

SmartValve™ 10-1800 v1.04

The SmartValve 10-1800 v1.04 builds upon the success of its predecessors. By using revolutionary power electronics, the SmartValve effectively increases or decreases the reactance of a given circuit, enabling real-time control of power flow. SmartValve is a modular, Static Synchronous Series Compensator (m-SSSC) that injects a leading or lagging voltage in quadrature with the line current, providing the functionality of a series capacitor or series reactor respectively. However, unlike conventional series capacitors or reactors, SmartValve can inject the voltage independently of the line current, thus increasing the ohmic injection when operated below the rated value. 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. As a modular device that can be deployed and re-deployed, the solution size of an installation can be scaled up or down to support the changing dynamic needs of the transmission grid. Given the fast response of the device's power electronics, the device can provide enhanced services, such as transient stability support, and its set point can be changed more frequently than legacy solutions to actively manage power flows with no degradation in device life.

SmartValve enables utilities to get more from their existing grid by:

- Accommodating changes in generation and load by deploying an installation in weeks rather than years
- Addressing short-duration and emergency needs with rapidly deployable and easily re-deployable solutions
- Pushing power away from overloaded transmission facilities or pulling power onto underutilized facilities
- Minimizing the use of precious substation space
- Providing high uptime via a modular solution with no single point of failure

The SmartValve 10-1800 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. Additionally, this product is available with three option packages, the Enhanced-Availability package, the Fast-Transient Injection package, and the Fiber-Optic package.

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.

Technical Specifications and Dimensions

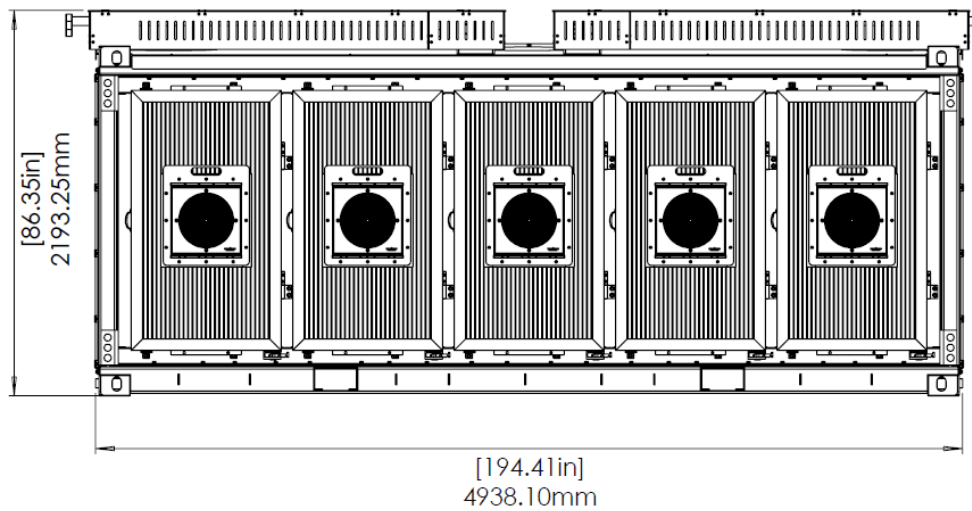


Fig. a Front view.

