OSCILLOQUARTZ
A division of Adtran

Oscilloquartz coreSync+™

Data Sheet

OSA 5440

Modular, redundant, high-capacity PTP grandmaster, SB/MB-GNSS receiver, SSU+

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

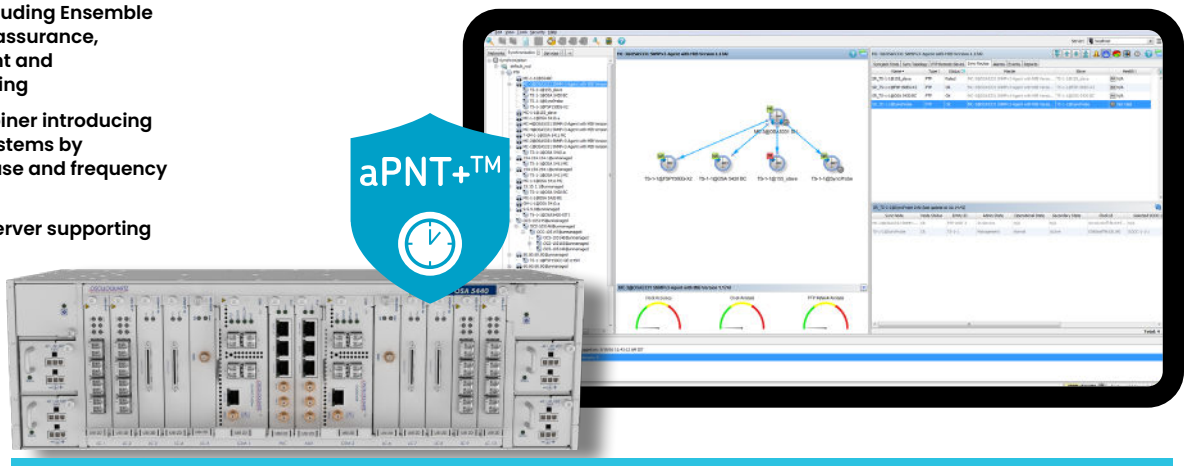
Benefits

- **Unique flexibility and versatility**
  Modular and scalable design, configurable to operate as ePRTC, PRTC A/B, SSU, PTP grandmaster clock, APTS, boundary clock and slave clock as well as NTP server
- **Simple migration from legacy to IP**
  Simple migration from legacy TDM to IP-based networks including CC, BITS and T1/DS1/E1 signals
- **Syncjack™ techonology**
  Built-in synchronization accuracy monitoring, testing and assurance functionality
- **Multi-technology high-speed connectivity**
  First telecom grandmaster supporting NTP, PTP and SyncE over 48 10Gbit/s as well as 1Gbit/s interfaces with hardware timestamping
- **Fully redundant hardware**
  All key modules are protected ensuring no loss of performance and high service availability
- **Operational simplicity**
  Ensemble Controller, including Ensemble Sync Director and GNSS assurance, for superior management and synchronization monitoring
- **Multisource ePRTC combiner introducing redundancy to ePRTC systems by combining up to five phase and frequency references**
- **High performance NTP server supporting up to 500.000 TPS**

Overview

Reliable and accurate delivery of synchronization from the core to the network edge is essential to meet the stringent requirements of new mobile, fixed and cable networks. However, the challenges go beyond accuracy. As well as strict precision, network operators need a robust, scalable and cost-effective solution that can work over packet-based networks as well as legacy infrastructure.

Our OSA 5440 is a carrier-grade ePRTC, PRTC A/B, SSU and IEEE 1588v2 grandmaster clock supporting 10Gbit/s and 1Gbit/s interfaces with hardware timestamping. Its modular design with technology-focused cards enables seamless capacity increases and technology migrations. The OSA 5440 supports all legacy sync signals and all IP-based timing protocols. Its NTP server, multiple types of outputs and GNSS receiver capabilities make it ideal for the smooth upgrade of legacy synchronization architectures. And with its ability to deliver precise synchronization to DOCSIS 3.1 remote PHY devices, the OSA 5440 is also a powerful tool to help cable operators tackle booming demand. Its modular design offers complete flexibility and supports a pay-as-you grow model. In addition, our integrated Syncjack™ technology provides in-service synchronization monitoring and assurance without the need for expensive test equipment. What's more, our OSA 5440 enables advanced high-capacity, multi-technology synchronization solutions with the most compact design.



