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 (June 2024 Draft)

Chapter 1: DBR M12 MultiCarrier Site Description
Chapter 2: DBR M12 MultiCarrier Site Equipment Installation
Chapter 3: DBR M12 MiltiCarrier Site Installation
Chapter 6.8: Configuring the DBR M12 Trunking RF Site
Chapter 7.18: RFDS Transmit Filter
Chapter 7.19: Setting the Transmitter Power
Chapter 9: DBR M12 MultiCarrier Site FRU Procedures

MOTOROLA SOLUTIONS

ASTRO® 25

INTEGRATED VOICE AND DATA

DBR M12 700/800 MHz RF Site Installation Guide

System Release 2022.HS, 2022.1, 2021.1

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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
Authentication Services Feature Guide	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.
Core Security Management Server Feature Guide	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.
Virtual Management Server Software User Guide	Provides procedures for implementing and managing VMware ESXi-based virtual server hosts on the common Hewlett-Packard Enterprise hardware platform in ASTRO® 25 systems.

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Chapter 1

DBR M12 MultiCarrier Site Description

1.1 DBR M12 MultiCarrier Site Components

Table 1: DBR M12 MultiCarrier Site Components

Site Component	Description
Multi-Carrier Power Amplifier (MCPA)	Accepts a low-level modulated RF signal from the XCVR modules of a given bank and amplifies it for transmission through the site transmit antenna and the combiner module.
Transceiver (XCVR)	Provides the control, exciter, and receiver functions for the base radio.
DSC 8500	Provides site reference, station controller, DSP, and site controller functionally for the base radio.
Combiner	Accepts and combines Tx output from the MCPA modules of a given bank, for delivery to its respective site Tx filter.
Splitter	Accepts the combined low-level modulated RF signal exciter outputs from all XCVR modules of a given bank and then splits the low-level modulated RF signal for delivery to the respective bank's MCPA modules.
Fan	Provides forced air cooling for the MCPA and XCVR modules.

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1.2 DBR M12 MultiCarrier Site Configurations

DBR M12 MultiCarrier Site can contain one or more configurable, integrated cabinets or open rack systems. Each rack or cabinet includes the following components:

- Radio Frequency Distribution System (RFDS) modules that support up to two transmit and receive antennas
  - Receive Multi-Couplers
  - RF combining and splitting modules
  - Transmitter post filter with power monitoring unit
- Up to six Multicarrier Power Amplifier Modules (MCPAs)
- Up to 12 transceiver modules (one module per channel)
- Redundant DSC 8500 that is used for site control, site reference and station control
- Internal DC Power Distribution
- Additional Juniper SRX Routers

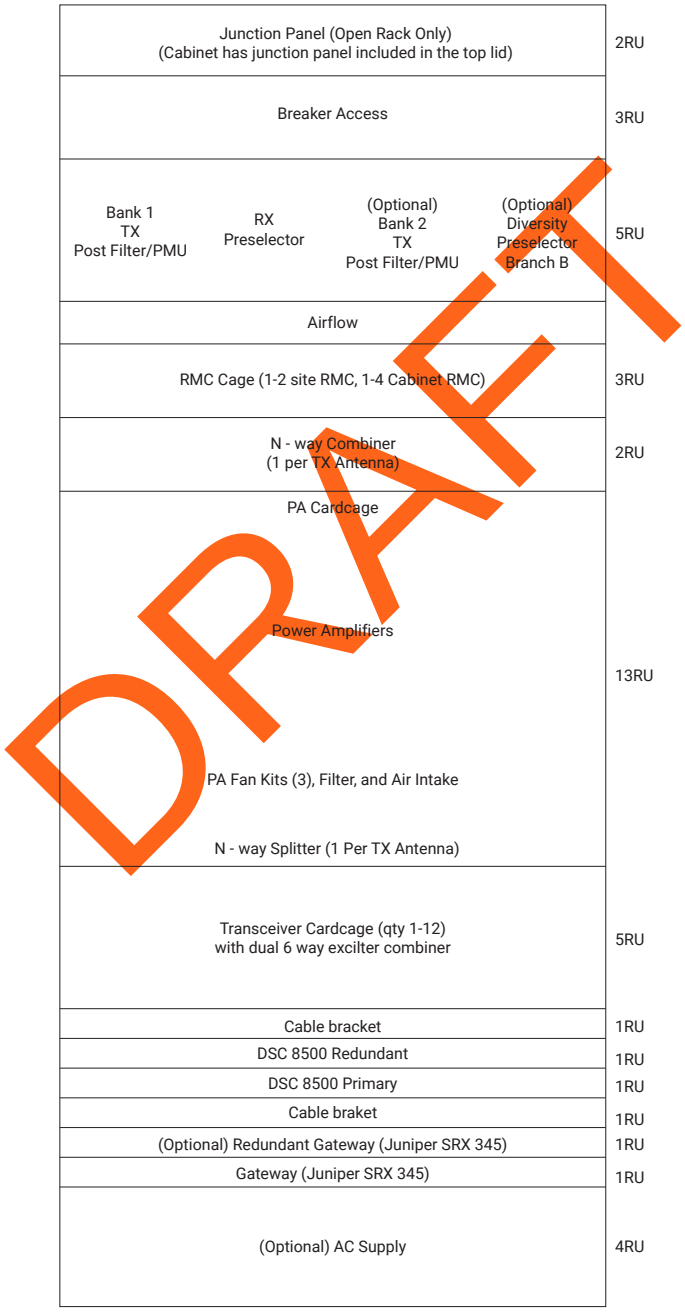
- Additional AC Supply

Each site can support up to 30 channels which means that one site can contain up to three cabinets or racks of equipment.

You can configure each cabinet or rack in a different way, depending on the amount of channels and optional modules that are present.

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

Figure 1: DBR M12 MultiCarrier Site Cabinet



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1.3
Power Distribution Subsection

The top of the rack/cabinet contains a power distribution subsection that takes in the DC feeds from the site DC power system. The power distribution subsection then distributes the power to the various loads within the rack/cabinet through its breaker panel.

1.3.1
DC Power Connections

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.

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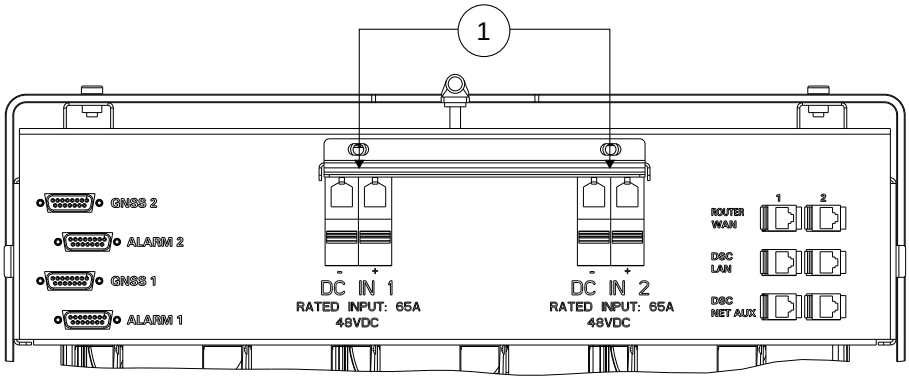
Figure 2: Junction Panel in DBR M12 MultiCarrier Site (Open Rack Version – Top View)



