

AQ 4000 Series

DOCSIS® & EURODOCSIS™ 3.0/3.1

Ethernet Business Services & Mobile Backhaul



Description

The AQ 4000 series Rugged Cable Modem is DOCSIS® 3.0/3.1 and EuroDOCSIS™ 3.0/3.1 compliant and is weatherproof and specially designed for installations where temperatures can be extreme, uncontrolled, and typical of the outside plant in an HFC cable network. This cable modem is designed to withstand electrical over-voltages and surges commonly experienced in HFC network outside plant. All Electroline AQ products have been designed to pass stringent surge tests specified by the Institute of Electrical and Electronics Engineers. It has a built in MEF Compliant Carrier Ethernet NID.

Carrier Ethernet Key Applications Highlights

- Segment, monitor and bridge diverse networks
- Integrated turn-up testing and service activation baseline reporting
- Fast, flexible, SLA-backed Carrier Ethernet service creation (point-to-point and multipoint)
- Real-time L2 & L3 performance monitoring and service assurance
- Granular traffic conditioning

Service Assurance Applications

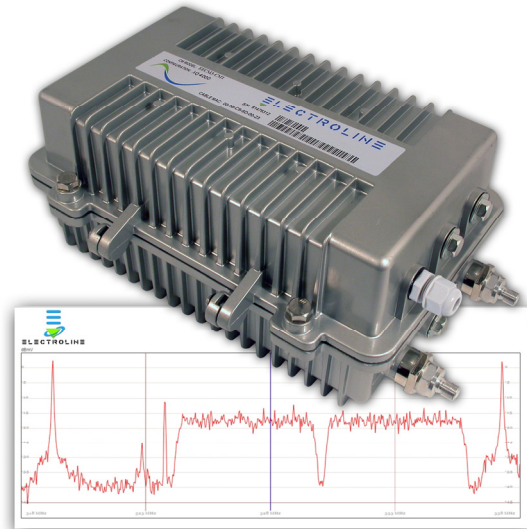
- Performance and Traffic Monitoring: Monitor and measure delay, delay variation, frame loss and continuity.
- Service Activation Testing: Use the integrated RFC-2544 based test suite
- Per-Flow Loopbacks: Monitor any Layer 2, 3 and 4 flow in real-time

Service Creation and Traffic Conditioning Applications

- Bandwidth Policing
- Zero-Delay Traffic Shaping
- Service Mapping
- Traffic Filtering

Benefits

- Virtualized, programmable instrumentation for QoS monitoring, OAM & turn up testing:
- Low-latency, wire-speed packet processing for uncompromised performance
 - Full line-rate loopback support for popular third-party test sets
 - DOCSIS-friendly management integration for easy BSoD deployments



Cable Modem Features

- Designed for DOCSIS® & EURODOCSIS™ 3.0/3.1 specifications
- Network Monitoring - Embedded Spectrum Analyzer
- For D3.0, 8x4 or 16x4 bonded channels with data rates in excess of 300 or 600 and 100 Mbps for DS and US respectively
- For D3.1, 32x8 channels and 2x2 OFDM bonded channels
- Support for BSOD, L2VPN and extended power option
- Strand, pedestal, mast, pole and wall mounting
- HFC cable powered, 40 to 90 VAC
- 10/100/1000 BASE-T auto sensing / auto-MDIX Ethernet port
- Power over Ethernet (PoE and PoE+) option to supply connected devices (choose from 1, 2, and 4-ports options)
- Temperature Hardened and weather proof housing.
- Optional wall outlet power supply
- Optional Optical Interface with SFP

Carrier Ethernet Features

- SNMP v1 and v2c support
- Automated Y.1564 & RFC-2544 test suites
- Multi-vendor Level 2 OAM (802.3ag, Y.1731) and Level 3 QoS (RFC-5357 TWAMP) monitoring and test set interoperability
- Integrated MEF Certified Carrier Ethernet networking
- Jumbo Frames support (to 10,240 bytes)
- Automated, instant provisioning (Plug & Go™)
- Wire-speed pass-through without adding delay or delay variation
- Real-time packet processing with microsecond measurement resolution
- Layer 2-4 Loopback functionality & third-party test set interoperability
- Thru-traffic per-flow statistics, tapping and filtering

