

Trans Max[®] Hardened Field Hubs

TM4100-R
HPON[™]/RFoG Repeater

FEATURES

- Economically supports HPON[™]/RFoG architectures beyond 20 km with optical amplification
- Enables segmented service groups and higher capacity per subscriber in conjunction with the CHP CORWave[®] multiwavelength transmitters
- Parts commonality with the Opti Max[™] OM4100 optical node reduces sparing and inventory SKUs
- Allows easy field conversion from an OM4100 node to a TM4100-R configuration
- Optional remote monitoring through CORView[™] EMS when equipped with digital return transmitter



PRODUCT OVERVIEW

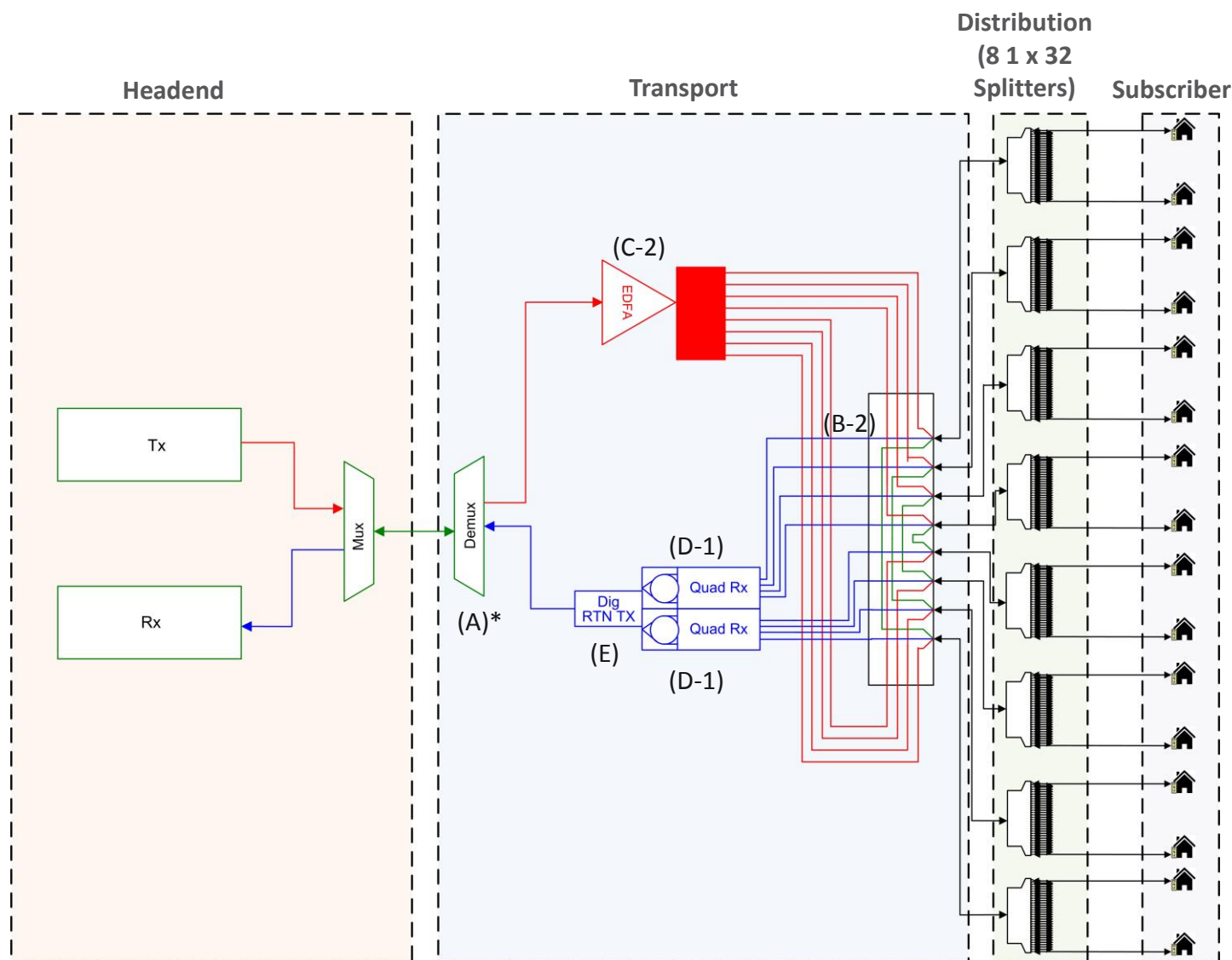
Reach More Customers with Longer Fiber Links

