SMART WIRES

REIMAGINE THE GRID

D000587 Rev C

SmartBypass™ User Guide

List of Revisions

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Preface

1 Scope

This user guide applies to the operation and purpose of the SmartBypass. It also provides the FCC compliance information.

2 Purpose

The purpose of this document is describe to the user the purpose, components, operation and communication method of the SmartBypass.

3 Abbreviations

Term	Definition
A RMS	Amperes Root Mean Squared
SCR	Silicon Controlled Rectifier
MOV	Metal Oxide Varistor
NC	Normally Closed
ISM	Industrial, Scientific, and Medical Radio Band

Table 1: Abbreviations

4 General Product Overview

Smart Wires' SmartBypass technology is designed to protect other Smart Wires series compensation devices. The SmartBypass does this by automatically activating switches to carry the transmission line current during line faults or when operators desire to manually bypass the series compensation. The SmartBypass technology builds on the protection used in other Smart Wires products, like the Power Guardian 390 which has internal protection on the secondary side of its injection transformer. The SmartBypass is installed on a single-phase basis, meaning that for most transmission deployments, there will be an equal number of units per phase.

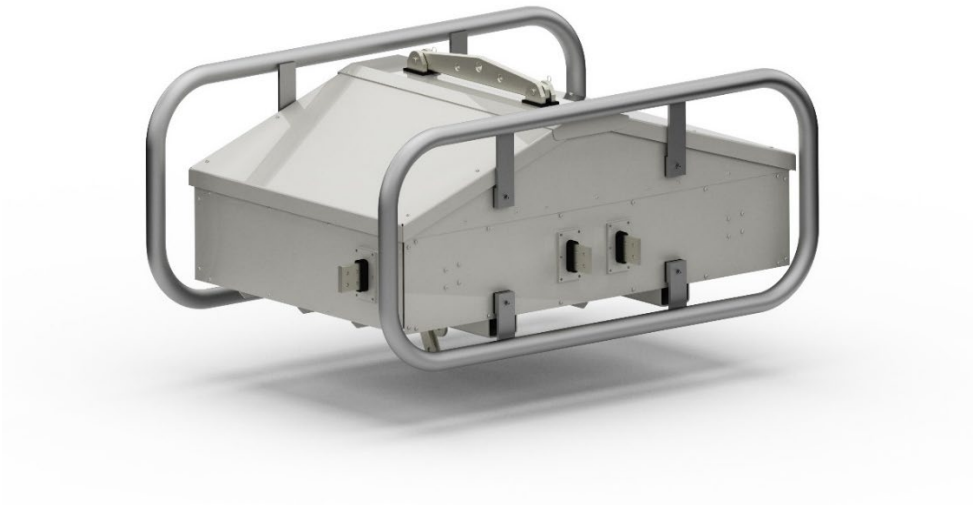

Figure 4-1: SmartBypass with Mounting Bracket and Corona Rings

5 Electrical Operation of Single Module

The SmartBypass comes in several different models as shown in Table 2. The SmartBypass can operate at line currents of thousands of amps during normal bypass operation and withstand different fault current levels depending on the model. The SmartBypass models are differentiated by continuous current rating and maximum fault current rating. For example, the SmartBypass 4000-63 is rated for continuous line currents up to 4000 A RMS and fault currents of up to 63 kA RMS for 1 second.

The SmartBypass provides telemetry when operating in monitoring mode or injection mode. The SmartBypass operates to protect the power electronic components within Smart Wires series compensation devices by operating when the devices are switched in series with the line, when a fault occurs on the line and when the devices are switched out of series with the line. The SmartBypass can bypass Smart Wires series compensation devices within in 1 msec of the inception of a fault, thus ensuring the protection of internal power electronics of the devices. Figure 5-1 illustrates the basic electrical configuration of the SmartBypass.

5.1 Enclosure

The enclosure of the SmartBypass is connected to the transmission line at one terminal, this ensures the enclosure is at line potential. All other terminals and components are insulated from the enclosure.

5.2 Inductors

Each SmartBypass contains two small inductors, represented by L1 and L2, one on either side of the normally closed vacuum series link, S1. The inductors ensure the voltage across S1 is close to 0 V when S1 opens and closes, extending the lifetime of this component.

