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SCTE Michigan: ARRIS OM6000 Fiber Deep Remote PHY Overview with HD Shelf and OM6000

May 2021

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Agenda

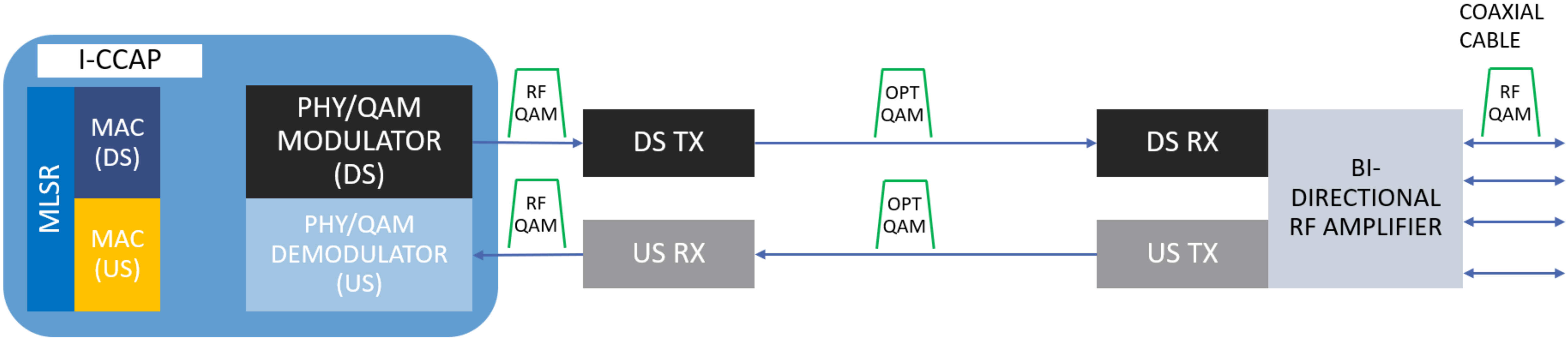
- Remote PHY Overview
- HD Shelf
- OM6000 Housing Mechanical Description
- OM6000 Fiber and Coaxial Entry
- OM6000 Powering and RPD Installation
- OM6000 Forward/Return Path

DAA

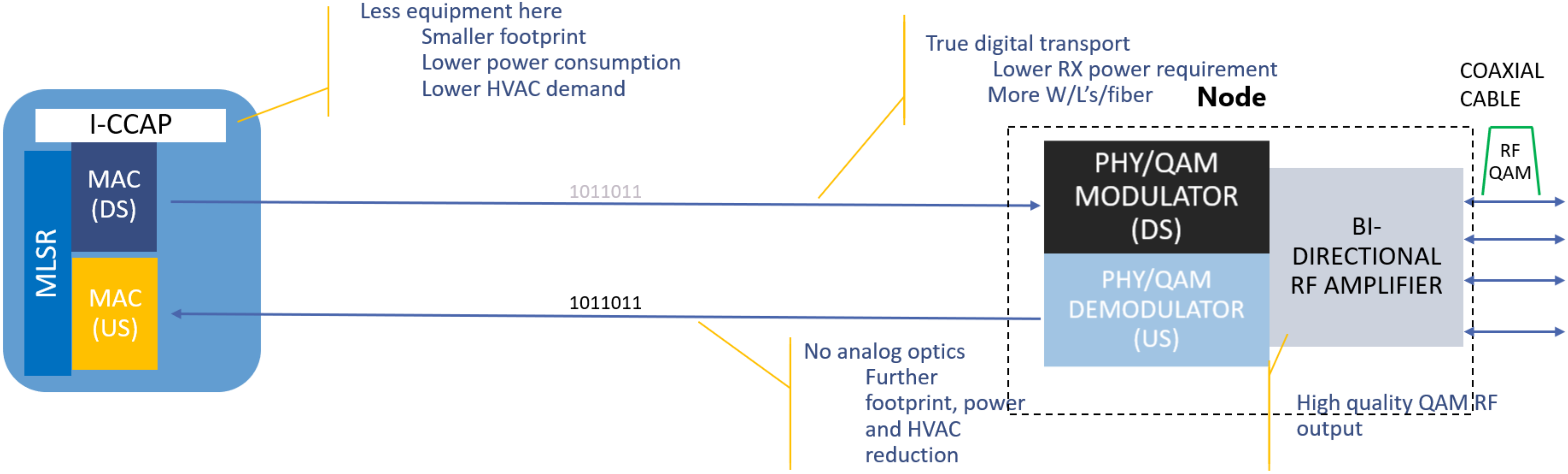
HFC networks are defined by their analog fiber plumbing. DAA replaces analog fiber with IP connections (digital fiber) and creates a software-defined network that supports:

- Node evolution with remote PHY and remote MAC-PHY
- Transition to digital optics, removing analog lasers
- Digital fiber closer to the subscriber’s home
- Migration to centralized data centers
- Flexible advertising, channel lineups and bandwidth management

What is Remote PHY?



What is Remote PHY?

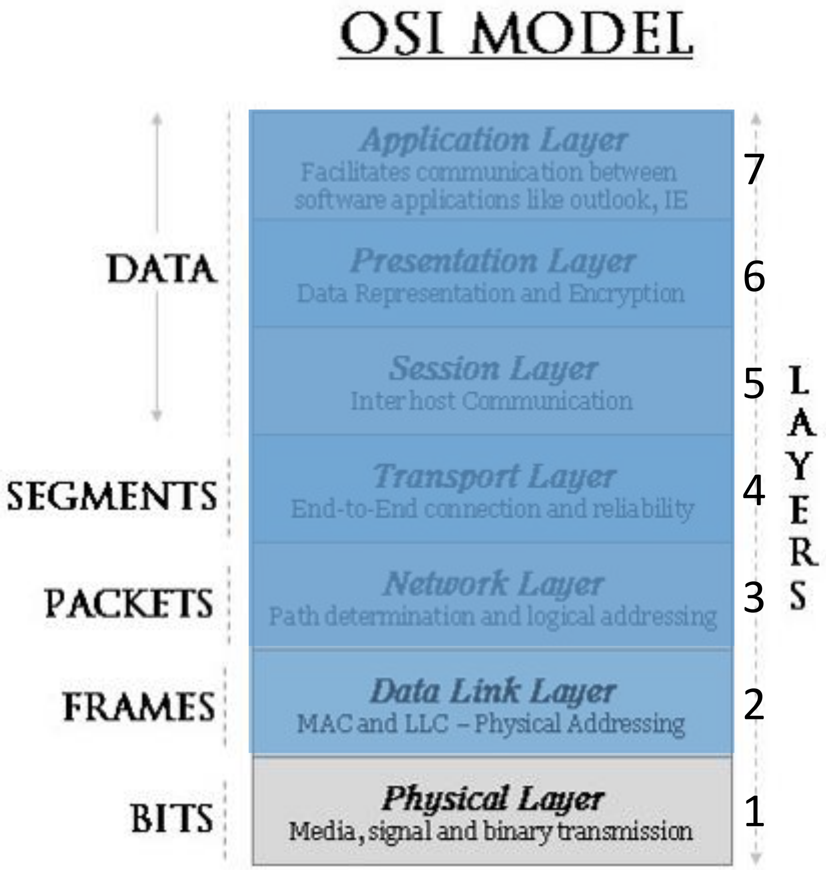


Remote PHY is an approach that takes the PHY chip out of a CMTS box and puts it at the edge of an IP network.

Why? To put the least amount of hardware and software at the end point and keep the complexity centralized.

Remote PHY works because it is built on top of open standards such as Ethernet, IP, L2TPv3 (Layer 2 Tunneling Protocol version 3) , and CableLabs MHA (Modular-Headend-Architecture

A Step into Layer 2 of the OSI Model



Historically, CATV outside plant techs were dealing with Layer 1 only

- Layer 1 involves the physical communications medium only
  - Fiber
  - Nodes
  - Coax
  - Amplifiers
  - Passives

Signal levels were measured, signal quality evaluated, but there was little or no effort to actually interpret the actual information being transported

With R-PHY, there will be a need to know how to understand some of the exchanges between the I-CCAP core and the R-PHY device

- That moves us also into Layer 2

Advantages of a DAA approach

Network efficiency

- Increased network capacity and simpler outside plant maintenance
- Node evolution with remote PHY, remote MAC-PHY and remote 10G EPON OLT
- Better end-of-line signal quality, higher modulation rates, higher bit rates
- Better spectral efficiency, more wavelengths per fiber

Operational and capital expenditure benefits

- Reduced head-end power, space and cooling requirements
- Hub consolidation
- Ability to add QAMs without changing the RF combining network
- Digital fiber “set and forget”

IP convergence

- Extend IP network to the node
- Alignment with FTTx build-out
- Ability to leverage standards-based interconnectivity and economies of scale

Acronyms

RPD: Remote PHY Device

Note: Not to be confused with Return Path Demodulator that was also referred to as an RPD and has since been replaced with the Advanced Return Path Demodulator (ARPD).

RMD: Remote MAC and PHY Device

I-CCAP: Integrated Converged Cable Access Platform

- Current architecture which brings DOCSIS and video modulation into a single converged chassis. Provides space savings as well as simplification of wiring.

DAA: Distributed Access Architecture

- New approach distributing signals throughout the network. QAM modulation/demodulation for DOCSIS and video is moved deeper into the network (formerly node location). This approach lessens space, power and HVAC demands at hub location. A significant improvement in signal quality will be realized.

FDX: Full Duplex

- Not a new term to communications, but a new approach being explored in DOCSIS 3.1. In this scheme, upstream and downstream signals share the DOCSIS channel and can enable dynamic configuration of upstream and downstream capacity.

Acronyms

GCP: Generic Control Protocol- GCP is used to pass configuration between cores (principal and auxiliary) and RPDs.

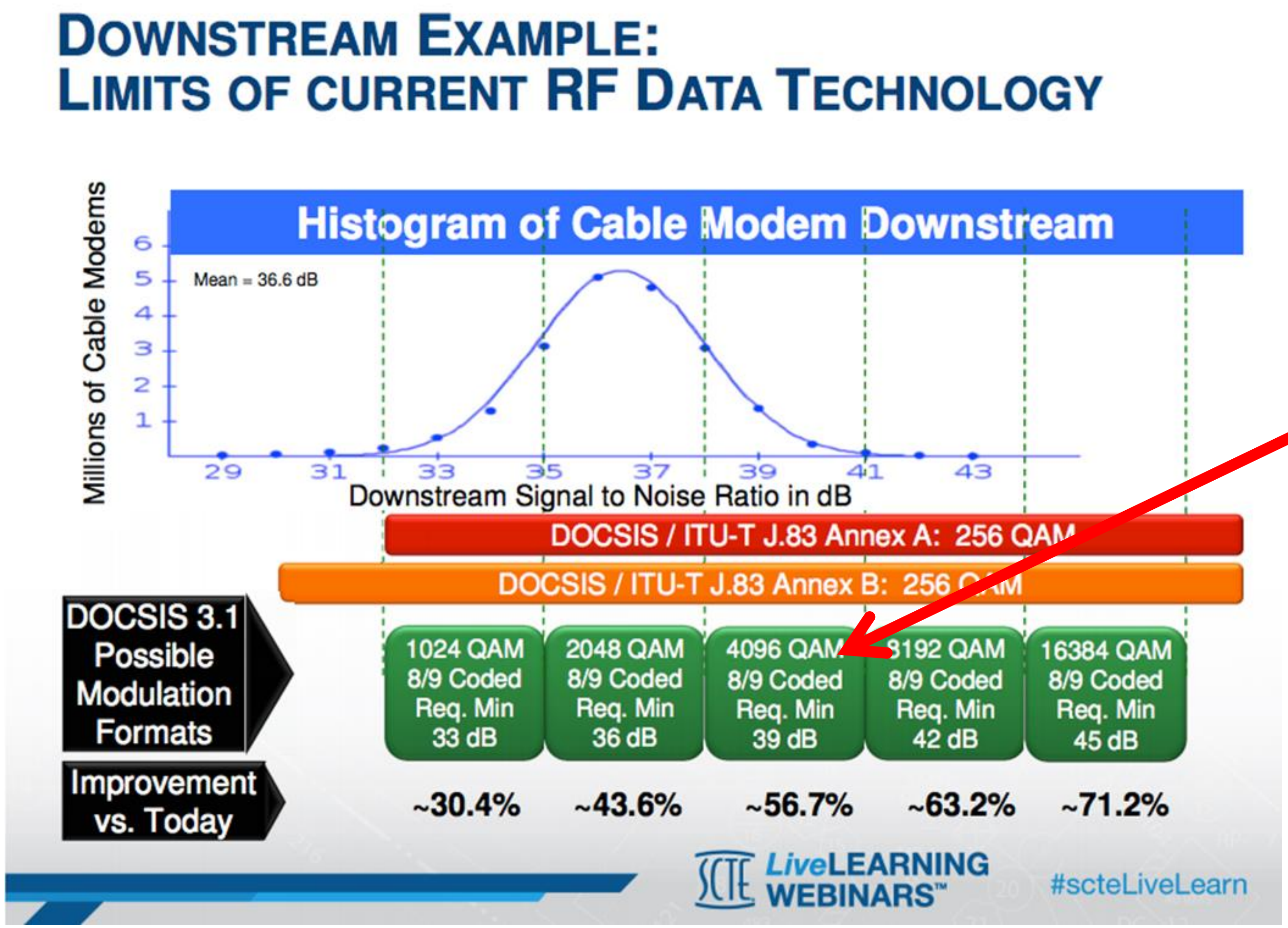
CIN: Converged Interconnect Network- Data network architecture interconnecting various servers (DOCSIS, video, etc.) to the RPD, RMD and R-OLT.

IEEE 1588 PTP: Precision Time Protocol- A protocol to establish a “grandmaster clock” and maintain synchronization with various slave clocks distributed along a network which is spread physically over a large geographic area.

MLSR-Multi Layered Switch Router

MAC- the medium access control (also called Media Access Control) sublayer is the layer that controls the hardware responsible for interaction with the wired, optical or wireless transmission medium.

Why is Remote PHY important to DOCSIS 3.1?

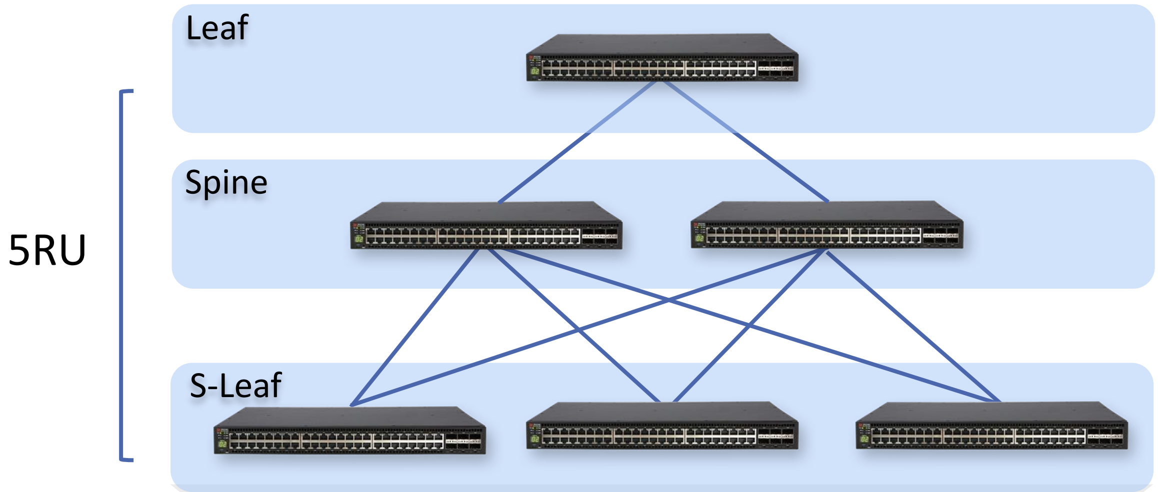


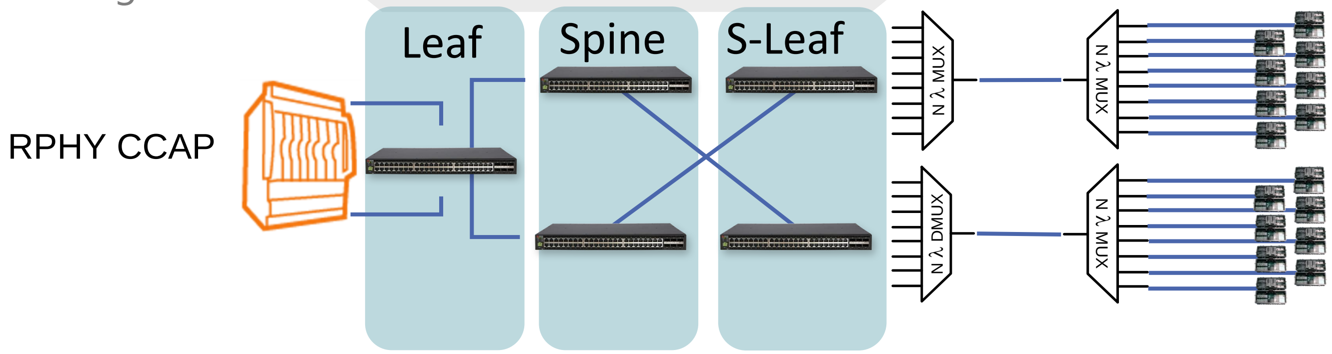
Existing plant conditions are not quite good enough to support 4096QAM

Closer Look at Ethernet Fabrics

Converged Interconnect Network "CIN"

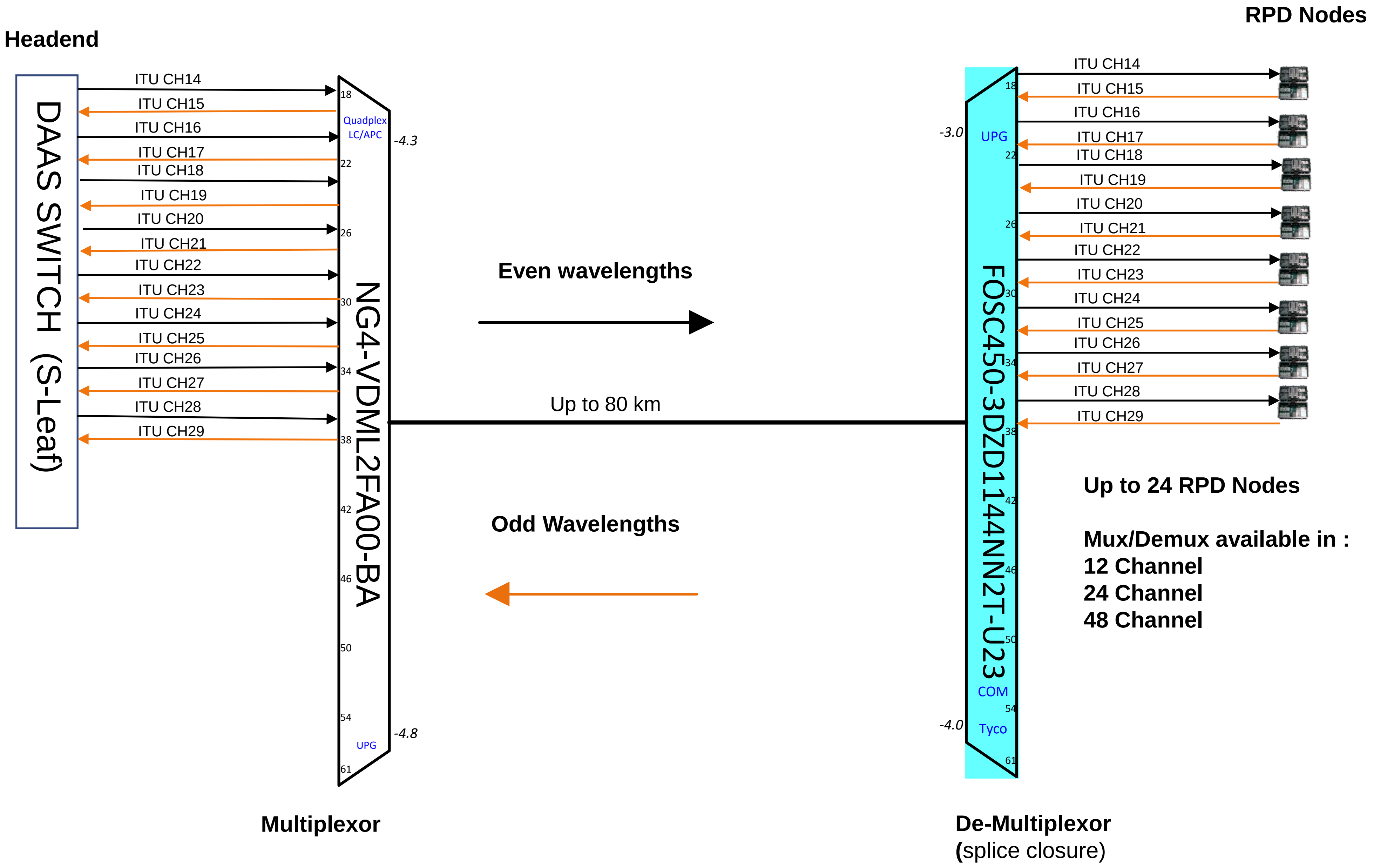
- Topology
  - Layer 2 and or Layer 3
  - Physical & Logical Mesh
  - Options for Fabric Networks
- Roles of Leaf, Spine, S-Leaf
  - Leaf terminates edges into Mesh
  - Spine is a the backbone of Mesh
  - S-Leaf – a MACSEC implementation Leaf Switch serving RPD's
- Authentication
  - S-Leaf is a NAS
  - NAS in a Controller
- Discovery for RPD to CORE
  - DHCP Based
    - Relay in the S-Leaf
    - Relay in a Controller





CIN Fabrics Enable Consolidation of all Remotes :
Remote PHY, Remote MAC, Wireless and Remote OLT PON Services

DWDM Single Fiber Solution



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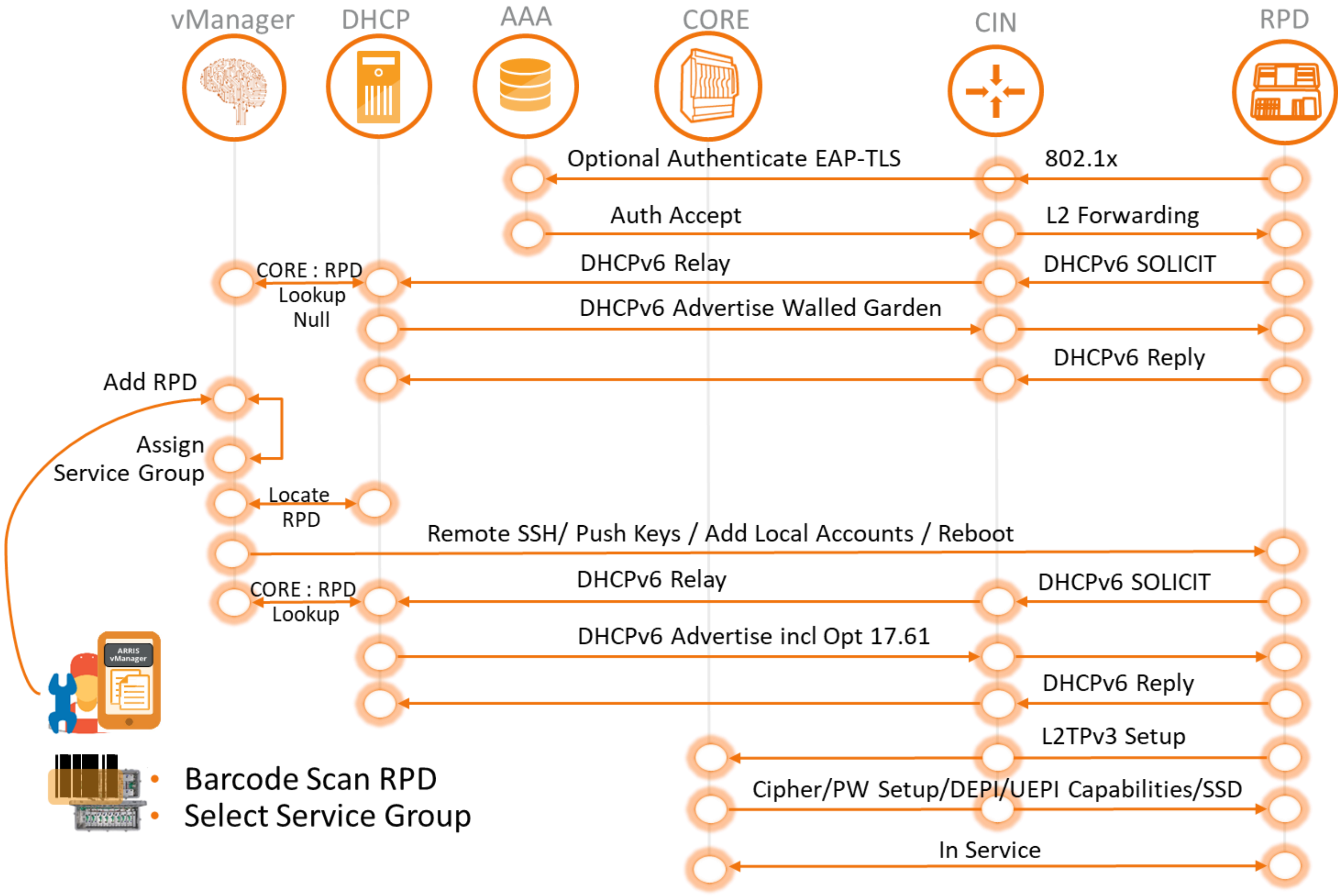
Some RPHY Drawbacks

- Not everything about RPHY is positive. There are a few things that will appear as “negatives”.
  - Boot process takes about 5 minutes
    - When an RPD goes down, the entire onboarding process must occur. That will take as much as 5 minutes
  - Firmware updates will need applied
    - Schedule in maintenance window
    - Will require reboot
  - Field troubleshooting is limited
    - Only optical level, voltages and LED status are field checkable. If those parameters are OK, then either provisioning is incorrect, or device is bad.

