Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

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HEAD OF NETWORK COMPONENTS
Adriano SABENE

1 DOCUMENT AIMS AND APPLICATION AREA

Scope of this document is to provide technical requirements for the supply of Hybrid Modules with rated voltage from 72,5 kV to 245 kV to be used in Primary Substations of the Enel Group Distribution companies, listed below:

Country	Distribution Company
Argentina	Edesur
Brazil	Enel Distribuição Rio Enel Distribuição Ceará Enel Distribuição São Paulo
Colombia	Codensa
España	e-distribución
Italy	e-distribuzione

Note: the indication "Latam" refers to the Enel Group Distribution companies in South America.

Hybrid Modules are compact metal-enclosed switchgear assemblies, SF6 insulated (in alternative, non-fluorinated greenhouse gases and vacuum circuit-breakers are also acceptable), for outdoor or indoor installation in Primary Substations. The outgoing connections can be air type, cable type or bus-duct type.

Some requirements are applicable only to one or more companies, therefore, depending on the destination of the Hybrid Modules, the supplied equipment shall comply these specific requirements.

This document shall be implemented and applied to the extent possible within the Enel Grids Business Line and in compliance with any applicable laws, regulations and governance rules, including any stock exchange and unbundling-relevant provisions, which in any case prevail over the provisions contained in this document.

1.1 RELATED DOCUMENTS TO BE IMPLEMENTED AT COUNTRY LEVEL

This document does not require implementation of further documents.

Anyway, each Enel Grids Company can issue, under the supervision of Enel Grids Global Network Components a detailed documents, according to the provisions of the present document and in case of specific needs.

2 DOCUMENT VERSION MANAGEMENT

Version	Date	Main changes description
0	28/11/2014	First emission
1	16/09/2016	Overall dimensions for Spain (annex C table 2) 2.- Components list Y2 for Latam, support 72,5 kV for EDE. Y2 type – Annex B.1 fig. 1 6.4.2 Bushing terminations – 6.4.2.1 Latam 6.7.- Current transformers. Codes.- 612 and 621 ANNEX A – LOCAL COMPONENTS CODIFICATION

2	25/11/2016	2 - COMPONENTS LIST. Current Transformer. Code – 620 Typographic error - 6.1 - Common general ratings. Protection stage. 6.7.- Current transformer. Code.- 620
3	06/11/2019	2- COMPONENTS LIST. Circuit-breaker drive mechanism. Code – 263 removed 4.1- General service conditions; SPS Class, only class e (Very Heavy) 4.2.3- Seismic qualification level; Enel_Codensa (AF5) 6.4.2- Bushing terminations; For 245 kV CBs the HV terminals shall be suitable to be interfaced with standardized e-distibuzione clamps (double cable). 6.7- Current transformer, New Code- 624. 6.8- Voltage transformers, New Code- 712. 8.1.1- General requirements, Selector switches positions, only 3 positions (Manual; Local; Remote) 8.1.2- Circuit-breakers drive mechanism, General requirements, manually the operating device energy, with a maximum effort below 200 N (EN 1005-3:2002+A1:2008) during the hole charge. ANNEX A – LOCAL COMPONENTS CODIFICATION ANNEX C – DIMENSIONAL DRAWINGS ANNEX D – ELECTRICAL SCHEMES
4	11/02/2020	Updated ANNEX D – ELECTRICAL SCHEMES Updated ANNEX A – LOCAL COMPONENTS CODIFICATION Updated 2- COMPONENT LIST
5	05/03/2020	Updated the name of the Global Standard for Hybrid Modules according GSGG001 Updated 2- COMPONENT LIST Updated ANNEX A – LOCAL COMPONENTS CODIFICATION
6	30/04/2020	Updated 2- COMPONENT LIST 8.4.3- Italy specific requirements Updated ANNEX A – LOCAL COMPONENTS CODIFICATION Updated for 72,5kV ANNEX C – DIMENSIONAL DRAWINGS
7	14/11/2022	Update of Company Name in Enel Grids Alignment to the new format Wiring control box modification (7.6.2) 7.6.1.2.a) – counter of turns deleted Deleted Romania, Goiás, Perú and Chile
	08/05/2024	7.1- Component list, New Code- 621 7.4.7- Current transformers, New Code- 621 ANNEX A – LOCAL COMPONENTS CODIFICATION (Colombia and Spain)
	09/08/2024	7.1- Component list, Bushing SF6 Free class “e”
	17/09/2024	ANNEX A – LOCAL COMPONENTS CODIFICATION (Italy and Spain)
	18/02/2025	ANNEX A – LOCAL COMPONENTS CODIFICATION (Italy)

	11/10/2025	ANNEX A – LOCAL COMPONENTS CODIFICATION (Spain)

3 UNITS IN CHARGE OF THE DOCUMENT

Responsible for drawing up the document:

- Enel Grids: Engineering and Construction / Components and Devices Design / Network Components unit.

Responsible for authorizing the document:

- Enel Grids: Head of Network Components unit
- Enel Grids: Head of Quality unit.

4 REFERENCES, LAWS AND STANDARDS

- 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;
- Enel Global Compliance Program (EGCP);
- Integrated Policy for Quality, Health and Safety, Environment, anti-Bribery and Information security;
- ISO 9001:2015 - Quality Management System - Requirements;
- ISO 14001:2015 - Environmental Management System - Requirements and user guide;
- ISO 45001:2018 - Occupational Health and Safety Management System - Requirements and user guide;
- ISO 50001:2018 - Energy management systems - Requirements with guidance for use;
- ISO 37001:2016 - Anti-bribery Management System - Requirements with guidance for use;
- ISO 27001:2017 - Information Security Management System – Requirements;
- IEC 62271-205 - High-voltage switchgear and controlgear - Part 205: Compact switchgear assemblies for rated voltages above 52 kV
- IEC 62271-1 - High-voltage switchgear and controlgear - Part 1: Common specifications
- IEC 62271-203 - High-voltage switchgear and controlgear - Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV
- IEC 62271-100 - High-voltage switchgear and controlgear – Part 100: Alternating current circuit-breakers
- IEC 62271-102 - High-voltage switchgear and controlgear – Part 102: High-voltage alternating current disconnectors and earthing switches
- IEC 62271-207 - High-voltage switchgear and controlgear - Part 207: Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52 kV

- IEC 62271-209 - High-voltage switchgear and controlgear - Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV - Fluid-filled and extruded insulation cables - Fluid-filled and dry-type cable-terminations
- IEC 62271-211 - High-voltage switchgear and controlgear – Part 211: Direct connection between power transformers and gas-insulated metal-enclosed switchgear for rated voltages above 52 kV
- IEC 60376 Specification of technical grade sulfur hexafluoride (SF6) for use in electrical equipment
- IEC/TR 62271-301 High-voltage switchgear and controlgear – Part 301: Dimensional standardization of high-voltage terminals
- IEC 62271-4 - High-voltage switchgear and controlgear – Part 4: Handling procedures for sulphur hexafluoride (SF6) and its mixtures
- IEC 60073 Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators
- IEC 60447 Basic and safety principles for man-machine interface, marking and identification - Actuating principles
- IEC 61869-1 - Instrument transformers – Part 1: General requirements
- IEC 61869-2 - Instrument transformers – Part 2: Additional Requirements for Current Transformers
- IEC 61869-3 - Instrument transformers – Part 3: Additional Requirements for Inductive Voltage Transformers
- IEC 61936-1 - Power installations exceeding 1 kV a.c. - Part 1: Common rules
- IEC/TS 60815-1 Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles
- IEC/TS 60815-3 Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems
- IEC 60137 Insulated bushings for alternating voltages above 1 000 V
- IEC 60332-3-24 Tests on electric and optical fibre cables under fire conditions – Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category C
- IEC 60529 Degree of protection provided by enclosures (IP Code)
- IEC 60068-2-17 Environmental testing – Part 2: Tests – Test Q: Sealing
- ISO 1461 Hot dip galvanized coatings on fabricated iron and steel articles- Specifications and test methods
- ISO 4126 Safety devices for protection against excessive pressure
- EN 1005-3:2002 Safety of machinery. Human physical performance Recommended force limits for machinery operation
- Specific for E-Distribuzione and Italy:

- D.M. 1/12/1980 and subsequent modification D.M. 10/9/1981 “Disciplina dei contenitori a pressione di gas con membrature miste di materiale isolante e di materiale metallico, contenenti parti attive di apparecchiature elettriche”.
- CEI 20-22/2 – Prove di incendio su cavi elettrici – Parte 2: Prova di non propagazione dell'incendio
- UNI 11144 – Bombole trasportabili per gas – Valvole per bombole per pressioni di esercizio 250 bar – Connessioni: forme e dimensioni
- ENEL operative note PVR001 (guarantee management)
- ENEL operative note PVR006 (bar code)
- ENEL Global Standard GST002 Power Transformers

- Specific for e-distribución and Spain:
  - Real Decreto Riesgo Eléctrico 614/2001 sobre disposiciones mínimas para la protección de la salud y seguridad de los trabajadores frente al riesgo eléctrico
  - Reglamento sobre condiciones técnicas y garantías de seguridad en instalaciones eléctricas de alta tensión, Real Decreto 337/2014.
  - Reglamento Electrotécnico para Baja Tensión, Real Decreto 842/2002.
  - Reglamento de puntos de Medida Real Decreto 1110/2007.
  - NNM001 – Normas de operación definiciones
- Specific for all European countries:
  - Commission Regulation (EC) 1494/2007 of 17 December 2007 (form of labels and additional labelling requirements as regards products and equipment containing certain fluorinated greenhouse gases).
- Specific for Brasil:
  - NR-10 - SEGURANÇA EM INSTALAÇÕES E SERVIÇOS EM ELETRICIDADE

5 ORGANIZATIONAL PROCESS POSITION IN THE PROCESS TAXONOMY

Value Chain/Process Area: Engineering and Construction

Macro Process: Materials management Devices and Components Development

Process: Standard Catalog Management

6 DEFINITIONS AND ACRONYMS

Acronym and Key words	Description
Technical Conformity Assessment (TCA)	A “conformity assessment”[1] with respect to “specified requirements”[2] 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

[1] Definition 2.1 of ISO/IEC 17000

[2] Definition 3.1 of ISO/IEC 17000

Type A documentation	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

7 DESCRIPTION

7.1 Components list

The Hybrid Modules are composed by assembling the modular base components listed below (intended as terns of 3 elements, one for phase, obviously with the exception of support and Control Box). Each base component operates individually but interacting with the others components, even by mean of functional and safety interlocks.

Some typical typologies are provided in chapter 7.3

If for manufacturer's design two or more base components are integrated in one component, it could be acceptable if compliant with the other requirements of this standard (in particular functional requirements).

Base component code	**Base component description**			
GSCH002/011	Lateral bay	With circuit-breaker	Air connection	72,5 kV
GSCH002/012				145 kV
GSCH002/013				170 kV
GSCH002/014				245 kV
GSCH002/021			Cable connection	72,5 kV
GSCH002/022				145 kV
GSCH002/023				170 kV
GSCH002/024				245 kV
GSCH002/031			Bus-duct connection	72,5 kV
GSCH002/032				145 kV
GSCH002/033				170 kV
GSCH002/034				245 kV
GSCH002/061		Without circuit-breaker	Air connection	72,5 kV
GSCH002/062				145-170 kV
GSCH002/063				245 kV
GSCH002/071			Cable connection	72,5 kV
GSCH002/072				145-170 kV
GSCH002/073				245 kV
GSCH002/081				72,5 kV

GSCH002/082			Bus-duct connection	145-170 kV
GSCH002/083				245 kV
GSCH002/111	Central bay	Without circuit-breaker	Air connection	72,5 kV
GSCH002/112				145-170 kV
GSCH002/113				245 kV
GSCH002/121			Cable connection	72,5 kV
GSCH002/122				145-170 kV
GSCH002/123				245 kV
GSCH002/131			Bus-duct connection	72,5 kV
GSCH002/132				145-170 kV
GSCH002/133				245 kV
GSCH002/211	Circuit-breaker drive mechanism	Single-pole	1°, 2° opening circuit	72,5 kV
GSCH002/212				145-170 kV
GSCH002/213				245 kV
GSCH002/221			1°, 2°, 3° opening circuit	72,5 kV
GSCH002/222				145-170 kV
GSCH002/223				245 kV
GSCH002/224			1°, 3° opening circuit	245 kV
GSCH002/261		Three-pole	1°, 3° opening circuit	72,5 kV
GSCH002/262				145-170 kV
GSCH002/271			1°, 2°, 3° opening circuit	72,5 kV
GSCH002/272				145-170 kV
GSCH002/281			1°, 2° opening circuit	72,5 kV
GSCH002/282				145-170 kV
GSCH002/311	Disconnector	72,5 kV		
GSCH002/312		145-170 kV		
GSCH002/313		245 kV		
GSCH002/321	Disconnector with earthing switch	72,5 kV		
GSCH002/322		145-170 kV		
GSCH002/323		245 kV		
GSCH002/331	Disconnector with ability of Bus-transfer current switching	72,5 kV		
GSCH002/332		145-170 kV		
GSCH002/333		245 kV		
GSCH002/411	Bushing SF6/air class “d”	72,5 kV		

GSCH002/412		145-170 kV
GSCH002/413		245 kV
GSCH002/421	Bushing SF6/air class “e”	72,5 kV
GSCH002/422		145-170 kV
GSCH002/423		245 kV
GSCH002/424	Bushing SF6 Free class “e”	72,5 kV
GSCH002/425		145-170 kV
GSCH002/426		245 kV
GSCH002/461	Cable connection upward exit	72,5 kV
GSCH002/462		145-170 kV
GSCH002/463		245 kV
GSCH002/464	Cable connection downward exit	72,5 kV
GSCH002/465		145-170 kV
GSCH002/466		245 kV
GSCH002/481	Equipments for direct connection between bus-duct and power transf.	72,5 kV
GSCH002/482		145-170 kV
GSCH002/483		245 kV
GSCH002/511	Bus-duct (1 linear meter x 3 poles)	72,5 kV
GSCH002/512		145-170 kV
GSCH002/513		245 kV
GSCH002/521	Bus-duct curve	72,5 kV
GSCH002/522		145-170 kV
GSCH002/523		245 kV
GSCH002/531	Bus-duct expansion compensator	72,5 kV
GSCH002/532		145-170 kV
GSCH002/533		245 kV
GSCH002/541	Bus-duct joint	72,5 kV
GSCH002/542		145-170 kV
GSCH002/543		245 kV
GSCH002/561	Partitioning with single-pole gas management (including relative equipments and control circuits)	72,5 kV
GSCH002/562		145-170 kV
GSCH002/563		245 kV
GSCH002/564		72,5 kV

GSCH002/565	Partitioning with three-pole gas management (including relative equipments and control circuits)	145-170 kV
GSCH002/566		245 kV
GSCH002/602	Current Transformer	
GSCH002/604		
GSCH002/605		
GSCH002/606		
GSCH002/607		
GSCH002/608		
GSCH002/612		
GSCH002/613		
GSCH002/614		
GSCH002/615		
GSCH002/620		
GSCH002/621		
GSCH002/621C		
GSCH002/622		
GSCH002/622C		
GSCH002/623		
GSCH002/625		
GSCH002/628		
GSCH002/629		
GSCH002/630		
GSCH002/631		
GSCH002/632		
GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	
GSCH002/701	Voltage Transformer	
GSCH002/702		
GSCH002/703		
GSCH002/704		
GSCH002/705		
GSCH002/711		
GSCH002/712		
GSCH002/721		

GSCH002/722				
GSCH002/723				
GSCH002/801	Support	e-distribuzione	Y1 type and Y2 type	72,5 kV
GSCH002/802				145-170 kV
GSCH002/803				245 kV
GSCH002/804			Single-bay type	72,5 kV
GSCH002/805				145-170 kV
GSCH002/806				245 kV
GSCH002/821		e distribución	Y1 type	145 kV
GSCH002/822			Y2 type	145 kV
GSCH002/823			Single-bay type	145 kV
GSCH002/824			Y1 type	72,5 kV
GSCH002/825			Y2 type	72,5 kV
GSCH002/826			Single-bay type	72,5 kV
GSCH002/841		Edesur	Y1 type	145 kV
GSCH002/842				245 kV
GSCH002/843			Y2 type	145 kV
GSCH002/844				245 kV
GSCH002/845			Single-bay type	145 kV
GSCH002/846				245 kV
GSCH002/861		Enel Distribuição Ceará	Y1 type	72,5 kV
GSCH002/862			Y2 type	72,5 kV
GSCH002/863			Single-bay type	72,5 kV
GSCH002/871		Enel Codensa	Y1 type	145 kV
GSCH002/872			Y2 type	145 kV
GSCH002/873			Single-bay type	145 kV
GSCH002/891		Enel Distribuição Rio, Enel Distribuição São Paulo	Y1 type	72,5 kV
GSCH002/892				145 kV
GSCH002/893			typeY2 type	72,5 kV
GSCH002/894				145 kV
GSCH002/895			Single-bay type	72,5 kV
GSCH002/896				145 kV
GSCH002/901	Control Box	e-distribuzione	Y1 type	
GSCH002/902			Y2 type	

GSCH002/903			Single-bay type	
GSCH002/921		e-distribución	Y1 type	Line bay
GSCH002/922				Transformer bay
GSCH002/923			Single-bay type	Bus Coupler
GSCH002/924				Line bay
GSCH002/925				Transformer bay
GSCH002/926			Y2 type	
GSCH002/931		Latam	Y1 type	
GSCH002/932			Y2 type	
GSCH002/933			Single-bay type	

For local components codification see annex A.

7.2 Service Conditions

7.2.1 General service conditions

Unless otherwise specified, the reference service conditions are the outdoor normal service conditions of IEC 62271-1 (par. 2.1.2).

Minimum ambient air temperature (°C)	-25
SPS Class (IEC/TS 60815 series)	e (Very Heavy)
Ice coating (mm)	10

7.2.2 Specific service conditions

7.2.2.1 *Colombia (Enel_Codensa)*

The reference altitude is 2.600 m[3].

7.2.3 Seismic qualification level

Enel_Codensa	AF5 (IEC 62271-207)
e-distribuzione	AF5 (IEC 62271-207)

[3] For Colombia the rated insulation levels in chapter 7.3 already consider the altitude effect on the external insulation, therefore the correction in clause 2.1.1 of IEC 62271-1 is not required. On the contrary are confirmed the precautions to be taken for low-voltage auxiliary and control equipments.

7.3 HYBRID MODULES COMPOSITION

In the following the typical Hybrid Modules compositions are described (the figures shall be intended as terns of 3 elements, one for phase). Considering the modularity of Hybrid Module, different compositions could be required. See annex A for some layout examples.

For each Hybrid Module the Enel Group Distribution company will provide the proper component list (using items in chapter 7.1) and the HV single-line diagram. It's up to the manufacturer to verify the coherence between the 2 documents and, if necessary, to ask for clarifications.

7.3.1 Y1 type

- n° 1 circuit-breaker with three-pole or single-pole mechanism
- n° 1 toroidal current transformer
- n° 3 SF6-air bushings (or cable connections or bus-duct connections)

Additionally, depending by the HV single-line diagram, the composition could include:

- up to n° 2 disconnectors (optionally with ability of Bus-transfer current switching), with motor-driven three-pole mechanism;
- up to n° 3 disconnector combined with earthing switch, with motor-driven three-pole mechanism
- up to n° 2 line voltage presence detectors

7.3.2 Y2 type

- n° 3 disconnectors combined with earthing switches, with motor-driven three-pole mechanism
- n° 2 circuit-breakers with three-pole or single-pole mechanism
- n° 2 toroidal current transformers
- n° 1 line voltage presence detector
- n° 3 SF6-air bushings (or cable connections or bus-duct connections)

7.3.3 Single-bay type

- n° 1 disconnector combined with earthing switch, with motor-driven three-pole mechanism
- n° 1 circuit-breaker with three-pole or single-pole mechanism
- n° 1 toroidal current transformer
- n° 2 SF6-air bushings (or cable connections or bus-duct connections)

Additionally, depending by the HV single-line diagram, the composition could include:

- n° 1 disconnector, with motor-driven three-pole mechanism
- n° 1 disconnector combined with earthing switch, with motor-driven three-pole mechanism

7.4 Technical characteristics

7.4.1 Common general ratings

Rated voltage *Ur* (kV)		**72,5**	**145**	**170**	**245**
Rated short-duration power-frequency withstand voltage *Ud* (kV rms):	Phase-to-earth, across open switching device and between phases	140	275		395
	Across the isolating distance	160	315		460
Rated lightning impulse withstand voltage *Up*	Phase-to-earth, across open switching device and between phases	325	650		950

(kVp):	Across the isolating distance	375	750	1050
Rated frequency *fr* (Hz)	Edesur, e distribución and e-distribuzione	50		
	Enel Distribuição Rio, Enel Codensa, Enel Distribuição Ceará and Enel Distribuição São Paulo	60		
Rated normal current *Ir* (A)		2000		
Rated short time withstand current *Ik* (kA)		31,5	40/50[4]	
Degrees of protection provided by enclosures (IEC 60529)		IP 54[5]		
Rated supply voltage *Ua* (Vdc)	e-distribución, Enel Distribuição Rio, Enel Codensa, Enel Distribuição Ceará, Enel Distribuição São Paulo, Enel Codensa and e-distribuzione	110~125		
	Edesur	220		
D.C. maximum absorbed power, for each bay (W/bay)		2.000		
Under-voltage release (if requested) – d.c. maximum absorbed power (W/coil)		100		
Rated supply voltage for anti-condensation circuits (Vac)	e-distribución and e-distribuzione	230		
	Enel Distribuição Rio, Enel Distribuição Ceará, Enel Distribuição São Paulo and Edesur	220		
	Enel_Codensa	120		
a.c. maximum absorbed power (VA)		600		
Protection stage (tab. 4 EN 62271-203)		2		
Auxiliary contact classes (Table 6 EN 62271-1)		1		

7.4.2 Circuit-breakers

In addition to paragraph 7.4.1 and to IEC 62271-100 requirements, the following further circuit-breakers ratings are required.

Rated voltage *Ur* (kV)	72,5	145	170	245
Rated short-circuit breaking current *Isc* (kA)	31,5	40/50[6]		

[4] Only in particular cases a value of 50 kA (*Ik*) will be requested.

[5] Applicable also to the Control Box and to the Operating Device Box(es).

[6] Only in particular cases a value of 50 kA (*Isc*) will be requested.

First-pole-to-clear factor k_{pp}	1,5 (non-effectively earthed neutral system)			1,3
Rated operating sequence	O - 0,3 s- CO -1 min - CO[7]			
Maximum break-time (ms)	60			
Circuit-breaker class	C2 – E1 – M2			
Rated line-charging breaking current *Il* (A)	10	50	63	125
Rated cable-charging breaking current *Ic* (A)	125	160		250
Rated out-of-phase making and breaking current *Id* (kA)	Clause 4.106 of IEC 62271-100			

7.4.3 Disconnectors and earthing switches

In addition to paragraph 7.4.1 and to IEC 62271-102 requirements, the following further disconnectors and earthing switches ratings are required.

Rated voltage *Ur* (kV)		72,5	145	170	245
Number of poles		3			
Opening (closing) time for motor operation (s)		≤15			
Disconnector mechanical endurance class *Mr*		M1			
Bus-transfer current switching by disconnectors (only if requested)	Rated bus-transfer current for disconnectors (A)	Clause B.4.106.1 of IEC 62271-102			
	Rated bus-transfer voltages for disconnectors (V)	Clause B.4.106.2 of IEC 62271-102 (referring to Air insulated disconnectors values)			
Earthing switches class		E0 – M1 – A			

7.4.4 SF6-air bushings

7.4.4.1 *General requirements*

The SF6-air bushings for the connections of Hybrid Modules terminations shall be compliant with IEC 60137, outdoor type, with internal SF6 insulation, composite type with glass fiber tube covered with silicone rubber. The color shall be light grey.

The complete Hybrid Module, bushing included, shall be designed to withstand static terminal load according to Table 14 of IEC 62271-100 (e.g. manufacturer shall demonstrate that stresses doesn't affect the proper CB and/or DS/ES functioning).

Bushings shall also be compliant with minimum values of cantilever withstand load provided by Table 1 of IEC 60137, Level I.

[7] This requirement can be verified by mean of type tests performed with O - 0,3 s – CO -3 min – CO operating sequence and a declaration of the manufacturer about the CB compliance with O - 0,3 s – CO - 1 min – CO operating sequence.

7.4.4.2 *Bushing terminations*

7.4.4.2.a) *Latam*

The bushing terminations shall be manufactured with corrosion resistant copper or aluminum alloy, in order to be interfaced with aluminum alloy connectors or clamps.

The terminals shall be rectangular shape with the following dimensions, according to fig. 3 (2x2 hole pattern) or fig. 4 (2x3 hole pattern) of IEC/TR 62271-301:

- Hole diameters Ø 14.3mm
- Distance between holes 44.5mm

7.4.4.2.b) *e-distribución and e-distribuzione*

The bushing terminations shall be realized with corrosion resistant copper or aluminum alloy, in order to be interfaced with aluminum alloy clamps.

The final bushing terminations shall have Ø 40 ±0,25 X 80 min (mm) (fig. 1 of IEC/TR 62271-301) dimensions.

For 245 kV CBs the HV terminals shall be suitable to be interfaced with standardized e-distibuzione clamps (double cable). Fig.1

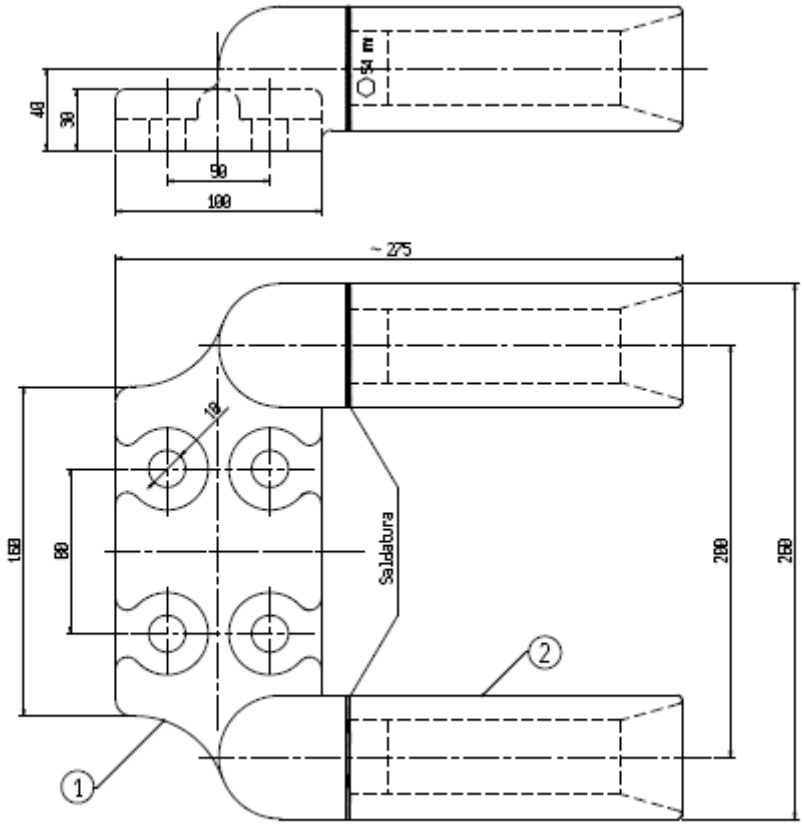


Fig. 1

7.4.5 Direct connections between bus-duct and power transformer with SF6/oil bushings

The direct connection between the bus-duct and the HV/MV power transformer can be requested in compliance with one of the following document:

a) IEC 62271-211
b) Enel Global Standard GST002 Power Transformers - Local section e-distribuzione

Compatibility verification of the interfaces of the bus-duct with the substation in order to ensure the proper connection is a manufacturer responsibility.

7.4.6 Cable connections

IEC 62271-209 applies.

The cable connections can be requested with upward exit or downward exit (in upward case, the manufacturer shall ensure the on-site compatibility between cable supports and Hybrid Module).

Usually the cable connection enclosure shall be suitable for the dry-type cable-termination (see figure 5 of IEC62271-209); only if requested it shall be for fluid-filled cable terminations (see figure 3 of IEC 62271-209).

In case of “plug-in” dry-type cable-terminations, they will be provided by Enel Group Distribution companies in order to be mounted by the manufacturer; if the Hybrid Module transportation is possible with components fully assembled in a single unit, it’s required the female cone factory preassembly.

7.4.7 Current transformers

In addition to IEC 61869-1 and IEC 61869-2 requirements, the following further toroidal current transformers requirements are prescribed.

Base component code (see par. 2)	**GSCH002/ 604**	**GSCH002/ 602 605**	**GSCH002/ 606**	**GSCH002/ 607**	**GSCH002/ 608**	**GSCH002/ 612**
Rated short-time thermal current I_{th} (kA)	40	40	40	40	40	40
Rated continuous thermal current I_{cth} (kA)	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}
Rated transformation ratio k_r (A/A)	200-400/1	400-800/1	1.600/1	200-400/1/1	400-800-1.600/1/1	400-800/5/1/1
Core number	1	1	1	2	2	3
Accuracy class[1]	5P30	5P30	5P30	5P30	5P30	0,2 – FS10
	n.a.	n.a.	n.a.	5P30	5P30	5P30
	n.a.	n.a.	n.a.	n.a.	n.a.	5P30
	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Rated burden (VA)	15	15	15	15	15	15
Maximum secondary winding resistance (R_{ct}) at 75 °C (Ω)	5	5	5	5	5	5 (only for 1 A cores)

[1] the accuracy requirements refer to all specified transformation ratio

Base component code (see par. 2)	**GSCH002/ 613**	**GSCH002/ 614**	**GSCH002/ 615**	**GSCH002/ 620**	**GSCH002/ 621**	**GSCH002/ 621C**
Rated short-time thermal current I_{th} (kA)	40	40	40	40	40	40
Rated continuous thermal current I_{cth} (kA)	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}
Rated transformation ratio k_r (A/A)	200-400/5	400-800/5/5	1000-2000/5	1.000-2.000/5/5/5	1.000-2.000/5/5/5	1.000-2.000/5/1/1
Core number	1	2	1	3	4	3
Accuracy class[1]	0.2s-Fs<5	5P30	5P20	0,5 – 5P20	0,2s – FS<5	0,5 – 5P20
	n.a.	5P30	n.a.	5P20	0,5 – 5P20	5P20
	n.a.	n.a.	n.a.	5P20	5P20	5P20
	n.a.	n.a.	n.a.	n.a.	5P20	n.a.
Rated burden (VA)	30	30	30	30	30	30
Maximum secondary winding resistance (R_{ct}) at 75 °C (Ω)	n.a.	n.a.	n.a.	n.a.	n.a.	5 (only for 1 A cores)

[1] the accuracy requirements refer to all specified transformation ratio

Base component code (see par. 2)	**GSCH002/ 622**	**GSCH002/ 622C**	**GSCH002/ 623**	**GSCH002/ 625**	**GSCH002/ 628**	**GSCH002/ 629**
Rated short-time thermal current I_{th} (kA)	40	40	40	40	40	40
Rated continuous thermal current I_{cth} (kA)	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}
Rated transformation ratio k_r (A/A)	400-800/5/5/5	400-800/5/5/5	1.000-2.000/5/5	600-1.000/1/1/1/1	600-1200/1/1/1	1.000-2.000/1/1/1
Core number	3	3	2	4	3	3
Accuracy class[1]	0,5 – 5P20	0,2s – FS10	5P20	0,2s – FS<5	0,5 – FS5	TPY Kssc = 40 tp =0,040 seg t´= t´al = 0,100 seg tfr = 0,300 seg t" = t"al = 0,060 seg Rb=5 Ω
	5P20	5P20	5P20	TPY Kssc = 25 tp =0,040 seg t´= t´al = 0,100 seg tfr = 0,300 seg t" = t"al = 0,060 seg Rb=5 Ω	5P20	TPY Kssc = 40 tp = 0,040 seg t´= t´al = 0,100 seg tfr = 0,300 seg t" = t"al = 0,060 seg Rb=5 Ω
	5P20	5P20	n.a.	TPY Kssc = 25 tp = 0,040 seg t´= t´al = 0,100 seg tfr = 0,300 seg t" = t"al = 0,060 seg Rb=5 Ω	5P20	0.2 5P20
	n.a.	n.a.	n.a.	5P20	n.a.	n.a.
Rated burden (VA)	30	30	30	20 (not applicable for the TPY cores)	15	30
Maximum secondary winding resistance (R_{ct}) at 75 °C (Ω)	n.a.	n.a.	n.a.	5 (not applicable for the TPY cores)	5	5

[1] the accuracy requirements refer to all specified transformation ratio

Base component code (see par. 2)	**GSCH002/ 630**	**GSCH002/ 631**	**GSCH002/ 632**
Rated short-time thermal current I_{th} (kA)	40	40	40
Rated continuous thermal current I_{cth} (kA)	120% of I_{pr}	120% of I_{pr}	120% of I_{pr}
Rated transformation ratio k_r (A/A)	1.000-2.000/1	2.000/1/1	1.000-2.000/1/1/1
Core number	1	2	3
Accuracy class[1]	0,2s – FS<5	0.2 5P20	TPX Issc = 40 kA tp =0,030 seg t´= t´al = 0,060 seg
	n.a.	5P20	TPX Issc = 40 kA tp =0,030 seg t´= t´al = 0,060 seg
	n.a.	n.a.	0.2 5P20
	n.a.	n.a.	n.a.
Rated burden (VA)	30	30	30
Maximum secondary winding resistance (R_{ct}) at 75 °C (Ω)	5	5	5

[1] the accuracy requirements refer to all specified transformation ratio

7.4.8 Voltage transformers

In addition to IEC 61869-1 and IEC 61869-3 requirements, the following further inductive SF6 insulated voltage transformers requirements are prescribed.

Base component code	**GSCH002/ 701**	**GSCH002/ 702**	**GSCH002/ 703**	**GSCH002/ 704**	**GSCH002/ 705**
Highest voltage for equipment U_m (kV)	72,5	145	170	245	72,5
Rated Insulation levels	According to 7.4.1				
Rated transformation ratio k_r (kV/kV)	$\frac{60:\sqrt{3}}{0.1:\sqrt{3}}$	$\frac{132:\sqrt{3}}{0.1:\sqrt{3}}$	$\frac{150:\sqrt{3}}{0.1:\sqrt{3}}$	$\frac{220:\sqrt{3}}{0.1:\sqrt{3}}$	$\frac{66:\sqrt{3}}{0.11:\sqrt{3}}$
Secondary windings	1	1	1	1	2
Rated voltage factor F_v	1,5 (rated time 30 s)				
Accuracy class	0,2 – 3P	0,2 – 3P	0,2 – 3P	0,2 – 3P	0,5 – 3P
	n.a.	n.a.	n.a.	n.a.	0,5 – 3P
	n.a.	n.a.	n.a.	n.a.	n.a.
Rated burden (VA)	25	25	25	25	25

Base component code	**GSCH002/ 711**	**GSCH002/ 712**	**GSCH002/ 721**	**GSCH002/ 722**	**GSCH002/ 723**
Highest voltage for equipment U_m (kV)	145	145	145	145	145
Rated Insulation levels	According to 7.4.1				
Rated transformation ratio k_r (kV/kV)	$\frac{120:\sqrt{3}}{0.1:\sqrt{3}}$	$\frac{110}{110:\sqrt{3}}$	$\frac{132:\sqrt{3}}{0.11:\sqrt{3}}$	$\frac{110:\sqrt{3}}{0.11:\sqrt{3}}$	$\frac{132:\sqrt{3}}{0.11:\sqrt{3}}$
Secondary windings	2	3	2	2	3
Rated voltage factor F_v	1,5 (rated time 30 s)				
Accuracy class	0,2	0,2	0,5 – 3P	0,5 – 3P	0,2
	0,2 – 3P	0,2 – 3P	0,5 – 3P	0,5 – 3P	0,5 – 3P
	n.a.	0,2 – 3P	n.a.	n.a.	0,5 – 3P
Rated burden (VA)	15	15	25	25	25

Referring to IEC 61869-1 table 8 “Arc fault duration and performance criteria”, it is requested:

- Protection stage: 2
- Internal arc fault protection: class II

7.4.8.1 *Specific requirements*

7.4.8.1.a) *e-distribuzione*

The SF6 insulated VT are included in the scope of D.M. 1/12/1980 and subsequent modification (D.M. 10/9/1981).

7.5 CONSTRUCTION CHARACTERISTICS

7.5.1 General characteristics

The Hybrid Module shall be manufactured in accordance with IEC 62271-205.

According to par. 1.101 of IEC 62271-205, each switching device and its controlgear forming part of a compact switchgear assembly shall comply with the relevant individual standard. Being the Hybrid Module formed also by metal enclosed switchgear devices, the requirements of IEC 62271-203 are applicable.

The Hybrid Module consists of a single enclosure for each phase.

The normal use, control and maintenance operations shall be performed with total workers safety.

Components identifications shall be performed by plates located close to them.

All the written tests (labels, synoptic etc.) shall be in the local language of destination.

The SF6 solid decomposition products shall not influence the insulation and the equipment operation.

The over-voltages caused by breaking or making of capacitive current shall not compromise dielectric insulation of components enclosed in the enclosure.

Hybrid modules shall comply with dimensional constraints shown in annex C.

7.5.2 Enclosures and support structure

The enclosures shall be metallic and with the mechanical robustness necessary to ensure the correct operation of all internal mobile parts.

Any cover or detachable part of the equipment shouldn’t be likely to be lost. All the detachable parts (including bolts) should be attached.

The enclosures shall be suitable for the vacuum treatment during gas filling processing, in factory or in field. Furthermore shall be able to absorb mechanical expansion due to normal service conditions.

The enclosures and support structure disposition shall ensure that:

- All equipment parts are easily accessible for normal check operations with the equipment in service. Manual operations shall be easily performed from the ground (maximum height 1.900 mm);
- It is possible to easily replace the complete pole elements without affect other poles;
- The maintenance or complete equipment/parts replacing are executable accessing with lifting vehicle (the manufacturer's maintenance manual shall indicate the procedure for carrying out this movement of the equipment).

The Hybrid Module enclosures shall be assembled on a metallic support structure suitable to be fixed on a foundation by means of chemical plugs or similar systems.

7.5.3 Dielectric mean

The dielectric mean for insulation and arc extinction is SF6, with a pressure over the atmospheric one.

The gas shall comply with EN 60376 standard. The manufacturer has to provide the necessary instructions for use and handling of SF6, in accordance with IEC 62271-4.

In alternative, non-fluorinated greenhouse gases and internal vacuum breaking unit are also acceptable.

7.5.4 Gas density control

The Hybrid Module is a closed pressure system. The relative leakage rate shall be *Frel* ≤ 0,5% per year. The value for the time between replenishments shall be at least 10 years (also valid for voltage transformers, if present).

It shall be possible to perform the SF6 replenishment with the equipment in service, avoiding the unwanted operation of the SF6 density control device.

Each pole and partition shall have a distinct SF6 circuit, with a device for the density control.

Solely the gas control circuit of the voltage transformers (when present) can be three-pole.

Each SF6 circuit shall provide a connection element (type DILO VK/BG-03/8 or equivalent[8]), with a non-return valve, both for SF6 control device and for gas filling/replenishment, provided by not losable protection screw taps (located not higher than 1.900 mm from the ground level).

The SF6 circuit piping shall be performed using stainless steel or painted copper, in order to reduce the stealing risk. Alternative solutions can be considered if the manufacturer proves their similar visible effect and equivalent technical and ageing characteristics.

The alarm threshold calibration has to take into account the leakage rate. The block threshold calibration shall be at least 0,02 MPa lower respect to the alarm threshold.

The SF6 density control device shall be:

- suitable to work in the provided temperature range;
- located in order to avoid the solar radiation influence on the external temperature measuring;
- Your indicator needle cannot be tampered with.
- insensitive to the vibration produced by the equipments operation;
- manufactured with stainless materials;
- realized in order to allow the functionality verification and the substitution with the poles under pressure;
- with the following scale(s) for a visible indication of gas density level:
  - The density meter should be colored and graduated.
  - There should be a nameplate with the relation between the SF6 pressure and ambient temperature

The SF6 density control device shall provide 2 operating levels independently adjustable (see details and specific requirements in 7.6.5):

- 1st minimum gas density level (“P1 gas”): alarm (replenishment necessary), with 2 contacts (1 contact in case of Single-bay type or voltage transformers);
- 2nd minimum gas density level (“P4 gas”): to get out of service (see 7.6.5 for details), with 2 contacts (1 contact in case of Single-bay type or voltage transformers).

The contacts operating tolerance shall be lower than ± 1,5% (referred to the full scale) in the provided temperature range; the contacts of each minimum gas density level shall have a difference ≤ 0,005 MPa between them.

7.5.5 Gas filling/replenishment device (Optional)

At request the manufacturer shall supply a device for the gas replenishment.

In case of SF6, the device shall be provided by female thread connection, W 21,7 x 1/14” (UNI 11144 – only for e-distribuzione) on gas bottle side and DILO VK/BG-03/8 or equivalent on pole junction device side. The device will consist of:

[8] In case of non-fluorinated green house gases, the Manufacturer will propose a suitable type different from the one used for SF6, in order to avoid mistakes.

- pressure regulator
- a safety valve (ISO 4126 compliant, calibrated at 8 bar rel);
- a pressure gauge 0÷1 MPa, 0,5 class, minim resolution ± 5 kPa, accompanied with a calibration certificate;
- flexible tube 5 meters long, DN≥8.

7.5.6 Partitioning

7.5.6.1 *Common requirements*

Generally the partitioning of each pole should be unique. At request could be required to have other partitions: in this case the new partitions will be managed including in the electric scheme the additional functionalities of the interlocking, automatic openings and remote signaling.

The partitions shall have adequate mechanical resistance to static and dynamic stresses and to vibrations due to both normal and short circuit operation. The partitions shall be designed for the maximum differential pressure in case of vacuum performed in one of the sections.

If the manufacturer consider necessary further partitions (i.e. V.T. presence), they will be subjected to Enel Group Distribution companies approval.

Partition examples are in annex B (represented in red color).

7.5.6.2 *Specific requirements*

7.5.6.2.a) *e-distribuzione*

The partitions are included in the scope of D.M. 1/12/1980 and subsequent modification (D.M. 10/9/1981).

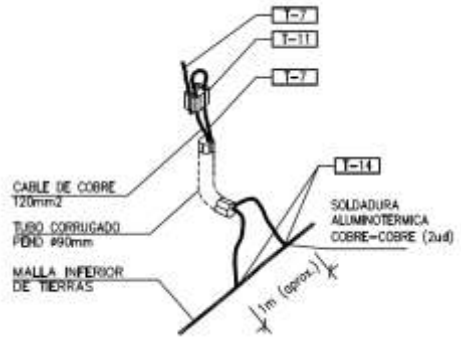
For 245 kV Y2 Hybrid Modules a partitioning between the two circuit-breakers shall be added (see annex B, Y2 examples, fig. 2); in this case the central bay, including its disconnector, will be part:

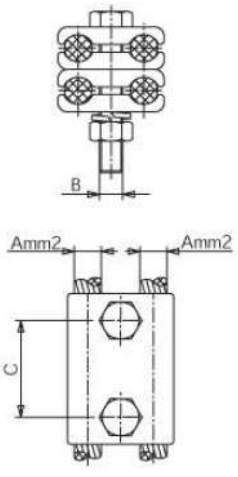
a) in case if one CB is used on Transformer bay, of the line bay partition;
b) in case of both CBs used on line bays, of one of them.

7.5.7 Earthing

The manufacturer shall ensure the equi-potentiality between all parts forming the equipment.

On the base of each support there shall be 2 earthing points equipped with (AISI 316) M12 stainless steel bolts (included in the scope of supply) separated 50 mm vertically.





Support cannot be used as earthing path (even for CTs and VTs, that will also have an earthing path connection directly to the earthing points in the support base).

The manufacturer must ensure that the earthing at each of these points independently establishes that all parts of the equipment are equipotential. The equipment does not need additional grounding points to ensure an equipotential bonding of all components.

As for instrument transformers, the following secondary terminals shall be earthed:

	e-distribuzione and Latam	**e-distribución**
CTs	S1	S2 or S3 (according to the used transformation ratio)
VTs	n	n

7.5.8 Internal arc and overpressure safety devices

In order to provide a high protection to workers, the external effects of an internal arc (pressure increase of gas and possible burn-through of enclosure) must be limited.

Referring to item 5.102.2 of IEC 62271-203 and the performance criteria – Table 104 – it is requested protection stage 2: no fragmentation (burn-through is acceptable).

All enclosures (VT included, if any) shall be equipped with safety devices against the internal overpressures compliant with ISO 4126 (alternative solutions could be evaluated if the manufacturer proves their adequacy) and properly calibrated over the maximum operating pressure, in order to avoid improper operations.

In case of overpressure safety valves operation, the expelled gas shall not run over people around the equipment and shall not damage Hybrid Module vital parts.

7.5.9 Current Transformers

The outdoor current transformers shall be manufactured in compliance to IEC 61869-1 and IEC 61869-2, toroidal type and suitable for exposed installation. They will be located close to the bushings (or to the cable or Bus-duct connections).

The secondary terminal box shall be located in order to be easily accessible.

Inside the Control Box shall be located a CT's terminal board, additional to the previous in the secondary terminal box, 6 mm^2 section. The terminal board inside the Control Box shall be short-circuitable on CT side and disconnectable on Control System side, with test sockets.

The connection cables between the secondary terminal boxes and the CT's terminal board shall be 2,5 mm^2 section if Isn =1 A or 4 mm^2 section if 5 A.

Manufacturer may omit the secondary terminal boxes: on this purpose the connections between the secondary windings and cables to CT's terminal board inside the Control Box shall be welded inside CTs. In this case the terminal board becomes the secondary terminals.

With reference to the annex C dimensional drawings, it is specified that the primary terminal "P1" shall be positioned toward the internal hybrid module side, as the "P2" is to SF6/air bushing or cable connection.

7.5.10 Voltage Transformers

The outdoor voltage transformers, suitable for exposed installation, shall be manufactured in compliance to IEC 61869-1 and IEC 61869-3 and partitioned respect to the hybrid modules enclosures.

7.5.11 Anti-condensation circuit

Inside all boxes a proper anti-condensation system shall be provided in order to prevent humidity damages and to ensure a proper air replacement.

The anti-condensation circuit shall be one for the overall equipment, supplied in a.c (see table in chapter 7.4 for the supply rated voltage) and protected with a magnetothermic automatic circuit-breaker. It shall be controlled by a humidistat; thermostat is admitted in addiction if the manufacturer needs it to comply the minimum ambient temperature requirement. Both shall have fixed regulation (typical regulation values are 60% R.H. and + 5°C) and the contacts shall be connected in parallel.

The heating elements shall be connected in series in order to open the circuit in case of breaking of an element; a minimum current sensor shall detect and signal the anomaly (obviously not when circuit is OFF for environmental causes).

In parallel connection case, the manufacturer shall assure a correct fault detection and distance anomaly signaling in case of failure of an element, properly evaluating the tolerances of the supply voltage and of the components resistance.

The heating elements should be easily replaced without affecting any other component of the enclosure (even wiring) and with the equipment in service.

7.5.12 Protective treatments

All external surfaces shall have an effective and enduring anti-corrosion protection.

On request the enclosures shall be painted in light gray color (RAL 7035). Painting is anyway admitted even if not expressly requested.

The external visible part of partitions, if any, shall be in orange color (RAL 2004).

All iron parts (e.g. support, Control Box, Drive Mechanism Boxes, bolts etc.) shall be in non-corrosive material (AISI 316) or hot dip galvanized in compliance with ISO 1461. All processing shall be completed before the protective treatments.

Protective treatments alternative to the hot dip galvanization could be accepted if the manufacturer proves its adequacy.

The metallic elements in contact shall be designed in order to avoid corrosion due to humidity galvanic effect.

7.5.13 Nameplate

7.5.13.1 *Common requirements*

The nameplates shall be in stainless steel. Alternative materials can be considered if the manufacturer proves the marking endurance respect to the ageing.

The nameplate must be in the language of the destination country.

5.10 of IEC 62271-205 applies. Moreover the nameplate, placed on the external side of the Control Box door, shall include:

- Art 5.10 Nameplates Applies 5.10 of IEC 62271-1 with the following addition: A common nameplate must be provided to identify the compact multi-function module. It must, as a minimum, specify the nominal characteristics listed in art. 4 of this Standard. The common plate must be clearly legible from the position of the local operating zone. For each individual appliance, a plate, in accordance with its own standard, is required when the nominal characteristics are not specified on the common plate.
- Art 4 Rated characteristics Article 4 of IEC 62271-1 applies in part with the following particularities: The rated characteristics of a compact multi-function module and its control equipment include the following:
- (a) rated voltage (Ur);
- (b) nominal insulation level;
- (c) rated frequency (fr);

- (d) rated thermal current (Ir) (for main circuits);
- (e) rated short-time permissible current (Ik) (for main and ground circuits);
- (f) Nominal permissible peak current (Ip) (for main and ground circuits);
- (g) rated short circuit duration (tk); and, where applicable,
- (h) the rated values of the equipment of the compact module, including its switching equipment (supply voltage and frequency) and its ancillary and control equipment.
- The rated characteristics of a compact multi-function module shall be assigned to ensure that the operation of the module within the limits of the assigned ratings does not expose any individual device to conditions exceeding its rated powers and ranges.
- reference to this Global Standard and revision
- composition type (Y1, Y2 or Single-bay);
- optional values, if any;
- the rated filling pressure value at 20°C (relative value).
- include number of SF6 kg and number of CO2 equivalent kgs.
- Include the sentence “Contains fluorinated greenhouse gases covered by the Kyoto Protocol” (in accordance with Commission Regulation (EC) 1494/2007 of 17 December 2007).
- Nameplate in the language of the destination country

7.5.13.2 *Latam specific requirements*

The self-adhesive nameplate to be located in the internal part of the Control Box door shall also contain the contract number.

7.5.13.3 *e-distribuzione specific requirements*

According to PVR006/ PVR016 a bar code shall be assigned to each base component and to the overall assembly (containing references to the base components forming the assembly). Further details will be discussed during the conformity assessment process.

7.6 FUNCTIONAL CHARACTERISTICS

7.6.1 Drive mechanisms

7.6.1.1 *General requirements*

The equipment controls shall be realized in order to be managed by one or more selector switches for the operation type choice, with the following characteristics:

Companies	Selector switches positions	Names	Key
e-distribuzione, Enel Distribuição Rio, Enel Distribuição Ceará, Enel Distribuição São Paulo, Edesur, Enel Codensa and e-distribución	3	Manual Local Remote	Requested (extractable only in manual position) If the Hybrid Module have more than one, they have to be different

These selector switches shall be located inside the Control Box.

In particular the following switches are necessary:

- for Y1, single-bay and double bus-bar types: n° 1;
- for Y2 type: n° 2 (one for bay 1 and 2 and one for bay 3 – see annex B).

In “remote” position the electric remote controls are enabled and the electric local controls are disabled.

In “local” position the electric remote controls are disabled and the electric local controls are enabled.

In “manual” position all electric (local and remote) operations are disabled.

The switch operation shall not cause unwanted equipment operations.

The local operation of circuit-breakers (only three-pole operations, it shall not be possible to operate locally single-pole operations) and disconnectors/earthing switches shall be controlled by push-buttons located in the Control Box (see 7.6.2.1), with the following colors:

Operation	**Enel Codensa, Edesur, e-distribuzione and e-distribución** (according with IEC 60073)	**Enel Distribuição Rio, Enel Distribuição Ceará, Enel Distribuição São Paulo** (according with NR10)
Closing	Black “I” on white background	White "L" on Red background
Opening	White “O” on black background	White "D" on Green background

The test lamp push button located in the Control Box should have the following color:

Push button	**Enel Codensa, Edesur, e-distribución, e-distribuzione, Enel Distribuição Rio, Enel Distribuição Ceará and Enel Distribuição São Paulo** (according with IEC 60073)
Test/reset lamp	White

Only one lamp test push button for the whole hybrid module.

The main contact position of circuit-breaker and disconnector/earthing switch indicators have the following characteristics:

Position	**Enel Codensa, Edesur, e-distribuzione and e-distribución** (according with IEC 60073)	**Enel Distribuição Rio, Enel Distribuição Ceará, Enel Distribuição São Paulo** (according with NR10)
Close	Black “I” on white background	White "L" on Red background
Open	White “O” on black background	White "D" on Green background

The location of the equipment's position indicator devices (open-closed) must guarantee that they are always visible to the operator at every instant of the operation.

Temporary block signalizations shall not be sent to the control system during normal operation.

As for D.C. supply it’s specified that:

- the remote/local control supply of each bay shall be independent from the others;
- the motors supply is common for all circuit-breakers and disconnector of the equipment. All motors shall be equipped with protection magnetothermic automatic circuit-breaker.

7.6.1.2 *Circuit-breakers drive mechanism*

7.6.1.2.a) *General requirements*

The Circuit-breakers drive mechanism shall be spring type, three-pole or single-pole type, except for 245kV has to be single-pole type.

The drive energy storage shall be normally made by mean of d.c. electric motor (see table in chapter 7.4.1 for the supply rated voltage); when necessary it shall be possible to restore manually the operating device energy, with a maximum effort below 200 N (EN 1005-3:2002+A1:2008) during the hole charge. The equipment must have an indicator of the state of the spring (loaded/unloaded) and it has to be visible from the maneuver position. The manual device shall exclude the motor operation, The insertion of the crank handle in the case of manual loading must automatically suppress any power supply to the motorized equipment being maneuvered, or in alterative shall be designed excluding its possible movement in case of unexpected spring operation. Every hybrid module shall have only one handcrank for each type of CB mechanism. Plastic component is forbidden in the handcrank design.

