxch2 -a1000 -r1

field> enable -orxch2 -soff
field> enable -orxch2 -dbr3 -son
field> ppc -orxch2 -mchn -s1
field> ppr -orxch2 -a1000 -r1
```

Check Receiver 3:

```
field> freq -orxch3 -f810  
field> enable -orxch3 -soff  
field> enable -orxch3 -dbr1 -son  
field> ppc -orxch3 -mchn -s1  
field> ppr -orxch3 -a1000 -r1  
  
field> enable -orxch3 -soff  
field> enable -orxch3 -dbr2 -son  
field> ppc -orxch3 -mchn -s1  
field> ppr -orxch3 -a1000 -r1  
  
field> enable -orxch3 -soff  
field> enable -orxch3 -dbr3 -son  
field> ppc -orxch3 -mchn -s1  
field> ppr -orxch3 -a1000 -r1
```

Check Receiver 4:

```
field> freq -orxch4 -f810  
field> enable -orxch4 -soff  
field> enable -orxch4 -dbr1 -son  
field> ppc -orxch4 -mchn -s1  
field> ppr -orxch4 -a1000 -r1  
  
field> enable -orxch4 -soff  
field> enable -orxch4 -dbr2 -son  
field> ppc -orxch4 -mchn -s1  
field> ppr -orxch4 -a1000 -r1  
  
field> enable -orxch4 -soff  
field> enable -orxch4 -dbr3 -son  
field> ppc -orxch4 -mchn -s1  
field> ppr -orxch4 -a1000 -r1
```

RF Cabinet Verification - QUAD Carrier

4. Enter the command to return all active alarms of the Base Radio. At the field> prompt, type:

```
field> alarms -ofault_hndl
```

NOTE

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

5. As shown below respectively for 800 MHz Quad Base Radios, the following command returns the kit numbers of the receiver and all other modules. At the field> prompt, type:

```
field> fc -oplatform
```

QUAD BR Receiver Sensitivity Measurement: Base Radio with RFDS

The receiver sensitivity measurement consists of sending a calibrated RF level of -113.5dBm to the antenna ports at the top of the rack. This includes the RFDS in the receive channel and measures the combined performance of the Base Radio and the RFDS. The R2660 output must be calibrated prior to the taking of this measurement.

Calibration of the R2660 output level

1. Verify that the R2660 is set to 810 MHz (898 MHz for 900 MHz QUAD BR) and adjust the output power to a level of -50dBm
2. Calibrate HP438A Power Meter. Refer to the HP users guide that came with the Meter. Below is a general procedure that can be followed.
 - 2.1 Attach 8481D Power Sensor to the **Sensor** input on the front of the 438A.
 - 2.2 Attach the included HP 11708A 30dB pad to the **Power REF** (8481D sensor) output on the front on the 438A.
 - 2.3 Power on the 438A.

- 2.4 Connect the Power Sensor to the female end of the 30dB pad extruding from the **Power REF** output.
 - 2.5 Press the **"Zero"** button on the 438A.
 - 2.6 Wait for Zeroing operation to complete.
 - 2.7 Press **"Shift-Zero"** to enter the Cal value. This is listed as **Cf** on the Power Sensor.
 - 2.8 Wait for Cal operation to complete.
 - 2.9 Press **"Shift-Freq"** to enter the Cal Factor. This is listed as **Cf** in a chart vs. freq on the Power Sensor. Choose the closest frequency range for the application. For 800/900 MHz measurements, interpolate between 1.0GHz and 0.5GHz to obtain a **Cf**.
 - 2.10 For measurement of iDEN 6:1 waveforms, press **"Offset"** and enter 7.78dB.
3. Disconnect Cable A (see Figure 3) from the Base Radio and connect it to the Power Sensor Head.
 4. Increase the power level on the R2660 until the HP 438A Power Meter reads -50dBm.
 5. Record the DISPLAYED power level of the R2660 as Calfactor A.
 6. The path loss through the cable and splitter system is Calfactor A + 50.
 Example: R2660 reads -44dBm
 HP 438A reads -50dBm
 Calfactor A = -44, path loss = 6dB
 7. Path loss must be determined for each Antenna cable A,B,C (see Figure 3). If comparable cables are used for all three paths, losses of all three should be approximately the same.
 8. Additional power will be added to the R2660 in the sensitivity measurement to balance out the additional path loss value.
 9. Reconnect cables A,B,C (see Figure 3) to Antenna Ports 1,2,3.
 10. Set the R2660 to Frequency 810 MHz (898 MHz for 900 MHz QUAD BR) and a Power level of -113.5dBm + path loss. For example, if your path loss was 6dB, set the R2660 to -107.5dBm.

Using the MMI commands below, issue the command to put the BR into single branch mode. If the resulting bit error rate for receiver branches 1, 2, and 3 is less than 8.00%, the receiver has passed the test.

RF Cabinet Verification - QUAD Carrier**NOTE**

Replace **810** with **898** for 900 MHz QUAD BR in the MMI command sessions below

```
field> freq -orxch1 -f810
field> enable -orxch1 -soff
field> enable -orxch1 -dbr1 -son
field> ppc -orxch1 -mchn -s1
field> ppr -orxch1 -a100 -r1

field> enable -orxch1 -soff
field> enable -orxch1 -dbr2 -son
field> ppc -orxch1 -mchn -s1
field> ppr -orxch1 -a100 -r1

field> enable -orxch1 -soff
field> enable -orxch1 -dbr3 -so
field> ppc -orxch1 -mchn -s1
field> ppc -orxch1 -mchn -s1
field> ppr -orxch1 -a100 -r1
```

Check Receiver 2:

```
field> freq -orxch2 -f810
field> enable -orxch2 -soff
field> enable -orxch2 -dbr1 -son
field> ppc -orxch2 -mchn -s1
field> ppr -orxch2 -a100 -r1

field> enable -orxch2 -soff
field> enable -orxch2 -dbr2 -son
field> ppc -orxch2 -mchn -s1
field> ppr -orxch2 -a100 -r1

field> enable -orxch2 -soff
field> enable -orxch2 -dbr3 -son
field> ppc -orxch2 -mchn -s1
field> ppr -orxch2 -a100 -r1
```

Check Receiver 3:

```
field> freq -orxch3 -f810
field> enable -orxch3 -soff
field> enable -orxch3 -dbr1 -son
field> ppc -orxch3 -mchn -s1
field> ppr -orxch3 -a100 -r1

field> enable -orxch3 -soff
field> enable -orxch3 -dbr2 -son
field> ppc -orxch3 -mchn -s1
field> ppr -orxch3 -a100 -r1

field> enable -orxch3 -soff
field> enable -orxch3 -dbr3 -son
field> ppc -orxch3 -mchn -s1
field> ppr -orxch3 -a100 -r1
```

RF Cabinet Verification - QUAD Carrier

Check Receiver 4:

```
field> freq -orxch4 -f810  
field> enable -orxch4 -soff  
field> enable -orxch4 -dbr1 -son  
field> ppc -orxch4 -mchn -s1  
field> ppr -orxch4 -a100 -r1  
  
field> enable -orxch4 -soff  
field> enable -orxch4 -dbr2 -son  
field> ppc -orxch4 -mchn -s1  
field> ppr -orxch4 -a100 -r1  
  
field> enable -orxch4 -soff  
field> enable -orxch4 -dbr3 -son  
field> ppc -orxch4 -mchn -s1  
field> ppr -orxch4 -a100 -r1
```

11. Enter the command to return all active alarms of the Base Radio. At the field> prompt, type:

```
field> alarms -ofault_hndl
```

NOTE

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

12. As shown below respectively for Quad Base Radios, the following command returns the kit numbers of the receiver and all other modules. At the field> prompt, type:

```
field> fc -oplatform
```


QUAD BR Receiver Verification: Measurement of the Base Radio (No RFDS)

The receiver verification procedure sends a known test signal into the Base Radio to verify the receive path. The signal is fed DIRECTLY into the ANTENNA PORTS in the back of the Base Radio. This excludes the RFDS and antenna cabling from the measurement. 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 services to system users.

Equipment Setup

Set up the equipment for the receiver verification 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 cables from the connectors labeled RX1, RX2, and RX3 on the back of the Base Radio. If the radio is configured for 2 Branch diversity, disconnect the RX1 and RX2 cables.
5. Connect test cables from each of the RX1, RX2, and RX3 connectors (Cables A,B,C in Figure 4) to the input ports of the 3-way splitter. For 2 Branch diversity tests, load the RX3 cable with an appropriate 50ohm load or connect it to the RX3 antenna port on the radio.
6. Connect an additional test cable (Cable D in Figure 3) from the summed port of the 3-way splitter 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.

RF Cabinet Verification - QUAD Carrier**NOTE**

Refer to the equipment manual provided with the R2660 for further information regarding mode configuration of the unit (Motorola Part No. 68P80386B72).

9. Set the R2660 to the EXT REF mode

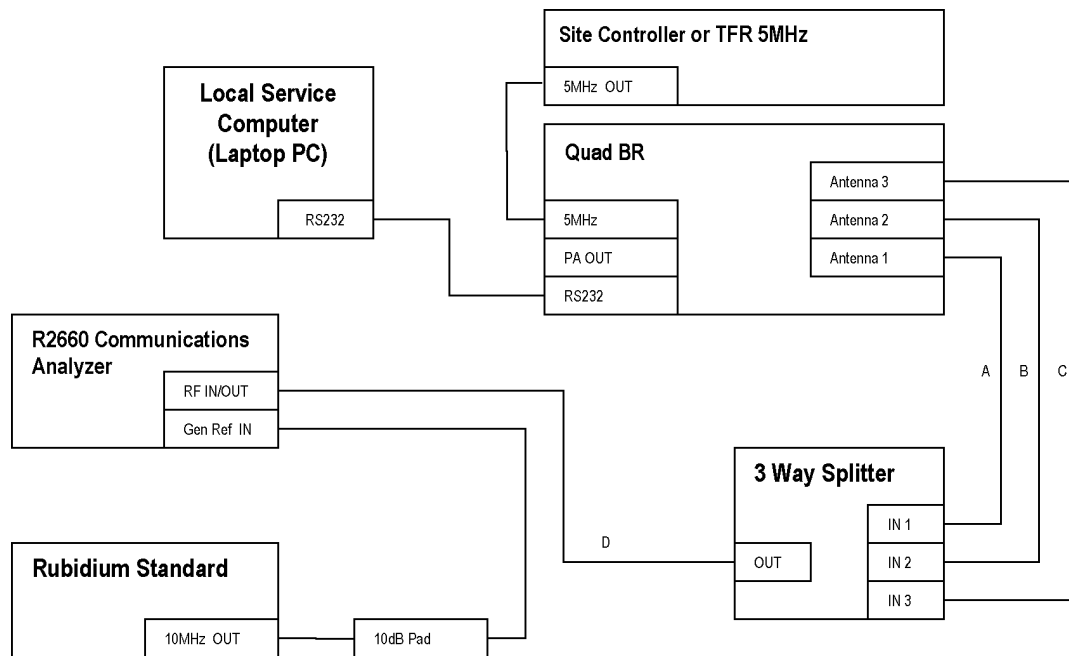


Figure 4 **QUAD BR Rx Verification Test Setup**

10. Apply power to the R2660.

NOTE

Due to the nature of the Quad BR configuration, Antenna 2 MUST be connected to the R2660 for synchronization (This is not required for SR9.6 and above). All three RX inputs on the back of the EBTS must be connected to the R2660 and calibrated such that EACH input receives the calibrated RF signal. (See "Calibration of the R2660 output level" on page 50.) If all RX inputs are not connected, some receive paths will not receive properly.

QUAD BR Distributed Multi-coupler

The Quad BR uses an internal distributed multi-coupler to distribute the RF signals from the 3 Antenna ports to the 4 Channels of the BR. Each Channel has 3 receivers.

QUAD BR Receiver Verification Procedure: Base Radio

This procedure provides commands and responses to verify proper operation of the Base Radio receiver paths. Perform the procedure on all four channels in each Base Radio in the EBTS.

1. Power on the BR using the front switch on the Power Supply Module. Press the reset button on the front of the EX/BRC module. Using the terminal program on the service computer, log onto the BR. Bold type indicates user input commands.

To enter field mode, at the > prompt type **login -ufield**.

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

The default factory set field password is **motorola**.

RF Cabinet Verification - QUAD Carrier**NOTE**

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

```
>login -ufield
password:<login password>

field>
```

2. Set the frequency to of the R2660 to 810MHz (898 MHz for 900 Mhz QUAD). Power out should be set to -80 dBm.

NOTE

Replace **810** with **898** for 900 MHz QUAD BR in the following MMI command sessions.

3. Set all channel frequencies.

```
field> freq -orxch1 -f810
field> freq -orxch2 -f810
field> freq -orxch3 -f810
field> freq -orxch4 -f810
```

4. Disable System Gain.

```
field> sgc -orx_all -soff
```

NOTE

This step should only be performed if the R2660 is connected directly to the Base Radio Antenna ports. If verification is performed at the top of the rack (adding an RFDS), disregard the above command.

5. Verify the R2660 signal level.

```
field> enable -orxch1 -dbr1 -son  
field> ppr -orxch1 -r1 -a100
```

RF Cabinet Verification - QUAD Carrier

6. The resulting output will look similar to this:

```
field> ppr -orxch1 -r1 -a100

SGC Atten.(dBm)=0.000000
Freq. Offset=-15.059323
Sync. Attempts=1.000000
Sync. Successes=1.000000
BER%=0.000000
RX Path1 RSSI=-80.934021
RX Path2 RSSI=-127.012520
RX Path3 RSSI=-127.012520
Chn sig. strength=-57.098698
Chn intf. strength=-91.696739
field>
```

NOTE

RX Path1 RSSI must read $-80\text{dBm} \pm 1\text{dBm}$ for the BER Floor verification to be accurate. Adjust the output level of the R2660 to compensate for loss in the test cables and three-way splitter.

QUAD BER Floor Measurement: Base Radio

1. Verify that the R2660 is set to 810 MHz (898 MHz for 900 MHz QUAD BR) and is producing a power level of -80dBm. (See "QUAD BR Receiver Verification Procedure: Base Radio with RFDS" on page 44.)
2. Using the MMI commands below, issue the command to put the BR into single branch mode. If the resulting bit error rate for receiver branches 1, 2, and 3 is less than 0.01%, the receiver has passed the test.

NOTE

Replace **810** with **898** for 900 MHz QUAD BR in the MMI command sessions below

3. Check Receiver 1.:

```
field> ppc -orxch1 -mchn -s1  
field> freq -orxch1 -f810  
  
field> enable -orxch1 -soff  
field> enable -orxch1 -dbr1 -son  
field> ppc -orxch1 -mchn -s1  
field> ppr -orxch1 -a1000 -r1  
  
field> enable -orxch1 -soff  
field> enable -orxch1 -dbr2 -son  
field> ppc -orxch1 -mchn -s1  
field> ppr -orxch1 -a1000 -r1  
  
field> enable -orxch1 -soff  
field> enable -orxch1 -dbr3 -son  
field> ppc -orxch1 -mchn -s1  
field> ppr -orxch1 -a1000 -r1
```

Check Receiver 2:

```
field> ppc -orxch2 -mchn -s1  
field> freq -orxch2 -f810  
  
field> enable -orxch2 -soff  
field> enable -orxch2 -dbr1 -son  
field> ppc -orxch2 -mchn -s1  
field> ppr -orxch2 -a1000 -r1  
  
field> enable -orxch2 -soff  
field> enable -orxch2 -dbr2 -son  
field> ppc -orxch2 -mchn -s1  
field> ppr -orxch2 -a1000 -r1  
  
field> enable -orxch2 -soff  
field> enable -orxch2 -dbr3 -son  
field> ppc -orxch2 -mchn -s2  
field> ppr -orxch2 -a1000 -r1
```

RF Cabinet Verification - QUAD Carrier

Check Receiver 3:

```
field> freq -orxch3 -f810

field> enable -orxch3 -soff
field> enable -orxch3 -dbr1 -son
field> ppc -orxch3 -mchn -s1
field> ppr -orxch3 -a1000 -r1

field> enable -orxch3 -soff
field> enable -orxch3 -dbr2 -son
field> ppc -orxch3 -mchn -s1
field> ppr -orxch3 -a1000 -r1

field> enable -orxch3 -soff
field> enable -orxch3 -dbr3 -son
field> ppc -orxch3 -mchn -s1
field> ppr -orxch3 -a1000 -r1
```

Check Receiver 4:

```
field> freq -orxch4 -f810

field> enable -orxch4 -soff
field> enable -orxch4 -dbr1 -son
field> ppc -orxch4 -mchn -s1
field> ppr -orxch4 -a1000 -r1

field> enable -orxch4 -soff
field> enable -orxch4 -dbr2 -son
field> ppc -orxch4 -mchn -s1
field> ppr -orxch4 -a1000 -r1

field> enable -orxch4 -soff
field> enable -orxch4 -dbr3 -son
field> ppc -orxch4 -mchn -s1
field> ppr -orxch4 -a1000 -r1
```


4. Enter the command to return all active alarms of the Base Radio. At the field> prompt, type:

```
field> alarms -ofault_hndlr
```

NOTE

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

5. As shown below respectively for 800/900 MHz Quad Base Radios, the following command returns the kit numbers of the receiver and all other modules. At the field> prompt, type:

```
field> fc -oplatform
```

QUAD BR Receiver Sensitivity Measurement: Base Radio

1. Verify that the R2660 is set to 810MHz (898 MHz for 900 MHz QUAD BR) and adjust the output power to a level of -50dBm.
2. Calibrate HP438A Power Meter. Refer to the HP users guide that came with the Meter. Below is a general procedure that can be followed.
 - 2.1 Attach 8481D Power Sensor to the **Sensor** input on the front of the 438A.
 - 2.2 Attach the included HP 11708A 30dB pad to the **Power REF** output on the front on the 438A.
 - 2.3 Power on the 438A.
 - 2.4 Connect the Power Sensor to the female end of the 30dB pad extruding from the **Power REF** output.
 - 2.5 Press the "**Zero**" button on the 438A.
 - 2.6 Wait for Zeroing operation to complete.
 - 2.7 Press "**Shift-Zero**" to enter the Cal value. This is listed as **CF** on the Power Sensor.
 - 2.8 Wait for Cal operation to complete.

RF Cabinet Verification - QUAD Carrier

2.9 Press **"Shift-Freq"** to enter the Cal Factor. This is listed as **Cf** in a chart vs. freq on the Power Sensor. Choose the closest frequency range for the application. For 800/900 MHz measurements, interpolate between 1.0GHz and 0.5GHz to obtain a Cf.

2.10 For measurement of iDEN 6:1 waveforms, press **"Offset"** and enter 7.78dB.

- 3.** Disconnect Cable A (see Figure 3) from the Base Radio and connect it to the Power Sensor Head.
- 4.** Increase the power level on the R2660 until the HP 438A Power Meter reads -50dB.
- 5.** Record the DISPLAYED power level of the R2660 as Calfactor A.
- 6.** The path loss through the cable and splitter system is Calfactor A + 50.

Example: R2660 reads -44dBm

HP 438A reads -50dBm

Calfactor A = -44, path loss = 6dB

- 7.** Path loss must be determined for each Antenna cable A,B,C (see Figure 3). If comparable cables are used for all three, the path losses of all three should be the same.
- 8.** Additional power will be added to the R2660 in the sensitivity measurement to balance out the additional path loss value.
- 9.** Reconnect cables A,B,C (see Figure 3) to Antenna Ports 1,2,3.
- 10.** Set the R2660 to Frequency 810 MHz (898 MHz for 900 MHz QUAD BR) and a Power level of -108dBm + path loss.

Example: If your path loss was 6dB, set the R2660 to -102dBm.

- 11.** Using the MMI commands below, issue the command to put the BR into single branch mode. If the resulting bit error rate for receiver branches 1, 2, and 3 is less than 8.00%, the receiver has passed the test.

NOTE

Replace **810** with **898** for 900 MHz QUAD BR in the MMI command sessions below

```
field> freq -orxch1 -f810
```

```
field> enable -orxch1 -soff
```

```
field> enable -orxch1 -dbr1 -son
```

```
field> ppc -orxch1 -mchn -s1
```

```
field> ppr -orxch1 -a100 -r1
```

```
field> enable -orxch1 -soff
```

```
field> enable -orxch1 -dbr2 -son
```

```
field> ppc -orxch1 -mchn -s1
```

```
field> ppr -orxch1 -a100 -r1
```

```
field> enable -orxch1 -soff
```

```
field> enable -orxch1 -dbr3 -son
```

```
field> ppc -orxch1 -mchn -s1
```

```
field> ppr -orxch1 -a100 -r1
```

RF Cabinet Verification - QUAD Carrier

Check Receiver 2:

```
field> freq -orxch2 -f810

field> enable -orxch2 -soff
field> enable -orxch2 -dbr1 -son
field> ppc -orxch2 -mchn -s1
field> ppr -orxch2 -a100 -r1

field> enable -orxch2 -soff
field> enable -orxch2 -dbr2 -son
field> ppc -orxch2 -mchn -s1
field> ppr -orxch2 -a100 -r1

field> enable -orxch2 -soff
field> enable -orxch2 -dbr3 -son
field> ppc -orxch2 -mchn -s1
field> ppr -orxch2 -a100 -r1
```

Check Receiver 3:

```
field> freq -orxch3 -f810

field> enable -orxch3 -soff
field> enable -orxch3 -dbr1 -son
field> ppc -orxch3 -mchn -s1
field> ppr -orxch3 -a100 -r1

field> enable -orxch3 -soff
field> enable -orxch3 -dbr2 -son
field> ppc -orxch3 -mchn -s1
field> ppr -orxch3 -a100 -r1

field> enable -orxch3 -soff
field> enable -orxch3 -dbr3 -son
field> ppc -orxch3 -mchn -s1
field> ppr -orxch3 -a100 -r1
```

Check Receiver 4:

```
field> freq -orxch4 -f810

field> enable -orxch4 -soff
field> enable -orxch4 -dbr1 -son
field> ppc -orxch4 -mchn -s1
field> ppr -orxch4 -a100 -r1

field> enable -orxch4 -soff
field> enable -orxch4 -dbr2 -son
field> ppc -orxch4 -mchn -s1
field> ppr -orxch4 -a100 -r1

field> enable -orxch4 -soff
field> enable -orxch4 -dbr3 -son
field> ppc -orxch4 -mchn -s1
field> ppr -orxch4 -a100 -r1
```

12. Enter the command to return all active alarms of the Base Radio. At the field> prompt, type:

```
field> alarms -ofault_hndlr
```

NOTE

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

13. As shown below respectively for 800/900 MHz Quad Base Radios, the following command returns the kit numbers of the receiver and all other modules. At the BRC> prompt, type:

```
field> fc -oplatform
```

QUAD Channel BR -- Checking Transmit Operation

The following procedures verify transmission from the system antennas.

ATTENTION

Do not transmit to an antenna for any reason, unless those frequencies are properly licensed.

NOTE

(Cavity Combining RFDS only)
Prior to performing this procedure, perform the cavity tuning procedure described in the Cavity Combining RFDS section of this manual.

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, 250 Wattenuator 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
(QUAD Carrier 800 MHz and 900 MHz Power Amplifiers)**

This procedure provides commands and responses to verify proper operation of the transmit path for 800 MHz and 900 MHz QUAD Channel Base Radios.

1. Power on the BR using the front switch on the Power Supply Module. Press the reset button on the Control Module front panel. At the prompt, hit a Carriage Return on the service computer to enter the test application mode. Using the user_id -ufield and the field password, login to the BR.

To enter field mode, at the > prompt type **login -ufield**.

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

The default factory set field password is **motorola**.

RF Cabinet Verification - QUAD Carrier**NOTE**

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

```
>login -ufield
password:<login password>

field>
```

2. Dekey the BR to verify that no RF power is being transmitted. Set the transmit DSP test mode to "stop." At the field > prompt, type:

```
field> power -otxch1 -p0
field> ptm -otx_all -mstop
field> dpm -otxch1 -mnone
field> dpm -otxch2 -mnone
field> dpm -otxch3 -mnone
field> dpm -otxch4 -mnone
```


NOTE

The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into an RF load.

3. Key the BR to 40 watts, following the steps below from the field > prompt:

- 3.1 Set the frequency of transmit channel 1 through 4 (800 MHz QUAD Channel).