Onboarding RPD Process Flow

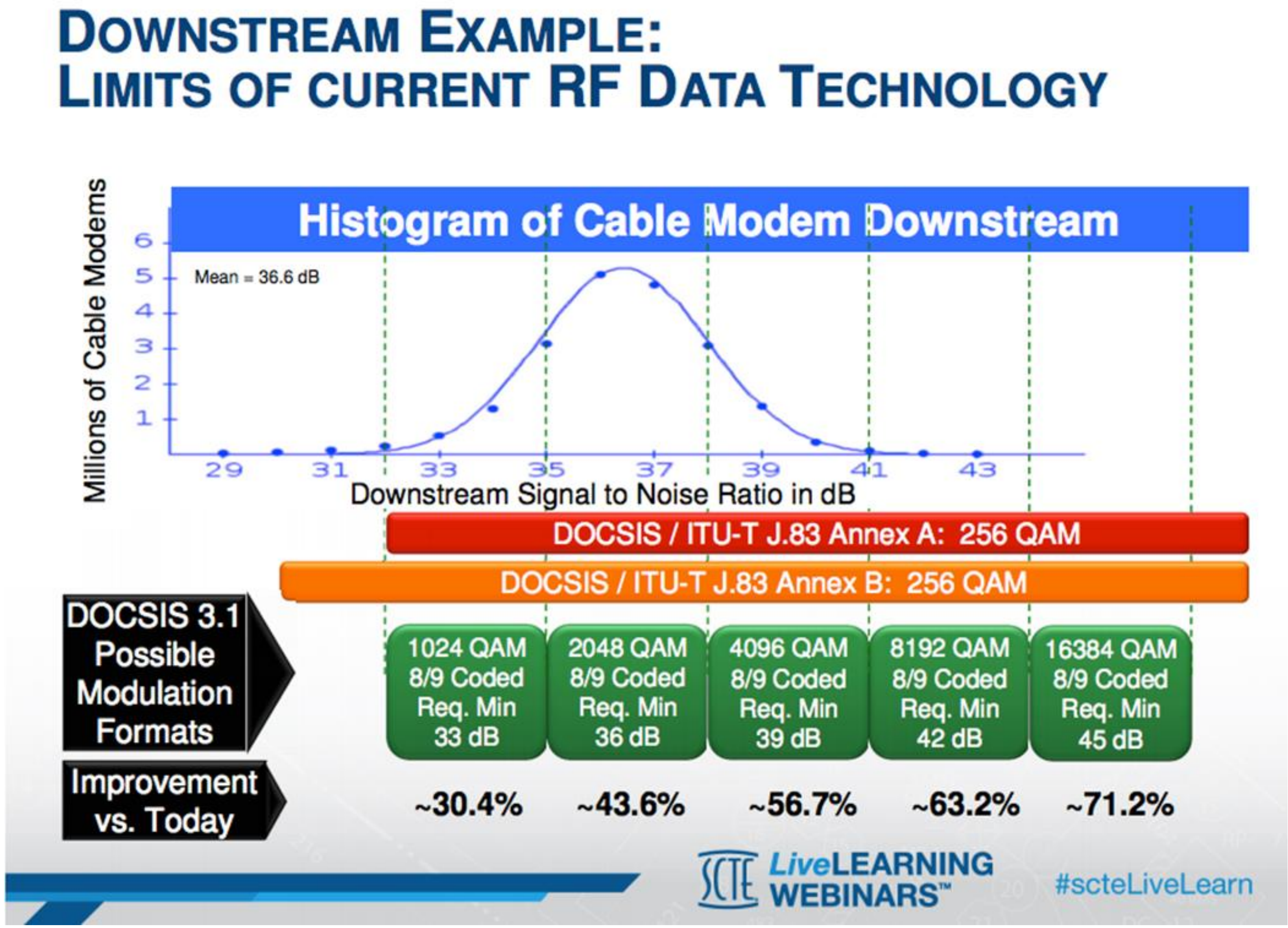
Power on to In Service

- RPD authentication at the Network
- Discovery of Principle & AUX Cores via DHCP
- L2TPv3 Tunnel
  - Setup to CORE(s)
  - Authentication
  - Encryption
  - Pseudo wires for DEPI and UEPI and OOB paths
- In Service

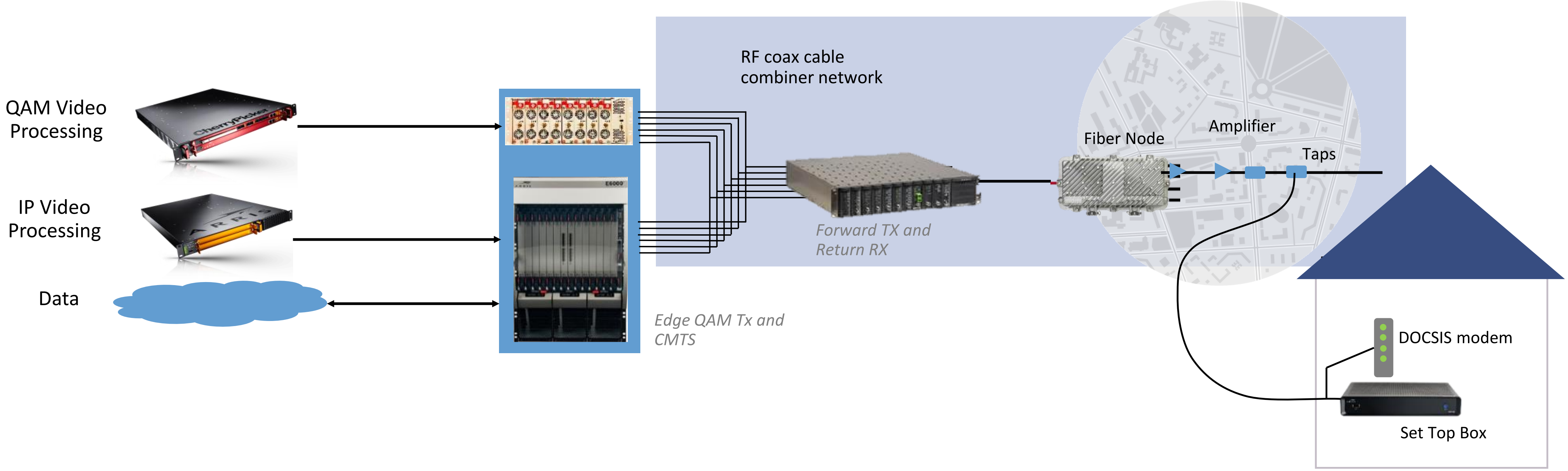


Improving Throughput

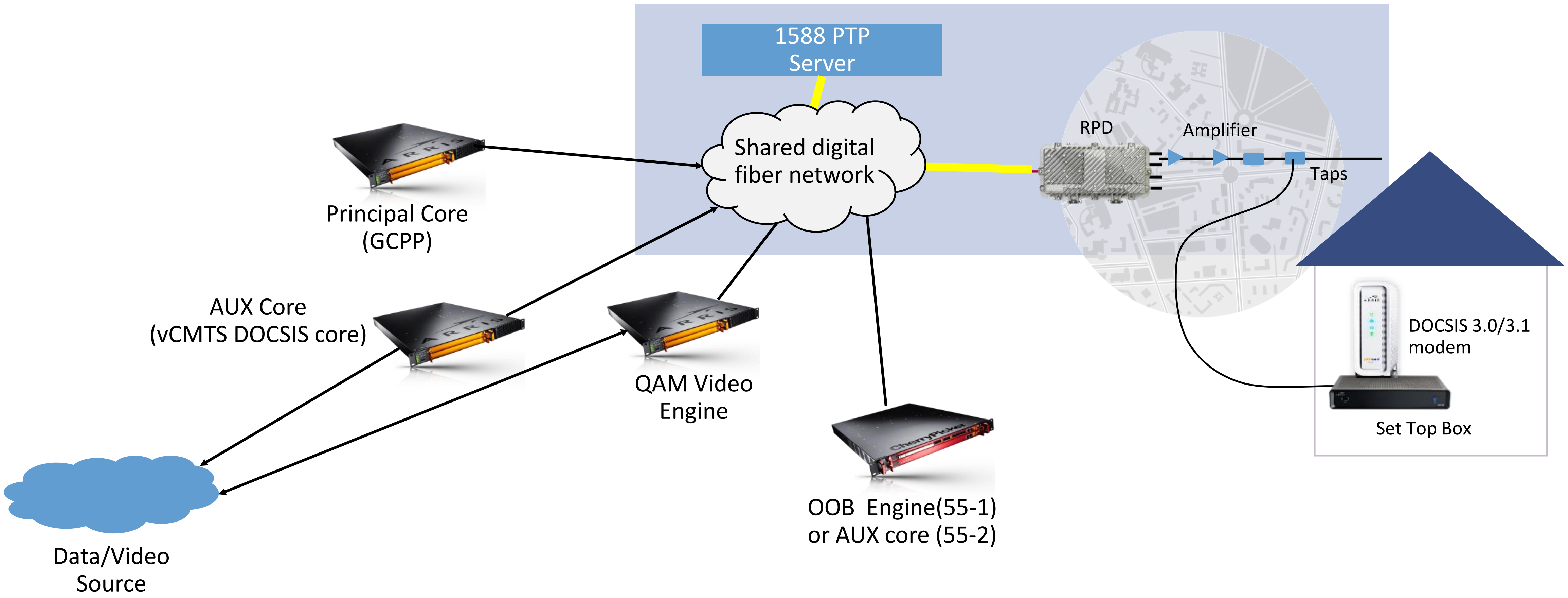
If we go Node + 0, then 16384 QAM is theoretically possible



CURRENT ACCESS NETWORK –



Remote PHY NETWORK (GCPP model) –



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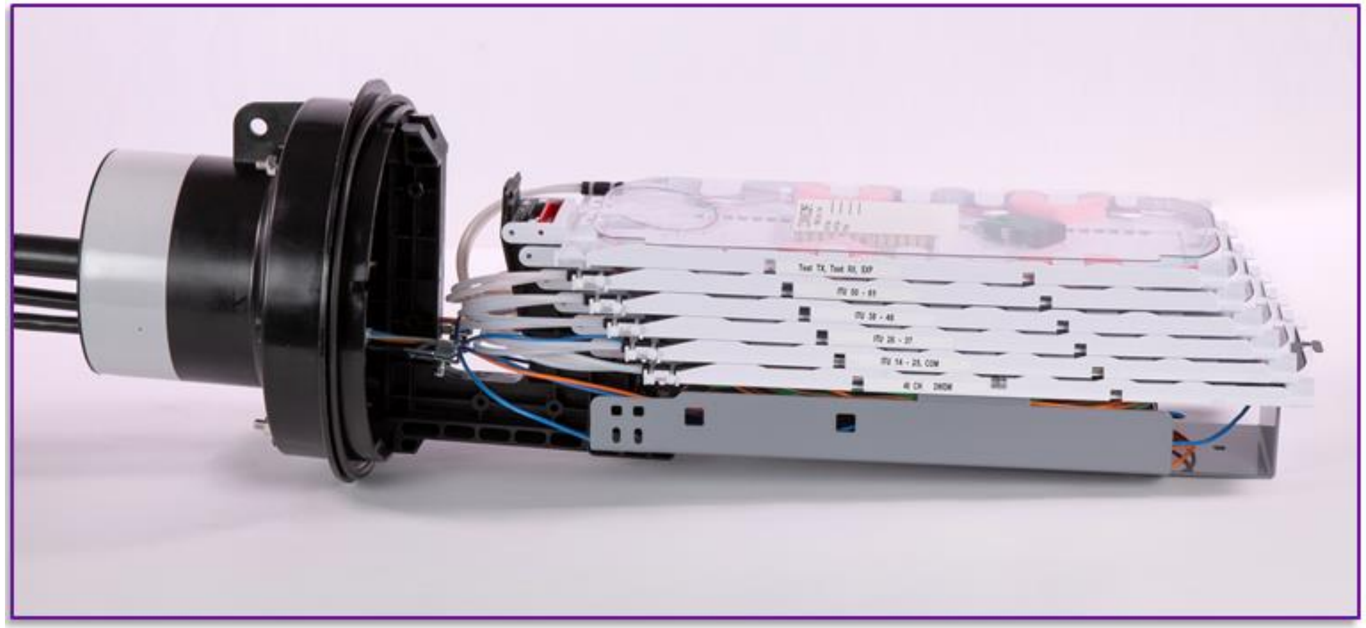
48CH ITU 14-61



SFP+ Fiber Optic Transceiver

FEATURES

- Provides long-haul 10G Ethernet optical transmission up to 80 km
- Supports ARRIS Remote Phy Device (RPD) and Remote OLT (R-OLT) DAA Solutions
- 10.3125 Gbps data Transmit/Receive operation
- Hot Pluggable SFP+ MSA footprint
- Duplex LC connector
- Very low jitter
- Metal enclosure for low EMI and durability
- Low power dissipation
- Extended industrial operating temperature range

10 G SFP+ Modules 40 Km and 80 Km Specifications DWDM

Arris Part Number	SFP+ Descriptiom	Optical Output Power	Receiver Sensitivity max	Optical Input Power
TTD4580-XX	10.3125 Gbps SFP+ DWDM Optical Transiver Module	-1.0 dBm	-24 dBm	-6.0 dBm

Remote PHY Module for OM6000

7-slot module for OM6000

1x1 (1 DS x 1 US) configuration

1x2 (1DS x 2US) Module available

1.2GHz downstream upper edge

- Up to 5 OFDM @ 192MHz
- Up to 128 Annex B or 96 Annex A SC-QAM (up to 1002MHz)

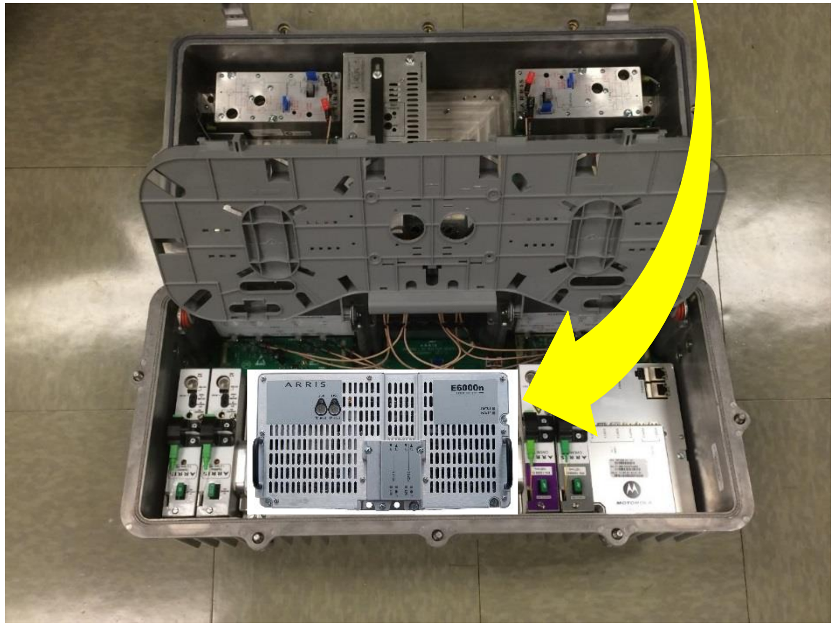
Downstream/Upstream Operational Bandwidth

54-1218 MHz	5-42 MHZ US
85-1218 MHz	5-65 MHz US
102-1218 MHz	5-85 MHz US
258-1218 MHz	5-204 MHZ US

- Up to 2 OFDMA @ 96MHz per upstream
- Up to 12 ATDMA (up to 85MHz) per upstream

DOCSIS 3.1/3.0 and Broadcast/Narrowcast video

Dual SFP+ cage



E6000r High Density R-PHY Shelf – Overview

1RU height shelf, 19” rack-mountable and stackable

Datacenter environment $0^{o}C$ to $+50^{o}C$

6 hot swappable fans providing front to back cooling

AC or DC Power Supply Units, dual redundant and load-sharing

Hosts 8 x HD Shelf RPDs (1x2 DS:US)

- 24 x F connectors at the back, providing up to a total of 8 DS-SG x 16 US-SG
- 2 x SFP+ cages per RPD
- Full spectrum DOCSIS 3.0/3.1
- RPDs managed via the CCAP Core

Local console port

High Density Shelf RPD – Hardware Capabilities

1 x 1 configuration support (1 DS-SG x 1 US-SG)

1 x 2 configuration support (1 DS-SG x 2 US-SG)

2 x SFP+ cages

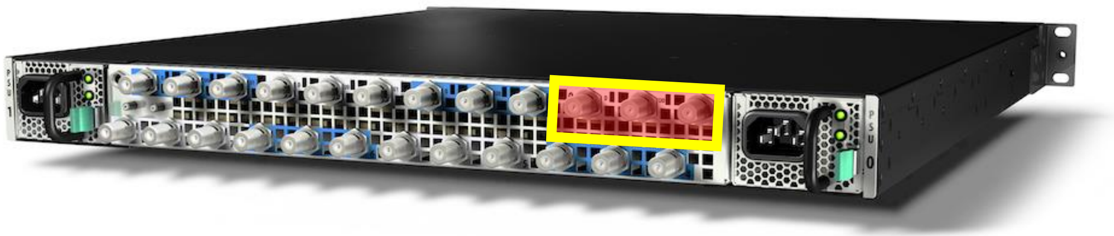
- 2 x 10Gbps
- Daisy-chaining

1 x DS-SG, up to 1.2 GHz

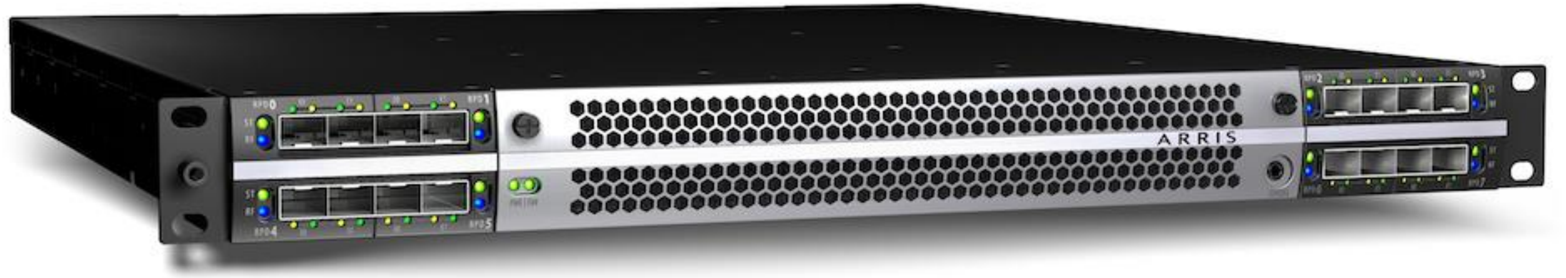
- Up to 5 OFDM DS @ 192 MHz
- Up to 128 Annex B or 96 Annex A SC-QAM
- I-CCAP DRFI spec compliant power levels

2 x US-SG, up to 204 MHz

- Each US-SG up to 12x SC-QAM + up to 2x 96MHz OFDM



High Density R-PHY Shelf – Use Cases



Head-ends and hub sites, especially where power space and cooling is a challenge

- MAC Core located at a remote site

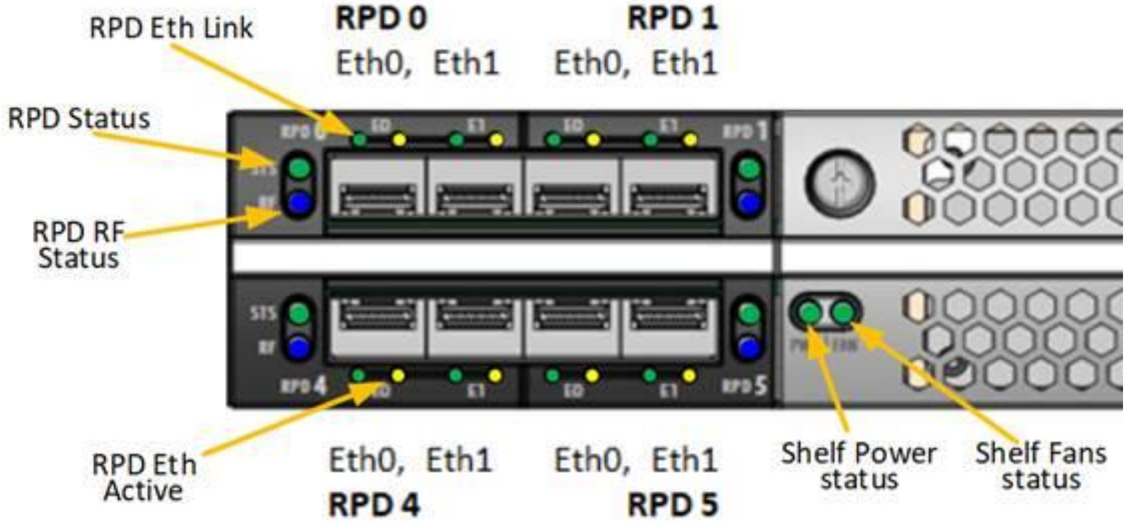
Replacement of legacy CMTS infrastructure,

- Overcomes channel density limitations and adds DOCSIS® 3.1 capability

Adds local serving group capability to MAC Core only products

- HD R-PHY Shelf and MAC Core in the same location

LED Status


RPD Eth Link
RPD 0
Eth0, Eth1
RPD 1
Eth0, Eth1
RPD Status
RPD RF Status
RPD Eth Active
Eth0, Eth1
RPD 4
Eth0, Eth1
RPD 5
Shelf Power status
Shelf Fans status

RPD LED Descriptions and Behavior

The following tables describes the RPD module’s LEDs and their associated behavior

LED LABEL	FUNCTION
STATUS LED	**Indicates general module status.** Off — Module is not receiving power **Slow Blinking Green(2 Hz)** — Module is initializing to the network **Fast Blinking Green (4Hz)**— IP address acquired **Solid Green** — Timing and configuration is complete and the module is operational

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RPD LED Descriptions and Behavior

The following tables describes the RPD module's LEDs and their associated behavior

LED LABEL	FUNCTION
POWER LED	**Indicates general power status.** Off — Module is not receiving power Solid Green — The module is receiving power and is operational Solid Red — Power Supply fault

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RPD LED Descriptions and Behavior

The following tables describes the RPD module's LEDs and their associated behavior

LED LABEL	FUNCTION
RF LED	**Indicates general power status.** Solid Green — RPD is configured for 1x1 Operation Solid Blue — RPD is configured for 1x2 Operation Solid Red — No upstream channel in service

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RPD LED Descriptions and Behavior

The following tables describes the RPD module’s LEDs and their associated behavior

LED LABEL	FUNCTION
SFP+ Link LED	**Indicates general power status.** Off — RX link fault or fiber is missing Solid Green — RX Link is up

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RPD LED Descriptions and Behavior

The following tables describes the RPD module's LEDs and their associated behavior

LED LABEL	FUNCTION
SFP+ Activity LED	**Indicates general power status.** Off — No data activity Solid/Flashing Yellow— Data activity is present (Note: at high data rate the LED may appear to be on steady)

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HD Shelf RF Output

Number of Channels	DRFI+3 Power per Channel (dbmv)	DRFI+3 Total Composite Power (dbmv)
16-17	48	59.8
18-21	47	59.6
22-26	46	59.4
27-32	45	59.3
33-38	44	59.2
39-47	43	58.9
48-57	42	58.8
58-69	41	58.6
70-83	40	58.5
84-101	39	58.2
102-123	38	58.1
124-149	37	57.9
150-181	36	57.8
182-194	35	57.6

RPD LED Descriptions and Behavior

The following tables describes the RPD module's LEDs and their associated behavior

LED LABEL	FUNCTION
FAN LED	**Indicates general power status.** Off —No Power **Solid Green** — Fan Operating Normal **Solid Red** — Fan Failure detected **Solid Yellow** — High Temperature Detected for Chassis or RPD

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Lesson 2

OM6000 Housing Mechanical Description

OM6000 Next Gen Optical Node
Fiber Deep/Segmentation/FTTx/DAA (Distributed Access Architecture

1.2 GHz Fiber Deep & HFC
Segmentable Optical Node

Fiber Deep (High Output)

64dBmV RF Output level @ -8dBm Optical Input

Segmentation 1x1/2x2

Optical module commonality with OM4100/OM2741 (selected optical modules)- 34 Volt DC

