OSCILLOQUARTZ
A division of Adtran

Oscilloquartz edgeSync™

Data sheet

OSA 5412

Compact highspeed PTP grandmaster, NTP server, SB/MB-GNSS receiver

5G Mobile | Telecom | Defense | Data center | Smart grid | Transportation | Financial | Broadcast

Benefits

- **High Accuracy White Rabbit PTP**
  Unlock sub nanosecond synchronization with a firmware upgrade only; no extra hardware needed
- **G.8271.1 HA-TT**
  system is compliant with G.8271.1 High Accuracy Time Transfer
- **ePRTC holdover re-learning continuity**
  Retains previously learned holdover parameters across reference loss and restore, ensuring continuous holdover readiness even with flapping phase references
- **Ultra-long Holdover**
  With improved ePRTC algorithm to provide up to 150 days of holdover within 100ns
- **G.8272.1 Amd.1 (07/2025) recovery from holdover**
  No impact to the end application during recovery from holdover
- **Multisource ePRTC combiner**
  Introducing redundancy to ePRTC systems by combining up to five phase and frequency sources with user defined or automatic references weights
- **G.8272.2 cnPRTC Annex A**
  UTC(k) insertion for cnPRTC clock combiner
- **IEEE 1588 2019 v2.1 Annex P Reference Validator (Prong C)**
  Redundancy by complementary timing systems, provides cross reference validation for multi-source combiner.
- **IEEE 1588 2019 v2.1 Annex P (Prong D)**
  Enhanced security by PTP monitoring and management features
- **NTS (Network Time Security) for NTP**
  Cryptographic authentication (RFC 8915) safeguarding timing against spoofing and man in the middle attacks

Overview

The number of applications that require accurate phase, frequency and time- of-day synchronization at the edge of mobile backhaul networks is continuously increasing. Achieving the levels of accuracy required by these applications in a cost-effective way has become a major challenge for network operators.

Most critical applications rely on highly precise phase, frequency and time-of-day synchronization. With our OSA 5412 ensuring cost-effective, accurate and reliable synchronization distribution for next-generation technologies is no longer a challenge. This family of IEEE 1588v2 Precision Time Protocol (PTP) grandmaster devices supporting 10Gbit/s as well as 1Gbit/s interfaces with hardware timestamping has been optimized for deployment at the network edge. What's more, with its NTP server and GNSS receiver capabilities, our OSA 5412 is also ideal for deployment in legacy synchronization architectures. Our OSA 5412 ensures reliable and precise synchronization that complies with the most stringent demands. To meet all installation demands, two ordering options are available: one with all connectors at the front and one with connectors at the rear side and a display at the front.

One of its standout features is its extended holdover capability, enabled by our ePRTC algorithm and the OSA cesium clock with Optical Pumping technology. Together, they ensure uninterrupted synchronization for up to 100 days with 100ns precision, providing unparalleled stability in the event of GNSS signal loss—critical for high-demand operations. OSA 5412 now supports White Rabbit PTP for sub-nanosecond synchronization, as a software feature white Rabbit expand its capabilities for high accuracy precise time distribution.

Oscilloquartz zero-trust multisource aPNT+™ platform

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High-level technical specifications

OSA 5412

- OCXO, high-quality OCXO, high-quality DOCXO and rubidium
- Multiple 1G/10G ports
- Up to 1536 unicast slaves @128pps
- Hot-swappable redundant PSU

Operation modes

- ePRTC, PRTC A and PRTC B
- White Rabbit PTP GM, White Rabbit Boundary Clock. White Rabbit Slave
- PTP GM, BC type D, slave, probe
- NTP server

Built-in GNSS receiver

- Embedded L1 multi- constellation receiver (GPS/GALILEO/BEIDOU/GLONASS)
- Optional multi-band, multi-constellation receiver for enhanced accuracy
- Jamming, spoofing detection

