

Exhibit D: User Manual**Operational or User's Manual**

The manual should include instruction, installation, operator, or technical manuals with required 'information to the users'. This manual should include a statement that cautions the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. The manual shall include RF Hazard warning statements, if applicable.

Manual Sections Provided:

DBR M12 700/800 MHz RF Site Installation Guide (July 2024 Draft)

Chapter 1: DBR M12 MultiCarrier Site Description
Chapter 2: DBR M12 MultiCarrier Site Equipment Installation
Chapter 3: DBR M12 MultiCarrier Site Installation
Chapter 7.7: Configuring the DBR M12 Trunking RF Site
Chapter 8.18 Setting the Transmitter Power
Chapter 10: DBR M12 MultiCarrier Site FRU Procedures

ASTRO® 25

INTEGRATED VOICE AND DATA

DBR M12 700/800 MHz RF Site Installation Guide

System Release 2022.HS, 2022.1, 2021.1

Provides detailed instructions for the installation of the DBR RF Site.

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About DBR RF Site Installation Guide

This manual provides information on the installation of the DBR RF Site.

Related Information

| Related Information | Purpose |
|--|---|
| <i>Authentication Services Feature Guide</i> | Provides information relating to the implementation and management of the Active Directory (AD) service, Remote Authentication Dial-In User Service (RADIUS), and Domain Name Service (DNS) in ASTRO® 25 systems. |
| <i>Core Security Management Server Feature Guide</i> | Provides information relating to the implementation and management of Core Security Management Server (CSMS). The CSMS hosts network security software components in ASTRO® 25 systems. This manual also includes information about managing system-wide threat prevention along with information associated with security manager user interface hosted on the CSMS. |
| <i>Virtual Management Server Software User Guide</i> | Provides procedures for implementing and managing VMware ESXi-based virtual server hosts on the common Hewlett-Packard Enterprise hardware platform in ASTRO® 25 systems. |

Chapter 1

DBR M12 MultiCarrier Site Description

The DBR M12 MultiCarrier Site is a complete, integrated solution of the RF equipment necessary for a highly fault tolerant, 700/800 MHz TDMA/FDMA P25 Trunking RF Site.

Supported system configurations:

- ASTRO® 25 Repeater Site
- Trunked IP Simulcast Subsystems

Supported trunked frequency bands:

- 800 MHz
- 700 MHz

1.1

DBR M12 MultiCarrier Site in an ASTRO Repeater Site

The DBR M12 MultiCarrier Site in an ASTRO® 25 repeater site is set up in a single trunked site, with one active control channel and a number of voice channels at the site, with a total of 28 channels. If packet data services are supported at the site, you can configure a number of voice channels with packet data channel capability. Voice traffic is routed to and from each channel (virtualized on a DSC 8500 and utilizing a transceiver) to the system for distribution to other sites and is repeated by the channel to support other local subscribers. However, data traffic is routed to the site controller. The site controller routes these packets upstream to the zone core for further processing and routing.

1.2

DBR M12 MultiCarrier Site in a Trunked IP Simulcast Subsystem

The RF channel (virtualized on a DSC 8500 and utilizing a transceiver) captures inbound signals through external receive (Rx) antennas from the subscriber/mobile radios and then amplifies, filters, and demodulates the signals into voice packets which are forwarded to a comparator.

The comparator processes the received voice packets for a particular call and forwards the best quality voice packets to the zone core, which routes them to the associated base radio at each remote site.

At a predetermined time, all RF channels transmit the voice packets simultaneously on the same frequency to complete the communication. You can install a maximum of 30 RF channels per a remote site.

1.3

DBR M12 MultiCarrier Site Components

The DBR M12 MultiCarrier Site consists of an open rack or cabinet that contains the following components:

- DSC 8500s
- Transceivers (XCVRs)

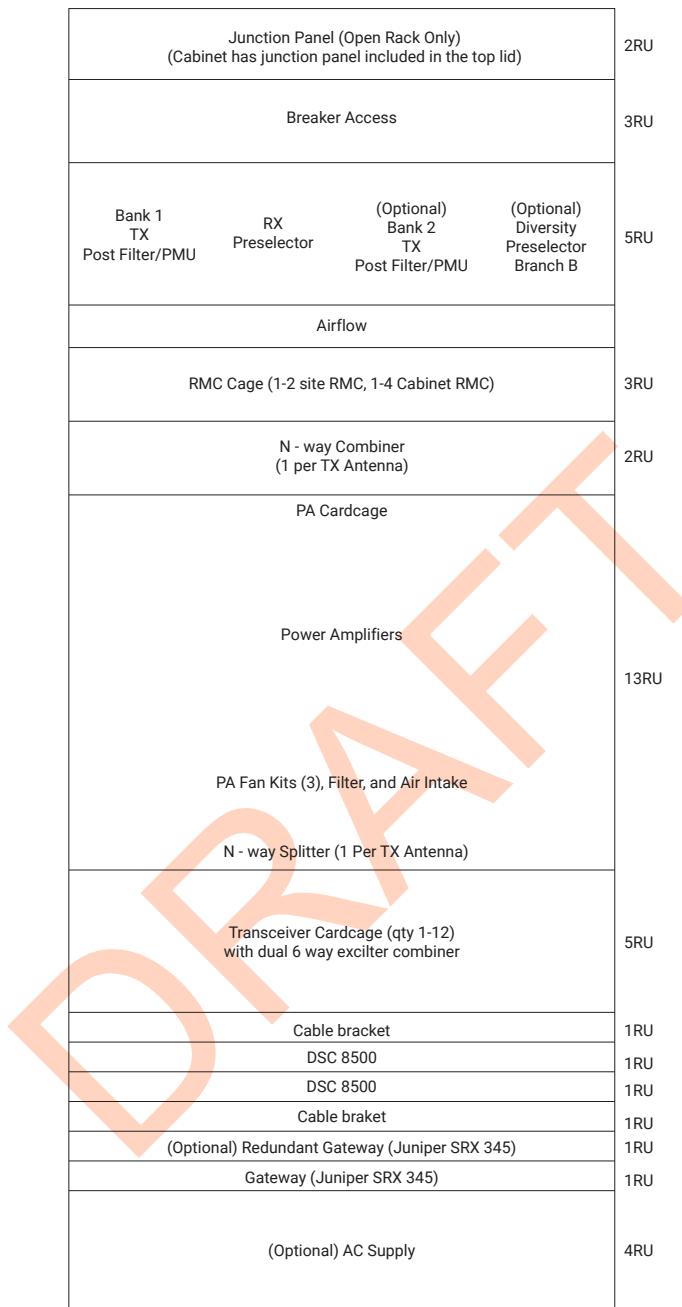
- MultiCarrier Power Amplifiers (MCPA)
- Transmitter (Tx) Radio Frequency Distribution System (RFDS) components (including an integrated Power Monitoring Unit (PMU))
- Receiver (Rx) RFDS components
- Fan modules
- Optional AC power supply shelf and modules
- Optional site routers

These modules and components (some of which may be shared among the carriers), provide the functionality necessary to support up to 12 transmit or receive carriers per cabinet or rack. Multiple cabinets or racks can be ordered (up to 3) to create a site with up to 28 channels or carriers (Site Repeater) or 30 channels (Simulcast).

Depending on the selected configuration options, the DBR M12 MultiCarrier Site rack or cabinet can have some or all of the modules shown in the following figure:

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Figure 1: DBR M12 MultiCarrier Site Components



DSC 8500s

The DBR M12MultiCarrier Site has two DSC 8500s that are provided for redundancy. Each of the DSC 8500s is able to fully support 12 carriers. The DSC 8500s provide the following functionalities:

- Site reference, distributed to all components that require frequency or timing through the Ethernet PTP
- Optionally an integrated Rubidium that provides up to 72 hours of hold over in the event of GNSS loss
- DSP symbol and IQ data conversions
- Station, carrier, channel, and site control (hardware and software)

- Single point of contact for site configuration, service and maintenance in the Provisioning Configuration Agent (PCA)
- Network management
- Alarm I/O ports
- Site switch interface for:
 - Local service
 - Site router
 - XCVR – Frequency reference, timing, modulation, control, monitoring and alarming
 - MCPA – Frequency reference, control, monitoring and alarming
 - PMU – Monitoring and alarming
 - Auxiliary connections – Conventional Base Radios, and other site equipment

Tx and Rx Generation

The XCVRs provide for the receiver (RF to IQ data) and exciter (IQ data to small signal RF) conversions in the DBR M12 MultiCarrier Site. Each configured channel (Rx/Tx Frequency) is associated with an XCVR at the site. The association between channel and XCVR is determined automatically by the software to optimize the frequency spacing per bank, the distribution of priority channels (control capable channels), and to support the XCVR n+1 redundancy feature. The association is re-evaluated on a change of frequency, addition/removal of hardware at the site, or during the XCVR n+1 failover.

Tx Subsystem (Final Tx Amplification and Tx RFDS)

The MCPA bank accepts the combined low-level modulated RF signals from the XCVR modules of a given bank and amplifies them for transmission to the site transmit antenna through the N-Way combiner and the Tx post filter. The use of MCPAs eliminates the cavity combiners and the maintenance they require. Additionally, this architecture provides the following features:

- Tx-Tx spacing of 50 kHz (minimum) without the use of hybrid combining
- Remote frequency changes without an RF site visit
- Fault tolerance – the loss of one MCPA results in the loss of at most one Tx carrier
- Improved site level carrier availability over temperature

The following are the additional DBR M12 MultiCarrier Site transmitter sub-system configurations and features in the same cabinet or rack:

- Up to 12 Tx carriers on one Tx antenna (same band)
- Up to 12 Tx carriers on one Tx antenna (diplexed 700 and 800 MHz bands)
- Up to two sets of six Tx carriers with each set on a separate Tx antenna (same or different bands)
- An integrated PMU within the Tx post filter for each Tx antenna (measures composite Tx power)

For more information about the splitting and combining configurations involved in the transmit path, see [DBR M12 MultiCarrier Site RFDS Transmit Path on page 45](#).

Rx RFDS

The DBR M12 MultiCarrier Site integrated RFDS provides a receive multicoupler (RMC) system that is optimized for the solutions that contain a tower top amplifier, and the solutions that do not, in both diversity and non-diversity configurations. The Rx RFDS includes the following components and features:

- Dual band (700/800 MHz) preselector for each Rx branch
- Active Site RMC modules with adjustable gain that support:

- 1 primary rack or cabinet and 2 expansion rack/cabinets
- RF fault tolerance
- Alarms
- Redundant power
- Passive Cabinet RMC modules that support up to twelve carriers per rack or cabinet

Rx RFDS supports:

- 30 Simulcast channels
- 28 Site Repeater channels
- 6 spare channels

Power Subsystem (DC and AC power)

The DBR M12 MultiCarrier Site employs a highly fault tolerant power system. When powered by a DC power source (native DBR M12 MultiCarrier Site configuration) a distributed DC architecture is utilized. This type of DC architecture offers the following features:

- Fault tolerance – single DC power source failure results in loss of at most one carrier.
- Reduces the number of FRUs necessary to support the DBR M12 MultiCarrier Site.

When the DBR M12 MultiCarrier Site is powered by an AC power source, an optional AC power supply can be ordered and field installed in the reserved space within the DBR M12 MultiCarrier Site rack or cabinet. This solution provides for $n+1$ redundancy where no carriers are lost in the event of a singular AC/DC power supply module failure.

For more information about the DBR M12 MultiCarrier Site power system, see [DBR M12 MultiCarrier Site DC Power System on page 41](#) and [DBR M12 MultiCarrier Site AC Power System on page 44](#).

1.3.1

DSC 8500 Physical Description

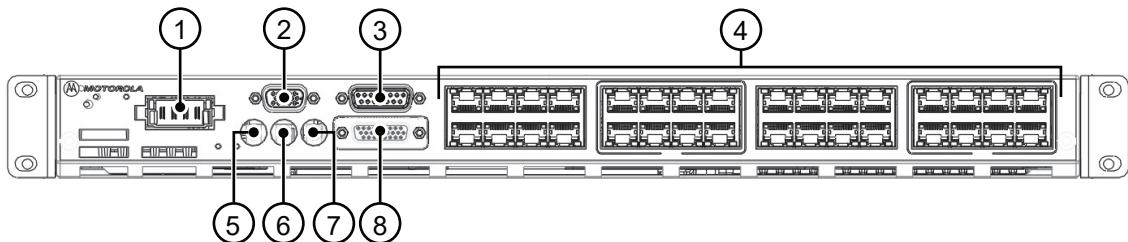
The DSC 8500 provides the station control and DSP operations of the individual RF channels assigned to a given rack/cabinet. Two DSC 8500 controllers are equipped in each rack/cabinet, but a single DSC 8500 can support all RF channels in the rack/cabinet it resides in. This arrangement aids in preventing a single point of failure.

The DSC 8500 also provides the RF Site controller and reference distribution functionality, also ensuring LAN connectivity and switching within the site. It also provides the time reference within the site and can be connected to a GNSS remote receiver, if already at the site.

Each DSC 8500 supports 14 digital inputs that can be monitored and configured to send fault management traps to registered fault managers. The 14 digital inputs are the pull to ground type, which can be driven by an open collector device that is capable of sinking 7 mA.

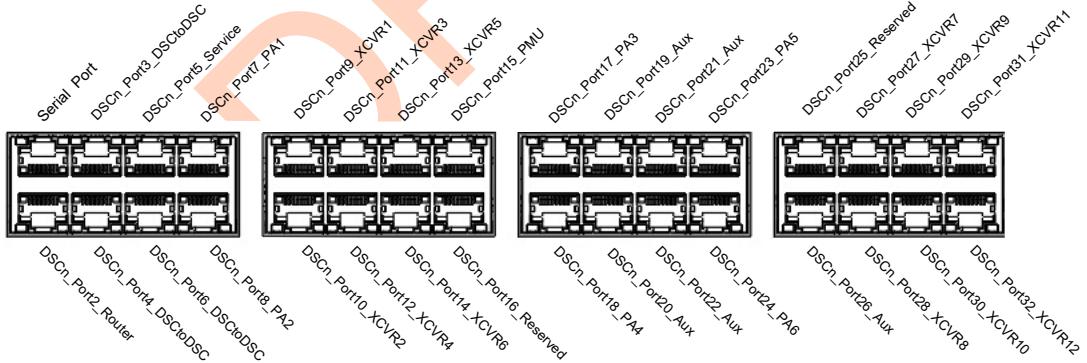
The DSC 8500 can be supplemented with an optional rubidium oscillator device to ensure an extended holdover in the event of GNSS signal loss.

