HYBRID MODULES

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02	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

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1 SCOPE

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:

- Ampla (Brazil)
- Chilectra (Chile)
- Codensa (Colombia)
- Coelce (Brazil)
- Edelnor (Perú)
- Edesur (Argentine)
- Endesa Distribución Eléctrica (Spain)
- Enel Distributie Banat (Romania)
- Enel Distributie Dobrogea (Romania)
- Enel Distributie Muntenia (Romania)
- e-distribuzione (Italy)

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.

2 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 5.

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			
GSH002/011	Lateral bay	With circuit-breaker	Air connection	72,5 kV
GSH002/012				145 kV
GSH002/013				170 kV
GSH002/014				245 kV
GSH002/021			Cable connection	72,5 kV
GSH002/022				145 kV
GSH002/023				170 kV
GSH002/024				245 kV
GSH002/031			Bus-duct connection	72,5 kV
GSH002/032				145 kV
GSH002/033				170 kV
GSH002/034				245 kV
GSH002/061		Without circuit-breaker	Air connection	72,5 kV
GSH002/062				145-170 kV
GSH002/063				245 kV
GSH002/071			Cable connection	72,5 kV
GSH002/072				145-170 kV
GSH002/073				245 kV
GSH002/081			Bus-duct connection	72,5 kV
GSH002/082				145-170 kV
GSH002/083				245 kV
GSH002/111	Central bay	Without circuit-breaker	Air connection	72,5 kV
GSH002/112				145-170 kV
GSH002/113				245 kV
GSH002/121			Cable connection	72,5 kV
GSH002/122				145-170 kV
GSH002/123				245 kV
GSH002/131			Bus-duct connection	72,5 kV
GSH002/132				145-170 kV
GSH002/133				245 kV

GSH002/211	Circuit-breaker drive mechanism	Single-pole	1°, 2° opening circuit	72,5 kV
GSH002/212				145-170 kV
GSH002/213				245 kV
GSH002/221			1°, 2°, 3° opening circuit	72,5 kV
GSH002/222				145-170 kV
GSH002/261		Three-pole	1°, 3° opening circuit	72,5 kV
GSH002/262				145-170 kV
GSH002/263				245 kV
GSH002/271			1°, 2°, 3° opening circuit	72,5 kV
GSH002/272				145-170 kV
GSH002/281			1°, 2° opening circuit	72,5 kV
GSH002/282				145-170 kV
GSH002/283				245 kV
GSH002/311	Disconnector	72,5 kV		
GSH002/312		145-170 kV		
GSH002/313		245 kV		
GSH002/321	Disconnector with earthing switch	72,5 kV		
GSH002/322		145-170 kV		
GSH002/323		245 kV		
GSH002/331	Disconnector with ability of Bus-transfer current switching	72,5 kV		
GSH002/332		145-170 kV		
GSH002/333		245 kV		
GSH002/411	Bushing SF6/air class “d”	72,5 kV		
GSH002/412		145-170 kV		
GSH002/413		245 kV		
GSH002/421	Bushing SF6/air class “e”	72,5 kV		
GSH002/422		145-170 kV		
GSH002/423		245 kV		
GSH002/461	Cable connection upward exit	72,5 kV		
GSH002/462		145-170 kV		
GSH002/463		245 kV		
GSH002/464	Cable connection downward exit	72,5 kV		
GSH002/465		145-170 kV		
GSH002/466		245 kV		

GSH002/481	Equipments for direct connection between bus-duct and power transf.	72,5 kV
GSH002/482		145-170 kV
GSH002/483		245 kV
GSH002/511	Bus-duct (1 linear meter x 3 poles)	72,5 kV
GSH002/512		145-170 kV
GSH002/513		245 kV
GSH002/521	Bus-duct curve	72,5 kV
GSH002/522		145-170 kV
GSH002/523		245 kV
GSH002/531	Bus-duct expansion compensator	72,5 kV
GSH002/532		145-170 kV
GSH002/533		245 kV
GSH002/541	Bus-duct joint	72,5 kV
GSH002/542		145-170 kV
GSH002/543		245 kV
GSH002/561	Partitioning with single-pole gas management (including relative equipments and control circuits)	72,5 kV
GSH002/562		145-170 kV
GSH002/563		245 kV
GSH002/564	Partitioning with three-pole gas management (including relative equipments and control circuits)	72,5 kV
GSH002/565		145-170 kV
GSH002/566		245 kV

GSH002/601	Current Transformer	72,5 kV
GSH002/602		
GSH002/603		
GSH002/604		145-170 kV
GSH002/605		
GSH002/606		
GSH002/607		245 kV
GSH002/608		
GSH002/611		
GSH002/612		
GSH002/620		
GSH002/621		
GSH002/622		
GSH002/623		
GSH002/700	EVDS - Electronic Voltage Detector System (capacitive dividers included)	
GSH002/701	Voltage Transformer	
GSH002/702		
GSH002/703		
GSH002/704		
GSH002/711		
GSH002/721		
GSH002/722		

GSH002/801	Support	e-distribuzione	Y1 type and Y2 type	72,5 kV
GSH002/802				145-170 kV
GSH002/803				245 kV
GSH002/804			Single-bay type	72,5 kV
GSH002/805				145-170 kV
GSH002/806				245 kV
GSH002/811		Enel Distributie	Y2 type	145 kV
GSH002/812			Single-bay type	145 kV
GSH002/821		Endesa Distribución	Y1 type	145 kV
GSH002/822			Y2 type	145 kV
GSH002/823			Single-bay type	145 kV
GSH002/824			Y1 type	72,5 kV
GSH002/825			Y2 type	72,5 kV
GSH002/826			Single-bay type	72,5 kV
GSH002/841		Edesur	Y1 type	145 kV
GSH002/842				245 kV
GSH002/843			Y2 type	145 kV
GSH002/844				245 kV
GSH002/845			Single-bay type	145 kV
GSH002/846				245 kV
GSH002/851		Edelnor	Y1 type	72,5 kV
GSH002/852				245 kV
GSH002/853			Y2 type	72,5 kV
GSH002/854				245 kV
GSH002/855			Single-bay type	72,5 kV
GSH002/856				245 kV
GSH002/861		Coelce	Y1 type	72,5 kV
GSH002/862			Y2 type	72,5 kV
GSH002/863			Single-bay type	72,5 kV
GSH002/871		Codensa	Y1 type	145 kV
GSH002/872			Y2 type	145 kV
GSH002/873			Single-bay type	145 kV
GSH002/881		Chilectra	Y1 type	145 kV
GSH002/882				245 kV
GSH002/883			Y2 type	145 kV
GSH002/884				245 kV

GSH002/885			Single-bay type	145 kV
GSH002/886				245 kV
GSH002/891		Ampla	Y1 type	72,5 kV
GSH002/892				145 kV
GSH002/893			Single-bay type	72,5 kV
GSH002/894				145 kV
GSH002/895			Single-bay type	72,5 kV
GSH002/896				145 kV

GSH002/901	Control Box	e-dstribuzione	Y1 type	
GSH002/902			Y2 type	
GSH002/903			Single-bay type	
GSH002/911		Enel Distributie	Y2 type	
GSH002/912			Single-bay type	
GSH002/921		Endesa Distribución	Y1 type	Line bay
GSH002/922				Transformer bay
GSH002/923			Single-bay type	Bus Coupler
GSH002/924				Line bay
GSH002/925				Transformer bay
GSH002/926			Y2 type	
GSH002/931		Latam	Y1 type	
GSH002/932			Y2 type	
GSH002/933			Single-bay type	

For local components codification see annex A.

3 REFERENCE LAWS AND STANDARDS

3.1 Laws

3.1.1 Latam

3.1.1.1 *Brasil*

NR-10 - segurança em instalações e serviços em eletricidade

3.1.2 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".*

3.1.3 Spain

Reglamento sobre condiciones técnicas y garantías de seguridad en instalaciones eléctricas de alta tensión, Real Decreto 337/2014.

Real Decreto Riesgo Eléctrico Real Decreto 614/2001.

Reglamento Electrotécnico para Baja Tensión, Real Decreto 842/2002.

Reglamento de puntos de Medida Real Decreto 1110/2007.

3.1.4 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).

3.2 Standards

The below listed reference documents shall be intended in the in-force edition at the contract date (amendments included).

3.2.1 Common standards

For Latin America destinations the reference standard are the IEC/ISO, whilst for Europe destinations the reference standard are the correspondent European standards (EN).

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

3.2.2 Specific standards

3.2.2.1 *Latam*

3.2.2.1.a) *Chilectra*

ETGI-1020 - Especificaciones técnicas generales - Requisitos de diseño sísmico para equipo electrico

3.2.2.2 *Endesa Distribución Eléctrica*

NNM001 – Normas de operación definiciones

NMC001 – Procedimiento para el conexionado de armarios cuadros y paneles

NNC007 – Cables de control multipolares

NZC001 – Procedimiento para la confección de proyectos de control y protección

3.2.2.3 *Enel Distributie*

Prescriptia Energetica PE 101/85 – Normativ pentru construcţia instalaţiilor electrice de conexiuni şi transformare cu tensiuni peste 1 kV

3.2.2.4 *e-distribuzione*

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

4 SERVICE CONDITIONS

4.1 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)	d (Heavy)	e (Very Heavy)
Ice coating (mm)	10	

4.2 Specific service conditions

4.2.1 Colombia

The reference altitude is 2.600 m[1].

4.2.2 Romania[2] (Enel Distributie)

Minimum ambient air temperature (°C)	-30
Ice coating (mm)	22

4.2.3 Seismic qualification level

Chilectra	ETGI-1020
Codensa	Moderate (IEC 62271-207)
Edelnor	High (IEC 62271-207)
Enel Distributie	High (IEC 62271-207)
e-distribuzione	High (IEC 62271-207)

5 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 B for some layout examples.

For each Hybrid Module the Enel Group Distribution company will provide the proper component list (using items in chapter 2) 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.

5.1 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

[1] For Colombia the rated insulation levels in chapter 5 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.

[2] In accordance with Prescriptia Energetica PE 101/85

5.2 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)

5.3 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

6 TECHNICAL CHARACTERISTICS

6.1 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* (kVp):	Phase-to-earth, across open switching device and between phases	325	650		950
	Across the isolating distance	375	750		1050
Rated frequency *fr* (Hz)	Chilectra, Edesur, Endesa Distribución, Enel Distributie and e-distribuzione	50			
	Ampla, Codensa, Coelce and Edelnor	60			
Rated normal current *Ir* (A)		2000			
Rated short time withstand current *Ik* (kA)		31,5	40		
Degrees of protection provided by enclosures (IEC 60529)		IP 54[3]			

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

Rated supply voltage *Ua* (Vdc)	Enel Distributie and e-distribuzione	110
	Endesa Distribución Eléctrica, Ampla, Coelce, Chilectra, Codensa, Edelnor	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)	Endesa Distribución, Enel Distributie and e-distribuzione	230
	Ampla, Coelce, Chilectra, Edelnor, Edesur	220
	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

6.2 Circuit-breakers

In addition to paragraph 6.1 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		
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[4]			
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			

6.3 Disconnectors and earthing switches

In addition to paragraph 6.1 and to IEC 62271-102 requirements, the following further disconnectors and earthing switches ratings are required.

[4] 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.

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			

6.4 SF6-air bushings

6.4.1 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.

6.4.2 Bushing terminations

6.4.2.1 *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

6.4.2.2 *Endesa Distribución Enel Distributie 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.

6.5 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.

6.6 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.

6.7 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)	**GSH002/ 601 604**	**GSH002/ 602 605**	**GSH002/ 603 606**	**GSH002/ 607**	**GSH002/ 608**
Rated short-time thermal current I_{th} (kA)	40				
Rated continuous thermal current I_{cth} (kA)	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
Core number	1	1	1	2	2
Accuracy class[5]	5P30	5P30	5P30	5P30	5P30
Rated burden (VA)	15	15	15	15	15
Maximum secondary winding resistance (R_{ct}) at 75 °C (Ω)	5	5	5	5	5

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

Base component code (see par. 2)	**GSH002/ 611**	**GSH002/ 612**	**GSH002/ 620**	**GSH002/ 621**	**GSH002/ 622**	**GSH002/ 623**
Rated short-time thermal current I_{th} (kA)	40					
Rated continuous thermal current I_{cth} (kA)	120% of I_{pr}					
Rated transformation ratio k_r (A/A)	200-400/1/1	400-800/5/1/1	1.000-2.000/5/5/5	1.000-2.000/5/1/1	400-800/5/5/5	1.000-2.000/5/5
Core number	2	3	3	3	3	2
Accuracy class[5]	5P30	0,2s - FS10	0,5 - 5P20	0,2s - FS10	0,5 - 5P20	5P20
	5P30	5P30	5P20	5P20	5P20	
	---	5P30	5P20	5P20	5P20	
Rated burden (VA)	15	15	30	30	30	30
Maximum secondary winding resistance (R_{ct}) at 75 °C (Ω)	5	5 (only for 1 A cores)	n.a.	n.a.	n.a.	n.a.

6.8 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	**GSH002/ 701**	**GSH002/ 702**	**GSH002/ 703**	**GSH002/ 704**
Highest voltage for equipment U_m (kV)	72,5	145	170	245
Rated Insulation levels	According to 6.1			
Rated transformation ratio k_r (kV/kV)	$\frac{60:\sqrt{3}}{0{,}1:\sqrt{3}}$	$\frac{132:\sqrt{3}}{0{,}1:\sqrt{3}}$	$\frac{150:\sqrt{3}}{0{,}1:\sqrt{3}}$	$\frac{220:\sqrt{3}}{0{,}1:\sqrt{3}}$
Secondary windings	1	1	1	1
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
Rated burden (VA)	25	25	25	25

Base component code	**GSH002/ 711**	**GSH002/ 721**	**GSH002/ 722**
Highest voltage for equipment U_m (kV)	145	145	145
Rated Insulation levels	According to 6.1		
Rated transformation ratio k_r (kV/kV)	$\frac{120:\sqrt{3}}{0{,}1:\sqrt{3};100}$	$\frac{132:\sqrt{3}}{0{,}11:\sqrt{3}}$	$\frac{110:\sqrt{3}}{0{,}11:\sqrt{3}}$
Secondary windings	2	2	2
Rated voltage factor F_v	1,5 (rated time 30 s)		
Accuracy class	0,2	0,5 – 3P	0,5 – 3P
	0,2 – 3P	0,5 – 3P	0,5 – 3P
Rated burden (VA)	15	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

6.8.1 Specific requirements

6.8.1.1 *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 CONSTRUCTION CHARACTERISTICS

7.1 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.

7.2 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.

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; in particular disconnectors manual operations shall be easily performed from the ground (maximum height 1.900 mm) and with the equipment in service;
- 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 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.

7.2.1 Specific requirements

7.2.1.1 *Endesa Distribucion Electrica*

According to NNM001 all accessible parts for operation and maintenance (including disconnectors manual operation) shall be at ≥ 2.000 mm from HV terminals to avoid “Trabajos en Tensión” (as it’s defined on Real Decreto Riesgo Eléctrico 614/2001) on normal inspection and operation works.

7.3 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.

7.4 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 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. For the eventual partitions the criteria is the following:

- 3 single-pole circuits in case of partition including circuit breaker;
- 3 single-pole circuits in case of partition with gas volume over 3,5 m^3;
- 1 three-pole circuit in case of partition without circuit breaker and with gas volume up to 3,5 m^3.

Each SF6 circuit shall provide a connection element (type DILO VK/BG-03/8 or equivalent[6]), 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;

[6] 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.

- located in order to avoid the solar radiation influence on the external temperature measuring;
- 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:

Type of scale	**Endesa Distribución Eléctrica, Enel Distributie and e-distribuzione**	**Latam**
Colored	Mandatory	Mandatory
Graduated	Forbidden	Mandatory

The SF6 density control device shall provide 2 operating levels independently adjustable (see details and specific requirements in 8.5):

- 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 8.5 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 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:

- 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.

7.6 Partitioning

7.6.1 Common requirements

Generally the partitioning of each pole shall 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).

7.6.2 Specific requirements

7.6.2.1 *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.

7.7 Earthing

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

At the base of each support upright shall be provided 2 earthing points, equipped with M12 stainless steel bolts (included in the supply).

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

	Enel Distributie, e-distribuzione and Latam	**Endesa Distribución Eléctrica**
CTs	S1	S2 or S3 (according to the used transformation ratio)
VTs	n	n

7.8 Internal arc and overpression 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.

7.9 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.

7.10 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.

7.11 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 6 for the supply rated voltage) and protected with a magnetothermic automatic circuit-breaker. It shall be controlled by an 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.

7.12 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 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.

7.13 Nameplate

7.13.1 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.

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

- reference to this Global Standard;
- composition type (Y1, Y2 or Single-bay);
- Assembly Type A documents list code;
- optional values, if any;
- composition of the assembly, consisting in a list of the base components indicating:
  - base component code (see chapter 2);
  - local codification (see Annex A);
- the rated filling pressure value at 20°C (relative value).

7.13.2 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.

7.13.3 European countries specific requirements

An informative nameplate with the sentence *"Contains fluorinated greenhouse gases covered by the Kyoto Protocol"* (in accordance with Commission Regulation (EC) 1494/2007 of 17 December 2007) shall be provided.

7.13.4 e-distribuzione specific requirements

According to PVR006 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.

7.14 Disconnector and earthing switches

7.14.1 Ampla and Coelce specific requirements

According to NR-10, moving contacts of disconnectors and earthing switches shall be visible.

8 FUNCTIONAL CHARACTERISTICS

8.1 Drive mechanisms

8.1.1 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
Ampla, Coelce, Chilectra, Codensa, Edelnor, Edesur, Enel Distributie and e-distribuzione	2	Remote Local[7]	Not requested
Endesa Distribución Eléctrica	3	Manual Local Remoto	Requested (extractable only in manual position)

[7] the words "remote" and "local" have to be translated in all documents as:

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 remote controls are enabled and the local controls are disabled.

In “local” position the enabling are the opposite.

In “manual” position (if required) 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 8.2.1), with the following colors:

Operation	**Chilectra, Codensa, Edelnor, Edesur, Endesa Distribución Eléctrica, Enel Distributie and e-distribuzione** (according with IEC 60073)	**Ampla, Coelce** (according with NR10)
Closing	White	White "L" on Red background
Opening	Black	White "D" on Green background

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

Position	**Chilectra, Codensa, Edelnor, Edesur, Endesa Distribución Eléctrica, Enel Distributie and e-distribuzione** (according with IEC 60073)	**Ampla, Coelce** (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

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.

8.1.2 Circuit-breakers drive mechanism

8.1.2.1 *General requirements*

The Circuit-breakers drive mechanism shall be spring type, three-pole or single-pole type.

The drive energy storage shall be normally made by mean of d.c. electric motor (see table in chapter 6.1 for the supply rated voltage); when necessary it shall be possible to restore manually the

- Italian language: *“Servizio”* (S) and *“Prova”* (P)
- Spanish language: *“Remoto”* and *“Local”*
- Romanian language: *“In functiune”* and *“Probe”*
- Portuguese language: “*Remoto”* and *“Local”*

operating device energy, with a maximum effort below 250 N. The manual device shall exclude the motor operation, or in alterative shall be designed excluding its possible movement in case of unexpected spring operation.

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[8]:

- 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.

8.1.2.2 *Release drive circuits*

Referring to the table in chapter 2, the release drive circuits typologies are:

- drive circuit of shunt closing release (always required);
- drive circuit of shunt opening release (1° and 2° circuit);
- 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 8.5 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).

8.1.2.2.a) *Endesa Distribución and Latam specific requirements*

The circuit breaker will be provided with two opening and independent coils.

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.

8.1.2.2.b) *Enel Distributie and 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. 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.

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

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.

8.1.3 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 manual operation in case of need. It will consist of a gear motor (see table in paragraph 6.1 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.

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

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[9]):

- in case of 2 positions selector switch the hand-crank insertion is enabled only in “local” position, pressing a button[10] 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[11] and shall disable the electric operations, both local and remote.

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 8.5 and represented in the electric scheme of annex D.

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[9] “DEC – Dispositivo Elettromagnetico Consenso” for Enel Distribuzione and Enel Distributie.

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

[11] “SNM – Sezionatore Non Manovrabile” for Enel Distribuzione and Enel Distributie.

8.1.3.1 *Endesa 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.

8.1.3.2 *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 8.5.

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.

8.2 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")

8.2.1 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. 7.9 and annex D).

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).

In addition to the IP requirement of table al chapter 6.1, 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 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. 8.5);
- anti-condensation circuit;
- internal lighting lamp, with automatic switching in case of open door.

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 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 signalization lamps and the internal lighting lamps shall not be incandescent type.

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.

8.2.1.1 *e-distribuzione and Enel Distributie 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.

8.2.1.2 *Endesa Distribución specific requirements*

Control box wiring and construction must be compliant with internal Endesa 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.

8.2.2 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. 10.2.2-9b), manufacturer shall provide the measuring points, properly machined.

In addition to the IP requirement of table at chapter 6, 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.

8.3 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.

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 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 1 s.

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.

8.4 Electric schemes, controls and signalizations

8.4.1 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.

8.4.2 Endesa specific requirements

Manufacturer definitive schemes must be compliant with Endesa internal procedure NZC001.

8.4.3 e-distribuzione, Enel Distributie and Latam 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 and Enel Distributie technical specifications (the previous reference doesn't mean that the electric scheme is exactly the same – some modifications have been introduced).

8.4.3.1 *Circuit-breakers*

Code	Description	Previous reference
CB-S/1.2.	C.B. Single-pole operation - 1°, 2° opening circuit	DY 2063 DY 2063 RO
CB-S/1.2.3.	C.B. Single-pole operation - 1°, 2°, 3° opening circuit	DY 2063/1 DY 2063/1 RO
CB-T/1.3.	C.B. Three-pole operation - 1°, 3° opening circuit	DY 2064 DY 2064 RO
CB-T/1.2.3.	C.B. Three-pole operation - 1°, 2°, 3° opening circuit	DY 2064/1 DY 2063/1 RO
CB-T/1.2.	C.B. Three-pole operation - 1°, 2° opening circuit	DY 2064/2 DY 2064/2 RO
245 CB-S/1.2.	245 kV C.B. Single-pole operation - 1°, 2° opening circuit	-

8.4.3.2 *Disconnectors/Earthing switches*

Code	Description	Previous reference
101	Line 1 Bay (Only “Y1” – EVDS)	DY 1107 p.2
102	Line 2 Bay (Only “Y1” – EVDS)	DY 1107 p.3
103	Customer Bay (Only “Y1”)	-
104	Busbar Bay (Only “Y1” – joined with Customer Bay)	-
201	Line Bay (External Voltage Transformers)	DY 1108 p.2
202	Line Bay (Integrated Gas insulated Inductive Voltage Transformers)	DY 1108 p.3
301	Busbar (or Line 2) Bay (EVDS)	DY 1109 p.2
302	Busbar (or Line 2) Bay (Integrated Gas insulated Inductive Voltage Transformers)	DY 1109 p.3
303	Busbar (or Line 2) Bay (EVDS and Partition)	-
401	Transformer Bay	DY 1110 p.2
402	Transformer Bay (Integrated Gas insulated Inductive Voltage Transformers)	DY 1110 p.3
DS electric scheme code	**Description**	**Previous reference**
501	Busbar Bay (Only “Single-bay” type)	DY 1111 p.2
502	Busbar Bay (Only “Single-bay” type - Partition)	-

8.4.3.3 *Motors and anti-condensation power supplies*

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

8.4.3.4 *Current and Voltage Transformers for e-distribuzione*

Code	Description	Previous reference
CT/1	Current Transformers (type GSH002/601 ÷ 606)	DY 1106 p.2
CT/2	Current Transformer (type GSH002/607)	-
CT/3	Current Transformer (type GSH002/608)	-
VT/1	Voltage Transformers (Inductive or Capacitor Voltage Transformers Version)	DY 1113 p. 2
VT/2	Voltage Transformers (Gas insulated Inductive Voltage Transf. Version)	DY 1113 p. 3

8.4.3.5 *Current and Voltage Transformers for Enel Distributie*

See the electric diagrams from page 110 to page 118.

8.5 Controls, signalizations, interlock and automatic openings

8.5.1 Endesa specific requirements

8.5.1.1 *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)
- 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).

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).

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 minitiaure 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.
- Anti-pumping circuit.
- 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 Manual-Local-Remote selector switch (hereinafter 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.

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.

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 DSs 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 generate the closed bus coupler state. Closed state implies that both DSs and CB are closed. The closed bus coupler circuit will enable the operation of all busbar DSs of the switchyard (See Annex D - Terminals X19:1-6)

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 y X3:51-52).
- Anti-condensation circuit 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 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 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).
- 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 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 NOT be a temporized one (See Annex D – Terminals X1:45-46).
- 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).

8.5.1.2 *Hybrid module Y1 type – used in Line bay*

<u>d.c. and a.c. supply</u>

- 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 Endesa (See Annex D - Terminals X0:19-20)

<u>Current circuits</u>

- Terminal block for the CT secondary terminals (See Annex D - Terminals X6:1-24 if CTs are supplied directly from factory with the primary transformation ratio required for each installation).

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 voltage-free contacts connected to terminals.
  - F102-SECONDARY PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed voltage-free contacts connected to terminals.
  - F103-MEASURE AND SYNCHRONISM VOLTAGE: 1 tripolar+neutral MCB with 1 normally closed and 1 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.
- Anti-pumping circuit.
- 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 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.
- 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 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)

- 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)

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 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).

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.
- In case of line earthing switch the interlocking which prevents the operation with voltage presence in line shall be included. 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.

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 X19:7-8)

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, X3,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; X3:51-52; X4:51-52 and X5:51-52)
- Anti-condensation circuit 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 voltage-free contact connected to terminals (See Annex D – Terminal X21-9)
- F102 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21-10)
- F103 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21-11)
- "MANUAL" position signal of 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 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)
- 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 NOT be a temporized one (See Annex D – Terminals X1:49-50)
- 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)

8.5.1.3 *Hybrid module Y1 type – used in Transformer bay*

<u>d.c. and a.c. supply</u>

- 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 Endesa (See Annex D - Terminals X0:19-20).

Current circuits

- Terminal block for the CTs secondary terminals (See Annex D - Terminals X6:1-24 if CTs are supplied directly from factory with the primary transformation ratio required for each installation).

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-MEASURE AND PROTECTION VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed voltage-free contacts connected to terminals.
  - F102-PROTECTION VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed voltage-free contacts connected to terminals.
  - F103-PROTECTION VOLTAGE: 1 tripolar+neutral MCB with 3 normally closed voltage-free contacts connected to terminals.
- 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)

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.
- Anti-pumping circuit.
- 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 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 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).

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.

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 X19:7-8)

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 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 and X3:51-52)
- Anti-condensation circuit 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 voltage-free contact connected to terminals (See Annex D – Terminal X21-9)
- F102 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21-10)
- F103 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21-11)
- Manual position signal of 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 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)
- 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 NOT be a temporized one (See Annex D – Terminals X1:49-50)

- 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)

8.5.1.4 *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 Endesa (See Annex D - Terminals X0:19-20).

Current circuits

- Terminal block for the CTs secondary terminals (See Annex D - Terminals X6:1-24 if CTs are supplied directly from factory with the primary transformation ratio required for each installation).

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 voltage-free contacts connected to terminals.
  - F102-SECONDARY PROTECTION RELAY VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed voltage-free contacts connected to terminals.
  - F103-MEASURE AND SYNCHRONISM VOLTAGE: 1 tripolar+neutral MCB with 1 normally closed and 1 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.
- Anti-pumping circuit.
- 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 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 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)

<u>2nd battery CB control and protection (P2-N2)</u>

- 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).

<u>DS/ESs control (P12-N12)</u>

- 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.
- In case of line earthing switch, the interlocking which prevents the operation with voltage presence in line shall be included. 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.

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 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 voltage-free contact connected to terminals (See Annex D – Terminal X21-9)
- F102 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21-10)
- F103 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21-11)
- Manual position signal of 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 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)
- 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 NOT be a temporized one (See Annex D – Terminals X1:49-50)
- 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).

8.5.1.5 *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 Endesa (See Annex D - Terminals X0:19-20).

Current circuits

- Terminal block for the CTs secondary terminals (See Annex D - Terminals X6:1-24 if CTs are supplied directly from factory with the primary transformation ratio required for each installation).

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-MEASURE AND PROTECTION VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed voltage-free contacts connected to terminals.
  - F102-PROTECTION VOLTAGE: 1 tripolar+neutral MCB with 2 normally closed voltage-free contacts connected to terminals.
  - F103-PROTECTION VOLTAGE: 1 tripolar+neutral MCB with 3 normally closed voltage-free contacts connected to terminals.
- 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)

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.
- Anti-pumping circuit.
- 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 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 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).

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.

