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

TBD 2020

6802800U74

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Declaration of Conformity

The declaration is applicable to the radio only if the radio is labeled with the FCC logo.

Declaration of Conformity

Per FCC CFR 47 Part 2 Section 2.1077(a)

Responsible Party

Name: Motorola Solutions, Inc.

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

Phone Number: 1-800-927-2744

Hereby declares that the product:

Model Name: MTS 2, and MTS 4

conforms to the following regulations:

FCC Part 15, subpart B, section 15.107(a), 15.107(d), and section 15.109(a)

Class A Digital Device

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1 This device may not cause harmful interference, and

2 This device must accept any interference received, including interference that may cause undesired operation

NOTICE:
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

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The label is placed in a customer visible position on the product. The first of the following examples means that the product contains no hazardous substances; the second means that the product contains hazardous substances, and has an Environmental Friendly Use Period (EFUP) of fifty years.

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The Disclosure Table, printed in simplified Chinese, is included with each customer order. An example of a Disclosure Table (in Chinese) follows:

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	×

本表格依据 SJ/T 11364 的规定编制。
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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Service Information

EMEA Technical Support Operations (TSO)

The EMEA Technical Support Operations (TSO) provides a remote Technical Support Service to help customers resolve technical issues and quickly restore networks and systems. This team of highly skilled professionals is available to customers with current service agreements in place that include the Technical Support Service. The TSO technical experts may be accessed through the Service Desk either electronically or using the listed telephone numbers. If you are unsure whether your current service agreement entitles you to benefit from this service, or if you would like more information about the Technical Support Service, contact your local customer support or account manager for further information.

Contact Details

Email: techsupport.emea@motorolasolutions.com

Table 1: List of Telephone Numbers

Country	In Country Number to Dial
AUSTRIA	0800 281 195
DENMARK	80 253 546
FRANCE	0800 914 532 or +33 176 775 609
GERMANY	0800 724 6872 or +49 69 22221568
ISRAEL	180 931 5818
ITALY	800 791 276
NETHERLANDS	0800 0249 893
NORWAY	800 14 802
POLAND	00800 1215 772
RUSSIA	810 800 286 15011
SAUDI ARABIA	800 811 0523
SOUTH AFRICA	0800 994 886
SPAIN	9009 416 84
UNITED KINGDOM	0800 731 3496 or +44 207 019 0461
UNITED ARAB EMIRATES	8000 3570 4387
All Other Countries	+44 207 019 0461

European Systems Component Centre (ESCC)

The European Systems Component Centre provides a repair service for infrastructure equipment. Customers requiring repair service should contact the Customer Information Desk to obtain a Return Material Authorization number. The equipment should then be shipped to the following address unless advised otherwise.

Motorola Solutions GmbH, European Systems Component Centre, Am Borsigturm 130,13507 Berlin, Germany

Contact Details

- E-Mail: escc.admin@motorolasolutions.com
- Telephone: +49 (0) 30 66861404
- Telefax: +49 (0) 30 66861426
- Monday – Friday 08:00 am to 06:00 pm (CET)

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Updated Versions of Manuals

Verify the current version of the manual at our Extranet site, Motorola Solutions Online: https://emeaonline.motorolasolutions.com.

Your Input

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 445. • 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 287. • 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 222. • Table 50: RF Cabling/Connections for MTS LiTE with One TX and One RX ant. No Diversity on page 177.	May 2012

Version	Description	Date
	• Service Cable and Connector Box Description on page 227. • Setting Base Radio IP on page 238.Station Verification Procedures on page 243. • Added Configuring the Base Radio VSWR on page 241. • Verifying the Base Radio Receiver Parameters in BR-Arch-1 Architecture on page 239. • XHUB Controller – Front Panel Indicators (LED) on page 315. • XHUB Controller – Front Panel Connectors on page 316. • Troubleshooting: General Check of a Site Controller File on page 352. • Added Ethernet Site Link on page 363. • Base Radio Alarms on page 370. • Miscellaneous Troubleshooting on page 397. • Field Replaceable Units (FRUs) on page 446. 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 249. Updated: • Ethernet Site Link on page 363. • Site Controller – Front Panel Indicators (LED) on page 298.	December 2012
6802800U74–AA	Added: • Encrypted Ethernet Site Links on page 367. • Verifying Encryption Capability on page 368. Updated: • Verifying and Tuning the Receiver RSSI Levels on page 249.	February 2013
6802800U74–AB	Updated the following: • Encrypted Ethernet Site Links on page 367. • Verifying Encryption Capability on page 368.	March 2014

Version	Description	Date
	• Field Replaceable Units for MTS LiTE on page 446. • Field Replaceable Units for MTS 2 on page 448. • Field Replaceable Units for MTS 4 on page 451. • Miscellaneous Troubleshooting on page 397.	
6802800U74–AC	Updated RF Cabling – MTS 4, No Diversity on page 187.	July 2014
6802800U74–AD	Added: • Resetting the RTC Battery Status on page 308. Updated: • Checking if the Site Controller Lithium Battery Needs Changing on page 308. • Replacing the Site Controller Lithium Battery on page 309.	September 2014
6802800U74–AE	Updated: • Field Replaceable Units (FRUs) on page 446. • E1 Interface on page 360. • MTS LVD Kit Installation on page 109.	April 2015
6802800U74–AF	Added: • GPS Connections on page 122. • Troubleshooting: status sc on page 349. • Troubleshooting: GPS and Site Reference Faults on page 353. • GPS Receiver Detailed Troubleshooting on page 356.	December 2015
6802800U74–AG	Introduced BR-Arch-2. Added: • Verifying Permanent Lock on page 369. • Unlocking the Site from the Permanent Lock State on page 369.	September 2016
6802800U74–AH	Updated: • LED Fault Indications on page 345 • Field Replaceable Units for MTS 2 on page 448 • Field Replaceable Units for MTS 4 on page 451	August 2017

Version	Description	Date
6802800U74–AJ	Updated for DIMETRA X Core.	September 2017
6802800U74–AK	Updated GPS Site Reference Operation Modes on page 123. Added Restriction of Hazardous Substances Compliance on page 398.	January 2018
6802800U74–AL	Updated • GPS Receiver Detailed Troubleshooting on page 356 • Note in Antenna Installation Considerations on page 70. • The PN/FRU numbers change from GMDN1172A to PMUG1017A Field Replaceable Units for MTS LiTE on page 446. • Note related to supporting GLONASS in the future. GPS Connections on page 122. • Information about supporting GLONASS in the future Site Controller – GPS Module on page 308. Added: • New FRU GMTF4695A in Field Replaceable Units for MTS LiTE on page 446	April 2018
6802800U74–AM	Minor changes.	November 2018
6802800U74–AN	Updates/new sections: • Declaration of Conformity on page 3	TBD 2019

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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 DIMETRA system. The manual provides the background need-

Document Title	Description
	ed 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 then 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 258 and Power Amplifier on page 323.

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 2: 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
rights reserved.
       MTS_BRC_CORE-R08.44.21. Copyright 2011-2016 Motorola Solutions Inc.
All rights reserved.

       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

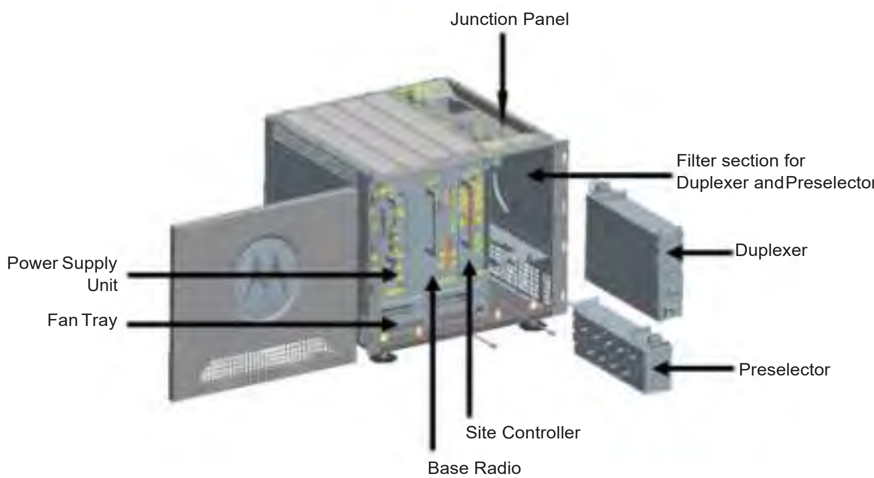


Table 3: MTS LiTE Cabinet

Callout Number	Description
1	Junction Panel
2	Filter section for Duplexer and Preselector
3	Duplexer
4	Preselector
5	Site Controller
6	Base Radio
7	Fan Tray

Callout Number	Description
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

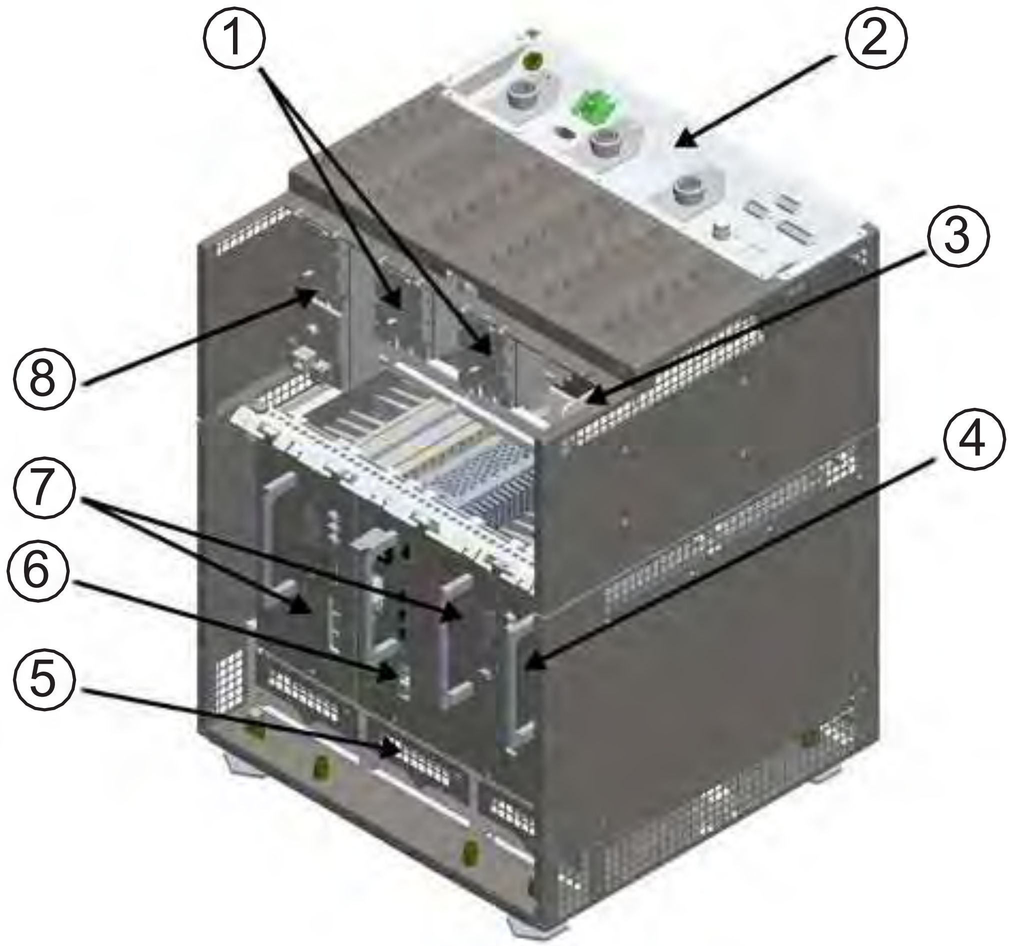


Table 4: MTS 2 Cabinet

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

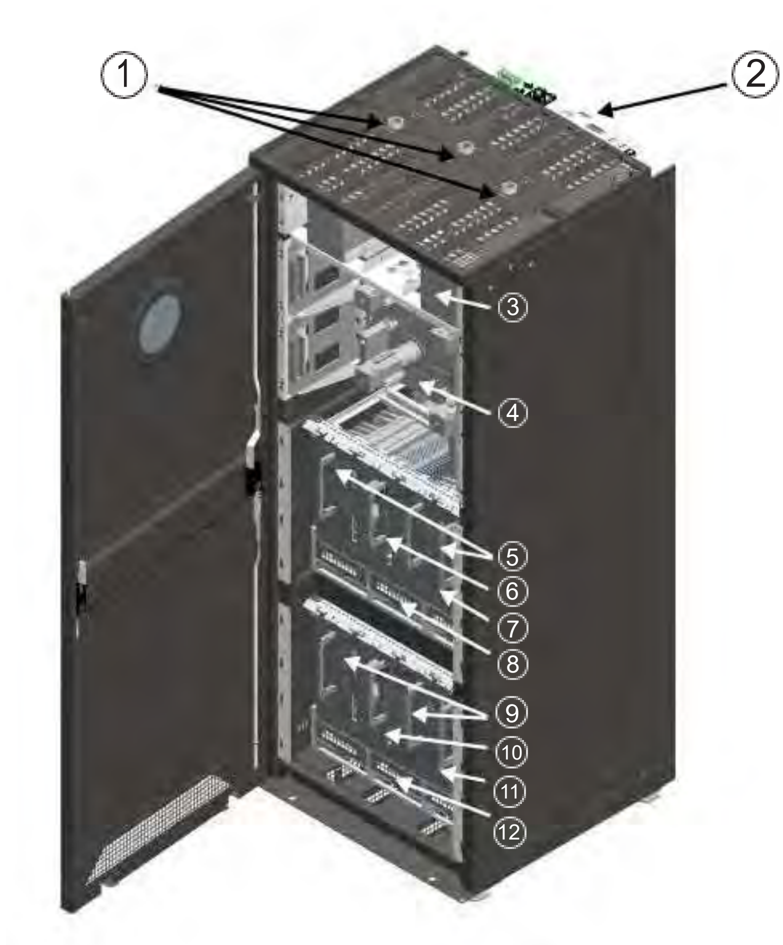


Table 5: MTS 4 Cabinet

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

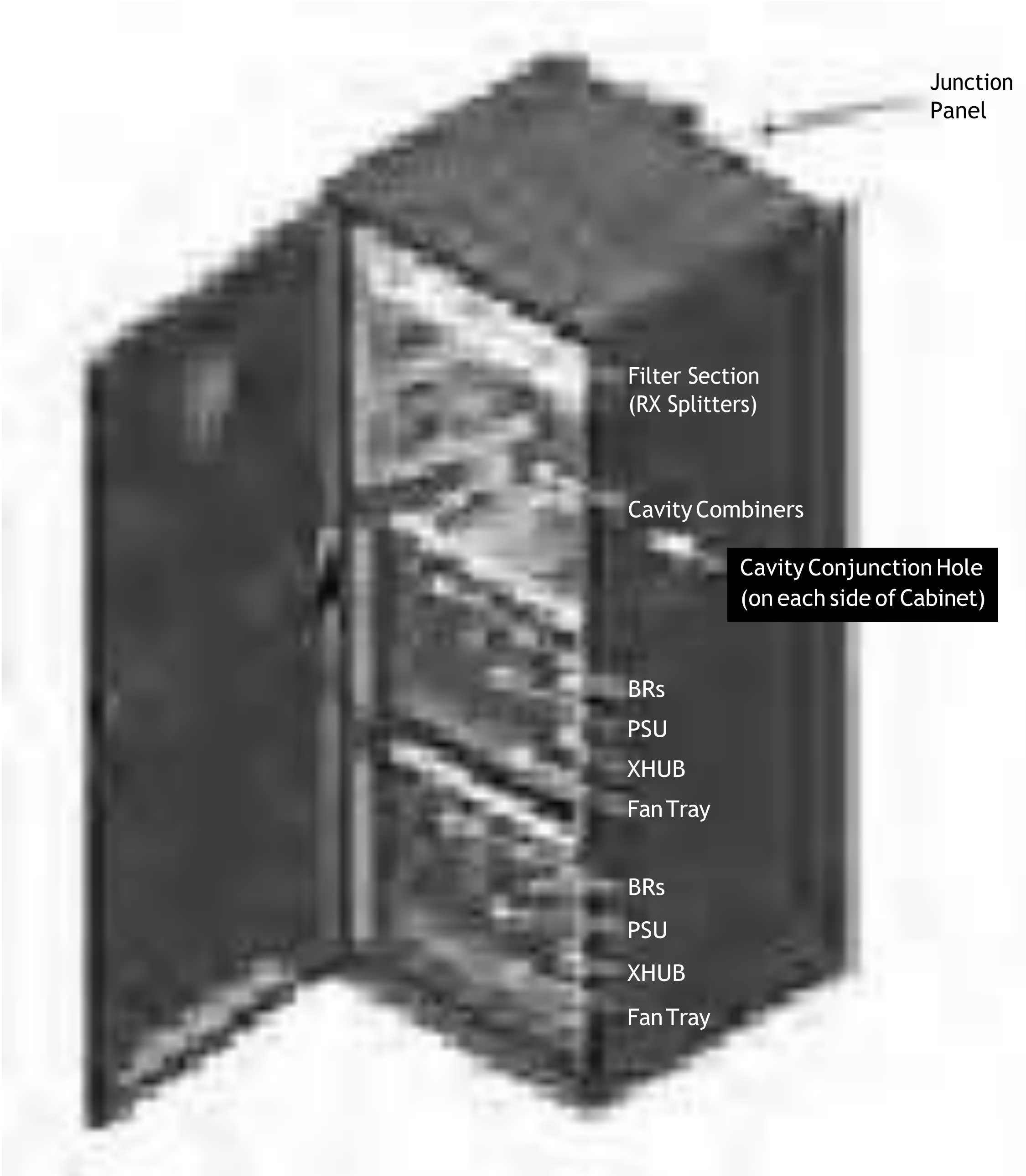


Table 6: MTS Expansion Cabinet

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 7: 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 8: 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 9: 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 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.

2.3 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 13: Typical Power Loads and Heat Dissipation Values – Expansion Cabinet 400 MHz BR-Arch-1 Configuration on page 78).
- 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 401.

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 456.

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

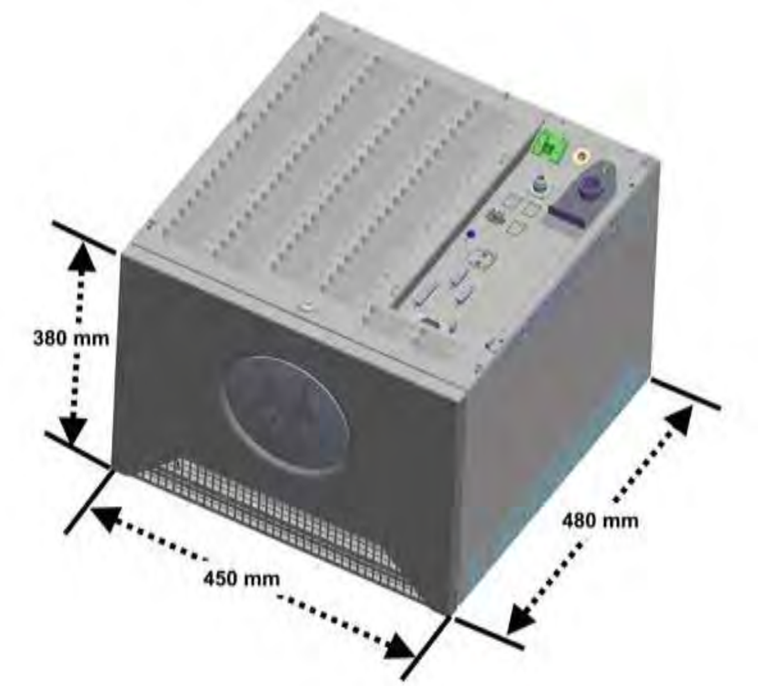
3.2
Cabinets Installation Considerations

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 5: MTS LiTE Cabinet Dimensions



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

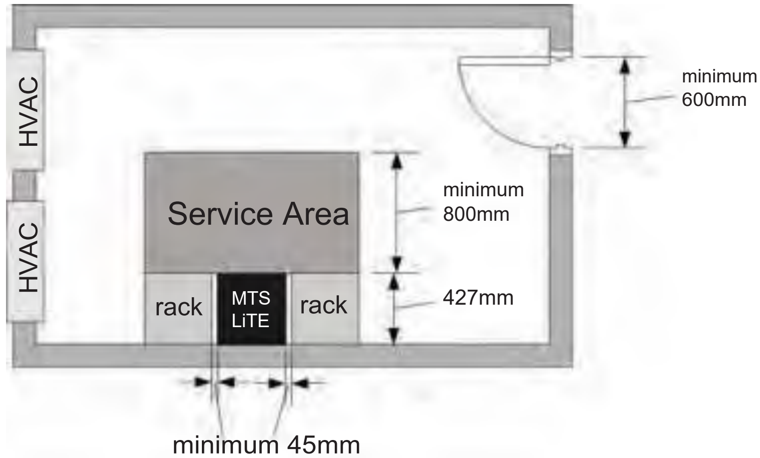
- 45 mm on both sides of the cabinet
- 800 mm of free space in front of the cabinet

The cabinet front door is removable. Figure 6: Suggested MTS LiTE Site Layout on page 65 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 6: 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 7: MTS 2 Cabinet Dimensions

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

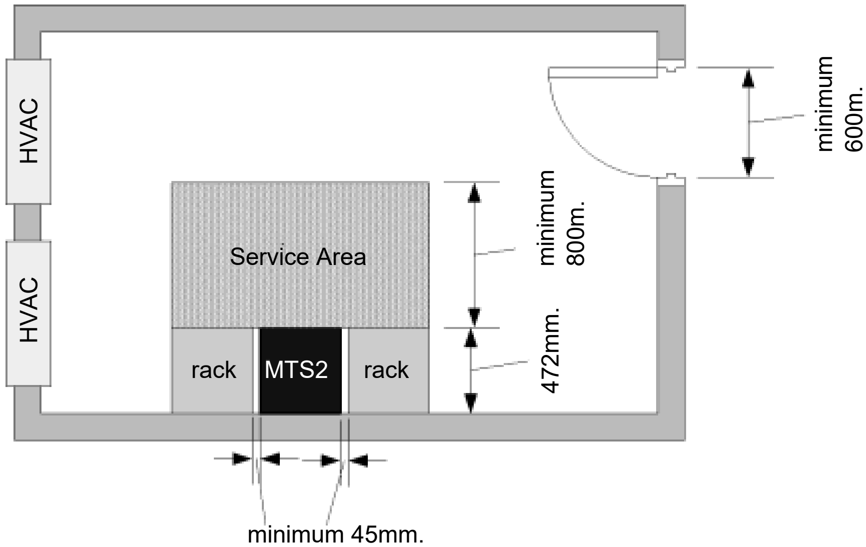
- 45 mm on both sides of the cabinet
- 800 mm of free space in front of the cabinet

The cabinet front door is removable. Figure 8: Suggested MTS 2 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.

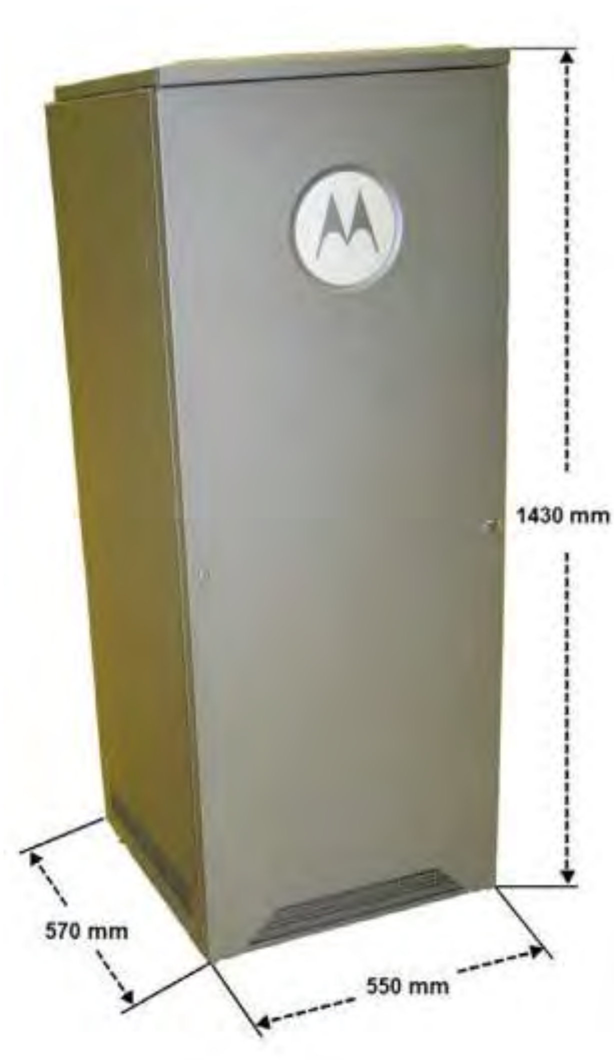
Figure 8: Suggested MTS 2 Site Layout



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 9: MTS 4 Cabinet Dimensions



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

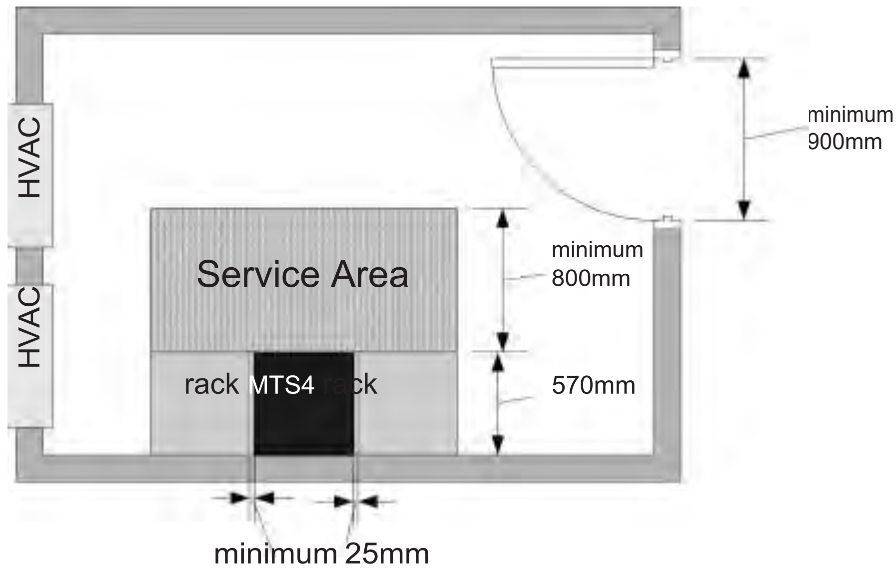
- 25 mm on both sides of the cabinet
- 800 mm of free space in front of the cabinet

The cabinet front door has hinges on both sides and it can be opened right, left, or removed. Figure 10: Suggested MTS 4 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 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 10: 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 11: Expansion Cabinet Dimensions

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

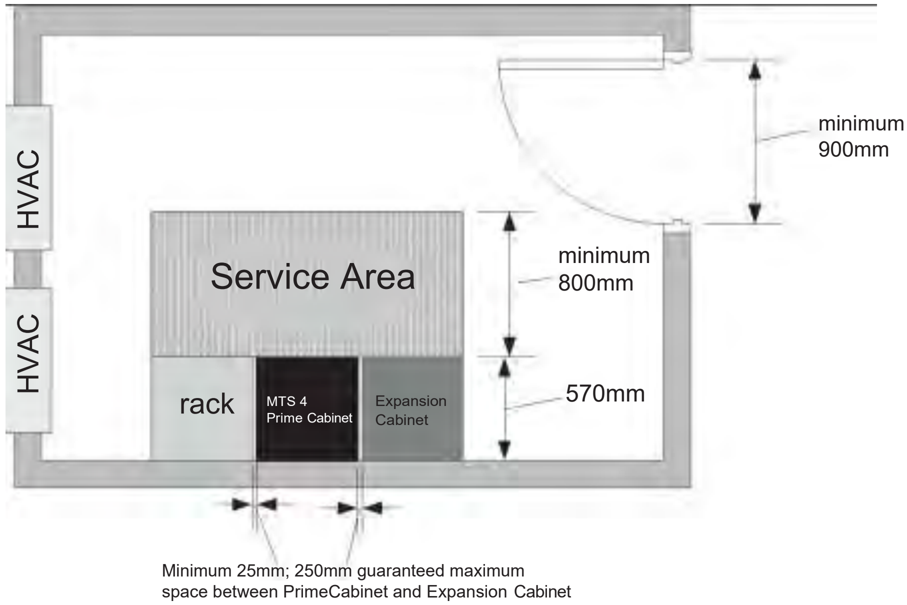
- 25 mm on both sides of the cabinet
- 800 mm of free space in front of the cabinet

The cabinet front door has hinges on both sides and it can be opened right, left, or completely removed. Figure 12: Suggested Expansion Cabinet 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 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 12: Suggested Expansion Cabinet Site Layout



NOTICE: Even though Figure 12: Suggested Expansion Cabinet Site Layout on page 70 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 129.

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 456 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 456 section in Field Replaceable Units (FRUs) on page 446 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 10: 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 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. 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)

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
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	1025	950	1785	1110	1000	925	High power PA, fans
MTS4 with 4 BRs w. MTCC/ATCC	1300	1200	2065	1375	1270	1170	High power PA, fans

Table 11: 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

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 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
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 12: 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

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
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
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 13: 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
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 14: 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							

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	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							
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 15: 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

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	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
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 16: 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

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
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
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 17: 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 18: 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 Charg ing (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

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 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

3.7.2.1.6
Power Loads and Heat Dissipation – Expansion Cabinet 800 MHz

Table 19: 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

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
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 456.

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 thejunction panel.
- DOOR alarm: Connected to the Site Controller

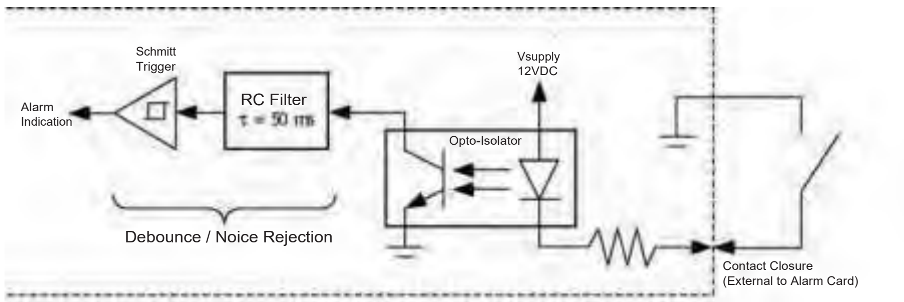
NOTICE:
All 15 alarm inputs and Door alarm use the same Alarm Ground. All these alarms and controls connect directly to the Site Controller (SC).

The Expansion Cabinet only offers the Door alarm feature.

For detailed information, see External Alarm Cabling on page 138 and User Alarms/Controls, X.21, RGPS, and GPS Cabling on page 155.

The following figure shows detailed User Alarms input structure.

Figure 13: 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 14: Lifting Point for MTS 4 and Expansion Cabinet

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

Figure 15: 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 16: MTS – Mounting Brackets on page 91.

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 16: 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 6: Suggested MTS LiTE Site Layout on page 65 for MTS LiTE, Figure 8: Suggested MTS 2 Site Layout on page 66 for MTS 2, Figure 10: Suggested MTS 4 Site Layout on page 68 for MTS 4, and Figure 12: Suggested Expansion Cabinet Site Layout on page 70 for Expansion Cabinet site.

2 Mark and then drill the floor according to the dimensions shown in Figure 17: MTS LiTE / MTS 2 – Drill Hole Position for the Mounting Brackets on page 92 and Figure 18: MTS 4 and Expansion Cabinet – Drill Hole Position for the Mounting Brackets on page 92. 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 17: MTS LiTE / MTS 2 – Drill Hole Position for the Mounting Brackets on page 92 and Figure 18: MTS 4 and Expansion Cabinet – Drill Hole Position for the Mounting Brackets on page 92.

Figure 17: MTS LiTE / MTS 2 – Drill Hole Position for the Mounting Brackets

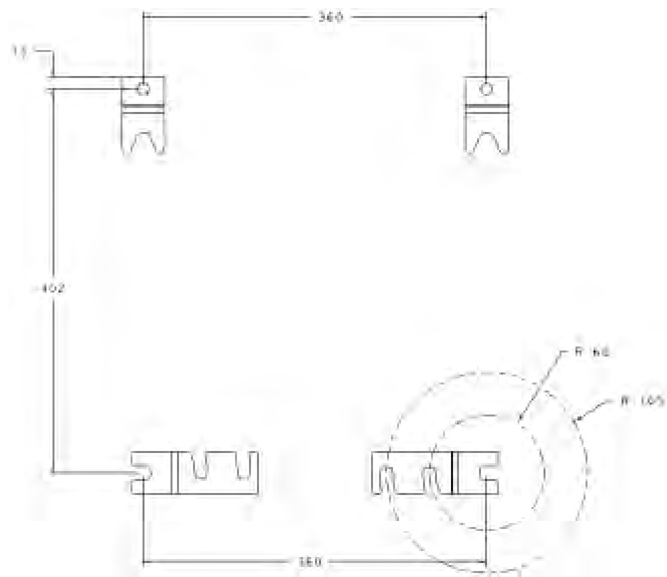
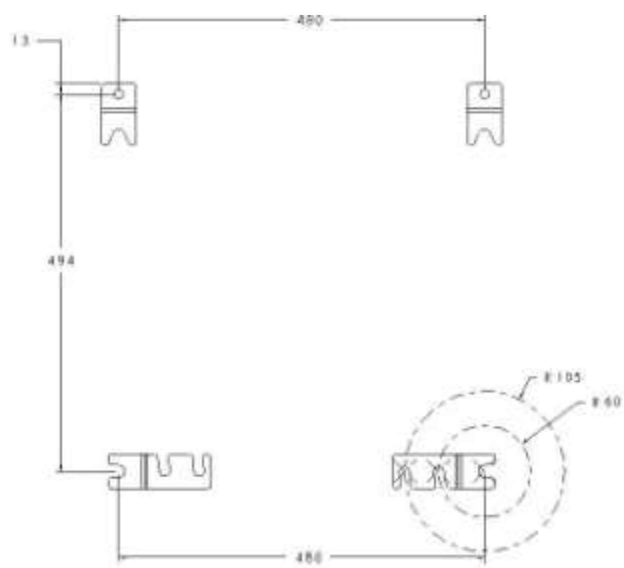


Figure 18: MTS 4 and Expansion Cabinet – Drill Hole Position for the Mounting Brackets

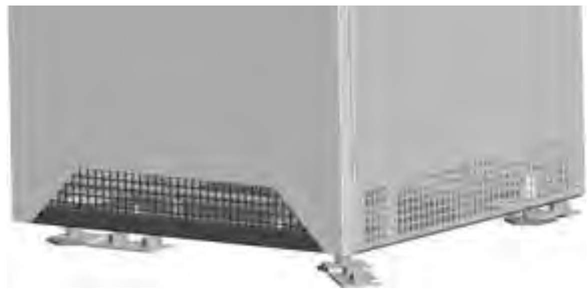


3 Secure the two rear brackets to the floor using one screw for each bracket.

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 19: 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 93.
2 Secure the cabinet to the mounting plate, see Securing Cabinet to a Mounting Plate on page 95.

NOTICE: Recommended clearances are shown in Figure 6: Suggested MTS LiTE Site Layout on page 65 for MTS LiTE, Figure 8: Suggested MTS 2 Site Layout on page 66 for MTS 2, in Figure 10: Suggested MTS 4 Site Layout on page 68 for MTS 4, and in Figure 12: Suggested Expansion Cabinet Site Layout on page 70 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 20: 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 6: Suggested MTS LiTE Site Layout on page 65 for MTS LiTE, Figure 8: Suggested MTS 2 Site Layout on page 66 for MTS 2, Figure 10: Suggested MTS 4 Site Layout on page 68 for MTS 4, and Figure 12: Suggested Expansion Cabinet Site Layout on page 70 for Expansion Cabinet.
2. Use the mounting plate as drilling template or mark the floor according to the dimensions shown in Figure 21: MTS LiTE/MTS 2 – Drill Hole Position for the Mounting Plate on page 95 and Figure 22: MTS 4 – Drill Hole Position for the Mounting Plate on page 95. 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 21: MTS LiTE/MTS 2 – Drill Hole Position for the Mounting Plate

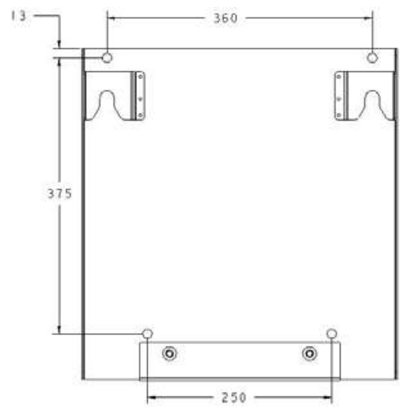
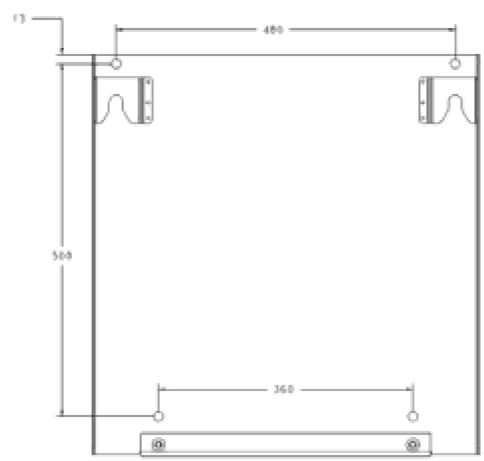


Figure 22: MTS 4 – Drill Hole Position for the Mounting Plate



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:

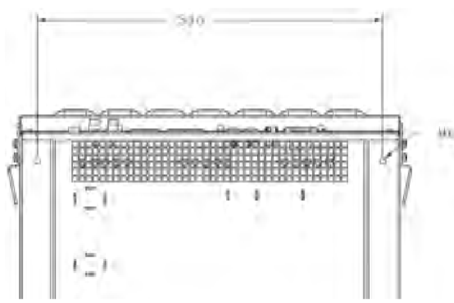
1 Move the MTS cabinet near to the mounting plate which has been fixed to the floor as described before.
2 Bring the MTS in position and lower it onto the mounting plate. Care must be taken not to lower the MTS onto the locating tabs on the rear of the mounting plate to avoid bending.
3 Move the MTS 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 23: Position of Security Screws on page 96. Recommended tool: allen wrench for M10, SW8 HEX screws (supplied with the mounting plate kit).

Figure 23: 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 24: 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 149, 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 456.

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 85 in Site Preparation on page 62.

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 25: Station Ground Point on the MTS LiTE Junction Panel on page 98.

For MTS 2, see Figure 26: Station Ground Point on the MTS 2 Junction Panel on page 98.

For MTS 4, see Figure 27: Station Ground Point on the MTS 4 Junction Panel on page 98.

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 26: Station Ground Point on the MTS 2 Junction Panel on page 98 and Figure 27: Station Ground Point on the MTS 4 Junction Panel on page 98 depict the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 25: Station Ground Point on the MTS LiTE Junction Panel

Figure 26: Station Ground Point on the MTS 2 Junction Panel

Figure 27: Station Ground Point on the MTS 4 Junction Panel

Figure 28: 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 29: Cabinet Grounding on page 99). 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 29: 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 143.

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: Figure 31: -48 VDC Connection on the MTS 2 Junction Panel on page 101 and Figure 32: -48 VDC Connections on the MTS 4 Junction Panel on page 101 depict the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 30: -48 VDC Connection on the MTS LiTE Junction Panel

Figure 31: -48 VDC Connection on the MTS 2 Junction Panel

Figure 32: -48 VDC Connections on the MTS 4 Junction Panel

Figure 33: -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 34: DC Plug MTS LiTE/MTS 2 (Motorola P/N 3166501A01) – Blue/Black Wires on page 103 for MTS 2 and Figure 36: DC Plug MTS 4 (Motorola P/N 3166501A02) – Blue/Black Wires on page 104 for MTS 4.
   - Red/Black wires: see Figure 35: DC Plug MTS LiTE/MTS 2 (Motorola P/N 3166501A01)– Red/Black Wires on page 103 for MTS 2 and Figure 37: DC Plug MTS 4 (Motorola P/N 3166501A02) – Red/Black Wires on page 104 for MTS 4.

Figure 34: 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 35: 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 36: DC Plug MTS 4 (Motorola P/N 3166501A02) – Blue/Black Wires

Plug blue wires into negative as shown in the picture.

Figure 37: 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

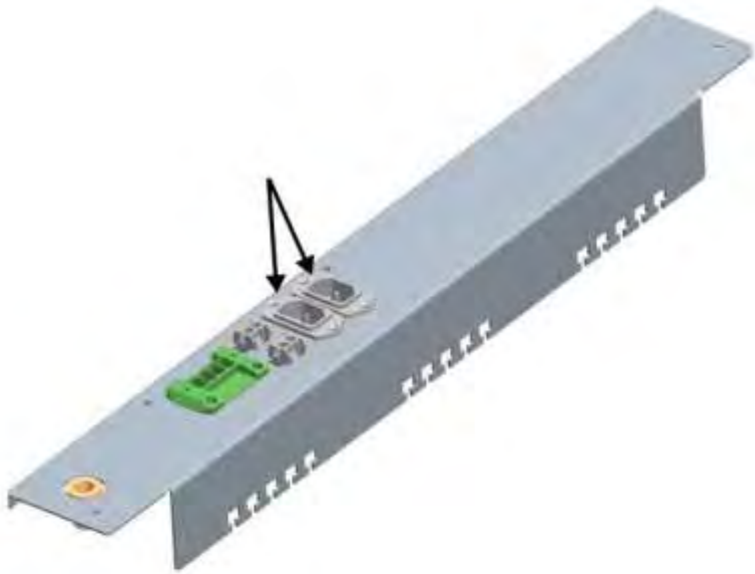
NOTICE: Figure 39: 100–240 VAC Connection on the MTS 2 Junction Panel on page 105 and Figure 40: 100–240 VAC Connections on the MTS 4 Junction Panel on page 105 depict the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 38: 100–240 VAC Connection on the MTS LiTE Junction Panel

Figure 39: 100–240 VAC Connection on the MTS 2 Junction Panel

Figure 40: 100–240 VAC Connections on the MTS 4 Junction Panel

Figure 41: 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 Figure 42: AC Socket (IEC Connector) on page 106. This fixture will only work with the supplied IEC connector.

   Figure 42: 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

For MTS LiTE, see Figure 43: Backup Battery Sensor Connection on MTS LiTE Junction Panel on page 107.

For MTS 2, see Figure 44: Backup Battery Sensor Connection on MTS 2 Junction Panel on page 107.

For MTS 4, see Figure 45: Backup Battery Sensor Connections on MTS 4 Junction Panel on page 108.

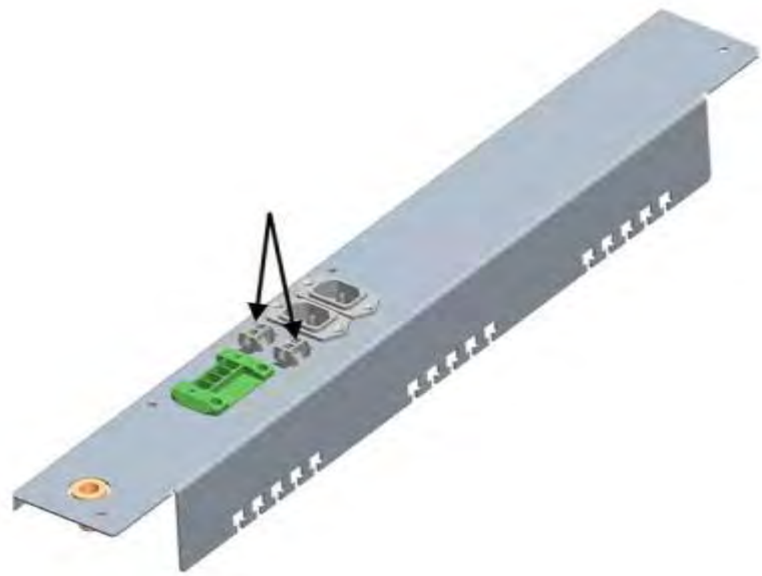
Figure 43: Backup Battery Sensor Connection on MTS LiTE Junction Panel

NOTICE: Figure 44: Backup Battery Sensor Connection on MTS 2 Junction Panel on page 107 and Figure 45: Backup Battery Sensor Connections on MTS 4 Junction Panel on page 108 depict the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 44: Backup Battery Sensor Connection on MTS 2 Junction Panel

Figure 45: Backup Battery Sensor Connections on MTS 4 Junction Panel

Figure 46: 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 47: 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 105.

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 100. 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 112 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 48: 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

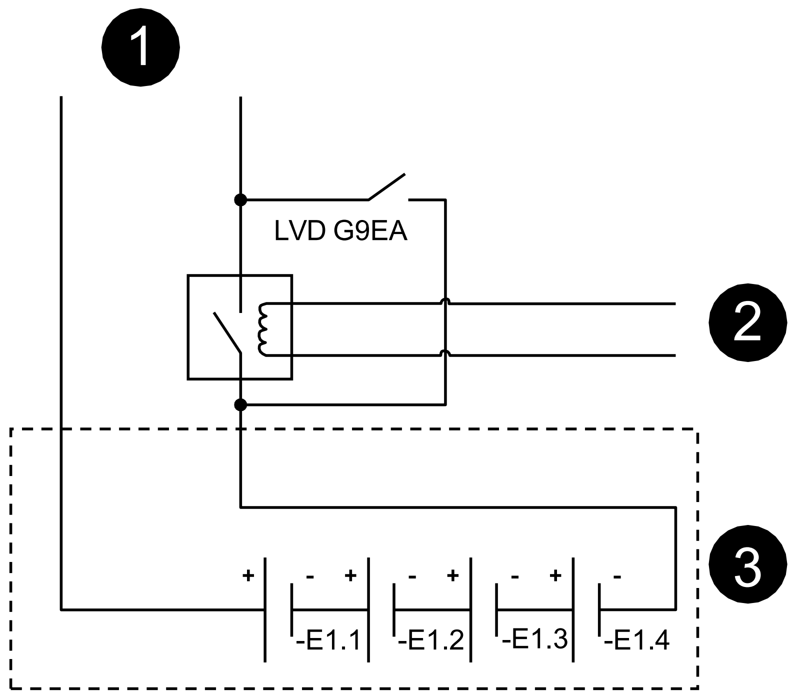


Figure 49: MTS LVD Kit Relay Connection Diagram – Dual PSU, Dual Batteries

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

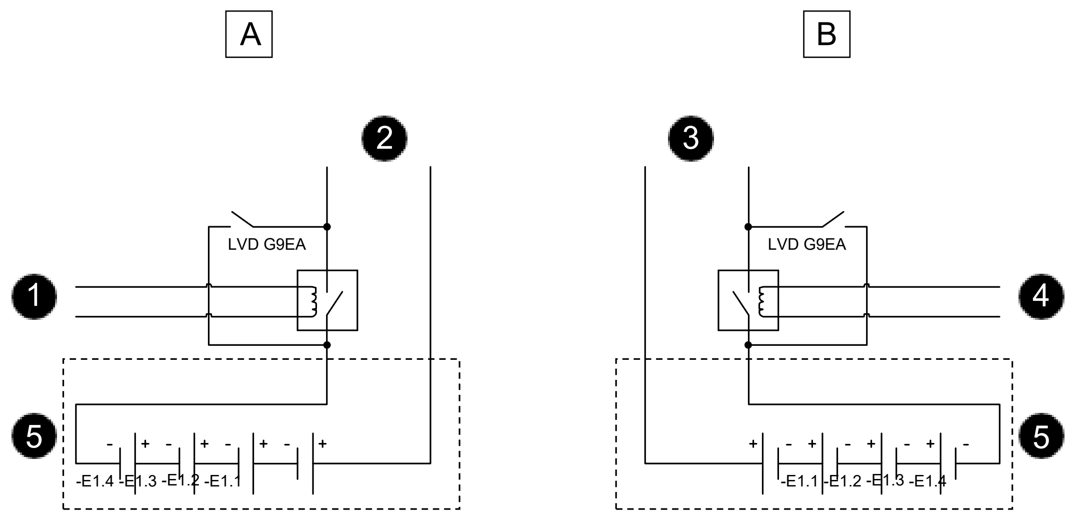
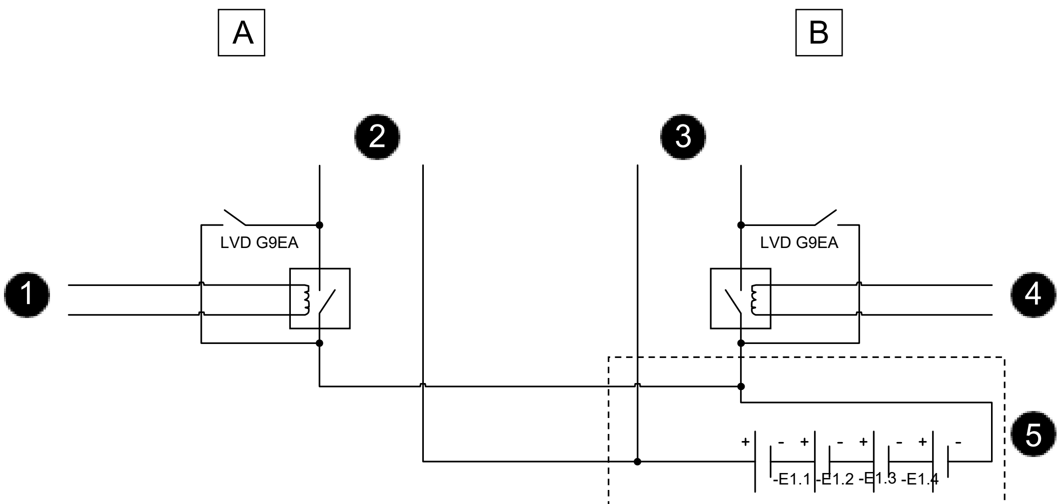


Figure 50: MTS LVD Kit Relay Connection Diagram – Dual PSU, Single Battery

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 51: 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 52: 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 53: 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 54: 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 55: Base Radio Antenna Connections – MTS LiTE on page 115, Figure 56: Base Radio Antenna Connections – MTS 2 on page 116 and Figure 57: Base Radio Antenna Connections – MTS 2 Non Duplexed on page 116. In the MTS 4, the RF antenna connectors are located in the top of the cabinet and integrated with the filter tray, see Figure 58: Base Radio Antenna Connections – MTS 4 on page 117.

Figure 55: Base Radio Antenna Connections – MTS LiTE

Figure 56: Base Radio Antenna Connections – MTS 2

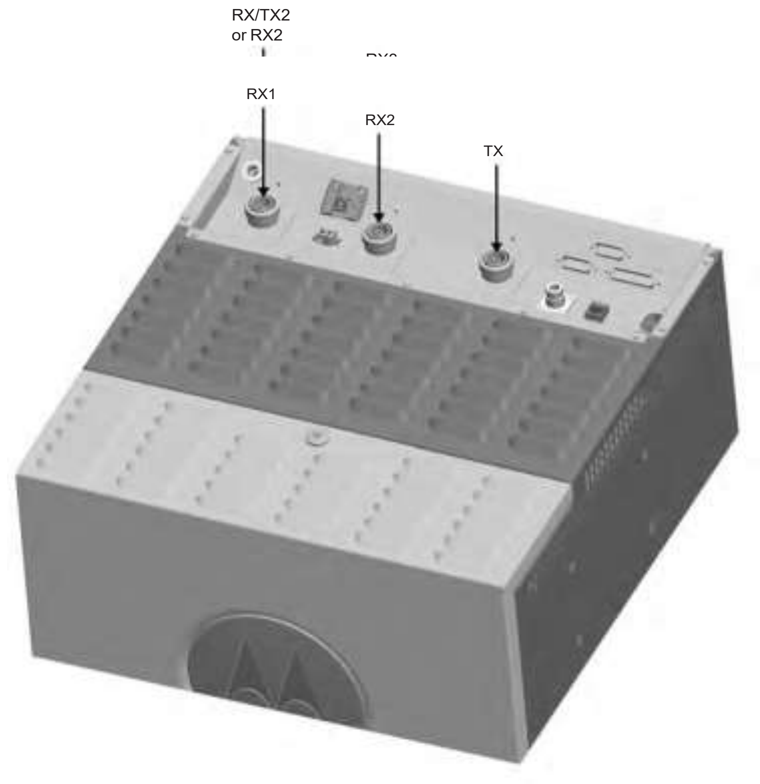
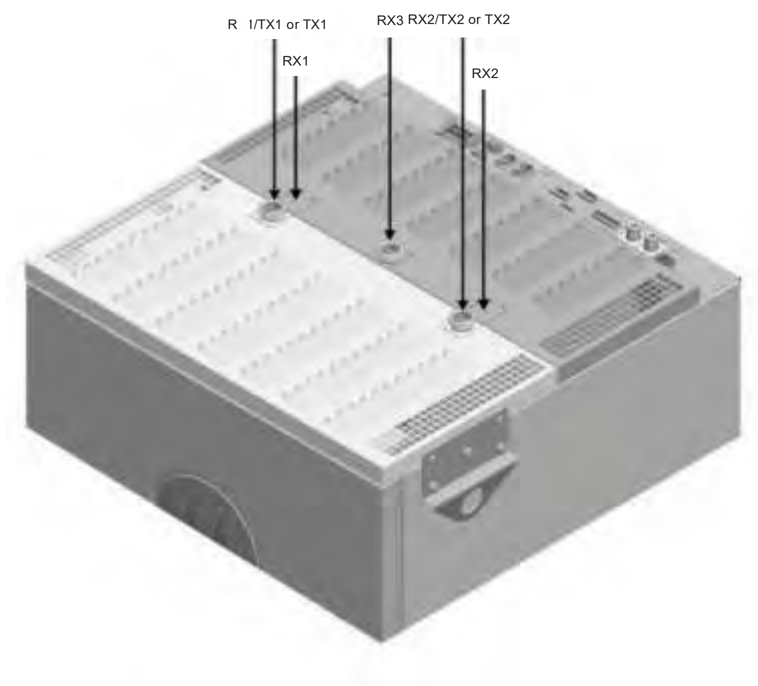


Figure 57: Base Radio Antenna Connections – MTS 2 Non Duplexed

Figure 58: 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 149, section RF Cabling on page 177 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 456 in Field Replaceable Units (FRUs) on page 446 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 20: 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

MTS RF Antenna Configuration	Low Power [W]	High Power [W]	Number of 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 available at this time

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

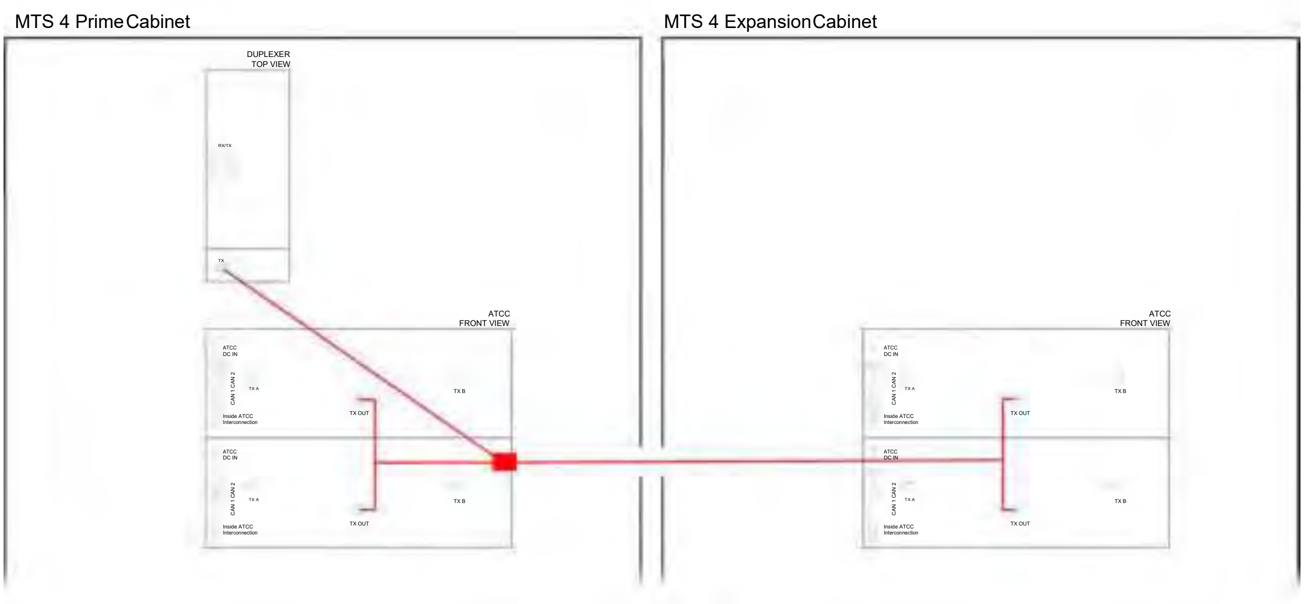
Depending on the Prime Cabinet configuration, TX connections between the MTS 4 Prime Cabinet and the MTS 4 Expansion Cabinet can be configured in two ways:

- 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 59: Connection Between MTS 4 Prime Cabinet and MTS 4 Expansion Cabinet – Phasing Harness on page 119, 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.

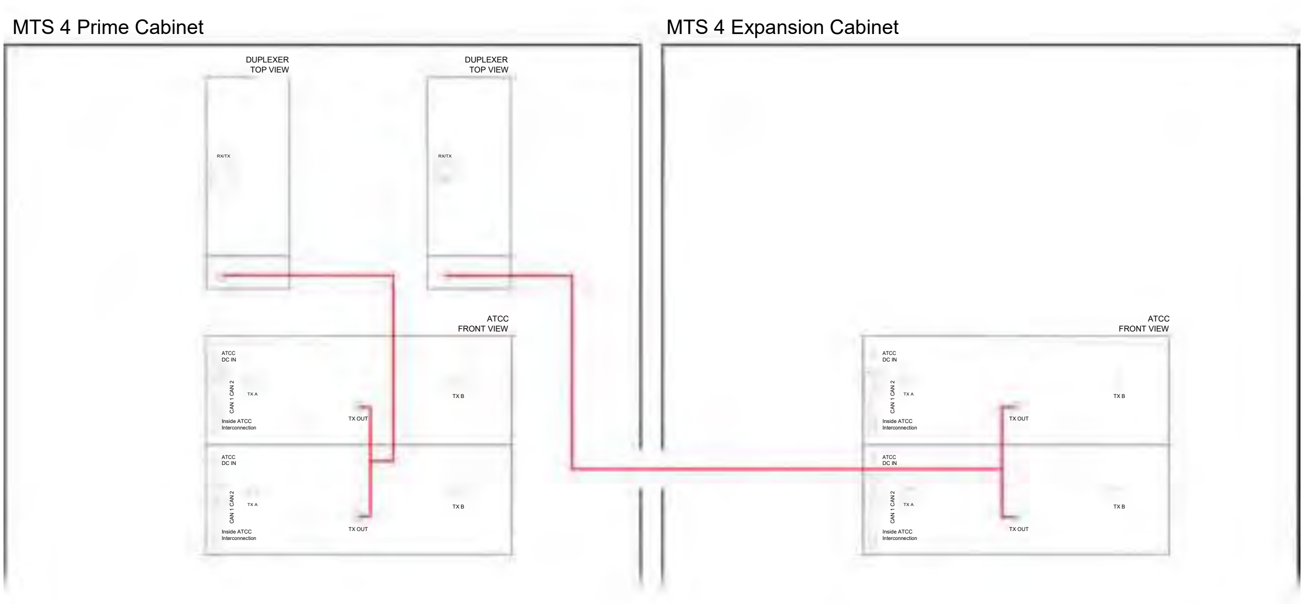
NOTICE: Tx cable from Prime Cabinet to Expansion Cabinet is routed through the conjunction hole on the side of the cabinets.

Figure 59: Connection Between MTS 4 Prime Cabinet and MTS 4 Expansion Cabinet – Phasing Harness



In Figure 60: Connections Between MTS 4 Prime Cabinet and MTS 4 Expansion Cabinet – Two Filters on page 119, 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 60: Connections Between MTS 4 Prime Cabinet and MTS 4 Expansion Cabinet – Two Filters

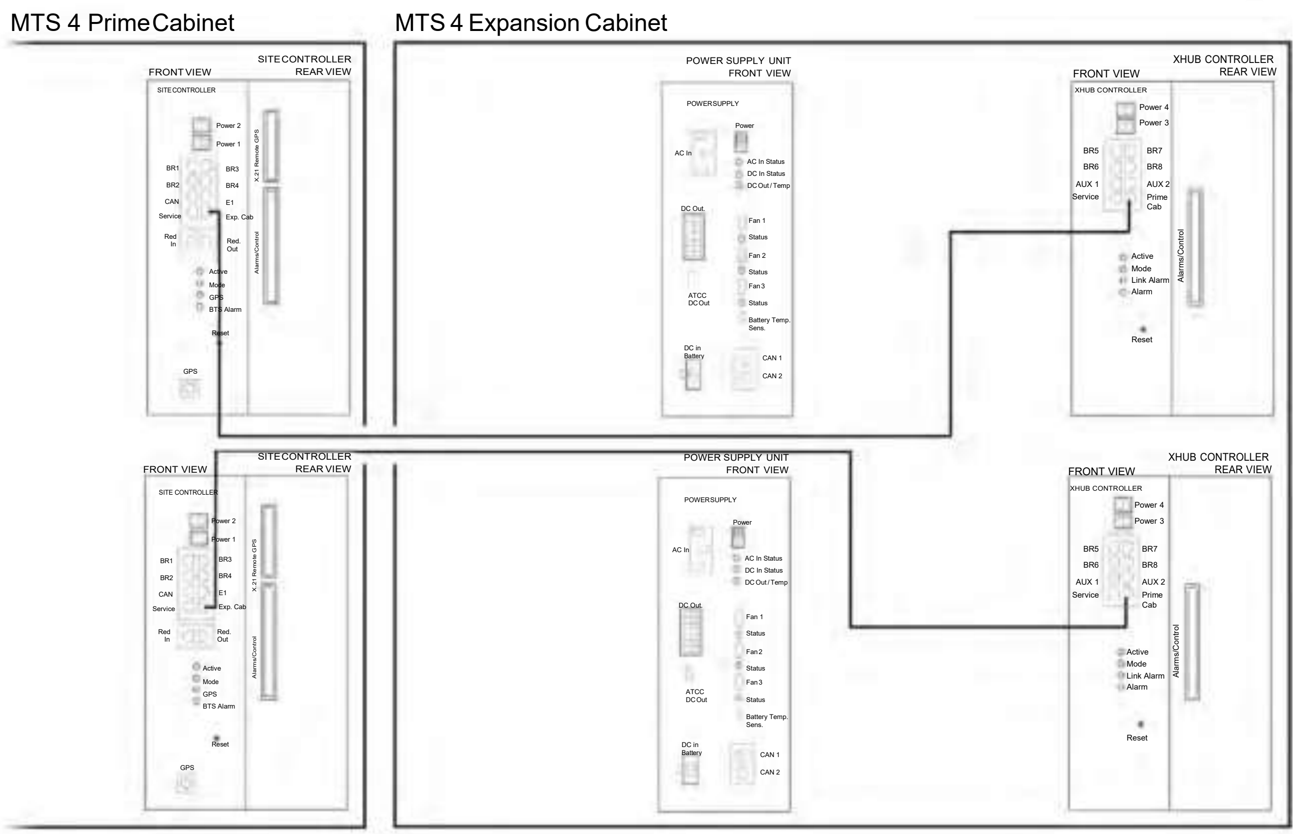


4.7.2 Connections between Site Controller and XHUB Controller

Figure 61: Connections Between Site Controller and XHUB Controller on page 120 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.

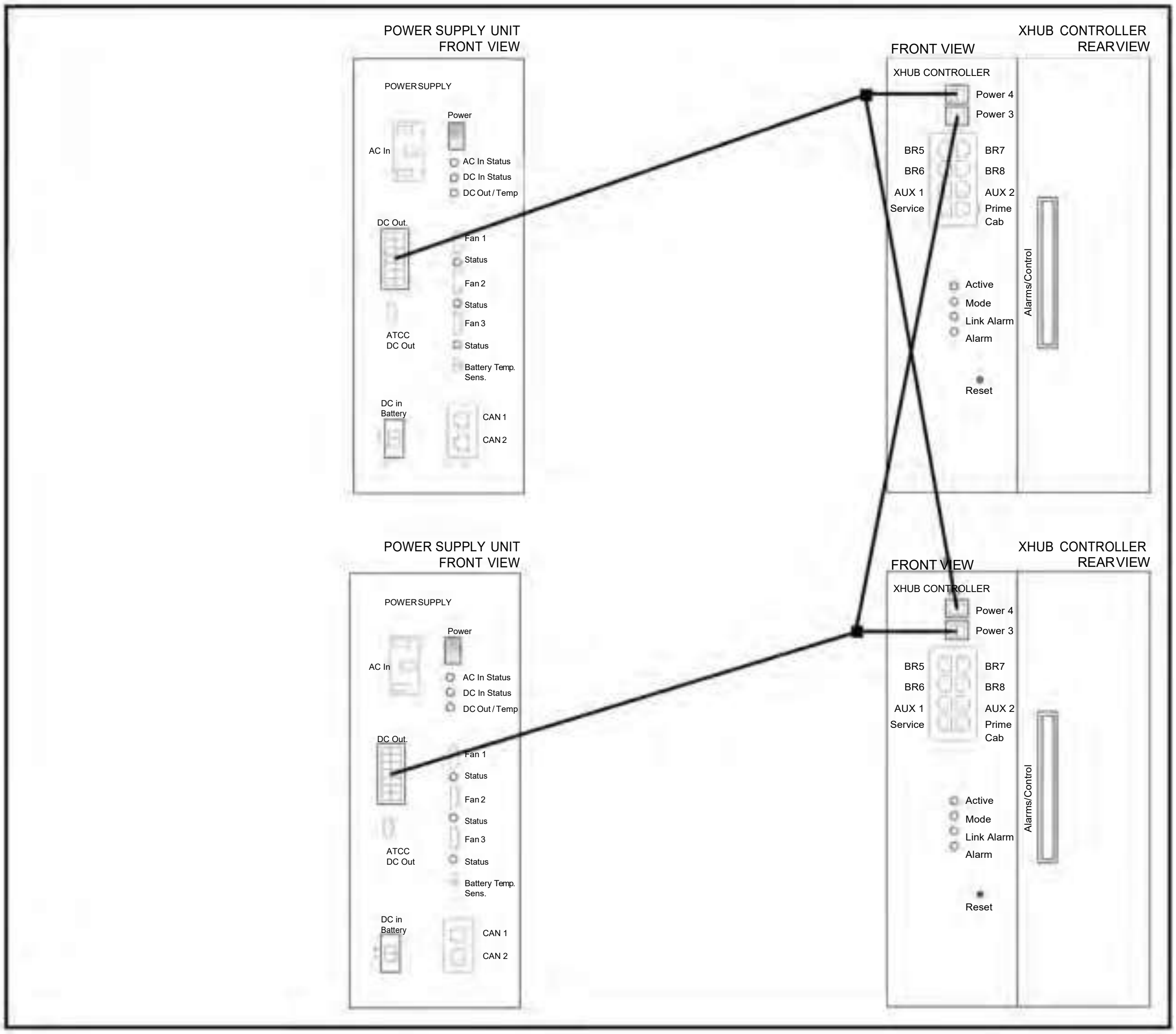
Figure 61: Connections Between Site Controller and XHUB Controller



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 62: Power Connection to the XHUB Controllers



4.7.4
CAN Bus Cabling

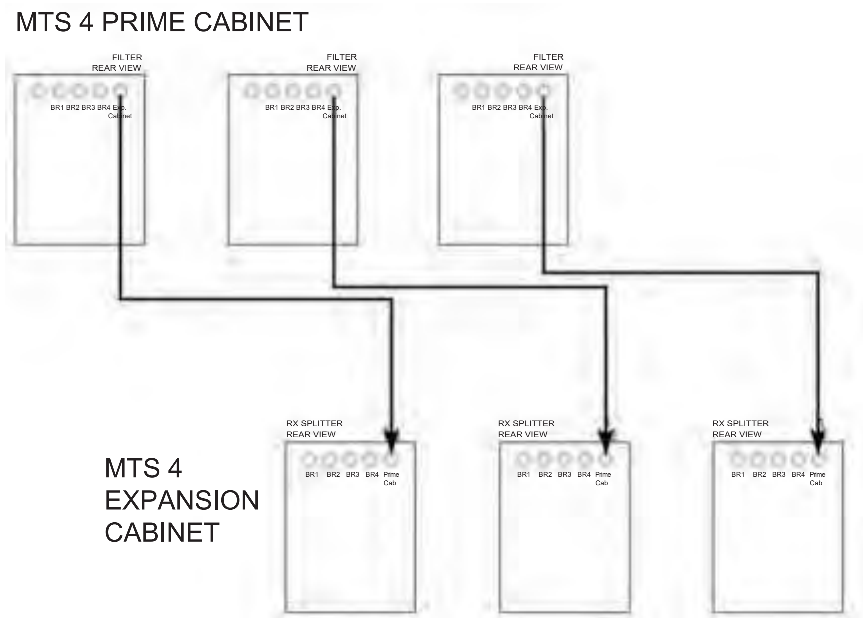
CAN Bus cabling between the MTS 4 Prime Cabinet and the MTS 4 Expansion Cabinet is described in section CAN Bus Cabling – Expansion Cabinet on page 219.

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 63: 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 64: 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 21: 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 65: Remote GPS Receiver Connection on MTS LiTE Junction Panel on page 126 for MTS LiTE, Figure 66: Remote GPS Receiver Connection on MTS 2 Junction Panel on page 126 for MTS 2 and Figure 67: Remote GPS Receiver Connection on MTS 4 Junction Panel on page 126 for MTS 4.

NOTICE: Figure 66: Remote GPS Receiver Connection on MTS 2 Junction Panel on page 126 and Figure 67: Remote GPS Receiver Connection on MTS 4 Junction Panel on page 126 depicts the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 65: Remote GPS Receiver Connection on MTS LiTE Junction Panel

Figure 66: Remote GPS Receiver Connection on MTS 2 Junction Panel

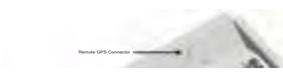


Figure 67: Remote GPS Receiver Connection on MTS 4 Junction Panel

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*.

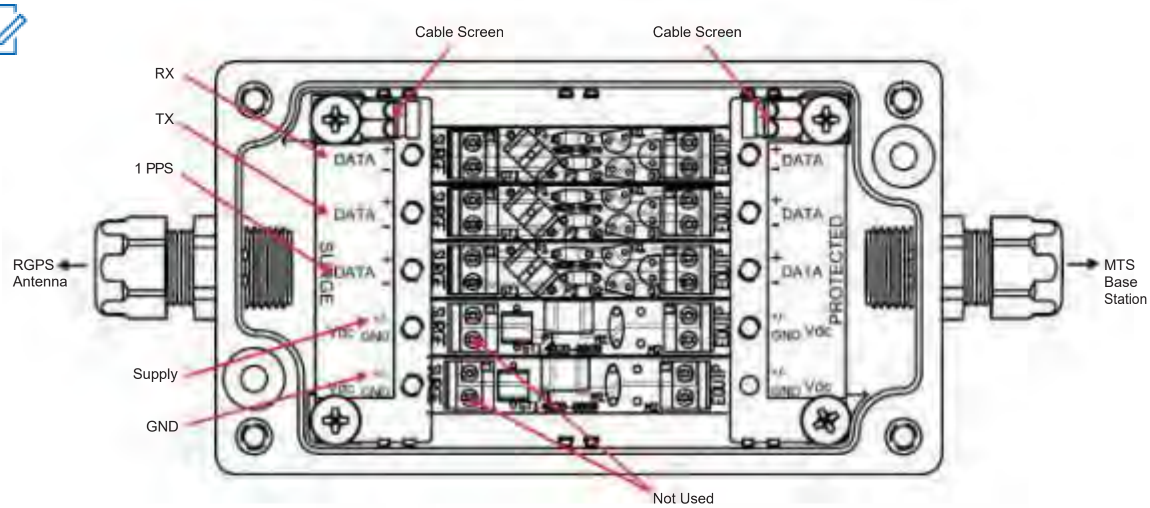
Table 22: RGPS Cables

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 68: 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 69: GPS Site Deutsch Connector no 680023-2212P1 (case-mount)

Figure 70: MTS Site RGPS Connector Pinout no DB15F

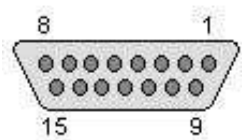


Table 23: RGPS Connector

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
14	1 pps (PPS_P)	TWISTED PAIR	GMDN0889 A	White/Brown stripe	11

MTS Site (15-pin SubD connector)		Description	Surge Protection	GPS Site (12-pin Deutsch connector)	
Pin No.	Description			Color	Pin No.
6	1 pps (PPS_N)		GMDN0889A	Brown/White stripe	12
NC	N/A	TWISTED PAIR	GMDN0889A	Blue/Red stripe	6
NC	N/A		GMDN0889A	Red/Blue stripe	7
1, 7, 8, 9, 15	Not Connected				

See User Alarms/Controls, X.21, RGPS, and GPS Cabling on page 155.

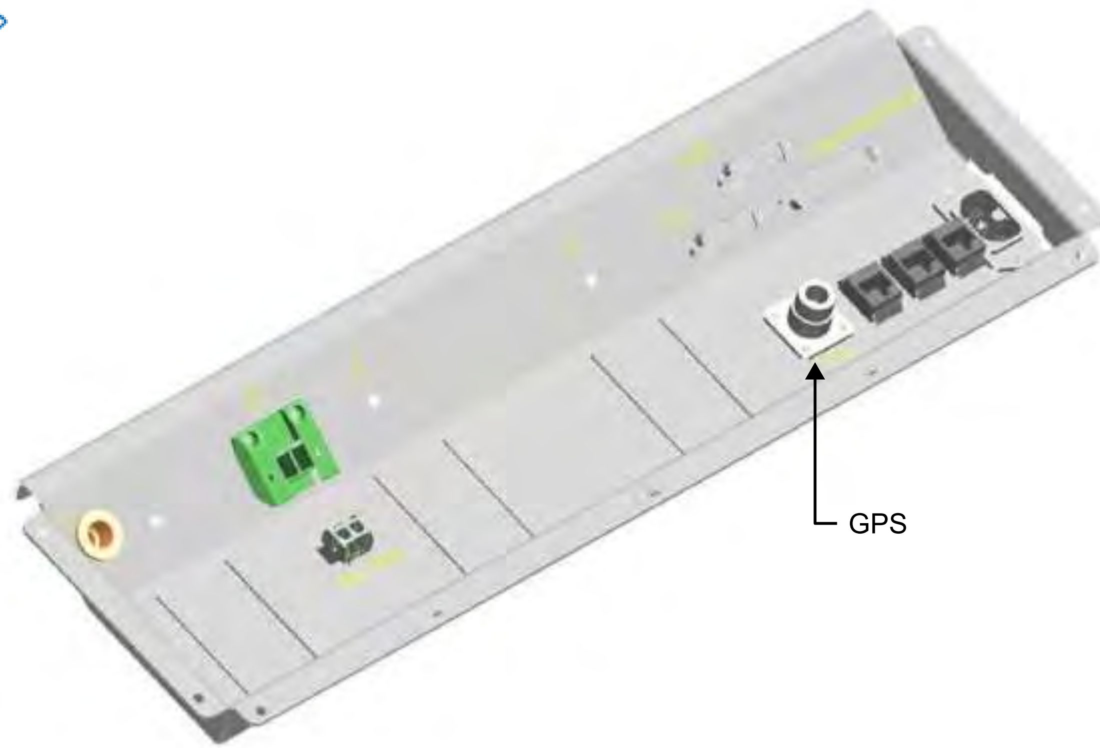
4.8.5
GPS Antenna Connection

The integrated GPS antenna connectors of N type, are placed on the junction panel, see Figure 71: GPS Antenna Connection on MTS LiTE Junction Panel on page 130 for MTS LiTE, Figure 72: GPS Antenna Connection on MTS 2 Junction Panel on page 131 for MTS 2 and Figure 73: GPS Antenna Connection on MTS 4 Junction Panel on page 131 for MTS 4.

NOTICE:
Figure 72: GPS Antenna Connection on MTS 2 Junction Panel on page 131 and Figure 73: GPS Antenna Connection on MTS 4 Junction Panel on page 131 depicts the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 71: GPS Antenna Connection on MTS LiTE Junction Panel

Figure 72: 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 456 in Field Replaceable Units (FRUs) on page 446 for more information.

Figure 73: 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. 1, E1-120Ω Cabling

A cable connects the network termination unit (NTU) and the E1/X.21 interface on the MTS Junction Panel, see Figure 74: E1/X.21 and Ethernet Site Link Connectors on the MTS LiTE Junction Panel on page 132 for MTS LiTE, Figure 75: E1/X.21 and Ethernet Site Link Connectors on the MTS 2 Junction Panel on page 133 for MTS 2 and Figure 76: E1/X.21 and Ethernet Site Link Connectors on the MTS 4 Junction Panel on page 133 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 162 and User Alarms/Controls, X.21, RGPS, and GPS Cabling on page 155 in Interconnection and Internal Cabling on page 149.

NOTICE: Figure 75: E1/X.21 and Ethernet Site Link Connectors on the MTS 2 Junction Panel on page 133 and Figure 76: E1/X.21 and Ethernet Site Link Connectors on the MTS 4 Junction Panel on page 133 depicts the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 74: E1/X.21 and Ethernet Site Link Connectors on the MTS LiTE Junction Panel

Figure 75: E1/X.21 and Ethernet Site Link Connectors on the MTS 2 Junction Panel

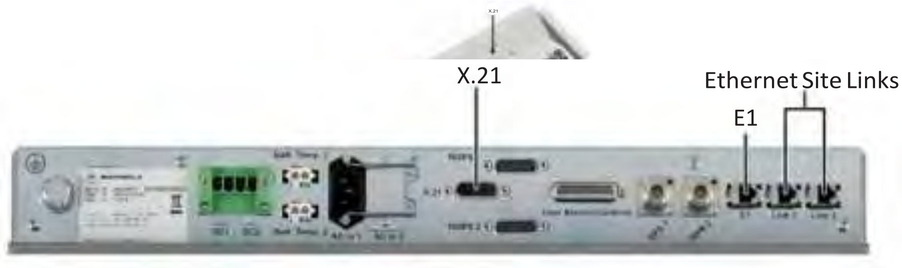


Figure 76: E1/X.21 and Ethernet Site Link Connectors on the MTS 4 Junction Panel

> **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 24: Site Link Connector E1 on Junction Panel on page 133 and Table 25: Site Link Connector X.21 on Junction Panel on page 134 show the pin assignment for E1 and X.21 connection.

The E1 connector described in Table 24: Site Link Connector E1 on Junction Panel on page 133 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 77: Site Link Connector E1 Pinout

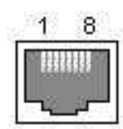


Table 24: Site Link Connector E1 on Junction Panel

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 78: Site Link Connector X.21 Pinout

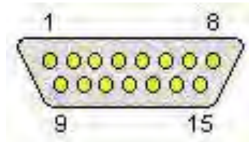


Table 25: Site Link Connector X.21 on Junction Panel

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

Figure 80: 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 135.

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 167.

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 26: 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
- **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 45: Ethernet Site Link Cabling for MTS 2 on page 168 and Figure 101: Ethernet Site Link Cabling for MTS 2 on page 169.

