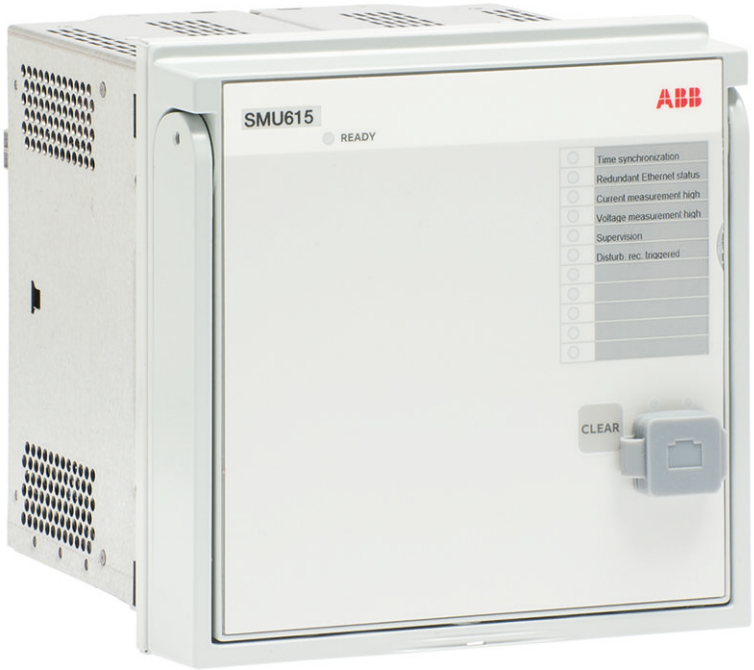
RELION®

Substation Merging Unit SMU615

Product Guide



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Conformity

This product complies with following directive and regulations.

Directives of the European parliament and of the council:

- Electromagnetic compatibility (EMC) Directive 2014/30/EU
- Low-voltage Directive 2014/35/EU
- RoHS Directive 2011/65/EU

UK legislations:

- Electromagnetic Compatibility Regulations 2016
- Electrical Equipment (Safety) Regulations 2016
- The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

These conformities are the result of tests conducted by the third-party testing in accordance with the product standard EN / BS EN 60255-26 for the EMC directive / regulation, and with the product standards EN / BS EN 60255-1 and EN / BS EN 60255-27 for the low voltage directive / safety regulation.

The product is designed in accordance with the international standards of the IEC 60255 series.

1. Description

SMU615 is a dedicated substation merging unit intended for measuring current and voltage signals from the instrument transformers and merging them into the standard digital output format that other devices can further use for various power system protection application purposes. SMU615 itself includes no protection functionality but it offers the physical interface into the switchgear primary equipment, that is, circuit breaker, disconnector and earthing switch. SMU615 is a member of ABB's Relion® product family and is characterized by the compactness, simplicity and withdrawable-unit design.

SMU615 has been designed to unleash the full potential of the IEC 61850 standard for communication and interoperability in the digital substations. SMU615 supports process bus according to IEC 61850-9-2 LE with IEEE 1588 v2 time synchronization and both conventional CT/VT inputs and sensor inputs.

2. Application configurations

SMU615 is fully configured to perform its designed primary function in the system as a merging unit and it includes only the relevant functions needed for maximum simplicity.

SMU615 is available in two alternative application configurations that can be selected depending on the amount of additional physical interfaces required. Both the application configurations can be selected either with conventional CT/VT inputs or with sensor inputs.

The merging unit is delivered from the factory with a default configuration including its internal connections. System level connections for the sampled measured values (SMV) and GOOSE signals are required between the devices.

Table 1: Application configurations

Description	Std.conf.
Merging unit with analog inputs	A
Merging unit with analog inputs, binary I/O and remote control	B

Table 2: Supported functions

Function	IEC 61850	A	B
Measurement			
Disturbance recorder	RDRE	1	1
Three-phase current measurement	CMMXU	1	1
Sequence current measurement	CSMSQI	1	1
Residual current measurement	RESCMMXU	1	1
Three-phase voltage measurement	VMMXU	1	1
Sequence voltage measurement	VSMSQI	1	1
Three-phase power and energy measurement	PEMMXU	1	1
Frequency measurement	FMMXU	1	1

Table continues on the next page

Function	IEC 61850	A	B
IEC 61850-9-2 LE sampled value sending	SMVSENDER	1	1
Condition monitoring and supervision			
Circuit-breaker condition monitoring	SSCBR		1
Trip circuit supervision	TCSSCBR	2 [1]	2
Current circuit supervision	CCSPVC	1	1
Fuse failure supervision	SEQSPVC	1	1
Arc detection	ARCDSARC	(3)	(3)
Control			
Circuit-breaker control	CBXCBR		1
Disconnector control	DCXSWI		2
Earthing switch control	ESXSWI		1
Disconnector position indication	DCSXSWI		2
Earthing switch indication	ESSXSWI		1
Other			
Minimum pulse timer (2 pcs)	TPGAPC	4	4
Minimum pulse timer (2 pcs, second resolution)	TPSGAPC	1	1
Minimum pulse timer (2 pcs, minute resolution)	TPMGAPC	1	1
Pulse timer (8 pcs)	PTGAPC	2	2
Time delay off (8 pcs)	TOFGAPC	4	4
Time delay on (8 pcs)	TONGAPC	4	4
Set-reset (8 pcs)	SRGAPC	4	4
Move (8 pcs)	MVGAPC	2	2
Generic control point (16 pcs)	SPCGAPC	2	2
Master trip	TRPPTRC	2 [1]	5

1, 2, ... = Number of included instances. The instances of a function represent the number of identical function blocks available in the application configuration.

() = optional

[1] Not included in the default application configuration

3. Communication

The IEC 61850 protocol is a core part of the SMU615 merging unit. Both Edition 1 and Edition 2 versions of the standard are supported.

The IEC 61850 communication implementation supports monitoring and control functions. Additionally, parameter settings and disturbance recordings can be accessed using the IEC 61850 protocol. Disturbance recordings are available to any Ethernet-based application in the standard COMTRADE file format. The merging unit supports simultaneous event reporting to five different clients on the station bus and can exchange data with other devices using the IEC 61850 protocol.

SMU615 supports IEC 61850 process bus by sending sampled values of analog currents and voltages. The measured values are transferred as sampled values using the IEC 61850-9-2 LE protocol. Merging units with process bus based applications use IEEE 1588 for high accuracy time synchronization.

The merging unit can send and receive signals from other devices using the IEC 61850-8-1 GOOSE (Generic Object Oriented Substation Event) profile. Binary GOOSE messaging can, for example, be employed for interacting with the switchgear primary equipment when utilizing the merging unit's physical interface. The merging unit meets the GOOSE performance requirements for tripping applications in distribution substations as defined by the IEC 61850 standard (<10 ms data exchange between the devices).

For redundant Ethernet communication, the merging unit offers either two optical or two galvanic Ethernet network interfaces. A third port with galvanic Ethernet network interface is also available. The third Ethernet interface provides connectivity for any other Ethernet device to an IEC 61850 station bus inside a switchgear bay, for example, a connection to a Remote I/O. Ethernet network redundancy can be achieved using the high-availability seamless redundancy (HSR) protocol or the parallel redundancy protocol (PRP).

The IEC 61850 standard specifies network redundancy which improves the system availability for substation communication. The network redundancy is based on two complementary protocols defined in the IEC 62439-3 standard: PRP and HSR. Both the protocols are able to overcome a failure of a link or switch with a zero switch-over time. In both the protocols, each network node has two identical Ethernet ports dedicated for one network connection. The protocols rely on the duplication of all transmitted information and provide a zero switch-over time if the links or switches fail, thus fulfilling all the stringent real-time requirements of substation automation.

In PRP each network node is attached to two independent networks operated in parallel. The networks are completely separated to ensure failure independence and can have different topologies. The parallel network operation provides zero-time recovery and continuous checking of redundancy to avoid failures.

HSR applies the PRP principle of parallel operation to a single ring. For each message sent, the node sends two frames, one through each port. Both the frames circulate in opposite directions over the ring. Every node forwards the frames it receives from one port to another to reach the next node. When the originating sender node receives the frame it sent, it discards the frame to avoid loops. The HSR ring with SMU615 merging units supports the connection of up to 30 devices. If more than 30 devices are to be connected, it is recommended to split the network into several rings to guarantee the performance for real-time applications.

