

## 8100 Product Series

Fully Modular

Time Reference Systems

### Key Features

- 1U fully modular subrack for 19-inch rack mounting
- LCD information display and LEDs for system status
- Redundant power supply option with load-balancing for increased life time
- Redundant time domain support for system partitioning or high-availability time source configurations
- All components are hot-plug capable field-replaceable units (FRU)
- Extended temperature range for reliable operation between  $-40^{\circ}$  and  $+70^{\circ}\text{C}$
- GPS, Galileo, GLONASS, BeiDou, NavIC time sources for reliable satellite synchronization
- Average accuracy of  $\pm 30$  ns to UTC, peak accuracy of  $\pm 100$  ns to UTC for demodulated IRIG-B and pulse outputs and  $\pm 1$   $\mu\text{s}$  for modulated IRIG-B output
- Synchronization of IEC 61850 compatible devices with support for highest performance class T5
- Typical NTP time stamp accuracy  $< 30$   $\mu\text{s}$
- Precision Time Protocol (PTP) option with peak time stamp accuracy  $\pm 100$  ns, support for IEC 61850-9-3:2016 Power Utility Automation Profile, IEEE C37.238-2017 Power Profile
- IEC 62439-3:2016 Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR) option, feature combinable with PTP

The 8100 product series are fully modular time reference systems that support the Global Navigation Satellite Systems (GNSS) GPS, Galileo, GLONASS, BeiDou and IRNSS/NavIC, as well as NTP, PTP and various other time sources for precise and reliable time synchronization at extremely competitive prices and are particularly well suited for critical infrastructure applications.



The 8100 product series time reference systems have been designed for mission critical applications with high requirements in terms of flexibility, availability, security and the support of a wide variety of time synchronization standards commonly used in public infrastructure, railway technology, air traffic control, power utility, digital smart grid, industry automation and data center facilities.

The modular system design facilitates easy spare part management and minimum mean time to repair (MTTR) due to all components support hot-plug capability. The modularity of the system also ensures security of investment if the requirements for the system should increase or change in the future.

The system supports both single and dual / redundant power supplies (PSU) to ensure higher availability. Power supplies are available for DC input voltages 24VDC (18 – 36VDC), 48VDC (36 – 76VDC), 110VDC (60 – 160VDC), wide range DC input voltages 19 – 75VDC and wide range AC/DC input voltages 85 – 264VAC (50Hz / 60Hz) / 125 – 250VDC. The DC voltage power supplies feature redundant power inputs for connection of two power sources to a single power supply. In the version with redundant power supplies, the available power supplies can be combined as required.

Up to six extension slots are available for time domain controller boards (time signal input from time source), service provider boards (time signal output / distribution to customer application) and management controller boards.

A variety of time service provider boards is available for, among others:

- Network time synchronization using Network Time Protocol (NTP / SNTP), SIMATIC NET SINEC H1 Time Datagram or IEEE 1588™-2019 Precision Time Protocol (PTP) with support for IEC 61850-9-3:2016 profile for power utility automation and IEEE Std C37.238™-2017 power profile
- IRIG-B and DCF77 signal output (demodulated / modulated)
- Programmable cyclic pulse (PPS, PPM, PPH)
- Serial time datagram (e. g. **hopf** Standard, IEC-103, ABB Melody / Freelance, Trimble TSIP, SAT1703 / SICAM RTU)
- Signal distribution via electrical or fiber-optic signal output

## Resilient Timing

- Built-in by default GNSS firewall with multi-layered anti-jamming and anti-spoofing technologies and interference mitigation
- Redundant time domains, multi redundant time sources and time source prioritization safeguard precise and resilient timing signal synchronization even at most demanding availability requirements

## System Configuration and Monitoring

- huma® web edition, HTTPS web interface
- Integrated event log
- Diagnostics and monitoring via SNMP v2c and v3 read operations (MIB II, **hopf** private enterprise MIB, NTPv4 MIB, PTPBASE MIB, IEEE37.238 MIB, IEC-62439-3 MIB)
- Event notification using SNMP traps, email messaging and / or external SYSLOG server

## Enhanced IT/OT Security

- Separation of diagnostic and operational / productivity networks for guaranteed cyber security
- Role based access control (RBAC) with support of LDAP and RADIUS authentication according to IEC 62351-8:2020
- Built-in by default network firewall for provision of barrier against network-based intrusion attempts
- Certificate signed configuration files and firmware packages

The 8100 product series time domain controllers facilitate evaluation of time signals from multiple time sources like GNSS satellite systems, NTP/PTP network time signals as well as various other time sources. On receiver and firmware level the time domain controllers implement consistency checks and statistical tests on features such as automatic gain control (AGC), clock error, signal quality, signal power, propagation delay and the angle of arrival in order to safeguard error-free and leap-free time signal evaluation. In case of signal loss due to antenna failure or identification of time signal mismatch due to jamming or spoofing attacks the time domain controller clock automatically switches to available redundant time sources or the integrated oscillator circuit holdover ensuring the oscillator dependent freewheeling accuracy. For unprecedented availability redundant time domain controller and multi redundant time source configurations with prioritizable fall back time sources are supported as well as the **hopf** Secure Timing Platform (hSTP).

Time domain controller boards with integrated management controller as well as standalone independent management controller boards allow easy configuration and monitoring using the **hopf** unified management application **huma® web edition** which features secure access to the system via an intuitive to use state-of-the-art web interface. All field replaceable units integrated into the enclosure can be centrally configured. System configurations may be saved for the whole enclosure or for each individual board separately.

The management controller continuously monitors the health status of all integrated boards and components. It collects diagnostic and statistical data for the integrated event log and for real time notification of critical events to external IT management systems using email messaging, SNMP traps or external SYSLOG server.

The current demand for the convergence of Information Technologies (IT) and Operational Technologies (OT) in critical infrastructure requires to ensure cyber security and reliability in compliance with regulatory requirements. The modular system design of the 8100 product series allows complete separation of networks (e.g. process bus for power utility applications) for guaranteed cyber security while allowing complete access to diagnostic data and critical events for IT network management via integrated or standalone management controller. Role based access control according to the most up-to-date standards safeguards secure access to the management controller by authorized staff. The built-in by default network firewall feature adds even increased security against network-based intrusion attempts by limiting access to the minimum necessary network connections and services. All configuration files and firmware update packages may be signed by certificate to ensure authenticity and eligibility for application. The system fulfills security level 2 according to IEC 62443-4-2:2019.

