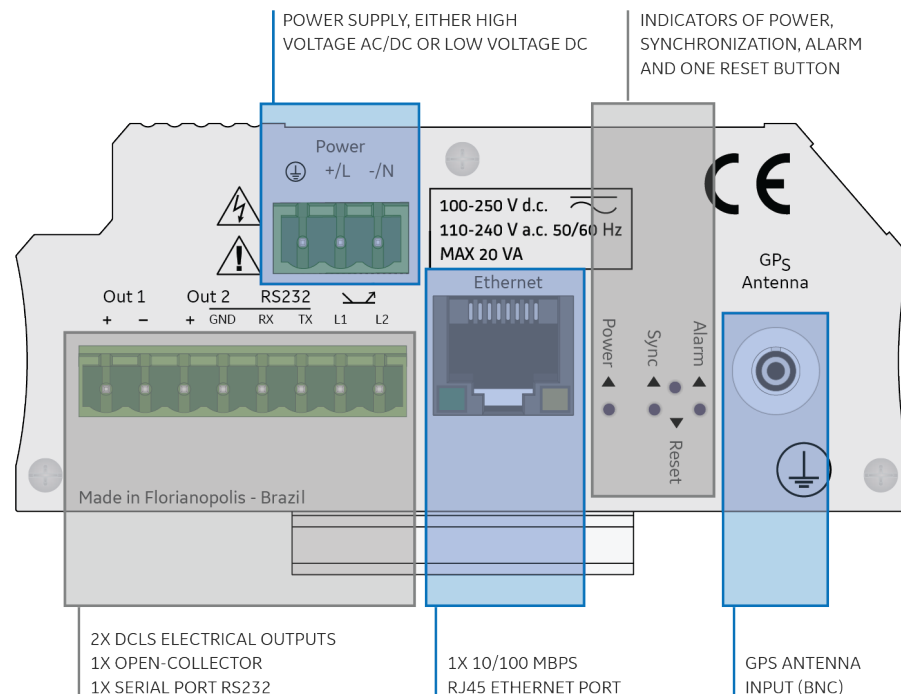# GE
Grid Solutions

Reason RT431

GPS Precision-Time Clock

The demand for accurate time synchronization available 24/7 increases with the growth of critical substation applications, such as phasor measurement, merging units, travelingwave fault location and current differential protection operating over Synchronous Optical Networking (SONET) and Multi-Protocol Label Switching (MPLS) systems. In order to yield the best accuracy and granularity from such applications, the use of a common, precision-time reference is essential.

Time Synchronization

The RT431 Time Code Generator is a compact GPS-based clock designed to be installed on a DIN-rail that supports electrical DC Level Shift time signals, serial datagrams, Network Time Protocol (NTP) / Simple Network Time Protocol (SNTP) and the IEEE 1588v2 Precision Time Protocol (PTP). When configured as PTP ordinary clock (slave), RT431 also works as a transceiver from PTP to IRIG-B, serial or pulse time codes, enabling the use of PTP on legacy IEDs that do not support this protocol.

POWER SUPPLY, EITHER HIGH VOLTAGE AC/DC OR LOW VOLTAGE DC

INDICATORS OF POWER, SYNCHRONIZATION, ALARM AND ONE RESET BUTTON

Power
⏚ +/L -/N

100-250 V d.c.
110-240 V a.c. 50/60 Hz
MAX 20 VA

Ethernet

GPS Antenna

Out 1 Out 2 RS232
+ − + GND RX TX L1 L2

Power Sync Alarm Reset

Made in Florianopolis - Brazil

2X DCLS ELECTRICAL OUTPUTS
1X OPEN-COLLECTOR
1X SERIAL PORT RS232

1X 10/100 MBPS
RJ45 ETHERNET PORT

GPS ANTENNA
INPUT (BNC)

Precise Time Synchronization

- Mean time accuracy of 100 ns for IRIG-B/PPS signals
- IEEE 1588v2 PTP, with better than 100 ns accuracy
- Operates as a PTP master clock or ordinary clock
- PTP Power Profile, in accordance with latest IEEE C37.238:2017 and its previous 2011 version
- PTP Profile for Power Utility automation, in accordance with IEC 61850-9-3:2016 standard
- NTP/SNTP time server
- PTP and NTP/SNTP simultaneously through the Ethernet port

Compact Design

- One 10/100 Mbps Ethernet port
- Two electrical DCLS output interfaces
- DCLS signal is configurable through the Web Interface
- One serial port RS232 for datagrams
- One open-collector output (voltage free contact)
- Web Interface available in five different languages

Hardened for Industry

- Robust design for harsh environments
- Supports Simple Network Management Protocol (SNMP) (v1, v2c and v3), including Management Information Base (MIB) files

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PTP Power Profiles

Following the latest standards, RT431 offers the most recent IEEE 1588v2 extended profiles for power system protection, control automation, and data communication applications, such as: IEEE C37.238:2017, IEC/IEEE 61850-9-3:2016 and IEEE C37.238:2011. All these are pre-configured on the RT431, making it easier to configure an IEEE 1588v2 network. The following table presents a comparison between the main characteristics of each profile.