Annotation	Description
1	DC Input Terminal Block Pairs

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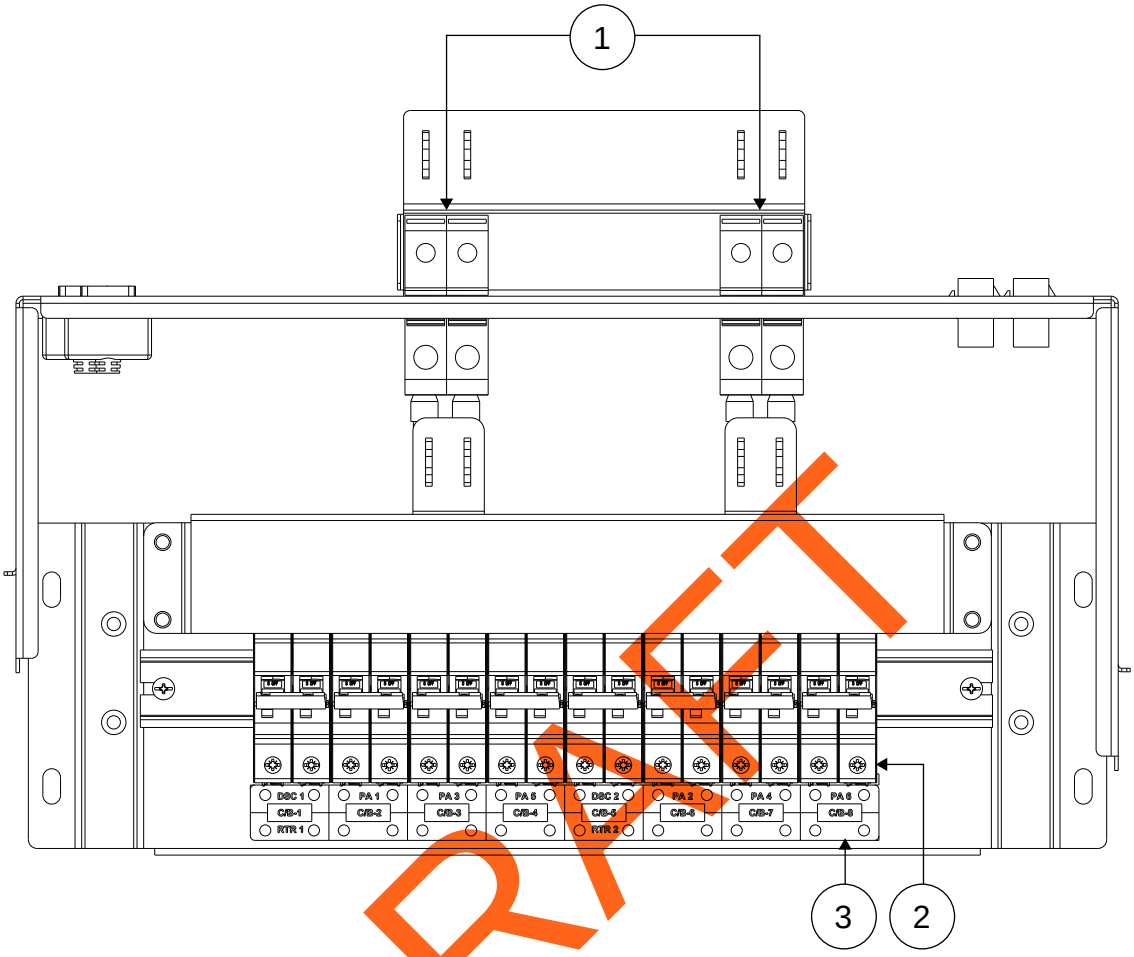
Figure 3: Power Input Distribution in DBR M12 MultiCarrier Site (Open Rack Version – Side View)



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

1.4 Module Physical Description

The following sections describe the physical characteristics of the various modules within the DBR M12 MultiCarrier Site, including the LED and port connection details.

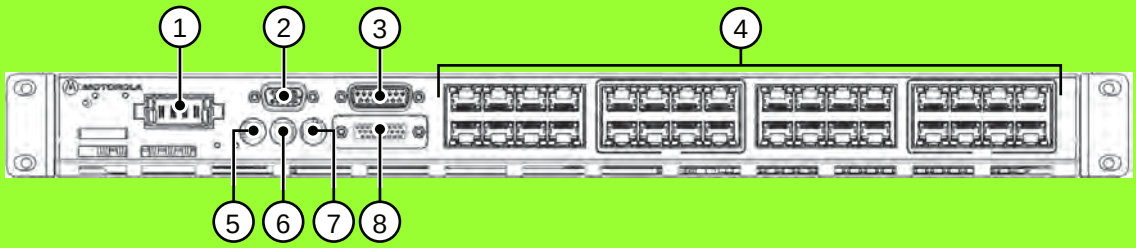
1.4.1 DSC 8500 Physical Description

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 or to an external time/frequency reference (TRAK), if already at the site.

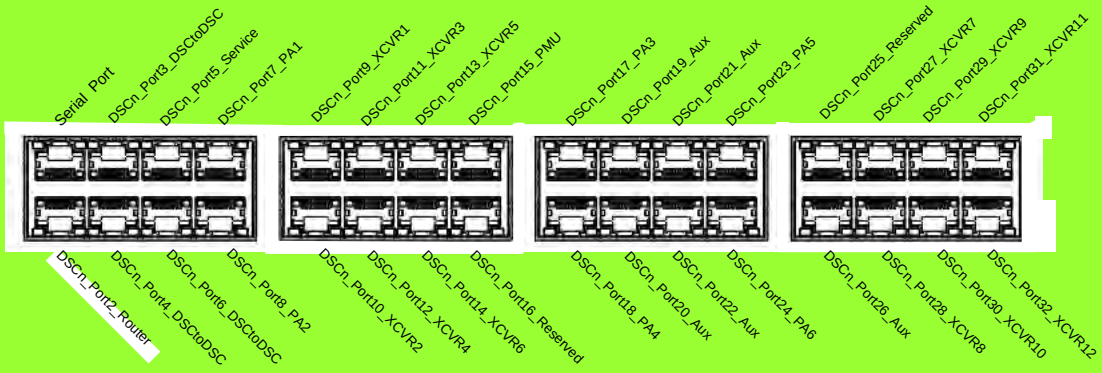
The DSC 8500 can be supplemented with an optional rubidium oscillator device to ensure an extended holdover in the event of GNSS signal loss.

Figure 4: DSC 8500 Front Panel 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 5: 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 2: 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	Function
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 6: Internal Site Alarm Input Pins for External Backup Power Supply Control

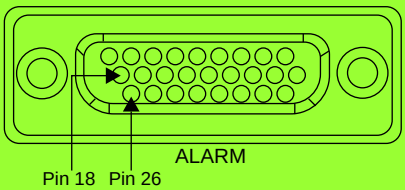
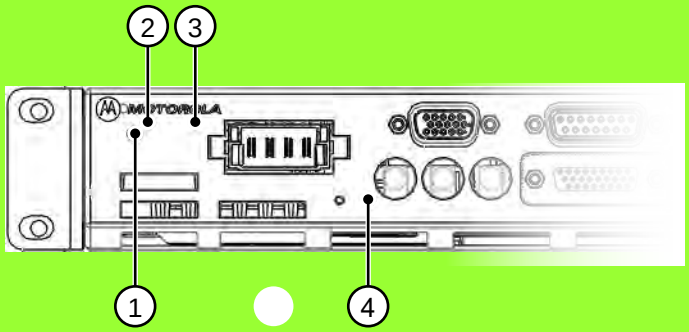


Table 3: DSC 8500 Serial Port Pinout Definition

Pin	Function
Pin 1	No connection
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 7: 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 failure
4	Status LED	GREEN: DSC 8500 functions properly AMBER: meaning is configurable in the Provisioning and Configuration Agent (PCA) RED: DSC 8500 failure

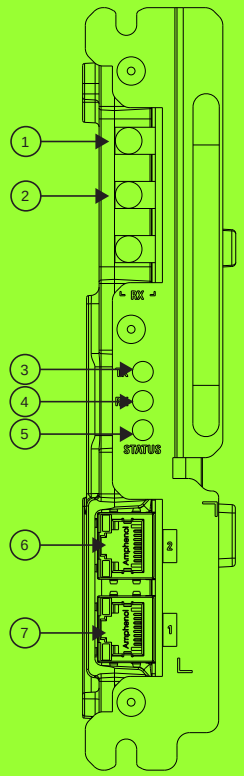
Table 4: DSC 8500 Physical Parameters

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)

1.4.2
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.

Figure 8: XCVR Front Panel LEDs and Ports



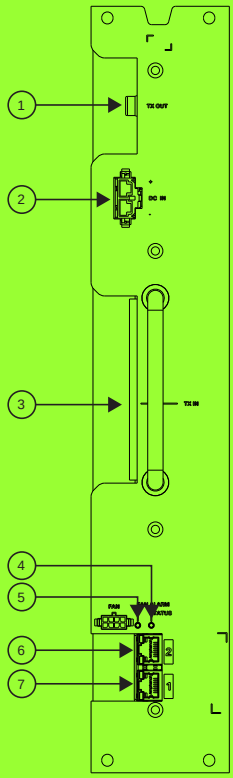
Item	Description	Status
1	RX 1	Receiver one RF input connection (QMA – female)
2	RX 2	Receiver two RF input connection (QMA – female)
3	Tx LED	SOLID GREEN: transmitter is keyed OFF: transmitter is not keyed
4	Rx LED	SOLID GREEN: receiving a qualified Rx carrier OFF: not receiving a qualified Rx carrier
5	Status LED	SOLID GREEN: XCVR is functioning properly SOLID AMBER: One of the two following conditions (not faults): ● 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: ● 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

1.4.3

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 9: 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	SOLID GREEN: MCPA functions properly SOLID AMBER: One of the two following conditions (not faults): ● MCPA waiting for Hardware Discovery to be executed ● MCPA is not enabled within its bank by the DSC 8500 FLASHING AMBER: MCPA is user disabled (not a fault) SOLID RED: One of the two following conditions: ● MCPA is booting (< 5 second duration immediately after power up) ● MCPA is in a fault condition
5	Fan Alarm LED	SOLID GREEN: transmitter is keyed OFF: transmitter is not keyed

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

1.4.4

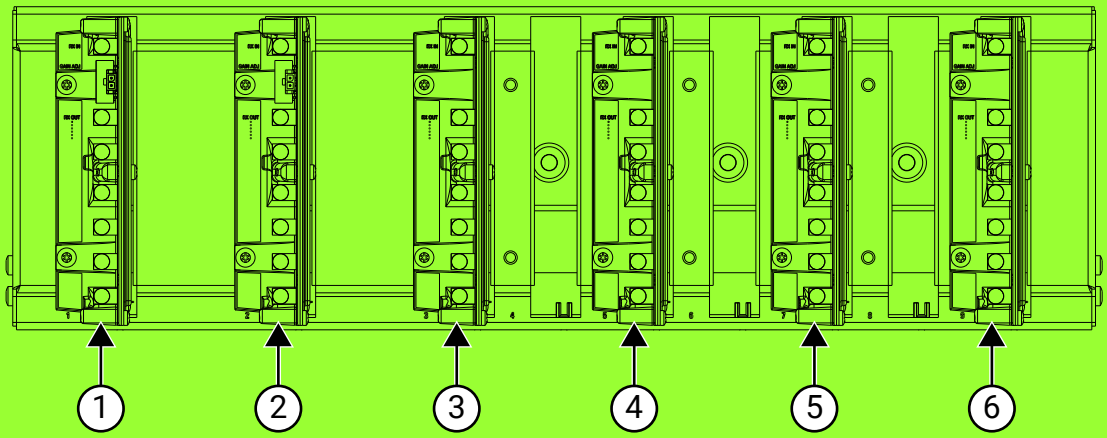
RMC Physical Description

The site Receive Multi-Coupler (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.