## Base System

### Enclosures

FG8101G01 FG8101G01-B000	8100 product series time reference system <ul style="list-style-type: none"> <li>■ 19-inch 1U modular subrack according to IEC 60297-3-100:2008</li> <li>■ 2 extension slots for redundant power supply units</li> <li>■ 6 extension slots for time domain controller, service provider and management controller boards</li> </ul>
FG8101G02 FG8101G02-B000	8100 product series time reference system <ul style="list-style-type: none"> <li>■ 19-inch 1U modular subrack according to IEC 60297-3-100:2008</li> <li>■ 2 extension slots for redundant power supply units</li> <li>■ 6 extension slots for time domain controller, service provider and management controller boards</li> <li>■ Preparation of slot 2 and slot 6 for usage with time domain controller boards FG8701Gxx</li> </ul>

## Base System Options

### Power Supplies

FG8901P01 FG8901P01-B000	Power Supply Unit for 8x00 product series, hot-plug capable <ul style="list-style-type: none"> <li>■ Wide range 85 – 264VAC (50Hz / 60Hz) / 125 – 250VDC</li> <li>■ Single power input for connection to a single power source</li> </ul>
FG8901P02 FG8901P02-B000	Power Supply Unit for 8x00 product series, hot-plug capable <ul style="list-style-type: none"> <li>■ Nominal 24VDC (18 – 36VDC)</li> <li>■ Dual power inputs for connection of redundant power sources</li> </ul>
FG8901P03 FG8901P03-B000	Power Supply Unit for 8x00 product series, hot-plug capable <ul style="list-style-type: none"> <li>■ Nominal 48VDC (36 – 76VDC)</li> <li>■ Dual power inputs for connection of redundant power sources</li> </ul>
FG8901P04 FG8901P04-B000	Power Supply Unit for 8x00 product series, hot-plug capable <ul style="list-style-type: none"> <li>■ Nominal 110VDC (60 – 160VDC)</li> <li>■ Dual power inputs for connection of redundant power sources</li> </ul>
FG8901P06 FG8901P06-B000	Power Supply Unit for 8x00 product series, hot-plug capable <ul style="list-style-type: none"> <li>■ Wide range 19 – 75VDC</li> <li>■ Dual power inputs for connection of redundant power sources</li> </ul>

### Time Domain Controller Boards

FG8701G01 FG8701G01-B000	Time Domain Controller Board for product series 8x00, hot-plug capable <ul style="list-style-type: none"> <li>■ High precision dual-band L1/L5/E5a GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC with connection via SMA connector (female)</li> <li>■ Rubidium oscillator for maximum precision freewheeling stability (432 ns per day after 3 months of continuous operation (<math>\pm 1^\circ\text{C}</math>))</li> <li>■ Dry contact for alarm / status output</li> <li>■ Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:           <ul style="list-style-type: none"> <li>- Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)</li> <li>- HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma® software (<b>hopf</b> unified management application)</li> </ul> </li> </ul>
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FG8701G02  
 FG8701G02-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- Maximum precision multi-band, multi-constellation GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC with all-in-view satellite tracking, advanced interference mitigation, monitoring and protection against ionospheric disturbances technology with connection via SMA connector (female)
- Rubidium oscillator for maximum precision freewheeling stability (432 ns per day after 3 months of continuous operation ( $\pm 1^\circ\text{C}$ ))
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma@ software (**hopf** unified management application)

FG8701G03  
 FG8701G03-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- **hopf** Secure Timing Platform (hSTP) for maximum precision and timing resilience with redundant GNSS receivers for multiple redundant time signal evaluation:
  - Maximum precision multi-band, multi-constellation GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC with all-in-view satellite tracking, advanced interference mitigation, monitoring and protection against ionospheric disturbances technology
  - High precision dual-band L1/L5/E5a GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC
  - Dual connection via redundant SMA connectors (female)
- Rubidium oscillator for maximum precision freewheeling stability (432 ns per day after 3 months of continuous operation ( $\pm 1^\circ\text{C}$ ))
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma@ software (**hopf** unified management application)

FG8702D01  
 FG8702D01-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- DCF77 receiver for receiving of the modulated DCF77 signal (77,5kHz) via BNC connector (female)
- TCXO oscillator (236,71  $\mu\text{s}$  per day at constant temperature after 2 days of continuous operation)
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma@ software (**hopf** unified management application)

FG8702G01  
 FG8702G01-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- Standard precision single-band L1 GNSS receiver for concurrent evaluation of GPS, GLONASS, BeiDou and Galileo with connection via SMA connector (female)
- TCXO oscillator (236,71  $\mu\text{s}$  per day at constant temperature after 2 days of continuous operation)
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma@ software (**hopf** unified management application)

FG8702G02  
 FG8702G02-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- Standard precision single-band L1 GNSS receiver for concurrent evaluation of GPS, GLONASS, BeiDou and Galileo with connection via SMA connector (female)
- OCXO oscillator for enhanced freewheeling stability (25,9  $\mu$ s per day after 7 days of continuous operation ( $\pm 1^\circ\text{C}$ ))
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma® software (**hopf** unified management application)

FG8702G03  
 FG8702G03-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- Standard precision single-band L1 GNSS receiver for concurrent evaluation of GPS, GLONASS, BeiDou and Galileo with connection via SMA connector (female)
- OCXO HPFS oscillator for high precision freewheeling stability (4,32  $\mu$ s per day after 7 days of continuous operation ( $\pm 1^\circ\text{C}$ ))
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma® software (**hopf** unified management application)

FG8702G04  
 FG8702G04-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- Redundant GNSS receivers:
  - Standard precision single-band L1 GNSS receiver for concurrent evaluation of GPS, GLONASS, BeiDou and Galileo
  - High precision dual-band L1/L5/E5a GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC
  - Dual connection via redundant SMA connectors (female)
- TCXO oscillator (236,71  $\mu$ s per day at constant temperature after 2 days of continuous operation)
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma® software (**hopf** unified management application)

FG8702G05  
 FG8702G05-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- Redundant GNSS receivers:
  - Standard precision single-band L1 GNSS receiver for concurrent evaluation of GPS, GLONASS, BeiDou and Galileo
  - High precision dual-band L1/L5/E5a GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC
  - Dual connection via redundant SMA connectors (female)
- OCXO oscillator for enhanced freewheeling stability (25,9  $\mu$ s per day after 7 days of continuous operation ( $\pm 1^\circ\text{C}$ ))
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma® software (**hopf** unified management application)



FG8702G06  
FG8702G06-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- Redundant GNSS receivers:
  - Standard precision single-band L1 GNSS receiver for concurrent evaluation of GPS, GLONASS, BeiDou and Galileo
  - High precision dual-band L1/L5/E5a GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC
  - Dual connection via redundant SMA connectors (female)
- OCXO HPFS oscillator for high precision freewheeling stability (4,32  $\mu$ s per day after 7 days of continuous operation ( $\pm 1^\circ\text{C}$ ))
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma@ software (**hopf** unified management application)

FG8702G11  
FG8702G11-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- High precision dual-band L1/L5/E5a GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC with connection via SMA connector (female)
- TCXO oscillator (236,71  $\mu$ s per day at constant temperature after 2 days of continuous operation)
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma@ software (**hopf** unified management application)

FG8702G12  
FG8702G12-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- High precision dual-band L1/L5/E5a GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC with connection via SMA connector (female)
- OCXO oscillator for enhanced freewheeling stability (25,9  $\mu$ s per day after 7 days of continuous operation ( $\pm 1^\circ\text{C}$ ))
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma@ software (**hopf** unified management application)

