TimeProvider® 4100
Precise Timing Gateway Clock

Features

- IEEE 1588v2 Precision Time Protocol (PTP) grandmaster
- GNSS (GPS, GLONASS, BeiDou, and Galileo)—QZSS ready, SBAS support
- Primary reference time clock (PRTC)
- Oscillator options—mini OCXO, OCXO, and Rubidium (Rb)
- IPv6/IPv4 on all ports
- Standard base unit with 8 Ethernet ports, 4 E1/T1 ports, 1 craft port, 2 × 1PPS/ToD ports, 2 × 1PPS/10 MHz ports
- Optional internal expansion module with 16 E1/T1 ports for a total of 20 E1/T1 outputs per unit
- Support for multiple IEEE 1588v2 profiles per unit
- Support for PTP master, client, probe, and NTPv4
- High performance: 512 PTP unicast clients at 128 PPS and 20,000 NTP requests/second
- Fully supports ITU-T profiles for phase synchronization: G.8275.1 and G.8275.2
- Fully supports ITU-T profiles for frequency synchronization: G.8265.1, Telecom 2008
- Other industry profiles: Default
- APTS with patented automatic asymmetry compensation (AAC) support
- Monitoring and measurement capabilities
- TimePictra® synchronization management system support

Benefits

- Sync solution for the mobile edge: 4G/LTE, cRAN, 5G
- Flexibility to leverage legacy and new investments
- Mitigates impact of backhaul noise, packet delay variation, and asymmetry
- Preserves current MPLS network engineering

Applications

- LTE-FDD, LTE-TDD, LTE-A networks, CRAN, 5G
- Ethernet backhaul networks, cable remote PHY

TimeProvider 4100 is a gateway clock, a new class of synchronization product that accepts multiple inputs from Global Navigation Satellite Systems (GNSS), Synchronous Ethernet (SyncE), and 1588 PTP and E1/T1 digital transmission links, and distributes timing flows to multiple endpoints such as base stations. A gateway clock benefits from multiple layers of protection leveraging other assets in the core of the network.

TimeProvider 4100 is a best-in-class 1588 grandmaster complemented by extensive port fan-out for PTP, Network Time Protocol (NTP), SyncE, and legacy building integrated timing supplies (BITS). With multiple ports for current, legacy, and future networks that can be connected to multiple base stations for 4G and 5G deployments, the device offers customers a cost-effective solution that can be easily adapted for a wide variety of use cases.

Best-of-Breed Master Clock

TimeProvider 4100 is an industry-leading grandmaster clock with a base model that offers multiple PTP profiles per unit, supporting IEEE 1588v2 frequency profiles such as Telecom 2008, G.8265.1, as well as the latest phase profiles such as G.8275.1 and G.8275.2.

It supports SyncE input and output, and is built on a best-in-class platform that associates connectivity to legacy networks as well as to the latest standards.

TimeProvider 4100 is based on Microsemi's newest platform as well as its latest packet engine generation. This provides the utmost flexibility to support multiple packet services in the box, to specify the service on each port (master, client, probe, NTP), and to select management and client service on either an RJ45 or an SFP port (depending on the network and preference). This flexibility enables operators to select and benefit from the number and types of ports and interfaces that are necessary to deploy and scale for specific use cases including 5G, cRAN, and DOCSIS remote PHY, without compromising performance or features.

TimeProvider 4100 meets stringent precise time standards and complies with primary reference time clock (PRTC), as well as the latest time and phase standards.

GNSS Support

The 72-channel GNSS receiver coupled with Microsemi's patented active thermal compensation technology. With the time source provided through GNSS satellite input, it is essential to provide flexible support for constellations of choice depending on the region. TimeProvider 4100 supports GPS, GLONASS, BeiDou, Galileo, and SBAS in its standard version. The hardware is also enabled to support QZSS.

Flexible Architecture

A key aspect of TimeProvider 4100 is its rich base platform with support for PTP, NTP, and legacy frequency timing applications. The clock features 4 BITS ports (E1/T1), 2 1PPS/ToD ports, 2 1PPS/10 MHz ports, 1 GNSS port, and 1 craft port.

Complementing its standard advanced feature set, TimeProvider 4100 offers an internal expansion module to add 16 E1/T1 synchronization ports to the device. Flexibility is of the utmost importance for enabling operators to select the appropriate package, options, and interfaces for their respective use cases and deployment models.

TimeProvider 4100 is a fanless device, which minimizes the risks associated with rotation or moving parts. It also features passive heat sinks, which enables great scalability with SFP ports in the base chassis.

