VCL-2145-D-E, GPS / GNSS PRIMARY REFERENCE CLOCK

PTP 1588v2 GRANDMASTER & NTP TIME SERVER

Introduction:

VCL-2145-D-E is a high-performance, GPS / GNSS (Global Navigation Satellite System) Primary Reference Clock that provides ITU-T G.811 Primary Reference Clock, PTP (IEEE 1588v2), NTP and IRIG-B outputs which are locked with GPS/GNSS or user-selected input reference source. (i.e., 2.048Mbit/s (E1), 2.048MHz and 10MHz).

The VCL-2145-D-E Satellite Receiver also has an integrated, high bandwidth NTP Server engine that is capable of handling up to 8,900 NTP requests per second. Multiple IRIG-B Outputs are also provided to synchronize local clock (time-of-day) display units to a central timing source with nanosecond accuracy.

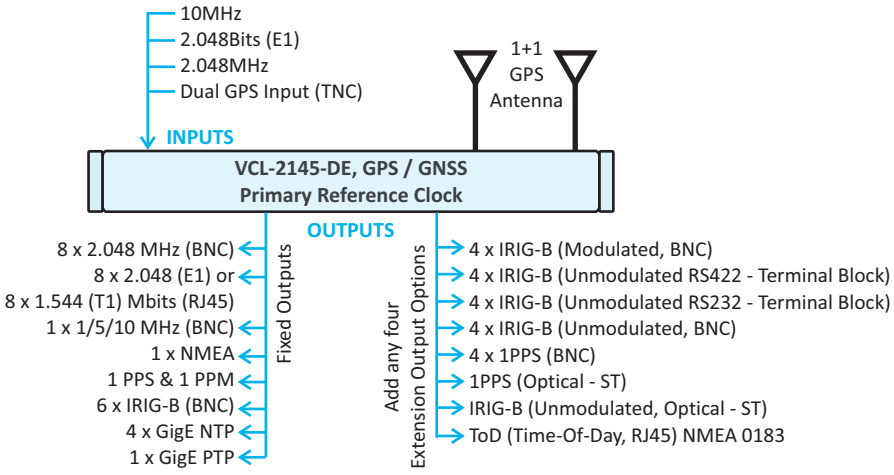
Features and Highlights:

- Reliable, Cost-Efficient Reference GPS Receiver
- 50 Channel GNSS, L1 frequency, C/A Code Receiver
- Up to 8,900 NTP requests per second
  - 71,200 NTP Slaves supported
  - 445,000 SNTP Slaves supported
- ITU-T G.811 / Stratum 1 compliant (PR) Primary Reference when locked to GPS
- ITU-T G.812 compliant holdover function
- SSM Message format Compliant with ITU-T G.704. Optional GR-378-CORE for SONET Networks
- GPS locked G.703 compliant 1.544Mbits, 2.048MBits, 2.048 MHz and 1 PPS outputs
- 1/5/10 MHZ, 1 PPS and IRIG-B outputs
- IEEE-1588v2 PTP Grandmaster
- ToD compliant to NMEA 0183 (DB9 Serial Port)
- 4 x 10/100/1000BaseT NTP Ports
- Additional 1 x 10/100 BaseT NTP Port for IPv4 / IPv6 operation
- Leap Second Correction Support
- Concurrent IPv4 and IPv6 Operations
- MD5 authentication for NTP clients
- 802.1Q VLAN support for NTP Ports
- SSH, Telnet, Radius, SNMP V2 MIB, Password Protection
- Available with 1+0 (VCL-2145-D-E, without GPS redundancy) and 1+1 (VCL-2145-D-E, with GPS redundancy) options
- Power Contact and Lightening Protection as per Telcordia GR-1089-CORE.
- Standard RJ45 and BNC connectors for all inputs and outputs
- LCD display with back light.
- Supports the KEY for MD5 encrypted NTP/ SNTP packets
- Support anti-jamming and anti-spoofing
- **GNSS Options:**
  - GPS, GLONASS, GPS+GLONASS and GPS+GLONASS+SBAS

VCL-2145-D-E, Primary Reference (PRC) Clock is specifically designed for frequency synchronization of mobile telecommunications networks as well as backhaul wire-line SDH / SONET and Synchronous Ethernet networks. It may be also used by Railways, Airports (and Air-Traffic Control), Power generation and distribution companies and other Utility companies who not only require highly precise G.811 frequency synchronization locked to a GPS Reference but who also need to provide an accurate time-of-day reference in their networks.