There are two types of RMCs that are used in the DBR M12 MutiCarrier Site rack.

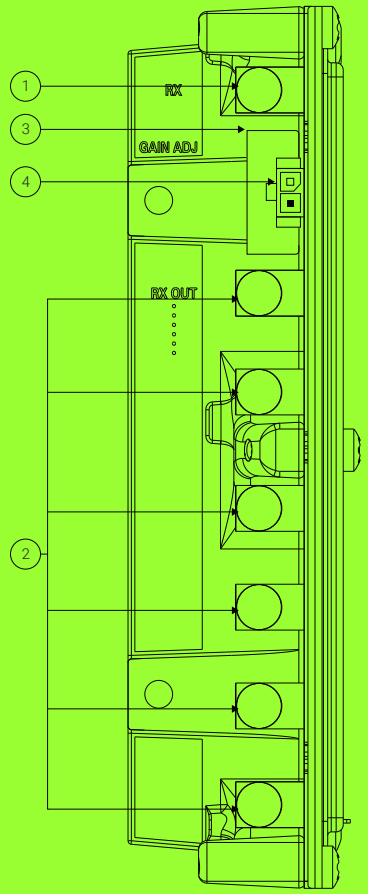
The cabinet RMCs take the receive signal from the site RMC and further split among XCVRs in the rack.

Figure 10: 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 11: Site RMC

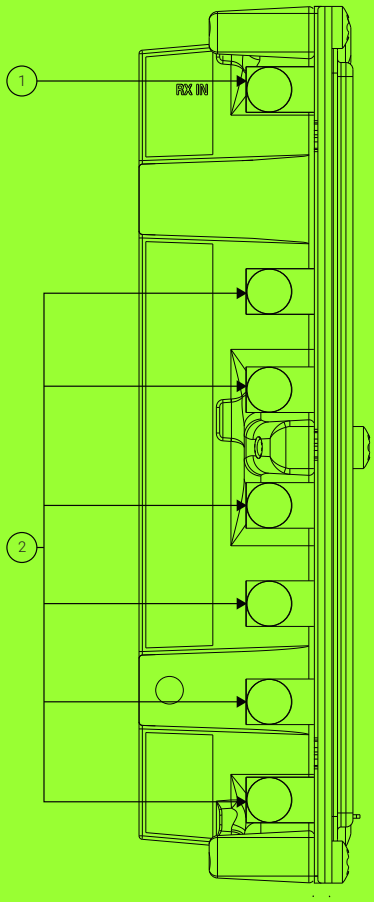


Annotation	Description
1	Rx In
2	Rx Out 1-6
3	Gain DIP Switch
4	RMC Alarm Connector

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 67.

Figure 12: 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 5: 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

1.4.5

N-Way Combiner Physical Description

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

Figure 13: 2-3 Way Combiner

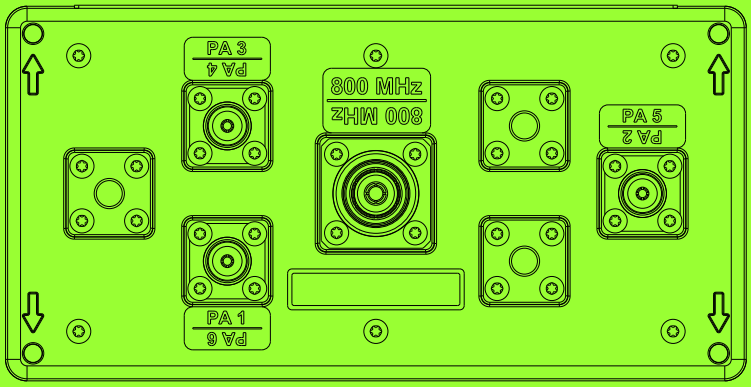


Figure 14: 2-3 Way Combiner on Bracket

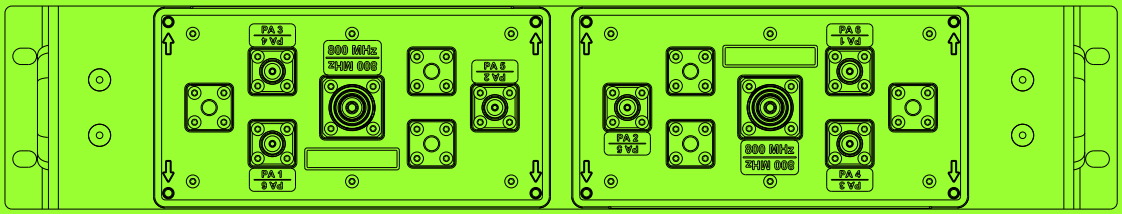


Figure 15: 4-6 Way Combiner

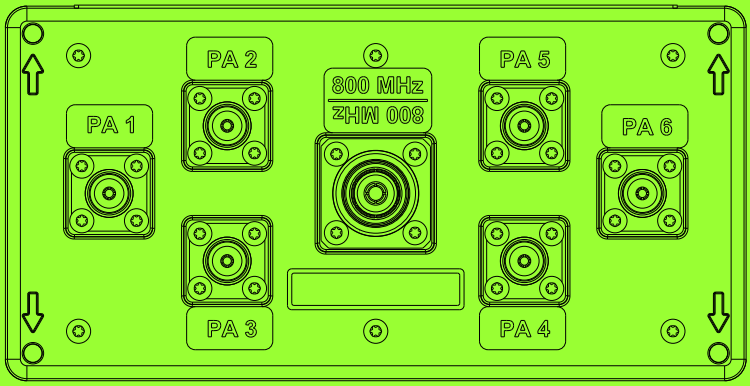
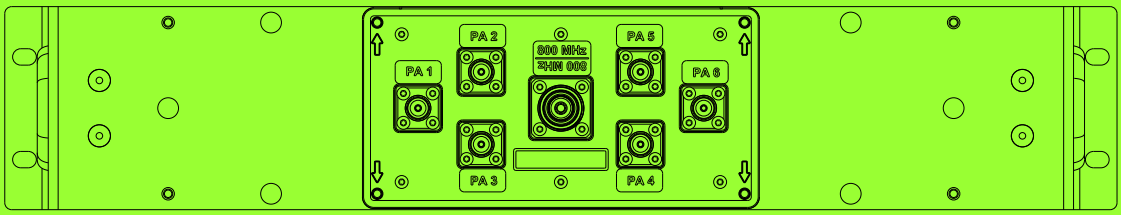


Figure 16: 4-6 Way Combiner on Bracket



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 Way combiner and the 4-6 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 Way combiners or one 4-6 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 combineur 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.

1.4.6
N-Way Splitter Physical Description

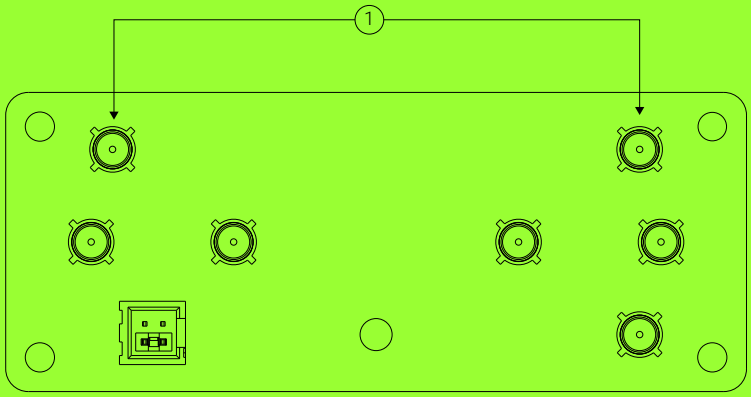
The DBR M12 MultiCarrier Site rack has two types of N-Way splitters, the 2-3 Way splitter and the 4-6 Way splitter.

The N-Way splitters take the combined XCVR output and split it to each Power Amplifier (PA). The functionality of the 2-3 Way splitter and the 4-6 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 Way splitters or one 4-6 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 17: 2-3 Way Splitter



Annotation	Description
1	Coax jumper connection. The 2-3 Way splitter contains a coax jumper that must to be connected to these connectors. In the 2-3 way splitter there is a 2 pin jumper in place on the header that must be placed as shown except when the 2-3 way splitter is used as the splitter for a second bank.