	IEEE C37.238:2011 PTP Power Profile	IEEE C37.238:2017 PTP Power Profile	IEC 61850-9-3:2016 PTP Profile for Power Utility Automation
Network Protocol	Ethernet Layer 2	Ethernet Layer 2	Ethernet Layer 2
Delay Mechanism	Peer-to-Peer (P2P)	Peer-to-Peer (P2P)	Peer-to-Peer (P2P)
Operation Mode	One Step	One or Two Step(s)	One or Two Step(s)
Sync / Announce Message Interval	1 per second / 1 per second	1 per second / 1 per second	1 per second / 1 per second
Grandmaster Priority	#1 and #2 = 128 Equal for all Grandmaster	Selectable, allowing to choose the best grandmaster for holdover conditions	Selectable, allowing to choose the best grandmaster for holdover conditions

The IEEE C37.238:2017 and IEC/IEEE 61850-9-3 are completely compatible and can work together without restrictions on the same network by setting its domain number. Although the C37.238:2011 was superseded by the other two standards, it is still available for legacy networks and may be compatible depending on the IEEE 1588v2 network configuration.

Technical Specification

POWER SUPPLY

Operating nominal voltage	100-250Vdc, 110-240Vac
Operating voltage range	80-300Vdc, 88-264Vac
Frequency	50/60 Hz ± 3 Hz
Power Consumption	MAX 20 VA
	Typical 10 W

ETHERNET PORT

Transmission Rates	10/100 Mbps
Connector	RJ45
Protocols Supported	NTP v2 (RFC 1119) NTP v3 (RFC 1305) NTP v4 (without RFC) SNTP (RFC 1769/2030/4330) SMNP (v1, v2c and v3), including MIB support. IEEE 1588v2:2008 HTTP, TCP/IP, UDP

GNSS ANTENNA TYPE

Type	3.3 V Active GNSS antenna (<20 mA)
Frequency	1588 ± 3MHz
Output / VSWR	2.0 Max
Impedance	50 Ω
Gain	30dB @ 25°C
Noise	3.3dB max (25°C ± 5°C)
Azimuth coverage	360° (omni-directional)
Elevation coverage	0°-90° elevation (hemispherical)
Operating Temperature	-40°C to +90°C
Connector	TNC Female

SURGE ARRESTER

Nominal discharge current In (8/20µs)	10 kA
Dynamic residual voltage	<600 V
Band width	<4 Ghz
Impedance	50 Ω
Connector	BNC
Includes 1 meter long cable	

GPS ANTENNA RECEIVER

Signal	GPS L1 Frequency, C/A code
Sensibility	-152 dBm (After acquisition) -142 dBm (During acquisition)
Number of channels	12
Antenna type	Active
Antenna's supply	3.3 V, max 100 mA
Impedance antenna	50 Ω
Connector	BNC (female)

Time Receiver Autonomous Integrity Monitoring (TRAIM) supported.

PRECISION TIME PROTOCOL PTP (IEEE 1588)

Time Accuracy	<100 ns
Protocols	UDP/IPv4 (Layer 3) IEEE 802.3 (Layer 2)
Delay Compensation	End-to-End (E2E) Peer-to-Peer (P2P)
Profiles	- Power - IEEE C37.238/2017 and 2011 - Power Utility - IEC/IEEE 61850-9-3/2016 - P2P Default - Custom

TTL LEVEL ELECTRICAL OUTPUTS

Time Accuracy	100ns (peak)
Number of Outputs	2
TTL Voltage Level	5 Vdc
High Level	> 4.8 Vdc
Low Level	< 0.2 Vdc
Impedance	18 Ω
Current	150 mA
Connectors	Euro-Type

Both TTL outputs are non-insulated.