PTP profiles

- L2 (Ethernet) and L3 (IP) default profiles
- Telecom profiles
- Enterprise hybrid profile
- Power and utility profiles
- Broadcast profiles

NTP server

- High capacity server
- Hardened NTP responder
- Hardware timestamping
- NTP/PTP/Sync-E/SSU supported simultaneously
- PTP to NTP conversion
- NTP authentication

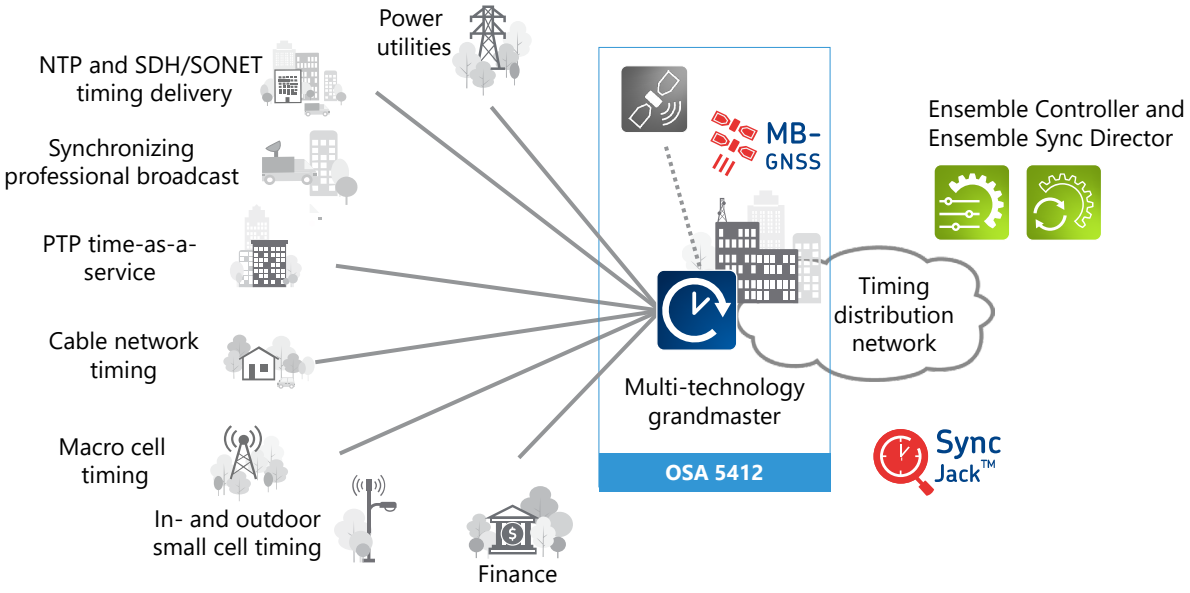
Syncjack™ technology

- Frequency and phase accuracy measurements
- TE, TIE and MTIE calculation
- PTP message transport analysis
- PTP network analysis

Applications in your network

Synchronization and time-as-a-service applications with the highest availability

- High Accuracy White Rabbit PTP Grand Master and Boundary Clock
- High Accuracy Time Transfer support
- Timing distribution at the edge of mobile backhaul and fronthaul networks for frequency and phase synchronization
- Cable networks (DOCSIS 3.1) synchronization
- Synchronization delivery within buildings for indoor small cell radio base stations
- Synchronization of legacy network architectures based on NTP, SSU
- Time as a service into data center, financial, health and media networks
- Modernized power utility networks
- Modernized digital broadcasting studios
- Compatible to Optical Timing Channel



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Product specifications

Product variants

	OSA 5412 quartz	OSA 5412 quartz HQ+	OSA 5412 quartz HQ++	OSA 5412 rubidium
Clock	OCXO	High-quality OCXO	High-quality DOCXO	Rubidium
Multi-band GNSS	(*)	Optional	Optional	Optional
PSU	Hot-swappable redundant PSU (AC/DC)	Hot-swappable redundant PSU (AC/DC)	Hot-swappable redundant PSU (AC/DC)	Hot-swappable redundant PSU (AC/DC)