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 45: Ethernet Site Link Cabling for MTS 2 on page 168 and Figure 101: Ethernet Site Link Cabling for MTS 2 on page 169.

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 46: Ethernet Site Link Cabling for MTS 4 with Single Site Controller on page 169 and Figure 102: Ethernet Site Link Cabling for MTS 4 with Single Site Controller on page 171 for further cabling and connections.
    - For configurations with dual Site Controller, follow Table 47: Ethernet Site Link Cabling for MTS 4 with Dual Site Controller on page 172 and Figure 103: Ethernet Site Link Cabling for MTS 4 with Dual Site Controller on page 173 for further cabling and connections.

NOTICE: In Table 46: Ethernet Site Link Cabling for MTS 4 with Single Site Controller on page 169 and Table 47: Ethernet Site Link Cabling for MTS 4 with Dual Site Controller on page 172; and Figure 102: Ethernet Site Link Cabling for MTS 4 with Single Site Controller on page 171 and Figure 103: Ethernet Site Link Cabling for MTS 4 with Dual Site Controller on page 173**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 48: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Single Site Controller on page 174 and Figure 104: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Single Site Controller on page 175 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 48: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Single Site Controller on page 174 and Figure 104: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Single Site Controller on page 175 for further cabling and connections.
   - For configurations with dual Site Controller, follow Table 49: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Dual Site Controller on page 175 and Figure 105: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Dual Site Controller on page 177 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 82: MTS 2 Junction Panel Alarm Wiring Connection on page 138 and Figure 83: MTS 4 Junction Panel Alarm Wiring Connection on page 139 depicts the newer version of the MTS Junction Panel. There may be small differences in older configurations.

Figure 81: MTS LiTE Junction Panel Alarm Wiring Connection

Figure 82: MTS 2 Junction Panel Alarm Wiring Connection

Figure 83: MTS 4 Junction Panel Alarm Wiring Connection

Figure 84: External Alarm Connector Pinout

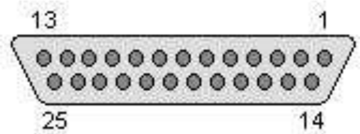


Table 27: External Alarm Connector

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 155.

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 140.
2. Power-up the MTS and the Expansion Cabinet.

   See Powering Up the MTS on page 140.

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 333.

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 28: 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 29: 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 301
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 30: 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 31: 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 32: 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 85: MTS LiTE Screws Positions

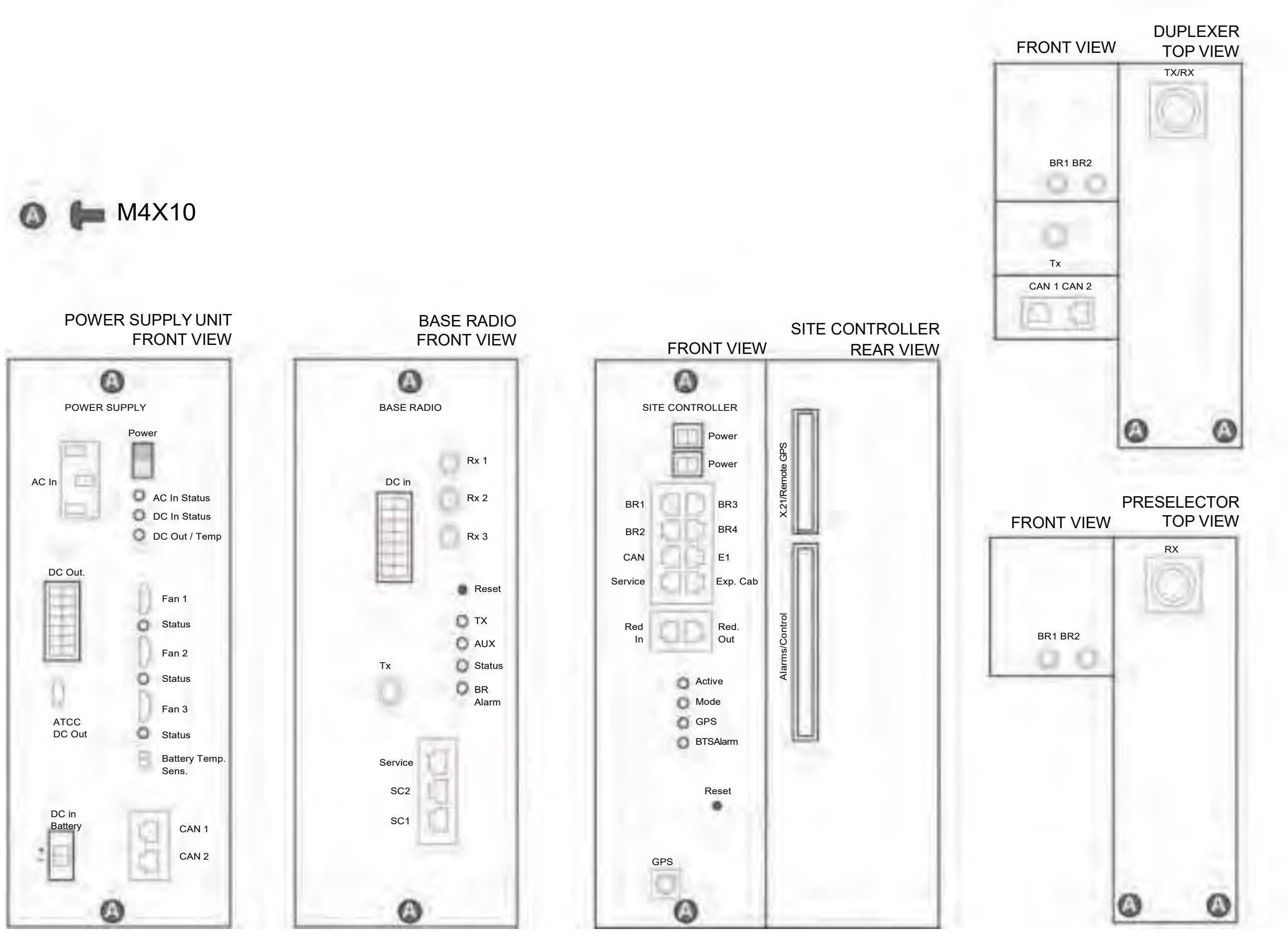


Figure 86: MTS 2 Screws Positions

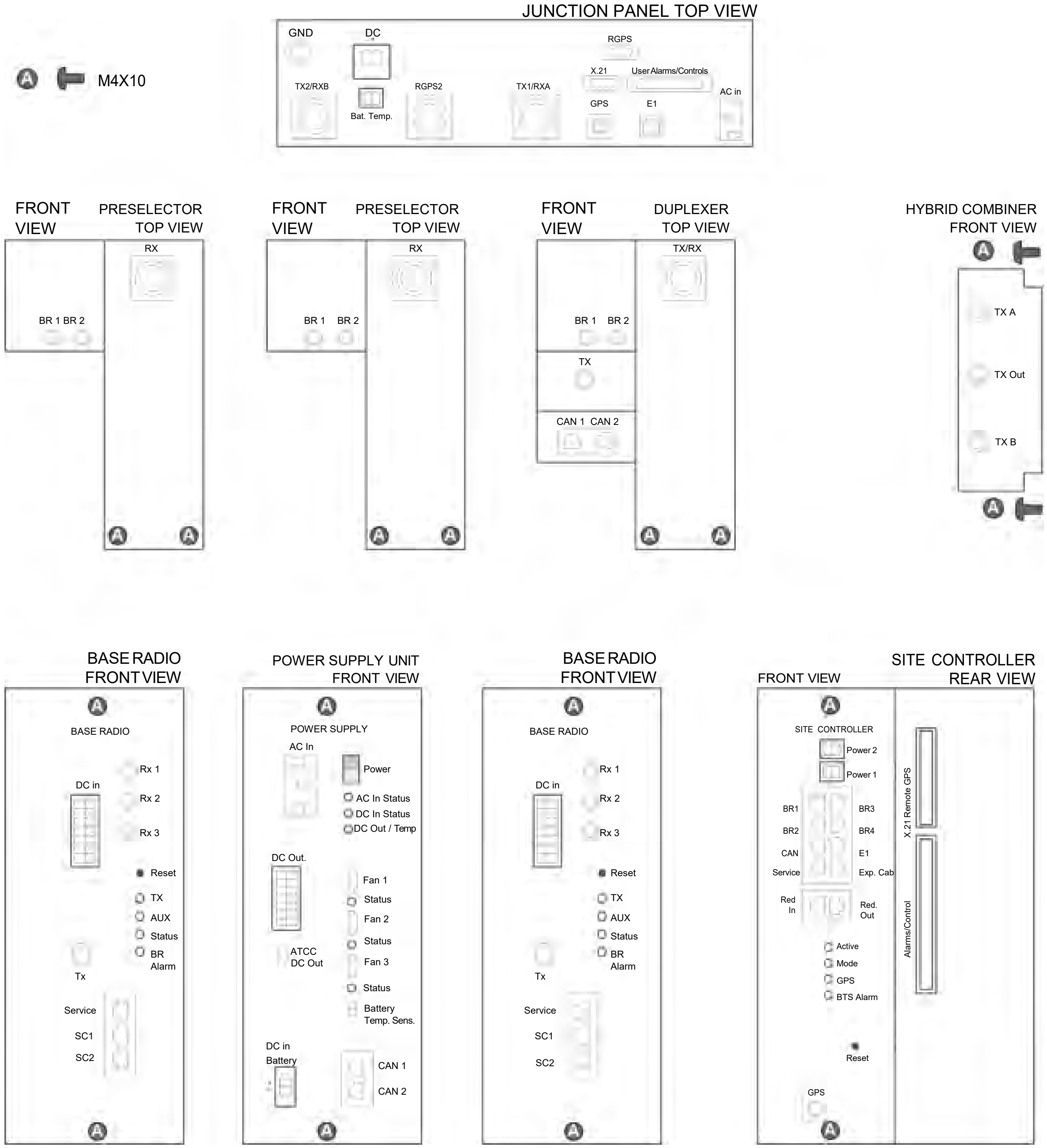


Figure 87: MTS 4 Screws Positions

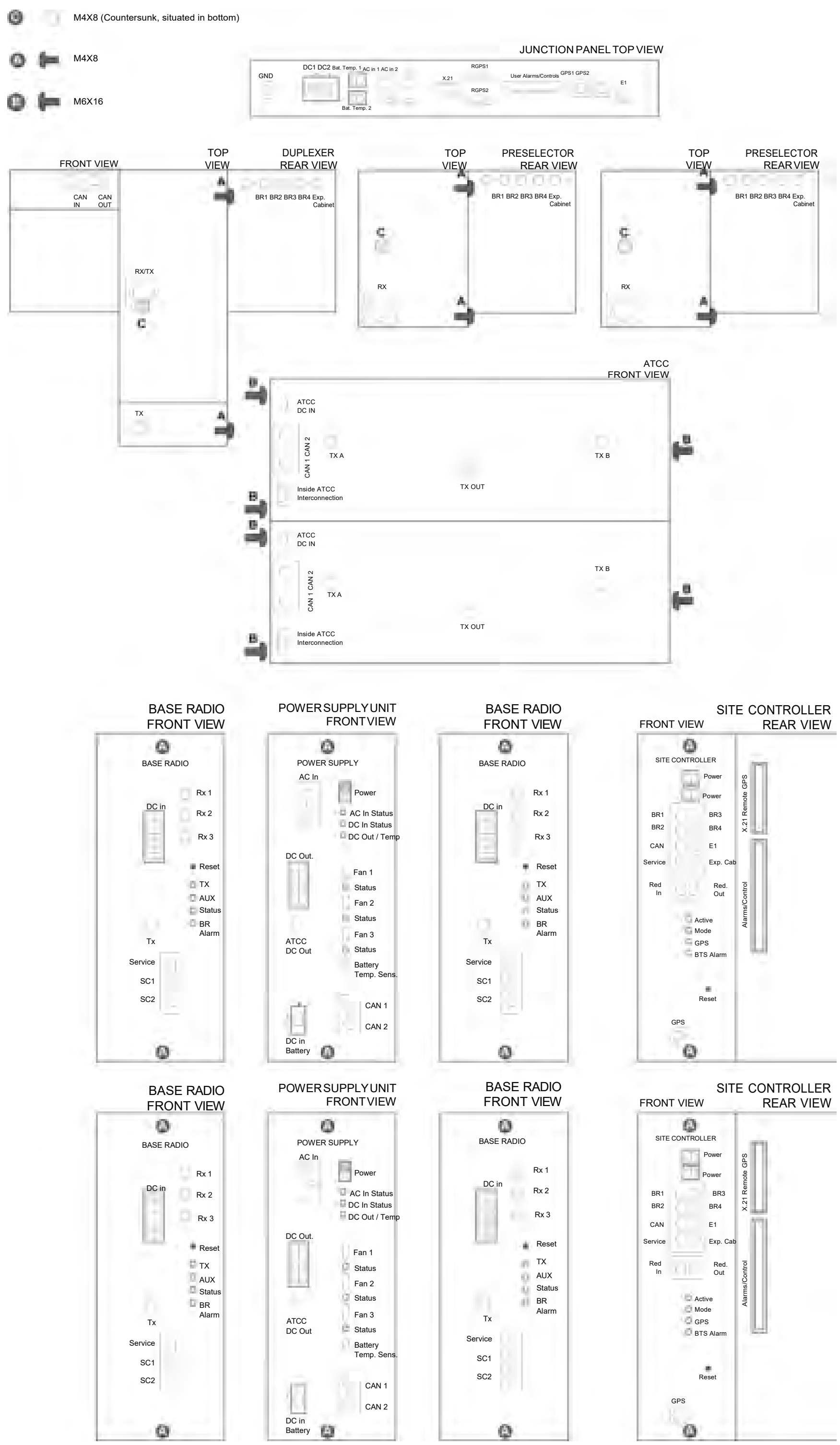
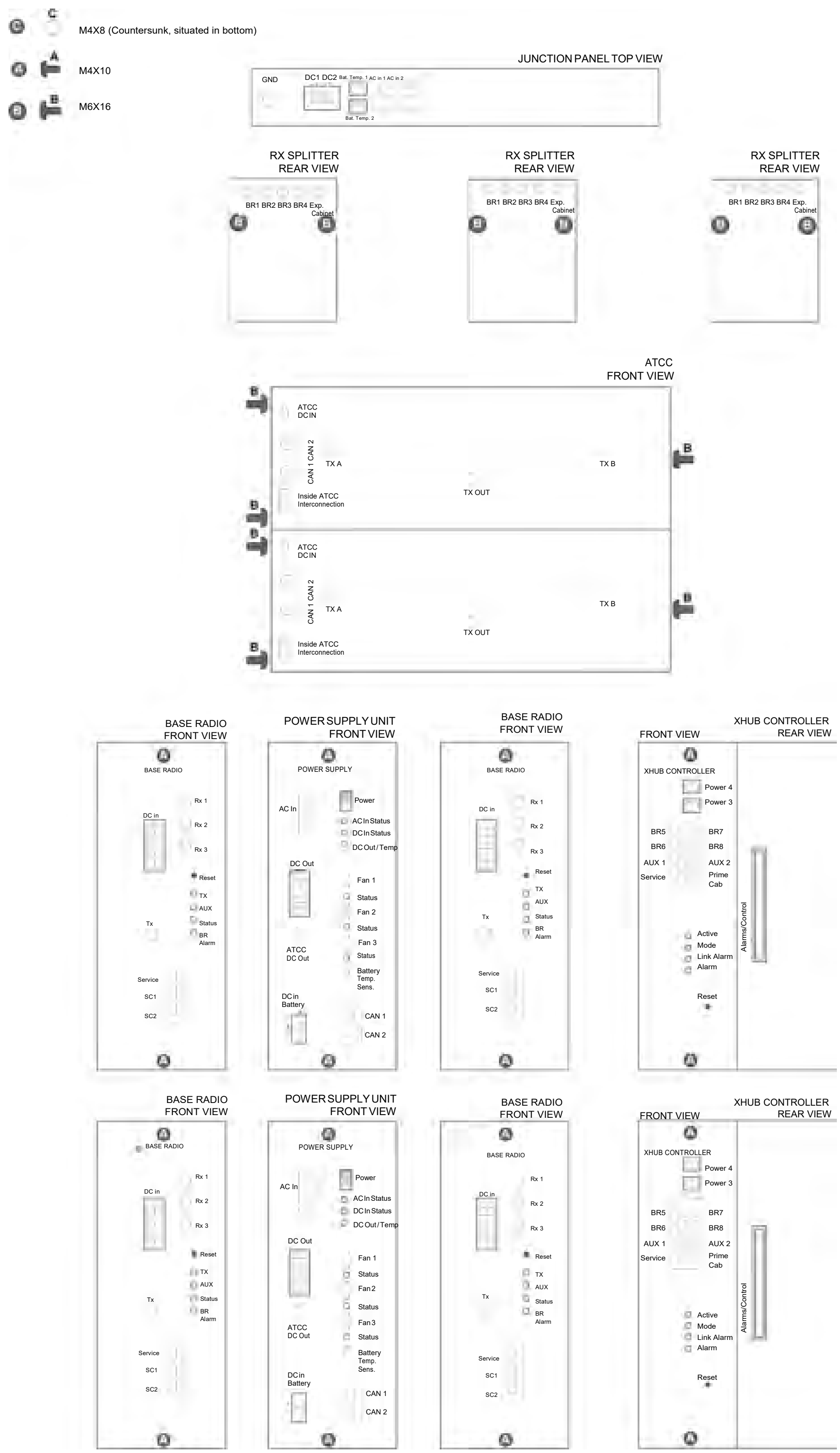


Figure 88: Expansion Cabinet Screw Positions



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.

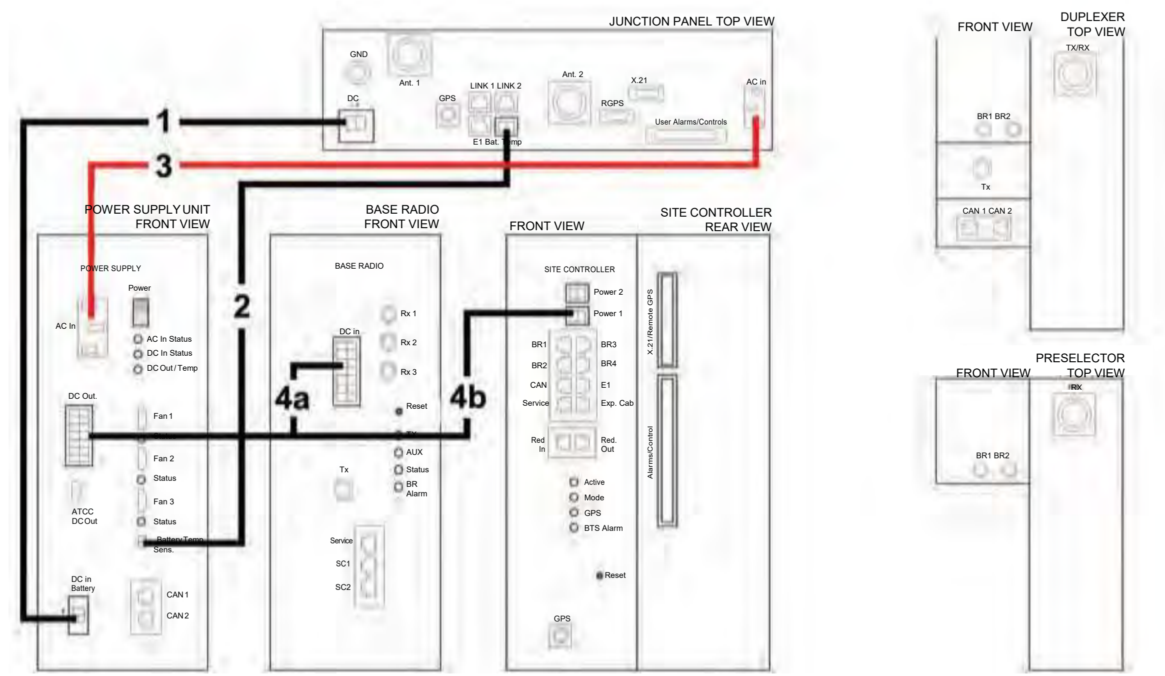
DC power cabling refers to the power connections between the Junction Panel and the Power Supply Unit and between the Power Supply Unit and other modules within the cabinet.

5.1.1 AC/DC Power Cabling – MTS LiTE

Table 33: 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 89: AC/DC Power Cabling Diagram for MTS LiTE



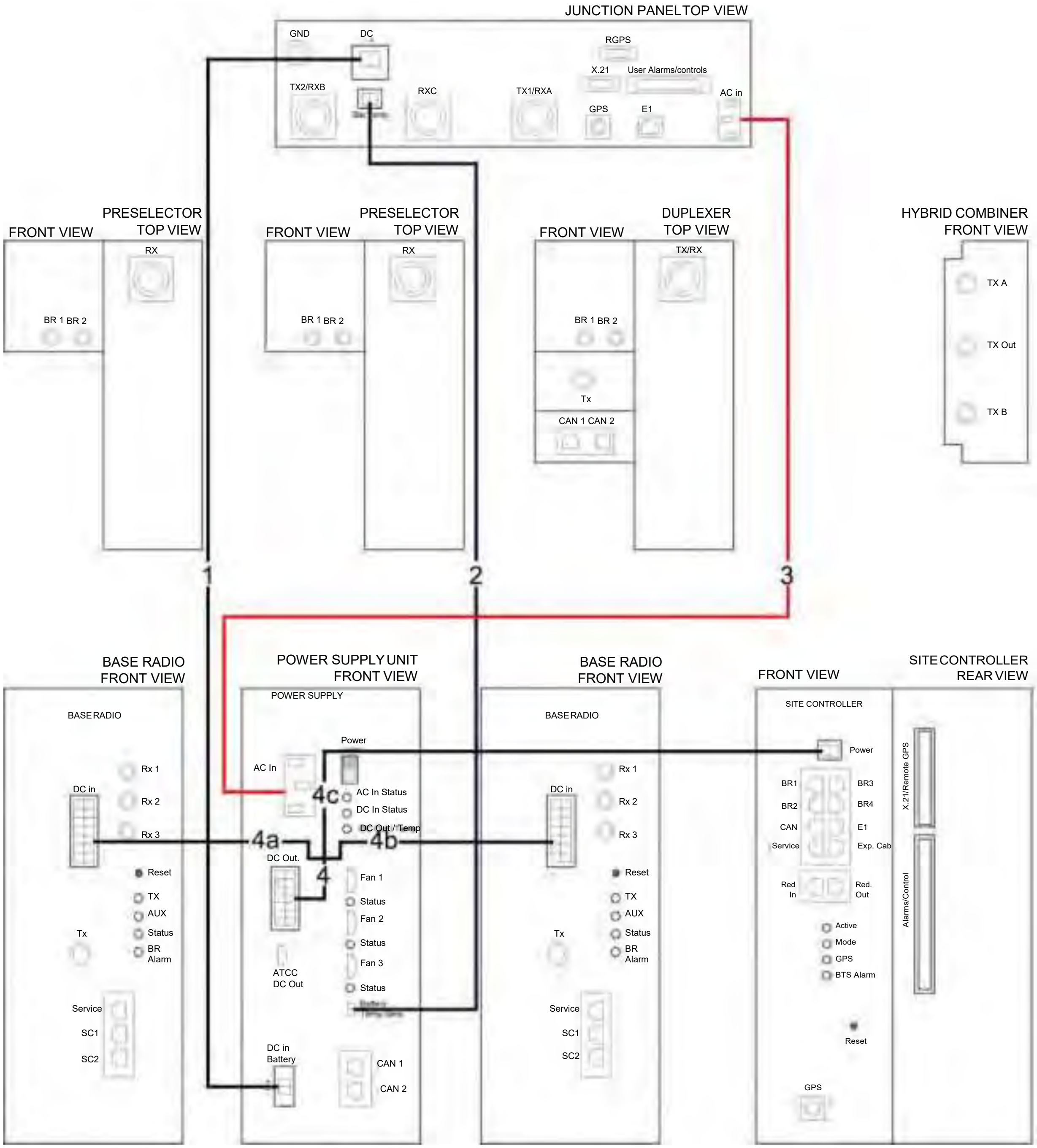
5.1.2

AC/DC Power Cabling – MTS 2

Table 34: 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 90: AC/DC Power Cabling Diagram for MTS 2



5.1.3

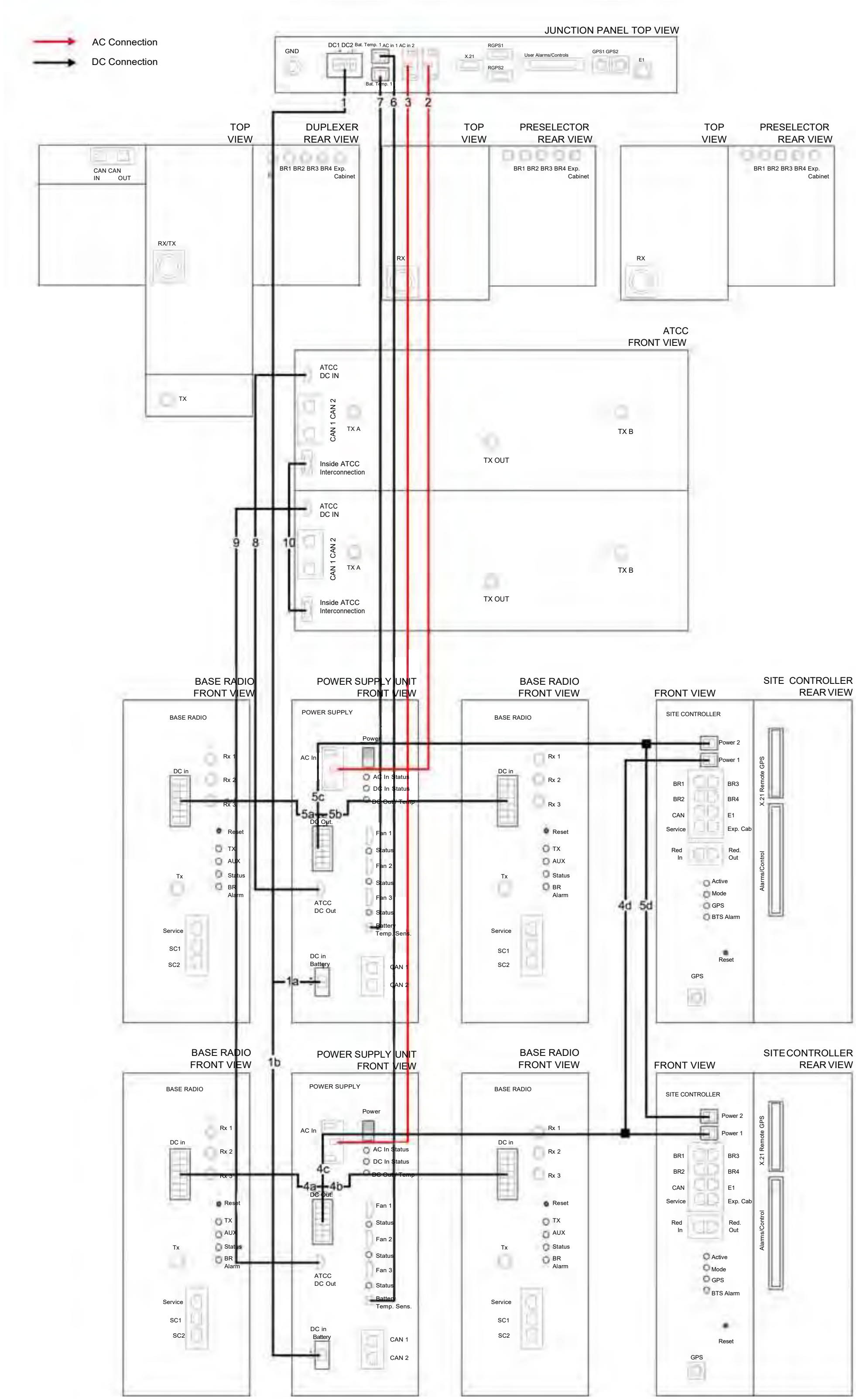
AC/DC Power Cabling – MTS 4

Table 35: 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

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1b		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			Base Radio 2/ DCIn	Pins: 4, 5, 6, 9, 12, and 13
4c			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			Base Radio 4/ DCIn	Pins: 4, 5, 6, 9, 12, and 13
5c			Y Splitter	Pins: 7, 14
5d	3066574B01	Splitter	Site Controller 1/ Power 2 Site Controller 2/ Power 1	
6	3066556B02	Junction Panel/ Bat-Temp. 1	Power Supply Unit 1/ BatteryTemp.Sens.	N/A
7	3066556B02	Junction Panel/ Bat-Temp. 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 91: AC/DC Power Cabling Diagram for MTS 4

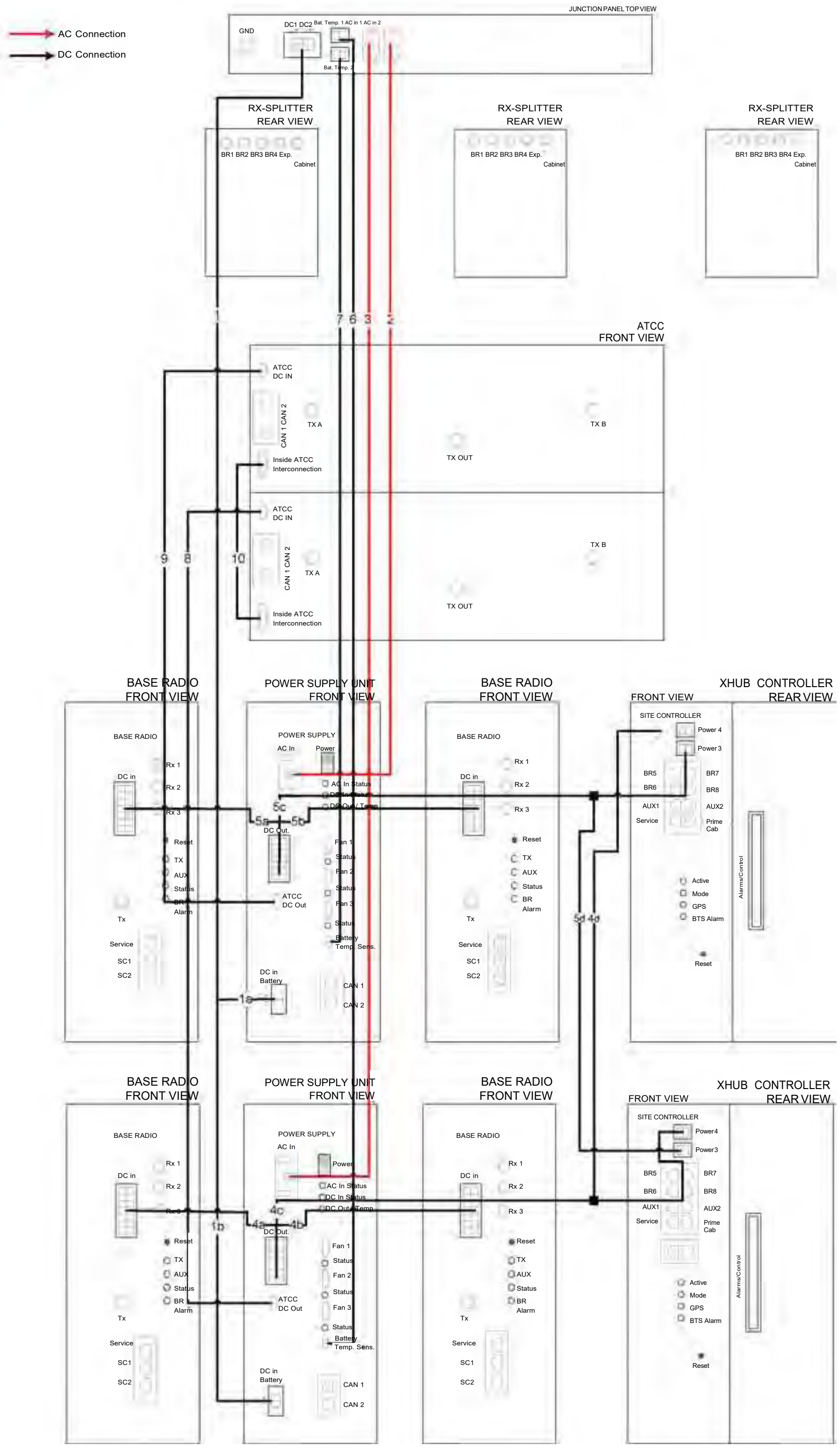


5.1.4
AC/DC Power Cabling – Expansion Cabinet

Table 36: 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 92: 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.

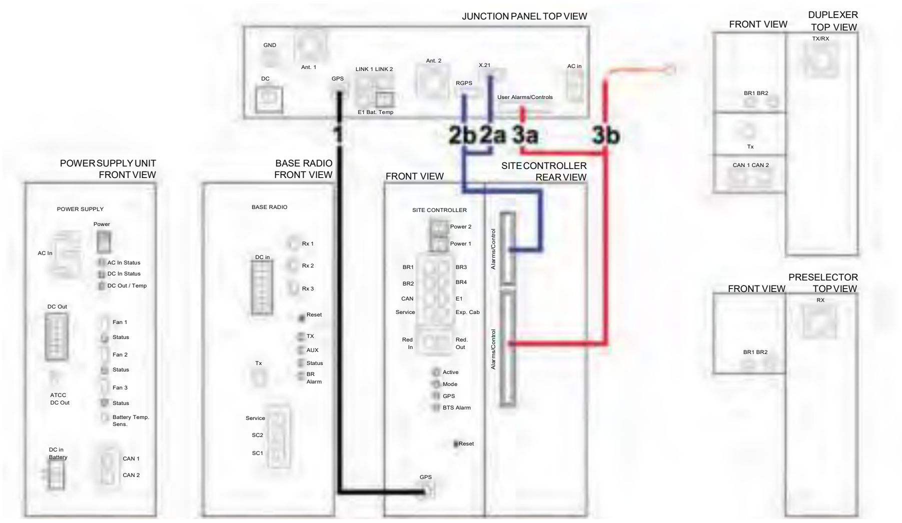
5.2.1

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

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

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

Figure 93: User Alarms/Controls, X.21, RGPS, and GPS Cabling Diagram for MTS LiTE



5.2.2

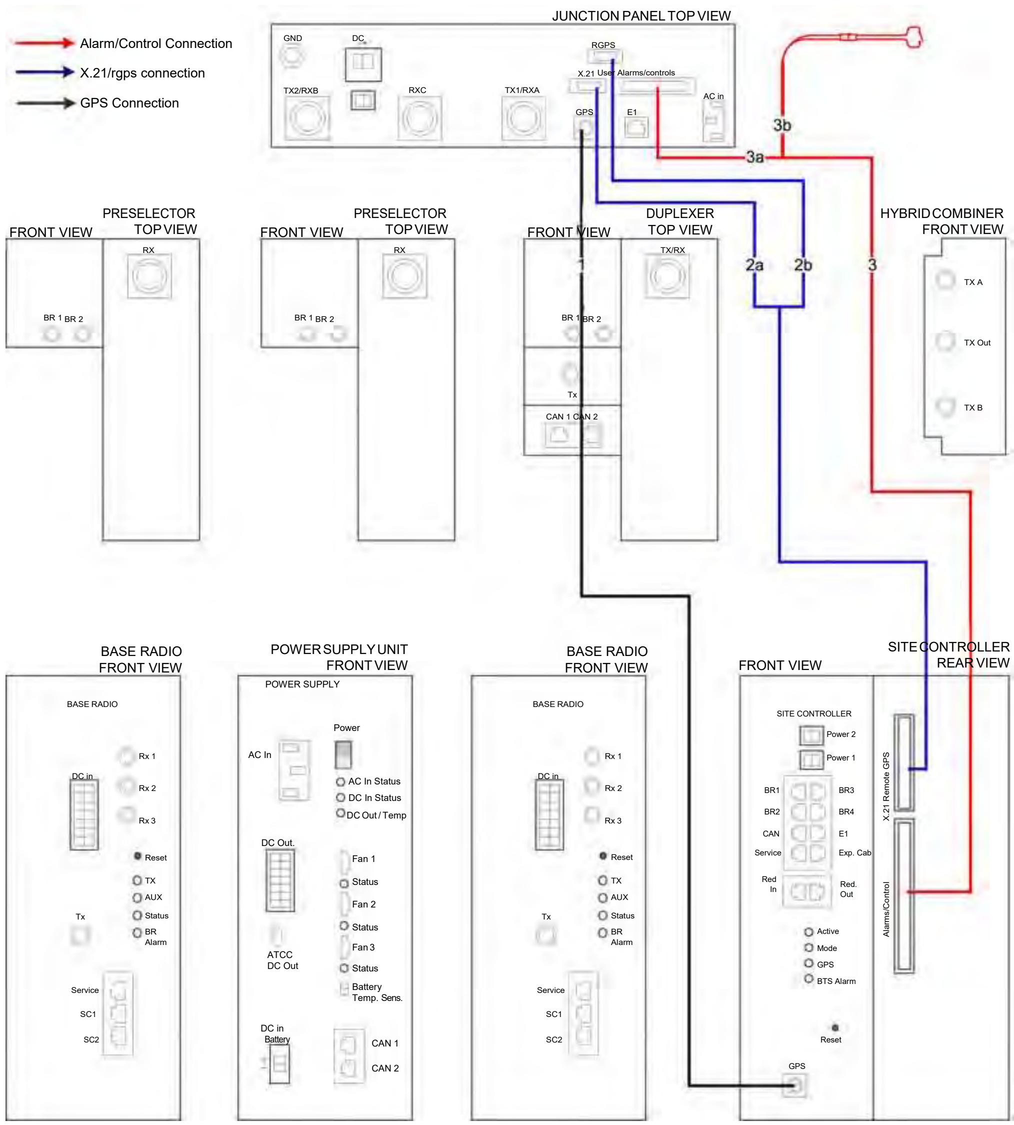
User Alarms/Controls, X.21, RGPS, and GPS Cabling – MTS 2

Table 38: 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
MTS 2 with Internal GPS and E1				
1	3066543B 07	Junction Panel/ GPS	Site Controller/ GPS	Coax cable

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
3a	3066549B01	Junction Panel/ User Alarms/ Controls	Site Controller/ Alarm/Controls	25 pin D female connector type
3b		Door Alarm		Molex connector type

Figure 94: User Alarms/Controls, X.21, RGPS, and GPS Cabling Diagram for MTS 2



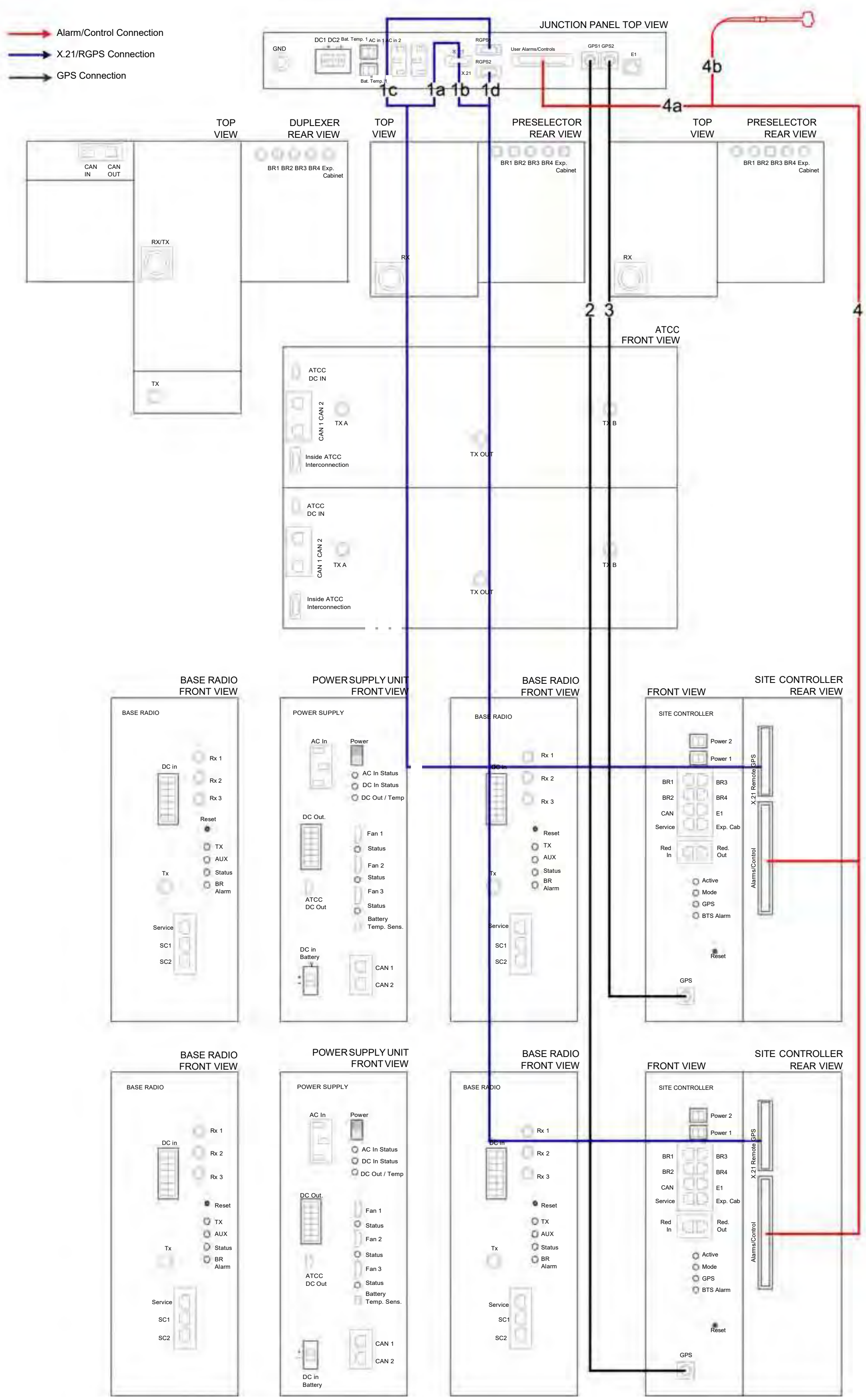
5.2.3
User Alarms/Controls, X.21, RGPS, and GPS Cabling –MTS 4

Table 39: 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 1b		Junction Panel/ X.21		15 pin D female connector type
1d		Junction Panel/ RGPS 2	Site Controller2/ X.21/Remote GPS	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 95: 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.

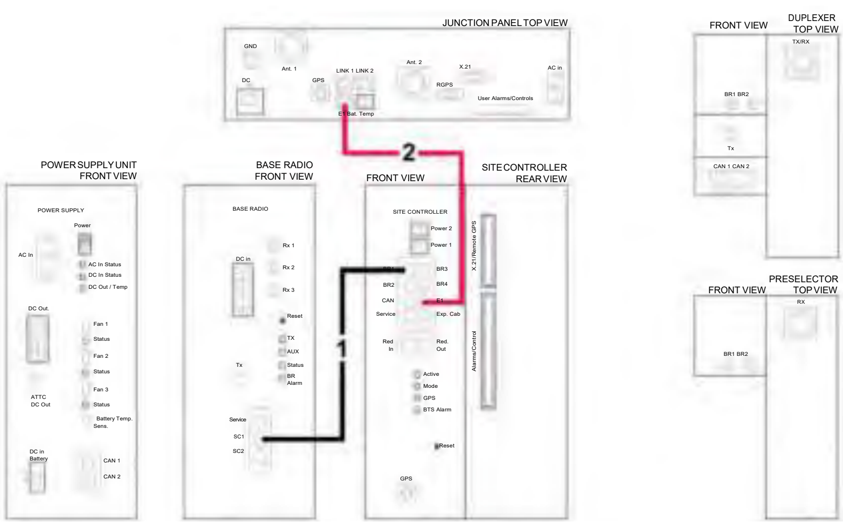
NOTICE: Either E1 or X.21 cabling is used, depending on which option is ordered.

5.3.1
E1 and Ethernet Cabling – MTS LiTE

Table 40: 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 96: E1 and Ethernet Cabling Diagram for MTS LiTE



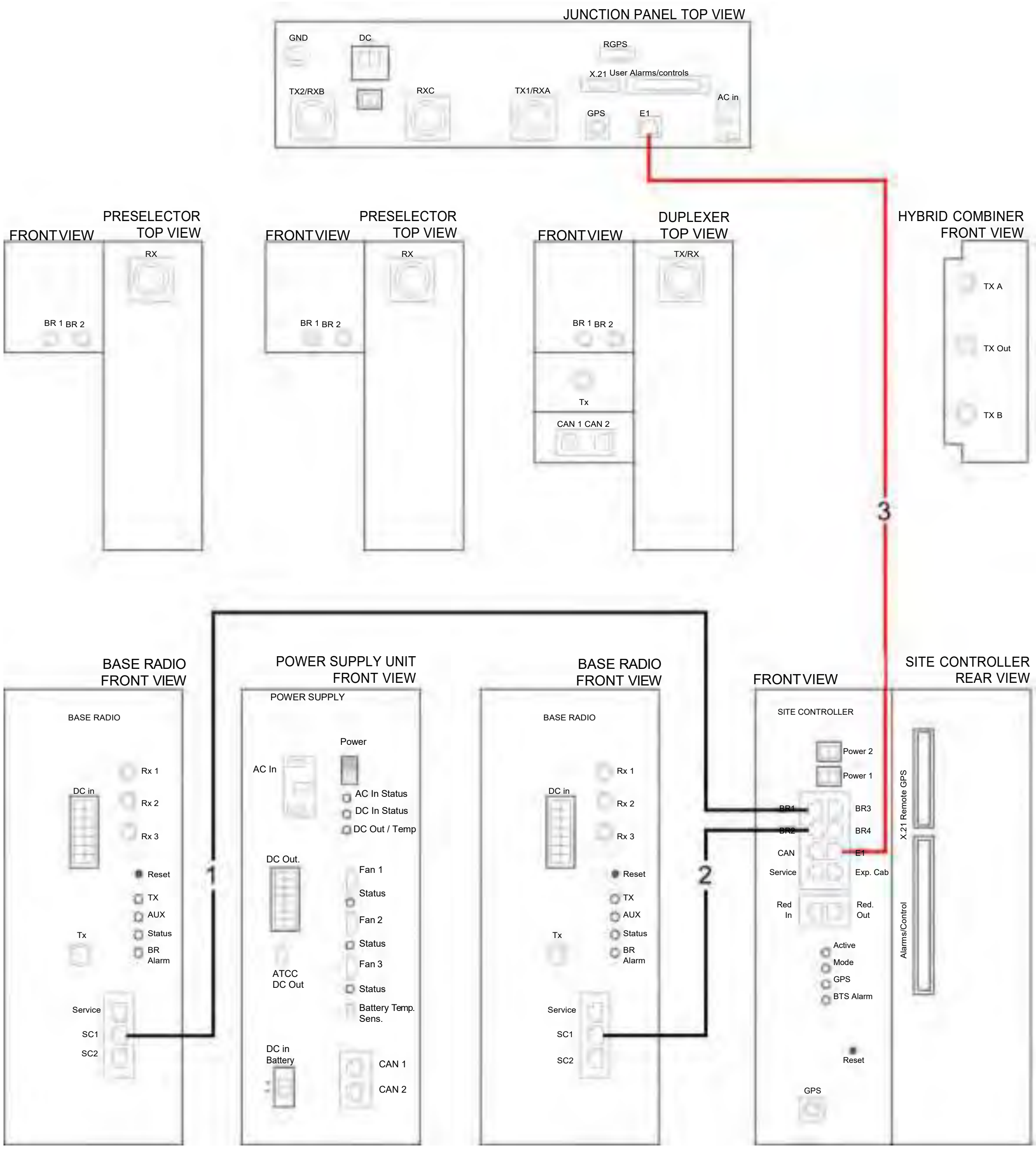
5.3.2
E1 and Ethernet Cabling – MTS 2

Table 41: 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 97: E1 and Ethernet Cabling Diagram for MTS 2

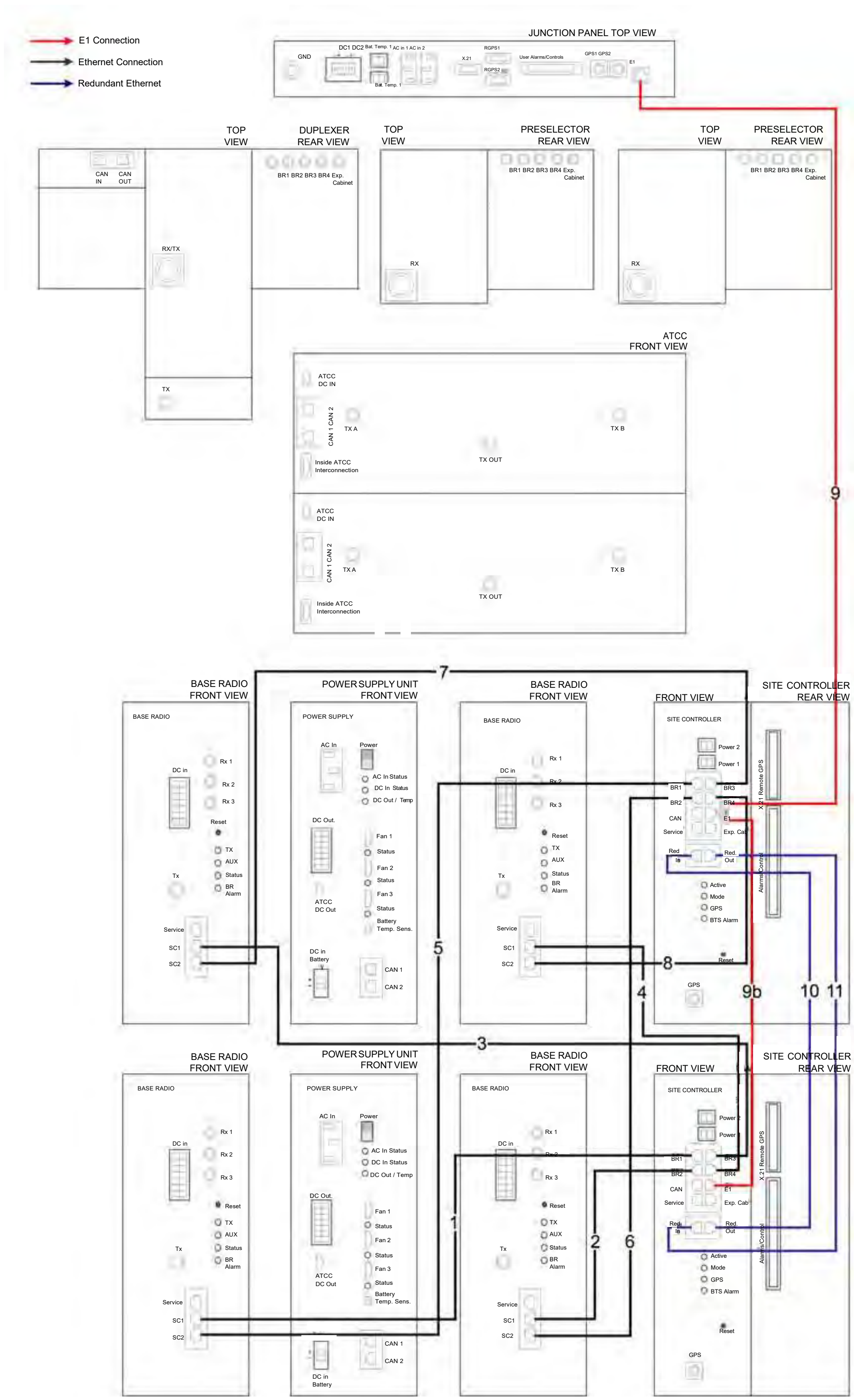


5.3.3
E1 and Ethernet Cabling – MTS 4

Table 42: 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 98: E1 and Ethernet Cabling Diagram for MTS 4

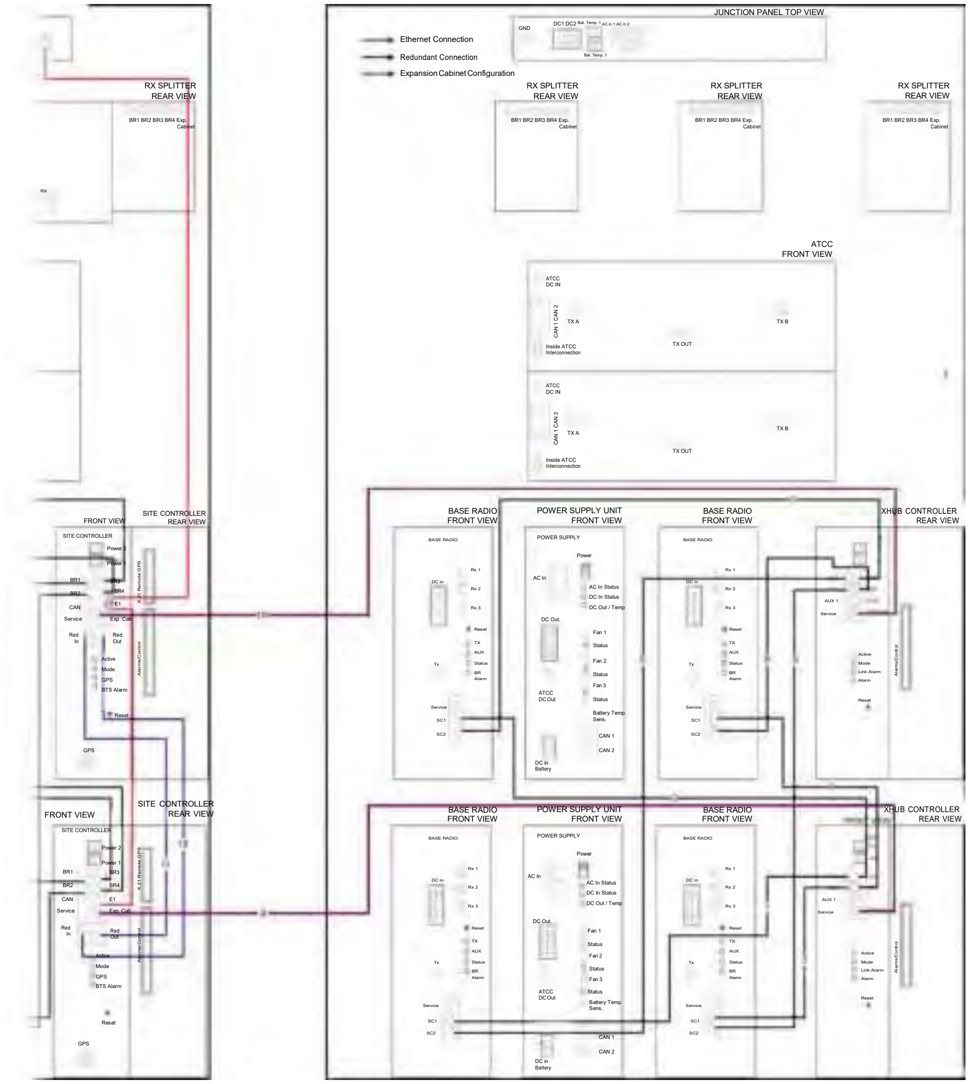


5.3.4
E1 and Ethernet Cabling – Expansion Cabinet

Table 43: E1 and Ethernet Cabling for Expansion Cabinet

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
1	3066544B 01	Base Radio 5 / SC 1	XHUB 1 / BR5	Ethernet link / Grey cable
2	3066544B 02	Base Radio 6 / SC 1	XHUB 1 / BR6	Ethernet link / Black cable
3	3066544B 04	Base Radio 7 / SC 1	XHUB 1 / BR7	Ethernet link / Grey cable
4	3066544B 05	Base Radio 8 / SC 1	XHUB 1 / BR8	Ethernet link / Black cable
5	3066544B 15	Base Radio 5 / SC 2	XHUB 2 / BR5	Ethernet link / Grey cable, Only for configuration with redundant Site Controller
6	3066544B 16	Base Radio 6 / SC 2	XHUB 2 / BR6	Ethernet link / Black cable, Only for configuration with redundant Site Controller
7	3066544B 01	Base Radio 7 / SC 2	XHUB 2 / BR7	Ethernet link / Grey cable, Only for configuration with redundant Site Controller
8	3066544B 02	Base Radio 8 / SC 2	XHUB 2 / BR8	Ethernet link / Black cable, Only for configuration with redundant Site Controller
9	3066544B 12	Site Controller 1 / Exp Cab	XHUB 1 / Prime Cab	Routed through conjunction hole at the side of the cabinet
10	3066544B 12	Site Controller 2 / Exp Cab	XHUB 2 / Prime Cab	Routed through conjunction hole at the side of the cabinet
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 99: 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 135.

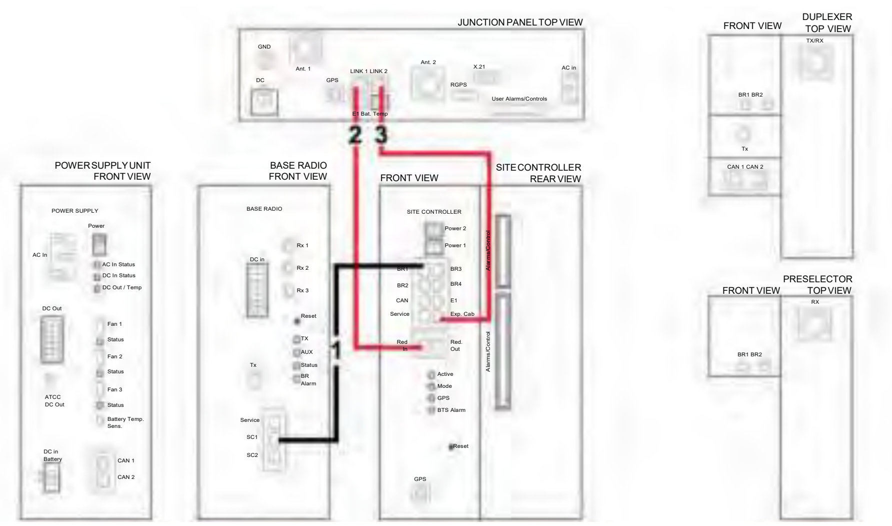
With such in place, see tables and figures below for configuration.

5.4.1 Ethernet Site Link Cabling – MTS LiTE

Table 44: Ethernet Site Link 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	30015009009	Site Controller/ Red In	Junction Panel/ Link1	Ethernet link
3	30015009010	Site Controller/ Exp Cab	Junction Panel/ Link2	Ethernet link / Only in Dual Enet Configuration

Figure 100: Ethernet Site Link Cabling for MTS LiTE

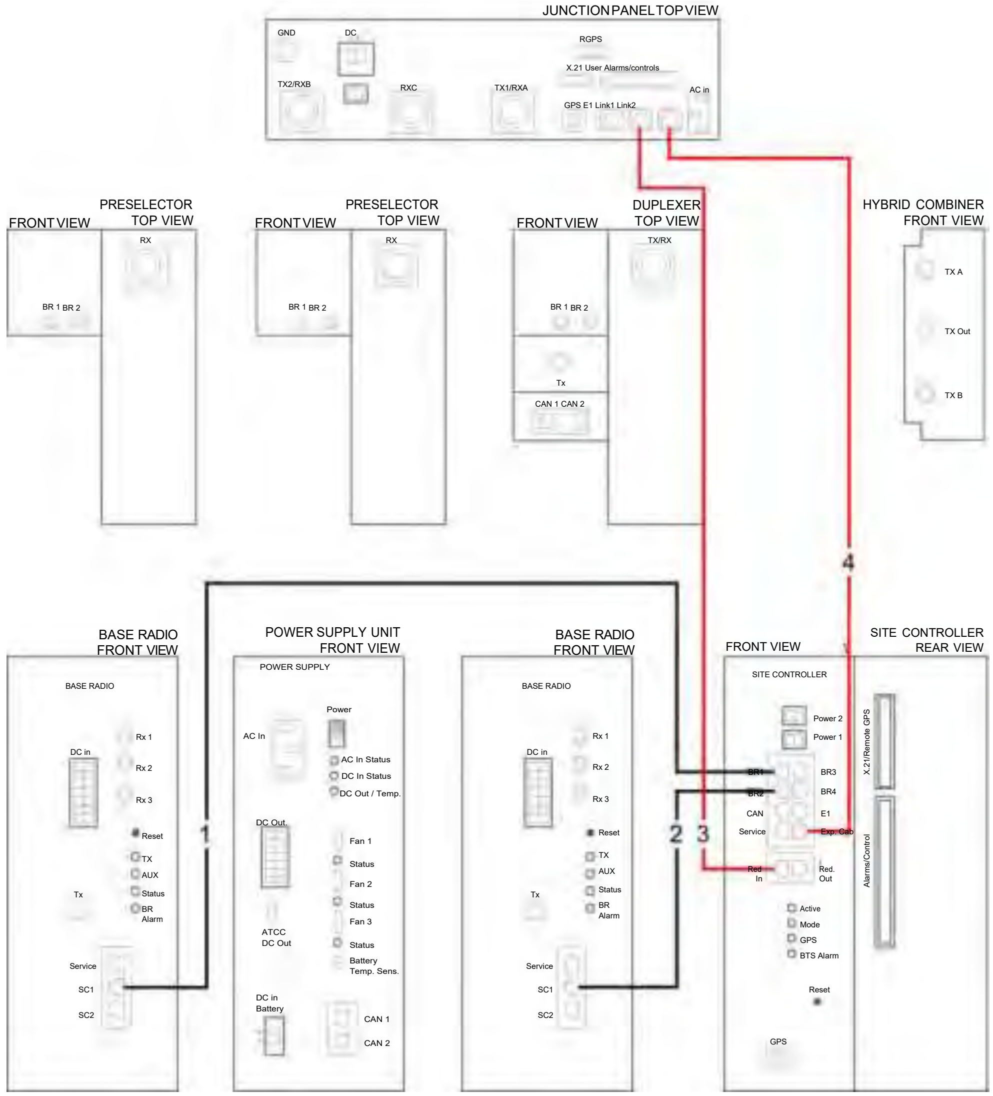


5.4.2 Ethernet Site Link Cabling – MTS 2

Table 45: 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 101: Ethernet Site Link Cabling for MTS 2



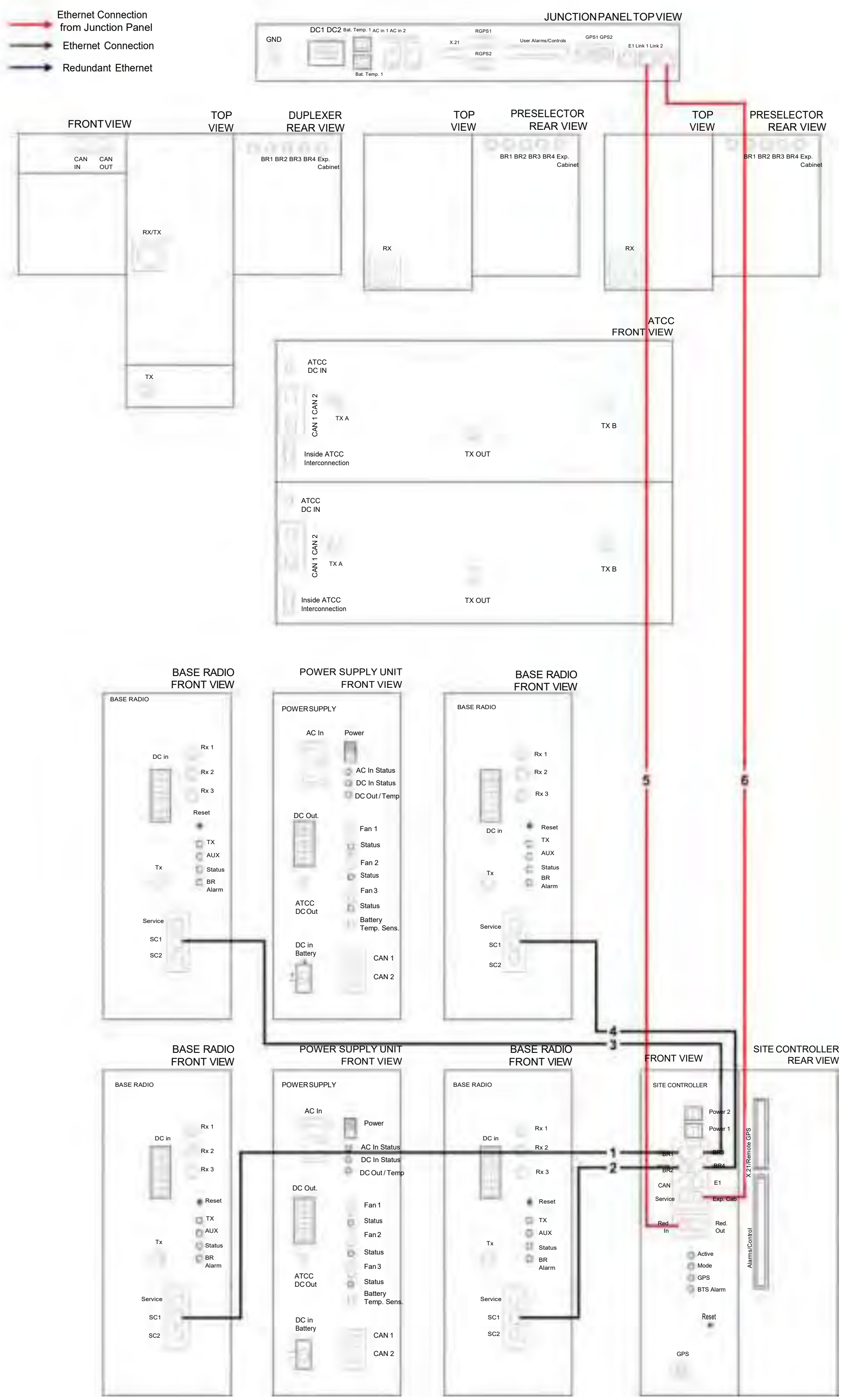
5.4.3
Ethernet Site Link Cabling – MTS 4 with Single Site Controller

Table 46: 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

Index	Cable Part Number	From Unit/ Connection Name	To Unit/ Connection Name	Notes
5	3066562B 01	Junction Panel/ Link1	RJ45 coupler	Bend Link breakout and insert RJ45 coupler.
	300150090 01	RJ45 coupler	Site Controller 1/ Red In	Ethernet link
6	3066562B 01	Junction Panel/ Link2	RJ45 coupler	Bend Link breakout and insert RJ45 coupler.
	300150090 03	RJ45 coupler	Site Controller 1/ Exp Cab	Ethernet link / Only in Dual Enet Configuration

Figure 102: Ethernet Site Link Cabling for MTS 4 with Single Site Controller

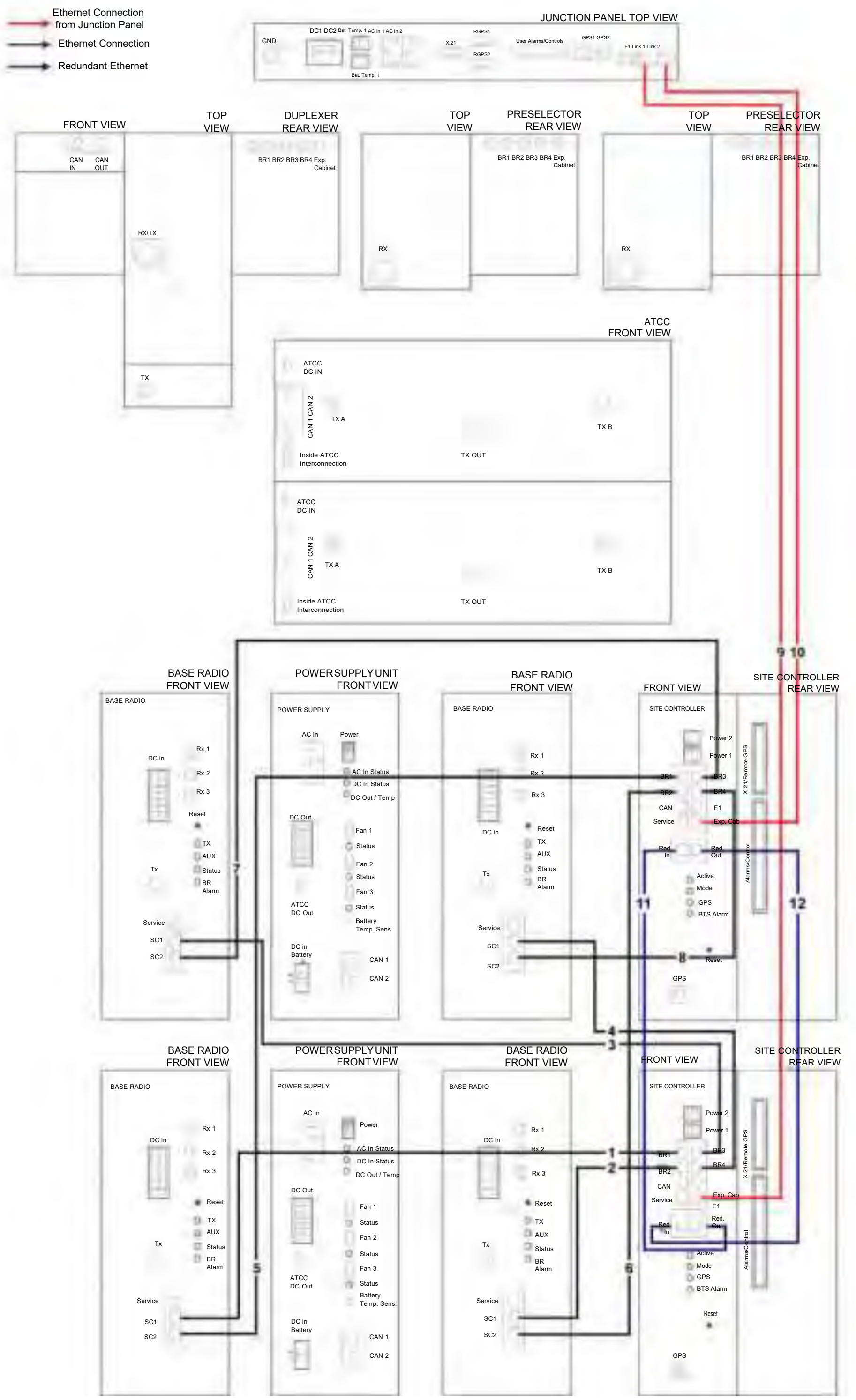


5.4.4 Ethernet Site Link Cabling – MTS 4 with Dual Site Controller

Table 47: 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 103: Ethernet Site Link Cabling for MTS 4 with Dual Site Controller

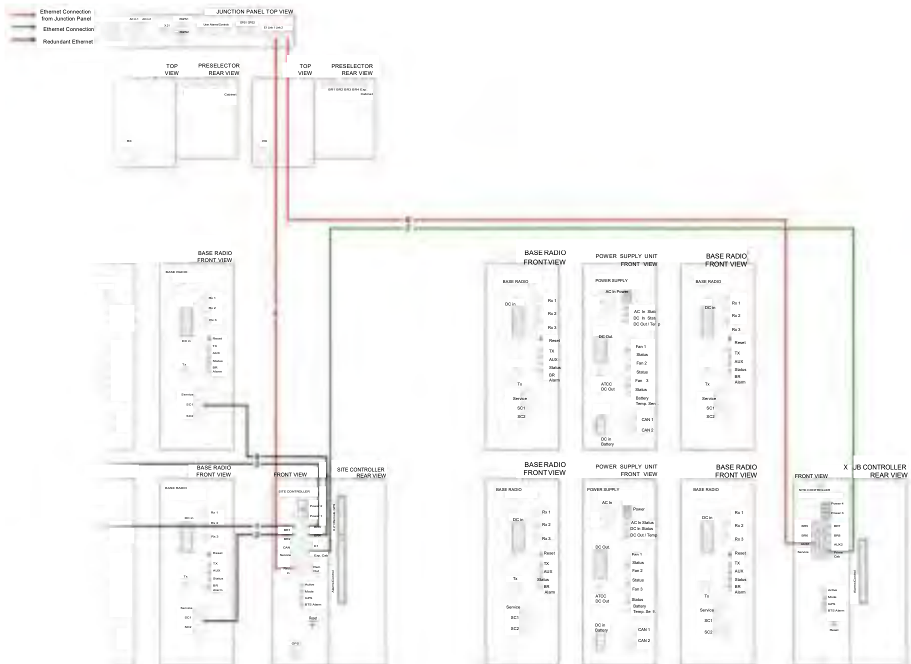


5.4.5 Ethernet Site Link Cabling – MTS 4 Expansion Cabinet with Single Site Controller

Table 48: 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 104: Ethernet Site Link Cabling for MTS 4 Expansion Cabinet with Single Site Controller



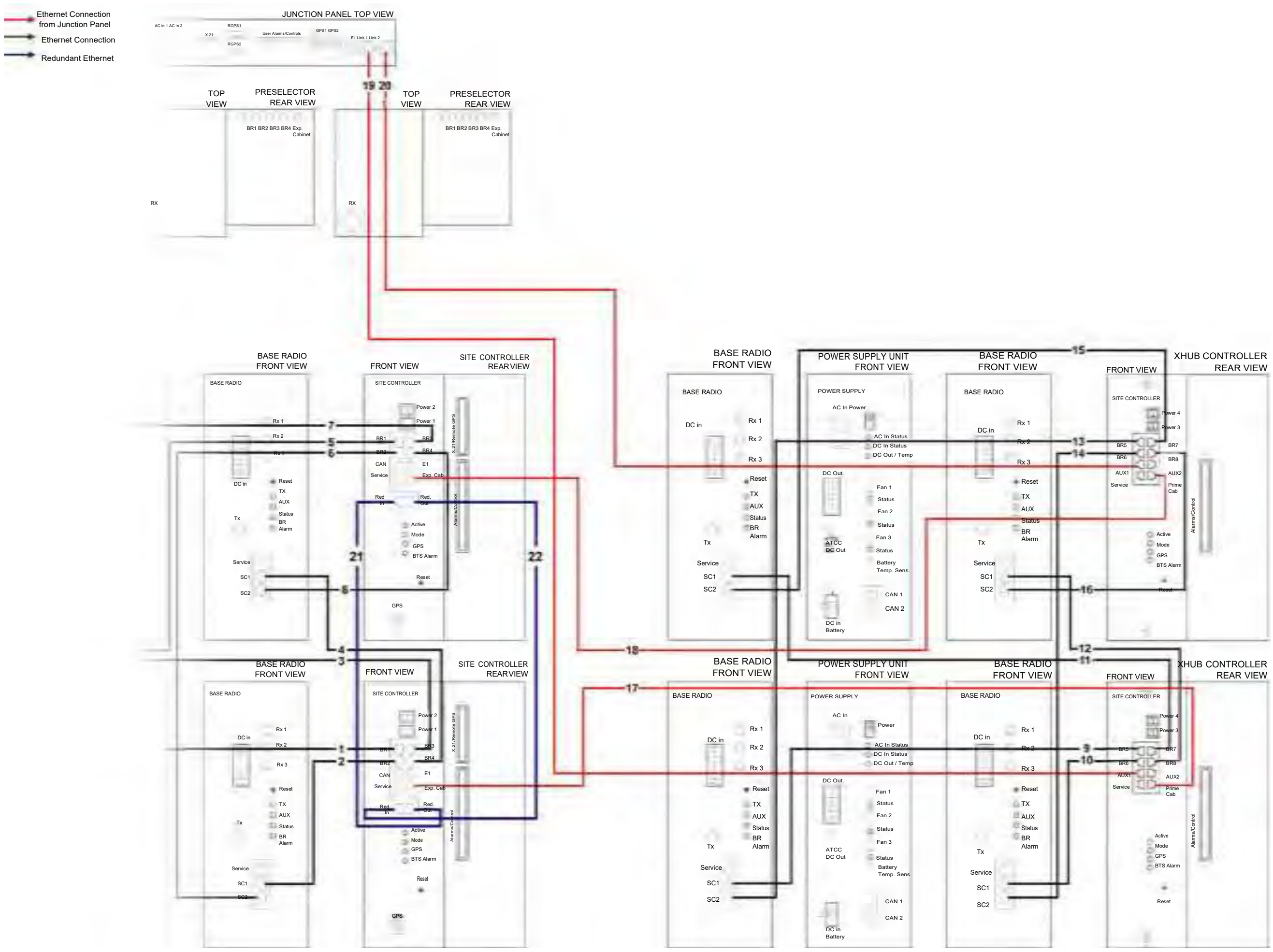
5.4.6 Ethernet Site Link Cabling – MTS 4 Expansion Cabinet with Dual Site Controller

Table 49: 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
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

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

Figure 105: 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.

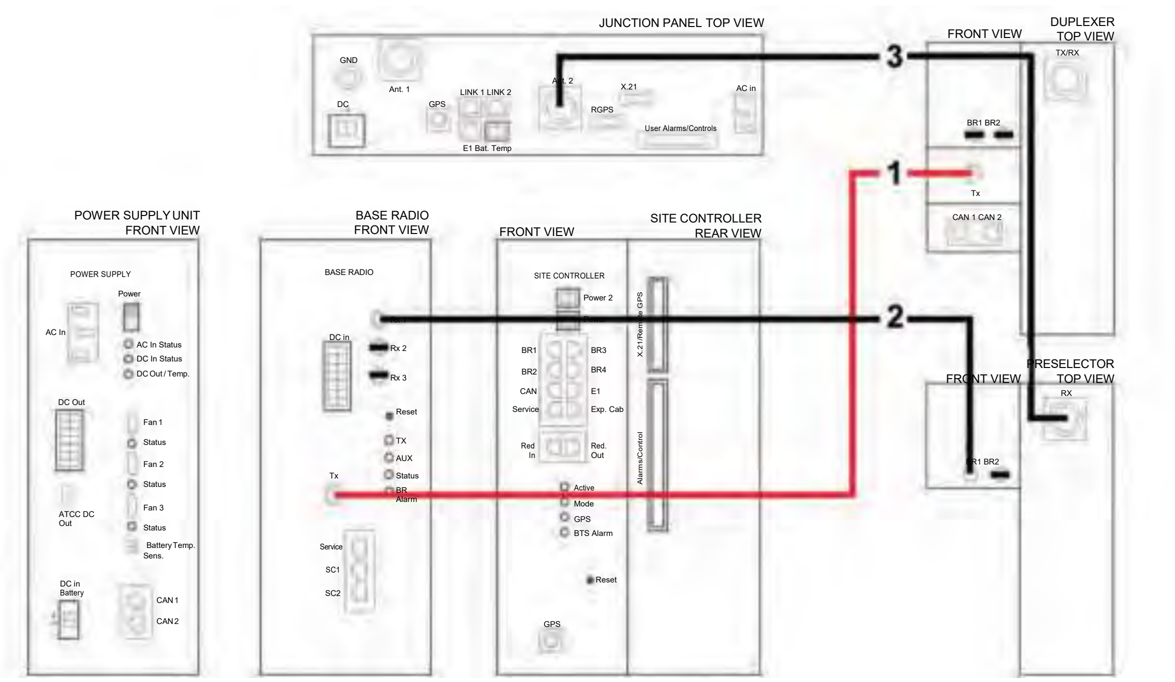
5.5.1 RF Cabling – MTS LiTE with One TX and One RX Antenna, No Diversity

Table 50: 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				

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
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 106: RF Cabling/Connections for MTS LiTE with One TX and One RX ant. No Diversity



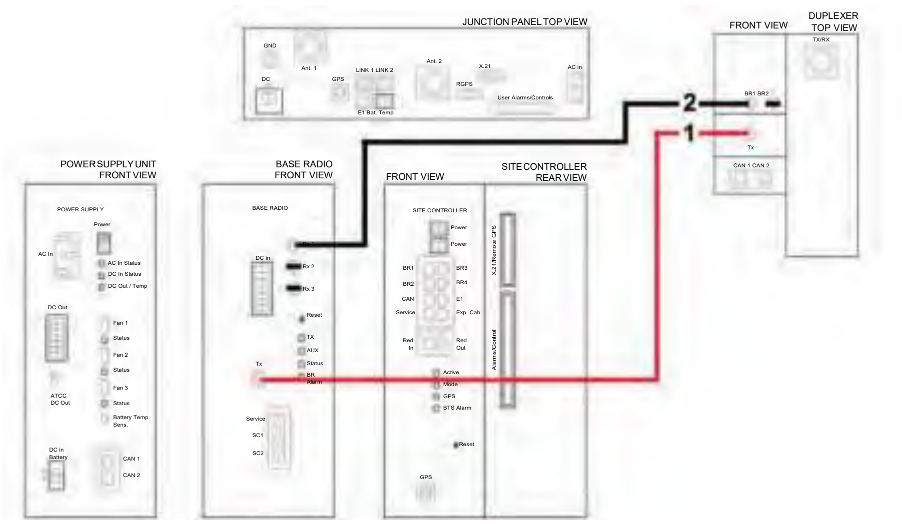
5.5.2 RF Cabling – MTS LiTE with One TX/RX Antenna

Table 51: 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

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
	2866544A01	Base Radio 1/ RX2		Terminator
		Base Radio 1/ RX3		Terminator
		Duplexer/ BR2		Terminator

Figure 107: RF Cabling/Connections for MTS LiTE with One TX/RX ant.