FG8702G13  
FG8702G13-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- High precision dual-band L1/L5/E5a GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC with connection via SMA connector (female)
- OCXO HPFS oscillator for high precision freewheeling stability (4,32  $\mu$ s per day after 7 days of continuous operation ( $\pm 1^\circ\text{C}$ ))
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma@ software (**hopf** unified management application)

FG8702G14  
 FG8702G14-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- Maximum precision multi-band, multi-constellation GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC with all-in-view satellite tracking, advanced interference mitigation, monitoring and protection against ionospheric disturbances technology with connection via SMA connector (female)
- OCXO HPFS oscillator for high precision freewheeling stability (4,32  $\mu$ s per day after 7 days of continuous operation ( $\pm 1^\circ\text{C}$ ))
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma® software (**hopf** unified management application)

FG8702G15  
 FG8702G15-B000

Time Domain Controller Board for product series 8x00, hot-plug capable

- **hopf** Secure Timing Platform (hSTP) for maximum precision and timing resilience with redundant GNSS receivers for multiple redundant time signal evaluation:
  - Maximum precision multi-band, multi-constellation GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC with all-in-view satellite tracking, advanced interference mitigation, monitoring and protection against ionospheric disturbances technology
  - High precision dual-band L1/L5/E5a GNSS receiver for GPS, GLONASS, BeiDou, Galileo and IRNSS/NavIC
  - Dual connection via redundant SMA connectors (female)
- OCXO HPFS oscillator for high precision freewheeling stability (4,32  $\mu$ s per day after 7 days of continuous operation ( $\pm 1^\circ\text{C}$ ))
- Dry contact for alarm / status output
- Time server and integrated management controller with 2x ethernet interface 10/100/1000Base-T (RJ45) according to IEEE 802.3 for:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma® software (**hopf** unified management application)

**Time Service Provider Boards**

FG8801N02  
 FG8801N02-B000

Time Service Provider Board for product series 8x00, hot-plug capable

- Time server with 2x ethernet interface 10/100/1000Base-T via 2x RJ45 connector (copper) according to IEEE 802.3 for output of:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)

FG8801F02  
 FG8801F02-B000

Time Service Provider Board for product series 8x00, hot-plug capable

- Time server with 2x ethernet interface via 2x SFP transceiver module with LC fiber optic connector according to IEEE 802.3 for output of:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)

FG8802S00  
FG8802S00-B000

Time Service Provider Board for product series 8x00, hot-plug capable

- 4 channel output via 4x SMA connector (female), each channel individually configurable
- Electrical signal output type:
  - DC level shift (DCLS) (pulse width coded without carrier), 5V active / 5V TTL signal level
  - DC level shift (DCLS) (pulse width coded without carrier), 12V active signal level
  - DC level shift (DCLS) (pulse width coded without carrier), 24V active signal level
  - Sine wave carrier (amplitude modulated), 1kHz carrier frequency (only applicable for IRIG-B time signal output)
  - Manchester modulated, 1kHz carrier frequency (only applicable for IRIG-B time signal output)
- Time signal output type:
  - IRIG-B with applicable standards: RCC IRIG STANDARD 200-04, RCC IRIG STANDARD 200-16, IEEE 1344-1995, IEEE C37.118-2005, IEEE C37.118.1-2011, IEEE C37.118.1a-2014, IEEE/IEC 60255-118-1-2018, AFNOR NF S 87-500 (2007)
  - DCF77 (DCLS)
  - Cyclic pulse (DCLS): PPS (pulse per second), PPM (pulse per minute), PPH (pulse per hour)

FG8802S01  
FG8802S01-B000

Time Service Provider Board for product series 8x00, hot-plug capable

- 4 channel output via 4x BNC connector (female), each channel individually configurable
- Electrical signal output type:
  - DC level shift (DCLS) (pulse width coded without carrier), 5V active / 5V TTL signal level
  - DC level shift (DCLS) (pulse width coded without carrier), 12V active signal level
  - DC level shift (DCLS) (pulse width coded without carrier), 24V active signal level
  - Sine wave carrier (amplitude modulated), 1kHz carrier frequency (only applicable for IRIG-B time signal output)
  - Manchester modulated, 1kHz carrier frequency (only applicable for IRIG-B time signal output)
- Time signal output type:
  - IRIG-B with applicable standards: RCC IRIG STANDARD 200-04, RCC IRIG STANDARD 200-16, IEEE 1344-1995, IEEE C37.118-2005, IEEE C37.118.1-2011, IEEE C37.118.1a-2014, IEEE/IEC 60255-118-1-2018, AFNOR NF S 87-500 (2007)
  - DCF77 (DCLS)
  - Cyclic pulse (DCLS): PPS (pulse per second), PPM (pulse per minute), PPH (pulse per hour)



FG8802S02  
FG8802S02-B000

- Time Service Provider Board for product series 8x00, hot-plug capable
- 4 channel output via 4x 2-pole pluggable screw terminal, each channel individually configurable
  - Electrical signal output type:
    - DC level shift (DCLS) (pulse width coded without carrier), 5V active / 5V TTL signal level
    - DC level shift (DCLS) (pulse width coded without carrier), 12V active signal level
    - DC level shift (DCLS) (pulse width coded without carrier), 24V active signal level
    - Sine wave carrier (amplitude modulated), 1kHz carrier frequency (only applicable for IRIG-B time signal output)
    - Manchester modulated, 1kHz carrier frequency (only applicable for IRIG-B time signal output)
  - Time signal output type:
    - IRIG-B with applicable standards: RCC IRIG STANDARD 200-04, RCC IRIG STANDARD 200-16, IEEE 1344-1995, IEEE C37.118-2005, IEEE C37.118.1-2011, IEEE C37.118.1a-2014, IEEE/IEC 60255-118-1-2018, AFNOR NF S 87-500 (2007)
    - DCF77 (DCLS)
    - Cyclic pulse (DCLS): PPS (pulse per second), PPM (pulse per minute), PPH (pulse per hour)

FG8802S03  
FG8802S03-B000

- Time Service Provider Board for product series 8x00, hot-plug capable
- 4 channel output via 4x TNC connector (female), each channel individually configurable
  - Electrical signal output type:
    - DC level shift (DCLS) (pulse width coded without carrier), 5V active / 5V TTL signal level
    - DC level shift (DCLS) (pulse width coded without carrier), 12V active signal level
    - DC level shift (DCLS) (pulse width coded without carrier), 24V active signal level
    - Sine wave carrier (amplitude modulated), 1kHz carrier frequency (only applicable for IRIG-B time signal output)
    - Manchester modulated, 1kHz carrier frequency (only applicable for IRIG-B time signal output)
  - Time signal output type:
    - IRIG-B with applicable standards: RCC IRIG STANDARD 200-04, RCC IRIG STANDARD 200-16, IEEE 1344-1995, IEEE C37.118-2005, IEEE C37.118.1-2011, IEEE C37.118.1a-2014, IEEE/IEC 60255-118-1-2018, AFNOR NF S 87-500 (2007)
    - DCF77 (DCLS)
    - Cyclic pulse (DCLS): PPS (pulse per second), PPM (pulse per minute), PPH (pulse per hour)

