SmartAX MA5633
D-CCAP Head End Device

Product Overview

Huawei SmartAX MA5633 distributed converged cable access platform (D-CCAP) head end device (MA5633 for short) is a full-service, digital cable network device designed for Fiber Deep migration. Installed at the edge of an HFC network, the MA5633 delivers a Gigabit bandwidth to a single group of users at a lower cost than FTTH. With the built-in EQAM or optical receiver, the MA5633 is fully backward compatible to existing QAM-based services. A Huawei OLT located at the head end aggregates up to hundreds of distributed MA5633s and provides space, power, and cooling efficiencies required for a large-scale transition toward Fiber Deep. Positioned to support the SDN framework, the D-CCAP further evolves HFC.

Product Highlights

High Bandwidth

Supports a maximum downstream rate of 1600 Mbit/s in QAM 256 mode and a maximum upstream rate of 320 Mbit/s in QAM 256 mode.

High Integration

- ✓ Built-in optical receiver or transceiver
  - ◆ Significantly simplifies installation and cable connections because only one chassis needs to be installed.
  - ◆ Reduces installation space, resolving issues caused by space limitations on installing a ground-based network box.
  - ◆ Supports remote management and alarm generation for the optical receiver or transceiver.
- ✓ Built-in wavelength division multiplexing (WDM)

  The built-in WDM applies in newly deployed networks where feeder fibers are insufficient, which reduces optical fiber investments and fiber routing.
- ✓ Built-in edge quadrature amplitude modulation (EQAM)

  The built-in EQAM applies in newly deployed networks or the networks requiring reconstruction in both downstream and upstream directions. On these networks, no external EQAM needs to be purchased or installed in a hub equipment room, which reduces investments and maintenance costs and simplifies hub equipment room deployment.

Comprehensive QoS Measures

- ✓ Supports traffic burst, which transiently improves user bandwidths using idle bandwidth resources without changing QoS parameter settings. This feature shortens user waiting time and enhances user experience.
- ✓ Supports the configuration of downstream and upstream committed information rates (CIRs), preferentially ensuring the bandwidths of VIP users.

Converged Services

- ✓ Supports heterogeneous access and shared platform for provisioning cable and fiber to the home (FTTH) services, which simplifies coordinate network construction.
- ✓ Supports L2VPN business services over DOCSIS (BSoD).
  - ◆ Dot1Q-based and Dot1ad-based L2VPN services
  - ◆ MPLS-based L2VPN service (An OLT model MA5800 is required.)
- ✓ Provides an integrated solution for video and data services using a built-in EQAM, which simplifies network deployment.

Dual-channel 60 V AC power supply

Ensue that the device functions normally when one-channel 60 V AC power supply fails.

Complete Maintenance and Management

- ✓ Supports centralized management. In this mode, the MA5633 is plug-and-play and regarded as a service board of the OLT. The functions of the combined OLT and MA5633 are the same as those of centralized CCAPs. All maintenance operations are performed on the OLT. The OLT supports remote configuration, upgrades, and O&M for the MA5633. This allows simple and efficient maintenance and management.
- ✓ Supports Internet Protocol Detail Record (IPDR), an efficient data statistics and reporting mechanism used for accounting, fault locating, and network running status monitoring purposes to meet routine O&M requirements.
- ✓ Supports upstream spectrum scanning. Upstream cable channels are prone to interference from external noises, which adversely affect CMs and user services.
  - ◆ In spectrum planning, this function enables the MA5633 to obtain noise distribution on upstream channels so that the MA5633 can configure services in the frequency bands with weakest noises, minimizing noise interference on services.
  - ◆ In network O&M, this function can be used to detect line noises to assist fault diagnosis.
  - ◆ This function supports the spectrum scanning file storage for follow-up manual analysis.
  - ◆ The U2000 supports upstream spectrum scanning. Spectrum range 0–81.92 MHz supports quiet noise scanning. The sampling is performed at an interval of 1s and step of 20 kHz. The collected data is displayed at a delay of 1s.
- ✓ Controls RF port status. The MA5633 supports two-status configuration. The two statuses are **enable** and **disable**. The two statuses work with the upstream spectrum scanning function provided by the U2000. In this way, the MA5633 can rapidly identify an RF line where a noise source locates, thereby improving troubleshooting efficiency.
- ✓ Supports proactive network maintenance (PNM): Before a network fault adversely affects user services, the fault diagnosis system connected to the MA5633 detects this fault based on the analysis on the pre-equalization coefficients obtained between CMs and the MA5633. This function maximally decreases faults, thereby reducing network O&M costs and improving carriers' service level agreement (SLA).
- ✓ Supports maintenance using mobile Apps. Using mobile Apps, CMCs, cables, and CMs can be maintained, and the following information can be queried: CMC statuses and locations, downstream and upstream channel parameters of cables, MAC and IP addresses of CMs, and working channels of CMs.

Reliability Design

The MA5633 features wide temperature range, low power consumption and noise, and can be used in extreme weather conditions.
It complies with IP65 when its 60 V AC voltage transmitted over the cable, and complies with IP20 when a port is used for 220 V AC power supply and 60 V AC power supply.

The shell of the MA5633 is made of die casting aluminum alloy, which enables the bottom layer of the shell to use cooling grooves to implement passive cooling.

The surge protection level of the MA5633 is as follows: 6 kV in both common and differentiated modes for the AC power port; 10 kA in common mode and 3 kA in differentiated mode for RF ports.

