Avari® VL™ Series

North America

Installation and Commissioning Guide

IN-BUILDING WIRELESS &
PUBLIC SAFETY COMMUNICATION

+1 (833) 502-2144 support@avariwireless.com www.avariwireless.com

Avari Wireless Corporation
8618 Commerce Court
Burnaby, BC V5A 4N6
Canada

Avari Wireless Inc.
1400 112th Ave SE
Ste 100
Bellevue, WA 98004
USA

info@avariwireless.com
Toll Free: +1 (833) 502-2144
Phone: +1 (778) 945-5085
Fax: +1 (778) 945-5086

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Safety Guidelines

General

Adhere to the following occupation safety recommendations when installing optical fiber:

- Wear safety glasses with side shields, or other eyewear that complies with relevant occupational safety regulations. Follow the manufacturer's installation instructions.
- Dispose of fiber scraps properly in a safe, marked container and wash hands thoroughly after handling, splicing or cleaning. Also ensure the area is thoroughly cleaned from the floor and work areas.
- Do not look directly into the end of any optical fiber unless you are certain no light is present in the fiber, including light invisible to the human eye.
- When installing fiber optic cables in areas already installed with electrical cables and hardware, take care to avoid contact with these cables or have the power disconnected during installation.

Installation

Before installing and commissioning components of the VL-Series, there are several important preparation tasks that will ensure the process goes safely and smoothly.

Make sure you:

- Heed all safety and electrical warnings, especially when working with electricity and electrical equipment.
- Follow any applicable regulations and recommendations for equipment rack specifications, placement, and layout.
- Ensure the VL-Series units come with all components and mounting hardware out of the box.

- Ensure you have all the required tools and the adequate number of trained personnel on hand before commencing.

All safety precautions should be read and understood prior to installing and commissioning the components of the VL-Series.

This equipment is to be installed in a restricted access area by professionally qualified and trained personnel.

This equipment contains components that emit laser radiation which can seriously damage the retina of the eye.

- Do not look into the ends of any optical fiber.
- Do not look directly into the optical transceiver of any digital unit to avoid eye damage.
- Place a protective cap or lid immediately over any radiating transceiver or optical fiber connector to avoid potential damage caused by radiation exposure. This practice also prevents dirt particles entering the openings.

Always allow sufficient fiber length to permit routing or patch cords and pigtails without severe bends. Fiber optic patch cords or pigtails may be permanently damaged if bent or curved to a radius of less than 2 inches (50 mm).

Cables attached to rack mounted units must use top and bottom cable management trays.

VL-Series master units, and remote units are powered by DC POWER ONLY. For sites with AC power source equipment, use a VL-Series AC/DC power supply.

To prevent electrical shock when installing or maintaining the unit, disconnect the wiring at the power source before working with un-insulated wires or terminals.

Static electricity can severely damage and corrupt essential circuitry within the equipment if not handled carefully.

Parts on the printed circuit boards as well as other parts in the equipment are sensitive to electrostatic discharge.

Never touch the printed circuit boards or un-insulated conductor surfaces unless necessary.

If the printed circuit boards must be handled, always use ESD protective devices or first touch the enclosure with your hand and then do not move your feet.

Wet locations and conditions will increase the risk of electrical shock when installing or using electrically powered equipment.

To prevent electrical shock, never install or use electrical equipment in wet locations or during lightning storms.

Regulatory Compliance

FCC

The following FCC compliance statement applies to the 150 MHz, 450 MHz, 700MHz, 800MHz and 900MHz frequency bands.

This device complies with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Caution – Any changes or modifications not expressly approved by Avari Wireless could void compliance with regulatory rules, and thereby your authority to operate this equipment.

Caution – Do not use this equipment with unauthorized antennas, cables, and/or coupling devices not conforming with ERP/EIRP and/or indoor-only restrictions.

Warning – This is NOT a CONSUMER device. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have a FCC LICENSE or express consent of an FCC Licensee to operate this device. You MUST register Class A signal boosters (as defined in 47 CFR 90.219) online at www.fcc.gov/signal-boosters/registration. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of $100,000 for each continuing violation.

FCC licensee is required to register the installed Class A devices at https://signalboosters.fcc.gov/signal-boosters/

This device complies with FCC Part 90.219 as a Class A Signal Booster. The selection and installation of an antenna must comply with the FCC RF exposure requirements. The FCC regulation mandates that the ERP of type A signal boosters should not exceed 5 Watt. In addition, there are limitations on radiated intermodulation products and re-radiated noise.

The Class A device described in this Installation and Commissioning Guide only has a composite output power of 37 dBm. With a typical antenna gain of 5 dB and distribution loss of cable and passive components, it will not exceed the 5 Watt ERP limit. See Signal Booster Installation Guidelines shown below.

Signal Booster Installation Guidelines

In general, the ERP of the output noise within the pass band should not exceed the level of 43 dBm in 10 kHz measurement bandwidth. The ERP of the output noise outside of the passband by more than 1 MHz should not exceed the level of -70 dBm in 10 kHz measurement bandwidth. The ERP of intermodulation products (IMD) should not exceed -30 dBm in 10 kHz measurement bandwidth.

The device shall NOT exceed the 5 Watt (37dBm) ERP limit. In order to achieve this 37dBm ERP limit, the “Maximum Power Output” of the device minus the “Distribution Loss” to the output of the antenna including multiplexer / filter loss, cable loss and antenna gain MUST be smaller than 37dBm. Distribution Loss is defined as the loss in multiplexer, filters, cables, splitters combiners plus the antenna gain. In addition, the maximum IMD at antenna output should not exceed -30dBm ERP.

Calibration Modes

Units are calibrated for 2 W or 5 W depending on the output power required:

- Mode A: 2 W
- Mode B: 5 W

ISED Canada

WARNING: The Industrial Zone Enhancers described in this document are NOT consumer devices. They are designed for installation by ISED licensees and qualified installers who have recognized RF training. One must be an ISED licensee or have the express consent of an ISED licensee to install or operate the device according to safety guidelines.

AVERTISSEMENT: Les enrichisseurs de zone industriels ne sont PAS des appareils de CONSOMMATION. Ils sont conçus pour être installés par des titulaires de licence d'ISDE et des installateurs qualifiés qui ont reçu une formation reconnue en RF. Vous DEVEZ être le titulaire de licence d'ISDE ou avoir le consentement exprès du titulaire de license d'ISDE pour installer ou exploiter cet appareil.

Hardware Version ID Number (HVIN) :

RU37-4-PS-ABGH-41-C-D0-2C (cabinet mount)

RU37-4-PS-ABGH-51-C-D0-2W (wall mount)

See Appendix H for more information about the two hardware models with different mounting options.

NOTE:

i. This device listed above contain licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:
ii. This device may not cause interference
iii. This device must accept any interference, including interference that may cause undesired operation of the device.

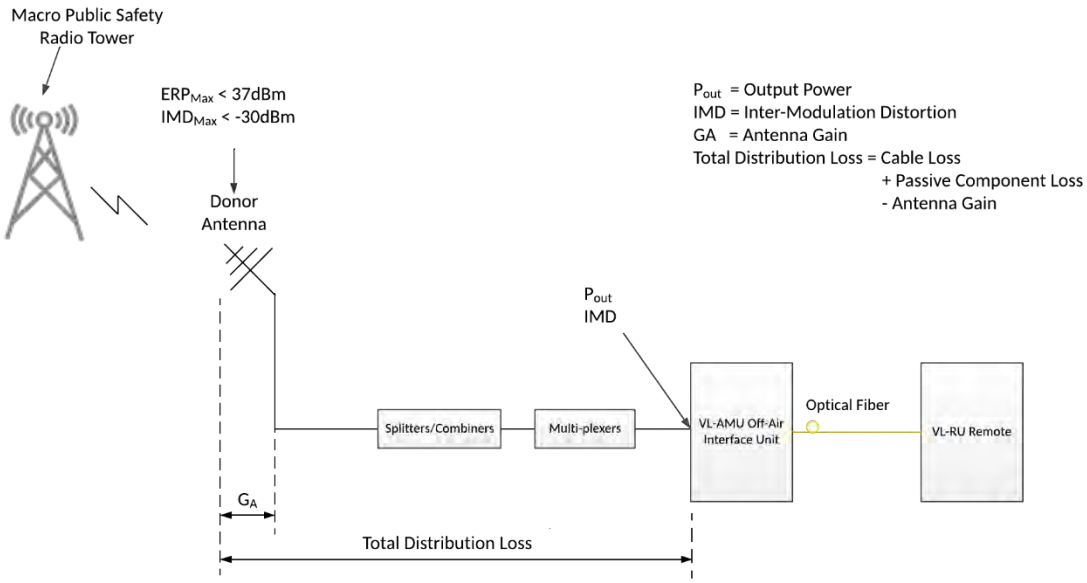
NOTE:

i. L'appareil mentionné ci-dessus contient des émetteurs/récepteurs exempts de licence, conformes aux normes RSS d'Innovation, Sciences et Développement économique Canada pour les appareils exempts de licence. Son fonctionnement est soumis aux deux conditions suivantes:

ii. Cet appareil ne doit pas causer d'interférences.

iii. Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable.

VL-AMU 37 Off-Air Master Unit



Sample Calculation of Minimum Distribution Loss:

Device Type	Frequency	Pout (dBm)	IMD (dBm)	Minimum Total Distribution Loss (dB)
VL-AMU 37	150MHz	37	-27.5	2.5
VL-AMU 37	450MHz	37	-31.5	0
VL-AMU 37	800MHz	37	-29.3	0.7

VL-RU 37 Remote Unit

Sample Calculation of Minimum Total Distribution Loss:

Device Type	Frequency	Pout (dBm)	IMD (dBm)	Minimum Total Distribution Loss (dB)
VL-RU 37	150MHz	37	-27.6	2.4
VL-RU 37	450MHz	37	-31.5	0
VL-RU 37	800MHz	37	-27.4	2.6

RF Exposure - FCC

According to FCC Part 1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines. More information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation".

The maximum power density limit allowed for the occupational / uncontrolled exposures for an average time of 30 minutes is frequency and output power dependent. Although the equipment under test is capable of producing a composite output power of up to 38dBm, the overall ERP can't exceed 37dBm. Cable distribution loss and antenna gain needs to be taken into account as part of the design and installation in order not to exceed the maximum 37dBm ERP limit. The table below illustrates the different operating scenarios with maximum allowed output power of 37dBm at the antenna representing worst case scenarios from a RF Exposure point of view.

VL-AMU 37 (150/450/700/800 MHz) Off-Air Master Unit

Frequency Band	Conducted Output Power (dBm)	Min. Cable Loss (dB)	Max Antenna Gain (dBi)	Max EIRP (mW)	Power Density Limit Allowed (mW/cm^2)	Safe Distance (cm)
150MHz	38	4	3	5012	0.200	45
450MHz	38	4	3	5012	0.320	36
700MHz	38	4	3	5012	0.517	28
800MHz	38	4	3	5012	0.579	27

VL-RU 37 (150/450/700/800 MHz) Remote Unit

Frequency Band	Conducted Output Power (dBm)	Min. Cable Loss (dB)	Max Antenna Gain (dBi)	Max EIRP (mW)	Power Density Limit Allowed (mW/cm^2)	Safe Distance (cm)
150MHz	38	4	3	5012	0.200	45
450MHz	38	4	3	5012	0.320	36
700MHz	38	4	3	5012	0.517	28
800MHz	38	4	3	5012	0.579	27

RF Exposure – ISED Canada

According to RSS-102, systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to radio frequency energy level in excess of ISED's specification. The ISED Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), sets out the requirements and measurement techniques for evaluating radio frequency exposure compliance of radiocommunication apparatus designed to be used within the vicinity of the human body. RSS-102, issue 6, replaces RSS-102, issue 5, dated March 19, 2015.

Per RSS102 Table 7, the maximum power density limits for devices used in uncontrolled environment is $0.02619\ f0.6834$ for frequency band 300 to 6000 MHz. The table below shows the splitter and cable loss required and the corresponding safe separation distance between the antenna and person.

Frequency Band	Conducted Output Power (dBm)	Min. Cable Loss (dB)	Max Antenna Gain (dBi)	Max EIRP (mW)	Power Density Limit Allowed (W/m^2)	Safe Distance (cm)
420MHz	38	10	3	5012	1.630	25
450MHz	38	10	3	5012	1.700	25
700MHz	38	10	3	5012	2.470	21
800MHz	38	10	3	5012	2.670	20
900MHz	38	10	3	5012	2.810	19

Disclaimer

Avari Wireless assumes no responsibility for errors or omissions that may appear in this publication. Avari Wireless reserves the right to make changes this publication at any time without notice as part of our continuing effort to improve our products.

1 System Overview

What's inside this chapter:

1.1 System Architecture

1.2 Public Safety Band Selection

1.3 VL-DMU Direct Connect Master Unit

1.4 VL-AMU 33/37 Off-Air Master Unit

1.5 VL-RU 33/37 Remote Radio

1.6 VL-EM Element Manager

1.7 VL-DU 8/14 Digital Distribution Unit

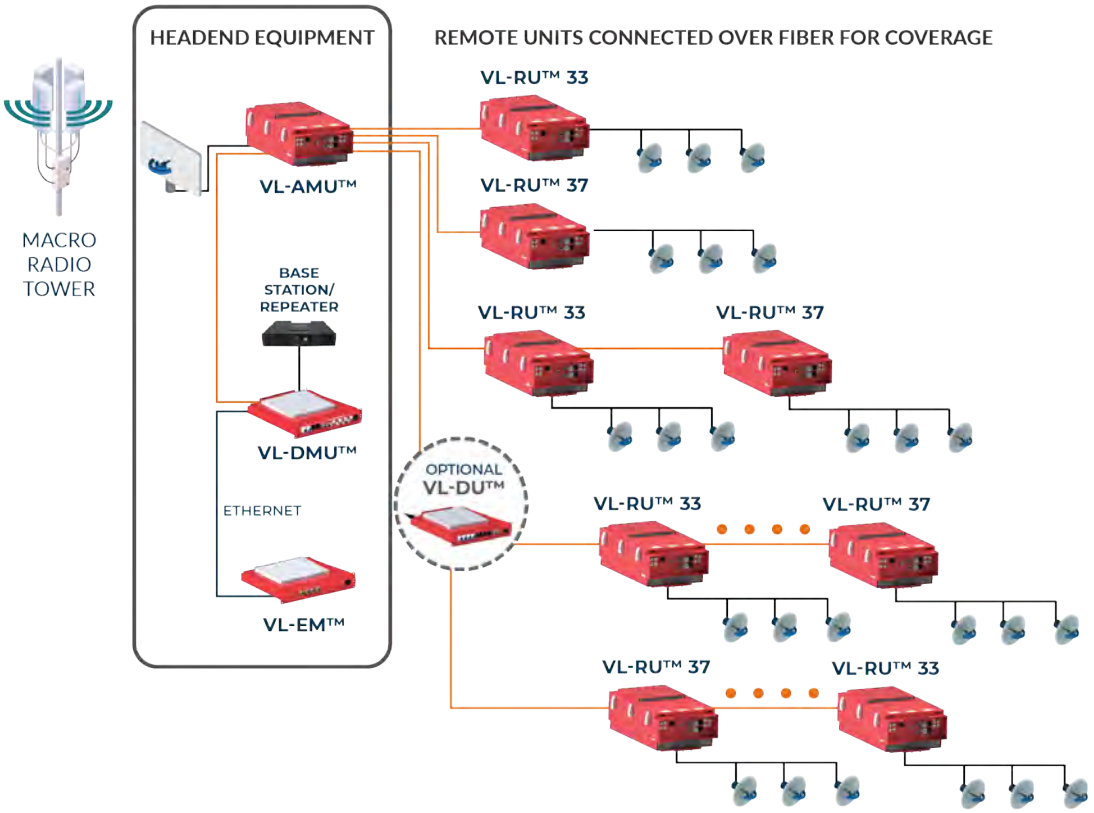
1.8 VL-CLK Clock Distribution Unit

1.9 VL-RLY Relay Unit

1.1 System Architecture

The modular architecture of the VL-Series public safety system means that public safety agencies and private enterprises can handle expansions and upgrades as they grow.

With flexibility in interfacing with off-air and direct connect radio signal sources, multiple public safety and private services can share the network infrastructure within a given site or facility.



The VL-Series consists of the following:

- **VL-DMU direct connect master unit** – master unit that connects directly to base stations or bi-directional amplifiers (BDAs) over an analog RF interface.
- **VL-AMU 33/37 off-air master unit** – 2 W and 5 W master unit that receives downlink analog RF signals from off-air donor antennas and transmits uplink RF signals back to the macro towers.

- **VL-RU 33/37** – 2 W and 5 W indoor/outdoor remote radios.
- **VL-EM element manager** –manages VL-Series devices from a central location and runs the element manager software for provisioning and monitoring the system.
- **VL-DU digital distribution unit** – expands the number of remotes that can be connected to a master unit using 10 Gbps data streams representing public safety and private radio signals.
- **VL-CLK clock distribution unit** – a 10 MHz clock reference used for headend redundancy and failover applications.
- **VL-RLY relay unit** – an optional network element to extend the capability of the other products by providing centralized and localized alarm connectivity (not depicted in this architecture diagram).

1.2 Public Safety Band Selection

The supported public safety frequency bands are:

- VHF or 150 MHz (138-174 MHz, bandwidth: 36 MHz, 2/5 W)
- UHF or 450 MHz (380-450/450-512 MHz, bandwidth: 70/62 MHz, 2/5 W)
- 700 MHz (bandwidth: 17 MHz, 2/5 W)
- 800 MHz (bandwidth: 18 MHz, 2/5 W)
- 900 MHz (bandwidth: 6 MHz, 2/5 W)

The master units and remotes support 1 to 3 bands, and 2 W or 5 W average composite output power per band.

Different band sets are pre-configured by Avari Wireless.

1.3 VL-DMU Direct Connect Master Unit

The VL-DMU direct connect master unit connects directly to base stations or bi-directional amplifiers (BDAs) over an analog RF interface to process 1 to 4 public safety RF bands simultaneously.

Features	Description
Band frequencies	VHF/150 MHz, UHF/450 MHz, 700 MHz, 800 MHz, 900 MHz
Band modules	Up to 4 band modules with digital conversion to/from analog RF
Data rate	10 Gbps per wavelength
Maximum DL Input power	–10 to +10 dBm per band
Bandwidth	Up to 320 MHz aggregated uplink/downlink per wavelength
Optical interfaces	8 x 10 Gbps optical interfaces with standard SFP+ optical transceivers
Ethernet interfaces	2 x 1 Gbps Ethernet interfaces
Power	48 VDC power interface <95 W power consumption
Configuration, control, and monitoring	Remote control and monitoring via Element Manager software, third party NMS, and SNMP

Downlink Path

On the downlink path the VL-DMU translates analog RF content into a digital data stream, and then transports it to distribution/remote units over one to eight optical links, each operating at a data rate of 10 Gbps.

Because all radio signals are processed and combined in the digital domain, no passive intermodulation (PIM) is introduced. The aggregated content is then sent over optical fiber to the distribution and remote units.

Uplink Path

On the uplink path, the VL-DMU performs the reverse functions. It delivers digitally transported uplink signals to corresponding base stations as analog RF signals and IP data from remotely connected IP devices to the Internet backbone or other devices in the cloud.

Ethernet Backhaul

The VL-DMU also supports 1 Gbps Ethernet backhaul for additional IP devices such as security cameras and Wi-Fi access points located close to remote units. This additional port could extend the functionality of this unit to carry 3P SNMP traffic. This type of input could come from Battery Backup monitoring from remote units back to the head end.

1.4 VL-AMU 33/37 Off-Air Master Unit

The VL-AMU 33 and VL-AMU 37 are off-air master units that accept downlink analog RF signals from off-air donor antennas and transmit uplink RF signals back to the macro towers at 2 W or 5 W composite average power per band. These units can process up to 3 bands simultaneously.

Product	Bands	Output Power
VL-AMU 33	1 – 3 bands	2 W per band
VL-AMU 37	1 – 3 bands	5 W per band

Features	Description
Band frequencies	VHF (150 MHz), UHF (450 MHz), 700 MHz, 800 MHz, 900 MHz
RF interfaces	Simplex interfaces for VHF and UHF bands Donor antenna ports for each band
Multiplexer	Internal multiplexer for 700, 800, 900 MHz bands
Band modules	1 to 3 bands modules
Data rate	10 Gbps
UL output power	VL-AMU 33: 2 W per band VL-AMU 37: 5 W per band
Optical interfaces	8 x 10 Gbps optical interfaces with standard SFP+ optical transceivers
Ethernet interfaces	2 x 1 Gbps Ethernet interfaces
Power interface	48 VDC
Power consumption	VL-AMU 33: 135 | 200 | 265 W (1 | 2 | 3 Bands) VL-AMU 37: 160 | 265 | 340 W (1 | 2 | 3 Bands)
Configuration, control, and monitoring	Remote control and monitoring via Element Manager web application, third party NMS, and SNMP

Downlink Path

On the downlink path, the VL-AMU translates analog RF content into a digital data stream, and then transports the data stream to remote units on one to eight optical links, each operating at 10 Gbps.

Because radio signals are processed and combined in the digital domain, no passive intermodulation (PIM) is introduced. The VL-AMU utilizes multiple custom coaxial resonator type RF filters, ceramic resonator type RF filters, custom IF SAW filters and variety of digital filters inside the FPGA, ensuring appropriate protection of the Active circuitry from out-of-band interferers.

Selectable digital filters enable per signal/ group of signals extraction.

The following digital filters are standard and more can be added per customer need (pass band/stop band offset to 60 dB rejection): 12.5 kHz, 25 kHz, 50 kHz, and 200 kHz.

Per signal and time slot (P25 phase 2 waveforms) squelch functionality is also implemented on the downlink path of the VL-AMU enabling system noise level reduction when signal level is below set threshold.

Uplink Path

On the uplink path the VL-AMU does the reverse.

The unit receives data streams from the distribution units or remotes, which are then converted back to analog RF. The signals are filtered and amplified to a composite power of 2 W/5 W per band, and then delivered back to the macro towers through outdoor directional antennas.

Per signal and time slot Automated Gain Control (AGC) function is implemented on the uplink path of the VL-AMU enabling signal level equalization and maximum output power per channel.

Ethernet Backhaul

The VL-AMU also supports 1 Gbps Ethernet backhaul for transporting the data from IP devices such as security cameras and Wi-Fi access points located close to remote units.

1.5 VL-RU 33/37 Remote Radio

The VL-RU 33 and VL-RU 37 are indoor/outdoor remote radios that provide 2 W or 5 W of composite output power per band in a sealed pluggable module chassis. These units can process up to 3 bands simultaneously and have field upgradeable RF band modules.

Product	Bands	Output Power
VL-RU 33	1 – 3 bands	2 W per band
VL-RU 37	1 – 3 bands	5 W per band

Features	Description
Band frequencies	Up to three bands Frequencies: VHF, UHF, 700 MHz, 800 MHz, 900 MHz
RF interfaces	Simplex interfaces for VHF and UHF bands Duplex antenna interface for 700-800-900 bands
Multiplexer	Internal multiplexer for 700, 800, 900 MHz bands
Band modules	1 to 3 band modules

Features	Description
Data rate	10 Gbps
DL output power	2 W per band (VL-RU 33) 5 W per band (VL-RU 37)
Optical interfaces	2/4 x 10 Gbps optical interfaces
Ethernet interfaces	2 x 1 Gbps Ethernet interfaces
Power interface	48 VDC
Power consumption	VL-AMU 33: 135 | 200 | 265 W (1 | 2 | 3 Bands) VL-AMU 37: 160 | 265 | 340 W (1 | 2 | 3 Bands)
Configuration, control, and monitoring	Remote control and monitoring via Element Manager web application, third party NMS, and SNMP

Downlink Path

On the downlink path, the VL-RU 33/37 receives an aggregated stream of digitized RF signals directly from a master unit or distribution unit which it then converts into analog RF signals. Per signal and time slot Automated Gain Control (AGC) function is implemented on the downlink path of the VL-RU 33/37 enabling maximum and uniform signal level output.

Depending on the frequency band, the signal is either amplified in the RF module and then sent out through simplex RF ports to an external filter, or sent to an internal multiplexer and then out through duplex N-type antenna ports.

Uplink Path

On the uplink path, the VL-RU 33/37 receives analog RF signals, either from an external VHF/UHF filter or directly from the antenna network. The RF signals are channelized and converted into a digital data stream and then delivered over fiber to the distribution unit or directly to master units.

The VL-RU 33/37 utilizes multiple custom coaxial resonator type RF filters, ceramic resonator type RF filters, custom IF SAW filters and variety of digital filters inside the FPGA, ensuring appropriate protection of the Active circuitry from out-of-band interferers.

Selectable digital filters enable per signal/group of signals extraction. The following types of digital filters are available: Pass band/stop band offset to

60 dB rejection (12.5kHz, 25kHz, 50kHz and 200 kHz). Per signal and time slot (P25 phase 2 waveforms) squelch functionality is also implemented on the UL path of the VL-RU 33/37 remote which enables system noise level reduction when signal level is below set threshold.

Ethernet Backhaul

The VL-RU 33/37 also accommodates a 1 Gbps Ethernet backhaul for transporting the data from nearby IP devices such as security cameras and Wi-Fi access points.

1.6 VL-EM Element Manager

The VL-EM is a unit that manages VL-Series devices from a central location and runs the Element Manager software for provisioning all elements in the network, storing configuration settings, monitoring alarms, and displaying performance data.

Features	Description
Ethernet interfaces	3 x 1 Gbps Ethernet interface
Configuration, control, and monitoring	Remote control and monitoring via Element Manager web application, third party NMS, and SNMP

SNMP client

The VL-EM also hosts a Simple Network Management Protocol (SNMP) client that enables SNMP traps and event messages to be sent from the EM to an SNMP Manager at the network operations center.

1.7 VL-DU 8/14 Digital Distribution Unit

The VL-DU is a digital distribution unit that enables transport of 10 Gbps data streams, representing public safety and private radio signals, from master units to multiple remotes and vice versa, hence increasing number of remotes that can be connected to a master unit.

The VL-DU is housed inside sealed 2RU 19-inch rack chassis with convection cooling and comes in two port configurations: 8 port and 14 port.

Product	Optical ports
VL-DU 8	8
VL-DU 14	14

The VL-DU can be located at the headend location with the master unit, or at the remote venue to achieve more efficient use of fiber infrastructure.

Features	Description
Data rate	10 Gbps
Optical interfaces	VL-DU 8: 8 x 10 Gbps Optical interfaces VL-DU 14: 14 x 10 Gbps Optical interfaces

Features	Description
Ethernet interfaces	2 x 1 Gbps Ethernet interfaces
Power	48 VDC power interface VL-DU 8: 65 W VL-DU 14: 125 W
Configuration, control, and monitoring	Remote control and monitoring via Element Manager web application, third party NMS, and SNMP

Downlink Path

On the downlink path, the VL-DU receives an aggregated stream of digitized RF signals, at 10 Gbps, from a master unit. The signals are then delivered over fiber to up to 7 or 13 remotes.

Uplink Path

On the uplink path the VL-DU receives data streams from multiple remotes. Multiple copies of the signals are processed and then delivered over fiber to a master unit at the headend location.

1.8 VL-CLK Clock Distribution Unit

The VL-CLK is a digital clock distribution unit with a 10 MHz clock reference used for headend redundancy and failover applications. It is used to synchronize the clock signal to master units over fiber.

The VL-CLK is typically installed at one of the two headend locations. Two strands of optical fiber are required from the VL-CLK location to the master unit equipment at each headend.

If a secondary, or backup, VL-CLK is required for failover protection of the reference clock, optical bypass switches ensure continuous operation if the primary clock reference unit fails.

Features	Description
Optical interfaces	4 x 10 Gbps optical interfaces
Ethernet interfaces	2 x 1 Gbps Ethernet interfaces
Power	48 VDC or 110/240 VAC power interface 65 W power consumption

The VL-CLK utilizes standard plug-and-play SFP+ optical transceivers.

1.9 VL-RLY Relay Unit

The Relay unit is an optional network element that extends the other products' capability to provide centralized and localized alarm connectivity. While all products are NFPA compliant and equipped with dry contact inputs

and outputs, it is not always possible to wire dry contact alarm outputs directly from every network element location to alarm annunciator or fire alarm panel unless they are in proximity.