Electronic Return Segmentation Capability Return Only (Reason: too much loss in the forward config board)

1x85 & 2x85 MHz Digital Return with Service Group Aggregation and Opti-Trace integration

HFC (Standard Output)

56dBmV RF Output level @ -8dBm Optical Input

Segmentation 1x1,2x2, 4X4

Optical module commonality with OM4100/OM2741 (All optical modules)- 24 Volt DC

Electronic Forward and Return Segmentation Capability Return

1x85 & 2x85 MHz Digital Return with Service Group Aggregation and Opti-Trace integration

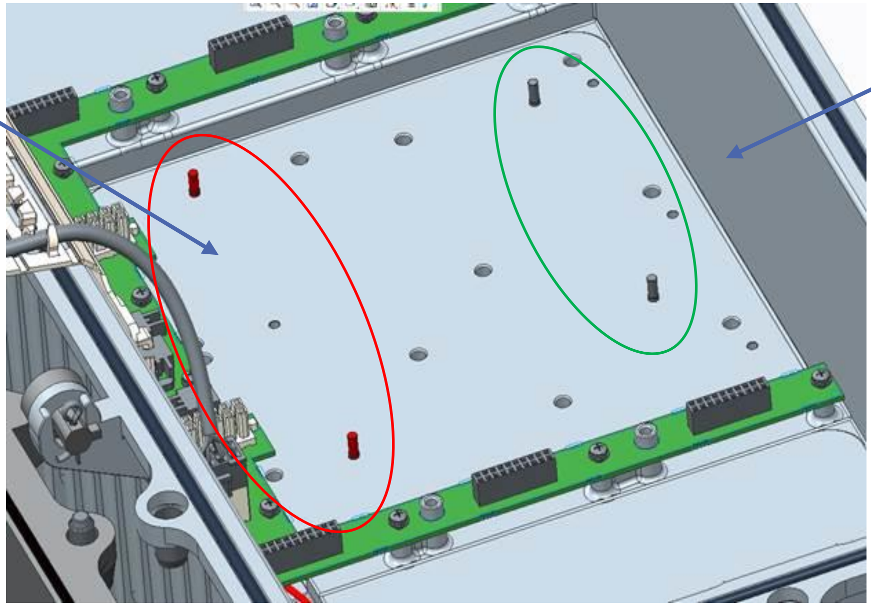
Node Model ID Stickers

Place one label on the base and two, left and right sides, on the lid of the housing

Fiber Deep/BAU(HFC) Node Mechanical Compatibility 1 of 3

Power Supply Guide Pins for HFC

Power Supply Guide Pins for Fiber Deep



Base

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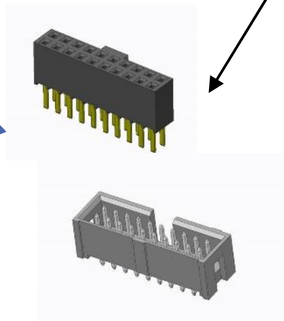
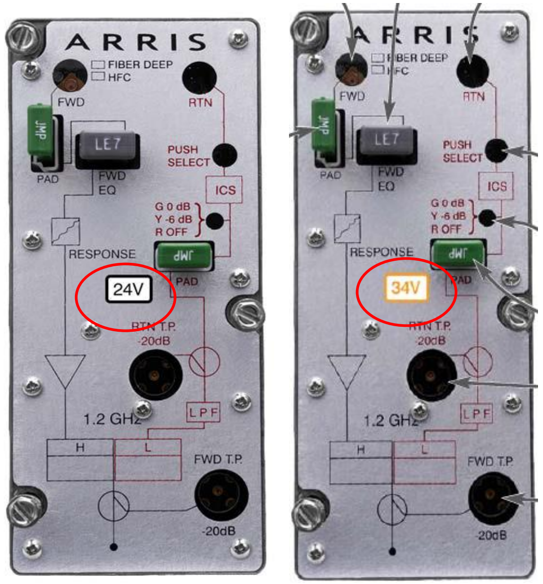
Fiber Deep/BAU(HFC) Node Mechanical Compatibility 2 of 3

FD RF Modules Keyed Connector Rotated 180°





- Designed to preclude accidental mixing of FD & HFC modules
- Modules labeled to indicate supply voltage compatibility.
- Guide pin locations are used to prevent insertion of incompatible modules.

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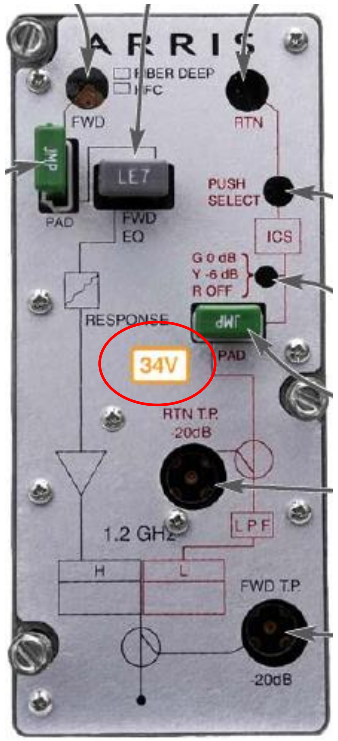
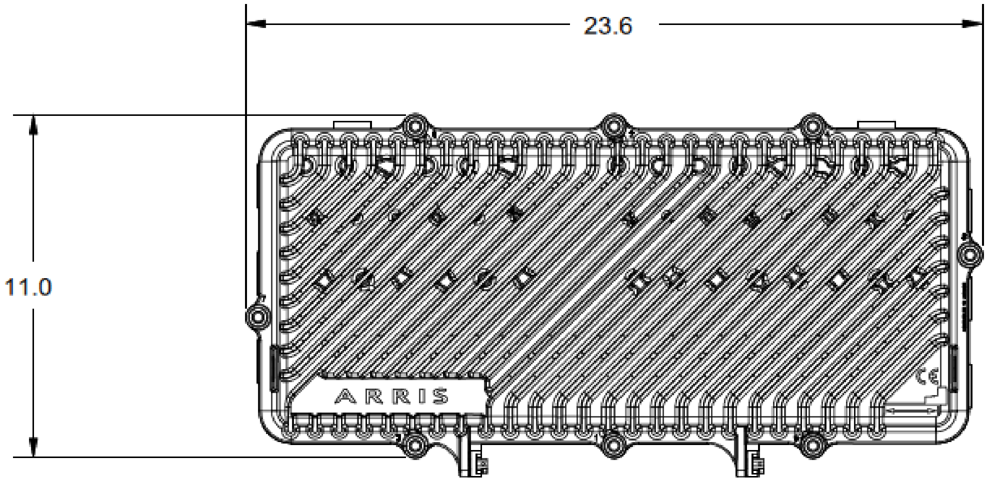
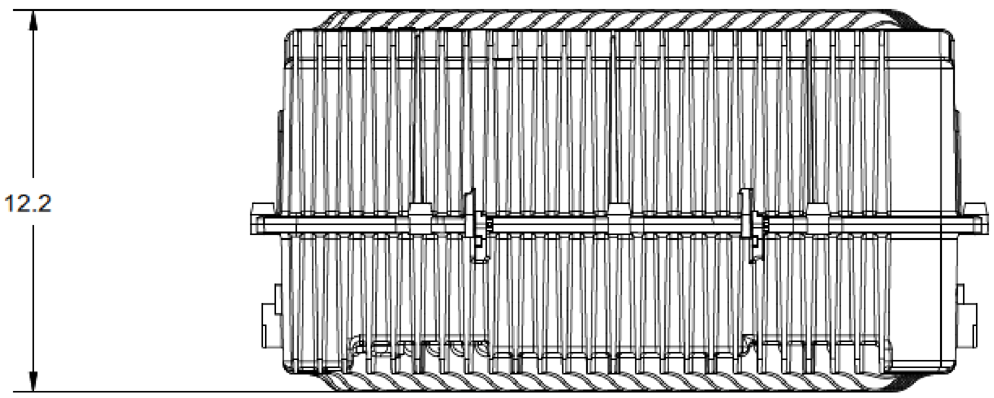
Fiber Deep/BAU(HFC) – Product Labeling



OM6000 Exterior Dimensions and Weight





Approximate Weight

1x1 OM6 Fiber Deep: **41 Lbs**
1 RX
1 DRT 2X
1 PS

2x2 OM6 Fiber Deep: **43 Lbs**
2 RX
1 DRT 2X
1 PS

4x4 OM6 HFC w/Digital Return: **45 Lbs**
4 RX
2 DRT 2X
1 Daughter card
1 PS

4x4 OM6 HFC w/Analog Return: **47 Lbs**
4RX
4 Tx
1 Daughter card
1 Transponder
1 PS

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OM4100 Dimensions for comparison

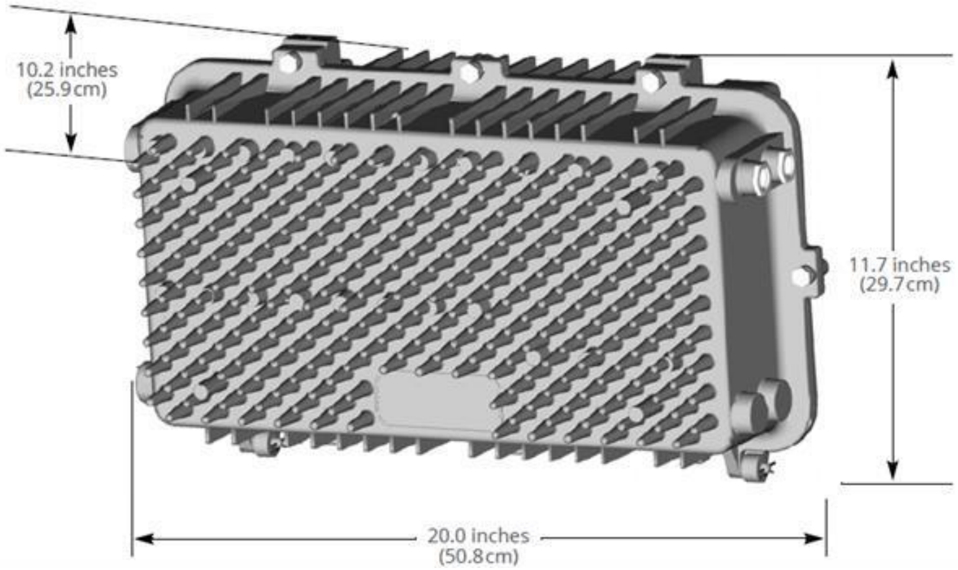
Table A.22 OM4100 Physical Specifications

Characteristic	Uncrated Measurement	Crated Measurements
Height	11.7 inches (29.7cm)	15.3 inches (38.9cm)
Width	20.0 inches (50.8cm)	23.25 inches (59.1cm)
Depth	10.2 inches (25.9cm)	13.63 inches (34.6cm
Weight[1]	43 pounds (19.5kg)	45 pounds (20.4)

1. Approximate weight for a fully-configured node built with four forward receivers, four return transmitters, two power supplies, a transponder, and appropriate accessories.

Figure A.9

OM4100 Dimensions



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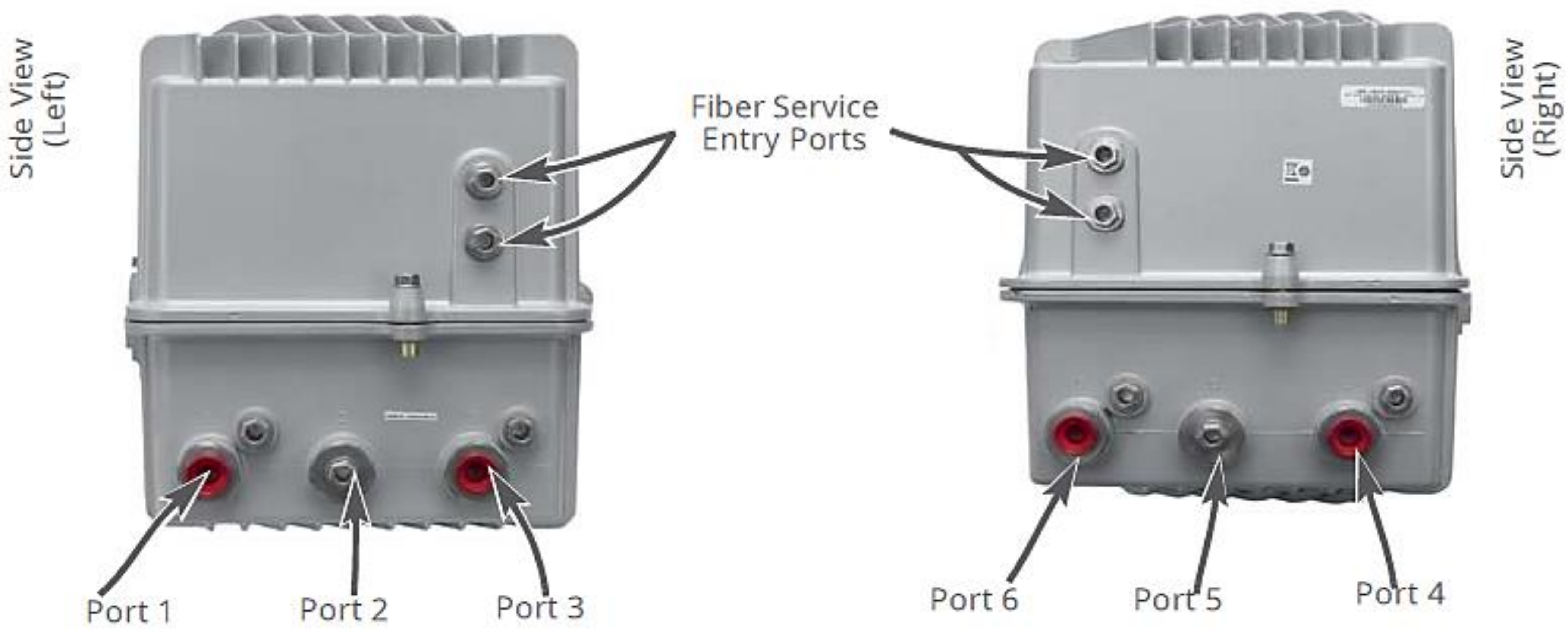
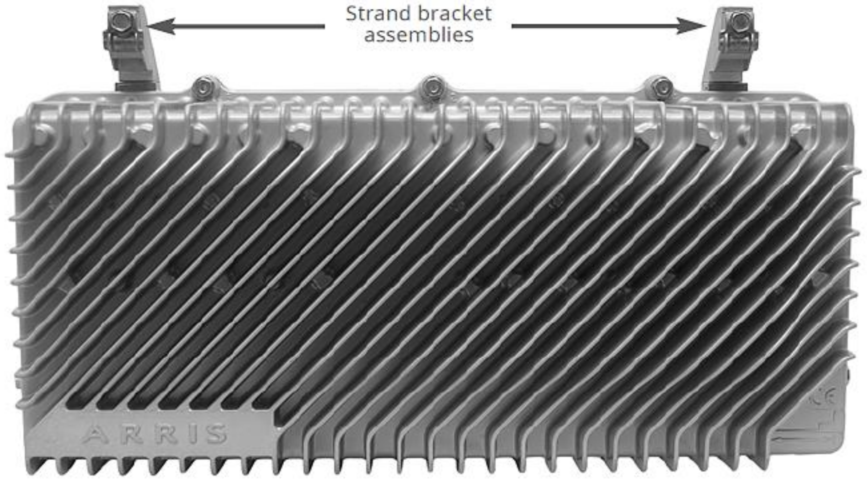
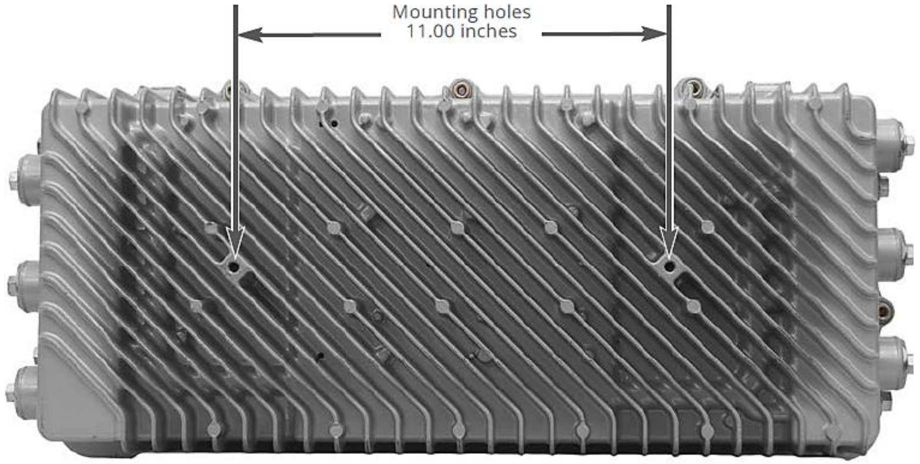
OM6000 Fiber Deep Side View



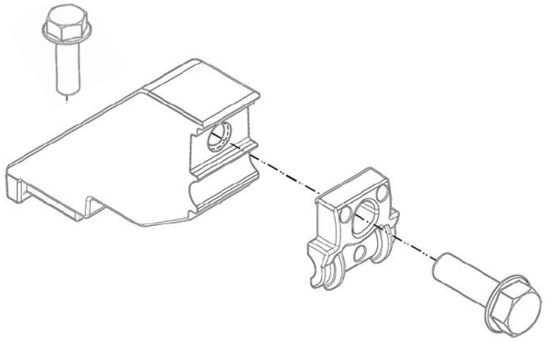
OM6000 Mounting the Housing





5X16” X .625” bolts

10-12 ft-lbs



5X16” X 1.0” bolts

10-12 ft-lbs

***CAUTION** ARRIS nodes are designed for an operating environment of -40°C to +60°C. The Mil Spec Hdbk 217 states that a 9°C increase in device operating environments will reduce the product’s reliability (and projected lifetime) by 50%. Therefore, you should take proper care to maximize airflow around the node and to minimize ambient temperatures, especially if you will be installing the node in an enclosed environment (e.g. pedestal, cabinet, etc.).*

OM6000 HOUSING COLOR

In mid-February 2018 timeframe new node housings will have a white coating.

Housings will retain same dimensions as first-generation housings.

Housings will still be manufactured from same materials.

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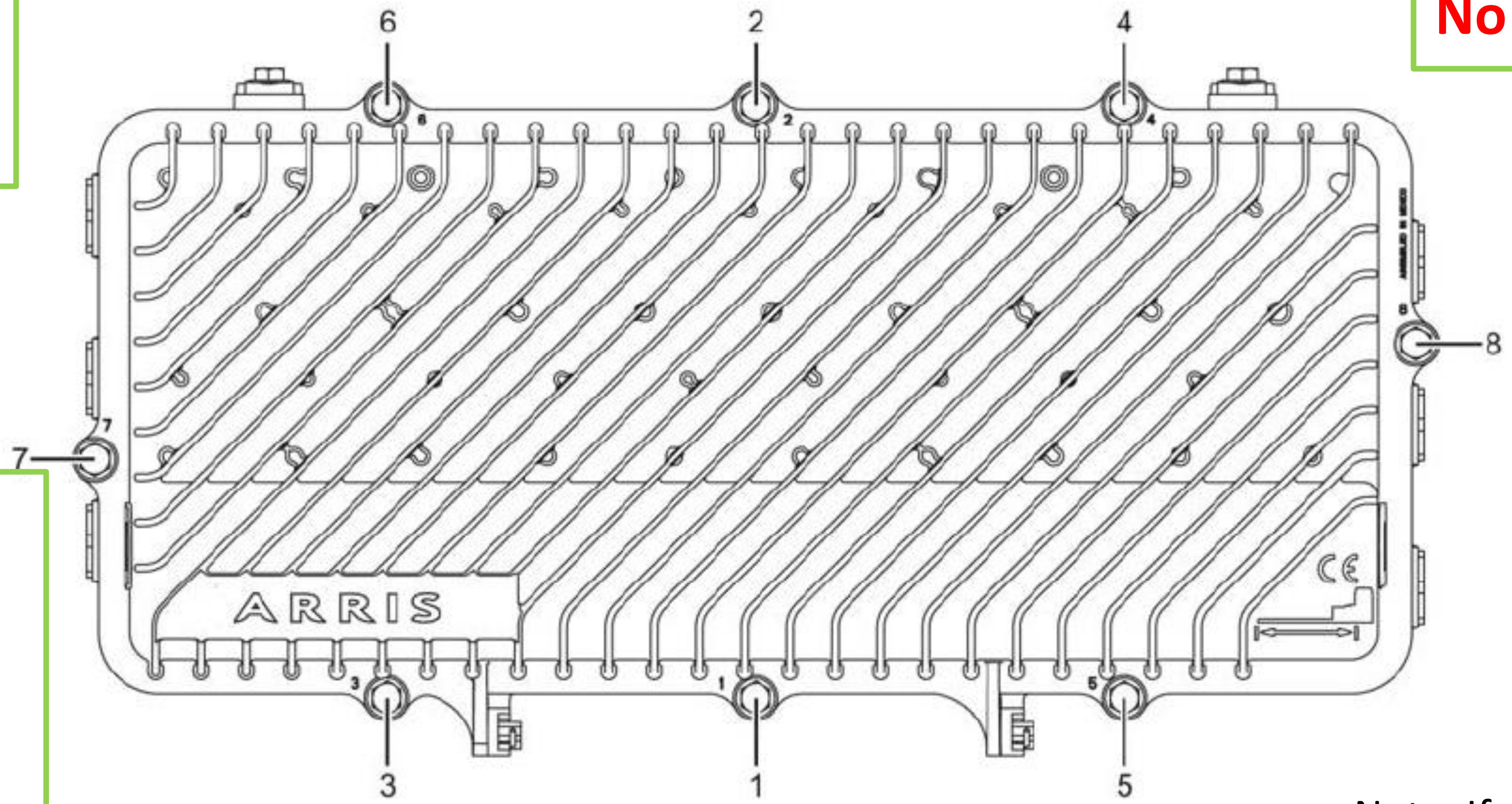
OM6000 HFC Closing the Housing

Use a long nut driver first to snug all bolts

No Drills !



Wipe RF gasket and rubber gasket with clean rag before closing

Make two passes with Torque wrench to ensure all bolts are torqued correctly

10-12 ft-lbs
120 to 144 inch pounds
13.56- 16.27 Newton Meters

Note: If a housing won't open it may be in a vacuum lock. Loosen test point cap to release pressure

Why it is important to follow Housing Closing Sequence

- Failure to do so and housing will not seal properly and could take on water.
- RF braided gasket will properly shield of any ingress. i.e. LTE cellular interference.
- Not closing the Node in the proper sequence could warp the Node housing then both the above could occur.

Note: Several OM6000 will go in an Underground Pedestal or Vault location which could be subject to flooding.

Housing Bolt Repair Kits

It is rare event, but should a bolt become damaged there are Replacement kits available.

Tech Tip 1510887 shows step by step how to replace Bolt and Rivnut

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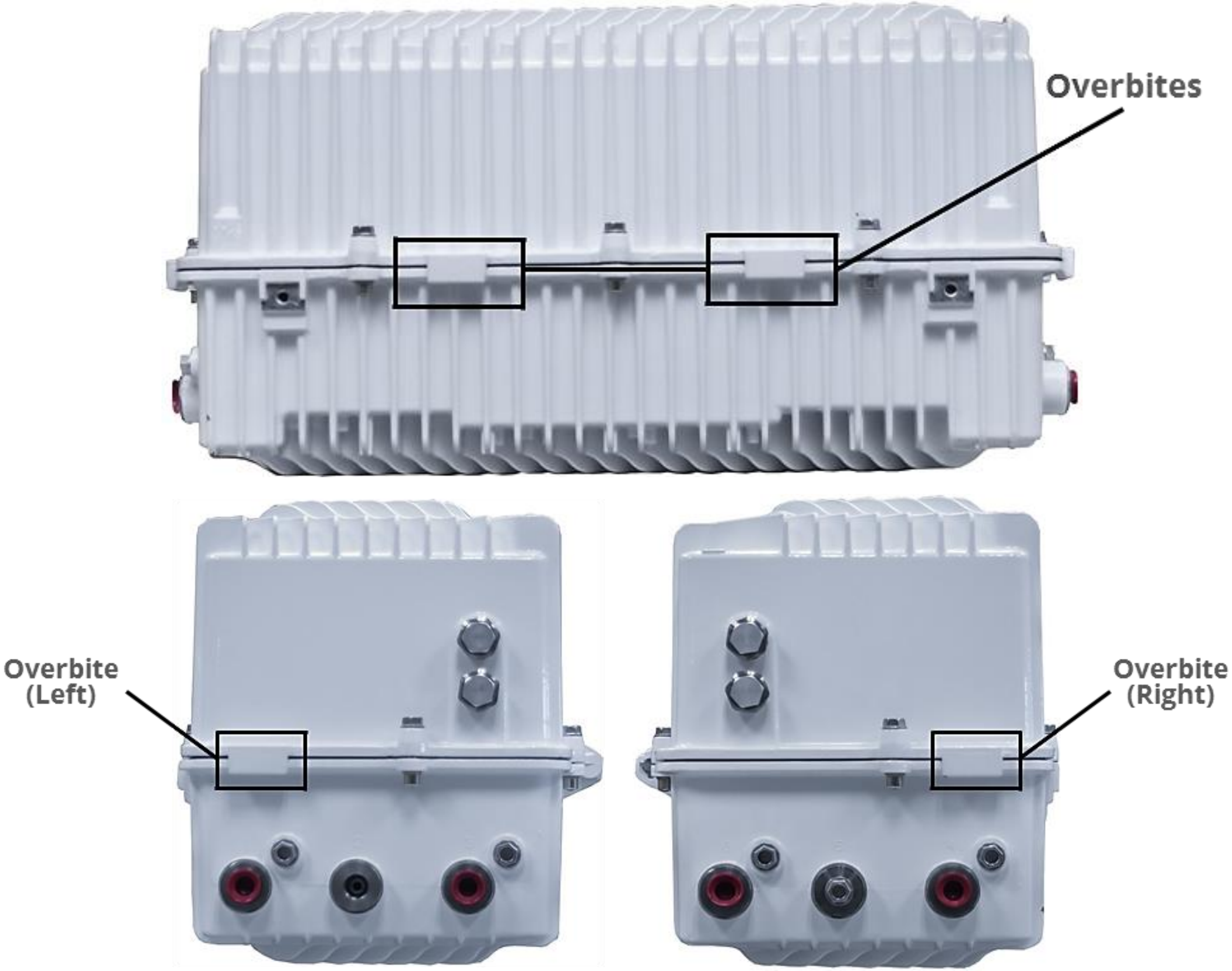
OM6000 HOUSING DESIGN ENHANCEMENTS

Housing “Overbites”

- New housings have “overbites” to assist with alignment of Lid bolts to Base holes when closing and tightening housing

- Improved alignment allows users to easily start threading bolts without lifting lid or applying added force during bolt tightening sequence.

