Assigning Remotes to a Master Unit

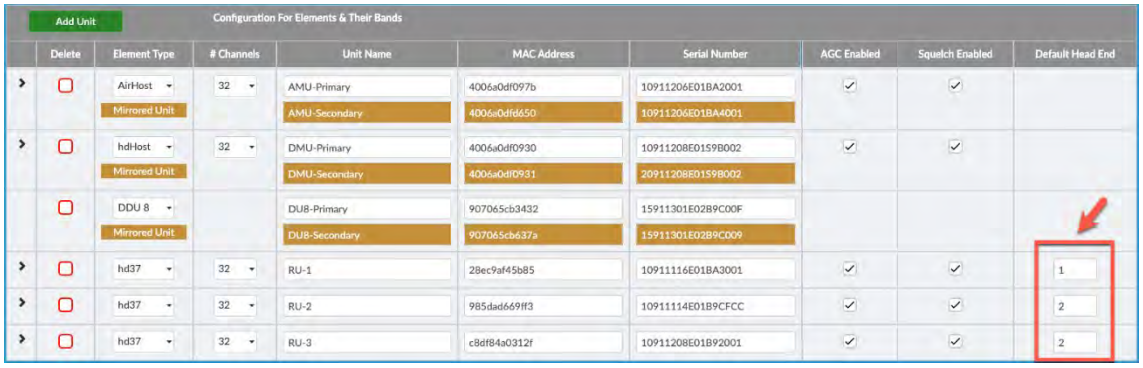
This step applies to ring failover topologies only.

Unlike star failover, ring failover operation can be configured in load sharing mode by assigning remotes to a default master unit.

The default master unit manages the signal traffic for a specific remote.

✦ **To assign remotes to a default master unit**

1. In the Unit Config Table, assign the remote to a primary or secondary master unit based on your failover topology:



- Enter **1** to assign the remote to the primary master unit
- Enter **2** to assign the remote to the secondary master unit.

2. Select **Save Config** and click **Save**.

9.4 Adding Master Units

You can add VL-AMU and VL-DMU master units to the system configuration. Configure both the unit and the band modules.

NOTE Master units are configured by Avari Wireless when the system is first installed and commissioned in the factory. In most cases, you will not need to change the configuration unless you are adding new units to the system, or you are directed by Avari Wireless to update these settings.

✦ To add a master unit

1. In the Unit Config Table, select **Add Unit** to create a new row.
2. In Element Type, select the type of master unit:
   - hdHost (VL-DMU)
   - airhost (VL-AMU)
3. Select **32** or **64** for the number of channels.
4. Enter a unit name following a consistent equipment naming convention.
5. Enter the MAC address and Serial Number.
6. Click the left arrow to expand the row, and then update the band module settings as needed:

Field	Description
Master unit	
Element Type	Type of master unit, distribution unit, or remote
# Channels	Number of channels in the system: 32 or 64
Unit Name	Name of the master unit. Follow a consistent equipment naming convention.
MAC Address	MAC address of the unit located on the manufacturer's sticker
Serial Number	Serial number of the unit located on the manufacturer's sticker
AGC Enabled	Automatic Gain Control is turned on.
Squelch Enabled	Squelch is turned on.
Squelch Threshold (dBFS)	Default: -60 dBFS is equivalent to -95 dBm signal level

Field	Description
Band module	
Band #	Slot on the unit in which the band module is installed
Enabled	If selected the band module is powered on and ready to carry RF signals. If not selected, the band module is disabled.
Active	If selected, the band module is carrying RF signals. If not selected the band module is deactivated.
Name	Name of the band module. Follow a consistent equipment naming convention.
Band	Band frequency
DL Max Composite Power (dBm)	Maximum downlink input power setting for the band module
DL Input Low Power Alarm (dBm)	Sets a threshold for the low input power alarm. If the input power falls below this threshold, a low power alarm is displayed. A value of -128.00 dBm disables the alarm.
UL Output Attenuation (dB)	Uplink output attenuation setting for the band module

7. Once complete, save and apply the configuration.

9.5 Adding Remotes

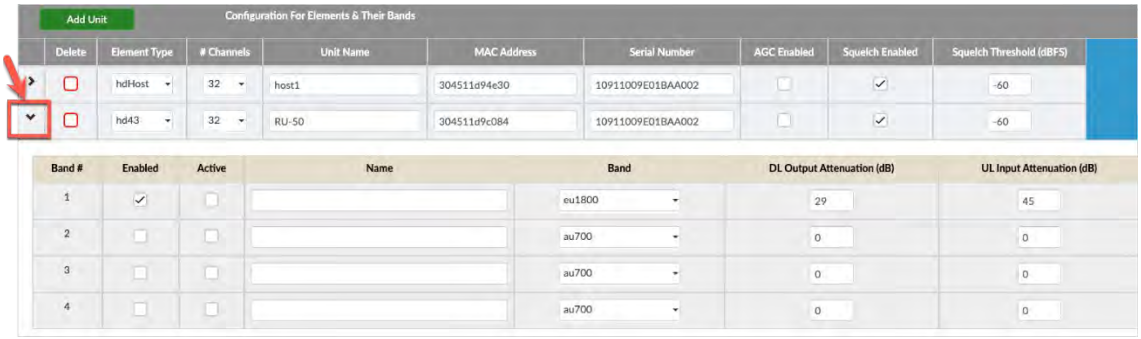
You can add VL-RU 33 and VL-RU 37 remotes to the system configuration. Configure both the unit and the band modules.

NOTE Remotes are configured by Avari Wireless when the system is first installed staged and commissioned in the factory. In most cases, you will not need to change the configuration unless you are adding new units to the system, or you are directed by Avari Wireless to update these settings.

✦ To add a remote

1. In the Unit Config Table, select **Add Unit** to create a new row.
2. In Element Type, select the type of remote:
   - hd37 (VL-RU 37)
   - hd33 (VL-RU 33)
3. Select **32** or **64** for the number of channels.

4. Enter a unit name following a consistent equipment naming convention.
5. Enter the MAC address and Serial Number.
6. Click the left arrow to expand the row and update the default band module settings.



Field	Description
Remote	
Element Type	Type of master unit, distribution unit, or remote
# Channels	Number of channels in the system: 32 or 64
Unit Name	Name of the unit displayed on the system tree and other element manager panels. Follow the recommended naming conventions.
MAC Address	MAC address of the unit located on the manufacturer's sticker
Serial Number	Serial number of the unit located on the manufacturer's sticker
AGC Enabled	Automatic Gain Control is turned on.
Squelch Enabled	Squelch is turned on.
Squelch Threshold (dBFS)	Default: -60 dBFS is equivalent to -95 dBm signal level
Default Headend	Ring Failover only. The master unit this remote is assigned to. 1 for the primary master unit. 2 for the secondary master unit.
Band module	
Band #	Slot occupied by the band module on the remote
Enabled	Band module is powered on and ready to carry RF signals
Active	Band module is carrying RF signals
Name	Name of the band module. Follow a consistent equipment naming convention.
DL Output Attenuation (dB)	Downlink output attenuator setting for particular band module
UL Input Attenuation (dB)	Uplink input attenuator setting for particular band module

7. Once complete, save and apply the configuration.

9.6 Adding Distribution Units

Distribution units are simpler to add than master units or remotes because they do not have RF band modules.

NOTE Digital distribution units are configured by Avari Wireless when the system is first installed and commissioned in the factory. In most cases, you will not need to change the configuration unless you are adding new units to the system, or you are directed by Avari Wireless to update these settings.

In the Unit Config Table, select **Add Unit**, and then select **DDU 8** or **DDU 14** in Element Type. Enter the number of channels, the unit name, MAC address, and serial number.

Once complete, save and apply the configuration.

9.7 Adding Optical Paths

Optical paths are the fiber connections between master units, distribution units, and remotes. These paths create the fiber topology.

When you add a new unit, you must define the optical paths between it and the other connected units.

NOTE In a failover configuration, the optical paths connected to the secondary master unit are called the secondary path, and are automatically configured to mirror the primary path.

✦ **To add a new optical path**

1. In Optical Paths Config Table, select **Add Optical Path** to create a new row.

2. Use the **From** and **To** fields to select the previously added units and ports you are connecting with fiber. Refer to the system diagram to make sure the units and ports match how the master units and remotes are physically connected.

3. Once complete, save and apply the configuration.

9.8 Adding Signals (Channels)

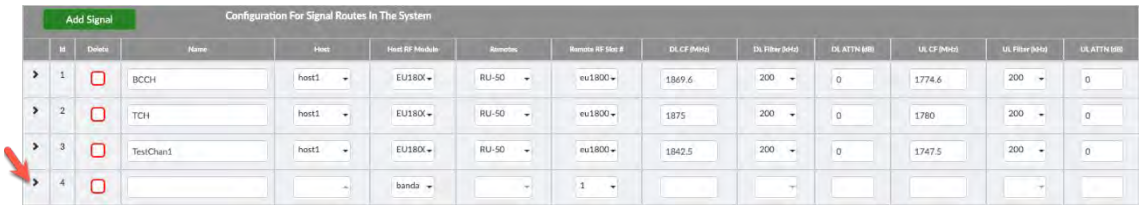
Signals are the channel frequencies to be transmitted over the system originating from the signal source. Depending on the system design, you can define a maximum of 32 or 64 channels.

For each channel, you must configure the signal by selecting a master unit remote, frequency, and channel filters.

NOTE Channels are configured by Avari Wireless in the factory if known at the time. In most cases, you will never need to change the configuration unless you are adding new channels to the system, or you are directed by Avari Wireless to update these settings.

✦ To add a signal

1. In Signal Routes Config Table, select **Add Signal** to create a new row.



2. Add the following settings.

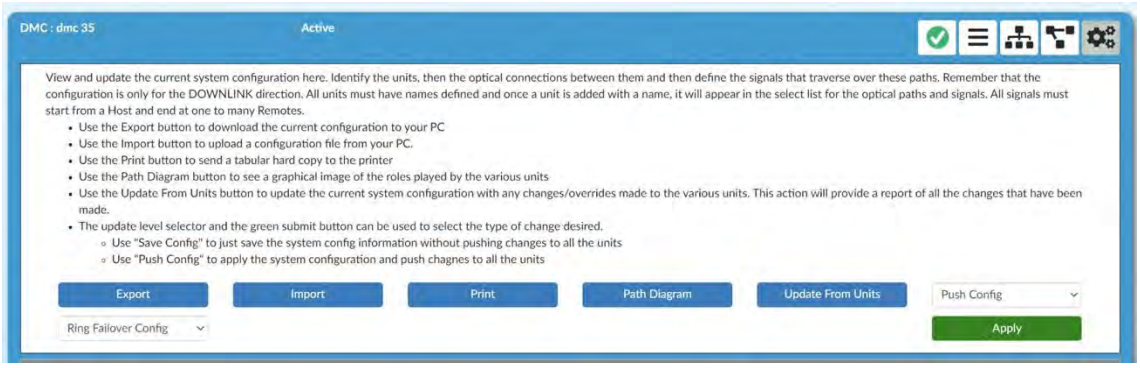
Field	Description
Id	Channel number. The system can have 32 or 64 channels.
Name	Channel name. Use the recommended naming convention.
Host	Name of the master unit where the signal route originates. The list includes the master units already configured.
Host RF Module	Band module on the master unit carrying the channel. The list includes the band modules already configured.
Remotes	Name of the remote the channel is connected to. The list includes the remotes already configured.
Remote RF Slot #	Band module on the remote carrying the channel. The list includes the remote band modules already configured.
DL CF (MHz)	Downlink center frequency
DL Filter (kHz)	Downlink filter. Select: 12.5 kHz, 25 kHz, 50 kHz, or 200 kHz.
DL ATTN (dB)	Downlink attenuation
UL CF (MHz)	Uplink center frequency
UL Filter (kHz)	Uplink filter. Select: 12.5 kHz, 25 kHz, 50 kHz, or 200 kHz.
UL ATTN (dB)	Uplink attenuation

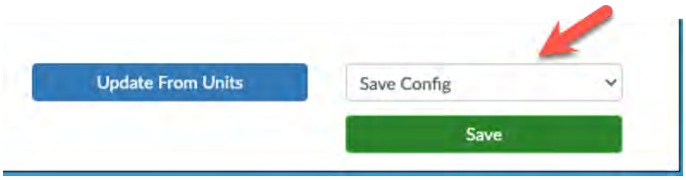
3. Once you complete the fields, click the left arrow to expand the row and display a graphic representation of the signal route between master unit and remote.

4. Once complete, save and apply the configuration.

9.9 Saving and Applying the System Configuration

Any changes to the system configuration panel are not saved until you select a save option and click **Save.**





Select one of the following options before applying the configuration:

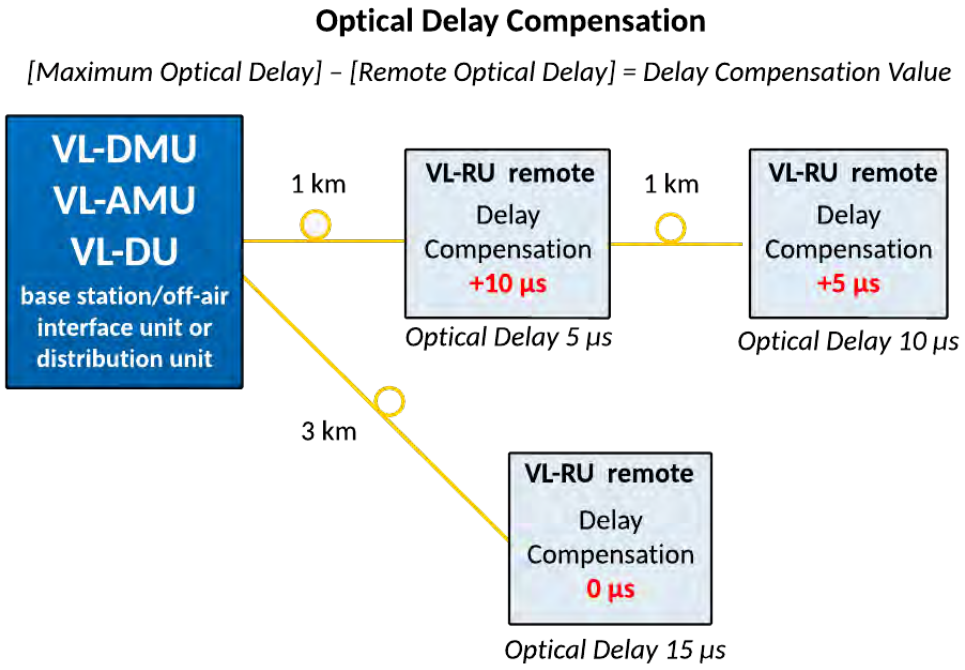
- **Push Config** saves and applies the configuration to all master units and remotes in the network.
- **Save Config** saves the system configuration without applying changes to all the units

9.10 Configuring Optical Delay Compensation

The optical delay between the master unit and the remote varies depending on the length of the fiber and the number of daisy-chained remotes.

Optical delay compensation ensures the downlink signal from the originating master unit is received by multiple remotes at the same time. Working in reverse, it also ensures the uplink signal from the remotes is received by master unit at the same time.

The offset timing added at each remote causes the delay to equalize across all remotes.



✦ **To configure delay compensation automatically for all remotes**

1. Select the element manager in the system tree, and then click **Info** ☰.
2. Click **Normalize**.

3. Note the **Auto Delay** value. This is the maxiumun optical delay in the system from the master unit to the farthest remote.

✦ **To display the delay compensation applied to a remote**

1. Select the remote in the system tree, and then click **Info** ☰.

2. Note the **Compensation** value. This is the optical delay applied to this specific remote.

9.11 Displaying the Clock Source

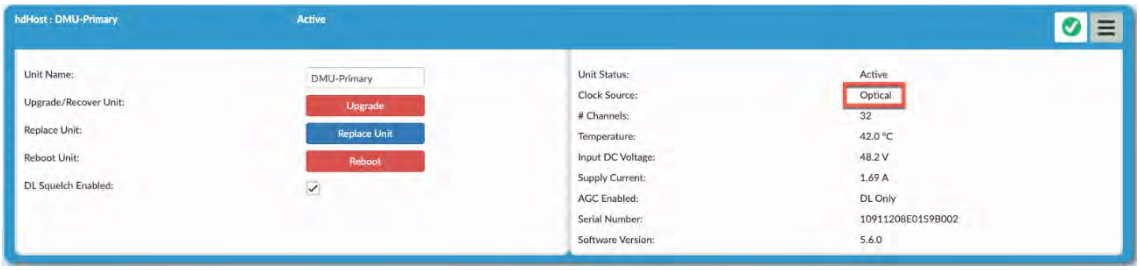
The VL-Series needs a reference clock source to synchronize the communications of all master units and remotes over fiber.

The clock source can be:

- **Internal** – Built-in 10 MHz clock source. All VL-AMU and VL-DMU master units, and VL-RU remotes have an internal clock reference.
- **Optical** – External clock source delivered over fiber. In a redundant configuration with failover, the optical clock source is provided by the VL-CLK digital clock distribution unit.

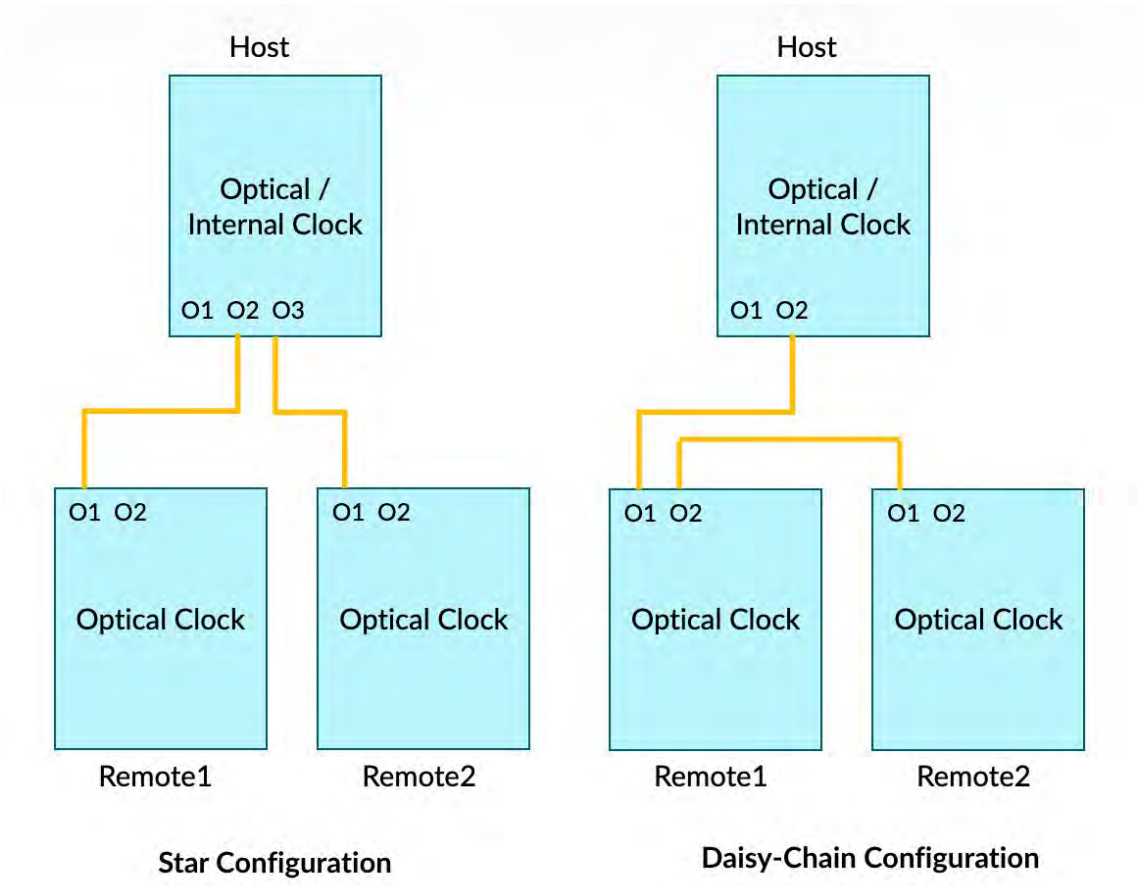
For master units, the clock source automatically switches between optical clock and internal clock. For example, if no optical clock is present the master unit will switch automatically to internal clock. For remote units, the clock source is always optical clock.

To display the master unit clock source in use, select the master unit in the system tree, and then click **Info** ☰.



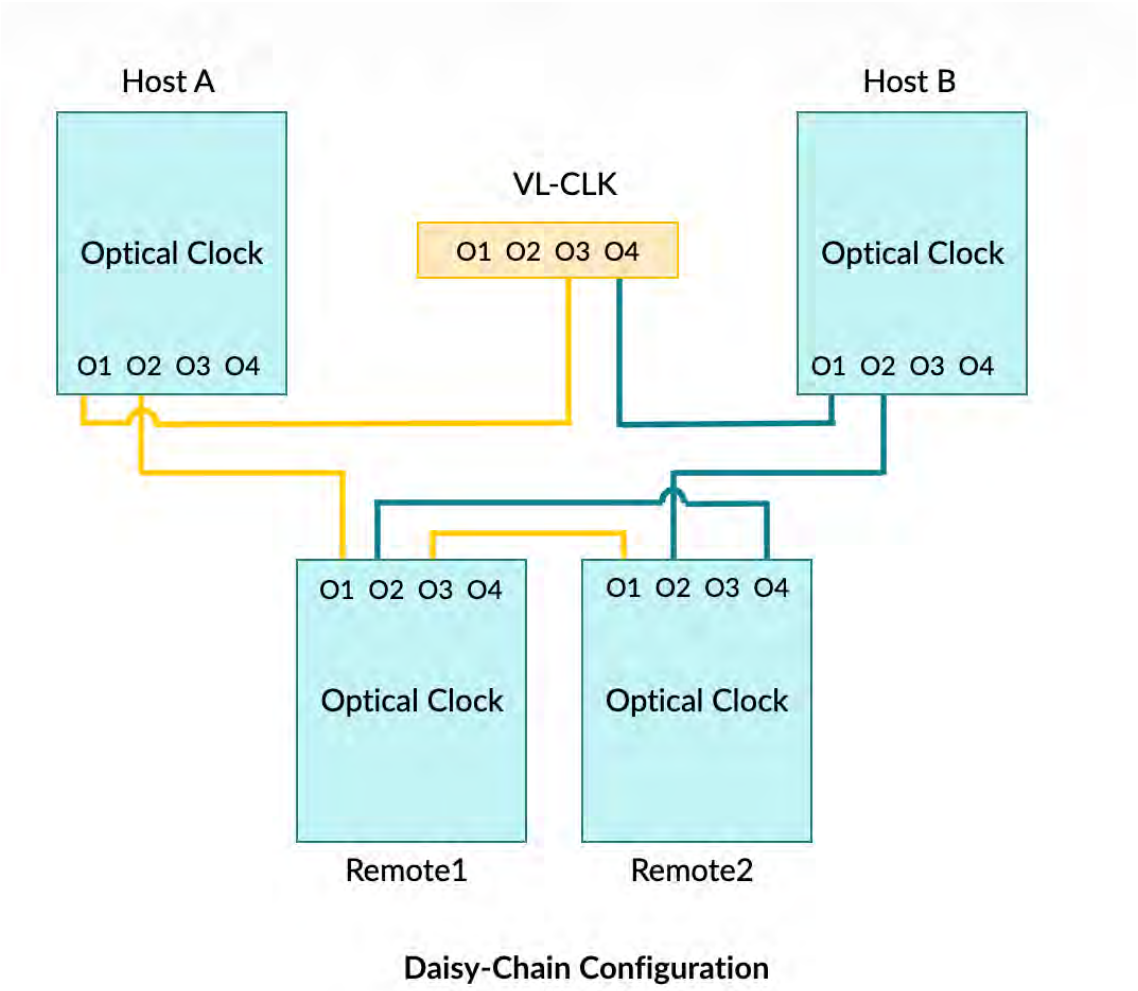
Clock Source No Headend Redundancy

In systems without headend redundancy, the master unit at the top of the system tree uses the **Internal** clock source to synchronize all master units, distribution units, and remotes below it. The downstream devices synchronize over optical port 1 and use **Optical** as the clock source.



Clock with Headend Redundancy

In systems with headend redundancy, both primary and secondary master units are synchronized with an external clock source, the VL-CLK clock distribution unit. The VL-CLK provides the clock source to both master units over fiber.