The Trans Max[®] TM4100 HPON/RFoG repeater is an essential part of an HPON/RFoG all fiber network. The TM4100 optically amplifies signals for service groups located beyond traditional HFC networks, all-fiber networks, or less densely populated areas where feeder fiber may be limited. The TM4100 works harmoniously in traditional RFoG systems as well as in new, innovative HPON designs in conjunction with AgileMax[®]. AgileMax HPON technology is totally OBI free, providing enhanced benefits to standard RFoG systems. By eliminating OBI, the TM4100/AgileMax pairing makes a powerful tool for maximizing the benefits of DOCSIS[®] 3.1 rollouts. Additionally, as operators look toward targeted services using traditional PON technology, the TM4100 can be configured to support a simplistic migration path. With optical passives designed with PON upgrade ports, in conjunction with the Fiber Link Modules (FLM), the TM4100 provides an easy pathway to PON as a targeted service for high end business and residential customers.

Application Diagrams

Figure 1 — Trans Max 4100 Classic RFoG Repeater Virtual Hub: 256 HHP DS, 2 x 128 HHP US

The Trans Max® TM4100 RFoG repeater Virtual Hub allows added reach beyond the typical distance of standard RFoG systems. Without the use of a repeater, the typical range of a standard 32-way split is 20 to 30 km. Using the TM4100 repeater extends the total reach of an RFoG network to 60 km (and beyond, depending on the network design). The TM4100 repeater achieves this added reach by utilizing high-performance EDFAs in conjunction with ARRIS digital return technology. Shown below is the classic repeater configuration. In the downstream, an eight-port EDFA amplifies optical signals to up to eight 32-way splitters. In the upstream, it uses 2:1 digital return technology to receive, combine, and re-transmit two groups of 128 subscriber signals back to the headend for processing.



*Denotes product specification

Figure 2 — Trans Max 4100 Virtual Hub: 1 x 128 HHP DS, 2 x 64 HHP US

The half TM4100 repeater shown in Figure 2 can be configured to work with next generation HPON™/RFoG networks using AgileMax® as the splitter distribution network. In the downstream, the half repeater can service four groups of 32 subscribers for a total customer coverage of 128 homes passed from a single TM4100. In the upstream, it uses 2:1 digital return technology to receive, combine, and re-transmit two groups of 64 subscriber signals back to the headend for processing. The TM4100 can service both traditional HPON/RFoG ONU devices and traditional HFC nodes. This capability allows greater flexibility when used in conjunction with traditional HFC networks. By adding an additional EDFA, passive set, and digital return transmitter, the half TM4100 repeater can support a full load of 256 homes passed. This configuration is shown on the following page in Figure 3.