*Note: please, consult factory

Main applications

- ePRTC , PRTC-A and PRTC-B
- 1588v2 PTP grandmaster clock (up to 1536 PTP unicast clients at 128pps)
- 1588v2 PTP boundary clock (up to 1536 PTP unicast clients at 128pps)
- G.8273.2 boundary clock class D
- 1588v2 APTS clock
- 1588v2 PTP slave clock
- Fan-out of multiple physical synchronization output interfaces
- NTP server
- Synchronization protocol and physical signal conversion
- Sync probe – Syncjack™ monitoring and assurance

PTP features

- PTP High Accuracy:
  - White Rabbit PTP profile
  - White Rabbit to IEEE PTP translation
- PTP profiles support:
  - ITU-T G.8265.1 frequency delivery profile (IP unicast over IPv4/IPv6)
  - ITU-T G.8275.1 time/phase delivery profile (Full timing support - Ethernet multicast)
  - ITU-T G.8275.2 time/phase delivery profile (APTS)
  - PTP enterprise profile (Mixed multicast and unicast over IPv4/IPv6)
  - IEEE 1588 2008 PTP default profile over IPv4/IPv6 multicast
  - IEEE 1588 2008 PTP default profile over Ethernet multicast (Annex F)
  - PTP power and utility profiles: IEC/IEEE 61850-9-3, IEEE C37.238-2011, IEEE C37.238-2017
  - PTP broadcast and media profiles: SMPTE ST 2059-2 AES67
- Up to 30,000 delay requests / delay responses in multicast and hybrid PTP profiles
- 1-step and 2-step clock
- Up to 16 master/BC IP addresses
- Multi VLAN flow point supporting a range of 4095 VLANs
- Support for multiple profiles simultaneously
- Support for PTP IPv4/IPv6 on the same port
- Support PTP (TAI) and arbitrary (ARB) timescales
- Support master and slave on any port simultaneously
- Up to three stacked VLANs per flow (Q-in-Q service provider tagged)
- ICMP/DSCP/TOS
- Configurable static routes and default getaways
- Enhanced PTP GM/BC/Slave statistics, performance monitoring (15min and 24h), threshold crossing alarm (TCA) and SNMP traps
- In-house best-in-class clock recovery algorithms
- DoS protection using hardware access control list (ACL) and traffic rate limiting
- Operates as single or double attached clock in PRP IEC 62439-3 network

NTP features

- Stratum 1 NTP server when locked to GNSS
- NTP v1, v2, v3, v4 and SNTP over IPv4/IPv6
- NTP unicast/multicast/broadcast
- Network Time Security (NTS)-RFC 8915
- MD5/SHA-1 symmetric key and Autokey authentication
- TIME & DAYTIME protocols
- NTP peering
- NTP selectable timescale (UTC/GNSS/local)
- Hardware timestamping
- Accuracy within +/–100nsec from UTC
- Up to 16 NTP server IP addresses
- Support PTP and NTP on same Ethernet port
- PTP to NTP translation
- Up to three stacked VLANs per flow (Q-in-Q service provider tagged)
- Enhanced NTP statistics and client lists
- NTPd up to 8,000 transactions per second
- NTP Responder up to 500.000 transactions per second without authentication
- PTP backup in case of GNSS outage

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Synchronization interfaces (onboard)

- Synchronous Ethernet (SyncE) over Ethernet interfaces
- 2x BITS-in and 2x BITS-out (2.048MHz, E1 or T1 (DS1) including SSM)
- 2x PPS in/out
- 2x time-of-day (ToD) + PPS in/out
- 2x CLK 10MHz input (10/2.048MHz) / output (10MHz)
- Antenna input for embedded GNSS receiver