All releases, both for closing and for opening, shall not work with a signal duration ≤ 3 ms.

The Circuit-breakers drive mechanism shall be able to perform the following cycles[9]:

- with motor working:
  - O – 0,3 s – CO – 1 min – CO with CB closed and opening and closing springs charged;
- with motor not working:
  - O – 0,3 s – CO with CB closed and opening and closing springs charged;
  - CO with CB open and closing springs charged;
  - O with CB closed and opening springs charged.

The single-pole CBs shall be equipped with a device for the signalization of poles not in the same position (closed or open). This is applicable also for three-pole CBs when they are electrically obtained by single-pole CBs, paralleling the releases coils.

[9] with the CB closed the opening springs shall be always charged.

7.6.1.2.b) *Release drive circuits*

Referring to the table in chapter 7.1, the release drive circuits typologies are:

- drive circuit of shunt closing release (always required);
- drive circuit of shunt opening release (1° and 2° circuit both independents);
- drive circuit of under-voltage release (3° circuit).

In the electric schemes in annex D both the control circuits for the different cases and the interlocks described in the paragraph 7.6.5 are shown.

It shall be possible to request the CB opening acting both on a single circuit at a time and concurrently on any combination of the different opening circuits.

In case during an operation an opposite operation request is received, the consent on the last operation shall be given only after the completion of on-going operation (in this case, only for single-pole CBs, the discrepancy between poles can exceeds the required limits).

The closing circuits shall be equipped with antipumping devices (1 for tripolar CBs and 3 for unipolar CBs) in order to inhibit further closing operations after the first one if an opening occurs during the initial closing request.

The main contacts position shall be assured stably and surely in the open and closed position. The CBs shall not operate in case of accidental auxiliary circuits supply interruption or in case of supply restore (excluding the drive circuit of under-voltage release).

It shall be possible to perform the CB closing and opening (when HV and d.c. supplies are off, i.e. due to a fault) by means of (safety located) hand operated levers or buttons.

7.6.1.2.b.1 e-distribuzione specific requirements

It shall be possible to manually lock/unlock the under-voltage release(s), both three-pole or single-pole type, by mean of a device provided of the “bloccato”/“sbloccato” indication (in local language). This device(s) shall be easily and safely accessible (shall not be necessary to open the part of the Operating Device Box where the operating devices are located) and shall be maneuverable from the ground level (maximum height 1.900 mm). It shall be possible to operate this device(s) with the CB in service and without causing an unwanted opening.

In the functional scheme the locked under-voltage release signalization shall be provided.

Under-voltage releases consisting of energy storage systems (for example capacitors) are not admitted.

The CB closing consensus shall be interdict in case under-voltage release drive circuits are not supplied.

7.6.1.3 *Disconnectors (DSs) and earthing switches (ESs) drive mechanism*

The DSs and ESs operation shall be performed by three-pole motor-drive mechanisms with the possibility of emergency (for instance: absence of DC power supply) manual operation in case of need. It will consist of a gear motor (see table in paragraph 7.4.1 for the supply rated voltage) which will transmit its movement to the drive shaft of the disconnector. The same applies to earthing switch.

The motor drive system can be unique for DS and ES.

The drive mechanism shall operate on a highly reliable transmission system, in order to avoid any interruptions.

Every hybrid module shall have only one handcrank for each type of DS and ES mechanism. Plastic component is forbidden in the handcrank design.

Position indicating devices of disconnectors and earthing switches shall comply IEC 62271 -102, annex A.

The location of the equipment's position indicator devices (open-closed) must guarantee that they are always visible to the operator at every instant of the operation.

DS and ES shall be both equipped with the following circuits:

a) n° 1 drive circuit of shunt closing release;

b) n° 1 drive circuit of shunt opening release.

The ongoing operations shall be completed even in case of opposite operation request.

The operation requests persistence after the operation conclusion shall not produce effects.

In case of a DS/ES operation is not completed, any previously received operation requests shall not remain stored. In case of motor supply outage during a DS/ES operation, the drive mechanism shall ensure:

- the keeping of the reached position, both during supply absence and at its restore;
- the execution after the supply restore of any requested closing or opening operation, independently from the operation type ongoing at supply outage instant;
- that in case of not completed operation the operation sequence shall be stopped and an anomaly remote signalization (Switch Not Maneuverable) shall be sent, by mean of a timed contact.

The operations shall not be carried out if the request signal duration is shorter than 3 ms.

The manual emergency operation shall be enabled by a Consensus Electromagnetic Device (CED[10]):

- in case of 2 positions selector switch the hand-crank insertion is enabled only in “local” position, pressing a button[11] and in presence of all requested consensus conditions (see electric schemes);
- in case of 3 positions selector switch the hand-crank insertion is enabled only in “manual” position and in presence of all requested consensus conditions (see electric schemes).

The hand-crank for manual operation shall be withdrawable type; its insertion shall cause an anomaly remote signalization[12] and shall disable the electric operations, both local and remote.

The insertion of the crank handle in the case of manual loading must automatically suppress any power supply to the motorized equipment being maneuvered.

The manual operation of DS and ES shall be compliant with IEC 60447.

The turns number for a complete manual operation shall not exceed 50.

All controls (remote, local and manual) shall be subject to the conditions described in paragraph 7.6.5 and represented in the electric scheme of annex D.

7.6.1.3.a) *e-distribución, Enel Distibutie and Latam specific requirements*

It shall be possible to lock DS/ES in open or closed position by mean of padlocks with Ø = 6 ÷ 10 mm pin.

7.6.1.3.b) *DS/ES mechanical locks and interlocks*

DS combined with ES as a single unit shall have a mechanical interlocking device that prevent the closure of ES when DS is closed and prevent closure of DS when ES is closed (not applicable in case of DS/ES for which it’s not physically possible to have these conditions).

Electrical interlocks are described in paragraph 7.6.5.

[10] “DEC – Dispositivo Elettromagnetico Consenso” for e-distribuzione.

[11] Different designs with the same functional results can be evaluated by Enel.

[12] “SNM – Sezionatore Non Manovrabile” for e-distribuzione.

All mechanical locks and interlocks shall be designed to withstand, preventing damages and without need of maintenance:

- in case of motor-operation, to the strains produced by the motor starting torque;
- in case of manual-operation, to 3 times the maximum force required for manual operation (5.105 of 62271-102), or, if a strain limiting device is present, to 1,5 times its intervention rated value.

7.6.2 Control Box and Drive Mechanism Box

The requested cabinets are the followings:

- a cabinet for control and interface with the remote control system (hereinafter “Control Box”)
- cabinets for the CBs, DSs and ESs operating devices (hereinafter “Operating device Box”)

7.6.2.1 *Control Box*

All Hybrid Module auxiliary and control equipments shall be placed in the Control Box, located in correspondence of the central pole, on the side indicated in annex C; the Control Box can be fixed on the Hybrid Module support or on a specific independent support (in this case see annex C for maximum distance). In this box also the cables coming from CTs and, if any, VTs shall be connected to the respective terminal boards (see par. 7.5.9 and annex D). If the manufacturer proposes the control box separate from the module, the connection between the CB and the module must be with heavy duty connection type (harting)

In case of interferences with some equipment parts (e.g. with VTs and HV cable connection) the box shall be located on the Hybrid Module side in correspondence with the LV cable shaft of the civil works (in this case some additional information should be provided by the user and the Control box position will be agreed).

The location of the control box should always consider pedestrian access to the equipment (projected and/or existing). Always prioritizing to facilitate the access and the operation of this.

In addition to the IP requirement of table al chapter 7.4.1, the box protection degree with open doors shall be minimum IP2X.

In addition to the dimensions shown in annex C, the box base height respect to the ground shall be ≥ 400 mm and all HMI (Human Machine Interface) elements (controls and signalizations) shall be at ≤ 1800 mm.

The box interior shall be accessible only from the front by mean of a door provided of handle and lock. The door (simple or double), hinged and provided of anti-wind system, shall be provided of a window in order to make visible from outside the synoptic and the signalization lamps. It shall be possible to open the door over 90°.

All accessories (hand cranks, document pocket etc.) shall be accommodated in the internal part of the box door.

All electric equipment components shall be:

- compliant with the respective IEC standards;
- equipped with an identification label indicating the codification used in the functional electric schemes;
- easily accessible for maintenance or substitution operations;
- of typologies for which interchangeable components are easily available in commerce (delivery time within 2 weeks) in the Hybrid Module destination country.

In particular, the extractible ones, plug-in connector included, shall be provided with proper anti-mistake coding.

The internal wiring of the control box and operating device box must be clearly, visibly and unambiguously identified with the following minimum requirements:

- Name of the terminal block and number of the destination terminal

In all cases, it must be visible from the front of the elements, without the need to turn or move the control cables or any other element of the indicated boxes.

Likewise, the substitution of any element inside these boxes must not imply the removal or movement of other elements. These conditions of labeling and visibility must be guaranteed throughout the useful life of the equipment.

The box internal wiring shall be made with conductors with adequate section (≥ 1mm^2), flexible type, compliant with IEC 60332-3-24 and insulated at Uo/U = 450/750 V.

The cable ends shall be provided by pre-insulated compression type terminals, suitable for the clamps where they have to be connected.

The connection cable from the Control Box to the equipments shall be of adequate section (≥ 1,5 mm^2), shielded, flexible, compliant with IEC 60332-3-24 and insulated at Uo/U = 0,6/1 kV.

Inside the Control Box an internal collector (in copper, section ≥ 60 mm^2 and M5 regular interval threaded hole) shall be present for the earthing connection of all cable shields; the Manufacturer shall guarantee its effective connection to the Hybrid Module earthing system.

The entrance of cable coming from equipments and control system shall be from the Control Box bottom side, where a removable loophole (in aluminum, with useful dimension of 300x300 mm) shall be provided.

At about 200 mm below the Control Box shall be provided a removable horizontal crossbar, suitable for the anchorage of all the cables by mean of cable-fixers.

The Control Box shall include:

- selector switches;
- synoptic (see annex E) representing the HV electric scheme, with the equipments position (close or open), the partitioning (if any), the alarm/block signalization lamps and the lamps testing button; the synoptic shall also include control buttons for CBs, DS and ES;
- gas density signalization lamps (for each gas circuit, yellow color about 1$_{st}$ minimum gas density level; red color about 2$_{nd}$ minimum gas density level).
- magnetothermic automatic circuit-breakers for the supplies protection (motors, lighting lamp, anti-condensation circuits – fuses are not admitted);
- interface terminal board for substation control system, including the CTs and VTs testing terminals (with correspondent automatic circuit-breakers, see par. 7.6.5);
- anti-condensation circuit;
- internal lighting lamp, with automatic switching in case of open door. The whole internal control box must be lightened to make easier the wiring works.

For each Hybrid Module the interface terminal boards composition depends on the HV switchgear typologies that form the whole assembly.

The interface terminal boards (and their modular terminals) shall be grouped, for every bay, switchgear by switchgear, according to principle electric schemes shown in annex D.

The terminals shall have section 4 mm² for control, signalization and anti-condensation circuits and section 10 mm² for the motors supply circuit.

The VTs (if any) terminals and protection circuit-breakers shall be located in the bottom part of the box, as close as possible to the cable entrance, in order to minimize the short circuit hazard.

Similarly also the CTs terminals shall be located in the bottom part of the box.

Two bridged terminals couples for the anti-condensation circuit and 2/3 (depending on the number of bays) bridged terminal couples for the motor supply circuit shall be provided.

The cable trunks close to the interface terminal boards shall be used for the control system wiring and cannot be used for the internal wiring.

The connections between the different equipment should be with the heavy duty connection type (harting). The protection degree has to be IP68.

The cable trunking systems for the internal wiring shall shave sufficient residual space (≥ 10% of used volume); the cables shall be anchored in some points in order to avoid their falling. The cable entry must have a cable gland.

The signalization lamps and the internal lighting lamps shall not be incandescent type (LED preferably). The lighting lamps shall be easily removable.

All provided electromechanical block keys (installed i.e. on transformer bay) shall be differently codified.

The earthing of a d.c. supply polarity is not admitted.

If diodes are used for the circuit separations or for the voltage return protection, they shall have reverse voltage ≥ 3 kV.

7.6.2.1.a) *e-distribuzione specific requirements*

In alternative to IEC 60332-3-24, cables compliant with CEI 20-22/2 and marked with CEI 20-22 II can be accepted.

7.6.2.1.b) *e-distribución specific requirements*

Control box wiring and construction must be compliant with internal e-distribución procedure NMC001, and NNC007.

It must be considered as a low voltage equipment. For that reason it also must be compliant with Reglamento Electrotécnico para Baja Tensión, Real Decreto 842/2002.

7.6.2.2 *Operating devices boxes*

The drive mechanisms, the CB operation counters (four-digits, not-resettable, mechanical or in alternative electromechanical – in the latter case located in the Control Box), the auxiliary electric equipments, the auxiliary contacts and the terminal boards (or connectors) shall be located:

- in a single cabinet for disconnectors/earthing switches and three-pole CBs;
- in 3 cabinets for single-pole CBs.

During normal operation, with enclosures and doors closed, the main contact position indication (close/open) and, for CBs, the spring loading condition signalization shall be visible from ground level.

In order to allow the verification, during maintenance activity, of the unchanged characteristics of the CB's no-load travel curve (see note in par. 7.8.2.2-9b), manufacturer shall provide the measuring points, properly machined.

In addition to the IP requirement of table at chapter 7.4, the box(es) protection degree with open doors or when using hand-crank (to charge CB's springs or manual operation on DS/ES) shall be minimum IP2X (unless the box can be opened only using tools).

All mechanical organs (included the motion transmission rods for three-pole CBs) shall be enclosed in metallic enclosures, IP2X, in order to prevent the access to parts in movement, unless they have slow motion (see par. 5.13.1 of IEC 62271-1) without cutting and crushing hazard.

The manufacturer shall provide the instruction for a safety access to mechanical organs.

7.6.3 Electronic Voltage Detector System EVDS

The EVDS detects the voltage presence in order to implement interlocks for preventing incorrect operation of disconnectors and earthing switches.

It is equipped with internal self-diagnostic.

The EVDS shall have a DC/failure auxiliary contact signalization.

If it is equipped with an ON/OFF button, in OFF position shall activate the DC/failure auxiliary contact signalization.

It's a low performance electronic device, not for measuring purpose, made by 2 parts.

The first device part, self-supplied, is connected to a capacitive divider tern located on the Hybrid Module (on the line or busbar bay). It provides a digital information related to the presence or absence of the HV voltage; it pilots an optical fiber interface, one for each pole, making a galvanic separation.

In alternative, this first part can be made with 3 separate units, each connected to its capacitive divider and each with its optical fiber connection.

The fixing system of the FO for the EVDS must guarantee a correct connection of this element through time, in the same way this connection must be able to withstand the vibrations inherent to the equipment maneuvers and/or any type of internal or external movement.

The second device part includes relays and is supplied in d.c.; it receives and elaborates the optical fiber signals and it implements the requested interlocks.

The operation and hysteresis threshold shall provide that:

- the voltage absence signalization is guaranteed with < 10% of rated voltage;
- the voltage presence signalization is guaranteed with > 45% of rated voltage.

The EVDS is equipped with 2 electromechanical relays.

The first relay signals the voltage presence/absence and disables/enables the operations in accordance with the logic of the following table:

HV presence	EVDS supply presence	Voltage detector relay coil	Interlocks contact
YES	NO	Not-energized	Open
YES	YES	Not-energized	Open
NO	NO	Not-energized	Open
NO	YES	Energized	Close

The voltage absence signalization and its restoration shall not be instantaneous but delayed of about 1s.

The second relay is activated by the internal self-diagnostic.

This diagnostic relay, if not energized, provides:

- to remote signal the "HV presence anomaly", by mean of wiring to the substation interface terminal board;
- to interact with the voltage presence/absence circuit, blocking operations for safety reason.

The diagnostic relay enables, if energized, the disconnectors or earth disconnectors operation in absence of HV.

Each EVDS shall be equipped with two leds for the following local state signalizations:

- red led on: voltage presence
- green led on: voltage absence

As for the first EVDS part:

- if three-phase type, it shall be located in the Control Box; the connections to the capacitive dividers shall be made using shielded cable; moreover, immediately close to each capacitive divider a restorable surge arrester shall be provided, in order to limit the residual voltage, in case of overvoltage, to 200 V;

- if single-phase type, the three devices shall be located immediately close to each capacitive divider. Three fiber optic cables, inserted in protective tubes, connect each device from capacitive divider to the second part.

The second EVDS part shall be located in the Control Box.

The EVDS correct operation shall be guaranteed in the required temperature range.

The EVDS supply shall be protected with an automatic circuit-breaker, whose operation signalization shall be associated with the “HV presence anomaly” in the substation interface terminal board.

7.6.4 Electric schemes, controls and signalizations

7.6.4.1 *General requirements*

The electric schemes shall:

a) be represented in the reference conventional conditions:
   - a.1) CB, DS and ES (if any) in open position;
   - a.2) CED not energized;
   - a.3) absence of a.c. and d.c. auxiliary supplies;
   - a.3) absence of HV;
   - a.4) gas absence;
   - a.5) closing springs discharged;
   - a.6) remote/local selector switch(es) in remote position;
   - a.7) in case of micro-switches with the state dependent on the opening/closing of the boxes/carters of operating devices, they shall be represented disabled (that is with boxes/carters open).
   - a.8) unlocked under-voltage release (when requested) for CB.

b) report the following pressures values at 20°C (relative values):
   - b.1) rated filling pressure;
   - b.2) threshold setting pressure of the 1st minimum gas density level (alarm, replenishment necessary);
   - b.3) threshold setting pressure of the 2nd minimum gas density level (block or automatic opening with open position blocking).

c) include the functional scheme, all information useful to identify each wire and cable, the equipments wiring schemes (auxiliary contacts, relays, gas density control devices etc.), the topographic schemes for interconnections between boxes, the topographic schemes about all the electric components in Control box/Operating device box(es), the anti-mistake coding.

Further details are in the specific requirements and in annex D, where the principle electric schemes of the different switchgears (and their functional typologies) are represented.

7.6.4.2 *Spain and Latam specific requirements*

Manufacturer definitive schemes must be compliant with e-distribución internal procedure NZC001.

7.6.4.3 *Italy specific requirements*

The Annex D principle electric schemes (and their identifying code) are listed in the following tables, with the references to previous e-distribuzione technical specifications (the previous reference doesn’t mean that the electric scheme is exactly the same – some modifications have been introduced).

7.6.4.3.a) *Circuit-breakers*

Code	Description
CB-S/1.2.	C.B. Single-pole operation - 1°, 2° opening circuit
CB-S/1.2.3.	C.B. Single-pole operation - 1°, 2°, 3° opening circuit
CB-T/1.3.	C.B. Three-pole operation - 1°, 3° opening circuit
CB-T/1.2.3.	C.B. Three-pole operation - 1°, 2°, 3° opening circuit
CB-T/1.2.	C.B. Three-pole operation - 1°, 2° opening circuit
245 CB-S/1.2.	245 kV C.B. Single-pole operation - 1°, 2° opening circuit

7.6.4.3.b) *Disconnectors/Earthing switches*

Code	Description
101	Line 1 Bay (Only “Y1” – EVDS)
102	Line 2 Bay (Only “Y1” – EVDS)
103	Customer Bay (Only “Y1”)
104	Busbar Bay (Only “Y1” – joined with Customer Bay)
201	Line Bay (External Voltage Transformers)
202	Line Bay (Integrated Gas insulated Inductive Voltage Transformers)
301	Busbar (or Line 2) Bay (EVDS)
302	Busbar (or Line 2) Bay (Integrated Gas insulated Inductive Voltage Transformers)
303	Busbar (or Line 2) Bay (EVDS and Partition)
401	Transformer Bay
402	Transformer Bay (Integrated Gas insulated Inductive Voltage Transformers)
DS electric scheme code	**Description**
501	Busbar Bay (Only “Single-bay” type)
502	Busbar Bay (Only “Single-bay” type - Partition)

7.6.4.3.c) *Motors and anti-condensation power supplies*

Code	Description
AM	Motors and anti-condensation terminal board power supplies

7.6.4.3.d) *Current and Voltage Transformers for e-distribuzione*

Code	Description
CT/1	Current Transformers (type GSCH002/601 ÷ 606)
CT/2	Current Transformer (type GSCH002/607)
CT/3	Current Transformer (type GSCH002/608)
VT/1	Voltage Transformers (Inductive or Capacitor Voltage Transformers Version)
VT/2	Voltage Transformers (Gas insulated Inductive Voltage Transf. Version)

7.6.5 Controls, signalizations, interlock and automatic openings

7.6.5.1 *Spain and Latam specific requirements*

7.6.5.1.a) *Hybrid module Single-bay type – used in Bus coupler bay*

d.c. and a.c. supply

- Terminal block for the CB and DSs motors d.c. supply (See Annex D - Terminals X0:1-4)
- Terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D - Terminals X0:5-6)
- Terminal block for the DSs drive circuits of shunt release d.c. supply (See Annex D - Terminals X0:7-8)
- Terminal block for the connection of the d.c. supply for the circuit associated with the control box synoptic signalization and for the signals communicated to the RTU (See Annex D - Terminals X0:9-10)
- Terminal block for the CB drive circuit of shunt release (2nd circuit) d.c. supply (See Annex D - Terminals X0:11-12)
- F3 MCB for the protection of the CB and DS/ES Anti-condensation circuits.
- Terminal block for the a.c. supply for the anti-condensation circuit associated with the CB, DSs and VTs of busbar 1 and busbar 2 control boxes (See Annex D - Terminals X0:13-18). Two extra terminals shall be available within the heating circuit, to be used for the heating power supply of the boxes associated to the VTs Busbar, installed by e-distribución (See Annex D - Terminals X0:19-20).
- F1 MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals X0:1/2-3/4).

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- F1 MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals X0:1-2).
- F21, F22, F23 and F24 MCBs for protecting circuits of the DS/ES motors d.c. supply (See Annex D - Terminals X0:3-4).
- F2 MCB for protecting circuits of the DS/ES drive circuit of shunt release d.c. supply (See Annex D - Terminals X0:7-8).

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB connected to the terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D – Terminals X0:01A-01B)

Current circuits

- Terminal block for the CT secondary terminals (See Annex D - Terminals X6:1-16 if CTs are supplied directly from factory with the primary transformation ratio required for each installation).

SPECIFIC REQUIREMENTS COLOMBIA

- Short circuit and connected to the ground terminal blocks when open in order to inject to the protection control box. Furthermore, include accessories to open simultaneously 3 phases and neutral with the capability to measure 1 phase.

Voltage circuits

- Busbar voltage circuit bus. Terminals associated with this functionality shall receive the voltages from the VTs of busbar 1 and busbar 2. This bus shall transmit the voltage of both busbars to each hybrid module in the substation (See Annex D - Terminals X0:21-28)
- Busbar voltage absence block selection bus. Terminals associated with this functionality shall receive the overcurrent protection miniature circuit breaker or molded case circuit breaker (hereinafter MCB in general) open signal from the VTs of busbar 1 and busbar 2 (See Annex D - Terminals X0:29-37).

1st battery CB control and protection (P1-N1)

- 1st drive circuit of shunt closing release control. The requirements described in SF6 Gas and simultaneous operations shall apply.
- In case of two batteries, the drive circuit of shunt closing release control has to take into account the SF6 second alarm level from the two batteries.
- Anti-pumping circuit and priority to the LOCAL opening maneuver has to work properly. None of two conditions should interfere with the other.
- 1st drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall apply. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.
- 1st battery CB closing (K0E) and opening (K0A) auxiliary relays. These relays shall receive closing and opening commands from the pushbuttons located in the Control Box and from RTU, depending on the S43 Manual-Local-Remote selector switch (hereinafter S43 M-L-R selector switch) position. The auxiliary closing relay coil K0E energization shall be able to include the synchronism permission to local and remote command, in series with the closing command. For both, closing and opening relays, a normally open contact shall be used to activate the drive circuit of shunt closing and opening release.

SPECIFIC REQUIREMENTS COLOMBIA

- When S43 M-L-R selector switch is in “LOCAL” position has to cut the negative of the K0E and K0A auxiliary relays. When S43 M-L-R selector switch is in “REMOTE” position, the K0E and K0A auxiliary relay connect to the negative from X1 terminal block (See annex D – Terminals X1:8C)

2nd battery CB control and protection (P2-N2)

- 2nd drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall apply. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.

SPECIFIC REQUIREMENTS COLOMBIA

- When S43 M-L-R selector switch is in “REMOTE” position, both positive and negative connect to the X1 terminal block (See annex D – Terminals X1:8A-8B)
- When S43 M-L-R selector switch is in “REMOTE” position, the positive of the preventive opening will be conditioned (See annex D – Terminals X1:67)

DSs control (P12-N12)

- DSs driving mechanisms operation shall not be executed directly on their motors. These motors shall implement control based on auxiliary relays, which shall receive the opening and closing commands.
- DSs/ESs automatism shall guarantee that simultaneous operation of several DSs/ESs may not be performed.
- No DSs shall be operated when the CB is in closed position.
- The auxiliary contacts of each DS operation diagram shall be represented, including precise identification of the DS position during its whole itinerary.

Busbar differential relay

- Open and closed DSs positions shall be reported (See Annex D - Select terminals from X2 and X3 terminal blocks).
- Open and closed CB position shall be reported (See Annex D - Select terminals from X1 terminal block).
- A normally open voltage-free contact connected to terminals of K0E (auxiliary closing relay) shall be used to inform the busbar differential relay when a circuit breaker closing command occurs (See Annex D - Terminals X20:3-4) .

Interlocking between hybrid modules

A closed bus coupler circuit shall be created through the X19 terminal block. This closed bus coupler circuit will be allow you to make a change of bars in other positions. You will also receive the grounding permit bars1 and bars 2 with busbar disconnectors from other positions in the open position. The bars 1 and bars 2 will be sent to the rest of positions that are not grounded. The intermediate position of any other bar positioner will block the opening of the coupling switch (See Annex D - Terminals X19:1-16)

Signals to RTU (P15-N15)

- Open and closed CB position shall be reported (See Annex D – Select terminals from X1 terminal block (X1:29-32)).
- Open and closed DSs positions shall be reported (See Annex D – Select terminals from X2 and X3 terminal blocks (X1:21-24)).
- Every motorized switchgear MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminals X1:51-52; X2:51-52 y X3:51-52).
- Anti-condensation circuit F3 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21:8)

- Anti-condensation circuits d.c. supply MCB open signal, located in the Busbar 1 voltage control box, shall be reported. The signal shall be sent to the hybrid module control box by means of a normally closed contact (See Annex D – Terminals X21:13-14).
- Anti-condensation circuits d.c. supply MCB open signal, located in the Busbar 2 voltage control box, shall be reported. The signal shall be sent to the hybrid control box by means of a normally closed contact (See Annex D – Terminals X21:15-16).
- Busbar 1 voltage MCB open signal, located in busbar 1 voltage control box, shall be reported. The signal shall be sent to the module control box by means of a normally closed contact (See Annex D – Terminals X21:9-10).
- Busbar 2 voltage MCB open signal, located in busbar 2 voltage control box, shall be reported. The signal shall be sent to the module control box by means of a normally closed contact (See Annex D – Terminals X21:11-12).
- Manual position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21-4).
- Local position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21-5).
- Remote position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21-5a).
- The anti-pumping relay activation shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:53-54).
- SF6 CB alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:55-56).
- SF6 CB block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:57-58).
- Discharged/Charged springs signal shall be reported by means of a voltage-free contact connected to terminals. If this signal comes from an auxiliary relay, the auxiliary relay MUST be a temporized one (See Annex D – Terminals X1:49-50 for discharged springs and X1:49-50A for charged springs)
- Operating time exceeded signal shall be reported by means of voltage-free contact connected to terminals (See Annex D – Terminals X2:53-54 and X3:53-54).
- SF6 busbar or module alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21-6).
- SF6 busbar or module block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21-7).
- DS/ES motor power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X2:55; X3:55; X4:55; X5:55).

SPECIFIC REQUIREMENTS BRAZIL

- Positive Remote signal supply terminals for the main protection (See Annex D – Terminal X0:38)
- Positive Remote signal supply terminals for the secondary protection (See Annex D – Terminal X0:39)
- Positive power supply for digital inputs to the RTU from the protection control box has to be independent of the power to local signals (See Annex D – Terminal X0:40)

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB Switch control power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X1:68)

7.6.5.1.b) *Hybrid module Y1 type – used in Line bay*

d.c. and a.c. supply

- Terminal block for the CB and DS/ESs motors d.c. supply (See Annex D - Terminals X0:1-4).
- Terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D – Terminals X0:5–6).
- Terminal block for the DS/ESs drive circuits of shunt release d.c. supply (See Annex D – Terminals X0:7–8).
- Terminal block for the connection of the d.c. supply for the circuit associated to the control box synoptic signalization and for the signals communicated to the RTU (See Annex D - Terminals X0:9-10).
- Terminal block for the CB drive circuit of shunt release (2nd circuit) d.c. supply (See Annex D - Terminals X0:11-12)
- Terminal block for the CB and DS/ESs anti-condensation circuit a.c. supply (See Annex D - Terminals X0:13-18). Two extra terminals shall be available within the heating circuit, to be used for the heating power supply of the boxes associated to the VTs bay (if exists), installed by ENEL (See Annex D - Terminals X0:19-20)
- F1 MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals X0:1/2-3/4).

SPECIFIC REQUIREMENTS BRAZIL

- F1 MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals X0:1-2).
- F21/S1, F21/S2, F21/L and F22/L MCBs for protecting circuits of the DS/ES motors d.c. supply (See Annex D - Terminals X0:3-4).
- F2 MCB for protecting circuits of the DS/ES drive circuit of shunt release d.c. supply (See Annex D - Terminals X0:7-8).

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB connected to the terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D – Terminals X0:01A-01B).

Current circuits

- Terminal block for the CT secondary terminals (See Annex D - Terminals X6:1-33 if CTs are supplied directly from factory with the primary transformation ratio required for each installation).

SPECIFIC REQUIREMENTS COLOMBIA

- Short circuit and connected to the ground terminal blocks when open in order to inject to the protection control box. Furthermore, include accessories to open simultaneously 3 phases and neutral with the capability to measure 1 phase.

Voltage circuits

- Terminal block for the VT secondary terminals (See Annex D - Terminals X7:1-29)
- MCBs for protecting circuits from X7 terminal block, associated with VTs bay. They shall be installed in the control box with the corresponding signal for each circuit breaker:
  - F101-MAIN PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.

- F102-SECONDARY PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.
- F103-MEASURE AND SYNCHRONISM VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals. The normally open contact is used to lock the line earthing switch.

- Bus related to synchronism busbar voltage circuit (See Annex D - Terminals X0:21-30).
- Bus related to block selection caused by lack of busbar voltage (See Annex D - Terminals X0:32-38).
- The auxiliary relays associated with the voltage presence shall be energized from the measure and synchronism voltage winding, to allow line earthing switch operation. The interlock is a series circuit of:
  - Normally closed contacts of the voltage presence auxiliary relays and
  - A normally open F103 MCB contact.

1st battery CB control and protection (P1-N1)

- 1st drive circuit of shunt closing release control. The requirements described in SF6 Gas and simultaneous operations shall be applied.
- In case of two batteries, the drive circuit of shunt closing release control has to take into account the SF6 second alarm level from the two batteries.
- Anti-pumping circuit and priority to the LOCAL opening maneuver has to work properly. None of two conditions should interfere with the other.
- 1st drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.
- 1st battery CB closing (K0E) and opening (K0A) auxiliary relays. These relays shall receive closing and opening commands from the pushbuttons located in the Control Box and from RTU, depending on the S43 M-L-R selector switch position. The auxiliary closing relay coil K0E energization shall be able to include the synchronism permission to local and remote command, in series with the closing command (X1:63–64). For both, closing and opening relays, a normally open contact shall be used to activate the drive circuit of shunt closing and opening release.
- A normally open voltage-free contact connected to terminals of K0E (auxiliary closing relay) shall be used to inform the main protection relay when a circuit breaker closing command occurs (See annex D – Terminals X20: 3-4).
- It shall be necessary to have a normally open voltage-free contact, connected to terminals of the opening auxiliary relay K0A in case of bays with distributed generation connected (See annex D – Terminals X20:7-8).
- It is necessary to have a contact in S43 M-L-R selector switch (when it is in “LOCAL” position) to set the reclosing automatism out of service (See annex D – Terminals X20:1-2).
- The main protection relay shall be informed when F101 MCB is open. A normally closed voltage-free contact connected to terminals shall be used for this purpose (See annex D – Terminals X20: 9-10)
- Open and closed CB position shall be reported to the main protection relay (See annex D – Select terminals from X1 terminal block (X1:21-24))
- Discharged springs signal shall be reported to the main protection relay by means of a voltage-free contact connected to terminals. These contacts shall be limit switch end position of circuit breaker discharged springs. If there are not enough available contacts, an auxiliary timing relay shall be used for this purpose (See annex D – Terminals X1: 45-46)

- SF6 circuit breaker block shall be reported to the main protection relay by means of a voltage-free contact connected to terminals (See annex D – Terminals X1: 57-58)

SPECIFIC REQUIREMENTS COLOMBIA

- When S43 M-L-R selector switch is in “LOCAL” position has to cut the negative of the K0E and K0A auxiliary relays. When S43 M-L-R selector switch is in “REMOTE” position, the K0E and K0A auxiliary relay connect to the negative from X1 terminal block (See annex D – Terminals X1:8C)

2nd battery CB control and protection (P2-N2)

- 2nd drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.
- A normally open voltage-free contact connected to terminals of K0E (auxiliary closing relay) shall be used to inform the secondary protection relay when a circuit breaker closing command occurs (See annex D – Terminals X20: 5-6).
- Open and closed CB position shall be reported to the secondary protection relay (See Annex D – Select terminals from X1 terminal block (X1:25-28)).
- The secondary protection relay shall be informed when F102 MCB is open. A normally closed voltage-free contact connected to terminals shall be used for this purpose (See Annex D – Terminals X20:11-12).
- Discharged springs signal shall be reported to the secondary protection relay by means of a voltage-free contact connected to terminals. These contacts should be limit switch end position of circuit breaker springs discharged. In case that there are not enough available contacts, an auxiliary timing relay shall be used for this purpose (See Annex D – Terminals X1: 47-48).
- SF6 circuit breaker block shall be reported to the secondary protection relay by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:59-60).

SPECIFIC REQUIREMENTS COLOMBIA

- When S43 M-L-R selector switch is in “REMOTE” position, both positive and negative connect to the X1 terminal block (See annex D – Terminals X1:8A-8B)
- When S43 M-L-R selector switch is in “REMOTE” position, the positive of the preventive opening will be conditioned (See annex D – Terminals X1:67)

DS/ESs control (P12-N12)

- DS/ESs driving mechanisms operation shall not be executed directly on their motors. These motors shall implement control based on auxiliary relays, which shall receive the opening and closing commands.
- DS/ESs automatism shall guarantee that simultaneous operation of several DS/ESs may not be performed.
- No DS/ESs shall be operated when the CB is in closed position.
- Extra terminals to connect the external interlockings shall be available.
- In case of line earthing switch the interlocking which prevents the operation with voltage presence in line shall be included (reserve 2 terminal blocks in the chain condition to include the interlocking). The interlock is a series circuit of:
  - Normally closed contacts of the voltage presence auxiliary relays and

- A normally open F103 MCB contact.

- The auxiliary contacts of each DS/ES operation diagram shall be represented, including precise identification of the DS/ES position during its whole itinerary.
- The busbar DS maneuver must contemplate the necessary interlocks to be able to make a busbar change taking into account:
  - The busbar coupling and the other busbar DS closed
  - Or the CB open and other busbar DS open.

Busbar differential relay

- Open and closed busbar DSs positions shall be reported (See Annex D - Select terminals from X2 and X3 terminal blocks)

Interlocking between hybrid modules

- A closed bus coupler shall be created through the X19 terminal block. This closed bus coupler circuit will receive the closed bus coupler state. The closed bus coupler circuit will enable the hybrid module busbar DSs operation (See Annex D - Terminals X19:1-6)
- The state of the hybrid module DSs shall be reported to the bus coupler. The bus coupler circuit breaker opening operation shall be locked if any DS of the switchyard is in the intermediate position (See Annex D - Terminals X19:7-16)

Signals to RTU (P15-N15)

- Open and closed CB position shall be reported.(See Annex D – Select terminals from X1 terminal block (X1:29-32))
- Open and closed DS/ESs positions shall be reported (See Annex D – Select terminals from X2:21-24, X3:21-24,X4:21-24 and X5:21-24 terminal blocks)
- Every motorized switchgear MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminals X1:51-52; X2:51-52; X3:51-52; X4:51-52 and X5:51-52)
- Anti-condensation circuit F3 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21:8)
- F101 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:9) and a normally open (See Annex D – Terminal X21:9A) voltage-free contacts connected to terminals
- F102 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:10) and a normally open (See Annex D – Terminal X21:10A) voltage-free contacts connected to terminals
- F103 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:11) and a normally open (See Annex D – Terminal X21:11A) voltage-free contacts connected to terminals
- “MANUAL” position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21:4)
- “LOCAL” position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21:5)
- “REMOTO” position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21:5A)
- The anti-pumping relay activation shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:53-54)
- SF6 CB alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:55-56)

- SF6 CB block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:61-62)
- Discharged/Charged springs signal shall be reported by means of a voltage-free contact connected to terminals. If this signal comes from an auxiliary relay, the auxiliary relay MUST be a temporized one (See Annex D – Terminals X1:49-50 for discharged springs and X1:49-50A for charged springs)
- Operating time exceeded signal shall be reported by means of voltage-free contact connected to terminals (See Annex D – Terminals X2:53-54; X3:53-54; X4:53-54 and X5:53-54)
- SF6 busbar or module Alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21:6)
- SF6 busbar or module Block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21:7)
- DS/ES motor power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X2:55; X3:55; X4:55; X5:55;)

SPECIFIC REQUIREMENTS BRAZIL

- Positive Remote signal supply terminals for the main protection (See Annex D – Terminal X0:31)
- Positive Remote signal supply terminals for the secondary protection (See Annex D – Terminal X0:32)
- Positive power supply for digital inputs to the RTU from the protection control box has to be independent of the power to local signals (See Annex D – Terminal X0:33).

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB Switch control power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X1:68)

7.6.5.1.c) *Hybrid module Y1 type – used in Transformer bay*

d.c. and a.c. supply

- Terminal block for the CB and DSs motors d.c. supply (See Annex D - Terminals X0:1–4)
- Terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D - Terminals X0:5–6)
- Terminal block for the DSs drive circuits of shunt release d.c. supply (See Annex D - Terminals X0:7–8)
- Terminal block for the connection of the d.c. supply for the circuit associated to the control box synoptic signalization and for the signals communicated to the RTU (See Annex D - Terminals X0:9–10)
- Terminal block for the CB drive circuit of shunt release (2nd circuit) d.c. supply (See Annex D - Terminals X0:11–12)
- Terminal block for the CB and DSs anti-condensation circuit a.c. supply (See Annex D - Terminals X0:13-18). Two extra terminals shall be available within the heating circuit, to be used for the heating power supply of the boxes associated to the VTs bay (if exists), installed by e-distribución (See Annex D - Terminals X0:19-20).
- F1 MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals X0:1/2-3/4).

SPECIFIC REQUIREMENTS BRAZIL

- F1 MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals X0:1-2).

- F21/S1, F21/S2, F21/TR and F22/TR MCBs for protecting circuits of the DS/ES motors d.c. supply (See Annex D - Terminals X0:3-4).
- F2 MCB for protecting circuits of the DS/ES drive circuit of shunt release d.c. supply (See Annex D - Terminals X0:7-8).

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB connected to the terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D – Terminals X0:01A-01B).

Current circuits

- Terminal block for the CTs secondary terminals (See Annex D - Terminals X6:1-33 if CTs are supplied directly from factory with the primary transformation ratio required for each installation).

SPECIFIC REQUIREMENTS COLOMBIA

- Short circuit and connected to the ground terminal blocks when open in order to inject to the protection control box. Furthermore, include accessories to open simultaneously 3 phases and neutral with the capability to measure 1 phase.

Voltage circuits

- Terminal block for the VTs secondary terminals (See Annex D - Terminals X7:1-29)
- MCBs to protect circuits from X7 terminal block, associated with VTs bay. They shall be installed in the control box with the corresponding signal for each circuit breaker:
  - F101-MAIN PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.
  - F102-SECONDARY PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.
  - F103-MEASURE AND PROTECTION VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals. The normally open contact is used to lock the line earthing switch.
- Bus related to synchronism busbar voltage circuit and interlocked with the DS position (See Annex D - Terminals X0:21-30)
- Bus related to block selection caused by lack of busbar voltage and interlocked with the DS position (See Annex D - Terminals X0:32-36)

Regulation of measuring points (RD 1110/2007)

- When regulated measuring point is required for the transformers bay, a sealable terminal block shall be available.

1st battery CB control and protection (P1-N1)

- 1st drive circuit of shunt closing release control. The requirements described in SF6 Gas and simultaneous operations shall be applied.
- In case of two batteries, the drive circuit of shunt closing release control has to take into account the SF6 second alarm level from the two batteries.
- Anti-pumping circuit and priority to the LOCAL opening maneuver has to work properly. None of two conditions should interfere with the other.

- 1st drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.
- 1st battery CB closing (K0E) and opening (K0A) auxiliary relays. These relays shall receive closing and opening commands from the pushbuttons located in the control box and from RTU, depending on the S43 M-L-R selector switch position. The auxiliary closing relay coil K0E energization shall be able to include the synchronism permission to local and remote command, in series with the closing command. For both, closing and opening relays, a normally open contact shall be used to activate the drive circuit of shunt closing and opening release.
- There shall be a contact in local position and a contact in remote position of S43 M-L-R selector switch in order to deactivate the blocking trip relay located in the protection panel (See Annex D – Terminals X20:1-2 and X20:3-4).

SPECIFIC REQUIREMENTS COLOMBIA

- When S43 M-L-R selector switch is in “LOCAL” position has to cut the negative of the K0E and K0A auxiliary relays. When S43 M-L-R selector switch is in “REMOTE” position, the K0E and K0A auxiliary relay connect to the negative from X1 terminal block (See annex D – Terminals X1:8C)

2nd battery CB control and protection (P2-N2)

- 2nd drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.

SPECIFIC REQUIREMENTS COLOMBIA

- When S43 M-L-R selector switch is in “REMOTE” position, both positive and negative connect to the X1 terminal block (See annex D – Terminals X1:8A-8B)
- When S43 M-L-R selector switch is in “REMOTE” position, the positive of the preventive opening will be conditioned (See annex D – Terminals X1:67)

DSs control (P12-N12)

- DSs driving mechanisms operation shall not be executed directly on their motors. These motors shall implement control based on auxiliary relays, which shall receive the opening and closing commands.
- DSs automatism shall guarantee that simultaneous operation of several DS/ESs may not be performed.
- No DSs shall be operated when the CB is in closed position.
- Extra terminals to connect the external interlockings shall be available.
- The auxiliary contacts of each DS operation diagram shall be represented, including precise identification of the DS position during its whole itinerary.

Busbar differential relay

- Open and closed busbar DSs positions shall be reported (See Annex D - Select terminals from X2 and X3 terminal blocks)

Interlocking between hybrid modules

- A closed bus coupler shall be created through the X19 terminal block. This closed bus coupler circuit will receive the closed bus coupler state. The closed bus coupler circuit will enable the hybrid module DSs operation (See Annex D - Terminals X19:1-6)
- The state of the hybrid module DSs shall be reported to the bus coupler. The bus coupler circuit breaker opening operation shall be locked if any DS of the switchyard is in the intermediate position (See Annex D - Terminals X19:7-16)

Signals to the main protection relay (P15-N15)

- Open and closed CB position shall be reported to the main protection relay (See Annex D - Select terminals from X1:21–24 terminal block)

Signals to RTU (P15-N15)

- Open and closed CB position shall be reported (See Annex D – Select terminals from X1 terminal block)
- Open and closed DSs positions shall be reported (See Annex D – Select terminals from X2 and X3 terminal blocks)
- Every motorized switchgear MCB open signal shall be reported by means of a normally closed, voltage-free contact connected to terminals (See Annex D – Terminals X1:51-52; X2:51-52; X3:51-52; X4:51-52 and X5:51-52)
- Anti-condensation circuit F3 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21:8)
- F101 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:9) and a normally open (See Annex D – Terminal X21:9A) voltage-free contacts connected to terminals
- F102 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:10) and a normally open (See Annex D – Terminal X21:10A) voltage-free contacts connected to terminals
- F103 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:11) and a normally open (See Annex D – Terminal X21:11A) voltage-free contacts connected to terminals
- Manual position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21-4)
- Local position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21-5)
- “REMOTO” position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21:5A)
- The anti-pumping relay activation shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:53-54)
- SF6 CB alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:55-56)
- SF6 CB block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:61-62)
- Discharged springs signal shall be reported by means of a voltage-free contact connected to terminals. If this signal comes from an auxiliary relay, the auxiliary relay MUST be a temporized one (See Annex D – Terminals X1:49-50 for discharged springs and X1:49-50A for charged springs)
- Operating time exceeded signal shall be reported by means of voltage-free contact connected to terminals (See Annex D – Terminals X2:53-54; X3:53-54; X4:53-54 and X5:53-54)

- SF6 busbar or module alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21-6)
- SF6 busbar or module block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21-7)
- DS/ES motor power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X2:55; X3:55; X4:55; X5:55;)

SPECIFIC REQUIREMENTS BRAZIL

- Positive Remote signal supply terminals for the main protection (See Annex D – Terminal X0:31)
- Positive Remote signal supply terminals for the secondary protection (See Annex D – Terminal X0:32)
- Positive power supply for digital inputs to the RTU from the protection control box has to be independent of the power to local signals (See Annex D – Terminal X0:33).

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB Switch control power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X1:68)

7.6.5.1.d) *Hybrid module Single-bay type – used in Line bay*

d.c. and a.c. supply

- Terminal block for the CB and DS/ESs motors d.c. supply (See Annex D - Terminals X0:1-4)
- Terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D - Terminals X0:5-6)
- Terminal block for the DS/ESs drive circuits of shunt release d.c. supply (See Annex D - Terminals X0:7-8)
- Terminal block for the connection of the d.c. supply for the circuit associated to the control box synoptic signalization and for the signals communicated to the RTU (See Annex D - Terminals X0:9-10)
- Terminal block for the CB drive circuit of shunt release (2nd circuit) d.c. supply (See Annex D - Terminals X0:11-12)
- Terminal block for the CB and DS/ESs anti-condensation circuit a.c. supply (See Annex D - Terminals X0:13-18). Two extra terminals shall be available within the heating circuit, to be used for the heating power supply of the boxes associated to the VTs bay (if exists), installed by e-distribución (See Annex D - Terminals X0:19-20).
- F1 MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals X0:1/2-3/4).

SPECIFIC REQUIREMENTS BRAZIL

- F1 MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals X0:1-2).
- F21, F22 and F23 MCBs for protecting circuits of the DS/ES motors d.c. supply (See Annex D - Terminals X0:3-4).
- F2 MCB for protecting circuits of the DS/ES drive circuit of shunt release d.c. supply (See Annex D - Terminals X0:7-8).

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB connected to the terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D – Terminals X0:01A-01B)

Current circuits

- Terminal block for the CTs secondary terminals (See Annex D - Terminals X6:1-33 if CTs are supplied directly from factory with the primary transformation ratio required for each installation).

SPECIFIC REQUIREMENTS COLOMBIA

- Short circuit and connected to the ground terminal blocks when open in order to inject to the protection control box. Furthermore, include accessories to open simultaneously 3 phases and neutral with the capability to measure 1 phase.

Voltage circuits

- Terminal block for the VTs secondary terminals (See Annex D - Terminals X7:1-29)
- MCBs to protect circuits from X7 terminal block, associated with VTs bay. They shall be installed in the control box with the corresponding signal for each circuit breaker:
  - F101-MAIN PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.
  - F102-SECONDARY PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.
  - F103-MEASURE AND SYNCHRONISM VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals. The normally open contact is used to lock the line earthing switch.
- Bus related to synchronism busbar voltage circuit (See Annex D - Terminals X0:21-26)
- Bus related to block selection caused by lack of busbar voltage (See Annex D - Terminals X0:27-29)
- The auxiliary relays associated with the voltage presence shall be energized from the measure and synchronism voltage winding, to allow the line earthing switch operation. The interlock is a series circuit of:
  - Normally close contacts of the voltage presence auxiliary relays and
  - A normally open F103 MCB contact.

1st battery CB control and protection (P1-N1)

- 1st drive circuit of shunt closing release control. The requirements described in SF6 Gas and simultaneous operations shall be applied.
- In case of two batteries, the drive circuit of shunt closing release control has to take into account the SF6 second alarm level from the two batteries.
- Anti-pumping circuit and priority to the LOCAL opening maneuver has to work properly. None of two conditions should interfere with the other.
- 1st drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.
- 1st battery CB closing (K0E) and opening (K0A) auxiliary relays. These relays shall receive closing and opening commands from the pushbuttons located in the control box and from RTU, depending

on the S43 M-R-L selector switch position. The auxiliary closing relay coil K0E energization shall be able to include the synchronism permission to local and remote command, in series with the closing command. For both, closing and opening relays, a normally open contact will be used to activate the drive circuit of shunt closing and opening release.

- A normally open voltage-free contact connected to terminals of K0E (auxiliary closing relay) shall be used to inform the main protection relay when a circuit breaker closing command occurs (See annex D – Terminals X20: 3-4).
- It shall be necessary to have a normally open voltage-free contact, connected to terminals of the opening auxiliary relay K0A in case of bays with distributed generation connected (See annex D – Terminals X20: 7-8).
- It is necessary to have a contact in S43 M-L-R selector switch (when it is in “LOCAL” position) to set the reclosing automatism out of service (See annex D – Terminals X20: 1-2)
- The main protection relay shall be informed when MCB F101 is open. A normally closed voltage-free contact connected to terminals shall be used for this purpose (See annex D – Terminals X20: 9-10)
- Open and closed CB position shall be reported to the main protection relay (See annex D – Select terminals from X1 terminal block)
- Discharged springs shall be reported to the main protection relay by means of a voltage-free contact connected to terminals. These contacts shall be limit switch end position of circuit breaker discharged springs. If there are not enough available contacts, an auxiliary timing relay shall be used for this purpose (See annex D – Terminals X1: 45-46)
- SF6 circuit breaker block shall be reported to the main protection relay by means of a voltage-free contact connected to terminals (See annex D – Terminals X1: 57-58)

SPECIFIC REQUIREMENTS COLOMBIA

- When S43 M-L-R selector switch is in “LOCAL” position has to cut the negative of the K0E and K0A auxiliary relays. When S43 M-L-R selector switch is in “REMOTE” position, the K0E and K0A auxiliary relay connect to the negative from X1 terminal block (See annex D – Terminals X1:8C)

2nd battery CB control and protection (P2-N2)

- 2nd drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.
- A normally open voltage-free contact connected to terminals of K0E (auxiliary closing relay) shall be used to inform the secondary protection relay when a circuit breaker closing command occurs (See annex D – Terminals X20: 5-6).
- Open and closed CB position shall be reported to the secondary protection relay (See Annex D – Select terminals from X1 terminal block).
- The secondary protection relay shall be informed when F102 MCB is open. A normally closed voltage-free contact connected to terminals shall be used (See Annex D – Terminal block X20:11-12).
- The secondary protection relay shall be informed about discharged springs by a voltage-free contact connected to terminals. These contacts shall be limit switch end position of springs discharged of circuit breaker. In case that there are not enough available contacts, an auxiliary timing relay shall be used for this purpose (See Annex D – Terminal block X1: 47-48).
- SF6 circuit breaker block shall be reported to the secondary protection relay by means of a voltage-free contact connected to terminals (See Annex D – Terminal block X1:59-60).

SPECIFIC REQUIREMENTS COLOMBIA

- When S43 M-L-R selector switch is in “REMOTE” position, both positive and negative connect to the X1 terminal block (See annex D – Terminals X1:8A-8B)
- When S43 M-L-R selector switch is in “REMOTE” position, the positive of the preventive opening will be conditioned (See annex D – Terminals X1:67)

DS/ESs control (P12-N12)

- DS/ESs driving mechanisms operation shall not be executed directly on their motors. These motors shall implement control based on auxiliary relays, which shall receive the opening and closing commands.
- DS/ESs automatism shall guarantee that simultaneous operation of several DS/ESs may not be performed.
- No DS/ESs shall be operated when the CB is in closed position.
- Extra terminals to connect the external interlockings shall be available.
- In case of line earthing switch, the interlocking which prevents the operation with voltage presence in line shall be included (reserve 2 terminal blocks in the chain condition to include the interlocking). The interlock is a series circuit of:
  - Normally closed contacts of the voltage presence auxiliary relays and
  - A normally open F103 MCB contact.
- The auxiliary contacts of each DS operation diagram shall be represented, including precise identification of the DS position during its whole itinerary.