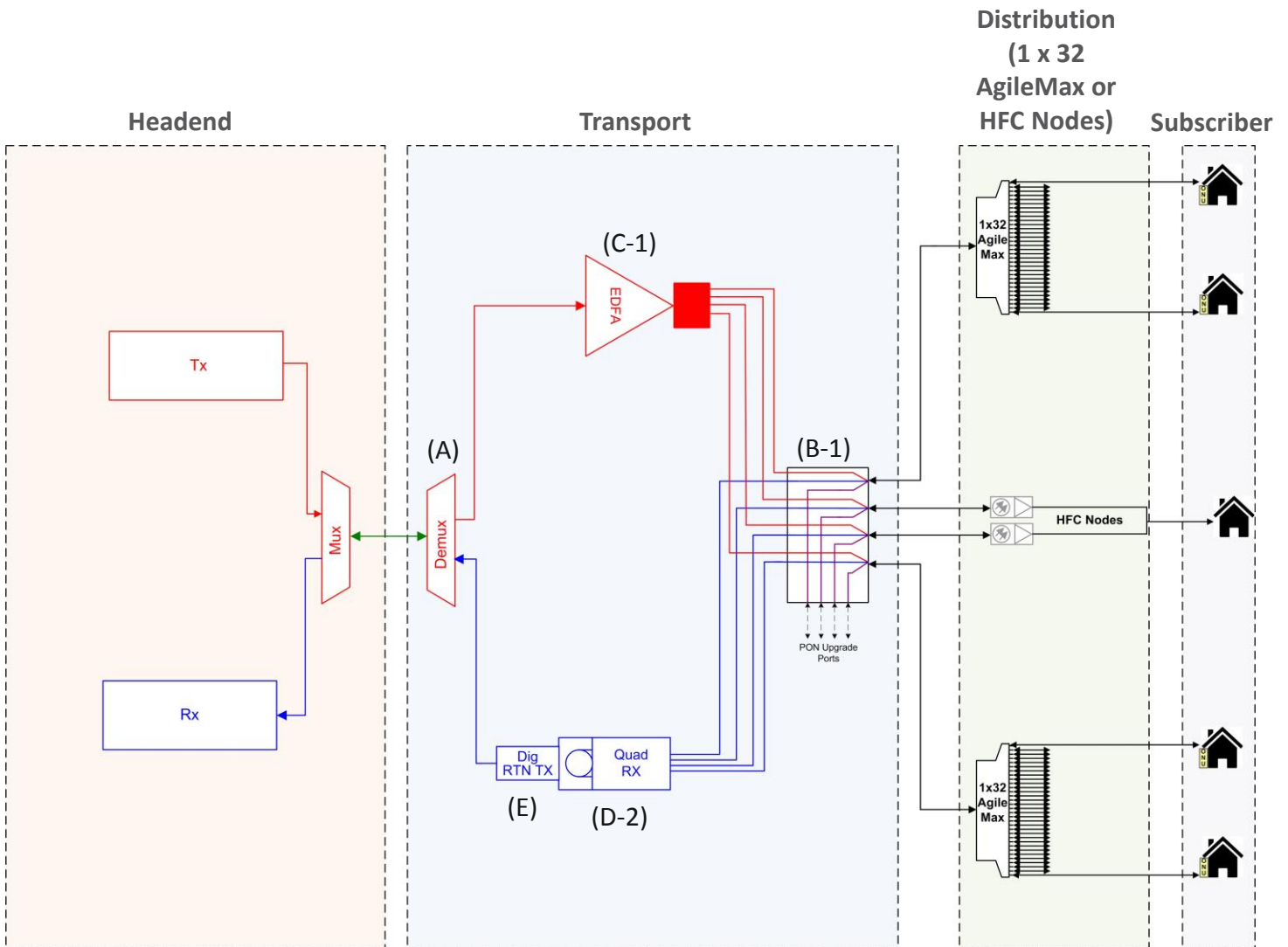


Figure 3 — Trans Max 4100 Virtual Hub: 2 x 128 HHP DS, 4 x 64 HHP US

An extension of the half repeater configuration shown on the previous page in Figure 2, a full TM4100 repeater configuration supports 256 homes passed by servicing up to eight groups of 32 subscribers in the downstream. In the upstream, it uses two 2:1 digital return transmitters to receive, combine, and re-transmit four groups of 64 subscriber signals back to the headend for processing by using a single transport fiber in conjunction with ARRIS multiwavelength technology. As network demands increase, this configuration can support a seamless transition to PON via optional PON upgrade ports. To further simplify the transition to PON, the TM4100 supports local insertion of 1G and 10G PON wavelengths from FLM modules, as shown on the next page in Figure 4.