Daisy-Chain Configuration

9.12 Editing Device Names

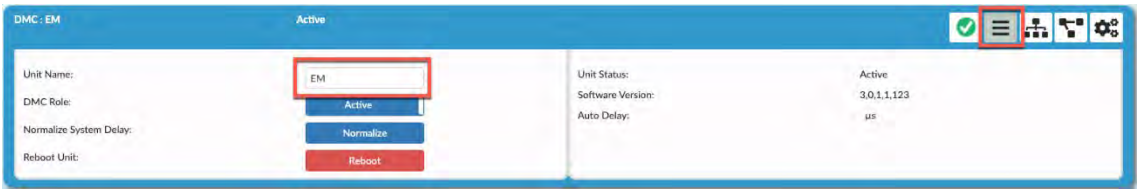
During installation and commissioning, Avari Wireless gives VL-Series elements custom names and identifiers in the element manager software.

You can edit these device names as needed. Use the recommended naming conventions.

Unit Names

✦ **To edit the name of an element manager, master unit, distribution unit, or remote:**

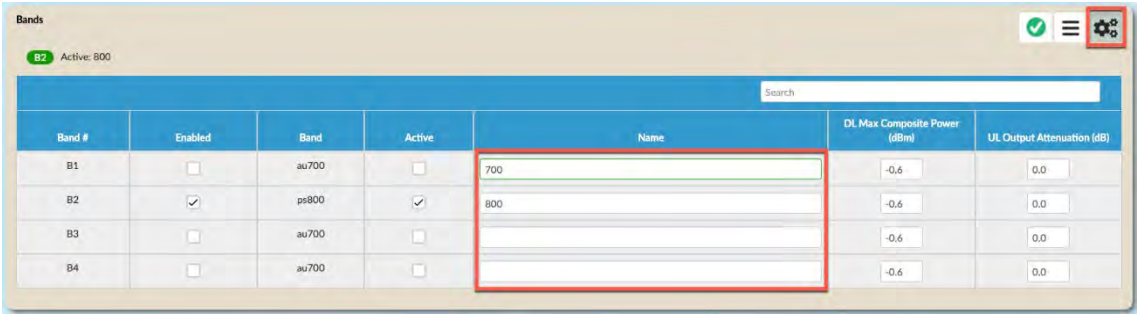
1. Select the unit in the system tree.
2. On the blue unit panel, click **Info** ☰.
3. Edit the **Unit Name** field. Wait a few seconds for the name to update automatically in the system tree.



Band Module Names

✦ **To edit the name of band modules for master unit or remote:**

1. Select the unit in the system tree.
2. On the Bands panels, click **Settings** ⚙.
3. Edit the **Name** field. Changes are saved automatically.



Naming Conventions

All name fields are limited to 31 characters.

Element	Name Format	Example
Element manager	[Unit Type]-[Site Code/Location]	EM-ATX
Master unit		DMU-ATX
Distribution unit		DU-ATX
Remote		RU37-ATX
Band modules	[Frequency]	700
		450
		800
Signals	[Channel#-Frequency]	ch1-450
		ch2-450
		ch1-150
		ch2-150

9.13 Configuring RF Input Power in the Master Unit

Before activating band modules in the master unit, you must set the maximum input power supplied by the off-air signal source or base station.

This value should match the signal source power after the attenuation equipment. The maximum downlink (DL) input power is based on the power when all channels in a frequency band are Active.

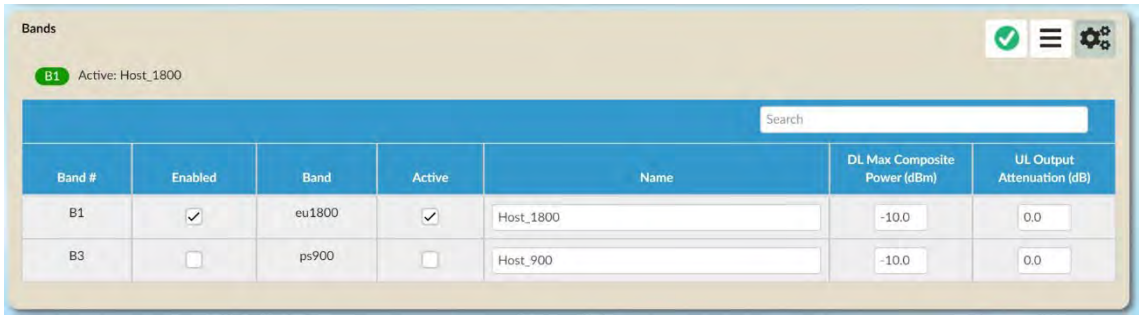
For information on applying attenuation once the band modules are Active, see DL and UL Gain Commissioning.

First, attenuate the base station or off-air power to the appropriate levels. Next, for each band module in the master unit, set the maximum composite DL input power level to the expected maximum level from the base station or off-air source.

For example, if the maximum composite value after the attenuation equipment is 0 dBm, then set the **DL Max Composite Power** value to 0 dBm.

✦ To configure the maximum DL input power

1. Select a master unit in the system tree, open the Bands panel, and click **Settings** ⚙.



2. Enter the maximum DL composite power expected at the input to the band module

- VL-DMU: -10 to +10 dBm
- VL-AMU 33/37: -95 to -10 dBm

3. Go to DL and UL Gain Commissioning to continue with optimizing DL and UL system gain.

When you set the appropriate DL input signal level, the system automatically adjusts the DL system gain so that the remote outputs maximum rated power.

10 DL and UL Gain Optimization

What's inside this chapter:

10.1 Balancing System Gain

The net system gain of the master unit and remote on both downlink (DL) and uplink (UL) paths should be balanced for optimal performance.

To balance system gain, set the maximum DL input power to the following range. The system automatically adjusts the system gain so that the DL output power at the remote unit is at its maximum rated power:

Master unit	Maximum DL input power range
DMU direct connect unit	-10 dBm to 10 dBm
AMU off air unit	< -55 dBm

NOTE External attenuation is required to ensure that the maximum DL input power from base station or repeater is within the range stated above.

For DL input signal over the air, if the maximum input power is over -55 dBm, DL attenuation must be set to avoid frequent automatic level control alarm to be triggered. See Configuring the Downlink Path.

The maximum system DL and UL gain for the remotes are as follows:

Master unit to remote	Downlink	Uplink
DMU to RU-37	47 dB	55 dB
DMU to RU-43	53 dB	55 dB
AMU to RU-37	92 dB	92 dB

With AGC on, the system adds up to 20 dB of additional digital gain per channel to normalize the DL and UL output power per channel and achieve rated maximum composite output power when the input is low.

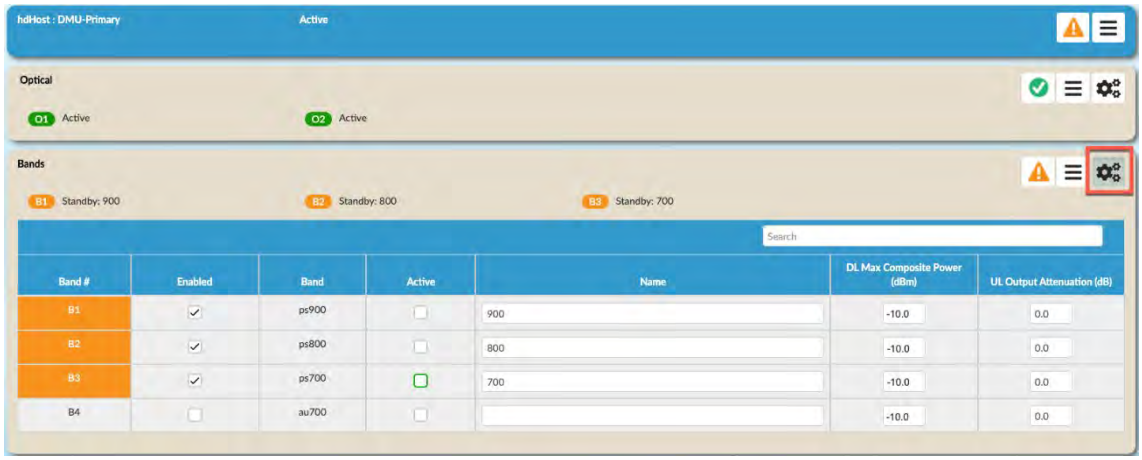
NOTE It is important to balance the antennae in the RF design to ensure power is evenly distributed.

10.2 Activating the RF Signal Path

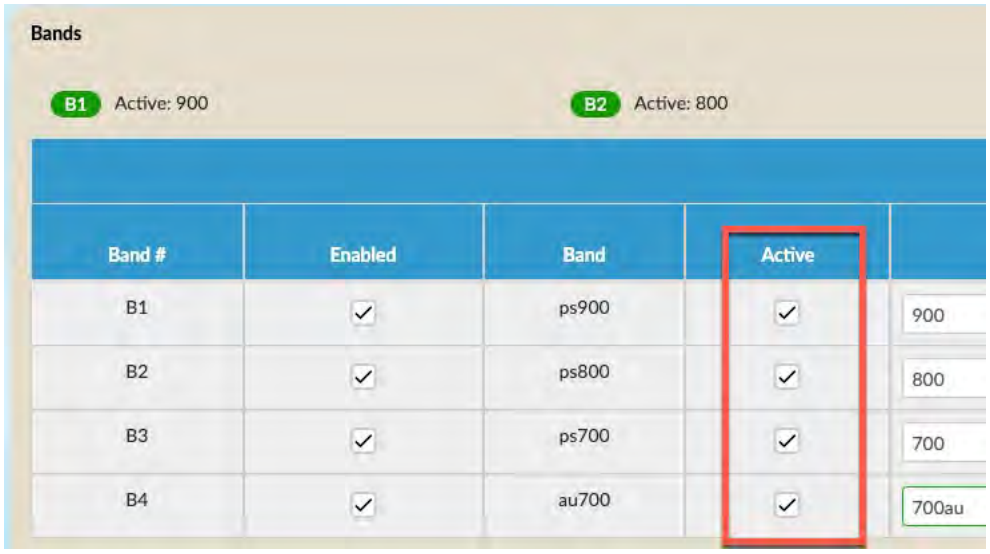
Before activating the RF signal path, address all major and critical alarms. The system tree should show only green or orange alarm indicators.

✦ **To activate the RF signal path for each band module**

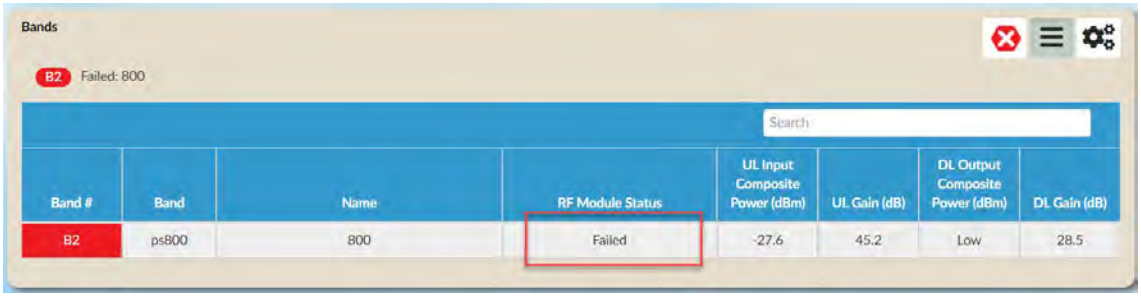
1. Select a master unit or remote in the system tree, and on the Bands panel, click **Settings** .



2. Select **Activate** for each band module.



If the band module can't activate, the RF Module Status displays **Failed** in the **Info** ☰.



Click the alarm icon to display the alarm description. Go back to **Settings** ⚙, uncheck **Activate**, resolve the alarm condition, and try activating the band again. If the Failed status persists, call Avari Customer Service.

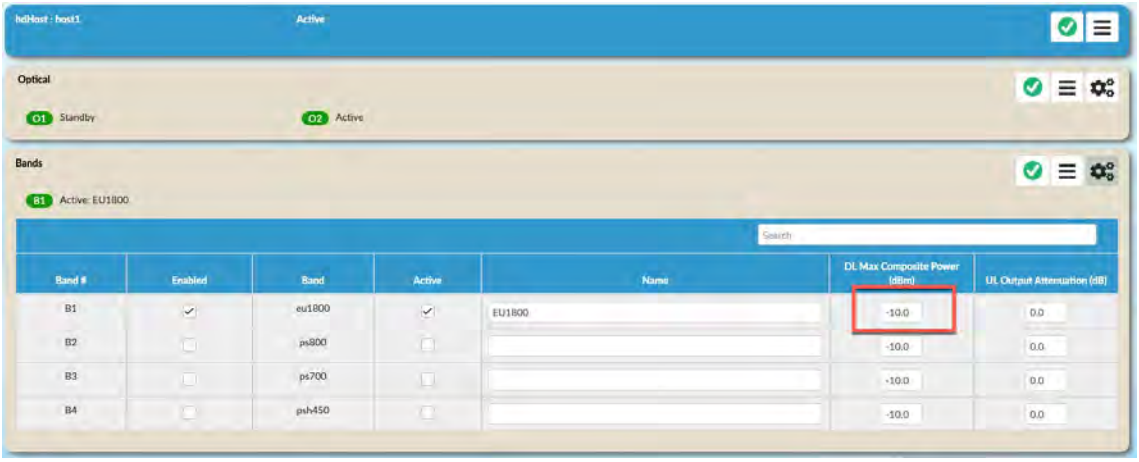
10.3 Configuring the Downlink Path

Configure the input power at the master unit and remote, and the output power of a specific signal.

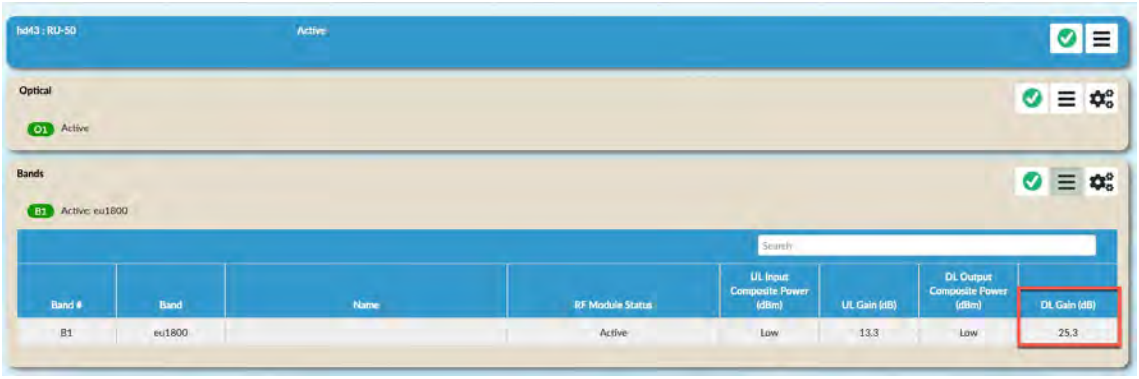
Master unit

✦ **To configure the DL input power at the master unit**

1. Select a master unit in the system tree and on the Bands panel, click **Settings** ⚙.
2. In **DL Max Composite Power**, enter the maximum DL composite power expected at the input of that band module.



3. The EM automatically configures the gain on the DL path to produce the maximum DL output power at the remote. To see the gain, select the remote in the system tree, and on the bands panel select **Info** ☰.

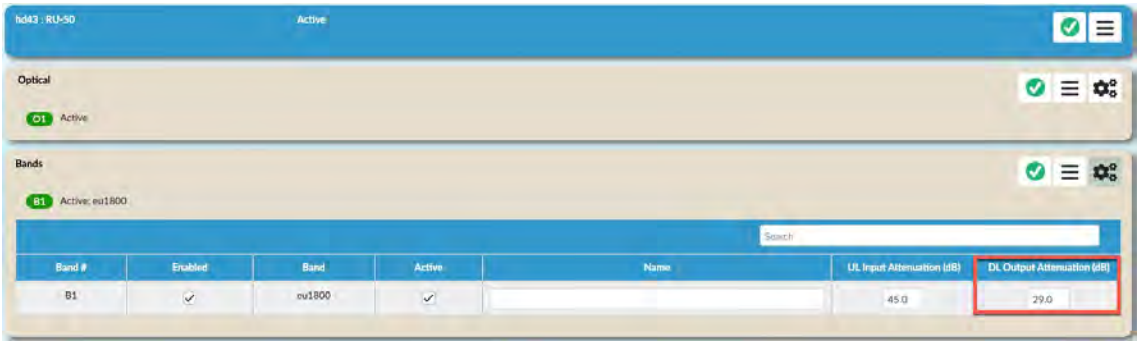


Remote

✦ **To configure the DL output power at the remote**

1. Select the remote in the system tree, and on the Bands panel click **Settings** ⚙.

2. In **DL Output Attenuation**, enter an attenuation value to lower the DL output power to meet ERP FCC guidelines.



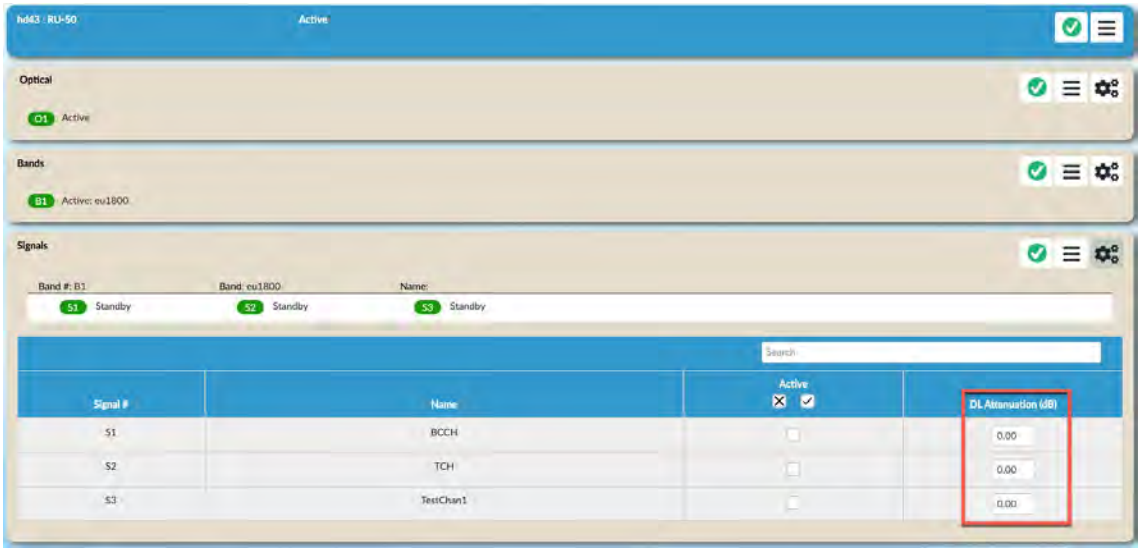
Downlink Signal Power

Automatic gain control is a process inside digital section of the remote that equalizes the power of all provisioned signals so that the maximum output power of the remote is spread equally over the number of provisioned signals. Learn more about Automatic Gain Control.

If needed, the output power of specific signals can be attenuated.

✦ **To adjust the output power of a specific signal at a remote**

1. Select the remote in the system tree, and on the Signals panel, click **Settings** ⚙.



2. In **DL Attenuation**, enter an attenuation value to lower the DL output power of a particular signal.

10.4 Configuring the Uplink Path

The goal of the uplink path is to ensure that UL power to the base station or off-air signal source has sufficient gain yet does not raise the noise floor so significantly that it affects service.

By default, the UL gain is at maximum and UL output attenuation is zero. In most cases, you need to apply attenuation to reduce UL gain.

Balancing UL Gain

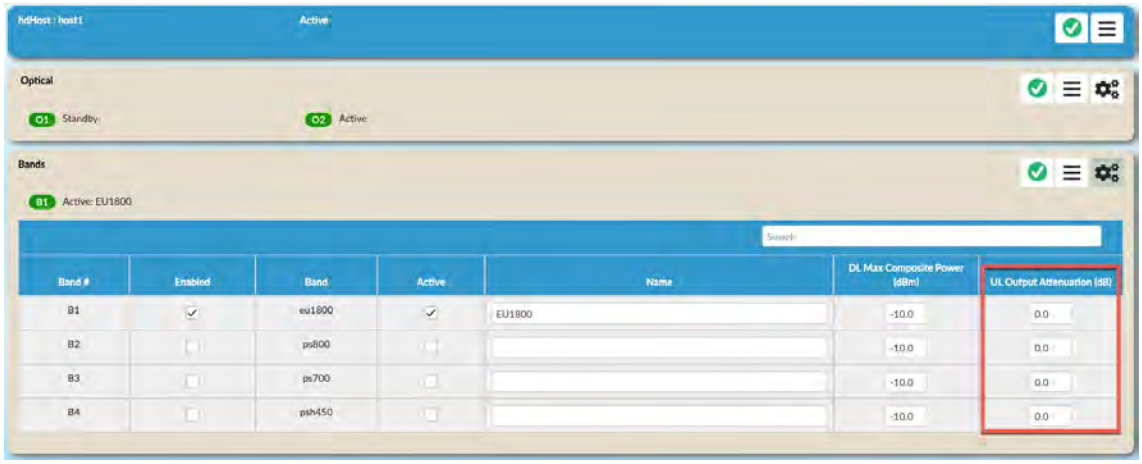
- Increasing UL gain also increases the noise content that is delivered to the base station.
- Optimization process requires operator involvement to monitor the base station UL noise level.
- Increase in noise floor observed at the base station should be within the limits required by the operator to ensure proper coverage.

Master Unit

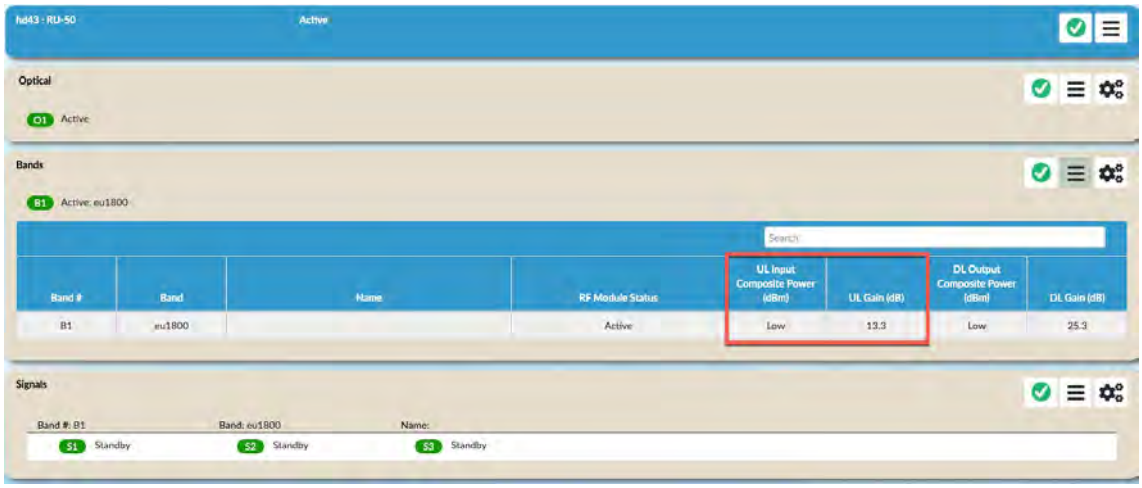
Use the UL output attenuation at the master unit to decrease the overall end-to-end UL system gain taking into account the point of interface (POI) loss and passive cable distribution loss.

✦ **To add UL attenuation to the master unit**

1. Select a master unit in the system tree, and on the Bands panel, click **Settings** .
2. Enter a value in the **UL Output Attenuation** field to lower the UL gain.



3. The EM automatically adjusts the UL output power and UL gain at the remote. Make sure these values match the expected gain lineup from the system design. To see the UL gain, select the remote in the system tree, and on the Bands panel select **Info** ☰ .