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 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 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 voltage-free contact connected to terminals (See Annex D – Terminal X21-9)
- F102 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21-10)
- F103 MCB open signal shall be reported by means of a normally closed voltage-free contact connected to terminals (See Annex D – Terminal X21-11)
- Manual position signal of 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 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)
- 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 NOT be a temporized one (See Annex D – Terminals X1:49-50)
- 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)

8.5.1.6 *Automatic openings*

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

8.5.2 e-distribuzione, Enel Distributie and Latam specific requirements

8.5.2.1 *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. 8.4.3.

As required in par. 8.1.1, 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.

<u>Circuit-breakers</u>

- 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)

<u>Disconnectors – Earthing Switches</u>

- 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.

- 4P circuit-breaker for protection of secondary VT circuits:

  Ue = 400 V ac; In = 3A; Electromagnetic over current release - short circuit current setting: 12 A (“B-type”); 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)

8.5.2.2 *Synoptic*

The synoptic alarm/block signalization lamps (see par. 8.2.1) 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.

8.5.2.3 *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.

8.5.2.3.a) *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. 8.5.2.3.b), 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.

8.5.2.3.b) *Hybrid module Y2 type*[12]

"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 189L1 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 152L1 closing lock for discharged springs;
- CB 152L1 closing lock for under-voltage release circuit not supplied;
- CB 152L1 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 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

[12] 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.

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.

8.5.2.3.c) *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. 8.5.2.3.b), 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").

8.5.2.4 *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.

9 TESTING

9.1 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.

9.2 Type tests

9.2.1 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

9.2.2 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.

9.2.2.1 *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 10.2.2.

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

9.2.2.2 *Dielectric tests*

(6.2 of IEC 62271-203)

9.2.2.3 *Radio interference voltage (r.i.v.) test*

(6.3 of IEC 62271-203)

Applicable only to SF6/air bushings.

9.2.2.4 *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.

9.2.2.5 *Temperature-rise tests*

(6.5 of IEC 62271-203)

9.2.2.6 *Short-time withstand current and peak withstand current tests*

(6.6 of IEC 62271-203)

9.2.2.7 *Verification of the protection*

(6.7 of IEC 62271-203)

9.2.2.8 *Tightness test*

(6.8 of IEC 62271-203)[13]

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.

9.2.2.9 *Electromagnetic compatibility tests (EMC)*

(6.9 of IEC 62271-203)

[13] 6.102 quoted in this paragraph shall be intended as 9.2.2.12 of this document.

9.2.2.10 *Additional tests on auxiliary and control circuits*

(6.10 of IEC 62271-203)

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.

9.2.2.11 *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.

9.2.2.12 *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 6.4.1 of this document.

9.2.2.12.a) *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.

9.2.2.12.b) *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. 8.1.3.2 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.

9.2.2.13 *Proof tests for enclosures*

(6.103 of IEC 62271-203)

9.2.2.14 *Pressure test on partitions*

(6.104 of IEC 62271-203)

9.2.2.15 *Test under conditions of arcing due to an internal fault*

(6.105 of IEC 62271-203)

9.2.2.16 *Insulator tests*

(6.106 of IEC 62271-203)

9.2.2.17 *Corrosion test on earthing connections*

(6.107 of IEC 62271-203)

9.2.2.18 *Corrosion test on enclosures*

(6.108 of IEC 62271-203)

9.2.2.19 *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.

9.2.2.20 *Seismic verification*

If requested, Hybrid Module (including the support) shall be compliant with seismic qualification, according with standards listed in 4.2.3.

9.2.3 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.

9.2.3.1 *Tests on Circuit-breakers*

IEC 62271-100 applies with the following additional information

9.2.3.1.a) *X-radiaton test procedure for vacuum interrupters*

(6.11 of IEC 62271-203)

Only in case of vacuum CBs.

9.2.3.1.b) *Critical current tests*

(IEC 62271-100 par. 6.107)

If applicable (see 6.107.1)

9.2.3.2 *Tests on disconnectors DS and earth switches ES*

IEC 62271-102 applies with the following additional information.

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

(IEC 62271-102 par. 6.105)

This test is mandatory.

9.2.3.2.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. 6.3 of this document).

9.2.3.2.c) *Induced current switching test*

(IEC 62271-102 par. 6.107)

This test is mandatory.

9.2.3.3 *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.

9.2.3.4 *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.

9.2.3.5 *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.

9.2.3.6 *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).

9.2.4 Specific requirements

9.2.4.1 *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).

9.3 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.

9.3.1 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.

9.3.2 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. 9.3.8, 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.

9.3.3 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.

9.3.4 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.

9.3.5 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. 9.2.2.19 of this document applies).

9.3.6 Pressure tests of enclosures

(IEC 62271-203 par. 7.101)

Manufacturer shall provide the results of internal tests.

9.3.6.1 *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).

9.3.7 Mechanical operation tests

(IEC 62271-203 par. 7.102)

9.3.7.1 *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 9.2.2.12.a)) 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.

9.3.7.2 *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.

9.3.8 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.

9.3.9 Pressure test on partitions

(IEC 62271-203 par. 7.104)

Manufacturer shall provide the results of testing on partitions.

9.3.10 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.

9.3.10.1 *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.

9.3.11 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: 9.3.8 applies.

9.3.11.1 *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.

9.3.12 Bushing tests

(IEC 60137 par.9.6)

Test reports issued by insulator manufacturer shall be provided.

9.4 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.

9.4.1 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.

9.4.2 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.

9.4.3 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.

9.4.4 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.

9.4.5 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. 10.3).

9.4.6 Mechanical operation tests

9.4.6.1 *Tests on Circuit-Breakers*

(IEC 62271-100 par. *10.2.102.2*)

Before this 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 9.2.2.12.a)) 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.

9.4.6.2 *Tests on disconnectors DS and earth switches ES*

(IEC 62271-102 par. 7.101)

The par. 9.3.7.2 of this document applies. The operation times and the drive motor absorption shall be performed only at rated voltage.

9.4.7 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 9.3.8), 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.

9.4.8 Gas quality verifications

(IEC 62271-203 par. 10.2.101.7)

Manufacturer shall perform this 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.

10 SUPPLY REQUIREMENTS

10.1 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).

10.2 Conformity assessment

10.2.1 Conformity assessment process

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

10.2.2 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. 5) and for each rated voltage Ur (72.5, 145-170, 245 kV).

10.2.2.1 *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. 2);
   - 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);
4) overall Hybrid Module pictures or 3D drawings;
5) HV single-line diagram;
6) electric diagram (see par. 8.4.1-c), low voltage components list included);
7) Control Box layout drawing;
8) reference resistance values.

10.2.2.2 *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)[14];
   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;
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);
13) only for e-distribuzione, INAIL (ex ISPESL) Certification "Certificato di conformità del prototipo" - D.M. 01/12/1980.

10.2.2.3 *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.).

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

10.3 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 CD-Rom 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.

10.3.1 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

Base component code	Latam	Italy	Romania	Spain
GSH002/011		162501	-	-
GSH002/012		-	616123	6711261
GSH002/013		162502	-	-
GSH002/014		162503	-	-
GSH002/021		162504	-	-
GSH002/022		-	616124	6711262
GSH002/023		162505	-	-
GSH002/024		162506	-	-
GSH002/031		162507	-	-
GSH002/032		-	616125	-
GSH002/033		162508	-	-
GSH002/034		162509	-	-
GSH002/061		162510	-	-
GSH002/062		162511	162511	6711263
GSH002/063		162512	-	-
GSH002/071		162513	-	-
GSH002/072		162514	162514	6711264
GSH002/073		162515	-	-
GSH002/081		162516	-	-
GSH002/082		162517	162517	-
GSH002/083		162518	-	-
GSH002/111		162519	-	-
GSH002/112		162520	162520	6711265
GSH002/113		162521	-	-
GSH002/121		162522	-	-
GSH002/122		162523	162523	6711266
GSH002/123		162524	-	-
GSH002/131		162525	-	-
GSH002/132		162526	162526	-
GSH002/133		162527	-	-
GSH002/211		162528	-	-
GSH002/212		162529	162529	-

GSH002/213		162530	-	-
GSH002/221		162531	-	-
GSH002/222		162532	162532	-
GSH002/261		162533	-	-
GSH002/262		162534	162534	-
GSH002/263		162535	-	-
GSH002/271		162536	-	-
GSH002/272		162537	162537	-
GSH002/281		162538	-	-
GSH002/282		162539	162539	6711267
GSH002/283		162540	-	-
GSH002/311		162541	-	-
GSH002/312		162542	162542	6711277
GSH002/313		162543	-	-
GSH002/321		162544	-	-
GSH002/322		162545	162545	6711268
GSH002/323		162546	-	-
GSH002/331		-	-	-
GSH002/332		-	-	6711269
GSH002/333		-	-	-
GSH002/411		-	-	-
GSH002/412		-	-	-
GSH002/413		-	-	-
GSH002/421		162547	-	-
GSH002/422		162548	162548	6711270
GSH002/423		162549	-	-
GSH002/461		162550	-	-
GSH002/462		162551	162551	-
GSH002/463		162552	-	-
GSH002/464		162553	-	-
GSH002/465		162554	162554	6711271
GSH002/466		162555	-	-
GSH002/481		162556	-	-
GSH002/482		162557	162557	-
GSH002/483		162558	-	-
GSH002/511		162559	-	-

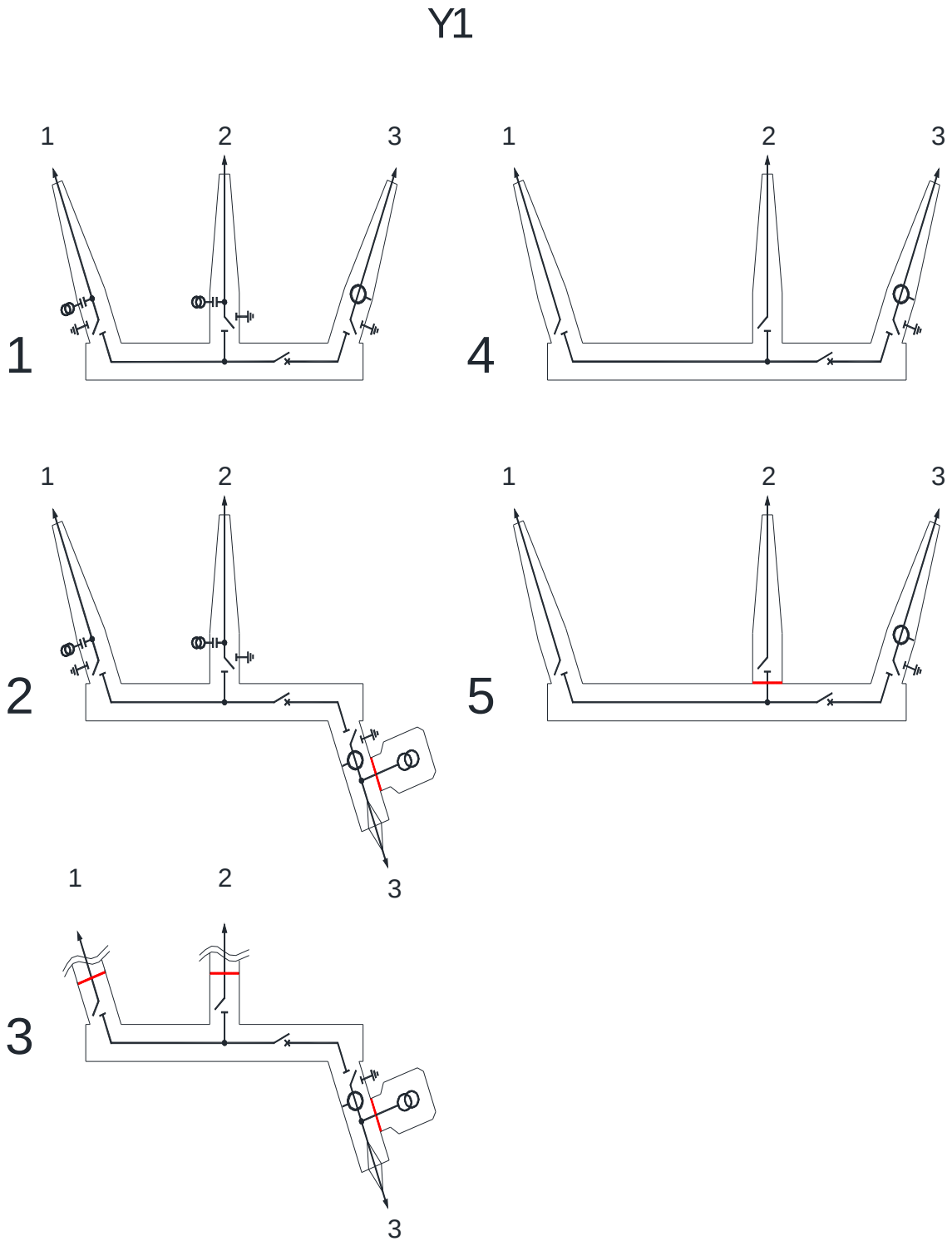
GSH002/512		162560	162560	-
GSH002/513		162561	-	-
GSH002/521		162562	-	-
GSH002/522		162563	162563	-
GSH002/523		162564	-	-
GSH002/531		162565	-	-
GSH002/532		162566	162566	-
GSH002/533		162567	-	-
GSH002/541		162568	-	-
GSH002/542		162569	162569	-
GSH002/543		162570	-	-
GSH002/561		162571	-	-
GSH002/562		162572	162572	-
GSH002/563		162573	-	-
GSH002/564		162574	-	-
GSH002/565		162575	162575	-
GSH002/566		162576	-	-
GSH002/601		162577	-	-
GSH002/602		162578	-	-
GSH002/603		162579	-	-
GSH002/604		162580	-	-
GSH002/605		162581	-	-
GSH002/606		162582	-	-
GSH002/607		162583	-	-
GSH002/608		162584	-	-
GSH002/611		-	616126	-
GSH002/612		-	616127	-
GSH002/613		-	-	-
GSH002/614		-	-	-
GSH002/621		-	-	6711272
GSH002/622		-	-	6711273
GSH002/623		-	-	6711274
GSH002/700		162585	162585	-
GSH002/701		162586	-	-
GSH002/702		162587	-	-
GSH002/703		162588	-	-

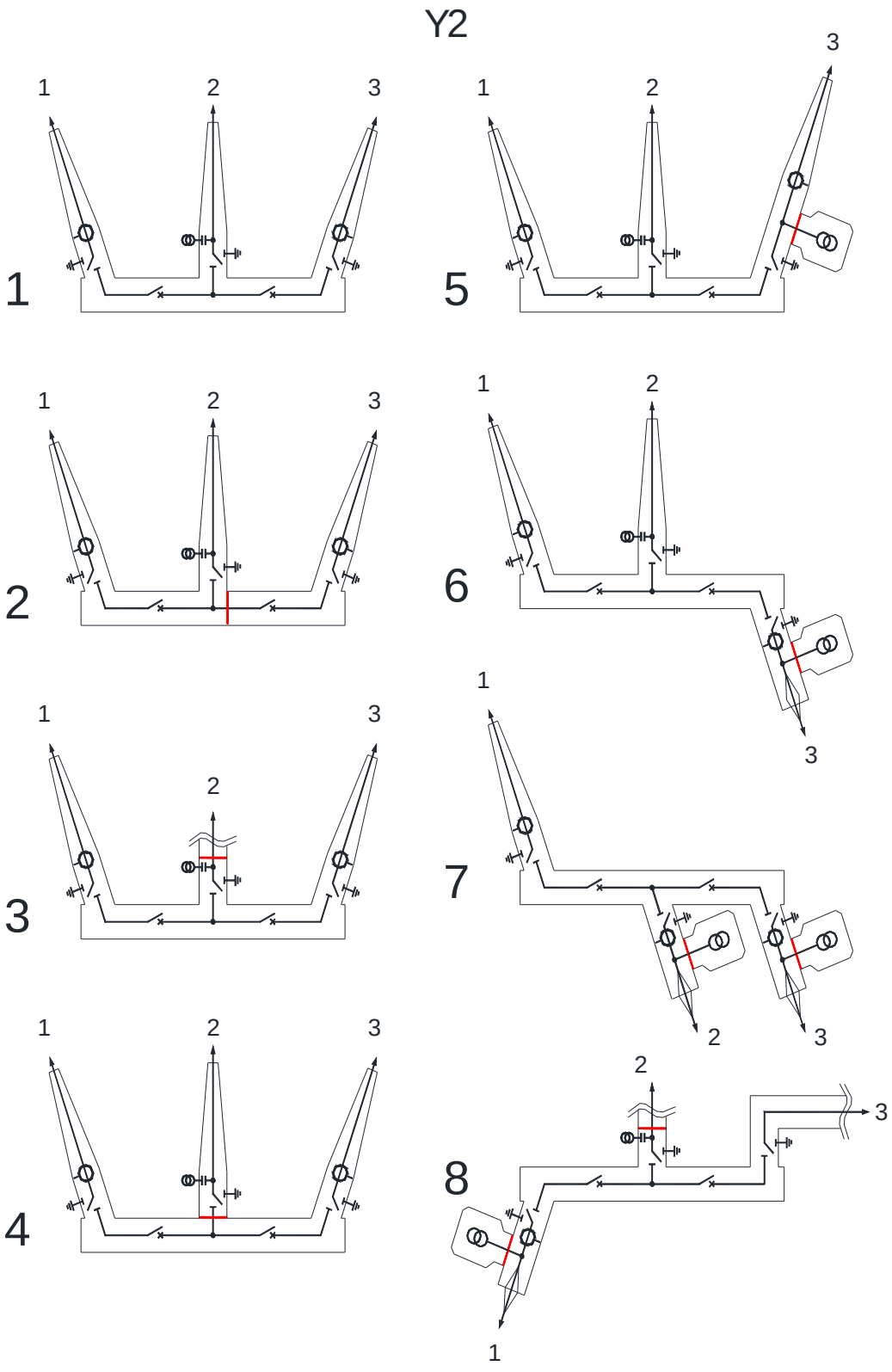
GSH002/704		162589	-	-
GSH002/711		-	616128	-
GSH002/721		-	-	6711275
GSH002/722		-	-	6711276
GSH002/801		162590	-	-
GSH002/802		162591	-	-
GSH002/803		162592	-	-
GSH002/804		162593	-	-
GSH002/805		162594	-	-
GSH002/806		162595	-	-
GSH002/811		-	616129	-
GSH002/812		-	616130	-
GSH002/821		-	-	6711279
GSH002/822		-	-	6711280
GSH002/823		-	-	-
GSH002/841		-	-	-
GSH002/842		-	-	-
GSH002/843		-	-	-
GSH002/844		-	-	-
GSH002/845		-	-	-
GSH002/846		-	-	-
GSH002/851		-	-	-
GSH002/852		-	-	-
GSH002/853		-	-	-
GSH002/854		-	-	-
GSH002/855		-	-	-
GSH002/856		-	-	-
GSH002/861		-	-	-
GSH002/862		-	-	-
GSH002/863		-	-	-
GSH002/871		-	-	-
GSH002/872		-	-	-
GSH002/873		-	-	-
GSH002/881		-	-	-
GSH002/882		-	-	-
GSH002/883		-	-	-

GSH002/884		-	-	-
GSH002/885		-	-	-
GSH002/886		-	-	-
GSH002/891		-	-	-
GSH002/892		-	-	-
GSH002/893		-	-	-
GSH002/894		-	-	-
GSH002/895		-	-	-
GSH002/896		-	-	-
GSH002/901		162596	-	-
GSH002/902		162597	-	-
GSH002/903		162598	-	-
GSH002/911		-	616131	-
GSH002/912		-	616132	-
GSH002/921		-	-	6711281
GSH002/922		-	-	6711282
GSH002/923		-	-	6711283
GSH002/924		-	-	6711284
GSH002/925		-	-	6711285
GSH002/926		-	-	6711286
GSH002/931		-	-	-
GSH002/932		-	-	-
GSH002/933		-	-	-

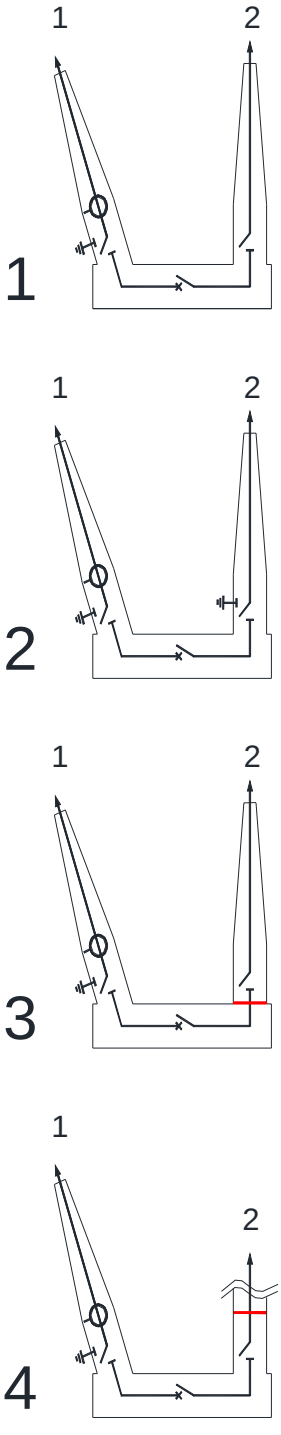
ANNEX B – LAYOUT EXAMPLES

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




Y2
1
1
2
3
5
1
2
3
2
1
2
3
6
1
2
3
3
1
2
3
7
1
2
3
4
1
2
3
8
2
3
1

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 GSH002/…	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 GSH002/…	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:

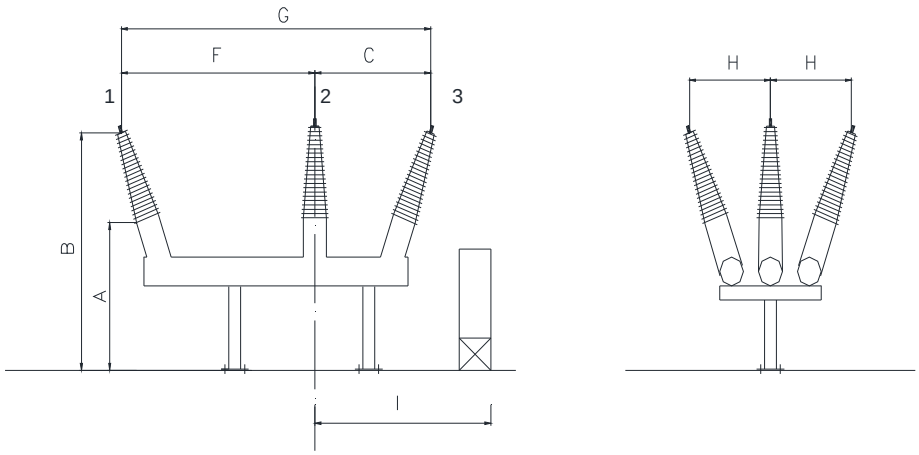
Base component description	BAY	Base component code GSH002/…	Nr (terns)
Lateral bay - With circuit-breaker - Air connection	1	012	1
Central bay - Without circuit-breaker - Air connection	2	112	1
Circuit-breaker drive mechanism - Three-pole	1	282	1
Disconnector with earthing switch	1	322	1
Disconnector	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):

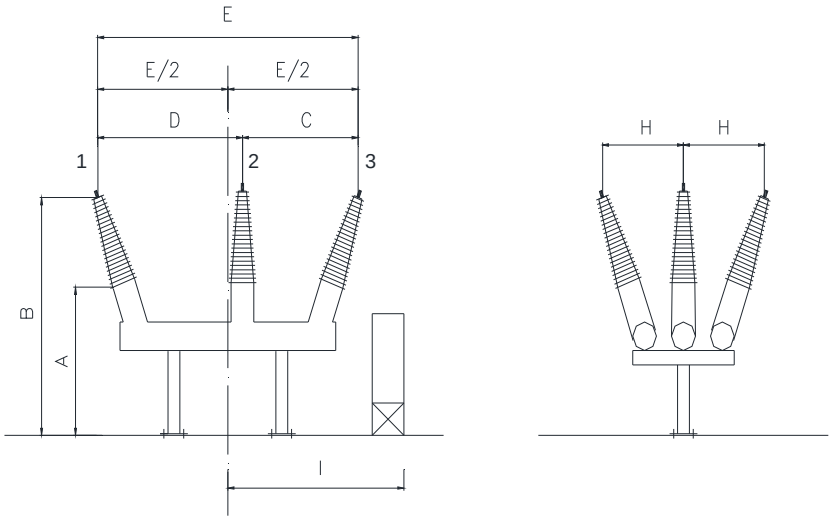
- BAY 1: Lateral Bay
- BAY 2: Central Bay

ANNEX C – DIMENSIONAL DRAWINGS

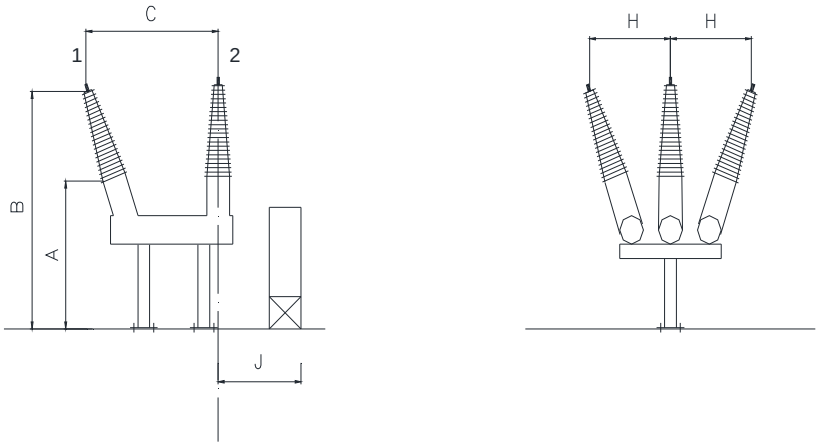
Y1



Y2



Single bay



Company	Ref. figure	A	B	C	D	E	F	G	H	I	J
Enel Distribuz. and Latam	Y1	≥ 2250[15]	≤ 3800	≥ 890	n.a.	n.a.	≥ 890	≤ 3000	≤ 1400	≤ 2200	n.a.
	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]

Company	Ref. figure	A	B	C	D	E	F	G	H	I	J
Endesa	Y1	≥ 2300[17]	≥3800 ≤4600	≥ 1725	n.a.	n.a.	≥ 1725	≤ 5000	≥ 1300	≤ 3000	n.a.
	Single bay				n.a.	n.a.	n.a.	n.a.		n.a.	≤ 1300
Enel Distribuz., Enel Distributie and Latam	Y1	≥ 2250[15]	≤ 4600	≥ 1725	n.a.	n.a.	≥ 1725	≤ 5000	≤ 2200	≤ 3000	n.a.
	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)[16]

Company	Ref. figure	A	B	C	D	E	F	G	H	I	J
Enel Distribuz. and Latam	Y1	≥ 2250[15]	≤ 5500	≥ 2475	n.a.	n.a.	≥ 2475	≤ 6500	≤ 3200	≤ 3750	n.a.
	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)[16]