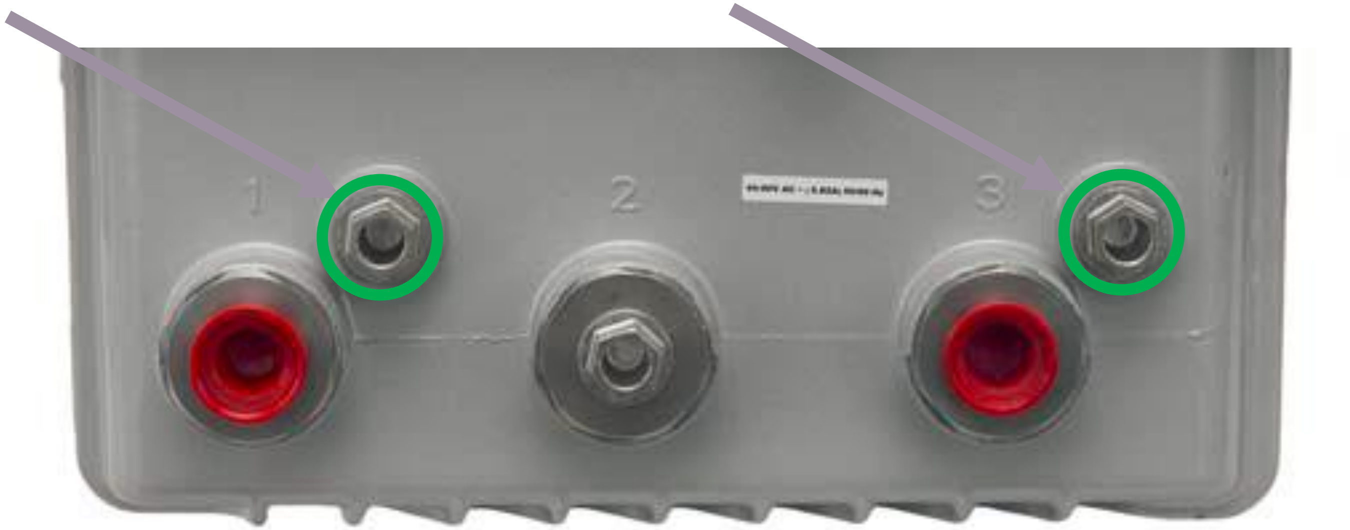


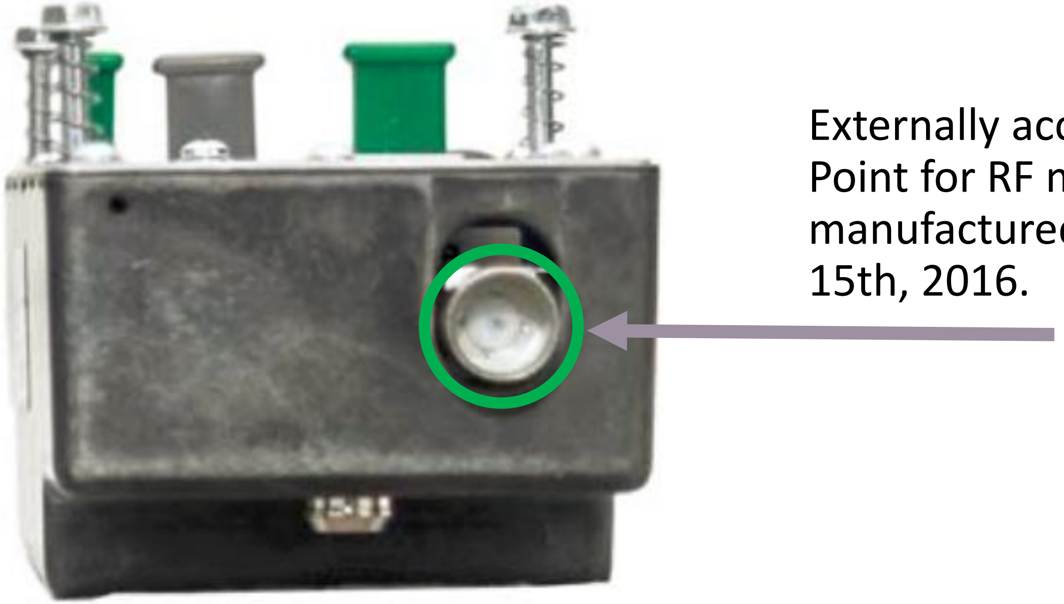
Externally Accessible Forward Test Points

OM6000 RF Modules manufactured after July 15, 2016 are equipped with Forward –20dB RF Test Points that are accessible through
the Housing's Test Point caps.

These modules still have the original Forward Test Point,
as well.

Be careful not to use both TP ports on each brick at the same time. Your measurement will be inaccurate due to double termination





Externally accessible Test Point for RF modules manufactured after July 15th, 2016.

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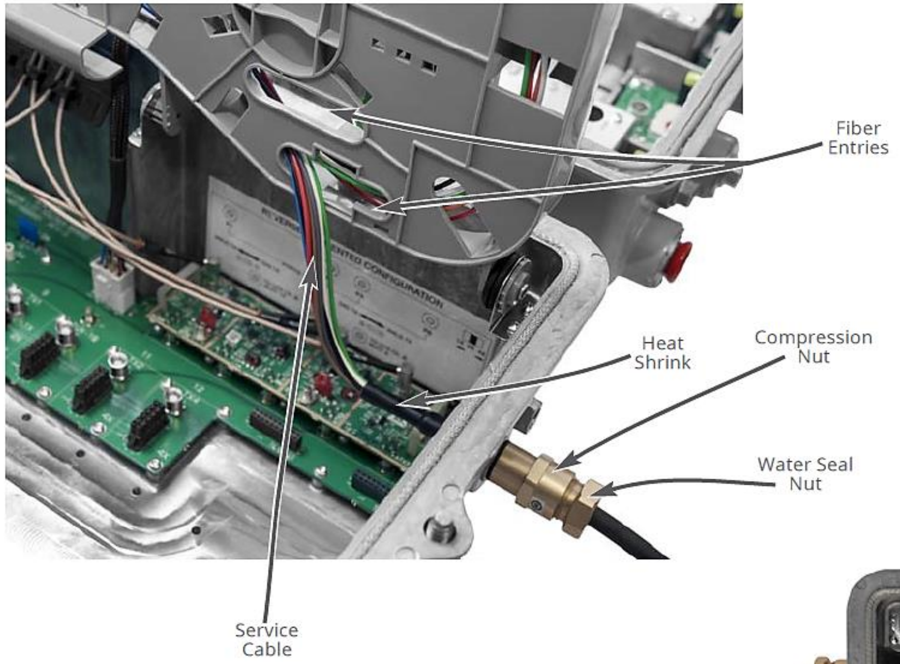
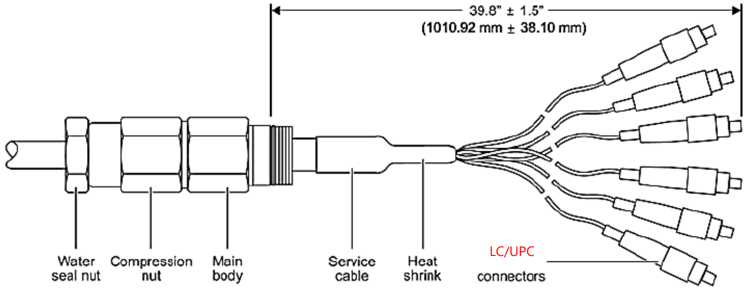
Lesson 3

OM6000 Fiber and Coaxial Entry

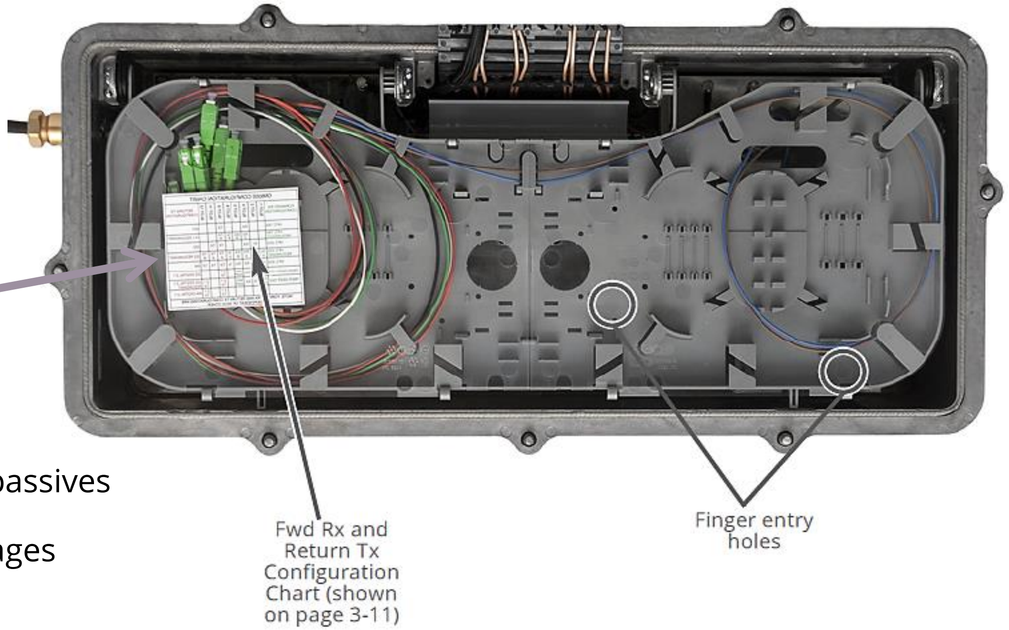
OM6000 Fiber Service Cable Installation





LC/UPC

connectors



- Tray Features
  - 6 SC to SC Adaptor locations
  - 4 MPO Adaptor Locations
  - 6 SC Connector Locations
  - 6 Splice Protector Locations
  - 6 5mm Splice Tube Locations
- Ample space to accommodate service cables, connectors, and passives
- Locking friction hinge
- Captive features for two different styles of optical passive packages
  - Two smaller flat packs can be installed with plastic pins

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Fiber Entry Ports

New node housing has improved fiber connector entry port design

New fiber entry ports create extra surface area between the housing wall and fiber receiver entry cable connector

Allows fiber connector shrink boot to seal along entire length from cable, up over connector, and onto fiber entry port

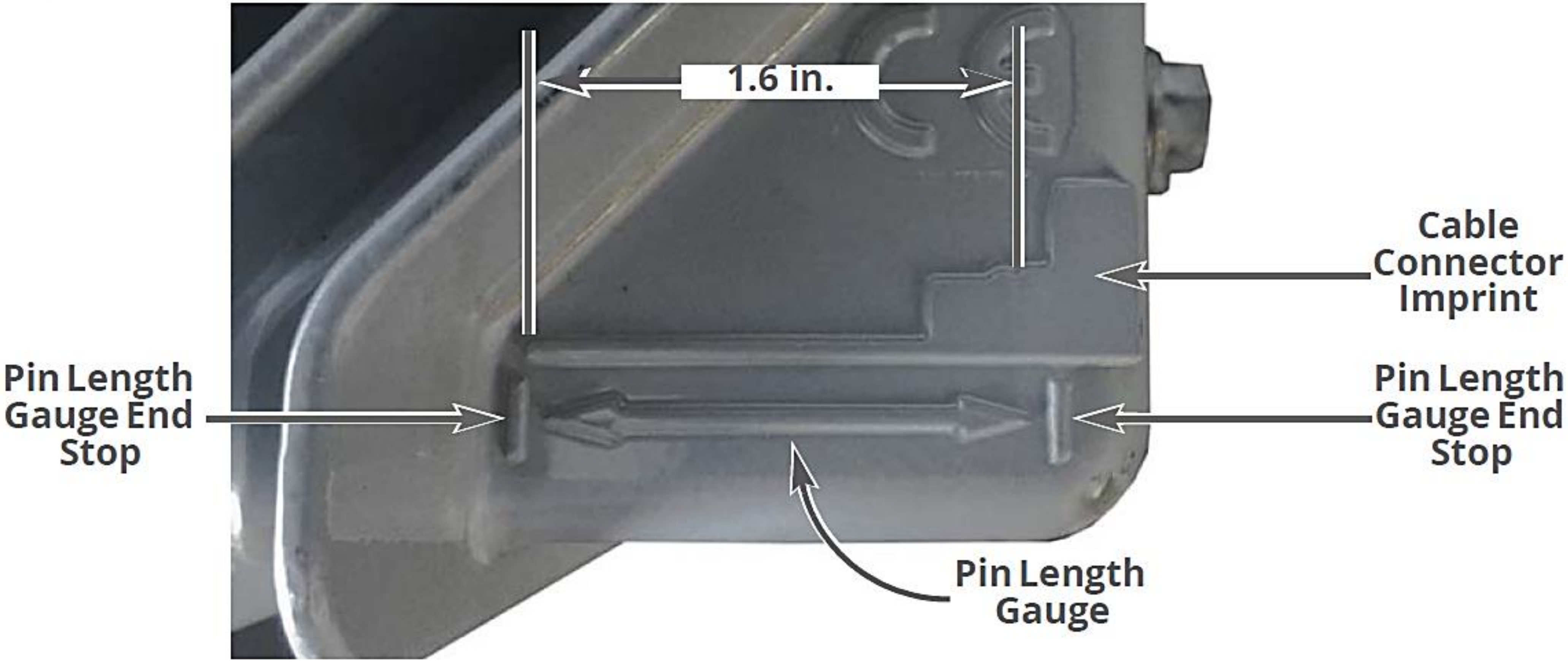
Seal ensures entire connector from housing wall to fiber cable jacket is completely weatherproof

Old Fiber Entry Ports

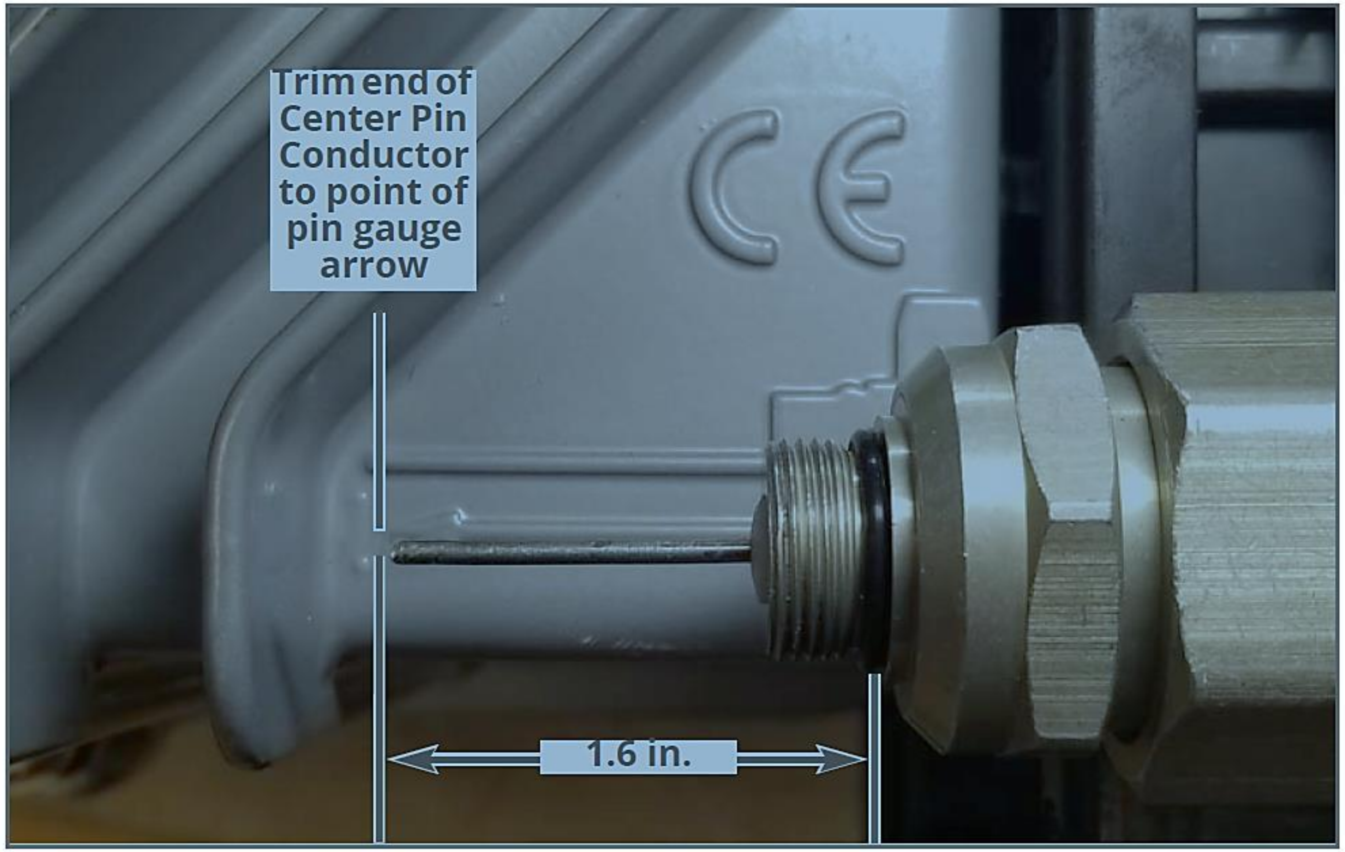
New Fiber Entry Ports

OM6000 Pin Length Gauge

OM6000 Pin Length Gauge and Cable Connector Imprint



OM6000 Pin Length Gauge



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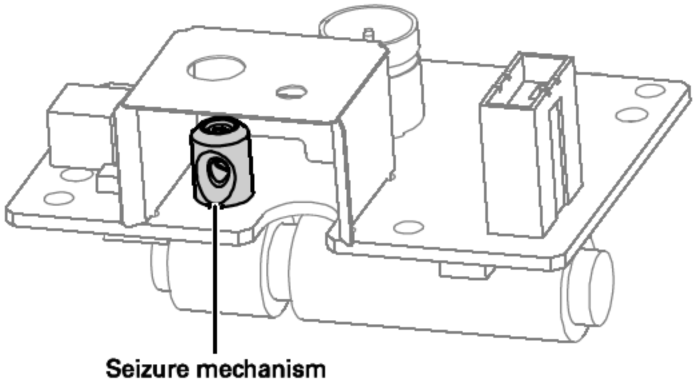
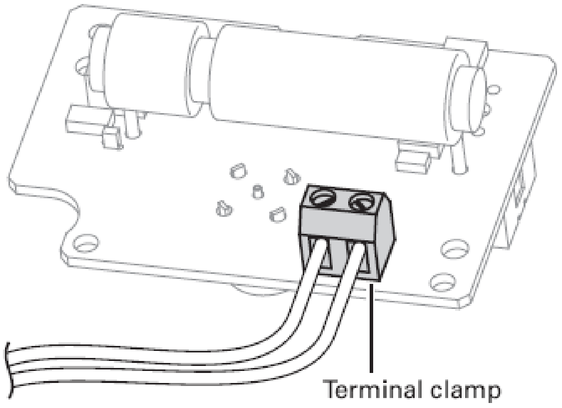
OM6000 HFC Coaxial Cable installation

1/16” hex-head “captive” seizure screw.
1 ft-lb Torque

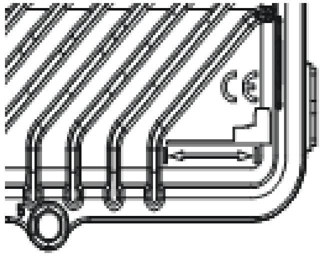
Seizure screw should come from factory in up position

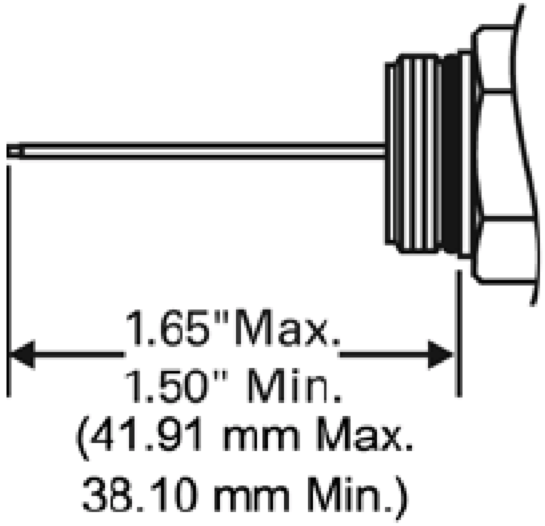




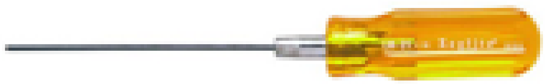
Important: **Ensure that you remove all power to the node before attempting to service the port entry board.**

Recommend exercising seizure screw down and then up before installing connector





Recommended Seizure Screw Tool Examples



Xcelite®

Allen® Type Hex Driver with 4" Blade, 1/16"

All-Spec #: LN21-12200 / MFG #: LN21N / Alternate Part #: LN21

Wera 05118076001 2054 Screwdriver for Hexagon Socket Screws for Electronic Applications, Hex-Plus. 1/16" x 60 mm

Wiha 96316 Precision Hex Inch Screwdriver, 1/16 x 50mm

17

If tool or seizure screw becomes stripped, it can create intermittent RF connections