All communication connectors, except for the front port connector, are placed on integrated communication modules. The merging unit can be connected to Ethernet-based communication systems via the RJ-45 connector (100Base-TX) or the fiber-optic LC connector (100Base-FX).

The merging unit supports the following high accuracy time synchronization method with a time-stamping resolution of 4 µs required in process bus applications and is included in all variants.

- PTP (IEEE 1588) v2 with Power Profile

IEEE 1588 v2 features

- Ordinary Clock with Best Master Clock algorithm
- One-step Transparent Clock for Ethernet ring topology
- 1588 v2 Power Profile

- Receive (slave): 1-step/2-step
- Transmit (master): 1-step
- Layer 2 mapping
- Peer to peer delay calculation
- Multicast operation

The required accuracy of the grandmaster clock is +/-1 µs. The merging unit can work as a master clock per BMC algorithm if the external grandmaster clock is not available for short term.

4. Application

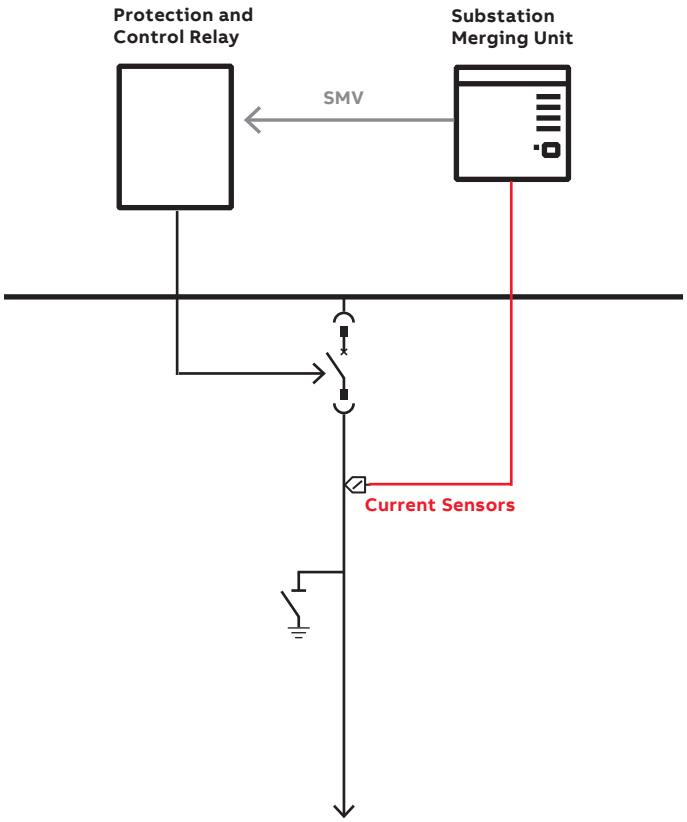

Figure 1: SMU615 sending current measurements as sampled measured values to a protection relay

As illustrated in *Figure 1*, SMU615 can measure the feeder currents with sensors and send them as sampled measured values over the Ethernet.

The protection relay on the same feeder can receive the sampled measured values over the Ethernet and use them for protection purposes.

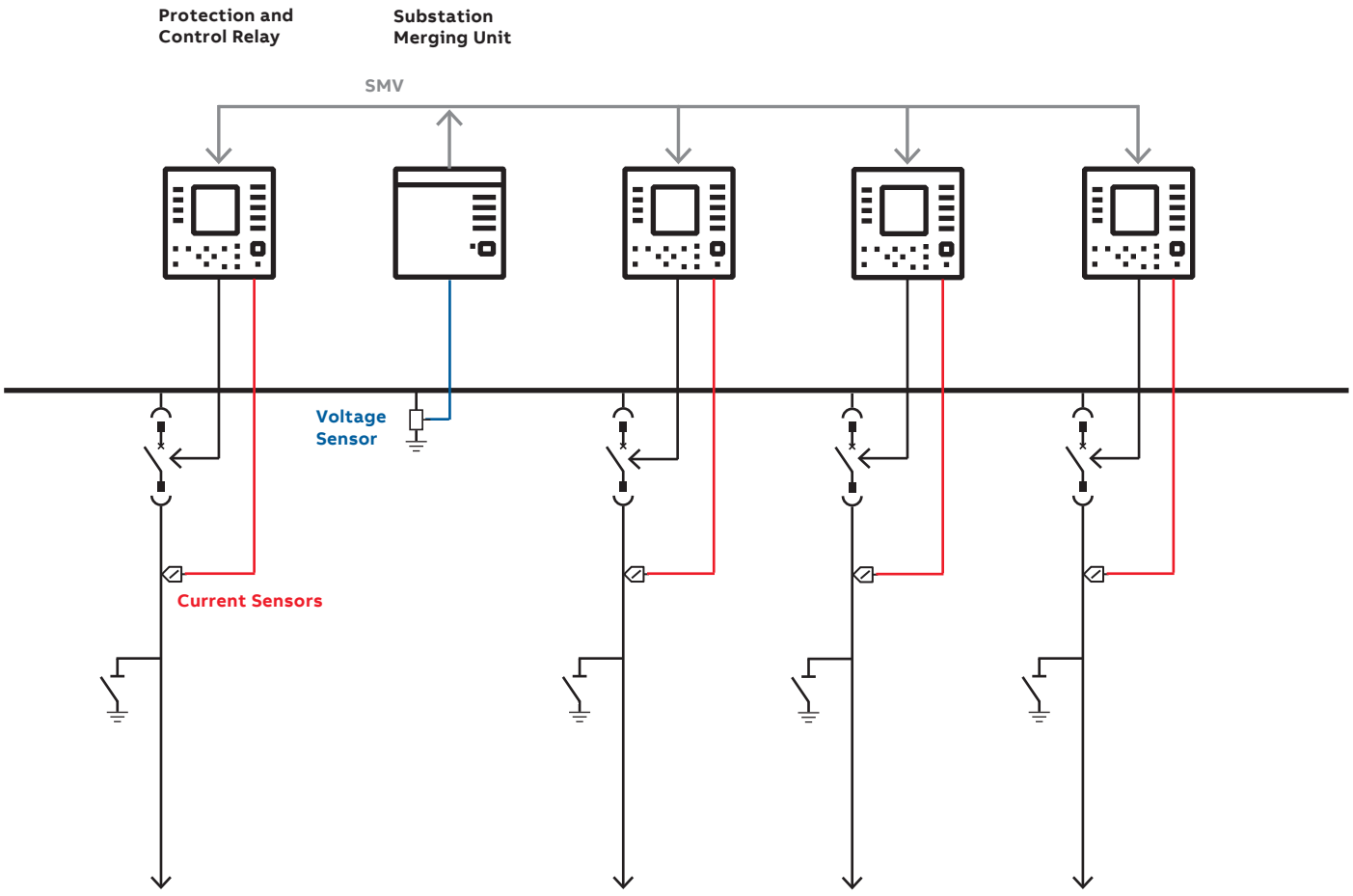

Figure 2: SMU615 sending voltage measurements as sampled measured values to protection relays

In *Figure 2* SMU615 measures the voltages in the substation and sends them as sampled measured values over the Ethernet. Within the substation, the protection relays with phase voltage based functions can receive the values and use them instead of the physically measured voltages from VTs or voltage sensors.