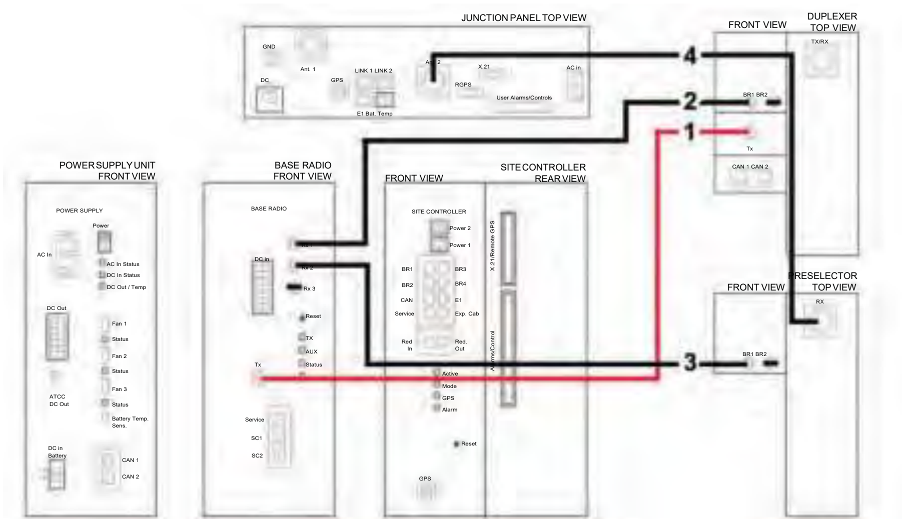


5.5.3
RF Cabling – MTS LiTE with One TX and Two RX Antennas

Table 52: 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
4	30015023001	Preselector/ RX	Junction Panel/ Ant. 2	
	2866544A01	Base Radio 1/ RX3		Terminator
		Duplexer/ BR2		Terminator
		Preselector/ BR2		Terminator

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



5.5.4

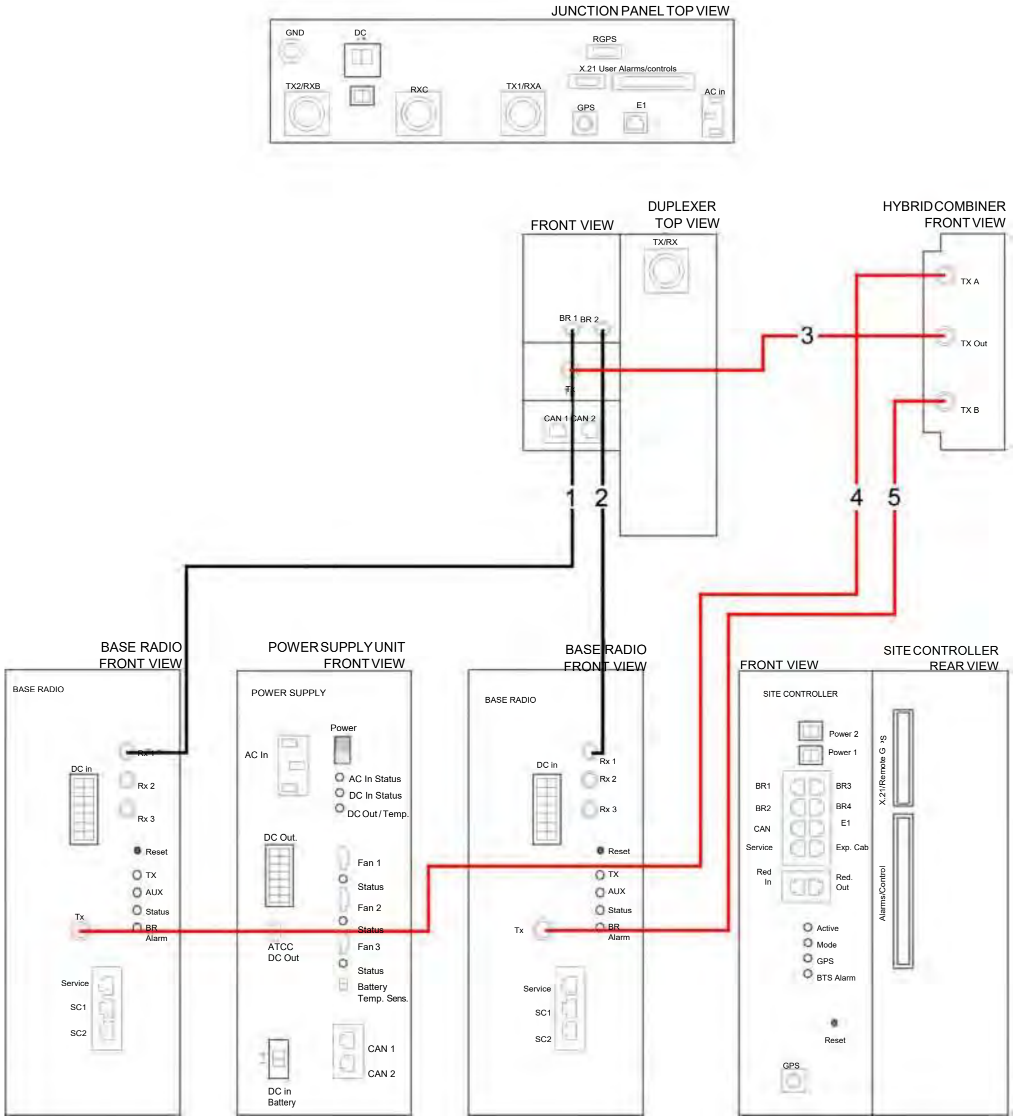
RF Cabling – MTS 2, No Diversity

Table 53: 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	3066543B01	Duplexer/ BR1	Base Radio 1/ RX1	RX path/ RX on 1 or 2 ant.
2	3066543B01	Duplexer/ BR2	Base Radio 2/ RX1	RX path/ RX on 1 or 2 ant.
3	3066543B06	Hybrid Combiner/ TXOut	Duplexer/ TX	TX path
4	3066543B12	Base Radio 1/ TX	Hybrid Combiner/ TX A	TX path
5	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 109: RF Cabling Diagram for MTS 2 with No Diversity



5.5.5

RF Cabling – MTS 2 with One TX Antenna

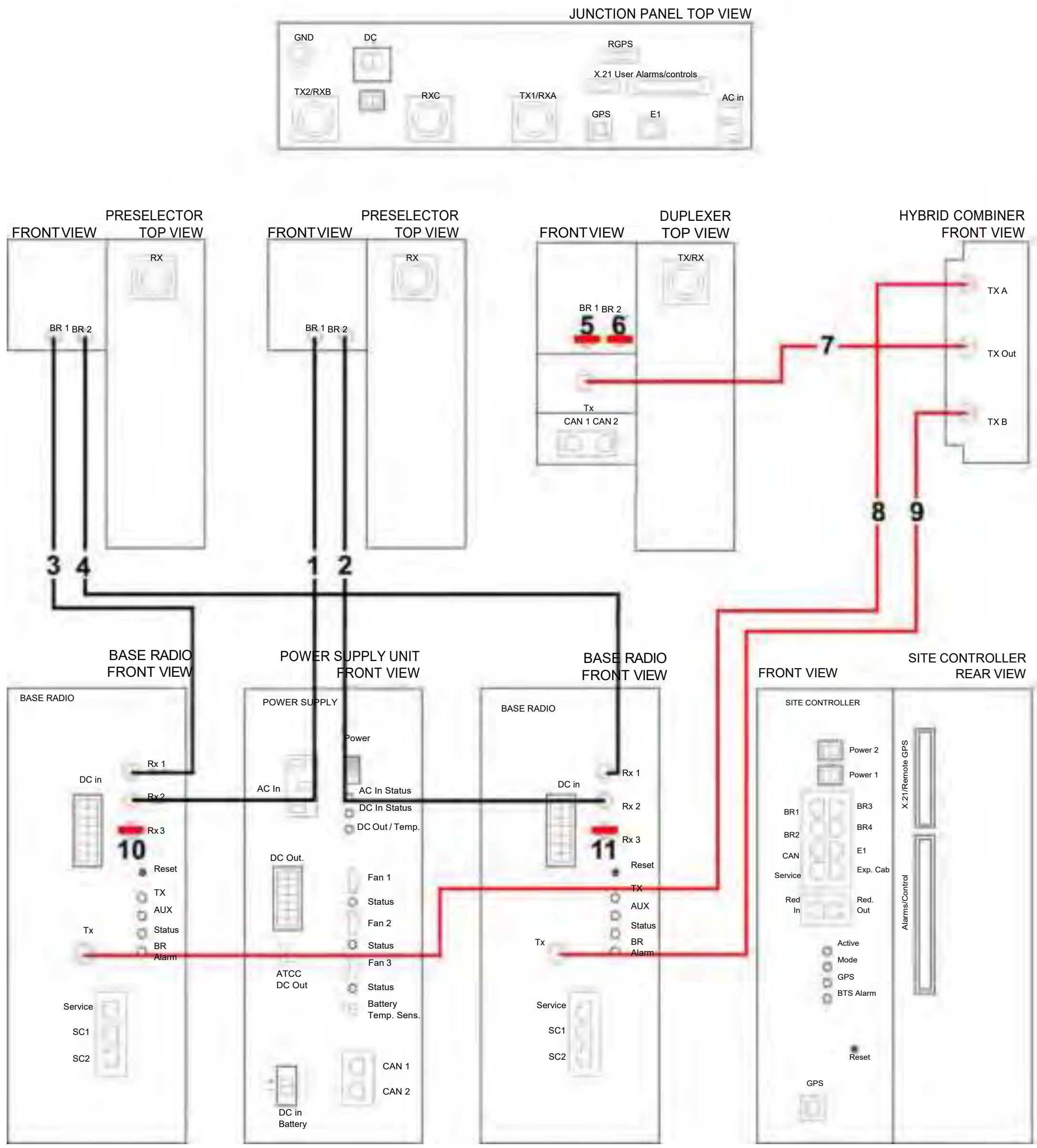
Table 54: RF Cabling/Connections for MTS 2 with One TX ant. and up to Two Additional RX ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS 2 - TX/RX on 1 ant.				
1	3066543B 01	Preselector 2/ BR1	Base Radio 1/ RX2	RX path / RX on ANT 3
2	3066543B 01	Preselector 2/ BR2	Base Radio 2/ RX2	RX path / RX on ANT 3.
3	3066543B 01	Preselector 1/ BR1	Base Radio 1/ RX1	RX path / RX on ANT 2

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
4	3066543B 01	Preselector 1/ BR2	Base Radio 2/ RX1	RX path / RX on ANT 2
5	2866544A 01		Duplexer/ BR1	terminate duplexed rx
6	2866544A 01		Duplexer/ BR2	terminate duplexed rx
7	3066543B 06	Hybrid Combiner/ TXOut	Duplexer/ TX	TX path
8	3066543B 12	Base Radio 1/ TX	Hybrid Combiner/ TX A	TX path on ANT 1
9	3066543B 05	Base Radio 2/ TX	Hybrid Combiner/TX B	TX path on ANT 1
10	2866544A 01		Base Radio 1/ RX3	terminate BR RX3
11	2866544A 01		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 110: 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

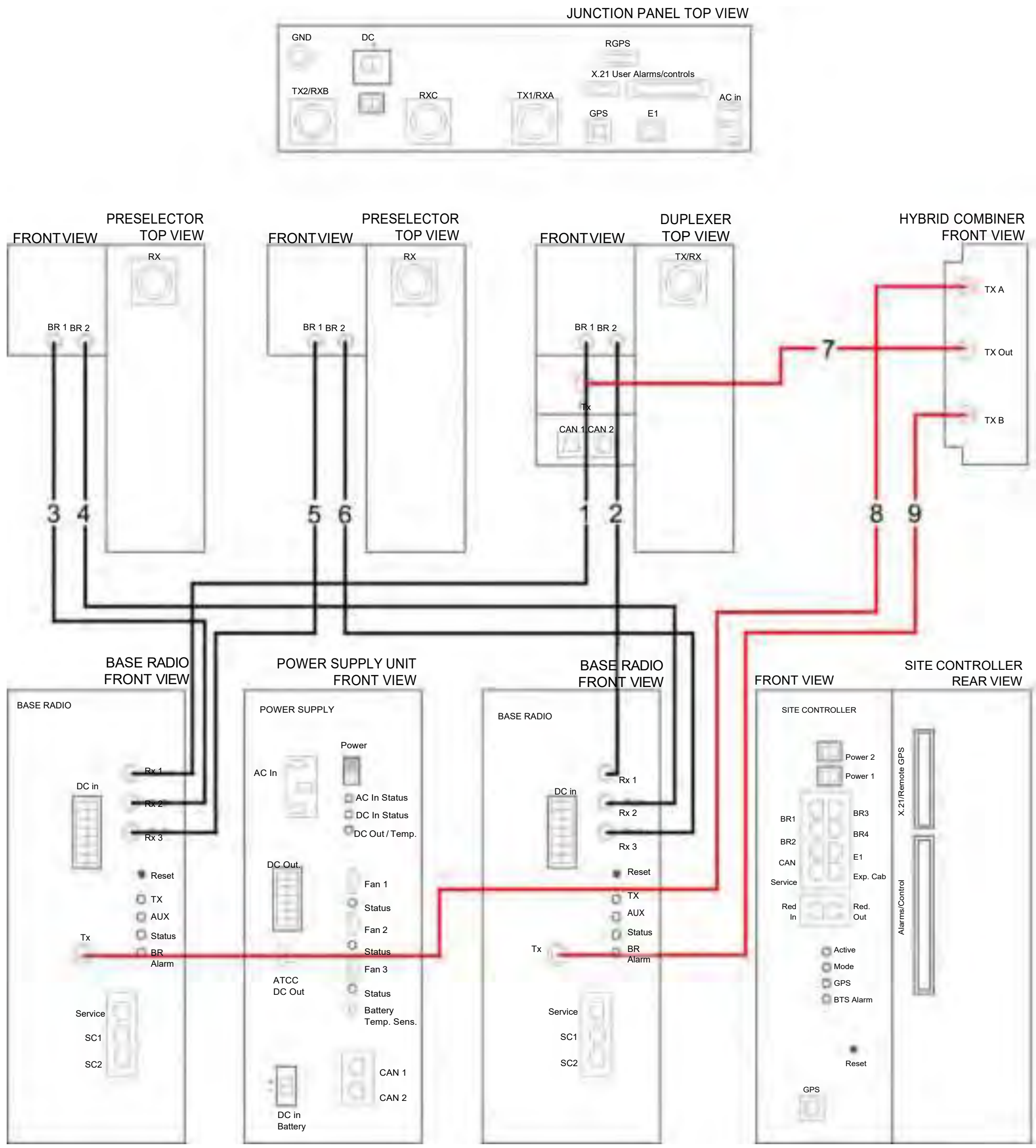
Table 55: RF Cabling/Connections for MTS 2 with One TX/RX ant. and up to Two Additional RX ant.

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

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
3	3066543B 01	Preselector 1/ BR1	Base Radio 1/ RX2	RX path on ANT 2
4	3066543B 01	Preselector 1/ BR2	Base Radio 2/ RX2	RX path on ANT 2
5	3066543B 01	Preselector 2/ BR1	Base Radio 1/ RX3	RX path on ANT 3
6	3066543B 01	Preselector 2/ BR2	Base Radio 2/ RX3	RX path on ANT 3
7	3066543B 06	Hybrid Combiner/ TXOut	Duplexer/ TX	TX path
8	3066543B 12	Base Radio 1/ TX	Hybrid Combiner/ TX A	TX path
9	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 111: 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

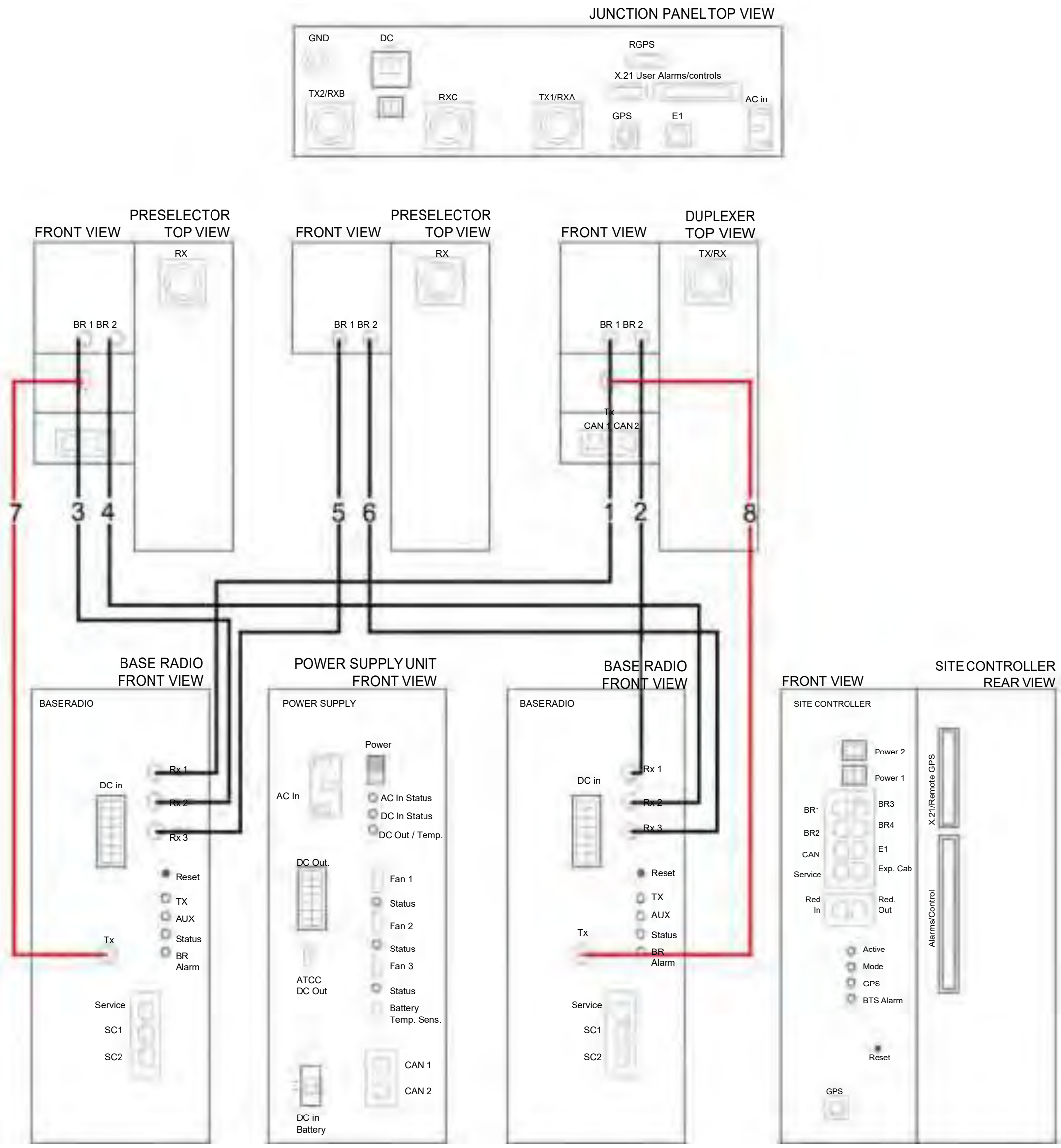
Table 56: RF Cabling/Connections for MTS 2 with Two TX/RX ant. and Up to One Additional RX ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS 2 - TX/RX on 2 ant.				
1	3066543B01	Duplexer 1/ BR1	Base Radio 1/ RX1	RX path/ no RX or RX on 1 ant.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
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 112: 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 57: 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.

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
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 58: TX ATCC Interconnect Harness Part Numbers on page 188	ATCC 1/ TX OUT ATCC 2/ TX OUT	ATCC (1, 2)	TX path, Interconnect harness

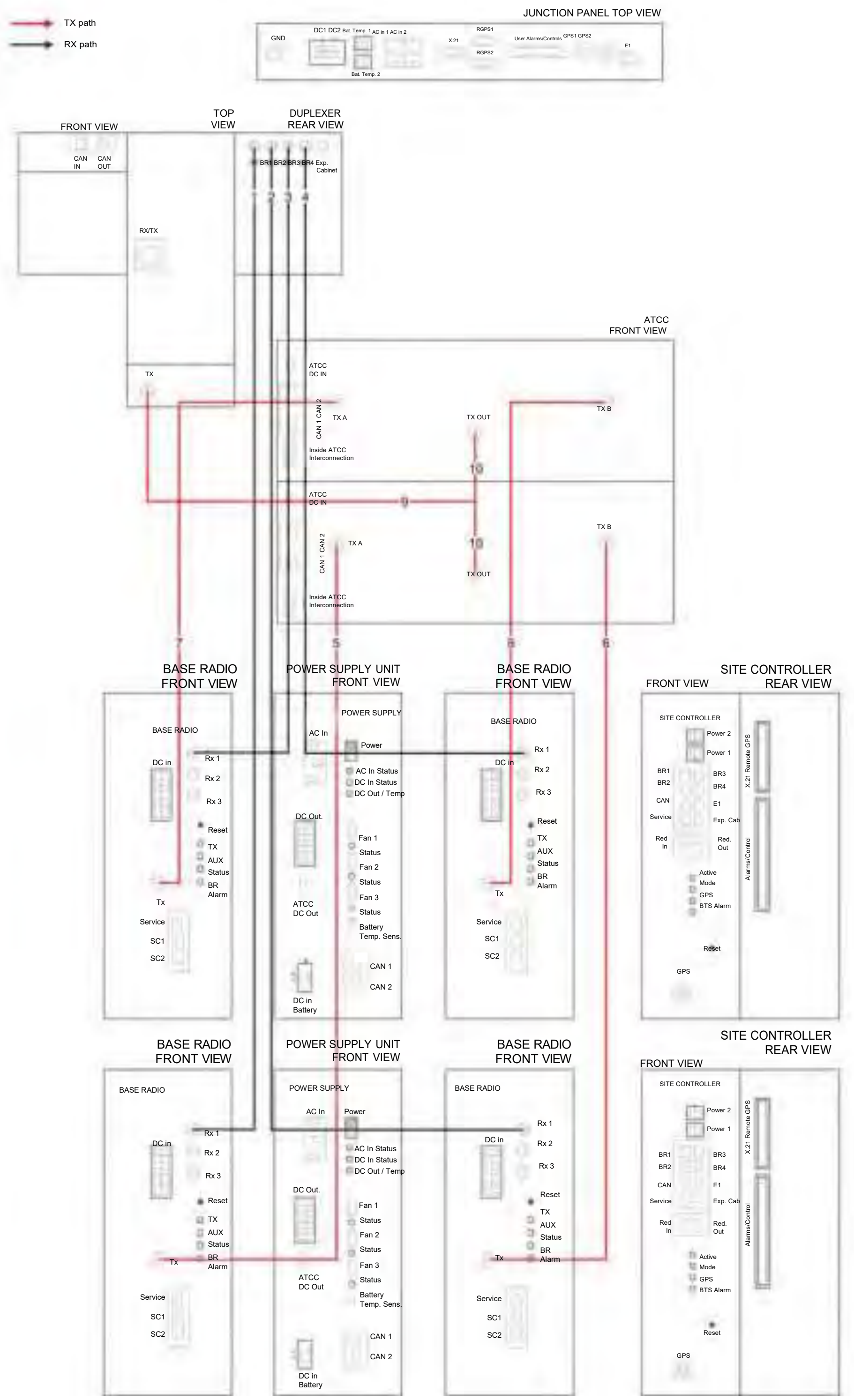
NOTICE:
The connectors on the top of the filters are directly fitted into appropriate holes in the Junction Panel.

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 58: 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
91015008001	260 MHz – 275 MHz
0166502N38	851 MHz – 870 MHz

Figure 113: RF Cabling Diagram for MTS 4 with No Diversity



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

Table 59: RF Cabling for MTS 4 with One TX/RX Antenna and Up to Two Additional RX Antennas

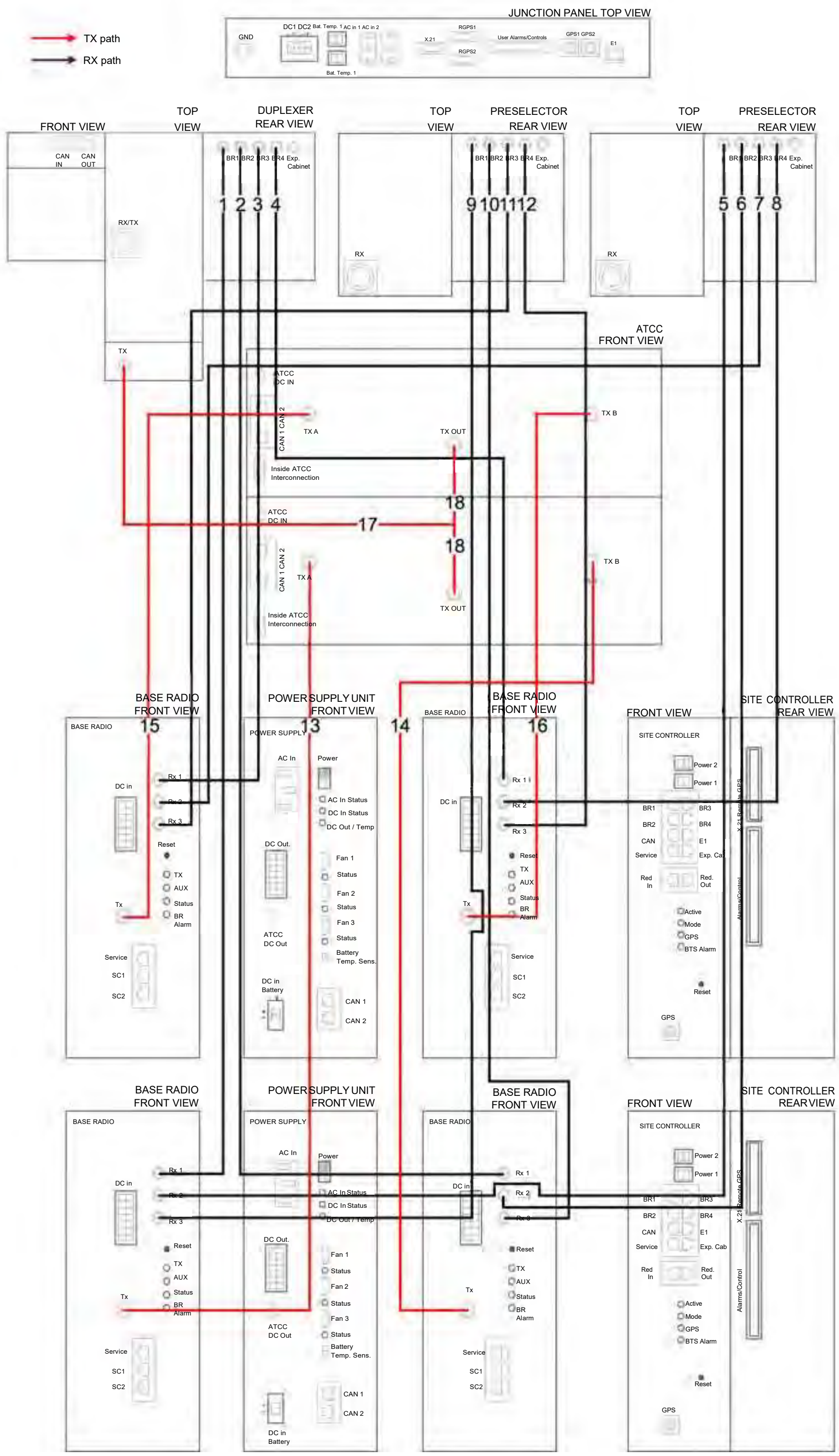
Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
1	3066543B02	Base Radio 1/ Rx1	Duplexer/ BR1	RX path/ RX on 1 or 2 ant.
2	3066543B02	Base Radio 2/ Rx1	Duplexer/ BR2	RX path/ RX on 1 or 2 ant.
3	3066543B03	Base Radio 3/ Rx1	Duplexer/ BR3	RX path/ RX on 1 or 2 ant.
4	3066543B03	Base Radio 4/ Rx1	Duplexer/ BR4	RX path/ RX on 1 or 2 ant.
5	3066543B02	Base Radio 1/ Rx2	Preselector 1/ BR1	RX path/ RX on 1 or 2 ant.
6	3066543B02	Base Radio 2/ Rx2	Preselector 1/ BR2	RX path/ RX on 1 or 2 ant.
7	3066543B03	Base Radio 3/ Rx2	Preselector 1/ BR3	RX path/ RX on 1 or 2 ant.
8	3066543B03	Base Radio 4/ Rx2	Preselector 1/ BR4	RX path/ RX on 1 or 2 ant.
9	3066543B02	Base Radio 1/ Rx3	Preselector 2/ BR1	RX path/ RX on 2 ant.
10	3066543B02	Base Radio 2/ Rx3	Preselector 2/ BR2	RX path/ RX on 2 ant.
11	3066543B03	Base Radio 3/ Rx3	Preselector 2/ BR3	RX path/ RX on 2 ant.
12	3066543B03	Base Radio 4/ Rx3	Preselector 2/ BR4	RX path/RX on 2 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, 2)	Duplexer/ TX	TX path, Duplexer Tx cable
18	See Table 58: 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 188.			

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 114: 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

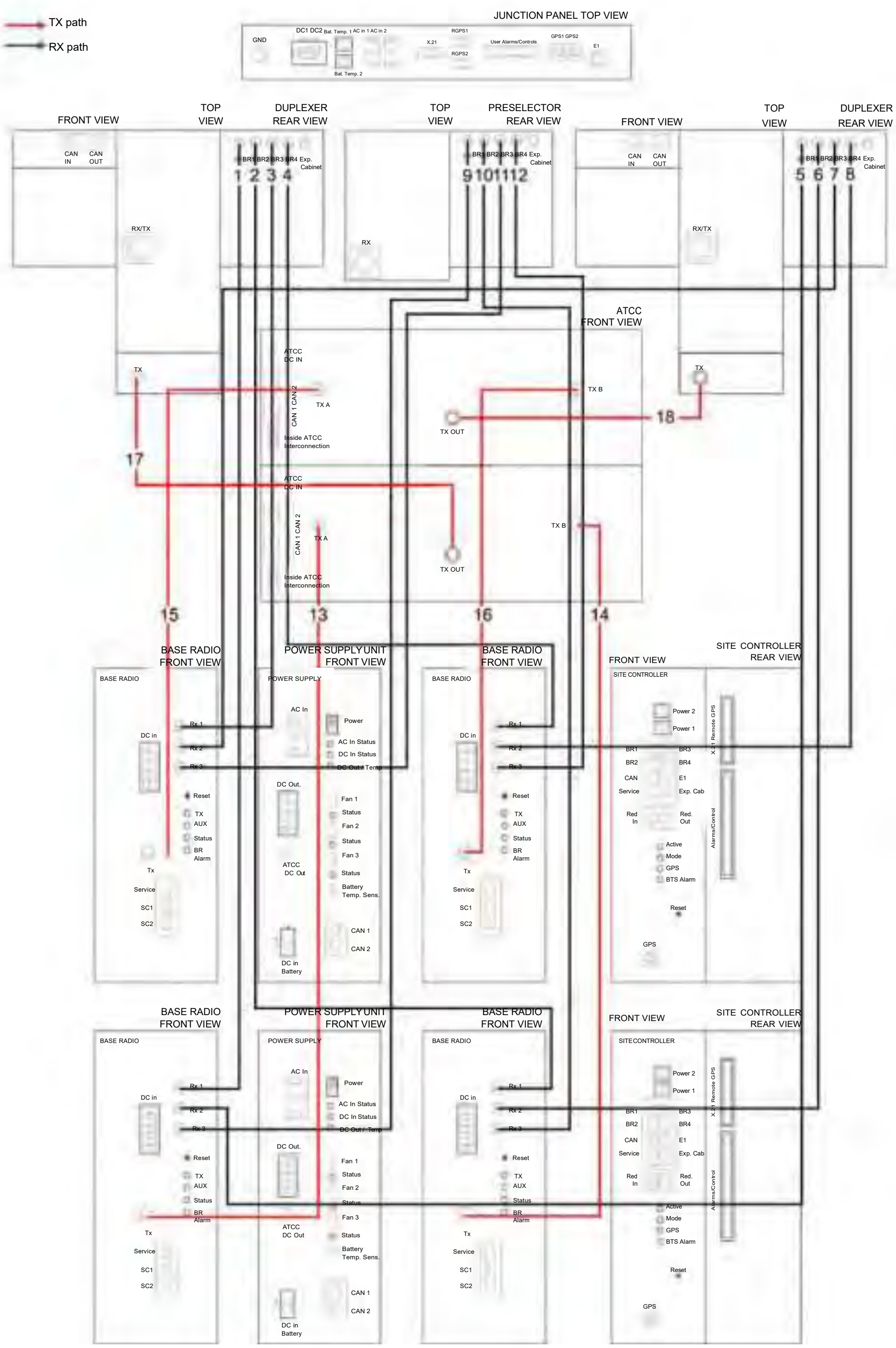
Table 60: RF Cabling/Connections for MTS 4 with Two TX/RX ant. and Up to One Additional RX ant.

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 115: 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 61: RF Cabling/Connections for MTS 4 with One TX ant. and Up to Three Additional RX ant.

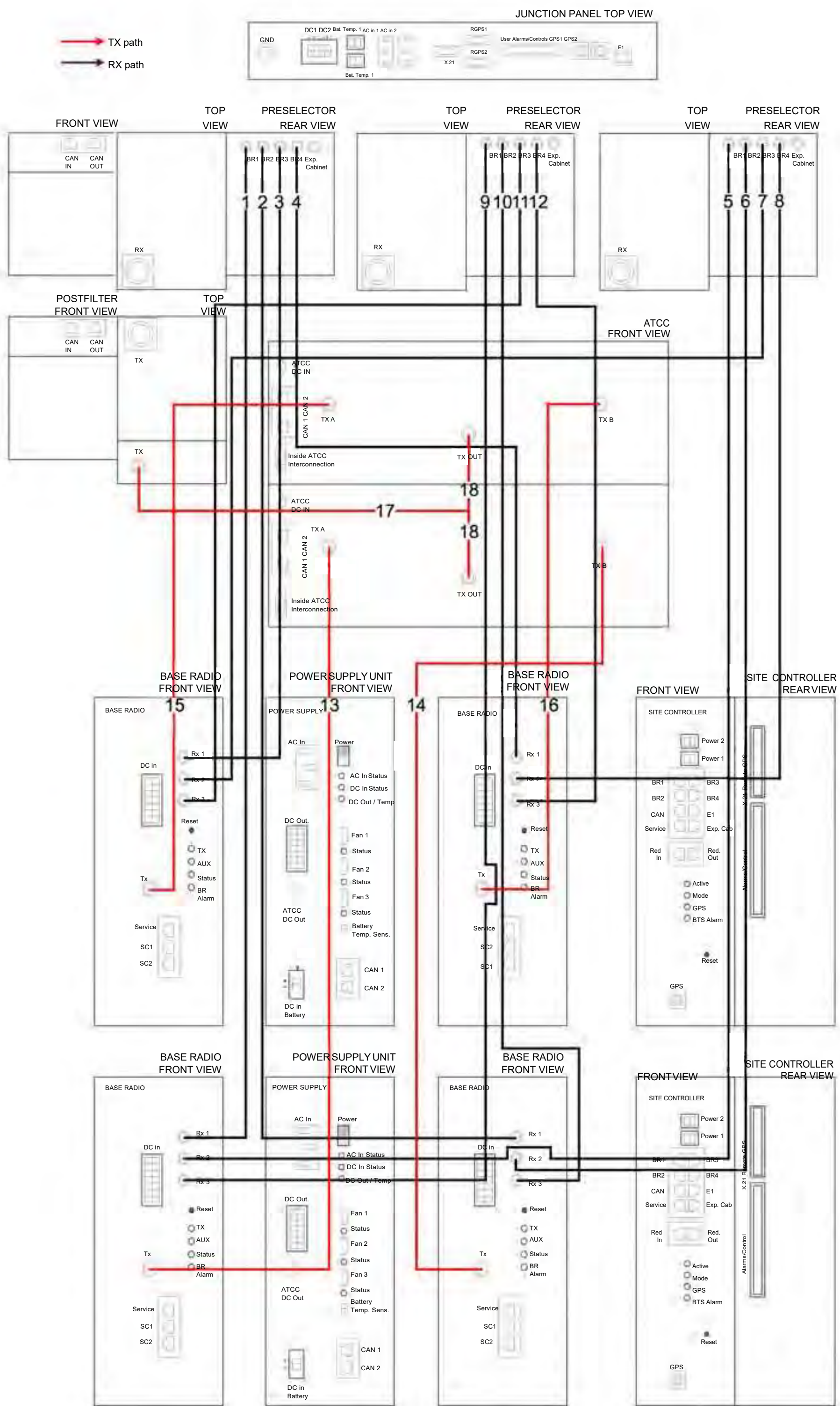
Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
1	3066543B02	Base Radio 1/ Rx1	Preselector 1/ BR1	RX path/ RX on 2 or 3 ant.
2	3066543B02	Base Radio 2/ Rx1	Preselector 1/ BR2	RX path/ RX on 2 or 3 ant.
3	3066543B03	Base Radio 3/ Rx1	Preselector 1/ BR3	RX path/ RX on 2 or 3 ant.
4	3066543B03	Base Radio 4/ Rx1	Preselector 1/ BR4	RX path/ RX on 2 or 3 ant.
5	3066543B02	Base Radio 1/ Rx2	Preselector 2/ BR1	RX path/ RX on 2 or 3 ant.
6	3066543B02	Base Radio 2/ Rx2	Preselector 2/ BR2	RX path/ RX on 2 or 3 ant.
7	3066543B03	Base Radio 3/ Rx2	Preselector 2/ BR3	RX path/ RX on 2 or 3 ant.
8	3066543B03	Base Radio 4/ Rx2	Preselector 2/ BR4	RX path/ RX on 2 or 3 ant.
9	3066543B02	Base Radio 1/ Rx3	Preselector 3/ BR1	RX path/ RX on 3 ant.
10	3066543B02	Base Radio 2/ Rx3	Preselector 3/ BR2	RX path/ RX on 3 ant.
11	3066543B03	Base Radio 3/ Rx3	Preselector 3/ BR3	RX path/ RX on 3 ant.
12	3066543B03	Base Radio 4/ Rx3	Preselector 3/ BR4	RX path/ RX on 3 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, 2)	Post Filter/ TX	TX path, Post Filter cable
18	See Table 58: 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 188.			

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 One TX ant. and Up to Three Additional RX ant.



5.5.12 RF Cabling – Expansion Cabinet with One TX/RX Antenna

Table 62: 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 58: 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 188			
18	See Table 63: TX ATCC Phasing Harness Part Numbers on page 199	ATCC (3, 4)	ATCC (1, 2) Prime Cabinet	TX path, Phasing Harness routed through conjunction hole at side of cabinet
19	3066543B 11	RX Splitter 1 / Prime Cab	Duplexer / Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 1 or 2 ant.
20	3066543B 11	RX Splitter 2 / Prime Cab	Preselector 1 / Exp Cab (in MTS 4 Prime Cabinet)	RX path/ RX on 1 or 2 ant.
21	3066543B 11	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.

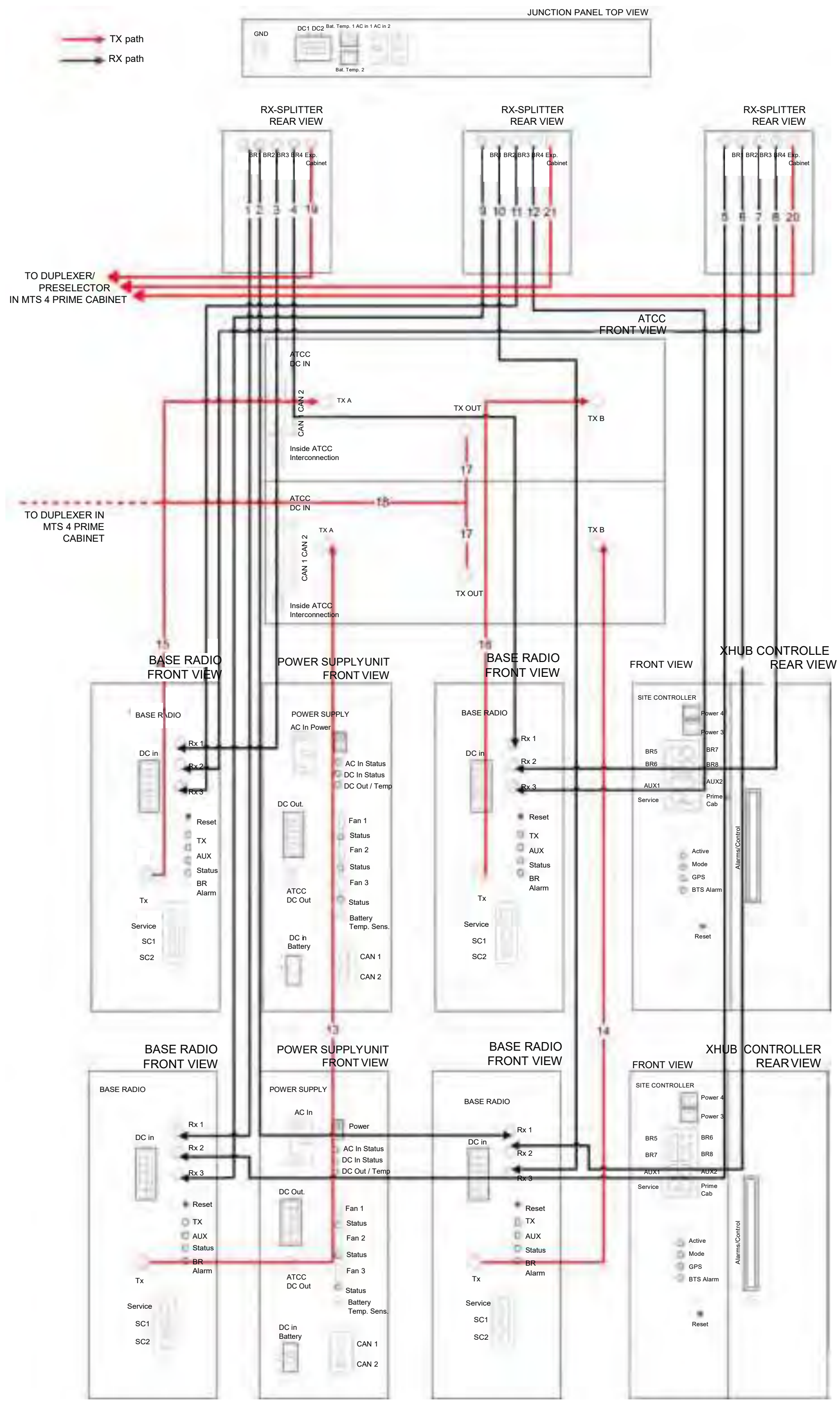
Figure 117: Holes in Top Lid for Rx Cables

Table 63: TX ATCC Phasing Harness Part Numbers

Part Number	Description	Frequency Band
0166502N09	Phasing harness, 8Ch	361 MHz – 366 MHz

Part Number	Description	Frequency Band
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
0166502N36	Phasing harness, 8Ch	800 MHz band (851 – 870 MHz)

Figure 118: 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 64: 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 58: TX ATCC Interconnect Harness Part Num-	ATCC 3 / TX OUT ATCC 4 / TX OUT	ATCC (3, 4)	TX path, Interconnect Harness

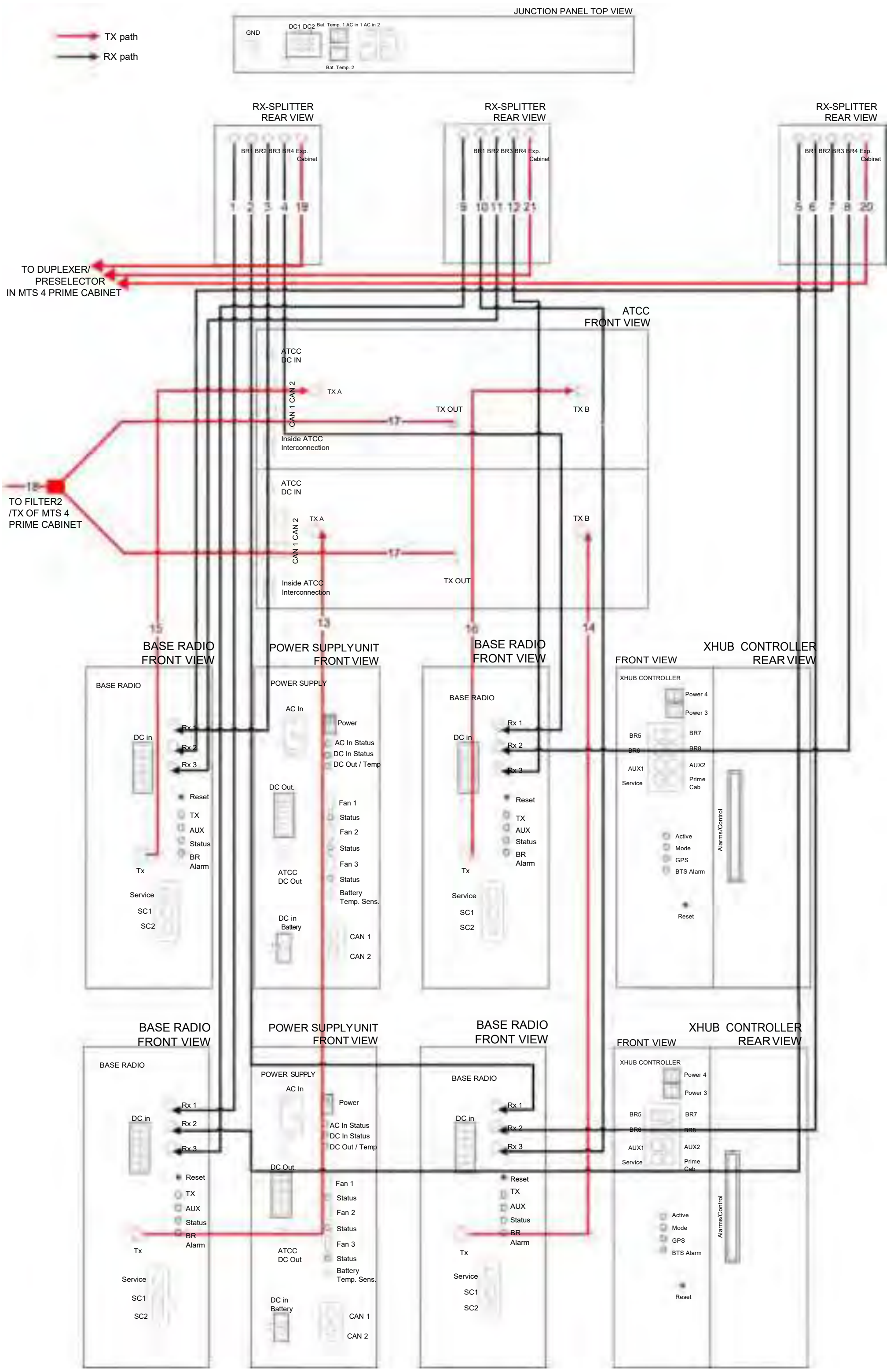
Index	Cable Part Number	From Unit	To Unit	Notes
	bers on page 188.			
18	3066543B16	ATCC (3, 4)	Duplexer 2 / TX in Prime Cabinet	TX path, Duplexer TX cable routed through conjunction hole at side of the cabinet
19	3066543B11	RX Splitter 1 / Prime Cab	Duplexer 1/ Exp Cab (in MTS 4 Prime Cabinet)	RX path/ 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 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 119: 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 65: 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 58: TX ATCC Interconnect Harness Part Num-	ATCC 3 / TX Out ATCC 4 / TX Out	ATCC (3, 4)	TX path, Interconnect Harness

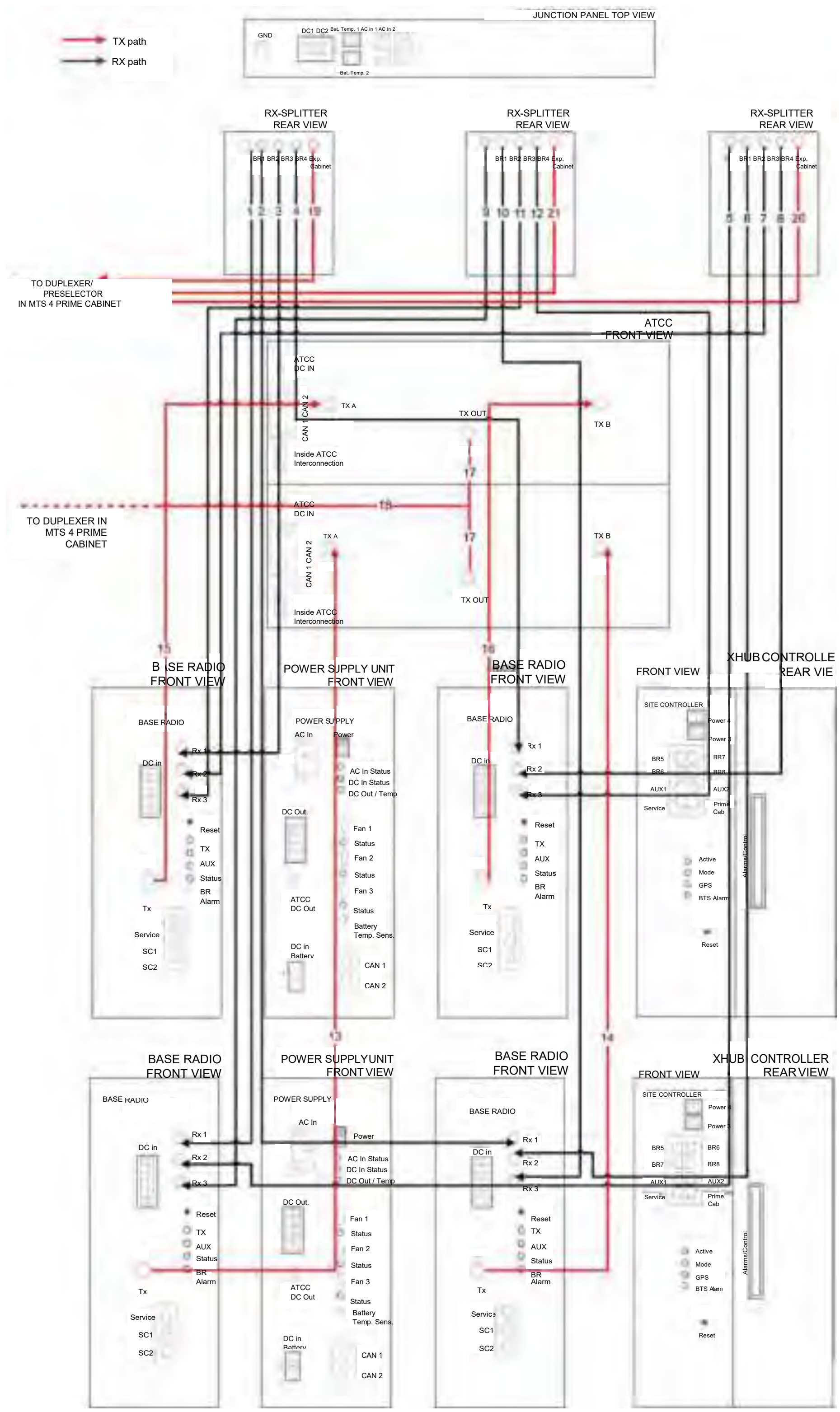
Index	Cable Part Number	From Unit	To Unit	Notes
	bers on page 188.			
18	See Table 63: TX ATCC Phasing Harness Part Numbers on page 199.	ATCC (3, 4)	ATCC (1, 2) in Prime Cabinet	TX path, Phasing Harness routed through conjunction hole at side of the cabinet
19	3066543B11	RX Splitter 1 / Prime Cab	Duplexer 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 120: 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 66: 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 58: TX ATCC Interconnect Harness Part Num-	ATCC 3 / TX Out ATCC 4 / TX Out	ATCC (3, 4)	TX path, Interconnect Harness

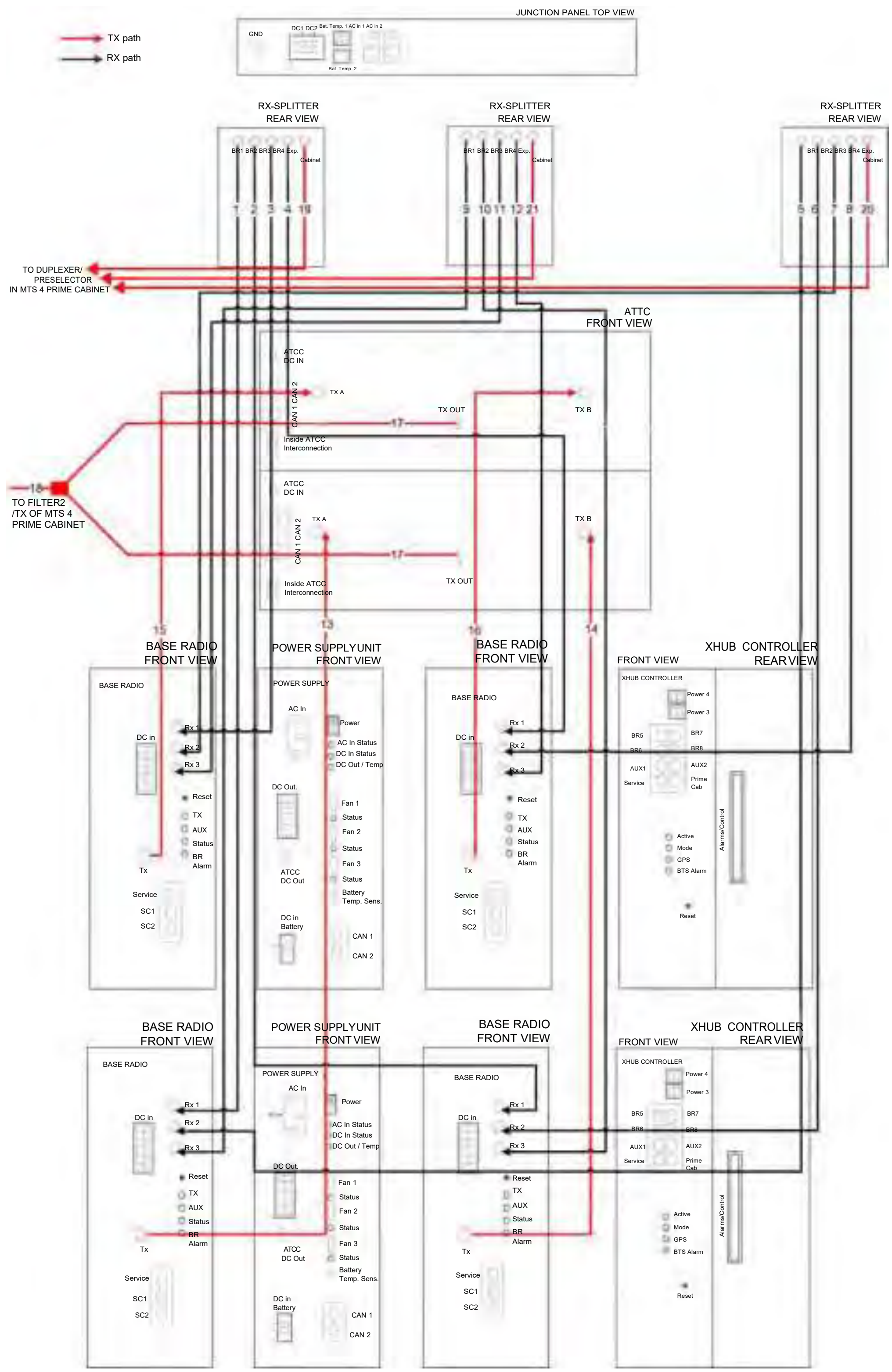
Index	Cable Part Number	From Unit	To Unit	Notes
	bers on page 188.			
18	3066543B 16	ATCC (3, 4)	Post Filter 2 / TX in Prime Cabinet	TX path, Post Filter cable routed through conjunction hole at side of the cabinet
19	3066543B 11	RX Splitter 1 / Prime Cab	Duplexer 1/ Exp Cab (in MTS 4 Prime Cabinet)	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 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 121: 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.

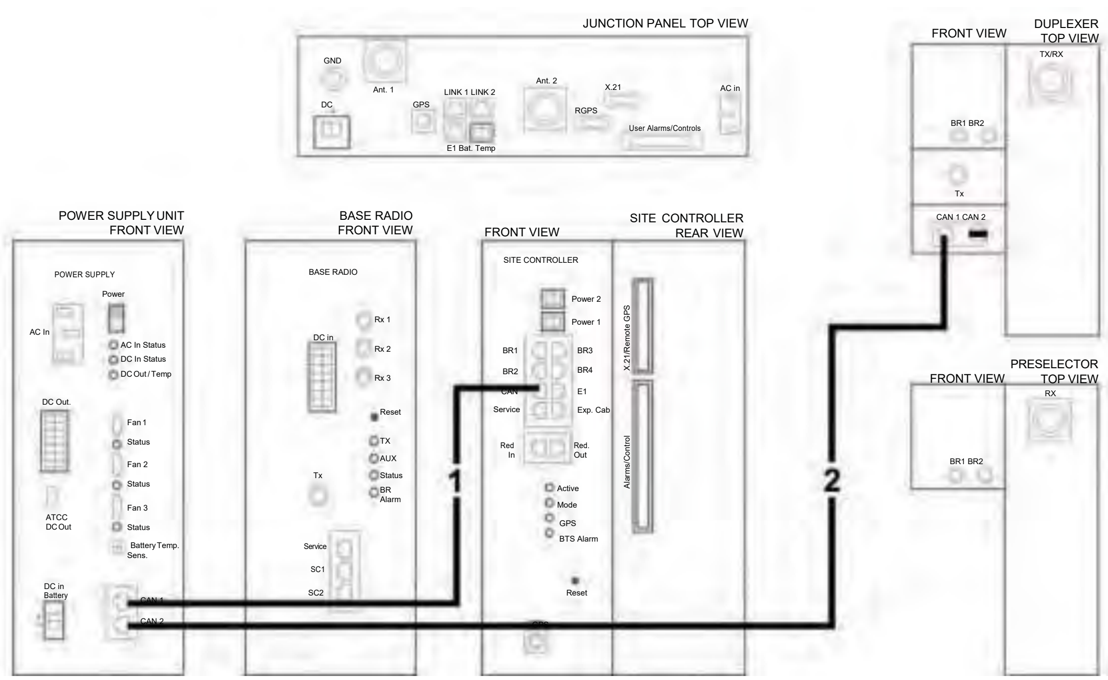
5.6.1
CAN Bus Cabling – MTS LiTE

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 67: 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 122: 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 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 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 123: CAN Bus Cabling Diagram for MTS 2 with TX/RX on 1 ant. RX on 2 ant.

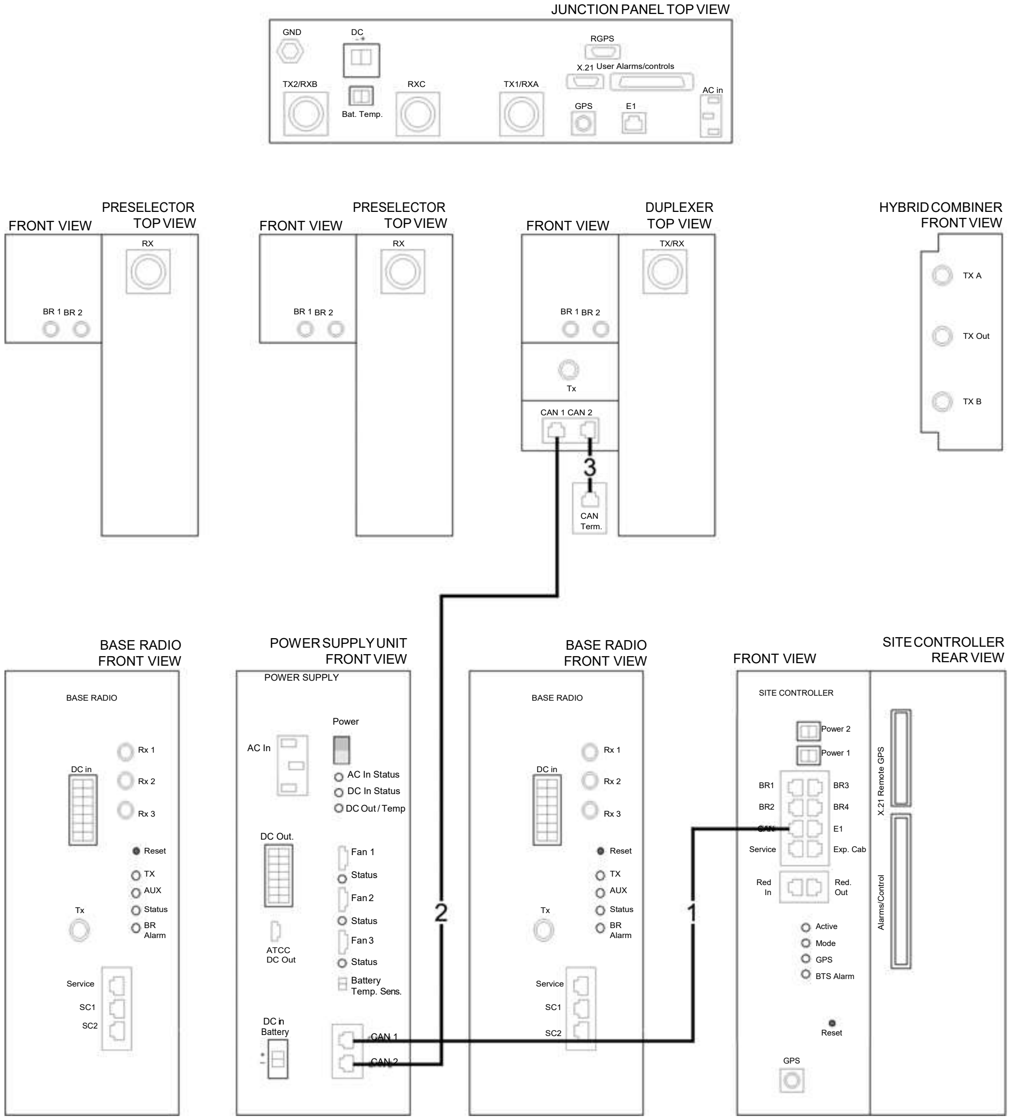
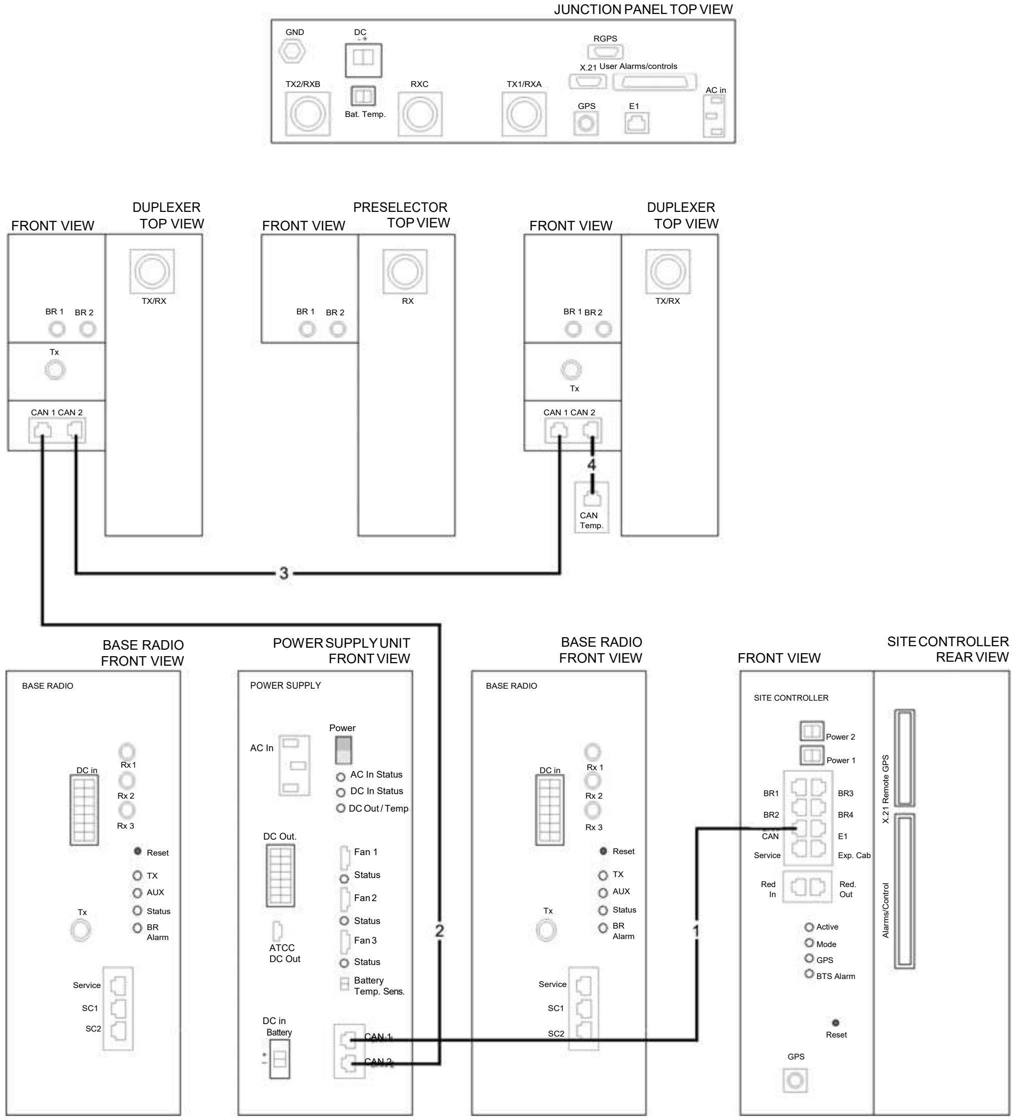


Table 69: CAN Bus Cabling for MTS 2 with TX/RX on 1 ant. RX on 2 ant.

In-dex	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS 2 (TX/RX on 2 ant. RX on 1ant.)				
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 124: 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 70: 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

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
2	3066544B06	Power Supply Unit1/ CAN2	Duplexer or Post Filter/ CAN1	Red cable
3	3066544B03	Duplexer or Post Filter/ CAN2	ATCC 1/ CAN1	Red cable
4	3066544B09	ATCC 1/ CAN2	ATCC 2/ CAN1	Red cable
5	3066544B06	ATCC 2/ CAN2	Power Supply Unit2/ CAN1	Red cable
6	3066575B01	Power Supply Unit2/ CAN2	Site Controller2/ CAN	With redundant Site Controller/ red cable
7	0966513A01	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 125: CAN Bus Cabling Diagram for MTS 4 with TX/RX or TX on 1 ant.

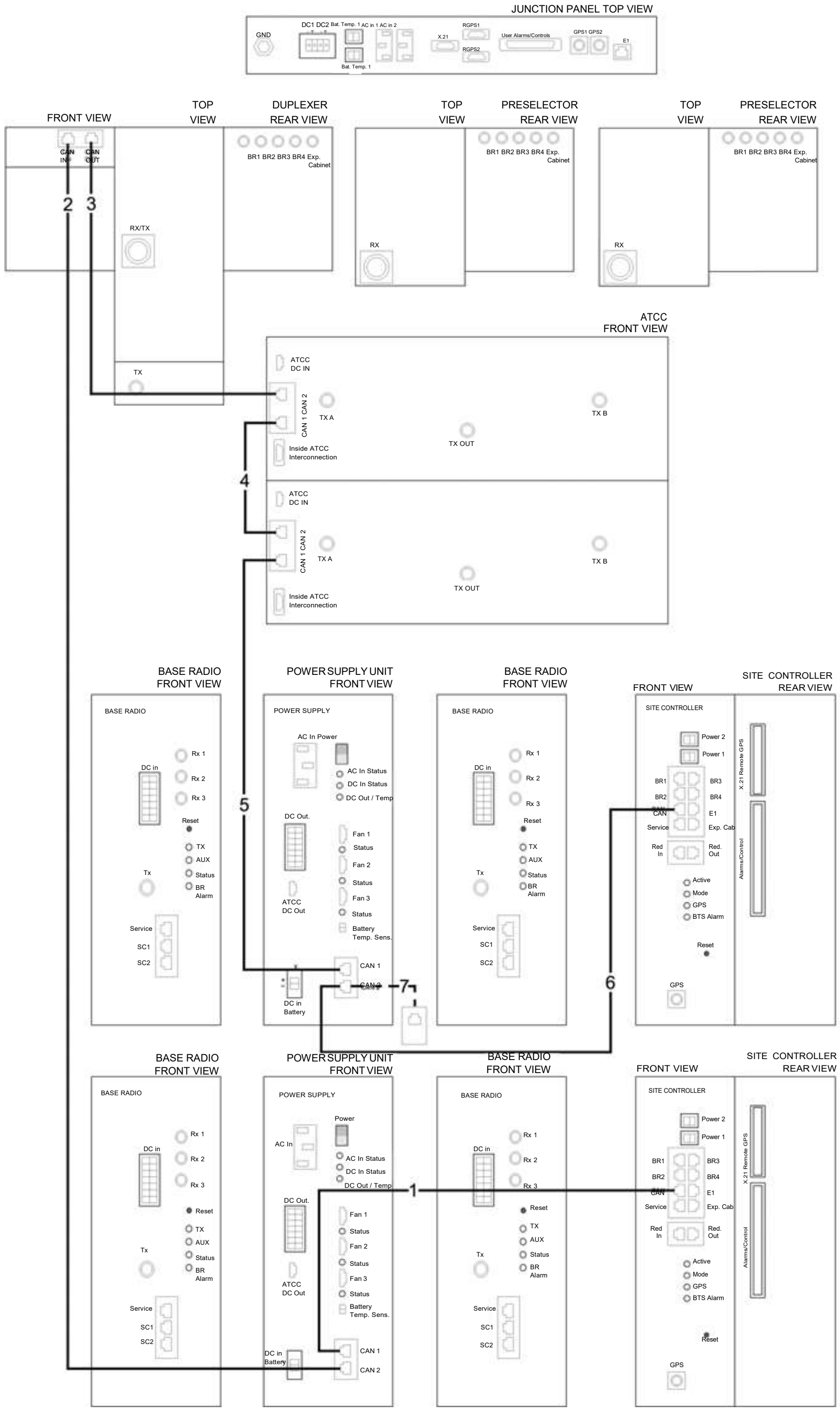


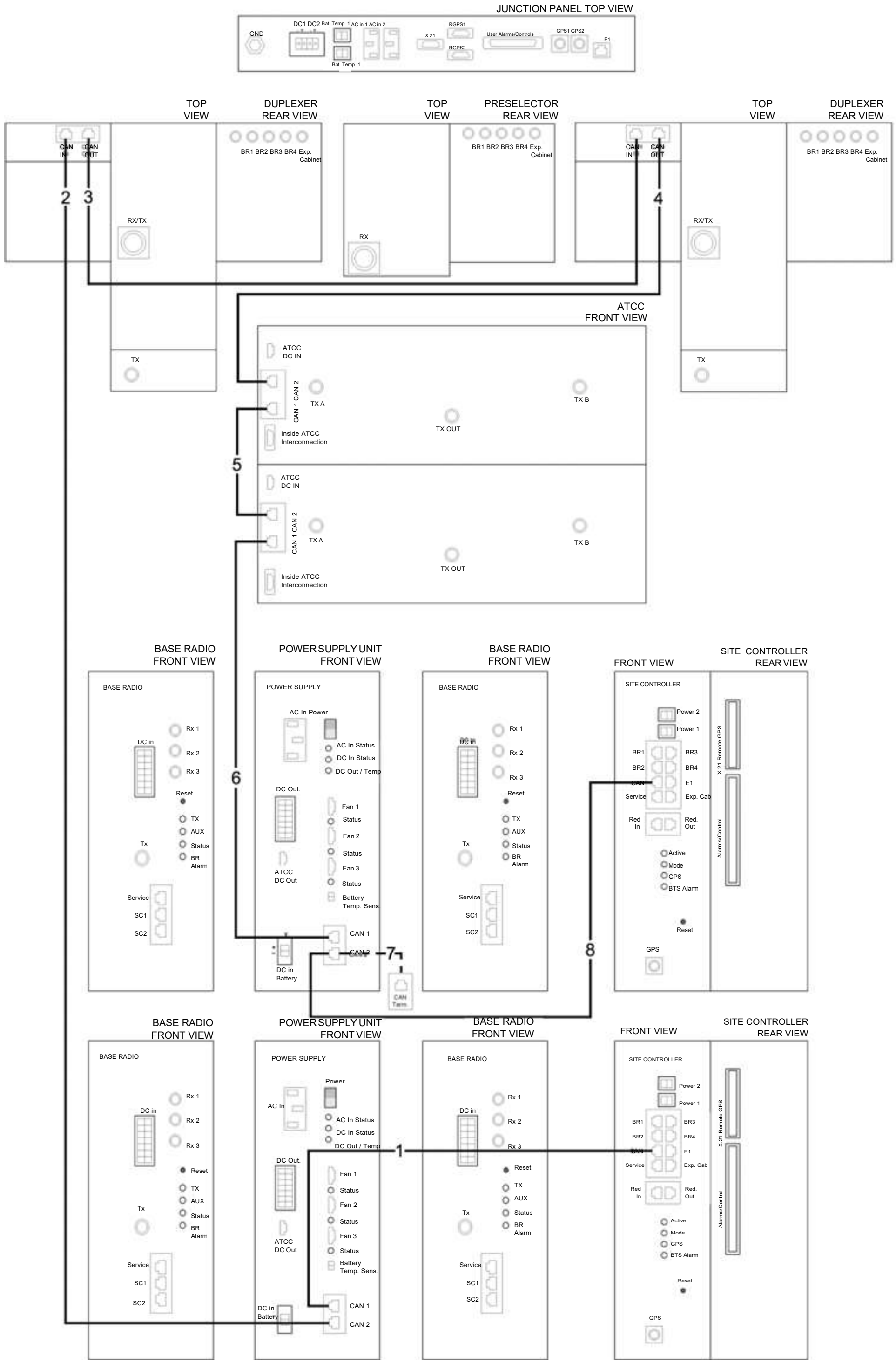
Table 71: CAN Bus Cabling for MTS 4 with TX/RX or TX on 2 ant. with ATCCs

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
MTS 4 (TX/RX or TX on 2 or ant. with ATCCs)				

Index	Cable Part Number	From Unit / Connection Name	To Unit / Connection Name	Notes
1	3066575B01	Site Controller1/ CAN	Power Supply Unit1/ CAN1	Red cable
2	3066544B06	Power Supply Unit1/ CAN2	Duplexer 1 or Post Filter 1/ CAN1	Red cable
3	3066544B09	Duplexer 1 or Post Filter1/ CAN2	Duplexer 2 or Post Filter 2/ CAN1	Red cable
4	3066544B03	Duplexer 2 or Post Filter 2 / CAN2	ATCC 1/ CAN1	Red cable
5	3066544B09	ATCC 1/ CAN2	ATCC 2/ CAN1	Red cable
6	3066544B06	ATCC 2/ CAN2	Power Supply Unit2/ CAN1	Red cable
7	0966513A01	Power Supply Unit2/ CAN2	CAN Bus termination	without redundant TCS
8	3066575B01	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 126: 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 72: 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 127: CAN Bus Cabling Diagram for MTS4 and Expansion Cabinet with ATCCs

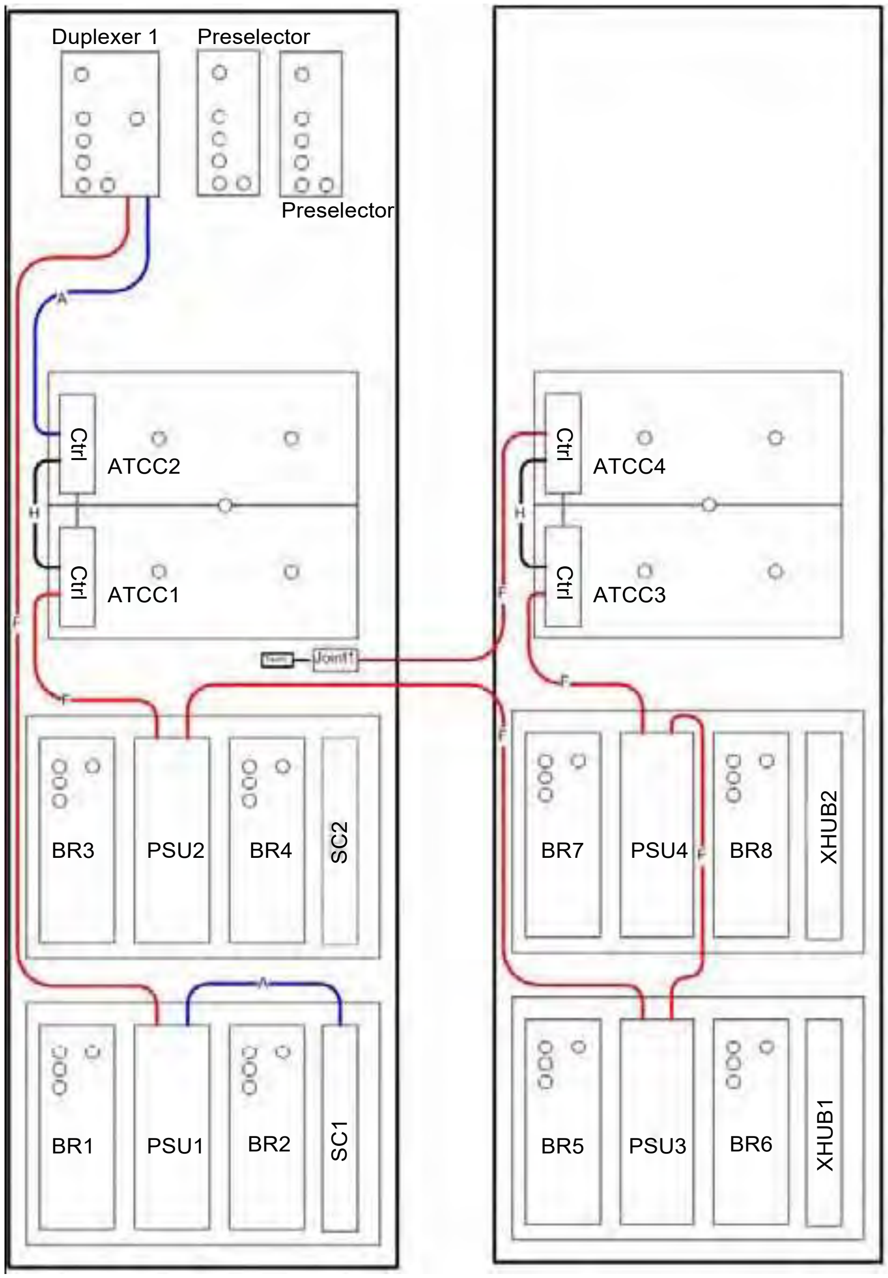
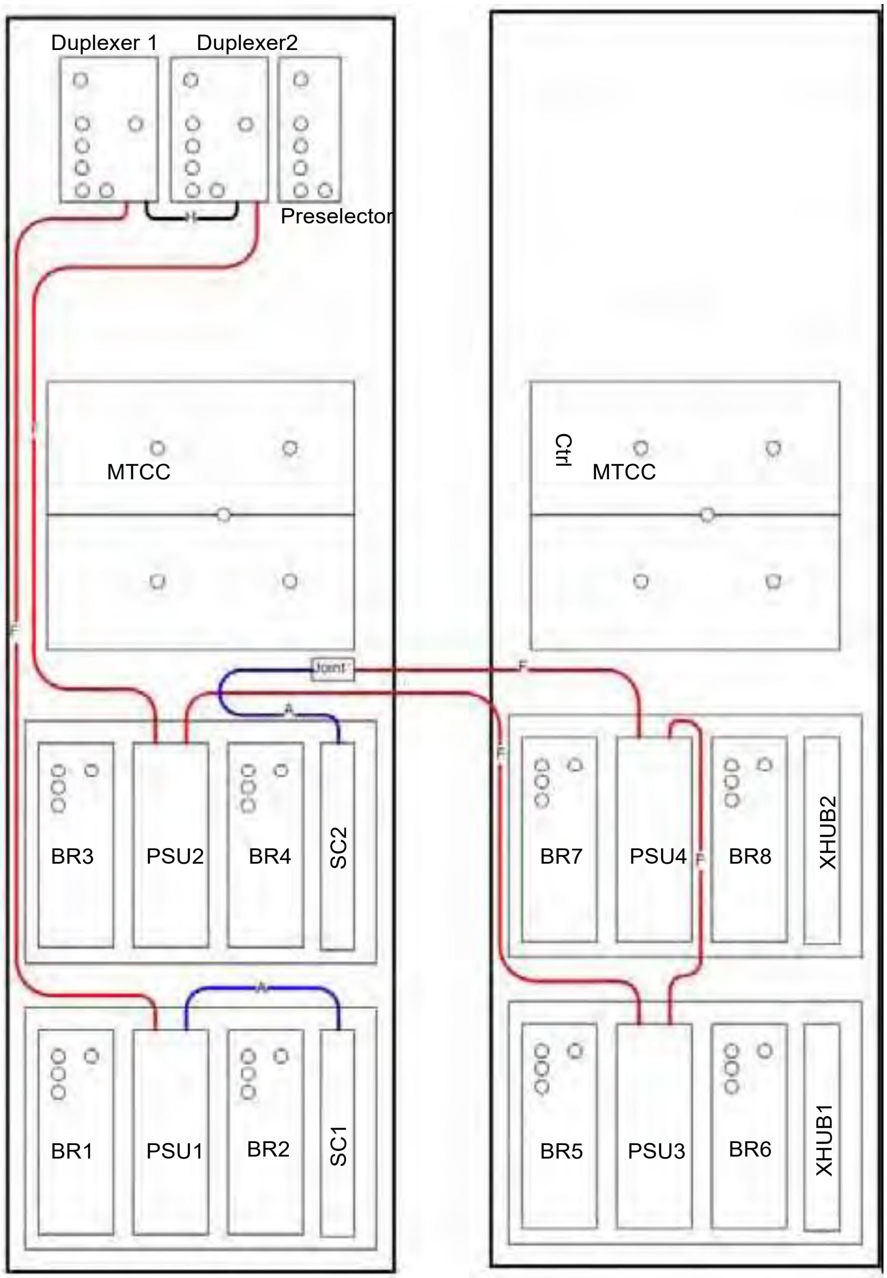


Figure 128: CAN Bus Cabling Diagram for MTS4 and Expansion Cabinet with MTCCs and Redundant Site Controller



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 345 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 446.

