DIMETRA™

DIMETRA X Core
DIMETRA Express
DIMETRA IP Scalable (DIPS)
DIMETRA IP Compact (DIPC)/Scalable DIMETRA IP (SDIP)
DIMETRA IP Micro/DIMETRA IP LiTE

MTS LiTE, MTS 2 and MTS 4 Installation, Configuration and Basic Service Manual

JUNE 2020

6802800U74-AP

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Declaration of Conformity

Per FCC CFR 47 Part 2 Section 2.1077(a)

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Address: 1303 East Algonquin Road, Schaumburg, IL 60196-1078, U.S.A.

Phone Number: 1-800-927-2744

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Model Name: MTS 2, MTS 4

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Disclosure table

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
金属部件	×	O	×	×	O	O
电路模块	×	O	×	×	O	O
电缆及电缆组件	×	O	×	×	O	O
塑料和聚合物部件	O	O	O	O	O	×

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O：表示该有毒有害物质在该部件所有均质材料中的含量均在 GB/T 26572 标准规定的限量要求以下。
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Contact Details

Technical Requests: techsupport.emea@motorolasolutions.com

Repair Support: repair.emea@motorolasolutions.com

Contact Us: https://www.motorolasolutions.com/en_xu/support.html

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Send questions and comments regarding user documentation to documentation@motorolasolutions.com.

Document History

Version	Description	Date
6802800U74–A	Initial version.	July 2006
6802800U74–B	Minor changes introduced.	August 2006
6802800U74–C	Updated: • Table 4–4. • Table 4–5 and inserted new note. • Table 5–6.	August 2006
6802800U74–D	Service Cable and Connector Box Description section updated.	October 2006
6802800U74–E	Updates throughout the manual.	February 2007
6802800U74–F	Expansion Cabinet updates throughout the manual, and addition of Expansion Options chapter.	August 2007
6802800U74–G	800 MHz updates throughout the manual.	November 2007
6802800U74–H	BTS Q108 SPU updates, including the addition of redundant power connector on the Site Controller.	March 2008
6802800U74–J	• Regulatory CE Labeling Compliance updated. • Added MTS 4 Outdoor Enclosure on page 477. • Added info about Base Radio dekey when Standby SC is powered on. • Added info about frequencies in receiver band that can cause high bit error rate to occur. • Updated FRU number for RX Splitter.	June 2008
6802800U74–K	• Updated MTS site link configuration info in Table 8–9. • Updated RF cabling/Connections for MTS 4 with two TX/RX antennas and up to one additional RX antenna (Table 5–13 and Figure 5–12). • Revision to FRU numbers for MTS fan and Hybrid Combiner. • Other minor updates.	December 2008
6802800U74–L	• Updated manual with TEDS compatibility. • Updates to the Power Supply Unit (PSU) DC Input Power.	April 2009

Version	Description	Date
	• Other minor updates throughout the manual.	
6802800U74–M	• Ethernet Site Link Cabling hardware installation information added. • Ethernet Site Link cabling and interconnection added. • Configuring Ethernet Site Link added.	June 2009
6802800U74–N	• Ethernet Site Link Retro-fit kit and configurations added. • Added section *MTS LVD Kit Installation* to *Hardware Installation* chapter.	September 2009
6802800U74–P	Updated: • With 260 MHz additions throughout the manual. • Information on LVD Kit Installation. • MTS 4 Duplexer FB diagram. • The *How to configure E1 links* procedure. • Other minor updates.	July 2010
6802800U74–R	Added non-duplexed MTS 2 configurations.	September 2010
6802800U74–T	Added MTS LiTE.	December 2010
6802800U74–U	• Added the *How to Upgrade the ATCC Firmware* procedure. • Updated the *How to Replace Site Controller Lithium Battery* procedure.	June 2011
6802800U74–V	• Added section Tuning the MTCC in a BTS in Tetra Application Mode on page 308. • Removed reference to obsolete item (surge arrestor for an MTS4 in 450 MHz band for TX/RX and/or RX antennas). • Added warning not to key the base station without a proper load. • Added New part numbers for duplexer and preselector (supplied by Fingu, replaces Power Wave). • General Defect Fixing.	March 2012
6802800U74–W	Updated the following: • MMI Commands and MTS Modes of Operation on page 239. • Table 49: RF Cabling/Connections for MTS LiTE with One TX and One RX ant. No Diversity on page 194.	May 2012

Version	Description	Date
	• Service Cable and Connector Box Description on page 244. • Setting Base Radio IP on page 256.Station Verification Procedures on page 260. • Added Configuring the Base Radio VSWR on page 258. • Verifying the Base Radio Receiver Parameters in BR-Arch-1 Architecture on page 257. • XHUB Controller – Front Panel Indicators (LED) on page 341. • XHUB Controller – Front Panel Connectors on page 342. • Troubleshooting: General Check of a Site Controller File on page 380. • Added Ethernet Site Link on page 394. • Base Radio Alarms on page 401. • Miscellaneous Troubleshooting on page 427. • Field Replaceable Units (FRUs) on page 478. Restoration content moved to the respective *Backup And Restore Including FRU/FRE* manuals (for DIMETRA IP Scalable and DIMETRA IP Compact systems) or *Service Manual* (for DIMETRA IP Micro system).	
6802800U74–Y	Added: • Verifying and Tuning the Receiver RSSI Levels on page 266. Updated: • Ethernet Site Link on page 394. • Site Controller – Front Panel Indicators (LED) on page 322.	December 2012
6802800U74–AA	Added: • Encrypted Ethernet Site Links on page 397. • Verifying Encryption Capability on page 399. Updated: • Verifying and Tuning the Receiver RSSI Levels on page 266.	February 2013
6802800U74–AB	Updated the following: • Encrypted Ethernet Site Links on page 397. • Verifying Encryption Capability on page 399.	March 2014

Version	Description	Date
	• Field Replaceable Units for MTS LiTE on page 478. • Field Replaceable Units for MTS 2 on page 480. • Field Replaceable Units for MTS 4 on page 483. • Miscellaneous Troubleshooting on page 427.	
6802800U74–AC	Updated RF Cabling – MTS 4, No Diversity on page 204.	July 2014
6802800U74–AD	Added: • Resetting the RTC Battery Status on page 332. Updated: • Checking if the Site Controller Lithium Battery Needs Changing on page 332. • Replacing the Site Controller Lithium Battery on page 333.	September 2014
6802800U74–AE	Updated: • Field Replaceable Units (FRUs) on page 478. • E1 Interface on page 390. • MTS LVD Kit Installation on page 119.	April 2015
6802800U74–AF	Added: • GPS Connections on page 135. • Troubleshooting: status sc on page 377. • Troubleshooting: GPS and Site Reference Faults on page 381. • GPS Receiver Detailed Troubleshooting on page 384.	December 2015
6802800U74–AG	Introduced BR-Arch-2. Added: • Verifying Permanent Lock on page 399. • Unlocking the Site from the Permanent Lock State on page 400.	September 2016
6802800U74–AH	Updated: • LED Fault Indications on page 373 • Field Replaceable Units for MTS 2 on page 480 • Field Replaceable Units for MTS 4 on page 483	August 2017

Version	Description	Date
6802800U74–AJ	Updated for DIMETRA X Core.	September 2017
6802800U74–AK	Updated GPS Site Reference Operation Modes on page 135. Added Restriction of Hazardous Substances Compliance on page 428.	January 2018
6802800U74–AL	Updated • GPS Receiver Detailed Troubleshooting on page 384 • Note in Antenna Installation Considerations on page 73. • The PN/FRU numbers change from GMDN1172A to PMUG1017A Field Re-placeable Units for MTS LiTE on page 478. • Note related to supporting GLONASS in the future. GPS Connections on page 135. • Information about supporting GLONASS in the future Site Controller – GPS Module on page 332. Added: • New FRU GMTF4695A in Field Replaceable Units for MTS LiTE on page 478	April 2018
6802800U74–AM	Minor changes.	November 2018
6802800U74–AN	Updates/new sections: • Declaration of Conformity on page 3 • Verifying and Tuning the Receiver RSSI Levels in a High Power Setting for BR-Arch-2 on page 268 • Configuring Ethernet Ports on page 465	October 2019
6802800U74–AP	Updated: • Declaration of Conformity on page 3 • RF Antenna Connections on page 125 • Resetting the RTC Battery Status on page 332 • Ethernet Site Link Retrofit Kit on page 149 Added: • Netcom Decoupling on page 387	June 2020

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About MTS LiTE, MTS 2 and MTS 4 Installation, Configuration and Basic Service Manual

This manual provides an overview of the Motorola Transceiver Station (MTS) within the DIMETRA System.

What Is Covered In This Manual?

This manual covers the basics of Installation, Configuration, and Service of the following TETRA stations:

- MTS LiTE 400 MHz and 800 MHz
- MTS 2 260 MHz, 400 MHz, and 800 MHz
- MTS 4 260 MHz, 400 MHz, and 800 MHz

NOTICE: This manual refers to the following MTS frequencies:

- **260 MHz:** covers the 260 MHz - 275 MHz frequency range
- **400 MHz:** covers the 350 MHz - 470 MHz (BR-Arch-1 architecture), and 330 - 470 MHz (BR-Arch-2 architecture) frequency ranges
- **800 MHz:** covers the 799 MHz - 870 MHz frequency range

Helpful Background Information

This manual is intended for use by the following audiences within the user community:

- Operations Group - This group is responsible for the day-to-day system operation and comprises system administrators and communication specialists, usually under the supervision of an operations manager.
- Field Technicians / Engineers - Responsible for installation, configuration, support of customer systems, and FRU replacement.

It is assumed that the reader is familiar with the operating principles of Motorola Solutions DIMETRA trunked radio equipment or similar.

Related Information

Document Title	Description
Glossary	The glossary provides a list of abbreviations, acronyms, and terms used in the DIMETRA system documentation.
Standards and Guidelines for Communication Sites	This manual provides standards and guidelines to follow when setting up a Motorola Solutions communications site. Also known as R56 manual.
System Overview	This manual provides basic radio system concepts, call processing basics, and an introduction to the various components and processes associated with the DIME-TRA system. The manual provides the background nee-

Document Title	Description
	ded to comprehend the theory of operation and it provides equipment/subsystem functional descriptions. It also describes the role of the numerous network management software applications used for managing the system
Ethernet Site Links	This manual contains information on the Ethernet Site Links (ESL) feature, which provides a means to establish Ethernet connections of the following type: • Base station links (single and redundant) • Inter-zone links • Remote control site links terminated at control site routers
Link Encryption	This manual describes the technical solution for setting up Encryption and Authentication, which is an extension to the Ethernet Site Links (ESL) feature, on Routers and Base Stations.
MTS Man Machine Interface (MMI) Commands	This manual describes the Man-Machine Interface commands used to test and configure MTS sites.
TESS Software User Guide	This manual is an introduction and guide to the use of the DIMETRA BTS (Base Transceiver System) Service Software. Through the DIMETRA BTS Service Software trained service personnel and systems engineers can configure and program a BTS.
MTS Lite, MTS 2, and MTS 4 Restoration	This manual contains the system backup and restoration procedures and their impact on the services as well as pre- and post-restoration checks for MTS Lite, MTS 2, and MTS 4.

Regulatory CE Marking Compliance

MTS LiTE, MTS 2 and MTS 4 are compliant with the essential requirements in article 3 of the E.U. Directive, 1999/5/EC, “Radio Equipment and Telecommunications Terminal Equipment and the Mutual Recognition of their Conformity (RTTE)”. This includes:

Article 3.1a: Safety, of the RTTE directive: Verification tests performed according to the harmonized European standard:

- EN 60950-1 Safety of information technology equipment; Part 1: General requirements.

Article 3.1b: EMC, of the RTTE directive: Verification tests performed according to the harmonized European standards:

- ETSI EN 301 489-1 EMC standard for radio equipment and services; Part 1: Common technical requirements.
- ETSI EN 301 489-18 EMC standard for radio equipment and services; Part 18: Specific conditions for Terrestrial Trunked Radio (TETRA) equipment.
- EN 61000-3-2 standard for Electromagnetic compatibility (EMC) -- Part 3-2: Limits - Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)

- EN 61000-3-3 standard for Electromagnetic compatibility (EMC) -- Part 3-3 Limits - Limitation of voltage changes, voltage fluctuations, and flicker in public low-voltage supply systems, for equipment with rated current =16 A per phase and not in subject to conditional connection.

NOTICE: This is a Class A product. In a domestic environment, this product may cause radio interference in which case you may be required to take adequate measures.

Article 3.2: Radio spectrum use, of the RTTE directive: Verification tests performed according to the harmonized European standards:

- ETSI EN 303 035-1 Harmonized EN for TETRA equipment covering essential requirements under article 3.2 of the RTTE directive; Part 1: Voice plus Data (V+D)
- ETSI EN 300 394-1 TETRA conformance testing specification; Part 1: Radio.
- ETSI EN 302 561 Radio equipment using constant or non-constant envelope modulation operating in a channel bandwidth of 25 kHz, 50 kHz, 100 kHz, or 150 kHz; Harmonized EN covering essential requirements of article 3.2 of the RTTE Directive.

MTS 2 and MTS 4 are also compliant with the following requirement:

- ARIB STD-T80 Digital Mobile Telecommunication System for Local Government TYPE 2

Icon Conventions

The documentation set is designed to give the reader more visual clues. The following graphic icons are used throughout the documentation set.

DANGER: The signal word DANGER with the associated safety icon implies information that, if disregarded, will result in death or serious injury.

WARNING: The signal word WARNING with the associated safety icon implies information that, if disregarded, could result in death or serious injury, or serious product damage.

CAUTION: The signal word CAUTION with the associated safety icon implies information that, if disregarded, may result in minor or moderate injury, or serious product damage.

CAUTION: The signal word CAUTION may be used without the safety icon to state potential damage or injury that is not related to the product.

IMPORTANT: IMPORTANT statements contain information that is crucial to the discussion at hand, but is not CAUTION or WARNING. There is no warning level associated with the IMPORTANT statement.

NOTICE: NOTICE contains information more important than the surrounding text, such as exceptions or preconditions. They also refer the reader elsewhere for additional information, remind the reader how to complete an action (when it is not part of the current procedure, for instance), or tell the reader where something is on the screen. There is no warning level associated with a notice.

Style Conventions

The following style conventions are used:

Convention	Description
Bold	This typeface is used for names of, for instance, windows, buttons, and labels when these names appear on the screen (example: the **Alarms Browser** window). When it is clear that we are referring to, for instance, a button, the name is used alone (example: Click **OK**).
`Monospacing font`	This typeface is used for words to be typed in exactly as they are shown in the text (example: In the **Username** field, type `Admin`).
	This typeface is used for messages, prompts, and other text displayed on the computer screen (example: `A new trap destination has been added`).
<Monospacing font in bold Italic>	This typeface is used with angle brackets as placeholders for a specific member of the group that the words represent (example: ***<router number>***). **NOTICE:** In sequences to be typed in, the angle brackets are omitted to avoid confusion whether to include the angle brackets in the text to be typed.
CAPITAL LETTERS	This typeface is used for keyboard keys (example: Press Y and press ENTER).
Italic	This typeface is used for citations. A citation usually is the name of a document or a phrase from another document (example: *DIMETRA System Overview*).
→	An → (arrow pointing right) is used for indicating the menu or tab structure in instructions on how to select a certain menu item (example: **File** → **Save**) or a certain sub-tab.

Chapter 1

MTS Overview

Motorola Transceiver Station (MTS) is a Base Station of a DIMETRA communication system. A Base Station serves as the Radio Frequency (RF) interface between the system infrastructure and the mobile stations. Base Stations in a trunked system have three primary interfaces:

- Receiver to pick up the RF signal from the mobile stations
- Transmitter to send RF signals to the mobile stations
- Wired interface to send audio and control traffic to the system infrastructure

Strategically placed base stations allow users to communicate with other mobile stations, dispatch operators, or telephone users using the DIMETRA system.

1.1 Base Radio Architecture Comparison

Two software architectures, called Architecture 1 (BR-Arch-1) and Architecture 2 (BR-Arch-2), are found within MTS Base Radios. Architecture 2 was introduced starting with GMTX4336A and has its origin in operating system and hardware changes.

Base Radios in BR-Arch-2 are available in different frequency ranges than BR-Arch-1 Base Radios. The new frequency ranges have no impact on BR-Arch-1 Base Radio ranges; for more details see RFDS Frequency Band and Bandwidth on page 275 and Power Amplifier on page 350.

The configuration and setup of MTS Base Radios in both architectures is almost identical. Minor differences that exist in the command sets of bootloaders and applications are appropriately marked in relevant processes for both architectures. The functionality of the Base Radio Application is the same for both software architectures.

The main change in the BR-Arch-2 architecture is the boot order. BOOT1 is not available in BR-Arch-2 Base Radios, where it is replaced by Core Application offering a similar functionality. By using Core Application you can perform basic BR configuration and start Base Radio Application or Test Application.

Table 1: Architecture comparison - boot order and functionalities of bootloaders and applications

BR-Arch-1	BR-Arch-2	Functionality
BOOT0 (1st stage bootloader)	U-Boot (1st stage bootloader)	Mode reserved for authorized technical personnel only.
BOOT1 (2nd stage bootloader)	Base Radio Core	Basic BR configuration; starts other applications.
BR Application	BR Application	Main BR Application; starts automatically if the boot process is not interrupted.
Test Application	Test Application	Application intended for testing, recommended to use by authorized technical personnel only.

The following examples show the boot processes in both architectures.

BR-Arch-1 boot process

```
POLO(release) ver. MTS_BRC_BOOT1-R08.40.02
       FEATURES flash telnetd testapp auxcmds /tftp /gzip dns boardparam
       Local Ethernet address......00:25:F1:28:DF:D2
       Local Ethernet address......00:25:F1:28:DF:D3
       DNS resolver not configured.

       These are the boot parameters:
       autoboot...............yes
       boot timeout...........5 seconds
       boot method 1..........
       boot method 2..........
       boot method 3..........
       boot method 4..........
       Press CTRL-C or ESCAPE to interrupt autoboot process, SPACE for
instant boot.
```

NOTICE: At this point you can interrupt booting of BR Application and and log on to BOOT1. If you do not interrupt the process, BR continues booting and displays the following output.

```
Booting image from /gzip//tftp/10.00.253.01/brc.code.1.rlj.
       ELF segment 0: Writing 0x540 bytes to addresses 0x40000 - 0x4053f.
       ELF segment 1: Writing 0x320050 bytes to addresses 0x40540 -
0x36058f.
       ELF segment 2: Writing 0xa7ec bytes to addresses 0x360590 - 0x36ad7b.
       ELF segment 3: Writing 0x1000 bytes to addresses 0x36ad7c - 0x36bd7b.
       ELF segment 4: Writing 0x107160 bytes to addresses 0x36bd7c -
0x472edb.
       ELF segment 5: Skipping since filesize = 0 (BSS).
       ELF segment 6: Skipping since filesize = 0 (BSS).
       Total text + data = 0x432edc, total bss = 0x204b590.
       Transferring control to image entrypoint at 0x40558.
       Starting FAM...
       Flash area base:0x10000000 size:0x800000 driver:cfi params:
       Checking partitions...
       Listing partitions on ramdisk:0
       #    VolName    Lo     Hi Format
       0                0      3 partman
       1                4   2031 hafsfat
       Verifying partition:1 name:ram device:ramdisk unit:0 lo:4 hi:2031
format:hafsfat
       Mounting volumes...
       Mounting volume: volume/1
       Mounting volume /ramlog format:clfs device:clfs
params:type=ram,blocksize=0x4000,size=0x48000
       Mounting volume: volume/2
       Mounting volume /log format:clfs device:clfs
params:type=flash,blocksize=0x20000,size=0x200000,start=0x12040000
       Mounting volume: volume/3
       Mounting volume /ram format:hafsfat device:ramdisk
params:unit=0,partition=1,quick
       Checking flash objects... SUCCESS
       username: Downloading configuration file (brc02.cf.2)... SUCCESS
```

NOTICE: BR Application is started, BR offers call services now, you can log in.

```
***
       password:
       *** You are now logged in with Factory access ***
       BR)
```

BR-Arch-2 boot process

```
U-Boot MTS_BRC_UBOOT-R08.44.03 (Nov 20 2015 - 21:43:13)

       CPU0:  P1021E, Version: 1.1, (0x80ec0111)
       Core:  E500, Version: 5.1, (0x80212051)
       Clock Configuration:
              CPU0:533.333 MHz, CPU1:533.333 MHz,
              CCB:266.667 MHz,
              DDR:333.333 MHz (666.667 MT/s data rate) (Asynchronous),
LBC:66.667 MHz
              QE:133.333 MHz
       L1:    D-cache 32 kB enabled
              I-cache 32 kB enabled
       Board: MTS BR Control
       I2C:   ready
       SPI:   ready
       DRAM:   1 GB
       L2:    256 KB enabled
       MMC:  FSL_ESDHC: 0
       In:    serial
       Out:   serial
       Err:   serial
       Net:   eTSEC1, eTSEC2
       Hit any key to stop autoboot: 0
       CRC32 for 00fff000 ... 00fff003 ==> 2144df1c
       CRC32 for 00fff000 ... 00fff003 ==> 5643ef8a
       Booting image from bank 1

       MMC read: dev # 0, block # 49152, count 1 ... 1 blocks read: OK

       MMC read: dev # 0, block # 49152, count 5632 … 5632 blocks read: OK
       WARNING: adjusting available memory to 30000000
       ## Booting kernel from Legacy Image at 01000000 ...
          Image Name:   MTS_BRC_CORE-R08.44.21
          Created:      2016-02-29  10:42:06 UTC
          Image Type:   PowerPC Enea OSE Kernel Image (gzip compressed)
          Data Size:    2675773 Bytes =  2.6 MB
          Load Address: 00200000
          Entry Point:  00200000
          Verifying Checksum ... OK
          Uncompressing Kernel Image ... OK

       RTOSE(release). Copyright 2003-2010 Enea Embedded Technology AB. All
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       MTS_BRC_CORE-R08.44.21. Copyright 2011-2016 Motorola Solutions Inc.
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       Local Ethernet address: 84:24:8D:0C:1B:55
       Local Ethernet address: 84:24:8D:0C:1B:56
       Local Ethernet address: 00:14:9F:05:00:12

       ### Downloading Tetra Application  ###
       ### Press ESC or CTRL-c to interrupt and run Core ###
```

NOTICE: At this point you can interrupt booting of BR Application and run Core Application. If you do not interrupt the process, BR continues booting and displays the following output.

```
      ### Tetra Application will start automatically within 5 seconds ###

      ### Press ESC or CTRL-c to run Core or Space to run Tetra Application
instantly ###
```

```
### Starting Tetra Application ###
### Press Enter ###

username: Downloading configuration file (brc01.cf.2)... SUCCESS
```

NOTICE: BR Application is started, BR offers call services now, you can log in.

```
username: ***
password: ***

*** You are now logged in with Factory access ***

BR)
```

1.2
MTS Platform Description

The MTS provides the interface between the mobile stations within the DIMETRA system and the rest of the system infrastructure. The MTS performs the following functions:

- Radio link formatting, coding, timing, framing, and error control
- Timing control supervision to mobile stations (Timing Advance)
- Radio link quality measurements (Signal Quality Estimate)
- Site to site frame synchronization
- Interface translation
- Switching functions between multiple base transceivers (radio carriers)
- Air Interface Encryption
- Local Site Trunking
- Operation, maintenance, and administration agent

There are three different versions of MTS:

- MTS LiTE – available in 400 MHz and 800 MHz versions.
- MTS 2 – available in 260 MHz, 400 MHz, 800 MHz and 900 MHz versions.
- MTS 4 – available in 260 MHz, 400 MHz, and 800 MHz versions.

MTS LiTE is the smallest of the three versions and supports one Base Radio. MTS 2 is the middle size version of the MTSs and supports from one to two Base Radios. MTS 4 is the largest of the three versions and supports from one to four Base Radios. The MTS 4 Expansion cabinet supports up to 4 additional Base Radios.

You build up MTS LiTE, MTS 2, and MTS 4 inside cabinets. The MTS cabinets contain card cages. The same card cage is used in MTS 2 and MTS 4 while a separate card cage type is used in MTS LiTE, which in turn house different configurations of modules, for example, Power Supply Units, Base Radios, and Site Controllers. These modules provide the MTSs functionality. The configuration and number of modules determine the MTSs functionality and capacity.

The three versions of MTS are, in general, similar in terms of functionality and the modules that they are comprised of. However, there are a number of important differences between them, which are highlighted in appropriate sections of this document.

The system infrastructures Network Management (NM) applications mange the MTSs. Communication between the MTSs and the NM applications takes place through E1 , X.21, or Ethernet link. Through this link, the NM applications can download new configuration files to the MTSs and receive alarm, event and performance statistics from them.

NOTICE: When an MTS LiTE is managed in TESS application, MTS 2 should be selected.

For information regarding Network Management configuration of the MTS, see the "MTS Site Object" sections of the *Zone Configuration Manager* manual and Online Help.

1.3 MTS LiTE Components

The MTS LiTE is comprised of the following components:

- A stainless steel and painted aluminum cabinet
- A removable (hingeless) front door
- A junction panel
- A filter section
- A 19 inch card cage
- Interface cabling
- Internal modules
- Cooling fans (optional)

NOTICE: MTS LiTE is available in 400 MHz and 800 MHz versions.

Figure 1: MTS LiTE Cabinet

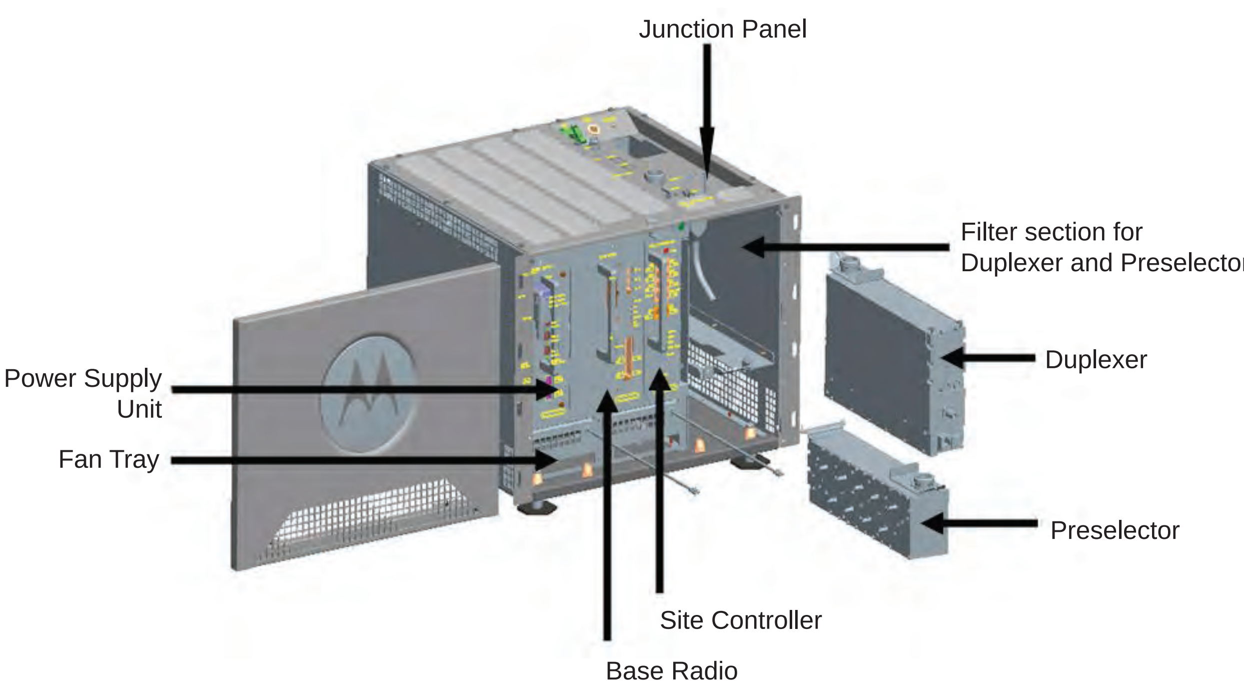


Table 2: MTS LiTE Cabinet

Callout Number	Description
1	Junction Panel
2	Filter section for Duplexer and Preselector

Callout Number	Description
3	Duplexer
4	Preselector
5	Site Controller
6	Base Radio
7	Fan Tray
8	Power Supply Unit

The modules that comprise a typical configuration MTS LiTE cabinet includes the following modules:

- Duplexer
- Preselector
- Site Controller
- Base Radio
- Power Supply Unit

The door of the cabinet has a lock to prevent unauthorized opening. Unauthorized opening of the door generates an alarm.

For a complete description of each module, refer to the appropriate chapter. Each chapter provides the theory of operation, a description of switches, indicators and connectors, and FRU replacement procedures for each module. Configuration and testing, and troubleshooting for MTSs are provided in separate chapters.

1.4
MTS 2 Components

The MTS 2 is comprised of the following components:

- A stainless steel and painted aluminum cabinet
- A removable (hingeless) front door
- A junction panel
- A filter section
- A 19 inch card cage
- Interface cabling
- Internal modules
- Cooling fans (optional)

NOTICE: MTS 2 cabinet is available in 260 MHz, 400 MHz, 800 MHz and 900 MHz versions.

Figure 2: MTS 2 Cabinet

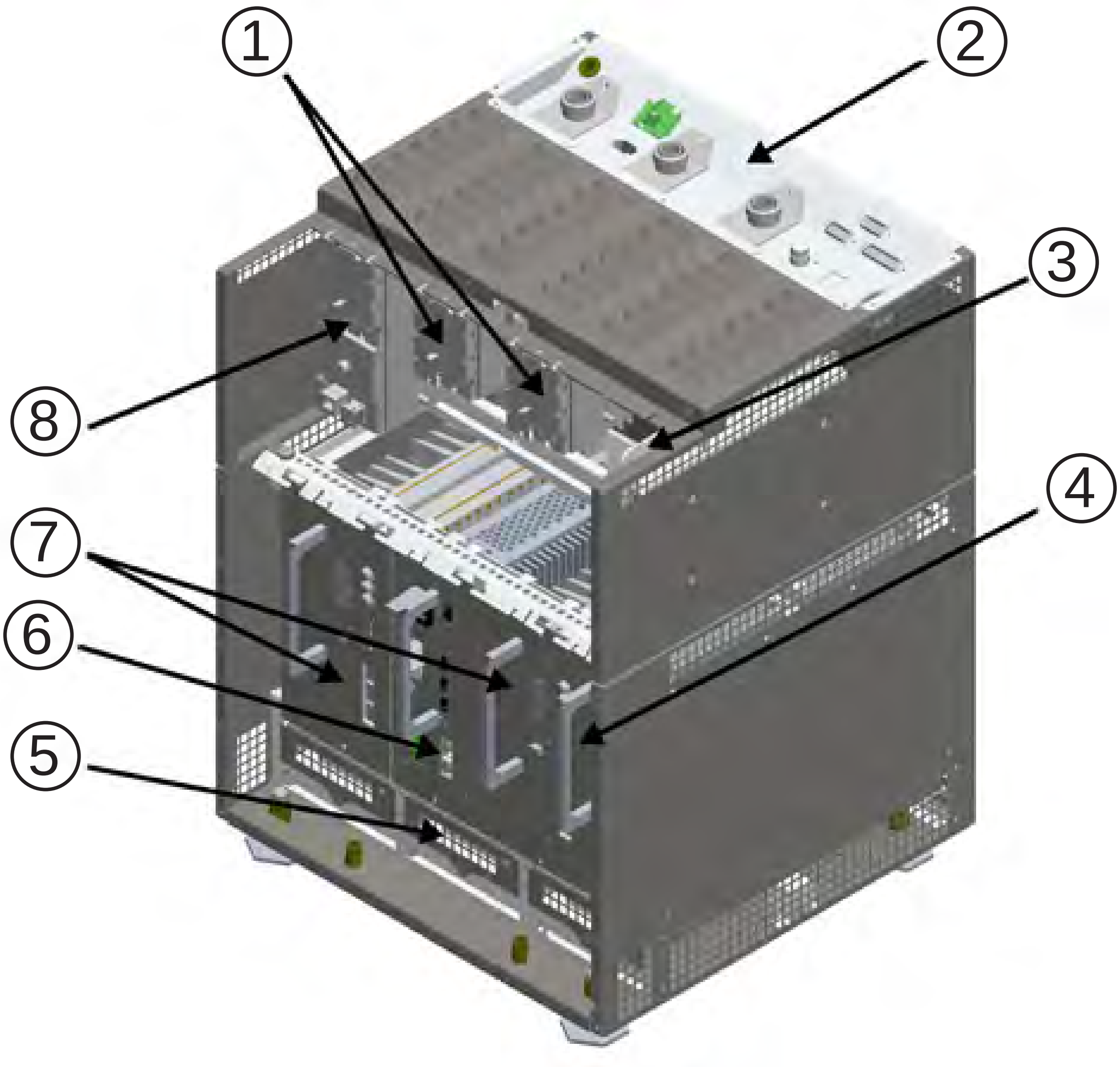


Table 3: MTS 2 Cabinet

Callout Number	Description
1	Preselectors
2	Junction Panel
3	HC
4	TSC
5	Fan Tray

Callout Number	Description
6	PSU
7	BRs
8	Duplexer

The modules that comprise the MTS 2 cabinet vary based on the type of configuration chosen. A typical configuration includes the following modules:

- Duplexer
- Preselector
- Hybrid Combiner
- Site Controller
- Base Radio(s)
- Power Supply Unit

The door of the cabinet has a lock to prevent unauthorized opening. Unauthorized opening of the door generates an alarm.

For a complete description of each module, refer to the appropriate chapter. Each chapter provides the theory of operation, a description of switches, indicators and connectors, and FRU replacement procedures for each module. Configuration and testing, and troubleshooting for MTSs are provided in separate chapters.

1.5
MTS 4 Components

The MTS 4 consists of the following components:

- Stainless steel and painted aluminum cabinet
- Removable front door opening to left or right
- A junction panel
- Filter section
- Combiner section
- One or two 19-inch card cages
- Interface cabling
- Internal modules
- Cooling fans

MTS 4 cabinet is available in 260 MHz, 400 MHz, and 800 MHz versions.

Figure 3: MTS 4 Cabinet

Table 4: MTS 4 Cabinet

Callout Number	Description
1	Antenna Connectors
2	Junction Panel
3	Filter Section
4	Cavity Combiners
5	BRs
6	PSU
7	SC

Callout Number	Description
8	Fan Tray
9	BRs
10	PSU
11	SC
12	Fan Tray

The modules that comprise the MTS 4 cabinet vary based on the type of configuration chosen. A typical configuration includes the following modules:

- Duplexer
- Preselector
- Post Filter
- Cavity Combiner
- Site Controller
- Base Radios
- Power Supply Unit

The cabinet door has a lock that prevents non-permitted access and that generates an alarm if unauthorized door opening occurs.

1.6 Expansion Cabinet Components

The Expansion Cabinet is comprised of the following components:

- A stainless steel and painted aluminum cabinet
- A front door opening to the left or right and removable
- A junction panel with AC/DC input
- A filter section (by default only splitters mounted)
- A combiner section
- 1 or 2, 19 inch card cages
- Interface cabling
- Internal modules
- Cooling fans

Figure 4: MTS Expansion Cabinet

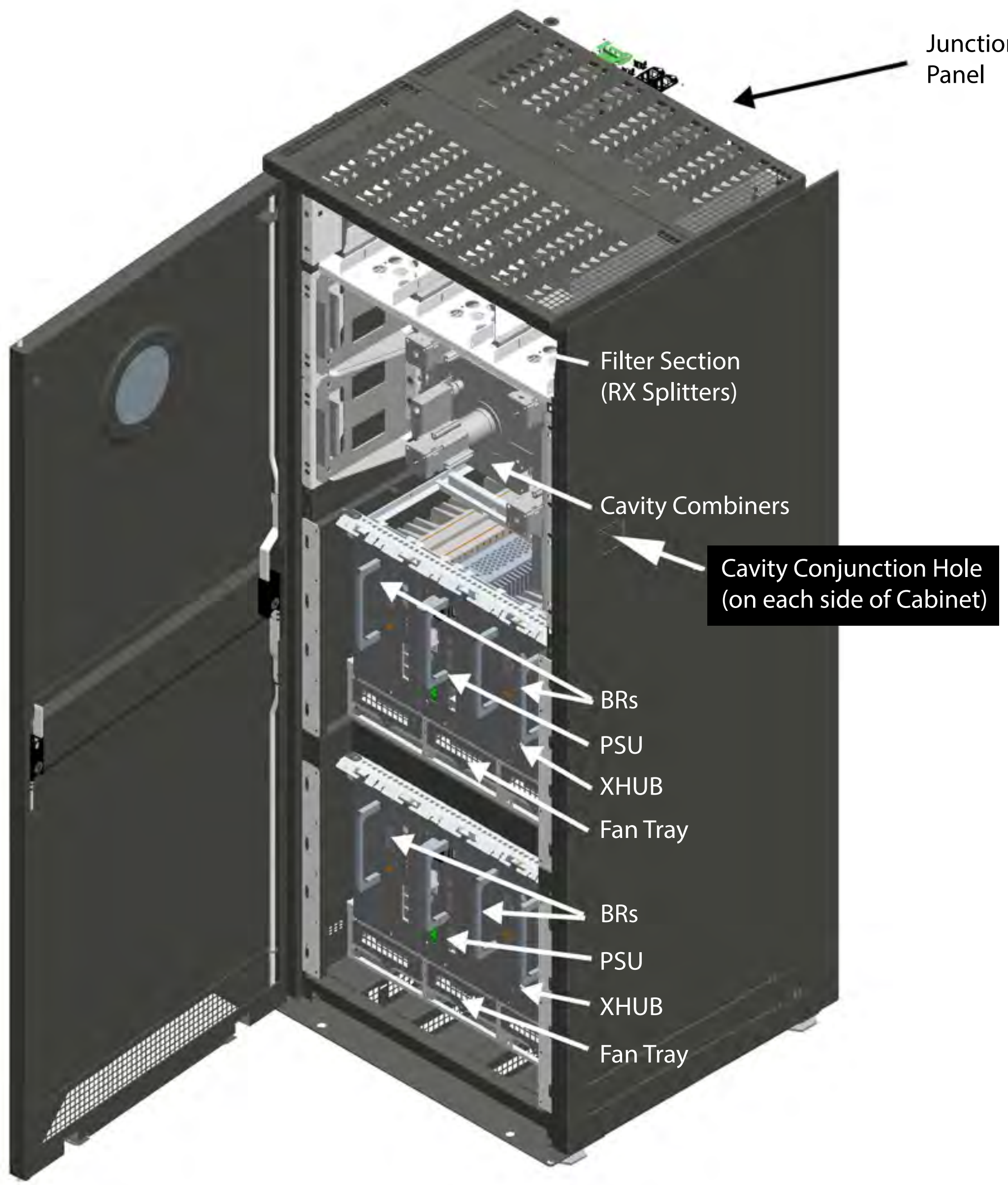


Table 5: MTS Expansion Cabinet

Callout Number	Description
1	Junction Panel
2	Filter Section (RX Splitters)
3	Cavity Combiners
4	Cavity Conjunction Hole (on each side of Cabinet)
5	BRs
6	PSU

Callout Number	Description
7	XHUB
8	Fan Tray
9	BRs
10	PSU
11	XHUB
12	Fan Tray

The modules that comprise the Expansion Cabinet vary based on the type of configuration chosen. A typical configuration includes the following modules:

- RX Splitter(s)
- Cavity Combiner(s)
- eXpansion HUB (XHUB)
- Base Radios
- Power Supply Unit(s)

The door of the cabinet has a lock to prevent unauthorized opening. Unauthorized opening of the door generates an alarm.

For a complete description of each module, refer to the appropriate chapter. Each chapter provides an overview, a description of switches, indicators and test connectors, and a functional description of each module. Troubleshooting and removal/replacement procedures are also included for modules having Field Replaceable Units (FRUs).

1.7 MTS Modules

Each MTS comprises of a number of modules. Some of these modules consist of subcomponents.

MTS modules include:

- RF Distribution System (RFDS) module
- RF Filter module
- Site controller module
- XHUB module
- Base Radio module
- Power supply module
- Cooling fans module

1.7.1 RF Distribution System

The RF Distribution System (RFDS) module has the following subcomponents:

- Preselector (MTS LiTE, MTS 2 and MTS 4 prime only)
- Duplexer (MTS LiTE, MTS 2 and MTS 4 prime only)
- Post Filter (MTS 4 prime only)
- Cavity Combiners (CC) (MTS 4 and Expansion Cabinet only)

- Hybrid Combiner (HC) (MTS 2 and MTS 4 Prime Cabinet only)
- Rx Splitter (Expansion Cabinet Only)

NOTICE: The Preselector types and Duplexer types used in MTS LiTE and MTS 2 are different from the types used in MTS 4.

1.7.1.1
Preselector

The Preselector is a bandpass filter, which allows only the receiver signals to pass. The Preselector incorporates a Receiver Multicoupler (RMC).

For 400 MHz, the filters bandwidth is 5 MHz, and it is designed to block transmitter frequencies as close as 5 MHz from its band edges.

Table 6: Preselector Filter Bandwidth

MTS Frequency	Bandwidth	Description
260 MHz	6 MHz	Designed to block transmitter frequencies as close as 6 MHz from its band edges.
400 MHz	5 MHz	Designed to block transmitter frequencies as close as 5 MHz from its band edges.
800 MHz	19 MHz	Designed to block transmitter frequencies as close as 19 MHz from its band edges.
900 MHz	5 MHz	Designed to block transmitter frequencies as close as 5 MHz from its band edges.

1.7.1.2
Duplexer

The Duplexer consists of two bandpass filters. One filter allows the transmitter signal to pass, while the other filter allows the receiver signal to pass.

The Duplexer incorporates both a Receiver Multicoupler (RMC) and a Digital Power Meter (DPM).

The following table describes filter bandwidth depending on the MTS frequency.

Table 7: Duplexer Filter Bandwidth

MTS Frequency	Bandwidth	Duplex Spacing
260 MHz	6 MHz	Duplex spacing between a transmitter frequency and the corresponding receive frequency is 9 MHz.
400 MHz	5 MHz	Duplex spacing between a transmitter frequency and the corresponding receive frequency is 10 MHz, with the

MTS Frequency	Bandwidth	Duplex Spacing
		transmitter frequency being higher.
800 MHz	19 MHz	Duplex spacing between a transmitter frequency and the corresponding receive frequency is 45 MHz.
900 MHz	5 MHz	Duplex spacing between a transmitter frequency and the corresponding receive frequency is 15 MHz.

1.7.1.3
Post Filter

A Post Filter consist of one bandpass filter which allows the transmitter signal to pass. The Post Filter supports non-duplexed configurations and incorporates a Digital Power Meter (DPM).

A Post Filter is only available for the MTS 4 as MTS LiTE and MTS 2 do not support non-duplexed configurations.

1.7.1.4
Cavity Combiners

A Cavity Combiner combines RF signal from a number of different base radios into one transmitter filter.

The following Cavity Combiner (CC) are available:

- Auto Tune Cavity Combiners (ATCC)
- Manual Tune Cavity Combiners (MTCC)

MTCCs are functionally the same as ATCCs except that they are tuned manually instead of electronically.

NOTICE: 260 MHz configurations do not support MTCC.

MTS LiTE and MTS 2 do not support Cavity Combiners.

Minimum channel spacing of the TX channels is 150 kHz while the recommended channel spacing is 250 kHz. This limitation applies to all Cavity Combiners in all cabinets connected to the same transmit antenna.

1.7.1.5
Hybrid Combiner

A Hybrid Combiner combines RF signal from a number of different base radios into one transmitter filter.

The Hybrid Combiner (HC) combines up to two transmitters.

The combiner has no limitations in respect to channel spacing of the TX channels. However, for frequency planning and interference reasons, at least 50 kHz is recommended.

NOTICE: MTS LiTE does not support Hybrid Combiners.

The following table shows the frequency range covered by various Hybrid Combiners.

Table 8: Hybrid Combiner — Frequency Range

Hybrid Combiner	Frequency Range
260 MHz	260 MHz — 275 MHz
400 MHz	350 MHz — 470 MHz
800 MHZ	850 MHz — 870 MHz
900 MHz	932 MHz — 942 MHz

1.7.1.6 Rx Splitter

The RX splitter is a passive device, receiving the signal from the Expansion Out connector of the Duplexer/Preselector in the MTS 4 Prime Cabinet and then distributes it to the Base Radios in the MTS 4 Expansion Cabinet.

1.7.2 Site Controller Module

The Site Controller (SC) controls resources within the base station, including frequency and slot assignment to mobile stations. The Site Controller incorporates a Global Positioning System (GPS), which receives signals for developing high-precision system timing signals.

The Site Controller communicates with the Base Radio through the 100Base-T Ethernet interface and with the network through an X.21 or E1 link.

1.7.3 XHUB

The eXpansion HUB (XHUB) is a non-intelligent switching and interface module, which plugs into the Site Controller slot of an MTS 4 Expansion Cabinet. It is connected through the Expansion Cab output of the Site Controller to the Prime Cab connector of the XHUB.

1.7.4 Base Radio Module

The Base Radio (BR) provides reliable digital communication capabilities. Each Base Radio contains the following subcomponents:

- Transceiver
- Power Amplifier (PA)

1.7.4.1 Base Radio Transceiver

The transceiver provides the BRs with signal transmission, receiving, processing, and modulation functions, incorporating a Base Radio Controller (BRC), Receiver (RCV), and Exciter (EXC).

The BRC serves as the main controller of the Base Radio, and provides signal processing and operational control for the other Base Radio modules.

1.7.4.2 Base Radio Power Amplifier

The Power Amplifier (PA) in conjunction with the exciter provides the transmitter functions for the Base Radio. The PA accepts the low-level modulated RF signal from the exciter and amplifies the signal for transmission through the RF output connector.

1.7.5 Power Supply Unit

Depending on the configuration, the MTS includes one or two Power Supply Units (PSUs).

The PSU allows the MTS to operate in any of the following configurations:

- DC power supply
- AC power supply
- AC power supply with a DC backup battery

1.7.5.1 Backup Battery

The PSU handles the automatic switchover to a backup battery in the event of an AC power supply failure. The MTS charges the backup battery during normal AC operation. A temperature sensor monitors the backup batteries temperature to ensure optimum charging.

NOTICE: The recommended batteries to be used are a Valve Regulated Lead Acid (VRLA) recombination type, with -48 VDC nominal. Such as Enersys Power safe VFT type.

1.7.6 Cooling Fans

One or more fan modules generate an airflow through the MTS cabinets to manage their temperature. Each module is comprised of two fans. Revolution of the fans is monitored by a sensor. In the event of a failure, an alarm will be generated.

NOTICE: Low-power configurations of MTS LiTE and MTS 2 can be operated without cooling fans.

Chapter 2

General Safety

This chapter summarizes the safety-related information that you should both understand and observe when working with Motorola Transceiver Stations (MTS). In addition to the information contained in this chapter, additional safety-related information can be found in other parts of the document.

IMPORTANT: This is not an exhaustive list of all the precautions and safety measures. Before carrying out any task with the MTS or associated equipment, implement all local and site safety measures.

For full instructions and guidelines, see the *Motorola Standards and Guidelines for Communications Sites, R56* document.

2.1
General Safety Precautions

WARNING: During thunder storms, do not service any base station or infrastructure items.

WARNING: Any device (for example, a power supply) providing isolation between the mains and the MTS must provide reinforced insulation to hazardous voltages. The DC power source providing power to the MTS must comply with requirements specified for a safety extra low voltage circuit (SELV) per EN60950.

WARNING: To reduce the risk of injury, use appropriate equipment and number of personnel whenever moving an MTS cabinet.

WARNING: The MTS Service Manual is intended for trained technicians experienced with Motorola Solutions Base Radio equipment or similar types of equipment.

WARNING: Use extreme caution when wearing a conductive wrist strap near sources of high voltage. The low impedance provided by the wrist strap also increases the danger of lethal shock should through accidental contact with high-voltage sources.

WARNING: Ensure that all power to the power supply equipment is off to prevent accidental contact with high energy and injury to personnel.

WARNING: RF energy burn hazard. Disconnect power in the MTS cabinet to prevent injury and equipment damage while disconnecting and connecting antennas.

WARNING: 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.

WARNING: If cooling fans are fitted, they are exposed after removing the modules from the rack. Touching the running fans poses an injury risk.

WARNING: Do not key the base station without a proper load. Risk of burn incidents and damage to the MTS base station.

CAUTION: Provides a short circuit protection closest to the batteries in the battery installation.

CAUTION: To prevent damage of the MTS modules by static discharge, always wear the ESD strap when servicing the MTS equipment.

CAUTION: Ground all antennae cables at the point that they enter the building.

CAUTION: Antenna design is the customers responsibility. All aspects of antenna design must comply with the relevant local regulations.

CAUTION: Familiarize yourself with Man-Machine Interface (MMI) commands and their usage before performing procedures in this documentation. Improperly applying MMI commands can result in equipment damage.

CAUTION: Do not attempt to make a resistance check of the GPS antenna, as it may result in damage to the active devices within the antenna element.

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

CAUTION: Do not key any Base Radio with the Signal Generator directly connected to a Tx antenna port as it damages a generator.

CAUTION: Some commands executed during Conformance Testing bypass normally available alarms and protection associated with the normal MTS operation. Therefore, adhere to all cautionary information and follow instructions exactly as in the procedures.

CAUTION: The MTS site must meet certain specifications for adequate protection from lightning induced transients. See the *Motorola Standards and Guidelines for Communications Sites, R56* manual.

CAUTION: The Site Controller motherboard contains a lithium battery. See local regulatory requirements for proper battery disposal.

IMPORTANT: Install the MTS in restricted access locations, as defined in EN/IEC 60950-1. Only the service personnel or users with appropriate technical experience and training can use the MTS.

IMPORTANT: Connect the MTS to earth and power it from a 100 V/240 VAC primary power source, or a -48 VDC secondary power source.

IMPORTANT: The batteries should be installed in the same building and properly ventilated.

2.2

Compliance Guidelines and Safety Precautions

FCC/ISED Compliance Guidelines

WARNING: Compliance with FCC/ISED guidelines for human exposure to Electromagnetic Energy (EME) at Transmitter Antenna sites generally requires that personnel working at a site must be aware of the potential for exposure to EME, and can exercise control of exposure by appropriate means, such as adhering to warning sign instructions, using standard operating procedures (work practices), wearing personal protective equipment, or limiting the duration of exposure. For more details and specific guidelines, see “Appendix A: Electromagnetic Energy Information” of the Motorola Solutions *Standards and Guidelines for Communication Sites* manual.

Notice to Users (Industry Canada)

The operation of your Motorola Solutions radio is subject to the Radiocommunications Act and must comply with rules and regulations of the Federal Government's department of Industry Canada. Industry Canada requires that all operators using Private Land Mobile frequencies obtain a radio license before operating their equipment.

Installation guidelines for compliance with RF exposure regulations

This equipment must be installed and operated at a fixed location, in compliance with all applicable code requirements. The antenna installation must comply with all applicable building and safety codes.

In order to ensure optimal communication performance and compliance with applicable RF exposure limits, it is recommended that the antenna is installed outside the building hosting this equipment, on the roof or on a tower if at all possible.

It is the licensee or site owner responsibility to establish an RF exposure safety program meeting the applicable regulatory requirements concerning RF exposure of working personnel and the general public, implementing actions such as site survey measurements and computational analysis, signage and barriers, site access restrictions, as needed.

General safety precautions during all phases of operation, service, and repair

Observe the following general safety precautions during all phases of operation, service, and repair of the equipment described in this manual. Follow the safety precautions listed and all other warnings and cautions necessary for the safe operation of all equipment. Due to the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modifications of equipment.

NOTICE: The installation process requires preparation and knowledge of the site before installation begins. Review installation procedures and precautions in the Motorola Solutions *Standards and Guidelines for Communication Sites* manual before performing any site or component installation.

Always follow all applicable safety procedures, such as Occupational Safety and Health Administration (OSHA) requirements, National Electrical Code (NEC) requirements, local code requirements, and safe working practices. Also, all personnel must practice good judgment. General safety precautions include the following:

- 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.
- If troubleshooting the equipment while power is on, be aware of the live circuits.
- Do not operate the radio transmitters unless all RF connectors are secure and all connectors are properly terminated.
- Ground all equipment properly in accordance with the Motorola Solutions *Standards and Guidelines for Communication Sites* manual and specified installation instructions for safe operation.
- Slots and openings in the cabinet are provided for ventilation. Do not block or cover openings that protect the devices from overheating.
- Only a qualified technician familiar with similar electronic equipment should service equipment.
- Some equipment components can become hot during operation. Turn off all power to the equipment and wait until sufficiently cool before touching.
- Maintain emergency first aid kits at the site.
- Direct personnel to call in with their travel routes to help ensure their safety while traveling between remote sites.
- Institute a communications routine during certain higher risk procedures where the on-site technician continually updates management or safety personnel of the progress so that help can be dispatched if needed.
- Never store combustible materials in or near equipment racks. The combination of combustible material, heat, and electrical energy increases the risk of a fire safety hazard.
- Equipment installed at the site meeting the requirements of a "restricted access location," per UL60950-1, is defined as follows: "Access can only be gained by service persons or by a user who has been warned about the possible burn hazard on equipment metal housing. Access to the equipment is by using a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location."

WARNING: Burn hazard. The metal housing of the product may become extremely hot. Use caution when working around the equipment.

Figure 5: Warning Label on Hot Modules

WARNING: DC input voltage must be no higher than 60 VDC. This maximum voltage includes consideration of the battery charging "float voltage" associated with the intended supply system, regardless of the marked power rating of the equipment. Failure to follow this guideline may result in electric shock.
RF energy burn hazard: disconnect power in the cabinet to prevent injury while disconnecting and connecting antennas.

CAUTION: All Tx and Rx RF cables outer shields must be grounded per Motorola Solutions *Standards and Guidelines for Communication Sites* manual requirements.
All Tx and Rx RF cables must be connected to a surge protection device according to the Motorola Solutions *Standards and Guidelines for Communication Sites* manual. Do not connect Tx and Rx RF cables directly to an outside antenna.

IMPORTANT: All equipment must be serviced by Motorola Solutions-trained personnel.

2.3 Mains Safety Precautions

This section contains information specifically related to mains safety when working with or operating MTS.

WARNING: Hazardous mains voltages exist within the power supply of the MTS. This module is not designed for field service. Depot servicing must include appropriate precautions when fault finding this switch-mode power supply.

2.4 Battery Safety Precautions

This section contains information specifically related to safety when working with, or operating the MTS batteries.

CAUTION: To prevent injury or burns, when replacing a Lithium battery, do not allow metal objects to come in contact with the battery terminals.

CAUTION: Harmful gases may be generated by the battery backup. Battery backup should only be operated in well ventilated areas.

WARNING: Batteries used for powering equipment pose the following risks:

- Explosion hazard resulting from inherent generation of hydrogen sulfide gas.
- Chemical burns/blindness resulting from sulfuric acid electrolyte.
- Very high current capabilities, with the possibility to burn, start fires, and result in arcing.

WARNING: Special precautions are required when handling batteries:

- To avoid spilling acid, do not tip batteries.
- Battery acid can cause severe burns and blindness if it comes into contact with skin or eyes. Wash affected skin or eyes immediately with running water. Seek medical help immediately.
- Jewelry should not be worn while working with batteries.
- Installation personnel should wear necessary safety equipment when installing batteries.
- Batteries may require two-person lift. Use proper lifting techniques and equipment to avoid injury. Insulated tools should be used when installing battery systems.

Chapter 3

Site Preparation

Before performing the MTS installation tasks, various considerations such as site planning or environmental requirements need to be taken into account.

3.1 Site Planning

Proper planning helps to prevent potential on-site and off-site interference from other RF systems, and helps maximize system performance. To minimize the cabling lengths between RF equipment, plan site layouts.

For full instructions and guidelines, see the *Motorola Standards and Guidelines for Communications Sites, R56* manual.

3.1.1 Site Survey

To place an order for the equipment, inspect or survey the site carefully using appropriate site survey forms before orders are placed for the equipment.

Plan for a participation of a technical representative from both the customer and the site owner in the survey.

To minimize any misunderstanding that may arise in the future, ensure that:

- all the attendees at the site survey approve the survey report
- you address all relevant issues for the MTS site installation
- all involved parties agree to all issues before any work starts.

The site survey issues typically include the following items:

- Potential MTS cabinet location, the equipment room size, and the doorway or access into it (including clearance for front door opening).
- Suitability of the existing heating-ventilation-air conditioning (HVAC) and other environmental criteria in relation to the MTS equipment (see Table 12: Typical Power Loads and Heat Dissipation Values – Expansion Cabinet 400 MHz BR-Arch-1 Configuration on page 80).
- Power requirements
- Check of the history of local voltage and frequency variations together with the possibility of supply interruptions to the site
- Stand-by power requirements for the site.
- Mains power distribution location
- Network terminating unit (NTU) for the Ethernet, X.21, or E1 leased line location
- Telephone connections location.
- Building earth and tower earth locations
- Building and tower earth inspection
- Cable entry point into the equipment room suitability, space availability, and location
- Existing lightning arrestors suitability and location

- Suitability, space availability, and location of the existing cable tray or ladder rack between the equipment room and the antenna tower or the antenna system support structure.
- Cable access route into the equipment room check
- Type of tower and the type of structure on which the GPS antenna will be mounted

3.1.2
Site Selection Considerations

Design the MTS site building to meet the requirements of any local building codes, and relevant regulations, applicable to the site location.

Motorola Solutions recommends the following considerations when selecting a site:

- For front access, stations allow only a minimum of 80 cm for access.
- The ceiling structure is able to support a cable tray assembly for routing the inter-cabinet cabling and other site cabling. The cable tray assembly is mounted to the site ceiling and walls per site plan.
- Room door dimensions:
  - MTS LiTE or MTS 2 cabinet transported on wooden pallet needs 86 cm width/without wooden pallet 59 cm
  - MTS 4 and Expansion cabinet transported on wooden pallet needs 86 cm width/without wooden pallet 68 cm
- MTS operating temperature:
  - MTS LiTE 400 MHz without fans: -30 °C to +55 °C
  - MTS LiTE 400 MHz with fans: -30 °C to +60 °C
  - MTS LiTE 800 MHz (always fans): -30 °C to +60 °C
  - MTS 2 260 MHz and 400 MHz without fans: -30 °C to +55 °C
  - MTS 2 400 MHz with fans: -30 °C to +60 °C
  - MTS 2 800 MHz (always fans): -30 °C to +60 °C
  - MTS 2 900 MHz (always fans): -30 °C to +60 °C
  - MTS 4 260 MHz and 400 MHz (always fans): -30 °C to +60 °C
  - MTS 4 800 MHz (always fans): -30 °C to +55 °C

  Maintain the site interior temperature within these limits. Maintaining a stable, moderate site temperature is the best approach for long-term reliability of the equipment.
- Mains socket outlet is available next to the MTS for the powering of test equipment. This mains outlet must be on the same electrical phase as the MTS supply.
- Proximity of a railway track: the MTS installation requires at least 3 meters distance from the center of the track.
- Consider the floor loading. See Dimensions of the MTS Cabinets on page 431.

NOTICE:
To prevent potential damage to the MTS, install proper surge protection on E1/Ethernet/X.21 site links, all antennas, and power inputs. For more information, see Surge Arrestors and Suppliers on page 488.

For full instructions and guidelines, see the *Motorola Standards and Guidelines for Communications Sites, R56* manual.

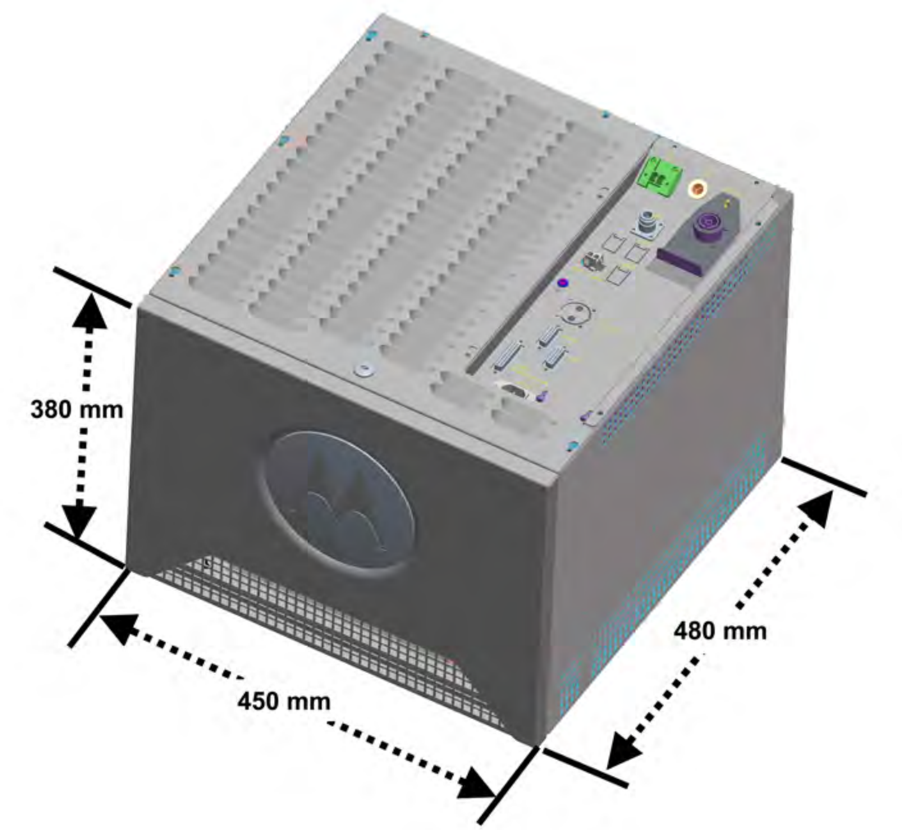
3.2
Cabinets Installation Considerations

The equipment cabinets are not approved or intended for outdoor use.

3.2.1
MTS LiTE Cabinet Considerations

The equipment cabinet dimensions are: 450 mm (width)/480 mm (depth)/380 mm (height) as shown in the following figure.

Figure 6: MTS LiTE Cabinet Dimensions



The equipment cabinet may be installed against adjacent equipment, however the following minimal distances must be retained:

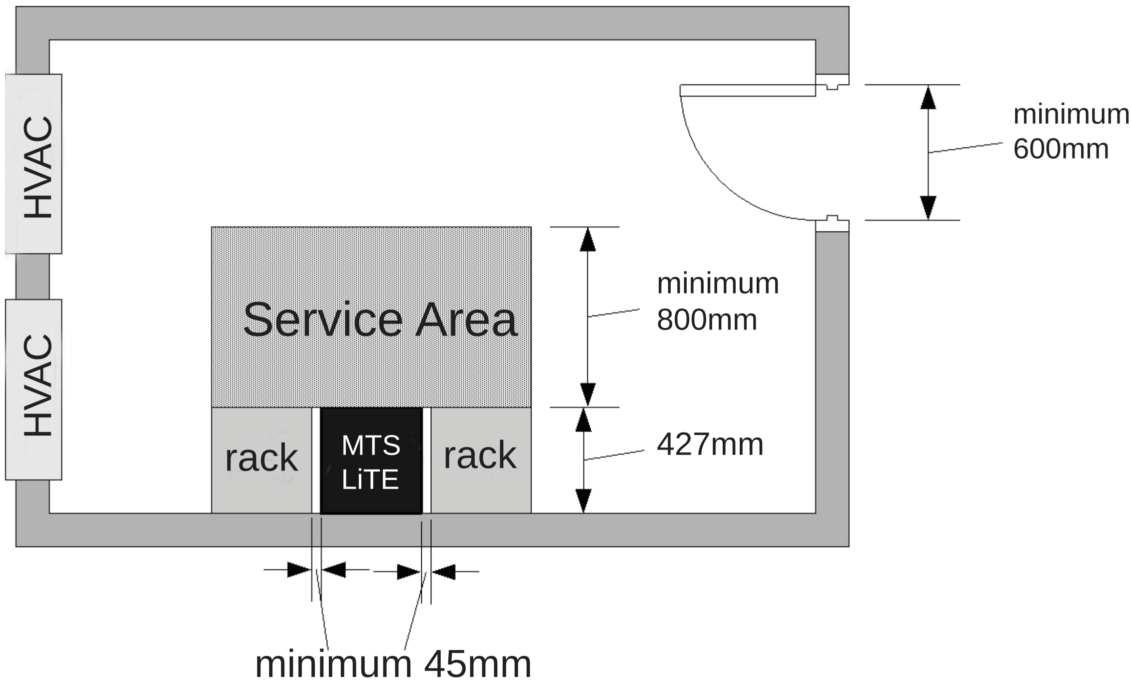
- 45 mm on both sides of the cabinet
- 800 mm of free space in front of the cabinet

The cabinet front door is removable. Figure 7: Suggested MTS LiTE Site Layout on page 66 shows the cabinet layout within a suggested site. Additional free space is recommended at the front of the cabinet to allow the service personnel to access the equipment easily.

CAUTION: To enable service access and assure the passive cooling ventilation, the free space above the cabinet must be at least 20 cm. The antenna cabling may require additional space.

NOTICE: Enable the opening of all doors to the equipment room to at least 90 degree. The cabinet has a removable door.

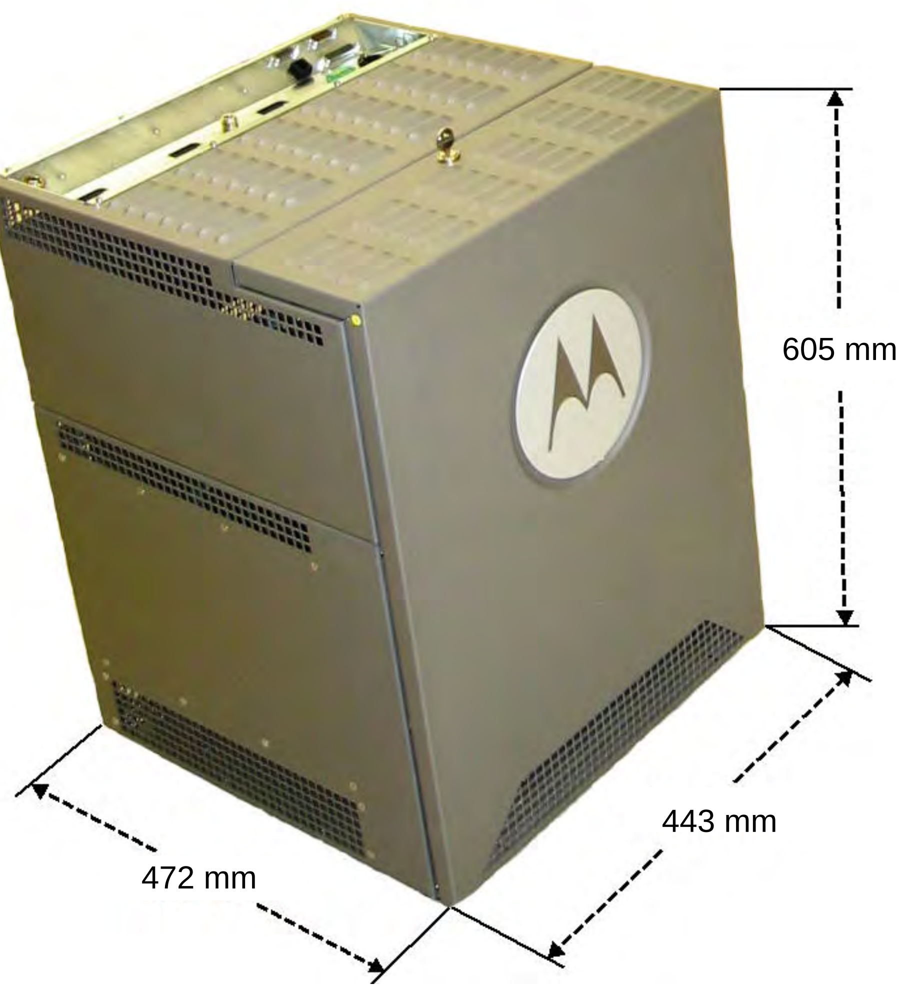
Figure 7: Suggested MTS LiTE Site Layout



3.2.2
MTS 2 Cabinet Considerations

The equipment cabinet dimensions are: 443 mm (width)/472 mm (depth)/605 mm (height) as shown in the following figure.

Figure 8: MTS 2 Cabinet Dimensions



The equipment cabinet may be installed against adjacent equipment, however the following minimal distances must be retained:

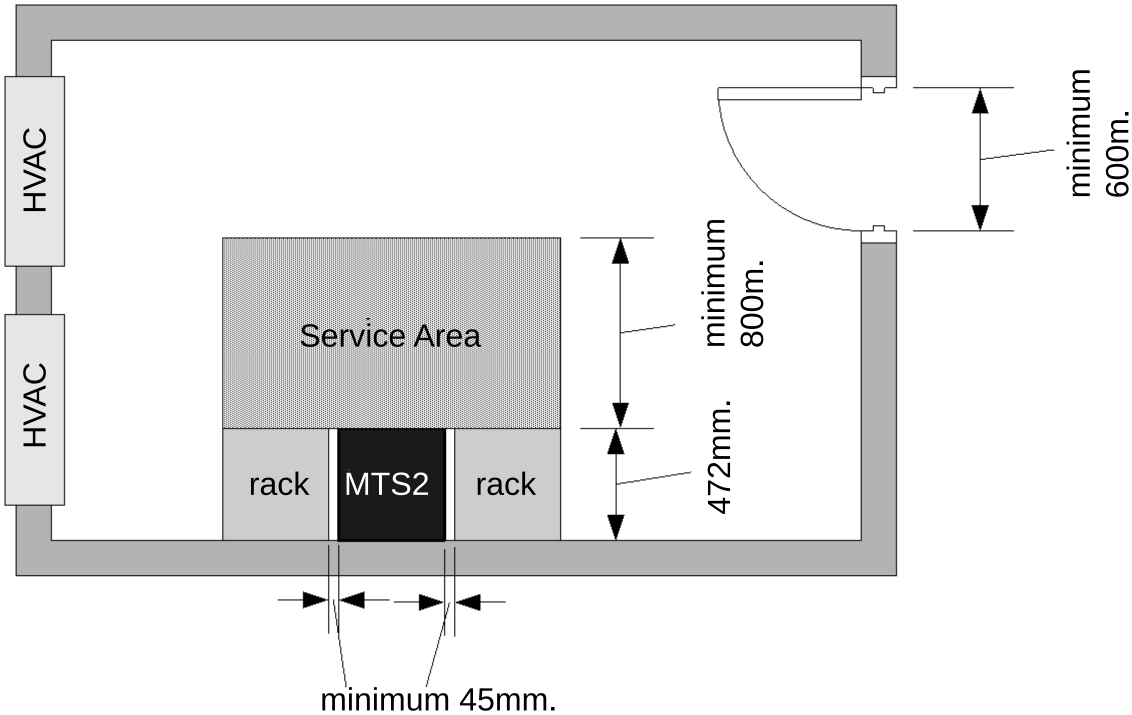
- 45 mm on both sides of the cabinet
- 800 mm of free space in front of the cabinet

The cabinet front door is removable. Figure 9: Suggested MTS 2 Site Layout on page 68 shows the cabinet layout within a suggested site. Additional free space is recommended at the front of the cabinet to allow the service personnel to access the equipment easily.

CAUTION: To enable service access and assure the passive cooling ventilation, the free space above the cabinet must be at least 20 cm. The antenna cabling may require additional space.

NOTICE: Enable the opening of all doors to the equipment room to at least 90 degree. The cabinet has a removable door.

Figure 9: Suggested MTS 2 Site Layout



3.2.3

MTS 4 Cabinet Considerations

The equipment cabinet dimensions are: 550 mm (width)/570 mm (depth)/1430 mm (height) as shown in the following figure.

Figure 10: MTS 4 Cabinet Dimensions

The equipment cabinet may be installed against adjacent equipment, however the following minimal distances must be retained:

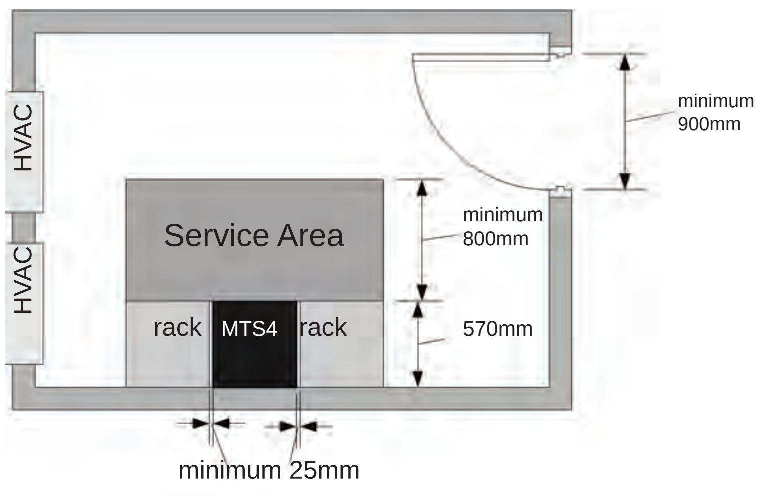
- 25 mm on both sides of the cabinet
- 800 mm of free space in front of the cabinet

The cabinet front door has hinges on both sides and it can be opened right, left, or removed. Figure 11: Suggested MTS 4 Site Layout on page 70 shows the cabinet layout within a suggested site. Additional free space is recommended at the front of the cabinet to allow service personnel easy access to the equipment.

CAUTION: To enable service access and assure the passive cooling ventilation, the free space above the cabinet must be at least 20 cm. The antenna cabling may require additional space.

NOTICE: Enable the opening of all doors to the equipment room to at least 90 degree. The cabinet has a removable door.

Figure 11: Suggested MTS 4 Site Layout



3.2.4

Expansion Cabinet Considerations

The Expansion Cabinet dimensions are: 550 mm (width)/570 mm (depth)/1430 mm (height) as shown in the following figure.

Figure 12: Expansion Cabinet Dimensions

The equipment cabinet may be installed against adjacent equipment, however the following minimal distances must be retained:

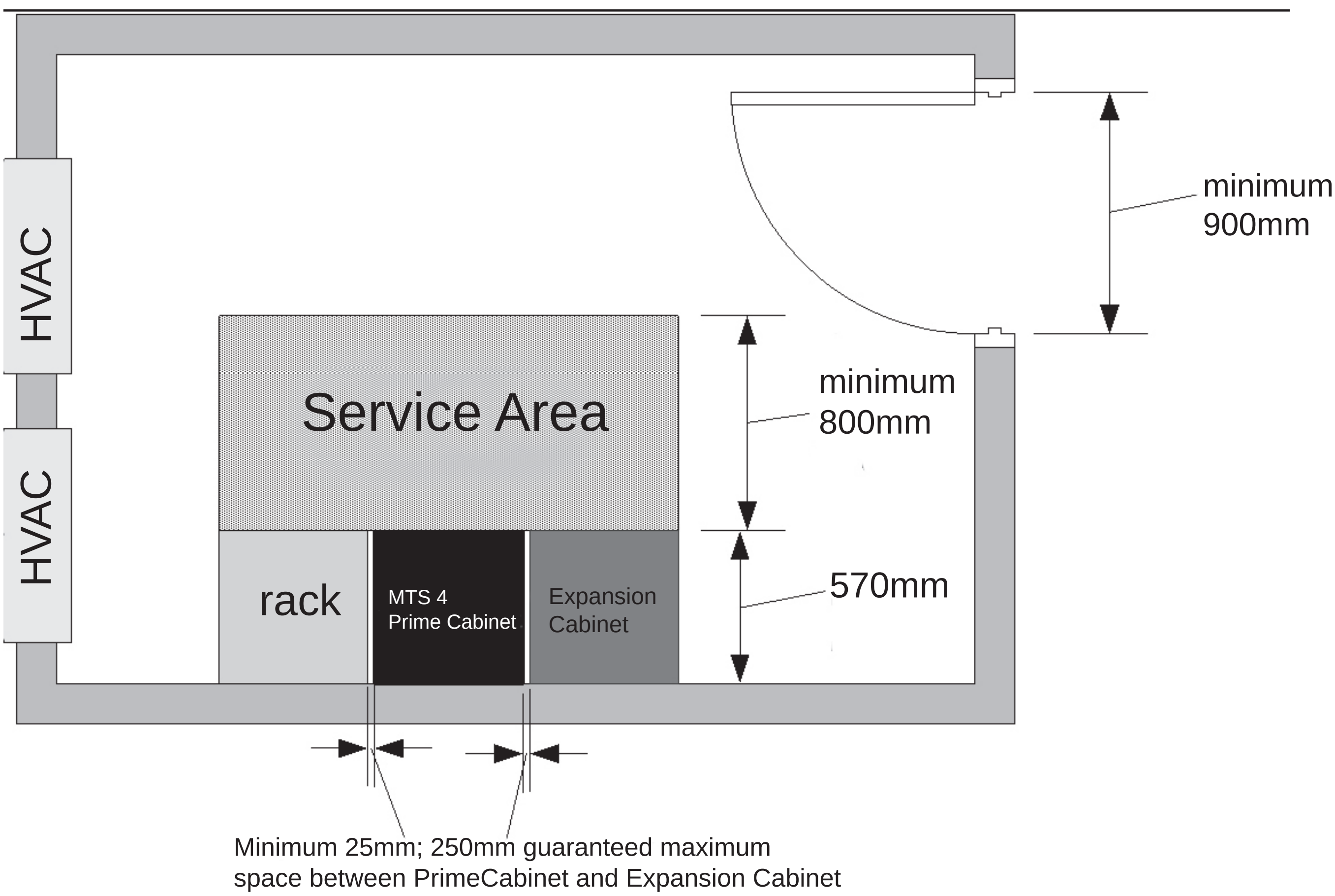
- 25 mm on both sides of the cabinet
- 800 mm of free space in front of the cabinet

The cabinet front door has hinges on both sides and it can be opened right, left, or completely removed. Figure 13: Suggested Expansion Cabinet Site Layout on page 72 shows the cabinet layout within a suggested site. Additional free space is recommended at the front of the cabinet to allow the service personnel to access the equipment easily.

CAUTION: To enable service access and assure the passive cooling ventilation, the free space above the cabinet must be at least 20 cm. The antenna cabling may require additional space.

NOTICE: Enable the opening of all doors to the equipment room to at least 90 degree. The cabinet has a removable door.

Figure 13: Suggested Expansion Cabinet Site Layout



NOTICE: Even though Figure 13: Suggested Expansion Cabinet Site Layout on page 72 illustrates the Expansion Cabinet to the right of the Prime Cabinet, the Expansion Cabinet can also be placed on either side of the Prime Cabinet.

WARNING: Only use RF Cable Harness provided by Motorola when connecting the Prime Cabinet to the Expansion Cabinet since cable length is critical.

3.3
Antenna Installation Considerations

When planning site for the RF system, consider proper antennas placement.

For full instructions and guidelines, see the *Motorola Standards and Guidelines for Communications Sites, R56* manual.

RF Antenna

Place the MTS equipment near to the existing cable tray or ladder rack for RF cabling.