[15] In accordance with par. 7.2.4 of IEC 61936-1

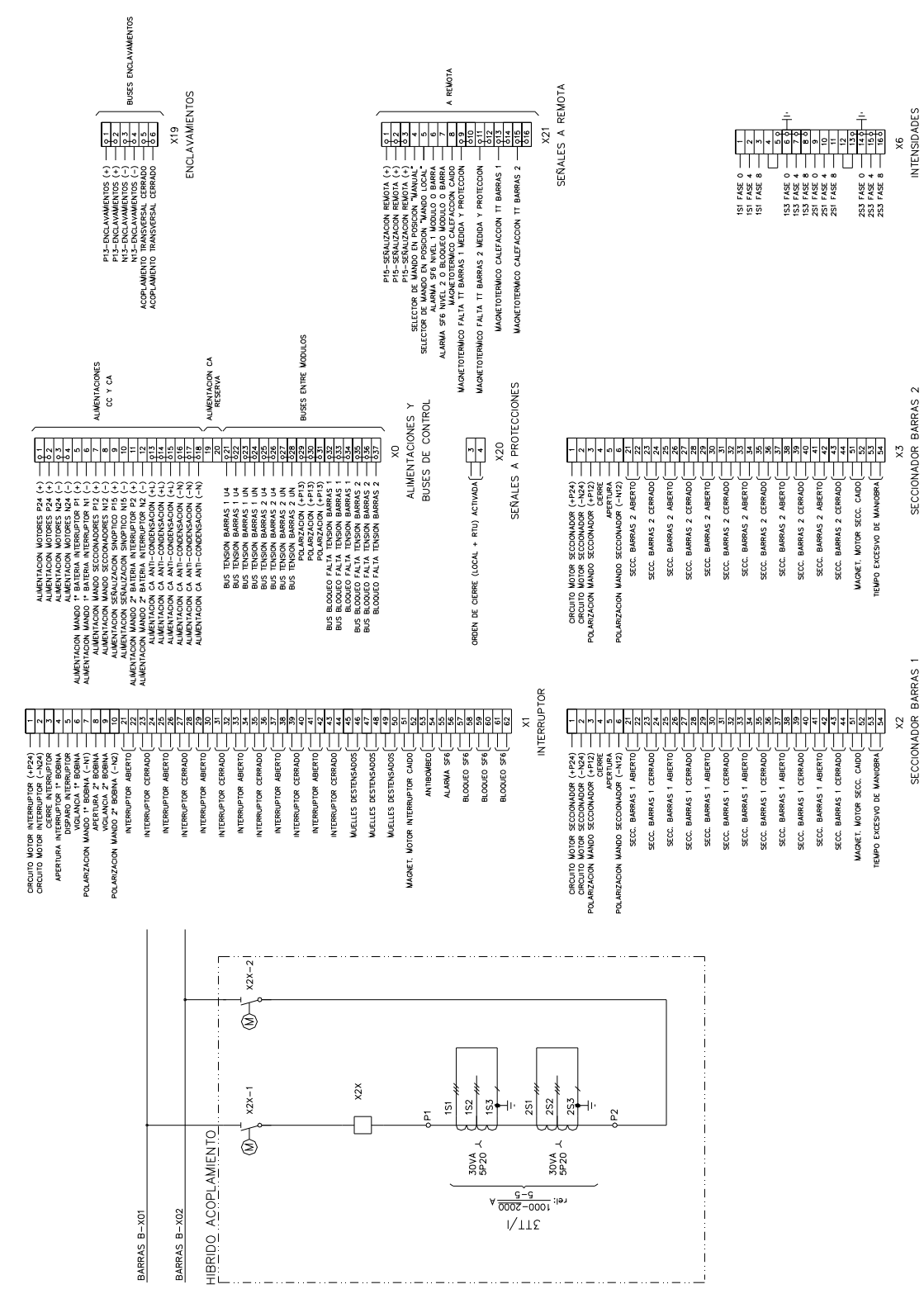
[16] Blank cell means that there isn't a mandatory requirement for that characteristic

[17] In accordance with Real Decreto Riesgo Eléctrico 614/2001

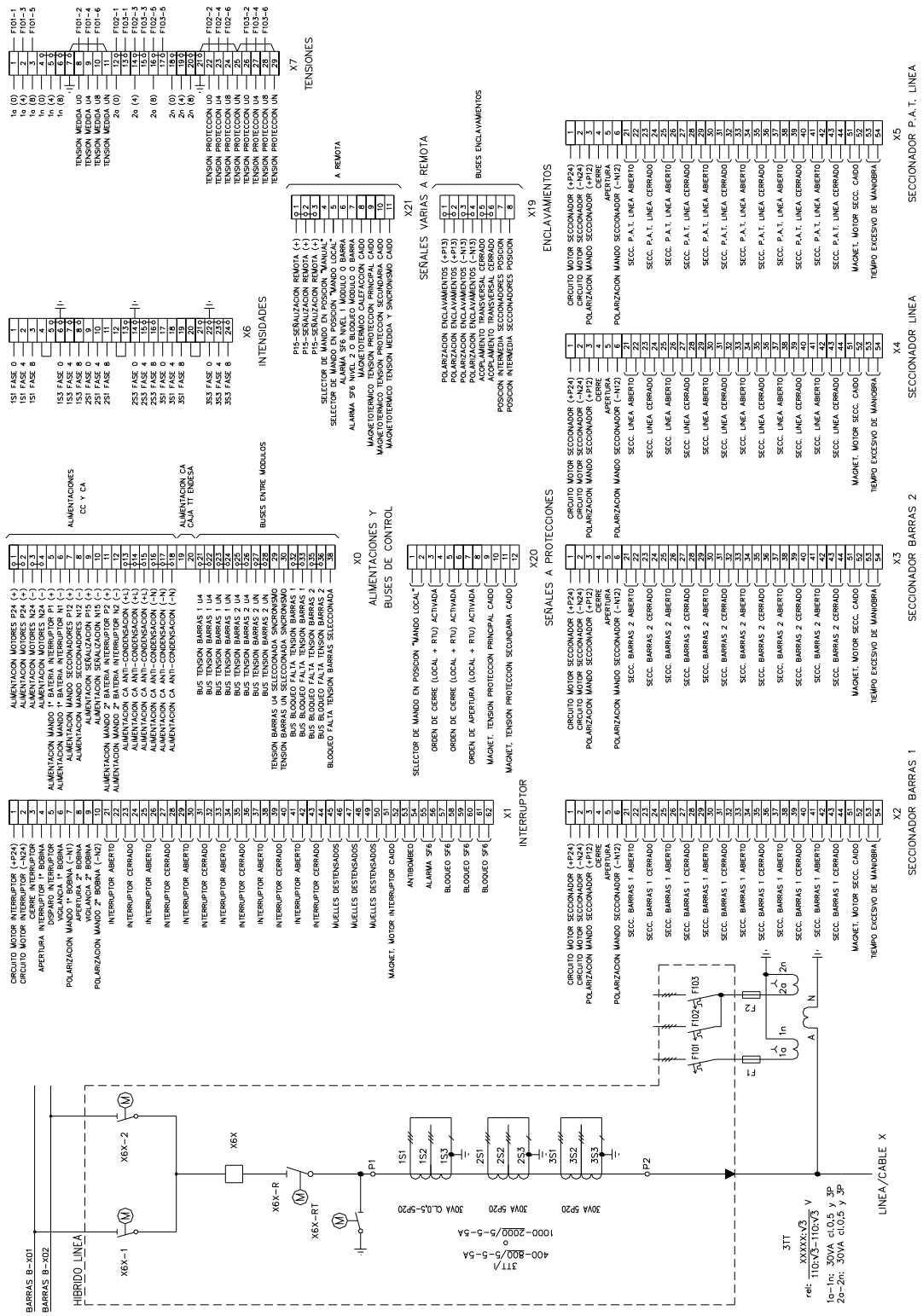
ANNEX D – ELECTRICAL SCHEMES

D.1 – ENDESA ELECTRICAL DIAGRAMS

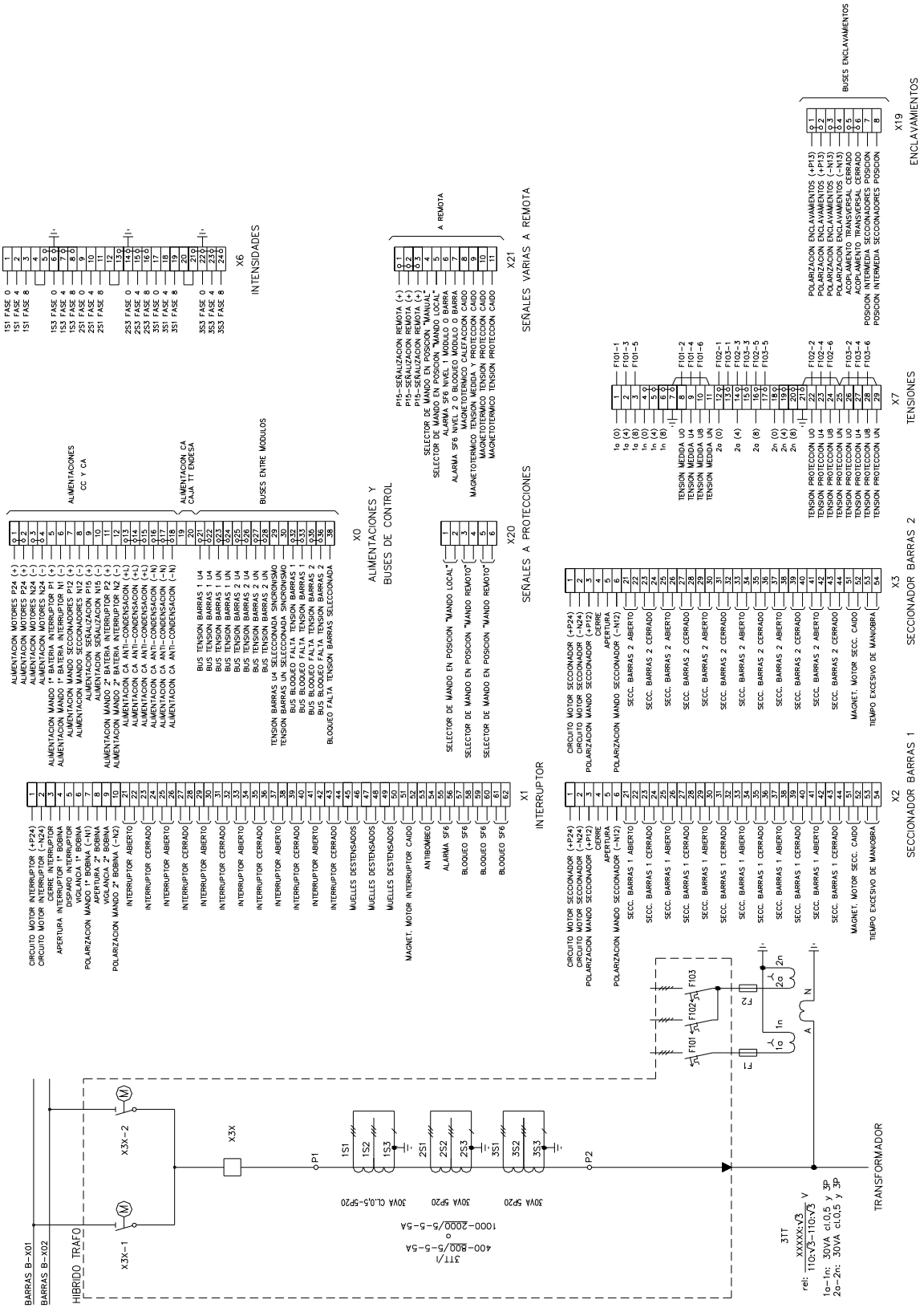
Hybrid module Single-bay type – used in Bus coupler bay


HIBRIDO ACOPLAMIENTO
BARRAS B-X01
BARRAS B-X02
X2X-1
X2X-2
X2X
P1
P2
1S1
1S2
1S3
2S1
2S2
2S3
30VA 5P20
30VA 5P20
3TT/1
ri: 1000-2000/5-5 A
X1 INTERRUPTOR
X2 SECCIONADOR BARRAS 1
X3 SECCIONADOR BARRAS 2
X0 ALIMENTACIONES Y BUSES DE CONTROL
X20 SEÑALES A PROTECCIONES
X21 SEÑALES A REMOTA
X19 ENCLAVAMIENTOS
X6 INTENSIDADES
ALIMENTACIONES CC Y CA
ALIMENTACION CA RESERVA
BUSES ENTRE MODULOS
BUSES ENCLAVAMIENTOS
A REMOTA
CIRCUITO MOTOR SECCIONADOR (+P24)
CIRCUITO MOTOR SECCIONADOR (-N24)
POLARIZACION MANDO SECCIONADOR (+P12)
CIERRE
APERTURA
POLARIZACION MANDO SECCIONADOR (-N12)
SECC. BARRAS 1 ABIERTO
SECC. BARRAS 1 CERRADO
SECC. BARRAS 2 ABIERTO
SECC. BARRAS 2 CERRADO
MAGNET. MOTOR SECC. CAIDO
TIEMPO EXCESIVO DE MANIOBRA
CIRCUITO MOTOR INTERRUPTOR (+P24)
CIRCUITO MOTOR INTERRUPTOR (-N24)
CIERRE INTERRUPTOR
APERTURA INTERRUPTOR 1ª BOBINA
DISPARO INTERRUPTOR
VIGILANCIA 1ª BOBINA
POLARIZACION MANDO 1ª BOBINA (+P1)
POLARIZACION MANDO 1ª BOBINA (-N1)
APERTURA 2ª BOBINA
VIGILANCIA 2ª BOBINA
POLARIZACION MANDO 2ª BOBINA (-N2)
INTERRUPTOR ABIERTO
INTERRUPTOR CERRADO
INTERRUPTOR ABIERTO
INTERRUPTOR CERRADO
INTERRUPTOR ABIERTO
INTERRUPTOR CERRADO
INTERRUPTOR ABIERTO
INTERRUPTOR CERRADO
INTERRUPTOR ABIERTO
INTERRUPTOR CERRADO
MUELLES DESTENSADOS
MUELLES DESTENSADOS
MAGNET. MOTOR INTERRUPTOR CAIDO
ANTIBOMBEO
ALARMA SF6
BLOQUEO SF6
BLOQUEO SF6
BLOQUEO SF6
ALIMENTACION MOTORES P24 (+)
ALIMENTACION MOTORES P24 (-)
ALIMENTACION MOTORES N24 (-)
ALIMENTACION MANDO 1ª BATERIA INTERRUPTOR P1 (+)
ALIMENTACION MANDO 1ª BATERIA INTERRUPTOR P1 (-)
ALIMENTACION MANDO SECCIONADORES P12 (+)
ALIMENTACION MANDO SECCIONADORES N12 (-)
ALIMENTACION SEÑALIZACION SINOPTICO P15 (+)
ALIMENTACION SEÑALIZACION SINOPTICO N15 (-)
ALIMENTACION MANDO 2ª BATERIA INTERRUPTOR N2 (+)
ALIMENTACION MANDO 2ª BATERIA INTERRUPTOR N2 (-)
ALIMENTACION CA ANTI-CONDENSACION (+L1)
ALIMENTACION CA ANTI-CONDENSACION (+L2)
ALIMENTACION CA ANTI-CONDENSACION (-N)
ALIMENTACION CA ANTI-CONDENSACION (-N)
BUS TENSION BARRAS 1 U4
BUS TENSION BARRAS 1 U4
BUS TENSION BARRAS 1 UN
BUS TENSION BARRAS 2 U4
BUS TENSION BARRAS 2 U4
BUS TENSION BARRAS 2 UN
BUS TENSION BARRAS 2 UN
POLARIZACION (+P13)
POLARIZACION (+P13)
POLARIZACION (-N13)
BUS BLOQUEO FALTA TENSION BARRAS 1
BUS BLOQUEO FALTA TENSION BARRAS 1
BLOQUEO FALTA TENSION BARRAS 1
BUS BLOQUEO FALTA TENSION BARRAS 2
BUS BLOQUEO FALTA TENSION BARRAS 2
BLOQUEO FALTA TENSION BARRAS 2
ORDEN DE CIERRE (LOCAL + RTU) ACTIVADA
P13-ENCLAVAMIENTOS (+)
P13-ENCLAVAMIENTOS (+)
N13-ENCLAVAMIENTOS (-)
N13-ENCLAVAMIENTOS (-)
ACOPLAMIENTO TRANSVERSAL CERRADO
ACOPLAMIENTO TRANSVERSAL CERRADO
P15-SEÑALIZACION REMOTA (+)
P15-SEÑALIZACION REMOTA (+)
P15-SEÑALIZACION REMOTA (+)
SELECTOR DE MANDO EN POSICION "MANUAL"
SELECTOR DE MANDO EN POSICION "MANDO LOCAL"
ALARMA SF6 NIVEL 1 O BLOQUEO MODULO O BARRA
ALARMA SF6 NIVEL 2 O BLOQUEO MODULO O BARRA
MAGNETOTERMICO CALEFACCION CAIDO
MAGNETOTERMICO FALTA TT BARRAS 1 MEDIDA Y PROTECCION
MAGNETOTERMICO FALTA TT BARRAS 2 MEDIDA Y PROTECCION
MAGNETOTERMICO CALEFACCION TT BARRAS 1
MAGNETOTERMICO CALEFACCION TT BARRAS 2
1S1 FASE 0
1S1 FASE 4
1S1 FASE 8
1S3 FASE 0
1S3 FASE 4
1S3 FASE 8
2S1 FASE 0
2S1 FASE 4
2S1 FASE 8
2S3 FASE 0
2S3 FASE 4
2S3 FASE 8

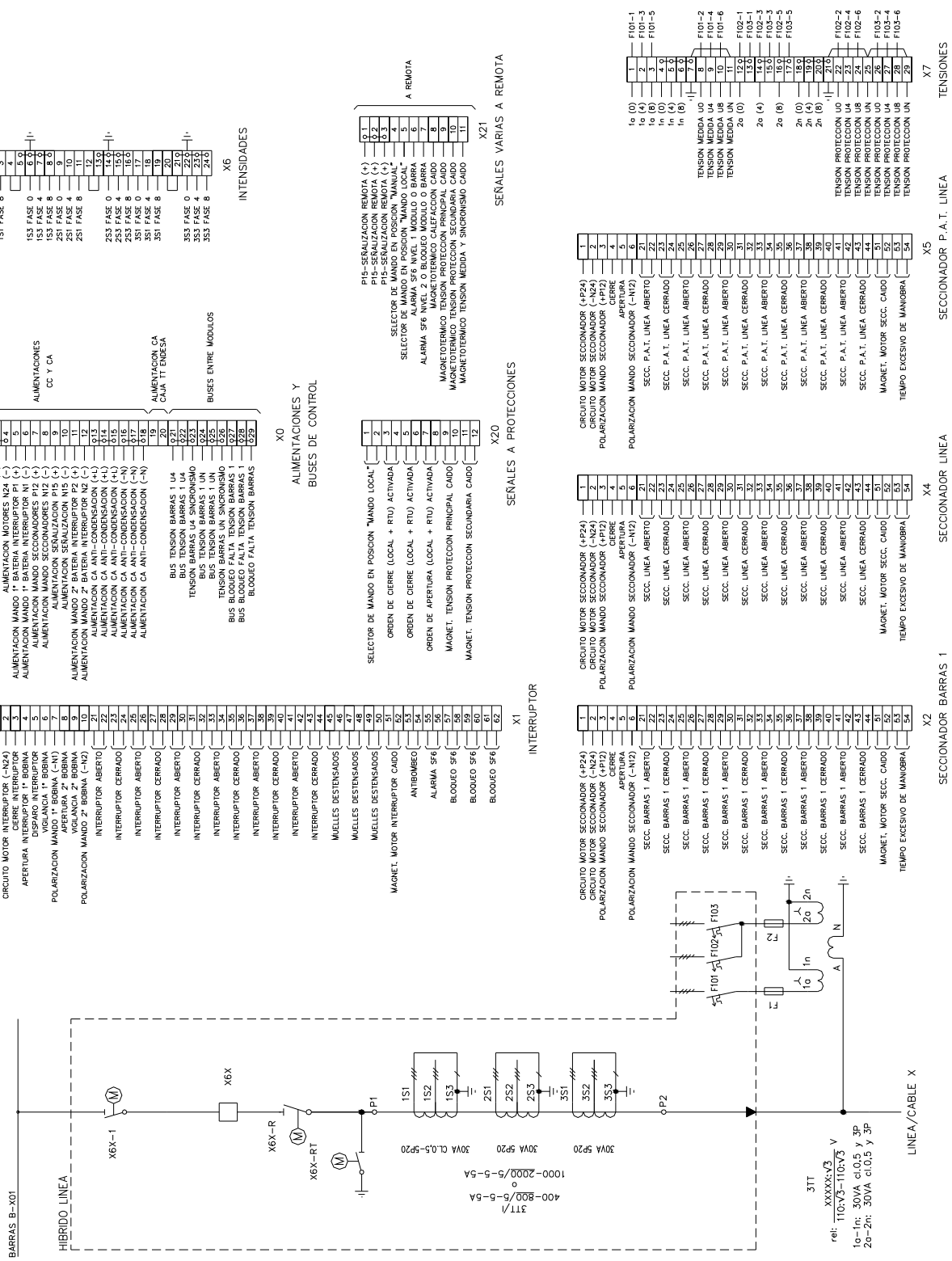
Hybrid module Y1 type – used in Line bay



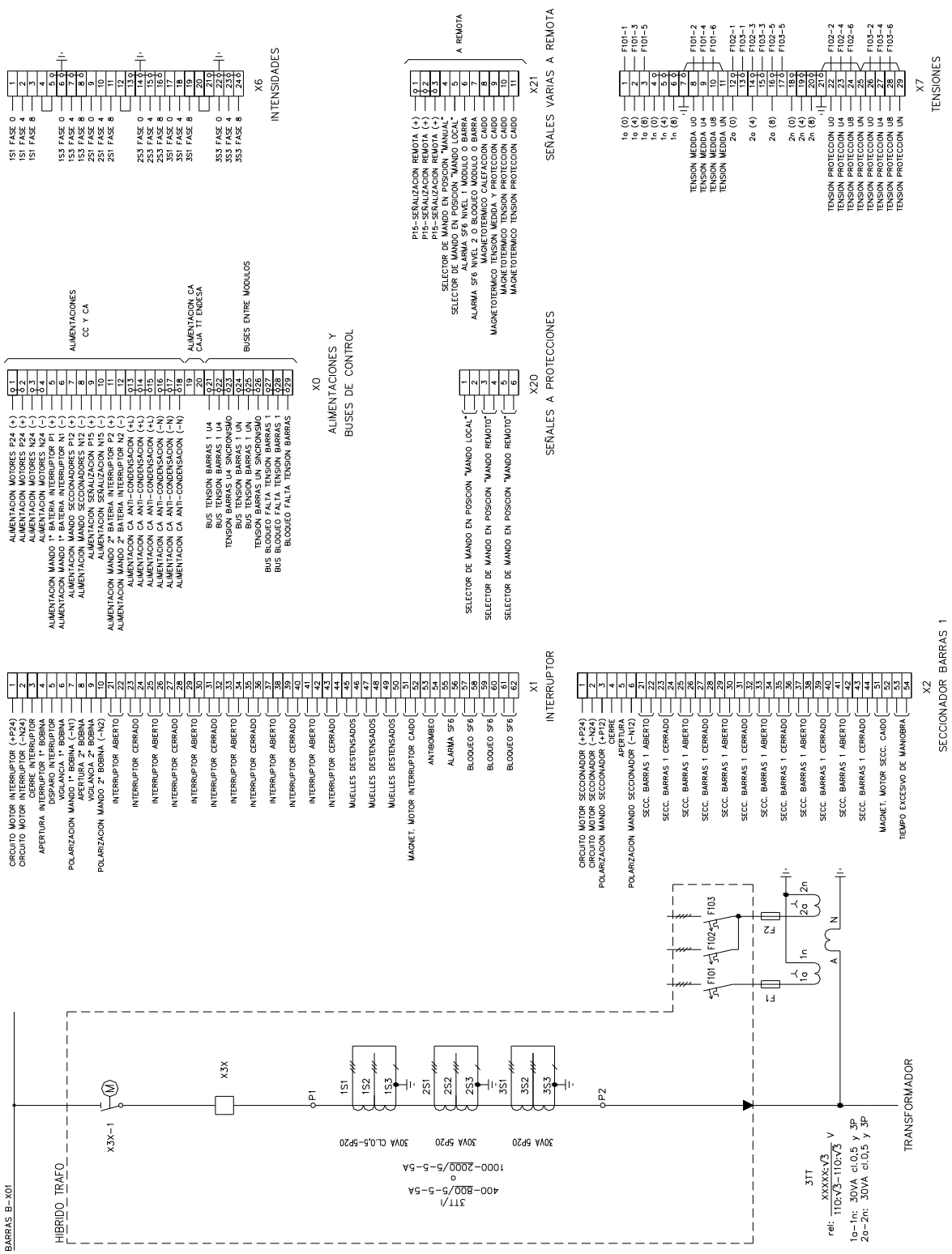
Hybrid module Y1 type – used in Transformer bay