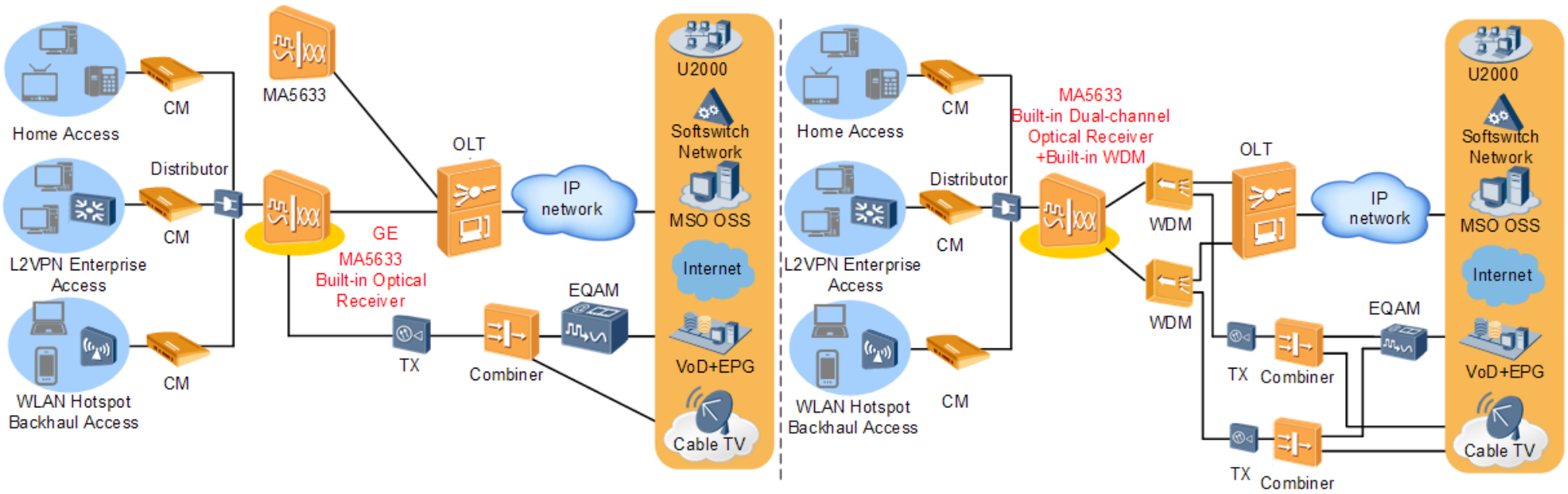
Application Scenarios

- ✓ Provides the HSI, VoD, CATV, and dynamic voice services for residential users to meet multiple service operators (MSOs)' service requirements.
- ✓ Provides the L2VPN BSoD service for enterprise users.
- ✓ Provides the WLAN hotspot backhaul service using APs.

Is equipped with dual WDM modules that support CATV protection and a dual-channel optical receiver, improving network reliability with type C protection enabled.

The MA5633 supports PON and GE upstream transmission. In the following networking application, the GE upstream transmission is used as an example in the built-in optical receiver scenario and GE upstream transmission is used as an example in embedded optical receiver and embedded WDM scenarios.