Uplink Signal Power

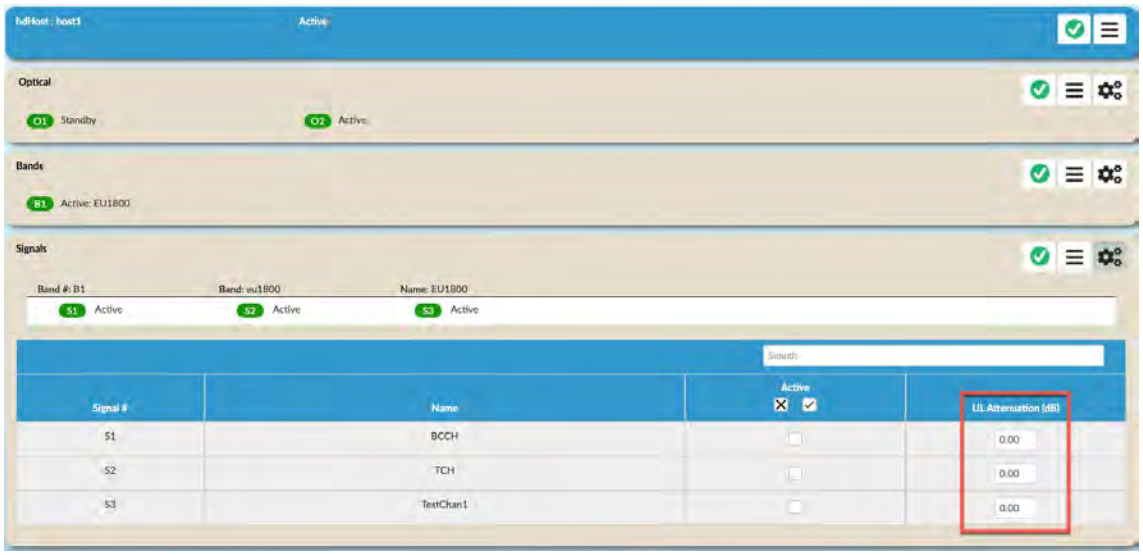
Automatic gain control is a process inside digital section of the master unit that equalizes the power of all provisioned signals so that the maximum uplink power of the master unit is spread equally over the number of provisioned signals. Learn more about Automatic Gain Control

If needed, the output power of specific signals can be attenuated.

✦ **To adjust the output power of a specific signal at a master unit**

1. Select the master unit in the system tree, and on the Signals panel, click **Settings** .

2. In **UL Attenuation**, enter an attenuation value to lower the UL gain of a particular signal.



10.5 Automatic Level Control

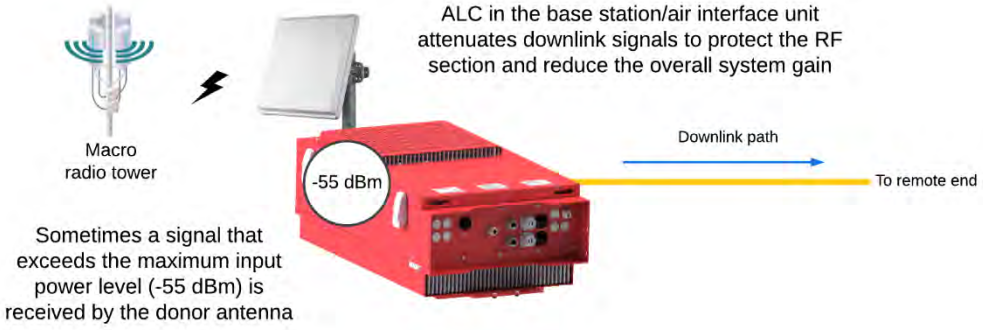
Automatic Level Control (ALC) is a process built into the remote and master that attenuates incoming signal when it is too strong.

> **NOTE** The broadband threshold for composite signal coming into the base station unit, air master unit, and remotes is -55 dBm.

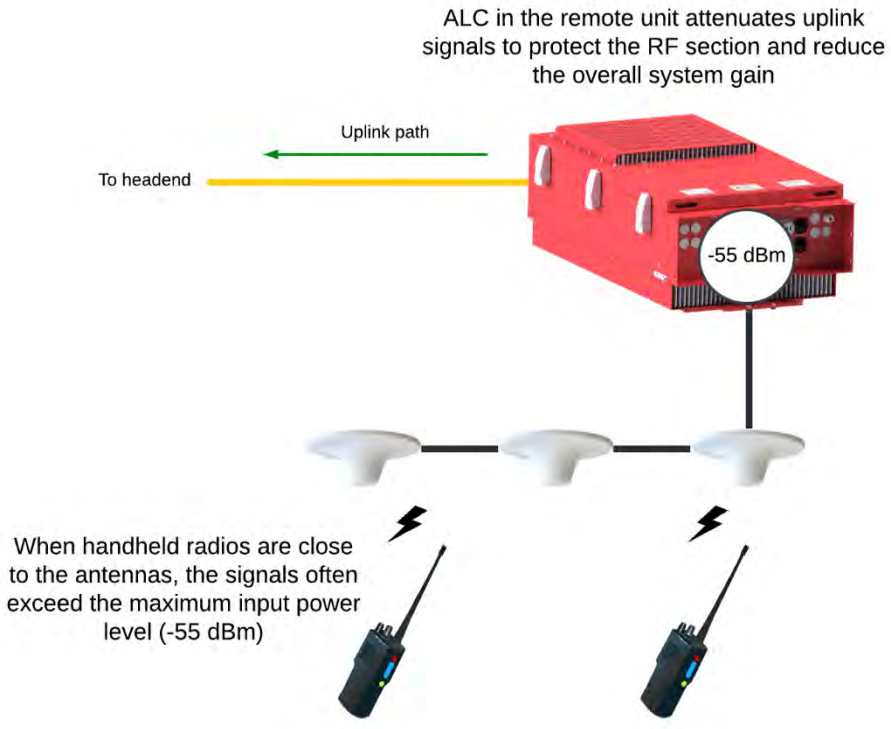
By attenuating the signal above the maximum input power as it passes through the unit, the ALC protects the band modules from overpowering the internal circuitry. The analog signal is then converted to digital and transmitted over the fiber.

Uplink and downlink attenuation

On the downlink path, ALC is applied at the master unit (VL-AMU or VL-DMU) to signals coming from a base station or donor antenna.



On the uplink path, ALC attenuation is applied at the remote for signals coming from handheld portable radios and other RF user devices.

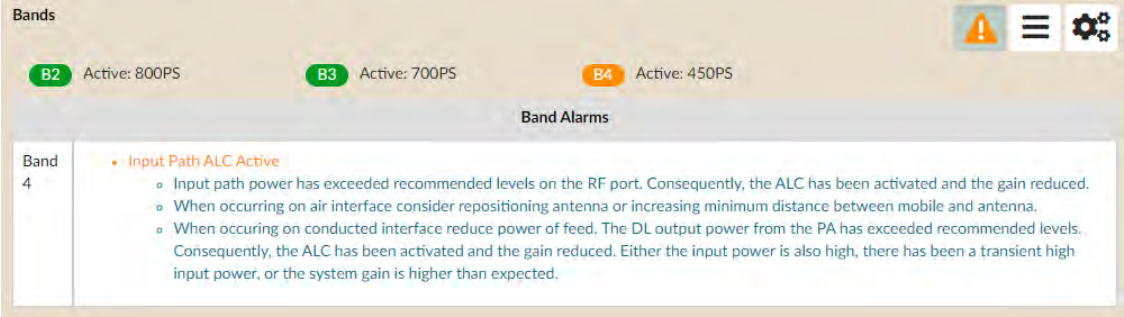


For example, an emergency responder with radio standing next to an antenna would likely generate a signal that's too powerful for the remote to safely receive and pass on. The ALC in the remote attenuates the signal to -55 dBm, a safe level for the remote.

Likewise, if a signal from a base station or donor antenna exceeds the threshold for the amplifiers in the master unit, the signal is attenuated to -10 dBm or -55 dBm respectively before being passed on for analog-to-digital conversion.

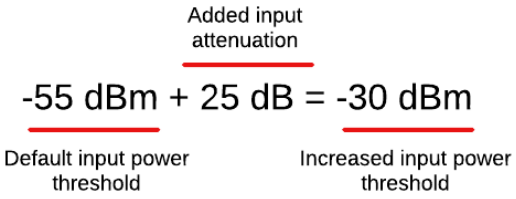
About ALC alarms

When ALC is activated because a signal exceeds the input power threshold, the remote or master unit generates an ALC alarm.



Depending on the location of remote antennas and the proximity of radios in the area, you could see dozens of alarms during a first responder event.

To reduce the number of these alarms in the alarm view, you can set remote uplink attenuation to 25 dB, which raises the alarm threshold to -30 dBm instead of -55 dBm.



The ALC still protects the band module by limiting the input power to -55 dBm. However, the input power alarm doesn't get triggered as often.

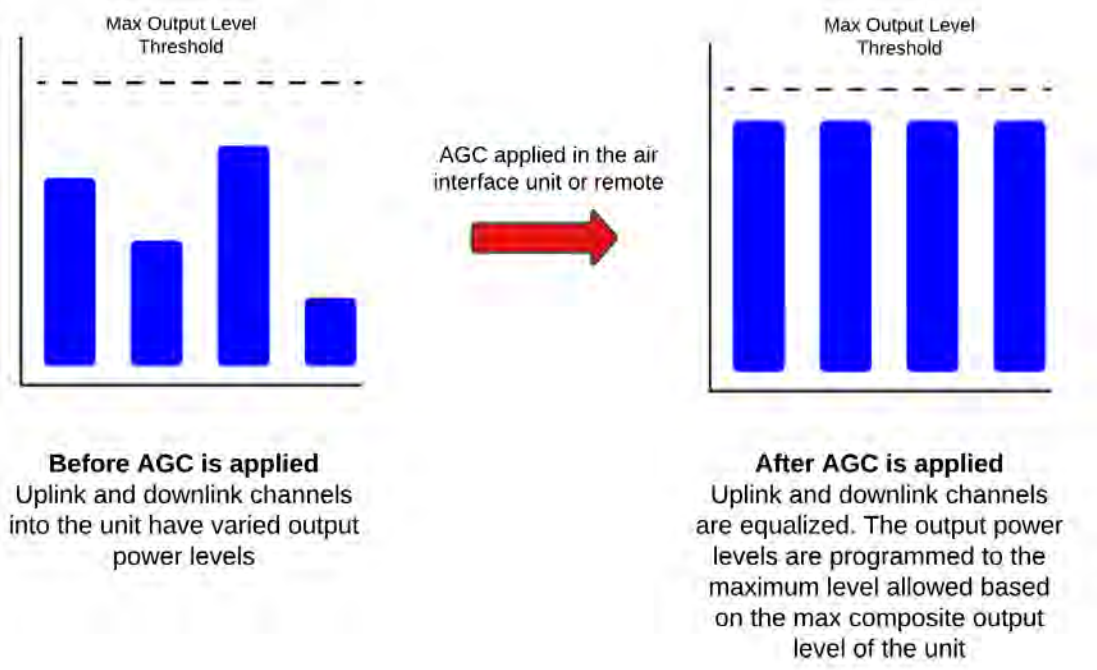
To increase the input power threshold, open the band module settings and enter **25.0** (or other similar value) in the **UL Input Attenuation** field.

10.6 Automatic Gain Control

To manage overall system gain, the VL-Series uses Automatic Gain Control (AGC), a mechanism in the master unit and remote for boosting signals evenly across all channels.

With multiple channels coming into the unit potentially at different power levels (some stronger or weaker than others), the result is varied signal strengths for users on handheld radios at the remote end.

To ensure the best coverage within range of the antennas, the AGC increases or attenuates the normalized signal to the maximum level rated for the unit without exceeding the overall composite output power rating.



Low versus high input power

If the input power to the unit is low, the AGC maximizes and balances the signal across all channels to improve reception.

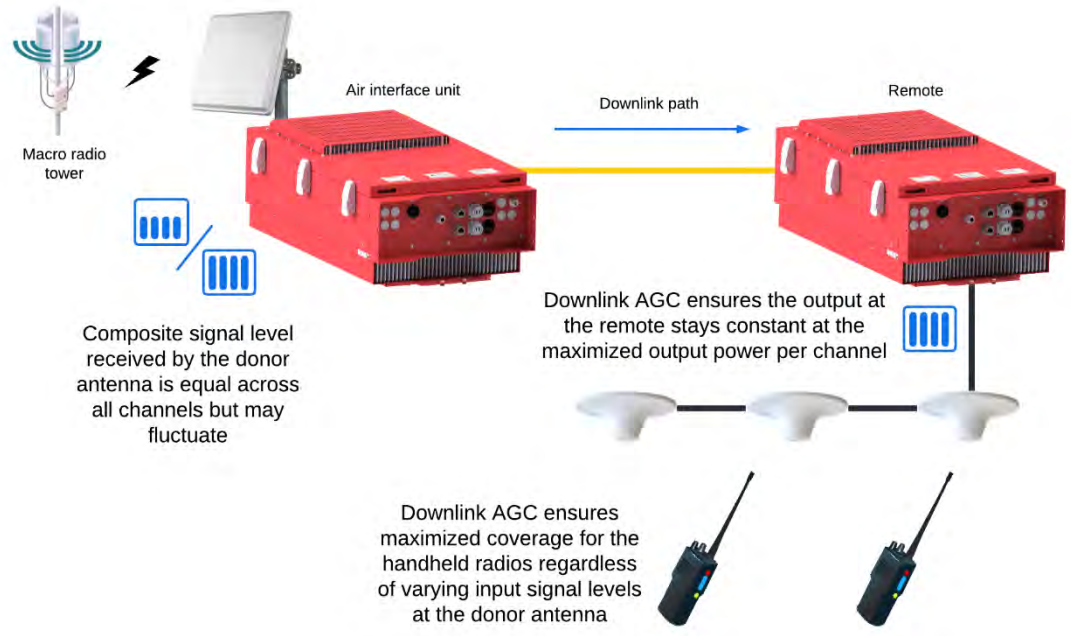
This means that no matter where a first responder is located within the coverage area, the signal strength coming into their handheld radio is at maximum power.

If the input power is high, the AGC attenuates the signal to the maximum power rated for the unit and then balances the signal so that all channels are equal.

Downlink path

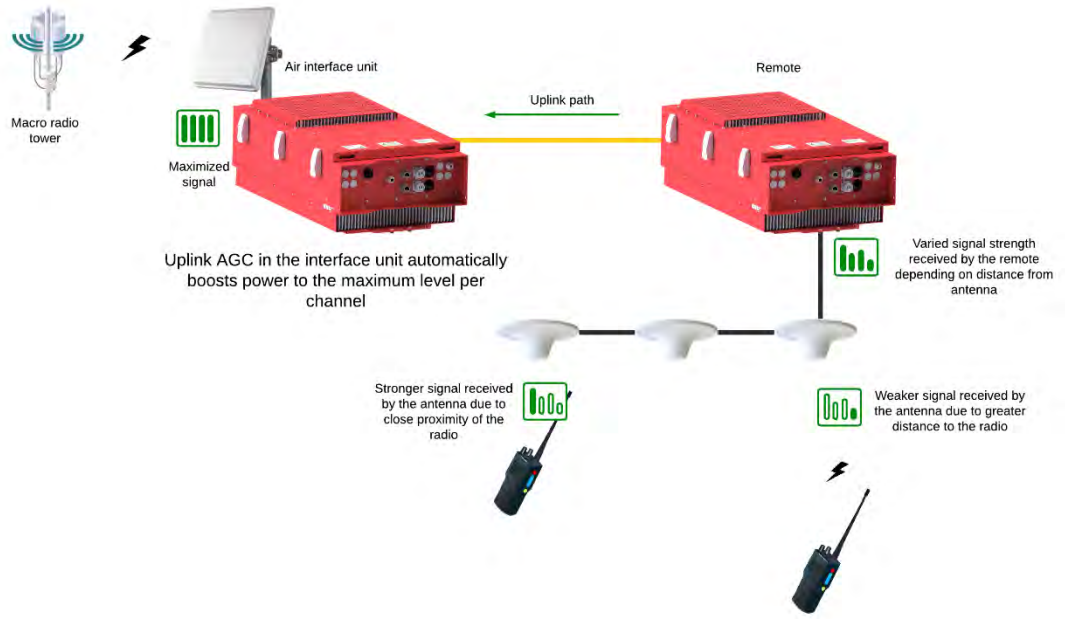
On the downlink path the composite signal level received by the donor level is equal across all channels, However, input power can fluctuate (be stronger or weaker) depending on the time of day or environmental conditions.

At the remote end, the downlink AGC makes sure the signal output stays constant and boosts the level to the maximum power rated for the unit.



Uplink path

On the uplink path, the varied signals received by the remote are boosted by uplink AGC at the master unit to the maximum level and equalized across all channels.



11 Operations and Maintenance

What's inside this chapter:

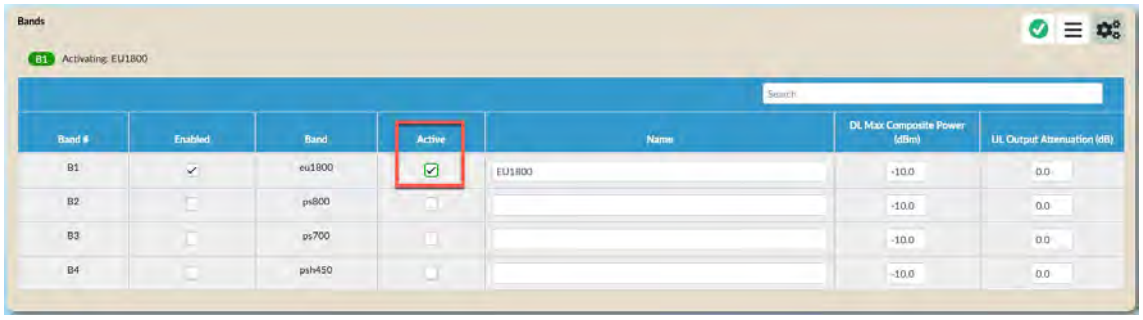
11.1 Activating and Deactivating Band Modules

When you activate a band module in a master unit or remote, the band module is taken out of Standby and placed in Active service, meaning the module begins passing RF signals on the uplink and downlink path.

Band module status appears as a colored indicators and highlighted **Band #** field. More about band module status.

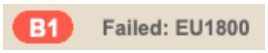
✦ **To activate a band module**

1. Select the master unit or remote in the system tree, and on the Bands panel, select **Settings** ⚙.
2. Select **Active** to activate the band module for service.



✦ If a Band Module Can't Activate

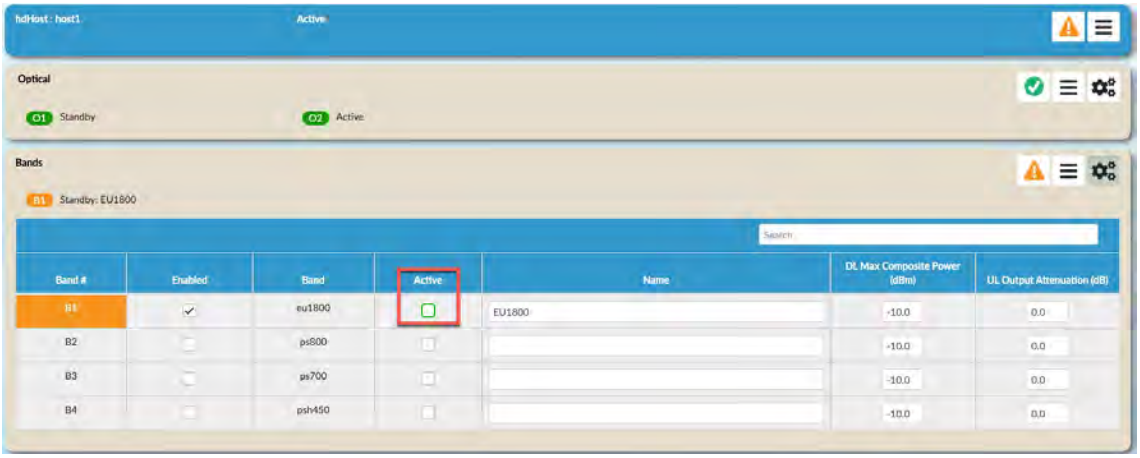
- The status changes to **Failed**.



- A critical alarm reports that the RF path has been deactivated.
- The band module may recover on its own and return to **Active** automatically. If it can't recover, then deactivate the band module to place it in Standby.

✦ To deactivate a band module (place in Standby)

1. On the Bands panel, select **Settings** ⚙.
2. Uncheck **Active**. The Band # changes status to orange, meaning the band is in Standby and no longer in service. An alert on the Signals panel also tells you that a band module has been taken offline.



Deactivate band modules for configuration, software upgrades, module replacements, and system restarts.

11.2 Enabling and Disabling Band Modules

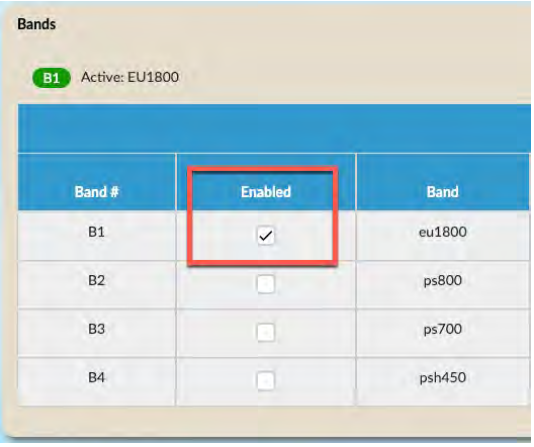
You can show or hide band modules in the Element Manger software by enabling or disabling them. Band modules that are disabled do not appear in **Info** and do not report alarms.

> **TIP** Disable a band module when a device is offline due to repair to prevent the alarms associated with the unit from cluttering up the Alarm view.

Only band modules that have been deactivated can be disabled.

✦ To enable (or show) a band module

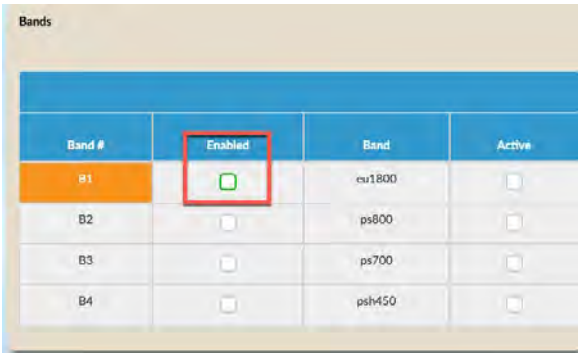
1. Select the master unit or remote in the system tree, and on the Bands panel, select **Settings**.
2. Select **Enabled**.



3. Wait for the checkmark outline to turn green.

✦ **To disable, or hide, a band module**

1. Select the master unit or remote in the system tree, and on the Bands panel, select **Settings** ⚙.
2. Uncheck **Active** to deactivate the band module. The Band # changes status to orange, meaning the band is in Standby and no longer in service. An alert on the Signals panel also tells you that a band module has been taken offline.
3. Uncheck **Enabled** to hide band module information and alarms.

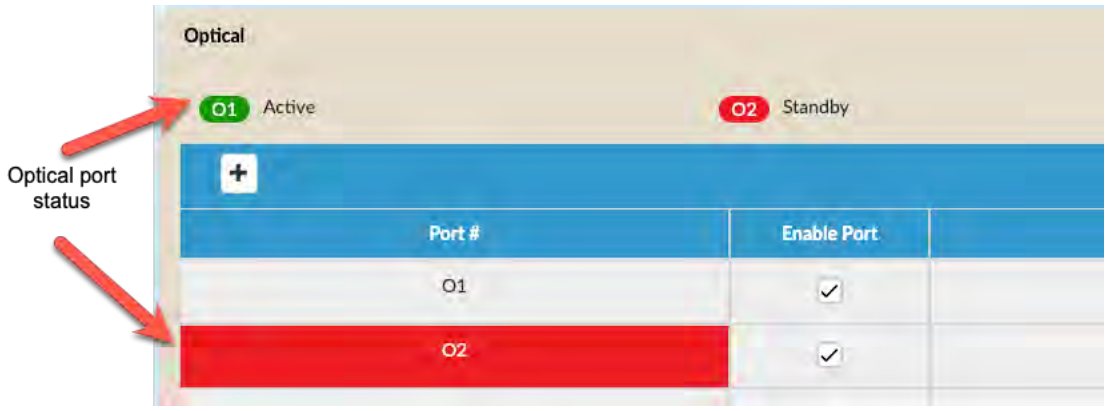


4. Confirm the band module is hidden by selecting **Info** ☰.

11.3 Activating and Deactivating Optical Ports

When you activate an optical port, you turn on SFP lasers so that the digital data stream can pass over the optical link.

Optical port status appears as colored indicators and highlighted **Port #** field. More about optical status.



TIP The difference between Standby and No Link is the following:

- Optical Standby: Optical port has been deactivated due to user request or critical alarm.
- Optical No Link: Optical port is unable to send signal to a downstream remote or receive signal from an upstream master unit.

✦ To activate or deactivate an optical port

1. Select the master unit, distribution unit, or remote in the system tree, and on the Optical panel, select **Settings** ⚙.
2. If the optical port is not enabled, select **Enable Port**. Only enabled ports can be activated.
3. Select **Active** to activate or uncheck to deactivate an optical port.

You cannot deactivate optical port O1 on a remote because it provides the only digital path to an upstream master unit or other remote.

✦ **If an optical port can't activate**

The optical port changes to **Failed** or **No Link**.

Failed

- There is a problem with the SFP associated with the optical port.
- Deactivate the optical port and try to activate. If the Failed status persists, contact Customer Service.

No Link

- There is a problem with the fiber between units, or band modules or SFPs have been deactivated to prevent damaging optical signals from being passed over the fiber.
- Repair the fiber, following all safety procedures.

