The Synchronization Experts.

Synchronization Solutions for the Power Industry

Meinberg provides IRIG-B format-compliant PTP & NTP time servers and modules that can be specifically tailored to the strict requirements of the power generation industry.

Microsecond-level time synchronization is essential for the power industry, as redundancy, security, and grid stability play an increasingly critical role with the growing adoption of renewable energies and distributed generation.

Frequency Stabilization

Meinberg time servers are used to assist with the automation of power substations to ensure that voltage, current, and frequency levels are maintained at a stable level. Given that the supply of power must be consistently balanced with network load to achieve this stability, rapid changes to the supply of energy have to be made in response to voltage & frequency changes, effectively in real time.

Such adjustments rely on data derived from comparisons between multiple synchrophasors—magnitude and phase angle measurements of a phasor value at different generation, distribution, and transmission locations. For this data to be comparable, the synchrophasors need to be synchronized against a common time reference with microsecond precision. To this end, Meinberg time servers directly support the IEEE C37.238-2017, IEEE C37.238-2011, and IEC 61850-9-3 profiles for time synchronization in power generation applications.

Grid Fault Diagnosis, State Estimation & Topology Identification

Accurate timestamping is an essential part of grid fault detection & diagnosis in SCADA systems. The vast majority of impedance faults can only be accurately diagnosed by comparing measurements from multiple locations to account for unusual but otherwise legitimate consumer behavior that might cause grid volatility, and so measurements are only actionable if it is possible to align measurements from multiple points at the exact same point in time. Because detection and responses generally need to be automated and executed within a matter of milliseconds, timely human intervention is impossible. This means that precise, automated timing is critical here. Two systems with clocks that are even just half a second out of sync cannot meaningfully coordinate with one another in a power grid that depends on split-second decisions.

For post-failure investigations, a timeline can only be assembled to trace faults back to their origin if the synchrophasors and IT system timestamps are comparable. Because the propagation of faults in a grid is a progressive process that occurs over a period measurable in mere milliseconds, the comparability of timestamps in data from multiple locations is a crucial factor in identifying which events occurred first, providing investigators with clues as to the source of the problem.

Power grids also rely on data collected from many different phasor measurement units (PMUs) to monitor asset health under normal operating conditions outside of specific fault scenarios. Timestamped synchrophasor data is essential for monitoring grid topology changes—inconsistencies in PMU data may be indicative of failing circuit breakers not properly executing the intended topological changes, for example.

Meinberg time servers provide a dependable common reference with maximum precision for timestamping events and logs from a wide-area network of generators, transmission infrastructure, and substations with pinpoint accuracy.

Parallel Redundancy Protocol

IEC 61850, which governs communication protocols for intelligent electronic devices (IEDs) used in electricity generation, in turn mandates compliance with IEC 62439-3, which establishes that power grid computer networks must implement a robust system of network infrastructure redundancy, known as the Parallel Redundancy Protocol (PRP). Annex C of IEC 62439-3 specifies the implementation of the PIP L2P2P Precision Time Protocol Industry Profile for clock synchronization in power generation environments.

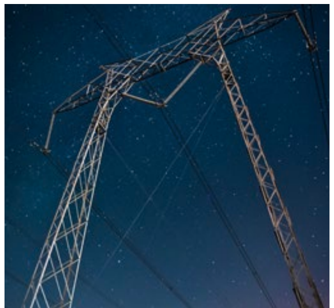
Meinberg IMS LANTIME servers equipped with at least two physical Ethernet interfaces (CPU-C15G2 board or LNE expansion module) provide configurable PRP support for the NTP service and management interfaces, while two HPS100 modules can be fitted to provide the two physical Ethernet interfaces needed to additionally provide PRP support for the PTP service.