Ethernet ports

- Hardware-based timestamping (PTP & NTP)
- 2x 100/1000BaseT copper ports
- One copper port is PoE driver (802.3af class 2, 6.49W max)
- Up to 8x 1GbE/100Mb FE (SFP)/10GbE (SFP+), user configurable per port
- All fiber ports support SM/MM colored/non-colored SFP and copper SFP
- Per-flow hardware-based policing and scheduling
- Configurable link asymmetry delay compensation

Synchronous Ethernet (SyncE)

- Supported by all Ethernet interfaces in fiber and copper modes
- Compliant to ITU-T G.8261/G.8262/G.8262.1/G.8264
- Ethernet synchronization message channel (ESMC)) and enhanced ESMC with enhanced SSM codes
- Sync-E for time holdover during GNSS outage

BITS in/out

- 2x BITS input and output over shielded RJ-48
- User-configurable: E1, T1 (DS1), 2.048MHz
- G.823 / G.824 sync interface compliant
- Synchronization status message (SSM)
- BITS input for time holdover during GNSS outage
- Output squelch option
- EEC/SEC/SSU filtering options

PPS in/out

- 2x PPS input and output (user configurable)
- User configurable input and output delay compensation
- SMA-F connector (50ohm)
- Output squelch option
- PPS configurable width

Time-of-day (ToD) in/out

- 2xToD+PPS input/output (user configurable)
- ITU-T G8271 compliant
- ToD formats – NMEA 0183 ($GPZDA sentence), ITU-T G.8271 and CCSA
- RS422 over shielded RJ-45
- PPS configurable width
- Output squelch option

GNSS receiver

Single-band receiver

- Multi-constellation GNSS L1 72 channels receiver
- GPS (L1C), GLONASS (L1OF), GALILEO, BeiDou (B1I), QZSS (L1C/A), SBAS (L1C/A: WAAS, EGNOS, MSAS, GAGAN)
- Three concurrent GNSS constellations

Multi-band GNSS receiver option

- Galileo Open Service Navigation Message Authentication (OSNMA)
- Provides enhanced accuracy for ePRTC and PRTC-B
- Multi-band, multi-constellation 184-channel GNSS receiver
- (L1C/A L2C):GPS, Galileo (E1B/C E5b), GLONASS (L1OF, L2OF), BeiDou (B1I, B2I), QZSS (L1C/A L2C), SBAS (L1C/A: WAAS, EGNOS, MSAS, GAGAN)
- L1/L5: GPS (L1C/A, L5), QZSS (L1C/A, L5), GAL (E1B/C, E5a), BDS (B1I, B1C, B2a), NavIC (L5), GLO (L1OF)
- Four concurrent GNSS constellations

Common GNSS receiver features

- Skyview and GNSS satellites status
- Configurable SNR, elevation and PDOP masks
- User-configurable antenna cable delay compensation
- Advanced interference detection
- Jamming and Spoofing detection and mitigation
- Support fixed positioning – single satellite mode
  - Support navigation mode with several dynamic platform models
- Voltage to antenna +5VDC
- Antenna connector SMA-F (50ohm)

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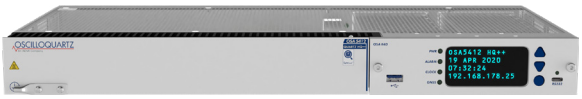
CLK in/out

- 2x CLK 10MHz input (10/2.048MHz) / output (10MHz) (user configurable)
- SMA-F connector (50ohm)
- Output squelch option

OLED display module

- Optional OLED display (reverse mounting)
- Press buttons
- Status LED's
- USB type A/serial connectors



