

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

**CONTENTS**

<b>1</b>	<b>DOCUMENT AIMS AND APPLICATION AREA .....</b>	<b>2</b>
<b>2</b>	<b>DOCUMENT VERSION MANAGEMENT .....</b>	<b>2</b>
<b>3</b>	<b>UNITS IN CHARGE OF THE DOCUMENT .....</b>	<b>3</b>
<b>4</b>	<b>REFERENCES .....</b>	<b>3</b>
<b>5</b>	<b>ORGANIZATIONAL process POSITION IN THE PROCESS TAXONOMY .....</b>	<b>3</b>
<b>6</b>	<b>DEFINITIONS AND ACRONYMS.....</b>	<b>4</b>
6.1	<i>Enel Global Infrastructure and Networks Reference standards RELATED TO TCA.....</i>	<i>5</i>
<b>7</b>	<b>DESCRIPTION .....</b>	<b>6</b>
7.1	<i>LIST OF COMPONENTS.....</i>	<i>6</i>
7.2	<i>Applicable laws and reference standards.....</i>	<i>9</i>
7.3	<i>Service conditions.....</i>	<i>11</i>
7.4	<i>Technical characteristics .....</i>	<i>11</i>
7.5	<i>CONSTRUCTION CHARACTERISTICS .....</i>	<i>20</i>
7.6	<i>TESTING .....</i>	<i>36</i>
7.7	<i>conditions of SUPPLY.....</i>	<i>45</i>
	<b>ANNEX A – SPECIFICATIONS FOR ELECTRONIC circuit-BREAKERS .....</b>	<b>47</b>

**THE HEAD OF Network Components**  
**Maurizio Mazzotti**

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

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## 1 DOCUMENT AIMS AND APPLICATION AREA

The scope of this document is to provide the technical requirements for the supply of automatic circuit-breakers for use in Low Voltage distribution networks and installed in secondary substations and pole-mounted transformers (PMT) of the Enel Group Distribution Companies, listed below:

Country	Distribution Company
Argentina	Edesur
Brazil	Enel Distribuição Rio Enel Distribuição Ceará Enel Distribuição Goiás Enel Enel Distribuição São Paulo
Chile	Enel Distribución Chile
Colombia	Enel Codensa
Iberia	e-distribución
Italy	e-distribuzione
Peru	Enel Distribución Perú
Romania	Enel Distribuție Banat Enel Distribuție Dobrogea Enel Distribuție Muntenia

**Table 1 - Distribution Companies**

## 2 DOCUMENT VERSION MANAGEMENT

Version	Date	Main changes description
0	20/06/2016	First Edition
1	29/09/2021	Document structure revision, inclusion of characteristics and test for motorization, VDS, MAT-O&M-NCS-2021-0033-EGIN introduction, Type test revision with IEC main standard

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

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### **3 UNITS IN CHARGE OF THE DOCUMENT**

Responsible for drawing up the document:

- Global Infrastructure and Networks: Engineering and Construction / Components and Devices Design / Network Components

Responsible for authorizing the document:

- Global Infrastructure and Networks: Head of Engineering and Construction unit
- Global Infrastructure and Networks: Head of Health, Safety, Environment and Quality unit.

### **4 REFERENCES**

- Code of Ethics of Enel Group.
- Enel Human Right Policy.
- The Enel Group Zero Tolerance of Corruption (ZTC) Plan.
- Organization and management model as per Legislative Decree No. 231/2001.
- RACI Handbook Infrastructure and Networks no. 06.
- Enel Global Compliance Program (EGCP).
- Integrated Policy of Quality, Health and Safety, Environment and anti-Bribery.

### **5 ORGANIZATIONAL PROCESS POSITION IN THE PROCESS TAXONOMY**

Value Chain/Process Area: Networks Management

Macro Process: Materials management

Process: Network Components

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

## 6 DEFINITIONS AND ACRONYMS

Acronym and Key words	Description
<b>Manufacturer Product</b>	Component manufactured by a Supplier in accordance with a technical specification
<b>Technical Conformity Assessment (TCA)</b>	A “conformity assessment” <sup>1</sup> with respect to “specified requirements” <sup>2</sup> consists in functional, dimensional, constructional and test characteristics required for a product (or a series of products) and quoted in technical specifications and quality requirements issued by Enel Group distribution companies. This also includes the verification of conformity with respect to local applicable regulation and laws and possession of relevant requested certifications
<b>Conformity assessment body</b>	Body that performs the conformity assessment activities [ISO 17000]
<b>Enel Equipment Key code</b>	It's an equipment representative for a group (family) of similar equipment chose by Enel
<b>Enel Equipment Family code</b>	Equipment belonging to a specific group (family) in which another equipment is identified as key code
<b>TCA systems</b>	The “conformity assessment systems”, is applicable specifying that the rules and procedures to carry on the TCA are those specified in the present document
<b>Type A documentation</b>	Not confidential documents used for product manufacturing and management from which it is possible to verify the product conformity to all technical specification requirements, directly or indirectly
<b>Type B documentation</b>	Confidential documents used for product manufacturing and management where all product project details are described, in order to uniquely identify the product object of the TCA
<b>TCA report</b>	Document describing the activities carried out for TCA

<sup>1</sup> Definition 2.1 of ISO/IEC 17000

<sup>2</sup> Definition 3.1 of ISO/IEC 17000

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

<b>TCA dossier</b>	Set of final documents delivered by the Supplier for the TCA
<b>Material LifeCycle Management (MLM)</b>	Integrated IT platform to manage the processes of Technical Specifications (TSM), Technical Conformity Assessment (TCA), Quality Control Tools (QCA), Defects Managing (CMD), Warranties and Materials Shipping (MSH)

## 6.1 ENEL GLOBAL INFRASTRUCTURE AND NETWORKS REFERENCE STANDARDS RELATED TO TCA

Reference documents listed below (amendments included) shall be the edition in-force at the TCA Request date.

ISO/IEC 17000	Conformity assessment – Vocabulary and general principles
ISO/IEC 17020	General criteria for the operation of various types of bodies performing inspection
ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories
ISO/IEC 17050-1	Conformity assessment - Supplier's declaration of conformity - Part 1: General requirements (ISO/IEC 17050-1:2004, corrected version 2007-06-15)
ISO/IEC 17050-2	Conformity assessment - Supplier's declaration of conformity - Part 2: Supporting documentation (ISO/IEC 17050-2:2004)
ISO/IEC 17065	Conformity assessment – Requirements for bodies certifying products, processes and services.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

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## 7 DESCRIPTION

### 7.1 LIST OF COMPONENTS

Type code	Abbreviation	Neutral	Iu (A)	Ics (kA)	Main use
GSCL003/06	40/D/10/PMT	DISCONNECTABLE	40	10	PMT
GSCL003/12	40/U/10/PMT	UNINTERRUPTED			
GSCL003/05	80/D/10/PMT	DISCONNECTABLE	80	10	PMT
GSCL003/11	80/U/10/PMT	UNINTERRUPTED			
GSCL003/04	125/D/25/PMT	DISCONNECTABLE	125	25	PMT
GSCL003/10	125/U/25/PMT	UNINTERRUPTED			
GSCL003/03	125/D/25/SS	DISCONNECTABLE			SS
GSCL003/09	125/U/25/SS	UNINTERRUPTED			
GSCL003/13	180/D/25/PMT	DISCONNECTABLE	180	25	PMT
GSCL003/14	180/U/25/PMT	UNINTERRUPTED			
GSCL003/02	180/D/25/SS	DISCONNECTABLE			SS
GSCL003/08	180/U/25/SS	UNINTERRUPTED			
GSCL003/41	250/D/25/PMT	DISCONNECTABLE	250	25	PMT
GSCL003/42	250/U/25/PMT	UNINTERRUPTED			
GSCL003/01	250/D/25/SS	DISCONNECTABLE			SS
GSCL003/07	250/U/25/SS	UNINTERRUPTED			
GSCL003/43	350/D/25/PMT	DISCONNECTABLE	350	25	PMT
GSCL003/44	350/U/25/PMT	UNINTERRUPTED			
GSCL003/15	350/D/25/SS	DISCONNECTABLE			SS
GSCL003/16	350/U/25/SS	UNINTERRUPTED			
GSCL003/17	630/D/25/SS	DISCONNECTABLE	630	25	SS
GSCL003/18	630/U/25/SS	UNINTERRUPTED			

Main use: PMT: Pole Mounted Transformers

SS: Secondary Substations

**Table 2 – Manual operating tetrapolar circuit-breakers**

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

Type code	Abbreviation	Neutral	Iu (A)	Ics (kA)	Main use
GSCL003/37	40/D/10/M/PMT	DISCONNECTABLE	40	10	PMT
GSCL003/38	40/U/10/M/PMT	UNINTERRUPTED			
GSCL003/39	80/D/10/M/PMT	DISCONNECTABLE	80	10	PMT
GSCL003/40	80/U/10/M/PMT	UNINTERRUPTED			
GSCL003/26	125/D/25/M/PMT	DISCONNECTABLE	125	25	PMT
GSCL003/28	125/U/25/M/PMT	UNINTERRUPTED			SS
GSCL003/20	125/D/25/M/SS	DISCONNECTABLE			
GSCL003/22	125/U/25/M/SS	UNINTERRUPTED			
GSCL003/31	180/D/25/M/PMT	DISCONNECTABLE	180	25	PMT
GSCL003/32	180/U/25/M/PMT	UNINTERRUPTED			SS
GSCL003/33	180/D/25/M/SS	DISCONNECTABLE			
GSCL003/34	180/U/25/M/SS	UNINTERRUPTED			
GSCL003/25	250/D/25/M/PMT	DISCONNECTABLE	250	25	PMT
GSCL003/27	250/U/25/M/PMT	UNINTERRUPTED			SS
GSCL003/19	250/D/25/M/SS	DISCONNECTABLE			
GSCL003/21	250/U/25/M/SS	UNINTERRUPTED			
GSCL003/29	350/D/25/M/PMT	DISCONNECTABLE	350	25	PMT
GSCL003/30	350/U/25/M/PMT	UNINTERRUPTED			SS
GSCL003/23	350/D/25/M/SS	DISCONNECTABLE			
GSCL003/24	350/U/25/M/SS	UNINTERRUPTED			
GSCL003/56	350/D/50/M/SS	DISCONNECTABLE	350	50	SS
GSCL003/57	350/U/50/M/SS	UNINTERRUPTED			
GSCL003/35	630/D/25/M/SS	DISCONNECTABLE	630	25	SS
GSCL003/36	630/U/25/M/SS	UNINTERRUPTED			

Main use: PMT: Pole Mounted Transformers

SS: Secondary Substations

**Table 3 – Motor driven tetrapolar circuit-breakers**

The term “Uninterrupted neutral” means a circuit-breaker with a neutral pole without an opening device, but only fitted (where required) with release coils on the neutral which operate on the simultaneous opening of the phase poles.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

