12/20(24) kV AND 18/30(36) kV SMART TERMINATION

Countries I&N	
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1. SCOPE

The scope of this document is to specify the requirements for Smart Termination to be used in the RETELE ELECTRICE primary or secondary substations. These MV terminations integrate sensors able to measure line current and voltage in order to be interfaced with the RETELE ELECTRICE RGDM (or RGDAT) equipment.

These standard applies to the Distribution Companies of RETELE ELECTRICE listed below:

REȚELE ELECTRICE ROMÂNIA

2. FIELD OF APPLICATION

These requirements apply to the underground distribution network with rated maximum voltage of 24 kV and 36 kV. Other existing rated maximum voltage levels up to 24 kV are covered by the 12/20(24) kV class, whereas those with rated maximum voltage up to 36 kV are covered by the 18/30(36) kV class.

3. REPLACED LOCAL STANDARDS

This standard replaces all the local standards used up to now by all the Distribution Companies.

- REȚELE ELECTRICE ROMÂNIA **:** DJ5400 RO

4. REFERENCE LAWS AND STANDARDS

International standards

- EN 50160
- HD 629-1
- IEC 60603-7-3
- IEC 60695-11-10
- IEC 60721-2-1
- IEC 61000-4-7
- IEC 61238-1
- IEC 61869-10-11
- IEC 62217
- IEC 17067

Standards

- GSC001[1]
- GSCC015
- GSCC005 Rev 3 (Terminations for MV cables)
- GSCC006 Rev.3 (Separable connectors for MV cables)
- GSCT005 (LPITs for RGDM-RGDAT)

Local standards

Romania

- GUI 101 RO

5. TERMS AND DEFINITIONS

See Cenelec HD 629-1 and IEC 61869-1

6. TERMINATION REQUIREMENTS

General

The Smart Termination installation procedure shall be suitable to be easily performed on-field, and its impact on the Smart Termination performances shall be minimized.

In case the sensors are separated components to be assembled on-site, it shall be possible to fix them on the termination body in order to avoid any possible movement that could influence the accuracy and/or the correct operation.

The product shall not require calibration after installation on the cable.

The terminations shall be suitable for all single-phase cables with extruded insulation (paper insulated cables are excluded).

The Smart Termination design and installation procedure shall be suitable for new cables lay-downs in the switchgears and/or for replacement of the possible existing terminations already installed on extruded cables connected in the past to the switchgear. In case of failure or replacement, the terminal should be able to be replaced by minimizing cable cuts

Types of Smart Termination

Type Code	Rated voltage U0/U (Um) (kV)		Type	Description
	12/20(24)	18/30(36)		
GSCC012/1	X		Smart termination	Voltage and current measurement
GSCC012/2		X		
GSCC012/3	X		Plug-in Smart Termination	
GSCC012/4		X		
GSCC012/5	X		Pre-assembly Smart Termination	

Table 1 - Smart Termination types.

Smart Termination

The termination shall be compliant with RETELE ELECTRICE standard GSCC005 rev 3, indoor type. Excluding for the total termination body length (once installed),that shall be minimum 350 mm and maximum 470 mm (instead of maximums described in GSCC005).

Different configurations can be taken into account after dielectric, voltage/current measurements, and dimensional/interface/installation compatibility verifications with the RETELE ELECTRICE standardized MV switchboards and RETELE ELECTRICE RGDM/RGDAT equipment.

Plug-in Smart Termination

The Plug-in termination shall be compliant with RETELE ELECTRICE standard GSCC006 Rev 3. GSCC006/7 and GSCC006/8 Type Codes, Tee (symmetric or asymmetric) shape and interface type C. except for the total termination body length (once installed), that shall be minimum 350 mm and maximum 450 mm (instead of maximum 410 mm).

Different configurations can be taken into account after dielectric, voltage/current measurements, and dimensional/interface/installation compatibility verifications with the RETELE ELECTRICE standardized MV switchboards and RETELE ELECTRICE RGDM (or RGDAT) equipment.