Figure 2: DSC 8500 Front Panel



| Item | Description |
|------|---|
| 1 | Power |
| 2 | PSU Alarm Inputs |
| 3 | GNSS |
| 4 | RJ45 ports |
| 5 | REF/1PPS IN (QMA connector) |
| 6 | 10MHz OUT (QMA connector) |
| 7 | 1PPS OUT (QMA connector) |
| 8 | Internal Site Alarm Inputs for General Purpose Fault Management |

Figure 3: DSC 8500 RJ45 Ports at DBR M12 MultiCarrier Site



| RJ45 Port | Description |
|--|-------------------|
| DSCn_Port02_Router | 100MbpsFullDuplex |
| DSCn_Port03_DSCtoDSC to DSCn_Port32_XCVR12 | AutoNegotiate |

Table 1: DSC 8500 Internal Site Alarm Input Port Pinout Definition

| Pin | Function |
|--------|--|
| Pin 1 | Reserved |
| Pin 2 | Reserved |
| Pin 3 | Ground |
| Pin 4 | Input Pin13 |
| Pin 5 | Input Pin10 |
| Pin 6 | Input Pin8 |
| Pin 7 | Input Pin6 |
| Pin 8 | Input Pin4 |
| Pin 9 | Input Pin2 |
| Pin 10 | Reserved |
| Pin 11 | Ground |
| Pin 12 | Ground |
| Pin 13 | Input Pin14 |
| Pin 14 | Ground |
| Pin 15 | Input Pin9 |
| Pin 16 | Input Pin7 |
| Pin 17 | Ground |
| Pin 18 | Input Pin1 – Reserved for External Backup Power Supply Control |
| Pin 19 | Reserved |
| Pin 20 | Ground |
| Pin 21 | Input Pin15 |
| Pin 22 | Input Pin12 |
| Pin 23 | Input Pin11 |
| Pin 24 | Input Pin5 |
| Pin 25 | Input Pin3 |
| Pin 26 | Input Pin0 – Reserved for External Backup Power Supply Control |

Figure 4: Internal Site Alarm Input Pins for External Backup Power Supply Control

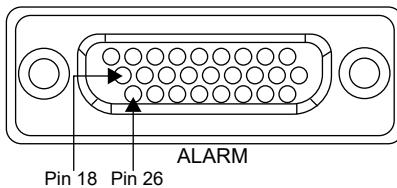
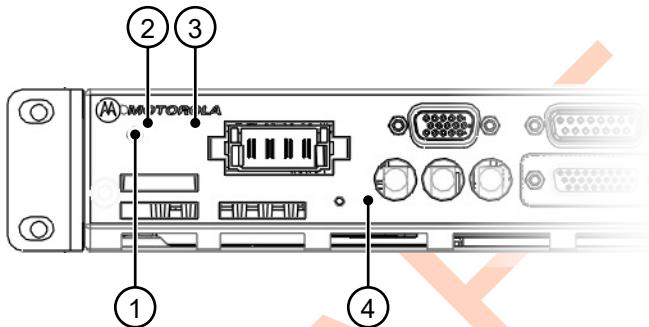


Table 2: DSC 8500 Serial Port Pinout Definition

| Pin | Function |
|-------|---------------|
| Pin 1 | No connection |

| Pin | Function |
|-------|---------------|
| Pin 2 | No connection |
| Pin 3 | No connection |
| Pin 4 | Tx |
| Pin 5 | No connection |
| Pin 6 | No connection |
| Pin 7 | Rx |
| Pin 8 | Ground |

Figure 5: DSC 8500 Front Panel LEDs and Buttons

| Item | Description | Status |
|------|--------------|--|
| 1 | Power button | Powers on and powers off the server board. A 1-second push/hold results in a graceful DSC 8500 shutdown. A 5-seconds push/hold results in a hard shutdown. |
| 2 | Power LED | ON: DSC 8500 board is powered up OFF: DSC 8500 board is powered off |
| 3 | Fan LED | GREEN: fans function properly RED: one or more fans failed |
| 4 | Status LED | GREEN: DSC 8500 functions properly AMBER: meaning is configurable in the Provisioning and Configuration Agent (PCA) RED: DSC 8500 failure |

Table 3: DSC 8500 Physical Parameters

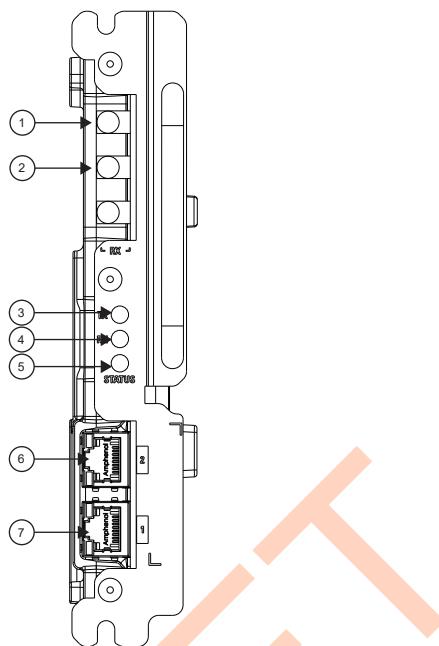
| Parameter | Value |
|-----------|----------------------|
| Width | 441 mm (17.4 in.) |
| Depth | 405.6 mm (15.97 in.) |
| Height | 44.0 mm (1.73 in.) |
| Weight | 7.5 kg (16.5 lb) |

1.3.2

XCVR Physical Description

The XCVR provides for two functions. For the RF transmitter, it converts the digital IQ samples, to be modulated from the DSC 8500, to a low level modulated RF carrier that is ultimately amplified by the MCPAs. For the RF receiver, it converts the modulated RF carrier from each of the Rx inputs, to digital IQ samples that are decoded by the DSC 8500.

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Figure 6: XCVR Front Panel LEDs and Ports

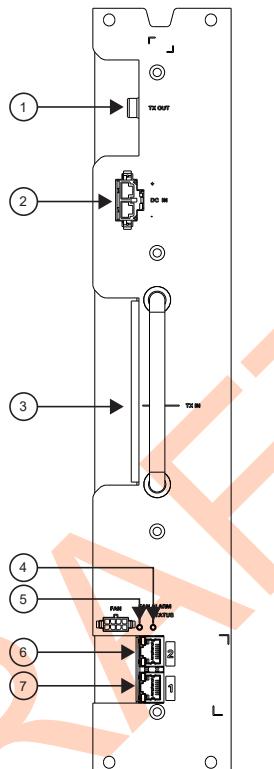
| Item | Description | Status |
|------|-------------|--|
| 1 | RX 1 | Receiver one RF input connection (QMA – female) |
| 2 | RX 2 | Receiver two RF input connection (QMA – female) |
| 3 | Tx LED | SOLID GREEN: transmitter is keyed OFF: transmitter is not keyed |
| 4 | Rx LED | SOLID GREEN: receiving a qualified Rx carrier OFF: not receiving a qualified Rx carrier |
| 5 | Status LED | SOLID GREEN: XCVR is functioning properly SOLID AMBER: One of the two following conditions (not faults): <ul style="list-style-type: none">• XCVR waits for Hardware Discovery to be executed• XCVR is not allocated/associated to a channel by the DSC 8500 FLASHING AMBER: XCVR is user disabled (not a fault) SOLID RED: One of the two following conditions: <ul style="list-style-type: none">• XCVR is booting (< 5 second duration immediately after power up)• XCVR is in a fault condition |
| 6 | ENET 2 | 1000 Base-T Ethernet connection (RJ45 jack) to the DSC 8500 |
| 7 | ENET 1 | 1000 Base-T Ethernet connection (RJ45 jack) to the DSC 8500 |

1.3.3

MCPA Physical Description

The MCPA amplifies the combined low level RF Tx carriers from the XCVRs of its respective bank to an RF power level suitable for the RF outbound coverage required.

Figure 7: MCPA Front Panel LEDs and Ports



| Item | Description | Status |
|------|---------------|---|
| 1 | TX OUT | RF output connection (QN – female) |
| 2 | DC IN | 48VDC power system connection |
| 3 | TX IN | RF input connection (QMA – female) |
| 4 | Status LED | <p>SOLID GREEN: MCPA functions properly</p> <p>SOLID AMBER: One of the two following conditions (not faults):</p> <ul style="list-style-type: none"> • MCPA waiting for Hardware Discovery to be executed • MCPA is not enabled within its bank by the DSC 8500 <p>FLASHING AMBER: MCPA is user disabled (not a fault)</p> <p>SOLID RED: One of the two following conditions:</p> <ul style="list-style-type: none"> • MCPA is booting (< 5 second duration immediately after power up) • MCPA is in a fault condition |
| 5 | Fan Alarm LED | <p>OFF: fan is functioning properly</p> <p>RED: fan failed</p> |

| Item | Description | Status |
|------|-------------|--|
| 6 | ENET 2 | 100 Base-T Ethernet connection (RJ45 jack) to the DSC 8500 |
| 7 | ENET 1 | 100 Base-T Ethernet connection (RJ45 jack) to the DSC 8500 |

1.3.4

RMC Physical Description

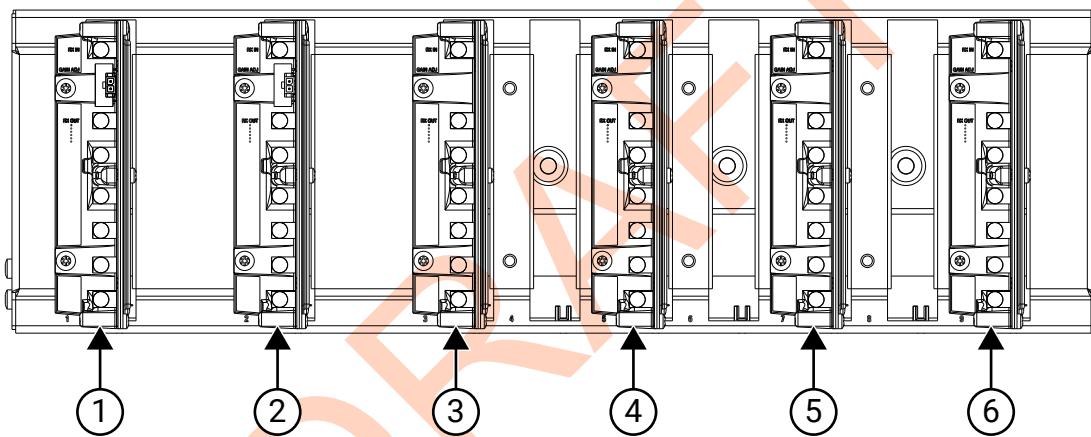
There are two types of Receive Multi-Couplers (RMCs) that are used in the DBR M12 MutiCarrier Site rack – the site and the cabinet RMCs.

The site RMC takes the receive signal from the preselector, amplifies it, and splits it to cabinet RMCs. The cabinet RMCs may be in the same physical rack, or in the expansion racks at the same site.

The cabinet RMCs take the receive signal from the site RMC and split it among XCVRs in the rack.

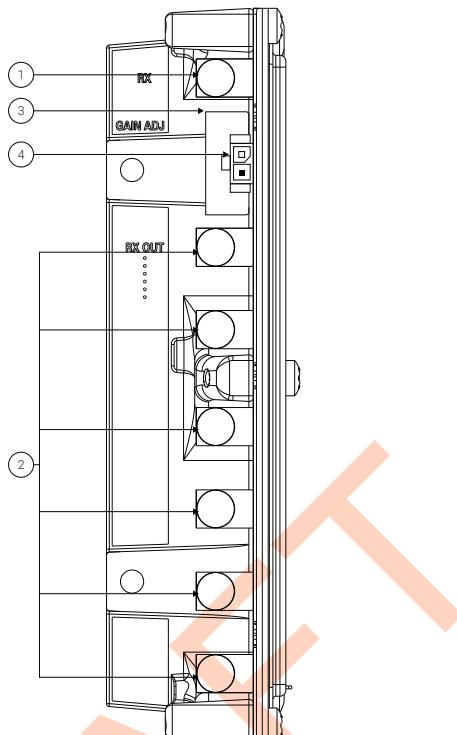
The cabinet RMCs may be in the same, physical rack, or in the expansion racks at the same site.

Figure 8: Fully Populated RMC Cardcage



| Annotation | Description |
|------------|--|
| 1 | Site RMC connected to the first preselector. |
| 2 | Site RMC installed if there are two preselectors with Rx diversity. |
| 3 | Cabinet RMC 1, always populated, connects to the site RMC 1. |
| 4 | Cabinet RMC 2, used in racks with Rx diversity, connects to site RMC 2. |
| 5 | Cabinet RMC 3, used in racks with more than 6 XCVR, connects to site RMC 1. |
| 6 | Cabinet RMC 4, used in racks with more than 6 XCVR and Rx diversity, connects to the site RMC 2. |

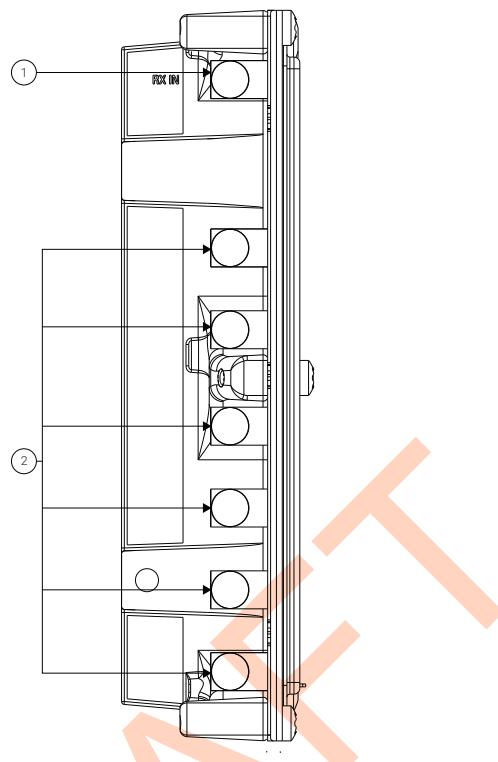
Figure 9: Site RMC



| Annotation | Description |
|------------|---------------------|
| 1 | Rx In |
| 2 | Rx Out 1-6 |
| 3 | Gain DIP Switch |
| 4 | RMC Alarm Connector |

The site RMC Rx In must always come from a preselector. Site RMC Rx out 1 and 2 must connect to the cabinet RMC in the same rack. The site RMC Rx out 3-6 must go to the cabinet RMC in the expansion racks at the site.

For more information about the gain settings and alarm, see [RMC Attenuation Configuration on page 86](#).

Figure 10: Cabinet RMC

| Annotation | Description |
|------------|-------------|
| 1 | Rx In |
| 2 | Rx Out 1-6 |

The cabinet RMC Rx In must always come from a site RMC. Cabinet RMC Rx Out 1-6 must go to Xcvr within the rack.

For more information about the cabinet RMC Rx connections, see the following table:

Table 4: Cabinet RMC Rx Connections

| Item | Rx Out Connection |
|---------------|-------------------|
| Cabinet RMC 1 | Xcvr 1-6 Rx 1 |
| Cabinet RMC 2 | Xcvr 1-6 Rx 2 |
| Cabinet RMC 3 | Xcvr 7-12 Rx 1 |
| Cabinet RMC 4 | Xcvr 7-12 Rx 2 |

1.3.5

N-Way Combiner Physical Description

The DBR M12 MultiCarrier Site rack has two types of N-Way combiners, the 2-3 N-Way combiner and the 4-6 N-Way Combiner.