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 222.
2. Identify all recommended test equipment for the Site Controller and Base Radio Verification.

   See Test Equipment on page 226.
3. Connect a service terminal.

   See Setting Up Service Terminal on page 229.

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 224.
- **Test Application** – see Logging on to the Test Application on page 225.
- **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 223.

The MTS Base Radio modes of operation are dependent on its architecture:

Table 73: MTS Base Radio Modes of Operation

BR-Arch-1 Modes		BR-Arch-2 Modes	
BOOT1	Logging on to the BOOT1 mode on page 224	**Base Radio Core**	Logging on to the Base Radio Core Mode on page 225
Test Application	Logging on to the Test Application on page 225	**Test Application**	Logging on to the Test Application on page 225
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 224	**Base Radio Application**	Logging on to the Base Radio Application through Serial Connection on page 224

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 Portusing the Service Cable.

   See Service Cable and Connector Box Description on page 227 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 227 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 223 or Logging on to the Base Radio Application through Serial Connection on page 224.

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 224.
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 224.
   - 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 225.
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 74: 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 129: 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 75: Basic Service Cable Pinout

RJ45 PIN	D-SUB 9 Female PIN	Description
1 (NC)		
2 (NC)		
3 (NC)		
4	3	RX
5	5	GND
6 (NC)		
7	2	TX

RJ45 PIN	D-SUB 9 Female PIN	Description
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 131: Service Connector Box Pinout on page 229.

Figure 130: 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 129: Basic Service Cable on page 227).

Figure 131: Service Connector Box Pinout

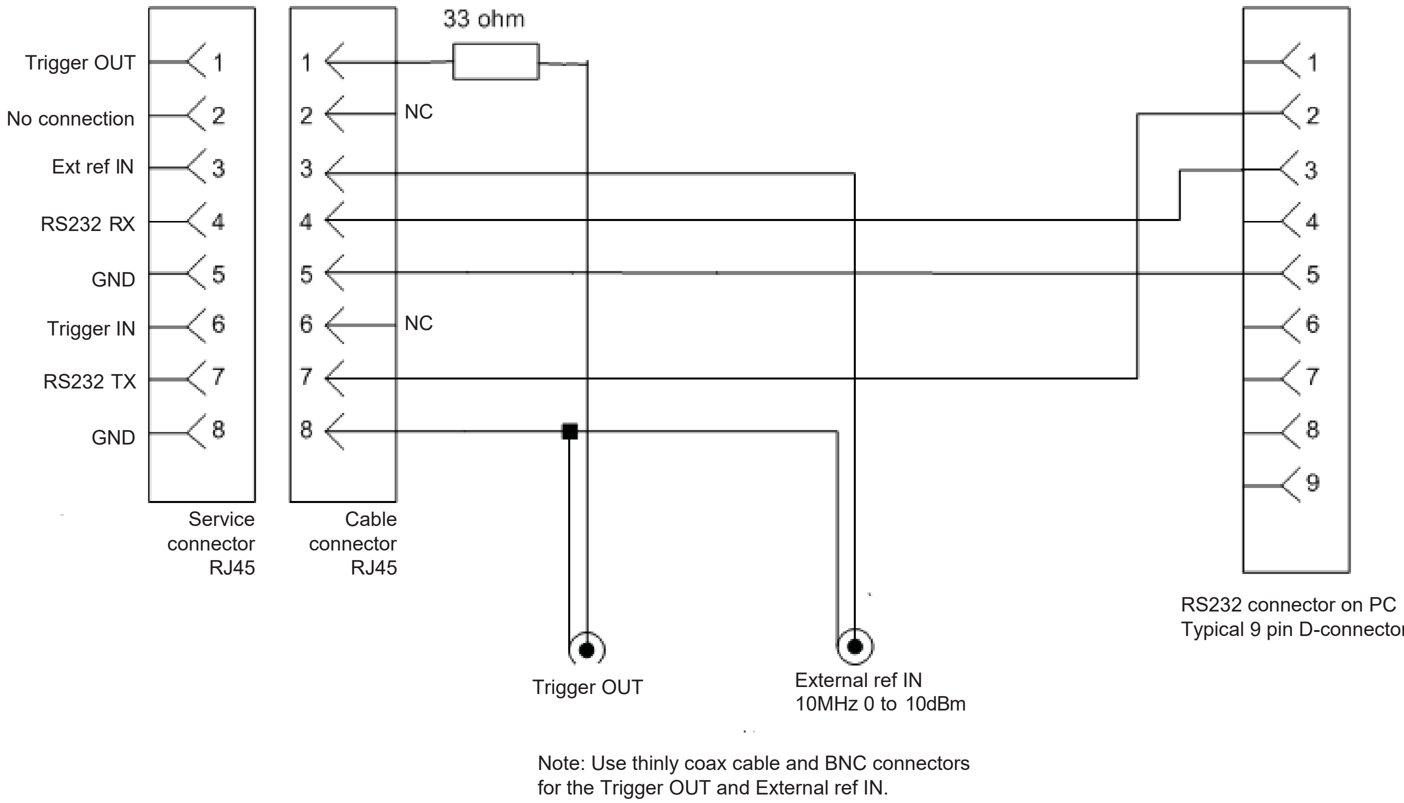


Table 76: Site Controller Service Port Pinout

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 229) to the **Site Controller** using the **Service Cable** (Service Cable and Connector Box Description on page 227).

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 230
- Fans CAN Bus Commands on page 231
- DPM CAN Bus Commands on page 231
- ATCC CAN Bus Commands on page 231
- Other CAN Bus Commands on page 232

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 232.
2. Perform E1 (X.21) Loopback to test the E1 (X.21) interface and cabling.

   See:
   - E1 Connection Test on page 233
   - X.21 Connection Test on page 233
3. Verify proper SRI functioning.

   See Site Reference Check on page 233.

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 222.
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 294.

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 222.

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 222.

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 222.

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 345 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 235.
2. Select Base Radio Position and Receivers Selection.

   See Base Radio Position and Receivers Selection on page 236:
   - Setup and Access to Base Radio Position on page 237
   - Setting and Accessing Base Radio Position by Using the cccp Command on page 237
   - Enabling Base Radio Receiver Branches on page 239
   - Additional Receiver Configuration for BR-Arch-1 on page 239
3. Configure the Base Radio DPM and ATCC mappings to the Site Controller. See Configuring the pm_config on page 242.
4. Verify the transmit and receive operations.

   See Station Verification Procedures on page 243:
   - Verifying the Base Radio Software Revision on page 243
   - Verifying the Transmitter on page 246
   - Receiver Verification on page 247
5. Display outstanding Base Radio alarm conditions.

   See Displaying Base Radio Alarms on page 254.

6.5.1
Base Radio Startup Sequence

Verify the following LED conditions on the base radio controller according to the following table.

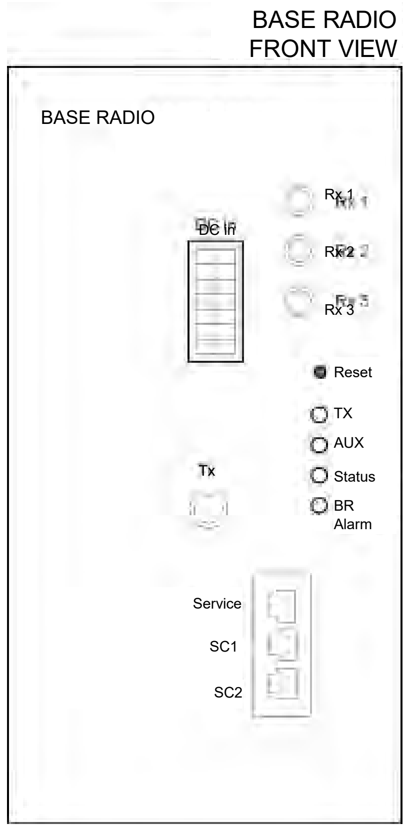
Table 77: Base Radio LEDs: Normal Startup Sequence

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 78: 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 132: 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:

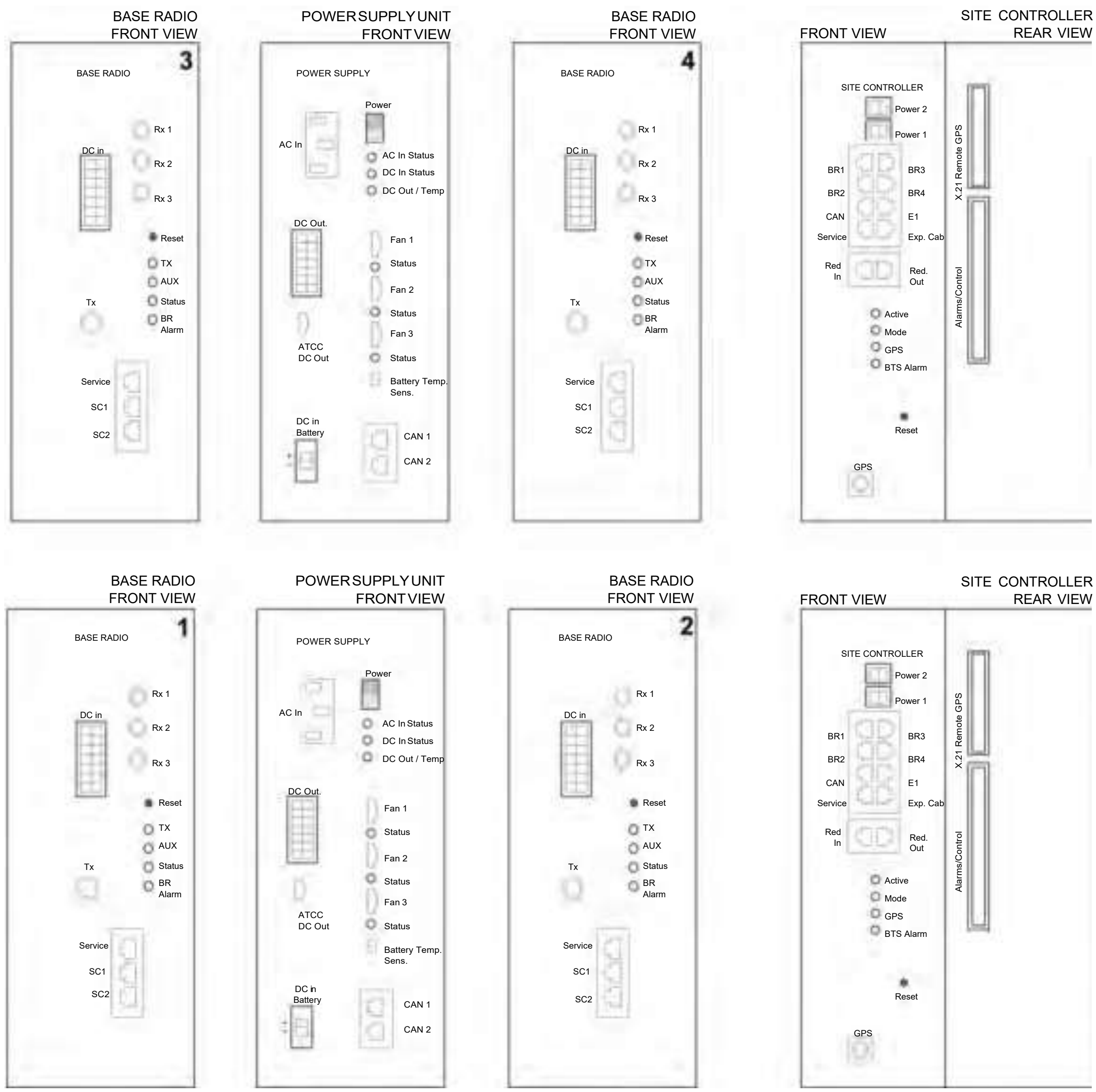
- Set the position identifier of the Base Radio within the cabinet. See Setting and Accessing Base Radio Position by Using the cccp Command on page 237.
- Set the number of active receivers (diversity) of the new Base Radio. See Enabling Base Radio Receiver Branches on page 239.
- **BR-Arch-1 Base Radios only:** Verify and configure additional receiver parameters. See Additional Receiver Configuration for BR-Arch-1 on page 239.

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 133: 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 224.
- 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 225.

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 237.

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 225.
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 237.

Procedure:

1. Log on to the Test Application. See Logging on to the Test Application on page 225.
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 224.
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 224.
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 79: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 240 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 79: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 240 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 79: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 240 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 79: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 240 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 79: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 240 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 79: Corrective Actions for Missing or Bad Base Radio Parameters in BR-Arch-1 Architecture on page 240 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 79: 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:

Missing or Bad Parameter	Corrective Action

	`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 224.
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 223.

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 224.
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 225.
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 244.

   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 244.

   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 224.

   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 225.

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 243 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 225.
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 225.
   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 225.
   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 80: 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 225.
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 225.

    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 248.

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 225.

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 251.

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 249.
- Set up the equipment for receiver verification and tuning. See Setting Up the Equipment for Receiver Verification on page 248.
- 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 225.

   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.

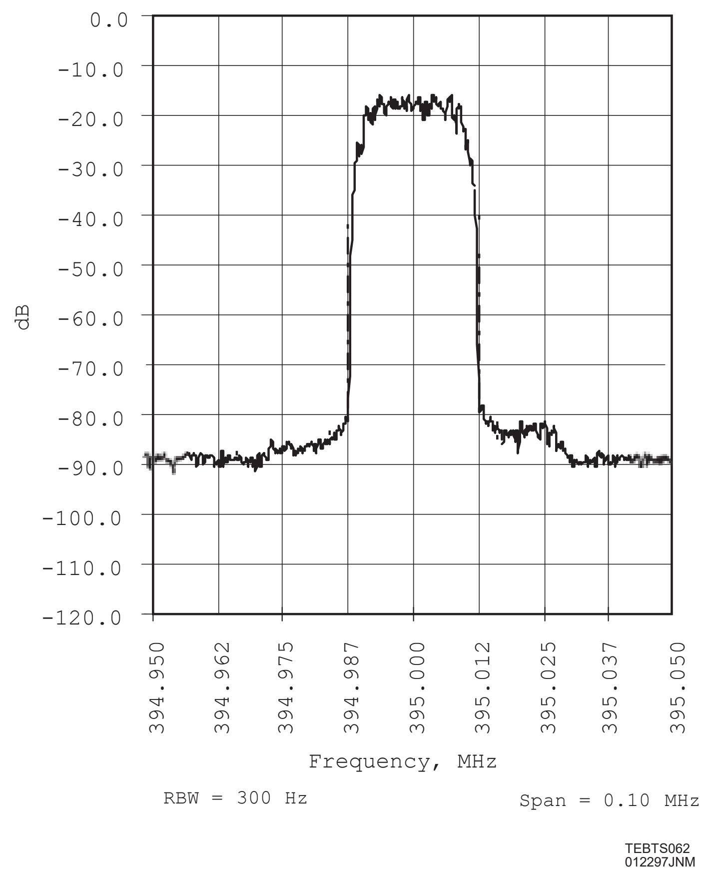
CAUTION: The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into a dummy load.

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 134: 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 303.

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 81: 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 142: Schematic Diagram of MTS LiTE / MTS 2 Preselector on page 265.

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 144: Schematic Diagram of MTS LiTE / MTS 2 Duplexer on page 268.

  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 82: MTS LiTE RF Configurations on page 260, 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 83: MTS 2 RF Configurations on page 261, *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 82: MTS LiTE RF Configurations on page 260 lists all filters configurations for MTS LiTE and Figure 135: MTS LiTE TX/RX on 1 ant. - Filter Configuration on page 260 and Figure 136: MTS LiTE

TX/RX on 1 ant., RX on 1 ant - Filter Configuration on page 261 show the positions of filters in the filter tray.

Table 82: 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 135: MTS LiTE TX/RX on 1 ant. - Filter Configuration

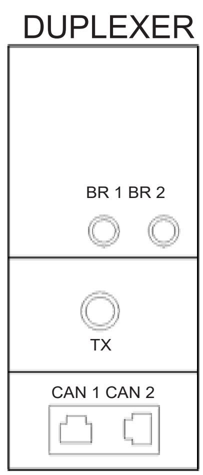


Figure 136: MTS LiTE TX/RX on 1 ant., RX on 1 ant - Filter Configuration

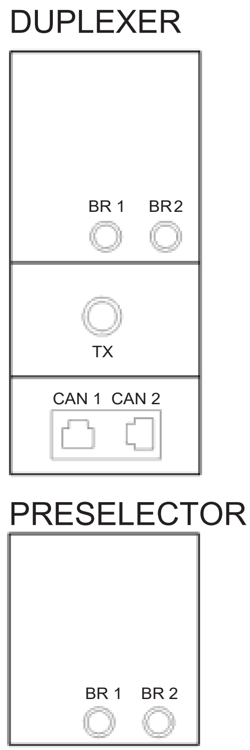


Table 83: MTS 2 RF Configurations on page 261 lists all filters configurations for MTS 2 and Figure 137: MTS 2 TX/RX on 2 ant. - Filter Configuration on page 262 to Figure 140: MTS 2 TX/RX on 1 ant., RX on 2 ant - Filter Configuration on page 263 show the positions of filters in the filter tray.

Table 83: 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 137: MTS 2 TX/RX on 2 ant. - Filter Configuration

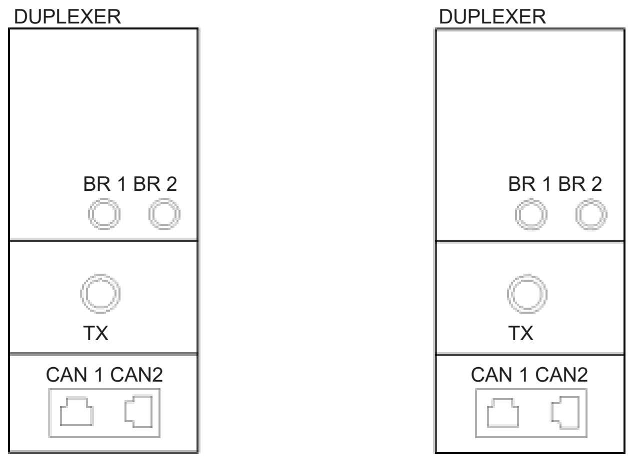


Figure 138: MTS 2 TX/RX on 2 ant., RX on 1 ant - Filter Configuration

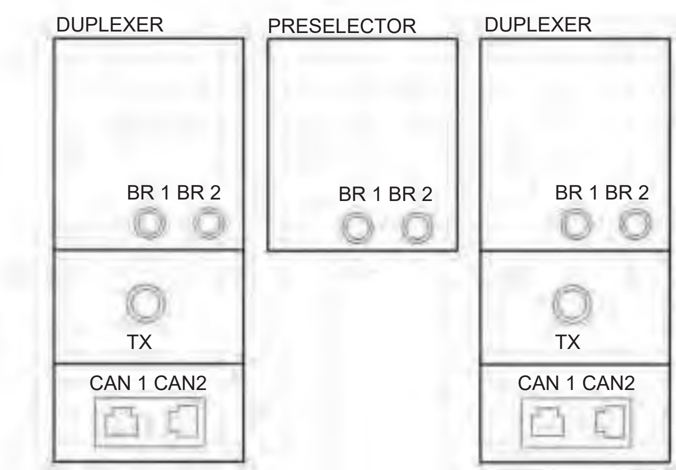


Figure 139: MTS 2 TX/RX on 1 ant., RX on 1 ant - Filter Configuration

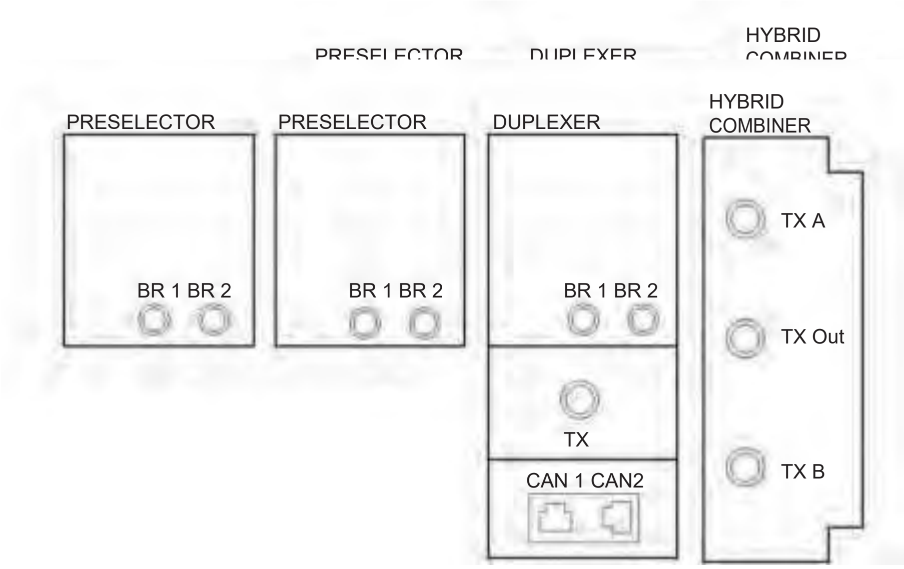


Figure 140: MTS 2 TX/RX on 1 ant., RX on 2 ant - Filter Configuration

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.

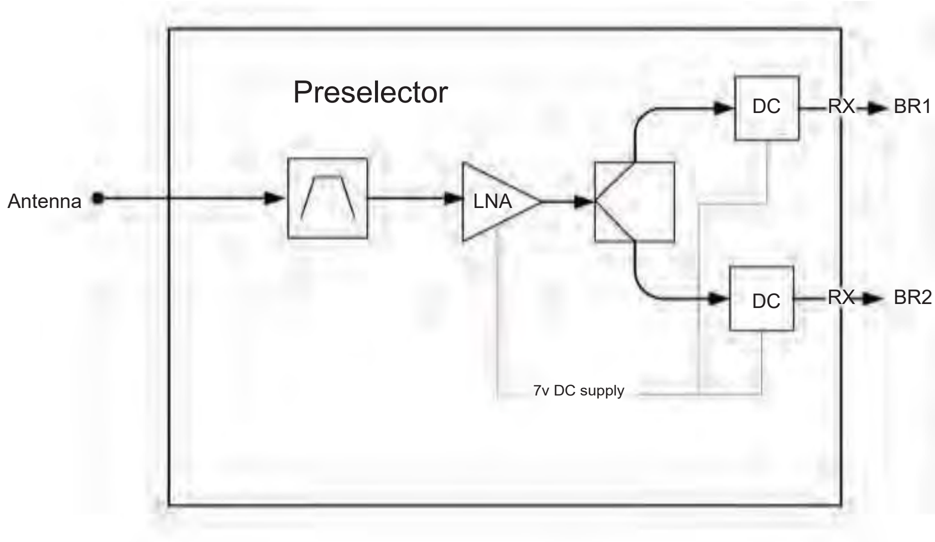
NOTICE: The MTS LiTE Preselector FRU is common with the MTS 2 Preselector.

Figure 141: 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 142: 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 446.

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 265 or Removing the Preselector – MTS 2 on page 266.
2. Reinstall the Preselector, see Reinstalling the Preselector – MTS LiTE on page 266 or Reinstalling the Preselector – MTS 2 on page 266.

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 143: 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.

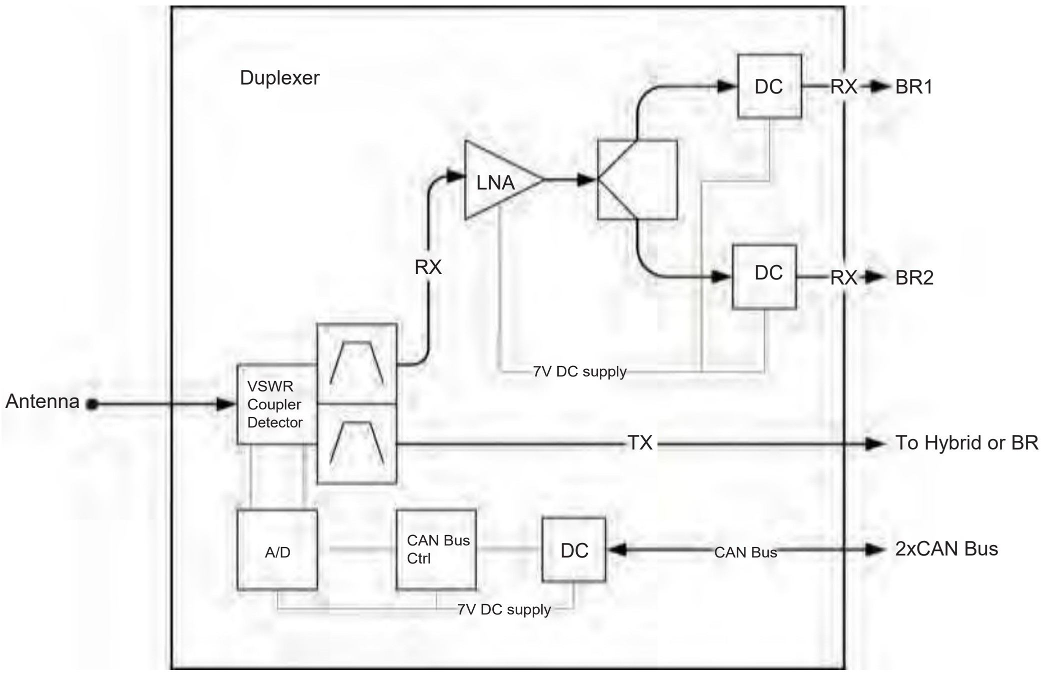
The MTS LiTE/MTS 2 Duplexer has 2 RX outputs and can handle a maximum power of 60 watts.

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 144: 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 446.

Process:

1. Remove the Duplexer, see Removing the MTS LiTE / MTS 2 Duplexer on page 269.
2. Insert the Duplexer into the filter tray, see Inserting the MTS LiTE / MTS 2 Duplexer into the Filter Tray on page 269.
3. Update the mapping list with the new unit TrackID, see Updating the Mapping List with the New Unit TrackID on page 269.

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 269.
2. Update the mapping list with the new unit TrackID.

   See Updating the Mapping List with the New Unit TrackID on page 269.

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`

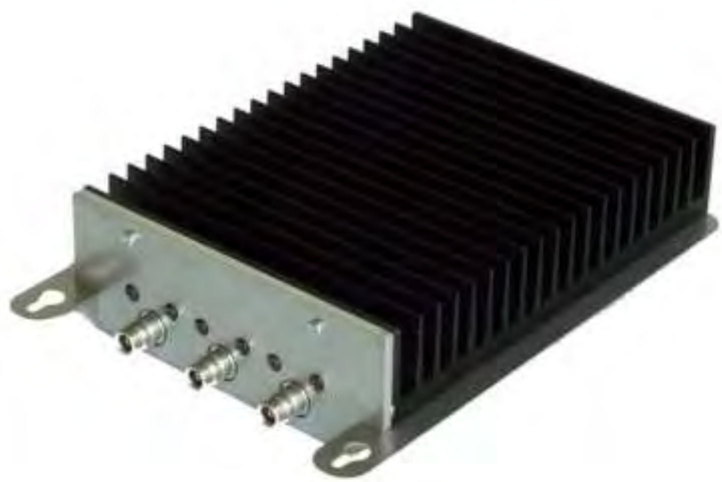
6 View the updated mapping list by entering: `can check_mapping`.

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 145: 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 271.
2. Reinstall the Hybrid Combiner.

   See Reinstalling the Hybrid Combiner on page 272.

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 84: MTS 4 RF Configurations

RF Configuration	Max Power [W]		Cavity Combiner	Duplexer	Preselector	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	-
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 146: MTS 4 TX/RX on one Antenna and up to two RX Antennas Filter Configuration

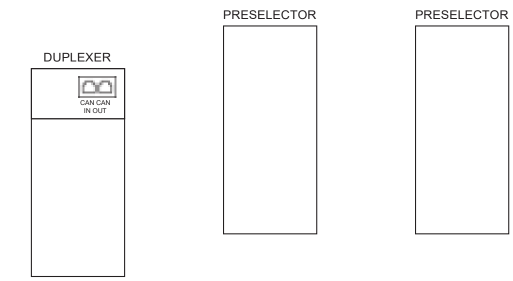


Figure 147: MTS 4 TX/RX on two Antennas and up to one RX Antenna Filter Configuration

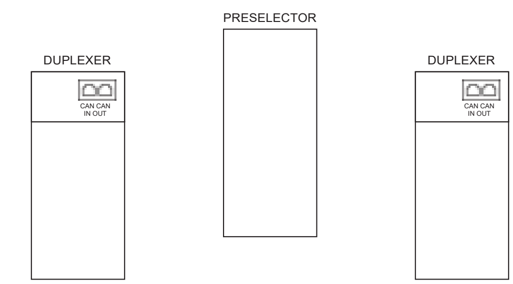


Figure 148: MTS 4 TX on one Antenna and up to three RX Antennas Filter Configuration

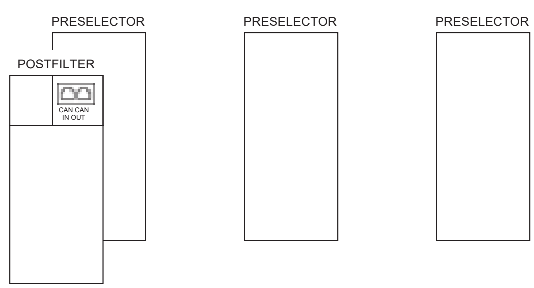


Figure 149: MTS 4 TX on one Antenna and two RX Antennas Filter Configuration

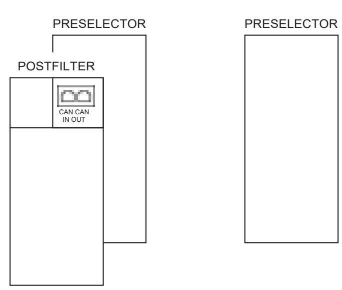
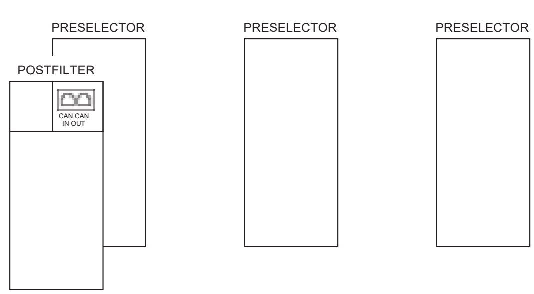


Figure 150: MTS 4 TX on one Antenna and three RX Antennas Filter Configuration



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

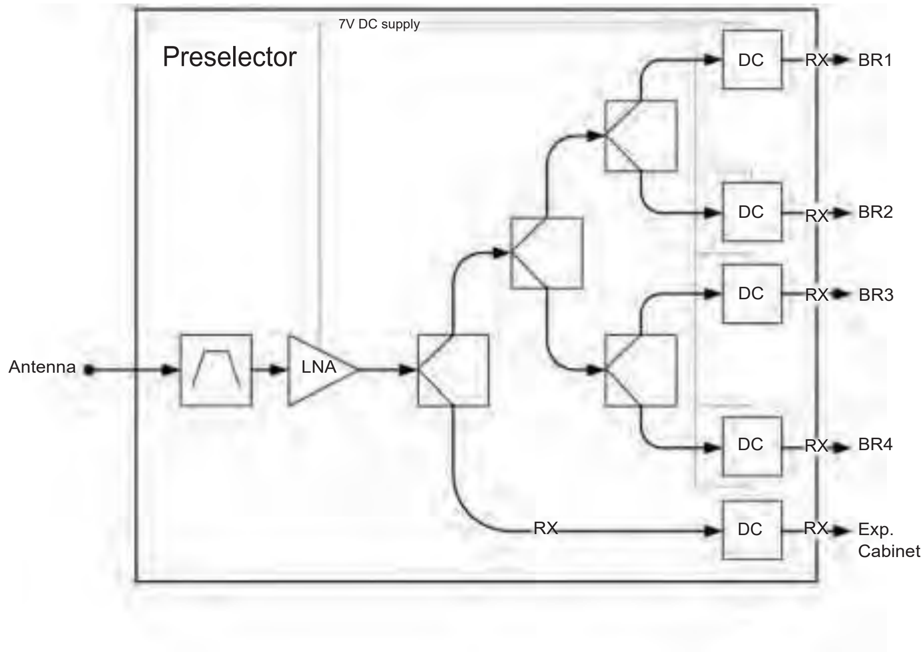
The filter's bandwidth is designed to block transmitter frequencies. The receive and transmit bandpass are 10 MHz apart for 400 MHz, 9 MHz apart for 260 MHz, and 45 MHz apart for 800 MHz. The Preselector incorporates an LNA followed by an RMC.

The MTS 4 Preselector has four RX outputs and one expansion output.

Figure 151: 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 152: 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 276.

2 Reinstall the Preselector.

See Reinstalling the MTS 4 Preselector on page 277.

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 154: Schematic Diagram of MTS 4 Duplexer on page 278

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.

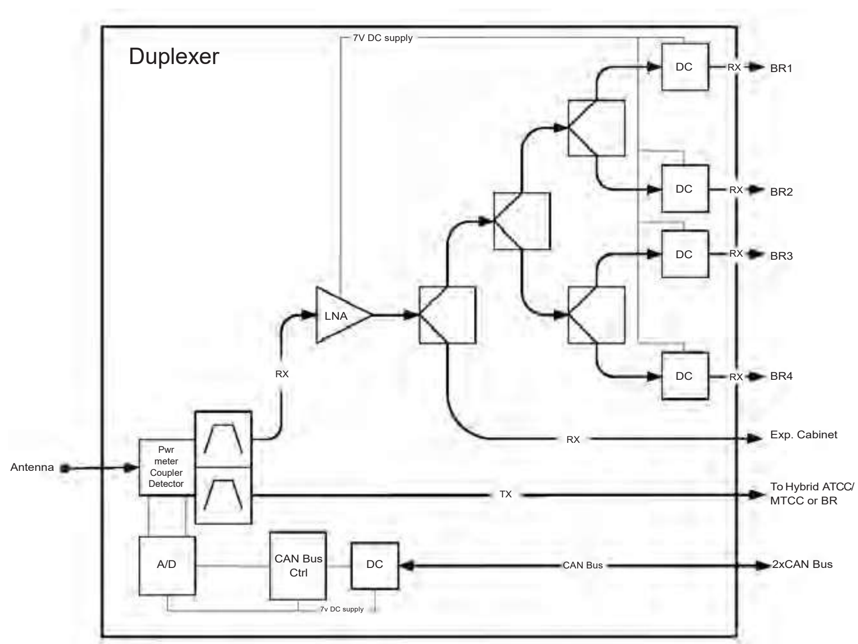
For 260 MHz, the duplex spacing between a transmit frequency and the corresponding receive frequency is 9 MHz, and leaves a 3 MHz spacing between the lowest possible transmit frequency and the highest possible receive frequency.

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 153: MTS 4 Duplexer

Figure 154: 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 279.

2 Insert the Duplexer into the filter tray.

See Inserting the MTS 4 Duplexer into the Cabinet on page 279.

3 Update the mapping list with the new unit TrackID.

See Updating the Mapping List with the New Unit TrackID on page 280.

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 279.
2. Update the mapping list with the new unit TrackID.

   See Updating the Mapping List with the New Unit TrackID on page 280.

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

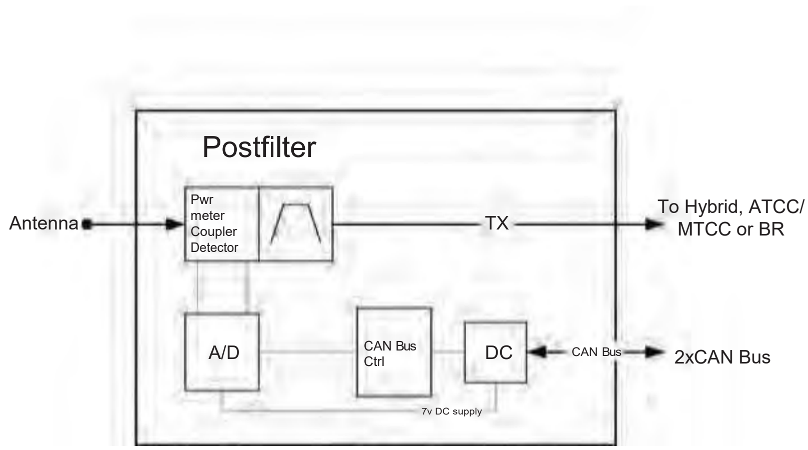
For details about the Hybrid Combiner (HC), see Hybrid Combiner on page 270.

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 155: Post Filter

Figure 156: 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 446.

Process:

1. Remove the Post Filter, see Removing the Post Filter on page 282.
2. Install the Post Filter into the cabinet, see Inserting the Post Filter into the Cabinet on page 282.
3. Update the mapping list with the new unit TrackID, see Updating the Mapping List with the New Unit TrackID on page 283.

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 276.
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 282.
2. Update the mapping list with the new unit TrackID.

   See Updating the Mapping List with the New Unit TrackID on page 283.

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 157: 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 285.

2 Reinstall the Cavity Combiner.

See Reinstalling the Cavity Combiner on page 285.

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 286.

2. **For redundant ATCC only:** Upgrade the redundant ATCC firmware.

   See Upgrading the Redundant ATCC Firmware on page 286.

3. **For ATCC only:** Update the mapping list with the new unit TrackID.

   See Updating the Mapping List with the New TrackID on page 286.

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:

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.

3 Loosen the all the locking knobs of the MTCC, see the figure below (the design of the MTCC may look slightly different), and turn the tuning knobs counter clock wise as many turns as possible.

Figure 158: Tuning Knob and Locking Knob

4 Power up the BTS and let all BRs key up. Observe that the TX LEDs of all BRs shine.

5 Connect the service computer to the service port of Base Radio 1 and log on. The service port connector is located on the front panel of the Base Radio module. The default password is `motorola`.

6 At the `BR)` prompt, type: `dekey` This command stops all RF transmission.

7 Repeat step 5 and 6 for all BRs.

8 Observe on the power meter that all BRs have dekeyed and that all TX LEDs are off.

9 Connect the service computer to the service port of Base Radio 1.

10 At the `BR)` prompt, type: `key`. After a while the TX LED of the BR will turn on and the power meter will show the BR output power minus the loss of the MTCC and the duplex filter.

11 Slowly turn the tuning knob of the cavity to be tuned, until the power level displayed at the power meter is at its absolute maximum.

12 Tighten the locking knob.

13 Repeat step 11 and 12 until the power level is still at its absolute maximum with the locking knob firmly tightened.

14 Dekey the BR.

15 Repeat step 9 to 14 for all remaining BRs connected to the MTCC.

7.4

Expansion Cabinet RFDS

The Expansion Cabinet uses a high-power RFDS intended for up to four high power Base Radios in addition to the Base Radios in the MTS 4 Prime cabinet. The RFDS in the Expansion Cabinet is made up of the following:

- Up to three RX Splitters – a passive device functioning as an extension for the Receiver Multi Coupler function of the Duplexer/Preselector in MTS 4 to support eight Base Radios. It is connected to the Exp Cabinet connector on the Duplexer/Preselector present in the MTS 4 Prime Cabinet giving the right signal level for the RX-Splitter.
- Cavity Combiners – combining of eight carriers on 1 TX antenna.

Table 85: MTS 4 Expansion Cabinet RF Configurations on page 289 lists the RF configurations of the MTS 4 Expansion Cabinet. In the table, *Low Power* is valid for both 400 MHz and 260 MHz versions of the Expansion Cabinet, while *High Power* is valid for both 400 MHz and 800 MHz versions of the Expansion Cabinet.

Table 85: MTS 4 Expansion Cabinet RF Configurations

RF Configuration	Max Power (W)		Cavity Combiner	RX Splitter
	Low Pwr	High Pwr		
1 – 2 BRs				
TX/RX on 2 ant.	10	25	1	2
TX/RX on 2 ant., RX on 1 ant.	10	25	1	3
TX on 2 ant., RX on 2 ant.	10	25	1	2
TX on 2 ant., RX on 3 ant.	10	25	1	3
TX/RX on 1 ant., RX on 1 ant	8	20	1 + phasing harness	2
TX/RX on 1 ant., RX on 2 ant.	8	20	1 + phasing harness	3
TX on 1 ant., RX on 2 ant.	10	20	1 + phasing harness	2
TX on 1 ant., RX on 3 ant.	10	20	1 + phasing harness	3
3 – 4 BRs				
TX/RX on 2 ant.	10	25	2 (comb)	2
TX/RX on 2 ant., RX on 1 ant.	10	25	2 (comb)	3
TX on 2 ant., RX on 2 ant.	10	25	2 (comb)	2
TX on 2 ant., RX on 3 ant.	10	25	2 (comb)	3
TX/RX on 1 ant., RX on 1 ant.	8	20	2 (comb) + phasing harness	2
TX/RX on 1 ant., RX on 2 ant.	8	20	2 (comb) + phasing harness	3
TX on 1 ant., RX on 2 ant.	8	20	2 (comb) + phasing harness	2
TX on 1 ant., RX on 3 ant.	8	20	2 (comb) + phasing harness	3

NOTICE: For 260 MHz version of MTS there are no phasing harness configurations, so please disregard from these in Table 85: MTS 4 Expansion Cabinet RF Configurations on page 289.

Figure 159: Expansion Cabinet with Single Diversity

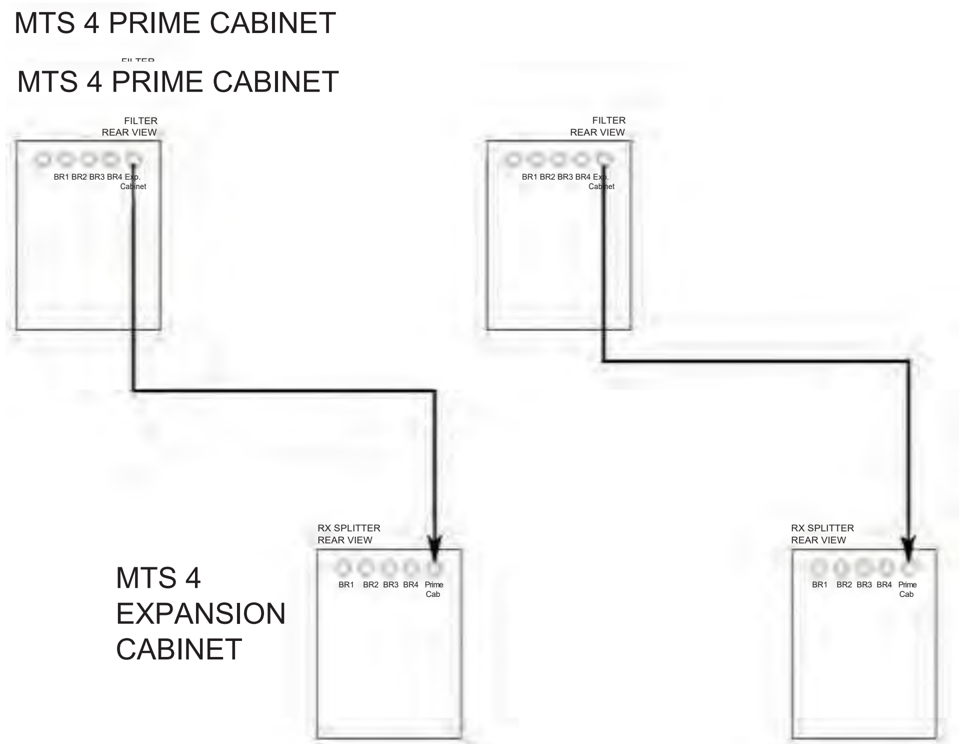
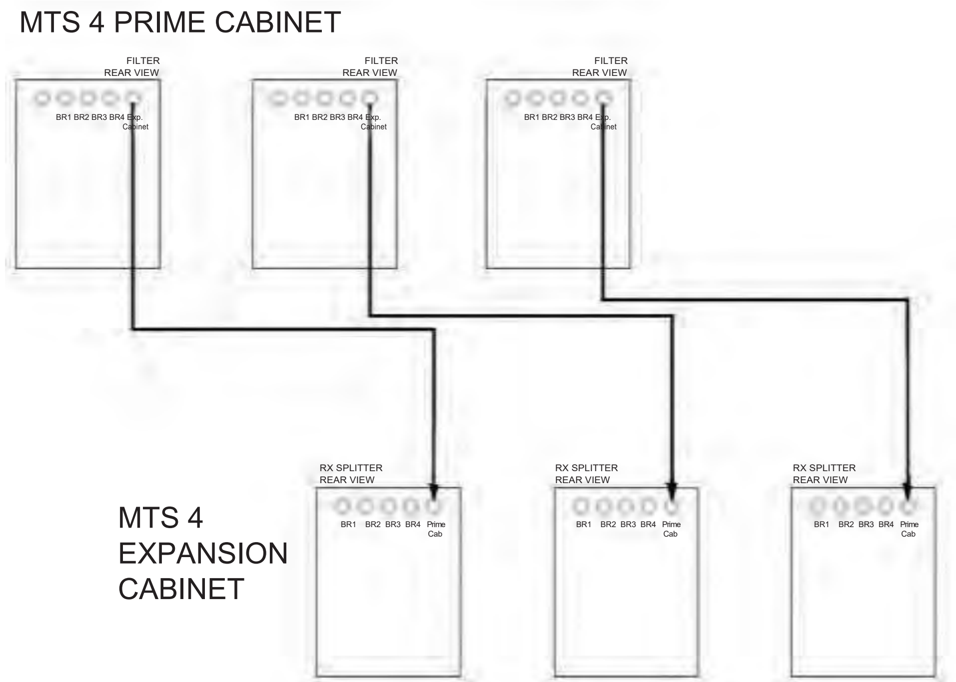


Figure 160: Expansion Cabinet with Dual Diversity

Figure 161: Expansion Cabinet with Triple Diversity



7.4.1
RX Splitter

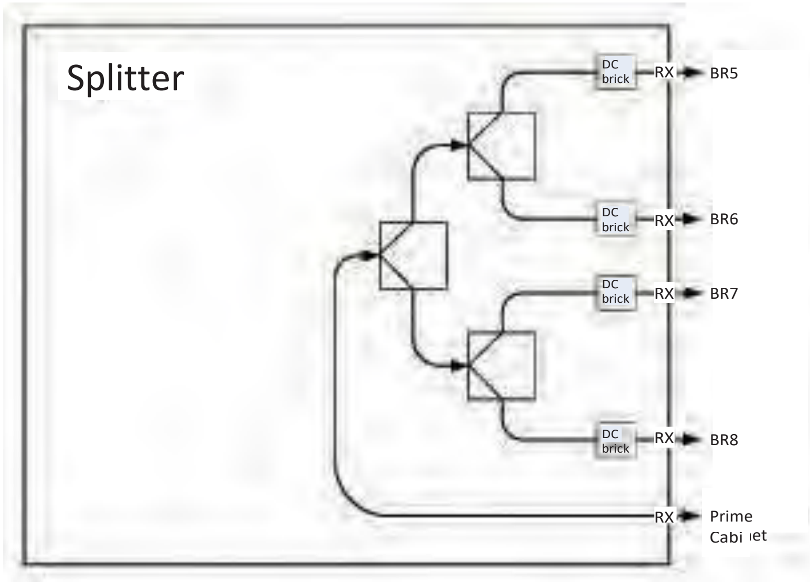
The RX Splitter is a passive device functioning as an extension for the Receiver Multi Coupler function of the Duplexer/Preselector in MTS 4 to support eight Base Radios. It is connected to the Exp Cabinet connector on the Duplexer/Preselector present in the MTS 4 Prime Cabinet giving the right signal level for the RX-Splitter.

There are two types of RX splitters covering the 260 MHz range and the 350–825 MHz range.

The following figure displays the Expansion Cabinet RX Splitter.

Figure 162: Expansion Cabinet RX Splitter

Figure 163: Schematic Diagram of RX Splitter



7.4.1.1
Replacing the Expansion Cabinet RX Splitter

This process outlines the recommended tasks to be performed to replace the Expansion Cabinet RX Splitter. For a list of available FRUs, see Field Replaceable Units (FRUs) on page 446.

Process:

1. Remove the RX splitter, see Removing the RX Splitter on page 292.
2. Reinstall the RX splitter, see Reinstalling the RX Splitter on page 293.

7.4.1.1.1
Removing the RX Splitter

This procedure describes how to remove the RX Splitter.

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. Remove the RX cables connected to the back of the RX Splitter.
6. Loosen the two fastening screws at the front enough to free the mounting bracket.
7. Slide the RX Splitter out of the cabinet.
8. Remove the RX Splitter from the bracket and replace with the new unit.

7.4.1.1.2
Reinstalling the RX Splitter

This procedure describes how to reinstall the RX Splitter.

Procedure:

1. Fasten the RX Splitter onto the bracket.
2. Slide the RX Splitter into the cabinet.
3. Tighten the two fastening screws at the front.
4. Connect the RX cables to the back of the RX Splitter.
5. Slide on the top rear and front panels and fasten these with screws.
6. Place the front panel back on and screw this into place.
7. Put the door of the cabinet back on.

7.4.2
Cavity Combiner

See Cavity Combiner on page 283.

Chapter 8

Site Controller

The following figures show the front and the rear view of the site controller.

Figure 164: Site Controller Front View

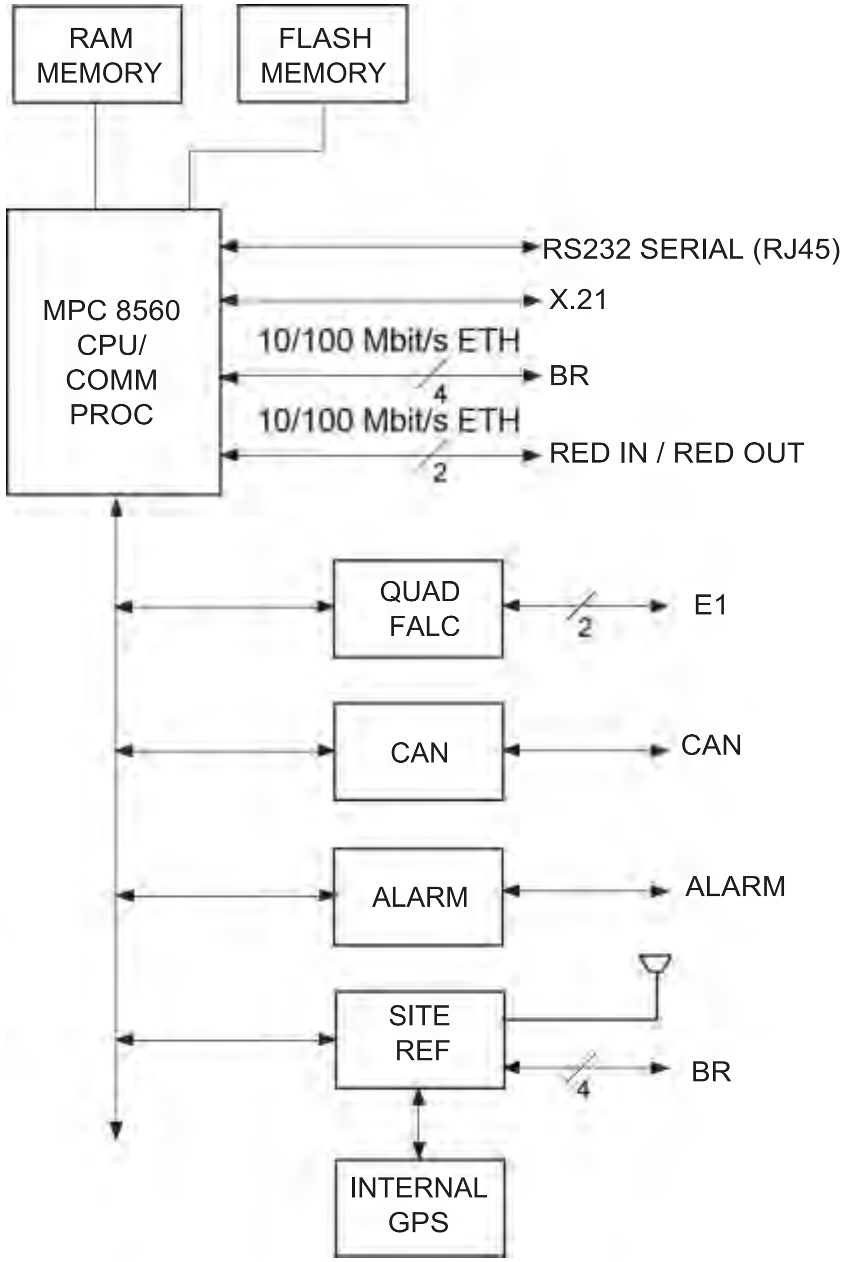
Figure 165: Site Controller Rear View

8.1
Site Controller – Theory of Operation

The Site Controller controls resources within the MTS, including assignment of frequencies and slots to mobile stations. The Site Controller incorporates a Global Positioning System (GPS) module. The GPS module provides a high precision timing signal used as reference for the Base Radio receive and transmit functionality.

See Site Controller Specifications on page 407 for Site Controller hardware specifications.

Figure 166: Site Controller - Functional Block Diagram



8.2

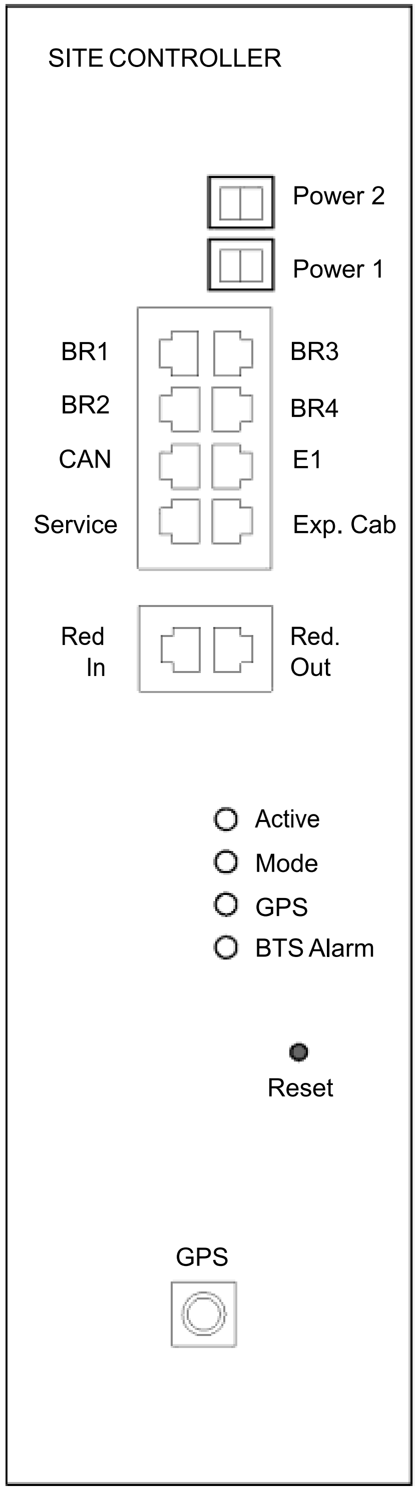
Site Controller – Indicators, Switches, and Connectors

This section contains information on indicators, switches, and connectors of the Site Controller.

8.2.1
Site Controller – Front Panel

BTSQ108SSR_MTS2and4_dr_SCCaptiveScrews_A

Figure 167: Site Controller - Front Panel



8.2.1.1
Site Controller – Front Panel Indicators (LED)

Figure 168: Site Controller - Front Panel LEDs Position

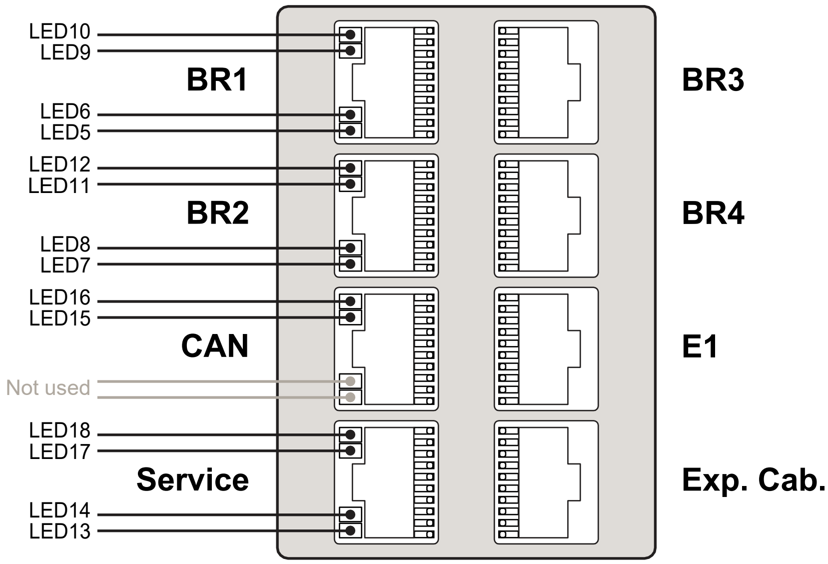


Table 86: Site Controller - Front Panel Indicators (LED)

LED	LED/Port Name	Position	Controlled by	Indication
LED1	Active	Front Panel	SW	Site Controller is active or standby: • OFF: Site Controller main application not running. • GREEN: E1/X.21 relay energized. • AMBER: E1/X.21 relay not energized. • RED: Failed Site Controller, replace FRU.
LED2	Mode	Front Panel	SW	Trunking status: • OFF: Boot up/No trunking/ Standby. • GREEN: Wide area trunking. • AMBER: Local site trunking.
LED3	GPS	Front Panel	SW	**Automatic Synchronized Configuration (ASC) Mode**: • OFF: Application is not running. • GREEN: BTS synchronized to GPS.

LED	LED/Port Name	Position	Controlled by	Indication
				• GREEN/AMBER Blinking: BTS synchronized to a standby SC. • AMBER Blinking: In training. • AMBER: GPS Free run mode synchronized (ETSI spec). • RED: NTP, NTP malfunction. • RED Blinking: Calibration is required. • GREEN/RED Blinking: Frequency lock is required, pull in. **Forced Non-Synchronized Configuration (FNC) Mode**: • OFF: Application is not running, free run or NTP. • GREEN: BTS synchronized to GPS. • GREEN/AMBER Blinking: BTS synchronized to a standby SC. • AMBER Blinking: In training. • RED Blinking: Calibration is required. • GREEN/RED Blinking: Frequency lock is required, pull in.
LED4	BTS Alarm	Front Panel	SW	• OFF: No alarms. • GREEN: Not used. • AMBER: CAN Bus problems. • RED: External alarms (major Alarm), Major/critical alarm, for details see Table 105: Site Controller LED Fault Indications on page 345.
			SW	3 LEDs blinking together: R (red) RRR->Y (yellow) YYY->G (green) GGG – LED test just after BTS reset or power up
			SW	RRRR blinking – replace the FRU
			SW	RRR blinking – replace the FRU
			SW	R->RR->RRR->RRRR->R->RR->RRR->RRRR-> ... – initializing file system (do not turn off and wait a few minutes, then application and configuration will have to be downloaded after initialization).

LED	LED/Port Name	Position	Controlled by	Indication
LED5	BR1	Port 1 LED1	HW, Enet switch	• OFF: Ethernet link not present. • GREEN: Ethernet link present.
LED6		Port 1 LED2	HW, Enet switch	• OFF: Ethernet activity not present. • YELLOW: Ethernet activity present.
LED7	BR2	Port 2 LED1	HW, Enet switch	• OFF: Ethernet link not present. • GREEN: Ethernet link present.
LED8		Port 2 LED2	HW, Enet switch	• OFF: Ethernet activity not present. • YELLOW: Ethernet activity present.
LED9	BR3	Port 3 LED1	HW, Enet switch	• OFF: Ethernet link not present. • GREEN: Ethernet link present.
LED10		Port 3 LED2	HW, Enet switch	• OFF: Ethernet activity not present. • YELLOW: Ethernet activity present.
LED11	BR4	Port 4 LED1	HW, Enet switch	• OFF: Ethernet link not present. • GREEN: Ethernet link present.
LED12		Port 4 LED2	HW, Enet switch	• OFF: Ethernet activity not present. • YELLOW: Ethernet activity present.
LED13	Service	Port 5 LED1	HW, Enet switch	• OFF: Ethernet link not present. • GREEN: Ethernet link present.
LED14		Port 5 LED2	HW, Enet switch	• OFF: Ethernet activity not present. • YELLOW: Ethernet activity present.
	CAN	Port 6 LED1		Not used.
		Port 6 LED2		Not used.
LED15	E1	Port 7 LED1		• OFF: Primary E1 not configured.

LED	LED/Port Name	Position	Controlled by	Indication
				• GREEN: Primary E1 OK (no LOS (Loss Of Signal)). • AMBER: Errors FE, CRC, BPV, PD. • RED: Primary E1 failure LOS.
LED1 6		Port 7 LED2		• OFF: Secondary E1 not configured. • GREEN: Secondary E1 OK (no LOS (Loss Of Signal)). • AMBER: Errors FE, CRC, BPV, PD. • RED: Secondary E1 failure LOS.
LED1 7		Port 8 LED1		• OFF: Ethernet link not present. • GREEN: Ethernet link present.
LED1 8	Exp.Cab.	Port 8 LED2		• OFF: Ethernet activity not present. • YELLOW: Ethernet activity present.

8.2.1.2
Site Controller – Front Panel Switches

Table 87: Site Controller - Front Panel Switches

Switch Name	Switch Function
Reset	The front-panel switch can be used to either generate an interrupt to the processor or to initiate a Hard Reset. • Push and hold (1 second) to generate interrupt. • Push and hold (>3 seconds) for Hard Reset.

8.2.1.3
Site Controller – Front Panel Connectors

Table 88: Site Controller - Front Panel Connectors

Connector Name	Connector Type	To/From	Comment
POWER SUPPLY	MOLEX (2 Pin)	PSU	28.5 VDC
BR	RJ45	BR	Ethernet
CAN	RJ45	BR	CAN Bus connection

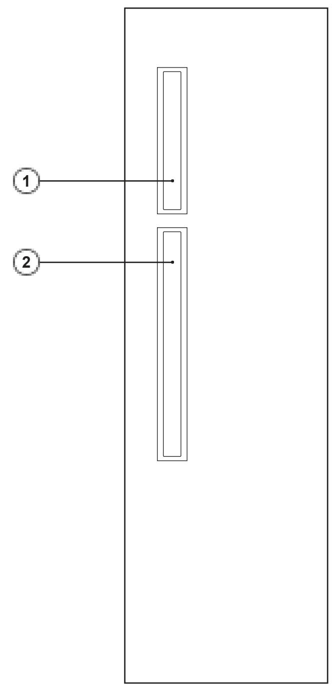
Connector Name	Connector Type	To/From	Comment
E1	RJ45	Junction Panel	Pin connections on the Site Controller are different from the ones on the Junction Panel connector.
Service	RJ45	Service Terminal	Provides service access. See Table 89: Site Controller - Service Cable Pinouts on page 302 for service cable pinout information. (Service Cable PN: 3066565B)
Exp.Cab.	RJ45	XHUB in MTS 4 Expansion Cabinet	Only in configurations with MTS 4 Expansion Cabinet
Red In / Red Out	RJ45	Redundant Site Controller	Ethernet
GPS Antenna (for Site Controller with internal GPS receiver)	QMA	Junction Panel	GPS antenna input. +5VDC bias for active antenna.

Table 89: Site Controller - Service Cable Pinouts

RJ45 PIN	D-SUB 9 FEMALE PIN	Description
1		
2		
3		
4	3	Rx
5	5	GND
6		
7	2	Tx
8	5	GND
9		

8.2.2
Site Controller Rear Panel

Figure 169: Site Controller Rear Panel



1 — X21/Remote GPS	
2 — Alarms/Control	

8.2.2.1
Site Controller – Rear Panel Connectors

Table 90: Site Controller - Rear Panel Connectors

Connector Name	Connector Type	To/From	Comment
Remote GPS/ X.21	IDE 26pin	Junction Panel	Connects to remote GPS/ X.21
Alarms/Control	IDE 34pin	Junction Panel	Provides Alarm/Control interface

8.3
Site Controller CAN Bus

The CAN Bus provides a common communication bus between RFDS equipment, Power Supply Unit (PSU) and the Site Controller. The CAN Bus connects to the Site Controller, PSU, DPM, and ATCC. The modules on the CAN Bus are assigned an address for the CAN Bus. When there are more than one modules of the same type, assigned a functionality in MTS to each node. Mapping between the track number, CAN ID, and function relies on the fact that the unique track number is available from each unit.

At initialization of the MTS, the factory configures the Site Controller with a relation between track number and the function of the node. You can modify this configuration in a service situation.

If a node is removed or is defective, the Site Controller knows the track number of a non-responding FRU and therefore it can make a proper service report which tells exactly what FRU to replace. When the service is carried out, replace the track number of the defective FRU with the new track number in the mapping list, that way the new track number is mapped to the function of the replaced FRU.

Figure 170: Site Controller - CAN Bus

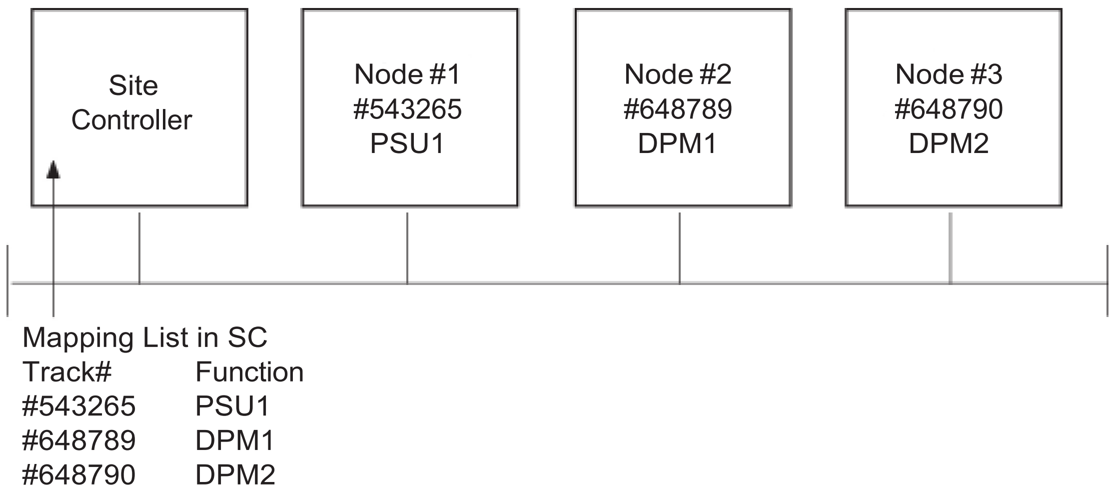


Table 91: Site Controller - CAN Bus Functionality

Unit	Function
PSU	Monitoring: • PSU temperature: -30 °C to +100 °C, tolerance: 2 °C. • Battery current: -20 A to +10 A, tolerance: ±1%. • Battery voltage: 30 V to 60 V, tolerance: ±1%. • Battery temperature: -30 °C to +100 °C, tolerance: 2 °C. • 7 V output voltage: 0 V to 10 V, tolerance: ±2%. • 7 V output current: 0 A to 10 A, tolerance: ±2%. • 28.5 V output voltage: 0 V to 30 V, tolerance: ±2%. • 28.5 V output current: 0 A to 10 A, tolerance: ±2%. • PSU output power: 0 W to 1100 W, tolerance: ±2%. • Fan output voltage: 0 V to 30 V, tolerance: ±2%. • PSU input air temp.: -30 °C to +100 °C, tolerance: ±2 °C.
	Alarms: • DC Source Fail: Indicating DC input voltage outside limits (below 43 V). • DC Out Fail: DC output voltages out of limits. • AC Source Fail: Early warning, indicating that the AC input is interrupted and the PSU starts to operate from DC input source in 15 ms. (if a backup source is present).

Unit	Function
	• Software Fail: Indicating software is corrupted or unable to initialize. • Over Temperature: Indicating over temperature detected 5 °C to 10 °C before shutdown. • Fan 1 alarm: Fan 1 not operating (fan has stopped or its running speed is below specification), PSU has received a high signal (open collector) from fan tray 1 through fan connector 1. • Fan 2 alarm: Fan 2 not operating (fan has stopped or its running speed is below specification), PSU has received a high signal (open collector) from fan tray 2 through fan connector 2. • Fan 3 alarm: Fan 3 not operating (fan has stopped or its running speed is below specification), PSU has received a high signal (open collector) from fan tray 3 through fan connector 3.
	Controls: • FORCE DC: Controls the PSU to force the usage of the DC input if usable, disregard presence of AC. If DC is outside the usable range for the PSU, the PSU shall indicate an alarm using the DC-fail output. If DC input voltage comes below 43 V ±2% and if AC is usable the PSU shall take the input power from AC, disregarding a Force-DC control input. **NOTICE:** Force DC operation on a bad DC supply PSU or Battery: Bad DC supply is defined as a DC source where the voltage drops below 43 V for a few milliseconds when the PSU is forced to operate on DC. In case of a force DC command and bad DC supply the 28.5 V output voltage is allowed to drop down to 27 V for a maximum of 5 second, while the PSU automatically switches back to AC mode and the 28.5 V rises from 27 V to 28.5 V. During this sequence the DC out alarm is suppressed. • Fan supply output voltage is also controlled by the CAN Bus in 5 steps from 24 V to 12 V. The highest value is set by CAN Bus or automatically. • DC operation only: Prevents AC fail alarms (and associated LED) from the PSU on CAN Bus when the PSU is supplied from DC only. If the AC supply becomes present during DC operation, the AC Source Fail alarm circuit is automatically be reactivated. • AC operation only: Prevents DC fail alarms (and associated LED) from the PSU on CAN Bus when the PSU is supplied from AC only. If the DC supply becomes present during AC operation, the DC-Fail alarm circuit is automatically reactivated. • No Fan 1: Prevents Fan 1 alarm (and associated LED) when no fan 1 is connected. If the Fan1 becomes present during operation, the Fan1 alarm circuit is automatically reactivated. • No Fan 2: Prevents Fan 2 alarm (and associated LED) when no fan 2 is connected. If the Fan2 becomes present during operation, the Fan2 alarm circuit is automatically reactivated. • No Fan 3: Prevents Fan 3 alarm (and associated LED) when no fan 3 is connected. If the Fan3 becomes present during operation, the Fan3 alarm circuit is automatically reactivated.

Unit	Function
	NOTICE: See the *MMI Commands* manual for additional information on commands and parameters.
ATCC	Monitoring: • Cavity status. • ATCC Heartbeat signal: heart beat signal is repeated every 30 s. Alarms: • Software corrupted. • Distance between two channels below 150 kHz. • Cavity VSWR alarm. • Master Slave communication error. • Motor alarm. • Cavity tuning error alarms together. • VSWR exceeded the specified value. • Unable to park cavity. • Cavity unable to tune to the current frequency in 3 attempts. Controls: • Cavity tune timeout: establishes a timeout period between a fine-tuning of the cavities. All cavities must be fine-tuned at the timeout. • Park a cavity: instructs the ATCC to park the specified cavity. This involves adjusting the cavity resonance to a frequency outside of the Tx band. If RF power is present, the cavity parks and then re-tunes to the input frequency. • VSWR Alarm Threshold: establishes a threshold for enabling a VSWR Alarm. Valid threshold values are in the range 1.00 to 10.00 where 1.00 means **No VSWR**. Recommended values for each MTS configuration are: - **400 MHz:** 3.00 - **260 MHz:** 3.00 - **800 MHz:** 4.00
DPM (Duplexer, Post Filter)	Monitoring: • Forward power on a digital power monitor: the input power range is from 0 W to 150 W. • Reverse power on a digital power monitor: the input power range is from 0 W to 40 W. • VSWR from a DPM. • DPM temperature. • DPM Heartbeat signal. Alarms: • SW is corrupted or unable to initialize.

Unit	Function
	• VSWR alarm. Controls: • VSWR Alarm Threshold: establishes a threshold for enabling a VSWR Alarm. Valid threshold values are in the range 1.00 to 10.00 where 1.00 means **No VSWR**. Recommended values for each MTS configuration are: - **400 MHz:** 3.00 - **260 MHz:** 3.00 - **800 MHz:** 4.00

8.3.1

Updating CAN Bus TrackID Mapping List

When and where to use:
Perform this procedure to update the Mapping List with the New Unit TrackID.