OPEN COLLECTOR ELECTRICAL OUTPUTS

Number of Outputs	1
Maximum collector emitter DC voltage	400 V
Maximum current	300 mA
Connectors	Euro-Type

ANTENNA CABLE

Length	Delay (ns)	Description	Attenuation @1500MHz
15 m (50 ft)	62.0	TNC Male to BNC Male connectors, RG58 Type	< 0.5 dB/m
25 m (82 ft)	102.6	TNC Male to BNC Male connectors, RG58 Type	< 0.5 dB/m
40 m (131 ft)	163.6	TNC Male to BNC Male connectors, RG58 Type	< 0.5 dB/m
75 m (246 ft)	305.9	TNC Male to BNC Male connectors, RG8 Type	< 0.2 dB/m
100 m (328 ft)	407.5	TNC Male to BNC Male connectors, RG8 Type	< 0.2 dB/m
150 m (492 ft)	611.3	TNC Male to BNC Male connectors, RG8 Type	< 0.2 dB/m
Velocity of propagation	82%		
Impedance	50 ohms		
Capacitance	81pF/m		

ENVIRONMENT

Operating temperature range	-40°C ... +55°C (or −40°F to +131°F)
As tested per IEC 60068-2-1	-40°C
As tested per IEC 60068-2-2	+85°C
Maximum operating altitude	2000 m (6560 ft)
Relative humidity	5 ... 95%, non-condensing
Enclosure Protection IEC 60529	IP20

SERIAL PORT (RS232)

Number of Outputs	1
Signal Level	RS232
Bitrate	1200, 2400, 4800, 9600 19200 or 38400 bps
Databits	7 or 8
Stopbits	1 or 2
Parity	nome, ever or odd
Connector	Euro-Type

TYPE TEST

EMC tests were performed according to IEC 60255-26 referring to the following standards

IEC 61000-4-2:2008	6 kV contact / 8 kV air
IEC 61000-4-3:2006	10 V/m
IEC 61000-4-4:2012	2 kV @ 5 kHz
IEC 61000-4-5:2005	Differential mode: 1 kV
	Common mode: 2 kV
IEC 61000-4-6:2008	10 V
IEC 61000-4-8:2009	30A/m continuos – 300A/m @ 1 s
IEC 61000-4-11:2004 IEC 61000-4-29:2000	A.C. and D.C. voltage dips Test level: 0% residual voltage Duration time A.C.: 1 cycle D.C.: 16.6 ms Test level: 40% residual voltage Duration time A.C.: 12 cycles D.C.: 200ms Test level: 70% residual voltage Duration time A.C.: 30 cycles D.C.:500 ms A.C. and D.C. voltage interruptions Test level: 0% residual voltage Duration time A.C.: 300 cycles D.C.: 5 s

IEC 61000-4-17:1999	Test level: 15% of rated DC value Test frequency: 120 Hz, sinusoidal waveform
IEC 61000-4-18:2006	Voltage oscillation frequency: 1 MHz Differential mode: 1 kV peak voltage; Common mode: 2.5 kV peak voltage
IEC 60255-26:2013 Gradual shut down / start-up tests	Shut-down ramp: 60 s Power off: 5 m Start-up ramp: 60 s
CISPR11:2009	Radiated emission Limits: 30 to 230 MHz – 50 dB (µV/m) quasi peak at 3 m 230 to 1000 MHz – 57 dB (µV/m) quasi peak at 3 m
CISPR22:2008	Radiated emission The definition of the limit frequency is based on the maximum internal frequency of the equipment. On RT431, the maximum internal frequency is 100 MHz. For this case, the levels of CISPR 11 satisfy the normative IEC 60255-26. Conducted emission Limits: 0.15 to 0.50 MHz - 79dB (µV) quasi peak; 66 dB (µV) average 0.5 to 30 MHz - 73dB (µV) quasi peak; 60 dB (µV) average

Environmental Tests

IEC 60068-2-1	-40°C, 16 hours (Cold)
IEC 60068-2-2	+85°C, 16 hours (Dry heat)
IEC 60068-2-30	95% no condensation, +55°C (Damp heat)
IEC 60068-2-14	-40°C to +85°C / 9 hours / 2 cycles (Change of temperature)
IEC 60255-21-1	Class 2 (Vibration)
IEC 60255-21-2	Class 1 (Shock)
IEC 60255-21-3	Class 2 (Seismic)

Safety Tests

IEC 61010-1 CE Certification	Safety requirements
IEC 60255-5	Inpulse: -5 kV Dielectric withstand: -3.3 kV dc Insulation: > 100 MΩ