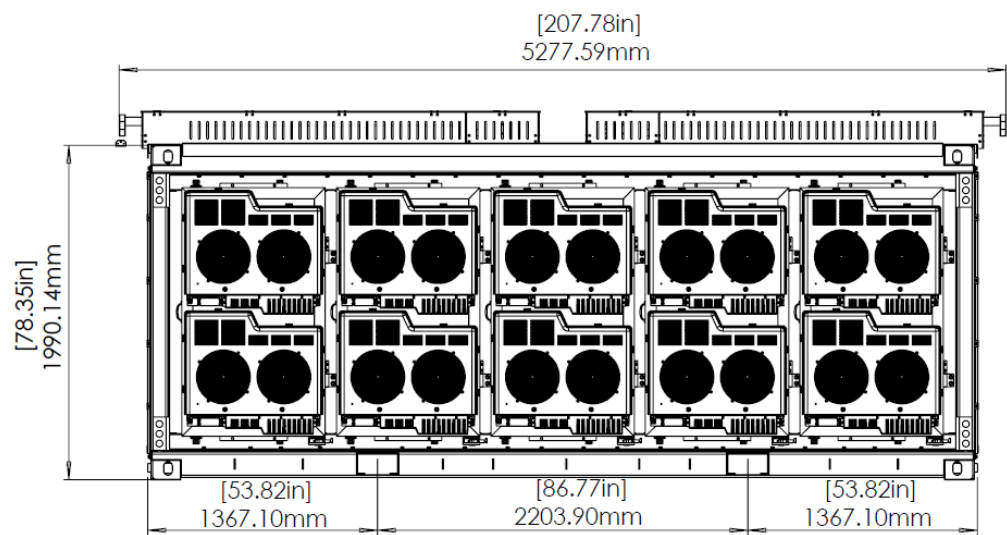


Fig. b. Back view

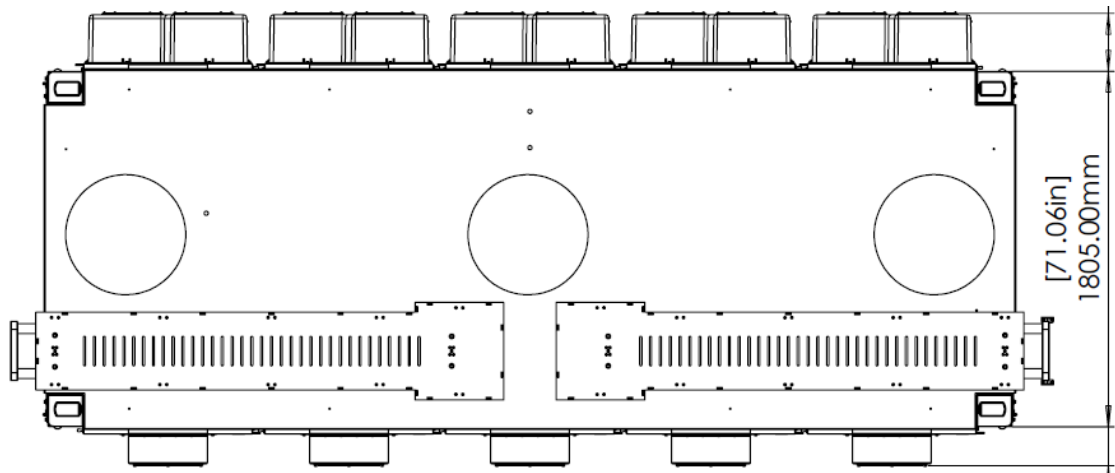


Fig. c. Top view

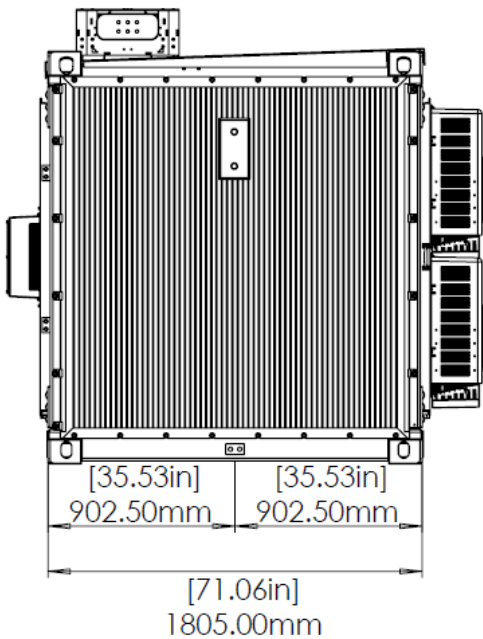


Fig. d. Side view

Fig.1 SmarValve 10-1800 Dimensions. (Values in inches are shown in brackets [])

Electrical

Maximum Voltage Injection at 50 Hz or 60 Hz ⁽¹⁾	± 5660 V RMS	Injection Mode 2-Hour Current Rating ^(5,6)	2160 A RMS
Minimum Injection Voltage at 50 Hz or 60 Hz ^(2,3)	± 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 ⁽⁴⁾	200 ms	Maximum Corona-Free Voltage	550 kV RMS line-to-line
Minimum Current for Monitoring ⁽⁵⁾	50 A RMS	Power Source	Powered by line current
Minimum Current for Injection ⁽⁵⁾	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 ^(5,6)	1800 A RMS	Fault Current Rating	63 kA RMS for 1 second
Monitoring Mode Continuous Current Rating ^(5,6)	2250 A RMS	Peak Fault Current Rating	164 kA @ 60Hz 158 kA @ 50 Hz

Physical

Mass	17000 lbs (7710 kg)	Operating Ambient Temperature Range ⁽⁷⁾	-18°F to 104°F (-28°C to 40°C)
Dimensions	See Figure Above	Storage Temperature Range	-18°F to 122°F (-28°C to 50°C)
Mounting	Supported by ground-mounted insulators	Condensing Operating Humidity Range	5% to 100%
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.	Maximum Sustained Rain	4.0 in/hr (102 mm/hr)
		Intrusion Protection	IEC 60529, Designed to IP 55, Tested to IP X5

Communication

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 Security Features	The communication protocol uses SHA-256 to ensure cryptographic integrity of all messages while supporting full observability by utility firewalls. The standard device uses an ISM band RF protocol optimized for fast telemetry. Product equipped with the fiber-optic package uses fiber-optic communication between the communication system and the SmartValve devices ⁽⁸⁾ .	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

Sensor Accuracy

AC Line Current ⁽⁹⁾	± 3 %
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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.

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.
3.

The value shown is for the standard device. When equipped with the Enhanced-Availability package, the minimum injection voltage for an individual device is 57 V RMS.
4.

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.
5.

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.
6.

The standard device fulfills this rating at 104°F (40°C), 1000 W/m² of solar radiation and 1000 m elevation. Ratings at other environmental conditions (e.g. 122°F (50°C)) or durations (e.g. 15 minutes) are available upon request.
7.

The device can operate in a de-rated mode at temperatures above 104°F (40°C) up to e.g. 122°F (50°C). Ratings for these conditions are available upon request.
8.

For the fiber-optic package, all radios are disabled via hardware modification.
9.

Applicable for line currents between 1440 A RMS and 2160 A RMS.

About Smart Wires

Smart Wires is a global power technology company advancing the delivery of affordable, clean electricity worldwide. With our innovative technology and advanced analytics, we maximize the grid’s capacity. This means more renewables, at a lower cost and with less disruption to communities and the environment. Smart Wires is headquartered in North Carolina, with European headquarters in Dublin, Ireland, and a global workforce of 200 professionals spread across four continents. Our team collaborates with our customers to achieve their strategic objectives and help them face an uncertain energy future with flexible, high-impact solutions.

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Smart Wires Inc.

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D001259 Rev B

Regulatory Compliance User Notice:

FCC:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

ISED:

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada’s licence-exempt RSS(s). Operation is subject to the following two conditions:

This device may not cause interference.

This device must accept any interference, including interference that may cause undesired operation of the device.

L’émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d’Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes :

L’appareil ne doit pas produire de brouillage;

L’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement.

CAUTION:

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTES:

*. 866 Mhz. operation is not supported in this version.