Procedure:

1. Log on to the Site Controller.
2. To view the mapping list, type `can check_mapping`.

   See example below:

   ```
   SC> can check_mapping
   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 list, locate the unit that you have removed and that is indicated as `Units are not present`.
4. Delete old CAN Bus unit from the CAN Bus unit mapping list. Type `can remove_mapping <Device>`, where <Device> is the old unit name. See example below:

   ```
   SC> can remove_mapping dpm 2
   ```
5. Add new CAN Bus unit to the CAN Bus unit mapping list.

   NOTICE: The new unit Track ID is present on the replaced unit label and indicated as `Track ID not mapped` in the list shown in step 2.

   Use `can add_mapping <Device> <TrackID>`, where< TrackID> is a TrackID of the new unit and <Device> is the new unit name. Units have the following names: psu X, dpm X, atcc X, where X denotes a digit between 0 and 3. See example below:

   ```
   SC> can add_mapping dpm 2 JTH0500102
   ```
6. View the updated mapping list using the `can check_mapping` command and check that there are no units labeled as `Track ID not mapped` or `Units are not present`.

8.4
Site Controller – GPS Module

The GPS module generates a highly accurate timing reference signal within the Base Station. The integrated GPS module tracks 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. A proper GPS signal must be provided to the QMA input connector on the Site Controller. The Site Controller provides a +5 V DC supply voltage on the QMA connector. It provides a voltage supply for active antennas.

NOTICE:
See Hardware Installation on page 86 for description of external GPS.

See respective restoration manual (DIPS/DIPC/X Core systems) or *Service Manual* (DIPM system) for procedures on how to verify the internal and external GPS module.

8.5
Site Controller – Lithium Battery

This section contains procedures on how to check if the lithium battery needs changing and how to correctly replace it.

8.5.1
Resetting the RTC Battery Status

The following procedure describes how to reset the status of the RTC battery. Perform this procedure after each RTC battery replacement.

Procedure:

In TETRA Application, enter `hw rtc reset batteryStatus`

The following message appears:

```
reset RealTimeClock battery status
  - Status: OK
```

8.5.2
Checking if the Site Controller Lithium Battery Needs Changing

Procedure:

1. Perform Resetting the RTC Battery Status on page 308.
2. Power down and then Power up the MTS.
3. Use the Site Controller Test Application to check the RTC alarm by typing `alarms -ofault_hndlr` and press **Enter**.
4. - If the battery is OK there should be no RTC related alarms reported. There is no need to change the Site Controller Lithium Battery.
   - If the battery still reports RTC related alarms, the battery is not working properly or not working at all. Proceed to Replacing the Site Controller Lithium Battery on page 309.

8.5.3
Replacing the Site Controller Lithium Battery

CAUTION: Danger of explosion if battery is replaced incorrectly. Replace battery only with the same or equivalent type recommended by manufacturer. Dispose of used batteries according to the manufacturers instructions.

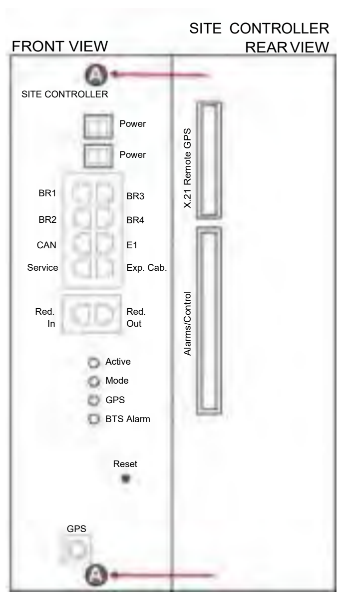
Procedure:

1. Examine the contents of the flash filling system using the monitor command `SC> attrib`. Record the file attributes for each of the files.
2. **WARNING:** Shock Hazard. The MTS contains dangerous voltages which can cause electrical shock or damage to equipment. Turn off the MTS and remove the power cabling before servicing this equipment. Make sure that all power is off to prevent accidental contact with high energy and injury to personnel.

   Switch the MTS Power Supply Unit OFF.

   IMPORTANT: If two PSUs are present, switch off the supplying the Site Controller being replaced. Do not power down the MTS. In configuration with non-redundant power connection, the MTS Power Supply Unit can be switched off as an alternative to removing the cables.
3. Wear an ESD strap and connect its cable to a verified good ground. This strap must be worn to prevent ESD damage to any components.
4. Tag and disconnect any cabling from the Site Controller.
5. Loosen the two M4X10 captive screws securing the Site Controller to the chassis.

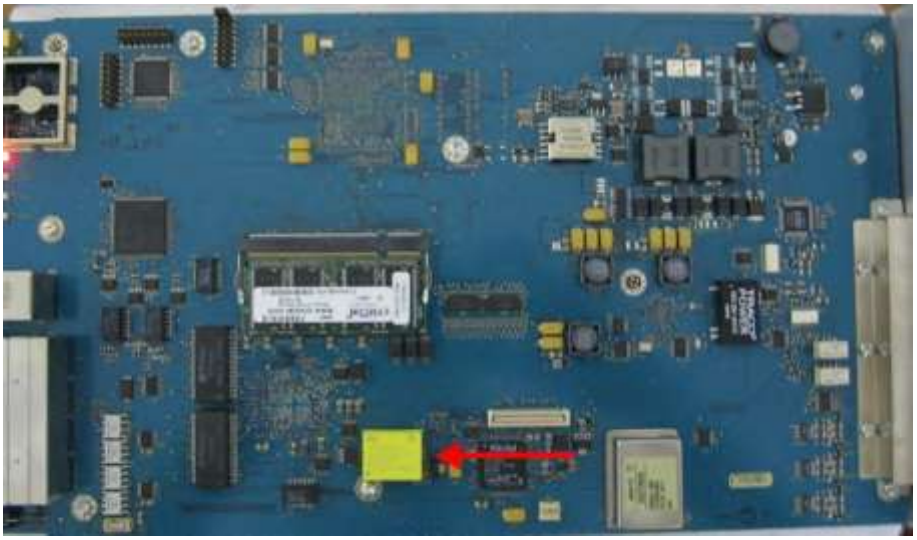
   Figure 171: Site Controller - Captive Screws



6. Use the handle, and gently slide the Site Controller from the slot, removing it from the chassis.

   IMPORTANT: There are cables connected at the rear of the Site Controller. Slide out the Site Controller carefully, tag and disconnect ribbon cables at the rear.
7. Remove the Site Controller cover. Unscrew 19 screws securing the cover and slide it off gently to avoid damage to components installed on the board (the cover can harm the springs on the RJ45 connectors (front side connectors), when the cover has been slid nearly completely off).
8. Remove the old battery from the socket on the board.

Figure 172: Site Controller - Lithium Battery Location



9 Install a replacement battery (Motorola p/n 5185151Y02) in its socket on the board.

IMPORTANT: Dispose or recycle the used battery according to local regulations.

10 Slide the cover gently on and secure it with 19 screws.

11 Install the Site Controller into the MTS. Use the handle to slide the unit into the chassis.

IMPORTANT: Connect the ribbon cables at the rear before sliding the unit into the chassis.

12 Secure the Site Controller in the chassis with the captive screws.

13 Except the power cables, reconnect all other cabling to the unit as tagged during the removal.

14 Power up the Site Controller:

- **a** Reconnect the power cables to the MTS Power Supply Units.
- **b** Set the power switch to the ON position.

15 Perform Resetting the RTC Battery Status on page 308.

Chapter 9

XHUB Controller

NOTICE: The content of this chapter is only supported in DIMETRA IP system releases D6.0 and later.

This chapter covers the following topics:

Figure 173: XHUB Controller

9.1
XHUB Controller – Theory of Operation

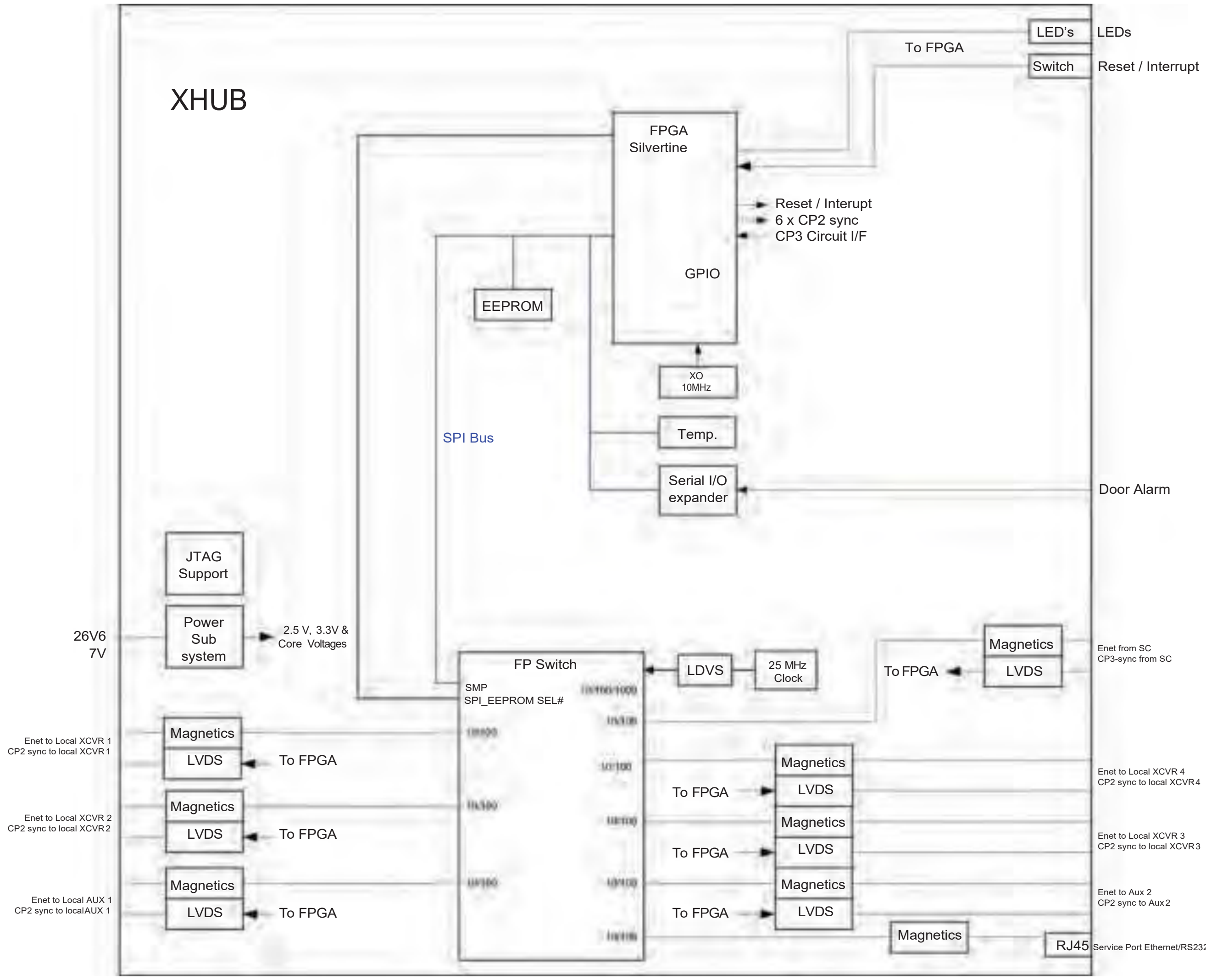
NOTICE: MTS 4 sites equipped with Site Controller Rev A or B may experience service interruption to Base Radio(s) located in the Expansion Cabinet. Prior to Expansion Cabinet installation, Site Controllers of Rev A or B must be sent to factory for FPGA upgrade or replacement. Please see Motorola Solutions Technical Notifications (MTNs) for more information.

The eXpansion HUB (XHUB Controller) is a non-intelligent switching and interface module which plugs into the Site Controller slot of MTS 4 Expansion Cabinet. With the usage of an Expansion Cabinet and an XHUB, a station can be increased by a number of four Base Radios. The XHUB receive the CP3 interface from the Site Controller in the Prime Cabinet, distribute the Enternet and timing as CP2 links to the Base Radios in the Expansion Cabinet. The XHUB also have a door alarm input. The RFDS alarms is reported through the CAN bus or the receivers. The XHUB has following modes of operation:

- **Normal mode:** XHUB Controller in the MTS 4 Expansion Cabinet has an active connection with a Site Controller in the MTS 4 Prime Cabinet. The XHUB may be used to extend the switching and interface capabilities of the Site Controller.
- **Impaired Normal mode:** If connection to the Site Controller of the MTS 4 Prime Cabinet is lost, the XHUB Controller will go into Impaired Normal mode. It will return to Normal mode as soon as the connection to the Site Controller is restored.
- **Standalone mode:** If no connection to the Site Controller is present when the XHUB is turned ON or being Reset, it will go into Standalone mode. In order to go to Normal mode, the XHUB Controller needs to be Reset again.

NOTICE: The Site Controller door alarm configuration is also valid for the XHUB.

Figure 174: XHUB Controller – Functional Block Diagram

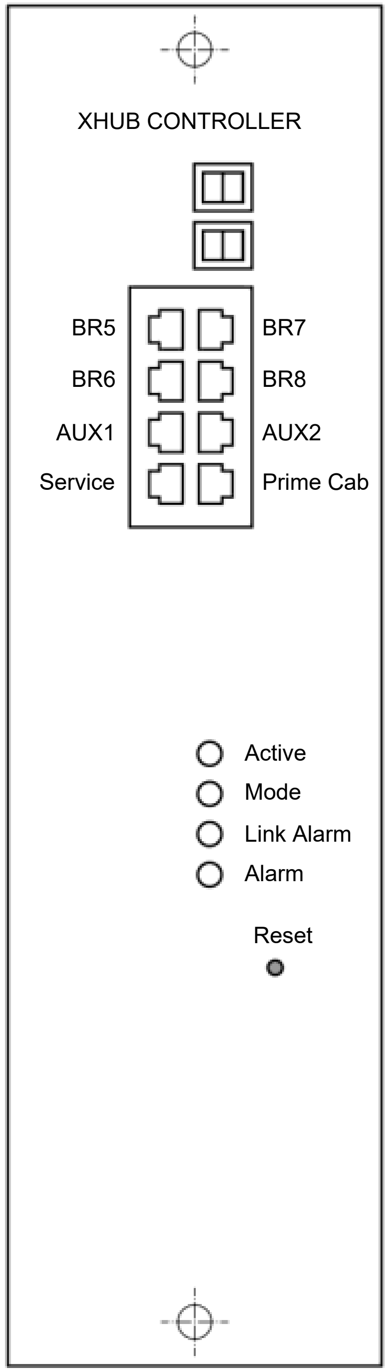


9.2 XHUB Controller – Indicators, Switches, and Connectors

This section contains information on indicators, switches, and connectors of the XHUB Controller.

9.2.1 XHUB Controller – Front Panel

Figure 175: XHUB Controller- Front Panel



This section contains following topics:

- XHUB Controller – Front Panel Indicators (LED) on page 315
- XHUB Controller – Front Panel Switches on page 316
- XHUB Controller – Front Panel Connectors on page 316

9.2.1.1
XHUB Controller – Front Panel Indicators (LED)

The following table lists the Front Panel LEDs.

Table 92: XHUB Controller – Front Panel Indicators (LED)

LED	LED/Port Name	Position	Controlled By	Indication
LED1	Active	Front Panel	SW	GREEN: XHUB is Active and in Normal mode OFF: XHUB in Standby or Standalone/Impaired Normal mode
LED2	Mode	Front Panel	HW	GREEN: Normal or Impaired Normal Mode OFF: Standalone mode
LED3	Link Alarm	Front Panel	HW	RED: Impaired Normal or Standalone mode OFF: Normal mode
LED4	Alarm	Front Panel	SW	RED: If Alarms (Problem or Failure) in Normal mode or Unknown XHUB state FLASH: Impaired Normal mode
LED5	BR5	Port 1 LED1	HW, Enet switch	OFF: Ethernet link not present GREEN: Ethernet link present
LED6		Port 1 LED2	HW, Enet switch	OFF: Ethernet activity not present YELLOW: Ethernet activity present
LED7	BR6	Port 2 LED1	HW, Enet switch	OFF: Ethernet link not present GREEN: Ethernet link present
LED8		Port 2 LED2	HW, Enet switch	OFF: Ethernet activity not present YELLOW: Ethernet activity present
LED9	BR7	Port 3 LED1	HW, Enet switch	OFF: Ethernet link not present GREEN: Ethernet link present
LED10		Port 3 LED2	HW, Enet switch	OFF: Ethernet activity not present YELLOW: Ethernet activity present
LED11	BR8	Port 4 LED1	HW, Enet switch	OFF: Ethernet link not present GREEN: Ethernet link present
LED12		Port 4 LED2	HW, Enet switch	OFF: Ethernet activity not present YELLOW: Ethernet activity present
LED13	Service	Port 5 LED1	HW, Enet switch	OFF: Ethernet link not present GREEN: Ethernet link present

LED	LED/Port Name	Position	Controlled By	Indication
LED14		Port 5 LED2	HW, Enet switch	OFF: Ethernet activity not present YELLOW: Ethernet activity present
LED15	AUX1	Port 6 LED1	HW, Enet switch	OFF: Ethernet link not present GREEN: Ethernet link present
LED16	AUX1	Port 6 LED2	HW, Enet switch	OFF: Ethernet link not present YELLOW: Ethernet link present
LED17	AUX2	Port 7 LED1	HW, Enet switch	OFF: Ethernet link not present GREEN: Ethernet link present
LED18	AUX2	Port 7 LED2	HW, Enet switch	OFF: Ethernet link not present YELLOW: Ethernet link present
LED19	Prime Cab	Port 8 LED1		OFF: Ethernet link not present GREEN: Ethernet link present
	Prime Cab	Port 8 LED2		OFF: Ethernet activity not present YELLOW: Ethernet activity present

9.2.1.2

XHUB Controller – Front Panel Switches

The following table lists the Front Panel switches of the XHUB Controller and their functions.

Table 93: XHUB Controller – Front Panel Switches

Switch Name	Switch Function
Reset	The front-panel switch can be used to initiate a Hard Reset of the XHUB Controller. Push and hold (>3 seconds) for Hard Reset.

9.2.1.3

XHUB Controller – Front Panel Connectors

The following table lists the front panel connectors of the XHUB controller.

Table 94: XHUB Controller – Front Panel Connectors

Connector Name	Connector Type	To/From	Comment
Power	MOLEX (2 Pin)	PSU	28.5 V DC
BR	RJ45	BR	Ethernet
AUX1	RJ45	BR or Ethernet Sitelink	Used in E-Tetra configurations or Ethernet Sitelink
AUX2	RJ45	BR	Used in E-Tetra configurations
Service	RJ45	Service Terminal	Provides service access

Connector Name	Connector Type	To/From	Comment
Prime Cab	RJ45	SC (in Prime Cab)	

9.2.2
XHUB Controller – Rear Panel

This section provides information about Rear Panel connectors of the XHUB Controller.

9.2.2.1
XHUB Controller – Rear Panel Connectors

The following table lists the rear panel connectors of the XHUB controller.

Table 95: XHUB Controller – Rear Panel Connectors

Connector Name	Connector Type	To/From	Comment
Alarms/Control	IDE 34-pin	Cabinet door sensor	Provide Alarm

9.3
Replacing the XHUB Controller

WARNING: See Static Precautions and ESD Strap on page 460 before proceeding with replacement process.

Procedure:

1 Disconnect the power cables to the MTS Power Supply Units.

WARNING: Shock Hazard. The MTS contains dangerous voltages which can cause electrical shock or damage to equipment. Turn off the MTS and remove the power cabling before servicing this equipment. Make sure that all power is off to prevent accidental contact with high energy and injury to personnel.

2 Wear an ESD strap and connect its cable to a verified good ground. This strap must be worn to prevent ESD damage to any components.

3 Tag and disconnect all other cabling from the XHUB Controller.

4 Loosen the two M4X10 captive screws securing the XHUB Controller to the chassis.

5 Use handle, and gently slide the XHUB Controller from the slot, removing it from the chassis.

IMPORTANT: There are cables connected at rear of the XHUB. Slide out the XHUB carefully, tag and disconnect ribbon cables at the rear.

6 Install the replacement XHUB Controller. Use handle to slide the unit into the chassis.

IMPORTANT: Connect the ribbon cables at the rear before sliding the unit into the chassis.

7 Secure the XHUB Controller in the chassis with the captive screws.

8 Reconnect all other cabling to the unit as tagged during the removal except the power cables.

9 Reconnect the power cables to the MTS Power Supply Units.

9.3.1
XHUB Controller – FRU

Table 96: XHUB Controller - FRU

Kit Number	Description
GMLN4689A	XHUB MTS-EXP Controller

See Planned Maintenance Inspection (PMI) on page 459 for list of Periodic Maintenance Inspections.

Chapter 10

Base Radio

This chapter covers the following topics:

10.1

Base Radio – Overview

Figure 176: Base Radio

The Base Radio provides reliable digital radio capabilities in a compact software-controlled design. High channel capacity is provided through voice compression techniques and Time Division Multiplexing (TDM).

On the Base Radio front panel there are connectors and indicators. The indicators provide a means for monitoring various status and operating conditions of the Base Radio, and also aid in isolating failures.

For more information on Base Radio indicators and connectors, see Base Radio – Indicators and Connectors on page 325 in this chapter.

10.2
Base Radio – Theory of Operation

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

- Transceiver consisting of a Base Radio Controller, a triple receiver, and an exciter
- Power Amplifier (PA)

In the MTS 2 and 4, the Base Radio (BR) operates in conjunction with the Site Controller (SC) through a properly terminated 100Base-T Ethernet link.

Figure 177: Base Radio Front Panel

On the front panel, there is a DC power input, three parallel receiver (RX) inputs, a high power transmitter output signal from the power amplifier, a service port, two interfaces to the Site Controllers, and LED indicators. For more information on the LED indicators, see Table 99: Base Radio – LED Indicators on page 325.

The following figures show overall block diagrams of the Base Radios for both architectures: BR-Arch-1 and BR-Arch-2.

Figure 178: BR-Arch-1 Base Radio – Functional Block Diagram

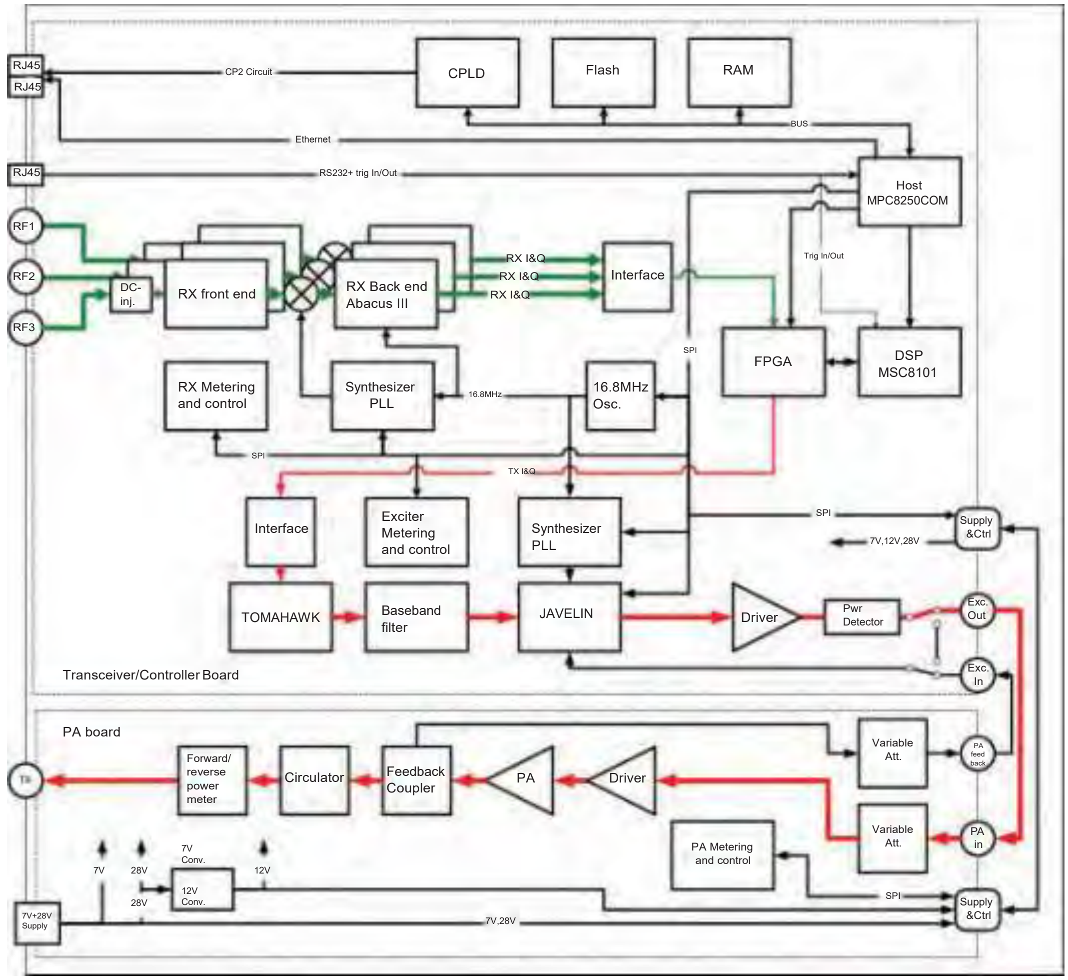
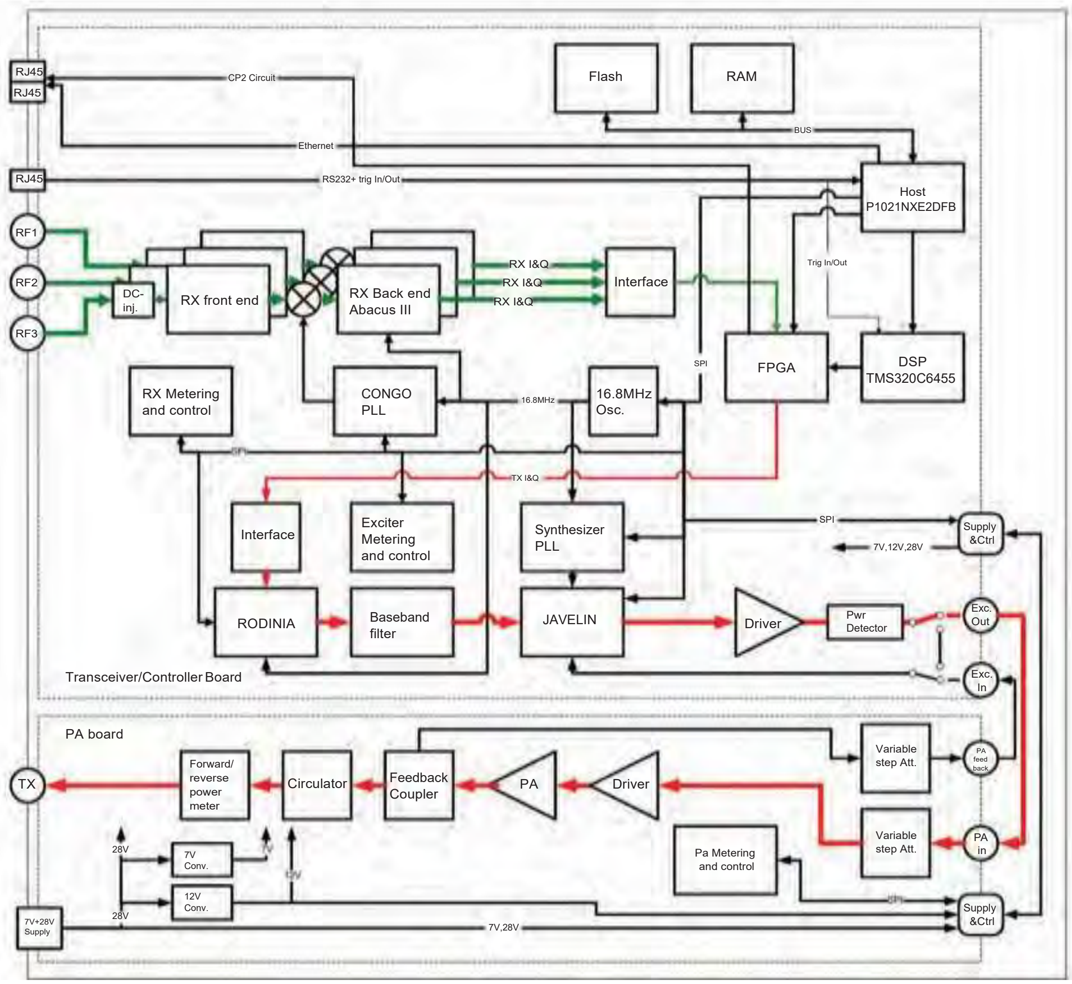


Figure 179: BR-Arch-2 Base Radio – Functional Block Diagram



Upon the power-up, BRC bootloader begins to download application code from SC over the Ethernet LAN. After successful download, the code is executed. Once the BRC application is started, it gets configuration parameters from SC. The configured BRC application allows the Base Radio to perform call processing functions.

Should any alarm conditions arise during BRC application, operation, they are reported to SC over Ethernet LAN. Alarm conditions may also be verified locally through the Service Access port linked to a service computer using the `get alarms` MMI command.

The Base Radio operates in a TDMA (Time Division Multiple Access) mode. This mode, combined with voice compression techniques, provides an increased channel capacity ratio of as much as 4 to 1. Both the receive and transmit signals of the Base Radio are divided into four individual timeslots. Each receive slot has a corresponding transmit slot; this pair of slots comprises a logical RF channel.

The Base Radio uses single, dual, and triple diversity reception for increased talkback coverage area and improved quality. The Transceiver contains a three-branch receiver section in which all receivers are used for triple diversity reception.

All receivers within a given Base Radio are programmed to the same receive frequency. The signals from each receiver are fed to the BRC where a diversity combining algorithm is performed on the signals. The resultant signal is processed for error correction and then sent to the Site Controller through the Ethernet LAN with the appropriate control information regarding its destination.

The transmit section of the Base Radio is comprised of the Exciter (EXC) and Power Amplifier (PA). The EXC processes the information to transmit from the BRC in the proper modulation format. This low-level signal is sent to the Power Amplifier where it is amplified to the desired output power level. The PA is a continuous-keyed linear amplifier. A power control routine monitors the output power of the Base Radio and adjusts it as necessary to maintain the proper output level.

For information on the performance specifications, see Technical Specifications on page 398.

NOTICE: The Base Radio is prepared for TEDS.

10.2.1
Transceiver (XCVR)

The transceiver provides the receive, transmit, and control functions for the Base Radio. The transceiver consists of three elements:

- Receiver-performs the receive function
- Exciter-performs the transmit function
- BR Controller-performs the control function

The receiver incorporates three separate receiver channels for use in diversity reception. The bias for the LNAs in the Preselectors is supplied by bias circuitry in the receiver. A +7 V dc voltage is the output on the QMA receive input connectors.

The receiver performs highly selective bandpass filtering and dual down conversion of the station receive RF signal. A custom receiver IC outputs the baseband information in a digital data format and sends it to the Base Radio controller.

The exciter in conjunction with the Power Amplifier (PA), provides the modulation and transmitter functions for the Base Radio.

The transceiver contains the Base Radio Controller (BRC). The BRC serves as the main controller of the Base Radio. The BRC provides signal processing and operational control for the other Base Radio circuit blocks.

The operating software and configuration data are contained within the BRC flash memory. The software defines operating parameters for the BR, such as output power and operating frequency.

NOTICE: To protect the key encryption key in use in the infrastructure, it is recommended that this key is overwritten using the Key Variable Loader (KVL) device (through the front serial port) before shipping for repair.

IMPORTANT: BR-Arch-1 Base Radios: To avoid the risk of causing a high bit errorrate to occur, do not use 385.572 MHz and 419.175 MHz as receiving frequencies in the BaseRadios of the MTS.

10.2.2
Power Amplifier

The Power Amplifier (PA) in conjunction with the exciter provides the transmitter functions for the Base Radio. The Power Amplifier accepts the low-power modulated RF signal from the exciter and amplifies the signal for transmission through the RF output connector. Base Radios in BR-Arch-2 architecture use single, high-power amplifiers capable of running efficiently in low-power settings.

Power Amplifiers in BR-Arch-1 Base Radios

Power Amplifiers in BR-Arch-1 are available in both high and low power versions. High-power PAs in 400 MHz band are available on two different frequency bands. The following table contains a list of all available PAs in BR-Arch-1 Base Radios.

Table 97: Power Amplifiers in BR-Arch-1 Architecture

MTS Band	Power Configuration	Frequency Bands
260 MHz	low-power	260 MHz – 275 MHz
400 MHz	high-power	350 MHz – 379 MHz
		380 MHz – 470 MHz
	low-power	380 MHz – 470 MHz
800 MHz	low-power	806 MHz – 870 MHz
900 MHz	low-power	932 MHz – 942 MHz

Figure 180: Low-power PA Functional Block Diagram

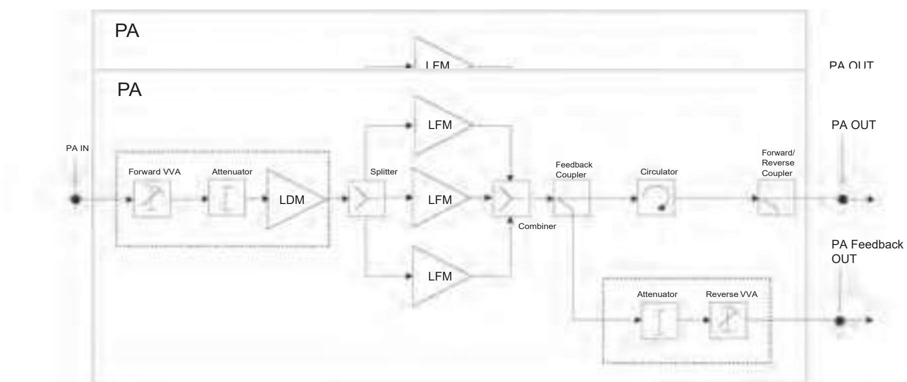


Figure 181: High-power PA Functional Block Diagram

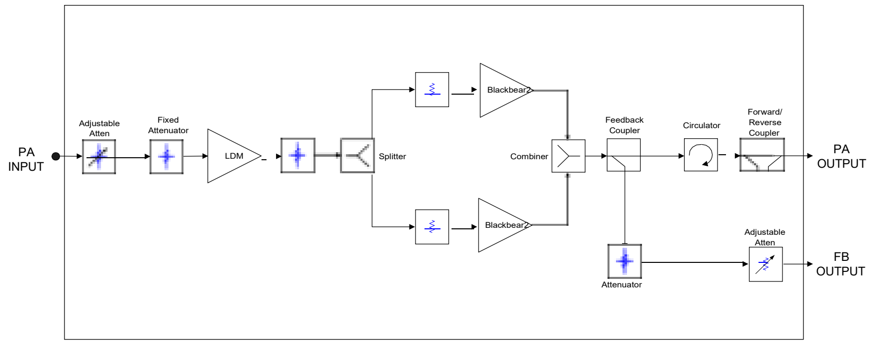
Power Amplifier in BR-Arch-2 Base Radios

Power Amplifiers in BR-Arch-2 are available in a single, high-power version capable of running efficiently in low-power setting. This version comes in different frequency bands. The following table contains a list of all available PAs in BR-Arch-2 Base Radios.

Table 98: Power Amplifiers in BR-Arch-2 Architecture

MTS Band	Power Configuration	Frequency Bands
400 MHz	high-low power	320 – 400 MHz
		380 – 470 MHz

Figure 182: Mid-power PA Functional Block Diagram



10.3
Base Radio – Indicators and Connectors

Table 99: Base Radio – LED Indicators

#	LED/Port name	Type	Controlled by	Indication
LED 1	Tx	Red/ Green	SW	BR keying: • OFF: BR is not keyed • AMBER: BR is keyed without service • GREEN: BR is keyed
LED 2	Aux	Red/ Green	SW	• OFF: No alarms • AMBER: not used • RED: not used
LED 3	Status	Red/ Green	SW Red LED will turn on before SW change any indication	BR status: • OFF: Status unknown, power off • GREEN: BRC main application is running • AMBER: Waiting for SWDL this is where the BR will wait if no Site Controller is present • RED: SW not started, power on
LED 4	BR Alarm	Red/ Green	SW	• OFF: No alarms • AMBER: BR minor alarm: PA, Exciter, RX, BRC Reduced performance • RED: BR failed: PA, Exciter, RX, BRC

#	LED/Port name	Type	Controlled by	Indication
LED5	SC 1	Green	HW, Enet IC	• OFF: Ethernet link not present • GREEN: Ethernet link present
LED6	SC 1	Yellow	HW, Enet IC	• OFF: Ethernet activity not present • YELLOW: Ethernet activity present
LED7	SC 2	Green	HW, Enet IC	• OFF: Ethernet link not present • GREEN: Ethernet link present
LED8	SC 2	Yellow	HW, Enet IC	• OFF: Ethernet activity not present • YELLOW: Ethernet activity present

Table 100: Base Radio – Connectors

Name of Connector	Type		To/From	Comment
SC1	RJ45		Site Controller	Ethernet/CP2 interface
SC2	RJ45		Site Controller	Ethernet/CP2 interface
Service	RJ45		BRC	Provides service access. See Table 101: Base Radio – Service Cable Pinouts on page 327 for service cable pinout information.
RX1	QMA		Preselector/ Duplexer	RF RX signal and +7 V dcl
RX2	QMA		Preselector/ Duplexer	RF RX signal and +7 V dc
RX3	QMA		Preselector/ Duplexer	RF RX signal and +7 V dc
Tx	QMA		Hybrid Combiner/ Cavity Combiner	RF TX signal
Power	MOLEX		Power Supply Unit	
	Pin 1 - 3	GND		
	Pin 4	+7 V		
	Pin 6 - 7	+28.5 V		

Name of Connector	Type	To/From	Comment
	Pin 5, 8 - 14	not used	

Table 101: Base Radio – Service Cable Pinouts

RJ45 PIN	D-SUB 9 FEMALE PIN	Description
1		
2		
3		
4	3	Rx
5	5	GND
6		
7	2	Tx
8	5	GND
9		

10.4
Replacing the Base Radio

For a list of available Field Replaceable Units (FRUs), see Field Replaceable Units (FRUs) on page 446.

Process:

1. Remove the Base Radio module, see Removing the Base Radio on page 328.
2. Reinstall the new Base Radio, see Reinstalling the Base Radio on page 328.
3. Perform the procedures from the Configuring and Verifying the Base Radio on page 234 section.
4. If Encryption and/or Authentication is used, see *MTS LiTE, MTS 2, and MTS 4 Restoration* manual (for DIPS/DIPC/X Core systems) or *Service Manual* (DIPM system) for details on loading Ki's into MTS.

10.4.1
Electrostatic Discharge Precaution

The Base Radio circuitry contains many CMOS and other electrostatic discharge sensitive devices. Take precautionary measures to prevent damage of Base Radio modules by static discharge when servicing the equipment.

Observe the following additional precautions:

- Wear a wrist strap (Motorola Part No. 4280385A59 or equivalent) at all times when servicing the Base Radio to minimize static build up.
- A jack is provided at top left of module cage marked with the ground symbol.
- Keep spare modules in factory packaging for transporting. When shipping modules, always pack in original packaging.

For more information, see Static Precautions and ESD Strap on page 460.

10.4.2
Restoring the Base Radio

Process:

1. Remove the Base Radio.

   See Removing the Base Radio on page 328.
2. Reinstall the Base Radio.

   See Reinstalling the Base Radio on page 328.

10.4.2.1
Removing the Base Radio

Procedure:

1. Remove power from the MTS by switching off the Power Supply Unit.

   NOTICE: To perform a hotswap of a Base Radio, do not turn off the Power Supply. Connect a terminal to the Service Port and log in. Make sure the Base Radio is not transmitting by entering the MMI command:

   - From the Base Radio Core or Boot1 use: `dekey`
   - From the Test Application use: `power -otxch1 -a0.0`

   For more information on this command, see *MMI Commands Manual*.
2. Unplug the cables at front of the Base Radio.
3. Remove the TORX screws securing the faulty module to the chassis; these are located on the top and bottom of the front plate of the faulty module. Save the screws for reuse.
4. **CAUTION:** The module can be very hot. To avoid injury, allow the module to cool down before servicing.

   Pull out the module.

10.4.2.2
Reinstalling the Base Radio

Procedure:

1. Insert the replacement Base Radio by aligning the side rails with the appropriate rail guides inside the Base Radio chassis.
2. Gently push the replacement module completely into the Base Radio chassis assembly using the module handle(s).
3. Secure the replacement module using two TORX screws removed during module removal. Tighten the screws to a torque of 2.7 Nm.
4. Reconnect the cables to the BR front plate.
5. Switch on the Power Supply Unit.

   NOTICE: Do not perform this step when doing a hotswap.

Chapter 11

Power Supply Unit

The following figure shows the front of the Power Supply Unit (PSU).

Figure 183: Power Supply Unit Front Panel

11.1

Power Supply Unit (PSU) – Theory of Operation

Dependent on its configuration the MTS is equipped with one or two high efficiency switch mode Power Supply Units (PSU). The PSU has a nominal AC input of 100VAC/240VAC (45-66 Hz) as well as a DC input of 48VDC.

The PSU:

- has the capability to charge a 48V backup battery during AC operation mod.
- provides several DC output voltages to supply Base Radios, Site Controller, ATCC and Fans
- complies with the appropriate CE marking, EMC, EMI and safety requirements.

There is an ON/OFF switch on the front panel of the PSU module which connects/disconnects DC output voltages.

The PSU operates in the following modes:

- DC only operation at -48VDC (within -41VDC to -60VDC).

  NOTICE: DC operation mode does not allow any battery controlling.

- AC only operation at 100/240VAC (within 90 VAC to 264 VAC;) without battery charging.
- AC operation (within 90 VAC to 264 VAC;) and automatic switch over to DC backup battery operation when AC fails.

WARNING: Input Reverse Voltage Protection: The PSU is protected from damage due to a reverse polarity input connection. If the input polarity is reversed, the DC In Status LED will be solid red.

The MTS cabinet itself is wired to positive ground earth. The Power Supply Unit has a floating DC ground concept.

For more information on PSU technical specifications, see Power Supply Unit Specifications on page 411.

11.1.1

PSU CAN Bus Monitoring, Alarms, and Controls

The PSU is monitored and controlled by the Site Controller. All monitoring outputs, alarm outputs, PSU ID number and control inputs are available through a CAN Bus. It is also possible to update the PSU firmware through the CAN Bus while the PSU is operational.

A unique identification of up to 4 PSUs is achieved by means of software. The assigned ID is used to identify the PSU on the CAN Bus for commands and alarms. For more information on CAN Bus, see Site Controller on page 294.

PSU monitoring parameters that can be measured through the CAN Bus:

- PSU temperature: -30 °C to +100 °C, tolerance: ±2 °C.
- Battery current: -20 A to +10 A, tolerance: ±1%.
- Battery voltage: 30 V to 60 V, tolerance: ±1%.
- Battery temperature: -30 °C to +100 °C, tolerance: ±2 °C.
- 7 V output voltage: 0 V to 10 V, tolerance: ±2%.
- 7 V output current: 0 A to 10 A, tolerance: ±2%.
- 28.5 V output voltage: 0 V to 30 V, tolerance: ±2%.
- 28.5 V output current: 0 A to 10 A, tolerance: ±2%.
- PSU output power: 0 W to 1100 W, tolerance: ±2%.
- Fan output voltage: 0 V to 30 V, tolerance: ±2%.
- PSU input air temp.: -30 °C to +100 °C, tolerance: ±2 °C.

PSU alarms available through CAN Bus:

- DC Source Fail: Indicating DC input voltage outside limits (below 43 V).
- DC Out Fail: DC output voltages out of limits.
- AC Source Fail: Early warning, indicating that the AC input is interrupted and the PSU starts to operate from DC input source in 15 ms. (if a backup source is present).
- Software Fail: Indicating software is corrupted or unable to initialize.

- Over Temperature: Indicating over temperature detected 5 °C to 10 °C before shutdown.
- Fan 1 alarm: Fan 1 not operating (fan has stopped or its running speed is below specification), PSU has received a high signal (open collector) from fan tray 1 through fan connector 1.
- Fan 2 alarm: Fan 2 not operating (fan has stopped or its running speed is below specification), PSU has received a high signal (open collector) from fan tray 2 through fan connector 2.
- Fan 3 alarm: Fan 3 not operating (fan has stopped or its running speed is below specification), PSU has received a high signal (open collector) from fan tray 3 through fan connector 3.

PSU Controls available through CAN Bus:

- FORCE DC: Controls the PSU to force the usage of the DC input if usable, disregard presence of AC. If DC is outside the usable range for the PSU, the PSU shall indicate an alarm using the DC-fail output. If DC input voltage comes below 43 V ±2% and if AC is usable the PSU shall take the input power from AC, disregarding a Force-DC control input.

  NOTICE: Force DC operation on a bad DC supply PSU or Battery: Bad DC supply is defined as a DC source where the voltage drops below 43 V for a few milliseconds when the PSU is forced to operate on DC. In case of a force DC command and bad DC supply the 28.5 V output voltage is allowed to drop down to 27 V for a maximum of 5 second, while the PSU automatically switches back to AC mode and the 28.5 V rises from 27 V to 28.5 V. During this sequence the DC out alarm is suppressed.
- Fan supply output voltage is also controlled by the CAN Bus in 5 steps from 24 V to 12 V. The highest value is set by CAN Bus or automatically.
- DC operation only: Prevents AC fail alarms (and associated LED) from the PSU on CAN Bus when the PSU is supplied from DC only. If the AC supply becomes present during DC operation, the AC Source Fail alarm circuit is automatically be reactivated.
- AC operation only: Prevents DC fail alarms (and associated LED) from the PSU on CAN Bus when the PSU is supplied from AC only. If the DC supply becomes present during AC operation, the DC-Fail alarm circuit is automatically reactivated.
- No Fan 1: Prevents Fan 1 alarm (and associated LED) when no fan 1 is connected. If the Fan1 becomes present during operation, the Fan1 alarm circuit is automatically reactivated.
- No Fan 2: Prevents Fan 2 alarm (and associated LED) when no fan 2 is connected. If the Fan2 becomes present during operation, the Fan2 alarm circuit is automatically reactivated.
- No Fan 3: Prevents Fan 3 alarm (and associated LED) when no fan 3 is connected. If the Fan3 becomes present during operation, the Fan3 alarm circuit is automatically reactivated.
- Fan Factor: Fan factor is used to determine automatically calculated Fan supply voltage - the higher factor is specified the higher voltage is calculated. The Fan Factor range is 0.5 - 2.0 (by default 1.0). In systems with only one BR this factor is typically set to 1.0.

See the *MMI Commands* manual for additional information on commands and parameters.

11.1.2 Backup Battery

The Power Supply Unit (PSU) handles the automatic switchover to a backup battery in the event of AC power supply failure. The MTS charges a backup battery during normal AC operation. The backup battery normally is located near to the cabinet.

This battery is connected to the DC connector on the front panel of the PSU through Junction Panel. Refer to Hardware Installation on page 86 and Interconnection and Internal Cabling on page 149 for more information.

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.

11.1.2.1
Backup Battery Charging Procedure

NOTICE: Selected Operation Mode: AC Operation

The backup battery charging output voltage is 40.5VDC to 57VDC and output current 0 to 6A.

A temperature sensor monitors the backup battery temperature to ensure optimum charging.

Available charge current is reduced linearly with increasing temperature from 6A to 0A when the PSU input air temperature increases from +30 °C to +60 °C

Charge voltage decreases with increasing battery temperature with the ratio of -72mV/C, starting with 56.88VDC +/-1% at -10 °C and ending with 52.56 VDC +/-1% at +50 °C

The PSU charges the backup batteries on the following conditions (**DC In Status** LED is flashing fast (0.5 s) red-green):

- Temperature range*:-10 °C to +50 °C
- Battery Low Voltage start up:40V -5%/+1%
- Battery Low Voltage Warning:43V ±2%

The PSU stops charging the backup battery on the following conditions:

- Internal PSU temperature:> 100 °C
- Battery Temperature*: -12.5 °C
- Battery Temperature*:> 53 °C

*When a temperature sensor is connected to the battery and PSU. If the battery sensor is not connected the battery will be charged with 54.24 ±1%VDC as if the battery temperature was 25 °C. The battery temperature monitored through CAN Bus will show 100 °C.

11.1.3
Fans

The PSU supplies fans, which are located in the fan trays under the module cage. For more information on fans, see Cooling Fans on page 339. The PSU DC output voltage dedicated for fans is 12 to 24VDC and the output current is 1 A for each fan.

Three fan output connectors supply three fan trays with two fans connected in parallel in each fan tray.

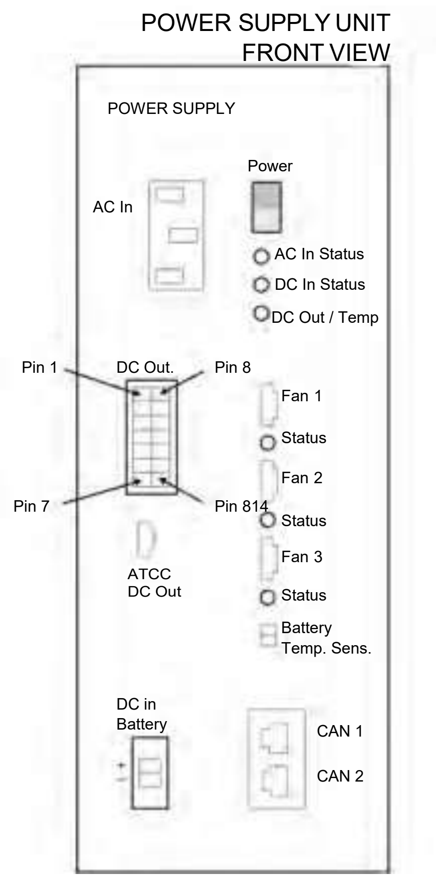
Fan supply output voltage can be automatically regulated as a function of PSU internal (ambient) temperature and its output power. Fan supply output voltage can also be controlled by the CAN Bus in 7 steps from 24V to 12V. The highest value wins – automatic control versus CAN control.

At an ambient temperature below -10 °C the fans are stopped and restarted again at -8 °C. The fan supply ramps up to 24V output for a few seconds in all start up situations.

11.2
Power Supply Unit (PSU) Indicators, Switches, and Connectors

The following figure shows the positions of indicators, switches and connectors on the PSU front panel.

Figure 184: PSU Front Panel



11.2.1
PSU LED Indicators

The following table lists and describes the PSU LED indicators and Figure 184: PSU Front Panel on page 333 shows their position.

Table 102: Power Supply Unit LED Indicators

LED Name	Color	Condition	Indications
AC In Status (AC input indicator)	dual color: LED green/red	AC input voltage is present and within limits	Green - solid
		AC input voltage is not present or below limits	Red - solid
		DC operations only mode	LED off or Orange – solid[1]
DC In Status (DC input and charging indicator)	dual color LED: green/red	PSU is supplied from DC input	Green - solid
		battery is being charged	Green/red flashing fast (2Hz)
		backup battery or a DC source supplies	Green/red flashing slow (0.5Hz), shift-

LED Name	Color	Condition	Indications
		the PSU and the source voltage drops below 43VDC ±3%	ing between red and green
		No source connected to DC input or the DC voltage is below 40,5V	Red - solid
		AC operations only mode	LED off or Orange – solid[1]
DC Out / Temp. (DC output and temperature indicator)	dual color LED: green/red	DC output voltages are present and within limits	Green - solid
		One or more of the output voltages failed	Red - solid
		Over temperature is detected, 5 -10 C before shutdown	Red - flashes
		PSU is in standby mode	LED off
Fan # Status (Fan indicator # near fan connector #)	dual color LED: green/red	Fan # programmed to operate and Fan # connected, operating and fan failure signal is high	Green - solid
		Fan # connected but programmed not to operate or Fan # voltage is out of limits or the fan failure signal is low	Red - solid
		Fan # not connected and programmed not to operate	No light
		Fan # not connected, at start up, but should have been as per CAN command	Red - flashing
LED indication in boot mode (firmware update through CAN)			
Upper 3 LEDs (AC In Status, DC In Status and DC Out/ Temp.)	3 dual color LEDs: green/red	only boot loader is running (meaning that the boot loader waits for an .exe file)	3 LEDs blinking together: R (red) R R -> G (green) G G, with 1 Hz frequency
		boot loader is loading a new hex file: (loading status)	R R G -> R G R-> G R R->... (circulating green LED)

[1] in kits GMPN4227A and earlier

LED Name	Color	Condition	Indications
Fan indicators 1 to 3		always	Red - solid

11.2.2
PSU Switch

Table 103: Power Supply Unit Controls on page 335 describes the PSU switch and Figure 184: PSU Front Panel on page 333 shows its position.

Table 103: Power Supply Unit Controls

Control	Description
ON/OFF Switch	This switch disconnects DC outputs and charging currents.

NOTICE:
When the power switch is turned off the PSU still consumes 2 mA.

If left connected to the battery for a very long time with no mains power, it could discharge the battery.

11.2.3
PSU Connectors

Table 104: Power Supply Unit Connectors on page 335 lists and describes the PSU connectors and Figure 184: PSU Front Panel on page 333 shows their position. For more information on PSU cabling, see Interconnection and Internal Cabling on page 149.

Table 104: Power Supply Unit Connectors

Name of Connector	Type	To/From	Comment
CAN1	RJ45	Site Controller	CAN Bus interface
CAN2	RJ45	Duplexer/ Post Filter/ ATCC/ Site Controller/ Terminator	CAN Bus interface
DC In Battery	Phoenix (2 pin)	Junction Panel	DC input and backup battery charging
AC In	IEC (high temperature version, male)	Junction Panel	AC input
Battery Temp. Sens.	MOLEX (2 pin)	Junction Panel	Connection with the backup battery tempera-ture sensor
ATCC Out	MOLEX (2 pin)	ATCC	DC power supply for ATCC
DC Out	MOLEX (14 pin)	2 Base Radios and Site Controller	DC power supply
	Pin 1 - 3 GND	Base Radio	
	Pin 8 +7 V		

Name of Connector	Type		To/From	Comment
	Pin 10 - 11	+28.5 V		
	Pin 4 - 6	GND	Base Radio	
	Pin 9	+7 V		
	Pin 12 - 13	+28.5 V		
	Pin 7	GND	Site Controller	
	Pin 14	+28.5 V		
Fan 1	MOLEX (4 pin, male)		Fan 1	DC supply for Fan 1
	Pin 1	+Vfan		
	Pin 1	-Vfan		
	Pin 1	-Vfan		
	Pin 1	Alarm		
Fan 2	MOLEX (4 pin, male)		Fan 2	DC supply for Fan 2
	Pin 1	+Vfan		
	Pin 1	-Vfan		
	Pin 1	-Vfan		
	Pin 1	Alarm		
Fan 3	MOLEX (4 pin, male)		Fan 3	DC supply for Fan 3
	Pin 1	+Vfan		
	Pin 1	-Vfan		
	Pin 1	-Vfan		
	Pin 1	Alarm		

11.3
Replacing the Power Supply Unit (PSU)

See the PSU power up sequence in Powering Up the MTS on page 140.

For a list of available FRUs, see Field Replaceable Units (FRUs) on page 446.

Process:

1. Remove the PSU, see Removing the Power Supply Unit (PSU) on page 337.
2. Install the Power Supply Unit into the cabinet, see Installing the Power Supply Unit (PSU) on page 337.
3. Update the mapping list with the new unit TrackID, see Updating the Mapping List with the New PSU TrackID on page 337.

11.3.1
Removing the Power Supply Unit (PSU)

Procedure:

1. Switch OFF the Power Supply Unit.

   WARNING:
   Make sure that the facility power outlet is off to prevent accidental contact with high energy and injury to personnel.

2. Remove all cables.
3. Remove two M4x10 Torx 20 screws which secure the PSU front panel to the module cage. Save screws and washers for reuse. The washers are required in Installing the Power Supply Unit (PSU) on page 337, step 2.
4. Pull out the Power Supply Unit from the module cage.

11.3.2
Installing the Power Supply Unit (PSU)

Procedure:

1. Place the Power Supply Unit on the slide rails in the module cage and push it to the back.
2. Secure the Power Supply Unit to the module cage with the two M4x10 Torx 20 screws.
3. Connect the power supply cables and optional backup battery cables (AC in, DC in / battery).
4. Connect remaining cables according to labels attached before PSU removal.
5. Switch ON the Power Supply Unit.
6. Check the LED indicators to verify the PSU is operating correctly. See *MTS LiTE, MTS 2 and MTS 4 Installation, Configuration and Basic Service Manual*.

11.3.3
Updating the Mapping List with the New PSU TrackID

Procedure:

1. Log on to the Site Controller.
2. Use the following MMI command to view the mapping list: `can check_mapping`.

   Step example:

   ```
   SC> can check_mapping
   Units are present:
   Device Track ID
   DPM 1 JTH0500101
   DPM 2 JTH0500105
   Units are not present:
   PSU 1 JTH0500200
   Track ID not mapped:
   JTH0500102
   ```

3. On the list, locate the unit that you have removed and that is indicated as `Units are not present`.
4. Delete old CAN Bus unit from the CAN Bus unit mapping list. Use `can remove_mapping` ***<Device>***, where ***<Device>*** is the old unit name.

Step example:

```
SC> can remove_mapping psu 1
```

5 Add new CAN Bus unit to the CAN Bus unit mapping list.

NOTICE: The new unit Track ID is present on the replaced unit label and indicated as `Track ID not mapped` in the list shown in step 2.

Use `can add_mapping` ***<Device><TrackID>***, where ***<TrackID>*** is a Track ID of the new unit and ***<Device>*** is the new unit name: psu X, where X denotes a digit between 0 and 2.

Step example:

```
SC> can add_mapping psu 1 JTH0500102
```

6 View the updated mapping list using the `can check_mapping` command and check that there are no units labeled as `Track ID not mapped` or `Units are not present`.

Chapter 12

Cooling Fans

One or more fan modules generate an airflow to manage the temperature within the MTS cabinets.

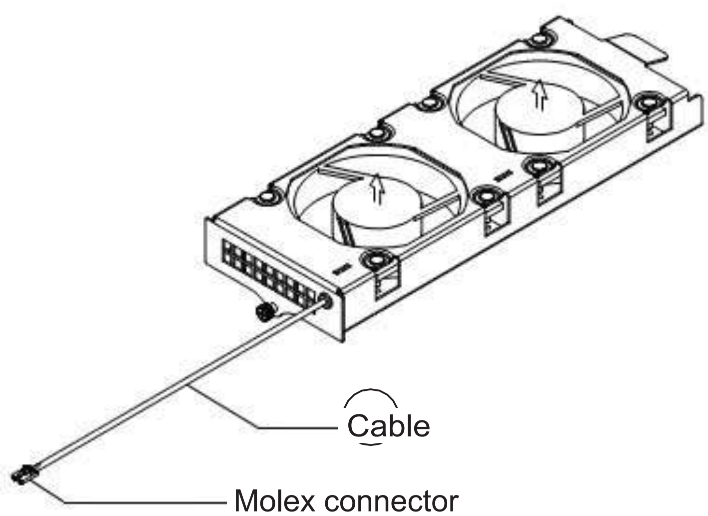
12.1

Cooling Fans Overview

Each fan module consists of two fans. A sensor monitors the fans revolution and in the event of failure, an alarm is generated.

NOTICE: Low power configurations of MTS LiTE and MTS 2 can optionally operate with cooling fans.

Figure 185: MTS Fan Kit



12.2

Cooling Fans Theory of Operation

The MTS card cage contains fan kits which reside below the modules. The PSU supplies and controls the three fan kits speed (max two for MTS LiTE) to reduce the noise in normal temperature environments. The fan speed is based on the temperature of the modules. The latter require that the Site Controller software monitors the module temperatures and controls the fans speed through the CAN Bus.

MTS LiTE and MTS 2 offer configurations which do not need fans. The temperature range is from -30 °C to 55 °C. If the temperature range is extended to 60 °C, two fan kits for MTS LiTE or three fan kits for MTS 2 need to be mounted. MTS 4 requires fans for all configurations. There is no need for the fans in MTS 2 for the low power PA BTS configurations. In other configurations, three fan kits are needed at the bottom of the card cages. There may be a reliability issue with the fans if operated below -10 °C. At an ambient temperature below -10 °C, the fans are stopped and restarted again at -8 °C. The fan supply ramps up to 24 V output for a few seconds in all start up situations.

NOTICE: The Site Controller Application automatically detects if you use a fanless configuration and causes the Base Radio Application to limit the power output.
The Test Application **does not** limit the power output automatically, so it is not recommended to use the Test Application to run a station in the fanless configuration in a high power mode. Testing the high power mode in the Test Application can be performed only by authorized technical personnel.

12.2.1
PSU Fan Control

The Power Supply Unit (PSU) contains three fan supply outputs with LED indicators.

Three fan connector outputs supply three fan kits with two fans connected in parallel in each fan tray.

The FAN output specifications are:

- Output Voltage: from 12 to 24 VDC ± 5 %
- Output Current: 1 A for each fan connector output

The fans supply output voltage is linear dependent on the total power delivered by the PSU and the ambient temperature. The fan supply starts with 24 V output for a few seconds.

For PSU LED indications, see PSU LED Indicators on page 333.

There are several MMI commands which control the fans:

- `psu` ***<PSU number>*** `get fan_voltage`
- `psu` ***<PSU number>*** `set fan_speed`
- `psu` ***<PSU number>*** `get fan_speed`
- `psu` ***<PSU number>*** `set fan_config`
- `psu` ***<PSU number>*** `get fan_config`
- `psu` ***<PSU number>*** `start_fan`

For description of the PSU fan commands, see the *MTS Man Machine Interface Commands* manual.

12.2.2
Alarms and Controls Available Through PSU CAN Bus Interface

The fan alarms available through the CAN Bus:

Fan 1 alarm
: Fan 1 not operating, PSU received a High signal (open collector) from fan tray 1 through fan connector 1.

Fan 2 alarm
: Fan 2 not operating, PSU received a high signal (open collector) from fan tray 2 through fan connector 2.

Fan 3 alarm
: Fan 3 not operating, PSU received a high signal (open collector) from fan tray 3 through fan connector 3.

The fans controls available through the CAN Bus:

No Fan 1
: Prevents Fan 1 alarm (and associated LED) when no fan 1 is configured.

No Fan 2
: Prevents Fan 2 alarm (and associated LED) when no fan 2 is configured.

No Fan 3

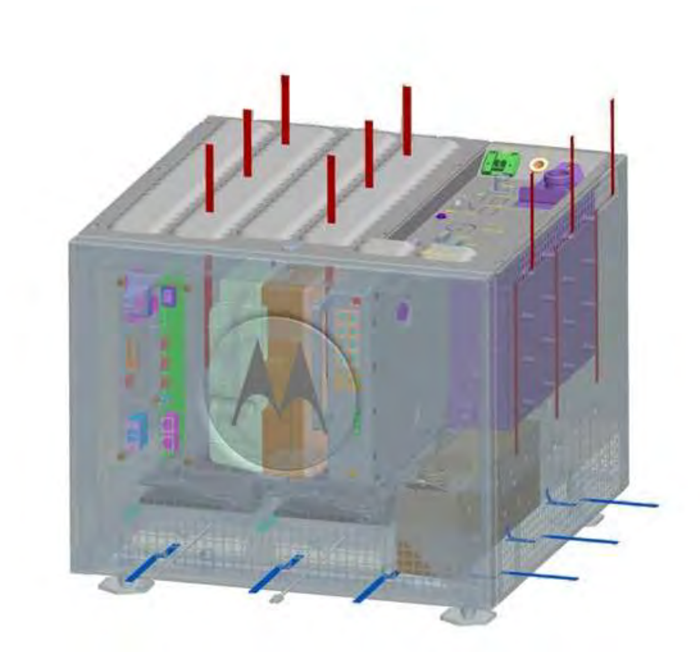
Prevents Fan 3 alarm (and associated LED) when no fan 3 is configured.

12.2.3
Airflow

MTS LiTE:

The card cage has a clear opening in the bottom front and small holes in the side and back. Ambient airflow enters at the bottom of the front, back and sides and passes up through the modules. The optimal solution is to allow the air inlet from all sides. At the top of the card cage there is enough space for the air to distribute and spread before passing out of the venting grill at the top. If there is nothing in close area to sides, the air can also exit here. The airflow routing is the same with or without fans.

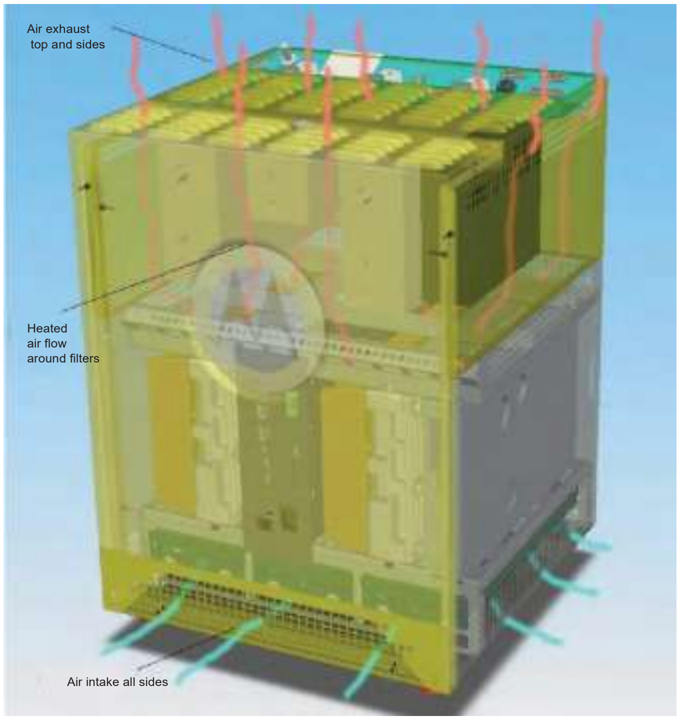
Figure 186: MTS LiTE Airflow



MTS 2:

The 2 BR card cage has a clear opening in the bottom front and small holes in the side and back. Ambient airflow enters at the bottom of the front, back and sides and passes up through the modules. The optimal solution is to allow the air inlet from all sides. At the top of the card cage there is enough space for the air to distribute and spread. It then passes up through the filter section and out of the venting grill at the top. If there is nothing in close area to sides, the air can also exit here. The airflow routing is the same with or without fans.

Figure 187: MTS 2 Airflow

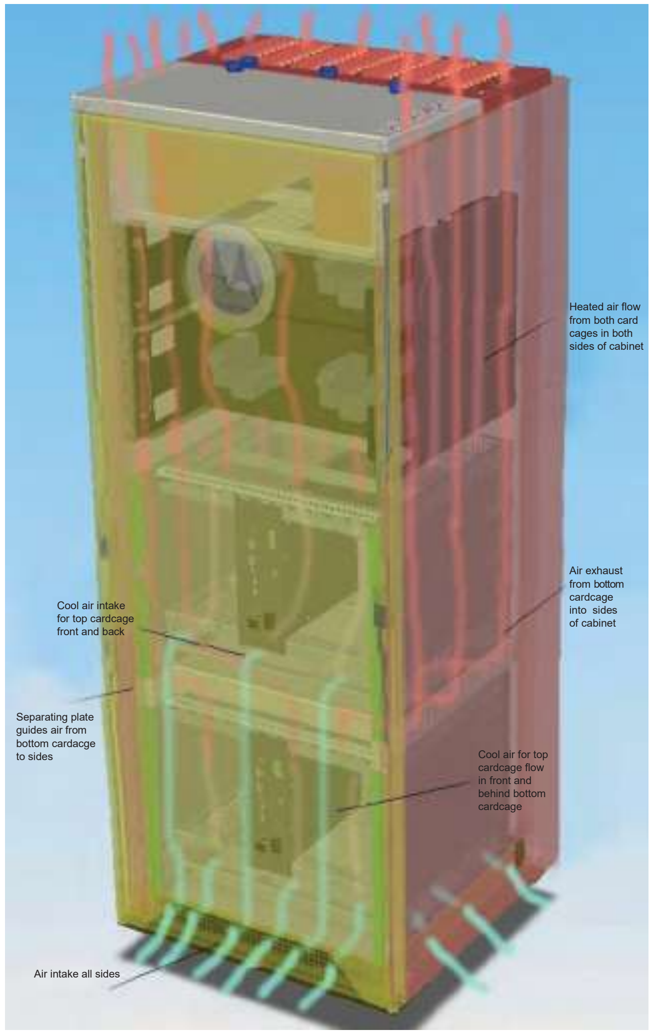


MTS 4:

In MTS 4 the airflow is different. The additional depth and width of the cabinet are used to guide and separate ambient air intake and heated air outlet. For both card cages the main airflow of ambient air enters at the front. At the bottom card cage the air can enter from all sides. For the top card cage the air has to pass in front of and behind the bottom card cage. In the front, between the modules and the cabinet door. In the back, between the bottom card cage back and the back of the cabinet. The flow is obstructed by an insert which guides the hot air from the bottom card cage out to the sides and up between the top card cage and the cabinet sides. The exhaust from the top card cage could be partly obstructed by a Cavity Combiner situated above. The exhaust can occur on all sides. No obstructions are inserted. Due to the obstructions in the airflow, fans are required for all configurations of MTS 4.

The fans have a low rpm alarm indication. Each fan module (part no. WALN4381) has two fans inside. In case of failure, one of the fans still gives an airflow. Therefore the fan module is not considered a periodic maintenance component, but is only replaced when it fails.

Figure 188: MTS 4 Airflow



12.2.4
Cooling

Natural convection cooling is applied. For example there is no fan when MTS 2 operates with a load of 295W for 2 BRs, low power PA, plus a charge current of 3 A at + 30 °C.

Forced air from fans placed below units is used when for example MTS 4 operates with a load of 640W for MTS 4 with 2 BRs, MTCC, high power PA plus a charge current of 6 A at + 30 °C.

For all configurations of MTS, see Table 13: Typical Power Loads and Heat Dissipation Values – Expansion Cabinet 400 MHz BR-Arch-1 Configuration on page 78

12.3
Replacing the Cooling Fans

Procedure:

1 **WARNING:** When unplugging the connector from the PSU, wait a few second for the fans to stop.

Open the housing of the cabinet of MTS and unplug the connector from the PSU.

2. Unlock the fan kit by unscrewing the M3x8 screws with serrated washers.
3. Slide out the fan kit from module cage.
4. Insert the new fan kit into module cage.
5. Secure the fan kit by screwing M3x8 screw with a serrated washer.
6. Plug the connector into PSU.

Chapter 13

MTS Troubleshooting

13.1
Site Controller Troubleshooting

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

13.1.1
Site Controller Fault Indications

This section provides fault indications for the Site Controller.

Some indications list several possible failures along with corresponding corrective actions. If a failure is isolated to the Site Controller, the suspected module should be replaced with a new one (For a list of available FRUs, see Field Replaceable Units (FRUs) on page 446. This restores the system to normal operation as quickly as possible.

Suspected Site Controllers should be shipped to the appropriate Motorola Solutions repair depot for repair.

Fault indications should be considered in the order shown in Table 105: Site Controller LED Fault Indications on page 345.

13.1.2
LED Fault Indications

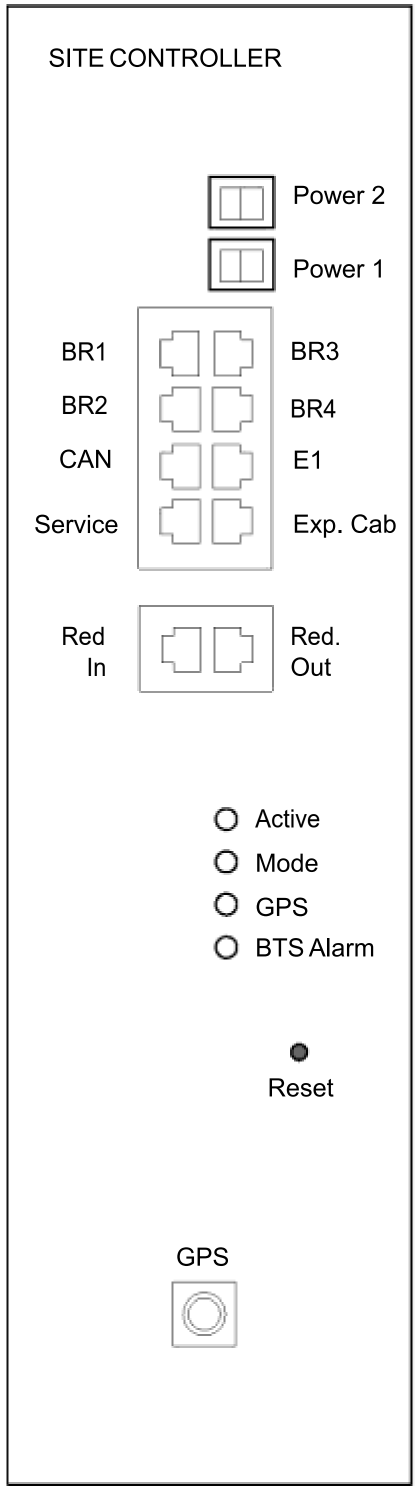
Table 105: Site Controller LED Fault Indications

Indication	Possible Failure	Corrective Action
All LEDs: OFF	Power Supply switch is OFF or power supply is damaged	• Check if power supply switch is ON • Verify power to the Site Controller cabling • Check LEDs on PS (power supply) • Replace PS (power supply)
Active LED: Amber BTS Alarm LED: RED	Application started after Booting, or failed activation, SC not active	If it is not booting / startup phase: • Check the Standby Site Controller cabling, connections to all units • Check its status of ports and links
Active LED: GREEN Mode LED: GREEN BTS Alarm LED: RED GPS LED: GREEN	WAT (Wide Area Trunking) with problem Eg. IAC,	• Check status of appropriate FRUs: atcc, dpm, psu (see can bus problems) • Check ports and links state: `port`, in case of problems check all cabling connections • Check the status of IAC inputs `status`

Indication	Possible Failure	Corrective Action
Mode LED: Green	E1/X.21 relay not energized Inactive, Site Controller stand-by	• Check site link failure: `.sitelink`, `status sc` • Check cabling, replace cabling if needed
Active LED: RED	Failed Site Controller or power up	• Replace FRU
GPS LED: RED	No GPS signal, no connection to remote GPS, or non-synchronized mode	• Check if GPS antenna is connected • Check `status sri`
BTS Alarm: Amber or Red	BTS alarm, External alarm, VSWR alarm, CAN Bus problems	**BTS alarm:** • Check status of BTS: `status bts`, `status bts -l` Verify status of components (Normal) **EAS alarm:** • Check status of alarm system: `status eas -p9` alarm when external alarms are activated. **VSWR alarm:** • Check status of BR `status br`, `brlock` if BRs are locked and dekeyed VSWR was probably too high, unlock BRs with: `brlock -clearall` **CAN bus problems:** • Check CAN bus registration table: `can check_mapping`* • Verify the registration table with existing FRU configuration • If units not present exist, check cabling (caution: all units connected in series). try to reset or reboot `can reset`*, `can reboot`* • If did not help may try to upgrade units software or replace faulty unit • If units not present doesn't exist – remove entry from registration table • If TrackID is not mapped, probably registration table not properly updated Error detected: • Get appropriate unit status / alarm to see details about possible alarm cause • If cause is in wrong configuration (wrong VSWR thresholds or fans not started) modify it. If alarms are considerably higher than the default values, investigate a potential hardware issue with the ATCC

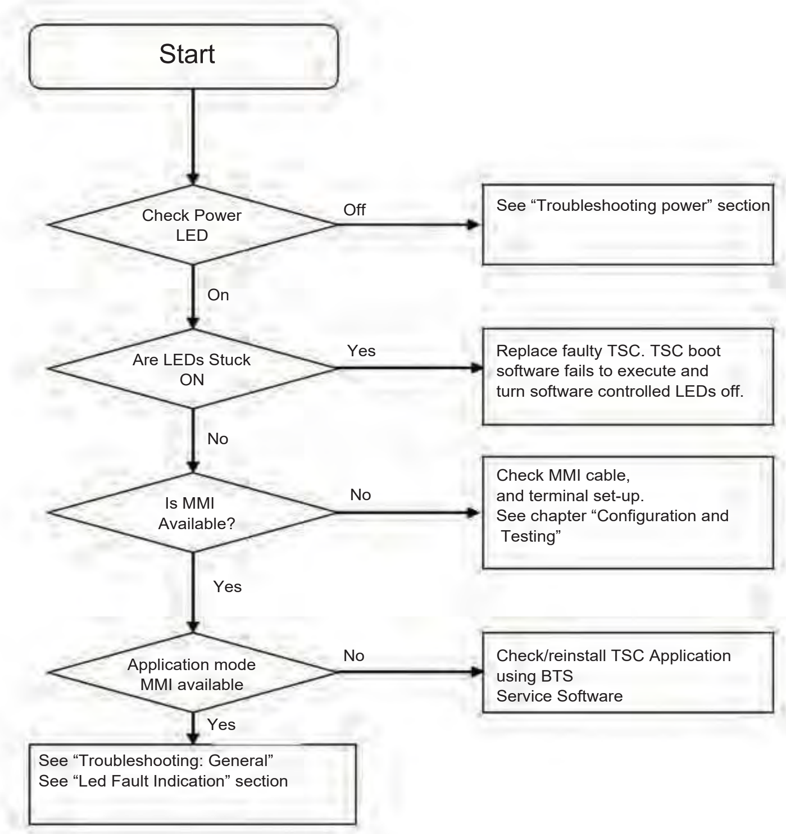
Indication	Possible Failure	Corrective Action
		• If FRU doesn’t work properly, try to upgrade code, or reset unit - If problem still exists replace faulty unit with new one BR configured loss: • Check state of BRs (br configured is missing) `status sc -all`, `status br` *) CAN bus commands
BR1 or BR2 or BR3 or BR4 or Service LED: OFF	Ethernet link not present	• Check if Ethernet cable is connected • If still no LED indication, replace the cable
E1 LEDs: Amber	Errors FE, CRC, BPV, PD	• Verify the cabling • Check if the cable is plugged to right connector • Replace E1 cable if no change • `status bsl`
E1 LEDs: RED	Primary E1 failure LOS, Link down	• Verify the cabling • If no change replace E1 cable

Figure 189: Site Controller LEDs



13.1.2.1
Troubleshooting Flow Chart

Figure 190: Troubleshooting Flow Chart



13.1.2.2
Troubleshooting: Power

- Check for Power Supply Unit failure.
- Verify power (voltage and polarity) on rear connector. If power is present and correct then replace the Site Controller. Otherwise check for the Site Controller power supply cabling fault.

NOTICE: Ensure that the polarity of DC cable connection is correct, as it is reversed in comparison to MBTS.

13.1.2.3
Troubleshooting: status sc

This section details usage of the Application mode MMI command `status sc` for general troubleshooting and to determine the Site Controller status.

Use the `status sc` command. Observe the Overall Status field of the resulting output and proceed as follows:

- If Overall Status = Active – ***<state>*** / ***<reason>***, this is an indication that the Site Controller is currently active, together with the site reference state and the reason for that state. These states and reasons are explained in Table 106: Site Reference States – status sc on page 350 and Table 107: Site Reference Reasons on page 350.
- If Overall Status = SC is going active – waiting for BRs, the Site Controller may be unable to communicate with the BRs. Waiting for the Site Controller configuration file load, the configuration file may be corrupt or is not present. See LED Fault Indications on page 345 and Troubleshooting: SC Config File on page 351.

Table 106: Site Reference States – status sc

Site Reference State	Explanation
UNKNOWN	The site reference is initializing - this is a transient state that may persist for a few minutes at start-up.
ENABLED SYNC	The site reference is fully trained to GPS - This is the highest level of functionality.
DISABLED	The site reference is not working.
FREE-RUN SYNC	This is the first level of fallback - The site reference continues to provide its highest level of service in this state until the free run timer expires.
NON-SYNC	This is the second-level fallback - The site reference is providing service however any feature that needs sites to be synchronized may be impaired.
NON-SYNC ADJ-REQUIRED	The site has been operating in its 2nd level fallback mode for too long (> 350 days) and should be disabled by the operator.
ENABLED NON-SYNC	The site has been configured to operate in its second-level fallback mode (FNC) to enable start-up without GPS.

Table 107: Site Reference Reasons

Site Reference Reason	Explanation
NO REASON	Normal operation - no explanation needed
1PPS LOST	The 1PPS timing source from the GPS is not present.
FREE RUN TIMER EXPIRED	The SR has been free running for longer than the time configured during installation.
UHSO AGEING	The UHSO (Ultra High Stability Oscillator) is approaching end of life and requires replacing soon.
SITE REFERENCE ALARM	An unspecified site reference condition has occurred.
FREQUENCY CALIBRATION TIMER EXPIRED	The SR has been free running without GPS for over 350 days - GPS calibration is required to ensure RF frequency stability compliance.
GPS OK	The GPS receiver is supplying a valid 1PPS timing source.
GPS AND NTS LOST	GPS, peer SC reference (second SC in the MTS with two SC), and NTS connection is lost. It means that at least NTS must be made available otherwise you need an adjustment

Site Reference Reason	Explanation
	of the SC internal clock before the expiry of the calibration timer. The adjustment of the SC internal clock is automatic. SC needs only a reference source to align with. It can align with GPS, NTS, or peer SC with properly working GPS. Detailed information on the expiry time may be obtained from the status sri -gps or status sri commands.

13.1.2.4
Troubleshooting: SC Config File

The SC does not boot or operate correctly and GPS does not start training unless a valid configuration file is stored in its flash filing system. Use the method described in Troubleshooting: General Check of a Site Controller File on page 352 to ensure that either **tsc.cf.1** or **tsc.cf.2** is selected as the current file, and is shown as valid.

13.1.2.5
Troubleshooting: status bts

The following table details usage of the Application mode MMI command `status bts` for general troubleshooting and determining the BTS subsystem status.

Table 108: Site Reference States – status bts

Site Reference State	Explanation
BRINT	Module fault
BRMTS	Status of the BR, whether it is keyed or not. Can report trap status of disabled with reason SC link failure indicating that the ethernet connection between the BR and SC is down
BRPORT	Reports status of BRs Ethernet ports whether up or in fault state
BRREC	Reports status of the BR receiver paths and reports, for example, a receiver signal problem. In this situation login, to the BR and check output of `get alarms` to confirm the RX path is in alarm
DPMINT	Reports status of Digital Power Meter. Check the DPM is mapped on the CANBUS. Could be an indication of hardware fault with the DPM if it cannot be re-mapped onto the CANBUS or is not responding to commands if mapped on CANBUS
EXT	Reports on configured EAS alarms and will advise which alarm contact is active
FAN	Reports status of the fan kits
MTS	Gives the status of the site, whether it is in Wide, Site or No Trunking and a reason for example No Control Channel
SCINT	Module fault
SCPORT	Status of the Site Controllers ethernet ports
SCREF	Gives status of the GPS signal and timing

13.1.2.6
Troubleshooting: BRC Config Files and Code File

The BRC does not boot or operate correctly unless a valid configuration file and code file is stored in the flash filing system of the Site Controller. Use the method described in Troubleshooting: General Check of a Site Controller File on page 352 to ensure that the file shown in the following table is valid for the BR of interest. For Code File, ensure that either **brc.code.1** or **brc.code.2** is selected as the current file.

NOTICE: Config files are only present for installed BRCs.

Table 109: BRC Config File Troubleshooting

BR Cabinet	BR Position	Filename
1	1	brc01.cf
1	2	brc02.cf
1	3	brc03.cf
1	4	brc04.cf
2	1	brc05.cf

13.1.2.7
Troubleshooting: General Check of a Site Controller File

To check the validity of a particular file in the Flash File System of the Site Controller, it is necessary to use the `attrib` command as explained below.

NOTICE: The `attrib` command works in Site Controller application as well as in boot1 mode.

This example looks at the configuration file of the Site Controller.

1 Use the `attrib` command to produce a listing of all files on the Site Controller. Check if the files of interest do not have any warning after their details. This shows only a small part of the typical output:

```
cn--r- tsc.cf.1        mts1v1         12/03/2012_13:42:14
----ra tsc.cf.2        mts1v2         24/01/2012_11:23:11
cn--ra tsc.code.1      R084007        24/01/2012_11:18:49
----ra tsc.code.2      R084007        10/01/2012_09:37:28
------ brc09           -              -
---w-- brc09.cf.1      -              -
---w-- brc09.cf.2      -              -
```

In this example tsc.cf.1 looks like a valid file, whilst brc09.cf.1 has a ‘w’ attribute so it is not valid.

2 Use the `attrib tsc.cf*` command to produce a listing of the configuration files attributes of the Site Controller.