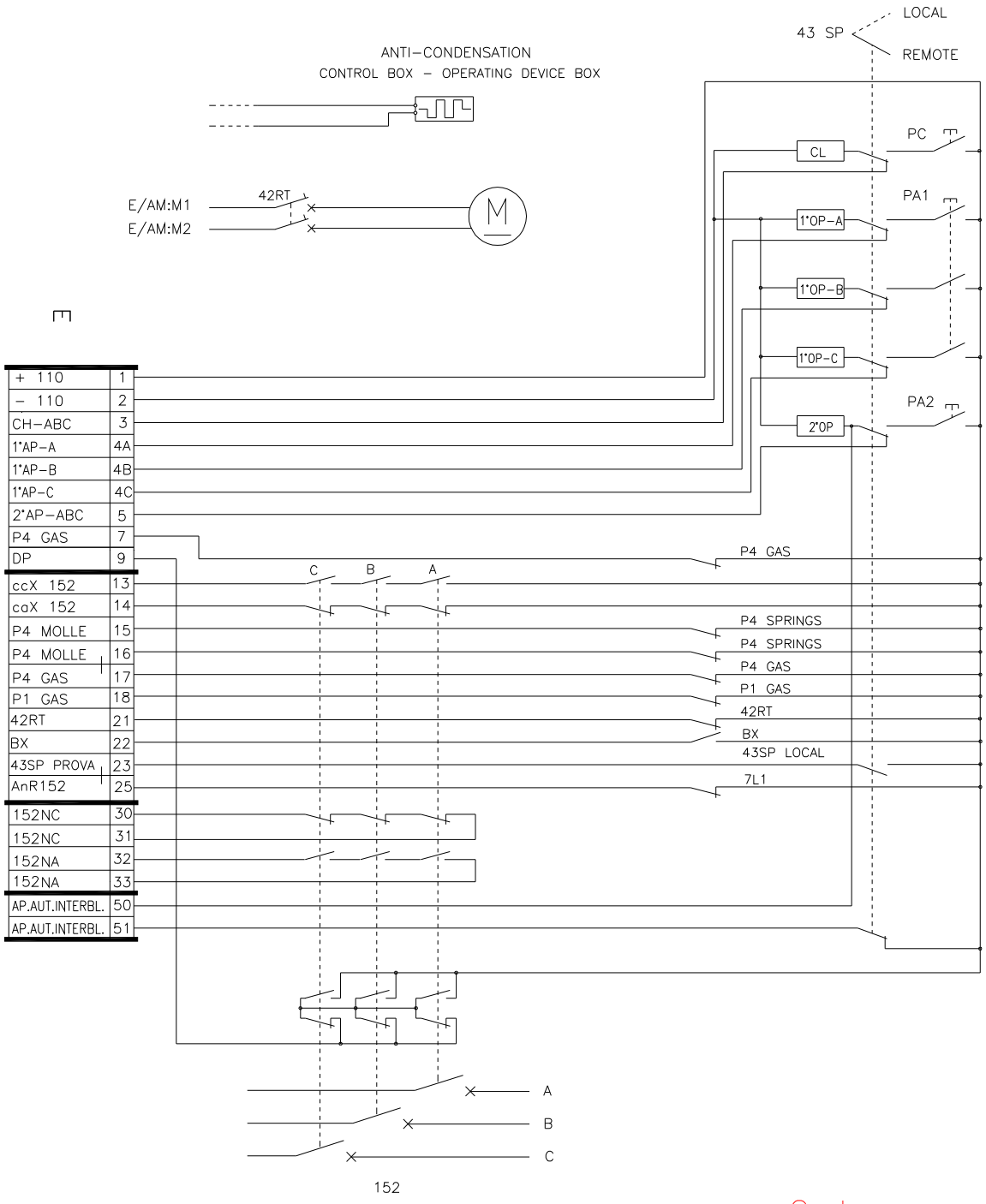


Hybrid module Single-bay type – used in Line bay

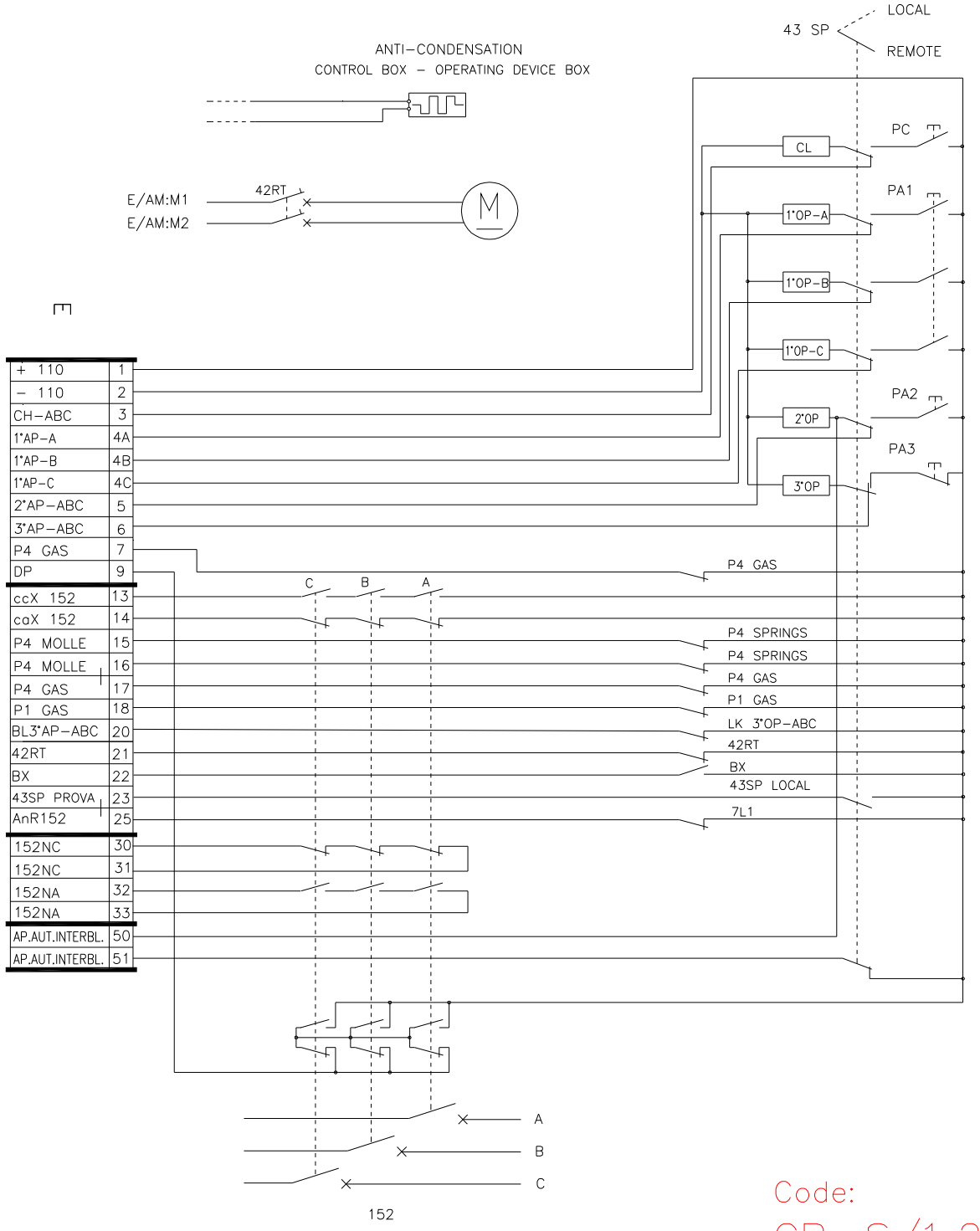


Hybrid module Single-bay type – used in Transformer bay

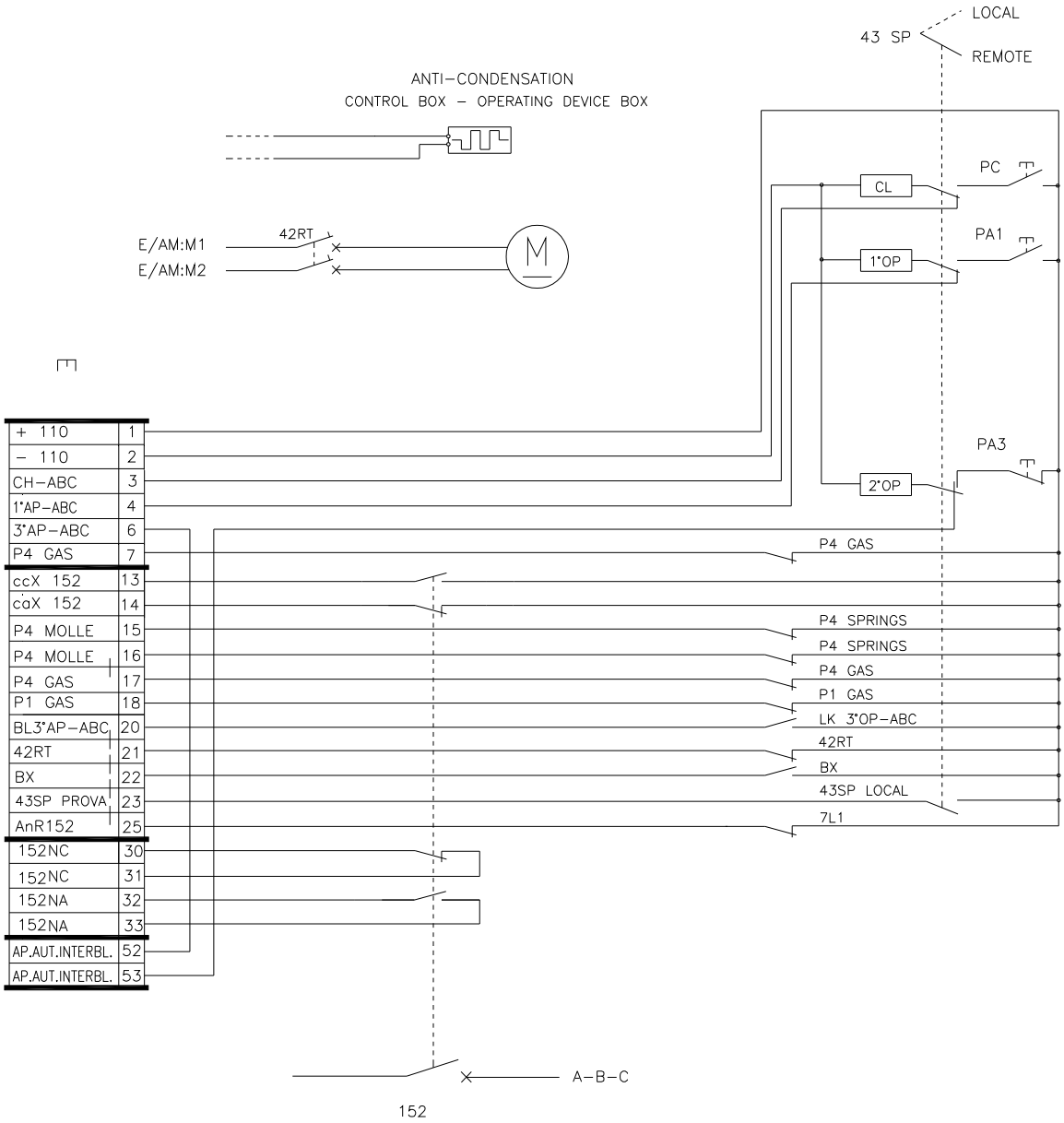



ANTI–CONDENSATION
CONTROL BOX – OPERATING DEVICE BOX
E/AM:M1
E/AM:M2
42RT
M
43 SP
LOCAL
REMOTE
PC
CL
PA1
1°OP–A
1°OP–B
1°OP–C
PA2
2°OP
+ 110 1
– 110 2
CH–ABC 3
1°AP–A 4A
1°AP–B 4B
1°AP–C 4C
2°AP–ABC 5
P4 GAS 7
DP 9
ccX 152 13
caX 152 14
P4 MOLLE 15
P4 MOLLE 16
P4 GAS 17
P1 GAS 18
42RT 21
BX 22
43SP PROVA 23
AnR152 25
152NC 30
152NC 31
152NA 32
152NA 33
AP.AUT.INTERBL. 50
AP.AUT.INTERBL. 51
C
B
A
P4 GAS
P4 SPRINGS
P4 SPRINGS
P4 GAS
P1 GAS
42RT
BX
43SP LOCAL
7L1
A
B
C
152

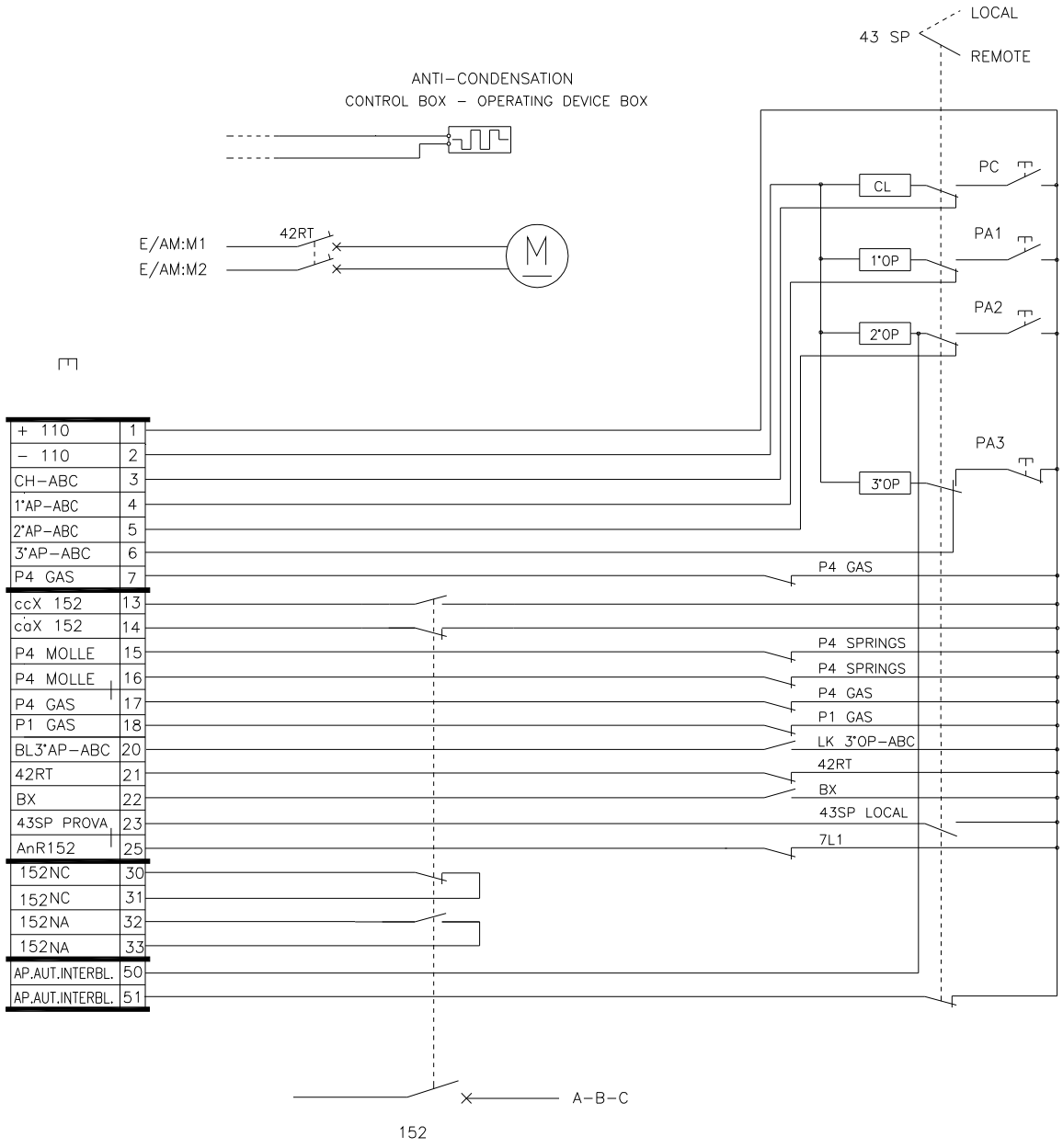
Code:
CB–S/1.2.


43 SP
LOCAL
REMOTE
ANTI–CONDENSATION
CONTROL BOX – OPERATING DEVICE BOX
E/AM:M1
E/AM:M2
42RT
M
PC
CL
PA1
1°OP–A
1°OP–B
1°OP–C
PA2
2°OP
PA3
3°OP
+ 110 1
– 110 2
CH–ABC 3
1°AP–A 4A
1°AP–B 4B
1°AP–C 4C
2°AP–ABC 5
3°AP–ABC 6
P4 GAS 7
DP 9
ccX 152 13
caX 152 14
P4 MOLLE 15
P4 MOLLE 16
P4 GAS 17
P1 GAS 18
BL3°AP–ABC 20
42RT 21
BX 22
43SP PROVA 23
AnR152 25
152NC 30
152NC 31
152NA 32
152NA 33
AP.AUT.INTERBL. 50
AP.AUT.INTERBL. 51
C
B
A
P4 GAS
P4 SPRINGS
P4 SPRINGS
P4 GAS
P1 GAS
LK 3°OP–ABC
42RT
BX
43SP LOCAL
7L1
A
B
C
152

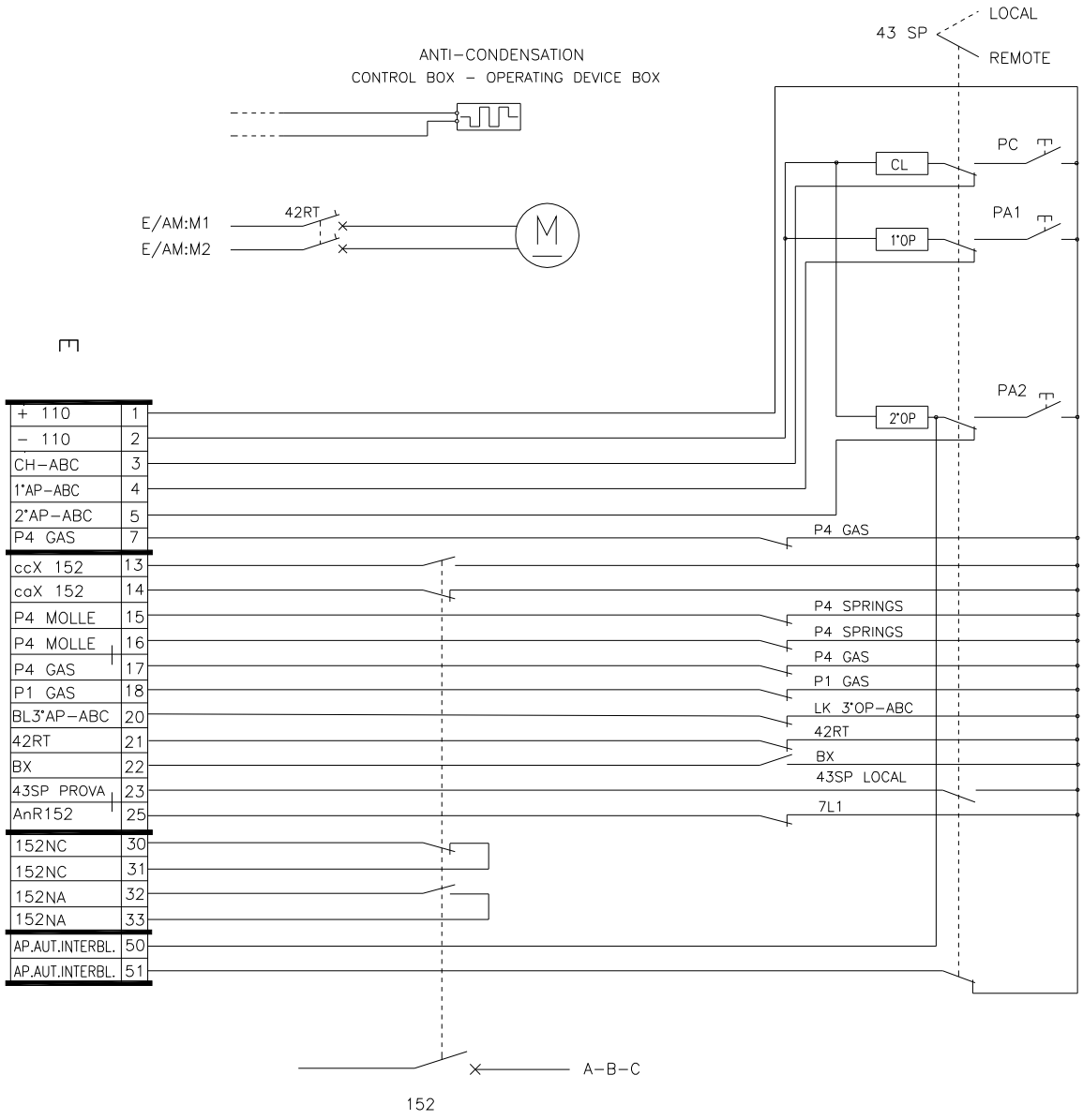
Code:
CB–S/1.2.3.


LOCAL
43 SP
REMOTE
ANTI-CONDENSATION
CONTROL BOX - OPERATING DEVICE BOX
E/AM:M1
E/AM:M2
42RT
M
CL
PC
1°OP
PA1
2°OP
PA3
+ 110 1
- 110 2
CH-ABC 3
1°AP-ABC 4
3°AP-ABC 6
P4 GAS 7
ccX 152 13
caX 152 14
P4 MOLLE 15
P4 MOLLE 16
P4 GAS 17
P1 GAS 18
BL3°AP-ABC 20
42RT 21
BX 22
43SP PROVA 23
AnR152 25
152NC 30
152NC 31
152NA 32
152NA 33
AP.AUT.INTERBL. 52
AP.AUT.INTERBL. 53
P4 GAS
P4 SPRINGS
P4 SPRINGS
P4 GAS
P1 GAS
LK 3°OP-ABC
42RT
BX
43SP LOCAL
7L1
A-B-C
152

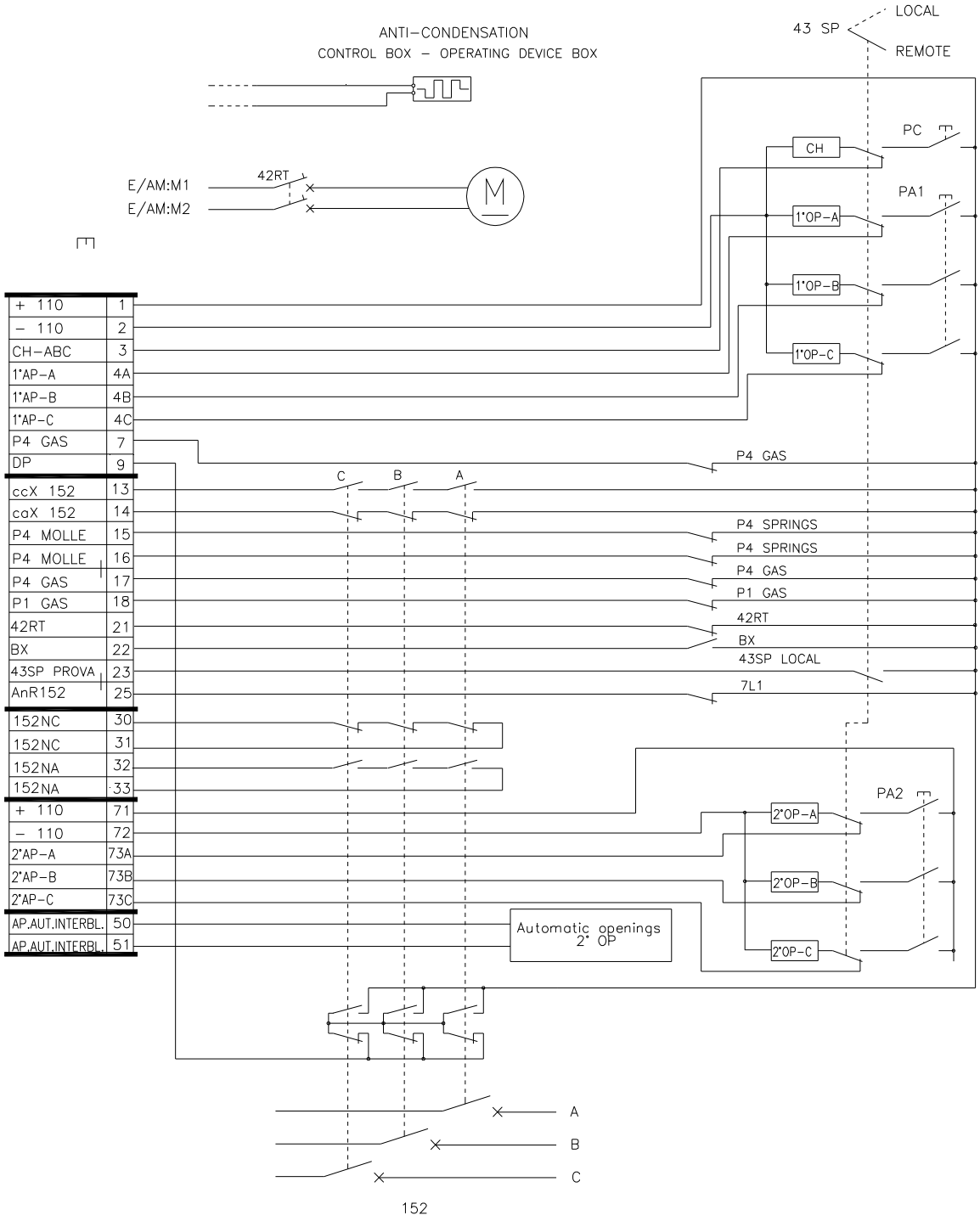
Code:
CB-T/1.3.


43 SP
LOCAL
REMOTE
ANTI–CONDENSATION
CONTROL BOX – OPERATING DEVICE BOX
E/AM:M1
E/AM:M2
42RT
M
PC
CL
PA1
1°OP
PA2
2°OP
PA3
3°OP
+ 110 1
– 110 2
CH–ABC 3
1°AP–ABC 4
2°AP–ABC 5
3°AP–ABC 6
P4 GAS 7
ccX 152 13
coX 152 14
P4 MOLLE 15
P4 MOLLE 16
P4 GAS 17
P1 GAS 18
BL3°AP–ABC 20
42RT 21
BX 22
43SP PROVA 23
AnR152 25
152NC 30
152NC 31
152NA 32
152NA 33
AP.AUT.INTERBL. 50
AP.AUT.INTERBL. 51
P4 GAS
P4 SPRINGS
P4 SPRINGS
P4 GAS
P1 GAS
LK 3°OP–ABC
42RT
BX
43SP LOCAL
7L1
A–B–C
152

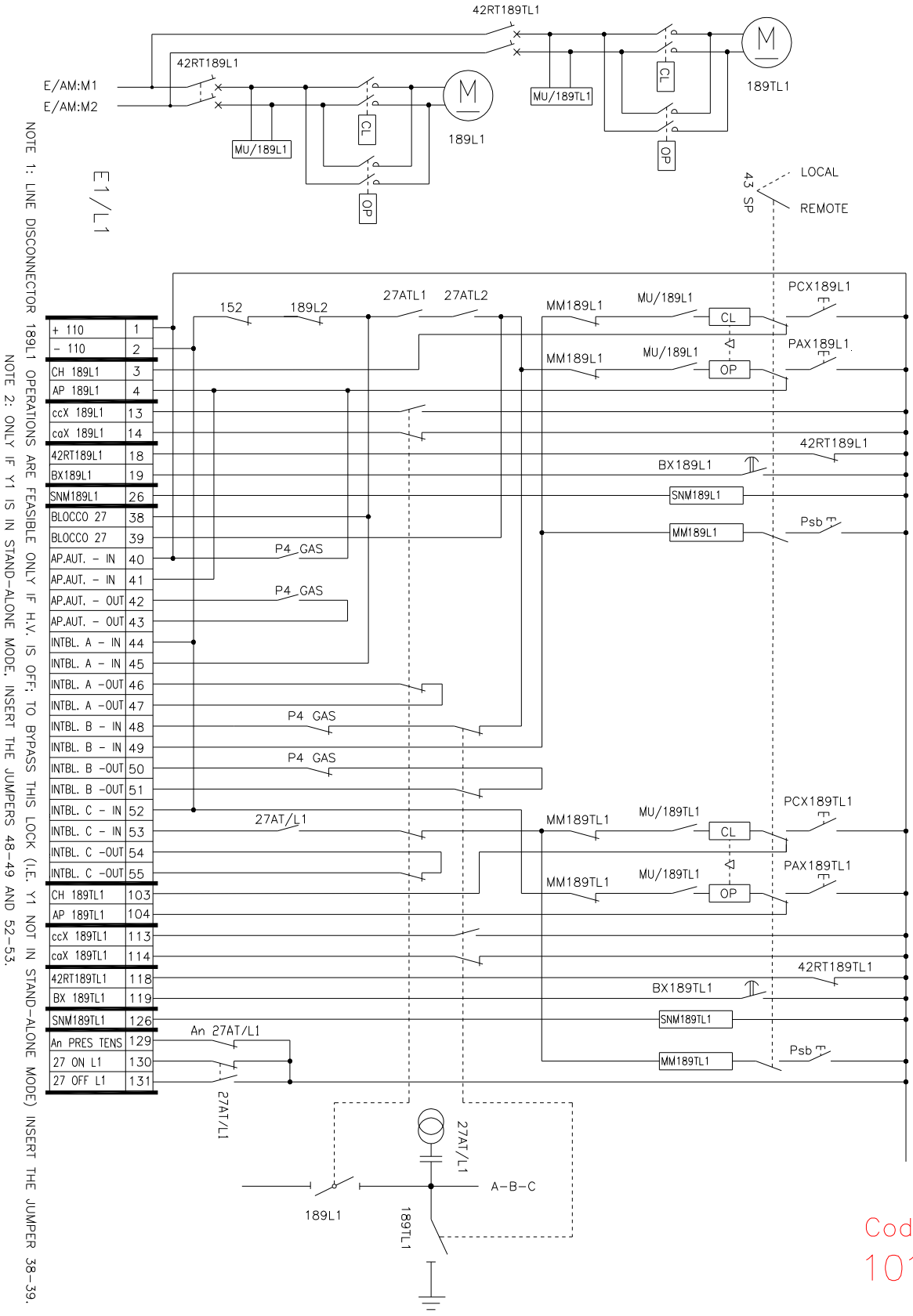
Code:
CB–T/1.2.3.


43 SP
LOCAL
REMOTE
ANTI–CONDENSATION
CONTROL BOX – OPERATING DEVICE BOX
PC
CL
PA1
1°OP
PA2
2°OP
E/AM:M1
E/AM:M2
42RT
M
+ 110 1
– 110 2
CH–ABC 3
1°AP–ABC 4
2°AP–ABC 5
P4 GAS 7
ccX 152 13
caX 152 14
P4 MOLLE 15
P4 MOLLE 16
P4 GAS 17
P1 GAS 18
BL3°AP–ABC 20
42RT 21
BX 22
43SP PROVA 23
AnR152 25
152NC 30
152NC 31
152NA 32
152NA 33
AP.AUT.INTERBL. 50
AP.AUT.INTERBL. 51
P4 GAS
P4 SPRINGS
P4 SPRINGS
P4 GAS
P1 GAS
LK 3°OP–ABC
42RT
BX
43SP LOCAL
7L1
A–B–C
152

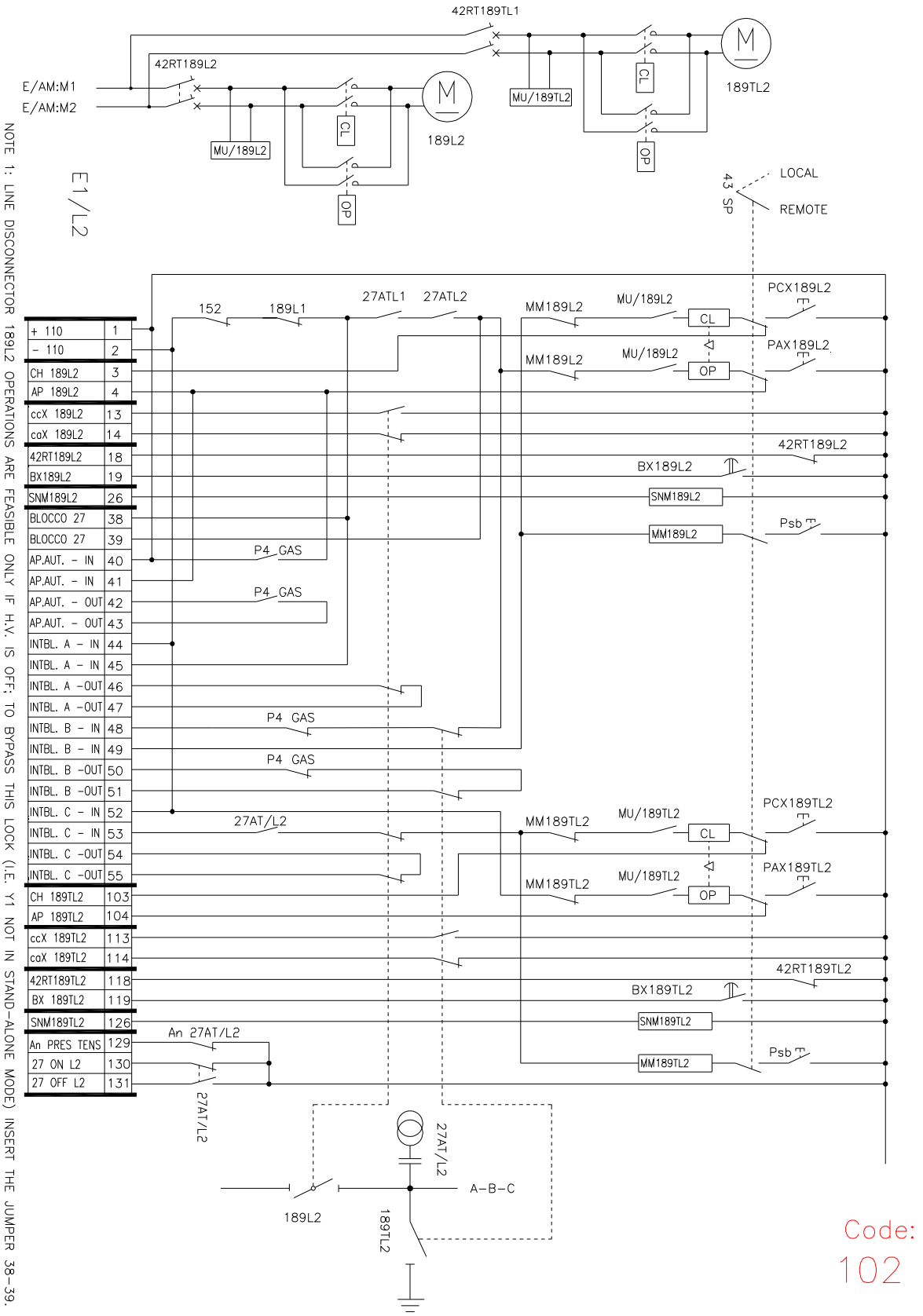
Code:
CB–T/1.2.