VCL-2145-D-E incorporates dual (1+1 redundant) GPS receiver engines and dual (1+1 redundant) power supply for added reliability which are always locked to a user selected satellite (GPS) reference to provide multiple G.811 / Stratum 1 quality frequency and time-of-day (PTP, NTP and IRIG-B) outputs. The VCL-2145-D-E is also equipped highly accurate, low-noise OCXO / Rubidium oscillator which provides a high stability holdover clock that is typical of a Network SSU in the event of loss of GPS signal, or its antenna failure.

Application Diagram



GPS/GNSS Receiver as a Primary Reference (PRC) Clock with IEEE-1588v2 Grandmaster and NTP Time Server

Additional Features:

- IEEE - 1588v2 PTP Grandmaster
- High bandwidth NTP Server supporting up to 8,900 NTP requests per second
- Redundant AC and DC power supply options
- Semi-modular GPS clock offering multiple factory-configured IRIG-B and 1PPS output options, ensuring reliable and stable time synchronization for critical applications.

Typical Synchronization Applications:

- Synchronizing Cellular networks like UMTS, GPRS, LTE, 3G, 4G and 5G
- Power generation and distribution companies and other utility companies
- Wireless and Wireline Telecom synchronization
- Distributing Time (ToD) and Frequency reference for power utilities across all nodes
- Synchronization of Defense Networks
- Synchronizing airports and aviation communications
- Synchronizing railway signaling networks and railway communications
- Synchronizing traffic management
- Broadcasting Network and Broadcast equipment synchronization.

Available versions:

Product	Description
VCL-2145-D-E, GPS Primary Reference (PRC) G.811 Clock, PTP 1588v2 Grandmaster and NTP Time Server (Available with 1+1 and 1+0 GPS receiver option)	• The VCL-2145-D-E, GPS/GNSS Satellite Receiver also has an integrated, high bandwidth NTP Time Server engine. This equipment provides multiple Input reference and output options. • **Input options:** Single or Dual (1+1) GPS/GNSS, 10MHz, 2.048MHz, 2.048 Mbps, 2.048MHz / 10MHz (TTL IN). • **Output options:** 8 x 2.048 Mbps / 1.544 Mbps, 8 x 2.048MHz, 1 x PTP 1588v2 Grandmaster, 5 x NTP Server, 1/5/10MHz, 1PPS, Major Alarm, Minor Alarm, NMEA-0183 (TOD - Time-Of-Day), IRIG-B. • **Holdover options**: OCXO or Rubidium.

Technical Specifications

GPS/GNSS Receiver Specifications:

- 50 Channel GPS Receiver
- 72 Channel GNSS Receiver
- GPS L1 frequency, C/A Code Receiver
- Tracks up to 12 satellites in GPS only mode (GPS only version)
- Tracks up to 24 satellites in GNSS mode (GNSS version)
- Synchronizing Time:
  - Acquisition time - Hot Start: 1 sec.
  - Acquisition time - Warm Start: 28 sec.
  - Acquisition time - Cold Start: 28 sec.
- GPS Signal
  - Tracking and Navigation: -162 dBm
  - Reacquisition -160 dBm
  - Cold Start -148 dBm
- Antenna Connector: TNC
- Accuracy Of Time-Pulse Signal referenced to GPS: ± 30ns (raw)
- Accuracy Of Time-Pulse Signal referenced to GNSS: ± 20ns (raw)
- Accuracy Of Time-Pulse Signal referenced to GPS/GNSS: ± 15ns (compensated)
  (Note: with all satellites in view at -130db)
- Phase Accuracy: As per ITU-T G.8272

Internal (G.812) Synchronization Options:

- Rubidium Oscillator
- OCXO (Oven-Controlled Crystal Oscillator)

Frequency holdover:

OCXO:
- Stability:
- $0.5x10^{-9}$(0.5 ppb) per day,
- $50x10^{-9}$(50 ppb) per year
- Frequency stability: $6x10^{-10}$(-5^{o}C to $+55^{o}$C)

Rubidium:
- Long term stability: ± $5x10^{-11}$ / month
- Frequency stability: < $1x10^{-10}$ (-5°C to +55°C)

Clock performance - GPS / GNSS:

- Performance when locked to GPS / GNSS Timing accuracy: complaint to ITU-T G.811

Frequency Accuracy:

- <$1x10^{-11}$ (24 hour average)
- G.811 quality when locked to GPS / GNSS

IEEE-1588 PTP Grandmaster:

- Compliant with IEEE-1588 v2 (2008) specifications
- Profiles supported: Telecom Profile, Power Profile
- Frequency Accuracy: ± 50ppb referenced to GPS
- SyncE
- Time Accuracy: < 50ns

Management and Monitoring Ports:

- RS-232C Connector
- USB Connector
- 10/100BaseT Ethernet
- 2 x External Alarm Relay Contact

Security and Protection:

- Password Protection
- Secured Access via SSH v1.3, SSH v1.5, SSH v2, RADIUS

NTP Server:

- NTP Protocols: NTP v2 (RFC 1119), NTP v3 (RFC 1305), NTP v4 (RFC 5905)
- SNTP Protocol: SNTP v3 (RFC 1769), SNTP v4 (RFC 2030)
- IP Protocols: IPV4 - DHCP (RFC 2131), IPV6 - DHCPv6 (RFC 3315)
- Time Protocol: (RFC 868)
- Daytime Protocol: (RFC 867)
- Network Protocol: TCP, UDP
- Synchronization of IEC 61850 compliant devices using NTP / SNTP / IRIG-B, protocol
- Capable of processing up to 8,900 requests per second .
- Multiple LAN Support

System Access, Control and Management Options:

- Telnet (RFC 854 - RFC 861), FTP, SSH (incl. SFTP, SCP), RADIUS
- HTTP/HTTPS (2616), SYSLOG, SNMP
- CLI Control Interface (HyperTerminal or VT100)
- SNMP v1, SNMP v2c, SNMP v3 Traps (MIB File provided)

MTBF:

MTBF for VCL-2145-D-E with RbXO Option:
- Per MIL-HDBK-217F: ≥ 17 years @ 40^{o}C
- Per Telcordia SSR 332, Issue 1: ≥ 20 years @ 40^{o}C

MTBF for VCL-2145-D-E with OCXO Option:
- Per MIL-HDBK-217F: ≥ 21 years @ 40^{o}C
- Per Telcordia SSR 332, Issue 1: ≥ 24 years @ 40^{o}C
- AC or DC

MTTR:

- < 3 hours (excluding travel time)

Antenna Specifications:

- Antenna Type: Active, Wall Mounting
- Polarization: Right hand circular
- Frequency Band: 1575.42 MHz ± 10 Mhz
- Amplifier Gain: 40dB ± 4dB
- VSWR: <2.0 Max, 1.0 Typical
- Operating temperature: -40C to +85C
- Reverse Polarity Protection
- Out of Band Rejection: ≥ -60dB @ ± 50MHz off center (1575.42 Mhz) frequency
- Lightening Protection: According to EN61000-4-5 Level 4.
- LMR400 (or equivalent) Cable Length - 30, 60, 90, 120 and 150 meters.

Configuration and Monitoring Software:

- CLI, English commands
- GUI (Graphical User Interface) - Windows

Standards & Compliance:

- **IEC -** EMC – Certified to EN 55022: 2005 / CISPR 32, EN 55024:2005, IEC 61000-4-2
- CE - 2001/95/EC, 2006/95/EC, EN60950-1, EN61000-6-2, EN61000-6-4
- FCC - FCC Part 15 B Class A : Conducted Emission test on Power Line
- FCC Part 15 B Class A : Radiated Emission >1 GHz FCC, 6 GHz, on Power Line

Power Supply Options:

- Dual Redundant
- 1+1 DC 24V power (12 to 32V DC)
- 1+1 DC -48V power (18 to 72V DC)
- 1+1 DC 110/125V DC power (90 to 260V DC)
- 1+1 AC power (100 to 240V AC, 50/60 Hz)

Power Consumption:

Power Consumption with OCXO Oscillator:
- < 25W during startup,
- < 18W at steady state 23°C

Power Consumption with Rubidium Oscillator:
- < 40W during startup,
- < 32W at steady state 23°C

Environmental (Equipment):

Operational	-10 C to +60 C (Typical: +25 C)
Cold start	0 C
Storage	-20 C to +70 C
Humidity	95% non-condensing
Cooling	Convention Cooled. No cooling fans are required.

Mechanical Specifications:

H x W x D	132 x 435 x 305 (mm)
Weight	4.2 Kg
Rack Mounts	19" 3U rack mounting options

Synchronization Input:

Input	Number of Input	Connector
GPS / GNSS	1+1 or 1+0	TNC

External Frequency Synchronization Inputs:

External Inputs	Number of Inputs	Connector
2.048 MHz, 75 Ohms	1	BNC
10 MHz, 50 Ohms	1	BNC
2.048 Mbps	1	BNC

Standard Frequency and ToD* Outputs:

Outputs:	Number of Ports	Connector
ITU-T G.811 Complaint 2.048 Mbit/s (E1) / 1.544 Mbit/s (T1)	8 (8E1 or 8T1)	RJ45
ITU-T G.811 Complaint 2.048 MHz, 75 Ohms	8	BNC
ITU-T G.811 Complaint 1/5/10 MHz, 50 Ohms	1	BNC
IEEE 1588v2 PTP Grandmaster: 10/100/1000 BaseT	1	RJ45
IRIG-B (Modulated) - (Type: B124)	4/8/12/16	BNC
IRIG-B (Unmodulated) - (Type: B004)	6/10/14/18/22	BNC / Terminal
1 PPS Optical	1/2/3/4	ST
1 PPS, phase-locked to UTC	4/8/12/16	BNC
TOD (Time-Of-Day) output compliant to NMEA0183	2/4/6/8	DB9, RS232C
NTP, 10/100/1000 BaseT (Default configuration)	5	RJ45
**ToD Time Of Day*		