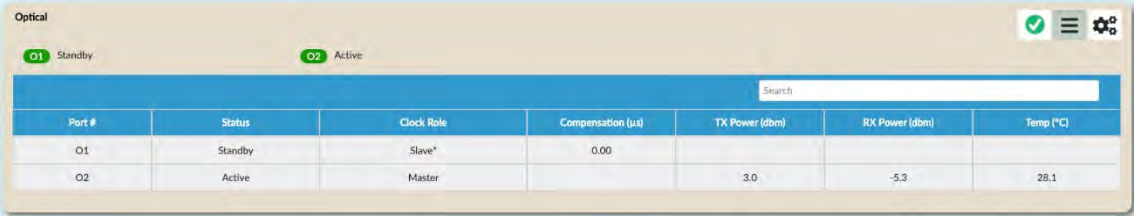
Verifying Optical Link Status

When commissioning the system, verify that all the optical ports are Active.

✦ **To verify the status of optical ports**

1. Select a master unit, distribution unit, or remote in the system tree, and on the Optical panel, select **Info** ☰.
2. For each optical port:

- Verify all optical ports in use are **Active**.
- If the port displays a status that is not **Active**, verify that the SFP is installed correctly.
- Deactivate any unused optical ports.



11.4 Monitoring Alarms

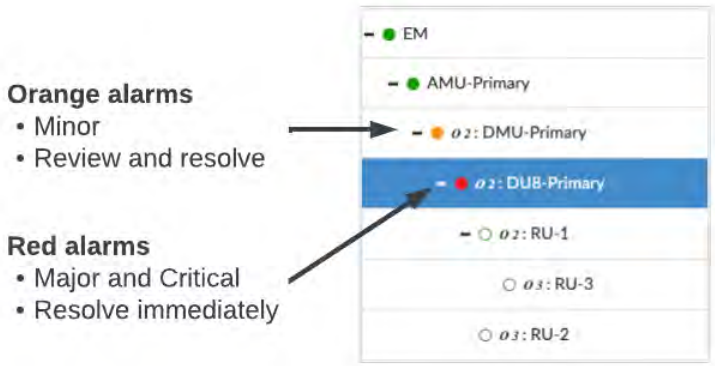
There are two ways of monitoring alarms in the VL-Series:

- Use the element manager software to display Active alarms for master units, remotes, band modules, and optical ports
- Use SNMP and integrate with a third party network management system (NMS). For information on downloading the Avari MIB, contact Avari Customer Service.

Displaying Alarms

The system tree is your first indicator of units, band modules or optical ports reporting alarms.

- Critical and Major: red
- Minor: orange
- No alarm: green



To display detailed alarm information, select a device on the system tree, and then select the alarm icon or on the Unit, Optical, Bands, or Signals panel.

Alarm Types

There are three categories of alarms: Critical, Major, and Minor.

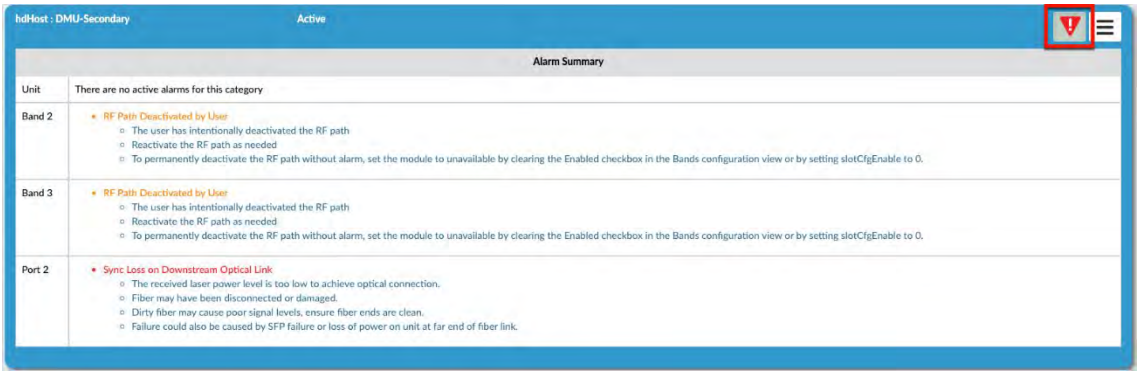
For Major and Critical alarms, you should address the root cause of the issue immediately. For Minor alarms, the system can continue operating without loss of service. However, these alarms can escalate to Critical if left unaddressed.

Alarm Color	Alarm Icon	Alarm State	Description
Red vibrating		Critical	Any service-affecting failure. A site visit may be required. On the physical device, the LED is red flashing.
Red		Major	A failure condition that is not service-affecting but must be addressed. Major alarms can escalate to critical if not resolved.
Orange		Minor	Warnings for planned outages or minor failures that don't prevent continued operation. For example, Input path ALC Active.
Green		No alarm	No alarm.

For a list of all alarms, see Appendix, Alarms.

Unit Alarms

For a list of alarms reported by the master unit, remote or distribution unit, select the alarm icon on the blue unit panel.

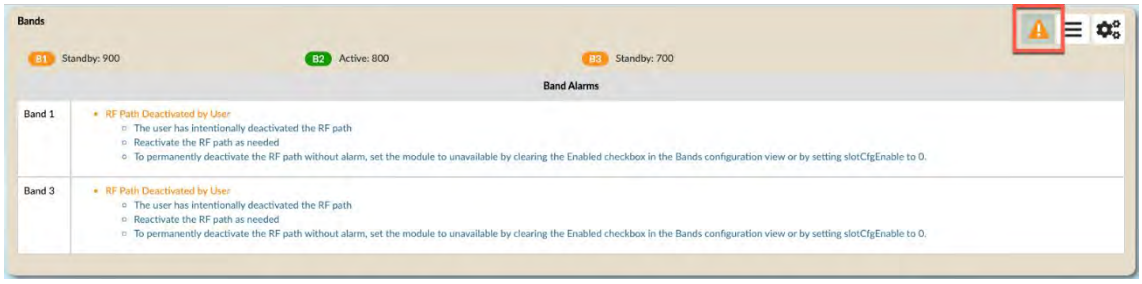


Optical Alarms

To display alarms for optical ports, select the alarm icon on the Optical panel of a master unit, distribution unit, or remote.

Band Alarms

To display alarms for band modules, select the alarm icon in the Bands panel of a master unit or remote.

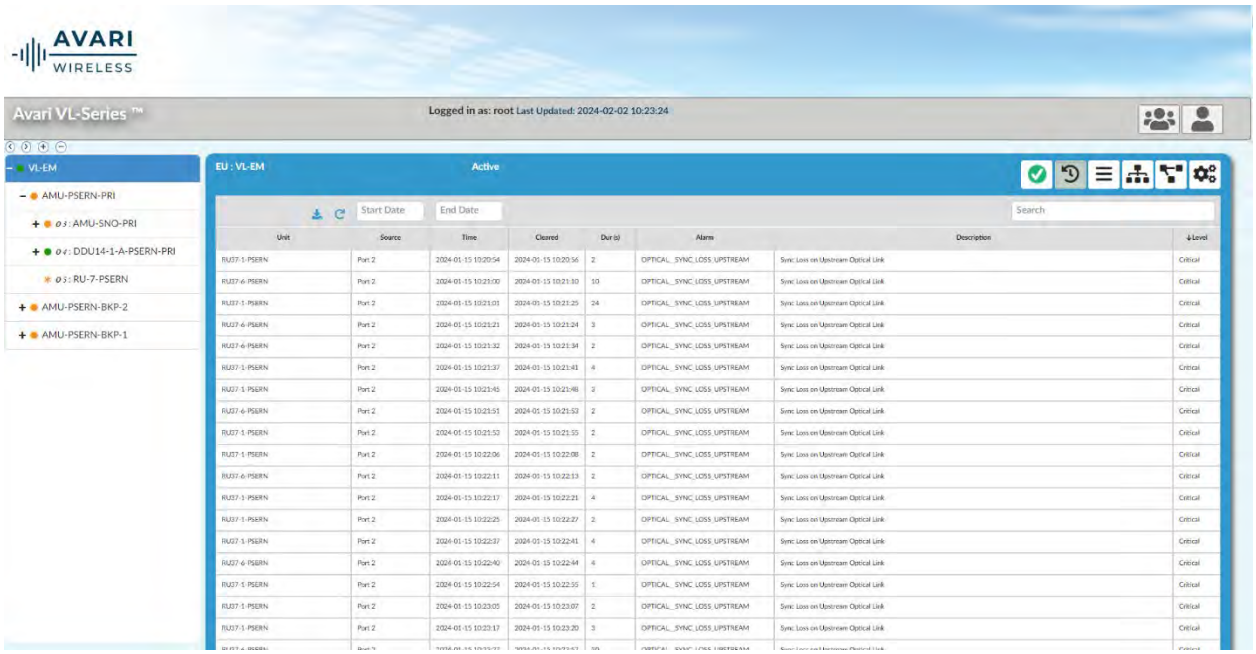


Clearing Alarms

Major and Minor alarms are cleared automatically when the alarm condition is resolved. Critical alarms require a user action to clear, such as re-activating an RF module or acknowledging a missing unit.

11.5 Alarm History

The Alarm History feature of the Element Manager software allows you to check for the most critical errors to prioritize your workflow. During system maintenance, you can investigate the units that fail most often.



The interface allows sorting by the level of alarm severity. This allows you to check for error repetition. From this view, you can monitor the system for optical sync loss, power outages, or failing components.

The Alarm History feature is available for the Element Manager software version 5.8+. The Alarm History shows alarms for each unit under the entire system tree.

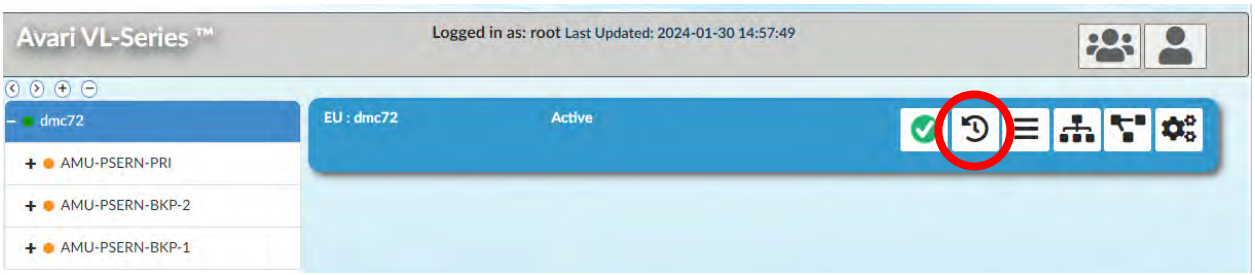
Browser Support

Chrome is the recommended browser for Avari Wireless Element Manager Software version 5.8 and above.

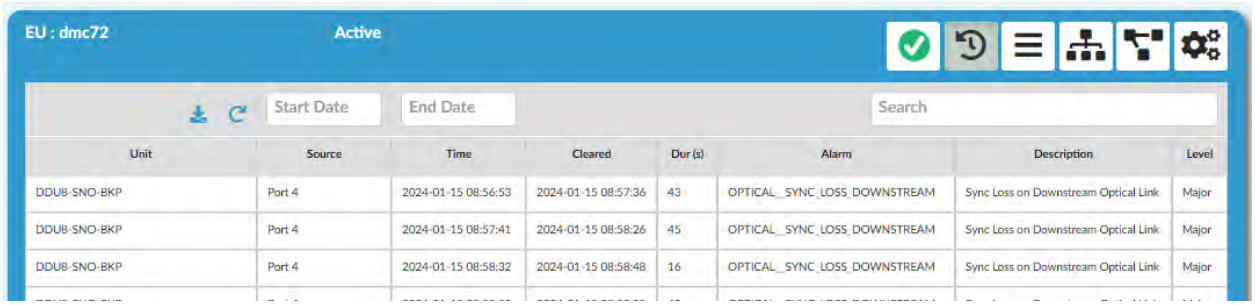
To check which version of Element Manager software your system has, follow the steps under Section 7.1 Element Manager.

Displaying the Alarm History

To display the Alarm History in the Element Manager software, click on the Element Manager in the system tree left-hand menu. Then click on the **History** icon in the blue Unit Panel.

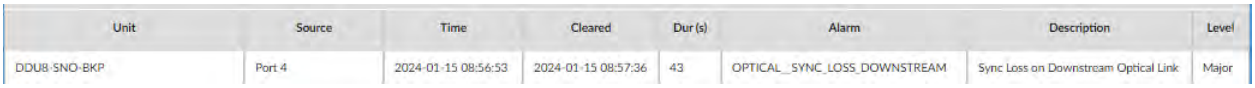


Up to 5000 alerts are displayed in the web browser. You can search the alerts from the Search box by their identifier, or in the "Start Date" and “End Date" fields. You can also sort the alerts by column. To refresh the list of alerts, click the **Reload** icon.



Sorting Alarm History

In the screenshot, each column (**Unit** identifier, alarm **Source**, **Time** generated, time **Cleared**, **Duration** of the alert (in seconds), **Alarm** identifier, alarm **Description**, and severity **Level**) can be sorted on by ascending or descending order.



This feature allows you to examine alarm priority by sorting on the **Level** of alarm severity.

To examine which units of the Element Manager could be faulty, sort on the **Unit** identifier.

Downloading Alarm History

The Alarm History feature also allows you to download the errors to a spreadsheet for further examination and record-keeping.

To download the alarm history list as CSV file, click on the **Download** icon. You can then sort the alarms by multiple columns in a spreadsheet.

11.6 Monitoring System Health

Optical Links

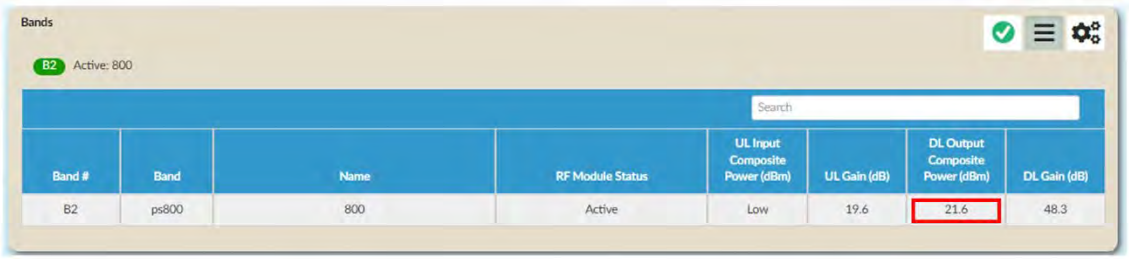
To check the optical losses on each Active unit, open the Optical panel and select **Info** ☰.

Weak **Rx Power** implies higher losses. Optical losses that are higher than average are potential causes for concern.

Composite DL Signal Levels

To check DL signal levels, open the Bands panel and look at **DL Output Composite Power**.

In this example, the downlink composite power is 21.6 dBm which is within acceptable output levels.



Channel Power

To check channel power, open the Signals panel and look at **DL Output Power**.

11.7 Managing Missing Units, Band Modules, and Optical Ports

If a master unit, distribution unit, or remote is removed from the system, or stops communicating with the element manager software, the unit's status changes to **Missing**. The blue panel cannot be expanded and a Critical alarm is raised.

System Tree

Sometimes an installed device does not appear in the system tree.

- Wait 6 to 10 seconds for the system tree to refresh.
- Check all cable connections and power, then refresh your browser or wait for the system tree to update.
- If a unit still does not appear in the tree, disconnect and re-install the unit.

Master Units

For missing master units, the unit panel is not available. Contact Avari Customer Service.

Remotes

For missing remotes, the unit panel is not available. However, you can reactivate the optical port on the master unit or distribution unit that the remote is connected to.

✦ **To reactivate the optical port on the master or distribution unit:**

1. Select the master unit or distribution unit on the system tree.
2. On the Optical panel, select **Settings** ⚙.
3. If the port connected to the remote appears to be Active, uncheck **Active** to place remote in Standby.
4. Select **Active** again to reactivate the port. (from ☑ to ☐ , and then back to ☑).

Learn more about placing RF Modules or Optical Ports in Standby.

Band Modules

When a band module no longer communicates with the element manager, the band module's status changes to **Missing**.

To re-establish connection to the element manager, deactivate the band module and then activate it again.

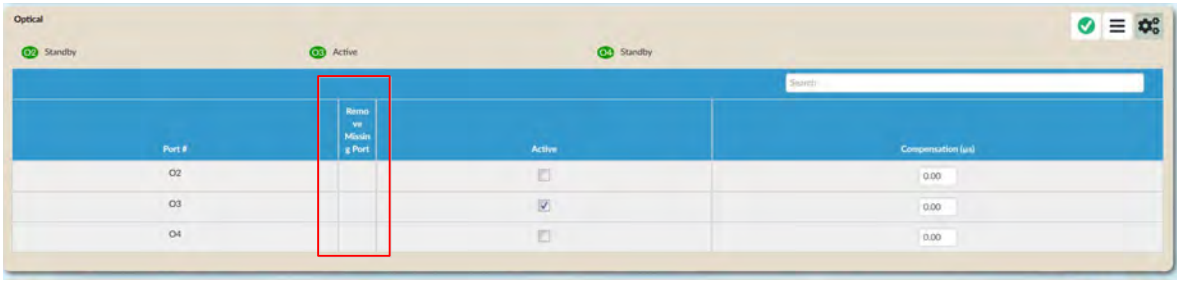
To do this, select the master unit or remote on the system tree. On the Bands panel, select **Settings** ⚙. Clear the **Active** checkbox for the missing band to place it in Standby. Then select Active again to reactivate (from ☑ to ☐ and then back to ☑).

If a band module is missing because of maintance activities, you can also disable (or hide) the band module. Uncheck **Enable** to hide the module and its associated alarms in the element manager. RF Modules in **Standby** and **Failed** states can also be disabled.

Optical Ports or SFPs

Optical ports or SFPs that are not responding also change status to **Missing** and cause a Critical alarm.

To clear a missing optical port alarm, click **Remove Missing Port**.



11.8 Equipment Maintenance

The VL-Series is designed to be maintenance free with no end-user replaceable components, such as fans.

Active RF equipment is housed in NEMA4 rated enclosures as per NFPA requirement.

Checking Equipment LEDs

You can check the health of the Active devices by looking at the following two external LEDs.

- PWR LED should be Green
- ALM LED should be Green under normal operations.

When both PWR LED and ALM LED are Green, the equipment is actively transmitting without problems. When ALM LED is amber or red, it means minor and major faults are detected respectively. When ALM LED on a

remote is flashing red, the most common cause is disconnection or damage to an upstream fiber, or manual deactivation of an optical port.

Make sure fiber connectors are securely locked in place, and that the upstream optical port is not de-activated.

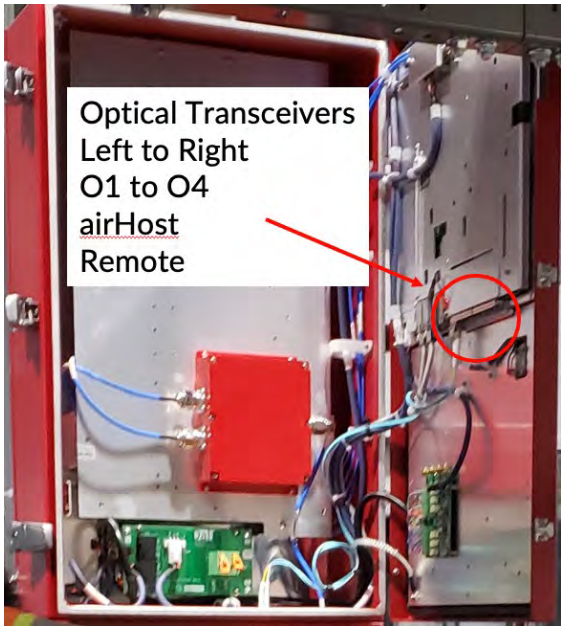
Servicing SFP Optical Transceivers

SFP optical transceivers can sometimes fail, although this is rare. If an SFP fails, you can expect the following alarms:

- Optical Sync Loss Alarms
- Optical Failure (No Link)
- Intermittent Alarms (Failure and Sync Loss Alarms)

Replacing SFPs

You can replace SFPs in the VL-AMU master unit and VL-RU remotes. Open the chassis door on the unit and locate the SFP connectors.



NOTE You cannot replace SFPs in the VL-DMU or VL-DU because the SFPs are internal to the unit.

Common Optical and RF Issues

Optical Sync Loss / No Link Alarms

- Often caused by unclean fiber connections. Clean fiber connectors following safe fiber cleaning procedures.
- SFP is faulty. Replace SFP or clean the SFP connector.
- High reflectance connections. The distribution and remote may not show any connectivity issues.

VSWR Alarms

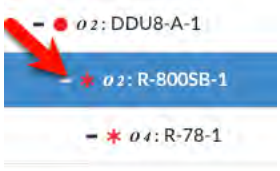
- RF connections with poor mismatch.
- Check all loose connections.
- Ensure RF cables do not exceed minimum bend radius.

Replacing Faulty Devices

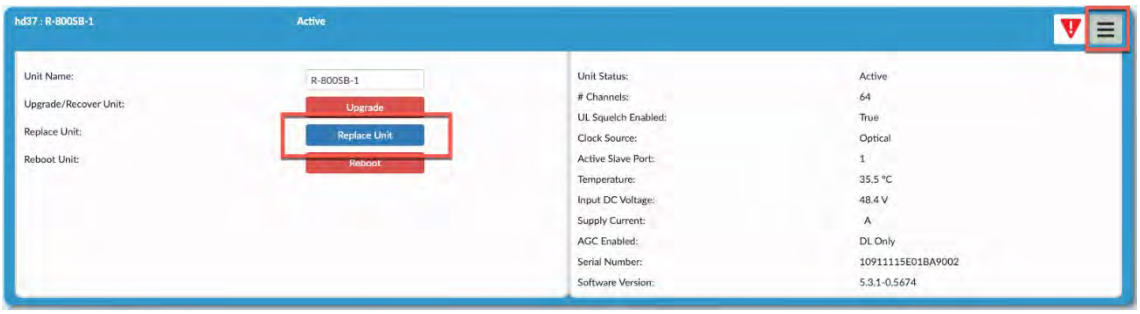
If a remote is faulty, you can replace the unit. Sometimes, the unit is reporting a Major alarm but can still communicate with the element manager. Or, the remote has lost communications with the element manager and is flagged as **Missing**.

✦ **To replace a remote that has a Major alarm but is still communicating with the element manager software.**

1. Select the remote in the system tree.



2. Click the blue unit panel to open it, and then select **Replace Unit**.



3. Enter the MAC address and serial number of the replacement unit.

4. Turn on the new remote and wait while the device completes the startup sequence.

5. Select **Submit**.

✦ **To replace a missing remote that is not communicating with the element manager**

1. Select the remote in the system tree. The unit panel tells you the remote is Missing.

2. Select **Replace**.

3. Enter the MAC address and serial number of the replacement unit.

4. Turn on the new remote and wait while the device completes the startup sequence.

5. Select **Submit**.

11.9 Backing Up and Restoring the System Configuration

You should back up the system configuration regularly and store the file in a safe location.

✦ **To back up the system configuration**

1. Log in as a system administrator and select the element manager in the system tree.

2. Click **Settings** .

3. Click **Export** to save the system configuration file to the appropriate folder on the PC.

✦ **To restore the system configuration using a backup file**

1. Log in as a system administrator and select the element manager in the system tree.

2. Click **Settings** .

3. Click **Import**, select the backup file from the appropriate folder, and click **OK**.

4. Select **Overwrite All Per Channel Attenuations**, and then click **Apply**.
5. Wait while the element manager re-applies the configuration to all units in the network. There will be a system outage during this period.

12 Headend Redundancy and Failover

What's inside this chapter:

12.1 How Failover Works

The VL-Series supports headend redundancy and automatic failover between the VL-DMU and VL-AMU master units.

Each VL-RU remote is equipped with dual fiber: one fiber connects to the primary master unit and the other fiber connects to the secondary, backup master unit.

During normal operation, the remote processes radio signal from the primary master unit via the primary path. If the upstream equipment fails or the fiber is disconnected, the remote switches over to use signal from secondary master unit via secondary path.

NOTE Remotes can also be equipped with an internal optical bypass switch. If an upstream remote fails, the optical bypass switch ensures the continuity of signal flow by connecting the fiber from the upstream device directly to the next remote in the chain. Contact Avari Customer Service about installation and configuration of this option.

Failover Topologies

VL-Series supports two types of failover topologies: ring failover and star failover.

Ring failover

In a ring failover topology, daisy-chained remotes are connected to a master unit at each end of the chain, creating a ring.