Cyber-Security & GPS/GNSS Spoofing

Power stations are considered to be critical infrastructure and are therefore attractive targets for malicious state-level, terrorist, and criminal operators. If improperly managed, time synchronization has the potential to be a weak link in the power generation chain for cyberattackers. GPS/GNSS spoofing & jamming and illicit access to insecure computer networks are two vectors that can potentially be exploited by bad-faith operators seeking to disrupt power infrastructure. Either method is easily capable of disrupting a power plant's time synchronization technology, especially if the time servers are insecure or lack reference redundancy. Disruptions to reference clocks can cripple a power generator's ability to properly detect or perform post-fault investigations of node or transmission line failures.

Meinberg servers offer dependable clock redundancy solutions with time servers capable of supporting a multitude of independent reference clocks (GPS/GNSS, IRIG time codes, DCF77), as well as powerful in-house holdover performance solutions (high-grade internal crystal oscillators, integration with rubidium atomic clocks). This makes the clocks less dependent on a single vulnerable GPS/GNSS lock, thus dramatically reducing the chances of success of attempts to spoof or jam a GPS/GNSS signal. Meinberg's "Trusted Source" feature also inspects the integrity and plausibility of GPS/GNSS signals and forces the time server to automatically fall back to a secondary master clock such as an XHE Rubidium atomic clock if signs of satellite signal manipulation are present.

Security is also a topic of paramount importance for Meinberg's developers—the hardware and underlying firmware are developed in accordance with established, proven security standards, the firmware is regularly maintained and updated, and security advisories are promptly published where necessary to keep plant network administrators informed.



IMS-FDM 180 – IMS Module for Monitoring Mains Grid Frequencies

The FDM180 module for Meinberg's LANTIME IMS platform is specifically designed to meet the needs of the power industry.

Using a serial time string and a pulse-per-second signal to synchronize the internal clock with the upstream reference, the FDM180 module monitors grid frequencies using two concurrently operating clocks. The "reference time" is synchronized using the upstream time string and pulse-per-second signal as the absolute and phase references respectively, while the "power line time" uses the mains frequency—which can be set to 50 or 60 Hz depending on the national mains standard—as its separate phase reference, with a supply voltage of up to 270 V AC.

The extent to which the power line time then "drifts" from the reference clock over time provides an initial, at-a-glance indication of longer-term power grid frequency volatility that power plant technicians can use in control rooms—for example on a wall-mounted display—to identify a possible need for further investigation.

The module can also be configured to provide alerts in the form of SMNP traps or email alerts sent via SMTP whenever this time drift exceeds a certain threshold. Graphs that are continuously updated and provided in PNG format also provide a clear overview of changes in mains frequency and clock drift over time. The absolute frequency values, frequency deviation, reference time, power line time, and time drift can all also be output as serial strings in configurable formats over two independent RS-232 interfaces available via the 16-pin DMC terminal.

The FDM180 has a dedicated crystal oscillator for excellent holdover performance in the event that the upstream clock reference is temporarily lost for any reason (for example, due to a lost GPS signal).

LEARN MORE ABOUT THE IMS-FDM180 >

Input Signals

- Serial time string via IMS unit as absolute clock reference
- PPS/10 MHz via IMS unit as phase reference
- Mains frequency: 50 or 60 Hz, 70–270 V

Output Interfaces

- Two independent RS-232 interfaces via 16-pin DMC terminal
- Two analog outputs via 16-bit DMC terminal for long-term recording of time/frequency deviation (–2.5 to +2.5 V)

Output String Formats

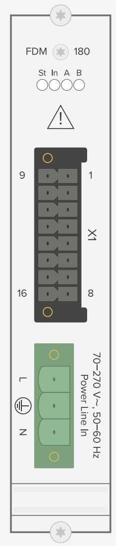
- Standard FDM String
- Short FDM String
- AREVA FDM String

Measurement Accuracy

- Frequency: 10 MHz ±100 µHz (oscillator accuracy)
- Clock deviation: PPS ±1ms (reference accuracy)

Electrical Specifications

- Current draw: 0.4–1 A
- Operating voltage: +5 V DC (from IMS unit)



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