```
field> freq -otxch1 -f860
field> freq -otxch2 -f860.025
field> freq -otxch3 -f860.05
field> freq -otxch4 -f860.075
```

- 3.2 Set the frequency of transmit channel 1 through 4 (900 MHz QUAD Channel).

```
field> freq -otxch1 -f935
field> freq -otxch2 -f935.025
field> freq -otxch3 -f935.05
field> freq -otxch4 -f935.075
```

- 3.3 Enable the channels by setting a data pattern to "iden"

```
field> dpm -otxch1 -miden
field> dpm -otxch2 -miden
field> dpm -otxch3 -miden
field> dpm -otxch4 -miden
```

RF Cabinet Verification - QUAD Carrier**NOTE**

After the following command is entered, power will be transmitted at the output of the Power Amplifier.

- 3.4** Set the transmit power to 40 watts and key the BR.

```
field> ptm -otx_all -mdnlk_framed  
field> power -otxch1 -p40
```

- 4.** 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 7.

NOTE

The reported value for forward power are not indicative of Base Radio performance. This value is reported from the internal wattmeter. These limits are only for verification of operation and are not representative of true operational power of the transmitter.

- 4.1** At the field > prompt, type:

```
field> power -otx_all
```

This command returns all active alarms of the Base Radio.

- 4.2** At the field > prompt, type:

```
field> alarms -ofault_hndlr
```

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

Table 7 800/900 MHz QUAD BR Transmitter Parameters

Parameter	Value or Range
Forward Power	Greater than 36 Watts
Reflected Power	Less than 2.0 Watts
VSWR	Less than 1.6:1

- View the spectrum of the transmitted signal on the R2660 Communications Analyzer in the Spectrum Analyzer mode. Figure 5 and Figure 6 shows a sample of the 800MHz and 900MHz spectrum, respectively.

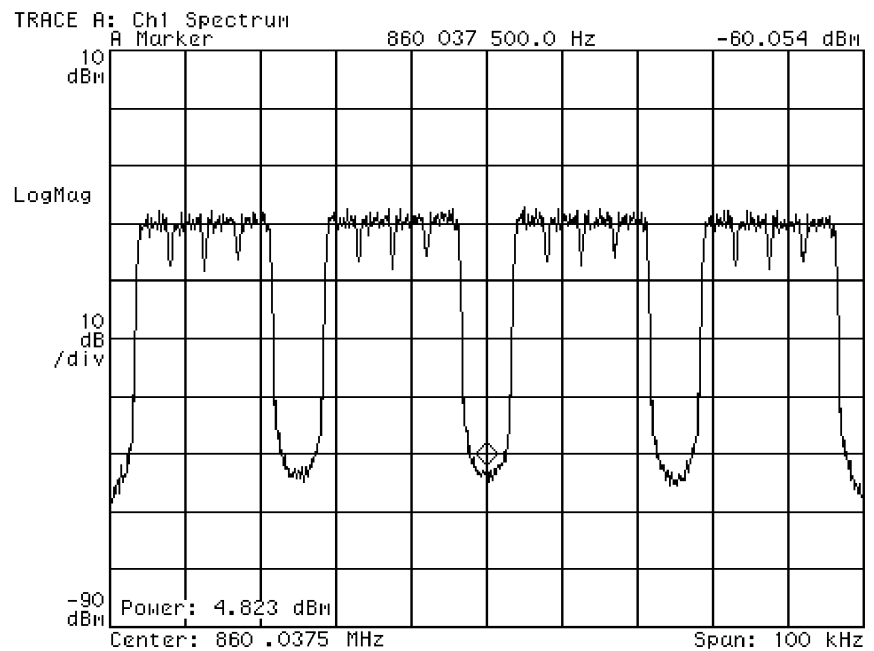


Figure 5 800 MHz Quad Carrier Spectrum

RF Cabinet Verification - QUAD Carrier

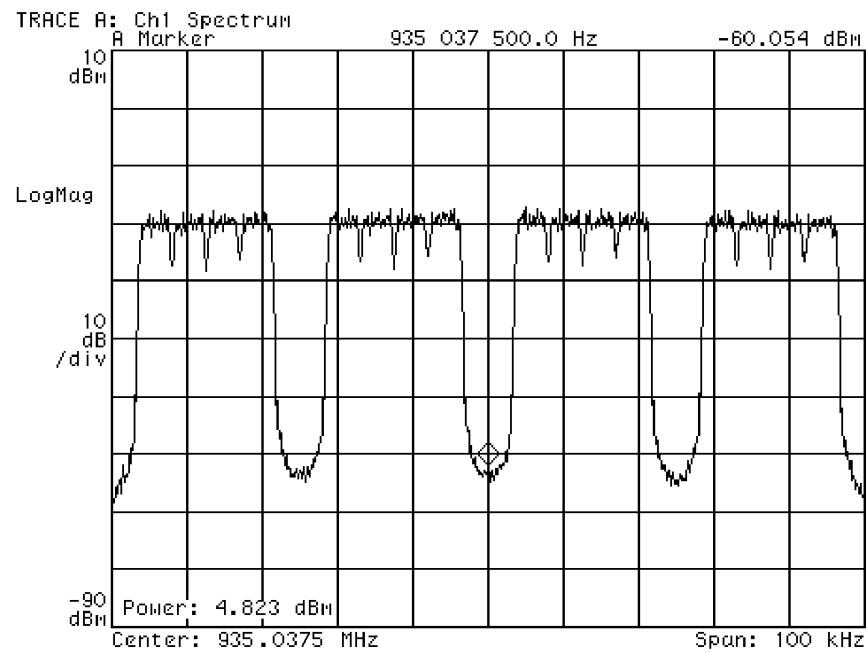


Figure 6 **900 MHz Quad Carrier Spectrum**

6. Dekey the BR so that no RF power is being transmitted. Set the transmit DSP test mode to "stop." At the field> prompt, type:

```
field> power -otxch1 -p0
field> ptm -otx_all -mstop
field> dpm -otxch1 -mnone
field> dpm -otxch2 -mnone
field> dpm -otxch3 -mnone
field> dpm -otxch4 -mnone
```

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.



CAUTION

Make sure power to BR is OFF before disconnecting transmitter RF connectors. Disconnecting transmitter RF connectors while the BR is keyed may result in RF burns from arcing.

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, 250W 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.
9. If necessary, continue with the Receiver Verification Procedure.

QUAD BR Channel Mapping

NOTE

The QUAD BR Test Application and Call Processing Application map frequencies in a different manner to allow for the service technician to easily identify any hardware failures using the Test Application. The Call Processing Application maps frequencies based on available hardware (configured at the time of code download from the ACG). The Test Application RX frequencies are mapped as shown in Table 8 by default. The Call Processing Application will map frequencies based on available hardware and Carrier configuration.

The tables below describe the frequency mapping:

Table 8 Test Application Mapping of Frequencies

	TX Freq 1	TX Freq 2	TX Freq 3	TX Freq 4
Carrier Configuration 1	F1	n/a	n/a	n/a
Carrier Configuration 2	F1	F2	n/a	n/a
Carrier Configuration 3	F1	F2	F3	n/a
Carrier Configuration 4	F1	F2	F3	F4

Table 9 Call Processing Application Mapping of Frequencies

	TX Freq 1	TX Freq 2	TX Freq 3	TX Freq 4
Carrier Configuration 1	—	—	F1	—
Carrier Configuration 2	—	F1	F2	—
Carrier Configuration 3	—	F1	F2	F3
Carrier Configuration 4	F1	F2	F3	F4

Transmit Side

DSP restricts the way in which the Call Processing Application can map channels on the transmit side. The following are the carrier combinations:

- 1 Carrier Configured: TX Carrier 3
- 2 Carriers Configured: TX Carriers 2, 3
- 3 Carriers Configured: TX Carriers 2, 3, 4
- 4 Carriers Configured: TX Carriers 1, 2, 3, 4

As can be seen, TX mapping does not start at 1 and then increment to 4 for 1-4 Carriers. After frequencies are set using the Call Processing Application and the technician starts the Test Application, mapping will be done as shown above.

Receive Side

Power Supply	Receiver 4
	Receiver 3
	Receiver 2
Control/Exciter	Receiver 1
Power Amplifier	

Figure 7 **Physical BR FRU Configuration**

Table 10 **Logical to Physical RX Channel Mapping in the Test Application**

	Physical Receiver 1	Physical Receiver 2	Physical Receiver 3	Physical Receiver 4
Logical RX Channel 1 (rxch1)	X			
Logical RX Channel 2 (rxch2)		X		
Logical RX Channel 3 (rxch3)			X	
Logical RX Channel 4 (rxch4)				X

QUAD BR Channel Mapping

The mapping in the Call Processing Application is more complicated on the receive side.

Bad or missing receivers cannot be mapped. For example, if Receiver 2 is bad, only Receivers 1, 3 and 4 can be mapped.

Next, the Call Processing Application attempts to map as many carriers as it can so if a QUAD BR is using fewer than the maximum number available Carriers, it can be quickly reconfigured to increase the number of Carriers with as little downtime as possible.

NOTE

This manual does not provide examples of this since reconfiguring the number of Carriers while running the Call Processing Application without resetting the BR is not allowed.

When the QUAD BR initializes, mapping begins from Receiver 1 (if available) and continues through Receiver 4. Active Carriers are mapped first, followed by inactive Carriers. This can cause the mapping process to be complex.

Examples:

All Receivers are available, 4 Carriers are configured in the Call Processing Application. The Test Application is started:

Carrier 1 maps to RX1
Carrier 2 maps to RX 2
Carrier 3 maps to RX 3
Carrier 4 maps to RX 4

All Receivers available, 3 Carriers configured in Call Processing Application. The Test Application is started:

Carrier 1 maps to RX 1
Carrier 2 maps to RX 2
Carrier 3 maps to RX 3
Carrier 4 is inactive

All Receivers available, 1 Carrier configured in the Call Processing Application. The Test Application is started:

Carrier 1 maps to RX 1
RX 2 is inactive
RX 3 is inactive
RX 4 is inactive

Receiver 2 is bad, 3 Carriers configured in the Call Processing Application. The Test Application is started:

Carrier 1 maps to RX 1
Carrier 2 maps to RX 3
Carrier 3 maps to RX 4

Receivers 2 and 4 are disconnected, 2 Carriers configured in the Call Processing Application. The Test Application is started:

Carrier 1 maps to RX 1
Carrier 2 maps to RX 3

NOTE

Carriers 1-4 in these examples are the received frequencies from the BRC, in order from lowest to highest. They do not correspond to Carriers 1-4 in the TX examples above

The following is a combined example (TX/RX) using the information from above:

Example:

Four Carriers are available- three sets of frequencies (Carriers) are sent by the BRC. The Test Application is started:

TX 1: Inactive
TX 2: Carrier 1
TX 3: Carrier 2
TX 4: Carrier 3

RX 1: Carrier 1
RX 2: Carrier 2
RX 3: Carrier 3
RX 4: Inactive

The Call Processing Application does not overwrite Inactive Channels in the Test Application. Therefore, confusion can occur if TX 1 and RX 4 were mapped using the Test Application and the configuration above is sent during the Call Processing Application.

QUAD BR Channel Mapping**NOTE**

There is a Call Processing Application command that can help resolve issues with a particular Carrier configuration and how it maps within the Call Processing Application. The command is **get rptr_status**. This command will return the number of working RX FRU's detected, the current RX FRU to RX channel mapping, the frequency band, and the actual RX/TX frequencies sent from the BRC (from lowest to highest). Refer to *BRC Host Software MMI Command Reference for QUAD BR Cell Processing Application*.

RF Cabinet Verification - Generation 2 BR

Section	Page	Description
Generation 2 RF Cabinet Test Equipment	81	Identifies all recommended test equipment for the RF Cabinet Verification.
Generation 2 Channel Base Radio Start-up Sequence	81	Describes how to connect the service computer and start-up the quad carrier Base Radio.
Selecting Generation 2 Base Radio Position and Receiver Complement	85	Describes how to select Base Radio. position and Receiver complement
Displaying Generation 2 Channel Base Radio Alarms	86	Describes how to verify the alarm conditions of the Base Radio.
Checking Generation 2 BR Receive Operation	87	Describes how to verify proper receive operation of the Base Radios.
Generation 2 BR -- Checking Transmit Operation	107	Describes how to verify proper transmit operation of the Base Radios.

Generation 2 RF Cabinet Test Equipment

Commercial Test Equipment

Table 11 lists the recommended test equipment for the RF Cabinet procedures. Equivalent equipment is acceptable, unless otherwise noted.

Generation 2 Channel Base Radio Start-up Sequence

NOTE

The Generation 2 BR must be in test mode in order to activate the BR installation software. This is done by performing a diagnostic reset. Press the reset button located on the BR front panel and follow the on-screen instructions. The Generation 2 BR software is resident on the Base Radio and need not be downloaded from the iSC/Gen 3 SC.

1. Find the STATUS connector on the front of BR, in sector 1. Connect an RS-232 cable between the service computer and the STATUS connector.

RF Cabinet Verification - Generation 2 BR**Table 11 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.			

2. If someone shut down the system between procedures, apply power.
(Generation 2 Base Radios should still be under power, due to the System Checkout procedure.)
3. After the BR is powered up using the front switch on the Power Supply Module, press the reset button on the Control Module front panel. At the prompt, hit a Carriage Return on the service computer to enter the test application mode. Using the field password, log in to the BR.

To enter field mode, at the > prompt type **login -ufield**.

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

The default factory set field password is **motorola**.

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

```
>login -ufield
password:<login password>

field>
```

4. On the BRC, verify LED conditions for each Base Radio. Refer to Table 2.

Table 12 **Generation 2 Channel Base Radio LED Indications**

LED	Color
BR	Green
PS	Red
EX	Red
PA	Red
CTL	Red
RX1	Red
RX2	Red
RX3	Red
NOTE: For conditions related to indications above, refer to this manual's Generation 2 Base Radio section.	

The following LED operation is normal for the Generation 2 BR:

RF Cabinet Verification - Generation 2 BR

- Loading of a file to RAM.
 - An LED pattern walks slowly in a series from right to left, and then repeats.
- Loading a file to NVM (FLASH).
 - An LED pattern walks slowly in a series from both ends towards the middle, and then repeats.
- Memory Testing.
 - A continuous LED pattern sweeps slowly in a series from left to right, and then right to left.

As software downloads from the Site Controller to the BR, the Green BR LED is off, otherwise:

- The BR LED flashes slowly when the BR is de-keyed.
- The BR LED lights and remains on while the BR is keyed.

5. On the Base Radio's Power Supply module, verify that the green LED is lit.

Selecting Generation 2 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 RF 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 Generation 2 Base Radio Position

The pi -oplatform command programs the position number of where a Base Radio is mounted within a selected RF Cabinet. Usage is below:

```
pi -oplatform -pX
```

where X is the position value

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

The ci -oplatform command programs the cabinet number of where a Base Radio is mounted. Usage is below:

```
ci -oplatform -cX
```

where X is the cabinet value

Selecting A Receiver Complement For A Generation 2 Base Radio

The diversity command sets which receivers should be present in a selected Base Radio. The command has provision for all possible complements of receivers. Usage is below:

```
diversity -orx_all -dX
```

where X enables the diversity configuration as below:

diversity -orx_all -d0	#Turn all branches off
diversity -orx_all -d1	#enable branch 1; 2 & 3 are off
diversity -orx_all -d10	#enable branch 2; 1 & 3 are off
diversity -orx_all -d11	#enable branch 1 & 2; 3 is off
diversity -orx_all -d100	#enable branch 3; 1 & 2 are off
diversity -orx_all -d101	#enable branch 3 & 1; 2 is off
diversity -orx_all -d110	#enable branch 3 & 2; 1 is off
diversity -orx_all -d111	# enable 1, 2 and 3

Displaying Generation 2 Channel Base Radio Alarms

NOTE

The Generation 2 BR must be in test mode in order to activate the BR installation software. This is done by performing a diagnostic reset. Press the reset button located on the BR front panel and follow the on-screen instructions. The Generation 2 BR software is resident on the Base Radio and need not be downloaded from the iSC/Gen 3 SC.

1. At the > prompt, initiate login to the Generation 2 BR.

To enter field mode, at the > prompt type **login -ufield**.

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

The default factory set field password is **motorola**.

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

```
>login -ufield
password:<login password>

field>
```


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. Type: alarms -ofault_hndlr

The ALARMS command returns the active 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:

```
field> alarms -ofault_hndlr

ACTIVE_FAULT_ID=RX_LO1_LOCK

field>
```

Checking Generation 2 BR Receive Operation

Receive operation test procedures must be performed on each Base Radio in the Main and Expansion (if used) RF Cabinets. 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 on the EBTS RF Cabinet.

NOTE

(800 MHz Cavity Combining RFDS only)
Prior to performing this procedure, perform the receiver equalization procedure described in the Cavity Combining RFDS section of this manual.

RF Cabinet Verification - Generation 2 BR**NOTE**

The following procedure requires the use of a calibrated test set-to-EBTS signal cable. Refer to the 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.

Generation 2 BR: 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.

Generation 2 BR Receiver Verification: Base Radio with RFDS (Measurement at the top of Rack)

The receiver verification procedure sends a known test signal into the Base Radio via the antenna ports at the top of the rack 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 taken 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 services to system users.

Equipment Setup

Set up equipment for the receiver verification 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 Enhanced Base Radio Controller (EBRC).
4. Disconnect the existing cables from the connectors labeled RX1, RX2, and RX3 at the top of the EBTS rack. If the radio is configured for 2 Branch diversity, disconnect the RX1 and RX2 cables.

NOTE

Connecting the R2660 to the EBTS rack antenna ports will introduce extra system gain into the measurement, which must be accounted for. This must be accounted for in the calibration procedure. (See "Calibration of the R2660 output level" on page 50.).

RF Cabinet Verification - Generation 2 BR

5. Connect test cables from each of the RX1, RX2, and RX3 connectors (Cables A,B,C in Figure 3) to the input ports of the 3-way splitter. For 2 Branch diversity tests, load the RX3 cable with an appropriate 50ohm load or connect it to the RX3 antenna port on the radio.
6. Connect an additional test cable (Cable D in Figure 3) from the summed port of the 3-way splitter to the RF IN/OUT connector on the R2660 Communications Analyzer.

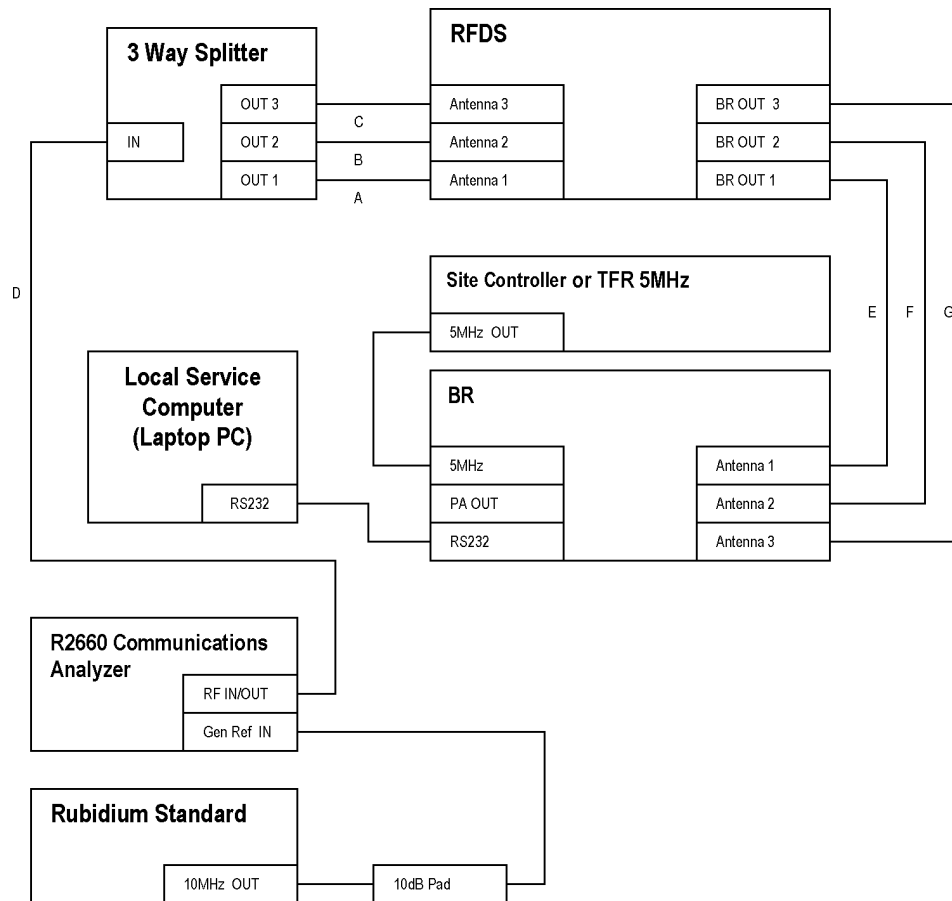


Figure 8 **Generation 2 BR w/ RFDS Verification Test Setup**

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.

NOTE

Refer to the equipment manual provided with the R2660 for further information regarding mode configuration of the unit (Motorola Part No. 68P80386B72).

9. Set the R2660 to the EXT REF mode.
10. Apply power to the R2660.

NOTE

Due to the nature of the Generation 2 Base Radio configuration, field technicians can hook up to any of the three Antenna ports since the Base Radio will lock on the inbound signal.

Generation 2 BR Receiver Verification Procedure: Base Radio with RFDS

This procedure provides commands and responses to verify proper operation of the Base Radio receiver paths. Perform the procedure on each Base Radio in the EBTS.

1. Power on the BR using the front switch on the Power Supply Module. Press the reset button on the front of the EX/BRC module. Using the terminal program on the service computer, log onto the BR. Bold type indicates user input commands.

To enter field mode, at the > prompt type **login -ufield**.

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

The default factory set field password is **motorola**.

RF Cabinet Verification - Generation 2 BR**NOTE**

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

```
>login -ufield  
password:<login password>  
  
field>
```

2. Set the Frequency of the R2660 to 810MHz. Power out should be set to -80 dBm.
3. Set channel frequency.