Code:
245 CB-S/1.2.


42RT189TL1
42RT189L1
E/AM:M1
E/AM:M2
MU/189L1
CL
OP
189L1
MU/189TL1
189TL1
E1/L1
43 SP
LOCAL
REMOTE
+ 110 1
- 110 2
CH 189L1 3
AP 189L1 4
ccX 189L1 13
coX 189L1 14
42RT189L1 18
BX189L1 19
SNM189L1 26
BLOCCO 27 38
BLOCCO 27 39
AP.AUT. - IN 40
AP.AUT. - IN 41
AP.AUT. - OUT 42
AP.AUT. - OUT 43
INTBL. A - IN 44
INTBL. A - IN 45
INTBL. A -OUT 46
INTBL. A -OUT 47
INTBL. B - IN 48
INTBL. B - IN 49
INTBL. B -OUT 50
INTBL. B -OUT 51
INTBL. C - IN 52
INTBL. C - IN 53
INTBL. C -OUT 54
INTBL. C -OUT 55
CH 189TL1 103
AP 189TL1 104
ccX 189TL1 113
coX 189TL1 114
42RT189TL1 118
BX 189TL1 119
SNM189TL1 126
An PRES TENS 129
27 ON L1 130
27 OFF L1 131
152
189L2
27ATL1
27ATL2
MM189L1
PCX189L1
PAX189L1
Psb
BX189L1
SNM189L1
MM189L1
P4 GAS
27AT/L1
An 27AT/L1
A-B-C
189L1
189TL1
NOTE 1: LINE DISCONNECTOR 189L1 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.

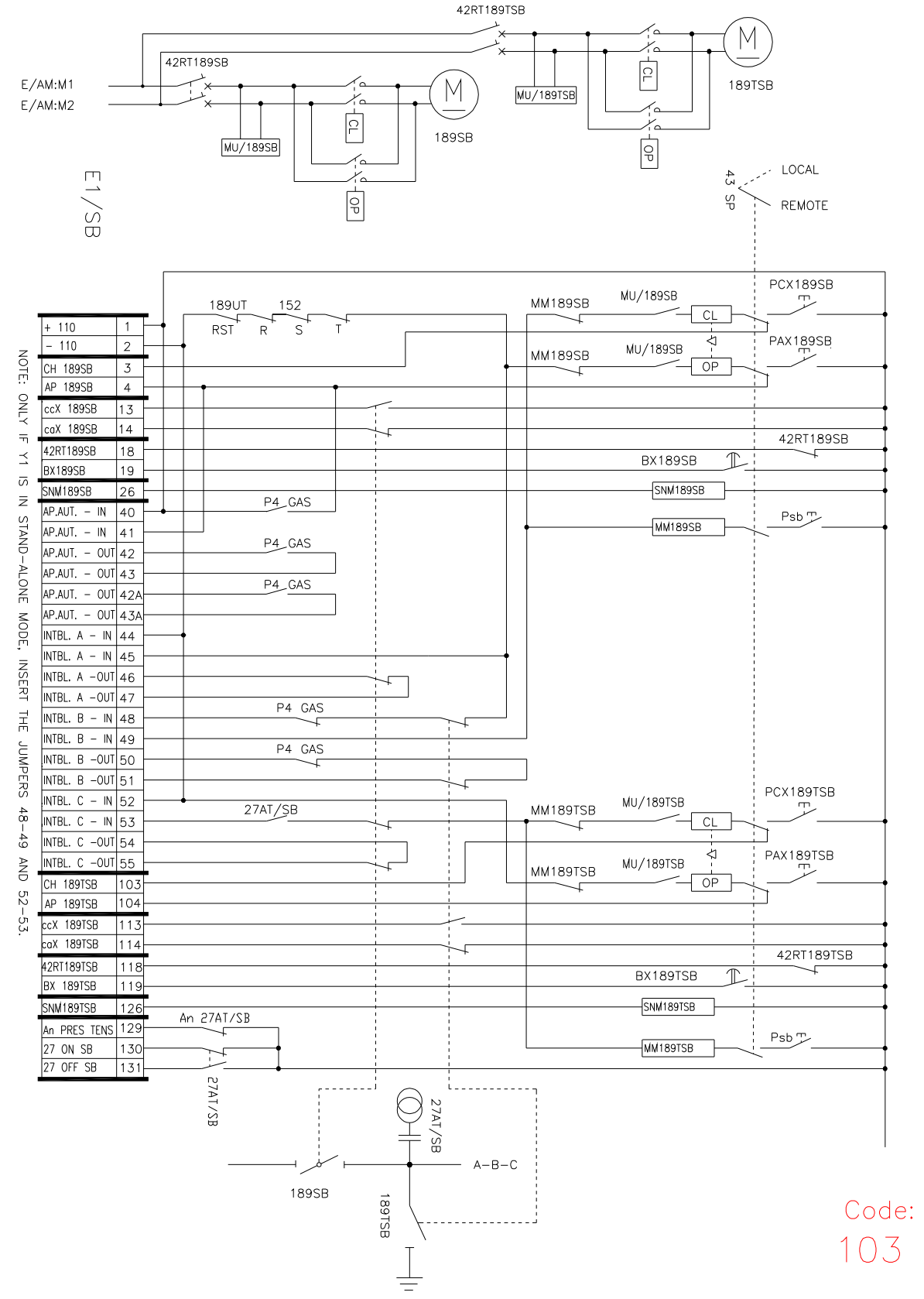
Code:
101

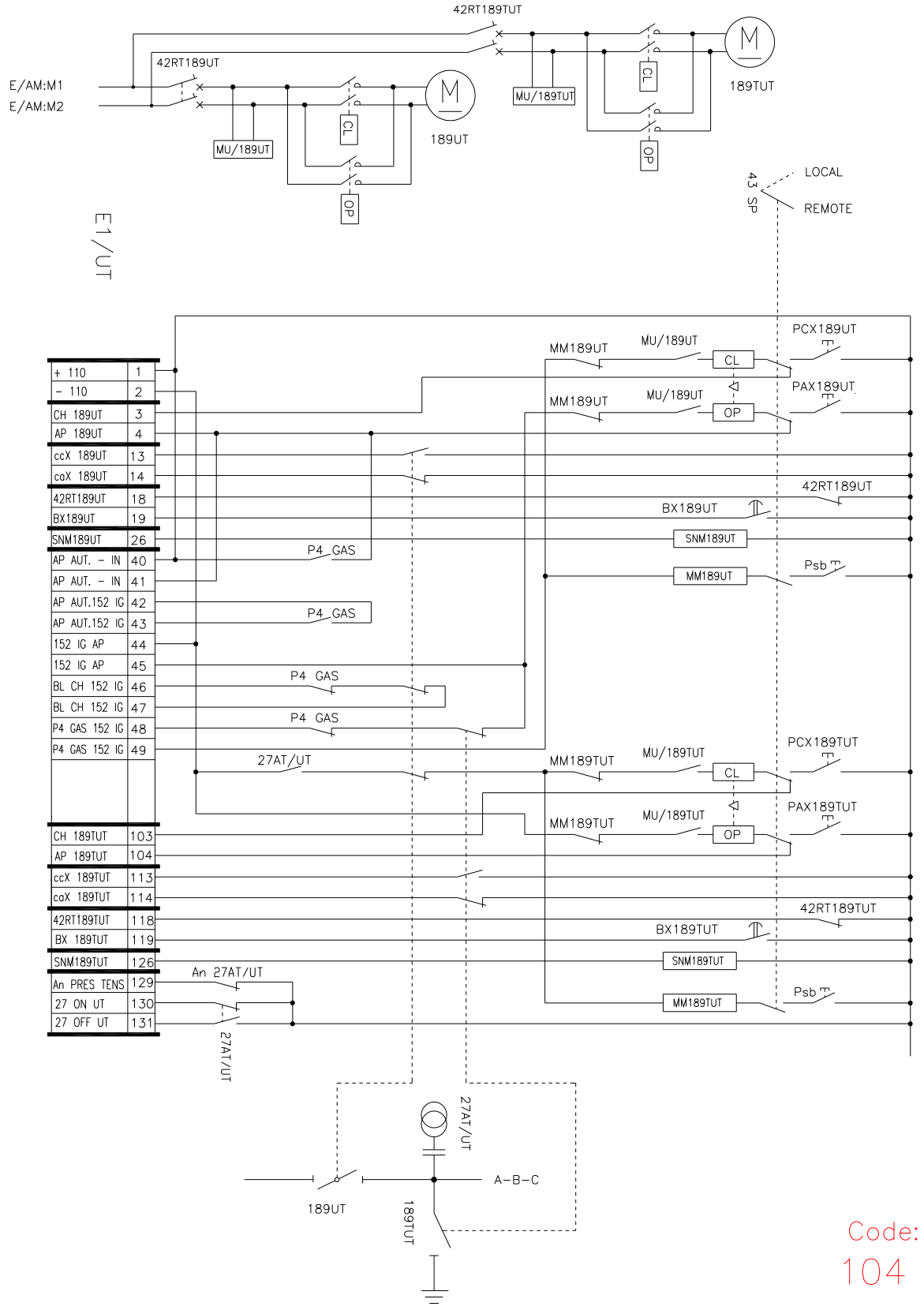


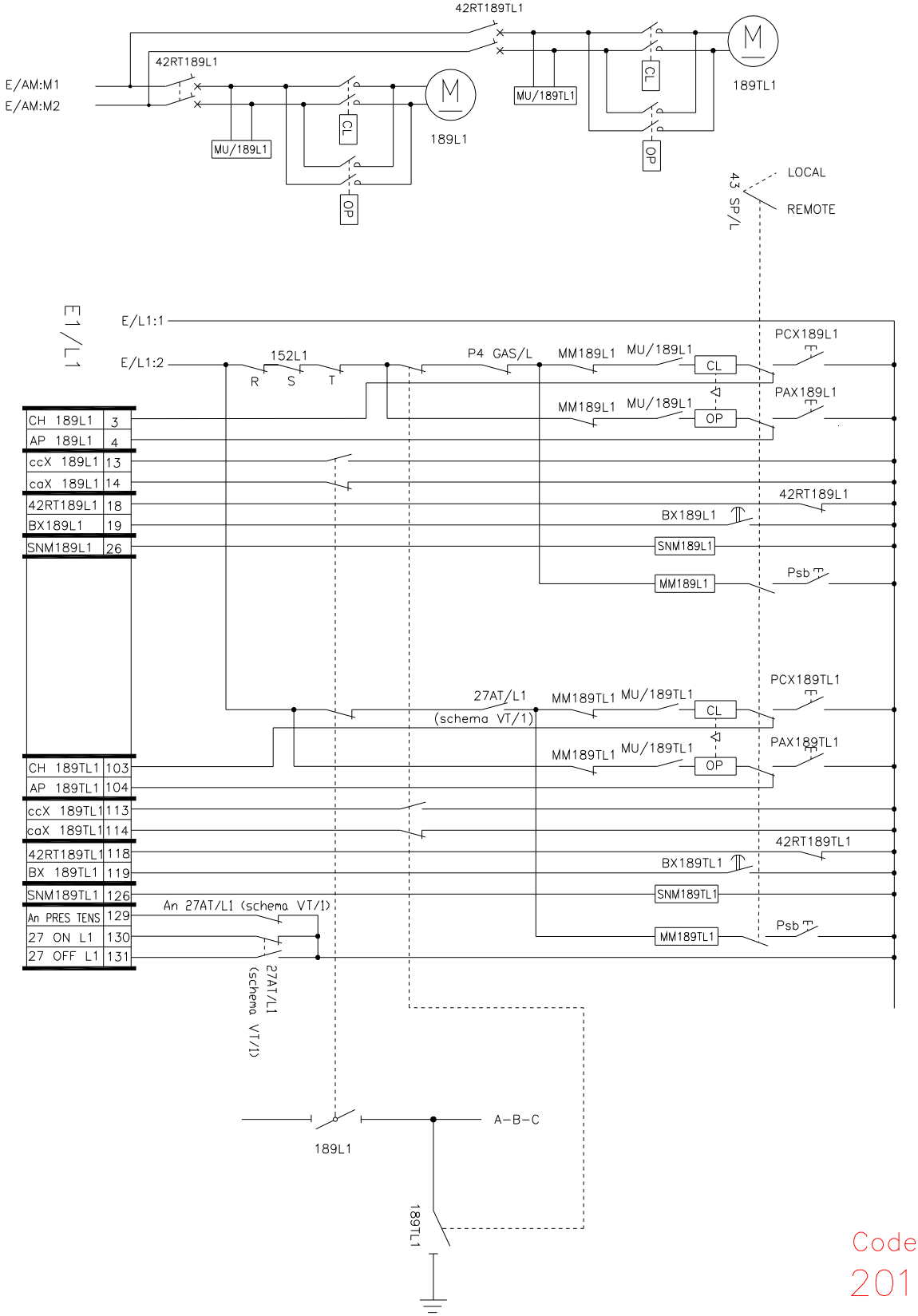
NOTE 1: LINE DISCONNECTOR 189L2 OPERATIONS ARE FEASIBLE ONLY IF H.V. IS OFF; TO BYPASS THIS LOCK (I.E. Y1 NOT IN STAND-ALONE MODE) INSERT THE JUMPER 38-39.

NOTE 2: ONLY IF Y1 IS IN STAND-ALONE MODE, INSERT THE JUMPERS 48-49 AND 52-53.

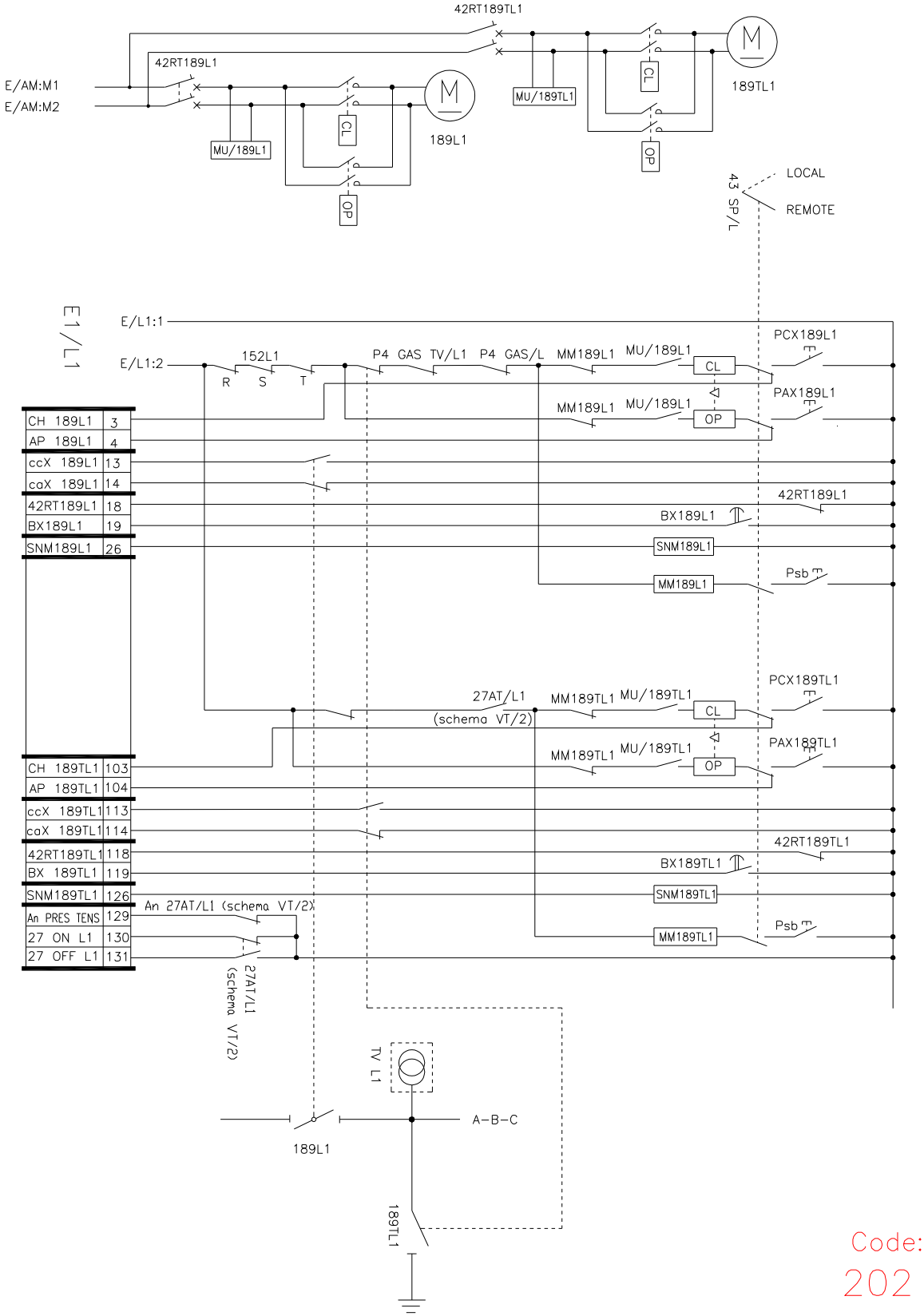
Code:
102


42RT189TSB
42RT189SB
E/AM:M1
E/AM:M2
MU/189SB
CL
189SB
MU/189TSB
189TSB
OP
E1/SB
43 SP
LOCAL
REMOTE
189UT
152
RST
R
S
T
MM189SB
MU/189SB
PCX189SB
PAX189SB
BX189SB
SNM189SB
Psb
P4 GAS
27AT/SB
MM189TSB
MU/189TSB
PCX189TSB
PAX189TSB
BX189TSB
SNM189TSB
An 27AT/SB
A-B-C
+ 110 1
- 110 2
CH 189SB 3
AP 189SB 4
ccX 189SB 13
caX 189SB 14
42RT189SB 18
BX189SB 19
SNM189SB 26
AP.AUT. - IN 40
AP.AUT. - IN 41
AP.AUT. - OUT 42
AP.AUT. - OUT 43
AP.AUT. - OUT 42A
AP.AUT. - OUT 43A
INTBL. A - IN 44
INTBL. A - IN 45
INTBL. A -OUT 46
INTBL. A -OUT 47
INTBL. B - IN 48
INTBL. B - IN 49
INTBL. B -OUT 50
INTBL. B -OUT 51
INTBL. C - IN 52
INTBL. C - IN 53
INTBL. C -OUT 54
INTBL. C -OUT 55
CH 189TSB 103
AP 189TSB 104
ccX 189TSB 113
caX 189TSB 114
42RT189TSB 118
BX 189TSB 119
SNM189TSB 126
An PRES TENS 129
27 ON SB 130
27 OFF SB 131
NOTE: ONLY IF Y1 IS IN STAND-ALONE MODE, INSERT THE JUMPERS 48-49 AND 52-53.
Code:
103

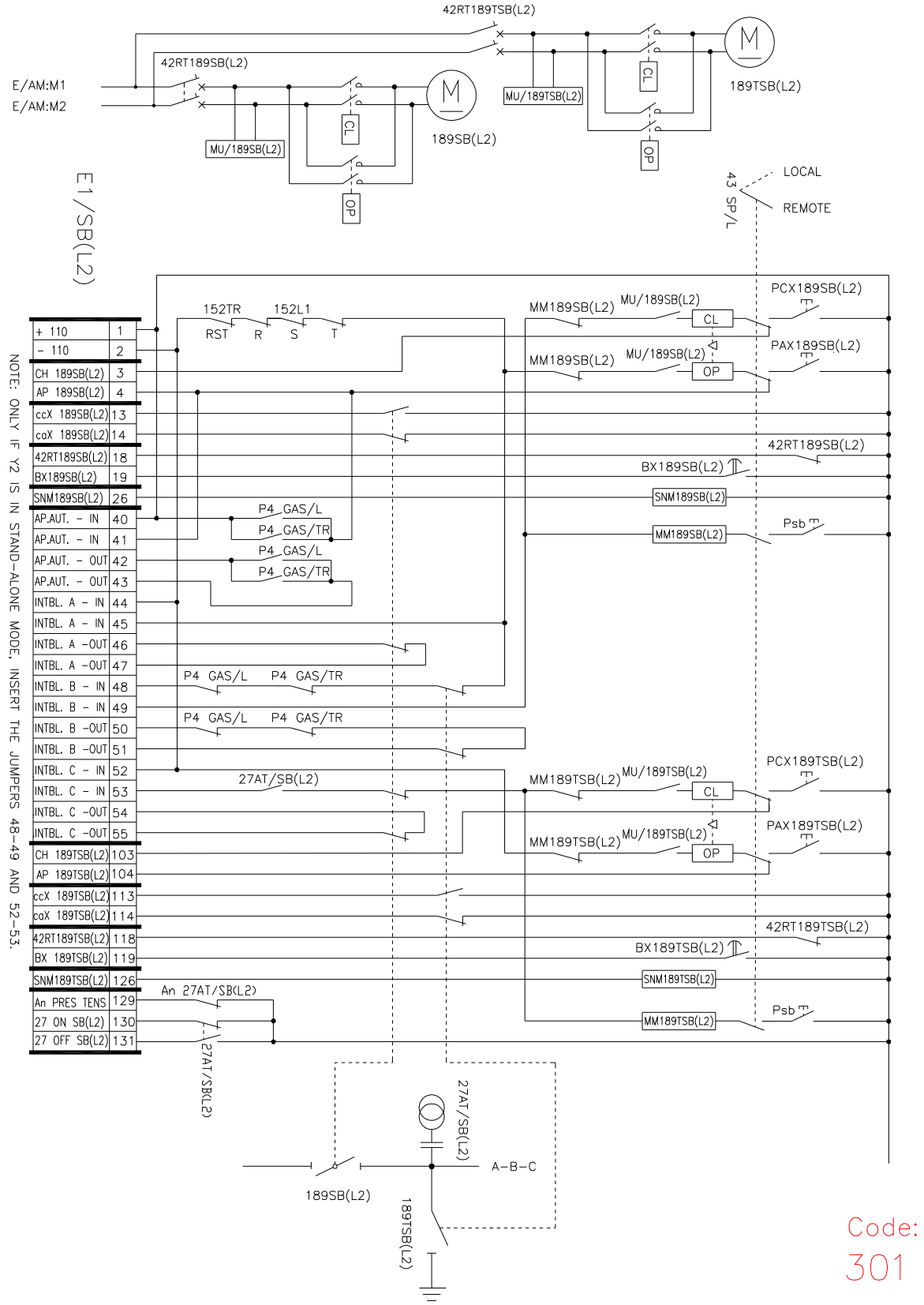

42RT189TUT
42RT189TUT
E/AM:M1
E/AM:M2
MU/189UT
CL
OP
189UT
MU/189TUT
189TUT
43 SP
LOCAL
REMOTE
E1/UT
+ 110 1
- 110 2
CH 189UT 3
AP 189UT 4
ccX 189UT 13
coX 189UT 14
42RT189UT 18
BX189UT 19
SNM189UT 26
AP AUT. - IN 40
AP AUT. - IN 41
AP AUT.152 IG 42
AP AUT.152 IG 43
152 IG AP 44
152 IG AP 45
BL CH 152 IG 46
BL CH 152 IG 47
P4 GAS 152 IG 48
P4 GAS 152 IG 49
CH 189TUT 103
AP 189TUT 104
ccX 189TUT 113
coX 189TUT 114
42RT189TUT 118
BX 189TUT 119
SNM189TUT 126
An PRES TENS 129
27 ON UT 130
27 OFF UT 131
P4 GAS
27AT/UT
An 27AT/UT
MM189UT
PCX189UT
PAX189UT
BX189UT
SNM189UT
Psb
A-B-C
Code:
104

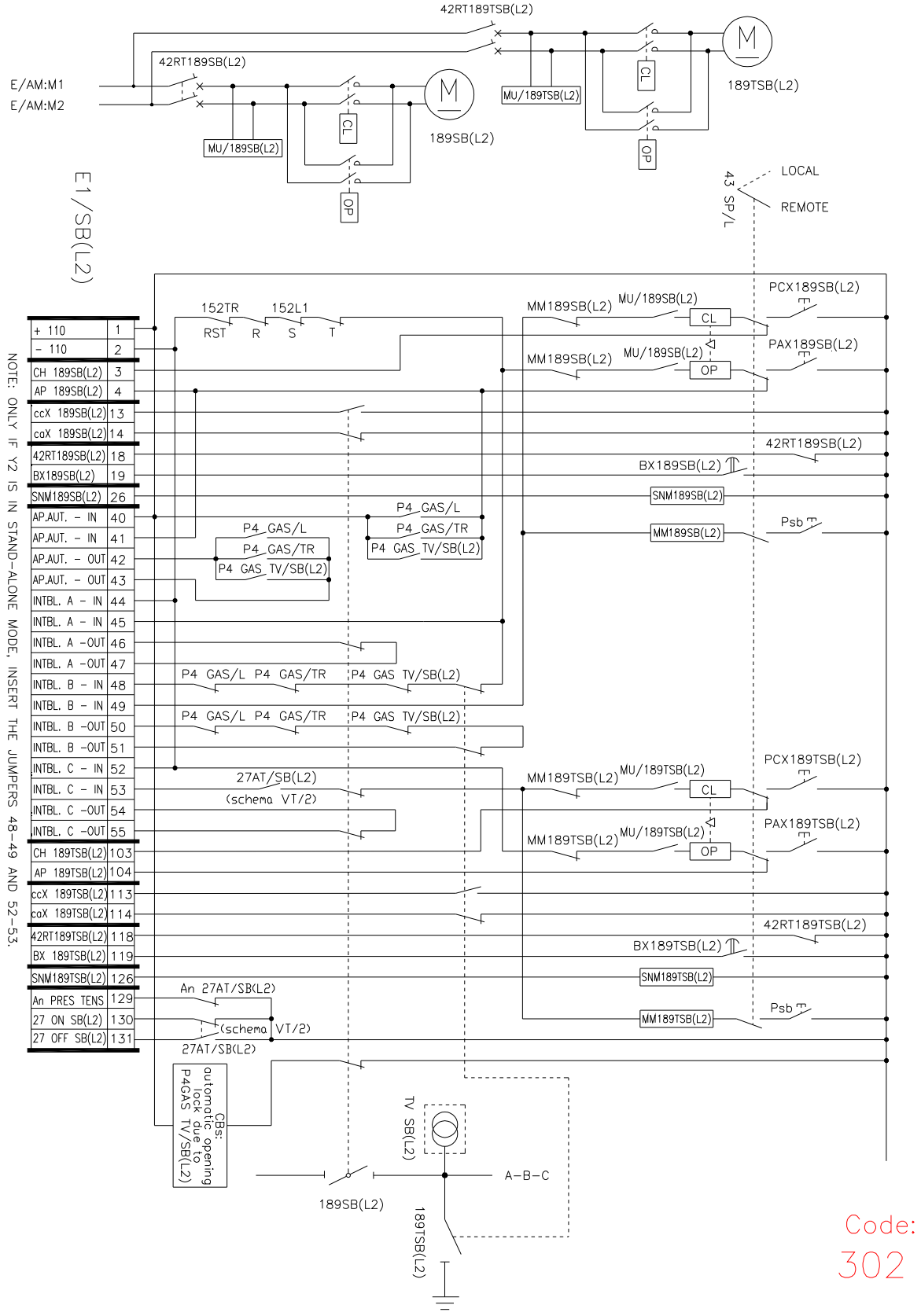

42RT189TL1
42RT189L1
E/AM:M1
E/AM:M2
MU/189L1
CL
OP
189L1
MU/189TL1
189TL1
LOCAL
43 SP/L
REMOTE
E1/L1
E/L1:1
E/L1:2
152L1
R S T
P4 GAS/L
MM189L1
MU/189L1
PCX189L1
PAX189L1
CH 189L1 3
AP 189L1 4
ccX 189L1 13
caX 189L1 14
42RT189L1 18
BX189L1 19
SNM189L1 26
BX189L1
SNM189L1
Psb
27AT/L1
(schema VT/1)
MM189TL1
CH 189TL1 103
AP 189TL1 104
ccX 189TL1 113
caX 189TL1 114
42RT189TL1 118
BX 189TL1 119
SNM189TL1 126
An PRES TENS 129
27 ON L1 130
27 OFF L1 131
An 27AT/L1 (schema VT/1)
A-B-C

