

# 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** allowing sub-nanosecond time synchronization achievable through firmware upgrade, no additional hardware required
- **Ultra-long Holdover** with improved ePRTC algorithm to provide up to 100 days of holdover within 100ns
- **Smooth Holdover Return feature** allow the system to avoid time jumps when reference is restored
- **Multisource ePRTC combiner** introducing redundancy to ePRTC systems by combining up to five phase and frequency references with user defined or automatic references weights
- **Reference Validator** provides cross reference validation for ePRTC multi-source combiner. With three or more phase references, validator is able to distinguish and invalidate the faulty source
- **High performance NTP** server supporting up to 500,000 TPS
- **Unique flexibility** unique flexibility can be used as PTP grandmaster clock, APTS, boundary clock and slave clock as well as NTP server and SSU/TSG
- **High-availability** automatic clock selection, self-calibrating delay asymmetry compensation, power supply redundancy and DoS protection
- **Syncjack™ technology** built-in synchronization accuracy monitoring and assurance functionality

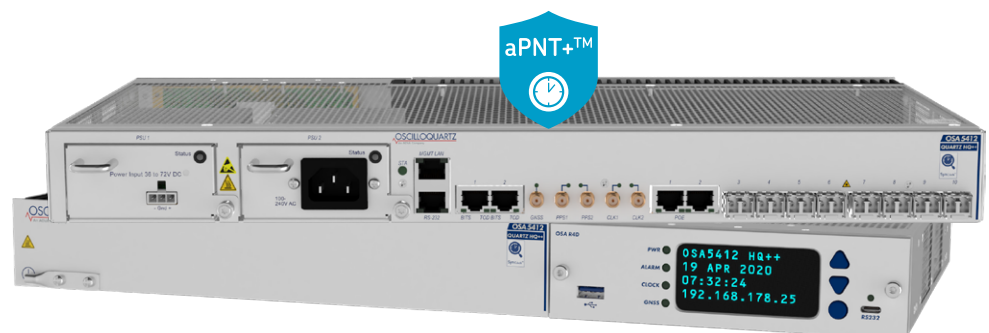
## Overview

**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

# OSA 5412

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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

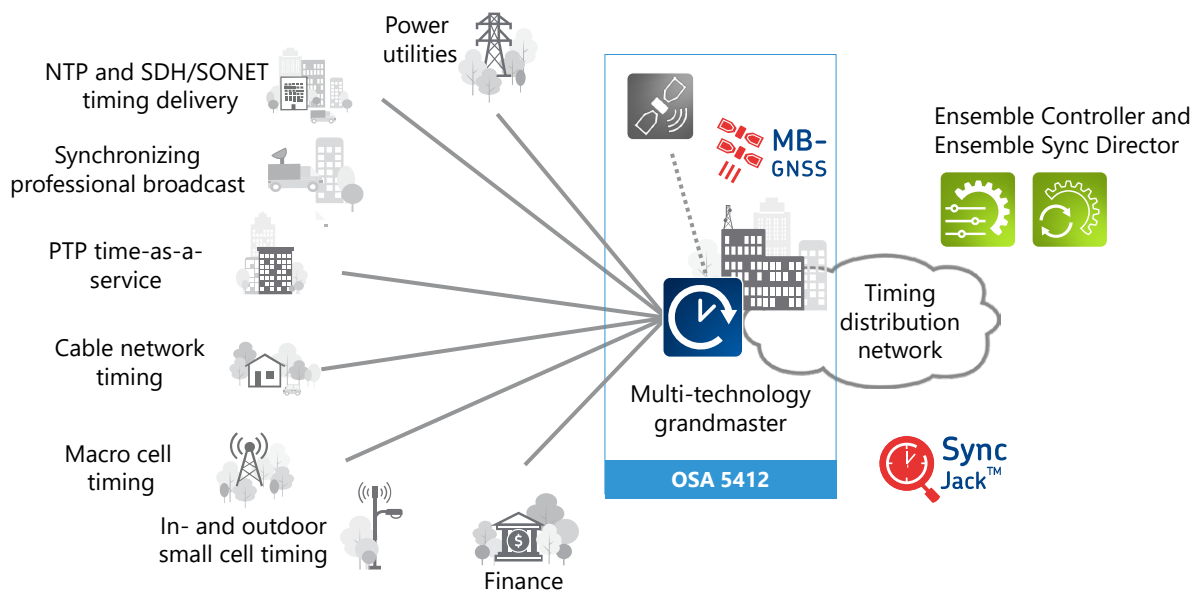
### Syncjack™ technology

- 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
- 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/CC
- Time as a service into data center, financial, health and media networks
- Modernized power utility networks
- Modernized digital broadcasting studios