FG8802S20  
 FG8802S20-B000

Time Service Provider Board for product series 8x00, hot-plug capable

- 4 channel output via 4x fiber optic connector for multimode fiber optic cable, wave length 820nm, connector type ST, each channel individually configurable
- Time signal output type:
  - IRIG-B with applicable standards: RCC IRIG STANDARD 200-04, RCC IRIG STANDARD 200-16, IEEE 1344-1995, IEEE C37.118-2005, IEEE C37.118.1-2011, IEEE C37.118.1a-2014, IEEE/IEC 60255-118-1-2018, AFNOR NF S 87-500 (2007)
  - DCF77
  - Cyclic pulse: PPS (pulse per second), PPM (pulse per minute), PPH (pulse per hour)

FG8803S02  
 FG8803S02-B000

Time Service Provider Board for product series 8x00, hot-plug capable

- 2 channel output of serial time datagram via 2x 9-pole D-SUB connector (male), each channel individually configurable
- Electrical signal output type: each channel available at RS232 and RS485 signal level
- Time signal output type: **hopf** standard serial time datagram types, IEC-103, ABB Melody, ABB Freelance, Trimble TSIP, SAT1703 / SICAM RTU, SINEC H1 Extended

FG8803S20  
 FG8803S20-B000

Time Service Provider Board for product series 8x00, hot-plug capable

- 2 channel output of serial time datagram via 2x2 fiber optic connector for multimode fiber optic cable, wave length 820nm, connector type ST, each channel individually configurable
- Time signal output type: **hopf** standard serial time datagram types, IEC-103, ABB Melody, ABB Freelance, Trimble TSIP, SAT1703 / SICAM RTU, SINEC H1 Extended

**Management Controller Boards**

FG8800M00  
 FG8800M00-B000

Standalone independent Management Controller Board for product series 8x00, hot-plug capable

- Dry contact for alarm / status output
- Management controller with 2x ethernet interface 10/100/1000Base-T via 2x RJ45 connector (copper) according to IEEE 802.3 for output of:
  - HTTP/HTTPS, SNMP, SNMP Traps, SMTP, Syslog and huma® software (**hopf** unified management application)
- Time server for output of:
  - Network Time Protocol NTP/SNTP v4.2.x (RFC 5905)

**Firmware Activation Options**

LI8100A01  
 LI8100A01-B000

Activation key for activation of the following feature for product series 8x00:

- Support for Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR) according to IEC 62439-3:2016 for use as Dual Attached Node (DAN)
- Activation key for one (1) board

LI8100A02 LI8100A02-B000	<p>Activation key for activation of the following feature for product series 8x00:</p> <ul style="list-style-type: none"> <li>■ Support for Precision Time Protocol (PTP) according to IEEE Std 1588™-2019 with support for IEEE Standard Profile for use of IEEE 1588™ Precision Time Protocol in Power System Applications (Power Profile v1) according to IEEE Std C37.238™-2011, Profile for Power Utility Automation according to IEC 61850-9-3:2016, IEEE Standard Profile for use of IEEE 1588™ Precision Time Protocol in Power System Applications (Power Profile v2) according to IEEE Std C37.238™-2017 and Telecom Profile for phase/time synchronization according to ITU-T G.8275.1 (from hardware Rev B)</li> <li>■ Activation key for one (1) board</li> </ul>
LI8100A03 LI8100A03-B000	<p>Activation key for activation of the following feature for product series 8x00:</p> <ul style="list-style-type: none"> <li>■ Support for SIMATIC NET SINEC H1 Time Datagram Protocol</li> <li>■ Activation key for one (1) board</li> </ul>
LI8100A04 LI8100A04-B000	<p>Activation key for activation of the following feature for product series 8x00:</p> <ul style="list-style-type: none"> <li>■ Support for Precision Time Protocol (PTP) according to IEEE Std 1588™-2019 as time source for time domain controller boards</li> <li>■ Activation key for one (1) board</li> </ul>
LI8100A05 LI8100A05-B000	<p>Activation key for activation of the following feature for product series 8x00:</p> <ul style="list-style-type: none"> <li>■ Support for Network Time Protocol (NTP/SNTP) according to RFC 5905 as time source for time domain controller boards</li> <li>■ Activation key for one (1) board</li> </ul>

## Accessories

FG9000F00	<p><b>hopf</b> SFP transceiver module, 1000BASE-SX</p> <ul style="list-style-type: none"> <li>■ Multi-mode fiber (MMF), wavelength 850nm</li> <li>■ Max. cable distance: 550m@50/125µm OM2 MMF 275m@62.5/125µm OM1 MMF</li> <li>■ Max. data rate: 1.25Gbps</li> <li>■ Connector: LC Duplex</li> <li>■ Temperature range: -40°C to +85°C (-40°F to +185°F)</li> </ul>
FG9000F01	<p><b>hopf</b> SFP transceiver module, 1000BASE-LX/LH</p> <ul style="list-style-type: none"> <li>■ Single-mode fiber (SMF), wavelength 1310nm</li> <li>■ Max. cable distance: 10km@OS1 SMF 20km@OS2 SMF</li> <li>■ Max. data rate: 1.25Gbps</li> <li>■ Connector: LC Duplex</li> <li>■ Temperature range: -40°C to +85°C (-40°F to +185°F)</li> </ul>
FG9000F02	<p><b>hopf</b> SFP transceiver module, 100BASE-FX</p> <ul style="list-style-type: none"> <li>■ Multi-mode fiber (MMF), wavelength 1310nm</li> <li>■ Max. cable distance: 2km@50/125µm OM2 MMF 1km@62.5/125µm OM1 MMF</li> <li>■ Max. data rate: 100Mbps</li> <li>■ Connector: LC Duplex</li> <li>■ Temperature range: -40°C to +85°C (-40°F to +185°F)</li> </ul>

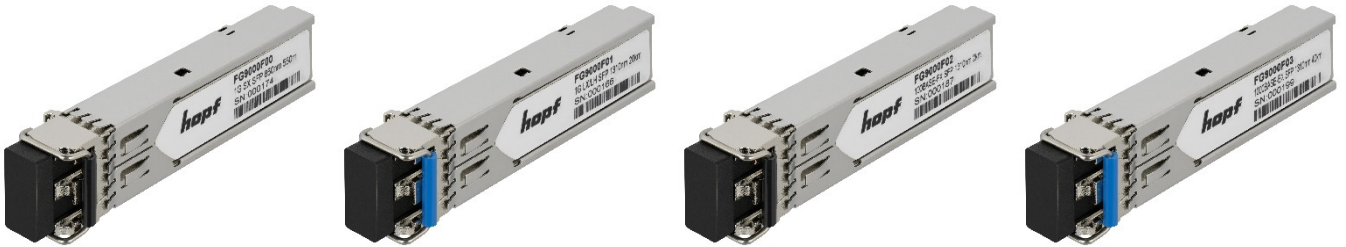
FG9000F03

**hopf** SFP transceiver module, 1000BASE-EX

- Single-mode fiber (SMF), wavelength 1310nm
- Max. cable distance: 40km@OS2 SMF
- Max. data rate: 1.25Gbps
- Connector: LC Duplex
- Temperature range: -40°C to +85°C (-40°F to +185°F)

FG8000H01

Blind panel for product series 8x00 for 4HP slots, spare part



Article numbers ending with '-B000' have to be used for purchase orders for systems where all components are intended to be assembled at the **hopf** factory.