Code:
201

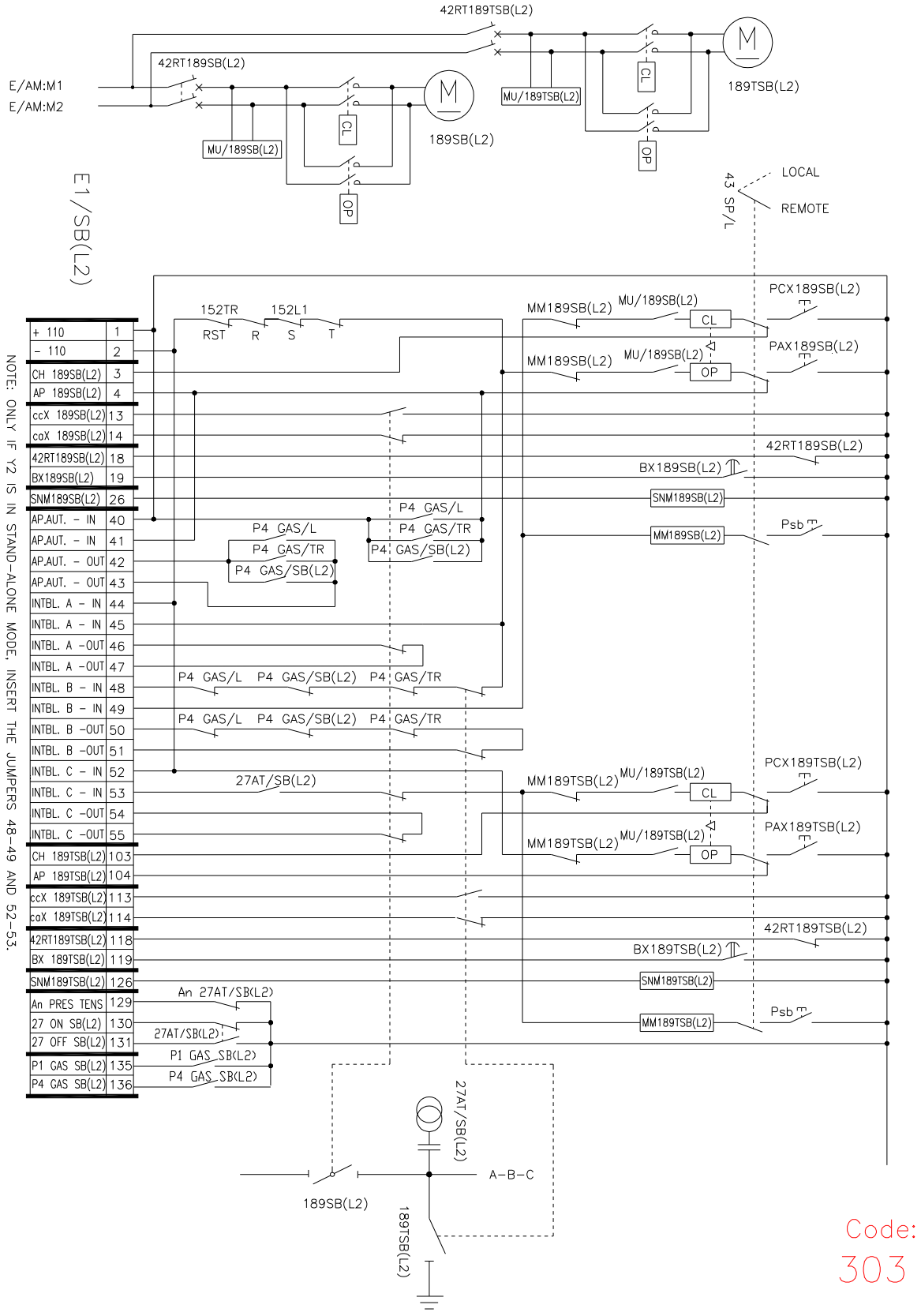

42RT189TL1
42RT189L1
E/AM:M1
E/AM:M2
MU/189L1
CL
OP
189L1
MU/189TL1
189TL1
43 SP/L
LOCAL
REMOTE
E1/L1
E/L1:1
E/L1:2
152L1
R S T
P4 GAS TV/L1
P4 GAS/L
MM189L1
MU/189L1
PCX189L1
PAX189L1
CH 189L1 3
AP 189L1 4
ccX 189L1 13
caX 189L1 14
42RT189L1 18
BX189L1 19
SNM189L1 26
Psb
27AT/L1
(schema VT/2)
CH 189TL1 103
AP 189TL1 104
ccX 189TL1 113
caX 189TL1 114
42RT189TL1 118
BX 189TL1 119
SNM189TL1 126
An PRES TENS 129
27 ON L1 130
27 OFF L1 131
An 27AT/L1 (schema VT/2)
TV L1
A-B-C

Code:
202

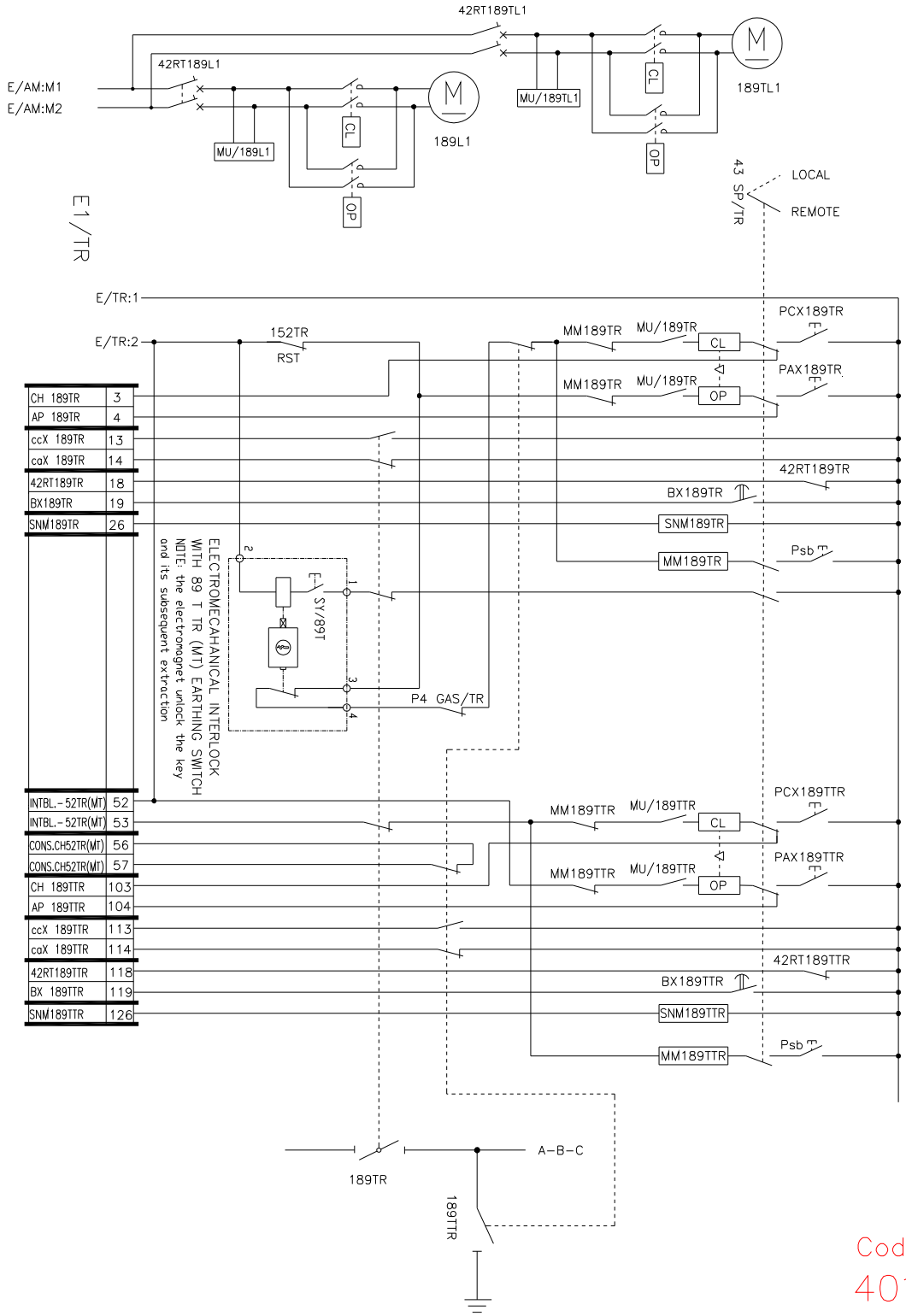

42RT189TSB(L2)
42RT189SB(L2)
E/AM:M1
E/AM:M2
MU/189SB(L2)
CL
OP
189SB(L2)
MU/189TSB(L2)
189TSB(L2)
E1/SB(L2)
43 SP/L
LOCAL
REMOTE
152TR
152L1
RST
R
S
T
MM189SB(L2)
PCX189SB(L2)
PAX189SB(L2)
42RT189SB(L2)
BX189SB(L2)
SNM189SB(L2)
Psb
P4 GAS/L
P4 GAS/TR
27AT/SB(L2)
MM189TSB(L2)
PCX189TSB(L2)
PAX189TSB(L2)
BX189TSB(L2)
An 27AT/SB(L2)
A-B-C
+ 110 1
- 110 2
CH 189SB(L2) 3
AP 189SB(L2) 4
ccX 189SB(L2) 13
coX 189SB(L2) 14
42RT189SB(L2) 18
BX189SB(L2) 19
SNM189SB(L2) 26
AP.AUT. - IN 40
AP.AUT. - IN 41
AP.AUT. - OUT 42
AP.AUT. - OUT 43
INTBL. A - IN 44
INTBL. A - IN 45
INTBL. A -OUT 46
INTBL. A -OUT 47
INTBL. B - IN 48
INTBL. B - IN 49
INTBL. B -OUT 50
INTBL. B -OUT 51
INTBL. C - IN 52
INTBL. C - IN 53
INTBL. C -OUT 54
INTBL. C -OUT 55
CH 189TSB(L2) 103
AP 189TSB(L2) 104
ccX 189TSB(L2) 113
coX 189TSB(L2) 114
42RT189TSB(L2) 118
BX 189TSB(L2) 119
SNM189TSB(L2) 126
An PRES TENS 129
27 ON SB(L2) 130
27 OFF SB(L2) 131
NOTE: ONLY IF Y2 IS IN STAND-ALONE MODE, INSERT THE JUMPERS 48-49 AND 52-53.
Code:
301


42RT189TSB(L2)
42RT189SB(L2)
E/AM:M1
E/AM:M2
MU/189SB(L2)
CL
OP
189SB(L2)
MU/189TSB(L2)
189TSB(L2)
E1/SB(L2)
43 SP/L
LOCAL
REMOTE
152TR
152L1
RST
R
S
T
MM189SB(L2)
PCX189SB(L2)
PAX189SB(L2)
P4 GAS/L
P4 GAS/TR
P4 GAS TV/SB(L2)
BX189SB(L2)
SNM189SB(L2)
Psb
27AT/SB(L2)
(schema VT/2)
MM189TSB(L2)
PCX189TSB(L2)
PAX189TSB(L2)
An 27AT/SB(L2)
CBs: automatic opening lock due to P4GAS TV/SB(L2)
TV SB(L2)
A-B-C
189SB(L2)
189TSB(L2)
+ 110 1
- 110 2
CH 189SB(L2) 3
AP 189SB(L2) 4
ccX 189SB(L2) 13
coX 189SB(L2) 14
42RT189SB(L2) 18
BX189SB(L2) 19
SNM189SB(L2) 26
AP.AUT. - IN 40
AP.AUT. - IN 41
AP.AUT. - OUT 42
AP.AUT. - OUT 43
INTBL. A - IN 44
INTBL. A - IN 45
INTBL. A -OUT 46
INTBL. A -OUT 47
INTBL. B - IN 48
INTBL. B - IN 49
INTBL. B -OUT 50
INTBL. B -OUT 51
INTBL. C - IN 52
INTBL. C - IN 53
INTBL. C -OUT 54
INTBL. C -OUT 55
CH 189TSB(L2) 103
AP 189TSB(L2) 104
ccX 189TSB(L2) 113
coX 189TSB(L2) 114
42RT189TSB(L2) 118
BX 189TSB(L2) 119
SNM189TSB(L2) 126
An PRES TENS 129
27 ON SB(L2) 130
27 OFF SB(L2) 131
NOTE: ONLY IF Y2 IS IN STAND-ALONE MODE, INSERT THE JUMPERS 48-49 AND 52-53.

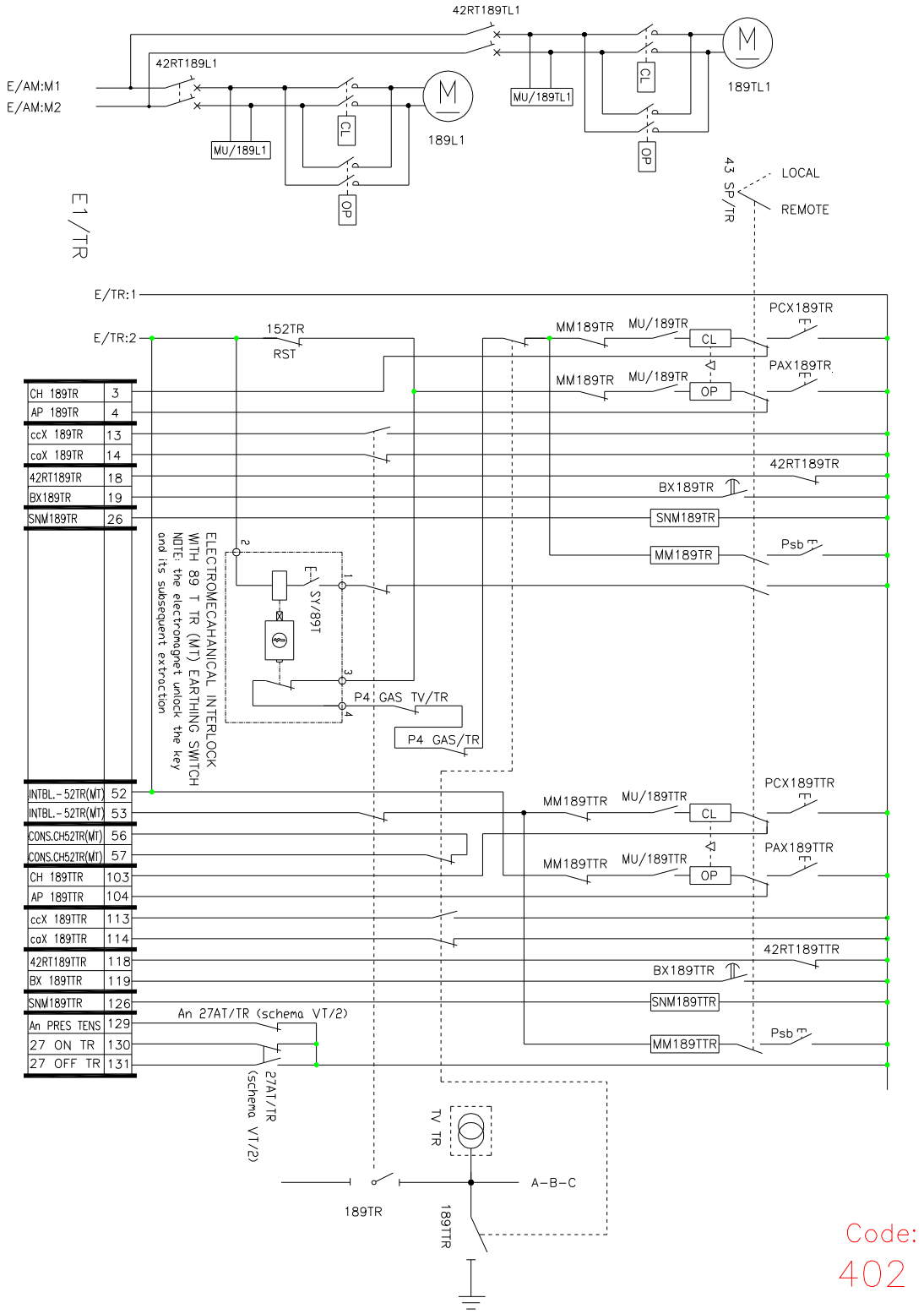
Code:
302


42RT189TSB(L2)
42RT189SB(L2)
E/AM:M1
E/AM:M2
MU/189SB(L2)
CL
OP
189SB(L2)
MU/189TSB(L2)
189TSB(L2)
E1/SB(L2)
43 SP/L
LOCAL
REMOTE
152TR
152L1
RST
R
S
T
MM189SB(L2)
PCX189SB(L2)
PAX189SB(L2)
BX189SB(L2)
SNM189SB(L2)
Psb
P4 GAS/L
P4 GAS/TR
P4 GAS/SB(L2)
27AT/SB(L2)
MM189TSB(L2)
PCX189TSB(L2)
PAX189TSB(L2)
An 27AT/SB(L2)
P1 GAS SB(L2)
A-B-C
NOTE: ONLY IF Y2 IS IN STAND-ALONE MODE, INSERT THE JUMPERS 48-49 AND 52-53.
+ 110 1
- 110 2
CH 189SB(L2) 3
AP 189SB(L2) 4
ccX 189SB(L2) 13
coX 189SB(L2) 14
42RT189SB(L2) 18
BX189SB(L2) 19
SNM189SB(L2) 26
AP.AUT. - IN 40
AP.AUT. - IN 41
AP.AUT. - OUT 42
AP.AUT. - OUT 43
INTBL. A - IN 44
INTBL. A - IN 45
INTBL. A -OUT 46
INTBL. A -OUT 47
INTBL. B - IN 48
INTBL. B - IN 49
INTBL. B -OUT 50
INTBL. B -OUT 51
INTBL. C - IN 52
INTBL. C - IN 53
INTBL. C -OUT 54
INTBL. C -OUT 55
CH 189TSB(L2) 103
AP 189TSB(L2) 104
ccX 189TSB(L2) 113
coX 189TSB(L2) 114
42RT189TSB(L2) 118
BX 189TSB(L2) 119
SNM189TSB(L2) 126
An PRES TENS 129
27 ON SB(L2) 130
27 OFF SB(L2) 131
P1 GAS SB(L2) 135
P4 GAS SB(L2) 136

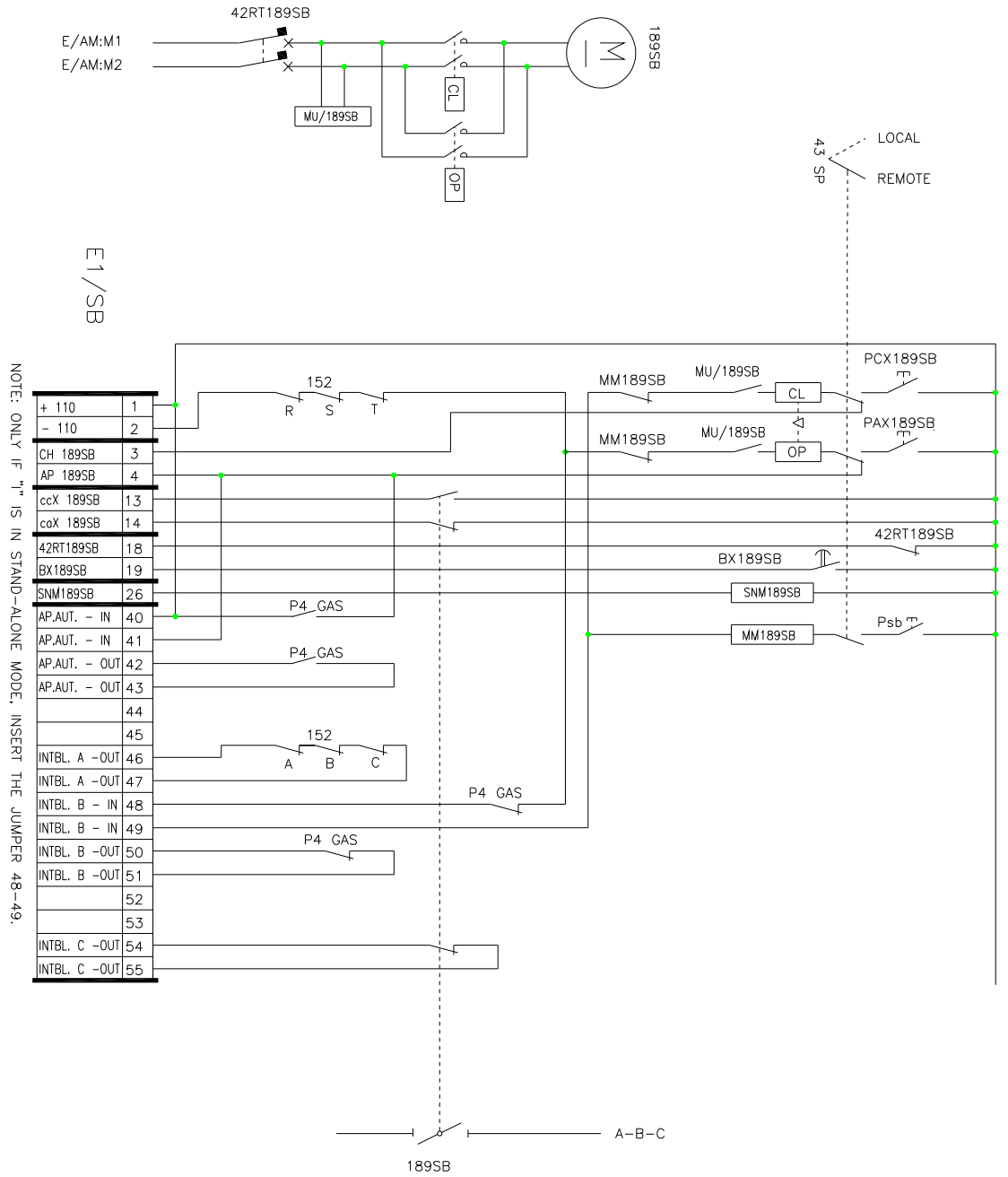
Code:
303


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
SY/89T
P4 GAS/TR
ELECTROMECAHANICAL INTERLOCK WITH 89 T TR (MT) EARTHING SWITCH
NOTE: the electromagnet unlock the key and its subsequent extraction
CH 189TR 3
AP 189TR 4
ccX 189TR 13
caX 189TR 14
42RT189TR 18
BX189TR 19
SNM189TR 26
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
caX 189TTR 114
42RT189TTR 118
BX 189TTR 119
SNM189TTR 126
MM189TTR
MU/189TTR
PCX189TTR
PAX189TTR
42RT189TTR
BX189TTR
SNM189TTR
Psb
189TR
A-B-C
189TTR

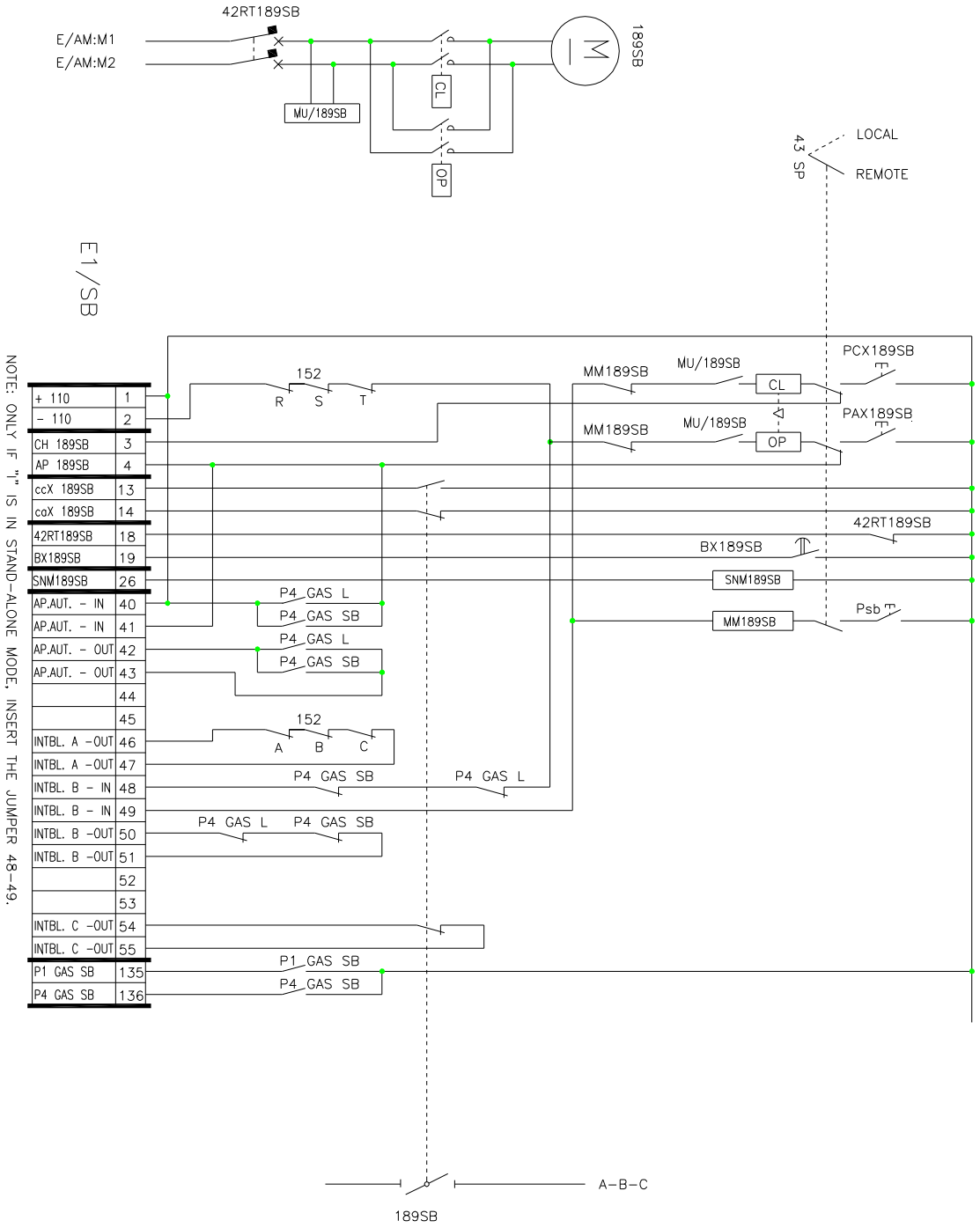
Code:
401


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
caX 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
caX 189TTR 114
42RT189TTR 118
BX 189TTR 119
SNM189TTR 126
An PRES TENS 129
27 ON TR 130
27 OFF TR 131
An 27AT/TR (schema VT/2)
27AT/TR (schema VT/2)
TV TR
A-B-C
189TR
189TTR

Code:
402


42RT189SB
E/AM:M1
E/AM:M2
MU/189SB
CL
OP
189SB
43 SP
LOCAL
REMOTE
E1/SB
NOTE: ONLY IF "I" IS IN STAND-ALONE MODE, INSERT THE JUMPER 48-49.
+ 110 1
- 110 2
CH 189SB 3
AP 189SB 4
ccX 189SB 13
caX 189SB 14
42RT189SB 18
BX189SB 19
SNM189SB 26
AP.AUT. - IN 40
AP.AUT. - IN 41
AP.AUT. - OUT 42
AP.AUT. - OUT 43
44
45
INTBL. A -OUT 46
INTBL. A -OUT 47
INTBL. B - IN 48
INTBL. B - IN 49
INTBL. B -OUT 50
INTBL. B -OUT 51
52
53
INTBL. C -OUT 54
INTBL. C -OUT 55
152
R S T
152
A B C
P4 GAS
P4 GAS
P4 GAS
P4 GAS
MM189SB
MU/189SB
CL
MM189SB
MU/189SB
OP
PCX189SB
PAX189SB
42RT189SB
BX189SB
SNM189SB
MM189SB
Psb
A-B-C
189SB

Code:
501


42RT189SB
E/AM:M1
E/AM:M2
MU/189SB
CL
OP
189SB
43 SP
LOCAL
REMOTE
E1/SB
NOTE: ONLY IF "i" IS IN STAND-ALONE MODE, INSERT THE JUMPER 48-49.
+ 110 1
- 110 2
CH 189SB 3
AP 189SB 4
ccX 189SB 13
coX 189SB 14
42RT189SB 18
BX189SB 19
SNM189SB 26
AP.AUT. - IN 40
AP.AUT. - IN 41
AP.AUT. - OUT 42
AP.AUT. - OUT 43
44
45
INTBL. A -OUT 46
INTBL. A -OUT 47
INTBL. B - IN 48
INTBL. B - IN 49
INTBL. B -OUT 50
INTBL. B -OUT 51
52
53
INTBL. C -OUT 54
INTBL. C -OUT 55
P1 GAS SB 135
P4 GAS SB 136
152
R S T
A B C
MM189SB
MU/189SB
CL
OP
PCX189SB
PAX189SB
42RT189SB
BX189SB
SNM189SB
MM189SB
Psb
P4 GAS L
P4 GAS SB
P1 GAS SB
A-B-C
189SB

Code:
502

MOTORS (D.C.) AND
ANTI-CONDENSATION (A.C.)
POWER SUPPLIES

ALIMENTAZIONI MOTORI (C.C.)
E ANTICONDENSA (C.A.)