Type code	Abbreviation	Iu (A)	Ics (kA)	Main use
GSCL003/45	40T/10/M/PMT	40	10	PMT
GSCL003/46	80T/10/M/PMT	80	10	PMT
GSCL003/47	125T/25/M/PMT	125	25	PMT
GSCL003/48	125T/25/M/SS	125	25	SS
GSCL003/49	180T/25/M/PMT	180	25	PMT
GSCL003/50	180T/25/M/SS	180	25	SS
GSCL003/51	250T/25/M/PMT	250	25	PMT
GSCL003/52	250T/25/M/SS	250	25	SS
GSCL003/53	350T/25/M/PMT	350	25	PMT
GSCL003/54	350T/25/M/SS	350	25	SS
GSCL003/55	630T/25/M/SS	630	25	SS

**Table 4 – Motor driven tripolar circuit-breakers**

Type code	Abbreviation	Iu (A)	Ics (kA)	Main use
GSCL003/67	40T/10/PMT	40	10	PMT
GSCL003/68	80T/10/PMT	80	10	PMT
GSCL003/58	125T/25/PMT	125	25	PMT
GSCL003/59	125T/25/SS	125	25	SS
GSCL003/60	180T/25/PMT	180	25	PMT
GSCL003/61	180T/25/SS	180	25	SS
GSCL003/62	250T/25/PMT	250	25	PMT
GSCL003/63	250T/25/SS	250	25	SS
GSCL003/64	350T/25/PMT	350	25	PMT
GSCL003/65	350T/25/SS	350	25	SS
GSCL003/66	630T/25/SS	630	25	SS

**Table 5 – Manual operating tripolar circuit-breakers**



**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

## **7.2 APPLICABLE LAWS AND REFERENCE STANDARDS**

Reference documents listed below (amendments included) shall be the edition in-force at the TCA request date.

### **7.2.1 International standard**

IEC 60947-1	Low-voltage switchgear and controlgear - Part 1: General rules
IEC 60947-2	Low-voltage switchgear and controlgear - Part 2: Circuit-breakers
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60695-2-10	Fire hazard testing - Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure.
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
IEC 61243-5	Live working - Voltage detectors - Part 5: Voltage detecting systems (VDS)

### **7.2.2 Enel standards**

- MAT-O&M-NCS-2021-0033-EGIN version 3 “Global Infrastructure and Networks – GSCG002 Technical Conformity Assessment”.
- GSTR001/1 rev.2 “Remote Terminal Unit for MV/LV substation – UP2020 Lite”.
- GSCL002 “LV Switchboard for Secondary Substations”.
- GSCL008 “Synthetic resin enclosure for 2 circuit breakers on pole”
- GSC002 “LV Underground Cables”
- GSCC009 “LV Aerial Bundled Cables”
- Contractual Requirements for Components and Materials Quality management.
- CNS-O&M-S&L-2021-0032-EGIN “Global Infrastructure and Networks Barcode specification.
- Packaging, transport, and delivery requirements rev.2.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

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**7.2.3 Brazil**

- NR-10 – Segurança em instalações e serviços em eletricidade.

**7.2.4 Chile**

- Elec 4/2003 – Instalaciones de consumo en baja tensión.
- NSEG 5. E.n.71 - Reglamento de Instalaciones Eléctricas de Corrientes Fuertes.

**7.2.5 Colombia**

- RETIE – Reglamento Técnico de Instalaciones Eléctricas.

**7.2.6 Perú**

- CNE – Suministro - Código Nacional de Electricidad – Suministro 2011.

**7.2.7 Italy**

- D.Lgs n. 81 of the 9th of April 2008 and subsequent modifications.
- D.P.R. n. 43 of the 27th of January 2012.
- Decreto Ministeriale Ambiente n. 20 – 24 Gen. 2011;
- Nota Operativa PVR001 – Rev. 2 – Ott. 2012 - Gestione Garanzie dei materiali di ENEL Distribuzione.

**7.2.8 Spain**

- The circuit-breaker must comply with the “Reglamento sobre condiciones técnicas y garantías de seguridad en instalaciones eléctricas de alta tensión y sus Instrucciones Técnicas Complementarias ITC-RAT 01 a 23 (R.D. 337/2014, de 9 de mayo)”, and consequently each circuit-breaker must be supplied accompanied by the "Declaración de Conformidad " required by this regulation, and the manufacturer or his authorized representative established in the European Union must keep the required “Expediente técnico” at disposal of the Spanish national market surveillance authority for inspection up to at least five years from the last date of manufacture of the product.
- Real Decreto 842/2002, de 2 de agosto, por el que se aprueba el Reglamento electrotécnico para baja tensión
- R.D. 614/2001, de 8 de junio, sobre disposiciones mínimas para la protección de la salud y seguridad de los trabajadores frente al riesgo eléctrico.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

### 7.2.9 Romania

- Legea securității și sănătății în muncă nr.319/2006, cu modificările și completările ulterioare.
- Ordonanța de Urgență nr. 195/22.12.2005 privind protecția mediului, cu toate modificările și completările în vigoare.
- Legea nr. 211/25.11.2011 privind regimul deșeurilor.
- H.G. 1037/03.11.2010 privind deșeurile de echipamente electrice și electronice.

### 7.2.10 Europe

- Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006.
- Directive 2004/108/EC electromagnetic compatibility.

## 7.3 SERVICE CONDITIONS

Clause 6 of IEC 60947-2 is applicable with the following addition

Lower limit of ambient air temperature	-20°C
Maximum reference altitude for Colombia	2.700 m

**Table 6 - Service Conditions**

## 7.4 TECHNICAL CHARACTERISTICS

The circuit-breakers must observe the general requirements and the regulations enforced by the reference documents in chapter 7.

The circuit-breakers shall be

- four-pole or three-pole
- moulded case type, with organic material enclosure without accessible metallic parts
- suitable for isolation
- non-maintenable
- vertical and horizontal installation type

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

Table 7 shows the specific requirements that all individual circuit-breakers must observe:

For special dielectric characteristics for the circuit-breakers delivered to Spain, refer to point 7.6.1.1.2 of this Standard.

CHARACTERISTIC	UNIT	VALUE
IP code <sup>(1)</sup>		IP3X <sup>(2)</sup>
Frequency	(Hz)	50/60
Making operating system		Independent manual with non-removable lever or motorized
Breaking operating system		Independent manual with non-removable lever or motorized and with thermal and magnetic releases
Rated voltage ( $U_e$ )	(V)	400
Rated insulation voltage ( $U_i$ )	(V)	690
Rated impulse withstand voltage ( $U_{imp}$ )	(kV)	8
Rated duty		Uninterrupted
Selectivity category		A

**Table 7 - Common characteristics of circuit-breakers**

(1) Except for the back side of the circuit-breaker.

(2) Except for terminal coverings (LOAD cable side) for which the IP2X degree of protection is required.

The characteristic tables shown below are for four-pole circuit-breakers. For three-pole circuit-breakers, the characteristics relative to the neutral are not taken into consideration.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

**7.4.1 Characteristics of circuit-breakers with 40 A rated current**

CHARACTERISTICS	UNIT	VALUE
Rated uninterrupted current at 40 °C ( $I_u$ )	(A)	40
Rated ultimate short-circuit breaking capacity ( $I_{cu}$ )	(kA)	10
Rated service short-circuit breaking capacity ( $I_{cs}$ )	(kA)	100% of $I_{cu}$
<b><u>Phase thermal release (1 per phase)</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	40
- conventional non tripping current	(A)	1.05 $I_{th}$
- conventional tripping current	(A)	1.30 $I_{th}$
- conventional time	(h)	1
- maximum breaking time at 2 $I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	6
<b><u>Phase magnetic release (1 per phase)</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	200
- breaking time for a tripping current of 3 $I_m$	(ms)	≤ 15
- tripping current precision	(%)	± 20
<b><u>Neutral thermal release</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	-
- conventional non tripping current	(A)	-
- conventional tripping current	(A)	-
- maximum breaking time at 2 $I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	-
<b><u>Neutral magnetic release</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	-
- breaking time for a tripping current of 3 $I_m$	(ms)	-
- tripping current precision	(%)	-

**Table 8 – Characteristics of circuit-breakers with 40 A rated current**

(3) Not adjustable.

40 A circuit-breakers are not fitted with release coils (magnetic or thermal) on the neutral pole.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

**7.4.2 Characteristics of circuit-breakers with 80 A rated current**

CHARACTERISTICS	UNIT	VALUE
Rated uninterrupted current at 40 °C ( $I_u$ )	(A)	80
Rated ultimate short-circuit breaking capacity ( $I_{cu}$ )	(kA)	10
Rated service short-circuit breaking capacity ( $I_{cs}$ )	(kA)	100% of $I_{cu}$
<b><u>Phase thermal release (1 per phase)</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	80
- conventional non tripping current	(A)	$1.05 I_{th}$
- conventional tripping current	(A)	$1.30 I_{th}$
- conventional time	(h)	2
- maximum breaking time at $2 I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	8
<b><u>Phase magnetic release (1 per phase)</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	400
- breaking time for a tripping current of $3 I_m$	(ms)	$\leq 15$
- tripping current precision	(%)	$\pm 20$
<b><u>Neutral thermal release</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	-
- conventional non tripping current	(A)	-
- conventional tripping current	(A)	-
- maximum breaking time at $2 I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	-
<b><u>Neutral magnetic release</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	-
- breaking time for a tripping current of $3 I_m$	(ms)	-
- tripping current precision	(%)	-

(3) Not adjustable.

**Table 9 – Characteristics of circuit-breakers with 80 A rated current**

80 A circuit-breakers are not fitted with release coils (magnetic or thermal) on the neutral pole.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

**7.4.3 Characteristics of circuit-breakers with 125 A rated current**

CHARACTERISTICS	UNIT	VALUE
Rated uninterrupted current at 40 °C ( $I_u$ )	(A)	125
Rated ultimate short-circuit breaking capacity ( $I_{cu}$ )	(kA)	25
Rated service short-circuit breaking capacity ( $I_{cs}$ )	(kA)	100% of $I_{cu}$
<b><u>Phase thermal release (1 per phase)</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	125
- conventional non tripping current	(A)	$1.05 I_{th}$
- conventional tripping current	(A)	$1.30 I_{th}$
- conventional time	(h)	2
- maximum breaking time at $2 I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	8
<b><u>Phase magnetic release (1 per phase)</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	800
- breaking time for a tripping current of $3 I_m$	(ms)	$\leq 15$
- tripping current precision	(%)	$\pm 20$
<b><u>Neutral thermal release</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	80
- conventional non tripping current	(A)	$1.05 I_{th}$
- conventional tripping current	(A)	$1.30 I_{th}$
- conventional time	(h)	2
- maximum breaking time at $2 I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	8
<b><u>Neutral magnetic release</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	500
- breaking time for a tripping current of $3 I_m$	(ms)	$\leq 15$
- tripping current precision	(%)	$\pm 20$

(3) Not adjustable.