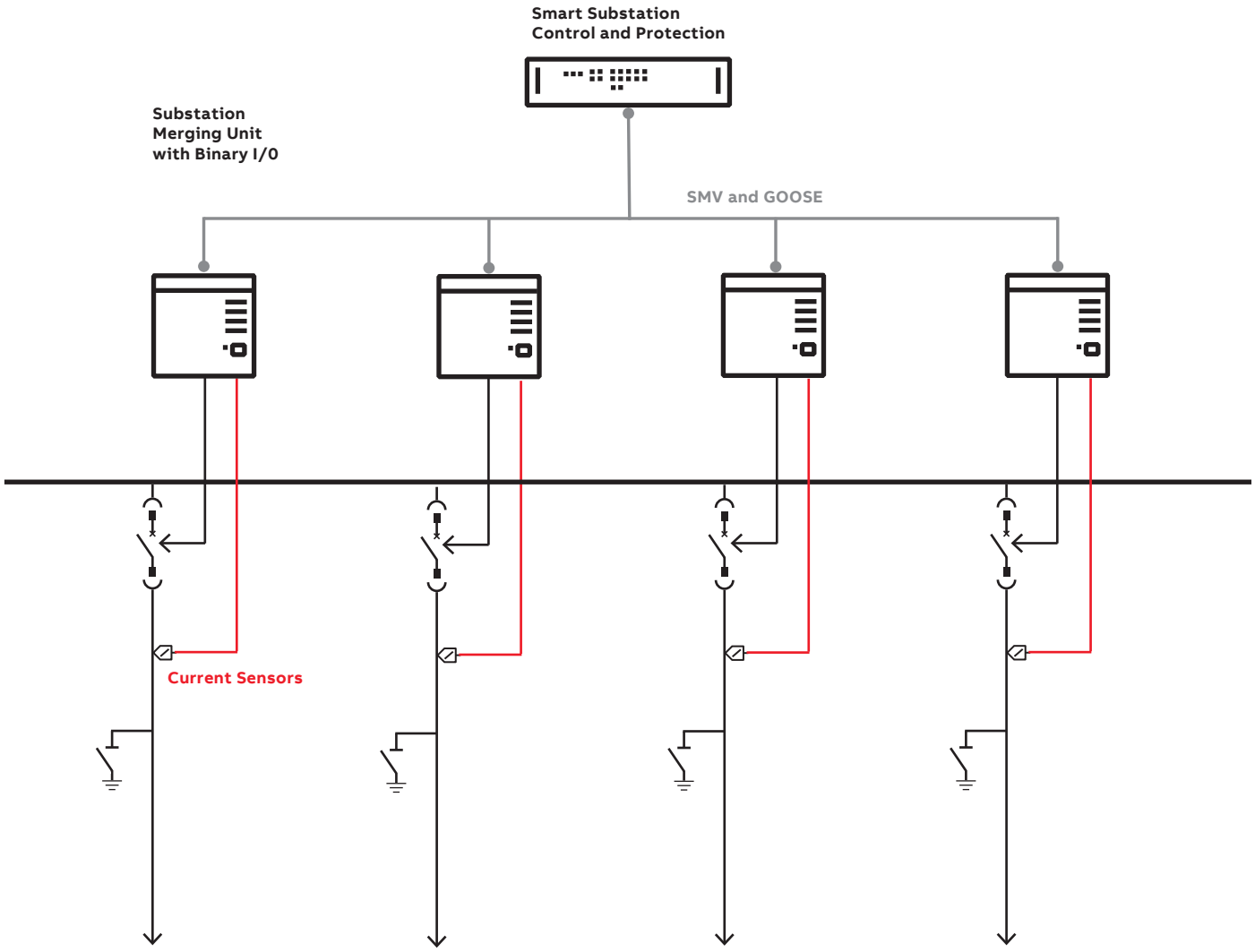

Figure 3: Smart substation control and protection SSC600 with SMU615

In *Figure 3* the SMU615 devices measure the feeder currents in the substation and send them as sampled measured values over the Ethernet. The centralized protection device in the substation can receive the SMVs from each SMU615 over the Ethernet and use these values for the protection of each feeder. SMU615 offers the physical interface to the switchgear primary equipment, that is, circuit breaker, disconnector and earthing switch accessible with the GOOSE communication.

5. Process bus

The process bus utilizing IEC 61850-9-2 LE together with the IEEE 1588 v2 accurate time synchronization provides sampled measured values over the Ethernet communication. The sampled measured values comprise four currents and four voltages, that is, phase and residual currents as well as phase and residual voltages. The residual voltage is calculated from the measured phase voltages. The sample rate is 4000/4800 samples per second depending on the selected system frequency.

6. Self-supervision

The merging unit’s built-in self-supervision system continuously monitors the state of the merging unit's hardware and the operation of the merging unit's software. Any fault or malfunction detected is used for alerting the operator.

A permanent merging unit fault blocks the application to prevent incorrect operation.

7. Secondary circuit supervision

Current circuit supervision is used for detecting faults in the current transformer secondary circuits. Upon detecting a fault, the current circuit supervision function activates an alarm. The current circuit supervision function calculates the sum of the phase currents from the protection cores and compares it to the measured single reference current from a core balance current transformer or from separate cores in the phase current transformers.

The fuse failure supervision detects failures between the voltage measurement circuit and the merging unit. The failures are detected either by the negative sequence-based algorithm or by the delta voltage and delta current algorithm. Upon detecting a fault, the fuse failure supervision function activates an alarm.

The trip-circuit supervision continuously monitors the availability and operability of the trip circuit. It provides open circuit monitoring both when the circuit breaker is in its closed and in its open position. It also detects loss of circuit-breaker control voltage.

8. Access control

To protect the merging unit from unauthorized access and to maintain information integrity, the merging unit is provided with a four-level, role based authentication system with administrator-programmable individual passwords for the viewer, operator, engineer and administrator levels. The access control applies to the Web HMI and PCM600.

9. Inputs and outputs

Depending on the analog input option selected, the merging unit is equipped either with three phase-current inputs, one residual-current input and three phase-voltage inputs or alternatively with one conventional residual current (Io 0.2/1 A) input and three sensor inputs for the direct connection of three combi sensors with RJ-45 connectors. As an alternative to the combi sensors, separate current and voltage sensors can be used utilizing adapters.

The phase current inputs are rated 1/5 A and the residual current input is 0.2/1 A. The three phase voltage inputs cover the rated voltages 60...210 V. Both phase-to-phase voltages and phase-to-earth voltages can be connected. However, phase-to-earth is recommended as the residual voltage can only be derived from the phase-to-earth voltages.

Enhanced with optional hardware and software, the merging unit also features three light detection channels for arc fault detection in the circuit breaker, busbar and cable compartment of metal enclosed indoor switchgear. The arc fault detection sensor interface is available on the optional communication module. The tripping decision is made by another protection device also typically combining several different criteria like checking of the fault current level.

Depending on the selected application configuration, the merging unit includes either 4 PO + 2 SO (a total of 6 binary outputs) or, when selected with the physical interface into the switchgear primary equipment, 8 binary inputs and 4 PO + 2 SO + 3 HSO (a total of 9 binary outputs). The high-speed binary outputs (HSO) decrease the total operate time typically with 4...6 ms compared to the normal power outputs.

All binary input and output contacts are freely configurable with the signal matrix or application configuration functionality of PCM600.

Table 3: Input/output overview

Appl. conf.	Order code digit		Analog channels			Binary channels	
	8	9-10	CT	VT	Combi sensor	BI	BO
A	A	AA	4	3	-	-	4PO+2SO
A	A	BA/CA	1	-	3	-	4PO+2SO
B	B	AB	4	3	-	8	4PO+2SO+3HSO
B	B	BB/CB	1	-	3	8	4PO+2SO+3HSO

10. Remote control and trip

SMU615 integrates functionality for the control of a circuit breaker by means of remote control commands. In addition to circuit-breaker control, the merging unit features two control blocks which are intended for the motor-operated control of disconnectors or a circuit breaker truck and for their position indications. Further, the merging unit offers one control block which is intended for the motor-operated control of one earthing switch control and its position indication. The control functionality is only available in application configuration B.

Two physical binary inputs and two physical binary outputs are needed in the merging unit for each controllable primary device taken into use. Application configuration B is fully configured to control one circuit breaker and to indicate the position of one circuit breaker, disconnector and earthing switch. The application configuration can be further modified to release some binary outputs which have been originally configured for other purposes.

The suitability of the merging unit's binary outputs, which have been selected for controlling of primary devices, should be carefully verified, for example, by considering the make and carry as well as the breaking capacity. In case the requirements for the control circuit of the primary device are not met, the use of external auxiliary relays should be considered.

SMU615 does not include protection functionality and it is not designed to make trip decisions. After the tripping decision is made by another protection device in the system, the opening of the circuit breaker can be performed by using the physical outputs of the merging unit. Application configuration B is ready-configured for receiving the tripping commands over GOOSE communication when the GOOSE signals are first connected from another device. High-speed binary outputs (HSO) can be used when the total operate time must be decreased.