Typical D-CCAP networking of the MA5633



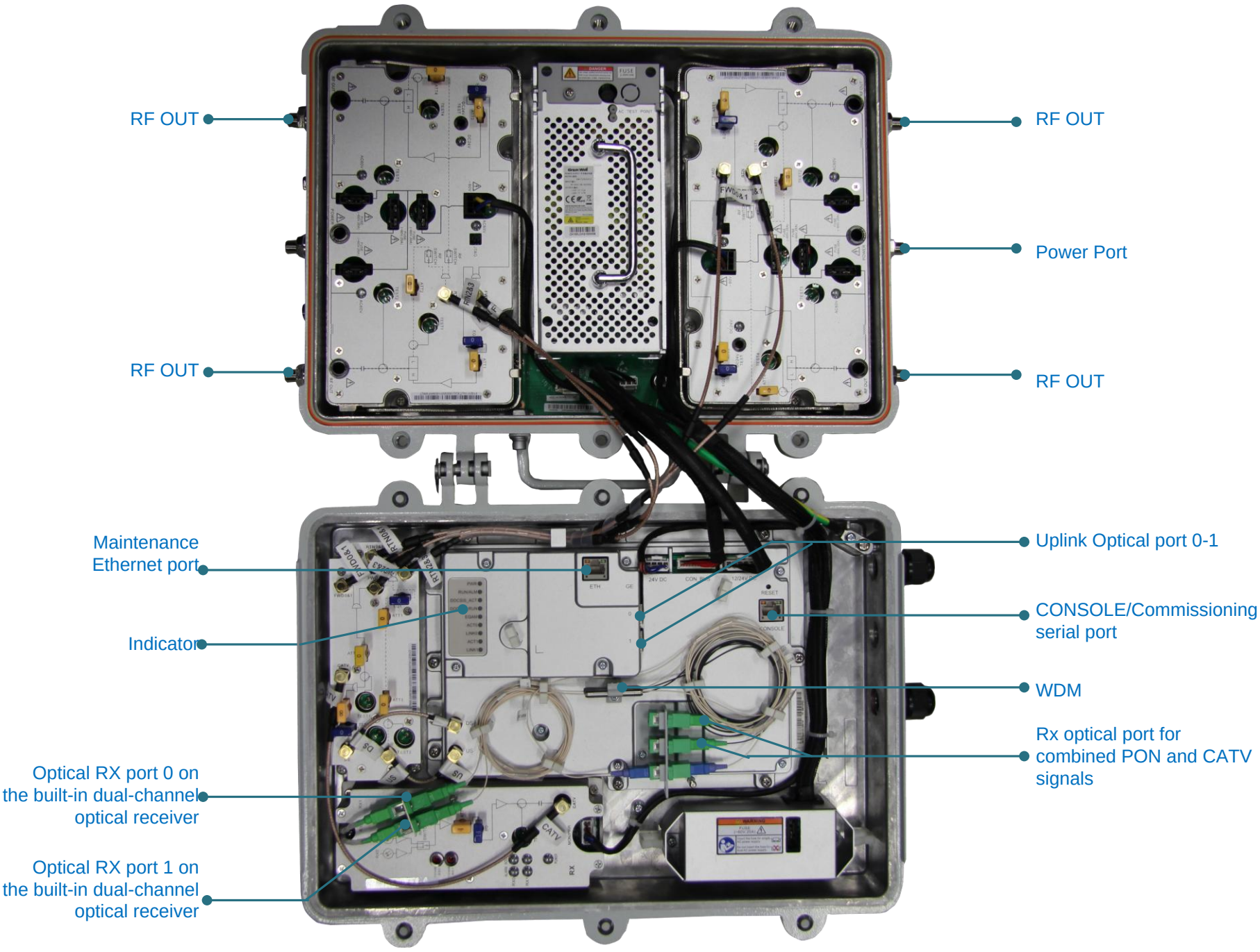
D-CCAP Network Structure

A distributed converged cable access platform (D-CCAP) network consists of an optical line terminal (OLT), coaxial media converters (CMCs), and a U2000 network management system, complying with the remote MACPHY architecture requirements specified by CableLabs DCA (Data-Over-Cable Service Interface Specifications).

- ✓ OLT: an aggregation device (CMC controller) that terminates the PON protocol and locates in a central office (CO). The OLT manages CMCs in a centralized manner.
- ✓ CMC: forwards data signals at Layer 2 between the upper-layer network and the HFC network.
- ✓ U2000: virtually manages and maintains NEs and services in the D-CCAP network.

