hopf

Time Reference Systems
Made in Germany

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° and +70°C
- GPS, Galileo, GLONASS, and BeiDou time sources for reliable satellite synchronization
- Average accuracy of ±30 ns to UTC, peak accuracy of ±100 ns to UTC for demodulated IRIG-B and pulse outputs and ±1 µs for modulated IRIG-B output
- Synchronization of IEC 61850 compatible devices
- Typical NTP time stamp accuracy <30 µs
- Precision Time Protocol (PTP) option with peak time stamp accuracy ±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, and BeiDou, 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 GNSS firewall with anti-jamming and anti-spoofing technologies at the signal receiver
- Multiple time source with fall back and time source prioritization for error-free and leap-free timing signal synchronization
- Automatic handling of leap second and week rollover

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, IEEEC37.238 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 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 satellite systems freely configurable for GPS, Galileo, GLONASS and BeiDou. 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 the integrated oscillator circuit holdover ensuring the oscillator dependent freewheeling accuracy. For unprecedented availability redundant time domain and multiple redundant time source configurations with prioritizable fall back time sources are supported.

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 operational / productivity 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 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 certificates to ensure authenticity and eligibility for application.

Base System

Enclosures

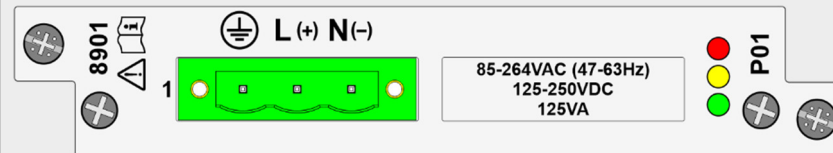|	
FG8101G01 FG8101G01-B000	8100 product series time reference system ■ 19-inch 1U modular subrack according to IEC 60297-3-100:2008 ■ 2 extension slots for redundant power supply units ■ 6 extension slots for time domain controller, service provider and management controller boards

Base System Options

■

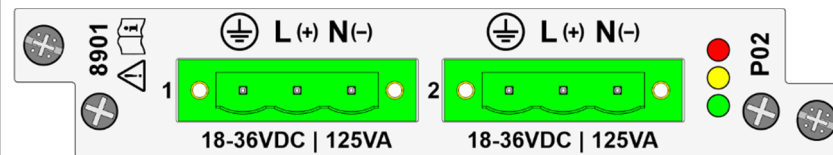### Power Supplies

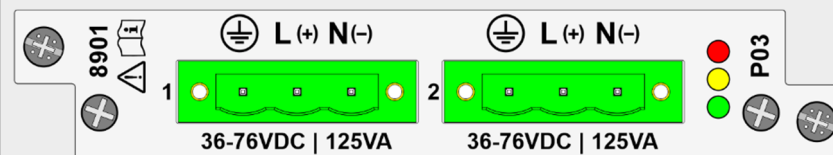|	
FG8901P01 FG8901P01-B000	Power Supply Unit for 8x00 product series, hot-plug capable 85 – 264VAC (50Hz / 60Hz) / 125 – 250VDC single power input for connection to a single power source 85-264VAC (47-63Hz) 125-250VDC 125VA
FG8901P02 FG8901P02-B000	Power Supply Unit for 8x00 product series, hot-plug capable 24VDC (18 – 36VDC) redundant power inputs for connection of the power sources 18-36VDC | 125VA 18-36VDC | 125VA
FG8901P03 FG8901P03-B000	Power Supply Unit for 8x00 product series, hot-plug capable 48VDC (36 – 76VDC) redundant power inputs for connection of the power sources 36-76VDC | 125VA 36-76VDC | 125VA
FG8901P04 FG8901P04-B000	Power Supply Unit for 8x00 product series, hot-plug capable 110VDC (60 – 160VDC) redundant power inputs for connection of the power sources 60-160VDC | 125VA 60-160VDC | 125VA

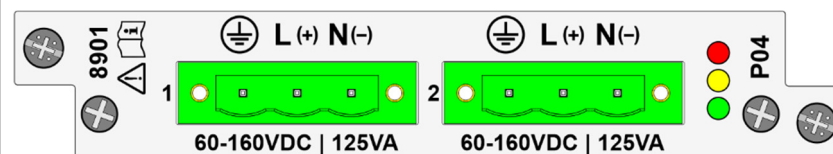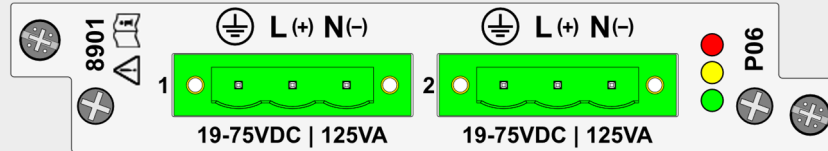| FG8901P06 FG8901P06-B000	Power Supply Unit for 8x00 product series, hot-plug capable 19 – 75VDC redundant power inputs for connection of the power sources