Article numbers without the suffix '-B000' are considered spare parts where each component is delivered in individual packaging.



*Rear view of fully equipped base system FG8101G01 with redundant power supplies FG8901P01 and FG8901P02, time domain controller board FG8702G01 and service provider boards FG8801N02, FG8802S00, FG8802S01, FG8802S02 and FG8802S20*

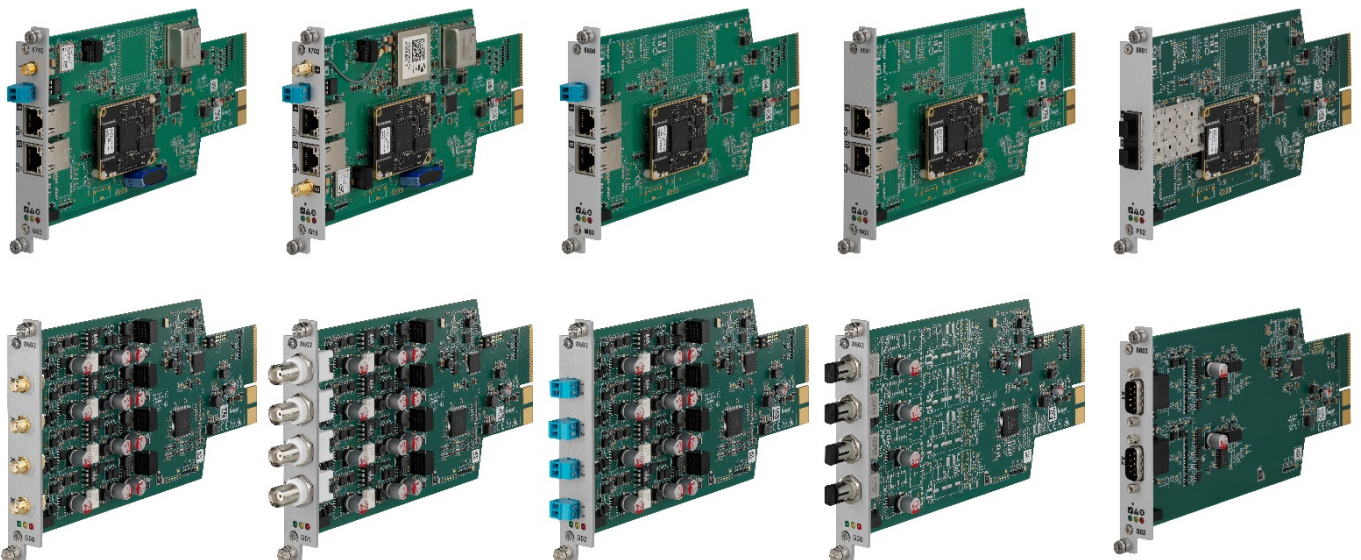




*Rear view of fully equipped base system FG8101G01 with redundant power supplies FG8901P01 and FG8901P02, redundant time domain controller boards FG8702G01 and FG8702G03 and service provider boards FG8801N02, FG8801F02, FG8802S01 and FG8802S20*



*Rear view of base system FG8101G01 with redundant power supplies FG8901P01, management controller board FG8800M00, time domain controller board FG8702G03 and service provider boards FG8801N02 and FG8801F02*





## Applied Standards

### Electromagnetic Compatibility

IEC 61000-3-2:2018 + A1:2020 + ISH1:2021	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current $\leq 16$ A per phase)
IEC 61000-3-3:2013 + A1:2017 + A2:2021 + A2:2021/COR1:2022	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current $\leq 16$ A per phase and not subject to conditional connection
IEC 61000-4-2:2008	Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test
IEC 61000-4-3:2020	Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test
IEC 61000-4-4:2012	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test
IEC 61000-4-5:2014 + A1:2017	Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test
IEC 61000-4-6:2013	Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields
IEC 61000-4-11:2020 + COR1:2020	Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests
IEC 61000-4-12:2017	Electromagnetic compatibility (EMC) – Part 4-12: Testing and measurement techniques – Ring wave immunity test
IEC 61000-4-17:1999 + A1:2001	Electromagnetic compatibility (EMC) - Part 4-17: Testing and measurement techniques - Ripple on d.c. input power port immunity test
IEC 61000-4-18:2019 + COR1:2019	Electromagnetic compatibility (EMC) - Part 4-18: Testing and measurement techniques - Damped oscillatory wave immunity test
IEC 61000-4-29:2000	Electromagnetic compatibility (EMC) - Part 4-29: Testing and measurement techniques; Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests
IEC 61000-6-2:2016	Electromagnetic compatibility (EMC). Part 6-2: Generic standards – Immunity for industrial environments
IEC 61000-6-3:2020	Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments

IEC 61000-6-4:2018	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
IEC 61000-6-5:2015/COR1:2017	Electromagnetic compatibility (EMC) - Part 6-5: Generic standards - Immunity for equipment used in power station and substation environment
EN 50121-4:2016	Railway applications - Electromagnetic compatibility - Part 4: Emission and immunity of the signalling and telecommunications apparatus
EN 55016-2-1:2014 /A1:2017 (CISPR 16-2-1:2014 +A1:2017)	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements
EN 55016-2-3:2017 /A1:2019 (CISPR 16-2-3:2016 +A1:2019)	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements
EN 55032:2015/AC:2016/A11:2020/A1:2020 (CISPR 32:2015 + COR1:2016 + A1:2019)	Electromagnetic compatibility of multimedia equipment – Emission Requirements (150kHz – 30 MHz)
EN 55035:2017 (CISPR 35:2016, modified)	Electromagnetic compatibility of multimedia equipment – Immunity requirements

**Safety**

IEC 62368-1:2018	Audio/video, information and communication technology equipment – Part 1: Safety requirements
IEC 60529:1989/A1:1999 /A2:2013	Degrees of protection provided by enclosures (IP Code)

**Security**

IEC 62443-4-2:2019	Security for industrial automation and control systems - Part 4-2: Technical security requirements for IACS components
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### Radio Equipment and GNSS receivers