```
SC: attrib tsc.cf*
cn--r- tsc.cf.1        mts1v1         12/03/2012_13:42:14
----ra tsc.cf.2        mts1v2         24/01/2012_11:23:11
```

Note which file has the ‘c’ (Current) attribute and ensure that it also has the ‘r’ (read) attribute. If the file has the ‘w’ attribute, it is not valid.

If there is no valid file then download it to the Site Controller again, using either DIMETRA BTS Service Software or Software Download (SWDL).

To check the version of the running Site Controller application, use the `ver` command:

```
SC: ver
Dimetra Site Controller
Application Version       : MTS_TSC_APP-R08.40.07
Release date              : Jan 16 2012 17:42:16
Software Part No.         : PC895F00B000084007
Boot0 Version             : MTS TSC BOOT0-R01.40.01
Boot1 Version             : MTS_TSC_BOOT1-R08.40.01
Copyright (C) 2011-2012, Motorola Solutions, Inc.
All rights reserved
Unauthorised Access Prohibited
SC:
```

13.1.3

MMI Fault Indications

Diagnosis of fault conditions are divided into diagnosis of the GPS/site reference and the site link.

13.1.3.1

Troubleshooting: GPS and Site Reference Faults

The timing subsystem within the MTS consists of two major components:

- the GPS receiver
- the Site Reference

The `status sri` command and its sub commands provide the capability to diagnose GPS and Site Reference faults. An output similar to the one shown below is obtained for a fully functional internal 8 channel receiver.

Site Reference Operating OK	: YES
Site Reference State	: MAINTAIN PHASE LOCK
Site Reference Configuration	: ASC
Site Reference 1 PPS Input Status	: VALID
GPS Operating OK	: YES
GPS STATE	: GPS 3D FIX
GPS Satellites Tracked	: 9
Sync Free Run Available (Minutes)	: 240
Unsync Free Run Available (Days Hours Mins)	: 2879 10 27
Last Calibration Date Time	: Thu Feb 1 08:40:25 2007
Calibration Due Date Time	: Fri Jan 30 08:40:25 2015
GPS Time	: Thu Feb 1 08:42:38 2007
UTC Time	: Thu Feb 1 08:42:24 2007
Local Time	: Thu Feb 1 10:42:24 2007

Precise UTC Time Mode	: YES
TETRA Slot	: H6121 M49 F15 S4
Synchronized	: YES

The following fields are of particular relevance during fault diagnosis:

- **Site Reference Operating OK**

  YES: This indicates that the site reference is providing timing services to the Site Controller.

  NO: The site reference is not operating, therefore the MTS cannot provide any service. Examining the state of items below indicates the reason for this condition.

- **Site Reference State**

  Site Reference State = START UP: The Site Controller is starting up and the site reference has not been fully initialized yet. The site reference and the MTS is not operational. This is a normal transitory state.

  Site Reference State = MAINTAIN PHASE LOCK: This is a normal operational mode of the site reference. The MTS is synchronized with any other MTS that has attained this state, this means that type 1 handovers and any other feature that require sites to be fully synchronized is available.

  Site Reference State = SYNCHRONISED FREE RUN: This is a fallback state which indicates that the MTS is not tracking sufficient GPS satellites to provide a timing reference to the site. The MTS is capable of operating with no loss of performance for up to 12 hours (dependent on configuration). If this condition occurs frequently or persists, the health of the GPS system should be assessed. See GPS Tracking criteria and GPS Antenna evaluation in section 4 of this manual.

  Site Reference State = UNSYNCHRONISED FREE RUN: This is a fallback state for an ASC configured MTS and the normal operating state for FNC configured MTS. When configured for ASC, the site will enter this state if adequate GPS tracking is not achieved before the configured GPS start-up timer expires or after the expiry of free run timer if the site was previously synchronized. The site is capable of operating in this mode for up to 12 months. In this state, the MTS is capable of providing all services except those that require synchronization between adjacent sites, for example, type 1 handovers.

  Site Reference State = MAINTAIN FREQUENCY LOCK: If an adequate GPS signal becomes available whilst operating in UNSYNCHRONISED FREE RUN, the MTS enters this state where the site reference calibration data is updated, thus prolonging the amount of time where service can be maintained.

  Site Reference State = DISABLED: The site reference has detected an error and is unable to provide any service. The MTS cannot provide any service whilst the site reference is in this state. The cause of this state is dependent on the configured operating mode of the MTS:

  - FNC / ASC: The MTS does not have any calibration data - The MTS needs to be run initially with GPS before FNC operation without GPS is possible.

  This condition may also be due to hardware failure within the Site Controller.

  Site Reference State = RECOVER PHASE: This state is a normal operational mode. This state indicates that MTS has acquired signal from GPS and found out that the reference GPS clock is not aligned with the MTS clock. In this state the MTS tries to align both phase and frequency of internal clock to the GPS reference clock. The recover phase can take long time, depending on how long MTS had been working without the GPS signal.

- **Site Reference Configuration**

  Site Reference Configuration = ASC or FNC: This is the installation-selected configuration of the site reference subsystem. See GPS Site Reference Operation Modes on page 123 for details.

- **Site Reference 1 PPS Input Status**

Site Reference 1 PPS Input Status = OK or NOT OK: This indicates whether a valid signal is being received by the site reference system.

- **GPS Operating OK**

  GPS Operating OK = YES or NO: This indicates whether the GPS receiver is tracking sufficient satellites to provide a timing reference input to the site reference. This parameter should be YES for ASC operation. Detailed information on the GPS receiver may be obtained from the status sri -t and status sri -gps commands. See the following section for details.

- **GPS State**

  GPS State = NOT TRACKING: The GPS receiver is not tracking any satellites. This condition may persist for some minutes after start-up. Detailed information on the GPS receiver may be obtained from the status sri -t and status sri -gps commands. See the following section for details.

  GPS State = POSITION HOLD/GPS 3D FIX: This is the normal operating state of the external/ internal GPS receiver.

  GPS State = SITE SURVEY: The GPS receiver will operate in this state for several hours after an MTS is started in a new location for the first time. The GPS receiver is attempting to determine accurate coordinates to enable operation in position hold.

- **GPS Satellites Tracked**

  GPS Satellites Tracked = 0.. 12>: This is the number of satellites tracked that are available for timing.

  NOTICE: If the `status sri` MMI command indicates that there are no satellites tracked, then there may be a possible hardware fault. See GPS Receiver Detailed Troubleshooting on page 356 for further details.

- **Sync Free Run Available**

  Sync Free Run Available (Minutes): This is the number of minutes that the MTS operates without any degradation of service if the GPS receiver stops working and the site reference is configured for ASC operation. If the site reference is already in the free run state, the time shown is the balance of free run time before the MTS stops operating or switches to a lower level of service.

  Unsync Free Run Available (Days Hours Mins): This shows the amount of time the sites second-level fallback (Unsynchronized free run) is capable of operating for. If the site reference is already in Unsynchronized free run the time shown will be the amount of time the MTS is capable of operating for before calibration is required.

- **Last Calibration Date Time**

  Last Calibration Date Time: The site reference is periodically calibrated whenever an adequate GPS signal is available. The MTS is capable of providing service for up to 12 months without GPS after each calibration. This parameter shows the date and time of the last calibration snapshot.

- **Calibration Due Date Time**

  Calibration Due Date Time: This shows the date when the MTS requires calibration if the GPS receiver was to fail at this time.

- **GPS Time**
- **UTC Time**
- **Local Time**
- **UTC Time Mode**

  UTC Time Mode = Not Precise or Precise: When the timing for the site reference is being derived from the GPS receiver the UTC mode is precise.

- **Synchronised**

Synchronised = YES or NO: This indicates whether this MTS is capable of operating synchronously with any neighboring MTS.

13.1.3.2 GPS Receiver Detailed Troubleshooting

The `status sri -gps` command provides detailed information on the GPS receivers operating state. This includes a detailed satellite tracking report. The following output is from a fully functional internal 12 channel receiver. Note that this output is an example, your GPS settings may vary depending on your system.

```
GPSR Type                                  : INTERNAL
GPSR Model                                 : GSCi4xxx
Software Ver                               : 225
Manufacture Data                           : Unknown
GPSR Antenna Status                        : CONNECTED
GPS Satellite Tracking                     : OK
GPS State                                  : GPS 3D FIX
GPS Satellites Visible                     : 12
GPS Satellites Tracked                     : 9
GPS Date Time                              : Thu Feb 21 09:17:36 2008
PDOP Status                                : GOOD
PDOP Value                                 : 1.6
RAIM Protection is                         : Disabled
Latitude                                   : N50 deg1 min 57.728 sec
Longitude                                  : E19 deg 56 min 21.808 sec
Altitude(Meters above GPS Ellipsoid)       : 296.69


     SatID Mode Flags C/N Ratio (dB-Hz) GNSS system
:-----------------------------------------------------
       6    8    0x00   43                GPS (1)
      19    0    0x00   49                GPS (1)
      25    8    0x00   35                GPS (1)
      16    8    0x00   49                GPS (1)
       3    8    0x00   48                GPS (1)
      15    8    0x00   39                GPS (1)
      21    8    0x00   48                GPS (1)
      18    8    0x00   50                GPS (1)
      29    0    0x00   18                GPS (1)
       8    0    0x00   43                GPS (1)
      27    3    0x00   34                GPS (1)
      22    8    0x00   54                GPS (1)
```

If `status sri -gps` returns no data or most fields are set to unknown, the internal GPS chip is most likely not operational and requires a reset. Reset the GPS chip by using the command `reset gps`.

Check GPS status by using the command `status sri -t` as shown below.

Note that this output is an example, your GPS settings may vary depending on your system.

```
GPS Receiver ID
==============
SOFTWARE VER # v3.1.5.1      SOFTWARE REV # GNSSLIB_7.3   SOFTWARE DATE
UNKNOWN
MODEL # SL869                SERIAL # UNKNOWN
OPTION LIST  UNKNOWN         MANUFACTURE DATA UNKNOWN

GPS Receiver Status:
=================

Model: SL869 - Self test results not supported.
  RTC Comm Time: N/A, Temperature Sensor: N/A
```

```
       RAM Test: N/A,            ROM Test: N/A
 1 kHZ Presence: N/A
Antenna Status : CONNECTED
  Almanac Data : NOT VALID
 Location Data : VALID
```

- The Antenna status is reported as:
  - `CONNECTED` when at least four satellites are being tracked.
  - `DISCONNECTED` when no satellites are being tracked.

  NOTICE: If the status is `DISCONNECTED`, you should verify if the cables are connected properly. If the status does not change, you should verify that the settings in TESS match the cable connection (both should be external or internal).
- **PDOP**: Positional Dilution of Precision it is a measure of geometrical strength of GPS satellite configuration. The lower value, the better accuracy.

  NOTICE: GPS antenna must be connected before the site is powered up to return this status correctly.
- If the site is being powered up in a new location for the first time, the Almanac Data and the Location data fields should display a status of Invalid. Use the `site_location -reset` command to ensure that the Almanac and Location data are cleared. The Site Controller must then be reset for these commands to take effect.
- The RAIM (Receiver Automatic Integrity Monitor) facility should be enabled to allow detection and correction of GPS errors. Refer to the *TETRA BTS Service Software (TESS) User Guide*.
- If no other fault, replace the Site Controller.

13.1.3.3 Troubleshooting Site Link Faults

13.1.3.3.1 Initial Verification

Use the `ping` MMI command to verify that the IP pathway to the two Core Routers is correct. Pings should be attempted to both Core Routers using both the default ping packet size of 32 bytes as well as using a packet size larger than the configured Frame relay fragmentation size. If router can be successfully pinged using the default size of 32, but pings using the large size are unsuccessful, this indicates an error in the configuration for Frame relay fragmentation.

```
SC: ping -s 32 172.24.16.201
Pinging 172.24.16.201 (172.24.16.201) with 32 bytes of data:
Reply from 172.24.16.201 bytes=32 time=0ms ttl=30
Reply from 172.24.16.201 bytes=32 time=0ms ttl=30
Reply from 172.24.16.201 bytes=32 time=0ms ttl=30
Reply from 172.24.16.201 bytes=32 time=0ms ttl=30
SC: ping -s 128 172.24.16.201
Pinging 172.24.16.201 (172.24.16.201) with 128 bytes of data:
Reply from 172.24.16.201 bytes=128 time=0ms ttl=30
Reply from 172.24.16.201 bytes=128 time=0ms ttl=30
Reply from 172.24.16.201 bytes=128 time=0ms ttl=30
Reply from 172.24.16.201 bytes=128 time=0ms ttl=30
SC:
```

13.1.3.3.2
Frame Relay Fragmentation

The `status frf` command displays fragmentation statistics as show below:

SC) status frf	
Transmit Frames fragmented	126
Number of fragments transmitted	12
Number of received frames	4
Number of received fragments	8
Number of ignored fragments	0
Number of discards when disabled	0

If the counter labeled "Number of discards when disabled" is not zero, this indicates that frame relay fragmentation is disabled on the Site Controller, but enabled on the remote equipment. If however, there are non-zero values for the counters labeled "Transmit Framed fragmented" and "Number of fragments transmitted" but the counters labeled "Number of received fragments" and "Number of received frames" are zero, this would indicate that the remote equipment has not been configured for FRF.20 frame relay fragmentation.

13.1.3.3.3
IP and Audio

If all is well with the site link, but there are issues with no uplink or downlink audio, the likely culprits are either the configuration of the UDP port used for voice, the CRTP configuration – or both. A quick check can be made for crtp activity by typing `status crtp`.

SC) status crtp	
Compressed Frame Count	0
Decompressed Frame Count	99
Contexts Invalidated	1
Tx Context State Packets	0
Rx Context State Packets	0
Tx Full Header Packets	0
Rx Full Header Packets	1
Discards when disabled	0

If the compressed frame count is zero, check the configuration to determine if CRTP is indeed enabled. If the decompressed frame count is zero, check the CRTP configuration on the core router to ensure this is enabled, and not set to "passive".

If the decompressed counter is non-zero, it would indicate that the Site Controller is receiving downlink audio however, the packets are not getting processed for some other reason. It should then be determined if the IP layer is discarding the received audio packets – this can be a result of not enabling header extensions with CRTP on the core router.

If there are issues with configuration for CRTP "header extensions", this is indicated by the counter labeled "UDP datagrams received for unknown ports or with other errors".

13.1.3.3.4
Site Link

Troubleshooting the Site Link essentially consists of checking the correct operation of each layer in the order starting with the physical layer.

The physical layer may be configured to be either E1 or X.21. The `status bsl` command provides different information for the two interface types.

13.1.3.3.5
X.21 Interface

If the Site Link interface had been configured to use X.21 interface, the information provided by the `status bsl` command is as follows:

SC) status bsl		
Primary Site Link State:DOWN	Speed: 0 bps	Rear port:X.21
HDLC Statistics:-	----Rx----	----Tx----
Good frames	: 0	0
Overruns | Under-runs	: 0	0
C Line | I Line lost	: 0	0
CRC/framing er-rors	: 0	
No buffers avail	: 0	
Buffer overflows	: 0	
Aborts	: 0	
Non octet aligned	: 0	
X.21 Interface:-		
Clock Loss events	: 2	
I Line Off events	: 0	
Current Clock state	: Failed	
Current I Line state	: On	
Current C Line state	: Off	

- The Site Link State should be shown as UP, the number of good frames transmitted and received should be non-zero and incrementing indicating site link traffic. The presence of non-zero data in other numeric fields may indicate a possible Site Link Problem.

- Verify that the Current I Line and C Line states are shown as ON and that the Current Clock state is shown as OK.

13.1.3.3.6
E1 Interface

If the site link interface had been configured to use an E1 interface, the state of the E1 interface may be determined by inspection of the front panel LEDs on the Site Controller. E1 error conditions are indicated using its LEDs:

- If LED is AMBER FE, CRC, BPV, PD
- If LED is RED – LOS

The LEDs labeled as "1", "2", on the E1 port indicate the physical E1 port that had been configured for the Site Link using the `e1config` MMI command.

NOTICE: Contact your local Motorola Solutions representative or Technical Support to obtain the password.

If the LED is indicating LOS (Loss of signal) error is illuminated, this indicates that there is no E1 framing signal being detected on the configured port. This may be due to external cabling issues, the lack of a connection to remote E1 equipment, or simply connecting the E1 feed to the wrong E1 connector on the Site Controller. If the LED is AMBER, this indicates that:

- There are E1 framing errors currently being detected. This condition is usually transitory, however, if persistent, it indicates a configuration mismatch of the E1 framing method in use. Both ends should be either using E1 multi-frame, or double- frame, but not a mix of the two framing modes FE/CRC error.
- The remote equipment is detecting errors on the traffic it is receiving on its E1 interface – again, this may be caused through transitory errors, or a mismatched configuration.
- Electrical noise on the E1 connection, though this may also be caused by faulty remote equipment BPV error.

The information provided by `status bsl` for an E1 interface is as follows:

SC) status bsl		
Primary Site Link State:DOWN	Speed: 64000 bps	Rear port:E11
HDLC Statistics:-	----Rx----	----Tx----
Good frames	: 30	10
Overruns | Under-runs	: 0	0
C Line | I Line lost	: 0	0
CRC/framing er-rors	: 0	
No buffers avail	: 0	
Buffer overflows	: 0	
Aborts	: 0	

Non octet aligned	: 0	

E1 Statistics:-		
Second timer expired	: 11	Remote Alarm :0
Line Loss	: 0	Framer Rx Data Overflow :0
Frame alignment Loss	: Failed	Framer Tx Data Underrun :0
AIS	: On	Negative Rx clock slip :0
CRC4 Error	: Off	Positive Rx clock slip :0
Errored Seconds	: 0	Negative Tx clock slip :0
Bipolar Violation	: 0	Positive Tx clock slip :0

E1 Configuration:-		
crc4:on crdStart:1	crd:1 ts16Skip:on	Port:1 Clock:External

For E1, the E1 statistics provide a running count of errors encountered or detected on the E1 interface. These include a count of the potential link loss errors as indicated by the front panel LEDs. For convenience, the current E1 timeslot configuration is also shown.

`Line Loss`
An increasing value of this statistic indicates existence of low-level E1 electric connection issues between the site and network equipment.

`AIS`
An increasing value of this statistic indicates that the network equipment directly connected to the site is not getting correct transmission from the far-end network equipment and it notifies the site about that fact.

`Remote Alarm`
An increasing value of this statistic indicates that the network equipment directly connected to the site is not getting correct E1 transmissions from the Site Controller and notifies the Site Controller of the error.

`Frame alignment Loss`
An increasing value of this statistic indicates that the E1 signal received by the site from the connected network equipment lost frame alignment. Each incremental increase of the statistic indicates that three or more frames have been received without alignment.

NOTICE: The growing value of the `Second timer expired` statistic is no reason for concern. The `Second timer expired`value is incremented every second no matter if the Site Link is up or down. The `Second timer expired` count does not indicate any Site Link failure.

The HDLC statistics provide a running counter of HDLC frames transmitted and received on the site link interface as shown by the "Good frames" counters. Incrementing counters with the absence of incrementing error counters such as CRC/framing errors, Aborts, or Non octet aligned errors indicates the correct transmission and reception of HDLC frames. Persistent large numbers of HDLC errors on an interface configured for E1 indicates errors in the configuration of the E1 data timeslots.

13.1.3.3.7 Frame Relay Layer

SC) status fr		
PVC	Primary	Backup
DLCI for this PVC	108	109
IP address of this PVC	10.2.45.251	10.2.55.251
Current status	Active	Active
Times changed state	0	0
Time in current state (secs)	3592	2988
Total time up (secs)	3599	3599
Total time down (secs)	0	0
Number of frames transmitted	10238	0
Number of frames received	10236	0
Invalid NLPID frames received	0	0
Invalid UI frames received	0	0

The current configuration for frame relay, and the current state of the primary and backup PVC may be determined using the `status fr` MMI command. If both PVCs are indicated as ACTIVE, the number of state changes for each PVC, the time in the current state, and the time in an active state should be inspected to determine the stability of the two PVCs as determined by the LMI link management protocol. If there is indication of rapid transitioning of the states of the PVCs, or the two PVCs are indicated as inactive – special attention should be given to the DLCI values displayed. If this is correct, this indicates a problem with the LMI layer.

SC) status lmi	
LMI frames transmitted	0
LMI frames received	0
Number of PVC state changes	2
Number of status inquiries tx	0
Number of status responses rx	0
Number of full status inquiries	0
Number of full status rx	0
Current primary PVC state	1
Current backup PVC state	1

Number of discards when disabled	0

The frames transmitted and the frames received counters should be incrementing between successive invocations of `status lmi`. If the received counter is not incrementing, this indicates that the remote equipment is not responding to LMI inquiry packets transmitted by the Site Controller – the problem is probably external to the Site Controller. However, if the receive counter is incrementing, it would indicate a configuration issue, either with the LMI configuration, or with the configuration of the DLCIs for the PVCs, check the DLCI numbers displayed by using the `status fr` command for the DLCI numbering, and use the `display config` command to verify the configuration for LMI.

Site Router	

CRTP enable	: Enabled(1)
CRTP context state packet time	: 1000
CRTP session timeout	: 3500
LMI enable	: Enabled(1)
LMI full status polling counter (n391)	: 6
LMI LIV time (t391)	: 300
LMI error threshold (n392)	: 3
LMI monitored events count (n393)	: 4
Type of Service Latency Time : 5	
Frame relay fragmentation size (bytes)	: 80

If LMI has been disabled in the Site Controllers configuration, no LMI exchanges take place, and the two PVCs are marked as permanently active. In normal configurations, this may be as a result of an unintended configuration error.

13.1.3.3.8
Ethernet Site Link

The following configuration parameters are available for Base Station Ethernet links:

- Physical sitelink interface
- Sitelink Type
- Passthrough
- Primary VLAN Tagging
- Primary Sat
- Primary WAN IP Address
- Primary WAN IP Mask
- Primary WAN Gateway
- Primary WAN VLAN ID
- Primary IP Tunnel Local Address
- Primary IP Tunnel Remote Address

- Primary IP Tunnel Fragmentation Size
- Secondary WAN Interface
- Secondary VLAN Tagging
- Secondary Sat
- Secondary WAN IP Address
- Secondary WAN IP Mask
- Secondary WAN Gateway
- Secondary WAN VLAN ID
- Secondary IP Tunnel
- Secondary IP Tunnel Local Address
- Secondary IP Tunnel Remote Address
- Secondary IP Tunnel Fragmentation Size
- Primary PVC BTS IP Address
- Primary PVC CR IP Address
- Primary PVC IP Mask
- Secondary PVC BTS IP Address
- Secondary PVC CR IP Address
- Secondary PVC IP Mask
- BFD Tx Interval
- BFD Tx Detect Multiplier
- BFD Protocol Status Flag
- Green Traffic Color Map
- Yellow Traffic Color Map
- QOS CIR [kbit]
- QOS CBS [bytes]
- QOS EIR [kbit]
- QOS EBS [bytes]
- QOS Coupling Flag
- Throttling algorithm
- Primary PVC PerfMon Jitter Threshold
- Primary PVC PerfMon Delay Threshold
- Secondary PVC PerfMon Jitter Threshold
- Secondary PVC PerfMon Delay Threshold

NOTICE:
For description of parameters listed above and instruction on how to configure them, see the *TETRA BTS Service Software (TESS) User Guide*.

Use the BTS Service Software tool for configuration of the Ethernet site link, especially during upgrade or migration procedures.

Encryption of the Ethernet site links can be enabled or disabled using the BTS Service Software. For the list of Ethernet site link encryption parameters, see Encrypted Ethernet Site Links on page 367.

After all parameters are configured properly and the configuration file is loaded to the MTS, the Ethernet site link configuration can be inspected by executing the `status bsl` command on the Site Controller MMI.

An example output of the `status bsl` command is shown below:

```
SC: status bsl

Option                                    Current           Next
-----------------------------------------------------------------------
 Physical sitelink interface              Ethernet          Ethernet
 Invert links for ring edge               not applicable    not applicable
 Ethernet sitelink type                   Dual              Dual
 Passthrough                              off (auto)        auto
 Primary VLAN Tagging                     off               off
 Primary Sat                              off               off
 Primary WAN IP Address                   172.32.1.4        172.32.1.4
 Primary WAN IP Mask                      255.255.255.224   255.255.255.224
 Primary WAN Gateway                      172.32.1.30       172.32.1.30
 Primary WAN VLAN ID                      3001              3001
 Primary IP Tunnel Local Address          172.32.1.4        172.32.1.4
 Primary IP Tunnel Remote Address         172.32.1.33       172.32.1.33
 Primary IP Tunnel Fragmentation Size     358 (auto)        auto
 Secondary WAN interface                  enable            enable
 Secondary VLAN Tagging                   off               off
 Secondary Sat                            off               off
 Secondary WAN IP Address                 172.32.1.132      172.32.1.132
 Secondary WAN IP Mask                    255.255.255.224   255.255.255.224
 Secondary WAN Gateway                    172.32.1.158      172.32.1.158
 Please hit any key to display next page or 'n' to abort
 Secondary WAN VLAN ID                    3011              3011
 Secondary IP Tunnel                      enable            enable
 Secondary IP Tunnel Local Address        172.32.1.132      172.32.1.132
 Secondary IP Tunnel Remote Address       172.32.1.161      172.32.1.161
 Secondary IP Tunnel Fragmentation Size   358 (auto)        auto
 Primary PVC BTS IP Address               172.24.16.18      172.24.16.18
 Primary PVC CR IP Address                172.24.16.17      172.24.16.17
 Primary PVC IP Mask                      255.255.255.252   255.255.255.252
 Secondary PVC BTS IP Address             172.24.20.18      172.24.20.18
 Secondary PVC CR IP Address              172.24.20.17      172.24.20.17
 Secondary PVC IP Mask                    255.255.255.252   255.255.255.252
 BFD Tx Interval                          300               300
 BFD Tx Detect Multiplier                 3                 3
 BFD Protocol Status Flag                 on                on
 Green Traffic Color Map                  7,6,5,4,3,2,1,0   7,6,5,4,3,2,1,0
 Yellow Traffic Color Map                 null              null
 QOS CIR [kbit]                           512               512
 QOS CBS [bytes]                          400               400
 QOS EIR [kbit]                           0                 0
 QOS EBS [bytes]                          0                 0
 QOS Coupling Flag                        off               off
 Throttling algorithm                     enable            enable
 Please hit any key to display next page or 'n' to abort
 Primary PVC PerfMon Jitter Threshold     0                 0
 Primary PVC PerfMon Delay Threshold      0                 0
 Secondary PVC PerfMon Jitter Threshold   0                 0
 Secondary PVC PerfMon Delay Threshold    0                 0

 General parameters                       Current
 -----------------------------------------------------------------------
 Runtime throttling bypass                off
 Primary eth sitelink port (pos ID)       L11_A: UP
 Primary intermediary port states         L2_B: UP, L3_B: UP
```

```
Secondary eth sitelink port (pos ID)      L11_B: UP
Secondary intermediary port states        N/A
```

At the end of its output, the `status bsl` command displays information about site link ports, Ethernet connection state (UP/DOWN), and position (TSC id A or B). The example above is from dual MTS4 configuration.

By L11 here the L1 port (pairs 1-2, 3-6) on the cover is meant.

The `status bsl` command displays two sets of settings for each parameter:

- **Current:** contains settings that were read from the configuration file during startup and are currently used by Base Station.
- **Next:** contains settings that can take effect after a reset of Base Station.

When the **Next** values are successfully validated and saved into the configuration file, they shall take effect after a reset of Base Station.

The `status bfd`command displays states of BFD protocol sessions SC uses to monitor links with Core Routers. BFD protocol must be enabled in Ethernet Site link configuration for this functionality.

```
SC: status bfd
    > Session:1 (172.24.16.18->172.24.16.17) UP
     ------------- RX ---------- TX -------------
       ctrl       1639560       1639729
       reply       817738        821821
       -----------------------------------------
       dropped          1
       up/down          3             2
       ----------- session details -------------
       KA timer 300(peer 300000) timeout 900
       ID 1(peer 4)

    > Session:2 (172.24.20.18->172.24.20.17) UP
     ------------- RX ---------- TX -------------
       ctrl       1640162       1640396
       reply       817672        822490
       -----------------------------------------
       dropped          0
       up/down          1             0
       ----------- session details -------------
       KA timer 300(peer 300000) timeout 900
       ID 2(peer 9)
```

If there is a performance issue with the Ethernet Site link, the “dropped” or “up/down” numbers are high, and there is a big difference between RX and TX values. See the following example of UP and DOWN Ethernet Site link sessions:

```
 > Session:1 (172.24.16.6->172.24.16.5) UP
   ------------- RX ---------- TX -------------
      ctrl       6961306       6961326
      reply      3469091       3492215
      -----------------------------------------
      dropped          0
      up/down          2             1
      ----------- session details -------------
      KA timer 300(peer 300000) timeout 3000
      ID 1(peer 1)

 > Session:2 (172.24.20.6->172.24.20.5) DOWN
   ------------- RX ---------- TX -------------
      ctrl             0       3469110
      reply            0             0
      -----------------------------------------
      dropped          0
```

```
    up/down          0             0
    ----------- session details -------------
    KA timer 300(peer 0) timeout 3000
    ID 2(peer 0)
```

NOTICE: Bidirectional Forwarding Detection (BFD) is a network protocol implemented on Base Stations and Core/Exit Routers used for Ethernet links to detect failure of any active component. BFD uses "keep-alive" packets and runs inside the IP tunnel established between a particular site and the pairs of Core Routers.

13.1.3.3.8.1 Encrypted Ethernet Site Links

NOTICE: This content is applicable to 8.1 System Release and onward.

Link encryption is an extension to the Ethernet Site Links (ESL) feature. When link encryption is implemented, a router/firewall and an MTS authenticate each other through a PreShared Key (PSK) that is loaded on both the router/firewall and the MTS.

The PSK consists of a key phrase (text characters) or a series of hexadecimal characters. The key authenticates the routers/gateways/firewalls/MTSs to enable a secure Internet Key Exchange (IKE) session. The devices communicate in encrypted state across the WAN link. Therefore, to establish a secure session, each peer router/gateway/firewall/MTS requires the same key. Each link can have a separate PSK or PSKs can be shared, depending on the security policies of your organization. PSKs cannot be only shared on encrypted Base Station links. If PSKs are not shared, a PSK is loaded on to the router/gateway/firewall/MTS for each link. The number of PSKs needed on an MTS depends on the number of links connected to that MTS.

Internet Key Exchange (IKE) generates keys that are used to encrypt, decrypt, and authenticate packets. The keys used by IPsec tunnel connection are regenerated by IKE every 1 hour by default. The keys used by IKE session to negotiate IPsec protocol keys are regenerated by IKE every 6 hours by default. The PreShared Key (PSK) is used to authenticate the MTSs during the IKE session establishing phase and are not used to encrypt, decrypt, or authenticate packets.

The following configuration parameters are specific to the Base Station Encrypted Ethernet site links:

- Encryption Enabled
- Encryption Algorithm
- Authentication Algorithm
- Authentication Method
- IKE SA Lifetime (hours)
- IPSEC SA Lifetime (hours)
- Encryption of performance monitoring packets

NOTICE:
For description of parameters listed above and instruction on how to configure them, see the *TETRA BTS Service Software (TESS) User Guide*.

Use the BTS Service Software tool for configuration of the Encrypted Ethernet site link, especially during upgrade or migration procedures.

The algorithms used for encryption are:

- AES 128
- AES 192
- AES 256

The algorithms used for authentication are:

- SHA-1
- SHA-256
- SHA-384
- SHA-512

To verify if the link encryption option is enabled or disabled in the system, use the `ipsec config` command. The command displays both, the Main system and the Local system site link encryption configuration.

```
SC: ipsec config
---------------------------------------------
 MSO: main
   encrypted sitelinks: enabled
   encryption algorithm: AES256
   authentication algorithm: sha1
   authentication method: pre-shared key
   IKE SA lifetime: 6h
   IPsec SA lifetime: 1h
   pm sessions encryption: disabled
---------------------------------------------

_____________________________________________
 MSO: local
   encrypted sitelinks: disabled
   encryption algorithm: AES256
   authentication algorithm: sha1
   authentication method: pre-shared key
   IKE SA lifetime: 6h
   IPsec SA lifetime: 1h
   pm sessions encryption: disabled
---------------------------------------------
SC:
```

To display statistics, execute the `ipsec stats show` command on the Site Controller MMI.

For more details on the Encryption configuration, see the “Link Encryption Configuration” chapter in the *Link Encryption* manual.

13.1.3.3.8.2 Verifying Encryption Capability

When and where to use:
Verify that the MTS software is encryption-capable.

NOTICE: This content is applicable to 8.1 System Release and onward.

Procedure:

1. At the MMI command prompt, type `ver` and find the build number which follows the pattern `MTS_TSC_APP-R`***<X>***.

   Where ***<X>*** is a digit.

2. Check if the third digit in the software build number is equal to 4.

   Step example: The third digit in build `MTS_TSC_APP-R08.41.06` is equal to 4, thus the MTS software supports encryption. In contrast, in the build `MTS_TSC_APP-R08.11.06` the third digit is not equal to 4, thus the MTS software does not support encryption.

13.1.4
Verifying Permanent Lock

Verify if the site is permanently locked before antenna maintenance work. Permanent lock is maintained after resets and power cycles.

Prerequisites: You must be remotely logged on to the MTS.

Procedure:

1. In the Site Controller application, enter `status sc`.

   The output containing the information: `Internal State: AS_L_E_IDL (Permanently Locked)` appears.

2. Enter `status br`.

   A list of BR statuses appears:

   ```
   ==========================  BR Status Information
   ===========================