Embedded DOCSIS® & EURODOCSIS™ 3.0 Cable-Modem Specifications

	DOCSIS® 3.0	EURODOCSIS™ 3.0
RF DOWNSTREAM		
Operating Frequency Range (center)	111 to 999 MHz	112 to 1002MHz
Tuner Frequency Range	Edge-to-edge 54-1002, 85-1002, 108-1002 MHz	108 to 1002MHz
Tuner	Full band capture frontend with 8 fully independent digital tuners	
Demodulation	8 demodulators, 64 QAM or 256 QAM	
Maximum Raw Data Rate	8 downstream channels, each 6 MHz channel: 42.88 Mbps for 256 QAM and 30.34 Mbps for 64 QAM	8 downstream channels, each 8 MHz channel: 55.62 Mbps for 256 QAM and 41.71 Mbps for 64 QAM
Bandwidth per Channel	6MHz	8MHz
Operating Level Range	-15 to +15dBmV	+43 to +73 dBµV for 64 QAM +47 to +77 dBµV for 256 QAM
Input Impedance	75 ohms	
RF UPSTREAM		
Operating Frequency Range (edge-	5 to 42 MHz, 5 to 65 MHz, or 5 to 85 MHz	5 to 65 MHz, or 5 to 85 MHz
Upstream Transmission	4 upstream channels	
Modulation	QPSK, 8 QAM, 16 QAM, 32 QAM, 64 QAM at ATDMA Mode QPSK, 8 QAM, 16 QAM, 32 QAM, 64 QAM, 128 QAM at SCDMA mode	QPSK, 8 QAM, 16 QAM, 32 QAM, 64 QAM at ATDMA Mode QPSK, 8 QAM, 16 QAM, 32 QAM, 64 QAM, 128 QAM at SCDMA mode
Maximum Data Rate per	Chnl Width (MHz) Raw Data Rate (Mb/s)	Chnl Width (MHz) Raw Data Rate (Mb/s)
Modulation		
QPSK	1.6 2.56	1.6 2.56
16 QAM	1.6 5.12	1.6 5.12
QPSK	3.2 5.12	3.2 5.12
16 QAM	3.2 10.24	3.2 10.24
32 QAM	3.2 12.8	3.2 12.8
8 QAM	6.4 15.4	6.4 15.4
16 QAM	6.4 20.5	6.4 20.5
32 QAM	6.4 25.6	6.4 25.6
64 QAM	6.4 30.72	6.4 30.72
ELECTRICAL		
Input Voltage	Cable powered 40 to 120 AC 50 / 60 hz sin or Quasi square wave; or Wall plug adaptor: @ Input = 100 to 240 volts Ac, 50/60 Hz	
Power Consumption (modem module)	<10 Watts	
Surge Protection (F connector) Ring Wave Combination wave	IEEE C62.41-1991, cat A3 6KV 200A IEEE C62.41- 1991, cat B3 6KV 3KA	IEC 61000-4-12, Level 4 (4KV/133A) IEC 61000-4-5, Level 4 (4KV/2KA)
Data Ports	Ethernet 10/100/1000BASE-T (Auto-sensing with Auto-MDIX) RJ-45 Ethernet (1)	
Optical (optional)	SFP cage	
RF	Female "F" type	
Power Over Ethernet (PoE+); choose from 1-port, 2-ports, and 4-ports options	For IEEE 802.3at configuration: 48Vdc at 600mA; Optional configurations: 24Vdc at 1A; or 12Vdc at 2A	
MECHANICAL		
Dimension (W x D x H)	Not including "F" connector: 11.8"x5.0"x7.7" (30cmx12.7cmx20cm)	
Weight	5 lbs	
Operating Temperature	-40° to 140°F (-40° to 60°C)	
Operating Humidity	0 to 90% RH non-condensing	
Designed to Comply with the Following Standards	DOCSIS / EuroDOCSIS 3.0, 2.0, 1.1, 1.0	
Regulatory and Safety Approvals	As required per country	