GPS Antenna

Mount the GPS antenna below the tallest point on the tower, pole, or roof of the MTS site.

For systems in the northern hemisphere, mount the GPS antenna to maintain a clear view of the southern sky. For systems in the southern hemisphere, mount the GPS antenna to maintain a clear view of the northern sky.

For more information about GPS antenna installation and cabling, see GPS Antenna Connection on page 142.

NOTICE: Each MTS in the system must be configured for the same GNSS System.

Surge Arrestors

To prevent potential damage to the MTS, install proper surge protection on all antennas.

To transport lightning strikes away from the equipment, install the lightning arrestors.

Install a lightning rod on a different tower leg than the antenna.

See Surge Arrestors and Suppliers on page 488 for more information.

3.4
Network Interface Installation Considerations

Depending on local regulations, a surge arrestor may be required at the Ethernet, X.21, or E1 service entrance.

Choose a proper arrestor for operation with an Ethernet, X.21, or E1 circuit and wire it according to manufacturer instructions. The arrestor typically is only installed on the customer side of the Ethernet, X.21, or E1 service entrance.

See Surge Arrestors and Suppliers on page 488 section in Field Replaceable Units (FRUs) on page 478 for more information.

3.5
MTS Installation Special Considerations

Special considerations includes MTS installation considerations for electrical service access, hazardous materials, and seismic active areas.

Electrical Service Access

Adhere to the local electrical codes and regulations regarding clearance for electrical service access.

Hazardous Materials and Equipment

Compliance with all local and any other regulations concerning the handling and use of hazardous materials and equipment is the sole responsibility of the customer and associated agents.

Seismic Active Areas

The MTS operating in seismic active areas may require additional bracing of the equipment cabinet.

3.6
Environmental Considerations

When planning the MTS site, carefully consider the environment in which the MTS operates.

Temperature Considerations

Regulated the temperature in which the MTS operates to ensure trouble-free operation. Excessive temperatures result in generated heat that may reduce the life-span of the electronic equipment, and cause permanent damage.

It is recommended that the ambient temperature (at the air inlet) does not exceed 35 °C in normal operating conditions.

WARNING:
Ensure that no other objects cover the top of the MTS and leave at least 20 cm of clearance above the cabinet.

Ensure that no other objects cover the top of the MTS and leave at least 20 cm of clearance above the rack.

For exceptional conditions, the ambient temperature must not exceed the following thresholds:

- MTS LiTE 400 MHz (without fans): 55 °C
- MTS 2 260 MHz and 400 MHz (without fans): 55 °C
- MTS 4 800 MHz: 55 °C
- MTS LiTE 400 MHz (with fans): 60 °C
- MTS 2 400 MHz (with fans): 60 °C
- MTS 4 260 MHz and 400 MHz: 60 °C
- MTS LiTE 800 MHz (always with fans): 60 °C
- MTS 2 800 MHz (always with fans): 60 °C
- MTS 2 900 MHz (always with fans): 60 °C

NOTICE: The low-power MTS LiTE and MTS 2 cabinet use passive convection cooling. In high ambient temperatures or at high altitude, you can add fan modules.

Humidity Considerations

For humidity, MTS complies with ETSI norm EN300 019 13 Class 3.2.

At 30 °C, the relative humidity within the site should be between 5% and 95% non-condensing.

Operation in Corrosive Environment

Do not expose the equipment to corrosive environments. To protect the equipment from salt mist contamination in a coastal environment, provide proper air filtration for the site.

Air Quality Considerations

For cabinet-mounted equipment operating in an area without environmental control, the airborne particulates level must not exceed concentration defined in ETSI norm EN300 019 1-3 Class 3.

Salt mist like sea salt and road salt is excluded and shall always be avoided.

3.7 Electrical Requirements

WARNING: The DC power source providing power to the MTS must be compliant with requirements specified for a safety extra low voltage circuit (SELV) per EN60950.

WARNING: Any device (that is power supply) providing isolation between the AC mains and the MTS must provide reinforced insulation to hazardous voltages.

CAUTION: All electrical wiring for the MTS site must meet the requirements of all applicable local codes and regulations.

CAUTION: The battery installation needs a short circuit protection closest to the batteries.

Install the batteries in the same building and provide proper ventilation.

3.7.1 Applicable Codes and Practices

IMPORTANT: If other codes and practices are beneficial, see your local standards.

Adhere to the following list of selected codes and practices:

- *Motorola Standards and Guidelines for Communications Sites, R56* manual
- UK - RPSG Installation Manual, System Quality Standard, specification number 2200 and part number. 68P02200F01.
- UK - Institution of Engineering and Technology (IET) - BS 7671:2001 16th Edition Wiring Regulations (Appendix 12, Cable Capacities of Conduit and Trunking).
- UK - Antenna System Installation Practice, issued by The Directorate of Telecommunications of the UK Home Office.
- UK - Details of Earthing Requirements for Masts, Aerial Feeder Cables, and Radio Equipment Rooms, issued by The Directorate of Telecommunications of the UK Home Office.
- GERMANY - VDE0100 Errichten von Starkstromanlagen bis 1000 Volt.
- GERMANY - VDE0185 Blitzschutzanlagen.
- GERMANY - VDE0510 Akkumulatoren und Batterieanlagen.
- GERMANY - VDE0855 Antennenanlagen, Errichtung und Betrieb.

3.7.2 AC and DC Power Supplies

The MTS cabinet is equipped with a high efficiency switch mode Power Supply Unit (PSU).

Operating modes are as follows:

- DC only operation (within -41 VDC to -60 VDC)
- AC only operation (within 90 VAC to 264 VAC; 45 Hz to 66 Hz)

- AC operation (within 90 VAC to 264 VAC; 45 Hz to 66 Hz) and switch over to DC backup operation when AC failed

The PSU handles the automatic switch over to a backup battery in the event of AC mains failure.

CAUTION: An external disconnect device and appropriate 20A fuse are required on the DC power supply line.

CAUTION: If the DC input on the station is connected to back up batteries, an external Low Voltage Disconnect (LVD) device should be introduced directly in the power line in order to protect the batteries against deep discharge. On the MTS 2, one relay rated min. 20 A/55 VDC should be introduced. And for the MTS 4, two of these units should be used, one for each of the two incoming DC lines. Alternatively for the MTS 4, one relay rated 40 A/55 VDC can be used if the two DC lines are connected to one battery pack. The relays should be controlled in a way that they disconnect the batteries once the voltage drops below 40.5 V, where the PSU in the MTS shuts down. Two Motorola Solutions kits are available for this purpose:

- MTS2 LVD RELAY RETROFIT KIT (Kit Number: GMDN2206A)
- MTS4 LVD RELAY RETROFIT KIT (Kit Number: GMDN2207A)

CAUTION: The battery installation need a short circuit protection closest to the batteries.

IMPORTANT: The batteries should be installed in the same building and properly ventilated.

3.7.2.1 Service Current Rating

When selecting the AC main service, consider the input current rating of the DC power supply equipment.

The DC power system has normal loads and start-up loads. These loads are dependent on the number of Base Radios in the site and the size and condition of the backup battery system. The loads may differ for the customer designed power systems.

3.7.2.1.1 Power Loads and Heat Dissipation – MTS 400 MHz and 800 MHz

Table 9: Typical Power Loads and Heat Dissipation Values – MTS 400 MHz BR-Arch-1 Configurations

MTS 400 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charg-ing (W)	DC -48 V (W)	Heat DC (W)	Comment
TETRA TX 10 W							
MTS2 with 1 BR	140	130	520	185	135	125	No combining, low power PA, no fans
MTS2 with 1 BR w. Hybrid	165	155	545	210	160	150	Low power PA, no fans
MTS2 with 2 BRs	245	225	625	280	240	220	Two TX ant., low power PA, no fans

MTS 400 MHz Configuration	AC (W)	Heat AC (W)	AC When Charg ing (W)	Heat AC When Charg- ing (W)	DC -48 V (W)	Heat DC (W)	Comment
MTS2 with 2 BRs w. Hybrid	295	275	675	330	285	265	Low power PA, no fans
MTS4 with 1 BR w. MTCC/ATCC	240	230	625	290	235	225	Low power PA, fans
MTS4 with 2 BRs w. MTCC/ATCC	375	355	755	410	365	345	Low power PA, fans
MTS4 with 3 BRs w. MTCC/ATCC	620	590	1380	705	605	575	Low power PA, fans
MTS4 with 4 BRs w. MTCC/ATCC	760	720	2005	835	745	705	Low power PA, fans
TETRA TX 25 W / 40 W and TEDS TX 10 W							
MTS LiTE and MTS2 with 1 BR	230	205	610	280	225	200	No combining, low power PA (25W)
MTS LiTE and MTS2 with 1 BR	370	345	750	420	365	340	No combining, high power PA (40W)
MTS2 with 1 BR w. Hybrid	230	205	610	280	225	200	Low power PA (10W)
MTS2 with 1 BR w. Hybrid	370	345	750	420	365	340	High power PA, fans (25W)
MTS2 with 2 BRs	430	380	810	470	420	370	Two TX ant., low power PA (25W)
MTS2 with 2 BRs	630	580	1010	670	615	565	Two TX ant., high power PA (40W)
MTS2 with 2 BRs w. Hybrid	430	380	810	470	420	370	Low power PA (10W)
MTS2 with 2 BRs w. Hybrid	630	580	1010	670	615	565	High power PA, fans (25W)
MTS4 with 1 BR w. MTCC/ATCC	370	345	750	420	365	340	High power PA, fans
MTS4 with 2 BRs w. MTCC/ATCC	630	580	1010	670	615	565	High power PA, fans
MTS4 with 3 BRs w. MTCC/ATCC	102 5	950	1785	1110	100 0	925	High power PA, fans

MTS 400 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
MTS4 with 4 BRs w. MTCC/ATCC	1300	1200	2065	1375	1270	1170	High power PA, fans

Table 10: Typical Power Loads and Heat Dissipation Values – MTS 400 MHz BR-Arch-2 Configurations

MTS 400 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
TETRA TX 10 W							
MTS2 with 1 BR	140	130	520	185	135	125	No combining, no fans
MTS2 with 1 BR w. Hybrid	185	175	565	230	180	170	No fans
MTS2 with 2 BRs	250	230	630	285	240	220	No combining, Two TX ant., no fans
MTS2 with 2 BRs w. Hybrid	335	315	720	375	330	310	No fans
MTS4 with 1 BR w. MTCC/ATCC	250	240	635	300	245	235	Fans
MTS4 with 2 BRs w. MTCC/ATCC	390	370	775	430	385	365	Fans
MTS4 with 3 BRs w. MTCC/ATCC	645	615	1410	730	630	600	Fans
MTS4 with 4 BRs w. MTCC/ATCC	800	760	1560	875	780	740	Fans
TETRA TX 25 W							
MTS2 with 1 BR	280	255	660	310	270	245	No combining, fans
MTS2 with 1 BR w. Hybrid	405	380	785	435	395	370	Fans
MTS2 with 2 BRs	445	395	825	450	435	385	Two TX ant, fans
MTS2 with 2 BRs w. Hybrid	695	645	1075	700	680	630	Fans
MTS4 with 1 BR w. MTCC/ATCC	375	350	755	410	365	340	Fans
MTS4 with 2 BRs w. MTCC/ATCC	640	590	1020	645	625	575	Fans

MTS 400 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
MTS4 with 3 BRs w. MTCC/ATCC	1035	960	1800	1075	1010	935	Fans
MTS4 with 4 BRs w. MTCC/ATCC	1320	1220	2080	1330	1290	1190	Fans
TETRA TX 40 W							
MTS2 with 1 BR	355	315	735	385	345	305	No combining, fans
MTS2 with 2 BRs	595	515	975	385	580	500	Two TX ant., no combining. fans

NOTICE:

- All the values in the table are calculated from AC = 230 V
- Add additional 5% for 110 V
- Charging is up to 6 A per PSU

Table 11: Typical Power Loads and Heat Dissipation Values – MTS 800 MHz BR-Arch-2 Configurations

MTS 800 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC-48 V (W)	Heat DC (W)	Comment
TETRA TX 10 W							
MTS2 with 1 BR	145	135	530	195	145	135	No combining, no fans
MTS2 with 1 BR w. Hybrid	185	175	570	235	180	170	No fans
MTS2 with 2 BRs	265	245	645	300	255	235	No combining, Two TX ant, no fans
MTS2 with 2 BRs w. Hybrid	340	320	725	380	335	315	No fans
MTS4 with 1 BR w. MTCC/ATCC	255	245	635	300	250	240	Fans
MTS4 with 2 BRs w. MTCC/ATCC	400	380	780	435	390	370	Fans

MTS 800 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC-48 V (W)	Heat DC (W)	Comment
MTS4 with 3 BRs w. MTCC/ATCC	655	625	1420	740	640	610	Fans
MTS4 with 4 BRs w. MTCC/ATCC	810	770	1575	885	795	755	Fans
TETRA TX 25 W							
MTS2 with 1 BR	280	255	660	310	270	245	No combining, fans
MTS2 with 1 BR w. Hybrid	400	375	780	430	390	365	Fans
MTS2 with 2 BRs	445	395	825	455	435	385	Two TX ant, fans
MTS2 with 2 BRs w. Hybrid	685	635	1070	695	670	620	Fans
MTS4 with 1 BR w. MTCC/ATCC	375	350	755	410	370	345	Fans
MTS4 with 2 BRs w. MTCC/ATCC	640	590	1020	650	625	575	Fans
MTS4 with 3 BRs w. MTCC/ATCC	1040	965	1800	1080	1015	940	Fans
MTS4 with 4 BRs w. MTCC/ATCC	1320	1220	2085	1335	1290	1190	Fans

3.7.2.1.2

Power Loads and Heat Dissipation – Expansion Cabinet 400 MHz and 800 MHz

Table 12: Typical Power Loads and Heat Dissipation Values – Expansion Cabinet 400 MHz BR-Arch-1 Configuration

Expansion Cabinet Consumptions MTS 400 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
TETRA TX 10 W							
MTS4 Exp. Cab. w 1 BR w. MTCC/ATCC	240	230	625	290	235	225	Low power PA, fans
MTS4 Exp. Cab. w. 2 BRs w. MTCC/ATCC	375	355	755	410	365	345	Low power PA, fans

Expansion Cabinet Consumptions MTS 400 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
MTS4 Exp. Cab. w. 3 BRs w. MTCC/ATCC	620	590	1380	705	605	575	Low power PA, fans
MTS4 Exp. Cab. w. 4 BRs w. MTCC/ATCC	760	720	2005	835	745	705	Low power PA, fans
TETRA TX 25 W and TEDS TX 10 W							
MTS4 Exp. Cab. w. 1 BR w. MTCC/ATCC	370	345	750	420	365	340	High power PA, fans
MTS4 Exp. Cab. w. 2 BRs w. MTCC/ATCC	630	580	1010	670	615	565	High power PA, fans
MTS4 Exp. Cab. w. 3 BRs w. MTCC/ATCC	1025	950	1785	1110	1000	925	High power PA, fans
MTS4 Exp. Cab. w. 4 BRs w. MTCC/ATCC	1300	1200	2065	1375	1270	1170	High power PA, fans

Table 13: Typical Power Loads and Heat Dissipation Values – Expansion Cabinet 400 MHz BR-Arch-2 Configuration

Expansion Cabinet Consumptions MTS 400 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
TETRA TX 10 W							
MTS4 Exp. Cab. w 1 BR w. MTCC/ATCC	250	240	635	300	245	235	Fans
MTS4 Exp. Cab. w. 2 BRs w. MTCC/ATCC	390	370	775	430	385	365	Fans
MTS4 Exp. Cab. w. 3 BRs w. MTCC/ATCC	645	615	1410	730	630	600	Fans
MTS4 Exp. Cab. w. 4 BRs w. MTCC/ATCC	800	760	2040	875	780	740	Fans
TETRA TX 25 W							

Expansion Cabinet Consumptions MTS 400 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
MTS4 Exp. Cab. w. 1 BR w. MTCC/ATCC	375	350	755	410	365	340	Fans
MTS4 Exp. Cab. w. 2 BRs w. MTCC/ATCC	640	590	1020	645	625	575	Fans
MTS4 Exp. Cab. w. 3 BRs w. MTCC/ATCC	1035	960	1800	1075	1010	935	Fans
MTS4 Exp. Cab. w. 4 BRs w. MTCC/ATCC	1320	1220	2080	1330	1290	1190	Fans

NOTICE:

- All the values in the table are calculated from AC = 230 V
- Add additional 5% for 110 V
- Charging is up to 6 A per PSU

Table 14: Typical Power Loads and Heat Dissipation Values – Expansion Cabinet 800 MHz BR-Arch-2 Configuration

Expansion Cabinet 800 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging	DC-48 V (W)	Heat DC (W)	Comment
TETRA TX 10 W							
MTS4 Exp. Cab. w 1 BR w. MTCC/ATCC	255	245	635	300	250	240	Fans
MTS4 Exp. Cab. w. 2 BRs w. MTCC/ATCC	400	380	780	435	390	370	Fans
MTS4 Exp. Cab. w. 3 BRs w. MTCC/ATCC	655	625	1420	740	640	610	Fans
MTS4 Exp. Cab. w. 4 BRs w. MTCC/ATCC	810	770	2055	885	795	755	Fans
TETRA TX 25 W							
MTS4 Exp. Cab. w. 1 BR w. MTCC/ATCC	375	350	755	410	370	345	Fans

Expansion Cabinet 800 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging	DC-48 V (W)	Heat DC (W)	Comment
MTS4 Exp. Cab. w. 2 BRs w. MTCC/ATCC	640	590	1020	650	625	575	Fans
MTS4 Exp. Cab. w. 3 BRs w. MTCC/ATCC	1040	965	1800	1080	1015	940	Fans
MTS4 Exp. Cab. w. 4 BRs w. MTCC/ATCC	1320	1220	2085	1335	1290	1190	Fans

3.7.2.1.3
Power Loads and Heat Dissipation – MTS 260 MHz

Table 15: Typical Power Loads and Heat Dissipation Values – MTS 260 MHz Configurations

MTS 260 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
TETRA TX 10 W							
MTS2 with 1 BR	140	130	520	185	135	125	No combining, low power PA, no fans
MTS2 with 1 BR w. Hybrid	165	155	545	210	160	150	Low power PA, no fans
MTS2 with 2 BRs	245	225	625	280	240	220	Two TX ant., low power PA, no fans
MTS2 with 2 BRs w. Hybrid	295	275	675	330	285	265	Low power PA, no fans
MTS4 with 1 BR w. ATCC	240	230	625	290	235	225	Low power PA, fans
MTS4 with 2 BRs w. ATCC	375	355	755	410	365	345	Low power PA, fans
MTS4 with 3 BRs w. ATCC	620	590	1380	705	605	575	Low power PA, fans
MTS4 with 4 BRs w. ATCC	760	720	2005	835	745	705	Low power PA, fans
TETRA TX 25 W							
MTS2 with 1 BR	230	205	610	280	225	200	No combining, low power PA

MTS 260 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
MTS2 with 2 BRs	430	380	810	470	420	370	Two TX ant., low power PA

NOTICE:

- All the values in the table are calculated from AC = 230 V
- Add additional 5% for 110 V
- Charging is up to 6 A per PSU

3.7.2.1.4

Power Loads and Heat Dissipation – Expansion Cabinet 260 MHz

Table 16: Typical Power Loads and Heat Dissipation Values – Expansion Cabinet 260 MHz Configuration

Expansion Cabinet Consumptions MTS 260 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
TETRA TX 10 W							
MTS4 Exp. Cab. w 1 BR w. ATCC	240	230	625	290	235	225	Low power PA, fans
MTS4 Exp. Cab. w. 2 BRs w. ATCC	375	355	755	410	365	345	Low power PA, fans
MTS4 Exp. Cab. w. 3 BRs w. ATCC	620	590	1380	705	605	575	Low power PA, fans
MTS4 Exp. Cab. w. 4 BRs w. ATCC	760	720	2005	835	745	705	Low power PA, fans

NOTICE:

- All the values in the table are calculated from AC = 230 V
- Add additional 5% for 110 V
- Charging is up to 6 A per PSU

3.7.2.1.5
Power Loads and Heat Dissipation – MTS 800 MHz / 900 MHz

Table 17: Typical Power Loads and Heat Dissipation Values – MTS 800 MHz / 900 MHz Configuration

MTS 800 MHz/ 900 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
TETRA TX 10 W							
MTS LiTE and MTS2 with 1 BR	280	270	660	325	215	205	No combining, high power PA, fans
MTS2 with 1 BR w. Hybrid	320	310	705	370	235	225	High power PA, fans
MTS2 with 2 BRs	445	425	825	480	315	295	Two TX ant., low power PA, fans
MTS2 with 2 BRs w. Hybrid	530	510	915	570	365	345	High power PA, fans
MTS4 with 1 BR w. MTCC/ATCC	320	310	705	370	235	225	High power PA, fans
MTS4 with 2 BRs w. MTCC/ATCC	530	510	915	570	365	345	High power PA, fans
MTS4 with 3 BRs w. MTCC/ATCC	855	825	1620	940	605	575	High power PA, fans
MTS4 with 4 BRs w. MTCC/ATCC	1080	1040	1840	1155	745	705	High power PA, fans
TETRA TX 25 W and TEDS TX 10 W							
MTS LiTE and MTS2 with 1 BR	330	305	715	380	325	300	No combining, High power PA, fans
MTS2 with 1 BR w. Hybrid	405	380	790	455	395	370	High power PA, fans
MTS2 with 2 BRs	550	500	930	590	540	490	Two TX ant., High power PA, fans
MTS2 with 2 BRs w. Hybrid	700	650	1085	740	685	635	High power PA, fans
MTS4 with 1 BR w. MTCC/ATCC	405	380	790	455	395	370	High power PA, fans
MTS4 with 2 BRs w. MTCC/ATCC	700	650	1085	740	685	635	High power PA, fans
MTS4 with 3 BRs w. MTCC/ATCC	1130	1055	1890	1215	1105	1030	High power PA, fans

MTS 800 MHz/ 900 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
MTS4 with 4 BRs w. MTCC/ATCC	1445	1345	2205	1515	1410	1310	High power PA, fans

NOTICE:

- All the values in the table are calculated from AC = 230 V
- Add additional 5% for 110 V
- Charging is up to 6 A per PSU

3.7.2.1.6
Power Loads and Heat Dissipation – Expansion Cabinet 800 MHz

Table 18: Typical Power Loads and Heat Dissipation Values – Expansion Cabinet 800 MHz Configuration

Expansion Cabinet Consumptions MTS 800 MHz Configuration	AC (W)	Heat AC (W)	AC When Charging (W)	Heat AC When Charging (W)	DC -48 V (W)	Heat DC (W)	Comment
TETRA TX 10 W							
MTS4 with 1 BR w. MTCC/ATCC	320	310	705	370	235	225	High power PA, fans
MTS4 with 2 BRs w. MTCC/ATCC	530	510	915	570	365	345	High power PA, fans
MTS4 with 3 BRs w. MTCC/ATCC	855	825	1620	940	605	575	High power PA, fans
MTS4 with 4 BRs w. MTCC/ATCC	1080	1040	1840	1155	745	705	High power PA, fans
TETRA TX 25 W and TEDS TX 10 W							
MTS4 with 1 BR w. MTCC/ATCC	405	380	790	455	395	370	High power PA, fans
MTS4 with 2 BRs w. MTCC/ATCC	700	650	1085	740	685	635	High power PA, fans
MTS4 with 3 BRs w. MTCC/ATCC	1130	1055	1890	1215	1105	1030	High power PA, fans
MTS4 with 4 BRs w. MTCC/ATCC	1445	1345	2205	1515	1410	1310	High power PA, fans

NOTICE:

- All the values in the table are calculated from AC = 230 V
- Add additional 5% for 110 V
- Charging is up to 6 A per PSU

3.7.2.2
AC and DC Current Load

WARNING: The MTS has a 2mA minimum power consumption even when the Power Supply Unit (PSU) is switched off. The switch only disconnects DC outputs and charging currents. In case of the field repair, disconnect all PSU connecting cables.

3.7.2.3
Backup Battery

The backup battery is normally located near the cabinet(s). The recommended batteries to be used are a VRLA (Valve Regulated Lead Acid) recombination type, with -48 VDC nominal.

3.7.3
Surge Arrestors

For details on surge arrestors, see Surge Arrestors and Suppliers on page 488.

IMPORTANT: To transport lightning strikes away from the equipment, install the lightning arrestors.

NOTICE: Install a lightning rod on a different tower leg than the antenna.

3.7.4
Power Panel

Use a standardized power panel including circuit breaker layout in all sites where an MTS is installed. Leave vacant space to allow for future requirements.

3.8
User Alarms, Control Outputs, and Door Alarm

The MTS in all configurations has the following alarm inputs and control outputs:

- 15 x 12 V opto-isolated alarm inputs: Available on the junction panel. Alarm inputs and Alarm ground are floating.
- D60_MTS2and4_MidpowerPA_CLE6165A_A
- 2 x Form A relay outputs with Common and Normally Open contacts: Available on the junction panel.
- DOOR alarm: Connected to the Site Controller

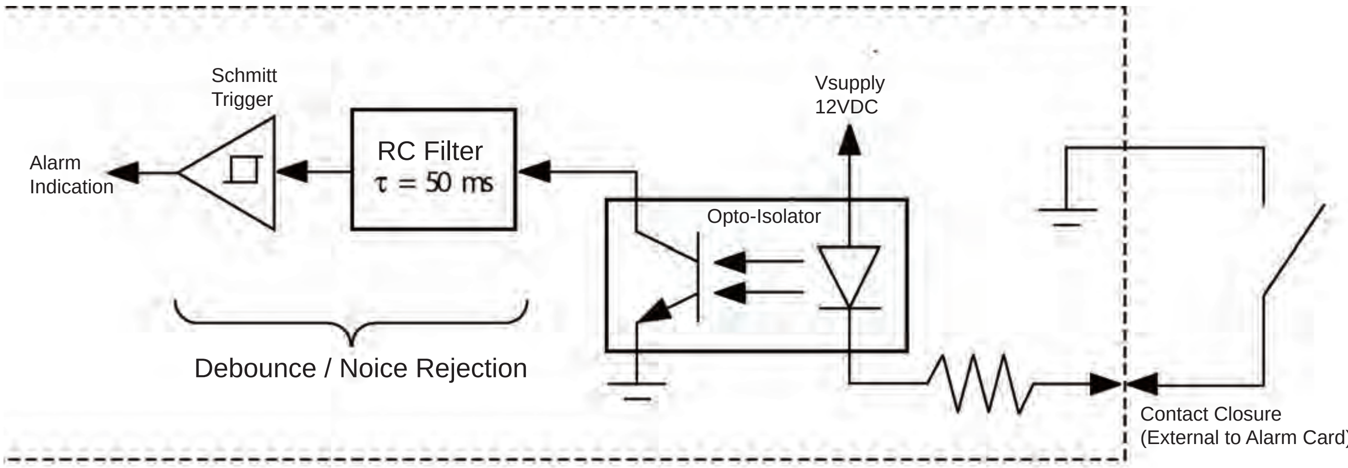
NOTICE:
All 15 alarm inputs and Door alarm use the same Alarm Ground. All these alarms and controls connect directly to the Site Controller (SC).

The Expansion Cabinet only offers the Door alarm feature.

For detailed information, see External Alarm Cabling on page 151 and User Alarms/Controls, X.21, RGPS, and GPS Cabling on page 170.

The following figure shows detailed User Alarms input structure.

Figure 14: Opto-isolated Alarm Input Structure



3.9

Grounding Requirements

WARNING: The MTS 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 Communications Sites, R56.*

NOTICE: The methods and standards cited in the following paragraphs are typical. Local codes, statutes, regulations, and standards supersede any information provided.

Use single-point ground method (where each cabinet is grounded to master ground using its own ground wire). For equipment cabinet, use green (or green-yellow) insulated wire with a minimum size of 16 mm^2 CSA (#5 AWG) for ground wire.

Ground any external -48 V DC power system in accordance with manufacturers instructions and any applicable local regulations.

NOTICE:
The MTS cabinet is wired to positive earth but the Power Supply Unit inside has a floating DC ground concept.

You can use different wire colors according to the local standards.

If the specified wire size is not available, use the next-larger available wire size.

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

Chapter 4

Hardware Installation

MTS hardware installation includes mounting the equipment, installing cables, and establishing connections for the input power, antennas, and site link interfaces.

4.1 Installation Overview

The MTS cabinets can be mounted in two ways:

- Directly to the floor using the mounting brackets
- Using the mounting plate

MTS LiTE, MTS 2, MTS 4, and the Expansion Cabinet all have four mounting holes for leveling feet. However, the position of the holes is not identical for the cabinets due to the stability of the different size cabinets.

For maintenance procedures, use the front access. To connect the external service, use the top access.

Perform the MTS installation procedures according to the techniques described in the *Motorola Standards and Guidelines for Communications Sites, R56* manual.

NOTICE: In an MTS site, the term cabinet is a generic term referring 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.

4.1.1 Installation Personnel

MTS site installation typically requires the following personnel:

- Installation supervisor.
- Minimum of two installers per MTS site. Two installers can include the supervisor, provided there are a minimum of two persons on each MTS site at all times.
- A commissioning engineer to attend only during the commissioning stage.

4.1.2 Receiving the MTS Equipment

After receiving the MTS equipment, inspect it as soon as all the equipment is unpacked.

CAUTION: To prevent electrostatic damage, observe guidelines for a safe handling of electrostatic sensitive devices.

Prerequisites: Before unpacking the equipment, check if no obvious damage has occurred to the shipping containers. If you notice such damage, contact the shipping agent and ask that a representative of their company is present while the equipment is unpacked. Then inform your Motorola Solutions representative.

Procedure:

1 Wear an anti-static wrist strap.

2 Check the MTS equipment against the itemized packing list.
3 If available, check the sales order with the packing list to account for all equipment ordered.

NOTICE: Contact your Motorola Solutions representative to report the missing items and for additional information.

4 Check for loose or damaged equipment.
5 Check all sides of the Base Stationcabinet for dents, scratches, or other damage.
6 Check all cabinet wiring to ensure that connections are in place.
7 Check modules and boards for physical damage to controls or connectors.
8 Verify that ground straps are secure.
9 If any equipment is damaged, contact the shipping company immediately, and then your Motorola Solutions representative.

4.2
Installation Prerequisites

Proper installation ensures the best possible performance and reliability of the MTS station. Before performing installation tasks, plan the mounting location of the cabinet in relation to input power, antennas, and site link interfaces. Also, consider the site environment conditions, the particular mounting method, and required tools and equipment.

For full instructions and guidelines, see the *Motorola Standards and Guidelines for Communications Sites, R56* manual.

Process:

1 Complete the antenna installation (including GPS antenna).
2 **For buildings with no grounding**: install earthing.
3 Order the installation of the Ethernet, X.21, or E1 link (to the control center) to the site link service provider.
4 Install the cable tray in the equipment room.
5 Optional: Increase the mains power supply capacity to serve all the site equipment.
6 Optional: Increase the stand-by mains power supply capacity to serve all the site equipment.
7 Complete any civil works on the site (for example, new or modified accommodation, new access road, and so on).
8 Agree on and mark the floor position of each piece of the equipment.
9 Optional: Reinforce the site floor to accommodate load of site equipment.
10 Order delivery and placement of all the equipment to its final position to the transportation company.
11 Install the proper surge protection on Ethernet, E1/X.21 site links, all antennas, and power inputs to prevent potential damage to the MTS.

4.3
Cabinet Transportation

To move and locate all the equipment to the final position, employ a transportation company specializing in heavy electronic equipment transport.

4.3.1
Transportation Safety Considerations

WARNING:
Crush hazard could result in personal injury or equipment damage.

MTS LiTE cabinet with packaging can weigh up to 49 kg, MTS 2 cabinet with packaging up to 64 kg and MTS 4 cabinet with packaging up to 170 kg.

Follow the instructions below when moving the equipment.

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 Solutions 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.

4.3.2
MTS LiTE and MTS 2 Cabinets Transportation

For MTS LiTE and MTS 2 cabinet, Motorola Solutions recommends the use of a sack trolley or appropriate lifting straps for transportation.

WARNING: A sack trolley will generally be used from the front of the MTS LiTE or the MTS 2 as this allows it to be moved into position. Protective padding or cardboard should be placed between the MTS and the sack trolley to prevent equipment damage.

4.3.3
Moving the MTS 4 and Expansion Cabinet

MTS LiTE cabinet with packaging can weigh up to 49 kg, MTS 2 cabinet with packaging up to 64 kg and MTS 4 cabinet with packaging up to 170 kg.

WARNING: Crush hazard could result in personal injury or equipment damage.

IMPORTANT:
Lift equipment racks without the use of lifting equipment only when there are sufficient personnel available.

Use appropriate powered mechanical lifting apparatus for moving and lifting the equipment racks

See to and comply with any local regulations for the use of lifting equipment.

Procedure:

1 Visually check the lifting brackets and associated rack hardware for transit damage.

  If any damage is apparent, contact Motorola Solutions for replacement. Correct lifting bracket tightness and alignment are crucial to ensure intended lifting capacity.

2 Screw the lifting brackets to both sides of the MTS 4 cabinet.

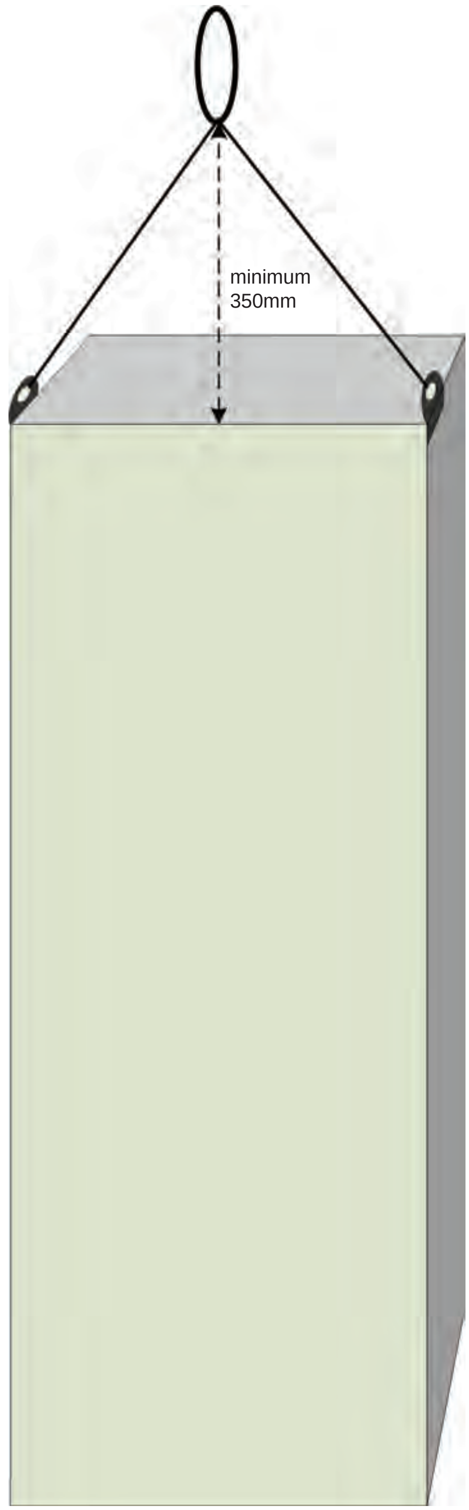
  The holes are pre-drilled. Use the three screws for each bracket.

3 Tighten the screws to 10-13.5 Nm (91-120 in-lbs) torque.

4 Lift the cabinet from a center point, keep the minimum distance of 350 mm between the lifting point and the top surface of the cabinet to ensure the proper lifting angle.

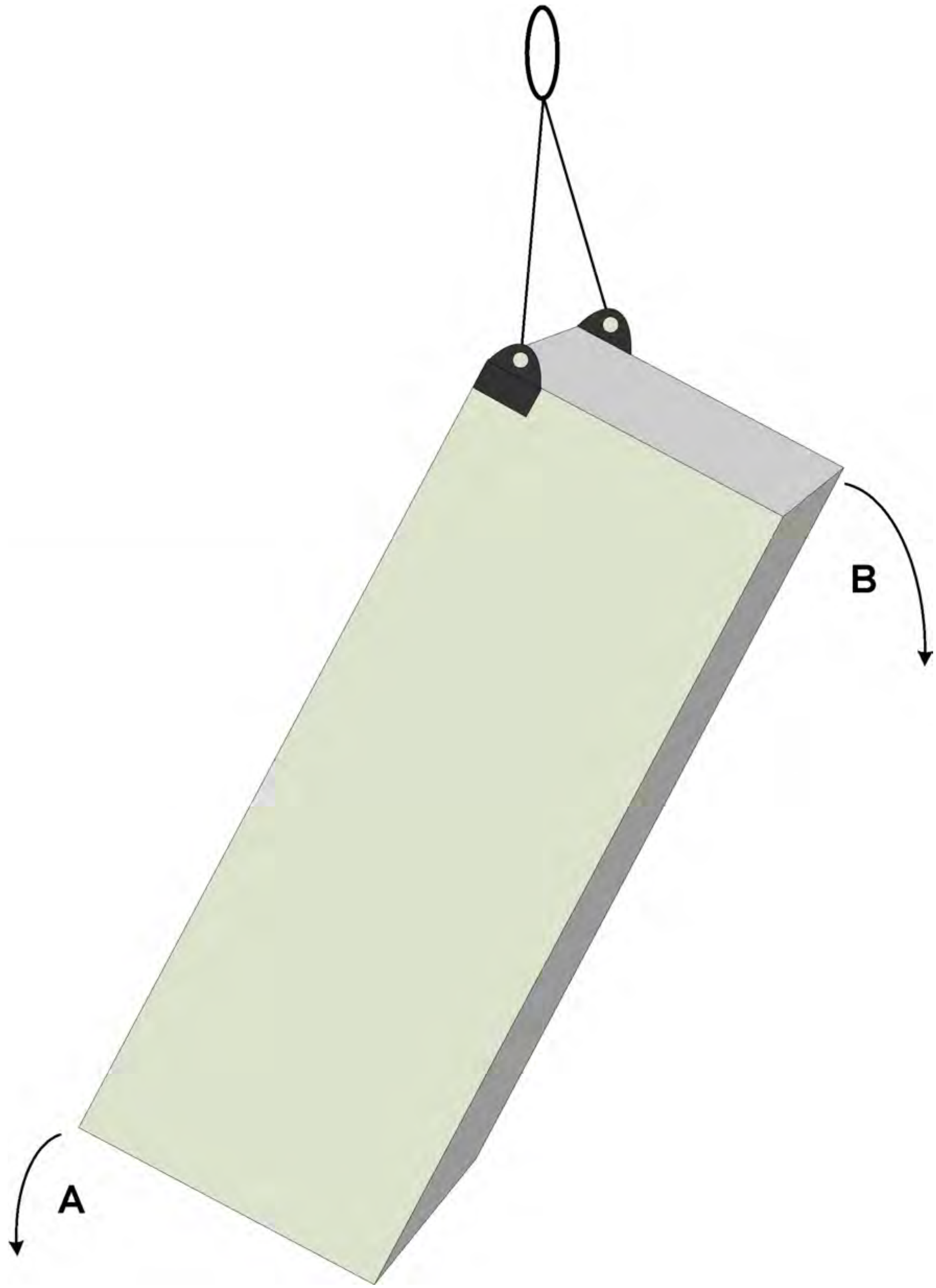
The lifting brackets may fail if the distance is shorter.

Figure 15: Lifting Point for MTS 4 and Expansion Cabinet



5 Put the MTS cabinet back on the floor, in the vertical or horizontal position.

Figure 16: Placing the MTS 4 and the Expansion Cabinet in the Vertical or Horizontal Position



4.4
Cabinet Installation

Depending on the MTS type, installing the MTS cabinet within a site may include wall fixing or floor fixing.

IMPORTANT:
To enable service access and assure the passive cooling ventilation, the free space above the cabinet must be 20 cm at minimum The antenna cabling may require additional space.

Allow at least 80 cm of floor space in front of the cabinet to permit access during installation. Although all maintenance, expansion, cabling, and antenna connections can be performed from the front or top. The required space towards the wall is ensured by an integrated spacer on the back of the cabinet.

Secure the cabinet to the floor for optimum stability.

4.4.1
Cabinet Bracing Considerations

The MTS cabinet is self-supporting. In seismically active areas, additional bracing of the cabinet could be required. However, the bracing hardware must be locally procured.

NOTICE: There are no specific procedures within this manual for bracing cabinets in active seismic areas.

4.4.2
Floor Mounting Instructions

The MTS LiTE, MTS 2, MTS 4, and Expansion Cabinets can be mounted directly to the floor using the mounting brackets, see Figure 17: MTS – Mounting Brackets on page 95.

NOTICE: The floor mounting brackets are not part of standard MTS shipment. If floor mounting brackets are to be used, they must be ordered as an accessory.

```
Partnumber 01015026001 STANDARD FLOOR MOUNT SET MTS
```

Figure 17: MTS – Mounting Brackets

4.4.3
Installing the Cabinet Using the Mounting Brackets

When and where to use: Perform this procedure to properly install the cabinet within the site facility using the mounting brackets.

Procedure:

1. Check that the mounting brackets have been correctly positioned in the equipment room, see Figure 7: Suggested MTS LiTE Site Layout on page 66 for MTS LiTE, Figure 9: Suggested MTS 2 Site Layout on page 68 for MTS 2, Figure 11: Suggested MTS 4 Site Layout on page 70 for MTS 4, and Figure 13: Suggested Expansion Cabinet Site Layout on page 72 for Expansion Cabinet site.
2. Mark and then drill the floor according to the dimensions shown in Figure 18: MTS LiTE / MTS 2 – Drill Hole Position for the Mounting Brackets on page 96 and Figure 19: MTS 4 and Expansion Cabinet – Drill Hole Position for the Mounting Brackets on page 96. Remember to keep the 13 mm distance behind the mounting plate. In each bracket, a 12 mm hole is pre-

drilled. The front brackets can be placed anywhere around the leveling feet at a radius of 60 mm or 105 mm (either hidden under the cabinet, or stuck out for easy mounting), see the circles in Figure 18: MTS LiTE / MTS 2 – Drill Hole Position for the Mounting Brackets on page 96 and Figure 19: MTS 4 and Expansion Cabinet – Drill Hole Position for the Mounting Brackets on page 96.

Figure 18: MTS LiTE / MTS 2 – Drill Hole Position for the Mounting Brackets

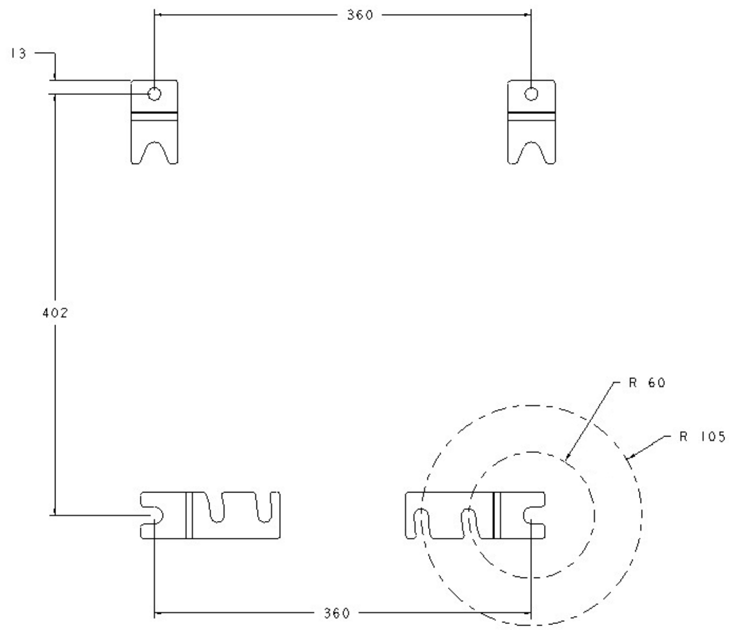
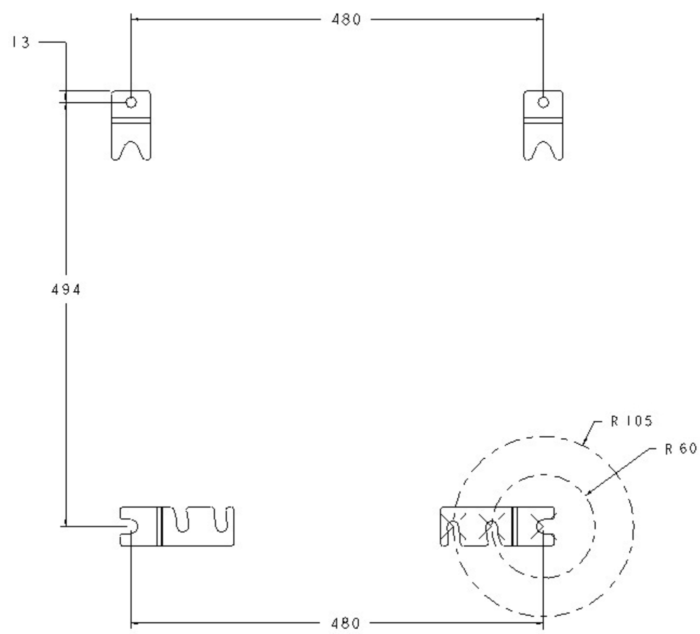


Figure 19: MTS 4 and Expansion Cabinet – Drill Hole Position for the Mounting Brackets



3 Secure the two rear brackets to the floor using one screw for each bracket.

4 Place 2 screws for each front bracket (2x2) in the drilled holes. Screw them almost all the way down but leave space rotate the bracket into position later.

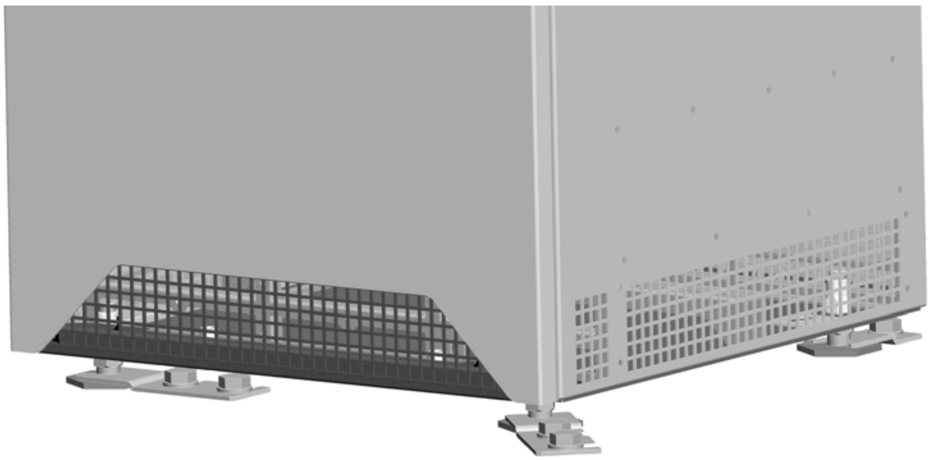
5 Move the MTS cabinet near to the mounting brackets.

6 Move the MTS backwards ensuring that the rear leveling feet of the MTS locate in the corresponding cups in the rear mounting brackets.

7 Push the front brackets over the corresponding leveling feet and swing them until they engage the screws.

8 Fully tighten the screws in the front brackets, see the following figure.

Figure 20: MTS – Mounting Brackets and the Cabinet



4.4.4
Installing the Cabinet Using the Mounting Plate

When and where to use:
Follow this process to mount the cabinet using the mounting plate.

Process:

1 Install the mounting plate to the floor, see Mounting Plate on page 97.

2 Secure the cabinet to the mounting plate, see Securing Cabinet to a Mounting Plate on page 99.

NOTICE: Recommended clearances are shown in Figure 7: Suggested MTS LiTE Site Layout on page 66 for MTS LiTE, Figure 9: Suggested MTS 2 Site Layout on page 68 for MTS 2, in Figure 11: Suggested MTS 4 Site Layout on page 70 for MTS 4, and in Figure 13: Suggested Expansion Cabinet Site Layout on page 72 for Expansion Cabinet.

4.4.4.1
Mounting Plate

NOTICE: MTS LiTE/MTS 2 and MTS 4/Expansion Cabinet mounting plates have different size and hole positions.

Figure 21: MTS Mounting Plate

The mounting plate is normally secured directly to the floor.

NOTICE: The use of an insulated base may be considered where additional lightning protection is required or where local regulations require this (see R56 Manual for further information).

4.4.4.2
Installing the Mounting Plate

When and where to use: Perform this procedure to properly install the mounting plate within the site facility.

Procedure:

1. Ensure that the mounting plate has been correctly positioned in the equipment room, see Figure 7: Suggested MTS LiTE Site Layout on page 66 for MTS LiTE, Figure 9: Suggested MTS 2 Site Layout on page 68 for MTS 2, Figure 11: Suggested MTS 4 Site Layout on page 70 for MTS 4, and Figure 13: Suggested Expansion Cabinet Site Layout on page 72 for Expansion Cabinet.

2 Use the mounting plate as drilling template or mark the floor according to the dimensions shown in Figure 22: MTS LiTE/MTS 2 – Drill Hole Position for the Mounting Plate on page 99 and Figure 23: MTS 4 – Drill Hole Position for the Mounting Plate on page 99. Remember to keep the 13 mm distance behind the mounting plate. Four 12 mm holes are pre-drilled. Additional holes may be drilled in the mounting plate where required.

Figure 22: MTS LiTE/MTS 2 – Drill Hole Position for the Mounting Plate

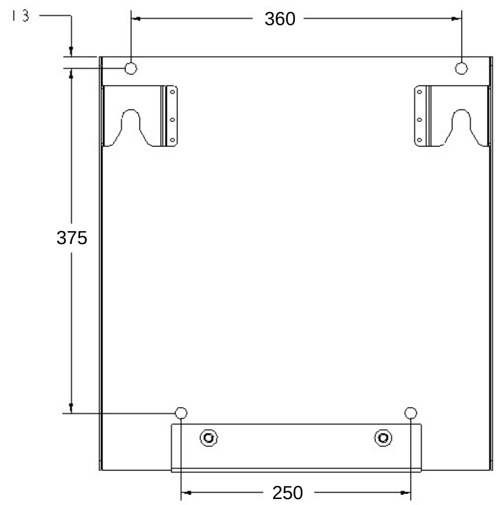
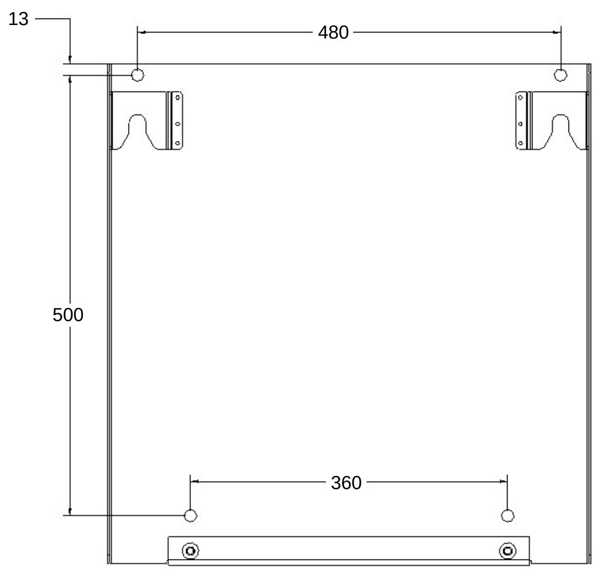


Figure 23: MTS 4 – Drill Hole Position for the Mounting Plate



3 Secure all mounting locations using nuts and lock washers.

4 Fully tighten all mounting nuts securing the mounting plate to the floor.

4.4.4.3
Securing Cabinet to a Mounting Plate

Procedure:

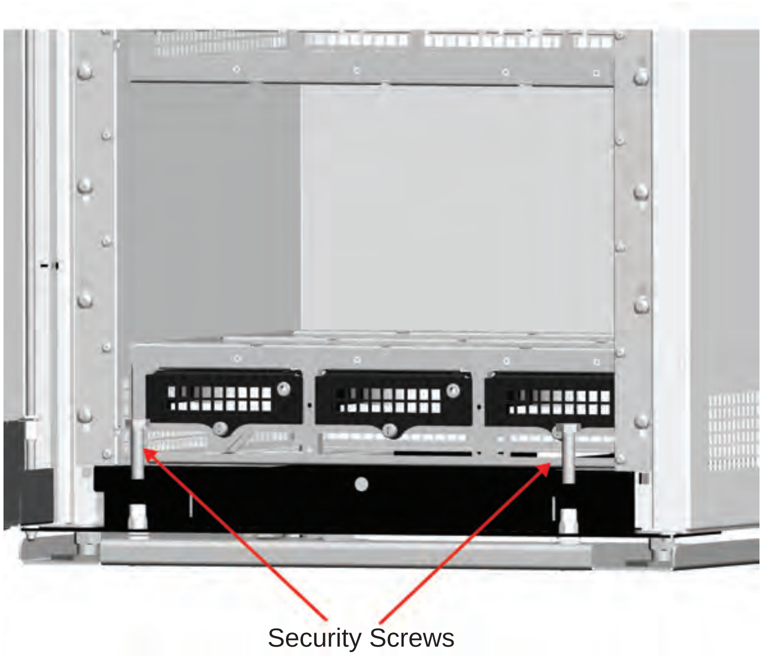
1 Move the MTS cabinet near to the mounting plate which has been fixed to the floor as described before.

2 Bring the MTS in position and lower it onto the mounting plate. Care must be taken not to lower the MTS onto the locating tabs on the rear of the mounting plate to avoid bending.

3 Move the MTS from the front to the back ensuring that the leveling feet of the MTS locate in the corresponding slots in the mounting plate.

4 Secure the MTS on the mounting plate using the two front security M10 screws. If the leveling feet are in the lowest position, M10x40 screws must be used. The position of the screws is shown in Figure 24: Position of Security Screws on page 100. Recommended tool: allen wrench for M10, SW8 HEX screws (supplied with the mounting plate kit).

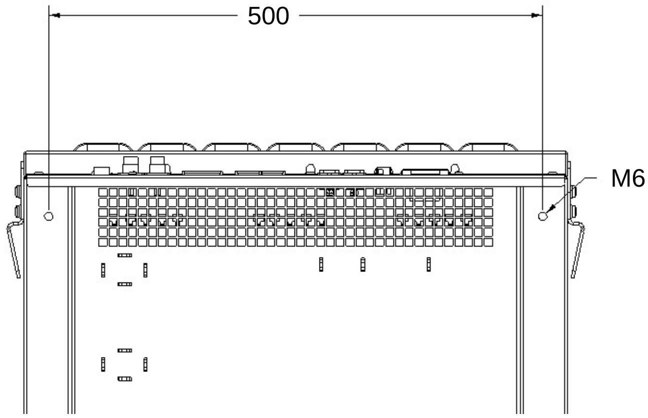
Figure 24: Position of Security Screws



4.4.5
Wall Fixing

The MTS 4 and Expansion Cabinet have the option of being fixed to a wall for extra stability. To do this, use the two M6 holes in the back of either the MTS 4 cabinet or the Expansion Cabinet. See the following figure.

Figure 25: MTS – Wall Fixing



NOTICE: Use brackets and screws appropriate for the site wall properties.

4.5
Electrical Connections

NOTICE:
Battery backup systems are not manufactured by Motorola Solutions. Consult the manufacturers instruction manual and other pertinent documentation for installing battery systems. Any local regulations shall be adhered to when installing battery equipment.

The equipment cabinet is shipped with all cabling within the cabinet factory-installed. If necessary, see Interconnection and Internal Cabling on page 163, for cabling within the cabinet.

After the station equipment mechanical installation, connect the following electrical cables:

- Grounding Cables
- Power Supply Cables
- Antenna Cables
- GPS Cables
  - Remote GPS Receiver Cable
  - Internal GPS Cable
- Site Link Cables
- Alarm System Cables

CAUTION: For lightning strikes and surge protection, ground the screens of the shielded cables and the coax cables and the Ground Box itself and Ground Box Junction in accordance with the *Motorola Standards and Guidelines for Communications Sites, R56* guidelines and national standards, at the entrance of the building.

NOTICE:
Proper surge protection should be installed on Ethernet/E1/X.21 site links, all antennas, and power inputs to prevent potential damage to the MTS. For more information, see Surge Arrestors and Suppliers on page 488.

For full instructions and guidelines, always see *Motorola Standards and Guidelines for Communications Sites, R56*.

4.5.1
Grounding Connection

Various cabling from the equipment cabinet to external equipment is made through the MTS Junction Panel located at the top-rear of the equipment cabinet. The Junction Panel is accessed from the top of the cabinet.

NOTICE: Depending on system configuration, not all connector locations on Junction Panel are populated.

Cabinet grounding wires may have been installed prior to the cabinet installation. If so, follow the instructions below.

If grounding wires have not yet been installed, refer to Grounding Requirements on page 88 in Site Preparation on page 63.

Single-point ground method (where each cabinet is grounded to master ground using its own ground wire) shall be used. The cabinet shall use green (or green-yellow) insulated wire with a minimum size of 16 mm^2 CSA (#5 AWG) for ground wire.

The MTS is connected to the site ground through the M10 station ground point located on the junction panel.

For MTS LiTE, see Figure 26: Station Ground Point on the MTS LiTE Junction Panel on page 103.

For MTS 2, see Figure 27: Station Ground Point on the MTS 2 Junction Panel on page 103.

For MTS 4, see Figure 28: Station Ground Point on the MTS 4 Junction Panel on page 104.

This connection is essential for the protection of the equipment against lightning induced surges.

If the specified wire size is not available, use the next-larger available wire size. During the installation of cabinet ground wires, ensure to check any factory-installed internal ground connections for tightness.

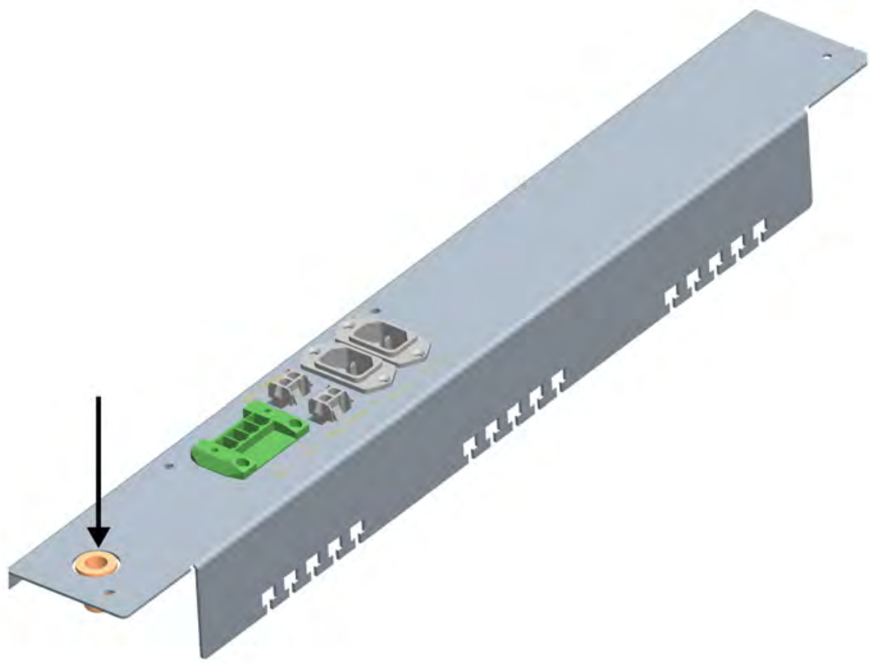
NOTICE: Figure 27: Station Ground Point on the MTS 2 Junction Panel on page 103 and Figure 28: Station Ground Point on the MTS 4 Junction Panel on page 104 depict the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 26: Station Ground Point on the MTS LiTE Junction Panel

Figure 27: Station Ground Point on the MTS 2 Junction Panel

Figure 28: Station Ground Point on the MTS 4 Junction Panel

Figure 29: Station Ground Point on the Expansion Cabinet Junction Panel



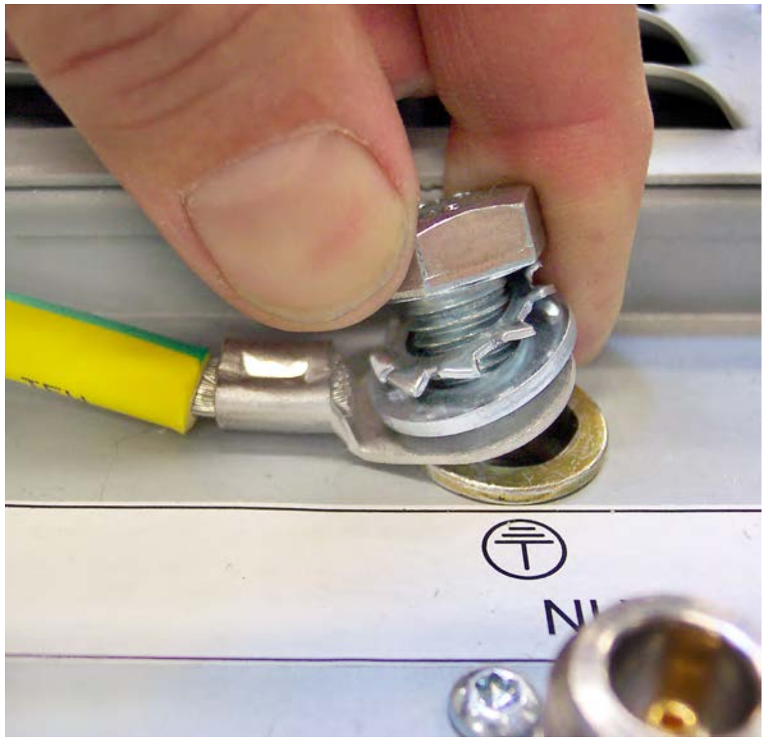
4.5.2
Grounding the Equipment Cabinet

To protect the equipment against lightning induced surges, install the cabinet grounding wires to the MTS cabinet.

Procedure:

1. Strip the end of the wire to be connected to the station ground point in the junction panel.
2. Using an appropriate tool, attach a crimp lug onto the cabinet ground wire. Ensure that the lug is securely fastened to wire.
3. Use a star type and a regular lock washer, which should be placed between the screw and the lug (as shown in Figure 30: Cabinet Grounding on page 105). The regular lock washer must be placed above the lug. The lug must have direct contact to the surface of the cabinet (no washer of any kind between the lug and the surface to which it contacts).

Figure 30: Cabinet Grounding



4 Using the M10 bolt provided, secure the cabinet ground wire to the M10 nut on the junction panel.

5 Ground connections should be checked after installation.

See Recommended Torque on page 157.

4.5.2.1

Battery System Grounding

Ground the battery cabinet (if used) in accordance with manufacturers instructions and any applicable local regulations.

4.5.2.2

Checking Grounding Connections

Perform this procedure to ensure adequacy of the cabinet-to-facility grounding (earth) connections.

Procedure:

1 Install the earth cable between the building earth and the earth point on the cabinet.

2 With a Milliohmmeter, check that the earth connection between the cabinet and the building earth in the room is 0.1 Ω.

4.5.3

Power Supply Connections

One of the following power supply connections is required for the MTS:

- DC in/out – within -41 VDC to -60 VDC – for MTS 4 two connectors are available
- AC in – within 100 VAC to 240 VAC (nominal values) – for MTS 4 two connectors are available

4.5.3.1
-48 VDC Input Power and Backup Battery Charging Connections

The -48 VDC connectors are used for:

- Supplying the MTS with power in the DC only mode – in DC only mode the MTS takes the power from a separate -48 VDC facility power system
- For charging backup batteries in the AC mode

CAUTION: An external disconnect device is required on the DC power supply line.

CAUTION: If the DC input on the station is connected to backup batteries, an external Low Voltage Disconnect (LVD) device should be introduced directly in the power line in order to protect the batteries against deep discharge. On the MTS 2, one relay rated min. 20A/55 VDC should be introduced. And for the MTS 4, two of these units should be used, one for each of the two incoming DC lines. Alternatively for the MTS 4, one relay rated 40A/55 VDC can be used if the two DC lines are connected to one battery pack. The relays should be controlled in a way that they disconnect the batteries once the voltage drops below 40.5 V, where the PSU in the MTS shuts down. Two Motorola Solutions kits are available for this purpose:

- MTS2 LVD RELAY RETROFIT KIT (Kit Number: GMDN2206A)
- MTS4 LVD RELAY RETROFIT KIT (Kit Number: GMDN2207A)

NOTICE: -48 VDC Connection on the MTS 2 Junction Panel and -48 VDC Connections on the MTS 4 Junction Panel depict the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 31: -48 VDC Connection on the MTS LiTE Junction Panel

Figure 32: -48 VDC Connection on the MTS 2 Junction Panel

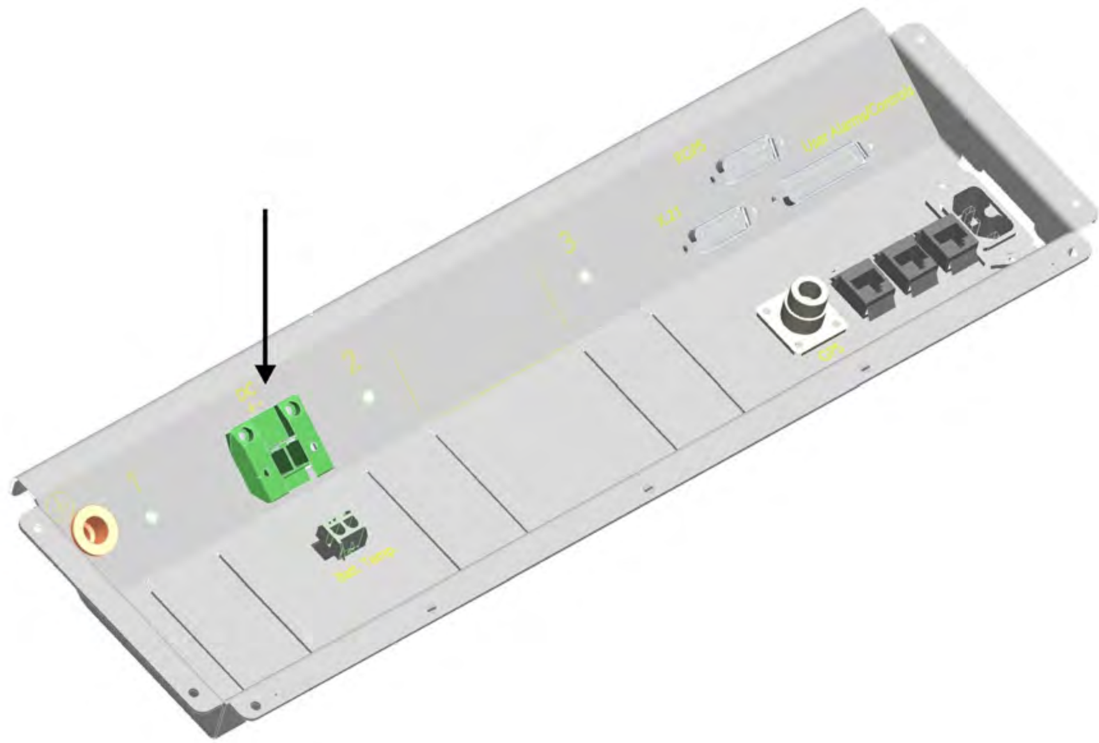
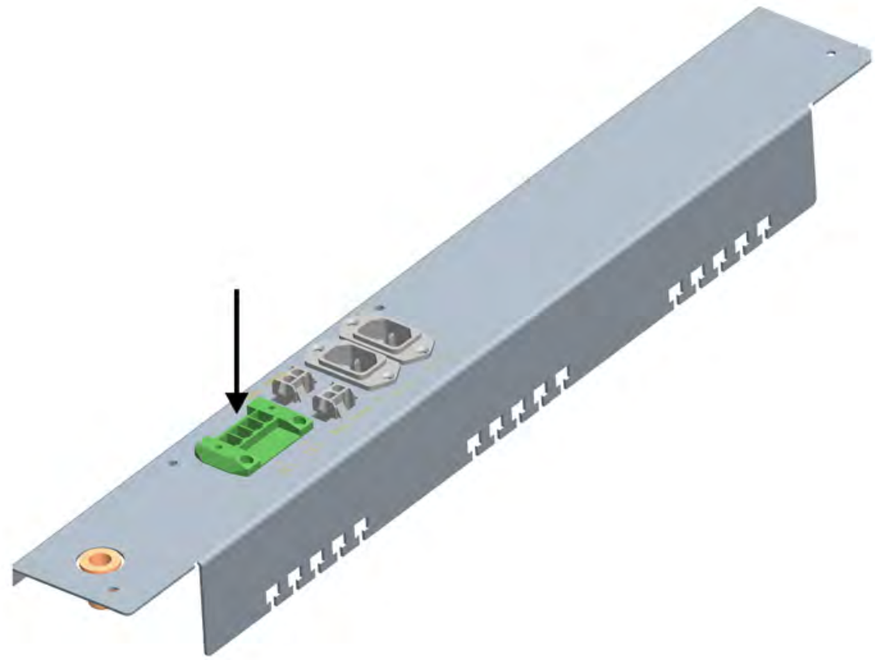


Figure 33: -48 VDC Connections on the MTS 4 Junction Panel

Figure 34: -48 VDC Connections on the Expansion Cabinet Junction Panel



4.5.3.2
Connecting -48 VDC Power Source to the Equipment Cabinet

Procedure:

1. **WARNING:** Make sure that all power is off to prevent accidental contact with high voltage and injury to personnel.
2. Route two runs of bulk wiring between the MTS DC input connector and the facility power supply -48 VDC connections.
3. Make sure that the wire runs are properly routed to the cabinet, allowing adequate slack.
4. Connect the free ends of the wire to the MTS DC plug, which is provided with the MTS. Following the industry standard for positive earth systems unless local regulations state something different:

   NOTICE: Do not use other types of DC Connectors than specified here.

   - Blue/Black wires: see Figure 35: DC Plug MTS LiTE/MTS 2 (Motorola P/N 3166501A01) – Blue/Black Wires on page 110 for MTS 2 and Figure 37: DC Plug MTS 4 (Motorola P/N 3166501A02) – Blue/Black Wires on page 111 for MTS 4.
   - Red/Black wires: see Figure 36: DC Plug MTS LiTE/MTS 2 (Motorola P/N 3166501A01) – Red/Black Wires on page 110 for MTS 2 and Figure 38: DC Plug MTS 4 (Motorola P/N 3166501A02) – Red/Black Wires on page 111 for MTS 4.

Figure 35: DC Plug MTS LiTE/MTS 2 (Motorola P/N 3166501A01) – Blue/Black Wires

Plug the blue wire into negative as shown in the picture.

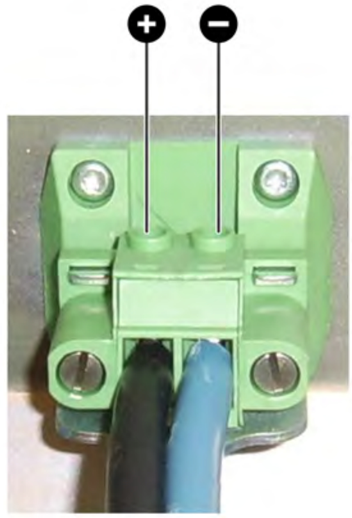


Figure 36: DC Plug MTS LiTE/MTS 2 (Motorola P/N 3166501A01) – Red/Black Wires

Plug the red wire into positive as shown in the picture.

Figure 37: DC Plug MTS 4 (Motorola P/N 3166501A02) – Blue/Black Wires

Plug blue wires into negative as shown in the picture.

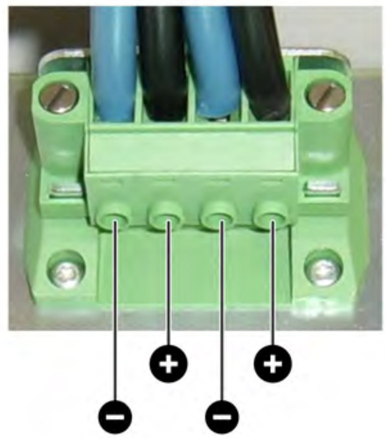
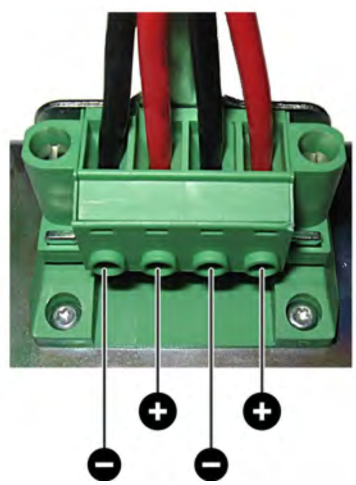


Figure 38: DC Plug MTS 4 (Motorola P/N 3166501A02) – Red/Black Wires

Plug red wires into positive as shown in the picture.



5 Connect the other end of wires to -48 VDC output in accordance with manufacturers instructions and any applicable local regulations.

6 The MTS DC plug shall be fixed to the DC connector using the plugs screws.

4.5.3.2.1 Power Connection Wire Size

WARNING: Wire size recommendations contained herein reflect Motorola Solutions engineering requirements for proper system operation. Local regulations shall be adhered to in any case and shall supersede any other specifications in this manual, where applicable.

WARNING: Wire used for DC connection shall not be smaller than 3.3 mm^2 (#12 AWG) or greater than 5.3 mm^2 CSA (#10 AWG). Blue is the color recommended for -48 VDC wires. However, if the wire is not color-coded, mark these leads with a colored tracer on each end. Wire used for AC connection shall not be smaller than 1.3 mm^2 CSA (#16 AWG) or greater than 2.1 mm^2 (#14 AWG).

4.5.3.3
100–240 VAC Input Power Connections

NOTICE: Figure 40: 100–240 VAC Connection on the MTS 2 Junction Panel on page 113 and Figure 41: 100–240 VAC Connections on the MTS 4 Junction Panel on page 113 depict the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 39: 100–240 VAC Connection on the MTS LiTE Junction Panel

Figure 40: 100–240 VAC Connection on the MTS 2 Junction Panel

Figure 41: 100–240 VAC Connections on the MTS 4 Junction Panel

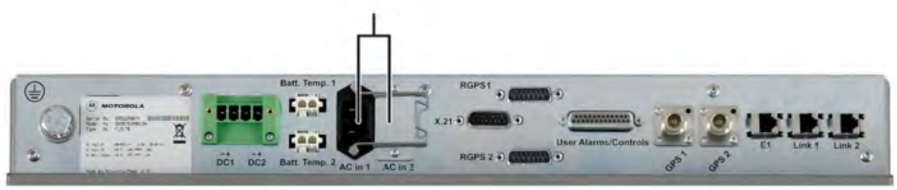
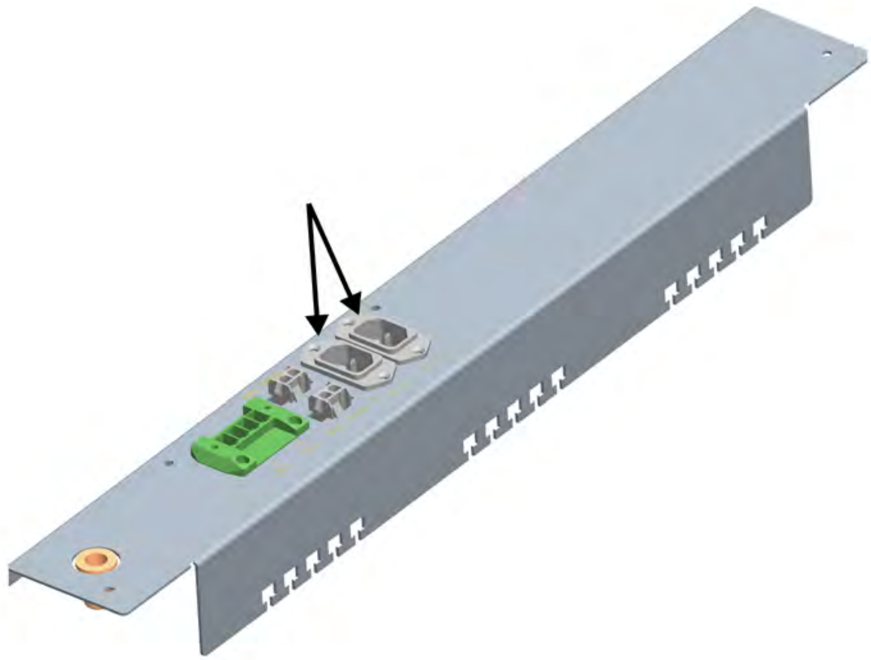


Figure 42: 100–240 VAC Connections on the Expansion Cabinet Junction Panel



4.5.3.4

Connecting 100–240 VAC Power Source to Equipment Cabinet

WARNING: Make sure all power to the Power Supply Unit is switched off to prevent accidental contact with high energy and injury to personnel.

Procedure:

1 Connect the AC cable to the AC socket (type IEC C15 line socket, Motorola P/N 3166502A01), which is provided with the MTS.

2 Insert the AC socket into the AC input connector on the MTS and fix with the retaining clip as shown in the following picture. This fixture will only work with the supplied IEC connector.