11. Technical data

11.1 Dimensions

Table 4: Dimensions

Description	Value	
Width	Frame	177 mm
	Case	164 mm
Height	Frame	177 mm (4U)
	Case	160 mm
Depth		201 mm (153 + 48 mm)
Weight	Complete merging unit	4.1 kg
	Plug-in unit only	2.1 kg

11.2 Power supply

Table 5: Power supply

Description	Type 1	Type 2
Nominal auxiliary voltage U_n	100, 110, 120, 220, 240 V AC, 50 and 60 Hz	24, 30, 48, 60 V DC
	48, 60, 110, 125, 220, 250 V DC	
Maximum interruption time in the auxiliary DC voltage without resetting the merging unit	50 ms at U_n	
Auxiliary voltage variation	38...110% of U_n (38...264 V AC)	50...120% of U_n (12...72 V DC)
	80...120% of U_n (38.4...300 V DC)	
Start-up threshold		19.2 V DC (24 V DC × 80%)
Burden of auxiliary voltage supply under quiescent (P_q)/operating condition	DC <13.0 W (nominal)/<18.0 W (max.) AC <16.0 W (nominal)/<21.0 W (max.)	DC <13.0 W (nominal)/<18.0 W (max.)
Ripple in the DC auxiliary voltage	Max 15% of the DC value (at frequency of 100 Hz)	
Fuse type	T4A/250 V	

11.3 Energizing inputs

Table 6: Energizing inputs

Description		Value	
Rated frequency		50/60 Hz	
Current inputs	Rated current, I_n	0.2/1 A	1/5 A
	Thermal withstand capability:		
	• Continuously	4 A	20 A
	• For 1 s	100 A	500 A
	Dynamic current withstand:		
	• Half-wave value	250 A	1250 A
	Input impedance	<100 mΩ	<20 mΩ
Voltage inputs	Rated voltage	60...210 V AC	
	Voltage withstand:		
	• Continuous	240 V AC	
	• For 10 s	360 V AC	
	Burden at rated voltage	<0.05 VA	

11.4 Energizing Inputs (SIM0002)

Table 7: Energizing Inputs (SIM0002)

Description		Value
Current sensor input	Rated current voltage (in secondary side)	75 mV ... 9000 mV [1]
	Continuous voltage withstand	125 V
	Input impedance at 50/60Hz	2...3 MΩ [2]
Voltage sensor input	Rated voltage	6 kV … 30 kV [3]
	Continuous voltage withstand	50 V
	Input impedance at 50/60Hz	3 MΩ

[1] Equals the current range of 40….4000 A with 80A, 3mV/Hz Rogowski
[2] Depending on the used nominal current (hardware gain)
[3] This range is covered (up to 2*rated) with sensor division ratio of 10 000:1

11.5 Energizing Inputs (SIM0005)

Table 8: Table 9: Energizing Inputs (SIM0005)

Description		Value
Current sensor input	Rated current voltage (in secondary side)	75 mV ... 9000 mV [1]
	Continuous voltage withstand	125 V
	Input impedance at 50/60Hz	2 MΩ
Voltage sensor input	Rated voltage	6 kV … 40,5 kV [2]
	Continuous voltage withstand	50 V
	Input impedance at 50/60Hz	2 MΩ

11.6 Binary inputs

Table 9: Binary inputs

Description	Value
Operating range	±20% of the rated voltage
Rated voltage	24...250 V DC
Current drain	1.6...1.9 mA
Power consumption	31.0...570.0 mW
Threshold voltage	16...176 V DC
Reaction time	<3 ms

11.7 Signal outputs

Table 10: Signal output X100: SO1

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	5 A
Make and carry for 3.0 s	15 A
Make and carry for 0.5 s	30 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at 48/110/220 V DC	1 A/0.25 A/0.15 A
Minimum contact load	100 mA at 24 V AC/DC

[1] Equals the current range of 40….40000 A with 80A, 3mV/Hz Rogowski
[2] Covers 6 kV…40.5 kV sensors with division ratio of 10 000:1. Secondary voltages 600mV/√3 … 4,05V / √3. Range up to 2 x Rated

Table 11: Signal outputs and IRF output

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	5 A
Make and carry for 3.0 s	10 A
Make and carry 0.5 s	15 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at 48/110/220 V DC	1 A/0.25 A/0.15 A
Minimum contact load	10 mA at 5 V AC/DC

11.8 Double-pole power output relays with TCS function

Table 12: Double-pole power output relays with TCS function

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	8 A
Make and carry for 3.0 s	15 A
Make and carry for 0.5 s	30 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at 48/110/220 V DC (two contacts connected in series)	5 A/3 A/1 A
Minimum contact load	100 mA at 24 V AC/DC
Trip-circuit supervision (TCS):	
• Control voltage range	20...250 V AC/DC
• Current drain through the supervision circuit	~1.5 mA
• Minimum voltage over the TCS contact	20 V AC/DC (15...20 V)

11.9 Single-pole power output relays

Table 13: Single-pole power output relays

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	8 A
Make and carry for 3.0 s	15 A
Make and carry for 0.5 s	30 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at 48/110/220 V DC	5 A/3 A/1 A
Minimum contact load	100 mA at 24 V AC/DC

11.10 High-speed output HSO with BIO0007

Table 14: High-speed output HSO with BIO0007

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	6 A
Make and carry for 3.0 s	15 A
Make and carry for 0.5 s	30 A
Breaking capacity when the control-circuit time constant L/R <40 ms, at 48/110/220 V DC	5 A/3 A/1 A
Operate time	<1 ms
Reset	<20 ms, resistive load

11.11 Front port Ethernet interfaces

Table 15: Front port Ethernet interfaces

Ethernet interface	Protocol	Cable	Data transfer rate
Front	TCP/IP protocol	Standard Ethernet CAT 5 cable with RJ-45 connector	10 MBits/s

11.12 Station communication link, fiber optic

Table 16: Station communication link, fiber optic

Connector	Fiber type[1]	Wave length	Typical max. length[2]	Permitted path attenuation[3]
LC	MM 62.5/125 or 50/125 µm glass fiber core	1300 nm	2 km	<8 dB

11.13 Degree of protection of flush-mounted merging unit

Table 17: Degree of protection of flush-mounted merging unit

Description	Value
Front side	IP 54
Rear side, connection terminals	IP 20

[1] (MM) multi-mode fiber, (SM) single-mode fiber
[2] Maximum length depends on the cable attenuation and quality, the amount of splices and connectors in the path.
[3] Maximum allowed attenuation caused by connectors and cable together

11.14 Sampled measured values accuracy

Table 18: Sampled measured values accuracy

Description	Value
Phase current	20%...6000%I_n [1] Amplitude: 1% or ±0.003×I_n Angle: ±2º
Residual current	1%...5%I_n Amplitude: 0.001×I_n Angle: ±4º
	5%...6000%I_n Amplitude: ±1% Angle: ±1º
Phase voltage	80%...120% of U_n Amplitude: ±0.5% Angle: ±1º
Residual voltage (calculated)	1%...100% of U_n Amplitude: ±0.5% or ±0.001×U_n Angle: ±2º

[1] In the 80 A/0.150 V at 50 Hz sensor applications the maximum range depends on the application nominal:

….833 A (...31.237 mV/Hz) corresponds to 6000%I_n

833...1250 A (31.237...46.875 mV/Hz) corresponds to 4000%I_n

1250...2500 A (46.875...93.750 mV/Hz) corresponds to 2000%I_n

2500...4000 A (93.750...150.000 mV/Hz) corresponds to 1250%I_n

11.15 Environmental conditions

Table 19: Environmental conditions

Description	Value
Operating temperature range	-25...+55°C (continuous)
Short-time service temperature range	-40...+85°C (<16 h) [1] [2]
Relative humidity	<93%, non-condensing
Atmospheric pressure	86...106 kPa
Altitude	Up to 2000 m
Transport and storage temperature range	-40...+85°C