EN 301 489-1 V2.2.3 (2019-11)	Electromagnetic Compatibility (EMC) standard for radio equipment and services – Part 1: Common technical requirements – Harmonized Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU
EN 301 489-19 V2.1.1 (2019-04)	Electromagnetic Compatibility (EMC) standard for radio equipment and services – Part 19: Specific conditions for Receive Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications and GNSS receivers operating in the RNSS band (ROGNSS) providing positioning, navigation and timing data – Harmonized Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU
EN 303 413 V1.2.1 (2021-04)	Satellite Earth Stations and Systems (SES) – Global Navigation Satellite System (GNSS) receivers – Radio equipment operating in the 1164 MHz to 1300 MHz and 1559 MHz to 1610 MHz frequency bands – Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

### Environmental

IEC 60068-2-1:2007	Environmental testing – Part 2-1: Tests – Test A: Cold
IEC 60068-2-2:2007	Environmental testing – Part 2-2: Tests – Test B: Dry heat
IEC 60068-2-30:2005	Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)
IEC 60255-21-1:1988	Electrical relays - Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment; section 1: Vibration tests (sinusoidal)
IEC 60255-21-2:1988	Electrical relays - Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment; section 2: Shock and bump tests
IEC 60255-21-3:1993	Electrical relays - Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment; section 3: Seismic tests
IEC 60721-2-3:2013	Classification of environmental conditions - Part 2-3: Environmental conditions appearing in nature - Air pressure
IEC 61850-3:2013	Communication networks and systems for power utility automation - Part 3: General requirements
IEC 63000:2016	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

IEEE 1613-2009

Environmental and testing requirements for communications networking devices installed in electric power substations

## Mechanical

IEC 60297-3-100:2008

Mechanical structures for electronic equipment - Dimensions of mechanical structures of the 482,6 mm (19 in) series - Part 3-100: Basic dimensions of front panels, subracks, chassis, racks and cabinets

## Power Industries Specific

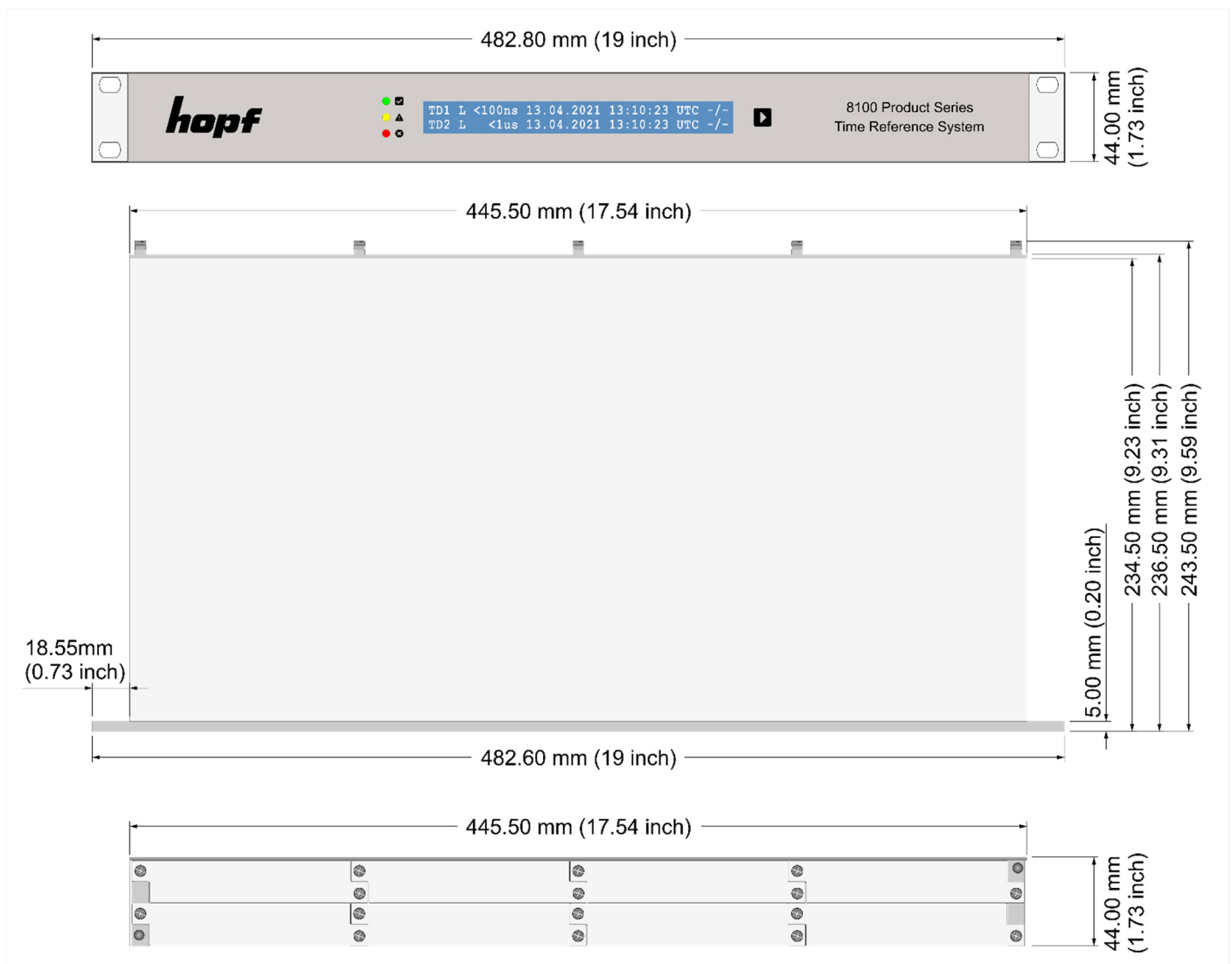
IEC 61850-5:2013

Communication networks and systems for power utility automation - Part 5: Communication requirements for functions and device models

## Technical Specifications

### Mechanical Data

Housing	19-inch 1U subrack according to IEC 60297-3-100
Dimensions	Width: 482.6 mm (19.00 inch) / 445.5 mm (17.54 inch) Height: 44.00 mm (1.73 inch) Depth: 236.5 mm (9.31 inch) / 243.5 mm (9.59 inch)
Material	metal, powder coated
Color (RAL)	light gray (7035)
Protection Class	IP30 according to IEC 60529
Weight	3.5 kg (7.7 lbs) without power supply units and extension boards





## Environmental Conditions

Operating Temperature	-40 °C to +70 °C (-40 °F to +158 °F) according to IEC 61850-3 and IEEE 1613
Storage Temperature	-40 °C to +70 °C (-40 °F to +158 °F) according to IEC 61850-3 and IEEE 1613
Operating Altitude	up to 5,000 m (16,404 ft) above sea level according to IEC 61850-3
Relative Humidity	5 to 95 % (non-condensing) at 40 °C (104 °F) according to IEC 61850-3
Operating Environment	Pollution Degree: 2 Overvoltage Category: II
Reliability (MTBF)	1.850.000h (without display and fan)