Figure 11: 2-3 N-Way Combiner

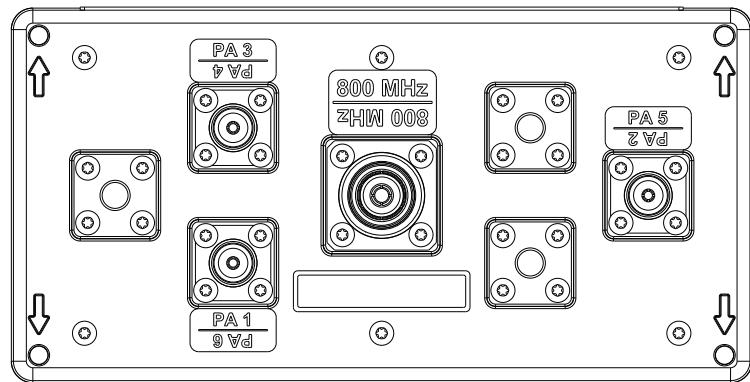


Figure 12: 2-3 N-Way Combiner on Bracket

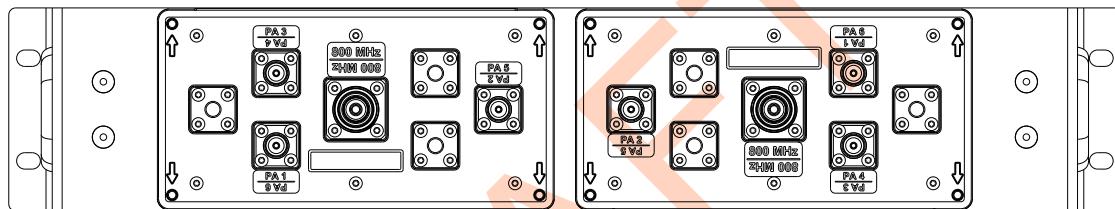


Figure 13: 4-6 N-Way Combiner

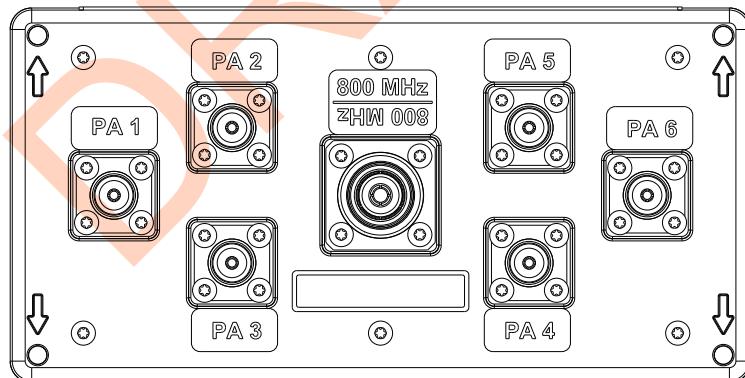
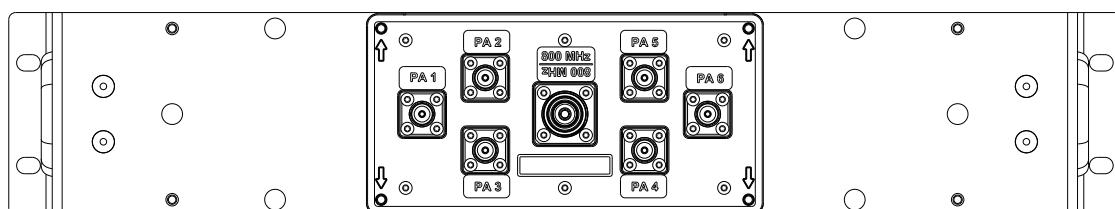


Figure 14: 4-6 N-Way Combiner on Bracket



The combiners take TX out from each power amplifier (PA), combine the signal, and connect to the post filter. The functionality of the 2-3 N-Way combiner and the 4-6 N-Way combiner is the same. The only difference between the two combiners is the number of power amplifiers that can be connected to them.

Each rack can support up to two 2-3 N-Way combiners or one 4-6 N-Way combiner.

WARNING: An RF Phasing cable must be connected to each input of the N-Way combiner at all times, even if there is no associated PA for that connection. Removing a phasing cable when the site is powered on can cause damage to the equipment. Cables for non-populated PAs must be placed in through the locating features in the PA blank panels.

AVERTISSEMENT: Un câble de phase RF doit être connecté à chaque entrée du combinateur N-Way à tout moment, même s'il n'y a pas d'amplificateur de puissance (AP) associé à cette connexion. Retirer un câble de phase lorsque le site est sous tension peut provoquer des dommages à l'équipement. Les câbles pour les AP non occupés doivent être placés par l'entremise des fonctions de localisation dans les panneaux vides de l'AP.

The center 4.3-10 connector on the N-Way combiner connects to the post filter. Each QN connector is connected to the PA associated with the label next to the connector, or connected to a cable with its other end placed behind the blank panel that corresponds to that PA.

1.3.6

N-Way Splitter Physical Description

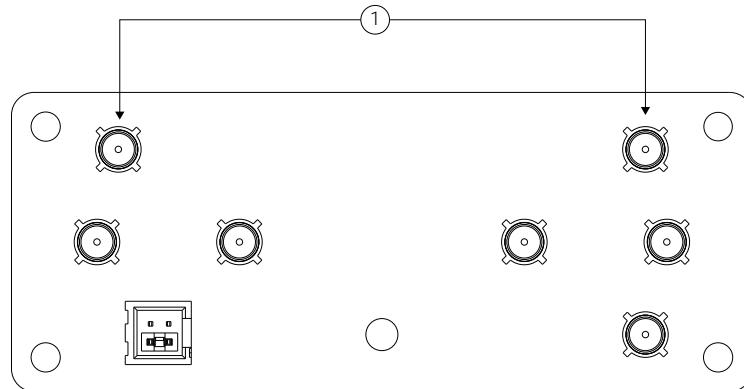
The DBR M12 MultiCarrier Site rack has two types of N-Way splitters, the 2-3 N-Way splitter and the 4-6 N-Way splitter.

The N-Way splitters take the combined XCVR output and split it to each Power Amplifier (PA). The functionality of the 2-3 N-Way splitter and the 4-6 N-Way splitter are the same. The only difference between the two splitters is the number of PAs that can be connected to them.

Each rack can support up to two 2-3 N-Way splitters or one 4-6 N-Way splitter.

On each board the connectors labeled as XCVR Bank A and XCVR Bank B are connected to the XCVR Combiner board in the XCVR card cage. Each connector labeled as MCPA X is connected to the corresponding PA.

Figure 15: 2-3 N-Way Splitter



| Annotation | Description |
|------------|--|
| 1 | <p>Coax jumper connection. The 2-3 N-Way splitter contains a coax jumper that must be connected to these connectors. In the 2-3 N-Way splitter there is a 2 pin jumper in place on the header that must be placed as shown. If the 2-3 N-Way splitter is used as the splitter for a second bank, it must be removed.</p> |

Figure 16: 2-3 N-Way Splitter on Bracket

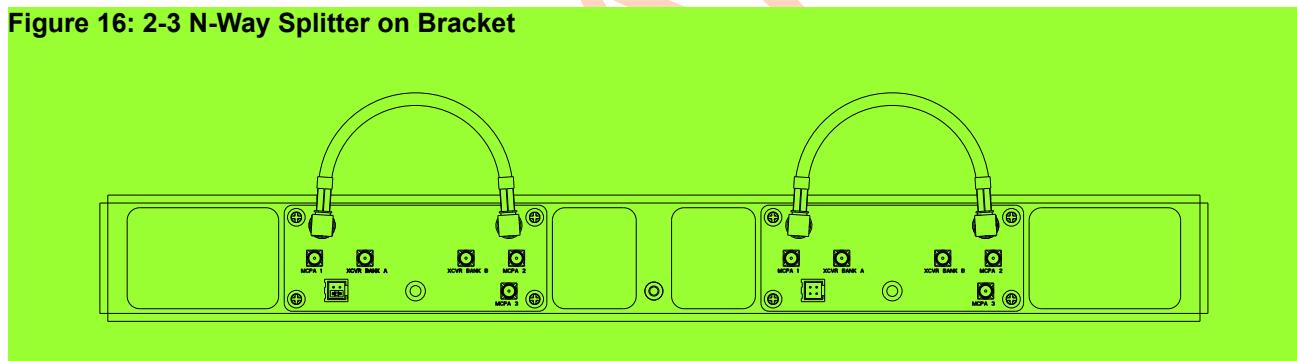


Figure 17: 4-6 N-Way Splitter

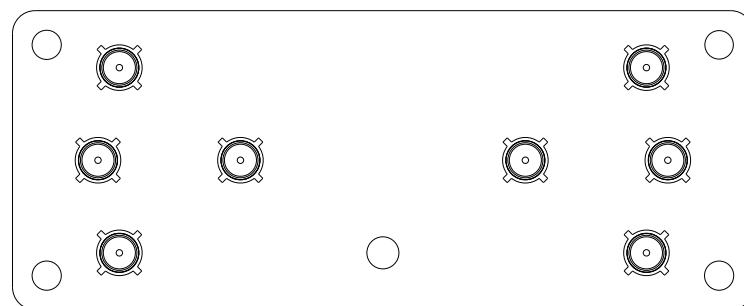
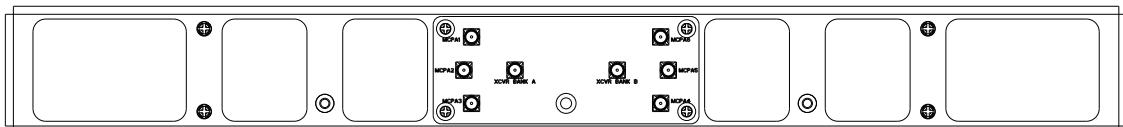


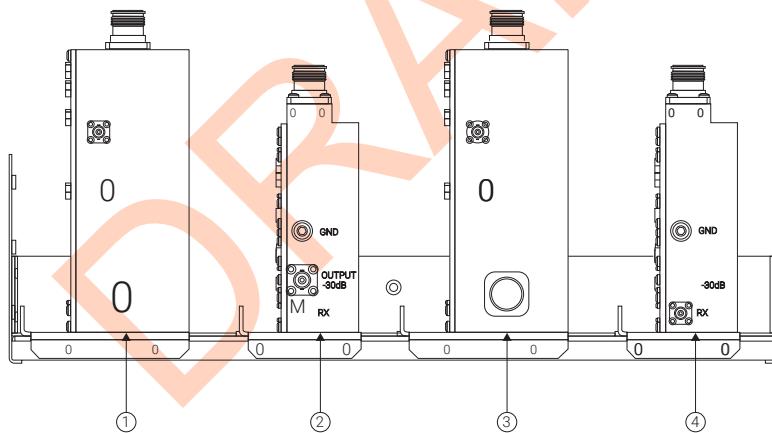
Figure 18: 4-6 N-Way Splitter on Bracket

WARNING: An RF Phasing cable must be connected to each input of the N-Way splitter at all times, even if there is no associated PA for that connection. Removing a phasing cable when the site is powered on can cause damage to the equipment. Cables for non-populated PAs must be placed in through the locating features in the PA blank panels.

1.3.7

RFDS Physical Description

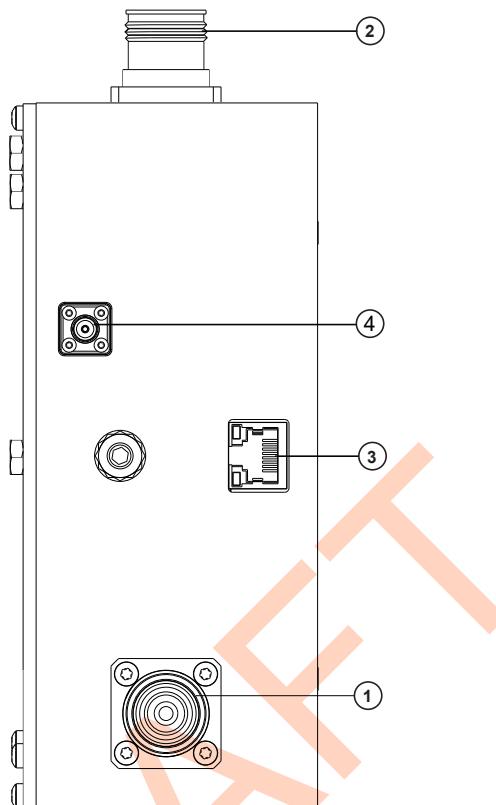
The Radio Frequency Distribution System (RFDS) section of the DBR M12 MultiCarrier Site Rack contains Tx filters and Rx preselectors.

Figure 19: RFDS Tray – Fully Populated

| Annotation | Description |
|------------|----------------------------------|
| 1 | Tx post filter |
| 2 | Rx preselector |
| 3 | Tx post filter for a second bank |
| 4 | Rx preselector for Rx diversity |

All racks contain at least one TX post filter. Expansion racks can contain an Rx preselector, depending on the number of receive antennas present at a site. A second Rx preselector is used for configurations with receive diversity. A second Tx post filter is used when there are two transmit banks, and two transmit antennas.

Figure 20: Tx post filter



| Annotation | Description |
|------------|--------------------------------------|
| 1 | Tx connection from combiner (4.3-10) |
| 2 | Tx to antenna (4.3-10) |
| 3 | Power monitor (Ethernet connection) |
| 4 | 30dB coupled output (QMA) |

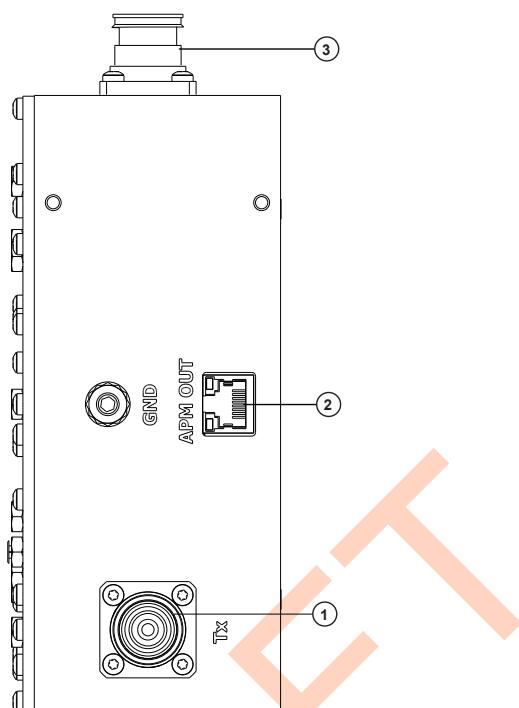
The transmit filter removes any remaining noise in the receive sub-band between the combiner and the transmit antenna. The transmit band pass filter has a built-in power monitor on the output for monitoring the antenna system voltage standing wave ratio (VSWR) and the composite transmitter output power in reference to the top of the DBR M12 MultiCarrier Site cabinet/rack. The composite transmitter output power and VSWR can be viewed in the Provisioning and Configuration Agent (PCA). Additionally, the VSWR alarms are routed to the infrastructure as they occur.

The transmit filter is either 768–776 MHz or 851–870 MHz.

The Tx post filter is band-dependent. There are two versions, one for the 700 MHz and one for the 800 MHz range. A rack can contain both bands if it is set up as a split bank.