11.16 Electromagnetic compatibility tests

Table 20: Electromagnetic compatibility tests

Description	Type test value	Reference
Slow damped oscillatory wave immunity test • Common mode • Differential mode	2.5 kV 2.5 kV	IEC 60255-26:2013 IEC 61000-4-18:2006+A1:2010 ANSI/IEEE C37.90.1-2012 GB 14598.26-2015
Electrostatic discharge test • Contact discharge • Air discharge	8 kV 15 kV	IEC 60255-26:2013 IEC 61000-4-2:2008 GB 14598.26-2015
Conducted immunity test	10 V (rms) f = 150 kHz...80 MHz	IEC 60255-26:2013 IEC 61000-4-6:2008 GB 14598.26-2015
Radiated electromagnetic field immunity test	20 V/m (rms) f = 80 MHz...1 GHz; 1.4...2.7 GHz	IEC 60255-26:2013 IEC 61000-4-3:2006 ANSI/IEEE C37.90.2-2004 GB 14598.26-2015
Electrical fast transient/burst immunity test	4 kV	IEC 60255-26:2013 IEC 61000-4-4:2012 ANSI/IEEE C37.90.1-2012 GB 14598.26-2015

Table continues on the next page

[1] Degradation in MTBF and HMI performance outside the temperature range of -25...+55 °C
[2] For marging units with an LC communication interface the maximum operating temperature is +70 °C

Description	Type test value	Reference
Surge immunity test • Communication • Other ports	0.5 kV, line-to-earth 1 kV, line-to-earth 2 kV, line-to-earth 0.5 kV, line-to-earth 1 kV, line-to-earth 2 kV, line-to-earth 0.5 kV, line-to-line 1 kV, line-to-line	IEC 60255-26:2013 IEC 61000-4-5:2005 GB 14598.26-2015
Power frequency magnetic field immunity test • Continuous • 1...3 s	300 A/m 1000 A/m	IEC 60255-26:2013 IEC 61000-4-8:2009 GB 14598.26-2015
Pulse magnetic field immunity test	1000 A/m 6.4/16 µs	IEC 61000-4-9:2001 GB 14598.26-2015
Damped oscillatory magnetic field immunity test • 2 s • 1 MHz	100 A/m 400 transients/s	IEC 61000-4-10:2001 GB 14598.26-2015
A.C. and D.C. voltage dips and interruptions test	30%/10 ms 60%/100 ms 60%/1000 ms >95%/5000 ms	IEC 60255-26:2013 IEC 61000-4-11:2004 IEC 61000-4-29:2000 GB 14598.26-2015
Power frequency immunity test • Common mode • Differential mode	Binary inputs only 300 V rms 150 V rms	IEC 60255-26:2013 IEC 61000-4-16:1998+A2:2009 GB 14598.26-2015
Emission tests • Conducted 0.15...0.50 MHz 0.5...30 MHz • Radiated 30...230 MHz 230...1000 MHz 1…3 GHz 3…6 GHz	<79 dB (µV) quasi peak <66 dB (µV) average <73 dB (µV) quasi peak <60 dB (µV) average <40 dB (µV/m) quasi peak, measured at 10m distance <47 dB (µV/m) quasi peak, measured at 10m distance <76 dB (µV/m) peak <56 dB (µV/m) average, measured at 3m distance <80 dB (µV/m) peak <60 dB (µV/m) average, measured at 3m distance	IEC 60255-26：2013 CISPR 11:2009+A1:2010 CISPR 22：2008 GB 14598.26-2015

11.17 Insulation tests

Table 21: Insulation tests

Description	Type test value	Reference
Dielectric tests	2 kV, 50 Hz, 1 min 500 V, 50 Hz, 1 min, communication	IEC 60255-272013
Impulse voltage test	5 kV, 1.2/50 µs, 0.5 J 1 kV, 1.2/50 µs, 0.5 J, communication	IEC 60255-272013
Insulation resistance measurements	>100 MΩ, 500 V DC	IEC 60255-272013

11.18 Mechanical tests

Table 22: Mechanical tests

Description	Reference	Requirement
Vibration tests (sinusoidal)	IEC 60068-2-6 (test Fc) IEC 60255-21-1: 1988	Class 2
Shock and bump test	IEC 60068-2-27 (test Ea shock) IEC 60068-2-29 (test Eb bump) IEC 60255-21-2: 1988	Class 2

11.19 Environmental tests

Table 23: Environmental tests

Description	Type test value	Reference
Dry heat test	• 96 h at +55ºC • 16 h at +85ºC	IEC 60068-2-2:2007
Dry cold test	• 96 h at -25ºC • 16 h at -40ºC	IEC 60068-2-1:2007
Damp heat test	• 6 cycles (12 h + 12 h) at +25°C…+55°C, humidity >93%	IEC 60068-2-30:2005
Change of temperature test	• 5 cycles (3 h + 3 h) at -25°C...+55°C	IEC 60068-2-14:2009

11.20 Product safety

Table 24: Product safety

Description	Reference
LV directive	2014/35/EU
Standard	EN / BS EN 60255-27 EN / BS EN 60255-1

11.21 EMC compliance

Table 25: EMC compliance

Description	Reference
EMC directive	2014/30/EU
Standard	EN / BS EN 60255-26

11.22 RoHS compliance

Table 26: RoHS compliance

Description
RoHS Directive 2011/65/EU

11.23 Condition monitoring and supervision functions

11.23.1 Circuit-breaker condition monitoring (SSCBR)

Table 27: Circuit-breaker condition monitoring (SSCBR)

Characteristic	Value
Current measuring accuracy	±1.5% or ±0.002 × I_n (at currents in the range of 0.1…10 × I_n) ±5.0% (at currents in the range of 10…40 × I_n)
Operate time accuracy	±1.0% of the set value or ±20 ms
Travelling time measurement	+10 ms / -0 ms

11.23.2 Current circuit supervision (CCSPVC)

Table 28: Current circuit supervision (CCSPVC)

Characteristic	Value
Operate time [1]	<30 ms

11.23.3 Current circuit supervision (CCSPVC) main settings

Table 29: Current circuit supervision (CCSPVC) main settings

Parameter	Function	Value (Range)	Step
Start value	CCSPVC	0.05...0.20 × I_n	0.01
Max operate current	CCSPVC	1.00...5.00 × I_n	0.01

[1] Including the delay of the output contact

11.23.4 Fuse failure supervision (SEQSPVC)

Table 30: Fuse failure supervision (SEQSPVC)

Characteristic		Value	
Operate time [1]	NPS function	U_{Fault} = 1.1 × set *Neg Seq voltage Lev*	<33 ms
		U_{Fault} = 5.0 × set *Neg Seq voltage Lev*	<18 ms
	Delta function	ΔU = 1.1 × set *Voltage change rate*	<30 ms
		ΔU = 2.0 × set *Voltage change rate*	<24 ms

11.23.5 Arc detection (ARCDSARC)

Table 31: Arc detection (ARCDSARC)

Characteristic	Value		
Operate time [2]	Minimum	Typical	Maximum
	9 ms [3]	10 ms [3]	12 ms [3]
	4 ms [4]	6 ms [4]	7 ms [4]

[1] Includes the delay of the signal output contact, f_n = 50 Hz, fault voltage with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements
[2] Includes the delay of the heavy-duty output contact
[3] Normal power output
[4] High-speed power output

11.24 Measurement functions

11.24.1 Three-phase current measurement (CMMXU)

Table 32: Three-phase current measurement (CMMXU)

Characteristic	Value
Operation accuracy	Depending on the frequency of the measured current: f_n ±2 Hz
	±0.5% or ±0.002 × I_n
	(at currents in the range of 0.01...4.00 × I_n)
Suppression of harmonics	DFT: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,…
	RMS: No suppression

11.24.2 Sequence current measurement (CSMSQI)

Table 33: Sequence current measurement (CSMSQI)

Characteristic	Value
Operation accuracy	Depending on the frequency of the measured current: f/f_n = ±2 Hz
	±1.0% or ±0.002 × I_n
	at currents in the range of 0.01...4.00 × I_n
Suppression of harmonics	DFT: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,…

11.24.3 Residual current measurement (RESCMMXU)

Table 34: Residual current measurement (RESCMMXU)

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f/f_n = ±2 Hz
	±0.5% or ±0.002 × I_n
	at currents in the range of 0.01...4.00 × I_n
Suppression of harmonics	DFT: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,…
	RMS: No suppression

11.24.4 Three-phase voltage measurement (VMMXU)

Table 35: Three-phase voltage measurement (VMMXU)