```
field> freq -orxch1 -f810
```

4. Verify the R2660 signal level:

```
field> enable -orxch1 -dbr1 -son  
field> ppr -orxch1 -r1 -a50
```

5. The resulting output will look similar to this:

```
field> ppr -orxch1 -r1 -a100

SGC Atten.(dBm)=0.000000
Freq. Offset=-15.059323
Sync. Attempts=1.000000
Sync. Successes=1.000000
BER%=0.000000
RX Path1 RSSI=-80.934021
RX Path2 RSSI=-127.012520
RX Path3 RSSI=-127.012520
Chn sig. strength=-57.098698
Chn intf. strength=-91.696739

field>
```

NOTE

RX Path1 RSSI must read -80dBm $\pm$ 1dBm for the BER Floor verification to be accurate. Adjust the output level of the R2660 to compensate for loss in the test cables and three-way splitter.

Generation 2 BER Floor Measurement: Base Radio with RFDS

1. Verify that the R2660 is set to 810MHz and is producing a power level of -80dBm. (See "Generation 2 BR Receiver Verification: Base Radio with RFDS (Measurement at the top of Rack)" on page 88.)
2. Using the MMI commands below, issue the command to put the BR into single branch mode. If the resulting bit error rate for receiver branches 1, 2, and 3 is less than 0.01%, the receiver has passed the test.
3. Check Receiver. At the field > prompt, type (inputs are in **bold**, comments are in *italics*):

RF Cabinet Verification - Generation 2 BR

```
field> freq -orxch1 -f810
field> enable -orxch1 -soff
field> enable -orxch1 -dbr1 -son
field> ppr -orxch1 -a1000 -r1

field> enable -orxch1 -soff
field> enable -orxch1 -dbr2 -son
field> ppr -orxch1 -a1000 -r1

(skip the step below if the system is configured for 2 Branch Diversity)

field> enable -orxch1 -soff
field> enable -orxch1 -db3 -son
field> ppr -orxch1 -a1000 -r1
```

4. Enter the command to return all active alarms of the Base Radio. At the field> prompt, type:

```
field> alarms -ofault_hndl
```

NOTE

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

5. As shown below respectively for 800 MHz Generation 2 Base Radios, the following command returns the kit numbers of the receiver and all other modules. At the field > prompt, type:

```
field> fc -oplatform
```


Generation 2 BR Receiver Sensitivity Measurement: Base Radio with RFDS

The receiver sensitivity measurement consists of sending a calibrated RF level of -113.5dBm to the antenna ports at the top of the rack. This includes the RFDS in the receive channel and measures the combined performance of the Base Radio and the RFDS. The R2660 output must be calibrated prior to the taking of this measurement.

Calibration of the R2660 output level

1. Verify that the R2660 is set to 810MHz and adjust the output power to a level of -50dBm
2. Calibrate HP438A Power Meter. Refer to the HP users guide that came with the Meter. Below is a general procedure that can be followed.
 - 2.1 Attach 8481D Power Sensor to the **Sensor** input on the front of the 437B.
 - 2.2 Attach the included HP 11708A 30dB pad to the **Power** input on the front on the 437B.
 - 2.3 Power on the 437B.
 - 2.4 Connect the Power Meter to the female end of the 30dB pad extruding from the **Power** input.
 - 2.5 Press the **"Zero"** button on the 437B.
 - 2.6 Wait for Zeroing operation to complete.
 - 2.7 Press **"Shift-Zero"** to enter the Cal value. This is listed as **CF** on the Power Sensor.
 - 2.8 Wait for Cal operation to complete.
 - 2.9 Press **"Shift-Freq"** to enter the Cal Factor. This is listed as **Cf** in a chart vs. freq on the Power Sensor. Choose the closest frequency range for the application. For 800MHz measurements, interpolate between 1.0GHz and 0.5GHz to obtain a **Cf** of 99.0
 - 2.10 For measurement of iDEN or Tornado 6:1 waveforms, press **"Offset"** and enter 7.78dB.
3. Disconnect Cable A (see Figure 3 on page -43) from the Base Radio and connect it to the Power Sensor Head.
4. Increase the power level on the R2660 until the HP 437B Power Meter reads -50dB.
5. Record the DISPLAYED power level of the R2660 as Calfactor A.
6. The path loss through the cable and splitter system is Calfactor A + 50.

Example: R2660 reads -44dBm

HP 437B reads -50dBm

Calfactor A = -44, path loss = 6dB

RF Cabinet Verification - Generation 2 BR

7. Path loss must be determined for each Antenna cable A,B,C (see Figure 3 on page -43). If comparable cables are used for all three the path losses of all three should be the same.
8. Additional power will be added to the R2660 in the sensitivity measurement to balance out the additional path loss value.
9. Reconnect cables A,B,C (see Figure 3 on page -43) to Antenna Ports 1,2,3.
10. Set the R2660 to Frequency 810MHz and a Power level of -113.5dBm + path loss.

Example: If your path loss was 6dB, set the R2660 to -107.5dBm.

11. Using the MMI commands below, issue the command to put the BR into single branch mode. If the resulting bit error rate for receiver branches 1, 2, and 3 is less than 8.00%, the receiver has passed the test.

```
field> freq -orxch1 -f810
field> enable -orxch1 -soff
field> enable -orxch1 -dbr1 -son
field> ppr -orxch1 -a100 -r1
```

```
field> enable -orxch1 -soff
field> enable -orxch1 -dbr2 -son
field> ppr -orxch1 -a100 -r1
```

(skip the step below if the system is configured for 2 Branch Diversity)

```
field> enable -orxch1 -soff
field> enable -orxch1 -db3 -son
field> ppr -orxch1 -a100 -r1
```

12. Enter the command to return all active alarms of the Base Radio. At the field> prompt, type:

```
field> alarms -ofault_hndl
```

NOTE

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

13. As shown below respectively for 800 MHz Generation 2 Radios, the following command returns the kit numbers of the receiver and all other modules. At the field> prompt, type:

```
field> fc -oplatform
```

Generation 2 BR Receiver Verification: Measurement of the Base Radio (No RFDS)

The receiver verification procedure sends a known test signal into the Base Radio to verify the receive path. The signal is fed DIRECTLY into the ANTENNA PORTS in the back of the Base Radio. This excludes the RFDS and antenna cabling from the measurement. This verification procedure is recommended after replacing a Receiver, EBRC, 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 services to system users.

Equipment Setup

Set up the equipment for the receiver verification 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 EBRC.

RF Cabinet Verification - Generation 2 BR

4. Disconnect the existing cables from the connectors labeled RX1, RX2, and RX3 on the back of the Base Radio. If the radio is configured for 2 Branch diversity, disconnect the RX1 and RX2 cables.
5. Connect test cables from each of the RX1, RX2, and RX3 connectors (Cables A,B,C in Figure 4) to the input ports of the 3-way splitter. For 2 Branch diversity tests, load the RX3 cable with an appropriate 50ohm load or connect it to the RX3 antenna port on the radio.
6. Connect an additional test cable (Cable D in Figure 3 on page -43) from the summed port of the 3-way splitter 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.

NOTE

Refer to the equipment manual provided with the R2660 for further information regarding mode configuration of the unit (Motorola Part No. 68P80386B72).

9. Set the R2660 to the EXT REF mode

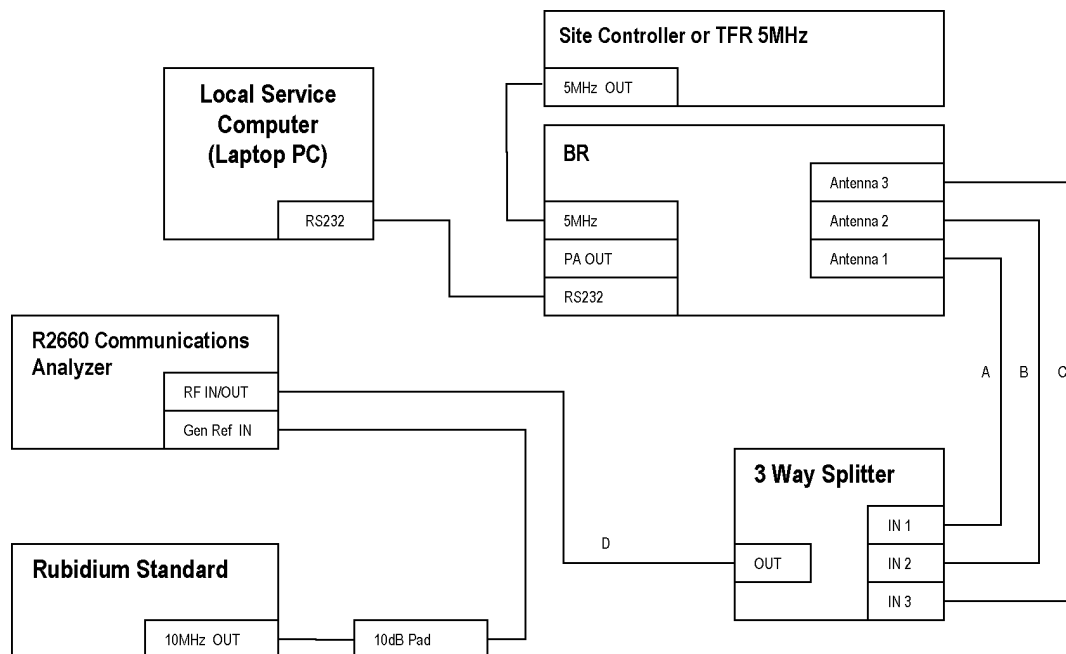


Figure 9 **Rx Verification Test Setup**

RF Cabinet Verification - Generation 2 BR

10. Apply power to the R2660.

NOTE

Due to the nature of the Generation 2 BR configuration, Antenna 2 **MUST** be connected to the R2660 for synchronization. All three RX inputs on the back of the EBTS must be connected to the R2660 and calibrated such that EACH input receives the calibrated RF signal. (See "Calibration of the R2660 output level" on page 50.) If all RX inputs are not connected, some receive paths will not receive properly.

Generation 2 BR Receiver Verification Procedure: Base Radio

This procedure provides commands and responses to verify proper operation of the Base Radio receiver paths. Perform the procedure on all four channels in each Base Radio in the EBTS.

1. Power on the BR using the front switch on the Power Supply Module. Press the reset button on the front of the EBRC module. Using the terminal program on the service computer, log onto the BR. Bold type indicates user input commands.

To enter field mode, at the > prompt type **login -ufield**.

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

The default factory set field password is **motorola**.

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

```
>login -ufield  
password:<login password>  
  
field>
```

2. Set the Frequency to of the R2660 to 810MHz. Power out should be set to -80 dBm.
3. Set all channel frequencies

```
field > freq -oxch1 -f810  
field > freq -oxch2 -f810  
field > freq -oxch3 -f810  
field > freq -oxch4 -f810
```

RF Cabinet Verification - Generation 2 BR

4. Disable System Gain.

```
field> sgc -orx_all -soff
```

NOTE

This step should only be performed if the Base Radio is connected directly to the Base Radio Antenna ports. If verification is being performed at the top of the rack (adding an RFDS), disregard the command above.

5. Verify the R2660 signal level.

```
field> enable -orxch1 -dbr1 -son  
field> ppr -orxch1 -r1 -a100
```

6. The resulting output will look similar to this:

```
field> ppr -orxch1 -r1 -a100  
  
SGC Atten.(dBm)=0.000000  
Freq. Offset=-15.059323  
Sync. Attempts=1.000000  
Sync. Successes=1.000000  
BER%=0.000000  
RX Path1 RSSI=-80.934021  
RX Path2 RSSI=-127.012520  
RX Path3 RSSI=-127.012520  
Chn sig. strength=-57.098698  
Chn intf. strength=-91.696739  
field>
```


NOTE

Rx Path1 RSSI must read -80dBm $\pm$ 1dB for the BER Floor verification to be accurate. Adjust the output level of the R2660 to compensate for loss in the test cables and three-way splitter.

Generation 2 BER Floor Measurement: Base Radio

1. Verify that the R2660 is set to 810MHz and is producing a power level of -80dBm. (See "Generation 2 BR Receiver Verification Procedure: Base Radio with RFDS" on page 91.)
2. Using the MMI commands below, issue the command to put the BR into single branch mode. If the resulting bit error rate for receiver branches 1, 2, and 3 is less than 0.01%, the receiver has passed the test.
3. Check Receiver. At the field> prompt, type (inputs are in bold, comments are in italics):

```
field> ppc -orxch1 -mchn -s1  
field> freq -orxch1 -f810
```

```
field> enable -orxch1 -soff  
field> enable -orxch1 -dbr1 -son  
field> ppr -orxch1 -a1000 -r1
```

```
field> enable -orxch1 -soff  
field> enable -orxch1 -dbr2 -son  
field> ppr -orxch1 -a1000 -r1
```

(skip the step below if the system is configured for 2 Branch Diversity)

```
field> enable -orxch1 -soff  
field> enable -orxch1 -db3 -son  
field> ppr -orxch1 -a1000 -r1
```

RF Cabinet Verification - Generation 2 BR

4. Enter the command to return all active alarms of the Base Radio. At the field> prompt, type:

```
field> alarms -ofault_hndlr
```

NOTE

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

5. As shown below respectively for 800 MHz Quad Base Radios, the following command returns the kit numbers of the receiver and all other modules. At the field> prompt, type:

```
field> fc -oplatform
```

Generation 2 BR Receiver Sensitivity Measurement: Base Radio

1. Verify that the R2660 is set to 810MHz and adjust the output power to a level of -50dBm.
2. Calibrate HP438A Power Meter. Refer to the HP users guide that came with the Meter. Below is a general procedure that can be followed.
 - 2.1 Attach 8481D Power Sensor to the **Sensor** input on the front of the 437B.
 - 2.2 Attach the included HP 11708A 30dB pad to the **Power** input on the front on the 473B.
 - 2.3 Power on the 437B.
 - 2.4 Connect the Power Meter to the female end of the 30dB pad extruding from the **Power** input.
 - 2.5 Press the "**Zero**" button on the 437B.
 - 2.6 Wait for Zeroing operation to complete.
 - 2.7 Press "**Shift-Zero**" to enter the Cal value. This is listed as **CF** on the Power Sensor.
 - 2.8 Wait for Cal operation to complete.

2.9 Press **"Shift-Freq"** to enter the Cal Factor. This is listed as **Cf** in a chart vs. freq on the Power Sensor. Choose the closest frequency range for the application. For 800MHz measurements, interpolate between 1.0GHz and 0.5GHz to obtain a Cf of 99.0

2.10 For measurement of iDEN or Tornado 6:1 waveforms, press **"Offset"** and enter 7.78dB.

- 3.** Disconnect Cable A (see Figure 3 on page -43) from the Base Radio and connect it to the Power Sensor Head.
- 4.** Increase the power level on the R2660 until the HP 437B Power Meter reads -50dB.
- 5.** Record the DISPLAYED power level of the R2660 as Calfactor A.
- 6.** The path loss through the cable and splitter system is Calfactor A + 50.

Example: R2660 reads -44dBm

HP 437B reads -50dBm

Calfactor A = -44, path loss = 6dB

- 7.** Path loss must be determined for each Antenna cable A,B,C (see Figure 3 on page -43). If comparable cables are used for all three, the path losses of all three should be the same.
- 8.** Additional power will be added to the R2660 in the sensitivity measurement to balance out the additional path loss value.
- 9.** Reconnect cables A,B,C (see Figure 3 on page -43) to Antenna Ports 1,2,3.
- 10.** Set the R2660 to Frequency 810MHz and a Power level of -108dBm + path loss.

Example: If your path loss was 6dB, set the R2660 to -102dBm.

RF Cabinet Verification - Generation 2 BR

11. Using the MMI commands below, issue the command to put the BR into single branch mode. If the resulting bit error rate for receiver branches 1, 2, and 3 is less than 8.00%, the receiver has passed the test.

```
field> ppc -orxch1 -mchn -s1
```

```
field> freq -orxch1 -f810
```

```
field> enable -orxch1 -soff
```

```
field> enable -orxch1 -dbr1 -son
```

```
field> ppr -orxch1 -a100 -r1
```

```
field> enable -orxch1 -soff
```

```
field> enable -orxch1 -dbr2 -son
```

```
field> ppr -orxch1 -a100 -r1
```

(skip the step below if the system is configured for 2 Branch Diversity)

```
field> enable -orxch1 -soff
```

```
field> enable -orxch1 -db3 -son
```

```
field> ppr -orxch1 -a100 -r1
```

12. Enter the command to return all active alarms of the Base Radio. At the field> prompt, type:

```
field> alarms -ofault_hndlr
```

NOTE

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

13. As shown below respectively for 800 MHz Quad Base Radios, the following command returns the kit numbers of the receiver and all other modules. At the field> prompt, type:

```
field> fc -oplatform
```

Generation 2 BR -- Checking Transmit Operation

The following procedures verify transmission from the system antennas.

ATTENTION

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

NOTE

(Cavity Combining RFDS only)
Prior to performing this procedure, perform the cavity tuning procedure described in the Cavity Combining RFDS section of this manual.

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, EBRC, 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.

RF Cabinet Verification - Generation 2 BR

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
(Generation 2 Single Carrier 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 40 or 70 Watt Power Amplifier.

1. Power on the BR using the front switch on the Power Supply Module. Press the reset button on the Control Module front panel. At the prompt, hit a Carriage Return on the service computer to enter the test application mode. Using the field password, login to the BR.

To enter field mode, at the > prompt type **login -ufield**.

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

The default factory set field password is **motorola**.

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

```
>login -ufield
password:<login password>

field>
```

2. Dekey the BR to verify that no RF power is being transmitted. Set the transmit DSP test mode to "stop." At the field> prompt, type:

```
field> power -otxch1 -p0
field> ptm -otx_all -mstop
```

RF Cabinet Verification - Generation 2 BR**NOTE**

The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into an RF load.

3. Key the BR to 40 watts, following the steps below from the BRC> prompt:

- 3.1 Set the frequency of transmit channel.

```
field> freq -otxch1 -f860
```

- 3.2 Enable the channels by setting a data pattern to "iden"

```
field> dpm -otxch1 -miden
```

NOTE

After the following command is entered, power will be transmitted at the output of the Power Amplifier.

- 3.3 Set the transmit power to 40 watts, set the transmit DSP test mode to "dnlk_framed" and key the BR.

```
field> ptm -otx_all -mdnlk_framed
field> power -otxch1 -p40
```

4. 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 13.

Table 13 **Generation 2 BR Transmitter Parameters**

Parameter	Value or Range
Forward Power	Greater than 36 Watts
Reflected Power	Less than 2.0 Watts
VSWR	Less than 1.6:1

NOTE

The reported value for forward power is not indicative of Base Radio performance. This value is reported from the internal wattmeter. These values are only for verification of operation and are not representative of true operational power of the transmitter.

4.1 At the field> prompt, type:

```
field> power -otx_all
```

This command returns all active alarms of the Base Radio.

4.2 At the field> prompt, type:

```
field> alarms -ofault_hdlr
```

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

RF Cabinet Verification - Generation 2 BR

5. View the spectrum of the transmitted signal on the R2660 Communications Analyzer in the Spectrum Analyzer mode. Figure 10 shows a sample of the spectrum on a high resolution display. The RS2660 does not have the same resolution.

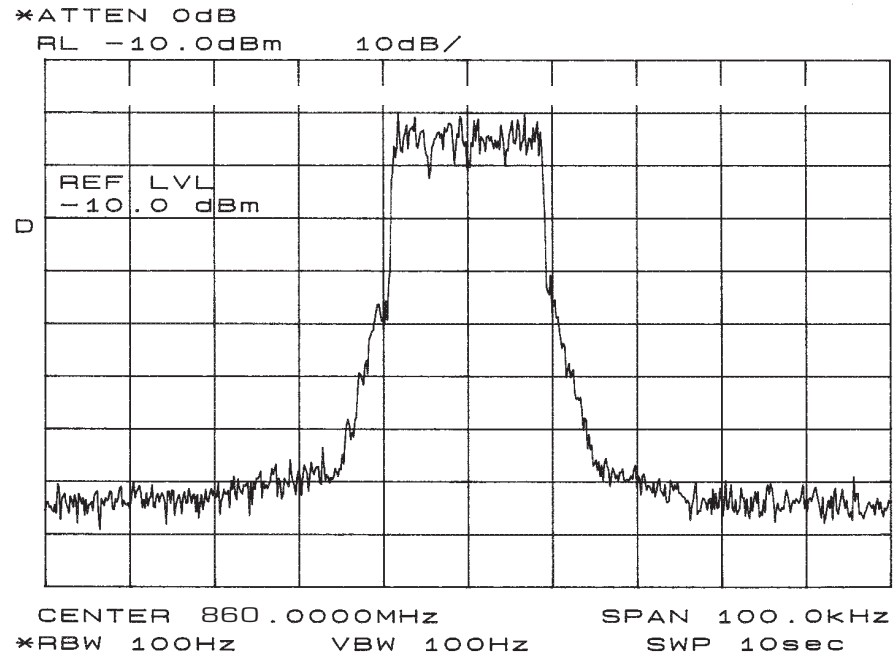


Figure 10 **Generation 2 BR Spectrum**

6. Dekey the BR to verify no RF power is being transmitted. Set the transmit DSP test mode to "stop." At the field> prompt, type:

```
field> power -otxch1 -p0
field> ptm -otx_all -mstop
```

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.

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System Troubleshooting

Overview

NOTE

In this section, “RF Cabinet” similarly denotes a stand-alone RF cabinet (Stand-Alone Control and RF Cabinet systems) or the RF subsystem of a Single Rack system (Single Rack, Redundant Controller or Single Rack, Single Controller system).

Refer to “EBTS Cabinet Configurations” (*System Description* section of this manual) for more information about system types and cabinet configurations.

This chapter provides troubleshooting procedures for the RF Cabinet portion of the EBTS.

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

Section	Page	Description
Troubleshooting	2	General information on field troubleshooting
Legacy, EBRC/Gen2 and QUAD MMI Cross Reference	3	Cross reference of software command forms for the various Base Radios.
Base Radio Fault Indications/Isolation	5	Defines the possible failures and corrective actions for failure symptoms of the Base Radio
Excessive BER Fault Isolation (Applicable to Legacy BR Only)	11	Procedure for fault isolating BER faults determined during System Testing
RF Distribution System Fault Isolation	16	Defines the possible failures and corrective actions for failure symptoms of the RF Distribution System
Miscellaneous Troubleshooting	19	Defines the possible failures and corrective actions for miscellaneous failure symptoms

Troubleshooting

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.

Legacy, EBRC/Gen2 and QUAD MMI Cross Reference

Field technicians can use the commands cross referenced in Table 1 to quickly identify Legacy Base Radio Controller MMI commands with Enhanced Base Radio Controller (EBRC)/Generation 2 BR (Gen 2 BR) and QUAD BR Controllers, and vice versa.

Table 1 **Legacy, EBRC/Gen2 and QUAD MMI Commands Cross Reference**

Legacy MMI Command	EBRC/Gen2 and QUAD MMI Command
get cabinet	cabinet_id -oplatform
set cabinet <cabinet #>	cabinet_id -oplatform -c <cabinet #>
dekey	power -otxch1 -p0; ptm -otx_all -mstop
get fwd_pwr	power -otx_all
help	help
key	peer_test_mode; data_pattern_mode; power (see manual)
get position	position_id -oplatform
set position <position #>	position_id -oplatform -p <position #>
get rptr_status	fru_config -oplatform
reset	reset -oplatform
get rssi <# reports> <# averages>	peer_performance_report -orxch {1 2 3 4} -r <# reports> -a <# averages>
get rssi_mode	peer_performance_config -orxch {1 2 3 4}
set rssi_mode {3rxber standard}	peer_performance_config -orxch {1 2 3 4} -m {path chn} -pall -s1 }
get rx_freq	freq -orxch {1 2 3 4}
set rx_freq <freq in mhz>	freq -orxch {1 2 3 4} -f <freq in mhz>
get rx_fru_config	diversity -orx_all
set rx_fru_config { 1 2 3 12 13 23 123 }	diversity -orx_all -d <bitmask>
get rx_mode	enable -orxch {1 2 3 4}
set rx_mode { 1 2 3 12 13 23 123 }	enable -orxch {1 2 3 4}(-dbr {1 2 3}) -s {on off}
get rx_status	status -orx_all; enable -orxch {1 2 3 4}
get tx_freq	freq -otxch {1 2 3 4}
set tx_freq <freq in mhz>	freq -otxch {1 2 3 4} -f <freq in mhz>
get tx_mode	peer_test_mode -otx_all
set tx_mode <mode>	peer_test_mode -otx_all -m <mode>
set tx_power <power in watts>	power -otxch1 -p <power in watts>
ver	firmware_version -oplatform

Legacy, EBRC/Gen2 and QUAD MMI Cross Reference**Table 1 Legacy, EBRC/Gen2 and QUAD MMI Commands Cross Reference (Continued)**

Legacy MMI Command	EBRC/Gen2 and QUAD MMI Command
N/A	data_pattern_mode -otxch{1 2 3 4} (-m{none iden})
N/A	login
N/A	external_synchronization -orx_all -t<mode>
N/A	logout
N/A	time
get brc_kit_no	kit_number -ocontrol
get brc_rev_no	revision_number -ocontrol
get brc_scratch	scratch -ocontrol
get ex_kit_no	kit_number -oex1
get ex_rev_no	revision_number -oex1
get ex_scratch	scratch -oex1
get pa_kit_no	kit_number -opa1
get pa_rev_no	revision_number -opa1
get pa_scratch	scratch -opa1
get ref_pwr	power -otx_all
get rx_sanity	status -orx_all
get rx_version	firmware_version -orxch1
get rx1_kit_no (rx2_kit_no, rx3_kit_no)	kit_number -orxch{1 2 3 4}
get rx1_rev_no (rx2_rev_no, rx3_rev_no)	revision_number -orxch{1 2 3 4}
get rx1_scratch (rx2_scratch, rx3_scratch)	scratch -orxch{1 2 3 4}
get tx_sanity	status -otx_all
get tx_version	firmware_version -otxch1
get txlin_stat	status -otx_all
get vswr	power -otx_all
get wattmeter	power -oext_wm
NOTE: The full set of EBRC/Gen2 & Quad MMI feild commands is cross-referenced to the corresponding Legacy field command subset. The full set of Legacy and EBRC/Gen2 and Quad MMI commands can be referenced in the Software Commands section of the document (EBTS Manual) Items in () are optional arguments. Items in { } are possible options for the command argument.	

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 (Gen 3 SC or iSC) will automatically reboot the new or serviced BR if the BR has been off-line for a period not less than that stipulated by the "Replacement BRC Accept Timer" value (default is 3 minutes). If the BR is turned on prior to the duration of the "Replacement BRC Accept Timer" value, power the BR down and wait the minimum timer length before re-powering the BR.

Base Radio Fault Indications/Isolation

Indication	Possible Failure	Corrective Action
BR LED (green) is not lit [Legacy / EBRC] Tx1, Tx2, Tx3, Tx4 (green) is not lit [QUAD]	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
BR LED (green) is not lit [Legacy / EBRC] Tx1, Tx2, Tx3, Tx4 (green) is not lit [QUAD]	BR waiting for registration	• Verify Ethernet cabling to Gen 3 SC or iSC • Verify Ethernet properly terminated • Verify Gen 3 SC or 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

Base Radio Fault Indications/Isolation

Indication	Possible Failure	Corrective Action
PS LED (red) is lit [Legacy, EBRC/Gen2, QUAD]	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 - Legacy BRC: Verify 5.1 VDC by executing get ps_ad2 MMI command - EBRC/Gen2 and QUAD: Verify 3.3 VCD by executing TBD 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
PS LED (red) is flashing [Legacy, EBRC/Gen2, QUAD]	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

Base Radio Fault Indications/Isolation

Indication	Possible Failure	Corrective Action
EX LED (red) is lit [Legacy & EBRC/Gen2:] EXBRC (red) is lit [QUAD] NOTE: At BR power-on, this LED lights until the BR software reaches a stable mode of operation	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 [Legacy, EBRC/Gen2] EXBRC (red) is flashing (QUAD)	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 [Legacy, EBRC/Gen2, QUAD]	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 [Legacy, EBRC/Gen2, QUAD]	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 [Legacy, EBRC/Gen2] EXBRC (red) is lit [QUAD]	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 (Legacy and EBRC/Gen2 Only) - Replace BRC module
CTL LED (red) is flashing [Legacy, EBRC/Gen2] EXBRC is lit [QUAD]	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

Base Radio Fault Indications/Isolation

Indication	Possible Failure	Corrective Action
R1, R2, or R3 LED (red) is lit [Legacy, EBRC / Gen2] R1, R2, R3, R4 LED (red) is / are lit [QUAD]	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 - 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 (Legacy and EBRC/Gen2 Only) - Check BR DSP by executing get rx_sanity MMI command - Replace BRC module
R1, R2, or R3 LED (red) is lit [Legacy, EBRC / Gen2] R1, R2, R3 or R4 LED (red) is flashing [QUAD]	Minor Receiver alarm	- Identify alarm condition by executing get_alarms MMI command - Reset the BR - Replace 3X Receiver module, as required
REF [QUAD]	Major Reference Alarm	- Identify alarm condition by executing get_alarms MMI command - Verify proper 5Mhz/1PPS cabling. - Reset the BR and verify the LED sequence. - Replace the BRC module
	Minor Reference Alarm	- Identify the alarm condition by executing get_alarms MMI commands - Reset the BR and verify the LED sequence. - Replace BRC module as required.

Excessive BER Fault Isolation (Applicable to Legacy BR Only)

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 RF Cabinet Verification procedures (*System Testing* section of this manual) should be repeated on the cabinet(s) where repairs were performed.

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.

Excessive BER Fault Isolation (Applicable to Legacy BR Only)

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:
$(-108.0 \text{ dBm}) + \text{Calibrated cable loss} = \text{Required R2660 Output Level}$
EXAMPLE: $(-108.0) + (1.7) = -106.3 \text{ dBm}$

- 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 10.

BRC> **get rssi 2 100**

Starting RSSI monitor for 2 repetitions averaged each 100 reports.

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

Excessive BER Fault Isolation (Applicable to Legacy BR Only)

6. Increase the R2260 output level by 2 dB.
7. Repeat the appropriate Single Channel BR or QUAD Channel BR MMI command as listed in step 5
8. At the BRC> prompt, again type: **get rssi 2 100**
9. 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.
10. 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.
11. If system is equipped with a cavity combining RFDS, proceed to step 12. If system is equipped with a duplexed RFDS, proceed to step 13.
12. As displayed on R2660 Output Level display, adjust the R2260 output level for **-107.5 dBm at the end of the cable** as follows:

800 MHz Cavity Combining RFDS Only:

(-107.5 dBm) + Calibrated cable loss= Required R2660 Output Level

EXAMPLE:

(-107.5) + (1.7)= -105.8 dBm

After setting level, proceed to step 14.

Excessive BER Fault Isolation (Applicable to Legacy BR Only)

13. 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

Duplexed RFDS:
$(-111.5 \text{ dBm}) + \text{Calibrated cable loss} = \text{Required R2660 Output Level}$
EXAMPLE: $(-111.5) + (1.7) = -109.8 \text{ dBm}$

After setting level, proceed to next step.

14. At the BRC> prompt, again type: **get rssi 2 100**
15. 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 12 (or 13) 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.

Excessive BER Fault Isolation (Applicable to Legacy BR Only)

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

RF Distribution System Fault Isolation

CAUTION

On gen 4 duplexed rfd, combiner and/or isolator deck surfaces are hot. contact can cause burns. allow deck surface to cool before touching.

Indication	Possible Failure	Corrective Action
An RF Amplifier resettable fuse (AMP1, AMP2, or AMP3) on the RFDS is tripped NOTE: Above applies only to 800 MHz Duplexed RFDS 0182020V06 (and prior).	Low Noise Amplifier module failure	Reset the appropriate fuse(s); if it trips again, replace the Low Noise Amplifier module
The POWER SUPPLY LED (green) on the RFDS Power Supply is not lit NOTE: Above applies only to 800 MHz Duplexed RFDS 0182020V06 (and prior).	RFDS Power Supply module failure	Replace Power Supply module
	No power connected to the Power Supply /RFDS	- Check RF Cabinet breakers (RFS1, RFS2) - Check power cabling to RFDS
RF Cabinet circuit breaker alarm	Breaker in RF Cabinet tripped or in OFF position	- Verify that ALL breakers in RF Cabinet 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 RF Cabinet 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 RF Cabinet 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

RF Distribution System Fault Isolation

Indication	Possible Failure	Corrective Action
RF Cabinet 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 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 RF Cabinet alarms by executing display_eas MMI command • Verify correct alarm cabling • Verify cabling integrity • Replace alarm cable, if appropriate
RF Cabinet 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 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 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 RF Cabinet 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
RF Cabinet 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 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 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 RF Cabinet 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
	Gen 3 SC or iSC failure	Refer to Gen 3 SC or 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
	Gen 3 SC or iSC failure	Refer to Gen 3 SC or 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.

Miscellaneous Troubleshooting

Indication	Possible Failure	Corrective Action
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	(SCRF or SRRC) Check module fault indicator(s), as applicable (SRSC) 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 <i>Final Checkout</i> section of this manual for power supply system checkout and setup.) NOTE: For SCRF and SRRC systems, power supply system is not part of EBTS. Refer to manufacturer's data for troubleshooting and maintenance instructions. For SRSC system, refer to "Replacement of AC/DC Power System FRUs" (<i>Single Rack, Single Controller</i> section of this manual) for maintenance instructions.

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 Generation 3 Site Controller (Gen 3 SC) or Integrated Site Controller (iSC) command set and Base Radio (BR) command set.

The Gen 3 SC or iSC command set is described in detail in the Gen 3 SC or iSC Supplement to this manual. Base radio commands are described herein.

The following table lists the chapter topics.

Section	Page	Description
MMI Command Overview	2	Describes the MMI command access levels, and conventions
Legacy Base Radio Commands	4	Defines Legacy Base Radio individual commands used to configure and test the Base Radios
Generation 2 Base Radio Software Command Overview	58	Describes the MMI command access levels and conventions.
QUAD Channel BR Software Commands	85	Describes the MMI and Base Radio software commands for the QUAD Channel BR.

MMI Command Overview

MMI Command Overview

This section describes all MMI commands pertaining to 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 field password. 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 field password that is programmed during manufacturing. The password will be changed by the Operations and Maintenance Center (OMC) as soon as the controller takes a download. The OMC default field password is **Motorola**. The field password is customer defined and can be changed at the OMC. Please check with the OMC operator on duty to obtain your unique customer field password.

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.

Legacy Base Radio Commands

Legacy 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|
```

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.

Legacy Base Radio Commands**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.

800 MHz Base Radio 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
```

Legacy Base Radio Commands

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.

800 MHz Base Radio Example:

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

Legacy Base Radio Commands**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.

800 MHz Base Radio 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
```

Legacy Base Radio Commands

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].
```

Legacy Base Radio Commands**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.

800 MHz Base Radio 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.

800 MHz Base Radio 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:

Legacy Base Radio Commands

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
```

Legacy Base Radio Commands

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.

Legacy Base Radio Commands**800 MHz Base Radio 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
```

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 dBm	RSSI2 dBm	RSSI3 dBm	SGC dB	DIVBER dBm%	SyncMiss %
----	-----	-----	-----	----	-----	-----
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	

Legacy Base Radio Commands

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.

800 MHz Base Radio 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
```

Legacy Base Radio Commands

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.

800 MHz 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}
```

Legacy Base Radio Commands

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

Legacy Base Radio Commands

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
0	0	0	0	0	0

Legacy Base Radio Commands

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.

Legacy Base Radio Commands**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.

800 MHz 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.

800 MHz Base Radio 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
```

Legacy Base Radio Commands**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
```

Legacy Base Radio Commands**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

get          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
```

Legacy Base Radio Commands

get/set	ref_wattmeter_scaling_factor
	reset
get	rom_ver
get	rprr_status
get	rsi
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
```

Legacy Base Radio Commands

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
```

Legacy Base Radio Commands

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.

Legacy Base Radio Commands**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
```

Legacy Base Radio Commands

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
```

Legacy Base Radio Commands

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*)_scaling_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 (800 MHz Base Radio)

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
```

Legacy Base Radio Commands

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).

Legacy Base Radio Commands**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}

ATTENTION

This command keys the transmitter. Verify transmission 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.

Legacy Base Radio Commands**Example:**

```
BRC> set txlin 1 08
set TXLIN 1 to 0x08 in RAM
```

**SET TX_FREQ
(800 MHz Base Radio)****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.

800 MHz Base Radio 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
```

Legacy Base Radio Commands

SET TX_POWER**Syntax:**

set tx_power {*value in Watts*}

ATTENTION

This command keys the transmitter. verify transmission 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, 60W, 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
```

Generation 2 Base Radio Software Command Overview

Generation 2 Base Radio Software Command Overview

Overview

This section provides definitions for Man-Machine-Interface (MMI) commands. MMI commands test and configure the EBTS equipment via a service computer. Two command sets accomplish these test and configuration tasks: The Generation 3 Site Controller (Gen3 SC) or integrated Site Controller (iSC) command set and Base Radio (BR) command set.

The Gen3 SC/iSC Supplement to this manual describes the controller command set in detail. This chapter section describes Generation 2 (Gen2) Base Radio commands.

The following table lists this section's topics.

Section	Page	Description
Generation 2 BR MMI Commands	59	Describes MMI commands, including access levels and conventions
Generation 2 Base Radio Commands	62	Defines the Base Radio commands used to configure and test Base Radios
Generation 2 Base Radio Application Examples	81	Demonstrates command use with sample settings.

Generation 2 BR MMI Commands

This section describes Test Application MMI commands for Generation 2 Base Radios. Command descriptions include syntax, definitions, and examples.

Call processing offers separate MMI commands that follow a different format. For information on the Call Processing MMI commands, refer to the System Release GR Binder.

An operator at a service computer inputs MMI commands to the system's RS-232 serial port. The transfer protocol is: 19,200 bps, 8-N-1. (That is, eight data bits, no parity, 1 stop bit.) Either the Gen3 SC/iSC or the front of the Enhanced Base Radio Controller (EBRC) in the RF Cabinet can access the RS-232 serial port.

The Base Radio test procedure uses MMI commands to test and configure the system. For Base Radio test procedures, refer to the Base Radio section of this manual.

NOTE

This section only covers Test Application MMI commands for Generation 2 Base Radios. For a complete description of MMI commands pertaining to the Gen3/iSC, refer to this manual's controller Supplement. For Single Carrier BR operation, refer to the Single Carrier BR MMI command section.

Access Level

The Test Application requires the user to log in, using a defined user ID and password. The login permits appropriate access to the MMI command set. The Test Application provides the following login IDs.

iDEN Generation 2 Login id's	Password	Configuration
field	motorola	factory default
field	Motorola	OMC default
field	<customer specified>	OMC customer set

Generation 2 BR MMI Commands**NOTE**

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

Example:

```
>login -ufield
password:<login password>

field>
```

Conventions

Generation 2 Base Radio MMI commands appear in alphabetical order. The command syntax is case sensitive. The syntax for each command appears as follows:

- ❑ Plain/**bold** text shows what to type to invoke a command or action.
- ❑ *Italic* text shows where to substitute a parameter or value.
- ❑ Text in braces { } indicates a selection or parameter that the operator **must** enter before the command can execute.
- ❑ A series of dots ... indicates one or more occurrences of a preceding parameter.

Generation 2 BR command syntax is case sensitive. Each example appears in the format that the operator should enter.

A definition details each command's purpose and function. Where helpful, an example of the command's response follows the definition. Whenever possible, this section uses typical values.

Some commands return varying responses (such as "available," "not available," "unknown," "o.k.," and "alarm"). Each example only lists one of the possible responses. Examples do not go through every possible scenario.

Generation 2 Base Radio Commands

Generation 2 Base Radio Commands

Command Detail

The commands in bold text appear in long form, followed in parenthesis by the short form.

ALARMS

Syntax:

STRINGX -object = {fault_hdlr}

The ALARMS command returns the active alarms.

Example:

```
field> alarms -ofault_hdlr

ACTIVE_FAULT_ID=RX_LO1_LOCK

field>
```

CABINET_ID (CI)

Syntax:

STRINGX -object = {platform}

STRINGX -cabinet = {any positive integer}

The CI command controls the cabinet identification number.

Examples:

```
field> ci -oplatform
Cabinet ID=0

field> ci -oplatform -c1

field> ci -oplatform
Cabinet ID=1
```

DATA_PATTERN_MODE (DPM)**Syntax:**

STRINGX -object = {txch1}

STRINGX -mode = {none, iden}

The DPM command controls the mode setting for the platform object's transmit path data pattern.

Examples:

```
field> dpm -otxch1

Mode=none

field> dpm -otxch1 -miden

field> dpm -otxch1

Mode=iden
```

DIVERSITY**Syntax:**

STRINGX -object = {rx_all}

Generation 2 Base Radio Commands

STRINGX -*diversity* = {right justified binary bit map of the receive branch configuration, the right most bit field corresponds to receive branch 1}

NOTE: This setting does not change the platform in anyway. It is simple used as a configuration parameter.

Examples:

```
field> diversity -orx_all -d0      #Turn all branches off
field> diversity -orx_all -d1      #enable branch 1; 2 & 3 are off
field> diversity -orx_all -d10     #enable branch 2; 1 & 3 are off
field> diversity -orx_all -d11     #enable branch 1 & 2; 3 is off
field> diversity -orx_all -d100    #enable branch 3; 1 & 2 are off
field> diversity -orx_all -d101    #enable branch 3 & 1; 2 is off
field> diversity -orx_all -d110    #enable branch 3 & 2; 1 is off
field> diversity -orx_all -d111    # enable 1, 2 and 3
```

ENABLE**Syntax:**

STRINGX -object = {txch1, rxch1}

for -object = rxch1

STRINGX -diversity = {br{1->3}}

STRINGX -state = {on, off, dumb}

The ENABLE command controls the enabled state of txch and rxch objects.

The Diversity option only applies to Rx

Examples:

```
field> enable -otxch1 -son

field> enable -otxch1
State=On

field> enable -orxch1 -son

field> enable -orxch1

br1=on
br2=on
br3=on

field> enable -orxch1 -dbr2 -soff

field> enable -orxch1

br1=on
br2=off
br3=on
```

EXTERNAL_SYNCHRONIZATION (ES)**Syntax:**

STRINGX -object = {rx_all, tx_all}

for -object = rx_all

STRINGX -type = {trig_def, global, ext_trigger, pps, in_ptt}

for -object = tx_all

STRINGX -type = {trig_def, out_pp3s, out_frame, out_slot,
out_ptt, out_mframe, out_fs_bs}

The ES command controls the object's external synchronization method.

Generation 2 Base Radio Commands**Examples:**

```
field> es -orx_all

Type=trig_def

field> es -orx_all -text_trigger

field> es -orx_all

Type=ext_trigger
```

FIRMWARE_VERSION (FV)**Syntax:**

STRINGX -object = {control, rxch1, txch1, platform, PS}

The FV command returns the object's firmware version. Specifying the object 'platform' causes the software to return additional information.

Example:

```
field> fv -oplatform

Test Application Version =D01.01.07

Controller Rev No   = R07.00.00
Controller Kit No   = CLN 7428A
Controller Firmware = 7.10.04
Power Supply Rev No = R06.00.00
Power Supply Kit No = CPN6080B
Core Software Ver   = 7.10.04
Platform ID        =
Tx1 Exciter Rev No  = R01.04.01
Tx1 Exciter Kit No  = TLF7000H
Tx1 Exciter Firmware = 01.00.02
Tx1 PA Rev No       = R40.01.00
Tx1 PA Kit No       = CLF1772B
Tx1 PA Firmware     =
Rx1 Rev No          = R01.03.00
Rx1 Kit No          = CRF6010D
Rx1 Firmware        = 01.00.00

Core Major Version=7
Core Minor Version=1

field>
```

FREQ**Syntax:**

STRINGX -object = {txch1, rxch1}

FLOATX -frequency = {use status -orx_all or status -otx_all for
applicable limits}

Generation 2 Base Radio Commands

The FREQ command controls synthesizer frequency settings for the rxch and txch objects.

Examples:

```
field> freq -otxch1 -f860
field> freq -otxch1
freq=860.000000
field> freq -orxch1 -f806
field> freq -orxch1
freq=806.000000
field>
```

FRU_CONFIGURATION (FC)**Syntax:**

STRINGX -object = {platform}

The FC command returns the fru configuration.

Example:

```
field> fc -oplatform

type=BRC
slot=Slot 04
revision number=R07.00.00
kit number=CLN7428AA
flags=Available,Supported, Known

type=Power Supply
slot=Slot 00
revision number=R06.00.00
kit number=CPN6080B
flags=Available,Supported, Known

type=Receiver
slot=Slot 03
revision number=R01.03.00
kit number=CRF6010D
flags=Available,Supported, Known
.
.
.
type=Exciter
slot=Slot 01
revision number=R01.00.00
kit number=CTF6321A
flags=Available,Supported, Known

type=Power Amplifier
slot=Slot 02
revision number=R45.01.00
kit number=CLF1772B
flags=Available,Supported, Known
```

Generation 2 Base Radio Commands**HELP****Syntax:**

STRINGX -command = {any string}

The HELP command displays help text for the test application. Help topics for the entered command string appear in alphabetical order. HELP operates similarly to a grep, where the string is part or all of the command.

Example:

```
field> help -cpower  
power: This command controls the platform object power settings  
  
arguments:  
-o(object)=txch1 (for write)  
-o(object)=tx,all, ex (for read)  
-p(power)= 5.0-40.0 Watts with 40 Watt PA, 5.0-70.0 with 70 Watt
```

KIT_NUMBER (KN)**Syntax:**

STRINGX -object = {ex1, pa1, rxch1, ps, control}

The KN command returns the object's kit number setting.

Example:

```
field> kn -opa1  
  
kit_number=CLFCLF1772B  
  
field>
```

LOGIN

Syntax:

STRINGX -userid = {dev, factory, field}

The LOGIN command allows the user to log in as a valid user. Note that each login requires a password and that the word 'login' be part of the command string.

Example:

```
> login -ufield
password: <field login password>

field>
```

iDEN Generation 2 Login id's	Password	Configuration
field	motorola	factory default
field	Motorola	OMC default
field	<customer specified>	OMC customer set

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

Generation 2 Base Radio Commands

LOGOUT

Syntax:

none

The LOGOUT command logs out the current user and displays the login prompt. No reset occurs.

Example:

```
field> logout
```

```
field>
```


PEER_PERFORMANCE_CONFIG (PPC)

Syntax:

STRINGX -object = {rxch1}

STRINGX -mode = {chn, path}

for -mode = path

INTX -path = {1,2,3, all}

for -mode = chn

INTX -slot = {1->6}

The PPC command controls the platform peer performance configuration. A -mode argument setting of “chn” provides the channel performance for all enabled branches. A -mode argument setting of “path” provides the individual receive path performance.

Examples:

```
field> enable -orxch1 -son
```

```
field> ppc -orxch1 -mpath -pall
```

```
field> ppc -orxch1
```

```
Mode=path
```

```
Path=all
```

```
field> ppc -orxch1 -mchn -s1
```

```
field> ppc -orxch1
```

```
Mode=chn
```

```
Slot=1
```

Generation 2 Base Radio Commands**PEER_PERFORMANCE_REPORT (PPR)****Syntax:**

STRINGX -object = {rxch1}, rx_all}

INTX -averages = {2- 65535 max}

INTX -reports = {1- 65535 max}

The PPR command returns the peer performance information. The operator must complete appropriate peer_performance_config settings before generating reports.

Example:

```
field> ppr -orxch1 -a10 -r1

SGC Atten.(dBm)=0.000000
Freq. Offset=-0.000031
Sync. Attempts=1.000000
Sync. Successes=0.000000
BER%=50.290699
RX Path1 RSSI=-129.727005
RX Path2 RSSI=-130.369965
RX Path3 RSSI=-132.486801
Chn sig. strength=-68.348839
Chn intf. strength=-68.348839
```

PEER_TEST_MODE (PTM)

Syntax:

STRINGX -object = {tx_all, rx_all}

for -object = rx_all

-mode = uplk_framed

for -object = tx_all

-mode = {dnlk_framed, tones, stop, suspend}

The PTM command controls the platform peer (DSP) test mode setting.

Examples:

```
field> ptm -otx_all

Mode=not_in_test

field> ptm -otx_all -mdnlk_framed

field> ptm -otx_all

Mode=dnlk_framed
```

POSITION_ID (PI)

Syntax:

STRINGX -object = {platform}

STRINGX -position = {any positive integer}

The PI command controls the platform position number.

Generation 2 Base Radio Commands**Examples:**

```
field> pi -oplatform

Position=0

field> pi -oplatform -p5

field> pi -oplatform

Position=5

field>
```

POWER**ATTENTION**

The POWER command keys the transmitter. Make sure that transmission only occurs on licensed frequencies, or into an RF dummy load.

Syntax:

STRINGX -object = {tx_all, txch1}

FLOATX -power = {use status -otx_all for applicable limits}

The POWER command controls the platform object's transmit output power. A -power argument setting greater than 0 keys up the transmitter at the indicated power level. A -power argument setting of 0 de-keys the transmitter. Before key-up, the operator must configure the appropriate freq, enable, peer_test_mode and data_pattern_mode settings.

NOTE

The operator must set "peer_test_mode" to "stop." Otherwise, residual power may still be present at the transmit port.

Examples:

```
field> freq -otxch1 -f860

field> dpm -otxch1 -miden

field> ptm -otx_all -mdnlk_framed

field> power -otxch1 -p30

field> power -otxch1

Forward Power=30.931942
Reflected Power=1.362578
VSWR=1.531271

field>
```

RESET**Syntax:**

STRINGX -object= platform

Executes the Core reset control for Gen2 and QUAD BRs.

Example:

```
field> reset -oplatform

field>
```

Generation 2 Base Radio Commands

REVISION_NUMBER (RN)

Syntax:

STRINGX -object = {ex1, pa1, rxch1, ps, control}

The RN command returns the revision number setting of the specified object.

Example:

```
field> rn -oex1

revision_number=R01.04.11

field>
```

SCRATCH

Syntax:

STRINGX -object = {control, ex1, pa1, rxch1, ps}

The SCRATCH command returns the scratch pad memory contents for the specified object.

Example:

```
field> scratch -orxch1

scratch=Motorola,Inc

field>
```

STATUS

Syntax:

STRINGX -object = {tx_all, rx_all}

The STATUS command returns status information for the specified object.

Examples:

```
field> status -otx_all
```

```
TX Sanity=Sane  
TX CPU Load=13.283999  
Number of TX Logical Channels=1  
Lowest Operational TX Frequency=851.000000  
Highest Operational TX Frequency=870.000000  
Minimum TX Output Power Capable=5.000000  
Maximum TX Output Power Capable=43.895771  
Training Data= 0x85, 0x4A, 0x02, 0x7F, 0xF10
```

```
field> status -orx_all
```

```
RX1 Sanity=Sane  
RX2 Sanity=N/A  
RX1 CPU Load=48.609333  
RX2 CPU Load=N/A  
RXCH1 Lock=Unlocked  
RXCH2 Lock=N/A  
RXCH3 Lock=N/A  
RXCH4 Lock=N/A  
Number of RX Logical Channels Supported=14  
Lowest Operational RX Frequency=806.000000  
Highest Operational RX Frequency=825.000000  
Number of Physical Branches per RX Channel=3
```

```
field>
```

SYSTEM_GAIN_ENABLE (SGE)**Syntax:**

STRINGX -object = {rx_all}

STRINGX -state = {on,off}

The SGE command controls the rx system gain enable state.

Generation 2 Base Radio Commands**Examples:**

```
field> sgc -orx_all

State=on

field> sgc -orx_all -soff

field> sgc -orx_all

State=off
```

TIME**Syntax:**

None

The TIME command displays the current platform time setting in seconds since the last reset. The system stamps events in the alarm_log with this time as reference.

Example:

```
field> time

Time=0000002703

field>
```

Generation 2 Base Radio Application Examples

Key the BR

1. Set channel 1's transmit frequency.

```
field> freq -otxch1 -f860
```

```
field>
```

2. Enable the channels by setting a data pattern to "iden."

```
field> dpm -otxch1 -miden
```

```
field>
```

ATTENTION

The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies, or into an RF dummy load.

3. Set the test mode.

Generation 2 Base Radio Application Examples

4. Set the transmit power to 40 watts. Key the BR.

```
field> power -otxch1 -p40
```

```
field>
```

Dekey Keyed BR

1. Set the transmit channel 1 power to 0.

```
field> power -otxch1 -p0
```

```
field>
```

2. Set the transmit DSP test mode to “stop.”

```
field> ptm -otx_all -mstop
```

```
field>
```

Query for BR Output Power

1. Query the current, channel 1 transmit power.

```
field> power -otxch1
```

```
field>
```

Query for RX Performance Data - Channel

1. Set the frequency of receive channel 1 to 806MHz.

```
field> freq -orxch1 -f806  
  
field>
```

2. Enable receive channel 1.

```
field> enable -orxch1 -son  
  
field>
```

3. Set the test mode of the receive channel 1 DSP to "uplk_framed."

```
field> ptm -orx_all -muplk_framed  
  
field>
```

4. Configure the DSP performance characteristics of receive channel 1 for channel reports using slot 1 data.

```
field> ppc -orxch1 -mchn -s1  
  
field>
```

5. Configure the receive channel 1 performance report. Begin reporting.

```
field> ppr -orxch1 -a1000 -r1  
  
field>
```

Generation 2 Base Radio Application Examples

Query for RX Performance Data - Path

1. Step1 - Set the frequency of receive channel 1 to 806MHz.

```
field> freq -orxch1 -f806  
  
field>
```

2. Enable receive channel 1.

```
field> enable -orxch1 -son  
  
field>
```

3. Set the test mode of the receive channel 1 DSP to “uplk_framed.”

```
field> ptm -orx_all -muplk_framed  
  
field>
```

4. Configure the DSP performance characteristics of receive channel 1 for path 1 reports.

```
field> ppc -orxch1 -mpath -p1  
  
field>
```

5. Configure the receive channel 1 performance report. Begin reporting.

```
field> ppr -orxch1 -a1000 -r1  
  
field>
```

QUAD Channel BR Software Commands

Overview

This section provides definitions for Man-Machine-Interface (MMI) commands. MMI commands test and configure the EBTS equipment via a service computer. Two command sets accomplish these test and configuration tasks: The integrated Site Controller (iSC) command set and Base Radio (BR) command set.

The iSC Supplement to this manual describes the iSC command set in detail. This chapter section describes QUAD Channel base radio commands.

The following table lists this section's topics.

Section	Page	Description
QUAD BR MMI Commands	86	Describes MMI commands, including access levels and conventions
QUAD Base Radio Commands	89	Defines the Base Radio commands used to configure and test Base Radios
QUAD Application Examples	108	Demonstrates command use with sample settings.

QUAD BR MMI Commands

QUAD BR MMI Commands

This section describes Test Application MMI commands for QUAD Channel Base Radios. Command descriptions include syntax, definitions, and examples.

Call processing offers separate MMI commands that follow a different format. For information on the Call Processing MMI commands, refer to TBD.

An operator at a service computer inputs MMI commands to the system's RS-232 serial port. The transfer protocol is: 19,200 bps, 8-N-1. (That is, eight data bits, no parity, 1 stop bit.) Either the iSC or the front of each BRC in the RF Cabinet can access the RS-232 serial port.

The Base Radio test procedure uses MMI commands to test and configure the system. For Base Radio test procedures, refer to the Base Radio section of this manual.

NOTE

This section only covers Test Application MMI commands for QUAD Channel Base Radios. For a complete description of MMI commands pertaining to the iSC, refer to this manual's iSC Supplement. For Single Carrier BR operation, refer to the Single Carrier BR MMI command section.

Access Level

The Test Application requires the user to log in, using a defined user ID and password. Each login permits appropriate access to the MMI command set. The Test Application provides the following login IDs.

iDEN Generation 2 Login id's	Password	Configuration
field	motorola	factory default
field	Motorola	OMC default
field	<customer specified>	OMC customer set

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

Example:

```
>login -ufield  
password:<login password>  
  
field>
```

QUAD BR MMI Commands

Conventions

QUAD Base Radio MMI commands appear in alphabetical order. The command syntax is case sensitive. The syntax for each command appears as follows:

- ❑ Plain/**bold** text shows what to type to invoke a command or action.
- ❑ *Italic* text shows where to substitute a parameter or value.
- ❑ Text in braces { } indicates a selection or parameter that the operator **must** enter before the command can execute.
- ❑ A series of dots ... indicates one or more occurrences of a preceding parameter.

QUAD Channel BR command syntax is case sensitive. Each example appears in the format that the operator should enter.

A definition details each command's purpose and function. Where helpful, an example of the command's response follows the definition. Whenever possible, this section uses typical values.

Some commands return varying responses (such as "available," "not available," "unknown," "o.k.," and "alarm"). Each example only lists one of the possible responses. Examples do not go through every possible scenario.

QUAD Base Radio Commands

Command Detail

The commands in bold text appear in long form, followed in parenthesis by the short form.

ALARMS

Syntax:

STRINGX -object = {fault_hdlr}

The ALARMS command returns the active alarms.

Example:

```
field> alarms -ofault_hdlr

ACTIVE_FAULT_ID=RX_LO1_LOCK

field>
```

CABINET_ID (CI)

Syntax:

STRINGX -object = {platform}

STRINGX -cabinet = {any positive integer}

The CI command controls the cabinet identification number.

QUAD Base Radio Commands**Examples:**

```
field> ci -oplatform
Cabinet ID=0

field> ci -oplatform -c1

field> ci -oplatform
Cabinet ID=1
```

DATA_PATTERN_MODE (DPM)**Syntax:**

STRINGX -object = {txch(1->4)}

STRINGX -mode = {none, iden}

The DPM command controls the mode setting for the platform object's transmit path data pattern.

Examples:

```
field> dpm -otxch1

Mode=none

field> dpm -otxch1 -miden

field> dpm -otxch1

Mode=iden
```

DIVERSITY

Syntax:

STRINGX **-object** = {rx_all}

STRINGX **-diversity** = {right justified binary bit map of the receive branch configuration, the right most bit field corresponds to receive branch 1}

NOTE: This setting does not change the platform in anyway. It is simple used as a configuration parameter.

Examples:

```
field> diversity -orx_all -d0      #Turn all branches off
field> diversity -orx_all -d1      #enable branch 1; 2 & 3 are off
field> diversity -orx_all -d10     #enable branch 2; 1 & 3 are off
field> diversity -orx_all -d11     #enable branch 1 & 2; 3 is off
field> diversity -orx_all -d100    #enable branch 3; 1 & 2 are off
field> diversity -orx_all -d101    #enable branch 3 & 1; 2 is off
field> diversity -orx_all -d110    #enable branch 3 & 2; 1 is off
field> diversity -orx_all -d111    # enable 1, 2 and 3
```

ENABLE

Syntax:

STRINGX **-object** = {txch{1->4}, rxch{1->4}}

for **-object** = rxch{1->4}

STRINGX **-diversity** = {br{1->3}}

STRINGX **-state** = {on, off, dumb}

The ENABLE command controls the enabled state of txch and rxch objects. Diversity option only applies to Rx.

QUAD Base Radio Commands**Examples:**

```
field> enable -otxch1 -son

field> enable -otxch1
State=On

field> enable -orxch1 -son

field> enable -orxch1

br1=on
br2=on
br3=on

field> enable -orxch1 -dbr2 -soff

field> enable -orxch1

br1=on
br2=off
br3=on
```

EXTERNAL_SYNCHRONIZATION (ES)**Syntax:**

```
STRINGX -object = {rx_all, tx_all}

for -object = rx_all

STRINGX -type = {trig_def, global, ext_trigger, pps, in_ptt}

for -object = tx_all

STRINGX -type = {trig_def,

out_pp3s, out_frame, out_slot, out_ptt, out_mframe,

out_fs_bs}
```

The ES command controls the object's external synchronization method.

Examples:

```
field> es -orx_all  
  
Type=trig_def  
  
field> es -orx_all -text_trigger  
  
field> es -orx_all  
  
Type=ext_trigger
```

FIRMWARE_VERSION (FV)**Syntax:**

STRINGX -object = {control, rxch1, txch1, platform. PS}

The FV command returns the object's firmware version. Specifying the object 'platform' causes the software to return additional information.

QUAD Base Radio Commands**Example:**

```
field> fv -oplatform

Test Application Version =D01.01.07

Controller Rev No   = R05.01.01
Controller Kit No   = CLF6290B
Controller Firmware = 1.222
Power Supply Rev No = R05.01.01
Power Supply Kit No = CLN7275A
Core Software Ver   = 1.222
Platform ID         =
Tx1 Exciter Rev No  = R05.01.01
Tx1 Exciter Kit No  = CLF6290B
Tx1 Exciter Firmware = 00.00.18
Tx1 PA Rev No       = R05.00.00
Tx1 PA Kit No       = CLF1400A
Tx1 PA Firmware     =
Rx1 Rev No          = R05.01.00
Rx1 Kit No          = CRF6060A
Rx1 Firmware        = 00.00.15
Rx2 Rev No          = R05.01.00
Rx2 Kit No          = CRF6060A
Rx2 Firmware        = 00.00.15
Rx3 Rev No          = R05.01.00
Rx3 Kit No          = CRF6060A
Rx3 Firmware        = 00.00.15
Rx4 Rev No          = R05.01.00
Rx4 Kit No          = CRF6060A
Rx4 Firmware        = 00.00.15

Core Major Version=1
Core Minor Version=222
```

FREQ

Syntax:

STRINGX -object = {txch{1->4}, rxch{1->4}}

FLOATX -frequency = {use status -orx_all or status -otx_all for applicable limits}

The FREQ command controls synthesizer frequency settings for the rxch and txch objects.

Examples:

```
field> freq -otxch2

freq=860.025000

field> freq -otxch2 -f865

field> freq -otxch2

freq=865.000000

field> freq -orxch3

freq=820.000000

field> freq -orxch3 -f810

field> freq -orxch3

freq=810.000000

field>
```

FRU_CONFIGURATION (FC)

Syntax:

STRINGX -object = {platform}

The FC command returns the fru configuration.

QUAD Base Radio Commands**Example:**

```
field> fc -oplatform

type=BRC
slot=Slot 01
revision number=R05.00.00
kit number=ABC1234A
flags=Available,Supported, Known

type=Power Supply
slot=Slot 00
revision number=R05.00.00
kit number=ABC1234A
flags=Available,Supported, Known

type=Receiver
slot=Slot 06
revision number=R05.01.00
kit number=CRF6060A
flags=Available,Supported, Known
.
.
.
type=Exciter
slot=Slot 01
revision number=R05.00.00
kit number=ABC1234A
flags=Available,Supported, Known

type=Power Amplifier
slot=Slot 02
revision number=R05.00.00
kit number=CLF1400A
flags=Available,Supported, Known
```

HELP**Syntax:**

STRINGX -command = {any string}

The HELP command displays help text for the test application. Help topics for the entered command string appear in alphabetical order. HELP operates similarly to

a grep (search and replace text utility), where the string is part or all of the command.

Example:

```
field> help -cpower
power: This command controls the platform object power settings

arguments:
  -o(object)=txch1,txch2,txch3,txch4 (for write)
  -o(object)=txch1,txch2,txch3,txch4,ta,wmt (for read)
  -p(power)=2.0-40.0 Watts on LSS, 5.0-56.5 Watts on Quad
  -a(auto power)=LSS Only: 2.0 - 40.0 W
```

KIT_NUMBER (KN)**Syntax:**

STRINGX -object = {ex1, pa1, rxch{1->4}, ps, control}

The KN command returns the object's kit number setting.

Example:

```
field> kn -opa1

kit_number=CLF1400A

field>
```

LOGIN**Syntax:**

STRINGX -userid = {dev, factory, field}

The LOGIN command allows the user to log in as a valid user. Note that each login requires a password and that the word 'login' be part of the command string.

QUAD Base Radio Commands**Example:**

```
> login -ufield
password: <field login password>

field>
```

iDEN Generation 2 Login id's	Password	Configuration
field	motorola	factory default
field	Motorola	OMC default
field	<customer specified>	OMC customer set

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

LOGOUT**Syntax:**

none

The LOGOUT command logs out the current user and displays the login prompt. No reset occurs.

Example:

```
field> logout
```

```
field>
```

PEER_PERFORMANCE_CONFIG (PPC)**Syntax:**

STRINGX -object = {rxch(1->4)}

STRINGX -mode = {chn, path}

for -mode = path

INTX -path = {1,2,3, all}

for -mode = chn

INTX -slot = {1->6}

The PPC command controls the platform peer performance configuration. A -mode argument setting of “chn” provides the channel performance for all enabled branches. A -mode argument setting of “path” provides the individual receive path performance.

QUAD Base Radio Commands**Examples:**

```
field> enable -orxch1 -son

field> ppc -orxch1 -mpath -pall

field> ppc -orxch1

Mode=path
Path=all

field> ppc -orxch1 -mchn -s1

field> ppc -orxch1

Mode=chn
Slot=1
```

PEER_PERFORMANCE_REPORT (PPR)**Syntax:**

STRINGX -object = {rxch{1->4}. rx_all}

INTX -averages = {2-65535 max}

INTX -reports = {1-65535 max}

The PPR command returns the peer performance information. The operator must complete appropriate peer_performance_config settings before generating reports.

Example:

```
field> ppr -orxch1 -a10 -r1

SGC Atten.(dBm)=0.000000
Freq. Offset=-0.000031
Sync. Attempts=1.000000
Sync. Successes=0.000000
BER%=50.290699
RX Path1 RSSI=-129.727005
RX Path2 RSSI=-130.369965
RX Path3 RSSI=-132.486801
Chn sig. strength=-68.348839
Chn intf. strength=-68.348839
```

PEER_TEST_MODE (PTM)**Syntax:**

STRINGX -object = {tx_all, rx_all}

for -object = rx_all

-mode = {uplk_framed}

for -object = tx_all

-mode = {dnlk_framed, tones, stop, suspend}

The PTM command controls the platform peer (DSP) test mode setting.

QUAD Base Radio Commands**Examples:**

```
field> ptm -otx_all

Mode=not_in_test

field> ptm -otx_all -mdnlk_framed

field> ptm -otx_all

Mode=dnlk_framed
```

POSITION_ID (PI)**Syntax:**

STRINGX -object = {platform}

STRINGX -position = {any positive integer}

The PI command controls the platform position number.

Examples:

```
field> pi -oplatform

Position=0

field> pi -oplatform -p5

field> pi -oplatform

Position=5

field>
```

POWER**ATTENTION**

The POWER command keys the transmitter. Verify transmission only occurs on licensed frequencies or into an RF dummy load.

Syntax:

STRINGX -object = {tx_all, txch{1-4}}

FLOATX -power = {use status -otx_all for applicable limits}

The POWER command controls the platform object's transmit output power. A -power argument setting greater than 0 keys up the transmitter at the indicated power level. A -power argument setting of 0 de-keys the transmitter. Before key-up, the operator must configure the appropriate freq, enable, peer_test_mode and data_pattern_mode settings.

NOTE

The operator must set "peer_test_mode" to "stop." Otherwise, residual power may still be present at the transmit port.

QUAD Base Radio Commands**Examples:**

```
field> freq -otxch1 -f860

field> dpm -otxch1 -miden

field> ptm -otx_all -mdnlk_framed

field> power -otxch1 -p30

field> power -otxch1

Forward Power=30.931942
Reflected Power=1.362578
VSWR=1.531271
Auto Power=0.000000

field>
```

RESET**Syntax:**

STRINGX -object= platform

Executes the Core reset control for Gen2 and QUAD BRs.

Example:

```
field> reset -oplatform

field>
```

REVISION_NUMBER (RN)**Syntax:**

STRINGX -object = {ex1, pa1, rxch{1->4}, ps, control}

The RN command returns the revision number setting of the specified object.

Example:

```
field> rn -oex1

revision_number=R05.00.00

field>
```

SCRATCH**Syntax:**

STRINGX -object = {control, ex1, pa1, rxch{1->4}, ps}

The SCRATCH command returns the scratch pad memory contents for the specified object.

Example:

```
field> scratch -orxch1

scratch=Motorola,Inc

field>
```

STATUS**Syntax:**

STRINGX -object = {tx_all, rx_all}

The STATUS command returns status information for the specified object.

QUAD Base Radio Commands**Examples:**

```
field> status -otx_all
```

```
TX Sanity=Sane  
TX CPU Load=13.283999  
Number of TX Logical Channels=4  
Lowest Operational TX Frequency=851.000000  
Highest Operational TX Frequency=870.000000  
Minimum TX Output Power Capable=5.000000  
Maximum TX Output Power Capable=62.150002  
Training Data=0x88, 0x51, 0x8e, 0xbf, 0xff, 0x7f, 0x13, 0x49, 0x7f, 0x7f,  
0x55
```

```
field> status -orx_all
```

```
RX1 Sanity=Sane  
RX2 Sanity=Sane  
RX1 CPU Load=48.609333  
RX2 CPU Load=48.609333  
RXCH1 Lock=Unlocked  
RXCH2 Lock=Unlocked  
RXCH3 Lock=Unlocked  
RXCH4 Lock=Unlocked  
Number of RX Logical Channels Supported=4  
Lowest Operational RX Frequency=806.000000  
Highest Operational RX Frequency=825.000000  
Number of Physical Branches per RX Channel=3
```

SYSTEM_GAIN_ENABLE (SGE)**Syntax:**

```
STRINGX -object = {rx_all}
```

```
STRINGX -state = {on,off}
```

The SGE command controls the rx system gain enable state.

Examples:

```
field> sge -orx_all

State=on

field> sge -orx_all -soff

field> sge -orx_all

State=off
```

TIME**Syntax:**

None

The TIME command displays the current platform time setting in seconds since the last reset. The system stamps events in the alarm_log with this time as reference.

Example:

```
field> time

Time=0000002703

field>
```

QUAD Application Examples

Key the BR (4 channels)

1. Set the frequency of transmit channel 1 through 4.

```
field> freq -otxch1 -f860
field> freq -otxch2 -f860.025
field> freq -otxch3 -f860.050
field> freq -otxch4 -f860.075

field>
```

2. Enable the channels by setting a data pattern to "iden."

```
field> dpm -otxch1 -miden
field> dpm -otxch2 -miden
field> dpm -otxch3 -miden
field> dpm -otxch4 -miden

field>
```

ATTENTION

The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies, or into an RF dummy load.

3. Set the transmit DSP test mode to "dnlk_framed."

```
field> ptm -otx_all -mdnlk_framed
field>
```

4. Set the transmit power to 40 watts. Key the BR

```
field> power -otxch1 -p40
```

```
field>
```

Dekey a Keyed BR

1. Set the transmit channel 1 power to 0.

```
field> power -otxch1 -p0
```

```
field>
```

2. Set the transmit DSP test mode to “stop.”