Time Domain Controller Boards

FG8702G01 FG8702G01-B000	Time Domain Controller Board for product series 8x00, hot-plug capable ■ 72-channel GNSS receiver for GPS, GLONASS, BeiDou, Galileo with connection via SMA connector (female) ■ Dry contact for alarm / status output ■ TCXO oscillator (236,71 µs per day at constant temperature after 2 days of continuous operation) ■ 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 ■ 72-channel GNSS receiver for GPS, GLONASS, BeiDou, Galileo with connection via SMA connector (female) ■ Dry contact for alarm / status output ■ OCXO oscillator for enhanced freewheeling stability (25,9 µs per day after 7 days of continuous operation (±1°C) ■ 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 ■ 72-channel GNSS receiver for GPS, GLONASS, BeiDou, Galileo with connection via SMA connector (female) ■ Dry contact for alarm / status output ■ OCXO HPFS oscillator for high precision freewheeling stability (4,32 µs per day after 7 days of continuous operation (±1°C) ■ 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 72-channel GNSS receiver for GPS, GLONASS, BeiDou, Galileo with connection via 2x SMA connector (female)
	■ Dry contact for alarm / status output
	■ TCXO oscillator (236,71 µs per day at constant temperature after 2 days of continuous operation)
	■ 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 72-channel GNSS receiver for GPS, GLONASS, BeiDou, Galileo with connection via 2x SMA connector (female)
	■ Dry contact for alarm / status output
	■ OCXO oscillator for enhanced freewheeling stability (25,9 µs per day after 7 days of continuous operation (±1°C)
	■ 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 72-channel GNSS receiver for GPS, GLONASS, BeiDou, Galileo with connection via 2x SMA connector (female)
	■ Dry contact for alarm / status output
	■ OCXO HPFS oscillator for high precision freewheeling stability (4,32 µs per day after 7 days of continuous operation (±1°C)
	■ 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	Activation key for activation of the following feature for product series 8x00: ■ 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 and 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 ■ Activation key for one (1) board
LI8100A03 LI8100A03-B000	Activation key for activation of the following feature for product series 8x00: ■ Support for SIMATIC NET SINEC H1 Time Datagram Protocol ■ Activation key for one (1) board
LI8100A04 LI8100A04-B000	Activation key for activation of the following feature for product series 8x00: ■ Support for Precision Time Protocol (PTP) according to IEEE Std 1588™-2019 as time source for time domain controller boards ■ Activation key for one (1) board
LI8100A05 LI8100A05-B000	Activation key for activation of the following feature for product series 8x00: ■ Support for Network Time Protocol (NTP/SNTP) according to RFC 5905 as time source for time domain controller boards ■ Activation key for one (1) board

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

Applied Standards

Electromagnetic Compatibility

IEC 61000-3-2:2018	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
IEC 61000-3-3:2013 + A1:2017	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 ≤ 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 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

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

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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 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