Characteristic	Value
Operation accuracy	Depending on the frequency of the voltage measured: f_n ±2 Hz At voltages in range 0.01…1.15 × U_n
	±0.5% or ±0.002 × U_n
Suppression of harmonics	DFT: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,… RMS: No suppression

11.24.5 Sequence voltage measurement (VSMSQI)

Table 36: Sequence voltage measurement (VSMSQI)

Characteristic	Value
Operation accuracy	Depending on the frequency of the voltage measured: f_n ±2 Hz At voltages in range 0.01…1.15 × U_n
	±1.0% or ±0.002 × U_n
Suppression of harmonics	DFT: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,…

11.24.6 Three-phase power and energy measurement (PEMMXU)

Table 37: Three-phase power and energy measurement (PEMMXU)

Characteristic	Value
Operation accuracy	At all three currents in range 0.10…1.20 × I_n At all three voltages in range 0.50…1.15 × U_n At the frequency f_n ±1 Hz
	±1.5% for apparent power S ±1.5% for active power P and active energy [1] ±1.5% for reactive power Q and reactive energy [2] ±0.015 for power factor
Suppression of harmonics	DFT: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,…

[1] |PF| >0.5 which equals |cosϕ| >0.5
[2] |PF| <0.86 which equals |sinϕ| >0.5

11.24.7 Frequency measurement (FMMXU)

Table 38: Frequency measurement (FMMXU)

Characteristic	Value
Operation accuracy	±5 mHz (in measurement range 35...75 Hz)

11.25 Other functions

11.25.1 Pulse timer (PTGAPC)

Table 39: Pulse timer (PTGAPC)

Characteristic	Value
Operate time accuracy	±1.0% of the set value or ±20 ms

11.25.2 Time delay off (8 pcs) (TOFPAGC)

Table 40: Time delay off (8 pcs) (TOFPAGC)

Characteristic	Value
Operate time accuracy	±1.0% of the set value or ±20 ms

11.25.3 Time delay on (8 pcs) (TONGAPC)

Table 41: Time delay on (8 pcs) (TONGAPC)

Characteristic	Value
Operate time accuracy	±1.0% of the set value or ±20 ms

12. Mounting methods

By means of appropriate mounting accessories, the standard merging unit case can be flush mounted, semi-flush mounted or wall mounted. The flush mounted and wall mounted merging unit cases can also be mounted in a tilted position (25°) using special accessories.

Further, the merging units can be mounted in any standard 19” instrument cabinet by means of 19” mounting panels available with cut-outs for one or two merging units. Alternatively, the merging units can be mounted in 19” instrument cabinets by means of 4U Combiflex equipment frames.

For routine testing purposes, the merging unit cases can be equipped with test switches, type RTXP 18, which can be mounted side by side with the merging unit cases.

Mounting methods

- Flush mounting
- Semi-flush mounting
- Semi-flush mounting in a 25° tilt
- Rack mounting
- Wall mounting
- Mounting to a 19" equipment frame
- Mounting with an RTXP 18 test switch to a 19" rack

Panel cut-out for flush mounting

- Height: 161.5 ±1 mm
- Width: 165.5 ±1 mm

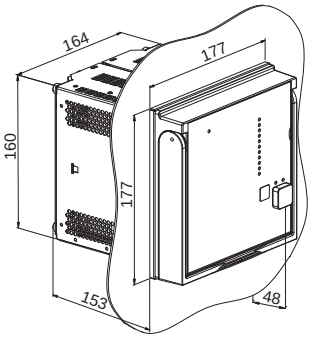

Figure 4: Flush mounting

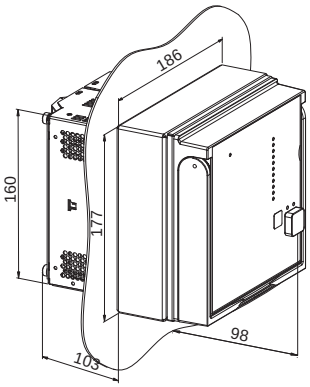

Figure 5: Semi-flush mounting

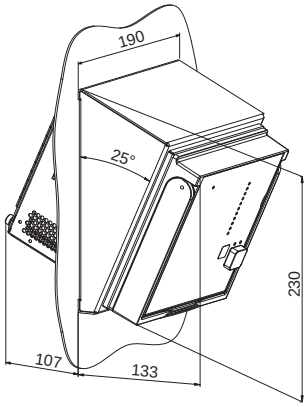

Figure 6: Semi-flush mounting in a 25º tilt

13. Merging unit case and plug-in unit

The merging unit cases are assigned to a certain type of plug-in unit. For safety reasons, the merging unit cases for current measuring units are provided with automatically operating contacts for short circuiting the CT secondary circuits when a merging unit is withdrawn from its case. The merging unit case is further provided with a mechanical coding system preventing the current measuring units from being inserted into the merging unit cases intended for the voltage measuring units.

14. Selection and ordering data

Contact ABB for ordering information.

15. Accessories and ordering data

Table 42: Cables

Item	Order number
Optical sensor for arc protection, cable length 1.5 m	1MRS120534-1.5
Optical sensor for arc protection, cable length 3.0 m	1MRS120534-3
Optical sensor for arc protection, cable length 5.0 m	1MRS120534-5
Optical sensor for arc protection, cable length 7.0 m	1MRS120534-7
Optical sensor for arc protection, cable length 10.0 m	1MRS120534-10
Optical sensor for arc protection, cable length 15.0 m	1MRS120534-15
Optical sensor for arc protection, cable length 20.0 m	1MRS120534-20
Optical sensor for arc protection, cable length 25.0 m	1MRS120534-25
Optical sensor for arc protection, cable length 30.0 m	1MRS120534-30

Table 43: Mounting accessories

Item	Order number
Semi-flush mounting kit	1MRS050696
Wall mounting kit	1MRS050697
Inclined semi-flush mounting kit	1MRS050831
19” rack mounting kit with cut-out for one merging unit	1MRS050694
19” rack mounting kit with cut-out for two merging units	1MRS050695
Mounting bracket for one merging unit with test switch RTXP in 4U Combiflex (RHGT 19” variant C)	2RCA022642P0001
Mounting bracket for one merging unit in 4U Combiflex (RHGT 19” variant C)	2RCA022643P0001
19” rack mounting kit for one merging unit and one RTXP18 test switch (the test switch is not included in the delivery)	2RCA021952A0003
19” rack mounting kit for one merging unit and one RTXP24 test switch (the test switch is not included in the delivery)	2RCA022561A0003

16. Tools

The default parameter setting values can be changed from the Web browser-based user interface (Web HMI) or Protection and Control IED Manager PCM600 in combination with the merging unit specific connectivity package.

PCM600 offers extensive merging unit configuration functions. For example, signals, application and IEC 61850 communication, including horizontal GOOSE communication, can be modified with PCM600.

When the Web HMI is used, the merging unit can be accessed either locally or remotely using a Web browser (Internet Explorer). The Web HMI functionality can be limited to read-only access.

The merging unit's connectivity package is a collection of software and specific merging unit information, which enables system products and tools to connect and interact with the merging unit. The connectivity packages reduce the risk of errors in system integration minimizing device configuration and setup times.

Table 44: Tools

Description	Version
PCM600	2.7 or later
Web browser	IE 8.0, IE 9.0, IE 10.0 or IE 11.0
SMU615 Connectivity Package	1.0 or later

Table 45: Supported functions

Function	Web HMI	PCM600
Merging unit parameter setting	●	●
Saving of merging unit parameter settings in the merging unit	●	●
Signal monitoring	●	●
Disturbance recorder handling	●	●
Alarm LED viewing	●	●
Access control management	●	●
Merging unit signal configuration (Signal Matrix)	-	●
Saving of merging unit parameter settings in the tool	-	●
Disturbance record analysis	-	●
XRIO parameter export/import	●	●
Application configuration	-	●
IEC 61850 communication configuration, GOOSE (communication configuration)	-	●
Phasor diagram viewing	●	-
Event viewing	●	●
Saving of event data on the user's PC	●	●
Online monitoring	-	●

● = Supported

17. Cyber security

The merging unit supports role-based user authentication and authorization. It can store 2048 audit trail events to a nonvolatile memory. The non-volatile memory is based on a memory type which does not need battery backup or regular component exchange to maintain the memory storage. FTP and Web HMI use TLS encryption with a minimum of 128 bit key length protecting the data in transit. In this case the used communication protocols are FTPS and HTTPS. The optional rear communication port and the optional Web HMI service can be deactivated according to the required system setup.