Extension Unit available Optional (4 Card / Chassis):

- Up to 6 User selectable output modules (Add any 4 output cards, in any combination Please specify in order)
  - Up to 16 x IRIG-B Un-Modulated outputs (RS422, RS485, RS232)
  - Up to 16 x IRIG-B Un-Modulated outputs (BNC)
  - Up to 8 x NMEA-0183 outputs (RJ45)
  - Up to 16 x 1 PPS outputs (BNC)
  - Up to 4 x 1 PPS outputs (ST)
  - Upto 4 x 1 PPS outputs
- DC or AC Power Supply options

Outputs:

Outputs	Number of Outputs	Connector
Pulse, Phase-locked to Input Pulse	4/8/12/16	BNC
ToD (Time-Of-Day) output compliant to NMEA 0183	2/4/6/8	RJ45
Optional Pulse Out	1/2/3/4	ST
1 PPS	2/4/6/8	BNC

PPS Output Interface

PPS Output interface	Number of Outputs	Connector
1PPS, phase-locked to GPS / GNSS	4 outputs per card	BNC
Maximum cards	Up to 4 cards per chassis	BNC
Maximum outputs	16 outputs per chassis	BNC

PPS + NMEA output interface

PPS + NMEA Outputs	Number of interface	Connector
PPS, phase-locked to GPS / GNSS	2 outputs per card	BNC
NMEA-0183	2 outputs per Card	RJ45
Maximum cards	Up to 4 outputs cards per chassis	8 x BNC 8 x RJ45
Maximum outputs	8 x PPS outputs & 8 x NMEA Outputs	8 x BNC 8 x RJ45

IRIG-B (Modulated) output interfaces

IRIG-B (Modulated) Output Interface	Number of Outputs	Connector
IRIG-B (Modulated) Outputs	4 outputs per card	BNC
Maximum cards	Up to 4 cards per chassis	BNC
Maximum outputs	Up to 16 outputs per Chassis	BNC

IRIG-B (Un-modulated) output interfaces

IRIG-B (Un-modulated) Output Interface	Number of Outputs	Connector
IRIG-B (Un-modulated) Outputs	4 outputs per Card	BNC
Maximum cards	Up to 4 cards per chassis	16 x BNC
Maximum outputs	Up to 16 outputs per chassis	16 x BNC

IRIG-B (Un-modulated RS422, RS485, RS232) outputs

IRIG-B (Un-modulated) Output	Number of Interface	Connector
IRIG-B (Un-modulated) Outputs RS422, RS485, RS232	4 outputs per card	Terminal
Maximum cards	Up to 4 cards per chassis	Terminal
Maximum outputs	Up to 16 outputs per chassis	Terminal

IRIG-B Format

IRIG-B	Format
Un-Modulated	B004
Modulated	B124

Optical: Pulse

Optical Pulse Output	Number of Outputs	Connector
Optical Output	1 outputs per Card	ST, 850nm Multi-Mode
Maximum cards	Up to 4 cards per chassis	4 x ST, 850nm Multi-Mode
Maximum outputs	Up to 4 outputs per Chassis	4 x ST, 850nm Multi-Mode

1 PPS :

Optical Pulse Output	Number of Outputs	Connector
Maximum Output	2/4/6/8	BNC

Extension Unit available Card options:

2488	4 Port x Unmodulated, 50 Ohms IRIG-B Interfaces (BNC F Connector)
2482-P	4 Port x 1PPS, 50 Ohms (BNC F connector) interfaces
2727-P	1 Port x 1PPS (Optical, Transmitter, 820nm, ST, Tx) interface
2480	4 Port x Modulated IRIG-B (BNC F Connector) interfaces
2444-485	4 Port x Unmodulated IRIG-B [RS485 / RS422] interfaces (8X2 M Terminal Block)
2447-232	4 Port x Unmodulated IRIG-B [RS232] interfaces (8X2 M Terminal Block)
2482-M	4 Port x 10MHz interfaces (BNC F connector)
2727-I	1 Port x IRIG-B (Optical, Transmitter 820nm, ST, Tx) interfaces
2485-N	- 2 Port x NMEA (RJ45 F Connector) and - 2 Port x 1PPS (BNC F Connector) Card (4 Cards (Max) per Chassis)

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