

Reason RPV311



Digital Fault Recorder with Fault Location and PMU

GE Vernova Reason RPV311 provides comprehensive digital fault recording, accurate fault location and phasor measurement recording, enabling improved transmission system reliability. Along with the Reason RA33x remote acquisition units and the Reason RT43x GNSS Master Clock, the RPV311 monitors and records electrical quantities to deliver the performance, modularity, and flexibility needed for transmission system applications.

High Density

With up to 64 analogue, 256 digital inputs and up to 320 GOOSE inputs per processing unit you can easily have your whole plant or substation information at a single device. With over 30GB of solid-state internal memory, the RPV311 can keep the data for or even years without external storage devices.

Turnkey Engineering and Retrofitting

Our engineering team can deliver a solution customized to your needs, from drafting to commissioning. Take advantage of our retrofitting solution and swap your old equipment without laying any new cables. From water to earthquake resistant panels, you can have it your way.

Future Proof

Protect your investment for future compatibility and reap the benefits of the newest reliability technology available, such as continuous recording for fault and disturbance, DNP3, and IEC61850 GOOSE and Sampled Values communication.

Reliability

Equipment conforms to IEC 61010-1 and IEC 60255-27 standards, ensuring reliability and ruggedness even under harsh environments. Manufactured units undergo comprehensive functional and stress tests to ensure the highest quality.

Process Bus Applications with IEC 61850-9-2

The RPV is ready for the digital substation with support for sampled value applications according to IEC 61850-9-2LE. Use the Reason MU320 as your digitized acquisition system or subscribe directly to third party merging units or digital instrument transformers. Such flexibility permits standardization of the DFR solution across substations employing different primary technology generations; it prepares for future substation extensions and allows a migration path to the full digital substation.

Situational Awareness

- Waveform recorder with samples per cycle
- Disturbance and continuous disturbance recorder
- Trend Recorder & sequence of events recorder
- Flicker and harmonics measurement
- Subscribes to Sampled Values IEC 61850-9-2LE
- PMU IEEE C37.118.1/2-2011/1a-2014 compliance
- WMU (Waveform Measurement Unit) for subsynchronous oscillation monitoring

High Density I/O

- Up to 64 analog inputs
- Up to 256 binary inputs
- Up to 320 GOOSE inputs

Accurate Fault Location

- Traveling wave fault location
- One-end impedance fault location

Communications

- Transmits MODBUS and DNP3
- GOOSE subscriber
- IRIG-B and NTP time sync
- Two Ethernet ports



Easy to Configure, Easy to Monitor

The RPV311 offers a unique graphical interface for online monitoring and configuration (RPV311 Configurator). Navigating the monitoring interface, measurements being generated by the RPV311 can be viewed in real-time without any other monitoring software. This is particularly useful during commissioning. A standalone version of the configuration system is also available offline without the need to be connected to a physical unit. This way creating template configuration files becomes a simplified task that can be done from anywhere. Moreover, the DR Manager software integrates in a single tool: automatic polling of records and alarms of all RPV311s in the network, on top of the automatic Traveling Wave Fault Location.

High Accuracy for AC & DC Applications

The RA33x acquisition units offer excellent accuracy on a wide bandwidth. High accuracy is achieved with an intelligent shunt measurement that isolates the external world from the internal electronics, which has no core to magnetize and thus no core to saturate. Accuracy is important in high-precision measurement and phasor applications, whilst also permitting DC quantities to be measured. That makes the Reason DFR solutions the perfect choice for HVDC installations. The RPV311 used in conjunction with GE Vernova Digital Instruments Transformers (DIT) can monitor DC currents for applications such as: Geomagnetically Induced Currents and HVDC earth return.

Phasor Measurement Unit (PMU)

The RPV311 can construct accurate synchrophasor data based on the incoming measurements from all available sources, including merging units and DITs. This makes the solution highly scalable and more cost-optimized than the addition of multiple discrete PMUs. Integrating the PMU function to the DFR system simplifies network architectures as the measurement accuracy, the precision time distribution, and the communication architecture are already in place, negating the requirement to install a duplicate architecture solely for PMU purposes. The RPV311 synchrophasor measurement and publishing are carried out according to the latest IEEE C37.118.1/2-2011 and C37.118.1a-2014 for synchrophasors in power systems.