The purpose of the RLY is to provide flexibility in dry contact alarm connectivity. The RLY can be pre-programmed to summarize alarms for a cluster of Avari's digital DAS equipment within a certain geographical area. For example, a RLY can be placed in every building to alert the local fire alarm panel for alarms only related to DAS equipment in that building. Alternatively, it can be pre-programmed to output all alarms from all buildings to a centralized fire alarm panel.

Leveraging on the IP backhaul over fiber capability in the Avari modular digital DAS solution, there is no need to run a separate cable to the fire alarm panel from every piece of DAS equipment. The RLY will take care of all the alarm connections, and it should be placed close to the fire alarm panel for direct wire connections. From there, an Ethernet cable is used to connect the RLY to the ETH port of any Avari equipment close by.

Once connected to the Avari equipment via Ethernet, the Avari Element Manager (EM) will instruct the RLY which dry contact output to turn on based on pre-programmed alarm rules.

Features	Description
Ethernet interfaces	1 x 1 Gbps Ethernet interfaces
Power	48 VDC or 110/240 VAC power interface 65 W power consumption

2 Installation Requirements

What's inside this chapter:

2.1 Installation Workflow

2.2 Documentation Requirements

2.3 Equipment Room Preparation

2.4 Rack Specifications and Installation

2.5 Fiber Plant

2.6 Cables and Cable Management

2.7 Cable Management

2.8 RF Antenna Infrastructure

2.9 Power Supply and Grounding

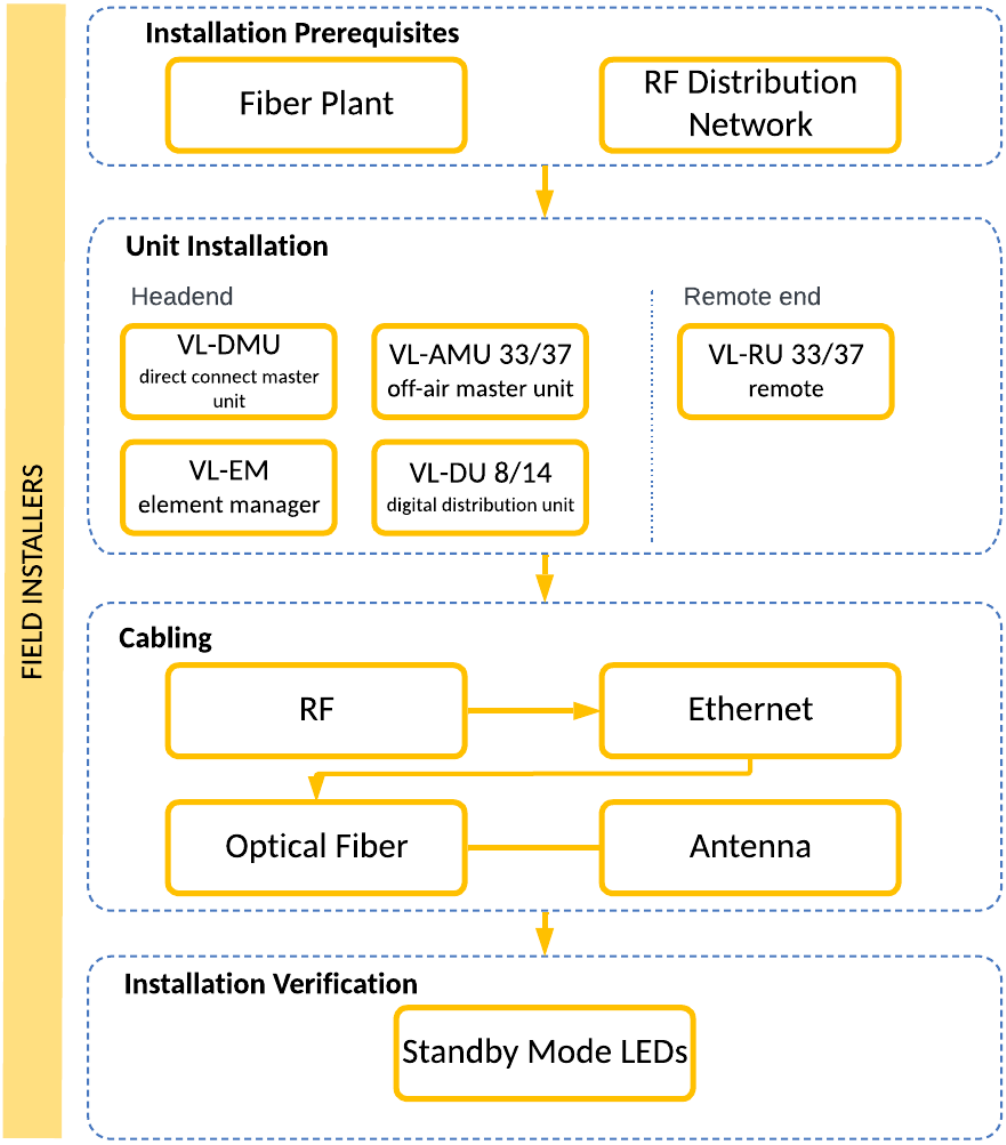
2.10 Tools and Equipment

2.11 Shipping Contents

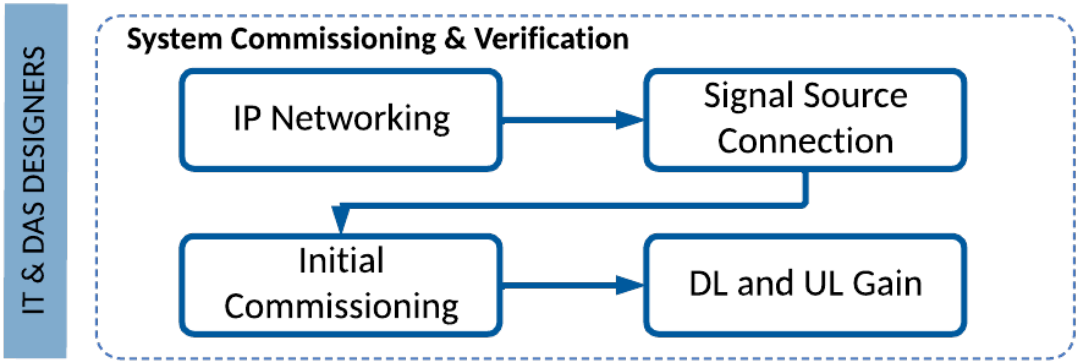
2.1 Installation Workflow

The recommended workflow for installing and commissioning the VL-Series breaks down into three phases depending on your role.

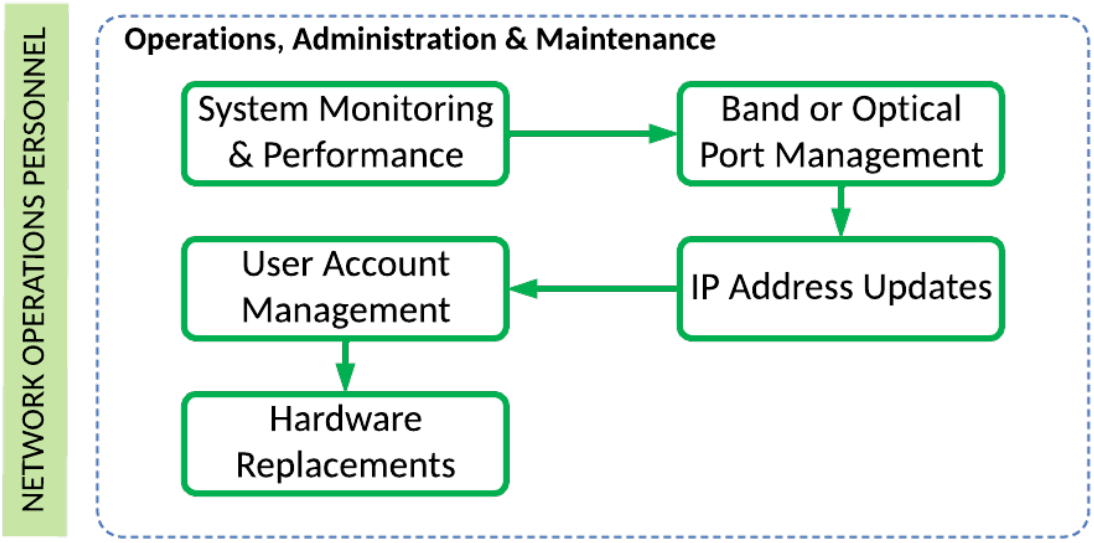
Field Installers



IT and DAS Designers



Network Operations



2.2 Documentation Requirements

The following site-specific documents are recommended. These documents are created by Avari-certified RF designers and system integrators.

- **System design and RF plan** describing detailed RF cabling, antenna installation and the logical layout of optical fiber

- **Fiber plan** describing the labelling of fiber runs, installation of optical fiber, and physical routing of optical fiber
- **Rack layout plan** describing the layout and interconnection of rack mounted units
- **Network design plan** for IP planning for remote access and NMS integration
- **Gain lineup spreadsheet** containing base station gain settings

2.3 Equipment Room Preparation

Item	Description
Equipment room temperature	The maximum ambient temperature (Tma) in the equipment room should be no higher than 50 °C (122 °F).
Network plan	Configuration planning documentation
Network addresses	List of network address information

2.4 Rack Specifications and Installation

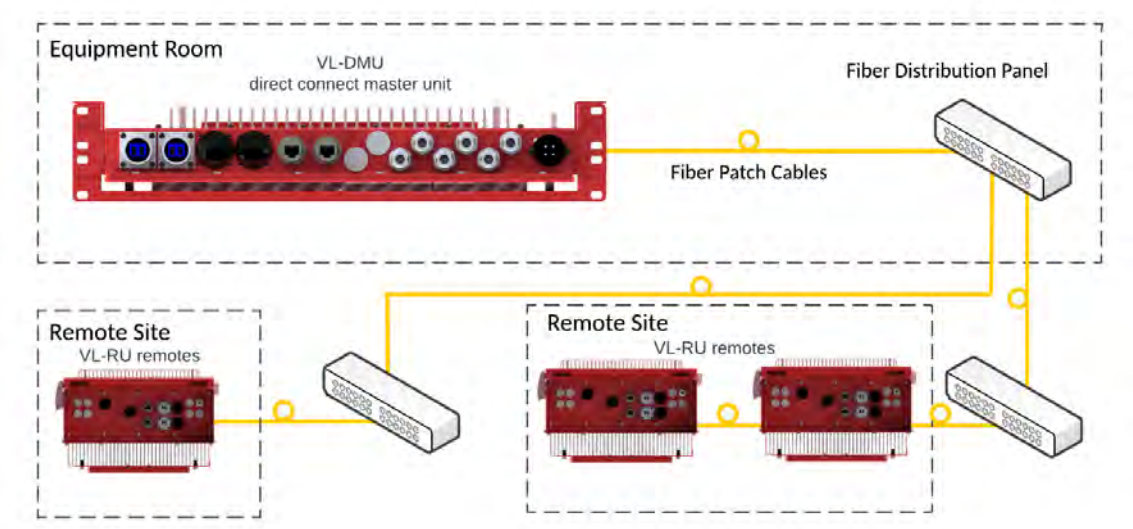
Item	Description
General rack specifications	A standard equipment rack is nominally 19 inches wide (including mounting hardware) and follows a standard set by the Electronics Industry Alliance (EIA) The 19-inch rack standard is called EIA-310-D, which is essentially equivalent to IEC-60297-3-100 or DIN 41494 in other regions.
4-post rack specifications	An open 4-post equipment rack with adjustable intermediate rail, or a 2-post rack can be used for mounting the VL-DMU, VL-AMU or VL-RU remote. Racks may be open or closed. Racks must be secured with floor or ceiling according to appropriate local building or seismic codes. Reinforce equipment racks with support brackets or rails as necessary to accommodate the weight of units.
Rack mounting and clearances	The rack should be mounted to the floor and levelled. Adhere to any applicable local or seismic guidelines for equipment installation. Allow a minimum clearance of 24 in (610 mm) at the rear of the rack for access to grounding lug and cooling fans.

Item	Description
Rack grounding	Reliable grounding of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch circuit (e.g. use of power strips). Install a ground bar bus on the rack to accept the ground wires from each unit in the rack. Use #10 AWG ground cable from the main facility ground to the rack grounding bus bar.
Rack cable management	Install 1RU cable management trays above and below units in the rack and vertical cable management trays for managing RF, optical, and Ethernet cables
Elevated Operating Ambient	If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Give consideration to installing the equipment in an environment compatible with the maximum ambient temperature (Tma) of 50 °C.
Reduced Air Flow	Install the equipment in a rack so that the amount of air flow required for safe operation of the equipment is not compromised.
Mechanical Loading	Mount the equipment in the rack so that a hazardous condition is not achieved due to uneven mechanical loading.
Circuit Overloading	Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern

2.5 Fiber Plant

The fiber plant for single mode fiber can be terminated in the equipment room to accommodate fiber patch cables from VL-DMU and VL-AMU in the headend location band modules in the chassis and the network of digital remotes.

Fiber distribution panels are to be interconnected between headend and remote locations to accommodate connections to distant remotes.



2.6 Cables and Cable Management

The cable requirements for the VL-Series will vary according to the nature and size of the system deployment, as well as the required adherence to local, state, and federal regulations.

The following cables need to be fabricated on site.

Item	Description
AC or DC power cable	Use 2-wire or 3-wire multi-conductor AWG #12, #14, or #16 stranded bare copper with unshielded outer jacket to connect the fuse panel and the unit.
RF cable	1/2-inch, or 7/8-inch coaxial cable Always consider the minimum bend radius provided by the cable manufacturer for the cable used.
Ethernet cable	CAT 5 Ethernet cables with RJ-45 connectors

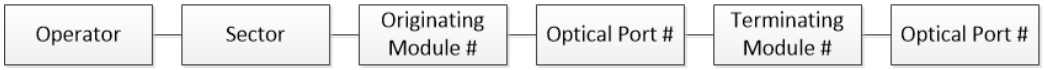
Item	Description
Optical fiber	Single-mode optical fiber (SMF 9/125 µm)

Cable Labeling

When labeling cables, include standard information that will aid field technicians troubleshoot cable connection problems.

Important – For clarity and consistency, use a cable labeling scheme that logically corresponds to a standardized naming scheme.

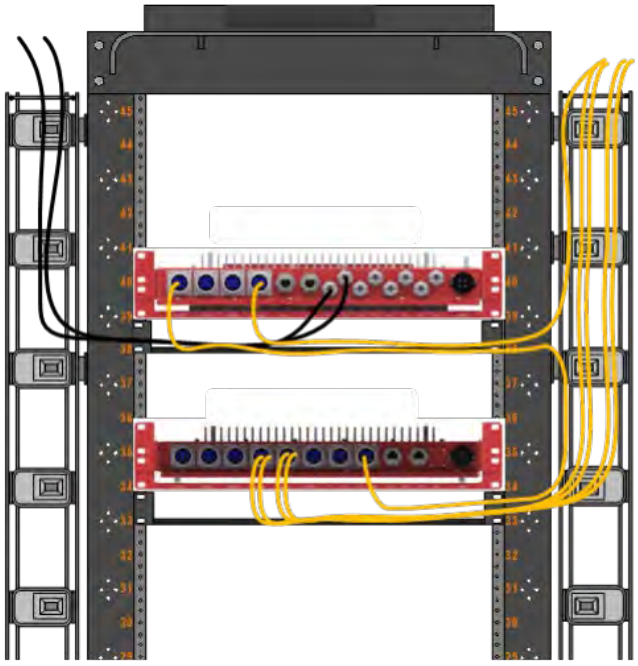
For example:



Cable labeling can correspond with the names attached to remotes or to RF feed names.

2.7 Cable Management

Racks should also be equipped with horizontal cable management trays and vertical cable management channels to manage base station feed, optical fiber, power, and Ethernet cabling.



2.8 RF Antenna Infrastructure

The planning and installation of antennas and supporting infrastructure, including optical fiber and RF cables, filters, splitters, couplers, and hybrid combiners, is beyond the scope of this document, but this should be completed in advance of connecting any distribution network to a VL-RU remote.

When validating the system design for an indoor or outdoor venue, crosscheck antennas and passive components to ensure they have been installed in the right locations, with proper orientation of ports and cabling, and appropriate terminations.

The entire infrastructure should be fully line-tested for:

- Insertion loss and VSWR (reflected power), or return loss using sweeping

- Passive Intermodulation (PIM) testing
- Distance to fault using Frequency Domain Reflectometry (FDR)

2.9 Power Supply and Grounding

The requirements for power supply and grounding will vary according to the nature and size of the system deployment, as well as the required adherence to local, state, and federal regulations.

Item	Description
Grounding	Use #10 AWG from the rack grounding bus bar to chassis ground. Make a chassis ground cable for each unit installed in the rack. There is no earthed conductor connected between the input terminals and other earthed parts of the unit.
Circuit protection	Circuit protection in the form of a fuse panel with 48 VDC power protection installed between the DC power plant and the unit. A fuse panel with a 1RU profile can be installed at the top of the rack for power distribution to the chassis. GMT fuses shall be 20 A.
Power supply	Each unit requires 48 VDC input power. Power supply cables must have a minimum temperature rating of 65 °C.
Disconnect device	The unit is considered as permanently connected device. A readily accessible disconnect device shall be incorporated external to the equipment.

2.10 Tools and Equipment

Tool or Equipment	Description
#2 Phillips screwdriver and small flat screwdriver	Used for or installing VL-Series equipment and DC power connectors
Wire cutters and strippers	Used for preparing DC power and grounding cables
Laptop with internet browser, and Ethernet cables	Used for commissioning and system monitoring
Cable and antenna analyzer	Used for cable testing and cable sweeps
Multimeter	Used for testing the of voltage of DC power feeds before connection to the VL-DMU
Optical power meter	Used for testing fiber optic cables before installation
Fiber cleaning equipment	Used for cleaning fiber optic cables before installation

2.11 Shipping Contents

Ensure that all shipping containers are received and inspected for visible signs of damage. Unpack each shipping container while checking contents for damage and verifying shipped contents against packing slip for each VL-Series component.

Contact Avari Customer Service if the box contents do not match the packing list or if any equipment appears damaged.

3 Equipment Installation

What's inside this chapter:

3.1 Preparing for Installation

3.2 Installing the VL-DMU Direct Master Unit

3.3 Installing the VL-AMU Air Master Unit and VL-RU Remote

3.4 Installing the VL-EM Element Manager

3.5 Installing the VL-DU 8/14 Distribution Unit

3.6 Installing the VL-CLK Clock Distribution Unit

3.1 Preparing for Installation

Before installing VL-Series equipment, become familiar with the power consumption ratings, rack mounting requirements and installation safety warnings.

Important For Declaration of Conformity, FCC compliance and Safety Information, see Regulatory Compliance at the beginning of this manual.

Power Consumption

See Appendix, Power Consumption.

Safety Warnings

Ensure the unit is fully grounded before connecting the power supply.

Ensure the DC power supply circuit is disconnected before connecting to power to the unit.

VL-DMU is considered a permanently connected device. Ensure a readily accessible disconnect device is incorporated external to the unit.

All VL Series equipment described in this chapter is not intended to be mounted at heights greater than 2 meters from ground. Failure to comply may lead to the device falling, resulting in serious injury or damage.

3.2 Installing the VL-DMU Direct Master Unit

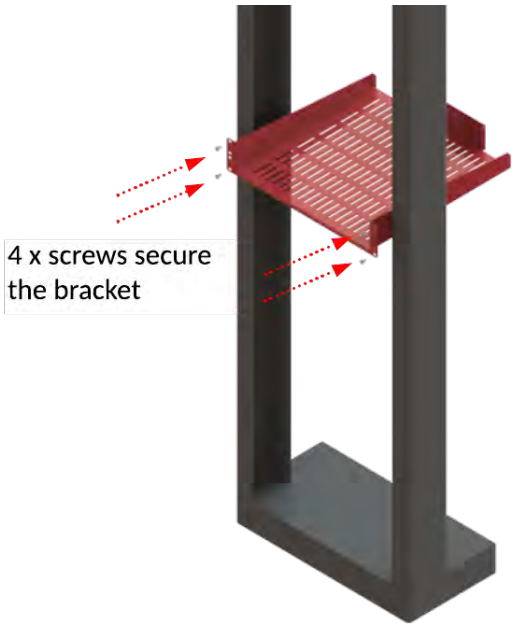
The VL-DMU 33/37 direct master unit can be installed in an equipment rack or wall mounted.

Use the mounting kits provided, and screws or mounting hardware suitable for the wall or rack type.

Rack Mount	Wall Mount
• Rack bracket (provided) • 8 rack screws • #2 Phillips screwdriver	• Wall bracket (provided) • 4 x L-brackets with captive locking and self-cinching screws (provided) • 6 x wall screws • #2 Phillips screwdriver

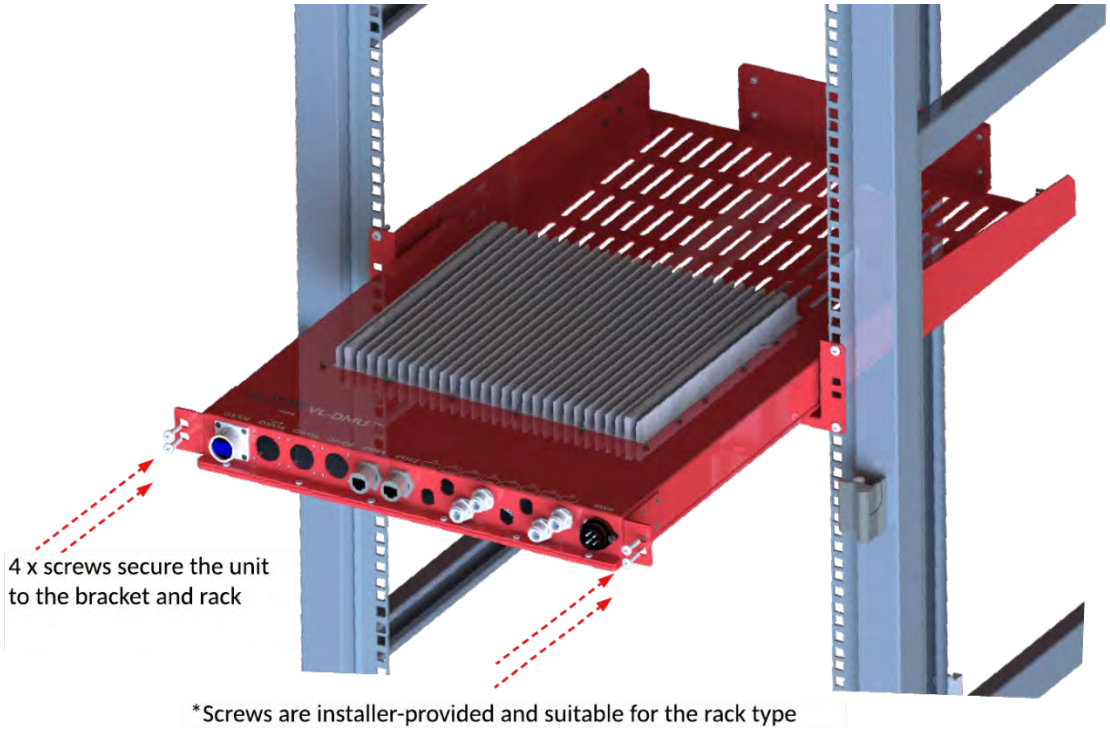
Rack Mounting

STEP 1 Attach the bracket to the rack with four rack screws.



*Screws are installer-provided and suitable for the rack type

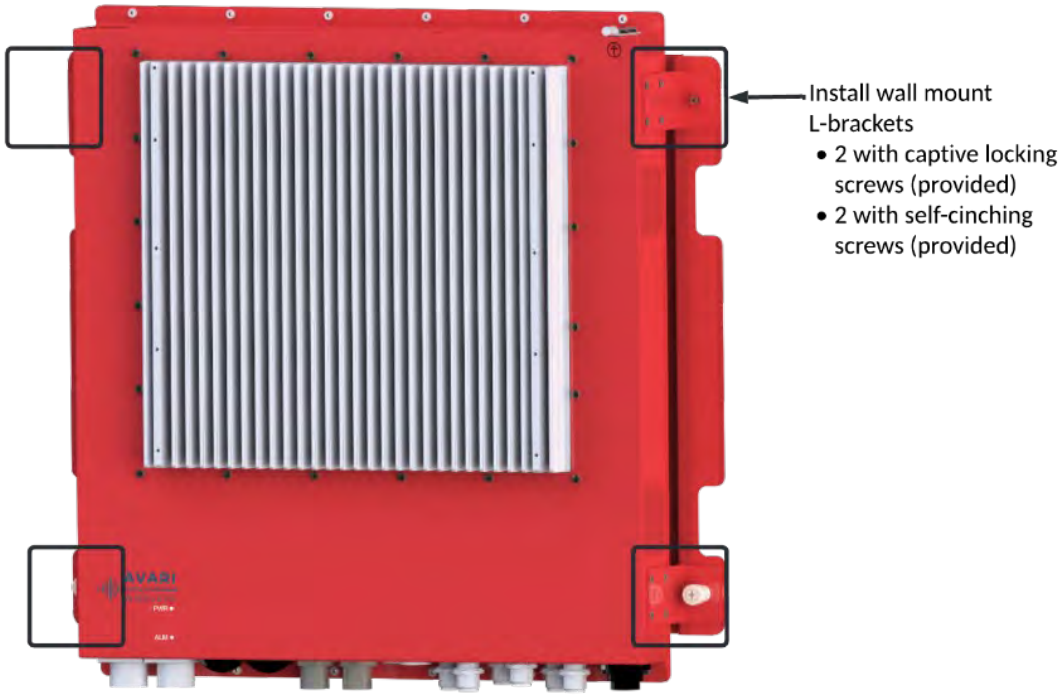
STEP 2 Slide the unit into the bracket until the front L-brackets are flush with the posts. Secure the unit using four rack screws.



Wall Mounting

STEP 1 Mount the bracket on the wall using 6 wall screws suitable for the wall type.

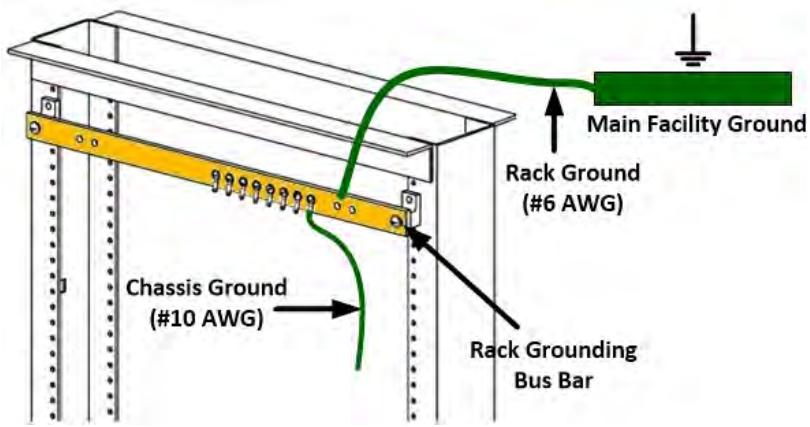
STEP 2 Remove the standard L-brackets and replace with wall mount L-brackets with captive locking screw and nut.



STEP 3 With the back of the unit facing the bracket, insert the shoulder bolts into the slots, and slide the unit down so that it locks in place. Tighten the locking screws on both sides of the unit using a #2 Phillips screwdriver to secure the unit to the bracket.

Grounding

Make sure the equipment rack is grounded to the main facility ground, and that the rack has a ground bus bar installed.

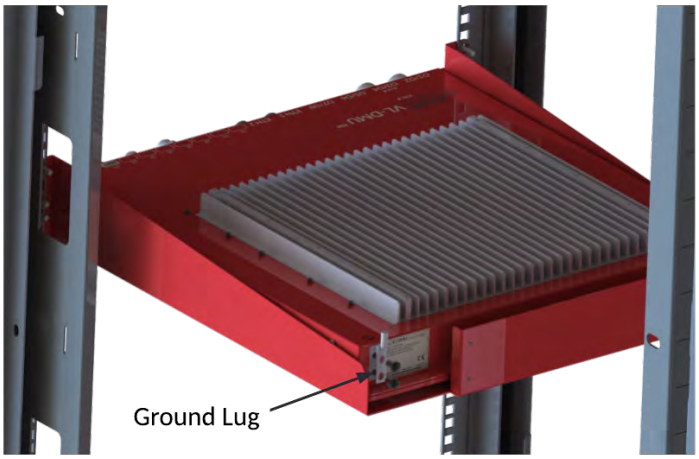


Ground the **VL-DMU** and **VL-DU** to the ground bus bar before connecting any cables.