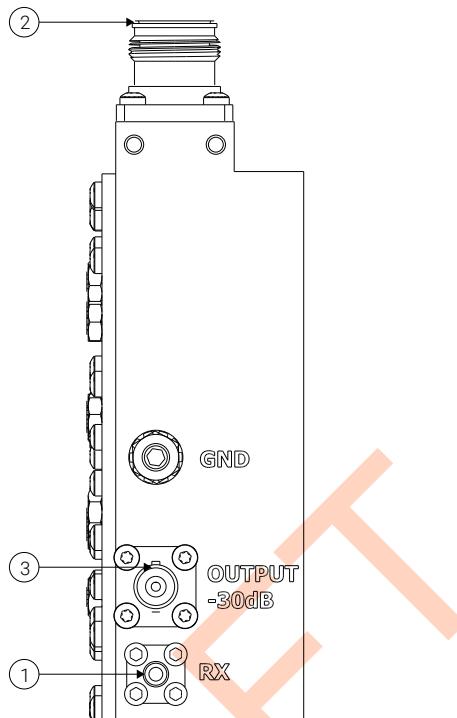
Tx post filter 1 connects to a 4-6 N-Way combiner, or a 2-3 N-Way combiner for a single or split bank configuration. Tx post filter 2 only connects to a 2-3 N-Way combiner in a split bank configuration.

The 30dB coupled output allows you to see the composite filtered output spectrum of the DBR M12 transmitter subsystem.

Figure 21: Transmit Filter (700/800/900 MHz)

| Annotation | Description |
|------------|--|
| 1 | Transmit in from the combiner (4.3-10 connector) |
| 2 | Transmit out to the antenna (4.3-10 connector) |
| 3 | Power monitor (Ethernet connection) |

Figure 22: Rx Preselector



| Annotation | Description |
|------------|--|
| 1 | Rx out to site Receive Multi-Coupler (RMC) (QMA) |
| 2 | Tx to antenna (4.3-10) |
| 3 | 30dB coupled output (BNC) |

The Rx preselector covers both the 700 MHz and the 800 MHz range. Only one preselector is required even if there is both a 700 MHz range and 800 MHz range transmit bank in the same rack.

The first preselector connects its Rx output to the site RMC 1. If there is Rx diversity, the second preselector connects to the site RMC 2.

The 30dB coupled output allows you to monitor the composite filtered input spectrum to the DBR M12 MultiCarrier Site receiver subsystem.

1.3.8

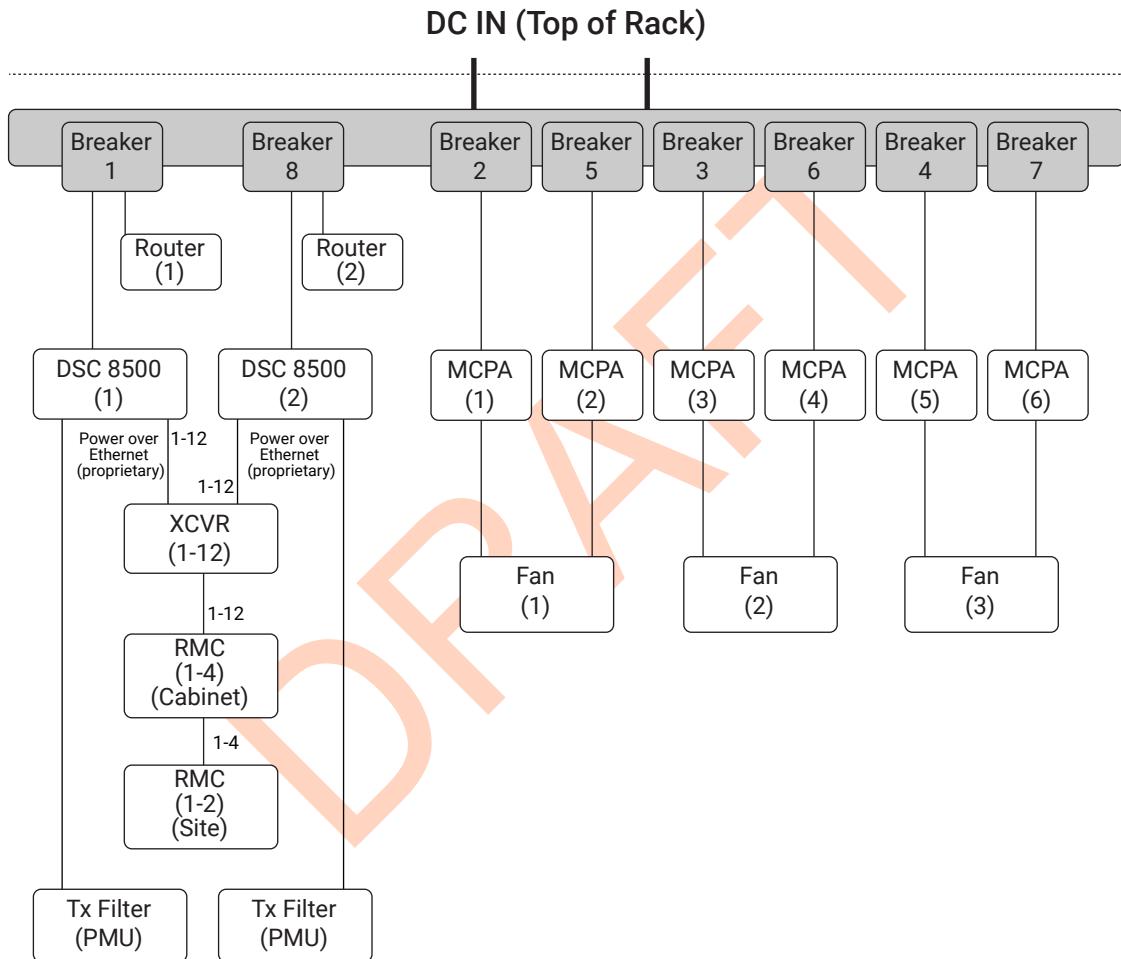
DBR M12 MultiCarrier Site DC Power System

The DC power is the default configuration of the DBR M12 MultiCarrier Site, unless the optional AC power supply (T8926A) is ordered.

The DBR M12 MultiCarrier Site employs a distributed DC architecture (there is no central DC supply). The DC-DC converters are distributed throughout the DBR M12 MultiCarrier Site that galvanically isolates and regulates the input 48 VDC power source connection (+/- 43.2-60 VDC). The DC-DC converters are located in each of the Multi-Carrier Power Amplifiers (MCPAs), Transceivers (XCVRs), and components of the distributed DC architecture in the DSC 8500.

This type of DC architecture offers high availability and reduces the number of FRUs necessary to support the DBR M12 MultiCarrier Site. The following are the selected functionalities of the DC architecture:

- Each MCPA has its own breaker.
- Each fan is powered by one of two MCPAs.
- Each router has a separate breaker.
- Each DSC 8500 has a separate breaker.
- Each XCVR is powered by one of the two DSC 8500s.
- Each Receive Multi-Coupler (RMC) (site and cabinet) is powered by one of the XCVRs (up to twelve XCVRs can be present).

Figure 23: DC Architecture

The DBR M12 MultiCarrier Site is galvanically isolated (floating ground) and may be connected to either a positive or negative grounded 48 VDC power source. Wire colors and schemes may differ, depending on the power ground reference or regional codes, but the polarity does not change. Regardless of power system ground reference, positive is positive, and negative is negative, and connection should be completed to that polarity.

DC Power Connections

For more information about the DC power connection, see [Breaker Recommendations on page 55](#) and [DC Power Connection Wire Gauge Calculations for Integrated Voice and Data on page 80](#).

The rack/cabinet is designed with two DC inputs to receive DC power from either a single DC source or from two separate DC sources. The default configuration is for power to be received from a single DC source through the two DC inputs.

If power system redundancy from the two separate DC sources is desired, then you must remove the DC jumper bridging the two DC inputs into the rack/cabinet. The noted jumper is located on the underside of the rack/cabinet breaker rail.



NOTE: You should only consider removing the DC jumper for rack/cabinets that are configured for two transmitter banks. Removing the DC jumper allows XCVRs 1-6, MCPAs 1, 3, and 5, and the bottom DSC 8500 to receive power from one DC source. The balance of the XCVRs, MCPAs, and DSC 8500 receives power from the other DC source.

This perfect split of the MCPA, XCVR, and DSC 8500 resources can not be achieved with a rack/cabinet configured for a single transmitter bank. Because of that, the DC jumper must remain in place for rack/cabinets configured for a single transmitter bank.

The top of the rack/cabinet contains two sets of terminal blocks for the purposes of reducing the current supplied through any one set of DC input cables to a value within the rating of the DC cables maximum size (1 AWG) and/or minimizing voltage drops.



NOTE: The terminal block screws must be tightened within the range of 6Nm and 8Nm.

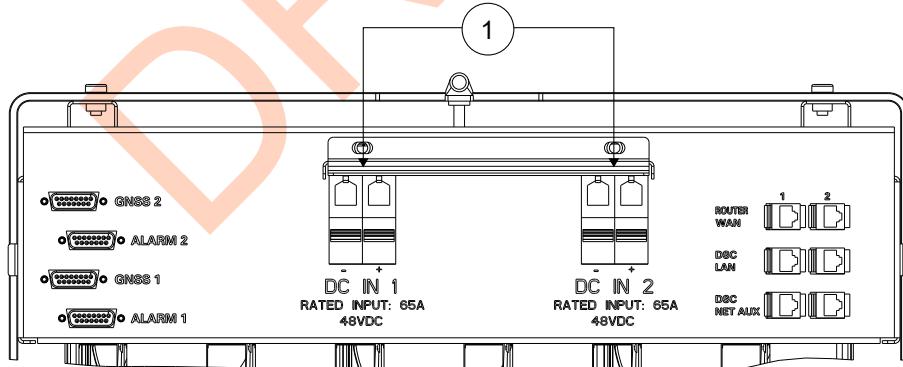
For racks/cabinets loaded with modules to support the maximum carrier capacity, both pairs of DC feeds must be installed to the power distribution subsection.



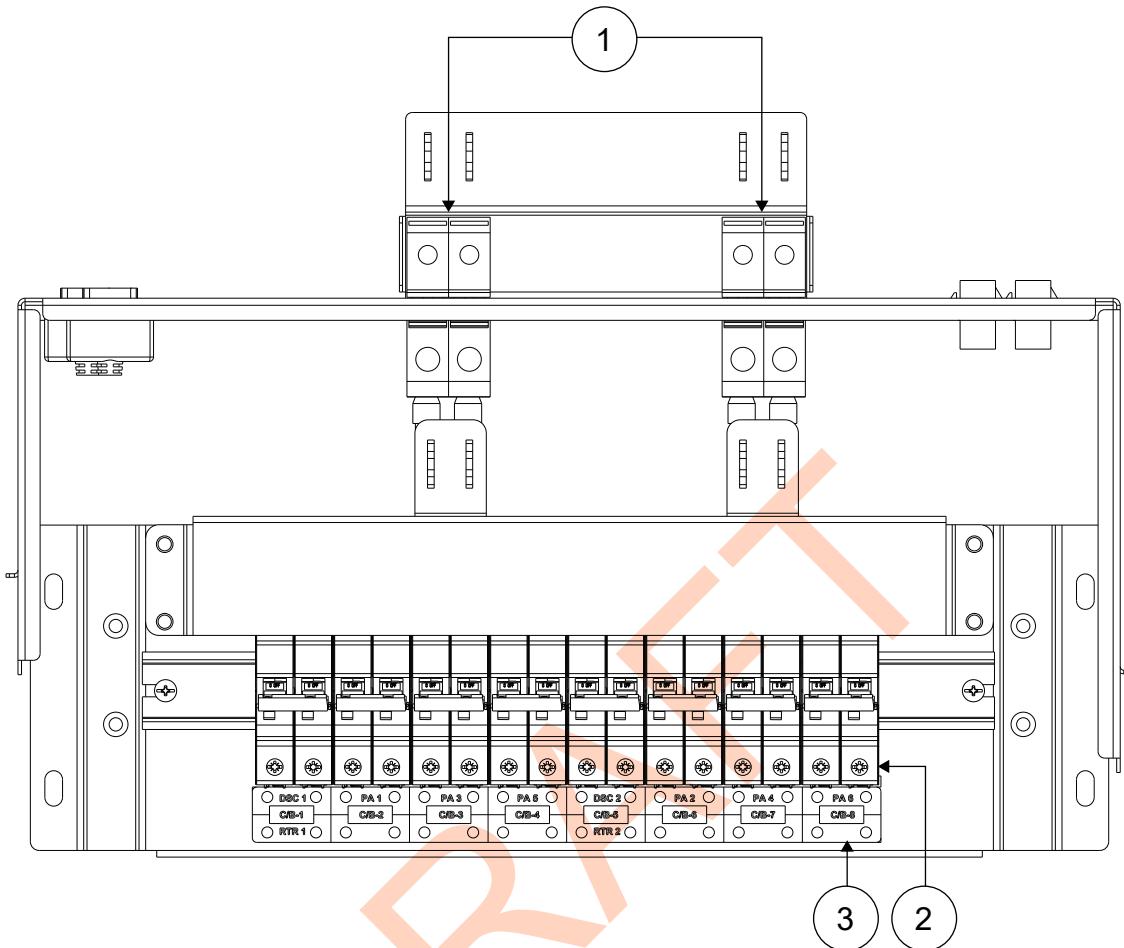
WARNING: Disconnect all Power before servicing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

AVERTISSEMENT: Débranchez toute alimentation avant l'entretien. Plusieurs sources d'alimentation peuvent être présentes. Ne pas le faire peut entraîner des dommages matériels, des blessures ou la mort.

Figure 24: Junction Panel in DBR M12 MultiCarrier Site (Open Rack Version – Top View)



| Annotation | Description |
|------------|-------------------------------|
| 1 | DC Input Terminal Block Pairs |

Figure 25: Power Input Distribution in DBR M12 MultiCarrier Site (Open Rack Version – Side View)

| Annotation | Description |
|------------|---|
| 1 | DC Input Terminal Block Customer Input Side |
| 2 | Breakers |
| 3 | Breaker Module Label |

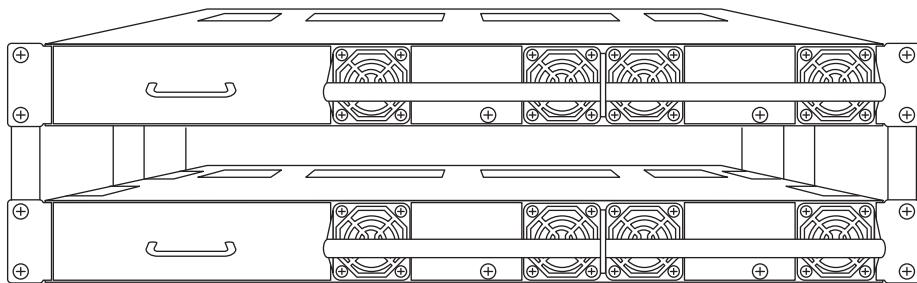
1.3.9

DBR M12 MultiCarrier Site AC Power System

An optional DBR M12 MultiCarrier Site AC Power Supply (T8926A) can be used to convert the AC power at the site to the DC power. The outputs of the DBR M12 MultiCarrier Site AC Power Supply connect to the DC power inputs at the top of the rack. For more information about the connections, see [DBR M12 MultiCarrier Site DC Power System on page 41](#) and [Connecting Power to an AC Power Source on page 81](#).

This option provides two power shelves that can support up to three 1300W AC/DC power supply modules each.

Figure 26: DBR M12 MultiCarrier Site Power Shelves



The DBR M12 MultiCarrier Site AC Power Supply is a separate component that is shipped separately. The integration must be done in the field or in staging at the reserved, open space, at the bottom of the rack.