Instead of connecting to every remote, the primary master unit (or Master A) connects to the first remote in the chain, which in turn connects to the next remote, and so on. The last remote connects to the secondary master unit (or Master B).

Ring failover configurations support two modes:

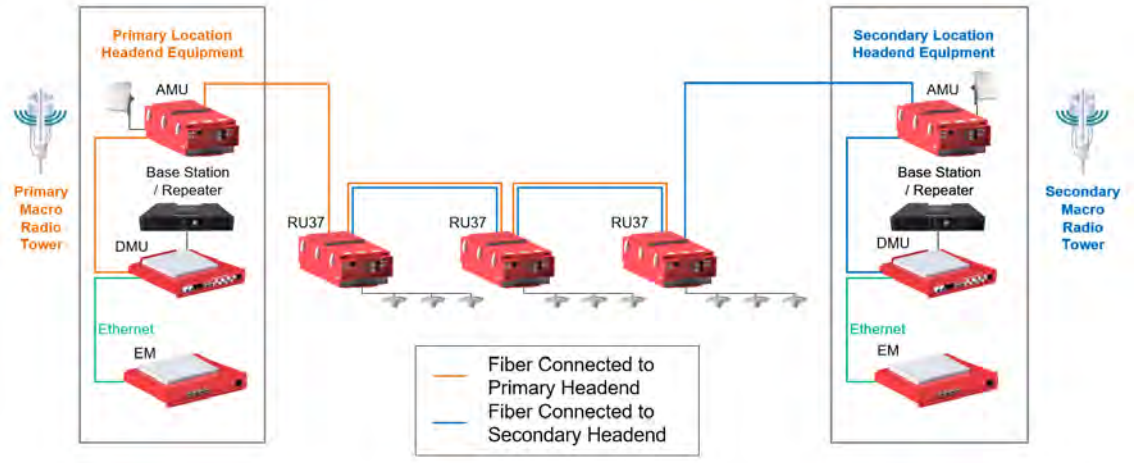
- **Active/Backup** – Master A is Active and Master B is backup

- **Load Sharing** – Both Master A and Master B are in use at the same time; each master unit delivers signal to specific remotes

Active/Backup mode is a configuration in that only one master unit is used at a time. The secondary master unit acts as a backup until a failover event occurs.

In Load Sharing mode, signal from both master units are in use at the same time based on how remotes are assigned to them. If a master unit fails or a fiber is cut, the remote switches to the other master unit. Learn more about assigning remotes to a master unit.

Load sharing is a more efficient use of resources because expensive equipment does not sit idle.

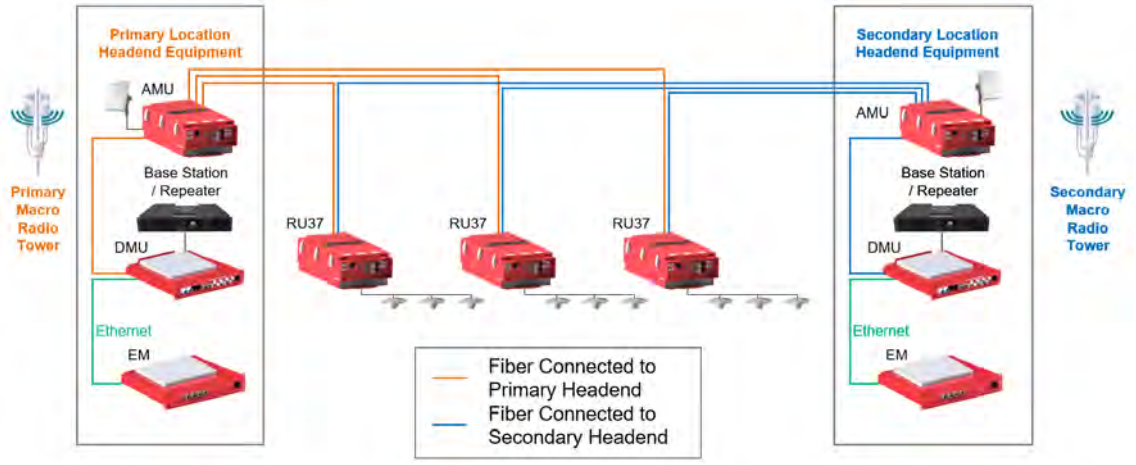


To learn more, see Failover Examples.

Star Failover

In a star failover topology, the primary master unit is mirrored by an identically configured secondary master unit. The secondary master unit is connected to a backup signal source.

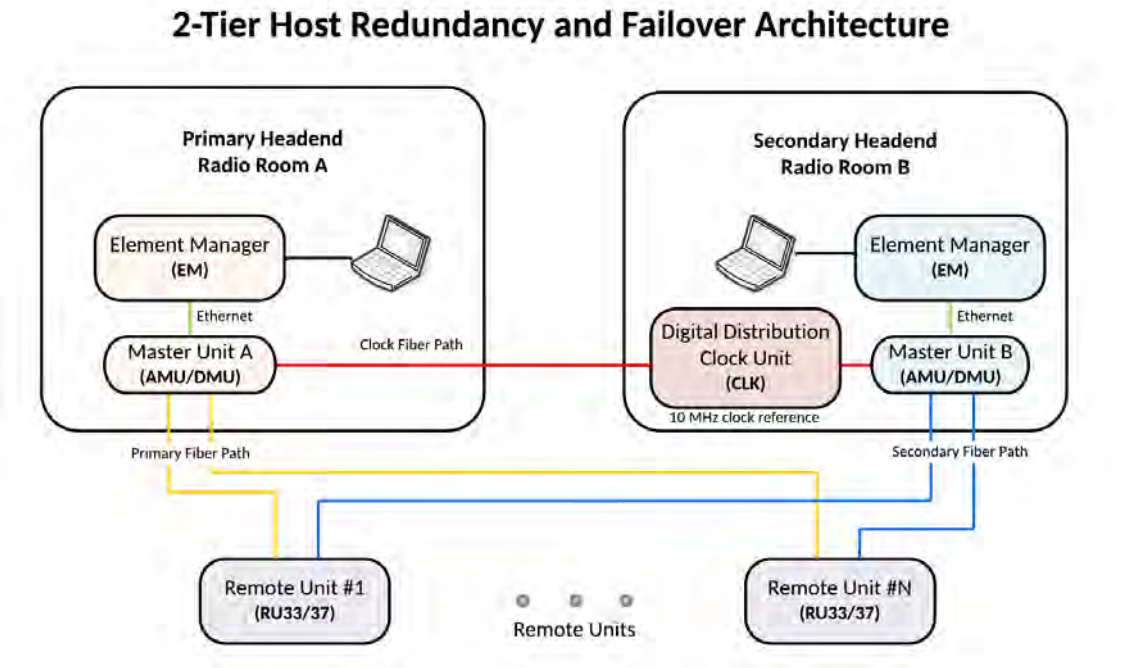
If the primary master unit fails or an optical fiber is damaged, the secondary master unit is used and the affected remotes switch over to using the secondary path signal. Note that both primary and secondary master units are always Active. The remote unit makes the decision to switch when the primary signal source is lost.



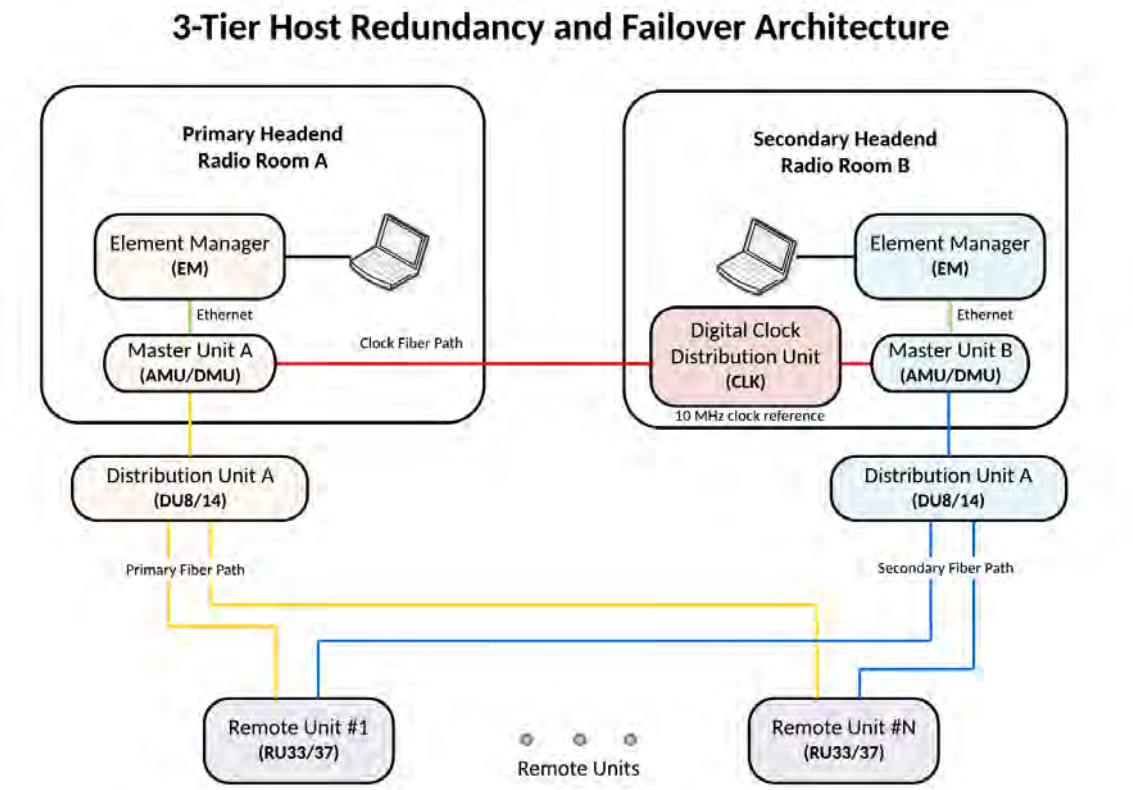
Tiered Architecture

Star failover topology supports basic and multi-tier architectures.

Basic architecture has two tiers: the headend layer and remote layer. Each remote connects to the master unit in different headend locations.



In a multi-tiered architecture, there are three tiers: the headend layer, remote layer, and distribution layer. A distribution unit between the master unit and remotes expands the number of optical ports available. By connecting to a single optical port on the master unit, the distribution unit lets you add up to 13 additional remotes.

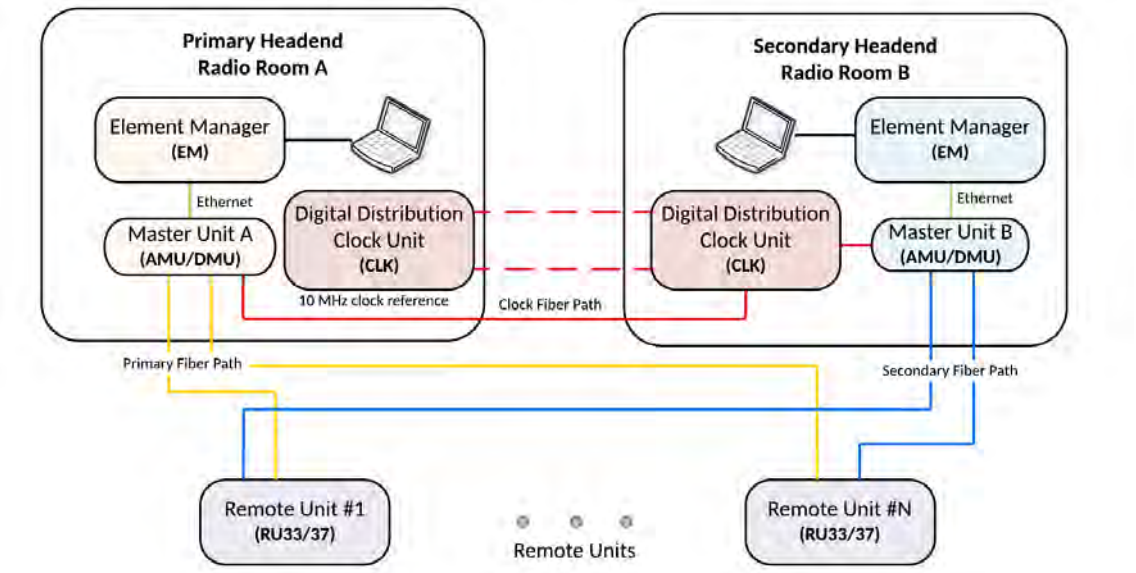


12.2 Shared Clock Reference Requirements

Master units in a redundant system must be synchronized with the same 10 MHz clock reference.

The VL-CLK clock distribution unit is used to synchronize the master units in different headend locations using single mode fiber. It has a built-in 10 MHz clock reference that does not require any external GPS signal source. The clock reference signal is distributed over fiber.

The configuration of the clock reference is automatic and managed by the element manager software.



12.3 Redundant Configurations in the System Tree

Redundant configurations appear in the system tree as two tree structures.

- Remotes on each tree are identical because they are dual fiber fed.
- In ring topology, the remotes appear in reverse order in the bottom tree.
- ✱ indicates the Active path that is processing signal from the primary or Active master unit.
- ○ indicates the secondary path that it is not processing signal from the secondary or backup master unit.

For example, this system tree displays a ring failover configuration using load sharing mode.

The top tree shows six daisy-chained remotes: RU-1, RU-2, RU-3 are processing signal from Master 1. The bottom tree shows six remotes ordered in reverse: RU-4, RU-5 and RU-6 are processing signal from master unit 2.

The remotes carrying signal are indicated with a ✱. The backup remotes are indicted with ○.

12.4 Resetting Remotes After Failover

After a failover has occurred, examine, repair or replace damaged equipment or fiber as needed.

To prevent ping-ponging between master units, the system does not automatically fail back to the primary master unit after a failover event.

Once you've repaired or replaced the equipment, restore the system manually to the original default failover settings.

✦ **To reset remotes to failover defaults**

1. Log in as system administrator.
2. Select the element manager in the system tree, and then select **Info** ☰.

3. Select **Initiate Failover**.
4. Wait while the element manager restores the remotes to their default master unit connection.

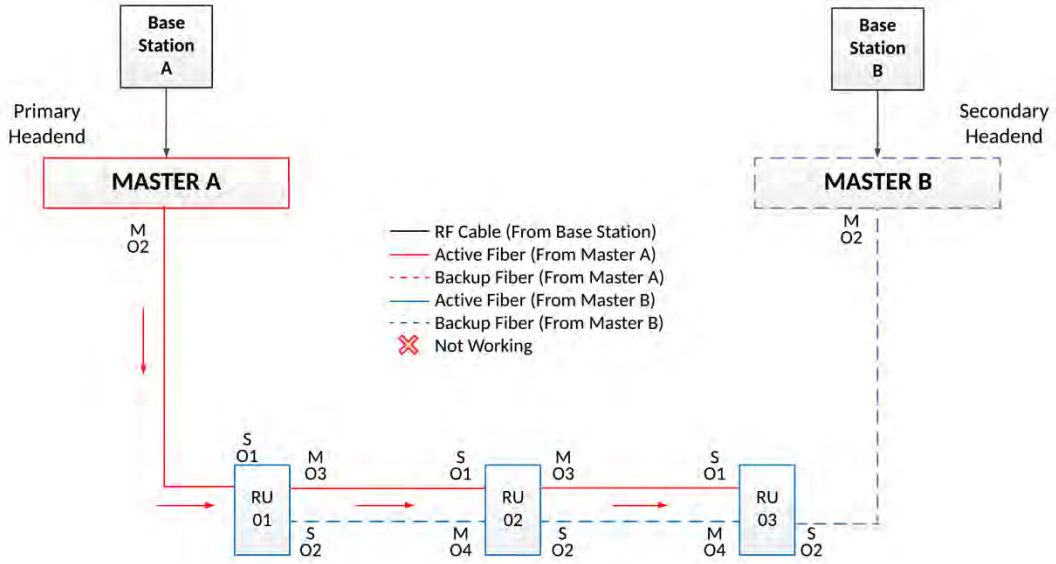
12.5 Failover Examples

The following examples demonstrate how master units behave during failover.

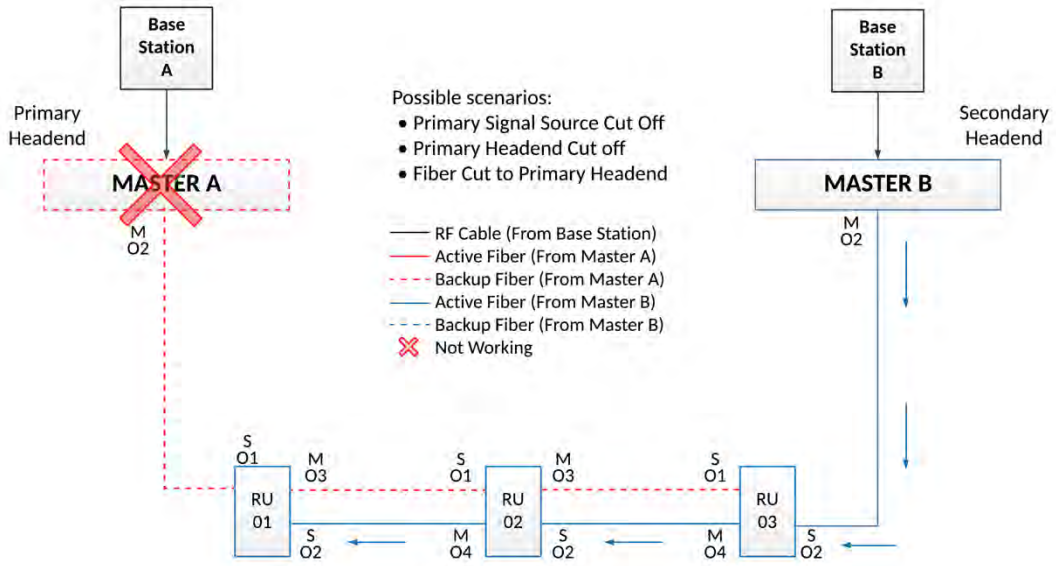
Ring Failover

The primary master unit (Master A) fails

The primary and secondary master units are in Active/Backup mode. The primary master unit (Master A) is normally Active, delivering signal to and from remotes RU-1, RU-2 and RU-3 over the Active fiber (shown in red). This is the primary path. The secondary master unit (Master B) is also Active but acts as a backup while also connected to all three remotes. The non-Active fiber (shown in blue) is known as the secondary path.



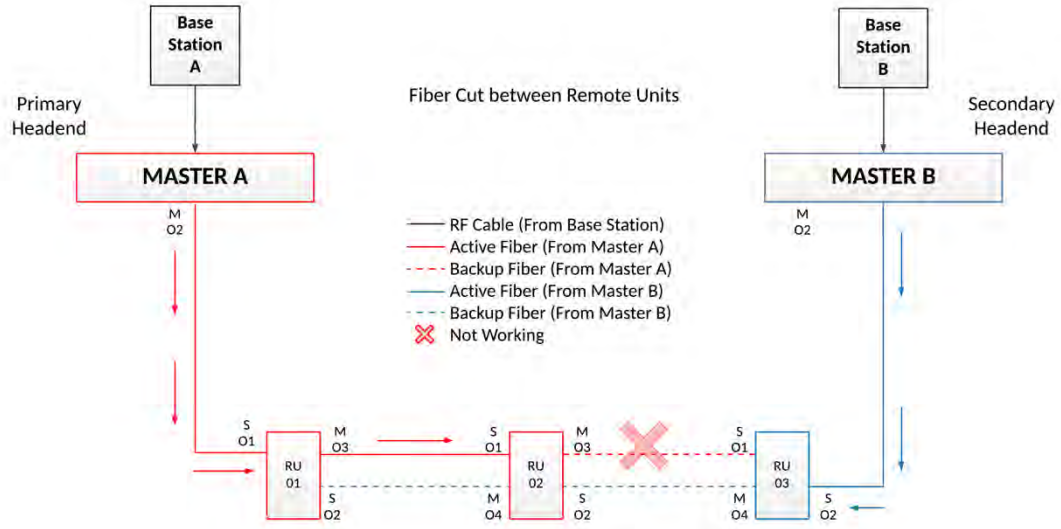
If the Master A fails, the primary path between Master A and all the remotes becomes the backup, secondary path (shown in red and dashed). Master B becomes the primary master unit and the remotes switch over internally to use signal from the Master B (shown in blue).



The optical fiber to the remote is cut or damaged

The primary and secondary master units are in Active/Backup mode. Master A is delivering the signal to the remotes on the primary path (shown in red).

If the fiber is cut between RU-2 and RU-3, remote RU-3 internally switches over to use signal from Master B. RU-1 and RU-2 are unaffected and continue using Master A.

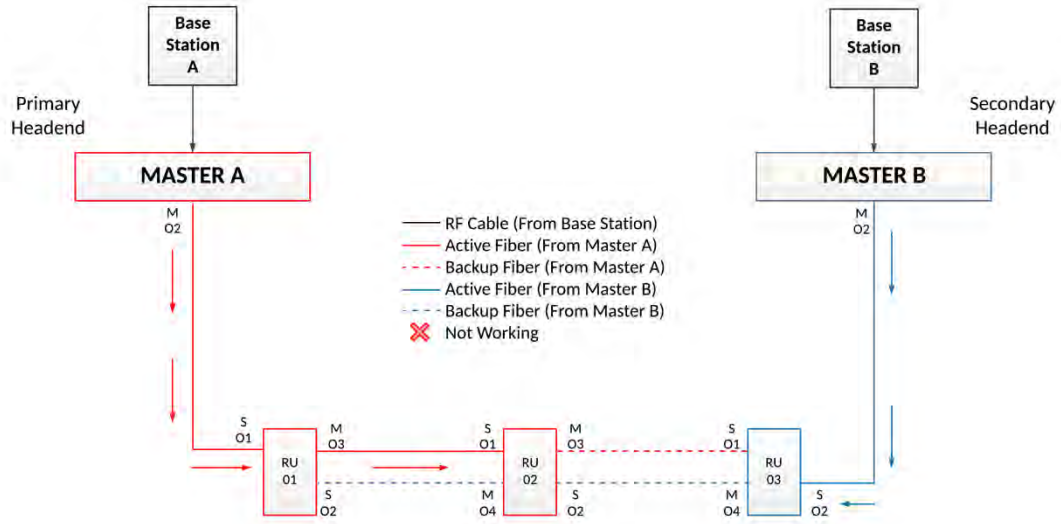


Load Sharing Mode

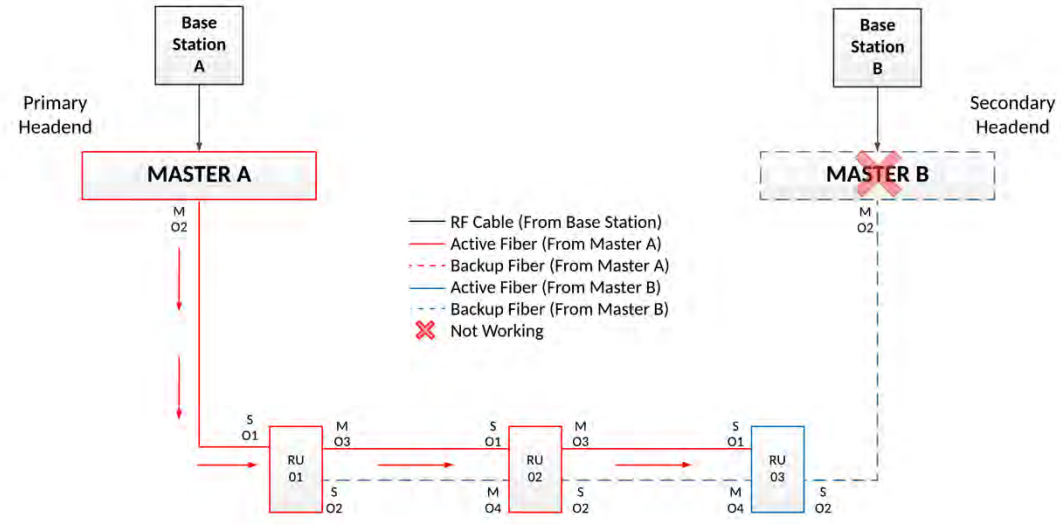
The secondary master unit (Host B) fails

The primary and secondary master units are in Load Sharing mode. This means that Master A and Master B are sending signal to the remotes assigned to them. In this case, RU-1 and RU-2 are assigned to receive signal from Master A, (shown in red). and RU-3 is assigned to Master B (shown in blue).

Note that while two fiber paths connect remotes to each other, only one fiber is the primary path at a time. The backup fiber is the secondary path.