Figure 18: 2-3 Way Splitter on Bracket

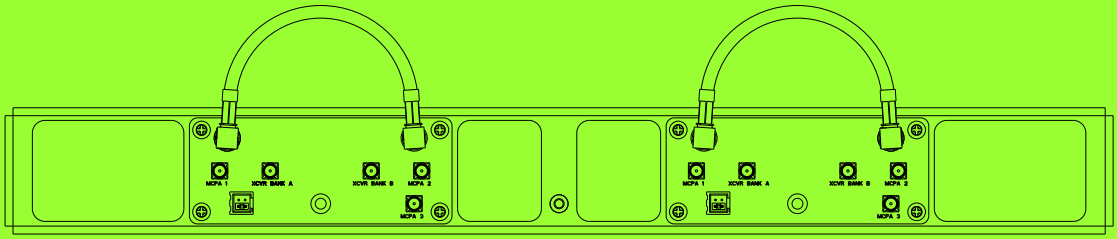


Figure 19: 4-6 Way Splitter

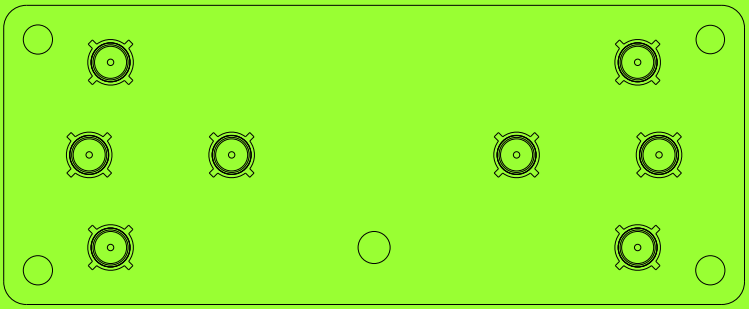
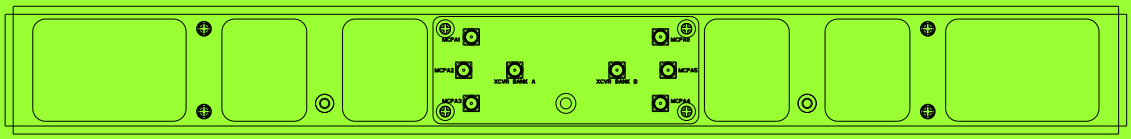


Figure 20: 4-6 Way Splitter on Bracket



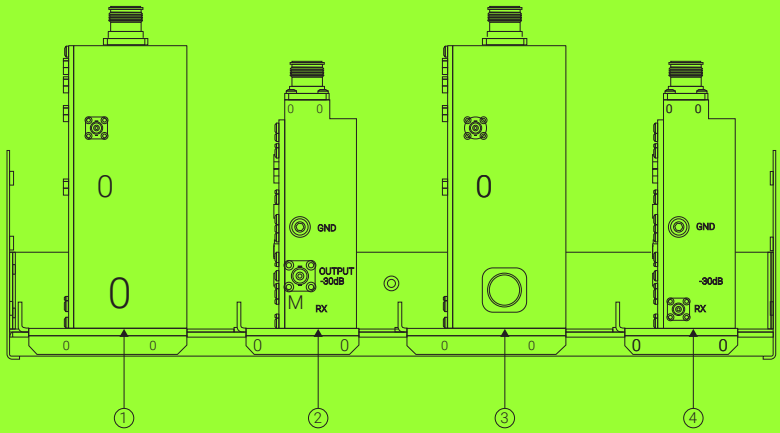
WARNING: An RF Phasing cable must be connected to each input of the N-Way splitter at all times, even if there is no associated PA for that connection. Removing a phasing cable when the site is powered on can cause damage to the equipment. Cables for non-populated PAs must be placed in through the locating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

1.4.7

RFDS Physical Description

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

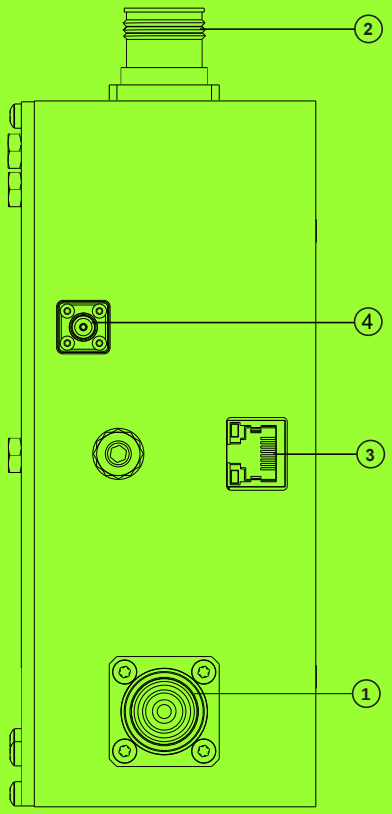
Figure 21: RFDS Tray – Fully Populated



Annotation	Description
1	Tx post filter
2	Rx preselector
3	Tx post filter for a second branch
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 branches, and two transmit antennas.

Figure 22: 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)

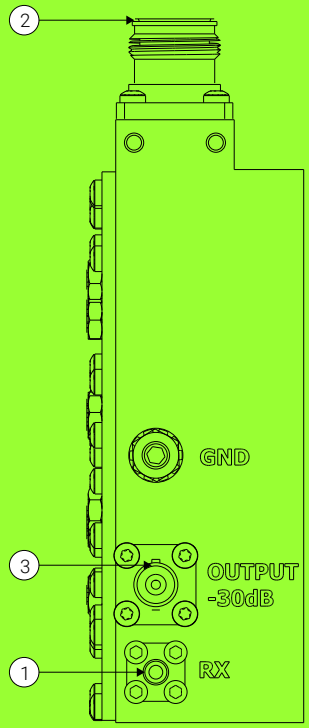
The Tx post filter is band-dependent. There are two versions, one for the 700 MHz and one for the 800 MHz range. A rack can contain both bands if it is set up as a split bank.

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

You can monitor the top of rack power by using the power monitor connected to the DSC 8500. For more information, see RFDS Transmit Filter (700/800) on page 150.

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

Figure 23: 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 branch 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 see the composite filtered input spectrum to the DBR M12 MultiCarrier Site receiver subsystem.

1.5

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 8000/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.

1.6

DBR M12 MultiCarrier Site in a Trunked IP Simulcast Subsystem

The RF channel (virtualized on a DSC 8000/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.

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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 rack/cabinet configuration that yields the greatest current draw.

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.

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- 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 24: Open Rack Floor Mounting Detail