Oscilloquartz zero-trust multisource & redundant aPNT+™ platform

OSA 5440

High-level technical specifications

System overview

- High-quality OCXO, DOCXO and rubidium
- Up to 8x 1/10GbE (base unit) plus 40x 1/10GbE (line card)
- Up to 1536 unicast slaves per CSM
- Hot-swappable, redundant clock, GNSS and PSU

Operation modes

- ePRTC, PRTC A and PRTC B
- IEEE 1588 PTP grandmaster, boundary clock, slave and probe
- NTP server
- PRC/SSU (Sync-E, BITS and CC)

GNSS receiver

- Embedded L1 multi-constellation receiver
- Optional multi-band, multi-constellation for enhanced accuracy
- GPS / GALILEO / BEIDOU / GLONASS / SBAS / QZSS

PTP profiles

- Default profiles over Ethernet and IP multicast
- Telecom profiles G.8265.1, G.8275.1 and G.8275.2
- Enterprise hybrid and power profiles
- Hardware-based packet processing

NTP server

- High-capacity Stratum 1 server
- Hardened NTP responder
- Hardware timestamping
- NTP/PTP/Sync-E/SSU supported simultaneously
- NTP authentication
- PTP to NTP conversion

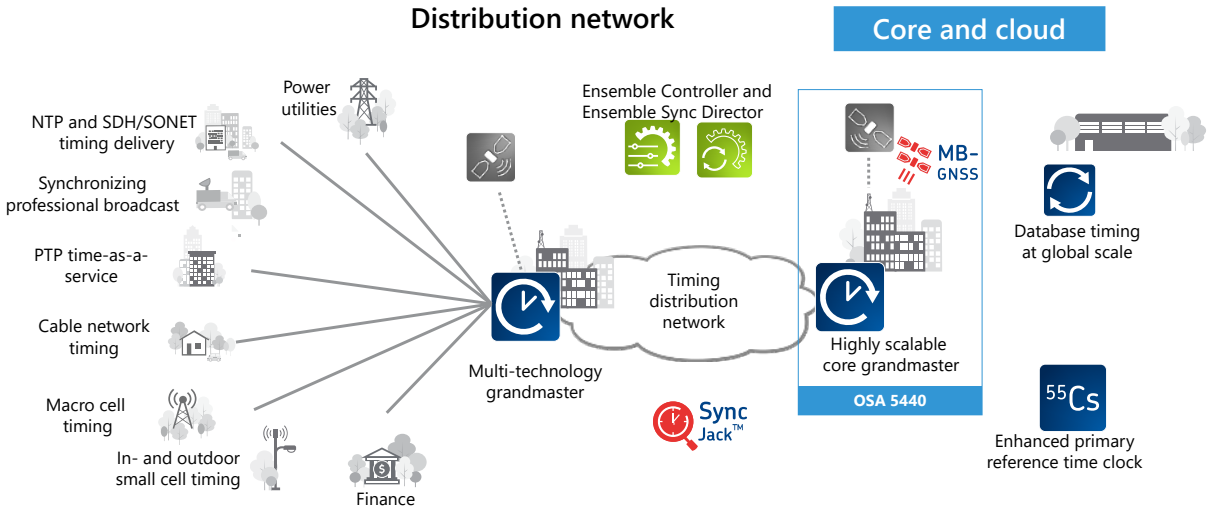
Expansion cards (optional)

- Ten hot-swappable expansion cards per OSA 5440
- Line cards:
  - 16x E1/T1/2.048MHz (120/100/75ohm)
  - 4x 1/10GbE (PTP/Sync-E)
  - Multi-band GNSS
  - 10x composite clock (CC)

Applications in your network

Timing distribution from the network core

- Radio access network synchronization including 4G, 4.5G LTE/LTE-A, 5G, femtocells and small cells
- Precise synchronization of legacy network architectures based on SSU/CC/PRC and NTP
- Cable networks (DOCSIS 3.1) and PON synchronization
- Data centers and enterprise networks synchronization
- Modernized and legacy power utilities networks
- Modernized digital broadcasting studios



