MultiSync™ 100
1588 GPS Clock

Modernize time synchronization for power systems

Accurate time synchronization is required to coordinate the actions of protective relays, generator controllers, distributed resources, power system controllers, energy storage, and microgrids. Every device must be synchronized to the same time source to ensure coordinated action. Traditional time synchronization methods have shortcomings, such as the separate analog copper wiring required for IRIG-B or the lower accuracy of SNTP/NTP over Ethernet networks.

The MultiSync 100 uses the IEEE® Standard 1588-2008 for Precision Clock Synchronization Protocols used in Networked Measurement and Control Systems, as well as the C37.238-2011 IEEE Standard Profile used in Precision Time Protocols within Power System Applications. As a result, the MultiSync 100 provides highly accurate time synchronization, and allows for the gradual retirement of less accurate or more costly methods.

Key Benefits
• Supports latest 1588-2008 and C37.238-2011 standards for Ethernet-based time synchronization
• Upgrade existing substations to 1588 support without replacing existing time synchronization infrastructure
• Provides accurate time synchronization for protection and control applications through MultiLink™ Ethernet switches, Multilin™ Universal Relays and Multilin 8 Series Relays
• Designed and tested specifically for rugged environments such as utility substations

Application
• Power substations for synchrophasor and grid modernization applications
• IEC® 61850 process bus sampled value applications
• Industrial Ethernet for time-based control
• Upgrading legacy installations to IEEE 1588

Precise Time Synchronization
• Supports IEEE 1588-2008 and C37.238-2011 for power system applications
• Operates as a master clock or ordinary clock
• Part of complete GE end-to-end timing solution for protection and control
• Integrates into existing time synchronization networks by supporting traditional time synchronizing methods

Supports Common Methods
• IEEE 1588-2008
• IEEE 1588-2008 / C37.238-2011
• NTP/SNTP
• IRIG-B
• DCF77
• TTL
• XYZ

Flexible Design
• Compact size and DIN rail mountable case for easy mounting
• Tested to substation environmental standards
• Wide range, isolated power supply
The need for cost-effective, accurate time synchronization

Accurate time synchronization is becoming a critical requirement in today’s power system substations. For example:

- Synchrophasor measurements to support wide area monitoring systems and remedial action schemes require time synchronization accurate down to 1 microsecond.
- Merging units, that publish sampled values for use by protective relays, meters, and control devices require time synchronization accuracy of 25 microseconds.
- Coordinating fault records and event logs across multiple devices requires time synchronization of 500 microseconds.

There are two different challenges to the traditional method for time synchronization. The first is that time synchronization has been implemented by connecting end devices to a local satellite clock. This synchronizes all elements in a specific substation together, but this may not be adequate for system wide synchrophasor applications. The second challenge is that accurate time synchronization has required a dedicated time network. The most common method employed which provides the accuracy required is IRIG-B. IRIG-B sends out analog pulses, which requires a dedicated analog network built on copper wiring. This network must be installed separately, and is challenged by voltage drop due to distance and the number of connected devices, as well as electrical interference. SNTP/NTP can send time synchronization signals via an Ethernet network, but does not account for switching time delays, and therefore doesn’t meet the accuracy requirements of time sensitive applications.

Upgrade to IEEE 1588 at low cost

IEEE 1588-2008 is the technical solution designed to provide cost effective time synchronization from devices in a substation up to the whole utility grid. The challenge to implementing 1588 in a substation is interfacing with devices that only support legacy time synchronization methods. The MultiSync 100 1588 GPS Clock is a cost-effective solution to this challenge. Compact size, with DIN rail mounting, provides great flexibility in installation. Network and analog output ports allow interfacing into legacy time synchronization networks while simultaneously providing IEEE 1588 signals.

The MultiSync 100 supports common network time synchronization methods, including IEEE 1588, C37.238 and SNTP/NTP. The MultiSync 100 also supports common analog methods of time synchronization, including IRIG-B, TTL, and user defined pulse methods. The network and analog methods can be supported simultaneously by MultiSync 100. One compact, affordable MultiSync 100 GPS Clock can provide timing synchronization for 1588 compliant devices and legacy devices in the substation, providing a simple, low cost upgrade path.