The DBR M12 MultiCarrier Site AC Power Supply supports $n+1$ redundancy so that no carriers are lost in the event of a singular AC/DC power supply module failure. To ensure that the correct number of AC/DC power supply modules are present to support the $n+1$ redundancy, see *Multicarrier Site Design Tool* and *DBR M12 MultiCarrier Site Ordering Guide*.

IMPORTANT: Ensure that an alarm is generated in the event of an AC/DC power supply module failure. The alarm outputs of the DBR M12 MultiCarrier Site AC Power Supply must be wired to the alarm inputs of the DSC 8500 (and configured in the PCA), MC-EDGE RTU or SDM 3000 RTU. A second AC/DC power supply module failure can power down an entire DBR M12 MultiCarrier Site rack or cabinet.

1.4

DBR M12 MultiCarrier Site RFDS Transmit Path

The DBR M12 transmitter does not use cavity combiners or lossy hybrid combiners to achieve power combining. The power combining is accomplished before the high power amplification and followed by bank(s) of highly linear MultiCarrier Power Amplifiers (MCpas) that amplify the already combined carriers.

The transmit path of the RFDS includes the following equipment:

- Transceiver's (XCVR) exciter:
 - Up to 12 in a single transmitter bank configurations (one Tx antenna)
 - Up to 6 per bank in configurations with two transmitter banks (two Tx antennas)
- 2 XCVR backplanes, each combining 6 XCVRs
- 4-6 N-Way splitter:
 - Up to 12 carriers in a bank
- 2-3 N-Way splitter:
 - Up to 6 carriers in a bank (with one bank, 6 carriers per rack or cabinet in total)
 - Up to 6 carriers in a bank (with two banks, 12 carriers per rack or cabinet in total)
- MCPAs:
 - 5-6 MCPAs in the 4-6 N-Way configuration
 - 3 MCPAs per bank in the 2-3 N-Way configuration
- 4-6 N-Way combiner:
 - Up to 12 carriers in a bank
- 2-3 N-Way combiner:

Up to 6 carriers in a bank (with one bank, 6 carriers per rack or cabinet in total)

Up to 6 carriers in a bank (with two banks, 12 carriers per rack or cabinet in total)

- Transmit post filter with integrated Power Monitoring Unit (PMU) (one per transmitter bank) that measures the composite transmitter carrier power of a given bank
- Diplexer Phasing Harness that combines a 700 MHz bank and an 800 MHz bank into one Tx antenna

 **NOTE:** The PMU functionality is not supported in configurations that employ the Diplexer Phasing Harness.

Figure 27: One Bank (Same Band)

One Tx Antenna is used for all Tx carriers.

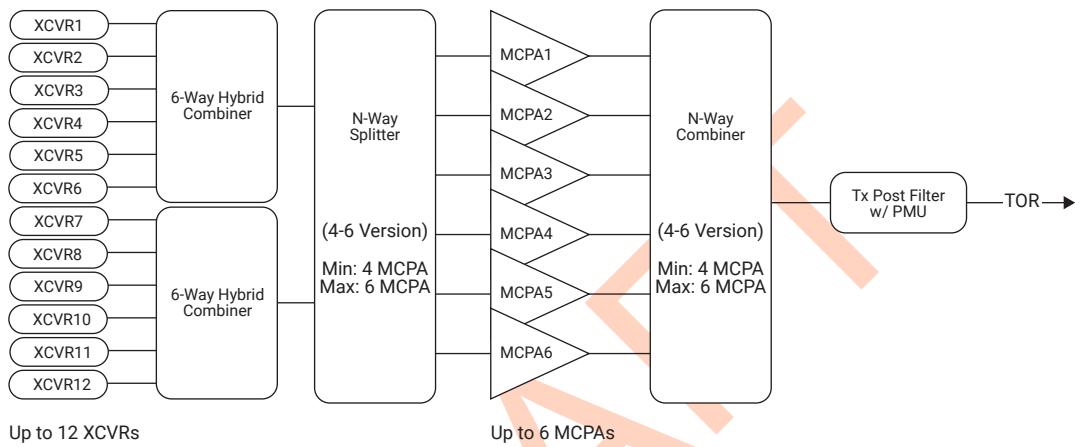


Figure 28: Two Banks (Same or Different Bands)

Two Tx Antennas are used to lower the Tx carrier count per one Tx antenna.

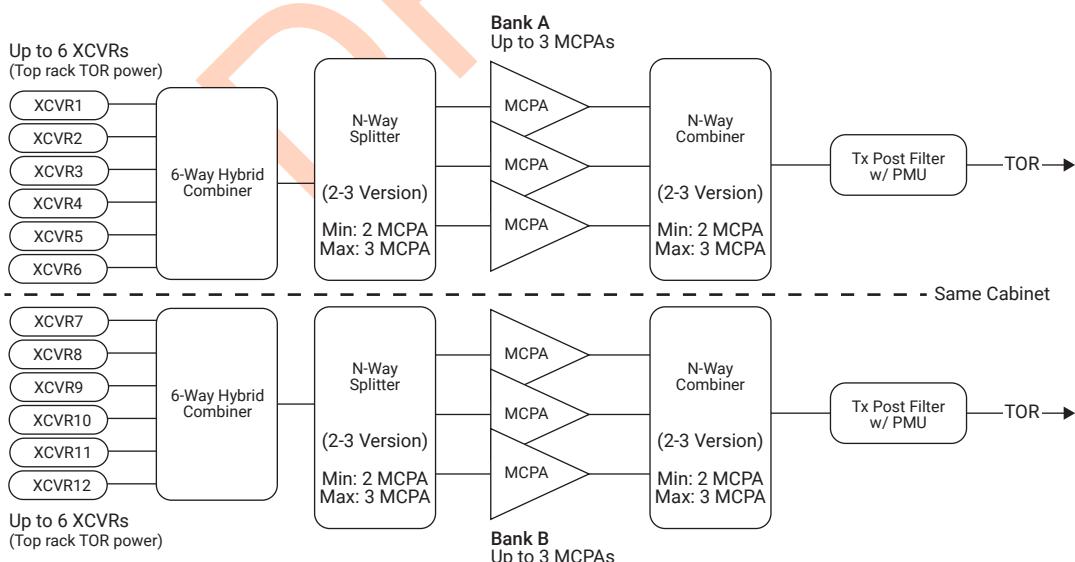


Figure 29: Two Banks with Diplexer Phasing Harness (Different Bands)

One Tx Antenna is used for all Tx carriers.

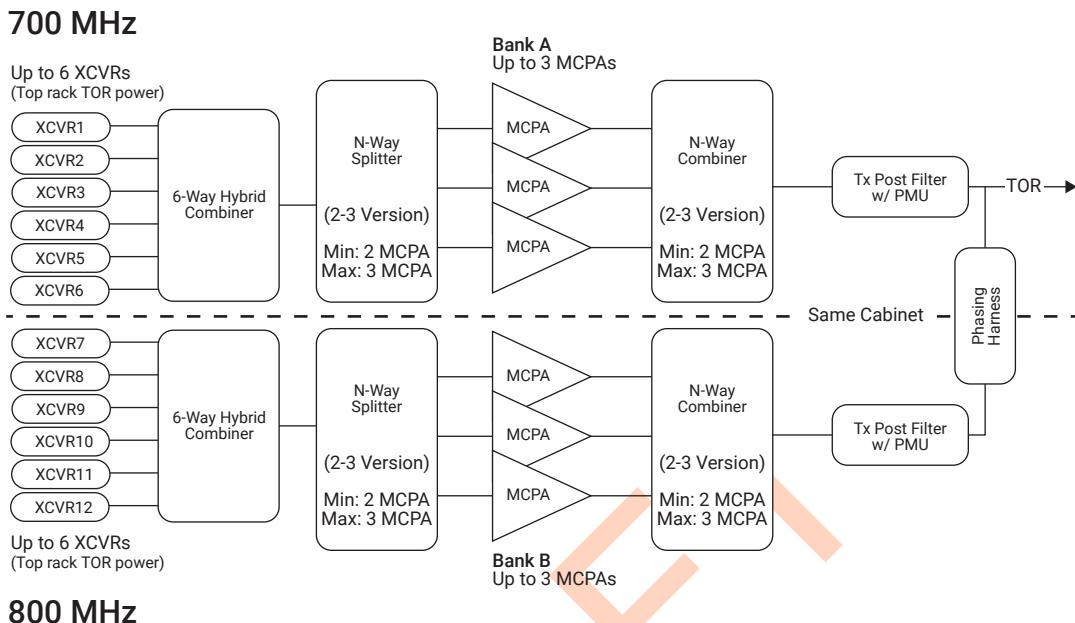


Figure 30: Top of Rack Power for Different Transmitter Configurations

One Bank - 1 to 12 channels with 1 Tx antenna

D-Series

| Single Transmit Antenna | | | | | | | | | | | | |
|-------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| Tx Carriers | 1 | 1-2 | 1-3 | 1-4 | 1-5 | 1-6 | 1-7 | 1-8 | 1-9 | 1-10 | 1-11 | 1-12 |
| Power per carrier (W) | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 32 | 29 |

Example 1:
Carriers 1 through 8 **each** deliver 37 Watts to ToR

Example 2:
Carriers 1 through 12 **each** deliver 29 Watts to ToR

Two Banks (with or without diplexing) - 1 to 12 channels with 2 Tx antennas or 1 Tx antenna diplexed

| D-Series | Transmit Antenna 1 | | | | | | Transmit Antenna 2 | | | | | |
|-----------------------|--------------------|----|-----|-----|-----|-----|--------------------|-----|-----|-----|------|------|
| | Tx Carriers | 1 | 1-2 | 1-3 | 1-4 | 1-5 | 1-6 | 1-7 | 1-8 | 1-9 | 1-10 | 1-11 |
| Power per carrier (W) | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |

1.5

DBR M12 MultiCarrier Site RFDS Receive Path

The receive path of the RFDS includes the following equipment for 700/800MHz:

Site Preselector

Provides signal filtering for the inbound signal. RF input and output connectors on the front of the device are connected to the antenna feed and a Receive Multi-Coupler (RMC). An port for monitoring the input spectrum is also provided.

Site Receive Multi-Couplers/Low Noise Amplifiers

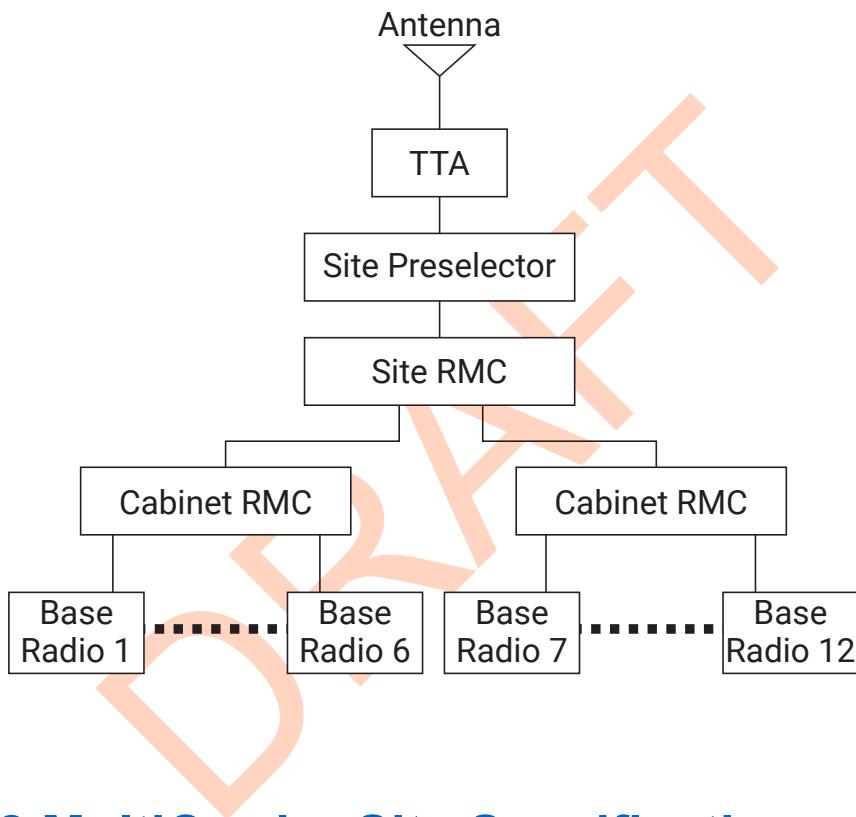
Each receive path includes an RMC or Low Noise Amplifier (LNA) with a balanced amplifier and a 6-way splitter that can be used to distribute inbound signaling to multiple expansion racks. RF input and output connectors on the front of the device are connected to the preselector and the cabinet RMC.

Cabinet Receive Multi-Couplers

Provide a 6-way splitter used to distribute inbound signaling to the base radios to complete the receive path. RF input and output connectors on the front of the device are connected to the Site RMC and the XCVR.

The Tower Top Amplifiers (TTAs) are only present if supplied by your organization.

Figure 31: DBR M12 MultiCarrier Site Receive Path (700/800 MHz)



1.6

DBR M12 MultiCarrier Site Specifications

The TIA specifications for the base radio include the following Methods and Performance recommendations:

Phase 1 (includes Linear Simulcast):

- Methods: TIA-102.CAAA-F, "Project 25 Digital C4FM/CQPSK Transceiver Measurement Methods" September 2021
- Performance: TIA-102.CAAB-E, "Project 25 Land Mobile Radio Transceiver Performance Recommendations, Digital Radio Technology, C4FM/CQPSK Modulation", September 2021

Phase 2:

- Methods: TIA-102.CCAA-C, "Project 25 Two-Slot Time Division Multiple Access Transceiver Measurement Methods", July 2022

- Performance: TIA-102.CCAB-B, "Project 25 Two-Slot Time Division Multiple Access Transceiver Performance Recommendations", July 2022.



IMPORTANT: Specifications are subject to change without notice.

1.6.1

Specifications for DBR M12 MultiCarrier Site for Integrated Voice and Data (700/800 MHz)

Table 5: General Specifications for DBR M12 MultiCarrier Site for IV&D (700/800 MHz)

| General Specifications | |
|--|--|
| Model Number | SQM01SUM0338A |
| Maximum Number of Channels | 12 |
| Height | |
| Cabinet Version: | 84.8 in. (215 cm) 43 Rack Units |
| 7.5 ft. Open Rack Version: | 90.4 in. (230 cm) 48 Rack Units |
| 7 ft. Open Rack Version: | 84.3 in. (214 cm) 44 Rack Units |
| Footprint (W x D) | |
| Cabinet Version: | 23.5 x 23.5 (60 x 60 cm) |
| Open Rack Version: | 20.5 x 23.5 in. (52 x 60 cm) |
| Weight (fully configured with gateways) | |
| Cabinet Version: | 660 lbs (300 kg) |
| 7 Foot Open Rack Version: | 500 lbs (227 kg) |
| 7.5 Foot Open Rack Version: | 510 lbs (231 kg) |
| Temperature Range, Operating | |
| Open Rack: | -22 to 140 °F (-30 to 60 °C) |
| Cabinet with Doors: | -22 to 140 °F (-30 to 60 °C) |
| Temperature Range, Storage | -40 to 185 °F (-40 to 85 °C) |
| Operating Altitude | Up to 1800 meters (5900 ft.) above mean sea level Above 1800 meters (5900 ft.), the derating is 1.5 °C/km (0.8 °F/1000 feet) Maximum operational altitude is 5000 meters (16900 ft.) |
| Power Supply Input | DC: 43.2–60 VDC AC: 90–264 VAC, 47–63 Hz (Optional T8926A) |
| Power Consumption – (2-40 W, 12 carriers) (without gateways) | DC: C4FM, H-DQPSK, LSM: 4800 W max. AC (Optional T8926A): C4FM, H-DQPSK, LSM: 5500 W max. |

General Specifications

Power Consumption – (2-40 W, 12 carrier) (with gateways)

DC: C4FM, H-DQPSK, LSM: 4800 W max.