TimeProvider 4100 can leverage a sub-tenancy architecture whereby a slave TimeProvider 4100 can subtend from a master TimeProvider 4100 unit using a ToD input/output. The master is connected to GNSS constellations and is recommended to be upgraded to the Rubidium atomic clock oscillator, whereas the slave TimeProvider 4100 can simply feature a lower cost oscillator without connectivity to GNSS. This architecture enables double the port count of the solution to 8 BITS ports and 16 Ethernet ports on the combined main chassis.

Resilient Solution

TimeProvider 4100 features layered protection and accepts PTP input with Microsemi's patented asymmetry compensation to provide best-in-class assisted partial timing support (APTS) to backup the GNSS signal. APTS is a key technology that accounts for high packet delay variation, timing jitter variation, and asymmetry challenges. As a second layer of protection, TimeProvider 4100 features optional oscillator upgrades for enhanced holdover performance. Additional output capabilities enable support of legacy frequency timing applications, including E1/ T1, 10 MHz, pulse per second (PPS), and time of day (ToD). In addition, TimeProvider 4100 provides dual DC input for power redundancy and geographical network redundancy for fail over.

Management

When deployed with Microsemi's TimePictra® synchronization management system, carriers can also benefit from superior monitoring information and management capabilities. TimeProvider 4100 features full FCAPS capabilities using TimePictra. Internal logging and SNMP are supported as well as security capabilities using SSH and firewall features. A separate management port can be selected either as RJ-45 or as an SFP port. In-band management is also supported.

In terms of monitoring, the focus is on helping customers with phase deployments. Monitoring PTP traffic is a primary focus with Time Error. 1PPS Monitoring is also available. A WebGUI is offered as user-friendly user interface for monitoring results, measurements, and calculations.

High Performance

High performance is another standard core attribute of TimeProvider 4100, which can support 512 PTP IEEE 1588v2 clients at the highest packet rate (128 PPS).

Similarly, NTP support is achieved at a high performance of 20,000 transactions per second due to utilization of hardware time stamping.

512 VLANs are supported, including 1 VLAN per client and 1 VLAN for management.

Optional Expansion Module

TimeProvider 4100 provides the necessary flexibility to add internal expansion modules for various capabilities. The expansion module is an optional upgrade to the base unit.

E1/T1 Expansion Module
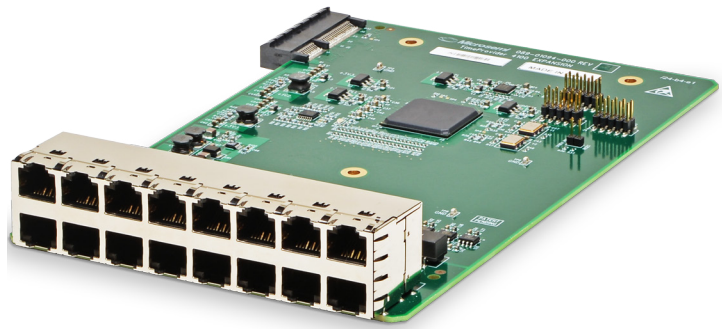
One such internal module is an E1/T1 internal module with 16 E1/T1 ports, which brings the maximum total in the unit to 20 E1/T1 ports (4 in base and 16 in expansion module).

Beyond 20 E1/T1 ports, TimeProvider 4100 is designed to enable to cascade units for higher density applications and use cases.

This deployment provides additional flexibility in that the second unit is a sub-tenant of first unit, thus there is no need for GPS on the second unit because the second unit inherits its reference from the first unit. In addition, both units cross-connect, and since each is connected to GPS, this enables a second reference when GNSS goes down.

For needs beyond 40 E1/T1 ports, TimeProvider 4100 unit can be connected to an SSU or BITS system as a master reference with full PRC traceability.

World-Class Oscillator Options Improve Holdover Accuracy and Save Valuable Time

The standard TimeProvider 4100 is equipped with a crystal oscillator that keeps the TimeProvider 4100 accurate to nanoseconds when tracking GNSS. However, if GNSS connectivity is lost, and the server is placed in holdover, the oscillator will begin to drift, impacting timing accuracy. Upgrading the oscillator significantly improves the holdover accuracy. For example, consider the drift rates listed in the following table for the standard oscillator compared to the OCXO and Rubidium upgrades.