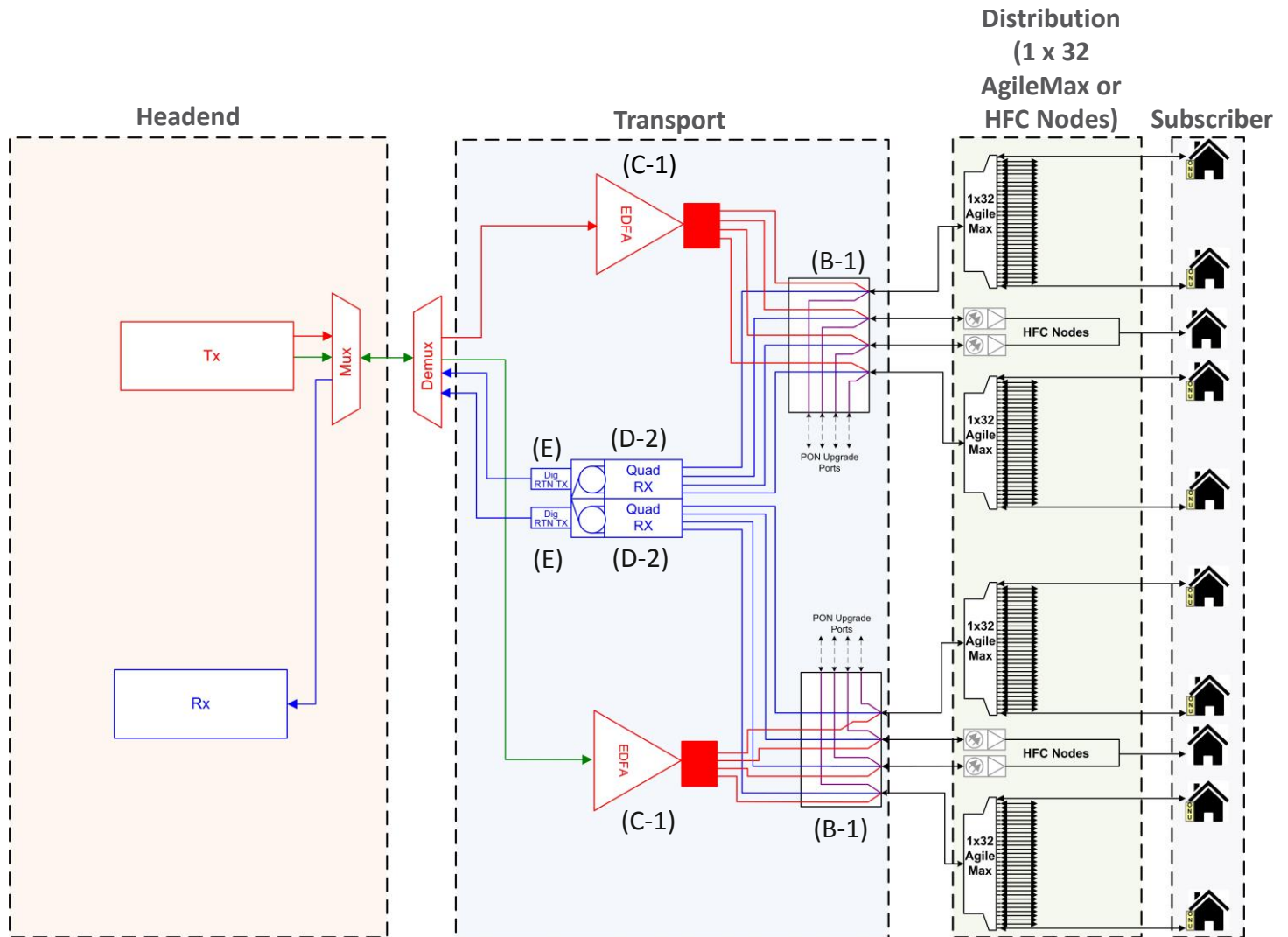