AC (Optional T8926A): C4FM, H-DQPSK, LSM: 5500 W max.

Power Supply Type

Switching

Input/Output Impedance

50 Ohms

Antenna Connector Types

Tx: 4.3-10 Female
Rx: 4.3-10 Female

Channel Spacing

12.5/25 kHz

Transmit Combiner Spacing

50 kHz

Frequency Stability

- Repeater Site*:
100 ppb/2yr or GPS synchronized
- Simulcast (multisite):
GPS synchronized

Frequency Generation

Synthesized

Table 6: Transmitter (Cabinet Output) Specifications for DBR M12 MultiCarrier Site for IV&D (700/800 MHz)

| Transmitter Specifications: Including RFDS | |
|--|--|
| Frequency Range | 768-776, 851-870 MHz |
| Average power output per channel | 2-40 W (w/2-3 N-Way, 1-6 channels) 2-37 W (w/ 4-6 N-Way, 1-10 channels) 2-32 W (w/4-6 N-Way, 1-11 channels) 2-29 W (w/4-6 N-Way, 1-12 channels) |
| Modulation Fidelity | 5% |
| Spurious and Harmonic Emissions Attenuation | 75/90 dB |
| Modulation | C4FM, LSM, H-DQPSK |
| Emissions Designators (Mid-Power, 700/800 MHz) | 8K70D1E, 8K70D1D, 8K70D1W 8K10F1E, 8K10F1D, 8K10F1W 9K80D7E, 9K80D7D, 9K80D7W |
| Adjacent Channel Power Ratio | |
| 12.5 kHz offset, 6 kHz BW: | 67 dB |
| Intermodulation Attenuation | 80 dB |

Table 7: Transmitter RF Distribution System for DBR M12 MultiCarrier Site for IV&D (700/800 MHz)

| Transmitter RF Distribution System Specifications | |
|---|----------------------|
| Frequency Range | 768-776, 851-870 MHz |
| Insertion Loss (50 kHz spacing) | 0.64 dB typ |

Table 8: Receiver (Top of Cabinet) Specifications for DBR M12 MultiCarrier Site for IV&D (700/800 MHz)

| Receiver Specifications, including RFDS | |
|--|-------------------|
| Frequency Range | 796-825 MHz |
| Modulation | C4FM, H-CPM |
| Digital Sensitivity 5% Bit Error Rate Static (BER) | |
| | C4FM: -123.5 dBm |
| | H-CPM: -121.5 dBm |
| Faded Sensitivity 5% Bit Error Rate (BER) | |
| | C4FM: -116 dBm |
| Intermodulation Rejection | 80 dB |
| Digital Adjacent Channel Rejection | 60 dB |
| Spurious and Image Response Rejection | 100 dB |
| Blocking Immunity | 100 dB |
| Signal Displacement Bandwidth | 1 kHz |
| Intermediate Frequencies | |
| | 1st: 73.35 MHz |
| | 2nd: 2.16 MHz |
| Electronic Bandwidth | Full Bandwidth |
| Conducted Spurious | -57 dBm |
| Bit Error Rate Floor | 0.01% |

Table 9: Receiver RF Distribution System for DBR M12 MultiCarrier Site for IV&D (700/800 MHz)

| Receiver RF Distribution System Specifications | | |
|--|-------------|-------------------------|
| | Typical | Limit |
| Frequency Range | 796–825 MHz | |
| Noise Figure | 3.5 dB | 5 dB |
| Gain | 10 dB | -21 to 31 dB adjustable |
| 3rd Order Output Intercept | 18 dB | |
| Amplifier Intercept | | 39 dBm |
| Preselector Bandwidth | 792–825 MHz | |
| RF Input Connector Type | QMA | |
| RF Output Connector Type | QMA | |

Table 10: FCC Identification for DBR M12 MultiCarrier Site for IV&D (700/800 MHz)

| FCC Identification | | | |
|--------------------|-------------|--------------|------------------------|
| Frequency Range | Type | Power Output | Type Acceptance Number |
| 851–870 MHz | Transmitter | 2-40 W | ABZ89FT5901 |

Table 11: DBR M12 MultiCarrier Site Transmit Filter Specifications (700/800/900 MHz)

| | Tx Filter Spec Limit (700/800/900 MHz) | Typical | Notes |
|--|---|---------|------------|
| Frequency Range | 762–776 MHz, 851–870 MHz | | |
| Insertion Loss (700 or 800 MHz filter) | 0.5 dB | 0.3 dB | |
| Port Return Loss | 14 dB | 17 dB | |
| Rx Selectivity | 60 dB | | |
| RMS Input Power | 650 W | | |
| Peak Instantaneous Power | 32k W | | |
| Passive Intermodulation | –135 dBc | | 2 x 43 dBm |
| RF Connector Type | Tx connection from combiner (4.3-10) | | |
| Power Monitor Unit (PMU) Accuracy | +/- 10% (20–600 W), +/- 20% (1–20 W) | | |
| Power Monitor Connector Type | RJ45 Ethernet | | |
| Forward and Reflected Power Range | 0–650 W | | |

Table 12: DBR M12 MultiCarrier Site Preselector Filter Specifications (700/800 MHz)

| | DBR M 12 RF Site Preselector Spec Limit (700/800 MHz) | Typical |
|---------------------------|---|---------|
| Frequency Range | 792–825 MHz | |
| Insertion Loss | 1 dB | 0.8 dB |
| Return Loss | 14 dB | 17 dB |
| Tx Selectivity | 75 dB | |
| Test Port Coupling | –30 dB | |
| Input Connector (Antenna) | 4.3-10 female | |
| Output Connector | QMA female | |
| Test Port Connector | BNC | |

DBR M12 MultiCarrier Site RFDS Elevation Derating

Above 3000 meters (9800'), the peak power derating for the Tx RFDS is 1dB/1km (0.3 dB/1000ft). So at 5000 meters (16400') full power is limited to 9 carriers.

1.6.1.1

DBR M12 MultiCarrier Site Innovation Science and Economic Development Canada (700/800 MHz)

Table 13: Innovation Science and Economic Development Canada for DBR M12 MultiCarrier Site (700/800 MHz)

| ISED Approval Number | Frequency Range | Type | Power Output | Hardware Version Identification Number (HVIN) |
|----------------------|----------------------------------|------|-------------------------------|---|
| 109AB-T5901 | Tx 851-869 MHz Rx 806-824 MHz | LSM | Variable 2-40 Watts (average) | T8899-800 |
| 109AB-T5901 | Tx 851-869 MHz Rx 806-824 MHz | C4FM | Variable 2-40 Watts | T8899-800 |

1.6.2

DBR M12 MultiCarrier Site Receive Expansion Cable Length Specifications

The receive expansion cables connect the expansion cabinets and are not provided. To achieve a good balance between all receivers, it is recommended to maintain the lengths within $\pm 50\%$ of the values listed in the following table. A nominal of 1dB is recommended.

Table 14: DBR M12 MultiCarrier Site Receive Expansion Cable Length Specifications

| Cable Type | Length (ft) | Length (m) |
|------------------------------|-------------|------------|
| EnviroFlex™ EF142 | 7 | 2.1 |
| 1/4" Superflex or equivalent | 18 | 5.4 |
| 3/8" Superflex or equivalent | 26 | 8 |
| 1/2" Superflex or equivalent | 29,5 | 9 |

1.6.3

Receive Multi-Coupler/Low Noise Amplifier(RMC/LNA) and Multi-Coupler (RMC) Specifications (700/800 MHz)

Table 15: Site Receive Multi-Coupler/Low Noise Amplifier Specifications

| Item | Site RMC/LNA Specification Limit | Site RMC/LNA Typical |
|---|----------------------------------|----------------------|
| Frequency Range | 796-825 MHz | |
| Attenuator Range | 0-31 dB | |
| Default Attenuator Setting (Factory preset) | 0 dB | |
| Default Gain (Factory preset) | 21.5 dB | 23 dB |
| Noise Figure | 1.7 dB | 1.4 dB |
| Third Order Output Intercept | | 29dBm |
| Input Connector Type | QMA | |
| Output Connector Type | QMA | |
| VSWR max (All ports) | 1.5 : 1 | |

Table 16: Cabinet Receive Multi-Coupler Specifications

| Item | Cabinet RMC Specification Limits | Cabinet RMC Typical |
|------------------------------|----------------------------------|---------------------|
| Frequency Range | 796-825 MHz | |
| Attenuator Range | N/A | |
| Default Attenuator Setting | N/A | |
| Default Gain | -9.6 dB | -10 dB |
| Noise Figure | 9.6 dB | 10 dB |
| Third Order Output Intercept | | 100dBm |
| Input Connector Type | QMA | |
| Output Connector Type | QMA | |
| VSWR max (All ports) | 1.5 : 1 | |

Chapter 2

DBR M12 MultiCarrier Site Equipment Installation

This chapter provides procedures necessary to install the DBR M12 MultiCarrier Site equipment.

2.1

Breaker Recommendations

This section provides information about the rack/cabinet configuration that yields the greatest current draw. That is, racks/cabinets loaded with modules to support 12 carriers transmitting at full rated output power, the receive diversity option, the site router option, and the DSC 8500 rubidium option.

The top of the rack/cabinet contains two sets of terminal blocks to accept the DC feed line sets. Both of these feed line sets are required to reduce the current supplied through any one set of DC input cables to a value within the rating of the DC cable's maximum size (1 AWG) or reasonably limiting the voltage drop of the two feed line sets.

The breaker recommendations for two 1 or 2 AWG feed line sets that feed the two terminal blocks are as follows:

- Site installation must include a current interrupting device (fuse or circuit breaker) on each of the two feed line sets supplying the two terminal blocks.
- The current interrupting device for each of the two feed line sets should be 85A.
- For more information about the sizing of cables and the DC power distribution in installations utilizing rack/cabinet configurations with lesser current draw, see the *Standards and Guidelines for Communication Sites* manual.

2.2

Cabling Requirements

Diagrams for cabling are typically included in the system-specific configuration documentation Motorola Solutions provides.

Also see the Motorola Solutions *Standards and Guidelines for Communication Sites* manual for cabling standards.



IMPORTANT: System certification was completed using shielded cables. To prevent emission problems, use only shielded cables. Do not substitute other cable types.

- Position the equipment to avoid excessive tension on cables and connectors. Cables must be loose with absolutely no stress on the connectors. Careful cable routing and securing the cables with tie wraps (or other devices) is one way to provide this protection. Set up preventive maintenance loops.
- Dress the cables neatly using cable ties. Do not tighten the cable ties until you are sure that the required service length and bend radius requirements are met. Leave cable ties loose enough to allow adjustment.
- Verify that all cables are properly labeled to match system-specific configuration documentation Motorola Solutions provided.

- Ensure that cables do not exceed the minimum bend radius as outlined in the Motorola Solutions manual for cabling standards.

⚠ CAUTION: Use only Category 5e Shielded Twisted Pair (or higher) for cabling Ethernet connections. Motorola Solutions has engineered this system to meet specific performance requirements. Using other cabling and connectors may result in unpredictable system performance or catastrophic failure.

ATTENTION: Utilisez uniquement une paire torsadée blindée de catégorie 5e (ou supérieure) pour le câblage des connexions Ethernet. Motorola Solutions a conçu ce système pour répondre à des exigences de rendement particulières. Utiliser d'autres câblages et connecteurs peut entraîner une performance imprévisible du système ou une panne catastrophique.

For more information on cabling guidelines, see the documentation supplied with components from each equipment manufacturer.

2.2.1

DBR M12 MultiCarrier Site Grounding

In the DBR M12 MultiCarrier Site, each module, or each card cage that contains multiple modules, is grounded to the rack grounding bar by the use of 6 AWG ground bond cables. The rack grounding bar must be connected to the master grounding bus bar by 2 gauge, 75C rated wire (capable of 170A single conductor) per NEC table 310.15(B)(17).

Ground conductor must be connected with the included Panduit LCC2-14A-Q crimp lugs. Crimp connections must be made in accordance with Panduit instructions and by using only the approved tools and dies.

The supplementary grounding bus bar must be connected to the master grounding bus bar by 2 gauge, 75C rated wire (capable of 170A single conductor) per NEC table 310.15(B)(17)

If a cabinet enclosure is used, you must create a connection from the cabinet top to the #2 wire by using an inline splice, #6 AWG wire, a 5/8" spacing double right angle lug, (Panduit LCC6-14AWF-L or equivalent UL rated crimp lug) and the two studs that use the M5 nuts.

If the site grounding system is below the rack instead of above the rack, all #6 AWG ground bonding cables must be rerouted or reversed to connect below each chassis and connection point on the equipment with accordance to R56 guidelines for cable dressing and bend radius requirements. New #6 AWG cables for the RFDS filter elements are required to connect all modules connected to the supplementary ground bus bar to the main grounding bus bar instead. These cables are not provided or available as a standard, and must be procured or fabricated separately.

For more information about the Panduit instructions, see <https://www.panduit.com/content/dam/panduit/en/products/media/1/51/051/7051/111357051.pdf>.

For more information about the approved tools and dies, see <https://www.panduit.com/content/dam/panduit/en/products/media/4/04/804/3804/100863804.pdf>.