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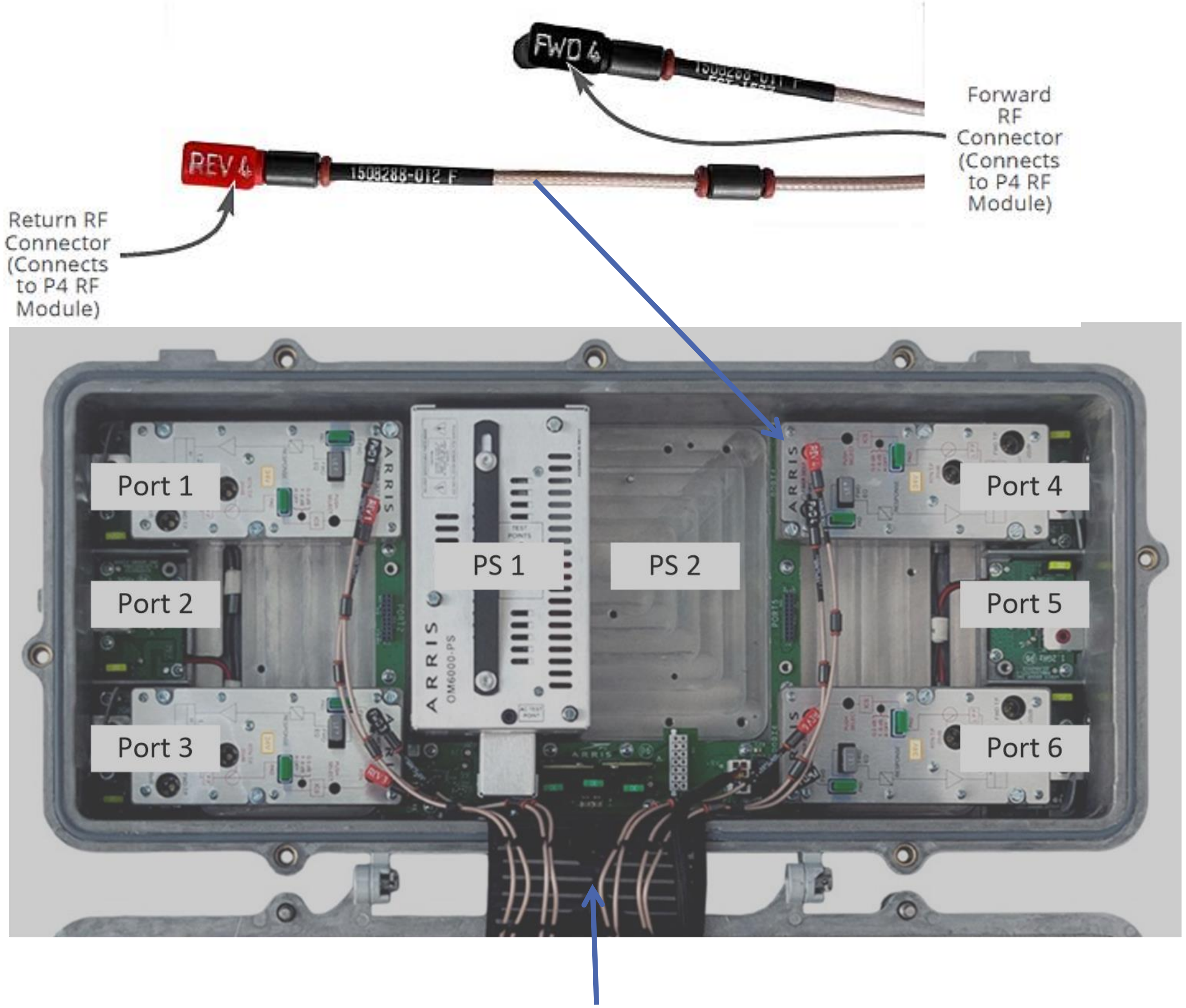
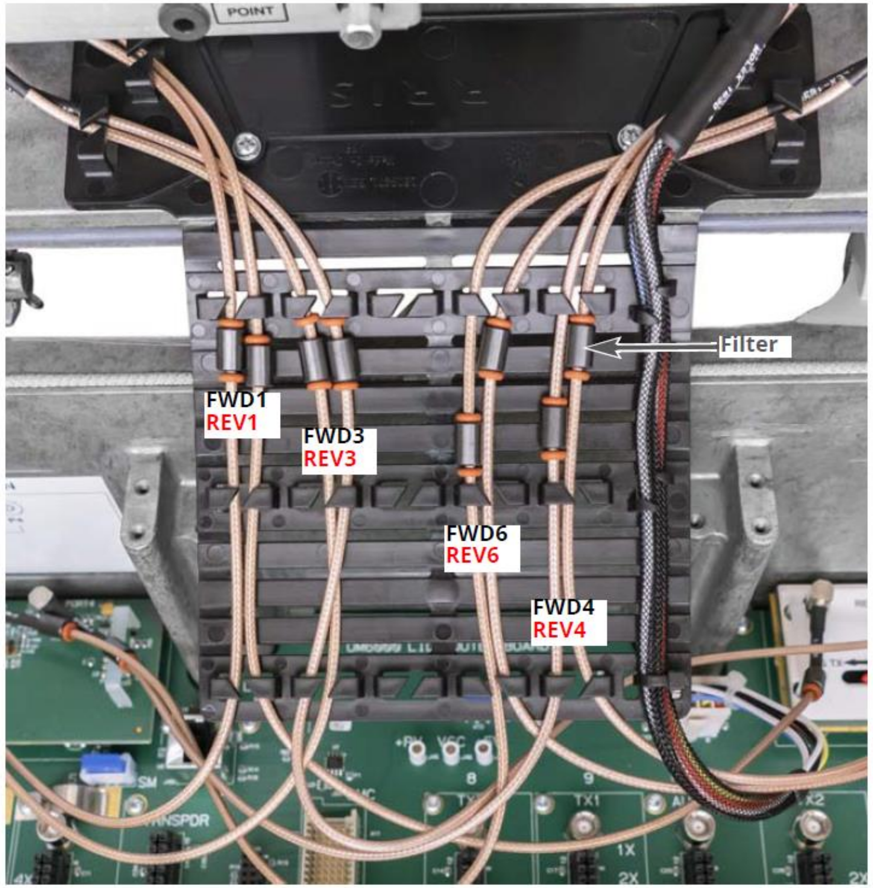
OM6000 Node Base



Cable Spline secures RF cables. All cables are installed day one!

OM6000 Fiber Tray Cable Shield

RF Cable Routing

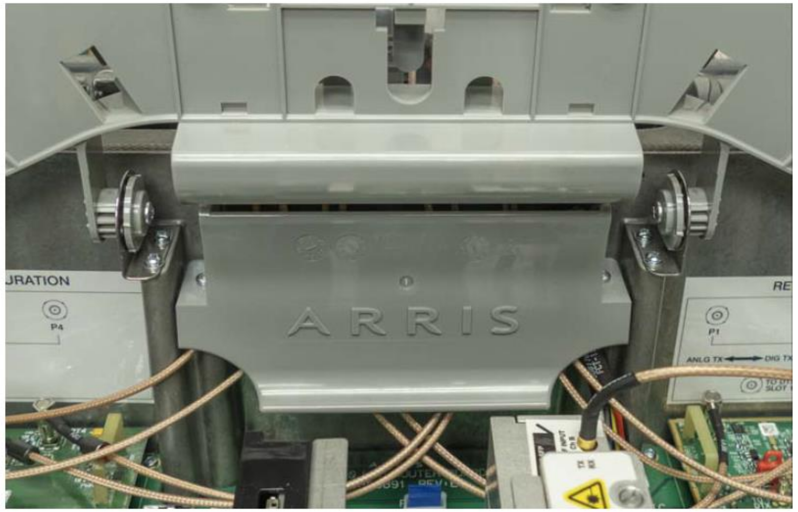


This depicts the current cable routing

OM6000 Fiber Tray Cable Shield Installed

Cable Shield Entry Holes

Installed Cable Shield



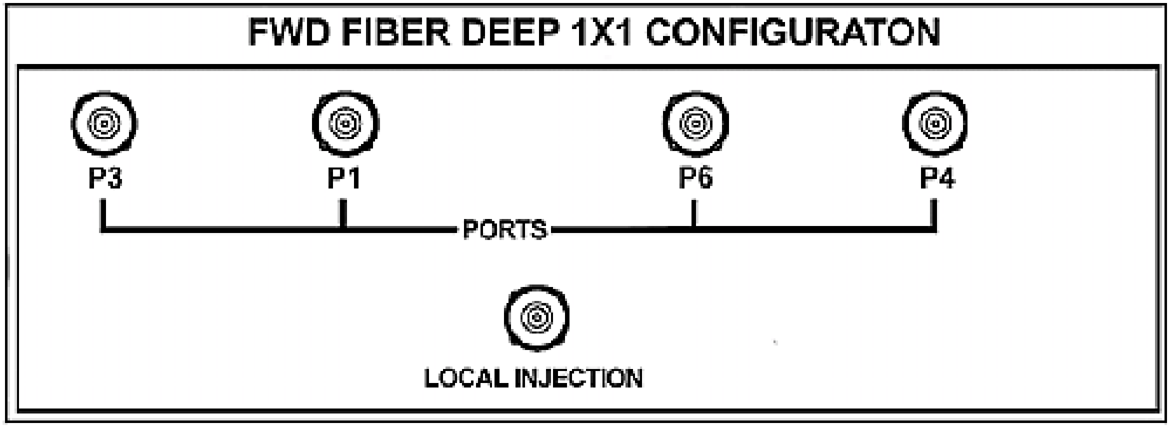
If your node was manufactured before August 2019, it did not ship with a cable shield installed. ARRIS, however, offers a Cable Guide Installation Kit (p/n OM6-GUIDE),

Lesson 4

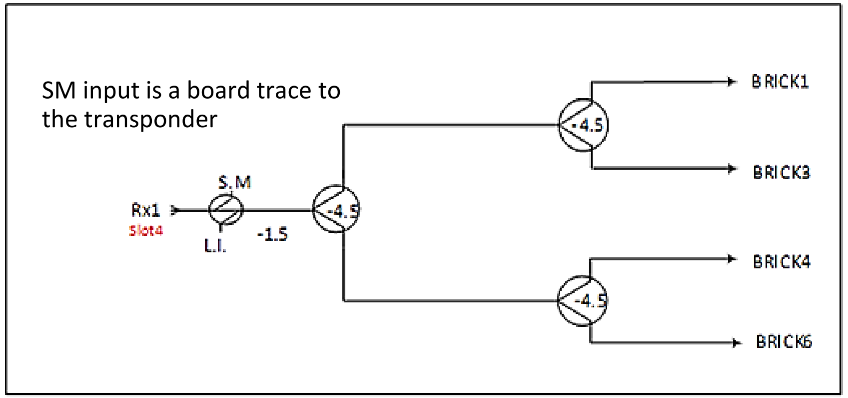
OM6000 Forward/Return Path

OM6000 Fiber Deep Forward Configuration Board (FCB)

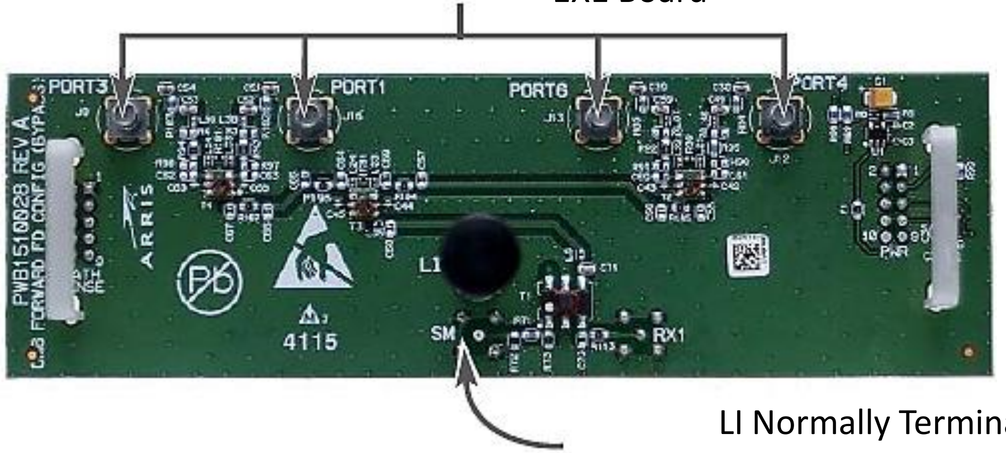
Label attached to Lid housing above configuration board



Forward N+0 1X Configuration Board

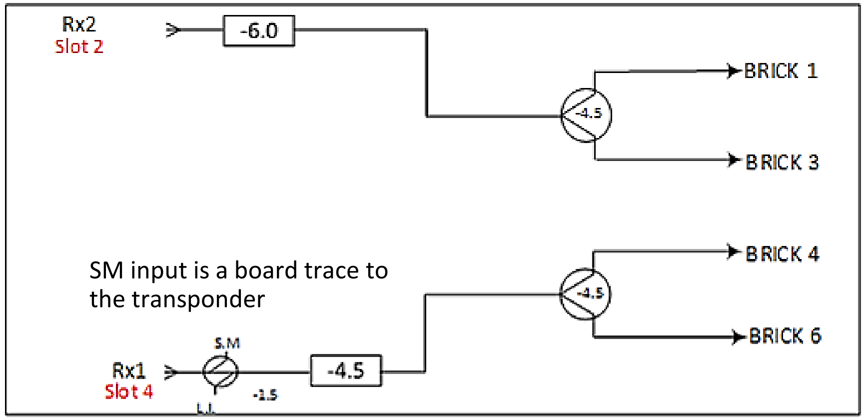


1X1 Board



LI Normally Terminated

Forward N+0 2X Configuration Board



Insertion of Local RF Feed

Table 3.10 1X and 2X Fiber Deep Forward Configuration Board Identification

Item	Label	Function
1	**PORT3 PORT1** **PORT6 PORT4** (RF Cable Connectors)	Connects forward path optical modules to RF modules via RF cables
2	**Local Injection Port**	Normally terminated. Injected signal is 16 dB below broadcast signal.

- Injection RF level should match adjacent Channel RF at OM6000 RPD Output

Local Injection Example @99 MHZ	
OM6000 RPD Output level from Chart at 100 MHZ	41 dBmV QAM
Loss of OM6000 Injection port	16 dB
QAM RF output of Local Modulator	57 dBmV QAM

Note: Not all QAM modulators are capable of this high of an RF output level

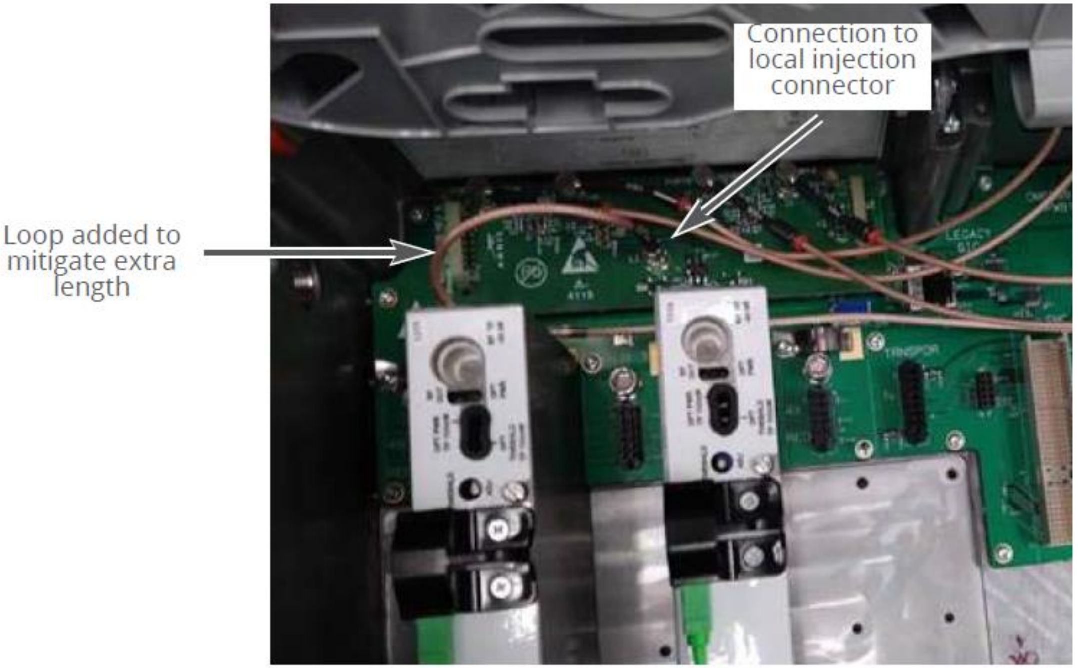
Local Injection Cable
(p/n 1511627-001)

Local Injection Cable

➤ *To install the local injection cable:*

1. Remove the port plug from an unused fiber entry port on the left side of the node lid. Refer to Figure 2.1 on page 2-2.
2. Feed the forward local injection cable through the port. Tighten the cable's port connector, torquing to 37 to 60 in-lb (4.2 to 6.8 N•m).
3. Remove the terminator from the forward configuration board's local injection connector.
4. Connect the local injection cable to the local injection connector. If necessary, add a loop to the cable to mitigate the extra length, as shown in Figure 3.8. You can secure the local injection cable to an RF cable using a tie wrap.

.8 shows a forward local injection cable connected to a forward configuration board's ection connector.



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RCB- Return Configuration Board

Figure 3.46

Redundant Return Configuration Board

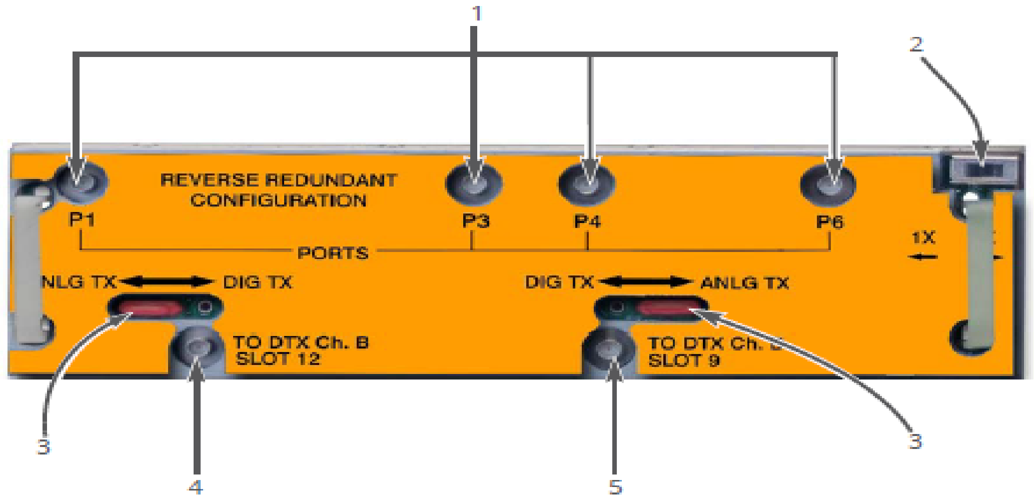
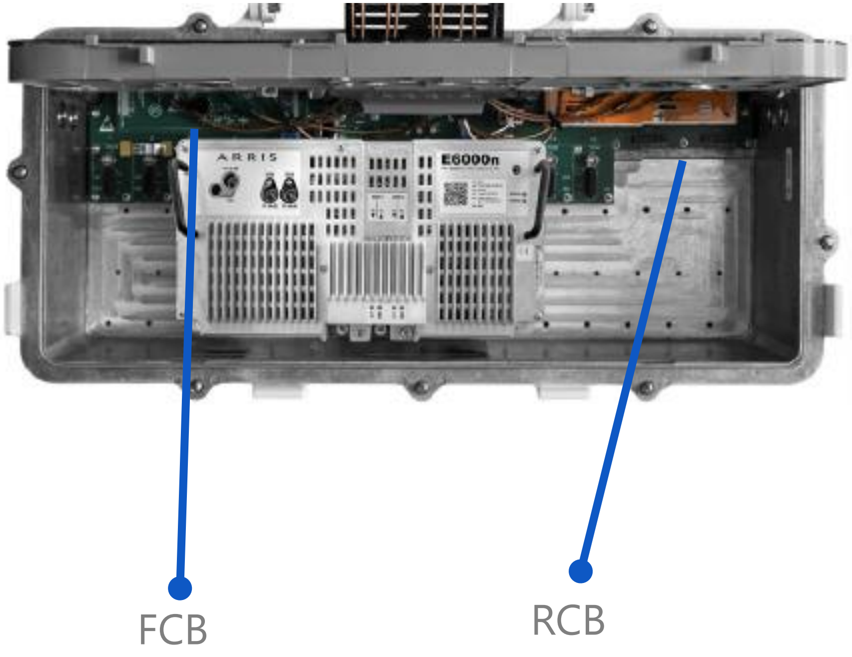


Table 3.36 Redundant Return Configuration Board Identification

Item	Label	Function
1	**P1 P3 P4 P6** (RF Cable Connectors)	Connects return path optical modules to RF modules via RF cables
2	**1X 2X** (Return Segmentation Switch)	Sets the return path segmentation as follows: ▪ Left switch position: 1X redundant segmentation ▪ Right switch position: 2X redundant segmentation
3	**ANLG TX/DIG TX** (Jumpers)	Supports return path transmitters as follows: ▪ Set each jumper to the outer position (shown above) for configurations using analog return transmitters ▪ Set each jumper to the inner position for configurations using digital return transmitters
4	**To DTX Ch.B Slot 12** (RF input connector)	(Digital Return Path Configurations only) Connects a digital transmitter in lid slot 12 to the return configuration board via a 5.5 inch RF cable.
5	**To DTX Ch.B Slot 9** (RF input connector)	(Digital Return Path Configurations only) Connects a digital transmitter in lid slot 9 to the return configuration board via a 5.5 inch RF cable.

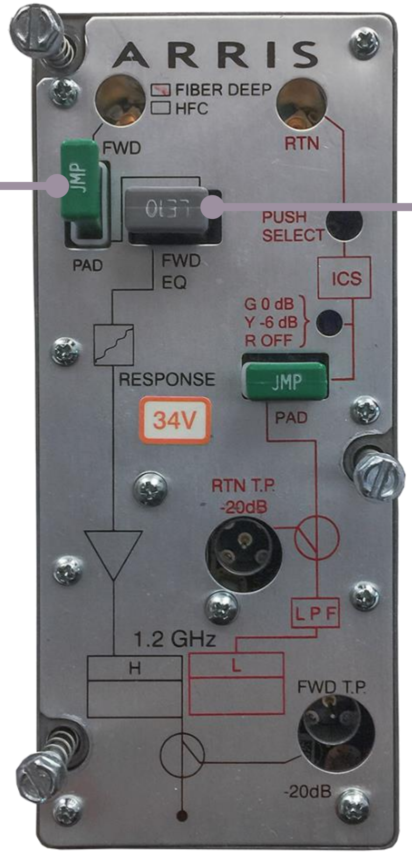


Configuring the RF Module

The RF modules are tested and configured in the factory to support maximum Fiber Deep output levels of 58 dBmV actual/64 dBmV virtual(analog equivalent) with 22 dB of tilt. Forward attenuation pads are factory selected for a range of 0 to 3 dB, in 0.5 dB steps, and forward equalizers are factory selected for a range of 10 ±1.0 dB. No further adjustments to the RF modules or the RPD module are required.

Example of Pre-configured RF Module

Forward Path Attenuator Pad (P/N NPB-000 shown)

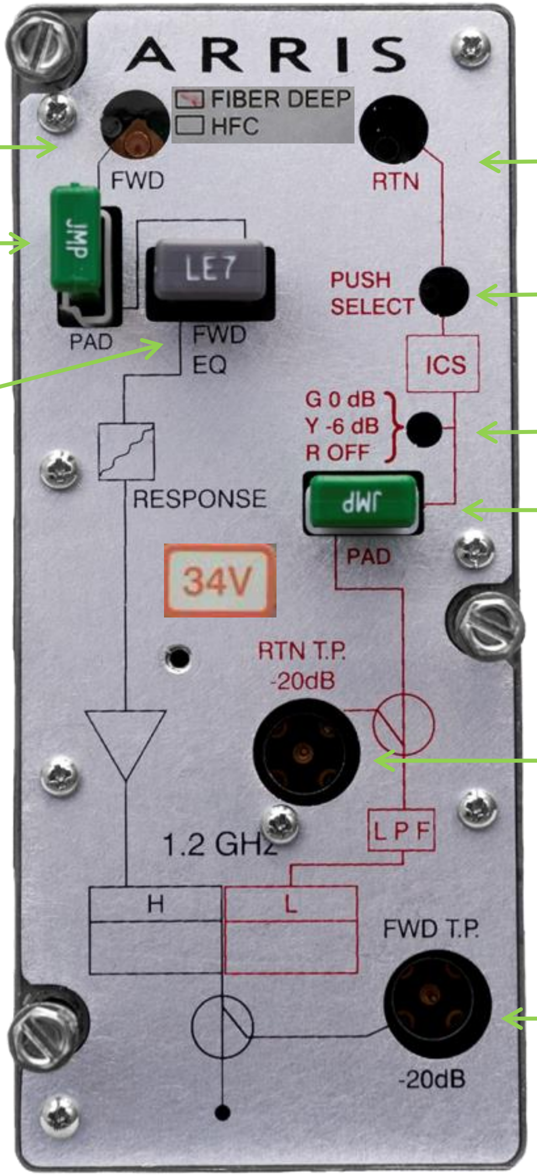


Forward Path Equalizer (p/n 1510053-xxx shown)

- Adjustable station slope at each port
- Plug in Diplex filter
- Thermal Comp
  - No AGC

Diplex Filter Upgrade

RF Module



PUSH SELECT	Sets the return path ICS attenuation value	- Push to toggle between the 0 dB and 6 dB attenuation state - Press and hold for 5 seconds to select the Off State - Press once to return to 0 dB Note: If left inactive after the Push button is pushed, the ICS will revert to 0 dB after 30 Minutes.
G 0 dB **Y –6 dB** **R OFF**	ICS LED	- Lights green when the return path attenuation is in the 0 dB state - Lights yellow when the return path attenuation is in the –6 dB state - Lights red when the return path attenuation state is off