**Table 10 – Characteristics of circuit-breakers with 125 A rated current**

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

**7.4.4 Characteristics of circuit-breakers with 180 A rated current**

CHARACTERISTICS	UNIT	VALUE
Rated uninterrupted current at 40 °C ( $I_u$ )	(A)	180
Rated ultimate short-circuit breaking capacity ( $I_{cu}$ )	(kA)	25
Rated service short-circuit breaking capacity ( $I_{cs}$ )	(kA)	100% of $I_{cu}$
<b><u>Phase thermal release (1 per phase)</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	180
- conventional non tripping current	(A)	$1.05 I_{th}$
- conventional tripping current	(A)	$1.30 I_{th}$
- conventional time	(h)	2
- maximum breaking time at $2 I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	10
<b><u>Phase magnetic release (1 per phase)</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	1000
- breaking time for a tripping current of $3 I_m$	(ms)	$\leq 15$
- tripping current precision	(%)	$\pm 20$
<b><u>Neutral thermal release</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	100
- conventional non tripping current	(A)	$1.05 I_{th}$
- conventional tripping current	(A)	$1.30 I_{th}$
- conventional time	(h)	2
- maximum breaking time at $2 I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	8
<b><u>Neutral magnetic release</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	600
- breaking time for a tripping current of $3 I_m$	(ms)	$\leq 15$
- tripping current precision	(%)	$\pm 20$

(3) Not adjustable.

**Table 11 – Characteristics of circuit-breakers with 180 A rated current**



**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

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Service Function: -

Business Line: *Infrastructure & Networks*

**7.4.5 Characteristics of circuit-breakers with 250 A rated current**

CHARACTERISTICS	UNIT	VALUE
Rated uninterrupted current at 40 °C ( $I_u$ )	(A)	250
Rated ultimate short-circuit breaking capacity ( $I_{cu}$ )	(kA)	25
Rated service short-circuit breaking capacity ( $I_{cs}$ )	(kA)	100% of $I_{cu}$
<b><u>Phase thermal release (1 per phase)</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	250
- conventional non tripping current	(A)	$1.05 I_{th}$
- conventional tripping current	(A)	$1.30 I_{th}$
- conventional time	(h)	2
- maximum breaking time at $2 I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	12
<b><u>Phase magnetic release (1 per phase)</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	1250
- breaking time for a tripping current of $3 I_m$	(ms)	$\leq 15$
- tripping current precision	(%)	$\pm 20$
<b><u>Neutral thermal release</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	125
- conventional non tripping current	(A)	$1.05 I_{th}$
- conventional tripping current	(A)	$1.30 I_{th}$
- conventional time	(h)	2
- maximum breaking time at $2 I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	8
<b><u>Neutral magnetic release</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	800
- breaking time for a tripping current of $3 I_m$	(ms)	$\leq 15$
- tripping current precision	(%)	$\pm 20$

(3) Not adjustable.

**Table 12 – Characteristics of circuit-breakers with 250 A rated current**

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

**7.4.6 Characteristics of circuit-breakers with 350 A rated current**

CHARACTERISTICS	UNIT	VALUE
Rated uninterrupted current at 40 °C ( $I_u$ )	(A)	350
Rated ultimate short-circuit breaking capacity ( $I_{cu}$ )	(kA)	25 or 50
Rated service short-circuit breaking capacity ( $I_{cs}$ )	(kA)	100% of $I_{cu}$
<b><u>Phase thermal release (1 per phase)</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	$280 \div 350$
- conventional non tripping current	(A)	$1.05 I_{th}$
- conventional tripping current	(A)	$1.30 I_{th}$
- conventional time	(h)	2
- maximum breaking time at $2 I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	12
<b><u>Phase magnetic release (1 per phase)</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	1750
- breaking time for a tripping current of $3 I_m$	(ms)	$\leq 15$
- tripping current precision	(%)	$\pm 20$
<b><u>Neutral thermal release</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	$140 \div 175$
- conventional non tripping current	(A)	$1.05 I_{th}$
- conventional tripping current	(A)	$1.30 I_{th}$
- conventional time	(h)	2
- maximum breaking time at $2 I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	12
<b><u>Neutral magnetic release</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	1000
- breaking time for a tripping current of $3 I_m$	(ms)	$\leq 15$
- tripping current precision	(%)	$\pm 20$

(3) Adjustable from 0.8 to  $1 I_{th}$  (factory default value set at  $1 I_{th}$ ).

**Table 13 – Circuit-breakers with 350 A rated current**

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

**7.4.7 Characteristics of circuit-breakers with 630 A rated current**

CHARACTERISTICS	UNIT	VALUE
Rated uninterrupted current at 40 °C ( $I_u$ )	(A)	630
Rated ultimate short-circuit breaking capacity ( $I_{cu}$ )	(kA)	25
Rated service short-circuit breaking capacity ( $I_{cs}$ )	(kA)	100% of $I_{cu}$
<b><u>Phase thermal release (1 per phase)</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	504 ÷ 630
- conventional non tripping current	(A)	1.05 $I_{th}$
- conventional tripping current	(A)	1.30 $I_{th}$
- conventional time	(h)	2
- maximum breaking time at 2 $I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	12
<b><u>Phase magnetic release (1 per phase)</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	5 $I_{th}$ phase
- breaking time for a tripping current of 3 $I_m$	(ms)	≤ 15
- tripping current precision	(%)	± 20
<b><u>Neutral thermal release</u></b> <sup>(3)</sup>		
- conventional free air thermal current at 40 °C ( $I_{th}$ )	(A)	256 ÷ 320
- conventional non tripping current	(A)	1.05 $I_{th}$
- conventional tripping current	(A)	1.30 $I_{th}$
- conventional time	(h)	2
- maximum breaking time at 2 $I_{th}$ on single pole with cool release at ambient temperature of 40 °C	(min)	12
<b><u>Neutral magnetic release</u></b> <sup>(3)</sup>		
- current setting ( $I_m$ )	(A)	5 $I_{th}$ neutral
- breaking time for a tripping current of 3 $I_m$	(ms)	≤ 15
- tripping current precision	(%)	± 20

(3) Adjustable from 0.8 to 1  $I_{th}$  (factory default value set at 1  $I_{th}$ ).

**Table 14 – Circuit-breakers with 630 A rated current**

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

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## **7.5 CONSTRUCTION CHARACTERISTICS**

### **7.5.1 Circuit-breaker construction**

This section provides the construction details of the circuit-breakers with limits on external size, installation assembly interface positions, the materials to be used and the surface coatings of the clamps.

The circuit-breaker must be designed to allow the connection of the proper functioning with the cables up to 240 mm<sup>2</sup> described in GSC002 and GSCC009 Standards.

These circuit-breaker characteristics are grouped together and can be seen in the schematic drawings with the following requirements:

Circuit-breaker shall comply the requirements stated in chapter 7 of IEC 60947-2 standard

The circuit-breaker shall be provided with means for indicating the closed and open positions, these positions shall be unambiguous and clearly indicated. This is done by means of a position indicating device.

The symbols used shall indicate the closed and open positions respectively, in accordance with IEC 60417-2:

- 60417-2-IEC-5007 I On (power)
- 60417-2-IEC-5008 O Off (power)

For equipment operated by means of two push-buttons, only the push-button designated for the opening operation shall be red or marked with the symbol "O".

Red colour shall not be used for any other push-button.

The colours of other push-buttons, illuminated push-buttons and indicator lights shall be in accordance with IEC 60073.

The circuit-breakers shall be provided with a clamping plate in order to be attached to the LV Panel described in the GSCL002 and GSCL008 Standards.

The clamping plate must be made of black RAL 8002 or grey RAL 7012 plastic of an appropriate thickness. It must bear the manufacturer's name.

The circuit-breaker and its components must not exceed the size of the clamping plate.

The position of the 4 openings of the clamping plate is free, but it must allow the connection of the assembly formed by the circuit-breaker on its clamping plate to the LV panel GSCL002 (note 7 in fig.1, fig 3).

The clamping screws of the circuit-breaker to the clamping plate must not stick out of rear side of the plate itself.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

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The terminal covers must be properly fixed to the circuit-breaker or the clamping plate (using screws or fasteners).

The circuit-breakers must be fitted with insulating separators between each terminal, fixed on the enclosure of the device, in order to guarantee electric insulation between terminals even if their coverings have been removed (note 10 in fig.1, fig 3)

The operating lever can be asymmetrical on the right or the left side.

The bolts made of iron must be protected using electrolytic zinc plating (minimum thickness 12µm).

The neutral pole, if present, must be placed strictly to the right of the R-S-T phase poles for Italy and Romania and to the left of the R-S-T phase poles for the rest of the countries and indelibly marked.

Each circuit-breaker must have a Barcode to allow it to be traced in the field (see CNS-O&M-S&L-2021-0032-EGIN "Global Infrastructure and Networks Barcode specification"); it must be placed on the body of the circuit-breaker so that it is still visible when flanked by other circuit-breakers.

The manufacturer of circuit-breaker must define the proper tightening torque for the connection of the cables to the circuit breaker terminals.

The circuit-breaker must allow the connection of the cables to the terminals by means of cable lug. These cable lugs shall be defined by each country where the circuit-breaker will be supplied.