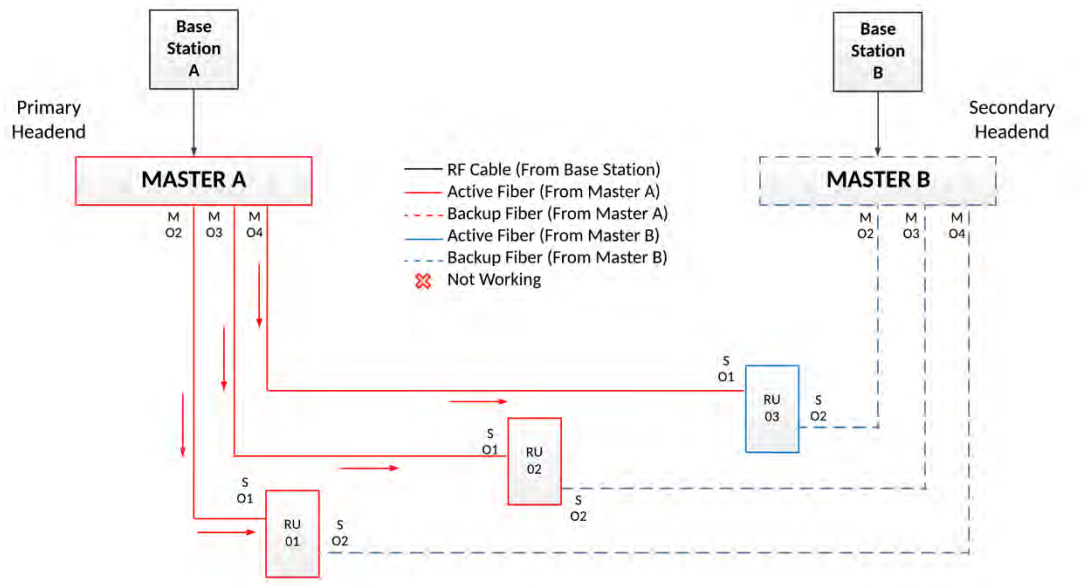
If the Master B fails, the fiber connected to RU-3 becomes the backup signal path (shown in blue and dashed). RU-3 internally switches over to using the signal from Master A (shown in red). RU-1 and RU-2 are unaffected because they are assigned to Master A, which did not suffer a service issue.



Star Failover

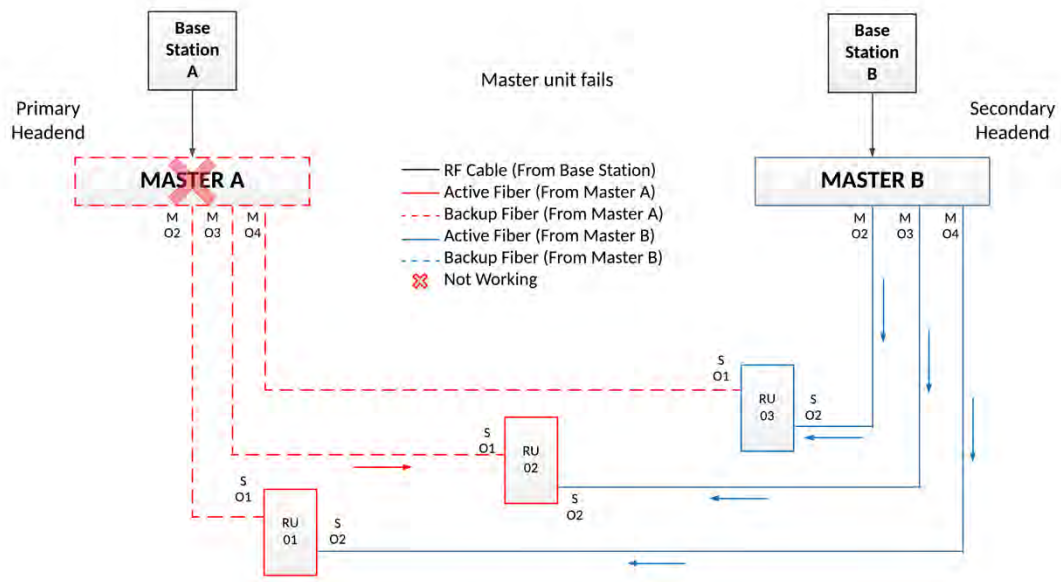
The primary master unit (Master A) fails

The primary and secondary master units are in Active/Backup mode, meaning Master A is the only master unit providing signal to all three remotes. The fiber connecting Master A to the remotes is the primary path (shown in red). Master B is the backup unit. Fiber connecting Master B to the remotes is the secondary path (shown in blue and dashed).



If Master A fails, the fiber connections to all three remotes become the backup secondary path (shown in red and dashed). And, RU-1, RU-2, and RU-3 automatically switch over to using the signal from Master B.

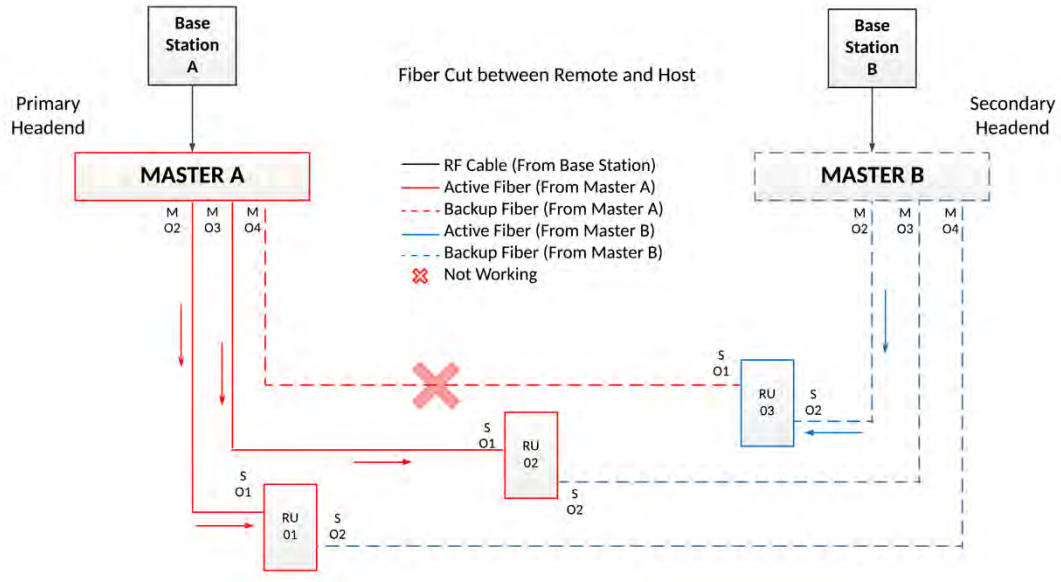
Master B goes from backup to Active, and the Master A fiber connections to the remotes become the primary path (shown in blue).



The optical fiber to the remote is cut or damaged

Fiber to a remote is cut or damaged and RU-3 can't receive signal from Master A. To maintain service without interruption, the remote internally switches to using signal from Master B (shown in blue).

RU-1 and RU-2 are unaffected and continue to use the Active path provided by fiber connected to Master A.



A. Product Specifications

- VL-Series Direct Master Unit (VL-DMU)
- VL-Series Air Master Unit 33, 37 (VL-AMU 33/37)
- VL-Series Distribution Unit 8, 14 (VL-DU 8/14)
- VL-Series Remote Unit 33, 37 (VL-RU 33/37
- VL-Series Element Manager (VL-EM)
- VL-Series Clock (VL-CLK)
- VL-Series Relay (VL-RLY)

AVARI WIRELESS

Enabling Emergency Communications Indoors

Avari® Direct Master Unit (VL-DMU™)

Headend Direct Master Unit

Avari's VL-DMU™ is a digital, intelligent, and programmable software platform that forms the headend of the DAS network. The DMU accepts the input from a public safety carrier's base stations and bi-directionally transfers public safety bands to RU 33/37 remote units. It can support up to eight independent optical fibers and transport digital signal to remote units over one of its 7 master optical links at a data rate of 10 Gbps. It also provides Ethernet backhaul at 1Gb/s for additional devices such as Wi-Fi and security cameras.

The DMU is the "core" of the system and performs a broad array of functions including digital signal processing, framing/de-framing and serializing/de-serializing, digital up/down conversion, and RF up/down conversion. Other advanced capabilities include flexible digital filtering, channelized operation for narrowband and broadband LTE applications, automatic digital gain control with squelch function, and channel re-routing as part of failover operation.

The DMU connects with Avari's RU 33/37 low and medium-power remotes in a "plug-and-play" manner. To serve additional public safety base station feeds located at different geographical locations, DMU units can be cascaded using fiber optic links over distances of up to 40km. Additional base station signals are processed and combined at the digital level; therefore, passive intermodulation (PIM) is not introduced. The aggregated content is then sent over optical fiber to the remotes.

1:1 redundancy of the DMU is achieved by deploying a secondary unit in a hot-standby mode. The intelligent software application at the remote unit can monitor the health status of the DMU and it will automatically switch to the secondary unit if failure is detected.

Features

- Supports VHF, UHF, 700, 800, and 900 bands (up to 4 bands in same chassis)
- Uses standard SFP+ format plug and play optical transceivers
- 4 or 8 x 10 Gbps optical interfaces
- 2 x 1 Gbps Ethernet interfaces
- 48 VDC or 110/240 VAC
- Can be cascaded to provide digital aggregation of signal sources from different physical locations
- Advanced digital filtering that supports both narrowband and broadband operations
- Automatic digital gain control with squelch function
- Optional headend redundancy with automatic failover and channel re-routing
- Reprogrammable software platform for easy upgrades
- Remote control and monitoring via VL-EM, NMS, and SNMP
- Local web-based management port for easy installation and maintenance
- FCC and UL certified
- Enclosure IP66/NEMA 4 compliant

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AVARI WIRELESS

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Avari® Air Master Unit (VL-AMU™33/37)

Low/Medium Power Headend Air Master Unit

Avari's VL Series Air Master Unit (VL-AMU™ 33/37) is a multi-band capable unit designed for acquiring RF signal over the air from macro public safety base stations using off-air donor antenna. The AMU 33/37 is available in 2 or 5 W of uplink output power per band. It replaces multiple traditional Off-Air Channelized BDAs.

On the downlink (DL) path it digitizes the analog RF content into a digital data stream, and then transports it to remote units over one of its 7 master optical links at a data rate of 10 Gbps.

On the uplink (UL) path the AMU receives data streams of digitized RF signals from the remotes which it then converts back to analog RF. The signals are filtered and amplified to a composite power of up to 2 or 5W per band for delivery back to the macro towers via outdoor directional antennas.

The AMU interfaces digitally with Avari's RU remote units via optical fiber in a "plug-and-play" manner. Configuration is done using the Avari® VL Series Element Manager (VL-EM™) with an intuitive graphical user interface (GUI).

To support more signal sources in multiple locations, AMU can be cascaded over fiber, and their signals processed and combined digitally to avoid introducing passive intermodulation (PIM). The aggregated content is then sent over optical fiber to the remote units. The AMU can also be cascaded with the DMU to aggregate both off-air and base station feeds.

Features

- Fully integrated and modular multi-band system
- Supports VHF, UHF, 700, 800, and 900 bands (up to 3 bands in the same chassis)
- Narrowband and LTE ready
- Channelized operation with Automatic Digital Gain Control (ADGC) and Squelch per signal and timeslot
- 1 to 8 x 10 Gbps optical interfaces
- 2 x 1 Gbps Ethernet interfaces
- Supports VL-AMU and VL-DMU cascading
- 48 VDC or 110/240 VAC
- Utilizes standard plug and play SFP+optical transceivers
- Reprogrammable software platform for easy upgrades
- Remote control and monitoring via VL-EM,NMS, and SNMP
- Dry contact alarm inputs and outputs
- Local web-based management port for easy installation and maintenance
- FCC and UL certified
- Enclosure IP66/NEMA 4 compliant

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AVARI WIRELESS

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Avari® Distribution Unit (VL-DU™)

Distribution Unit

The Avari® Distribution Unit 8/14 (VL-DU™ 8/14) is a digital distribution unit that receives digital data streams from one or more DMU / AMU 33/37 units and distributes the digital content to multiple RU 33/37 remote units. It features 8 or 14 independent optical fiber interfaces, each running at a data rate of up to 10 Gbps per wavelength.

Distribution Units can be connected in a cascading manner to expand the number of available ports.

Features

- 8 or 14 x 10 Gbps optical interfaces
- 2 x 1 Gbps Ethernet interfaces
- 48 VDC or 110/240 VAC
- Power consumption: 65 or 125 W
- Utilizes standard plug and play SFP+ optical transceivers
- Reprogrammable software platform for easy upgrades
- Remote control and monitoring via VL-EM, NMS, and SNMP
- Local web-based management port for easy installation and maintenance
- Dry contact alarm input and output
- FCC and UL certified
- Enclosure IP66/NEMA 4 compliant

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AVARI WIRELESS

Enabling Emergency Communications Indoors

Avari® Remote Unit (VL-RU™33/37)

Low/Medium Power Remote Unit

Avari's VL-RU™ 33/37 is a low/Medium-power multi-band capable remote unit. The RU 33/37 is available in 2W or 5W output power per band for up to 3 RF bands in a single chassis.

On the DL path, the RU 33/37 receives the digital data stream over fiber and converts it back to RF content. After amplification, the RF signals are delivered to the antennas for wireless coverage.

On UL path, the RU 33/37 receives the RF content from the passive antennae. The RF content is then translated to digital data stream and delivered via optical fiber to headend master unit. It also accommodates 1 Gb/s Ethernet backhaul.

The RU 33/37 can support dual optical inputs to provide fiber diversity and redundancy. In addition, it can connect to Avari's master unit at the headend in a star, daisy-chain, or hybrid star/daisy-chain configuration.

The RU 33/37 offers optical bypass kit that enables optical pass-through in a daisy-chain configuration in case remote unit fails. Built in intelligence provides automatic switchover between primary and secondary headend fiber links when equipment or fiber failure is detected.

The RU 33/37 is convection cooled which contributes to high Mean Time Between Failure (MTBF). Monitoring and control can be performed locally via the Ethernet craft ports or remotely through the Avari® VL Series Element Manager (VL-EM™).

Features

- Supports VHF, UHF, 700, 800, and 900 bands (up to 3 bands in same chassis)
- Supports redundant, dual optical feed
- Uses standard SFP+ format plug and play optical transceivers
- 1 to 4 x 10 Gbps optical interfaces
- 2 x 1 Gbps Ethernet interfaces
- 48 VDC or 110/240 VAC
- Advanced digital filtering that supports both narrowband and broadband operations
- Automatic digital gain control with squelch function
- Optional headend redundancy with automatic failover and channel re-routing
- Reprogrammable software platform for easy upgrades
- Remote control and monitoring via VL-EM, NMS, and SNMP
- Dry contact alarm inputs and outputs
- Local web-based management port for easy installation and maintenance
- FCC and UL certified
- Enclosure IP66/NEMA 4 compliant

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Enabling Emergency Communications Indoors

Avari® Element Manager (VL-EM™)

Element Manager

The Avari® Element Manager (VL-EM™) simplifies the management and control of Avari's Public Safety distributed antenna system within a single centralized unit.

The Element Manager is not only used for provisioning all network elements in the system, it also provides configuration management, alarm management and performance management functions.

Each network element is monitored and controlled by the Element Manager in real time. When faults are detected, alarms will be visible and audible via the user interface or sent using SNMP protocol to external network management systems. Intelligent rules can be pre-defined to action on detection of specific fault condition. For example, a rule can be added to cause all remote units to fail-over to secondary radio source when loss of control channel signal from primary radio source is detected.

The Element Manager can also be set up in an active / standby configuration for mission critical applications with geographic diversity, headend redundancy and automatic fail-over protection.

With a built-in web server, there is no software to install. A web-browser is all it takes to access the user-friendly graphical user interface. The intuitive web page layout allows user to perform all operation and maintenance tasks with ease.

Features

- Centralized control and management of the Avari® VL-Series products
- User-friendly browser-based web interface
- Display of 5000 historic alarm entries
- 48 VDC or 110/240 VAC
- Power consumption: 30 W
- System-wide alarm, performance, and configuration management
- Dry contact input alarm sensing and alarm reporting
- Intelligent rules engine for custom alarm treatments
- External alarm reporting via SNMP
- FCC and UL certified
- Enclosure IP66/NEMA 4 compliant

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AVARI WIRELESS

Enabling Emergency Communications Indoors

Avari® Clock (VL-CLK™)

Digital Clock Distribution Unit

Avari's Clock (VL-CLK™) is a digital clock distribution unit that has a built-in 10MHz clock reference signal. It is used to feed the same clock reference signal to two separate DMU / AMU units over fiber in a redundant head-end configuration. For automatic fail-over protection to work, the 2 master units at the headend locations must be synchronized with the same clock reference.

The CLK is typically installed at one of the two headend locations. A total of 2 strands of fiber is required from the CLK location to the MUs in each headend location. Customers have the option to purchase a backup CLK unit for protecting the reference clock. In such a configuration, optical bypass switches are used to ensure continuous operation when the primary clock reference unit fails.

Features

- 4 x 10 Gbps optical interfaces
- 2 x 1 Gbps Ethernet interfaces
- 48 VDC or 110/240 VAC
- Power consumption: 65 W
- Utilizes standard plug and play SFP+ optical transceivers
- Dry contact alarm input and output
- FCC and UL certified
- Enclosure IP66/NEMA 4 compliant

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AVARI WIRELESS

Enabling Emergency Communications Indoors

Avari® Relay Unit (VL-RLY™)

Relay Unit

Avari's Relay (VL-RLY™) is an optional network element that extends Avari® Wireless 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

- 1 x 1 Gbps Ethernet interface
- 48 VDC or 110/240 VAC
- Power consumption: 65 W
- Dry contact alarm input and output
- FCC and UL certified
- Enclosure IP66/NEMA 4 compliant

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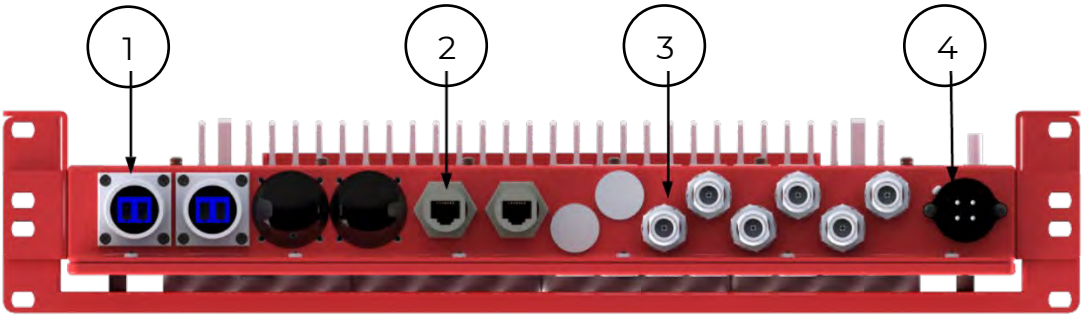
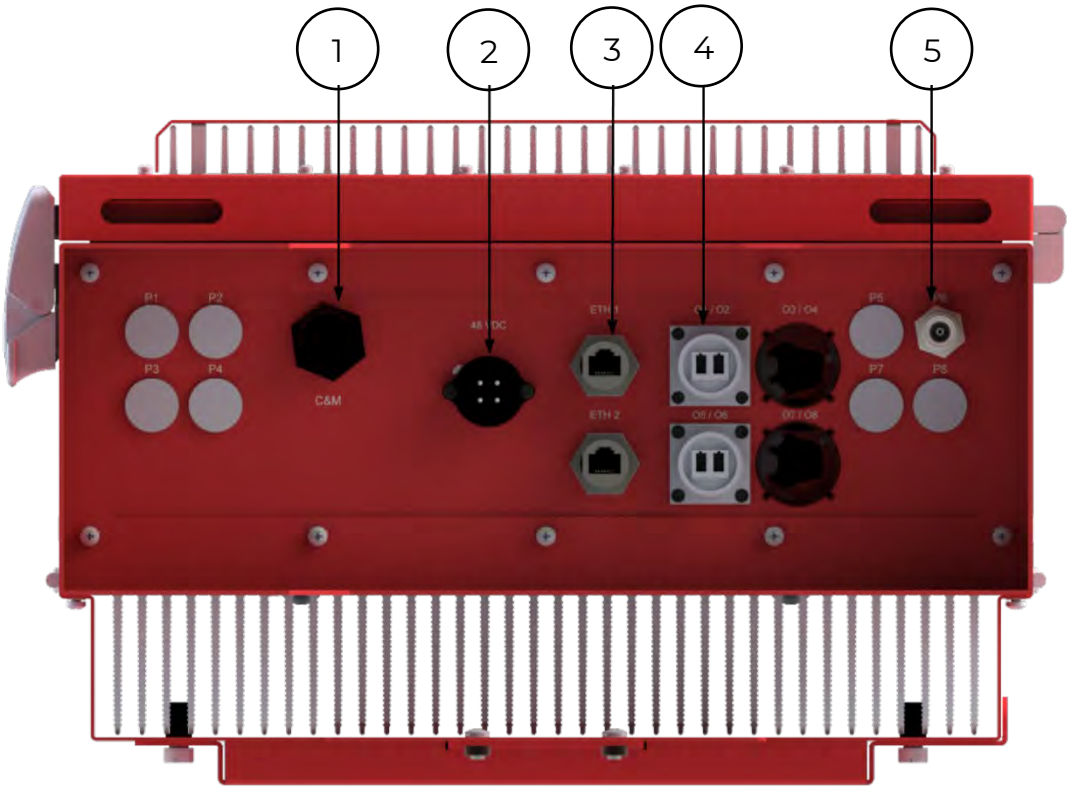
B. External Interfaces

VL-DMU



#	Label	Interface	Description
1	O1 to O8	LC/UPC Duplex	Dual LC/UPC optical ports for single mode fiber up to 8 optical ports available
2	ETH1, ETH2	RJ-45	2 x 1 Gbps Ethernet interfaces
3	P1 to P8	N-type	Maximum 8 simplex RF interfaces. The number of RF interfaces depends on the band configuration of the unit
4	Power	3-pin AC or 4-pin DC power interface	48 VDC input power for DC version equipment. Internal AC/DC power adapter for AC version equipment.

VL-AMU 33/37

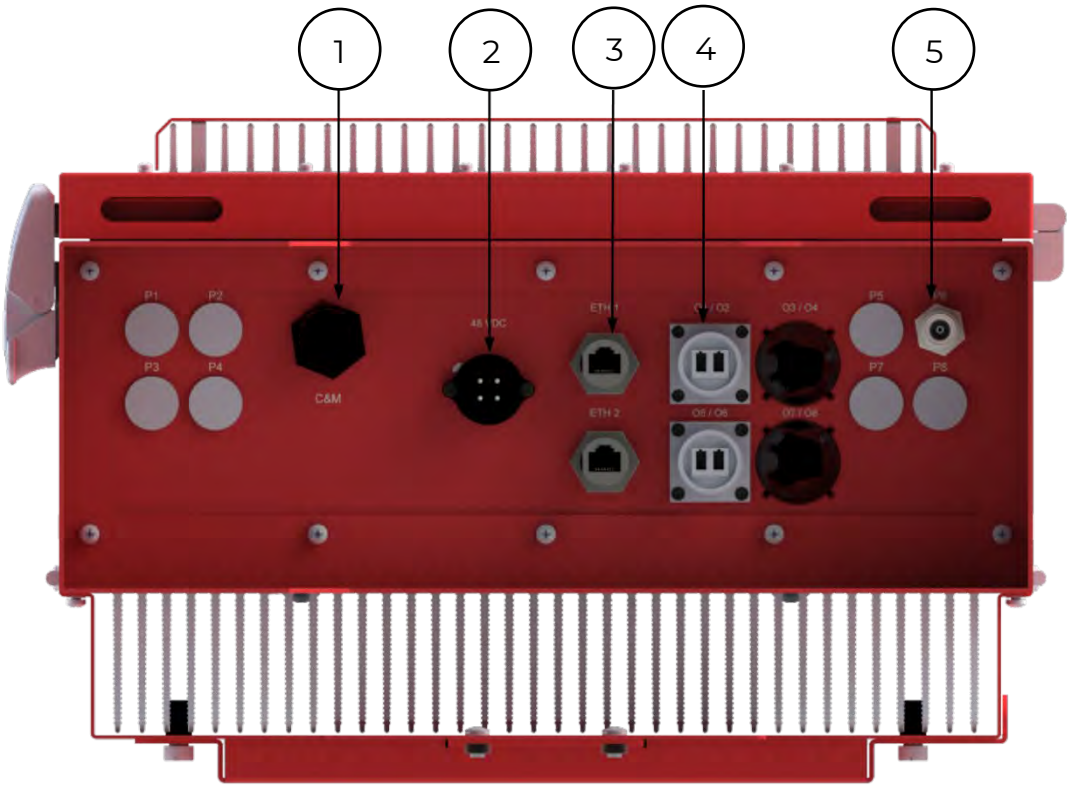


#	Label	Interface	Description
1	C&M	Dry Contact	Not supported. Contact Avari Customer Service
2	48 VDC	Open Wire	48 VDC input power for DC version equipment. External AC/DC power adapter for AC version equipment.
3	ETH1, ETH2	RJ-45	2 x 1 Gbps Ethernet interfaces
4	O1 to O8	LC/UPC Duplex	Up to 8 dual LC/UPC optical ports for single mode fiber
5	P1 to P8	N-type	Maximum 8 simplex RF interfaces. The number of RF interfaces depends on the band configuration of the unit

VL-DU 8/14

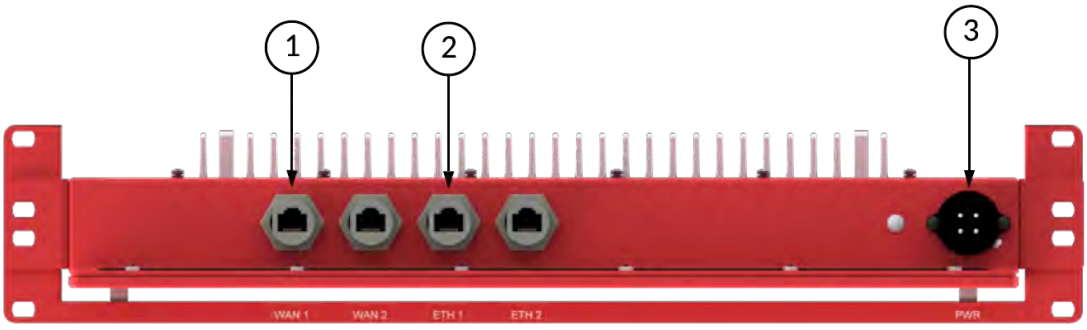
#	Label	Interface	Description
1	O1 to O14	LC/UPC Duplex	8 or 14 x 10 Gbps optical interfaces for single mode fiber
2	ETH1, ETH2	RJ-45	2 x 1 Gbps Ethernet interfaces
3	Power	3-pin AC or 4-pin DC power interface	48 VDC input power for DC version equipment. Internal AC/DC power adapter for AC version equipment.