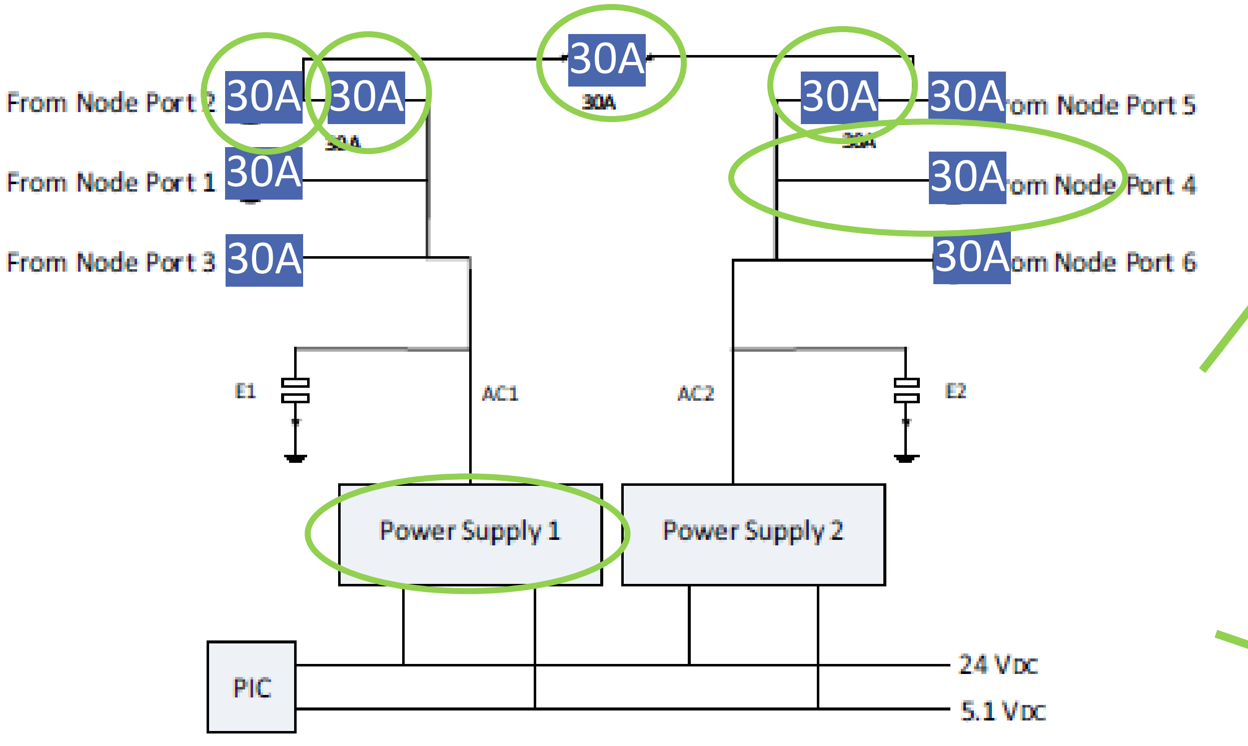
Lesson 5

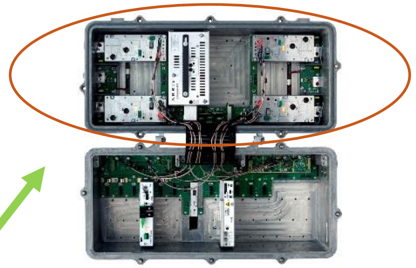
OM6000 Powering and RPD Installation

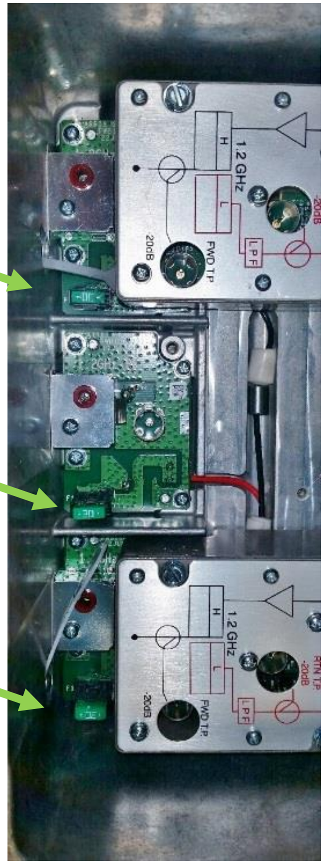
OM6000 HFC AC Power Distribution

Table 3.1 Power Distribution Board Identification (cont'd)

Label	Function
F1	Power Jumper; location for installing a 30A fuse when operating the node with a single network power source ▪ Installed — passes AC power from the left to the right, or from the right to the left, side of the node ▪ Removed — isolates the right and left halves so you can loop a different AC source through the side of the node that is not powered
F2	Passes AC power from Port 2 to the rest of the node
F3	Passes AC power from Port 5 to the rest of the node
PIC Connector	Passes power to the Lid Interface Board via the node's power cable (P/N 1508176-001)
PORT 1	Passes AC power to/from Port 1 of the housing base
PORT 2	Passes AC power to/from Port 2 of the housing base
PORT 3	Passes AC power to/from Port 3 of the housing base
PORT 4	Passes AC power to/from Port 4 of the housing base
PORT 5	Passes AC power to/from Port 5 of the housing base
PORT 6	Passes AC to/from Port 6 of the housing base







Supports independent AC source powering

PIC (Power Interface Cable) Carries DC and Communications from the base to the lid

All Six ports are rated for 15 amperes power passing (Factory installs 30 amp fuses)

E1

***CAUTION** Damaged fuseclips or misaligned fuses can cause heat damage. Do not force or misalign the fuse when installing.*

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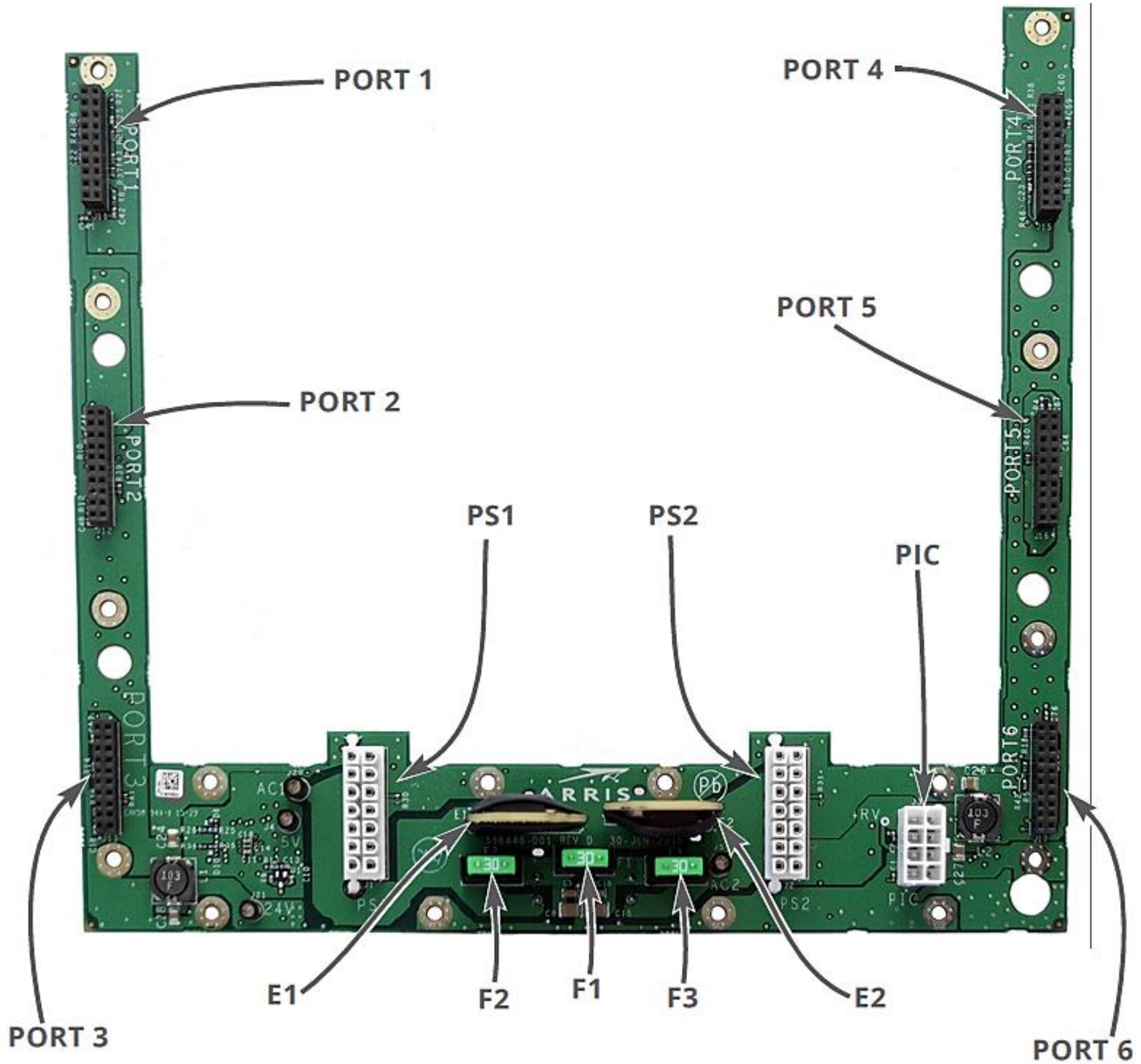
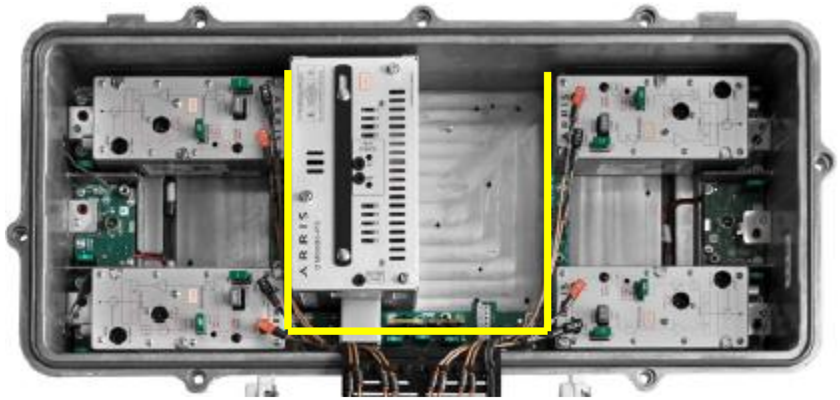
OM6000 Fiber Deep Power Distribution Board





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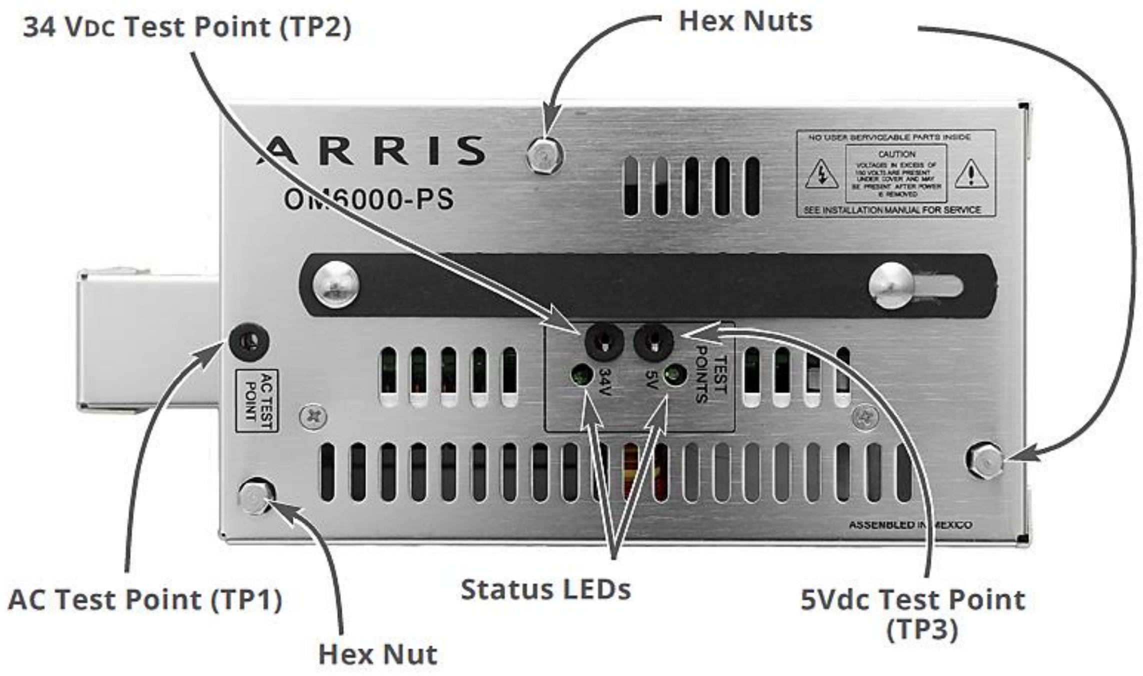
OM6000 34VDC Fiber Deep Power Supply

- High Capacity Power Supply
  - Single supply supports 2X2
- 2nd Supply for Redundancy (load sharing)
- Hot Swappable (Blind Mate Connections)
- AC Input Range: 42-90VAC



To Install Power supply:

Using a 1/4 inch nut driver, first tighten the hold-down hex nut closest to the hinged side of the lid. Torque to between 0.8 and 1.0 ft-lbs (1.1 and 1.4 N▯m). Then tighten and torque the other hex nuts. This ensures proper heatsinking.

OM6000 34VDC Power Hold Up Module

OM6000 Power Hold-up Module Installed in Node Base

The OM6000 Power Hold-up Module is a hot-swappable power supply option that is designed to sustain power to the entire node during occasional, short-interval network powering disruptions. The power hold-up capability significantly reduces RPD device reboots to ensure system reliability.

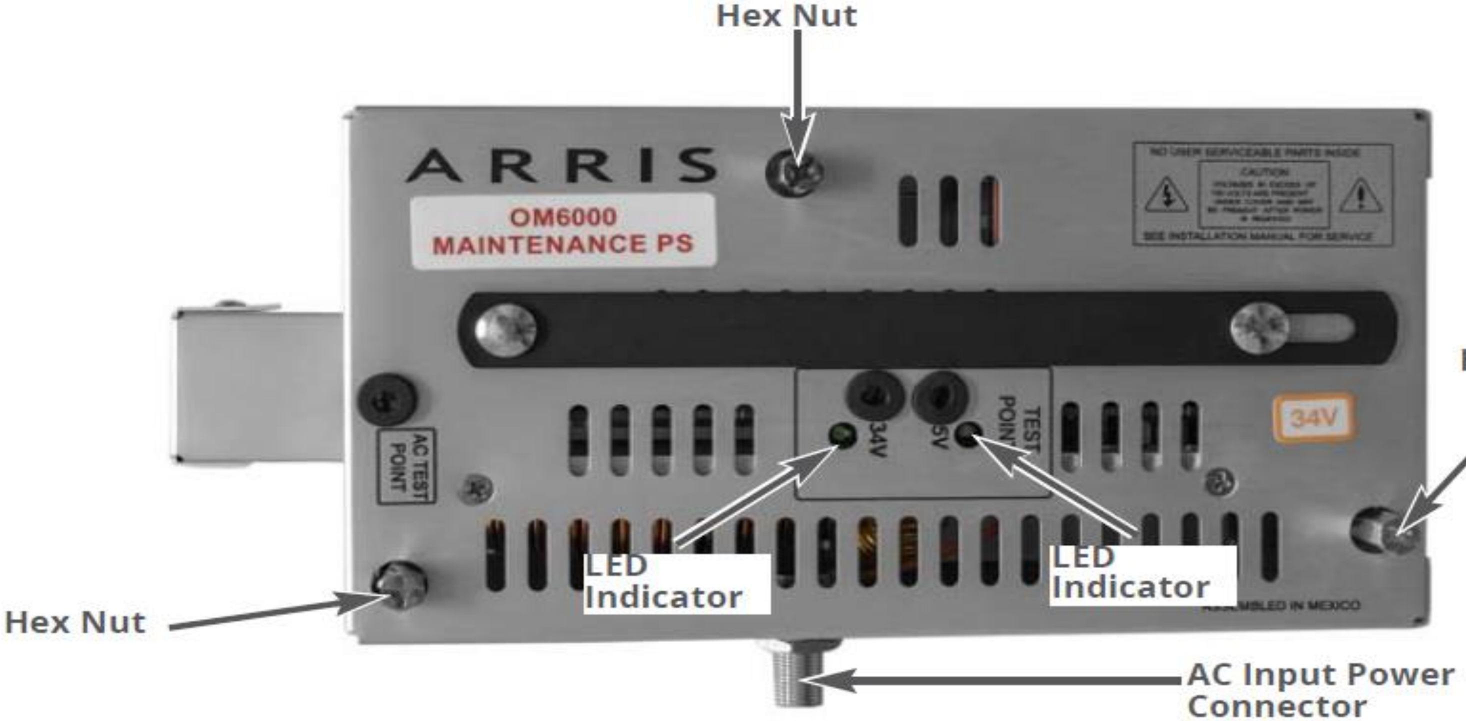
The Power Hold-up Module utilizes the OM6000's second power supply location to provide more than 500 ms of DC power continuity (in 34V Fiber Deep nodes) during these short-interval network power disruptions. No special cabling, connections, or node configuration is required for installing and operating the Power Hold Up Module.

The Power Hold-up Module is designed to support RPD operation in both 24V HFC nodes and 34V Fiber Deep OM6000 nodes. The installation procedure is the same for both node models. Installing a Power Hold-up Module eliminates the redundant powering option for the node

OM6000 RPD Current Draw

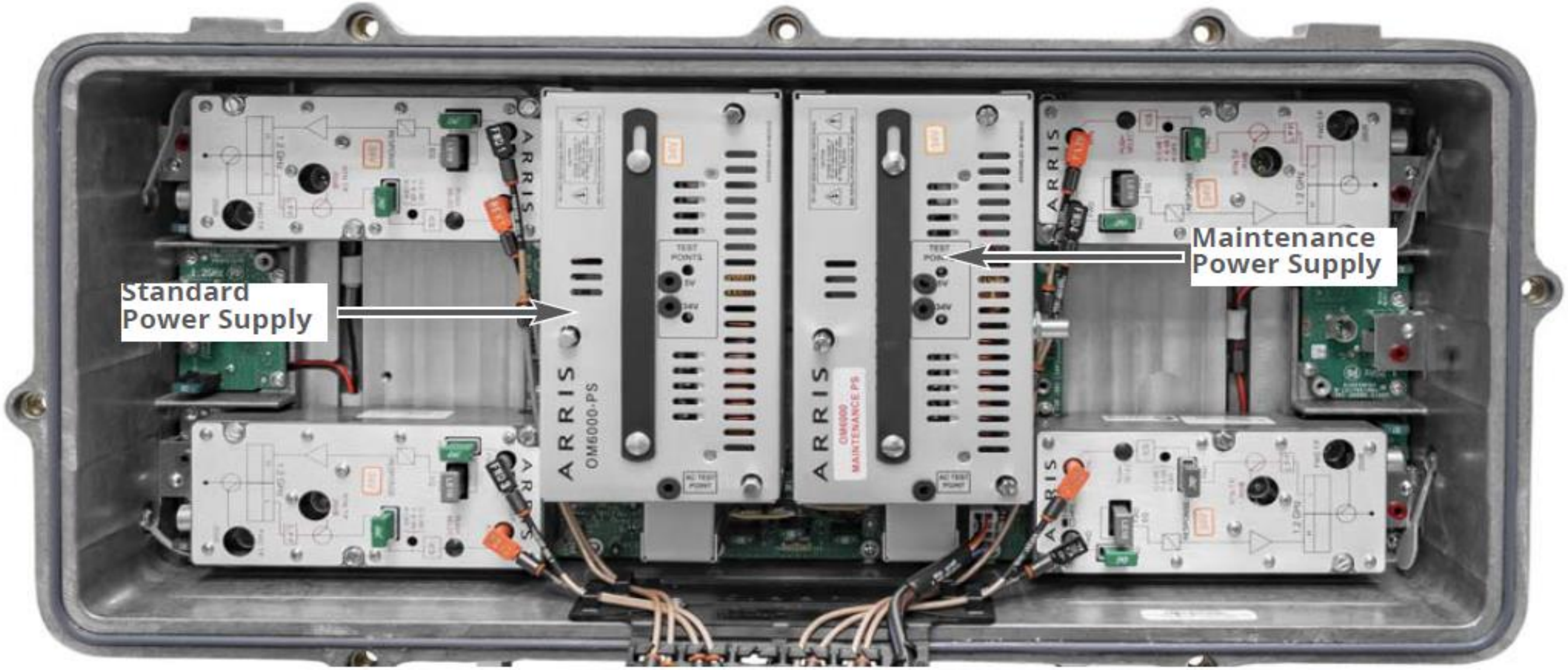
		AC Voltage									
		90	85	80	75	70	65	60	55	50	45
1x1 w/Digital Tx	AC current [A]	1.85	1.93	2.05	2.15	2.25	2.40	2.55	2.70	2.90	3.15
	Power [W]	127.0	126.5	126.0	126.0	125.5	125.0	125.0	125.0	126.0	126.5
1x1 w/1x1 RPD	AC current [A]	2.16	2.26	2.36	2.46	2.60	2.77	2.94	3.18	3.50	3.80
	Power [W]	155.9	155.7	155.7	155.7	155.9	156.3	157.0	158.1	160.3	161.4

Maintenance Power Supply



To prevent the RPD from going offline and rebooting when the primary AC power source is removed from an OM6000 Fiber Deep node, ARRIS has designed a hot-swappable, 34V Maintenance Power Supply module. Technicians can install this module in an OM6000 base and connect it to a secondary power source before interrupting or removing the primary AC power source from the node. This will ensure the RPD module remains powered during the maintenance window and prevent the RPD from rebooting.

Maintenance Power Supply Cont.



Indication	Status
Green	DC output voltage is present
Off	DC output voltage not present, or the power supply is not receiving AC voltage

Due to the orientation of the AC input power connector, the OM6000 Maintenance Power Supply module must be installed in the right power supply slot in the base.

Installation Steps

- Apply power to the Maintenance Power Supply module.
- Attach a coaxial cable from your secondary power source to the AC input power connector on the side of the Maintenance Power Supply module.
- Apply power to the Maintenance Power Supply module. Confirm the LED indicators are lit **Green**, which indicates the module is receiving AC input and outputting DC power to the node. Confirm the RPD module's **STATUS** and **POWER** LEDs are lit **Green**, which indicates the module is online and receiving power.
- Remove the primary AC power from the standard power supply module located in the left power supply slot. Typically, the node is powered through a coaxial connection to node port 2. Alternatively, power may be applied via a connection to node port 5 or any RF port.
The module's LED indicators, which are located in the same location as those on the Maintenance Power Supply, will turn off to indicate it is no longer receiving AC power input or outputting DC power to the node.
 Proceed with maintenance, as required.
- After maintenance is completed, reapply AC power to the standard power supply module in the left power supply slot by reconnecting the primary power source to the node port you removed it from in
- Confirm the module's LED indicators are lit green, which indicates the module is receiving AC power input and outputting DC power to the node.

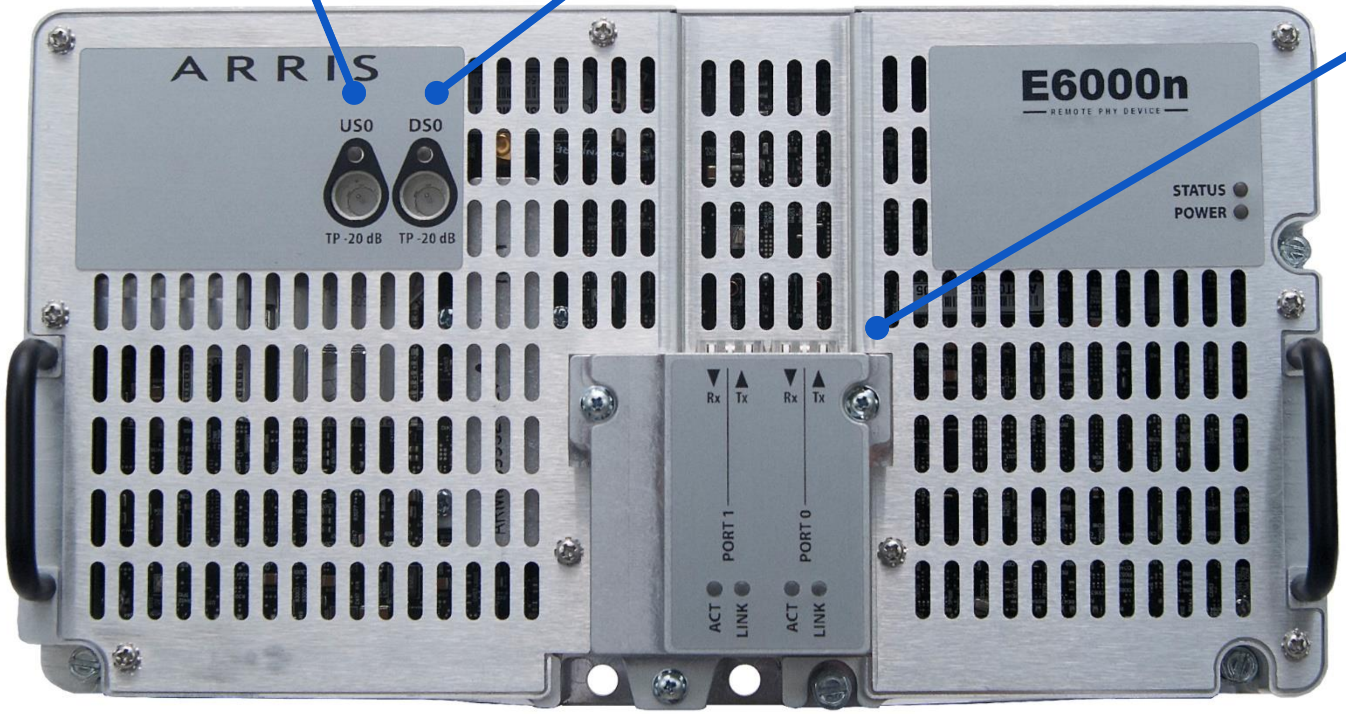
TN-19-017 / 1513566

COMMSCOPE®

OM6000 1x1 RPD Module

US0 TP –20 dB: –20 dB directional testpoint for measuring the return RF output level out of the module. Input level = 9 dBmV; Test Point Injection Level: 29 dBmV

DS0 TP –20 dB: –20 dB directional testpoint for measuring the forward RF output level out of the module. Output level= 50 dBmV(actual)/56 dBmv(virtual or analog equivalent)



PORT 0—Establishes forward and return connections via a 594900-0xx-00 SFP+ module in 1X1 configurations.