Travelling Wave Fault Location (TWFL)

Traveling wave (TW) fault location (TWFL) is an extremely precise method to define where a fault occurred on a transmission line, or span length of conductors. Such accuracy to within a few hundreds of meters of the actual fault point is not possible to achieve which errors are in the range of several kilometers. The highly reliable fault location system uses an innovative and patented combination of travelling wave and fault detection algorithms where all the triggers normally associated with Digital Fault Recorders (DFRs) can also be used to record TW events. Precision is not affected by line and fault impedance, mutual coupling effects (parallel lines), load, or compensation circuits (capacitor banks). The DR Manager software automatically downloads the traveling wave records, calculates the fault location making it available on its HMI and via MODBUS for supervisory system integration. Maintenance crews are thus directed to the exact location of the fault without the need to resort to vehicular, helicopter or foot patrols to find the exact location.

Technical Specifications

ENVIRONMENTAL CONDITIONS

Equipment	RPV311	RA33x
Operating temperature range	- 10... +50 °C (14°F to +122°F)	-40 ... +55 °C (-40°F to +131°F)
Maximum operating altitude	2000 m (6560 ft)	2000 m (6560 ft)
Relative humidity	5 ... 95 %, noncondensing	5 ... 95 % noncondensing
As tested per 60068-2-1	-10°C	-40°C
As tested per 60068-2-2	+50°C	+85°C

OPTICAL ETHERNET PORT

Interface	10BASE-T / 100BASE-TX
Bit Rate	10 / 100 Mbps
Connector	ST
Fiber Type	Multimode 62.5 / 125 µm
Emission Power	- 20 dBm
Receiver sensitivity	- 32 dBm
Maximum Applicable Power	- 14 dBm

ELECTRICAL ETHERNET PORT

Name	Eth 1 and 2	Eth 3
Use	Configuration, monitoring and GOOSE	IEC 61850-9-2LE Sampled Values and GOOSE
Interface	10BASE-T 100BASE-TX	1000 BASE-TX
Bit Rate	10 / 100 Mbps	1 Gbps
Connector	RJ 45	RJ 45
Isolation Level	1.44 kVdc	1.44 kVdc

OPTICAL IRIG-INPUT

Signal	IRIG-B004
Wavelength	820 nm
Fiber type	Multimode 62.5 / 125 µm
Connector	ST
Sensitivity	- 24 dBm

TW ANALOG ACQUISITION RA333

Resolution	8 bits
Sampling frequency	5 MHz
Time skew	0 µs

DRY-CONTACT RELAY OUTPUTS

Max Voltage	250 Vdc
Max Current	1A
Load	Resistive
Contact Numbers	1 normally closed
	3 normally open
Isolation Level	2.8 kVdc

SAFETY TESTS

Standard	Tests
IEC 61010-1	Voltage Impulse Withstand - 5kV (power supply, IRIG-B and Binary outputs) - 1kV (RJ45 ethernet ports)
	Dielectric Voltage Withstand – 2.8 kVdc for 60 seconds Insulation > 100M Ω at 500Vdc

RPV311 POWER SUPPLY

Nominal voltage range	125-250 Vdc, 110-240 Vac
Maximum voltage range	102-300 Vdc, 88-264 Vac
Frequency	50 / 60 Hz, ± 3 Hz
Power consumption RPV311	MAX 60 VA Typically 50W
Isolation Level	2.8 kVdc

FIBER-OPTIC LINKS

Wavelength	1300 nm
Fiber Type	Multimode 62.5 / 125 μ m
Connector	ST
Emission Power	- 20 dBm
Receiver sensitivity	- 32 dBm
Maximum Applicable Power	- 14 dBm

ENVIRONMENTAL TESTS

Standard	RPV311	RA33x
IEC 60068-2-1:2007	-10°C, 16 hours (Cold op.)	-40°C, 16 hours (Cold op.)
IEC 60068-2-1:2007	-25°C, 16 hours (Cold storage)	-40°C, 16 hours (Cold storage)
IEC 60068-2-2:1993	+50°C, 16 hours (Dry heat op.)	+85°C, 16 hours (Dry heat op.)
IEC 60068-2-2:1993	+70°C, 16 hours (Dry heat sto.)	+85°C, 16 hours (Dry heat sto.)
IEC 60068-2-30:2005	40°C, 95% RH, 6 cycles (12+12 hours) (Damp heat)	55°C, 95% RH, 6 cycles (12+12 hours) (Damp heat)
IEC 60068-2-78:2001	40°C, 10 days, 93% RH	---
IEC 60068-2-14:2009	-10°C to 50°C, 6 hours, 5 cycles	-40°C to 85°C, 6 hours, 5 cycles
IEC 60255-21-1:1988	Class 1 (Vibration)	Class 2 (Vibration)
IEC 60255-21-2:1988	Class 1 (Shock)	Class 1 (Shock)
IEC 60255-21-2:1988	---	Class 1 (Bump)
IEC 60255-21-3:1993	Class 1 (Seismic)	Class 2 (Seismic)