Busbar differential relay

- Open and closed busbar DSs positions shall be reported (See Annex D - Select terminals from X2 terminal blocks)

Signals to RTU (P15-N15)

- Open and closed CB position shall be reported.(See Annex D – Select terminals from X1 terminal block)
- Open and closed DS/ESs positions shall be reported (See Annex D – Select terminals from X2, X4 and X5 terminal blocks)
- Every motorized switchgear MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminals X1:51-52; X2:51-52; X4:51-52 and X5:51-52)
- Anti-condensation circuit F3 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21-8)
- F101 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:9) and a normally open (See Annex D – Terminal X21: 9A) voltage-free contacts connected to terminals
- F102 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:10) and a normally open (See Annex D – Terminal X21:10A) voltage-free contacts connected to terminals
- F103 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:11) and a normally open (See Annex D – Terminal X21:11A) voltage-free contacts connected to terminals
- “MANUAL” position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21:4)

- "LOCAL" position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21:5)
- "REMOTO" position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21:5A)
- The anti-pumping relay activation shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:53-54)
- SF6 CB alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:55-56)
- SF6 CB block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:61-62)
- Discharged/Charged springs signal shall be reported by means of a voltage-free contact connected to terminals. If this signal comes from an auxiliary relay, the auxiliary relay MUST be a temporized one (See Annex D – Terminals X1:49-50 for discharged springs and X1:49-50A for charged springs)
- Operating time exceeded signal shall be reported by means of voltage-free contact connected to terminals (See Annex D – Terminals X2:53-54; X4:53-54 and X5:53-54)
- SF6 busbar or module Alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21-6)
- SF6 busbar or module block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21-7).
- DS/ES motor power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X2:55; X4:55; X5:55;)

SPECIFIC REQUIREMENTS BRAZIL

- Positive Remote signal supply terminals for the main protection (See Annex D – Terminal X0:31)
- Positive Remote signal supply terminals for the secondary protection (See Annex D – Terminal X0:32)
- Positive power supply for digital inputs to the RTU from the protection control box has to be independent of the power to local signals (See Annex D – Terminal X0:33).

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB Switch control power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X1:68)

7.6.5.1.e) *Hybrid module Single-bay type – used in Transformer bay*

d.c. and a.c. supply

- Terminal block for the CB and DSs motors d.c. supply (See Annex D - Terminals X0:1-4)
- Terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D - Terminals X0:5-6)
- Terminal block for the DSs drive circuits of shunt release d.c. supply (See Annex D - Terminals X0:7-8)
- Terminal block for the connection of the d.c. supply for the circuit associated to the control box synoptic signalization and for the signals communicated to the RTU (See Annex D - Terminals X0:9-10)
- Terminal block for the CB drive circuit of shunt release (2nd circuit) d.c. supply (See Annex D - Terminals X0:11-12)

- Terminal block for the CB and DSs anti-condensation circuit a.c. supply (See Annex D - Terminals X0:13-18). Two extra terminals shall be available within the heating circuit, to be used for the heating power supply of the boxes associated to the VTs bay (if exists), installed by e-distribución (See Annex D - Terminals X0:19-20).

SPECIFIC REQUIREMENTS BRAZIL

- F1 MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals X0:1-2).
- F21/S1, F21/TR and F22/TR MCBs for protecting circuits of the DS/ES motors d.c. supply (See Annex D - Terminals X0:3-4).
- F2 MCB for protecting circuits of the DS/ES drive circuit of shunt release d.c. supply (See Annex D - Terminals X0:7-8).

Current circuits

- Terminal block for the CTs secondary terminals (See Annex D - Terminals X6:1-33 if CTs are supplied directly from factory with the primary transformation ratio required for each installation).

SPECIFIC REQUIREMENTS COLOMBIA

- Short circuit and connected to the ground terminal blocks when open in order to inject to the protection control box. Furthermore, include accessories to open simultaneously 3 phases and neutral with the capability to measure 1 phase.

Voltage circuits

- Terminal block for the VTs secondary terminals (See Annex D - Terminals X7:1-29)
- MCBs for protecting circuits from X7 terminal block, associated with VTs bay. They shall be installed in the control box with the corresponding signal for each circuit breaker:
  - F101-MAIN PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.
  - F102-SECONDARY PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.
  - F103-MEASURE AND PROTECTION VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals. The normally open contact is used to lock the line earthing switch.
- Bus related to synchronism busbar voltage circuit and interlocked with the DS position (See Annex D - Terminals X0:21-30)
- Bus related to block selection caused by lack of busbar voltage and interlocked with the DS position (See Annex D - Terminals X0:32-35)

Regulation of measuring points (RD 1110/2007)

- When regulated measuring point is required for the transformers bay, a sealable terminal block shall be available.

1st battery CB control and protection (P1-N1)

- 1st drive circuit of shunt closing release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. In addition to this, there shall be two spare terminals in the closing circuit for including external interlockings.

- In case of two batteries, the drive circuit of shunt closing release control has to take into account the SF6 second alarm level from the two batteries.
- Anti-pumping circuit and priority to the LOCAL opening maneuver has to work properly. None of two conditions should interfere with the other.
- 1st drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.
- 1st battery CB closing (K0E) and opening (K0A) auxiliary relays. These relays shall receive closing and opening commands from the pushbuttons located in the Control Box and from RTU, depending on the S43 M-L-R selector switch position. The auxiliary closing relay coil K0E energization shall be able to include the synchronism permission to local and remote command, in series with the closing command. For both, closing and opening relays, a normally open contact will be used to activate the drive circuit of shunt closing and opening release.
- There shall be a contact in local position and a contact in remote position of S43 M-L-R selector switch in order to deactivate the blocking trip relay located in the protection panel (See Annex D – Terminals X20: 1-2 and X20: 3-4).

SPECIFIC REQUIREMENTS COLOMBIA

- When S43 M-L-R selector switch is in “LOCAL” position has to cut the negative of the K0E and K0A auxiliary relays. When S43 M-L-R selector switch is in “REMOTE” position, the K0E and K0A auxiliary relay connect to the negative from X1 terminal block (See annex D – Terminals X1:8C)

2nd battery CB control and protection (P2-N2)

- 2nd drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB connected to the terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D – Terminals X0:39-40, X0:5–6 and X0:11-12).
- When S43 M-L-R selector switch is in “REMOTE” position, both positive and negative connect to the X1 terminal block (See annex D – Terminals X1:8A-8B)
- When S43 M-L-R selector switch is in “REMOTE” position, the positive of the preventive opening will be conditioned (See annex D – Terminals X1:67)

DS control (P12-N12)

- DSs driving mechanisms operation shall not be executed directly on their motors. These motors shall implement control based on auxiliary relays, which shall receive the opening and closing commands.
- DSs automatism shall guarantee that simultaneous operation of several DS/ESs may not be performed.
- No DSs shall be operated when the CB is in closed position.
- Extra terminals to connect the external interlockings shall be available.
- The auxiliary contacts of each DS operation diagram shall be represented, including precise identification of the DS position during its whole itinerary.

Busbar differential relay

- Open and closed busbar DSs positions shall be reported (See Annex D - Select terminals from X2 terminal blocks)

Signals to the main protection relay (P15-N15)

- Open and closed CB position shall be reported to the main protection relay (See Annex D - Select terminals from X1 terminal block)

Signals to RTU (P15-N15)

- Open and closed CB position shall be reported.(See Annex D – Select terminals from X1 terminal block)
- Open and closed DSs positions shall be reported (See Annex D – Select terminals from X2 terminal block)
- Every motorized switchgear MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminals X1:51-52 and X2:51-52)
- Anti-condensation circuit F3 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21-8)
- F101 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:9) and a normally open (See Annex D – Terminal X21: 9A) voltage-free contacts connected to terminals
- F102 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:10) and a normally open (See Annex D – Terminal X21:10A) voltage-free contacts connected to terminals
- F103 MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21:11) and a normally open (See Annex D – Terminal X21:11A) voltage-free contacts connected to terminals
- "MANUAL" position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21:4)
- "LOCAL" position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21:5)
- "REMOTO" position signal of S43 M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21:5A)
- The anti-pumping relay activation shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:53-54)
- SF6 CB alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:55-56)
- SF6 CB block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1:61-62)
- Discharged/Charged springs signal shall be reported by means of a voltage-free contact connected to terminals. If this signal comes from an auxiliary relay, the auxiliary relay MUST be a temporized one (See Annex D – Terminals X1:49-50 for discharged springs and X1:49-50A for charged springs)
- Operating time exceeded signal shall be reported by means of voltage-free contact connected to terminals (See Annex D – Terminals X2:53-54)
- SF6 busbar or module alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21-6)
- SF6 busbar or module block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21-7)
- DS/ES motor power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X2:55; X4:55; X5:55;)

SPECIFIC REQUIREMENTS BRAZIL

- Positive Remote signal supply terminals for the main protection (See Annex D – Terminal X0:31)
- Positive Remote signal supply terminals for the secondary protection (See Annex D – Terminal X0:32)
- Positive power supply for digital inputs to the RTU from the protection control box has to be independent of the power to local signals (See Annex D – Terminal X0:33).

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB Switch control power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X1:68)

7.6.5.1.f) *Hybrid module Y2 type*

d.c. and a.c. supply

- Terminal block for the CB and DS/ESs motors d.c. supply (See Annex D - Terminals X0:1-6)
- F3 MCB for the protection of the CB and DS/ES Anti-condensation circuits.
- Terminal block for the CB and DSs anti-condensation circuit a.c. supply (See Annex D - Terminals X0:7-10). Two extra terminals shall be available within the heating circuit, to be used for the heating power supply of the boxes associated to the VTs bay (if exists), installed by e-distribución (See Annex D - Terminals X0:11-12).

SPECIFIC REQUIREMENTS BRAZIL

- F21L, F22L independent MCBs for protecting circuits of the DS/ES motors d.c. supply (See Annex D - Terminals X0:3-4)
- F21T, F22T independent MCBs for protecting circuits of the DS/ES motors d.c. supply (See Annex D - Terminals X0:5-6)
- F21S, F22S independent MCBs for protecting circuits of the DS/ES motors d.c. supply (See Annex D - Terminals X0S:6A-6B)

Signals to RTU (P15-N15)

- Anti-condensation circuit F3 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21-4)

7.6.5.1.g) *Hybrid module Y2 type – Line bay*

d.c. power supply SF6

- The pressures switches (P1+P4) alarm / gas block SF6, will have independent external power circuits for the entire hybrid module Y2 (See Annex D - Terminals X0:13-16)

d.c. and a.c. supply

- Terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D - Terminals X0L:1-2)
- Terminal block for the DS/ESs drive circuits of shunt release d.c. supply (See Annex D - Terminals X0L:3-4)

- Terminal block for the connection of the d.c. supply for the circuit associated to the control box synoptic signalization and for the signals communicated to the RTU (See Annex D - Terminals X0L:5-6)
- Terminal block for the CB drive circuit of shunt release (2nd circuit) d.c. supply (See Annex D - Terminals X0L:7-8)
- F1/L MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals).
- F21L, F22L MCB for protecting circuits of the DS/ES drive circuit of shunt release d.c. supply (See Annex D - Terminals).

SPECIFIC REQUIREMENTS BRAZIL

- F1 MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals X0:1-2).
- F21/L and F22/L MCBs for circuits of the DS/ES motor d.c. supply (See Annex D - Terminals X0:3-4).
- F2L MCB for protecting circuits of the DS/ES drive circuit of shunt release d.c. supply (See Annex D - Terminals X0L:3-4).

SPECIFIC REQUIREMENTS COLOMBIA

- F11L MCB connected to the terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D – Terminals X0L:01A-01B)

Current circuits

- Terminal block for the CTs secondary terminals (See Annex D - Terminals X6L:1-24 if CTs are supplied directly from factory with the primary transformation ratio required for each installation).

SPECIFIC REQUIREMENTS COLOMBIA

- Short circuit and connected to the ground terminal blocks when open in order to inject to the protection control box. Furthermore, include accessories to open simultaneously 3 phases and neutral with the capability to measure 1 phase.

Voltage circuits

- Terminal block for the VTs secondary terminals (See Annex D - Terminals X7L:1-29)
- MCBs to protect circuits from X7 terminal block, associated with VTs bay. They shall be installed in the control box with the corresponding signal for each circuit breaker:
  - F101/L-MAIN PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.
  - F102/L-SECONDARY PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.
  - F103/L-MEASURE AND SYNCHRONISM VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals. The normally open contact is used to lock the line earthing switch.
- Bus related to synchronism busbar voltage circuit (See Annex D - Terminals X0L:9-14)
- Bus related to block selection caused by lack of busbar voltage (See Annex D - Terminals X0L:15-17)

- The auxiliary relays associated with the voltage presence shall be energized from the measure and synchronism voltage winding, to allow the line earthing switch operation. The interlock is a series circuit of:
  - Normally close contacts of the voltage presence auxiliary relays and
  - A normally open F103/L MCB contact.

1st battery CB control and protection (P1-N1)

- 1st drive circuit of shunt closing release control. The requirements described in SF6 Gas and simultaneous operations shall be applied.
- In case of two batteries, the drive circuit of shunt closing release control has to take into account the SF6 second alarm level from the two batteries.
- Anti-pumping circuit and priority to the LOCAL opening maneuver has to work properly. None of two conditions should interfere with the other.
- 1st drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.
- 1st battery CB closing (K0EL) and opening (K0AL) auxiliary relays. These relays shall receive closing and opening commands from the pushbuttons located in the control box and from RTU, depending on the S43/L M-R-L selector switch position. The auxiliary closing relay coil K0EL energization shall be able to include the synchronism permission to local and remote command, in series with the closing command. For both, closing and opening relays, a normally open contact will be used to activate the drive circuit of shunt closing and opening release.
- A normally open voltage-free contact connected to terminals of K0EL (auxiliary closing relay) shall be used to inform the main protection relay when a circuit breaker closing command occurs (See annex D – Terminals X20L: 3-4).
- It shall be necessary to have a normally open voltage-free contact, connected to terminals of the opening auxiliary relay K0AL in case of bays with distributed generation connected (See annex D – Terminals X20L: 7-8).
- It is necessary to have a contact in S43/L M-L-R selector switch (when it is in “LOCAL” position) to set the reclosing automatism out of service (See annex D – Terminals X20L:1-2)
- The main protection relay shall be informed when MCB F101/L is open. A normally closed voltage-free contact connected to terminals shall be used for this purpose (See annex D – Terminals X20L: 9-10)
- Open and closed CB position shall be reported to the main protection relay (See annex D – Select terminals X1L:21-24)
- Discharged springs shall be reported to the main protection relay by means of a voltage-free contact connected to terminals. These contacts shall be limit switch end position of circuit breaker discharged springs. If there are not enough available contacts, an auxiliary timing relay shall be used for this purpose (See annex D – Terminals X1L:45-46)
- SF6 circuit breaker block shall be reported to the main protection relay by means of a voltage-free contact connected to terminals (See annex D – Terminals X1L:57-58)

SPECIFIC REQUIREMENTS COLOMBIA

- When S43L M-L-R selector switch is in “LOCAL” position has to cut the negative of the K0E and K0A auxiliary relays. When S43 M-L-R selector switch is in “REMOTE” position, the K0E and K0A auxiliary relay connect to the negative from X1 terminal block (See annex D – Terminals X1L:3A-3B)

2nd battery CB control and protection (P2-N2)

- 2nd drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.
- A normally open voltage-free contact connected to terminals of K0EL (auxiliary closing relay) shall be used to inform the secondary protection relay when a circuit breaker closing command occurs (See annex D – Terminals X20L:5-6).
- Open and closed CB position shall be reported to the secondary protection relay (See Annex D – Select terminals X1L:25-28).
- The secondary protection relay shall be informed when F102/L MCB is open. A normally closed voltage-free contact connected to terminals shall be used (See Annex D – Terminal block X20L:11-12).
- The secondary protection relay shall be informed about discharged springs by a voltage-free contact connected to terminals. These contacts shall be limit switch end position of springs discharged of circuit breaker. In case that there are not enough available contacts, an auxiliary timing relay shall be used for this purpose (See Annex D – Terminal block X1L:47-48).
- SF6 circuit breaker block shall be reported to the secondary protection relay by means of a voltage-free contact connected to terminals (See Annex D – Terminal block X1L:59-60).

SPECIFIC REQUIREMENTS COLOMBIA

- When S43/L M-L-R selector switch is in “REMOTE” position, both positive and negative connect to the X1 terminal block (See annex D – Terminals X1L:8A-8B)
- When S43/L M-L-R selector switch is in “REMOTE” position, the positive of the preventive opening will be conditioned (See annex D – Terminals X1L:67)

DS/ESs control (P12-N12)

- DS/ESs driving mechanisms operation shall not be executed directly on their motors. These motors shall implement control based on auxiliary relays, which shall receive the opening and closing commands.
- DS/ESs automatism shall guarantee that simultaneous operation of several DS/ESs may not be performed.
- No DS/ESs shall be operated when the CB is in closed position.
- Extra terminals to connect the external interlockings shall be available.
- In case of line earthing switch, the interlocking which prevents the operation with voltage presence in line shall be included (reserve 2 terminal blocks in the chain condition to include the interlocking). The interlock is a series circuit of:
  - Normally closed contacts of the voltage presence auxiliary relays and
  - A normally open F103/L MCB contact.
- The auxiliary contacts of each DS operation diagram shall be represented, including precise identification of the DS position during its whole itinerary.

Signals to RTU (P15-N15)

- Open and closed CB position shall be reported.(See Annex D – Select terminals X1L:29-32)
- Open and closed DS/ESs positions shall be reported (See Annex D – Select terminals X4L:21-24 and X5L:21-24)
- Every motorized switchgear MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminals X1L:51-52; X4L:51-52 and X5L:51-52)

- F101/L MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21L:9) and a normally open (See Annex D – Terminal X21L:9A) voltage-free contacts connected to terminals
- F102/L MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21L:10) and a normally open (See Annex D – Terminal X21L:10A) voltage-free contacts connected to terminals
- F103/L MCB open signal shall be reported by means of a normally closed (See Annex D – Terminal X21L:11) and a normally open (See Annex D – Terminal X21L:11A) voltage-free contacts connected to terminals
- "MANUAL" position signal of S43/L M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21L:4)
- "LOCAL" position signal of S43/L M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21L:5)
- "REMOTO" position signal of S43/L M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21L:5A)
- The anti-pumping relay activation shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1L:53-54)
- SF6 CB alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1L:55-56)
- SF6 CB block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1L:61-62)
- Discharged/Charged springs signal shall be reported by means of a voltage-free contact connected to terminals. If this signal comes from an auxiliary relay, the auxiliary relay MUST be a temporized one (See Annex D – Terminals X1L:49-50 for discharged springs and X1L:49-50A for charged springs)
- Operating time exceeded signal shall be reported by means of voltage-free contact connected to terminals (See Annex D – Terminals X4L:53-54 and X5L:53-54)
- SF6 busbar or module Alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21L-6)
- SF6 busbar or module block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21L-7).
- DS/ES motor power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X4L:55; X5L:55;)
- F21L, F22L, MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X2, X3, X4 and X5:52)

SPECIFIC REQUIREMENTS BRAZIL

- Positive Remote signal supply terminals for the main protection (See Annex D – Terminal X0L:18)
- Positive Remote signal supply terminals for the secondary protection (See Annex D – Terminal X0L:19)
- Positive power supply for digital inputs to the RTU from the protection control box has to be independent of the power to local signals (See Annex D – Terminal X0L:20).

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB Switch control power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X1:68)

7.6.5.1.h) *Hybrid module Y2 type – Transformer bay*

d.c. and a.c. supply

- Terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D - Terminals X0T:1-2)
- Terminal block for the DSs drive circuits of shunt release d.c. supply (See Annex D - Terminals X0T:3-4)
- Terminal block for the connection of the d.c. supply for the circuit associated to the control box synoptic signalization and for the signals communicated to the RTU (See Annex D - Terminals X0T:5-6)
- Terminal block for the CB drive circuit of shunt release (2nd circuit) d.c. supply (See Annex D - Terminals X0T:7-8)
- F1/T MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals).
- F2/T MCB for protecting circuits of the DS/ES drive circuit of shunt release d.c. supply (See Annex D - Terminals).

SPECIFIC REQUIREMENTS BRAZIL

- F1 MCB for protecting circuits of the CB motor d.c. supply (See Annex D - Terminals X0:1-2).
- Independent MCBs (F21/T and F22/T) for circuits of the DS/ES motor d.c. supply (See Annex D - Terminals X0:5-6).
- F2T MCB for protecting circuits of the DS/ES drive circuit of shunt release d.c. supply (See Annex D - Terminals X0T:3-4).

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB connected to the terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D – Terminals X0T:01A-01B)

Current circuits

- Terminal block for the CTs secondary terminals (See Annex D - Terminals X6T:1-33 if CTs are supplied directly from factory with the primary transformation ratio required for each installation).

SPECIFIC REQUIREMENTS COLOMBIA

- Short circuit and connected to the ground terminal blocks when open in order to inject to the protection control box. Furthermore, include accessories to open simultaneously 3 phases and neutral with the capability to measure 1 phase.

Voltage circuits

- Terminal block for the VTs secondary terminals (See Annex D - Terminals X7T:1-29)
- MCBs for protecting circuits from X7 terminal block, associated with VTs bay. They shall be installed in the control box with the corresponding signal for each circuit breaker:
  - F101/T-MAIN PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.
  - F102/T-SECONDARY PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals.

- F103/T-MEASURE AND PROTECTION VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed + 2 normally open voltage-free contacts connected to terminals. The normally open contact is used to lock the line earthing switch.

- Bus related to synchronism busbar voltage circuit and interlocked with the DS position (See Annex D - Terminals X0T:9-14)
- Bus related to block selection caused by lack of busbar voltage and interlocked with the DS position (See Annex D - Terminals X0T:15-17)

Regulation of measuring points (RD 1110/2007)

- When regulated measuring point is required for the transformers bay, a sealable terminal block shall be available.

1st battery CB control and protection (P1-N1)

- 1st drive circuit of shunt closing release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. In addition to this, there shall be two spare terminals in the closing circuit for including external interlockings.
- In case of two batteries, the drive circuit of shunt closing release control has to take into account the SF6 second alarm level from the two batteries.
- Anti-pumping circuit and priority to the LOCAL opening maneuver has to work properly. None of two conditions should interfere with the other.
- 1st drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.
- 1st battery CB closing (K0ET) and opening (K0AT) auxiliary relays. These relays shall receive closing and opening commands from the pushbuttons located in the Control Box and from RTU, depending on the S43/T M-L-R selector switch position. The auxiliary closing relay coil K0ET energization shall be able to include the synchronism permission to local and remote command, in series with the closing command. For both, closing and opening relays, a normally open contact will be used to activate the drive circuit of shunt closing and opening release.
- There shall be a contact in local position and a contact in remote position of S43/T M-L-R selector switch in order to deactivate the blocking trip relay located in the protection panel (See Annex D – Terminals X20T:1-2 and X20T:3-4).

SPECIFIC REQUIREMENTS COLOMBIA

- When S43/T M-L-R selector switch is in “LOCAL” position has to cut the negative of the K0E and K0A auxiliary relays. When S43 M-L-R selector switch is in “REMOTE” position, the K0E and K0A auxiliary relay connect to the negative from X1 terminal block (See annex D – Terminals X1T:3A)

2nd battery CB control and protection (P2-N2)

- 2nd drive circuit of shunt opening release control. The requirements described in SF6 Gas and simultaneous operations shall be applied. The drive circuit of shunt opening release shall be prepared to supervise the shunt opening release.

SPECIFIC REQUIREMENTS COLOMBIA

- F4T MCB connected to the terminal block for the CB drive circuit of shunt release (1st circuit) d.c. supply (See Annex D – Terminals X0T:20-21, X0T:1/7 and X0T:2/8).

- When S43/T M-L-R selector switch is in “REMOTE” position, both positive and negative connect to the X1 terminal block (See annex D – Terminals X1L:8A-8B)
- When S43/T M-L-R selector switch is in “REMOTE” position, the positive of the preventive opening will be conditioned (See annex D – Terminals X1L:67)

DS control (P12-N12)

- DSs driving mechanisms operation shall not be executed directly on their motors. These motors shall implement control based on auxiliary relays, which shall receive the opening and closing commands.
- DSs automatism shall guarantee that simultaneous operation of several DS/ESs may not be performed.
- No DSs shall be operated when the CB is in closed position.
- Extra terminals to connect the external interlockings shall be available.
- The auxiliary contacts of each DS operation diagram shall be represented, including precise identification of the DS position during its whole itinerary.

Signals to the main protection relay (P15-N15)

- Open and closed CB position shall be reported to the main protection relay (See Annex D - Select terminals X1T:21-24)

Signals to RTU (P15-N15)

- Open and closed CB position shall be reported.(See Annex D – Select terminals X1T:25-28)
- Open and closed DSs positions shall be reported (See Annex D – Select terminals X4T:21-24 and X5T:21-24)
- Every motorized switchgear MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminals X1T:51-52, X4T:51-52 and X5T:51-52)
- F101/T MCB open signal shall be reported by means of a normally closed and a normally open (See Annex D – X21T Terminals) voltage-free contacts connected to terminals
- F102 MCB open signal shall be reported by means of a normally closed and a normally open (See Annex D – X21T Terminals) voltage-free contacts connected to terminals
- F103 MCB open signal shall be reported by means of a normally closed and a normally open (See Annex D – X21T Terminals) voltage-free contacts connected to terminals
- “MANUAL” position signal of S43/T M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21T:4)
- “LOCAL” position signal of S43/T M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21T:5)
- “REMOTO” position signal of S43/T M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21T:5A)
- The anti-pumping relay activation shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1T:53-54)
- SF6 CB alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1T:55-56)
- SF6 CB block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminals X1T:61-62)
- Discharged/Charged springs signal shall be reported by means of a voltage-free contact connected to terminals. If this signal comes from an auxiliary relay, the auxiliary relay MUST be a temporized

one (See Annex D – Terminals X1T:49-50 for discharged springs and X1T:49-50A for charged springs)

- Operating time exceeded signal shall be reported by means of voltage-free contact connected to terminals (See Annex D – Terminals X4T:53-54 and X5T:53-54)
- SF6 busbar or module alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21T:6)
- SF6 busbar or module block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21T:7)
- DS/ES motor power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X4T:55 and X5T:55;)

SPECIFIC REQUIREMENTS BRAZIL

- Positive Remote signal supply terminals for the main protection (See Annex D – Terminal X0T:18)
- Positive Remote signal supply terminals for the secondary protection (See Annex D – Terminal X0T:19)
- Positive power supply for digital inputs to the RTU from the protection control box has to be independent of the power to local signals (See Annex D – Terminal X0T:20).

SPECIFIC REQUIREMENTS COLOMBIA

- F11 MCB Switch control power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X1:68)

7.6.5.1.i) *Hybrid module Y2 type – BusBar bay*

d.c. and a.c. supply

- Terminal block for the DSs drive circuits of shunt release d.c. supply (See Annex D - Terminals X0S:3-4)
- Terminal block for the connection of the d.c. supply for the circuit associated to the control box synoptic signalization and for the signals communicated to the RTU (See Annex D - Terminals X0S:5-6)
- F2/S MCB for protecting circuits of the DS/ES drive circuit of shunt release d.c. supply (See Annex D - Terminals).

SPECIFIC REQUIREMENTS BRAZIL

- F21/S and F22/S MCBs for circuits of the DS/ES motor d.c. supply (See Annex D - Terminals X0:6A-6B).
- F2S MCB for protecting circuits of the DS/ES drive circuit of shunt release d.c. supply (See Annex D - Terminals X0S:3-4).

DS control (P12-N12)

- DSs driving mechanisms operation shall not be executed directly on their motors. These motors shall implement control based on auxiliary relays, which shall receive the opening and closing commands.
- DSs automatism shall guarantee that simultaneous operation of several DS/ESs may not be performed.
- No DSs shall be operated when the CB is in closed position.

- Extra terminals to connect the external interlockings shall be available.
- The auxiliary contacts of each DS operation diagram shall be represented, including precise identification of the DS position during its whole itinerary.

Signals to RTU (P15-N15)

- Open and closed DSs positions shall be reported (See Annex D – Select terminals X2S:21-24 and X3S:21-24)
- Every motorized switchgear MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminals X2S:51-52 and X3S:51-52)
- "MANUAL" position signal of S43/S M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21S:4)
- "LOCAL" position signal of S43/S M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21S:5)
- "REMOTO" position signal of S43/S M-L-R selector switch shall be reported by means of a closed contact when the selector is in that position (See Annex D – Terminal X21S:5A)
- Operating time exceeded signal shall be reported by means of voltage-free contact connected to terminals (See Annex D – Terminals X2S:53-54 and X3S:53-54)
- SF6 busbar or module alarm signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21S:6)
- SF6 busbar or module block signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X21S:7)
- DS/ES motor power supply signal shall be reported by means of a voltage-free contact connected to terminals (See Annex D – Terminal X2S:55 and X3S:55;)

SPECIFIC REQUIREMENTS BRAZIL

- Positive power supply for digital inputs to the RTU from the protection control box has to be independent of the power to local signals (See Annex D – Terminal X0S:7).

7.6.5.1.j) *Automatic openings*

Circuit breaker should open when second level of SF6 alarm activates. Circuit breaker should keep blocked in open position.

7.6.5.2 *Italy specific requirements*

7.6.5.2.a) *Terminal Boards for interface with the control system*

The equipment controls, the contacts related to their operating status and the possible anomalies shall be reported in the terminal boards for the interface with the substation control system, as shown in the principle electric diagrams listed in par. 7.6.4.3.

As required in par. 7.6.1.1, during normal operation temporary block signalizations shall not be sent to the control system.

Used abbreviations in electric diagrams and their meaning are listed in the following; for those related to the substation interlocks see the relevant section.

Italian is the language used in the terminal boards abbreviations; for the other languages the equivalent abbreviations as well as the synoptic will be agreed with the specific Enel Group Distribution company.

Circuit-breakers

- drive circuit of shunt closing release control (CH-ABC)
- 1st drive circuit of shunt opening release control (1° AP-A; 1°AP- B; 1°AP-C or 1°AP-ABC)
- 2nd drive circuit of shunt opening release control (2° AP-ABC)
- 3rd drive circuit of under-voltage release control (3° AP-ABC)
- close position (ccX152 or 152NA)
- open position (caX152 or 152NC)
- remote/local selector switch in local (P) position (43SP-PROVA)
- 1st minimum gas density level (P1 GAS)
- 2nd minimum gas density level (P4 GAS)
- discharged springs (P4 MOLLE)
- intervention of motor protection device and/or auxiliary supply missing (42RT)
- motor maximum operation time (BX)
- anti-condensation circuit anomaly (AnR152)
- poles discrepancy - only single-pole CB (DP)
- locking of drive circuit of under-voltage release control – only if assembled (BL3°AP-ABC)

Disconnectors – Earthing Switches

- drive circuit of shunt closing release control (DS: CH189”XY”; ES: CH189T”XY”; “XY” means the bay name i.e. L1, L2, TR, etc.)
- drive circuit of shunt opening release control (DS: AP189”XY”; ES: AP189T”XY”; “XY” means the bay name i.e. L1, L2, TR, etc.)
- close position (DS: ccX189”XY”; ES: ccX189T”XY”)
- open position (DS: caX189”XY”; ES: ccX189T”XY”)
- intervention of motor protection device and/or auxiliary supply missing (DS: 42RT189”XY”; ES: 42RT189T”XY”)
- motor maximum operation time (DS: BX189”XY; ES: 42RT189T”XY”)
- not-maneuverable DS (DS: SNM189”XY”; ES: 42RT189T”XY”)

Earthing Switches

Further specific control circuits, using signals from secondary terminals of on-site Inductive or Capacitive Voltage Transformers (see electric diagrams “VT/1” and “VT/2"), elaborate absence of voltage on HV line (and status ON/OFF of relative low voltage protection CBs) to enable the ES closing:

- voltage presence (27ON”XY”)
- voltage absence (27OFF”XY”)
- voltage presence anomaly (An PRES TENS”XY”)

For this purpose the low voltage components shall have the following characteristics.

- 3P+N switch for protection of VT secondary circuits:
  Ue = 400 V ac; In = 3A; Electromagnetic overcurrent relay - short-circuit current setting: 12 A ("type MA"); Icu ≥ 25 kA;
- K27A/L, K27B/L and K27ATL relays:
  Rated voltage = 100 V AC.

Disconnectors – special cases – codes “101” and “102”

Similarly to the above “Earthing Switches” the specific voltage control circuits shall enable not only the ES closing but also the DS closing/opening, to guarantee operations without energy transit:

- voltage presence (27ON”XY”)
- voltage absence (27OFF”XY”)
- voltage presence anomaly (An PRES TENS”XY”)

Voltage transformers – codes “VT/1” and “VT/2”

(more details in “Earthing Switches”)

- Phase voltage (V”X”; “X” means the electrical phase i.e, 4, 8, 12; 0 is ground potential)
- Open position low voltage CB “ ATV1” (ATV)
- Closed position low voltage CB “ ATV1” (+ATV)
- 1st minimum gas density level – only SF6 VTs (P1 GAS)
- 2nd minimum gas density level – only SF6 VTs (P4 GAS)

7.6.5.2.b) *Synoptic*

The synoptic alarm/block signalization lamps (see par. 7.6.2.1) shall be those indicated in the previous paragraph.

Some signalizations, due to their nature, may be common to more switchgears, therefore they shall be grouped together.

For example, in the case of hybrid module Y2 type, having two remote/local selector switches (“Servizio/Prova”), one for Line-bay and Bus-bar, the other for Transformer bay, we have:

Line-bay and Bus-bar common signalizations

- remote/local selector switch in local (P) position (43SP/L-PROVA).
- 1st minimum gas density level (P1 GAS).
- 2nd minimum gas density level (P4 GAS).
- anti-condensation circuit anomaly (AnR)
- Lamps test button (PL) (only one but working also on lamps of the other bay)

Transformer-bay common signalizations

- remote/local selector switch in local (P) position (43SP/TR-PROVA).
- 1st minimum gas density level (P1 GAS).
- 2nd minimum gas density level (P4 GAS).
- anti-condensation circuit anomaly (AnR)

In annex E some synoptic drawing examples are shown; other cases will be assessed with the manufacturer.

Note: In case of single-pole CB, the synoptic shall have an additional signal lamp that is activated when the three mechanical locks of the under-voltage releases are - between them - in a not congruent position.

7.6.5.2.c) *Interlocks*

The hybrid modules shall be equipped with operation locks to ensure safety of both workers and switchgears, preventing wrong operations being performed either in electric (remote or local) or manual mode (only for DS/ESs, in local mode).

The required operation locks are:

- specific of the single switchgear (locks);
- between switchgears part of the same hybrid module (interlocks);
- between interfaced equipments (substation interlocks):
    a. switchgears of different hybrid modules
    b. stand-alone switchgears (CBs, DSs/ESs)
    c. medium voltage switchboards

There are two types of substation interlocks:

- incoming (working on the hybrid module)
- outgoing (working on switchgears external to the hybrid module)

The differentiation is included in the abbreviations used for the same type of interlock (see in the principle electric diagrams, i.e. “INTBL. A – IN”; “INTBL. B – OUT”).

The main operating locks, divided for module type, are listed in the following.

7.6.5.2.d) *Hybrid module Y1 type*

“Linea 1” bay – code “101” (or “Linea 2” – code “102”)

- Disconnector 189L1 (or 189L2) closing lock for 2nd minimum gas density level (“P4 gas”);
- Interlock between CB 152, disconnector 189L1 and disconnector 189L2: impossibility of disconnector 189L1 (or 189L2) operation if CB 152 and disconnector 189L2 (or 189L1) are closed. The opening and closing operations of this disconnector are enabled, alternatively to the opening of CB 152 and disconnector 189L2 (or 189L1), by an external consensus (substation interlocks: “INTBL. A – IN”);
- Impossibility of disconnector 189L1 (or 189L2) operation in presence of HV on both lines L1 and L2. The closing and opening operations of this disconnector are enabled, alternatively to the HV absence on both lines L1 and L2, by an external consensus (substation interlocks: “BLOCCO 27”);
- Interlock between disconnector 189L1 (or 189L2) and his earthing switch 189TL1 (or 189TL2): impossibility to close the earthing switch if disconnector is closed and vice versa;
- Impossibility to close disconnector 189L1 (or 189L2) for external consensus absence (i.e. for presence of external earthing switch in closed position or for SF6 absence; substation interlocks: “INTBL. B – IN”);
- Impossibility to close earthing switch 189TL1 (or 189TL2) for external consensus absence (substation interlocks: “INTBL. C – IN”);
- Impossibility to close earthing switch 189TL1 (or 189TL2) for presence of HV on line L1 (or L2).

Circuit breaker bay

Circuit breaker bay shall be provided of the same locks as for Y2 type described in the following par. 7.6.5.2.e), differentiating their use whether as Line bay (see "Line 1" bay) or as Transformer bay (see "Transformer" bay).

Specifically, the:

- Closing lock of CB 152TR (or 152L) for disconnectors incomplete operation, shall be related to the three hybrid module disconnectors.

7.6.5.2.e) *Hybrid module Y2 type*[13]

"Linea 1" bay – code "201" and "202"

- CB 152L1 and disconnector 189L1 closing lock for 2nd minimum gas density level ("P4 gas");
- CB 152L1 closing lock for discharged springs;
- CB 152L1 closing lock for under-voltage release circuit not-supplied (if any) and, if single-pole type, with mechanical locks of the three under-voltage releases in a not congruent position (between them);
- CB 152L1 closing lock for incomplete operation of disconnectors 189L1 and 189Sb(L2);
- Impossibility to operate disconnector 189L1 when CB 152L1 is closed;
- Interlock between disconnector 189L1 and his earthing switch 189TL1: impossibility to close the earthing switch if disconnector is closed and vice versa;
- Impossibility to close earthing switch 189TL1 for presence of HV on line L1.

"Sbarra (Linea 2)" bay – code "301", "302" and "303"

- Disconnector 189SB1 closing lock for 2nd minimum gas density level ("P4 gas");
- Interlock between disconnector 189Sb(L2) and his earthing switch 189TSB(L2): impossibility to close the earthing switch if disconnector is closed and vice versa;
- Interlock between disconnector 189Sb(L2), CB 152 L1 and CB 152TR: impossibility to operate disconnector 189SB(L2) if these CBs are closed. The opening and closing operations of this disconnector are enabled, alternatively to the opening of CBs 152L1 and 152TR, by an external consensus (substation interlocks: "INTBL. A – IN");
- Impossibility to close disconnector 189SB(L2) for external consensus absence (i.e. for presence of external earthing switch in closed position or for SF6 absence; substation interlocks: "INTBL. B – IN");
- Impossibility to close earthing switch 189SB(L2) for external consensus absence (substation interlocks: "INTBL. C – IN");
- Impossibility to close earthing switch 189SB(L2) for presence of HV on busbar/Line2.

"Trasformatore" bay – code "401" and "402"

- CB 152TR and disconnector 189TR closing lock for 2nd minimum gas density level ("P4 gas");
- CB 152TR1 closing lock for discharged springs;
- CB 152TR1 closing lock for under-voltage release circuit not supplied;
- CB 152TR1 closing lock for disconnectors 189TR and 189Sb(L2) incomplete operation;
- Impossibility to operate disconnector 189TR when CB 152TR is closed;
- Interlock between disconnector 189TR and his earthing switch 189TTR: impossibility to close the earthing switch if disconnector is closed and vice versa;
- Interlock between disconnector 189TR and earthing switch 89TTR on MV side of HV/MV transformer: impossibility to close the disconnector 189TR if earthing switch 89TTR is closed and vice versa. This function shall be achieved by means of a device containing an electromagnet, which is energized, by means of a push-button, by a discordant auxiliary

[13] Note: in the following is described the case in which the two CBs of the Y2 type hybrid module are used in a Line bay and in a Transformer bay; but if both are used in Line bays the symbol "152TR" in sub-paragraph "Sbarra (Linea 2)" bay – code "301", "302" and "303" becomes "152L2". The same applies in principle electric diagrams.

contact of the disconnector 189 TR if the remote/local selector switch is in “Prova” position. The device shall allow the rotation and extraction of a key enabling the closing of the MV earthing switch 89TTR.

- Interlock between earthing switch 189TTR and CB MV 52TR: impossibility to close the earthing switch 189TTR if CB MV 52TR is closed and vice versa.

7.6.5.2.f) *Hybrid module Single-bay type*

Circuit-breaker bay

Circuit breaker bay shall be equipped with the same locks as for Y2 type described in cap. 7.6.5.2.e), using according to the application locks of Line bay (see “Linea 1” bay, changing the “L1” part of the abbreviation in “L”) or locks of Transformer bay (see “Trasformatore” bay).

Specifically, the:

- CB 152L (or 152TR) closing lock for disconnectors incomplete operation, shall be related to all disconnectors of the hybrid module.

“Sbarra” bay – code “501” and “502”

- Disconnector 189SB closing lock for 2nd minimum gas density level (“P4 gas”);
- Interlock between CB 152L (or 152 TR) and disconnector 189 SB: impossibility to operate disconnector 189SB when CB is closed;
- Impossibility to close disconnector 189SB for external consensus absence (i.e. for presence of external earthing switch in closed position or for SF6 absence; substation interlocks: “INTBL. B – IN”).

7.6.5.3 *Automatic openings*

Following intervention for SF6 gas low-pressure (P4gas) due to a severe failure in a switchgear, the HV faulty part of the substation shall be isolated from the healthy part not subject to failure.

For this purpose commands for automatic opening shall be activated and simultaneously condition for the service restoring shall be prepared, even by means of specific substation automatisms.

If partitions are present the automatic opening logical operations shall work with the same criteria (see i.e. code “303” and “502”).

The automatic opening commands work both internally, in the faulty hybrid module, and simultaneously externally to the substation HV sections still healthy.

Consequently the automatic opening commands, similarly to the substation interlocks, can be both incoming and outgoing; in the principle electric diagrams of DS/ES they are abbreviated with “AP.AUT. – IN” and “AP.AUT. – OUT”, while in CBs ones the command (only incoming) is “AP.AUT.INTERBL”.

All the automatic openings are enabled only if remote/local selector switch is in “Servizio” position.

Generally in CBs case the automatic opening having internal origin work on 1st and 2nd drive circuits of shunt opening release control; in case of 152TR they work on 1st drive circuit of shunt opening release control and on 3rd drive circuit of under-voltage release control.

Circuit breaker, after the automatic opening, shall be blocked in open position.

Specifically, for 2nd minimum gas density level (“P4 gas”) intervention, the following operations shall occur, depending on the hybrid module type (see the principle electric diagrams; possible special cases will be assessed with the manufacturer):

Y1 type

CB opens and in line disconnectors an auxiliary contact (voltage-free) becomes available for an outgoing open command;

Y2 type

CBs and disconnector 189Sb(L2) open and in busbar disconnector an auxiliary contact (voltage-free) becomes available for an outgoing open command;

Single-bay type

CB open and in busbar disconnector 189SB (if present) an auxiliary contact (voltage-free) becomes available for an outgoing open command.

In case of failure in one of the SF6 insulated VT (if presents), the interventions for SF6 low pressure (P4 gas) in their specific partition work as follows:

Y1 type

a) if the fault has occurred in a VT of "Line 1" (or "Line 2") bay the CB opens and, in case of external consensus (i.e. HV = off), the disconnector L1 (or L2) opens as well. The disconnector 189L1 (or 189L2), once open, intercepts the automatic opening command coming from the VT of "Line 1" (or "Line 2") bay in order to allow the CB closing.

b) if the fault has occurred in a VT of the CB bay, the CB opens;

Y2 type

a) if the fault has occurred in a VT of the CB bay, the CB opens;

b) if the fault has occurred in a VT of SB(L2) bay, both CBs and the busbar disconnector open. The busbar disconnector, once open, intercepts the automatic opening command coming from the VTs in order to allow the CBs closing;

Single-bay type

CB and busbar 189SB disconnector (if any) open.

7.7 TESTING

7.7.1 General information

The applicable standard is IEC 62271-205, where is stated (par. 1.101) “If part of the compact switchgear assembly is formed by metal enclosed switchgear devices the requirements of IEC 62271-203 apply”, consequently the IEC 62271-203 tests are also applicable with the clarifications stated in this chapter.

The tests to be performed on Hybrid Module are divided in:

- Type tests;
- Routine tests on factory;
- Commissioning tests.

7.7.2 Type tests

7.7.2.1 *General*

In principle type tests should be performed on a complete Hybrid Module manufactured in accordance with the present technical specification.

Type tests are be classified in:

- tests on the complete assembly
- tests on base components

7.7.2.2 *Type tests on the complete assembly*

(6.1 of IEC 62271-205)

The tests listed in the following paragraphs shall be performed on a complete Hybrid Module manufactured in accordance with the present technical specification (the layout shall be suggested by the manufacturer and approved by user).

The applicability of a type test performed on one of the provided layouts to an equipment with a different layout shall be demonstrated by the manufacturer (by mean of a technical report) and approved by the user.

7.7.2.2.a) *Visual check and constructive characteristics check*

The Hybrid Module, complete of all accessories and fully assembled in operation layout, shall be subject to a visual inspection in order to verify its functional, dimensional and constructive compliance with this Global Standard and with technical documentation listed in paragraph 7.8.2.2.

Visual inspection shall be repeated each time the required assembly includes at least one new base components never subject to this check.

7.7.2.2.b) *Dielectric tests*

(6.2 of IEC 62271-203)

7.7.2.2.c) *Radio interference voltage (r.i.v.) test*

(6.3 of IEC 62271-203)

Applicable only to SF6/air bushings.

7.7.2.2.d) *Measurement of the resistance of circuits*

(6.4 of IEC 62271-203)

The measure shall cover all Hybrid Module components, using all available access points.

7.7.2.2.e) *Temperature-rise tests*

(6.5 of IEC 62271-203)

7.7.2.2.f) *Short-time withstand current and peak withstand current tests*

(6.6 of IEC 62271-203)

7.7.2.2.g) *Verification of the protection*

(6.7 of IEC 62271-203)

7.7.2.2.h) *Tightness test*

(6.8 of IEC 62271-203)[14]

Test must be performed using test Qm, method 1 “Cumulative Test”, IEC 60068-2-17.

The initial gas concentration Co, with Hybrid Module filled at nominal density, shall be measured after at least 2 hours from pressurizing; the final concentration C1 shall be measured after more than 8 hours.

7.7.2.2.i) *Electromagnetic compatibility tests (EMC)*

(6.9 of IEC 62271-203)

7.7.2.2.j) *Additional tests on auxiliary and control circuits*

(6.10 of IEC 62271-203)

[14] 6.102 quoted in this paragraph shall be intended as 7.7.2.2.l) of this document.

For this verification the manufacturer shall provide a paper copy of the Hybrid Module electric schemes.

The correct operation of all controls, interlocking, automatic openings and signalizations shall be also verified.

The absorption curves of closing and opening (shunt and under-voltage) releases, taking note of the maximum values, shall be registered in the following conditions:

- at rated voltage;
- at 110% of the rated voltage;
- at 70% of the rated voltage, for opening releases;
- at 85% of the rated voltage, for closing release.

The absorption curves of the CB and DS/ES motors (taking note of the maximum values, inrush excluded), of the springs charging times and of the DS/ES operating times, shall be registered in the following conditions:

- at rated voltage;
- at 110% of the rated voltage;
- at 85% of the rated voltage.

The heating and/or anti-condensation circuit absorption shall be measured.

7.7.2.2.k) *Verification of making and breaking capacities*

(6.101 of IEC 62271-203)

According with this requirement the manufacturer shall demonstrate that associated components excluded from this test or changed respect to the tested one don't affect the making and breaking performances.

7.7.2.2.l) *Mechanical and environmental tests*

6.101 of IEC 62271-205 applies with the following additional information.

The static terminal load test (6.101.5 of IEC 62271-205) shall be performed considering the requirements in 7.4.4.1 of this document.

7.7.2.2.m) *Tests on Circuit-breakers*

Mechanical and environmental tests

(IEC 62271-100 par. 6.101)

Humidity test is not required.

A new definition for operation with under-voltage release is added, similar to "opening time", IEC 62271-100 par. 3.7.133 a):

"*The opening time with under-voltage release is the time interval between the instant when the voltage drops suddenly to zero, the circuit-breaker being in the closed position, and the instant when the arcing contact are separated in all poles.*"

In case of the under-voltage release is requested, its characteristics shall be verified in accordance with IEC 62271-1 (par. 5.8.4) at ambient temperature.

Moreover, for routine tests and commissioning tests purpose, the reference values and their tolerance at 110%, 100% and 70% of the rated voltage shall be provided.

7.7.2.2.n) *Tests on disconnectors DS and earth switches ES*

IEC 62271-102 (and Annex E) applies with following additional information

Operating and mechanical endurance test

(IEC 62271-102 par. 6.102)

Note: par. 6.102.3.2 applies also to measuring of resistance of earthing switch.

During test, referring par. 7.6.1.3.b) of this Global Standard, the DS/ES mechanical locks and interlocks operation shall be checked.

Operation under severe ice conditions

(IEC 62271-102 par. 6.103)

Note: par. 6.103.4.2 applies also to measuring of resistance of earthing switch.

This test is mandatory.

Operation at the temperature limits

(IEC 62271-102 par. 6.104)

This test is mandatory.

7.7.2.2.o) *Proof tests for enclosures*

(6.103 of IEC 62271-203)

7.7.2.2.p) *Pressure test on partitions*

(6.104 of IEC 62271-203)

7.7.2.2.q) *Test under conditions of arcing due to an internal fault*

(6.105 of IEC 62271-203)

7.7.2.2.r) *Insulator tests*

(6.106 of IEC 62271-203)

7.7.2.2.s) *Corrosion test on earthing connections*

(6.107 of IEC 62271-203)

7.7.2.2.t) *Corrosion test on enclosures*

(6.108 of IEC 62271-203)

7.7.2.2.u) *Protective treatments*

Hot dip galvanized coatings on iron and steel components shall be verified in accordance with ISO 1461 by mean of magnetic flux equipments, performing at least 5 measures on each component, in uniform manner on the various surfaces, avoiding edges and angular parts.

The verification of other protective coatings shall be performed considering their characteristics: the manufacturer will indicate the minimum thickness allowed and the others characteristics.

7.7.2.2.v) *Seismic verification*

If requested, Hybrid Module (including the support) shall be compliant with seismic qualification, according with standards listed in 7.2.3.

7.7.2.3 *Type tests on base components*

The type tests listed in the following paragraphs can be performed on the single base component or on a different assembly equipped with the same component used for the Hybrid Modules.

The applicability of these type tests on the different Hybrid Modules layouts shall be demonstrated by the manufacturer (by mean of a technical report) and approved by the user.

7.7.2.3.a) *Tests on Circuit-breakers*

IEC 62271-100 applies with the following additional information

7.7.2.3.b) *X-radiaton test procedure for vacuum interrupters*

(6.11 of IEC 62271-203)

Only in case of vacuum CBs.

7.7.2.3.c) *Critical current tests*

(IEC 62271-100 par. 6.107)

If applicable (see 6.107.1)

7.7.2.4 *Tests on disconnectors DS and earth switches ES*

IEC 62271-102 applies with the following additional information.

7.7.2.4.a) *Test to verify the proper functioning of the position indicating device*

(IEC 62271-102 par. 6.105)

This test is mandatory.

7.7.2.4.b) *Bus-transfer current switching tests*

(IEC 62271-102 par. 6.106)

This test is mandatory only for DS for which this characteristic is requested (see par. 7.4.3 of this document).

7.7.2.4.c) *Induced current switching test*

(IEC 62271-102 par. 6.107)

This test is mandatory.

7.7.2.5 *Tests on toroidal Current Transformers*

(IEC 61869-2)

Manufacturer shall perform also the IEC 61869-2 par. 7.3.201 test; the CT technical documentation shall include the tolerance range for the secondary winding resistance.

7.7.2.6 *Tests on Voltage Transformers*

(IEC 61869-3)

Test under conditions of arcing due to an internal fault is required

Manufacturer shall perform also the IEC 61869-3 par. 7.4.6 and 7.4.7 tests.

7.7.2.7 *Tests on SF6/air bushings, cable connections, transformer connections*

SF6/air bushings, cable connections and transformer connections shall be tested in accordance with their respective IEC standards.

7.7.2.8 *Tests on EVDS*

Following checks shall be performed:

- verification of the intervention and hysteresis threshold;
- verification of interlocks with the line disconnectors and/or earth switches;
- verification of activation of self diagnostic function (internal fault presence signaling).

7.7.2.9 *Specific requirements*

7.7.2.9.a) *e-distribuzione*

Tests on enclosures, partitions, voltage transformer, SF6/air bushings, insulator, are included in the scope of D.M. 1/12/1980 and subsequent modification (D.M. 10/9/1981).

7.7.3 Routine tests in factory

(IEC 62271-203 par. 7)

The Routine tests (also called acceptance tests) shall be made in the manufacturer's factory on each Hybrid module supplied, to ensure the product compliance with:

- base components approved during the conformity assessment (homologation, certification etc.) process and on which the type tests have been performed;
- the approved technical documentation of the assembly specific layout to be supplied (layout drawing, electric schemes - both HV and low voltage, Control Box drawing etc.).

Test values/results shall be in compliance with rated values (and respective tolerances).

The manufacturer shall provide, for each Hybrid Module supplied, the report of all measures and tests carried out.

7.7.3.1 *Dielectric test on the main circuit*

(7.1 of 62271-203, partial discharge included)

Alternative methods for the partial discharge measurement can be proposed by the manufacturer and shall be approved by Enel Group Distribution companies.

7.7.3.2 *Tests on auxiliary and control circuits*

(IEC 62271-203 par. 7.2)

Functional tests (par. 7.2.2 of IEC 62271-1) shall be performed together with tests in par. 7.7.3.8, only at rated voltage.

Dielectric tests (par. 7.2.4 of IEC 62271-1) shall be performed applying 1 kV for 1 s.

Electronic devices, motors etc. can be excluded by dielectric test only if agreed during the conformity assessment (homologation, certification etc.) process.

EVDS shall be disconnected before dielectric test.

7.7.3.3 *Measurement of the resistance of the main circuit*

(IEC 62271-203 par. 7.3)

To be performed after mechanical operating tests.

The ambient temperature influence can be neglected.

The test shall be performed also on ES.

7.7.3.4 *Tightness test*

(IEC 62271-203 par. 7.4)

To be performed at least at 2nd minimum gas density level (block).

Manufacturer shall provide the results of tests on subassemblies. Sniffing device may be used to check the joint between subassemblies.