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
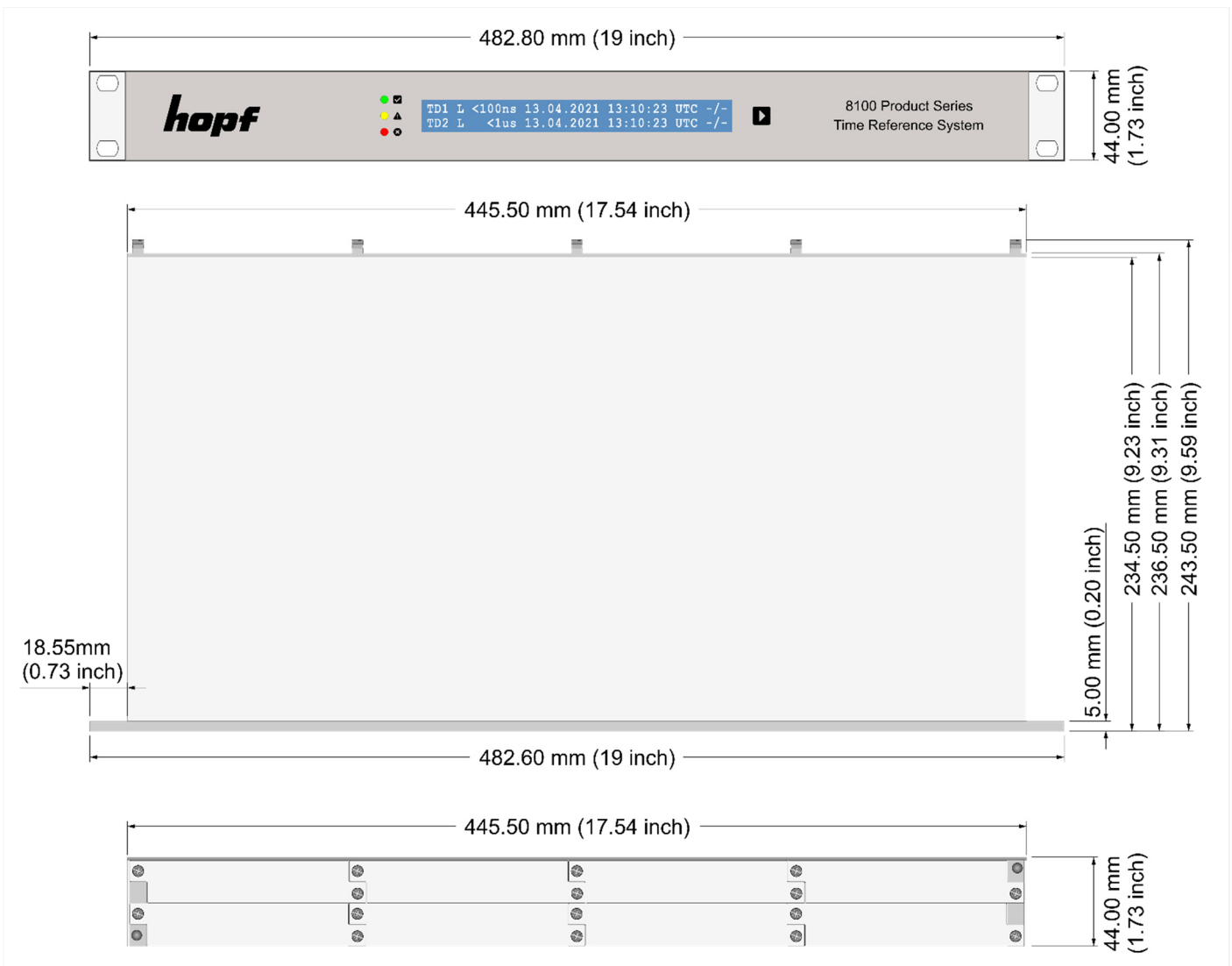
Environmental Conditions

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
FG8702G04

Ethernet

Ports	2
Data Rate	10/100/1000Mbps
Connector	RJ45

Status Output

Dry Contact

| Operating Voltage | +/-250VDC |
| Operating Current | max. 120mA |

Boot time

typ. ≤ 40 seconds depending on the configuration

Antenna

| Supply Voltage | 5V±10% |
| Current | max. 100mA |

Receiver

GNSS systems	GPS, GLONASS, Beidou, Galileo
Channels	72
Time to first fix	Warm start:	<2 s
	Cold start:	<30 s
	First initialization:	<750 s
Sensitivity	Tracking:	-166dBm
	Warm start:	-157dBm
	Cold start:	-148dBm

Clock Accuracy

| Internal PPS | ±15ns (after 5 minutes GNSS reception with clear sky view) |
| Holdover | 236,71µs per day at constant temperature after 2 days of continuous operation |

NTP

| Timestamp Accuracy | typ. <30µs |
| Requests per second | 25.000 |

	PTP
	Timestamp Accuracy typ. <50ns to system internal PPS
	Reliability
	MTBF 1.100.000h
FG8702G02 FG8702G05	Identical to FG8702G01 / FG8702G04 except holdover **Clock Accuracy** Holdover 25,9µs per day after 7 days of continuous operation (±1°C)
FG8702G03 FG8702G06	Identical to FG8702G01 / FG8702G04 except holdover **Clock Accuracy** Holdover 4,32µs per day after 7 days of continuous operation (±1°C)
FG8801N02	**Ethernet** Ports 2 Data Rate 10/100/1000Mbps Connector RJ45 **Boot time** typ. ≤ 40 seconds depending on the configuration **Time Accuracy** Internal time accuracy ±15ns to system internal PPS **NTP** Timestamp Accuracy typ. <30µs Requests per second 25.000 **PTP** Timestamp Accuracy typ. <50ns to system internal PPS **Reliability** MTBF 1.250.000h
FG8801F02	**Ethernet** Ports 2 Data Rate dependent on SFP transceiver module Connector LC **Boot time** typ. ≤ 40 seconds depending on the configuration **Time Accuracy** Internal time accuracy ±15ns to system internal PPS **NTP** Timestamp Accuracy typ. <30µs Requests per second 25.000 **PTP** Timestamp Accuracy typ. <50ns to system internal PPS **Reliability** MTBF 1.250.000h

FG8800M00

Ethernet
Ports	2
Data Rate	10/100/1000Mbps
Connector	RJ45

Status Output
Dry Contact
Operating Voltage	+/-250VDC
Operating Current	max. 120mA

Boot time
typ. ≤40 seconds depending on the configuration

Time Accuracy
Internal time accuracy ±15ns to system internal PPS

NTP
Timestamp Accuracy	typ. <30µs
Requests per second	25.000

Reliability
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
- 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
- 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