Chassis Ground Lug

The ground lug for the VL-DMU is located at the rear of the unit.

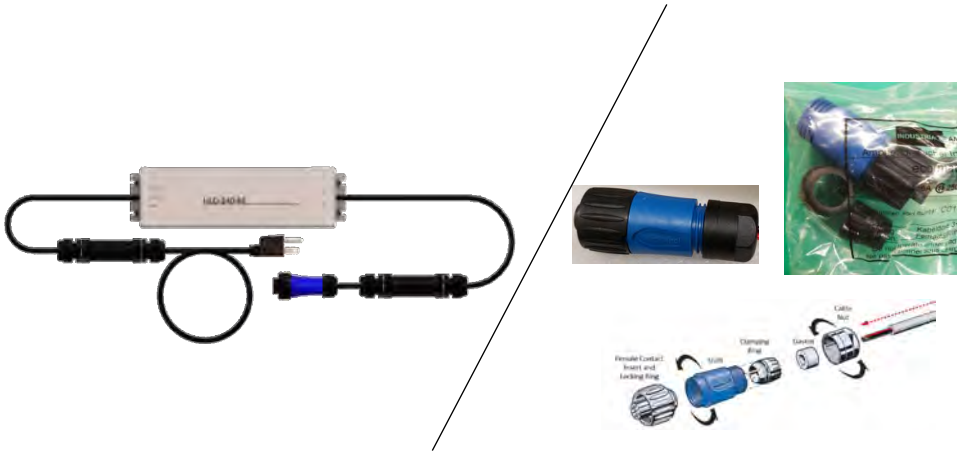
Use a #2 Phillips screwdriver to remove ground lug. Insert a #10 AWG ground wire into the ground lug, crimp, reattach and tighten both screws.



Connecting Power

The VL-DMU requires an uninterrupted 48 VDC power supply. For sites with an AC power source, the unit includes an AC/DC power adapter when ordering AC version equipment.

Use the AC or DC power connector provided.



AC-DC Power Adapter or DC power connector (not include wire)

DC power cable requirements

Use a DC cable at a suitable gauge for the distance from the fuse panel to the unit.

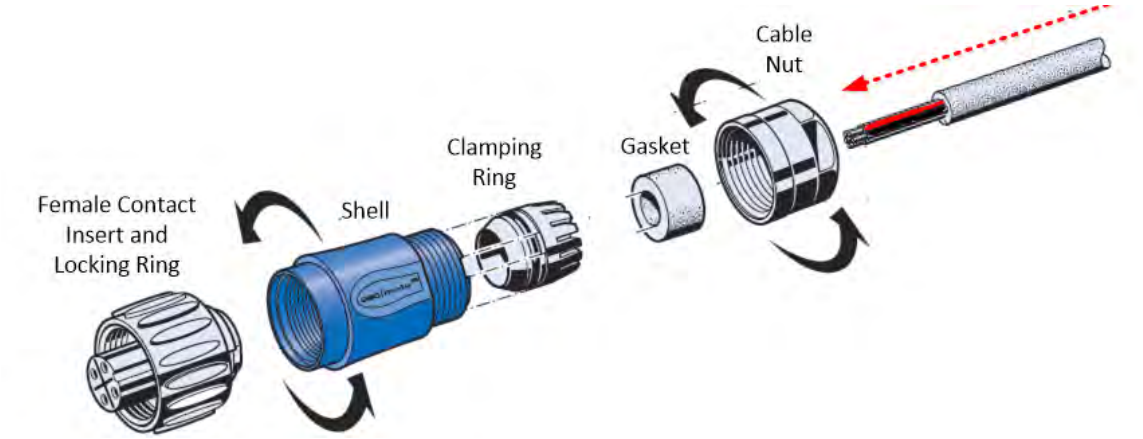
The voltages shown in the following table are voltages at the power sourcing equipment.

AWG	42 V (3% loss)	48 V (3% loss)	56 V (3% loss)
#12	162 ft (49 m)	211 ft (64 m)	287 ft (88 m)
#14	102 ft (31 m)	133 ft (40 m)	181 ft (55 m)
#16	64 ft (19 m)	83 ft (25 m)	114 ft (35 m)

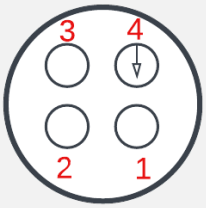
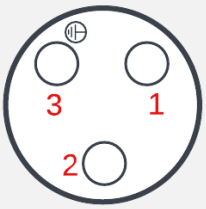
Power cable assembly

Assemble the power cable following the assembly diagram below. Adhere to the recommended wire stripping lengths.

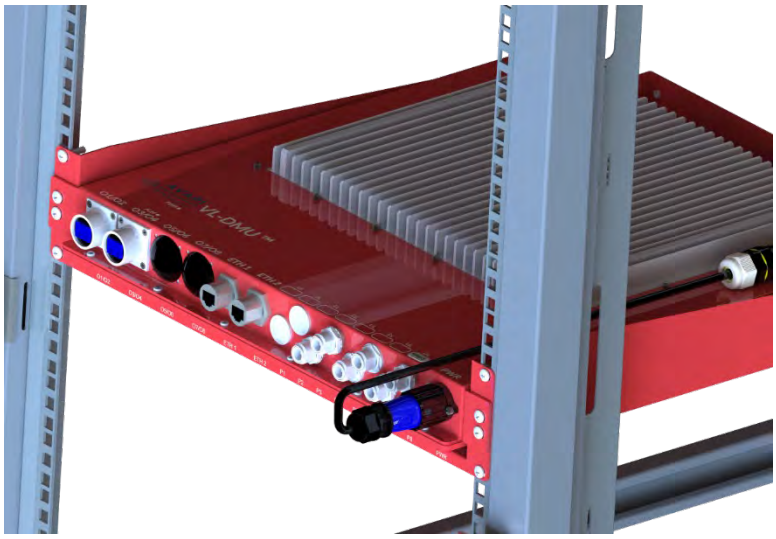
Stripping Lengths	
Outer jacket	0.78 inch (20 mm)
Wire	0.35 inch (9 mm)



Attach the wires to the terminals in the contact insert using a small flathead screwdriver.

DC connector	AC connector
	
1= Positive 2 = Negative 3 = Not used 4 = Power source ground Only connect power source ground if the power supply equipment is located in a different facility than the unit.	1 = AC L 2 = AC N 3 = Ground
Ensure that wire leads on DC-input power wires are not exposed. DC-input power can conduct harmful levels of electricity.	

Connect the power cable to the power interface on the unit and tighten the locking ring. The fit should be snug. Do not overtighten.



Turning On the Unit

After the power is connected, the unit starts up and enters Standby mode.

NOTE In Standby mode, the VL-DMU is powered but not passing Active RF signals.

The power and alarm LEDs display the following sequence while the unit is starting up.

Power LED	Alarm LED	Description
Red	Off	Software is starting
Orange flashing	Off	Software is loading
Green	Orange or Green	Software is running and unit is in Standby mode

For more information about LEDs, see Startup LEDs.

✦ **To verify power to the VL-DMU:**

1. Apply power at the AC or DC power source.
2. Wait about two minutes while the startup sequence completes.
3. Confirm the following unit LEDs for Standby mode.

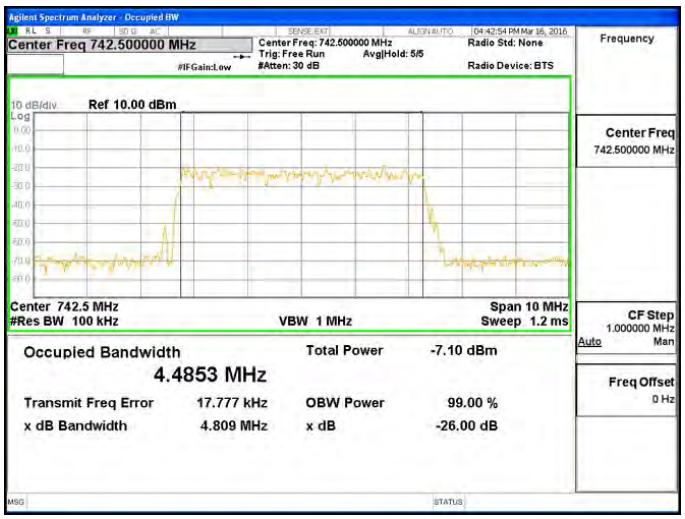
4. If the unit LEDs do not indicate Standby mode, check the power supply and connections.

Connecting the Uplink and Downlink Feeds

Base station feed cables terminated at the VL-DMU should be 1/2-inch and 7/8-inch coaxial cable. Always consider and respect the minimum bend radius provided by the cable manufacturer.

Verify that power levels on the RF feeds are within the specified range using a spectrum analyzer.

For example:



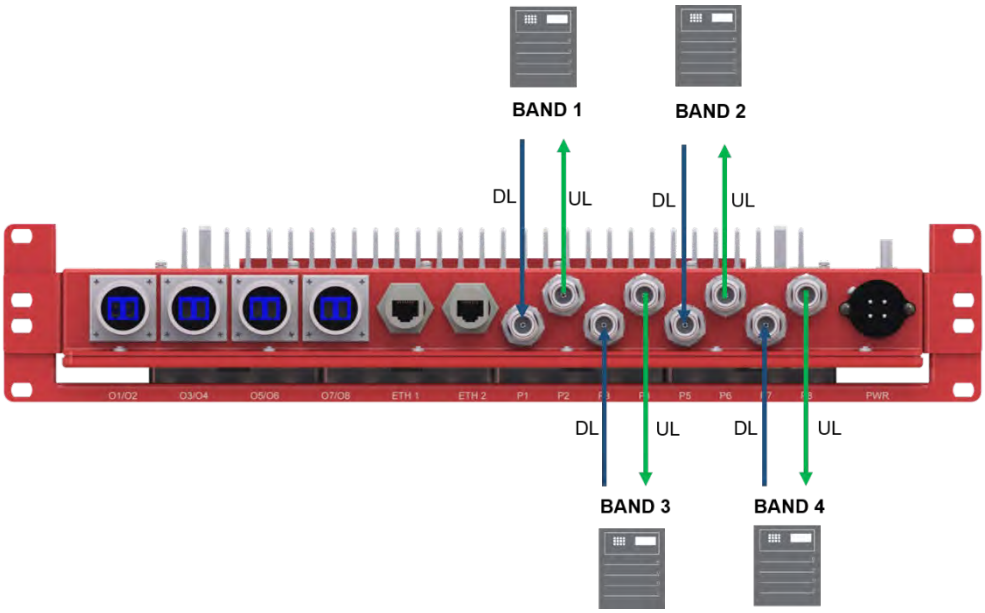
The base station maximum power level must be within **-10 dBm** to **+10 dBm**.

Verify base station feed cable performance and test each RF coaxial cable for return loss.

> ⚠ Excessive RF power levels can cause severe damage to the VL-DMU.

Connecting RF Cables to the VL-DMU

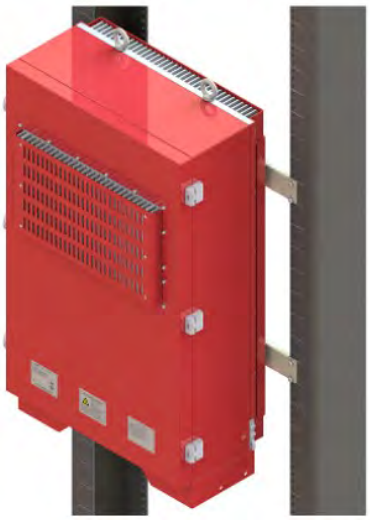
The VL-DMU has up to eight, N-type simplex RF interfaces for connecting a maximum of four public safety bands. For each band, connect the uplink (UL) and downlink (DL) feed cable.



3.3 Installing the VL-AMU Air Master Unit and VL-RU Remote

The VL-AMU air master unit and VL-RU remote can be mounted to a wall or post, or installed in an equipment rack.

NOTE The VL-AMU and VL-RU have the same chassis style. The instructions in this section can be used for installing both units.



Use the mounting kits provided, and screws or mounting hardware suitable for the wall or rack type.

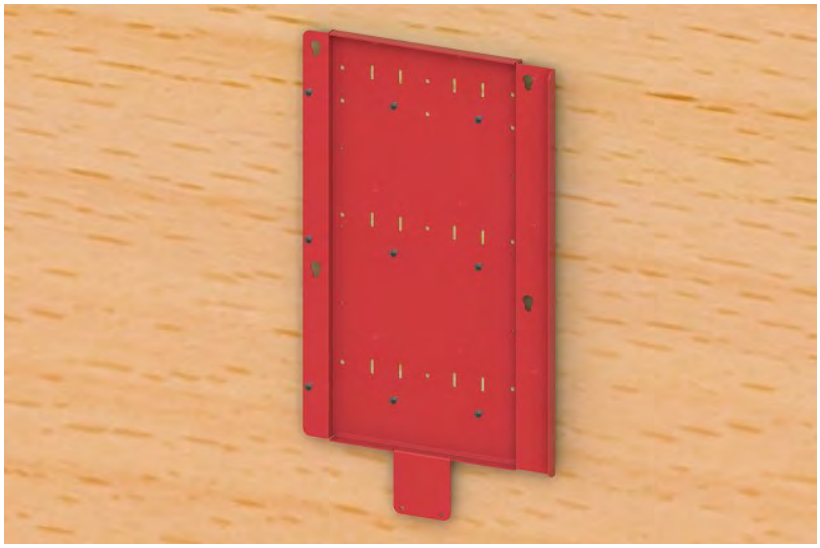
Wall Mount	Rack Mount	Post Mount
• Wall bracket (provided) • 2 x M6 screws (provided) • 9 wall screws • #2 Phillips screwdriver	• Wall bracket (provided) • 2 mounting bars and screws (provided) • 2 x M6 screws (provided) • 8 rack screws • #2 Phillips screwdriver	• Wall bracket (provided) • 2 x M6 screws (provided) • Metal strapping for mounting on a 3.5-inch to 6.5-inch post • #2 Phillips screwdriver

For wall mount use a minimum ¾” plywood with lag screws (1/4” x 1-1/2”) and washers.

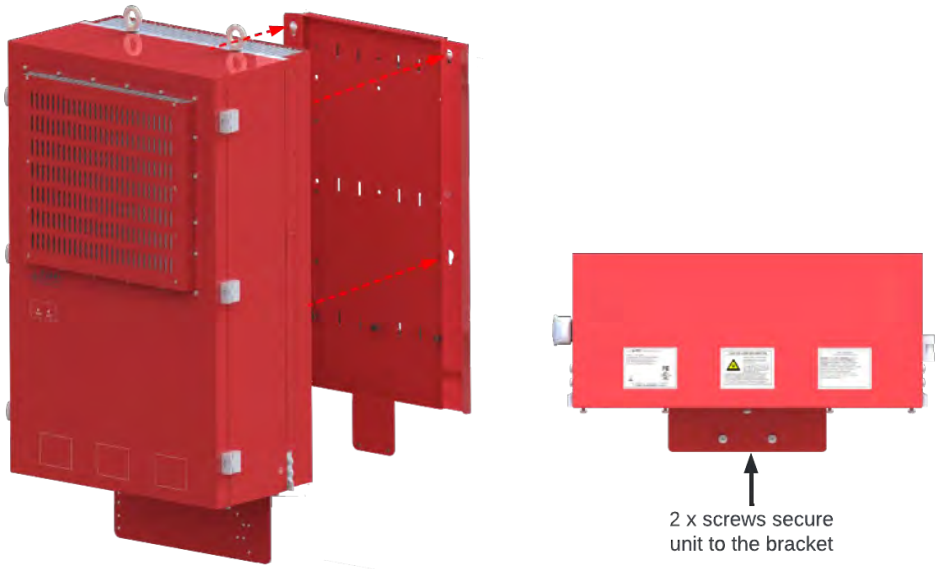
If mounting to a concrete wall, DIN Rails, or any other materials, refer to the local building code.

Wall Mounting

STEP 1 Attach the bracket with 6 wall screws. Make sure the flange is facing down.



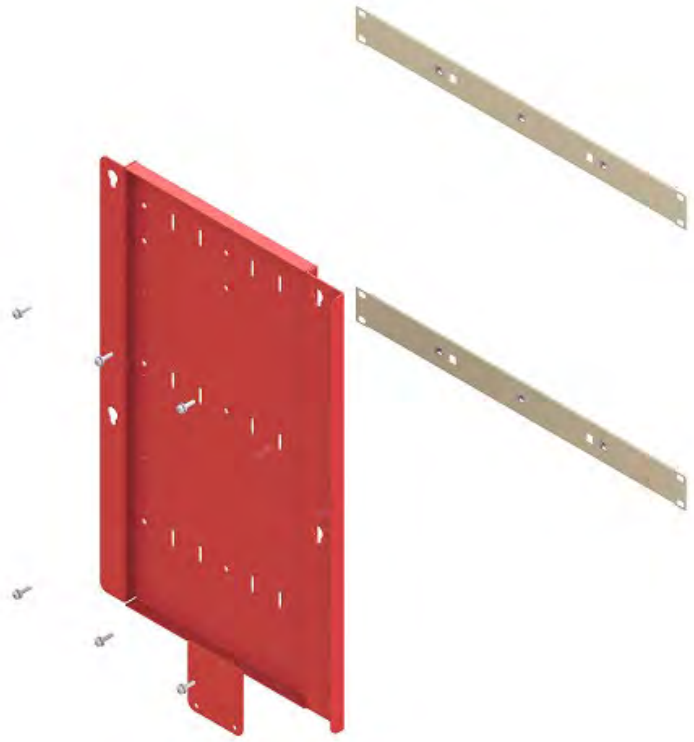
STEP 2 With the back of the unit facing the bracket, insert the shoulder bolts into the slots, and slide the unit down so that it locks in place. Install the two M6 screws through the front of the unit into the bracket flange, and tighten with a Phillips screwdriver.



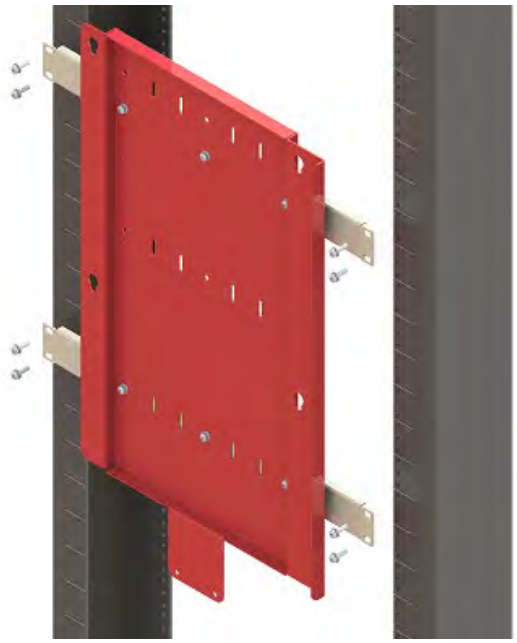
Rack Mounting

IMPORTANT Make sure the equipment rack has adequate support, and is bolted to the floor and ceiling as required by local regulatory authorities.

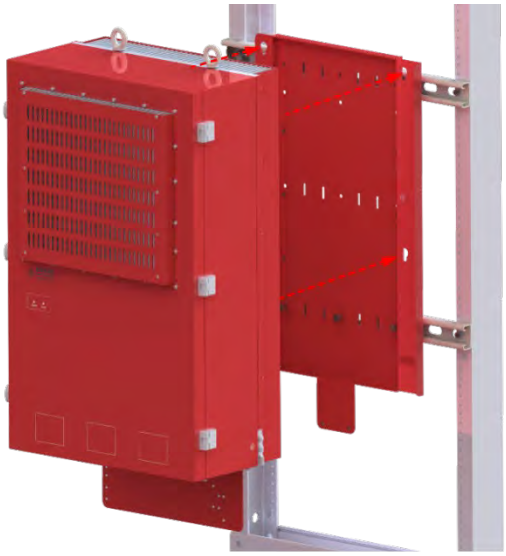
STEP 1 Attach the bars to the bracket using the screws provided in the rack kit. One installed, the bars are spaced 9RU apart. Ensure any rack-specific mounting hardware is installed in the rack at the appropriate spacing.



STEP 2 Mount the bracket assembly to the rack using 8 screws suitable for the rack type.



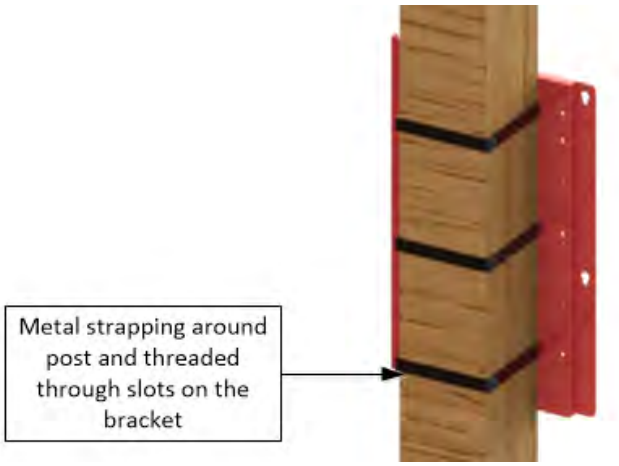
STEP 3 With the back of the unit facing the bracket, insert the shoulder bolts into the slots, and slide the unit down so that it locks in place. Install the two M6 screws through the front of the unit into the bracket flange, and tighten with a Phillips screwdriver.



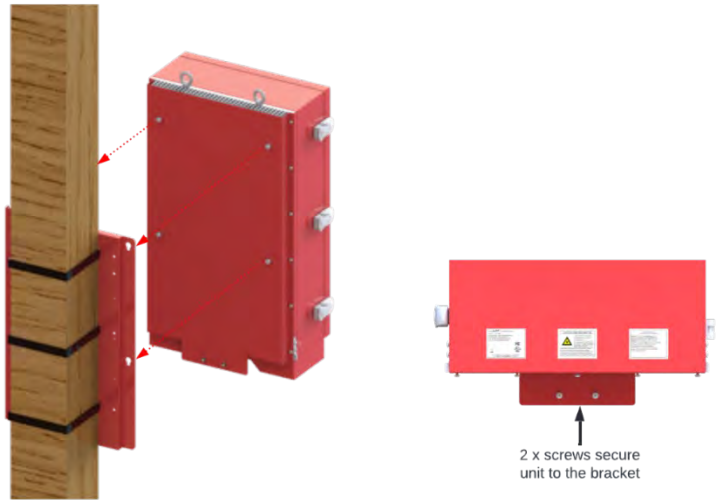
Post Mounting

STEP 1 With another person assisting, position and hold the bracket in place and thread strapping through the top slots and around the post.

Tension the strapping firmly and then crimp. Do not bend the bracket. Ensure that the bracket is level and vertical, with the securing flange on the bottom. Repeat for the remaining middle and bottom strapping slots.



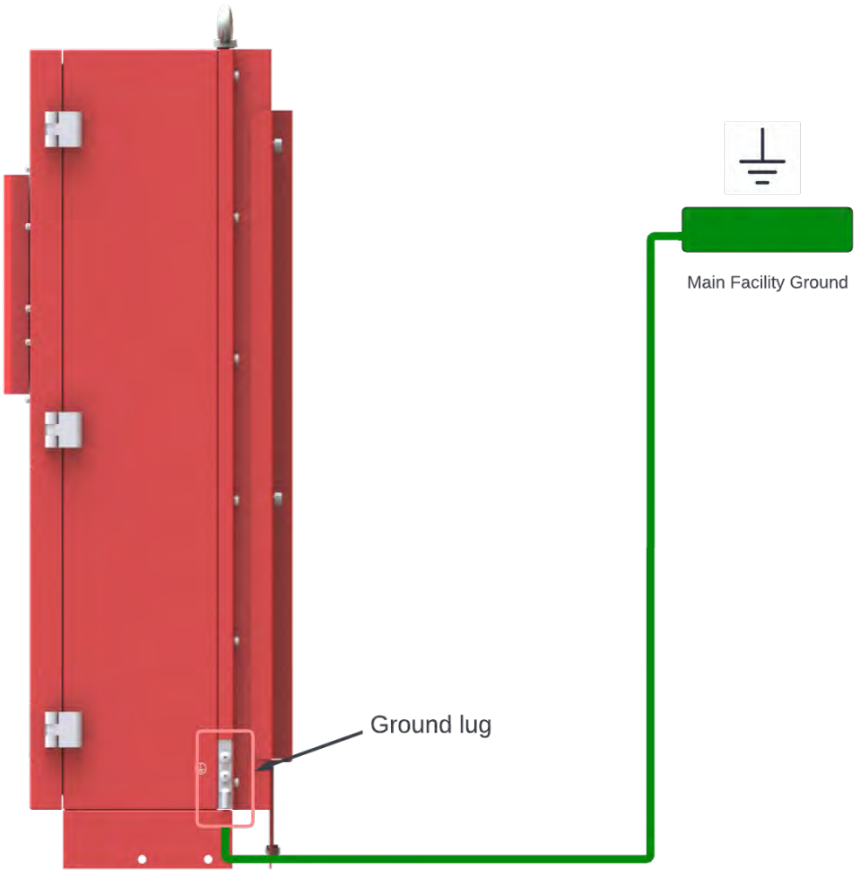
STEP 2 With the back of the unit facing the bracket, insert the shoulder bolts into the slots, and slide the unit down so that it locks in place. Install the two M6 screws through the front of the unit into the bracket flange, and tighten with a Phillips screwdriver.



Grounding

A ground lug is provided on the side of the unit.

Use a #2 Phillips screwdriver to remove ground lug. Insert a #10 AWG ground wire into the ground lug and crimp. Reattach the lug and tighten both screws. Run the ground wire to the facility grounding point and secure it.



Connecting Power

The VL-AMU and VL-RU require an uninterrupted 48 VDC power supply. For sites with an AC power source, the unit includes an AC/DC power adapter when ordering AC version equipment.

Use the AC or DC power connector provided.

Power Supply with mounting plate
only provide power supply for AC version AMU & RU

DC power cable requirements

Use a DC cable at a suitable gauge for the distance between the fuse panel and unit.

The voltages shown in the following table are voltages at the power sourcing equipment.

AWG	42 V (3% loss)	48 V (3% loss)	56 V (3% loss)
#12	162 ft (49 m)	211 ft (64 m)	287 ft (88 m)
#14	102 ft (31 m)	133 ft (40 m)	181 ft (55 m)
#16	64 ft (19 m)	83 ft (25 m)	114 ft (35 m)

Power cable assembly

Connect the open-wired power cable to the power interface on the unit.

The following table describes the maximum distance between the power source equipment and the unit. The values assume a maximum recommended loss of 3%. The voltages shown are voltages at the power sourcing equipment.

AWG	42 V (3% loss)	48 V (3% loss)	56 V (3% loss)
AWG #10	47 ft (14 m)	61 ft (19 m)	83 ft (25 m)

These values assume the following:

- Maximum power consumption is 340 W
- Wire gauge is AWG #10 stranded bare copper
- Maximum recommended loss of 3%

Turning on the Unit

After the power is connected, the unit starts up and enters Standby mode. The power and alarm LEDs display the following sequence while the unit is starting up.

Power LED	Alarm LED	Description
Red	Off	Software is starting
Orange flashing	Off	Software is loading
Green	Orange or Green	Software is running and unit is in Standby mode

For more information, see Startup LEDs.

✦ **To turn on the unit**

1. Apply power at the AC or DC power source.
2. Wait about two minutes while the unit starts up.
3. Confirm the following LEDs for Standby mode:

- **Pwr** LED: green
- **Alm** LED: green or orange

> **NOTE** In Standby mode, the VL-AMU or VL-RU is powered but not passing Active RF signals.

4. If the unit does not reach Standby mode, check the power supply and connections.

Locking the Unit

The VL-AMU and VL-RU have a locking door to restrict access. Keys are common to all units.

Connecting RF Cables

Depending on the RF design, the VL-AMU and VL-RU have different of RF interface options for connecting to public safety signal sources.