OSA 5440

Product specifications

Product overview

	OSA 5440
	
Size (WxHxD)	3RU 443mm x 132.5mm x 216mm / 17.44" x 5.21" x 8.50"
Clock	Quartz (OCXO) Quartz HQ+ (high-quality OCXO) Quartz HQ++ (enhanced high-quality DOCXO) Rubidium
Expansion line Cards	Up to 10
PTP/NTP/Sync-E ports	Up to 48
BITS output ports	Up to 161
Composite clock ports	Up to 100
PSU	Hot-swappable redundant DC PSU (up to 4)
Fan units	Hot-swappable redundant Up to 2 (optional)

Main applications

- Enhanced primary time clock (ePRTC)
- Primary time clock (PRTC A and PRTC B)
- 1588v2 PTP grandmaster clock (up to 1536 PTP clients at 128pps per CSM)
- 1588v2 PTP boundary clock (up to 1536 PTP clients at 128pps per CSM), G.8273.2 BC type D
- 1588v2 PTP slave input (as backup to GNSS) - APTS
- GNSS receiver and PRC/PRTC including fan-out of multiple physical synchronization output interfaces
- Synchronization supply unit (SSU) and composite clock generator
- NTP server
- Sync probe – Syncjack™ monitoring and assurance

NTP features

- Stratum 1 NTP server when locked to GNSS
- NTP v1, v2, v3 and v4 over IPv4 and IPv6
- NTP unicast/multicast/broadcast
- Symmetric key and Autokey authentication
- TIME & DAYTIME protocols
- NTP peering
- NTP selectable timescale (UTC/GNSS/Local)
- Nanosecond-accurate hardware timestamping
- NTP server accuracy within +/–100nsec from UTC when locked to GNSS
- 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 8000 transactions per second, per CSM
- Up to 500.000 transactions per second without authentication, per CSM
- PTP backup in case of GNSS outage

PTP networking features

- 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 (assisted partial timing support - IPv4/IPv6)
  - PTP enterprise profile (mixed multicast and unicast)
  - IEEE 1588 2008 PTP default profile over IP 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
- 1-step and 2-step clock
- No performance degradation as slave capacity grows
- Up to 16 master/BC IP addresses (IPv4 and IPv6 supported simultaneously on same port) per CSM
- Up to 16 EVCs (IEEE 802.1Q customer-tagged) and stacked VLANs
- Support for multiple profiles simultaneously
- Support PTP (TAI) and arbitrary (ARB) timescales
- Nanosecond-accurate hardware timestamping
- Support master and slave on any port simultaneously
- Up to three stacked VLANs per flow (Q-in-Q service provider tagged)
- 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

Hardware modules

- Modules:
  - CSM: Clock synchronization module
  - AUX: Auxiliary I/O module
  - PSU: Power supply unit
- Expansion line cards (optional):
  - XGE-4S-P: 4x 1/10Gbit/s Ethernet card
  - BTOH-P-16: 16x BITS outputs card
  - MB-GNSS: multi-band GNSS input card
  - CCO: 10x composite clock outputs
- Same modules for OSA 5430 and OSA 5440
- Number of modules supported per product

	OSA 5440
CSM	1-2
AUX	1-2
PSU	1-4
Line Cards	0-10

Clock synchronization module (CSM)

- Dual CSM design allows full protection of all critical components including GNSS, PTP/NTP ports, oscillator and management

CSM oscillator options

- Quartz (OCXO)
- Quartz HQ+ (high-quality OCXO)
- Quartz HQ++ (enhanced high-quality DOCXO)
- Rubidium

4x Ethernet ports

- Hardware-based timestamping (PTP and NTP)
- 4x 1Gbit/s /100 Mb FE (SFP) or 10Gbit/s (SFP+), user configurable per port
- All fiber ports support SM/MM colored/non-colored/dual/single fiber SFP/SFP+ and copper SFP
- Per-flow hardware-based policing and scheduling
- Configurable link asymmetry delay compensation

Synchronous Ethernet (SyncE)