Assured PNT(aPNT) solution

- Multiple backups to GNSS including PTP, SyncE, CLK BITS and local oscillator
- PRTC can automatically select between 3 available input references
- Frequency outputs are automatically selected between 3 available input frequency references
- Improved holdover with HQ+/HQ++/rubidium oscillator
- Atomatic switchover in case of jamming/spoofing/ intererence detection
- Multisource ePRTC combines up to five phase (GNSS/ PTP/PPS+ToD) and frequency (ePRC) references to improve accuracy in locked mode and extended holdover in case of GNSS outage
- Interoperable with OSA 5405 smart antenna
- PTP and GNSS assurance using Mosaic Sync director

Holdover performance

	Clock	Aging / day (after 30 days)	Temperature stability
Quartz	OCXO Stratum 3 / G.812 Type III	$\pm 5x10^{-10}$	$\pm 50x10^{-10}$
Quartz HQ+	High-quality OCXO G.812 Type I	$\pm 2x10^{-10}$ / $\pm 1x10^{-10}$*	$\pm 2x10^{-10}$
Quartz HQ++	High-quality DOCXO Stratum 2 / G.812 Type II	$\pm 5x10^{-11}$ / $\pm 1x10^{-11}$*	$\pm 1x10^{-11}$
Rubidium	Rubidium Stratum 2 / G.812 Type II	$\pm 5x10^{-12}$	$\pm 2x10^{-10}$/$\pm 2x10^{-11}$**

*Note: Effective daily aging after device has been powered for one month and locked to GPS for three days, for the following three days
**Note: effective temperature stability after compensation

	200nsec	400nsec	1.1usec	1.5usec	5usec	10usec	16ppb	After 24 Hours
Quartz	1 hours	2 hours	4 hours	5 hours	8 hours	14 hours	1 month	22us
Quartz HQ+	4 hours	8 hours	14.5 hours	16.5 hours	1.5 days	2 days	0.5 years	2.3us
Quartz HQ++	10 hours	17 hours	1.5 days	2.2 days	4.4 days	6.6 days	>1.5 years	600ns
Rubidium	1 day	1.8 days	3.5 days	4 days	8 days	12 days	>5 years	200ns

Note: The above are typical values (1 sigma confident) assuming controlled temperature environment, after the device has been powered for one month and locked to GPS for 72 hours. Due to the excellent temperature stability of the HQ++, the HQ++ holdover will outperform the Rubidium holdover when significant temperature variations are presented.

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Sync signal conversion

	SyncE Tx	BITS OUT	CLK OUT (10MHz)	PTP	NTP	PPS OUT	ToD
GPS/GNSS	✓	✓	✓	✓	✓	✓	✓
SyncE Rx	✓	✓	✓	✓	n/a	freq.	n/a
BITS IN	✓	✓	✓	✓	n/a	freq.	n/a
CLK IN	✓	✓	✓	✓	n/a	freq.	n/a
PPS IN	✓	✓	✓	✓	✓	✓	✓
PTP	✓	✓	✓	✓	✓	✓	✓

GM / PRTC frequency and time accuracy

- While locked to GNSS:
  - Phase and time
    - <15nsec RMS from UTC
    - Single band GNSS, PRTC-A: ±100nsec from UTC
    - Multi band GNSS, PRTC-B: ±40nsec from UTC
  - Frequency – exceed PRC / G.811 frequency accuracy

GM/ePRTC frequency and time accuracy

- While locked to GNSS and connected to ePRC
- Phase and time – ePRTC / G.8272.1 phase accuracy ±30nsec from UTC
- Max holdover performance
  - 100nsec over min 40/60 days (guaranteed / typical) with ePRC+
  - 100nsec over min 55/90 days (guaranteed / typical) with SePRC
  - 100nsec over 100/150 days (guaranteed / typical) with SePRC+

