Introduction:

VCL-2145 (VCL-GPS-2145), GPS Primary Reference Clock with IEEE-1588v2 Grandmaster and NTP Server is a high precision, multi-service, time and frequency synchronization solution which can be used to provide ITU-T, G.811 Primary Reference Clocks which are referenced to a GPS source, as well as to synchronize the time-of-day and frequency across multiple nodes of the network. The VCL-2145 (VCL-GPS-2145) Receiver also has an integrated, high bandwidth NTP Server engine that is capable of handling up to 8900 NTP requests per second (71,200 NTP Slaves supported). Multiple IRIG-B Outputs are also provided to synchronize local clock (time-of-day) display units as well as RTUs to a central timing source with nanosecond accuracy.

The VCL-2145 (VCL-GPS-2145), GPS Primary Reference (PRC) Clock is specifically designed for the synchronization of 2G, 3G, HetNet and LTE mobile telecommunications networks as well as backhaul wire-line SDH / SONET and Synchronous Ethernet networks. It may be also used by Railways, Airports (including air-traffic control), Power generation and distribution companies and other Utility companies who not only require a highly precise time-of-day and G.811 frequency synchronization locked to a GPS Reference but who also need to distribute highly precise time-of-day and frequency synchronization across all nodes of their networks.

The VCL-2145 / VCL-GPS-2145 is always locked to a GPS reference to provide multiple G.811 / Stratum 1 quality frequency and time-of-day (IRIG-B and NTP) outputs. The VCL-2145 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 the GPS signal or its antenna failure.

Features and Highlights:

- Reliable, Cost-Efficient Reference GPS Receiver
- 50 Channel GPS, L1 frequency, C/A Code Receiver
- Simultaneous tracking of up to 12 GPS satellites
- ITU-T G.811 Primary Reference (PRC) Clock
- GPS locked G.703 compliant E1, 2.048MBits, 1.544Mbits and 2.048 MHz outputs
- Primary reference and holdover functionality:
  - ITU-T G.811 / Stratum 1 compliant (PR) Primary Reference when locked to GPS
  - ITU-T G.812 compliant holdover
- SSM Message format Compliant with ITU-T G.704. Optional GR-378-CORE for SONET Networks
- 1/5/10 MHz output
- 1 PPS outputs
- IEEE-1588v2 Precision Time Protocol Grandmaster
- PTP Grandmaster support for up to 150 PTP Clients
- Supports Multicast and Unicast PTP packets
- Nanosecond accuracy
- IRIG-B outputs
- Standard RJ45 and BNC connectors for all inputs and outputs
- ToD compliant to NMEA 0183 (DB9 Serial Port).

Additional Features:

- NTP Server supporting up to 8900 NTP requests per second
  - 71,200 NTP Slaves supported
  - 445,000 SNTP Slaves supported
- Separate, independent, IEEE-1588 and NTP Server engines
- IPv4 and IPv6 compatible NTP Server
- SSH, Telnet, Radius, SNMP V2 MIB, Password Protection
- Redundant AC and DC power supply options
- 4, 10/100/1000BaseT Network Interface Ethernet Ports
  - 2 x 10/100/1000BaseT Network Interface Ethernet Ports
  - 2 x 1000BaseSX/LX Network Interface Ethernet Ports
- VLAN and Packet priority feature - allows the user to assign priorities to different types of clients
- Supports QoS, 802.1p based packet priority
- Supports 802.1Q based VLANs.
- Power Contact and Lightening Protection as per Telcordia GR-1089-CORE.

Available in two Version:

1. **GPS, PTP IEEE-1588v2 Grandmaster and Primary Reference Clock**

   Description: (i) VCL-2145, GPS Primary Reference (PRC) G.811 Clock. Provides 1PPS, NMEA, 1/5/10MHz, 2.048MHz, 2.048Mbits with SSM, 1.544Mbits Frequency Outputs with High Stability OCXO and Rubidium (G.812) Holdover Clock options.

   (ii) VCL-2145, GPS Primary Reference (PRC) G.811 Clock and PTP Grandmaster (IEEE-1588v2) with NTP Server. May be used in multi-service applications as a G.811, Primary Reference (PRC) Clock as well as a IEEE-1588v2 Grandmaster and NTP Server (IPv4 and IPv6). Provides IRIG-B, 1PPS, NMEA, 1/5/10MHz, 2.048MHz, 2.048Mbits with SSM, 1.544Mbits GPS referenced outputs. OCXO and Rubidium (G.812) Holdover Clock options available.

2. **PTP (IEEE-1588v2) Slaves**

   Description: (i) PTP (IEEE-1588v2) Slave - synchronizes to PTP Grandmaster to provide IRIG-B, 1PPS, NMEA, 1/5/10MHz, 2.048MHz, 2.048Mbits outputs. OCXO and Rubidium Holdover Clock options available.

   (ii) PTP (IEEE-1588v2 Slave) for ToD (Time of Day) Synchronization. PTP (IEEE-1588v2) Slave - synchronizes to PTP Grandmaster to provide IRIG-B, 1PPS, NMEA, 2.048MHz, 2.048Mbits outputs.