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Typical Timekeeping in Holdover

Oscillator	200 ns	400 ns	1.1 μs	1.5 μs	5 μs	10 μs
mini OCXO						
OCXO	4 hrs	8 hrs	14 hrs	16 hrs	1.5 days	2 days
MAC laser-driven Rubidium	1 day	1.8 days	3.5 days	4 days	8 days	12 days

Note: This table lists typical (1 sigma confidence) values. Assume a benign temperature environment. The values include initial phase and frequency errors. TimeProvider 4100 is assumed to be powered-up for 3 weeks and locked to GNSS for 96 hours.

The value of the upgraded oscillator is that if the GNSS signal is lost, TimeProvider 4100 can continue to serve very accurate PTP and NTP services, allowing plenty of time to correct the problem with no degradation or disruption in time synchronization accuracy.

TimeProvider 4100 base unit comes with a mini-OCXO. It provides the necessary flexibility to selct among three oscillator models, depending on deployment need. Two upgrade options are offered. One option is to select an OCXO. The other option is to select an upgrade to Rubidium.

It is crucial to understand that at the high-end, Rubidium oscillators are unequalled for telecom applications and it is extremely important to be aware of the design differences between models in the marketplace.

Small Form Factor Rubidium Oscillator

Not all Rubidium oscillators are equal and there are strong arguments in favor of Rubidium over OCXOs.

Microsemi's miniature Rubidium clocks each have a unique physics package based on the coherent population trapping (CPT) atomic clock. It consumes less power and has wide-spectrum temperature operation and longer life cycles than legacy lamp-based Rubidiums used by competitors.

Rubidium clocks have much shorter lock times than OCXOs: 24 hours after power-up versus 2 to 5 weeks. This differentiation alone is a tremendous reason for using Rubidium-based units over OCXO-based units.

Specifications

Mechanical
- Size: 1 RU
- 1.73 in. (44 mm) (H) × 17.24 in. (438 mm) (W) × 9.30 in. (237 mm) (D), or 10.07 in. (256 mm) (D) including connectors on faceplate
- 1.75 in. (H) × 17.5 in. (19 in. with handle bracket) (W) × 9.5 in. (10.5 in with BNC connector)
- Rack mounts: 19-inch and 23-inch options
- Weight: 8 pounds (10 pounds with shipping box)

Power
- DC power models: dual-power feeds, –38.4 VDC to –72 VDC
- Power consumption: OCXO model with DC supply: 20 Watts (max), 17 Watts (typical) Rubidium model with DC supply: 28 Watts (max), 20 Watts (typical)

Oscillator
- Standard oscillator: Mini-OCXO
- Oscillator upgrade options: OCXO and Rubidium

GNSS
- Constellations: GPS, GLONASS, BeiDou, and Galileo
- QZSS ready
- SBAS support

Timing Services: PTP Client (PTP input)
- Profile: Telecom-2008
- Profile: ITU-T G.8265.1
- Profile: ITU-T G.8275.1
- Profile: ITU-T G.8275.2
- BMCA and alternate BMCA support

Timing Services: PTP Master (PTP output)
- Profile: Ethernet default
- Profile: Telecom-2008
- Profile: ITU-T G.8265.1
- Profile: ITU-T G.8275.1
- Profile: ITU-T G.8275.2
- Profile: Default (IPv4 only)
- Multiple PTP profiles support per box
- NTP V4
- NTP or PTP support per port
- Total of 6 ports can operate in parallel with any packet engine services
- Management is possible in-band or out-of-band from ports 1 or 3
- MGMT port is capable of PTP client timing service as well
- Ports 2–8 can operate as master timing services (PTP GM, NTP, PTP probe)
- 1 PTP client (input)
- PTP client timing service can be set on any one of the ports (1–8)
- Maintains performance levels for a period of time until technicians can re-establish GPS or fix the disruption
- APTS with patented automatic asymmetry correction and SyncE input
- Configurable bridging time
- Geographical redundancy through network topology and failover
- Several levels of oscillators (hold 1 μsec for a full day) to enable remediation

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Scalability
- 512 PTP clients at 128 PPS per box in unicast
- NTP up to 20,000 transactions per second

Licensing
- Base unicast client count of 64 clients and software upgrade options through licensing to 128, 256, and 512 clients at 128 packets per second

Management
- Separate management port from the other forms of traffic (PTP Grand Master, NTP server, and more)
- In-band management (from PTP client interface)
- IPv4 or IPv6 support for management traffic
- FCAPS on Microsemi TimePictra platform
- Internal log
- SNMP traps (v2 and v3)
- CLI through SSHv2

Security
- Firewall limits access to only specific protocols such as SNMP, SSH, ICMP, and more
- Traffic port denial of service mitigation with port limiters and PTP packet reception/generation in hardware-level packet