VL-RU 33/37



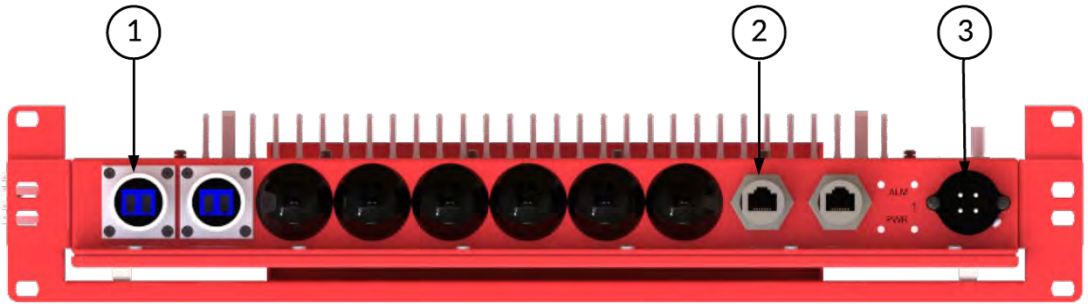
#	Label	Interface	Description
1	C&M	Dry Contact	Not supported. Contact Avari Customer Service
2	48 VDC	Open wire	48 VDC input power for DC version equipment. External AC/DC power adapter for AC version equipment.
3	ETH1, ETH2	RJ-45	2 x 1 Gbps Ethernet interfaces
4	O1 to O8	LC/UPC Duplex	Up to 8 dual LC/UPC optical ports for single mode fiber
5	P1 to P8	N-type	Up to 8 simplex RF interfaces depending on the band configuration of the unit

VL-EM



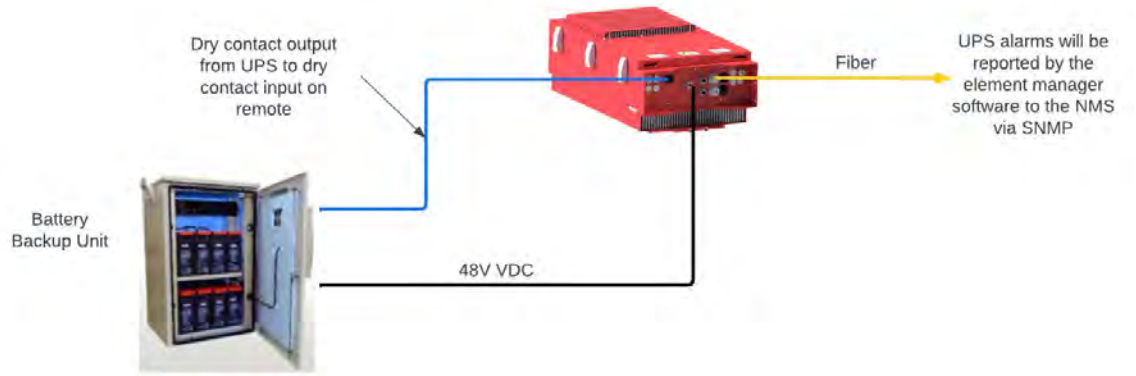
#	Label	Interface	Description
1	WAN1, WAN2	RJ-45	Ethernet ports for connecting to the external customer IP network
2	ETH1, ETH2	RJ-45	2 x 1 Gbps Ethernet interfaces
3	Power	3-pin AC or 4-pin DC power interface	48 VDC input power for DC version equipment. Internal AC/DC power adapter for AC version equipment.

VL-CLK



#	Label	Interface	Description
1	O1 to O4	LC/UPC Duplex	4 x 10 Gbps optical ports for single mode fiber
2	ETH1, ETH2	RJ-45	2 x 1 Gbps Ethernet interfaces
3	Power	3-pin AC or 4-pin DC power interface	48 VDC input power for DC version equipment. Internal AC/DC power adapter for AC version equipment.

Battery Backup Unit



#		Alarm Input	
19	Orange	Input 1	Loss of AC Power
20	Orange/White	Input 1 Return	
21	Red	Input 2	Failure of battery charger
22	Red/White	Input 2 Return	
23	Green	Input 3	Low battery capacity (70% reduction)
24	Green/White	Input 3 Return	

C. Power Consumption

VL-DMU

Unit	Voltage	Maximum Power
VL-DMU with 1 RF module	48 VDC	80 W
VL-DMU with 2 RF modules	48 VDC	90 W
VL-DMU with 3 RF modules	48 VDC	100 W
VL-DMU with 4 RF modules	48 VDC	110 W

VL-AMU 33/37

Unit	Voltage	Thermal Load	Max Power
VL-AMU 33W with 2 RF modules	48 VDC	477 BTU/hr	200 W
VL-AMU 37W with 1 RF module	48 VDC	545 BTU/hr	160W
VL-AMU 37W with 2 RF modules	48 VDC	904 BTU/hr	265 W
VL-AMU 37W with 3 RF modules	48 VDC	1160 BTU/hr	340 W

VL-DU 8/14

Unit	Voltage	Maximum Power
VL-DU with 8 optical ports	48 VDC	65 W
VL-DU with 14 optical ports	48 VDC	125 W

VL-RU 33/37

Unit	Voltage	Thermal Load	Max Power
VL-RU 33W with 1 RF modules	48 VDC		135 W
VL-RU 33W with 2 RF modules	48 VDC	477 BTU/hr	200 W
VL-RU 33W with 3 RF modules	48 VDC		265 W
VL-RU 37W with 1 RF module	48 VDC	545 BTU/hr	160W
VL-RU 37W with 2 RF modules	48 VDC	904 BTU/hr	265 W
VL-RU 37W with 3 RF modules	48 VDC	1160 BTU/hr	340 W

VL-EM

Unit	Voltage	Max Power
VL-EM	110/240 VAC	30 W

D. Alarms

Alarm	Description and Tips	Severity
Configuration Database Parsing Failure	Unit operation is not recommended. The unit may be recoverable by Avari Customer Service. A software update will not resolve this issue.	CRITICAL
CRC Errors on Upstream Optical Link	Fiber signal could be properly decoded. Fiber signal format could be incompatible. Received power levels may be marginal. Dirty fiber may cause poor signal levels, ensure fiber ends are clean.	CRITICAL
Failed to Initialize a Critical SPI Device	Operation may not be possible. Attempt to recover by power cycling the unit.	CRITICAL
Failed to Initialize Data Clock	Operation is not possible.	CRITICAL
Failed to Initialize RF Module Communication	Operation is not possible. Attempt to recover by power cycling the unit. Disconnect band modules to determine if one of them is causing the failure.	CRITICAL
Failed to initialize the I2C Controller	Operation is not possible. Attempt to recover by power cycling the unit. Disconnect RF Modules to determine if one of them is causing the failure.	CRITICAL
FPGA Initialization Failure	Operation is not possible Attempt to recover by power cycling the unit. Rewriting the FPGA image with a software update may repair the unit.	CRITICAL
Input Path ALC Range Exceeded	Input path power has exceeded safe levels and consequently the RF path has been deactivated. Adjust input power setting or add external attenuation if input power is above the rated level. Once the cause has been addressed, reactivate the RF path.	CRITICAL

Alarm	Description and Tips	Severity
Input Path High Power	Input path power has exceeded safe levels and consequently the RF path has been deactivated. Adjust input power setting or add external attenuation if input power is above the rated level. Once the cause has been addressed, reactivate the RF path.	CRITICAL
Input Path LO Out of Lock	Band module has been deactivated. Ensure unit is operating within valid temperature range. Attempt to recover the LO lock by disabling and re-enabling module.	CRITICAL
Mixed Signal Failure	Mixed signal operation has failed on this slot. Unit will continue to function on other slots.	CRITICAL
One of the main board PLLs has lost lock.	Check for optical or FPGA failures.	CRITICAL
Optical Transceiver is Missing	SFP optical transceiver has failed or has been intentionally removed. Replace with a functional SFP.	CRITICAL
Output Path ALC Range Exceeded	The output path power has exceeded safe levels and consequently the RF path has been deactivated. The input path power may also be high or there has been a transient high input power. The system gain may be higher than expected. Once the cause has been addressed reactivate the RF path.	CRITICAL
Output Path High Power	The output path power has exceeded safe levels and consequently the RF path has been deactivated. The input path power may also be high or there has been a transient high input power. The system gain may be higher than expected. Once the cause has been addressed reactivate the RF path.	CRITICAL
Output Path LO Out of Lock	Module has been deactivated. Ensure unit is operating within valid temperature range. Attempt to recover the LO lock by disabling and re-enabling module.	CRITICAL
Reboot to Recovery Console failed	Check FPGA status on master units and remotes. Reduce system load and try again.	CRITICAL
RF Module Deactivated Itself	A band module has deactivated itself for an unknown reason. Attempt to recover by reactivating module.	CRITICAL

Alarm	Description and Tips	Severity
	Power to RF module may have been interrupted due to high load. RF module may have been reset.	
RF Module is Missing	A band module has failed or has been intentionally removed. Replace with a functional RF module. To clear this alarm, either replace a module in this slot, or mark the slot as Unavailable.	CRITICAL
Sync Loss on Upstream Optical Link	The received laser power level is too low to achieve optical connection. Fiber may have been disconnected or damaged. Dirty fiber may cause poor signal levels, ensure fiber ends are clean. Failure could also be caused by SFP failure or loss of power on unit at far end of fiber link.	CRITICAL
Unit config.db does not contain a serial number or database is missing.	Create and install the configuration database. (Avari Customer Service only.)	CRITICAL
Unit is Missing	A unit has failed or has been intentionally removed. Check network connectivity to the unit. To clear this alarm mark the unit as Unavailable.	CRITICAL
Oscillation Detected	There is oscillation in the system. Check to see if donor antenna / passive DAS antenna has been dis-oriented. Check system isolation.	MAJOR
Fan Control Failure	Communication failure to fan controller. Operation may be possible if the fans are still running. Verify this manually. Monitor unit temperatures. Temperature alarm will indicate the need to shut down if necessary.	MAJOR
Fan Failures (two or more fans have failed)	More than one fan is not operating as expected. Monitor the unit temperature and replace fans as soon as possible. Fans are field replaceable without service interruption.	MAJOR
Hardware Initialization Failure	Only limited operation may be possible.	MAJOR
Hardware Initialization Failure (Other)	Operation may be possible.	MAJOR
High Temperature	May be caused by unit or remote fan failures. Check the ambient temperature to ensure it is not above the rated temperature. Ensure that airflow from the bottom of the heat sink and above the fans is not obstructed. Ensure unit is positioned correctly.	MAJOR

Alarm	Description and Tips	Severity
Input DC Voltage Out of Range	Unit input voltage has exceeded acceptable range. Check the reported input voltage. Adjust input voltage or repair power feed as necessary.	MAJOR
Input Path ALC Active	Input path power has exceeded recommended levels on the RF port. Consequently, the ALC has been activated and the gain reduced. When occurring on air interface consider repositioning antenna or increasing minimum distance between mobile and antenna. When occurring on conducted interface reduce power of feed. The DL output power from the PA has exceeded recommended levels. Consequently, the ALC has been activated and the gain reduced. Either the input power is also high, there has been a transient high input power, or the system gain is higher than expected.	MAJOR
Intermediate Current Out of Range	DC current consumption by band modules is outside the acceptable range. For shelf controllers this may be corrected by removing modules to reduce power draw. Refer to documentation for maximum shelf load. For master units or remotes this indicates a failure condition with a band module.	MAJOR
Intermediate Voltage Out of Range	DC voltage to the band module is outside the acceptable range. It may be affected by external conditions. Check input voltage to the unit. Disconnect band modules to determine if one of them is drawing high current.	MAJOR
Output Path ALC Active	Output path power has exceeded recommended levels. Consequently the ALC has been activated and the gain reduced. The input path power may also be high or there has been a transient high input power. The system gain may be higher than expected.	MAJOR
Output Path Low RF Module Gain	An element in the path is not providing sufficient RF gain This may be the RF module or mixed signal portions of the unit Ensure DC power is available by checking the input voltage reported by module If it is field replaceable try an alternate module	MAJOR
Output RF Path Low Gain	RF path gain is lower than expected. RF levels may be out of range.	MAJOR

Alarm	Description and Tips	Severity
	Module may be damaged.	
RF Module Activating Error	Error received when activating RF module. Attempt to recover by deactivating and reactivating module.	MAJOR
RF Module Being Serviced	Band module is physically present but regular communication is not possible due to servicing. Wait for software upgrade to complete for up to 5 or 10 minutes. An interruption of software upgrade due to power loss may cause RF module to remain in this state. Remote servicing of unit will put module in this state.	MAJOR
RF Module Communications Failure	A band module was detected but communication to the module has failed.	MAJOR
RF Module Not Ready	Wait for boot process to complete and PLL to lock.	MAJOR
Temperature Sensor Failure	Failed to initialize unit temperature sensor. Operation is possible but unit temperature should be monitored manually.	MAJOR
CRC Errors on Downstream Optical Link	Fiber signal could be properly decoded. Fiber signal format could be incompatible. Received power levels may be marginal. Dirty fiber may cause poor signal levels, ensure fiber ends are clean.	MINOR
DL Input Path Low Power	Input power is below what is configured for Input Power Low Alarm Threshold. Check source power and cable connections. If input power is as expected then adjust alarm threshold.	MINOR
Fan Failures (one fan has failed)	A fan is not operating as expected. Monitor the unit temperature and replace fan at your convenience. Fans are field replaceable without service interruption.	MINOR
Input DC Voltage Marginal	Unit input voltage is close to exceeding acceptable range. Check the reported input voltage. Adjust input voltage or repair power feed as necessary.	MINOR
Output Path High VSWR	The reflected power (VSWR) threshold is exceeded. Ensure that the load on the antenna port is properly matched to 50 ohms. Check for damaged or disconnected cables or antennas.	MINOR

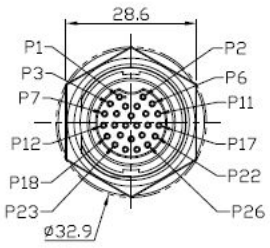
Alarm	Description and Tips	Severity
POE Initialization Failure	Operation is possible except for use of POE. Alternate power sources for POE devices will be required.	MINOR
RF Path Deactivated by User	The user has intentionally deactivated the RF path Reactivate the RF path as needed To permanently deactivate the RF path without alarm, set the slot to Unavailable.	MINOR
Sync Loss on Downstream Optical Link	The received laser power level is too low to achieve optical connection. Fiber may have been disconnected or damaged. Dirty fiber may cause poor signal levels, ensure fiber ends are clean. Failure could also be caused by SFP failure or loss of power on unit at far end of fiber link. If this alarm is displayed on chained master unit, address as Critical.	MINOR
Voltage to RF module is Out of Range	An internal voltage is out of range. It may be affected by external conditions. Check input voltage to the unit.	MINOR
Failed to Initialize PWM	No user intervention necessary.	INFORMATION

E. NFPA Alarm Connections

The VL-Series supports the following three types of alarms as per NFPA / IFC standards for in-building 2-way emergency radio communication systems.

- Donor Antenna Malfunction
- Active RF Emitting Device Failure
- Active System Component Failure

The three types of alarms can be supervised via dry contact / relay connections to Fire Alarm Panel. The diagram below shows the alarm pin-out connections from the VL-Series equipment.



Detail Wiring to Building Alarm Panel

Connector Pin	Wire Color	Pin Description	Alarm Type
		Alarm Output	
1	Black	Relay 1 - NC	Donor Antenna Failure
2	Black/White	Relay 1 - Common	
11	Light Green	Relay 1 - NO	
3	Brown	Relay 2- NC	Active RF Emitting Device Failure
4	Brown/White	Relay 2 - Common	
12	Light Green/Black	Relay 2 - NO	
5	Yellow	Relay 3 - NC	Active System Component Failure
6	Yellow/Black	Relay 3 - Common	
13	Light Blue	Relay 3- NO	
		Alarm Input	
19	Orange	Input 1	Loss of AC Power
20	Orange/White	Input 1 Return	
21	Red	Input 2	Failure of Battery Charger
22	Red/White	Input 2 Return	
23	Green	Input 3	Low Battery Capacity (70% reduction)
24	Green/White	Input 3 Return	

Normal Close (NC) – high impedance when in alarm state (open circuit)
Normal Open (NO) – low impedance when in alarm state (short circuit)

F. UL 2524

Overview

UL 2524 includes additional critical safety and performance requirements for in-building, 2-way emergency radio communication enhancement systems.

Products such as repeater, transmitter, receiver, signal booster components, external filters, and battery charging system components are required to be monitored by fire alarm system using supervisory signals to annunciate the following conditions.

In emergency radio communication systems	In battery backup systems
• Donor Antenna failure • Active RF emitting device failure • System component failure	• Loss of normal AC power • Battery Charger failure • Loss of battery capacity (70% depletion)

The Avari Wireless VL-Series Distributed Antenna System (DAS) used for in-building emergency 2-way radio communications supports the required donor antenna failure alarm, active RF emitting device failure alarm and system component failure alarm via dry contact outputs for easy integration with alarm annunciators or fire alarm panels. To learn more, see Appendix E, NFPA Alarm Connections for dry contact output details.

Avari uses third party qualified UL 2524 battery backup systems where it is required.

Automatic Oscillation Detection

The VL-Series also has a built-in automatic oscillation detection mechanism.

When an abnormal increase in output power corresponding to input power is detected over a short period, an Oscillation Detected alarm with major severity is raised.

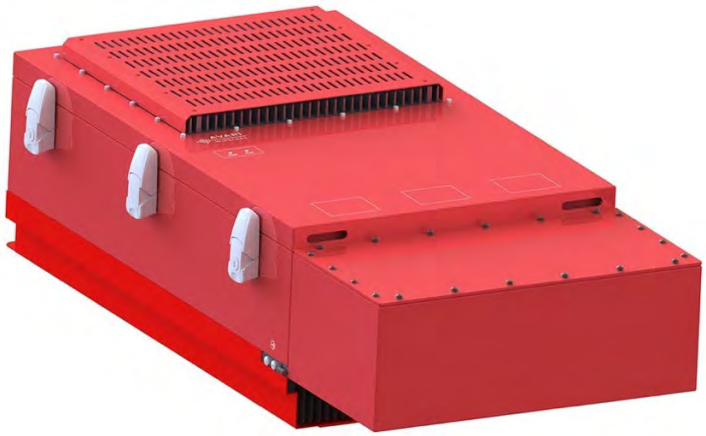
To mitigate the situation, the system automatically reduces the system gain by 15 dB to contain the runaway power output level.

When oscillation is detected, it is important for the system administrator to investigate what may have changed in the passive distributed antenna network. Possible causes include existing antenna dis-orientation or new antenna installation. The alarm stays active until it is manually cleared by de-activating and re-activate the affected RF band.

UL 50 Compliant Chassis

As part of UL 2524, Avari VL-Series equipment chassis are UL 50 certified.

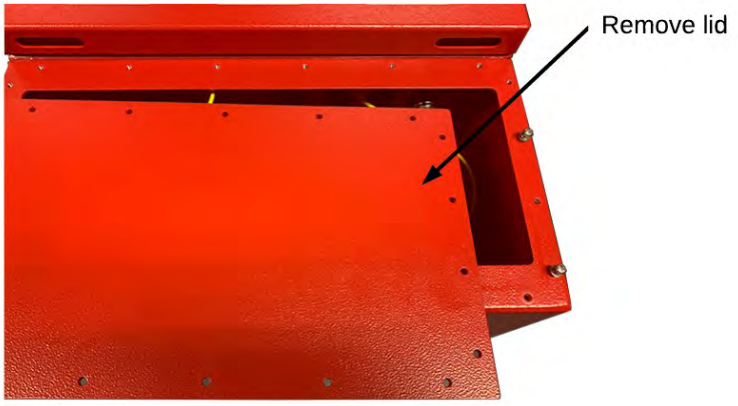
The UL 50 complaint chassis have a waterproof conduit enclosure for protecting the RF, fiber, Ethernet, and power cables from fire, shock, and water damage. Cables are run through conduit and terminated inside the unit. Holes for conduit are drilled as needed during installation in the field.



Installing Cabling

- **Step 1. Open the conduit enclosure**

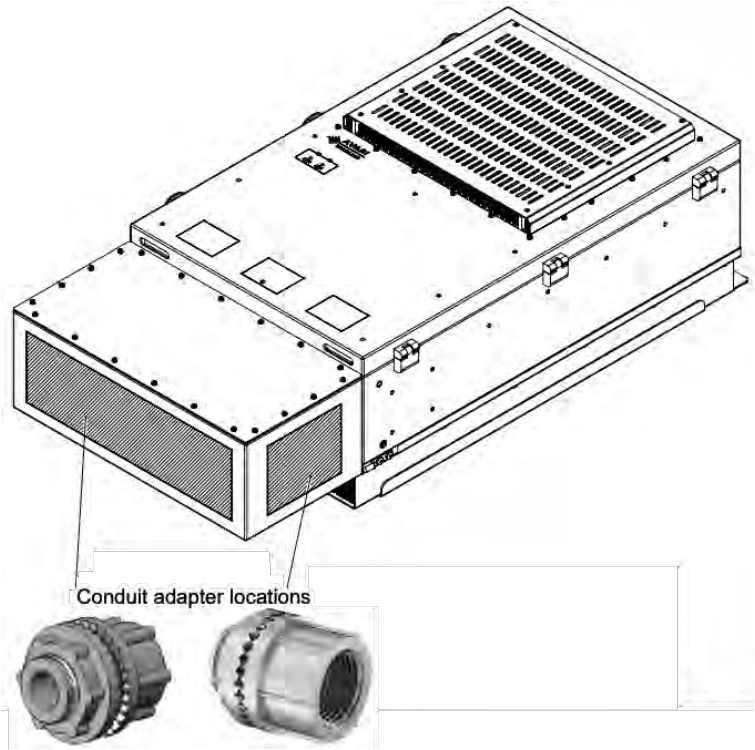
Unscrew and remove the lid of the conduit enclosure. Inside, the chassis has knockouts for guiding the necessary cables.