Embedded DOCSIS® & EURODOCSIS 3.1 Cable-Modem Specifications

Upstream			
Frequency Range ⁽¹⁾ (edge to edge)	Full band: Switchable sub-band:	5-F _{US_MAX} 5-42 (for North America model) 5-65 (for EURO model)	MHz
Output Impedance		75	Ω
Maximum Transmit Level		(Total average power) +65	dBmV
Output Return Loss (across freq. range)		≥ 6	dB
SC-QAM channels			
Signal Type	TDMA, S-CDMA		
Number of Channels		8	max
Modulation Type	QPSK, 8 QAM, 16 QAM, 32 QAM, 64 QAM, and 128 QAM		
Modulation Rate (nominal)	TDMA: 1280, 2560, and 5120 S-CDMA: 1280, 2560, and 5120 Pre-DOCSIS3 operation: TDMA: 160, 320, and 640		KHz
Bandwidth	TDMA: 1600, 3200, and 6400 S-CDMA: 1600, 3200, and 6400 Pre-DOCSIS3 operation: TDMA: 200, 400, and 800		KHz
Minimum Transmit Level	P _{min} = +17 at ≤1280KHz modulation rate P _{min} = +20 at 2560KHz modulation rate P _{min} = +23 at 5120KHz modulation rate		dBmV
OFDMA channels			
Signal Type	OFDMA		
Maximum OFDMA Channel Bandwidth ⁽²⁾		96	MHz
Minimum OFDMA Occupied Bandwidth		6.4 (for 25 KHz subcarrier spacing) 10 (for 50 KHz subcarrier spacing)	MHz
Number of Independently configurable OFDMA channels		2	
Subcarrier Channel Spacing		25, 50	KHz
FFT Size	50 KHz: 2048 (2K FFT); 1900 Maximum active subcarriers 25 KHz: 4096 (4K FFT); 3800 Maximum active subcarriers		
Sampling Rate		102.4 (96 MHz Block Size)	MHz
FFT Time Duration		40 (25 KHz subcarriers) 20 (50 KHz subcarriers)	μs
Modulation Type	BPSK, QPSK, 8-QAM, 16-QAM, 32-QAM, 64-QAM, 128-QAM, 256-QAM, 512-QAM, 1024-QAM, 2048-QAM, 4096-QAM		
Bit Loading	Variable from minislot to minislot. Constant for subcarriers of the same type in the minislot. Support zero valued subcarriers per profile and minislot.		
Pilot Tones	14 data patterns and 2 subslot patterns, minislot subcarrier size and length dependent.		

Notes: (1) F_{US_MAX} determined by external diplexer. Maximum upstream frequency supported by SoC: 204 MHz.

(2) Not including external diplexer bandwidth limitation.

Downstream		
Frequency Range ⁽¹⁾ (edge to edge)		F _{DS_MIN} -1218MHz MHz
Input Impedance		75 Ω
Total Input Power		< 40 dBmV
Input Return Loss (across freq. range)		≥ 6 dB
SC-QAM channels		
Number of Channels		32 max
Level Range (one channel)		North Am (64 QAM and 256 QAM): -15 to +15 EURO (64 QAM): -17 to +13 EURO (256 QAM): -13 to +17 dBmV
Modulation Type		64 QAM and 256 QAM
Symbol Rate (nominal)		North Am (64 QAM): 5.056941 North Am (256 QAM): 5.360537 EURO (64 QAM and 256 QAM): 6.952 Msym/s
Bandwidth		North Am (64 QAM/256QAM with α=0.18/0.12): 6 EURO (64 QAM/256QAM with α=0.15): 8 MHz
OFDM channels		
Signal Type		OFDM
Maximum OFDM Channel Bandwidth		192 MHz
Minimum Contiguous-Modulated OFDM Bandwidth		24 MHz
Number of OFDM channels		2
Frequency Boundary Assignment Granularity		25 KHz 8K FFT 50 KHz 4K FFT
Subcarrier Spacing / FFT Duration		25 KHz / 40 μs 50 KHz / 20 μs
Modulation Type		QPSK, 16-QAM, 64-QAM, 128-QAM, 256-QAM, 512-QAM, 1024-QAM, 2048-QAM, 4096-QAM
Variable Bit Loading		Support with subcarrier granularity Support zero bit loaded subcarriers
Level Range (24 MHz min occupied BW)		-9 dBmV/24 MHz to 21 dBmV/24 MHz
Equivalent Power Spectral Density to SC-QAM of -15 dBmV to +15 dBmV per 6MHz.		
Maximum average power per MHz input to the CM from 54 MHz to 1218 MHz		Let X = Average power of lowest power 24 MHz of modulated spectrum for demodulation Additional Demodulated Bandwidth, B _{DEM0D} : ≤ Min [X - 10*log(24) + 10; 21 - 10*log(24)] Additional Non-Demodulated Bandwidth, B _{NO-DEM0D} : ≤ Min [X - 10*log(24) + 10; 26 - 10*log(24)] For up to 12 MHz of occupied bandwidth (analog, OOB, QAM, OFDM) ≤ Min [X - 10*log(24) + 10; 21 - 10*log(24)] For all remaining bandwidth dBmV/ MHz

Notes: (1) F_{DS_MIN} determined by external diplexer.