D-CCAP Network Structure

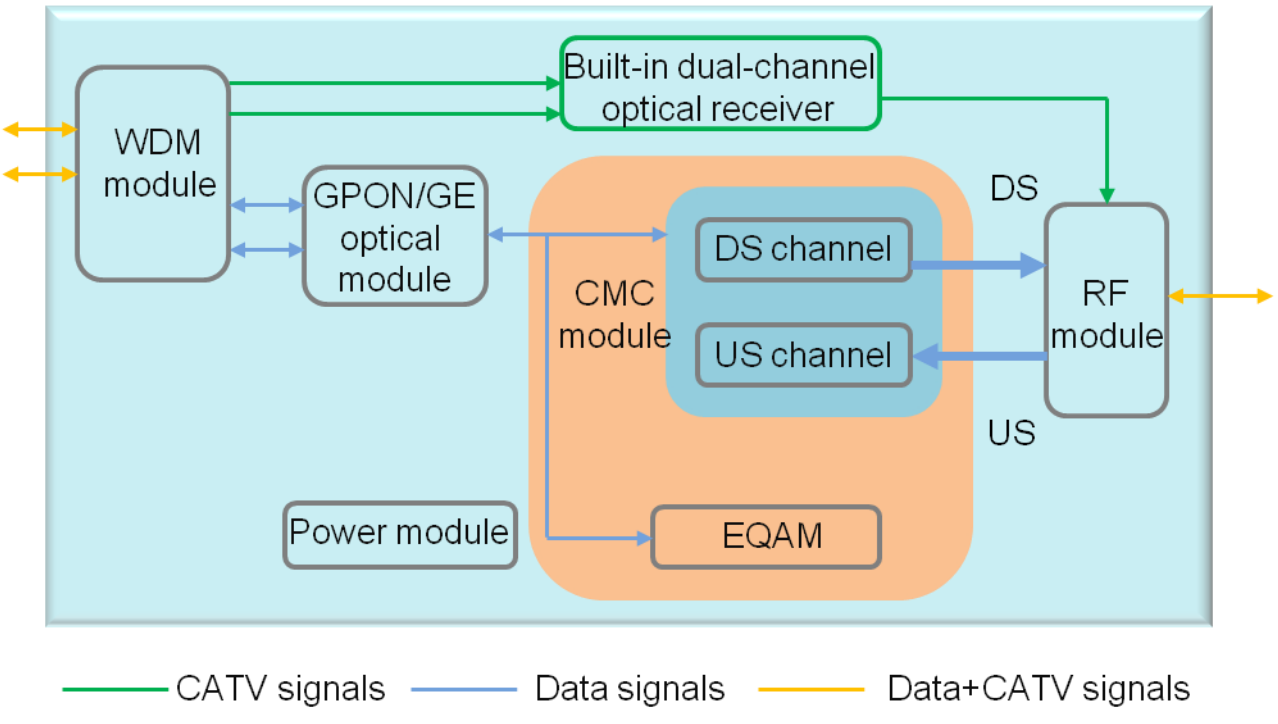
Hardware Structure



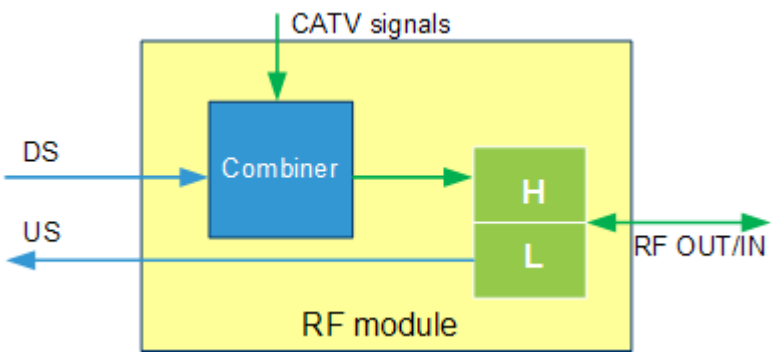
Port Description

Port Type	Silkscreen	Description	DOCSIS 3.0 CMC with cable outlets on both sides
Power port	Power	Introduces the 220 V AC power to the MA5633. NOTE Block this port if you do not use it. Replace this port with an F connector when the MA5633 uses the 60 V AC power supply.	1
Uplink optical port	OPTICAL	Provides two uplink port, which can be a GPON or GE port, which uses a small form-factor pluggable (SFP) module.	2
Optical RX port on the built-in dual-channel optical receiver	RX0/RX1	Can only be of the SC/APC type.	2
Commissioning serial port	CONSOLE	Supports local maintenance and remote maintenance.	1
Maintenance Ethernet port	ETH	A 100M Base-T commissioning Ethernet port and supports 100M full-duplex autonegotiation.	1
RF port	RF OUT	Inputs and outputs CATV and data signals.	4-out

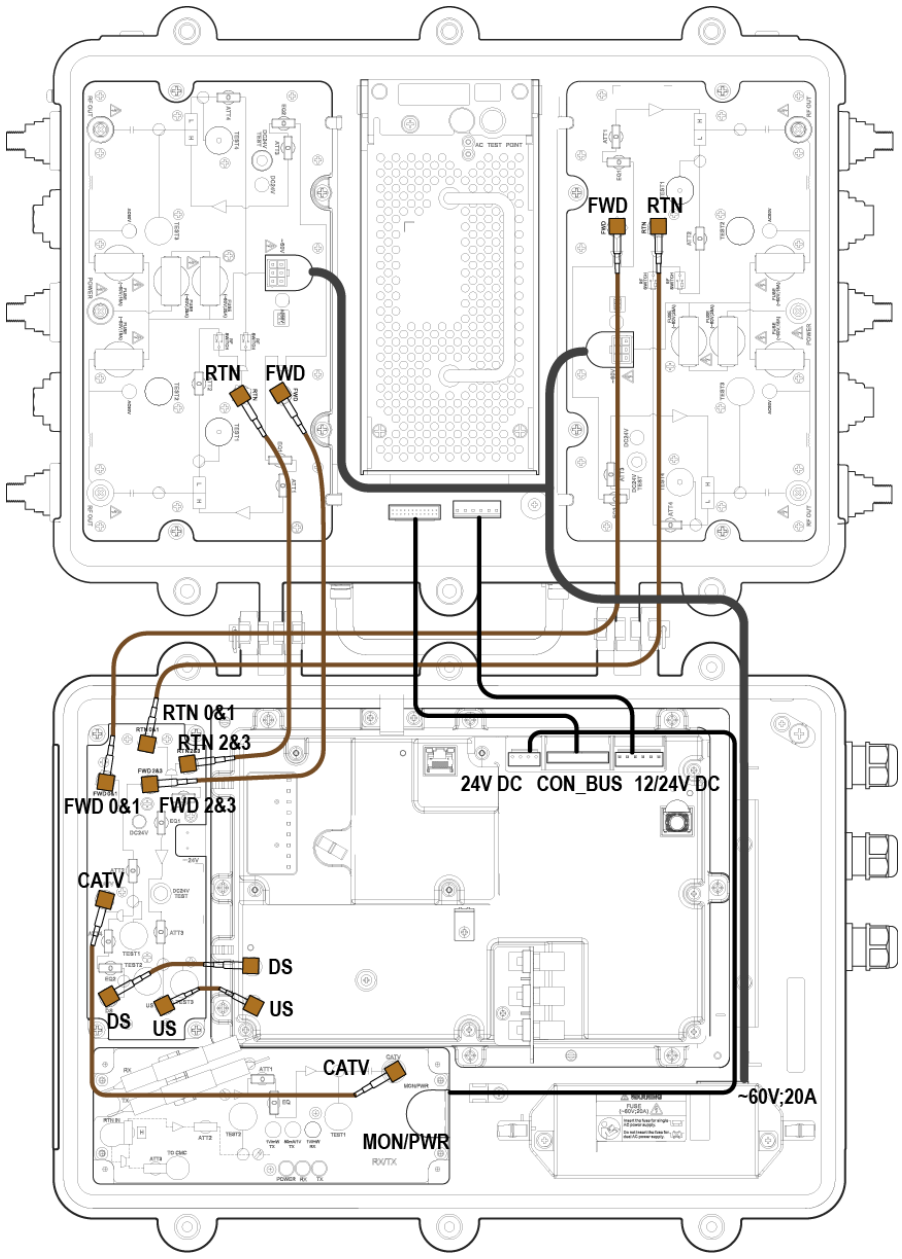
Functional Modules



Functional modules include the power module, optical receiver/transceiver module, CMC module, and RF module, which are separate modules and can be replaced onsite.

Module	Function
Power module	Converts the input 220 V AC or 60 V AC voltage to the 24 V or 12 V DC voltage required by each module.
WDM module	The WDM combiner located in the branch equipment room combines data signals with CATV signals for transmission over one feeder fiber and the WDM module built in the MA5633 on an FN separates data signals from CATV signals. ✓In the downstream direction, the WDM module sends the CATV signals to the optical receiver or transceiver module and the data signals through PON or GE optical module to the CMC module for forwarding. ✓ In the upstream direction, the WDM module sends the data signals to the upper-layer device.
Optical receiver	The functions of an optical receiver module are as follows: ✓ Optical receiver module: converts optical signals to RF signals. An optical receiver module consists of optical receiving components, an RF power amplifier, a gain regulator, and an EQ regulator. The RF signals after O/E conversion are sent to the RF module.
CMC module	Converts data between the upper-layer network and the HFC network. ✓ In the downstream direction, the CMC module modulates data signals to RF signals and sends the RF signals to the RF module. ✓ In the upstream direction, the CMC module demodulates the RF signals sent by the RF module to data signals for data conversion.
RF module	✓ In the downstream direction, the RF module uses a combiner to combine downstream signals with CATV signals. The combined signals are high-frequency signals. These signals pass through a high-pass/low-pass filter to CMs connected to RF ports. ✓ In the upstream direction, upstream signals are low-frequency signals. They pass through RF ports and a high-pass/low-pass filter over upstream channels to the RF module for modulation. 
EQAM	Multiplexes and modulates IP-based media data to RF signals and sends these signals over downstream channels to the RF module and then to STBs.