For low frequency bands, 150 MHz and 450 MHz, the unit has simplex RF interfaces for connecting to external pass-band filter.

For 700 MHz, 800 MHz, and 900 MHz bands, the units connect directly to an internal duplexer or multiplexer.

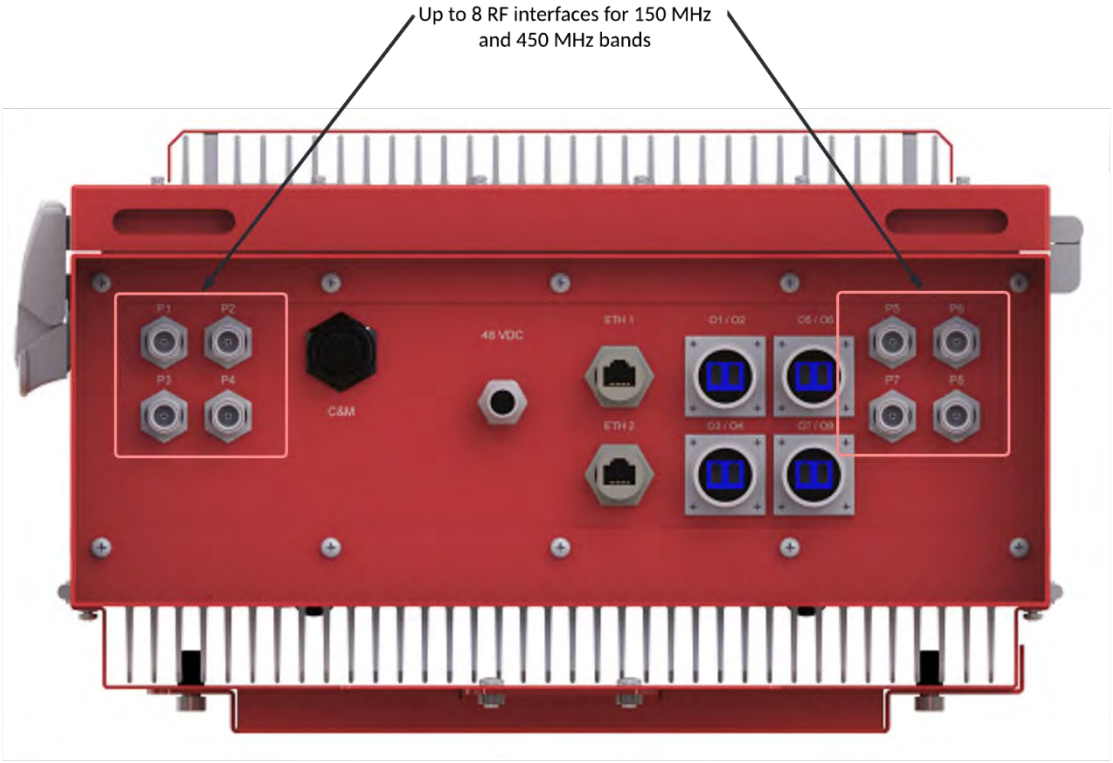
NOTE When connecting RF cables:

- Terminate coaxial cables with N-type male connectors.
- Apply 12-15 in-lbs (136 N-cm) torque to secure the cables.

RF Cabling for Low Frequency Bands

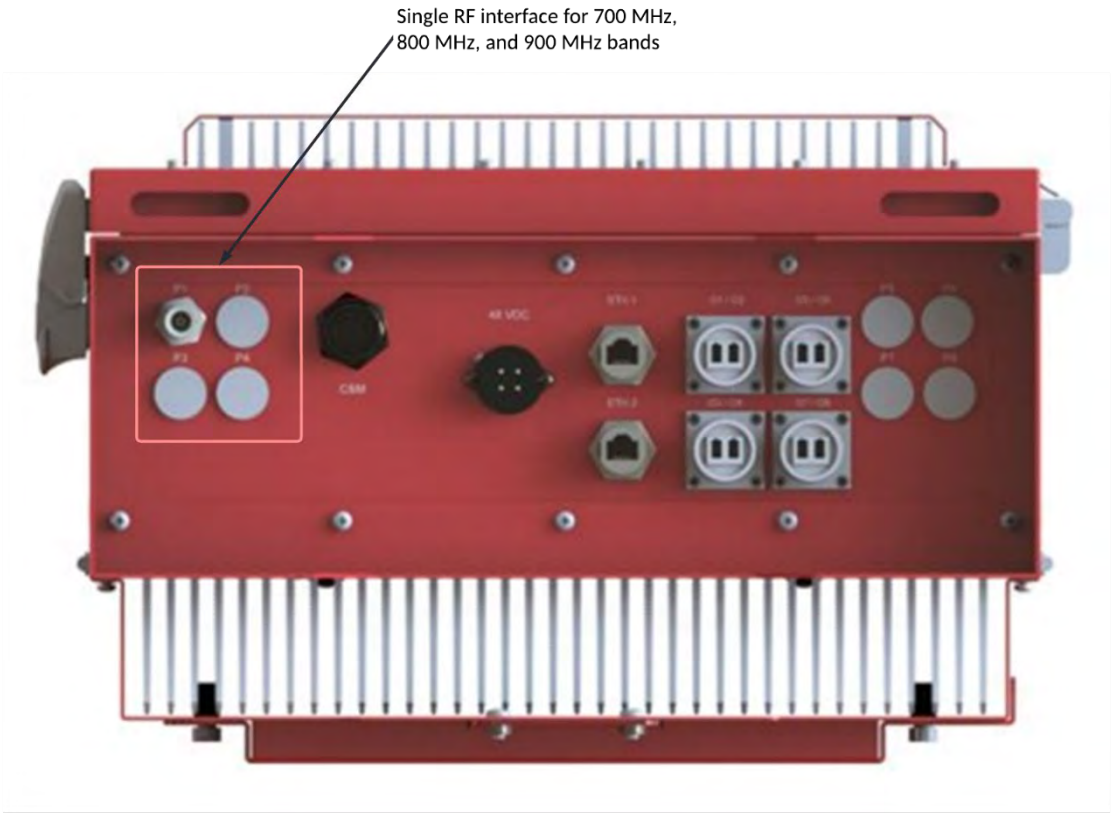
For units connected to an external pass-band filter, connect the downlink and uplink RF cables to the N-type RF interfaces.

This option is suitable for low frequency public safety bands, such as 150 MHz and 450 MHz.



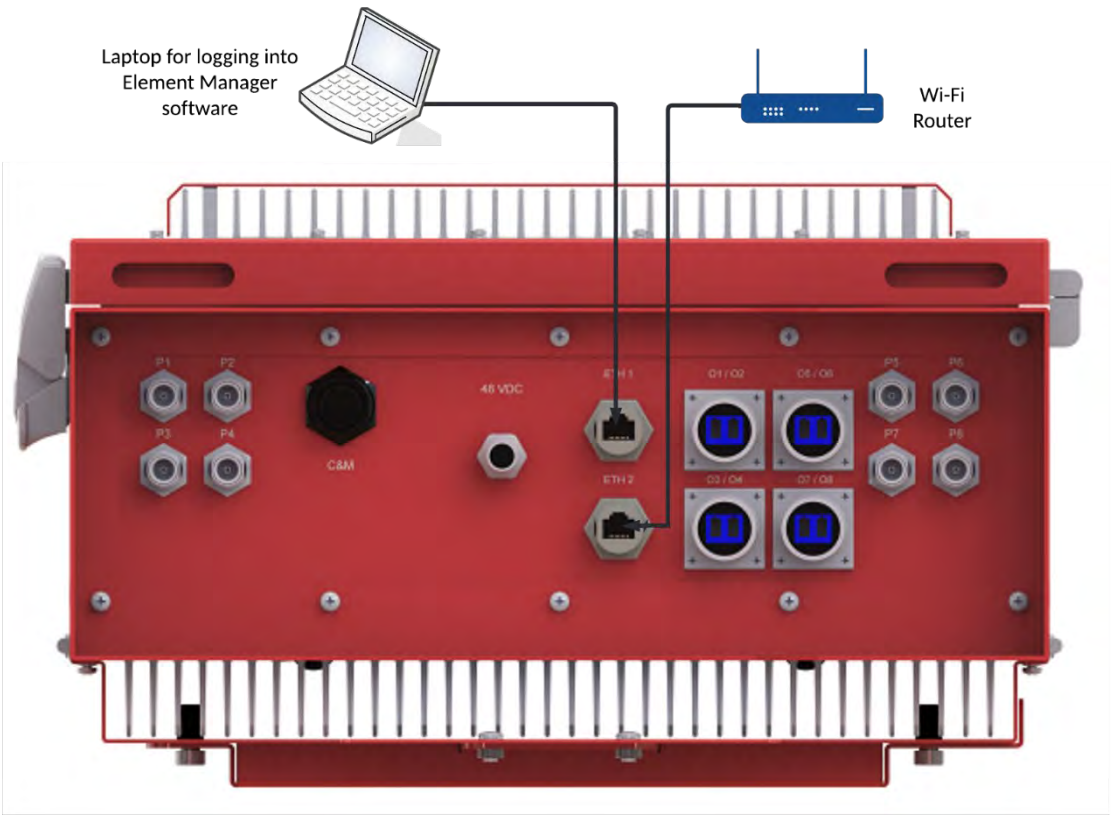
RF Cabling for Units with Internal Duplexer/Multiplexer

For units with an internal duplexer or multiplexer, connect the RF cable coming from antennas or RF combining equipment to a single N-type RF port.



Connecting Ethernet Cables (VL-RU only)

The VL-RU has two Ethernet interfaces for connecting a laptop, Wi-Fi access point, security cameras, or other Internet devices.



Ethernet cables are connected to the unit using a weatherproof RJ-45 connector provided by Avari Wireless.

3.4 Installing the VL-EM Element Manager

The VL-EM element manager can be installed in an equipment rack or wall mounted.

Use the mounting kits provided, and screws or mounting hardware suitable for the wall or rack type.

Rack Mount	Wall Mount
• Rack bracket (provided) • 8 rack screws • #2 Phillips screwdriver	• Wall bracket (provided) • 4 x L-brackets with captive locking and self-cinching screws (provided) • 6 x wall screws • #2 Phillips screwdriver

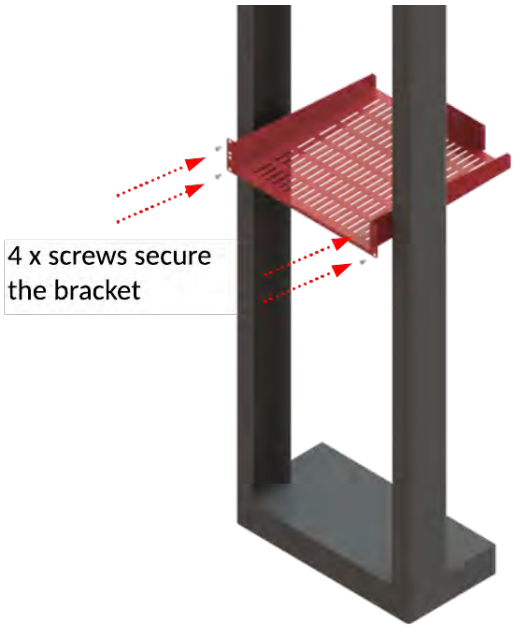
For the rack mount use the recommended captive nuts and screws from the rack/cabinet supplier.

For wall mount use a minimum ¾” plywood with lag screws (1/4” x 1-1/2”) and washers.

If mounting to a concrete wall, DIN Rails, or any other materials, refer to the local building code.

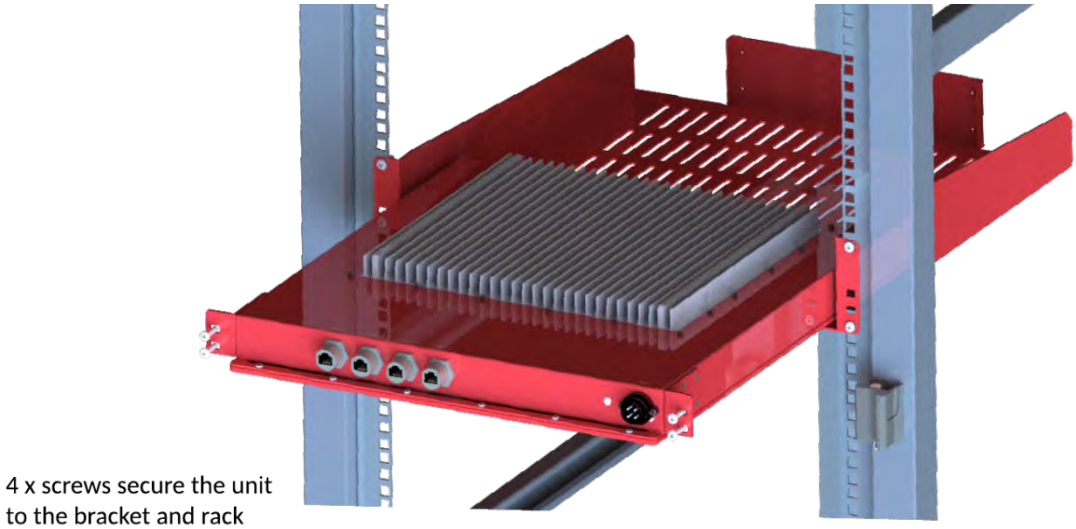
Rack Mounting

STEP 1 Attach the bracket to the rack with four rack screws.



*Screws are installer-provided and suitable for the rack type

STEP 2 Slide the unit into the bracket until the front L-brackets are flush with the posts. Secure the unit using four rack screws.

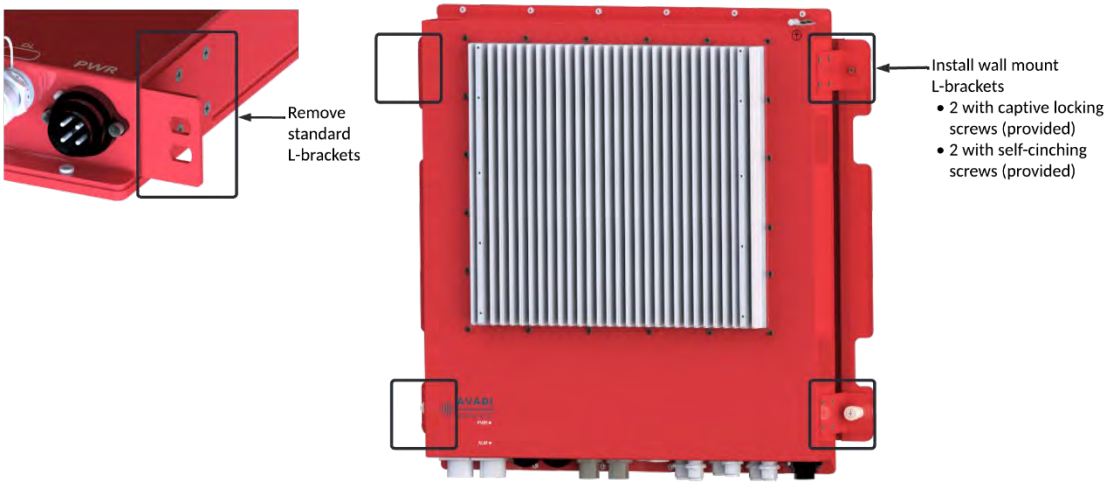


*Screws are installer-provided and suitable for the rack type

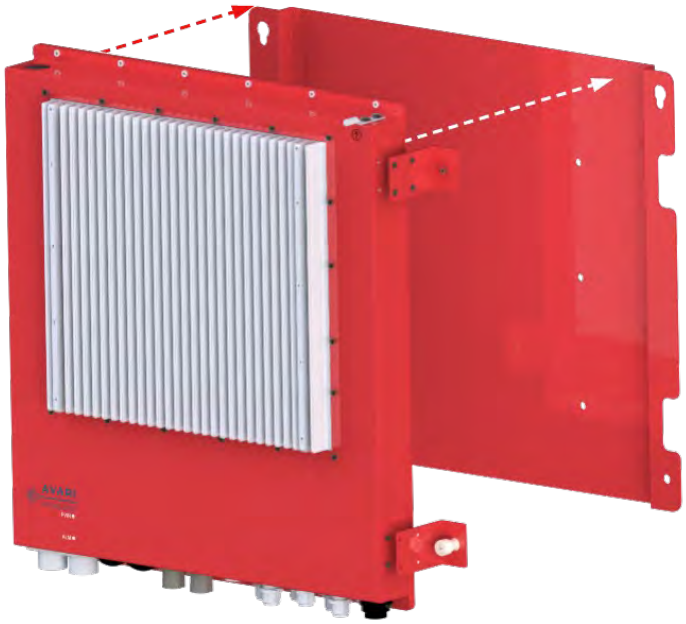
Wall Mounting

STEP 1 Mount the bracket on the wall using 6 wall screws suitable for the wall type.

STEP 2 Replace the standard L-brackets with the wall mount L-brackets with captive locking screw and nut.



STEP 3 With the back of the unit facing the bracket, insert the shoulder bolts into the slots, and slide the unit down so that it locks in place. Tighten the locking screws on both sides of the unit using a #2 Phillips screwdriver to secure the unit to the bracket.

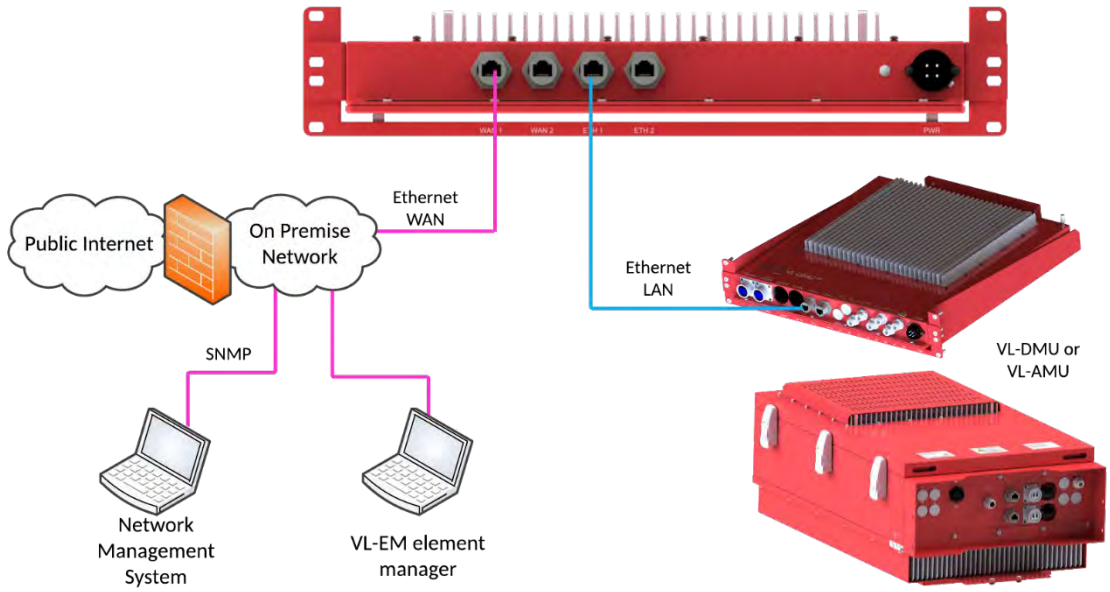


Connecting Ethernet Cables

The VL-EM has 4 Ethernet ports for connecting to local and wide area networks.

Use **WAN1** for connecting to the customer IP network and **ETH1** for connecting to the master units. For more information, see IP Network Configuration.

If the system has more than one master unit, connect each master unit to the VL-EM using available Ethernet interfaces.

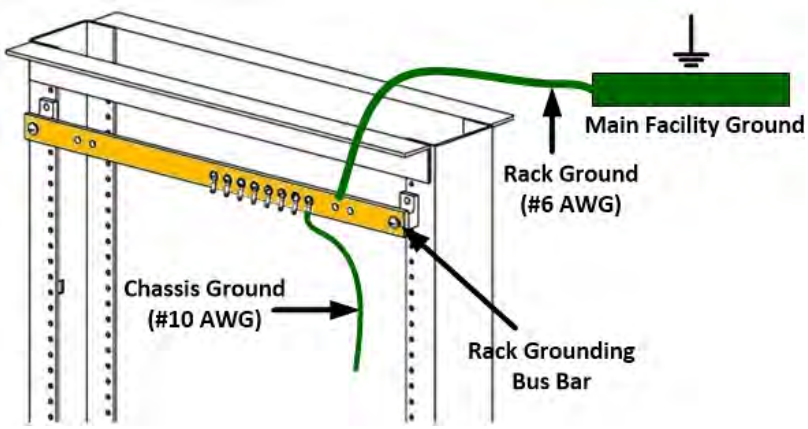


Connect Ethernet cables to the unit using the weatherproof, field installable RJ-45 connector provided.

Assemble the Ethernet cable and RJ-45 connector. Plug the connector into the interface on the remote, and finger tighten the locking ring to secure.

Grounding

Make sure the equipment rack is grounded to the main facility ground, and that the rack has a ground bus bar installed.

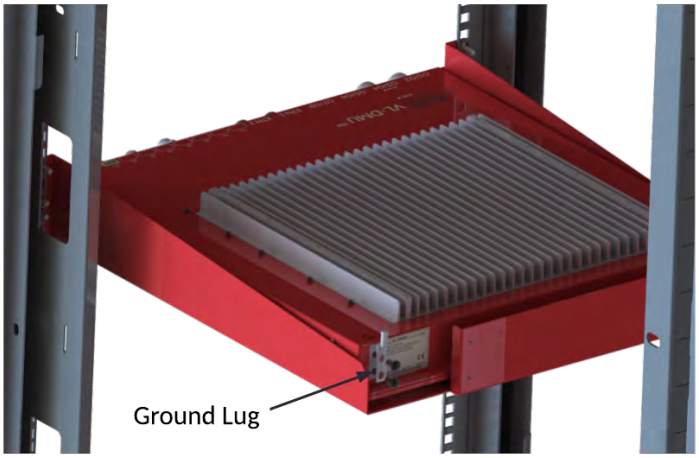


Ground the **VL-EM** to the ground bus bar before connecting any cables.

Chassis Ground Lug

The ground lug for the VL-EM is located at the rear of the unit.

Use a #2 Phillips screwdriver to remove ground lug. Insert a #10 AWG ground wire into the ground lug, crimp, reattach and tighten both screws.



Connecting Redundant Element Managers

For uninterrupted monitoring and control of master units and remotes, you can install redundant element managers.

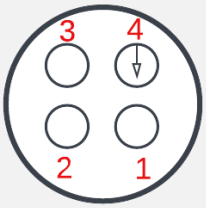
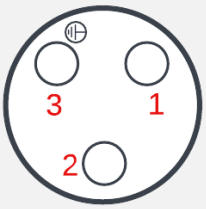
Use a primary element manager for managing configuration changes through the VL-EM, and a secondary, backup unit. If the primary unit fails, you can manually switch to the secondary unit.

Learn more about headend redundancy and failover.

Turning on the Unit

The VL-EM requires AC or DC power.

The VL-EM requires an uninterrupted 48 VDC power supply. For sites with an AC power source, the unit includes a built in AC/DC power adapter when ordering AC version equipment.

DC connector	AC connector
	
1= Positive 2 = Negative 3 = Not used 4 = Power source ground Only connect power source ground if the power supply equipment is located in a different facility than the unit.	1 = AC L 2 = AC N 3 = Ground
Ensure that wire leads on DC-input power wires are not exposed. DC-input power can conduct harmful levels of electricity.	

Connect the power cable to the power interface on the unit and tighten the locking ring. The fit should be snug. Do not overtighten.

AC Power Cord or DC power connector (not include wire)

3.5 Installing the VL-DU 8/14 Distribution Unit

The VL-DU 8/14 distribution unit can be installed in an equipment rack or wall mounted.

Use the mounting kits provided, and screws or mounting hardware suitable for the wall or rack type.

Rack Mount	Wall Mount
• Rack bracket (provided) • 8 rack screws • #2 Phillips screwdriver	• Wall bracket (provided) • 4 x L-brackets with captive locking and self-cinching screws (provided) • 6 x wall screws • #2 Phillips screwdriver

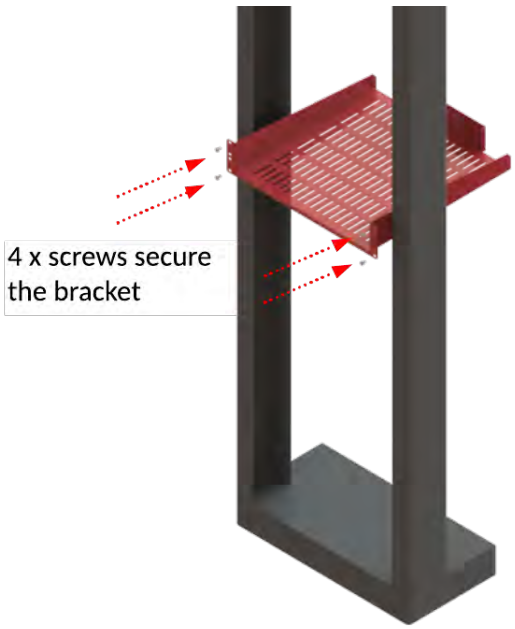
For the rack mount use the recommended captive nuts and screws from the rack/cabinet supplier.

For wall mount use a minimum ¾” plywood with lag screws (1/4” x 1-1/2”) and washers.

If mounting to a concrete wall, DIN Rails, or any other materials, refer to the local building code.

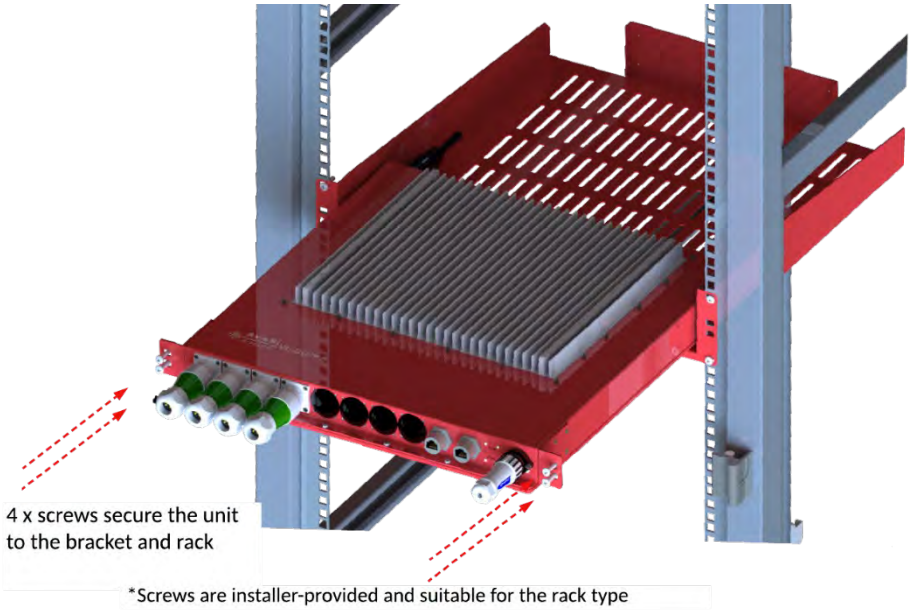
Rack mounting

Step 1 Attach the bracket to the rack with four rack screws.



*Screws are installer-provided and suitable for the rack type

Step 2 Slide the unit into the bracket until the front L-brackets are flush with the posts. Secure the unit using four rack screws.