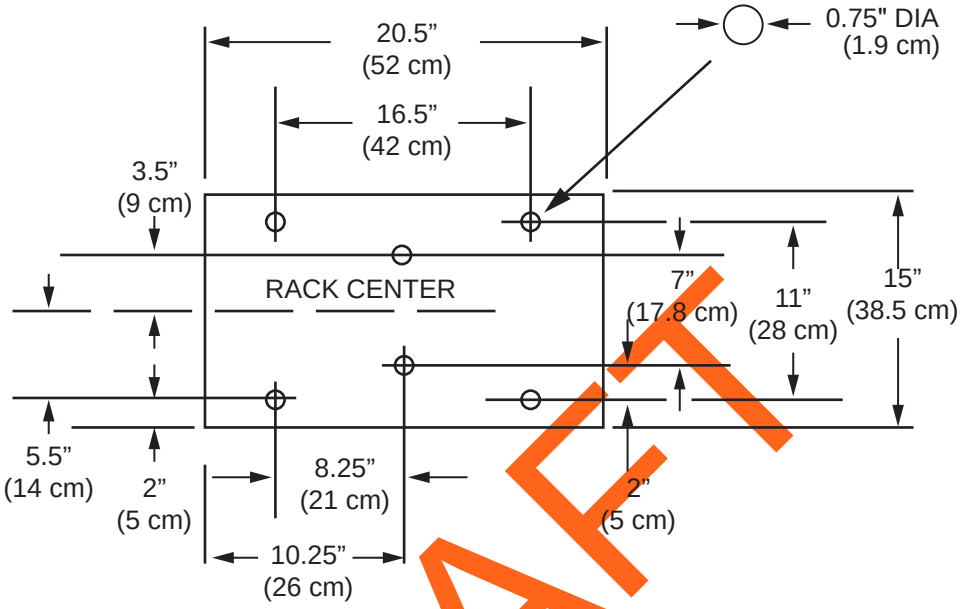

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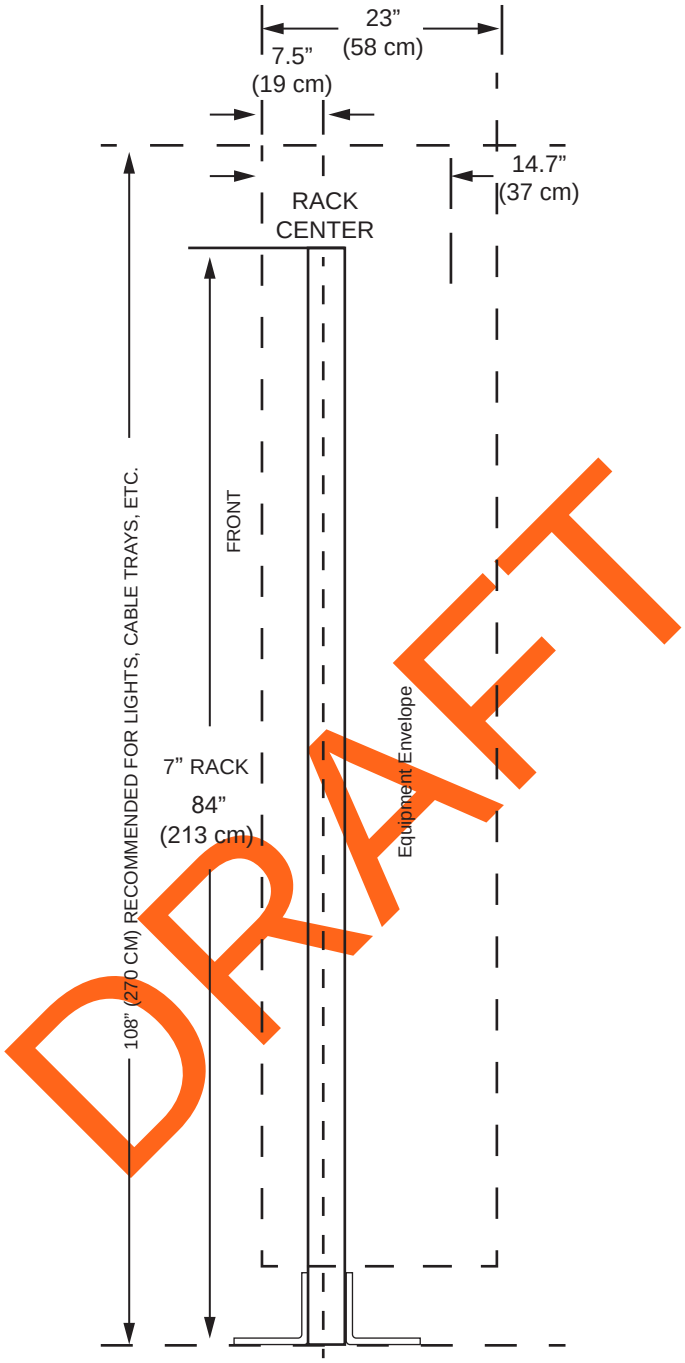
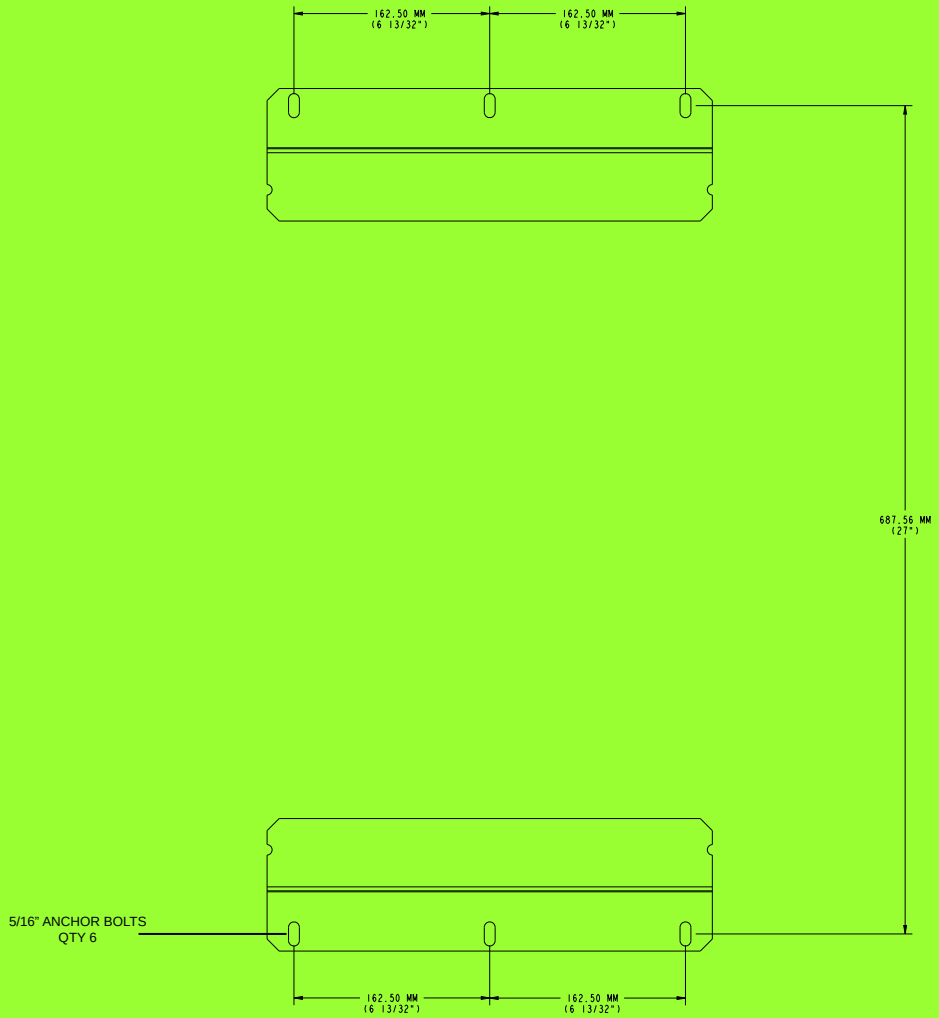
Figure 25: Open Rack – Side View



Cabinet

Figure 26: 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. The GPS option includes 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. For customers upgrading an existing RF site with a TRAK timing and frequency reference, that system may be reused with the DSC 8000 Trunking RF Site.

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

Procedure:

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 47.
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 54.
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 60.
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

   GCD_Comment: Which section should be linked here?

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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 (Industry Canada)

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

Installation guidelines for compliance with RF exposure regulations

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

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

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.

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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.

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Figure 27: 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.

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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 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.

3.2.2.2
Multiple Power Sources

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.

3.2.2.3
Connection to Primary Power

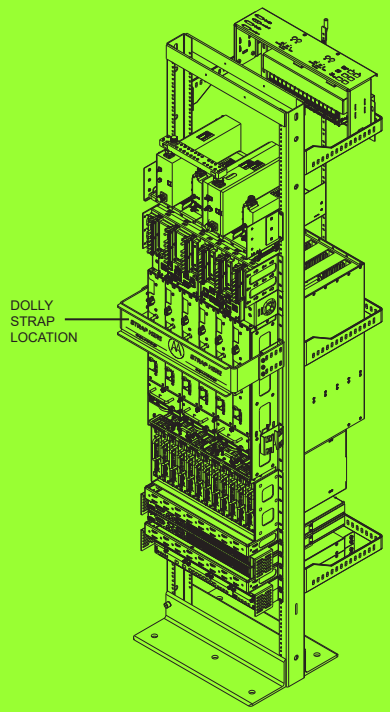
For supply connections, use wires suitable for at least 75 °C.

3.2.2.4
Replaceable Batteries

WARNING: Risk of Explosion if you replace the battery with an incorrect type. Dispose of used batteries according to the instructions.

3.2.3
Rack Transportation Strap Bar

Figure 28: Rack Transportation Strap Location



If you transport the rack on a hand truck or dolly, you should use the rack strap bar as the location for securing the straps.

You must remove the rack strap bar after the rack is transported to the site. There are six M6 screws that attach the bar to the rack brackets. The six M6 screws can be removed with a driver with a T30 bit. You cannot remove the brackets that the rack strap bar is attached to, they are used for cable management.

WARNING: When securing the rack by using the strap bar do not tilt the rack forward or side to side more than 15 degrees.
AVERTISSEMENT: Lorsque vous fixez un bâti à l'aide de la barre de sangle, n'inclinez pas le bâti vers l'avant ou d'un côté à l'autre à plus de 15 degrés d'inclinaison.

3.2.4
Maintenance Requiring Two People

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

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

3.2.5
Equipment Racks

Lift equipment racks without the use of lifting equipment only when sufficient personnel are available to ensure that regulations covering health and safety are not breached. Use an appropriately powered mechanical lifting apparatus for moving and lifting the equipment racks. In addition to these points, comply with any local regulations that govern the use of lifting equipment.

WARNING: Crush Hazard could result in death, personal injury, or equipment damage. Equipment racks can weigh up to 360 kg (800 lb).

AVERTISSEMENT: Le risque d'écrasement peut entraîner la mort, des blessures ou des dommages matériels. Les bâtis d'équipement peuvent peser jusqu'à 360 kg (800 lb).

3.2.5.1
Lifting Equipment Racks Horizontally

In some cases, equipment racks are shipped in the horizontal position. Use the appropriate lifting apparatus to lift the racks upright. Comply with all applicable health and safety regulations, and any other regulations applicable to lifting heavy equipment.

WARNING: Crush Hazard could result in death, personal injury, or equipment damage.
Do not use the eyenuts mounted on the top of the rack to lift the rack upright from a horizontal position. The eyenuts are not designed to lift horizontally and could fail resulting in damage to the equipment or injury to personnel.