Connect the downstream fiber to the SFP+'s RX input port.

Connect the upstream fiber to the SFP+'s TX input port.

RPD 1x2 Module

Additional US Test point. US1

Mini Coax connection with SMB connector required to RF CH B port on RCB.

15” reverse RF cable p/n 1508288-013 included with 1x2 RPD Module

1x2 Module

1x2 module can be configured as a 1x1 then changed to a 1x2 via software configuration

OM6000 RPDs: 1x2 vs 1x1

1x2

PID: **1001421**

CIFA: **106491**

node CIFA 106579

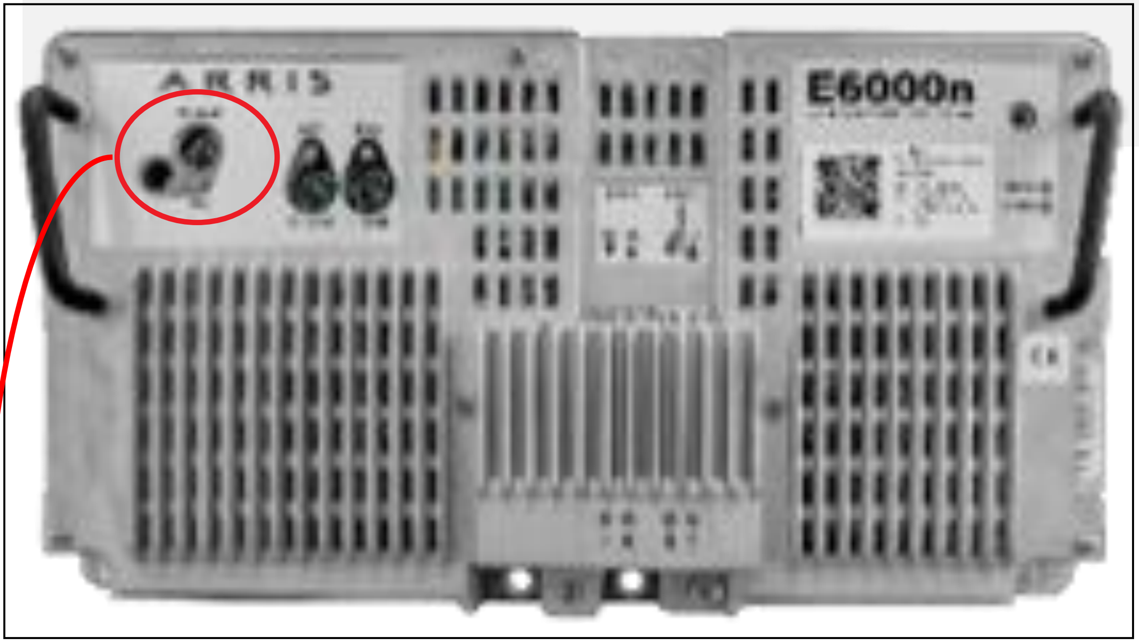
1x1

PID: **1001241**

CIFA: **300122**

Use with 34V power supply / base node CIFA 300172

node CIFA 300172



1x2 has the 2nd upstream port and test point at the upper left

OM6000 RPDs: 1x2 vs 1x1

The “MN” listed on the modules should indicate:

OM6-RPD-112 . . . for 1x2

OM6-RPD-111 . . . for 1x1

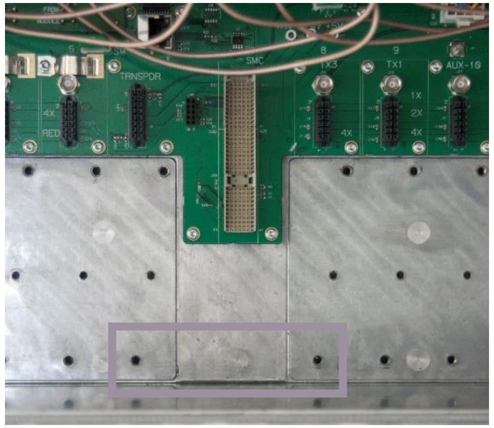
This is a 1x2

Installing the RPD

- The RPD is seated in a fixed location in the OM6000's lid that spans slots 3 through 10. Pre-configured OM6000 nodes are shipped from the factory with the RPD already installed.
- If you are installing an RPD module in a previously configured node, you will need to remove the transmitter(s), receiver(s), the status monitor card, and other optical modules that are currently seated in the lid.

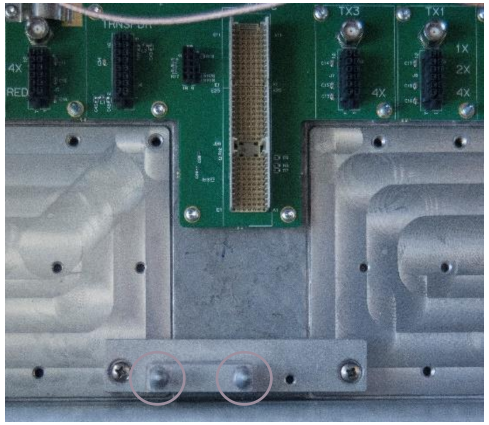
Install the alignment bracket in the location shown. Lower the RPD module into the node and align the module's alignment holes with the Alignment Guide Bracket's guide pins. Alternately tighten the RPD's hold-down screws to a recommended torque value between 2.1 and 2.25 ft-lbs (2.8 and 3.1 N·m).

1.



Mounting Bracket Location

2.



Ensure mounting bracket guide pins are oriented in a position closest to the wall of the housing

3.

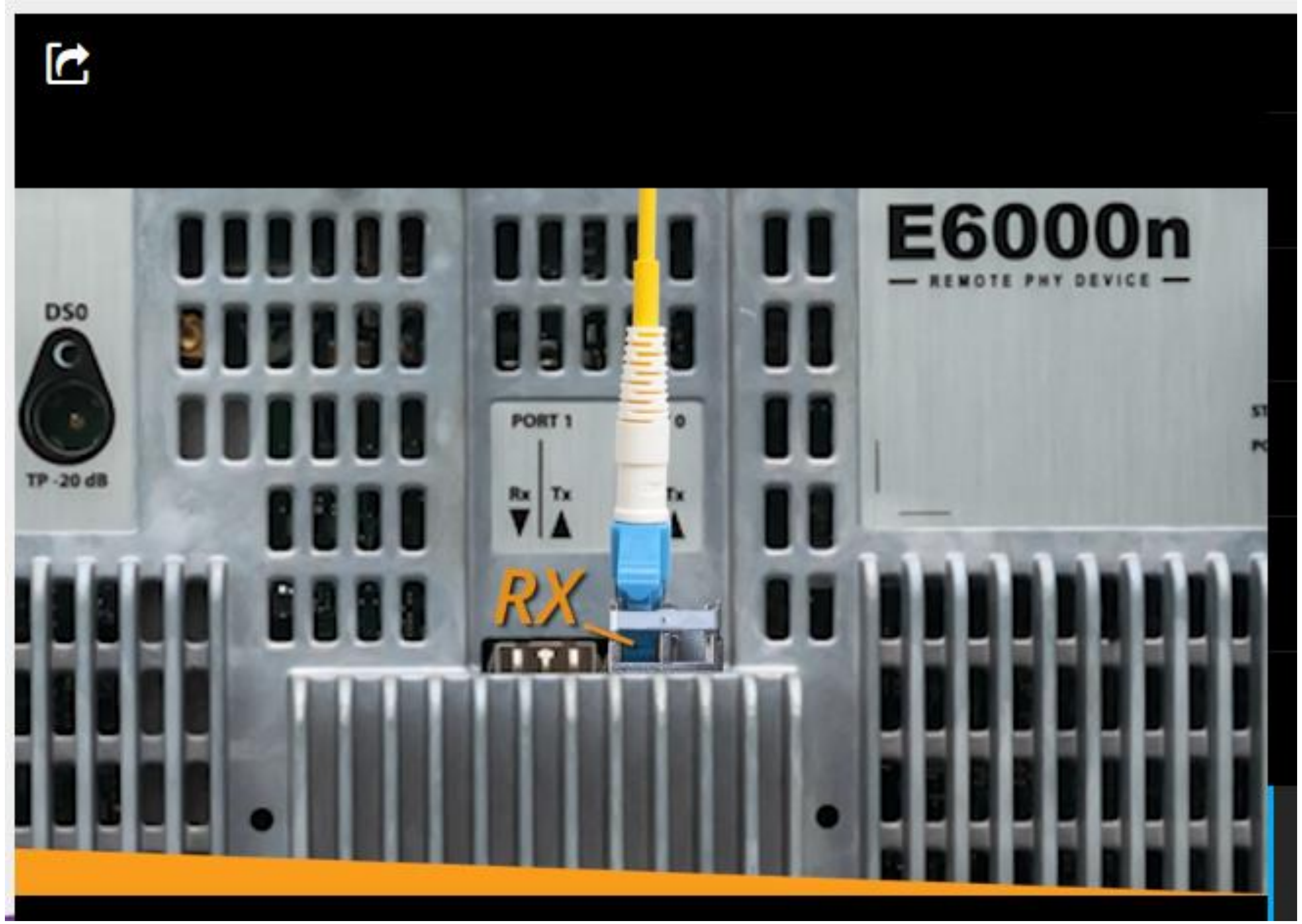
Align the RPD's alignment holes with the guide pins and seat the module

4.

Fully seated RPD

COMMSCOPE

SFP+ Fiber Connection (RX)



LC/UPC Connector

Clean and Scope connector before connecting to SFP

SFP+ Fiber Connection (TX)

LC/UPC Connector

Clean and Scope connector before connecting to SFP

Recommended Adapter for Test Points

G Type Female to F type Female adapter

P/N TP4003 (4” Test Probe)
P/N: 566948-001-00 (5” Test Probe)

ACI RF Test probe: CIFA: 300035

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QR Code on RPD Module

Note : QR Code on all modules.
Used for initial registration process.

Configuring the OM6 For 1X1 RPD Operation

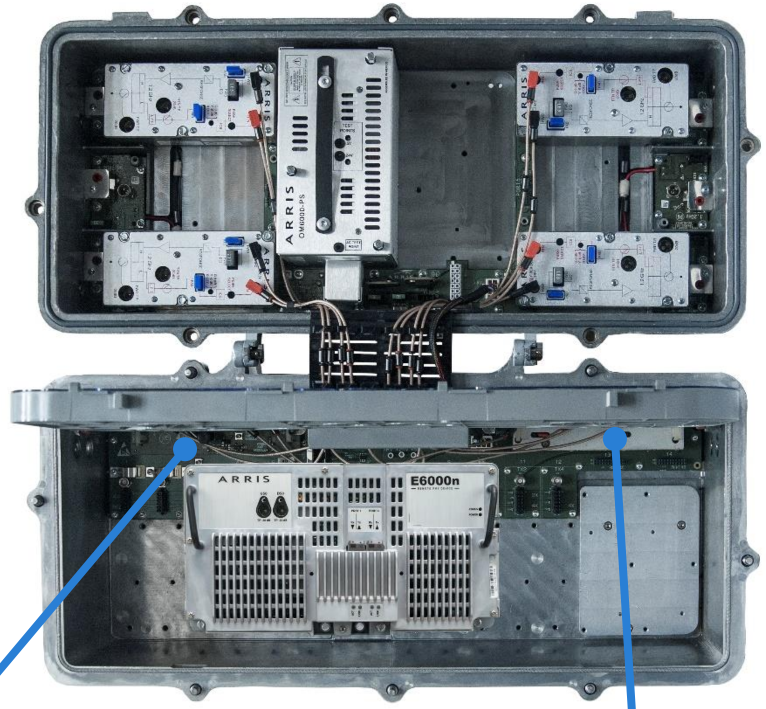
- OM6 segmentation is determined via the Forward and Return Configuration boards seated in the lid. To ensure proper operation, ensure a 1x1 Forward Configuration board is installed in the node. No further configuration of the Forward Configuration Board is necessary. Ensure the Return Configuration board's segmentation switch is set to the left to enable 1X segmentation, and ensure the board's DIG TX jumpers are set to the inner position to enable digital return through lid slot 9.

Return Configuration Board

Segmentation switch set to left (1X position)

DIG TX jumper set to inner position

DIG TX jumper set to inner position



Forward Configuration Board location

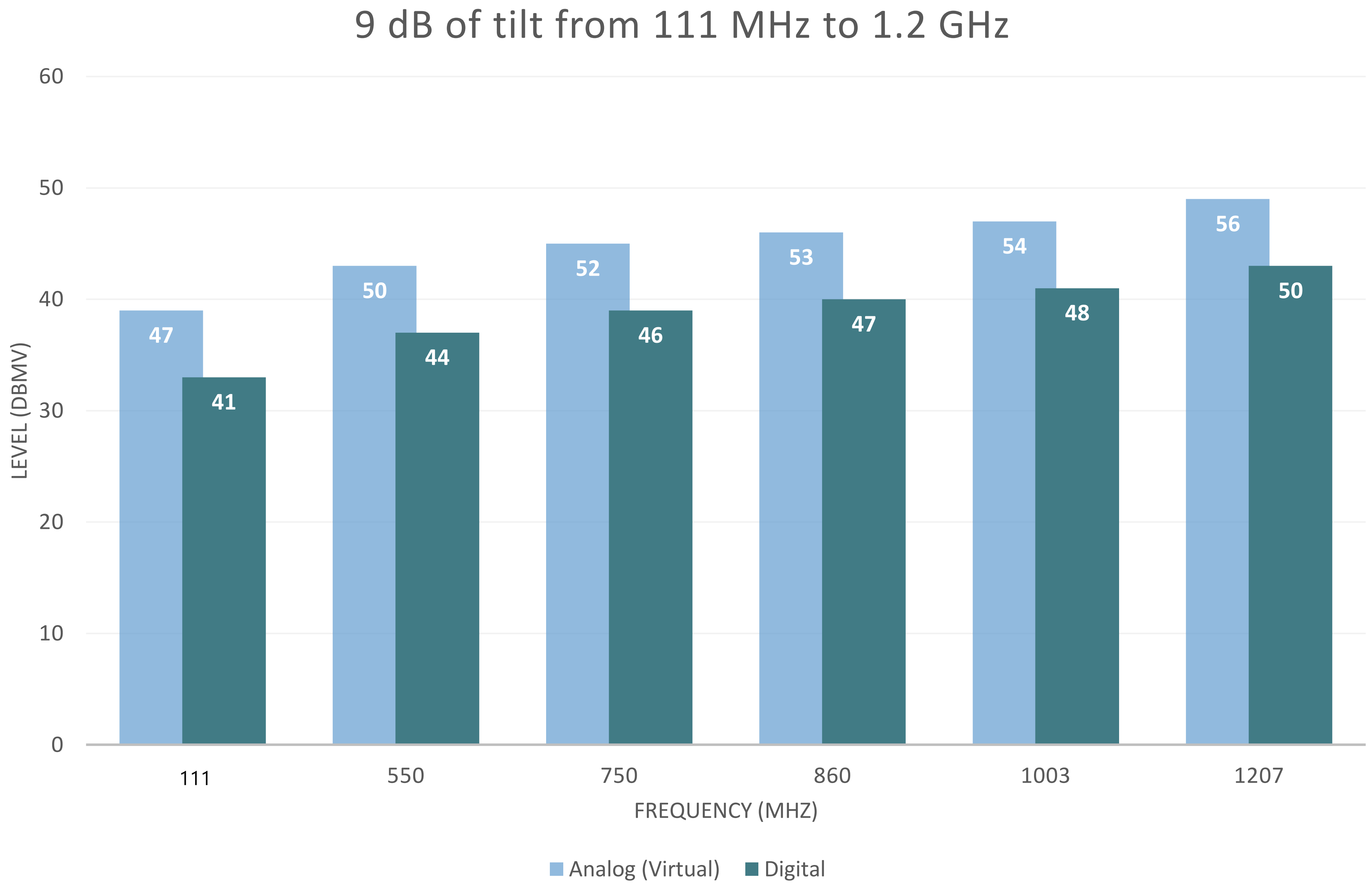
Return Configuration Board location

COMMSCOPE

RPD RF levels US & DS

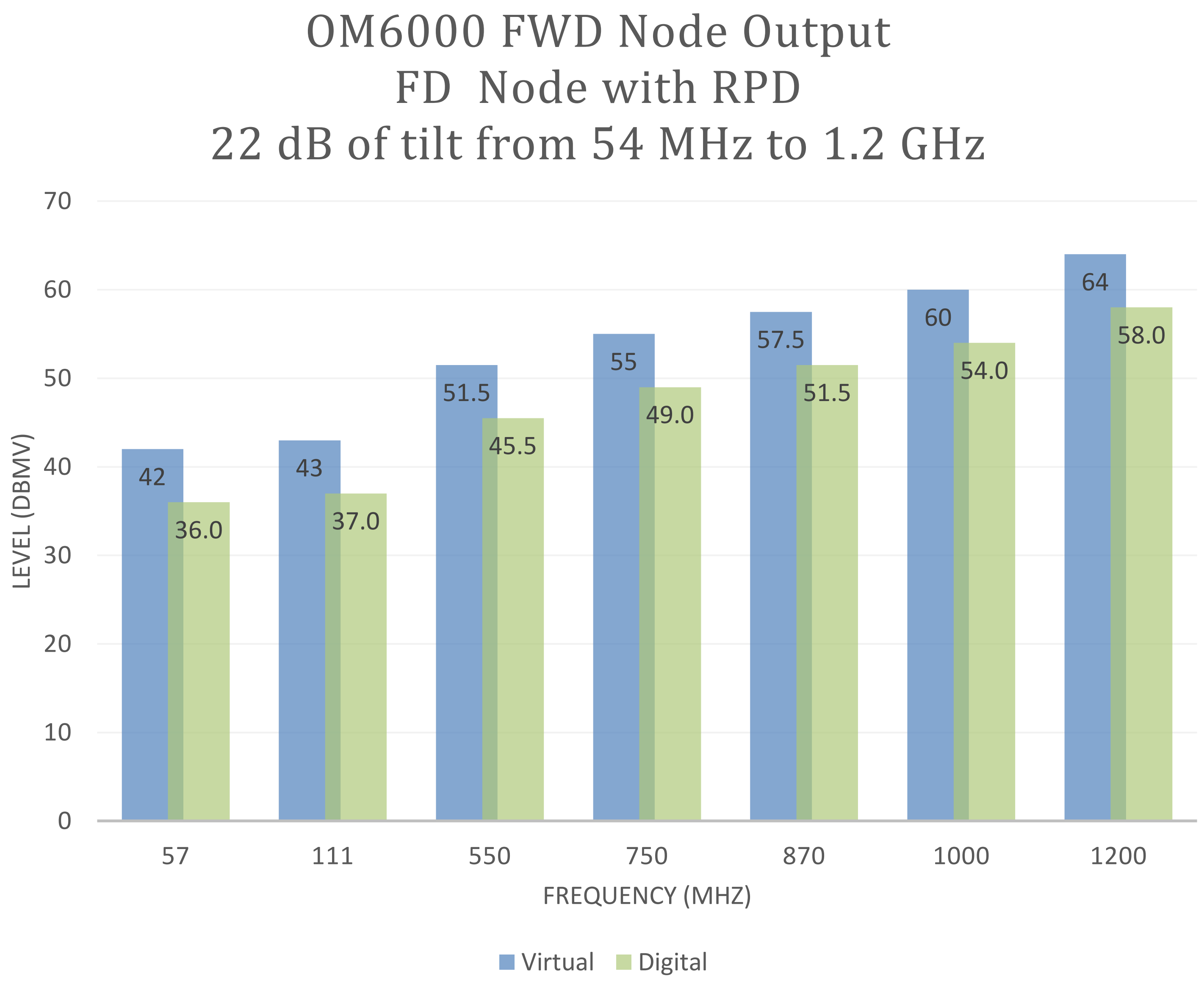
- The RPHY module is tuned to expect an upstream input level of 0 to +9 dBmV.
- The little bit of dynamic adjustability in the module is meant for calibration and compensation (to hold the levels steady across –40 to +85(Celsius) temperature swings).
- The module itself is designed to have an output that “looks” exactly like an HFC forward receiver to the node, namely producing a known (fixed) output level and known (fixed) tilt. (see following chart).
- The RPD can be treated like a Fiber Node.
- With the default node configuration, the node’s output is 54dBmV (QAM) @ 999 MHz, linearly decreasing to 37dBmV (virtual) @ 111 MHz. (a CM is expecting 0-dBmV +/- 6dB) .
- The output power and tilt can be decreased by changing out the pluggable pads (available in 1dB increments between 0 and 20 in each leg of the base amps) and equalizers (available in 1dB increments between 0 and 12, resulting in node tilt 12 to 24) in the RF bricks.