E/AM

ANTICOND. SUPPLY	R0
ANTICOND. SUPPLY	R4
+MOTORS	M1
+MOTORS	M1
+MOTORS	M1
-MOTORS	M2
-MOTORS	M2
-MOTORS	M2

Code/Codice:
AM

SIDE: BUSBAR
LATO: SBARRA

P1

CT A POLE
TA POLO A

CT B POLE
TA POLO B

CT C POLE
TA POLO C

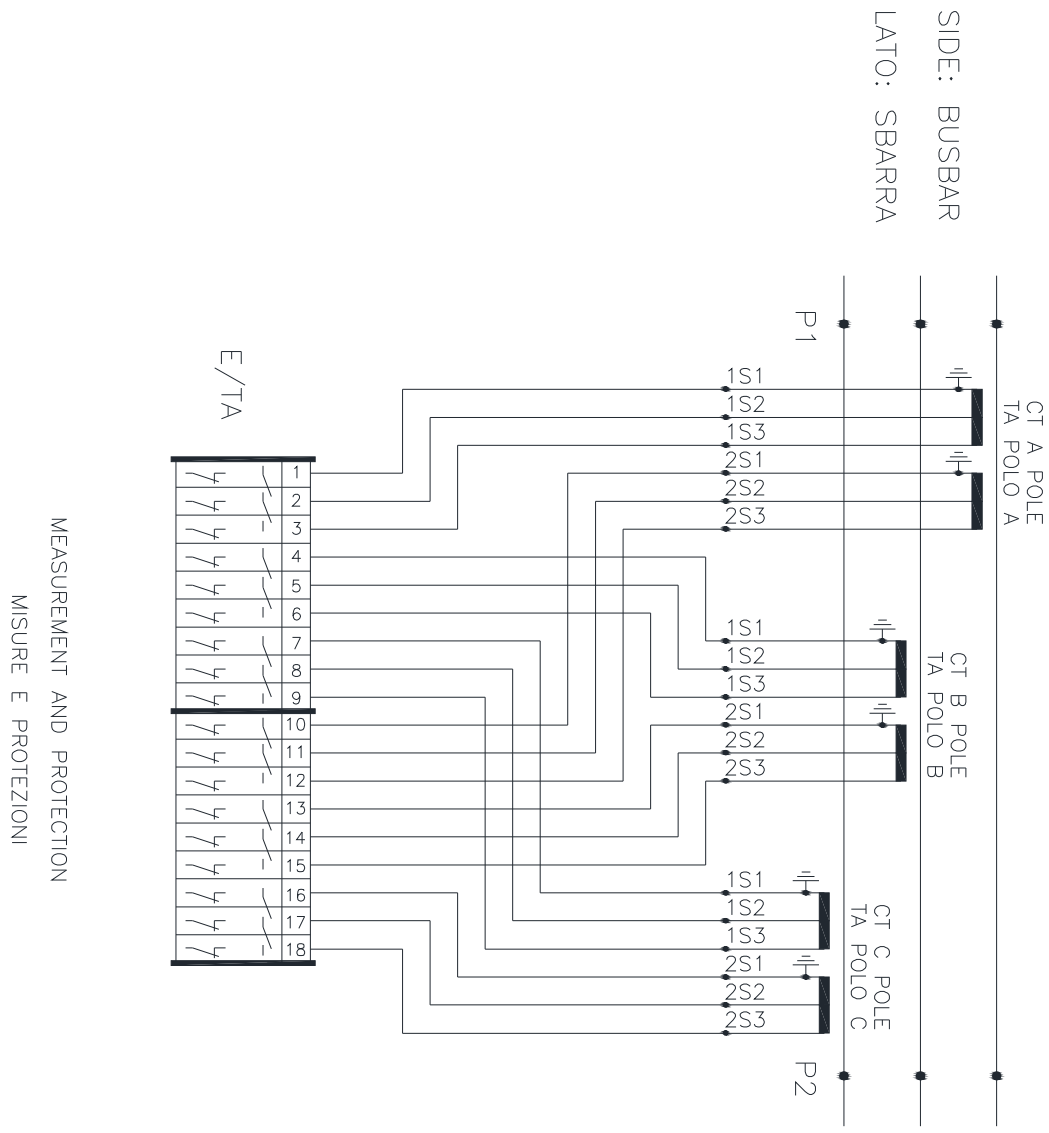
P2

E/TA

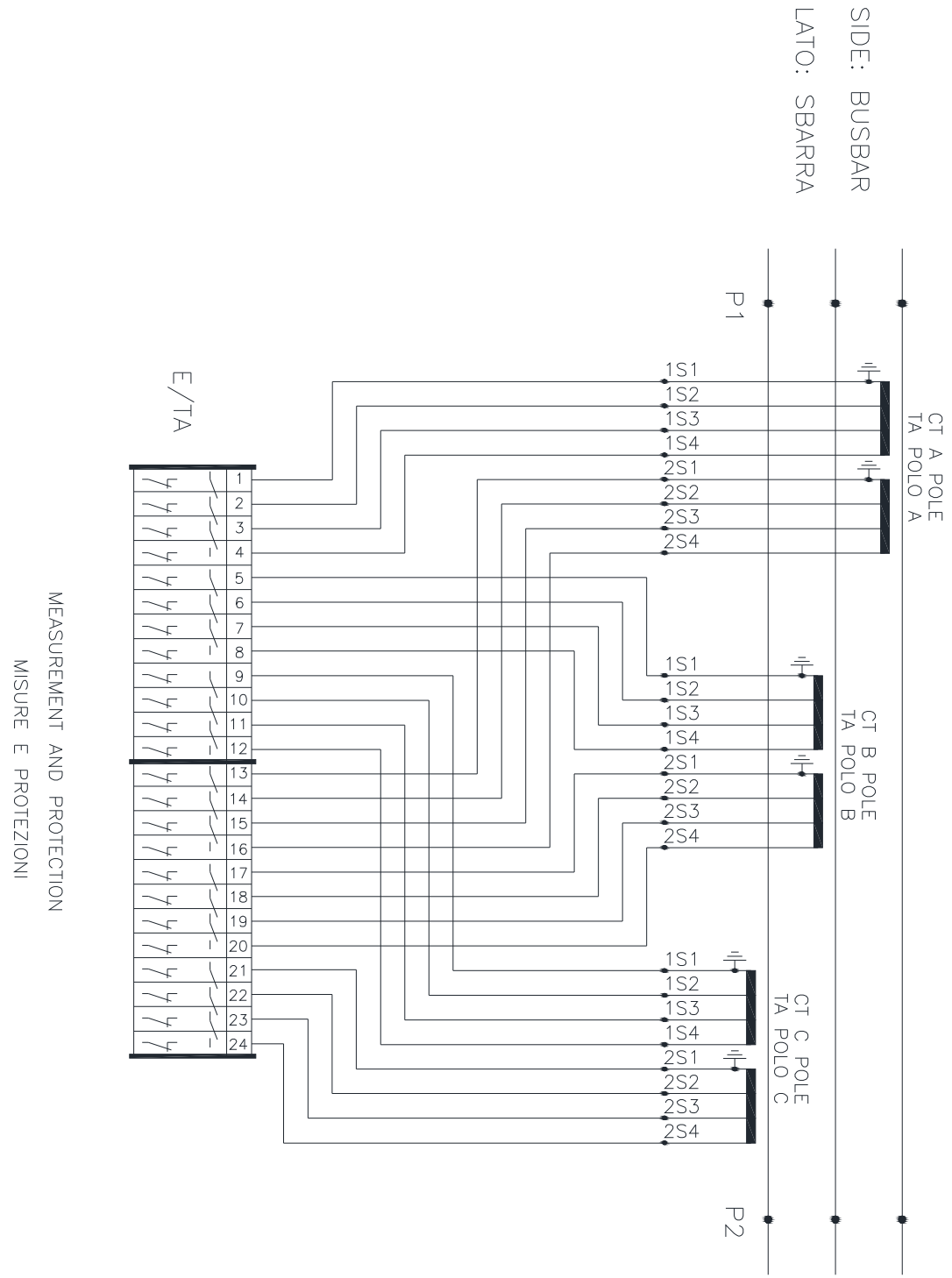
S1	1
S2	2
S3	3
S1	4
S2	5
S3	6
S1	7
S2	8
S3	9

MEASUREMENT AND PROTECTION
MISURE E PROTEZIONI

Code/Codice:
CT/1



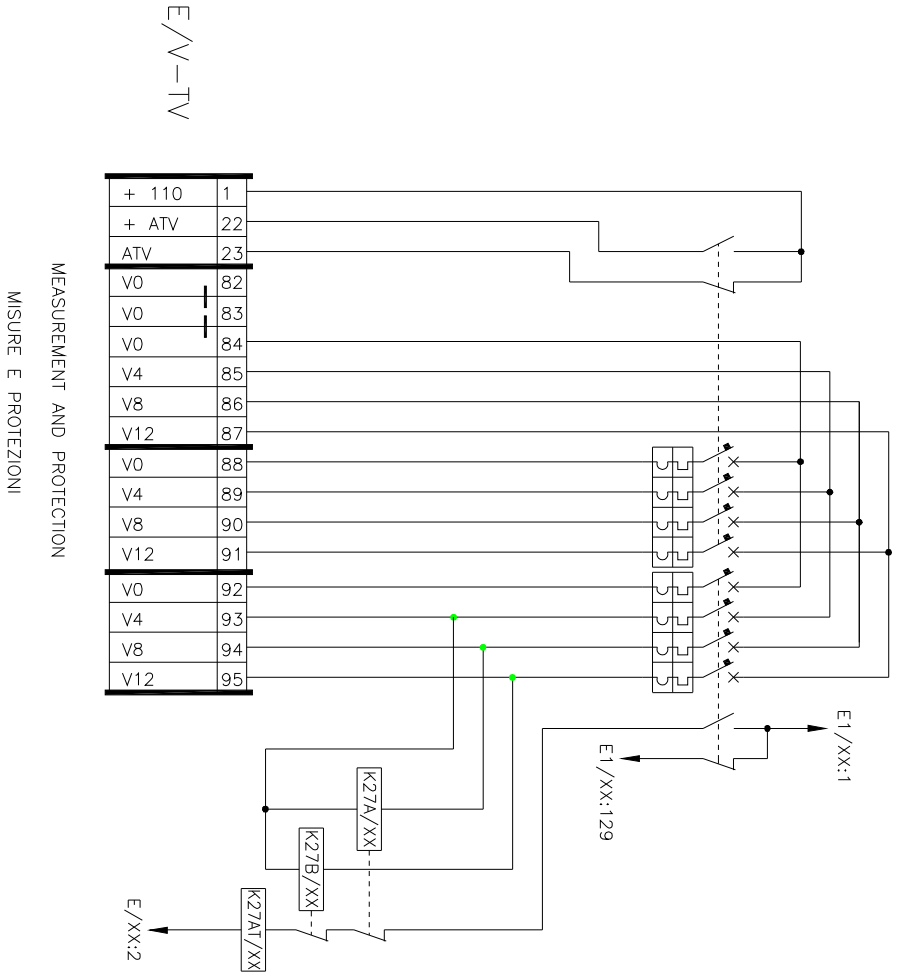
Code/Codice:
CT/2



Code/Codice:
CT/3

Inductive or Capacitor Voltage Transformers Version

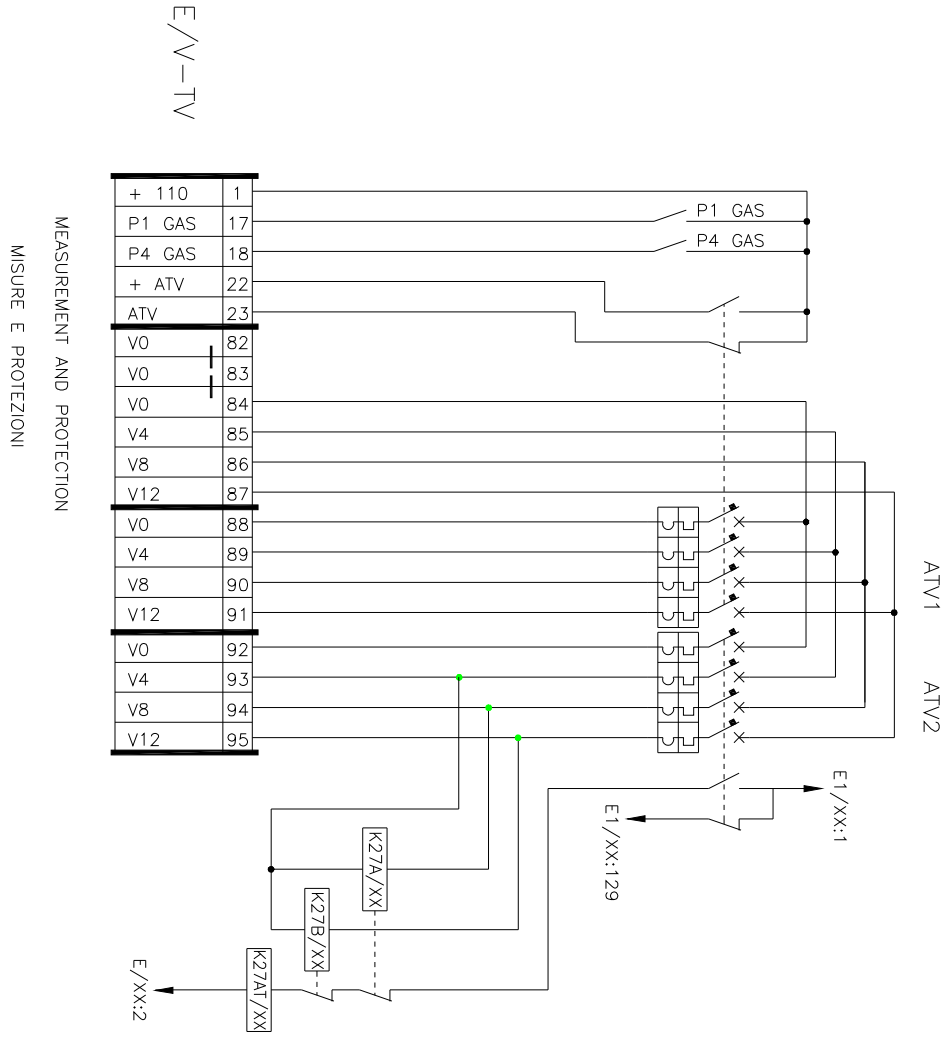
Versione con TV – TVC tradizionali esterni



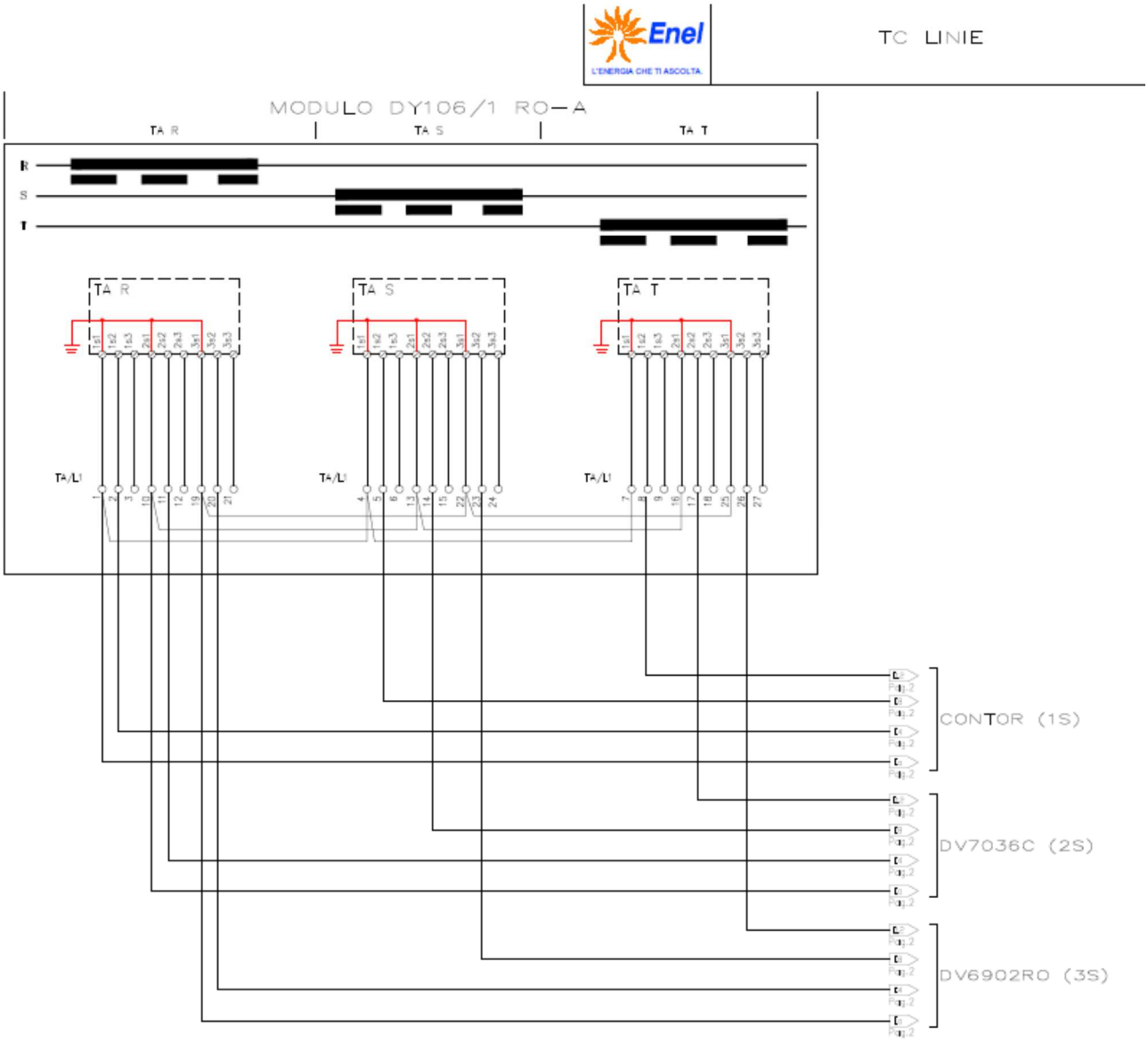
Code/Codice:
VT/1

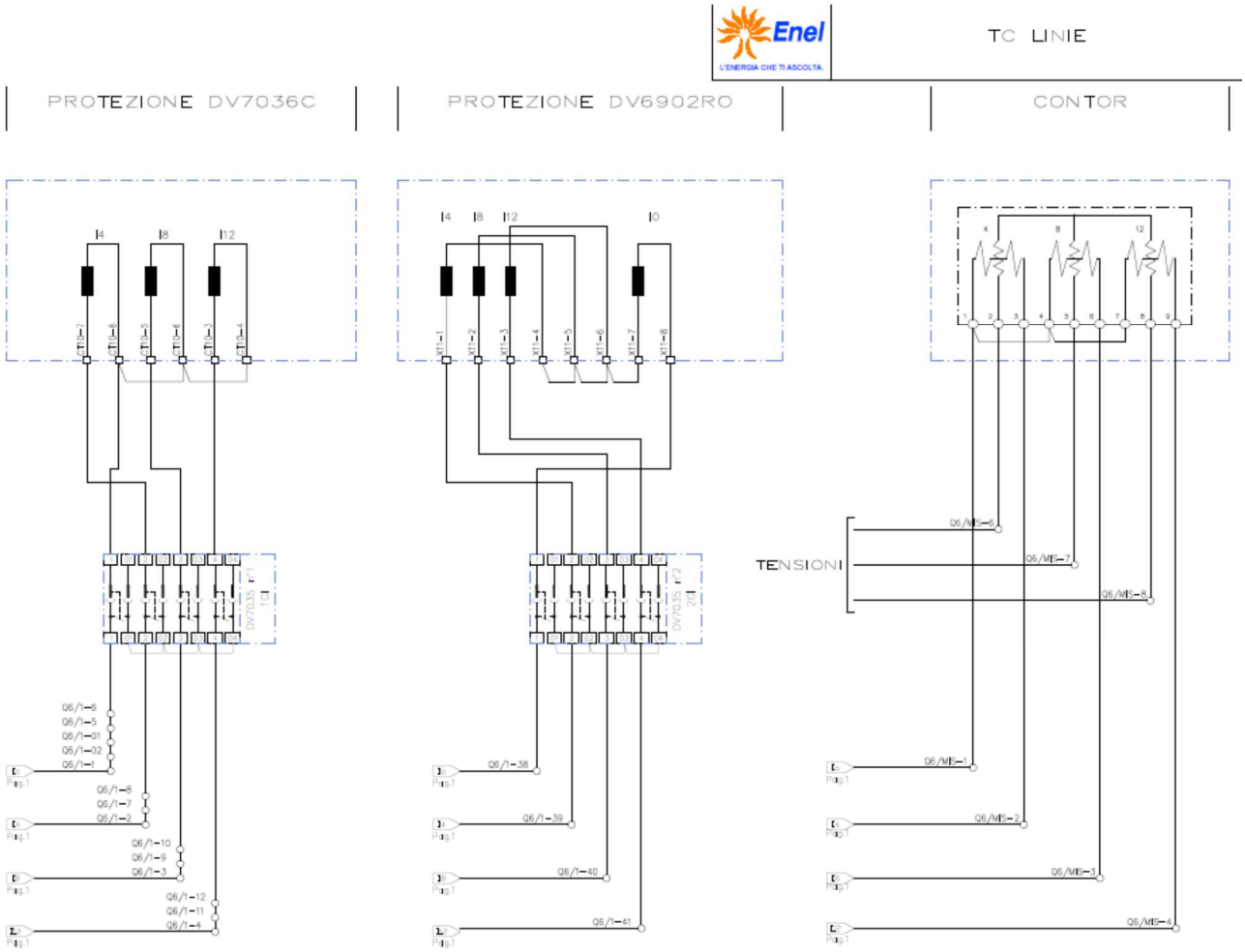
Gas insulated Inductive Voltage Transformers Version

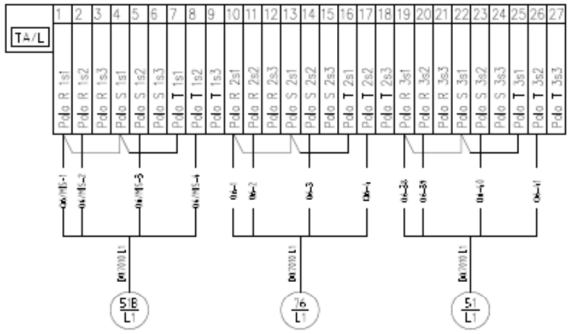
Versione con TV in SF6 e relativa compartimentazione

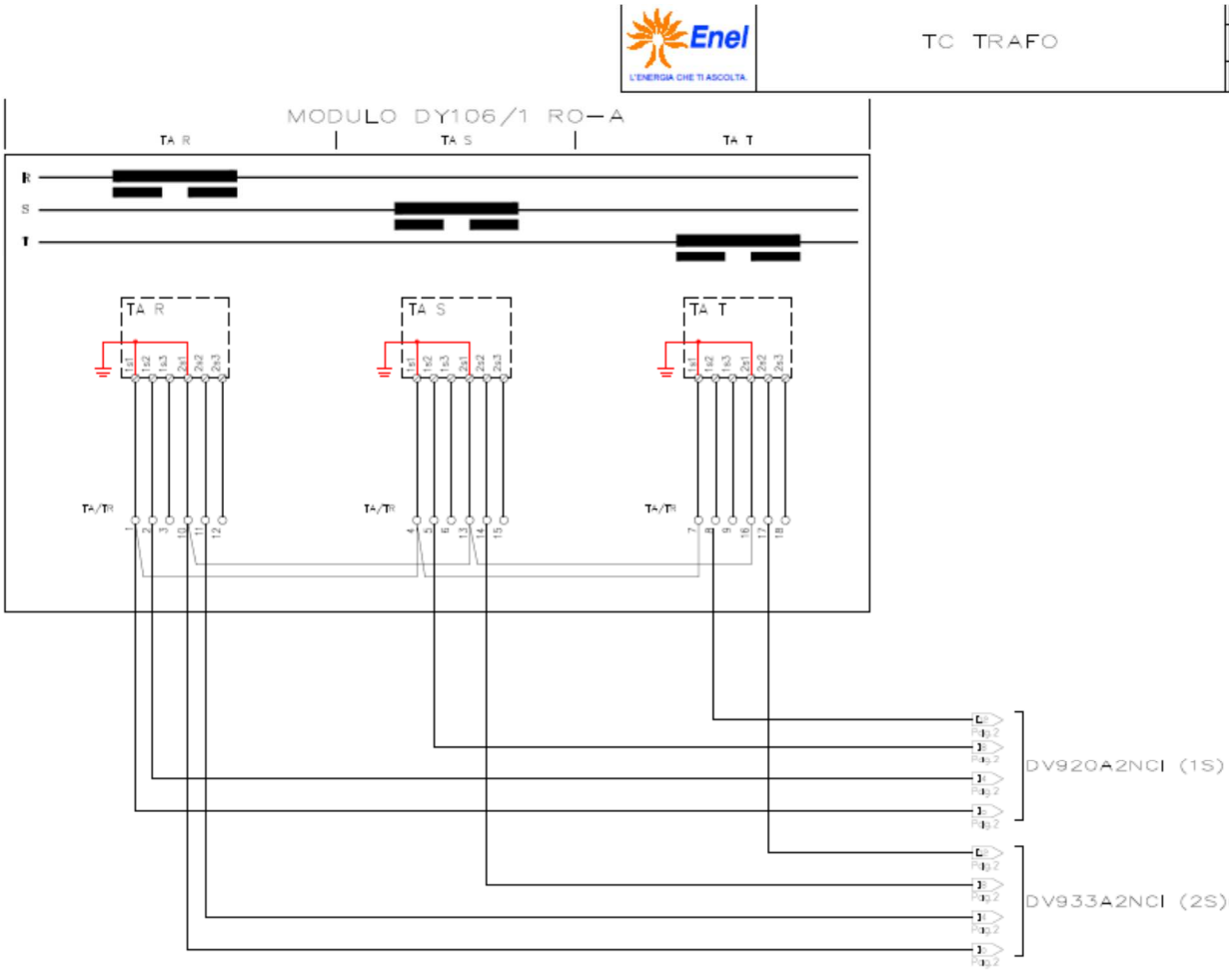


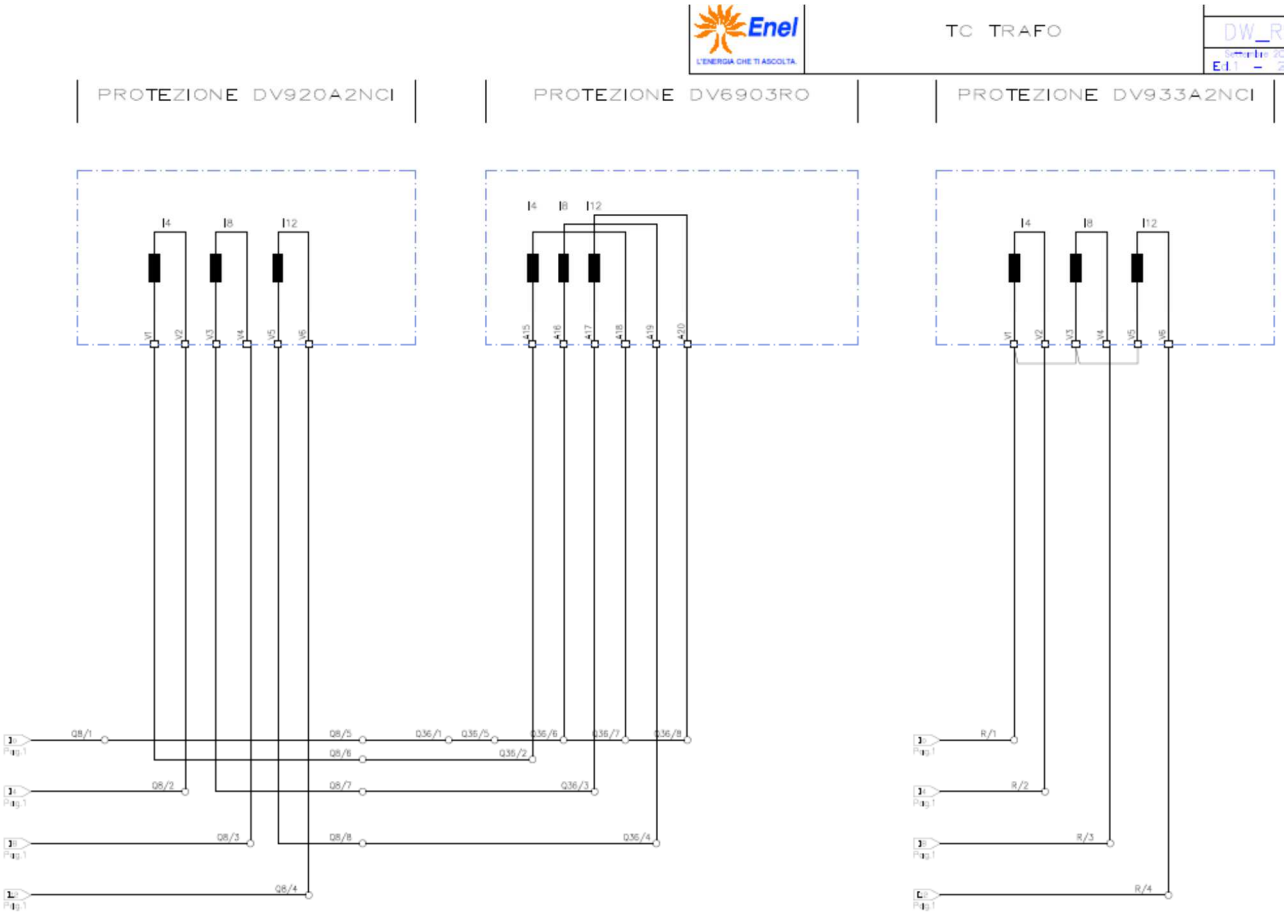
Code/Codice:
VT/2

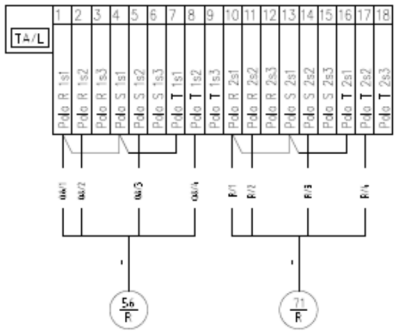

TC LINIE
MODULO DY106/1 RO—A
TA R
TA S
TA T
R
S
T
TA/LI
CONTOR (1S)
DV7036C (2S)
DV6902RO (3S)