- 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

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CSM GNSS receiver

- Redundant GNSS receivers and antenna inputs (one on each CSM)
- Multi-constellation GNSS (GPS / GLONASS / BEIDOU/ GALILEO) L1 32-channel receiver
- Skyview and GNSS satellites status
- Configurable SNR, elevation and PDOP masks
- User-configurable antenna cable delay compensation
- Support fixed positioning – single satellite mode
- Software configurable mode of operation
  - GPS (1575.42MHz)
  - GLONASS (1601.5MHz)
  - BEIDOU (1561MHz)
  - GALILEO (1575.42 MHz)
  - Combined GPS + GLONASS
  - Combined GPS + BEIDOU
  - Combined GPS + GALILEO
- Voltage to antenna +5VDC
- Antenna connector SMA-F (50ohm)

Multi-band GNSS receiver card

- Redundant, hot-swappable, GNSS receivers and antenna inputs (with two cards)
- Provide 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
- Skyview and GNSS satellites status
- Configurable SNR, elevation and PDOP masks
- User-configurable antenna cable delay compensation
- Support fixed positioning – single satellite mode
- Jamming and spoofing detection
- Voltage to antenna +5VDC
- Antenna connector SMA-F (50ohm)

Auxiliary card (AUX)

- Dual AUX design allows full protection of AUX inputs

Synchronization interfaces

- 1x BITS in
- 1x BITS out
- 1x PPS in/out
- 1x Time-of-day (ToD) + PPS in/out
- 2x CLK in(2.048/10MHz)/out(10MHz)

BITS in/out

- 1x BITS input + 1x BITS 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
- SSU filtering option

PPS in/out

- 1x PPS input/output (user configurable)
- User configurable input and output delay compensation
- SMA-F connector (50ohm)
- Output squelch option
- PPS configurable width

ToD + PPS in/out

- G.8271 compliant
- ToD formats – NMEA 0183 ($GPZDA sentence), ITU-T G.8271 and CCSA
- RS422 over shielded RJ-45
- Output squelch option
- PPS configurable width
- Output squelch option

CLK in/out

- 2x CLK in(2.048/10MHz)/out(10MHz) (user configurable)
- SMA-F connector (50ohm)

Output expansion line cards

- Line cards:
  - XGE-4S-P: 4x 1/10Gbit/s Ethernet card
  - BTOH-16: 16x BITS card
  - CCO: 10x composite clock outputs
- Up to ten line cards per OSA 5440
- Field upgradable
- Hot insertion / extraction support
- Overvoltage / current protection
- Two line cards share a single mountable patch panel with 16x RJ-48 / RJ-45 and/or 16x BNC connectors
- Composite clock patch panel supporting up to 40 protected outputs

	BTOH-P-16 (16 x BITS)	XGE-4S-P (4 x 1/10Gbit/s)
		
Capabilities	16x BITS outputs over high density connector (VHDCI) – supporting 2.048MHz, E1 or T1 (DS1), SW configurable of output signals type and line impedance (E1, 2.048MHz) 1:1 output card redundancy	4x1/10Gbit/s fiber Ethernet ports (PTP / Sync-E)

	CCO (10xCC)	MB-GNSS
		
Capabilities	10x composite clock output pairs over high density connector, SW configurable shutdown of output signals, 1x composite clock input 1:1 output card redundancy	Multi-band, multi-constellation GNSS input card

Holdover performance

	Clock	Aging / Day (after 30 days)	Temperature stability
Quartz CSM	High-quality OCXO Stratum 3 / G.812 Type III	$\pm 5x10^{-10}$	$\pm 50x10^{-10}$
Quartz HQ+ CSM	High-quality OCXO G.812 Type I	$\pm 2x10^{-10}$ / $\pm 1x10^{-10}$*	$\pm 2x10^{-10}$
Quartz HQ++ CSM	DOCXO Stratum 2 / G.812 Type II	$\pm 5x10^{-11}$ / $\pm 1x10^{-11}$*	$\pm 1x10^{-11}$
Rubidium CSM	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
Quartz CSM	1 hour	2 hours	4 hours	5 hours	8 hours	14 hours	1 month
Quartz HQ+ CSM	4 hours	8 hours	14.5 hours	16.5 hours	1.5 days	2 days	0.5 years
Quartz HQ++ CSM	10 hours	17 hours	1.5 days	2.2 days	4.4 days	6.6 days	>1.5 years
Rubidium CSM	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