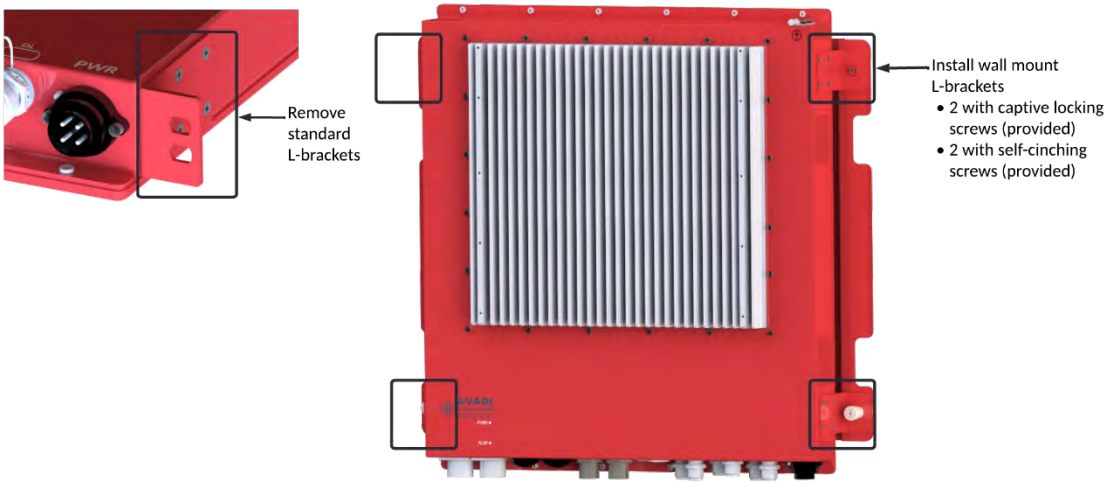


*Screws are installer-provided and suitable for the rack type

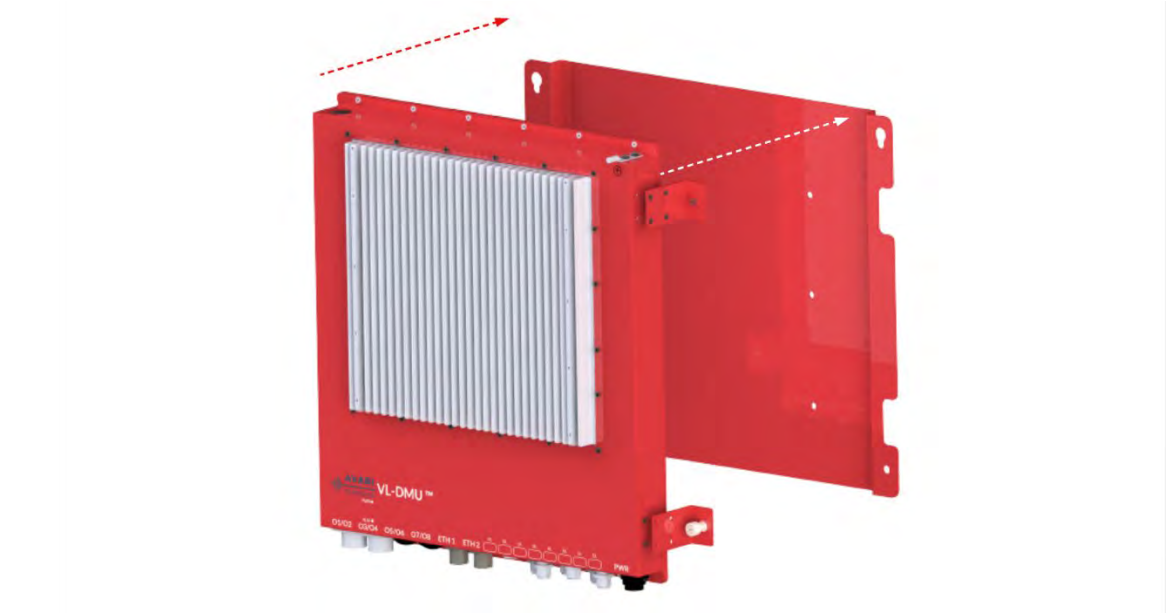
Wall Mounting

STEP 1 Mount the bracket on the wall using 6 wall screws suitable for the wall type.

STEP 2 Remove the standard L-brackets and replace with wall mount L-brackets with captive locking screw and nut.



STEP 3 With the back of the unit facing the bracket, insert the shoulder bolts into the slots, and slide the unit down so that it locks in place. Tighten the locking screws on both sides of the unit using a #2 Phillips screwdriver.



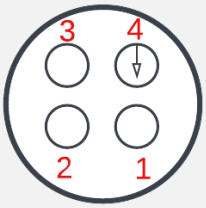
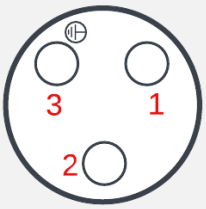
Grounding

The VL-DU is grounded the same way as the VL-DMU. Make sure the equipment rack is grounded to the main facility ground, and that the rack has a ground bus bar installed.

To ground the unit, follow the instructions for grounding the VL-EM .

Connecting Power

The VL-DU requires AC or DC power. For sites with an AC power source, the unit includes a built in AC/DC power adapter when ordering AC version equipment.

DC connector	AC connector
	
1= Positive 2 = Negative 3 = Not used 4 = Power source ground Only connect power source ground if the power supply equipment is located in a different facility than the unit.	1 = AC L 2 = AC N 3 = Ground
Ensure that wire leads on DC-input power wires are not exposed. DC-input power can conduct harmful levels of electricity.	

Connect the power cable to the power interface on the unit and tighten the locking ring. The fit should be snug. Do not overtighten.

AC Power Cord or DC power connector (not include wire)

Use the AC or DC power connector provided.

Turning On the Unit

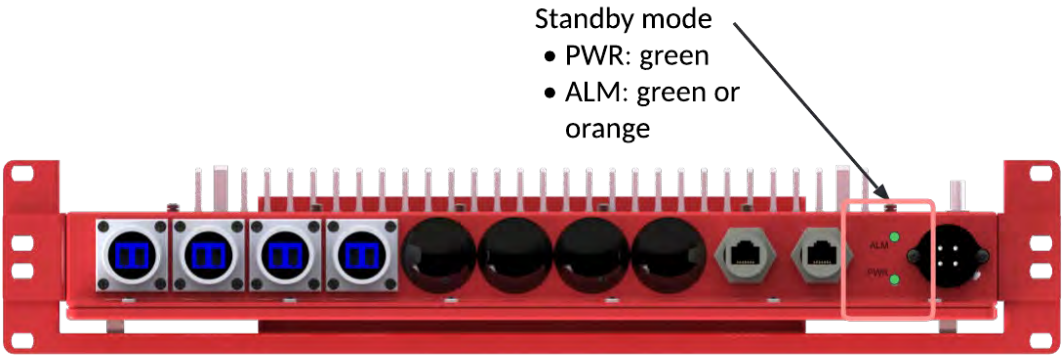
After the power is connected, the unit starts up and enters Standby mode.

> **NOTE** In Standby, the VL-DU is powered but not transporting data streams.

The power and alarm LEDs display the following sequence while the unit is starting up.

Power LED	Alarm LED	Description
Red	Off	Software is starting
Orange flashing	Off	Software is loading
Green	Orange or Green	Software is running and unit is in Standby mode

For more information about LEDs, see Startup LEDs.

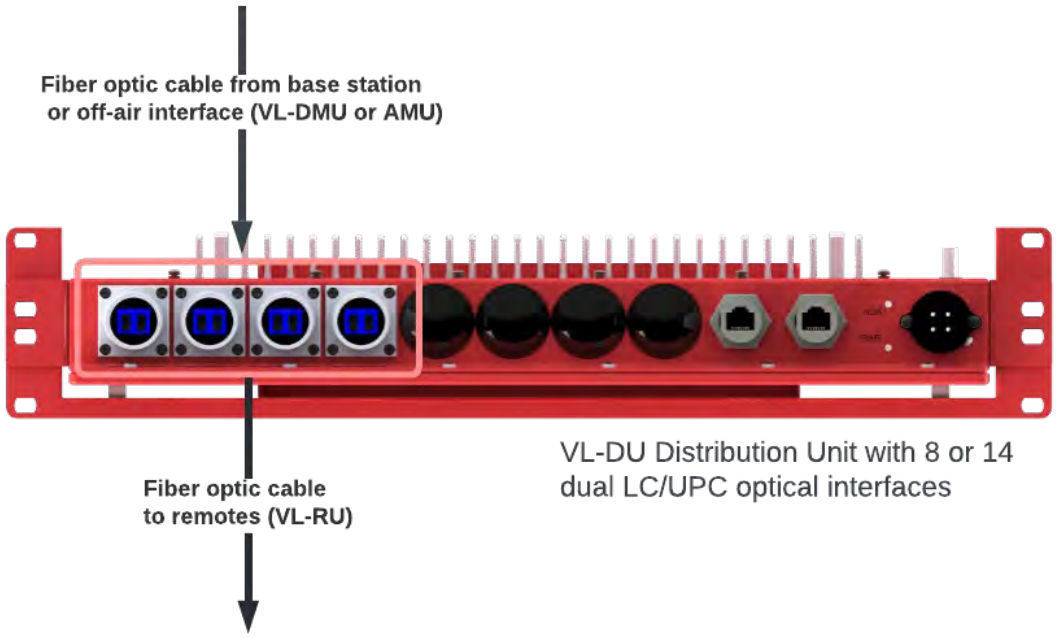


✦ **To turn on the VL-DU:**

1. Apply power at the power source.
2. Wait two minutes while the startup sequence completes.
3. Confirm that the unit is in Standby mode.
4. If the unit LEDs do not indicate Standby, check the power supply and connections.

Connecting Fiber Cables

The VL-DU 8/14 supports 7 or 13 downstream optical ports for directly connecting remotes, and 1 upstream optical port for connecting to a master unit.



For more information on connecting fiber cables in some common network topologies, see Fiber Installation.

3.6 Installing the VL-CLK Clock Distribution Unit

For systems with requiring headend redundancy and failover, install the VL-CLK clock in an equipment rack or wall mount using appropriate hardware.

NOTE The VL-CLK has the same chassis style as the VL-DU distribution unit. Follow the instructions for installing the VL-DU distribution unit.

4 Fiber Installation

What's inside this chapter:

4.1 Handling Fiber

4.2 Fiber Topologies

4.3 Connecting Single Mode Fiber

4.1 Handling Fiber

This equipment contains components that emit laser radiation which can seriously damage the retina of the eye.

- Do not look into the ends of any optical fiber.
- Do not look directly into the optical transceiver of any digital unit to avoid eye damage.
- Place a protective cap or lid immediately over any radiating transceiver or optical fiber connector to avoid potential damage caused by radiation exposure. This practice also prevents dirt particles entering the openings.

Follow the safety guidelines for handling fiber-optic cables.

Installation Requirements

The general installation requirements for installing fiber should follow the *NECA/FOA 301 Standard for Installing and Testing Fiber Optic Cables*.

The specific requirements for installing fiber for the VL-Series are:

- Install premises cabling in cable trays, ladder racks, j-hooks, or other appropriate support structures.
- Install outside and inside plant cables in conduit (yellow) or plenum protected innerduct (bright orange) to identify fiber optic cable and protect it from damage.
- Follow the NECA/FOA 301 standard for fiber cable splicing and termination hardware.
- Do not install fiber cable in conduit or duct that already contains cabling (such RF, Ethernet, or power).
- Ensure properly installed support structures and patch panels for fiber cable are available for routing cable from VL-DMU and VL-AMU to remotes.

Fiber Testing

After installation, verify each fiber in all fiber cables by performing the following tests:

- Continuity testing to ensure that the fiber routing is correct
- Insertion loss testing using an OLTS power meter and source. Use TIAEIA 527-7 for single mode fiber.
- OTDR testing (optional) to verify cable installation performance

4.2 Fiber Topologies

Remotes can be connected to a master unit and distribution unit in the following fiber topologies: star, daisy-chain, and hybrid.

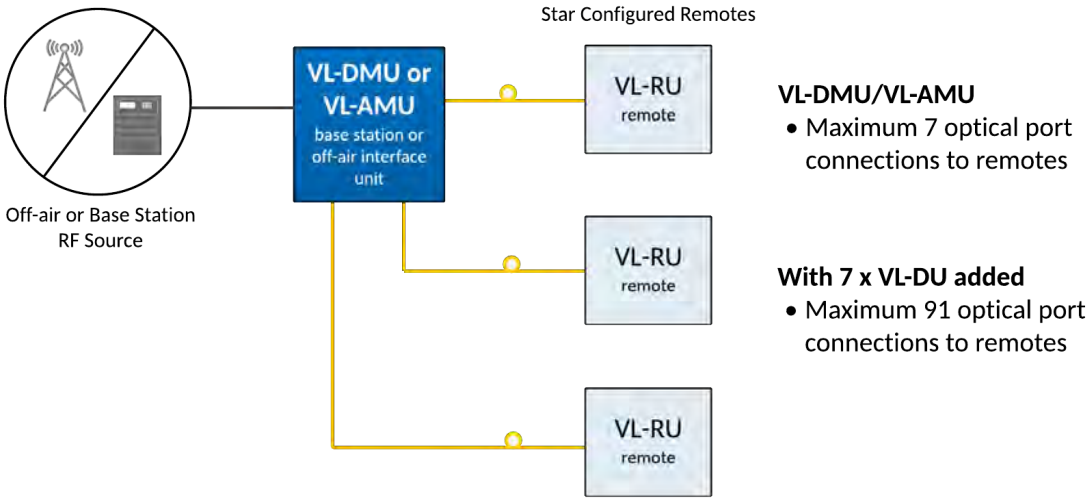
Star Topology

In a star topology, each remote connects to a different optical port on the master unit or distribution unit. Each master unit supports 7 optical ports for directly connecting seven remotes, and 1 optical port reserved for connecting to another master unit.

Each distribution unit supports up to 7 or 13 downstream optical ports for directly connecting remotes, and 1 optical upstream port for connecting to a master unit.

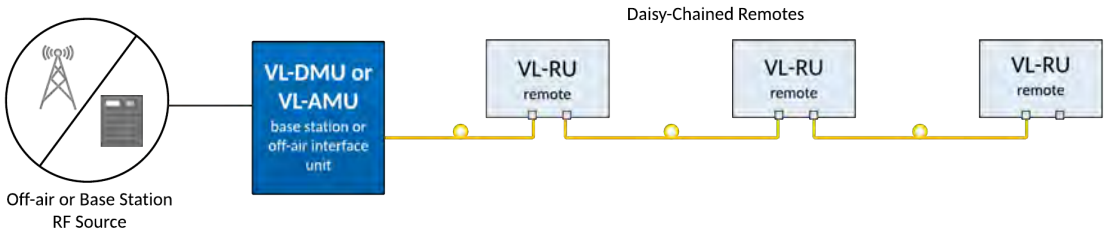
One master unit and seven, 14-port VL-DU 14 distribution units can serve 91 remotes in a star topology.

Star topologies are the most robust because each remote receives a dedicated optical link from the master unit.



Daisy-chain Topology

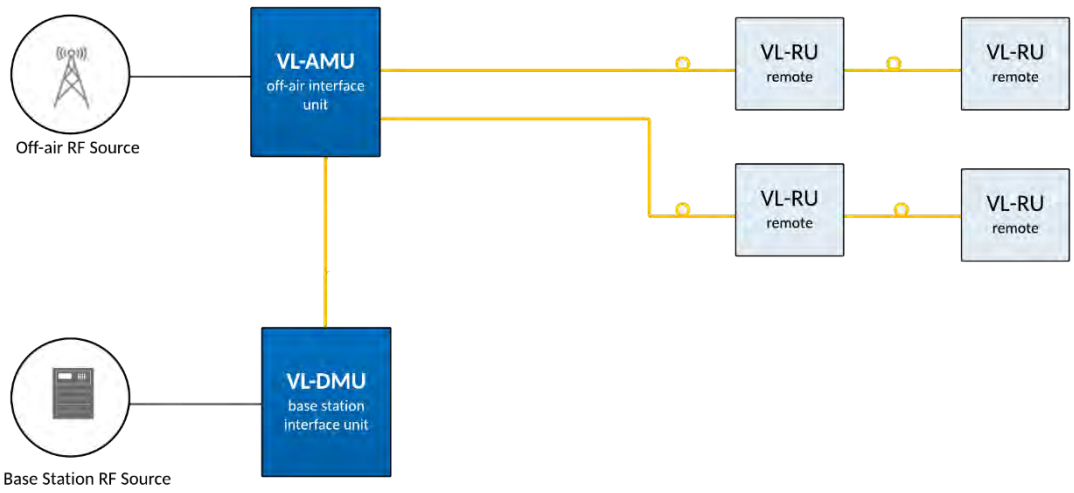
In a daisy-chain topology, the first remote in the chain is connected to the master unit or distribution unit. The second remote connects to a first remote, and so on.



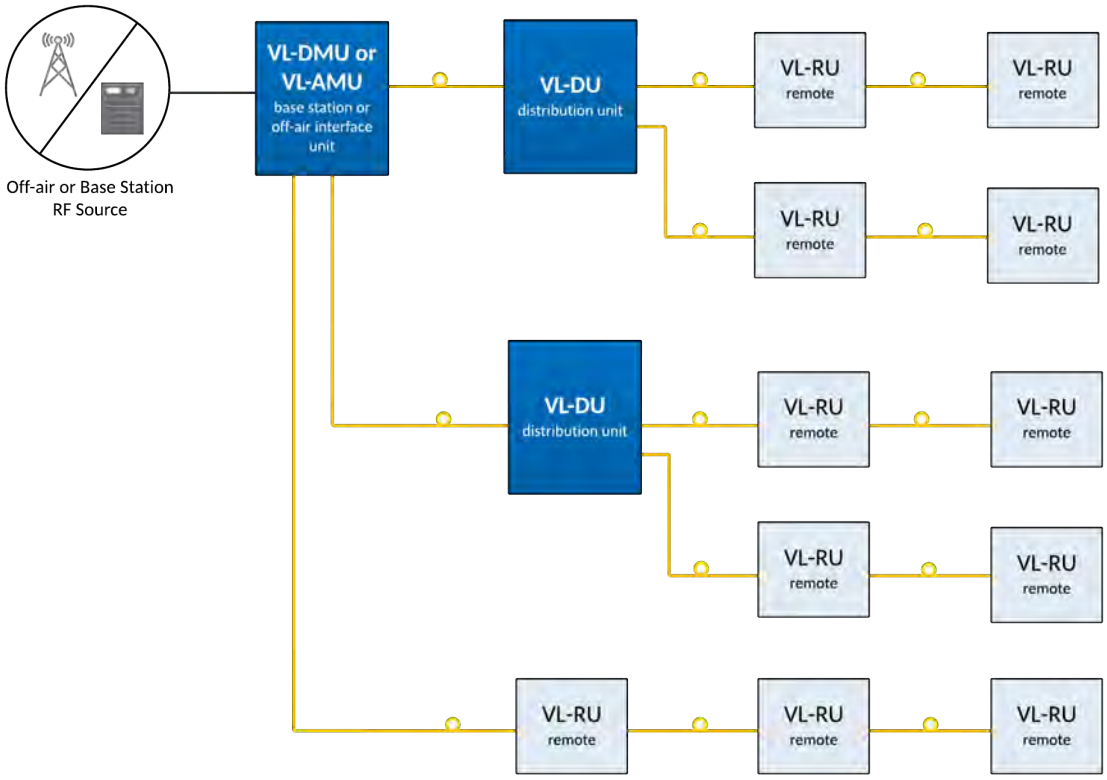
When remotes are daisy-chained, the failure of one remote in the chain can cause the downstream remotes to lose signal. Remote units can be equipped with optical bypass switch that ensures the continuity of signal flow by rerouting the signal from the failed unit to the next remote in the chain. Contact Avari Customer Service about installation and configuration of this option.

The number of daisy-chained remotes depends on maximum round trip delay between the master unit and the furthest remote. For example, an office building with a dedicated base station could support 20 or more daisy-chained remotes.

Master units can also be chained, to aggregate RF signal source from different locations.

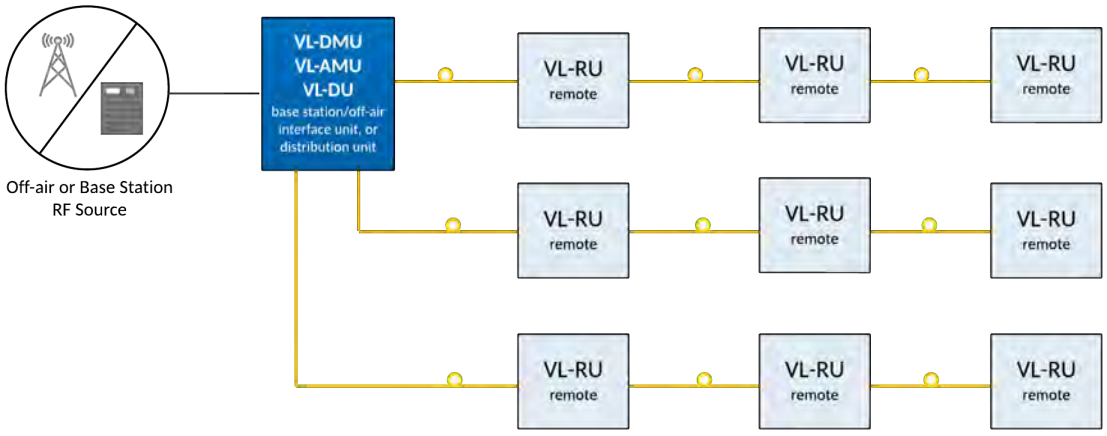


And, distribution units can be added to expand the number optical ports.



Hybrid Topology

In a hybrid topology, multiple remote daisy-chains connect to different optical ports on the master unit or distribution unit. The total number of remotes depends on maximum round trip delay and maximum allowed UL noise contribution.

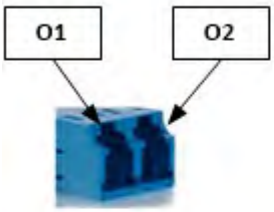


4.3 Connecting Single Mode Fiber

Optical connections between master units and remotes are made using single mode fiber, or patch cords, terminated with LC/UPC type connectors.

For connecting fiber, use the weatherproof, field-installable optical connector assembly provided. The optical cable assembly consists of a three-foot long duplex optical cable with a weatherproof locking optical connector on one end, and on the other, two LC/UPC optical connectors.

The dual LC/UPC optical interfaces on the master unit and remote is housed in an environmentally sealed adaptor with protective screw-on cover.



Before connecting the optical connector, remove all dust plugs from both the optical interface on the unit, and from the cable.

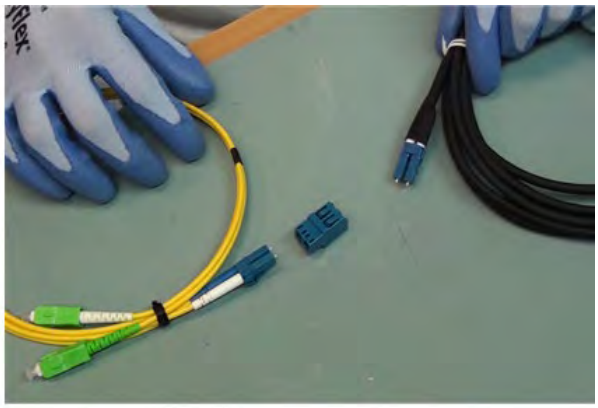
Failure to remove the dust plugs can seriously damage the interface or cable.

✦ **To connect the optical cable to the remote:**

1. Remove the dust plugs from both the optical connector and remote optical interface and store them for future use.
2. Insert the connector into the optical interface and quarter turn the locking ring to secure.

Optical Fiber Adapter Kit

If your optical terminations are either SC/APC, FC/APC, use the VL-Series optical adapter kit. The adapter kit comes with an LC adapter and a patch cord pre-fitted with the desired termination.



5 Startup LEDs

What's inside this chapter:

5.1 Startup LED Sequence

5.2 Standby LEDs

5.3 Troubleshooting Startup LEDs

5.1 Startup LED Sequence

When input power is applied to each device, the LEDs on the front panel display the following sequence. The startup sequence lasts approximately two minutes.

Power LED	Alarm LED	Description
Red	Off	Software is starting.
Orange flashing	Off	Software is loading.
Green	Orange	Software is running. Unit is in Standby mode.

When the startup sequence finishes, the units are in Standby, or not Active. This means band modules are on but are not transmitting or receiving RF signals. The optical ports on the unit are Active, but are not transmitting or receiving the data stream.

If a unit does not reach Standby after completing the startup sequence, the LEDs flash red or orange, indicating that there is an alarm condition to be reviewed or resolved.

5.2 Standby LEDs

VL-DMU and VL-DU

LEDs	Color	Description
PWR	● Green	Power is on
ALM	● Orange	Minor alarm indicating no RF signal detected

VL-AMU and VL-RU

LED	Color	Description
PWR	● Green	Power is on
ALM	● Orange	Minor alarm indicating no RF signal detected

5.3 Troubleshooting Startup LEDs

Alarm LED

ALM LED	Possible Alarm Conditions
● Green	No alarm
● Orange	Standby mode or one the following Minor alarms: • Downstream optical link failure causing a downstream unit to be offline/disconnected • RF signal power is below the configured threshold • Reflected power (VSWR) threshold exceeded
Orange flashing	Major alarm: • RF signal power is above the rated power (Input Path ALC Active alarm)

ALM LED	Possible Alarm Conditions
●/● Red/Orange alternating	Critical alarm • Upstream optical link failure causing this unit to be offline or disconnected
● Red	Major alarm • High temperature • Multiple fan failure
Red flashing	Critical alarm • Shutdown due to high RF power

Power LED

PWR LED	Possible Alarm Conditions
● Green	No alarm
● Orange	Minor alarm • DC voltage is marginal
Orange flashing	Minor alarm • See Startup LED Sequence
● Red	Major alarm • RF module in Standby • Shutdown of RF module due to high power • Shutdown of RF module due to upstream optical path failure • DC voltage is out of range
Red flashing	Critical alarm • See Startup LED Sequence

6 Logging into the Element Manager Software

What's inside this chapter:

6.1 Setting up a Laptop

6.2 Logging in as a System Administrator

6.3 Changing a Password

6.4 Adding a User Account

6.1 Setting up a Laptop

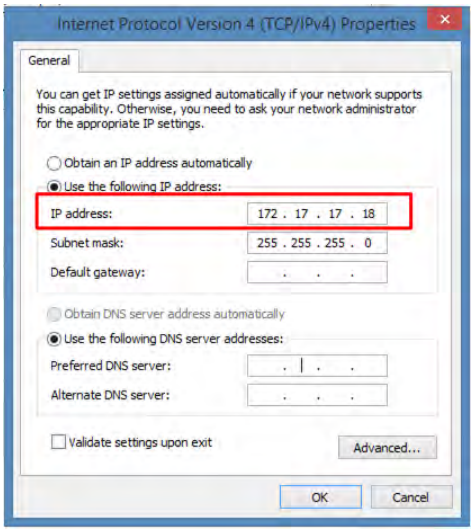
Before logging into the element manager software, you need to set up a laptop with an IP address.

IPv4 Access

If you're logging into the element manager with a static IP4 address, make sure the laptop is on the same subnet as the VL-EM. Make sure Wi-Fi on the computer is turned off.

✦ **To assign the laptop a fixed IPv4 address**

1. In Windows, open **Control Panel**, and then **Network and Sharing Center**.
2. Select **Change adapter settings**.
3. Right-click your local adapter and select **Properties**.
4. Highlight **Internet Protocol Version 4 (TCP/IPv4)** and click **Properties** button.
5. Select **Use the following IP address** and enter the IP address you want to use:



6. Click **OK** to save settings, and then **Close** to exit the properties window and wait while Windows runs network diagnostics.

7. Ensure the laptop is connected with a CAT5 cable to the ETH port on a master unit or remote.

8. Open a web browser and enter the IPv4 address to connect to the VL-EM and start Element Manager software.

IPv6 Access

If you're logging into the element manager using a static IPv6 address, make sure IPv6 protocol is enabled on the laptop or computer and add a static route if necessary.

Make sure Wi-Fi on the computer is turned off

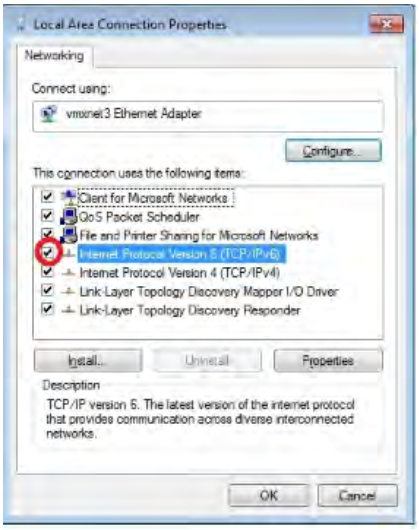
✦ **To enable IPv6 protocol on the laptop and add a static route**

1. In Windows, open **Control Panel**, and then **Network and Sharing Center**.

2. Select **Change adapter settings**.

3. Right-click your local adapter and select **Properties**.

4. Select **Internet Protocol Version 6 (TCP/IPv6)**, and then click **OK**.



5. Ensure the laptop is connected to the system controller through the customer IP network.

6. Open a web browser and enter the link local IPv6 address in square brackets (**[ ]**) to connect to the controller. For example*:*
   [fe80::9a5d:adff:fe47:cc12]

7. If this method does not launch the element manager software, you may need to add a static route to the IPv6 address on your PC Ethernet interface.

