

SmartValve™

10-1800 v1.04

SmartValve is a digital power flow control technology that quickly solves overloads and grid congestion issues to unlock extra capacity on the existing network. It is a patented, award-winning, single-phase, modular Static Synchronous Series Compensator (m-SSSC) that injects a voltage in quadrature with the line current to synthesize a capacitive or inductive reactance. This means it can increase or decrease power flows on a circuit and perform dynamic services including improving voltage stability and transient stability. SmartValve is the next logical step in the progression of series-connected FACTS (Flexible Alternating Current Transmission Systems). SmartValve employs Voltage-Sourced Converter (VSC) technology, and its power electronics use Insulated-Gate Bipolar Transistors (IGBTs) that have been widely used for utility-scale VSCs, including StatComs and HVDC systems. Unlike physical series capacitors or inductors, the injected voltage can be controlled independently of the line current, allowing the series reactance produced by the device to be varied in real time. Also, SmartValve does not have the negative characteristics of these passive devices, such as high risk of sub-synchronous resonance (SSR) with series capacitors and the constant VAR consumption of series reactors.

Previous SSSC technologies required custom designs, series injection transformers, water cooling across a high-voltage gradient, circuit breaker bypass protection, and considerable substation space – all driving significant solution costs. SmartValve leverages a modular, transformerless approach, sealed cooling systems at line potential, integrated fast-acting semiconductor switch bypass, and deployment flexibility to deliver greater solution value. This move towards a modular, standard offering eliminates many disadvantages of previous devices, providing a flexible and scalable technology with high reliability, faster delivery and installation, with multiple network applications.

SmartValve solves critical grid challenges:

- Unlock extra capacity on the grid
- Quickly connect new renewables and demand
- Deliver critical projects on time and on budget
- Enable greater power flows between regions
- Lower cost of energy for consumers
- Eliminate risk of stranded assets

Technical specifications

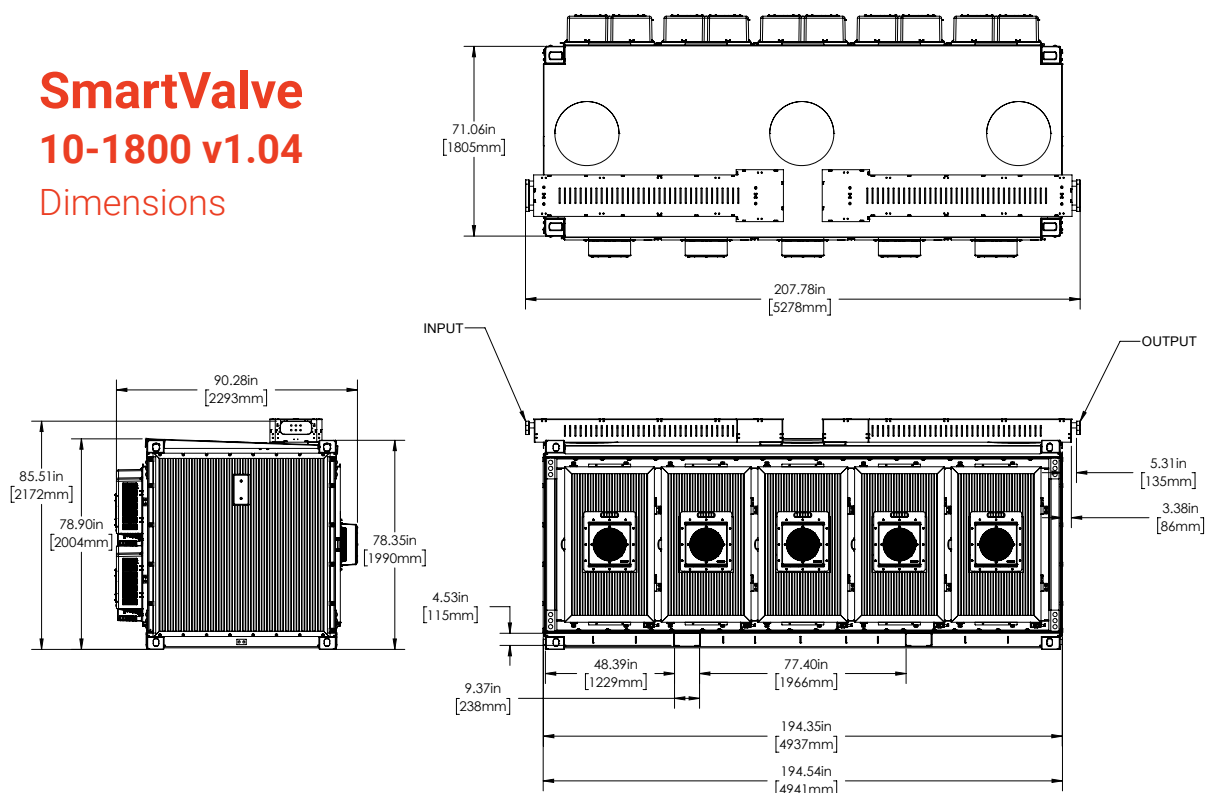
SmartValve 10-1800 v1.04 has a maximum continuous rating of 10 MVar and a maximum continuous current rating of 1800 A RMS. The device is equipped with an integrated bypass and can withstand fault currents up to 63 kA for 1 second.