INTERNAL OSCILLATOR

Drift (without external reference)	< 0.1 ppm (10^{-7})

DIMENSIONS, WEIGHT

Height	105 mm (4.1 in)
Width (body)	117 mm (4.6 in)
Depth	51 mm (2 in)
Weight	1 kg (2.2 lbs)

	RT430	RT431	RT434
GNSS (GPS + GLONASS)	✓	GPS only	✓
IEEE 1588 PTP and NTP/SNTP protocols	✓	✓	✓
SNMP Monitoring	✓	✓	✓
TCXO Internal Oscillator	✓	--	✓
Parallel Redundancy Protocol (PRP)	✓	--	--
10/100 BASE-T Ethernet ports	2	1	4
TTL (electric) outputs	4	2	4
Open collector outputs	2	1	2
Optical outputs	2	--	2
IRIG-B 004, PPS, PPM, DCF77 and low frequency pulses	✓	✓	✓
IRIG-B 124 AM outputs	✓	--	✓
Time sync throught serial port	✓	✓	✓
LOCKED dry contact relay	✓	--	✓
Web-browser configuration*	✓	✓	✓
Full range power supply	✓	✓	✓
Redundant power supply	✓	--	✓
Power Consumption (Typical)	15W	10W	15W
Mouting	19" Rack	DIN Rail	19" Rack

* Web-browser configuration is available in English, French, Portuguese, Russian and Spanish.

RT431 Ordering

	RT431	*	*	C	*	B	*	*	*	**RT431 GPS Precision-Time Clock**
Power Supply		3								100-250 Vdc / 110-240 Vac
Ethernet Interface				C						RJ45 copper 100BASE-TX for configuration only
				N						RJ45 copper 100BASE-TX for NTP server and configuration
				P						RJ45 copper 100BASE-TX for PTP (IEEE 1588) server, NTP server and configuration
				S						RJ45 copper 100BASE-TX for PTP (IEEE 1588) client
Customization / Regionalisation				C						GE branding
Firmware Version				08						Latest available firmware - 08
Hardware Design Suffix						B				GNSS version
GPS Antenna							0			Without antenna
							2			3.3V TNC Female active GNSS antenna
Antenna Cable								0		No cable
								1		15 m (50 ft) TNC Male to BNC Male (Attenuation < 0.5 dB/m @ 1500 MHZ)
								2		25 m (82 ft) TNC Male to BNC Male (Attenuation < 0.5 dB/m @ 1500 MHZ)
								3		40 m (131 ft) TNC Male to BNC Male (Attenuation < 0.5 dB/m @ 1500 MHZ)
								4		75 m (246 ft) TNC Male to BNC Male (Attenuation < 0.2 dB/m @ 1500 MHZ)
								5		100 m (328 ft) TNC Male to BNC Male (Attenuation < 0.2 dB/m @ 1500 MHZ)
								6		150 m (492 ft) TNC Male to BNC Male (Attenuation < 0.2 dB/m @ 1500 MHZ)
Surge Arrester									0	Without surge arrester
									1	10 kA, 50 Ohms, BNC-type connector Surge Arrester for 0-2000 MHz

Accessories

RT411 Time Signal Distributor

Optical or Electrical input for time reference
Up to 10 optical outputs
Up to 10 electrical outputs (Two BNC connector)
Full range power supply

Model Type	RT411	*	C	A	RT411 Time Signal Distributor
Power Supply 1		3			100-250 Vdc / 110-240 Vac
Customization / Regionalisation			C		GE branding
Hardware Design Suffix				A	Initial version

RT412 Optical Transceiver

Optical-electrical or electrical-optical converter
One Optical output
Two Electrical outputs
DIN rail mounting
Full range power supply

Model Type	RT412	*	C	A	RT412 Optical Transceiver
Power Supply 1		3			100-250 Vdc / 110-240 Vac
Customization / Regionalisation			C		GE branding
Hardware Design Suffix				A	Initial version

Antenna + Cables + Kit Mounting

GNSS Antenna (Order Code: Q020)
Surge Arrester (Order Code: Q010)
Antenna wall mount kit (Order Code: Q065)
Antenna Cable options: - 15 m (50 ft) (Order Code: Q001)
                             - 25 m (82 ft) (Order Code: Q002)
                             - 40 m (131 ft) (Order Code: Q003)
                             - 75 m (246 ft) (Order Code: Q004)
                             - 100 m (392 ft) (Order Code: Q005)
                             - 150 m (492 ft) (Order Code: Q064)

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