## Environmental and Electromagnetic Compatibility Tests

Temperature	IEC 60068-2-1	Severity Level 16h at -40°C
	IEC 60068-2-2	Severity Level 16h at +85°C storage Severity Level 16h at +65°C operating
	IEC 60068-2-14	Severity Level -20° to +55°C, 5 cycles
	IEC 60068-2-30	Severity Level +25° to +55°C, 6 cycles, RH 95%
	IEC 60068-2-78	Severity Level 240h at +40°C, RH 95%
Mechanical Stress	IEC 60255-21-1	Severity Level Class 2
	IEC 60255-21-2	Severity Level Class 2
	IEC 60255-21-3	Severity Level Class 2
Electromagnetic Compatibility	EN 55032 (CISPR 32)	Class B
	IEC 61000-4-2	Severity Level 4 8kV contact / 15kV air
	IEC 61000-4-3	Severity Level 3 10V/m
	IEC 61000-4-4	Severity Level 4 4kV power connector 4kV signal connector
	IEC 61000-4-5	Severity Level 4 2kV line-to-line 4kV line-to-earth
	IEC 61000-4-6	Severity Level 3 10V
	IEC 61000-4-11	Severity Level X 30% one period 60% 50 periods 100% 5 periods 100% 50 periods
	IEC 61000-4-12	Severity Level 3 1kV line-to-line 2,5kV line-to-earth
	IEC 61000-4-17	Severity Level 3 10%
	IEC 61000-4-18	Severity Level 3 1kV line-to-line 2,5kV line-to-earth
	IEC 61000-4-29	Severity Level X 30% 0,1sec 60% 0,1sec 100% 0,05sec

**Extension Card Dependent Specifications**

FG8901P01	Input Voltage: 85-264VAC 125-250VDC Input Frequency: 47-63Hz for AC input voltage Input Current: max. 1,3A@100VAC max. 0,7A@200VAC Reliability (MTBF): 250.000h
FG8901P02	Input Voltage: 18-36VDC Input Current: max. 5,47A@24VDC Reliability (MTBF): 300.000h
FG8901P03	Input Voltage: 36-76VDC Input Current: max. 2,69A@48VDC Reliability (MTBF): 300.000h
FG8901P04	Input Voltage: 60-160VDC Input Current: max. 1,1A@110VDC Reliability (MTBF): 300.000h
FG8901P06	Input Voltage: 19-75VDC Input Current: max. 5,7A@24VDC Reliability (MTBF): 300.000h
FG8702G01	<p><b>Ethernet</b></p> Ports 2 Data Rate 10/100/1000Mbps Connector RJ45
	<p><b>Status Output</b></p> Dry Contact Operating Voltage +/-250VDC Operating Current max. 120mA
	<p><b>Boot time</b></p> typ. ≤40 seconds depending on the configuration
	<p><b>Antenna</b></p> Supply Voltage 5V±10% Current max. 100mA
	<p><b>Receiver</b></p> Receiver type Standard precision, single-band L1 GNSS systems GPS, GLONASS, Beidou, Galileo Channels 92 Time to first fix Warm start: <2s Cold start: <29s Sensitivity Tracking: -166dBm Warm start: -159dBm Cold start: -148dBm Accuracy RMS 30ns
	<p><b>Clock Accuracy</b></p> Internal PPS ±15ns (after 5 minutes GNSS reception with clear sky view, fixed position mode) Holdover 236,71µs per day at constant temperature after 2 days of continuous operation
	<p><b>NTP</b></p> Timestamp Accuracy typ. <30µs Requests per second 25.000

	<p><b>PTP</b>          Timestamp Accuracy typ. &lt;50ns to system internal PPS</p> <p><b>Reliability</b>          MTBF 1.100.000h</p>
FG8702G02	<p>Identical to FG8702G01 except holdover</p> <p><b>Clock Accuracy</b>          Holdover 25,9µs per day after 7 days of continuous operation (±1°C)</p>
FG8702G03	<p>Identical to FG8702G01 except holdover</p> <p><b>Clock Accuracy</b>          Holdover 4,32µs per day after 7 days of continuous operation (±1°C)</p>
FG8702G04	<p>Identical to FG8702G01 but with additional redundant receiver:</p> <p><b>2<sup>nd</sup> Receiver</b>          Receiver type High precision, dual-band L1/L5/E5a          GNSS systems GPS, GLONASS, Beidou, Galileo, IRNSS/NavIC</p> <p>Time to first fix Warm start: &lt;2s          Cold start: &lt;29s</p> <p>Sensitivity Tracking: -167dBm          Warm start: -159dBm          Cold start: -148dBm</p> <p>Accuracy 1-sigma 10ns          1-sigma jitter removed 5ns</p>
FG8702G05	<p>Identical to FG8702G02 but with additional redundant receiver:</p> <p><b>2<sup>nd</sup> Receiver</b>          Receiver type High precision, dual-band L1/L5/E5a          GNSS systems GPS, GLONASS, Beidou, Galileo, IRNSS/NavIC</p> <p>Time to first fix Warm start: &lt;2s          Cold start: &lt;29s</p> <p>Sensitivity Tracking: -167dBm          Warm start: -159dBm          Cold start: -148dBm</p> <p>Accuracy 1-sigma 10ns          1-sigma jitter removed 5ns</p>
FG8702G06	<p>Identical to FG8702G03 but with additional redundant receiver:</p> <p><b>2<sup>nd</sup> Receiver</b>          Receiver type High precision, dual-band L1/L5/E5a          GNSS systems GPS, GLONASS, Beidou, Galileo, IRNSS/NavIC</p> <p>Time to first fix Warm start: &lt;2s          Cold start: &lt;29s</p> <p>Sensitivity Tracking: -167dBm          Warm start: -159dBm          Cold start: -148dBm</p> <p>Accuracy 1-sigma 10ns          1-sigma jitter removed 5ns</p>

FG8702G11

<b>Ethernet</b>	
Ports	2
Data Rate	10/100/1000Mbps
Connector	RJ45
<b>Status Output</b>	
Dry Contact	
Operating Voltage	+/-250VDC
Operating Current	max. 120mA
<b>Boot time</b>	
typ. ≤ 40 seconds depending on the configuration	
<b>Antenna</b>	
Supply Voltage	5V±10%
Current	max. 100mA
<b>Receiver</b>	
Receiver type	High precision, dual-band L1/L5/E5a
GNSS systems	GPS, GLONASS, Beidou, Galileo, IRNSS/NavIC
Time to first fix	Warm start: <2s Cold start: <29s
Sensitivity	Tracking: -167dBm Warm start: -159dBm Cold start: -148dBm
Accuracy	1-sigma 10ns 1-sigma jitter removed 5ns
<b>Clock Accuracy</b>	
Internal PPS	±10ns (after 5 minutes GNSS reception with clear sky view, fixed position mode)
Holdover	236,71µs per day at constant temperature after 2 days of continuous operation
<b>NTP</b>	
Timestamp Accuracy	typ. <30µs
Requests per second	25.000
<b>PTP</b>	
Timestamp Accuracy	typ. <50ns to system internal PPS
<b>Reliability</b>	
MTBF	1.100.000h
FG8702G12	Identical to FG8702G11 except holdover
<b>Clock Accuracy</b>	
Holdover	25,9µs per day after 7 days of continuous operation (±1°C)
FG8702G13	Identical to FG8702G11 except holdover
<b>Clock Accuracy</b>	
Holdover	4,32µs per day after 7 days of continuous operation (±1°C)