```
field> ptm -otx_all -mstop
```

```
field>
```

Query the BR Output Power

1. Query the current, channel 1 transmit power.

```
field> power -otxch1
```

```
field>
```

QUAD Application Examples**Query the RX performance data - Channel**

1. Set the frequency of receive channel 1 to 806MHz.

NOTE

Substitute **898** for **806** for 900 MHz QUAD BR

```
field> freq -orxch1 -f806
```

```
field>
```

2. Enable receive channel 1.

```
field> enable -orxch1 -son
```

```
field>
```

3. Set the test mode of the receive channel 1 DSP to “uplk_framed.”

```
field> ptm -orx_all -muplk_framed
```

```
field>
```

4. Configure the DSP performance characteristics of receive channel 1 for channel reports using slot 1 data.

```
field> ppc -orxch1 -mchn -s1
```

```
field>
```

5. Configure the receive channel 1 performance report. Begin reporting.

```
field> ppr -orxch1 -a1000 -r1
```

```
field>
```

Query the RX performance data - Path

1. Step1 - Set the frequency of receive channel 1 to 806MHz.

```
field> freq -orxch1 -f806  
  
field>
```

2. Enable receive channel 1.

```
field> enable -orxch1 -son  
  
field>
```

3. Set the test mode of the receive channel 1 DSP to "uplk_framed."

```
field> ptm -orx_all -muplk_framed  
  
field>
```

4. Configure the DSP performance characteristics of receive channel 1 for path 1 reports.

```
field> ppc -orxch1 -mpath -p1  
  
field>
```

5. Configure the receive channel 1 performance report. Begin reporting.

```
field> ppr -orxch1 -a1000 -r1  
  
field>
```

QUAD Application Examples**Query the Alarm log**

1. Display the Alarm Log contents.