7.7.3.5 *Design and visual checks*

(IEC 62271-203 par. 7.5)

Following items shall be verified:

- switchgear compliance with approved documents;
- no visible defects;
- protective coatings (par. 7.7.2.2.u) of this document applies.

7.7.3.6 *Pressure tests of enclosures*

(IEC 62271-203 par. 7.101)

Manufacturer shall provide the results of internal tests.

7.7.3.6.a) *e-distribuzione Specific requirements*

Manufacturer shall provide the “Certificazione di rispondenza” (see: D.M. 1/12/1980, Allegato A, Regola VSR.8.B.1, par. 5.2), including partitions, bushings and VTs (if any).

7.7.3.7 *Mechanical operation tests*

(IEC 62271-203 par. 7.102)

7.7.3.7.a) *Tests on Circuit-Breakers*

(IEC 62271-100 par.7.101)

The following items shall be recorded:

a. at Vmax, Vn, Vmin, closing (C) and opening (O) times, time spread (on each release);
a1. at Vmax, Vn, Vmin opening (O) times, time spread of under-voltage release coil (if present - see 7.7.2.2.m)) and it shall be verified its compliance with IEC 62271-1 par. 5.8.4;
b. at Vn, close-open (CO) time and open-close-open (O-t-CO) cycle;
c. at Vn, the operation time of one of each type (make and break) of auxiliary contacts, respect to the operation of main contacts on closing and on opening of CB;
d. no-load travel curves.

The absorption curves of closing and opening (shunt and under-voltage) releases, taking note of the maximum values, shall be registered in the following conditions:

- at rated voltage;
- at 110% of the rated voltage;
- at 70% of the rated voltage, for opening releases;
- at 85% of the rated voltage, for closing release.

The spring recharging time of the motor after a closing operation and its absorption (maximum value, inrush excluded) shall be measured at rated voltage.

7.7.3.7.b) *Tests on disconnectors DS and earth switches ES*

(IEC 62271-102 par. 7-101)

The following items shall be verified:

- operation times and the drive motor absorption (inrush excluded) at Vmax, Vn, Vmin;
- manual and electrical operation and its (mechanical and electrical) interlock devices;
- satisfactory operation of the auxiliary contacts and position indicating devices;
- mechanical locks.

7.7.3.8 *Tests on auxiliary circuits, equipment and interlocks in the control mechanism*

(IEC 62271-203 par. 7.103)

For this verification the manufacturer shall provide a paper copy of the Hybrid Module electric schemes.

Following items shall be verified:

- EVDS device (operation, interlocks with DS or ES, internal self-diagnostic) referring to its testing procedures;
- SF6 density control devices: the verification shall be performed at ambient temperature, in the real operating position, using nitrogen, with decreasing pressure values. SF6 can be used only in presence of recovery systems.
  Test reports issued by the density control device manufacturer shall be provided (test position shall be evidenced too).
- correct operation of all controls, interlocking, automatic openings and signalizations, including galvanic separation between the power supplies of various circuits;
- heating and/or anti-condensation circuit absorption.

7.7.3.9 *Pressure test on partitions*

(IEC 62271-203 par. 7.104)

Manufacturer shall provide the results of testing on partitions.

7.7.3.10 *Tests on Current Transformers*

(IEC 61869-2 par. 7.1.2, Table 10: Routine tests including par. 7.3.201; Sample Test, par. 7.5.2 when applicable).

The tests of CTs shall be repeated sampling at least one unit for each tern.

It shall be verified also:

a. the CTs compliance with approved documents;
b. no visible defects;
c. the presence of producer test reports of all CTs.

7.7.3.10.a) *e-distribuzione Specific requirements*

The supplier shall inform e-distribuzione for routine tests in the instrument transformers manufacturer factory. In case Enel will not attend these tests they shall be repeated in the Hybrid Modules manufacturer factory according to the given criteria.

7.7.3.11 *Tests on Voltage Transformers*

(IEC 61869-3 par. 7.1.2, Table 10: Routine tests par. 7.3).

The tests of VTs shall be repeated sampling one unit for each tern.

It shall be verified also:

a. the VTs compliance with approved documents;
b. no visible defects;
c. the presence of producer test reports of all VTs;
d. SF6 density control devices: 7.7.3.8 applies.

7.7.3.11.a) *e-distribuzione Specific requirements*

The supplier shall inform e-distribuzione for routine tests in the instrument transformers manufacturer factory. In case Enel will not attend these tests they shall be repeated in the Hybrid Modules manufacturer factory according to the given criteria.

7.7.3.12 *Bushing tests*

(IEC 60137 par.9.6)

Test reports issued by insulator manufacturer shall be provided.

7.7.4 Commissioning tests

(IEC 62271-203 par. 10)

The Commissioning tests (also called on-site acceptance tests) shall be performed in the Enel Group Distribution company plant on each Hybrid Module supplied, after its installation.

The manufacturer, at the end of the on-site tests, shall deliver the report containing the results of the measures and tests performed on the Hybrid Module. These measures shall include check of transportation pressure, to be performed before installation.

This report, in paper and in electronic format (e.g. one or more “pdf” files) shall include also factory routine tests and all sub-components test reports.

IEC 62271-1 Par. 10.2.1 is applicable.

7.7.4.1 *Dielectric test on the main circuit*

(IEC 62271-203 par. 10.2.101.2 and C.3.2.3)

Dielectric test shall be performed on Hybrid Module, if disassembled in transport units and if stated in the approved technical documentation of the assembly specific layout to be supplied.

In alternative to test methods provided by par. 10.2.101.2.3 of IEC 62271-203, a test applying the grid rated voltage (see IEC - par. C.3.2.3) for 24 hours without energy transit can be performed.

7.7.4.2 *Dielectric test on auxiliary circuits*

(IEC 62271-203 par 10.2.101.3; IEC 62271-1 applies only par. 7.2.4)

Dielectric tests shall be performed applying 1 kV for 1 s.

EVDS shall be disconnected before dielectric test; others electronic devices, motors etc. can be excluded by dielectric test only if agreed during the conformity assessment (homologation, certification etc.) process.

7.7.4.3 *Measurement of the resistance of the main circuit*

(IEC 62271-203 par. 10.2.101.4)

To be performed after mechanical operating tests.

The ambient temperature influence can be neglected.

The test shall be performed also on ES.

7.7.4.4 *Gas tightness test*

(IEC 62271-203 par. 10.2.101.5)

To be performed at rated pressure.

The test shall be performed using test Qm, method 2 “Probing Test”, IEC 60068-2-17, after all the other tests, eight hours after the gas filling (for example one night is enough).

Fittings, gas density control devices and piping shall be checked. Manufacturer shall verify all on-site assembled connections between transport units.

The sensitivity of the sniffing device shall be at least 10^{-8} Pa x m^3/s.

7.7.4.5 *Checks and verifications*

(IEC 62271-203 par. 10.2.101.6)

Following items shall be verified:

- assembly in accordance with the manufacturer’s drawings and instructions;
- control of damage absence;
- presence of accompanying required documentation and materials (see par. 7.8.3).

7.7.4.6 *Mechanical operation tests*

7.7.4.6.a) *Tests on Circuit-Breakers*

(IEC 62271-100 par. *10.2.102.2*)

Before these tests at least 30 C-O no-load operations shall be performed.

The following items shall be recorded:

a. at Vmax, Vn, Vmin, closing (C) and opening (O) times, time spread (on each release);
a1. at Vmax, Vn, Vmin opening (O) times, time spread on under-voltage release coil (if present see 7.7.2.2.m)) and it shall be verified its compliance with IEC 62271-1 par. 5.8.4;
b. at Vn, close-open (CO) time and open-close-open (O-t-CO) cycle;
c. at Vn, the operation time of one of each type (make and break) of auxiliary contacts, respect the operation of main contacts on closing and on opening of CB.

The absorption curves of closing and opening (shunt and under-voltage) releases, taking note of the maximum values, shall be registered in the following conditions:

- at rated voltage;
- at 110% of the rated voltage;
- at 70% of the rated voltage, for opening releases;
- at 85% of the rated voltage, for closing release.

The spring recharging time of the motor after a closing operation and its absorption (maximum value, inrush excluded) shall be measured only at Vn.

7.7.4.6.b) *Tests on disconnectors DS and earth switches ES*

(IEC 62271-102 par. 7.101)

The par. 7.7.3.7.b) of this document applies. The operation times and the drive motor absorption shall be performed only at rated voltage.

7.7.4.7 *Tests on auxiliary circuits, equipment and interlocks in the control mechanism*

(IEC 62271-203 par. 7.103)

To be performed after dielectric test on auxiliary circuit.

The following items shall be verified:

- EVDS device (operation, interlocks with DS or ES, internal self-diagnostic) referring its testing procedures;
- all SF6 density control devices, including VT's ones - SF6 can be used only in presence of recovery systems; the verification shall be performed with the same modalities of the routine test (see 7.7.3.8), taking into account the ambient conditions (solar radiation, temperature) and comparing between them the intervention threshold pressure measured values;
- functional operations of whole circuit diagram (fault signals, switchgear automatic openings, interlocks etc. including from/to external ones);
- heating and/or anti-condensation circuit absorption.

7.7.4.8 *Gas quality verifications*

(IEC 62271-203 par. 10.2.101.7)

Manufacturer shall perform these verifications on Hybrid Module which have been object of vacuum treatment, i.e. in case of:

- on-field assembling and connections between transport units;
- enclosure opening, with gas recovery and new filling.

In this case the gas tightness checks shall be repeated.

7.8 Supply requirements

7.8.1 Tender's technical documentation

For tender's technical evaluation the supplier shall provide the Annex F properly filled for each one of the possible rated voltages for the equipment (72,5 kV, 145-170 kV, 245 kV).

7.8.2 Conformity assessment

7.8.2.1 *Conformity assessment process*

The conformity assessment processes (homologation, certification etc.) are specified in the proper contractual documents.

7.8.2.2 *Conformity assessment documentation*

The "Conformity assessment documentation" consists in the project documentation that the supplier uses to manufacture Hybrid Modules and can be divided in:

a) "Specific Assembly Type A documents" (public, not confidential, referred to a specific assembly);
b) "General Type A documents" (public, not confidential, including common documents and base components type A documents);
c) "General Type B documents" (confidential, referred to each base components).

The documentation shall be collected separately for each Enel Group Distribution company, for each composition type (see par. 7.3) and for each rated voltage Ur (72.5, 145-170, 245 kV).

7.8.2.2.a) *Specific Assembly Type A documents*

The Specific Assembly Type A documentation shall consist at least in:

1) Specific Assembly Type A documents list;
2) composition of the assembly, consisting in a list of the base components indicating:
   - base component code (see par. 7.1);
   - local codification (see Annex A);
   - base component description;
   - corresponding supplier's model designation;
3) overall dimensions drawing (including the stresses transmitted to the foundations, the transport units, the partitions – if any – and their density control devices position); The height of all the manual operations must be included.
4) overall Hybrid Module pictures or 3D drawings;
5) HV single-line diagram;
6) electric diagram (see par. 7.6.4.1-c), low voltage components list included);
7) Control Box layout drawing;
8) reference resistance values.

7.8.2.2.b) *General Type A documents*

The General Type A documentation shall consist at least in:

1) General Type A documents list, sub-divided into common documents and into each base component documents;
2) Operating Device Box(es) layout drawings;
3) Electric diagram of individual devices (CB, DS, ES);
4) Interconnection cables path (typical);
5) Nameplate (typical);
6) Installation, use and maintenance handbook/manual;
7) Routine and commissioning tests:
   a) test report form (two documents, one for factory tests and one for on-site tests);
   b) reference values table (with tolerances)[15];
   c) EVDS device - testing procedures;
   d) protective coatings description (typology, minimum thickness, reference standards);
8) documentation of safety device for protection against pole excessive pressure (ISO 4126, only if present);
9) list of documentation, materials and accessories supplied;
10) about gas:
    a) gas circuit(s) drawing with density control device positions;
    b) gas density control device characteristics and drawings;
    c) pressure/temperature table for rated density level, 1st minimum gas density level and 2nd minimum gas density level;

[15] specific detailed instructions to verify the CBs no-load travel curves during maintenance activity shall be included in the manual

11) main sub-components suppliers list, subdivided into the various types of base components;
12) List of materials used including packaging and relevant quantities (for disposal purposes and recycle);
13) only for e-distribuzione, INAIL (ex ISPESL) Certification “Certificato di conformità del prototipo” - D.M. 01/12/1980.

7.8.2.2.c) *General Type B documents*

The General Type B documentation shall consist at least in:

1) General Type B documents list, sub-divided into each base component documents;
2) overall base component dimensions drawing;
3) nameplate and labels drawings (Operating Device Box(es), poles, coils, sequence operation plate, only for e-distribuzione: manual lock/unlock of under-voltage release, etc.).

7.8.3 Packaging, transport, storage and installation/testing

Par. 10.1 and 10.2 of IEC 62271-203 apply.

The package shall be suitable to guarantee:

- the protection during transport (including by ship, if necessary);
- an elevation from the ground at least of 100 mm;
- the external storage for at least three months.

On external side of packaging, the following information shall be present:

1) manufacturer name;
2) manufacturing year/month;
3) manufacturer designation type;
4) manufacturer serial number;
5) reference to this Global Standard;
6) contract number;
7) destination substation;
8) total weight;
9) lifting information (showing the points and the correct method of lifting);
10) only for e-distribuzione, the assembly bar code, in accordance with PVR006.

With each assembly the following items shall be supplied (items from 4) to 9) shall be in the local language of destination and shall be provided in paper form):

1) the support structure;
2) anchor bolts to the civil works (optional supply, they shall be provided only if expressly requested. In this case they shall be stainless or hot dip galvanized steel, chemical type);
3) springs hand-crank (and other tools according to the manufacturer design);
4) list of documentation, materials and accessories supplied (“packing list”);
5) overall dimensions drawing;
6) electric diagram;
7) installation, use and maintenance handbook/manual;
8) routine and commissioning tests:
   a) routine (factory and commissioning) test reports;
   b) reference values table (with tolerances);

9) about gas:
   a) dielectric gas;
   b) pressure/temperature table for rated density level, 1st minimum gas density level and 2nd minimum gas density level;
10) one digital support containing the whole type A documentation (pdf file format);
11) only for e-distribuzione: Manufacturer shall provide the “Certificazione di rispondenza” (see: D.M. 1/12/1980, Allegato A, Regola VSR.8.B.1, par. 5.2), including partitions, bushings and VTs (if any).

Only for e-distribuzione, items from 4) to 9) shall be also provided in electronic format together with the guarantee and barcode data requested by PVR001 and PVR006 (The file sending modalities will be discussed during the conformity assessment process).

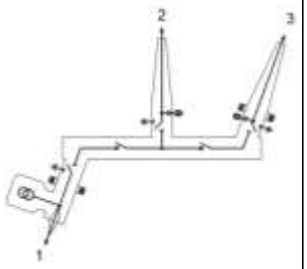
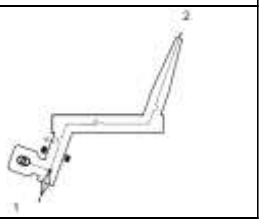
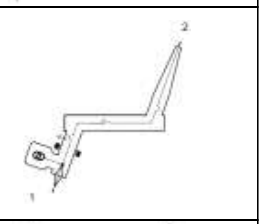
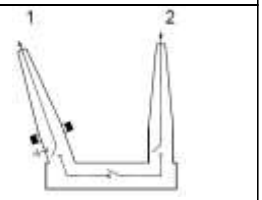
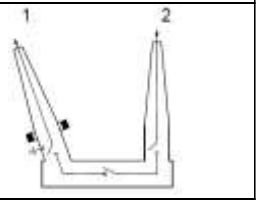
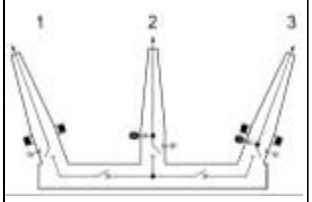
If on-site assembly is performed by the manufacturer, waste (including packaging) shall be disposed by him.

7.8.3.1 *Specific requirements for Spain*

The provider will also attach a declaration of conformity as indicated in ITC-RAT 03 of Reglamento sobre condiciones técnicas y garantías de seguridad en instalaciones eléctricas de alta tensión, Real Decreto 337/2014.

ANNEX A – LOCAL COMPONENTS CODIFICATION

ITALY e-distribuzione

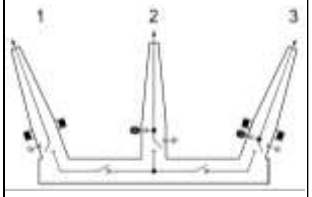
Hybrid Module: Configuration from base components						
Code		**TS**	**Description**	**Units/ Module**		
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
Tab UE DY106	**GSCH002/1025**	**150009**	**HM Y2 145kV C-A-A SPO-TPO CT1600+400 VT132**	**Bay**	**Q.ty**	
		GSCH002/023	Lateral bay - With circuit-breaker - Cable_connection - 145-170 kV	1	1	
		GSCH002/465	Cable connection downward exit 145-170 kV	1	1	
		GSCH002/352	Disconnector with Fast earthing switch 145-170 kV	1	1	
		GSCH002/608	Current Transformer 400-800-1600/1/1 (5P30/5P30)	1	1	
		GSCH002/702	Voltage Transformer 132kV 145 kV	1	1	
		GSCH002/212	Circuit-breaker drive mechanism - Single_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	2	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	2	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145-170 kV	3	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	3	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	3	1	
		GSCH002/607	Current Transformer 200-400/1/1 (5P30/5P30)	3	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	3	1	
		GSCH002/262	Circuit-breaker drive mechanism - Three_pole - 1°, 3° opening circuit - 145-170 kV	3	1	
		GSCH002/802	Support - Y1 type and Y2 type 145-170 kV	-	1	
		GSCH002/902	Control Box - Y2 type	-	1	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
Tab UE DY107	**GSCH002/1019**	**150023**	**HM SB 170kV C-A TPO LINE CT1600 VT150**	**Bay**	**Q.ty**	
		GSCH002/023	Lateral bay - With circuit-breaker - Cable_connection - 170 kV	1	1	
		GSCH002/342	Disconnector with fast earthing switch 145 - 170 kV	1	1	
		GSCH002/465	Cable connection downward exit 145-170 kV	1	1	
		GSCH002/608	Current Transformer 400-800-1600/1/1 (5P30/5P30)	1	1	
		GSCH002/703	Voltage Transformer 150kV 170 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	2	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1	
		GSCH002/312	Disconnector 145-170 kV	2	1	
		GSCH002/805	Support - Single-bay type 145-170 kV	-	1	
		GSCH002/903	Control Box - Single-bay type	-	1	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
Tab UE DY107	**GSCH002/1010**	**150021**	**HM SB 145kV C-A SPO LINE CT1600 VT132**	**Bay**	**Q.ty**	
		GSCH002/022	Lateral bay - With circuit-breaker - Cable_connection - 145 kV	1	1	
		GSCH002/342	Disconnector with fast earthing switch 145 - 170 kV	1	1	
		GSCH002/465	Cable connection downward exit 145-170 kV	1	1	
		GSCH002/608	Current Transformer 400-800-1600/1/1 (5P30/5P30)	1	1	
		GSCH002/702	Voltage Transformer 132kV 145 kV	1	1	
		GSCH002/212	Circuit-breaker drive mechanism - Single_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	2	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1	
		GSCH002/312	Disconnector 145-170 kV	2	1	
		GSCH002/805	Support - Single-bay type 145-170 kV	-	1	
		GSCH002/903	Control Box - Single-bay type	-	1	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
Tab UE DY107/7	**GSCH002/1018**	**150016**	**HM SB 170kV A-A SPO1/2/3 LINE CT1600**	**Bay**	**Q.ty**	
		GSCH002/013	Lateral bay - With circuit-breaker - Air_connection - 170 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/608	Current Transformer 400-800-1600/1/1 (5P30/5P30)	1	1	
		GSCH002/222	Circuit-breaker drive mechanism - Single_pole - 1°, 2°, 3º opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	2	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1	
		GSCH002/312	Disconnector 145-170 kV	2	1	
		GSCH002/805	Support - Single-bay type 145-170 kV	-	1	
		GSCH002/903	Control Box - Single-bay type	-	1	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
Tab UE DY107/7	**GSCH002/1000**	**162357**	**HM SB 72,5kV A-A SPO LINE CT800**	**Bay**	**Q.ty**	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/605	Current Transformer 400-800/1 72,5 kV	1	1	
		GSCH002/211	Circuit-breaker drive mechanism - Single_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	2	1	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	2	1	
		GSCH002/311	Disconnector 72,5 kV	2	1	
		GSCH002/804	Support - Single-bay type 72,5 kV	-	1	
		GSCH002/903	Control Box - Single-bay type	-	1	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
Tab UE DY106/2	**GSCH002/1033**	**150028**	**HM Y2 245kV A-A-A SPO-STPO CT1600+400**	**Bay**	**Q.ty**	
		GSCH002/014	Lateral bay - With circuit-breaker - Air_connection - 245 kV	1	1	
		GSCH002/423	Bushing SF6/air class "e" 245 kV	1	1	
		GSCH002/323	Disconnector with earthing switch 245 kV	1	1	
		GSCH002/608	Current Transformer 400-800-1.600/1/1 (5P30/5P30)	1	1	
		GSCH002/213	Circuit-breaker drive mechanism - Single_pole - 1°, 2° opening circuit - 245 kV	1	1	
		GSCH002/113	Central bay - Without circuit-breaker - Air_connection - 245 kV	2	1	
		GSCH002/423	Bushing SF6/air class "e" 245 kV	2	1	
		GSCH002/323	Disconnector with earthing switch 245 kV	2	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	3	1	
		GSCH002/014	Lateral bay - With circuit-breaker - Air_connection - 245 kV	3	1	
		GSCH002/423	Bushing SF6/air class "e" 245 kV	3	1	
		GSCH002/323	Disconnector with earthing switch 245 kV	3	1	
		GSCH002/607	Current Transformer 200-400/1/1 245 kV	3	1	
		GSCH002/224	Circuit-breaker drive mechanism - Single_pole - 1°, 3° opening circuit - 245 kV	3	1	
		GSCH002/803	Support - Y1 type and Y2 type 245 kV	-	1	
		GSCH002/902	Control Box - Y2 type	-	1	

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

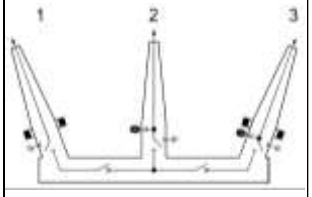
Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

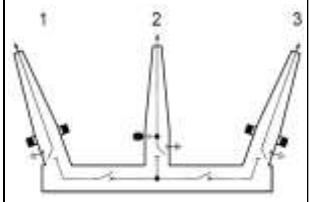
Local code	Type Code	GSCH002 SubCode	Description			
Tab UE DY106/1	GSCH002/1024	150007	HM Y2 170kV A-A-A SPO-TPO CT:1600+400	Bay	Q.ty	
		GSCH002/013	Lateral bay - with circuit breaker - Air connection - 170 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" - 145 kV-170 kV	1	1	
		GSCH002/322	Disconnector with earthing switch 145 kV - 170 kV	1	1	
		GSCH002/608	Current trasformer 400-800-1600/1/1 (5P30/5P30)	1	1	
		GSCH002/212	Circuit breaker mechanism - Single pole - 1°, 2° opening circuit - 145 kV-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit breaker - Air connection - 145 kV- 170 kV	2	1	
		GSCH002/322	Disconnector with earthing switch 145 kV - 170 kV	2	1	
		GSCH002/422	Bushing SF6/air class "e" - 145 kV-170 kV	2	1	
		GSCH002/700	EVDS - Electronics Voltage Detector System (capacitive dividederes included)	2	1	
		GSCH002/013	Lateral bay - with circuit breaker - Air connection - 170 kV	3	1	
		GSCH002/422	Bushing SF6/air class "e" - 145 kV-170 kV	3	1	
		GSCH002/322	Disconnector with earthing switch 145 kV - 170 kV	3	1	
		GSCH002/604	Current trasformer 200-400/1	3	1	
		GSCH002/700	EVDS - Electronics Voltage Detector System (capacitive dividederes included)	3	1	
		GSCH002/262	Circuit breaker mechanism - Three pole - 1°, 3° opening circuit - 145 kV-170 kV	3	1	
		GSCH002/802	Support - Y1 type and Y2 type - 145 kV-170kV	-	1	
		GSCH002/902	Control Box - Y2 type	-	1	



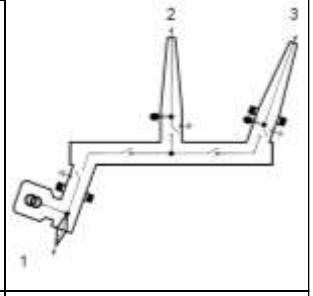
Local code	Type Code	GSCH002 SubCode	Description			
Tab UE DY106/1	GSCH002/1024	150006	HM Y2 170kV A-A-A SPO1/2/3-TPO CT:1600+400	Bay	Q.ty	
		GSCH002/013	Lateral bay - with circuit breaker - Air connection - 170 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" - 145 kV-170 kV	1	1	
		GSCH002/322	Disconnector with earthing switch 145 kV - 170 kV	1	1	
		GSCH002/608	Current trasformer 400-800-1600/1/1 (5P30/5P30)	1	1	
		GSCH002/222	Circuit breaker mechanism - Single pole - 1°, 2°, 3° opening circuit - 145 kV-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit breaker - Air connection - 145 kV- 170 kV	2	1	
		GSCH002/422	Bushing SF6/air class "e" - 145 kV-170 kV	2	1	
		GSCH002/322	Disconnector with earthing switch 145 kV - 170 kV	2	1	
		GSCH002/700	EVDS - Electronics Voltage Detector System (capacitive dividederes included)	2	1	
		GSCH002/013	Lateral bay - with circuit breaker - Air connection - 170 kV	3	1	
		GSCH002/422	Bushing SF6/air class "e" - 145 kV-170 kV	3	1	
		GSCH002/322	Disconnector with earthing switch 145 kV - 170 kV	3	1	
		GSCH002/604	Current trasformer 200-400/1	3	1	
		GSCH002/700	EVDS - Electronics Voltage Detector System (capacitive dividederes included)	3	1	
		GSCH002/262	Circuit breaker mechanism - Three pole - 1°, 3° opening circuit - 145 kV-170 kV	3	1	
		GSCH002/802	Support - Y1 type and Y2 type - 145 kV-170kV	-	1	
		GSCH002/902	Control Box - Y2 type	-	1	



Local code	Type Code	GSCH002 SubCode	Description			
Tab UE DY106/1	GSCH002/1024	150010	HM Y2 170kV A-A-A SPO-SPO1/2/3 CT1600+1600	Bay	Q.ty	
		GSCH002/013	Lateral bay - With circuit-breaker - Air_connection - 170 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/608	Current trasformer 400-800-1600/1/1 (5P30/5P30)	1	1	
		GSCH002/212	Circuit-breaker drive mechanism - Single_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	2	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	2	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	1	
		GSCH002/013	Lateral bay - With circuit-breaker - Air_connection - 170 kV	3	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	3	1	
		GSCH002/312	Disconnector 145-170 kV	3	1	
		GSCH002/342	Fast earthing switch 145-170 kV	3	1	
		GSCH002/608	Current trasformer 400-800-1600/1/1 (5P30/5P30)	3	1	
		GSCH002/222	Circuit breaker mechanism - Single pole - 1°, 2°, 3° opening circuit - 145 kV-170 kV	3	1	
		GSCH002/802	Support - Y1 type and Y2 type 145-170 kV	-	1	
		GSCH002/902	Control Box - Y2 type	-	1	



Local code	Type Code	GSCH002 SubCode	Description			
Tab UE DY106	GSCH002/1034	150024	HM Y2 170kV C-A-A SPO-TPO CT1600+400 VT150	Bay	Q.ty	
		GSCH002/023	Lateral bay - With circuit-breaker - Cable Connection - 170 kV	1	1	
		GSCH002/465	Cable connection downward exit 170 kV	1	1	
		GSCH002/342	Disconnector with fast earthing switch 145 - 170 kV	1	1	
		GSCH002/608	Current Transformer 400-800-1.600/1/1 (5P30/5P30)	1	1	
		GSCH002/703	Voltage Transformer 150kV 170 kV	1	1	
		GSCH002/212	Circuit breaker mechanism - Single pole - 1°, 2° opening circuit - 145 kV-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit breaker - Air connection - 145 kV- 170 kV	2	1	
		GSCH002/422	Bushing SF6/air class "e" - 145 kV-170 kV	2	1	
		GSCH002/322	Disconnector with earthing switch 145 kV - 170 kV	2	1	
		GSCH002/700	EVDS - Electronics Voltage Detector System (capacitive dividederes included)	2	1	
		GSCH002/013	Lateral bay - with circuit breaker - Air connection - 170 kV	3	1	
		GSCH002/422	Bushing SF6/air class "e" - 145 kV-170 kV	3	1	
		GSCH002/700	EVDS - Electronics Voltage Detector System (capacitive dividederes included)	3	1	
		GSCH002/322	Disconnector with earthing switch 145 kV - 170 kV	3	1	
		GSCH002/262	Circuit breaker mechanism - Three pole - 1°, 3° opening circuit - 145 kV-170 kV	3	1	
		GSCH002/607	Current Transformer 200-400/1/1 170 kV	3	1	
		GSCH002/802	Support - Y1 type and Y2 type 170 kV	-	1	
		GSCH002/902	Control Box - Y2 type	-	1	



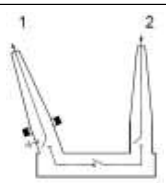
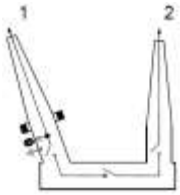
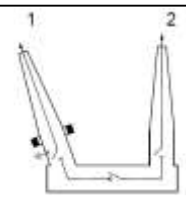
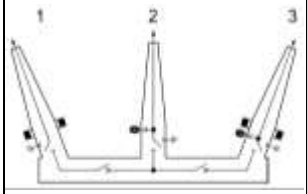
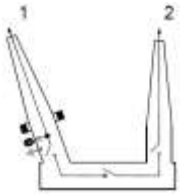
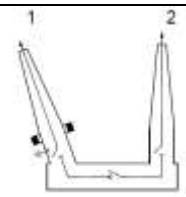
Local code	Type Code	GSCH002 SubCode	Description			
Tab UE DY107/9	GSCH002/1019	150025	HM SB 170kV C-A SPO LINE CT:1600 VT150	Bay	Q.ty	
		GSCH002/023	Lateral bay - With circuit-breaker - Cable connection - 170 kV	1	1	
		GSCH002/465	Cable connection downward exit 145 - 170 kV	1	1	
		GSCH002/342	Disconnector with fast earthing switch 145 - 170 kV	1	1	
		GSCH002/608	Current Transformer 400-800-1.600/1/1 (5P30/5P30)	1	1	
		GSCH002/703	Voltage Transformer 150kV 170 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Single_pole - 1°, 2° opening circuit - 145 - 170 kV	1	1	
		GSCH002/112	Central bay - Without circuit breaker - Air connection 145-170 kV	2	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1	
		GSCH002/312	Disconnector 145 - 170 kV	2	1	
		GSCH002/805	Support - Single-bay type 145-170 kV	-	1	
		GSCH002/903	Control Box - Single-bay type	-	1	

Material Specification code: GRI-GRI-MAT-E&C-0019

Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

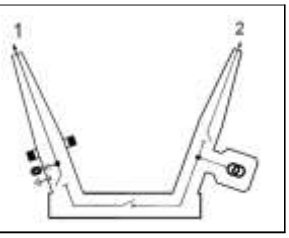
Local code	Type Code	GSCH002 SubCode	Description			
Tab UE DY107/8	GSCH002/1000	162358	HM SB 72,5kV A-A TPO LINE CT400	Bay	Q.ty	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/604	Current Transformer 200-400/1 72,5 kV	1	1	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	2	1	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	2	1	
		GSCH002/311	Disconnector 72,5 kV	2	1	
		GSCH002/804	Support - Single-bay type 72,5 kV	-	1	
		GSCH002/903	Control Box - Single-bay type	-	1	
Local code	Type Code	GSCH002 SubCode	Description			
Tab UE DY107/2	GSCH002/1018	150070	HM SB 170kV A-A TPO TRAFO CT400	Bay	Q.ty	
		GSCH002/013	Lateral bay - With circuit-breaker - Air_connection - 170 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/607	Current Transformer 200-400/1/1 (5P30/5P30)	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/262	Circuit-breaker drive mechanism - Three_pole - 1°, 3° opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	2	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1	
		GSCH002/312	Disconnector 145-170 kV	2	1	
		GSCH002/805	Support - Single-bay type 145-170 kV	-	1	
		GSCH002/903	Control Box - Single-bay type	-	1	
Local code	Type Code	GSCH002 SubCode	Description			
Tab UE DY107/7	GSCH002/1018	150071	HM SB 170kV A-A SPO LINE CT1600	Bay	Q.ty	
		GSCH002/013	Lateral bay - With circuit-breaker - Air_connection - 170 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/608	Current Transformer 400-800-1.600/1/1 (5P30/5P30)	1	1	
		GSCH002/212	Circuit-breaker drive mechanism - Single_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	2	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1	
		GSCH002/312	Disconnector 145-170 kV	2	1	
		GSCH002/805	Support - Single-bay type 145-170 kV	-	1	
		GSCH002/903	Control Box - Single-bay type	-	1	
Local code	Type Code	GSCH002 SubCode	Description			
Tab UE DY106/1	GSCH002/1024	150072	HM SF6FREE170kV AAA SPOTPO Y2 CT1600-400	Bay	Q.ty	
		GSCH002/013	Lateral bay - with circuit breaker - Air connection - 170 kV	1	1	
		GSCH002/425	Bushing Green Air class "e" - 145 kV-170 kV	1	1	
		GSCH002/322	Disconnector with earthing switch 145 kV - 170 kV	1	1	
		GSCH002/608	Current trasformer 400-800-1600/1/1 (5P30/5P30)	1	1	
		GSCH002/212	Circuit breaker mechanism - Single pole - 1°, 2° opening circuit - 145 kV-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit breaker - Air connection - 145 kV- 170 kV	2	1	
		GSCH002/322	Disconnector with earthing switch 145 kV - 170 kV	2	1	
		GSCH002/425	Bushing Green Air class "e" - 145 kV-170 kV	2	1	
		GSCH002/700	EVDS - Electronics Voltage Detector System (capacitive divideders included)	2	1	
		GSCH002/013	Lateral bay - with circuit breaker - Air connection - 170 kV	3	1	
		GSCH002/425	Bushing Green Air class "e" - 145 kV-170 kV	3	1	
		GSCH002/322	Disconnector with earthing switch 145 kV - 170 kV	3	1	
		GSCH002/607	Current trasformer 200-400/1/1	3	1	
		GSCH002/700	EVDS - Electronics Voltage Detector System (capacitive divideders included)	3	1	
		GSCH002/262	Circuit breaker mechanism - Three pole - 1°, 3° opening circuit - 145 kV-170 kV	3	1	
		GSCH002/802	Support - Y2 type - 145 kV-170kV	-	1	
		GSCH002/902	Control Box - Y2 type	-	1	
Local code	Type Code	GSCH002 SubCode	Description			
Tab UE DY107/2	GSCH002/1018	150074	HM SF6FREE 170kV AA TPO SB TRAFO CT400	Bay	Q.ty	
		GSCH002/013	Lateral bay - With circuit-breaker - Air_connection - 170 kV	1	1	
		GSCH002/425	Bushing Green Air class "e" - 145 kV-170 kV	1	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/607	Current Transformer 200-400/1/1 (5P30/5P30)	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/262	Circuit-breaker drive mechanism - Three_pole - 1°, 3° opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	2	1	
		GSCH002/425	Bushing Green Air class "e" - 145 kV-170 kV	2	1	
		GSCH002/312	Disconnector 145-170 kV	2	1	
		GSCH002/805	Support - Single-bay type 145-170 kV	-	1	
		GSCH002/903	Control Box - Single-bay type	-	1	
Local code	Type Code	GSCH002 SubCode	Description			
Tab UE DY107/7	GSCH002/1018	150073	HM SF6FREE 170kV AA SPO SB LINE CT1600	Bay	Q.ty	
		GSCH002/013	Lateral bay - With circuit-breaker - Air_connection - 170 kV	1	1	
		GSCH002/425	Bushing Green Air class "e" - 145 kV-170 kV	1	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/608	Current Transformer 400-800-1.600/1/1 (5P30/5P30)	1	1	
		GSCH002/212	Circuit-breaker drive mechanism - Single_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	2	1	
		GSCH002/425	Bushing Green Air class "e" - 145 kV-170 kV	2	1	
		GSCH002/312	Disconnector 145-170 kV	2	1	
		GSCH002/805	Support - Single-bay type 145-170 kV	-	1	
		GSCH002/903	Control Box - Single-bay type	-	1	

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

Local code	Type Code	GSCH002 SubCode	Description		
Tab UE DY107/2	GSCH002/1018	150076	HM SB 170kV A-A SPO REACTOR CT400	Bay	Q.ty
		GSCH002/013	Lateral bay - With circuit-breaker - Air_connection - 170 kV	1	1
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	1
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1
		GSCH002/607	Current Transformer 200-400/1/1 145-170 kV	1	1
		GSCH002/222	Circuit-breaker drive mechanism - Single_pole - 1°, 2°, 3° opening circuit - 145-170 kV	1	1
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	2	1
		GSCH002/703	Voltage Transformer 150kV	2	1
		GSCH002/312	Disconnector 145-170 kV	2	1
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1
		GSCH002/805	Support - Single-bay type 145-170 kV	-	1
		GSCH002/903	Control Box - Single-bay type	-	1



170kV - Variation in the cost if the base configuration change with:
1 One bay connection change from air to cable
2 Include one EVDS
3 Circuit-breaker drive mechanism change from Single-pole to Three-pole.
4 Include the VT GSCH002/702
5 Include the VT GSCH002/703
6 Include the CT GSCH002/604
7 Include the CT GSCH002/605

72,5kV - Variation in the cost if the base configuration change with:
1 One bay connection change from air to cable
2 Include one EVDS
3 Circuit-breaker drive mechanism change from Single-pole to Three-pole.
4 Include the VT GSCH002/701
5 Include the CT GSCH002/601

245kV - Variation in the cost if the base configuration change with:
1 One bay connection change from air to cable
2 Include one EVDS
3 Circuit-breaker drive mechanism change from Single-pole to Three-pole.
4 Include the VT GSCH002/704
5 Include the CT GSCH002/605
6 Include the CT GSCH002/608

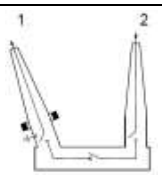
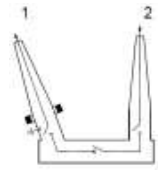
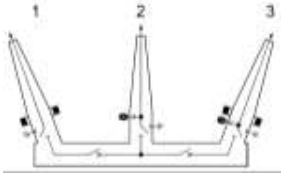
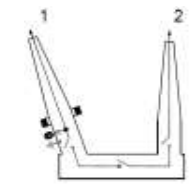
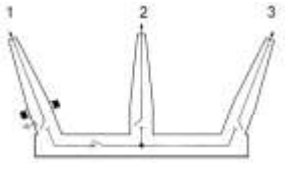
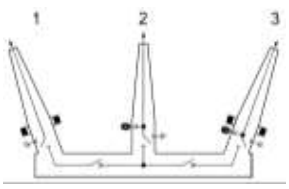
Material Specification code: GRI-GRI-MAT-E&C-0019

Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

SPAIN e-distribución

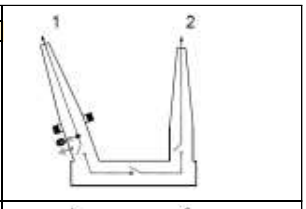
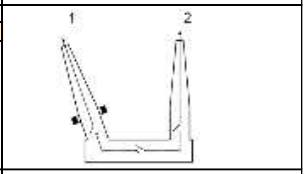
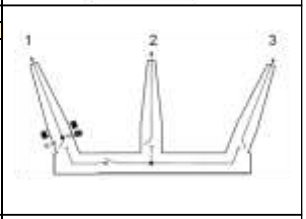
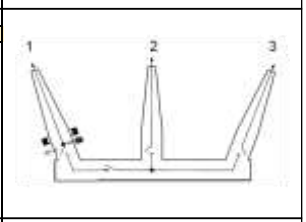
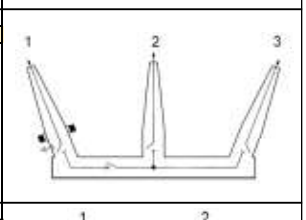
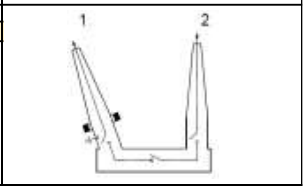
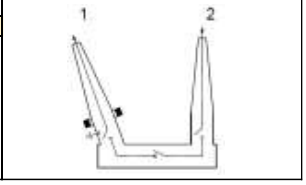
Hybrid Module: Configuration from base components						
Code		**TS**	**Description**	**Units/ Module**	**Bay**	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6705448	**GSCH002/1009**	**150457**	**HM SB 145kV TPO LINE A-A CT2000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+2	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (0,5–5P20; 5P20; 5P20)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/823	Support - Single-bay type 145 kV	1	-	
		GSCH002/924	Control Box - Single-bay type Line bay	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6705449	**GSCH002/1009**	**150458**	**HM SB 145kV TPO LINE A-A CT800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+2	
		GSCH002/622	Current Transformer 400-800/5/5/5	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/823	Support - Single-bay type 145 kV	1	-	
		GSCH002/924	Control Box - Single-bay type Line bay	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6708241	**GSCH002/1015**	**220034**	**HM Y2 145kV TPO-TPO A-A-A CT2000+800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	3	1+2+3	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	3	1+2+3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	2	1+3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	2	1+3	
		GSCH002/622	Current Transformer 400-800/5/5/5	1	3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/822	Support - Y2 type 145 kV	1	-	
		GSCH002/926	Control Box - Y2 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6705468	**GSCH002/1009**	**150466**	**HM SB 145kV TPO TRAFO A-A CT800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+2	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/622	Current Transformer 400-800/5/5/5	1	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/823	Support - Single-bay type 145 kV	1	-	
		GSCH002/925	Control Box - Single-bay type Transformer bay	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6705425	**GSCH002/1010**	**150444**	**HYBRID MODULE SINGLE BAY TYPE TR 145 kV CABLE-AIR**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	2	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/022	Lateral bay - With circuit-breaker - Cable_connection - 145 kV	1	1	
		GSCH002/622	Current Transformer 400-800/5/5/5	1	1	
		GSCH002/721	Voltage Transformer 132kV 145 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/465	Cable connection downward exit	1	1	
		GSCH002/823	Support - Single-bay type 145 kV	1	-	
		GSCH002/925	Control Box - Single-bay type Transformer bay	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6705446	**GSCH002/1012**	**150455**	**HYBRID MODULE Y1 LINE TYPE 145 kV AIR-AIR-AIR**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	2+3	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	3	
		GSCH002/821	Support - Y1 type 145 kV	1	-	
		GSCH002/921	Control Box - Y1 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6708263	**GSCH002/1006**	**220037**	**HYBRID MODULE Y2 TYPE 72,5 kV AIR-AIR-AIR**			
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5	1	1	
		GSCH002/622	Current Transformer 400-800/5/5/5	1	3	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	2	1+3	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	3	1+2+3	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	2	1+3	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	3	1+2+3	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/926	Control Box - Y2 type	1	-	
		GSCH002/826	Support - Single-bay type 72,5 kV	1	-	

Material Specification code: GRI-GRI-MAT-E&C-0019

Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

Local code	Type Code	GSCH002 SubCode	Description			
6705358	GSCH002/1000	150419	HM SB 72,5kV A-A TPO TRAFO CT2000			
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (0,5 5P20/5P20/5P20)	1	1	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	2	1+2	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/311	Disconnector 72,5 kV	1	2	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/925	Control Box - Single-bay type Transformer bay	1	-	
		GSCH002/826	Support - Single-bay type 72,5 kV	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
	GSCH002/1009	150553	HM SB 145kV A-A TPO COUPLING CT2000			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+2	
		GSCH002/623	Current Transformer 1.000-2.000/5/5 (5P20/5P20)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	2	1+2	
		GSCH002/823	Support - Single-bay type 145 kV	1	-	
		GSCH002/923	Control Box - Single-bay type Coupling bay	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
6705446	GSCH002/1012	150559	HM Y1 145kV A-A-A TPO TRAFO CT2000RPM			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	2+3	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/621	Current Transformer 1.000-2.000/5/5/5 (0,2s–FS<5/0,5 5P20/5P20/5P20)	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/821	Support - Y1 type 145 kV	1	-	
		GSCH002/921	Control Box - Y1 type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
6705446	GSCH002/1012	150558	HM Y1 145kV A-A-A TPO TRAFO CT2000			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	2+3	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (0,5 5P20/5P20/5P20)	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/821	Support - Y1 type 145 kV	1	-	
		GSCH002/921	Control Box - Y1 type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
6705446	GSCH002/1012	150557	HM Y1 145kV A-A-A TPO LINE CT800			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	2+3	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/622	Current Transformer 400-800/5/5/5 (0,5 5P20/5P20/5P20)	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	3	
		GSCH002/821	Support - Y1 type 145 kV	1	-	
		GSCH002/921	Control Box - Y1 type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
	GSCH002/1000	94518	HM SB 72,5kV A-A TPO LINE CT2000			
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (0,5 5P20/5P20/5P20)	1	1	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	2	1+2	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/311	Disconnector 72,5 kV	1	2	
		GSCH002/924	Control Box - Single-bay type Line bay	1	-	
		GSCH002/826	Support - Single-bay type 72,5 kV	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
	GSCH002/1000	94519	HM SB 72,5kV A-A TPO LINE CT800			
		GSCH002/622	Current Transformer 400-800/5/5/5 (0,5 5P20/5P20/5P20)	1	1	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	2	1+2	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/311	Disconnector 72,5 kV	1	2	
		GSCH002/924	Control Box - Single-bay type Line bay	1	-	
		GSCH002/826	Support - Single-bay type 72,5 kV	1	-	

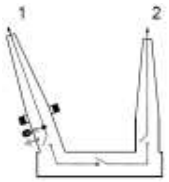
Material Specification code: GRI-GRI-MAT-E&C-0019

Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

Local code	Type Code	GSCH002 SubCode	Description		
	GSCH002/1000	94520	HM SB 72,5kV A-A TPO TRAFO CT800		
		GSCH002/622	Current Transformer 400-800/5/5/5 (0,5 5P20/5P20/5P20)	1	1
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	2	1+2
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2
		GSCH002/311	Disconnector 72,5 kV	1	2
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1
		GSCH002/925	Control Box - Single-bay type Transformer bay	1	-
		GSCH002/826	Support - Single-bay type 72,5 kV	1	-



SINGLE BAY - Variation in the cost if the base configuration change with:

1 One bay connection change from air to cable
2 Include one EVDS
3 Circuit-breaker drive mechanism change from Single-pole to Three-pole.
4 Include the VT GSCH002/721
5 Include the VT GSCH002/722
6 Include the CT GSCH002/622
7 Include the CT GSCH002/620

Y2 TYPE - Variation in the cost if the base configuration change with:

1 One bay connection change from air to cable
2 Include one EVDS
3 Circuit-breaker drive mechanism change from Single-pole to Three-pole.
4 Include the CT GSCH002/622
5 Include the CT GSCH002/620

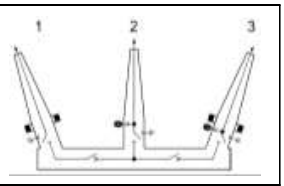
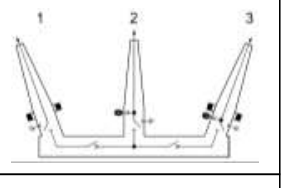
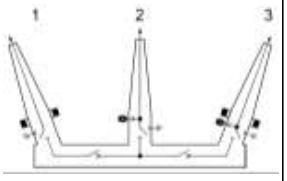
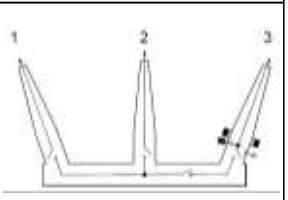
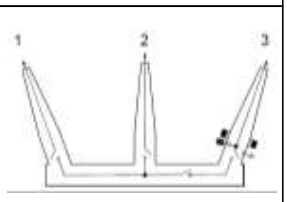
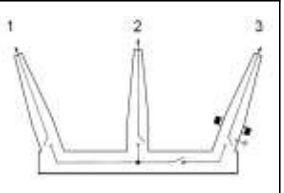
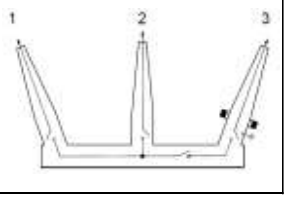
Material Specification code: GRI-GRI-MAT-E&C-0019

Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

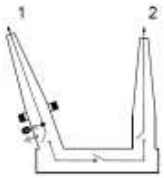
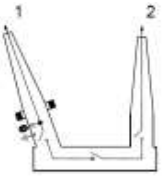
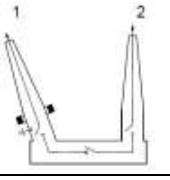
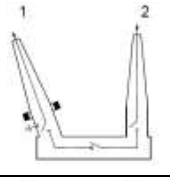
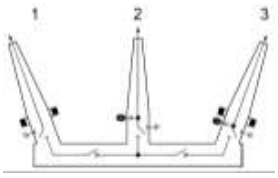
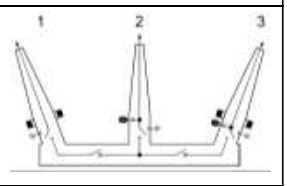
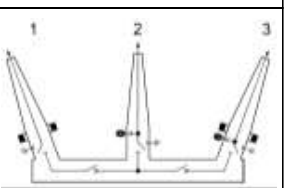
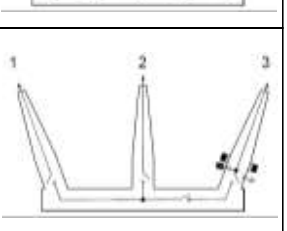
BRAZIL Rio (Ampla)

Hybrid Module: Configuration from base components						
Code	**TS**		**Description**	**Units/ Module**	**Bay**	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6815218	**GSCH002/1015**	**150800**	**HM Y2 145kV AIR-AIR-AIR TI:2000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	3	1+2+3	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	2	1+3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	2	1+3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	2	1+3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/894	Support - Y2 type 145 kV	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150103	**GSCH002/1015**	**150855**	**HM Y2 145kV AIR-AIR-AIR TI:800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	3	1+2+3	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	2	1+3	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	2	1+3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	2	1+3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/894	Support - Y2 type 145 kV	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150104	**GSCH002/1015**	**601012**	**HM Y2 145kV AIR-AIR-AIR TI:2000 y 800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	3	1+2+3	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	2	1+3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	2	1+3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/894	Support - Y2 type 145 kV	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6815217	**GSCH002/1012**	**150799**	**HM Y1 145kV AIR-AIR TPO TRAFO TI 800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	3	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	1+2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	3	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	3	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	1	
		GSCH002/892	Support - Y1 type 145 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150102	**GSCH002/1012**	**601009**	**HM Y1 145kV AIR-AIR TPO TRAFO TI 2000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	3	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	1+2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	3	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	1	
		GSCH002/892	Support - Y1 type 145 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150101	**GSCH002/1012**	**601008**	**HM Y1 145kV AIR-AIR TPO LINE TI 2000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	3	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	1+2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	3	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	1	
		GSCH002/892	Support - Y1 type 145 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150015	**GSCH002/1012**	**601007**	**HM Y1 145kV AIR-AIR TPO LINE TI 800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	3	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	1+2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	3	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	3	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	1	
		GSCH002/892	Support - Y1 type 145 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

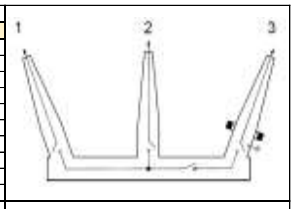
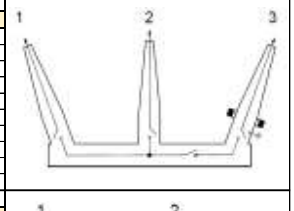
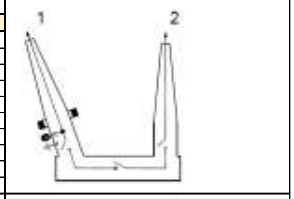
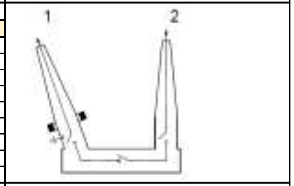
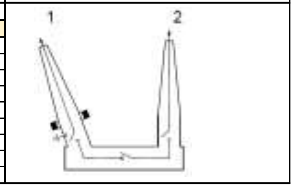
Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