ENCLOSURE PROTECTION IEC 60529

Equipment	RPV311	RA33x
Front flush mounted with panel	IP40	IP54
Rear / sides	IP20 / IP20	IP10 / IP20

DIMENSIONS

Equipment	RPV311	RA33x
Height (front panel)	133.55 mm (3 U)	222 mm (5 U)
Height (rear)	86 mm	200 mm
Width (front panel)	482.6 mm (19")	222 mm (1/2 19")
Width (rear)	427 mm	214 mm
Depth	260 mm	100 mm
Weight	< 4.0 kg	< 3.0 kg

TTL IRIG INPUT

Signal	IRIG-B004
Minimum voltage input	4.20 V
Maximum input voltage	9.80 V
Impedance	200 Ω
Connector	Terminal block 5.08
Isolation Level	2.8 kVdc

R33X DC TRANSDUCER INPUTS

	RPV311	RA33x
Full Scale	± 16.68 V	± 41.5 mA
Input range	± 10 V	± 20 mA
Analog Input Accuracy	$\pm 2\%$ of FS magnit. range	$\pm 2\%$ of FS magnit. range
Impedance	> 5k Ω	>70 Ω

TYPE TESTS RPV311

Standard	Test Level
IEC 61000-4-2:2008 (Electrostatic discharge)	6kV contact / 8kV air (Level 3)
IEC 61000-4-3:2010 (RF immunity)	10 V/m, 80MHz to 2.7 GHz, 80% AM (1kHz) (level 3)
IEC 61000-4-4:2012 (Fast transient disturbance)	2 kV @ 5kHz (level 3)
IEC 61000-4-5:2005 (Surge immunity)	Differential mode: 2kV Common mode: 1kV (level 3)
IEC 61000-4-6:2008 (Conducted RF immunity)	10Vrms, 0.15 to 80 MHz, 80% AM (1kHz) (level 3)
IEC 61000-4-8:2009 (Power magnetic immunity)	30A/m continuous 300A/m @ 1s.
IEC 61000-4-11:2004 IEC 61000-4-29:2000 (Voltage dip, short interruptions and voltage variation immunity tests)	AC and DC voltage dips Test level: 0% residual voltage AC: 30ms / DC: 30ms Test level: 40% residual voltage AC: 12 cycles / DC: 200ms Test level: 70% residual voltage AC: 30 cycles / DC:500ms AC and DC voltage interruptions Test level: 0% residual voltage AC: 300 cycles / DC: 5s
IEC 61000-4-17:1999 (Voltage ripple)	Test level: 15 % of rated DC value Test frequency: 120Hz, sinusoidal waveform. (Level 4)
IEC 61000-4-18:2006 (Damped oscillatory wave immunity test)	Voltage oscillation frequency: 1MHz Damped oscillatory mode: 1kV peak voltage; Common mode 2.5kV peak voltage (Level 3)
IEC 60255-26:2013 (Gradual shut-down/ start-up DC only)	Shut-down ramp: 60s Power off: 5m Start-up ramp: 60s
CISPR11:2009 (Radiated emission – Below 1GHz)	30 to 230MHz - 50dB(μ V/m) quasi peak at 10m 230 to 1000MHz - 57dB(μ V/m) quasi peak at 10m
CISPR22:2008 (Radiated Emission – Above 1GHz)	1 to 3GHz-56dB(μ V/m) average; 76dB(μ V/m) peak at 3m 3 to 6GHz-60dB(μ V/m) average; 80dB(μ V/m) peak at 3m
CISPR22:2008 (Conducted emission)	0.15 to 0.50MHz-79dB(μ V) quasi peak; 66dB(μ V) avg 0.5 to 30MHz-73dB(μ V) quasi peak; 60dB(μ V) avg

RA33x POWER SUPPLY

Nominal voltage range	100-250 Vdc, 110-240 Vac
Maximum voltage range	80-300 Vdc, 88-264 Vac
Frequency	50 / 60 Hz, ± 3 Hz
RA331 and RA332 Power Consumption	MAX 20 VA
RA333 Power Consumption	MAX 30 VA

R33X VOLTAGE INPUTS (50/60 HZ)

Nominal Voltage (Vn)	115 V
Voltage range	0.02-230 V
Analog Input Accuracy	$\pm 0.1\%$ of FS magnitude range
Impedance	> 200 k Ω
Burden In	< 0.1 VA
Continuous Overload	230 V (2 x Vn)
Maximum Overload (1 s)	460 V (4 x Vn)