A complete end-to-end solution for IEEE 1588

One compact, affordable MultiSync 100 GPS Clock can provide timing synchronization for 1588 compliant devices and legacy devices in the substation, providing a simple, low cost upgrade path.
IEEE 1588-2008 support

The MultiSync 100 clock is a 1588 GrandMaster clock that can be synchronized to a GPS satellite, and also an ordinary clock synchronized to a local or system wide 1588 GrandMaster clock. The operating mode is determined by the Best Master Clock algorithm. The MultiSync 100 supports both IEEE 1588-2008 and the C37.238-2011 Power Profile. Specifics of the 1588-2008 implementation are as follows:

- Timing accuracy is <100ns to UTC for 1588 and SNTP/NTP
- Best Master Clock algorithm to determine GrandMaster or ordinary clock operation
- Profile selection: 1588-2008 or C37.238-2011
- Layer 2 or Layer 3 mapping
- Peer-to-Peer and End-to-End delay support
- Multicast operation
- Typical ordinary clock PPS accuracy (single subnet) <250ns

A complete end-to-end solution for IEEE 1588

The MultiSync 100 is part of a complete end-to-end 1588 time synchronization solution for power system substations and industrial applications. This solution includes:

- MultiSync 100 operating as a GrandMaster clock
- MultiLink ML3001/ML3100 Ethernet switches with 1588 modules
- The MultiLink switches can operate as a 1588 Transparent Clock or 1588 Boundary Clock

Retrofit application

A utility desires to add 1588/C37.238 time synchronization to an existing substation. Installed devices only support IRIG-B or other traditional time synchronization methods. The MultiSync 100 integrates into the existing infrastructure through the included TTL (IRIG-B) analog output ports, while simultaneously publishing 1588/C37.238 time synchronization signals over the Ethernet network. Adding 1588 simply requires installing the MultiSync 100, and an Ethernet switch that supports 1588 such as the MultiLink ML3000 Series.
Ease of configuration

The MultiSync 100 provides intuitive software to completely configure all aspects of the clock, as well as to display time synchronization data. Timing and synchronization options include:

- Worldwide daylight savings and local time configuration using rule based or fixed date methods
- Adjustable holdover times for reliability for poor GPS coverage
- Compensation for installation parameters such as GPS signal delay through antenna cable
- Programmable outputs include:
  - IRIG-B (B00x/B22x) time code with selectable IEEE 1344 and AFNOR S87-500 extensions
  - DCF77 time code
  - ~1000Hz (500-ns) pulse
  - User defined pulse sequences with repetition rates from 20ms to 24 hours, and 100ns accuracy

**Connection drawings**

![Connection drawings for MultiSync 100](image)

- Top of the clock
  - IRIG-B (TTL) Output
  - IRIG-B (TTL) Output
  - Alarm Contacts
  - GPS Antenna Input

- Bottom of the clock
  - Power Supply Inputs
  - Ground Input
  - USB Port
  - Ethernet Port for 1588, NTP, configuration
Technical specifications

**ELECTRICAL**

**POWER SUPPLY**
- Voltage: 36 to 300 VDC
- Power drain: 5 W max

**ISOLATION**
- Power to antenna: 3.75kV
- Power to I/O: 3.75kV

**INPUTS**
- RJ45 UTP connector: 10/100 Mbps
- USB2.0 Type B

**OUTPUTS**
- Sync indication output: 200 V, 150 mA (max)
- 2 x TTL outputs:
  - Time codes or pulses or user defined
  - Electrical specifications: TTL/CMOS compatible
  - 0-5 V, 150 mA sink/source
  - Timing accuracy ≤ 100 ns to UTC

**NETWORKING**

**GENERAL**
- DHCP: Auto-configuration with fallback to ARP tested link-local Address
- VLAN: Packet tagging
- PTP (IEEE 1588 v2):
  - General: One-step or two-step operation
  - End-to-end or peer-to-peer delay calculations
  - Layer 2 (Ethernet) or Layer 3 (UDP) transport
- Time Synchronization:
  - Power Profile support: C37.238
  - TLV support: C37.238
  - Alternate Time Offset TLV support: with automatic or manual offset

**OUTPUT OPTIONS**

**TTL**
- Programmable pulses: From 1000 per second to 1 per day with programmable offset & duration
  - DC level shift
  - Local or universal time
- DCF-77:
  - DC level shift or Modified Manchester
  - IEEE 1344 extensions (C37.118)
- IRIG-B:
  - DC level shift or Modified Manchester
  - IEEE 1344 extensions (C37.118)
- AFNOR NF S87-500 extensions
  - Local or universal time

**SNMP**

**GENERAL**
- V1, V2C, and V3 support, independently enabled
- Configurable V1 and V2C community names and security groups
- Fully configurable via SNMP
- V3 User-based Security Module (USM) support
- USM-MIB support
- MDS, SHA

**USM authentication methods**

**USM privacy methods**

**NOTIFICATIONS**

**GENERAL**
- SNMP trap generation V1, V2C, and V3
- SNMPv3 traps authenticated and privatized via USM
- Syslog (RFC-3164 and 5424 verified)

**COMPLIANCE**

<table>
<thead>
<tr>
<th>COMPLIANCE</th>
<th>APPLICABLE COUNCIL DIRECTIVE</th>
<th>ACCORDING TO</th>
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<tbody>
<tr>
<td>CE compliance</td>
<td>Low voltage directive</td>
<td>EN60950-1</td>
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<tr>
<td>EMC directive</td>
<td>EN61000-6-2, EN61000-6-4</td>
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<td>North America</td>
<td>UL60950-1, C22.2 No. 60950-1, CB Report</td>
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<td>ISO</td>
<td>Manufactured under a registered quality program</td>
<td>ISO 9001:2008</td>
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IEEE 1613 (37.90.X) EMI immunity type tests