**Subject:** Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR SECONDARY SUBSTATIONS

## Application Areas

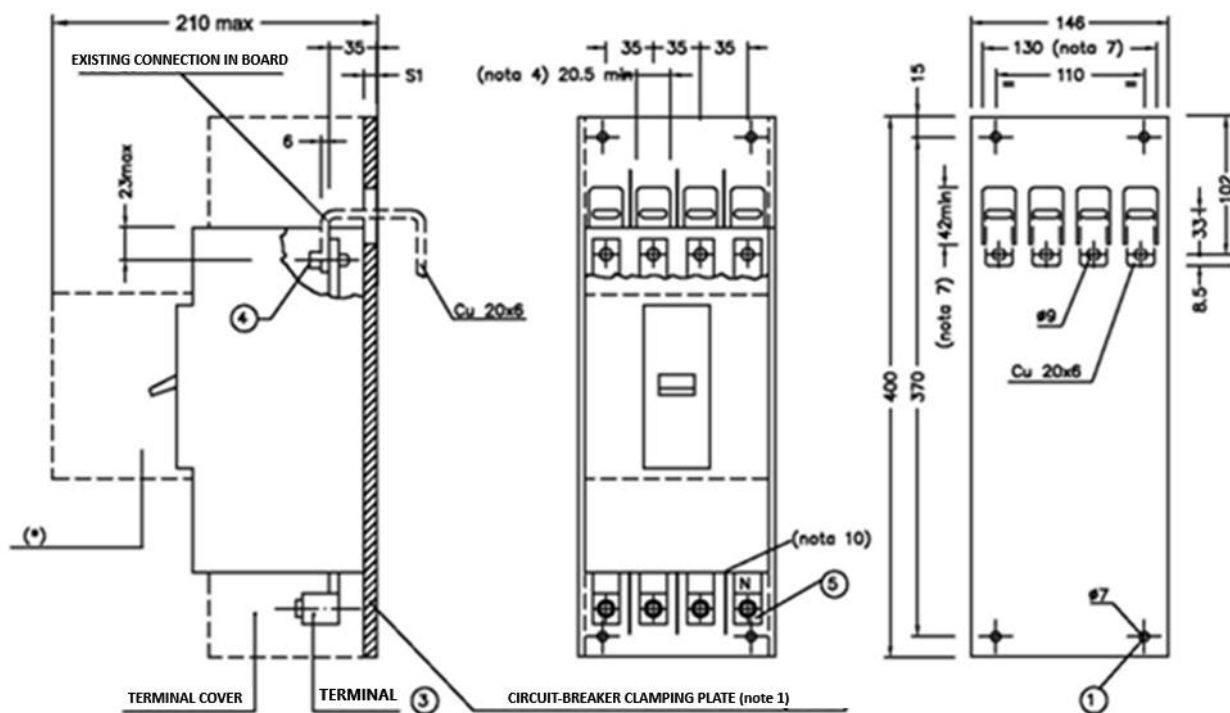
Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

#### 7.5.1.1 Construction of circuit-breaker up to 250 A



**Figure 1 – Circuit-breaker for Secondary substations with 125, 180 and 250 A**

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

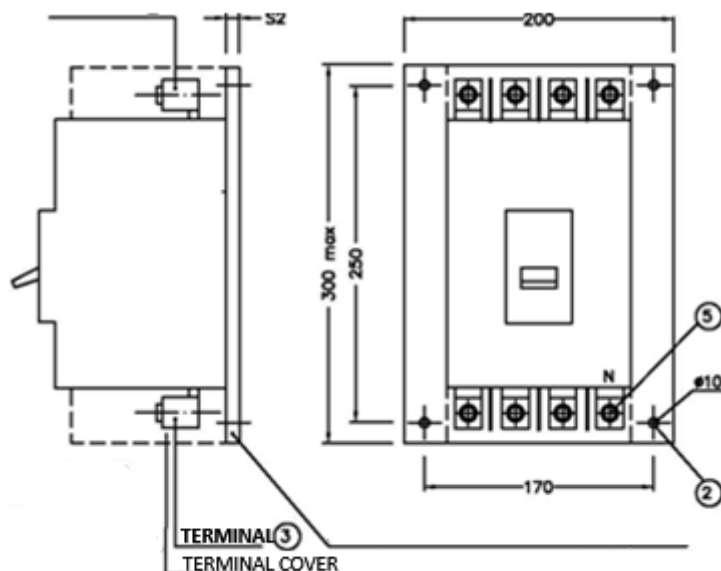
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Service Function: -

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**Figure 2 – Circuit-breaker for Pole-mounted transformers 40, 80, 125, 180 and 250 A**

1	No. 4 screws TC M5 x (S1+5) ISO 1207 / DIN84 No. 4 steel spring washers 5.3x11 DIN 137
2	No. 4 screws TC M8 x (S2+15) ISO 1207 / DIN84 No. 4 steel spring washers 8.4x15 DIN 137
3	Connection clamp screws must be embedded hexagon type for S = 5 mm Allen spanners for phase or neutral; use with the required torque
4	ISO 4762 M8 (max) screws with embedded hexagon type for S = 5 mm for phase or neutral; Use the required torque for the size of the circuit-breaker.
5	The neutral clamp must be able to tighten the conductor of the copper cable

**Table 15 – References to figures 1 and 2**

- The clamping bolts and all iron accessories must be protected using electrolytic zinc plating FeZn 8c ISO 2081 and ISO 4095
- The 3-4 screws must be inspected according to ISO 3269.
- (\*) Space allocated to motor

**Subject:** Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR SECONDARY SUBSTATIONS

## Application Areas

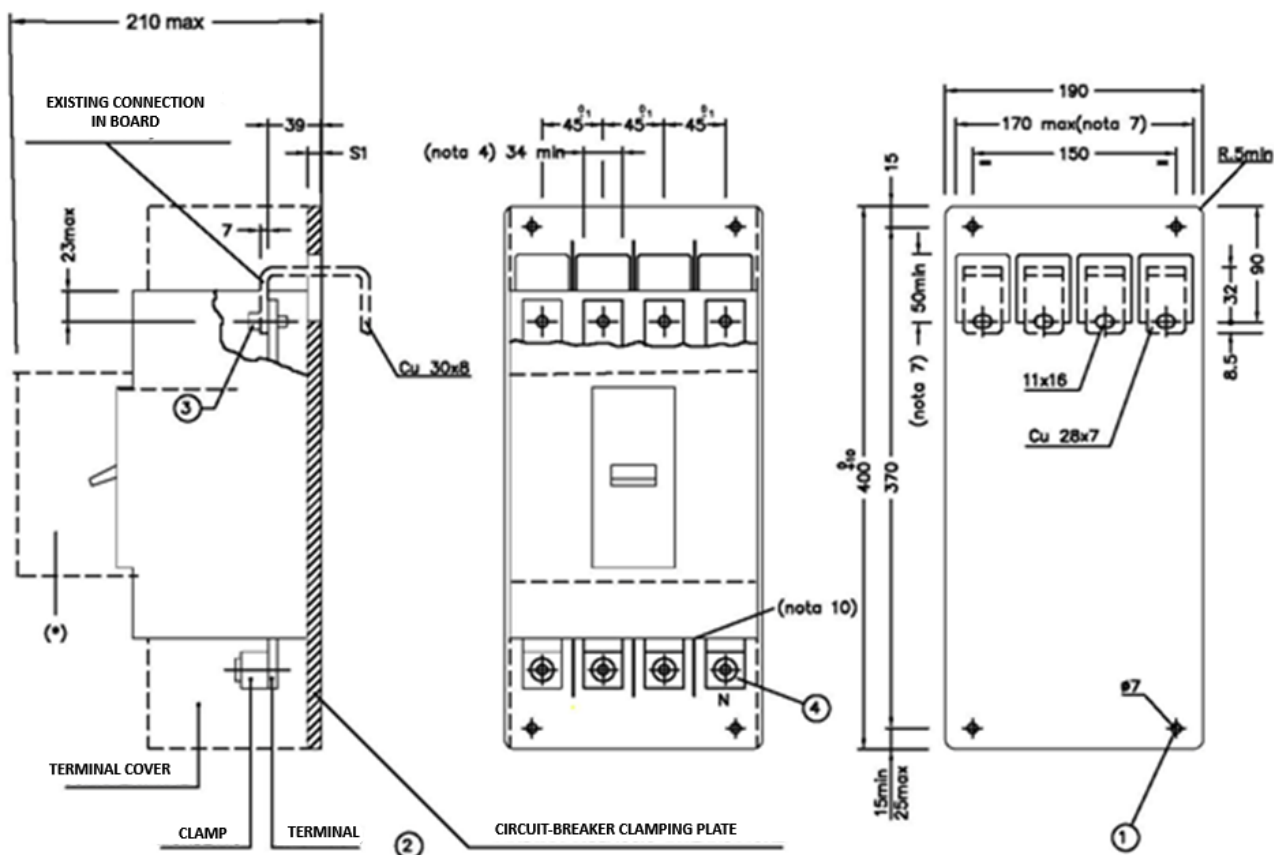
Perimeter: *Global*

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Service Function: -

Business Line: *Infrastructure & Networks*

#### 7.5.1.2 Construction of circuit-breaker with 350 A



**Figure 3 – Circuit-breaker for Secondary substations with 350 A**

1	No. 4 screws TC M5 x (S1+5) ISO 1207 / DIN84 No. 4 steel spring washers 5.3x11 DIN 137
2	Load clamp screws shall be embedded hexagon type for S = 8 mm Allen spanners for phase or neutral of type, use with the required torque  Load terminals must be also suitable to clamp cable terminals (see fig. 4) using M8 screws (instead of clamps).
3	M10 screws ISO 4762 with embedded hexagon type for S = 8 mm; use with the required torque.
4	The neutral load clamp must be designed to be connected to the conductor of both copper cable and aluminium cable

### Table 16 – References to figure 3



**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

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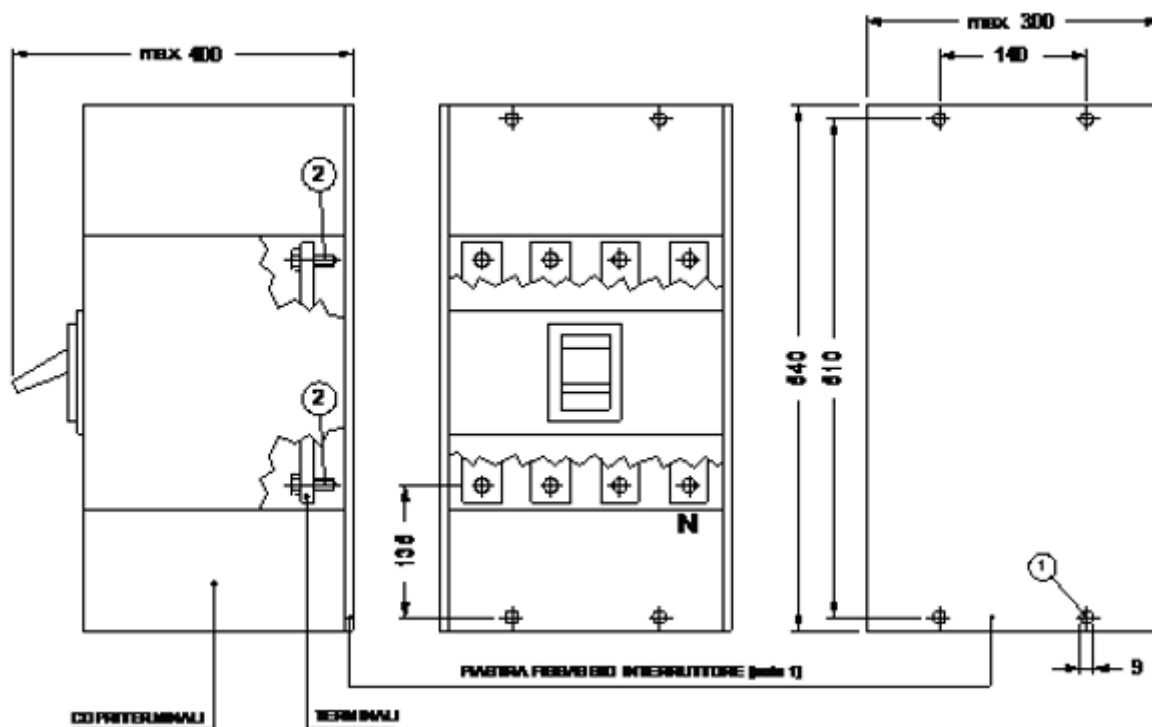
Staff Function: -

Service Function: -

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- The clamping bolts and all iron accessories must be protected using electrolytic zinc plating FZn 8c ISO 2081 and ISO 4095
- The screws (points 2-3) must be inspected according to ISO 3269
- (\*) Space allocated to motor

**7.5.1.3 Construction of circuit-breaker with 630 A**



**Figure 4 – Circuit-breaker for Secondary substations with 630 A**

1	No. 4 M8x25 screws complete with nuts and washers (for application to separator assembly)
2	M10 or M12 screws with spring and flat washers, for application on cable terminals with a maximum width of 31 mm and a Ø13 hole

**Table 17 – References to figure 4**

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

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Staff Function: -

Service Function: -

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### **7.5.2 VDS Construction**

The voltage detecting system (VDS) must be present on all supplied automatic circuit breakers.