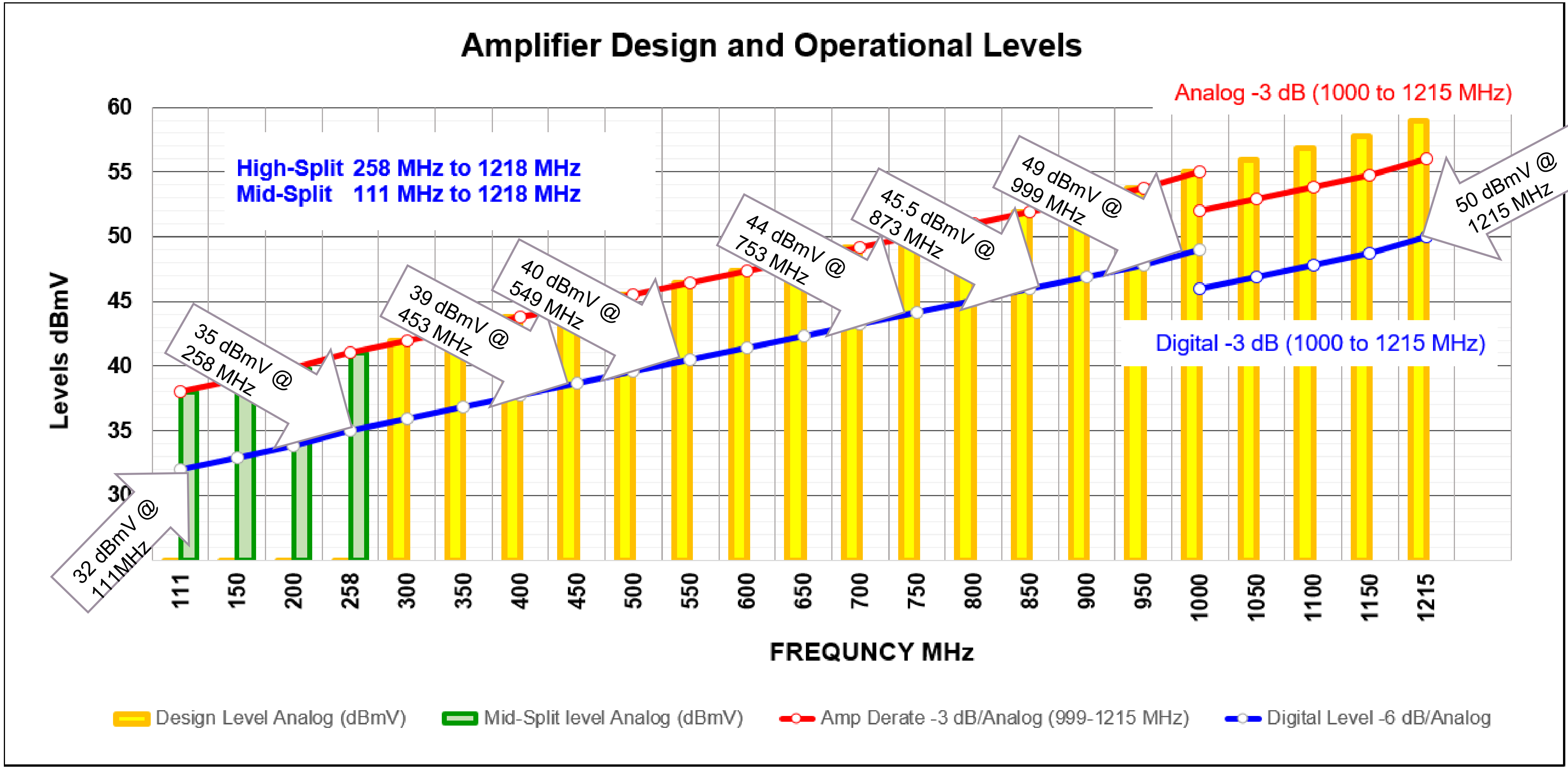
OM6000 FD RPD Output



Freq	Rx Tilt
550	3
750	5
860	6
1003	7
1207	9

OM6000 RF Output 22dB Tilt Chart

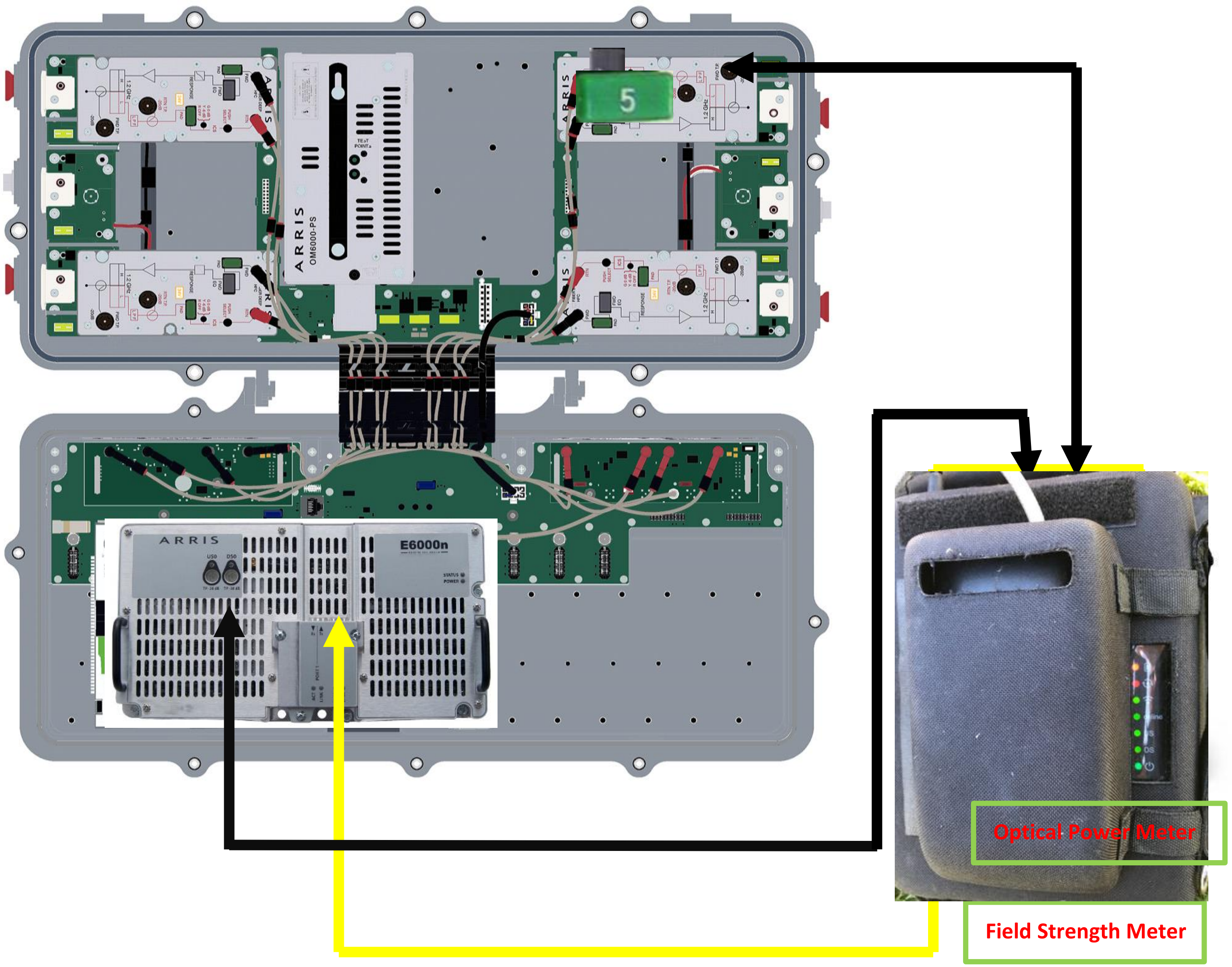




MHz	111	150	200	258	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1215
Design Level Analog (dBmV)	38	39	40	41	42	43	44	45	46	46	47	48	49	50	51	52	53	54	55	56	57	58	59
Operational Amplifier Derate -3 dB/Analog (999-1215 MHz)	38	39	40	41	42	43	44	45	46	46	47	48	49	50	51	52	53	54	55	53	54	55	56
Operational Digital Level -6 dB/Analog	32	33	34	35	36	37	38	39	40	40	41	42	43	44	45	46	47	48	49	47	48	49	50

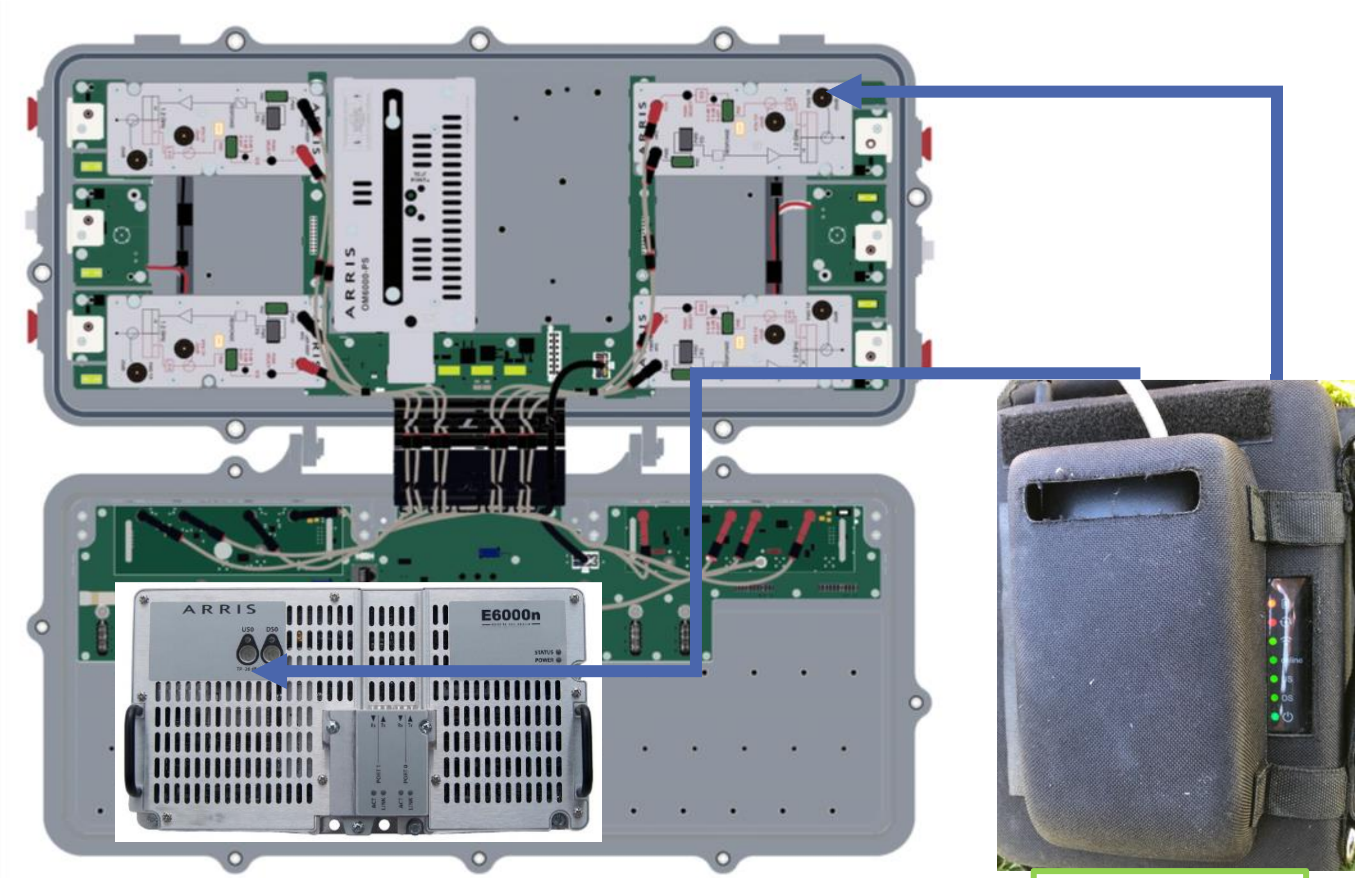
(All Levels are in dBmV)

Forward Configuration – Forward Setup



- Start by measuring the optical power level at the RPD input.
  -SFP Optical Input Range: -6 to-24 dBm
- Note It may take 2 to 4 minutes for RPD Module to reinitialize after disconnecting fiber input
- Verify the RPD Output Level @ DS test point+ 48dBmV QAM @999MHz\ 41dBmV QAM @ 111 MHz
- Measure the RF output, adjust the EQ and Pad to achieve your desired output.
- Adjust the EQ to achieve desired Slope.
- Adjust the Pad to achieve desired Output Level.
- **Repeat for all 4 Node RF Modules**

Return Configuration – Return Setup



Field Strength Meter

Start by injecting a return carrier at the FWD - 20 dB test point that represents the desired CPE transmit level based on the plant design. Example +29 dBmV(+9 dBmV @ port) (+9dBmV at RPD module)
Measure the level at the input to the RPD on US0 -20 dB test point. (Loopback test)

Adjust the return Pad in order to achieve the optimum input to the RPD
Example -11dBmV(+9dBmV actual) Repeat for all 4 Node RF Modules

:

NOTE: Unity gain between RF port after Pad and RPD input

Recommended Transmitter input for full spectrum loading

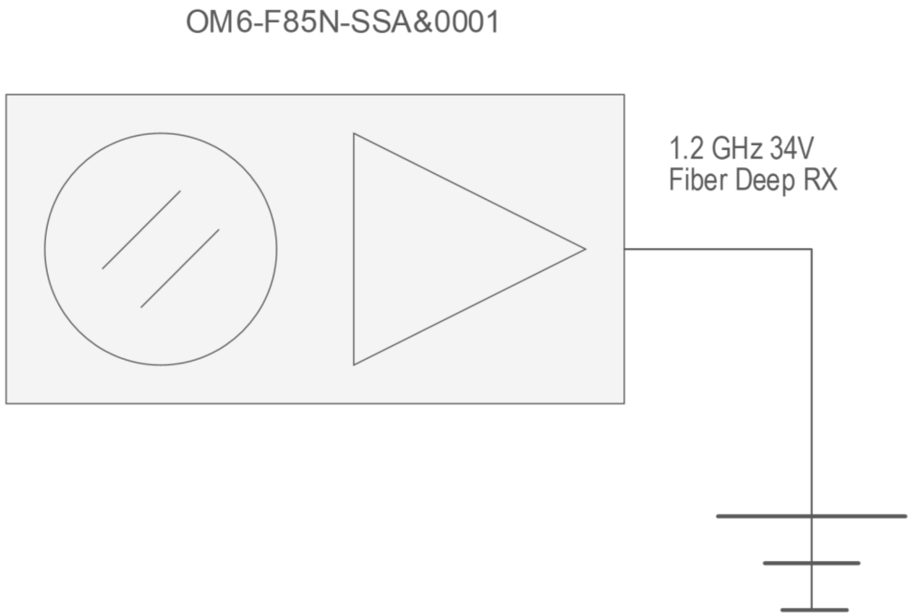
Return Frequency Split	Recommended Input (6.4 MHz)	RPD Test Point(6.4 MHz)
5-42 MHz	12 dBmV	-8 dBmV
5-65 MHz	10 dBmV	-10 dBmV
5-85 MHz	9 dBmV	-11 dBmV

Activating a New OM6000

1. Ground OM6000 per your systems Node grounding specifications.

2. Activate AC Power and OM6000 Power Supply(s)

3. Verify Correct Optical Power and Connect Fiber to RPD 10 G SFP+

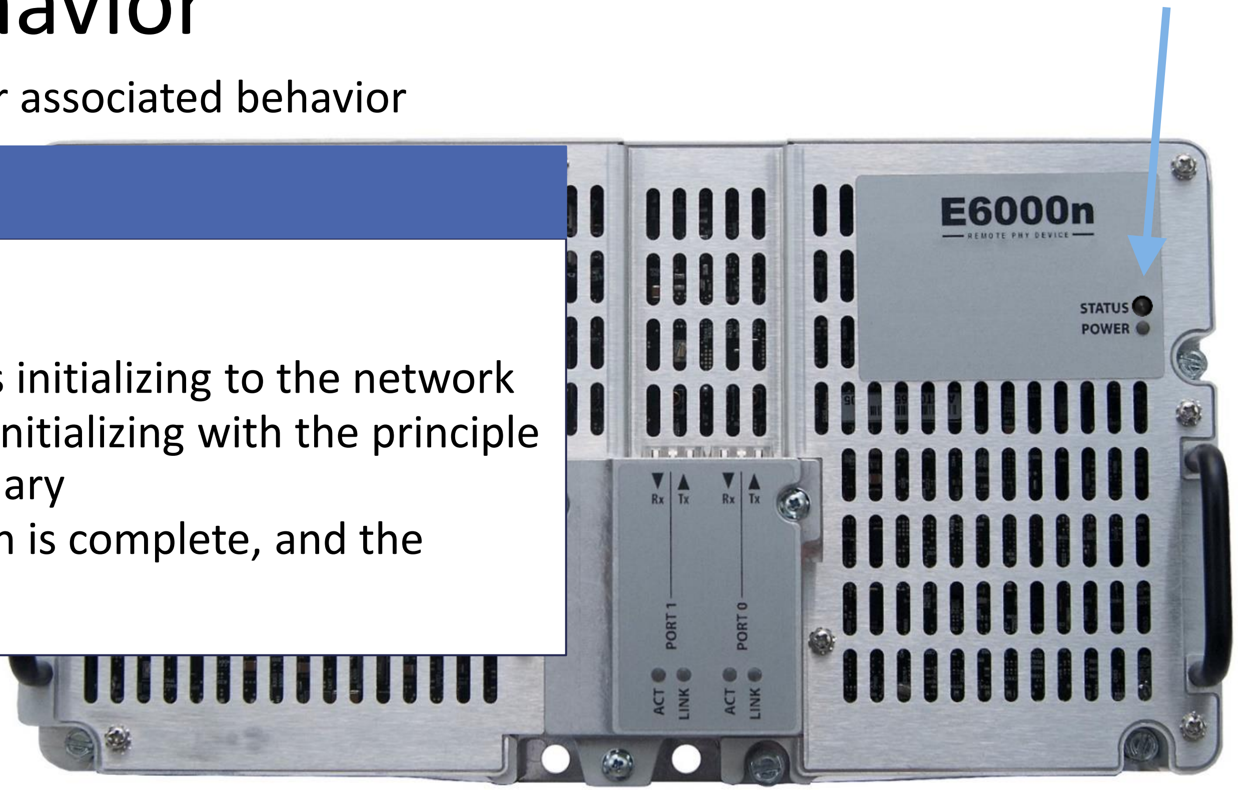


- Proper Grounding first is very important to protect the Node and RPD modules

RPD LED Descriptions and Behavior

The following tables describes the RPD module's LEDs and their associated behavior

LED LABEL	FUNCTION
STATUS LED	**Indicates general module status.** Off — Module is not receiving power **Slow Blinking Green(2 Hz)** — Module is initializing to the network **Fast Blinking Green (4Hz)**— Module is initializing with the principle CCAP Core and 1588 timing primary **Solid Green** — Timing and configuration is complete, and the module is operational



RPD LED Descriptions and Behavior

The following tables describes the RPD module's LEDs and their associated behavior

LED LABEL	FUNCTION
POWER LED	**Indicates general power status.** Off — Module is not receiving power Solid Green — The module is receiving power and is operational Solid Red — Power Supply fault

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RPD LED Descriptions and Behavior

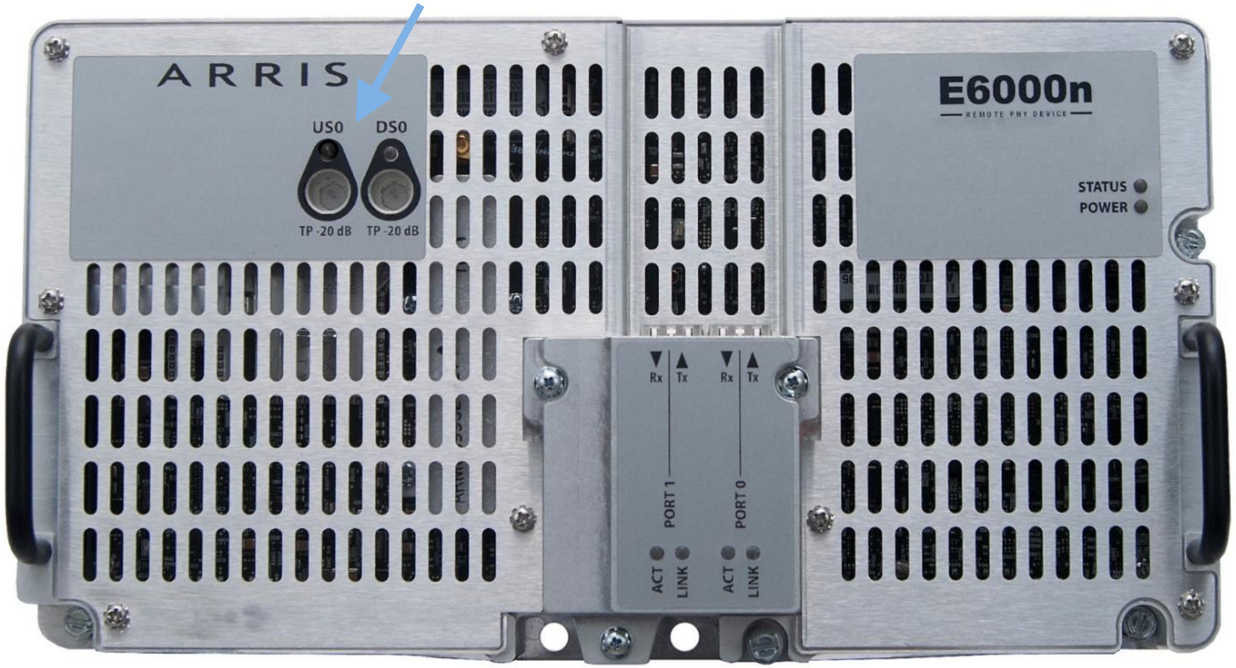
The following tables describes the RPD module's LEDs and their associated behavior

LED LABEL	FUNCTION
DSO LED	**Indicates downstream module status.** Off — Downstream Port Not Configured Solid Green — Downstream Port has Been Configured and Enabled

RPD LED Descriptions and Behavior

The following tables describes the RPD module's LEDs and their associated behavior

LED LABEL	FUNCTION
USO LED	**Indicates upstream module status.** Off — Upstream Port Not Configured Solid Green — Upstream Port has Been Configured and Enabled



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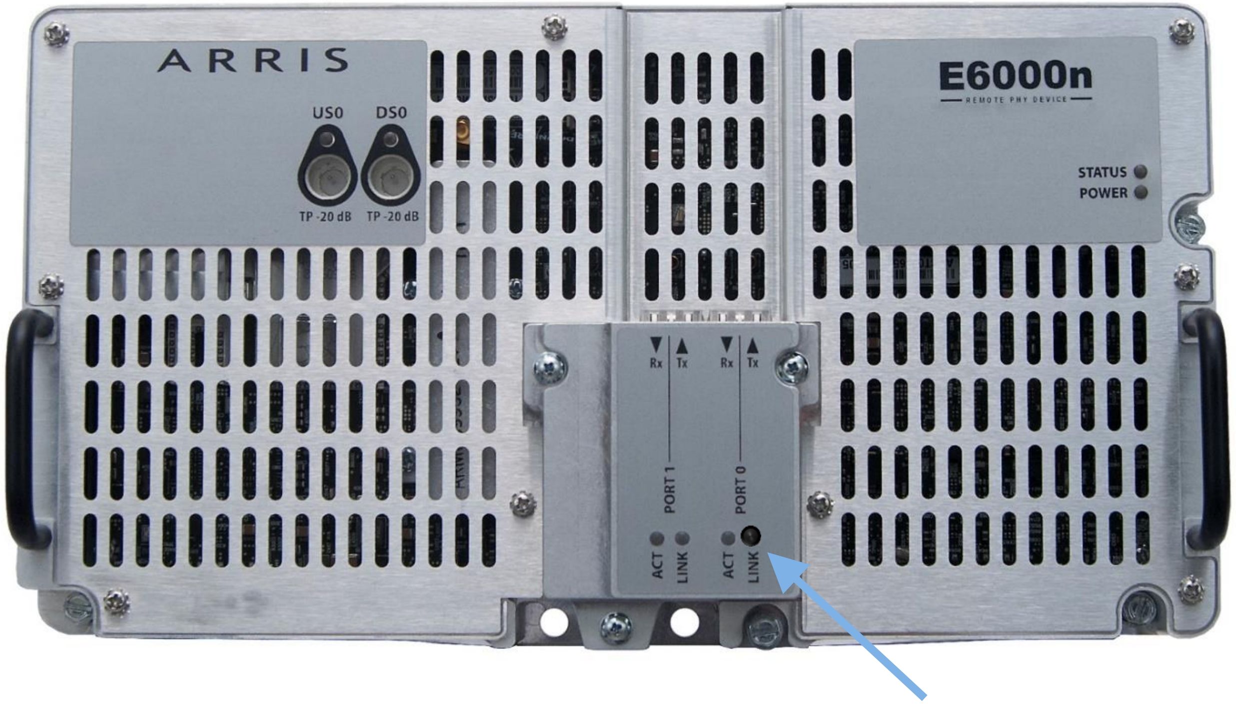
RPD LED Descriptions and Behavior

The following tables describes the RPD module's LEDs and their associated behavior

LED LABEL	FUNCTION
Link LED	**Indicates fiber link status.** Off — RX link is off or bad Solid Green — Rx Link is good



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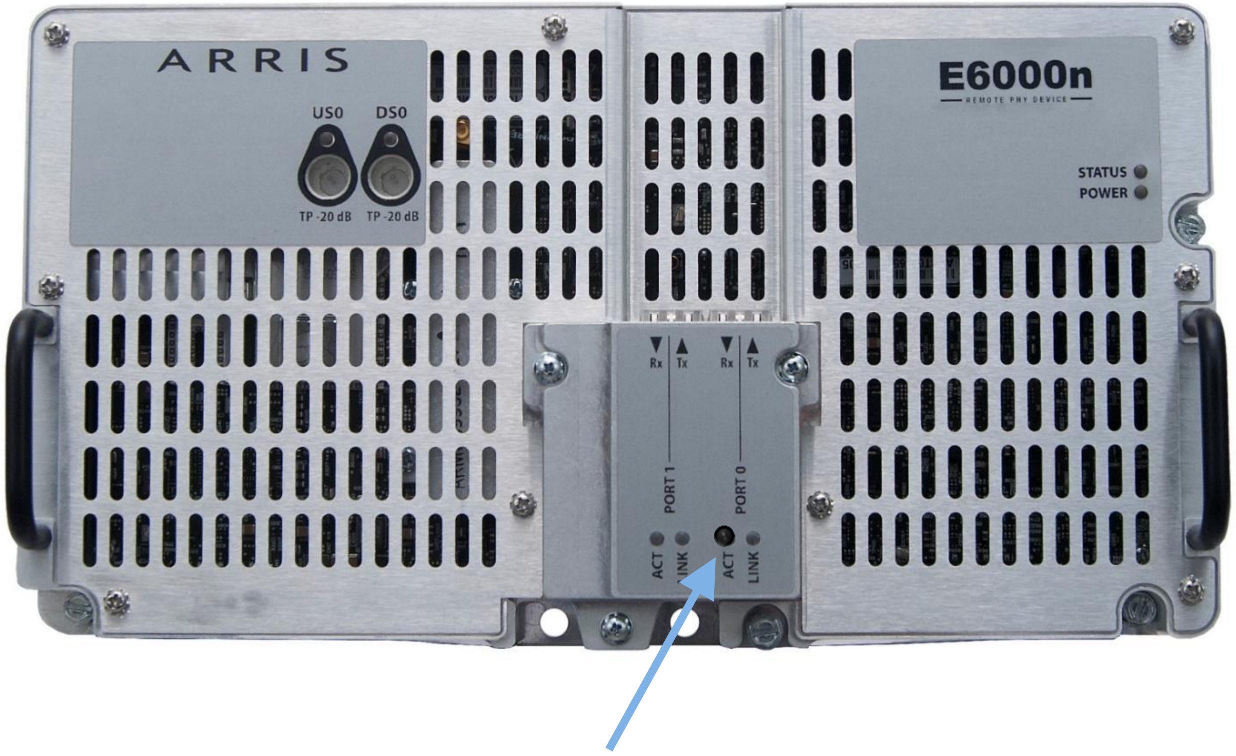
RPD LED Descriptions and Behavior

The following tables describes the RPD module's LEDs and their associated behavior

LED LABEL	FUNCTION
ACT LED	**Indicates link activity.** Off — RX link is off or bad Solid/Flashing Amber — Rx Link is good



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OM6000 HFC RPD Optical Node Overview

Modular, 1.2 GHz
RF Amplifiers designed for FD

SG4000 Housing Leveraged for Maximum Thermal Capacity

OM6000 Rated to 180W (AC) heat dissipation

Load Sharing, Redundant Power Supplies Capability

Console port (only supported with debug versions of code)

Two SFP ports to CMTS/Clock source with link LEDs for connection status (only one supported)

20 dB down US and DS test points

10 OM-style module slots

Thank You

Any Questions?

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