Block Diagram (with a Built-in Optical Receiver)



In the preceding figure,

- ✓Black lines indicate power cable connections.
- ✓Brown lines indicate downstream transmission, upstream transmission, and CATV connections.
- ✓RF ports are of SMB type.

CMC Module Specifications

GPON Upstream Transmission	Description	Notes
Standards compliance	ITU-T G.984	
Port type	SC/UPC	
TX rate	1.244 Gbit/s	
RX rate	2.488 Gbit/s	
TX wavelength	1310 nm	
RX wavelength	1490 nm	
Minimum TX optical power	0.5 dBm	
Maximum TX optical power	5 dBm	
RX sensitivity	–27 dBm	
Overload optical power	–8 dBm	
Transmission distance	20 km	

Performance Parameter of the Integrated Device	Description	Notes
Maximum throughput	✓Downstream: 1600 Mbit/s@256 QAM ✓Upstream: 320 Mbit/s@256 QAM	1 and 2
Number of supported service flows	4000 in both downstream and upstream directions	
Number of concurrent online CMs	1023 DOCSIS 3.0-compliant CMs	
System reliability specifications	System availability for the typical configuration: > 99.999% Mean time between failures (MTBF): about 35 years.	3

Notes:

1: The rate is obtained at the PHY layer.

2: The test is performed under the condition of 32 downstream channels (8 MHz per channel) and 8 upstream channels (6.4 MHz per channel).

3. Due to different network environments and different configurations used by devices, the preceding MTBF (35 years) of the MA5633 is only for reference. The preceding values are only for reference. For details, contact the related Huawei engineers.

Performance Parameter of the DOCSIS Module	Description	Notes
Standards compliance	DOCSIS 3.0 or DOCSIS 2.0	
Upstream communication protocol	ATDMA	
Frequency band	North American standard: ✓Downstream: 54–1002 MHz ✓Upstream: 5–42 MHz European standard 1: ✓Downstream: 87–1006 MHz ✓Upstream: 5–65 MHz European standard 2: ✓Downstream: 108–1006 MHz ✓Upstream: 5–85 MHz	4
Channel width	North American standard: 6 MHz European standard: ✓Downstream: 8 MHz ✓Upstream: 1.6 MHz, 3.2 MHz, or 6.4 MHz	
Number of channels	✓Downstream: 32 ✓Upstream: 8	5
Modulation	✓Downstream: 64 QAM or 256 QAM ✓Upstream: QPSK, 16 QAM, 32 QAM, 64 QAM, or 256 QAM	
Maximum QAM output level of a Single Channel (obtained based on the number of CMC channels)	42 dBmV@32 channels 45 dBmV@16 channels 49 dBmV@8 channels 52 dBmV@4 channels 60 dBmV@1 channel	1 and 2
Output impedance	75 ohms	
Upstream input level (can be configured using software)	–13.0 dBmV to 23.0 dBmV	6
Downstream MER	≥ 43 dB (after equalization) ≥ 35 dB (before equalization)	3

Notes:

1: The CMC output is flat. The output level of each channel can be configured. Configure the output level for channels one by one.

2: The maximum downstream output level can be set by running the **cable downstream** *channel-id* **rf-power** *value* command. The default value is 45 dBmV.

3: The values are obtained on CMC RF_OUT ports.

4: European standards 1 and 2 specify different RF module configurations.