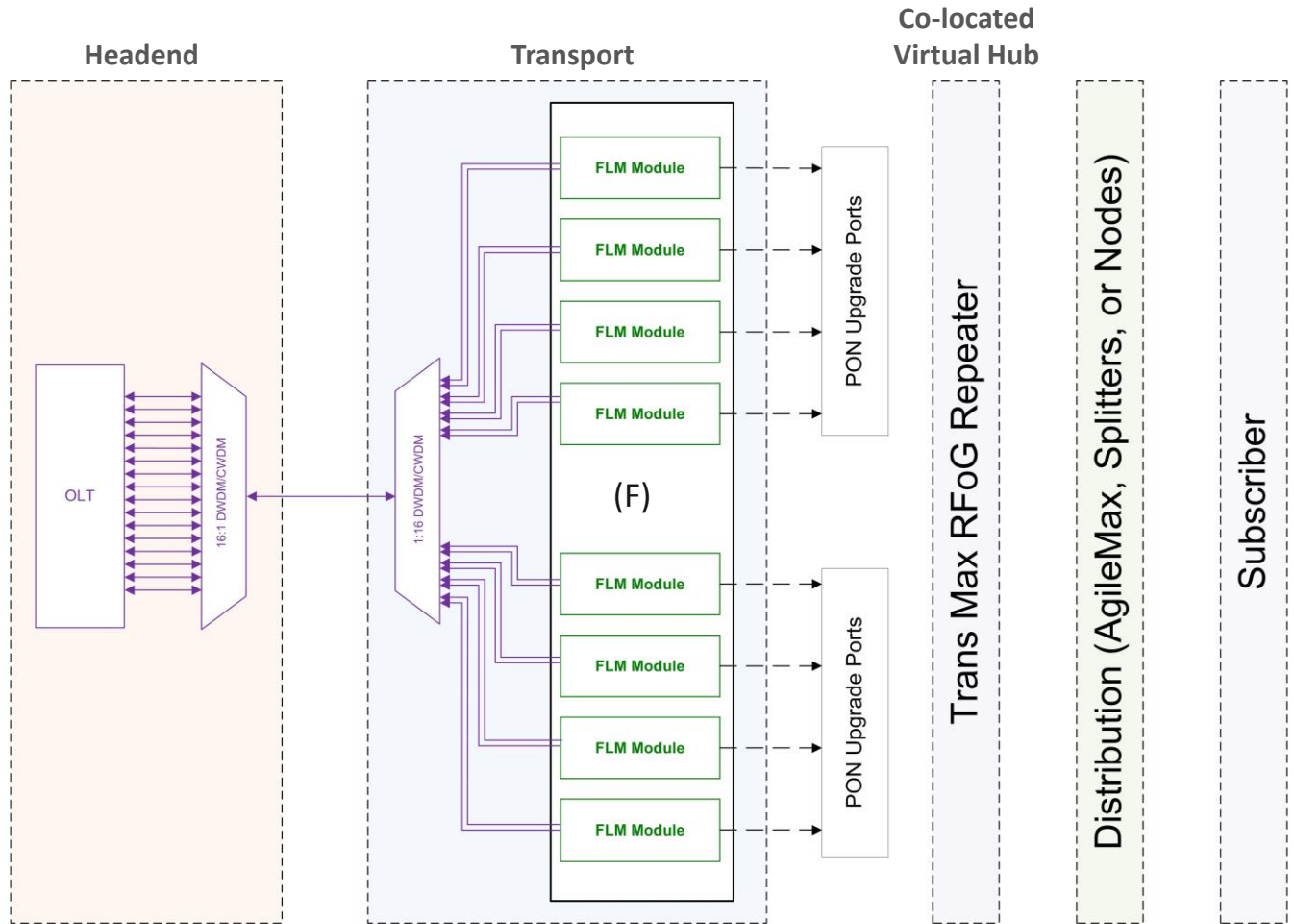