Figure 43: AC Socket (IEC Connector)

3 Connect the other end of the AC cable to the facility AC outlet.

4.5.3.5

Backup Battery Sensor Connections

Figure 44: Backup Battery Sensor Connection on MTS LiTE Junction Panel

NOTICE: Figure 45: Backup Battery Sensor Connection on MTS 2 Junction Panel on page 117 and Figure 46: Backup Battery Sensor Connections on MTS 4 Junction Panel on page 117 depict the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 45: Backup Battery Sensor Connection on MTS 2 Junction Panel

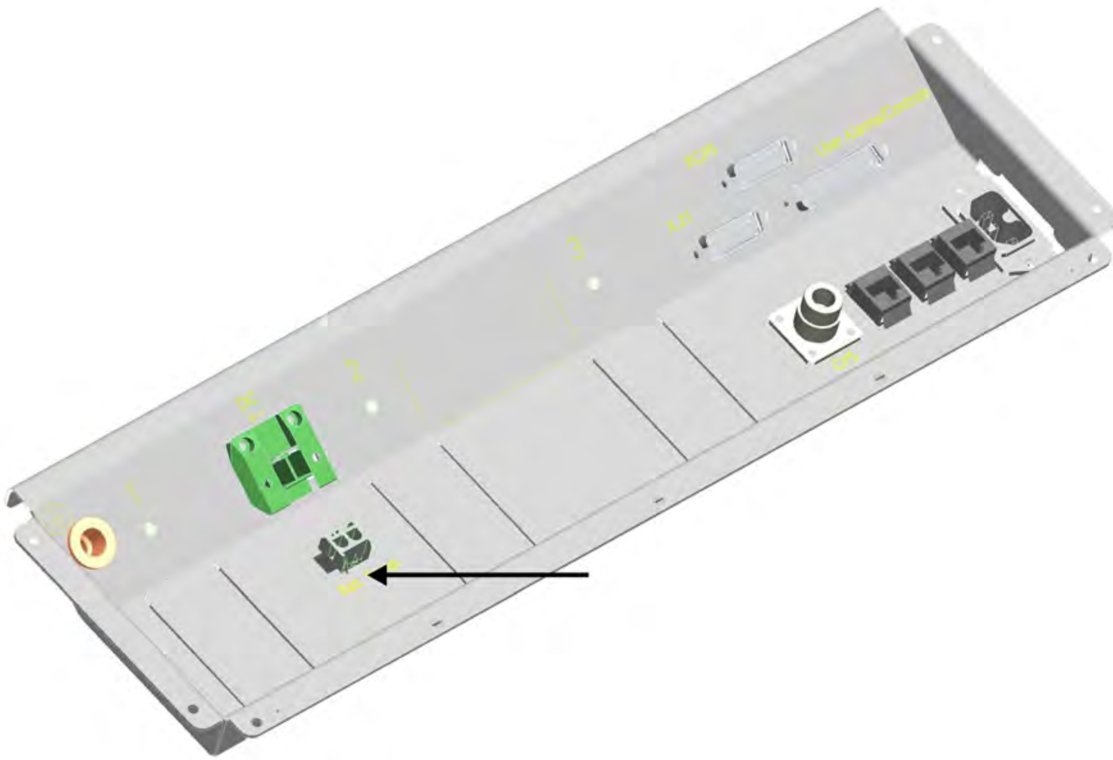
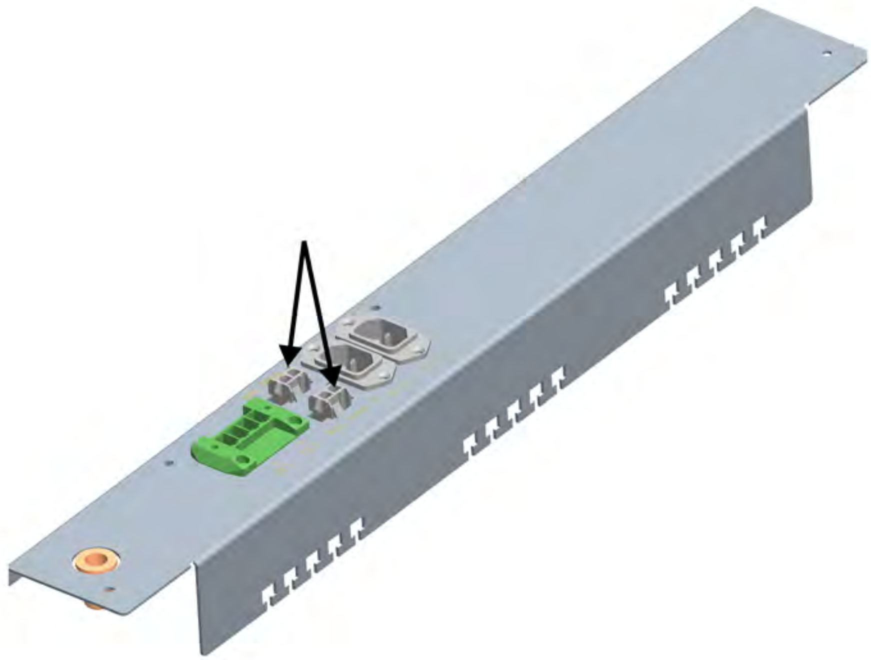


Figure 46: Backup Battery Sensor Connections on MTS 4 Junction Panel

Figure 47: Backup Battery Sensor Connections on Expansion Cabinet Junction Panel



4.5.3.6

Connecting the Backup Battery Sensor to the Equipment Cabinet

WARNING: Make sure all power to the Power Supply Unit is off to prevent accidental contact with high energy and injury to personnel.

NOTICE: Ensure that all the battery temperature sensor cables are fitted into the battery associated with the appropriate PSUs.

CAUTION: The MTS station is to be connected only to those backup batteries, which are in accordance with the applicable electrical codes for the end use country.

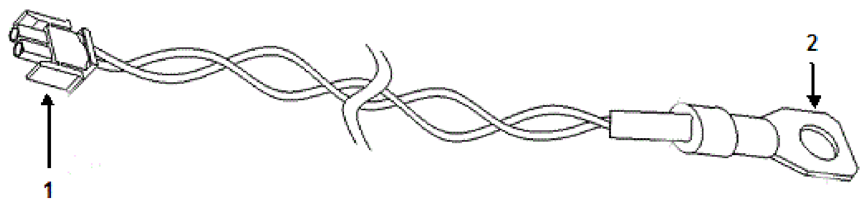
NOTICE: Backup battery systems are not manufactured by Motorola Solutions. Consult the manufacturer's instruction manual and other pertinent documentation for installing a battery systems. Any local regulations shall be adhered to when installing the battery equipment.

Procedure:

1. Plug the temperature sensor cable (Motorola P/N 0166501N84) into the 2-pin connector on one side and attach the sensor to the backup battery according to the manufacturers instructions, which are supplied with the accessory kit. See the following figure.

Figure 48: Backup Battery Temperature Sensor Cable

1	Connect to junction panel
2	Connect to backup batteries rack



2 Make AC cable connection between the facility AC outlet and AC connector on the junction panel using plug (Motorola P/N 3166502A01 for MTS LiTE/MTS 2 and Motorola P/N 3166502A02 for MTS 4) as described in 100–240 VAC Input Power Connections on page 112.

3 Make DC cable connection between backup battery and DC connector on the junction panel using the DC plug (Motorola P/N 3166501A01) as described for -48 VDC input power connections in -48 VDC Input Power and Backup Battery Charging Connections on page 106. It is recommended that an in-line fuse (20 A slow-blow type) should be installed in the negative line near to the battery.

4.5.3.7

MTS LVD Kit Installation

This section provides a quick reference for installation of the LVD Kit for use with both MTS 2 and MTS 4. The MTS LVD kit consists of an aluminum housing including Power relay and push button for hot activation of LVD and controller cable for plugging the LVD to an MTS base station.

When installed, the kit enables a low voltage disconnection option of batteries connected to an MTS backup system, as a discharge of a battery pack below 40,5V can cause permanent damage.

The LVD also offers a push button which gives an override function, which powers up the Base station power supply, which also will enable normal activation of the LVD.

Section Installing the MTS LVD Kit on page 122 describes how to install the MTS LVD kit. For installing the MTS LVD kit, the following tools are needed:

- PZ2 and PH2 screwdriver
- Hammer
- Cutting tool for cable ties, etc.
- 2 Nm torque tool and crimp tool for ring terminal (optional)

The following figures depict the relay connection as diagrams.

Figure 49: MTS LVD Kit Relay Connection Diagram – Single PSU

1	To DC Main circuit breaker
2	Connect to Power outlet on Site Controller
3	Power Supply 48 VDC

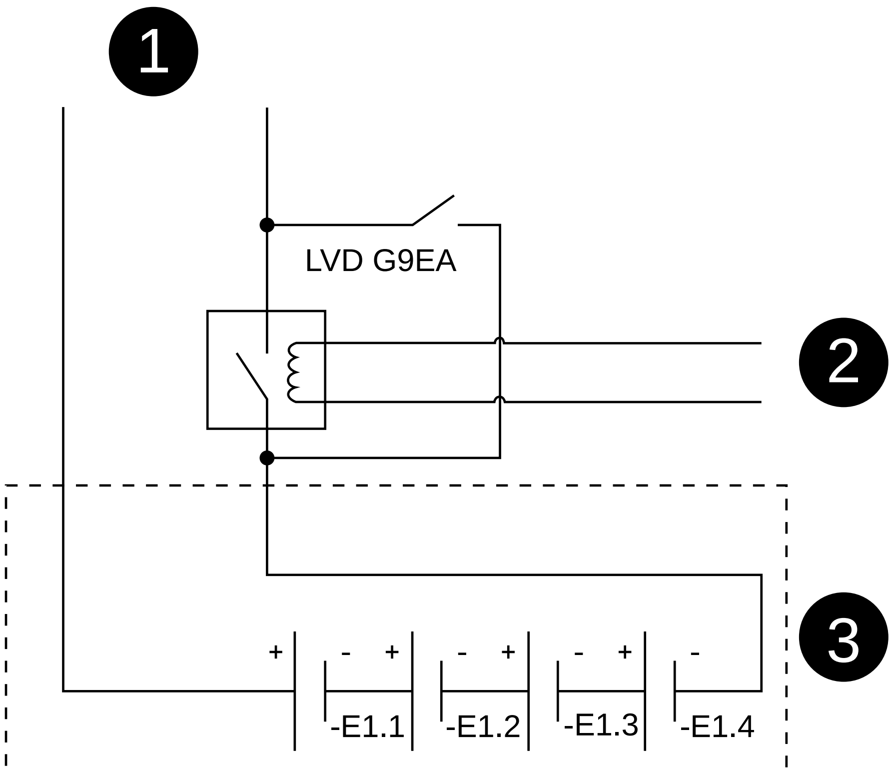


Figure 50: MTS LVD Kit Relay Connection Diagram – Dual PSU, Dual Batteries

A	To PSU 1
1	Connect to Power 1 on Site Controller 1
2	To DC Main circuit breaker
5	Power Supply 48 VDC
B	To PSU 2
3	To DC Main circuit breaker
4	Connect to Power 2 on Site Controller 1 or Power 1 on Site Controller 2
5	Power Supply 48 VDC

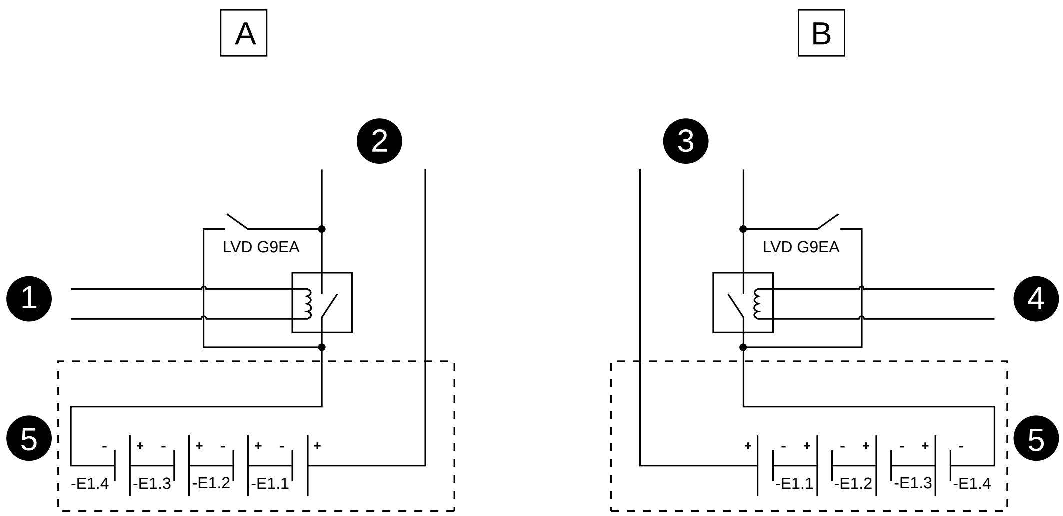
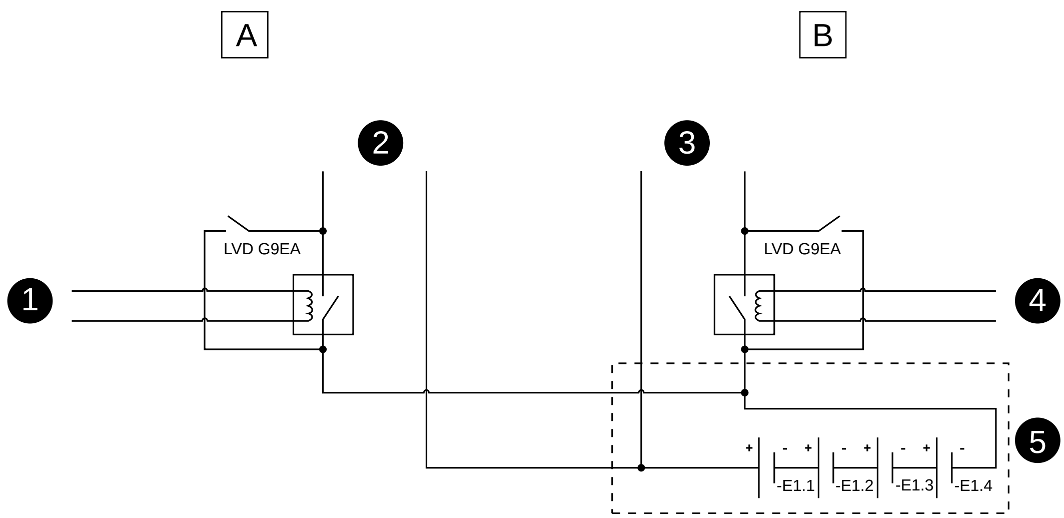


Figure 51: MTS LVD Kit Relay Connection Diagram – Dual PSU, Single Battery

A	To PSU 1
1	Connect to Power 1 on Site Controller 1
2	To DC Main circuit breaker
B	To PSU 2
3	To DC Main circuit breaker
4	Connect to Power 2 on Site Controller 1 or Power 1 on Site Controller 2
5	Power Supply 48 VDC



The number of LVD Kits used depends on the type of MTS:

- For MTS 2, only one LVD is necessary.
- For MTS 4 with two batteries, two LVD devices have to be used (one LVD for each PSU).
- For MTS 4 powered with a single battery, LVD battery cables should be connected in parallel. LVD controller cables should be connected to separate PSUs so each PSU controls a LVD.
- For MTS with XHUB configuration, see the first two points in this list.

4.5.3.8
Installing the MTS LVD Kit

Procedure:

1. Unpack the kit and check if all items are present.

   WARNING: Working on live system is hazardous, switch off power!

2. Perform the following actions:

   a Connect the battery cables (Ø6 ring terminals apply) using a PH2 screwdriver. Recommended torque is max 2 Nm.

b Two spare Ø6 terminals for 16 mm^2 cable are included. Special crimp tool applies on fitting these (not included).

c Click the protection cap on. Additional break away windows are available on cap allowing multiple entry of cables.

NOTICE: Make sure no damage are done on cables by sharp edges on the cap.

d Check that cables are secured properly and tighten the included cable tie retainers.

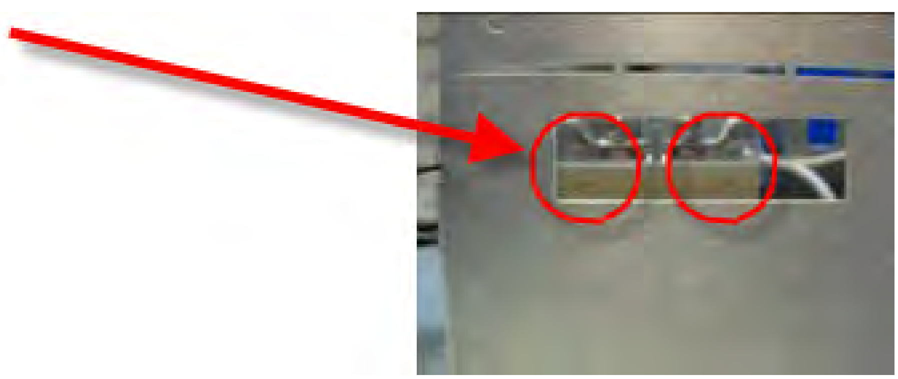
WARNING: Be very careful not to short circuit the battery poles.

NOTICE: The cables shall not touch the metal housing.

Figure 52: MTS LVD Kit Battery Cable Connections

3 Note the small + and – signs on the side of the relay. The pole with the – sign is recommended to be connected to the – pole on the battery.

Figure 53: MTS LVD Kit Plus and Minus Signs



4 Flip the backplate by hand, and insert the 2 rivet plugs as in the following figure.

Figure 54: MTS LVD Kit Backplate Plugs

5 Mount the LVD housing to the intended location, i.e. on top of the MTS as shown in Figure below, using a hammer for snapping in the screw.

Figure 55: Mounting the MTS LVD Kit

NOTICE: The plug fits into any Ø7 mm hole. Center diameter between the two rivet plugs is 90 mm.

6 Locate the **Power** connector on the Site Controller and disconnect this.

7 Plug the LVD controller cable into the now empty power slot and plug the existing power plug just removed in step above into the empty socket on the controller cable.

8 Secure LVD controller cable using cable ties to the best possible routing toward the LVD relay. Avoid any potential damages on cable due to sharp edges etc.

9 Switch power on.

10 Check if the relay is engaged, when MTS 4 is powered up.

4.6 RF Antenna Connections

In the MTS 2, the RF antenna connectors are placed on the junction panel, see Figure 56: Base Radio Antenna Connections – MTS LiTE on page 125, Figure 57: Base Radio Antenna Connections – MTS 2 on page 126 and Figure 58: Base Radio Antenna Connections – MTS 2 Non Duplexed on page 127. In the MTS 4, the RF antenna connectors are located in the top of the cabinet and integrated with the filter tray, see Figure 59: Base Radio Antenna Connections – MTS 4 on page 128.

Figure 56: Base Radio Antenna Connections – MTS LiTE

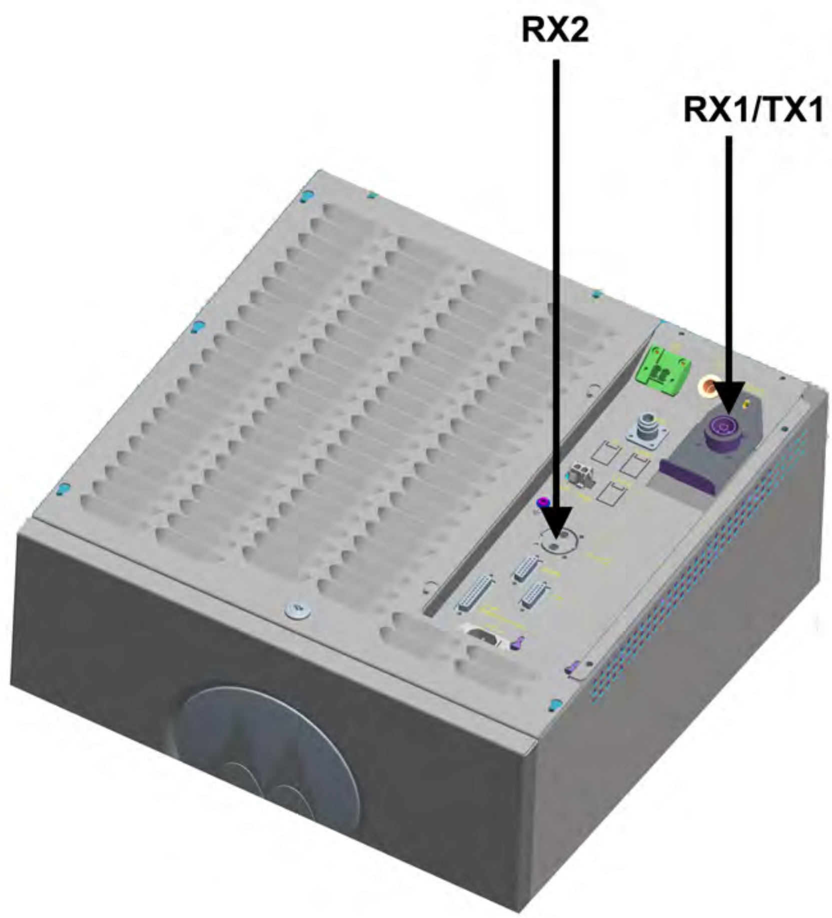


Figure 57: Base Radio Antenna Connections – MTS 2

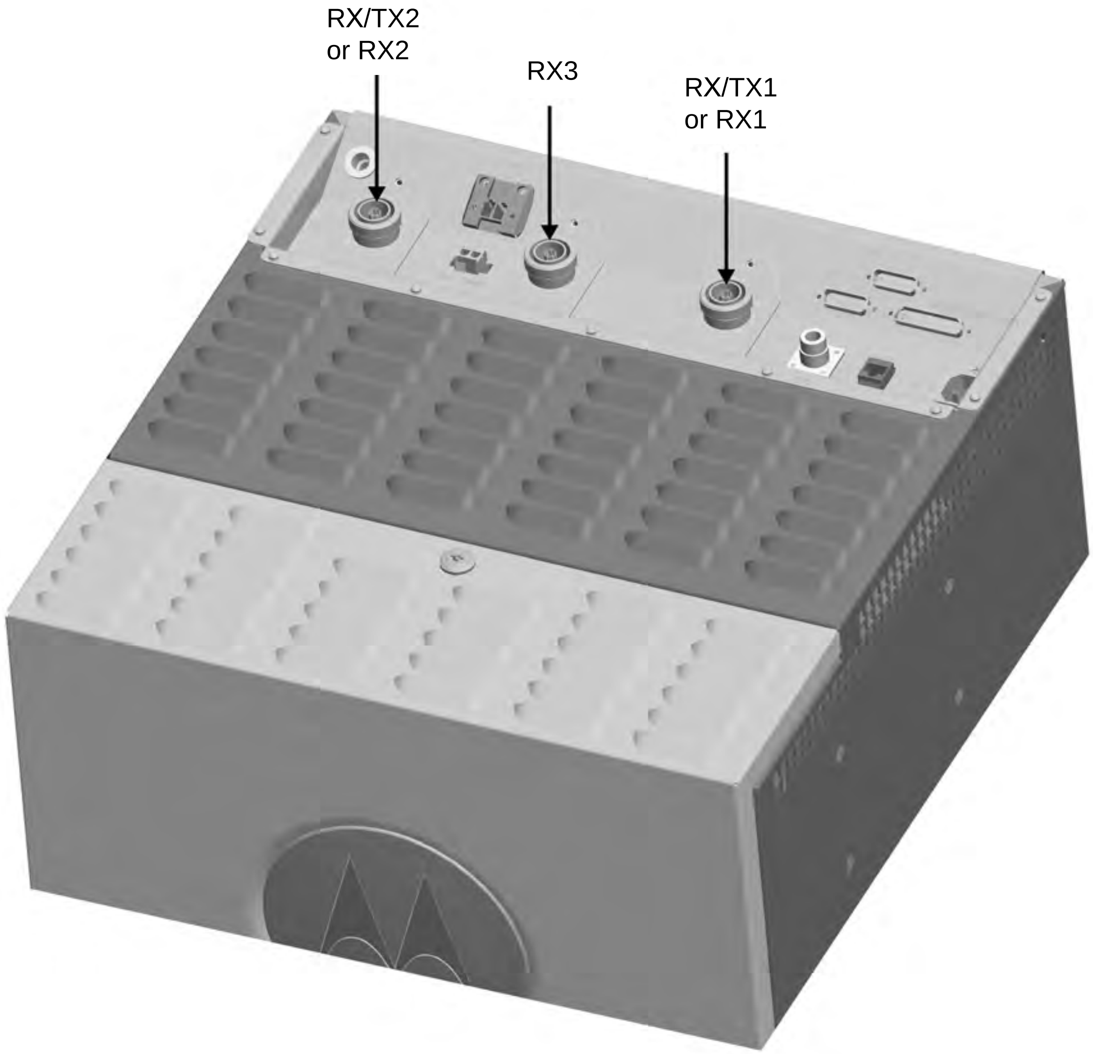


Figure 58: Base Radio Antenna Connections – MTS 2 Non Duplexed

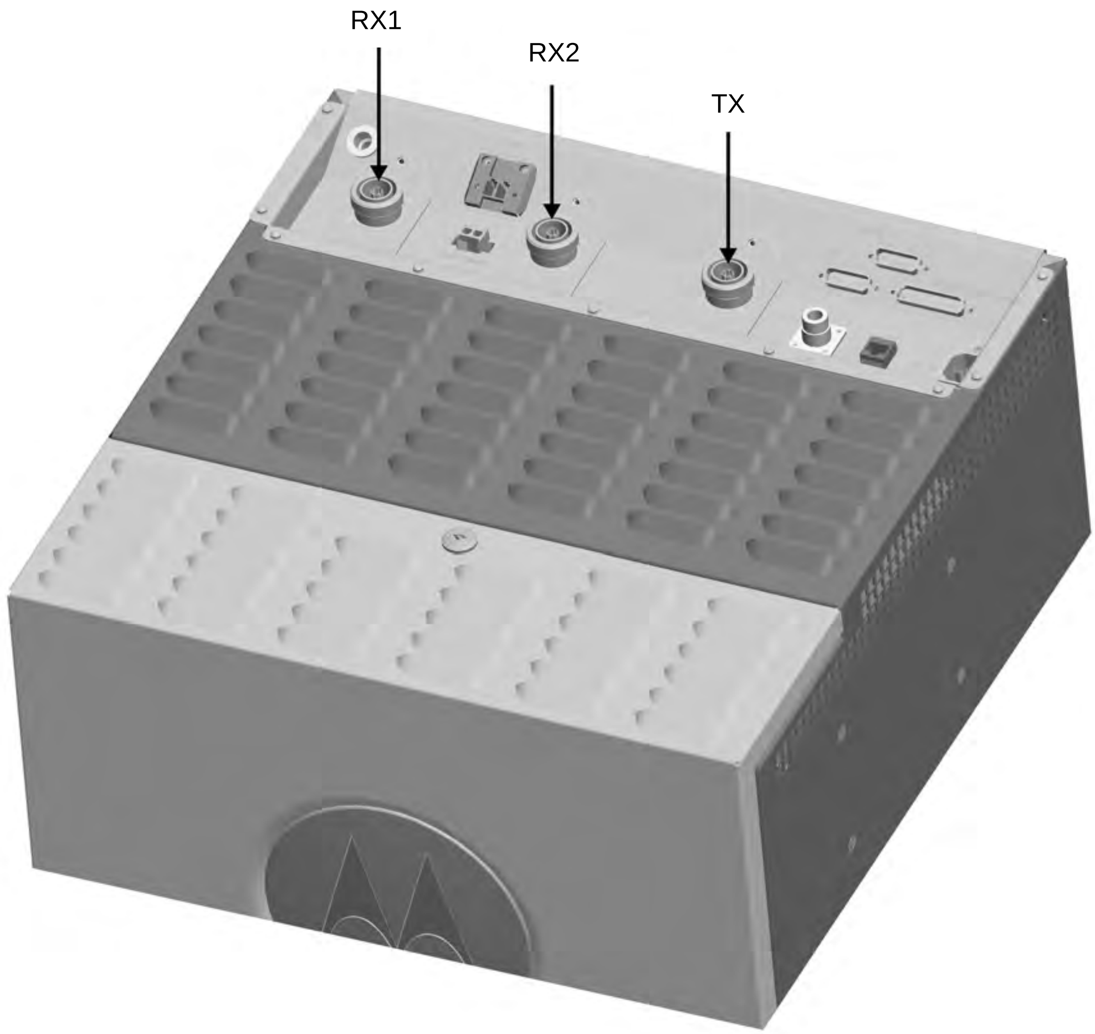
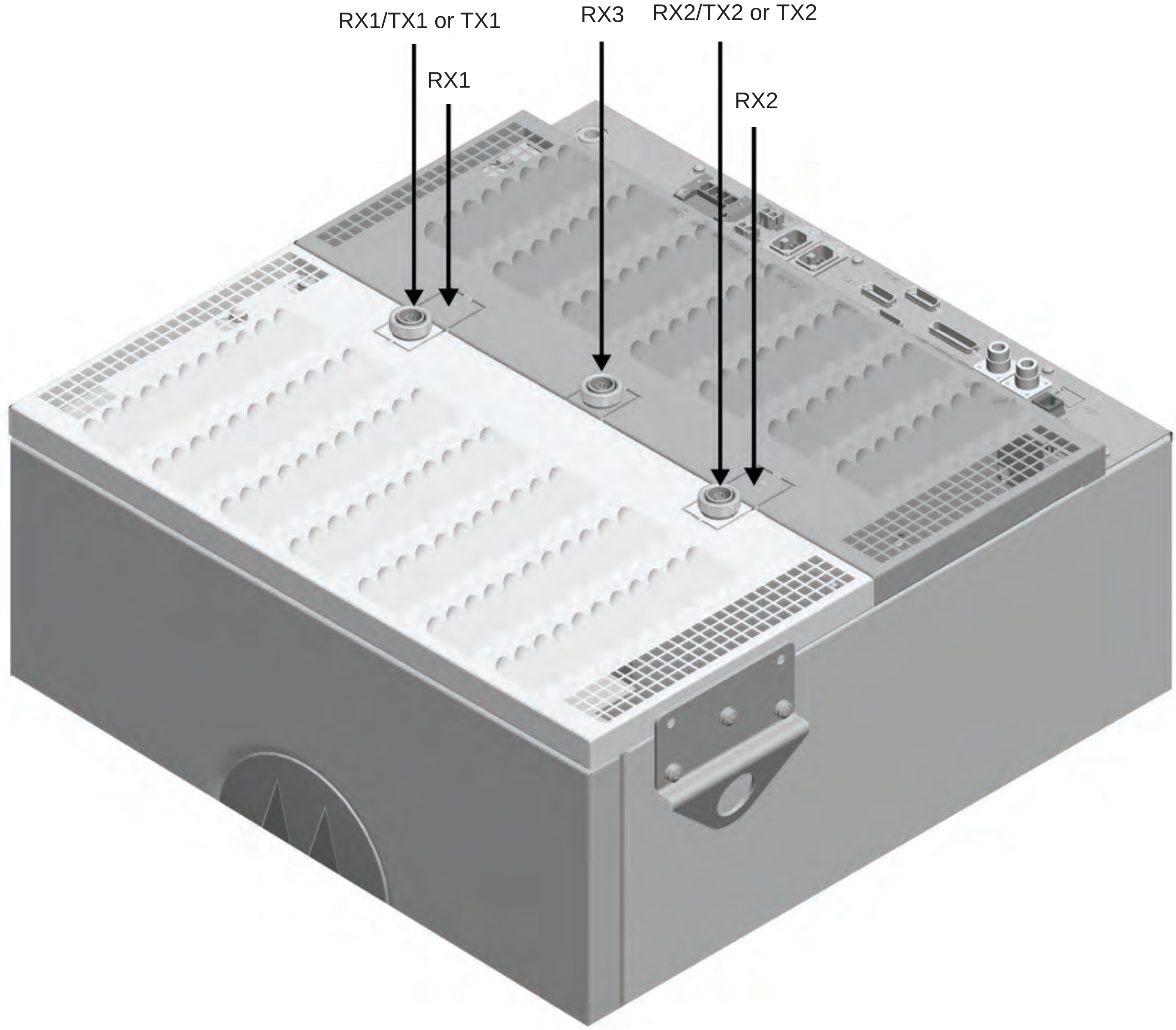


Figure 59: Base Radio Antenna Connections – MTS 4



The antenna leads should be dropped above the MTS cabinet as per the site plan. It is assumed that the Base Radio antennas have been installed before and that the RFDS section is properly configured. (If required, refer to chapter Interconnection and Internal Cabling on page 163, section RF Cabling on page 193 for RF cabling diagrams.)

Identify and tag all antenna cables designated for connection to the MTS. Be sure to document this information for future use.

NOTICE:
Proper surge protection should be installed on RF inputs to prevent potential damage to the MTS. See Surge Arrestors and Suppliers on page 488 in Field Replaceable Units (FRUs) on page 478 for more information.

The antenna connectors are DIN 7–16. The center connector is usually silver coated, the outer body is usually aluminum or silver. It is recommended that mating antenna feed connectors match metal plating correspondingly.

The screens of the antenna cables have to be grounded near to the MTS in accordance with the R56 guidelines and national standards.

Table 19: Antenna Connections

MTS RF Antenna Configuration	Low Power [W]	High Power [W]	Number of BRs
MTS LiTE			
TX/RX on 2 ant.	25	40	1 BR
TX on 1ant., RX on 1 ant.	25	40	1 BR
MTS 2			
TX/RX on 2 ant.	25	40 (20)	1 2 BRs
TX on 2 ant., RX on 1 ant.	25	40 (20)	1 2 BRs
TX on 1ant., RX on 1 ant.	10	25 (10)	1 2 BRs
TX on 1 ant., RX on 2 ant.	10	25 (10)	1 2 BRs
MTS 4			
TX/RX on 2 ant.	25	40 (20)	1 2 BRs*
	10	25 (10)	3 4 BRs
TX on 2 ant., RX on 1 ant.	25	40 (20)	1 2 BRs*
	10	25 (10)	3 4 BRs
TX on 2 ant., RX on 2 ant.	25	40 (20)	1 2 BRs*
	10	25 (10)	3 4 BRs
TX on 2 ant., RX on 3 ant.	25	40 (20)	1 2 BRs*
	10	25 (10)	3 4 BRs
TX on 1 ant., RX on 1 ant.	10	25 (10)	1 4 BRs
TX on 1 ant., RX on 2 ant.	10	25 (10)	1 4 BRs
TX on 1ant., RX on 2 ant.	10	25 (10)	1 4 BRs
TX on 1 ant., RX on 3 ant.	10	25 (10)	1 4 BRs

*This configuration is not currently available.

NOTICE:
In the preceding table, *Low Power* is valid for 400 MHz and 260 MHz, while *High Power* is valid for 400 MHz, 800 MHz and 900 MHz.

The numbers illustrated are applicable for TETRA with TEDS numbers within parentheses.

4.7
Expansion Cabinet Connections

With an Expansion Cabinet, a site may be increased by up to four Base Radios per Expansion Cabinet. The MTS 4 Expansion Cabinet can be placed on either the left side of the MTS 4 Prime Cabinet or on the right side. Different scenarios of connecting the MTS 4 Expansion Cabinet with the MTS 4 Prime Cabinet are described in the following sections.

4.7.1
TX Connections

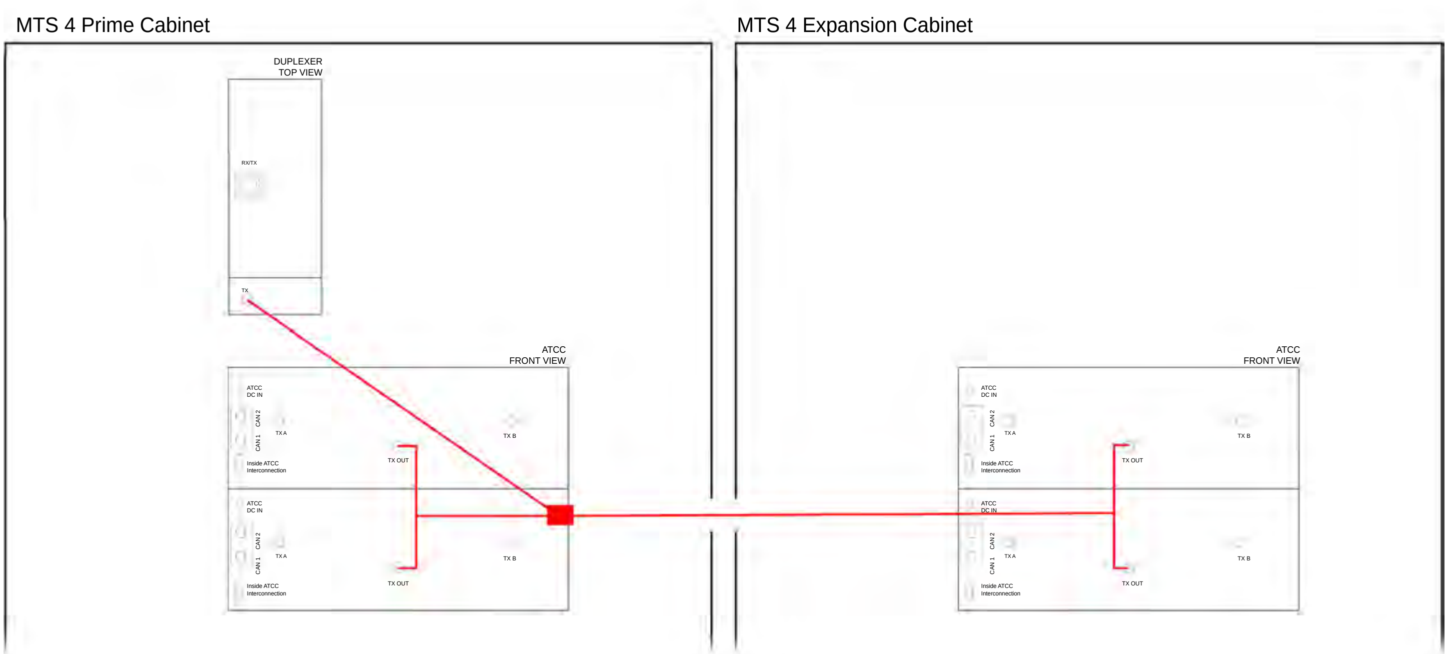
Depending on the Prime Cabinet configuration, TX connections between the MTS 4 Prime Cabinet and the MTS 4 Expansion Cabinet can be configured in two ways:

- Combining eight channels onto one Duplexer/Post Filter in the MTS 4 Prime Cabinet using a phasing harness.
- Combining four channels from the MTS 4 Prime Cabinet onto one Duplexer/Post Filter in the Prime Cabinet and combining four channels from the MTS 4 Expansion Cabinet onto another Duplexer/ Post Filter in the Prime Cabinet.

In Figure 60: Connection Between MTS 4 Prime Cabinet and MTS 4 Expansion Cabinet – Phasing Harness on page 130, all the eight channels (four channels from MTS 4 Prime Cabinet and four channels from MTS 4 Expansion Cabinet) are combined using a phasing harness and connected to one Duplexer/Post Filter in the MTS 4 Prime Cabinet.

NOTICE: Tx cable from Prime Cabinet to Expansion Cabinet is routed through the conjunction hole on the side of the cabinets.

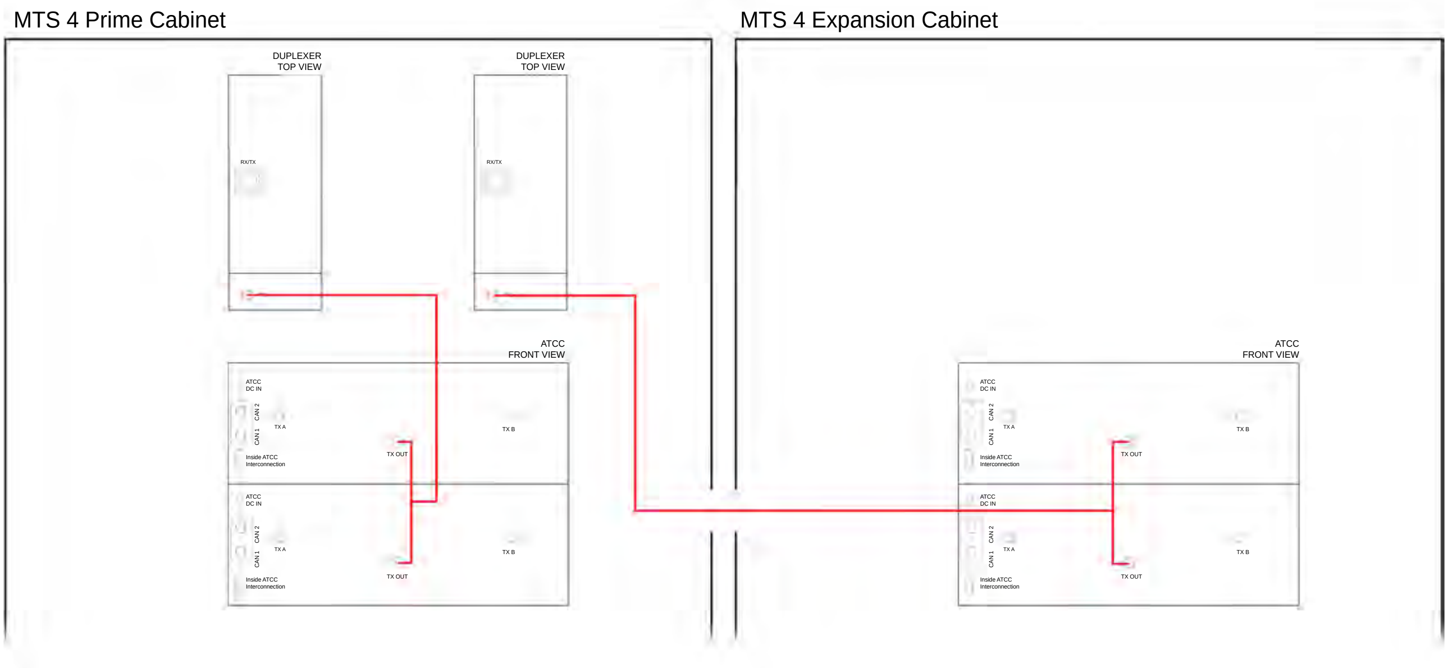
Figure 60: Connection Between MTS 4 Prime Cabinet and MTS 4 Expansion Cabinet – Phasing Harness



In Figure 61: Connections Between MTS 4 Prime Cabinet and MTS 4 Expansion Cabinet – Two Filters on page 131, four channels from MTS 4 Prime cabinet are combined and connected to one Duplexer/

Post Filter in the MTS 4 Prime Cabinet and four channels from the MTS 4 Expansion Cabinet are combined and connected to a second Duplexer/Post Filter in the MTS 4 Prime Cabinet

Figure 61: Connections Between MTS 4 Prime Cabinet and MTS 4 Expansion Cabinet – Two Filters



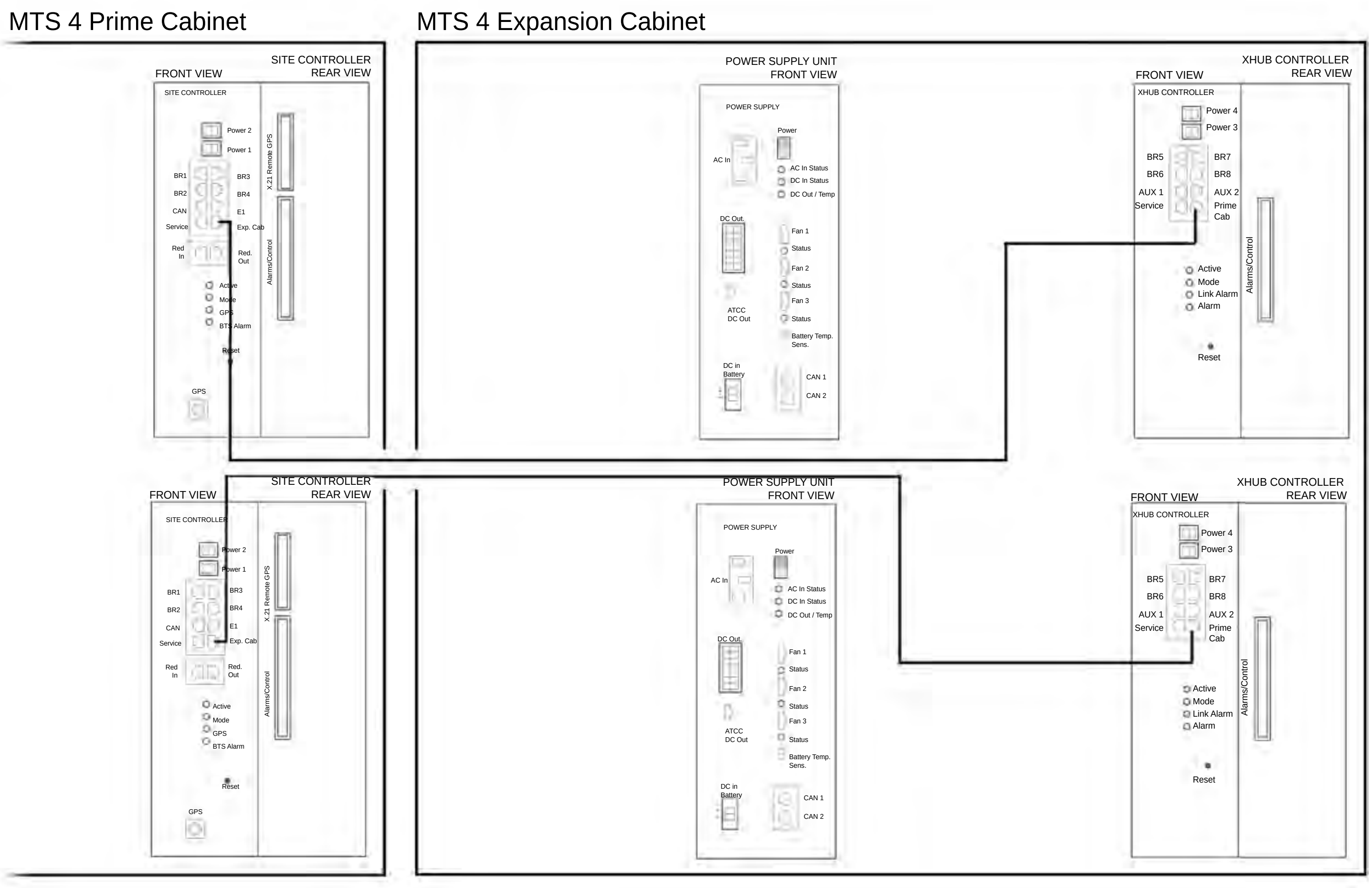
4.7.2

Connections between Site Controller and XHUB Controller

Figure 62: Connections Between Site Controller and XHUB Controller on page 132 illustrates how two SCs are connected to two XHUBs. SC 1/Exp Cab is connected to the XHUB 1/Prime Cab and SC 2/Exp Cab is connected to XHUB 2/Prime Cab. Connections between the Site Controller and the XHUB are the same, if redundant Site Controller is being used.

NOTICE: Ethernet cables from Prime Cabinet to Expansion Cabinet are routed through the conjunction hole on the side of the cabinets.

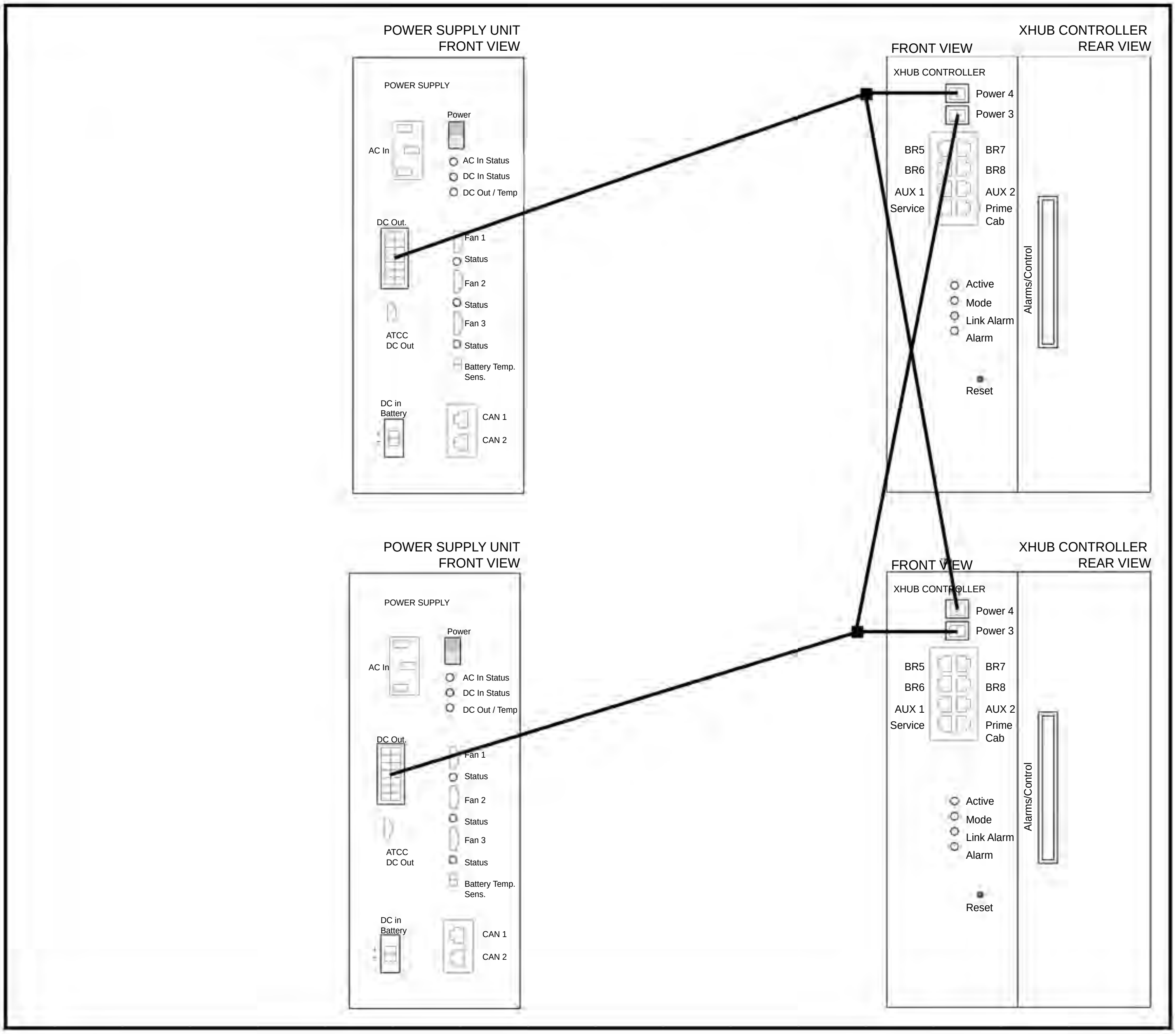
Figure 62: Connections Between Site Controller and XHUB Controller



4.7.3
Power Connection to the XHUB Controllers

Along with the XHUB Controller, the concept of Redundant PSU power is introduced. The power from PSU 3/DC Out is split into two, supplying power to both XHUBs through the Power 3 connector. The power from PSU 4/DC Out is also split into two, bringing power through the Power 4 connector on both XHUBs.

Figure 63: Power Connection to the XHUB Controllers



4.7.4 CAN Bus Cabling

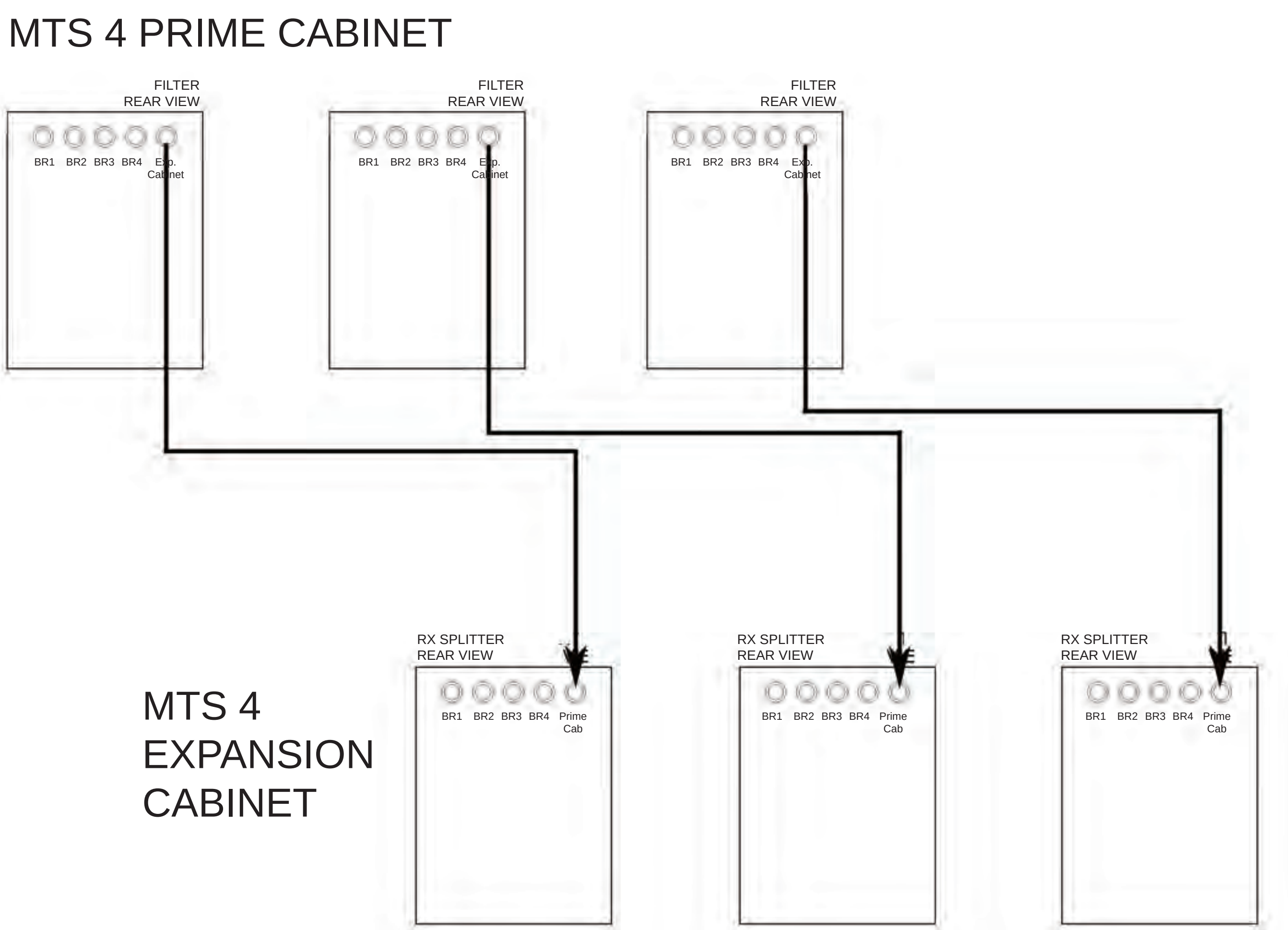
CAN Bus cabling between the MTS 4 Prime Cabinet and the MTS 4 Expansion Cabinet is described in section CAN Bus Cabling – Expansion Cabinet on page 236.

4.7.5
RX Connection

RX connection between the MTS 4 Prime Cabinet is dependent on the diversity of the MTS 4 Prime Cabinet.

- For Single diversity, Filter 1 (far left) in the MTS 4 Prime Cabinet is connected to the RX Splitter 1 in the Expansion Cabinet.
- For Dual diversity, Filter 1 (far left) in the MTS 4 Prime Cabinet is connected to the RX Splitter 1 in the Expansion Cabinet; Filter 2 (far right) is connected to the RX Splitter 2 in the Expansion Cabinet.
- For Triple diversity, Filter 1 (far left) in the MTS 4 Prime Cabinet is connected to the RX Splitter 1 in the Expansion Cabinet; Filter 2 (far right) is connected to the RX Splitter 2 in the Expansion Cabinet; Filter 3 (in the middle) is connected to the RX Splitter 3 in the Expansion Cabinet.

Figure 64: RX Connection Between MTS 4 Prime Cabinet and MTS4 Expansion Cabinet



NOTICE: Rx connection cables between the MTS 4 Prime Cabinet and the Expansion Cabinet are routed on the outside of the cabinet, as shown in the Figure below.

Figure 65: Holes in Top Lid for Rx Cables

4.8
GPS Connections

The MTS Site Controller (SC) has an integrated GPS module and an option for a remote GPS module. The selection is done by configuring MTS using the BTS Service Software (TESS). The integrated GPS module can track both GPS and GLONASS satellites. At least 1 GPS satellite needs to be traced to provide time reference for the SC. Remote GPS module currently supports GPS and Beidou GNSS. GLONASS on the remote GPS module will be supported in the future.

The main purpose of the GPS module is to allow accurate absolute timing of less than ½ of a symbol between adjacent base stations and to supply UTC (Universal Time Coordinate). DIMETRA does not need the functionality of measuring the cable delay at start-up. The Site Controller supports connection to a remote GPS antenna that is 600 m away or less. No manual configuration is required.

The antenna/receiver must have a sufficiently clear view of the sky (10º above the horizon in all directions without any obstructions) to be able to 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 called 3D fix mode. This process can take up to 30 minutes, but typically is completed in less than 5 minutes.

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

4.8.1
GPS Site Reference Operation Modes

The ETSI standard allows two modes of operation of adjacent cells: Synchronized and Non-Synchronized relative to the serving cell. The MTS uses GPS to synchronize to the same time reference. Both the serving MTS and the adjacent cell need to be synchronized to GPS for an adjacent cell to be indicated for synchronization.

MTS can be configured through the BTS Service Software for four different operating configurations, which control the synchronization mode:

- **Automatic Synchronized Configuration (ASC)**

  This configuration is used to specify that the MTS should operate in synchronized mode relative to GPS. However, if the GPS reference is lost, the MTS continues to operate in synchronized mode for a configurable period (free run time – no upper limit). It should be noted that setting this value greater than the recommended values (4 hours) may mean that the BTS is unable to maintain synchronization and can result in call failures and erratic network performance. If the GPS reference is not recovered in this time period, the MTS switches to the non-synchronized mode. If an MTS is started when no GPS reference is available, it operates in the non-synchronized mode.

Non-synchronized mode will not have optimized hand-over performance. When an MTS operates in non-synchronized mode, all the adjacent cells will be indicated as non-synchronized with this MTS. By default the re-synchronization of MTS running non-synchronized is done automatically whenever there is valid GPS reference signal and the site does not handle traffic. Prolonged operation in non-synchronized mode will eventually lead to critical alarms and the frequency accuracy of the MTS will no longer be guaranteed.

To maintain the frequency accuracy, it is necessary that the oscillator within the MTS is periodically recalibrated. The periodic recalibration happens automatically when a GPS reference is present. The critical alarms indicate that recalibration is due and should be performed without delay.

- **Forced Non-Synchronized Configuration (FNC)**

  FNC is not recommended for System Release D6.0. In this configuration, the MTS always operates non-synchronized to GPS. The failure or lack of GPS will not be reported as an alarm. The sets of events that are reported in ASC and FNC modes are the same, however the events reported in ASC mode with **Minor** severity, in FNC mode are reported with lower – **Normal** severity.

  The MTS starts up in non-synchronized mode regardless of the presence of a GPS signal. However if GPS is present, the site reference is trained accordingly. Prolonged operation in this configuration without GPS eventually leads to critical alarms and the frequency accuracy of the MTS is no longer guaranteed. Frequency accuracy is expected to be maintained for 4 to 8 years.

  To maintain the frequency accuracy, it is necessary that the oscillator within the MTS is periodically recalibrated (every 8th year (400 MHz and 260 MHz) or every 4th year (800 MHz and 900 MHz)). The periodic recalibration happens automatically when a GPS reference is present. If no GPS reference is present, it is necessary to ship the Site Controller for calibration at a repair center. The critical alarms indicate that recalibration is due and should be performed without delay.

  It is possible to change configuration with BTS Service Software. The new configuration will only be active after an MTS reset.

- **NSC mode**

  This mode can be configured through TESS for compatibility reasons but will be treated as ASC.

- **Non-GPS / Non-Synchronized mode**

  The Non-GPS / Non-Synchronized mode introduced in System Release D6.1 guarantees frequency accuracy of the site reference and the introduction of a Network Time Server (NTS) using Network Time Protocol (NTM) allows the MTS to operate in non-synchronized mode without being characterized as a malfunction and with accurate frequency and Network time.

  When the BTS is GPS non-synchronized and without GPS and if an NTS is available the NTP time shall be used to maintain and adjust frequency stability, network time for UTC (Coordinated Universal Time) and timestamps for BTS log.

  If GPS is not available and an NTS is configured with IP address, the time derived from NTP shall be used for UTC and time stamping of BTS logs.

  If the selected NTS is of sufficient accuracy and the BTS is configured for “Allow NTS frequency locking” the NTS is used for frequency locking of the Oven-Controlled Crystal Oscillator (OCXO), a type of crystal oscillator used to control the frequency of transmitters, base stations, and other communications equipment. The usability of the NTS is based on NTS alarm condition, Stratum, Precision, root distance, reference ID, and reference time.

  If GPS is not available and NTS is configured and allowed for locking and the BTS cannot establish the connection to the NTS or the NTS is not usable for a period of more than an

NTS_Free_Run_Timer the operator is informed by the `GPS AND NTS LOST` alarm that the NTS is failing.

4.8.2 Tracking Criteria

To allow a system to successfully initialize for the first time at a new location, the Position Dilution Of Position (PDOP) must be less than 2.0. A low PDOP value indicates a low error (higher accuracy) in the position calculated by the GPS receiver. A site with a large PDOP value may incur a delay when the site is first initialized.

PDOP is an accuracy factor, which is a function of the relative positions of the satellites. If the satellites being tracked by the GPS receiver are within close relative proximity to each other, the resulting PDOP is poor. Conversely, if the satellites are relatively far from each other, PDOP improves. Because any error in position results in a timing error in the BR transmission, the BRs are not allowed to key until the position error is acceptably low.

CAUTION: After FRU replacement or moving the Site Controller in some other manner, the position memory is reset using MMI commands.

Excessive PDOP values may result from the GPS receiver not having an adequate view of the sky to initially determine its position. Motorola Solutions recommends locating the antennas such that there are no PDOP values that exceed 10.0 for periods of more than 15 minutes. Maintaining a maximum reliability requires tracking four satellites at all time.

Site Reference requirements for proper operation:

- Tracking a minimum of four satellites during initial start-up
- Sustaining PDOP less than 10
- Working in 3D fix mode for the most of the time

4.8.3 GPS Start Up

GPS startup is the significant contributing factor in determining system start up times. The start up times are counted from applying power to the system until GPS LED is solid green illuminating.

Initial Start

This is the first time an MTS is powered on or after the almanac or position information has been erased from non-volatile memory (NVM). The site needs to locate 4 satellites and then train the reference oscillator from an unknown state.

Warm Start

The MTS has been previously powered up and the non-volatile memory contains valid almanac and position information and the reference oscillator was trained before starting the site. The times quoted are for a power-off restart. A software restart will be slightly faster.

Soft Restart

This is an MTS restart, where power is maintained during the reset, for example, the remote MTS restart after software upgrade. The GPS receiver will continue to track satellites during the MTS restart, thus eliminating the search for satellites phase of start-up.

Table 20: GPS Start-up Time

Initial Start		Normal Start		Soft restart	
Typical	Maximum	Typical	Maximum	Typical	Maximum
10 Minutes	30 Minutes	4 Minutes	10 Minutes	90 Seconds	8 Minutes

NOTICE: If these start-up times are exceeded, then follow the procedures for GPS Site Controller fault indications section.

4.8.4
Remote GPS Antenna/Receiver Connection

The remote GPS antenna connectors of DB15 type are placed on the junction panel, see Figure 66: Remote GPS Receiver Connection on MTS LiTE Junction Panel on page 138 for MTS LiTE, Figure 67: Remote GPS Receiver Connection on MTS 2 Junction Panel on page 139 for MTS 2 and Figure 68: Remote GPS Receiver Connection on MTS 4 Junction Panel on page 139 for MTS 4.

NOTICE: Figure 67: Remote GPS Receiver Connection on MTS 2 Junction Panel on page 139 and Figure 68: Remote GPS Receiver Connection on MTS 4 Junction Panel on page 139 depicts the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 66: Remote GPS Receiver Connection on MTS LiTE Junction Panel

Figure 67: Remote GPS Receiver Connection on MTS 2 Junction Panel

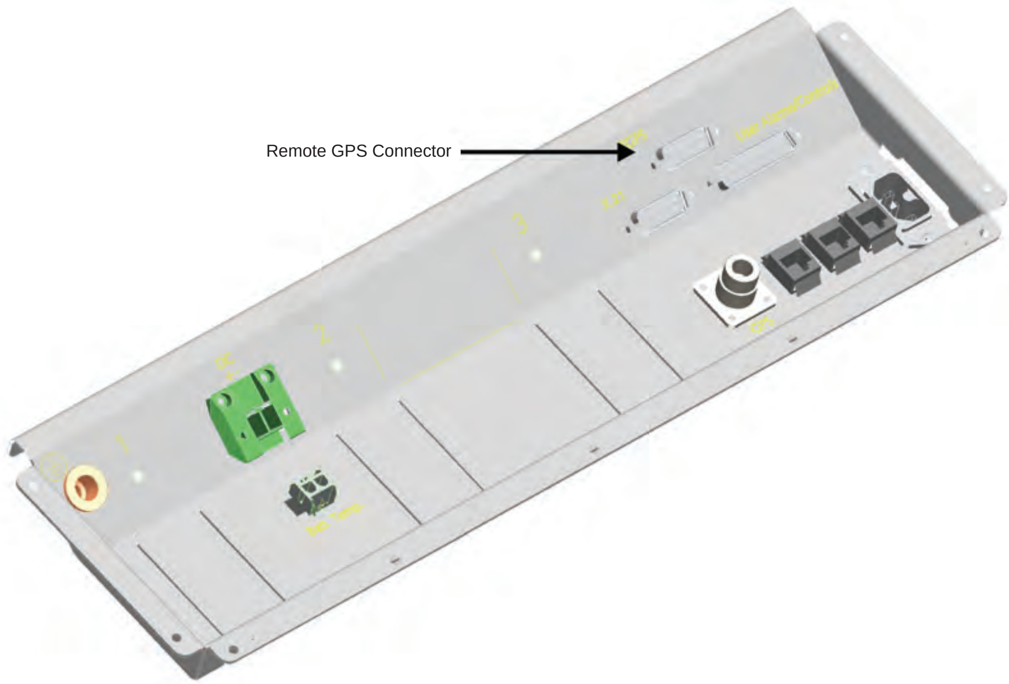
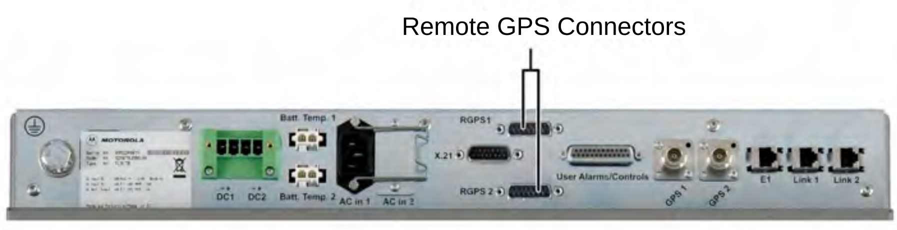


Figure 68: Remote GPS Receiver Connection on MTS 4 Junction Panel



4.8.4.1
Remote GPS Receiver Placement Requirements

Mount the GPS antenna below the tallest point on the tower, pole, or roof of the MTS site.

For systems in the northern hemisphere, mount the GPS antenna to maintain a clear view of the southern sky. For systems in the southern hemisphere, mount the GPS antenna to maintain a clear view of the northern sky.

The recommendation is to maintain a view to the entire sky (10º above the horizon in all directions without any obstructions).

Isolate the remote GPS receiver from RF interference by mounting the antenna at least 3.7 m (12 in.) horizontally from other transmitting antennas. For mounting and physical installation, see instructions enclosed with the external GPS receiver head.

4.8.4.2
Remote GPS Receiver Cabling

The remote GPS (RGPS) receiver is connected to the junction panel using one of the three standardized cables or a customer provided alternative.

RGPS Cables

The RGPS receiver cable has to be a shielded cable.

The screen has to be grounded through the metal shell of the D type connector. However, it is required for the cable screen to be connected also to the site ground where the cable enters the building.

It is similar to the grounding applied to the RF cables. See *Motorola Standards and Guidelines for Communications Sites, R56*.

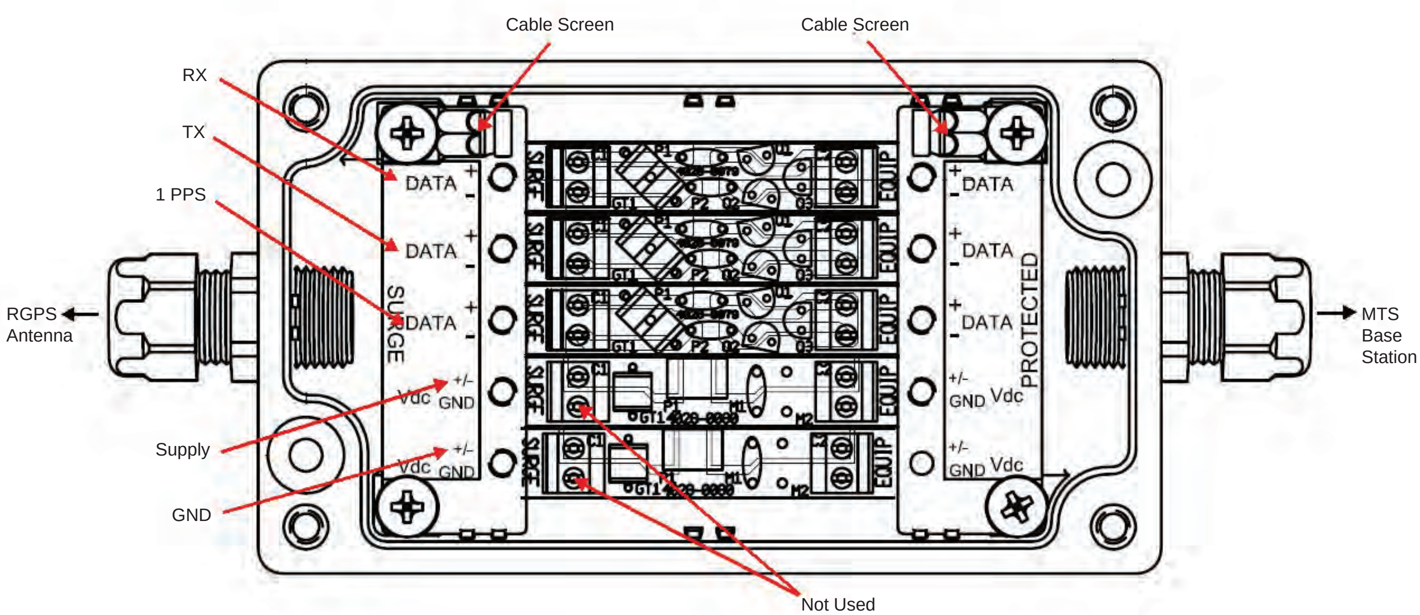
Table 21: RGPS Cables

Pos.	Length	Kit Number
1	40 m	3066564B01
2	150 m	3066564B02
3	600 m	3066564B03

RGPS Surge Protectors

Use the modular data surge protector (Part Number: GMDN0889A) for the remote GPS cable, shown in the following figure. The surge arrestor must be installed on a grounding plate, or a ground connection stud added to the side of the box.

Figure 69: RGPS Modular Data Surge Protector



NOTICE: The duplicated Supply and GND connections should be joined together at the surge protector.

RGPS Connectors

The RGPS standardized cables are terminated with a Deutsch connector (remote GPS receiver site) and a metal shell 15-pin SubD connector (MTS site). The cable is supplied with an additional SubD connector insert that enables the cable shortening and re-termination where required.

Figure 70: GPS Site Deutsch Connector no 680023-2212P1 (case-mount)

Figure 71: MTS Site RGPS Connector Pinout no DB15F

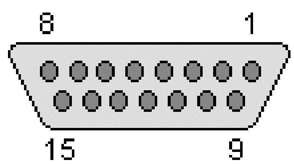


Table 22: RGPS Connector

MTS Site (15-pin SubD connector)		Description	Surge Protection	GPS Site (12-pin Deutsch connector)	
Pin No.	**Description**			**Color**	**Pin No.**
11	Supply	TWISTED PAIR	GMDN0889 A	White/Blue stripe	1
3	GND		GMDN0889 A	Blue/White stripe	9
4	Rx (RXD_N)	TWISTED PAIR	GMDN0889 A	Green/White stripe	4
12	Rx (RXD_P)		GMDN0889 A	White/Green stripe	5
5	Tx (TXD_N)	TWISTED PAIR	GMDN0889 A	White/Grey stripe	2
13	Tx (TXD_P)		GMDN0889 A	Grey/White stripe	3
2	GND	TWISTED PAIR	GMDN0889 A	Orange/White stripe	8
10	Supply		GMDN0889 A	White/Orange stripe	10

MTS Site (15-pin SubD connector)		Description	Surge Protection	GPS Site (12-pin Deutsch connector)	
Pin No.	Description			Color	Pin No.
14	1 pps (PPS_P)	TWISTED PAIR	GMDN0889 A	White/Brown stripe	11
6	1 pps (PPS_N)		GMDN0889 A	Brown/White stripe	12
NC	N/A	TWISTED PAIR	GMDN0889 A	Blue/Red stripe	6
NC	N/A		GMDN0889 A	Red/Blue stripe	7
1, 7, 8, 9, 15	Not Connected				

See User Alarms/Controls, X.21, RGPS, and GPS Cabling on page 170.

4.8.5

GPS Antenna Connection

The integrated GPS antenna connectors of N type, are placed on the junction panel, see Figure 72: GPS Antenna Connection on MTS LiTE Junction Panel on page 143 for MTS LiTE, Figure 73: GPS Antenna Connection on MTS 2 Junction Panel on page 144 for MTS 2 and Figure 74: GPS Antenna Connection on MTS 4 Junction Panel on page 144 for MTS 4.

NOTICE:
Figure 73: GPS Antenna Connection on MTS 2 Junction Panel on page 144 and Figure 74: GPS Antenna Connection on MTS 4 Junction Panel on page 144 depicts the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 72: GPS Antenna Connection on MTS LiTE Junction Panel

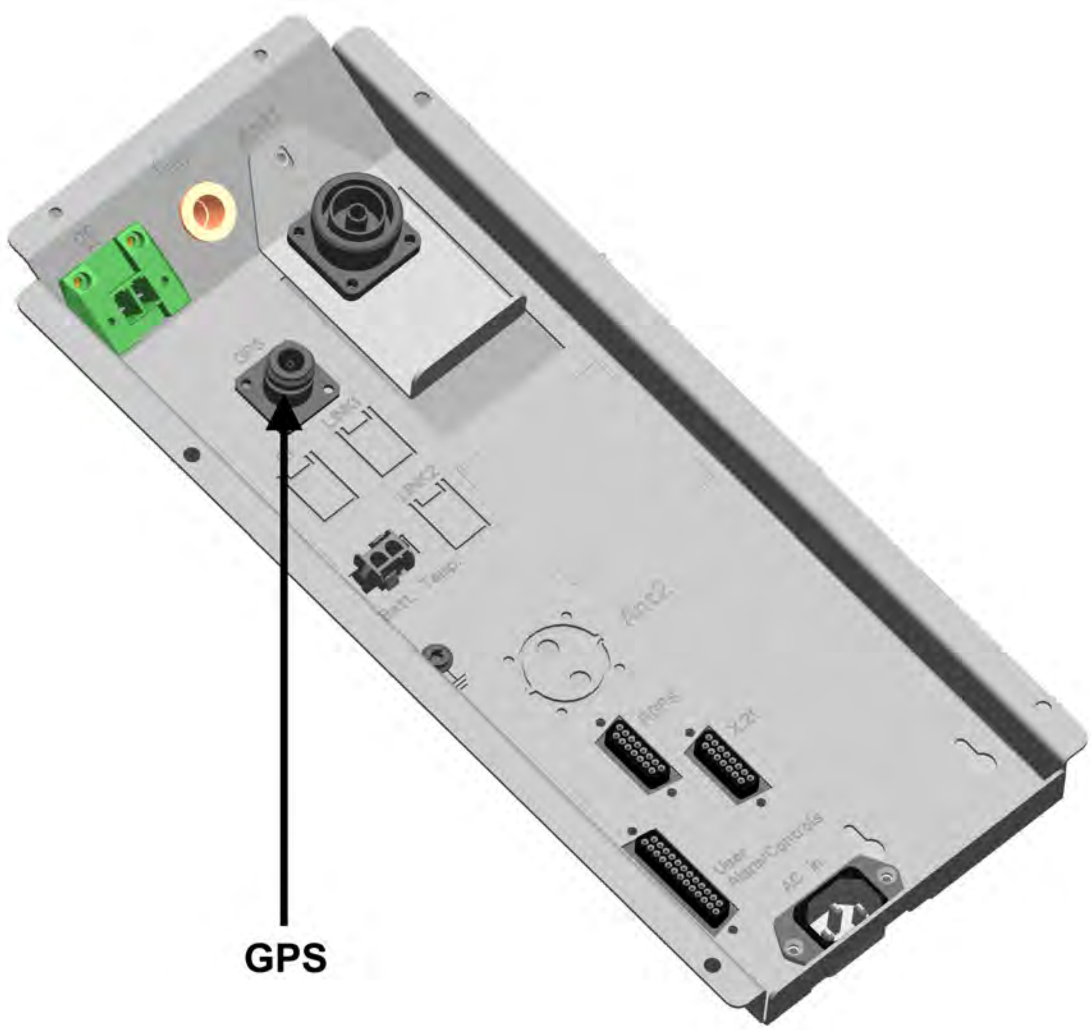
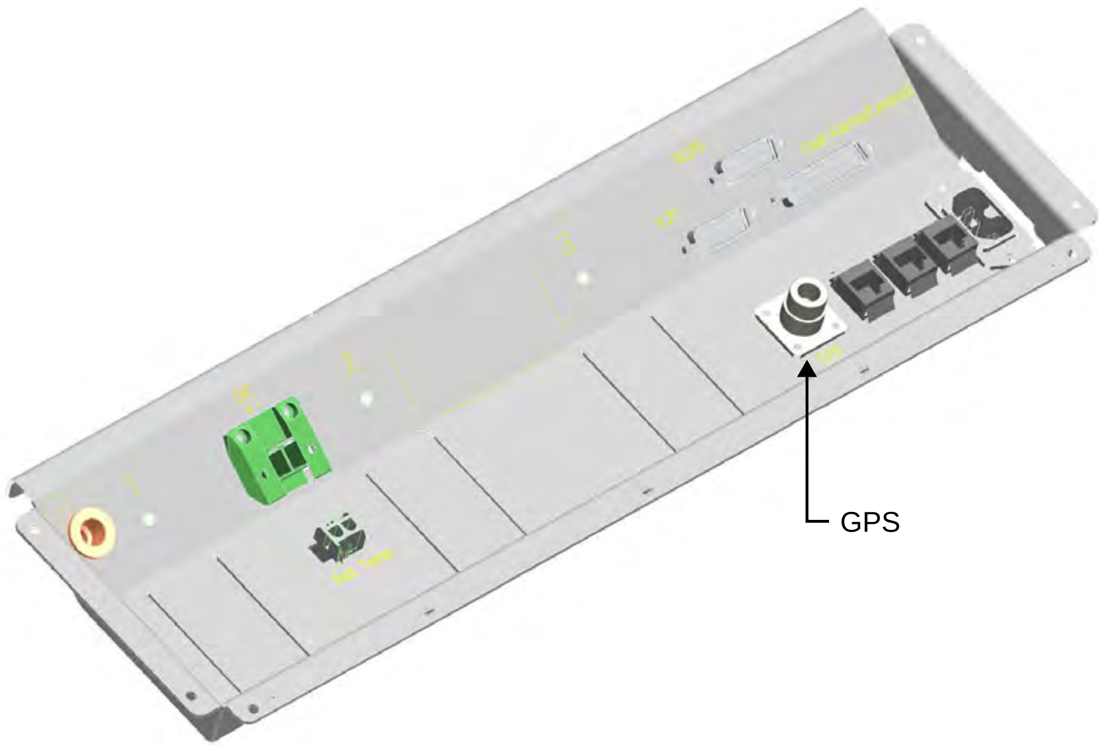


Figure 73: GPS Antenna Connection on MTS 2 Junction Panel



NOTICE: Protect the GPS Antenna with a grounded surge arrestor of the type that allows DC to pass through. See Surge Arrestors and Suppliers on page 488 in Field Replaceable Units (FRUs) on page 478 for more information.