5.3 Normally Closed (NC) Contactor

The normally closed contactor, represented by S1-NC, carries the current when the Smart Wires series compensation devices are bypassed under normal conditions. S1 is what determines the continuous current rating of the SmartBypass, S1 can carry either 2000 A RMS continuously or 4000 A RMS continuously.

5.4 Silicon Controlled Rectifiers

Each SmartBypass contains one or more pairs of anti-parallel silicon-controlled rectifier (SCR), shown as S2 in figure 2. The SCRs carry the line current in the case of a fault or when S1 operates to switch in or switch out the Smart Wires series compensation devices.

5.5 Metal Oxide Varistor

The SmartBypass is equipped with a metal oxide varistor, MOV1 in Figure5-1. MOV1 protects the internal components of the SmartBypass from high current events such as lightning strikes.

Model	Continuous Current Rating (A RMS)	Maximum 2-Hour Emergency Current (A RMS)	Fault Current Rating (kA RMS for 1 s)	Peak Fault Current (kA)	
				60 Hz	*50 Hz*
SmartBypass 2000-63	2000	2160	63.0	164.0	158.0
SmartBypass 2000-50	2000	2160	50.4	131.0	126.0
SmartBypass 2000-38	2000	2160	38.0	98.8	95.0
SmartBypass 2000-25	2000	2160	25.2	65.0	63.0
SmartBypass 2000-12	2000	2160	12.6	32.0	31.5
SmartBypass 4000-63	4000	4320	63.0	164.0	158.0
SmartBypass 4000-50	4000	4320	50.4	131.0	126.0
SmartBypass 4000-38	4000	4320	38.0	98.8	95.0
SmartBypass 4000-25	4000	4320	25.2	65.0	63.0
SmartBypass 4000-12	4000	4320	12.6	32.0	31.5