Local code	Type Code	GSCH002 SubCode	Description			
6815216	GSCH002/1009	150798	HM SB 145kV AIR-AIR TPO TRAFO TI 800			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	2	1+2	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/896	Support - Single-bay type 145 kV	1	-	
		GSCH002/933	Control Box - Single-bay type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
T150003	GSCH002/1009	601001	HM SB 145kV AIR-AIR TPO TRAFO TI 2000			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	2	1+2	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/896	Support - Single-bay type 145 kV	1	-	
		GSCH002/933	Control Box - Single-bay type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
T150110	GSCH002/1009	601002	HM SB 145kV AIR-AIR TPO LINE TI 2000			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	2	1+2	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/896	Support - Single-bay type 145 kV	1	-	
		GSCH002/933	Control Box - Single-bay type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
T150111	GSCH002/1009	601003	HM SB 145kV AIR-AIR TPO LINE TI 800			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	2	1+2	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/896	Support - Single-bay type 145 kV	1	-	
		GSCH002/933	Control Box - Single-bay type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
6815291	GSCH002/1006	150803	HM Y2 72,5kV AIR-AIR-AIR TI:2000			
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	2	1+3	
		GSCH002/421	Bushing SF6/air class “e” 72,5 kV	3	1+2+3	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	2	1+3	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	3	1+2+3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	2	1+3	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/893	Support - Y2 type 72,5 kV	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
T150108	GSCH002/1006	601013	HM Y2 72,5kV AIR-AIR-AIR TI:800			
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	2	1+3	
		GSCH002/421	Bushing SF6/air class “e” 72,5 kV	3	1+2+3	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	2	1+3	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	3	1+2+3	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	2	1+3	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/893	Support - Y2 type 72,5 kV	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
T150109	GSCH002/1006	601014	HM Y2 72,5kV AIR-AIR-AIR TI:2000 y 800			
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	2	1+3	
		GSCH002/421	Bushing SF6/air class “e” 72,5 kV	3	1+2+3	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	2	1+3	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	3	1+2+3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	3	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/893	Support - Y2 type 72,5 kV	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
6815290	GSCH002/1003	150802	HM Y1 72,5kV AIR-AIR TPO TRAFO TI 800			
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	3	
		GSCH002/931	Control Box - Y1 type	1	-	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	3	
		GSCH002/421	Bushing SF6/air class “e” 72,5 kV	3	1+2+3	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	3	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	3	
		GSCH002/331	Disconnector 72,5 kV with ability of Bus-transfer current switching	2	1+2	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	3	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/061	Lateral bay - Without circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/891	Support - Y1 type 72,5 kV	1	-	

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

Local code	Type Code	GSCH002 SubCode	Description			
T150112	GSCH002/1003	601010	HM Y1 72,5kV AIR-AIR TPO LINE TI 2000			
		GSCH002/931	Control Box - Y1 type	1	-	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	3	
		GSCH002/421	Bushing SF6/air class “e” 72,5 kV	3	1+2+3	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	3	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	3	
		GSCH002/331	Disconnector 72,5 kV with ability of Bus-transfer current switching	2	1+2	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	3	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/061	Lateral bay - Without circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/891	Support - Y1 type 72,5 kV	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
T150113	GSCH002/1003	601011	HM Y1 72,5kV AIR-AIR TPO LINE TI 800			
		GSCH002/931	Control Box - Y1 type	1	-	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	3	
		GSCH002/421	Bushing SF6/air class “e” 72,5 kV	3	1+2+3	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	3	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	3	
		GSCH002/331	Disconnector 72,5 kV with ability of Bus-transfer current switching	2	1+2	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	3	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/061	Lateral bay - Without circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/891	Support - Y1 type 72,5 kV	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
6815219	GSCH002/1000	150801	HM SB 72,5kV AIR-AIR TPO TRAFO TI 800			
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	1	
		GSCH002/933	Control Box - Single-bay type	1	-	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/421	Bushing SF6/air class “e” 72,5 kV	2	1+2	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/311	Disconnector 72,5 kV	1	2	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/895	Support - Single-bay type 72,5 kV	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
T150114	GSCH002/1000	601005	HM SB 72,5kV AIR-AIR TPO LINE TI 2000			
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/933	Control Box - Single-bay type	1	-	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/421	Bushing SF6/air class “e” 72,5 kV	2	1+2	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/311	Disconnector 72,5 kV	1	2	
		GSCH002/895	Support - Single-bay type 72,5 kV	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
T150115	GSCH002/1000	601006	HM SB 72,5kV AIR-AIR TPO LINE TI 800			
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	1	
		GSCH002/933	Control Box - Single-bay type	1	-	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/421	Bushing SF6/air class “e” 72,5 kV	2	1+2	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/311	Disconnector 72,5 kV	1	2	
		GSCH002/895	Support - Single-bay type 72,5 kV	1	-	

145kV - Variation in the cost if the base configuration change with:

1 One bay connection change from air to cable
2 Include one EVDS
3 Circuit-breaker drive mechanism change from Three-pole to Single-pole
4 Include the VT GSCH002/702
5 Include the VT GSCH002/711
6 Include the VT GSCH002/721
7 Include the VT GSCH002/722
8 Include CT GSCH002/605
9 Include CT GSCH002/621

72,5kV- Variation in the cost if the base configuration change with:

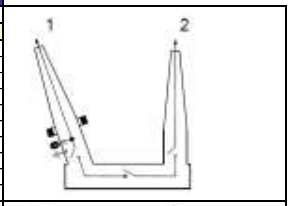
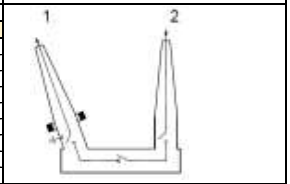
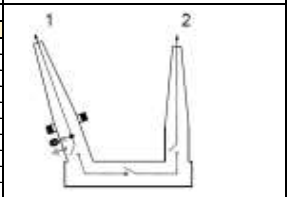
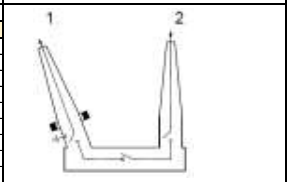
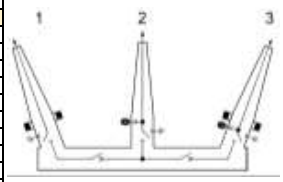
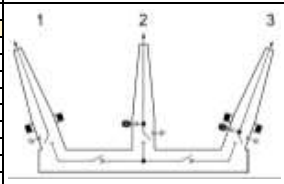
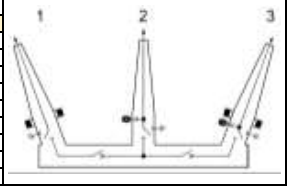
1 One bay connection change from air to cable
2 Include one EVDS
3 Circuit-breaker drive mechanism change from Three-pole to Single-pole
4 Include the VT GSCH002/701
5 Include CT GSCH002/602
6 Include CT GSCH002/601
7 Include CT GSCH002/621

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

BRAZIL Ceara (Coelce)

Hybrid Module: Configuration from base components						
Code	**TS**		**Description**	**Units/ Module**	**Bay**	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150106	**GSCH002/1000**	**150856**	**HM SB 72,5kV A-A TPO TRAFO TI:2000**			
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/933	Control Box - Single-bay type	1	-	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/421	Bushing SF6/air class "e" 72,5 Kv	2	1+2	
		GSCH002/311	Disconnector 72,5 kV	1	2	
		GSCH002/863	Support - Single-bay type 72,5 kV	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150107	**GSCH002/1000**	**150857**	**HM SB 72,5kV AIR-AIR TPO LINE TI:2000**			
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/933	Control Box - Single-bay type	1	-	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	2	1+2	
		GSCH002/311	Disconnector 72,5 kV	1	2	
		GSCH002/863	Support - Single-bay type 72,5 kV	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6811997	**GSCH002/1000**	**111683**	**HM SB 72,5kV AIR-AIR TPO TRAFO TI:800**			
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/933	Control Box - Single-bay type	1	-	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	2	1+2	
		GSCH002/311	Disconnector 72,5 kV	1	2	
		GSCH002/863	Support - Single-bay type 72,5 kV	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150105	**GSCH002/1000**	**601004**	**HM SB 72,5kV AIR-AIR TPO LINE TI:800**			
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	1	
		GSCH002/933	Control Box - Single-bay type	1	-	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	1	1	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	1	1	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	1	1	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	2	1+2	
		GSCH002/311	Disconnector 72,5 kV	1	2	
		GSCH002/863	Support - Single-bay type 72,5 kV	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150004	**GSCH002/1006**	**150956**	**HM Y2 72,5kV A-A-A TPO-TPO CT2000+800**			
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	2	1+3	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	3	1+2+3	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	2	1+3	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	3	1+2+3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	3	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/862	Support - Y2 type 72,5 kV – Coelce	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150005	**GSCH002/1006**	**150804**	**HM Y2 72,5kV AIR-AIR-AIR TI:800**			
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	2	1+3	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	3	1+2+3	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	2	1+3	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	3	1+2+3	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	2	1+3	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/862	Support - Y2 type 72,5 kV – Coelce	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150006	**GSCH002/1006**	**150957**	**HM Y2 72,5kV AIR-AIR-AIR TI:2000**			
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/011	Lateral bay - With circuit-breaker - Air_connection - 72,5 kV	2	1+3	
		GSCH002/421	Bushing SF6/air class "e" 72,5 kV	3	1+2+3	
		GSCH002/281	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 72,5 kV	2	1+3	
		GSCH002/321	Disconnector with earthing switch 72,5 kV	3	1+2+3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	2	1+3	
		GSCH002/111	Central bay - Without circuit-breaker - Air_connection - 72,5 kV	1	2	
		GSCH002/862	Support - Y2 type 72,5 kV – Coelce	1	-	

72,5kV- Variation in the cost if the base configuration change with:

1 One bay connection change from air to cable
2 Include one EVDS
3 Circuit-breaker drive mechanism change from Three-pole to Single-pole
4 Include the VT GSCH002/701
5 Include CT GSCH002/602
6 Include CT GSCH002/601
7 Include CT GSCH002/621
8 Include CT GSCH002/608
9 Include CT GSCH002/612
10 Include CT GSCH002/623

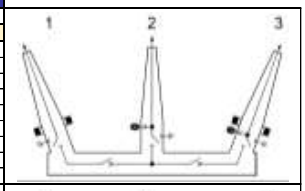
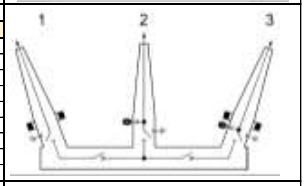
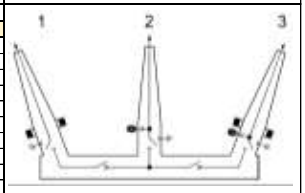
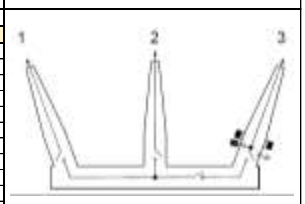
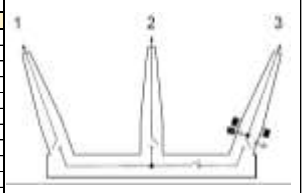
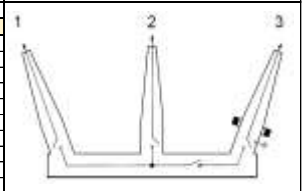
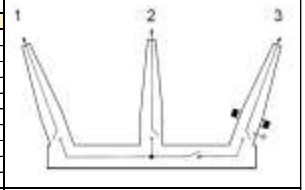
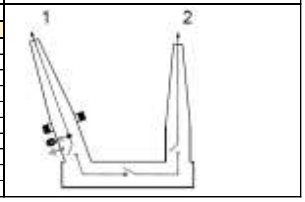
Material Specification code: GRI-GRI-MAT-E&C-0019

Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

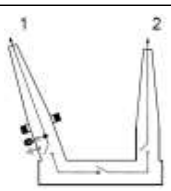
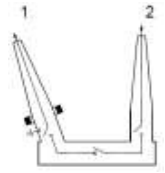
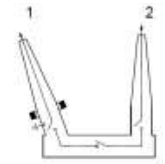
BRAZIL São Paolo

Hybrid Module: Configuration from base components						
Code	**TS**		**Description**	**Units/ Module**	**Bay**	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6815218	**GSCH002/1015**	**150800**	**HM Y2 145kV AIR-AIR-AIR TI:2000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	3	1+2+3	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	2	1+3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	2	1+3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	2	1+3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/894	Support - Y2 type 145 kV	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150103	**GSCH002/1015**	**150855**	**HM Y2 145kV AIR-AIR-AIR TI:800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	3	1+2+3	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	2	1+3	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	2	1+3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	2	1+3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/894	Support - Y2 type 145 kV	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150104	**GSCH002/1015**	**601012**	**HM Y2 145kV AIR-AIR-AIR TI:2000 y 800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	3	1+2+3	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/932	Control Box - Y2 type	1	-	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	2	1+3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	2	1+3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/894	Support - Y2 type 145 kV	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6815217	**GSCH002/1012**	**150799**	**HM Y1 145kV AIR-AIR TPO TRAFO TI 800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	3	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	1+2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	3	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	3	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	1	
		GSCH002/892	Support - Y1 type 145 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150102	**GSCH002/1012**	**601009**	**HM Y1 145kV AIR-AIR TPO TRAFO TI 2000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	3	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	1+2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	3	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	1	
		GSCH002/892	Support - Y1 type 145 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150101	**GSCH002/1012**	**601008**	**HM Y1 145kV AIR-AIR TPO LINE TI 2000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	3	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	1+2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	3	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	3	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	1	
		GSCH002/892	Support - Y1 type 145 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T150015	**GSCH002/1012**	**601007**	**HM Y1 145kV AIR-AIR TPO LINE TI 800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	3	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	2	1+2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	3	1+2+3	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	3	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	3	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	1	
		GSCH002/892	Support - Y1 type 145 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
6815216	**GSCH002/1009**	**150798**	**HM SB 145kV AIR-AIR TPO TRAFO TI 800**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class “e” 145-170 kV	2	1+2	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/896	Support - Single-bay type 145 kV	1	-	
		GSCH002/933	Control Box - Single-bay type	1	-	

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

Local code	Type Code	GSCH002 SubCode	Description			
T150003	GSCH002/1009	601001	HM SB 145kV AIR-AIR TPO TRAFO TI 2000			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+2	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/896	Support - Single-bay type 145 kV	1	-	
		GSCH002/933	Control Box - Single-bay type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
T150110	GSCH002/1009	601002	HM SB 145kV AIR-AIR TPO LINE TI 2000			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+2	
		GSCH002/620	Current Transformer 1.000-2.000/5/5/5 (3 cores)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/896	Support - Single-bay type 145 kV	1	-	
		GSCH002/933	Control Box - Single-bay type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
T150111	GSCH002/1009	601003	HM SB 145kV AIR-AIR TPO LINE TI 800			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+2	
		GSCH002/622	Current Transformer 400-800/5/5/5 (3 cores)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/896	Support - Single-bay type 145 kV	1	-	
		GSCH002/933	Control Box - Single-bay type	1	-	

145kV - Variation in the cost if the base configuration change with:

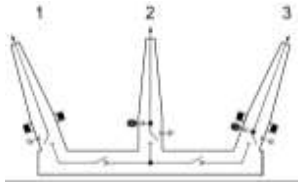
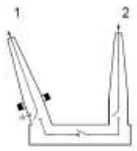
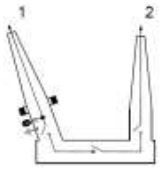
1 One bay connection change from air to cable
2 Include one EVDS
3 Circuit-breaker drive mechanism change from Three-pole to Single-pole
4 Include the VT GSCH002/702
5 Include the VT GSCH002/711
6 Include the VT GSCH002/721
7 Include the VT GSCH002/722
8 Include CT GSCH002/605
9 Include CT GSCH002/621

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

COLOMBIA Codensa

Hybrid Module: Configuration from base components						
Code		**TS**	**Description**	**Units/ Module**	**Bay**	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
	GSCH002/1015	**150153**	**HM Y2 145kV TPO-TPO A-A-A CT2000+400+800+2000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	3	1+2+3	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	3	1+2+3	
		GSCH002/620	Current Transformer 1000-2000/5/5/5A (0.5–5P20/5P20/5P20)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	2	1+3	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	2	1+3	
		GSCH002/613	Current Transformer 200-400/5 (0,2s–FS<5)	1	3	
		GSCH002/614	Current Transformer 400-800/5/5 (5P30/5P30)	1	3	
		GSCH002/615	Current Transformer 1000-2000/5 (5P20)	1	3	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	2+3	
		GSCH002/872	Support - Y2 type 145 kV	1	-	
		GSCH002/932	Control Box - Y2 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
	GSCH002/1009	**150154**	**HM SB 145kV TPO LINE A-A CT2000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+2	
		GSCH002/620	Current Transformer 1000-2000/5/5/5A (0,5–5P20/5P20/5P20)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/873	Support - Single-bay type 145 kV	1	-	
		GSCH002/933	Control Box - Single-bay	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
	GSCH002/1009	**150152**	**HM SB 145kV A-A TPO TRAFO CT400+800+2000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+2	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/613	Current Transformer 200-400/5 (0,2s–FS<5)	1	1	
		GSCH002/614	Current Transformer 400-800/5/5 (5P30/5P30)	1	1	
		GSCH002/615	Current Transformer 1000-2000/5 (5P20)	1	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/873	Support - Single-bay type 145 kV	1	-	
		GSCH002/933	Control Box - Single-bay	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
	GSCH002/1009	**150146**	**HM SB 145kV A-A TPO COUPLING CT2000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+2	
		GSCH002/623	Current Transformer 1000-2000/5/5 (5P20/5P20)	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	2	1+2	
		GSCH002/823	Support - Single-bay type 145 kV	1	-	
		GSCH002/923	Control Box - Single-bay type Coupling bay	1	-	

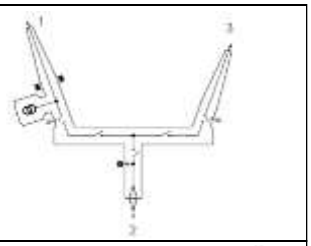
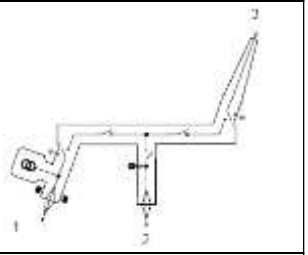
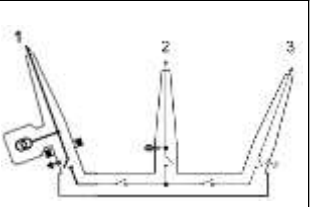
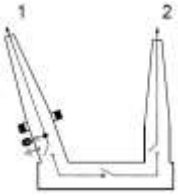
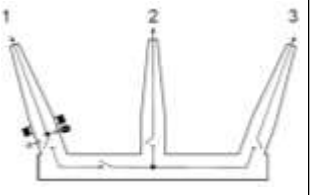
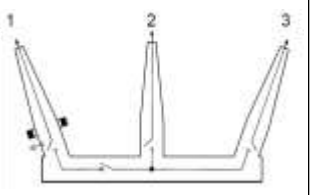
145kV- Variation in the cost if the base configuration change with:
1 One bay connection change from air to cable
2 Include one EVDS
3 Circuit-breaker drive mechanism change from Three-pole to Single-pole
4 Include the VT GSCH002/702
5 Include the VT GSCH002/711
6 Include the VT GSCH002/721
7 Include the VT GSCH002/722
8 Include CT GSCH002/606
9 Include CT GSCH002/612
10 Include CT GSCH002/621

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

ARGENTINA Edesur

Hybrid Module: Configuration from base components						
Code	**TS**		**Description**	**Units/ Module**	**Bay**	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
P-8008	**GSCH002/1016**	**0103-2786**	**HM Y2 145kV A-C-A TPO-TPO CT800 VT132**			
Q-3819		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	2	1+3	
		GSCH002/122	Central bay - Without circuit-breaker - Cable_connection - 145-170 kV	1	2	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	2	1+3	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	2	1+3	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+3	
		GSCH002/465	Cable connection downward exit 145-170 kV	1	2	
		GSCH002/612	Current Transformer 400-800/5/1/1 (3 cores)	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	2	
		GSCH002/721	Voltage Transformer 145kV 132:√3/0,11:√3 0,5-3P/0,5-3P	1	1	
		GSCH002/843	Support - Y2 type 145 kV	1	-	
		GSCH002/932	Control Box - Y2 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
T-3817	**GSCH002/1016**	**0103-2787**	**HYBRID MODUL Y2 TYPE 145 kV C-C-A**			
		GSCH002/022	Lateral bay - With circuit-breaker - Cable_connection - 145 kV	1	1	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	3	
		GSCH002/122	Central bay - Without circuit-breaker - Cable_connection - 145-170 kV	1	2	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	2	1+3	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	2	1+3	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	3	
		GSCH002/465	Cable connection downward exit 145-170 kV	2	1+2	
		GSCH002/612	Current Transformer 400-800/5/1/1 (3 cores)	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	2	
		GSCH002/721	Voltage Transformer 145kV 132:√3/0,11:√3 0,5-3P/0,5-3P	1	1	
		GSCH002/843	Support - Y2 type 145 kV	1	-	
		GSCH002/932	Control Box - Y2 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
Q-3800	**GSCH002/1015**	**0103-2788**	**HM Y2 145kV A-A-A TPO-TPO CT800 VT132**			
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	2	1+3	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	2	1+3	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	2	1+3	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	3	1+2+3	
		GSCH002/612	Current Transformer 400-800/5/1/1 (3 cores)	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	2	
		GSCH002/721	Voltage Transformer 145kV 132:√3/0,11:√3 0,5-3P/0,5-3P	1	1	
		GSCH002/843	Support - Y2 type 145 kV	1	-	
		GSCH002/932	Control Box - Y2 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
49729	**GSCH002/1009**	**0107-0106**	**HM SB 145kV A-A TPO TRAFO CT1000**			
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	2	1+2	
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/625	Current Transformer 600-1000/1/1/1/1	1	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/845	Support - Single-bay type 145 kV	1	-	
		GSCH002/933	Control Box - Single-bay type Transformer bay	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
	GSCH002/1030		**HM Y1 245kV A-A-A TRAFO SPO (TPO actuation) TI 2000**			
		GSCH002/014	Lateral bay - With circuit-breaker - Air_connection - 245 kV	1	1	
		GSCH002/423	Bushing SF6/air class "e" 245 kV	1	1	
		GSCH002/632	Current Transformer 1000-2000/1/1/1	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/323	Disconnector with earthing switch 245 kV	1	1	
		GSCH002/213	Circuit-breaker drive mechanism - Single_pole - 1°, 2° opening circuit - 245 kV	1	1	
		GSCH002/113	Central bay - Without circuit-breaker - Air_connection - 245 kV	1	2	
		GSCH002/423	Bushing SF6/air class "e" 245 kV	1	2	
		GSCH002/333	Disconnector 245 kV with ability of Bus-transfer current switching	1	2	
		GSCH002/063	Lateral bay - Without circuit-breaker - Air_connection - 245 kV	1	3	
		GSCH002/423	Bushing SF6/air class "e" 245 kV	1	3	
		GSCH002/333	Disconnector 245 kV with ability of Bus-transfer current switching	1	3	
		GSCH002/842	Support - Y1 type 245 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	
Local code	**Type Code**	**GSCH002 SubCode**	**Description**			
	GSCH002/1030		**HM Y1 245kV A-A-A LINE SPO TI 2000**			
		GSCH002/014	Lateral bay - With circuit-breaker - Air_connection - 245 kV	1	1	
		GSCH002/423	Bushing SF6/air class "e" 245 kV	1	1	
		GSCH002/629	Current Transformer 1000-2000/1/1/1	1	1	
		GSCH002/630	Current Transformer 1000-2000/1	1	1	
		GSCH002/323	Disconnector with earthing switch 245 kV	1	1	
		GSCH002/213	Circuit-breaker drive mechanism - Single_pole - 1°, 2° opening circuit - 245 kV	1	1	
		GSCH002/113	Central bay - Without circuit-breaker - Air_connection - 245 kV	1	2	
		GSCH002/423	Bushing SF6/air class "e" 245 kV	1	2	
		GSCH002/333	Disconnector 245 kV with ability of Bus-transfer current switching	1	2	
		GSCH002/063	Lateral bay - Without circuit-breaker - Air_connection - 245 kV	1	3	
		GSCH002/423	Bushing SF6/air class "e" 245 kV	1	3	
		GSCH002/333	Disconnector 245 kV with ability of Bus-transfer current switching	1	3	
		GSCH002/842	Support - Y1 type 245 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	

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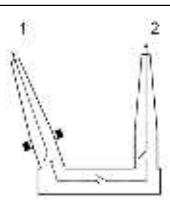
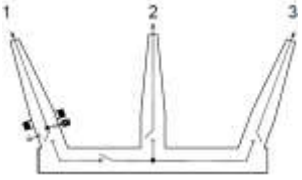
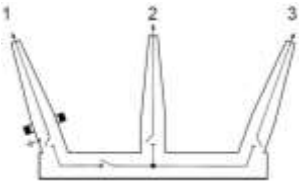
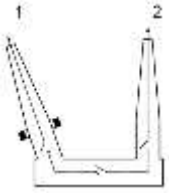
Service Function: -
Business Line: *Enel Grids*

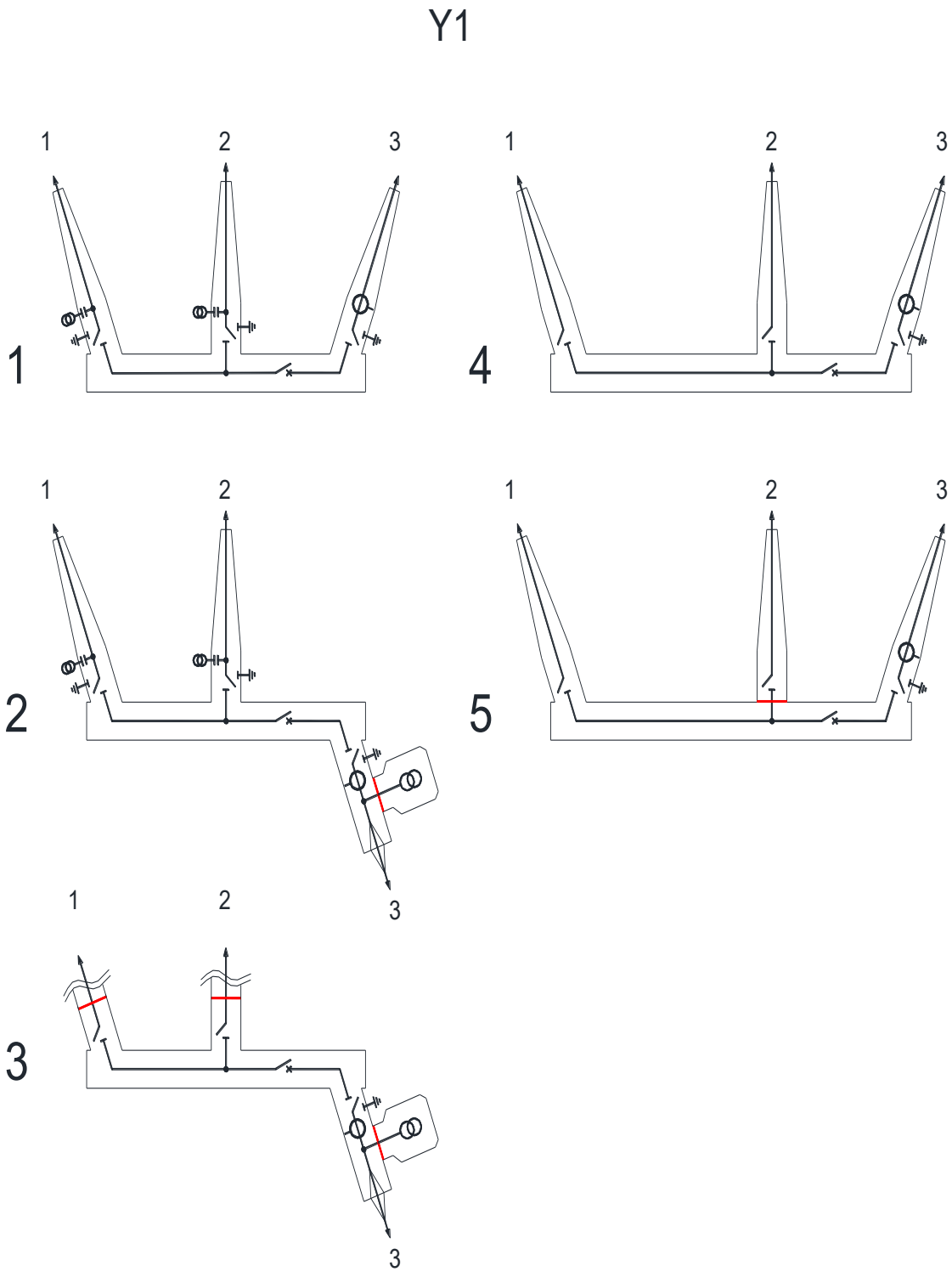
Local code	Type Code	GSCH002 SubCode	Description			
	GSCH002/1027		HM SB 245kV A-A COUPLING SPO (TPO actuation) TI 2000			
		GSCH002/014	Lateral bay - With circuit-breaker - Air_connection - 245 kV	1	1	
		GSCH002/423	Bushing SF6/air class "e" 245 kV	1	1	
		GSCH002/631	Current Transformer 2000/1/1	1	1	
		GSCH002/313	Disconnector 245 kV	1	1	
		GSCH002/213	Circuit-breaker drive mechanism - Single_pole - 1°, 2° opening circuit - 245 kV	1	1	
		GSCH002/113	Central bay - Without circuit-breaker - Air_connection - 245 kV	1	2	
		GSCH002/423	Bushing SF6/air class "e" 245 kV	1	2	
		GSCH002/313	Disconnector 245 kV	1	2	
		GSCH002/846	Support - SB type 245 kV	1	-	
		GSCH002/933	Control Box - SB type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
	GSCH002/1012		HM Y1 145kV A-A-A TRAFO TPO TI 2000			
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	1	
		GSCH002/632	Current Transformer 1000-2000/1/1/1	1	1	
		GSCH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	1	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	2	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	1	2	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	3	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	3	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	1	3	
		GSCH002/841	Support - Y1 type 145 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
	GSCH002/1012		HM Y1 145kV A-A-A LINE TPO TI 1000			
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	1	
		GSCH002/625	Current Transformer 600-1000/1/1/1/1	1	1	
		GSCH002/322	Disconnector with earthing switch 145-170 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	2	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	1	2	
		GSCH002/062	Lateral bay - Without circuit-breaker - Air_connection - 145-170 kV	1	3	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	3	
		GSCH002/332	Disconnector 145-170 kV with ability of Bus-transfer current switching	1	3	
		GSCH002/841	Support - Y1 type 145 kV	1	-	
		GSCH002/931	Control Box - Y1 type	1	-	
Local code	Type Code	GSCH002 SubCode	Description			
	GSCH002/1009		HM SB 145kV A-A COUPLING TPO TI 2000			
		GSCH002/012	Lateral bay - With circuit-breaker - Air_connection - 145 kV	1	1	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	1	
		GSCH002/631	Current Transformer 2000/1/1	1	1	
		GSCH002/312	Disconnector 145-170 kV	1	1	
		GSCH002/282	Circuit-breaker drive mechanism - Three_pole - 1°, 2° opening circuit - 145-170 kV	1	1	
		GSCH002/112	Central bay - Without circuit-breaker - Air_connection - 145-170 kV	1	2	
		GSCH002/422	Bushing SF6/air class "e" 145-170 kV	1	2	
		GSCH002/312	Disconnector 145-170 kV	1	2	
		GSCH002/845	Support - SB type 145 kV	1	-	
		GSCH002/933	Control Box - SB type	1	-	

Variation in the cost if the base configuration change with:

1 One bay connection change from air to cable
2 Include one EVDS
3 Circuit-breaker drive mechanism change from Three-pole to Single-pole
4 Include the VT GSCH002/702
5 Include the VT GSCH002/711
6 Include the VT GSCH002/721
7 Include the VT GSCH002/722
8 Include CT GSCH002/605
9 Include CT GSCH002/621

ANNEX B – LAYOUT EXAMPLES

B.1 – Examples of layout compositions with single line diagrams



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Service Function: -
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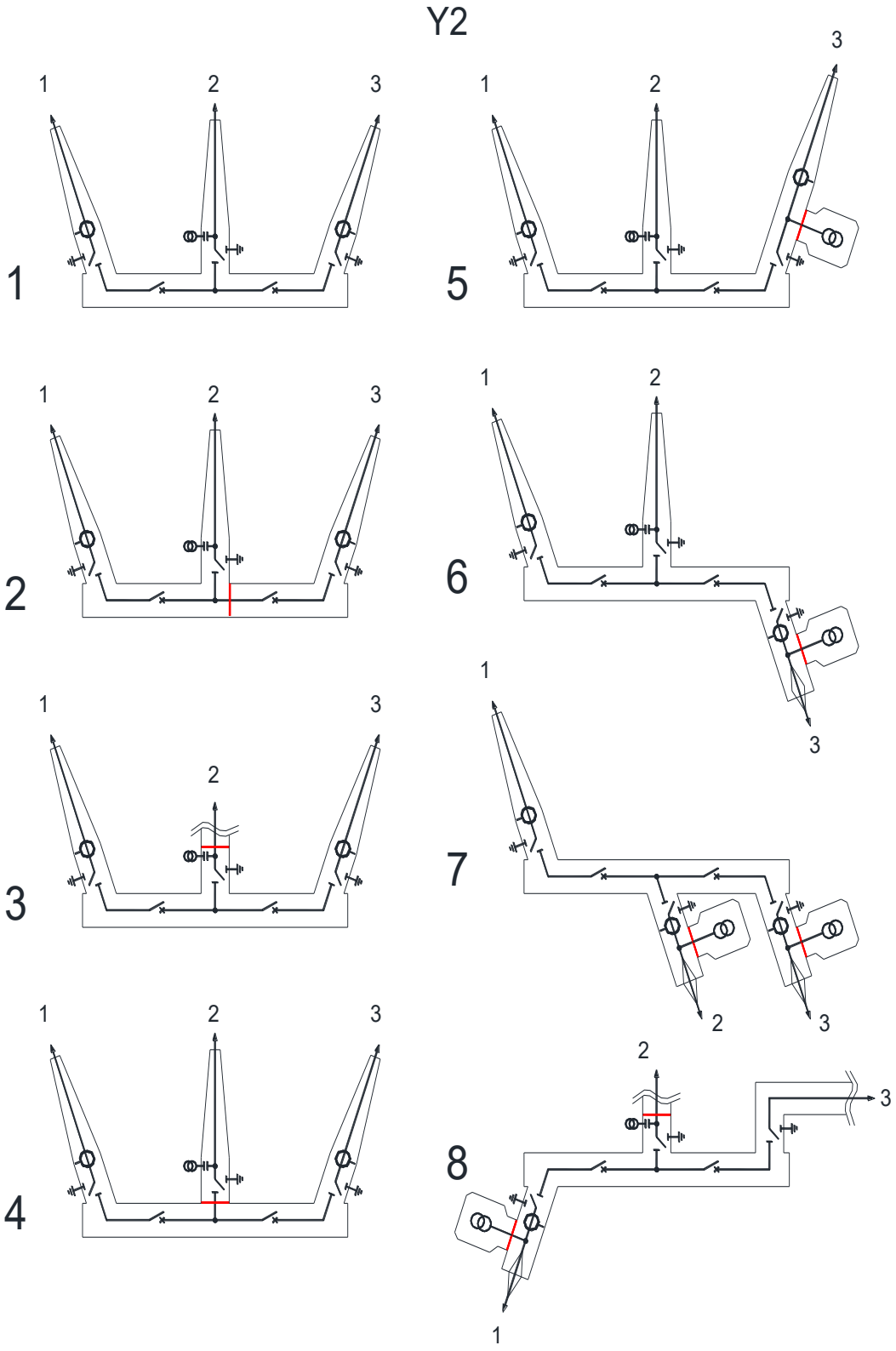
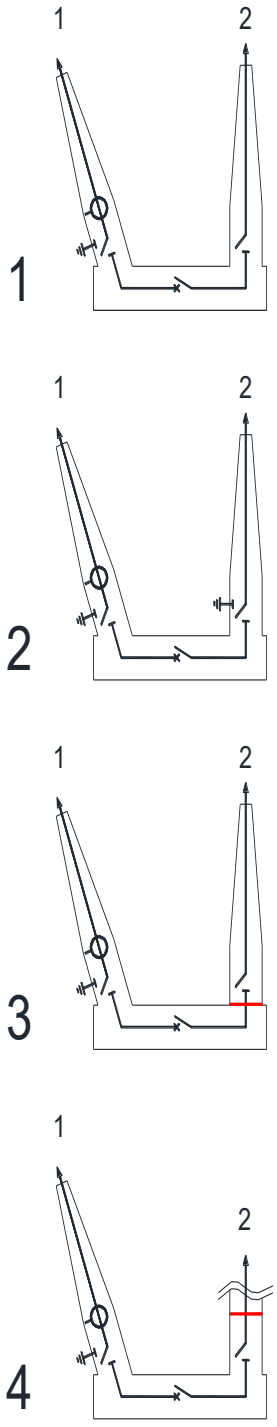


Single bay



B.2 - Examples of composition lists using “Base component codes”

Y1 type – Annex B.1 fig. 4:

Base component description	BAY	Base component code GSCH002/…	Nr (terns)
Lateral bay - Without circuit-breaker - Air connection	1	062	1
Central bay - Without circuit-breaker - Air connection	2	112	1
Lateral bay - With circuit-breaker - Air connection	3	012	1
Circuit-breaker drive mechanism - Three-pole	3	282	1
Disconnector with ability of Bus-transfer current switching	1	332	1
Disconnector with ability of Bus-transfer current switching	2	332	1
Disconnector with earthing switch	3	322	1
Bushing SF6/air class “e”	1	422	1
Bushing SF6/air class “e”	2	422	1
Bushing SF6/air class “e”	3	422	1
Current Transformer	3	622	1
Support	-	821	1
Control Box - Y1 type used in Line bay	-	921	1

Note (referring Annex B1 drawings):

- BAY 1: Lateral Bay
- BAY 2: Central Bay
- BAY 3: Lateral Bay

Y2 type – Annex B.1 fig. 1:

Base component description	BAY	Base component code GSCH002/…	Nr (terns)
Lateral bay - With circuit-breaker - Air connection	1	013	1
Central bay - Without circuit-breaker - Air connection	2	112	1
Lateral bay - With circuit-breaker - Air connection	3	013	1
Circuit-breaker drive mechanism - Single-pole	1	212	1
Circuit-breaker drive mechanism - Three-pole	3	262	1
Disconnector with earthing switch	1	322	1
Disconnector with earthing switch	2	322	1
Disconnector with earthing switch	3	322	1
EVDS - Electronic Voltage Detector System (capacitive dividers included)	2	700	1
Bushing SF6/air class “e”	1	422	1
Bushing SF6/air class “e”	2	422	1
Bushing SF6/air class “e”	3	422	1
Current Transformer	1	605	1
Current Transformer	3	604	1
Support	-	802	1
Control Box – Y2 type	-	902	1

Note (referring Annex B1 drawings):

- BAY 1: Lateral Bay
- BAY 2: Central Bay
- BAY 3: Lateral Bay

Single bay type – Annex B.2 fig. 1:

Base component description	BAY	Base component code GSCH002/…	Nr (terns)
Lateral bay - With circuit-breaker - Air connection	1	012	1
Central bay - Without circuit-breaker - Air connection	2	112	1
Circuit-breaker drive mechanism - Three-pole	1	282	1
Disconnector with earthing switch	1	322	1
Disconnector	2	312	1
Bushing SF6/air class “e”	1	422	1
Bushing SF6/air class “e”	2	422	1
Current Transformer	1	622	1
Support	-	822	1
Control Box – Single bay type used in Line bay	-	924	1

Note (referring Annex B1 drawings):

- BAY 1: Lateral Bay
- BAY 2: Central Bay

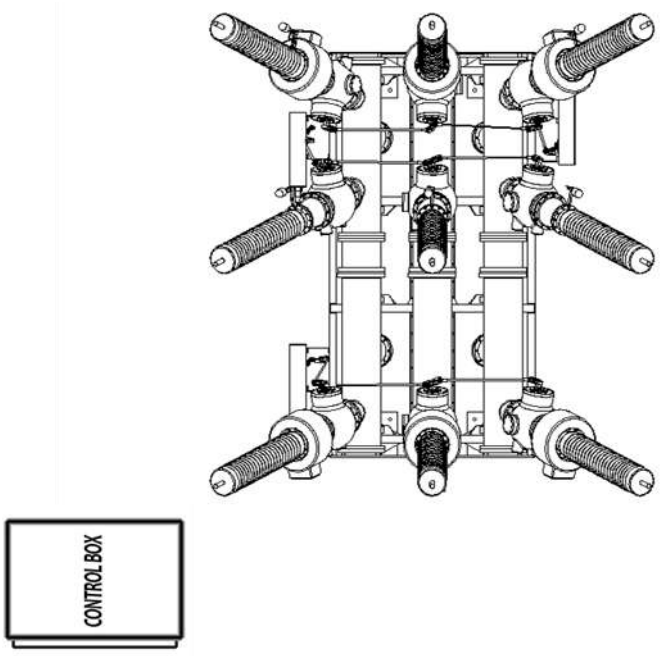
ANNEX C – DIMENSIONAL DRAWINGS

CONTROL BOX LOCATION

	BAY 1	BAY 2	BAY 3
Y1	LINE/TRAFO (*)	BUSBAR 1	BUSBAR 2
Y2	LINE	BUSBAR 1	TRAFO (*)
SB	LINE/TRAFO (*)	BUSBAR 1	-

(*) PHYSICAL POSITION CONTROL BOX

In case the control box is not attached to the equipment position should follow the figure below (in order to take out the hybrid module with a lift truck):



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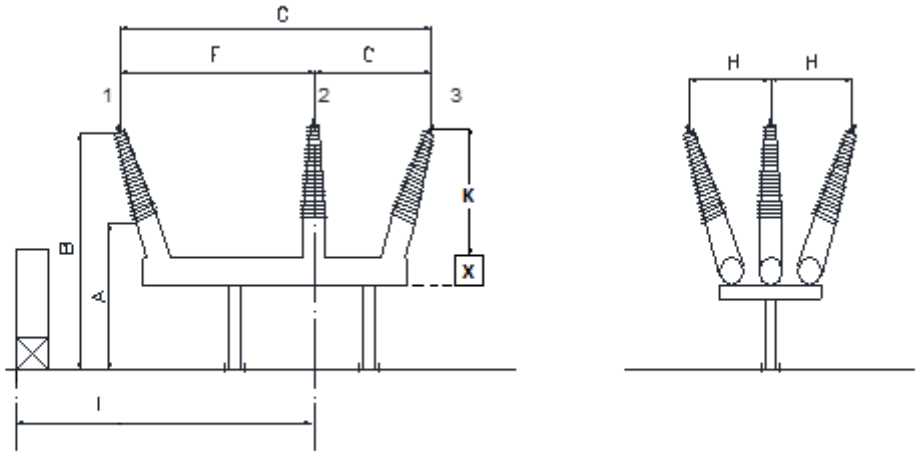
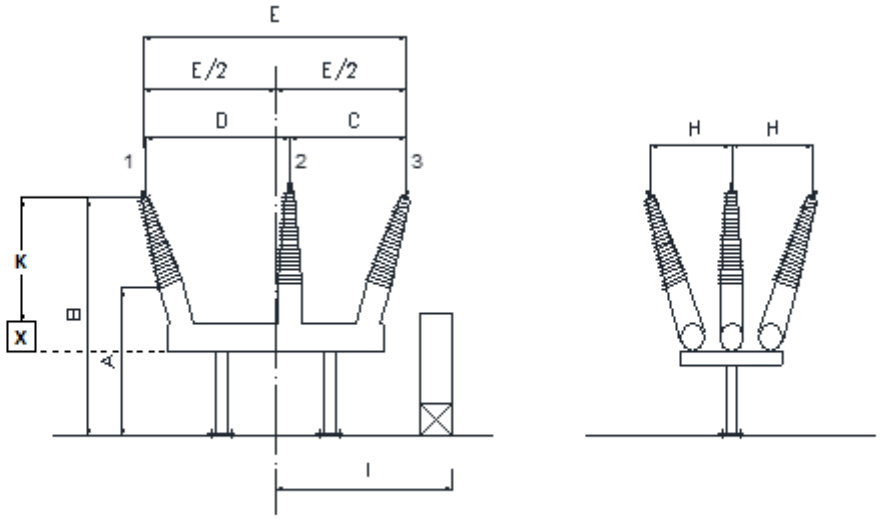
Business Line: *Enel Grids*

Y1

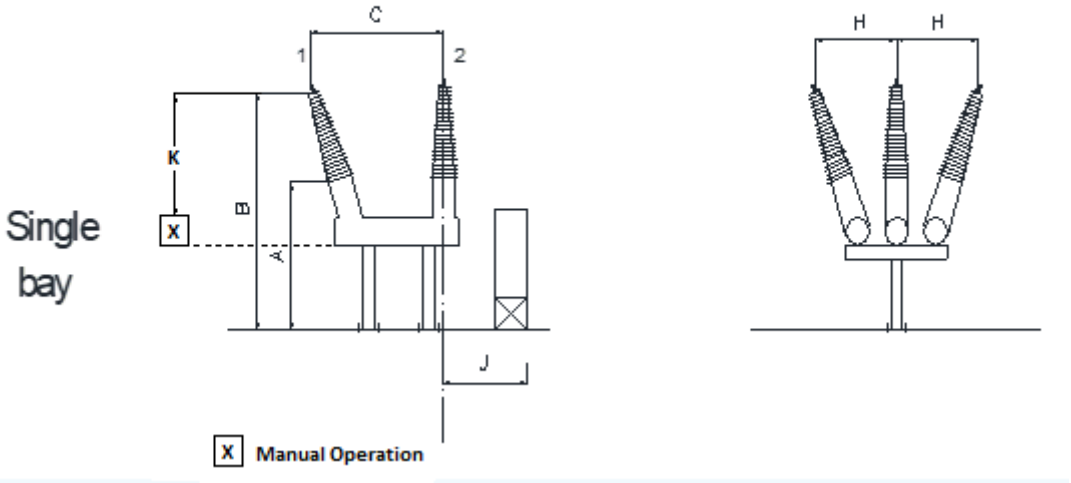


X Manual Operation

Y2



X Manual Operation



Ref. figure	A	B	C	D	E	F	G	H	I	J	K
Y1	≥ 2250[16]	≤ 3800	≥ 890	n.a.	n.a.	≥ 890	≤ 3000	≤ 1400	≤ 2200	n.a.	> 1400
Y2				≥ 890	≤ 3000	n.a.	n.a.				
Single bay				n.a.	n.a.	n.a.	n.a.		n.a.	≤ 1300	

Table 1 – Dimensions for 72,5 kV Hybrid Modules (mm)

[16] For e-distribución in accordance with the Real Decreto 337/2014 has to be ≥ 2300 mm

Ref. figure	A	B	C	D	E	F	G	H	I	J	K
Y1	≥ 2250[17]	≥3800 ≤4700	≥ 1725	n.a.	n.a.	≥ 1725	≤ 5000	≥ 1300 ≤ 2200	≤ 3000	n.a.	> 2000
Y2				≥ 1725	≤ 5000	n.a.	n.a.				
Single bay				n.a.	n.a.	n.a.	n.a.		n.a.	≤ 1300	

Table 2 – Dimensions for 145 kV (and, only for e-distribuzione, 170 kV) Hybrid Modules (mm)

Ref. figure	A	B	C	D	E	F	G	H	I	J	K
Y1	≥ 2250[18]	≤ 6000	≥ 2475	n.a.	n.a.	≥ 2475	≤ 6500	≤ 3200	≤ 3750	n.a.	> 3000
Y2				≥ 2475	≤ 6500	n.a.	n.a.				
Single bay				n.a.	n.a.	n.a.	n.a.		n.a.	≤ 1300	

Table 3 – Dimensions for 245 kV Hybrid Modules (mm)

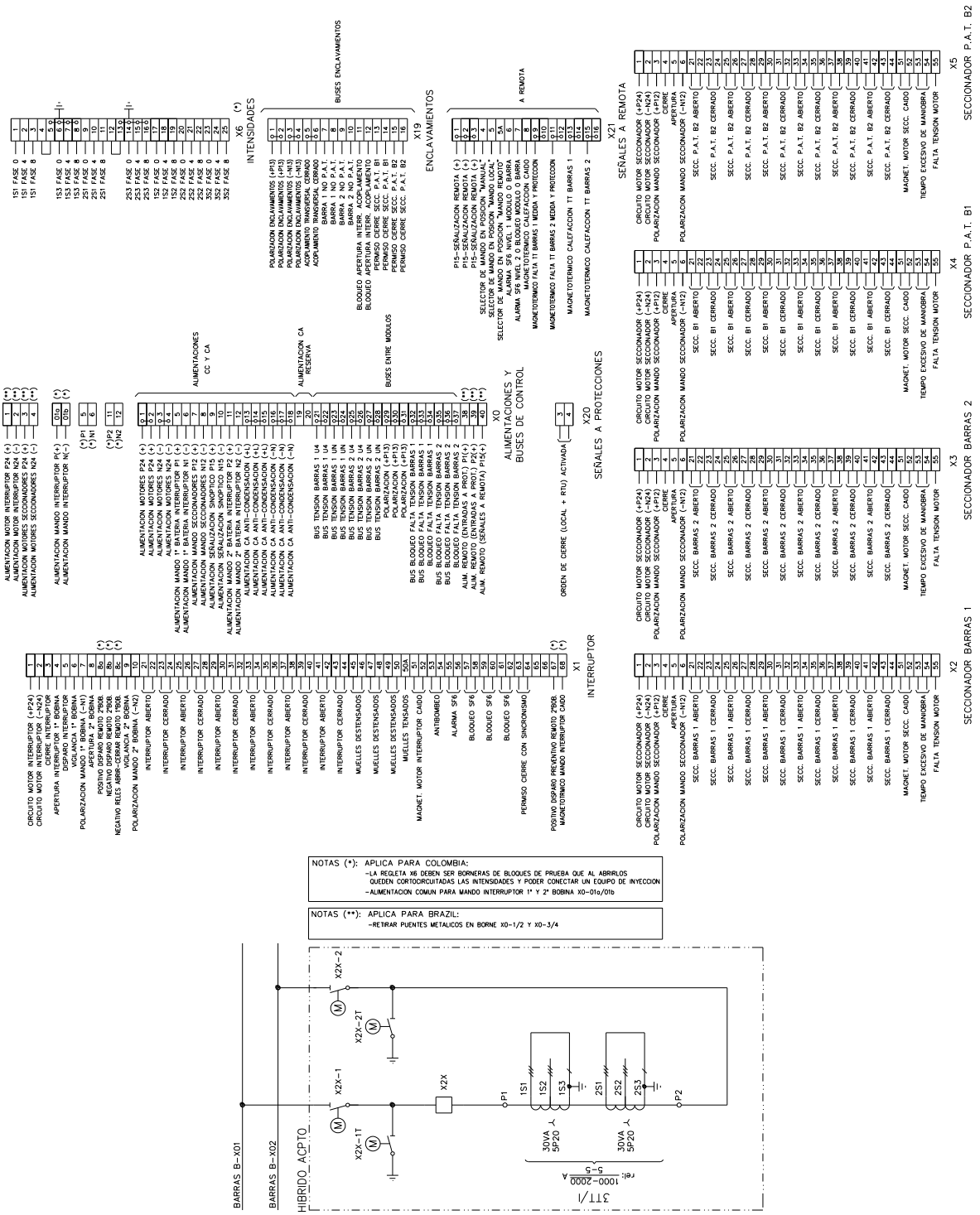
[17] For e-distribución in accordance with the Real Decreto 337/2014 has to be ≥ 2300 mm