Figure 74: GPS Antenna Connection on MTS 4 Junction Panel

4.8.5.1
GPS Antenna Line Loss

The maximum allowable line attenuation between the antenna and the Site Controller GPS Receiver input is 6dB. There is an additional attenuation of 4dB for foliage. In a typical MTS installation with 1/2 inch low density foam coaxial cable (or equivalent). Do not exceed the 46 m length of the cable run. This is sufficient for most installations.

When considering the use of longer cables, calculate the cable lengths allowing 4.5dB of loss at 1.5 GHz GPS receiver frequency. The interior site cabling and connectors provide the remaining attenuation of 1.5 dB.

4.8.6
GPS Interference Avoidance

You can employ the following two strategies to mitigate against jamming signals:

- Determine a location where adequate GPS signals are available using a hand held receiver and move the Base station GPS antenna to this location.
- Construct a shield (Cardboard Foil is adequate) to exclude the jamming signal. Locate the shield approximately 6 cm from the antenna body and connect it to an earth point.

4.9
X.21, E1-120Ω Cabling

A cable connects the network termination unit (NTU) and the E1/X.21 interface on the MTS Junction Panel, see Figure 75: E1/X.21 and Ethernet Site Link Connectors on the MTS LiTE Junction Panel on page 145 for MTS LiTE, Figure 76: E1/X.21 and Ethernet Site Link Connectors on the MTS 2 Junction Panel on page 146 for MTS 2 and Figure 77: E1/X.21 and Ethernet Site Link Connectors on the MTS 4 Junction Panel on page 146 for MTS 4.

The E1 or X.21 (only one of them can be used) connectors on the Junction Panel are connected with the Site Controller through an internal extension cable. For more information, see E1 and Ethernet Cabling on page 176 and User Alarms/Controls, X.21, RGPS, and GPS Cabling on page 170 in Interconnection and Internal Cabling on page 163.

NOTICE: Figure 76: E1/X.21 and Ethernet Site Link Connectors on the MTS 2 Junction Panel on page 146 and Figure 77: E1/X.21 and Ethernet Site Link Connectors on the MTS 4 Junction Panel on page 146 depicts the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 75: E1/X.21 and Ethernet Site Link Connectors on the MTS LiTE Junction Panel

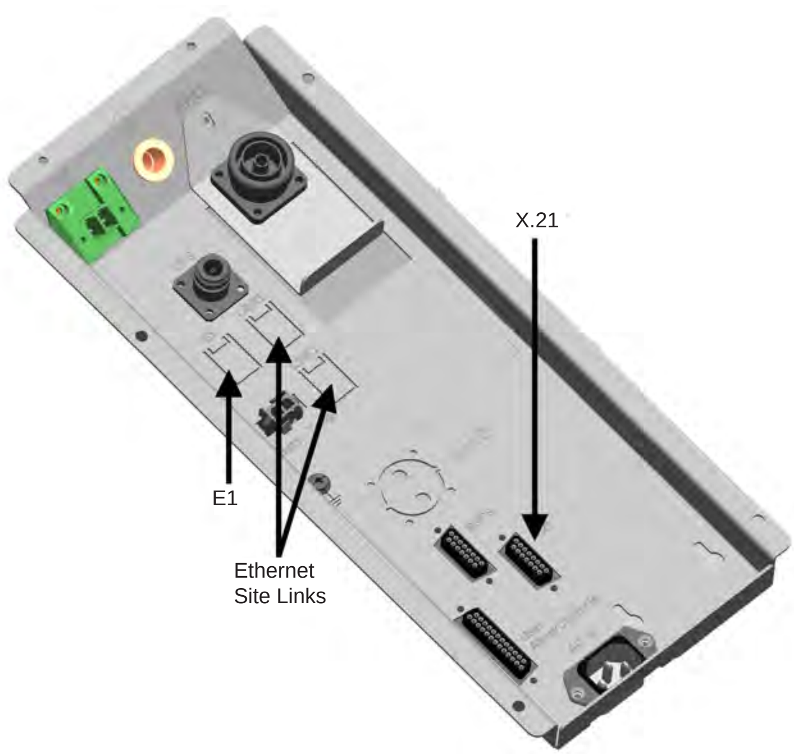


Figure 76: E1/X.21 and Ethernet Site Link Connectors on the MTS 2 Junction Panel

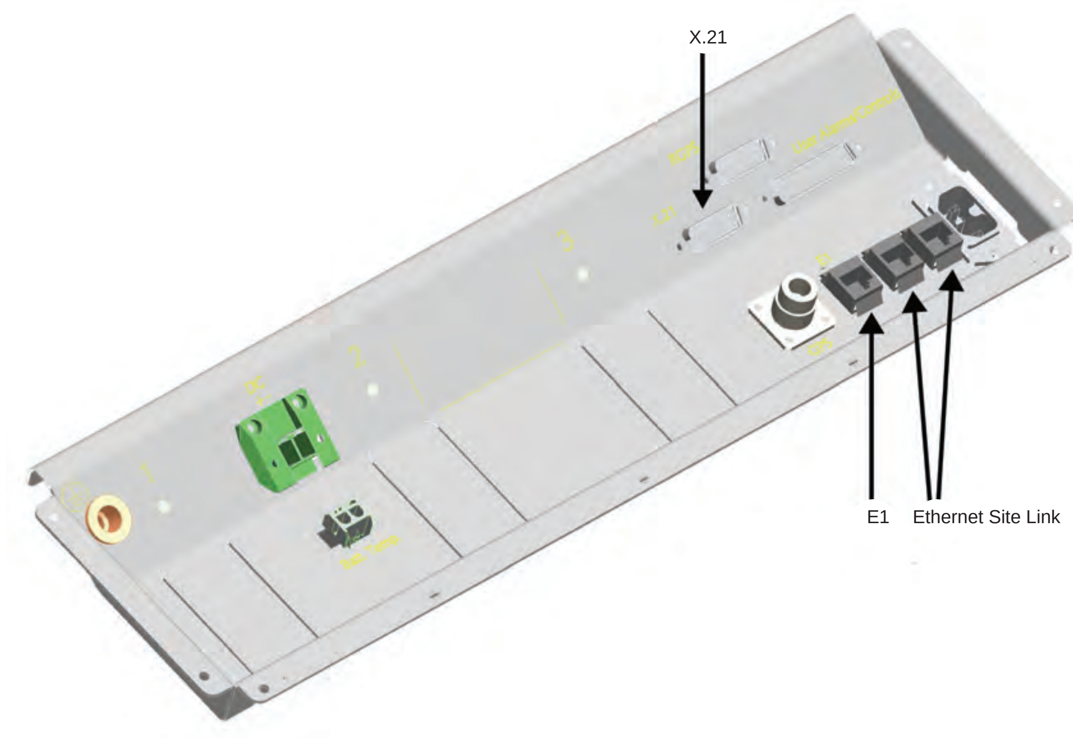
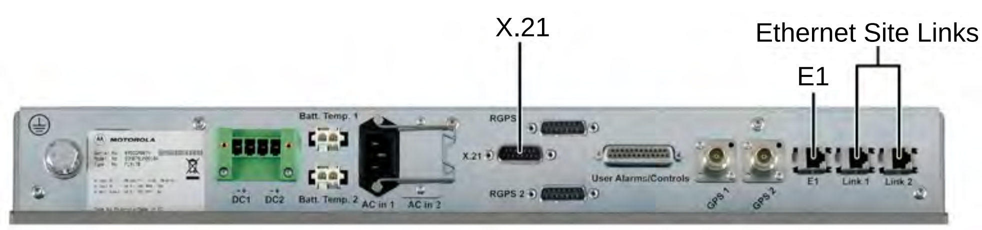


Figure 77: E1/X.21 and Ethernet Site Link Connectors on the MTS 4 Junction Panel



NOTICE:
The network termination unit (NTU) in the same building shall provide the necessary isolation between the X.21/E1 interface and the network, and should be approved for use by the appropriate agency in the end user country.

Do not remove the supplied caplug and retaining bag from the D-type connector of the X.21 or E1 cable.

A surge arrestor should be used. For full instructions and guidelines, please refer always to *Motorola Standards and Guidelines for Communications Sites, R56*.

Table 23: Site Link Connector E1 on Junction Panel on page 147 and Table 24: Site Link Connector X.21 on Junction Panel on page 147 show the pin assignment for E1 and X.21 connection.

The E1 connector described in Table 23: Site Link Connector E1 on Junction Panel on page 147 contains two E1 lines. If only one line is needed, use Receive 1 and Transmit 1. Be aware that the Pin definitions on the Site Controller are different from the E1 connector on the Junction Panel.

Figure 78: Site Link Connector E1 Pinout

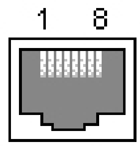


Table 23: Site Link Connector E1 on Junction Panel

Pin No.	Function
1	Receive 1 positive
2	Receive 1 negative
3	Receive 2 positive
4	Transmit 1 positive
5	Transmit 1 negative
6	Receive 2 negative
7	Transmit 2 positive
8	Transmit 2 negative

Figure 79: Site Link Connector X.21 Pinout

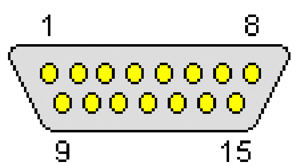


Table 24: Site Link Connector X.21 on Junction Panel

Pin No.	Function
1	Not Used
2	Tx Data B
3	Control B
4	Rx Data B
5	Indication B
6	Signal Timing B
7	Byte Timing B
8	Ground
9	Tx Data A
10	Control A
11	Rx Data A
12	Indication A

Pin No.	Function
13	Signal Timing A
14	Byte Timing A
15	Not Used

4.10
Ethernet Site Link Cabling

Newer versions of the MTS 2 and MTS 4 Junction Panels contain breakouts for Ethernet Site Link connectors (labeled as Link1 and Link2). To gain Ethernet site link functionality on these newer versions of Junction Panel, remove the breakout(s) and insert a RJ45 coupler. For information on placement on the Junction Panel, see the following figures.

Figure 80: MTS 2 Junction Panel E1/X.21 and Ethernet Site Link Connectors

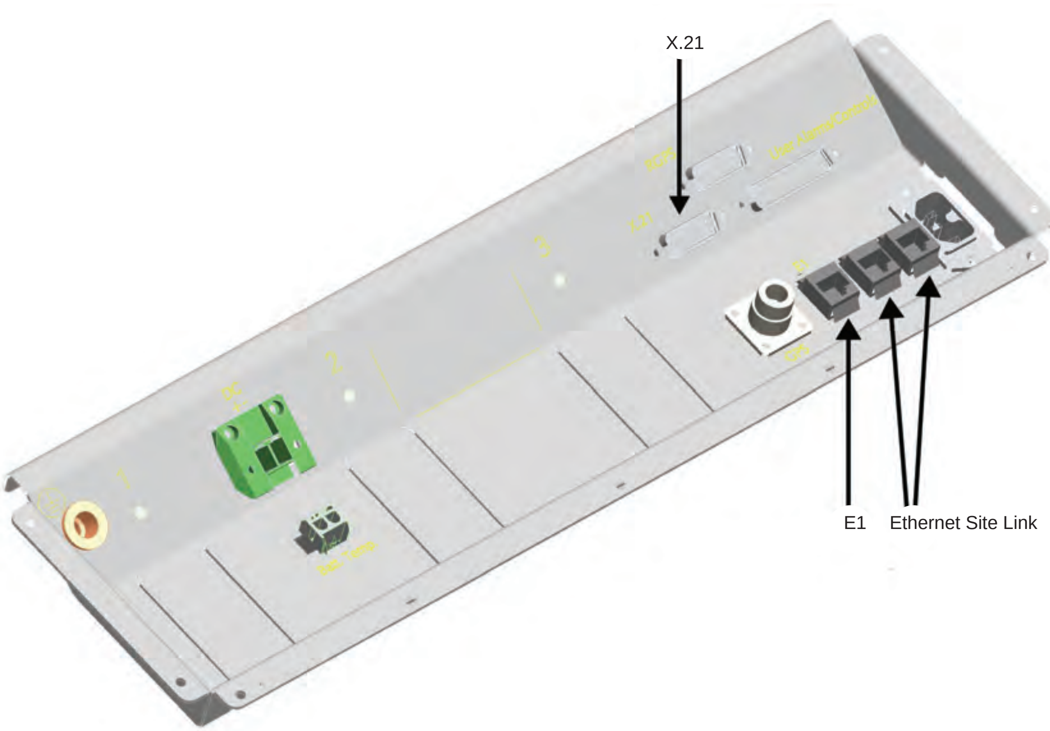
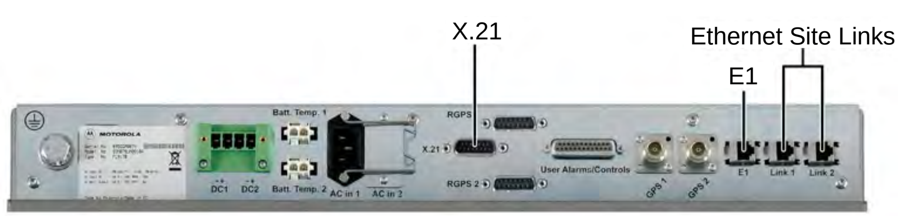


Figure 81: MTS 4 Junction Panel E1/X.21 and Ethernet Site Link Connectors



Previous version of the MTS 2 Junction Panel contains no breakouts while the previous version of the MTS 4 Junction Panel contain an AUX breakout. To gain Ethernet site link functionality on those previous versions of MTS 2 and MTS 4 Junction Panels, use the MTS Ethernet Retrofit Kit. See Ethernet Site Link Retrofit Kit on page 149.

The Site Controller connects to the MTS Link1 and Link2 connectors through an internal extension cable.

For more information, see Ethernet Site Link Cabling on page 183.

The following table shows the pin assignment for Ethernet Site Link connection. The Ethernet Site Link MDIX connector pin out applies to both Link1 and Link2. The pin definitions on the Site Controller are different from the Link1 and Link2 connectors on the Junction Panel.

Table 25: Junction Panel Ethernet Site Link Connector Pins

Pin No	Function
1	RX+
2	RX-
3	TX+
4	Not used
5	Not used
6	TX-
7	Not used
8	Not used

4.10.1

Ethernet Site Link Retrofit Kit

The Ethernet Site Link Retrofit kit is used convert one **E1** output to two Ethernet outputs on MTS 2 Junction Panels not equipped with such Ethernet outputs in order to get Ethernet Site-link functionality. On MTS 4 Junction Panels, the Ethernet Site link Retrofit kit is used to convert existing **E1** and **AUX** outputs in order to get Ethernet site link functionality.

The following Ethernet Site Link Retrofit Kits can be used for older versions of the Junction Panels where Ethernet connectors are missing (only E1 present):

- **GMKN4746A** - for MTS 2 with new version of junction panel.
- **GMKN4747A** - for MTS 2 with old version of junction panel.
- **GMKN4745A** - for MTS 4 Prime Cabinet
- **GMKN4744A** - for MTS 4 Expansion Cabinet

NOTICE: GMKN4744A contains **only** the cables for the expansion cabinet. GMKN4745A needs to be ordered separately for the MTS 4 Prime Cabinet.

4.10.1.1

Connecting Ethernet Site Link Retrofit Kit for MTS 2 (old JP)

When and where to use:
Follow this procedure to gain Ethernet Site Link functionality from the E1 connector on the previous type of MTS 2 Junction Panel.

Procedure:

1. Remove existing E1 cable from the **E1** connector on Junction Panel.
2. Connect the open **E1** connector on the Junction Panel with the RJ45 coupler (3066562B01).
3. Connect the Ethernet Y Splitter (01015002001) to the lose end of the RJ45 coupler connected in previous step.

4 Connect the **Link1** and **Link2** outputs on the Ethernet Y Splitter to the Site Controller by using the Ethernet cables as described in Table 44: Ethernet Site Link Cabling for MTS 2 on page 184 and Figure 102: Ethernet Site Link Cabling for MTS 2 on page 185.

4.10.1.2
Connecting Ethernet Site Link Retrofit Kit for MTS 2 (new JP)

Procedure:

1 Bend open and connect the open **Link1** connector on the Junction Panel with the RJ45 coupler (3066562B01).

2 Bend open and connect the open **Link2** connector on the Junction Panel with the RJ45 coupler (3066562B01).

3 Connect the **Link1** and **Link2** outputs on the Ethernet Y Splitter to the Site Controller by using the Ethernet cables as described in Table 44: Ethernet Site Link Cabling for MTS 2 on page 184 and Figure 102: Ethernet Site Link Cabling for MTS 2 on page 185.

4.10.1.3
Connecting Ethernet Site Link Retrofit Kit for MTS 4

Unlike the MTS 2, the previous type of MTS 4 Junction Panel has an unused AUX breakout which will be used, together with the existing E1 connector, for Ethernet Site Link functionality.

When and where to use:
Follow this procedure to gain Ethernet Site Link functionality from the E1 and AUX connectors on the previous type of MTS 4 Junction Panel.

Procedure:

1 Remove existing E1 cable from **E1** connector on Junction Panel.

2 Connect the open **E1** connector on the Junction Panel with the RJ45 coupler (3066562B01).

3 Bend **AUX** breakout and insert the second RJ45 coupler (3066562B01).

4 Attach remaining cables.

- For configurations with single Site Controller, follow Table 45: Ethernet Site Link Cabling for MTS 4 with Single Site Controller on page 186 and Figure 103: Ethernet Site Link Cabling for MTS 4 with Single Site Controller on page 187 for further cabling and connections.
- For configurations with dual Site Controller, follow Table 46: Ethernet Site Link Cabling for MTS 4 with Dual Site Controller on page 188 and Figure 104: Ethernet Site Link Cabling for MTS 4 with Dual Site Controller on page 189 for further cabling and connections.

NOTICE: In Table 45: Ethernet Site Link Cabling for MTS 4 with Single Site Controller on page 186 and Table 46: Ethernet Site Link Cabling for MTS 4 with Dual Site Controller on page 188; and Figure 103: Ethernet Site Link Cabling for MTS 4 with Single Site Controller on page 187 and Figure 104: Ethernet Site Link Cabling for MTS 4 with Dual Site Controller on page 189**E1** on old Junction Panel is equivalent to Link1 and **AUX** on old Junction Panel is equivalent to Link2.

4.10.1.4
Connecting Ethernet Site Link Retrofit Kit for MTS 4 with Expansion Cabinet (old JP)

When and where to use:

Follow this procedure to gain Ethernet Site Link functionality from the E1 and AUX connectors on the previous type of MTS 4 Junction Panel. The procedure applies to an MTS Expansion Cabinet configuration with single Site Controller.

Procedure:

1. On the MTS Prime Cabinet, remove existing E1 cable from **E1** connector on Junction Panel.
2. Connect the open **E1** connector on the Junction Panel with the RJ45 coupler (3066562B01).
3. Bend **AUX** breakout and insert the second RJ45 coupler (3066562B01).
4. Follow Table 47: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Single Site Controller on page 190 and Figure 105: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Single Site Controller on page 191 for further cabling and connections.

4.10.1.5

Connecting Ethernet Site Link Retrofit Kit for MTS 4 with Expansion Cabinet (new JP)

When and where to use:
Follow this procedure to gain Ethernet Site Link functionality from the Link1 and Link2 connectors on the newer type of MTS 4 Junction Panel. The procedure applies to an MTS Expansion Cabinet configuration with single or dual Site Controllers.

Procedure:

1. Bend open and connect the open **Link1** connector on the Junction Panel with the RJ45 coupler (3066562B01).
2. Bend open and connect the open **Link2** connector on the Junction Panel with the RJ45 coupler (3066562B01).
3. Attach remaining cables.
   - For configurations with single Site Controller, follow Table 47: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Single Site Controller on page 190 and Figure 105: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Single Site Controller on page 191 for further cabling and connections.
   - For configurations with dual Site Controller, follow Table 48: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Dual Site Controller on page 191 and Figure 106: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Dual Site Controller on page 193 for further cabling and connections.

4.11

External Alarm Cabling

The MTS supports the following alarm inputs and control outputs in all configurations:

- 15 opto-isolated 12 V alarm inputs
  - Alarm inputs and Alarm ground are floating
- External alarms are connected to an External Alarm 2-16 port and one of the 6 GND (Alarm) ports
- The 6 GND (Alarm) ports are connected internally
- External alarm voltage (open) = 12 V typical
- External alarm current (short circuit) = 8 mA typical
- Control output 1 (2 pins) = alarm relay (Normally Open and Common contacts)
- Control output 2 (2 pins) = alarm relay (Normally Open and Common contacts)

The alarms/outputs connections are located on the junction panel.

NOTICE: Figure 83: MTS 2 Junction Panel Alarm Wiring Connection on page 152 and Figure 84: MTS 4 Junction Panel Alarm Wiring Connection on page 153 depicts the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 82: MTS LiTE Junction Panel Alarm Wiring Connection

Figure 83: MTS 2 Junction Panel Alarm Wiring Connection

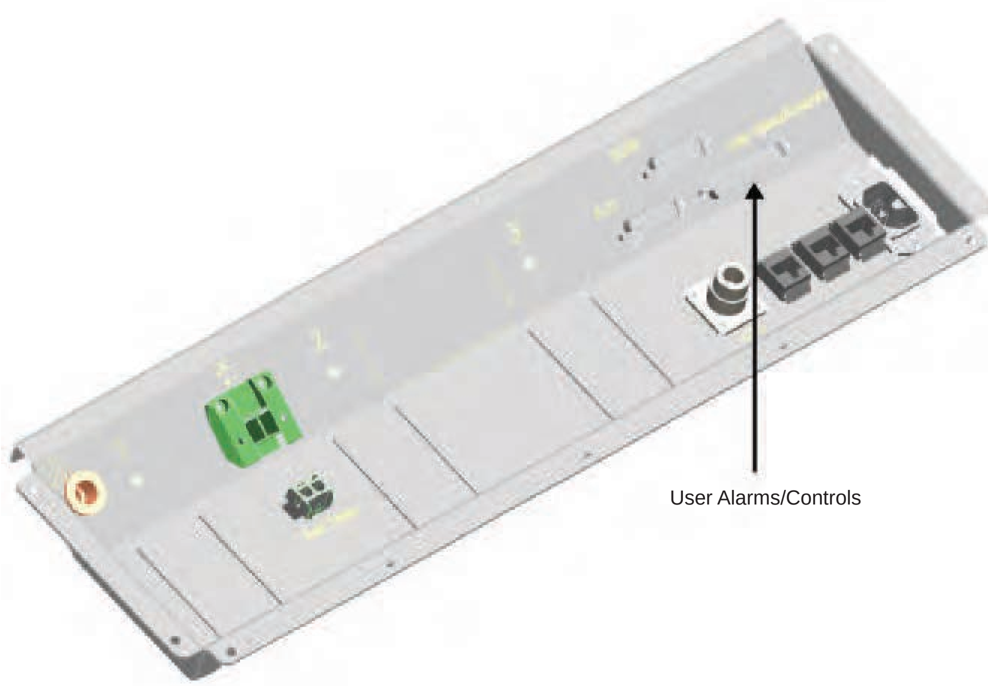


Figure 84: MTS 4 Junction Panel Alarm Wiring Connection

Figure 85: External Alarm Connector Pinout

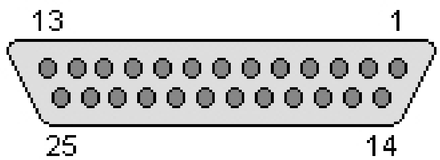


Table 26: External Alarm Connector

Port 2 D-Type 25 Pin	Description
13	Control Output 2
25	Control Output 2
12	Control Output 1
24	Control Output 1
11	GND (Alarm)
23	GND (Alarm)
10	GND (Alarm)
22	GND (Alarm)
9	GND (Alarm)
21	GND (Alarm)
8	External Alarm 16
20	External Alarm 15
7	External Alarm 14
19	External Alarm 13
6	External Alarm 12
18	External Alarm 11
5	External Alarm 10
17	External Alarm 9
4	External Alarm 8
16	External Alarm 7
3	External Alarm 6
15	External Alarm 5

Port 2 D-Type 25 Pin	Description
2	External Alarm 4
14	External Alarm 3
1	External Alarm 2

For more information on alarm wiring, see User Alarms/Controls, X.21, RGPS, and GPS Cabling on page 170.

4.12

Performing a Final Check-Out after Installation

Perform the following procedure after the completion of the MTS installation. This final check-out procedure ensures the proper operation of the MTS.

Process:

1. Perform the Cabinet final check-out.

   See Checking the Cabinet after Setup on page 154.
2. Power-up the MTS and the Expansion Cabinet.

   See Powering Up the MTS on page 154.

4.12.1

Checking the Cabinet after Setup

Procedure:

1. Switch to OFF the Power Supply Unit.
2. Verify that the connections on all modules and on the junction panel are secure. Make any necessary adjustments.
3. **Installations with a backup battery only:** Check if the wires on plus (+) and minus (-) poles are securely connected.
4. **Installations with a temperature sensor:** Check that the temperature sensor is attached.

4.12.2

Powering Up the MTS

CAUTION: Power-up procedure is arranged to prevent MTS damage in case of an equipment or installation defect.

Procedure:

1. Ensure the switch on the Power Supply Unit is switched OFF before proceeding.
2. Check the connections at Power Supply Unit.
3. **Installation with the battery backup only:** Check the connections at the backup battery.
4. Set the switch to ON.

   NOTICE: The Power Supply Unit automatically recognizes a connected backup battery and begins charging, in operation or at start up.
5. Watch the Power Supply Unit LED indicators to monitor the PSU inputs and outputs during the startup procedure.

See PSU LED Indicators on page 361.

6 Verify the voltage level between -44 VDC and -60 VDC at the -48 VDC- (hot) terminal and Return-terminal of the Power Supply Unit.

Use a digital voltmeter (DVM).

4.13
Recommended Installation Tools, Parts, and Test Equipment

The list of the recommended tools, parts, and test equipment includes also locally procured parts required for the installation procedure. The model numbers listed are recommended, but equivalent tools and equipment of other manufacturers are acceptable.

4.13.1
Recommended Installation Tools

WARNING: Select tools with insulated grips and handles to prevent a potential injury resulting from electrical shock.

CAUTION:
Avoid cold welding.

When screwing in a stainless steel screw, do not apply any pressure to the power tool.

Table 27: Recommended Installation Tools

Tool	Supplier	Description
Electronics Technician Tool Kit	Locally procured	Miscellaneous tools
Sack trolley	Locally procured	Ensure that fork size is compatible with MTS
Wrist strap	Locally procured	Ensure this is regularly tested
Torx30 screwdriver	Locally procured	For mounting lifting brackets on MTS4 For mounting Cavity Combiners in MTS4 cabinet
Long shafted Torx30 screwdriver	Locally procured	For mounting toplids (front and rear) and RFDS front cover in MTS 4
Torx20 screwdriver	Locally procured	For mounting Base Radio, Site Controller, and Power Supply Unit in the module cage For mounting filters in module cage in MTS 2 For mounting filters to the filter bracket in MTS 2 For mounting filter bracket in the MTS 4 cabinet For mounting filter bracket in the MTS4L rack For Hybrid Combiner
Torx10 screwdriver	Locally procured	For fixing Fan Kit
SW19 wrench	Locally procured	For adjusting the leveling feet on MTS 2/4
SW8, allen wrench, HEX	Locally procured	For fixing the cabinet to the mounting plate

4.13.2
Recommended Test Equipment

The following table lists the test equipment recommended for installation. Procure the following equipment locally as it is not part of the MTS shipment. All model numbers are Motorola Solutions part numbers unless noted otherwise.

Table 28: Recommended Installation Test Equipment

Test Equipment	Model/Type	Supplier	Description
Digital Multimeter (only 1 required)	Fluke 77	Fluke	AC/DC measurements. Equivalent instrument is acceptable
Time Domain Reflectometer (TDR)		Locally Procured	Possibly needed by Field Installation Team
Ground Resistance Ohmmeter	AEMC 3700 clamp-on ground tester	Locally Procured	Possibly needed by Field Installation Team
Service Computer		Locally Procured	Local service terminal
Service Connector Box	p/n: 0166502N05	Motorola Solutions	Used for measuring receiver sensitivity
Basic Service Cable (RS232)	p/n: 3066565B01	Motorola Solutions	For pinout information, see Site Controller – Front Panel Connectors on page 325
TETRA Signal Generator	Rhode & Schwarz: SMU200A + SMU-K68	Rhode & Schwarz	Used for checking receive and transmit operation
TETRA Analyzer	Rhode & Schwarz: FSQ + FS-K110 + FSQ-K70		Used for checking receive and transmit operation
RF Attenuator, 250 W, 40 dB	Weinschel 404043		Protection for HP89441A
RF Attenuator, 10 dB	minimum 100 W	Motorola Solutions	Protection for HP89441A
RF Adapter	33 QMA-N-50-1/133 NE	Huber & Suhner	N female to QMA male
RF Adapter	31 N-QMA-50-1/1- -NE	Huber & Suhner	N female to QMA female
RF Adapter	33_716-N-50-1/- -_UE	Huber & Suhner	N female to DIN 7-16 male

4.13.3
Recommended Parts

The following table lists the parts recommended for installation. Procure the following parts locally as they are not part of the MTS shipment. All model numbers are Motorola Solutions part numbers unless noted otherwise.

Table 29: Recommended Installation Parts

Part	Type/Size	Supplier	Where Used
Cover or blanket		Locally Procured	Protection of cabinet from dust while drilling
Anchor Kit	10 mm Rawl Bolts (concrete fixing bolts)	Locally Procured	MTS cabinet floor anchors
Grease	anti-oxidant	Locally Procured	Battery terminal corrosion control
AC Power Cable minimum size	1.3 mm^2 (#16 AWG)	Locally Procured	Mains Supply wiring
AC Power Cable maximum size	2.1 mm^2 (#14 AWG)	Locally Procured	Mains Supply wiring
DC Power Cable	3.3 mm^2 (12 AWG) (Length: more than 3 m)	Locally Procured	DC and Backup Battery wiring
DC Power Cable	5.3 mm^2 (10 AWG) (Length: more than 3 m)	Locally Procured	DC and Backup Batter wiring
100-240 VAC Connector	Motorola P/N 3166502A01	Supplied with MTS	AC Mains Connector
-48 VDC Connector	MTS 2: Motorola P/N 3166501A01 MTS4: Motorola P/N 3166501A02	Supplied with MTS	DC Connector Backup Battery connector

4.13.4
Recommended Torque

The following table lists the recommended torque for RF connectors, screws, nuts, and bolts.

Table 30: Recommended RF Connectors, Screws, and Nuts Torque

Item	Torque Nm	Torque lbfin
“N” Coupling Nuts	0.68 – 1.13	6.02 10
“SMA” Coupling Nuts	1.0	9
Screws up to M 3.5	0.6	5.31
Nuts up to M 3.5	1.2 for class 80 steel, 0.9 for class 70 steel, and 0.4 for class 50 steel	11 for class 80 steel, 8 for class 70 steel, and 3.5 for class 50 steel
Screws M4 (Torx 20)	4.5	40

Item	Torque Nm	Torque lbfin
Screws M6 (Torx 30)	6 (minimum)	40
Nuts from M4 to M 6	4.5	40
M8 screw	15	130
M 10 Screw	6.8	60
DIN 7–16	25 – 30	221 – 266

4.13.5
Mounting Screws

The following table lists the screws used for mounting modules in MTS 2 and MTS 4 cabinets.

CAUTION:
Avoid cold welding.

When screwing in a stainless steel screw, do not apply any pressure to the power tool.

Table 31: MTS LiTE, MTS 2, and MTS 4 and Expansion Cabinets Mounting Screws

Module Part	Screws/Washers	Part Number	Tool
Site Controller and XHUB	2 pcs M4X10/captivatedstarwasher	0310909C61	Torx 20
Power Supply Unit	2 pcs M4X10/captivatedstarwasher	0310909C60	Torx 20
Base Radio	2 pcs M4X10/captivatedstarwasher	0310909C60	Torx 20
Filters in MTS 2	3 pcs M4X10/captivatedstarwasher	0310909C60	Torx 20
Filters in MTS 4	Mounting on the filter bracket:		
	2pcsM4X10/captivatedstarwasher	0310909C60	Torx 20
	1 pc. M4X8 countersunk	0310913A35	Torx 20
	Mounting filter bracket in the cabinet:		
	2 pcs M4X10/captivatedstar washer	0310909C60	Torx 20
Cavity Combiners	3 pcs M6X16, captivated star washer	0310909C92	Torx 30
Hybrid Combiner	2 pcs M4X10, captivated star washer	0310913A35	Torx 20
Fan Kit	1 pc M3X8, captivated star washer	0310909C32	Torx 10
RFDS front cover – MTS4/ Expansion Cabinet	4 pcs M6X16, captivated star washer	0310909C92	Torx 30

Module Part	Screws/Washers	Part Number	Tool
Toplids (front and rear) – MTS4/Expansion Cabinet	2 x 4 pcs M6X16, captivated star washer	0310909C92	Torx 30
Rx Splitter	2 pcs M6X16, captivated star washer	0310909C92	Torx 30

The following figures show the positions of screws for the most popular configurations of MTS LiTE, MTS 2, and MTS 4.

Figure 86: MTS LiTE Screws Positions

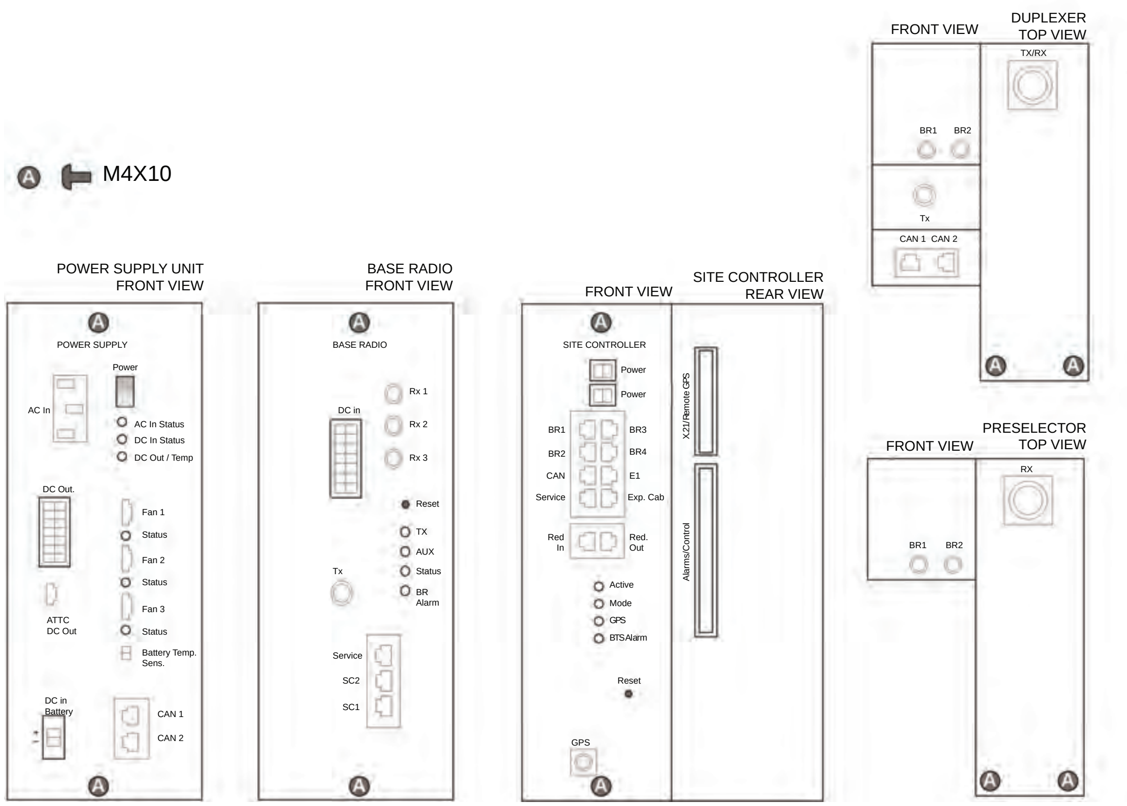


Figure 87: MTS 2 Screws Positions

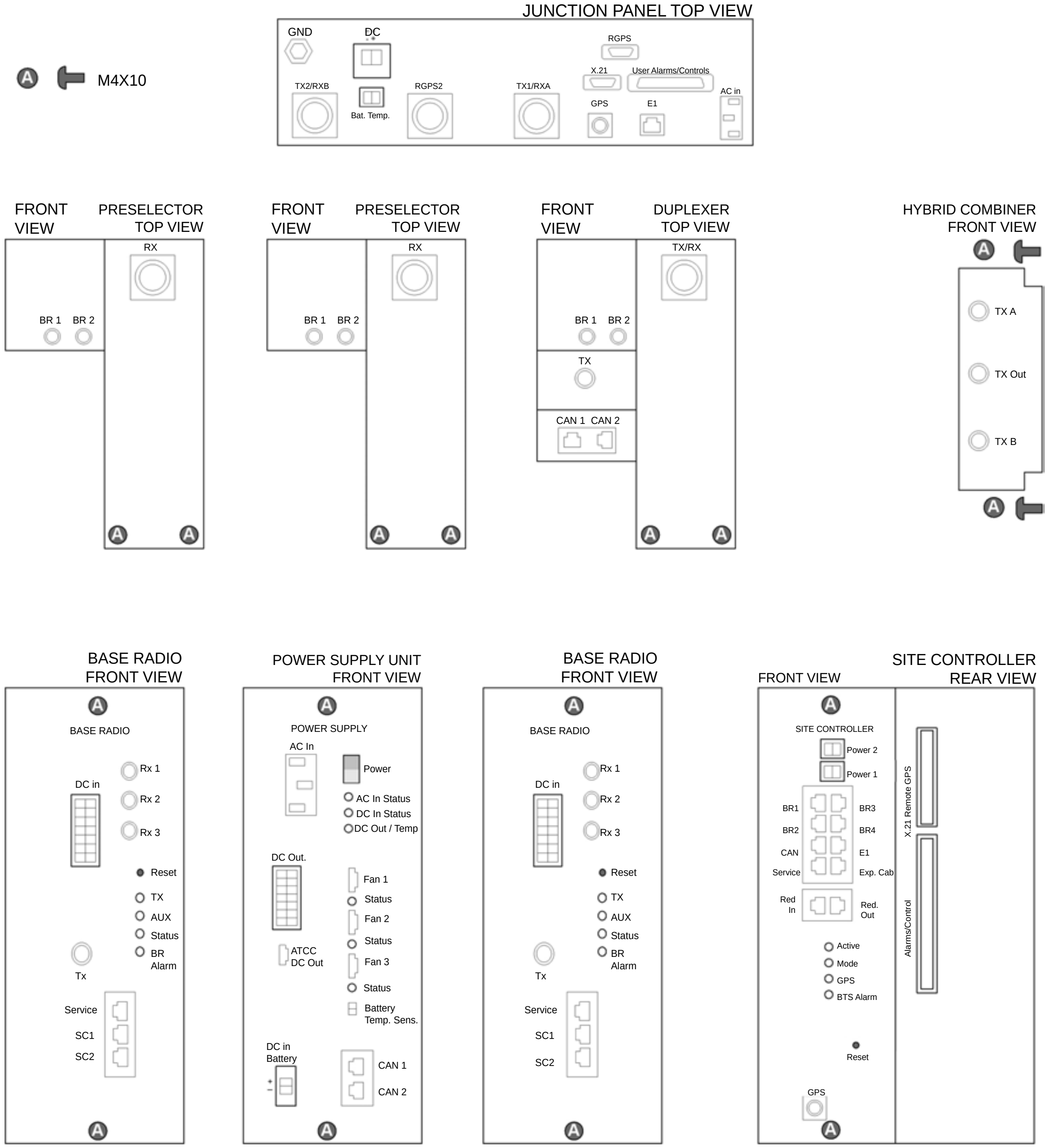


Figure 88: MTS 4 Screws Positions

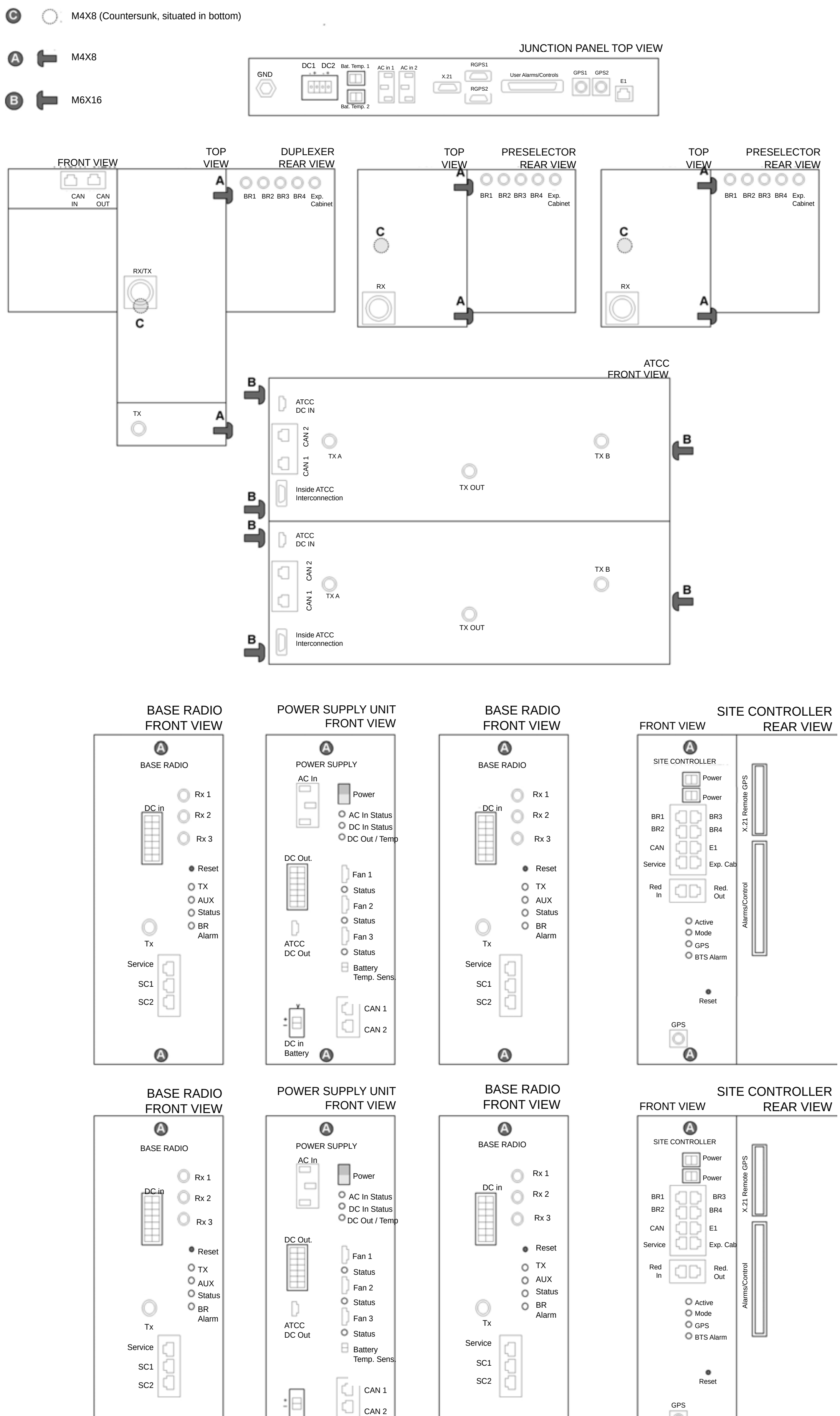
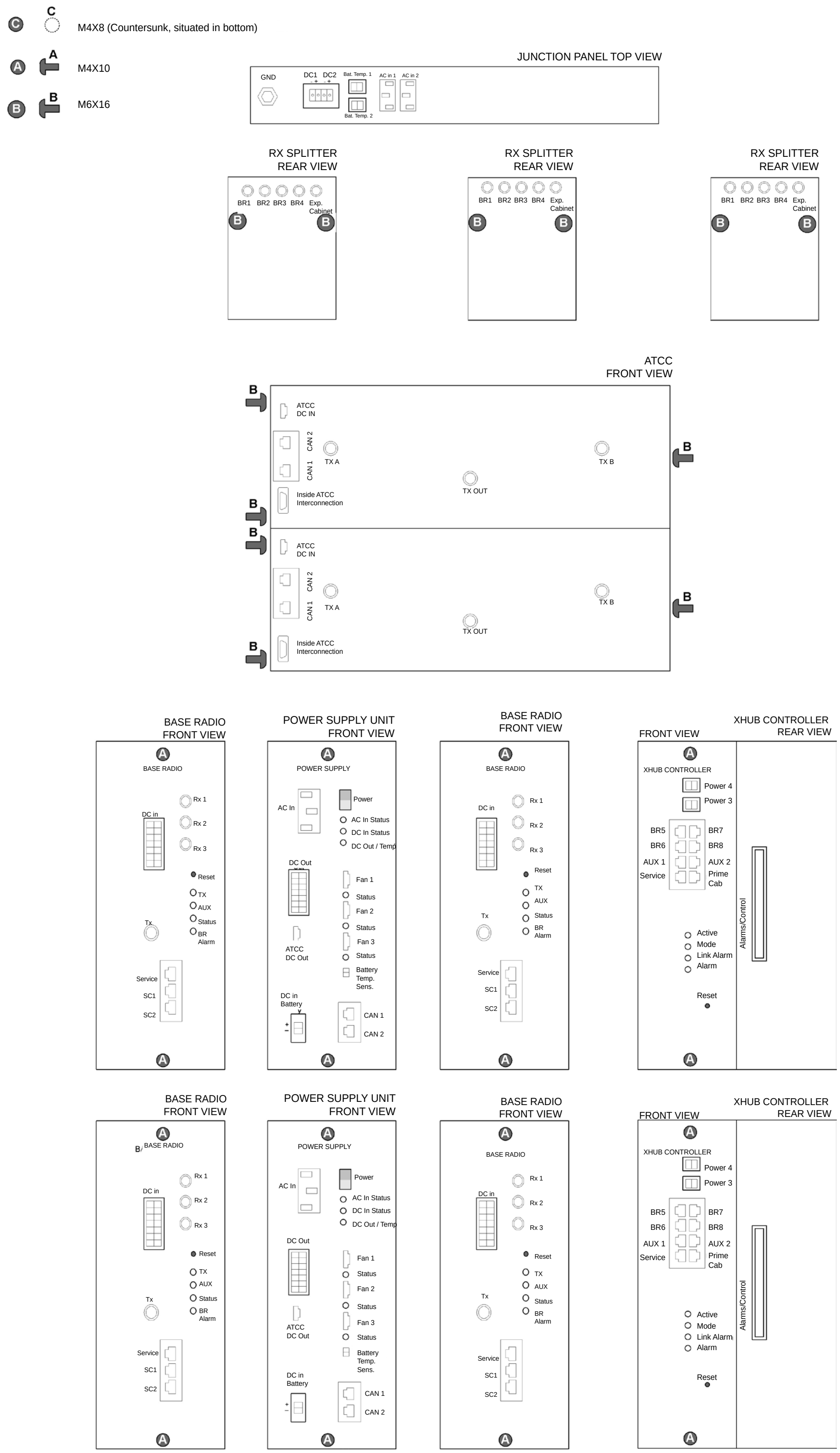


Figure 89: Expansion Cabinet Screw Positions



Chapter 5

Interconnection and Internal Cabling

MTS installation requires proper interconnection and internal cabling. The connection types include:

- Power cabling
- User alarms and control cabling
- E1, Ethernet, and site link cabling
- RF cabling
- CAN Bus cabling

5.1

AC/DC Power Cabling

AC power cabling refers to the connection between the Junction Panel and the Power Supply Unit.

DC power cabling refers to the power connections between the Junction Panel and the Power Supply Unit and between the Power Supply Unit and other modules within the cabinet.

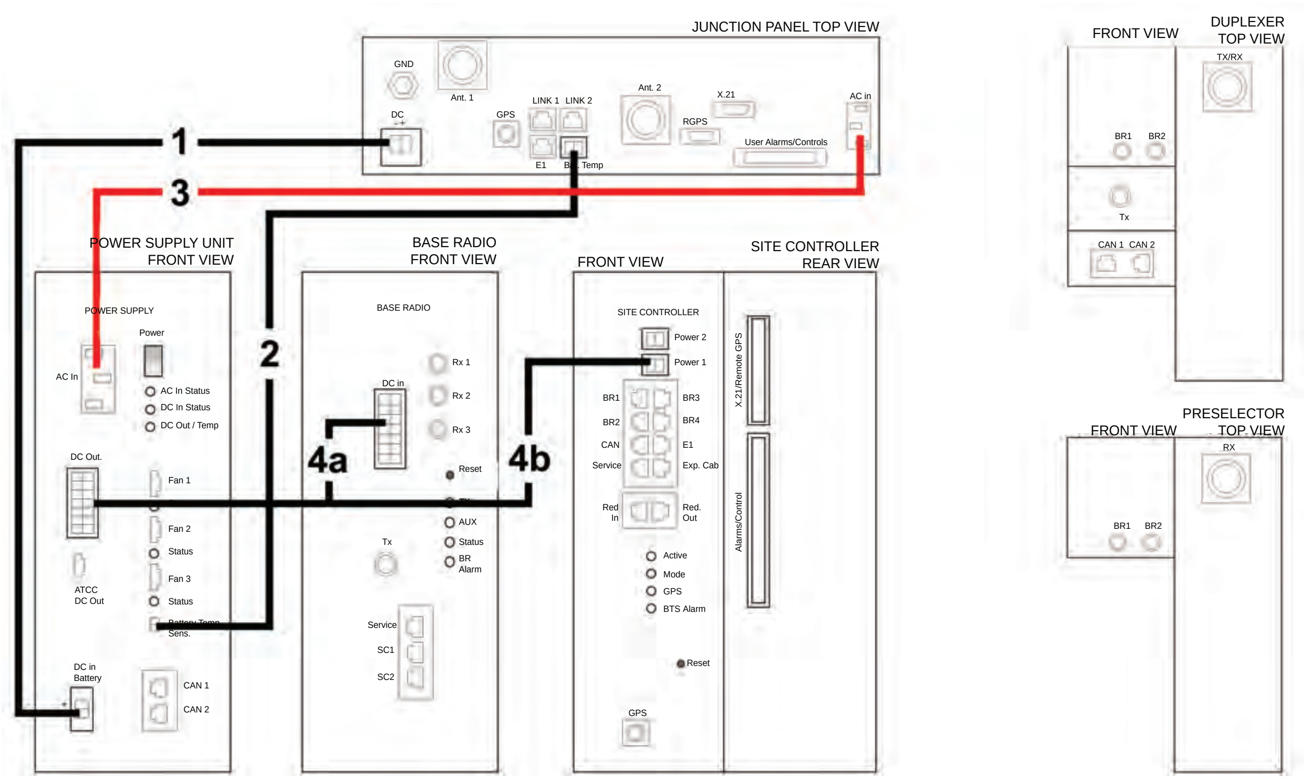
5.1.1

AC/DC Power Cabling – MTS LiTE

Table 32: AC/DC Power Cabling for MTS LiTE

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066550B01	Junction Panel/ DC	Power Supply Unit/ DCIn Battery	N/A
2	3066556B01	Junction Panel/ Bat-Temp.	Power Supply Unit/ BatteryTemp.Sens.	N/A
3	3066552B02	Junction Panel/ AC In	Power Supply Unit/ ACIn	With retaining clip
4a	3066545B02	Power Supply Unit/ DC Out	Base Radio 1/ DCIn	Pins: 1, 2, 3, 8, 10, and 11
4b			Site Controller/ Power 1	Pins: 7 and 14

Figure 90: AC/DC Power Cabling Diagram for MTS LiTE



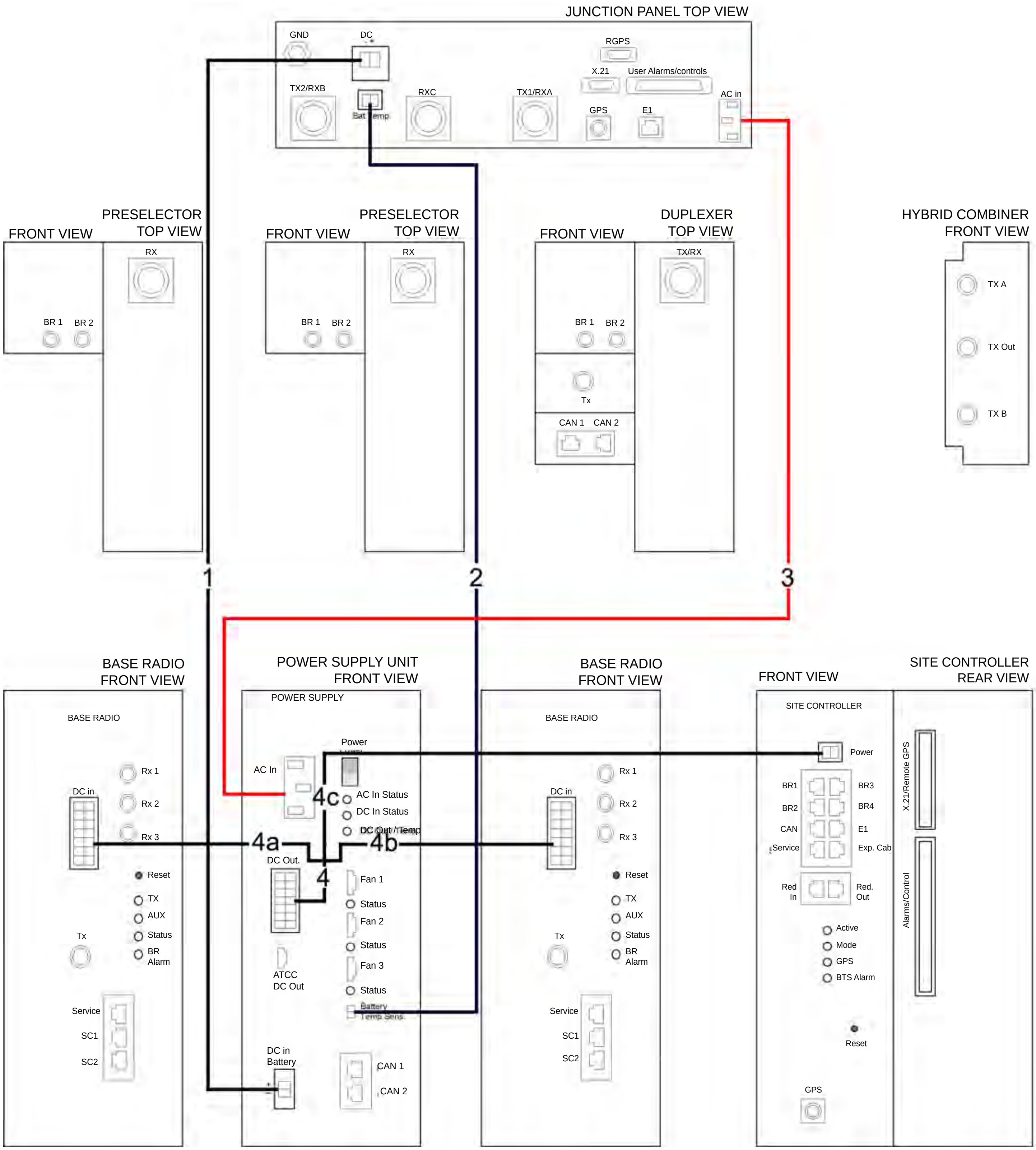
5.1.2

AC/DC Power Cabling – MTS 2

Table 33: AC/DC Power Cabling for MTS 2

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066550B01	Junction Panel/ DC	Power Supply Unit/ DCIn Battery	N/A
2	3066556B01	Junction Panel/ Bat-Temp.	Power Supply Unit/ BatteryTemp.Sens.	N/A
3	3066552B01	Junction Panel/ AC In	Power Supply Unit/ ACIn	With retaining clip
4a	3066545B01	Junction Panel/ AC In 2	Base Radio 1/ DCIn	Pins: 1, 2, 3, 8, 10, and 11
4b			Base Radio 2/ DCIn	Pins: 4, 5, 6, 9, 12, and 13
4c			Site Controller/ Power	Pins: 7 and 14

Figure 91: AC/DC Power Cabling Diagram for MTS 2

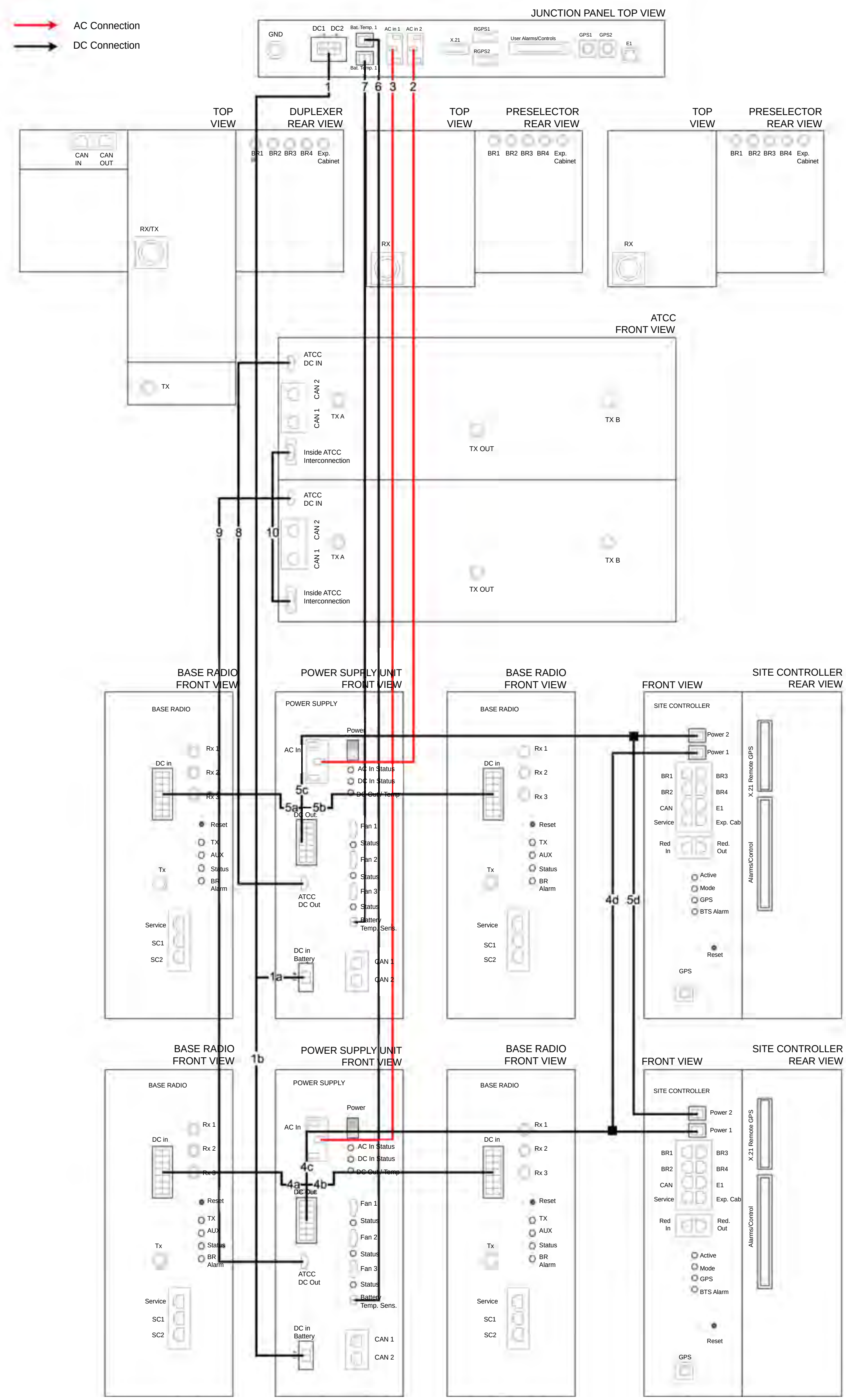


5.1.3
AC/DC Power Cabling – MTS 4

Table 34: AC/DC Power Cabling for MTS 4

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1a	3066551B01	Junction Panel/ DC1	Power Supply Unit 1/ DCIn Battery	N/A
1b	3066551B01	Junction Panel/ DC2	Power Supply Unit 2/ DCIn Battery	N/A
2	3066553B01	Junction Panel/ AC In 1	Power Supply Unit 1/ ACIn	With retaining clip
3	3066553B01	Junction Panel/ AC In 2	Power Supply Unit 2/ ACIn	With retaining clip
4a	3066545B01	Power Supply Unit 1/ DCOut	Base Radio 1/ DCIn	Pins: 1, 2, 3, 8, 10, and 11
4b	3066545B01	Power Supply Unit 1/ DCOut	Base Radio 2/ DCIn	Pins: 4, 5, 6, 9, 12, and 13
4c	3066545B01	Power Supply Unit 1/ DCOut	Y Splitter	Pins: 7 and 14
4d	3066574B01	Y Splitter	Site Controller 1/ Power 1 Site Controller 2/ Power 2	
5a	3066545B01	Power Supply Unit 2/ DCOut	Base Radio 3/ DCIn	Pins: 1, 2, 3, 8, 10, and 11
5b	3066545B01	Power Supply Unit 2/ DCOut	Base Radio 4/ DCIn	Pins: 4, 5, 6, 9, 12, and 13
5c	3066545B01	Power Supply Unit 2/ DCOut	Y Splitter	Pins: 7, 14
5d	3066574B01	Splitter	Site Controller 1/ Power 2 Site Controller 2/ Power 1	
6	3066556B02	Junction Panel/ BatTemp. 1	Power Supply Unit 1/ BatteryTemp.Sens.	N/A
7	3066556B02	Junction Panel/ BatTemp. 2	Power Supply Unit 2/ BatteryTemp.Sens.	N/A
8	3066557B01	Power Supply Unit 1/ ATCC DC Out	ATCC 1/ DC In	Only for configuration with ATCC
9	3066557B01	Power Supply Unit 2/ ATCC DC Out	ATCC 2/ DC In	Only for configuration with two ATCCs
10	306659B01	ATCC 1/Inside ATCC Interconnection	ATCC 2/Inside ATCC Interconnection	Only for configuration with two ATCCs

Figure 92: AC/DC Power Cabling Diagram for MTS 4

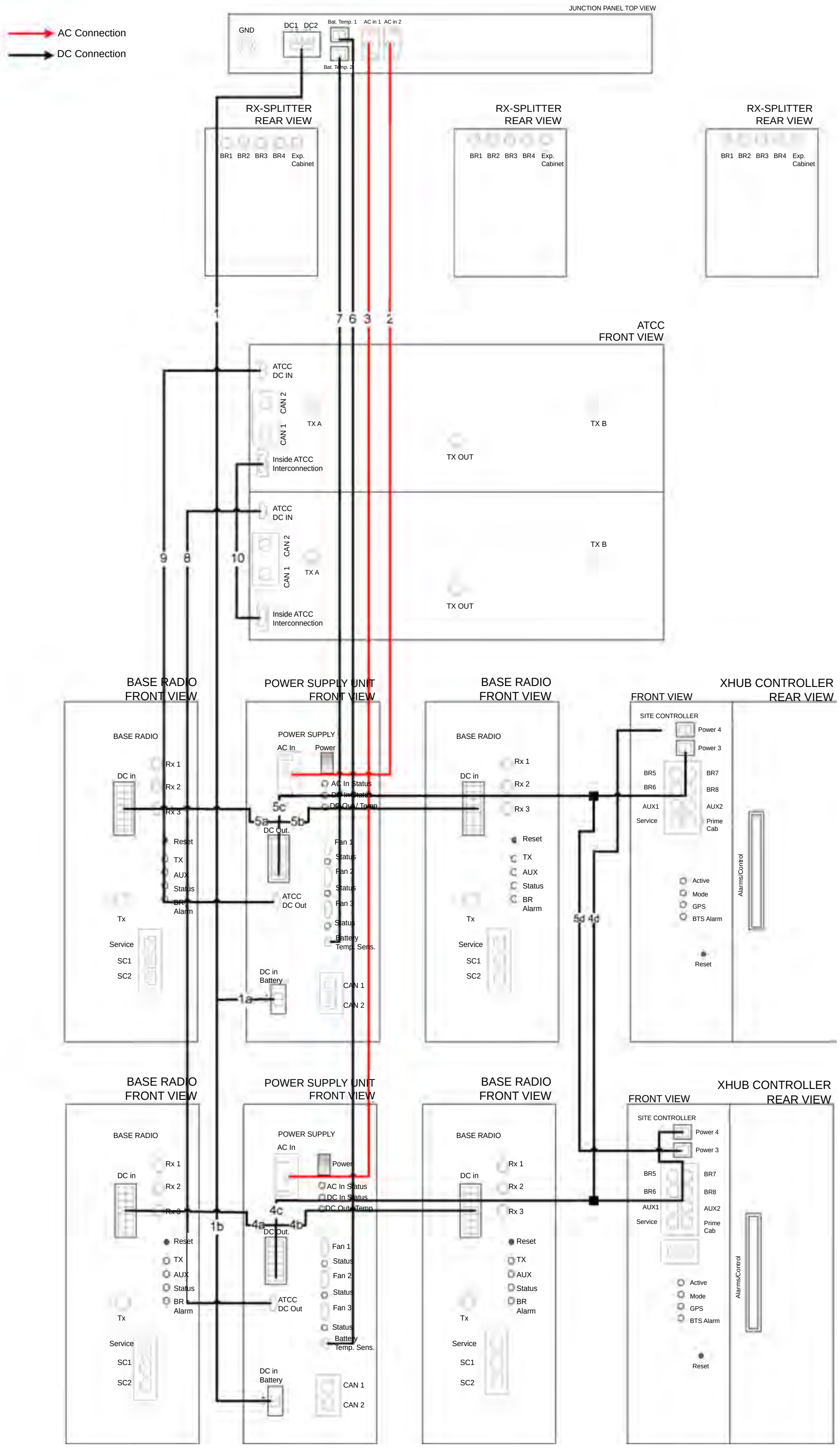


5.1.4
AC/DC Power Cabling – Expansion Cabinet

Table 35: AC/DC Power Cabling for Expansion Cabinet

Index	Cable Part Number	From Unit	To Unit	Notes
1a	3066551B01	Junction Panel / DC1	Power Supply Unit 3/DC In Battery	N/A
1b		Junction Panel / DC2	Power Supply Unit 4/DC In Battery	N/A
2	3066553B01	Junction Panel / AC In 1	Power Supply Unit 3 / AC In	With retaining clip
3	3066553B01	Junction Panel / AC In 2	Power Supply Unit 4 / AC In	With retaining clip
4a	3066545B01	Power Supply Unit 3 / DC Out	Base Radio 5 / DC In	Pins: 1, 2, 3, 8, 10, and 11
4b			Base Radio 6 / DC In	Pins: 4, 5, 6, 9, 12, and 13
4c			Y Splitter	Pins: 7 and 14
4d	3066574B01	Y Splitter	XHUB 1 / Power 3 XHUB 2 / Power 3	
5a	3066545B01	Power Supply Unit 4 / DC Out	Base Radio 7 / DC In	Pins: 1, 2, 3, 8, 10, and 11
5b			Base Radio 8 / DC In	Pins: 4, 5, 6, 9, 12, and 13
5c			Y Splitter	Pins: 7 and 14
5d	3066574B01	Y Splitter	XHUB1 / Power 4 XHUB 2 / Power 4	
6	3066556B02	Junction Panel / Bat Temp 1	Power Supply Unit 3 / Battery Temp Sens.	N/A
7	3066556B02	Junction Panel / Bat Temp 2	Power Supply Unit 4 / Battery Temp Sens.	N/A
8	3066557B01	Power Supply Unit 3 / ATCC DC Out	ATCC 3 / DC In	Only for configuration with ATCC
9	3066557B01	Power Supply Unit 4 / ATCC DC Out	ATCC 4 / DC In	Only for configuration with two ATCCs
10	3066559B01	ATCC 3 / Inside ATCC Interconnection	ATCC 4 / Inside ATCC Interconnection	Only for configuration with two ATCCs

Figure 93: AC/DC Power Cabling Diagram for Expansion Cabinet



5.2

User Alarms/Controls, X.21, RGPS, and GPS Cabling

X.21 cabling refers to the cabling between the Site Controller and the X.21 connector on the Junction Panel.

NOTICE: Either X.21 or E1 cabling is used, depending on which option is ordered.

User Alarms/Controls cabling refer to the cabling between the Site Controller and the connector on the Junction Panel.

RGPS and GPS cabling refer to the cabling between the Site Controller and the connectors on the Junction Panel.

NOTICE: X.21 and RGPS cabling depends on ordered configuration.

5.2.1

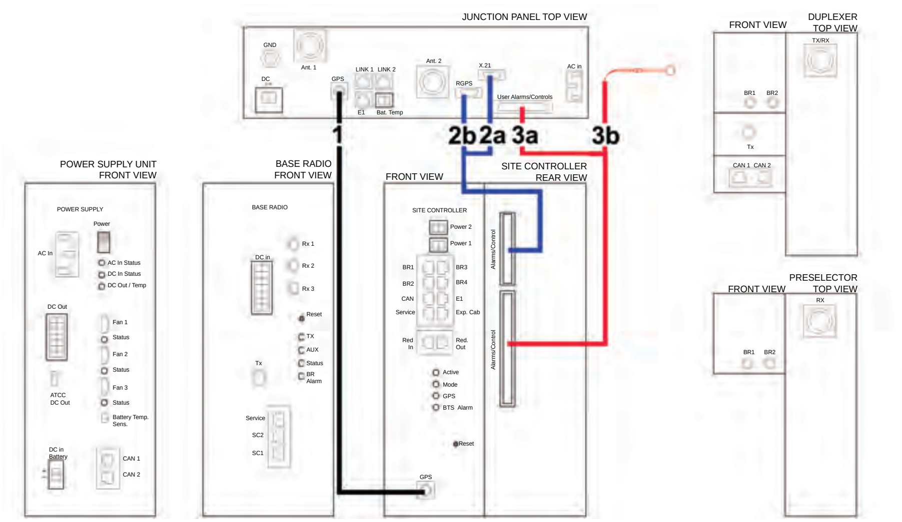
User Alarms/Controls, X.21, RGPS, and GPS Cabling – MTS LiTE

Table 36: User Alarms/Controls, X.21, RGPS, and GPS Cabling for MTS LiTE

<table>
<tr><th>Index</th><th>Cable Part Number</th><th>From Unit/ Connection Name</th><th>To Unit/ Connection Name</th><th>Notes</th></tr>
<tr><td colspan="5">MTS LiTE with RGPS and E1 or RGPS and X.21</td></tr>
<tr><td>2a</td><td rowspan="2">3066546B09</td><td>Junction Panel/ X.21</td><td rowspan="2">Site Controller/ X.21/Remote GPS</td><td>15 pin D male connector type</td></tr>
<tr><td>2b</td><td>Junction Panel/ RGPS</td><td>15 pin D female connector type</td></tr>
<tr><td>3a</td><td rowspan="2">3066549B03</td><td>Junction Panel/ User Alarms/ Controls</td><td rowspan="2">Site Controller/ Alarm/Controls</td><td>25 pin D female connector type</td></tr>
<tr><td>3b</td><td>Door Alarm</td><td>Molex connector type</td></tr>
<tr><td colspan="5">MTS LiTE with Internal GPS and X.21</td></tr>
<tr><td>1</td><td>3066543B23</td><td>Junction Panel/ GPS</td><td>Site Controller/ GPS</td><td>Coax cable</td></tr>
<tr><td>2a</td><td>3066546B10</td><td>Junction Panel/ X.21</td><td>Site Controller/ X.21/Remote GPS</td><td>N/A</td></tr>
<tr><td>3a</td><td rowspan="2">3066549B03</td><td>Junction Panel/ User Alarms/ Controls</td><td rowspan="2">Site Controller/ Alarm/Controls</td><td>25 pin D female connector type</td></tr>
<tr><td>3b</td><td>Door Alarm</td><td>Molex connector type</td></tr>
<tr><td colspan="5">MTS LiTE with Internal GPS and E1</td></tr>
<tr><td>1</td><td>3066543B23</td><td>Junction Panel/ GPS</td><td>Site Controller/ GPS</td><td>Coax cable</td></tr>
<tr><td>3a</td><td>3066549B03</td><td>Junction Panel/ User Alarms/ Controls</td><td>Site Controller/ Alarm/Controls</td><td>25 pin D female connector type</td></tr>
</table>

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
3b		Door Alarm		Molex connector type

Figure 94: User Alarms/Controls, X.21, RGPS, and GPS Cabling Diagram for MTS LiTE



5.2.2

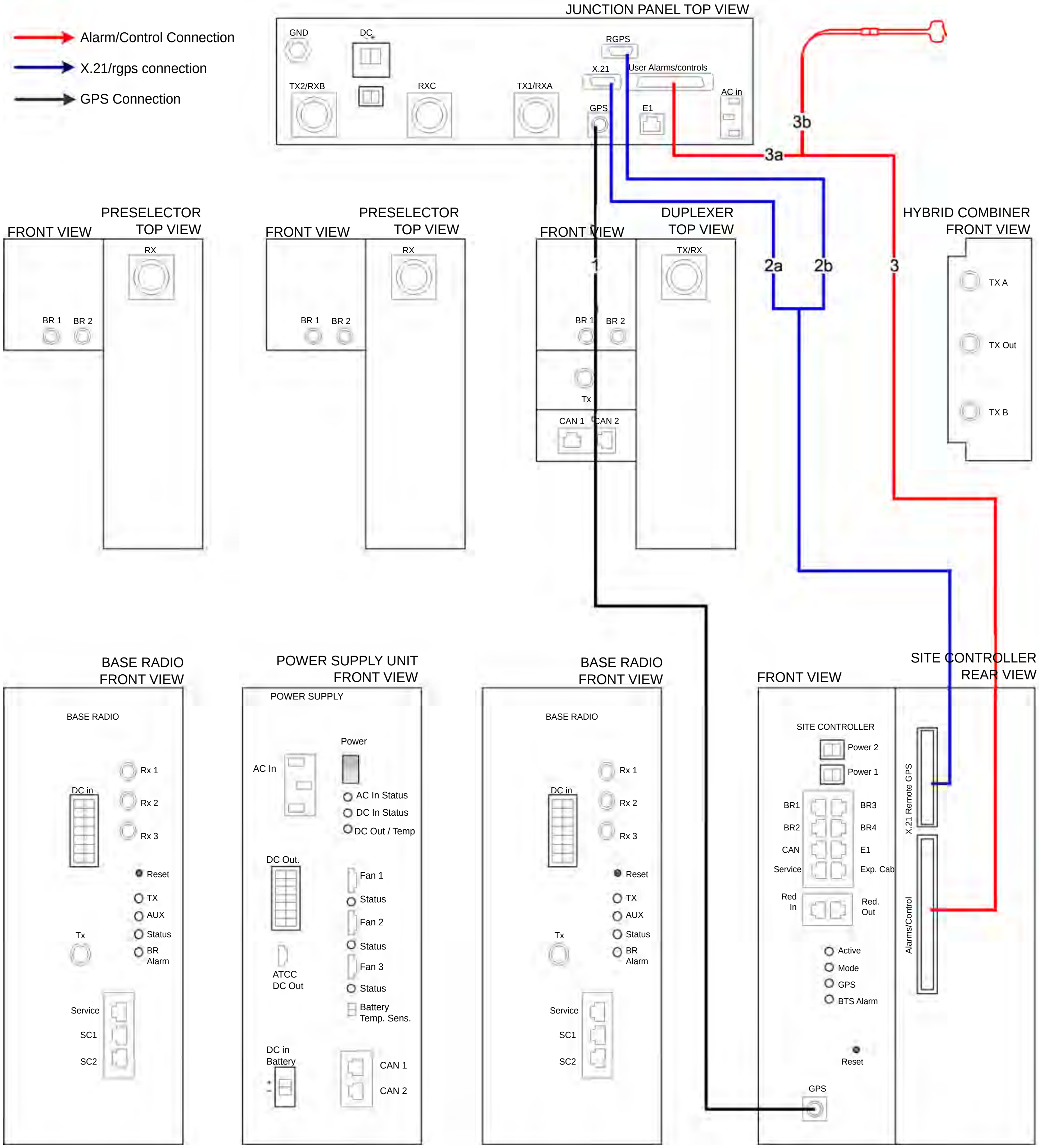
User Alarms/Controls, X.21, RGPS, and GPS Cabling – MTS 2

Table 37: User Alarms/Controls, X.21, RGPS, and GPS Cabling for MTS 2

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
MTS 2 with RGPS and E1 or RGPS and X.21				
2a	3066546B 01	Junction Panel/ X.21	Site Controller/ X.21/Remote GPS	15 pin D male connector type
2b		Junction Panel/ RGPS		15 pin D female connector type
3a	3066549B 01	Junction Panel/ User Alarms/ Controls	Site Controller/ Alarm/Controls	25 pin D female connector type
3b		Door Alarm		Molex connector type
MTS 2 with Internal GPS and X.21				
1	3066543B 07	Junction Panel/ GPS	Site Controller/ GPS	Coax cable
2a	3066546B 02	Junction Panel/ X.21	Site Controller/ X.21/Remote GPS	N/A
3a	3066549B 01	Junction Panel/ User Alarms/ Controls	Site Controller/ Alarm/Controls	25 pin D female connector type
3b		Door Alarm		Molex connector type

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
MTS 2 with Internal GPS and E1				
1	3066543B07	Junction Panel/ GPS	Site Controller/ GPS	Coax cable
3a	3066549B01	Junction Panel/ User Alarms/ Controls	Site Controller/ Alarm/Controls	25 pin D female connector type
3b		Door Alarm		Molex connector type

Figure 95: User Alarms/Controls, X.21, RGPS, and GPS Cabling Diagram for MTS 2



5.2.3

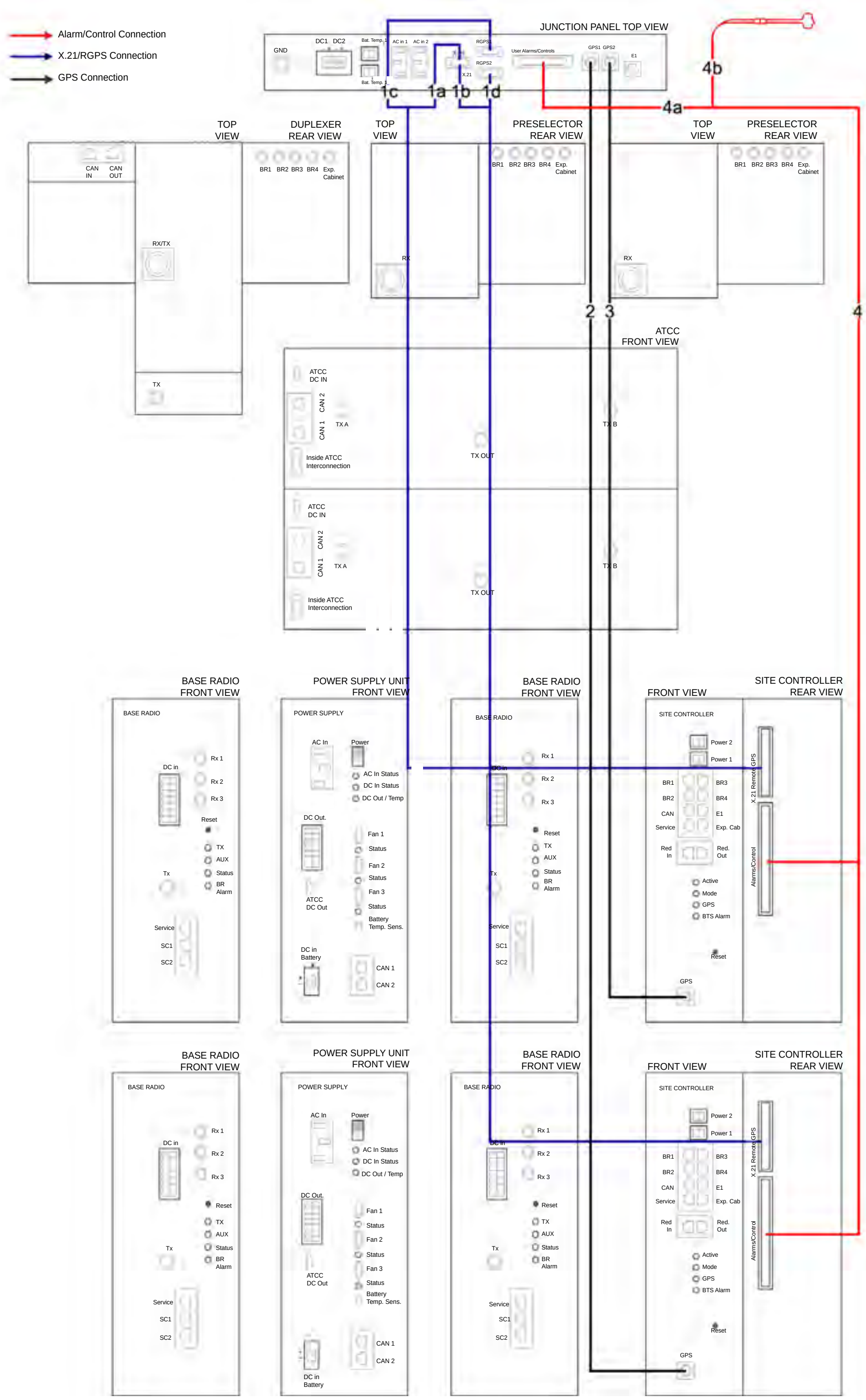
User Alarms/Controls, X.21, RGPS, and GPS Cabling –MTS 4

Table 38: User Alarms/Controls, X.21, RGPS, and GPS Cabling for MTS 4

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
MTS 4 with RGPS and E1 or RGPS and X.21				
1c	3066546B 03	Junction Panel/ RGPS 1	Site Controller1/ X.21/Remote GPS	15 pin D male connector type
1a		Junction Panel/ X.21		15 pin D female connector type
1b			Site Controller2/ X.21/Remote GPS	
1d		Junction Panel/ RGPS 2		15 pin D male connector type
4a	3066547B 01	Junction Panel/ User Alarms/ Controls	Site Controller1 and 2/ Alarm/ Controls	25 pin D female connector type
4b		Door Alarm		Molex connector type
MTS 4 with Internal GPS and X.21				
1a 1b	3066546B 04	Junction Panel/ X.21	Site Controller1and 2/ X.21/ Remote GPS	N/A
2	3066543B 10	Junction Panel/ GPS 1	Site Controller1/ GPS	Coax cable
3	3066543B 10	Junction Panel/ GPS 2	Site Controller2/ GPS	Coax cable Only for configuration with redundant Site Controller
4a	3066547B 01	Junction Panel/ User Alarms/ Controls	Site Controller1 and 2/ Alarm/ Controls	25 pin D female connector type Only for configuration with redundant Site Controller
4b		Door Alarm		Molex connector type Only for configuration with redundant Site Controller
MTS 4 with Internal GPS and E1				
2	3066543B 10	Junction Panel/ GPS 1	Site Controller1/ GPS	Coax cable
3	3066543B 10	Junction Panel/ GPS 2	Site Controller2/ GPS	Coax cable Only for configuration with redundant Site Controller
4a	3066547B 01	Junction Panel/ User Alarms/ Controls	Site Controller1 and 2/ Alarm/ Controls	25 pin D female connector type

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
4b		Door Alarm		Molex connector type

Figure 96: User Alarms/Controls, X.21, RGPS and GPS Cabling Diagram for MTS 4



5.3
E1 and Ethernet Cabling

E1 cabling refers to the cabling between Site Controller and the E1 connector on the Junction Panel.