18. Terminal diagrams

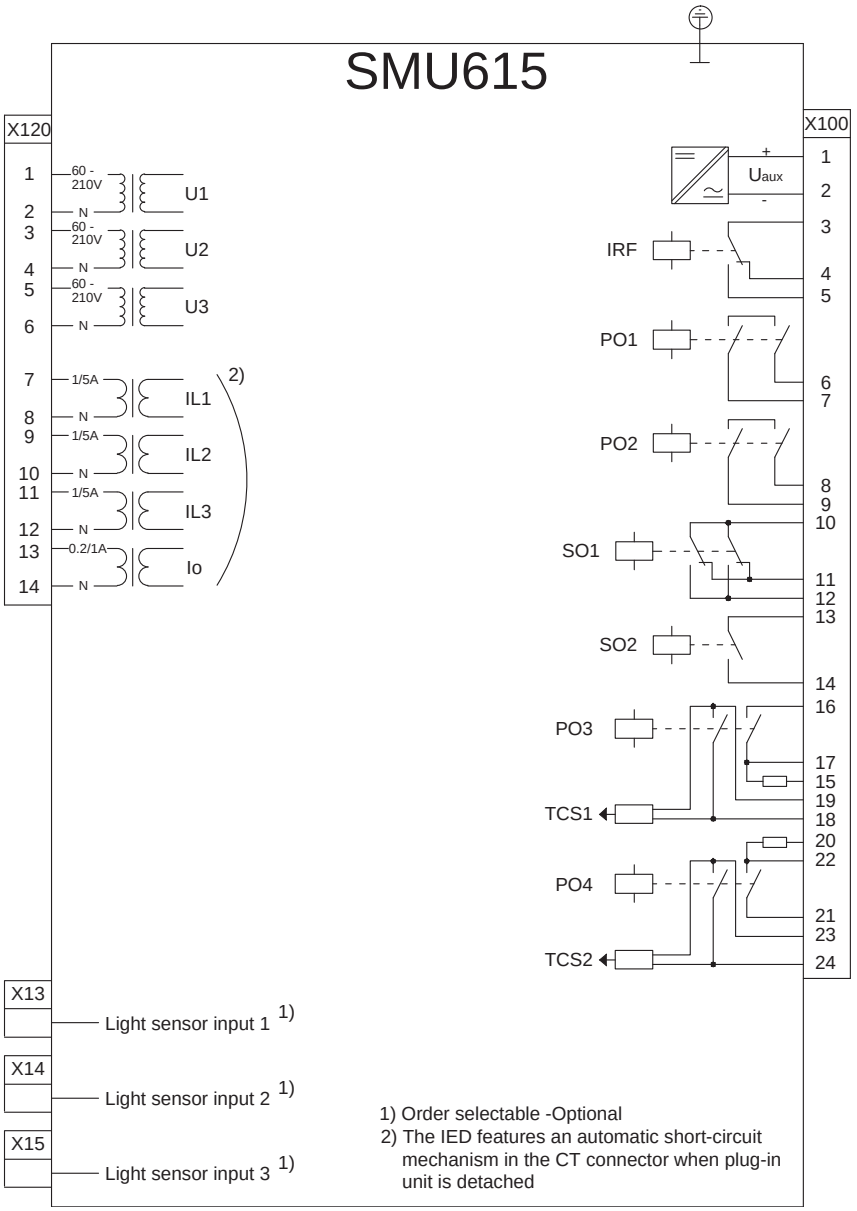

Figure 7: Terminal diagram for application configuration A with CT and VT inputs

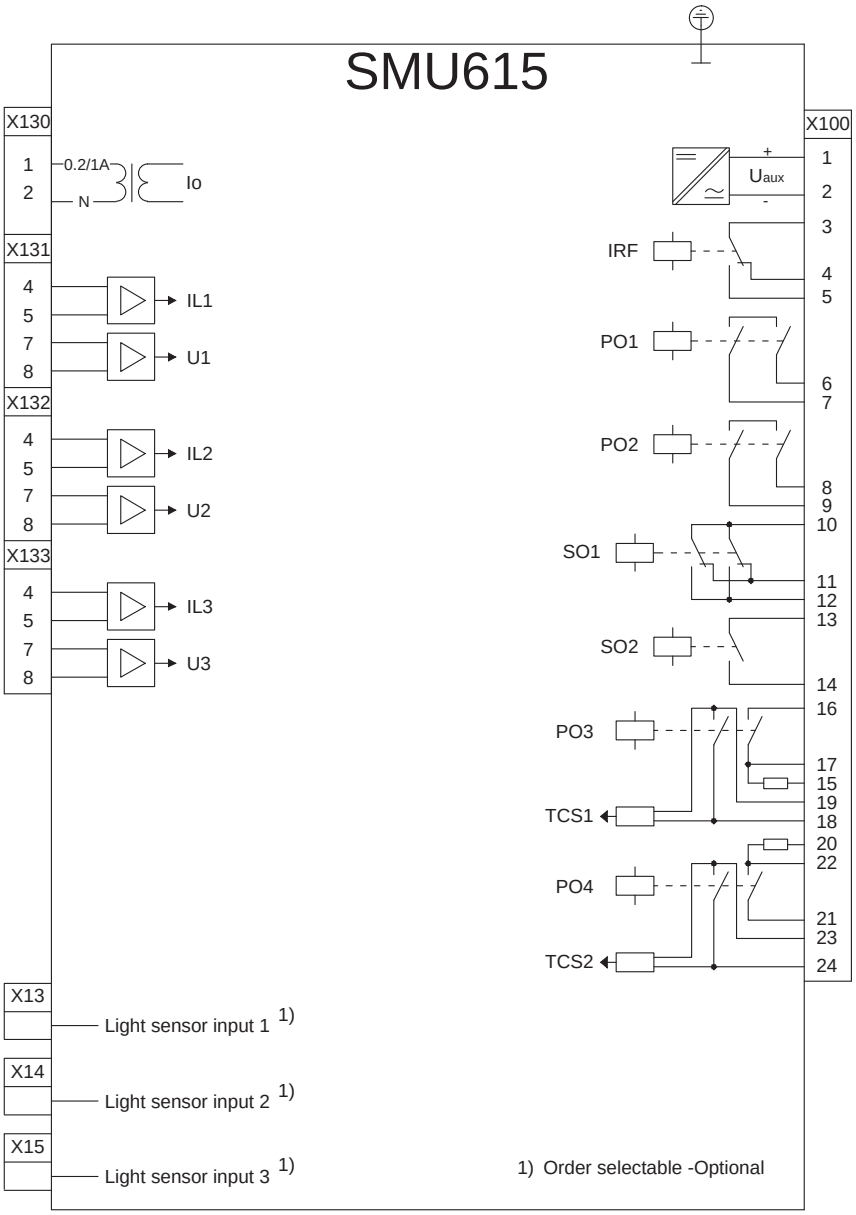

Figure 8: Terminal diagram for application configuration A with sensor inputs

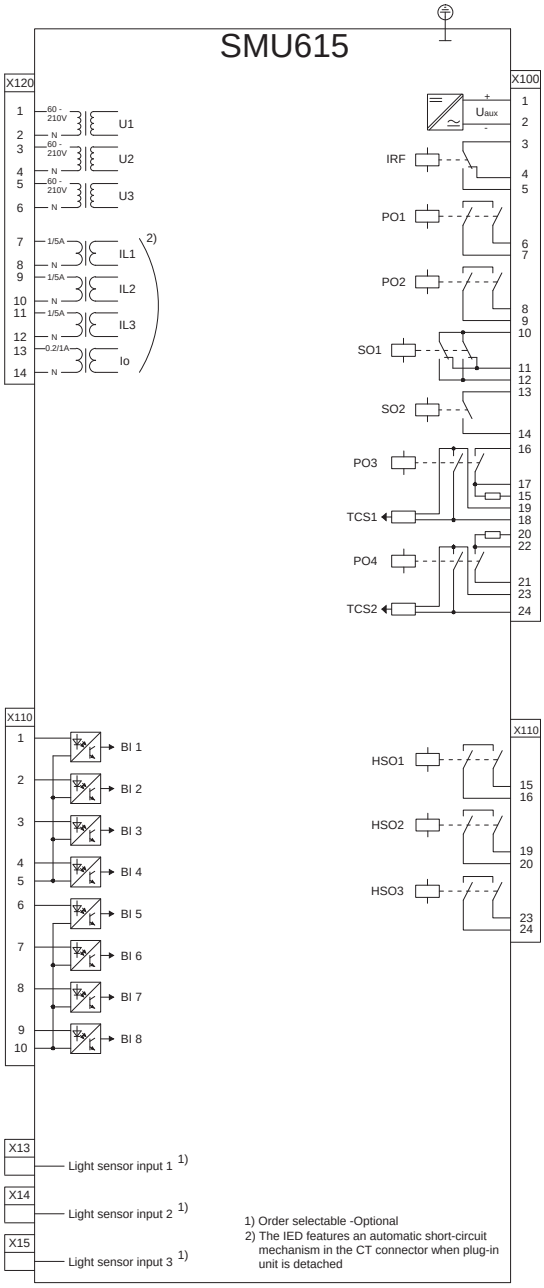

Figure 9: Terminal diagram for application configuration B with CT and VT inputs

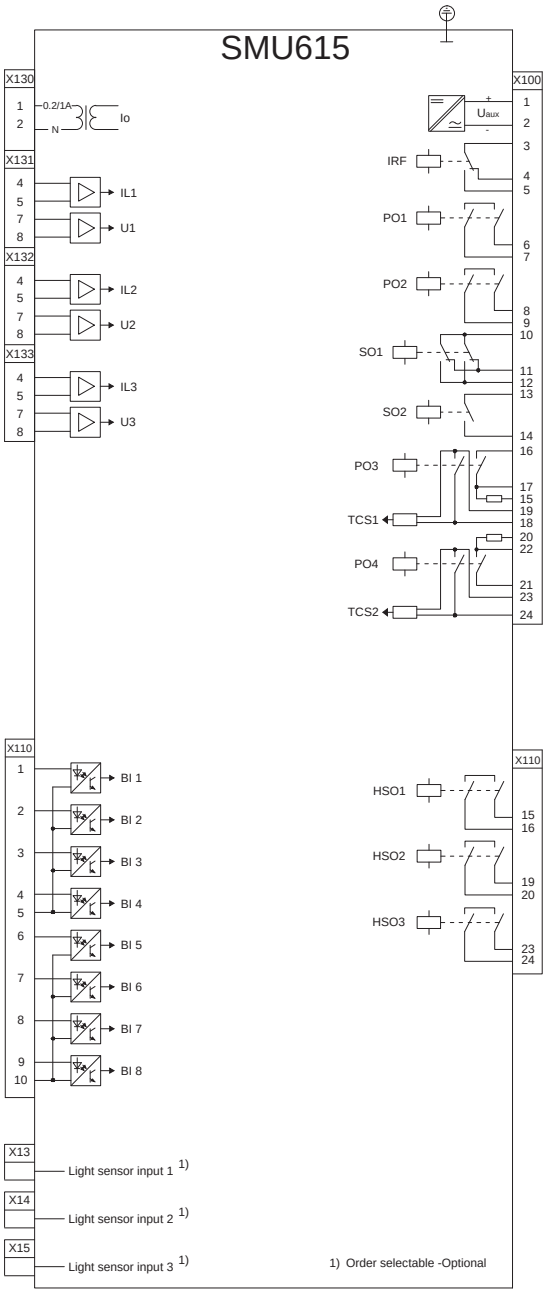

Figure 10: Terminal diagram for application configuration B with sensor inputs

19. References

The www.abb.com/substationautomation portal provides information on the entire range of distribution automation products and services.

20. Functions, codes and symbols

Table 46: Functions included in the merging unit

Function	IEC 61850	IEC 60617	IEC-ANSI
Measurement			
Disturbance recorder	RDRE1	DR (1)	DFR (1)
Three-phase current measurement	CMMXU1	3I (1)	3I (1)
Sequence current measurement	CSMSQI1	I1, I2, I0 (1)	I1, I2, I0 (1)
Residual current measurement	RESCMMXU1	Io (1)	In (1)
Three-phase voltage measurement	VMMXU1	3U (1)	3V (1)
Sequence voltage measurement	VSMSQI1	U1, U2, U0 (1)	V1, V2, V0 (1)
Three-phase power and energy measurement	PEMMXU1	P, E (1)	P, E (1)
Frequency measurement	FMMXU1	f (1)	f (1)
IEC 61850-9-2 LE sampled value sending	SMVSENDER	SMVSENDER	SMVSENDER
Condition monitoring and supervision			
Circuit-breaker condition monitoring	SSCBR1	CBCM (1)	CBCM (1)
Trip circuit supervision	TCSSCBR1	TCS (1)	TCM (1)
	TCSSCBR2	TCS (2)	TCM (2)
Current circuit supervision	CCSPVC1	MCS 3I (1)	MCS 3I (1)
Fuse failure supervision	SEQSPVC1	FUSEF (1)	60 (1)
Arc detection	ARCDSARC1	ARCD (1)	AFD (1)
	ARCDSARC2	ARCD (2)	AFD (2)
	ARCDSARC3	ARCD (3)	AFD (3)
Control			
Circuit-breaker control	CBXCBR1	I <-> O CB (1)	I <-> O CB (1)