Figure 4* — Trans Max 4100 RFoG + 10G EPON Solution: 2 x 128 HHP DS, 2 x 128 HHP US with co-located housing for PON insertion

The TM4100 can be configured to work in conjunction with a full EPON overlay and ARRIS Fiber Link Modules (FLMs). In this configuration, a TM4100 that is populated with FLMs is collocated beside a TM4100 RFoG Repeater to provide complete HFC, HPON/RFoG, and EPON service to distinct customer groups. Combining these disparate technologies on a single network allows MSOs to easily deploy gigabit services, Ultra High Definition Video, and other next generation services.



*For a complete representation of the RFoG Repeater, Distribution options, and delivery to the Subscriber, refer to Figure 3.

SPECIFICATIONS

(A) Headend Facing Multiplexer (P/N 1505521-001)¹

Downstream Passband, nm	1260 to 1598.5
Upstream Passband, nm ²	1611 ± 7.5
Downstream Insertion Loss, dB max. ³	1.4
Downstream Test Point Level, dB max. relative to input	-21.5
Upstream Insertion Loss, dB max. ³	1.75
Optical Interface Connector Type	SC/APC or LC/APC



(B) Customer Facing Optical Passive Module
(B-1) 4 Way Model with PON Injection (P/N 1505523-004)
(B-2) 8 Way Model (P/N 1505523-001 or -002) ¹

Downstream Passband, nm	1260 to 1598.5 (8 Way Model)
Upstream Passband, nm	1611 ± 7.5 (8 Way Model)
Downstream Insertion Loss, dB max.	1.25 (8 Way Model)
EMS Tap Port Loss, dB max. relative to output	15 (8 Way Model)
Upstream Insertion Loss, dB max. ⁴	1.5 (8 Way Model)
Operating Wavelength Range	
1550 nm region, nm	1525 to 1565 (4 Way Model)
1610 nm region, nm	1611 ± 7.5 (4 Way Model)
PON Wavelengths, nm	1260 to 1500 and 1575 to 1598.5
Insertion Loss, dB max.	1.25 (4 Way Model)
Optical Interface Connector Type	LC/APC



(C) EDFA¹
(C-1) OM4-EDFA-20-4-M-N (4 output model)
(C-2) OM4-EDFA-17-8-M-N (8 output model)

EDFA Type	Constant Power
Input Wavelength Range, nm	1534 to 1562
Input Optical Connector Type	SC/MPO
Optical Input Range, dBm	0 to 12
Number of Outputs	4 or 8
Output Power per Port, dBm min.	20 (4 output model) 17 (8 output model)
Power per Port Tolerance, dB	+1.0/-0.0
Noise Figure, 0 to 6 dBm in 1550 ± 5 nm range, dB typ./max. ⁵	6.0/6.5
Noise Figure, 0 to 6 dBm in 1534 to 1562 nm range, dB max. ⁵	8.0
Noise Figure, > 6 dBm in 1550 ± 5 nm range, dB typ./max. ⁶	7.0/7.5
Noise Figure, > 6 dBm in 1534 to 1562 nm range, dB max. ⁶	10.0



SPECIFICATIONS

(D) Optical Quad Receiver
(D-1) P/N 150664-001 Standard
(D-2) P/N 150664-002 AgileMax

Frequency Range, MHz	5 to 85
Optical Wavelength, nm	1290 to 1620
Optical Inputs	4
RF Outputs ⁷	2
Optical Input Range, dBm	-23 to -10 (150664-001) -9 to 0 (150664-002)
Quad Analog Rx Attenuation Range, dB	0 to 18, in 2 dB increments
Output Level, (-20.5 dBm input, 14% OMI, 0 dB Atten.), dBmV ⁸	20 ± 0.5
Optical Test Point, V/mM	1
Return Loss, (All Ports 18 dB typ.), dB min. ⁷	16
Isolation in-band 5 to 110 MHz, dB, min.	45
Isolation out of band, 110 to 500 MHz, dB, min.	50
Equivalent Input Noise, pA/Hz ^{0.5}	0.75
Quad Analog Rx Attenuation Range, dB	0 to 18, in 2 dB steps
Optical Connector, (Quad bulkhead adapter on Rx)	LC/APC