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

ANNEX D – ELECTRICAL SCHEMES

D.1 – SPAIN AND LATAM ELECTRICAL DIAGRAMS

D.1.1 – Hybrid module Single-bay type – used in Bus coupler bay

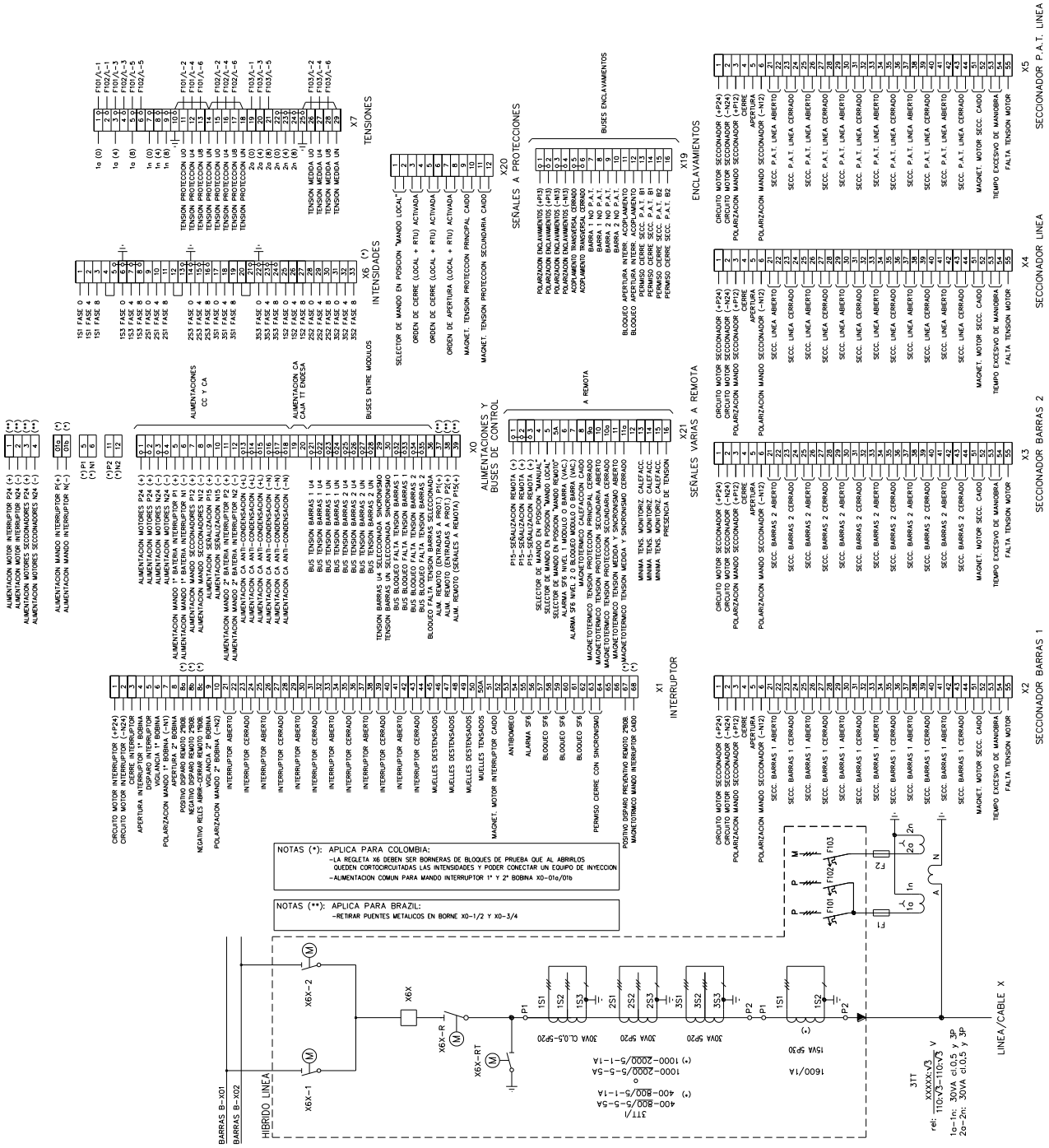


Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

D.1.2 – Hybrid module Y1 type – used in Line bay

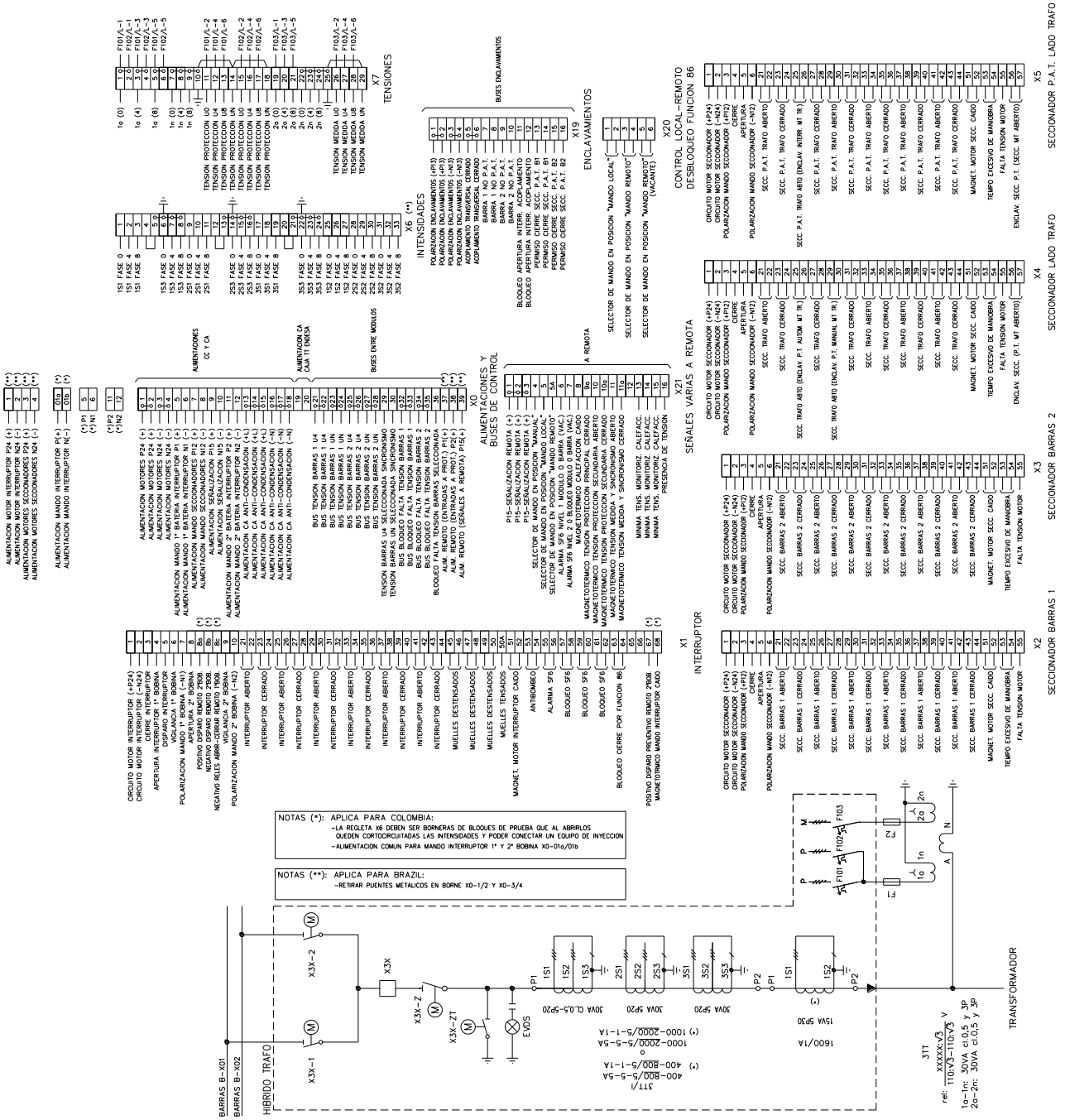


Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

D.1.3 – Hybrid module Y1 type – used in Transformer bay

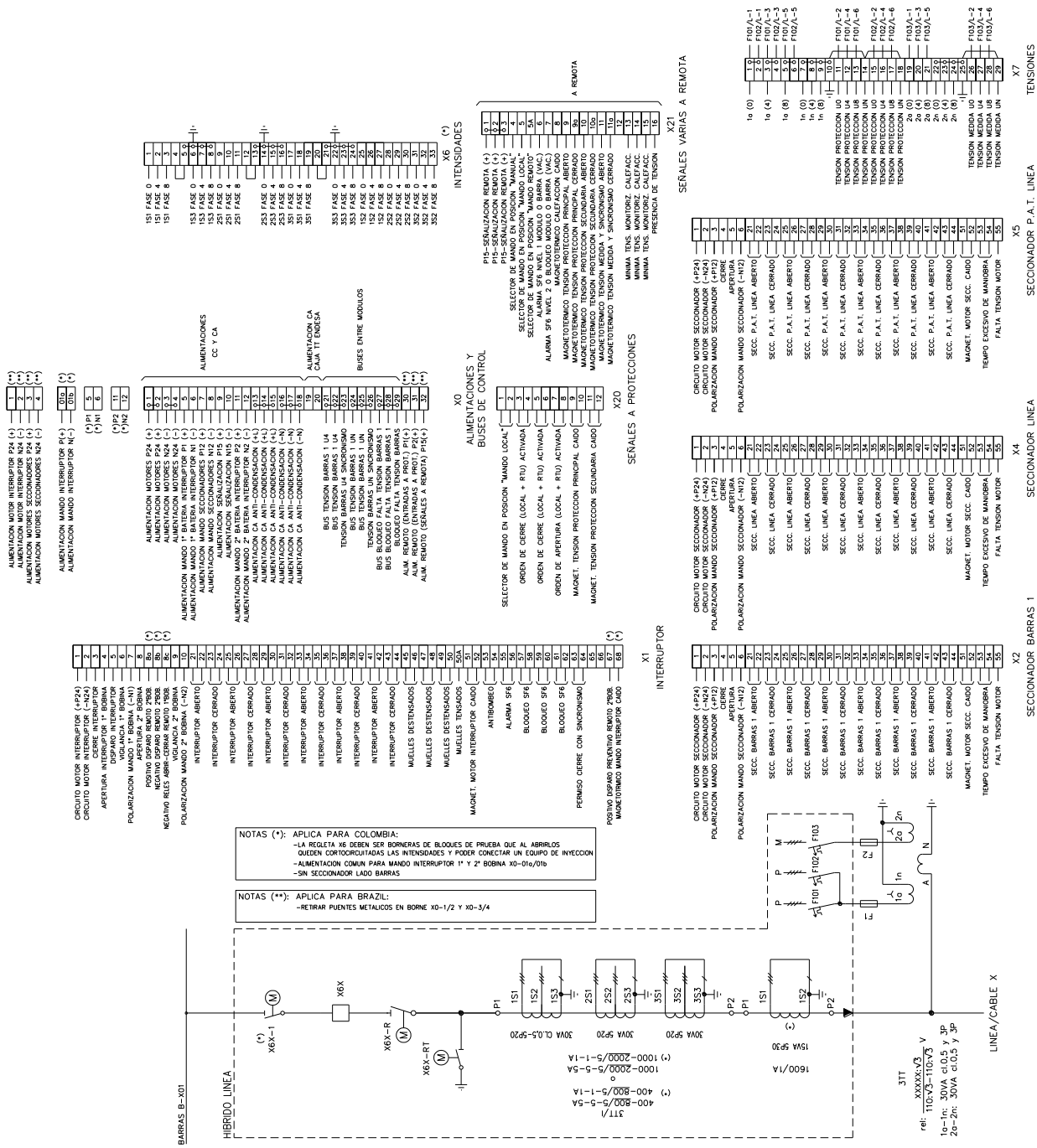


Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

D.1.4 – Hybrid module Single-bay type – used in Line bay

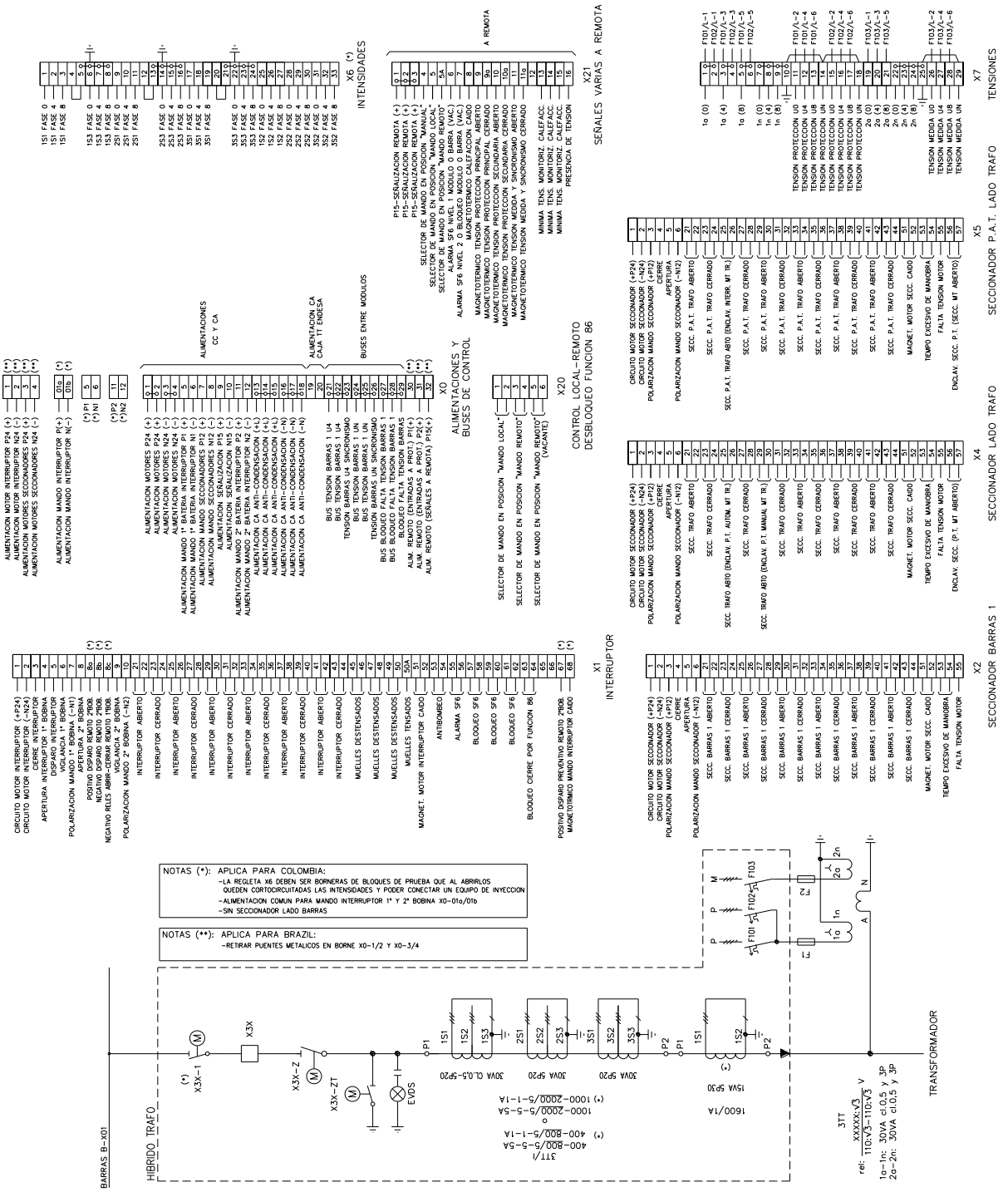


Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

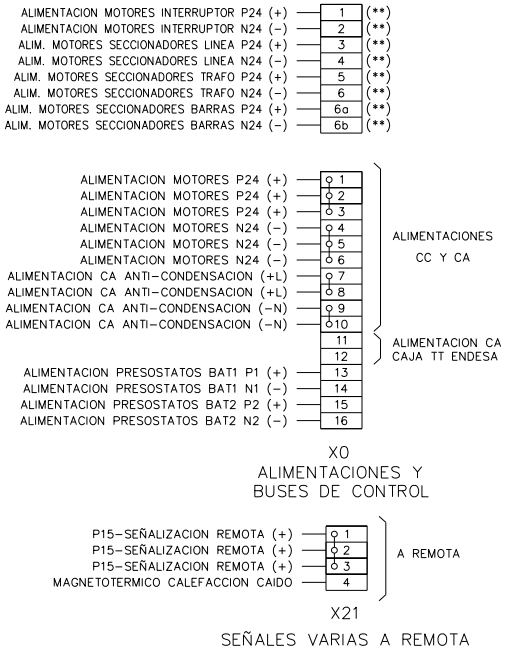
Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

D.1.5 – Hybrid module Single-bay type – used in Transformer bay



Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

D.1.6 – Hybrid module Y2 type

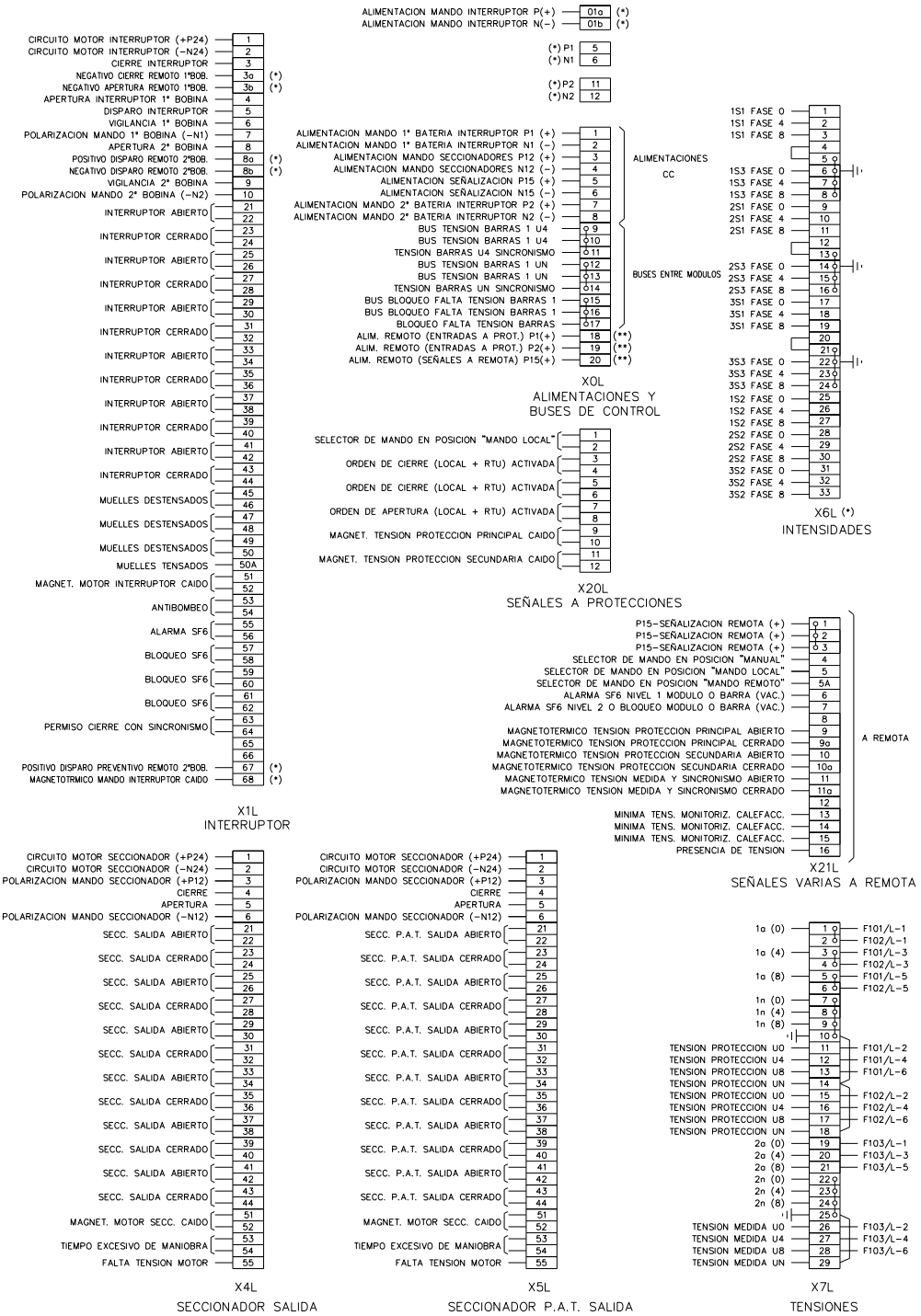


NOTAS (**): APLICA PARA BRAZIL:
-RETIRAR PUENTES METALICOS EN BORNES X0-1/2/3 Y X0-4/5/6

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



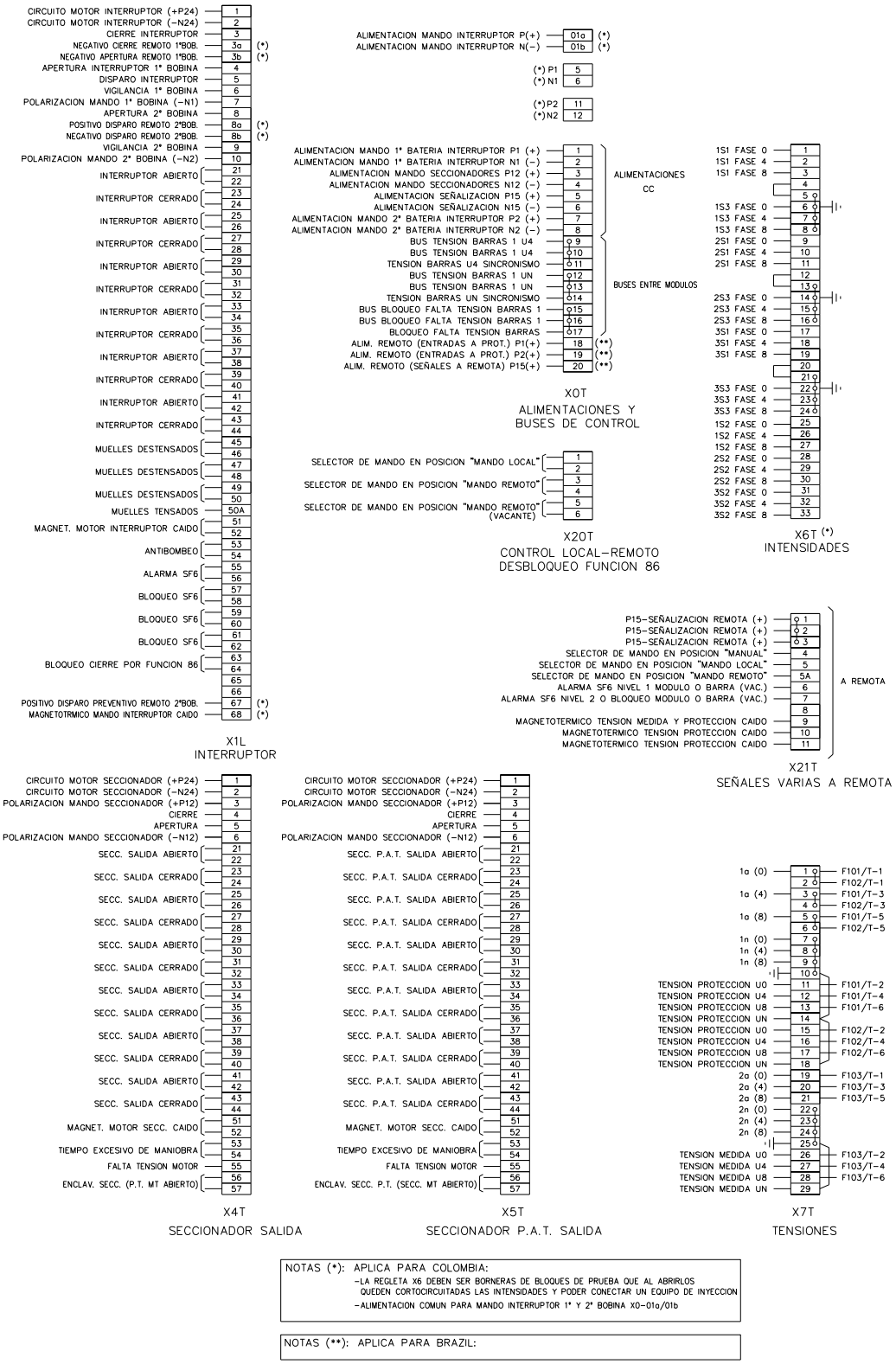
NOTAS (*): APLICA PARA COLOMBIA:
- LA REGLETA X6 DEBEN SER BORNERAS DE BLOQUES DE PRUEBA QUE AL ABRIRLOS QUEDEN CORTOCIRCUITADAS LAS INTENSIDADES Y PODER CONECTAR UN EQUIPO DE INYECCION
- ALIMENTACION COMUN PARA MANDO INTERRUPTOR 1ª Y 2ª BOBINA X0-01a/01b

NOTAS (**): APLICA PARA BRAZIL:

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

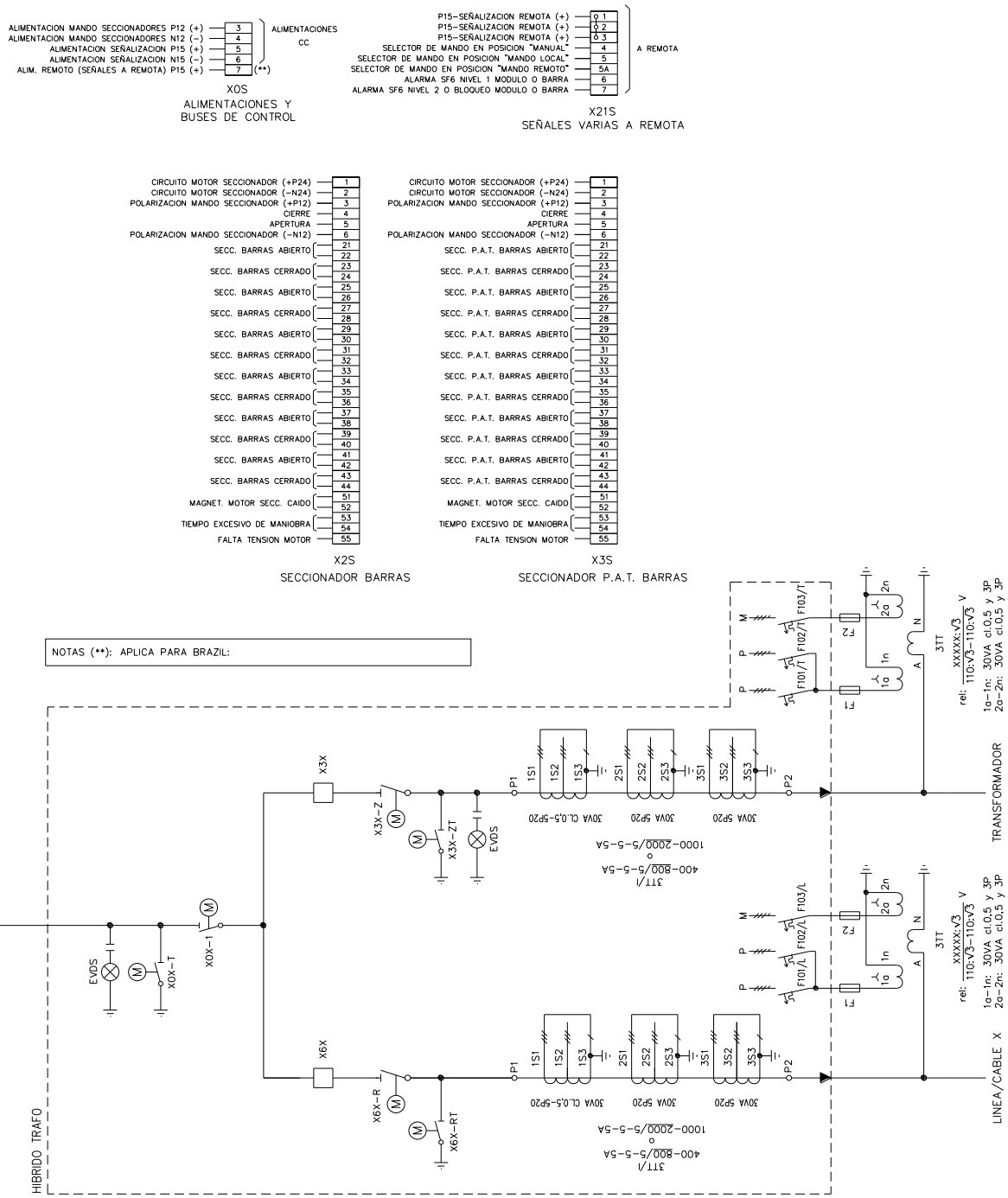
Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

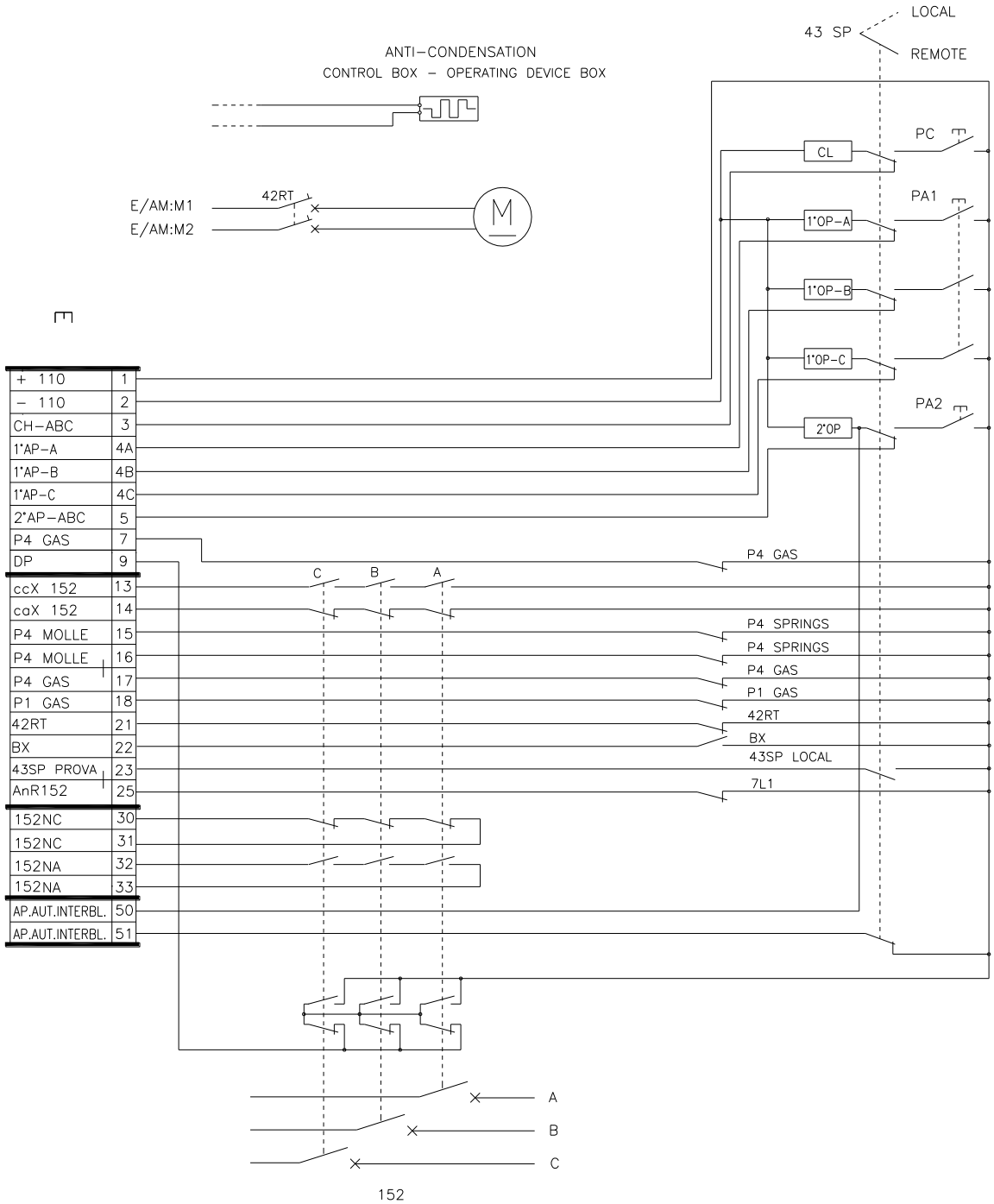


Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

D.2 – ITALY ELECTRICAL DIAGRAMS



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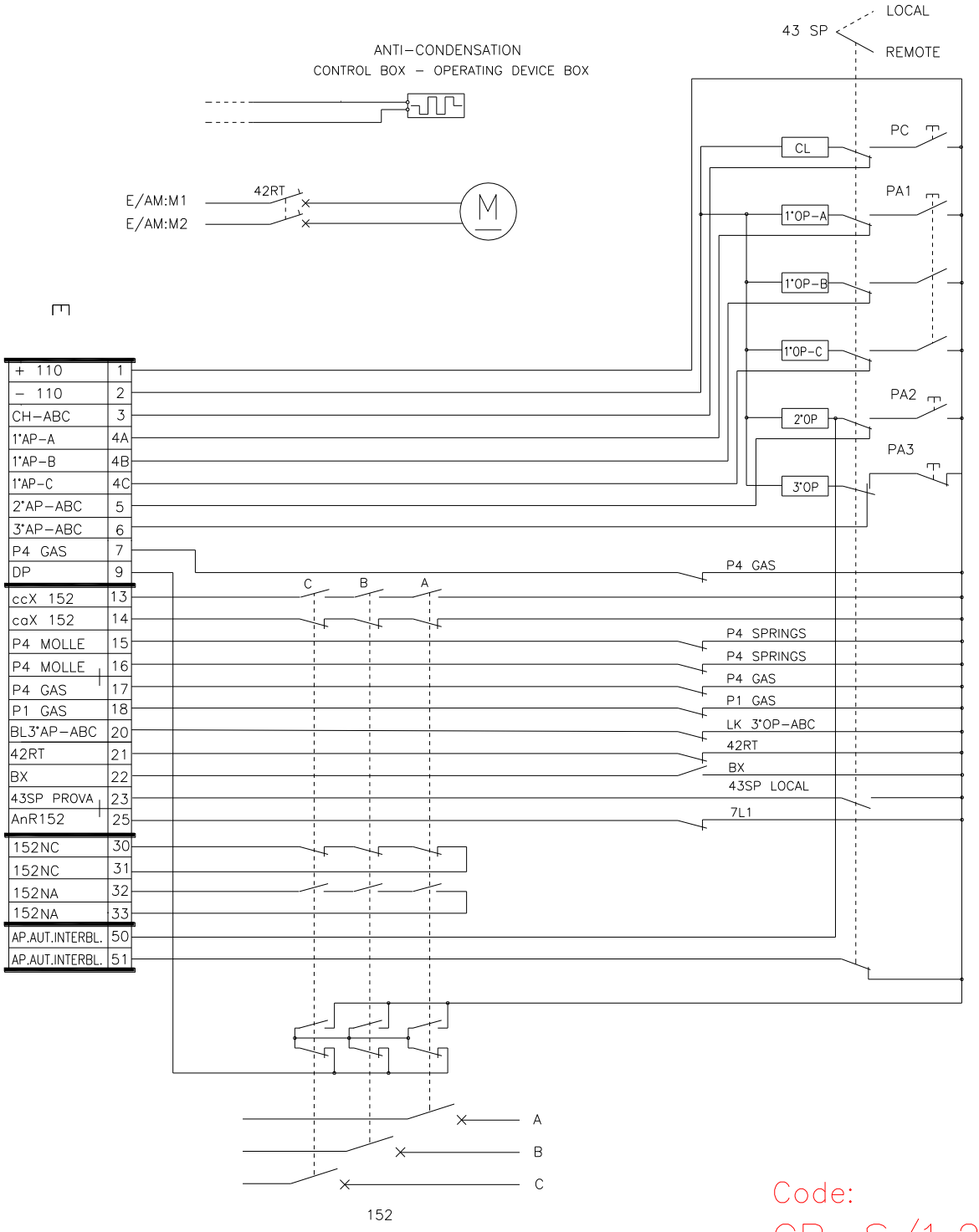
Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025
Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



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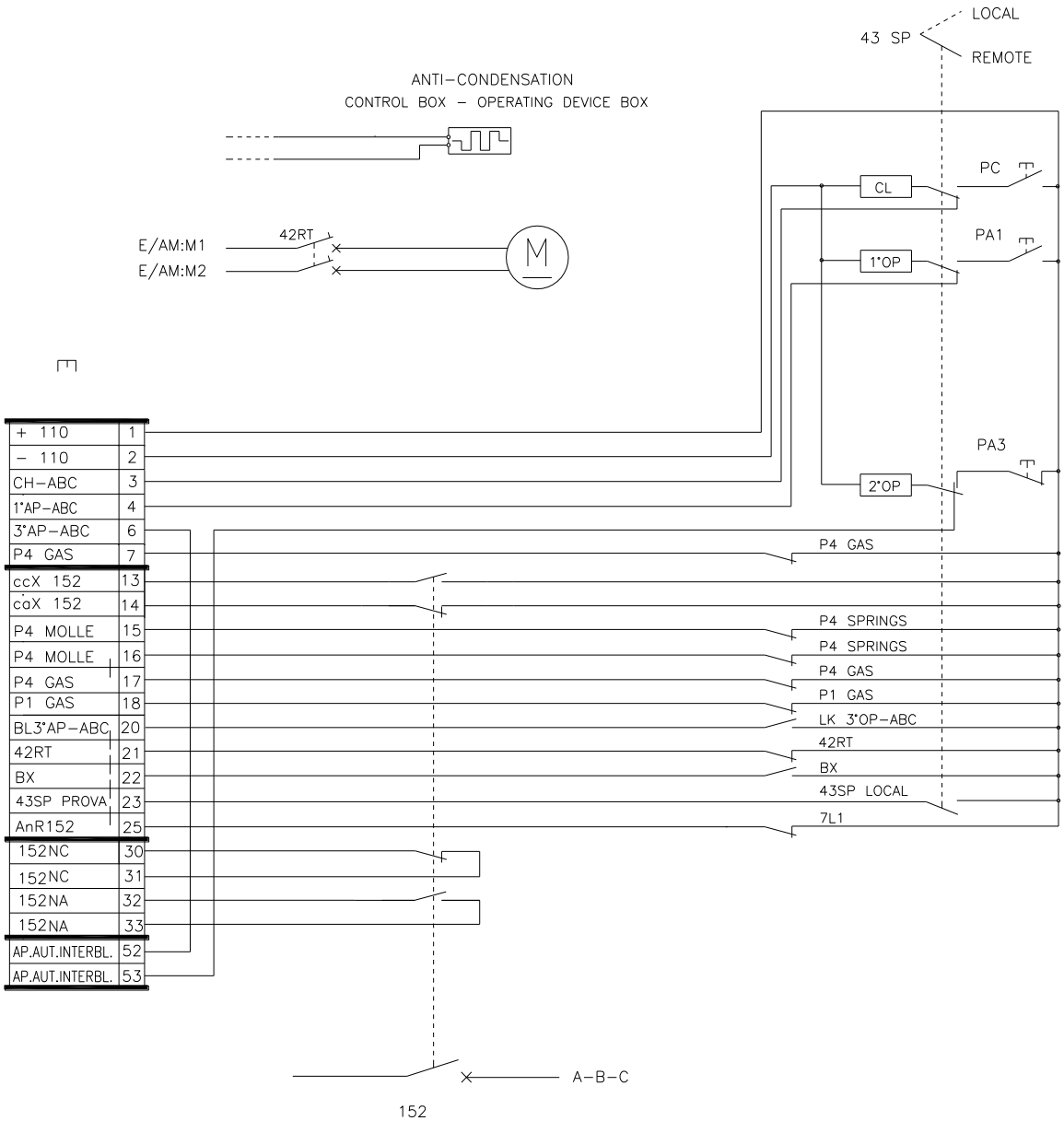
CB–S/1.2.3

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



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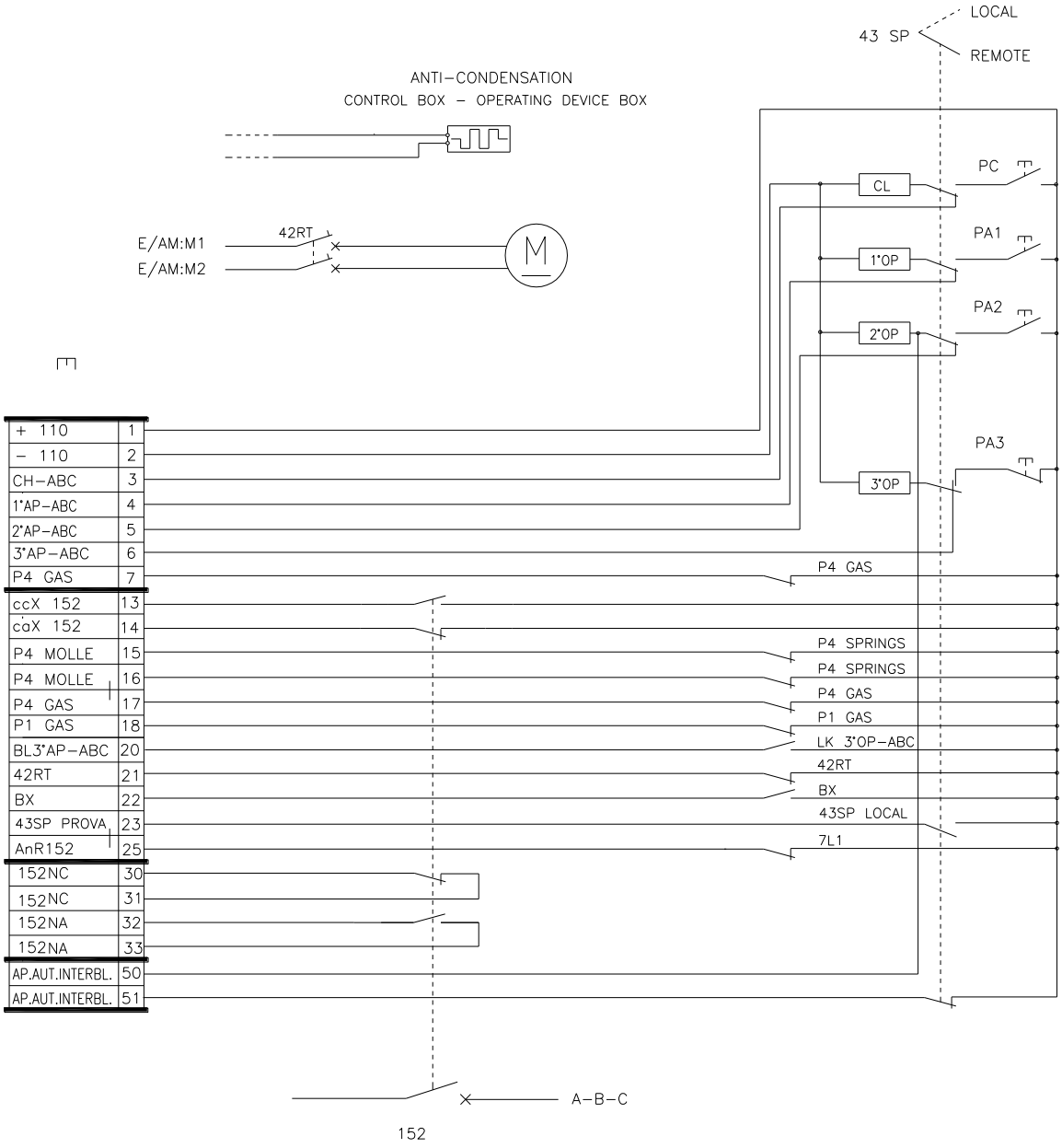
Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



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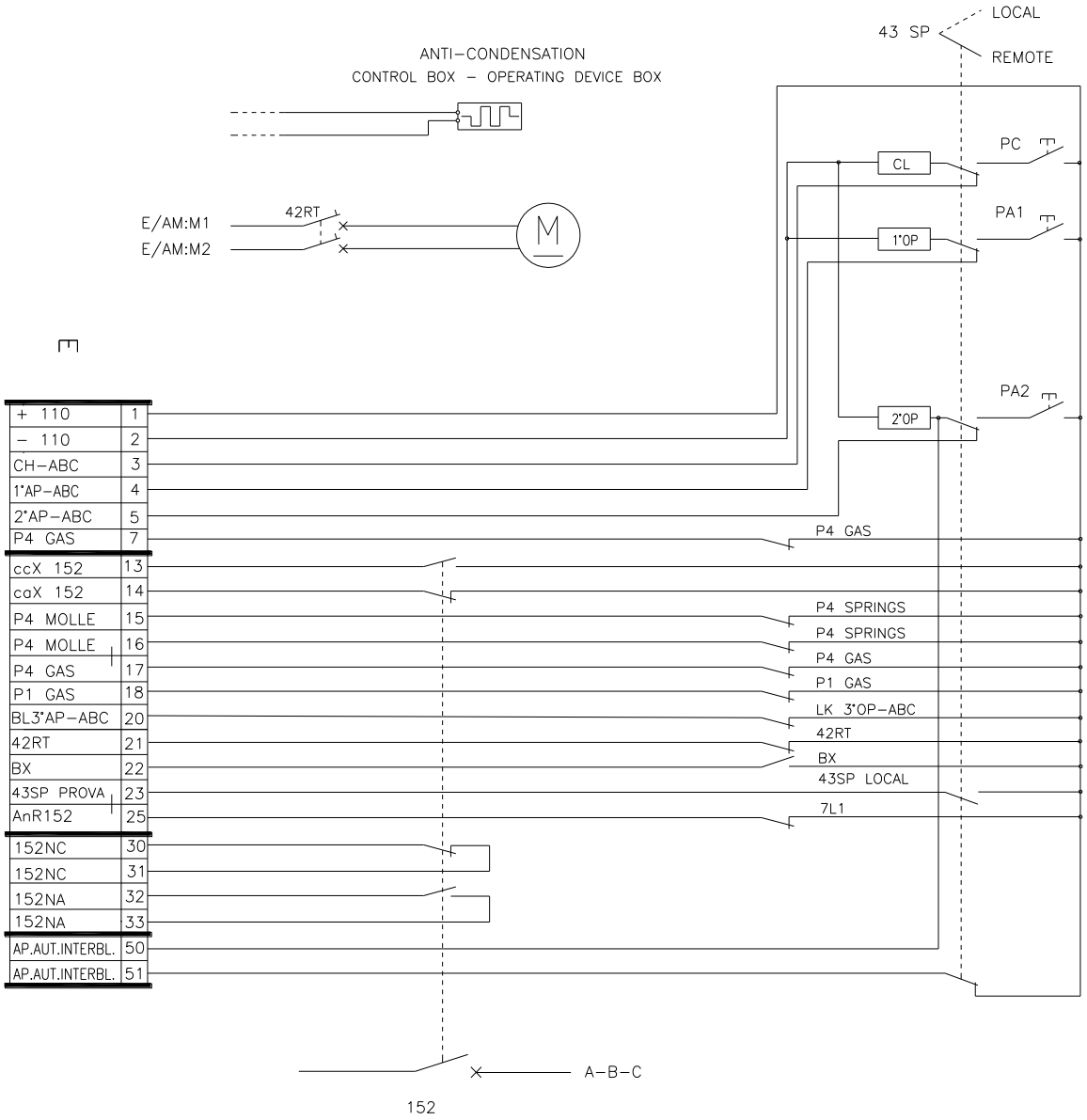
Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



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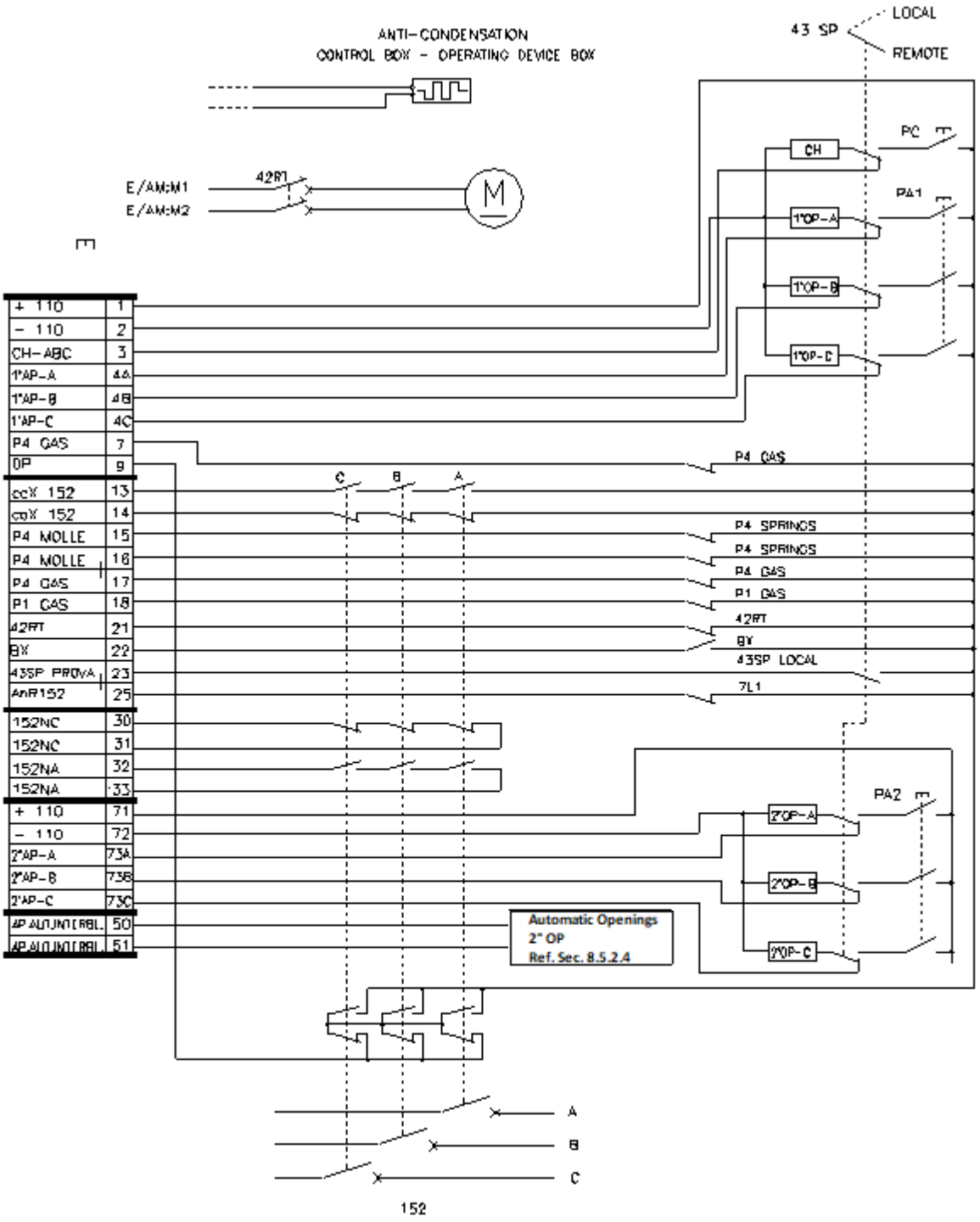
CB–T/1.2.

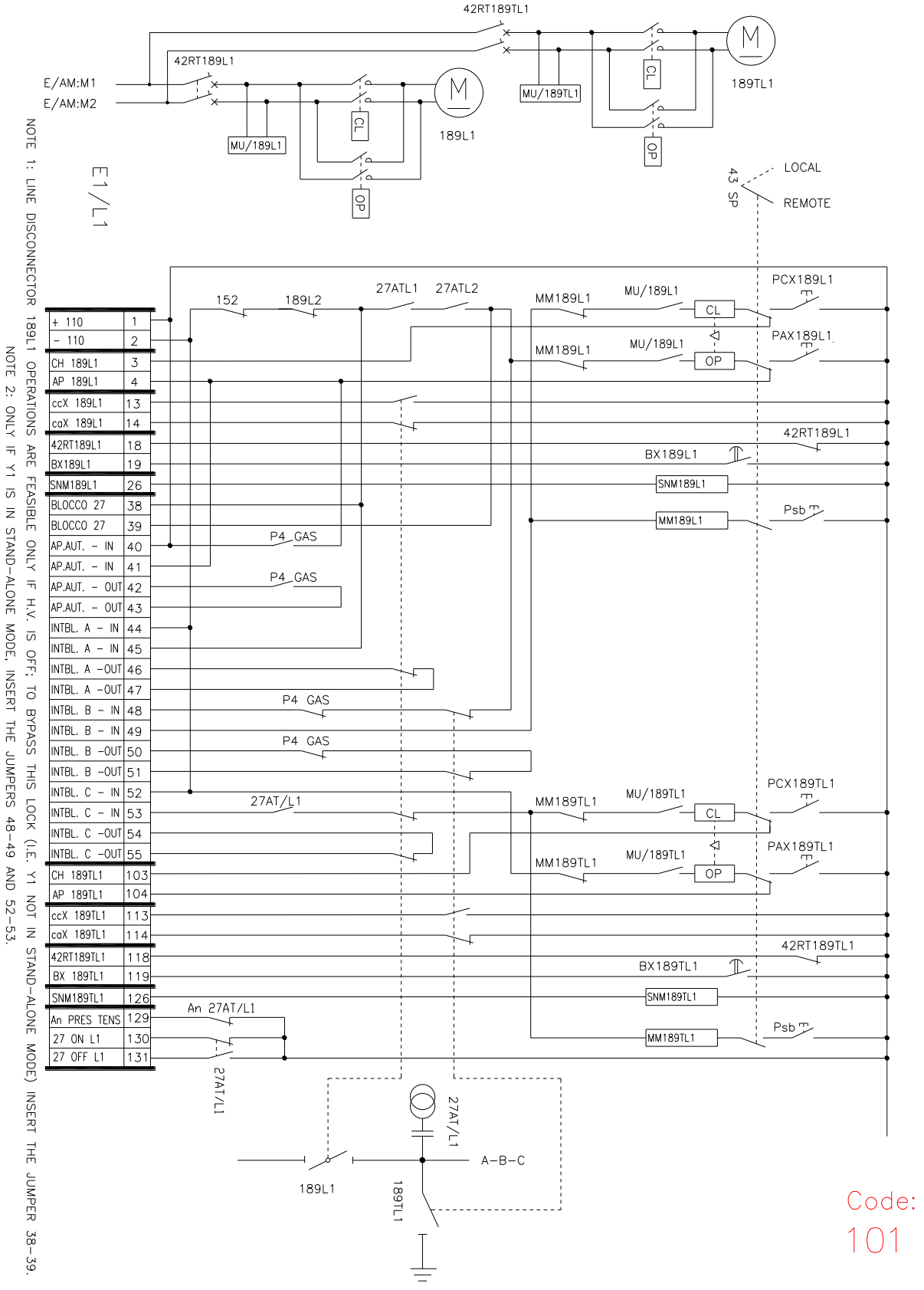


Code:
245 CB-S/1.2.