Application Diagram:
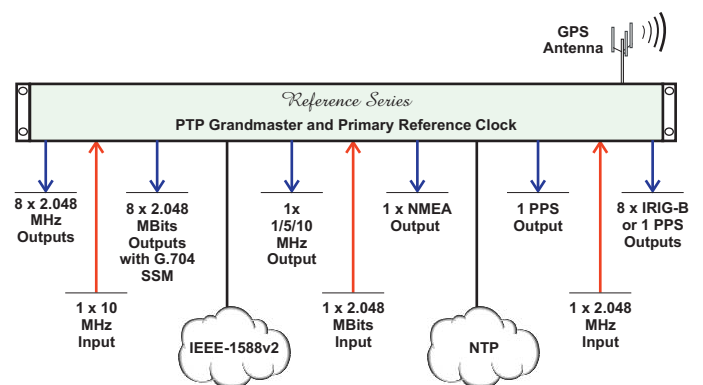
GPS Receiver as a Primary Reference (PRC) Clock
with IEEE-1588v2 Grandmaster and NTP Server

Typical Synchronization Applications:

- Synchronizing Cellular networks like UMTS, GPRS, 3G & LTE
- 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 of the network
- 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.

Technical Specifications

GPS Receiver:

- 50 Channel GPS Receiver
- GPS L1 frequency, C/A Code Receiver
- Tracks up to 12 satellites simultaneously
- Synchronizing Time:
  - Acquisition time - Hot Start: Less than 15 sec. (90%)
  - Acquisition time - Warm Start: Less than 45 sec. (90%)
  - Acquisition time - Cold Start: Less than 140 sec. (90%)
- 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
- Accuracy Of Time-Pulse Signal referenced to GPS: +/-15ns (compensated)
  (Note: with all satellites in view at -130db)

Clock performance - GPS:

- Performance when locked to GPS / GNSS Timing accuracy: < 60ns (at constant temperature) < 90ns (at variable temperature, -5°C to +55°C)

Internal (G.812) Synchronization Options:

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

Frequency holdover:

OCXO:
- Long-term stability: 1×10^{-10}/day, 2×10^{-8}/year
- Frequency stability: 6×10^{-10}(-5^0C to $+55^0$C)

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

Standard Frequency and ToD* Outputs:

Output Type	Number Of Outputs	Connector
2.048 Mbit/s (E1) / 1.544 Mbit/s (T1) compliant with ITU-T G.703	8 (8E1 or 8T1)	RJ45
2.048 MHz, 75 Ohms, phase-locked to GPS	8	BNC
1/5/10 MHz, 50 Ohms, phase-locked to GPS	1	BNC
IRIG-B, synchronized to GPS**	8	BNC
1 PPS, phase-locked to UTC**	8	BNC
TOD (Time-Of-Day) output compliant to NMEA0183	1	DB9, RS-232C
NTP / PTP (10/100/1000) Network Interface	4	RJ45
2 x 10/100/1000BaseT Network Interface Ethernet Ports,	2	RJ45 (Optional)
2 x 1000BaseSX/LX Network Interface Ethernet Ports	2	Optical (Optional)

**Note: User selectable between IRIG-B and 1PPS Outputs*

NTP Server:

- NTP Protocols: NTP v2 (RFC 1119), NTP v3 (RFC 1305), NTP v4
- IP Protocols: IPV4, IPV6
- Time Protocol: (RFC 868)
- Daytime Protocol: (RFC 867)
- Synchronization of IEC 61850 compliant devices using NTP/ SNTP protocol
- Capable of processing up to 8900 requests per second.

IEEE-1588v2 PTP Grandmaster:

- Compliant with IEEE-1588 v2 (2008) specifications
- Maximum number of addressable PTP Clients - 128
- Power and Telecom Profiles

Management and Monitoring Ports:

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

System Access, Control and Management Options:

- Telnet, SSH, RADIUS
- CLI Control Interface (HyperTerminal or Vt100)
- SNMP V2 Traps (MIB File provided)

Security and Protection:

- Password Protection
- Secured Access via SSH V2
- Separate VLAN on monitoring and access

Power Supply Options:

- Dual Redundant
- 1+1 AC power (100 to 240V AC, 50/60 Hz)
- 1+1 DC 24V power
- 1+1 DC -48V power
- 1+1 DC 110/125V DC power
- AC or DC

MTBF:

MTBF for VCL-2145 with RbXO Option:
- Per MIL-HDBK-217F: ≥ 17 years @ 40^0C
- Per Telcordia SSR 332, Issue 1: ≥ 20 years @ 40^0C

MTBF for VCL-2145 with OCXO Option:
- Per MIL-HDBK-217F: ≥ 21 years @ 40^0C
- Per Telcordia SSR 332, Issue 1: ≥ 24 years @ 40^0C

External Frequency Synchronization Inputs:

Intput Type	Number Of Inputs	Connector
2.048 MHz, 75 Ohms	1	BNC
10 MHz, 50 Ohms	1	BNC
2048 Mbps	1	BNC