   Cab    TX     1PPS    Ref.Sign  TX        RX        Current        IP
   & Pos  Keyed  Status   Status   Freq      Freq      Mode
   Address
   -----  -----  ------  --------  --------  --------  -------------
   -----------
   01 01    N      OK       OK     000.0000  000.0000       N/A
   10.0.253.11
   01 02    N      OK       OK     000.0000  000.0000       N/A
   10.0.253.12
   ```

3. Verify that the BRs' TX Freq and RX Freq equals 000.0000.

If any of the system outputs deviate from the description, the site is not permanently locked. For details, see “Lock” in the *MTS Man Machine Interface Commands* manual.

13.1.5
Unlocking the Site from the Permanent Lock State

Follow this procedure to turn off the permanent lock after antenna maintenance work is completed. Permanent lock is maintained after resets and power cycles.

Prerequisites: You must be remotely logged on to the MTS.

Procedure:

1. Verify that antenna maintenance work is completed.
2. Ensure that no maintenance works are currently performed.
3. To unlock the site:
   a. Enter: `unlock -p`
   b. If it is safe to unlock the site, when prompted for confirmation, enter: `Y`

The site is unlocked.

13.1.6
Other Site Controller Symptoms

Table 110: Other Site Controller Symptoms

Symptom	Possible Failure	Corrective Action
Initial power up self test fails	Site Controller	Replace Site Controller.
Service terminal unable to communicate with Controller	Incorrect cable Incorrect setup parameters	Verify cable. Check terminal configuration.
Controller cannot communicate over Ethernet	Cabling problem Site Controller	Check Ethernet cable and 50-Ohm terminator on Ethernet termination. Replace Site Controller.
Site Controller functions normally at first then fails after a period of time	Controller overheating	Replace if required.

13.2
Base Radio / RFDS / Miscellaneous Troubleshooting

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

13.2.1
Base Radio Troubleshooting

This section serves as a guide to isolate Base Radio failures to the module level. It contains procedures for:

- Troubleshooting
- Verification/Station Operation

13.2.1.1
Base Radio Alarms

The following table displays the generic base radio alarms that can be listed using MMI command `get alarms`.

Table 111: Generic Base Radio Alarms

Alarm ID	Description	Recovery Action	Clear Action	Notes
• ALM_BRC_NVM_CKSUM_FAULT • ALM_BRC_NVM_CKSUM_FAIL	Checksum fault for the XCVR NVM parameters was detected during initialization - some of the XCVR	Software attempts to set the parameters to the default values taken from the default region	If the operation of restoring defaults is successful the alarm is cleared. Otherwise the alarm status	Corrupted configuration parameters may cause that BRC works incorrectly. The default values may be different than the lost parameter

Alarm ID	Description	Recovery Action	Clear Action	Notes
	configuration parameters may be corrupted.	in the NVM memory.	is unchanged.	values. To ensure that the parameters can be restored manually to the earlier backed up values.
• ALM_BRC_16_8MHZ_FAIL_ALM • ALM_BRC_16_8MHZ_FAIL	The 16.8MHz reference failure - this alarm originates from the VCXO and it is reported by the interrupt (Host IRQ4).	BRC is dekeyed by the software.	The alarm is cleared only after resetting BRC.	The alarm may be reported because of the BRC hardware failure.
ALM_RX_LO1_LOCK	Receiver synthesizer lock detect failure.	Receiver is disabled by the software - BRC is unable to receive.	If the alarm condition disappears then Receiver is re-enabled by the software.	The alarm may be reported because of the BRC hardware failure or because RX VCO is not properly tuned (BCD NVM parameters configuration).
ALM_RX_SYNTH_LD_FAIL	Reported when ALM_RX_LO1_LOCK is set and ALM_BRC_16_8MHZ_FAIL_ALM is cleared			
• ALM_RX_LO1_SL • ALM_RX_SYNTH_SL_FAIL	Receiver synthesizer steering line failure.	Receiver is disabled by the software - BRC is unable to receive.	If the alarm condition disappears then Receiver is re-enabled by the software.	The alarm may be reported because of the BRC hardware failure or because RX VCO is not properly tuned (BCD NVM parameters configuration).
• ALM_RX_VCO_MON_FAULT • ALM_RX_VCO_MON_FAIL	Receiver VCO monitoring failure.	Receiver is disabled by the software - BRC is unable to receive.	If the alarm condition disappears then Receiver is re-enabled by the software.	**Alarm for BR-Arch-1 only.** The alarm may be reported because of the BRC hardware failure or config-

Alarm ID	Description	Recovery Action	Clear Action	Notes
				uration problems.
ALM_BRC_VCXO_UNLOCK_ALM	VCXO is unlocked - the alarm is reported as a fault indication message from DSP.	No recovery action taken by the software.	The alarm is cleared after de-keying BRC.	The alarm means that the BRC reference is not locked to an external reference and VCXO frequency tolerance can vary between 0.025 and 1.5ppm. The alarm may be reported because of the external reference failure or BRC hardware failure.
ALM_BRC_REPLACE_VCXO_ALM	VCXO should be replaced - the alarm is reported as a fault indication message from DSP.	No recovery action taken by the software.	The alarm is cleared after de-keying BRC.	This is an indication the reference clock may go out of lock in the future.
• ALM_RX_ABACUS_CLK_SL • ALM_RX_ABACUS_CLK_SL_FAIL	Receiver main Abacus clock failure.	Receiver is disabled by the software - BRC is unable to receive.	If the alarm condition disappears then Receiver is re-enabled by the software.	The alarm may be reported because of the BRC hardware failure or configuration problems.
ALM_RX_ABACUS_LO2_SL	Receiver main Abacus 2nd LO failure.	Receiver is disabled by the software - BRC is unable to receive.	If the alarm condition disappears then Receiver is re-enabled by the software.	The alarm may be reported because of the BRC hardware failure or configuration problems.
ALM_RX_ABACUS_2LO_SL_FAIL	Reported when ALM_RX_ABACUS_LO2_SL is set and ALM_RX_5_VOLT is cleared			
• ALM_BRC_ABACUS_CLK1_ALM • ALM_BRC_ABACUS_CLK1_FAIL	Abacus clock 1 is not present - the alarm is reported as a fault in-	BRC is de-keyed by the software.	The alarm is cleared just after BRC is de-keyed.	The alarm may be reported because of the BRC hardware failure.

Alarm ID	Description	Recovery Action	Clear Action	Notes
	dication message from DSP.			
• ALM_BRC_ABACUS_CLK2_ALM • ALM_BRC_ABACUS_CLK2_FAIL	Abacus clock 2 is not present - the alarm is reported as a fault indication message from DSP.	BRC is dekeyed by the software.	The alarm is cleared just after BRC is de-keyed.	The alarm may be reported because of the BRC hardware failure.
• ALM_BRC_ABACUS_CLK3_ALM • ALM_BRC_ABACUS_CLK3_FAIL	Abacus clock 3 is not present - the alarm is reported as a fault indication message from DSP.	BRC is dekeyed by the software.	The alarm is cleared just after BRC is de-keyed.	The alarm may be reported because of the BRC hardware failure.
• ALM_BRC_ABACUS_FS1_ALM • ALM_BRC_ABACUS_FS1_FAIL	Abacus frame sync 1 is not present - the alarm is reported as a fault indication message from DSP.	BRC is dekeyed by the software.	The alarm is cleared just after BRC is de-keyed.	The alarm may be reported because of the BRC hardware failure.
• ALM_BRC_ABACUS_FS2_ALM • ALM_BRC_ABACUS_FS2_FAIL	Abacus frame sync 2 is not present - the alarm is reported as a fault indication message from DSP.	BRC is dekeyed by the software.	The alarm is cleared just after BRC is de-keyed.	The alarm may be reported because of the BRC hardware failure.
• ALM_BRC_ABACUS_FS3_ALM • ALM_BRC_ABACUS_FS3_FAIL	Abacus frame sync 3 is not present - the alarm is reported as a fault indication mes-	BRC is dekeyed by the software.	The alarm is cleared just after BRC is de-keyed.	The alarm may be reported because of the BRC hardware failure.

Alarm ID	Description	Recovery Action	Clear Action	Notes
	sage from DSP.			
• ALM_RX_3_3_VOLT_FAULT • ALM_RX_DC_3_3V_FAIL	Receiver DC 3.3V line failure.	Receiver is disabled by the software - BRC is unable to receive.	If the alarm condition disappears then Receiver is re-enabled by the software.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
• ALM_RX_5_VOLT • ALM_RX_DC_5V_FAIL	Receiver DC 5V line failure.	Receiver is disabled by the software - BRC is unable to receive.	If the alarm condition disappears then Receiver is re-enabled by the software.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
• ALM_RX_12_VOLT • ALM_RX_DC_12V_FAIL	Receiver DC 12V line failure.	Receiver is disabled by the software - BRC is unable to receive.	If the alarm condition disappears then Receiver is re-enabled by the software.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
• ALM_RX_27_VOLT_FAULT • ALM_RX_DC_27V_FAIL	Receiver DC 27V line failure.	Receiver is disabled by the software - BRC is unable to receive.	If the alarm condition disappears then Receiver is re-enabled by the software.	**Alarms for BR-Arch-1 only.** The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
ALM_RX_DC_1_8V_FAIL	Receiver DC 1.8V line failure.	Receiver is disabled by the software - BRC is unable to receive.	If the alarm condition disappears then Receiver is re-ena-	**Alarm for BR-Arch-2 only.** The alarm may be reported because of some power supply

Alarm ID	Description	Recovery Action	Clear Action	Notes
			bled by the software.	problems (cables, connectors) or the BRC hardware failure / configuration problem.
ALM_RX_DC_2_775V_FAIL	Receiver DC 2.775V line failure.	Receiver is disabled by the software - BRC is unable to receive.	If the alarm condition disappears then Receiver is re-enabled by the software.	**Alarm for BR-Arch-2 only.** The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
• ALM_RX_NVM_CKSUM_FAULT • ALM_RX_NVM_CKSUM_FAIL	Checksum fault for the Receiver NVM parameters was detected during initialization - some of the Receiver configuration parameters may be corrupted.	Software attempts to set the parameters to the default values taken from the default region in the NVM memory.	If the operation of restoring defaults is successful the alarm is cleared. Otherwise the alarm status is unchanged.	Corrupted configuration parameters may cause that BRC works incorrectly. The default values may be different than the lost parameter values. To ensure that the parameters can be restored manually to the earlier backed up values.
ALM_RX_FRU_BAND_MISMATCH	Band mismatch between BRC receivers was detected during initialization. Since BRC has only one receiver this alarm should be never observed.	No recovery action taken by the software.	The alarm is cleared only after resetting BRC.	If the alarm is reported it means some software error.

Alarm ID	Description	Recovery Action	Clear Action	Notes
• ALM_AMBIENT_TEMP_ALM_WARN • ALM_AMBIENT_TEMP_WARN	The ambient temperature is above the ambient temperature threshold for the low output power.	No recovery action taken by the software.	If the alarm condition disappears then the alarm is cleared.	
• ALM_AMBIENT_TEMP_ALM_FAULT • ALM_AMBIENT_TEMP_FAULT	The ambient temperature is greater than the allowable high temperature threshold or lower than the allowable low temperature threshold.	BRC is de-keyed by the software if the ambient temperature is greater than the allowable high temperature threshold.	If the alarm condition disappears the alarm is cleared and BRC can be re-keyed again.	
ALM_TX_LO_LOCK	Exciter synthesizer lock detect failure.	BRC is de-keyed by the software.	If the alarm condition disappears the alarm is cleared and BRC can be re-keyed again.	The alarm may be reported because of the BRC hardware failure or because TX VCO is not properly tuned (BCD NVM parameters configuration).
ALM_TX_PLL_LOCK_DETECT_FAIL	Reported when ALM_TX_LO_LOCK is set and ALM_BRC_16_8MHZ_FAIL_ALM is cleared			
• ALM_TX_LO_SL • ALM_TX_PLL_SL_FAIL	Exciter synthesizer steering line failure.	BRC is de-keyed by the software.	If the alarm condition disappears the alarm is cleared and BRC can be re-keyed again.	The alarm may be reported because of the BRC hardware failure or because TX VCO is not properly tuned (BCD NVM parameters configuration).
ALM_TX_TEMP_INTERNAL_FAIL	Exciter temperature is too high.	BRC is de-keyed by the software.	If the alarm condition disappears	

Alarm ID	Description	Recovery Action	Clear Action	Notes
			the alarm is cleared and BRC can be re-keyed again.	
• ALM_TX_VCO_MON_FAIL • ALM_TX_VCO_MONITOR_FAIL	Exciter VCO monitoring failure.	BRC is de-keyed by the software.	If the alarm condition disappears the alarm is cleared and BRC can be re-keyed again.	
ALM_TX_TRAINING_FAIL	It was detected that the software did not schedule the DSP training when it was necessary.	BRC is de-keyed by the software.	The alarm is cleared just after BRC is de-keyed.	If the alarm is reported it means some software error.
ALM_TX_FRU_BAND_MISMATCH	Band configuration mismatch between Exciter and Power Amplifier was detected during initialization.	No recovery action taken by the software.	The alarm is cleared only after resetting BRC.	If the alarm is reported it means that Exciter and Power Amplifier may be incompatible. The initialization fails - BRC cannot be keyed.
• ALM_EX_NVM_CKSUM_FAULT • ALM_EX_NVM_CKSUM_FAIL	Checksum fault for the Exciter NVM parameters was detected during initialization - some of the Exciter configuration parameters may be corrupted.	Software attempts to set the parameters to the default values taken from the default region in the NVM memory.	If the operation of restoring defaults is successful the alarm is cleared. Otherwise the alarm status is unchanged.	Corrupted configuration parameters may cause that BRC works incorrectly. The default values may be different than the lost parameter values. To ensure that the parameters can be restored manually to the earlier backed up values.

Alarm ID	Description	Recovery Action	Clear Action	Notes
• ALM_TX_CLIP_DETECT_ALM_FAULT • LM_TX_CLIP_DETECT_FAULT	Reported when Javelin clip detected failure condition still exists after 1 minute.	BRC is dekeyed by the software.	BRC is rekeyed by the software. If the alarm condition disappears after key-up then the alarm is cleared. If the alarm is reported for the third time it cannot be cleared until next BRC reset.	The alarm may be reported because of the BRC hardware failure or configuration problems.
• ALM_TX_CLIP_DETECT_ALM_WARN • ALM_TX_CLIP_DETECT_WARN	Exciter Javelin clip detected.	The output power is reduced by the software.	If the alarm condition disappears then the output power is restored by the software to the target level. If the alarm is reported for the third time it cannot be cleared until next reset.	The alarm may be reported because of the BRC hardware failure or configuration problems.
ALM_TX_TEMP_INTERNAL_WARN	Internal Power Amplifier temperature is too high.	The output power is reduced by the software.	If the alarm condition disappears then the output power is restored by the software to the target level.	
• ALM_TX_TEMP_INTERNAL_FAULT • ALM_PA_TEMP_INTERNAL_WARN • ALM_PA_TEMP_INTERNAL_FAULT	Internal Power Amplifier temperature is too high.	BRC is dekeyed by the software.	If the alarm condition disappears the alarm is cleared and BRC can be re-keyed again.	

Alarm ID	Description	Recovery Action	Clear Action	Notes
• ALM_TX_TEMP_INTERNAL_SEVERE • ALM_PA_TEMP_INTERNAL_SEVERE	Internal Power Amplifier temperature is too high.	BRC is dekeyed by the software.	If the alarm condition disappears the alarm is cleared and BRC can be re-keyed again.	
• ALM_TX_DC_PS • ALM_PA_IN_RUSH_FAIL	Power Amplifier DC supply failure.	BRC is dekeyed by the software.	If the alarm condition disappears the alarm is cleared and BRC can be re-keyed again.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
ALM_TX_3_3V_PS	Power Amplifier 3.3V DC supply failure.	BRC is dekeyed by the software.	If the alarm condition disappears the alarm is cleared and BRC can be re-keyed again.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
ALM_PA_3_3V_SUPPLY_FAIL	Reported when ALM_TX_3_3V_PS is set and ALM_TX_DC_PS is cleared			
ALM_TX_5V_PS	Power Amplifier 5V DC supply failure.	BRC is dekeyed by the software.	If the alarm condition disappears the alarm is cleared and BRC can be re-keyed again.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
ALM_PA_5V_SUPPLY_FAIL	Reported when ALM_TX_5V_PS is set and ALM_TX_DC_PS is cleared			
ALM_TX_LVL_PWR_FAIL	The power leveling procedure failed to establish the output power at the re-	BRC is dekeyed by the software.	The alarm is cleared just after BRC is de-keyed.	The power leveling is done periodically to ensure that the output power does not deviate from the required level. It is

Alarm ID	Description	Recovery Action	Clear Action	Notes
	quested level.			also done each time when the target output power is changed by recovery or clear actions of some alarms.
• ALM_PA_NVM_CKSUM_FAULT • ALM_PA_NVM_CKSUM_FAIL	Checksum fault for the Power Amplifier NVM parameters was detected during initialization - some of the Power Amplifier configuration parameters may be corrupted.	Software attempts to set the parameters to the default values taken from the default region in the NVM memory.	If the operation of restoring defaults is successful the alarm is cleared. Otherwise the alarm status is unchanged.	Corrupted configuration parameters may cause that BRC works incorrectly. The default values may be different than the lost parameter values. To ensure that the parameters can be restored manually to the earlier backed up values.
• ALM_TX_DEKEYED_FWD_PWR_HIGH • ALM_PA_DEKEYED_POWER_PRESENT	Reported if Transmitter is dekeyed and the forward power meter still measures some output power that exceeds the configured acceptable level.	BRC is dekeyed again by the software.		The alarm may be reported because of some software error or the BRC hardware failure.
• ALM_RX_DC_INJ1_FAULT • ALM_RX_DC_INJ1_FAIL	Receiver branch1 LNA DC injection failure.	Branch1 of Receiver is disabled by the software - if no more enabled branches then BRC is unable to receive, otherwise BRC is still able to receive but	If the alarm condition disappears then branch1 of Receiver is re-enabled by the software.	The alarm may be reported because of the BRC hardware failure or configuration problems.

Alarm ID	Description	Recovery Action	Clear Action	Notes
		the coverage can be lower		
• ALM_RX_DC_INJ2_FAULT • ALM_RX_DC_INJ2_FAIL	Receiver branch2 LNA DC injection failure.	Branch2 of Receiver is disabled by the software - if no more enabled branches then BRC is unable to receive, otherwise BRC is still able to receive but the coverage can be lower	If the alarm condition disappears then branch2 of Receiver is re-enabled by the software.	The alarm may be reported because of the BRC hardware failure or configuration problems.
• ALM_RX_DC_INJ3_FAULT • ALM_RX_DC_INJ3_FAIL	Receiver branch3 LNA DC injection failure.	Branch3 of Receiver is disabled by the software - if no more enabled branches then BRC is unable to receive, otherwise BRC is still able to receive but the coverage can be lower	If the alarm condition disappears then branch3 of Receiver is re-enabled by the software.	The alarm may be reported because of the BRC hardware failure or configuration problems.
ALM_RX_DC_INJ_FAIL	Reported when ALM_RX_DC_INJx_FAULT alarms for all Receiver branches are set			
• ALM_RX_DC_INJ1_SHORT_FAULT • ALM_RX_DC_INJ1_SHORT_FAIL	Receiver branch1 LNA DC injection failure.	Branch1 of Receiver is disabled by the software - if no more enabled branches then BRC is unable to receive, otherwise BRC is still able to receive but	If the alarm condition disappears then branch1 of Receiver is re-enabled by the software.	The alarm may be reported because of the BRC hardware failure.

Alarm ID	Description	Recovery Action	Clear Action	Notes
		the coverage can be lower		
• ALM_RX_DC_INJ2_SHORT_FAULT • ALM_RX_DC_INJ2_SHORT_FAIL	Receiver branch2 LNA DC injection failure.	Branch2 of Receiver is disabled by the software - if no more enabled branches then BRC is unable to receive, otherwise BRC is still able to receive but the coverage can be lower	If the alarm condition disappears then branch2 of Receiver is re-enabled by the software.	The alarm may be reported because of the BRC hardware failure.
• ALM_RX_DC_INJ3_SHORT_FAULT • ALM_RX_DC_INJ3_SHORT_FAIL	Receiver branch3 LNA DC injection failure.	Branch3 of Receiver is disabled by the software - if no more enabled branches then BRC is unable to receive, otherwise BRC is still able to receive but the coverage can be lower	If the alarm condition disappears then branch3 of Receiver is re-enabled by the software.	The alarm may be reported because of the BRC hardware failure.
ALM_RX_DC_INJ_SHORT_FAIL	Reported when ALM_RX_DC_INJx_SHORT_FAIL alarms for all Receiver branches are set			
ALM_RX_INJ1_SHORT_LONG_FAULT	Reported when ALM_RX_DC_INJ1_SHORT_FAIL is set for longer time than 5 minutes	Branch1 of Receiver is finally disabled (by setting DC supply control line for the LNA)	There is no automatic recovery from this alarm.	The alarm may be reported because of the BRC hardware failure.
ALM_RX_INJ2_SHORT_LONG_FAULT	Reported when ALM_RX_DC_INJ2_SH	Branch2 of Receiver is finally disabled (by set-	There is no automatic recovery	The alarm may be reported because of the

Alarm ID	Description	Recovery Action	Clear Action	Notes
	ORT_FAIL is set for longer time than 5 minutes	ting DC supply control line for the LNA)	from this alarm.	BRC hardware failure.
ALM_RX_INJ3_SHORT_LONG_FAULT	Reported when ALM_RX_DC_INJ3_SHORT_FAIL is set for longer time than 5 minutes	Branch3 of Receiver is finally disabled (by setting DC supply control line for the LNA)	There is no automatic recovery from this alarm.	The alarm may be reported because of the BRC hardware failure.
ALM_RX_INJ_SHORT_LONG_FAIL	Reported when ALM_RX_INJx_SHORT_LONG_FAULT alarms for all Receiver branches are set			
ALM_PLAT_PEER_HW	FPGA failure detected by DSP - the alarm is reported as a fault indication message from DSP.	BRC is dekeyed by the software.	The alarm is cleared just after BRC is de-keyed.	The alarm may be reported because of the BRC hardware failure.
ALM_PLAT_PEER_FATAL	Memory / Illegal instruction / Watchdog failure detected by DSP - the alarm is reported as a fault indication message from DSP.	BRC is dekeyed by the software.	The alarm is cleared just after BRC is de-keyed.	The alarm may be reported because of some software error or the BRC hardware failure.
ALM_PLAT_PEER_TIMING	Timing / clock fault detected by DSP - the alarm is reported as a fault indication message from DSP.	No recovery action taken by the software.	The alarm is cleared after de-keying BRC.	The alarm may be reported because of the BRC hardware failure.
ALM_PLAT_NO_EXP_CB	No CoreLib exception	No recovery action taken	The alarm is cleared only	Software error

Alarm ID	Description	Recovery Action	Clear Action	Notes
	callback set in BRC Application - internal software error	by the software.	after resetting BRC.	
ALM_PLAT_NO_GEN_CB	No CoreLib command complete callback set in BRC Application - internal software error	No recovery action taken by the software.	The alarm is cleared only after resetting BRC.	Software error
ALM_PLAT_NO_EVT_CB	No CoreLib event callback set in BRC Application - internal software error	No recovery action taken by the software.	The alarm is cleared only after resetting BRC.	Software error
ALM_PLAT_NO_RF_CB	No CoreLib DSP receive / transmit data callback set in BRC Application - internal software error	No recovery action taken by the software.	The alarm is cleared only after resetting BRC.	Software error
ALM_TX_FINAL_FAILURE_FLT	Power Amplifier final failure.	BRC is dekeyed by the software.	If the alarm condition disappears the alarm is cleared.	The alarm may be reported because of the BRC hardware failure or configuration problems.
ALM_TX_FINAL_FAILURE	Power Amplifier final failure.	The output power is reduced by the software.	If the alarm condition disappears then the output power is restored by the software to the target level.	The alarm may be reported because of the BRC hardware failure or configuration problems.

Alarm ID	Description	Recovery Action	Clear Action	Notes
• ALM_TX_VSWR_ALARMING • ALM_PA_VSWR_ALARMING	Voltage Wave Standing Ratio is high.	No recovery action taken by the software.		The alarm may be reported because of the BRC hardware failure or configuration problems.
• ALM_TX_REFL_PWR_ALM_FAULT • ALM_PA_REFL_PWR_FAULT	Reflected power is high.	BRC is dekeyed by the software.	BRC stays de-keyed until reset occurs.	The alarm may be reported because of the BRC hardware failure or configuration problems.
• ALM_TX_REFL_PWR_ALM_WARN • ALM_PA_REFL_PWR_WARN	Reflected power is high.	The output power is reduced by the software.	If the alarm condition disappears then the output power is restored by the software to the target level.	The alarm may be reported because of the BRC hardware failure or configuration problems.
ALM_TX_KEYED_FWD_PWR_LOW	The output power dropped below 60% of the current target (programmed) power (the power level that is expected to be currently set).	The power leveling procedure is executed to get the output power to the expected level.	When the output power is restored to the expected level the alarm is cleared	The alarm may be reported because of the BRC hardware failure or configuration problems.
ALM_PA_OTHER_RF_FAIL	The same as ALM_TX_KEYED_FWD_PWR_LOW			
ALM_TX_KEYED_FWD_PWR_HIGH	The output power rose above 140% of the current target (programmed) power (the power level that is expected to be currently set).	The power leveling procedure is executed to get the output power to the expected level.	When the output power is restored to the expected level the alarm is cleared	The alarm may be reported because of the BRC hardware failure or configuration problems.

Alarm ID	Description	Recovery Action	Clear Action	Notes
ALM_BRC_ETH_LAN1_LINK_ALM	Ethernet LAN1 Link is down - the link state change is reported by CPLD by the interrupt (Host IRQ2).	No recovery action taken by the software.	When the link is up then the alarm is cleared.	The link to Site Controller is disconnected or failed.
ALM_BRC_ETH_LAN2_LINK_ALM	Ethernet LAN2 Link is down - the link state change is reported by CPLD by the interrupt (Host IRQ2).	No recovery action taken by the software.	When the link is up then the alarm is cleared.	The link to Site Controller is disconnected or failed.
ALM_BRC_ETH_LAN_LINK_FAIL	Reported when ALM_BRC_ETH_LAN1_LINK_ALM is set and ALM_BRC_ETH_LAN2_LINK_ALM is set	No recovery action taken by the software.	When the link is up then the alarm is cleared.	Both links to Site Controller are disconnected or failed.
ALM_BRC_CP2A_LINK_FAIL_ALM	CP2A Link failure - the link state change is reported by CPLD by the interrupt (Host IRQ2).	CPLD will automatically switch to CP2B.	When the link is up then the alarm is cleared.	The link to Site Controller is disconnected or failed.
ALM_BRC_CP2B_LINK_FAIL_ALM	CP2B Link failure - the link state change is reported by CPLD by the interrupt (Host IRQ2).	CPLD will automatically switch to CP2A.	When the link is up then the alarm is cleared.	The link to Site Controller is disconnected or failed.

Alarm ID	Description	Recovery Action	Clear Action	Notes
ALM_BRC_CP2A_REF_ALM	CP2A reference is not present - the alarm originates from the STIC FPGA (which is read by DSP) and it is reported as a fault indication message from DSP	Hardware automatically selects another reference which is present.	The alarm is cleared after de-keying BRC.	The alarm may be reported because of the external reference failure or BRC hardware failure.
ALM_BRC_CP2B_REF_ALM	CP2B reference is not present - the alarm originates from the STIC FPGA (which is read by DSP) and it is reported as a fault indication message from DSP	Hardware automatically selects another reference which is present.	The alarm is cleared after de-keying BRC.	The alarm may be reported because of the external reference failure or BRC hardware failure.
ALM_DEKEY_FROM_MMI	BRC is dekeyed by using dekey MMI command	BRC is dekeyed by the software.	The alarm is cleared (and BRC is rekeyed again) after using key MMI command.	
ALM_GPS_FAILURE	GPS failure detected - 1PPS signal is lost.	No recovery action taken by the software.	After de-keying BRC and regaining the 1PPS signal the alarm is cleared.	The alarm may be reported because of the 1PPS signal from SC failure or link to SC failure or BRC hardware failure.
ALM_RESET_PENDING_ALARM	CMP Reset request received from Site Controller but	After the delay time elapses the BRC is reset.	The alarm is cleared only after resetting BRC.	

Alarm ID	Description	Recovery Action	Clear Action	Notes
	delay time for the reset is set.			
ALM_HW_INIT_FAILED	Hardware initialization failure.	No recovery action taken by the software.	The alarm is cleared only after resetting BRC.	The alarm may be reported because of BRC hardware configuration error or BRC hardware failure.
ALM_RX1_PATH	RSSI for Receiver path 1 is much lower than maximal RSSI measured for the remaining configured paths.	No recovery action taken by the software.	When the clear condition is met then the alarm is cleared.	Each time when RSSI for path 1 is less than (max_RSSI - mts_receive_path_threshold) then RSSI failure counter for path 1 is incremented by 1. Otherwise the counter is decremented by 2. After checking the alarm condition the counter is set to 0 if it has a negative value. The rssicnt command can be used for checking the threshold that is currently used. The alarm may be reported because of the BRC hardware failure or configuration problems.
ALM_RX2_PATH	RSSI for Receiver path 2 is much lower than maximal RSSI measured for the remaining	No recovery action taken by the software.	When the clear condition is met then the alarm is cleared.	Each time when RSSI for path 2 is less than (max_RSSI - mts_receive_path_threshold) then RSSI failure counter for path 2 is incremented

Alarm ID	Description	Recovery Action	Clear Action	Notes
	configured paths.			by 1. Otherwise the counter is decremented by 2. After checking the alarm condition the counter is set to 0 if it has a negative value. The rssicnt command can be used for checking the threshold that is currently used. The alarm may be reported because of the BRC hardware failure or configuration problems.
ALM_RX3_PATH	RSSI for Receiver path 3 is much lower than maximal RSSI measured for the remaining configured paths.	No recovery action taken by the software.	When the clear condition is met then the alarm is cleared.	Each time when RSSI for path 3 is less than (max_RSSI - mts_receive_path_threshold) then RSSI failure counter for path 3 is incremented by 1. Otherwise the counter is decremented by 2. After checking the alarm condition the counter is set to 0 if it has a negative value. The rssicnt command can be used for checking the threshold that is currently used. The alarm may be reported because of the BRC hardware failure or configuration problems.

Alarm ID	Description	Recovery Action	Clear Action	Notes
ALM_RF_JAMMING	Uplink channel RF interference detected.	No recovery action taken by the software.	The alarm is cleared if no longer interference is detected.	
ALM_RF_JAMMING_WITH_AIH	Uplink channel RF interference detected with Automatic Interference Handler is enabled.	Information sent to Site Controller. MCCH setup requests are rejected by BRC.	The alarm is cleared if no longer interference is detected.	
ALM_LAPD_LINK	LAPD connection is down.	BRC is dekeyed by the software.	The alarm is cleared after the LAPD connection is restored.	The alarm may be reported because of the link to SC failure.
ALM_RX_IF1_FAULT	Current consumption failure of IF amplifier in branch 1	Receiver Branch 1 is disabled	If condition disappears branch 1 is enabled	The alarm may be reported if current is outside specified limits.
ALM_RX_IF2_FAULT	Current consumption failure of IF amplifier in branch 2	Receiver Branch 2 is disabled	If condition disappears branch 2 is enabled	The alarm may be reported if current is outside specified limits.
ALM_RX_IF3_FAULT	Current consumption failure of IF amplifier in branch 3	Receiver Branch 3 is disabled	If condition disappears branch 3 is enabled	The alarm may be reported if current is outside specified limits.
ALM_EX_DC_27V_FAULT	Exciter DC 27V line failure.	Transmitter is disabled by the software - BRC is unable to transmit.	If the alarm condition disappears then transmitter is reenabled by the software.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.

Alarm ID	Description	Recovery Action	Clear Action	Notes
ALM_EX_DC_12V_FAULT	Exciter DC 12V line failure.	Transmitter is disabled by the software - BRC is unable to transmit.	If the alarm condition disappears then transmitter is re-enabled by the software.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
ALM_EX_DC_5V_FAULT	Exciter DC 5V line failure.	Transmitter is disabled by the software - BRC is unable to transmit.	If the alarm condition disappears then transmitter is re-enabled by the software.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
ALM_EX_DC_2_775V_FAULT	Exciter DC 2.775V line failure.	Transmitter is disabled by the software - BRC is unable to transmit.	If the alarm condition disappears then transmitter is re-enabled by the software.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
ALM_EX_DC_3_3V_FAULT	Exciter DC 3.3V line failure.	Transmitter is disabled by the software - BRC is unable to transmit.	If the alarm condition disappears then transmitter is re-enabled by the software.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.
ALM_EX_DC_1_875V_FAULT	Exciter DC 1.875V line failure.	Transmitter is disabled by the software - BRC is unable to transmit.	If the alarm condition disappears then transmitter is re-enabled by the software.	The alarm may be reported because of some power supply problems (cables, connectors) or the BRC hardware failure / configuration problem.

13.2.1.2
Recommended Test Equipment

The following table lists the recommended test equipment to perform the Base Radio troubleshooting/station operation procedures.

Table 112: Recommended Test Equipment

Test Equipment	Model Number	Use
TETRA Signal Generator	Rhode Schwarz: SMU200A + SMU-K68	Used for checking receive and transmit operation.
TETRA Analyzer	FSQ+FS-K110+FSQ-K70	
Dummy Load (50 Ω, 250 W)	Weinschel 453033	Used to terminate output
Service Terminal	VT100 or compatible	Local service terminal
Power Meter	HP 437B	Used to measure reflected and forward power
RF Attenuator, 250 W, 40 dB	Weinschel 404043	Protection for HP89441A
RF Attenuator, 10 dB	minimum 100 W	Protection for HP89441A

13.2.1.3
Troubleshooting Procedures

The Base Radio is computer-controlled and employs digital signal processing techniques. Many of the troubleshooting and station operation procedures require Man-Machine Interface (MMI) commands. These commands are used to communicate station level commands to the Base Radio through the RS-232 communications port located on the front of the BRC.

The field maintenance philosophy for the Base Radio is to repair by replacement. The station is comprised of self-contained Field Replaceable Units (FRU).

A defective FRU is replaced with a non-defective module. This method of troubleshooting limits down-time and quickly restores the Base Radio back to normal operation.

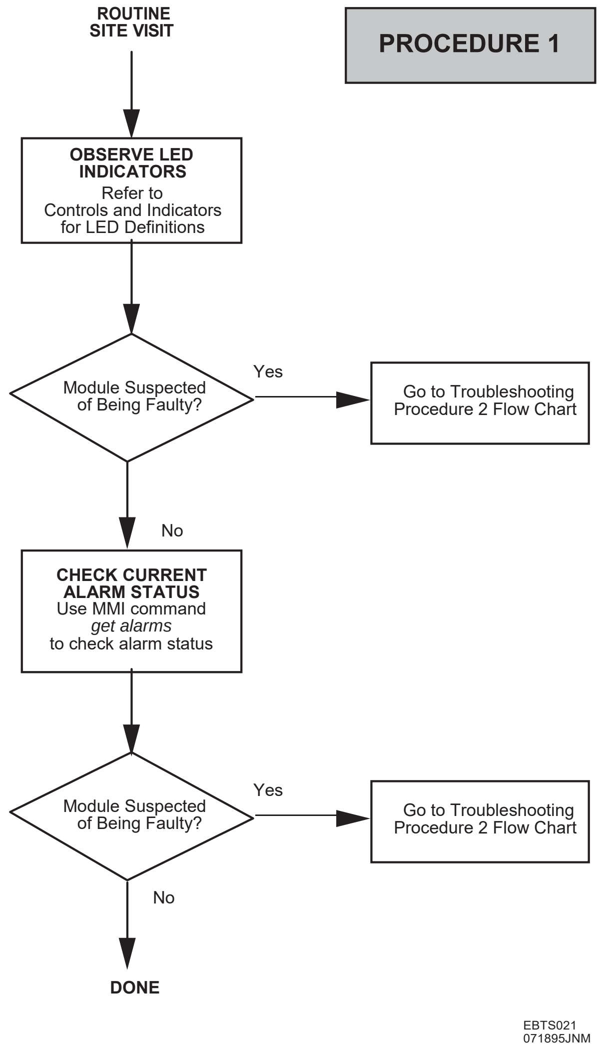
Ship defective modules to a Motorola Solutions repair depot for repair.

This manual provides two troubleshooting procedures for the Base Radio. Each procedure is designed to quickly identify faulty modules.

13.2.1.4
Routine Checkout

Procedure 1 is a quick, non-intrusive test performed during a routine site visit. Use this procedure to verify proper station operation without taking the station out of service. The following figure shows the Procedure 1 Troubleshooting Flowchart.

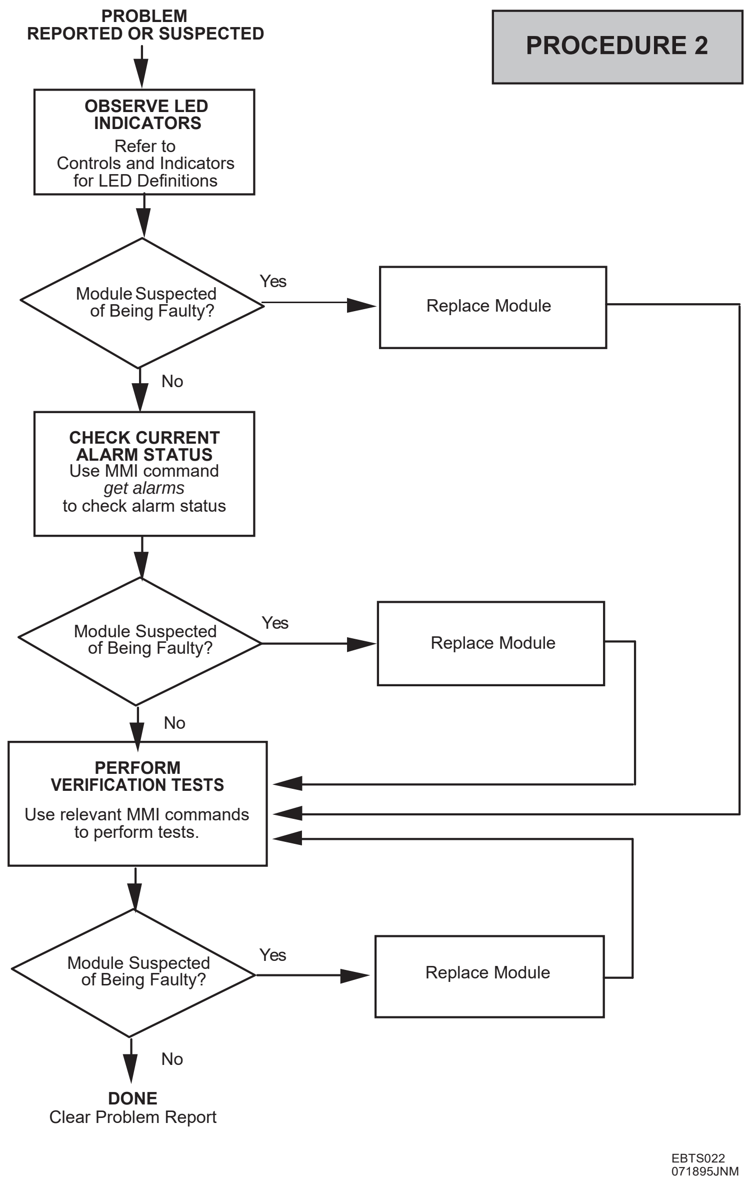
Figure 191: Procedure 1 Troubleshooting Flowchart



13.2.1.5
Reported/Suspected Problems

Use Procedure 2 to troubleshoot reported or suspected equipment malfunctions. Perform this procedure with equipment in service (non-intrusive) and with equipment taken temporarily out of service (intrusive).

Figure 192: Procedure 2 Troubleshooting Flowchart

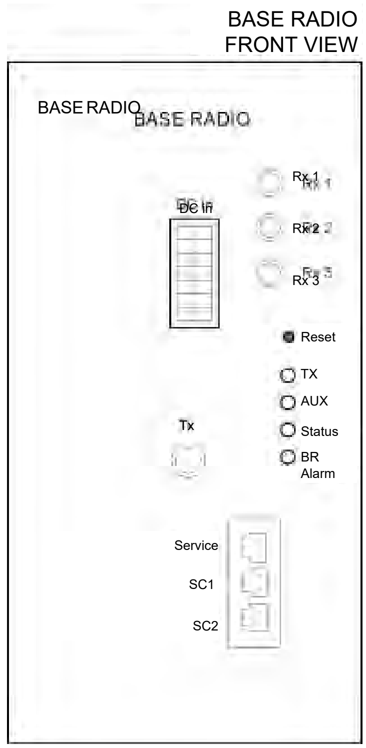


13.2.1.5.1
Base Radio Replacement

Replace suspected modules within the BR with known non-defective module to restore the station to proper operation. For a list of available FRUs, see Field Replaceable Units (FRUs) on page 446.

13.2.2
Base Radio Fault Indications

Figure 193: Base Radio LEDs



The BRC have 4 LEDs that are under software control: only 3 of these are used (TX, Status, BR Alarm). The LEDs indicate the main operating state of the BRC, as outlined in the table below. Additionally there are two SC1, SC2 LEDs indicating network problems.

Table 113: Base Radio Fault Indications

Indication	Possible Failure	Corrective Action
All LEDs: OFF	Power Supply switch is OFF or power supply is damaged	• Check if power supply switch is ON • Verify power to the BR, cabling • Check LEDs on PSU (power supply) - replace PSU (power supply)
Status LED: Amber, Alarm LED: RED	Waiting for software download, this is where BRC will wait if no Site Controller present	• Check SC link LEDs • Reset the MTS and interrupt the autoboot process. Log on to the required application: Boot1 on BR-Arch-1, Base Radio Core on BR-Arch-2. Then use the following commands, to check if IP/MAC addresses are valid and are different on each interface (to avoid conflicts):

Indication	Possible Failure	Corrective Action
		- `spr inet/if/eth0` - `spr inet/if/eth1` • Check also if the IP suffix matches BR Cabinet ID/Position ID combination, for example: 10.0.253.cp where c = 1 (Cabinet ID) and p = 2 (Position ID) give us 10.0.253.12. Use the following command: `cccp` • Reset BR
Status LED: GREEN, Alarm LED: RED	BRC application is running but an alarm is preventing the BR from keying	• Check logs through SC • Verify proper cabinet/position by executing **get cabinet**, **get position** MMI commands • Check BR IP addresses by executing **get ifconfig** MMI command • Check for alarm conditions by executing **get alarms** MMI command or by test application (PA temperature alarm, lock and ref alarms, all receivers failed, PA VSWR, alarm...) • Check the Power Amplifier by executing **get pa_status** MMI command (check parameters: fwd power, frequencies) • Start test application and check for current alarms by executing test application command: **alarms -ofault_hndlr** ; check TX (transmitter) and RX (receiver) frequency by executing **freq -otx_all, freq -orx_all** test application commands • Check reference signal from SC link • Reset BR • Replace BR
SC1, SC2 LED: GREEN OFF	Ethernet link not present	• Check cabling to Site Controller • Check Site Controller status
SC1, SC2 LED: YELLOW OFF	No ethernet activity	• If ethernet link present check proper IP address by executing **get ifconfig** MMI command • Check Site Controller IP address • Check connection to the Site Controller

13.2.3
Miscellaneous Troubleshooting

Table 114: Miscellaneous Troubleshooting Items

Indication	Possible Failure	Corrective Action
No over-the-air communication	Open Ethernet cable, or missing termination of Ethernet cable	Verify no open or damage to Ethernet cable, or missing termination.
	Open or damaged BR antenna, lead in or surge arrestor	Verify no open or damage to BR antenna, lead-in or surge arrestor.
No internal site communication (Ethernet)	Open Ethernet cable, missing termination of Ethernet cable	Verify no open or damage to Ethernet cable, or missing termination.
Transmissions bad or unusable	Open or damaged BR antenna, lead in or surge arrestor	• Verify no open or damage to BR antenna, lead-in or surge arrestor. • Possible intermodulation desensitizing, carrier interference, X.21 or E1 link defect.
Entire site off air after several hours	AC or DC Power failure	Verify AC or DC input voltage on Power Supply Unit.
Bad VSWR reported or TX_REFL_POWER alarm reported (ALM_PA_REFL_PWR_FAULT will be raised)	Open or damaged BR antenna, lead in or surge arrestor	Verify no open or damage to BR antenna, lead-in or surge arrestor.

Chapter 14

Technical Specifications

14.1

Restriction of Hazardous Substances Compliance

This is to declare that MSI products comply with the EU Directive 2011/65/EU (Restriction of Hazardous Substance or RoHS-2) and India RoHS, including applicable exemptions, with respect to the following substances:

- Lead (Pb) < 0.1% by weight (1000 ppm)
- Mercury (Hg) < 0.1% by weight (1000 ppm)
- Cadmium (Cd) < 0.01% by weight (100 ppm)
- Hexavalent Chromium (Cr6+) < 0.1% by weight (1000 ppm)
- Polybrominated Biphenyls (PBB) < 0.1% by weight (1000 ppm)
- Polybrominated Diphenyl Ethers (PBDE) < 0.1% by weight (1000 ppm)

14.2

Environmental and Standards Specifications

This section presents the Environmental Specifications and the Standards Specifications.

14.2.1

Environmental Specifications

Table 115: Environmental Specifications

Environmental Specifications	Description
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 2 400 MHz (without fans) -30 °C to 55 °C • MTS 2 400 MHz (with fans) -30 °C to 60 °C • MTS 2 260 MHz (without fans) -30 °C to 55 °C • MTS 2 800 MHz (always fans) -30 °C to 60 °C • MTS 2 900 MHz (always fans) -30 °C to 60 °C • MTS 4 400 MHz (with fans) -30 °C to 60 °C • MTS 4 400 MHz (without fans) -30 °C to 55 °C • MTS 4 260 MHz (always fans) -30 °C to 60 °C • MTS 4 800 MHz (with fans) -30 °C to 55 °C
Storage temperature	-40 °C to 85 °C

Environmental Specifications	Description
Humidity	5% to 95% non-condensing for 30 C. EN 300 019 1-3 Class3.2
Operational altitude	-300 m to 3000 m
Environmental protection	IP 20 according to IEC 60529
Operating in use	Shock: EN300 019-2-3 T 3.2
	Vibration: EN300 019-2-3 T 3.2
Storage and Transportation	• Weather protected, not temperature-controlled storage locations. ETSI EN 300 019-1-1 Class 1.2, and EN 300 019-2-1 T1.2 • ETSI EN 300 019-1-2 Class2.3 public transportation, and EN 300 019-2-2 T2.3.

14.2.2
Standards Specifications

Table 116: MTS Standards Specifications

Standards Specifications	Description
Harmonized EN for TETRA	EN 303 035-1: TErrestial Trunked RAdio TETRA EN 302 561: TErrestial Trunked RAdio (TETRA)
Air-Interface	EN 300 392-2
Conformance Test	EN 300 394-1
EU Directives	R&TTE - Radio and Telecommunications Terminal Equipment Directive 1999/5/EC WEEE - Waste Electrical and Electronic Equipment Directive 2002/96/EC RoHS - Restriction of Hazardous Substances Directive 2002/95/EC
Digital Line Interfaces: E1	ITU-T Rec. G. 703: Physical/electrical characteristics of hierarchical digital interfaces.
	Terminal Equipment Requirements (Site Controller and Routers): • TBR 12 (1993-12) / A1 (1996-01), which is a subset of EN 300 248 (Unstructured E1) • TBR 13 (1996-01) which is a subset of EN 300 420 (Structured E1)
	Leased Line Requirements: • ETSI EN 300 418 v1.2.1 (2001-07) and ETSI EN 300 247 v1.2.1 (2001-07) (Unstructured E1) • ETSI EN 300 418 v1.2.1 (2001-07) and ETSI EN 300 419 v1.2.1 (2001-07) (Structured E1)

Standards Specifications	Description
	• ETSI EN 300 766 v1.2.1 (2001-07) with octet sequence integrity. (Fractional E1) In case of base stations connected in a redundant ring structure the lowest sum of the link delays between a base station and the zone core shall not exceed 14 ms. No more than 10 base stations can be connected in a ring.
X.21	ITU-T Rec. V11: Electrical characteristics for balanced double current interchange circuits. ETSI EN 300 766 v1.2.1 (2001-07)
Safety	EN60950 - 1: Harmonized Safety Standard R56: Motorola Solutions international installation standard
EMC	EN 301 489-1: Common Technical Requirements EN 301 489-18: Specific Requirements for TETRA EN 50121-4 : Railway applications EMC
Environmental	EN 300 019-1-1 class 1.2 Storage EN 300 019-1-2 class 2.3 Transportation EN 300 019-13 class 3.2 Operation, extended temp -30 °C to 55 °C without fans EN 300 019-13 class 3.2 Operation, extended temp -30 °C to 60 °C with fans

14.3
Cabinet and Module Specifications

The cabinet and module specifications include the dimensions for the cabinet and the technical specifications for the different modules in the cabinets.

14.3.1
MTS Cabinets Frequency Range

The following table lists the frequency values supported for the MTS LiTE, MTS 2, MTS 4.

Table 117: Frequency values supported for the MTS LiTE, MTS 2, MTS 4

MTS Cabinet	Frequency Range
MTS LiTE	400 MHz and 800 MHz
MTS 2	260 MHz, 400 MHz, 800 MHz and 900 MHz
MTS 4	260 MHz, 400 MHz, and 800 MHz

14.3.2
Dimensions of the MTS Cabinets

The following table lists the dimensions of the MTS LiTE, MTS 2, MTS 4, and MTS 4 Expansion Cabinets.

Table 118: Dimensions of the MTS 2, MTS 4, and MTS 4 Expansion Cabinets

Physical Dimensions	Description
Depth:	MTS LiTE: 480 mm MTS 2: 472 mm MTS 4: 570 mm
Height:	MTS LiTE: 380 mm MTS 2: 605 mm MTS 4: 1430 mm
Width:	MTS LiTE: 450 mm MTS 2: 443 mm MTS 4: 550 mm
Weight:	with full equipment: MTS LiTE: 35 kg MTS 2: 48 kg MTS 4: 141 kg with full equipment incl. packaging: MTS LiTE: 51 kg MTS 2: 64 kg MTS 4: 170 kg

14.3.3
RF Specifications

Table 119: RF Specifications

RF Specifications	Description	Value or Range
Frequency	Low 400 MHz band (TETRA and TEDS):	350 MHz 430 MHz
	High 400 MHz band (TETRA and TEDS):	380 MHz 470 MHz
	260 MHz (TETRA)	260 MHz – 275 MHz
	800 MHz (TETRA and TEDS):	806 MHz – 870 MHz
	900 MHz (TETRA and TEDS):	917 MHz – 942 MHz
	Duplex spacing:	400 MHz: 10 MHz 260 MHz: 9 MHz

RF Specifications	Description	Value or Range
		800 MHz: 45 MHz 900 MHz: 15 MHz
	Bandwidth:	400 MHz: 5 MHz 260 MHz: 6 MHz 800 MHz: 19MHz 900 MHz: 10 MHz
	Channel spacing TETRA:	25 kHz (Raster in 6.25 kHz)
	Channel spacing TEDS:	25/50 kHz (Raster in 6.25 kHz)
Transmit Power	Maximum: • 10 W (TEDS High Power, one TX ant., 2 BRs, 2 Duplexers) • 20 W (TEDS High Power, two TX ant., 2 BRs, with fans, 2 Duplexers) • 25 W (TETRA Low Power, two TX ant., 2 BRs, 2 Duplexers) • 40 W (TETRA High Power, two TX ant., 2 BRs, with fans, 2 Duplexers) **NOTICE:** Cavity Combiner and channel spacing less than 250 kHz gives maximum output power between 20 W and 25 W.	
	Adjustable down with 12 dB	

NOTICE:
The first usable TETRA center frequency in each range is 12.5 kHz above the low range and below high range.

The first usable TEDS center frequency in each range is:

- 12.5 kHz above the low range and below high range for 25 kHz channel
- 25 kHz above the low range and below high range for 50 kHz channel

NOTICE: ETSI Compliance Notice: The Base Radio is only ETSI-compliant when used in conjunction with a RF distribution system (RFDS) supplied by Motorola Solutions. The Base Radio shall not be used without a RFDS approved by Motorola Solutions.

Table 120: Auto Tune and Manual Tune Cavity Combining Transmitter-to-Antenna Port Specifications

Specifications	Value or Range
Cavity Combiner Maximum Insertion Loss:	3.9 dB maximum
(@ 150 kHz Channel Spacing, four-channel)	3.5 dB typical **NOTICE:** The cavities are factory set for 150 kHz spacing. Cavities are not tuned to customer frequency and may be field tuned. Cavity combiner insertion loss is combiner only.
Duplex Filter Insertion Loss	1.6 dB maximum
	1.2 dB typical
Total RFDS Insertion Loss	4.5 - 5.2 dB
150 kHz Channel Spacing, four-channel	5.2 dB typical

Specifications	Value or Range
250 kHz Channel Spacing, four-channel	4.7 dB typical
250 kHz Channel Spacing, two-channel	4.5 dB typical

Table 121: Hybrid Combining Transmitter-to-Antenna Port Specifications

Specifications	Value or Range
Hybrid Combiner Maximum Insertion Loss:	3.3 dB maximum
	3.2 dB typical
Duplex Filter Insertion Loss	1.6 dB maximum
	1.2 dB typical
Total Hybrid Combiner Insertion Loss	4.9 dB maximum
	4.4 dB typical
Input Return Loss	14 dB minimum
	>20 dB typical
Antenna-to-PA Isolation	20 dB minimum

14.3.4
Transmitter Specifications

The following tables list the TETRA and TEDS specifications.

NOTICE: All specifications listed in the following two tables are observed at RF distribution system output unless stated otherwise.

Table 122: Transmit Specifications – TETRA

Transmitter Specification	Value or Range
Pi/4DQPSK Transmitted Power (10, 25, 40 Watts depending on the configuration) measured at RFDS antenna port:	10 W, 25 W, 40 W
Normal Conditions:	+2.0 dB
Extreme Conditions:	+3.0/-4.0 dB
Transmitter Power (off/standby)	-36 dBm/-40 dBc
Frequency Stability	± 0.007 ppm **NOTICE:** Stability with site reference connected to station and locked to GPS.
Base Radio Power Limits	High Power BR: 5W - 80 W Low Power BR: 2W - 36W **NOTICE:** Base Radio Power Limits above are also applicable for 800 MHz. 260 MHz Low Power BR: 2W - 40 W

Transmitter Specification	Value or Range	
Transmitter Power Control	12 dB	
Carrier Feedthrough	-26 dBc	
Transmitter Modulation Accuracy	6% RMS/Burst	(30% peak/symbol)
Synchronization	1/4 symbol	
Adjacent-channel Power due to Modulation (Normal Conditions)	± 25 kHz ± 50 kHz ± 75 kHz	-60 dBc (800 MHz/ 900 MHz: -55 dBc) -70 dBc (800 MHz/ 900 MHz: -65 dBc) -70 dBc(800 MHz/ 900 MHz: -65 dBc)
Adjacent-channel Power due to Modulation (Extreme Conditions)	± 25 kHz ± 50 kHz ± 75 kHz	-50 dBc(800 MHz/ 900 MHz: -45 dBc) -60 dBc(800 MHz/ 900 MHz: -55 dBc) -60 dBc (800 MHz/ 900 MHz: -55 dBc)
Adjacent-channel Power due to Switching	-50 dBc	
Adjacent-channel Power due to Linearization	-30 dBc	
Tx Conducted Emission	100 - 250 kHz 250 - 500 kHz 500 - frb kHz At receive band	-80 dBc -85 dBc -90 dBc -100 dBc
Intermodulation Attenuation	70 dB	
RF Input Impedance	50 (nom.)	

Table 123: Transmit Specifications – TEDS

Transmitter Specification	Value or Range
QAM (TEDS) Transmitted Power (10, 20 Watts depending on the configuration) measured at RFDS antenna port:	10 W, 20 W
Normal Conditions:	+2.0 dB
Extreme Conditions:	+3.0/-4.0 dB
Transmitter Power (off/standby)	-36 dBm/-40 dBc
Frequency Stability	± 0.007 ppm **NOTICE:** Stability with site reference connected to station and locked to GPS.
Base Radio Power Limits	High Power TEDS BR: 2W - 32 W

Transmitter Specification	Value or Range	
	NOTICE: Base Radio Power Limits above are also applicable for 800 MHz.	
Transmitter Power Control	12 dB	
Transmitter Modulation Accuracy	10% RMS/Burst	
Synchronization	1/4 symbol	
Adjacent-channel power (25kHz)	**Offset**	**Limit**
	25	-55
	50	-65
	75	-67
Adjacent-channel power (50kHz)	**Offset**	**Limit**
	37.5	-55
	62.5	-63
	87.5	-65
Adjacent-channel Power due to Switching	-45 dBc	
Tx Conducted Emission (25kHz TEDS)	100 - 250 kHz	-70 dBc
	250 - 500 kHz	-80 dBc
	500 - 2500 kHz	-80 dBc
	2500 - frb kHz	-90 dBc
	>frb	-95 dBc
Tx Conducted Emission (50kHz TEDS)	112.5 - 262.5 kHz	-70 dBc
	262.5 - 500 kHz	-75 dBc
	500 - frb kHz	-80 dBc
	>frb	-95 dBc
Intermodulation Attenuation	70 dB	
RF Input Impedance	50 (nom.)	

14.3.5
Receiver Specifications

The receiver specifications are listed in Table 124: Receiver Specifications – TETRA on page 405 and Table 125: Receiver Specifications – TEDS on page 406.

All specifications listed in the following two tables are through the RF Distribution System, unless otherwise stated.

Table 124: Receiver Specifications – TETRA

Receiver Specification	Value or Range
Sensitivity (normal conditions, unprotected T1, static, 4% BER):	

Receiver Specification	Value or Range
population mean:	-120.0 dBm(-119.5 dBm 800 MHz)
spec limit:	-117.5 dBm
Sensitivity (normal conditions, faded, TU50, 4% BER):	
population mean :	-113.5 dBm(-113.5 dBm 800 MHz)
spec limit:	-111.0 dBm
Degradation (extreme conditions, static and faded)	3 dB
Nominal Error Rate (unprotected T1):	
Static, -85 to -40 dBm:	0.01%
Static -40 to -20 dBm:	0.1%
TU50, -84 to -40 dBm:	0.4%
Maximum On-channel Desired Power Level	-20 dBm
Co-channel Interference (19 dB C/I, faded, unprotected T1): TU50	2.0%
Adjacent Channel Interference (faded, unprotected T1, normal conditions, 45 dB C/I (40 dB C/I for 800 MHz), at -103 dBm): TU50	2.0%
Adjacent Channel Interference (faded, unprotected T1, extreme conditions, 35 dB C/I (30 dB C/I for 800 MHz)), at -97 dBm): TU50	2.0%
Blocking (static, normal conditions, 4% BER):	
50 - 100 kHz	-40 dBm
100 - 200 kHz	-35 dBm
200 - 500 kHz	-30 dBm
>500 kHz	-25 dBm
Spurious Responses (normal conditions)	6 max.
1st Image	70 dB
1/2 IF	70 dB
2nd Image	70 dB
1/2 2nd IF	70 dB
Intermodulation Response Rejection: Normal conditions	65 dB

Table 125: Receiver Specifications – TEDS

Receiver Specification	Value or Range
Degradation (extreme conditions, static and faded)	3 dB
Maximum On-channel Desired Power Level	-30 dBm
Co-channel Interference (19dB C/I, faded, 16QAM, rate=1/2) TU50:	10.0%
Adjacent Channel Interference (static, 64QAM, 50kHz, 30dB C/I at -97dBm, rate = 1/1) Applicable for both normal and extreme conditions.	3.0%
Blocking 25kHz TEDS (static, normal conditions, 3% BER):	

Receiver Specification	Value or Range
75 kHz	-40 dBm
150 kHz	-35 dBm
350 kHz	-30 dBm
1, 2, 5, 10 MHz	-25 dBm
Blocking 50 kHz TEDS (static, normal conditions, 3% BER):	
150 kHz	-40 dBm
350 kHz	-35 dBm
700 kHz	-30 dBm
2, 5, 10 MHz	-25 dBm
Spurious Responses (normal conds, QAM4, 25k, static, rate=1/1)	
1st Image	68 dB
1/2 IF	68 dB
2nd Image	68 dB
1/2 2nd IF	68 dB
Intermodulation Response Rejection (normal conds, QAM4, 25kHz, static, rate = 1/1)	66 dB

14.3.6
Site Controller Specifications

Table 126: Site Controller Performance Specifications

Site Controller Specification	Value or Range
Power Consumption	20–25 W
Dimension	Height: 240 mm Width: 61 mm Depth: 393 mm
Weight	2.3 kg
Memory	DDRSDRAM: one removable, single-bank, 128 Mbyte module, 64-bit wide, 266 MHz data-rate, JEDEC-standard, 200-pin, PC2100, unbuffered, CAS latency 2.5, SO-DIMM.
	Boot Flash: a single, 16-bit wide sectored Flash device

14.3.7
Internal GPS Module Input Specifications

Table 127: Internal GPS Input Specifications

Internal GPS Input specifications	Description
Sensitivity	TTFF (Time to First Fix) = 120 s @ -133 dBm
Max input power level	-40 dBm
GPS antenna bias voltage	+5.0 V
Maximum output current	30 mA

14.3.8
MTS LiTE / MTS 2 Duplexer Specifications

Table 128: MTS LiTE / MTS 2 Duplexer Specifications

MTS 2 Duplexer Specifications	Description
Dimensions	Height: 170 mm Width: 70 mm Depth: 280 mm
Weight	5.3 kg
Forward Reverse Power Measurement Accuracy	+1.0/-1.2 dB

14.3.9
MTS LiTE / MTS 2 Preselector Specifications

Table 129: MTS LiTE / MTS 2 Preselector Specifications

MTS 2 Preselector Specifications	Description
Dimensions	Height: 85 mm Width: 70 mm Depth: 280 mm
Weight	2.8 kg

14.3.10
MTS 4 Duplexer Specifications

Table 130: MTS 4 Duplexer Specifications

MTS 4 Duplexer Specifications	Description
Dimensions	Height: 180 mm Width: 90 mm

MTS 4 Duplexer Specifications	Description
	Depth: 400 mm
Weight	7.6 kg
Forward Reverse Power Measurement Accuracy	±0.5 dB

14.3.11
MTS 4 Post Filter Specifications

Table 131: MTS 4 Post Filter Specifications

MTS 4 Post Filter Specifications	Description
Dimensions	Height: 100 mm Width: 167 mm Depth: 200 mm
Weight	5 kg
Forward Reverse Power Measurement Accuracy	±0.5 dB
TX signal	PI/4DQPSK, up to 4 carriers
Avg. Input Power	180 W

14.3.12
MTS 4 Preselector Specifications

Table 132: MTS 4 Preselector Specifications

MTS 4 Preselector Specifications	Description
Dimensions	Height: 90 mm Width: 180 mm Depth: 200 mm
Weight	3.6 kg

14.3.13
Auto Tune Cavity Combiner (ATCC) Specifications

Table 133: Auto Tune Cavity Combiner (ATCC) Specifications

Auto Tune Cavity Combiner (ATCC) Specifications	Description
Dimensions	Height: 173 mm Width: 447 mm Depth: 435 mm
Weight	12.2 kg

Auto Tune Cavity Combiner (ATCC) Specifications	Description
Vendor Default Settings	150 kHz channel spacing Fine-tune interval 8 hours

14.3.14
Manual Tune Cavity Combiner (MTCC) Specifications

Table 134: Manual Tune Cavity Combiner (MTCC) Specifications

Manual Tune Cavity Combiner (MTCC) Specifications	Description
Dimensions	Height: 173 mm Width: 447 mm Depth: 435 mm
Weight	11.3 kg

14.3.15
Hybrid Combiner Specifications

Table 135: Hybrid Combiner Specifications

Hybrid Combiner Specifications	Description
Dimensions	Height: 170 mm Width: 55 mm Depth: 255 mm
Weight	2.1 kg
Carrier combine power	2x35 W without fans 2x80 W with fans

14.3.16
Base Radio Specifications

Table 136: Base Radio Specifications

BR Specification	Description
Dimensions	Height: 240 mm Width: 124 mm Depth: 393 mm
Weight	8.9 kg

14.3.17
Power Supply Unit Specifications

Table 137: Power Supply Specifications

PSU Specifications	Description
Technical Requirements	Input Voltage DC: -41 to -60 VDC Input Voltage AC: 90 to 264 VAC; The PSU shall withstand 300 VAC Input Frequency AC: 45 to 66 Hz
	Output Voltage 1: 28.5 VDC 2% Output Current 1: 20 A
	Output Voltage 2: 7.0 VDC +5 -0% Output Current 2: 8 A
	Output Voltage ATCC: 28.5 VDC ±5% Output Current ATCC: 400 mA, 1000 mA peak for less than 3 ms
	Output Voltage Fan: 12–24 VDC ±5% Output Current Fan: 3 A (1 A for each output)
	Battery Charging Output Voltage 3: 40.5–57 VDC Output Current 3: 0–6 A (temperature dependent) Ripple and Noise at full load: ≤ 100 mVpp [20 MHz bandwidth]
	Total Output Power: 1035 W
	Efficiency: ≥ 84% @ 184 VAC to 270 VAC ≥ 80% @ 90 VAC to 184 VAC ≥ 88% @ –48 VDC ≥ 86% @ –40,5 VDC
	Hold up time, at AC mains dropout: 15 ms Hold up time, at 48 VDC input dropout: 2 ms @ 48 VDC operation, full load and +30 °C Minimum current when power supply switch is turned off: 2 mA
Safety	EN 60950-1/2001, UL 1950, CSA 22.2 No. 950, protection class 1, DC outputs designed as Safety Extra Low Voltage CE marked, designed to meet CB certification and cULus requirements
EMC	Immunity: EN 55024/1998 + A1/2001 EN 61000-4-3, EN 61000-4-2, EN 61000-4-6, EN 61000-4-5, EN 61000-4-4, EN 61000-4-11
	Emission: EN 55022 class A EN 61000-3-3, EN 61000-3-2
Dimensions	Height: 240 mm Width: 97 mm Depth: 391 mm

PSU Specifications	Description
Weight	5 kg

14.3.18
XHUB Controller Specifications

The following table lists the XHUB controller performance specifications.

Table 138: XHUB Controller Specifications

XHUB Controller Specification	Value or Range
Power Consumption	5 W to 8 W
Dimension	Height: 240 mm Width: 61 mm Depth: 393 mm
Weight	2.2 kg

14.3.19
RX Splitter Specifications

The following table lists the RX Splitter specifications.

Table 139: MTS 4 Expansion Cabinet RX Splitter Specifications

RX Splitter Specification	Value or Range
Dimension	Height: 139 mm Width: 124 mm Depth: 45 mm
Weight	0.4 kg

14.3.20
MTS LiTE, MTS 2, and MTS 4 Connectors

Table 140: MTS LiTE/MTS 2 Connectors

Connector	Type	Description
External GPS	SUB D	DB15 Female connector
Alarms	SUB D	DB25 Female connector
E1	RJ45	Functionality described in Hardware installation chapter
X.21	SUB D	DB15 Male connector Functionality described in Hardware installation chapter

Connector	Type	Description
Ethernet	RJ45	Functionality described in Hardware installation chapter
Internal GPS	N type	Female connector
Mains input	IEC 320	230 V Supply
DC	-48 VDC	2 pin Phoenix connector
Antennas	DIN 7–16	Female connector

Table 141: MTS 4 Connectors

Connector	Type	Description
External GPS1 and GPS2	SUB D	DB15 Female connector
Alarms	SUB D	DB25 Female connector
E1	RJ45	Functionality described in Hardware installation chapter
X.21	SUB D	DB15 Male connector
Ethernet	RJ45	Functionality described in Hardware installation chapter
Internal GPS	N type	Female connector
Mains input	IEC 320	230 V Supply
DC	-48 VDC	4 pin Phoenix connector
Antennas	DIN 7–16	Female connector

Chapter 15

Expansion Options

Expansion options can be ordered from Motorola Solutions. To order an expansion option, see the Ordering Guide on ECAT.

15.1

Additional Base Radio for MTS 2

It is possible to complement MTS 2 (with one Base Radio) with additional Base Radio.

NOTICE: The second Base Radio for MTS 2 is delivered with the expansion kit that includes required equipment and cables.

15.1.1
Cable Connections

Cable connections before expansion

Figure 194: RF Cabling Diagram for MTS 2 with one TX/RX ant. and up to two additional RX ant. before Expansion

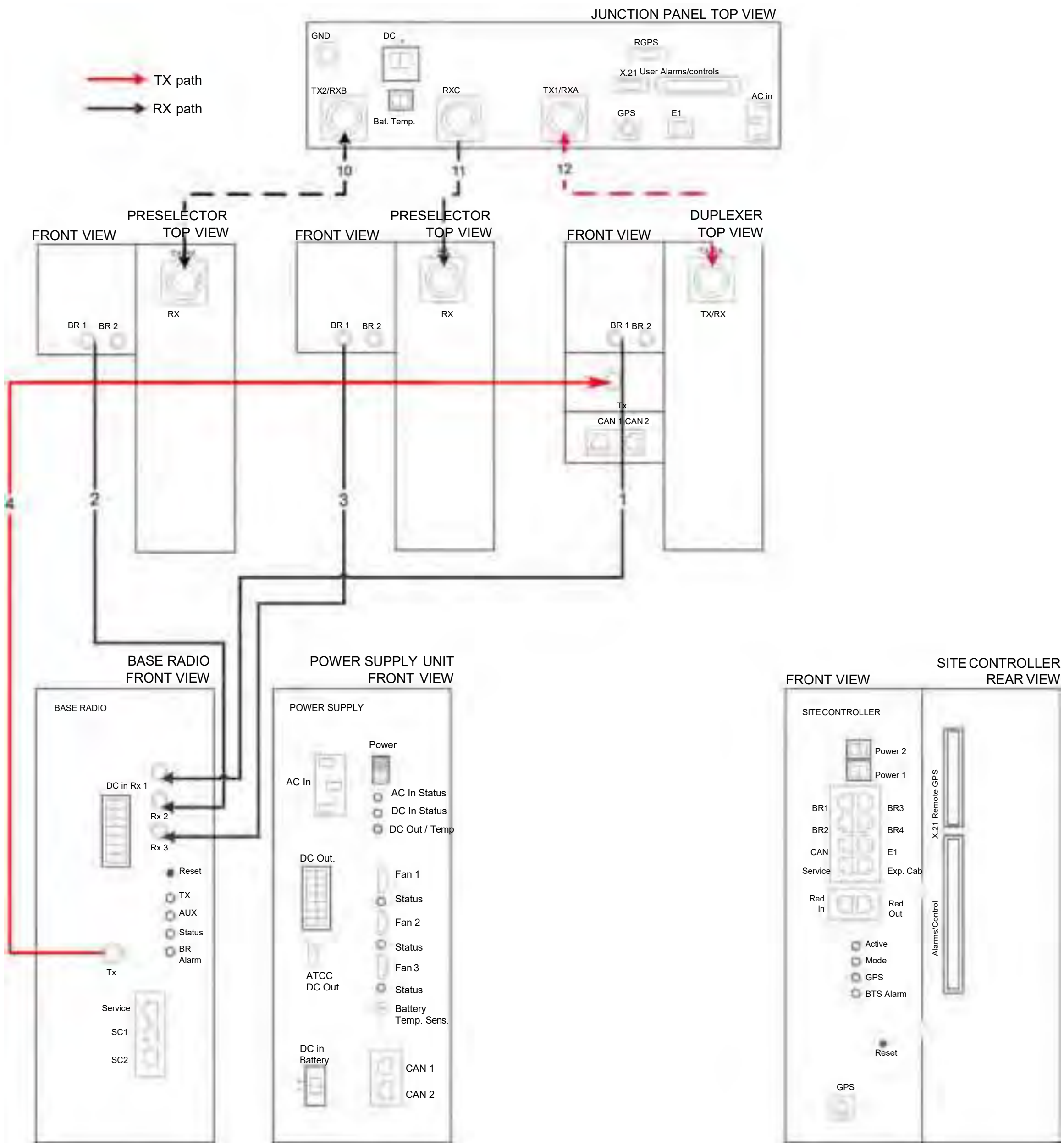
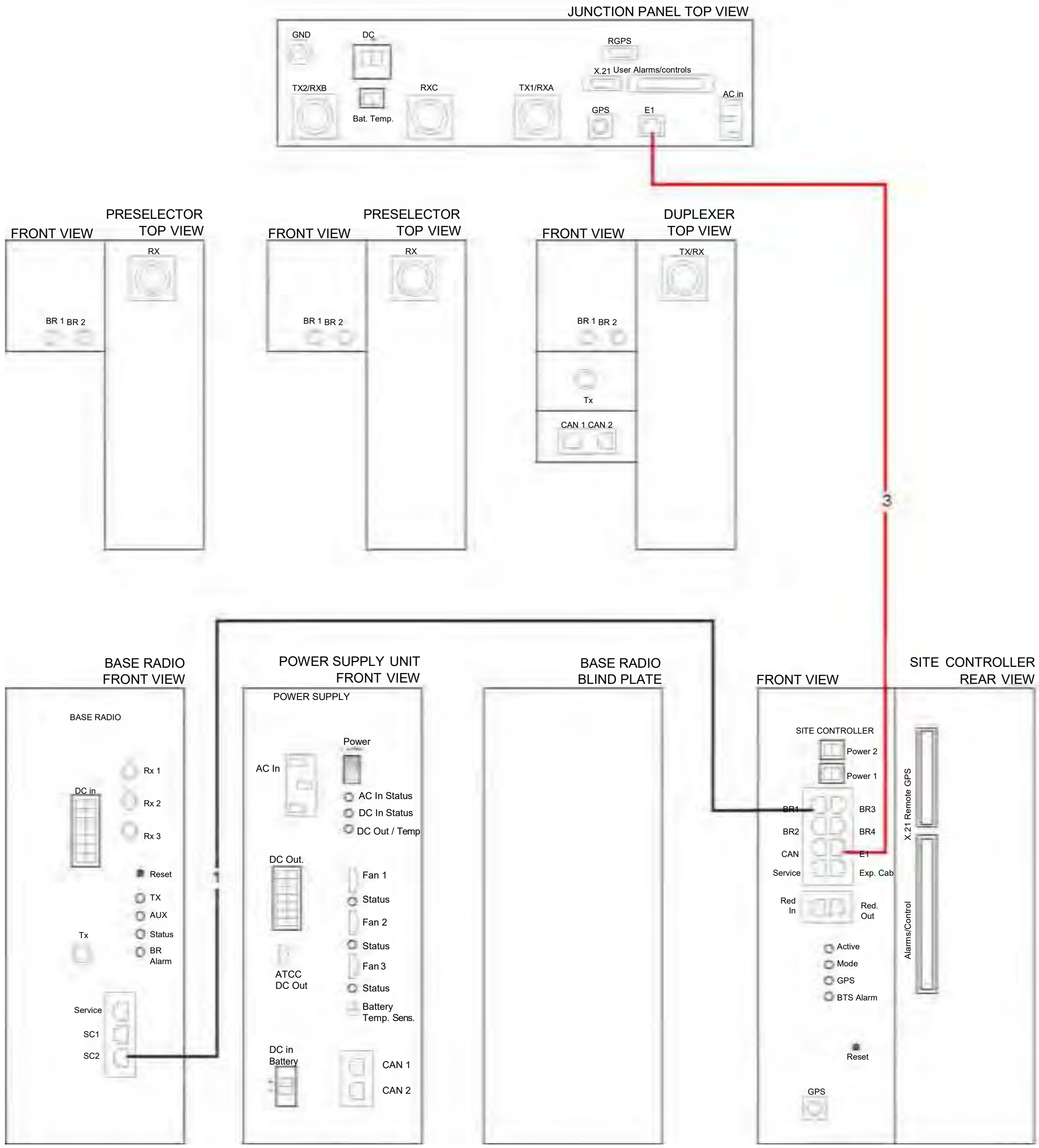
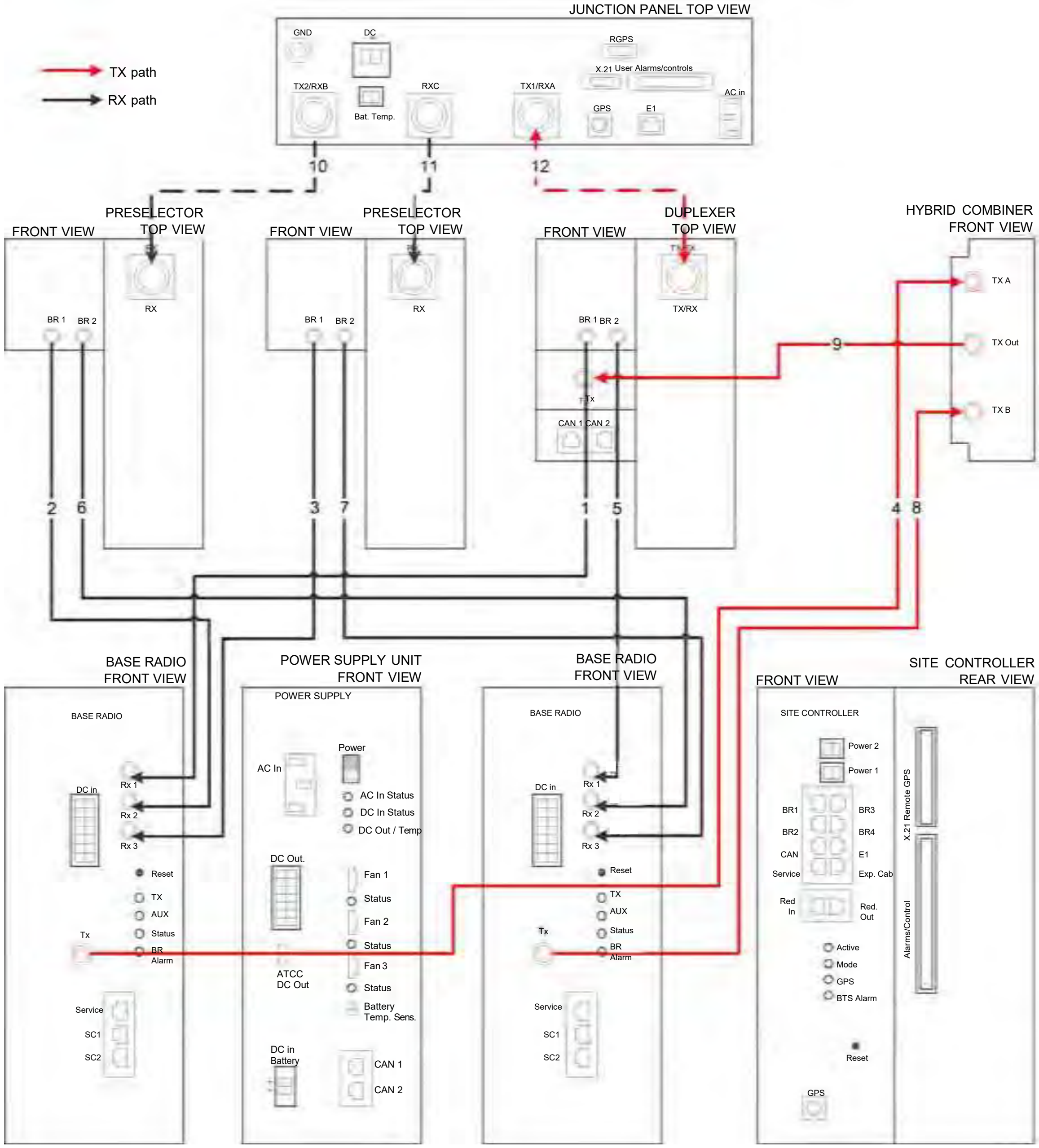


Figure 195: E1 and Ethernet Cabling Diagram for MTS 2 before Expansion



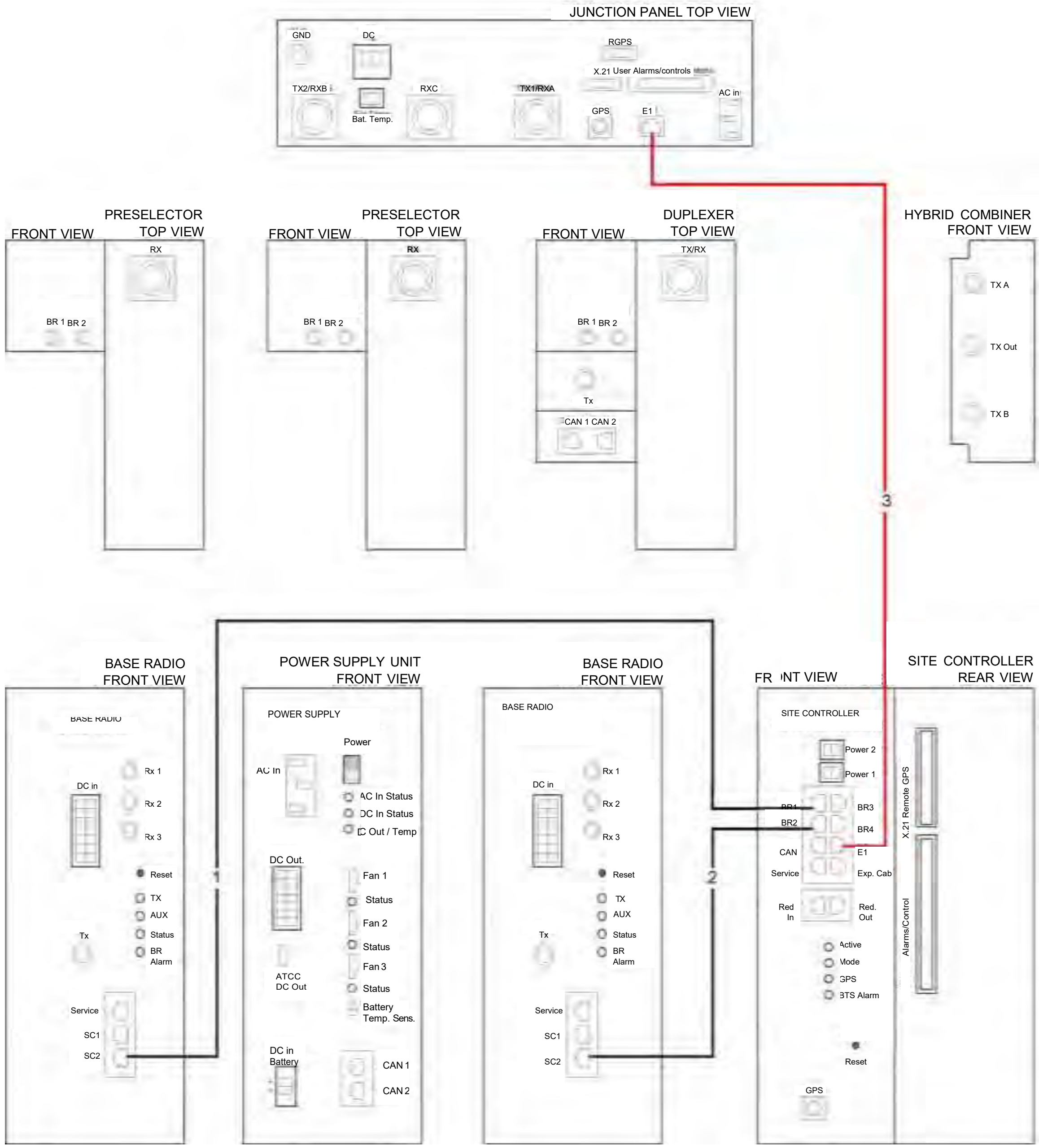
Cable connections after expansion

Figure 196: RF Cabling Diagram for MTS 2 with one TX/RX ant. and up to two RX ant. after Expansion



NOTICE: For non-duplexed RF/TX, please see Figure 110: RF Cabling/Connections for MTS 2 with One TX ant. and up to Two Additional RX ant. on page 183.

Figure 197: E1 and Ethernet Cabling Diagram for MTS 2 after Expansion



15.1.2 Adding an Additional Base Radio to MTS 2

When and where to use:

Follow this process install the second Base Radio to the MTS 2 cabinet.

Process:

1. Installing an Additional Base Radio to MTS 2 on page 419
2. Installing the Hybrid Combiner on page 420
3. Configuring and Verifying the Base Radio on page 234

15.1.2.1
Installing an Additional Base Radio to MTS 2

Procedure:

1 Remove the Blind Plate where the additional Base Radio is to be assembled.
2 Label all new Rx cables with labels included in the expansion kit.
3 Attach the Rx cables to the filters. Connect them according to the scheme below:

#	Part no	Cable type	Label	From	To
5	3066543B01	Rx cable	Rx1	Filter pos 1 / BR2	BR2 / Rx1
6	3066543B01	Rx cable	Rx2	Filter pos 2 / BR2	BR2 / Rx2
7	3066543B01	Rx cable	Rx3	Filter pos 3 / BR2	BR2 / Rx3

NOTICE: Index numbers in table above refer to cable connections shown in Figure 196: RF Cabling Diagram for MTS 2 with one TX/RX ant. and up to two RX ant. after Expansion on page 417.

NOTICE: At this stage only connect the cables to the filters.

4 Attach the Tx-cable to the **Tx** input of the filter in position 2.

NOTICE: At this stage only connect the cable to the filter.

5 Attach the Ethernet cable 3066544B02 to the **BR2** connector on the Site Controller. This is illustrated in Figure 197: E1 and Ethernet Cabling Diagram for MTS 2 after Expansion on page 418 as connection #2.

NOTICE: At this stage only connect the cable to the Site Controller. Follow the color scheme displayed on the Site Controller front panel.

6 Insert the additional Base Radio by aligning the side rails with the appropriate rail guides inside the Base Radio chassis.
7 Gently push the additional module completely into the Base Radio chassis assembly using the module handle.

CAUTION: Be careful not to damage any of the cables previously connected when pushing the Base Radio into position.

8 Secure the additional module using two TORX screws. Tighten the screws to a torque of 2.7 Nm.
9 Connect the Power cables, Ethernet cable, Tx cable and Rx Cables to the BR front plate. Make sure cables are connected according to scheme below:

#	Part number	Cable type	Label	From	To
N/A	3066545B01	DC Power Cable	N/A	PSU / DC Out	BR1 / DC IN
					BR2 / DC In
					SC1 / Power
5	3066543B01	Rx Cable	Rx1	Filter pos 1 / BR2	BR2 / Rx1
6			Rx2	Filter pos 2 / BR2	BR2 / Rx2

7			Rx3	Filter pos 3 / BR2	BR2 / Rx3
N/A	3066543B05	Tx Cable	N/A	Filter pos 2 / Tx	BR2 / Tx
2 in **A)**	3066545B02	Ethernet	N/A	SC1 / BR2	BR2 / SC1

NOTICE: Index numbers in table above refer to cable connections shown in Figure 196: RF Cabling Diagram for MTS 2 with one TX/RX ant. and up to two RX ant. after Expansion on page 417 or in Figure 197: E1 and Ethernet Cabling Diagram for MTS 2 after Expansion on page 418 for **A)**.

NOTICE: DC Power Cable (3066545B01) already exists before expansion of MTS 2.

10 Switch ON the Power Supply Unit (You do not need to do this if doing a hotswap).

15.1.2.2
Installing the Hybrid Combiner

If current MTS 2 configuration include one Duplexer, installation of the Hybrid Combiner also included in the expansion option is necessary.

NOTICE: If current MTS 2 configuration includes two Duplexers, installation of the Hybrid Combiner is not needed.

Procedure:

1. Switch OFF the Power Supply Unit.
2. On the Duplexer, unplug the TX cable connected to the first Base Radio.
3. Assemble the Bracket with the three M6x10 screws.
4. Fasten the two M4x10 screws that are to hold the Hybrid Combiner, but do not tighten them fully.
5. Place the Hybrid Combiner on the bracket of the cabinet, with the heat sing facing inwards toward the center of the cabinet.
6. Slide the Hybrid Combiner at an angle ensuring that the lip at the back of the Hybrid Combiner is secured behind the bracket.
7. Tighten the two M4x10 screws to the bracket.
8. Attach the TX cables according to the scheme below:

#	Part number	From	To	Notes
4	3066543B12	BR1 / TX	Hybrid Combiner / TX A	Existing cable previously unplugged from the Duplexer
8	3066543B05	BR2 / TX	Hybrid Combiner / TX B	
9	3066543B06	Hybrid Combiner / TX Out	Duplexer / TX	

NOTICE: Index numbers in table above refer to cable connections shown in Figure 196: RF Cabling Diagram for MTS 2 with one TX/RX ant. and up to two RX ant. after Expansion on page 417.

9. Switch ON the Power Supply Unit.

15.1.3
Configuration

When the additional Base Radio has been installed properly it needs to be configured and verified. In order to do so, follow Configuring and Verifying the Base Radio on page 234.

In addition to this, the following parameters need to be configured in TESS application:

- Factory password
- Field password
- Cabinet ID
- Position ID
- Carrier Number (TX/RX frequencies are auto-generated based on Carrier Number setting)
- Default TX Power level

NOTICE: When these parameters have been configured in TESS Application and after the modified configuration file has been uploaded to the Site Controller, the complete site needs to be reset to implement the configuration change.

15.2
Additional Module Cage for MTS 4

It is possible to complement MTS 4 with additional module cage.

NOTICE: The module cage for MTS 4 is delivered with the expansion kit that includes required equipment and cables.

15.2.1
Adding an Additional Module Cage to MTS 4

Follow the procedure below to add a second module cage to the MTS 4 cabinet.

Procedure:

1. Remove the Module Cage Beauty Plate.
2. Mount all cables going from the lower Module Cage in your specific configuration and fix them temporarily in the rack before mounting the air divider and module cage.

   NOTICE: This would typically be:

   - Ethernet cables from Base Radio(s) in lower Module Cage to SC in upper Module Cage (SC2).
   - Ethernet cables from Base Radio(s) in upper Module Cage to SC in lower Module Cage (SC1).
   - CAN Bus cables to and from Filters.