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



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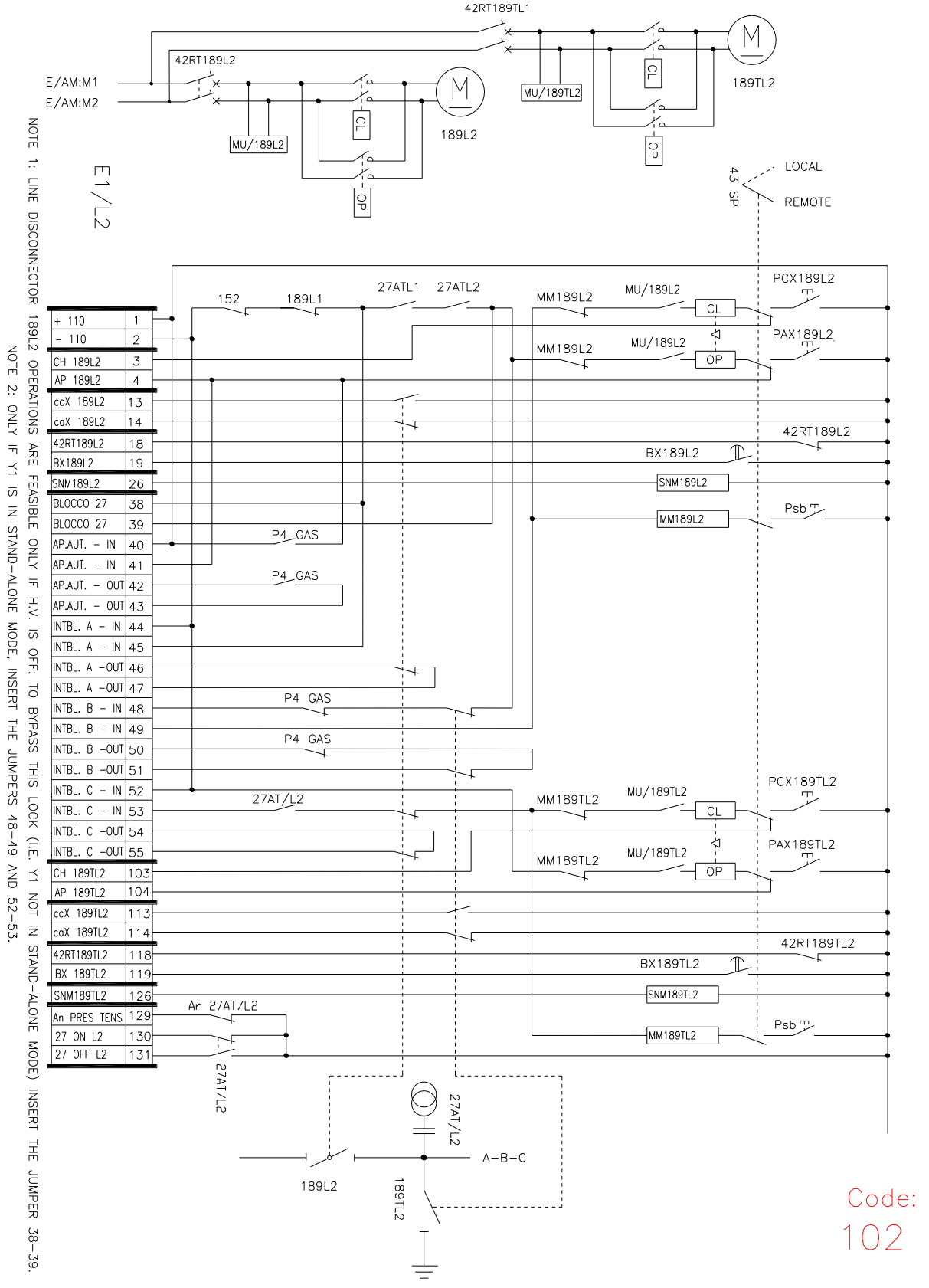
101

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



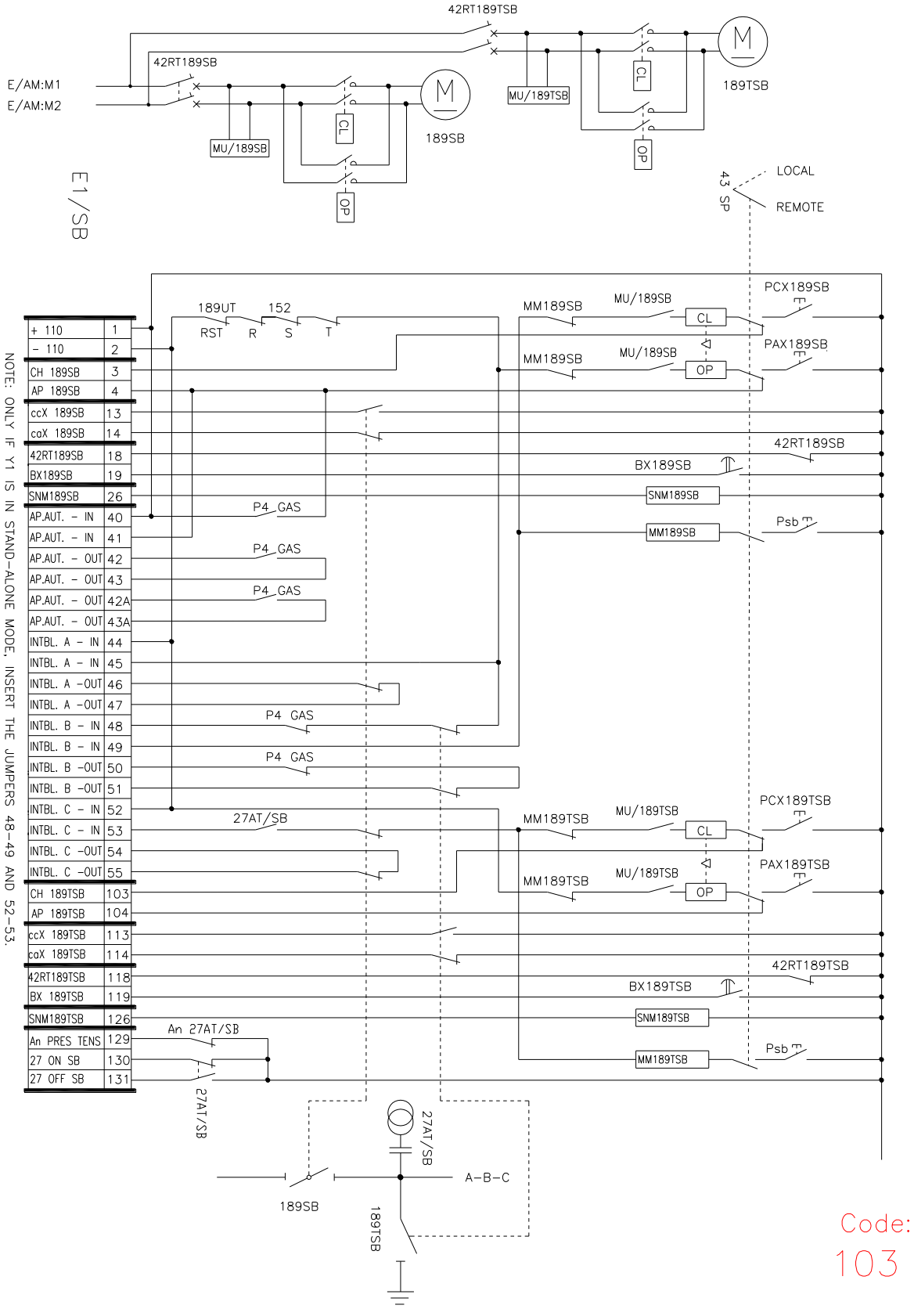
NOTE 1: LINE DISCONNECTOR 189L2 OPERATIONS ARE FEASIBLE ONLY IF H.V. IS OFF; TO BYPASS THIS LOCK (I.E. Y1 NOT IN STAND-ALONE MODE) INSERT THE JUMPER 38-39.
NOTE 2: ONLY IF Y1 IS IN STAND-ALONE MODE, INSERT THE JUMPERS 48-49 AND 52-53.

Code:
102

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

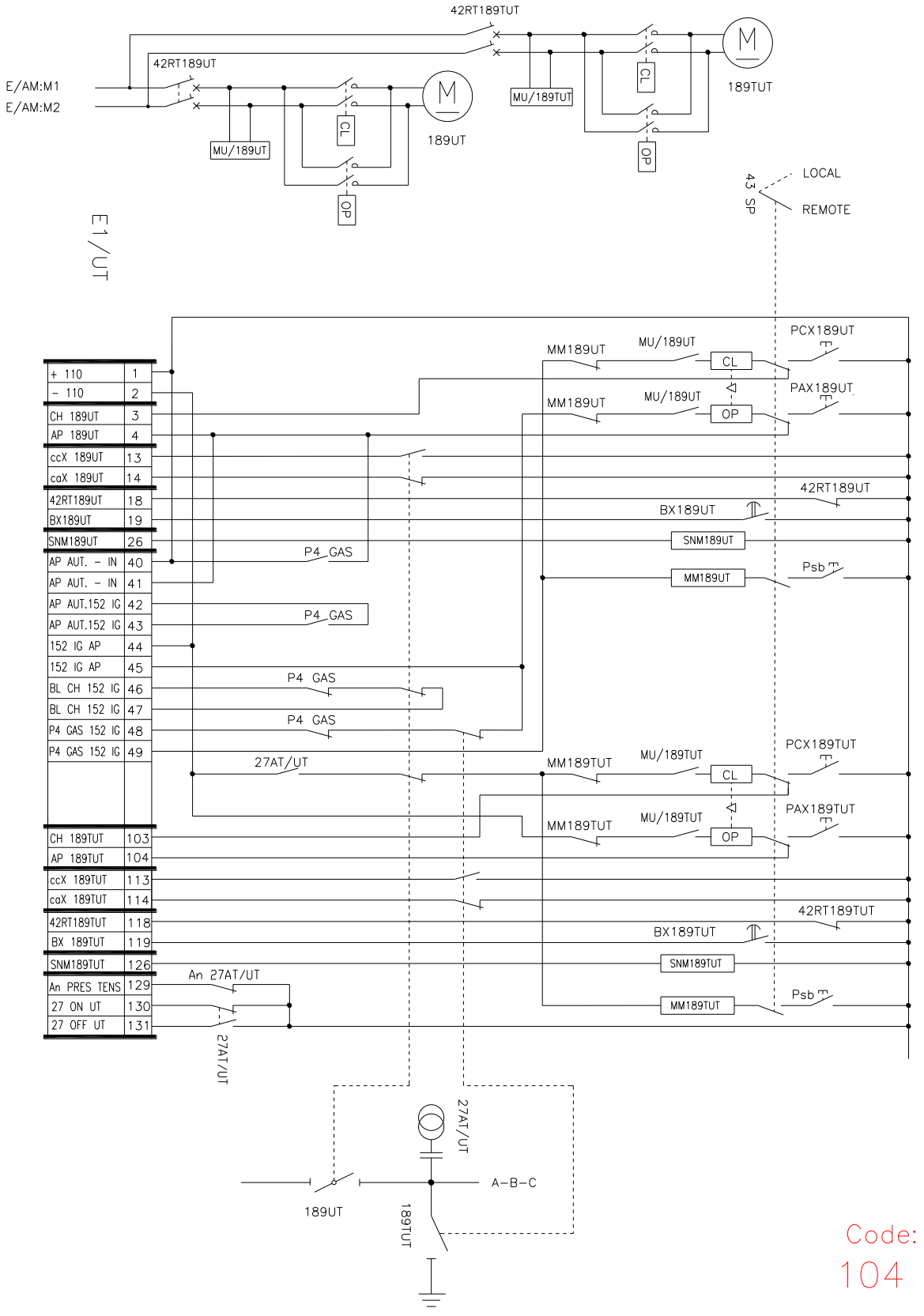


Code:
103

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

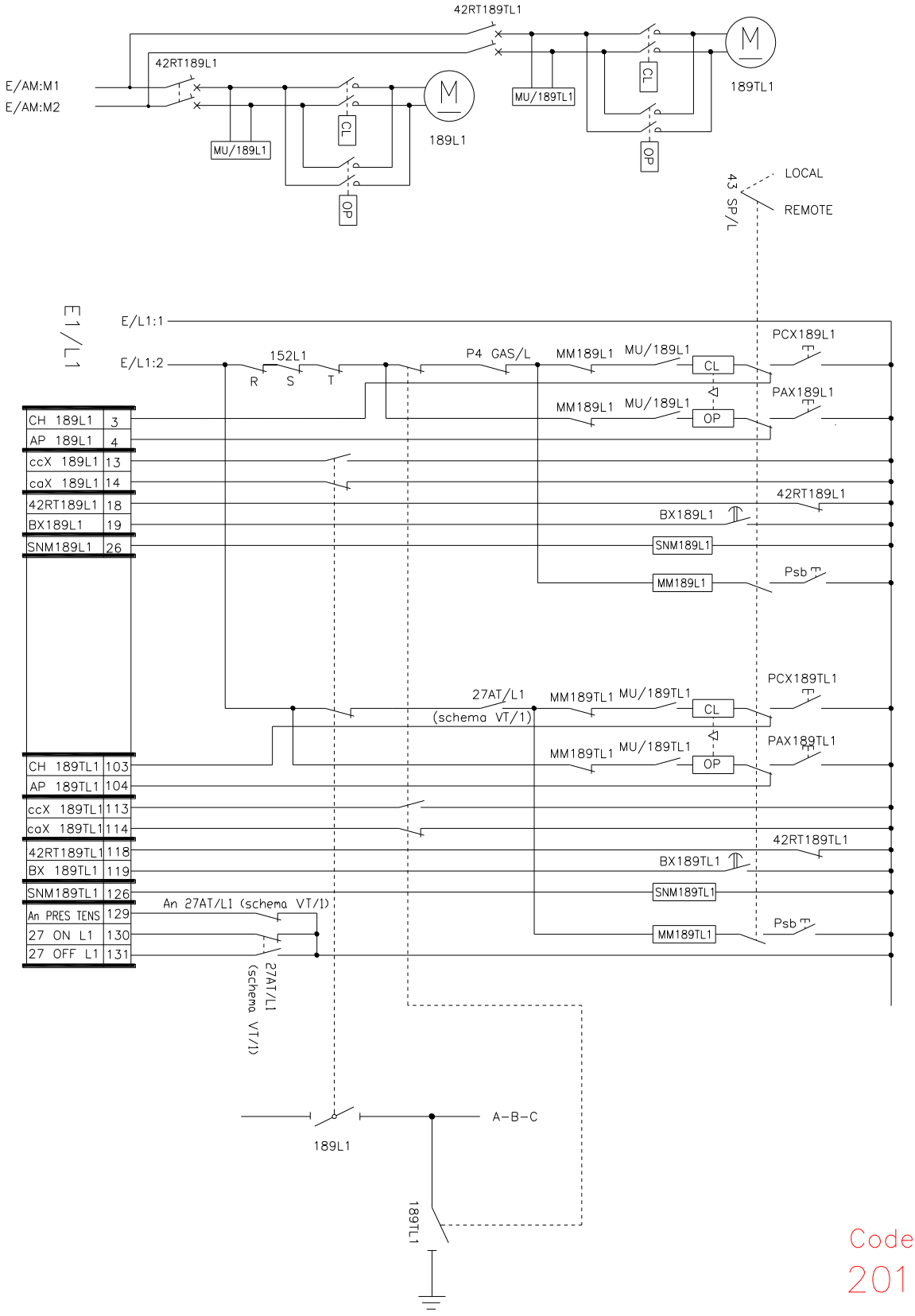


Code:
104

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

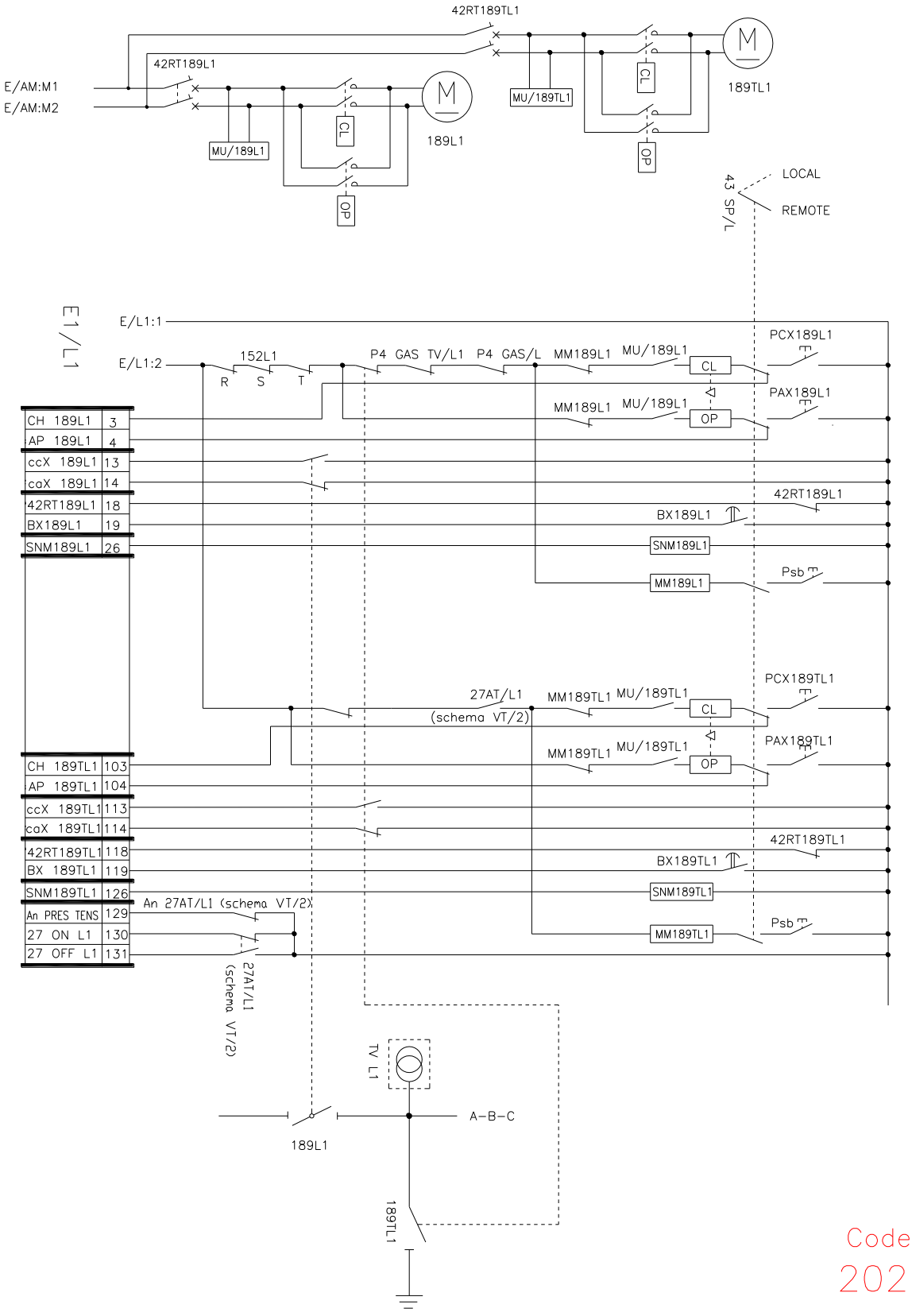


Code:
201

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

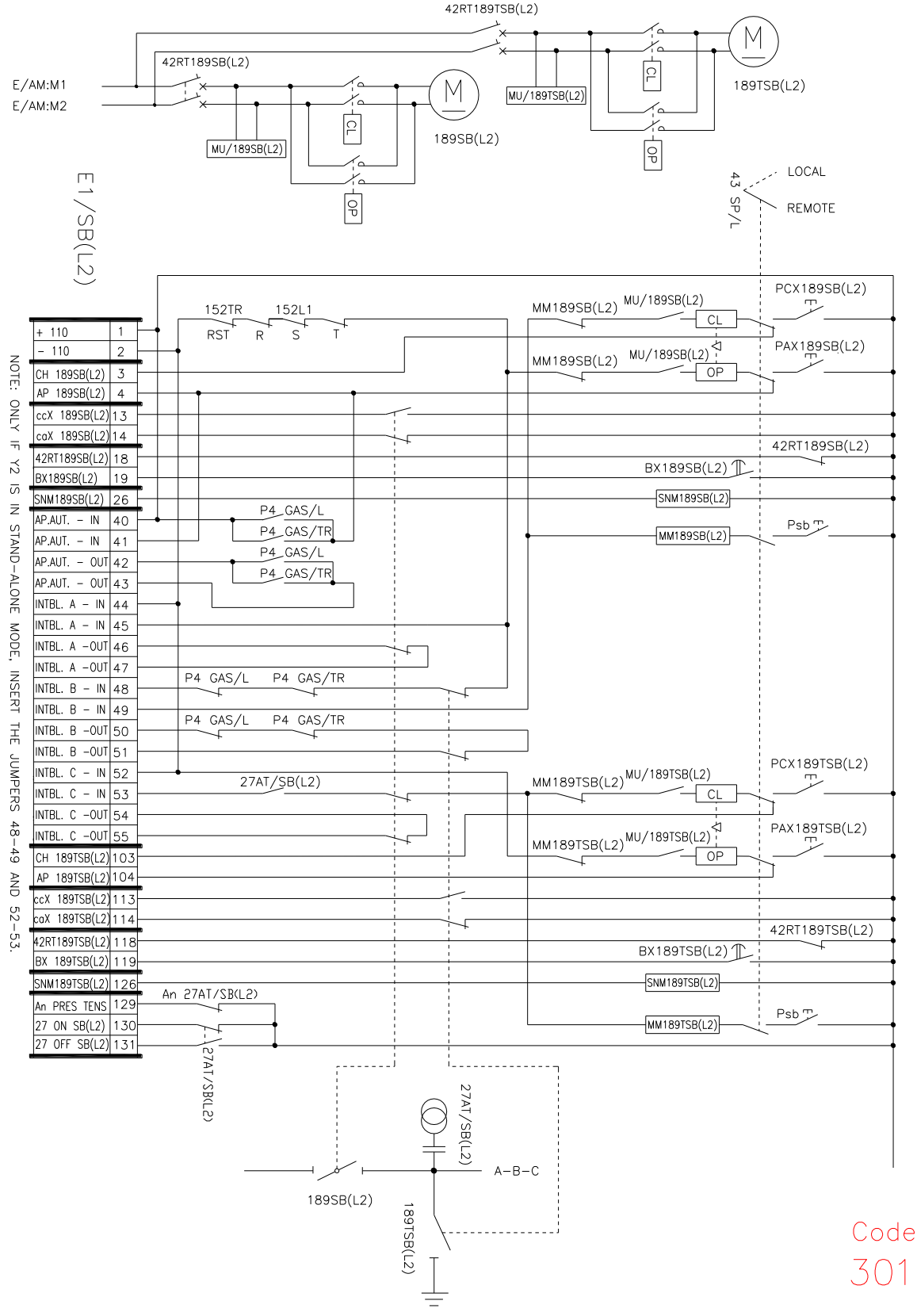


Code:
202

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

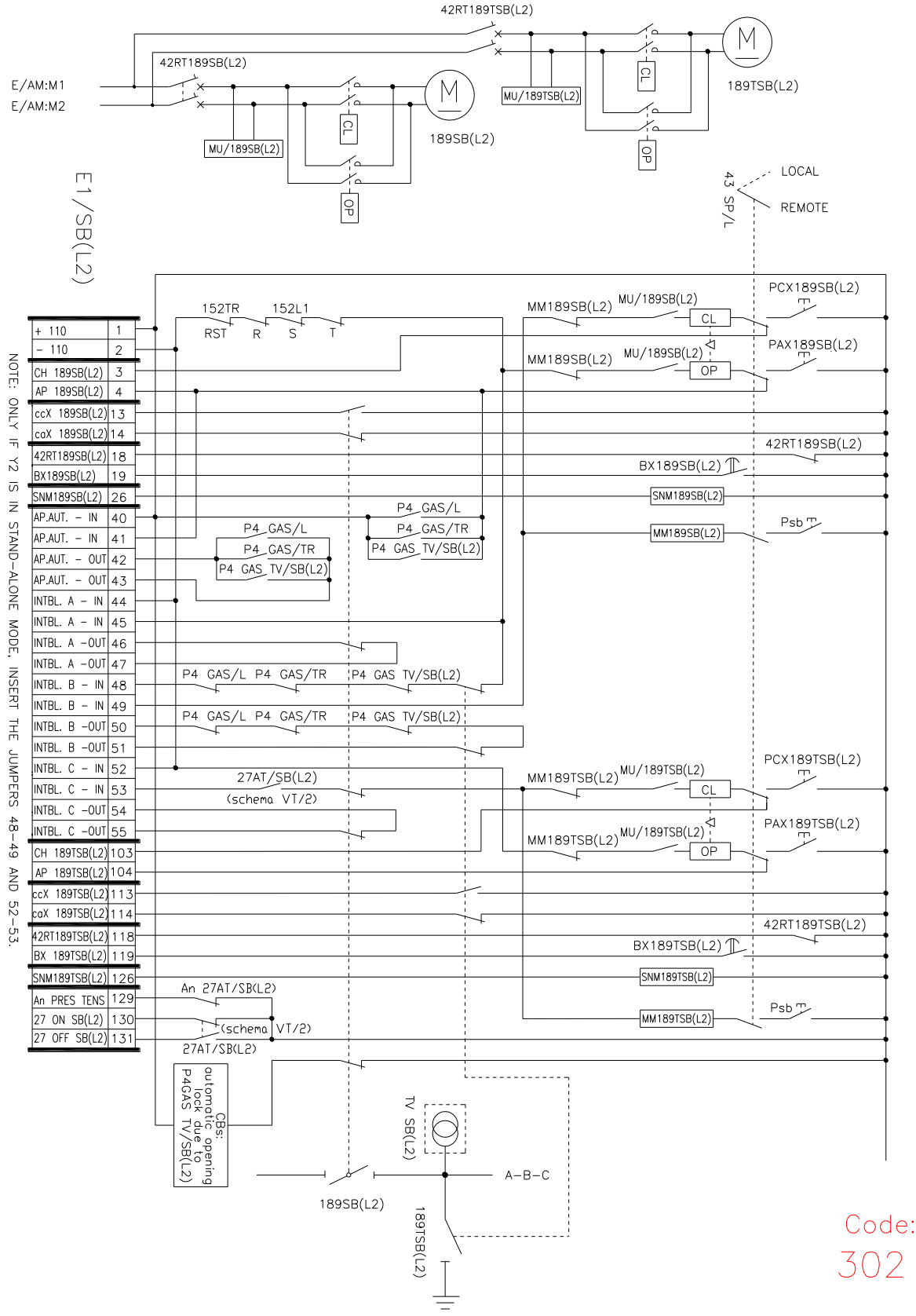


Code:
301

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

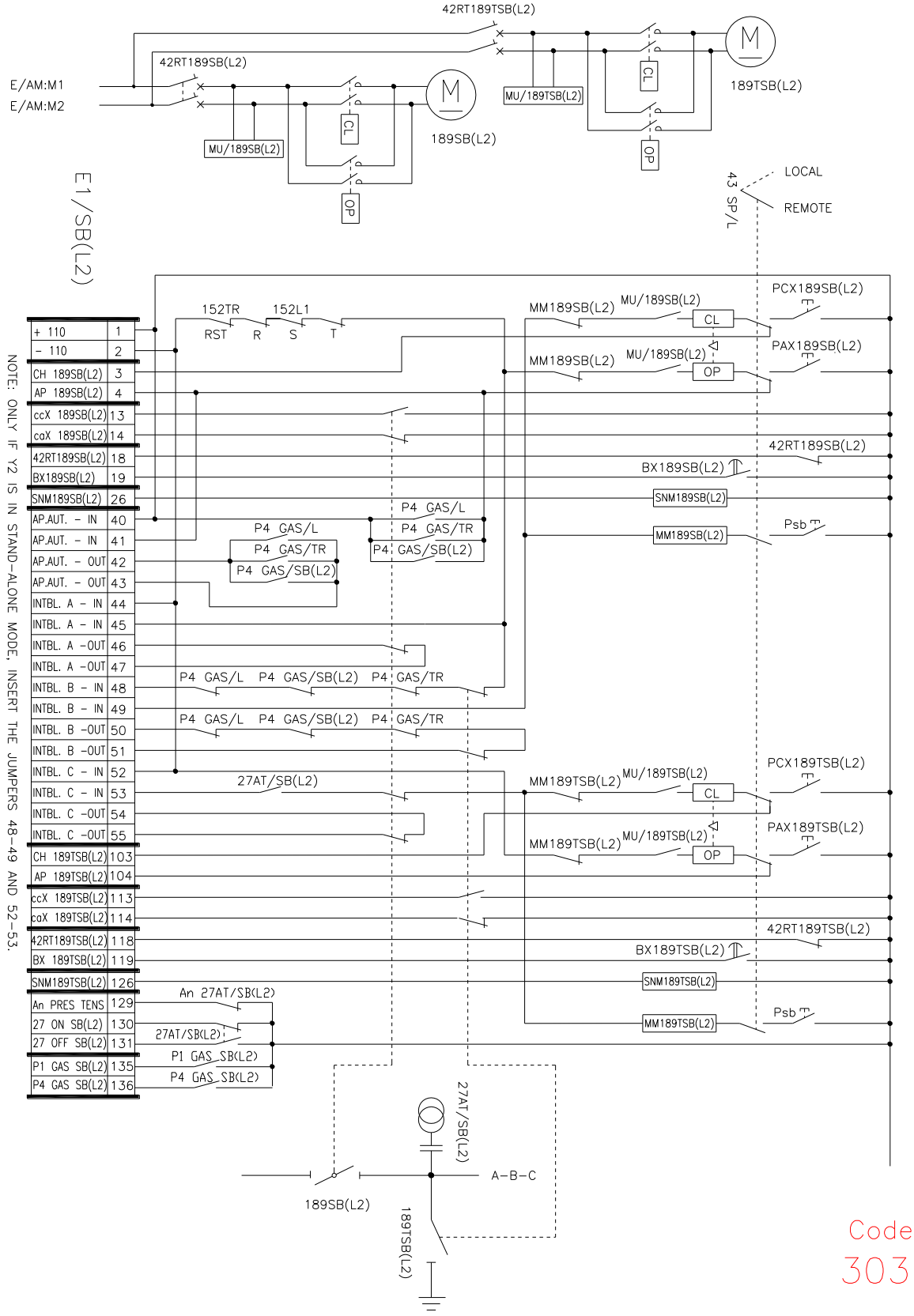


Code:
302

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

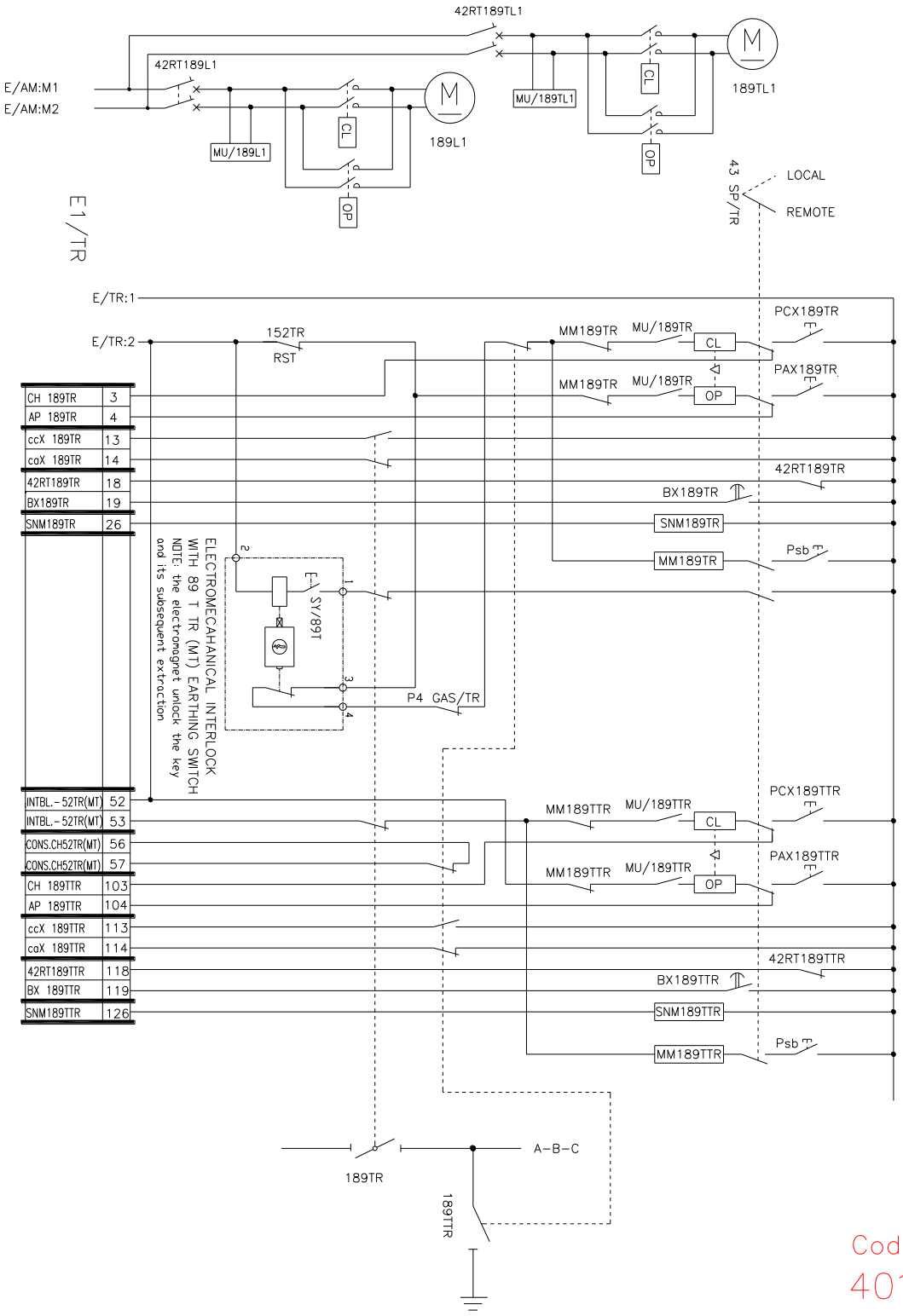


Code:
303

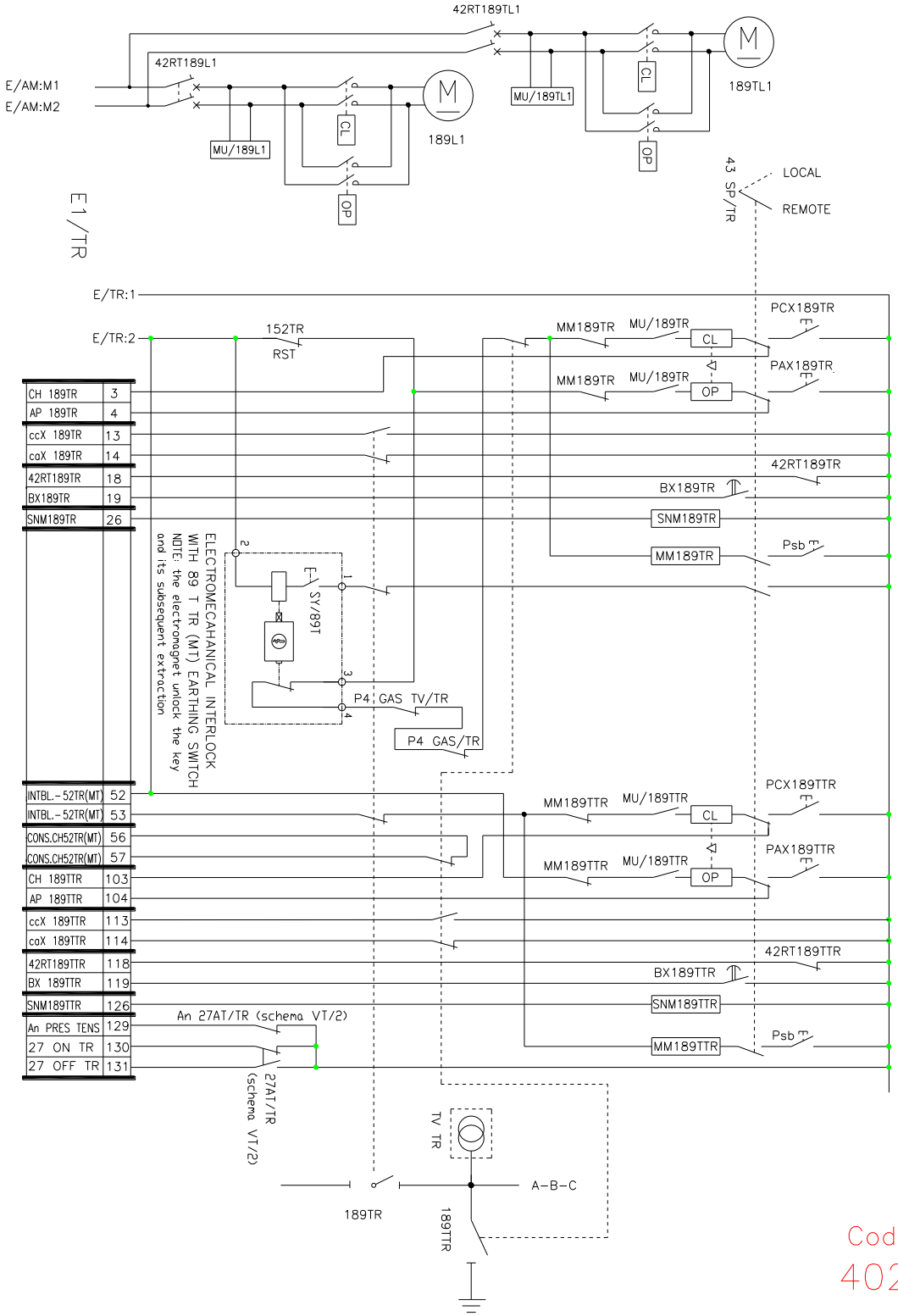
Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



Code:
401

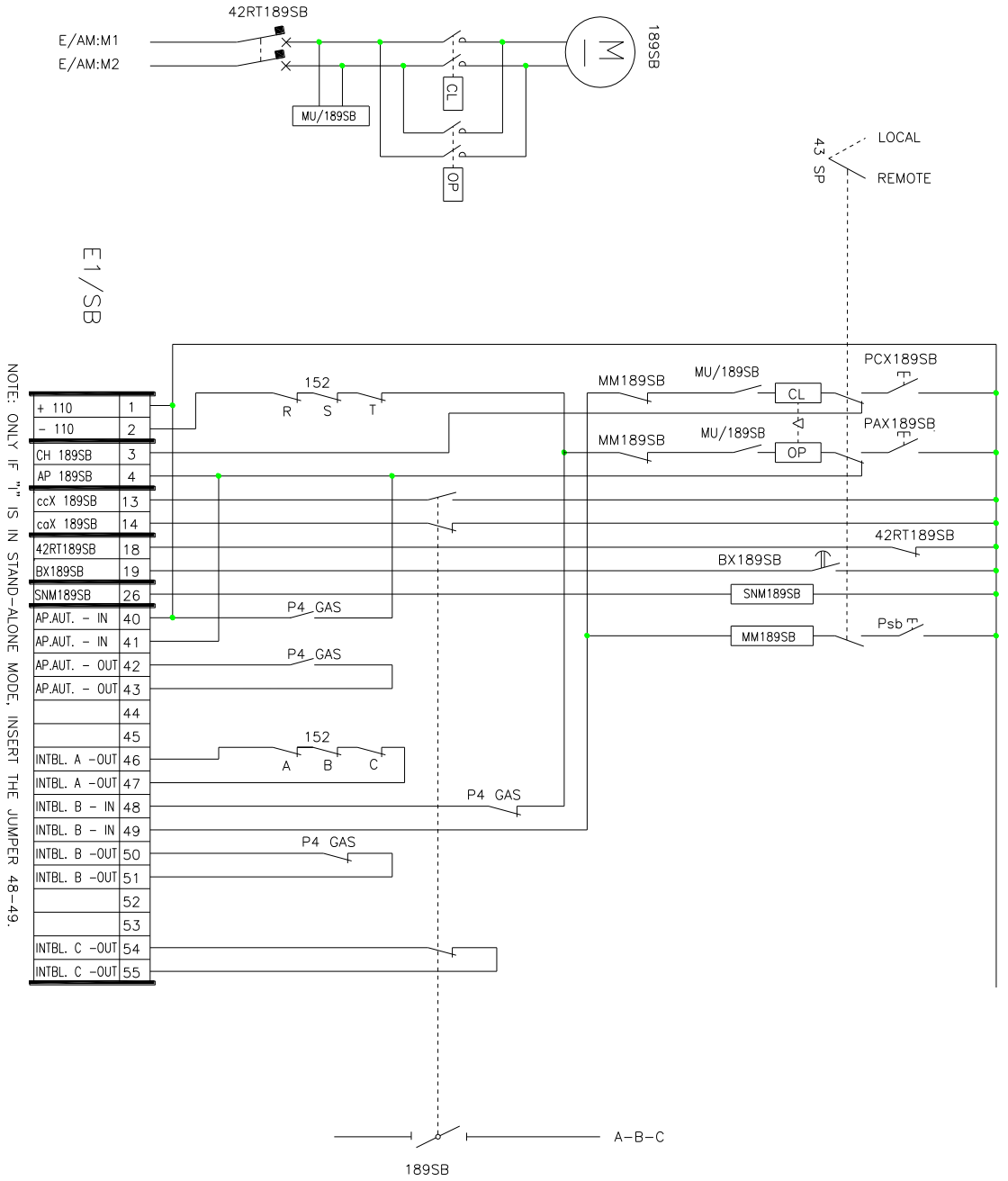

42RT189TL1
42RT189L1
E/AM:M1
E/AM:M2
MU/189L1
CL
OP
189L1
MU/189TL1
189TL1
43 SP/TR
LOCAL
REMOTE
E1/TR
E/TR:1
E/TR:2
152TR
RST
MM189TR
MU/189TR
PCX189TR
PAX189TR
42RT189TR
BX189TR
SNM189TR
Psb
CH 189TR 3
AP 189TR 4
ccX 189TR 13
coX 189TR 14
42RT189TR 18
BX189TR 19
SNM189TR 26
ELECTROMECAHANICAL INTERLOCK WITH 89 T TR (MT) EARTHING SWITCH
NOTE: the electromagnet unlock the key and its subsequent extraction
SY/89T
P4 GAS TV/TR
P4 GAS/TR
INTBL.-52TR(MT) 52
INTBL.-52TR(MT) 53
CONS.CH52TR(MT) 56
CONS.CH52TR(MT) 57
CH 189TTR 103
AP 189TTR 104
ccX 189TTR 113
coX 189TTR 114
42RT189TTR 118
BX 189TTR 119
SNM189TTR 126
An PRES TENS 129
27 ON TR 130
27 OFF TR 131
MM189TTR
MU/189TTR
PCX189TTR
PAX189TTR
42RT189TTR
BX189TTR
SNM189TTR
Psb
An 27AT/TR (schema VT/2)
27AT/TR (schema VT/2)
TV TR
A-B-C
189TR
189TTR

Code:
402

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

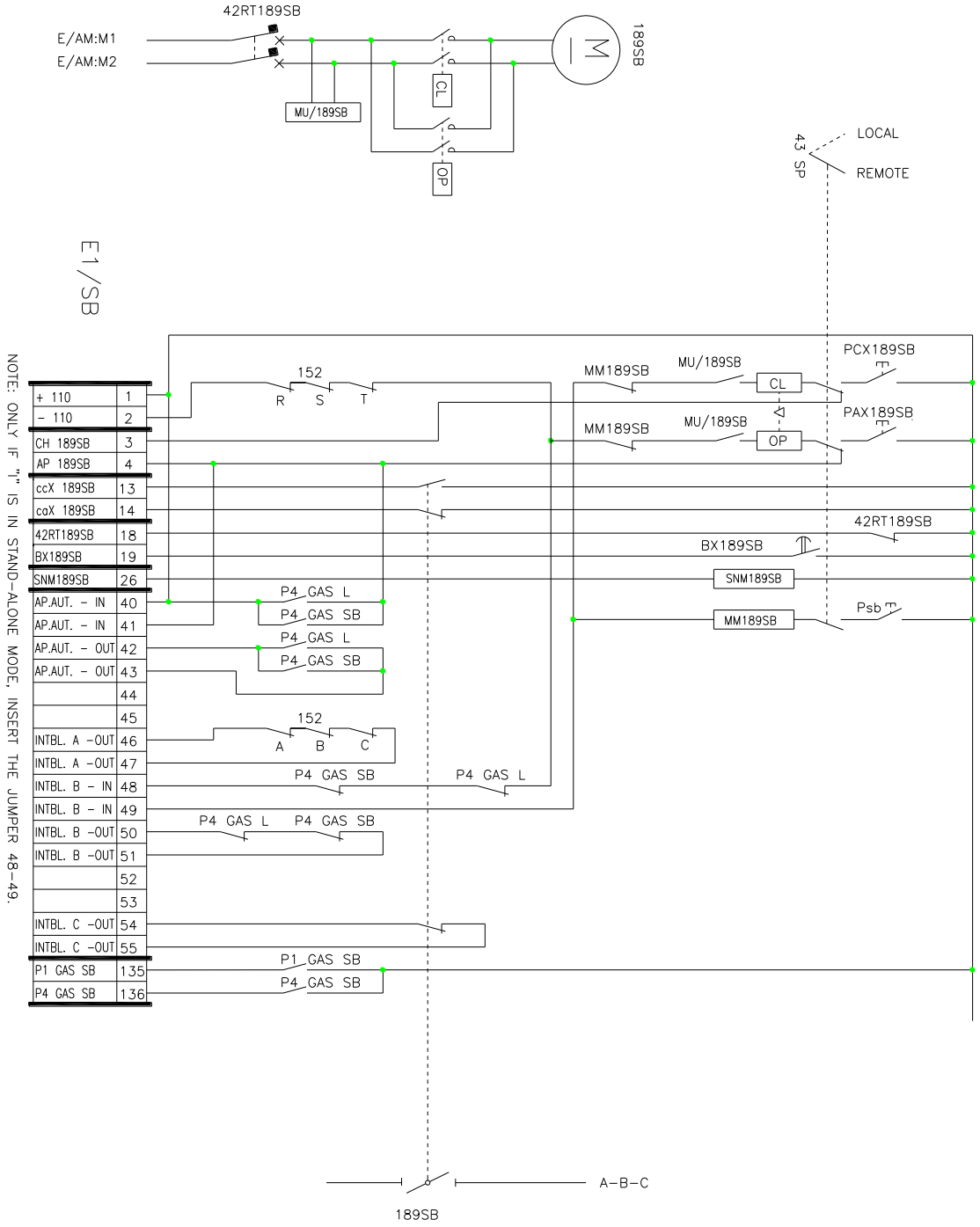


Code:
501

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

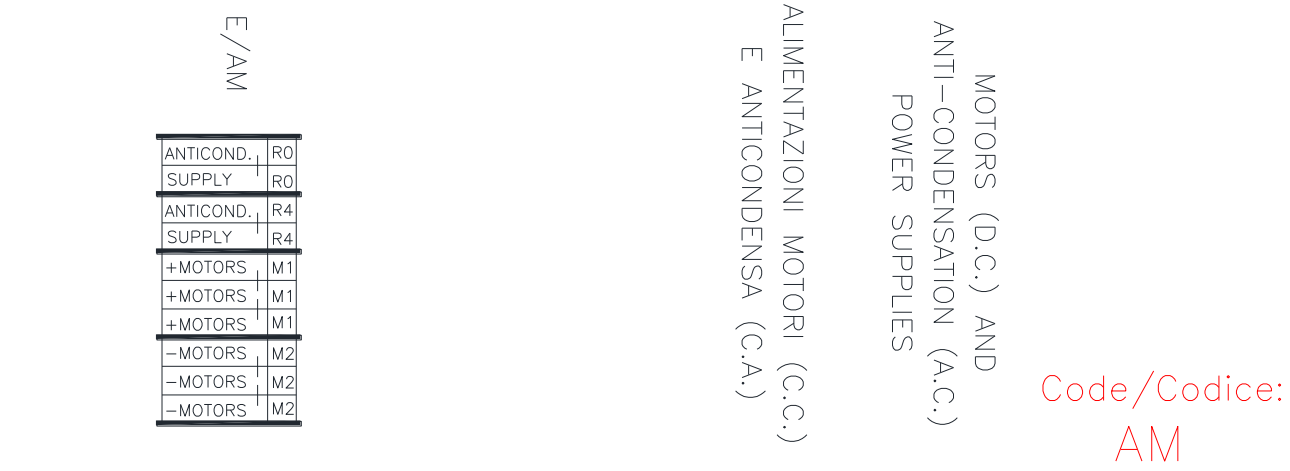


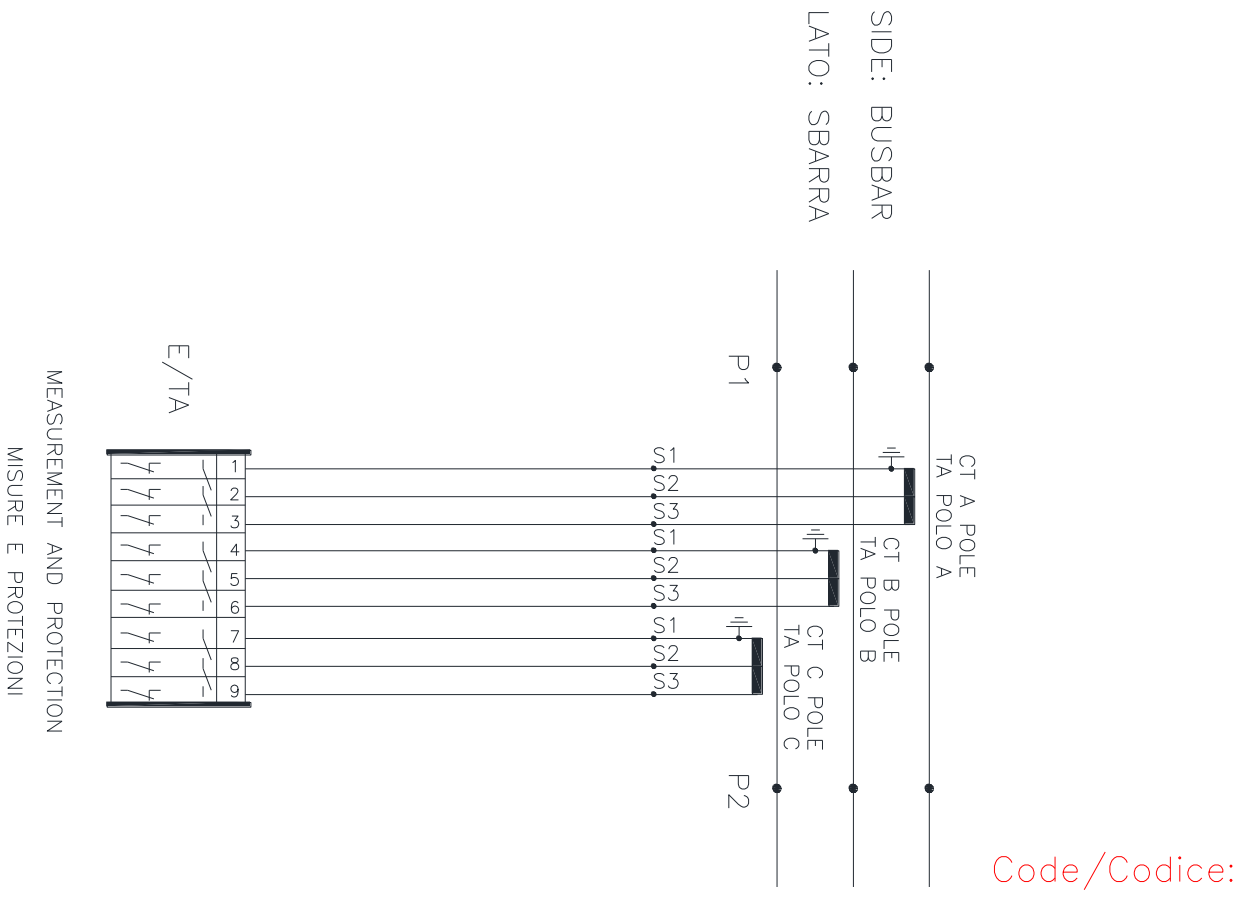
Code:
502

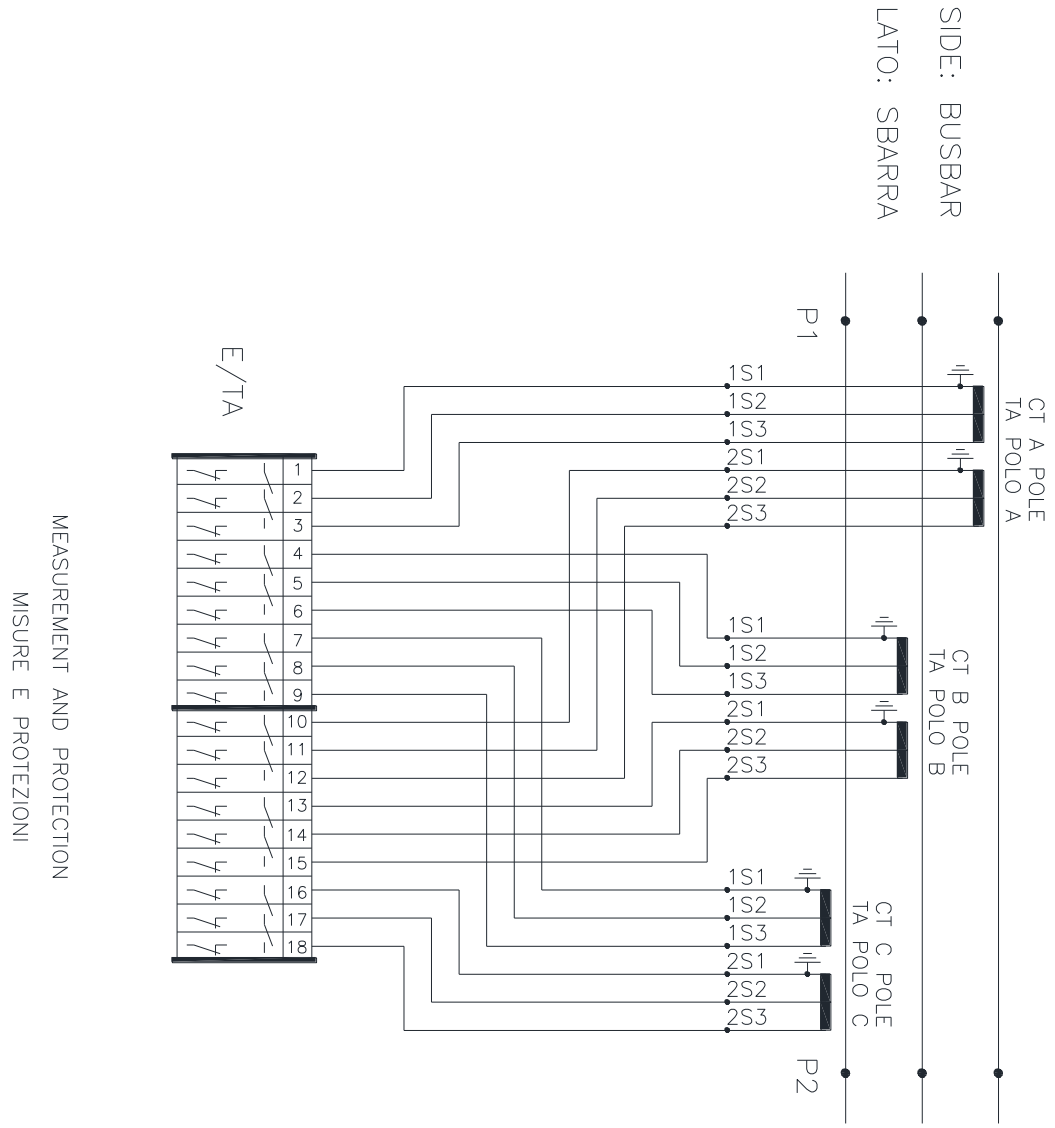
Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*