```
field> alarms -ofault_hndlr
```

```
field>
```


Site Controllers

Chapter Overview

This chapter provides a brief overview of the Generation 3 Site Controller (Gen3 SC) and the integrated Site Controller (iSC). For greater detail, refer to the appropriate manual supplement.

Section	Page	Description
Generation 3 Site Controller (Gen3 SC)	2	This section briefly describes the Gen3 SC.
integrated Site Controller	3	This section briefly describes the iSC

Generation 3 Site Controller (Gen3 SC)

Generation 3 Site Controller (Gen3 SC)

Overview

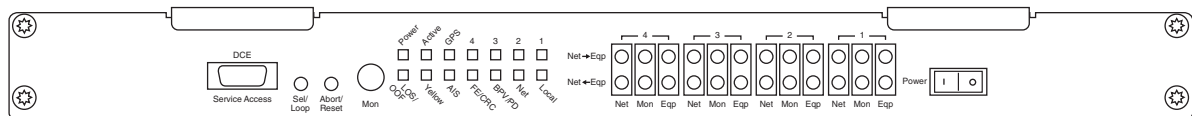
This section provides a brief overview and technical information for the Generation 3 Site Controller (Gen 3 SC). For complete information on the Gen 3 SC, refer to the Gen 3 SC Supplement to this manual (68P80801E30).

Gen3 SC Major Components

The Site Controller supports the following I/O:

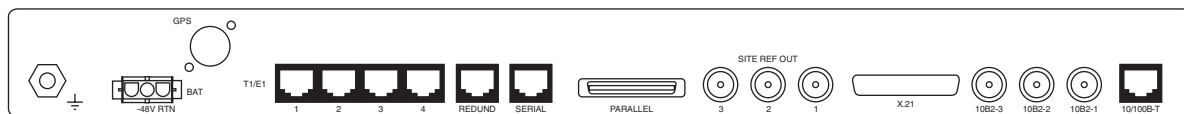
- ☐ One 10 / 100BaseT Ethernet port
- ☐ Three 10Base2 Ethernet ports
- ☐ Four T1 / E1 connections
- ☐ One X.21 connection
- ☐ One IEEE 1284 parallel port (for connecting to the EAS)
- ☐ One front panel RS232 MMI
- ☐ Three time / frequency reference outputs
- ☐ GPS
- ☐ RJ45 Serial
- ☐ RJ45 Redundancy

Figure 1 and Figure 2 show front and rear views of the Controller.



iSC401
103100JNM

Figure 1 **Gen 3 SC Controller (front view)**



iSC400
102600JNM

Figure 2 **Gen 3 SC Controller (rear view)**

integrated Site Controller

Overview

This section provides a brief overview and technical information for the integrated Site Controller (iSC). For complete information on the iSC, refer to the iSC Supplement to this manual (68P81098E05).

iSC Major Components

The major components of the Controller are listed below. Refer to the iSC Supplement to this manual for detailed information on the Controller.

- ☐ Power PC™ motherboard
- ☐ Front Panel Display card
- ☐ Site Reference ISA (SRI) card
- ☐ Subrated T1 PCI (STP) card
- ☐ Subrated E1 PCI (SEP) card
- ☐ Ethernet LAN PCI (ELP) card
- ☐ T1 and Serial/Parallel (S/P) Transient card
- ☐ Expansion slots

The Controller uses a Power PC motherboard. Slots for PCI and ISA compliant cards are also included. The Power PC CPU, memory, and expansion slots reside on the motherboard.

Memory is provided by commercially available 72-pin SIMMs. The motherboard contains four SIMM sockets for DRAM and can accept up to a total of 128 Mb. The Controller is shipped with two SIMM sockets occupied.

The Controller provides:

- ☐ an IEEE 1284 port for peripheral applications
- ☐ an IEEE 802.3 10base 2 Ethernet connection
- ☐ a RS232 port for peripheral applications
- ☐ T1 or E1 channelized subrated link
- ☐ time reference status indicators
- ☐ network access connections
- ☐ network status indicators
- ☐ a service access port
- ☐ a CPU reset switch
- ☐ a loop reset switch

Figure 1 and Figure 2 show front and rear views of the Controller.

The rear panel of the Motorola Integrated Site Controller features the following components:

- Top Left:** Motorola logo and the text "MOTOROLA INTEGRATED SITE CONTROLLER".
- Top Right:** A power switch labeled "Power".
- Left Side:** Two vertical columns of six RJ45 ports each, labeled "Port 1" through "Port 12".
- Bottom Left:** A "Network Access" section containing a 4-pin DIN connector labeled "From NMT", "Alarm NMT Equip", "Equip to Alarm Out", and "Alarm Equip to NMT".
- Bottom Center:** A "Network Status" section with 24 LEDs labeled: Loop, Yellow Alarm, Red Alarm, Alarm, CPU Error, CPU OK, Redundant Loop, Online, Keep Alive, Modem, Frame Relay, X25, Packet, WAN, WAN, power On, Online, First Lock, GPS Tracking, Alarm, and Auto.
- Bottom Right:** A "Service Access" section including a "JOC/E" port and a "CPU Reset" button.

Figure 3 *iSC Controller (front view)*

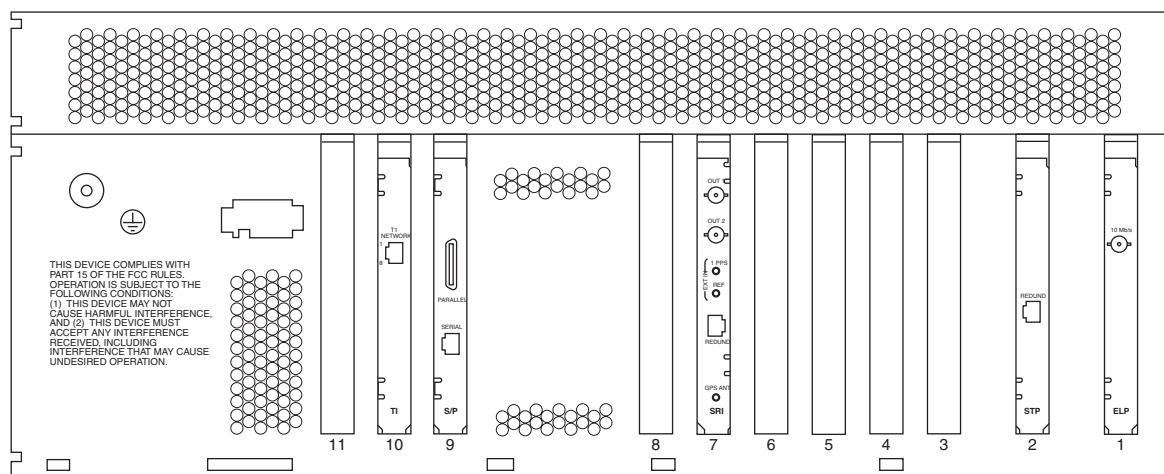


Figure 4 *iSC Controller (rear view)*

A/D	Analog-to-Digital	CC	Control Cabinet
A	Amperes	CD	Carrier Detect
AC	Alternating Current	cd	change directory
ACT	active	CLK	Clock
ADA	Americans with Disabilities Act	CLT	Controller
AGC	Automatic Gain Control	cm	centimeter
AIC	Ampere Interrupting Capacity	CMOS	Complementary Metal Oxide Semiconductor
AIS	Alarm Indication Signal (Keep Alive)	CPU	Central Processing Unit
ANSI	American National Standards Institute	CSMA/CD	Carrier Sense Multiple Access with Collision Detect
ASCII	American National Standard Code for Information Interchange	CTI	Coaxial Transceiver Interface
ASIC	Application Specific Integrated Circuit	CTL	Control (Base Radio Control)
Aux	auxiliary	CTS	Clear-to-Send
avg	average	D/A	Digital-to-Analog
AWG	American Wire Gauge	DAP	Dispatch Application Processor
bd	baud	DB-15	15-pin D-subminiature
BDM	Background Debug Mode	DB-9	9-pin D-subminiature
BER	Bit Error Rate	dB	Decibel
BERT	Bit Error Rate Test	dBc	Decibels relative to carrier
BMR	Base Monitor Radio	dBm	Decibels relative to 1mW
BNC	Baby "N" Connector	DC	Direct Current
BPV	Bipolar Variation	DCE	Data Circuit-Terminating Equipment
BR	Base Radio	DCSPLY	DC Supply
BRC	Base Radio Controller	DDM	Dual Device Module
BSC	Base Site Controller	deg	degree
BTU	British Thermal Unit	DIN	<i>Deutsche Industrie-Norm</i>
BW	bandwidth	DIP	Dual In-line Package
C/N + I	Carrier Power to Noise + Interference Ratio	div	division

DMA	Direct Memory Access	HSMR	High Elevation Specialized Mobile Radio
DOP	Dilution of Precision	HSO	High Stability Oscillator
DRAM	Dynamic Random Access Memory	HVAC	Heating/Ventilation/Air Conditioning
DSP	Digital Signal Processor	Hz	Hertz
DTE	Data Terminal Equipment	I/O	Input/Output
DTTA	Duplexed Tower-Top Amplifier	IC	Integrated Circuit
DVM	Digital Volt Meter	iDEN	integrated Dispatch Enhanced Network
E1	European telephone multiplexing standard	IEEE	Institute of Electrical and Electronic Engineers
EAS	Environmental Alarm System	IF	intermediate frequency
E-NET	Ethernet	iMU	iDEN Monitor Unit
EBTS	Enhanced Base Transceiver System	in	inches
EGB	Exterior Ground Bar	in	injection
EIA	Electronics Industry Association	ISA	Industry Standard Architecture
EMI	Electro-Magnetic Interference	iSC	integrated Site Controller
EPROM	Erasable Programmable Read Only Memory	kg	kilogram
EEPROM	Electrically Erasable Programmable Read Only Memory	kHz	kiloHertz
ERFC	Expansion RF Cabinet	LAN	Local Area Network
ESI	Ethernet Serial Interface	LANIIC	Local Area Network Interface IC
ESMR	Enhanced Special Mobile Radio	LAPD	Link Access Procedure D-Channel
EX	Exciter	lbs	pounds
FB	feedback	LDM	Linear Driver Module
FCC	Federal Communications Commission	LED	Light Emitting Diode
FIFO	First-In, First-Out	LFM	Linear Final Module
FNE	Fixed Network Equipment	LIU	Line Interface Unit
freq	frequency	LLC	Link Layer Controller
FRU	Field Replaceable Unit	LNA	Low Noise Amplifier
Gen 3 SC	Generation 3 Site Controller	LO	Local Oscillator
GFI	Ground Fault Interrupter	LOS	Loss of Signal
GND	ground	MAU	Media Access Unit
GPS	Global Positioning System	max	maximum
GPSR	Global Positioning System Receiver	MC	Multicoupler
HDLC	High-level Data Link	MGB	Master Ground Bar
		MGN	Multi-Grounded Neutral

MHz	MegaHertz	ppm	parts per million
min	minimum	PPS	Pulse Per Second
min	minute	PS	Power Supply
MISO	Master In/Slave Out	PSTN	Public Switched Telephone Network
mm	millimeter	PVC	Polyvinyl Chloride
MMI	Man-Machine-Interface	pwr	power
MOSI	Master Out/Slave In	QAM	Quadrature Amplitude Modulation
MPM	Multiple Peripheral Module	QRSS	Quasi Random Signal Sequence
MPS	Metro Packet Switch	Qty	Quantity
MS	Mobile Station	R1	Receiver #1
ms	millisecond	R2	Receiver #2
MSC	Mobile Switching Center	R3	Receiver #3
MSO	Mobile Switching Office	RAM	Random Access Memory
MST	Modular Screw Terminals	RCVR	Receiver
mV	milliVolt	Ref	Reference
mW	milliWatt	RF	Radio Frequency
N.C.	Normally Closed	RFC	RF Cabinet
N.O.	Normally Open	RFDS	RF Distribution System
NEC	National Electric Code	RFS	RF System
NIC	Network Interface Card	ROM	Read Only Memory
no.	number	RPM	Revolutions Per Minute
NTM	NIC Transition Module	RSSI	Received Signal Strength Indication
NTWK	Network	RTN	Return
OMC	Operations and Maintenance Center	RU	Rack Unit
OSHA	Occupational Safety and Health Act	Rx	Receive
PA	Power Amplifier	RXDSP	Receive Digital Signal Processor
PAL	Programmable Array Logic	SCI	Serial Communications Interface
PC	Personal Computer	SCON	VME System Controller
PCCH	Primary Control Channel	SCRF	Stand-alone Control and RF Cabinet (configuration)
PDOP	Position Dilution of Precision	SCSI	Small Computer System Interface
pF	picoFarad	sec	second
PLL	Phase Locked Loop	SGC	Software Gain Control
P/N	Part Number	SINAD	Signal Plus Noise Plus Distortion to Noise Plus Distortion Ratio
P/O	Part Of		

SMART	Systems Management Analysis, Research and Test	V	Volts
SPI	Serial Peripheral Interface	VAC	Volts - alternating current
SQE	Signal Quality Estimate	VCO	Voltage Controlled Oscillator
SRAM	Static Random Access Memory	VCXO	Voltage Controlled Crystal Oscillator
SRC	Substrate Controller	VDC	Volts - direct current
SRI	Site Reference Industry standard	VFWD	Voltage representation of Forward Power
SRIB	SMART Radio Interface Box	VME	Versa-Module Eurocard
SRRC	Single Rack, Redundant Controller (configuration)	Vp-p	Voltage peak-to-peak
SRSC	Single Rack, Single Controller (configuration)	VREF	Voltage representation of Reflected Power
SS	Surge Suppressor	VSWR	Voltage Standing Wave Ratio
SSC	System Status Control	W	Watt
SSI	Synchronous Serial Interface	WDT	Watchdog Timer
ST	Status	WP	Write Protect
STAT	Status	WSAPD	Worldwide Systems and Aftermarket Products Division
Std	Standard		
S/W	Software		
T1	North American telephone multiplexing standard		
TB	Terminal Board		
TDM	Time Division Multiplex		
telco	telephone company		
SCON	VME System Controller		
TISIC	TDMA Infrastructure Support IC		
TSI	Time Slot Interface		
TSI	Time Slot Interchange		
TTA	Tower-Top Amplifier		
TTL	Transistor - Transistor Logic		
Tx	Transmit		
TXD	Transmit Data		
TXDSP	Transmit Digital Signal Processor		
Txlin	Tranlin IC		
typ	typical		
UL	Underwriters Laboratories		

Parts and Suppliers

This appendix contains recommended part numbers (p/n) and manufacturers for various hardware, tools, and equipment used during installation of the EBTS.

Also contained in this appendix is other installation related information, such as determining types of wire lugs, lengths and sizes of various wires and cables, custom cabling information, and fuses.

All suppliers and model numbers listed are included due to their performance record in previous installations. Motorola cannot guarantee the effectiveness of the installation or performance of the system when using these or other suppliers' parts.

Addresses, phone numbers, fax numbers, websites, and other information is presented for each of the recommended suppliers, when possible.

NOTE

In some listings, phone number and address are for corporate or main sales office. Other sales locations may be available. Call number given or go to website for expanded listings.

Information herein is subject to change without notice.

Surge Arrestors

Two types of surge arrestors should be used in the EBTS site, including:

- ☐ AC Power and Telco
- ☐ Antenna Surge Arrestors

AC Power and Telco Surge Arrestors

The recommended AC Power and Telco surge arrestors are both manufactured by Northern Technologies. The model numbers are:

- ☐ AC power - *LAP-B* for 120/240 single-phase
LAP-C for 208 Vac three-phase
- ☐ Telco - *TCS T1DS*

Northern Technologies

23123 E. Mission
Liberty Lake, WA 99019
Phone: 800-727-9119
Fax: 509-927-0435
Internet: <http://www.northern-tech.com>

Antenna Surge Arrestors

The recommended antenna surge arrestors are manufactured by Polyphaser Inc. The following models are recommended:

- ☐ Base Monitor Radio antennas - *ISS50NXXC2MA*
- ☐ Base Radio antenna (800 MHz tower top amplifier only) - *094-0801T-A*
- ☐ Base Radio antenna (800 MHz cavity combined, transmit only; up to 5 channels) - *IS-CT50HN-MA*
- ☐ Base Radio antennas (800 MHz duplexed) - *IS-CT50HN-MA*
- ☐ Base Radio antennas (900 MHz duplexed) - *097-0311G-A.2*
- ☐ GPS antennas - *092-082-0T-A*
- ☐ Lightning arrestor bracket kit - *Contact your local Motorola Sales representative to order this kit*
- ☐ Receive Tower Top amplifier - *094-0801T-A*
- ☐ Tower top test port cable - *IS-50NX-C2*

Polyphaser, Inc.

P.O. Box 9000
Minden, NV 89423-9000
Phone: 800-325-7170
775-782-2511
Fax: 775-782-4476
Internet: <http://www.polyphaser.com>

Motorola has set up several kits that contain the necessary arrestors with proper mounting hardware for the various antenna configurations. Contact your local Motorola representative for these OEM kits.

RF Attenuators

Several RF attenuators are needed at a site to ensure proper receive adjustments. The attenuators are used at the LNA sites to offset the excess gain from the Tower Top amplifiers, to balance the receive path, and to attenuate the BMR signal path. Use the following specifications when choosing vendors:

- ☐ Specified frequency range
 - **800 MHz systems** – requires attenuator specification to include 806-821 MHz range
 - **900 MHz systems** – requires attenuator specification to include 896-901 MHz range
- ☐ 1 dB increments
- ☐ 0.5 dB accuracy or better
- ☐ Female N connector / Male N connector

Alan Industries, Inc.

745 Green Way Drive
P.O. Box 1203
Columbus, IN 47202
Phone: 800-423-5190
812-372-8869
Fax: 812-372-5909

Internet: <http://www.alanindustries.com>

Huber + Suhner, Inc.

19 Thompson Drive
Essex, VT 05452
Phone: 802-878-0555
Fax: 802-878-9880
Internet: <http://www.hubersuhnerinc.com>

JFW Industries, Inc.

5134 Commerce Square Drive
Indianapolis, IN 46237
Phone: 877-887-4JFW
317-887-1340
Fax: 317-881-6790
Internet: <http://www.jfwindustries.com>

Pasternack Enterprises

P.O. Box 16759
Irvine, CA 92623-6759
Phone: 949-261-1920
Fax: 949-261-7451
Internet: <http://www.pasternack.com>

RF attenuators are also needed for test equipment. The attenuators must be used between frequency reference equipment, service monitors, and the Motorola

EBTS equipment. The following attenuators should be used at the site during optimization:

- ❑ Female BNC connector / Male BNC connector, 10 dB attenuator (1 W) between the Rubidium Standard and the R2660 Communications Analyzer. Refer to the System Testing section.
- ❑ Female BNC connector / Male BNC connector, 30 dB attenuator (1 W) between the Rubidium Standard and the R2660. Refer to the System Testing, section.

Emergency Generator

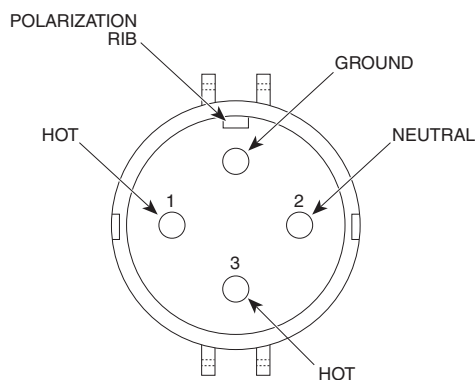
Several different sizes of generators are available. Determine the loading requirements of the site prior to ordering a generator. A recommended manufacturer of the emergency backup generator power system is:

Generac Corporation

P.O. Box 8
Waukesha, WI 53187
Phone: 262-544-4811
Fax: 262-544-0770

Portable Generator Connection

The recommended portable generator connection is the *AJA200-34200RS*, manufactured by Appleton Electric. Figure 1 is a view of a connector located on the building. An adapter may be required if local electrical standards conflict with the wiring configuration.



EBTS078
061295JNM

Figure 1 **Portable Generator Connector**

An alternate supplier of the portable generator connection is the *ARKTITE Heavy Duty Receptacle Model 80, Style 2, 200 Amps*, manufactured by Crouse-Hinds.

**Cooper Industries
Crouse-Hinds, Inc.**

P.O. Box 4999

Syracuse, NY 13221

Phone: 315-477-5531

Fax: 315-477-5719

Internet: <http://www.crouse-hinds.com>**GPS Evaluation Kit**

The Motorola GPS evaluation kit (Motorola part number DQGTEVAL0002) is available from Synergy Systems.

Synergy Systems

P.O. Box 262250

San Diego, CA 92196

Phone: 858-566-0666

Internet: <http://www.synergy-gps.com>**GPS Antenna Amplifier**

There are two recommended manufacturers of the GPS antenna amplifiers.

- ☐ LA20RPDC-N (GPS Networking)
- ☐ LA-21-L1/L2 (Starlink, Inc.)

GPS Networking

710A West 4th St.

Pueblo, CO 81003

Phone: 800-463-3063

719-595-9880

Fax: 719-595-9890

Internet: <http://www.gpsnetworking.com>**Starlink Inc.**

6400 Highway 290 East

Suite 202

Austin, TX 78723

Phone: 512 454-5511

800 460-2167

Fax: 512 454-5570

Internet: <http://www.starlinkdgps.com>

Specifications	Type 1	Type 2
Dimensions	3.293" x 2" x 1"	0.6" Dia. x Approx. 3.8"
Connectors	Type N female, both ends	Type N female, both ends
Gain	23 dB gain typical 20 dB min.	20 dB $\pm$ 3 dB
Noise Figure	2.6 dB typical	<3.0 dB
VSWR	< 2.2:1	Not Specified
Frequency Range	1575.42 $\pm$ 50 MHz	L1 / L2
Filtering	Yes	Yes
Maximum Input Power	+ 13 dBm	Not Specified
Voltage	4.5 - 15 VDC	3 - 28 VDC
Current @ 5 V	< 15 mA @ 5V typical	8mA @ 3V

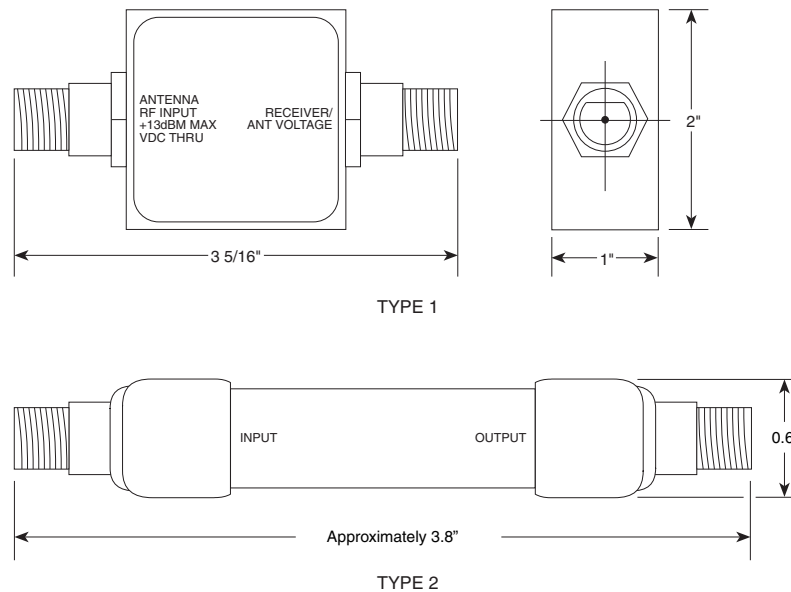


Figure 2 **GPS Antenna Amplifiers**

Site Alarms

Three types of alarms should be used in an EBTS site, including:

- ☐ Intrusion Alarm
- ☐ Smoke Alarm
- ☐ Temperature Alarm

Intrusion Alarm

The intrusion alarm is the *Sonitrol Door contact 29A*.

Sonitrol

211 N. Union Street, Suite 350
Alexandria, VA 22314
Phone: 800-326-7475
703-684-6606
Fax: 703-684-6612
Internet: <http://www.sonitrol.com>

Smoke Alarm

An available smoke alarm is the *Sentrol 320CC*. This smoke alarm provides a relay closure for the iMU alarm. These smoke detectors are available from many electrical wholesale distributors. For the location nearest you, call between 6 a.m. and 5 p.m. Pacific Standard Time and ask Sales for the location of the nearest EW (Electric Wholesale) distributor.

Sentrol, Inc. GE Interlogix

12345 SW Leveton Drive
Tualatin, OR 97062
Phone: 800-547-2556
503-692-4052
Internet: <http://www.sentrol.com>

Temperature Alarm

The recommended temperature alarm is the *Grainger #2E206* thermostat. This alarm is manufactured by Dayton Electronics and distributed by W.W. Grainger:

W.W. Grainger

Locations Nationwide

Phone: 888-361-8649
Internet: <http://www.grainger.com>

Cabinet Mounting Hardware

The cabinet mounting hardware is site dependent and must be procured locally.

Equipment Cabinets

The mounting hardware used to secure the Equipment Cabinets containing control and/or RF hardware must be able to provide 1545 pounds of retention force.

- ☐ If the cabinets are to be secured to a concrete floor, 1/2" grade 8 bolts with anchors are recommended.
- ☐ If the cabinets are to be secured to another type of floor, determine the appropriate mounting hardware.

Power Supply Rack

The Motorola offered Power Supply rack from Power Conversion Products is available in a standard and an earthquake rack.

Power Conversion Products, Inc.

115 Erick Street
Crystal Lake, IL 60039-0380
Phone: 800-435-4872 (customer service)
815-479-0682
Fax: 815-459-0453
Internet: <http://www.eltekenenergy.com>

If the earthquake rack is used, it must be bolted to the floor using the 02100-13 *High Performance Anchor Kit*, consisting of:

- ☐ anchors (qty. 4)
- ☐ load sharing plates (qty. 2)
- ☐ large square washers (qty. 8)

Hendry Telephone Products

55 Castilian Drive
Santa Barbara, CA 93117-3080
Phone: 805-968-5511
Fax: 805-968-9561
Internet: <http://www.hendry.com>

Cable Connections

The recommended manufacturer for all wire lugs used during EBTS installation is Thomas & Betts. All wire lug part numbers listed are for Thomas & Betts.

Thomas & Betts

8155 T&B Boulevard

Memphis, TN 38125

Phone: 800-888-0211 (general information)

800-248-7774 (sales/technical support)

Internet: <http://www.tnb.com>

NOTE

Double hole wire lugs are preferred, but single hole wire lugs can be used where mounting requirements dictate their use.

Selecting Master Ground Bar Lugs

Table 1 identifies recommended part numbers for wire lugs used to connect chassis ground wiring to the master ground bar from each cabinet.

Table 1 **Recommended Master Ground Bar Lugs**

Wire Size	Wire Type	Lug Color	Description	P/N †
#2 AWG	Stranded	Brown	Single 1/4" diameter hole	54107
#2 AWG	Stranded	Brown	Double 1/4" diameter hole, 5/8" center	54207
#6 AWG	Stranded	Blue	Single 1/4" diameter hole	54105
#6 AWG	Stranded	Blue	Double 1/4" diameter hole, 5/8" center	54205
NOTE: These lugs require the use of the TBM5-S crimping tool. † All part numbers are Thomas & Betts.				

Selecting Cabinet Ground Lugs

Table 2 identifies recommended part numbers for wire lugs used to connect chassis ground wiring to the grounding point of each cabinet.

Table 2 **Recommended Junction Panel Ground Lugs**

Wire Size	Wire Type	Lug Color	Description	P/N †
#2 AWG	Stranded	Brown	Single 1/2" diameter hole	54145
#6 AWG	Stranded	Blue	Single 3/8" diameter hole	E6-12
NOTE: These lugs require the use of the TBM5-S crimping tool. † All part numbers are Thomas & Betts.				

Battery System Connections

The cable loop length refers to the total length of wire within a given circuit. For example, the combined length of the -48 VDC (hot) lead and the DC return lead equals the cable loop length. This would mean that a cabinet that needs 16 feet of wire between the batteries and Power Supply Rack has a total loop length of 32 feet.

Determining Battery System Wire Size

The wire size for the connection between the batteries and the Power Supply Rack is determined by the required wire length and the maximum allowable voltage drop. The voltage drop in the loop must be kept to below 200 mV. The wire selected should be UL approved and contain a high number of strands for flexibility.

For a standard configuration, the Power Supply rack is located directly adjacent to the batteries with a cable loop length of 20 feet or less, which requires the use of a 4/0 wire. Table 3 shows recommended wire sizes for various loop lengths. Larger wire sizes may be used if the recommended sizes are not available. The recommended wire sizes are large enough to allow site expansion to a fully loaded site.

Table 3 **Battery System Wire Size**

Loop Length	Wire size
20 feet	4/0 (or 250 MCM)
30 feet	350 MCM
45 feet	500 MCM

Selecting Battery System Lugs

Depending on the wire size used and the manufacturer of the Batteries, different wire lugs are crimped onto the power cable ends. After the wire size has been determined from Table 3, verify the manufacturer of the Batteries (*Dynasty* or *Absolyte*).

Two different battery systems are offered with the EBTS. The *Dynasty* system is a low to medium capacity, field expandable system supplied for smaller sites or sites with minimal backup hour requirements. This system is custom designed to Motorola specifications. The *Dynasty* system is manufactured by Johnson Controls:

C & D Technologies Dynasty Division

900 East Keefe Avenue
P.O. Box 591
Milwaukee, WI 53212
Phone: 800-396-2789
414-967-6500
Fax: 414-961-6506
Internet: www.dynastybattery.com

The *Absolute IIP* battery system is a heavy duty, high capacity battery system manufactured by GNB Technologies:

GNB Technologies

829 Parkview Boulevard
Lombard, IL 60148
Phone: 630-629-5200
Fax: 630-629-2635
Internet: www.gnb.com/stationary/stat-absp.html

Refer to Table 4 to determine the proper wire lug for the connection of that wire to the Power Supply rack.

Table 4 **Power Supply Rack Connection Lugs**

Wire Size	Cabinet Lug	Crimp Tool	Lug P/N †
4/0	Double 3/8" hole, 1" center	TBM5-S	54212
250 MCM	Double 3/8" hole, 1" center	TBM8-S	54213
350 MCM	Double 3/8" hole, 1" center	TBM8-S	54215
500 MCM	Double 3/8" hole, 1" center	TBM8-S	54218
† All part numbers are Thomas & Betts.			

Refer to Table 5 to determine the proper wire lug for the connection to the batteries, based on the wire size and battery manufacturer. One column lists the selection for *Dynasty* and the other lists the selection for *Absolyte IIP*.

Table 5 **Battery Connection Lugs**

Wire Size	Lug Color	Dynasty		Absolyte IIP	
		Description	P/N	Description	P/N
4/0	Purple	Double 3/8" hole, 1" center	54212	Single 1/2" hole	54170
250 MCM	Yellow	Double 3/8" hole, 1" center	54215	Single 1/2" hole	54113
350 MCM	Red	Double 3/8" hole, 1" center	54218	Single 1/2" hole	54115
500 MCM	Brown	Double 3/8" hole, 1" center	54220	Single 5/8" hole	54118

Anti-Oxidant Greases

Any one of the following anti-oxidant greases are recommended for connections to the positive (+) and negative (-) terminals of the batteries:

- ☐ No-Ox
- ☐ OxGuard
- ☐ Penetrox

Intercabinet Cabling

Ethernet and alarm cables connecting to the junction panels of each cabinet are supplied with the system. These cables may not be suitable for every EBTS site. It may be necessary to locally manufacture cables for a custom fit. Information is provided for both supplied cables and custom cables.

Supplied Cables

The cables listed in Table 6 are supplied with the system. The length of these cables should be sufficient if the considerations outlined in the Pre-Installation section are followed.

Table 6 **Supplied Inter-Cabinet Cabling**

Description	Qty.	P/N †
120" long, N-type Male to N-type male cable	3	0112004B24
108" long, BNC Male-to-BNC Male, RG400 cable	2*	0112004Z29
210" long, 8-pin Modular plug cable	1*	3084225N42
186" long, PCCH redundancy control cable	1**	3082070X01
Phasing Harness	1	0182004W04
† All part numbers are Motorola. * Per RF rack. ** Per Control rack.		

Making Custom Cables

If custom Ethernet or 5 MHz cables must be locally manufactured, use the part numbers listed in Table 7 for ordering the required materials.

Table 7 **Parts for Ethernet and 5 MHz Cables**

Description	Qty.	P/N †
Connector, BNC male	As required	2884967D01
Cable, RG400	As required	3084173E01
† All part numbers are Motorola.		

Table 8 lists the part numbers for custom alarm cables.

Table 8 Parts for Alarm Cables

Description	Qty.	P/N †
Connector, 8-pin modular	As required	2882349V01
Cable, 8-wire	As required	Locally procured
† All part numbers are Motorola.		

Table 9 lists the part numbers for custom PCCH cables.

Table 9 Parts for Extending PCCH Redundancy Control Cables

Description	Qty.	P/N †
186" long, PCCH redundancy control cable	1*	3082070X01
8-pin male Telco to 8-pin male Telco extension cable, length: as needed	As required	Locally procured
Modular, 8-pin female-to-female adaptor	As required	Locally procured
NOTE: Motorola does not guarantee proper operation of system if longer PCCH cable is used. † All part numbers are Motorola. * Per Control rack.		

Equipment Cabinet Power Connections

Selecting Power Connection Lugs

Table 10 identifies recommended part numbers for lugs used for power connections between the Power Supply rack and the Control and RF Cabinets. The maximum wire size accepted by the Control and RF Cabinets is 2/0. The Control and RF Cabinets use screw type compression connectors and do not require lugs.

Table 10 Recommended Power Connection Lugs for Power Supply Rack

Size	Lug Color	Description	P/N †
2/0	Black	Double 3/8" hole, 1" center	54210
#2 AWG	Brown	Double 1/4" hole, 5/8" center	54207
#4 AWG	Gray	Double 1/4" hole, 5/8" center	54206
#6 AWG	Blue	Double 1/4" hole, 5/8" center	54205
† All part numbers are Thomas & Betts.			

Determining Power Connection Wire Size

The cable loop length refers to the total length of wire within a given circuit. For example, the combined length of the -48 VDC (hot) lead and the DC return lead equals the cable loop length. This would mean that a cabinet which needs 16 feet of wire between the Power Supply rack and equipment cabinets has a total loop length of 32 feet.

The wire size for the connection between the Power Supply rack and the equipment cabinets is determined by the required wire length and the maximum allowable voltage drop. The voltage drop in the loop must be kept to below 500 mV. The wire selected should be UL approved and contain a high number of strands for flexibility. Table 11 shows the recommended wire sizes for various loop lengths of the RF Cabinet. Table shows the recommended wire sizes for loop lengths of the Control Cabinet

For a standard configuration, the equipment cabinets are located adjacent to the Power Supply rack with a cable loop length less than 35'.

Table 11 Power Connection Wire Size

Loop Length	Wire Size
25 feet or less	#6 AWG
25 to 40 feet	#4 AWG
40 to 60 feet	#2 AWG
60 to 130 feet	1/0 AWG
NOTE: The wire sizes listed are large enough to allow full RF Cabinet Base Radio capacity.	

Table 12 Power Connection Wire Size for Control Cabinet

Loop Length	Wire Size
150 feet or less	#6 AWG

Each equipment cabinet has a total of four Power Supply Rack connections; two -48 VDC (hot) and two DC return. Each equipment cabinet contains two separate power distribution systems. A single hot wire and a single return wire are used for each side of the bus. Two return leads provide redundancy and allow a uniform wire size to be used for all 48 VDC power distribution system connections.

Other Recommended Suppliers

The following are the addresses of various suppliers for tools and equipment used during installation of the EBTS.

Test Equipment

- ☐ PRFS Rubidium Frequency Standard

Datum Inc.

3 Parker
Irvine, CA 92618-1605
Phone: 800-EFRATOM (337-2866)
949-590-7600
Fax: 949-598-7650
Internet: <http://www.datum.com>

- ☐ Fluke 77 Digital Multimeter

Fluke Corporation

P.O. Box 9090
Everett, WA 98206-9090
Phone: 800-44-FLUKE
425-347-6100
Fax: 425-356-5116
Internet: <http://www.fluke.com>

Drive Test Equipment

A PC can be used for EBTS optimization and field service. The following are the minimum requirements:

- ☐ 19,200 bps serial port
- ☐ one floppy drive
- ☐ communication software, such as Smartcomm II or Procomm Plus

A drive test application is only available for the PC platform and is currently called iFTA (iDEN Field Test Application). Contact your local Motorola sales representative for more information.

Software

- ❑ ProComm Plus software

Symantec Corporation

20330 Stevens Creek Blvd.

Cupertino, CA 95014

Phone: 408-517-8000

Internet: <http://www.symantec.com>

Spare Parts Ordering**Motorola Inc.**

Accessories and Aftermarket Division

Attn: Order Processing

1307 E. Algonquin Road

Schaumburg, IL 60196

Returns:

2222 Glavin Drive

Elgin, IL 60123

Phone: 800-422-4210 (sales/technical support)

Fax: 847-538-8198

Newark Electronics

Call for a local phone number in your area to order parts

Phone: 800-463-9275 (catalog sales)

773-784-5100

Fax: 847-310-0275

Internet: <http://www.newark.com>

Optional High Precision Receiver BER Testing

IMPORTANT

This section is only applicable to the Legacy Base Radio. These procedures will not work with the Generation 2 or QUAD BRs

This optional procedure can be used in cases where the field Excessive BER Fault Isolation procedure in the System Troubleshooting section cannot provide a clear indication as to the item(s) causing excessive BER. This procedure offers the following benefits:

- ❑ Decreases the occurrence of properly functioning Base Radio receiver modules being erroneously returned to the factory as defective. Eliminating erroneous return of receiver FRUs helps maintain adequate field spares inventory and eliminate unnecessary costs.
- ❑ Helps reduce fault isolation uncertainty by positively resolving whether or not a Base Radio receiver module meets factory BER/sensitivity specifications.

In the majority of cases the field BER Floor and Sensitivity Verification tests (and, where required, the Excessive BER Fault Isolation procedure) provide clear pass/fail results. However, in cases where several elements within the receive system (RFDS, cabling, and/or receiver module) are near the lower pass limit, the cumulative effect can sometimes results in marginal BER readings. Typical field tests may not have the required precision in such cases, resulting in erroneous BER failure results when, actually, the receiver module is within specifications.

NOTE

The procedures in this appendix are **not intended as a normal system functional test**, nor are they intended for field use. Refer to the System Testing section of this manual for standard system verification procedures.

Required Test Equipment and Shop Fixture Setup

Required Test Equipment and Shop Fixture Setup

Shop Fixture Setup

The procedure is intended for the testing of individual receiver module FRUs removed from field equipment where a receiver BER failure could not be positively determined.

As such, the procedure requires that the field central repair facility have an EBTS RF Cabinet mock-up, complete with at least one BR and normal interface equipment (EAS, Site Controller, etc.). The BR serves as a hot mock-up fixture for testing receiver modules.

Required Test Equipment

Table 1 lists the equipment required to perform the high-precision procedures.

NOTE

Do not attempt to perform procedure if any of the equipment in Table 1 is not available or certified as calibrated (where applicable).

Required Test Equipment and Shop Fixture Setup**Table 1 Required Test Equipment (High-Precision Test)**

Equipment	Model/Type	Manufacturer
Service Computer †	80286 or better	IBM, IBM compatible, or Macintosh
Application Code	n/a	Motorola
Communication Software	ProComm Plus	DataStorm
RS-232 Cable	n/a	Locally Procured
RF Attenuator, 250W, 10dB	01-80301E72	Motorola
RF Power Meter††	HP438A	Hewlett-Packard
Low-Power Sensor Head	HP8481D	Hewlett-Packard
Rubidium Frequency Standard	PRFS	Ball/Efratom
iDEN Test Set	R2660	Motorola
Calibrated Test Cable	n/a	Locally Procured
50Ω, 2W Coaxial Termination	HP908A	Hewlett-Packard
Power Splitter	HP11667A	Hewlett-Packard
Precision Attenuator, 1-dB/step	HP355C	Hewlett-Packard
Precision Attenuator, 10-dB/step	HP355D	Hewlett-Packard
Various RF cable assortment	—	locally procured
† 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.		

Test Equipment Setup and Calibration Procedures

Test Equipment Setup and Calibration Procedures

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.

NOTE

Perform all procedures in the order specified.

The following procedures allow the R2660 to indirectly provide high-precision test signals for measuring receiver sensitivity and BER.

High precision is obtained by measuring the insertion loss of every item in the RF path using the RF power meter and an unmodulated RF carrier from the R2660. This calibration includes the splitter, all RF interconnecting cables and, especially, each and every setting of the precision attenuators.

The Test Setup Calibration Procedure below calibrates the interconnecting cables and power splitter. The Step Attenuator Calibration Procedure below calibrates the 1-dB/step and 10-dB/step attenuators used in the test setup. If the procedures are properly followed, the total error will be less than 0.25 dB at the end of the cable feeding the signal to the Base Radio receiver module under test.

NOTE

After performing the following calibration procedures, testing should be performed soon thereafter.

Also, do not disturb the test setup described in the following Test Setup Calibration Procedure; it must be left intact in order to preserve calibration.

R2660 Checks

The following steps provide a quick check of the R2660.

1. Connect the power meter sensor head to R2660 RF IN/OUT connector.
2. Turn on the R2660.
3. Set R2660 for continuous unmodulated carrier.
4. Adjust R2660 output level until a reading of -55.0 dBm is displayed on power meter.
5. On R2660 RF Output Level display, observe reading on R2660.
If the RF output level display reading is not between -53.0 and -57.0 dBm, have the R2660 calibrated.
6. Adjust R2660 output level until a reading of -52.2 dBm is displayed on power meter.
7. Set the RF power meter for level 9 filtering (long time averaging).
8. Note the reading on the power meter.
9. After at least 30 seconds have elapsed, the reading should have returned to -52.2 dBm.
10. Set the R2660 to generate a 6:1 iDEN test signal.
11. Note the reading on the power meter.
12. After at least 30 seconds have elapsed, the reading should indicate -60.0 dBm.

NOTE

In the previous step, power level is not actually decreased. The indicated power drops only because it is now present only 1/6 of the time.

13. If the reading is not within ± 0.5 dB of -60.0 dBm, have the R2660 serviced.

Test Equipment Setup and Calibration Procedures**Test Setup Calibration Procedure**

The following steps measure the loss of each RF cable and a splitter device used in the test setup RF path. With the loss of each item known, the losses can be nulled from the test measurements.

1. (See Figure 1.) Noting the splitter and various RF cables shown in Figure 1, obtain these items. Noting the equipment layout, choose cables of appropriate lengths.

NOTE

A mock hook-up of the items is useful in making sure cabling lengths are sufficient between all items in the setup.

NOTE

“Cable ‘E’” in the test setup (Figure 1) can be the Calibrated Test Cable specified in the System Testing section of this manual. If this cable is used, include its calibration value where a calibration value for “Cable ‘E’” is requested.

2. Connect power meter sensor head to the R2660 Test Set RF IN/OUT connector.
3. Turn on the R2660. Set R2660 for a continuous unmodulated carrier at a frequency within the approximate range of the receiver(s) being tested.
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. For each RF cable to be used in the test setup (cables ‘A’ through ‘E’ in Figure 1), calibrate each cable as follows:
 - 5.1 Connect one end of the test cable to the R2660 RF IN/OUT connector.
 - 5.2 Connect the power meter sensor head to the other end of the test cable.
 - 5.3 Observe the reading on the power meter.
 - 5.4 Subtract the reading obtained in the previous step from -55 dBm. This is the cable loss.
 - 5.5 Apply a tag to the cable, noting its position in the test setup (cable ‘A’ thru ‘E’ designation) and its measured loss.
6. Repeat steps 5.1 through 5.5 for each cable in the setup.

Test Equipment Setup and Calibration Procedures

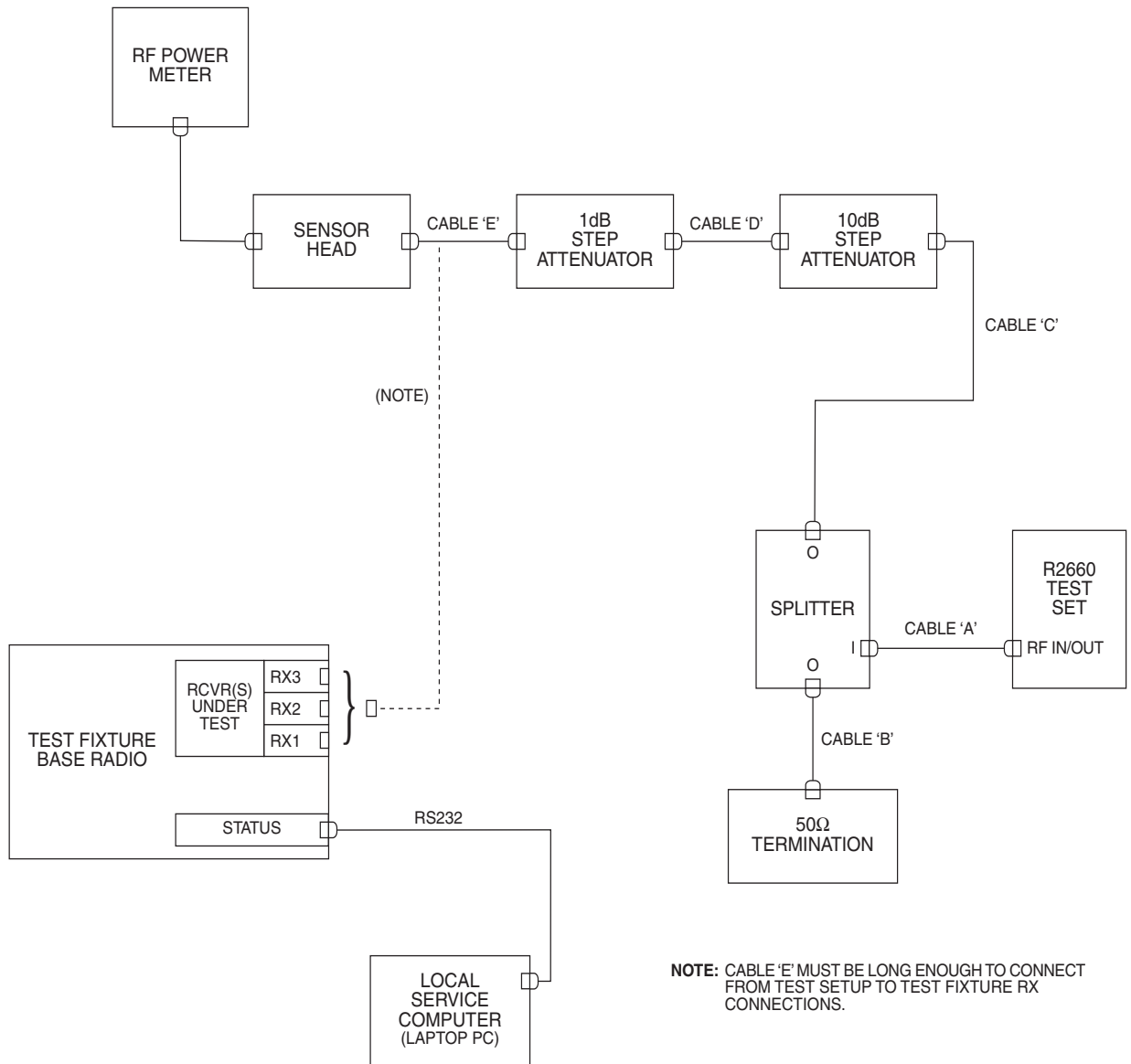
EBTS409
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Figure 1 Test Equipment Calibration Setup

Test Equipment Setup and Calibration Procedures

7. On the splitter to be used in the test setup, calibrate splitter as follows:
 - 7.1 Terminate one of the two output ports with a 50Ω load. Connect the power meter sensor head to the open output port.
 - 7.2 Connect the input port of the splitter to the R2660 RF IN/OUT connector using one of the tagged calibrated cables.
 - 7.3 Observe the reading on the power meter.
 - 7.4 Calculate the port loss as follows:

Calculating Splitter Port Loss:

$$(\text{meter reading}) - (\text{tagged cable loss}) - (\text{ref. level } \{-55 \text{ dBm}\}) = \text{port loss}$$

EXAMPLE:

reference level= -55 dBm
 tagged cable loss= 2 dB
 meter reading= -67 dBm

Therefore:

$$67 - (2) - (55) = 10 \text{ dB port loss}$$

- 7.5 Place a tag at the port, noting measured loss.
 - 7.6 Repeat steps 7.1 through 7.5 for the opposite output port on the splitter.
8. Proceed to Step Attenuator Calibration Procedure.

Step Attenuator Calibration Procedure

The following steps calibrate the 1-dB/step and 10-dB/step attenuators used in the test setup.

1. Perform test setup shown in Figure 1.
2. On the 1-dB/step attenuator and 10-dB/step attenuator, set both attenuators to 0 dB.
3. Turn on R2660 and set for unmodulated carrier output.
4. Observe power meter. Gradually adjust R2660 output level for -20 dBm, as displayed on power meter.

CAUTION

Make certain level at power meter sensor head does not exceed -20 dBm. Damage to sensor head could result if -20 dBm power level is exceeded.

5. Starting with the 1-dB/step attenuator, obtain the true attenuation-per-step as follows:
 - 5.1 On attenuator, select the attenuation position to be calibrated.
 - 5.2 Observe power meter reading.
 - 5.3 Obtain true attenuation-per-step using the formula below.

Calibrating the 1-dB/Step Attenuator Positions:

(meter reading) – (reference level {-20 dBm})= actual attenuation per step

EXAMPLE:

meter reading= -21.2 dBm

reference level= -20 dBm

Therefore:

(21.2) – (20)= 1.2 dB actual attenuation

6. Repeat steps 5.1 through 5.3 for each setting of the 1-dB/step attenuator. Notate the Actual Attenuation for each step in a photocopy of the log below.

Attenuator Step (dB)	Actual Attenuation (dB)
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Test Equipment Setup and Calibration Procedures

7. Set the 1-dB/step attenuator to its zero setting.
8. On the 10-dB/step attenuator, repeat the above procedure (steps 5 through 5.3) for the first five settings (0, -10, -20, -30, -40 dB settings) of the attenuator.

Enter the measured values in a photocopy of the log below.

Attenuator Step (dB)	Actual Attenuation (dB)
0	
10	
20	
30	
40	

9. Calibrate the 50 and 60 dB attenuation steps of the attenuator as follows:
 - 9.1 Set the 1-dB/step attenuator to 10 dB. Set the 10-dB/step attenuator to 0 dB.
 - 9.2 Gradually adjust the R2660 output level for a reading of -20 dB, as displayed by power meter.
 - 9.3 Set the 10-dB/step attenuator to 50 dB.
 - 9.4 Set the 1-dB/step attenuator to zero.
 - 9.5 Observe power meter reading.
 - 9.6 Calculate and record the actual attenuation value for 50 dB attenuation setting using the formula below.

Calibrating 50 dB and 60 dB Attenuator Positions:
$(\text{meter reading}) + (\text{actual atten. value for "10 dB" - (ref. level \{-20 dBm\})}$ $\text{position of 1-dB/step}$ $\text{1-dB/step atten. \{step 6\}})$ $= \text{Actual attenuation per step}$
EXAMPLE: power meter reading= -59.8 dBm actual atten. value for 10 dB step= 10.4 dB reference level= -20 dBm Therefore: $(59.8) + (10.4) - (20) = 50.2 \text{ dB actual attenuation value}$

- 9.7 Set the 10-dB/step attenuator to 60 dB setting. Repeat steps 9.1 through 9.6 for 60 dB setting. Record value obtained.

10. Enter the measured values for the 50 and 60 dB steps in a photocopy of the log below.

Attenuator Step (dB)	Actual Attenuation (dB)
50	
60	

11. Set R2660 output level control to full counter-clockwise (minimum signal level).
12. On both step attenuators, return settings to zero.
13. Set the R2660 to generate an iDEN BER test signal.
14. Set the power meter averaging function to 9.
15. On R2660, adjust the R2660 output level for a reading of -57.8 dBm on the power meter.

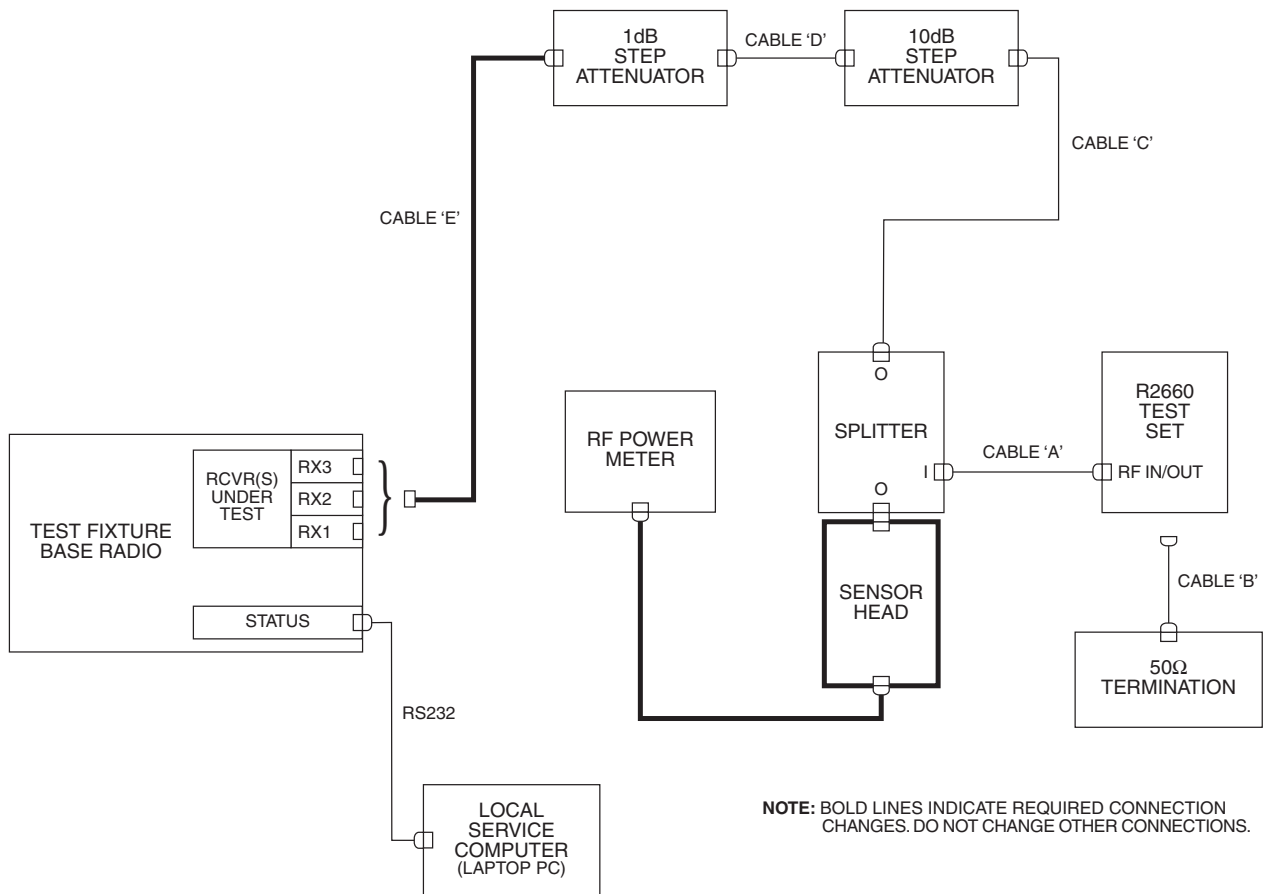
Displayed reading of -57.8 dBm results in actual power level of -50 dBm, thereby compensating for the RF output 1/6 duty cycle.

NOTE

The software version has an effect on the correction factor needed for average power measurements. Older units may require up to 5 db of level offset to compensate for the effects of the training pulse at the beginning of each time slot being larger than published specifications.

16. (See Figure 2.) Without changing any equipment settings, reconfigure the setup as shown by the bold lines in Figure 2.
17. Proceed to Setting Signal Level At Base Radio procedure.

Test Equipment Setup and Calibration Procedures

EBTS410
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Setting Signal Level At Base Radio

As discussed earlier, all items in the RF path between the R2660 and the Base Radio **RX** input are now calibrated and require their respective calibration factors to be considered when setting the R2660 output level (power meter reading) for referenced (dBm) levels at the Base Radio.

1. Make certain all items in the RF signal have been calibrated.
A checklist of the items that need to be factored are listed below.

Factors:	
D —	Desired level at Base Radio.
Σ —	Summation (Σ) of cal factors (losses and actual attenuator values), consisting of: • cables • splitter • 1-dB step attenuator actual value • 10-dB step attenuator actual value

2. Set the R2660 output for a **target** power meter reading that results in the **desired** level at the Base Radio using the formula below.

Formula:
Target power meter reading (T) that R2660 must be set for to produce desired level at Base Radio equals: Desired level at Base Radio + summation of cal factors $T = D + \Sigma$

An example is shown below.

Example:
A desired level of -108.0 dBm is required Summation of cal factors (losses) is 60.6 dB, as follows: • 5 dB (cables) • 2 dB (splitter port) • 4.2 dB (actual attenuation value for “4 dB” position of 1-dB step attenuator) • 49.4 dB (actual attenuation value for “50 dB” position of 10-dB step attenuator) Therefore: $(-108.0) + 60.6 = -47.4$ dB R2660 is adjusted for “hotter” output of -47.4 dBm to compensate for 60.6 dB losses and provide true -108.0 dBm at Base Radio RX input

Test Equipment Setup and Calibration Procedures**NOTE**

Whenever a target value is arrived at, it **must** be monitored and maintained throughout the following procedure. Small level adjustments (using the R2660 output level control) may be required in maintaining power meter Target level throughout the course of the procedure.

3. Proceed to BER Sensitivity Test Procedure.

BER Sensitivity Test Procedure

Individual procedures are respectively provided for 800 MHz and 900 MHz receiver modules.

Proceed to 800 MHz Receiver Test Procedure or 900 MHz Receiver Test Procedure, as applicable.

QUAD Channel BR Receiver Test Procedure

Configure the QUAD BR Rx test setup as described in Volume 2: QUAD BR Installation and Troubleshooting: Receiver Verification. Use MMI commands as outlined in Volume 2: QUAD BR Installation and Troubleshooting: Receiver Verification.

Generation 2 BR Receiver Test Procedure

Configure the Generation 2 BR RX test setup as described in Volume 2, Generation 2 Installation and Troubleshooting: Receiver Verification. Use MMI commands as outlined in Volume 2: Generation 2 BR Installation and Troubleshooting: Receiver Verification

800 MHz Receiver Test Procedure

Perform 800 MHz receiver module sensitivity verification as follows:

NOTE

If testing a 3X Receiver, refer to “3X Receiver” subsection of Base Radio section of this manual for special compatibility and installation information regarding 3X Receiver installation into a Base Radio.

1. Make certain test fixture Base Radio **POWER SUPPLY** switch is set to 0 (off).
2. Connect the service computer to the local service port (STATUS connector) of the test fixture Base Radio.
3. Remove power from the R2660 and connect the Rubidium Frequency Standard 10 MHZ OUTPUT to a 10 dB attenuator.
4. Connect the other end of the 10 dB attenuator to the 10 MHZ REFERENCE OSCILLATOR IN/OUT connector on the R2660.
5. Put the R2660 in EXT REF mode.
6. Apply power to the R2660.

BER Sensitivity Test Procedure

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

NOTE

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

8. Install receiver module FRU under test into test fixture Base Radio. (If only one receiver module is to be tested, use the RX1 slot.)
9. Set the test fixture Base Radio **POWER SUPPLY** switch to 1 (on).
10. Log onto the test fixture Base Radio.
11. When prompted, as shown below, enter the password for the test fixture Base Radio.

The default factory set field password is **motorola**.

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

Enter login password:

BRC>

After entering password, **BRC>** prompt shown above appears.

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

This command stops all RF transmission.

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

CAUTION

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.

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

This command disables the software gain control routine within the test fixture Base Radio.

14. 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
```