3. Connect the Rx cables to the filters and let them hang on the back side behind Cavity Combiners that may exist in configuration.
4. Connect the AC Power cable (3066553B01), the DC Power cable (3066553B01) and the Battery Sensor cable (3066556B02) to the adequate connectors on the Junction Panel and let them hang on the back side behind Cavity Combiners that may exist in configuration.
5. Catch Rx cables, AC Power cable, DC Power cable and Battery Sensor cable in the empty space where new module cage is to be assembled and temporarily fix them at the front.

6 Assemble the Air Separator shelf above the existing Module Cage. Use four M6x16 screws included in the expansion kit.

7 Assemble the new Module Cage on top of the Air Separator shelf. Use eight M6x16 screws included in the expansion kit.

NOTICE: You may have to temporarily remove the fans in order to fasten the screws.

8 If applicable, remove the Power Supply Unit Blind Plate.

NOTICE: If Power Supply Unit has been pre-assembled in your configuration, jump directly to Step 8.

9 Place the Power Supply Unit on the slide rails in the Module Cage and push it to the back.

10 Secure the Power Supply Unit to the Module Cage with the two M4x10 Torx screws and lock the washers.

11 Connect the power supply cables and optional backup battery cables according to the scheme below:

Part no	Cable type	From	To
3066551B01	DC Power Cable	Junction panel / DC2	PSU2 / DC In
3066553B01	AC Power Cable	Junction panel / AC In 2	PSU2 / AC In
3066556B02	Batt Sens cable	Junction panel / Bat Temp 2	PSU2 / Battery Temp. Sens.
3066545B01	DC Power Cable	BR3 / DC In	PSU2 / DC Out
		BR4 / DC In	
		Site Controller / Power	

NOTICE: If Base Radio being added is the second Base Radio in a Module Cage (BR2 or BR4), DC Power Cable (3066545B01) is already existing in configuration.

12 Connect the RJ45 cable according to the scheme below:

Part no	Cable type	From	To
3066544B06	RJ45 Cable	PSU2 / CAN1	CAN socket where terminator is situated (terminator to be removed and replaced by the cable instead). Could be on a filter or ATCC. In case of no redundant Site Controller, the terminator should be placed in PSU 2/ CAN 2 output.

13 Switch ON the Power Supply Unit.

14 Check the LED indicators to verify the PSU is operating correctly.

15.2.2
Configuration

No configuration in itself is needed for the module cage, but the Power Supply Unit needs to be configured and this is described in Updating the Mapping List with the New PSU TrackID on page 337.

Installation and configuration of additional Base Radios are described separately in Additional Base Radio for Existing Module Cage in MTS 4 on page 423.

Furthermore, if an additional Site Controller is ordered as a separate expansion kit, it needs to be installed and configured, see Redundant Site Controller on page 431.

15.3
Additional Base Radio for Existing Module Cage in MTS 4

It is possible to add a Base Radio into an existing module cage of the MTS 4.

NOTICE: The additional Base Radio is delivered with the expansion kit that includes required equipment and cables.

15.3.1 Cable Connections

Cable Connections Before Expansion

Figure 198: RF Cabling of MTS 4 with one TX ant. Before Expansion

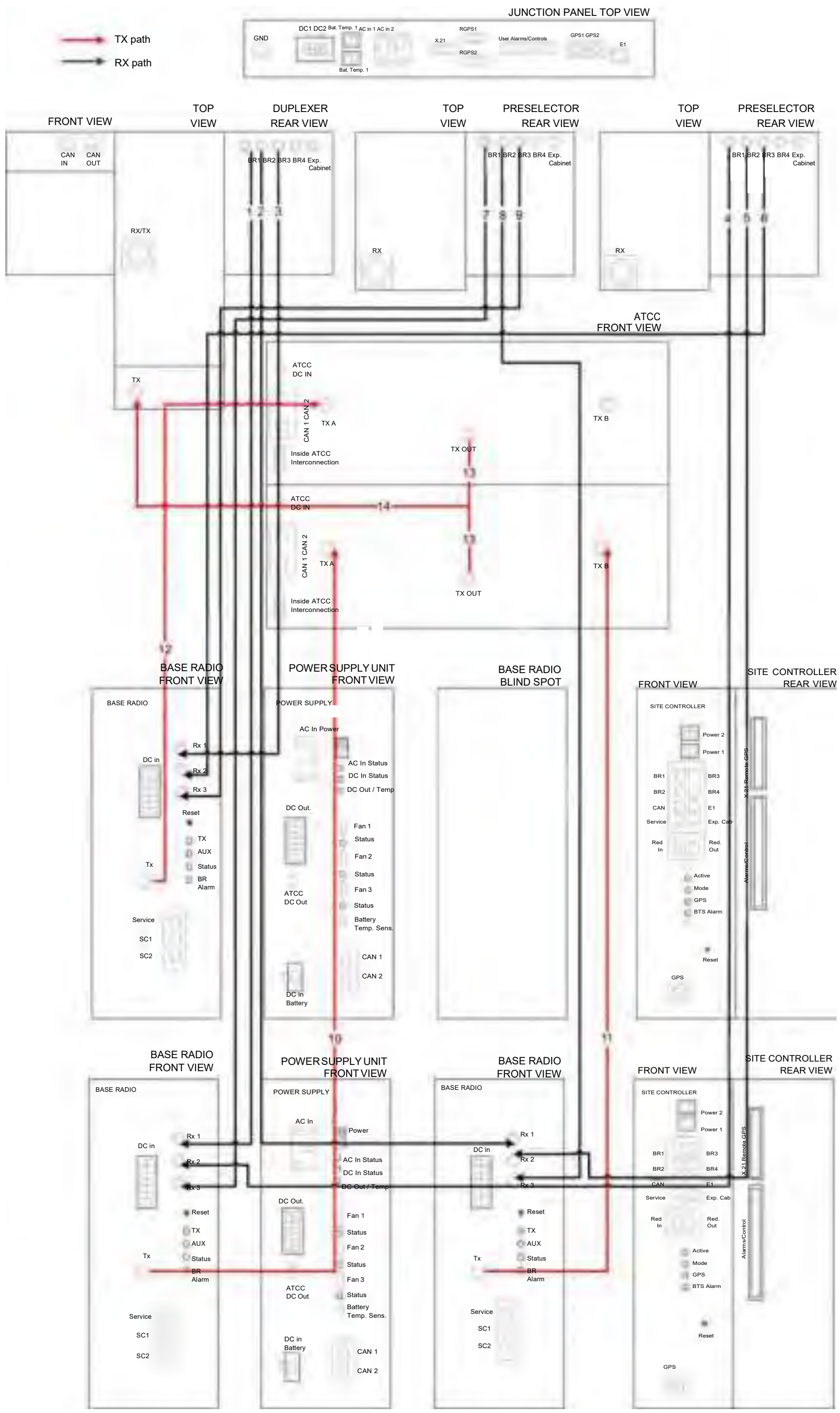


Figure 199: RF Cabling of MTS 4 with two TX ant. Before Expansion

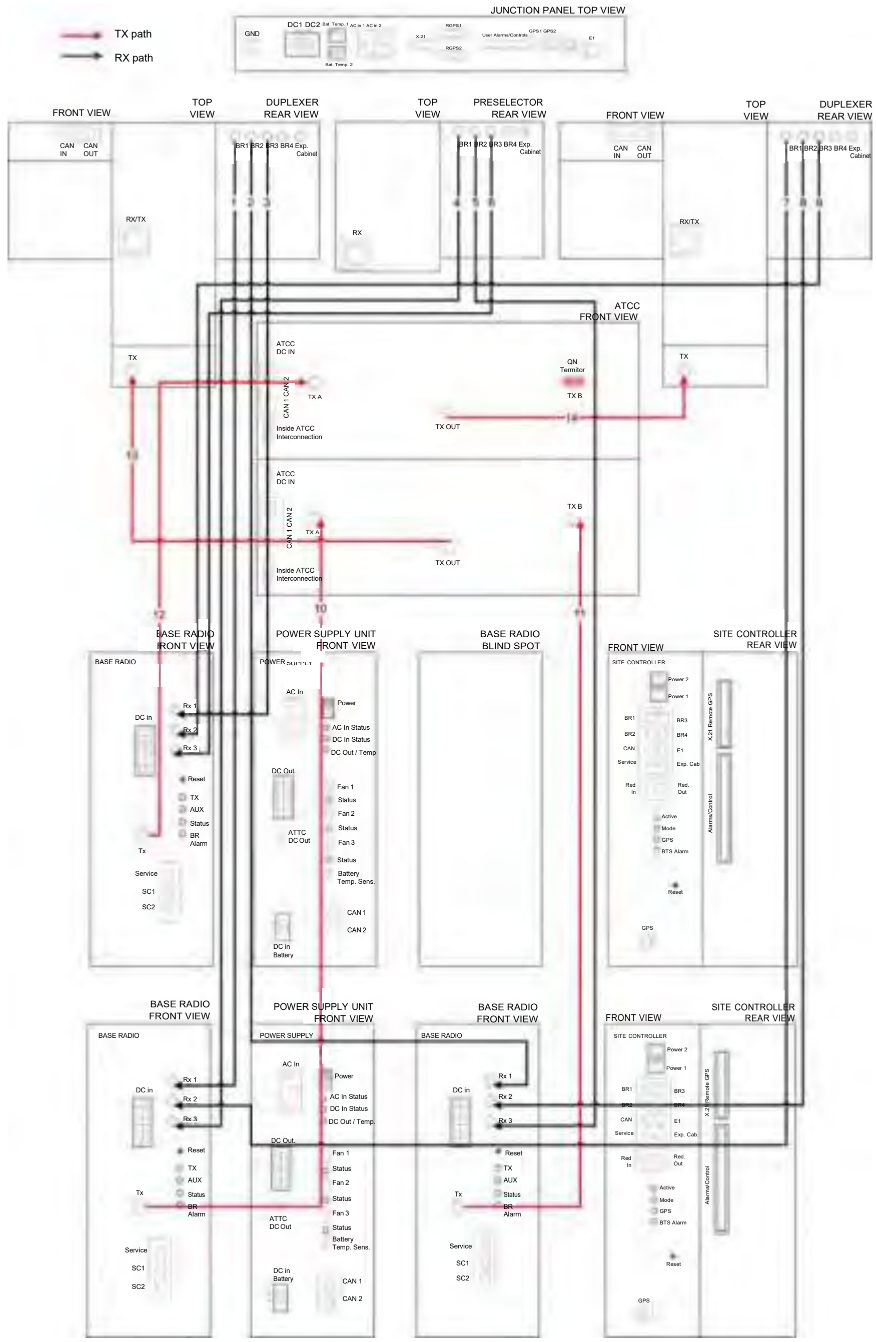
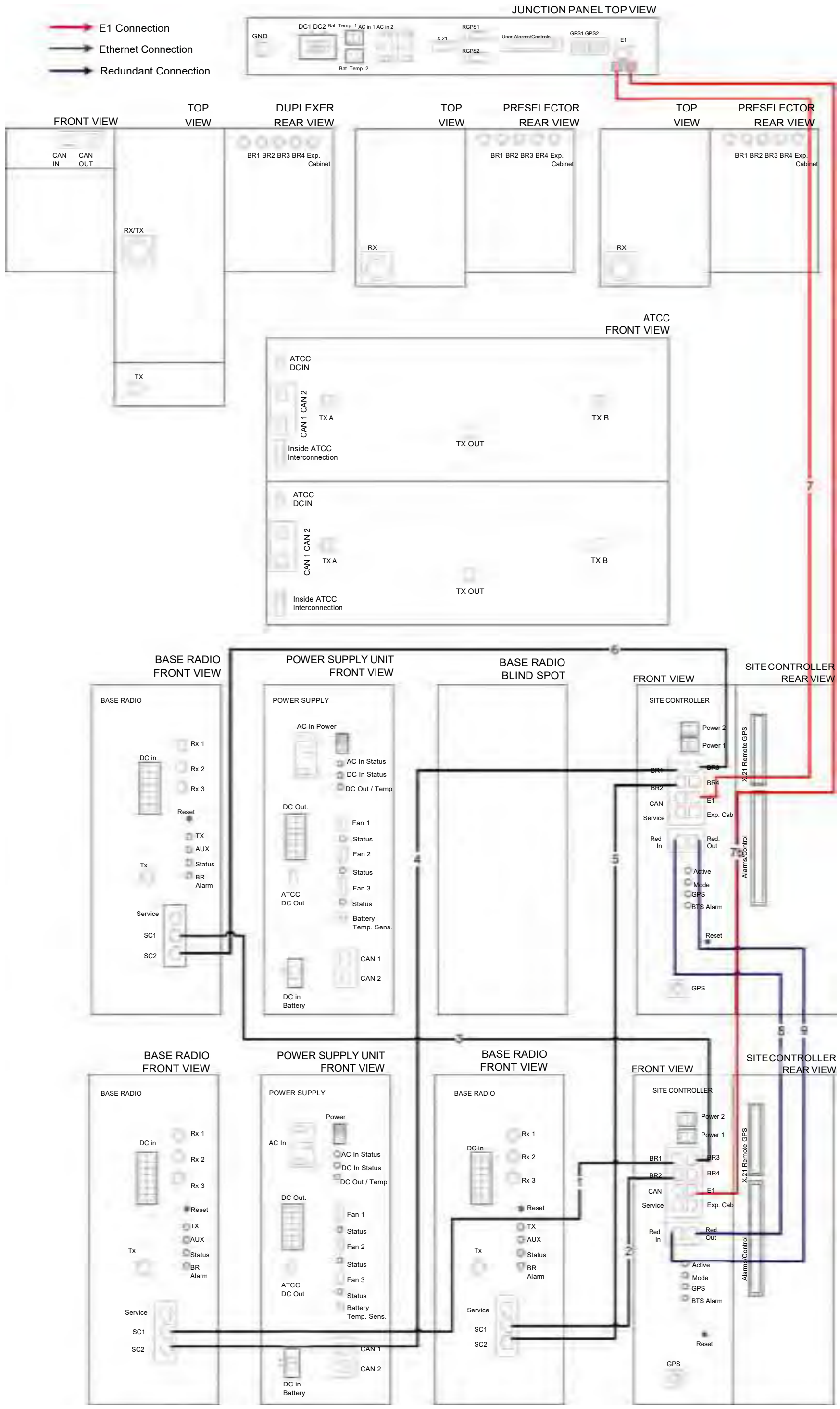
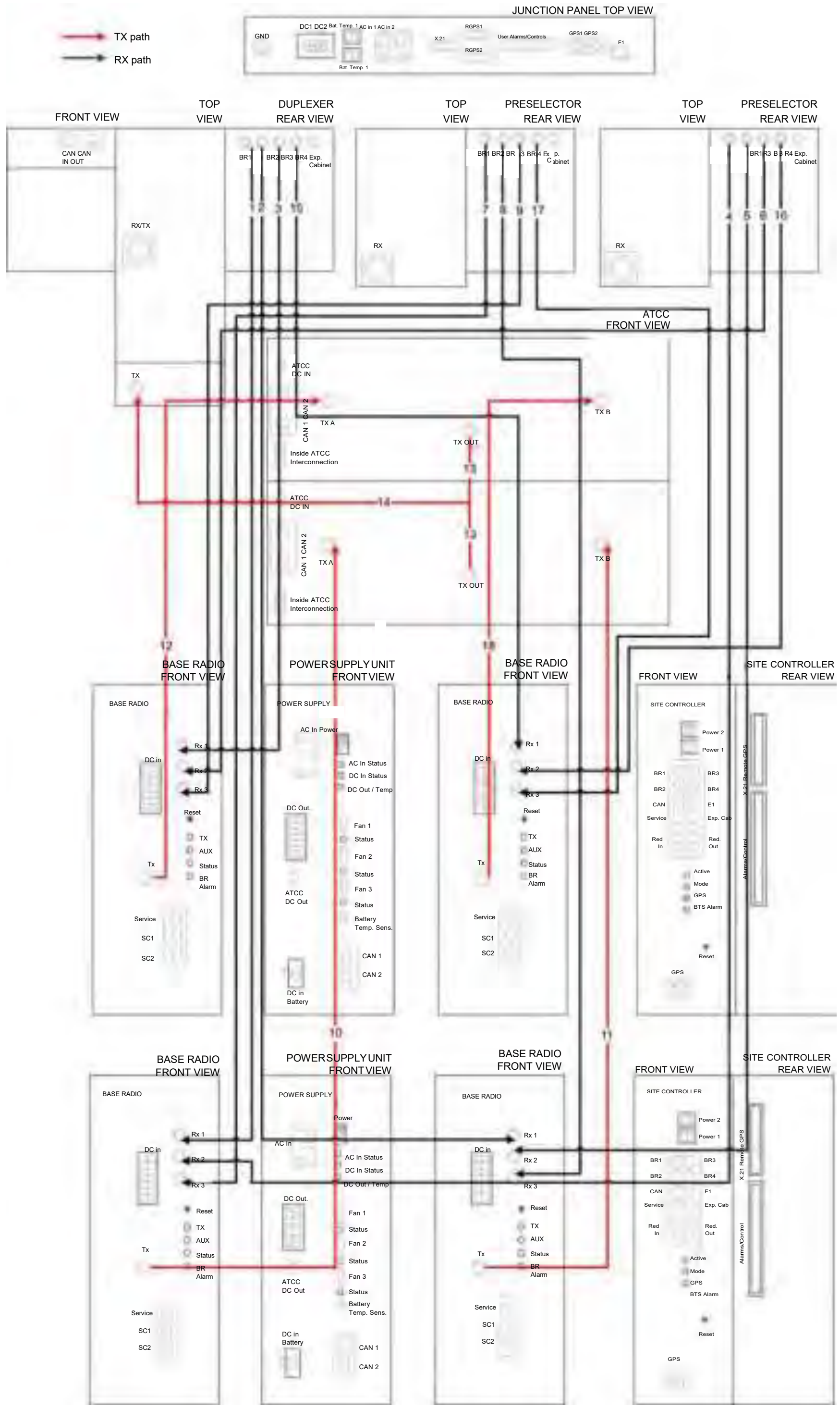


Figure 200: E1 and Ethernet Connections of MTS 4 Before Expansion



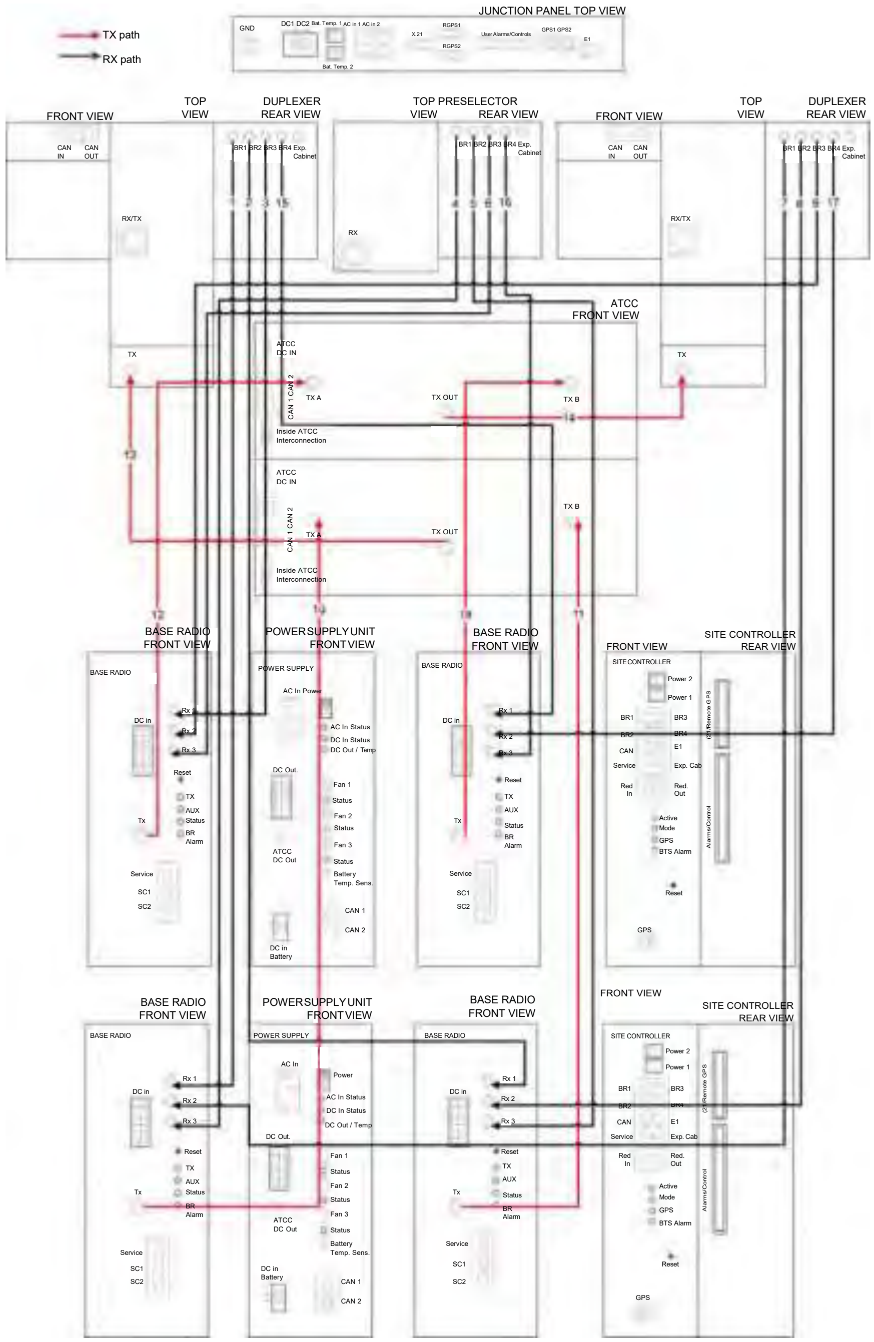
Cable Connections After Expansion

Figure 201: RF Cabling Diagram of MTS 4 with One TX ant. After Expansion



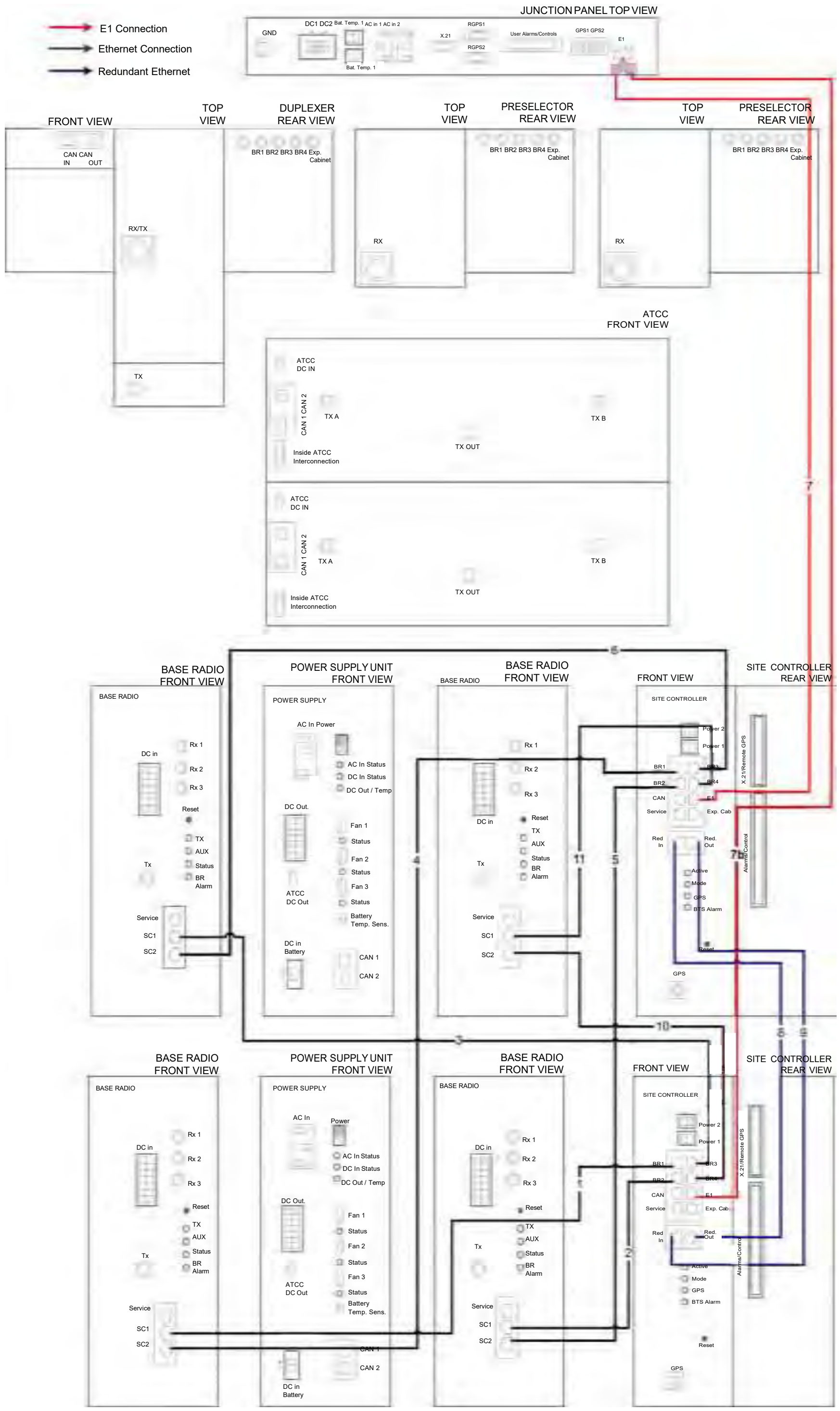
NOTICE: Cables 15, 16, 17, and 18 in Figure 201: RF Cabling Diagram of MTS 4 with One TX ant. After Expansion on page 427 have been added during expansion.

Figure 202: RF Cabling Diagram of MTS 4 with two TX ant. After Expansion



NOTICE: Cables 15, 16, 17, and 18 in Figure 202: RF Cabling Diagram of MTS 4 with two TX ant. After Expansion on page 428 have been added during expansion.

Figure 203: E1 and Ethernet Cabling of MTS 4 After Expansion



NOTICE: Cables 10 and 11 in Figure 203: E1 and Ethernet Cabling of MTS 4 After Expansion on page 429 have been added during expansion.

15.3.2 Adding an Additional Base Radio to MTS 4

Follow the procedure below to install an additional Base radio for MTS 4. The images below illustrate cable connections before adding a third Base Radio to the configuration.

Procedure:

1. Remove the Blind Plate where the additional Base Radio is to be added.
2. Label all Rx cables with labels included in the expansion kit.
3. Attach the Rx cables to the filters. Connect them according to the scheme below:

#	Part no	Cable type	Label	From	To
15	3066543B02	RX cable	Rx1	Filter 1 / BR#	BR# / Rx1
16			Rx2	Filter 2/ BR#	BR# / Rx2
17			Rx3	Filter 3/ BR#	BR# / Rx3

NOTICE: If Base Radio to be added is BR2, replace BR# with BR2 i table above, and so on.

NOTICE: Index numbers in table above refer to cable connections shown in Cable Connections.

NOTICE: At this stage only connect the cables to the filters.

4. Attach the Tx cable to the Tx input of the Cavity Combiner according to the scheme below:

#	Note	Part no	Cable type	From	To
11	If BR2	3066543B08	Tx cable	CC1 / TxB	BR2 / Tx
12	If BR3	3066543B08	Tx cable	CC2 / TxA	BR3 / Tx
18	If BR4	3066543B08	Tx cable	CC2 / TxB	BR4 / Tx

NOTICE: Index numbers in table above refer to cable connections shown in Cable Connections.

NOTICE: At this stage only connect the cable to the Cavity Combiner (ATCC or MTCC).

5. Attach the Ethernet cable to the appropriate BR input of the Site Controller according to the scheme below:

#	Note	Part no	Cable type	From	To
2	If BR2	3066544B02	Ethernet cable	BR2 / SC1	SC1 / BR2
6	If BR3	3066544B04	Ethernet cable	BR3 / SC1	SC1 / BR3
11	If BR4	3066544B05	Ethernet cable	BR4 / SC1	SC1 / BR4

NOTICE: Index numbers in table above refer to cable connections shown in Cable Connections.

NOTICE: At this stage only connect the cable to the Site Controller.

NOTICE: If the Ethernet cable is being wired from a Base Radio in one Module Cage to a Site Controller in another Module Cage, the Ethernet cable is to be drawn outside of the Module Cage.

6 Insert the additional Base Radio by aligning the side rails with the appropriate rail guides inside the Base Radio chassis.
7 Gently push the additional module completely into the Base Radio chassis assembly using the module handle(s). Be careful not to damage any of the cables previously connected when pushing the Base Radio into position.
8 Secure the additional module using two TORX screws. Tighten the screws to a torque of 2.7 Nm.
9 Connect the Power cables, Ethernet cable, Tx cable and Rx cables to the BR front plate.

NOTICE: If single or dual diversity, use QMA terminator (2866544A01) in unused Rx connectors on Base Radio(s).

10 Switch ON the Power Supply Unit. You do not need to do this if doing a hotswap.

15.3.3
Configuration

Basic configuration of base radios is needed when additional base radio(s) has been added to the MTS 4 cabinet. This is described in Configuring and Verifying the Base Radio on page 234.

NOTICE:
Base radios in the second Module Cage should be configured with ***<cabinet>*:*<position>*** set as `1:3` and `1:4`.

NOTICE: For configurations with Manual Tuned Cavity Combiner(s), the MTCC needs to be tuned after adding additional Base Radio.

In addition to this, the following parameters need to be configured in TESS application:

- Factory password
- Field password
- Cabinet ID
- Position ID
- Carrier Number (TX/RX frequencies are auto-generated based on Carrier Number setting)
- Default TX Power level

NOTICE: When these parameters have been configured in TESS Application and after the modified configuration file has been uploaded to the Site Controller, the complete site needs to be reset to implement the configuration change.

15.4
Redundant Site Controller

It is possible to add an additional (redundant) Site Controller to MTS 4. To add a redundant Site Controller, two module cages must be present in the MTS 4.

NOTICE: If a redundant Site Controller is added to an MTS with an expansion cabinet, a redundant XHUB must also be added.

NOTICE:
Redundant Site Controller feature is supported on releases:

- R6.0_001.12, MTS 05
- R5.2_002.34, MTS 10

and later.

The additional Site Controller is delivered with the expansion kit that includes required equipment and cables.

15.4.1
Adding a Redundant Site Controller

This section described how to install and configure an additional Site Controller, gaining Redundant Site Controller functionality.

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.

IMPORTANT:
Disable your Firewall application before attempting to transfer files.

The MTS Site Controller has the following modes of operation:

- **BOOT1** – to access this mode interrupt the booting process by pressing **Escape** key or **Control+C** combination when appropriate message is shown. A password may be required to enter this mode.
- **Test Application** – to access this mode enter the `testapp` command when in BOOT1 mode. To go back to normal Site Controller Application enter reset `-oplatform` command to reboot and resume normal operation.
- **Site Controller Application** – if the boot process is not interrupted, this is the default mode of operation.

NOTICE: When adding an additional (redundant) Site Controller, there will be some service downtime while making physical modifications.

Process:

1. Back up the Site Controller configuration of the existing Site Controller.

   See the respective restoration manual (DIPS/DIPC/X Core systems) or *Service Manual* (DIPM system) for MTS Configuration Backup procedures.

   NOTICE: This assumes that the existing Site Controller is properly configured and in service.

2. Install second Site Controller.

   See Installing a Second Site Controller on page 433.

3. Restore the Site Controller Software on the second Site Controller.

   See the respective restoration manual (DIPS/DIPC/X Core systems) or *Service Manual* (DIPM system) for details on restoring the Site Controller software.

4. Configure E1 Links on the second Site Controller.

   See the respective restoration manual (DIPS/DIPC/X Core systems) or *Service Manual* (DIPM system) for details on how to configure the E1 links.

5. Configure CAN Bus on the second Site Controller.

For detailed procedures, see the respective restoration manual (DIPS/DIPC/X Core systems) or *Service Manual* (DIPM system).

6 Load Ki’s into MTS.

   See the respective restoration manual (DIPS/DIPC/X Core systems) or *Service Manual* (DIPM system) for details on loading Ki's Into MTS.

7 Check the MTS post-restoration checks.

   For details, see the respective restoration manual (DIPS/DIPC/X Core systems) or *Service Manual* (DIPM system).

   IMPORTANT:
   When adding a second Site Controller it will automatically become standby meaning that performance of Site Controller post-restoration checks will not be possible.

   In order to perform a Site Controller Post-restoration check on the second Site Controller, the first Site Controller needs to be reset allowing the second Site Controller to become active leading to interruption of service for several seconds.

8 Configure Redundant Site Controller feature.

   See Configuring Redundant Site Controller on page 434.

15.4.1.1
Installing a Second Site Controller

Procedure:

1 Wear an ESD strap and connect its cable to a verified good ground. This strap must be worn to prevent ESD damage to any components.
2 Remove the Site Controller Blind Plate.
3 Label the cables with labels included in the expansion kit.
4 Connect the Ethernet cables to the Base Radio(s) according to the scheme below:

Part no	Cable type	From	To
3066544B02	Ethernet cable	SC2 / BR4	BR4 / SC2
3066544B15	Ethernet cable	SC2 / BR1	BR1 / SC2
3066544B16	Ethernet cable	SC2 / BR2	BR2 / SC2
3066544B01	Ethernet cable	SC2 / BR3	BR3 / SC2

   NOTICE: At this stage only connect the cables to the Base Radios.

5 Strap the cables. Connect RF cable 3066543B10 to the GPS2 connector on the Junction Panel and let it hang. Catch the cable in the empty space where the Site Controller is to be assembled and temporarily fix it at the front.
6 Install the Site Controller. Use the handle to slide the unit into the chassis.

   IMPORTANT: Connect the ribbon cables at the rear before sliding the unit into the chassis. Be careful not to damage the cables when sliding the Site Controller into place.

7 Secure the Site Controller in the chassis with two M4X10 captive screws.

8 Connect the Ethernet cables previously attached to the Base Radio(s) to the Site Controller. Also connect the newly added Site Controller to the junction panel according to the scheme below:

Part no	Cable type	From	To
3066543B10	RF Cable	Junction Panel / E1	Y splitter
3066560B01		Y splitter	SC1 / E1
3066567B02		Y splitter	SC2 / E1

9 Connect RF cable 3066543B10 to GPS connector.

10 Connect the redundant control signal cable according to the scheme below:

Part no	Cable type	From	To
3066544B17	Redundant CTRL signal cable	SC1 / RedIn	SC2 / RedOut
3066544B17	Redundant CTRL signal cable	SC1 / RedOut	SC2 / RedIn

NOTICE: Make sure to follow the color indications on both the cables as well as on the Site CONTROLLER.

11 Remove the Terminator from the CAN2 output on the Power Supply Unit and connect the CAN Bus cable according to the scheme below:

Part no	Cable type	From	To
3066544B03	CAN Bus cable	SC2 / CAN	PSU2 / CAN2

12 Connect the power cables to the MTS Power Supply Units.

15.4.2
Configuring Redundant Site Controller

NOTICE: Redundant Site Controller feature is supported by MTS Software releases:
- MTS SPU R5.2_002.34 or later
- MTS SPU R6.0_001.12 or later

NOTICE: On power up of the Standby Site Controller the Base Radios may dekey and reset. Base Radios will automatically recover and key up again within 20 seconds.

Process:

1 Perform Site Controller Hardware Pre-Checks.

See Performing Site Controller Hardware Pre-Checks on page 435.

2 Configure the Site Controller Configuration Files.

See Configuring Site Controller Configuration Files on page 435.

3 Configure Ethernet ports connecting the two Site Controllers.

See Configuring Ethernet Ports on page 435.

4 Configure the ID values of the Site Controllers.

See Configuring Site Controller IDs on page 436.

15.4.2.1
Performing Site Controller Hardware Pre-Checks

Procedure:

1. Ensure that both Site Controllers are correctly installed and are running identical software applications, Boot images and configuration files.
2. In order for the Redundant Site Controller feature to work correctly, the Site Controller and BR Boot1 version must be:
   - TSC_RLJ_BOOT1–R06.40.07 or later for SC.
   - BRC_RLJ_BOOT1–R06.40.05 or later for Base Radio.

   NOTICE: The Boot1 version can be checked on the Site Controller and BRs by resetting the Site Controller/BR and interrupting the startup sequence when prompted to go into Boot1 mode. The software version is displayed when entering Boot1 mode.
3. Check that the redundant Site Controller Ethernet Link cables are connected correctly, as shown in Cable Connections.
4. Proceed to Configuring Site Controller Configuration Files on page 435 below.

15.4.2.2
Configuring Site Controller Configuration Files

NOTICE: To check that the Site Controller configuration files have the Standby Site Controller Installed parameter enabled, follow the steps below.

IMPORTANT: Remember to check the configuration of both Site Controllers.

Procedure:

1. Log onto the Site Controller Application MMI.
2. From the SC: prompt, run the command `display config`.
3. Check the output of the configuration and confirm if the Standby Site Controller parameter is enabled or not.
4. If no Standby Site Controller is enabled, upload the Active Site Controller configuration file.
5. Modify the configuration file in TESS to enable Standby Site Controller.
6. Download the new configuration file to the InActive Bank (set to use as next after reset).
7. Reset the Site Controller.
8. Confirm the configuration is correct.

15.4.2.3
Configuring Ethernet Ports

In order for the Redundant Site Controller feature to work correctly, the Ethernet ports used to connect the two Site Controllers need to be specifically configured. The correct IP addresses for each Site Controller must be as specified below.

Site Controller 1 (SC1)

- **eth0: 10.0.253.1**
- **eth1: 10.0.254.1**

Site Controller 2 (SC2)

- **eth0: 10.0.254.2**
- **eth1: 10.0.253.2**

NOTICE: For an MTS using a single Site Controller, the Ethernet settings should be checked using the `ifconfig -a` command from the SC application prompt. From the output, confirm that the eth0 and eth1 ports are configured as expected. See Procedure below for more information on how to set SC IDs.

Procedure:

1. Log onto Boot1 of the Site Controller during startup.
2. From the prompt, run the command `spr inet/if/eth0`.
3. From the prompt, run the command `spr inet/if/eth1`.
4. Take note of the IP addresses and the MAC addresses.

   NOTICE: If the IP addresses are set correctly (as stated in lists before this procedure), continue to **Step 8** below.

   NOTICE: If the IP addresses are set incorrectly, they must be changed as follows in the next step.
5. Log onto Boot1 of the Site Controller.
6. From the prompt, run the command
   `spw inet/if/eth0 "dhcp:no addr:10.0.253.X mask:255.255.255.0 dev_name:tsec dev_unit:0 ethaddr:yy:yy:yy:yy:yy:yy mtu:1500"`

   NOTICE:

   - **X** = 1 for SC1, and 2 for SC2
   - **yy:yy:yy:yy:yy:yy** = the MAC address of the interface. Note that eth0 and eth1 have different MAC addresses.
7. From the prompt, run the command
   `spw inet/if/eth1 "dhcp:no addr:10.0.254.X mask:255.255.255.0 dev_name:tsec1 dev_unit:1 ethaddr:yy:yy:yy:yy:yy:yy mtu:1500"`

   NOTICE:

   - X = 1 for SC1, and 2 for SC2
   - yy:yy:yy:yy:yy:yy = the MAC address of the interface. Note that eth0 and eth1 have different MAC addresses.
8. **IMPORTANT:** Remember to check the IP settings on both SCs.

15.4.2.4
Configuring Site Controller IDs

NOTICE: The Site Controllers must have different ID values configured. To check the SC id, follow the steps below.

Procedure:

1. Log onto the Site Controller Application MMI.
2. From the SC: prompt, run the command `id`.

3 An id value of either A or B is displayed.

4 Perform the same check on the second Site Controller.

5 If the IDs are the same, one of the ID values have to be changed. To do so, log onto the Site Controller Application MMI.

> **NOTICE:** It does not matter if it is the ID value of SC1 or SC2 that is changed, as long as they do not have the same ID value.

6 From the SC: prompt, run the command `id x` where **x** can be either A or B. Make sure to define a value different for the two Site Controllers.

7 Reset the Site Controller.

15.5 Expansion from Two-Channel to Four-Channel Cavity Combiner

It is possible to expand from a two-channel Cavity Combiner to a four-channel Cavity Combiner.

The order of an additional Cavity Combiner is dependent on the type of Cavity Combiner existing in the current configuration of the MTS 4 cabinet. There are type of the Cavity Combiner:

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

> **NOTICE:** The additional Cavity Combiner is delivered with the expansion kit that includes required equipment and cables.

15.5.1 Cable Connections

Figure 204: ATCC Cabling Diagram — MTS 4 with 1 TX Antenna before Expansion

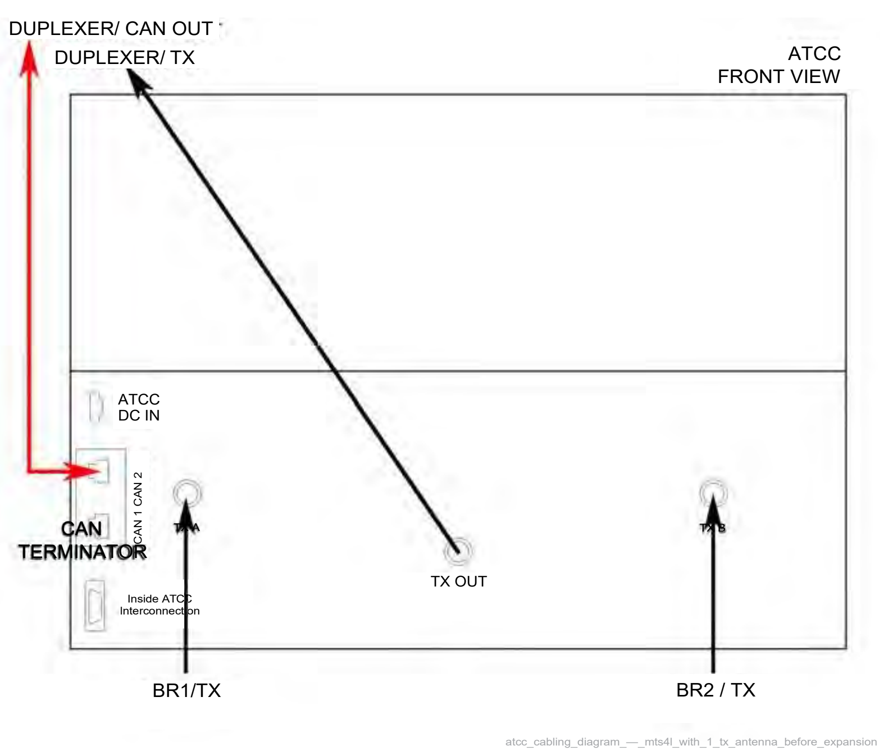
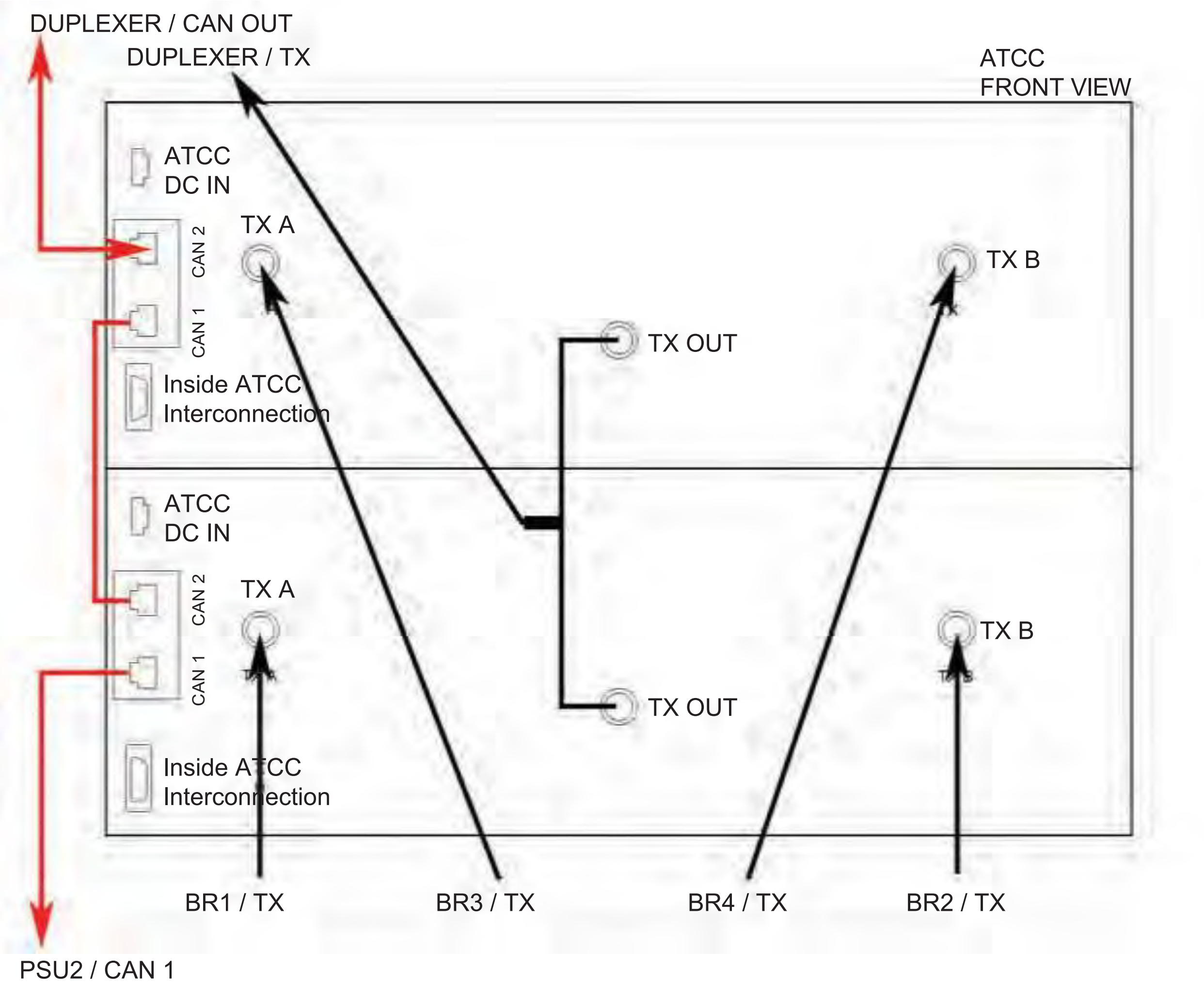


Figure 205: ATCC Cabling Diagram — MTS 4 with 1 TX Antenna after Expansion



15.5.2
Adding the Four-Channel Cavity Combiner

Follow the process below to install the Cavity Combiner.

NOTICE: Procedure is the same whether it is an Auto Tuned Cavity Combiner (ATCC) or a Manual Tuned Cavity Combiner (MTCC) being installed.

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. Make sure the combiner is fully supported when free from mounting rails to avoid injury to personnel and equipment damage.

Process:

1. Install the new Cavity Combiner into the cabinet.

   See Installing the Cavity Combiner into the Cabinet on page 439.
2. Update the mapping list with the new unit TrackID.

   See Updating the Mapping List with the New TrackID on page 286.

15.5.2.1
Installing the Cavity Combiner into the Cabinet

Procedure:

1 Switch OFF the Power Supply Unit.

NOTICE: Only applies for Auto Tuned Cavity Combiner (ATCC).

2 Remove the panel in front of where the additional Cavity Combiner is to be assembled.

3 Assemble bracket with 3 M6x10 screws.

4 Attach the DC cable to DC ATCC Out on the Power Supply Unit. Connect it to the DC socket on the control box on the Cavity Combiner.

NOTICE: Only applies for Auto Tuned Cavity Combiner.

NOTICE: Route the DC cable so it will be placed behind the additional Cavity Combiner.

5 Slide the Cavity Combiner into the cabinet.

6 Fasten the three screws (two on the left and one on the right) that hold the Cavity Combiner onto the brackets of the cabinet.

7 Attach the TX cables to the Base Radios.

8 Unplug the TX cable connected to ATCC 1 / TX Out connector and attach the TX Interconnect Harness to the ATCC 1 / TX Out and ATCC 2 / TX Out connectors. Connect the original cable to the TX Interconnect Harness.

9 Unplug the CAN Bus cable connected to ATCC 1 / CAN2 connector and attach it to ATCC 2 / CAN2 instead.

Action	From	To
Before	Duplexer / CAN Out	ATCC 1 / CAN2
After	Duplexer / CAN Out	ATCC 2 / CAN2

NOTICE: When Manually Tuned Cavity Combiners are used, the CAN Bus is connected directly from Duplexer or PostFilter / CAN2 connector to Power Supply Unit 2 / CAN1 connector.

10 Connect the CAN Bus cable from the existing Cavity Combiner to the new Cavity Combiner according to the scheme below:

Part no	Cable type	From	To
3066544B09	CAN Bus cable	ATCC 1 / CAN2	ATCC 2 / CAN1
3066544B06	CAN Bus cable	ATCC 1 / CAN1	PSU2 / CAN1

NOTICE: If a terminator is situated in the ATCC 1 / CAN1 connector before cabling according to scheme above, the terminator is removed.

11 Switch ON the Power Supply Unit.

15.5.3
Configuration

When the new Cavity Combiner has been installed, the mapping list needs to be updated with the new TrackID. For more information, see Updating the Mapping List with the New TrackID on page 286.

15.6
Hybrid Combiner Expansion

It is possible to expand the MTS 4 with additional Hybrid Combiner.

NOTICE: The additional Hybrid Combiner is delivered with the expansion kit that includes required equipment and cables.

15.6.1
Installing an additional Hybrid Combiner

Follow the instructions below to install the additional Hybrid Combiner.

Procedure:

1. Switch OFF the Power Supply Unit.
2. Assemble the Bracket with the three M6x10 screws.
3. Fasten the two M4x10 screws that are to hold the Hybrid Combiner but do not tighten them fully.
4. Place the Hybrid Combiner on the bracket of the cabinet with the heat sink facing the side of the cabinet.
5. Slide the Hybrid Combiner at an angle ensuring that the lip at the back of the Hybrid Combiner is secured behind the bracket.
6. Tighten the two M4x10 screws to the bracket.
7. Attach the TX and antenna cables.
8. Switch ON the Power Supply Unit.

15.6.2
Configuration

No further configuration is needed when having installed the Hybrid Combiner.

15.7
Expansion from MTS 2 to MTS 4 Cabinet

It is possible to expand from an existing MTS 2 to MTS 4.

NOTICE: When expanding from MTS 2 to MTS 4, an additional Base Radio is delivered with the expansion kit that includes required equipment and cables.

15.7.1
Expanding from MTS 2 to MTS 4

Follow the process below to extract the Module Cage from MTS 2 and assemble it into the expanding MTS 4 Cabinet.

Process:

1. Extract the Module Cage from MTS 2, see Extracting the Module Cage from MTS 2 on page 441.
2. Assemble the Module Cage in the MTS 4 cabinet, see Assembling the Module Cage in the MTS 4 Cabinet on page 443

15.7.1.1
Extracting the Module Cage from MTS 2

Procedure:

1. Remove all RF cables (RX, TX, and GPS if mounted).
2. Disconnect all cables between the module cage and the Junction Panel.
3. Remove any CAN Bus cables going to and from the Filter(s).
4. Remove the filter section by:
   - Removing 6 pcs. M4 screws using TORX20.
   - Remove the special Ground screw using a normal screw driver.

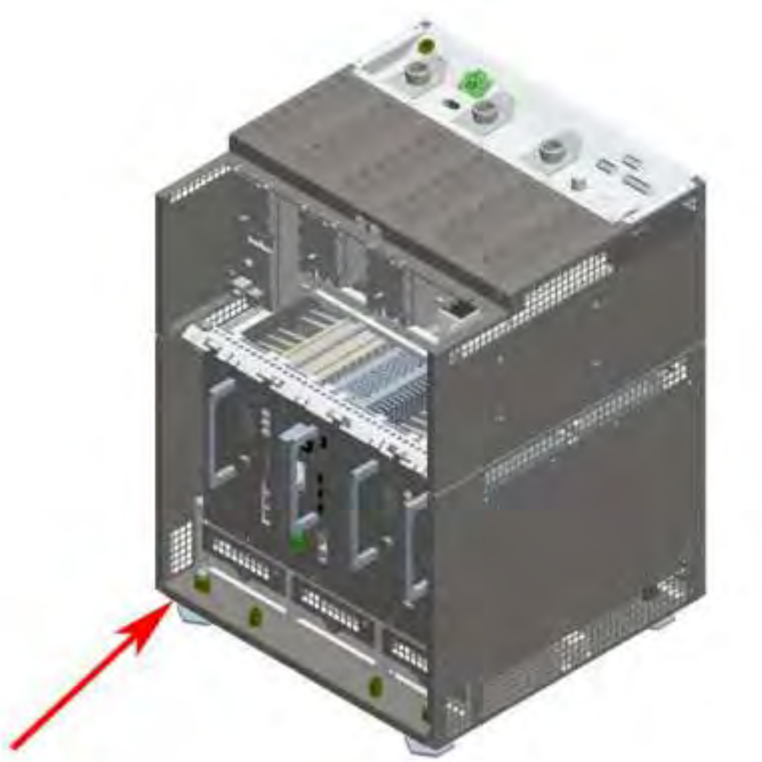
   NOTICE: Filter modules need to be removed in order to have access.

   NOTICE: The Ground screw should be reattached after removal of the filter section.

Figure 206: M4 Screw Position

5 Remove bottom plate by removing the 20 pcs M3 TEXTRON screws using M1.5 Hex.

Figure 207: M3 Screw position



6 Remove the Ribbon cable from the Module cage.

7 Mount the two brackets to the Module cage using 10 pcs. M4 screws.
8 Bend in the area at the back of the Module Cages for Ribbon cables to be routed through later.

15.7.1.2
Assembling the Module Cage in the MTS 4 Cabinet

Procedure:

1 Remove the Module Cage Beauty Plate (if any).
2 Mount all cables going from the lower Module Cage in your specific configuration and fix them temporarily in the rack before mounting the air separator shelf and module cage.

NOTICE: This would typically be:

- Ethernet cables from Base Radio(s) in lower Module Cage to SC in upper Module Cage (SC2).
- Ethernet cables from Base Radio(s) in upper Module Cage to SC in lower Module Cage (SC1).
- CAN Bus cables to and from Filters.

3 Assemble the Air Separator shelf above the existing Module Cage using four M6 screws.
4 Assemble the Module Cage extracted from MTS 2 in Extracting the Module Cage from MTS 2 on page 441.

NOTICE: For more information regarding assembling of a module cage in the MTS 4 Cabinet, see Adding Additional Module Cage to MTS 4.

5 Connect the power supply cables and optional backup battery cables.
6 Connect the Ethernet cables and CAN Bus cables mounted in Step 2 above.
7 Switch ON the Power Supply Unit.
8 Check the LED indicators to verify the PSU is operating correctly.

15.7.2
Configuration

No configuration in itself is needed for the module cage, but the Power Supply Unit needs to be configured and this is described in Updating the Mapping List with the New PSU TrackID on page 337.

Installation and configuration of additional Base Radios are described separately in Additional Base Radio for Existing Module Cage in MTS 4 on page 423.

Furthermore, if an additional Site Controller is ordered as a separate expansion kit, it needs to be installed and configured, see Redundant Site Controller on page 431.

15.8
Redundant XHUB Controller

It is possible to add an redundant XHUB Controller to an MTS 4 Expansion Cabinet.

NOTICE: In order to be able to expand to a redundant XHUB Controller, a redundant Site Controller **must** be present in the MTS 4 Prime Cabinet.

The additional XHUB Controller is delivered with the expansion kit that includes required equipment and cables.

15.8.1
Adding a Redundant XHUB Controller

Procedure:

1. Wear an ESD strap and connect its cable to a verified good ground. This strap must be worn to prevent ESD damage to any components.
2. Remove XHUB Controller blind plate if such exist in the upper module cage of the MTS 4 Expansion Cabinet.
3. Label the cables with labels included in the expansion kit.
4. Connect the Ethernet cables to the Base Radio(s) according to the scheme below:

Part no	Cable type	From	To
3066544B02	Ethernet cable	BR4 / SC2	XHUB2 / BR4
3066544B15	Ethernet cable	BR1 / SC2	XHUB2 / BR1
3066544B16	Ethernet cable	BR2 / SC2	XHUB2 / BR2
3066544B01	Ethernet cable	BR3 / SC2	XHUB2 / BR3

NOTICE:
Ethernet cables stated above derives from the Base Radio(s) in the MTS 4 Expansion Cabinet.

At this stage only connect the cables to the Base Radio(s).

5. Strap the cables.
6. Install the additional XHUB Controller. Use handle to slide the unit into the chassis.

IMPORTANT: Connect the ribbon cables at the rear before sliding the unit in to the chassis.

7. Secure the XHUB Controller in the chassis with two M4X10 captive screws.
8. Connect the Ethernet cables to the unit as tagged earlier.
9. Connect the 3066544B12 cable that derives from the upper Site Controller in the MTS 4 Prime Cabinet (Exp Cab connector).
10. Reconnect the power cables to the MTS Power Supply Units.

NOTICE: If prime MTS4 is configured with Ethernet site link (Link1 Link2 RJ45 connector at prime rack junction panel are assy), connect cable 30015009004 (black plug) to lower XHUB connector ‘AUX1’. Use the RJ45 coupler 3066562B01 to connect the other side of 30015009004 cable from MTS4 Expansion to MTS4 prime cable 30015009003 (going to ‘Link2’ junction panel connector).

15.8.2
Configuration

No configuration is needed.

Chapter 16

MTS 4 Outdoor Enclosure

The MTS 4 outdoor enclosure is designed to accommodate an MTS 4 base station and it is designed to withstand rough environment and many years of service. Basis is a welded steel frame with dismountable side panels with protected double gaskets for protecting the sealed environment inside.

The MTS 4 outdoor enclosure is described in detail in *MTS 4 Outdoor Enclosure*.

Appendix A

Field Replaceable Units (FRUs)

A.1

Field Replaceable Units for MTS LiTE

Table 142: Available FRUs for MTS LiTE on page 446 lists the available Field Replaceable Units (FRUs) for MTS LiTE and Table 143: Other FRUs for MTS LiTE Available from After Market Operations (AMO) on page 446 lists the other FRUs for MTS LiTE available from After Market Operations (AMO).

Table 142: Available FRUs for MTS LiTE

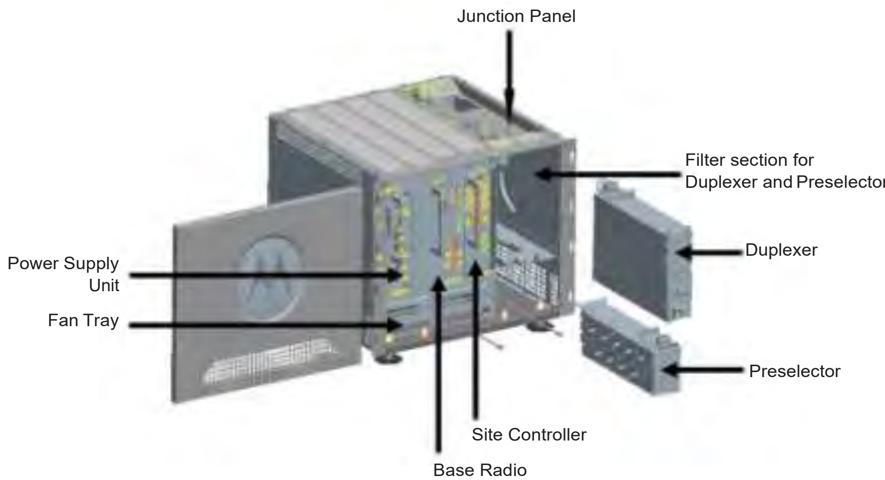
FRU	Description
GMCN4737A	Site Controller
GMTX4325A	High Power Base Radio 350 – 380 MHz, TEDS compatible
GMTF4690A	High Power Base Radio 806 – 870 MHz, TEDS compatible
GMTX4333A	High Power Base Radio 380 – 470 MHz, TEDS compatible
GMTX4334A	Low Power Base Radio 380 – 470 MHz, TEDS compatible
WAPN4335A	Power Supply Unit
FRUs for BR-Arch-2 Base Radios (supported for SER releases 8.0 and above)	
GMTX4335A	High-Low Power Base Radio 320 - 400 MHz
GMTX4336A	High-Low Power Base Radio 380 - 470 MHz
GMTF4695A	High-Low Power Base Radio 800 MHz

Table 143: Other FRUs for MTS LiTE Available from After Market Operations (AMO)

Part Number	Description
WALN4381A	Fan kit
9166516A01	Low Power Duplexer 351 MHz – 356 MHz
9166516A02	Low Power Duplexer 353 MHz – 358 MHz
9166516A03	Low Power Duplexer 372 MHz – 377 MHz
9166516A04	Low Power Duplexer 374 MHz – 379 MHz
9166516A05	Duplexer Rx 380 MHz – 385 MHz
9166516A06	Duplexer Rx 382,5 MHz – 387,5 MHz
9166516A07	Duplexer Rx 385 MHz – 390 MHz
9166516A15	Duplexer Rx 395 MHz – 400 MHz
9166516A08	Duplexer Rx 410 MHz – 415 MHz
9166516A09	Duplexer Rx 412.5 MHz – 417.5 MHz

Part Number	Description
9166516A10	Duplexer Rx 415 MHz – 420 MHz
9166516A11	Duplexer Rx 450 MHz – 455 MHz
9166516A12	Duplexer Rx 455 MHz - 460 MHz
9166516A13	Duplexer Rx 452.5 MHz - 457.5 MHz
9166516A14	Duplexer MTS2 RX 851 MHz – 870 MHz
9166515A01	Low Power Pre Selector 351 MHz – 356 MHz
9166515A02	Low Power Pre Selector 353 MHz – 358 MHz
9166515A03	Low Power Pre Selector 372 MHz – 377 MHz
9166515A04	Low Power Pre Selector 374 MHz – 379 MHz
9166515A05	Pre Selector Rx 380 MHz – 385 MHz MTS 2
9166515A06	Pre Selector Rx 382.5 MHz – 387.5 MHz MTS 2
9166515A07	Pre Selector Rx 385 MHz – 390 MHz MTS 2
9166515A15	Pre Selector Rx 395 MHz - 400 MHz
9166515A08	Pre Selector Rx 410 MHz – 415 MHz MTS 2
9166515A09	Pre Selector Rx 412.5 MHz – 417.5 MHz MTS 2
9166515A10	Pre Selector Rx 415 MHz – 420 MHz MTS 2
9166515A11	Pre Selector Rx 450 MHz – 455 MHz MTS 2
9166515A12	Pre Selector Rx 455 MHz - 460 MHz
9166515A13	Pre Selector Rx 452.5 MHz - 457.5 MHz
9166515A14	Pre Selector MTS2 RX 806 MHz - 825 MHz
PMUG1017A	Remote GNSS Receiver/Antenna
GMDN5007A	GPS Antenna (Internal GPS Receiver), Post Mount N Male Con
3066564B01	REMOTE GPS CABLE 40 m
3066564B02	REMOTE GPS CABLE 150 m
3066564B03	REMOTE GPS CABLE 600 m
5185151Y02	Site Controller Lithium Battery
01015026001	STANDARD FLOOR MOUNT SET MTS
GMKN4747A	Ethernet Site Link Retrofit Kit MTS2

Figure 208: Position of Modules in MTS LiTE Cabinet



A.2

Field Replaceable Units for MTS 2

Table 144: Available FRUs for MTS 2 on page 448 lists the available Field Replaceable Units (FRUs) for MTS 2 and Table 145: Other FRUs for MTS 2 Available from After Market Operations (AMO) on page 448 lists the other FRUs for MTS 2 available from After Market Operations (AMO).

IMPORTANT: If the MTS 2 is already pre-wired for the second BR, order the BR FRU only. If the MTS 2 is not pre-wired for the second BR, an expansion BR kit is required.

Table 144: Available FRUs for MTS 2

FRU	Description
GMCN4737A	Site Controller
GMTX4325A	High Power Base Radio 350 – 380 MHz, TEDS compatible
GMTF4690A	High Power Base Radio 806 – 870 MHz, TEDS compatible
GMTX4333A	High Power Base Radio 380 – 470 MHz, TEDS compatible
GMTX4334A	Low Power Base Radio 380 – 470 MHz, TEDS compatible
GMWD4513A	Low Power Base Radio 260 MHz – 275 MHz
WAPN4335A	Power Supply Unit
GMLN4752B	DIMETRA Express Server with Trusted Platform Module (TPM)
FRUs for BR-Arch-2 Base Radios (supported for SER releases 8.0 and above)	
GMTX4335A	High-Low Power Base Radio 320 - 400 MHz
GMTX4336A	High-Low Power Base Radio 380 - 470 MHz

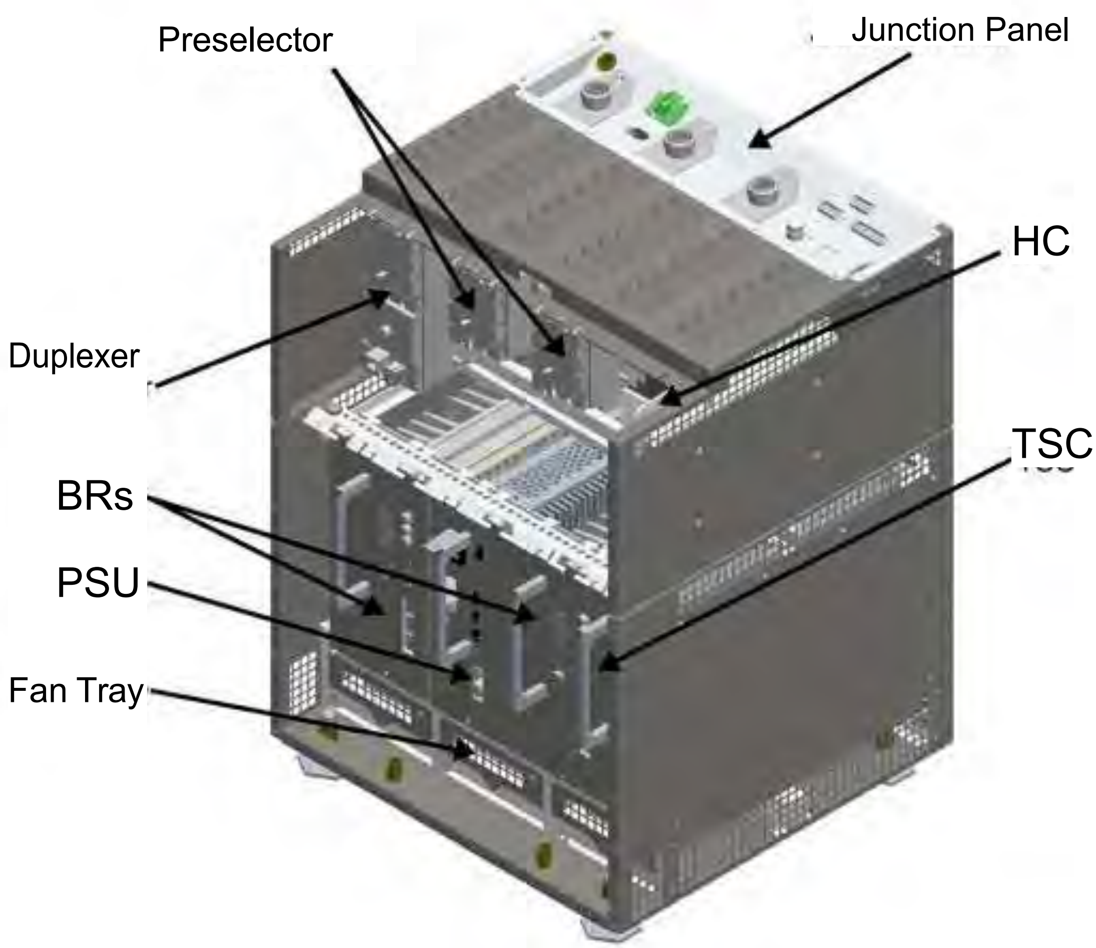
Table 145: Other FRUs for MTS 2 Available from After Market Operations (AMO)

Part Number	Description
WATX4379A	Hybrid Combiner 400 MHz

Part Number	Description
WATF4380A	Hybrid Combiner TX 851 MHz – 870 MHz
GMLD4641A	Hybrid Combiner 260 MHz – 275 MHz
GMLF4711A	Hybrid Combiner 932 MHz – 942 MHz
WALN4381A	Fan kit
9166516A07	Duplexer Rx 385 MHz - 390 MHz
9166516A15	Duplexer Rx 395 MHz – 400 MHz
9166516A08	Duplexer Rx 410 MHz - 415 MHz
9166516A09	Duplexer Rx 412.5 MHz – 417.5 MHz
9166516A10	Duplexer Rx 415 MHz – 420 MHz
9166516A11	Duplexer Rx 450 MHz – 455 MHz
9166516A12	Duplexer Rx 455 MHz - 460 MHz
9166516A13	Duplexer Rx 452.5 MHz - 457.5 MHz
9166516A01	Duplexer Rx 351 MHz – 356 MHz
9166516A02	Duplexer Rx 353 MHz – 358 MHz
9166516A03	Duplexer Rx 372 MHz – 377 MHz
9166516A04	Duplexer Rx 374 MHz – 379 MHz
9166516A05	Duplexer Rx 380 MHz – 385 MHz
9166516A06	Duplexer Rx 382.5 MHz – 387.5 MHz
91015003001	Duplexer (Hi Pwr) Rx 260 MHz – 266 MHz
91015006001	Duplexer (Lo Pwr) Rx 260 MHz – 266 MHz
9166516A14	Duplexer MTS2 RX 806 MHz – 825 MHz
9166516A16	Duplexer Rx 917 MHz – 922 MHz
9166516A17	Duplexer Rx 922 MHz – 927 MHz
9166515A01	Pre Selector Rx 351 MHz – 356 MHz
9166515A02	Pre Selector Rx 353 MHz – 358 MHz
9166515A03	Pre Selector Rx 372 MHz – 377 MHz
9166515A04	Pre Selector Rx 374 MHz – 379 MHz
9166515A05	Pre Selector Rx 380 MHz – 385 MHz MTS 2
9166515A06	Pre Selector Rx 382.5 MHz – 387.5 MHz MTS 2
9166515A07	Pre Selector Rx 385 MHz – 390 MHz MTS 2
9166515A15	Pre Selector Rx 395 MHz - 400 MHz
9166515A08	Pre Selector Rx 410 MHz – 415 MHz MTS 2
9166515A09	Pre Selector Rx 412.5 MHz – 417.5 MHz MTS 2
9166515A10	Pre Selector Rx 415 MHz – 420 MHz MTS 2
9166515A11	Pre Selector Rx 450 MHz – 455 MHz MTS 2
9166515A12	Pre Selector Rx 455 MHz - 460 MHz
9166515A13	Pre Selector Rx 452.5 MHz - 457.5 MHz

Part Number	Description
91015004001	Pre Selector (Hi Pwr) Rx 260 MHz – 266 MHz
91015007001	Pre Selector (Low Pwr) Rx 260 MHz – 266 MHz
9166515A14	Pre Selector MTS2 RX 806 MHz – 825 MHz
9166515A16	Pre Selector Rx 917 MHz – 922 MHz
9166515A17	Pre Selector Rx 922 MHz - 927 MHz
GMDN1172A	Remote GPS Antenna MOBRA ROHS Compliant (GPS RF Antenna with integrated GPS Receiver)
GMDN5007A	GPS Antenna (Internal GPS Receiver), Post Mount N Male Con
3066564B01	REMOTE GPS CABLE 40 m
3066564B02	REMOTE GPS CABLE 150 m
3066564B03	REMOTE GPS CABLE 600 m
5185151Y02	Site Controller Lithium Battery
01015026001	STANDARD FLOOR MOUNT SET MTS
GMDN2206A	MTS2 LVD RELAY RETROFIT KIT
GMKN4747A	Ethernet Site Link Retrofit Kit MTS2

Figure 209: Position of Modules in MTS 2 Cabinet



A.3

Field Replaceable Units for MTS 4

Table 146: Available FRUs for MTS 4 on page 451 lists the available FRUs for MTS 4 and Table 147: Other Field Replaceable Units for MTS 4 Available from After Market Operations (AMO) on page 452 lists other FRUs for MTS 4 available from AMO.

IMPORTANT: If the MTS 4 is already pre-wired for the second BR, order the BR FRU only. If the MTS 4 is not pre-wired for the second BR, an expansion BR kit is required.

Table 146: Available FRUs for MTS 4

FRU	Description
GMCN4737A	Site Controller
GMTX4325A	High Power Base Radio 350 – 380 MHz, TEDS compatible
GMTF4690A	High Power Base Radio 806 – 870 MHz, TEDS compatible
GMTX4333A	High Power Base Radio 380 – 470 MHz, TEDS compatible

FRU	Description
GMTX4334A	Low Power Base Radio 380 – 470 MHz, TEDS compatible
GMWD4513A	Low Power Base Radio 260 MHz – 275 MHz
WAPN4335A	Power Supply Unit
GMLN4752B	DIMETRA Express Server with Trusted Platform Module (TPM)
FRUs for BR-Arch-2 Base Radios (supported for SER releases 8.0 and above)	
GMTX4335A	High-Low Power Base Radio 320 - 400 MHz
GMTX4336A	High-Low Power Base Radio 380 - 470 MHz

Table 147: Other Field Replaceable Units for MTS 4 Available from After Market Operations (AMO)

Part Number	Description
WATX4379A	Hybrid Combiner 400 MHz
GMLD4641A	Hybrid Combiner 260 MHz – 275 MHz
WATF4380A	Hybrid Combiner TX 851 MHz – 870 MHz
WALN4381A	Fan kit
GMDN1172A	Remote GPS Antenna MOBRA ROHS Compliant (GPS RF Antenna with integrated GPS Receiver)
GMDN5007A	GPS Antenna (Internal GPS Receiver), Post Mount N Male Con
9166519A05	MTCC (2 chan.) 360 MHz – 370 MHz
9166519A06	MTCC (2 chan.) 380 MHz – 400 MHz
9166519A07	MTCC (2 chan.) 410 MHz – 433 MHz
9166519A08	MTCC (2 chan.) 460 MHz – 470 MHz
9166519A09	MTCC (2 chan.) TX 851 MHz – 870 MHz
9166519A01	ATCC (2 chan.) 360 MHz – 370 MHz
9166519A02	ATCC (2 chan.) 380 MHz – 400 MHz
9166519A03	ATCC (2 chan.) 410 MHz – 430 MHz
9166519A04	ATCC (2 chan.) 460 MHz – 470 MHz
91015008001	ATCC (2 chan.) 260 MHz – 275 MHz
9166519A10	ATCC (2 chan.) TX 851 MHz – 870 MHz
9166512B17	Duplexer Rx 351 MHz – 356 MHz (supplier Fungu) Replaces Power Wave 9166512A17 duplexer.
9166512B18	Duplexer Rx 353 MHz – 358 MHz (supplier Fungu) Replaces Power Wave 9166512A18 duplexer.
9166512B19	Duplexer Rx 372 MHz – 377 MHz (supplier Fungu) Replaces Power Wave 9166512A19 duplexer.
9166512B20	Duplexer Rx 374 MHz – 379 MHz (supplier Fungu)

Part Number	Description
	Replaces Power Wave 9166512A20 duplexer.
9166512B01	Duplexer Rx 380 MHz – 385 MHz (supplier Fungu) Replaces Power Wave 9166512A01 duplexer.
9166512B02	Duplexer Rx 382.5 MHz – 387.5 MHz (supplier Fingu). Replaces Power Wave 9166512A02 duplexer.
9166512B03	Duplexer Rx 385 MHz – 390 MHz (supplier Fungu) Replaces Power Wave 9166512B03 duplexer.
9166512B10	Duplexer Rx 410 MHz – 415 MHz (supplier Fungu) Replaces Power Wave 9166512A10 duplexer.
9166512B11	Duplexer Rx 412.5 MHz – 417.5 MHz (supplier Fungu) Replaces Power Wave 9166512A11 duplexer.
9166512B12	Duplexer Rx 415 MHz – 420 MHz (supplier Fungu) Replaces Power Wave 9166512A12 duplexer.
9166512B14	Duplexer Rx 450 MHz – 455 MHz (supplier Fungu) Replaces Power Wave 9166512A14 duplexer.
9166512B15	Duplexer Rx 452.5 MHz – 457.5 MHz
9166512B16	Duplexer Rx 455 MHz – 460 MHz
91015003001	Duplexer (Hi Pwr) 260 MHz – 266 MHz
91015006001	Duplexer (Lo Pwr) 260 MHz – 266 MHz
9166512B21	Duplexer MTS4 RX 806 MHz – 825 MHz (supplier Fungu) Replaces Power Wave 9166512A21 duplexer.
9166511B17	Post Filter Tx 361 MHz – 366 MHz (supplier Fingu) Replaces Power Wave 9166511A17 filter.
9166511B18	Post Filter Tx 363 MHz – 368 MHz (supplier Fingu) Replaces Power Wave 9166511A18 filter.
9166511B19	Post Filter Tx 382 MHz – 387 MHz (supplier Fingu) Replaces Power Wave 9166511A19 filter.
9166511B20	Post Filter Tx 384 MHz – 389 MHz (supplier Fingu) Replaces Power Wave 9166511A20 filter.
9166511B01	Post Filter Tx 390 MHz – 395 MHz (supplier Fingu) Replaces Power Wave 9166511A01 filter.
9166511B02	Post Filter Tx 392.5 MHz – 397.5 MHz (supplier Fingu) Replaces Power Wave 9166511A02 filter.
9166511B03	Post Filter Tx 395 MHz – 400 MHz (supplier Fingu) Replaces Power Wave 9166511A03 filter.

Part Number	Description
9166511B10	Post Filter Tx 420 MHz – 425 MHz (supplier Fingu) Replaces Power Wave 9166511A10 filter.
9166511B11	Post Filter Tx 422.5 MHz – 427.5 MHz (supplier Fingu) Replaces Power Wave 9166511A11 filter.
9166511B12	Post Filter Tx 425 MHz – 430 MHz (supplier Fingu) Replaces Power Wave 9166511A12 filter.
9166511B14	Post Filter Tx 460 MHz – 465 MHz (supplier Fingu) Replaces Power Wave 9166511A14 filter.
9166511B15	Post Filter Tx 462.5 MHz – 467.5 MHz
9166511B16	Post Filter Tx 465 MHz – 470 MHz
91015005001	Post Filter (Hi Pwr) Tx 269 MHz – 275 MHz
9166511B21	Post Filter MTS4 TX 851 MHz – 870 MHz
9166510B01	Pre Selector Rx 380 MHz – 385 MHz MTS 4 (supplier Fingu) Replaces Power Wave 9166510A01 filter.
9166510B02	Pre Selector Rx 382,5 MHz – 387,5 MHz MTS 4 (supplier Fingu). Replaces Power Wave 9166510A02 filter.
9166510B03	Pre Selector Rx 385 MHz – 390 MHz MTS 4 (supplier Fingu) Replaces Power Wave 9166510A03 filter.
9166510B10	Pre Selector Rx 410 MHz – 415 MHz MTS 4 (supplier Fingu) Replaces Power Wave 9166510A10 filter.
9166510B11	Pre Selector Rx 412.5 MHz – 417.5 MHz MTS 4 (supplier Fingu) Replaces Power Wave 9166510A11 filter.
9166510B12	Pre Selector Rx 415 MHz – 420 MHz MTS 4 (supplier Fingu) Replaces Power Wave 9166510A12 filter.
9166510B20	Pre Selector Rx 351MHz 356 MHz MTS 4 (supplier Fingu) Replaces Power Wave 9166510A20 filter.
9166510B21	Pre Selector Rx 353 MHz – 358 MHz MTS 4 (supplier Fingu) Replaces Power Wave 9166510A21 filter.
9166510B22	Pre Selector Rx 372 MHz – 377 MHz MTS 4 (supplier Fingu) Replaces Power Wave 9166510A22 filter.
9166510B23	Pre Selector Rx 374 MHz – 379 MHz MTS 4 (supplier Fingu) Replaces Power Wave 9166510A23 filter.
9166510B17	Pre Selector Rx 450 MHz – 455 MHz MTS 4 (supplier Fingu) Replaces Power Wave 9166510A17 filter.

Part Number	Description
9166510B18	Pre Selector Rx 452.5 MHz – 457.5 MHz MTS4
9166510B19	Pre Selector Rx 455 MHz – 460 MHz MTS4
91015004001	Pre Selector (Hi Pwr) 260 MHz – 266 MHz
91015007001	Pre Selector (Lo Pwr) 260 MHz – 266 MHz
9166510B24	Pre Selector MTS4 RX 806 MHz – 825 MHz (supplier Fingu) Replaces Power Wave 9166510A24 filter.
5185151Y02	Site Controller Lithium Battery
01015026001	STANDARD FLOOR MOUNT SET MTS
GMDN2207A	MTS4 LVD RELAY RETROFIT KIT
GMKN4745A	Ethernet Site Link Retrofit Kit MTS4

Table 148: Available Field Replaceable Units for MTS 4 Expansion Cabinet on page 455 lists the available FRUs and Table 149: Other Field Replaceable Units for MTS 4 Expansion Cabinet Available from After Market Operations (AMO) on page 455 lists the other FRUs for MTS 4 Expansion Cabinet available from After Market Operations (AMO).

Table 148: Available Field Replaceable Units for MTS 4 Expansion Cabinet

Kit Number	Description
GMLN4689A	XHUB Controller

Table 149: Other Field Replaceable Units for MTS 4 Expansion Cabinet Available from After Market Operations (AMO)

Part Number	Description
0166502N08	RX Splitter (350 MHz – 825 MHz)
01015008001	RX Splitter (260 MHz – 266 MHz)
GMKN4744A	Ethernet Site Link Retrofit Kit MTS4 Expansion Cabinet
GMCN4735A	Redundant XHUB Controller and cable kit

Figure 210: Position of Modules in MTS 4 cabinet

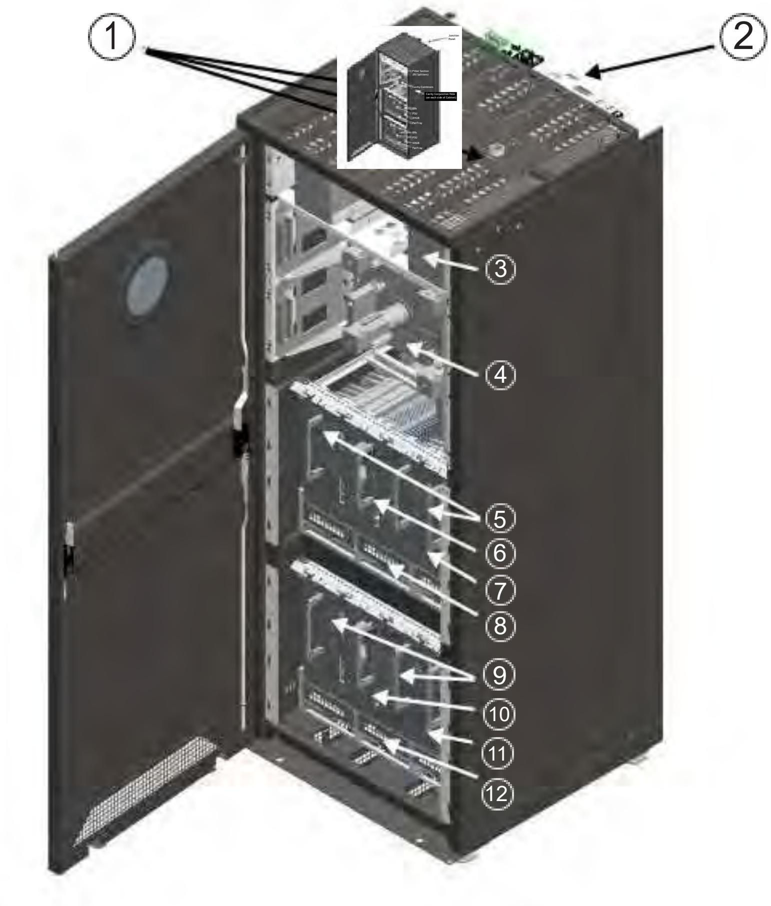


Figure 211: Position of Modules in Expansion Cabinet

A.4
Surge Arrestors and Suppliers

Three types of surge arrestors should be used in the MTS site:

1 AC Power and X.21/E1 Interface Surge Arrestor

2 Antenna Surge Arrestor

3 Lightning Arrestor

A.4.1
AC Power and E1/X.21 Interface Surge Arrestors

Surge arrestors shall be locally procured. The selected items should be specifically designed for the application and meet all local regulations.

Supplier addresses:

- **DITHA**

  Suedfeldtrasse 7

  D - 30453 Hannover

  Germany

  Telephone: +49 (0)511 - 21260

  Telefax: +49 (0)511 - 2108302

- **DEHN GmbH Co KG**

  Postfach 1640

  D - 92306 Neumarkt

  Germany

  Telephone: +49 (0)9181 - 9060

  Telefax: +49 (0)9181 - 906100

A.4.2
Antenna Surge Arrestors

The recommended antenna surge arrestors are manufactured by Polyphaser Inc.

POLYPHASER, INC.

PO Box 9000

Minden, NV 89423

North Latin America:

Toll free: 800-325-7170

Telephone: + 775-782-2511

Telefax: + 775-782-4476

Internet: http://www.polyphaser.com

Recommended models

- 260 MHz MTS antenna (transmit/receive) - VHF50HD (Motorola P/N DSVHF50HD)
- 400 MHz MTS antenna (transmit/receive) - VHF50HD (Motorola P/N DSVHF50HD)
- 800 MHz MTS antenna 7/16 DIN (transmit/receive) - TSX-DFF-BF (Motorola P/N DSTSXDFFBF)
- 800 MHz MTS antenna (transmit/receive) - DSXL (Motorola P/N DSDSXL)
- MTS antenna (receive only) - IS-B50HN-C2 (Motorola P/N RRX4027)
- GPS Antenna - DGXZ + 06NFNF-A (Motorola P/N DSDGXZ06NFNFA)
- Remote GPS Antenna - IX-3L2DC48 (Motorola P/N DSIX3L2DC48)

NOTICE: The IX- series of the arrestor units from Polyphaser are combined units that are applicable for data and power lines.

A.4.3
Lightning Arrestors

Lightning Arrestors are available from Following European Supplier:

HOFI GmbH Co KG

Wittenbacherstrasse 12

D - 91614 Moenchsroth

Germany

Telephone: +49 (0)9853 - 1003

Telefax: +49 (0)9853 - 1005

Appendix B

Planned Maintenance Inspection (PMI)

To assist maintenance of DIMETRA products, Motorola Solutions publishes advice for recommended Planned Maintenance Inspections (PMI). For each Motorola Solutions Part Number, the Inspection Schedule indicates whether any PMI action is required/recommended, the regularity of the recommended/required action, and a brief description of the activity. The Inspection Schedule also indicates Motorola Solutions recommended PMI testing activities that should be carried out as part of the PMI Schedule.

Always read the PMI Inspection Schedule in conjunction with the relevant Motorola Solutions or Motorola Solutions 3rd party suppliers Standard Product Manuals and any Technical Information Bulletins (TIBs), which include the methods of access and other useful information.

In additional to the Planned Maintenance Inspections, Motorola Solutions recommends to run the basic functional test every 24 months. These functional tests should include RF power, RF frequency, and Bit Error Rate measurements.

Motorola Solutions recommends regular site visits for other inspections, for example, site physical security checks, generator maintenance, and so on.

Motorola Solutions also recommends the antennas and PSU/Battery/UPS tests and functional inspection according to the respective manufacturers suggestions.

CAUTION: Ensure the ventilation holes and grilles on the are not covered.

NOTICE: In the configuration with the backup battery: Check the backup battery charged by the MTS in accordance to the manufacturers instructions.

Table 150: Required Planned Maintenance Inspection Actions

Component	Required PMI Action
Site Controller Lithium backup battery	Replace every 8 years.
Heat sinks and interior of the MTS	Perform periodic inspections which require cleaning occasionally due to the buildup of dust. The frequency of this inspection is dependent upon the local environment and is more important when the MTS is operating at a high ambient temperature.

Appendix C

Static Precautions and ESD Strap

This Appendix covers the following topics:

C.1
Static Sensitive Precautions

The static grounding wrist strap (Motorola P/N 4280385A59) must always be used when handling any board or module within the MTS. Many of the boards or modules used in the MTS equipment are vulnerable to damage from static charges.

Extreme care must be taken while handling, shipping, and servicing these boards or modules. To avoid static damage, observe the following precautions:

- Before handling, shipping, and servicing MTS equipment, connect a wrist strap to the grounding clip on the equipment cabinet which is located at the bottom of the cabinet and marked with a yellow label. This discharges any accumulated static charges.

  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 accidental contact with high voltage sources occur.

- Avoid touching any module, board circuitry, including any connector pins with your hands.
- Before removing a board or module, disconnect its individual power supply first.
- Avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, and so on) during service or repair due to the possibility of static buildup.
- Apply power to the circuit under test before connecting low impedance test equipment (such as pulse generators). When testing is complete, disconnect the test equipment before power is removed from the circuit under test.
- Be sure to ground all electrically powered test equipment. Connect a ground lead (-) from the test equipment to the board or module before connecting the test probe (+). When testing is complete, remove the test probe first, then remove the ground lead.
- Lay all circuit boards and modules on a static dispersive surface (a proper antistatic map) when removed from the system. This mat will be connected to ground through a high resistance element.
- Never use non-conductive material for packaging modules being transported. All modules should be wrapped with anti-static packaging material. Replacement modules shipped from the factory are packaged in a conductive material, for example, antistatic bag.

C.2
ESD Wrist Strap Safety Precautions

The ESD socket built into the cabinet housing provides a point to which a wire from a wrist strap can be connected. This is for ESD (electrostatic discharge) protection.

ESD wrist strap use is critical in the following cases:

- Replacement of any module inside a box, which includes service of any modules in a base radio.

- Service of receiver multicoupler (RMC).

CAUTION:
The RMC is a relatively open mechanical design and ESD protection is critical when servicing this module. In case of field repair, first connect the cable to the Duplexer or Preselector, then connect to the RMC. NEVER do this the other way round.

NEVER connect or disconnect the cable that connects the Duplexer and Preselector RX outputs to the inputs of the RMC without using a correctly earthed ESD wrist strap.

Figure 212: MTS LiTE ESD Strap Connection

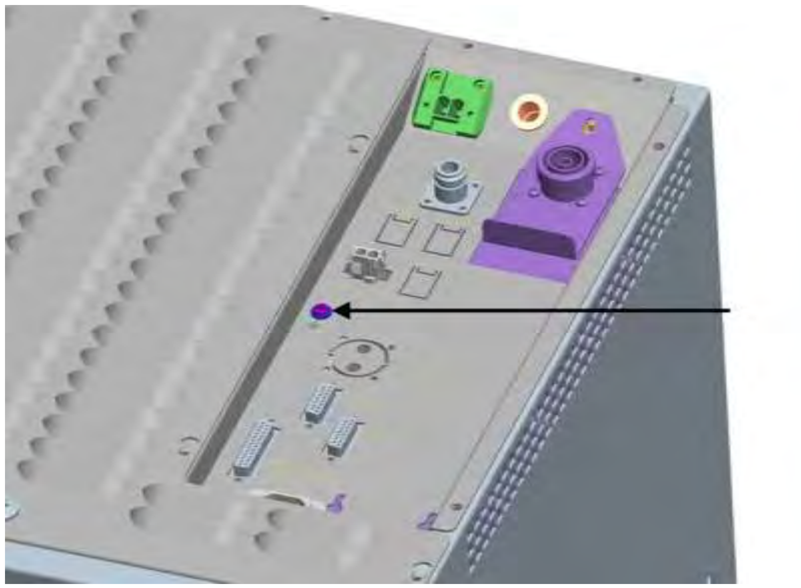
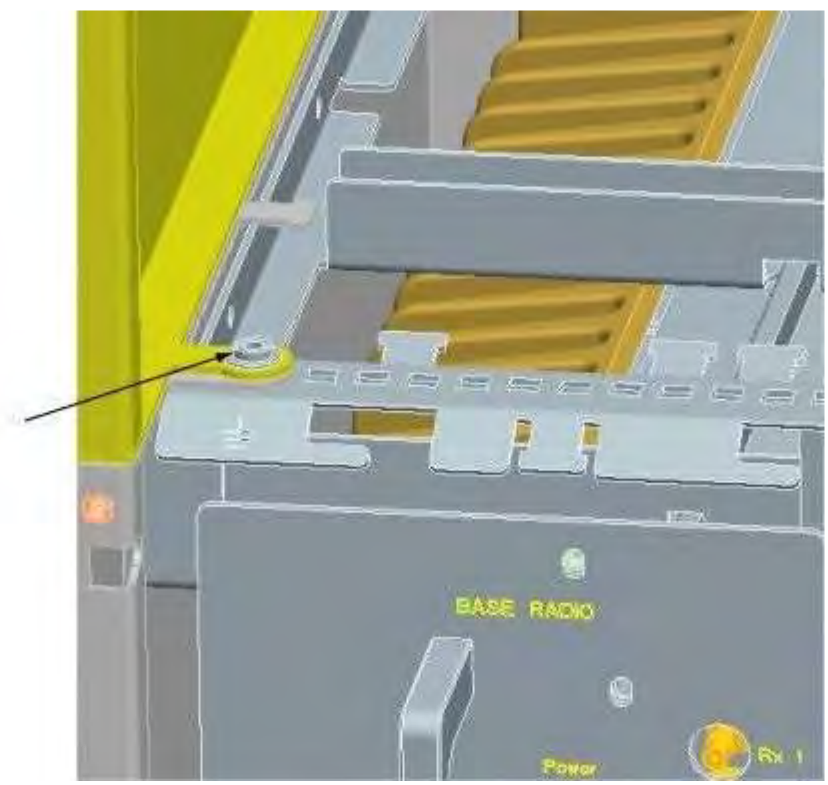


Figure 213: MTS 2 and MTS 4 ESD Strap Connection



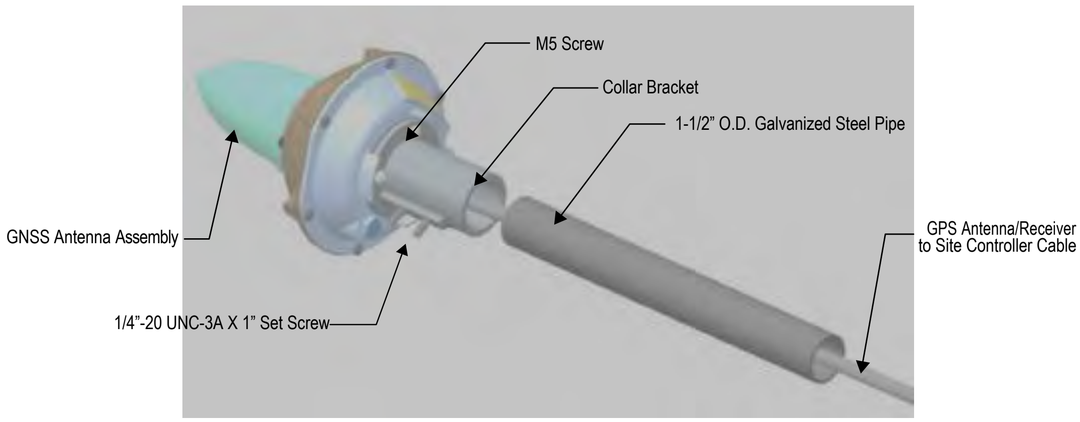
Appendix D

Assembling the GNSS Antenna

Perform this procedure to assemble a GNSS antenna.

The following figure presents the exploded view of the GNSS antenna.

Figure 214: GNSS Antenna Assembly - Exploded View



The following part numbers are valid for the relevant elements:

GNSS Antenna Assembly
PMLN7532A

Collar Bracket
BR000247A01

GPS Antenna/Receiver to Site Controller Cable
3066564B, *<CL>*, where *<CL>* is the cable length code of 01, 02, or 03, meaning 40, 150, or 600 meters of cable length, respectively.

Prerequisites: Verify that you have the Allen wrench (included in the set), a T30 screwdriver, and a Phillips screwdriver.

Procedure:

1. Run the digital cable through the steel pipe and collar bracket. Attach the digital cable connector to bottom of the antenna module (male to female Deutsch connector).

   Figure 215: GNSS Antenna Assembly – Cable

2. Align four bracket screw holes with the GNSS antenna bottom mounting holes and screw the collar bracket to the bottom of the antenna module using a Phillips screwdriver.

Figure 216: GNSS Antenna Assembly – Collar Bracket

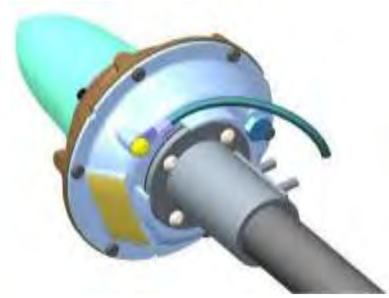
3 Fix the mounting pipe to the mounting bracket by tightening the two set screws.

Figure 217: GNSS Antenna Assembly – Securing the Pipe

4 Attach the mounting pipe to the support structure.

5 Attach the grounding cable to the antenna module by tightening a T6 screw using a T30 screwdriver.

Figure 218: GNSS Antenna Assembly – Grounding Cable



Appendix E

TETRA/DIMETRA Acronyms

The table explains the acronyms used throughout this manual and in the DIMETRA System and is not system release specific. Therefore not all terms may be relevant for a specific system or release.

Table 151: TETRA/DIMETRA Acronyms

Item	Description
A-ISSI	Assigned ISSI
A/V	Anti-Virus
AAA	Authentication, Authorization, and Accounting
ABO	Automatic Busy Override
ACC	Adjacent Control Channel
ACCH	Associated Control Channel
ACELP	Algebraic Code Excited Linear Prediction
AD	Active Directory
ADM	Alias Database Manager (part of CENTRACOM Gold Server)
AEB	Ambassador Electronics Bank
AEI	Audio Expansion Interface
AGC	Automatic Gain Control
AI	Air Interface Additional Identity
AIE	Air Interface Encryption
AIMI	Ambassador Interface Multiplex Interface
AIS	Alias Integrated Solution Archiving Interface Server
ALOM	Advanced Lights Out Management
AMB	Ambassador Board
AMS	Alert Management System
API	Application Programming Interface
APN	Access Point Name
ARP	Address Resolution Protocol
AS	Alias Server
ASC	Automatic Synchronization Configuration
ASIC	Application Specific Integrated Circuit
ASSI	Alias Short Subscriber Identity

Item	Description
ATCC	Auto Tune Cavity Combiner
ATG	Announcement Talkgroup
ATIA	Air Traffic Information Access
ATM	Asynchronous Transfer Mode
ATR	Air Traffic Router
ATS	Alphanumeric Text Service
AuC	Authentication Centre
AVC	Aggregated Virtual Circuit.
BCCH	Broadcast Control Channel
BER	Bit Error Rate
BERT	Bit Error Rate Test
BIC	Barring of Incoming Calls
BIM	Base Interface Module
BLT	Bulk Loader Tool
BNCH	Broadcast Network Channel
BOC	Barring of Outgoing Calls
bps	bits per second
BR	Base Radio
BRC	Base Radio Controller
BS	Billing Service
BSCH	Broadcast Synchronisation Channel
BTS	Base Transceiver System
CAD	Computer Aided Dispatch
CADI	Computer Aided Dispatch Interface
CAI	Common Air Interface
CAS	Channel Associated Signaling Child AntiVirus Server
CAT	Coverage Acceptance Test
CATP	Coverage Acceptance Test Procedure
CBR	Constant Bit Rate
CC	Command Control
CC	Crypto Card
CCC	Crypto Communications Controller
CCGW	Conventional Channel Gateway
CCH	Control Channel
CCI	Command Control Interface
CCITT	Consultative Committee for International Telegraph and Telephone

Item	Description
CCK	Common Cipher Key
CCM	Channel Control Module
CCMS	Customer Configuration Management System
CDM	Configuration Database Manager (part of CENTRACOM Gold Server)
CDR	Call Detail Record
CE	Crypto Engine
CEB	Central Electronics Bank
CEN	Customer Enterprise Network
CES	CENTRACOM Elite Server
CG	Charging Gateway
CHS	Cluster Hot Standby, Equivalent to Synchronised Standby
CIE	Console Interface Electronics
CIS	Center for Internet Security
CK	Cipher Key
CKEK	Common Key Encryption Key
CLIP	Calling Line Identification Presentation
CLIR	Calling/Connected Line Identification Restriction
CMG	Crypto Management Group
CMS	Cable Management System
CMSU	Central Mass Storage Unit
CNE	Central Network Equipment
CNI	Customer Network Interface
COAM	Customer Owned And Operated
COIM	Console Operator Interface Module
CORBA	Common Object Request Broker Architecture
CORI	Console Operated Remote Interface
CoU	Class of Usage
cPCI	compact Peripheral Component Interconnect
CPS	Customer Programming Software
CRC	Cyclic Redundancy Check
CRHN	Control Room Head Number
CSMA/CD	Carrier Sense Multiple Access/Collision Detect
CSMS	Core Security Management Server
CSV	Comma Separated Values
CVC	Constituent Virtual Circuit
CVO	Clear Voice Override
CWR	Cooperative WAN Routing

Item	Description
CZC	Controlling Zone Controller
DAOS	Data Add-On Services
DAQ	Delivered Audio Quality
DAT	Digital Audio Tape
DB	Data Base
DBP	Downstream Billing Processor
DC	Dispatch Console (D5.5SER and backward) Domain Controller (D6.0SER and forward)
DCE	Data Communication Equipment
DCK	Derived Cipher Key
DDI	Data Distribution Interface
DDP	Disabled Dialling Pattern
DG	Data Gateway
DEM	Digital Elevation Model
DGNA	Dynamic Group Number Assignment
DIB	Data Interface Box
DID	Direct Inbound Dialing
DL	Discreet Listening
DLCI	Data Link Connection Identifier
DM	Direct Mode Operation
DM-SCK	Direct Mode Static Cipher Key
DMO	Direct Mode Operation
DMZ	DeMilitarized Zone
DNS	Domain Name Services
DPM	Digital Power Meter
DSP	Digital Signal Processing
DSU	Data Service Unit
DSC	Digital Service Cross Connect
DTE	Data Terminal Equipment Data Traffic Estimator
DTM	Digital Terrain Model
DTMF	Dual Tone Multi-Frequency
DVD	Digital Versatile Disc
E2E	End-to-End Encryption Key Variable Loader
E2E KVL	End-to-End Encryption Key Variable Loader
EAS	Environmental Alarm System

Item	Description
EBTS	Enhanced Base Transceiver System
EC	Electronic Codebook Echo Canceller
ECK	Encryption Cipher Key
ECN	Exclusion Class Number
ECTA	Extended Console Talkgroup Assignment
ECU	Environmental Conditioning Unit
EEPROM	Electrically Erasable Programmable Read Only Memory
EIA	Electronic Industries Association
EOL	End Of Life
ESD	Electrostatic Discharge
ETG	Enhanced Telephone Gateway
ETSI	European Telecommunications Standards Institute
FACCH	Fast Associated Control Channel
FAS	Frame Alignment Signal
FAT	Factory Acceptance Test
FIFO	First in, first out
FIPS	Federal Information Processing Standards
FLM	Formatted Logical Message
FNE	Fixed Network Equipment
FRAD	Frame Relay Access Device
FRE	Field Replaceable Entity
FRU	Field Replaceable Unit
FSSN	Fleet Specific Subscriber Number
FSU	Fault Sense Unit
FT	Fault Tolerant
FTP	File Transfer Protocol
FV	FullVision
FVS	FullVision Server
FW	Firewall
G-HLR	Group Home Location Register
GAS	General Application Server
GBN	Ground Based Network
GCK	Group Cipher Key
GCKN	Group Cipher Key Number
GMS	Group Message Server
GOS	Grade Of Service

Item	Description
GPIOM	General Purpose Input/Output Module
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSKO	Group Session Key for OTAR
GSSI	Group Short Subscriber Identity
GTP	GPRS Tunneling Protocol
GTSI	Group TETRA Subscriber Identity
GUI	Graphical User Interface
HDD	Hard Disc Drive
HDLC	High level Data Link Control
HLA	Home Location Area
HLR	Home Location Register
HPOV	Hewlett-Packard OpenView
HSRP	High Speed Redundancy Protocol
HSSI	High Speed Serial Interface
HZM	Home Zone Map
IDC	Initialization Default Configuration
I-HLR	Individual subscriber unit HLR
ICCS	Integrated Command and Control System
ICMP	Internet Control Message Protocol
ID	Identifier or Identification
IDSS	Intrusion Detection System Sensor
IEC	International Electro-technical Committee
IEEE	Institute of Electrical and Electronic Engineers.
IFM	Interzone Fault Management
IGMP	Internet Group Management Protocol
iLO	Integrated Lights-Out
INM	Integrated Network Manager (FullVision)
IOP	Inter OPerability
IP	Internet Protocol
IRR	Instant Recall Recorder
ISA	Industry Standard Architecture
ISDN	Integrated Services Digital Network
ISI	Inter System Interface
ISSI	Individual Short Subscriber Identity
ITC	Inter TETRA Connection
ITSI	Individual TETRA Subscriber Identity

Item	Description
ITU	International Telecommunications Union
IVD	Integrated Voice and Data
IVN	InterVening Network
IZ	Interzone
IZAC	Interzone Audio Channel
IZCP	Interzone Control Path
IZNM	Interzone Network Manager
K	Authentication Key
KAG	Key Association Group
KEK	Key Encryption Key
KID	Key Identification
KMF	Key Management Facility
KMM	Key Management Message
KSG	Key Stream Generator
KSS	Key Stream Segments
KVL	Key Variable Loader
KVM	Keyboard, Video, and Mouse
LA	Local Area
LAN	Local Area Network
LED	Light Emitting Diode
LMI	Link Management Interface
LNA	Low Noise Amplifier
LOMI	Logging Operator Multiplex Interface
LORI	Logging Recorder Interface
LLR	Local Logging Recorder
LST	Local Site Trunking
LULC	Land Use Land Cover
LZC	Large Zone Core
MAC	Media Access Control
MBTS	Mini Base Transceiver System
MCC	Mobile Country Code
MCCH	Main Control Channel
MDG	Mobile Data Gateway
MDM	Preside Multiservice Data Manager
MER	Message Error Rate
MFR	Multilink Frame Relay
MG	Multigroup

Item	Description
MGCK	Modified Group Cipher key
MGEG	Motorola Gold Elite Gateway
MIB	Management Information Base
MiBAS	Motorola integrated Billing and Administration System
MLE	Mobile Link Entity
MMC	Microsoft Management Console
MMI	Man Machine Interface
MNC	Mobile Network Code
MND	Motorola Networks Division
MNR	Motorola Network Router
MO	Mobile Originated
MOSES	Make Our System Easier to Support
MoU	Memorandum of Understanding
MS	Mobile Station
MSEL	Multiselect
MSFC	Multilayer Switch Feature Card
MSK	Minimum Shift Keying
MSO	Mobile Switching Office
MT	Mobile Terminated
MTBF	Mean Time Between Failures
MTIG	Motorola Telephone Interconnect Gateway
MTS	Motorola Transceiver System
MTU	Maximum Transmission Unit
MUX	MultipleXer
MZS	Multi-Zone System
NACK	Negative status acknowledgment
NAM	Network Analyzer Module
NAT	Network Address Translation
NI	Network Interface
NIB	Network Interface Barrier
NIC	Network Interface Card (Ethernet Card)
NIS	Network Information Service
NM	Network Management
NMC	Network Management Centre
NMT	Network Management Terminal
NNM	Network Node Manager.
NOC	Network Operations Centre

Item	Description
NS	Network Security
NSC	Normal Synchronization Configuration
NSM	Juniper NetScreen-Security Manager
NSMS	Network Security Management Subsystem
NT	New Technologies. A Microsoft Windows environment Network Termination
NTMS	Network Transport Management Server
NTP	Network Time Protocol
NTS	Network Time Server
OOB	Out-Of-Band
OS	Operating System
OSI	Open Systems Interconnect
OSPF	Open Shortest Path First
OSS	Operations Support Subsystem
OTAK	Over-The-Air-Key management
OTAR	Over-The-Air-Rekeying protocol
P-ISSI	Permanent ISSI
P25	APCOs Project 25
PA	Power Amplifier
PABX	Private Automatic Branch Exchange
PCI	Peripheral Component Interconnect
PCM	Pulse Code Modulation
PD	Packet Data
PDCH	Packet Data Channel
PDG	Packet Data Gateway
PDN	Packet Data Network
PDR	Packet Data Router
PDS	Packet Data Service
PDU	Protocol Data Unit
PEI	Peripheral Equipment Interface
PIM-SM	Protocol Independent Multicast-Sparse Mode
PIN	Personal Identification Number
PKI	Public Key Infrastructure
PN	Peripheral Network
PN Router	Peripheral Network Router
PPC	Pre-emptive Priority Call
PPP	Point-to-Point Protocol

Item	Description
PrC	Provisioning Center
PRC	Primary Reference Clock
PRNM	Private Radio Network Management.
PROM	Programmable Read Only Memory.
PSK	Phase Shift Keying.
PSM	Public Safety Microphone.
PSTN	Public Switched Telephone Network
PSU	Power Supply Unit
PTT	Push-To-Talk
PVC	Permanent Virtual Circuit
QOS	Quality Of Service
QSIG	Q-reference point Signalling
R-ISSI	Radio ISSI
RADIUS	Remote Authentication Dial-in User Service
RAG	Resource Allocation Group.
RAID	Redundant Array of Independent Disks
RAM	Random Access Memory
RAPI	Radio Applications Programming Interface
RAS	Remote Access Server
RCM	Radio Configuration Manager
RDP	Remote Desktop Protocol
RF	Radio Frequency
RFDS	Radio Frequency Distribution System
RIP	Routing Information Protocol.
RMC	Receiver Multicoupler.
RME	Resource Manager Essentials
RNG	Radio Network Gateway
RNI	Radio Network Infrastructure
ROCI	Remote Operator Console Interface
RoHS	Reduction of Hazardous Substances
RP	Rendezvous Point
RSM	Remote Speaker Microphone (for a Mobile Station)
RSSI	Radio Signal Strength Indicator
RSS	Radio Service Software
RSU	Recent System User
RTC	Real Time Clock
RUA	Radio User Assignment

Item	Description
RUI	Radio User Identity
RX	Receiver
SF	Store and Forward feature
SAC	Subscriber Access Control
SAI	Session Authentication Information
SACCH	Slow Associated Control Channel
SAS	Serial Attached SCSI Symantec AntiVirus™ Server
SATA	Serial ATA
SATN	System Architecture and Transport Network
SAV	Symantec AntiVirus Client
SAVCE	Symantec AntiVirus Corporate Edition
SC	Site Controller
SCI	Serial Communications Interface
SCK	Static Cipher Key
SCK-TMO	Static Cipher Key for Trunked Mode Operation
SCKN	Static Cipher Key Number
SCO	Site Capacity Option
SD	Short Data
SDR	Short Data Router
SDS	Short Data Service
SDS - TL	Short Data Service Transport Layer
SDTS	Short Data Transport Service
SEK	Signalling Encryption Key
SFS	Store and Forward Server
SGSN	Serving GPRS Support Node
SIB	Service Interface Barrier
SIM	Subscriber Identity Module
SIMM	Single In-Line Memory Module
SIT	System Integration and Test
SMS	Secure Manager Subsystem
SMSO	Shared MSO
SNDCP	Sub Network Dependent Convergence Protocol
SNMP	Simple Network Management Protocol
SOC	Security Operations Centre
SONET	Synchronous Optical Network
SPAS	System Parent Anti Virus Server

Item	Description
SPI	Smart Phone Interface
SRAM	Static Random Access Memory
SR	System Release
SRI	Site Reference ISA
SS7	Signaling System 7
SSC	Symantec System Center™
SSI	Short Subscriber Identity.
SSL	Secure Socket Layer
SSS	System Statistics Server
STM	System Timer Module
SVC	Switched Virtual Circuit
SWC	Site Wide Call
SWDL	Software Download feature
SWDLM	Software Download Manager
SwMI	Switching and Management Infrastructure
SWTG	Site Wide Talkgroup
SZC	Small Zone Core
TCH	Traffic Channel.
TCP/IP	Transmission Control Protocol / Internet Protocol.
TDMA	Time Division Multiple Access
TE	Terminal Equipment
TEI	TETRA Equipment Identity
TEK	Traffic Encryption Key
TESS	TETRA BTS Service Software
TETRA	TErrestrial Trunked RAdio
TG	Talkgroup
TI	Telephone Interconnect
TIA	Telecommunications Industries Association
TIG	Telephone Interconnect Gateway
TLAN	Transitional Local Area Network
TM-SCK	Trunked Mode Static Cipher Key
TMI	TETRA Management Identity
TMO	Trunked Mode Operation
TMSS	Transmit Mode Selector Switch
TNM	Transport Network Management
TNPS	Transport Network Performance Server
TPI	Talking Party Identification

Item	Description
TSC	TETRA Site Controller
TSI	TETRA Subscriber Identity
TX	Transmitter
Tx-I	Transmit Inhibit
UCL	User Configuration of Logging interfaces
UCM	User Configuration Manager Universal Crypto Module
UCS	User Configuration Server
UDP	User Data Protocol
UI	User Interface
UKEK	Unique Key Encryption Key
UPS	Uninterruptible Power Supply
UTC	Universal Time Coordinated
V+D	Voice and data
VDTM	Virus Definition Transport Method
VICP	Very Intelligent Communications Processor
VLAN	Virtual Local Area Network
VLR	Visitor Location Register
VM	Virtual Machine
VOX	Voice Operated Control
VPN	Virtual Private Network
VPN-1	Checkpoints VPN implementation.
VRF	VPN Routing and Forwarding
VRRP	Virtual Router Redundancy Protocol
VU	Voice Unit
WAN	Wide Area Network
WEEE	Waste Electrical and Electronic Equipment
XML	eXtensible Mark-up Language
ZC	Zone Controller
ZCM	Zone Configuration Manager
ZDS	Zone Database Server
ZLM	Zone Link Multiplexer
ZM	Zone Manager
ZMS	Zone Manager Subsystem
ZSS	Zone Statistics Server