The VDS device must be integral part of the circuit-breaker body. Voltage detection sensors must be also integral part of the circuit breaker.

The materials used for the realization of the VDS must comply with the RoHS 2011/65 / CE directives and the standard IPC-A-610 rev. E.

The VDS device must comply with Directive 2004/108 / EC (EMC) and being a component of the circuit-breaker, it must pass the immunity tests provided for in Annex J of the IEC 60947-2 Standard in ambient conditions A.

The VDS device must detect the voltage from inside the circuit-breaker downstream of the interruption chamber (e.g., at the output of the lower terminals), maintaining the IP3X protection degree required by the circuit-breakers.

A contact called "RVL BT" must be provided which, if wired, reports the voltage presence information to RTU.

The VDS device detects the mains voltage from the three phases RST and from the neutral N (circuit-breaker output terminals), if present, and through a coupling system it supplies the measurement signal to an electronic monitoring circuit with a voltage threshold set at  $U_{th} = 30 \text{ VAC}$  (with tolerance  $\pm 1 \text{ V}$ ).

The indication of the status of the three lights (L1-L2-L3) in red must be perceived by an observer located 750 mm away with a minimum visibility angle of 60 degrees from the horizontal and vertical axis

The VDS must also work with a single phase (R/S/T) in voltage; moreover, it must not be influenced by the presence of the voltage  $+24\text{Vcc} \pm 20\%$  on the neutral, due to the power supply of RTU connected to ground and consequently to the neutral of the LV system (230/380 VAC).

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR SECONDARY SUBSTATIONS**

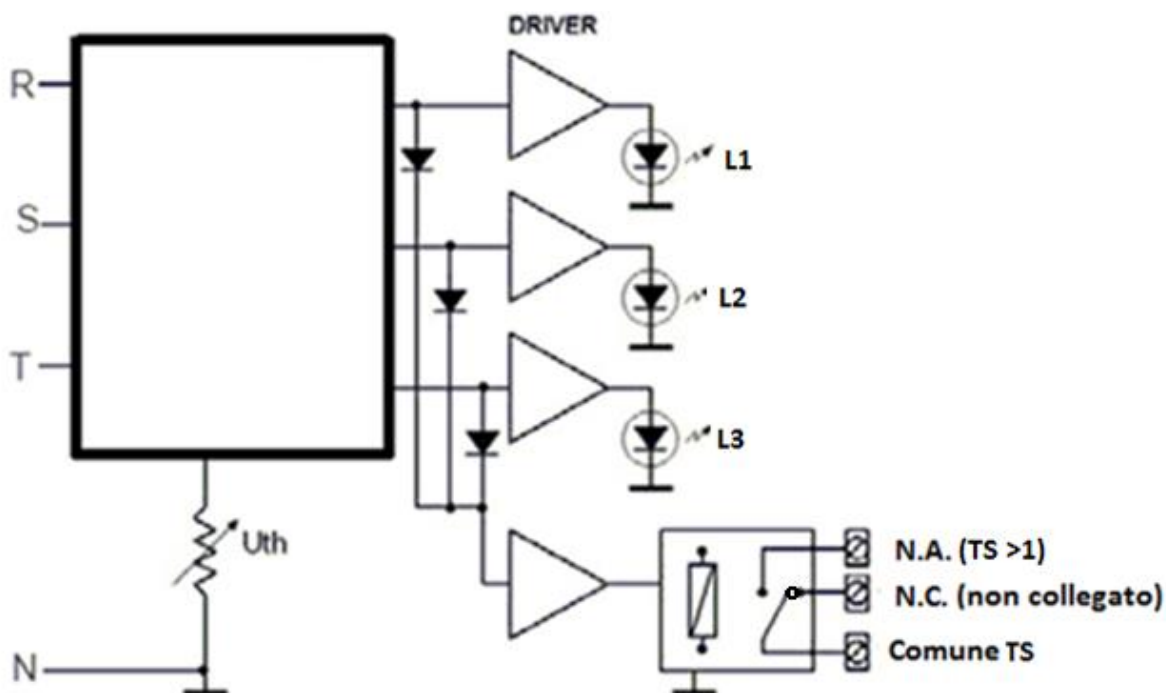
**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

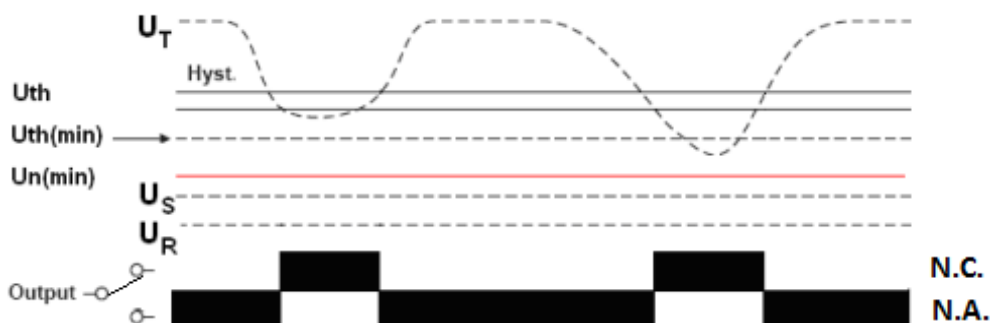
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**Figure 5 – Example of circuit with use of LEDs (status not activated - LEDs off)**

When at least one phase voltage is higher than the threshold voltage, the corresponding phase red light must be on and the "RVL BT" contact must be in closed position.

When all the phase voltages are lower than the threshold voltage, the lamps (L1-L2-L3) must be turned off and the "RVL BT" contact must be in the open position.



$U_{th}$  = adjustable threshold voltage;  $U_{th(min)}$  = minimum regulation voltage;  $U_n(min)$  = minimum phase voltage for operation of the VDS;  $U_R$ ,  $U_S$  e  $U_T$  = phase voltages.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

The measured voltage threshold value ( $U_{th}$ ) must be adjustable and not accessible from the outside. If it is made with a potentiometer, after the factory calibration, it must be blocked with paint.

The VDS must comply with the characteristics indicated in table 18.

<b>Characteristics of the VDS</b>	
Rated voltage ( $U_n$ )	380 $V_{ca}$
Maximum measurement voltage ( $U_{mm}$ )	415 $V_{ca} + 10\%$
Frequency (f)	47÷63 Hz
Minimum operating phase voltage $U_n(\min)$	24 $V_{ca}$
Threshold voltage regulation – ( $U_{th}$ )	$24 V_{ca} \leq U_{th} \leq 50 V_{ca}$
Maximum consumption	< 2,5 W
Operating temperature	-20 ÷ +40° C
Storage temperature	-25 ÷ +70° C
Humidity (without ice and condensation)	≤ 95 %
MTBF-GB (MIL-STD-217F)	100.000 Hrs
Enclosure protection degree	IP 40
Mobile contact "RVL BT"	24 $V_{cc}$ / 500 mA
Degree of relay protection ≥	IP54
Dielectric strength	2 kV

**Table 18 – Characteristics of the VDS**

For the circuit-breakers delivered to Spain, see chapter 7.6.1.1.2 for special dielectric characteristics.

To guarantee the insulation voltage of the circuit-breakers ( $U_i=690V$ ) it is necessary that:

- during the insulation frequency tests of the circuit-breaker (performed at 1890  $V_{AC}$ ) it must be possible to disconnect the VDS (designed for applied voltages, between pole and pole not exceeding 415  $V_{AC} + 10\%$ );
- the VDS has a system that allows withstanding and consequent proper operation of the circuit-breaker also following overvoltage impulse that could compromise the operation of the VDS itself.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

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### **7.5.3 Motorization construction**

#### **7.5.3.1 Characteristics of the motorization**

The electrical operations of the circuit-breaker must take place through an electric motor (or equivalent mechanism), with a size that allows that, even at the minimum concurrent values of the supply voltage and the operating temperature, the time required to perform a maneuver (of opening or closing) does not exceed 5 sec.

The excitation time of the electric control must be such as to guarantee its self-holding with a command impulse of a duration not exceeding 300 msec.

In the event that the circuit-breaker is in Trip position (following manual operation or the intervention of the protection relay), the same must remain in this position until a closing command is sent. When sending this command, the motor must load the springs to reset the switch and then close. Remote closing must also be possible with the circuit breaker in the open position.

With the circuit breaker in the closed position, a remote opening command must cause the opening of the apparatus (release plus spring reload).

The circuit breaker must be equipped with the functionality for manual local maneuvers in closing (I), opening (O) and release (Trip).

The circuit-breaker must be equipped with a manual selector (local/remote) to three-position: remote, local and lockable. The execution of remote electric maneuvers must be inhibited with the selector placed in a local or lockable position (this condition must be achieved by mechanical impedance of the kinematic mechanism and by cutting the motor power supply). The remote position must however guarantee the possibility of the local trip of the circuit breaker. The circuit breaker must be lockable only in the open position.

The device must be equipped with an anti-reclosing (anti-pumping) device with the purpose of inhibiting further closings beyond the first until the closing command is released.

The manual operating lever (handle of the switch) must be inaccessible to the motorization system installed.

The installation of the switch on the LV switchboard must be possible without removing the motorization system.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

Characteristics of the motorization	
Motor supply voltage:	24 Vdc $\pm$ 20%
Maximum permissible absorbed current value (RMS - excluding starting)	13 A
Maximum maneuver time:	5 s
Degree of motor protection:	IP4X
Other engine features	IEC 60034
Minimum operating temperature	-20°C
Maximum operating temperature (with average value, referring to a period of 24h, not exceeding 35°C)	+40°C
Storage temperature:	-25 ÷ +70°C
Relative humidity (without condensation or ice):	$\leq$ 95%

**Table 19 – Characteristics of the motorization**

The motorization circuit must not absorb any current when it is in the stand-by state.