TC LINIE
PROTEZIONE DV7036C
PROTEZIONE DV6902RO
CONTOR
TENSIONI

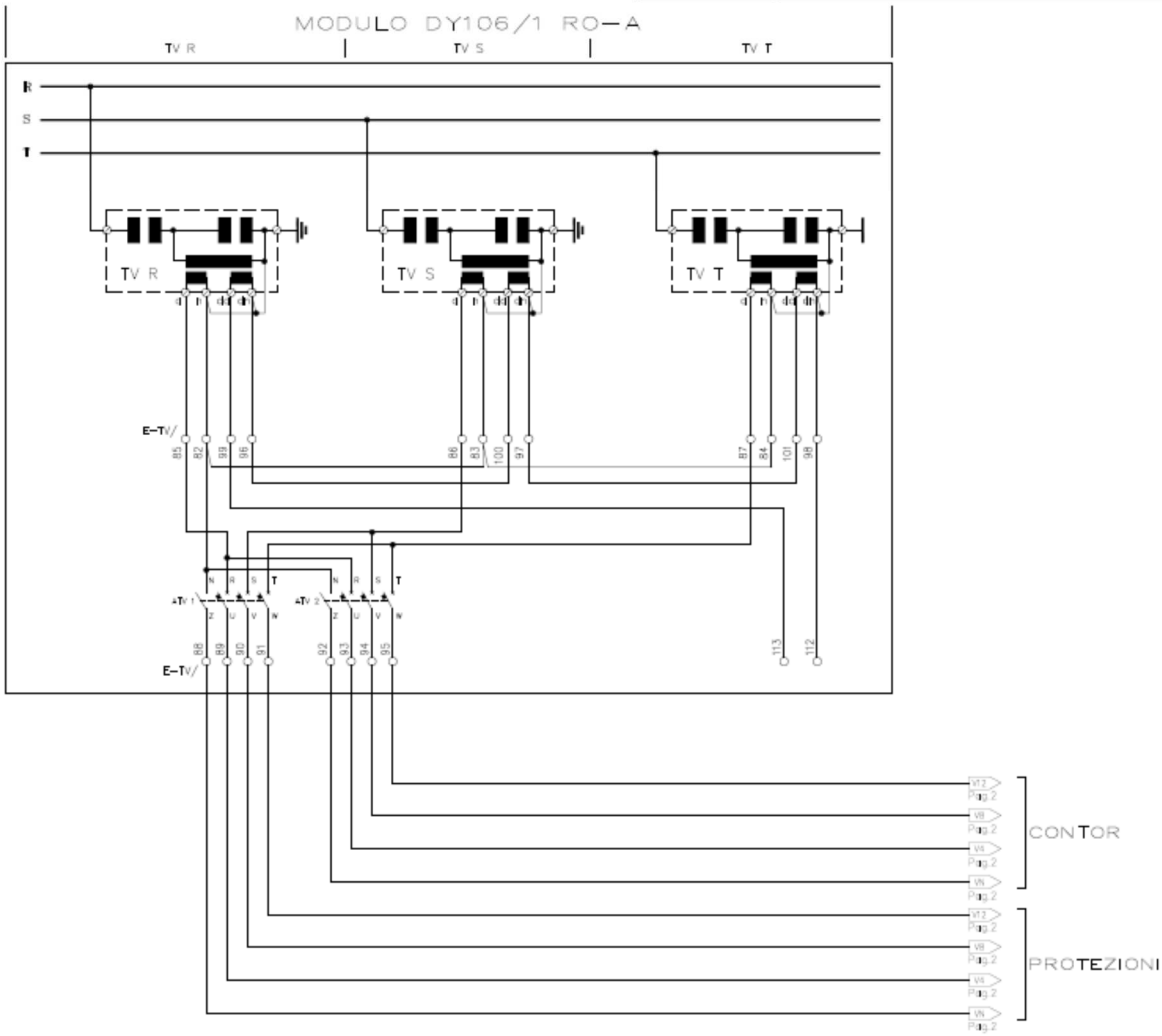

TA/L
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Pde R 1s1
Pde R 1s2
Pde R 1s3
Pde S 1s1
Pde S 1s2
Pde S 1s3
Pde T 1s1
Pde T 1s2
Pde T 1s3
Pde R 2s1
Pde R 2s2
Pde R 2s3
Pde S 2s1
Pde S 2s2
Pde S 2s3
Pde T 2s1
Pde T 2s2
Pde T 2s3
Pde R 3s1
Pde R 3s2
Pde R 3s3
Pde S 3s1
Pde S 3s2
Pde S 3s3
Pde T 3s1
Pde T 3s2
Pde T 3s3

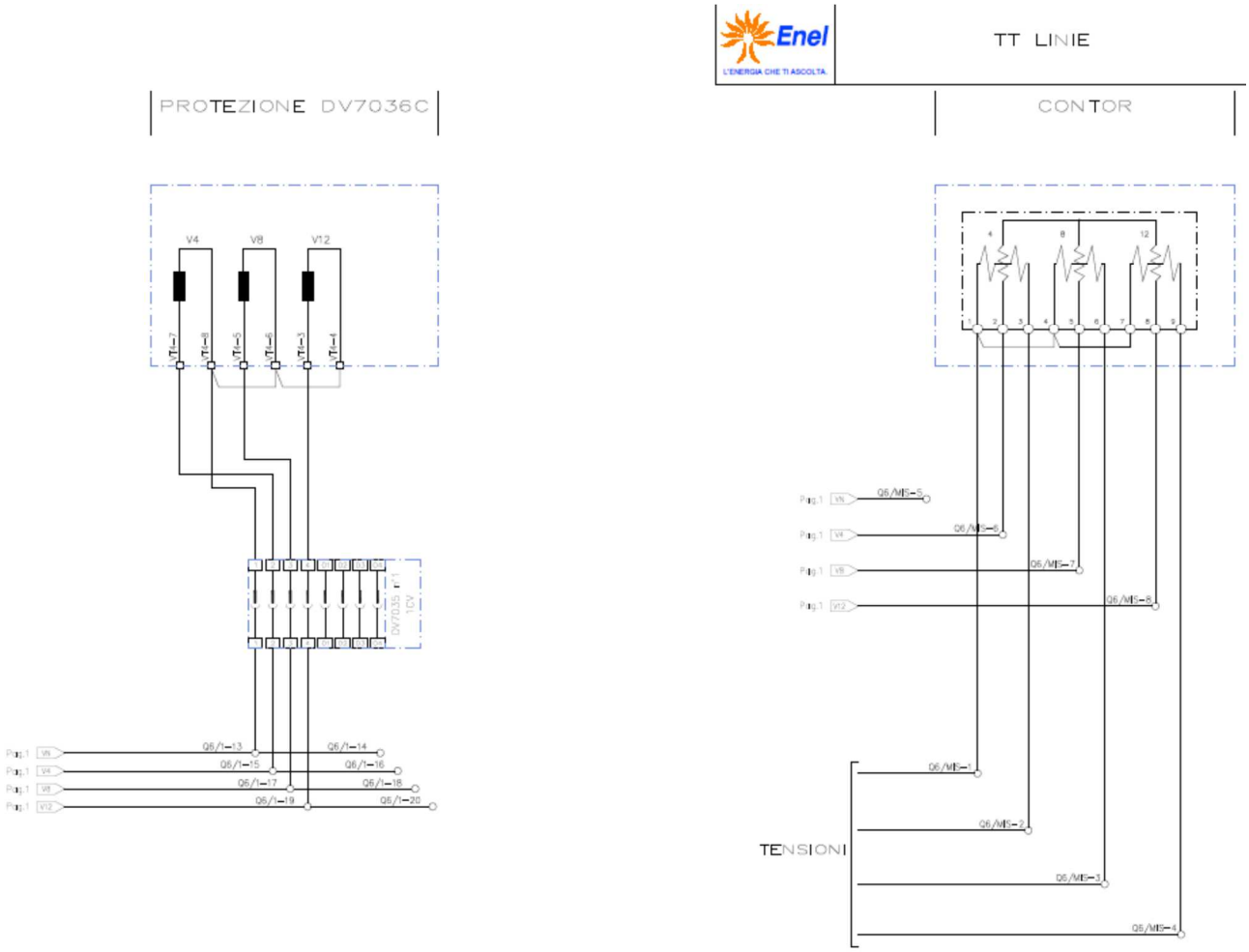

TC TRAFO
MODULO DY106/1 RO-A
TA R
TA S
TA T
R
S
T
TA/TR
DV920A2NCI (1S)
DV933A2NCI (2S)

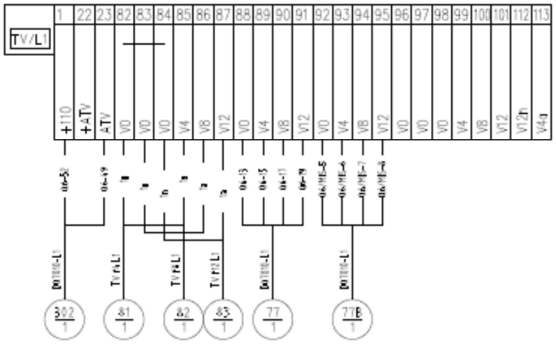

TC TRAFO
PROTEZIONE DV920A2NCI
PROTEZIONE DV6903RO
PROTEZIONE DV933A2NCI


TA/L
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Pdo R 1s1
Pdo R 1s2
Pdo R 1s3
Pdo S 1s1
Pdo S 1s2
Pdo S 1s3
Pdo T 1s1
Pdo T 1s2
Pdo T 1s3
Pdo R 2s1
Pdo R 2s2
Pdo R 2s3
Pdo S 2s1
Pdo S 2s2
Pdo S 2s3
Pdo T 2s1
Pdo T 2s2
Pdo T 2s3
56
F
71
F

TT LINIE


MODULO DY106/1 RO—A
TV R
TV S
TV T
R
S
T
TV R
TV S
TV T
E—TV/
ATV 1
ATV 2
E—TV/
CONTOR
PROTEZIONI

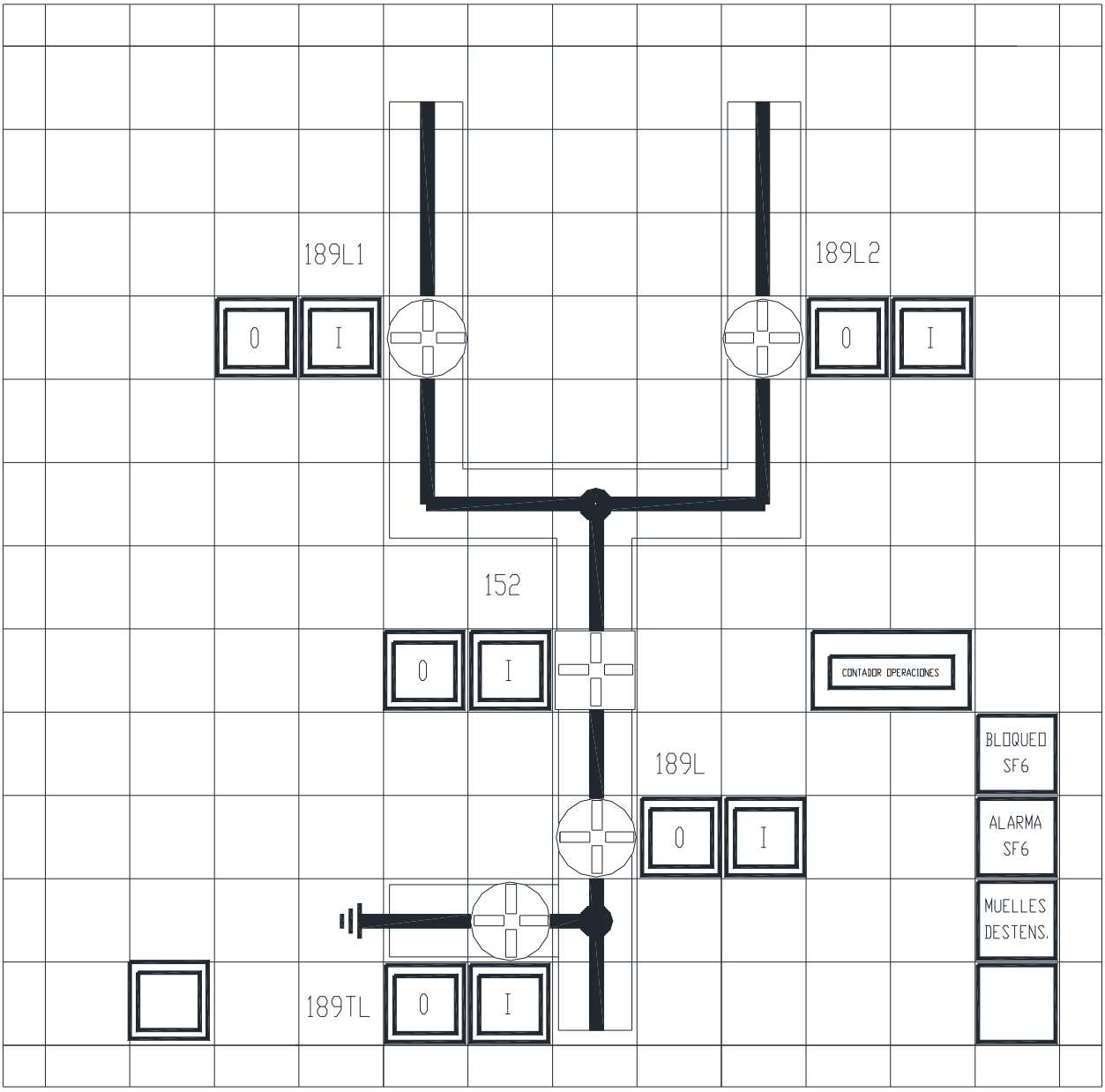

Enel
L'ENERGIA CHE TI ASCOLTA
TT LINIE
PROTEZIONE DV7036C
CONTOR
V4
V8
V12
TENSIONI


TV/LI
1 22 23 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 112 113
+110
+4TV
-4TV
V0
V0
V0
V4
V8
V12
V0
V4
V8
V12
V0
V4
V8
V12
V0
V0
V0
V4
V8
V12
V12h
V4-3
302
81
82
83
77
77B

ANNEX E – SYNOPTIC EXAMPLES

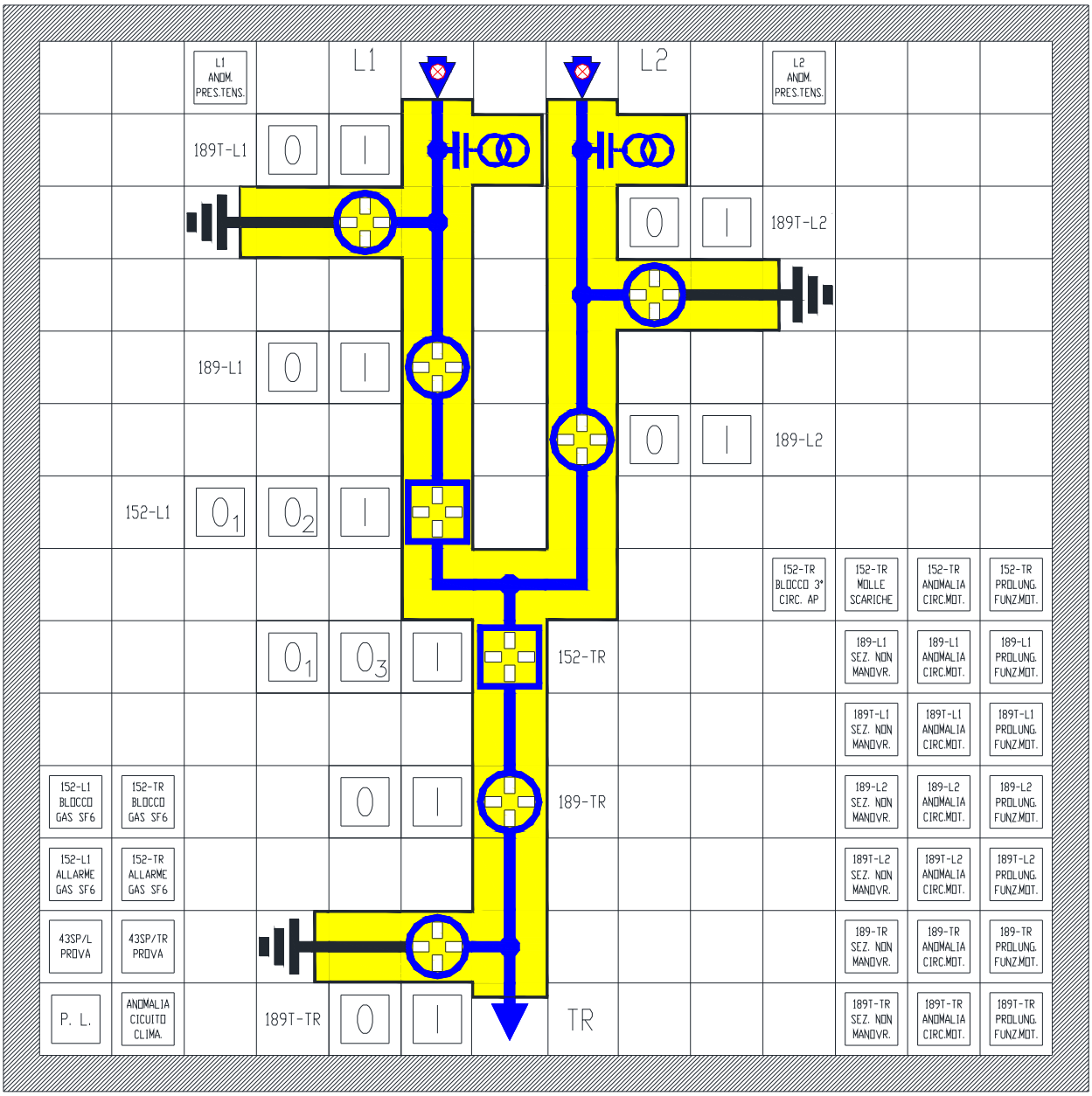
E.1 – ENDESA SYNOPTIC EXEMPLES

Example of Y1 type – used in Line bay

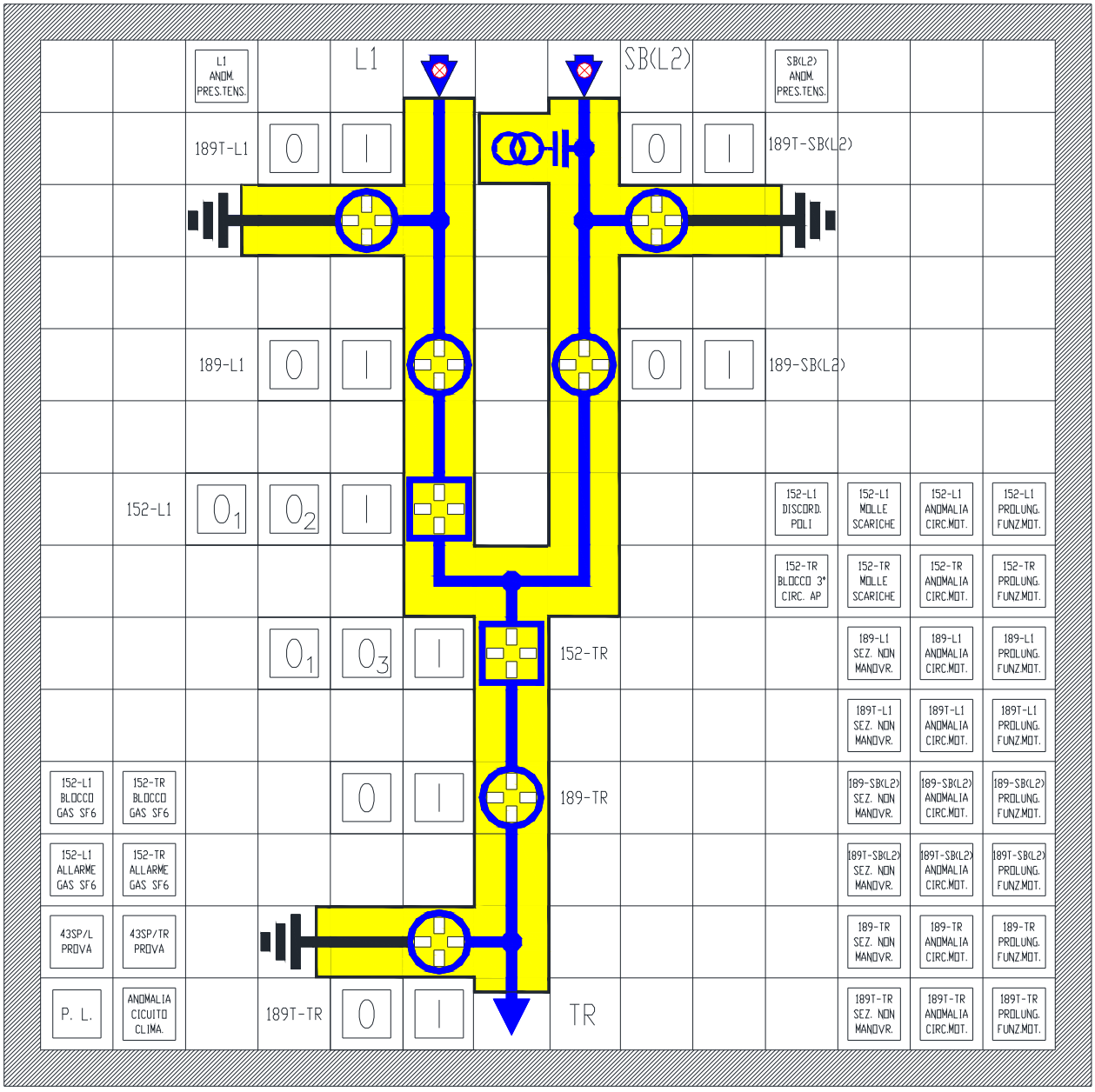


E.2 – ENEL DISTRIBUTIE, ENEL DISTRIBUZIONE AND LATAM SYNOPTIC EXEMPLES

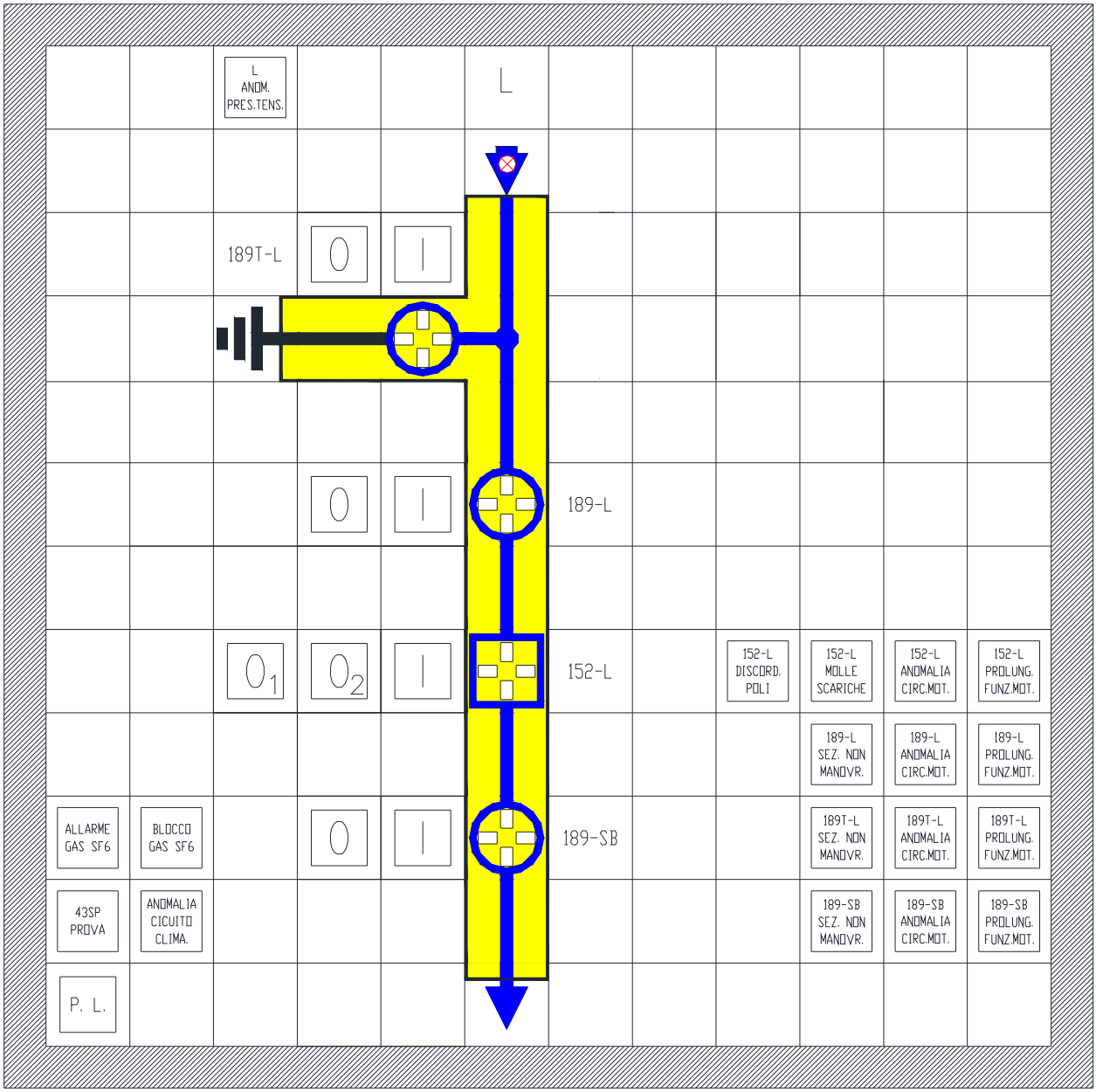
Example of Y1 type: Line 1 bay, Line 2 bay, Transformer bay



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: GSH002 – 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 (- 30 for Romania)	
SPS Class (IEC/TS 60815 series)		d) or e)	
Ice coating (mm)		10 (22 for Romania)	
Seismic qualification level		See table in 4.2.3	
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)	