Carrier Ethernet Highlights

Network Security	Upgraded security with port-isolation, basic ACL, broadcast/multicast/DLF storm control, unique port loopback detection, and DHCP Client/Option82 functionality
Resiliency & Protection	ITU-T G.8031 linear and ITU-T G.8032 ring protection with switching time less than 50ms IEEE 802.1ax Link Aggregation G.8131 linear protection for MPLS-TP in LSP layer and PW layer
MEF CE2.0	MEF ELINE, ELAN, ETREE service available
Ethernet OAM	IEEE 802.3ah Link OAM, IEEE 802.1ag end-to-end connectivity OAM and ITU-T Y.1731 end-to-end service and performance, SLA reporting
Management	Auto-Provisioning, plug&play, single IP for all the connected remote devices, end to end configuration Device management and VPN service management
SAT	Service activation test using Y.1564 up to 8 stream, act as a generator or a reflector
QoS	Advanced QoS technology allows stream-marking based on CoS, DSCP, IP precedence and priority; scheduling modes including SP, WRR, SP+WRR; WRED, flow-based mirroring/rate-limit/redirection/VLAN swapping and rewriting
Power Reliability	Dual hot-swappable power supply, with voltage/temperature alarms
TWAMP-Light	Standard IP SLA measurement, include generator and reflector
SLA Portal	B/S architecture, SLA TWAMP KPIs monitor(include FD, FDV, FLR, availability, bandwidth, bandwidth utilization)
E2E Provisioning	Standard MEF40 architecture, include bandwidth/performance profile GUI, standard service modules(ELINE, ELAN, ETREE), and End-to-End configuration based on service

Carrier Ethernet Key Features

Switching Mode	Store and forward mode; Supports jumbo frame
Ethernet	MTU:12,288 byte Up to 8k MAC Support 4,094VLANs (C-tag), stacked VLANs (QinQ, S-tag) Layer 2 loopback on single and multiple flows Layer 2 control protocol (L2CP) handling
IP Services	DHCP client, option61 IPv4, Static management routing
Traffic Management	Service classification per port/VLAN/CoS(DSCP) Support SP, WRR and SP+WRR scheduling modes, and up to 8 queues per port MEF-compliant 3-color policing with color-aware and color-blind mode Bandwidth throttling per port/VLAN/CoS(DSCP), CIR/EIR per flow
Security	ACL based on VLAN, CoS, MAC, EtherType, IPv4, IPv6, or user-define RADIUS, TACACS+ Storm control (broadcast, multicast, DLF)
Reliability	Link aggregation group (LAG) Interface backup ITU-T G.8031 Ethernet link protection switching (ELPS) and G.8032 Ethernet ring protection switching (ERPS) with the automatic protection switchover time less than 50ms Port/VLAN-based Ethernet local loop detection Fault propagation AC&DC dual-feed power supplies

Ethernet OAM	IEEE 802.3ah EFM-OAM link management IEEE 802.1ag connectivity fault management (CFM) with 3.3ms CCM resolution ITU-T Y.1731 performance monitoring (PM) Hardware-based frame delay (FD) measurement Y.1564 TWMAP-Light Hardware-based SLA KPIs per port or EVC, which include throughput, delay, jitter, packet loss and availability Dying gasp message in case of power failure
Auto-Provisioning	Auto-establishment of management tunnels across L2/L3 networks
System Management	Remote management via SNMP v1/v2/v3, Telnet and SSH v1/v2 Local management via console interface MEF 36 compliant MIB KeepAlive, RMON, LLDP, Syslog Port/VLAN/CoS-based statistics SFP digital diagnostic management (DDM) Temperature and CPU monitoring Voltage and temperature monitoring Dual system
Fault Propagation	From line to client interface fault propagation (user configurable) Client interface fault propagation
Compliances, standards and protocols	IEEE802.3,802.3u IEEE802.3ad Link Aggregation IEEE802.1p,802.1Q VLAN IEEE802.1ad QinQ IEEE802.3ah OAM IEEE802.1ag CFM ITU-T Y.1731 Services OAM ITU-T G.8031 ELPS ITU-T G.8032 ERPS IGMP v1/v2/v3 SNMPv1/v2c/v3 CE certified ,UL RoHS compliance EMI Class A MEF6,8,9,10,11,13,14,16,17,20,31,36

Specifications are subject to change without prior notification.

For more information on our products, please visit: www.electroline.com or call: 800-461-3344