2.3

Floor Mounting

Open Rack

Figure 32: Open Rack Floor Mounting Detail

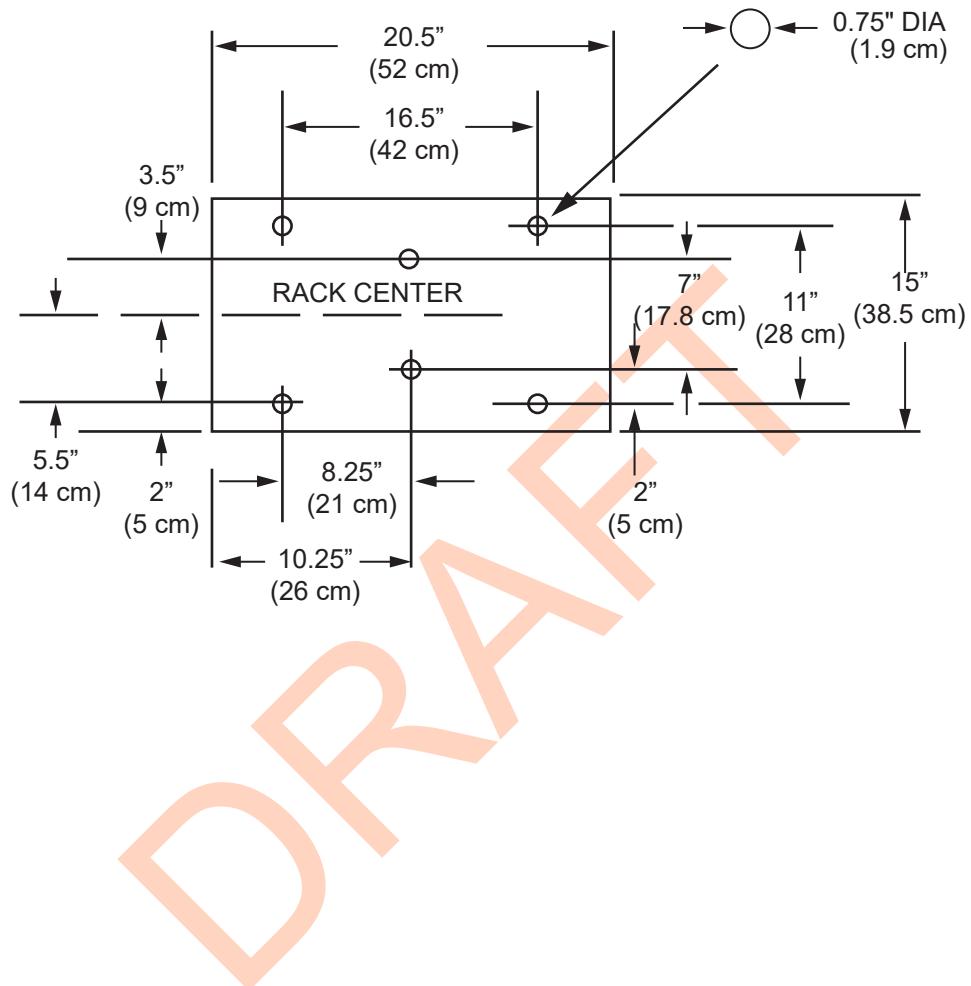
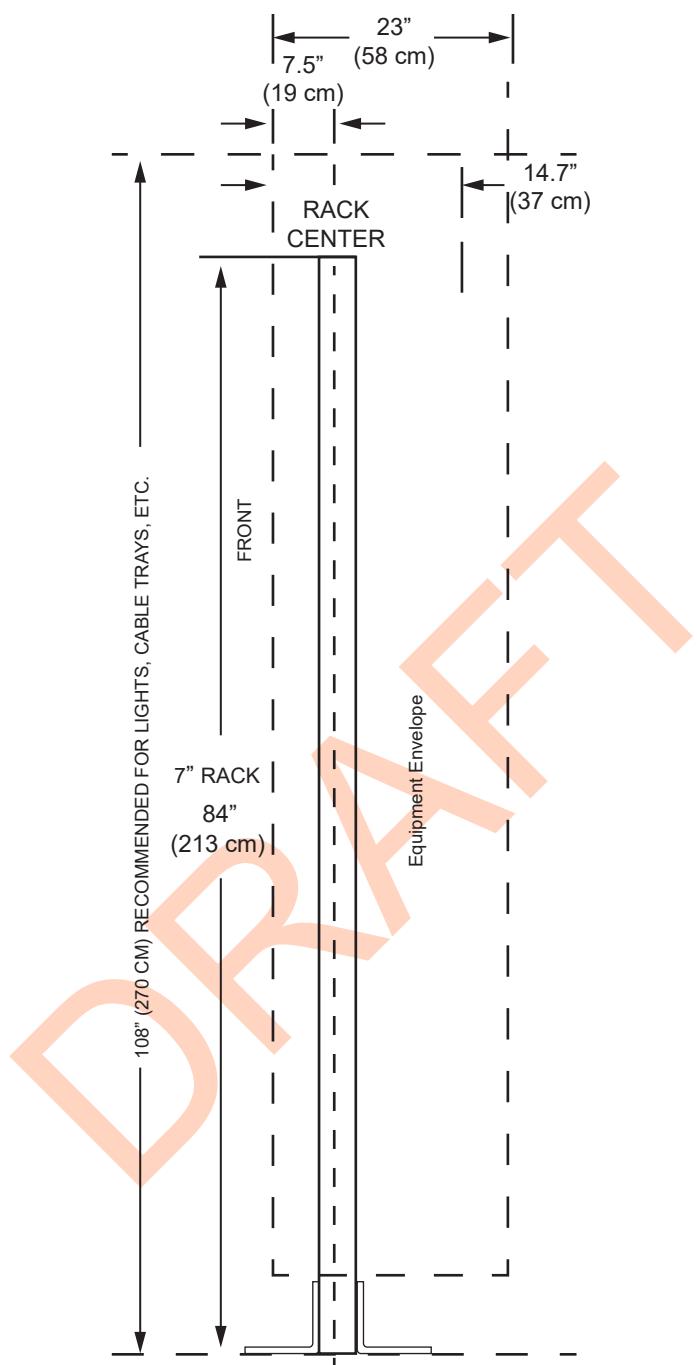
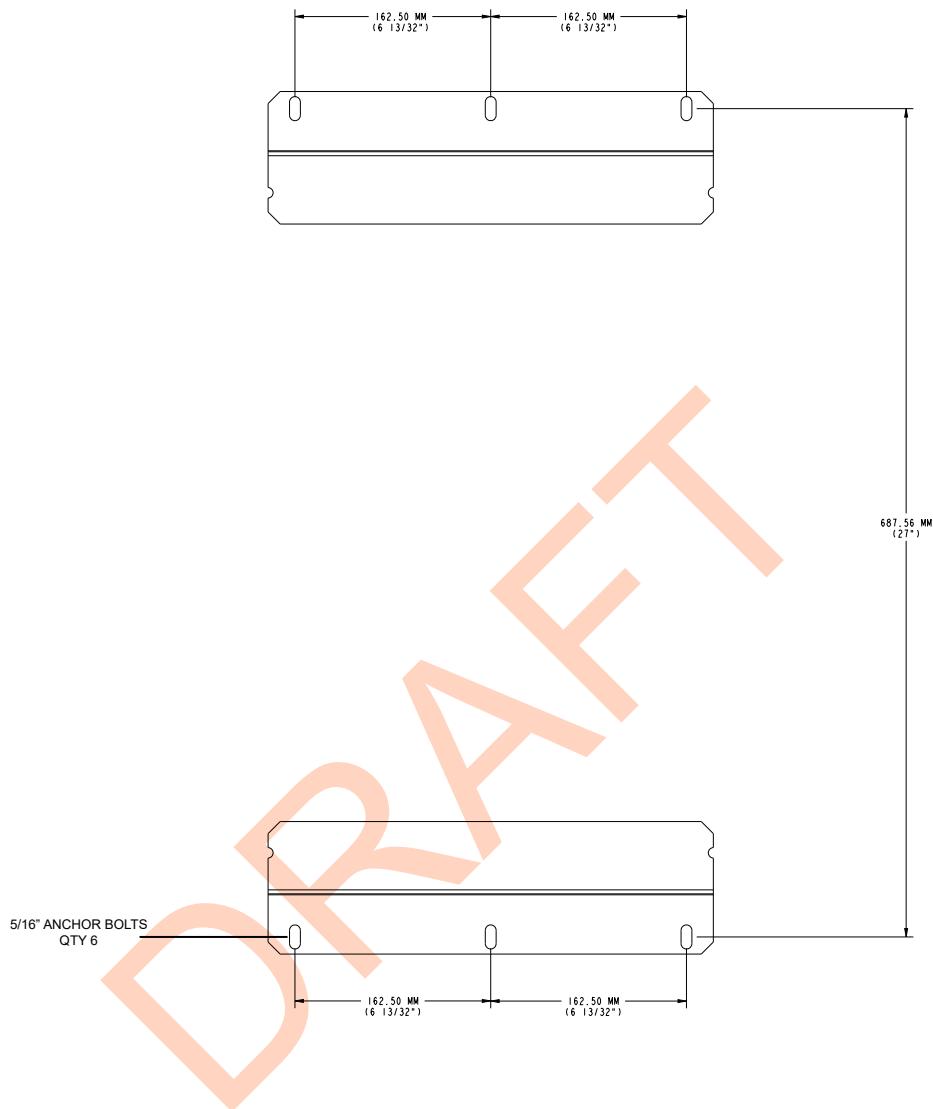


Figure 33: Open Rack – Side View

Cabinet

Figure 34: Cabinet Floor Mounting Detail



2.4

Frequency Reference Connection

The DBR M12 MultiCarrier Site is a fully integrated solution with an option to interface to GPS receivers. You can add redundant rubidium frequency references to provide an extended holdover on GPS signal loss.

It is recommended that new sites utilize these new capabilities as they save space and power at the site.

2.5

Connecting GPS to the DSC 8500

Procedure:

1. Assemble the GNSS antenna. See [Assembling the GNSS Antenna on page 60](#).
2. Connect the lightning arrestor to the GNSS antenna cable.

For information on the lightning arrestor, see [GNSS Lightning Arrestor on page 62](#).

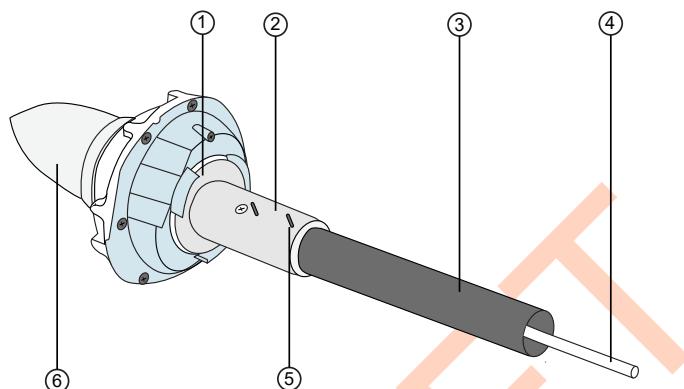
3. Install the GNSS antenna. See [Installing the GNSS Antenna on page 63](#).

2.5.1

Assembling the GNSS Antenna

You can use this procedure to assemble a Global Navigation Satellite System (GNSS) antenna in a trunking system.

Figure 35: PMUG1018A GNSS Antenna Assembly – Exploded View



| Annotation | Description |
|------------|--|
| 1 | M4 screw |
| 2 | Collar bracket |
| 3 | 1" ID Schedule 40 Aluminum pipe |
| 4 | GNSS antenna/receiver to site controller cable |
| 5 | M3 set screw |
| 6 | GNSS antenna assembly |

The following part numbers are valid for the relevant elements:

GNSS Antenna Assembly

PMUG1018A

Mounting Pole (aluminum pipe)

DSP04268

Wall Mount Brackets for GNSS Timing Antenna

DSWM4

GNSS Antenna/Receiver to DMS 8000 Cable

- CB001133A05 (125 ft)
- CB001133A01 (350 ft)

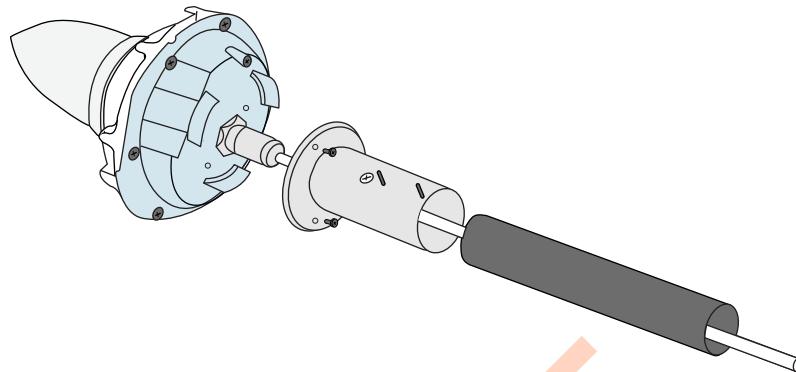
Prerequisites:

Verify that you have a 1.5 mm Allen wrench, a T20 and T40 screwdrivers, and a Phillips screwdriver.

Procedure:

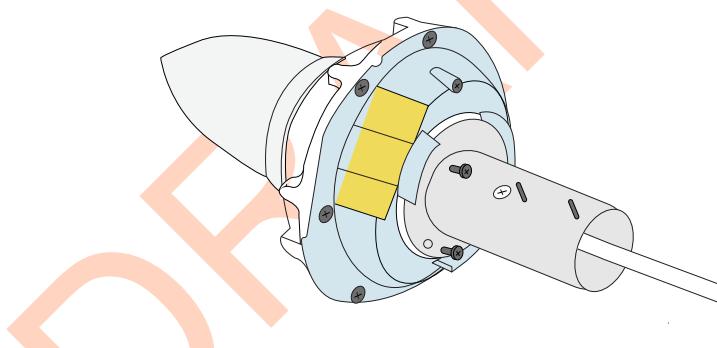
1. Run the digital cable through the mounting pole and collar bracket. Attach the digital cable connector to bottom of the antenna module (Male to female Hirose Connector).

Figure 36: PMUG1018A GNSS Antenna Assembly – Cable



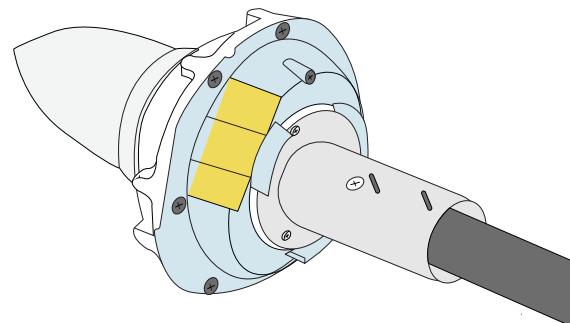
2. Align three bracket screw holes with the GNSS antenna bottom mounting holes and screw the collar bracket to the bottom of the antenna module by tightening the three M4 screws to 10 in-lb with the T20 bit screwdriver.

Figure 37: PMUG1018A GNSS Antenna Assembly – Collar Bracket



3. Fix the mounting pipe to the mounting bracket by tightening the two M3 set screws to 5 in-lb by using a 1.5 mm hex driver or an Allen key.