Ethernet cabling refers to the cabling between Site Controller and Base Radios.

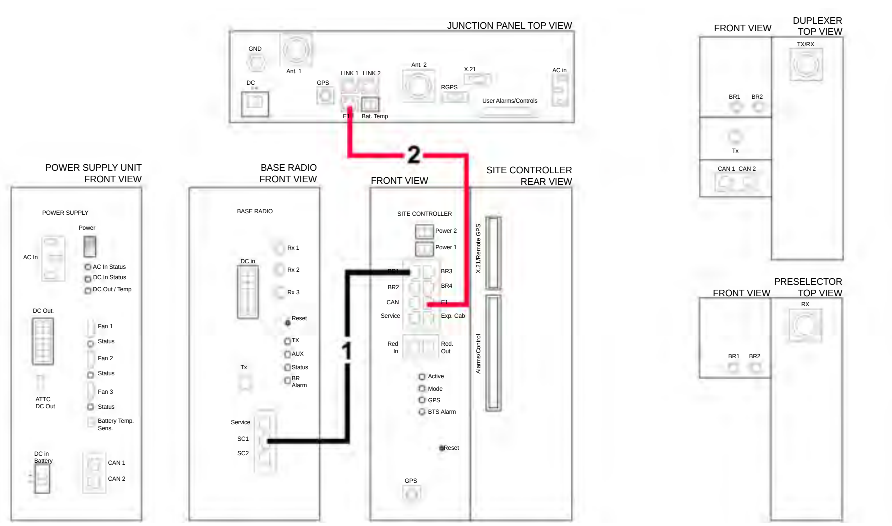
NOTICE: Either E1 or X.21 cabling is used, depending on which option is ordered.

5.3.1
E1 and Ethernet Cabling – MTS LiTE

Table 39: E1 and Ethernet Cabling for MTS LiTE

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066544B24	Base Radio 1 / SC1	Site Controller/ BR1	Ethernet link/ Grey cable
2	3066567B03	Site Controller/ E1	Junction Panel/ E1	E1 link/ Green cable

Figure 97: E1 and Ethernet Cabling Diagram for MTS LiTE



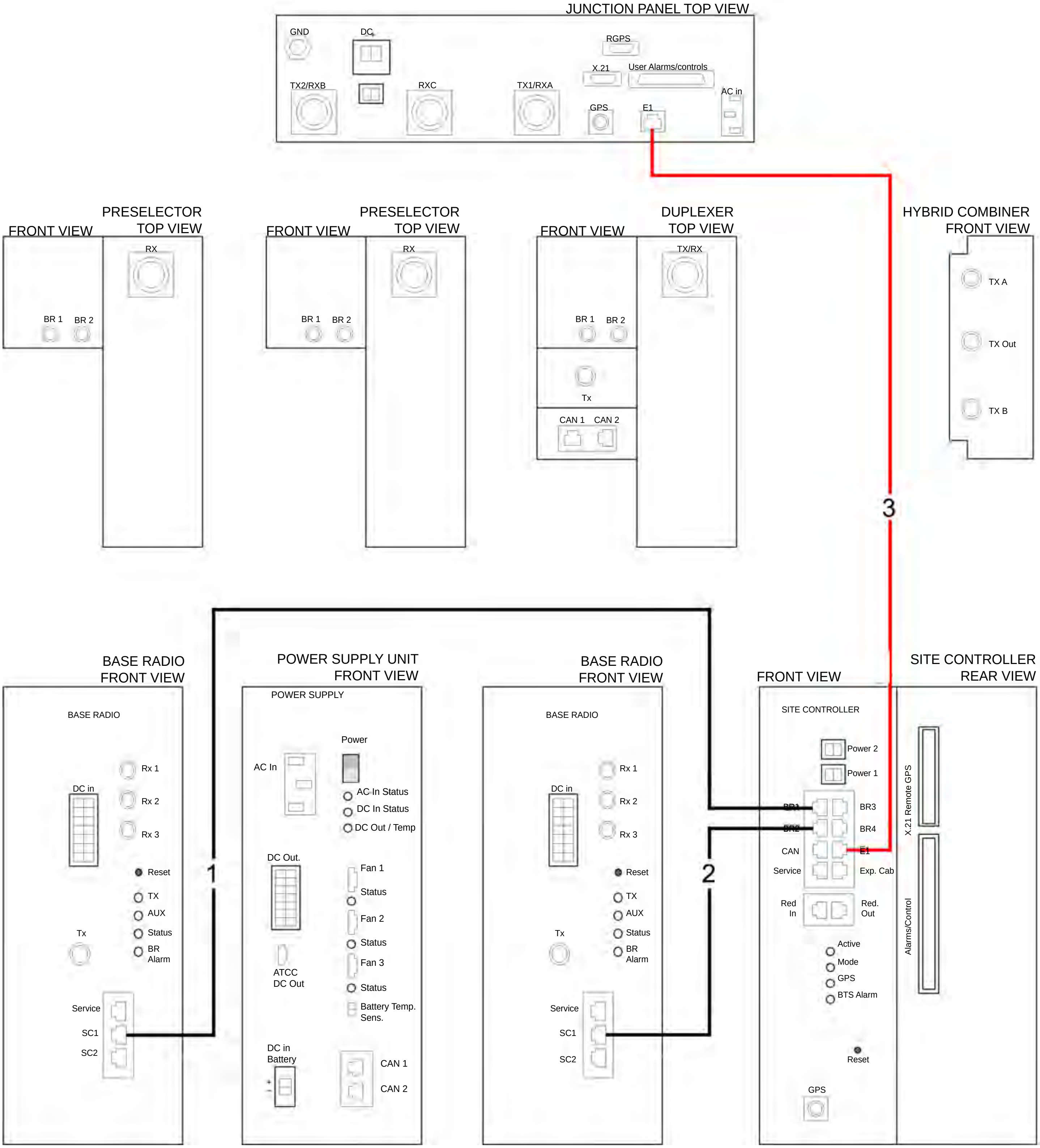
5.3.2
E1 and Ethernet Cabling – MTS 2

Table 40: E1 and Ethernet Cabling for MTS 2

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066544B01	Base Radio 1 / SC1	Site Controller/ BR1	Ethernet link/ Grey cable

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
2	3066544B02	Base Radio 2/ SC1	Site Controller/ BR2	Ethernet link/ Black cable
3	3066567B01	Site Controller/ E1	Junction Panel/ E1	E1 link/ Green cable

Figure 98: E1 and Ethernet Cabling Diagram for MTS 2

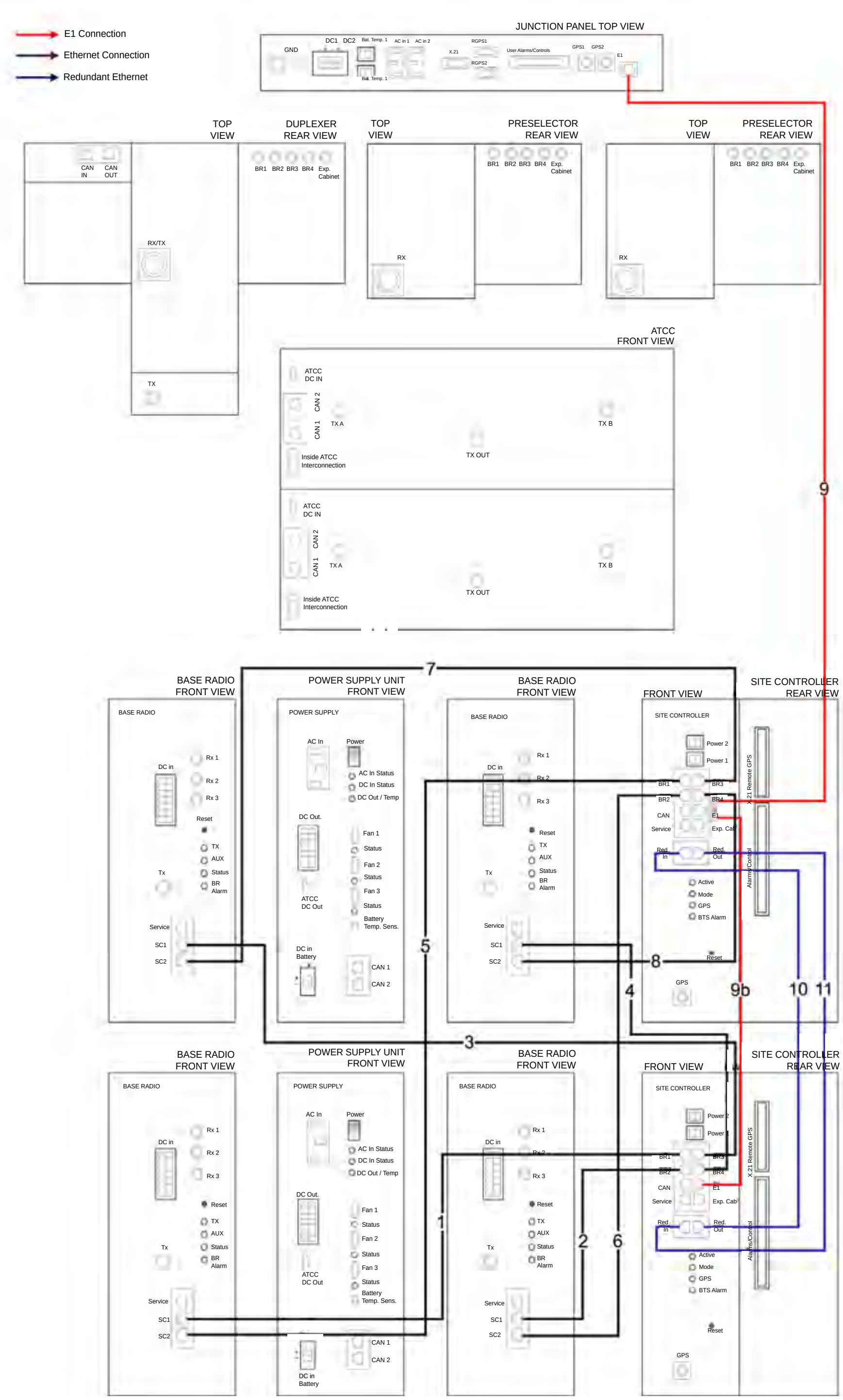


5.3.3
E1 and Ethernet Cabling – MTS 4

Table 41: E1 and Ethernet Cabling for MTS 4

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066544B 01	Base Radio 1 / SC1	Site Controller1/ BR1	Ethernet link/ Grey cable
2	3066544B 02	Base Radio 2/ SC1	Site Controller1/ BR2	Ethernet link/ Black cable
3	3066544B 04	Base Radio 3/ SC1	Site Controller1/ BR3	Ethernet link/ Grey cable
4	3066544B 05	Base Radio 4/ SC1	Site Controller1/ BR4	Ethernet link/ Black cable
5	3066544B 15	Base Radio 1 / SC2	Site Controller2/ BR1	Ethernet link/ Grey cable, only for configuration with redundant Site Controller
6	3066544B 16	Base Radio 2/ SC2	Site Controller2/ BR2	Ethernet link/ Black cable, only for configuration with redundant Site Controller
7	3066544B 01	Base Radio 3/ SC2	Site Controller2/ BR3	Ethernet link/ Grey cable, only for configuration with redundant Site Controller
8	3066544B 02	Base Radio 4/ SC2	Site Controller2/ BR4	Ethernet link/ Black cable, only for configuration with redundant Site Controller
9	3066567B 02	Junction Panel/ E1	Y-splitter	E1 link/ Green cable
	3066560B 01	Y-splitter	Site Controller1	Y-splitter, 8-pin, 2-jack to 1- plug
9b	3066567B 02	Y-splitter	Site Controller2	E1 link/ Green cable, only for configuration with redundant Site Controller
10	3066544B 17	Site Controller2/ Red. Out	Site Controller1/ Red. In	Ethernet link/ Blue cable, only for configuration with redundant Site Controller
11	3066544B 17	Site Controller1/ Red. Out	Site Controller2/ Red. In	Ethernet link/ Blue cable, only for configuration with redundant Site Controller

Figure 99: E1 and Ethernet Cabling Diagram for MTS 4

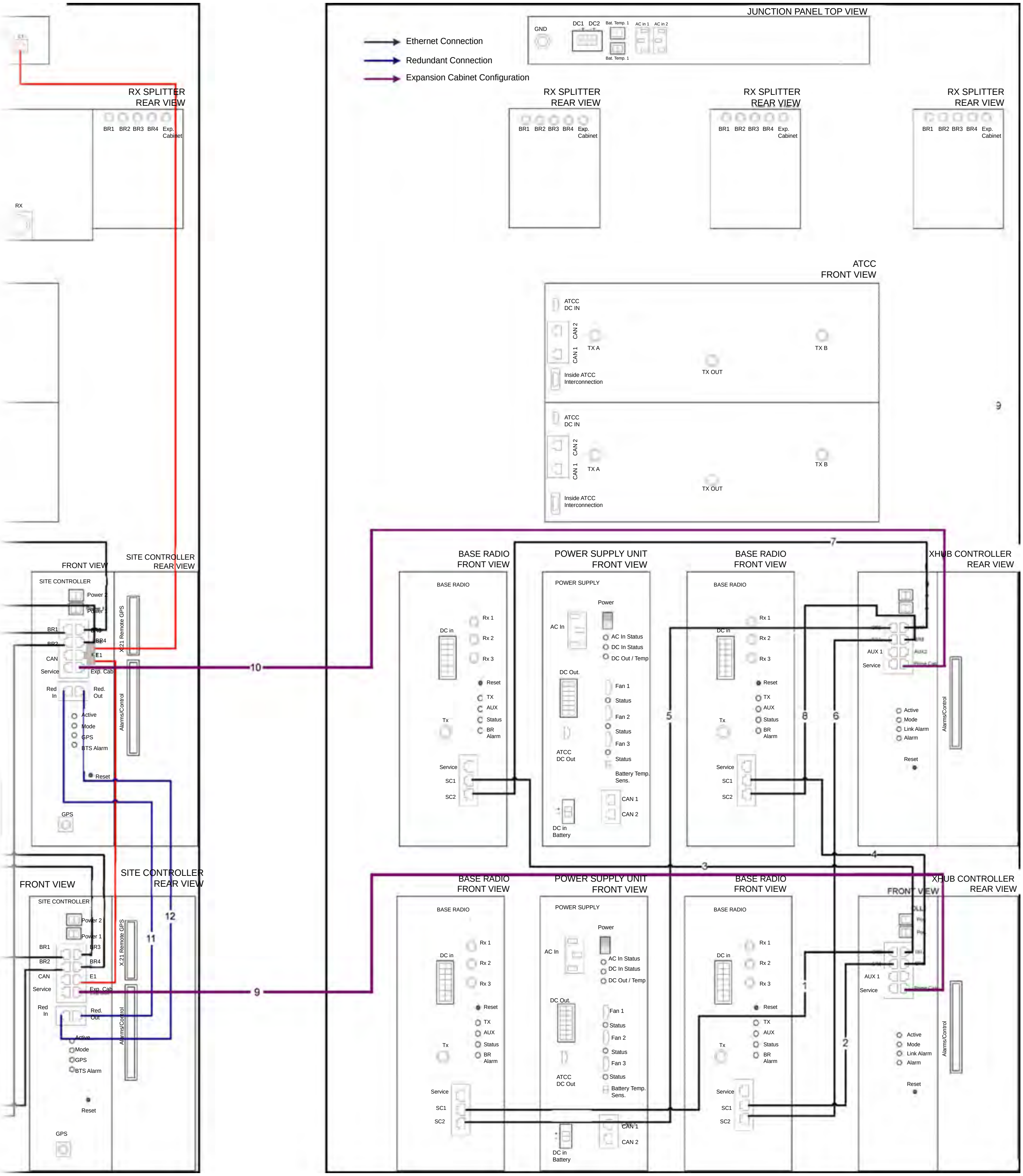


5.3.4
E1 and Ethernet Cabling – Expansion Cabinet

Table 42: E1 and Ethernet Cabling for Expansion Cabinet

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066544B01	Base Radio 5 / SC 1	XHUB 1 / BR5	Ethernet link / Grey cable
2	3066544B02	Base Radio 6 / SC 1	XHUB 1 / BR6	Ethernet link / Black cable
3	3066544B04	Base Radio 7 / SC 1	XHUB 1 / BR7	Ethernet link / Grey cable
4	3066544B05	Base Radio 8 / SC 1	XHUB 1 / BR8	Ethernet link / Black cable
5	3066544B15	Base Radio 5 / SC 2	XHUB 2 / BR5	Ethernet link / Grey cable, Only for configuration with redundant Site Controller
6	3066544B16	Base Radio 6 / SC 2	XHUB 2 / BR6	Ethernet link / Black cable, Only for configuration with redundant Site Controller
7	3066544B01	Base Radio 7 / SC 2	XHUB 2 / BR7	Ethernet link / Grey cable, Only for configuration with redundant Site Controller
8	3066544B02	Base Radio 8 / SC 2	XHUB 2 / BR8	Ethernet link / Black cable, Only for configuration with redundant Site Controller
9	3066544B12	Site Controller 1 / Exp Cab	XHUB 1 / Prime Cab	Routed through conjunction hole at the side of the cabinet
10	3066544B12	Site Controller 2 / Exp Cab	XHUB 2 / Prime Cab	Routed through conjunction hole at the side of the cabinet
11	3066544B17	Site Controller2/ Red. Out	Site Controller1/ Red. In	Ethernet link/ Blue cable, only for configuration with redundant Site Controller
12	3066544B17	Site Controller1/ Red. Out	Site Controller2/ Red. In	Ethernet link/ Blue cable, only for configuration with redundant Site Controller

Figure 100: E1 and Ethernet Cabling for MTS 4 with Expansion Cabinet (to the Right)



5.4

Ethernet Site Link Cabling

IMPORTANT:
If an older version of the MTS Junction panel is used, containing only a E1 output (and AUX output on MTS4 Junction Panel) and no Ethernet Site Link outputs (Link1 and Link2), use the MTS Ethernet Site Link Retrofit kit in order to get Ethernet Site-link functionality. For more information, see Ethernet Site Link Retrofit Kit on page 149.

With such in place, see tables and figures below for configuration.

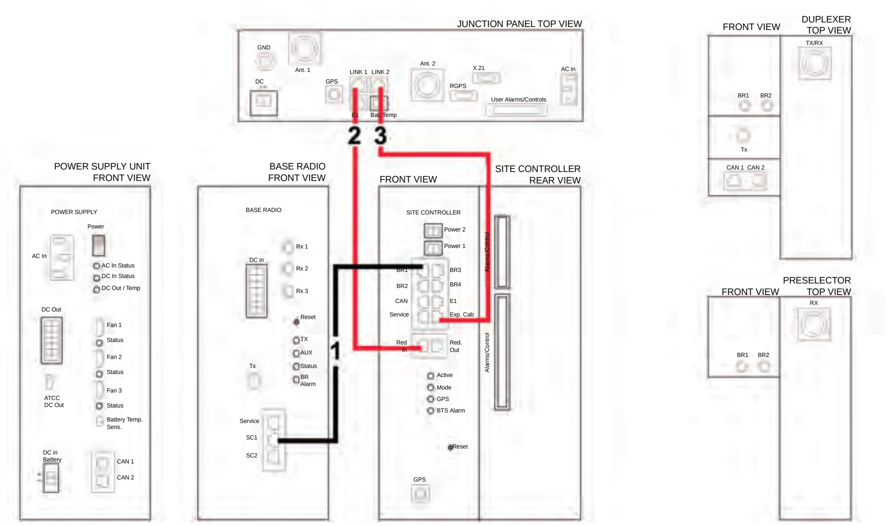
5.4.1

Ethernet Site Link Cabling – MTS LiTE

Table 43: Ethernet Site Link Cabling for MTS LiTE

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066544B 24	Base Radio 1 / SC1	Site Controller/ BR1	Ethernet link/ Grey cable
2	30015009 009	Site Controller/ Red In	Junction Panel/ Link1	Ethernet link
3	30015009 010	Site Controller/ Exp Cab	Junction Panel/ Link2	Ethernet link / Only in Dual Enet Configuration

Figure 101: Ethernet Site Link Cabling for MTS LiTE

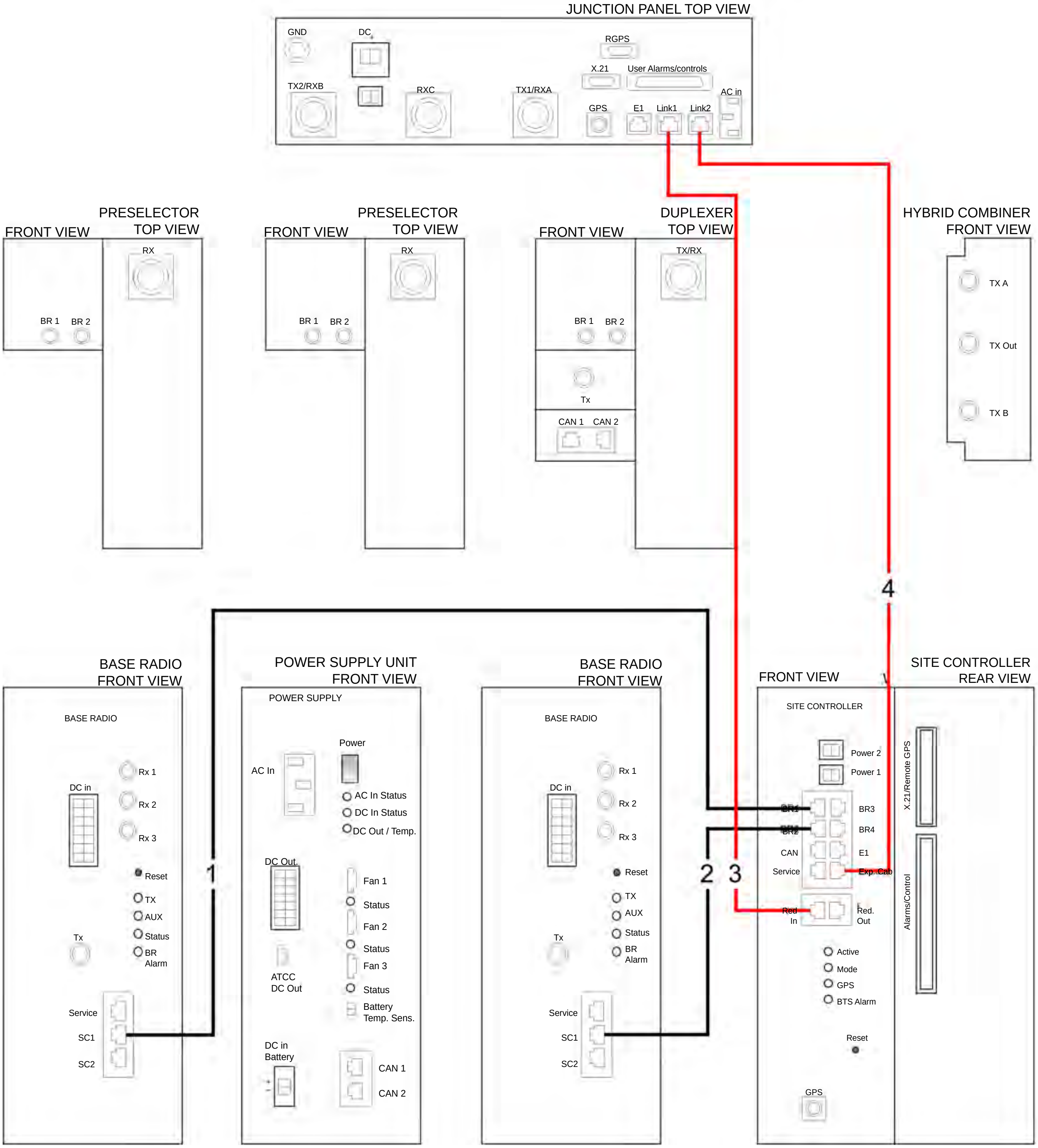


5.4.2 Ethernet Site Link Cabling – MTS 2

Table 44: Ethernet Site Link Cabling for MTS 2

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066544B01	Base Radio 1 / SC1	Site Controller/ BR1	Ethernet link/ Grey cable
2	3066544B02	Base Radio 2/ SC1	Site Controller/ BR2	Ethernet link/ Black cable
3	30015009005	Site Controller/ Red In	Junction Panel/ Link1	Ethernet link
4	30015009006	Site Controller/ Exp Cab	Junction Panel/ Link2	Ethernet link / Only in Dual Enet Configuration

Figure 102: Ethernet Site Link Cabling for MTS 2

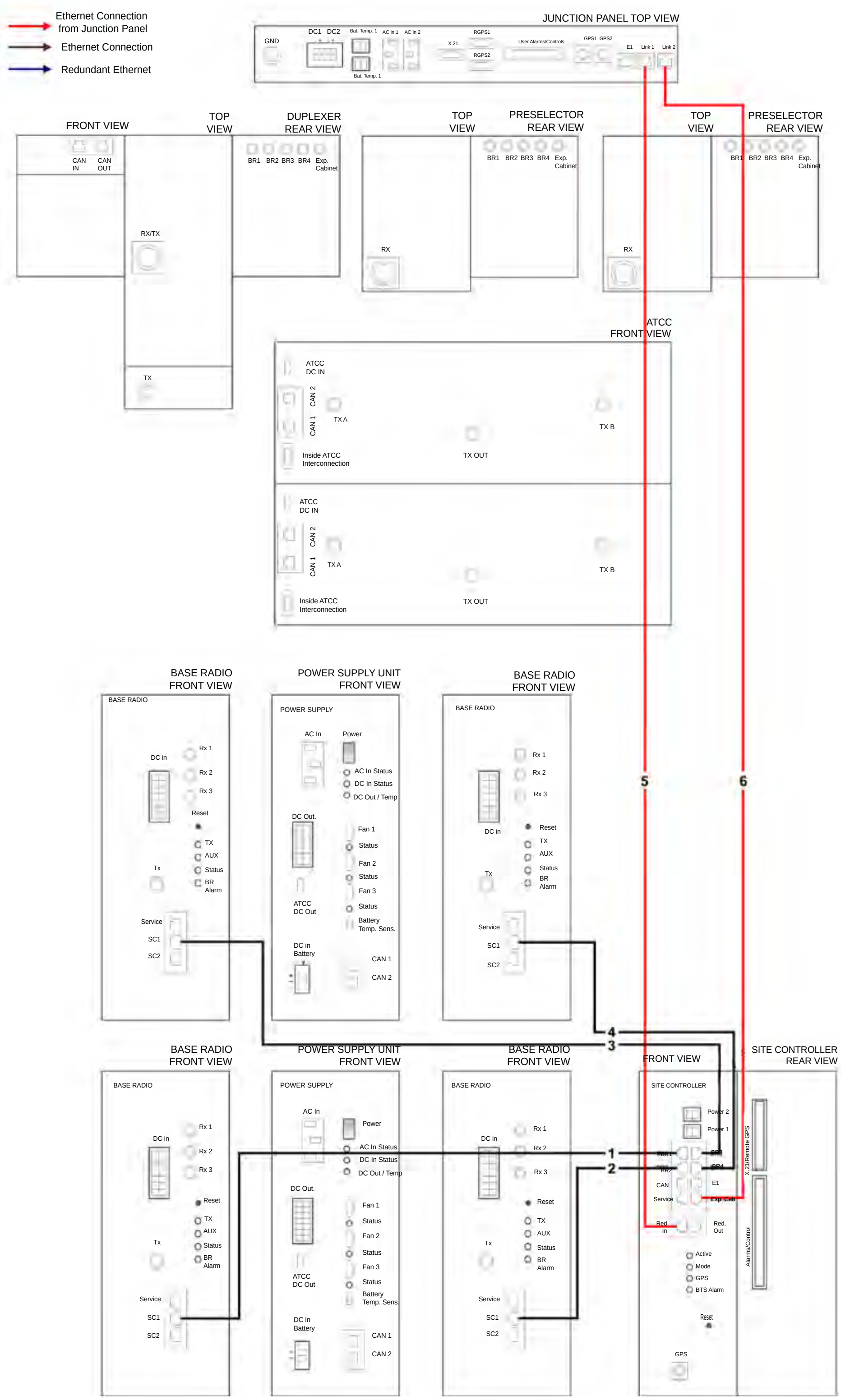


5.4.3
Ethernet Site Link Cabling – MTS 4 with Single Site Controller

Table 45: Ethernet Site Link Cabling for MTS 4 with Single Site Controller

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066544B01	Base Radio 1 / SC1	Site Controller1/ BR1	Ethernet link/ Grey cable
2	3066544B02	Base Radio 2/ SC1	Site Controller1/ BR2	Ethernet link/ Black cable
3	3066544B04	Base Radio 3/ SC1	Site Controller1/ BR3	Ethernet link/ Grey cable
4	3066544B05	Base Radio 4/ SC1	Site Controller1/ BR4	Ethernet link/ Black cable
5	3066562B01	Junction Panel/ Link1	RJ45 coupler	Bend Link breakout and insert RJ45 coupler.
	30015009001	RJ45 coupler	Site Controller 1/ Red In	Ethernet link
6	3066562B01	Junction Panel/ Link2	RJ45 coupler	Bend Link breakout and insert RJ45 coupler.
	30015009003	RJ45 coupler	Site Controller 1/ Exp Cab	Ethernet link / Only in Dual Enet Configuration

Figure 103: Ethernet Site Link Cabling for MTS 4 with Single Site Controller

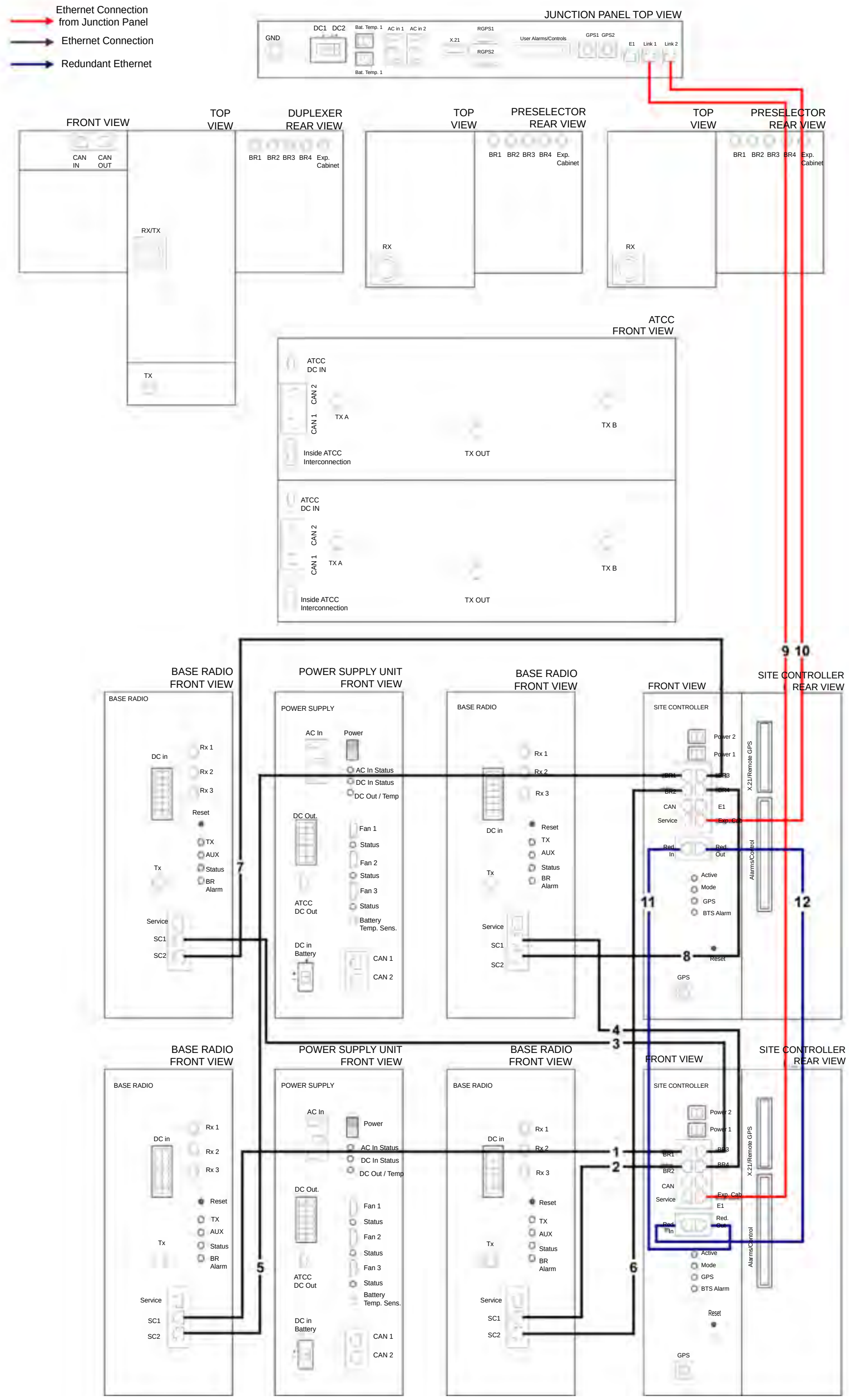


5.4.4 Ethernet Site Link Cabling – MTS 4 with Dual Site Controller

Table 46: Ethernet Site Link Cabling for MTS 4 with Dual Site Controller

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066544B 01	Base Radio 1 / SC1	Site Controller1/ BR1	Ethernet link/ Grey cable
2	3066544B 02	Base Radio 2/ SC1	Site Controller1/ BR2	Ethernet link/ Black cable
3	3066544B 04	Base Radio 3/ SC1	Site Controller1/ BR3	Ethernet link/ Grey cable
4	3066544B 05	Base Radio 4/ SC1	Site Controller1/ BR4	Ethernet link/ Black cable
5	3066544B 15	Base Radio 1 / SC2	Site Controller2/ BR1	Ethernet link/ Grey cable, only for configuration with redundant Site Controller
6	3066544B 16	Base Radio 2/ SC2	Site Controller2/ BR2	Ethernet link/ Black cable, only for configuration with redundant Site Controller
7	3066544B 01	Base Radio 3/ SC2	Site Controller2/ BR3	Ethernet link/ Grey cable, only for configuration with redundant Site Controller
8	3066544B 02	Base Radio 4/ SC2	Site Controller2/ BR4	Ethernet link/ Black cable, only for configuration with redundant Site Controller
9	3066562B 01	Junction Panel/ Link1	RJ45 coupler	Bend Link breakout and insert RJ45 coupler.
	30015009 003	RJ45 coupler	Site Controller1/ Exp Cab	Ethernet link
10	3066562B 01	Junction Panel/ Link2	RJ45 coupler	Bend Link breakout and insert RJ45 coupler.
	30015009 002	RJ45 coupler	Site Controller2/ Exo Cab	Ethernet link
11	3066544B 17	Site Controller2/ Red. Out	Site Controller1/ Red. In	Ethernet link/ Blue cable, only for configuration with redundant Site Controller
12	3066544B 17	Site Controller1/ Red. Out	Site Controller2/ Red. In	Ethernet link/ Blue cable, only for configuration with redundant Site Controller

Figure 104: Ethernet Site Link Cabling for MTS 4 with Dual Site Controller

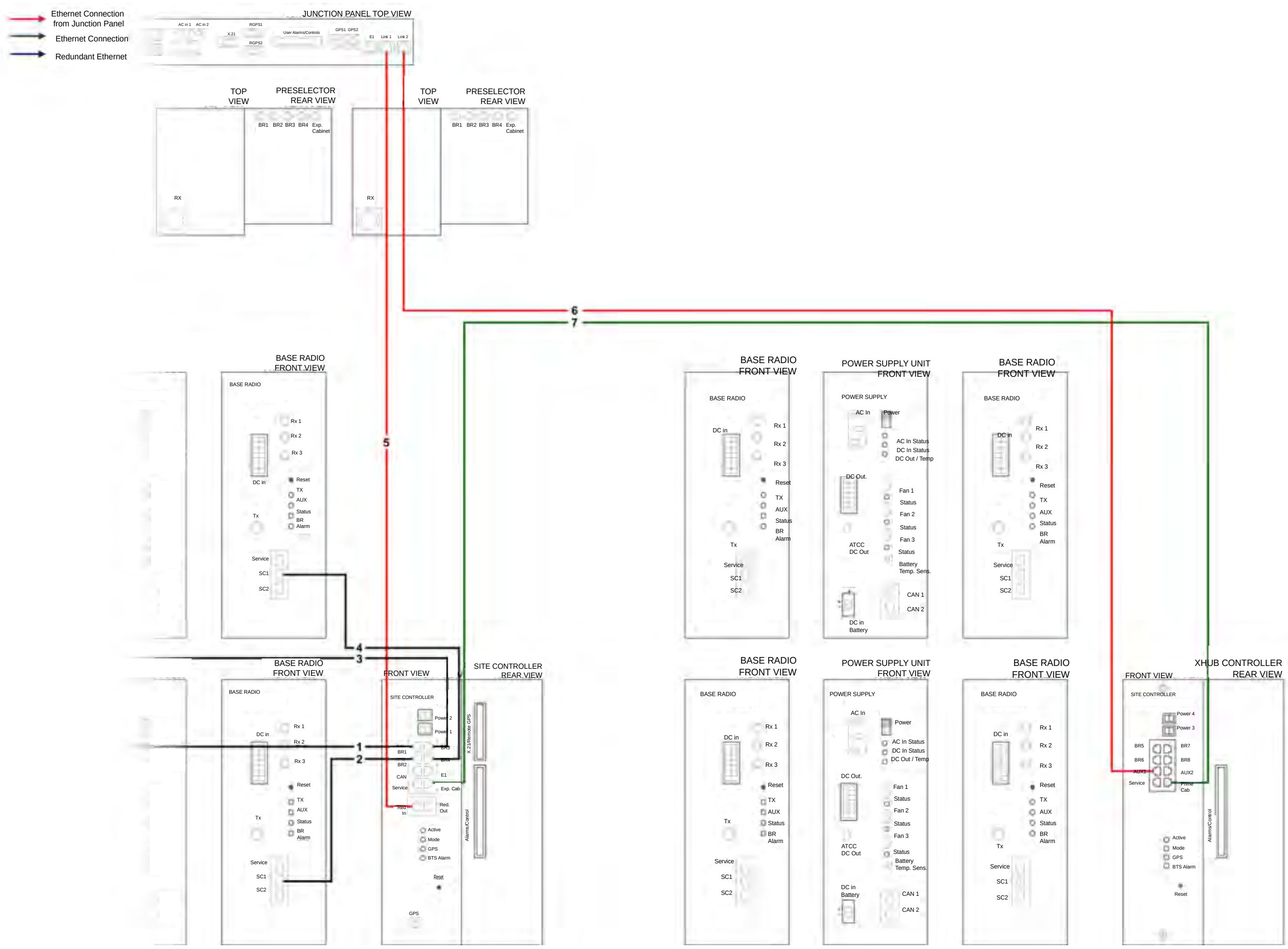


5.4.5 Ethernet Site Link Cabling – MTS 4 Expansion Cabinet with Single Site Controller

Table 47: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Single Site Controller

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066544B01	Base Radio 1 / SC1	Site Controller1/ BR1	Ethernet link/ Grey cable
2	3066544B02	Base Radio 2/ SC1	Site Controller1/ BR2	Ethernet link/ Black cable
3	3066544B04	Base Radio 3/ SC1	Site Controller1/ BR3	Ethernet link/ Grey cable
4	3066544B05	Base Radio 4/ SC1	Site Controller1/ BR4	Ethernet link/ Black cable
5	3066562B01	Junction Panel/ Link1	RJ45 coupler	Bend Link breakout and insert RJ45 coupler.
	30015009001	RJ45 coupler	Site Controller1/ RedIn	Ethernet link/ Blue cable
6	3066562B01	Junction Panel/ Link2	RJ45 coupler	Bend Link breakout and insert RJ45 coupler.
	30015009004	RJ45 coupler	XHUB Controller 1/ AUX1	Ethernet link/ Beige cable Only in dual eNET configuration
7	3066544B12	Site Controller1/ Exp Cab	XHUB Controller1/ Prime Cab	Ethernet link

Figure 105: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Single Site Controller



5.4.6 Ethernet Site Link Cabling – MTS 4 Expansion Cabinet with Dual Site Controller

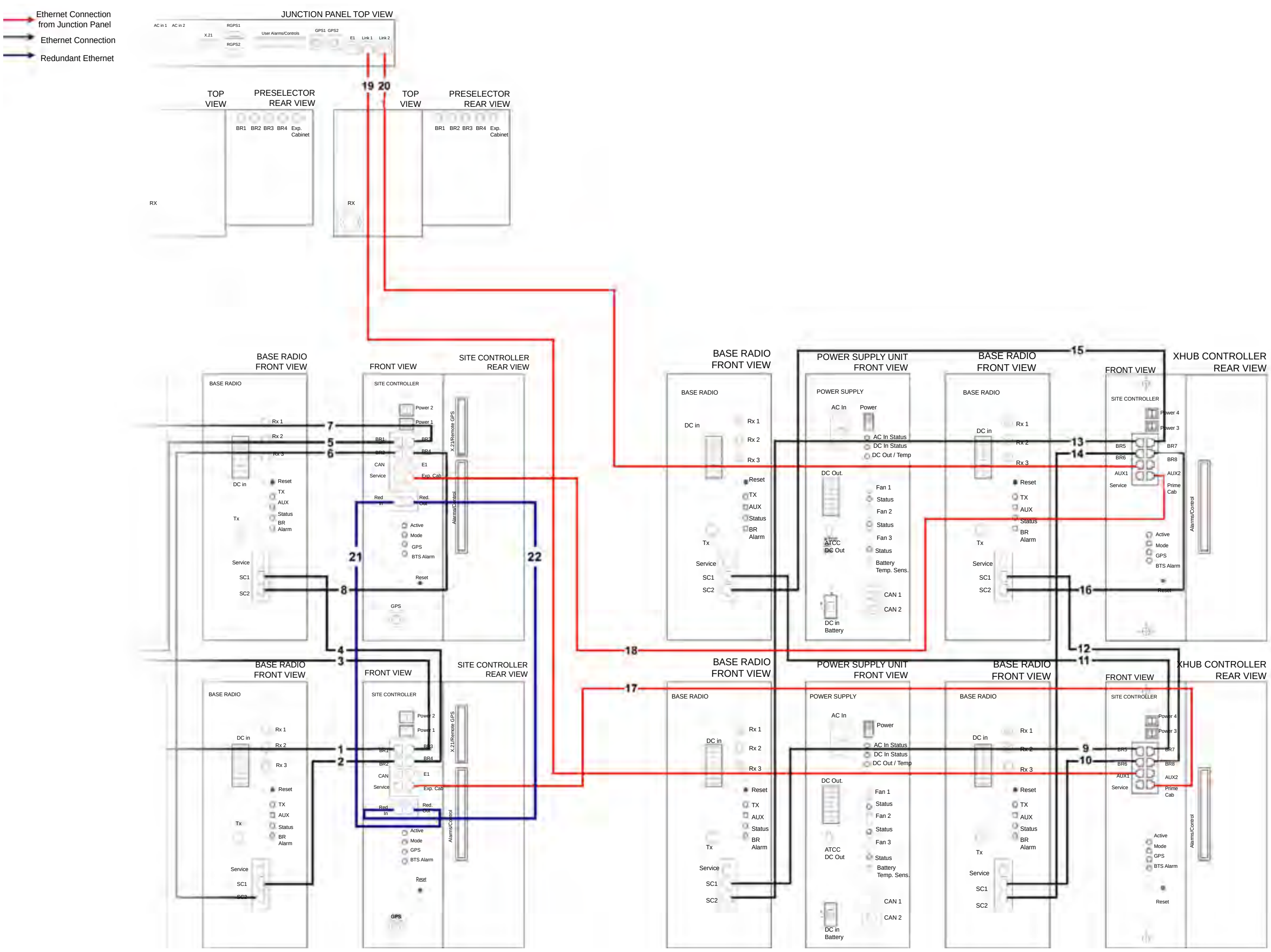
Table 48: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Dual Site Controller

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066544B01	Base Radio 1 / SC1	Site Controller1/ BR1	Ethernet link/ Grey cable
2	3066544B02	Base Radio 2/ SC1	Site Controller1/ BR2	Ethernet link/ Black cable
3	3066544B04	Base Radio 3/ SC1	Site Controller1/ BR3	Ethernet link/ Grey cable
4	3066544B05	Base Radio 4/ SC1	Site Controller1/ BR4	Ethernet link/ Black cable

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
5	3066544B15	Base Radio 1 / SC2	Site Controller2/ BR1	Ethernet link/ Grey cable
6	3066544B16	Base Radio 2/ SC2	Site Controller2/ BR2	Ethernet link/ Grey cable
7	3066544B01	Base Radio 3/ SC2	Site Controller2/ BR3	Ethernet link/ Grey cable
8	3066544B02	Base Radio 4/ SC2	Site Controller2/ BR4	Ethernet link/ Grey cable
9	3066544B01	Base Radio 5/ SC1	XHUB1/ BR5	Ethernet link/ Grey cable
10	3066544B02	Base Radio 6/ SC1	XHUB1/ BR6	Ethernet link/ Grey cable
11	3066544B04	Base Radio 7/ SC1	XHUB1/ BR7	Ethernet link/ Grey cable
12	3066544B05	Base Radio 8/ SC1	XHUB1/ BR8	Ethernet link/ Grey cable
13	3066544B15	Base Radio 5/ SC2	XHUB2/ BR5	Ethernet link/ Grey cable
14	3066544B16	Base Radio 6/ SC2	XHUB2/ BR6	Ethernet link/ Grey cable
15	3066544B01	Base Radio 7/ SC2	XHUB2/ BR7	Ethernet link/ Grey cable
16	3066544B02	Base Radio 8/ SC2	XHUB2/ BR8	Ethernet link/ Grey cable
17	3066544B12	Site Controller 1 / Exp Cab port on Site Controller 1	XHUB 1 / Prime Cab port on XHUB 1	Routed through conjunction hole at the side of the cabinet
18	3066544B12	Site Controller 2 / Exp Cab port on Site Controller 2	XHUB 2 / Prime Cab port on XHUB 2	Routed through conjunction hole at the side of the cabinet
19	3066562B01	Junction Panel/ Link1	RJ45 coupler	Bend Link breakout and insert RJ45 coupler.
	30015009004	RJ45 coupler	XHUB Controller 1/ AUX1	Ethernet link/ Beige cable
20	3066562B01	Junction Panel/ Link2	RJ45 coupler	Bend Link breakout and insert RJ45 coupler.
	30015009004	RJ45 coupler	XHUB Controller 2/ AUX1	Ethernet link/ Beige cable
21	3066544B17	Site Controller2/ Red. Out	Site Controller1/ Red. In	Ethernet link/ Blue cable, only for configuration with redundant Site Controller

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
22	3066544B17	Site Controller1/ Red. Out	Site Controller2/ Red. In	Ethernet link/ Blue cable, only for configuration with redundant Site Controller

Figure 106: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Dual Site Controller



5.5 RF Cabling

RF cabling refers to the cable connections among antenna connectors, the RF Distribution System (RFDS), and the Base Radios and it depends on filter configuration.

RF Cabling diagrams and details for different RF configuration types are presented in subsequent sections.

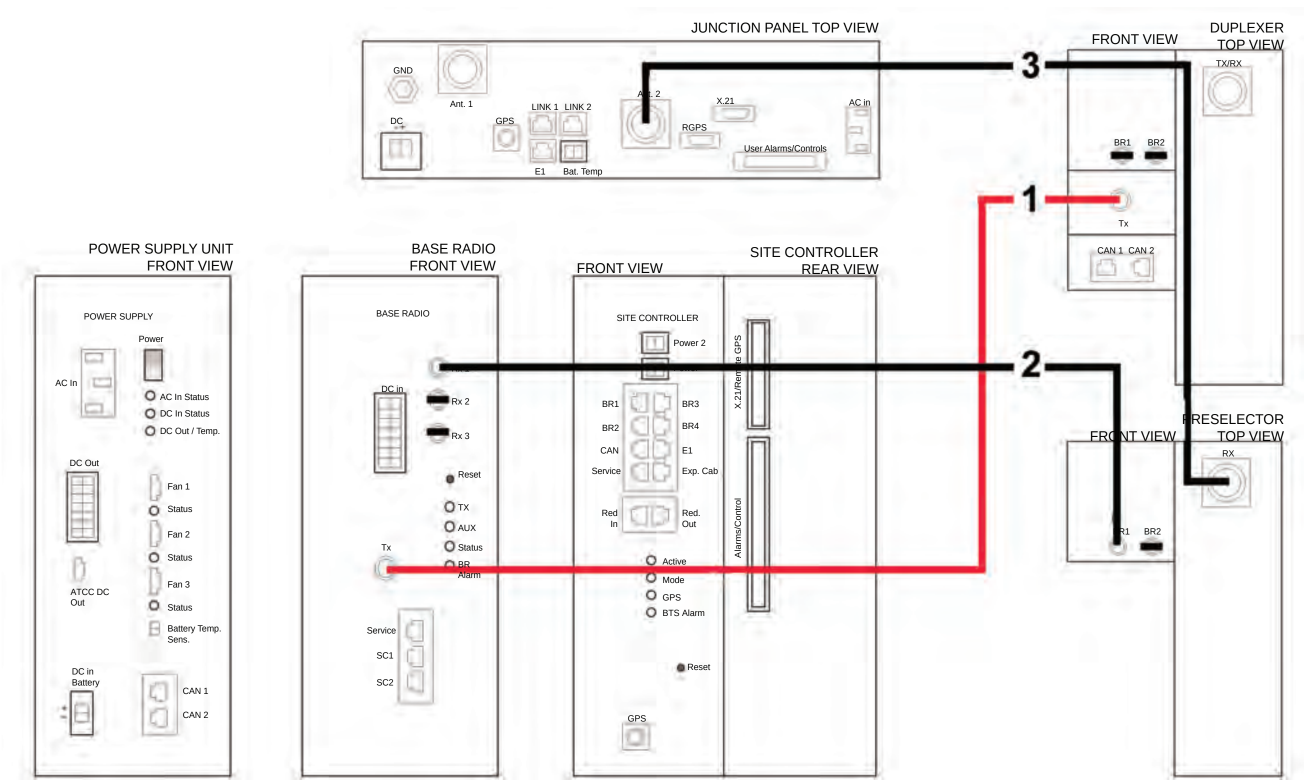
NOTICE: Not all Base Radios, filters, and associated cables are present in each configuration.

5.5.1 RF Cabling – MTS LiTE with One TX and One RX Antenna, No Diversity

Table 49: RF Cabling/Connections for MTS LiTE with One TX and One RX ant. No Diversity

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS LiTE with One TX and One RX ant. No Diversity				
1	3066543B05	Base Radio 1/ TX	Duplexer/ TX	TX path
2	3066543B18	Preselector/ BR1	Base Radio 1/ RX1	RX path on ANT 2
3	30015023001	Preselector/RX	Junction Panel/ Ant.2	
	2866544A01	Base Radio 1/ RX2		Terminator
		Base Radio 1/ RX3		Terminator
		Duplexer/ BR2		Terminator
		Preselector/ BR2		Terminator

Figure 107: RF Cabling/Connections for MTS LiTE with One TX and One RX ant. No Diversity

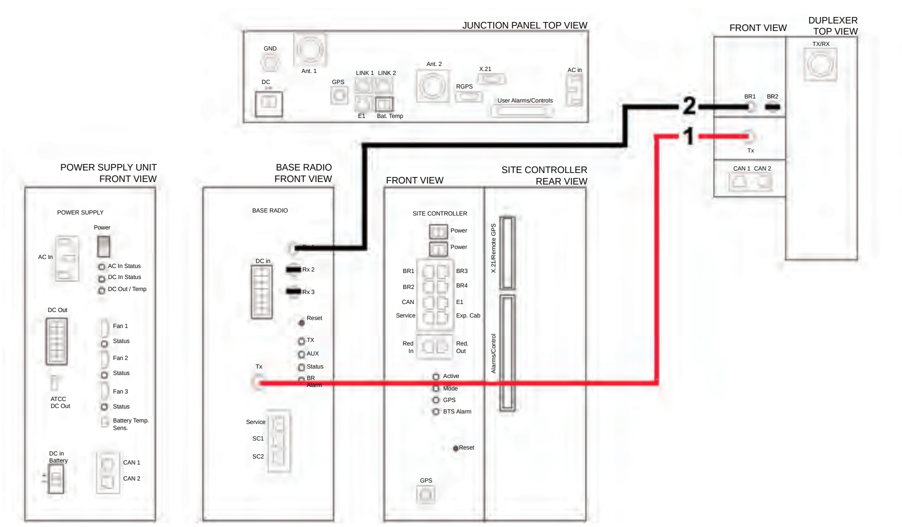


5.5.2
RF Cabling – MTS LiTE with One TX/RX Antenna

Table 50: RF Cabling/Connections for MTS LiTE with One TX/RX ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS LiTE with One TX/RX ant.				
1	3066543B05	Base Radio 1/ TX	Duplexer/ TX	TX path
2	3066543B01	Duplexer/ BR1	Base Radio 1/ RX1	RX path on ANT 1
	2866544A01	Base Radio 1/ RX2		Terminator
		Base Radio 1/ RX3		Terminator
		Duplexer/ BR2		Terminator

Figure 108: RF Cabling/Connections for MTS LiTE with One TX/RX ant.



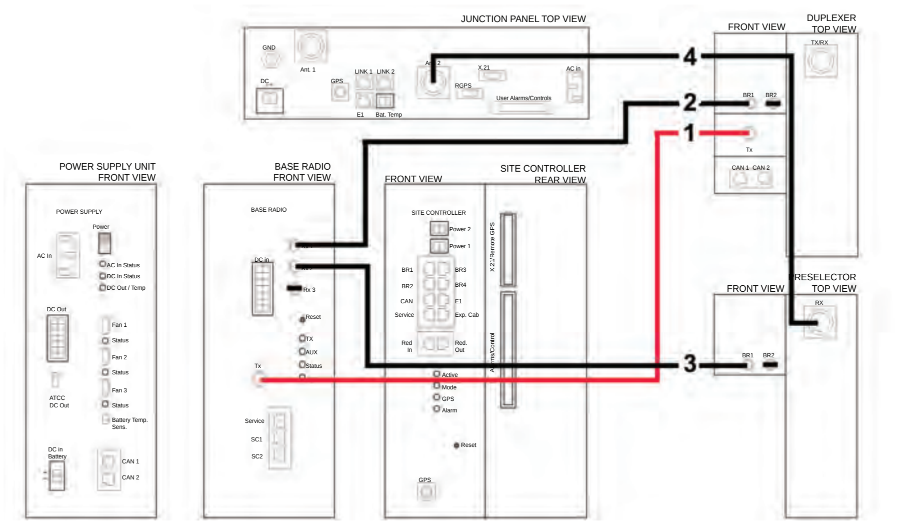
5.5.3
RF Cabling – MTS LiTE with One TX and Two RX Antennas

Table 51: RF Cabling/Connections for MTS LiTE with One TX/RX ant. and One Additional RX ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS LiTE with One TX/RX ant. and One Additional RX ant.				
1	3066543B05	Base Radio 1/ TX	Duplexer/ TX	TX path
2	3066543B01	Duplexer/ BR1	Base Radio 1/ RX1	RX path on ANT 1
3	3066543B18	Preselector/ BR1	Base Radio 1/ RX2	RX path on ANT 2

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
4	30015023001	Preselector/ RX	Junction Panel/ Ant. 2	
	2866544A01	Base Radio 1/ RX3		Terminator
		Duplexer/ BR2		Terminator
		Preselector/ BR2		Terminator

Figure 109: RF Cabling/Connections for MTS LiTE with One TX/RX ant. and One Additional RX ant.



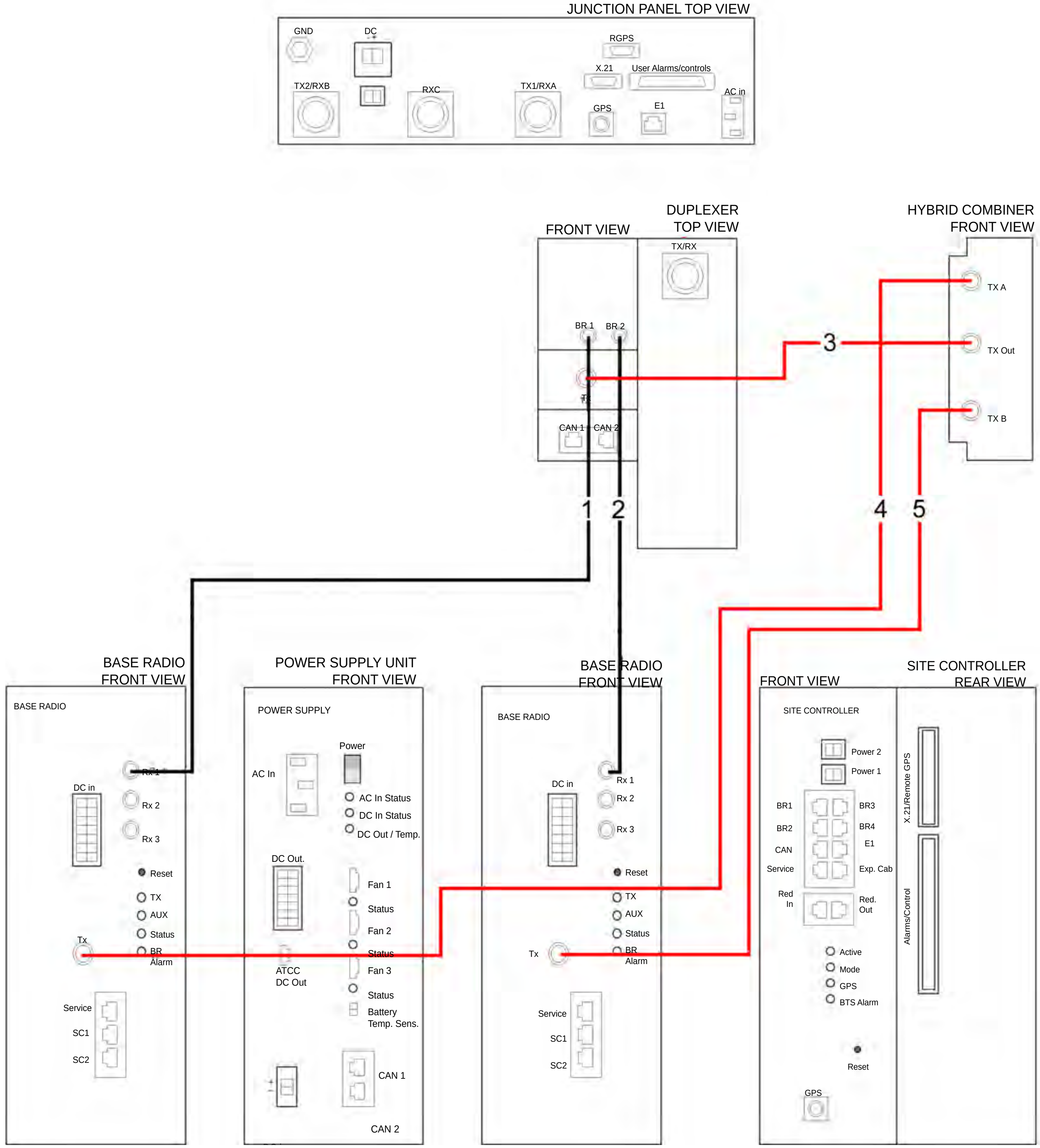
5.5.4 RF Cabling – MTS 2, No Diversity

Table 52: RF Cabling/Connections for MTS 2 with no diversity

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS 2 - No diversity				
1	3066543B 01	Duplexer/ BR1	Base Radio 1/ RX1	RX path/ RX on 1 or 2 ant.
2	3066543B 01	Duplexer/ BR2	Base Radio 2/ RX1	RX path/ RX on 1 or 2 ant.
3	3066543B 06	Hybrid Combiner/ TXOut	Duplexer/ TX	TX path
4	3066543B 12	Base Radio 1/ TX	Hybrid Combiner/ TX A	TX path
5	3066543B 05	Base Radio 2/ TX	Hybrid Combiner/TX B	TX path

NOTICE: The connectors on the top of the filters are directly fitted into appropriate holes in the Junction Panel.

Figure 110: RF Cabling Diagram for MTS 2 with No Diversity



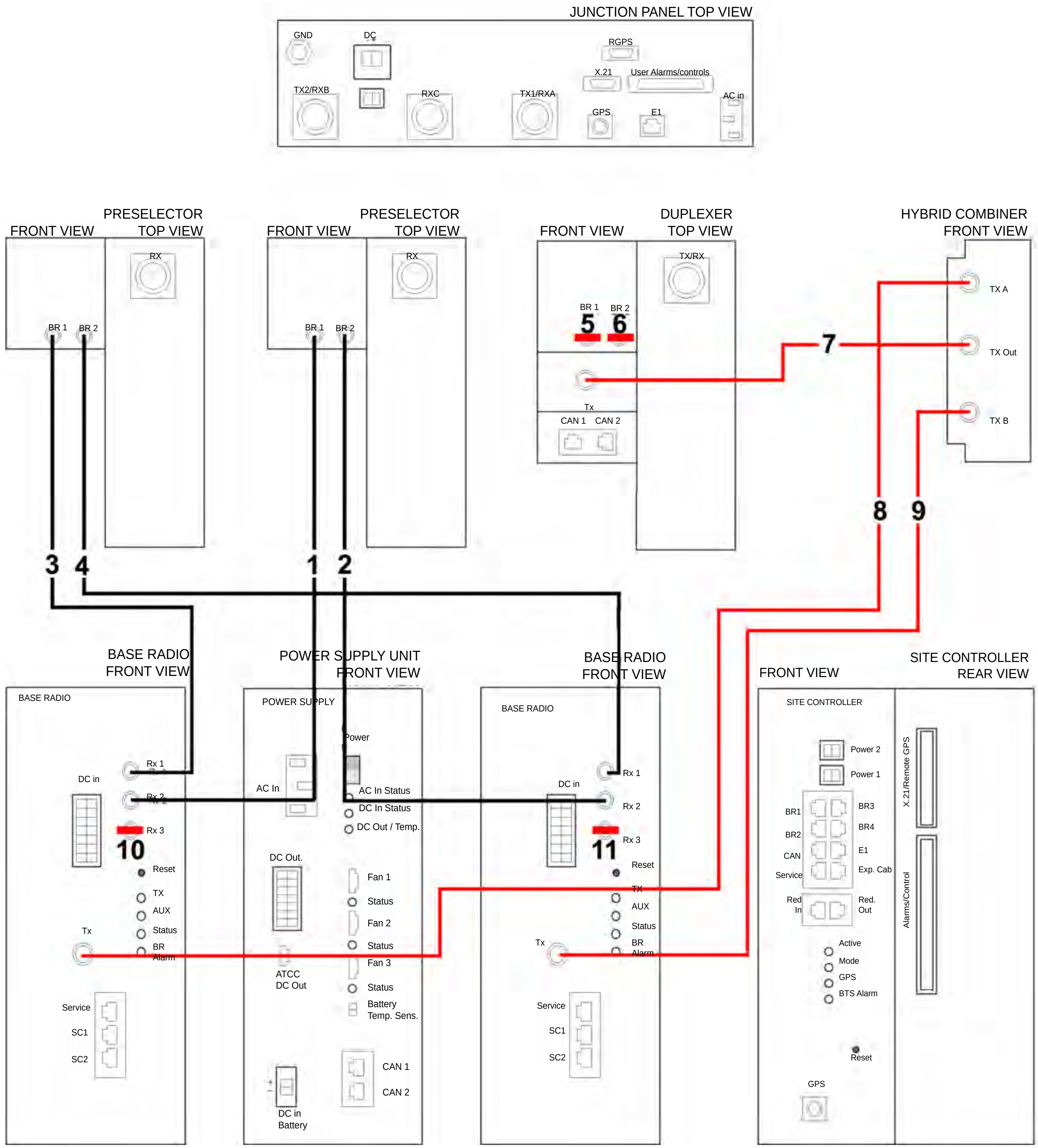
5.5.5
RF Cabling – MTS 2 with One TX Antenna

Table 53: RF Cabling/Connections for MTS 2 with One TX ant. and up to Two Additional RX ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS 2 - TX/RX on 1 ant.				
1	3066543B01	Preselector 2/ BR1	Base Radio 1/ RX2	RX path / RX on ANT 3
2	3066543B01	Preselector 2/ BR2	Base Radio 2/ RX2	RX path / RX on ANT 3.
3	3066543B01	Preselector 1/ BR1	Base Radio 1/ RX1	RX path / RX on ANT 2
4	3066543B01	Preselector 1/ BR2	Base Radio 2/ RX1	RX path / RX on ANT 2
5	2866544A01		Duplexer/ BR1	terminate duplexed rx
6	2866544A01		Duplexer/ BR2	terminate duplexed rx
7	3066543B06	Hybrid Combiner/ TXOut	Duplexer/ TX	TX path
8	3066543B12	Base Radio 1/ TX	Hybrid Combiner/ TX A	TX path on ANT 1
9	3066543B05	Base Radio 2/ TX	Hybrid Combiner/TX B	TX path on ANT 1
10	2866544A01		Base Radio 1/ RX3	terminate BR RX3
11	2866544A01		Base Radio 2/ RX3	terminate BR RX3

NOTICE: The connectors on the top of the filters are directly fitted into appropriate holes in the Junction Panel.

Figure 111: RF Cabling/Connections for MTS 2 with One TX ant. and up to Two Additional RX ant.



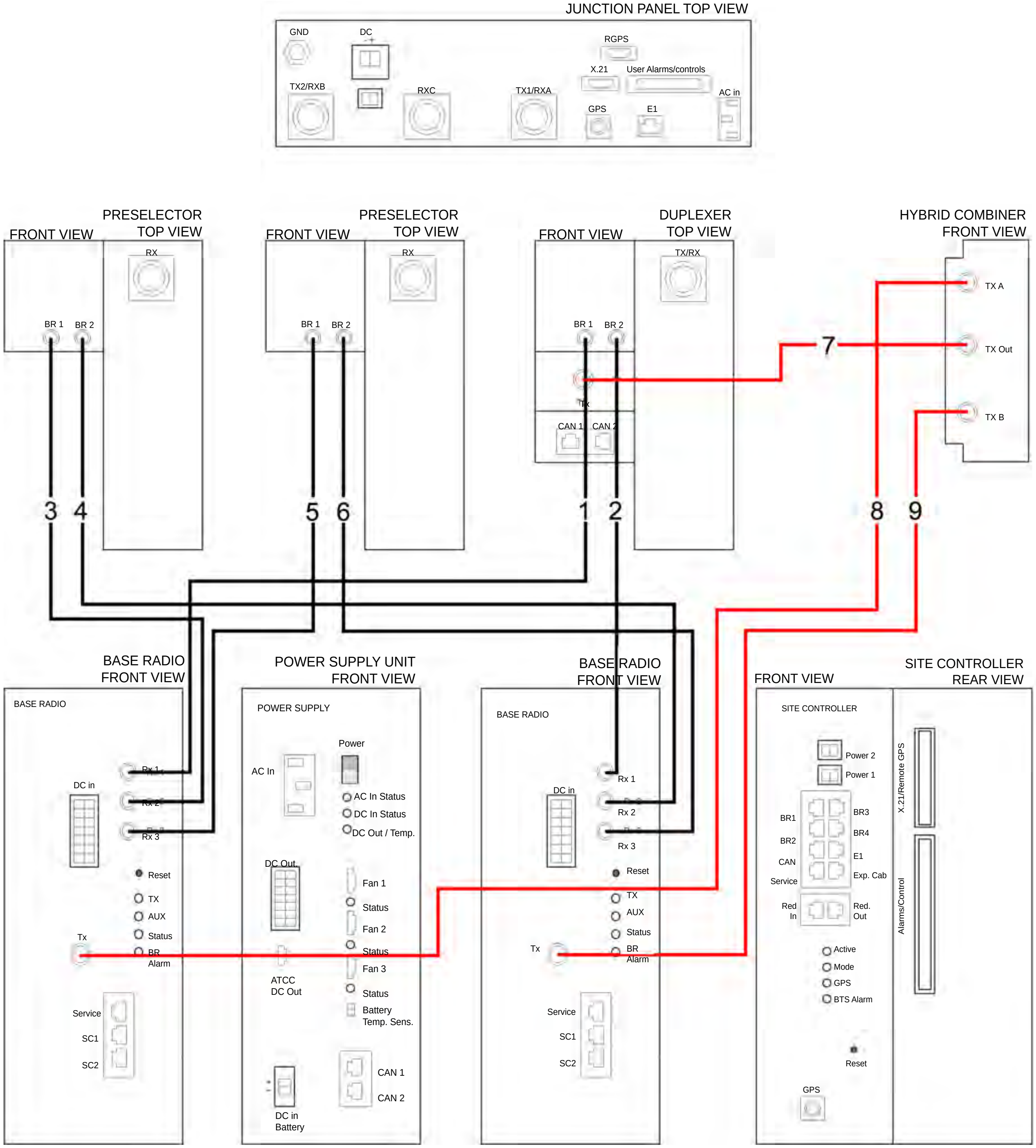
5.5.6
RF Cabling – MTS 2 with One TX/RX Antenna

Table 54: RF Cabling/Connections for MTS 2 with One TX/RX ant. and up to Two Additional RX ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS 2 - TX/RX on 1 ant.				
1	3066543B01	Duplexer/ BR1	Base Radio 1/ RX1	RX path on tx/rx ANT 1
2	3066543B01	Duplexer/ BR2	Base Radio 2/ RX1	RX path on tx/rx ANT 1
3	3066543B01	Preselector 1/ BR1	Base Radio 1/ RX2	RX path on ANT 2
4	3066543B01	Preselector 1/ BR2	Base Radio 2/ RX2	RX path on ANT 2
5	3066543B01	Preselector 2/ BR1	Base Radio 1/ RX3	RX path on ANT 3
6	3066543B01	Preselector 2/ BR2	Base Radio 2/ RX3	RX path on ANT 3
7	3066543B06	Hybrid Combiner/ TXOut	Duplexer/ TX	TX path
8	3066543B12	Base Radio 1/ TX	Hybrid Combiner/ TX A	TX path
9	3066543B05	Base Radio 2/ TX	Hybrid Combiner/TX B	TX path

NOTICE: The connectors on the top of the filters are directly fitted into appropriate holes in the Junction Panel.

Figure 112: RF Cabling Diagram for MTS 2 with One TX/RX ant. and Up to Two Additional RX ant.



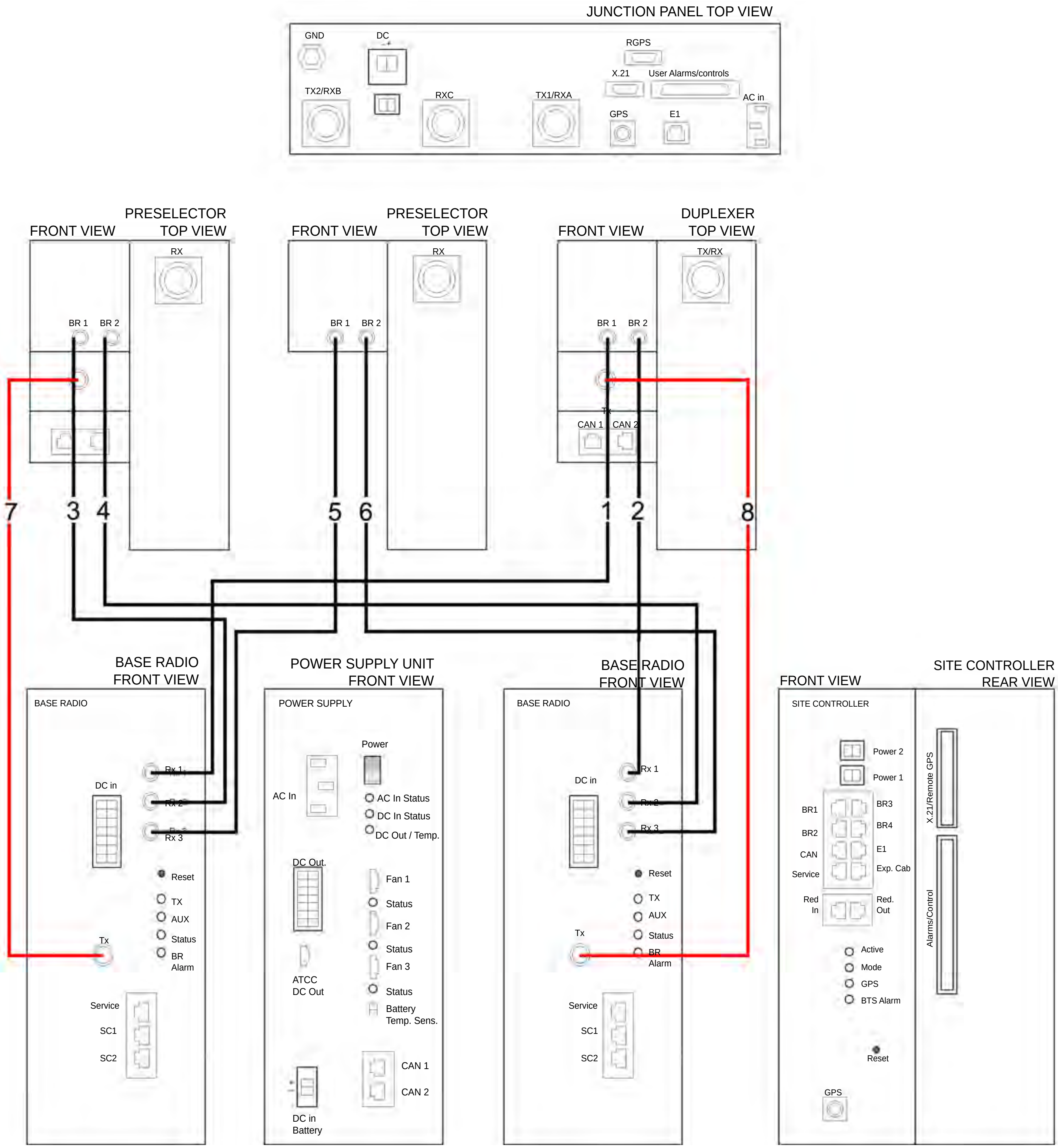
5.5.7
RF Cabling – MTS 2 with Two TX/RX Antennas

Table 55: RF Cabling/Connections for MTS 2 with Two TX/RX ant. and Up to One Additional RX ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS 2 - TX/RX on 2 ant.				
1	3066543B 01	Duplexer 1/ BR1	Base Radio 1/ RX1	RX path/ no RX or RX on 1 ant.
2	3066543B 01	Duplexer 1/ BR2	Base Radio 2/ RX1	RX path/ no RX or RX on 1 ant.
3	3066543B 01	Duplexer 2/ BR1	Base Radio 1/ RX2	RX path/ no RX or RX on 1 ant.
4	3066543B 01	Duplexer 2/ BR2	Base Radio 2/ RX2	RX path/ no RX or RX on 1 ant.
5	3066543B 01	Preselector 1/ BR1	Base Radio 1/ RX3	RX path/ RX on 1 ant.
6	3066543B 01	Preselector 1/ BR2	Base Radio 2/ RX3	RX path/ RX on 1 ant.
7	3066543B 05	Base Radio 1/ TX	Duplexer 1/ TX	TX path
8	3066543B 05	Base Radio 2/ TX	Duplexer 2/ TX	TX path

NOTICE: The connectors on the top of the filters are directly fitted into appropriate holes in the Junction Panel

Figure 113: RF Cabling Diagram for MTS 2 with Two TX/RX ant. and Up to One Additional RX ant.