8. Open a command prompt window and run the following command to locate the interface number of your network card:

   `netsh interface ipv6 show interfaces`

For example:

```
U:\>netsh interface ipv6 show interfaces
Idx     Met      MTU           State            Name
---  -------  ----------   ------------  -------------------
  1     75     4294967295   connected       Loopback Pseudo-Interface 1
 11     50           1500   connected       Wi-Fi
 10      5           1500   disconnected    Ethernet
 16     65           1500   disconnected    Bluetooth Network Connection
```

9. In the first column (**Idx**), find the number of the network card you are connected to.

10. Create the route by entering the following command:

    netsh interface ipv6 add route *<IPv6 address>*/**128 interface**=*<x>*

    where *<IPv6 address>* is the address configured in the Network view, and *<x>* is your network card interface number.

For example:

```
netsh interface ipv6 add route fe80::9a5d:adff:fe45:909c/128
interface=11
```

11. Open a web browser and enter the IPv6 address in square brackets ([ ]) to connect to the system controller and start the EMS.

6.2 Logging in as a System Administrator

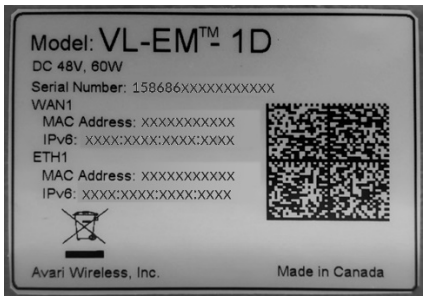
Use the following default system administrator username and password:

- Username: **admin**
- Default password: **Avari1234**

The default system administrator username cannot be changed. To change the password, see Changing the Password.

✦ **To log into the element manager**

1. Find the IPv6 addresses on the VL-EM label. Any one of these addresses can be used to log into the unit when a laptop is connected directly to ETH 1 or ETH 2.



2. Turn off your laptop Wi-Fi so that the laptop doesn't connect to other wireless networks in the area.

3. Connect the laptop to a WAN or ETH port on the element manager. If you're connecting to an ETH port, it doesn't matter which one you use. All ETH ports use the same ETH IPv6 link-local address.

4. In a browser window, enter the link-local IP address in square brackets. For example: **[fe80::9a5d:adff:fe47:cc12]**.

If this method does not launch the element manager software, you may need to add a static route to the IPv6 address on your PC Ethernet interface. See Setting up a Laptop for IPv6 Access.

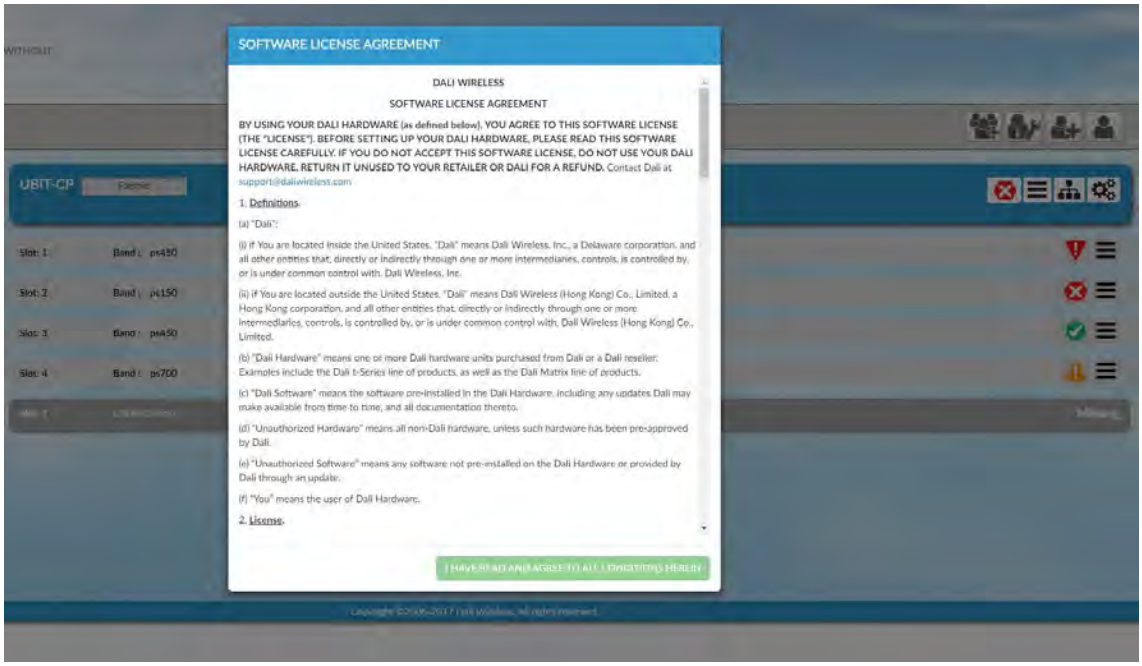
5. In the login screen, enter the administrator username **admin**, and password **Avari1234**.

6. Click **Submit.**

License Agreement

The software license agreement displays the first time you log into the element manager.

Read the agreement and click the **Agree** button to dismiss the dialog box and continue.



6.3 Changing a Password

Any user (system administrator or technical staff) can change their own password once logged in.

✦ **To change a password**

1. Click **My Profile** .

2. Enter a new password and click **Submit**.

6.4 Adding a User Account

System administrators can add user accounts to the Element Manager. There are two types of user roles: system administrator and technical staff.

Permission	System Administrator	Technical Staff
Configure units, routes and signals	☑	
Configure IP network and SNMP settings	☑	☑
Add or edit users	☑	
Reboot or upgrade software	☑	
Activate/deactivate bands and optical links	☑	☑
Display unit, band, optical port, and signal information	☑	☑
Display alarm details	☑	☑

✦ To add a user account

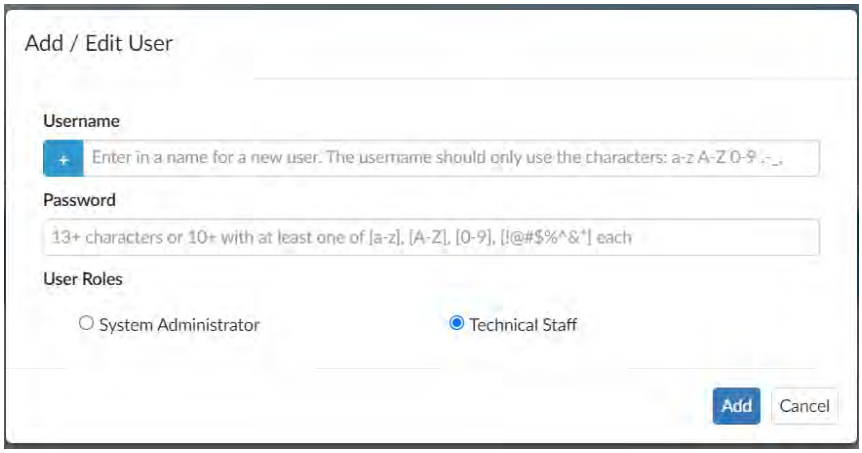
1. Log in as system administrator Use the default user name and password if no other system administrator user exists.

   Default username: **admin**

   Default password: **Avari1234**

2. Select **Add/Edit User**

3. Select **Add Username** and then enter a new name. Use any combination of lower or uppercase letters and numbers.



4. Enter a password. Passwords must 13 characters with at least one lower case letter, uppercase letter, number, and special character.

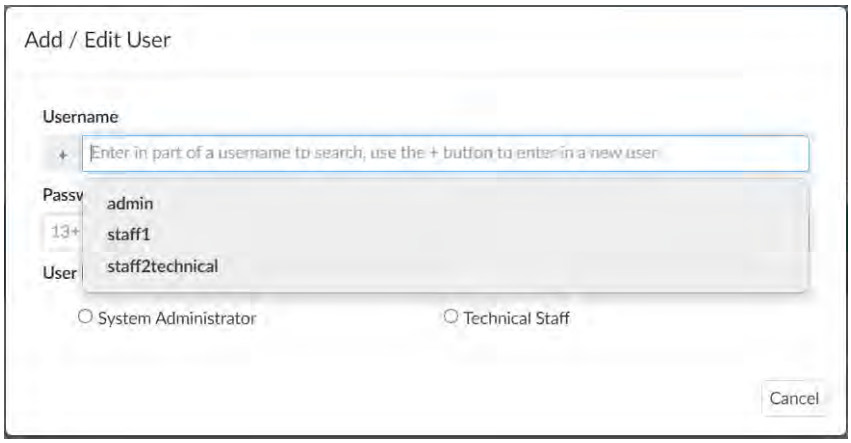
   The software prompts you to change your password every 90 days.

5. Select a user role.

6. Select **Add** to create the user account.

✦ To edit a user account

1. Click anywhere in the **Username** field to see a list of user accounts.



2. Select an account.
3. Change the username, password or user role as needed.
4. Select **Update** to save the changes.

7 Element Manager Software Overview

What's inside this chapter:

7.1 What is the Element Manager Software

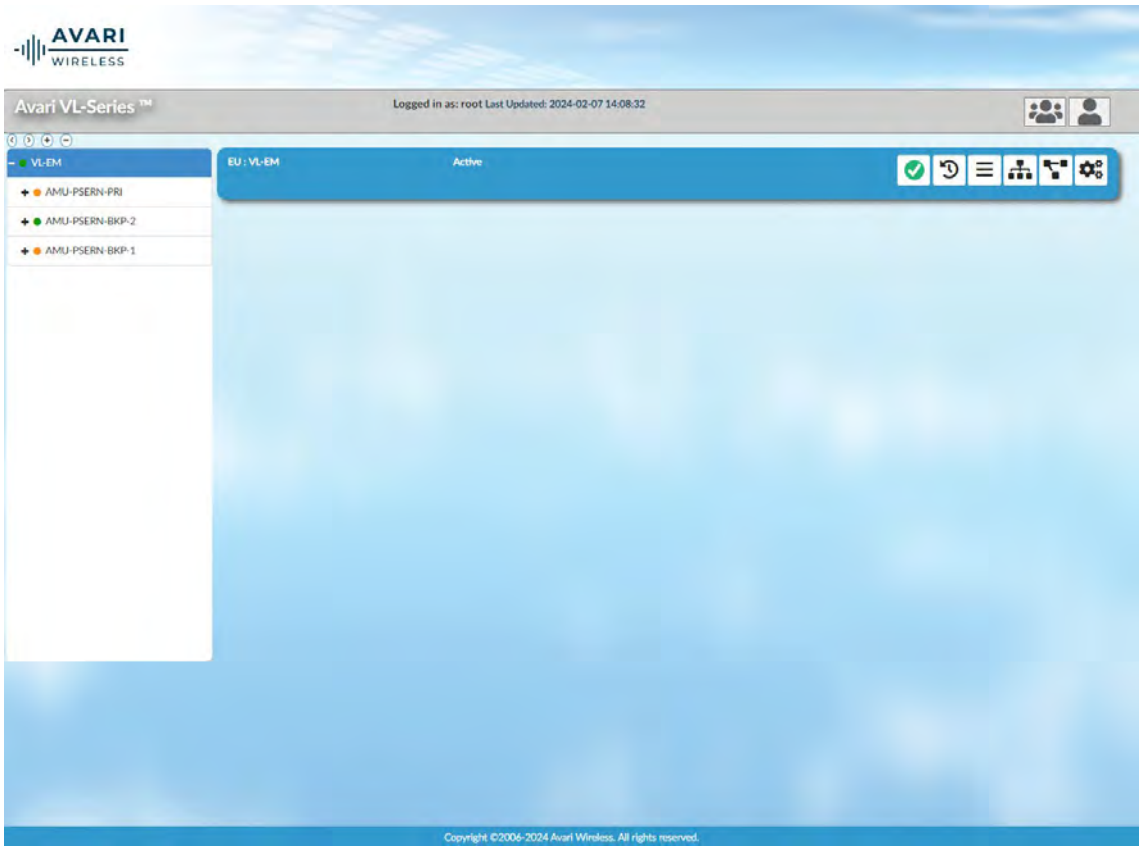
7.2 Element Manager Panels and Views

7.3 Field Descriptions

7.4 Status Descriptions

7.1 What is the Element Manager Software?

The Element Manager Software is a JavaScript-based web app that allows you to control and configure Avari's hardware products. It also allows individual units and chains to be managed and monitored remotely.



The software runs directly on the VL-EM unit and allows for:

- Tracking units as they are added or removed from the system and maintaining a system-wide inventory.
- Maintaining configuration settings for each unit.
- Collecting and monitoring alarm and performance data.
- Providing different users access to the Element Manager software.
- Remote monitoring through Simple Network Management Protocol (SNMP).

The subsequent sections of this manual go into detail about the capabilities of this software.

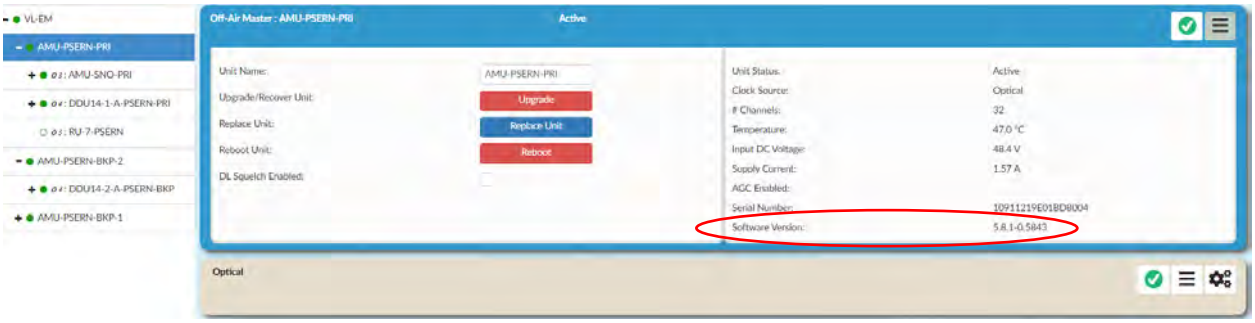
Browser Support

The software supports the latest version of the following browsers:

- Chrome, version 48 or later
- Firefox, version 45 or later
- Internet Explorer 11 or later
- Microsoft Edge
- Edge

> Chrome is the recommended browser for Avari Wireless' Element Manager Software versions 5.8 and above.

You can find the version of the software by clicking on a master unit in the system tree. Then click on the **Info** icon on the blue master unit panel. The software version on that master unit is displayed on the bottom right-hand side.



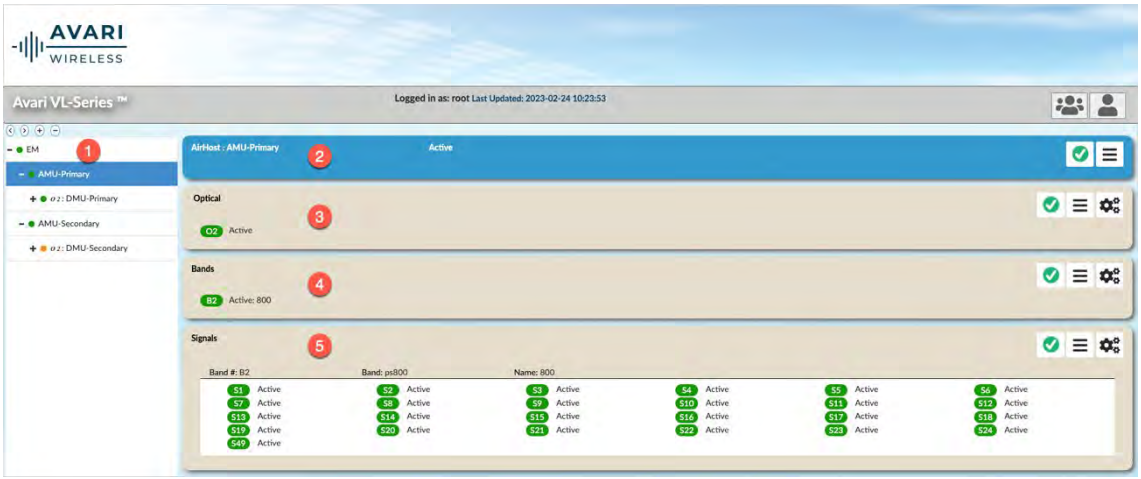
Troubleshooting

If the software is slow to respond to mouse-clicks or text entry, clear the browser cache and try again.

7.2 Element Manager Panels and Views

The Element Manager app displays devices in the VL-Series in a hierarchical system tree. Each unit in the tree has different panels for showing units, optical ports, bands, and signals.

In turn, each individual panel of a particular unit displays the alarms, devices and network information, and settings.

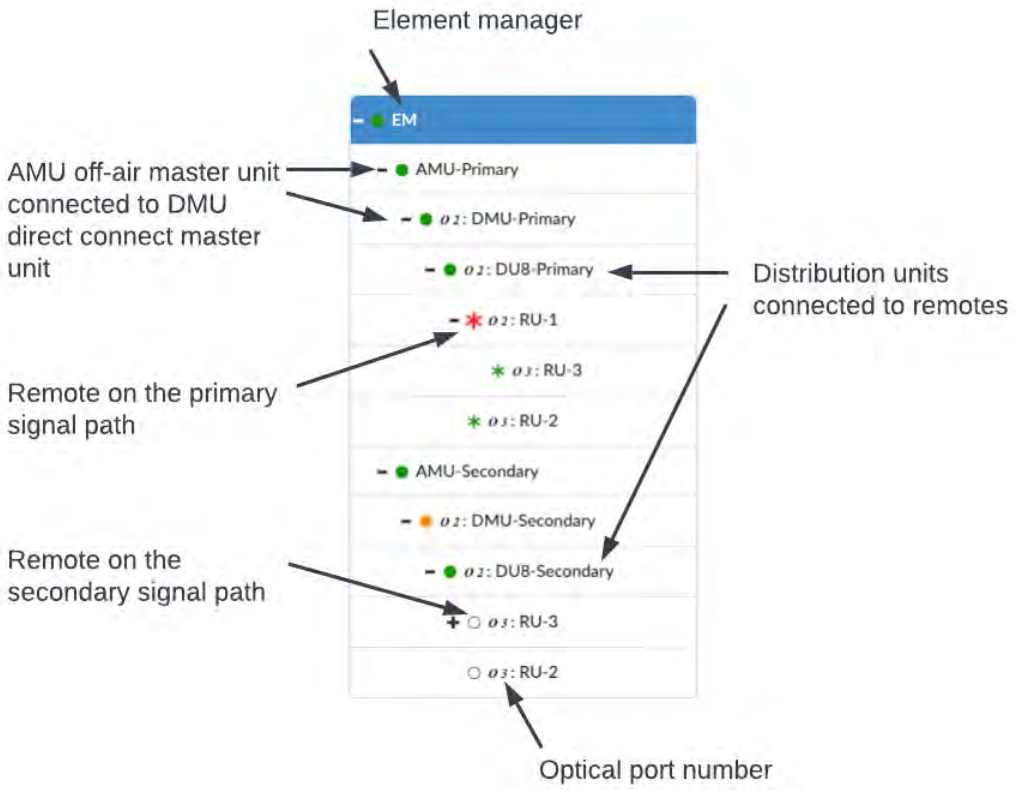


1	System tree – Nested list of VL-Series devices in the network
2	Unit panel – Information about element manager units, master units, distribution units, and remotes
3	Optical panel – Information about optical ports and optical transceivers that are plugged into a specific unit
4	Bands panel – information about RF band modules
5	Signals panel – Information about configured signals or channels

System Tree

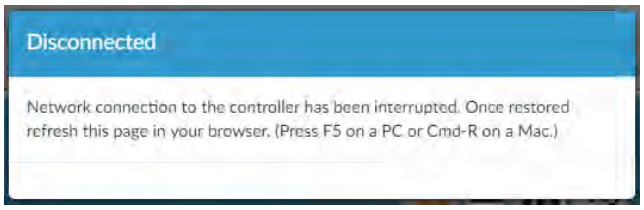
The system tree displays a list of VL-Series devices with the VL-EM element manager at the top. The master units, distribution units, and remotes are nested below it. Remotes appear below the master unit or distribution unit to which they are connected.

To expand the tree to see all modules and remotes, click the **+** icon beside a device label.



The optical port number displayed on the tree is the optical port of the upstream device connected to the unit.

If a device is missing in the tree, the hardware is either not installed correctly or the element manager software is no longer communicating with the VL-EM (in which case a Disconnected dialog appears).



For more information about missing units, see Managing Missing Units, Band Modules and SFPs.

7.3 Field Descriptions

Unit Information Fields

Unit level fields are displayed on the blue unit information panels.

To find out more about a unit, click on its label in the system tree. On the blue unit panel, click the **Info** ☰ icon.

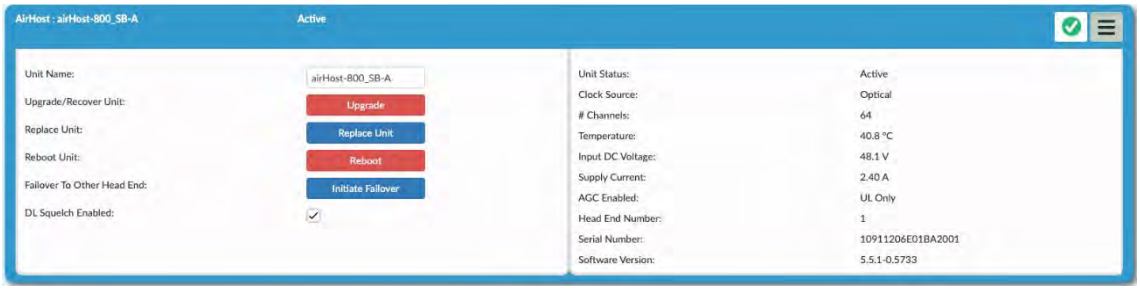
Element Manager

These fields apply to the VL-EM element manager:

Field	Description
Unit Name	Name of the element manager, as defined by the system administrator. See also Editing Device Names.
DMC Role	Select **Active**: the unit is communicating with all devices in the network. Select **Standby**: the unit is not communicating.
Normalize System Delay	Select **Normalize** to automatically balance all optical delays in the system.
Reboot Unit	Select **Reboot** to restart the unit.
Failover to Defaults	Select **Initiate Failover** to force the system to return to the default failover configuration. For example, to switch the system back to the primary master unit after the network elements have failed over to the Standby or secondary master unit.
Unit Status	Status of the element manager. For example, Active, Standby, Failed. See also Unit Status.
Software Version	Software version of the element manager.
Auto Delay	The highest optical delay from the master unit to the farthest remote.

Master Unit

These fields apply to the VL-DMU and VL-AMU 33/37 master units:



Field	Description
Unit Name	Name of the master unit, as defined by the system administrator. See also Editing Device Names.
Upgrade/Recover Unit	Select **Upgrade** to reboot and upgrade the software on the master unit.
Replace Unit	Select **Replace Unit** to replaces a master unit with new MAC address and serial number. See also Managing Missing Units, Band Modules, and Optical Ports
Reboot Unit	Select **Reboot** to restart the master unit.
Failover to Other Headend	Select **Initiate Failover** to force the system to return to the default failover configuration. For example, to switch the system back to the primary master unit after the network elements have failed over to the Standby or secondary master unit.
DL Squelch Enabled	Select checkbox to turn downlink squelch on or off.
Unit Status	Status of the master unit: Active, Standby, Missing. See also Unit Status.
Clock Source	Clock source for the master unit: optical or internal. Defined automatically.
# Channels	Number of RF channels/signals/carriers supported: 32 or 64
Temperature	Internal temperature of the master unit.
Input DC Voltage	External supply voltage to the master unit. For the VL-DMU this is a measurement of the backplane voltage.
Supply Current	Cumulative current drawn by the RF modules.
AGC Enabled	On the uplink path, Automatic Gain Control is turned on or off for the master unit. See also Automatic Gain Control.
Headend Number	In a redundant system, either the primary headend (1) or secondary headend (2).
Serial Number	Serial number located on the side of the module or unit.
Software Version	Software version of the master unit.

Distribution Unit

These fields apply to the VL-DU 8/14 distribution unit:

Field	Description
Unit Name	Name of the distribution unit, as defined by the system administrator. See also Editing Device Names.
Upgrade/Recover Unit	Select **Upgrade** to upgrade the software on the distribution unit.
Replace Unit	Select **Replace Unit** to re-configure a missing distribution unit. See also Managing Missing Units, Band Modules, and Optical Ports.
Reboot Unit	Select **Reboot** to restart the distribution unit.
Unit Status	Status of the distribution unit: Active, Standby, Missing. See also Unit Status.
Clock Source	Default clock source for the distribution unit. Always **Optical**.
# Channels	Number of RF channels/signals/carriers supported: 32 or 64.
Temperature	Internal temperature of the distribution unit.
Input DC Voltage	External supply voltage to the distribution unit.
Supply Current	Cumulative current drawn by the distribution unit.
Serial Number	Serial number of the distribution unit located on the side of the unit.
Software Version	Software version of the distribution unit.

Remote

These fields apply to the VL-RU 33/37 remote:

Field	Description
Unit Name	Name of the remote, as defined by the system administrator. See also Editing Device Names.
Upgrade/Recover Unit	Select **Upgrade** to upgrade the software on the remote.
Replace Unit	Select **Replace Unit** to replace a remote with new MAC address and serial number. See also Managing Missing Units, Band Modules, and Optical Ports.
Reboot Unit	Select **Reboot** to restart remote.
UL Squelch Enabled	Select checkbox to turn uplink squelch on or off.
Unit Status	Status of the remote: Active, Standby, missing, Failed. See also Unit Status.
Clock Source	Optical clock reference.
# Channels	Number of RF channels/signals/carriers supported: 32 or 64.
Active Slave Port	
Temperature	Internal temperature of the remote.
Input DC Voltage	External supply voltage to the remote.
Supply Current	Cumulative current drawn by RF modules.
AGC Enabled	On the downlink path, Automatic Gain Control is turned on or off for the remote. See also Automatic Gain Control.
Serial Number	Serial number of the remote located on the side of the module or unit.
Software Version	Software version of the remote.

Optical Information Fields

Optical panels are displayed under each unit that has an optical connection. Select a unit in the system tree. On an Optical panel, click on the **Info** ☰ icon to display optical port information.

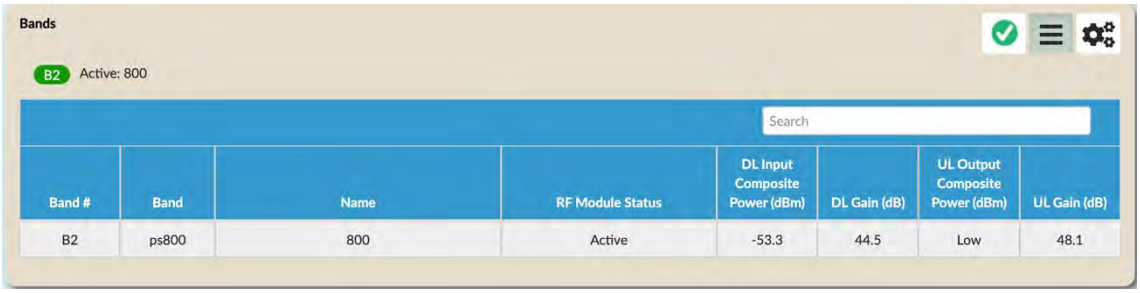
Field	Description
Port #	Master unit: • Port O1 is reserved for connecting to an upstream master unit. Remote: • Port O1 on a downstream remote connects to an upstream master unit or remote. • Port O2 on an upstream remote connects to a downstream remote. • Disable Port O2 on the last remote in a daisy-chain.
Status	Status of the optical path: Active, Standby, Missing, Failed, No Link. See also Optical Port Status.
Clock Role	Slave – accepts clock reference from the upstream port Master – port is clock reference for the Slave port on a downstream unit.
Compensation	Delay compensation applied to this optical link. See also Configuring Delay Compensation.
Tx Power (dBm)	Transmit power for the SFP. Compare to Rx Power on the other end of the optical link to determine fiber loss.
Rx Power (dBm)	Receive power for the SFP. Compare to Tx Power on the other end of the optical link to determine fiber loss.
Temperature (°C)	SFP optical transceiver temperature.