Disconnector control	DCXSWI1	I <-> O DCC (1)	I <-> O DCC (1)
	DCXSWI2	I <-> O DCC (2)	I <-> O DCC (2)
Earthing switch control	ESXSWI1	I <-> O ESC (1)	I <-> O ESC (1)
Disconnector position indication	DCSXSWI1	I <-> O DC (1)	I <-> O DC (1)
	DCSXSWI2	I <-> O DC (2)	I <-> O DC (2)
Earthing switch indication	ESSXSWI1	I <-> O ES (1)	I <-> O ES (1)

Table continues on the next page

Function	IEC 61850	IEC 60617	IEC-ANSI
Other			
Minimum pulse timer (2 pcs)	TPGAPC1	TP (1)	TP (1)
	TPGAPC2	TP (2)	TP (2)
	TPGAPC3	TP (3)	TP (3)
	TPGAPC4	TP (4)	TP (4)
Minimum pulse timer (2 pcs, second resolution)	TPSGAPC1	TPS (1)	TPS (1)
Minimum pulse timer (2 pcs, minute resolution)	TPMGAPC1	TPM (1)	TPM (1)
Pulse timer (8 pcs)	PTGAPC1	PT (1)	PT (1)
	PTGAPC2	PT (2)	PT (2)
Time delay off (8 pcs)	TOFGAPC1	TOF (1)	TOF (1)
	TOFGAPC2	TOF (2)	TOF (2)
	TOFGAPC3	TOF (3)	TOF (3)
	TOFGAPC4	TOF (4)	TOF (4)
Time delay on (8 pcs)	TONGAPC1	TON (1)	TON (1)
	TONGAPC2	TON (2)	TON (2)
	TONGAPC3	TON (3)	TON (3)
	TONGAPC4	TON (4)	TON (4)
Set-reset (8 pcs)	SRGAPC1	SR (1)	SR (1)
	SRGAPC2	SR (2)	SR (2)
	SRGAPC3	SR (3)	SR (3)
	SRGAPC4	SR (4)	SR (4)
Move (8 pcs)	MVGAPC1	MV (1)	MV (1)
	MVGAPC2	MV (2)	MV (2)
Generic control point (16 pcs)	SPCGAPC1	SPC (1)	SPC (1)
	SPCGAPC2	SPC (2)	SPC (2)
Master trip	TRPPTRC1	Master Trip (1)	94/86 (1)
	TRPPTRC2	Master Trip (2)	94/86 (2)
	TRPPTRC3	Master Trip (3)	94/86 (3)

Table continues on the next page

Function	IEC 61850	IEC 60617	IEC-ANSI
	TRPPTRC4	Master Trip (4)	94/86 (4)
	TRPPTRC5	Master Trip (5)	94/86 (5)

21. Document revision history

Document revision/date	Product version	History
A/2017-09-26	1.0	First release
B/2019-05-17	1.0	Content updated
C/2022-09-30	1.0	Content updated

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