5.5.8 RF Cabling – MTS 4, No Diversity

Table 56: RF Cabling/Connections for MTS 4 with No Diversity

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
1	3066543B02	Base Radio 1/ Rx1	Duplexer/ BR1	RX path/ RX on 1 or 2 ant.
2	3066543B02	Base Radio 2/ Rx1	Duplexer/ BR2	RX path/ RX on 1 or 2 ant.
3	3066543B03	Base Radio 3/ Rx1	Duplexer/ BR3	RX path/ RX on 1 or 2 ant.
4	3066543B03	Base Radio 4/ Rx1	Duplexer/ BR4	RX path/ RX on 1 or 2 ant.
5	3066543B08	Base Radio 1/ Tx	ATCC 1/ TX A	TX path, Coax cable, low loss
6	3066543B08	Base Radio 2/ Tx	ATCC 1/ TX B	TX path, Coax cable, low loss
7	3066543B09	Base Radio 3/ Tx	ATCC 2/ TX A	TX path, Coax cable, low loss
8	3066543B09	Base Radio 4/ Tx	ATCC 2/ TX B	TX path, Coax cable, low loss
9	3066543B15	ATCC (1, 2)	Duplexer/ TX	TX path, Duplexer Tx cable
10	See Table 57: TX ATCC Interconnect Harness Part Numbers on page 204	ATCC 1/ TX OUT ATCC 2/ TX OUT	ATCC (1, 2)	TX path, Interconnect harness

NOTICE:
The connectors on the top of the filters are directly fitted into appropriate holes in the Junction Panel.

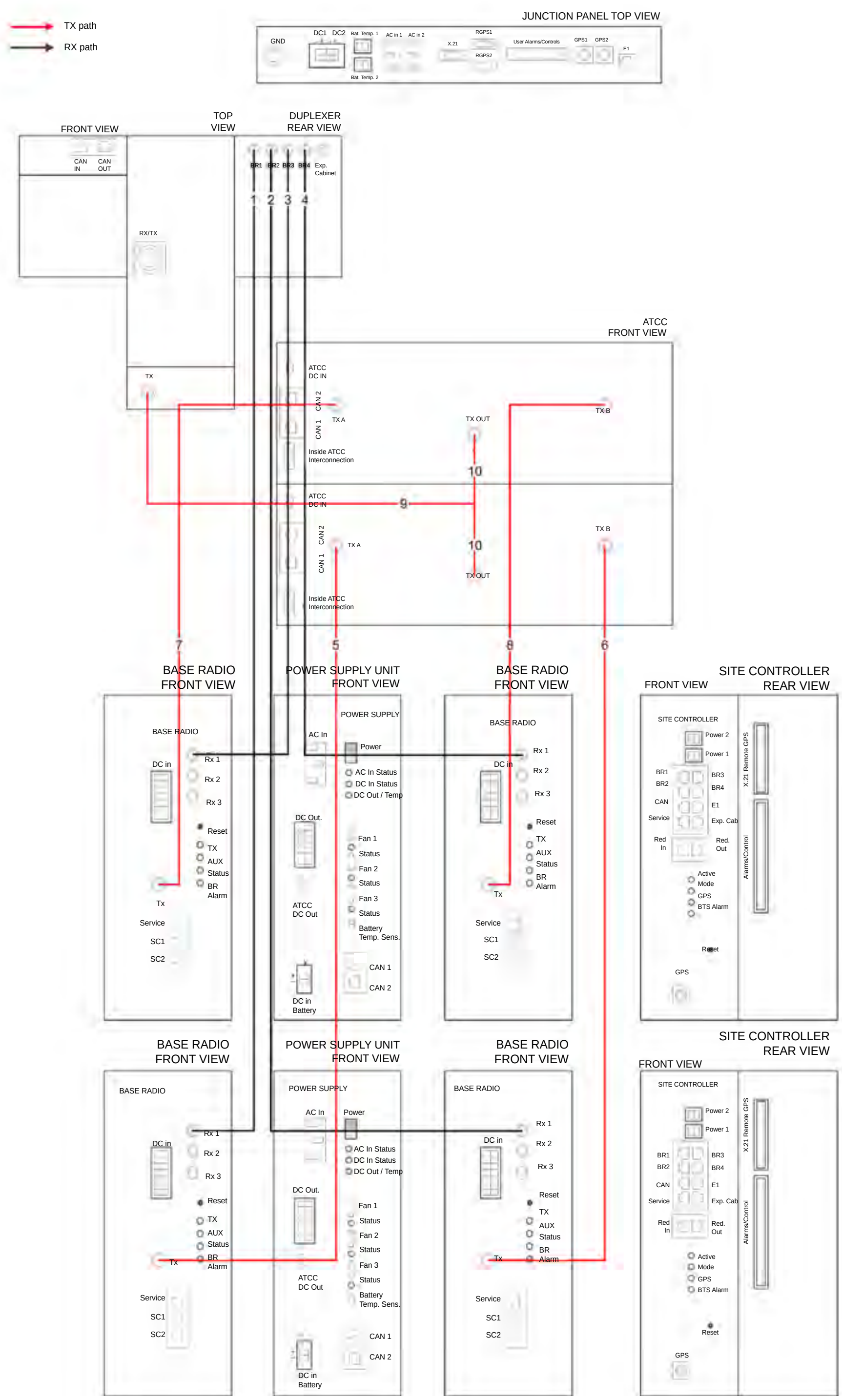
When Hybrid Combiner (HC) or Manual Tune Cavity Combiner (MTCC) are used instead of Auto Tune Cavity Combiner (ATCC), connect the cables to corresponding inputs and outputs.

Table 57: TX ATCC Interconnect Harness Part Numbers

Part Number	Frequency Band
0166501N60	360 MHz – 370 MHz
0166501N61	380 MHz – 400 MHz
0166501N63	420 MHz – 430 MHz
0166501N64	460 MHz – 470 MHz

Part Number	Frequency Band
91015008001	260 MHz – 275 MHz
0166502N38	851 MHz – 870 MHz

Figure 114: RF Cabling Diagram for MTS 4 with No Diversity



5.5.9
RF Cabling – MTS 4 with One TX/RX Antenna

Table 58: RF Cabling for MTS 4 with One TX/RX Antenna and Up to Two Additional RX Antennas

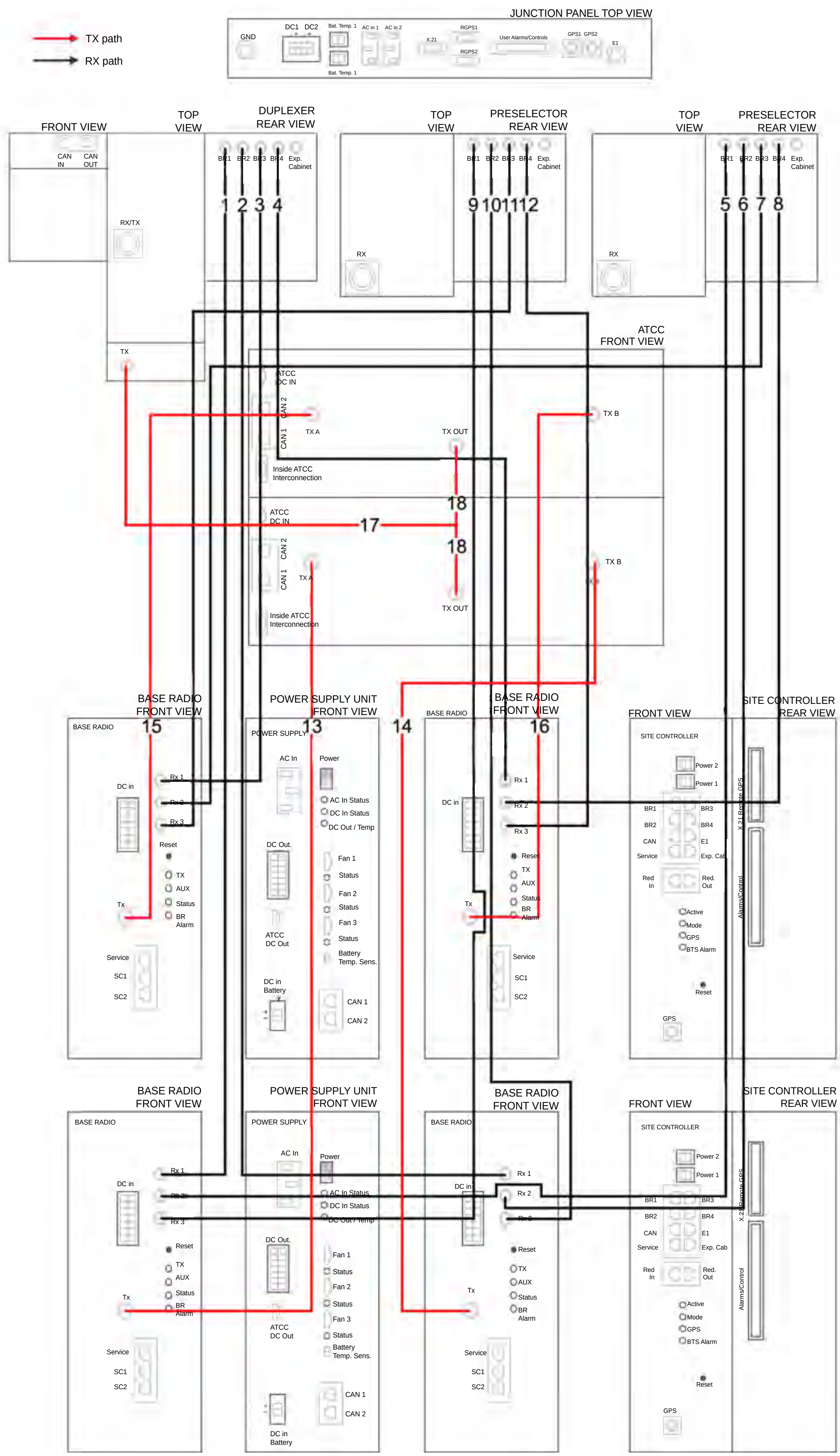
Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
1	3066543B 02	Base Radio 1/ Rx1	Duplexer/ BR1	RX path/ RX on 1 or 2 ant.
2	3066543B 02	Base Radio 2/ Rx1	Duplexer/ BR2	RX path/ RX on 1 or 2 ant.
3	3066543B 03	Base Radio 3/ Rx1	Duplexer/ BR3	RX path/ RX on 1 or 2 ant.
4	3066543B 03	Base Radio 4/ Rx1	Duplexer/ BR4	RX path/ RX on 1 or 2 ant.
5	3066543B 02	Base Radio 1/ Rx2	Preselector 1/ BR1	RX path/ RX on 1 or 2 ant.
6	3066543B 02	Base Radio 2/ Rx2	Preselector 1/ BR2	RX path/ RX on 1 or 2 ant.
7	3066543B 03	Base Radio 3/ Rx2	Preselector 1/ BR3	RX path/ RX on 1 or 2 ant.
8	3066543B 03	Base Radio 4/ Rx2	Preselector 1/ BR4	RX path/ RX on 1 or 2 ant.
9	3066543B 02	Base Radio 1/ Rx3	Preselector 2/ BR1	RX path/ RX on 2 ant.
10	3066543B 02	Base Radio 2/ Rx3	Preselector 2/ BR2	RX path/ RX on 2 ant.
11	3066543B 03	Base Radio 3/ Rx3	Preselector 2/ BR3	RX path/ RX on 2 ant.
12	3066543B 03	Base Radio 4/ Rx3	Preselector 2/ BR4	RX path/RX on 2 ant.
13	3066543B 08	Base Radio 1/ Tx	ATCC 1/ TX A	TX path, Coax cable, low loss
14	3066543B 08	Base Radio 2/ Tx	ATCC 1/ TX B	TX path, Coax cable, low loss
15	3066543B 09	Base Radio 3/ Tx	ATCC 2/ TX A	TX path, Coax cable, low loss
16	3066543B 09	Base Radio 4/ Tx	ATCC 2/ TX B	TX path, Coax cable, low loss
17	3066543B 15	ATCC (1, 2)	Duplexer/ TX	TX path, Duplexer Tx cable
18	See Table 57: TX ATCC Interconnect	ATCC 1/ TX OUT ATCC 2/ TX OUT	ATCC (1, 2)	TX path, Interconnect harness

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
	Harness Part Numbers on page 204.			

NOTICE:
The connectors on the top of the filters are directly fitted into appropriate holes in the Junction Panel.

When Hybrid Combiner (HC) or Manual Tune Cavity Combiner (MTCC) are used instead of Auto Tune Cavity Combiner (ATCC), connect the cables to corresponding inputs and outputs.

Figure 115: RF Cabling/Connections for MTS 4 with one TX/RX ant. and Up to Two Additional RX ant.



5.5.10
RF Cabling – MTS 4 with Two TX/RX Antennas

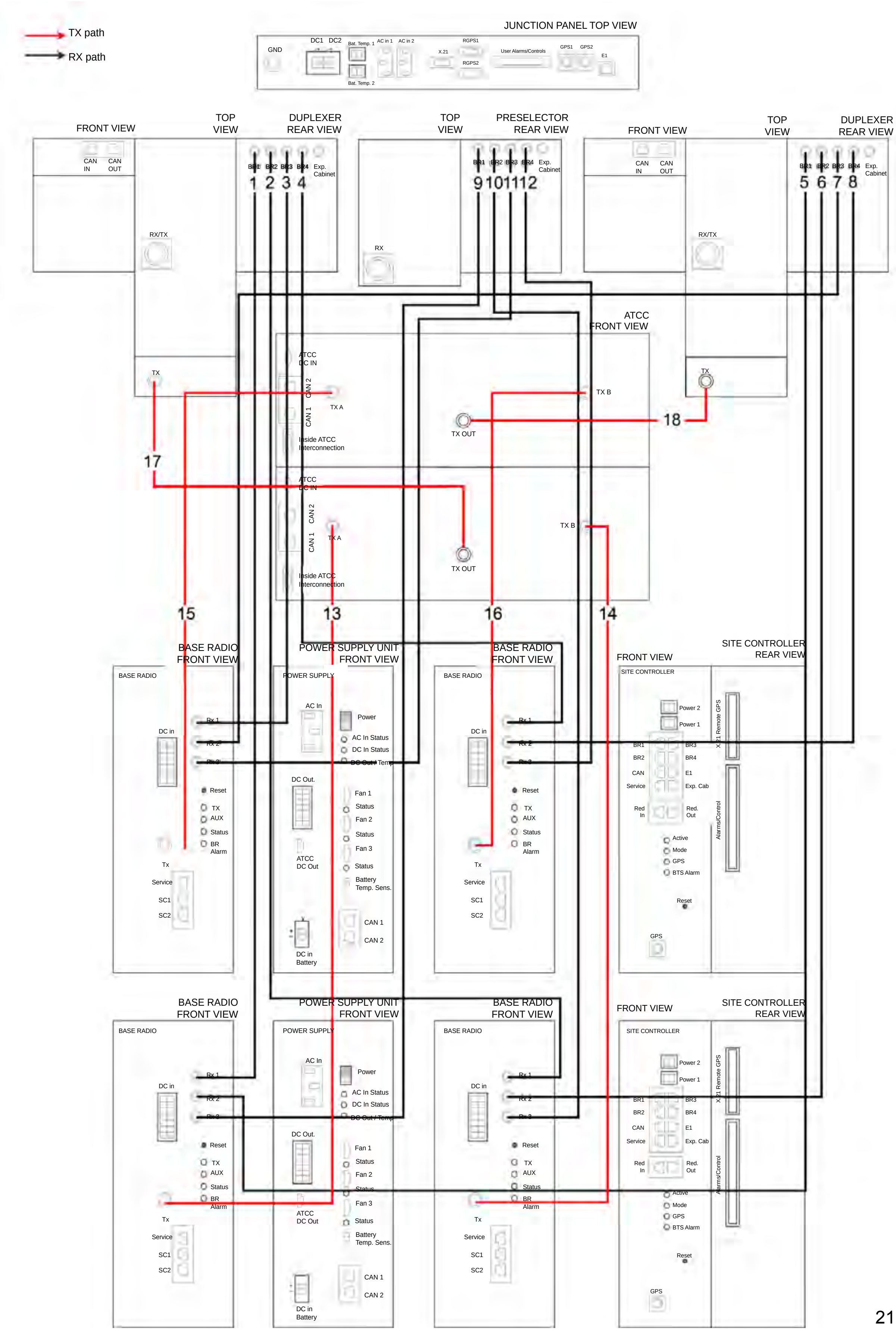
Table 59: RF Cabling/Connections for MTS 4 with Two TX/RX ant. and Up to One Additional RX ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
1	3066543B02	Base Radio 1/ Rx1	Duplexer 1/ BR1	RX path/ no RX or RX on 1 ant.
2	3066543B02	Base Radio 2/ Rx1	Duplexer 1/ BR2	RX path/ no RX or RX on 1 ant.
3	3066543B03	Base Radio 3/ Rx1	Duplexer 1/ BR3	RX path/ no RX or RX on 1 ant.
4	3066543B03	Base Radio 4/ Rx1	Duplexer 1/ BR4	RX path/ no RX or RX on 1 ant.
5	3066543B02	Base Radio 1/ Rx2	Duplexer 2/ BR1	RX path/ no RX or RX on 1 ant.
6	3066543B02	Base Radio 2/ Rx2	Duplexer 2/ BR2	RX path/ no RX or RX on 1 ant.
7	3066543B03	Base Radio 3/ Rx2	Duplexer 2/ BR3	RX path/ no RX or RX on 1 ant.
8	3066543B03	Base Radio 4/ Rx2	Duplexer 2/ BR4	RX path/ no RX or RX on 1 ant.
9	3066543B02	Base Radio 1/ Rx3	Preselector/ BR1	RX path/ RX on 1 ant.
10	3066543B02	Base Radio 2/ Rx3	Preselector/ BR2	RX path/ RX on 1 ant.
11	3066543B03	Base Radio 3/ Rx3	Preselector/ BR3	RX path/ RX on 1 ant.
12	3066543B03	Base Radio 4/ Rx3	Preselector / BR4	RX path/RX on 1 ant.
13	3066543B08	Base Radio 1/ Tx	ATCC 1/ TX A	TX path, Coax cable, low loss
14	3066543B08	Base Radio 2/ Tx	ATCC 1/ TX B	TX path, Coax cable, low loss
15	3066543B09	Base Radio 3/ Tx	ATCC 2/ TX A	TX path, Coax cable, low loss
16	3066543B09	Base Radio 4/ Tx	ATCC 2/ TX B	TX path, Coax cable, low loss
17	3066543B15	ATCC 1/ TX OUT	Duplexer 1/ TX	TX path
18	3066543B15	ATTC 2/ TX OUT	Duplexer 2/ TX	TX path

NOTICE:
The connectors on the top of the filters are directly fitted into appropriate holes in the Junction Panel.

When Hybrid Combiner (HC) or Manual Tune Cavity Combiner (MTCC) is used instead of Auto Tune Cavity Combiner (ATCC), connect the cables to the corresponding inputs and outputs.

Figure 116: RF Cabling/Connections for MTS 4 with Two TX/RX ant. and Up to One Additional RX ant.



5.5.11
RF Cabling – MTS 4 with One TX Antenna

Table 60: RF Cabling/Connections for MTS 4 with One TX ant. and Up to Three Additional RX ant.

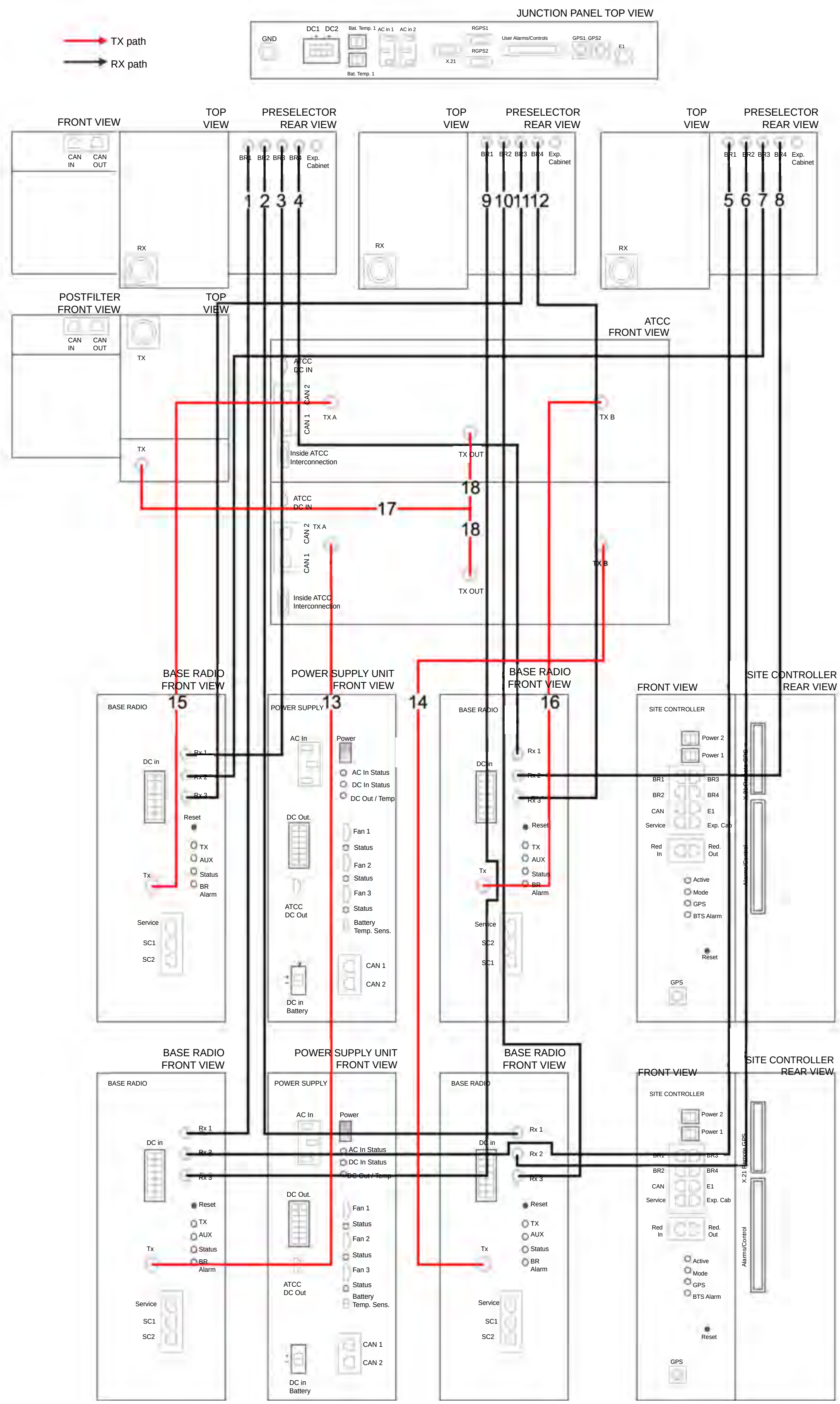
Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
1	3066543B 02	Base Radio 1/ Rx1	Preselector 1/ BR1	RX path/ RX on 2 or 3 ant.
2	3066543B 02	Base Radio 2/ Rx1	Preselector 1/ BR2	RX path/ RX on 2 or 3 ant.
3	3066543B 03	Base Radio 3/ Rx1	Preselector 1/ BR3	RX path/ RX on 2 or 3 ant.
4	3066543B 03	Base Radio 4/ Rx1	Preselector 1/ BR4	RX path/ RX on 2 or 3 ant.
5	3066543B 02	Base Radio 1/ Rx2	Preselector 2/ BR1	RX path/ RX on 2 or 3 ant.
6	3066543B 02	Base Radio 2/ Rx2	Preselector 2/ BR2	RX path/ RX on 2 or 3 ant.
7	3066543B 03	Base Radio 3/ Rx2	Preselector 2/ BR3	RX path/ RX on 2 or 3 ant.
8	3066543B 03	Base Radio 4/ Rx2	Preselector 2/ BR4	RX path/ RX on 2 or 3 ant.
9	3066543B 02	Base Radio 1/ Rx3	Preselector 3/ BR1	RX path/ RX on 3 ant.
10	3066543B 02	Base Radio 2/ Rx3	Preselector 3/ BR2	RX path/ RX on 3 ant.
11	3066543B 03	Base Radio 3/ Rx3	Preselector 3/ BR3	RX path/ RX on 3 ant.
12	3066543B 03	Base Radio 4/ Rx3	Preselector 3/ BR4	RX path/ RX on 3 ant.
13	3066543B 08	Base Radio 1/ Tx	ATCC 1/ TX A	TX path, Coax cable, low loss
14	3066543B 08	Base Radio 2/ Tx	ATCC 1/ TX B	TX path, Coax cable, low loss
15	3066543B 09	Base Radio 3/ Tx	ATCC 2/ TX A	TX path, Coax cable, low loss
16	3066543B 09	Base Radio 4/ Tx	ATCC 2/ TX B	TX path, Coax cable, low loss
17	3066543B 15	ATCC (1, 2)	Post Filter/ TX	TX path, Post Filter cable
18	See Table 57: TX ATCC Interconnect	ATCC 1/ TX OUT ATCC 2/ TX OUT	ATCC (1, 2)	TX path, Interconnect Harness

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
	Harness Part Numbers on page 204.			

NOTICE:
The connectors on the top of the filters are directly fitted into appropriate holes in the Junction Panel.

When Hybrid Combiner (HC) or Manual Tune Cavity Combiner (MTCC) is used instead of Auto Tune Cavity Combiner (ATCC), connect the cables to the corresponding inputs and outputs.

Figure 117: RF Cabling/Connections for MTS 4 with One TX ant. and Up to Three Additional RX ant.



5.5.12
RF Cabling – Expansion Cabinet with One TX/RX Antenna

Table 61: RF Cabling/Connections for Expansion Cabinet with One TX/RX ant. and Up to Two Additional RX ant.

Index	Cable Part Number	From Unit	To Unit	Notes
1	3066543B02	Base Radio 5 / RX-S 1	RX-S 1 / BR 5	RX path / RX on 1 or 2 ant.
2	3066543B02	Base Radio 6 / RX-S 1	RX-S 1 / BR 6	RX path / RX on 1 or 2 ant.
3	3066543B03	Base Radio 7 / RX-S 1	RX-S 1 / BR 7	RX path / RX on 1 or 2 ant.
4	3066543B03	Base Radio 8 / RX-S 1	RX-S 1 / BR 8	RX path / RX on 1 or 2 ant.
5	3066543B02	Base Radio 5 / RX-S 2	RX-S 2 / BR 5	RX path / RX on 1 or 2 ant.
6	3066543B02	Base Radio 6 / RX-S 2	RX-S 2 / BR 6	RX path / RX on 1 or 2 ant.
7	3066543B03	Base Radio 7 / RX-S 2	RX-S 2 / BR 7	RX path / RX on 1 or 2 ant.
8	3066543B03	Base Radio 8 / RX-S 2	RX-S 2 / BR 8	RX path / RX on 1 or 2 ant.
9	3066543B02	Base Radio 5 / RX-S 3	RX-S 3 / BR 5	RX path / RX on 2 ant.
10	3066543B02	Base Radio 6 / RX-S 3	RX-S 3 / BR 6	RX path / RX on 2 ant.
11	3066543B03	Base Radio 7 / RX-S 3	RX-S 3 / BR 7	RX path / RX on 2 ant.
12	3066543B03	Base Radio 8 / RX-S 3	RX-S 3 / BR 8	RX path / RX on 2 ant.
13	3066543B08	Base Radio 5 / Tx	ATCC 3 / TX A	TX path, Coax cable, low loss
14	3066543B08	Base Radio 6 / Tx	ATCC 3 / TX B	TX path, Coax cable, low loss
15	3066543B09	Base Radio 7 / Tx	ATCC 4 / TX A	TX path, Coax cable, low loss
16	3066543B09	Base Radio 8 / Tx	ATCC 4 / TX B	TX path, Coax cable, low loss
17	See Table 57: TX ATCC Interconnect Harness Part Num-	ATCC 3 / TX Out ATCC 4 / TX Out	ATCC (3, 4)	TX path, Interconnect Harness

Index	Cable Part Number	From Unit	To Unit	Notes
	bers on page 204			
18	See Table 62: TX ATCC Phasing Harness Part Numbers on page 217	ATCC (3, 4)	ATCC (1, 2) Prime Cabinet	TX path, Phasing Harness routed through conjunction hole at side of cabinet
19	3066543B11	RX Splitter 1 / Prime Cab	Duplexer / Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 1 or 2 ant.
20	3066543B11	RX Splitter 2 / Prime Cab	Preselector 1 / Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 1 or 2 ant.
21	3066543B11	RX Splitter 3 / Prime Cab	Preselector 2 / Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 2 ant.

NOTICE:
In the Prime Cabinet, detach the Duplexer Tx cable in the prime cabinet from the T connector on the Interconnect Harness in the prime. Connect the free end of the Phasing Harness from the expansion cabinet to the T connector on the Interconnect Harness in the prime cabinet and connect the Duplexer Tx cable to the T connector in the Phasing Harness. This way all eight channels are connected to a single Duplexer.

When Manual Tune Cavity Combiner (MTCC) is used instead of Auto Tune Cavity Combiner (ATCC), connect the cables to corresponding inputs and outputs.

RX cables from Filters in Prime Cabinet to RX Splitters in the Expansion Cabinet are routed through holes on the back side of the top-lid.

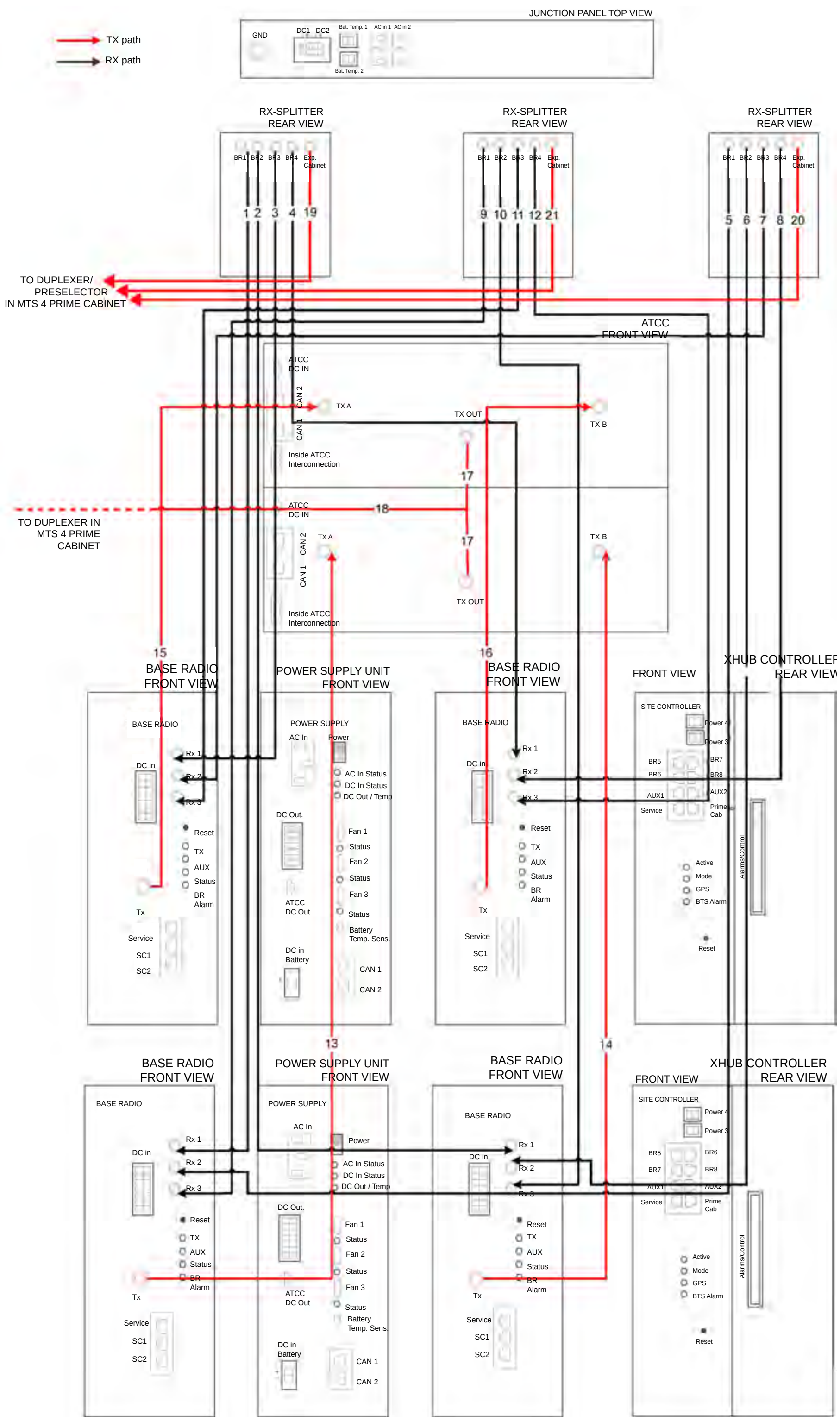
Figure 118: Holes in Top Lid for Rx Cables

Table 62: TX ATCC Phasing Harness Part Numbers

Part Number	Description	Frequency Band
0166502N09	Phasing harness, 8Ch	361 MHz – 366 MHz
0166502N10	Phasing harness, 8Ch	363 MHz – 368 MHz
0166502N11	Phasing harness, 8Ch	382 MHz – 387 MHz
0166502N12	Phasing harness, 8Ch	384 MHz – 389 MHz
0166502N13	Phasing harness, 8Ch	390 MHz – 395 MHz
0166502N14	Phasing harness, 8Ch	392 MHz.5-397.5 MHz
0166502N15	Phasing harness, 8Ch	395 MHz – 400 MHz
0166502N16	Phasing harness, 8Ch	420 MHz – 425 MHz
0166502N17	Phasing harness, 8Ch	422.5 MHz – 427.5 MHz
0166502N18	Phasing harness, 8Ch	425 MHz – 430 MHz
0166502N19	Phasing harness, 8Ch	460 MHz – 465 MHz
0166502N22	Phasing harness, 8Ch	462.5 MHz – 467.5 MHz
0166502N23	Phasing harness, 8Ch	465 MHz – 470 MHz

Part Number	Description	Frequency Band
0166502N36	Phasing harness, 8Ch	800 MHz band (851 – 870 MHz)

Figure 119: RF Cabling/Connections for Expansion Cabinet with One TX/RX ant. and Up to Two Additional RX ant.



5.5.13 RF Cabling – Expansion Cabinet with Two TX/RX Antennas

Table 63: RF Cabling/Connections for Expansion Cabinet with Two TX/RX ant. and Up to One Additional RX ant.

Index	Cable Part Number	From Unit	To Unit	Notes
1	3066543B02	Base Radio 5 / RX-S 1	RX-S 1 / BR 5	RX path / no RX or RX on 1 ant.
2	3066543B02	Base Radio 6 / RX-S 1	RX-S 1 / BR 6	RX path / no RX or RX on 1 ant.
3	3066543B03	Base Radio 7 / RX-S 1	RX-S 1 / BR 7	RX path / no RX or RX on 1 ant.
4	3066543B03	Base Radio 8 / RX-S 1	RX-S 1 / BR 8	RX path / no RX or RX on 1 ant.
5	3066543B02	Base Radio 5 / RX-S 2	RX-S 2 / BR 5	RX path / no RX or RX on 1 ant.
6	3066543B02	Base Radio 6 / RX-S 2	RX-S 2 / BR 6	RX path / no RX or RX on 1 ant.
7	3066543B03	Base Radio 7 / RX-S 2	RX-S 2 / BR 7	RX path / no RX or RX on 1 ant.
8	3066543B03	Base Radio 8 / RX-S 2	RX-S 2 / BR 8	RX path / no RX or RX on 1 ant.
9	3066543B02	Base Radio 5 / RX-S 3	RX-S 3 / BR 5	RX path / RX on 1 ant.
10	3066543B02	Base Radio 6 / RX-S 3	RX-S 3 / BR 6	RX path / RX on 1 ant.
11	3066543B03	Base Radio 7 / RX-S 3	RX-S 3 / BR 7	RX path / RX on 1 ant.
12	3066543B03	Base Radio 8 / RX-S 3	RX-S 3 / BR 8	RX path / RX on 1 ant.
13	3066543B08	Base Radio 5 / Tx	ATCC 3 / TX A	TX path, Coax cable, low loss
14	3066543B08	Base Radio 6 / Tx	ATCC 3 / TX B	TX path, Coax cable, low loss
15	3066543B09	Base Radio 7 / Tx	ATCC 4 / TX A	TX path, Coax cable, low loss
16	3066543B09	Base Radio 8 / Tx	ATCC 4 / TX B	TX path, Coax cable, low loss
17	See Table 57: TX ATCC Interconnect Harness Part Num-	ATCC 3 / TX OUT ATCC 4 / TX OUT	ATCC (3, 4)	TX path, Interconnect Harness

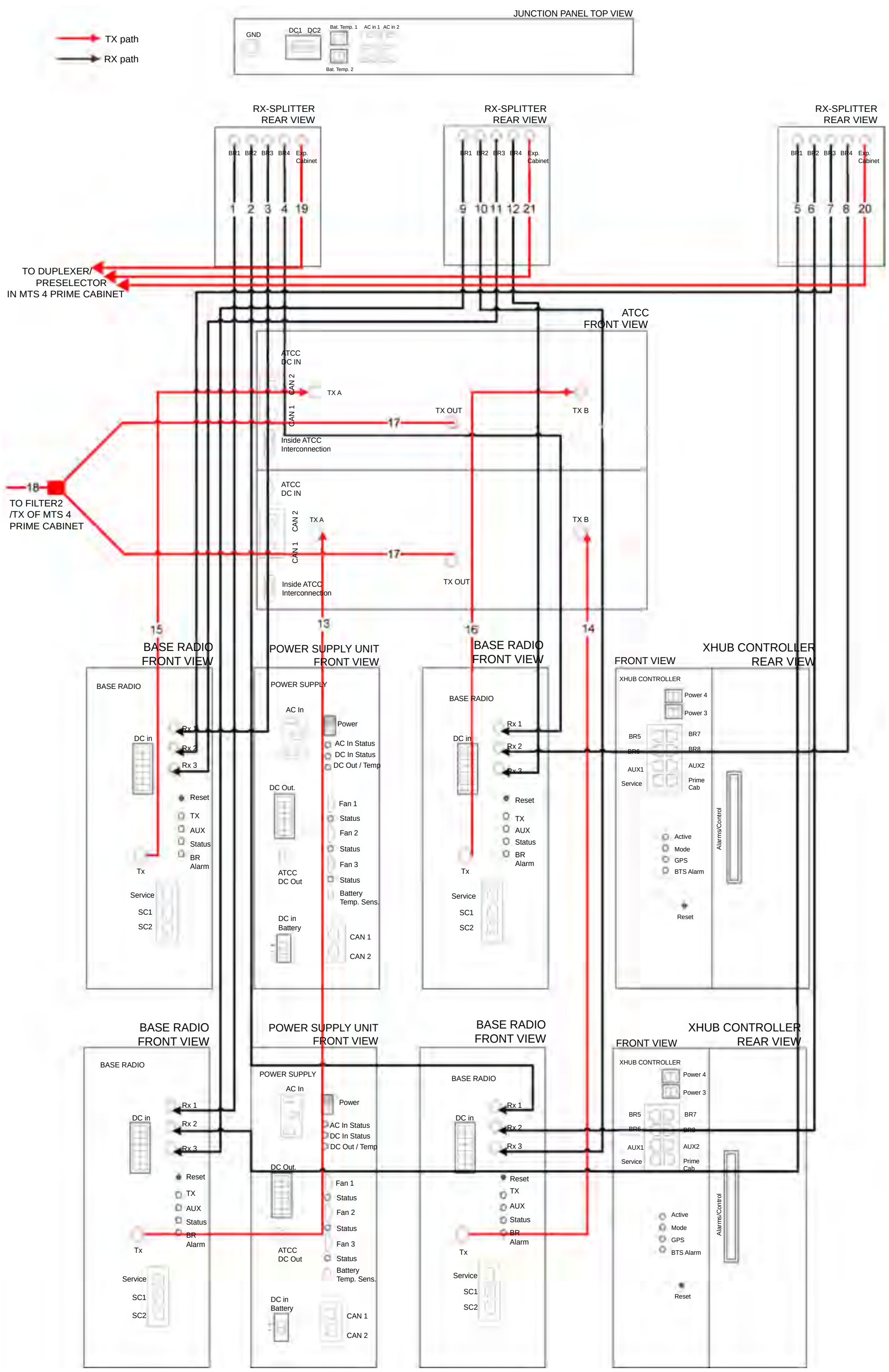
Index	Cable Part Number	From Unit	To Unit	Notes
	bers on page 204.			
18	3066543B 16	ATCC (3, 4)	Duplexer 2 / TX in Prime Cabinet	TX path, Duplexer TX cable routed through conjunction hole at side of the cabinet
19	3066543B 11	RX Splitter 1 / Prime Cab	Duplexer 1/ Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 1 or 2 ant.
20	3066543B 11	RX Splitter 2 / Prime Cab	Duplexer 2 / Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 1 or 2 ant.
21	3066543B 11	RX Splitter 3 / Prime Cab	Preselector / Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 2 ant.

NOTICE:
In the Prime Cabinet, the cables from ATCC 1/TX OUT to Duplexer 1/TX and from ATCC 2/TX to Duplexer 2/TX needs to be combined with a T Cable and connected to Duplexer 1/TX, allowing Expansion Cabinet channels to be connected to Duplexer 2/TX.

When MTCC is used instead of ATCC, connect the cables to corresponding inputs and outputs.

RX cables from Filters in Prime Cabinet to RX Splitters in the Expansion Cabinet are routed through holes on the back side of the top-lid.

Figure 120: RF Cabling/Connections for Expansion Cabinet with Two TX/RX ant. and Up to One Additional RX ant.



5.5.14
RF Cabling – Expansion Cabinet with One TX Antenna

Table 64: RF Cabling/Connections for Expansion Cabinet with One TX ant. and Up to Three Additional RX ant.

Index	Cable Part Number	From Unit	To Unit	Notes
1	3066543B02	Base Radio 5 / RX-S 1	RX-S 1 / BR 5	RX path / RX on 2 or 3 ant.
2	3066543B02	Base Radio 6 / RX-S 1	RX-S 1 / BR 6	RX path / RX on 2 or 3 ant.
3	3066543B03	Base Radio 7 / RX-S 1	RX-S 1 / BR 7	RX path / RX on 2 or 3 ant.
4	3066543B03	Base Radio 8 / RX-S 1	RX-S 1 / BR 8	RX path / RX on 2 or 3 ant.
5	3066543B02	Base Radio 5 / RX-S 2	RX-S 2 / BR 5	RX path / RX on 2 or 3 ant.
6	3066543B02	Base Radio 6 / RX-S 2	RX-S 2 / BR 6	RX path / RX on 2 or 3 ant.
7	3066543B03	Base Radio 7 / RX-S 2	RX-S 2 / BR 7	RX path / RX on 2 or 3 ant.
8	3066543B03	Base Radio 8 / RX-S 2	RX-S 2 / BR 8	RX path / RX on 2 or 3 ant.
9	3066543B02	Base Radio 5 / RX-S 3	RX-S 3 / BR 5	RX path / RX on 3 ant.
10	3066543B02	Base Radio 6 / RX-S 3	RX-S 3 / BR 6	RX path / RX on 3 ant.
11	3066543B03	Base Radio 7 / RX-S 3	RX-S 3 / BR 7	RX path / RX on 3 ant.
12	3066543B03	Base Radio 8 / RX-S 3	RX-S 3 / BR 8	RX path / RX on 3 ant.
13	3066543B08	Base Radio 5 / Tx	ATCC 3 / TX A	TX path, Coax cable, low loss
14	3066543B08	Base Radio 6 / Tx	ATCC 3 / TX B	TX path, Coax cable, low loss
15	3066543B09	Base Radio 7 / Tx	ATCC 4 / TX A	TX path, Coax cable, low loss
16	3066543B09	Base Radio 8 / Tx	ATCC 4 / TX B	TX path, Coax cable, low loss
17	See Table 57: TX ATCC Interconnect Harness Part Num-	ATCC 3 / TX Out ATCC 4 / TX Out	ATCC (3, 4)	TX path, Interconnect Harness

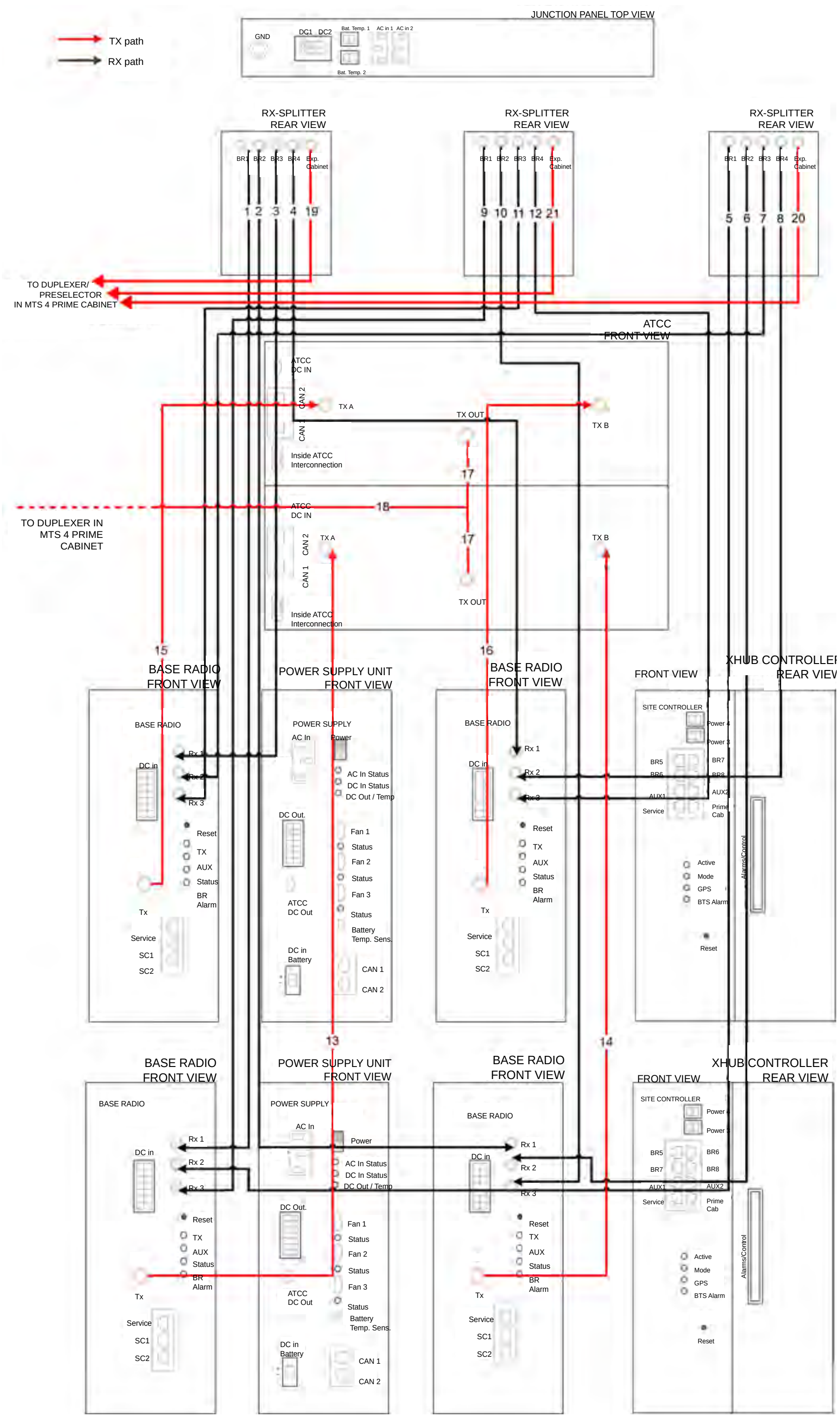
Index	Cable Part Number	From Unit	To Unit	Notes
	bers on page 204.			
18	See Table 62: TX ATCC Phasing Harness Part Numbers on page 217.	ATCC (3, 4)	ATCC (1, 2) in Prime Cabinet	TX path, Phasing Harness routed through conjunction hole at side of the cabinet
19	3066543B11	RX Splitter 1 / Prime Cab	Duplexer 1/ Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 1 or 2 ant.
20	3066543B11	RX Splitter 2 / Prime Cab	Duplexer 2 / Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 1 or 2 ant.
21	3066543B11	RX Splitter 3 / Prime Cab	Preselector / Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 2 ant.

NOTICE:
When MTCC is used instead of ATCC, connect the cables to corresponding inputs and outputs.

In the Prime Cabinet, detach the Post Filter cable in the prime cabinet from the T connector on the Interconnect Harness in the prime. Connect the free end of the Phasing Harness from the expansion cabinet to the T connector on the Interconnect Harness in the prime cabinet and connect the Post Filter cable to the T connector in the Phasing Harness. This ensures that all eight channels are connected to a single Post Filter.

RX cables from Filters in Prime Cabinet to RX Splitters in the Expansion Cabinet are routed through holes on the back side of the top-lid.

Figure 121: RF Cabling/Connections for Expansion Cabinet with One TX ant. and Up to Three Additional RX ant.



5.5.15
RF Cabling – Expansion Cabinet with Two TX Antennas

Table 65: RF Cabling/Connections for Expansion Cabinet with Two TX ant. and Up to Three Additional RX ant.

Index	Cable Part Number	From Unit	To Unit	Notes
1	3066543B02	Base Radio 5 / RX-S 1	RX-S 1 / BR 5	RX path / RX on 2 or 3 ant.
2	3066543B02	Base Radio 6 / RX-S 1	RX-S 1 / BR 6	RX path / RX on 2 or 3 ant.
3	3066543B03	Base Radio 7 / RX-S 1	RX-S 1 / BR 7	RX path / RX on 2 or 3 ant.
4	3066543B03	Base Radio 8 / RX-S 1	RX-S 1 / BR 8	RX path / RX on 2 or 3 ant.
5	3066543B02	Base Radio 5 / RX-S 2	RX-S 2 / BR 5	RX path / RX on 2 or 3 ant.
6	3066543B02	Base Radio 6 / RX-S 2	RX-S 2 / BR 6	RX path / RX on 2 or 3 ant.
7	3066543B03	Base Radio 7 / RX-S 2	RX-S 2 / BR 7	RX path / RX on 2 or 3 ant.
8	3066543B03	Base Radio 8 / RX-S 2	RX-S 2 / BR 8	RX path / RX on 2 or 3 ant.
9	3066543B02	Base Radio 5 / RX-S 3	RX-S 3 / BR 5	RX path / RX on 3 ant.
10	3066543B02	Base Radio 6 / RX-S 3	RX-S 3 / BR 6	RX path / RX on 3 ant.
11	3066543B03	Base Radio 7 / RX-S 3	RX-S 3 / BR 7	RX path / RX on 3 ant.
12	3066543B03	Base Radio 8 / RX-S 3	RX-S 3 / BR 8	RX path / RX on 3 ant.
13	3066543B08	Base Radio 5 / Tx	ATCC 3 / TX A	TX path, Coax cable, low loss
14	3066543B08	Base Radio 6 / Tx	ATCC 3 / TX B	TX path, Coax cable, low loss
15	3066543B09	Base Radio 7 / Tx	ATCC 4 / TX A	TX path, Coax cable, low loss
16	3066543B09	Base Radio 8 / Tx	ATCC 4 / TX B	TX path, Coax cable, low loss
17	See Table 57: TX ATCC Interconnect Harness Part Num-	ATCC 3 / TX Out ATCC 4 / TX Out	ATCC (3, 4)	TX path, Interconnect Harness

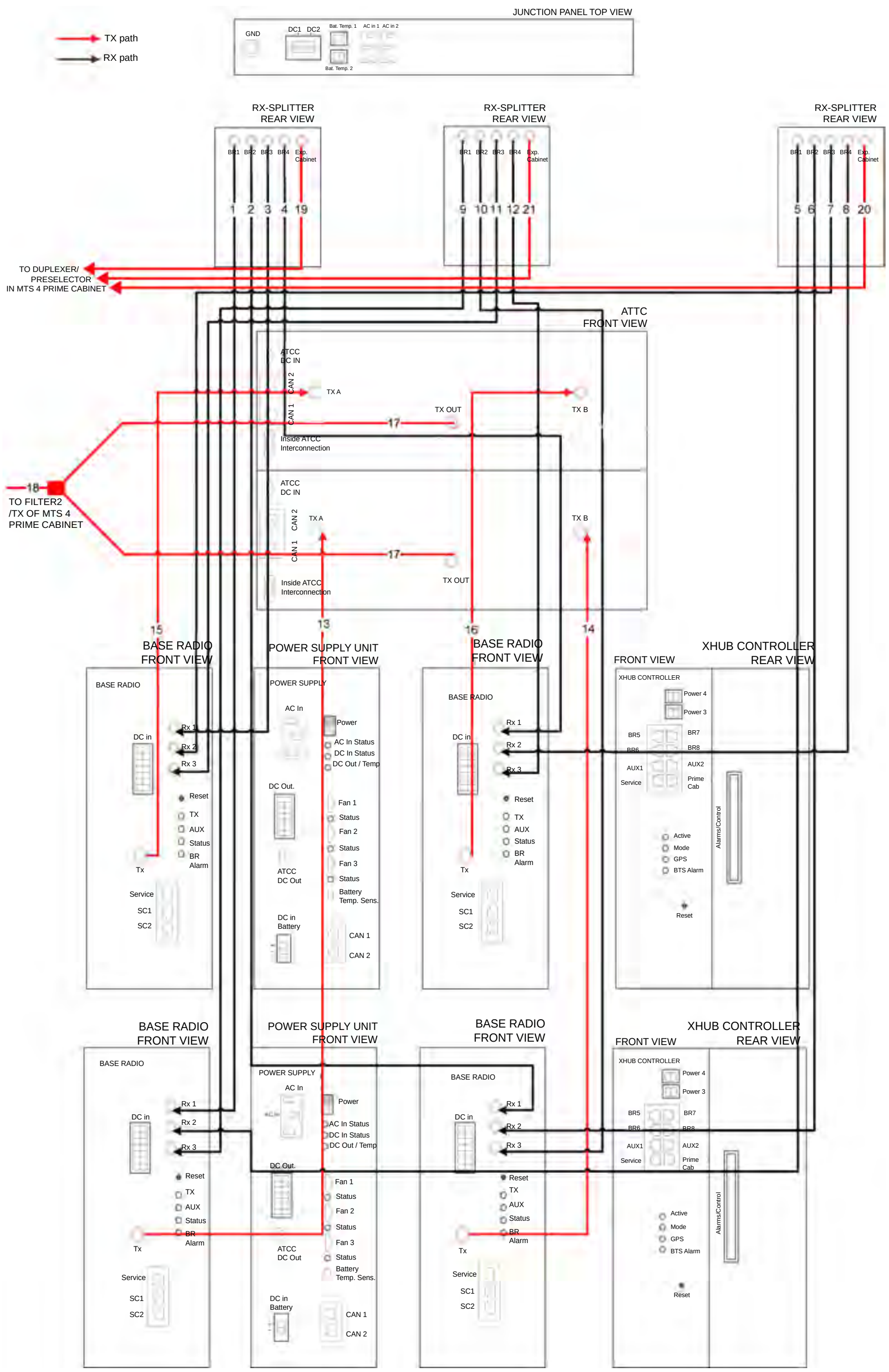
Index	Cable Part Number	From Unit	To Unit	Notes
	bers on page 204.			
18	3066543B16	ATCC (3, 4)	Post Filter 2 / TX in Prime Cabinet	TX path, Post Filter cable routed through conjunction hole at side of the cabinet
19	3066543B11	RX Splitter 1 / Prime Cab	Duplexer 1/ Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 1 or 2 ant.
20	3066543B11	RX Splitter 2 / Prime Cab	Duplexer 2 / Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 1 or 2 ant.
21	3066543B11	RX Splitter 3 / Prime Cab	Preselector / Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 2 ant.

NOTICE:
In the Prime Cabinet, the cables from ATCC 1/TX OUT to Post Filter 1/TX and from ATCC 2/TX to Post Filter 2/TX needs to be combined with a T Cable and connected to Post Filter 1/TX, allowing Expansion Cabinet channels to be connected to Post Filter 2/TX.

When MTCC is used instead of ATCC, connect the cables to corresponding inputs and outputs.

RX cables from Filters in Prime Cabinet to RX Splitters in the Expansion Cabinet are routed through holes on the back side of the top-lid.

Figure 122: RF Cabling/Connections for Expansion Cabinet with Two TX Antennas and up to Three Additional RX ant.



5.6 CAN Bus Cabling

The CAN Bus is integrated in the Site Controller. There is one CAN Bus in the cabinet. The CAN Bus can be connected to the Site Controllers, PSUs, DPMs, and ATCCs.

NOTICE: The pinout has been designed so that an accidental mis-connection by one or into one of the other RJ45 connectors (Ethernet, Service port, or E1) does not damage any circuitry.

The CAN Bus is a 120 twisted line with termination at the ends.

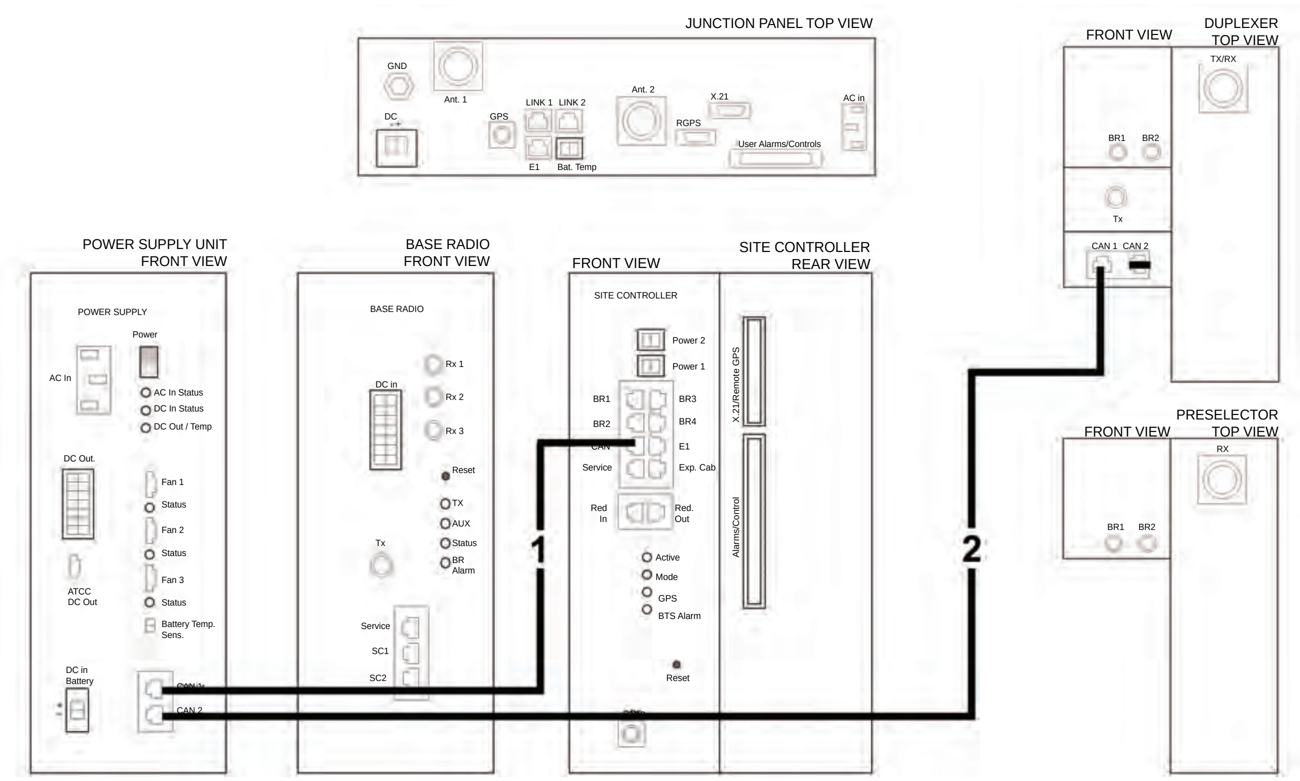
5.6.1
CAN Bus Cabling – MTS LiTE

The Site Controller contains the internal termination in one end of the CAN Bus, and the last Duplexer in the CAN Bus has a terminator in one connector.

Table 66: CAN Bus Cabling for MTS LiTE

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS LiTE				
1	3066575B01	Site Controller/ CAN	Power Supply Unit/ CAN1	Red cable
2	3066544B25	Power Supply Unit/ CAN2	Duplexer/ CAN1	Red cable
3	0966513A01	Duplexer/ CAN2	CAN Bus termination	

Figure 123: CAN Bus Cabling Diagram for MTS LiTE



5.6.2
CAN Bus Cabling – MTS 2

The Site Controller contains the internal termination in one end of the CAN Bus, and the last Duplexer in the CAN Bus has a terminator in one connector.

NOTICE: CAN Bus cabling depends on filter configuration.

Table 67: CAN Bus Cabling for MTS 2 with TX/RX on 1 ant. RX on 2 ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS 2 (TX/RX on 1 ant. RX on 2 ant.)				
1	3066575B01	Site Controller/ CAN	Power Supply Unit/ CAN1	Red cable
2	3066544B10	Power Supply Unit/ CAN2	Duplexer/ CAN1	Red cable
3	0966513A01	Duplexer/ CAN2	CAN Bus termination	

Figure 124: CAN Bus Cabling Diagram for MTS 2 with TX/RX on 1 ant. RX on 2 ant.

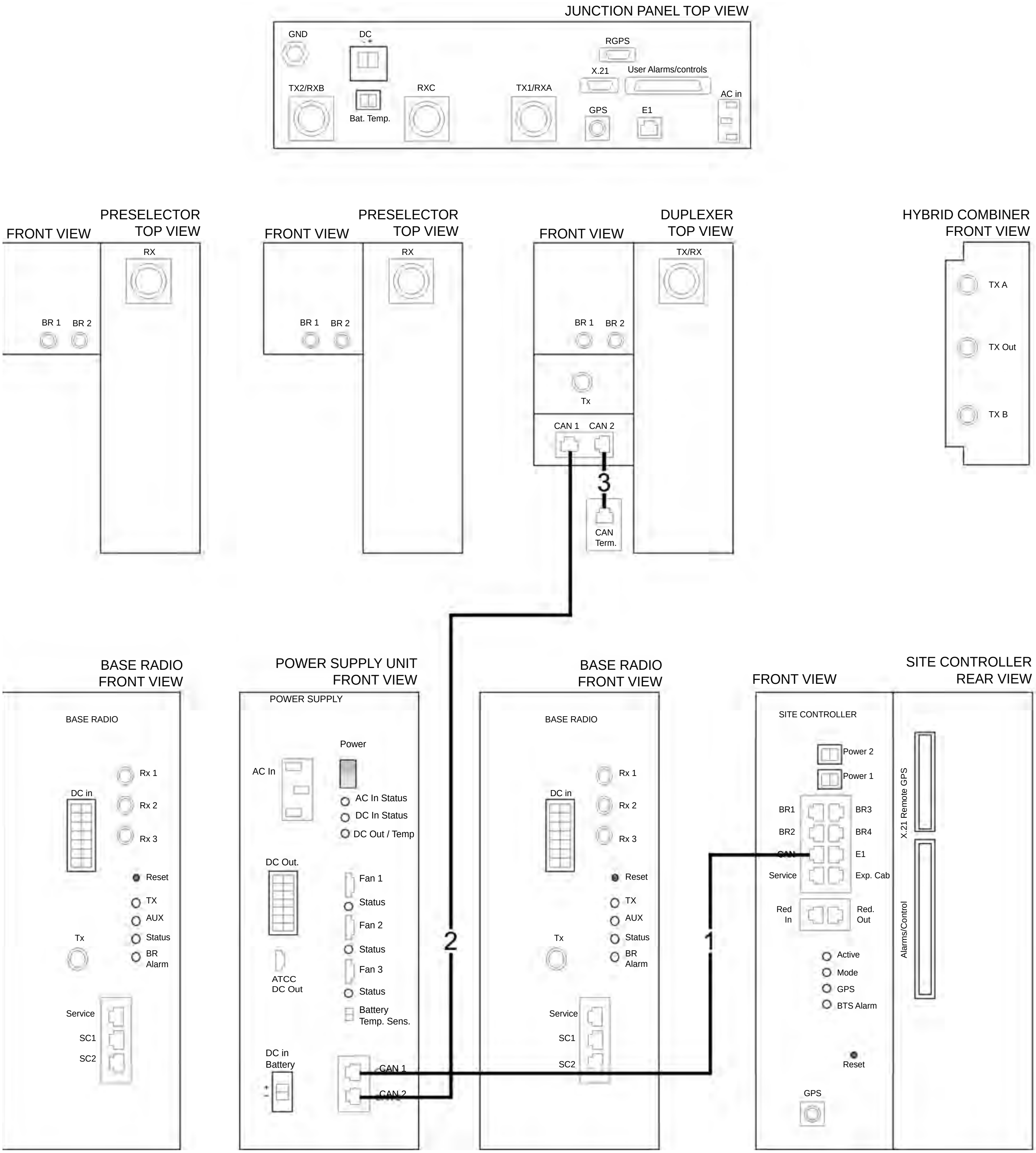
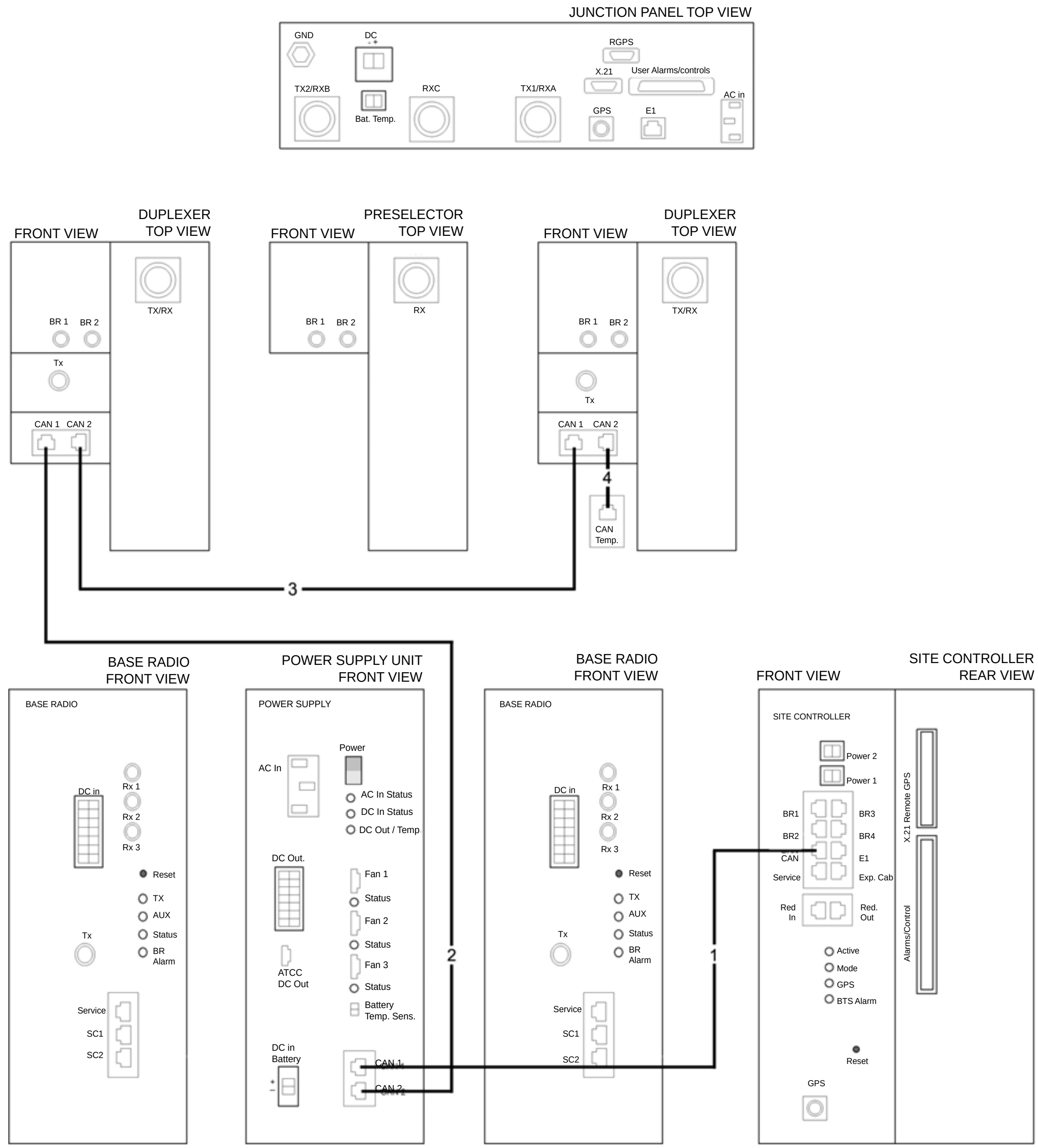


Table 68: CAN Bus Cabling for MTS 2 with TX/RX on 1 ant. RX on 2 ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS 2 (TX/RX on 2 ant. RX on 1ant.)				

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
1	3066575B 01	Site Controller/ CAN	Power Supply Unit/ CAN1	Red cable
2	3066544B 10	Power Supply Unit/ CAN2	Duplexer1/ CAN1	Red cable
3	3066544B 03	Duplexer1/ CAN2	Duplexer2/ CAN1	Red cable
4	0966513A 01	Duplexer2/ CAN2	CAN Bus termination	

Figure 125: CAN Bus Cabling Diagram for MTS 2 with TX/RX on 2 ant. RX on 1ant.



5.6.3
CAN Bus Cabling – MTS 4

The Site Controller contains the internal termination in one end of the CAN Bus, and the last Duplexer in the CAN Bus has a terminator in one connector.

NOTICE: CAN Bus cabling depends on filter configuration.

Table 69: CAN Bus Cabling for MTS 4 with TX/RX or TX on 1 ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS 4 (TX/RX or TX on 1 ant. with ATCCs)				
1	3066575B 01	Site Controller1/ CAN	Power Supply Unit1/ CAN1	Red cable
2	3066544B 06	Power Supply Unit1/ CAN2	Duplexer or Post Filter/ CAN1	Red cable
3	3066544B 03	Duplexer or Post Filter/ CAN2	ATCC 1/ CAN1	Red cable
4	3066544B 09	ATCC 1/ CAN2	ATCC 2/ CAN1	Red cable
5	3066544B 06	ATCC 2/ CAN2	Power Supply Unit2/ CAN1	Red cable
6	3066575B 01	Power Supply Unit2/ CAN2	Site Controller2/ CAN	With redundant Site Controller/ red cable
7	0966513A 01	Power Supply Unit2/ CAN2	CAN Bus termination	Without redundant Site Controller

NOTICE: When MTCCs or HCs are used instead of ATCCs, the CAN Bus is connected directly from Duplexer or Post Filter/ CAN2 connector to Power Supply Unit2/ CAN1 connector.

Figure 126: CAN Bus Cabling Diagram for MTS 4 with TX/RX or TX on 1 ant.

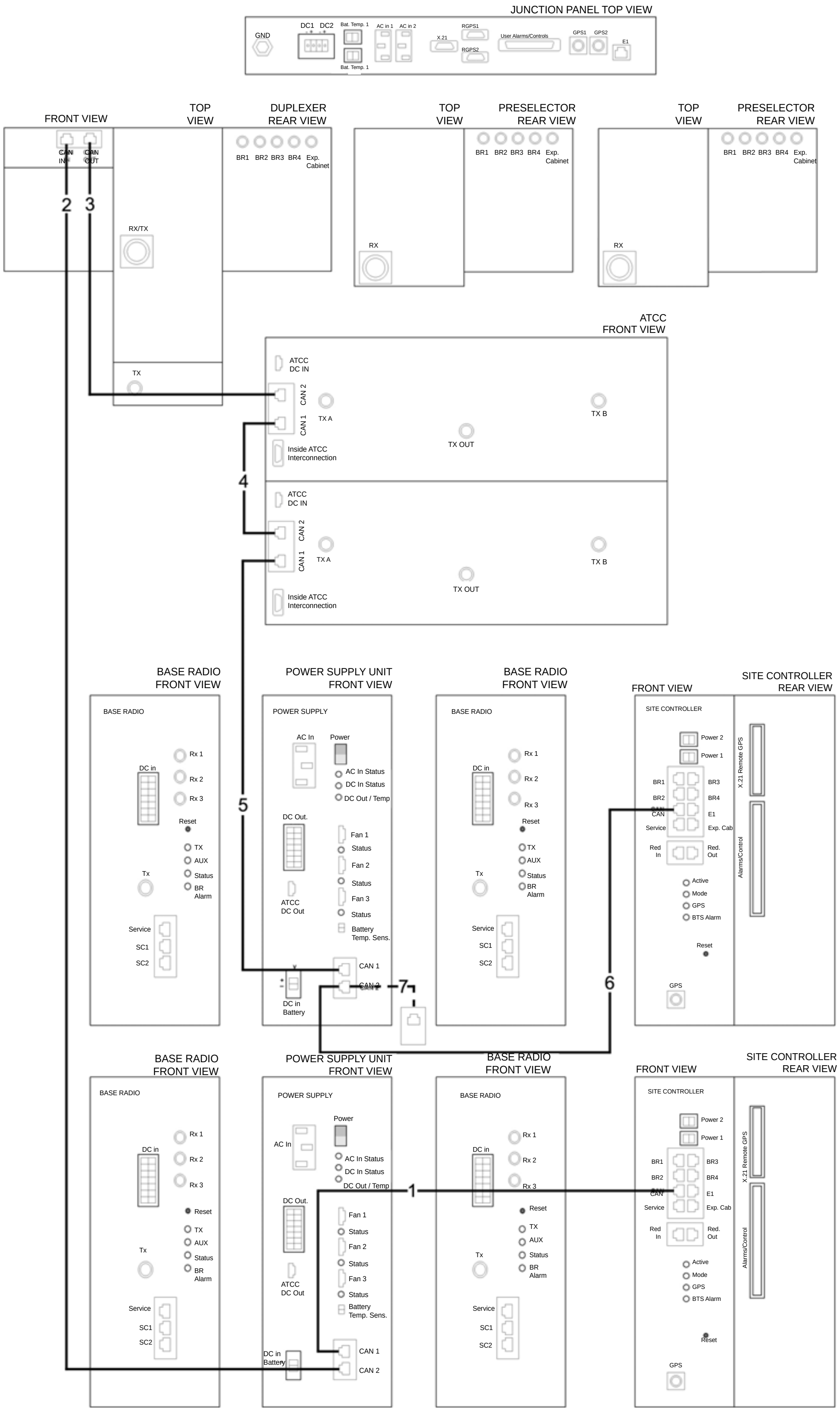


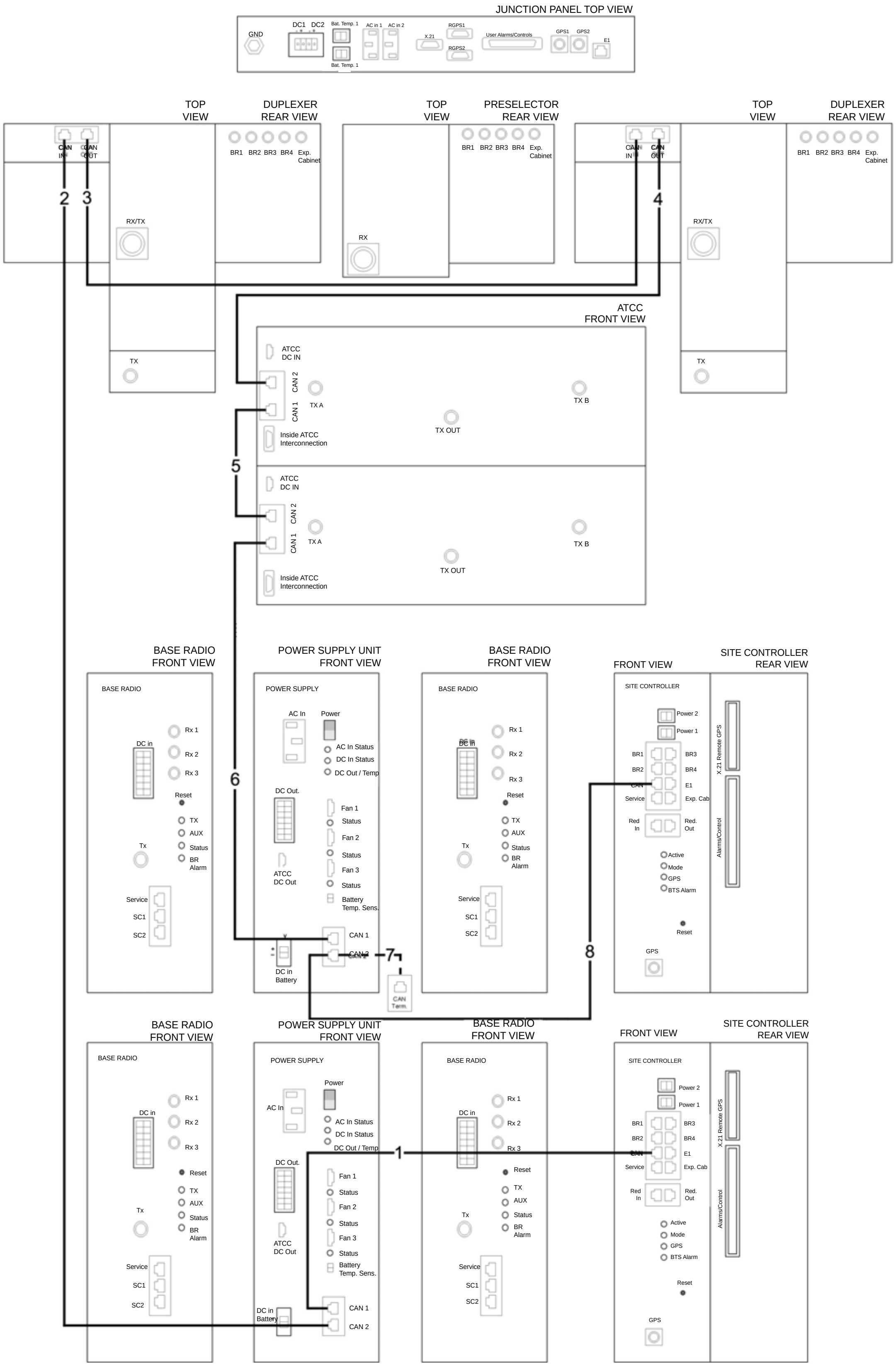
Table 70: CAN Bus Cabling for MTS 4 with TX/RX or TX on 2 ant. with ATCCs

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
1	3066575B 01	Site Controller1/ CAN	Power Supply Unit1/ CAN1	Red cable
2	3066544B 06	Power Supply Unit1/ CAN2	Duplexer 1 or Post Filter 1/ CAN1	Red cable
3	3066544B 09	Duplexer 1 or Post Filter1/ CAN2	Duplexer 2 or Post Filter 2/ CAN1	Red cable
4	3066544B 03	Duplexer 2 or Post Filter 2 / CAN2	ATCC 1/ CAN1	Red cable
5	3066544B 09	ATCC 1/ CAN2	ATCC 2/ CAN1	Red cable
6	3066544B 06	ATCC 2/ CAN2	Power Supply Unit2/ CAN1	Red cable
7	0966513A 01	Power Supply Unit2/ CAN2	CAN Bus termination	without redundant TCS
8	3066575B 01	Power Supply Unit2/ CAN2	Site Controller2/ CAN	with redundant Site Controller/ red cable

NOTICE: When MTCCs or HCs are used instead of ATCCs, the CAN Bus is connected directly from Duplexer 2 or Post Filter 2/ CAN2 connector to Power Supply Unit2/ CAN1 connector.