Table 2: SmartBypass Models and Specifications

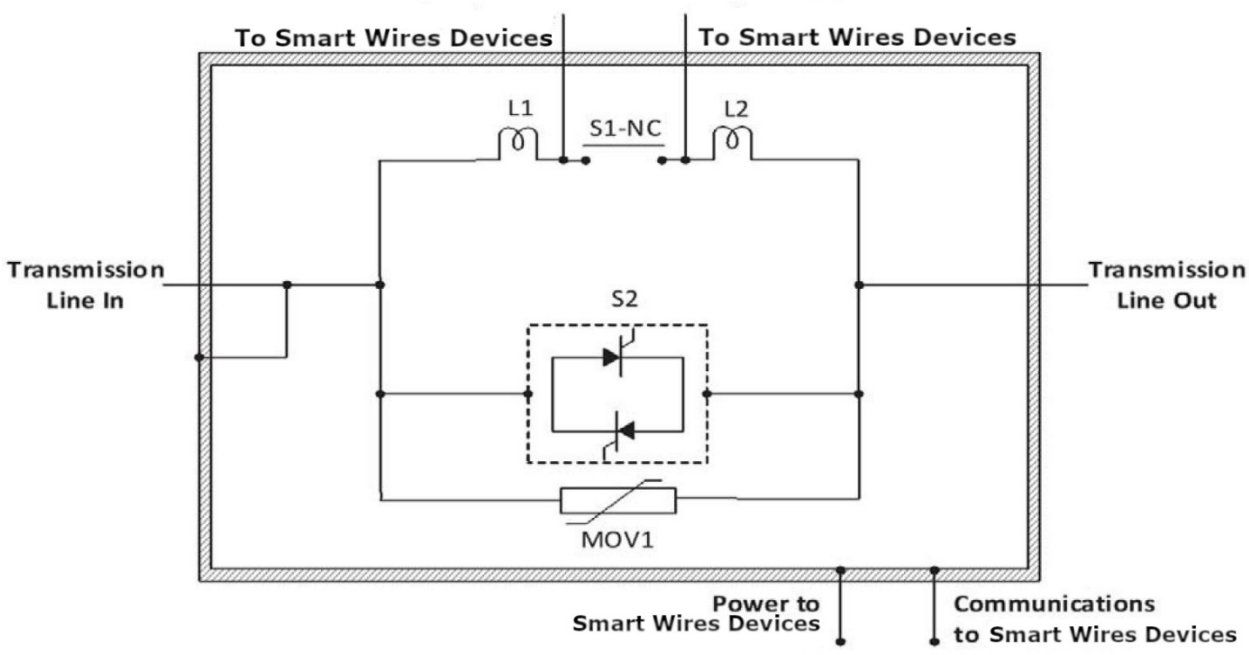

Figure 5-1: SmartBypass System Diagram

6 SmartBypass Control

The SmartBypass has 2 distinct modes of operation, the performance and operation of the modes is described below.

1. Monitoring Mode – The normally closed contactor S1 is closed. The SmartBypass bypasses the Smart Wires series compensation devices across its terminals so no reactance is injected. The SmartBypass can transmit telemetry data in this mode. When the SmartBypass senses a line current which exceeds its rated tolerance, it automatically bypasses the Smart Wires series compensation devices with fast-acting antiparallel SCR switches (S2), entering monitoring mode within 1 millisecond.

2. Injection Mode – The normally closed contactor S1 is open. SmartBypass allows the Smart Wires series compensation devices to inject their reactance across its terminals in series with the line.

7 Product Components

The individual components of the SmartBypass are shown in Figure 7-1.

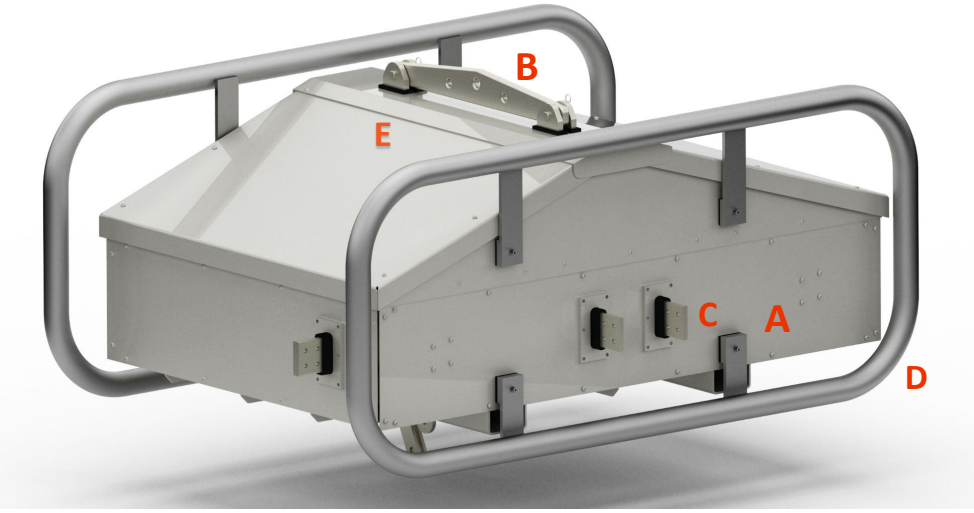

Figure 7-1: Individual Components of the SmartBypass

A – Protection Circuitry – the Silicon Controlled Rectifiers (SCRs) are housed longitudinally along the interior floor of the unit.

B – Yoke Plate – this plate is the fixture point for insulators supporting the unit from above.

C – NEMA Pads – these are the electrical connection points for the unit.

D – Corona Rings – surround both latitudinal sides of the device to prevent corona at high voltages.

E – Normally Closed Contactor – the normally closed contactor is housed across the top of the inside of the enclosure parallel to the yoke plate.

8 Wireless Communication

The SmartBypass has the capability to communicate over a secure wireless Industrial, Scientific and Medical (ISM) band. The ISM Secure Wireless Mesh is the communication network protocol based on Radio Frequency wireless communication for between ground-based equipment and the SmartBypass. The SmartBypass support the 2.4 Ghz band in the US. The SmartBypass uses a frequency-hopping spread-spectrum solution. It does not occupy a single user-selectable-channel like, for example, WiFi does.

9 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.

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

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