# OSA 5412

## Product specifications

### Product variants

	OSA 5412 quartz	OSA 5412 quartz HQ+	OSA 5412 quartz HQ++	OSA 5412 rubidium
<b>Clock</b>	OCXO	High-quality OCXO	High-quality DOCXO	Rubidium
<b>Multi-band GNSS</b>	(*)	Optional	Optional	Optional
<b>PSU</b>	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 300,000 delay requests / delay responses in multicast and hybrid PTP profiles
- 1-step and 2-step clock
- Up to 16 master/BC IP addresses

- Up to 16 VLANs (IEEE 802.1Q customer-tagged) and stacked 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 gateways
- 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
- 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
- Up to 8,000 transactions per second
- PTP backup in case of GNSS outage
- Up to 500,000 transactions per second without authentication

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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

- Provides enhanced accuracy for ePRTC and PRTC-B
- Multi-band, multi-constellation 184-channel GNSS receiver
- GPS (L1C/A L2C), Galileo (E1B/C E5b), GLONASS (L1OF, L2OF), BeiDou (B1I, B2I), QZSS (L1C/A L2C), SBAS (L1C/A: WAAS, EGNOS, MSAS, GAGAN)
- Four concurrent GNSS constellations
- Jamming and spoofing detection

## Common GNSS receiver features

- Skyview and GNSS satellites status
- Configurable SNR, elevation and PDOP masks
- User-configurable antenna cable delay compensation
- Advanced interference detection
- Support fixed positioning – single satellite mode
- Advanced spoofing and interference detection mitigation
- 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
- Automatic switchover in case of jamming/spoofing/interference 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	$\pm 5 \times 10^{-10}$	$\pm 50 \times 10^{-10}$
Quartz HQ+	High-quality OCXO G.812 Type I	$\pm 2 \times 10^{-10} / \pm 1 \times 10^{-10}^*$	$\pm 2 \times 10^{-10}$
Quartz HQ++	High-quality OCXO Stratum 2 / G.812 Type II	$\pm 5 \times 10^{-11} / \pm 1 \times 10^{-11}^*$	$\pm 1 \times 10^{-11}$
Rubidium	Rubidium Stratum 2 / G.812 Type II	$\pm 5 \times 10^{-12}$	$\pm 2 \times 10^{-10} / \pm 2 \times 10^{-11}^{**}$

\*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
Quartz	1 hours	2 hours	4 hours	5 hours	8 hours	14 hours	1 month
Quartz HQ+	4 hours	8 hours	14.5 hours	16.5 hours	1.5 days	2 days	0.5 years
Quartz HQ++	10 hours	17 hours	1.5 days	2.2 days	4.4 days	6.6 days	>1.5 years
Rubidium	1 day	1.8 days	3.5 days	4 days	8 days	12 days	>5 years

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:  $\pm 100$ nsec from UTC
  - Multi band GNSS, PRTC-B:  $\pm 40$ nsec 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:  $\pm 30$ nsec from UTC
- Holdover:
  - 100nsec over min 30 days (guaranteed) with ePRC+(typical 40 days)
  - 100nsec over min 45 days (guaranteed) with SePRC(typical 55 days)
  - 100nsec over 100 days (guaranteed) with SePRC+ (typical 120 days)
- Up to five phase/frequency references to ePRTC Multisource combiner
- Cross-reference validator capable of invalidating faulty source when three or more references connected

### 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
- Programmable source and reference signals including SyncE, BITS, PPS, GNSS 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
- Clock analysis for up to four 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
- Programmable reference signals including SyncE, BITS, PPS, GNSS 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
- 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
  - Programmable reference signals including SyncE, BITS, PPS, GNSS and CLK
- All probes include enhanced sync assurance statistics, performance monitoring (15min & 24h), including data export, threshold crossing alarm (TCA) and SNMP traps
- User-configurable MTIE masks
- Spoofing meaconing attack detection and Prevention

### Low-touch provisioning

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

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## 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 gateways
- 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)

### Secure administration

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

### IP networking

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

## SMTP Client

- System send 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
- ITU-T G.8265.1, G.8275.1, G.8275.2
- IEC60068-2-1
- 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-swappable, 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  $V_{in}=48V$ ):
  - 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, lightning 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

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