Figure 127: CAN Bus Cabling Diagram for MTS 4 with TX/RX or TX on 2 ant. with ATCCs



5.6.4
CAN Bus Cabling – Expansion Cabinet

The following table lists the CAN Bus Cabling for MTS 4 with Expansion Cabinet.

Table 71: CAN Bus Cabling for MTS 4 with Expansion Cabinet

Index	Cable Part Number	From Unit	To Unit	Notes
A	3066544B 09	Duplexer or PostFilter / CAN2	ATCC 2 / CAN1	Prime Cabinet
H	3066544B 09	ATCC 2 / CAN2	ATCC 1 / CAN1	Prime Cabinet
F	3066544B 03	ATCC 1 / CAN2	PSU 2 / CAN1	Prime Cabinet
F	3066544B 08	PSU 2 / CAN 2 (Prime Cab)	PSU 3 / CAN1 (Exp Cab)	In all configurations
F	3066544B 06	PSU 3 / CAN2 (Exp Cab)	Joint 1	If only one PSU and no ATCC in Exp Cab
		PSU 3 / CAN2 (Exp Cab)	PSU 4 / CAN1	If two PSUs in Exp Cab
		PSU 3 / CAN2 (Exp Cab)	ATCC 3 / CAN1	If one PSU and ATCC in Exp Cab
F	3066544B 06	PSU 4 / CAN2 (Exp Cab)	Joint 1	If no ATCC in Exp Cab
		PSU 4 / CAN2 (Exp Cab)	ATCC 3 / CAN1	If ATCC in Exp Cab
F	3066544B 09	ATCC 3 / CAN2	Joint 1	If one ATCC in Exp Cab
H		ATCC 3 / CAN2	ATCC 4 / CAN1	If two ATCC in Exp Cab
F	3066544B 06	ATCC 4 / CAN2	Joint 1	If two ATCC in Exp Cab
	3066544B 03	Joint 1	CAN Bus termination	Without redundant Site Controller
		Joint 1	SC 2/ CAN	With redundant Site Controller / red cable

NOTICE: CAN Bus cables from Prime Cabinet to Expansion Cabinet are routed through the conjunction hole on the side of the cabinets.

Figure 128: CAN Bus Cabling Diagram for MTS4 and Expansion Cabinet with ATCCs

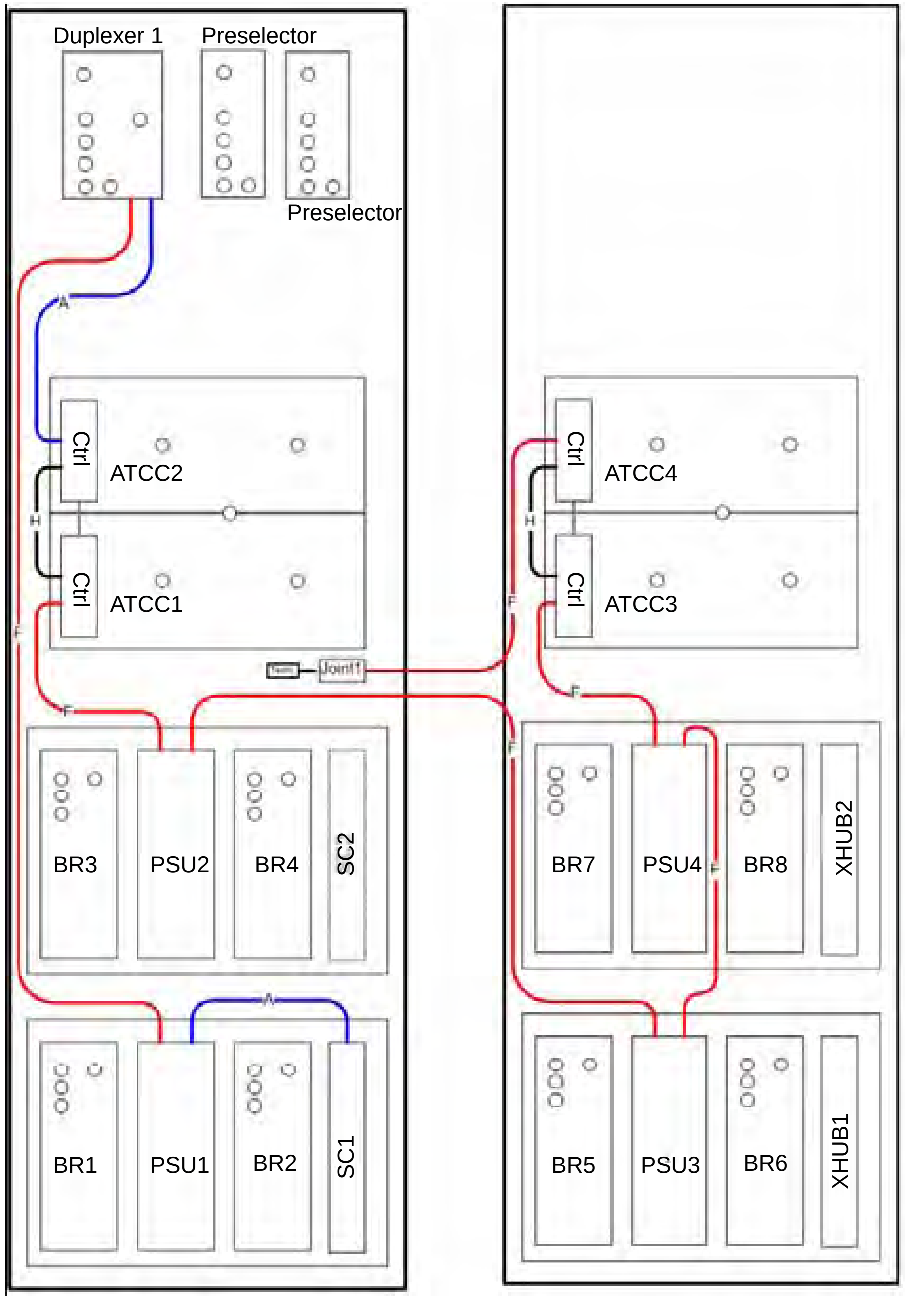
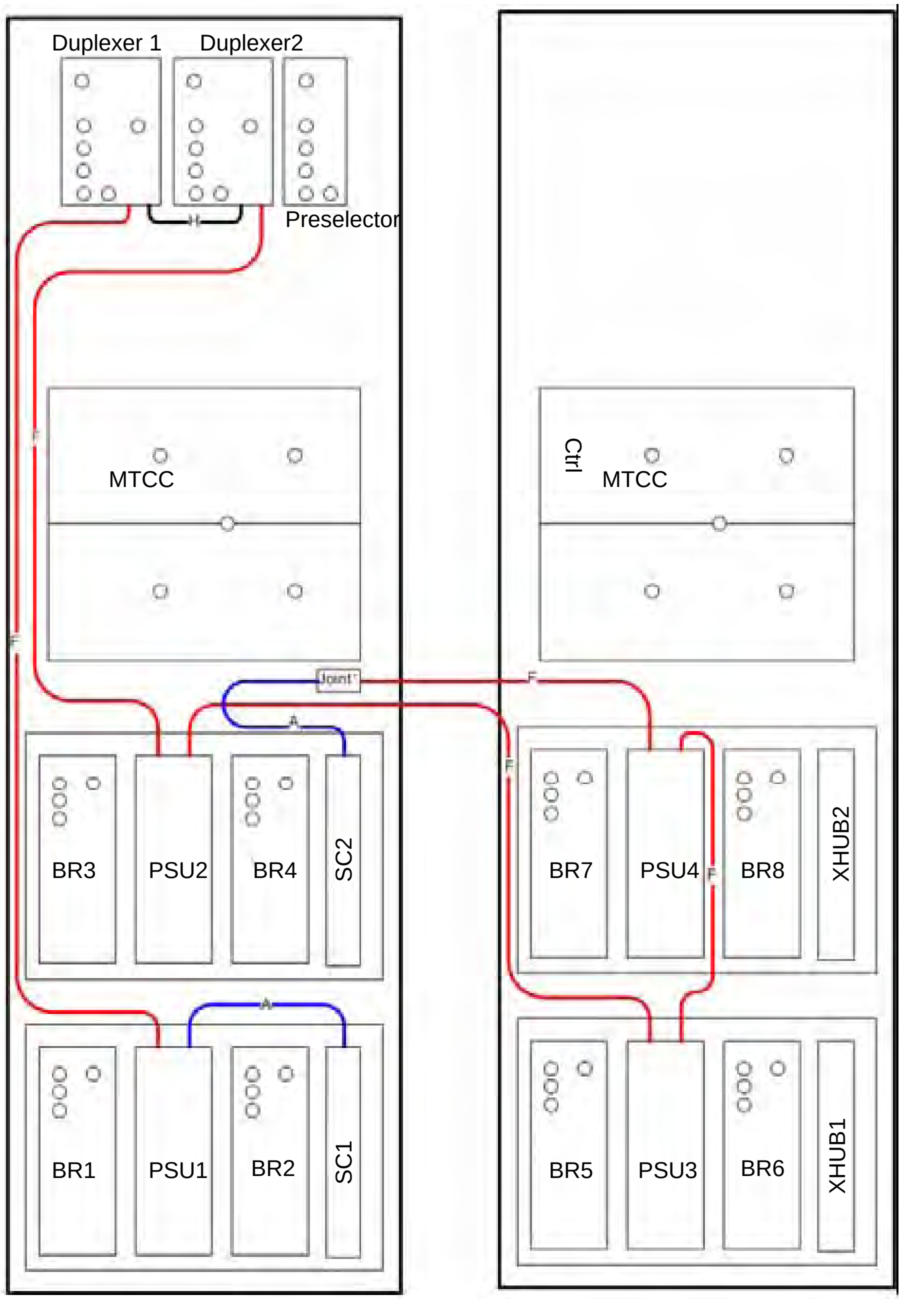


Figure 129: CAN Bus Cabling Diagram for MTS4 and Expansion Cabinet with MTCCs and Redundant Site Controller



Chapter 6

Configuration and Testing

The setup and testing procedures covered in this manual are intended to be used in conjunction with the information provided in MTS Troubleshooting on page 373 and MMI Commands Manual.

Together, the troubleshooting solutions and testing procedures, provide the necessary information to isolate failures to a Field Replaceable Unit (FRU) or replaceable part. This helps to keep the system down time to a minimum by quickly returning the site to normal operation.

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

For a list of available FRUs, see Field Replaceable Units (FRUs) on page 478.

6.1
Setup and Testing Overview

The setup and test procedures are used to test the functionality of the MTS and help isolate failures to the module level.

The setup and testing procedures include preparation, CAN Bus configuration, and verification and configuration of the Site Controller and Base Radio.

6.2
Preparing for Configuration and Testing

When and where to use: Perform the following steps before proceeding with configuration and testing of the MTS.

Process:

1. Familiarize yourself with the usage of Man Machine Interface Commands.

   See MMI Commands and MTS Modes of Operation on page 239.
2. Identify all recommended test equipment for the Site Controller and Base Radio Verification.

   See Test Equipment on page 243.
3. Connect a service terminal.

   See Setting Up Service Terminal on page 246.

6.2.1
MMI Commands and MTS Modes of Operation

CAUTION: You must be familiar with Man-Machine Interface (MMI) commands and their usage before performing procedures in this chapter. An improper application of the MMI commands can damage the equipment.

NOTICE: *The MTS MMI Commands Manual* serves as an introduction and reference for using the software commands. If you are not familiar with using the commands, read the *MTS MMI Commands Manual* before proceeding.

Service technicians can communicate with the MTS through the MMI commands and a service terminal (laptop). 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 controller and base radio(s) for intended operation, and to enable various system tests.

The testing of the MTS by using the MMI can be done in Test Application Mode or with sets of commands available for Site Controller and Base Radio.

The complete set of MMI commands, including both Site Controller and base radio commands, is defined in the *MTS MMI Commands Manual*.

The MTS Site Controller has the following modes of operation:

- **BOOT1** – see Logging on to the BOOT1 mode on page 241.
- **Test Application** – see Logging on to the Test Application on page 242.
- **Site Controller Application** – if the boot process is not interrupted, this is the default mode of operation. See Logging on to the Site Controller Application through Serial Connection on page 240.

The MTS Base Radio modes of operation are dependent on its architecture:

Table 72: MTS Base Radio Modes of Operation

BR-Arch-1 Modes		BR-Arch-2 Modes	
BOOT1	Logging on to the BOOT1 mode on page 241	**Base Radio Core**	Logging on to the Base Radio Core Mode on page 242
Test Application	Logging on to the Test Application on page 242	**Test Application**	Logging on to the Test Application on page 242
Base Radio Application (if the boot process is not interrupted, this is the default mode of operation)	Logging on to the Base Radio Application through Serial Connection on page 241	**Base Radio Application**	Logging on to the Base Radio Application through Serial Connection on page 241

Each of these modes contains a different set of the Man Machine Interface Commands.

CAUTION: The Test Application mode is a powerful mode. Inappropriate use of the Test Application MMI can lead to a permanent hardware failure. Proceed with extreme caution.

6.2.1.1

Logging on to the Site Controller Application through Serial Connection

Procedure:

1. Connect the port RS232 of the Service Terminal with the Site Controller RJ45 Service Port using the Service Cable.

   See Service Cable and Connector Box Description on page 244 for more information about the Service Cable.
2. On the Service Terminal start the BTS Service Software application, select the proper MTS type and log on.
3. In the **Configuration** → **Direct Settings** → **Direct Serial Port Settings** menu, verify the correct settings:
   - **Port**: The appropriate serial port is selected.
   - **Speed**: 19200 baud

- **Data Bits**: 8
- **Stop Bits**: 1
- **Handshaking**: none
- **Parity**: none

4 Establish connection by selecting **Connection** → **Connect Direct**.

5 Log on to the Site Controller application by entering the username and password.

The Site Controller application prompt appears:

```
SC:
```

6.2.1.2
Logging on to the Base Radio Application through Serial Connection

Prerequisites: Ensure the Base Radio is connected to the Site Controller.

Procedure:

1 Connect the port RS232 of the Service Terminal with the Base Radio RJ45 Service Port using the Service Cable.

See Service Cable and Connector Box Description on page 244 for more information about the Service Cable.

2 On the Service Terminal start the BTS Service Software application, select the proper MTS type and log on.

3 In the **Configuration** → **Direct Settings** → **Direct Serial Port Settings** menu, verify the correct settings:

- **Port**: The appropriate serial port is selected.
- **Speed**: 19200 baud
- **Data Bits**: 8
- **Stop Bits**: 1
- **Handshaking**: none
- **Parity**: none

4 Establish connection by selecting **Connection** → **Connect Direct**.

5 Log on to the Base Radio application by entering the username and the password.

The Base Radio application prompt appears:

```
BR)
```

6.2.1.3
Logging on to the BOOT1 mode

BOOT1 is the second stage bootloader in the BR-Arch-1 architecture. Use this mode to start other applications (for example the Test Application), and set the basic Base Radio configuration.

Procedure:

1 Log on to Site Controller application or Base Radio application, depending on which application you need to use.

See Logging on to the Site Controller Application through Serial Connection on page 240 or Logging on to the Base Radio Application through Serial Connection on page 241.

2. In the command line, type `reset` and confirm if necessary.
3. Interrupt the reboot procedure with the ESCAPE key.
4. Log on to BOOT1 mode.

   The BOOT1 mode prompt appears. For a Site Controller, it is:

   ```
   SC#
   ```

   and in the case of Base Radio it is:

   ```
   boot1>
   ```

Postrequisites: To return to the default Base Radio application or the Site Controller application, type `reset -oplatform`.

6.2.1.4

Logging on to the Base Radio Core Mode

Base Radio Core is the second stage bootloader in the BR-Arch-2 architecture. Use this mode to start other applications (for example the Test Application), and set the basic Base Radio configuration.

Procedure:

1. Log on to the Base Radio application. See Logging on to the Base Radio Application through Serial Connection on page 241.
2. In the command line, type `reset` and confirm if necessary.
3. Interrupt the reboot procedure with the ESCAPE key.
4. Log on to Base Radio Core mode.

   The Base Radio Core mode prompt appears:

   ```
   Core)
   ```

6.2.1.5

Logging on to the Test Application

Procedure:

1. Log on to the Site Controller or Base Radio mode appropriate for your architecture:
   - If you want to log on to the Test Application on Site Controller or Base Radio in BR-Arch-1 architecture, see Logging on to the BOOT1 mode on page 241.
   - If you want to log on to the Test Application on Base Radio in BR-Arch-2 architecture, see Logging on to the Base Radio Core Mode on page 242.
2. In the command line, start the Test Application by performing one of the following actions:

If…	Then…
If you want to log on to the Test Application in the BR-Arch-1 architecture,	perform the following actions: **a** In the command line enter the command: `testapp` **b** Log on with the command `login -u`***<X>*** where ***<X>*** is the user name you want to use. **c** At the prompt, enter the password.

If…	Then…
If you want to log on to the Test Application in the BR-Arch-2 architecture,	In the command line enter the command: `testapp`

Postrequisites:

NOTICE: To reset Base Radio and return to the default Base Radio application, type `reset -oplatform`.

6.2.2
Test Equipment

The following table lists the recommended test equipment for the equipment cabinet procedures. Equivalent equipment is acceptable.

WARNING: Ensure that the test equipment is connected to the same ground system as the equipment under test before any other connections are made to the test equipment.

Table 73: Equipment for Cabinet Testing

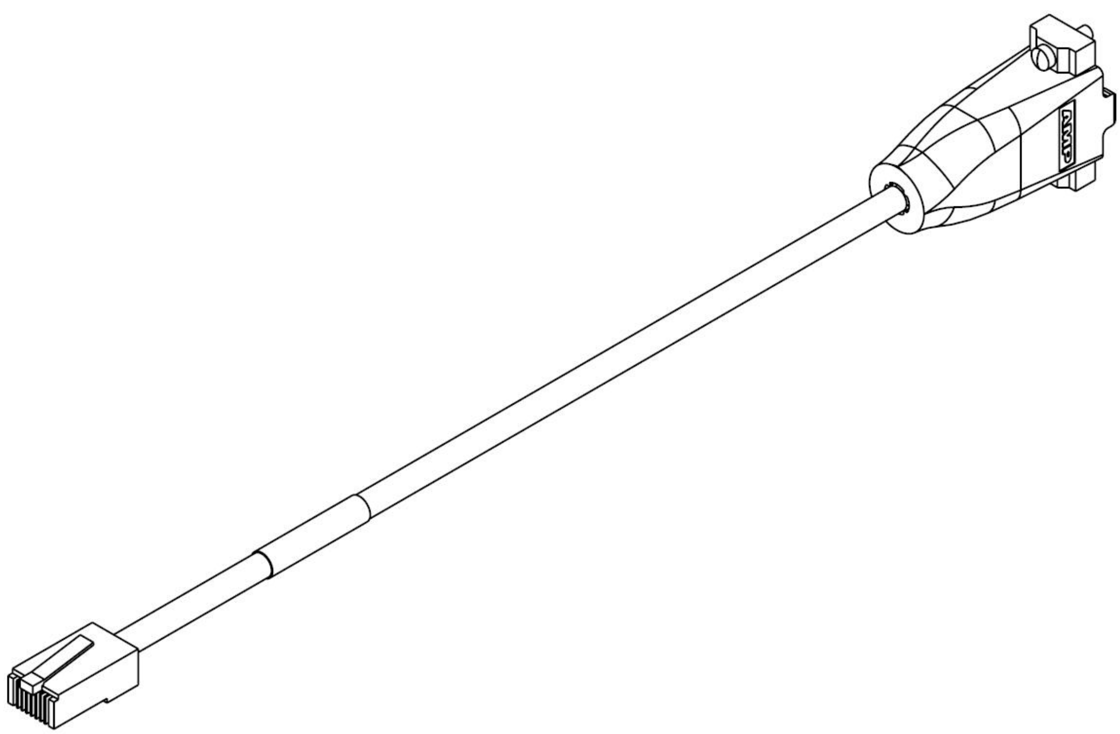
Equipment	Model/Type	Manufacturer	Description
Service Terminal		Locally Procured	Used to access and interface with Site Controller and BR MMI
Service Connector Box	0166502N05	Motorola Solutions	Used for measuring receiver sensitivity
Basic Service Cable	3066565B01	Motorola Solutions	
Coaxial Directional Coupler	3041-20	Narda	Used for receive test signal injection into duplex TX/RX antenna port
Circulator, 260 MHz band		Ferrocom	
Circulator, 360 MHz–405 MHz	9C30-41	Ferrocom	
Circulator, 800 MHz–900 MHz	9C78	Ferrocom	
Load	375 BNM	Narda	
RF Attenuator, 10dB	minimum 100 W	Motorola Solutions	Used to attenuate transmit signals for testing
RF Adapter	33 QMA-N-50-1/133 NE	Huber & Suhner	"N" female to "QMA" male
RF Adapter	31 N-QMA- 1/1- - NE	Huber & Suhner	"N" female to "QMA" female
RF Adapter	33_716-N-50-1/- - -_UE	Huber & Suhner	N female to DIN 7-16 male
Rubidium Frequency Standard	PRFS (or 2008)	Ball/Efratom (UCT)	Used as a frequency standard for receive test

Equipment	Model/Type	Manufacturer	Description
TETRA Signal Generator	Rhode & Schwarz: SMU200A + SMU-K68	Rhode & Schwarz:	Used for checking receive and transmit operation
TETRA Analyzer (optional)	FSQ+FS-K110+FSQ-K70		Used for checking receive and transmit operation
Miscellaneous Cabling and Connectors		Locally Procured	Used to connect the signal generator to the antenna ports

6.2.3
Service Cable and Connector Box Description

The **Service Cable** (3066565B01) is used to connect the Service Terminal RS232 port (DB9M) to the Site Controller RJ45 Service Port or the Base Radio RJ45 Service Port to run the MMI commands. The **Service Cable** is specially crafted for measuring sensitivity. It can also be used for connecting a computer. A simple **Service Cable** without the trigger wires is also sufficient to connect to the Site Controller or the Base Radio to use MMI Commands.

Figure 130: Basic Service Cable



NOTICE: Only the D-SUB 9 Female PINs that are connected are presented in the following table. The rest is not connected (NC).

Table 74: Basic Service Cable Pinout

RJ45 PIN	D-SUB 9 Female PIN	Description
1 (NC)		

RJ45 PIN	D-SUB 9 Female PIN	Description
2 (NC)		
3 (NC)		
4	3	RX
5	5	GND
6 (NC)		
7	2	TX
8	5	GND

The **Service Connector Box** (0166502N05) is used for connecting a PC to the Base Radio. It has additional functionality for measuring receiver sensitivity, see Figure 132: Service Connector Box Pinout on page 246.

Figure 131: Service Connector Box

NOTICE: This cable is necessary for BR measurement. To only access the serial console, you can use the basic service cable (see Figure 130: Basic Service Cable on page 244).

Figure 132: Service Connector Box Pinout

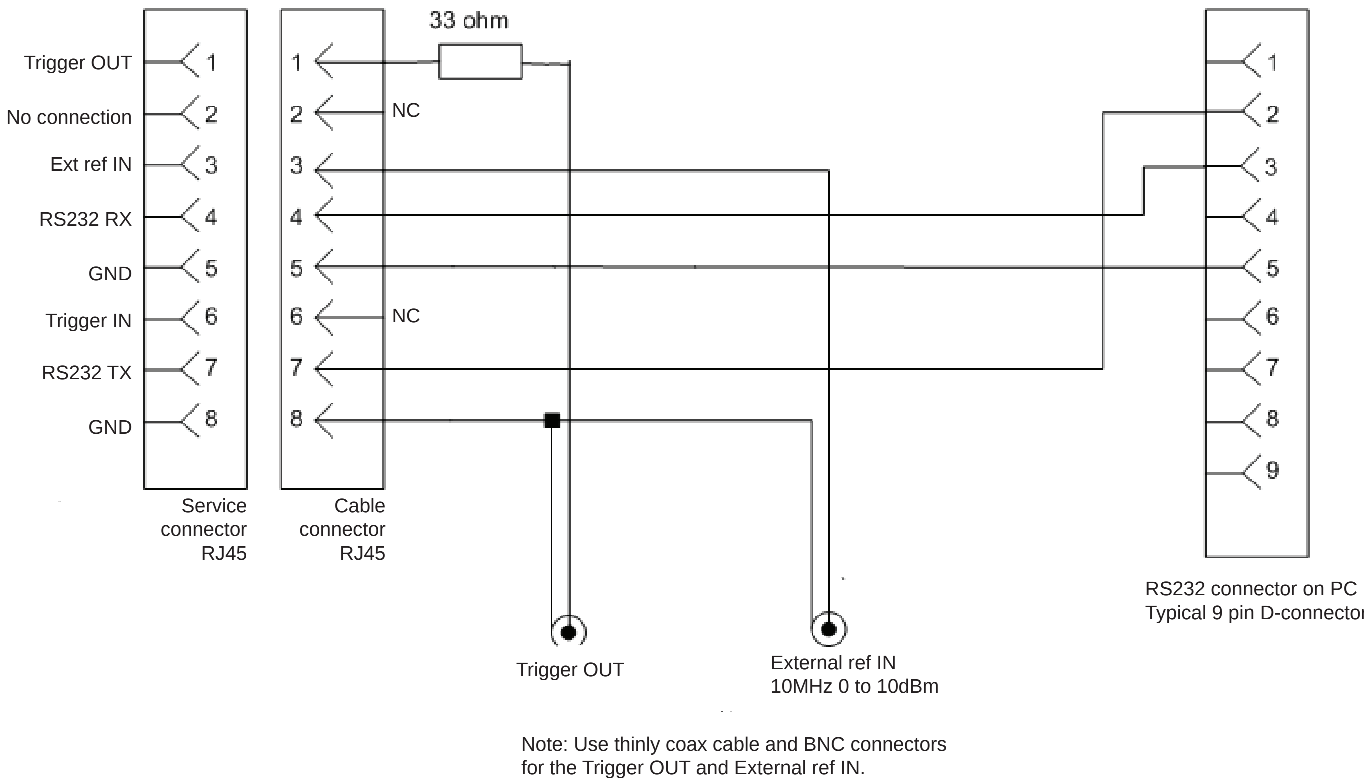


Table 75: Site Controller Service Port Pinout

RJ45 PIN	Description
1	FE Rx+
2	FE Rx-
3	FE Tx+
4	RxD
5	NC
6	FE Tx-
7	TxD
8	GND

6.2.4

Setting Up Service Terminal

Procedure:

1 Configure the service terminal RS232 port with the following parameters:

- **Baud Rate**: 19200
- **Parity Bit**: none
- **Data Bits**: 8
- **Stop Bits**: 1

2 Connect an RS232 cable from the serial port on the service terminal to the RJ45 Site Controller service port on the front of the Site Controller.

6.3
CAN Bus Configuration

CAN Bus interconnects units in the BTS. It is used for signaling, configuration and troubleshooting.

CAN Bus configuration and diagnosis in done through use of MMI Commands from the **Site Controller**. To use the commands connect the **Service Terminal** (Setting Up Service Terminal on page 246) to the **Site Controller** using the **Service Cable** (Service Cable and Connector Box Description on page 244).

NOTICE: All the CAN Bus related Commands are covered in detail in the *MMI Commands* manual.

Using CAN Bus MMI Commands it is possible to diagnose the state of all the devices connected to the CAN Bus:

- PSU CAN Bus Commands on page 247
- Fans CAN Bus Commands on page 248
- DPM CAN Bus Commands on page 248
- ATCC CAN Bus Commands on page 248
- Other CAN Bus Commands on page 249

6.3.1
PSU CAN Bus Commands

Use the PSU CAN Bus Commands to verify the state of the Power Supply Unit.

`psu <PSU number> get alarm`

Indicates a problem if any of the fail fields displays `YES`.

Example:

`DC in fail: YES` – indicates battery failure. For an MTS not equipped with backup battery it is normal behavior and does not indicate any malfunction.

`AC in fail: YES` – indicates no or too low AC input voltage.

`psu <PSU number> get status`

Shows the status of all power sources (AC/DC, in/out).

`psu <PSU number> get battery_voltage`

Shows the battery voltage.

For an MTS not equipped with backup battery it shows the DC source input voltage.

`psu <PSU number> get battery_current`

Shows the battery current.

For an MTS not equipped with backup battery it shows the DC source input voltage.

`psu <PSU number> get battery_temperature`

Shows the battery temperature.

For an MTS not equipped with backup battery it shows the DC source input voltage.

6.3.2 Fans CAN Bus Commands

Use the Fans CAN Bus Commands to verify the state of the Cooling Fans connected through CAN Bus.

psu *<PSU number>* get status
Shows the number of fans installed in the system.

psu *<PSU number>* get fan_config
Shows the number of fans installed in the system.

psu *<PSU number>* get alarm
Indicates a failure of a fan if any of `FAN fail (1/2/3)` fields equals `YES`.

psu *<PSU number>* get psu_temperature
Shows the Power Supply Unit temperature. Indicates a cooling problem when the displayed value is too high.

psu *<PSU number>* get alarm
Displays `Over temp.` alarm showing `YES` if the temperature is too high.

IMPORTANT:
During initial commissioning, verify that fan configuration matches the actual number of fans in the system. If needed, use the `psu # set fan_config` command to change the fan configuration.

Examples:

`psu 1 set fan_config 1 1 1` to define three fans present on PSU1.

`psu 1 set fan_config 1 1 0` to define fans present on PSU1 Fan 1 and 2, and no fan present on PSU 1 Fan 3.

`psu 2 set fan_config 0 0 0` to define no fans present on PSU2.

6.3.3 DPM CAN Bus Commands

Use the DPM CAN Bus Commands to verify the state of the Digital Power Meter.

dpm *<DPM number>* get alarm
Shows all the alarms related to the DPM.

`VSWR alarm: YES` alarm can indicate a broken antenna.

dpm *<DPM number>* get fwd_power
Indicates a problem with the connection between the DPM and Base Radio if the reading is too low.

6.3.4 ATCC CAN Bus Commands

Use the ATCC CAN Bus Commands to verify the state of the Cavity Combiners.

atc *<ATCC number>* get alarm
Indicates a problem with the Cavity Combiner if there is at least one `Cavities VSWR Alarm`.

atc *<ATCC number>* get cav_status*<cav_number>*
Shows the ATCC status. Use this command for each Cavity Combiner.

Lists the frequencies of each Cavity Combiner, this can be compared to the setting of the corresponding Base Radio for verification.

`Cavity VSWR Alarm` – this Cavity Combiner is unable to tune. An actual value of VSWR is shown.

`Channel Spacing Alarm` – means that frequency of one Base Radio is tuned too close to another.

6.3.5
Other CAN Bus Commands

`can check_mapping`

Lists the registered, unregistered and unknown devices connected through CAN Bus.

Indicates possible cable corruption If there are no devices present.

Map all the `not mapped` devices.

6.4
Configuring and Verifying the Site Controller

The Site controller (SC) setup and checkout procedures specify steps that verify operation within the Site Controller.

Process:

1 Verify the Site Controller configuration.

See Setting Up the Site Controller on page 249.

2 Perform E1 (X.21) Loopback to test the E1 (X.21) interface and cabling.

See:

- E1 Connection Test on page 250
- X.21 Connection Test on page 250

3 Verify proper SRI functioning.

See Site Reference Check on page 250.

6.4.1
Setting Up the Site Controller

Prerequisites: If an MTS or Site Controller is moved, clear the site location memory to force the stored position data to be re-initialized. Enter the `site_location -reset` command on the Site Controller terminal whilst the MTS is running in application mode.

Procedure:

1 Switch the Power Supply Unit on.

2 Start up the service terminal.

There is a series of self-tests. By default, after a few seconds, the Site Controller launches the Site Controller Application. For description of other modes, see MMI Commands and MTS Modes of Operation on page 239.

3 At the prompt, enter `status sc —all`.

The command displays preliminary diagnostics information on the Site Controller. This includes the health of the Site Controller, the trunking state, the internal state and the site link status.

NOTICE: If all details for the status is needed, use the `status bts -l` command.

4 If any device drivers are reported as `failed to initialize`, perform further tests. To re-run the tests, reset the Site Controller.

The `failed to initialize` status indicates a problem with that peripheral. A successful initialization of a device does not guarantee that it is fully functional; further tests are required to ensure this. The above tests are carried out upon power-up or reset. The command reports the last status of the test.

For more details on available commands, see *MTS Man Machine Interface Commands Manual* or use the `help` command.

NOTICE: This procedure may be halted and restarted at any time by pressing the RESET push button for at least 2 seconds on the Site Controller front panel.

NOTICE: For Site controller indicators, see Site Controller on page 317.

6.4.2
E1 Connection Test

NOTICE: The E1 connection test requires that the Site Controller is connected to an active E1 line.

The E1 tests the connection between the Site Controller and the CNE core router. All applications that communicate with the CNE utilize the Internet Protocol (IP).

To obtain the current state and statistics for IP, use the `netstat` and `netstat -s` commands.

The correct functioning of the IP layer may be determined through careful use of the `ping` command. For more information, see the *MTS MMI Commands Manual*.

Enter the following loopback test command in Site Controller Test Application: `e1e1`. MMI modes are described in MMI Commands and MTS Modes of Operation on page 239.

6.4.3
X.21 Connection Test

NOTICE: The X.21 connection test requires the Site Controller to be connected to a Network Terminating Unit (NTU) which supports the X.21 loop 3 command.

Enter the following loopback test command in Site Controller Test Application: `e1e1`. MMI modes are described in MMI Commands and MTS Modes of Operation on page 239.

6.4.4
Site Reference Check

The SRI status is checked from the Site Controller Application. MMI modes are described in MMI Commands and MTS Modes of Operation on page 239.

Verify the GPS Receiver status as follows:

At the prompt, type: `status sri`

Verify that:

- GPS State is `GPS 3D FIX` or `GPS POSITION HOLD` depending on the type of GPSR (internal/ external)

- GPS Operating OK is `YES`

The GPS LED will flash satellite tracking commences and will be fully on, once GPS is fully trained.

If satellite tracking is `NOT ADEQUATE`, make sure:

- The GPS receiver has been allowed enough time to locate the satellites (in extreme cases this may take up to 2 hours).
- The GPS antenna cable is properly connected. If it is not, reconnect the cable properly and then reset the Site Controller. If cable is found to be properly connected, the GPS antenna is possibly faulty.

See MTS Troubleshooting on page 373 for more information on troubleshooting GPS.

CAUTION: Do not attempt to make a resistance check of the GPS antenna. Damage to the active devices within the antenna element may result.

6.5
Configuring and Verifying the Base Radio

For the Base Radio, there are a number of procedures that you must follow to ensure that it is up and running.

All module-specific information is programmed in the factory before shipment. Base Radio-specific parameters (for example, receive and transmit frequencies) are downloaded to the Base Radio from the network/Site Controller.

Process:

1. Verify the BRC state using the front panel LEDs.

   See Base Radio Startup Sequence on page 252.
2. Select Base Radio Position and Receivers Selection.

   See Base Radio Position and Receivers Selection on page 253:

   - Setup and Access to Base Radio Position on page 254
   - Setting and Accessing Base Radio Position by Using the cccp Command on page 255
   - Enabling Base Radio Receiver Branches on page 256
   - Additional Receiver Configuration for BR-Arch-1 on page 256
3. Configure the Base Radio DPM and ATCC mappings to the Site Controller. See Configuring the pm_config on page 259.
4. Verify the transmit and receive operations.

   See Station Verification Procedures on page 260:

   - Verifying the Base Radio Software Revision on page 260
   - Verifying the Transmitter on page 263
   - Receiver Verification on page 265
5. Display outstanding Base Radio alarm conditions.

   See Displaying Base Radio Alarms on page 271.

6.5.1 Base Radio Startup Sequence

Verify the following LED conditions on the base radio controller according to the following table.

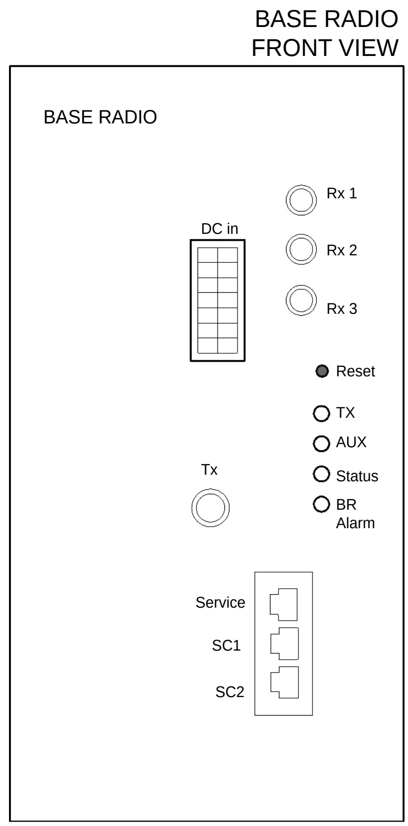
Table 76: Base Radio LEDs: Normal Startup Sequence

Status	Tx (Transmit)	Alarm	Description
off	off	off	No power / initial
			LED test (flashing multicolor)
off	off	Red	Booting
Amber	off	Red	Waiting for SWDL this is where the BR will wait if no Site Controller is present.
Green	off	Red	BRC main application is running
Green	off	off	No active alarms
Green	Green	off	BR is keyed

Table 77: Base Radio LEDs: Hardware Failure

Status	Tx (Transmit)	Alarm	Description
off	off	off	No power / initial
			LED test (flashing multicolor)
off	off	Red	Booting
Amber	off	Red	Waiting for SWDL this is where the BR will wait if no Site Controller is present.
Green	off	Red	BRC main application is running but an alarm is preventing the BRC from keying

Figure 133: BRC Indicators



6.5.2

Base Radio Position and Receivers Selection

The new Base Radio needs to be assigned a position identifier. This operation is performed from the Service port.

Use the MMI commands to:

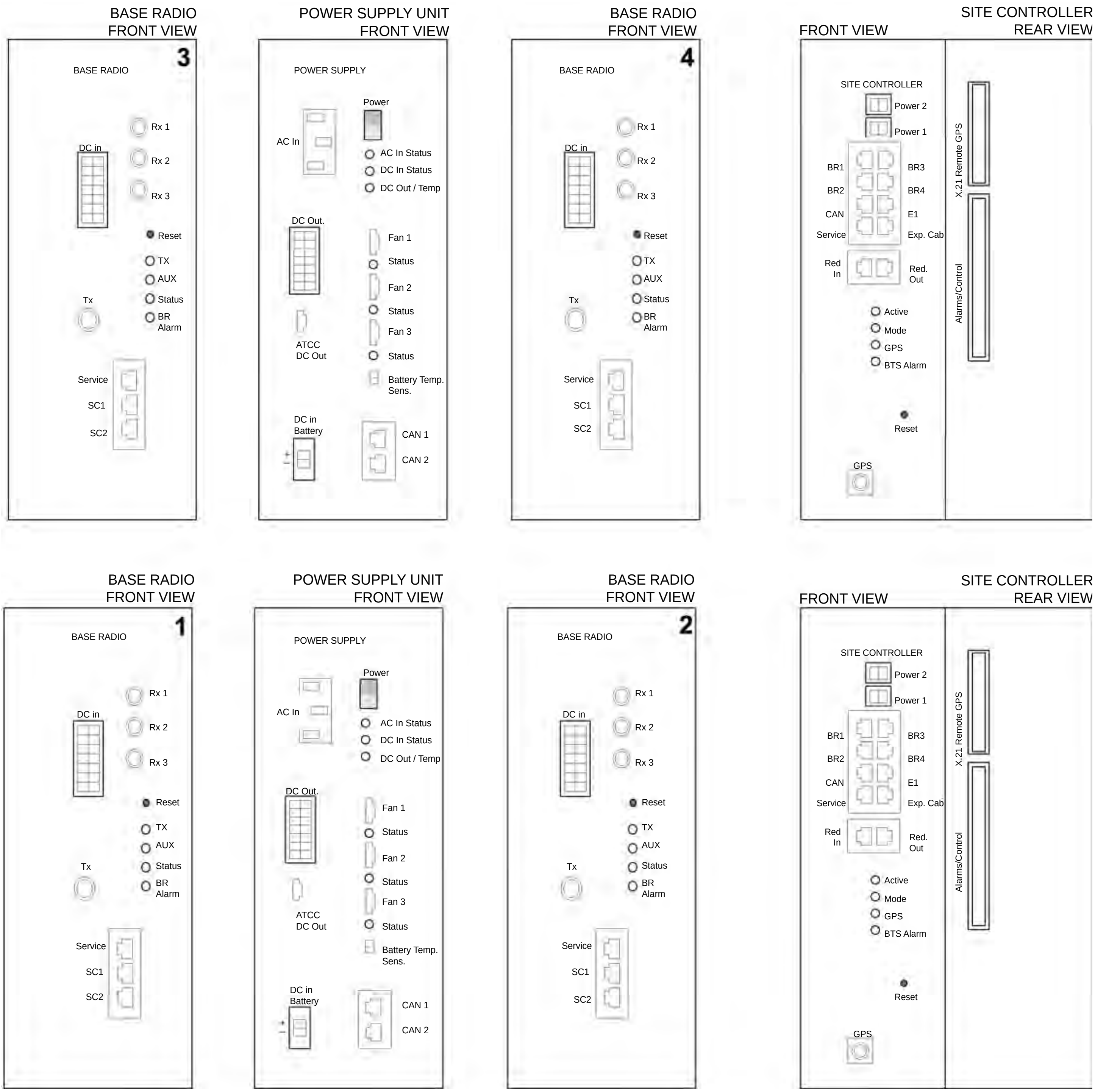
- Set the position identifier of the Base Radio within the cabinet. See Setting and Accessing Base Radio Position by Using the cccp Command on page 255.
- Set the number of active receivers (diversity) of the new Base Radio. See Enabling Base Radio Receiver Branches on page 256.
- **BR-Arch-1 Base Radios only:** Verify and configure additional receiver parameters. See Additional Receiver Configuration for BR-Arch-1 on page 256.

For detailed information on the MMI commands, see the *MTS Man Machine Interface Commands Manual*.

6.5.2.1

Setup and Access to Base Radio Position

Figure 134: Base Radios Cabinet Positions and Numbering



NOTICE: The MTS 4 Expansion Cabinet Base Radio Positions and Numbering are exactly the same as in the figure above. Only Cabinet ID differs.

6.5.2.1.1

Setting and Accessing Base Radio Position by Using the `cccp` Command

Perform this procedure to program the number of the position within a selected cabinet of where a Base Radio is mounted.

Setting Base Radio position using the `cccp` command automatically sets the Base Radio IP address.

Procedure:

1 Log on to the Base Radio mode appropriate for your architecture:

- For a Base Radio in BR-Arch-1 architecture, log on to Boot1. See Logging on to the BOOT1 mode on page 241.
- For a Base Radio in BR-Arch-2 architecture, log on to Base Radio Core. See Logging on to the Base Radio Core Mode on page 242.

2 At the command prompt, enter: `cccp` ***<cabinet><position>***

The Base Radio designation starts with the left Base Radio designated as **1**.

In the Prime cabinet with two Base Radios, the left Base Radio is designated as **1**, and the right is designated as **2**.

Step example:

To set BR Position ID to 2 and Cabinet ID to 1 by using BRC Boot1, enter: `cccp 1 2`

To set Base Radio position for base radio in MTS 4 Expansion Cabinet by using BRC Boot1, enter: `cccp 2 2`

6.5.2.1.2

Manual Configuration of Base Radio Position and IP

It is not recommended to manually configure the position and IP address of a Base Radio. Manual procedures can be performed only by authorized technical personnel. Use the `cccp` command for automatic position and IP address configuration. See Setting and Accessing Base Radio Position by Using the cccp Command on page 255.

6.5.2.1.2.1

Setting and Accessing Base Radio Position Using Test Application

It is not recommended to manually configure the position and IP address of a Base Radio. Manual procedures can be performed only by authorized technical personnel. Use the `cccp` command for automatic position and IP address configuration.

Procedure:

1 Log on to the Test Application. See Logging on to the Test Application on page 242.

2 Perform the following actions:

- To configure the BR cabinet id, type `ci -oplatform -c`***<n>*** at the command prompt. ***<n>*** is a number between 1 and 8 corresponding to the cabinet id of the Base Radio.
- To configure BR position, type `pi -oplatform -p`***<n>*** at the command prompt. ***<p>*** is a number between 1 and 8 corresponding to the position id of the Base Radio.

6.5.2.1.2.2
Setting Base Radio IP

It is not recommended to manually configure the position and IP address of a Base Radio. Manual procedures can be performed only by authorized technical personnel. Use the cccp command for automatic position and IP address configuration.

Do not perform this procedure after performing Setting and Accessing Base Radio Position by Using the cccp Command on page 255.

Procedure:

1. Log on to the Test Application. See Logging on to the Test Application on page 242.
2. To configure the IP address of the Base Radio, enter one of the following commands:
   - cpp -olan1 -i***<IP>***
   - cpp -olan2 -i***<IP>***

   where ***<IP>*** is the new IP address, for example 10.0.253.11.

   IMPORTANT: Do NOT change the original MAC addresses of the Base Radio.

6.5.2.2
Enabling Base Radio Receiver Branches

Every new Base Radio requires enabling receivers. It is possible to separately enable or disable every branch.

Procedure:

1. Log on to the Base Radio in application mode. See Logging on to the Base Radio Application through Serial Connection on page 241.
2. Verify if there are any existing settings present. Enter the following command: get nvm_param rx1 rx_fru_config and press ENTER.

   The branch setting depends on the receiver diversity required for the site.
3. If the Base Radio Application does not return any values, or returns an incorrect setting, fix the parameter by entering the following command: set nvm_param rx1 rx_fru_config ***<X>*** where ***<X>*** is a number corresponding to one of the following settings:
   - 1 - Receiver branch 1 enabled
   - 2 - Receiver branch 2 enabled
   - 3 - Receiver branches 1, and 2 enabled
   - 4 - Receiver branch 3 enabled
   - 5 - Receiver branches 1, and 3 enabled
   - 6 - Receiver branches 2, and 3 enabled
   - 7 - Receiver branches 1, 2, and 3 enabled

6.5.2.3
Additional Receiver Configuration for BR-Arch-1

The receivers in BR-Arch-1 Base Radios might require additional parameter modification. The procedures in this section are applicable **only** to Base Radios in BR-Arch-1 architecture. Do **not** perform these actions in BR-Arch-2 architecture.

6.5.2.3.1
Verifying the Base Radio Receiver Parameters in BR-Arch-1 Architecture

The procedure below can be done locally as well as remotely. The commands to check and change the BR parameters require the use of BRC Application MMI. Receivers in BR-Arch-2 do **not** require reconfiguring.

Procedure:

1. Log on to the Base Radio in application mode. See Logging on to the Base Radio Application through Serial Connection on page 241.
2. Enter:
   `get nvm_param rx1 atten_default`

   The correct setting should be `0` for MTS 4 and `4` for MTS 2. If the command does not return any parameter value, then the parameter is missing. See Table 78: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 258 to add the parameter.
3. Enter:
   `get nvm_param pa dekey_limit`

   The correct setting should be `26`. If the command does not return any parameter value, then the parameter is missing. See Table 78: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 258 to add the parameter.
4. Enter:
   `get nvm_param rx1 rx_dc_inj_usl`

   The correct setting should be `2.5`. If the command does not return any parameter value, then the parameter is missing. See Table 78: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 258 to add the parameter.
5. Enter:
   `get nvm_param rx1 rx_dc_inj_lsl`

   The correct setting should be `0`. If the command does not return any parameter value, then the parameter is missing. See Table 78: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 258 to add the parameter.
6. Enter:
   `get nvm_param rx1 ad1_scaling6`

   The correct setting should be `28.9`. If the command does not return any parameter value, then the parameter is missing. See Table 78: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 258 to add the parameter.
7. Enter:
   `get nvm_param rx1 rx_fru_config`

   The setting will depend on the receiver diversity required for the site. If the command does not return any parameter value, then the parameter is missing. See Table 78: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 258 to add the parameter.

Postrequisites:
After updating the parameters, enter: `reset` and then enter: `y` for the configuration changes to take effect.

6.5.2.3.1.1
Corrective Actions for the BR-Arch-1 Base Radio Receiver Configuration

NOTICE: Use corrective actions **only** for Base Radio receivers in BR-Arch-1 configuration.

Table 78: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture

Missing or Bad Parameter	Corrective Action

atten_default	• For MTS 4, enter:
	`set nvm_param rx1 atten_default 0`
	• For MTS 2, enter:
	`set nvm_param rx1 atten_default 4`
	• If the parameter is missing for MTS 4, add it by entering
	`set nvm_miss_param rx1 atten_default 0`
	• If the parameter is missing for MTS 2, add it by entering
	`set nvm_miss_param rx1 atten_default 4`

dekey_limit	Enter: `set nvm_param pa dekey_limit 26`
rx_dc_inj_usl	Enter: `set nvm_param rx1 rx_dc_inj_usl 2.5`
rx_dc_inj_lsl	Enter: `set nvm_param rx1 rx_dc_inj_lsl 0`
ad1_scaling6	Enter: `set nvm_param rx1 ad1_scaling6 28.9`
rx_fru_config	Enter: `set nvm_param rx1 rx_fru_config <[X]>` where the values for `<[X]>` are: • 1 - Receiver branch 1 enabled • 2 - Receiver branch 2 enabled • 3 - Receiver branches 1 and 2 enabled • 4 - Receiver branch 3 enabled • 5 - Receiver branches 1 and 3 enabled • 6 - Receiver branches 2 and 3 enabled • 7 - Receiver branches 1, 2 and 3 enabled

6.5.2.3.2
Configuring the Base Radio VSWR

When and where to use: The procedure below can be done locally as well as remotely. The commands to check and change the BR parameters require the use of BRC Application MMI.

NOTICE: Configure the Base Radio VSWR **only** for Base Radios in BR-Arch-1 configuration.

Procedure:

1. Log on to the Base Radio in application mode. For the logging procedure, see Logging on to the Base Radio Application through Serial Connection on page 241.
2. Type `get nvm_param pa max_prev` and press **Enter**.

   The correct value should be 30.

   NOTICE: If there is no returned value or the value is incorrect, type
   `set nvm_param pa max_prev 30`
   .
3. Type `get nvm_param pa dekey_limit` and press **Enter**.

   The correct value should be 26.

   NOTICE: If there is no returned value or the value is incorrect, type
   `set nvm_param pa dekey_limit 26`
   .

6.5.3
Configuring the pm_config

The `pm_config` command configures DPM and ATCC mapping to Base Radio(s) on the Site Controller.

For more information about how to use the `pm_config` command, see *MTS Man Machine Interface Commands Manual*.

When and where to use: The `pm_config` command defines the relationship between RFDS components and Base Radios. If one cavity in an ATCC measures a high Voltage Standing Wave Radio (VSWR), it results in the dekey of the corresponding Base Radio. A broken antenna or failure on a feeder cable indicates a bad VSWR on the DPM. It also results in the decay of Base Radios using this DPM.

Procedure:

1. Log on to the Site Controller Application. See Logging on to the Site Controller Application through Serial Connection on page 240.
2. To set up `pm_config` for MTS 4 with ATCC and one TX antenna, use the following commands:
   - `pm_config br 1 dpm 1`
   - `pm_config br 1 atcc 1 cav 1`
   - `pm_config br 2 dpm 1`
   - `pm_config br 2 atcc 1 cav 2`
   - `pm_config br 3 dpm 1`
   - `pm_config br 3 atcc 2 cav 1`
   - `pm_config br 4 dpm 1`
   - `pm_config br 4 atcc 2 cav 2`

NOTICE: To get help, use the following command: `SC: pm_config -`
If Expansion cabinet is used, *pm_config* needs to be setup accordingly. By default, the following commands could be used:

- `pm_config br 5 dpm 2`
- `pm_config br 5 atcc 3 cav 1`
- `pm_config br 6 dpm 2`
- `pm_config br 6 atcc 3 cav 2`
- `pm_config br 7 dpm 2`
- `pm_config br 7 atcc 4 cav 1`
- `pm_config br 8 dpm 2`
- `pm_config br 8 atcc 4 cav 2`

To set up pm_config for MTS-2 with one TX antenna, use the following commands:

- `pm_config br 1 dpm 1`
- `pm_config br 2 dpm 1`

3 To configure the DPM and ATCC mapping to BR, type `pm_config [-?]`.
4 To configure the ATCC (cavity) to BR mapping, type `br` ***
*** `atcc` ***<atcc>*** `cav` ***<cavity>***.
5 To configure the DPM to BR mapping, type `br` ***
*** `dpm` ***<dpm>***.
6 To clear the mapping for a given BR, type `-invalidate` ***
***.
7 To clear all mapping, type `-invalidate`.
8 To print all mapping, type `-print`.

6.5.4 Station Verification Procedures

Station verification procedures cover methods to verify transmit and receive operations after the Base Radio module installation or replacement. Each section contains the equipment setup and the procedure.

6.5.4.1 Verifying the Base Radio Software Revision

Procedure:

1 Log on to the Base Radio Application using the procedure Logging on to the Base Radio Application through Serial Connection on page 241.
2 Enter the command `ver` to check current versions of your Base Radio applications.
3 Log on to the Test Application of the Base Radio using procedure Logging on to the Test Application on page 242.
4 Collect revision numbers from the BR by typing: `fv -oplatform`.
5 Note down the test application software version and then see the System Software Release Note for the correct software version number.
6 To exit BR Test Application mode, reset the BR using the following command from the MMI: `reset -oplatform`

7 If the software version numbers do not match, update the Test Application. For BR-Arch-1, see Upgrading the Base Radio Test Application Software in BR-Arch-1 Architecture (Optional) on page 261.

Base Radios in BR-Arch-2 architecture do **not** require manual updates. If you want to update the software in BR-Arch-2 Base Radios for testing purposes, see Upgrading the Base Radio Software in BR-Arch-2 Architecture (Optional) on page 262.

NOTICE: BR-Arch-2 Base Radio software updates can be performed only by authorized technical personnel.

6.5.4.1.1 Upgrading the Base Radio Test Application Software in BR-Arch-1 Architecture (Optional)

Perform this procedure only on Base Radios in BR-Arch-1 architecture. This procedure **does not** apply to BR-Arch-2.

When and where to use:

IMPORTANT: Never use this procedure to downgrade the Test Application software.

Procedure:

1. Place the BRC Test App software in the root directory of the TFTP server.
2. Connect an RJ45 cable to the serial port of the PC and the Base Radio Service port.
3. Connect a crossed Ethernet cable to the PC and the SC1 port on BR.
4. Reset BR and enter Boot1 mode. See Logging on to the BOOT1 mode on page 241.

   NOTICE: Do not enter the testapp mode from here.

5. Type `ferase 0x10100000 4M` and press **Enter**.
6. When the prompt returns, type `ifconfig eth0 address 10.0.253.`***<CAB><POS>*** and press **Enter**.
7. When the prompt returns, type `finstall testapp /tftp/10.0.253.100/R064020ROM.srec` and press **Enter**.

   NOTICE: `R064020ROM.srec` in the command is an example. Indicate latest released file when entering command.

   BRC resets itself at the end.

8. Log on to the Test Application using the procedure Logging on to the Test Application on page 242.
9. Log on as a factory user in the testapp mode, type `fv -oplatform` and press **Enter**.
10. On the last line of the output, verify that the version is R064020 or whichever version was upgraded to in step 7.
11. Reset the BR by typing `reset -oplatform` and press **Enter**.
12. Disconnect the service cable from the BR and reconnect the Ethernet cable to LAN 1.
13. Rerun Verifying the Base Radio Software Revision on page 260 to verify that the latest versions have been installed correctly.

6.5.4.1.2
Upgrading the Base Radio Software in BR-Arch-2 Architecture (Optional)

Software updates for Base Radios in BR-Arch-2 architecture should be performed only for testing purposes by authorized technical personnel.

NOTICE: This procedure has no impact on normal functioning of Base Radio. It is intended for testing purposes only. Perform this procedure only on Base Radios in BR-Arch-2 architecture. This procedure **does not** apply to BR-Arch-1.

Prerequisites:

- Ensure the Base Radio is **not** connected to the Site Controller.
- Ensure you are aware that connecting the Base Radio to the Site Controller after the software update does not have any impact on normal functioning of the Base Radio. However, it will have the following consequences:
  - The Test Application might become incompatible with the Base Radio Core.
  - The Base Radio Core will be overwritten with the version downloaded from the Site Controller.

Procedure:

1. Place the BRC Test Application and Core Application software in the root directory of the TFTP server.
2. Connect an RJ45 cable to the serial port of the PC and the Base Radio Service port.
3. Connect a crossed Ethernet cable to the service PC and the SC1 port on BR.
4. Reset BR and enter Base Radio Core mode. See Logging on to the Base Radio Core Mode on page 242.
5. Update the Base Radio Core by entering the following command:
   swmgr -icore -f/tftp/***<service PC IP address>***/***<name of the Base Radio Core file stored on the service PC>***
   and press **Enter**.

   Step example:
   swmgr -icore -f/tftp/10.0.253.100/MTS_BRC_CORE-R08.44.20.img
6. Update the Test Application by entering the following command:
   swmgr -itestapp -f/tftp/***<service PC IP address>***/***<name of the Base Radio Core file stored on the service PC>***
   and press ENTER.

   Step example:
   swmgr -itestapp -f/tftp/10.0.253.100/MTS_BRC_TESTAPP-R08.44.20.elf
7. When the prompt returns, reset the Base Radio by entering the following command: reset
8. Verify the if the Base Radio contains the new Base Radio Core version by performing the following steps:
   a. Log on to the Base Radio Core. See Logging on to the Base Radio Core Mode on page 242.
   b. Enter the following command: ver and press ENTER.
   c. Verify if the value in the Current core version parameter corresponds to the software version downloaded from the service PC.
9. Verify the if the Base Radio contains the new Test Application version by performing the following steps:
   a. Log on to the Test Application. See Logging on to the Test Application on page 242.
   b. Enter the following command: fv -oplatform and press ENTER.

c Verify if the value in the `Test Application Version` parameter corresponds to the software version downloaded from the service PC.

6.5.4.2
Transmitter Verification

Table 79: Transmitter Verification Specifications

Parameter		Lower Side Limit	Typical	Upper Side Limit
MTS 2 low power, RMS power out on Antenna port	W	10	13	
	dbm	40	41	
EVM, RMS average	%			10
EVM, Peak confidence	%			30
Carrier feed through / Residual carrier	%			5
TX frequency error	Hz	-80		80

6.5.4.2.1
Verifying the Transmitter

Prerequisites: Take the MTS out of service.

WARNING: RF energy burn hazard. Disconnect power in the cabinet to prevent injury and equipment damage while disconnecting and connecting antennas.

IMPORTANT: Unless it is already out of service, Motorola Solutions recommends performing this procedure during off-peak hours to minimize or eliminate a disruption of service to system users.

When and where to use: This procedure provides commands and responses to verify proper operation of the transmit path for the Power Amplifier and is recommended after replacing the Base Radio module.

IMPORTANT: BR-Arch-1 Base Radios: To avoid the risk of causing a high bit error rate to occur, do not use 385.572 MHz and 419.175 MHz as receiving frequencies in the Base Radios of the MTS.

Procedure:

1. Log on to the Test Application of the Base Radio.

   See Logging on to the Test Application on page 242.

2. Type `power -otxch1 -a0` in the command line.

   This command dekeys the transmitter.

3 **NOTICE:** The following commands key the transmitter. Make sure that transmission only occurs on licensed frequencies or into an RF dummy load. To ask for the current transmitter frequency, enter: `freq -otxch1`. To change the transmit frequency, enter:

- **for BR-Arch-1**: `vco -otx_all -f`***<X>***
- **for BR-Arch-2**: `freq -otx_all -f`***<X>***

where ***<X>*** is a transmit frequency. For example, to set the transmit frequency to 410.0125 MHz, type `vco -otx_all -f410.0125`.

To key the transmitter with a T2 type channel type these three commands:

```
enable -otx_all son
```

```
ptm -orx_all -mTx_T2 -s15 -tNo_Trigger -d0
```

```
power -otxch1 -aXX
```

These commands set the transmitter to a specified power (in Watts) without altering any programmed parameters. For example, to key the Power Amplifier to 15W, type `power –otxch1 -a15`.

NOTICE: To transmit a TCH 7.2 channel type, type: `ptm -orx_all -mTCH_72 -s15 -tNo_Trigger -d0`

NOTICE:
The measurement equipment setting for MCC, MNC and BCC: 0

Burst Type: NCDB

4 At the prompt, type these three commands:

`meter –opa1 –mpa_pwr_fwd`. This command returns the current value of forward power from the RF Power Amplifier.

`meter –opa1 –mpa_pwr_re`. This command returns the current value of reflected power from the RF Power Amplifier.

`meter –opa1 –mpa_vswr`. This command calculates the current Voltage Standing Wave Ratio (VSWR) from the RF Power Amplifier.

5 At the prompt, type: `alarms –ofault_hndlr`.

This command returns all active alarms of the Base Radio.

6 At the prompt, type: `power -otxch1 —a0`.

This command stops all transmitter activity.

7 Replace the existing cable from the Base Radio TX connector with a test cable to the TX connector. Connect a 40 dB attenuator to the other end of the cable.

8 From the attenuator, connect a cable to the RF IN/OUT connector on the TETRA Analyzer.

9 Connect the 50 Ohm Coax cable from the 10 MHz REFERENCE OSCILLATOR IN/OUT connector of the TETRA Analyzer (on the back of the TETRA Analyzer) to the 10 MHz input connector on the Service Connector Box.

10 Set the TETRA Analyzer to the EXT REF mode. Set TETRA Analyzer to ON and to the proper channel type.

6.5.4.3
Receiver Verification

The receiver verification procedure sends a known test signal to the Base Radio to verify the receive path and is recommended after replacing a Base Radio.

WARNING: RF energy burn hazard. Disconnect power in the cabinet to prevent injury and equipment damage while disconnecting and connecting antennas.

6.5.4.3.1
Setting Up the Equipment for Receiver Verification

IMPORTANT: BR-Arch-1 Base Radios: To avoid the risk of causing a high bit error rate to occur, do not use 385.572 MHz and 419.175 MHz as receiving frequencies in the Base Radios of the MTS.

Procedure:

1. Connect one end of the Service cable to the service computer.
2. Connect the other end of the Service cable to the BR Service Access port on the front panel of the BR.
3. Disconnect the existing cables from the Base Radio TX and RX connectors (or the connector corresponding to the receiver under test).
4. Connect a test cable to the TX and RX connectors.
5. Connect the other end of the test cable to the RF output on a TETRA Signal Generator.
6. Connect 10MHz REF output from signal generator to "ext ref in" on the Service Port Cable.
7. Connect the Trigger Output connector on the Service Port Cable to the External Trigger Input on the TETRA Signal Generator.
8. Set the TETRA Signal Generator to EXT REF mode.
9. Set TETRA Signal Generator to ON.
10. Set the TETRA Signal Generator to the receive frequency of the Base Radio under test.

    All receivers within a single Base Radio have the same receive frequency.
11. Configure the generator for a TCH 7.2 TETRA channel.
12. Set the TETRA Signal Generator to generate the test signal at an output level of -110 dBm.

6.5.4.3.2
Verifying the Receiver

This procedure provides commands and responses to verify proper operation of the Base Radio receiver path and is recommended after replacing a Base Radio. The Bit Error Rate (BER) measurement meets specifications at less than 0.01% (1.0e-02%) to pass the process.

Prerequisites: Take the Base Radio out of service. Unless the Base Radio is currently out of service, Motorola Solutions recommends performing this procedure during off-peak hours. This minimizes or eliminates disruption of service to system users.

Procedure:

1. Switch the MTS on.
2. Enter the BR Test Application mode and login with `dev` credentials. See Logging on to the Test Application on page 242.

NOTICE:
If the prompt does not show, wait for the BR to reboot automatically in less than 30 s.

Contact your local Motorola Solutions representative or Technical Support to obtain the password.

3 At the prompt, type: `freq -orxch1` and record the result.

4 Optional: If you need to change the TX or RX frequencies, enter the following commands:

`freq -otx_all -f`***<X>***

`freq -orx_all -f`***<X>***

where ***<X>*** is the frequency you want to set.

Step example: To set the receive frequency to 401.0125 MHz, type `freq -orx_all -f401.0125`.

5 Type `sge -orx_all -son` and press Enter to enable system gain alignment.

6 At the prompt, type: `ptm -orx_all -mTCH_72 -s15 -tMulti_Frame_Trigger -d0`

For Stabilock 4031/4032, use single slot only and delay : -6

`ptm -orx_all -mTCH_72 -s8 -tFrame_Trigger -d-6`

NOTICE: It may be necessary to adjust the trigger delay set by changing the -d parameter and running the ppr command in step 9. The Sync Location should be around 1000.

7 At the prompt, type: `enable -orxch1 -dbr1 -son`.

This command enables the receiver branch under test and should enable br1, br2, or br3 respectively depending on the branches that you are testing.

8 Set the signal generator to generate a T1 signal and inject to the relevant antenna port.

9 Type `ppr -orxch1 -a1000 -r1` to analyze the received RF signal quality of the Base Radio. Record the results.

Step example:

```
Receiver Number          =    1             2             3
SGC Attenuation (dB)     =    0             0             0
Sync. Location (1/10 us) =    1058          1058          1058
Sync. Amplitude (dB)     =    -81           -81           -81
Total Bits/Msgs          =    86400         86400         86400
Bits/Msgs in Error       =    2186          2214          2251
BER/MER (%)              =    2.530092      2.562500      2.605324
RSSI (dBm)               =    -118          -118          -119
```

10 Type `ppr -orxch1 -a1 -r200` to check for small peaks of interference. Record the results.

11 Repeat step 9 through step 10 for all receiver branches.

12 Disconnect the equipment.

13 Repeat procedure for all remaining Base Radios.

6.5.4.3.3
Verifying and Tuning the Receiver RSSI Levels

The RSSI level affects the sensitivity of the interference alarm.

Prerequisites:
Set up the equipment for receiver verification and tuning. Perform Setting Up the Equipment for Receiver Verification on page 265.

Contact your local Motorola Solutions representative or Technical Support to obtain required password.

WARNING: RF energy burn hazard or equipment damage. Before disconnecting antenna and connecting signal generator to the antenna connector, ensure that none of the Base Radios is currently transmitting.

Procedure:

1 Turn on the BR.

2 Enter the BR Test Application mode and log on with `dev` credentials. See Logging on to the Test Application on page 242.

NOTICE: If the prompt does not show, wait for the BR to reboot automatically in less than 30 s.

3 Reset all cal_br* values to 0 by performing the following actions:

   a Enter the following command:
   `fcp -orxch1 -pcal_br`***<receiver number>***`-v0`

   b Repeat step 3 a for each branch.

   Step example:

```
fcp -orxch1 -pcal_br1 -v0

fcp -orxch1 -pcal_br2 -v0

fcp -orxch1 -pcal_br3 -v0
```

4 Turn off the system gain and reset the BR. Type the following commands:

```
sge -orx_all -soff

reset -ocontrol
```

5 Display the receive frequency for the current Base Radio. At the prompt, type: `freq -orxch1` and record the result.

   If displayed frequency is suitable for measurement, continue with step 7.

6 Set the RX frequency. Use the `freq -orx_all -f`***<X>*** command, where ***<X>*** is the receive frequency.

   Step example: To set the receive frequency to 401.0125 MHz, enter `freq -orx_all -f401.0125`.

7 Configure the TETRA Signal Generator (VSG) to produce TCH/7.2 logical channel at the Base Radio's current RX frequency by performing the following steps:

   a Connect signal generator to the antenna connector on top of the cabinet.

   b Set the RF Signal Generator to -100 dBm at the Rx input.

8 Configure the station to decode TCH/7.2 logical channel type. Type `ptm -orx_all -mTCH_72 -s15 -tFrame_Trigger -d-5`

9 Type `enable -orxch1 -dbr1 -son` to enable the receiver branch under test.

   This command should enable br1, br2, or br3 respectively depending on the receive branches that you are testing.

10 Type `sge -orx_all -soff` to turn off the sys gain.

11 Measure RSSI for receive path 1, 2, and 3. Check that BER is 0%. Type `ppr -orxch1 -a10 -r1`

   Step example:

```
Receiver Number = 1             2             3
SGC Attenuation = 26214         26214         26214
```

```
Sync Location    = 276          264          258
Sync. Amplitude = 131070       131070       131070
Total Bits       = 2592         2592         2592
Bits in Error    = 0            0            0
BER (%)          = 0.0000000000 0.0000000000 0.0000000000
RSSI (dBm)       = -96          -97          -96
```

12 For each receiver branch, calculate the difference between -100 dBm and measured RSSI level using the following formula:

RX***<receiver branch number>*** delta = -100-(-***<RSSI (dBm) measured level>***)

Step example:

RX1 delta : -100-(-96) = -4

RX2 delta: -100-(-97) = -3

RX3 delta: -100-(-96) = -4

13 Set the RSSI calibration values using the results from step 12 using the following command: `fcp -orxch1 -pcal_br`***<receiver number>*** `-v`***<calculated calibration value>***

Step example:

```
fcp -orxch1 -pcal_br1 -v-4
```

```
fcp -orxch1 -pcal_br2 -v-3
```

```
fcp -orxch1 -pcal_br3 -v-4
```

NOTICE: RSSI calibration is not operational before the BR is reset.

14 Repeat step 2 and then step 5 through step 13 for all branches until the RSSI level is correctly calibrated for all branches.

15 Reset the BR. Use the following commands:

```
sge -orx_all -soff
```

```
reset -ocontrol
```

16 Verify RSSI for receive path 1, 2, and 3. Type `ppr -orxch1 -a10 -r1`

The following example shows a correctly calibrated RSSI level for all 3 receive paths.

Step example:

```
Receiver Number = 1            2            3
SGC Attenuation = 26214        26214        26214
Sync Location    = 276          264          258
Sync. Amplitude = 131070       131070       131070
Total Bits       = 2592         2592         2592
Bits in Error    = 0            0            0
BER (%)          = 0.0000000000 0.0000000000 0.0000000000
RSSI (dBm)       = -100         -100         -101
```

Postrequisites: BR-Arch-2 only: Verify and tune the receivers for the high power setting. See Verifying and Tuning the Receiver RSSI Levels in a High Power Setting for BR-Arch-2 on page 268.

6.5.4.3.4

Verifying and Tuning the Receiver RSSI Levels in a High Power Setting for BR-Arch-2

Receivers in BR-Arch-2 can work with two different power levels and require additional actions to fully configure their RSSI levels. Perform this procedure only in BR-Arch-2 architecture.

Prerequisites:

- Ensure that the RSSI levels for low power setting are properly configured. See Verifying and Tuning the Receiver RSSI Levels on page 266.
- Set up the equipment for receiver verification and tuning. See Setting Up the Equipment for Receiver Verification on page 265.
- Contact your local Motorola Solutions representative or Technical Support to obtain required password.

WARNING: RF energy burn hazard or equipment damage. Before disconnecting antenna and connecting signal generator to the antenna connector, ensure that none of the Base Radios is currently transmitting.

Procedure:

1 Turn on the BR.

2 Enter the BR Test Application mode and log on with `dev` credentials. See Logging on to the Test Application on page 242.

NOTICE: If the prompt does not show, wait for the BR to reboot automatically in less than 30 s.

3 Reset cal_br* values to 0 for high power configuration by performing the following actions:

a Enter the following command:
`fcp -orxch1 -pcal_br`***`<receiver number>`***`_hp -v0`

b Repeat step 3 a for each branch.

Step example:

```
fcp -orxch1 -pcal_br1_hp -v0

fcp -orxch1 -pcal_br2_hp -v0

fcp -orxch1 -pcal_br3_hp -v0
```

4 Turn off the system gain and reset the BR. Type the following commands:

```
sge -orx_all –soff

reset -ocontrol
```

5 At the prompt verify the receive frequency for the current Base Radio by typing: `freq -orxch1` and record the result.

If displayed frequency is suitable for measurement, continue with step 7.

6 Set the RX frequency. Use the `freq -orx_all -f`***`<X>`*** command, where ***`<X>`*** is the receive frequency.

Step example: To set the receive frequency to 401.0125 MHz, enter `freq -orx_all -f401.0125`.

7 Configure the TETRA Signal Generator (VSG) to produce TCH/7.2 logical channel at the Base Radio’s current RX frequency by performing the following steps:

a Connect signal generator to the antenna connector on top of the cabinet.

b Set the RF Signal Generator to -40 dBm at the Rx input.

8 Configure the station to decode TCH/7.2 logical channel type. Type
`ptm -orx_all -mTCH_72 -s15 -tFrame_Trigger -d-5`

NOTICE:
Depending on the testbox equipment model, the delay parameter **-d** may vary and should be adjusted accordingly.

Some testbox equipment can only generate T1 signal according to EN 300 394 (with synchronization information in Frame 18), which can negatively impact BER measurement results. If this is the case, it is recommended to perform measurements on a single time slot by changing the TS parameter value **-s** to one of the following values:

- -s8
- -s4
- -s2
- -s1

In this way, the only TSs used are 4, 3, 2, or 1.

For details regarding different available parameters options, see the “peer_test_mode” section in *MTS Man Machine Interface Commands*.

9 Type `enable -orxch1 -dbr1 -son` to enable the receiver branch under test.

This command should enable br1, br2, or br3 respectively depending on the receive branches that you are testing.

10 Type `sge -orx_all -soff` to turn off the sys gain.

11 Measure RSSI for receive path 1, 2, and 3. Check that BER is 0%. Type `ppr -orxch1 -a10 -r1`

Step example:

```
Receiver Number = 1            2            3
SGC Attenuation = 26214        26214        26214
Sync Location   = 276          264          258
Sync. Amplitude = 131070       131070       131070
Total Bits      = 2592         2592         2592
Bits in Error   = 0            0            0
BER (%)         = 0.0000000000 0.0000000000 0.0000000000
RSSI (dBm)      = -36          -37          -36
```

12 For each receiver branch, calculate the difference between -40 dBm and measured RSSI level using the following formula:

RX***<receiver branch number>*** delta = -40-(-***<RSSI (dBm) measured level>***)

Step example:

RX1 delta : -40-(-36) = -4

RX2 delta: -40-(-37) = -3

RX3 delta: -40-(-36) = -4

13 Set the RSSI calibration values using the results from step 12 using the following command: `fcp -orxch1 -pcal_br`***<receiver number>*** `-v`***<calculated calibration value>***

Step example:

```
fcp -orxch1 -pcal_br1_hp -v-4

fcp -orxch1 -pcal_br2_hp -v-3

fcp -orxch1 -pcal_br3_hp -v-4
```

NOTICE: RSSI calibration is not operational before the BR is reset.

14 Repeat step 2 and then step 5 through step 13 for all branches until the RSSI level is correctly calibrated for all branches.

15 Reset the BR. Use the following commands:

`sge -orx_all -soff`

`reset -ocontrol`

16 Verify RSSI for receive path 1, 2, and 3. Type `ppr -orxch1 -a10 -r1`

The following example shows a correctly calibrated RSSI level for all 3 receive paths.

Step example:

```
Receiver Number = 1            2            3
SGC Attenuation = 26214        26214        26214
Sync Location   = 276          264          258
Sync. Amplitude = 131070       131070       131070
Total Bits      = 2592         2592         2592
Bits in Error   = 0            0            0
BER (%)         = 0.0000000000 0.0000000000 0.0000000000
RSSI (dBm)      = -40         -40          -40
```

6.5.4.4
Displaying Base Radio Alarms

Perform this procedure to display outstanding Base Radio alarm conditions.

Prerequisites: In the Site Controller procedures, the base radios were connected to the Site Controller and received downloaded test software through the BR-Site Controller Ethernet link. If necessary, reset the base radio to obtain the password prompt, or enter the Test Application mode of the BR.

Procedure:

1 When prompted, type the password.

The prompt is displayed on the service terminal.

2 Perform one of the following actions:

- **BR Application**: Type `get alarms`. This command displays all alarms for this Base Radio together with its current states (active/inactive).
- **BR Test Application**: Type `alarms -ofault_hndlr`. This command displays all the all active alarms on the Base Radio.

NOTICE: When using Test Application, the fault management engine can be disabled. In such a case, **no** alarms are visible.

- To display current FM state: `dev> fme -ofault_hndlr`
- To enable FM: `dev> fme -ofault_hndlr -son`
- To disable FM: `dev> fme -ofault_hndlr -soff`

6.5.4.5
Viewing the Transmit Spectrum (Optional)

The transmit spectrum can be viewed on the Spectrum Analyzer. Perform the following procedure to view the transmitted signal spectrum.