FG8801N02

<b>Ethernet</b>	
Ports	2
Data Rate	10/100/1000Mbps
Connector	RJ45
<b>Boot time</b>	
typ. ≤ 40 seconds depending on the configuration	
<b>Time Accuracy</b>	
Internal time accuracy ±15ns to system internal PPS	
<b>NTP</b>	
Timestamp Accuracy	typ. <30µs
Requests per second	25.000
<b>PTP</b>	
Timestamp Accuracy	typ. <50ns to system internal PPS
<b>Reliability</b>	
MTBF	1.250.000h

FG8801F02

<b>Ethernet</b>	
Ports	2
Data Rate	dependent on SFP transceiver module
Connector	LC
<b>Boot time</b>	
typ. ≤ 40 seconds depending on the configuration	
<b>Time Accuracy</b>	
Internal time accuracy ±15ns to system internal PPS	
<b>NTP</b>	
Timestamp Accuracy	typ. <30µs
Requests per second	25.000
<b>PTP</b>	
Timestamp Accuracy	typ. <50ns to system internal PPS
<b>Reliability</b>	
MTBF	1.250.000h



FG8800M00

<b>Ethernet</b>	
Ports	2
Data Rate	10/100/1000Mbps
Connector	RJ45
<b>Status Output</b>	
Dry Contact	
Operating Voltage	+/-250VDC
Operating Current	max. 120mA
<b>Boot time</b>	
typ. ≤ 40 seconds depending on the configuration	
<b>Time Accuracy</b>	
Internal time accuracy ±15ns to system internal PPS	
<b>NTP</b>	
Timestamp Accuracy	typ. <30µs
Requests per second	25.000
<b>Reliability</b>	
MTBF	1.250.000h



## Network Standards and Protocols

### General standards and protocols

- IEEE 802.1Q VLANs
- IEEE 802.3 Type 10BASE-T
- IEEE 802.3ab 1000BASE-T
- IEEE 802.3ad Link Aggregation Control Protocol (LACP)
- IEC 62439-3:2016 Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR)
- RFC 768 User Datagram Protocol (UDP)
- RFC 791 Internet Protocol, Version 4 (IPv4)
- RFC 792 Internet Control Message Protocol (ICMPv4)
- RFC 793 Transmission Control Protocol (TCP)
- RFC 826 Address Resolution Protocol (ARP)
- RFC 1035 Domain Names (client)
- RFC 1918 Address Allocation for Private Internet
- RFC 4443 Internet Control Message Protocol (ICMPv6)
- RFC 2131 Dynamic Host Configuration Protocol (DHCPv4)
- RFC 3484 Default Address Selection for Internet Protocol version 6 (IPv6)
- RFC 3596 DNS Extensions to Support IP Version 6
- RFC 8200 Internet Protocol, Version 6 (IPv6)
- RFC 8415 Dynamic Host Configuration Protocol for IPv6 (DHCPv6)

### Device and Network Management

- RFC 1098 A Simple Network Management Protocol (SNMP)
- RFC 1155 Structure and Identification of Management Information for TCP/IP-based Internets
- RFC 1213 Management Information Base for Network Management of TCP/IP-based internets: MIB-II
- RFC 2578 Structure of Management Information Version 2 (SMIv2)
- RFC 2579 Textual Conventions for SMIv2
- RFC 3411 An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks
- RFC 3412 Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)
- RFC 3413 Simple Network Management Protocol (SNMP) Applications
- RFC 3414 User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)
- RFC 3418 Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)
- RFC 3584 Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework

- RFC 4250/4251/5252/4253/4254 The Secure Shell (SSH) Protocol
- RFC 5321 Simple Mail Transfer Protocol
- RFC 5424 The Syslog Protocol
- RFC 7540 Hypertext Transfer Protocol Version 2 (HTTP/2)
- **hopf** Private Enterprise MIB

### Security / Authentication

- IEC 62351-8:2020 Power systems management and associated information exchange - Data and communications security - Role-based access control
- IEC 62443-4-2:2019 Security for industrial automation and control systems - Technical security requirements for IACS components
- IEEE 1686-2013 Standard for Intelligent Electronic Devices Cyber Security Capabilities
- IEEE 802.1AE Media Access Control (MAC) Security (MACsec)
- RFC 4510/4511/4512/4513/4514/4515/4516/4517/4518/4519/4520 Lightweight Directory Access Protocol (LDAP)
- RFC 2865 Remote Authentication Dial In User Service (RADIUS)
- RFC 2866 RADIUS Accounting
- RFC 7384 Security Requirements of Time Protocols in Packet Switched Networks
- RFC 8915 Network Time Security for the Network Time Protocol

### Time Synchronization

- RFC 5905 Network Time Protocol Version 4: Protocol and Algorithms Specification
- RFC 5906 Network Time Protocol Version 4: Autokey Specification
- RFC 5907 Definitions of Managed Objects for Network Time Protocol Version 4 (NTPv4)
- IEEE 1588-2019 Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems (PTP v2.1)
- IEEE C37.238-2017 Standard Profile for Use of IEEE 1588 Precision Time Protocol in Power System Applications
- IEC 61850-9-3:2016 Communication networks and systems for power utility automation - Precision time protocol profile for power utility automation
- IEEE 60255-118-1:2018-12 Measuring relays and protection equipment - Synchrophasor for power systems – Measurements
- ITU-T G.8275.1 / G.8275.2 Precision Time Protocol telecom profile for phase/time synchronization
- SIMATIC NET SINEC H1 Time Datagram

## huma® web edition software

huma® web edition – **hopf** unified management application – is the highly flexible, versatile, secure, and easy-to-use system configuration and management software that is integral part of each system’s management controller hardware. The software is accessible using the local computer’s web browser and network connection.

### System requirements

Web browsers	Google Chrome (Version > 89), Microsoft Edge (Version > 89), Mozilla Firefox (Version > 87), Opera (Version > 75), Brave (Version > 1.23)
Browser technology support	HTML5, CSS3, JavaScript enabled, ECMAScript 2016, Local Storage (min. 1MB)

- State-of-the-art user interface
- At-a-glance status information
- Realtime event notification
- Role-based user authentication
- Secure system configuration management and firmware update



Referring to the information in this product sheet: After the editorial deadline of this publication, August 16, 2024, changes may have been made to the product. Subject to changes of structural or design changes, changes to the scope and scale of discounts by the manufacturer during the delivery period as long as the changes or deviations are reasonable under consideration of the interest of the seller to the buyer. Errors and technical data are subject to change without prior notice.

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