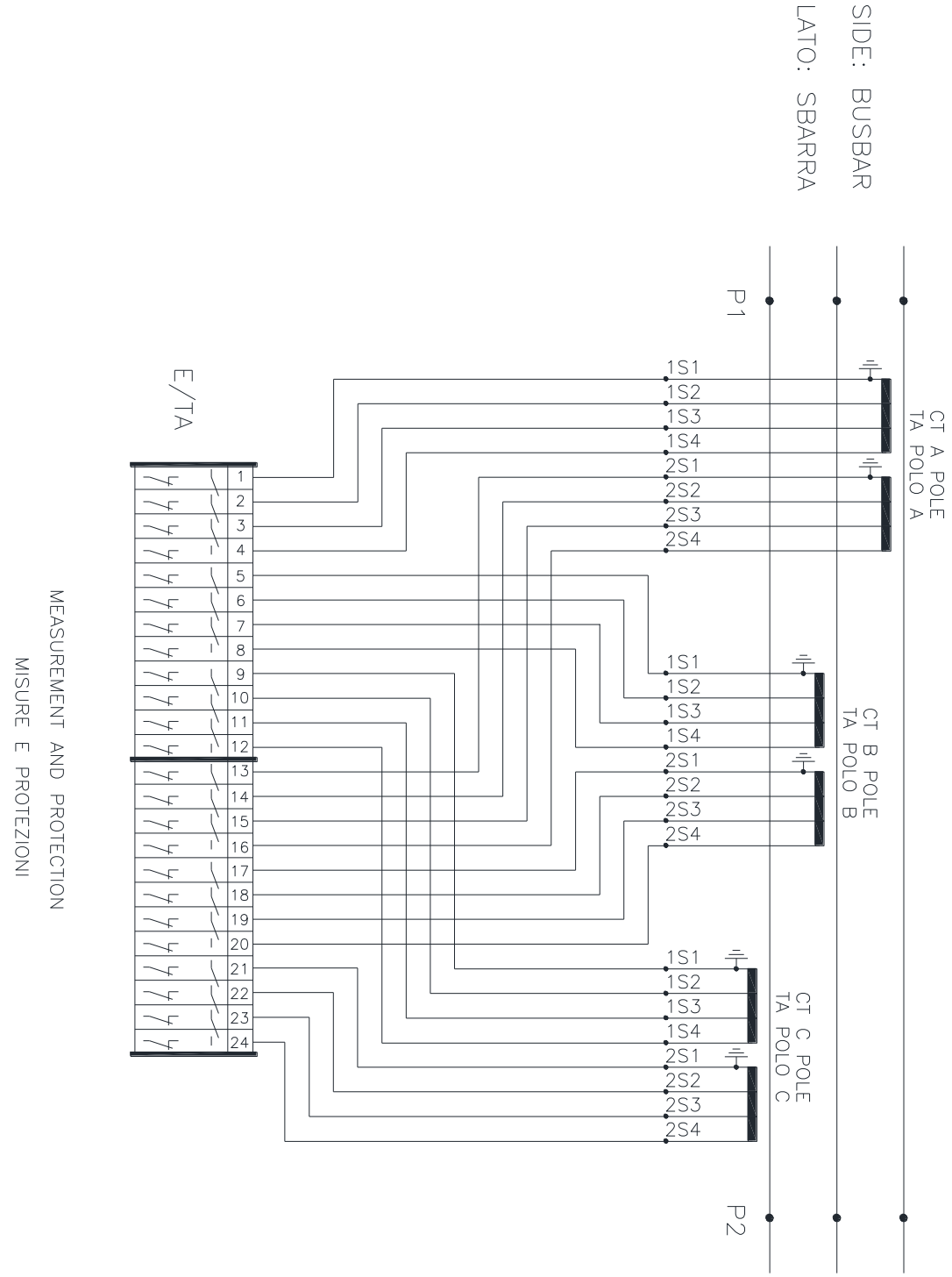


Code/Codice:
CT/2

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



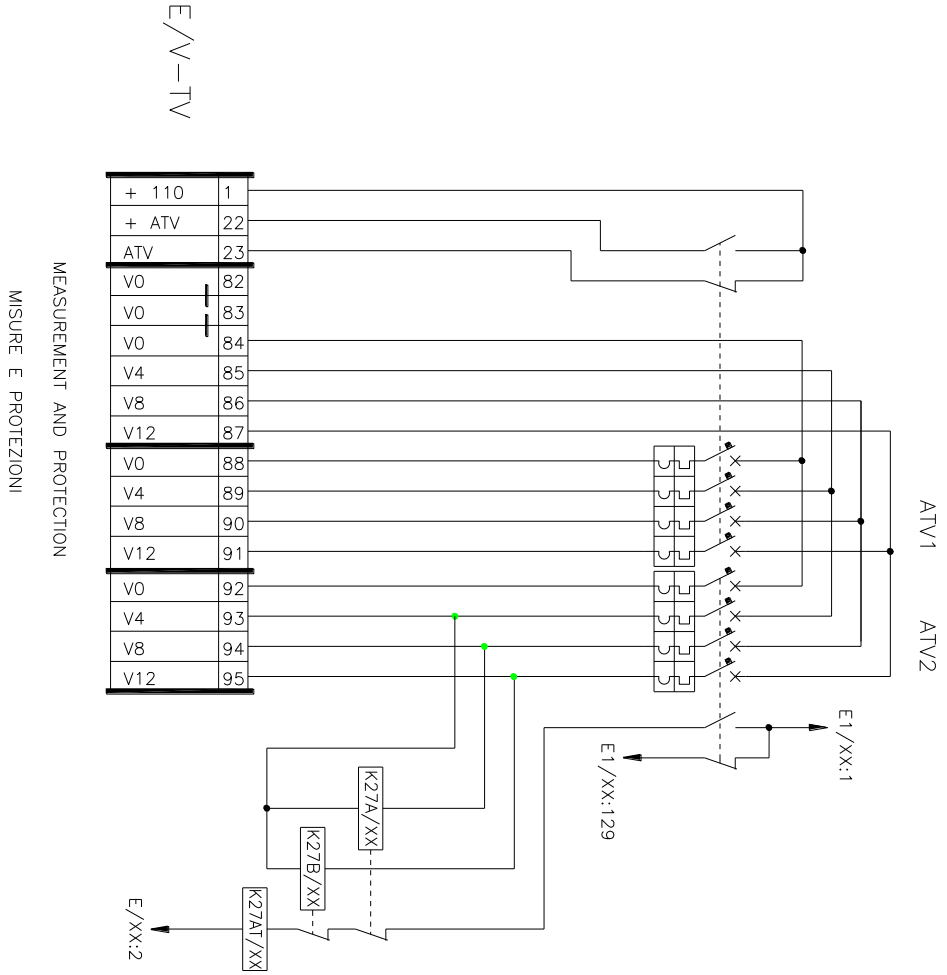
Code/Codice:
CT/3

Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025
Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

Inductive or Capacitor Voltage Transformers Version

Versione con TV – TVC tradizionali esterni



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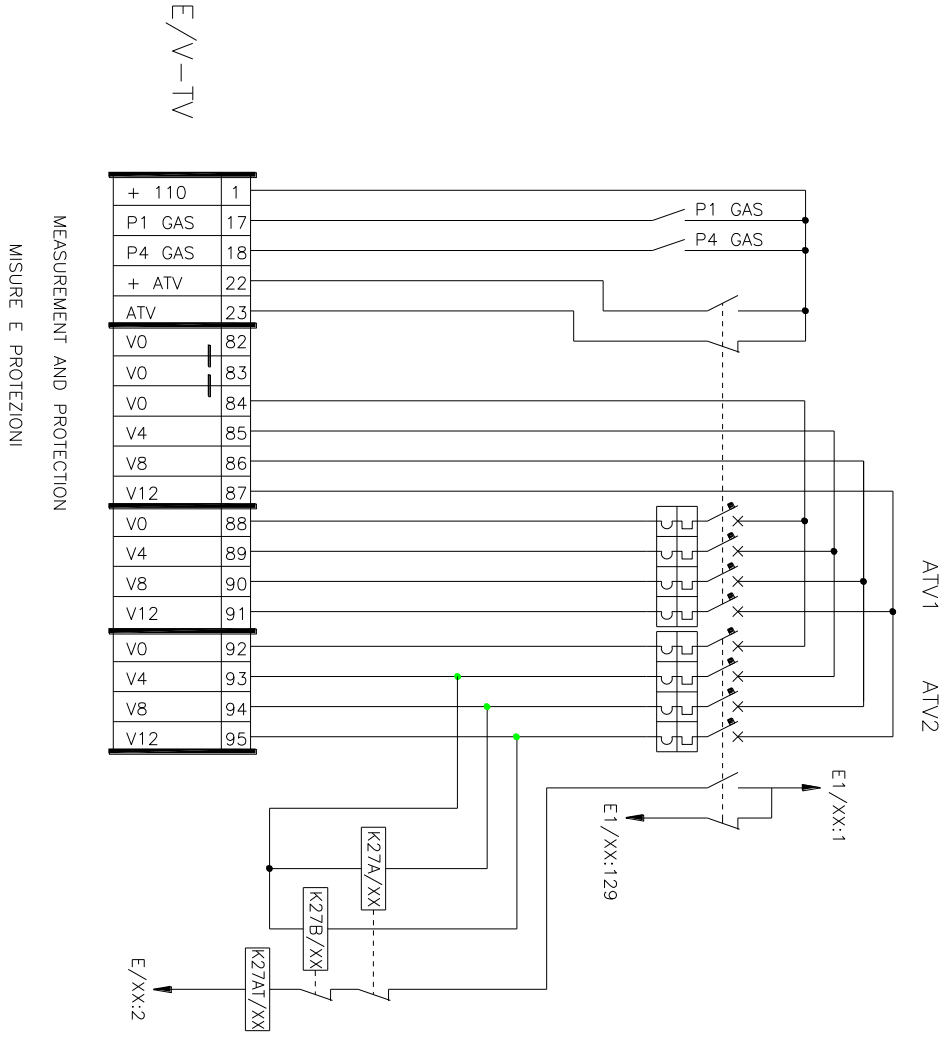
Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

Gas insulated Inductive Voltage Transformers Version

Versione con TV in SF6 e relativa compartimentazione



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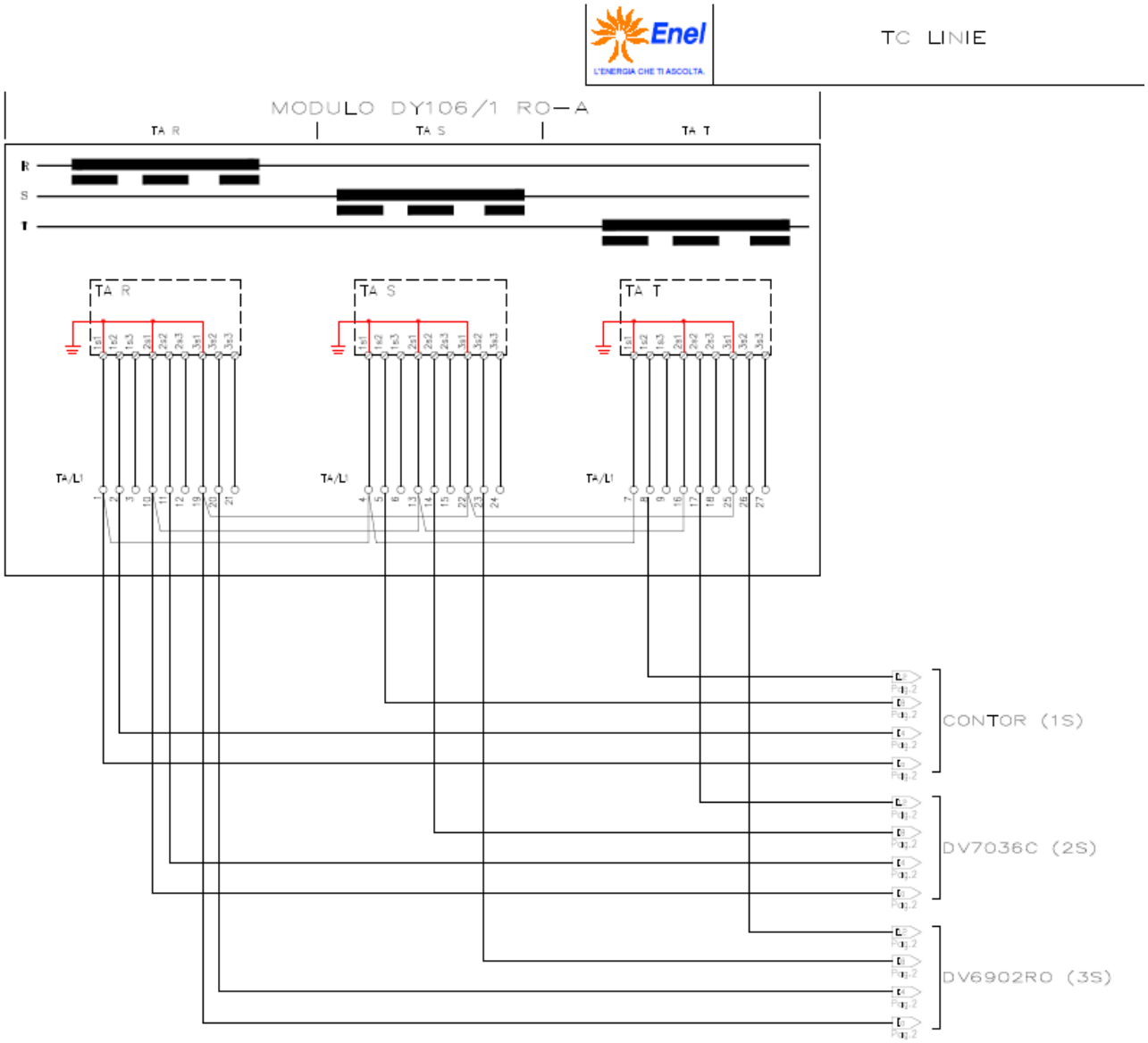
Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

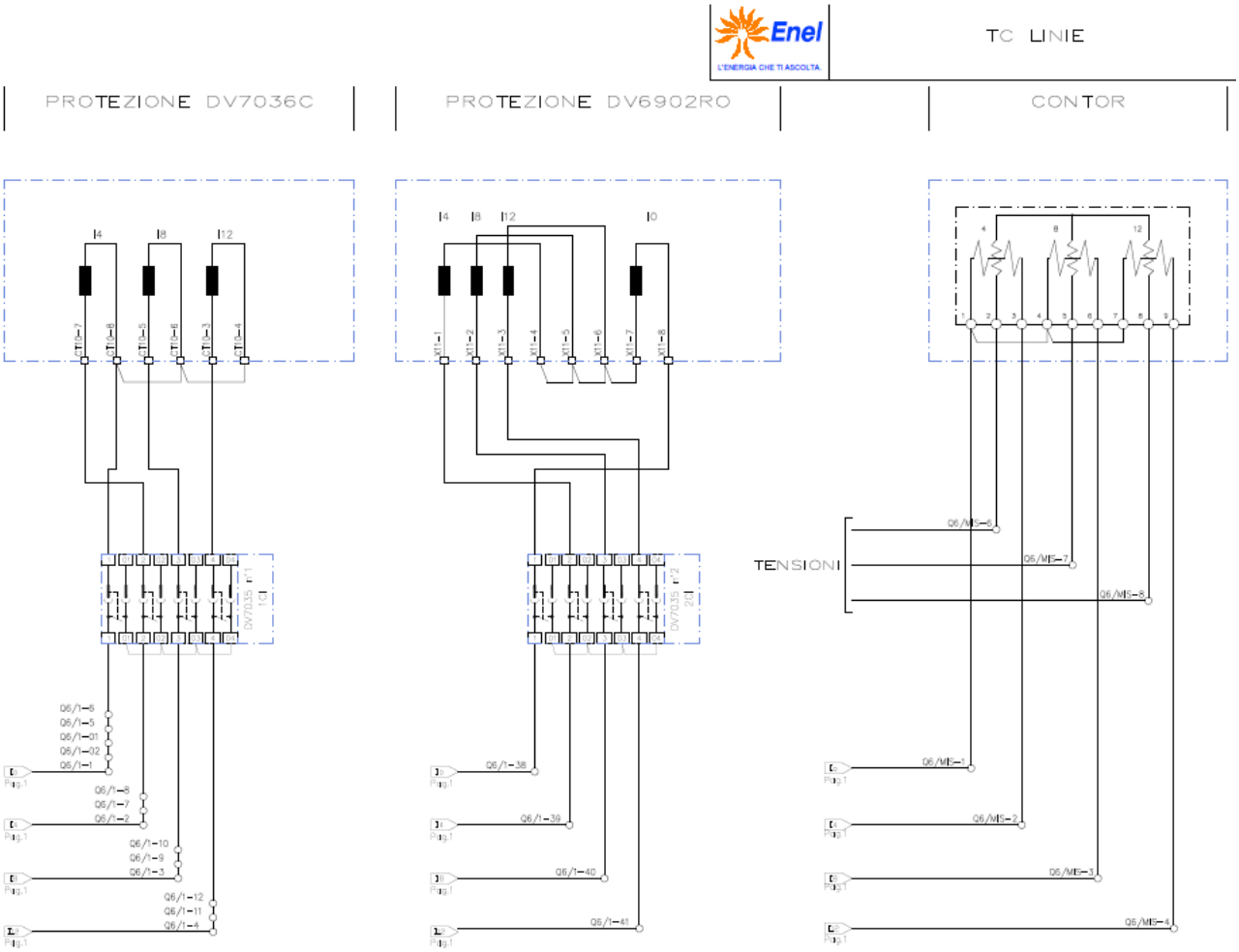
Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

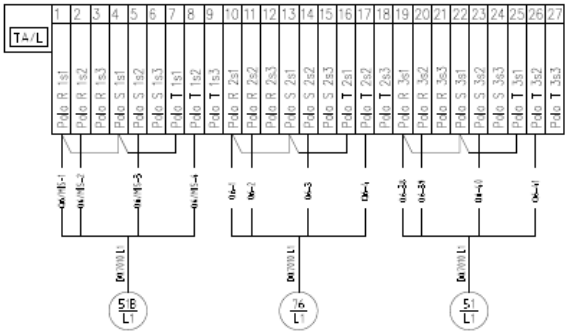
Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

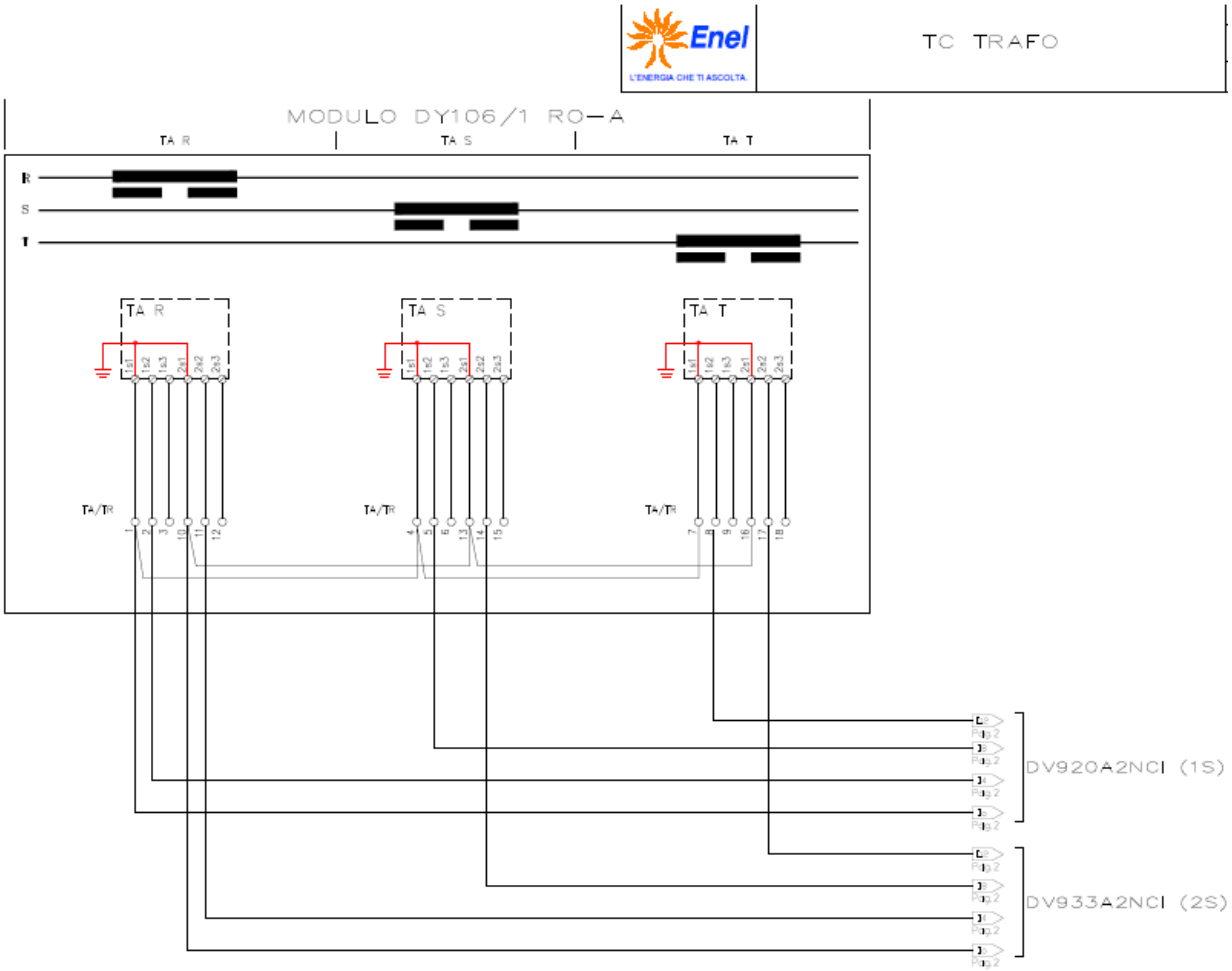
Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

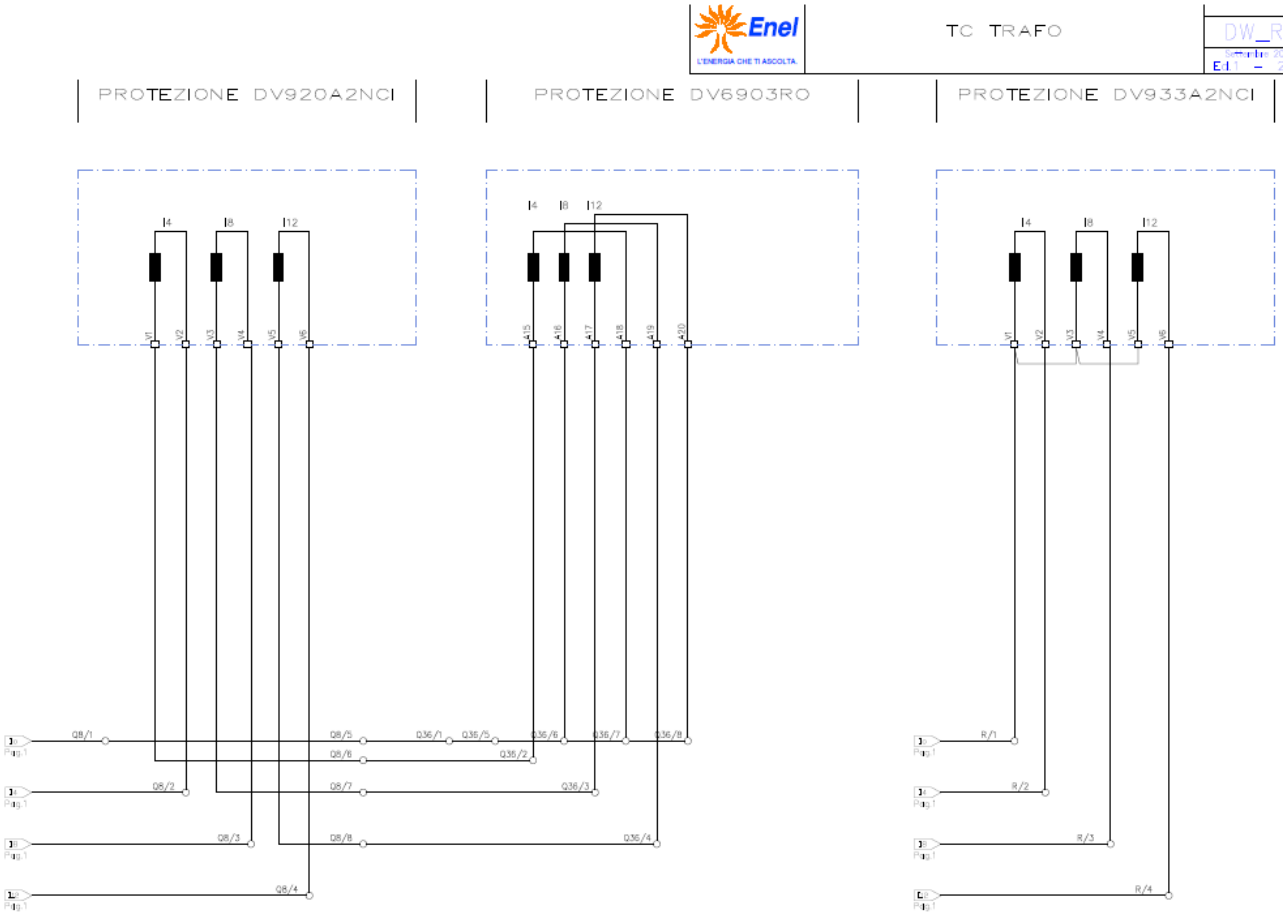
Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



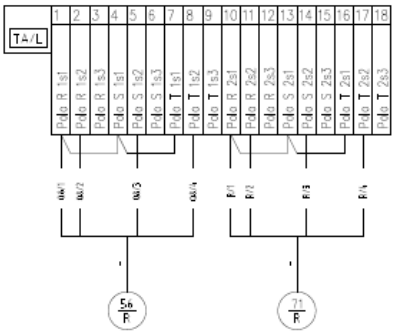
Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



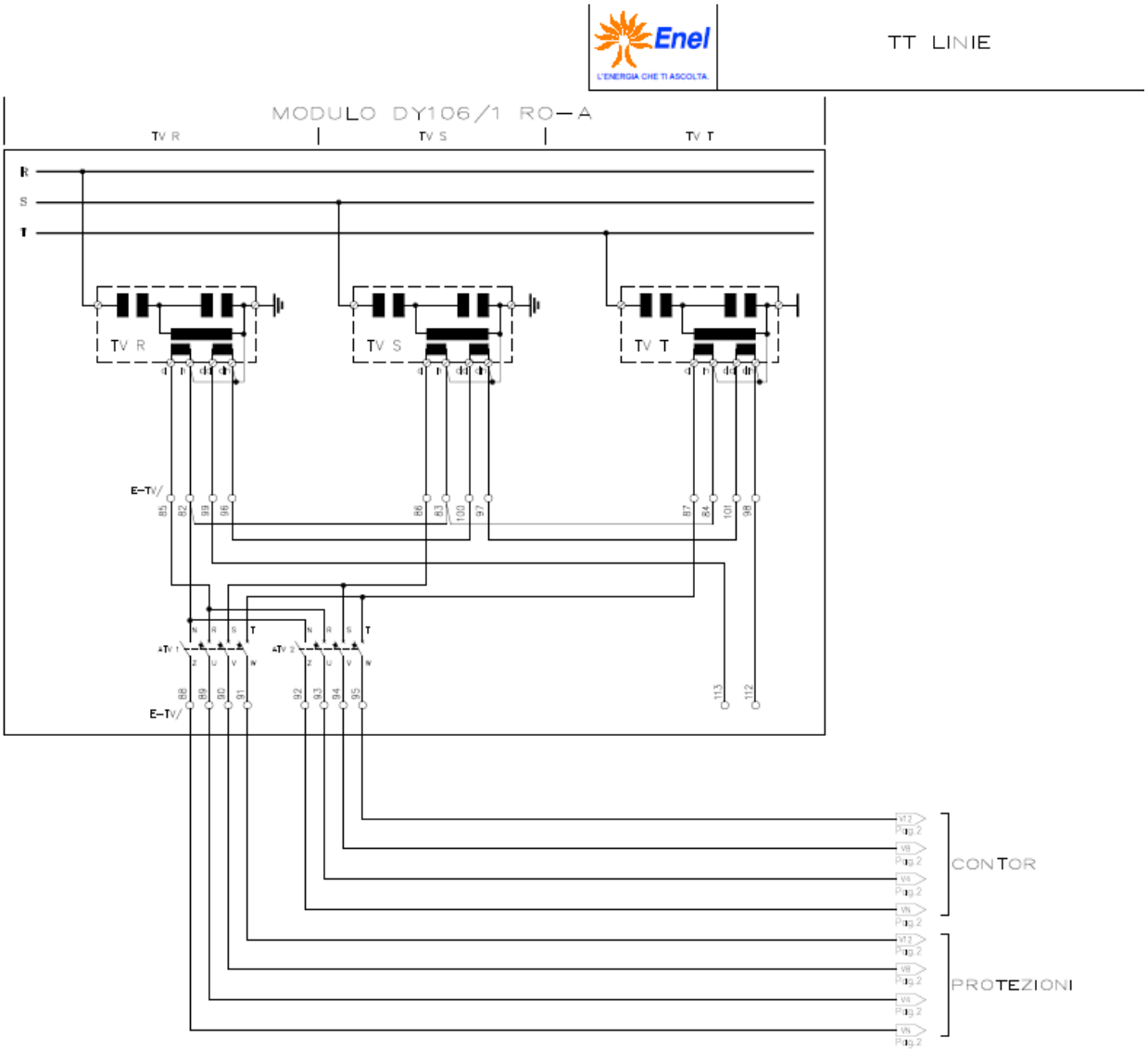
Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*



Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

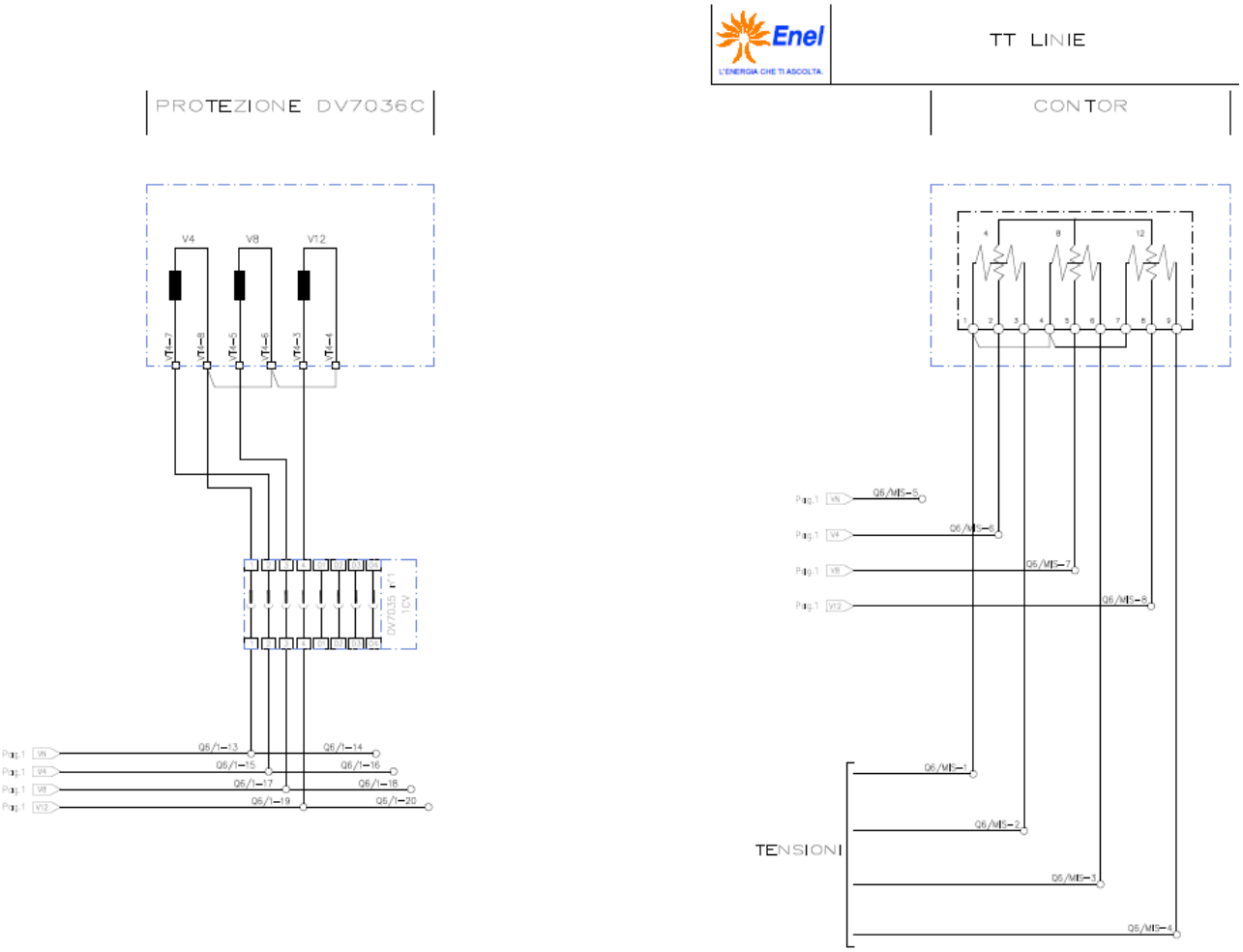
Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

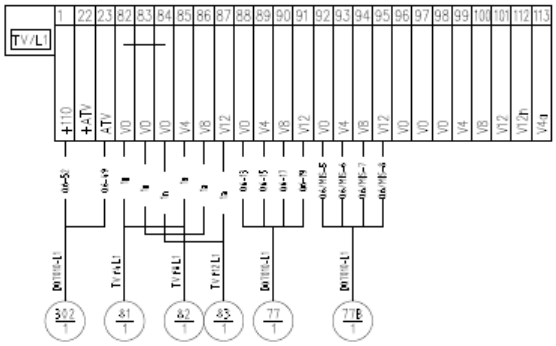


Material Specification code: GRI-GRI-MAT-E&C-0019
Version no. 7 dated 11/10/2025

Subject: GSCH002 HYBRID MODULES

Application Areas
Perimeter: *Global*
Staff Function: -
Service Function: -
Business Line: *Enel Grids*

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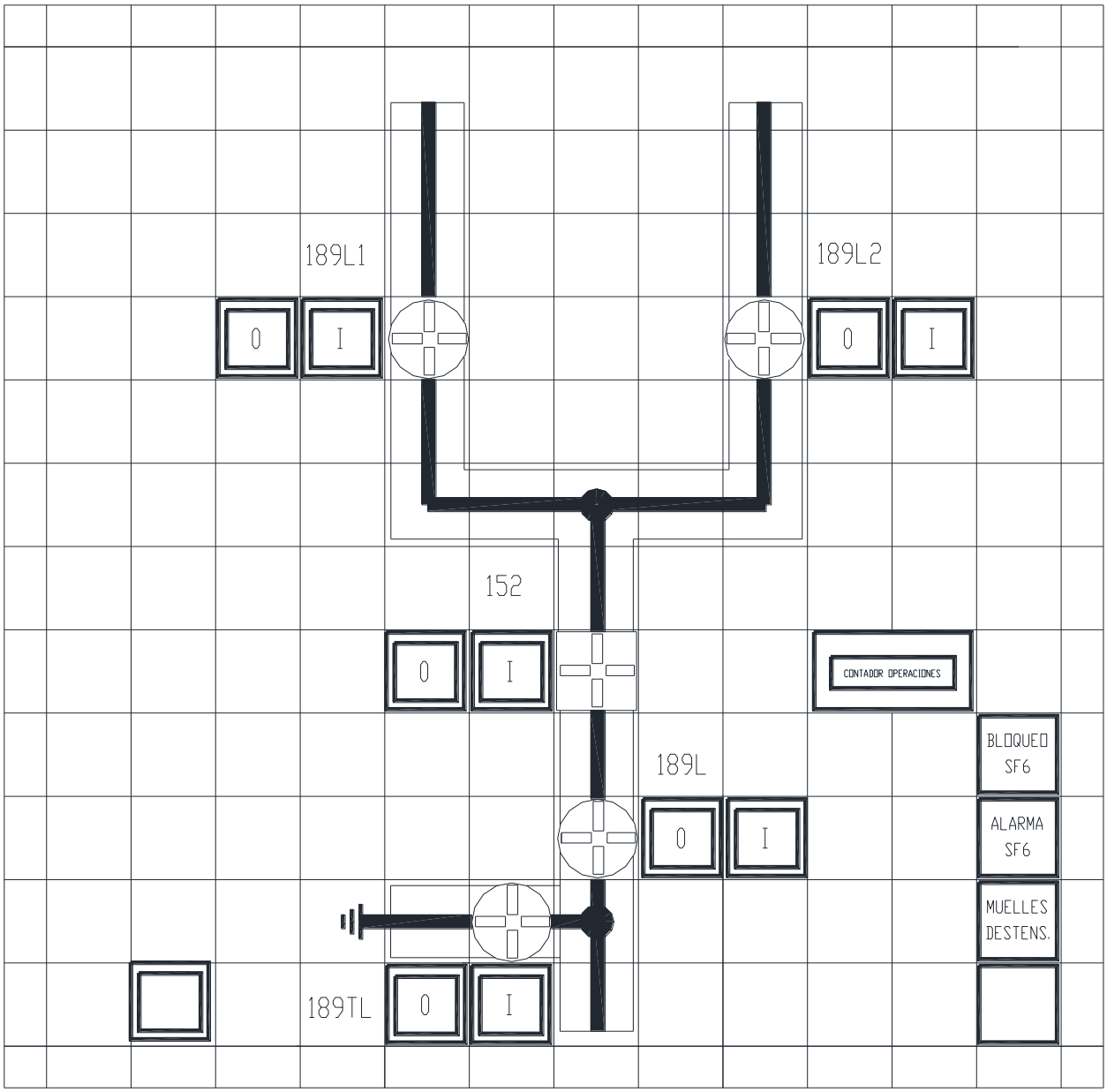
113
+110
+ATV
V0
V4
V8
V12

ANNEX E – SYNOPTIC EXAMPLES

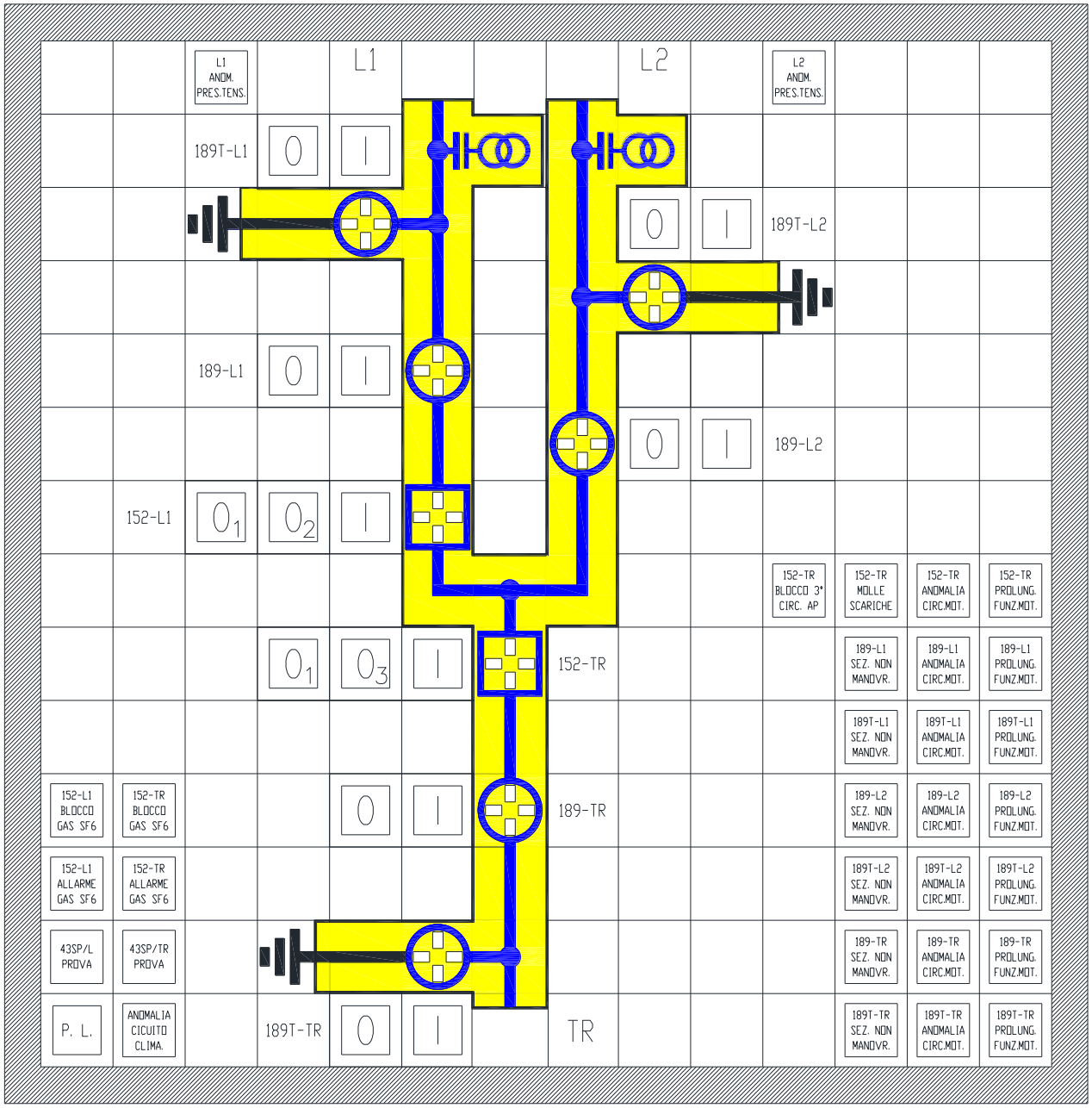
E.1 – e-distribución AND LATAM SYNOPTIC EXEMPLES

Example of Y1 type – used in Line bay

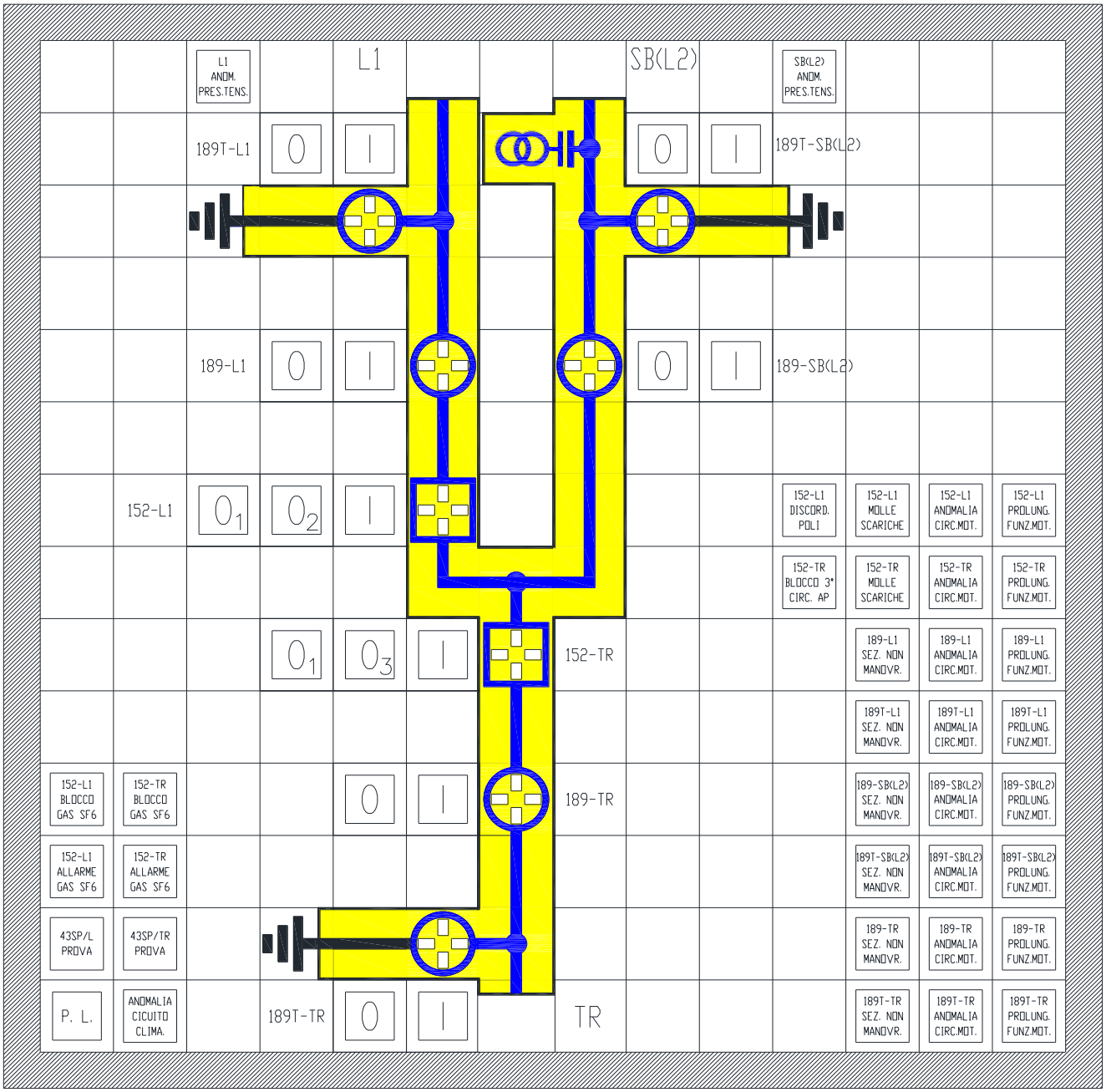


E.2 – E-DISTRIBUZIONE SYNOPTIC EXEMPLES

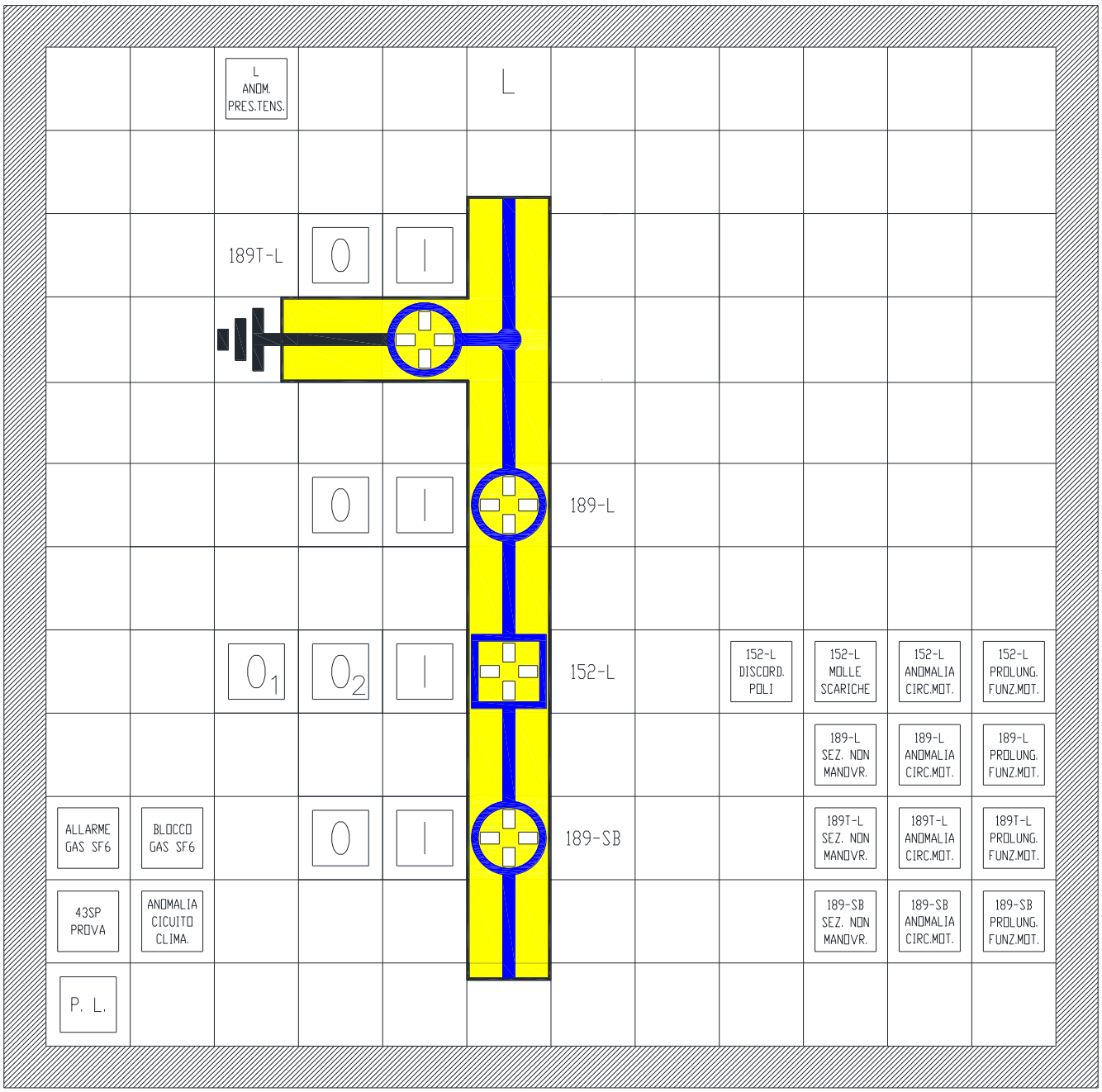
Example of Y1 type: Line 1 bay, Line 2 bay, Transformer bay



Example of Y2 type: Line bay, Busbar (or Line bay), Transformer bay



Example of Single-bay type: Line bay, Busbar bay



ANNEX F – TENDER'S TECHNICAL DOCUMENTATION

GLOBAL STANDARD: GSCH002 – HYBRID MODULES		**TENDER:**	
SUPPLIER:		**FACTORY:**	
RATED VOLTAGE FOR EQUIPMENT Ur (kV):		**SUPPLIER MODEL:**	
TECHNICAL CHARACHTERISTIC		***STANDARD REQUIREMENT***	***SUPPLIER OFFER***
Service conditions			
Service conditions		outdoor normal service conditions of IEC 62271-1	
Reference altitude (m)		≤ 1.000 (2.600 for Colombia)	
Minimum ambient air temperature (°C)		- 25	
SPS Class (IEC/TS 60815 series)		d) or e)	
Ice coating (mm)		10	
Seismic qualification level		See table in 7.2.3	
Common general ratings			
Rated short-duration power-frequency withstand voltage Ud (kV rms):	Phase-to-earth, across open switching device and between phases		
	Across the isolating distance		
Rated lightning impulse withstand voltage Up (kVp):	Phase-to-earth, across open switching device and between phases		
	Across the isolating distance		
Rated frequency fr (Hz)		50 and 60	
Rated normal current Ir (A)		2.000	
Rated short-time withstand current Ik (kA)			
Degrees of protection provided by enclosures (IEC 60529)		IP54	
Protection stage (tab. 104 EN 62271-203)		2	
Maximum SF6 leakage rate (% / year)		≤ 0,5%	
HV Single-line diagram			To enclose a HV single-line diagram for each one of the detailed layout examples in Annex B.2
Dimensions		See Annex C	To enclose an overall equipment drawing for each one of the detailed layout examples in Annex B.2

Circuit breakers			
Rated short-circuit breaking current Isc (kA)			
First-pole-to-clear factor kpp			
Rated operating sequence		O - 0,3 s- CO -1 min - CO	
Maximum break-time (ms)		60	
Circuit-breaker class		C2 – E1 – M2	
Rated line-charging breaking current Il (A)			
Rated cable-charging breaking current Ic (A)			
Rated out-of-phase making and breaking current Id (kA)		Clause 4.106 of IEC 62271-100	
Disconnectors and earthing switches			
Opening (closing) time for motor operation (s)		≤ 15	
Disconnector mechanical endurance class Mr		M1	
Bus-transfer current switching by disconnectors (only if requested)	Rated bus-transfer current for disconnectors (A)	Clause B.4.106.1 of IEC 62271-102	
	Rated bus-transfer voltages for disconnectors (V)	Clause B.4.106.1 of IEC 62271-102	
Earthing switches class		E0 – M1 – A	
SF6-air Bushings			
Insulators materials		Composite	
Bus ducts			To enclose an overall equipment drawing of a solution with bus-ducts
Cable connections			To enclose an overall equipment drawing of a solution with cable connections
Current transformers			
Rated short-time thermal current Ith (kA)		40	
Rated continuous thermal current Icth (kA)		120% of Ipr	
Core number		1 or 2	
Voltage transformers			
Secondary windings		1, 2 or 3	
Rated voltage factor Fv		1,5 (rated time 30 s)	