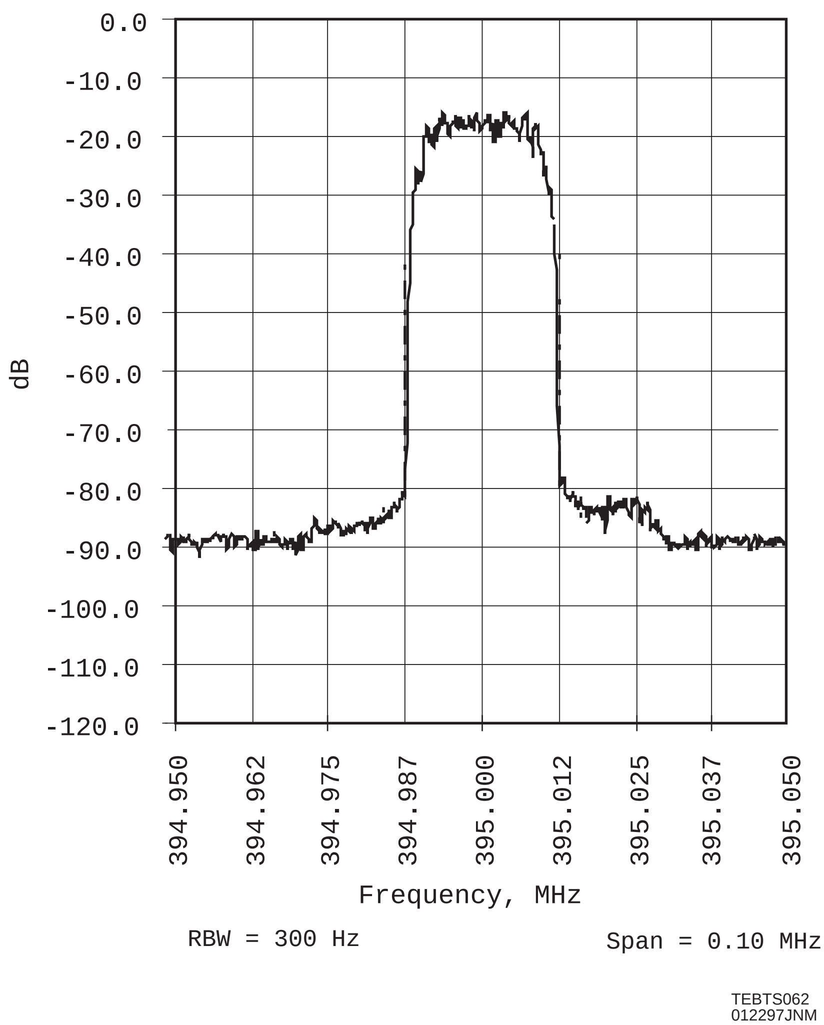
CAUTION: The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into a dummy load.

Procedure:

1. At the Test Application prompt, type: `power -otxch1 -a35` to set the transmitter output to maximum rated output.

   The following figure shows the transmitted signal on the Spectrum Analyzer.

   Figure 135: Spectrum Analyzer Display of Transmitted Signal

2. At the prompt, type: `power -otxch1 -a0` to stop RF transmission.
3. Repeat this procedure for each base radio.

6.5.5
Synchronizing Non-Volatile Memory (NVM) Regions

After introducing major changes in the Non-Volatile Memory (NVM) settings, Motorola Solutions recommends to synchronize NVM regions using the commands described below. Each physical NVM object has two copies of its contents called the **working region** and the **default region**. The working region is used for normal operation, while the default region is a backup from where the settings are recovered in a memory fault (incorrect checksum) detected in the working region.

Procedure:

To backup the current data from the working region and save it into the default region, use the following commands at the command prompt:

- `sfcp -ocontrol -sworking -ddefault`
- `sfcp -oex1 -sworking -ddefault`
- `sfcp -opa1 -sworking -ddefault`
- `sfcp -orxch1 -sworking -ddefault`

Chapter 7

Radio Frequency Distribution System

The Radio Frequency Distribution System (RFDS) distributes and manages the communications network frequencies and mitigates interference between multiple radios, allowing them to operate simultaneously. This results in improved radio reception performance across the frequency ranges where multiple transmitters are broadcasting.

7.1
RFDS Theory of Operation

The RFDS module is made up of the following subcomponents:

- Preselector (MTS LiTE, MTS 2, and MTS 4)
- Duplexer (MTS LiTE, MTS 2, and MTS 4)
- Cavity Combiners (MTS 4 and Expansion Cabinet)
- Hybrid Combiner (MTS 2, MTS 4 uses either HC or CC)
- Post Filter (MTS 4 only)
- RX Splitter (Expansion Cabinet only)

The RFDS module supports the combining and filtering of multiple Base Radio transmitters to one or more antenna outputs. The RFDS module supports up to triple receive diversity. Signals are filtered by either the Duplexer or the Preselector, then amplified and distributed by the integrated Receiver Multicoupler (RMC). In configurations with an Expansion Cabinet, the RX-splitter is used to distribute the received signal.

The RFDS also conditions the transmit and receive signal using filters. After combining the Base Radio transmitters in the Hybrid Combiner (or in the Cavity Combiner in the case of the MTS 4), the transmit signals are filtered in the transmit path of the Duplexer, which supplies the antenna connector on the cabinet.

MTS LiTE, MTS 2 and MTS 4, with or without Expansion Cabinet configuration, use different types of RFDS modules. The following are the distinct differences:

- MTS 2 supports Hybrid Combiners
- MTS 4 supports Cavity Combiners or Hybrid Combiners
- MTS LiTE/MTS 2 and MTS 4 do not use the same filters and mechanics for the filter tray
- MTS LiTE support one RF channel
- MTS 2 supports up to two RF channels
- MTS 4 supports up to four RF channels
- Expansion Cabinet supports eight RF channels (four in MTS 4 Prime Cabinet and four in MTS 4 Expansion Cabinet)

MTS 2 only has up to two carriers (the frequency that it sends out) and, as a result there are no Post Filters for a non-duplexed operation. A non-duplexed operation is achieved using a Duplexer as the Post Filter and not using the receive path of the Duplexer. This configuration does not allow room for a third Preselector inside the cabinet; however, it is possible to situate one outside the cabinet, for example, on the wall.

7.1.1
CAN Bus

The intercommunication between the RFDS units (the Duplexers, Post Filters, and Cavity Combiners) and the Site Controller is carried out through the CAN Bus at 125 kB/second. The connectors for the CAN Bus are RJ45 connectors. The CAN Bus is terminated at each end, either by the Site Controller or by an RJ45 terminator.

Each device is registered at the Site Controller (SC), which specifies the particular channel for each unit. Every 30 seconds, each unit on the CAN Bus transmits status and alarm information. Alarms are triggered when any thresholds are exceeded, (failure alarms, software revisions, and so on). The following common information is available from the CAN Bus: serial number, TrackID, software revisions, and the Motorola Solutions kit number. For each unit, specific information is available, for example, voltage standing wave ratio (VSWR) for DPMs and tuning information for Cavity Combiners.

The receive path of the Preselector or Duplexer is not connected to the CAN Bus. Because the supply voltage is supplied from the Base Radio, the Base Radio can withstand a short or 50 ohms connection to the RX input without the Base Radio or the Power Supply Unit (PSU) being damaged.

For more information on CAN Bus, see Site Controller CAN Bus on page 327.

7.1.2
RFDS Frequency Band and Bandwidth

The following table contains all the frequency bands available in MTS LiTE, MTS 2, and MTS 4.

Table 80: RFDS Frequency Bands and Bandwidth

Frequency Band	MTS Version	Filter Bandwidth	Duplex Spacing
350 MHz – 470 MHz	• MTS LiTE • MTS 2 • MTS 4	5 MHz	10 MHz
260 MHz – 275 MHz	• MTS 2 • MTS 4	6 MHz	9 MHz
851 MHz – 870 MHz	• MTS LiTE • MTS 2 • MTS 4	19 MHz	45 MHz

7.2
MTS LiTE and MTS 2 RFDS

In terms of RFDS, MTS 2 uses a low-power, cost effective RFDS placed on top of a card cage, intended for up to 2 Base Radios. For MTS LiTE, the RFDS is placed beside the card cage intended for only 1 Base Radio.

The RFDS in MTS LiTE and MTS 2 is made up of the following:

- One or two Preselectors with integrated high performance low noise amplifier (LNA). The supply voltage for the LNA is supplied through the RX out connected to the Base Radios. The Preselector has two outlets for two Base Radios. The dimensions of the filter are: 85 x 280 x 70 mm, excluding connectors. The antenna connectors are DIN 7–16, the receive side is connected with QMA connectors. See the block schematic of the MTS LiTE/MTS 2 Preselector in Figure 143: Schematic Diagram of MTS LiTE / MTS 2 Preselector on page 282.

NOTICE: MTS LiTE supports up to one Preselector.

- One or two Duplexers rated for up to two TETRA modulated carriers. The antenna connectors are DIN 7–16, the transmit side is connected with QN connectors. The Duplexer has an integrated digital VSWR meter. The supply voltage for the digital VSWR meter is supplied through the CAN Bus interface. The receive side has integrated LNA as for the Preselector and two RX outputs (QMA). The supply voltage for the LNA is supplied through the RX ports. The filter dimensions are approximately: 170 x 280 x 70 mm excluding connectors. See the block schematic of the MTS LiTE/MTS 2 Duplexer in Figure 145: Schematic Diagram of MTS LiTE / MTS 2 Duplexer on page 286.

  NOTICE:
  MTS LiTE supports one Duplexer.

  Because the MTS 2 has only up to two carriers, there is no need for Post Filters for non-duplexed operation (you can achieve non-duplexed operation by using the Duplexer as the Post Filter and not using the receive path of the Duplexer).

- Hybrid Combiner. MTS 2 can have either a Hybrid Combiner for transmission on one antenna, or without combining for transmission on two separate antennas.

MTS 2 is equipped with a digital voltage standing wave ratio (VSWR) monitor to ensure site availability at remote low-traffic sites and for public safety customers. The digital VSWR monitor can make a quite accurate VSWR reading because the measurement is relative between the forward and reverse power.

The VSWR monitor does not have the same accuracy in power reading as the digital power monitor (DPM) in the MTS 4, but it still allows a cost-effective monitoring of the integrity of the antenna.

7.2.1 MTS LiTE and MTS 2 Filter Tray

The MTS LiTE filter tray can carry one Duplexer and one Preselector or one Duplexer and no Preselector. The antenna connectors from the Duplexer extend from the MTS LiTE junction panel while antenna connection from the Preselector is connected via the use of cable. Antenna cables are connected directly onto the filters.

NOTICE:
In Table 81: MTS LiTE RF Configurations on page 277, Low Power is valid for 400 MHz, while High Power is valid for 400 MHz, 800MHz and 900 MHz. The numbers illustrated are applicable for TETRA.

The MTS 2 filter tray can carry up to two Duplexers and one Preselector or one Duplexer and two Preselectors. There is also room for a Hybrid Combiner. The antenna connectors extend from the MTS 2 junction panel and antenna cables are connected directly onto the filters.

NOTICE: In Table 82: MTS 2 RF Configurations on page 278, *Low Power* is valid for 400 MHz and 260 MHz, while *High Power* is valid for 400 MHz, 800MHz and 900 MHz. The numbers illustrated are applicable for TETRA with TEDS numbers within parentheses.

Table 81: MTS LiTE RF Configurations on page 277 lists all filters configurations for MTS LiTE and Figure 136: MTS LiTE TX/RX on 1 ant. - Filter Configuration on page 277 and Figure 137: MTS LiTE

TX/RX on 1 ant., RX on 1 ant - Filter Configuration on page 277 show the positions of filters in the filter tray.

Table 81: MTS LiTE RF Configurations

RF Configuration	Max Power [W]		Duplexer	Preselector
	Low Pwr	High Pwr		
TX/RX on 1 ant.	25	40	1	-
TX/RX on 1 ant., RX on 1 ant.	25	40	1	1

Figure 136: MTS LiTE TX/RX on 1 ant. - Filter Configuration

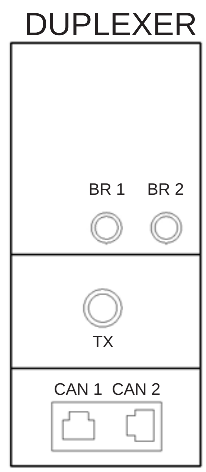


Figure 137: MTS LiTE TX/RX on 1 ant., RX on 1 ant - Filter Configuration

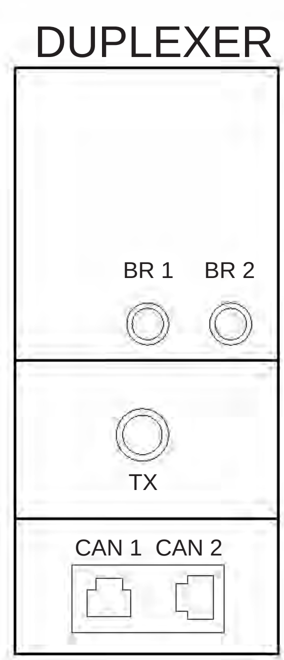


Table 82: MTS 2 RF Configurations on page 278 lists all filters configurations for MTS 2 and Figure 138: MTS 2 TX/RX on 2 ant. - Filter Configuration on page 278 to Figure 141: MTS 2 TX/RX on 1 ant., RX on 2 ant - Filter Configuration on page 280 show the positions of filters in the filter tray.

Table 82: MTS 2 RF Configurations

RF Configuration	Max Power [W]		Hybrid Combiner	Duplexer	Preselector
	Low Pwr	High Pwr			
TX/RX on 2 ant.	25	40 (20)	-	2	-
TX/RX on 2 ant., RX on 1 ant.	25	40 (20)	-	2	1
TX/RX on 1 ant., RX on 1 ant.	10	25 (10)	1	1	1
TX/RX on 1 ant., RX on 2 ant.	10	25 (10)	1	1	2

Figure 138: MTS 2 TX/RX on 2 ant. - Filter Configuration

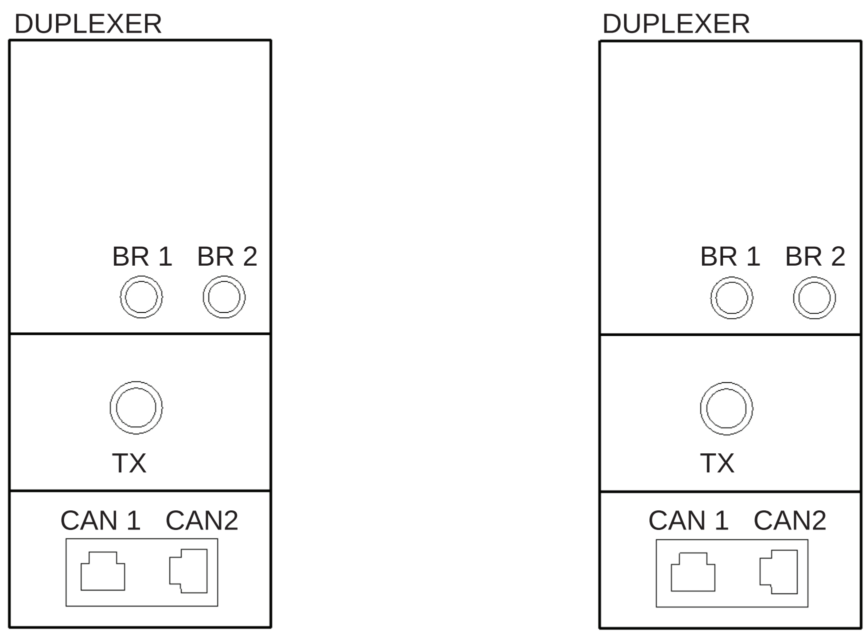


Figure 139: MTS 2 TX/RX on 2 ant., RX on 1 ant - Filter Configuration

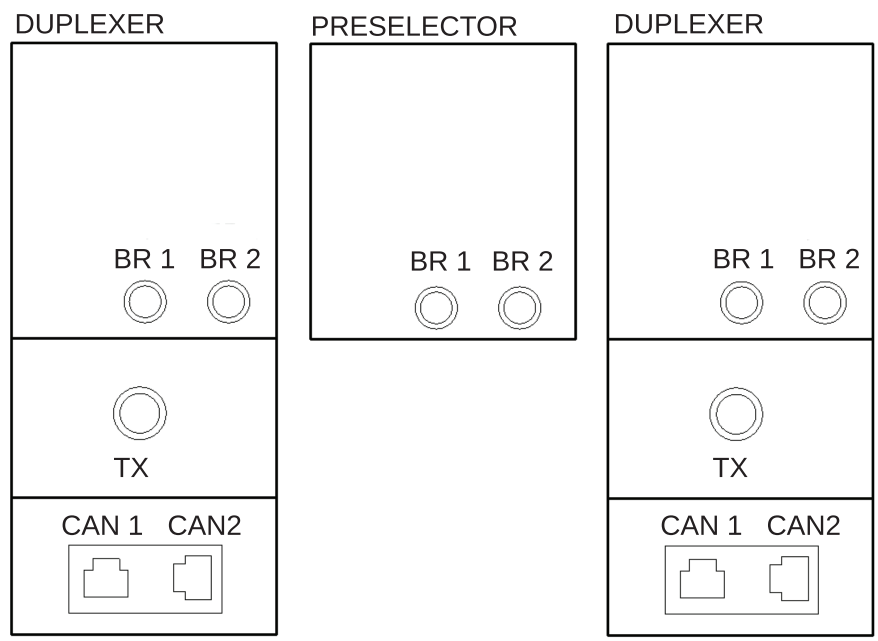


Figure 140: MTS 2 TX/RX on 1 ant., RX on 1 ant - Filter Configuration

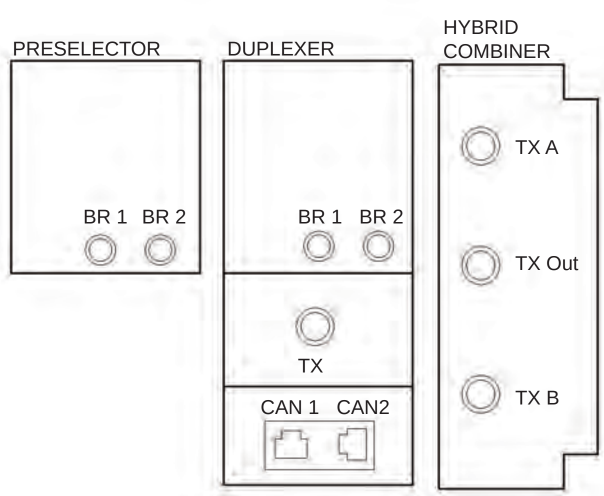
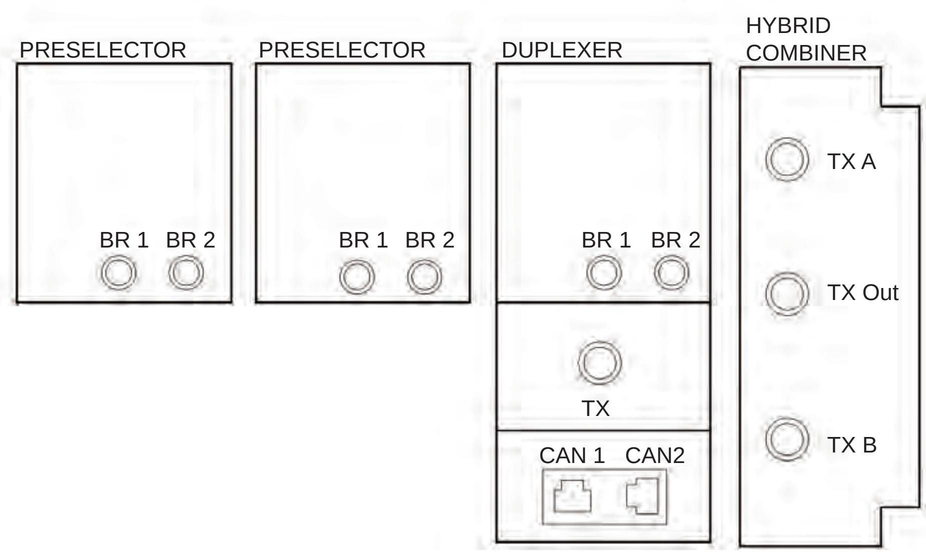


Figure 141: MTS 2 TX/RX on 1 ant., RX on 2 ant - Filter Configuration



7.2.2
MTS LiTE / MTS 2 Preselector

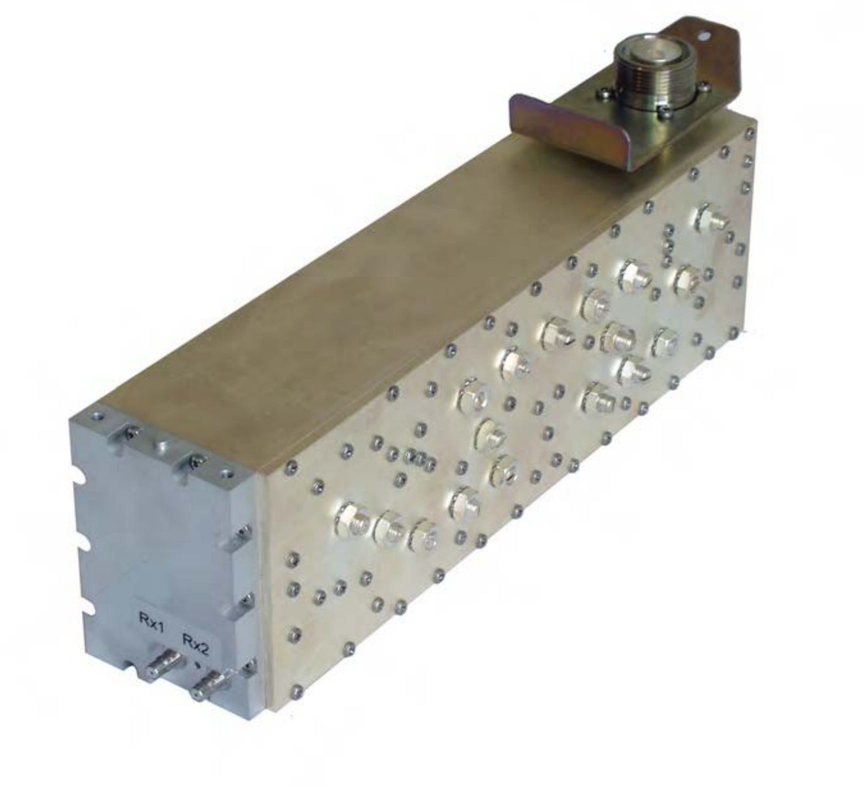
The MTS LiTE/MTS 2 Preselector is a bandpass filter, which only allows the receiver signals to pass. With a bandwidth of:

- 5 MHz for 400 MHz version
- 6 MHz for 260 MHz version (MTS 2 only)
- 19 MHz for 800 MHz version
- 5 MHz for 900 MHz version

The filters bandwidth is designed to block transmitter frequencies. The receive and transmit bandpass are 10 MHz apart for 400 MHz, 45 MHz apart for 800 MHz and 15 MHz apart for 900 MHz. The Preselector incorporates an LNA followed by an RMC.

NOTICE: The MTS LiTE Preselector FRU is common with the MTS 2 Preselector.

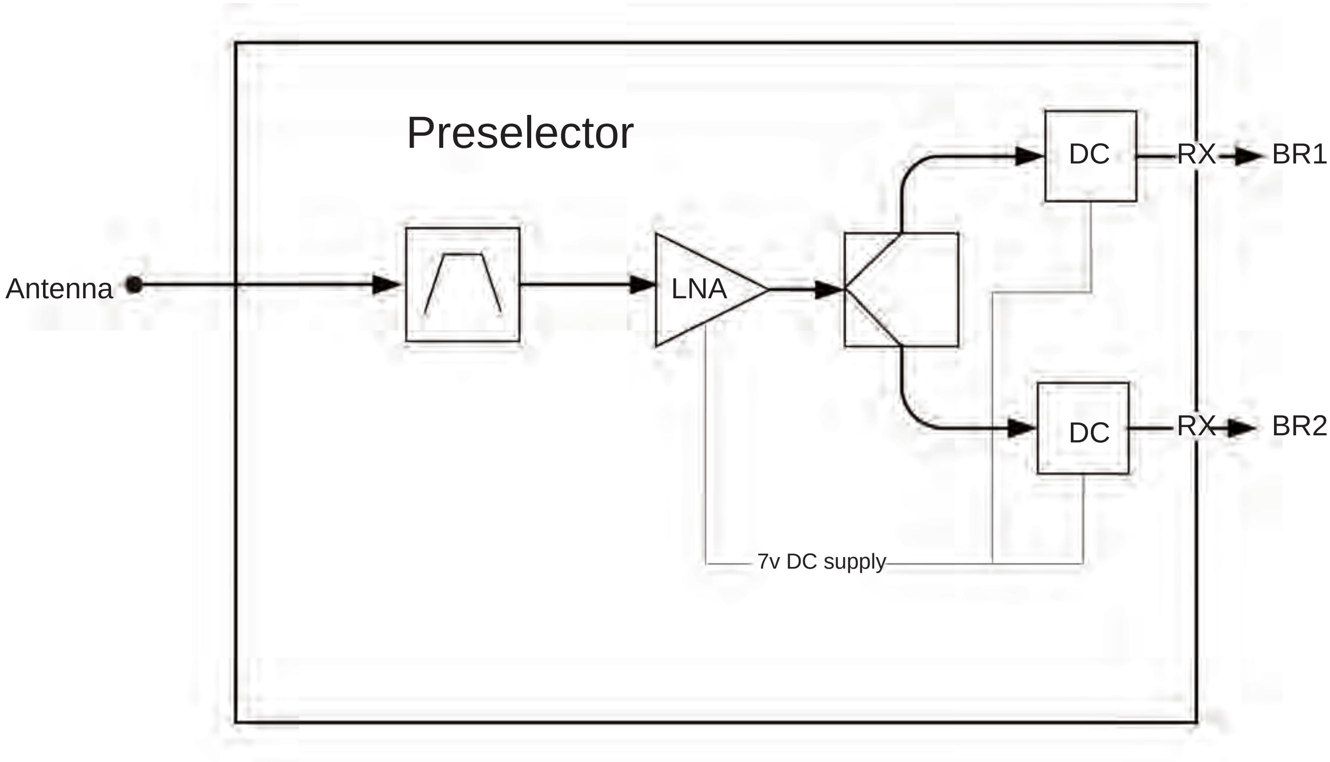
Figure 142: MTS LiTE / MTS 2 Preselector



NOTICE: Unused RX outputs should be terminated.

The MTS LiTE/MTS 2 Preselector only has two RX outputs and no expansion output. In MTS LiTE/MTS 2 the Preselector has an integrated high performance low noise amplifier (LNA). The supply voltage for the LNA is supplied through the RX out connected to the Base Radios. The Preselector has two outlets for two Base Radios. The antenna connectors are DIN 7–16, the receive side is connected with QMA connectors. See the block schematic of the MTS LiTE/MTS 2 Preselector in the following figure.

Figure 143: Schematic Diagram of MTS LiTE / MTS 2 Preselector



NOTICE: Unused RX outputs should be terminated.

7.2.2.1
Replacing the MTS LiTE / MTS 2 Preselector

For a list of available FRUs, see Field Replaceable Units (FRUs) on page 478.

Prerequisites:

WARNING: RF energy burn hazard. Disconnect power in the cabinet to prevent injury and equipment damage while disconnecting and connecting antennas.

Process:

1. Remove the Preselector, see Removing the Preselector – MTS LiTE on page 283 or Removing the Preselector – MTS 2 on page 283.
2. Reinstall the Preselector, see Reinstalling the Preselector – MTS LiTE on page 283 or Reinstalling the Preselector – MTS 2 on page 284.

7.2.2.1.1
Removing the Preselector – MTS LiTE

Procedure:

1. Remove the door of the cabinet completely.
2. Unscrew the antenna cable on the Preselector.
3. Remove the two fastening screws behind the antenna.
4. Loosen the two fastening screws at the front enough to free the center tab.

   CAUTION: Do not remove the screws entirely because the filter will drop.
5. Slide the Preselector out of the cabinet.
6. Remove all RX cable connections on the Preselector.
7. Remove and keep the RF Terminator from the BR2 connector.
8. Remove and keep the bracket at the front.

7.2.2.1.2
Removing the Preselector – MTS 2

Procedure:

1. Remove the door of the cabinet completely.
2. Unscrew the antenna cable. Remove all RX cables connected to the Preselector.
3. Remove the fastening screw behind the antenna.
4. Loosen the two fastening screws at the front enough to free the center tab.

   CAUTION: Do not remove the screws entirely because the filter will drop.
5. Slide the Preselector out of the cabinet.

7.2.2.1.3
Reinstalling the Preselector – MTS LiTE

Procedure:

1. Assemble the rear bracket at the Preselector.
2. Assemble the front bracket at the antenna connector with a screw.
3. Connect the RF Terminator to the BR2 output of the Preselector.
4. Connect the RX cable to the BR1 connector of the Preselector.
5. Slide the Preselector into the filter tray in the cabinet.
6. While supporting the Preselector fasten the screws at the front bracket.
7. Attach the RF cable on the Preselector antenna connector.
8. Switch ON the Power Supply Unit.

7.2.2.1.4
Reinstalling the Preselector – MTS 2

Procedure:

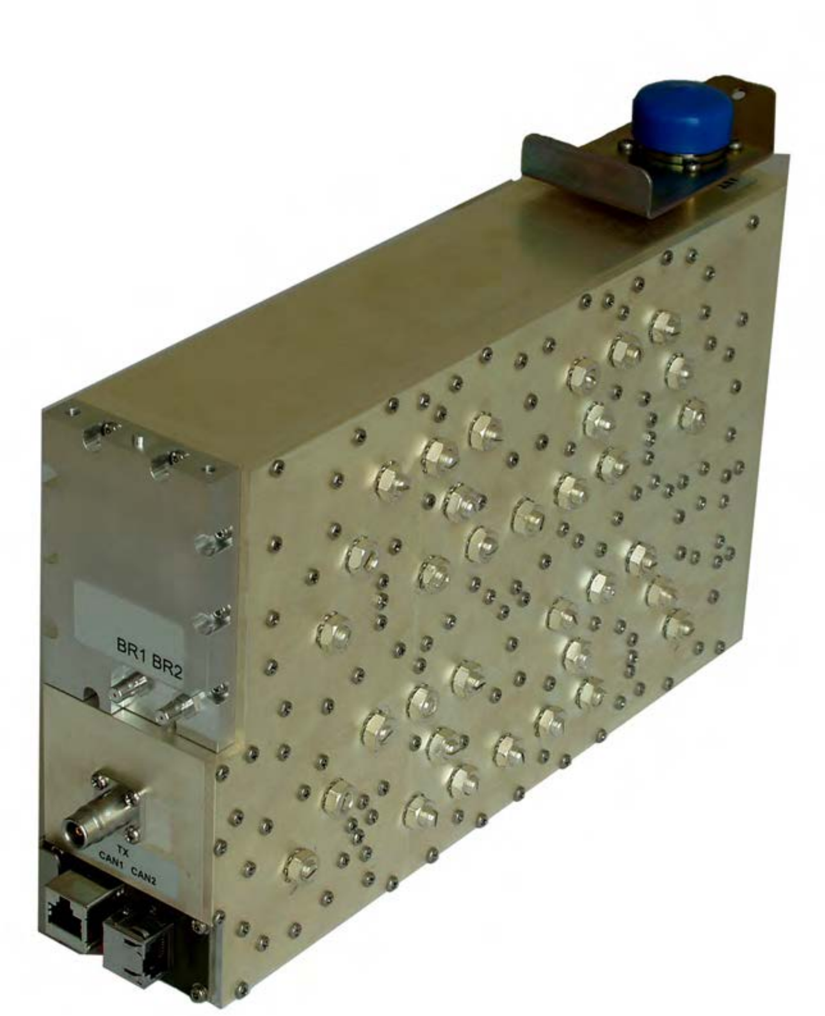
1. Slide the Preselector into the filter tray in the cabinet. Make sure the rear center tab fits into the appropriate slot.
2. While supporting the Preselector fasten the two screws at the front.
3. Fasten the screw in the center tab behind the antenna.
4. Attach all RX, TX and signal cables to the Preselector. Fasten the antenna cable.
5. Switch ON the Power Supply Unit.

7.2.3
MTS LiTE / MTS 2 Duplexer

The Duplexer is a Preselector with Integrated Receiver Multicoupler (RMC) and a Post Filter with a digital power monitor (DPM) combined into one unit. These form the two bandpass filters that make up the Duplexer; one is a receive filter and the other a transmit filter.

NOTICE: The MTS LiTE Duplexer is common with the MTS 2 Duplexer.

Figure 144: MTS 2 Duplexer



NOTICE: Unused RX outputs should be terminated.

The duplex spacing between a transmit frequency and the corresponding receive frequency is 10 MHz, with the transmit frequency highest. This leaves a 5 MHz spacing between the lowest possible transmit frequency and the highest possible receive frequency.

For MTS 2 260 MHz, the duplex spacing between a transmit frequency and the corresponding receive frequency is 9 MHz, and leaves a 3 MHz spacing between the lowest possible transmit frequency and the highest possible receive frequency.

For 800 MHz, the duplex spacing between a transmit frequency and the corresponding receive frequency is 45 MHz, and leaves a 19 MHz spacing between the lowest possible transmit frequency and the highest possible receive frequency in each duplexer.

For 900 MHz, the duplex spacing between a transmit frequency and the corresponding receive frequency is 15 MHz, and leaves a 10 MHz spacing between the lowest possible transmit frequency and the highest possible receive frequency.

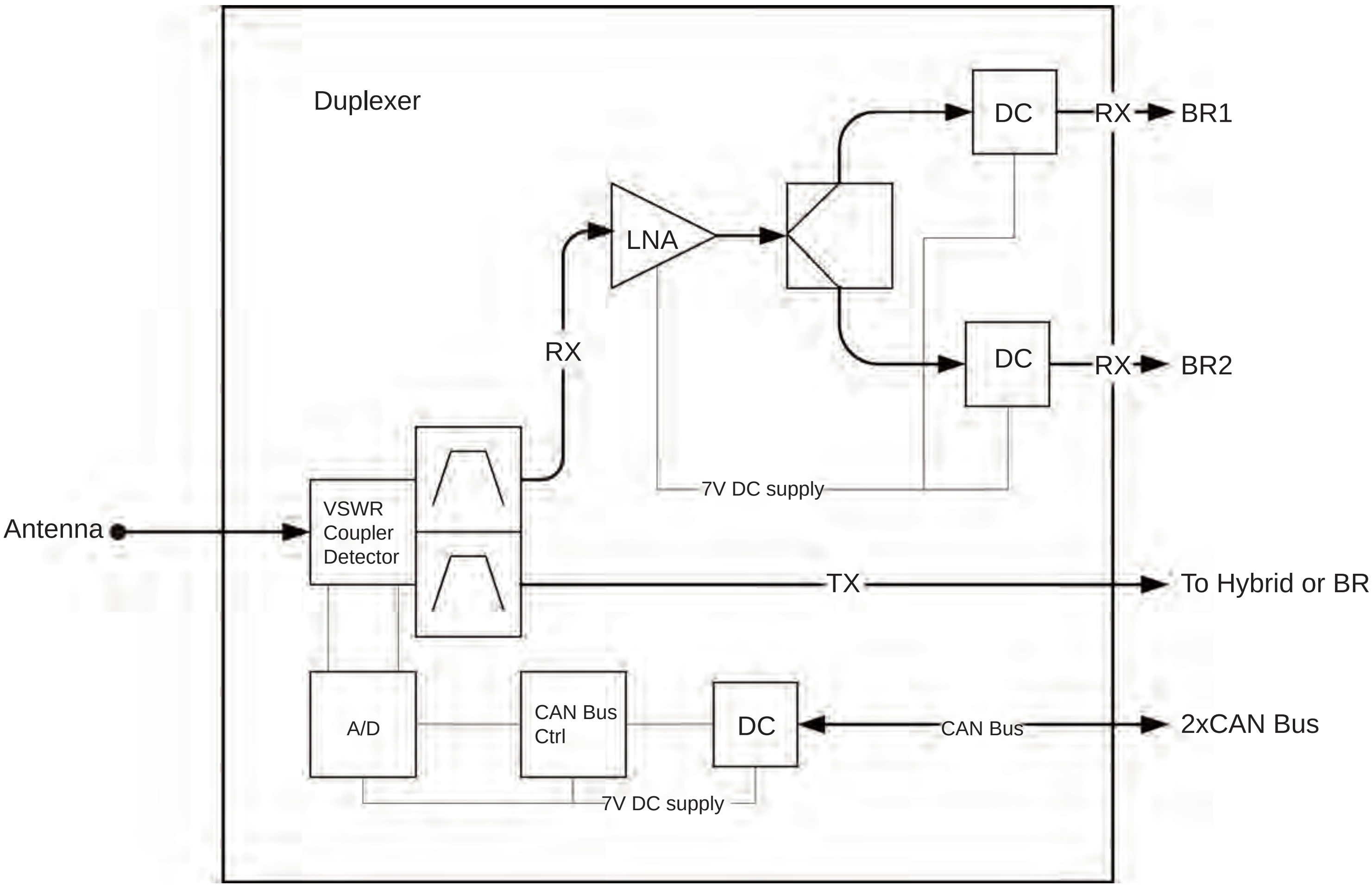
The MTS LiTE/MTS 2 Duplexer has 2 RX outputs and can handle a maximum power of 60 watts.

NOTICE: Unused RX outputs should be terminated.

The receiver LNA and splitter provides multiple receive signal ports. An amplified output is provided for connection to the other cabinet in an expansion configuration.

The digital power monitor (DPM) is a directional coupler that measures forward and reverse Power. Power and VSWR information can be read through the CAN bus.

Figure 145: Schematic Diagram of MTS LiTE / MTS 2 Duplexer



NOTICE: Unused RX outputs should be terminated.

7.2.3.1
Replacing the MTS LiTE / MTS 2 Duplexer

For a list of available FRUs, see Field Replaceable Units (FRUs) on page 478.

Process:

1 Remove the Duplexer, see Removing the MTS LiTE / MTS 2 Duplexer on page 287.

2 Insert the Duplexer into the filter tray, see Inserting the MTS LiTE / MTS 2 Duplexer into the Filter Tray on page 287.

3 Update the mapping list with the new unit TrackID, see Updating the Mapping List with the New Unit TrackID on page 287.

7.2.3.1.1

Removing the MTS LiTE / MTS 2 Duplexer

WARNING: RF energy hazard and potential equipment damage precaution: Turn off all power to the Power Supply Unit before performing the following procedures to prevent accidental contact with high energy and injury to personnel.

Procedure:

1. Switch OFF the Power Supply Unit.
2. Unscrew the antenna cable. Remove all RX, TX and signal cables connected to the Duplexer.
3. Remove the fastening screw behind the antenna.
4. Loosen the two fastening screws at the front enough to free the center tab.

   CAUTION: Do not remove the screws entirely because the filter will drop.
5. Slide the Duplexer out of the cabinet.

7.2.3.1.2

Reinstalling the MTS LiTE / MTS 2 Duplexer

Procedure:

1. Insert the Duplexer into the filter tray.

   See Inserting the MTS LiTE / MTS 2 Duplexer into the Filter Tray on page 287.
2. Update the mapping list with the new unit TrackID.

   See Updating the Mapping List with the New Unit TrackID on page 287.

7.2.3.1.3

Inserting the MTS LiTE / MTS 2 Duplexer into the Filter Tray

Procedure:

1. Slide the Duplexer into the filter tray in the cabinet. Make sure the rear center tab fits in the appropriate slot.
2. While supporting the Duplexer fasten the two screws at the front.
3. Fasten screw in the center tab behind the antenna.
4. Attach all RX, TX and signal cables to be connected to the Duplexer. Fasten the antenna cable.
5. Switch ON the Power Supply Unit.

7.2.3.1.4

Updating the Mapping List with the New Unit TrackID

Procedure:

1. Log on to the Site Controller.
2. View the mapping list by entering: `can check_mapping`.

   Step example:

   ```
   Units are present:
   Device Track ID
   DPM 1 JTH0500101
   PSU 1 JTH0500200
   ```

```
Units are not present:
DPM 2 JTH0500105
Track ID not mapped:
JTH0500102
```

3. On the mapping list, locate the removed unit indicated as `Units are not present`.
4. Delete the old CAN Bus unit from the CAN Bus unit mapping list by entering: `can remove_mapping` ***<X>***.

   <X> identifies the old unit name and is digit between 0 and 3.

   Step example: `can remove_mapping dpm 2`.
5. Add the new CAN Bus unit to the CAN Bus unit mapping list by entering: `add_mapping dpm`***<X><track ID>***.

   <track ID> is a Track ID of the new unit.

   <X> identifies the new unit name and is a digit between 0 and 3.

   NOTICE: The new unit Track ID is present on the replaced unit label and indicated as `Track ID not mapped`.

   Step example: `can add_mapping dpm 2 JTH0500102`
6. View the updated mapping list by entering: `can check_mapping`.
7. On the mapping list, check that there are no units labeled as `Track ID not mapped` or `Units are not present`.

7.2.4
Hybrid Combiner

The Hybrid Combiner is a part of the transmitter path in the RF Distribution System. The Hybrid Combiner provides very reliable combining of up to two transmitters. The Hybrid Combiner has no limitations in respect to channel spacing of the TX channels; however, for frequency planning and interference reasons, at least 50 kHz is recommended.

Figure 146: Hybrid Combiner

The TX signals from two Base Radios are attached to the respective Hybrid Combiner inputs. The combined signal at the Hybrid Combiner out port is then applied to the Duplexer.

The Hybrid Combiner contains one printed circuit board.

7.2.4.1 Replacing the Hybrid Combiner

Process:

1. Remove the Hybrid Combiner.

   See Removing the Hybrid Combiner on page 289.
2. Reinstall the Hybrid Combiner.

   See Reinstalling the Hybrid Combiner on page 290.

7.2.4.1.1 Removing the Hybrid Combiner

Procedure:

1. **WARNING:** RF energy hazard and potential equipment damage.

   Switch OFF the Power Supply Unit to prevent accidental contact with high energy and injury to personnel.

2. **WARNING:** The Hybrid Combiner may be hot.

   To avoid injury, allow the Hybrid Combiner to cool down before servicing.
3. Remove the TX and antenna cables.
4. Loosen the two screws that secure the Hybrid Combiner onto the bracket.
5. Slide the Hybrid Combiner forward and pull free from the screws. Slide it out from the bracket.

7.2.4.1.2
Reinstalling the Hybrid Combiner

Procedure:

1. Place the Hybrid Combiner on the bracket of the cabinet with the heat sink facing the side of the cabinet.

   NOTICE: In the MTS 2, the heat sink should face inwards towards the center of the cabinet.
2. Slide in the Hybrid Combiner at an angle.
3. Secure the lip at the back of the Hybrid Combiner behind the bracket.
4. Fasten the screws to the bracket.
5. Attach the TX and antenna cables.
6. Switch ON the Power Supply Unit.

7.3
MTS 4 RFDS

The MTS 4 uses a high-power RFDS intended for up to 4 high power Base Radios. The RFDS in MTS 4 is made up of the following:

- Up to three Preselectors low-loss Preselectors with integrated high performance LNA and RMC. The supply voltage for the LNA is supplied through the RX out connected to the Base Radios. The Preselectors have outputs for four Base Radios. Dimensions of the filter are 90 x 180 x 200 mm excluding connectors. The antenna connectors are DIN 7–16. The RX signals from Base Radios are connected with QMA connectors.
- Up to two Post Filters low-loss Post Filters rated for up to 8 TETRA modulated carriers. The antenna connectors are DIN 7–16, the TX signals to Cavity Combiners are connected with QN connectors.
- Up to two Duplexers Preselectors with an integrated receiver multicoupler (RMC) and a Post Filter with a digital power monitor (DPM) combined into one unit. Duplexer is rated for up to four TETRA modulated carriers. The antenna connectors are DIN 7–16, the transmit site is connected with QN connectors. The receive side has integrated LNA as for the Preselector and four RX outputs (QMA). The supply voltage for the LNA is supplied through the RX ports.
- Hybrid Combiner – combining of four carriers on 2 TX antennas. Cavity Combiners - combining of four carriers on 1 TX antenna.

MTS 4 is equipped with a digital power monitor to ensure diagnostic availability. The digital interface has the same benefits as described for the MTS 2 digital VSWR monitor.

7.3.1
MTS 4 Filter Tray

The MTS 4 filter tray can carry different filter configurations. The antenna connectors extend from the cabinet top cover and antenna cables connect directly onto the filters.

The following table lists all configurations for MTS 4.

NOTICE: The numbers illustrated are applicable for TETRA with TEDS numbers within parentheses.
Low Power is valid for 400 MHz and 260 MHz, while High Power is valid for both 400 MHz and 800 MHz.

Table 83: MTS 4 RF Configurations

RF Configuration	Max Power [W]		Cavity Combin-er	Duplex-er	Pre se-lector	Post Filter
	Low Pwr	High Pwr				
1 - 2 BRs						
TX/RX on 2 ant.	25	40 (20)	-	2	-	-
TX/RX on 2 ant., RX on 1 ant.	25	40 (20)	-	2	1	-
TX on 2 ant., RX on 2 ant.	25	40 (20)	-	-	2	2
TX on 2 ant., RX on 3 ant.	25	40 (20)	-	-	3	2
TX/RX on 1 ant., RX on 1 ant.	10	25 (10)	1	1	1	-
TX/RX on 1 ant., RX on 2 ant.	10	25 (10)	1	1	2	-
TX on 1 ant., RX on 2 ant.	10	25 (10)	1	-	2	1
TX on 1 ant., RX on 3 ant.	10	25 (10)	1	-	3	1
3 - 4 BRs						
TX/RX on 2 ant.	10	25 (10)	2	2	-	-
TX/RX on 2 ant., RX on 1 ant.	10	25 (10)	2	2	1	-
TX on 2 ant., RX on 2 ant.	10	25 (10)	2	-	2	2
TX on 2 ant., RX on 3 ant.	10	25 (10)	2	-	3	2
TX/RX on 1 ant., RX on 1 ant.	10	25 (10)	2 (comb)	1	1	-

RF Configuration	Max Power [W]		Cavity Combiner	Duplexer	Pre selector	Post Filter
	Low Pwr	High Pwr				
TX/RX on 1 ant., RX on 2 ant.	10	25 (10)	2 (comb)	1	2	-
TX on 1 ant., RX on 2 ant.	10	25 (10)	2 (comb)	-	2	1
TX on 1 ant., RX on 3 ant.	10	25 (10)	2 (comb)	-	3	1

The following figures show the positions of filters in the filter tray.

Figure 147: MTS 4 TX/RX on one Antenna and up to two RX Antennas Filter Configuration

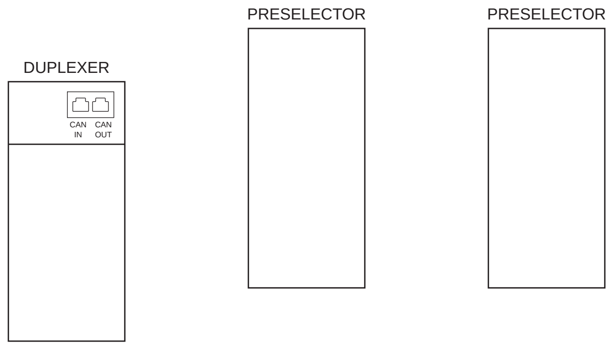


Figure 148: MTS 4 TX/RX on two Antennas and up to one RX Antenna Filter Configuration

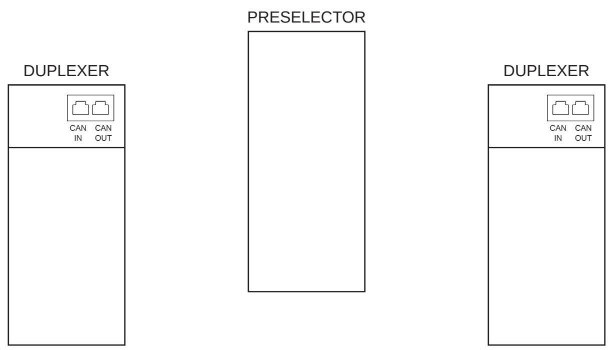


Figure 149: MTS 4 TX on one Antenna and up to three RX Antennas Filter Configuration

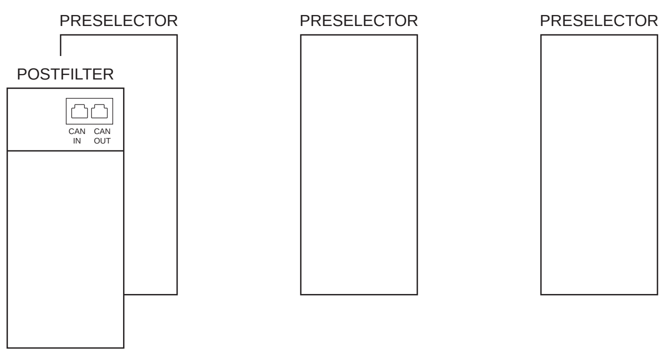


Figure 150: MTS 4 TX on one Antenna and two RX Antennas Filter Configuration

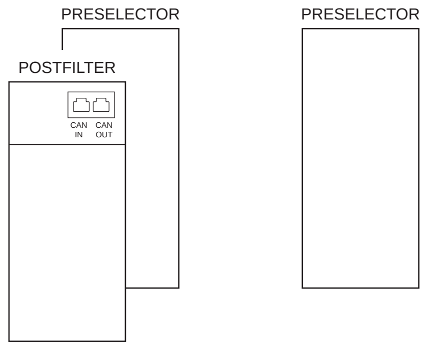
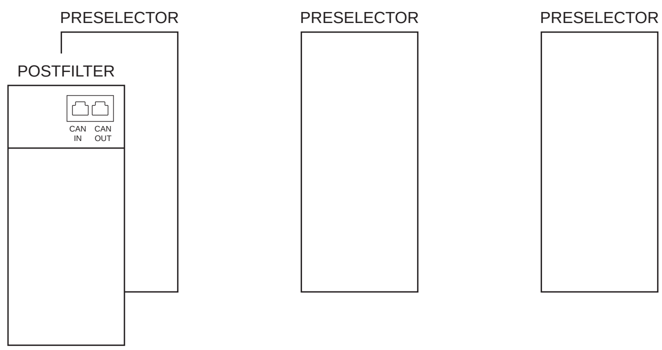


Figure 151: MTS 4 TX on one Antenna and three RX Antennas Filter Configuration



7.3.2

MTS 4 Preselector

The MTS 4 Preselector is a bandpass filter, which only allows the receiver signals to pass.

MTS 4 Preselector bandwidth is:

- 5 MHz for 400 MHz version
- 6 MHz for 260 MHz version
- 19 MHz for 800 MHz version

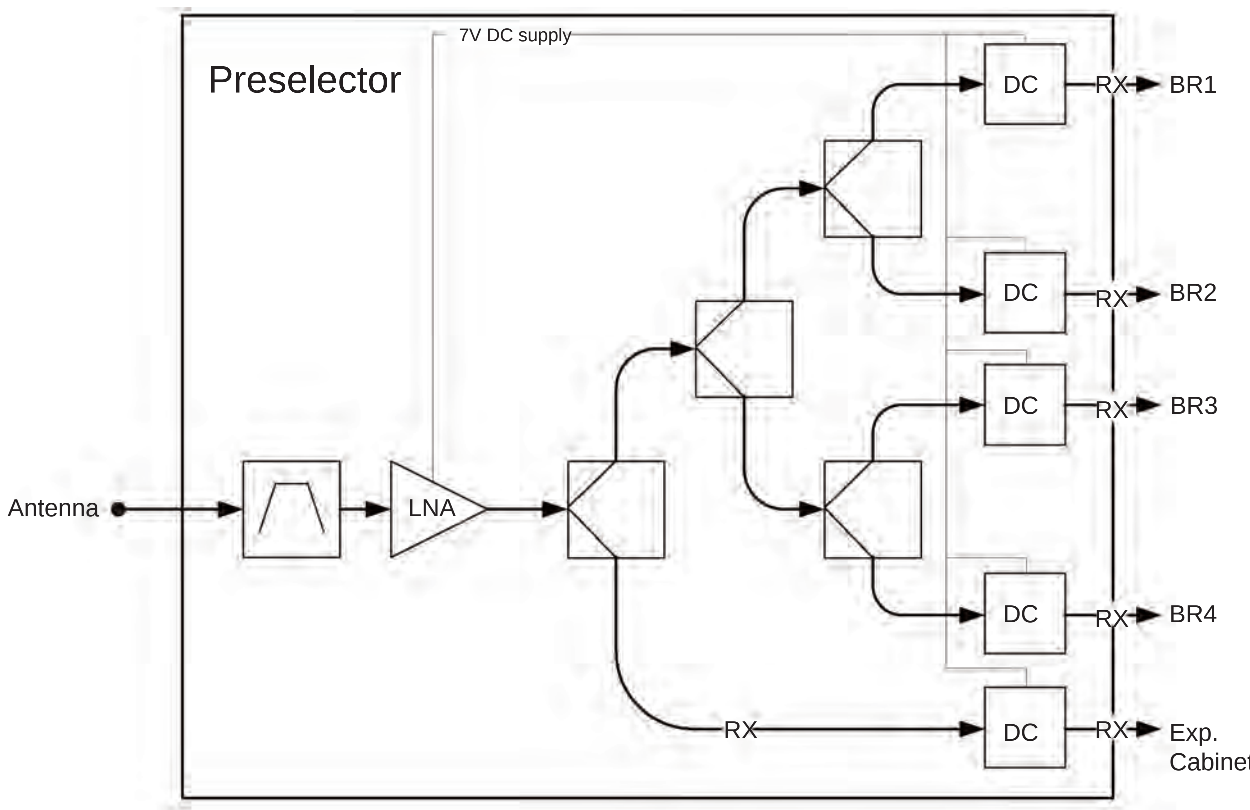
The filter's bandwidth is designed to block transmitter frequencies. The receive and transmit bandpass are 10 MHz apart for 400 MHz, 9 MHz apart for 260 MHz, and 45 MHz apart for 800 MHz. The Preselector incorporates an LNA followed by an RMC.

The MTS 4 Preselector has four RX outputs and one expansion output.

Figure 152: MTS 4 Preselector

In the MTS 4, the Preselector has an integrated high performance LNA and RMC. The supply voltage for the LNA is supplied through the RX out connected to the Base Radios. The Preselector has outputs for four Base Radios The antenna connector is DIN 7–16. The receive side is connected by QMA connectors.

Figure 153: Schematic Diagram of MTS 4 Preselector



7.3.2.1
Replacing the MTS 4 Preselector

WARNING: RF energy burn hazard. Disconnect power in the cabinet to prevent injury and equipment damage while disconnecting and connecting antennas.

Process:

1. Remove the Preselector.

   See Removing the MTS 4 Preselector on page 295.
2. Reinstall the Preselector.

   See Reinstalling the MTS 4 Preselector on page 296.

7.3.2.1.1
Removing the MTS 4 Preselector

Procedure:

1. Remove the door of the cabinet completely.
2. Remove the four screws holding the front panel.
3. Loosen the two screws holding the front section of the top panel and slide off the panel.
4. Loosen the screws fastening the rear section of the top panel and slide off the panel.
5. Unscrew the antenna cable and remove the RX cables connected to the back of the Preselector.

6. Loosen the two fastening screws at the front enough to free the mounting bracket.
7. Slide the Preselector out of the cabinet.
8. Remove the Preselector from the bracket and replace with the new unit.

7.3.2.1.2 Reinstalling the MTS 4 Preselector

Procedure:

1. Fasten the Preselector onto the bracket.
2. Slide the Preselector into the cabinet.
3. Tighten the two fastening screws at the front.
4. Screw on the antenna cable and connect the RX cables to the back of the Preselector.
5. Slide on the top rear and front panels and fasten these with screws.
6. Put the front panel back on and screw this into place.
7. Put the door of the cabinet back on.

7.3.3 MTS 4 Duplexer

The Duplexer is a Preselector with an integrated receiver multicoupler (RMC) and a Post Filter with a digital power monitor (DPM) combined into one unit. These form the two bandpass filters that make up the Duplexer; one is a receive filter and the other a transmit filter. See the block schematic of the MTS 4 Duplexer in Figure 155: Schematic Diagram of MTS 4 Duplexer on page 298

For 400 MHz, the duplex spacing between a transmitter frequency and the corresponding receive frequency is 10 MHz, with the transmitter frequency highest. This leaves a 5 MHz spacing between the lowest possible transmit frequency and the highest possible receive frequency.

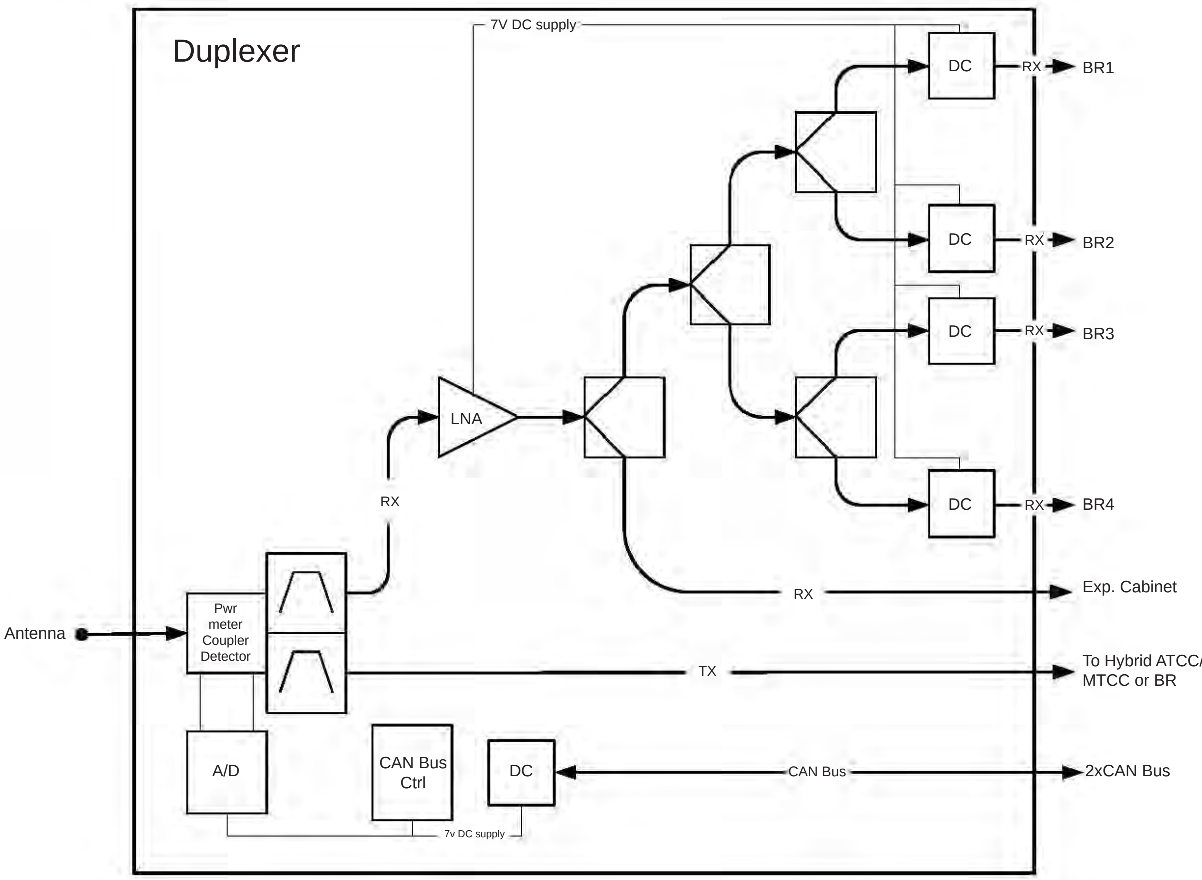
For 260 MHz, the duplex spacing between a transmit frequency and the corresponding receive frequency is 9 MHz, and leaves a 3 MHz spacing between the lowest possible transmit frequency and the highest possible receive frequency.

For 800 MHz, the duplex spacing between a transmit frequency and the corresponding receive frequency is 45 MHz, and leaves a 19 MHz spacing between the lowest possible transmit frequency and the highest possible receive frequency.

The MTS 4 Duplexer has 4 RX outputs and one expansion output. It can handle a maximum power 180 Watts.

Figure 154: MTS 4 Duplexer

Figure 155: Schematic Diagram of MTS 4 Duplexer



7.3.3.1
Replacing the MTS 4 Duplexer

Process:

1 Remove the Duplexer.

See Removing the MTS 4 Duplexer on page 298.

2 Insert the Duplexer into the filter tray.

See Inserting the MTS 4 Duplexer into the Cabinet on page 299.

3 Update the mapping list with the new unit TrackID.

See Updating the Mapping List with the New Unit TrackID on page 299.

7.3.3.1.1
Removing the MTS 4 Duplexer

Procedure:

1 **WARNING:** RF energy hazard and potential equipment damage precaution.

To prevent accidental contact with high energy and injury to personnel, switch ff all power to the Power Supply Unit.

2 Remove the four screws holding the front panel.
3 Loosen the two screws holding the front section of the top panel and slide off the panel.
4 Loosen the screws fastening the rear section of the top panel and slide off the panel.
5 Unscrew the antenna cable and remove the RX, TX and signal cables.
6 Loosen the two fastening screws at the front enough to free the mounting bracket.
7 Slide the Duplexer out of the cabinet.
8 Remove the Duplexer from the bracket and replace.

7.3.3.1.2
Reinstalling the MTS 4 Duplexer

Procedure:

1 Insert the Duplexer into the cabinet.
   See Inserting the MTS 4 Duplexer into the Cabinet on page 299.
2 Update the mapping list with the new unit TrackID.
   See Updating the Mapping List with the New Unit TrackID on page 299.

7.3.3.1.3
Inserting the MTS 4 Duplexer into the Cabinet

Procedure:

1 Fasten the Duplexer onto the bracket with screws.
2 Slide the Duplexer into the cabinet.
3 Tighten the two fastening screws at the front to secure the mounting bracket
4 Attach the antenna cable and the RX, TX and signal cables.
5 Slide on the top rear and front panels and fasten these with screws.
6 Put the front panel back on and screw this into place.
7 Put the door of the cabinet back on.

7.3.3.1.4
Updating the Mapping List with the New Unit TrackID

Procedure:

1 Log on to the Site Controller.
2 View the mapping list by entering: `can check_mapping`.

   Step example:

```
Units are present:
Device Track ID
DPM 1 JTH0500101
PSU 1 JTH0500200
Units are not present:
DPM 2 JTH0500105
Track ID not mapped:
JTH0500102
```

3 On the mapping list, locate the removed unit indicated as `Units are not present`.

4 Delete the old CAN Bus unit from the CAN Bus unit mapping list by entering: `can remove_mapping` ***<X>***.

<X> identifies the old unit name and is digit between 0 and 3.

Step example: `can remove_mapping dpm 2`.

5 Add the new CAN Bus unit to the CAN Bus unit mapping list by entering: `add_mapping dpm`***<X><track ID>***.

<track ID> is a Track ID of the new unit.

<X> identifies the new unit name and is a digit between 0 and 3.

NOTICE: The new unit Track ID is present on the replaced unit label and indicated as `Track ID not mapped`.

Step example: `can add_mapping dpm 2 JTH0500102`

6 View the updated mapping list by entering: `can check_mapping`.

7 On the mapping list, check that there are no units labeled as `Track ID not mapped` or `Units are not present`.

7.3.4 Hybrid Combiner in MTS 4

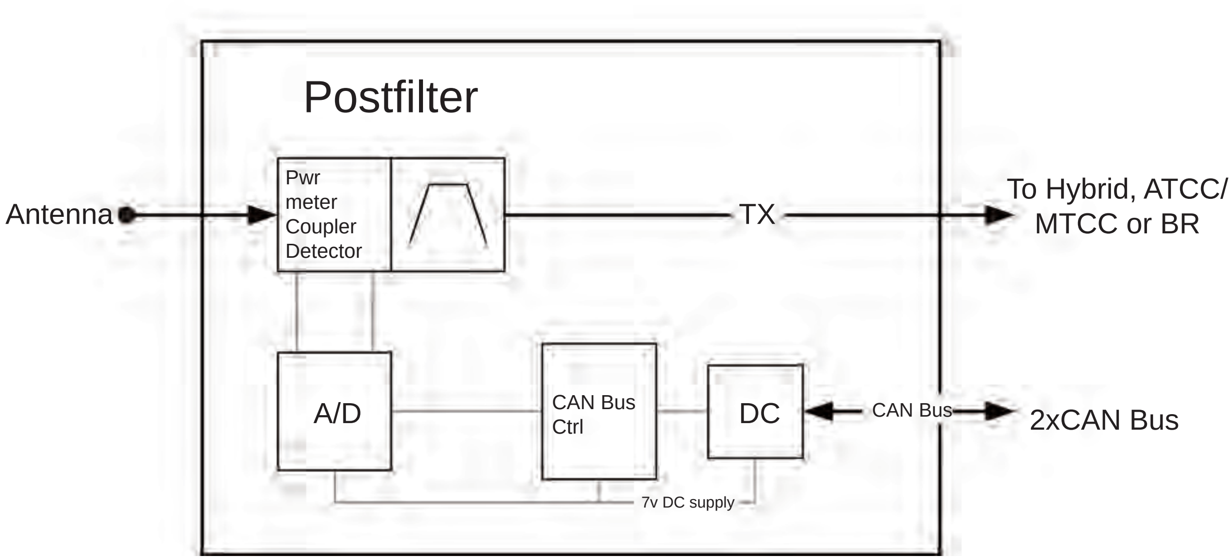
For details about the Hybrid Combiner (HC), see Hybrid Combiner on page 288.

7.3.5 Post Filter

The Post Filter supports non-duplexed configurations. The Post Filter incorporates a DPM. A Post Filter is only available for the MTS 4 because the MTS 2 does not support non-duplexed configurations. The bandwidth is 5 MHz on 400 MHz, 6 MHz on 260 MHz, and 19 MHz on 800 MHz.

Figure 156: Post Filter

Figure 157: Schematic Diagram of Post Filter



7.3.5.1
Replacing the Post Filter

For a list of available FRUs, see Field Replaceable Units (FRUs) on page 478.

Process:

1. Remove the Post Filter, see Removing the Post Filter on page 302.
2. Install the Post Filter into the cabinet, see Inserting the Post Filter into the Cabinet on page 303.
3. Update the mapping list with the new unit TrackID, see Updating the Mapping List with the New Unit TrackID on page 303.

7.3.5.1.1
Removing the Post Filter

Procedure:

1. **WARNING:** RF energy hazard and potential equipment damage precaution.

   To prevent accidental contact with high energy and injury to personnel, switch off the Power Supply Unit.
2. Remove the four screws holding the front panel.
3. Loosen the two screws holding the front section of the top panel and slide off the panel.
4. Loosen the screws fastening the rear section of the top panel and slide off the panel.

5 Unscrew the antenna cable and remove the TX and signal cables.

6 Loosen the two fastening screws at the front enough to free the mounting bracket.

NOTICE: If a Preselector is mounted on the same bracket, remove the Preselector to slide out the filter bracket. See Removing the MTS 4 Preselector on page 295.

7 Slide the Post Filter out of the cabinet.

8 Remove the Post Filter from the bracket and replace with the new unit.

7.3.5.1.2
Reinstalling the Post Filter

Procedure:

1 Insert the Post Filter into the cabinet.

See Inserting the Post Filter into the Cabinet on page 303.

2 Update the mapping list with the new unit TrackID.

See Updating the Mapping List with the New Unit TrackID on page 303.

7.3.5.1.3
Inserting the Post Filter into the Cabinet

Procedure:

1 Fasten the Post Filter onto the bracket with screws.

2 Slide the Post Filter into the cabinet.

3 Tighten the two fastening screws at the front to secure the mounting bracket.

4 Attach the antenna and the TX and signal cables.

5 Slide on the top rear and front panels and fasten these with screws.

6 Put the front panel back on and screw this into place.

7 Put the door of the cabinet back on.

7.3.5.1.4
Updating the Mapping List with the New Unit TrackID

Procedure:

1 Log on to the Site Controller.

2 View the mapping list by entering: `can check_mapping`.

Step example:

```
Units are present:
Device Track ID
DPM 1 JTH0500101
PSU 1 JTH0500200
Units are not present:
DPM 2 JTH0500105
Track ID not mapped:
JTH0500102
```

3 On the mapping list, locate the removed unit indicated as `Units are not present`.

4 Delete the old CAN Bus unit from the CAN Bus unit mapping list by entering: `can remove_mapping` ***<X>***.

<X> identifies the old unit name and is digit between 0 and 3.

Step example: `can remove_mapping dpm 2`.

5 Add the new CAN Bus unit to the CAN Bus unit mapping list by entering: `add_mapping dpm`***<X><track ID>***.

<track ID> is a Track ID of the new unit.

<X> identifies the new unit name and is a digit between 0 and 3.

NOTICE: The new unit Track ID is present on the replaced unit label and indicated as `Track ID not mapped`.

Step example: `can add_mapping dpm 2 JTH0500102`

6 View the updated mapping list by entering: `can check_mapping`.

7 On the mapping list, check that there are no units labeled as `Track ID not mapped` or `Units are not present`.

7.3.6
Cavity Combiner

NOTICE: MTS 2 does not support Cavity Combiners.

There are two types of Cavity Combiners available:

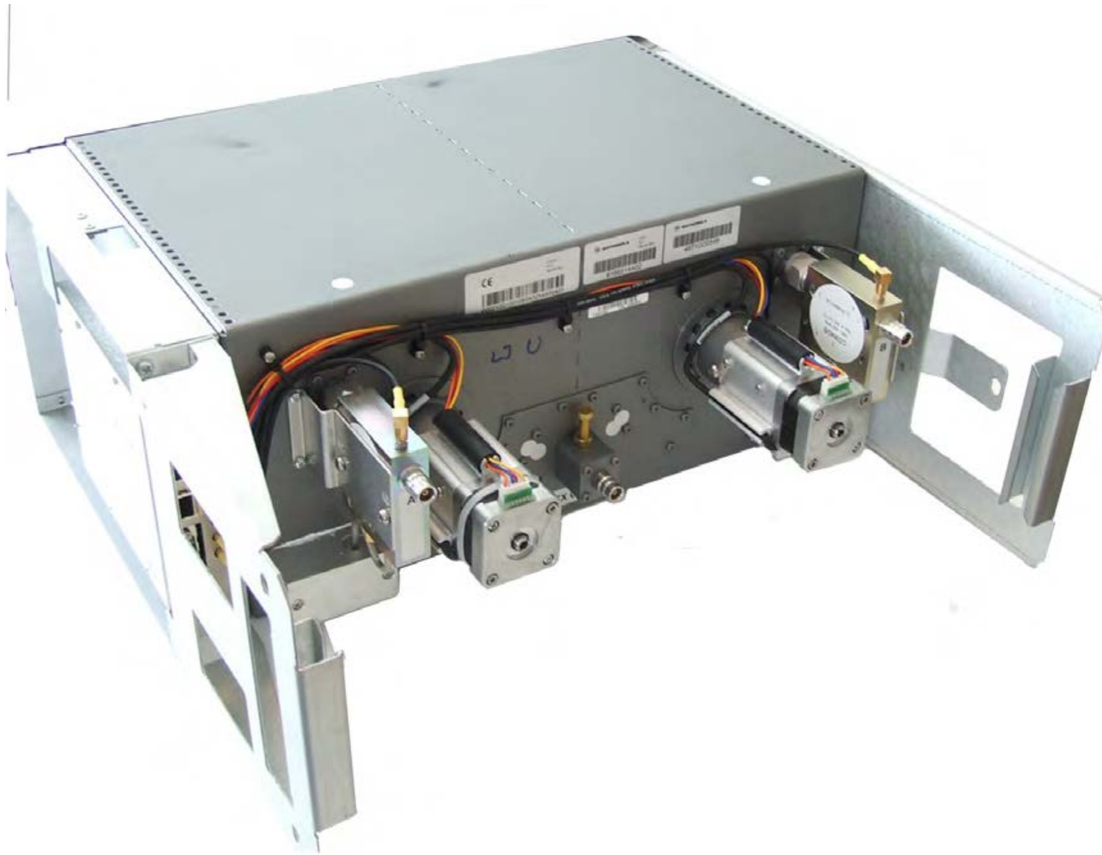
- Auto Tune Cavity Combiners (ATCC)
- Manual Tune Cavity Combiners (MTCC)

  MTCCs are functionally the same as ATCCs except that they are tuned manually instead of electronically.

  NOTICE: 260 MHz configurations does not support MTCC.

Minimum channel spacing of the TX channels is 150 kHz while the recommended channel spacing is 250 kHz. This limitation applies to all Cavity Combiners in all cabinets connected to the same transmit antenna.

Figure 158: Auto Tune Cavity Combiner



7.3.6.1
Cavity Combiner - Theory of Operation

A minimum of 2 watts is needed at a cavity input. The ATCC will automatically tune in 40 seconds maximum. For more detail, see the ATCC specification.

Once an RF signal greater than 2 watts is detected, the ATCC tunes the cavity and continuously keeps it tuned over humidity, temperature and changing transmit frequency, so long as it does not sense one of the following alarm conditions:

- Channel Spacing alarm
- VSWR alarm
- Failure to Tune alarm

Being tuned means that a cavity is within the insertion loss specification at the frequency of the applied PI/4DQPSK or QAM4,16,64 signal that is within the average input power range specified above. Being tuned also means that the cavity peak response is no greater than 25 kHz away from the TX carrier center frequency. If the TX carrier does not change channel or average power level, the auto tune algorithm will not initiate a re-tuning on its own which exceeds +/- 300 kHz from the carrier frequency. The only exception occurs when the fine tune timer event happens. The fine tune timer is used to compensate for large variations in humidity and is default set to 480 Minutes. The Cavity Combiner is temperature compensated but large variations in humidity can de-tune the cavities up to 150 kHz with the result of an increasing insertion loss.

When the fine tune timer event occurs, all cavities with RF applied will be re-tuned for maximum output power of each TX carrier. The fine tune timer can be adjusted to compensate for fast humidity variations; for instance if the MTS 4 is installed in outdoor sites without air-conditioning. The recommended setting of the fine tune timer, if the MTS 4 is installed in a controlled environment, is 480 Minutes. For sites where the MTS 4 is exposed to more than +/- 20% variation in RH, the recommended setting of the fine tune timer is 60-200 minutes depending on the speed of the variation.

Having a second cavity tune up and pass through the desired channel, the desired channels insertion loss dips no more than 3 dB more than the max insertion spec for a period of 0.25 seconds. The cavity tuning rate should be faster than 1 MHz per second.

The following list contains control and monitoring features available through the CAN Bus:

- Request current tuned position/frequency of a specific cavity.
- Fine tune time feature, to re-tune each cavity with a specified interval.
- Park an individual cavity, but if RF power is still present, cavity will park and then retune again.
- Input power: request current measured input reflected power of a specific cavity.
- VSWR: request input VSWR of an individual cavity.
- Tuning status of each cavity; parked, tuning, tuned, and parking.
- Alarm conditions of each cavity are reported when requested, including : VSWR, subband, channel spacing and failure to tune.

7.3.6.2
Replacing the Cavity Combiner

Process:

1. Remove the Cavity Combiner.

   See Removing the Cavity Combiner on page 306.
2. Reinstall the Cavity Combiner.

   See Reinstalling the Cavity Combiner on page 307.

7.3.6.2.1
Removing the Cavity Combiner

Procedure:

1. **WARNING:** RF energy hazard and potential equipment damage precaution.

   To prevent accidental contact with high energy and injury to personnel, switch off the Power Supply Unit.
2. Remove the door of the cabinet completely.
3. Remove the three screws fastening the Cavity Combiner to the brackets of the cabinet.

   Two screws are on the left and one is on the right side of the Cavity Combiner.
4. Remove all TX and signal cables.
5. **CAUTION:** The Cavity Combiner can weigh up to 11.8 kg (26 lbs.). Use caution when removing or installing Cavity Combiner into the equipment rack. To avoid injury to personnel and equipment damage, ensure that the combiner is fully supported when free from mounting rails.

   Slide out the Cavity Combiner.

7.3.6.2.2
Reinstalling the Cavity Combiner

Procedure:

1. **CAUTION:** The Cavity Combiner can weigh up to 11.8 kg (26 lbs.). Use caution when removing or installing Cavity Combiner into the equipment rack. To avoid injury to personnel and equipment damage, ensure that the combiner is fully supported when free from mounting rails.

   Insert the Cavity Combiner into the cabinet.

   See Inserting the Cavity Combiner into the Cabinet on page 307.
2. **For redundant ATCC only:** Upgrade the redundant ATCC firmware.

   See Upgrading the Redundant ATCC Firmware on page 307.
3. **For ATCC only:** Update the mapping list with the new unit TrackID.

   See Updating the Mapping List with the New TrackID on page 308.

7.3.6.2.3
Inserting the Cavity Combiner into the Cabinet

Procedure:

1. Slide the Cavity Combiner into the cabinet.
2. Attach the TX and signal cables.
3. Fasten the three screws that hold the Cavity Combiner onto the brackets of the cabinet.

   Two screws are on the left and one is on the right side of the Cavity Combiner.
4. Put the door of the cabinet back on.
5. Switch on the Power Supply Unit.

7.3.6.2.4
Upgrading the Redundant ATCC Firmware

Procedure:

1. Connect a PC with the TFTP server to the Base Station.
2. Place the new firmware on the TFTP server.
3. Log on to the Site Controller.
4. At the command prompt, enter:
   `tftp` ***<IP address>*** `get` ***<tftp server directory>***`\SU11075-15.a90 /ffx/SU11075-15.a90`

   The firmware is transferred from the PC to the Base station.
5. Load the file into the ATCC by entering `atc 1 load_program /ffx/SU11075-15.a90`.

   The firmware is loaded to the ATCC and the upload status displays.
6. Verify the successful upgrade by entering `atc 1 get device_id`.

   The device ID matches the firmware version.

7.3.6.2.5
Updating the Mapping List with the New TrackID

Procedure:

1. Log on to the Site Controller.
2. View the mapping list by entering: `can check_mapping`.

   Step example:

   ```
   Units are present:
   Device Track ID
   DPM 1 JTH0500101
   DPM 2 JTH0500105
   PSU 1 JTH0500200
   Units are not present:
   ATCC 1 JTH0500201
   Track ID not mapped:
   JTH0500102
   ```
3. On the mapping list, locate the removed unit indicated as `Units are not present`.
4. Delete the old CAN Bus unit from the CAN Bus unit mapping list by entering: `can remove_mapping attc`***`<X>`***.

   <X> identifies the new unit name and is a digit between 0 and 2.

   Step example: `can remove_mapping atcc 1`
5. Add the new CAN Bus unit to the CAN Bus unit mapping list by entering: `add_mapping attc`***`<X><track ID>`***.

   <track ID> is a Track ID of the new unit.

   <X> identifies the new unit name and is a digit between 0 and 2.

   NOTICE: The new unit Track ID is present on the replaced unit label as `Track ID not mapped`.

   Step example: `can add_mapping atcc 1 JTH0500102`
6. View the updated mapping list by entering: `can check_mapping`.
7. On the mapping list, check that there are no units labeled as `Track ID not mapped` or `Units are not present`.

7.3.6.3
Tuning the MTCC in a BTS in Tetra Application Mode

The Manually Tuned Cavity Combiner (MTCC) can have 2 or 4 inputs. The TX output of each BR is connected to an input on the MTCC. The output of the MTCC is connected to the Antenna Port of the BTS via the TX-path of a duplex filter. A configuration file has been uploaded to the Site Controller, defining the TX frequencies of all the BRs.

Equipment: High Power Power Meter (PM) like Stabilock 4032, which can handle up to 120W. Service computer.

Procedure:

1. Calibrate the PM and set the frequency to the center frequency of the duplex filter. Set the PM to display Watts.
2. Connect the PM to the TX antenna connector of the BTS.