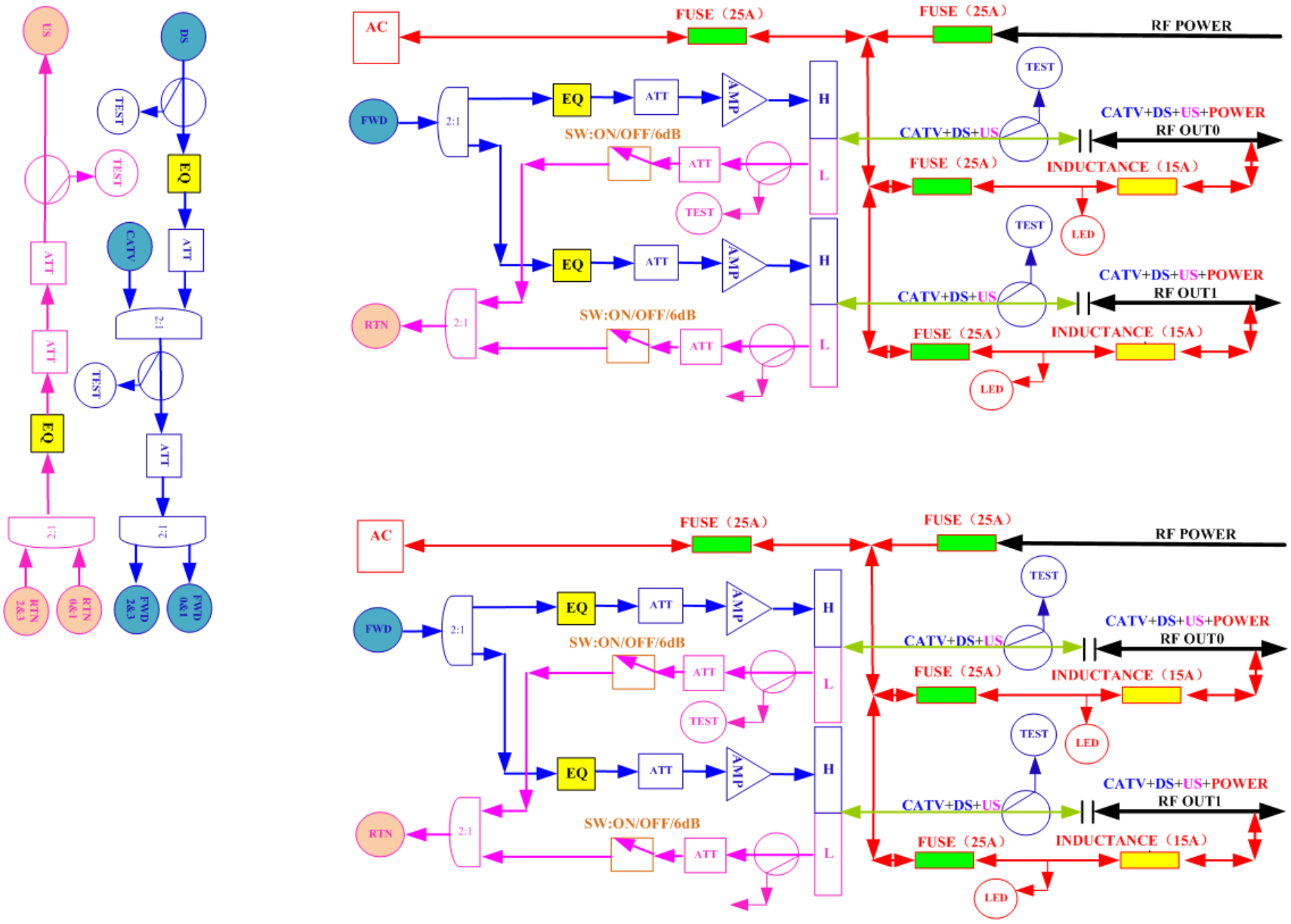
5: Downstream channels can be of DOCSIS or VoD type.

6: The range of the upstream input level is the collection of powers supported by all frequency ranges. When the configured upstream input level is out of the value range specified by the protocol, the CMC adjusts the upstream input level. The following table lists the adjustment method and the value range supported by the protocol.

Frequency Range (Unit: kHz)	Value Range of the Upstream Input Level (Unit: dBmV)	Notes
1600	–13 to 17	
3200	–10 to 20	
6400	–7 to 23	

RF Section Specifications

RF Module Diagram



Forward Station Performance	Description	Notes
Frequency range (downstream)	✓European standard 1: 87–1006 MHz ✓European standard 2: 108–1006 MHz ✓North American standard: 54–1002 MHz	1
Operational gain (from CATV to RF_OUT)	9±1 dB	6
Frequency flatness	✓±0.75 dB@54–750 MHz ✓±1 dB@54–1002 MHz	
EQ	0–14 dB (Default value: 0 dB)	
Port-to-port isolation	≥ 23 dB (5–1002 MHz)	
Noise figure@54–1002MHz	✓≤8 dB@87 MHz ✓≤8 dB@1002 MHz	4
Maximum output level@1002 MHz	114 dBuV	2
Output return loss	≥ 16 dB (5–1002 MHz)	
Hum modulation	≥ 65 dB	5
Test point	✓20±0.75 dB@54–750 MHz ✓20±1 dB@54–1002 MHz	
Output impedance	75 ohms	
Current pass-through capability	15 A (35–95 V AC pass-through voltage)	
Distortion@77 NTSC (CW)+75 QAM (with RX module)	✓CSO ≥ 63 dB ✓CTB ≥ 65 dB ✓CNR ≥ 51 dB ✓XMOD ≥ 60 dB	3

Notes:

1: European standards 1 and 2 specify different RF module configurations. All European standard 2 parameters can be obtained in European standard 1.

2: The test is performed at 14 dB equalization. The QAM carrier level is –6 dB lower than the analog video carrier level. The output level of the RF port on the integrated device is adjusted based on the actual output level of the DS port on the CMC and the attenuation of the RF module.

3: Loaded with 77 NTSC CW carriers from 77–550 MHz. QAM refers to 550–1002 MHz loading.

4: The test is performed on the RF_OUT port of the RF module under ATT 0 dB and EQ 14 dB.

5: The test is performed at the 15 A pass-through current in the frequency band of 54–1002 MHz.

6: The test is performed at 0 dB attenuation and equalization in the downstream direction within the frequency band of 54–1002 MHz.