Class of Service (CoS) and VLANs
- Up to 512 VLANs for PTP master, both for IPv4 and IPv6
- One VLAN per supported PTP client for both IPv4 and IPv6
- 1 VLAN for management
- Total number of VLANs is 512 per system

Time and Frequency Accuracy
- PRTC: fully compliant with ITU-T G.8272
- ePRTC: designed with ToD input that is fully compliant with Microsemi's TimeSource ePRTC system
- Frequency accuracy: conforms with ITU-T G.811
- Frequency output accuracy: <1 x 10^{-12} at 1 day locked to GPS

Monitoring
- 1PPS measurement (one channel)
- Packet probing and monitoring with threshold level
- Presentation of network accuracy with all available data through local web GUI
- WebGUI through HTTPS

Synchronous Ethernet (SyncE)
- SyncE can be used as a frequency input and it can be generated as an output (as a master)
- Conforms to relevant sections ITU-T G.8261, G.8262, and G.8264 Ethernet Synchronization Message Channel (ESMC)

Physical Interfaces
- 2 × Gigabit Ethernet—Shielded RJ45, 100/1000 BaseT Ethernet
- 6 × Gigabit Ethernet SFP cages—ports support either:
    - SFP (optical), 1000 BaseX
    - SFP (electrical), 1000 BaseT
- 4 x E1/T1: 2 × input/output ports + 2x output ports over balanced RJ48c connectors, 120 Ω/100 Ω impedance.
- Optional expansion module: 16 × E1/T1 output ports over balanced RJ48c connectors, 120 Ω/100 Ω impedance.
- 2 × 10 Mhz/1PPS input/output ports over single-ended BNC connectors, 50 Ω impedance.
- 2 × ToD/1PPS input/output over RS-422 RJ45 connectors, 100 Ω impedance

Network Support
- IPv4 and IPv6 (PTP and management)
- HTTP/HTTPS/SSL
- ICMP (RFC 792)
- DHCP client (RFC2131)
- IEEE 1588v2 PTP
- IEEE 802.1Q, 802.1p VLAN filtering/tagging
- DSCP
- SSHv2
- SNMPv2, SNMPv3

Regulatory and Environmental Requirements

Environmental
- Acoustic noise level: 0 dBA
- Operating temperature: –5 °C to 55 °C
- Storage temperature: –40 °C to 70 °C
- Relative humidity: 5% to 90% non-condensing, 100% with condensation

EMC Compliance Under Directive 2014/30/EU and 2014/53/EU (RTT&E)

Emmisions
- FCC Part 15 (Class A)
- ICES 003 (Class A)
- VCCI (Class A)
- EN 300 386 Telecommunications Network Equipment (EMC)
    - CISPR32
    - EN55032
    - KN55032
    - EN 300 440

Immunity
- EN301 489
- EN55024 (Class A)
- KN55035 (Class A)
    - EN/KN-61000-4-2 ESD
    - EN/KN-61000-4-3 radiated immunity
    - EN/KN-61000-4-4 EFT
    - EN/KN-61000-4-5 surge
    - EN/KN-61000-4-6 low frequency common immunity

Safety Compliance
- UL 62368-1
- CAN/CSA-22.2 No. 62368-1
- IEC 62368-1
- EN 62368-1
- Safety Directive 2014/35/EU
    - CE mark

Environmental Compliance
- EN300-019-2-3, Class T3.2
- ETSI EN 300 019-2-2 (1999) – Transportation, Class T2.3
- ETSI EN 300 019-2-1 (2000) – Storage, Class T1.2
- GR-63
- RoHS (6 of 6)

Network Equipment Building System
- NEBS Level 3*, GR-1089 *: When following deployment guidelines as specified in the user manual

TimeProvider 4100 Physical Outline

Power A DC

4 E1/T1 ports
RJ48c 120 Ω

8 ETH ports
(6 SFP + 2 RJ45)

Craft port
RS232

2x 1PPS/
10 MHz In/Out

16x E1/T1/2.048 MHz/1.544 MHz Out
Internal Expansion RJ48c

GNSS

2x E1/T1/2.048 MHz/1.544 MHz In/Out (programmable)
2x E1/T1/2.048 MHz/1.544 MHz Out with SSU function

2x 1PPS/
ToD In/Out

Power B DC

1x packet Ethernet In + management (with SyncE) – 1x RJ45 or 1x SFP cage.
Either in-band management or out-of-band.
6x packet Ethernet Out (with SyncE) – 1x RJ45 and 5x SFP cage.

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