<table>
<thead>
<tr>
<th>TEST</th>
<th>DESCRIPTION</th>
<th>LEVELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE 37.90.3</td>
<td>ESD Enclosure Contact</td>
<td>+/-2 kV, +/-4 kV, +/- 8 kV</td>
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<tr>
<td>IEEE 37.90.2</td>
<td>Radiated RFI Enclosure Ports</td>
<td>35 V/m</td>
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<tr>
<td>IEEE 37.90.1</td>
<td>Fast Transient Signal Ports</td>
<td>+/-4 kV @2.5kHz</td>
</tr>
<tr>
<td>IEEE 37.90.1</td>
<td>Oscillatory Signal Ports</td>
<td>2.5kV common mode @1MHz</td>
</tr>
<tr>
<td>IEEE 37.90</td>
<td>H.V. Impulse Signal Ports</td>
<td>5 kV (fail-safe relay output)</td>
</tr>
<tr>
<td>IEEE 37.90</td>
<td>Dielectric Strength Signal Ports</td>
<td>2 kVAC</td>
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<tr>
<td>IEEE 37.90</td>
<td>D.C. Power ports</td>
<td>2 kVAC</td>
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</tbody>
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**NTP**

**GENERAL**
- Stratum-1 NTP & SNTP time server
- Multicast & Broadcast server capability
- Optional MDS authentication

**Type tests**

<table>
<thead>
<tr>
<th>TEST</th>
<th>REFERENCE STANDARD</th>
<th>LEVELS</th>
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<tbody>
<tr>
<td>Electrostatic Discharge</td>
<td>EN61000-4-2</td>
<td>Level 4</td>
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<tr>
<td>RF immunity</td>
<td>EN61000-4-3</td>
<td>Level 3</td>
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<tr>
<td>Fast Transient Disturbance</td>
<td>EN61000-4-4</td>
<td>Level 3 &amp; 4</td>
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<tr>
<td>Surge immunity</td>
<td>EN61000-4-5</td>
<td>Level 4</td>
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<tr>
<td>Conducted RF Immunity</td>
<td>EN61000-4-6</td>
<td>Level 3</td>
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<tr>
<td>Power magnetic Immunity</td>
<td>IEC61000-4-8</td>
<td>Level 3</td>
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<tr>
<td>Voltage Dip &amp; interruption</td>
<td>IEC61000-4-29, IEC61000-4-11</td>
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<td>Ripple on DC power supply</td>
<td>IEC61000-4-17</td>
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<tr>
<td>Damped Oscillatory</td>
<td>IEC61000-4-12</td>
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<tr>
<td>Radiated &amp; Conducted Emissions</td>
<td>CISPR22</td>
<td>Class A</td>
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<tr>
<td>Sinusoidal Vibration</td>
<td>60255-21-1</td>
<td>Class 1</td>
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<tr>
<td>Shock &amp; Bump</td>
<td>60255-21-2</td>
<td>Class 1</td>
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<tr>
<td>Seismic</td>
<td>60255-21-3</td>
<td>Class 2</td>
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<td>RF Immunity</td>
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<td>20 V/m, 80-1 GHz</td>
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<td>Oscillatory Surge</td>
<td>IEC61850-3</td>
<td>Level 4 kV</td>
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<tr>
<td>Dielectric</td>
<td>IEEE 1613</td>
<td>2 kV, 500 V</td>
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<tr>
<td>Impulse</td>
<td>IEEE 1613</td>
<td>5 kV</td>
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Environmental type tests

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<tr>
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<th>DESCRIPTION</th>
<th>LEVELS</th>
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<tbody>
<tr>
<td>IEC 60068-2-1</td>
<td>Cold Temperature Test Ad</td>
<td>-40°C, 16 hours</td>
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<tr>
<td>IEC 60068-2-2</td>
<td>Dry Heat Test Bd</td>
<td>+85°C, 16 hours</td>
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<tr>
<td>IEC 60068-2-30</td>
<td>Humidity (Damp Heat, Cyclic) Test Db</td>
<td>95% Non-condensing, 55°C, 6 cycles</td>
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<tr>
<td>IEC 60255-21-1</td>
<td>Vibration</td>
<td>2 g at 10-150 Hz</td>
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<tr>
<td>IEC 60255-2</td>
<td>Shock</td>
<td>30 g @ 11 mS</td>
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Product ordering

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
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<tr>
<td>MultiSync 100-P</td>
<td>MultiSync 100 1588/C37.238 GPS Clock</td>
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