AVERTISSEMENT: Le risque d'écrasement peut entraîner la mort, des blessures ou des dommages matériels. N'utilisez pas les écrous à œil montés sur le dessus du bâti pour soulever le bâti à la verticale depuis une position horizontale. Les écrous à œil ne sont pas conçus pour lever un objet horizontalement et pourraient se briser, entraînant des dommages à l'équipement ou des blessures au personnel.

3.2.5.2
Lifting Equipment Racks Vertically

Some equipment racks have four M10 eyenuts mounted in the top of the rack. Use these eyenuts to lift the equipment rack vertically. Before using these eyenuts, visually check them and the rack hardware for any damage that may have occurred during shipping.

WARNING: Do not use the eyenuts if damage is apparent. Contact the Centralized Managed Support Operations (CMSO) for replacements.

AVERTISSEMENT: N'utilisez pas les écrous à œil si des dommages sont apparents. Communiquez avec le Centre des opérations de soutien centralisé Centralized Managed Support Operations (CMSO) pour les remplacements.

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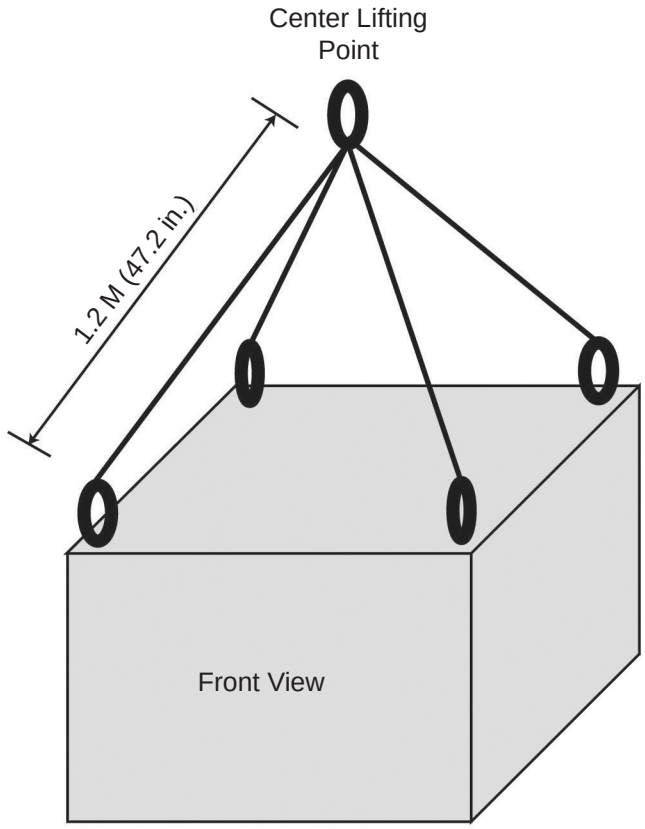
Use all four eyenuts when lifting the equipment rack. The minimum distance from each eyenut to the lifting point is 1.2 meters (47.2 in). Using a shorter length than specified could cause the eyenuts to fail. The figure below shows the minimum lengths and proper lifting angles using the eyenuts.

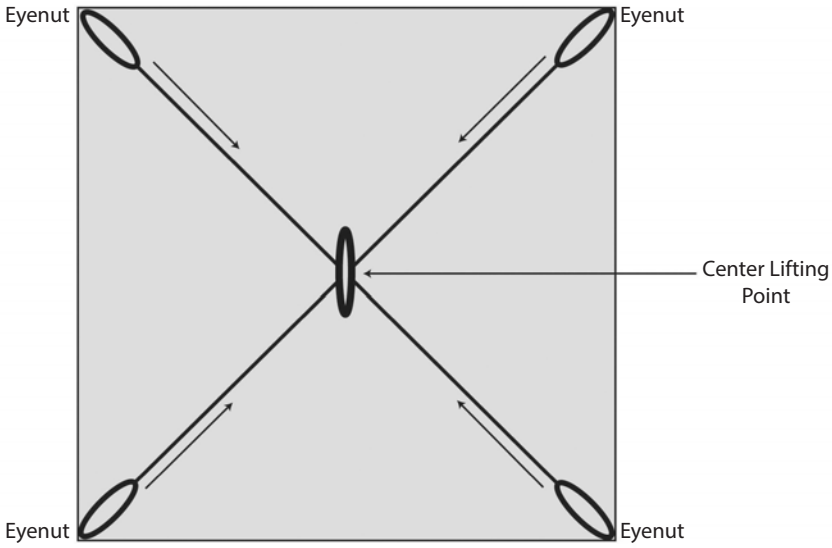
Figure 29: Lengths and Angles for Lifting Using the Eyenuts



If eyenuts are removed or become loose, install them properly before lifting the equipment rack. Tighten the eyenuts and bolt assembly by hand. Correct eyenut tightness and alignment are crucial to ensure that the eyenut assembly performs to its intended lifting capacity. Align the eyenuts to point towards the center lifting point of the cabinet and tightened to between 90 to 120 in-lb torque.

The figure below shows the proper alignment of the eyenuts.

Figure 30: Proper Alignment of the Eyenuts



3.3 General Installation Standards and Guidelines

This section provides several guidelines to ensure a quality install. Review these guidelines before unpacking and installing the system. Additionally, review the installation information in the Motorola Solutions Standards and Guidelines for Communication Sites manual for more details, including:

- Equipment installation
- Antenna installation

Review the installation information specific for the DBR M12 MultiCarrier Site. See DBR M12 MultiCarrier Site Installation on page 46.

3.3.1 Site Preparation Overview

Perform the activities listed in this table to ensure proper site preparation. The table references specific chapters in the Motorola Solutions *Standards and Guidelines for Communication Sites* manual for more information.

Table 6: Activities for Site Preparation

Activity	Description of Activity	Chapter Reference
Review the site plan.	• Prevents potential on-site and off-site interference by local trunked systems. • Minimizes cable lengths. • Determines the location of telecom equipment.	• "Site Design and Development"

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Activity	Description of Activity	Chapter Reference
Determine site access and security.	Outlines of site access and security measures.	• "Site Design and Development"
Review safety considerations.	Outlines general, installation, and environmental safety guidelines and requirements and OSHA-related considerations.	• "Communications Site Building Design and Installation"
Schedule installation of telephone service.	Ensures options and functions of on-site, two-way communications for personnel safety and maintenance.	• "Communications Site Building Design and Installation"
Review grounding specifications.	Ensures that the site meets or exceeds the Quality Audit Checklist in Appendix F as well as the Power and Grounding Checklist in Appendix D.	• “Grounding (Earthing) Electrode System Testing/Verification” • “R56 Compliance Checklist”
Schedule installation of site power.	Covers grounding, power sources, and surge protection.	• "External Grounding (Earthing)" • "Internal Grounding (Earthing)" • "Power Sources" • "Surge Protective Devices"

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3.3.2
Equipment Inspection and Inventory Recommendations

Ensure to fulfill the following general equipment inspection and inventory recommendations:

- Take an inventory of all equipment with a Motorola Solutions representative to ensure that the order is complete.
- Carefully inspect all equipment and accessories to verify that they are in good condition.
- Promptly report any damaged or missing items to a Motorola Solutions representative.

CAUTION: Do not tamper with factory configuration settings for these devices. These settings include software configuration, firmware release, password, and physical connections. Motorola Solutions has configured and connected these devices to meet specific performance requirements. Tampering with these devices may result in unpredictable system performance or catastrophic failure.

3.3.3
Placement and Spacing Recommendations

Proper spacing of equipment is essential for ease of maintenance and safety of personnel. Spacing requirements have been established to meet the National Fire Protection Associations (NFPA) code, and

the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) standards. Adhere to any local regulations that apply to the installation.

WARNING: Install only on concrete or other non-combustible surface.
AVERTISSEMENT: Installer uniquement sur du béton ou toute autre surface non combustible.

Placing Equipment Recommendations

- Place each rack on a firm, level, and stable surface, and bolt the racks together.
- Use the proper mounting hardware and shims to prevent rack movement. See the *Standards and Guidelines for Communication Sites* manual.
- Use strain relief when installing and positioning cables and cords to help ensure that no interruption of service occurs.
- Provide an appropriate amount of space around all components to allow for proper air flow, cooling, and safe access to equipment.
- Locate the site racks and other equipment with enough spacing to allow access for service.
- Locate the system in an area free of dust, smoke, and electrostatic discharge (ESD).
- Equipment that is not part of the defined product configurations should not be added to the rack. Extraneous hardware may compromise thermal performance by raising the temperature or impeding airflow.
- External cables coming into the racks must not significantly reduce airflow.
- For grounding racks information, see the *Standards and Guidelines for Communication Sites* manual.

Detailed Spacing Recommendations

Cabinets and racks allow equipment to be added to a site. Always consider room for expansion when setting up a site. Cabinets or racks may be installed next to each other or to other equipment. However, provide all cabinets and racks with sufficient floor space to permit access for installation and service.

Front access:

- At least 2 ft floor access in front of the cabinet or rack.

Side and rear access:

- At least 2 ft floor access at the rear of the cabinet or rack.
- At least 2 ft access on at least one side of the cabinet or rack, plus 6 inches at the rear of the cabinet or rack.

For details on space requirements, see the *Standards and Guidelines for Communication Sites* manual.