### 7.5.3.2 Characteristics of the relays

The motor must be activated by non-specified time all-or-nothing relays (power relays to energize the motor, rescuers to receive remote commands).

The relays used must be chosen by the manufacturer according to the type of motor and the kinematic forces of the appliance regarding the nominal capacity of the contacts

Characteristics of the relays	
protection level (contacts only)	$\geq$ IP55
service type	continuous
mechanical durability	equal to that of the circuit breaker
electrical durability:	equal to that of the circuit breaker
work class (IEC 61810-1)	C

**Table 20 – Characteristics of the relays**

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

The relays must be insensitive to the stresses caused by the maneuvers and, in case of using an extractable version, they must be tied to the relative sockets with an anti-extraction device.

### 7.5.3.3 Characteristics of the auxiliary contacts

Microswitches capable of switching small currents (even 20 mA at 24 Vdc) must be used for remote signaling of the circuit-breaker position and that of the protection. The contacts must be driven by the main shafts (not by the operating ones).

Three separate microswitches must be provided for the signaling of the switch position: one for the open (89cax) signal, one for the close (89ccx) signal and one for the tripped signal (trip).

The nominal capacity of the contacts and the 24 Vdc opening and closing power of the auxiliary contacts used must be chosen by the manufacturer

Characteristics of the auxiliary contacts	
Electric maneuvers guaranteed	equal to those of the circuit breaker
Mechanical maneuvers guaranteed	equal to those of the circuit breaker
Degree of protection (contacts only)	≥ IP55

**Table 21 – Characteristics of the auxiliary contacts**

### 7.5.4 Connections construction

The connection diagram between the circuit breaker motorization and the RTU and between the VDS and the RTU is shown in figure 6.

All the connectors used must be equipped with a cable clamp, polarization and coupling must be ensured by means of elastic locking appendages.

The fixed part of the proprietary connector (A) must be equipped with male contacts, the mobile part with female contacts.

The mobile part of the rectangular connectors (B) provided at the other end of the cable must be of the type shown in fig. 10 and equipped with male contacts.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR SECONDARY SUBSTATIONS**

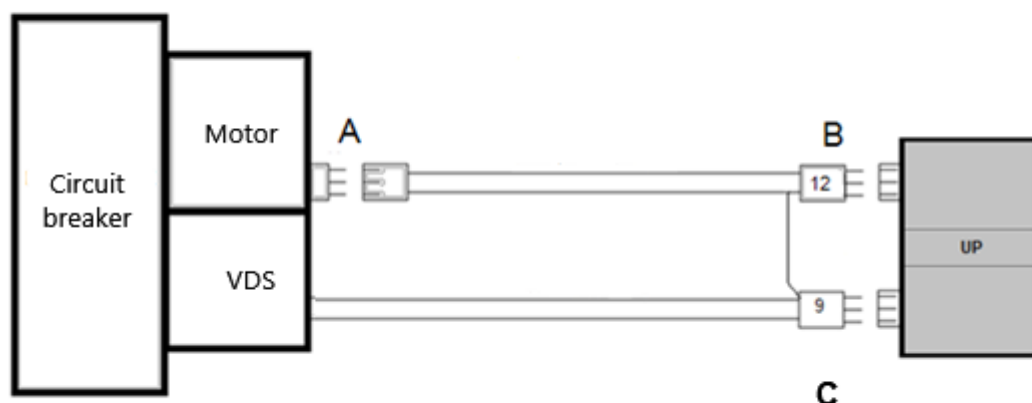
**Application Areas**

Perimeter: *Global*

Staff Function: -

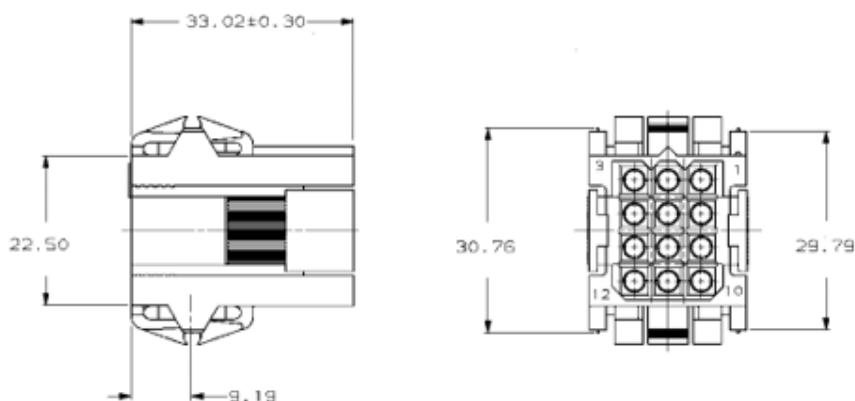
Service Function: -

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**Figure 6 – Connection scheme**

Both the fixed and the mobile parts must be made of insulating material and with adequate mechanical characteristics; they must be equipped with only the contacts necessary to perform the functions indicated and whose use is illustrated in figure 7.



1	+L	Local controls power supply (+24 Vdc)	1 mm <sup>2</sup>	7	AP	Opening command	1 mm <sup>2</sup>
2	+M	Motor power supply (+24 Vdc)	2 mm <sup>2</sup>	8	CH	Closing command	1 mm <sup>2</sup>
3	+M	Motor power supply (+24 Vdc)	2 mm <sup>2</sup>	9	89cax	Circuit breaker open signal	1 mm <sup>2</sup>
4	89ccx	Circuit breaker closed signal	1 mm <sup>2</sup>	10	-M	Motor power supply (-24 Vdc)	2 mm <sup>2</sup>
5	+A	Common (+24Vdc) signals	1 mm <sup>2</sup>	11	-M	Motor power supply (-24 Vdc)	2 mm <sup>2</sup>
6		Not used		12	-A	Common commands (-24Vdc)	1 mm <sup>2</sup>

**Figure 7 – Dimensional characteristics and use of the pin of connector B**



**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

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Service Function: -

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The contacts used must be able to accommodate 2 mm<sup>2</sup> section conductors which must be attested by crimping; they can also be of the printed type as long as they are suitable, also considering the finishing and surface treatment, to guarantee the achievement of the following characteristics

Characteristics of the 12-pin connector B	
Nominal operating voltage	24 Vdc
Nominal current capacity	13 A
Voltage drop on a male-female pair crossed by a current of 5 A	≤ 50 mV
Insertion-extraction force	0,40 ÷ 10 N/contacts
Number of guaranteed insertion-extraction cycles	≥ 100

**Table 22 – Characteristics of the 12-pin connector B**

The wire (TSD trip / SGN), of a section of 1 mm<sup>2</sup> not connected to the plug B, must be attested with a "suitable" cable lug to be inserted (in the field) in the 9-pole connector C of the VDS on pin 2 and will have a minimum useful length of 500 mm at the cable exit before connector B.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

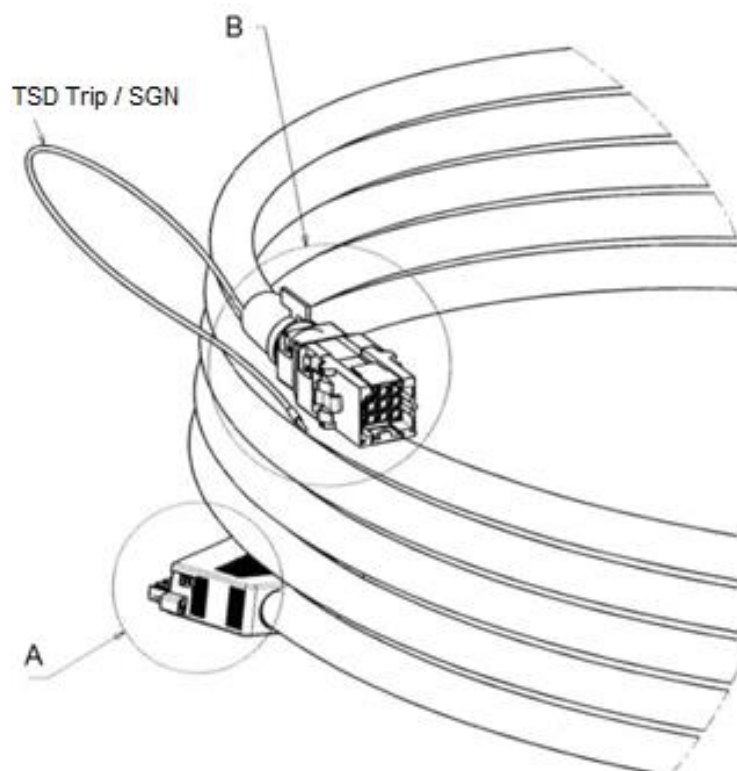
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**Figure 8 – Detail of TSD trip wire**

The 9-pin VDS connector shown in figure 6 shall be according to figure 9

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

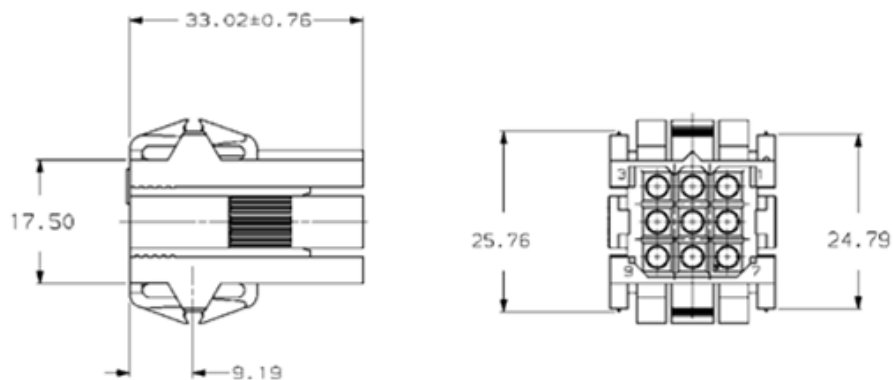
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1	Com TS	Power Supply (+24V <sub>cc</sub> ) and common Telesignals
2	TS trip / SGN	Field wire to be inserted (in the field) in the connector coming from motorized cable see Fig. 11
3	TS pres. V	RVL BT
4		Not used
5		Not used
6		Not used
7		Not used
8		Not used
9		Not used

**Figure 9 – Dimensional characteristics and use of the pin of connector C**

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

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Business Line: *Infrastructure & Networks*

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## **7.6 TESTING**

Tests are divided in:

- Type tests.
- Routine tests.
- Acceptance test

Technical Conformity Assessment (TCA) shall be compliant with MAT-O&M-NCS-2021-0033-EGIN.

