VPX-100 Radial Clock Card

Summary

The VPX-100 radial clock card is a grandmaster timing card, developed in alignment with the Sensor Open Systems Architecture® (SOSA®) Technical Standard. The VPX-100 is a radial clock slot card capable of generating timing signals and PNT data for use within a chassis. The card can host several PNT sources, including a multi-band, multi-constellation GNSS receiver; a rubidium Miniature Atomic Clock (MAC); and a low-phase-noise, Oven-Controlled Crystal Oscillator (OCXO). The VPX-100 can act as a PTP grandmaster or NTP server to provide precise time over a network and radial clock outputs over a chassis backplane.

Key Features

- SOSA aligned
- 3U VPX form factor
- PolarFire® SoC FPGA/CPU
- 1 PPS and 100 MHz radial clock outputs
- IEEE 1588 PTP grandmaster
- NTP server
- Hitless reference switching
- Advanced timing holdover algorithms

PNT Source Options:

- L1, L1/L2, L1/L5 GNSS receiver
- Rubidium MAC
- 100 MHz, low-phase-noise OCXO
- External PNT reference inputs

MAC

The MAC rubidium frequency reference enables the PNT source card to be a system reference with excellent holdover during periods of GNSS denial. The internal MAC uses a physics package based on the Coherent Population Trapping (CPT) atomic clock. It consumes less power and has broad temperature operation and longer life than legacy lamp-based rubidium clocks.

Stability

ADEV	SA55 (Hz/Hz)	SA53 (Hz/Hz)
τ = 1 s	$< 1.5 \times 10^{-11}$	$< 3 \times 10^{-11}$
τ = 10 s	$< 5 \times 10^{-12}$	$< 1 \times 10^{-11}$
τ = 100 s	$< 1.5 \times 10^{-12}$	$< 3 \times 10^{-12}$
τ = 1,000 s	$< 5 \times 10^{-13}$	$< 1 \times 10^{-12}$
τ = 10,000 s	$< 1.5 \times 10^{-12}$	$< 3 \times 10^{-12}$
Frequency Drift	**SA55 (Hz/Hz)**	**SA53 (Hz/Hz)**
Monthly[3]	$< 5 \times 10^{-11}$	$< 1 \times 10^{-10}$
Yearly	$< 6 \times 10^{-10}$	$< 1.5 \times 10^{-9}$
Daily[4]	$< 2.5 \times 10^{-11}$	$< 2.5 \times 10^{-11}$

[3]After 1 month of continuous operation
[4]After 1 day of continuous operation

Timing Architecture

The VPX-100 combines the long-term stability of the atomic clocks onboard the GNSS satellites via the GNSS receiver, the timing holdover capability of the rubidium atomic clock, and the ultra-low phase noise and short-term stability of the 100 MHz Ultra-Low-Noise (ULN) OCXO. This timing architecture enables stable, clean timing signals to users and other systems relying on the VPX-100 as a timing reference. The advanced oscillator aging, temperature and environmental compensation, and holdover algorithms provide precise timing, even during jamming and spoofing events.

GNSS Receiver

The VPX-100 has a dual-band, multi-GNSS receiver that provides precise time and position data to users. The GNSS receiver supports the following features:

- Supports GPS, Galileo, BeiDou and NAVIC L5 constellations
- L1+L2 or L1+L5 operation, user selectable
- 5 ns, 1σ timing accuracy
- Raw GNSS observables

PTP Implementation

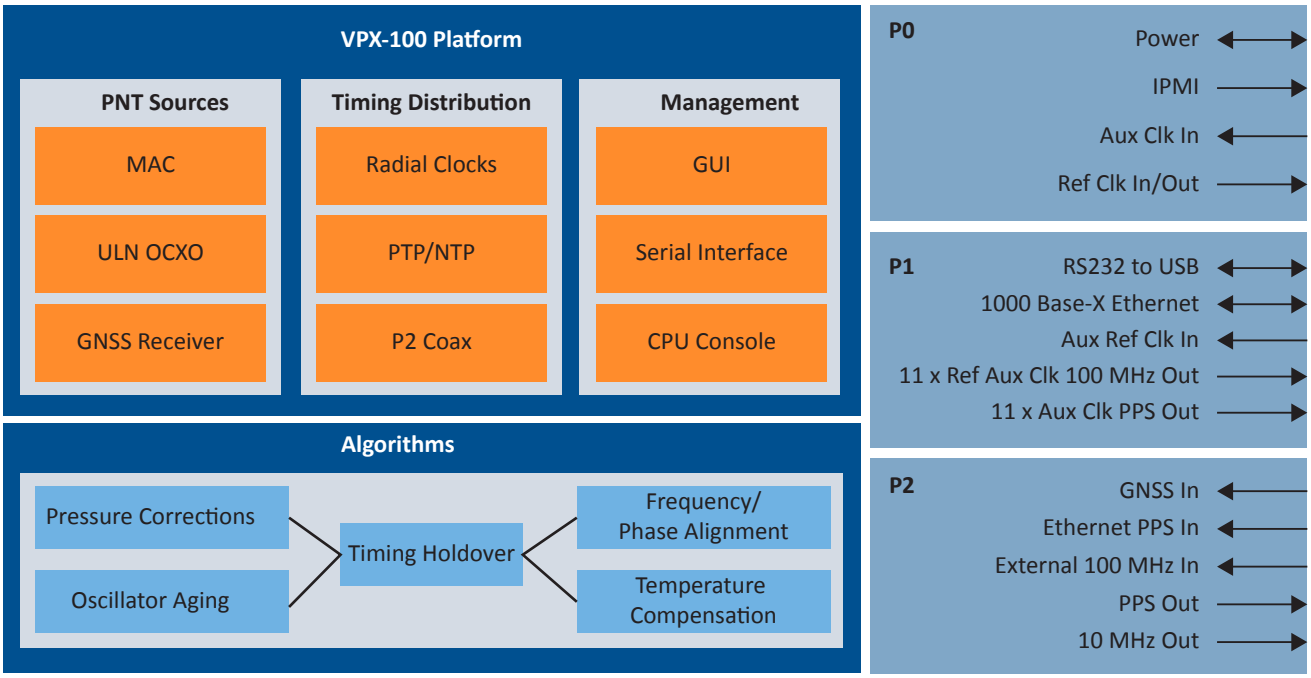
The VPX-100 can operate as a PTP grandmaster or client. The card has a dual-port, 1 Gigabit Ethernet (GbE) PHY with IEEE 1588v2 PTP hardware timestamping and SyncE support. The card supports the following profiles:

- G.8275.1 Layer 2 Multicast
- G.8275.2 Layer 3 Unicast
- 802.1AS gPTP Layer 2

Management Interface

The VPX-100 utilizes the VDOM Monitor 3 monitoring software, which is a graphical user interface available from a Windows® host PC. The card can also be controlled and configured over a serial interface or Ethernet using the Vectron® Serial Interface Protocol (VSIP), which is a NMEA-0183-based protocol. Additional configuration can be accessed through the CPU console, including IP configuration, PTP configuration and services, such as start/stop.

Card Functional Block Diagram



VPX-100 Slot Profile and P2 Connector Layout

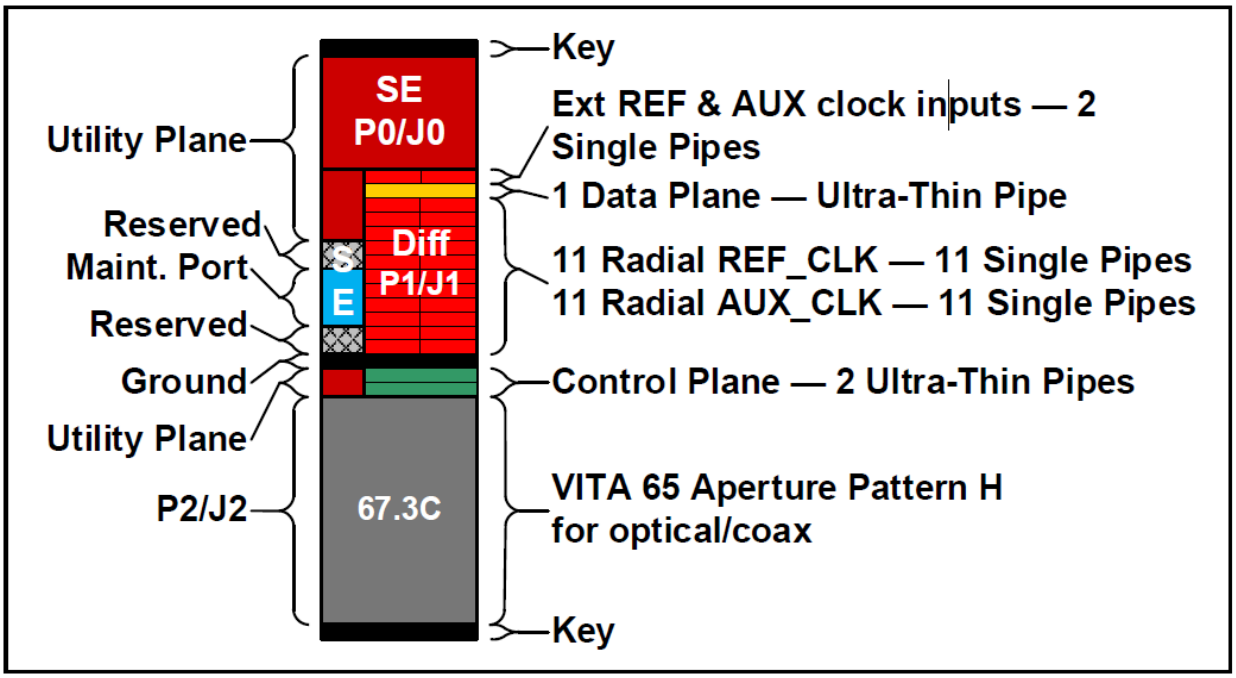


Figure 14.9.2-1 SLT3x-TIM-2S1U22S1U2U1H-14.9.2-n

Ordering Options

Part Number	Description
VPX-100	PNT Grandmaster Radial Clock Card