Note: The tracking period for maximum holdover may vary

- GNSS-independent ePRTC operation – the ePRTC algorithm can discipline phase and time using alternative references e.g. PPS+ToD, PTP, and White Rabbit, not only GNSS
- Meets timing characteristics of G.8272.2 cnPRTC
- Up to five phase/frequency references to ePRTC multisource combiner
- Advanced Reference Weighting (Automatic or Manual) for both frequency and phase references:
  - Automatic mode – system assigns optimal weights
  - Manual mode – user defines the weight per reference
  - Includes support for a “golden reference” intended for direct UTC(k) insertion as per cnPRTC G.8272.2 Annex A
- Holdover re-learning continuity. After a reference loss and restore (e.g., GNSS jamming/spoofing), the system retains previously learned holdover parameters—no “start from zero.” This keeps the platform holdover ready even under flapping phase references.
- Cross-reference validator capable of invalidating faulty source when three or more references connected, as per IEEE1588 2019 v2.1 Annex P Prong C
- Phase output steering in holdover
- Live holdover readiness and time to threshold. The UI exposes learning status while locked and, during holdover, shows time remaining to the 100 ns error threshold
- Graceful return from holdover protecting timing networks from phase jumps

Syncjack™ monitoring and assurance tools

- Clock accuracy for up to two clock probes – computing TE, TIE and MTIE of physical clocks
  - Calculation of maximum, constant and dynamic TE, TIE and MTIE between physical source and reference signals
- Clock analysis for up to eight PTP clock probes – packet TE, TIE and MTIE
  - Calculation of packet maximum, constant and dynamic TE, TIE and MTIE between physical reference signal and timestamps within the PTP packets
  - Support for active and passive probe mode
- PTP network analysis including PTP network probe
  - Packet delay and packet delay variation performance statistics
  - Delay asymmetry
  - Network usability statistics (FPP based on G.8261.1)
  - Packet loss statistics
- All probes include enhanced sync assurance statistics, performance monitoring (15min & 24h), including data export, threshold crossing alarm (TCA) and SNMP traps
- Programmable source and reference signals including SyncE, BITS, PPS, GNSS, PTP, IRIG and CLK
- MTIE mask and time error threshold alarms based on SNMP traps
- TE/TIE raw data collection and export to server
- Daily MTIE and TE performance monitoring reports
- User-configurable MTIE masks
- Meaconing Firewall – Record/Replay spoofing attack detection and Prevention

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Low-touch provisioning

- Text-based configuration files
- FTP/SFTP/SCP for configuration file copy
- Remote software upgrade

Management and security

Local management

- Serial port (RS232 over RJ45) for CLI

Remote management

- Local LAN port (100/1000BaseT over RJ45) using CLI, SNMP and Web GUI interfaces
- Support for IPv4 and IPv6
- Barrier free GUI
- Maintains in-band VLAN and MAC-based management tunnels
- Static routes & configuration of default getaways
- Fully interoperable with Adtran FSP 150 and Adtran FSP 3000 products
- Supported by Mosaic Controller, including Mosaic Sync Director and GNSS assurance

Management protocols

- Telnet, SSH (v1/v2)
- HTTP/HTTPS (TLS 1.2)
- SNMP (v1/v2c/v3)

Certificates

- CA-signed X.509 certificates
- Automatic certificate enrollment with full integration into PKI (Public Key Infrastructure)
- Self-signed certificates

Secure administration

- Configuration database backup and restore
- System software download via FTP, HTTPS, SFTP or SCP (dual flash banks)
- Remote authentication via RADIUS/TACACS+/LDAPv3
- SNMPv3 with authentication and encryption
- Access control list (ACL)
- ICMP filtering and rate limiting
- Automatic certificate enrollment with full integration into PKI

IEEE 1588 2019 v2.1 Annex P Security

- Prong C – redundancy by complementary timing systems – With three or more phase references, validator is able to distinguish and invalidate the faulty source
- Prong D – Monitoring and management mechanism – to enhance security in PTP deployments

IP networking

- DHCP
- ARP cache access control
- RIPv2 and static routes
- IPv6 NDP address resolution
- RIPng for IPv6
- ICMP

SMTP Client

- System sends the email to defined recipient in case of alarm

System logging

- Syslog, alarm log, audit log and security log
- Configurable system timing source – local / NTP / PTP / PRTC (GNSS)
- User configurable time zone & daylight saving time