### **7.6.1 Compliance with constructional requirements**

Chapter 8.2 of IEC 60947-2 Standard applies.

### **7.6.2 Type tests**

#### **7.6.2.1 Circuit breaker type tests**

The type test shall be performed according to chapter 8.3 of IEC 60947-2 Standard.

##### **7.6.1.1.1 Visual inspection**

One circuit-breaker for each type must be checked to verify compliance with this Standard

All the nameplate data and markings defined in paragraph 5.2 of IEC 60947-2 must be shown on the circuit-breakers, including a declaration of compliance with the standard itself.

In addition, all circuit-breakers should have a barcode to allow them to be traced in the field (see CNS-O&M-S&L-2021-0032-EGIN).

In particular, the positions and dimensions of the drillings for fastening the circuit-breakers (to clamp the base plate to the LV assembly), the degree of protection prescribed for the casing (see ref. n. 13-14 – Verification examples for protection against access by dangerous parts of Standard IEC 60529) and the accuracy of the data found on the nameplate.

##### **7.6.1.1.2 Test sequences**

The circuit-breakers shall be tested according the Test sequences I (chapter 8.3.3 of IEC 60947-2) and II (chapter 8.3.4 of IEC 60947-2)

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

In relation with the test for the dielectric properties, in addition to what is indicated in the tests for dielectric properties, the following test shall be done for the circuit-breakers delivered to Spain:

For power frequency withstand verification, a test voltage of 10 kV is applied between all the terminals of the main circuit connected together (including the control, VDS, auxiliary circuits connected to the main circuit and the connection cables to the UP) and a metallic foil wrapped around the assembly formed by the circuit-breaker with the contacts in all normal positions of operation and the connection cables to the UP.

For impulse withstand verification, 15 pulses of negative polarity and 15 pulses of positive polarity will be applied, with a peak value of 20 kV, applied between all the terminals of the main circuit connected together (including the control, VDS, auxiliary circuits connected to the main circuit and the connection cables to the UP) and a metallic foil wrapped around the assembly formed by the circuit-breaker with the contacts in all normal positions of operation and the connection cables to the UP.

Test sequences	Tests
I General performance characteristics	<ul style="list-style-type: none"> <li>• Tripping limits and characteristics</li> <li>• Dielectric properties</li> <li>• Mechanical operation and operational performance capability</li> <li>• Overload performance</li> <li>• Verification of dielectric withstand</li> <li>• Verification of temperature-rise</li> <li>• Verification of overload releases</li> </ul>
II Rated service short-circuit breaking capacity	<ul style="list-style-type: none"> <li>• Rated service short-circuit breaking capacity</li> <li>• Operational performance capability</li> <li>• Verification of dielectric withstand</li> <li>• Verification of temperature-rise</li> <li>• Verification of overload releases</li> </ul>

#### 7.6.1.1.3 Verification of mechanical operation at low temperature

This test is performed at the lowest temperature indicated in this Standard, on new samples. Upon reaching the thermal regime, 5 cycles of C-O manual operations (10 minutes between each operation) must be performed without the formation of ice or condensation. The test is considered passed if these operations are carried out without problems and the samples tested are fully functional (check for continuity and insulation on

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

---

the pole meters). A photograph of the test sample, prepared in a climatic chamber, must be included in the test report.

**7.6.1.1.4 Test to verify the circuit-breaker in case of special environmental conditions (temperature, humidity and saline atmosphere)**

The test shall be made according to chapter 8.5 of IEC 60947-2 with the classification of the circuit-breaker as Category C (see annex Q of IEC 60947-1)

**7.6.2.2 Electrical command type tests**

**7.6.2.2.1 Verification of the connections of the auxiliary circuits**

The correspondence of the connections to the electrical diagram approved by Enel must be verified.

**7.6.2.2.2 Insulation test**

The motor cables and any transient suppressors must be properly disconnected and insulated. The test must be carried out by applying a voltage of 2000 V<sub>eff</sub> with a frequency of 50/60 Hz for 1 min to the free end of the conductors of the connection cable with the power supply, having the other end connected to the control.

**7.6.2.2.3 Verification of the operation of the local/remote selector switch**

It must be verified that with the local/remote selector in the local position, it is not possible to carry out operations with the remote electric control on the circuit breaker. It must be verified that with the local/remote selector in the lockable position it is not possible to carry out operations with the remote electric control on the circuit breaker. It must be verified that with the local/remote selector in the remote position it is possible to manually release the circuit breaker. It must also be checked that the circuit breaker can be locked only in the open position.

After what is indicated, the selector must be positioned in a lockable position and the circuit breaker must be tampered in such a way as to make the electric control available. Under these conditions, 100 closing commands must be sent interspersed with each other for 15 sec; the test result is positive if none of these closing maneuvers is completed.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

---

**7.6.2.2.4 Verification of the degree of protection of the enclosures**

Verifications of the degree of protection (IEC 60529) presented by all the components used on the motorized control must be carried out, for which this characteristic has been specified in the requirements.

**7.6.2.2.5 Verification of the operation of the electric drive at the extreme values of temperature and supply voltage**

The correct operation of the motorized circuit-breaker must be checked by carrying out 10 successive cycles (O - 5 s - C - 5 s) with power supply, with nominal current, at the minimum motor voltage of 19.2 Vdc and maximum of 28.8 Vdc, having previously brought the circuit-breaker itself to thermal conditions at an ambient temperature of  $-20^{\circ}\text{C}$ . The same test must be repeated on two new samples and at temperatures of  $+20^{\circ}\text{C}$  and  $+40^{\circ}\text{C}$ .

At the end of each of the three tests, the circuit-breakers must not show signs of damage that would compromise their further use. The opening and closing times must be recorded as well as the values of the current absorbed by the motor at the minimum, nominal and maximum values of the supply voltage and at the fixed test temperature. The recorded values must not exceed the parameters indicated in point 7.5.3.1 of this specification.

**7.6.2.2.6 Functional tests**

The correct operation of the device must be verified (i.e. performing the maneuvers remotely and locally and sending the signals) under installation conditions that faithfully reproduce the operating conditions.

**7.6.2.2.7 Verification of the operation of the anti-pumping device**

Starting from the initial conditions of the circuit breaker in the trip position, a closing command must be sent. With the circuit breaker closed and the closing command maintained permanently, the release of the device must be caused, and it must be checked that the circuit breaker remains in the disconnected position. Subsequently, the closing command should be released and then restored, in these conditions the circuit-breaker must be closed.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

---

### **7.6.2.3 VDS type tests**

#### **7.6.2.3.1 Visual examination**

The device must be checked by visual inspection to verify that the product complies with the requirements indicated in this specification; in particular, the following must be verified:

- a) compliance with the specified requirements (signal lights, RTU contact) and verification of the circuit breaker disassembly and assembly procedure according to the instructions indicated in the manual.
- b) presence of the identification of lights L1, L2 and L3.
- c) compliance with the relevant Rohs Standards; IPC-A-610 and Electromagnetic Compatibility (EMC) through examination of the certification / declarations.
- d) compliance of the circuits and related internal and external wiring with the requirements indicated in this specification and with the IEC Standard.

#### **7.6.2.3.2 Construction and performance requirements**

The mechanical, electrical and thermal suitability of the construction materials and parts of the device is considered proven with the checks of the construction and performance characteristics indicated below (IEC 60947-1 chap. 7):

- a) Verification of the resistance of insulating materials to normal heat (7.2.2.7).
- b) Verification of the resistance of materials to abnormal heat and fire that occurs for internal electrical effects (7.1.2.1). To be carried out according to IEC 60695-2-10 Standard: glow wire test at 650 °C.
- c) Verification of the degree of protection against external mechanical impacts: the device container must resist an impact of 10 joules with IK 09 degree according to Standard IEC 62262.

#### **7.6.2.3.3 Degree of protection of the enclosures (7.1.12)**

The device, fully equipped, must be subjected to the verification of the degree of protection in accordance with the IEC 60529 standard; the minimum degree to be verified is IP40.



**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

#### **7.6.2.3.4 Distance between air and surface insulation (7.1.4)**

It must be checked that the minimum air and surface insulation distances comply with Tables 13 and 15 of the IEC 60947-1 par. 7.1.4. with pollution degree 3.

#### **7.6.2.3.5 Verification of the dielectric properties (7.2.3)**

To check the tightness of the insulations (solid and surface of the insulating supports and in the air between the bare parts with different potential) regarding the transient and temporary over-voltages, the VDS devices must undergo respectively the following dielectric checks:

a) Verification of the rated impulse withstand voltage (7.2.3.1).

The test must be performed on the fully wired device under the following conditions:

- device permanently fixed on a metal plate connected to earth.
- all input circuits must be short-circuited together.

5 positive and 5 negative pulses must be applied between the input circuit and the metal plate mentioned above, at intervals of at least 1 s between one pulse and the next, with a waveform of 1.2 / 50  $\mu$ s, and peak value nominal = 8 kV (see Standard IEC 60947-1 - table 12 for the determination of the real peak value to be applied based on the altitude of the test site)

b) Verification of the voltage at operating frequency (7.2.3.2).

Under the test conditions indicated in the previous paragraph, an operating frequency voltage of RMS value equal to 1890 VAC must be applied for a period of 5 s (IEC 60947-1 - tab. 12A,  $U_i = 415 \pm 10\%$  VAC).

c) Verification of the insulating material casings

For enclosures in insulating material, an additional dielectric test must be performed, applying the AC test voltage between a metal sheet placed outside the casing and the active parts connected to the masses located inside; the test voltage must be 1.5 times the values of table 12A of IEC 60947-1.

d) Verification of the degree of insulation  $U_i=690$ V (required by the LV circuit-breakers) after high voltage disturbance at industrial frequency

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

---

By applying a voltage  $\geq 1500$  VAC for one minute between the 4 wires of the VDS connection (in the various possible phase-phase and phase-neutral configurations), voluntary damage to the VDS must be caused. The VDS device, even if it is no longer working, must guarantee, without further operations, that the circuit breaker passes the verification of the dielectric withstand (by successfully performing the of IEC 60947-2)

#### **7.6.2.3.6 Functionality tests**

On the sample that has successfully passed tests 10.5 a) b) and c), through an industrial frequency voltage generator, the output terminals of the circuit breaker under test must be powered (in single-phase and three-phase mode) and it must be checked that:

- at a voltage of 25 VAC the lights must certainly be off and the mobile contact in open position.
- at a voltage of 35 VAC the lights must certainly be on and the mobile contact in closed position.