R33X DIGITAL INPUTS

Nominal Voltage	125 Vdc	250 Vdc	24 / 48 Vdc
Level Low	40 V	110 V	08 V
Level High	85 V	170 V	17 V
Impedance	82 kΩ	180 kΩ	15 kΩ
Burden	< 0.25 W	< 0.5 W	< 0.2 W
Continuous Overload ¹	240 V	340 V	100 V

R33X CURRENT CLAMP

Manufacturer / Model	AEMC / MN312
Dynamic range	0.1 A ... 100 A
Frequency response	40 Hz ... 10 kHz
Accuracy	2 % ± 0.02 mA (0.1 to 1 A)
	1 % ± 0.02 mA (1 to 80 A)
	2 % ± 0.02 mA (80 to 100 A)
Jaw opening	21 mm
Maximum conductor size	20 mm
Weight	180 g
Operating temperature	- 10 ... 55 °C

R33X CURRENT CLAMP INPUTS

Nominal Current (In)	100 mA (Clamps)
Current range	0.005 ... 0.1 A
Analog Input Accuracy	± 1 % FS
Impedance	1 Ω
Burden	< 0.01 VA
Continuous Overload	0.5 A
Maximum Overload (1 s)	2 A

RA33X CURRENT INPUTS (50/60 HZ)

Resolution	16 bits
Acquisition Rate	256 ppc
Bandwidth	DC to 3.0 kHz
Attenuation @ 3000 Hz	< 0.1 dB
Attenuation @ 6400 Hz	> 30 dB
Time skew	0 μs
Frequency Tracking Range	Nominal Frequency ±5Hz

CURRENT INPUTS SPECIFICATIONS (50/60HZ)

CORTEC option	1	2	5	6	T
Nominal Current (In)	1 A		5 A		5 A (Measurement CT)
Current range	0.01... 20 A (20xIn)	0.01... 40 A (40xIn)	0.05... 100 A (20xIn)	0.05... 200 A (40xIn)	0.01... 14 A
Analog Input Accuracy	± 0.1 % FS				
Resistance	15 mΩ	5 mΩ	3 mΩ	1 mΩ	15 mΩ
Burden In	< 0.02 VA				
Continuous overload (rms)	10 A (10 x In)		20 A (4 x In)		10 A (2 x In)
AC current thermal withstand (Ith rms for 1 sec)	40 A (40 x In)	100 A (100 x In)	100 A (20 x In)	200 A (40 x In)	40 A (8 x In)

RPV311 Ordering

Model Type	RPV311	*	*	*	*	*	C	*	C	RPV311 Multifunction Recorder
Power Supply	3									100-250 Vdc / 110-240 Vac
Network Interface	O									Two RJ45 copper or duplex ST-type connector 100BASE-X Ethernet interfaces
Functions and Protocols		***								IEC 61850-9-2LE Inputs
		***								Travelling Wave Fault Location
		***								Waveform Measurement Unit (WMU)
		***								Phasor Measurement Unit (PMU)
		***								GOOSE Message Subscription
		***								MODBUS/DNP3.0 Interface
		***								Power Quality
		***								Fault Recorder
		***								Sequence of Events Recorder
		***								Disturbance Recorder
	***								Continuous Fault and Disturbance Recorder	
Customization / Regionalization							C			GE branding
Firmware Version								15		Firmware 15
Hardware Design Suffix									E	Fifth version

Details on functions and protocols selection can be obtained on the GE Vernova Grid Solutions online store

RA331 Ordering

Model Type	RA331	*	*	*	*	*	C	C	RA331 Acquisition Module for RPV311
Power Supply	1								24-48 Vdc
	3								100-250 Vdc / 110-240 Vac
Analogue Inputs 1 to 4	2								Voltage inputs 115 V / Current inputs 1 A; full-scale 40 A (Ith = 100 A)
	6								Voltage inputs 115 V / Current inputs 5 A; full-scale 200 A (Ith = 320 A)
	D								Voltage inputs ±10 Vdc / Current inputs 0-20 mAdc
	P								Voltage inputs 115 V / Current inputs 100 mA; full-scale 100 mA (Ith = 2 A)
	X								Not installed
Analogue Inputs 5 to 8	2								Voltage inputs 115 V / Current inputs 1 A; full-scale 40 A (Ith = 100 A)
	6								Voltage inputs 115 V / Current inputs 5 A; full-scale 200 A (Ith = 320 A)
	D								Voltage inputs ±10 Vdc / Current inputs 0-20 mAdc
	P								Voltage inputs 115 V / Current inputs 100 mA; full-scale 100 mA (Ith = 2 A)
	X								Not installed
Digital Inputs 1 to 16	1								24 V / 48 V
	2								125 V
	3								250 V
	X								Not installed
Digital Inputs 17 to 32	1								24 V / 48 V
	2								125 V
	3								250 V
	X								Not installed
Customization / Regionalization							C	GE branding	
Hardware Design Suffix							C	Third version	