Standards compliance

- ITU-T G.8261, G.8262, G.8264, G.703, G.704, G.781, G.812
- ITU-T G.8272, G.8273.2, G.8273.4
- ITU-T G.8265.1, G.8275.1, G.8275.2
- IEC 60068-2-1
- IEC 60068-2-2, IEC 60068-2-78, IEC 60068-2-6, IEC 60068-2-27, IEC 61810-1
- IEEE 1588v2 (PTP), 802.1Q (VLAN), 802.1ad, 802.1p (Priority)
- RFC 2863 (IF-MIB), RFC 2865 (RADIUS), RFC 2819 (RMON)
- RFC 1059 (NTPv1), RFC 1119 (NTPv2), RFC 1305 (NTPv3), RFC 5905 (NTPv4), RFC 4330 (SNTPv4)

Regulatory compliance

- CE compliance (directive 2011/65/EU)
- RoHS compliance (directive 2011/65/EU)
- LVD compliance (directive 2014/35/EU)
- WEEE compliance (2002/96/EC)
- VCCI compliance
- EMC compliance (2014/30/EU)
- NEBS level 3 compliance (GR-1089-CORE/GR-63-CORE)
- IEEE 1613, IEC 61850-3
- Power: ETSI 300 132-2, BTNR2511, ETS 300-019, ETS 300-019-2-[1,2,3], ANSI C84.1-1989
- Safety: UL/TUV IEC 62368-1 , 21CFR1040.10, EN 60825
- EMI: EN 55022 2010 Class A, EN550035,EN 61000-3-2-2006, EN 61000-3-3 2008, EN 300 386 v1.6.1 2012, FCC 47FR Part 15 , 2014 Class A, ICES-002 2012 Class A

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Power supply

- Hot-swappable, modular AC-PSU: 100 to 240VAC (47 to 63Hz) with over-voltage and over-current protection
- Hot-swappable, modular DC-PSU: -48 to -60VDC (tolerate -36 to -72VDC) with over-voltage and over-current protection
- Hot-swapable, high-voltage DC-PSU: 90 to 250VDC with over-voltage and over-current protection
- Power consumption (with OLED display and two PSUs, without LCs or SFPs and Vin=48V):
  - OSA 5412 Quartz: 36W (typical), 40W (max.)
  - OSA 5412 Quartz HQ+: 38W (typical), 44W (max.)
  - OSA 5412 Quartz HQ++: 40W (typical), 48W (max.)
  - OSA 5412 Rubidium: 42W (typical), 50W (max.)

Environmental

- Dimensions: 443mm x 44mm x 250mm /17.44" x 1.73" x 9.84" (W x H x D), ETSI-complaint
- Weight: 4.15 - 5.2Kg
- Operating temperature (ambient):
  - Quartz, Quartz HQ+, Quartz HQ++: -40 to +65°C (hardened environment)
  - Rubidium: -20 to +65°C
  - Optional versions for -5 to 55°C
- Storage temperature: -40 to +70°C (GR-63-CORE)
- Humidity: 5 to 100% (with condensation)

Optional accessories

- Single and multi-band GNSS (GPS/ GLONASS/BEIDOU/ GALILEO/SBAS/QZSS) antenna kits 10 / 20 / 60 / 120 / 150m (32.8ft / 65.6ft / 196.85ft / 393.7ft / 492.1ft), including indoor and outdoor cables, roof antenna, lighting protector and mounting kit
- Anti-jamming/anti-spoofing signal band GNSS(GPS/ GLONASS/BEIDOU/GALILEO/SBAS/QZSS) antenna
- 1:2 / 1:4/1.8 GNSS (GPS/ GLONASS/BEIDOU/GALILEO) splitters
- GNSS window antenna
- Cables and adapters accessory kit

Updated May 13, 2026