Reverse Station Performance	Description	Notes
Frequency range (upstream)	✓European standard 1: 5–65 MHz ✓European standard 2: 5–85 MHz ✓North American standard: 5–42 MHz	1
Operational gain (from RF_OUT to US port)	–13±1 dB	2
Frequency flatness	±0.75dB @ 5~42MHz;	-
Test point	20±1dB @ 5~42MHz;	-
EQ	0–5 dB (Default value: 0 dB)	-
Path-to-path isolation	≥ 23 dB (5–1002 MHz)	-

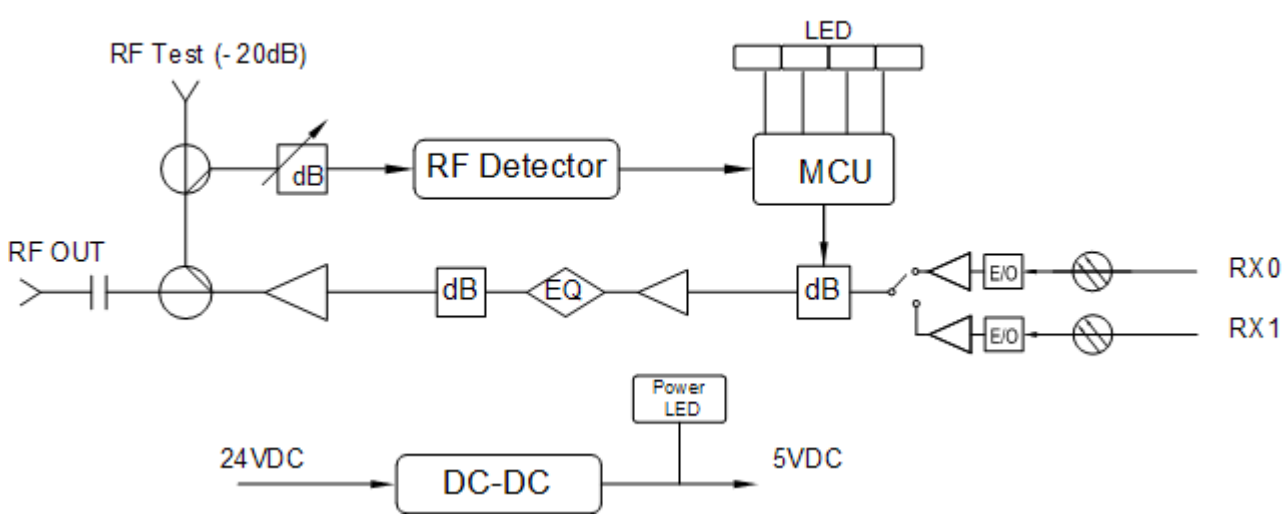
Notes:

1: European standards 1 and 2 specify different RF module configurations. All European standard 2 parameters can be obtained in European standard 1.

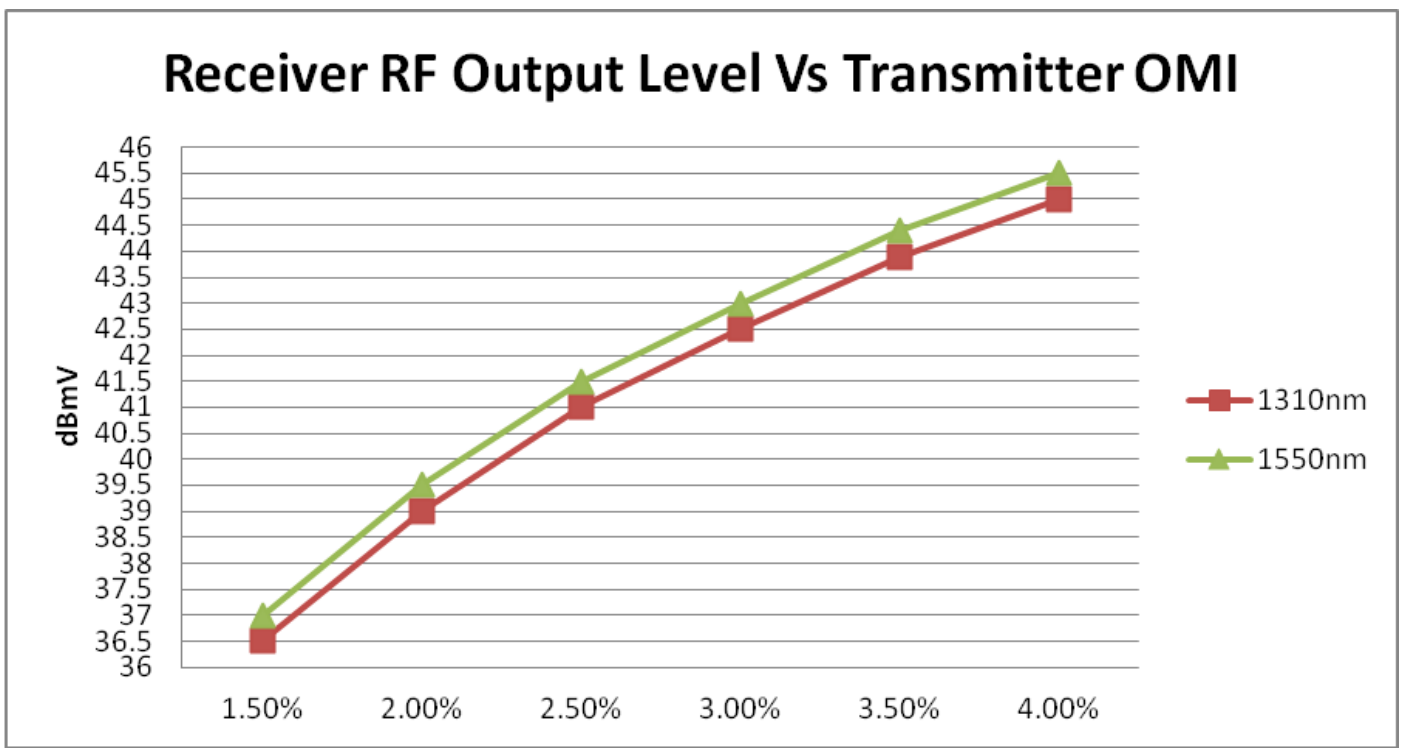
2: The test is performed at 0 dB attenuation and equalization in the upstream direction within the frequency band of 5–42 MHz.