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RA332 Ordering Reason DR Manager

Model Type	RA332	*	*	*	*	*	*	*	C	C	RA332 Acquisition Module for RPV311
Power Supply	1										24-48 Vdc
	3										100-250 Vdc / 110-240 Vac
Analogue Inputs 1 to 4	2										Voltage inputs 115 V / Current inputs 1 A; full-scale 40 A (Ith = 100 A)
	6										Voltage inputs 115 V / Current inputs 5 A; full-scale 200 A (Ith = 320 A)
	D										Voltage inputs ±10 Vdc / Current inputs 0-20 mAdc
	P										Voltage inputs 115 V / Current inputs 100 mA; full-scale 100 mA (Ith = 2 A)
	X										Not installed
Analogue Inputs 5 to 8	2										Voltage inputs 115 V / Current inputs 1 A; full-scale 40 A (Ith = 100 A)
	6										Voltage inputs 115 V / Current inputs 5 A; full-scale 200 A (Ith = 320 A)
	D										Voltage inputs ±10 Vdc / Current inputs 0-20 mAdc
	P										Voltage inputs 115 V / Current inputs 100 mA; full-scale 100 mA (Ith = 2 A)
	X										Not installed
Analogue Inputs 9 to 12	2										Voltage inputs 115 V / Current inputs 1 A; full-scale 40 A (Ith = 100 A)
	6										Voltage inputs 115 V / Current inputs 5 A; full-scale 200 A (Ith = 320 A)
	D										Voltage inputs ±10 Vdc / Current inputs 0-20 mAdc
	P										Voltage inputs 115 V / Current inputs 100 mA; full-scale 100 mA (Ith = 2 A)
	X										Not installed
Analogue Inputs 13 to 16	2										Voltage inputs 115 V / Current inputs 1 A; full-scale 40 A (Ith = 100 A)
	6										Voltage inputs 115 V / Current inputs 5 A; full-scale 200 A (Ith = 320 A)
	D										Voltage inputs ±10 Vdc / Current inputs 0-20 mAdc
	P										Voltage inputs 115 V / Current inputs 100 mA; full-scale 100 mA (Ith = 2 A)
	X										Not installed
Digital Inputs 1 to 16	1										24 V / 48 V
	2										125 V
	3										250 V
	X										Not installed
Digital Inputs 17 to 32	1										24 V / 48 V
	2										125 V
	3										250 V
	X										Not installed
Customization / Regionalization									C		GE branding
Hardware Design Suffix										C	Third version

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RA333 Ordering

Model Type	RA333	*	*	*	*	*	*	C	C	RA333 Travelling Wave and DFR Acquisition Module for RPV311
Power Supply	1									24-48 Vdc
	3									100-250 Vdc / 110-240 Vac
Analogue Inputs 1 to 4	2									Voltage inputs 115 V / Current inputs 1 A; full-scale 40 A (Ith = 100 A)
	6									Voltage inputs 115 V / Current inputs 5 A; full-scale 200 A (Ith = 320 A)
	D									Voltage inputs ±10 Vdc / Current inputs 0-20 mAdc
	P									Voltage inputs 115 V / Current inputs 100 mA; full-scale 100 mA (Ith = 2 A)
	X									Not installed
Analogue Inputs 5 to 8	2									Voltage inputs 115 V / Current inputs 1 A; full-scale 20 A (Ith = 100 A)
	6									Voltage inputs 115 V / Current inputs 5 A; full-scale 200 A (Ith = 320 A)
	D									Voltage inputs ±10 Vdc / Current inputs 0-20 mAdc
	P									Voltage inputs 115 V / Current inputs 100 mA; full-scale 100 mA (Ith = 2 A)
	X									Not installed
Digital Inputs 1 to 16						1				24 V / 48 V
						2				125 V
						3				250 V
						X				Not installed
Digital Inputs 17 to 32							1			24 V / 48 V
							2			125 V
							3			250 V
							X			Not installed
Travelling Wave Input							V		Three-phase bus or line voltage	
Customization / Regionalization								C	GE branding	
Hardware Design Suffix									D	Fourth version

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