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3.3.4

Cabinet Bracing Recommendations

Use all supplied bracing hardware when installing a rack or cabinet, and secure all equipment within a rack or cabinet.

If additional equipment is installed, see the system design document the field engineer provided, or consult the Motorola Solutions Field Representative.

Subsystem cabinets are self-supporting structures. In areas subject to seismic activity, additional bracing of the cabinet may be required to prevent it from tipping. However, the bracing hardware must be locally procured. No specific procedures are provided within this manual for bracing cabinets in active seismic areas.

See the Motorola Solutions *Standards and Guidelines for Communication Sites* manual for details on seismic conditions.

3.3.5
Mounting Cabinets or Racks to a Floor

Perform the following steps to properly install a cabinet or open rack within a site building. Secure the cabinets and racks to the floor for optimum stability. This procedure is written so that the cabinet or rack is moved only once.

Procedure:

1. Carefully mark the mounting holes with a pencil, as indicated on the appropriate cabinet or rack footprint.
2. Drill the marked mounting holes to the appropriate depth of the mounting hardware with a hammer drill and bit.
3. Insert an anchor into the drilled hole. If necessary, tap the anchor into place using a hammer.
4. For cabinets, adjust leveling feet until the mounting plate solidly touches the floor.
5. Carefully move the cabinet or rack into the position indicated by the holes in the floor.

   WARNING: Equipment cabinets and racks are heavy and may tip. Use extreme caution when moving. Lift from top eyenuts with the appropriate apparatus, or secure the cabinet or rack from tipping if lifting from the bottom. Failure to do so could result in death or serious injury or equipment damage.
   AVERTISSEMENT: Les armoires et les bâtis d'équipement sont lourds et peuvent basculer. Soyez extrêmement prudent lorsque vous les déplacez. Soulevez-les à partir des écrous à œil supérieurs avec l'appareil approprié ou prévenez le basculement de l'armoire ou du bâti si vous le soulevez par le bas. Ne pas le faire pourrait entraîner la mort, des blessures graves ou des dommages matériels.
6. Adjust and level the cabinet or rack as necessary to position the cabinet mounting holes with the pre-drilled holes.
7. Secure the cabinet or rack to the site floor with the locally procured mounting hardware.

   IMPORTANT: If securing a rack to a concrete floor, use 1/2-inch grade 8 bolts with anchors, for a cabinet use 5/16-inch grade 8 bolts with anchors.
8. For cabinets, adjust leveling feet until they touch the mounting surface.

3.3.6
Bonding and Grounding Requirements

Cabinets and racks include a Rack Grounding Bar (RGB) with the capacity to terminate numerous ground wires, which are associated with internal metallic or fiber optic cables and external grounding to power company equipment.

Attach equipment added to the cabinet or rack to the ground bar using solid or stranded 6 AWG copper wire.

The RGB uses dual-hole lugs to terminate ground wires. The minimum number of dual-hole attachments is system-dependent and specified by your organization. This bar provides electrical continuity between all bonds and ground wire with a current-carrying capacity equal to or exceeding that of a 6 AWG copper wire.

See the Motorola Solutions *Standards and Guidelines for Communication Sites* manual for more information on proper bonding and ground at a site.

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3.3.7
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.
AVERTISSEMENT: 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.

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3.3.8
Power Guidelines and Requirements

For information on providing electrical service, power budgeting, selecting batteries, and other topics for supplying power at the site, see the Motorola Solutions *Standards and Guidelines for Communication Sites* manual.

Perform electrical installation work in accordance with the current edition of the NFPA 70 and local building codes. Where required, use a qualified and licensed electrician for all electrical installations.

NOTE: In the event of a power supply failure, the AUX BUS connection configuration prevents transceivers in the chassis with the failed power supply from going offline. When the failed Power Supply is replaced, the lower transceiver card in the chassis resets automatically. The reset is needed for the transceiver to recognize the new Power Supply. Similarly, if the AC and/or DC input to the Power Supply is removed and then reconnected, the same reset scenario occurs.

3.3.8.1
AC Power Guidelines and Requirements

The Motorola Solutions *Standards and Guidelines for Communication Sites* manual defines the guidelines and requirements for cabinets and racks which house equipment that requires AC power input.

Some of the guidelines and requirements are as follows:

- The cabinet or rack is designed to accept 120/240 V, single-phase power with an amperage service size as required by the electronic equipment.
- Cabinets and racks powered by commercial power must be equipped with a Nationally Recognized Test Laboratory (NRTL) certified power distribution module that contains a main circuit breaker, or individual circuit breakers of the correct size as required for the electronic equipment, or as specified by your organization.
- A decal showing an electrical schematic of the power wiring is affixed to the inside surface of the cabinet.
- All AC power equipment and electrical components must conform to National Electrical Manufacturers Association (NEMA) and National Electrical Code (NEC). The AC power equipment must also be listed by an NRTL.
- A surge arrestor, designed to protect equipment systems from a 120/240 V service and load center, is placed on the power feed ahead of all individual load center circuit breakers. This gapless arrestor must be listed by an NRTL for the purpose intended.
- Selection of a surge arrestor is based on the susceptibility of the equipment powered by the electrical service, with margin provided for locally generated disturbances. See ANSI/IEEE C62.41 (21) for more details.
- At least one 120 VAC, 15 A duplex convenience outlet equipped with Ground Fault Interrupter (GFI) protection must be provided in the electronic equipment compartment.

CAUTION: Do not use surge/transient suppressors without careful and expert power system analysis.
AVERTISSEMENT: N'utilisez pas de suppresseurs de surtensions/surtensions transitoires sans faire faire une analyse minutieuse du système d'alimentation par un expert.

TIP: Redundant devices could be terminated on different AC main phases so that a single phase failure does not result in a power loss for both devices.

3.3.9
Electrostatic Discharge Recommendations

Electronic components, such as circuit boards and memory modules, can be sensitive to Electrostatic Discharge (ESD).

Use an antistatic wrist strap and a conductive foam pad when installing or upgrading the system.

If an ESD station is not available, wear an antistatic wrist strap. Wrap the strap around the wrist and attach the ground end (usually a piece of copper foil or an alligator clip) to an electrical ground. An electrical ground can be a piece of metal that literally runs into the ground (such as an unpainted metal pipe), or the metal part of a grounded electrical appliance. An appliance is grounded if it has a three-prong plug and is plugged into a three-prong grounded outlet.

NOTE: Do **not** use a computer as a ground, because it is not plugged in during installation.

3.3.10
FCC Requirements

Radio frequency (RF) transmitters installed at sites within the US must be in compliance with the following FCC regulations:

- The station licensee is responsible for the proper operation of the station at all times and is expected to provide observations, servicing, and maintenance as often as may be necessary to ensure proper operation.
- The transmitter ERP must not exceed the maximum power specified on the current station authorization.

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- The frequency of the transmitter must be checked during initial installation of the transmitter, when replacing modules, or when making adjustments that affect the carrier frequency or modulation characteristics.

3.3.11
Networking Tools

Use the following networking tools for installing and servicing the network:

- Fluke® OneTouch Assistant LAN tester
- NiMH rechargeable battery for Fluke
- Serialtest® software with the ComProbe® and SerialBERT option

3.3.12
Installation/Troubleshooting Tools

If information is needed regarding where to obtain any of the equipment and tools listed, contact the Centralized Managed Support Operations (CMSO).

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General Tools

Use the following general tools to install, optimize, and service equipment in the system:

- 150 MHz 4 Channel Digital Storage Oscilloscope
- Transmission Test Set (TIMS Set)
- Aeroflex 3900 Series Service Monitor or equivalent
- 50 Ohm Terminated Load
- Digital Multimeter (DMM)
- Terminal Emulation Software
- DB-9 Straight through serial cable
- RS-232 Cable (DB9 to RJ45)
  RJ45 pinout: pin 4 = RX, pin 7 = TX, pin 8 = Ground
- Punch Block Impact Tool
- MODAPT – RJ-45 Breakout Box
- Remote RJ-11/ RJ-45 Cable Tester (1200 ft length maximum)
- PC Cable Tester (RG-58, 59, 62, BNC, RJ-45, RJ-11, DB-9, DB-15, DB-25, Centronics 36-pin connectors)
- ESD field service kit
- Amprobe Instruments GP-1 Earth Tester
- AEMC 3730 Clamp-on Ground Resistance Tester

Rack Tools

Use the following tools to install, optimize, and service the equipment:

- Aeroflex 3900 Series Service Monitor with P25 Options installed (plus Time Division Multiple Access (TDMA) option, as required)
- Windows 10 (Server 2012 R2) Operating System Personal Computer
- Hardware Requirements:

  - 1 GHz or higher Pentium grade processor
  - 2 GB RAM processor memory (recommended for Windows 10)
  - 300 MB minimum free hard disk space (for a Typical Installation, including Help Text and Software Download Manager)
  - 100 MB minimum free hard disk space (for a Compact Installation)
  - Peripherals:
    - Microsoft Windows supported mouse or trackball
    - Microsoft Windows supported serial port for product communication
    - Microsoft Windows supported Ethernet port for product communication
    - Microsoft Windows supported printer port for report printing
- Ethernet cable
- Antenna tester
- 50 Ohm terminated load
- Rohde & Schwarz NRT-Z14 Directional Power Sensor, 25-1000 GHz, 0.1-120 W. Recommended for all uses when a service monitor is not available.