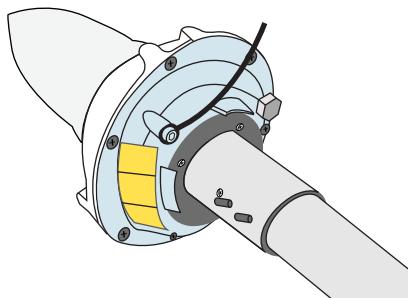
Figure 38: PMUG1018A GNSS Antenna Assembly – Securing the Pipe



4. Attach the mounting pipe to the support structure.

5. Attach the 6 gauge grounding cable to the antenna module by tightening a T6 screw using a T40 screwdriver.

Figure 39: PMUG1018A GNSS Antenna Assembly – Grounding Cable



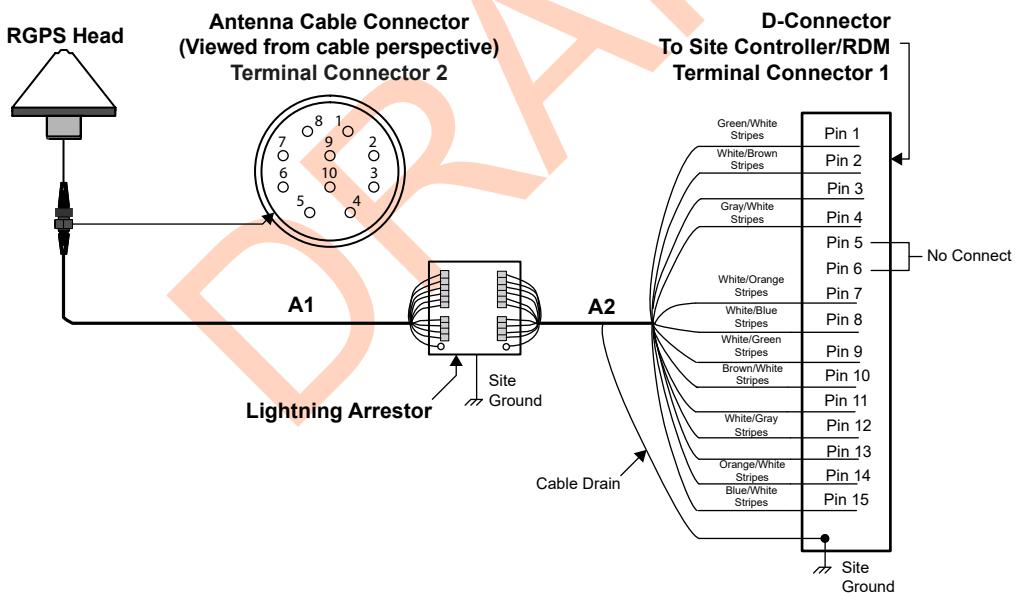
2.5.2

GNSS Lightning Arrestor

A lightning arrestor must be installed between a DSC 8500 and the Global Navigation Satellite System (GNSS) antenna.

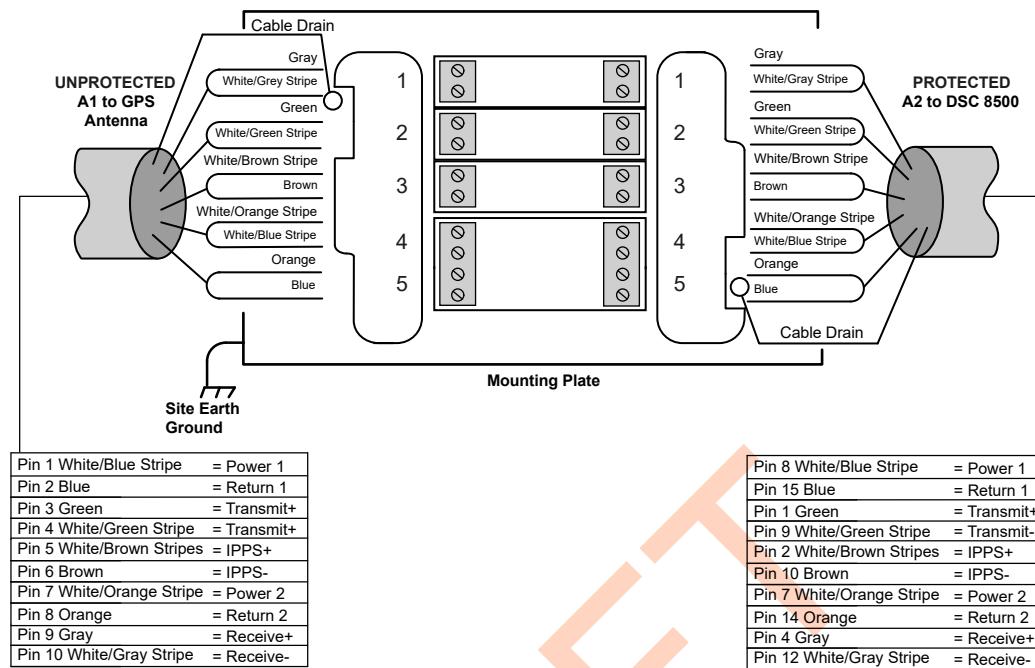
One GNSS antenna is connected to each of the DSC 8500. Each GNSS unit requires its own arrestor. The following figure shows the connections between the lightning arrestor and the DSC 8500.

Figure 40: Lightning Arrestor – System Connections



The following figure shows a possible configuration of the connections and terminal assignments for installing the recommended DS-IX-2L1M1DC48-IG model lightning arrestor.

Figure 41: Lightning Arrestor DS-IX-2L1M1DC48-IG Model Wiring



2.5.3

Installing the GNSS Antenna

Procedure:

1. Mount the GNSS antenna with an unrestricted aerial down view to within ten degrees of the horizon in all directions.
2. Mount the GNSS antenna high enough so it has an unobstructed view of the sky.
For northern hemisphere installations, an unobstructed view of the southern sky must be maintained.
For southern hemisphere installations, an unobstructed view of the northern sky must be maintained.
Adjacent structures (such as trees, buildings, and antenna towers) are considered obstructions. If an unobstructed view is not possible, install the GNSS antenna so it has a clear view of the appropriate sky region. Adjacent antenna towers at the RF site which protrude into the required region have a minimal effect on GNSS antenna reception due to their narrow, largely open profiles and are not considered obstructions.
3. Isolate the GNSS antenna from RF interference by mounting the antenna at a distance of at least 3.66 m (12 ft) horizontally from the other antennas.
4. Validate the correctness of the position information (latitude, longitude, elevation) reported by the GNSS antenna.
Proper timing operation is dependent on proper position identification.
5. Connect the GNSS antenna cable to the GNSS port on the DSC 8500.
6. In the Provisioning and Configuration Agent (PCA), discover the GNSS antenna. See [Discovering the Hardware on page 140](#).
7. In the PCA, configure the GNSS antenna. See [Configuring the GNSS Antenna on page 135](#).

Chapter 3

DBR M12 MultiCarrier Site Installation

This chapter details installation procedures relating to the DBR M12 MultiCarrier Site.

3.1

Pre-Installation Tasks

Before installing the DBR M12 MultiCarrier Site, you must obtain the following:

- Appropriate cables
- On-Premises Software Hub (OPSH)
- Provisioning and Configuration Agent (PCA)
- Unified Network Configurator (UNC)
- IP and Domain Name Service (DNS) information
- Appropriate credentials

3.1.1

Preparing the Equipment for Installation

Process:

1. Prepare the site to comply with the Motorola Solutions requirements and specifications for the equipment, as listed in the Motorola Solutions *Standards and Guidelines for Communication Sites* manual. The base radio may be installed in a suitable, restricted access, indoor enclosure in any location suitable for electronic communications equipment. Other codes and guidelines that may apply to the location must also be met. See [General Safety Precautions on page 65](#).
2. Inspect and inventory all racks, cabinets, cables, and other equipment with a Motorola Solutions representative to ensure that the order is complete. See [General Installation Standards and Guidelines on page 72](#).
3. Various tools are used to install and service the equipment. If information is needed regarding where to obtain any of the equipment and tools listed, contact the Centralized Managed Support Operations (CMSO). For a list of general recommended tools for installing and servicing the hardware, see [Installation/Troubleshooting Tools on page 78](#).
4. Install all equipment by using the site drawings and other documents provided by the Field Engineer. Use the installation standards and guidelines for placing and installing equipment.
5. Properly ground all the racks and cabinets to protect against ground faults, electrical surges, and lightning.
6. Connect all necessary cables within a rack and between the racks for system interconnection.
7. Run a preliminary check of a site before applying power.
8. For a list of items you need access to before installing the software, see [Installation/Troubleshooting Tools on page 78](#).

3.2

General Safety Precautions

FCC/ISED Compliance Guidelines

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

AVERTISSEMENT: Les directives de la FCC/ISDÉ en matière d'exposition humaine à l'énergie électromagnétique à proximité des antennes émettrices exigent en général que les personnes qui travaillent sur de tels sites soient conscientes du risque d'être exposées à l'énergie électromagnétique et de la possibilité de contrôler les risques d'exposition en respectant strictement les instructions figurant sur les panneaux d'avertissement, en se reportant aux procédures opérationnelles standard (pratiques de travail), en portant un équipement de protection individuelle ou en limitant le temps d'exposition. Pour plus de détails et des lignes directrices précises, consultez l'« Annexe A : Renseignements sur l'énergie électromagnétique » du manuel des normes et lignes directives relatives aux sites de communications de Motorola Solutions *Standards and Guidelines for Communication Sites*.

Notice to Users (Innovation, Science and Economic Development Canada Canada)

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

Installation guidelines for compliance with RF exposure regulations

This equipment must be installed and operated at a fixed location, in compliance with all applicable code requirements. The antenna installation must comply with all applicable building and safety codes. In order to ensure optimal communication performance and compliance with applicable RF exposure limits, it is recommended that the antenna is installed outside the building hosting this equipment, on the roof or on a tower if at all possible.

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

Declaration of Compliance for the Use of Distress and Safety Frequencies

The radio equipment does not employ a modulation other than the internationally adopted modulation for maritime use when it operates on the distress and safety frequencies specified in RSS-182 Section 7.3.

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

Observe the following general safety precautions during all phases of operation, service, and repair of the equipment described in this manual. Follow the safety precautions listed and all other warnings and cautions necessary for the safe operation of all equipment.

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

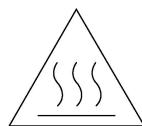
 **NOTE:** The installation process requires preparation and knowledge of the site before installation begins. Review installation procedures and precautions in the Motorola Solutions *Standards and Guidelines for Communication Sites* manual before performing any site or component installation.

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

- Read and follow all warning notices and instructions marked on the product or included in this manual before installing, servicing, or operating the equipment. Retain these safety instructions for future reference.
- If troubleshooting the equipment while power is on, be aware of the live circuits.
- Do not operate the radio transmitters unless all RF connectors are secure and all connectors are properly terminated.
- Ground all equipment properly in accordance with the Motorola Solutions *Standards and Guidelines for Communication Sites* manual and specified installation instructions for safe operation.
- Slots and openings in the cabinet are provided for ventilation. Do not block or cover openings that protect the devices from overheating.
- Only a qualified technician familiar with similar electronic equipment should service equipment.
- Some equipment components can become hot during operation. Turn off all power to the equipment and wait until sufficiently cool before touching.
- Maintain emergency first aid kits at the site.
- Direct personnel to call in with their travel routes to help ensure their safety while traveling between remote sites.
- Institute a communications routine during certain higher risk procedures where the on-site technician continually updates management or safety personnel of the progress so that help can be dispatched if needed.
- Never store combustible materials in or near equipment racks. The combination of combustible material, heat, and electrical energy increases the risk of a fire safety hazard.
- Equipment installed at the site meeting the requirements of a "restricted access location," per UL 62368-1, is defined as follows: "Access can only be gained by service persons. Access to the equipment is by using a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location."

 **BURN HAZARD:** The metal housing of the product may become extremely hot. Use caution when working around the equipment.

Figure 42: Warning Label on Hot Modules



WARNING: DC input voltage must be no higher than 60 VDC. This maximum voltage includes consideration of the battery charging "float voltage" associated with the intended supply system, regardless of the marked power rating of the equipment. Failure to follow this guideline may result in electric shock.

AVERTISSEMENT: La tension d'entrée CC ne doit pas être supérieure à 60 V CC. Cette tension maximale tient compte de la « tension flottante » de charge de la batterie associée au système d'alimentation prévu, quelle que soit la puissance nominale indiquée sur l'équipement. Le non-respect de cette directive peut entraîner une décharge électrique.

BURN HAZARD: Disconnect power in the cabinet to prevent injury while disconnecting and connecting antennas.

CAUTION:

All Tx and Rx RF cables outer shields must be grounded per Motorola Solutions *Standards and Guidelines for Communication Sites* manual requirements.

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

AVERTISSEMENT: Tous les blindages extérieurs des câbles RF d'émission et de réception doivent être mis à la terre conformément au manuel des normes et lignes directives relatives aux sites de communications de Motorola Solutions. Tous les câbles RF d'émission et de réception doivent être connectés à un dispositif de protection contre les surtensions conformément au manuel des normes et lignes directives relatives aux sites de communications de Motorola Solutions (*Standards and Guidelines for Communication Sites*). Ne connectez pas les câbles RF d'émission et de réception directement sur une antenne extérieure.

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

3.2.1

RF Site Devices Supplemental Safety Installation Requirements

The Supplemental Safety and Installation Requirements include the following:

- The RF site device must be installed in a suitable, in-building enclosure. A restricted access location is required when installing this equipment into the end system.
- The device can be outfitted with a Class 1 power supply component. This component is equipped with an appliance inlet for connecting to an AC input.
- This device contains a distributed DC power system with DC input terminals that meet SELV DC circuit requirements.
- When installing the equipment, all requirements of relevant standards and local electrical codes must be fulfilled.
- The maximum operating ambient temperature of this equipment is 60 °C. The maximum operating altitude is 3000 meters above sea level.
- The maximum operating ambient temperature of this equipment is 60 °C. The maximum operating altitude is 5000 meters above sea level.

The maximum altitude for full performance of the optionally installed router is 3000 meters above sea level.

For more information, see [Specifications for DBR M12 MultiCarrier Site for Integrated Voice and Data \(700/800 MHz\) on page 49](#).

- The 48 VDC system output to the Multi-Carrier Power Amplifier (MCPA) and DSC 8500 is at an energy hazard level (exceeds 240 VA). When installing into the end system, care must be taken so as not to touch the output wires.
- When the device is used in a DC system, the DC power supply must be located in the same building as the device, and it must meet the requirements of a SELV circuit.

3.2.2

DC Mains Grounding Connections

 **CAUTION:** This equipment is designed to permit the connection of the grounded conductor of the DC supply circuit to the grounding conductor at the equipment. If this connection is made, you must meet all following conditions:

- Connect this equipment directly to the DC supply system grounding electrode conductor or to a bonding jumper from a grounding terminal bar or bus in which the DC supply system grounding electrode conductor is connected.
- Locate this equipment in the same immediate area (such as adjacent cabinets) as any other equipment that has a connection between the grounded conductor of the same DC supply circuit and the grounding conductor (and also the point of grounding of the DC system). Do not ground the DC system elsewhere.
- Locate the DC supply source within the same premises as the equipment.
- Do not install switching or disconnecting devices in the grounded circuit conductor between the DC source and the point of connection of the grounding electrode conductor.

AVERTISSEMENT: Cet équipement est conçu pour permettre la connexion du conducteur de terre du circuit d'alimentation CC au conducteur de terre de l'équipement. Si cette connexion est établie, vous devez respecter toutes les conditions suivantes :

- Connectez cet équipement directement au conducteur de l'électrode de terre du système d'alimentation CC ou à un cavalier de liaison à partir d'un bornier ou d'un bus de terre auquel le conducteur d'électrode de terre du système d'alimentation CC est connecté.
- Placez cet équipement dans la même zone immédiate (comme dans des armoires adjacentes) que tout autre équipement doté d'une connexion entre le conducteur de terre du même circuit d'alimentation CC et le conducteur de terre (et également le point de mise à la terre du système CC). Ne mettez le circuit CC à la terre à aucun autre endroit.
- Localisez la source d'alimentation CC dans les mêmes locaux que l'équipement.
- N'installez pas de dispositifs de commutation ou de déconnexion dans le conducteur de terre entre la source d'alimentation CC et le point de connexion du conducteur d'électrode de terre.

3.2.2.1

Disconnect Device Permanently Connected

Incorporate a readily accessible disconnect device (circuit breaker or switch) in the building installation wiring.