SmartValves and corresponding communication equipment are typically installed as part of a SmartValve system. The SmartValve system enables a continuous range of control between the minimum injection voltage of a single device per phase up to the aggregate maximum injection voltage rating of all devices in the system.

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Dimensions



Electrical

Maximum Voltage Injection at 50 Hz or 60 Hz ⁽¹⁾	± 5660 V RMS	Injection Mode 20-Minute Emergency Current Rating ^(2,3,4)	2160 A RMS
Minimum Injection Voltage at 50 Hz or 60 Hz ^(5,6)	± 566 V RMS	Maximum Rate of Change of Frequency (RoCoF) Withstand	2 Hz/s for up to 0.5 s and 1 Hz/s for up to 1 s
Max Ramp Time from 0% to 90% of Maximum Injection Voltage ⁽⁷⁾	200 ms	Maximum Corona-Free Voltage	550 kV RMS line-to-line
Minimum Current for Monitoring ⁽²⁾	50 A RMS	Power Source	Powered by line current
Minimum Current for Injection ⁽²⁾	100 A RMS	Operational Frequency Range	47.00 Hz to 52.00 Hz 57.00 Hz to 62.00 Hz
Injection Mode Continuous Current Rating ^(2,3)	1800 A RMS	Fault Current Rating	63 kA RMS for 1 second
Monitoring Mode Continuous Current Rating ^(2,3)	2250 A RMS	Peak Fault Current Rating	164 kA @ 60Hz 158 kA @ 50 Hz

Physical

Mass	17000 lbs (7710 kg)
Dimensions	See Figure Above
Mounting	Supported by ground-mounted insulators
Cooling	Liquid-cooling interface between power semiconductors and fan-equipped liquid-to-air heat exchangers using redundant fans and pumps all at line potential. Sealed enclosure coolers for controlling internal ambient temperature.

Environmental

Operating Ambient Temperature Range ⁽⁸⁾	-18°F to 104°F (-28°C to 40°C)
Storage Temperature Range	-18°F to 122°F (-28°C to 50°C)
Condensing Operating Humidity Range	5% to 100%
Maximum Sustained Rain	4.0 in/hr (102 mm/hr)



Intrusion Protection	IEC 60529, Designed to IP 55, Tested to IP X5		
Communication		Other	
Communication Architecture	EMS integration via PowerLine Gateway™ located at substation	Electrical Connections	Joints that carry current during faults and Monitoring Mode tested to IEC 61284. Joints that carry current during Injection Mode tested to ANSI-C119.4
Communication Method	Fiber-optic communication between the communication system and the SmartValve devices	Communication Security Features	The communication protocol uses SHA-256 to ensure cryptographic integrity of all messages while supporting full observability by utility firewalls
Sensor Accuracy			
AC Line Current ⁽⁹⁾	± 3 %		

Notes:

1. Maximum RMS AC of the output voltage for an individual device. Maximum voltage injection of a SmartValve System of n devices in series per phase is n times the Maximum Voltage Injection of an individual device.
2. In Monitoring Mode, the SmartValve is bypassed and does not inject voltage, while telemetry data is still transmitted. In Injection Mode, the SmartValve injects voltage in series with the line and telemetry data is transmitted.
3. The standard device fulfills this rating at 104°F (40°C), 1000 W/m² of solar radiation, and 1000 m elevation when operating at maximum fan speed. Ratings at other environmental conditions (e.g. 122°F (50°C)), durations (e.g. 10 minutes), or fan speeds are available upon request.
4. Assumes continuous operating in Injection Mode at 1800 A RMS prior to the start of the two-hour window.
5. Minimum RMS AC of the output voltage for an individual device. Minimum voltage injection per phase of a SmartValve System consisting of n devices per phase is the Minimum Injection Voltage of a single device as the other n-1 devices per phase can be operated in Monitoring Mode.
6. The value shown is for the standard device. When equipped with the Enhanced-Availability package, the minimum injection voltage for an individual device is 120 V RMS.
7. The value shown is for an individual device, provided the line current is at least 750 A RMS. For a SmartValve System with n devices in series per phase, the maximum ramp rate of the set is n times the Maximum Ramp Rate.
8. The device can operate in a de-rated mode at temperatures up to 122°F (50°C). Ratings for these conditions are available upon request.
9. Applicable for line currents between 1440 A RMS and 2160 A RMS.



About Smart Wires

Smart Wires is the world's leading grid-enhancing technology and services provider. We quickly solve bottlenecks and grid issues to create extra capacity and provide advice on the policies, market design, and solutions critical to creating the digital grid. Headquartered in Research Triangle Park, North Carolina, with additional offices in Ireland, Colombia, Greece, and Australia, Smart Wires has a global workforce of visionary, tenacious, industry-leading experts spread across four continents. Together we are paving the way to energy certainty on a global scale. Working with our customers, industry partners, policymakers, and regulators, we are transforming the grid into a digital, secure, and accessible platform capable of delivering net zero, new business models, jobs, and prosperity.

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