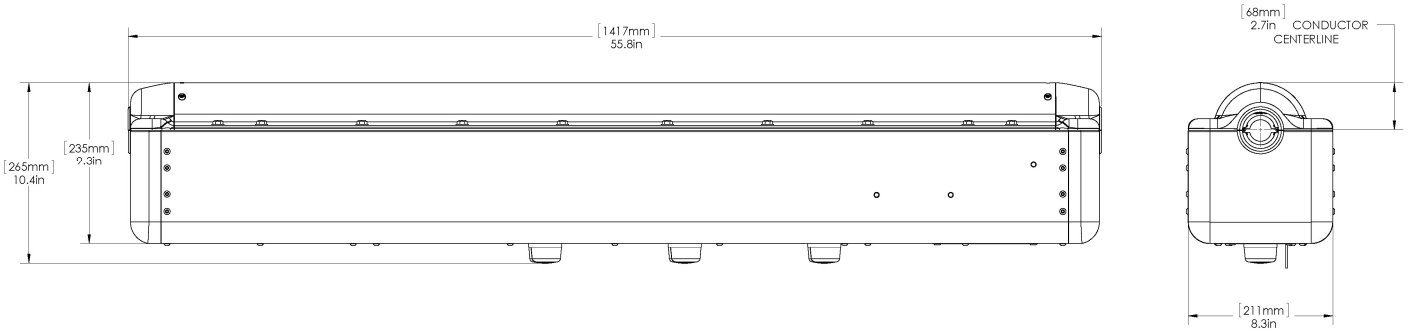
PowerLine Guardian

The Smart Wires PowerLine Guardian® is a modular, switched series reactor wrapped directly around the conductor of an overhead facility. A fleet of units provides a virtually continuous range of reactance from zero up to the collective rating of the deployment. This product provides immense value to electric utilities seeking to develop a dynamic high-voltage grid.

The PowerLine Guardian enables utilities to get more from their existing grid by:

- Addressing short duration and emergency needs with rapidly deployable and easily re-deployable solutions
- Accommodating changes in generation and load by deploying a fleet of units in weeks rather than years
- Routing power away from overloaded transmission facilities and onto facilities with spare capacity to provide reliable delivery of low-cost, low-carbon generation
- Avoiding the use of precious substation space
- Improving visibility on overhead facilities by sensing phase currents, conductor temperatures and conductor vibrations
- Providing high uptime via a modular, redundant solution

The PowerLine Guardian models are differentiated by continuous current rating and maximum conductor size, which collectively determine the maximum inductance per unit. For example, a standard diameter (SD) unit rated for a continuous current of 1000 A RMS is denoted as PowerLine Guardian 1000-SD4. Medium and large diameter units are indicated by MD and LD respectively.



Technical Specifications

Electrical

Maximum Continuous Current	See Model Table Below	Maximum Voltage (Corona-free)	362 kV RMS line-to-line
Maximum Emergency Current	120% of continuous rating for 4 hours[1]	Fault Current Rating	63 kA RMS for 30 cycles 164 kA peak for first cycle
Minimum Reactance in Injection Mode	See Model Table Below	Power	Powered by line current
Minimum Current for Monitoring Mode[2]	50 A RMS	Minimum Current for Injection Mode[3]	150 A RMS

Physical

Mass	211 lbs (96 kg)		
Dimensions	See Figure Above	Minimum Conductor Diameter	0.563 in. (14.3 mm)
Conductor Type	ACSR, AAC, AAAC, ACCR, CU and others	Maximum Conductor Diameter	SD: 1.11 in. (28.1 mm) MD: 1.30 in. (33.0 mm) LD: 1.46 in. (37.1 mm)

Sensor Accuracy

AC Line Current	+/- 3%
Conductor Temperature	+/- 9 °F (+/-5°C)

Communications

Communication Architecture	EMS integration using Smart Wires gateway located at substation
Mesh Communication Security Features	Multilevel ISM band wireless protocol optimized for fast telemetry. Protocol uses SHA-256 to ensure cryptographic integrity of all messages while supporting full observability by utility firewalls

Environmental

Operating Ambient Temperature Range[4]	-40 °F to 118 °F (-40 °C to 48 °C)	Condensing Operating Humidity Range	5% to 100%
Continuous Conductor Temperature Range	-40 °F to 212 °F (-40 °C to 100 °C)	Maximum Sustained Rain	4.0 in./hr (101.6 mm/hr)

PowerLine Guardian Models

Model	Maximum Continuous Current at Maximum Operating Ambient Temperature[5] (A RMS)	SD4 Minimum Reactance in Injection Mode at Rated Current (mΩ)		MD4 Minimum Reactance in Injection Mode at Rated Current (mΩ)		LD4 Minimum Reactance in Injection Mode at Rated Current (mΩ)	
		60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz
PowerLine Guardian 400-	400	40.7	33.9	37.7	31.4	33.8	28.2
PowerLine Guardian 500-	500	31.9	26.6	29.9	24.9	26.6	22.1
PowerLine Guardian 600-	600	25.4	21.1	24.5	20.4	21.1	17.6
PowerLine Guardian 700-	700	21.4	17.8	20.3	16.9	17.8	14.9
PowerLine Guardian 800-	800	18.6	15.5	17.7	14.8	15.5	12.9
PowerLine Guardian 900-	900	17.2	14.4	16.4	13.6	14.4	12.0
PowerLine Guardian 1000-	1000	15.8	13.2	15.0	12.5	13.2	11.0
PowerLine Guardian 1100-	1100	14.9	12.4	13.9	11.6	12.4	10.4
PowerLine Guardian 1200-	1200	13.8	11.5	12.9	10.7	11.5	9.6

[1] For the Models with a continuous current rating of 1100 A RMS and 1200 A RMS, the maximum emergency current is 1250 A RMS for 4 hours.
[2] In Monitoring Mode, the PowerLine Guardian is bypassed and does not inject reactance. Telemetry data is still transmitted.
[3] In Injection Mode, the PowerLine Guardian injects the rated reactance in series with the line and telemetry data is transmitted.
[4] For the Models with a continuous current rating of 1100 A RMS and 1200 A RMS, operating range is -40°F to 109°F (-40 °C to 43 °C).
[5] Higher continuous current ratings are feasible at lower operating ambient temperatures.

About Smart Wires

Based on the San Francisco Bay Area, with offices in the United States, the United Kingdom, Ireland and Australia, Smart Wires is the leader in grid optimization solutions that leverage its patented modular power flow control technology. Smart Wires solutions are quickly deployable, enabling utilities to react quickly and address emergency problems. This flexible technology is also easily re-deployable, providing a robust investment to solve short duration need windows and hedge against the uncertain nature of their systems' future needs. Driven by a world-class leadership team with extensive experience delivering innovative solutions, Smart Wires partners with utilities around the globe to address the unique challenges of the rapidly evolving electric system. Smart Wires' technology was developed by utilities for utilities, led by a consortium of large U.S. utilities at the National Electric Energy Testing Research and Applications Center (NEETRAC). This core group of utilities, which included Southern Company and Tennessee Valley Authority (TVA), defined the vision for the original modular power flow control solution. PG&E, EirGrid (Ireland), Minnesota Power, Central Hudson, and Western Power (Australia) are some of the other utilities leveraging Smart Wires power flow control solutions.

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