Band Information Fields

Band information is available for each RF unit. Select a unit in the system tree. On a Bands panel, click on the **Info** ☰ icon to display band information.

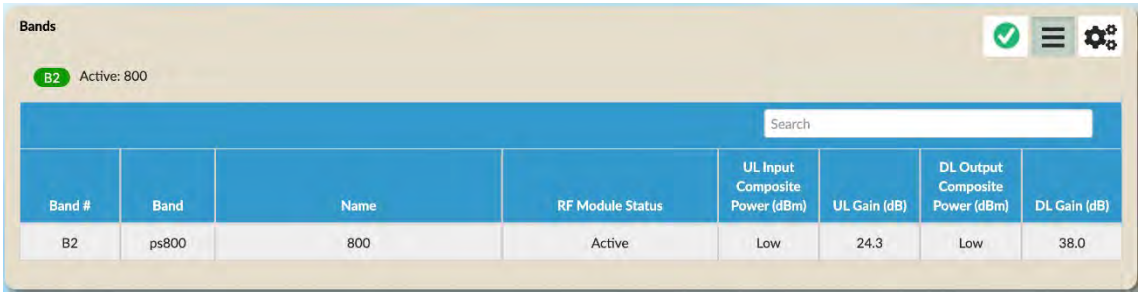
Master Unit

For a Master Unit, the Bands panel contains the following:



Remote

For a Remote Unit, the Bands panel contains the following:



The fields for both types of units are the same. They are described in this table:

Field	Description
Band #	Slot number on the unit: 1, 2, 3, 4
Band	Band type reported by the system.
Name	Band name as defined by the system administrator.
RF Module Status	Status of the band module: Active or Standby.
DL Input Composite Power (dBm)	Master unit: Composite DL average input power measured by the unit.
DL Gain (dB)	Master unit: Gain of the downlink path at the master unit. Remote: Displays the gain of the downlink path at the remote.
UL Output Composite Power (dBm)	Master unit: Composite UL average output power measured by the unit.

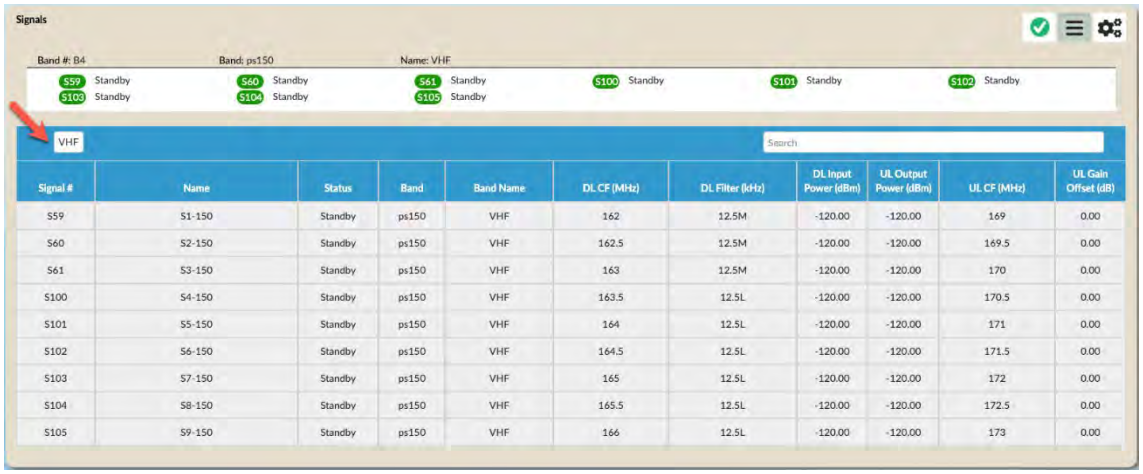
Field	Description
UL Gain (dB)	Master unit: Displays the gain of the uplink path at the master unit. **Remote**: Displays the gain of the uplink path at the remote.
UL Input Composite Power (dBm)	Remote: Composite UL average input power measured by the unit.
DL Output Composite Power (dBm)	Remote: Composite DL average output power measured by the unit.
DL Gain (dB)	Master unit: Displays the gain of the downlink path at the master unit. **Remote**: Displays the gain of the downlink path at the remote.

Signal Information Fields

Signal information is available for each unit. Select a unit in the system tree. On a Signals panel, click on the **Info** ☰ icon to display signal information.

Master Unit

For a Master Unit, the Signals panel contains the following:

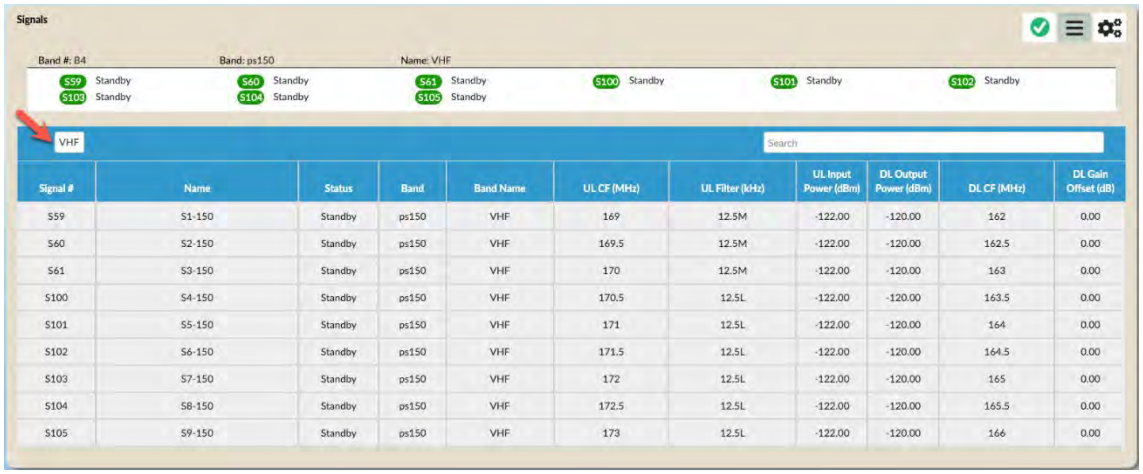


Field	Description
Band Filtration button 	Select to filter the table by the selected band.
Signal #	Signal number information.
Name	Signal name as defined by the system administrator.
Status	Signal status: Active, Busy, Hidden. See also Signal Status.
Band	Band type reported by the system.

Field	Description
Band Name	Band name as defined by the system administrator.
DL CF (MHz)	Signal downlink center frequency information.
DL Filter (kHz)	Properties of the filter applied to the downlink signal: pass bandwidth, offset to stop band -60 dB rejection, and delay introduced by the filter.
DL Input Power (dBm)	Signal downlink power before Automatic Gain Control is applied. See also Automatic Gain Control.
UL Output Power (dBm)	Signal uplink power.
UL CF (MHz)	Signal uplink center frequency information.
UL Gain Offset (dB)	Amount of attenuation applied at the master unit uplink signal (after Automatic Gain Control is applied).

Remote

For a Remote Unit, the Signals panel contains the following:



Field	Description
Band Filtration button 	Select to filter the table by the selected band.
Signal #	Signal number information.
Name	Signal name as defined by the system administrator.
Status	Signal status: Active, Busy, Hidden. See also Signal Status.
Band	Band type reported by the system.
Band Name	Band name as defined by the system administrator.
UL CF (MHz)	Signal uplink center frequency information.

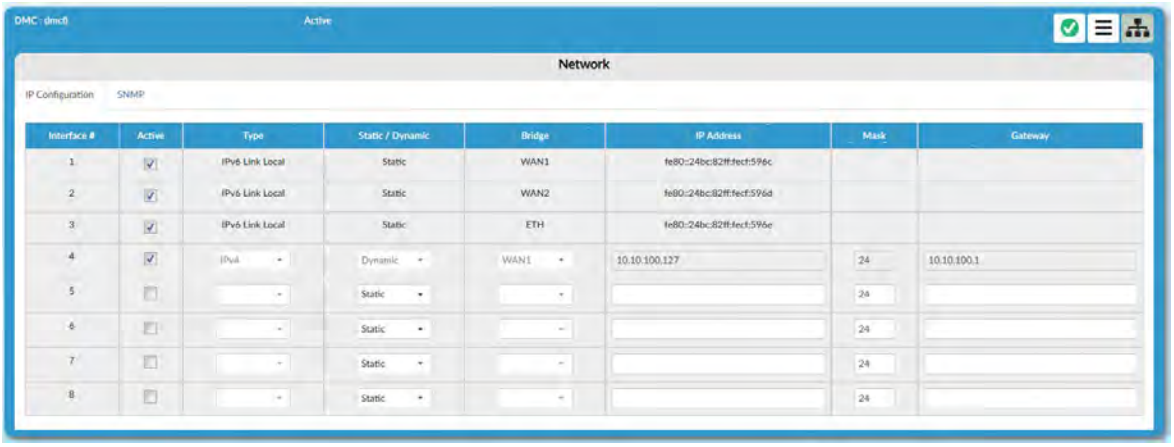
Field	Description
UL Filter (kHz)	Properties of the filter supplied to the uplink signal: pass bandwidth, offset to stop band -60 dB rejection, and delay introduced by the filter.
UL Input Power (dBm)	Signal uplink power before Automatic Gain Control is applied. See also Automatic Gain Control.
DL Output Power (dBm)	Signal downlink power.
DL CF (MHz)	Signal downlink center frequency information
DL Gain Offset (dB)	Amount of attenuation applied at the remote downlink signal (after Automated Gain Control is applied)

Network Configuration Fields

Select the VL-EM element manager in the system tree. On the blue unit panel, click the **IP Network**  . icon

The unit panel displays two network tabs: IP Configuration and SNMP.

Select the **IP Configuration** tab to configure network IP addresses. In addition to the default IPv6 addresses, you can configure IPv4 address to access the EM user interface via the WAN or ETH port.



Field	Description
Interface #	Interface number information.
Active	Status checkbox activates or places an IP address in Standby. When Active, an IP configuration is applied on the master unit. In Standby, the IP configurations are not applied on the master unit. IP configurations in Standby are not available for accessing the element manager.

Field	Description
Type	Select **IPv4** or **IPv6**. IPv6 Link-local is displayed for the first three IP interfaces but is not available to assign by the system administrator.
Static / Dynamic	Select **Static** to assign either an IPv4 or IPv6 address. Select **Dynamic** to enable DHCP for the interface; IP addresses are assigned by a DHCP server. The address fields are unavailable for editing.
Bridge	Selects the bridge interface for the IP address: • **WAN1**: accesses the external, customer IP network • **WAN2**: second WAN interface for accessing multiple external networks • **ETH**: LAN interface for direct access to the element manager
IP Address	Assigns a static IP address. For IPv6 addresses, only the address field is available.
Mask	Assigns a network mask.
Gateway	Assigns a default gateway for a static IP address. Not available for IPv6 addresses.

Select the **SNMP** tab to configure SNMP target IP addresses:

Field	Description
SNMP Target	Sets up to 4 SNMP target IP addresses.

Optical Configuration Fields

Select a master unit, distribution unit, or remote in the system tree. Then on the Optical panel, click the **Settings** icon.

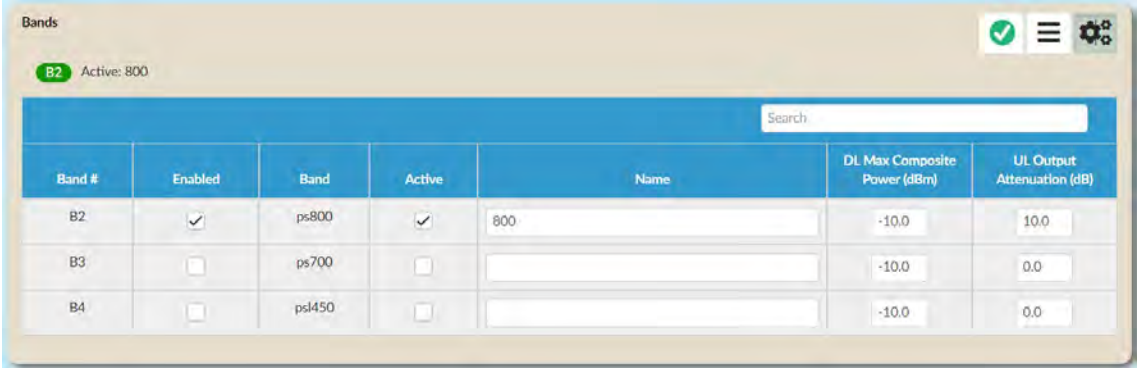
Field	Description
Port #	Optical port number.
Enable Port	Select the checkbox to enable the optical port. When enabled, the port appears on Info and is ready for configuration.
Active	Select the checkbox to activate or place an optical port in Standby. When Active, an optical port passes data stream. In Standby, the data stream is not delivered to the connected units.
Compensation (us)	Optical delay setting applied on a specific optical path/port.

Band Configuration Fields

Select a master unit or remote in the system tree, and then on the Bands panel, select **Settings**.

Master Unit

For a Master Unit, the Bands configuration panel contains the following:



Field	Description
Band #	RF module slot number on the master unit.
Enabled	Select the checkbox to enable the band. When enabled, the band module appears on **Info** ☰ and is ready for configuration.
Band	Band name as reported by the master unit.
Active	Select the checkbox to activate or place a band module in Standby. When Active, a band module passes the RF signal. In Standby, the RF signal at the band module is not delivered to the antenna network or base station.
Name	Name for the band module. See also Editing Device Names.
DL Max. Composite Power (dBm)	Maximum downlink input power setting for the band module.
UL Output Attenuation (dB)	Uplink output attenuation setting for the band module.

Remote

For a Remote Unit, the Bands configuration panel contains the following:

Field	Description
Band #	Band module slot number on the remote.

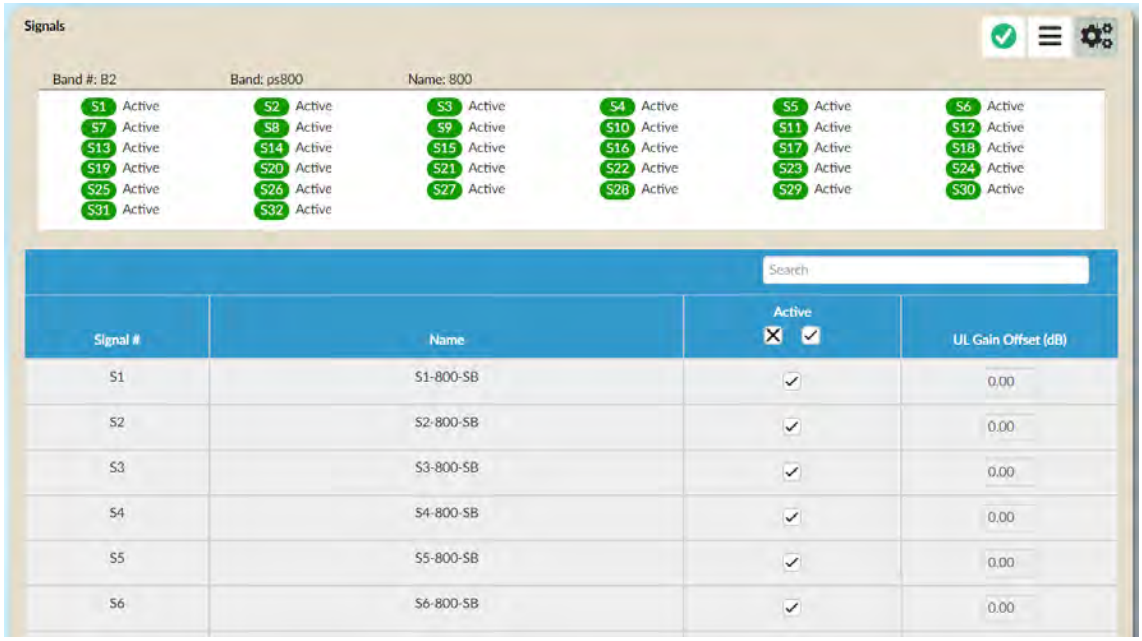
Enabled	Select the checkbox to enable the band. When enabled, the band module appears on Info ☰ and is ready for configuration.
Band	Band name as reported by the unit.
Active	Select the checkbox to activate or place a band module in Standby. When Active, a band module passes the RF signal. In Standby, the RF signal at the band module is not delivered to the antenna network or base station.
Name	Name for the band module. See also Editing Device Names.
UL Input Attenuation (dB)	Uplink input attenuator setting for a band module
DL Output Attenuation (dB)	Downlink output attenuator setting for a band module

Signal Configuration Fields

Select a master unit, distribution unit, or remote in the system tree. Then on the Signals panel, click the **Settings** icon.

Master Unit

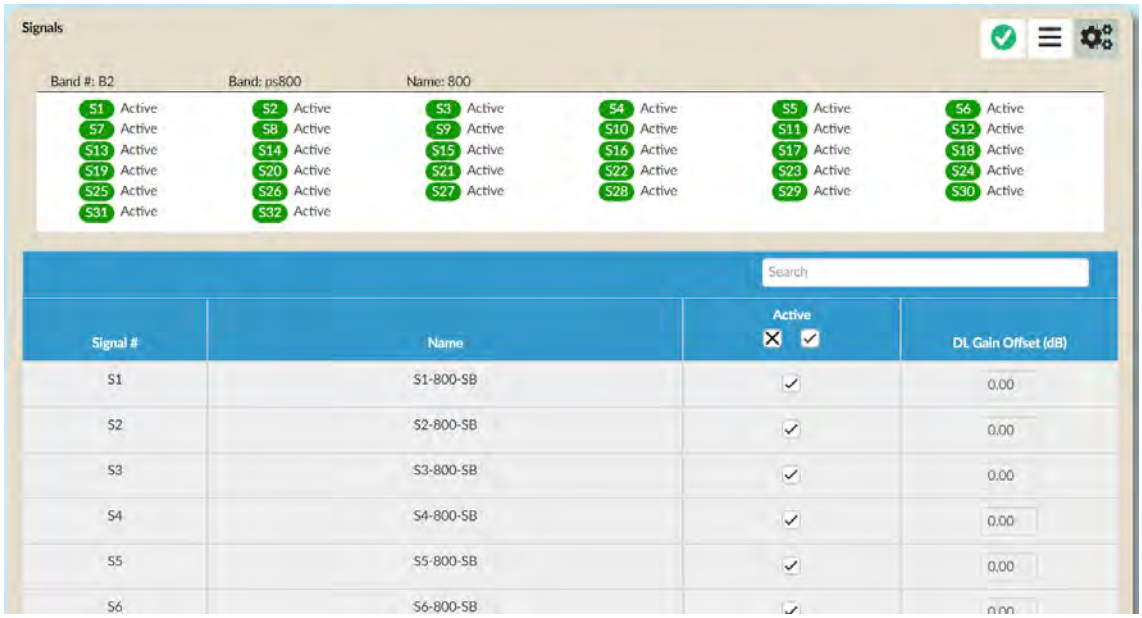
For a Master Unit, the Signals configuration panel contains the following:



Field	Description
Signal #	Signal number information number.
Name	Name assignment for the signal.
Active	Select the checkbox to activate or place a signal in Standby. When Active, an RF signal is processed. In Standby, the RF signal is not passing through the master unit.
UL Gain Offset (dB)	Master unit uplink attenuation setting for the signal (after Automatic Gain Control).

Remote

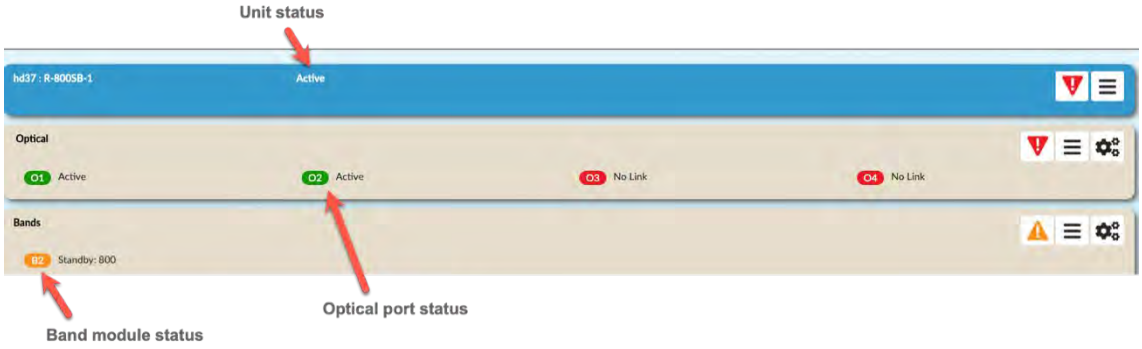
For a Remote Unit, the Signals configuration panel contains the following:



Field	Description
Signal #	Signal number information number
Name	Name assignment for the signal
Active	Select the checkbox to activate or place a signal in Standby. When Active, an RF signal is processed. In Standby, the RF signal is not passing through the remote.
DL Gain Offset (dB)	Remote downlink attenuation setting for the signal (after Automatic Gain Control).

7.4 Status Descriptions

The element manager software displays the status of units, optical ports, band modules, and signals at the top of each panel.



Unit Status

Unit Status	Description
Standby	• Unit has powered on successfully but is not carrying RF signals. All the band modules in the unit are also in Standby. • Unit is ready for configuration or servicing (including upgrades or restarts).
Active	• Unit is carrying RF signals. At least one RF module in the unit is Active. • Minor or major alarms may be present.
Failed	• Unit is reporting a critical alarm. • If the unit cannot recover and activate automatically, the unit can be manually placed in Standby by placing all band modules in Standby.
Missing	• Unit has lost communication with the element manager because an Ethernet cable has been disconnected, or the optical link has been lost. Always accompanied by missing unit Critical alarm. • May change to Standby if the unit is replaced. • If the missing unit alarm is acknowledged by the operator, the unit is removed from the system tree. • If the unit is reconnected in the same location or moved to another location in the system, then the missing unit alarm is cleared and the unit re-establishes the connection with the element manager.
Not Ready	• May be seen briefly during the boot sequence. The unit changes to Standby once the application software is running.
No Link	• If all optical links on a remote are also showing No Link, see Optical Port Status. • Band modules are deactivated to prevent damaging optical signals from being passed over the optical link. • When optical links have been restored, the modules return to Active or Failed status.

Unit Status	Description
In Service	• Unit is physically present, but communication is not possible due to servicing (such as calibration, debug mode or software update). Always accompanied by a minor alarm. • Unit returns to Standby automatically when servicing is complete. Unit cannot be configured while in service.

Optical Port Status

By default, optical ports are **Active**.

Port Status	Description
Active	• SFP lasers are Active. • Critical alarms that affect the optical link may be present. • Minor or major alarms that only affect the SFP may be present. • Clear the **Active** checkbox to deactivates the SFP and change the optical port status to Standby.
Standby	• Optical signal path and SFP have been deactivated manually or automatically because of a critical alarm. • Selecting the **Active** checkbox activates the SFP and changes the optical port status to Active.
Failed	• Optical signal path cannot activate and SFP lasers are disabled. • Always accompanied by a critical alarm indicating the cause of the failure. • Indicates that the SFP may be incompatible SFP or not fully inserted. • Select **Failed** to deactivate the SFP and return the optical port status to Standby.
Missing	• SFP is now missing, causing a critical alarm. • May change to Standby if the SFP is replaced.
Activating	• SFP is changing from Standby to Active status (displays briefly).
No Link	• Optical link to the far end device is unable to carry optical signals. • Accompanied by a minor optical alarm if the port is unable to send optical signal to a downstream remote (master port). • Accompanied by a critical optical alarm if the port is unable to receive optical signal from an upstream master unit or remote (slave port). • SFP changes to Active or Failed when optical link has been restored.

Band Module Status

Band Status	Description
Standby	• Band module has powered on successfully but is not sending or receiving RF signals. • Band module is ready for configuration or servicing (such as upgrades or restarts). • Select the **Active** checkbox to activate the module, changing the status to Active.
Active	• Band module is sending or receiving RF signals. • Minor or major alarms may be present. • Clearing the **Active** checkbox deactivates the module, changing the status to Standby.
Failed	• A module critical alarm has occurred, and the RF path has been deactivated. • Always accompanied by a critical alarm which indicates the cause of the failure. • Band module may recover and activate automatically. If the RF module cannot recover, then the module can be placed in Standby manually. • Clicking **Failed** deactivates the module, changing the status to Standby.
Activating	• Band module is changing from Standby to Active (displays briefly)
Missing	• Band module has been physically removed. • Always accompanied by an associated critical alarm. • May change to Standby if the module is replaced. • If the module is replaced elsewhere or the slot is reused, the critical alarm is cleared. • Band module cannot be configured while missing.

Signal Status

By default, signals are **Active**.

Signal Status	Description
Standby	• Signal is not passing through the unit. • Signal is ready for configuration or servicing (such as upgrades or restarts). • Select the **Active** checkbox activates the signal.
Active	• Signal is processed and passing through the unit. • Minor or major alarms may be present. • Clearing the Active checkbox deactivates the signal, changing the status to Standby.

Signal Status	Description
Failed	• A signal critical alarm has occurred, and the signal has been deactivated. • Always accompanied by a critical alarm which indicates the cause of the failure.

8 IP Network Configuration

What's inside this chapter:

8.1 Internal and External IP networks

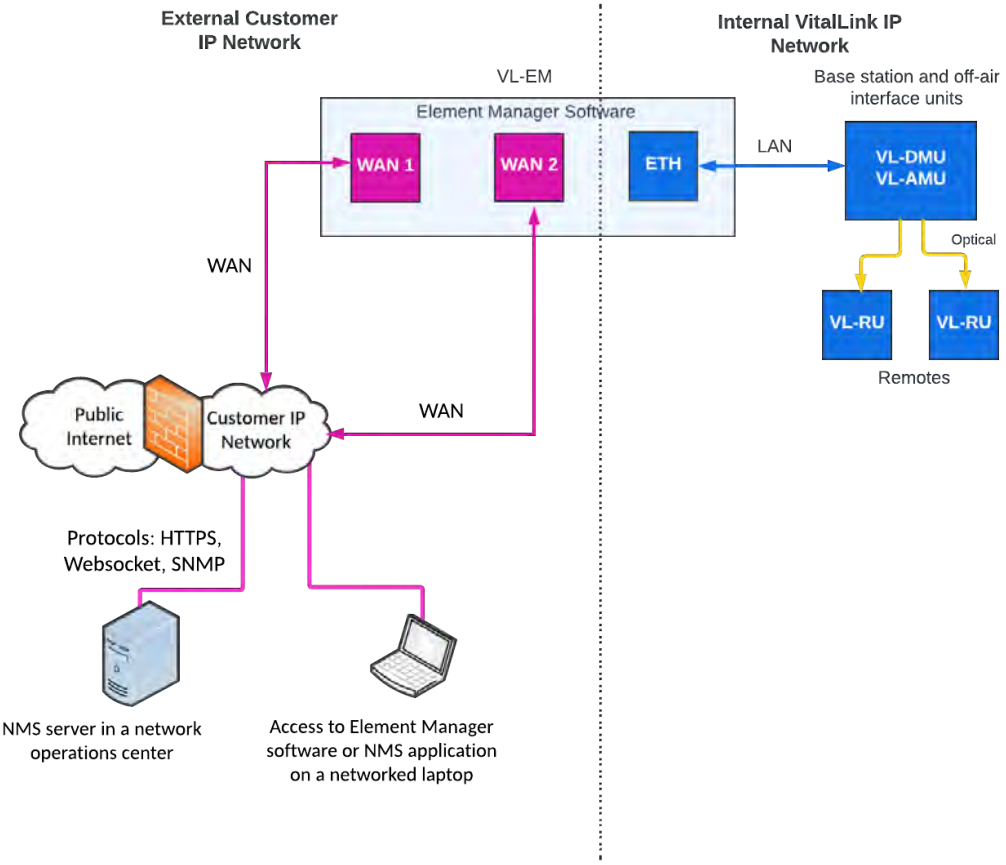
8.2 Configuring IP addresses

8.3 Configuring SNMP

8.1 Internal and External IP Networks

The IP network for the VL-Series consists of the internal IP network (LAN), and the external customer IP network (WAN).