(E) Digital Return Processing Module (P/N OM4DTX-SFP-242-5A8)

Electrical Bandwidth, MHz	5 to 42
Data Rate, Gb/s	2.488
Flatness, dB	± 0.50
NPR Dynamic Range, dB min., >30 dB NPR ¹²	16
Digital Return Input Level, dBmV/6 MHz typ. ¹³	12
Digital Return Link Gain, dB typ. ¹⁴	32
Digital Return Transmitted Wavelength	1611 nm standard, other wavelengths available
Digital Return Tx Output Optical Power, dBm	-1 to 5



(F) Fiber Link Module – Selectable 10/10G or 10/1G EPON
P/N OM-FLM-10G

Operating Wavelength	
Downstream 10G EPON	1575 – 1580 nm
Upstream 10G EPON	1260 – 1280 nm
Upstream 1G EPON	1260 – 1360 nm
Interfaces	
Trunk Port	10 Gbps SFP+ (dual LC/UPC connectors)
Optical Distribution Network Port	LC/UPC
OTL Link Budget	Up to 22 dB
ODN Link Budget	PR30/PRX30 Optics, 28 dB Link Budget
Physical Layer Compliance/Compatibility	802.3 Clause 75



SPECIFICATIONS

Powering Specifications

AC Current Passing, A	15
Input Voltage Range, VAC	45 to 90

General Specifications

Number of AC Powering Ports	2
Number of Optical Ports	4
Operating Temperature Range, °C	-40 to 60 (-40 to 140 °F)

Notes:	Refer to the Trans Max 4100 Hardened Field Hub Equipment Manual (1505707) for additional information.
1. Refer to actual module specifications for more information.	
2. Optional, other wavelength ranges are available.	
3. Includes 0.5 dB loss for optical patch cables.	
4. Includes 0.5 dB loss for MPO to LC fan-out optical patch cable.	
5. Optical input range of 0 to 6 dBm.	
6. Optical input is > 6 dBm.	
7. External combiners allow for additional RF combinations based on repeater configuration.	
8. Digital return transmitter optimum input is 12 dBmV/6 MHz. With 8 dB of loss between the receiver output and the transmitter input, the minimum receiver input is: -22 dBm optical input @ 19.5% OMI/channel or -23 dBm optical input @ 24.5% OMI/channel.	
9. Unless otherwise specified, the listed specifications are for the combined Analog Rx, RF Configuration/Combining Assemblies, Digital Return Transmitter, and CHP D1RRx Digital Return Receiver.	
10. Measuring using a best fit approximation.	
11. Measured with respect to slope.	
12. Analog section measured using FTTM20J-Ax-xxxx-05 ONU reference Tx with an output power of 3 dBm. Repeater optical input = -15.5 dBm. This represents a typical link loss equivalent to 5 km of fiber and a 32 way splitter. Quad Analog Rx attenuator set to 6 dB attenuation. Digital section measured using CHP-D1RRX-S reference receiver over a 60 km fiber link.	
13. Repeater 8 Way Customer Facing Optical Passive Module input level = -18.5 (-20.5 Rx Input) dBm, 14% OMI, 0 dB Rx Attenuator. Transmitter input level is independent of segmentation configuration.	
14. Specified for OM4DTX-SFP-xxx-xxx digital return transmitter and CHP-D1RRx digital return receiver.	

RELATED PRODUCTS

Digital Transmitters	DOCSIS-based Element Management System
Optical Passives	CORView™ Element Management System
Quad Path Analog Receivers	Dual Redundant Load Sharing Power Supplies

Note: Specifications are subject to change without notice.

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Virtual Hub-TM4100