Optical Section Specifications

Optical Receiver Diagram



Optical Section — Optical Receiver Module	Description	Notes
Center wavelength	1310 nm or 1550 nm	
Optical input range	–8 dBm to 3 dBm	1
AGC range	–6 dBm to 0 dBm	1
Pass band	45–1002 MHz	
Frequency response	±0.75 dB	2
Attenuate	0–16 dB(Default value: 4 dB)	
EQ	0–14 dB(Default value: 14 dB)	
RF output level@0 dBm optical RX power	See the following chart.	3
Optical input test point (±10%)	1 V/mW	
RF output test point	–20±1 dB	



Notes:

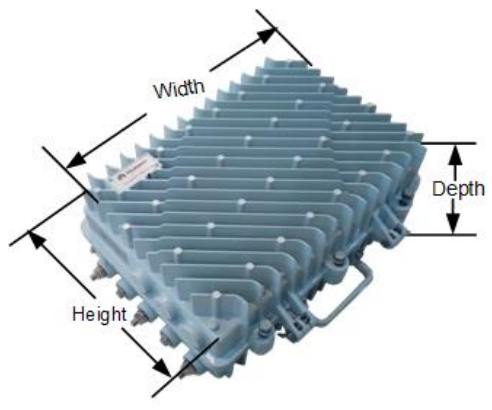
1: In actual applications, the input optical power is suggested to range from 0 dBm to －6 dBm for the optimal RF performance.

2: The test is performed at 4 dB attenuation and 0 dB equalization.

3: The RF levels showed on the "Receiver RF Output level Vs Transmitter OMI" are minimum output levels measuring at 1002 MHz, it is tested under 0 dB attenuation and 14 dB equalization.

Mechanical Specifications

Parameter			
Weight	13.5 kg		
Dimensions (width x height x depth)	400 mm x 275 mm x 175 mm		
Environment Parameter			
Operating Temperature	**Operating Humidity**	**Atmospheric Pressure**	**Altitude**
–40°C to +55°C The MA5633 can start at a lowest temperature of –25°C.	5% RH to 95% RH	70 kP_a to 106 kP_a	< 4000 m*



* The air density varies with the altitude, which affects the heat dissipation of the MA5633. Therefore, the operating temperature of the MA5633 varies with the altitude.

Power Specifications

Power Specifications		
Input AC voltage (typical)	220 V AC	60 V AC
Operating voltage	90 V AC to 300 V AC	35 V AC to 95 V AC
Input current	< 0.8 A	< 3 A

MA5633 Power Consumption Specifications

Power Consumption of the Integrated Device (Unit: W)		
Typical Configuration	60 V AC	220 V AC
Equipped with built-in dual-channel optical receiver+ built-in WDM	125	126

Notes: The power consumption of the integrated device has considered the conversion efficiency of the primary power supply.

Standards Compliance

CMTS

DOCSIS 2.0

DOCSIS 3.0

European DOCSIS 2.0

European DOCSIS 3.0

GPON

ITU-T G.984.1

ITU-T G.984.2

ITU-T G.984.3

ITU-T G.984.4

ITU-T G.983.3

ITU-T G.983.3 Amendment 1

GE

IEEE 802.z

IEEE 802.3

IEEE 802.3x

Environment Standards

ETS 300 019-1-1

ETS 300 019-1-2

ETS 300 019-1-4

ETS 300 019-2-1

ETS 300 019-2-2

ETS 300 019-2-4

Electromagnetic Compatibility Standards

CISPR 22

CISPR 24

EN 50083-2

EN 55022

EN 55024

ETSI EN 300 386

ETSI ES 201 468

Security Standards

EN 60065

EN 60728-11

IEC 60950-1

EN 60950-1

IEC 60950-22

EN 60950-22

EN 41003

EN 60825-1

EN 60825-2

IEC 60825-1

IEC 60825-2

UL60065

UL60950-1

UL60950-22

MPE System Standards

ETSI 300 119

Other Standards

BELLCORE TR-332/SR-332

ISTA Procedure 2A/2B

Primary Function List

Cable Access

Channel management

Load balancing

Channel bonding

Information statistics

Spectrum management policy group

Dynamic Voice

Dynamic voice service creation using PacketCable

Video Service

EQAM

Multicast

NGOD D6

CM Management

CM registration and management

Limitation on the number of CPEs connected to a CM

CM admission control

CM information query

Periodic statistics for CMs

CM event reporting

Layer 2 Management

MAC address management

Layer 2 forwarding policy (VLAN+MAC address)

QoS

Priority processing

Traffic management

Congestion management

Access control list (ACL) policies

Traffic burst

QoS adjustment

Emulation Service

Dynamic Host Configuration Protocol (DHCP) emulation

IPv6

IPv6 ACL

DHCPv6 Option 18 or 37

IPv6 neighbor discovery (ND)

MLD proxy or snooping

Layer 3 Features

DHCP client

DHCP relay

ARP

Static route

Clock Features

Network time synchronization

User Security

DHCP Option 82

Relay agent info option (RAIO)

MAC address anti-spoofing

MAC address anti-duplication

Source address verification (SAV)

User isolation

BPI+

X.509 authentication

Message integrity check

TFTP proxy

System Security

Destination IP address filtering (IP address access list)

DoS anti-attack

ICMP or IP address anti-attack

Destination MAC address filtering

Source route filtering

Firewall and blacklist

Setting of permitted or denied source IP address segments

O&M Security

Simple Network Management Protocol (SNMP)

Secure shell (SSH)

Operator management

Remote connection security

Log management

Centralized management

DHCP dialup emulation

Remote software commissioning for DHCP GE upstream transmission

Remote software commissioning for NAC upstream transmission

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