Networking Tools

- Fluke® OneTouch Assistant LAN tester
- NiMH rechargeable battery for Fluke
- Serialtest® software with the ComProbe® and SerialBERT option

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3.3.13
Technical Support for Installation

Technical support is available from the site-specific documents the Field Engineer or Motorola Solutions Field Representative provided for the system, Centralized Managed Support Operations (CMSO), or qualified subcontractors.

- Centralized Managed Support Operations (CMSO) can help technicians and engineers resolve system problems and ensure that warranty requirements are met. Check your contract for specific warranty information.
- The Motorola Solutions System Service Subcontractor Assessment program ensures that service people contracted by Motorola Solutions meet strict minimum requirements before they can work on any system. For more information on this program, contact the Motorola Solutions representative.

3.3.13.1
Site-Specific Information

When Motorola Solutions stages a system, the Field Engineer assigned to the system creates all site-specific system documentation to document how the system was staged.

Site-specific information includes the following:

- Site design drawings showing the location of racks, cabinets, cable trays, and other components
- Rack drawings showing the location of the equipment in each rack
- Cable matrix in a table format that shows each cable and its connections
- Interconnect wiring diagrams to show the cable connections between devices

- Pre-programmed parameters of each site component
- Templates used to program each device
- All firmware and software revisions of each site component
- Test data from each device that requires operational verification
- Optimization requirements and settings of each electrical path
- Acceptance Test Plan for the site components

NOTE: Maintain this site-specific information to reflect the current site configuration and layout for the system.

3.4

Power Connections

This section covers topics on connecting power cables to the DBR M12 Site and the power distribution module, calculating the length of wire for various gauges, and mounting the battery temperature sensor.

3.4.1

DC Power Connection Wire Gauge Calculations for Integrated Voice and Data

Since the power supply disconnects itself from the DC input when it senses that DC voltage has dropped to 42 VDC, it is important to minimize the voltage drop in the DC power supply loop (the total length of the 48 VDC hot wire and the DC return wire) to no more than 1 V total. Minimizing the voltage drop ensures that the maximum energy is removed from the battery before disconnecting the power supply from the DC input line.

A DBR M12 MultiCarrier Site rack/cabinet configured with a single 2-3 N - way combiner bank, with 6 carriers at rated RF output, can consume up to 2400W. This equates to 44A of current when operating from a 54 V source (nominal 48 VDC system). As the voltage decreases (due to the standby battery discharging) the current increases proportionally (since the base radio appears to be a constant power load). At the low voltage disconnect point (42 V for a nominal 48 VDC system), the current is up to 57 A. If a single pair of 2 AWG wires is used to connect the battery to the junction panel, the maximum length of a single conductor is 17m (55 ft). Use of smaller gauge wire would reduce the length of a single conductor, depending on the resistance of the wire. To determine the maximum length of wire for wire other than 2 AWG, you can refer to the following relationship:

- Length (meter/feet) = V/I/R

where:

- V = voltage drop in one leg of the loop (max = 0.5 V)
- I = current drawn by the base radio during DC operation
- R = resistance of the wire being considered (in Ohms per meter/foot)

For common wire sizes for an IV&D site, the maximum distances apply.

Table 7: DC Power Connection Wire Gauge Maximum Distances for an IV&D Site

AWG	Resistance (ohm/1000 ft)	Maximum Distance (for 57 A)
1	0.1239	21m (70 ft)
2	0.1563	17m (55 ft)
4	0.2485	11m (35 ft)

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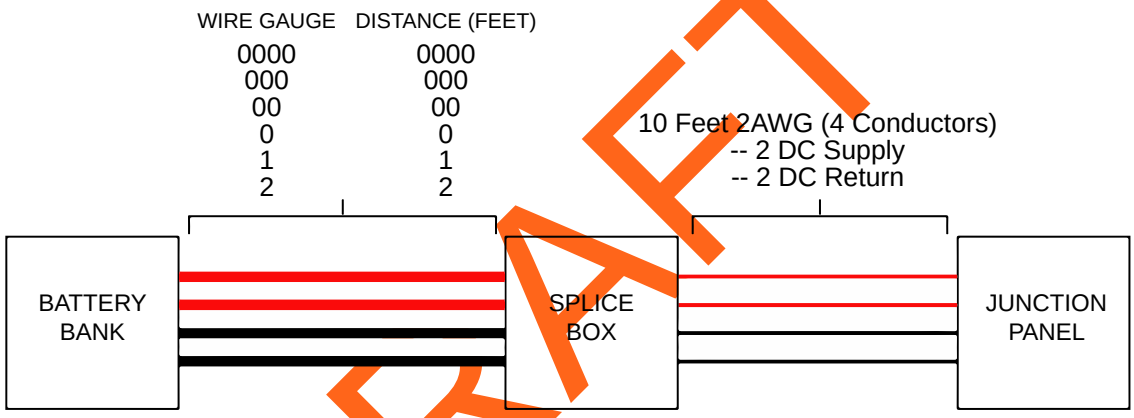
AWG	Resistance (ohm/1000 ft)	Maximum Distance (for 57 A)
6	0.3951	7m (23 ft)

In some installations, local codes may require the installation of wire heavier than 2 AWG. In these situations, a local splice box can be used to reduce the incoming wire to the 2 AWG needed for connection to the input terminal box. The splice box should be as close as possible to the junction panel.

If two pairs of 2 AWG wire are used to connect the DBR M12 MultiCarrier Site to the battery bank, the maximum distance from the battery to the junction panel would be 110 ft. If longer distances are required, a splice box must be included in the DC distribution. In that event, the following diagram provides guidance regarding the maximum distance permitted for various wire gauges available. These values are based on a splice box located 10 ft from the junction panel. If the splice box is more than 10 ft from the junction panel, the allowable distance between the splice box and the battery bank is shorter.

NOTE: Each DC input termination is rated for a maximum of 65 A.

Figure 31: Wire Gauge and Distance Guide



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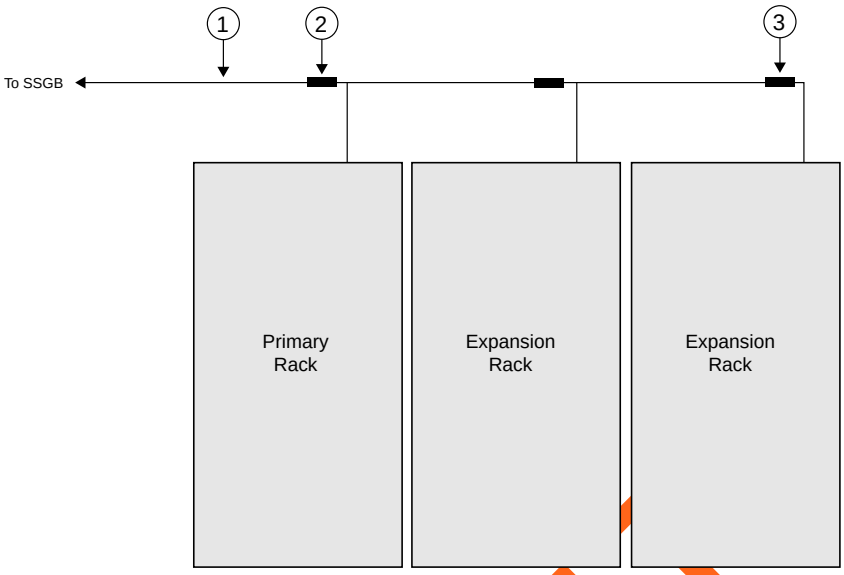
3.5 Grounding

Detailed grounding information is beyond the scope of this manual. See the Motorola Solutions *Standards and Guidelines for Communication Sites* manual for detailed information about grounding and lightning protection.

IMPORTANT: Ground the battery system, either positive or negative, at the battery. The DC input (battery charger output) of the power supply is floating with respect to earth ground. The power supply can therefore be used in either positive ground or negative ground DC systems. The appropriate terminal (+ or -) of the DC system should be connected to protective earth at the battery.
These instructions assume that all telephone lines, antenna cables, and AC or DC power cables have been properly grounded and lightning-protected.

When rack installations have a primary rack and one or more expansion racks, all these racks must be connected to the same Sub System Ground Bus Bar (SSGB) (and no other rack connected to the SSGB). Grounding ensures that surge events do not produce ground potential differences that affect signals between the racks.

Figure 32: Rack Grounding



Annotation	Description
1	Ground BUS Conductor
2	Irreversible Crimp Connector or Split Bolt
3	Route Conductors Toward Ground BUS and SSGB

3.6

Junction Panel Connections

The junction panel for the DBR M12 MultiCarrier Site cabinet/rack provides locations for all the non-RF connections to external devices. Cables provided by Motorola Solutions include the specific connectors for the junction panel on one end and the subsystem equipment on the other end.

NOTE: All RF connections to the DBR M12 MultiCarrier Site cabinet/rack are facilitated directly at the RF connectors of the Tx post filter(s), Preselctor(s) and RMC.

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