The element manager is the central access point for the WAN and LAN sides of the network. Network management system (NMS) servers and Avari Customer Support (through a firewall) connect to the WAN bridge interfaces, WAN1 and WAN2. On the LAN side, base station and off-air master units connect to the ETH bridge interface.



External Network Requirements

Ensure the external customer IP network meets the following requirements:

- Implements firewall protection
- Does not connect VL-Series equipment directly to the public IP network

- Separates VL-Series equipment from other customer equipment (guest Wi-Fi generally meets all these requirements)

Internal Network Requirements

Ensure the internal IP network meets the following requirements:

- Element manager is link local to all units in the system
- No routing or L3 switch functionality between the system controller and the other units
- All units, including the system controller, are on the same broadcast domain

Ports

Depending on the intended use of the system, the following firewall ports must be open. Most users only require web access. Advanced monitoring with a NMS may require SNMP access.

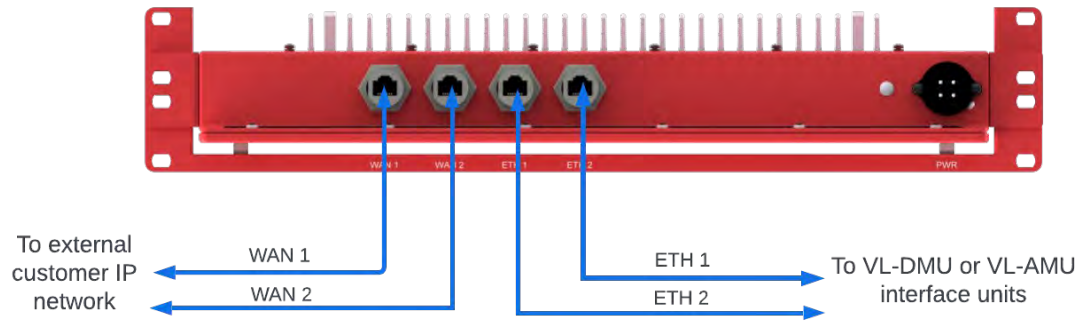
For this access	Open this port
Web access	Port 80
SNMP monitoring (polling)	UDP Port 161
Outgoing SNMP traps	UDP Port 162

8.2 Configuring IP Addresses

The VL-EM has 4 physical Ethernet interfaces and supports up to 8 IP addresses.

The following 3 default IPv6 link-local addresses are read-only and configured during commissioning:

- **WAN1** IPv6 link-local: IP address for connecting to the external, customer IP network
- **WAN2** IPv6 link-local: a second customer IP address, used only when there are multiple external IP networks
- **ETH** IPv6 link-local: IP address for connecting to the internal IP network



The following table lists the possible IP address configurations for each bridge interface.

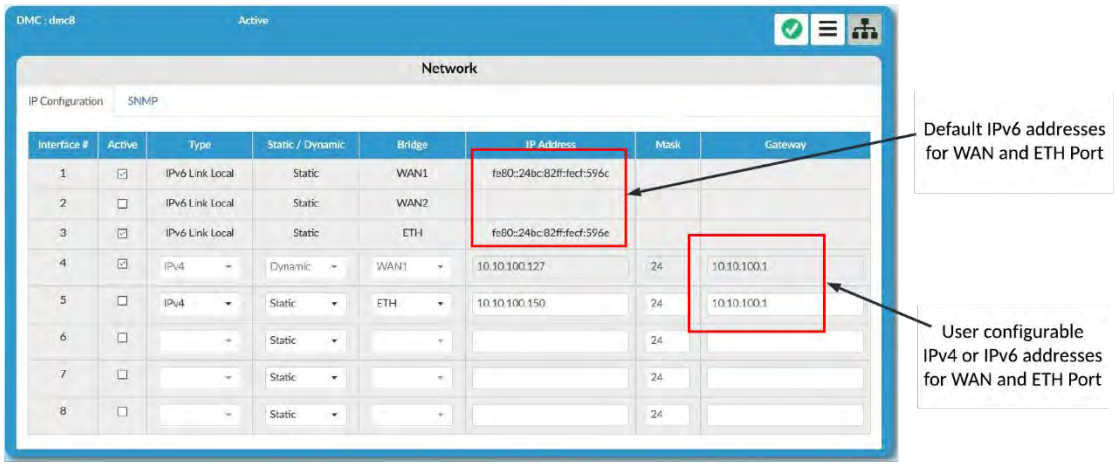
Bridge Interface	Address Type	Static/Dynamic	Physical Port
WAN1	Default IPv6 (read-only) User-assigned IPv4 or IPv6	Static or Dynamic	WAN1
WAN2	Default IPv6 Link-local (read-only) User-assigned IPv4 or IPv6	Static or Dynamic	WAN2
ETH	Default IPv6 Link-local (read-only) User-assigned IPv4 or IPv6	Static only	ETH1 to ETH2

You can configure IP addresses in the element manager software. Select an element manager in the tree and click **Settings** . For a description of fields, see Network Configuration Fields.

Display Default IPv6 Addresses

The element manager software displays the IP addresses for ports that have a physical Ethernet cable connected. Even if an IP address is not displayed in the Network view, you can still use it for logging into the unit.

Once logged into the system, user can also change the WAN and ETH ports to IPv4 addresses.



If the unit has only one Ethernet cable plugged into an **ETH** port, the Network view displays the ETH IPv6 link-local IP address. The **WAN1** and **WAN2** addresses are still available, but just not visible in the user interface.

The process of configuring IP addresses involves logging into the element manager software and then adding and verifying each WAN and ETH IP address.

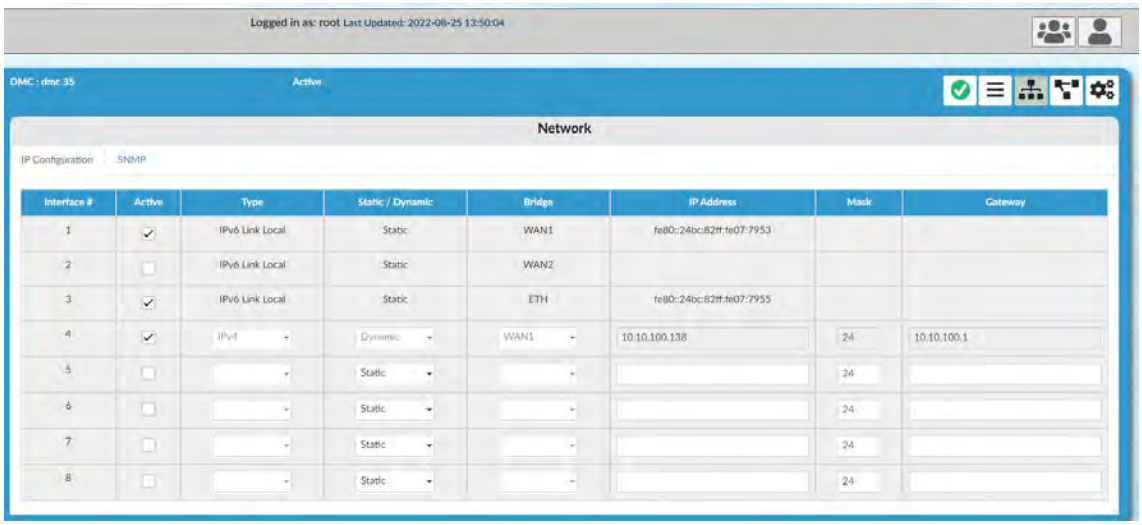
You can assign up to five IP addresses (total).

Adding Static IP Addresses

You can add a static IPv4 or IPv6 address to the WAN1, WAN2, and ETH bridge interface.

✦ **To add a static IP address**

1. Select the Element Manager in the System Tree and click **IP Network** .



2. In an empty row, select **IPv4** or **IPv6** as the type of IP address.
3. Select **Static**.
4. Select the bridge interface to use: **WAN1**, **WAN2**, or **ETH**.
5. Enter the **IP address**, **Mask**, and **Gateway address** if available. The field values are saved automatically when you click anywhere outside the field you're editing, or when you press **Tab** to advance to the next field. The field outline turns green to indicate the data has been saved but not activated.
6. Select **Active** to activate the IP address.

> You can log into the Element Manager software only when the IP addresses are Active. Configured addresses that are in Standby are not available.

Adding Dynamic IP Addresses

You can add a dynamic IPv4 or IPv6 address to the WAN1 and WAN2 bridge interface. Dynamic IP addresses are not supported on ETH.

✦ **To add a dynamic IP address:**

1. Select the Element Manager in the system tree and click **Network**.

2. In an empty row, select **IPv4** as the type of IP address.
3. Select **Dynamic**. The IP address fields become grayed out and can't be edited.
4. Select the bridge interface to use: **WAN1** or **WAN2**. Dynamic addresses are not supported on **ETH**.
5. Select **Active** to Activate the IP address.
6. Wait 5 to 10 seconds for the addresses provided by the DHCP server to display. If the addresses don't appear, DHCP server could be offline or there could be a networking issue. See Troubleshooting IP Address Configurations.

> You can log into the element manager software only when the IP addresses are Active. Configured addresses that are in Standby are not available.

Verifying Network Connections

After configuring IP addresses, verify the network connections by logging in using each one.

✦ **To verify the WAN network addresses**

1. Log out of the element manager.
2. Connect the laptop to the WAN, or customer IP network.
3. Log into element manager using the WAN1 IP address (or WAN2 address, if used).

✦ **To verify the ETH network address**

1. Log out of the element manager.
2. Connect the laptop directly to an ETH port on the system controller or master unit.

3. Log into the element manager using the ETH IP address.

For more detail about of logging in with IPv4 and IPv6 addresses, see Logging into the Element Manager.

Troubleshooting IP Address Configurations

Problem	Solution
Status button toggles back to Standby when activating Or, the Status button has a red outline	• There is a problem with the address format. • Verify that all IP values are correct. • There is a mismatch between the type of address selected (IPv6 or IPv4) and the actual address entered. • Verify the IP address matches the address type. • You tried to configure a dynamic IP address on ETH. • Dynamic IPv4 and IPv6 addresses are not supported on ETH. Configure dynamic addresses on WAN1 or WAN2. • You've tried to add both static and dynamic IPv6 addresses on the same bridge interface. For example, on WAN1, you tried to add a static IPv6 address, and a dynamic IPv6 address. • Choose either Static, or Dynamic. Do not mix static and dynamic IPv6 configurations on the same bridge interface.
IP/Mask or Gateway field has a red outline	• You entered an incorrect IP address format. • Delete the address completely (the field should be blank), and retype the correct address. Press Tab or click the anywhere outside the field. If the address is in the correct format, the field outline turns green for 5 to 10 seconds indicating the configuration is saved.
IP addresses do not appear when activating a dynamic IP address Or, the IP address fields are blank even though the Status button is Active	• The DHCP server is offline or there is a networking issue. The Status button displays Active, but the IP address is not available for accessing the EMS. • Once the DHCP server is back online, the EMS automatically retrieves the IP addresses from the server and saves them. While you do not need to do anything further, the Network view may not display the retrieved IP addresses right away. If you're not sure if the DHCP server has provided the requested IP addresses, try placing the address in Standby, and then re-setting to Active.
You can't log in using a IPv6 link-local address	• The system controller may be restarting. Wait two minutes for startup to complete.
Selecting an item in a drop down list causes the Network view to collapse	• Restart your computer.

8.3 Configuring SNMP

For system monitoring and fault management, VL-Series supports SNMP Version 3 and works with SNMP network management systems.

To configure the system controller to send SNMP traps to an NMS, install the VL-Series (labeled *Dali*) MIB file in your NMS (network management system), and assign the IP addresses of up to four SNMP trap receivers.

Downloading the MIB File

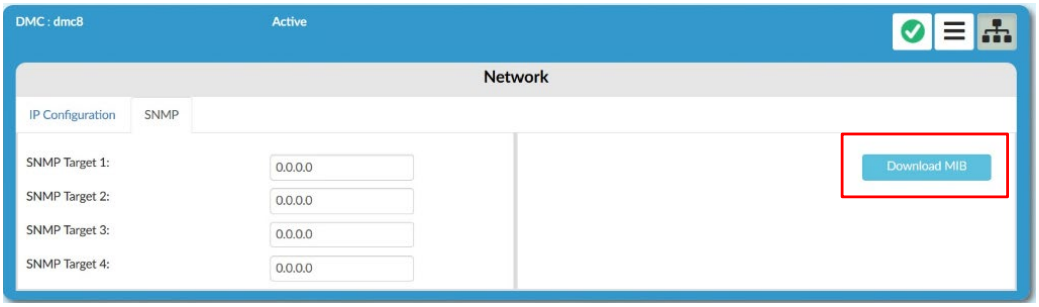
To integrate the element manager with your NMS, download the MIB file and then upload the MIB to your NMS.

For information on using SNMP, see the *SNMP & Alarm Reference Guide*.

✦ **To download the MIB file:**

1. In the system tree, select the element manager, and then click **Network** .

2. Select the **SNMP** tab.



3. Click **Download MIB** to save the file *DALI-10G-MIB.mib* to a hard drive.

4. Install the MIB in a location used by the NMS, or through SNMP command line tools, such as `snmpset` and `snmpget`.

5. Ensure the following common MIB files are also installed:

- RFC-1212
- SNMPv2-SMI

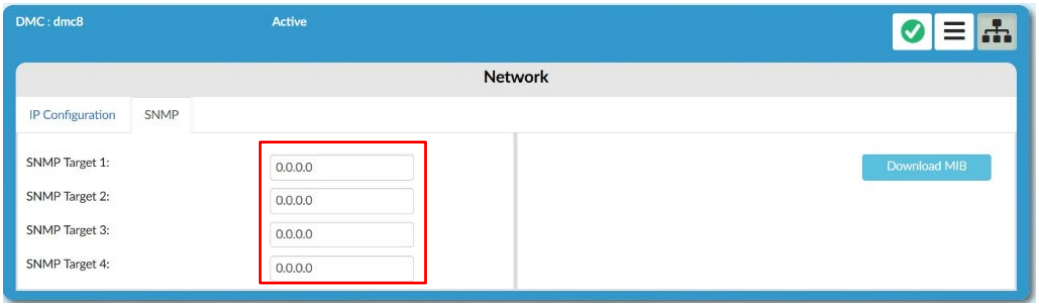
- SNMPv2-TC
- IPV6-TC
- SNMPv2-CONF

Configuring SNMP Trap Receivers

In addition to uploading the MIB file to your NMS, you must configure the network addresses of the SNMP trap receivers. The system supports up to 4 SNMP destinations.

✦ **To set up SNMP receivers:**

1. In the system tree, select the element manager, and then click **Network** .
2. Select the **SNMP** tab.
3. Enter up to four SNMP receiver addresses.



9 System Commissioning

What's inside this chapter:

9.1 What is System Commissioning

9.2 Displaying the System Configuration

9.3 Configuring Failover

9.4 Adding Master Units

9.5 Adding Remotes

9.6 Adding Distribution Units

9.7 Adding Optical Paths

9.8 Adding Signals (Channels)

9.9 Saving and Applying the System Configuration

9.10 Configuring Optical Delay Compensation

9.11 Displaying the Clock Source

9.12 Editing Device Names

9.13 Configuring RF Input Power in the Master Unit

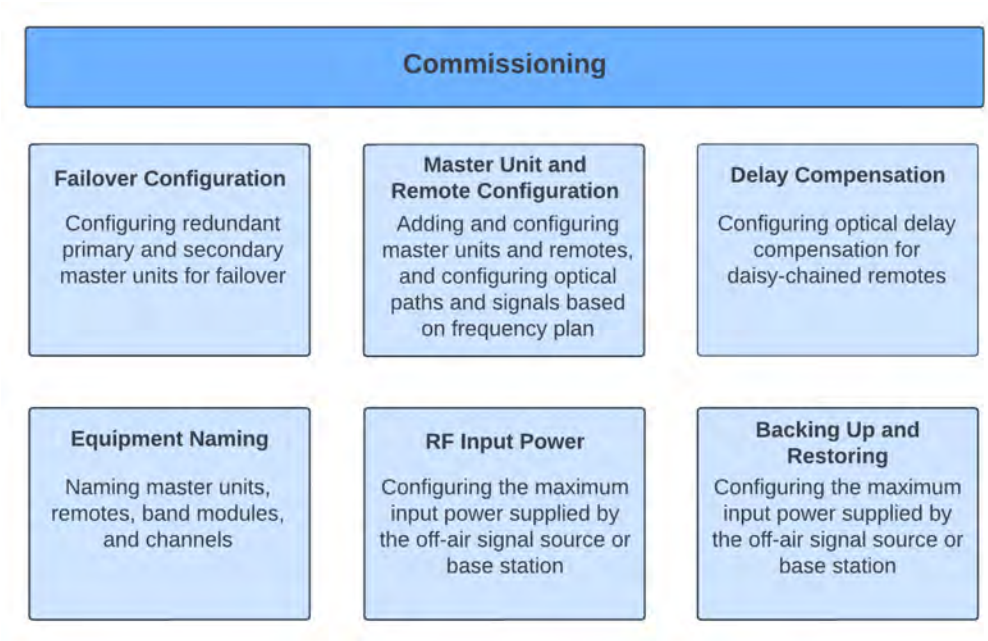
9.1 What is System Commissioning

System commissioning is the process of defining RF signals (channels) and setting up connections between master units, distribution units, and remotes in the element manager software.

Avari Wireless typically preconfigures all the signals and network element connectivity based on the system design prior to shipping equipment to the customer. However, the customer may need to add new equipment to the network or update the system configuration in the future.

The commissioning process is divided into the following parts:

- Configuring failover for systems with headend redundancy
- Adding and configuring master units, distribution units and remotes
- Defining optical paths and channels between units and remotes
- Configuring optical delay compensation to equalize the fiber delay between remotes
- Naming elements using consistent naming conventions
- Configuring the downlink RF input power for master units
- Backing up the system configuration so that it can be restored later if needed.



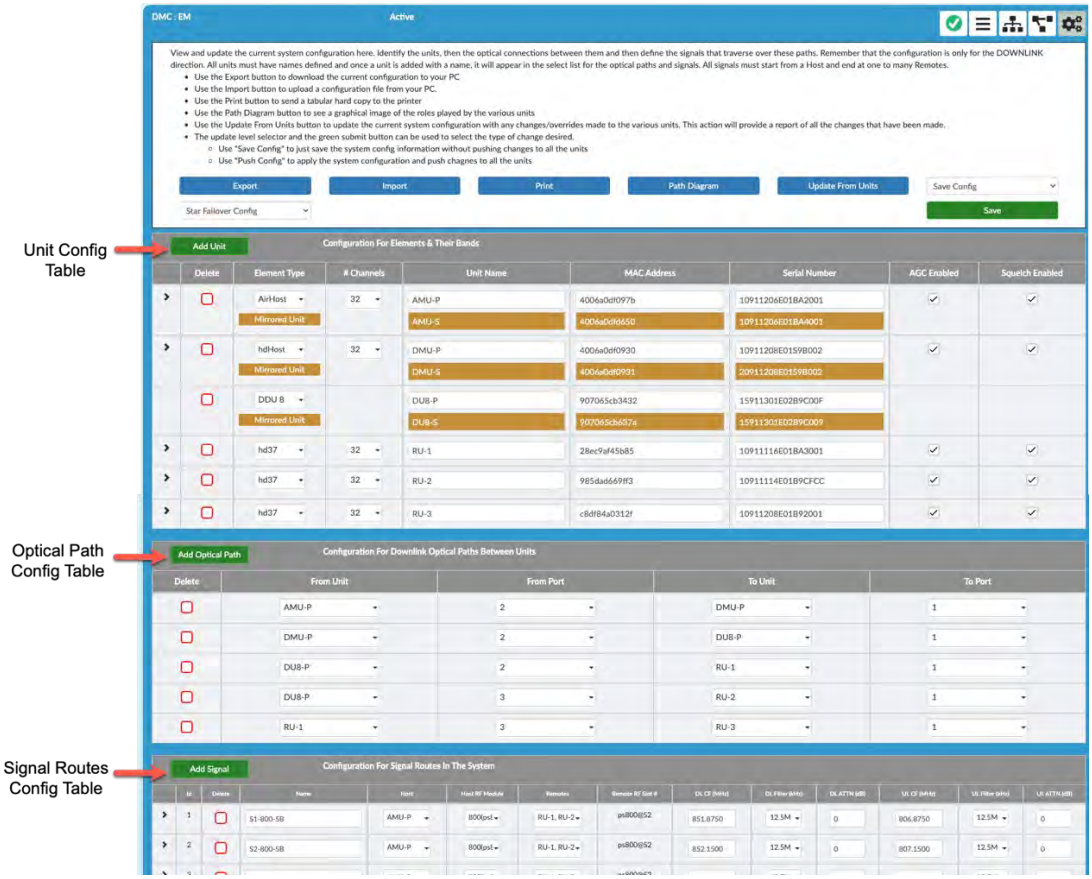
9.2 Displaying the System Configuration

For the VL-EM to manage network elements, all master units and remotes must be defined in the system configuration.

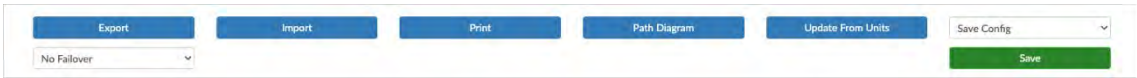
To display the system configuration panel, log in as a system administrator. Select the VL-EM element manager in the system tree, and then select **Settings** ⚙.

The panel has three main sections:

- **Unit Config Table** – Includes settings for unit type, number of channels, MAC address, serial numbers, band frequency, downlink attenuation, and uplink attenuation for master units and remotes.
- **Optical Paths Config Table** – Includes settings for downlink optical path configuration between units.
- **Signals Routes Config Table** – Includes settings for signal (channel) configuration for each optical path.



The panel also displays options for exporting, importing, and saving the system configuration.



- **Export** – Downloads the current system configuration to your computer where the element manager software is running.
- **Import** – Uploads a system configuration file from your computer.
- **Print** – Prints the system configuration as a text file.
- **Path Diagram** – Displays a general diagram of the roles played by each unit in the system.
- **Update from Units** – Updates the current system configuration with any changes made to the various units. This action provides a report of all the changes that have been made.
- **Apply** – Saves the configuration file with the following 2 types of actions:
  - **Push config** saves and applies the changes to all the units and remotes in the network. If the system is large, with many Active units, the completion of this action takes more time.
  - **Save Config** saves the changes without overwriting the system configuration in all units and remotes.

9.3 Configuring Failover

If the system is designed for mission critical applications with a backup master unit in the case of equipment or optical link failure, then you need to configure the system for failover operation. Learn more about headend redundancy and failover topologies.

Configuring failover in the element manager software includes:

- Selecting a failover type
- Configuring primary and secondary master units
- Assigning remotes to a master unit (ring failover only)

NOTE: In a failover operation, the clock signal from the primary and secondary master units is synchronized using an external 10 MHz optical reference clock source: the VL-CLK clock distribution unit.

The VL-CLK can be installed in any headend location. The VL-CLK connects to the two master units over single mode fiber. In the element manager software, the reference clock is automatically configured as **Optical**. Learn more about clock source configuration.

Selecting a Failover Type

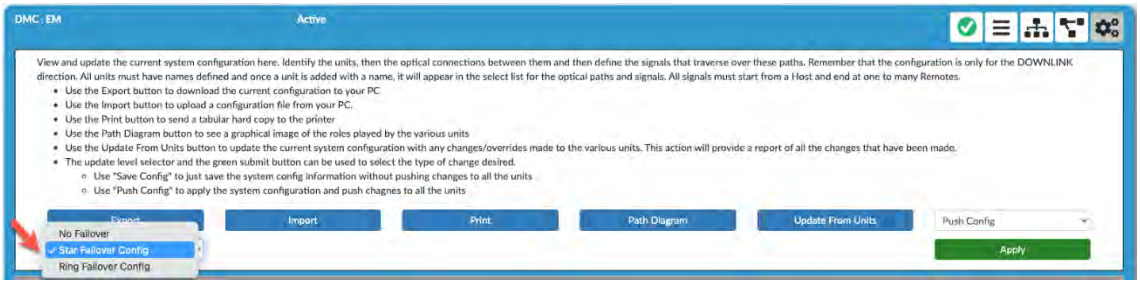
The VL-Series supports two types of failover types: star and ring. The type used in your system is defined in the system design. Learn more about failover topologies.

When commissioning a failover system, first select the failover type to create a secondary, or mirrored master unit in the system configuration. If you select Ring topology, then you must also assign remotes to each master unit.

✦ **To select a failover type**

1. Select the element manager in the system tree, and then click **Settings** .

2. Click the failover dropdown list and select a topology.



- **No failover** – If the master unit or remotes fail, there is no backup.
- **Star Failover Config** – Two master units, a primary and secondary, are installed in a star topology. If the primary unit fails, the secondary unit

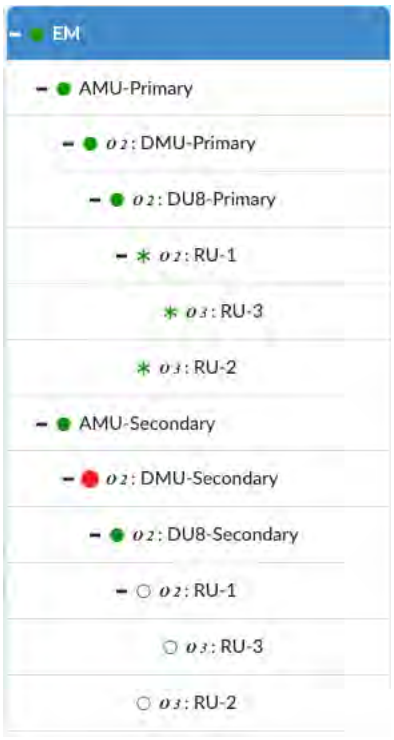
takes over. The secondary master unit does not carry signal until the primary master unit fails.

- **Ring Failover Config** – Two master units are installed in a ring topology. Both master units can either share the signal and traffic load between them for a more efficient use of resources. Or, the secondary master unit can be a Standby backup of the primary unit. Learn more about load sharing and Active/Standby modes.

3. Select **Push Config** and then click **Save**.

4. Inspect the system tree to see the failover topology. If you selected **Ring Failover Config**, the remotes in the system tree appear in reverse order.

Star Failover



Ring Failover

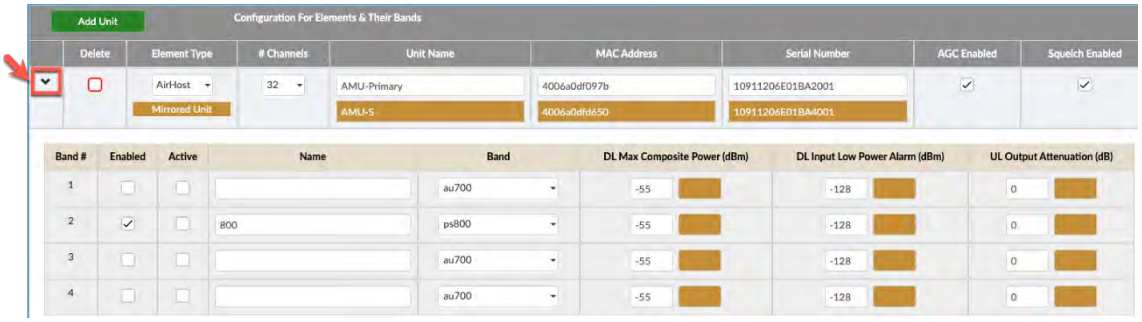
Configuring Primary and Secondary Master Units

When you select a failover type, the element manager software automatically creates a secondary master unit that mirrors the primary master unit in the Unit Config Table. The secondary master unit is the same type as the primary. For example, an VL-AMU cannot be backup for a VL-DMU.

In the Unit Config Table, the secondary master unit name, MAC address and serial number are highlighted in gold.

✦ **To configure the band modules in a master unit**

1. Expand the master unit row by clicking the arrow on the left side.



The row expands to show the max composite power levels, low power alarm threshold and UL output attenuation for each band module. The settings for the secondary unit are in brown.

2. Adjust the power and attenuation settings if needed. Both master unit settings can be adjusted independently. **Squelch Threshold** must be the same for both.

3. Select **Save Config** option and then click **Save**.