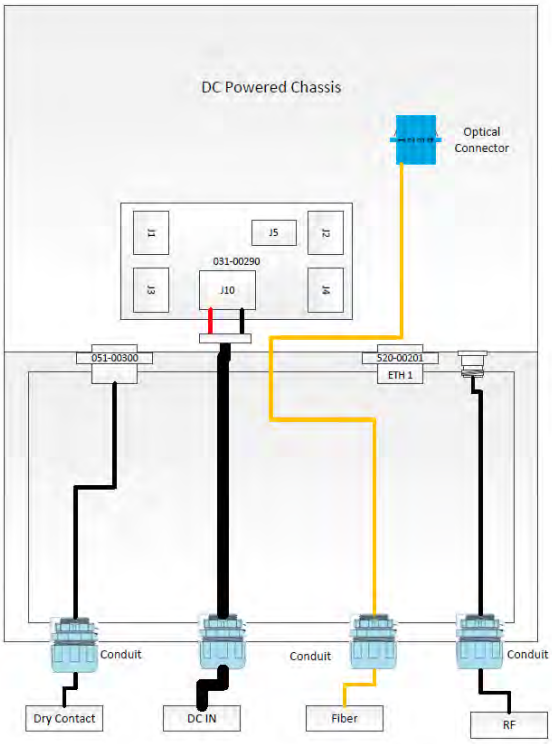
✦ Step 2. Drill conduit holes

Drill holes in the bottom or right face of the conduit enclosure, and fit with the following waterproof metal conduit adapters:

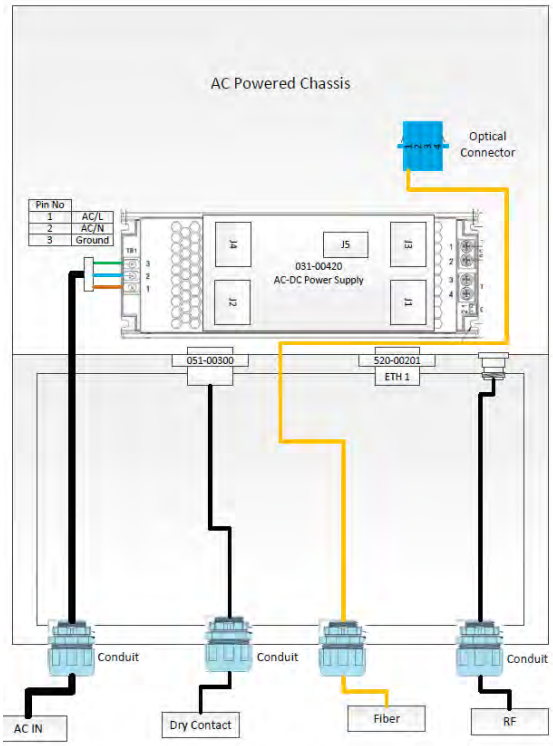
- Type: Liquid-Tight Flexible Metal Conduit Adapter with Locknut, Zinc Straight
- Size: 1 or 3/4 Trade Size Female x NPSM Male



- 4 conduits are required for feeding the different types of cables through the conduit enclosure as shown below.



Reference: Appendix F, Installation and Commissioning Guide R5.



Reference: Appendix F, Installation and Commissioning Guide R5.

NOTE The AC and DC power cables are input cables from a UL 2524 power source to be housed inside its own conduit, separate from other types of cables.

The dry contact cable is a non-power limited cable for “low voltage” use. Its purpose is to provide and to detect open-circuit and close-circuit conditions for fire alarm panel. The dry contact cable is not part of a fire alarm system to control elevator shutdown, door release, smoke doors, damper control and fan shutdown as defined in National Electrical Code in NFPA70 Article 760. Each dry cable pair is designed to switch a relay in a fire alarm panel with a maximum power rating of 1A 30VDC or 0.3A 125VAC at 85C.

✦ Step 3. Terminate cables

Pass cables through the conduit enclosure to the appropriate termination points.

NOTE RF, Ethernet, and dry contact cables are terminated at connectors pre-fitted on the panel inside the conduit enclosure. Fiber, power cables are terminated inside the chassis.

Similar to dry contact cable, Ethernet cable is a non-power limited cable for “low voltage” use. Its purpose is for connecting to a computer for system configuration and monitoring. It is NOT required for the system operation. The Ethernet cable is not part of a fire alarm system to control elevator shutdown, door release, smoke doors, damper control and fan shutdown as defined in National Electrical Code in NFPA70 Article 760. The Ethernet cable is designed for data communications only with a maximum power rating of 5 mA at 2.5V.

RF cables

Connect RF cable to the N-type or other RF connectors on the internal connector panel.

Connect RF cables to the pre-fitted **P1** to **P4** RF connectors on the panel

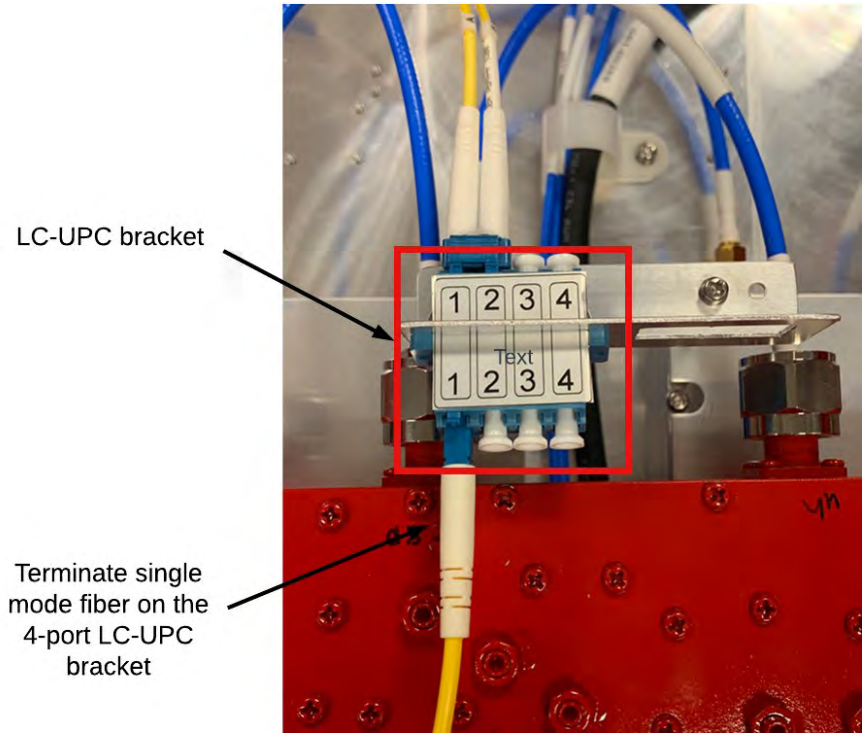
Dry Contact Cable

Connect the dry contact cable to the 26-pin **C&M** connector on the panel. The supplied dry contact cable consists of AWG 26 wires for connecting to fire alarm panel.

Connect the dry contact cable to the 26-pin **C&M** connector on the panel

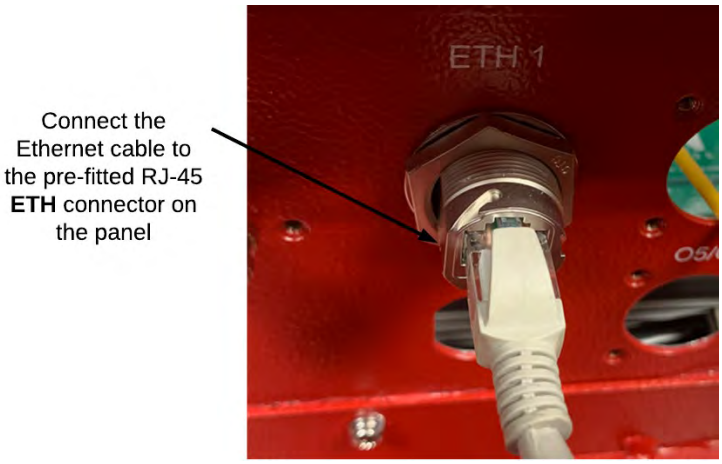
Fiber

Run fiber through any knockout on the panel and connect to the LC-UPC bracket.



Ethernet Cables

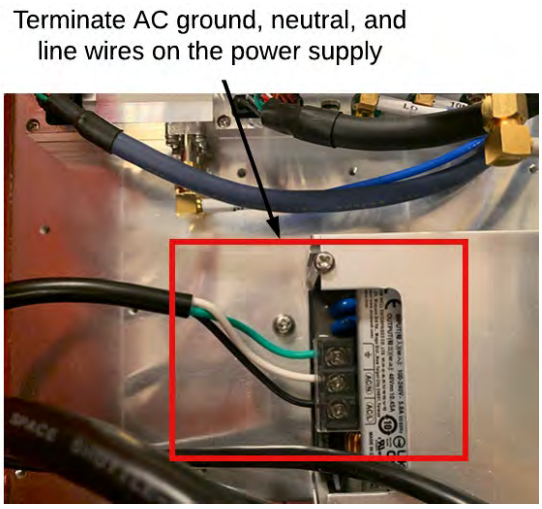
Connect the Ethernet cable to the RJ-45 **ETH** connecter on the panel.



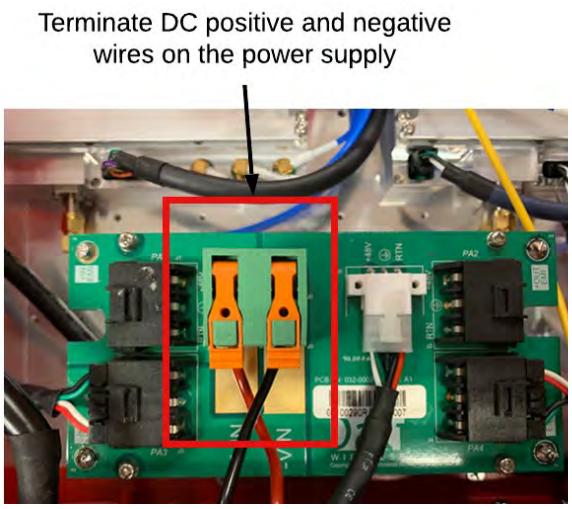
Power Cable

Connect the AC or DC to the appropriate termination posts on the power supply.

AC power supply



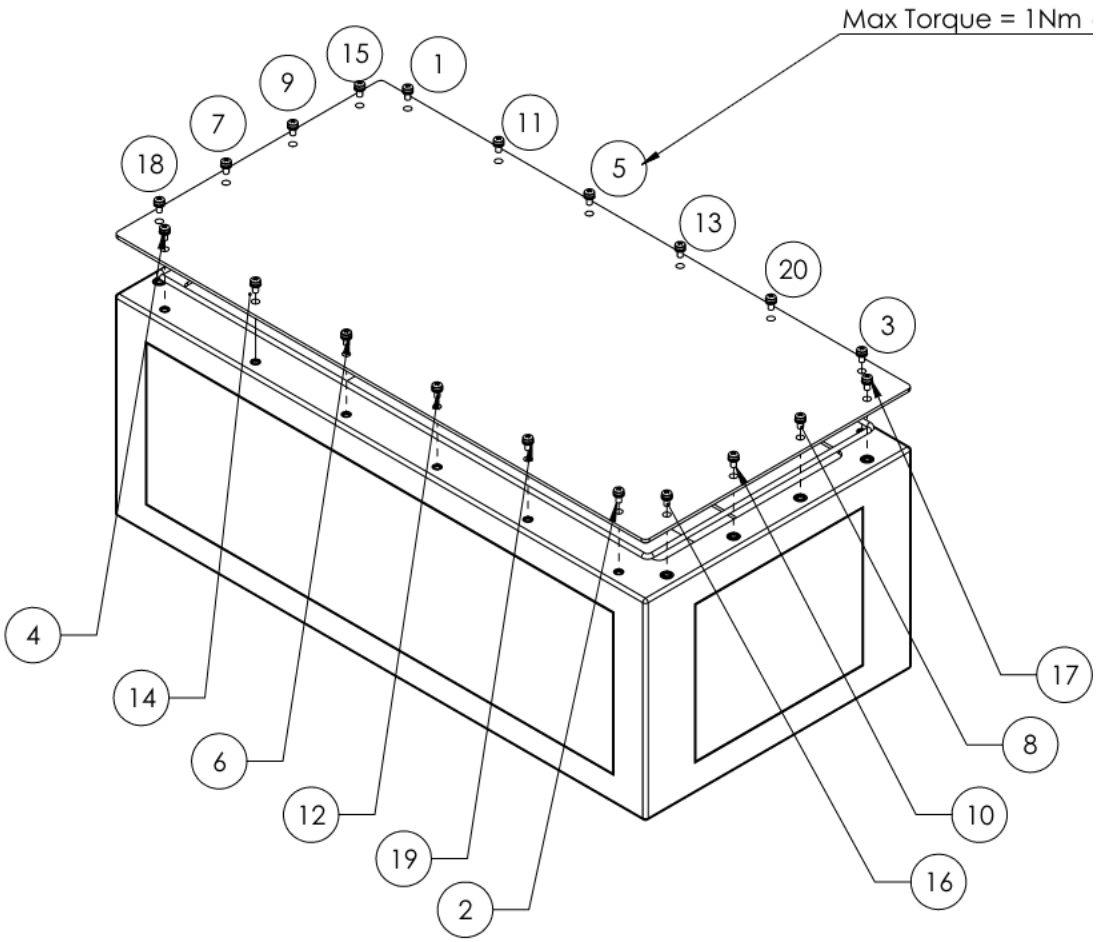
DC power supply



✦ Step 3. Reseal the enclosure lid

Once you've connected all cables, replace the enclosure lid and secure with the screws provided.

- Replace and tighten screws the order shown in the diagram.
- Tighten crews to 0.8 Nm to 1.0 Nm (maximum) torque.



G. Optical Connector Cleaning

Connector contamination due to fiber mishandling is the single greatest point of failure in many fiber-optic networks. The optical connectors used in deploying the VL-Series must be clean and free of contaminants prior to connection.

This appendix describes the recommended procedures for cleaning and handling fiber-optic cable, including:

- Laser Safety Warnings
- Fiber Handling Guidelines
- Bend Radius Guidelines
- Inspecting Fiber-Optic Connectors
- Cleaning Fiber-Optic Connectors

Laser Safety Warnings

This equipment uses a Class 1 Laser according to FDA/CDRH rules.

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 or exposure to laser radiation may result. 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.

An optical power meter should be used to verify Active fibers. A protective cap or hood MUST be immediately placed over any radiating transceiver or optical fiber connector to avoid the potential of dangerous amounts of radiation exposure. This practice also prevents dirt particles from entering the adapter or connector.

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

Safety Guidelines

- Observe all local carrier and manufacturer-suggested safety practices concerning fiber handling and preservation.
- Observe all local carrier and manufacturer-suggested requirements for safety on the job.
- Point all fibers away from yourself and others at all times.

Do not look into the ends of fibers, or point fibers at others. Most laser energy is invisible to the human eye and yet can be at very damaging power levels to the human eye.

Fiber Handling Guidelines

Poor fiber handling practices and bends in the fiber cable cause signal attenuation. Adhere to the following guidelines for handling fiber-optic cable:

- Do not step on or set anything on top of fiber-optic cable
- Do not twist fiber-optic cables
- Do not pull on fiber-optic cable (pull on strength members only)
- Do not pull on connectors
- Do not look at connectors and end faces (unless both cable ends are in hand)
- Do not look into equipment ports housing lasers

Inspecting Optical Connectors

An important part of the recommended cleaning procedure for optical connectors is inspecting the end face of the connector.

Optimally, the end face must be clean and free from cracks, scratches, edge chips, hackles, pits and other anomalies.

Using a fiberscope with at least 200X magnification, inspect the optical connectors before and after cleaning. Follow the fiberscope manufacturer instructions.

Always turn the lasers off before beginning the inspection.

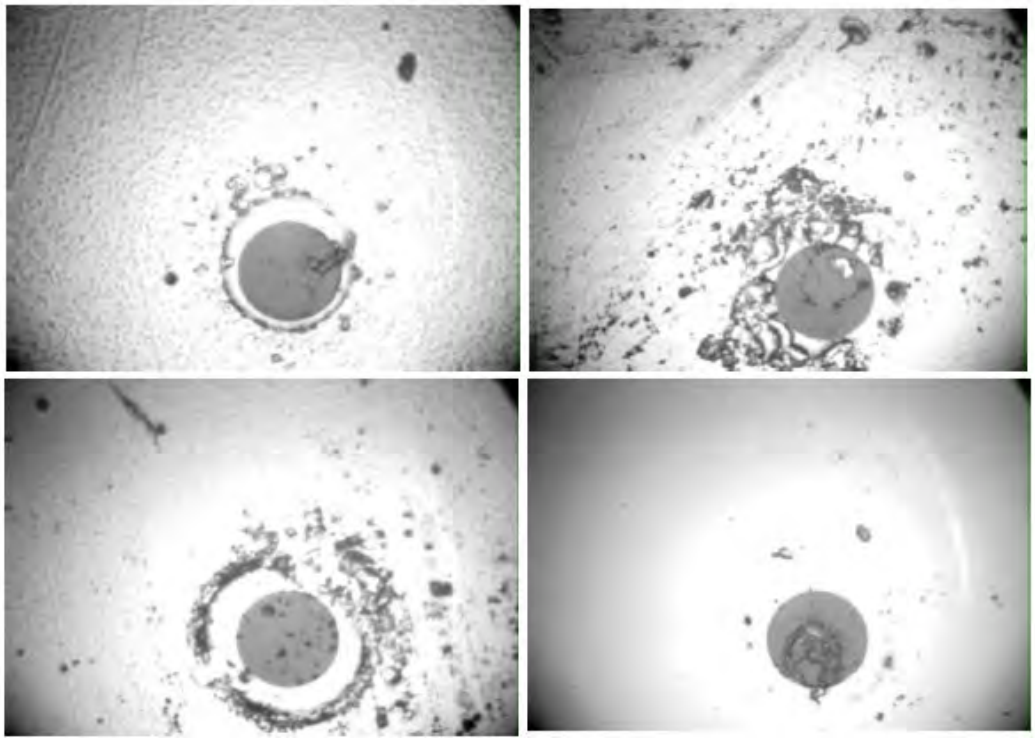


Figure 18-1: Poorly Cleaned Fiber-Optic Endfaces

Figure 18-9 shows a properly cleaned endface.

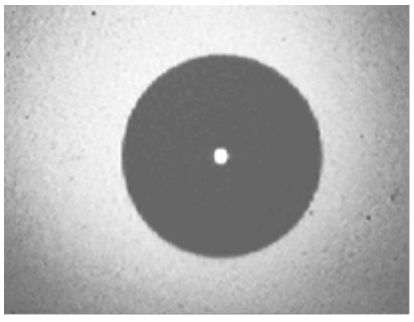


Figure 18-2: Clean Fiber-Optic Endface

Fiber Bend Radius Guidelines

All fiber-optic cables have a minimum bend radius, which is the minimum curve radius allowed while bending the fiber cable during installation or in its final resting position.

The bend radius is specified by the fiber manufacturer. You can make larger curves but never smaller than specified.

Macrobend—a bend in the fiber cable which exceeds the minimum bend radius.

- The minimum bend radius for fiber-optic cables should not be less than 10x the outer diameter of the fiber cable jacketing or 2 inches, whichever is larger.
- Radius Limiters are designed to eliminate macrobends.

Microbend—a small nick in the cladding of an optical fiber.

Cleaning Fiber-Optic Connectors

The importance of clean fiber-optic connectors cannot be overstated. Ensuring fiber-optic connectors are free of face debris and damage will eliminate the vast majority of reported problems in the DAS.

Improperly cleaned, a contaminated optical connector can:

- Damage the end-face of a mating connector.
- Turn end-face debris into plasma which can permanently damage the end-face polish or form.
- Cause back reflections damaging optical fiber terminal equipment.

Cleaning Guidelines

Here are a few simple and easy to implement tips for avoiding contaminated junctions:

- Keep environment as clean, dry, and dust free as possible.

- Wash hands immediately prior to fiber work.
- Keep all connectors and jacks properly CAPPED until use.
- Clean connectors using ONLY approved cleaning kits.
- Learn and master appropriate steps to clean junctions.
- Inspect connections with a 200X fiber scope when installed.
- Record and validate “as-built” F.O. link budget information.
- Always clean fiber connectors prior to mating.

Do not use of canned air because it is ineffective on oils, residues, and small static charged particles.

Types of Fiber-Optic Cleaning Procedures

There are three main methods of cleaning fiber-optic connectors:

- Cassette Cleaning Method
- Wet to Dry Method
- Dry Method

Depending on the method used, always use the appropriate cassettes, swabs, washers and wipes that come with the fiber cleaning kit. Under no circumstances use canned air, clothing, tissues or other material not designed for fiber cleaning.

Cassette Cleaning Method (Recommended)

Avari Wireless recommends the Cletop cassette cleaning system for cleaning fiber-optic connectors.

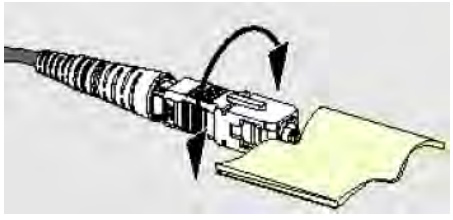
To use Cletop cassette cleaners, follow the manufacturer's instructions to advance the tape to a clean section and clean the end face. Remember to uncap the optical connector just prior to cleaning, and then recap immediately after.

Wet-to-Dry Cleaning Method

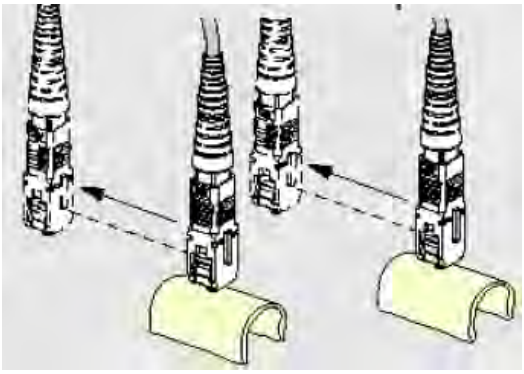
The wet-to-dry cleaning method requires 99% isopropyl alcohol solution and optical grade lint-free tissues.

✦ **To clean optical connectors using the wet to dry method**

5. Ensure the lasers are turned off before you begin, and inspect the connector through a fiberscope.
6. Fold a lint-free tissue into a 1 ½-inch square (refolding approximately four to six times).
7. Spray a small amount (a drop) of isopropyl alcohol on the wipe.
8. Clean the edge of the connector by gently rolling the tip along the edge of the wipe.



9. Clean the tip of the connector by gently swiping the end face in one direction only along the wipe.



10. Discard the wet wipe and obtain a dry one. Fold the dry wipe as described in step 2.
11. Repeat steps 4 and 5 with a dry wipe to clean the connector edge and end face.
12. Inspect the connector again with a fiberscope.
13. Repeat the process as necessary until the end face is free from contamination.
14. Replace the end caps on the connector if not connecting immediately.

Dry Cleaning Method

The dry cleaning method requires lint-free optical grade tissues.

✦ **To clean optical connectors using the dry method**

1. Ensure the lasers are turned off before you begin, and inspect the connector through a fiberscope.
2. Fold a lint-free tissue into a 1 ½-inch square (refolding approximately four to six times).
3. Clean the connector end face by moving the tip in a figure-eight motion on the wipe.
4. Inspect the connector again with a fiberscope.

5. Repeat the process as necessary until the end face is free from contamination.

6. Replace the end caps on the connector if not connecting immediately.

H. Other Chassis Types

To accommodate different applications, the Avari VL-Series Remote Unit (RU) comes in different color, sizes and mounting options. The RU described throughout this guide is known as the standard Type 2 chassis that comes in red. This appendix describes 2 additional types of RU chassis known as Type 4 and Type 5 in beige color.

The Type 4 chassis is designed to be mounted inside a 19 inch cabinet with convection cooling via air flow. It accommodates up to 4 frequency band modules inside. The dimensions of the Type 4 chassis are shown below.

Hardware Version ID Number (HVIN) / Model No:

RU37-4-PS-ABGH-41-C-D0-2C

Mechanical Specifications	Cabinet-Mount Chassis
External Interface	4 conduit entries (2 x 1 trade sizes; 2 x 3/4 trade sizes)
Size (W x H x D)	17.1" x 31.5" x 10.0" | 433 x 799.5 x 253.2 mm
Weight	< 106 lbs. | < 48 kg

The Type 5 chassis is designed to be mounted on a wall with convection cooling via air flow. It accommodates up to 4 frequency band modules inside. The dimension of the Type 5 chassis is shown below.

Hardware Version ID Number (HVIN) / Model No:

RU37-4-PS-ABGH-51-C-D0-2W

Mechanical Specifications	Wall-Mount Chassis
External Interface	4 conduit entries (2 x 1 trade sizes; 2 x 3/4 trade sizes)
Size (W x H x D)	21.1" x 26.9" x 17.4" | 536 x 683.4 x 442.2 mm
Weight	< 112.5 lbs. | < 51 kg

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