From / To	SyncE Tx	BITS/CC OUT	CLK OUT (10MHz)	PTP	NTP	1PPS OUT	ToD
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 – PRTC / G.8272 phase accuracy
  - Single band GNSS, PRTC-A: ±100nsec from UTC
  - Multi band GNSS, PRTC-B: ±40nsec from UTC
- Frequency – 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
- Holdover
  - 100nsec over min 25 days (guaranteed) with ePRC+(typical 30 days)
  - 100nsec over min 45 days (guaranteed) with SePRC(typical 55 days)
- Up to five phase/frequency references to ePRTC Multisource combiner

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 automatically selected between 3 available input frequency references
- Improved holdover with HQ+/HQ++/rubidium oscillator
- Automatic switchover in case of jamming / spoofing/interference detection
- ePRTC combines GNSS/PTP/PPS+ToD with cesium clock from improved accuracy in locked mode and extended holdover in case of GNSS outage
- Interoperable with OSA 5405 smart antenna
- PTP and GNSS assurance using ENC Sync Director

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
  - 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
  - Calculation of packet maximum, constant and dynamic TE, TIE and MTIE between physical reference signal and timestamps within the PTP packets
- 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
- Enhanced sync assurance statistics, performance monitoring (15min and 24h), including data export, threshold crossing alarm (TCA) and SNMP traps
- User configurable MTIE masks

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 (on CSM)

Remote management

- Local LAN port (100/1000BaseT over RJ45) using CLI, SNMP and Web GUI interfaces (on AUX)
- Support for IPv4 and IPv6 (dual stack)
- Maintains in-band VLAN-based management tunnels
- Configurable static routes and default getaways
- Fully interoperable with Adtran FSP 150 and Adtran FSP 3000 products
- Ensemble management, control 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 v4/v6
- ARP cache access control
- IPv4 RIPv2 and static routes
- IPv6 NDP address resolution and static routes
- RIPng for IPv6
- ICMP

System logging

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

Standards compliance

- ITU-T G.8261, G.8261.1, G.8262, G.8264, G.703, G.704, G.781, G.812, G.811
- ITU-T G.8272.1, G.8272, G.8273.2
- ITU-T G.8265.1, G.8275.1, G.8275.2
- IEEE 1588v2 (PTP), 802.1Q (VLAN), 802.1ad, 802.1p (priority), 802.3ae (10G)
- RFC 2863 (IF-MIB), RFC 2865 (RADIUS), RFC 2819 (RMON), RFC 2460 (IPv6)
- RFC 1059 (NTPv1), RFC 1119 (NTPv2), RFC 1305 (NTPv3), RFC 5905 (NTPv4), RFC 4330 (SNTPv4), RFC868 (TIME), RFC867(DAYTIME), RFC 1321 (autokey)

Regulatory compliance

- CE compliance
- RoHS compliance
- Power: ETSI 300 132-2, BTNR2511, ETS 300-019, ETS 300-019-2-[1,2,3], ANSI C84.1-1989
- Safety: EN 60950-1, 21CFR1040.10, EN 60825
- EMI: EN 55022 2010 Class A, 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

Power supply

- Hot-swappable, modular DC-PSU: -48 to -60VDC (tolerate -36 to -72VDC) with over-voltage and over-current protection
- Each PSU supports dual power feeds
- Optional external 85-264VAC to 48VDC converter

OSA 5440

Environmental

- Dimensions (W x H x D): 443mm x 132.5mm x 216mm / 17.44" x 5.21" x 8.50" (compatible with ETSI 300mm depth rack)
- Weight (depending on the configuration): 8.5kg to 14.5kg
- Operating temperature (ambient): -5 to 45ºC
- Storage temperature: -40 to +70ºC (GR-63-CORE)
- Humidity: 5 to 95% (non-condensing)
- Operational altitude: -450m to 5000m

Optional accessories

- GNSS (GPS/ GLONASS/BEIDOU/GALILEO/SBAS/ QZSS) single and multi-band 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 single 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
- Patch panels for BITS line cards