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

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

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

This command enables only antenna/receiver 1 while disabling the remaining antenna/receivers.

```
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
```

BER Sensitivity Test Procedure**NOTE**

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

17. As shown in Figure 2, connect test cable 'E' between the R2660 **RF IN/OUT** connector and the RX port of the receiver module under test.
18. Noting the required **target** power meter level and attenuator settings, set the R2660 and attenuators for a **desired** power level of -108.0 dBm **at the end of the cable feeding the Base Radio** as follows:

Setting the Target Power Level:

Target power meter level= Desired level at Base Radio + Summation of cal factors

EXAMPLE:

A desired level of -108.0 dBm is required

Summation of cal factors (losses) is 60.6 dB, as follows:

- 5 dB (cables)
- 2 dB (splitter port)
- 4.2 dB (actual attenuation value for "4 dB" position of 1-dB step attenuator)
- 49.4 dB (actual attenuation value for "50 dB" position of 10-dB step attenuator)

Therefore:

$$(-108.0) + 60.6 = -47.4 \text{ dB}$$

NOTE

Target power levels (as displayed on power meter) **must** be monitored and maintained throughout the following procedure. Small level adjustments (using the R2660 output level control) may be required in maintaining power meter Target level throughout the course of the procedure.

19. Set the R2660 for an output level (as displayed on power meter) as determined above.

20. At the BRC> prompt, type: **get rssi 2 100** to obtain BER reading.

Note the BER result on each line of the displayed results and proceed as listed below.

NOTE

If your particular test setup losses will not permit an **exact** -108.0 dBm level at the cable end (e.g., only choices are -107.5 or -108.5), perform step 20 at the **lower** (more stringent) of the two possible levels (for example, -108.5 dBm) and again at the next-higher level (for example, -107.5 dBm). Note BER readings at each level.

– If BER **passes at more stringent level**, or if BER **fails for both levels**, proceed as listed below.

– If BER fails at more stringent level, but passes at next-higher level, interpolate the pass/fail levels and BER readings to obtain the exact level at which 8% BER occurs. Proceed as listed below using interpolated -108.0 dBm value.

BRC> **get rssi 2 100**

Starting RSSI monitor for 2 repetitions averaged each 100 reports.

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

- If BER at -108.0 dBm is **greater than 8% (8.0e - 00%)**, Base Radio **receiver module is defective**. Return module to depot for repair.
- If BER at -108.0 dBm (or better) is **8% (8.0e - 00%) or less**, Base Radio **receiver module is OK**. Re-install module in Base Radio where it was removed.

Refer to System Troubleshooting section for fault isolation of items other than the Base Radio.

21. Depending on whether a Single Receiver FRU or 3X Receiver FRU is being tested, proceed as follows:
- For 3X Receiver FRU, proceed to step 22.
 - For Single Receiver FRU, proceed to step 23.

BER Sensitivity Test Procedure

22. Noting the procedure differences below for each receiver branch within the 3X receiver module, repeat steps 16 through 20 for the RX2 receiver, and then for the RX3 receiver.

Receiver Being Tested	Cable 'E' Connection	Set Rx Mode Command
RX2	Connect Test Cable 'E' to receiver RX2 port.	At the BRC> prompt, type: set rx_mode 2
RX3	Connect Test Cable 'E' to receiver RX3 port.	At the BRC> prompt, type: set rx_mode 3

23. If other receiver modules are to be tested, turn off Base Radio and repeat steps 8 through 21 for each receiver module.
24. After all modules are tested, turn off Base Radio and R2660.
25. Disconnect test setup and reconnect any test fixture cabling removed for this test.

900 MHz Receiver Test Procedure

Perform 900 MHz receiver module sensitivity verification as follows:

1. Make certain test fixture Base Radio **POWER SUPPLY** switch is set to **0** (off).
2. Connect the service computer to the local service port (STATUS connector) of the test fixture Base Radio.
3. Remove power from the R2660 and connect the Rubidium Frequency Standard 10 MHZ OUTPUT to a 10 dB attenuator.
4. Connect the other end of the 10 dB attenuator to the 10 MHZ REFERENCE OSCILLATOR IN/OUT connector on the R2660.
5. Put the R2660 in EXT REF mode.
6. Apply power to the R2660.
7. Set the R2660 to generate the 6/1 iDEN test signal.

NOTE

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

8. Install receiver module FRU under test into test fixture Base Radio.

9. Set the test fixture Base Radio **POWER SUPPLY** switch to 1 (on).
10. Log onto the test fixture Base Radio.
11. When prompted, as shown below, enter the password for the test fixture Base Radio.

The default factory set field password is **motorola**.

NOTE

The 'Out of Box' default factory set field password is deleted and is replaced by the customer defined field password contained within the OMC. This occurs as soon as the controller module receives its initial OMC download.

The default OMC set field password is **Motorola**.

NOTE

The OMC field password is customer configurable. Please contact the Operations and Maintenance Center (OMC) operator on duty to obtain your customer unique field password.

Enter login password:

BRC>

After entering password, **BRC>** prompt shown above appears.

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

This command stops all RF transmission.

BRC> **dekey**
XMIT OFF INITIATED

BER Sensitivity Test Procedure**CAUTION**

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.

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

This command disables the software gain control routine within the test fixture Base Radio.

14. 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 896.00000 MHz
```

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

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

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

This command enables only antenna/receiver 1 while disabling the remaining antenna/receivers.

```
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.

17. As shown in Figure 2, connect test cable 'E' between the R2660 **RF IN/OUT** connector and the RX port of the receiver module under test.

18. Noting the required **target** power meter level and attenuator settings, set the R2660 and attenuators for a **desired** power level of -108.0 dBm **at the end of the cable feeding the Base Radio** as follows:

Setting the Target Power Level:

Target power meter level= Desired level at Base Radio + Summation of cal factors

EXAMPLE:

A desired level of -108.0 dBm is required

Summation of cal factors (losses) is 60.6 dB, as follows:

- 5 dB (cables)
- 2 dB (splitter port)
- 4.2 dB (actual attenuation value for “4 dB” position of 1-dB step attenuator)
- 49.4 dB (actual attenuation value for “50 dB” position of 10-dB step attenuator)

Therefore:

$$(-108.0) + 60.6 = -47.4 \text{ dB}$$

NOTE

Target power levels (as displayed on power meter) **must** be monitored and maintained throughout the following procedure. Small level adjustments (using the R2660 output level control) may be required in maintaining power meter Target level throughout the course of the procedure.

19. Set the R2660 for an output level (as displayed on power meter) as determined above.
20. At the BRC> prompt, type: **get rssi 2 100** to obtain BER reading.

Note the BER result on each line of the displayed results and proceed as listed below.

NOTE

If your particular test setup losses will not permit an **exact** -108.0 dBm level at the cable end (e.g., only choices are -107.5 or -108.5), perform step 20 at the **lower** (more stringent) of the two possible levels (for example, -109.5 dBm) and again at the next-higher level (for example, -107.5 dBm). Note BER readings at each level.

– If BER **passes at more stringent level**, or if BER **fails for both levels**, proceed as listed below.

– If BER fails at more stringent level, but passes at next-higher level, interpolate the pass/fail levels and BER readings to obtain the exact level at which 10% BER occurs. Proceed as listed below using interpolated -108.0 dBm value.

BRC> **get rssi 2 100**

Starting RSSI monitor for 2 repetitions averaged each 100 reports.

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

- If BER at -108.0 dBm is greater than 8% (8.0e - 00%), Base Radio **receiver module is defective**. Return module to depot for repair.
- If BER at -108.0 dBm (or better) is 8% (8.0e - 00%) **or less**, Base Radio **receiver module is OK**. Re-install module in Base Radio where it was removed.

Refer to System Troubleshooting section for fault isolation of items other than the Base Radio.

BER Sensitivity Test Procedure

21. Noting the procedure differences below for each receiver branch within the 3X receiver module, repeat steps 16 through 20 for the RX2 receiver, and then for the RX3 receiver.

Receiver Being Tested	Cable 'E' Connection	Set Rx Mode Command
RX2	Connect Test Cable 'E' to receiver RX2 port.	At the BRC> prompt, type: set rx_mode 2
RX3	Connect Test Cable 'E' to receiver RX3 port.	At the BRC> prompt, type: set rx_mode 3

22. If other receiver modules are to be tested, turn off Base Radio and repeat steps 8 through 21 for each receiver module.
23. After all modules are tested, turn off Base Radio and R2660.
24. Disconnect test setup and reconnect any test fixture cabling removed for this test.

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