#### **7.6.2.3.7 Verification of the brightness of the lamps**

The safe perception of the visual indication must be verified, by means of the test indicated in the paragraph 5.22 of IEC 61243-5 for internal use indicators.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

---

### **7.6.3 Routine tests**

#### **7.6.3.1 Mechanical operation tests**

The test shall be according to chapter 8.4.2 of IEC 60947-2 standard

#### **7.6.3.2 Verification of overcurrent releases**

The test shall be according to chapter 8.4.3 of IEC 60947-2 standard with a value of multiple of the current setting of 2 (x2) for the inverse time-delay releases.

For instantaneous release, the verification shall be with the values of chapter 8.3.3.2.2 of IEC 60947-2 Standard.

#### **7.6.3.3 Dielectric tests**

The test shall be according point a) of chapter 8.4.6 of IEC 60947-2 standard

### **7.6.4 Acceptance tests**

Excluding the test described in paragraph 8.1, below, the number of samples to be subjected to routine tests must be determined statistically according to the indications given in Table ISO 2859-1 using:

- Sample plan: simple reduced.
- Current testing at Level II.
- Acceptable Quality Level (AQL): 0.65%.

In the case of negative results of the test, Enel reserves the right, for subsequent tests, to use test plans that involve a larger sample than the previous test, starting from the simple ordinary type (statistical testing where the AQL = 0.65%) up to 100% of the batch.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

---

#### **7.6.4.1 Acceptance tests of circuit-breaker**

Verification must be carried out by checking the construction correspondence approved by ENEL in the TCA process.

The acceptance tests of circuit-breaker are the same describes in the chapter 7.6.2 of this standard.

#### **7.6.4.2 Acceptance tests of the motorization**

Verification must be carried out by checking the construction correspondence approved by ENEL in the TCA process.

In addition to the tests described in chapter 7.6.2.1 of this standard, the following tests shall be performed:

##### **Verification of the connections of the auxiliary circuits**

The verification must be carried out in the manner expressed in point 7.6.1.2.3

##### **Insulation test**

The verification must be carried out in the manner expressed in point 7.6.1.2.3

##### **Verification of the functioning of the local/remote selector**

It must be verified that with the local/remote selector in the local position, it is not possible to carry out operations with the remote electric control on the circuit breaker.

It must be verified that with the local/remote selector in the lockable position it is not possible to carry out operations with the remote electric control on the circuit breaker.

It must be verified that with the local/remote selector in the remote position it is possible to manually release the circuit breaker.

Finally, it must be checked that the circuit breaker can be locked only in the open position.

##### **Functional tests**

The correct functioning of the device must be verified (in terms of performing the manoeuvres remotely and locally and sending the signals).

##### **Verification of the operation of the anti-pumping device**

The verification must be carried out in the manner expressed in point 7.6.1.2.8.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

### 7.6.4.3 Acceptance test of the VDS

Verification must be carried out by checking the construction correspondence approved by ENEL in the TCA process.

### Dielectric tests

The tests described in the previous paragraph must be performed on the VDS device, point (b) of chapter 7.6.1.3.5 but with a voltage reduced to  $415 + 10\% \text{ VCA}$  for 5 s.

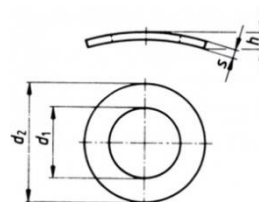
### 11.3 Functionality tests

After the dielectric tests indicated above, the functionality of the VDS device must be checked as indicated in point 7.6.1.3.6

## 7.7 CONDITIONS OF SUPPLY

Each circuit-breaker must have its own individual packaging and all the accessories for its correct use, installation and start-up. In particular, each package must contain:

- n. 1 circuit-breaker with VDS already mounted to the clamping plate with insulating separators between the terminals and the clamp covers already mounted.
- Motorization and remote control equipment already installed (when necessary)
- Cable and connectors for connection of motorization to the RTU (when necessary)
- Cable and connector for connection of VDS to the RTU (when necessary)
- a bag containing n. 4 screws and n. 4 spring washers for the installation of the circuit-breaker clamping plate



- circuit-breaker instructions manual (with warnings concerning the installation of insulating separators and clamp covers) and instructions for mounting on GSCL002 assemblies and GSCL008 cabinet.

A label with the following minimum information must be put on each single package:



**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

---

- Supplier name
- Circuit-breaker model name
- Enel code
- Individual package gross weight

Before shipping products to ENEL deposits, the tasks listed in CNS-O&M-S&L-2021-0032-EGIN must be performed for each circuit-breaker with a serial number.

The requirements regarding dimensions for delivery to ENEL deposits are reported in Packaging, transport and delivery requirements.

Marking, technical documentation and packaging shall be in the language of the destination country.

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

**ANNEX A – SPECIFICATIONS FOR ELECTRONIC CIRCUIT-BREAKERS**

This document aims at describing additional characteristics for electronic motorized LV circuit breakers with reference to this Technical Specification.

Prescriptions apply to four pole electronic circuit breakers to be installed in secondary substations, following a deploying plan approved by local DSO.

This document shall be used exclusively during tender process and TCA verifications by competent unit in charge of TCA process.

MOTOR-DRIVEN CIRCUIT-BREAKERS							
e- distributione	TYPE CODE	DESCRIPTIVE ABBREVIATION	NEUTRAL	I <sub>u</sub> (A)	I <sub>cs</sub> (kA)	REFERENCE CHARACTERISTICS	MAIN USE
130001	GSCL003A/1	250/D/25/M/E	DISCONNECTABLE	250	25	A	SECONDARY SUBSTATIONS
130002	GSCL003A/2	250/NP/25/M/E	NOT PRESENT	250	25	A	LINE JUNCTION BOX
<p>I<sub>u</sub> = rated current at 40 °C I<sub>cs</sub> = short circuit rated current            Neutral state: D = Disconnectable, C = Continuo, NP = Not Present;            M = Motorized, E=Electronic</p>							

**Electronic functions**

Electronic LV circuit breakers shall have same properties of thermomagnetic circuit breakers described in GSCL003 specification and shall operate properly even in reverse energy flow condition. In case of damages to the electronic board a mechanical / magnetic “lifesaving” opening device in case of short circuit shall be foreseen (intervention within 2 I<sub>m</sub>).

Main features required:

- “L” (from overload) and “I” (from short-circuit) protection ensured by electronic micro-processor function
- Current and Time setting of L and I interventions
- Circuit-breaker electronic command and motorization powered by external supply (24 V<sub>DC</sub>), properly insulated from main power circuits

**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

- Circuit-breaker status remote control and signaling (open/close/trip)
- System fault signaling (local and remote alarm), for each phase and neutral pole remote measurement of main electrical quantities (below described)
- Threshold signaling for voltages higher than 30 V downstream of the output terminals to be remote controlled (to be evaluated optionally).
- Protection relay remote setting (to be evaluated optionally)
- MODBUS TCP communication module (embedded or separate form circuit-breaker body) to be interfaced with Enel RTU (see GSTR002 – UP2020 Lite Technical Specification, supplier Modbus configuration map shall be shared).
- IEC 61850 communication module (to be evaluated optionally).
- Set of required measurements and functions: Voltage and Current measurement (RMS), Active Power/Energy, Reactive Power/Energy (RMS), even in unbalanced network configuration or reverse energy flow conditions, recording of interventions, type of intervention, temperature (measure or alarm).

## **Specific Requirement for installation in LV line junction box**

- a. 3-pole electronic circuit breaker shall be supplied
- b. Circuit-breaker to be supplied without the interface plate for the LV switchboard nor accessories for cables on the lower terminals (busbar connection as for the upper ones).
- c. 230 V<sub>AC</sub> power supply for motorization function.
- d. Opening release for opening circuit-breaker by means of a remote command even in no voltage condition.

### **5.2 Derogations**

Special derogations with respect to this Standard technical Specification can be accepted for electronic circuit breakers due to the experimental characteristics of supply:

- Neutral protection can be accepted down to 50% with respect to phase protection
- Intervention time at  $3 I_m < 30$  ms.
- insulation level between the active parts (phases and neutral) and earth (considering earth also any point on the outside surface of the circuit breaker envelope) according insulation required by relevant standard.

Mandatory requirement for three buttons can be released provided that:

- Other possibilities rather than three buttons manual command execution (I) , (O), (Trip) can be evaluated.



**Subject: Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS**

**Application Areas**

Perimeter: *Global*

Staff Function: -

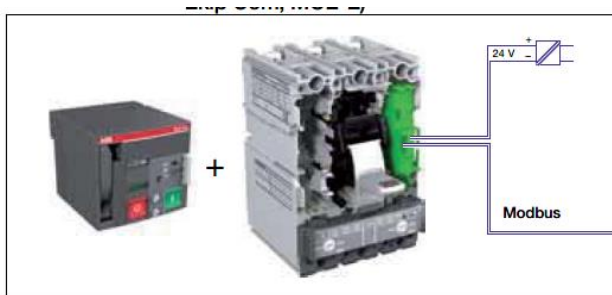
Service Function: -

Business Line: *Infrastructure & Networks*

- Other possibilities rather than single command for spring charging and circuit-breaker closing can be evaluated.
- Remote/Local selector function shall be guaranteed.
- “Local” selection shall inhibit remote commands, opening and closing of circuit breaker locally shall be permitted
- “Remote” selection shall inhibit local command though tripping command shall be permitted
- Multipolar cable with 12 pin connector (for connection to RTU) shall be replaced by proper connection wire for MODBUS communication (male/female Ethernet plug) to Enel RTU and for 24Vdc supply and for motorization commands shall be included.

No cable with 9 pin connector for VDS connection with RTU shall be supplied.

**Example of CB to RTU connection and 24 V<sub>dc</sub> supply**



**TESTING**

Paragraph 7.6.1 of this Standard specification is intended to be applied as to give complete compliance to relevant standard to Circuit Breaker and applied motor-driver mounted on the switch body as far as electrical, mechanical and safety aspects are concerned.

Following modifications apply to specific points below mentioned:

- Temperature rise test: Only verifications on simultaneous feeding of the 3 phases shall be performed; with a current equal to the  $I_{th}$  current setting (of the thermal overload phase release)
- Test Sequences I and II according IEC 60947-2 shall be performed, using the electronic relay; Tests performed on different sequences allowed by IEC can be evaluated by ENEL;
- Chapter 7.6.1.1.4: test is substituted by Annex F - Additional tests for circuit-breakers with electronic over-current protection of 60947-2.

**Subject:** Global Infrastructure and Networks – GSCL003 AUTOMATIC CIRCUIT-BREAKERS FOR  
SECONDARY SUBSTATIONS

**Application Areas**Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Infrastructure & Networks*

---

Furthermore, complete functional verifications of Circuit Breaker and motor drive shall be performed in order to check correct functionality of remote control via Modbus TCP, according to GSTX001:

- Open/close command
- Anti-pumping device
- CB contacts position
- voltage presence in output line
- voltage and current measurement
- 24 V<sub>dc</sub> power supply

Insulation of electronic circuits and 24 Vdc from main power supply