The termination shall be suitable for all single-phase cables with extruded insulation according to GSCC006/7 and GSCC006/8 types codes from GSCC006 Rev 3.

7. ELECTRICAL CHARACTERISTICS

The rated voltage levels of the cables and the frequency of the electrical network for which is foreseen the installation of the smart termination is the following:

Rated voltage of the smart termination U_o/U (U_m) (kV)	**12/20(24)**	**18/30(36)**	**Frequency (Hz)**
Distribution Company (Country)	**Rated voltage of the cables U_o/U (U_m) (kV)**		
REȚELE ELECTRICE ROMÂNIA	12/20(24)	-	50

Table 2 - Rated voltage of the cables and network frequency.

8. SENSOR'S SIGNALS FUNCTIONAL REQUIREMENTS

The output signals from the current and voltage sensors will be processed by the RGDM (or RGDAT) equipment for the following functionalities:

- Detecting polyphase and phase-to-ground faults, with insulated or grounded by impedance neutral
- detecting line voltage absence
- measuring voltage and active and reactive power on the MV line
- measuring voltage and current THD (for PQ monitoring purpose)
- driving the circuit breaker opening and closing in case of faults or remote control commands
- interfacing with the MV grid generators in order to coordinate the line voltage regulation and the remote disconnection signals.

9. GENERAL SENSORS REQUIREMENTS

a. Applicable standards

The sensors shall be fully compliant with RETELE ELECTRICE standard GSCT005.

When applicable, the sensors shall be compliant with the IEC 61869-11 and IEC 61869-10.

b. Connections

The RGDM side of the connection cable shall be provided with an RJ45 connector (compliant with IEC 606037-3) that shall pass through a hole of 22 mm, the Pins assignations [2]for RJ45 connector shall be compliant with the GSCT005.

The sensors shall be provided with a suitable shielded connection cable(s) for the RGDM or (RGDAT). Such connection cable length shall be compliant with table 3 from cable outlet point on termination body up to the RJ45 edge.

The VT secondary terminal intended to be earthed shall be internally connected to the termination shield, by ensuring a reliable and safe connection. The connection method, for ground connection or signals, shall be in compliance with IEC 60352-2.

For the signal cable, no interruptions must be foreseen (e.g. connectors are not allowed), and any alternative solution must be discussed with RETELE ELECTRICE and validated by RETELE ELECTRICE. In any case, a signal cable shield shall be grounded with a reliable and safe connection.

No special tools shall be required for the assembly of ground or signal connection, even in the event of the conductor being pulled out of the connector

The termination shall be provided of a yellow-green cable of proper section and length for the termination shield connection to a grounding terminal present in the MV switchboard. For further details, refer to standard GSCT005.

10. ACCURACY SENSORS REQUIREMENTS

a. GENERAL

The requested accuracy can be reached either by the sensors itself (without electronic compensation) or considering a constant *Actual transformation ratio* (*Vka* and/or *Ika*) and/or a constant *phase shift (*Vk_a and/or Ik_a*)*, to be declared on the rating plate.

The accuracy shall be verified also with the maximum operating temperature expected for the installation solution, considering the heating of cables, busbars, terminations, etc., as well as the maximum ambient temperature (see the temperature category shown in the GSCT005.).

The accuracy shall be intended at the RGDM/RGDAT side terminals of the connection cables.

b. Current accuracy

The current accuracy of each sensor shall be compliant with the GSCT005 and shall be able to measure according to the frequency of the electrical network of each country, which is specified in table 2.

[2] A different pin assignation could be requested by RETELE ELECTRICE within the start of the TCA process.

c. Voltage accuracy

The voltage accuracy of each sensor shall be compliant with the GSCT005.

d. PQ monitoring accuracy

For PQ monitoring purpose (THD measurement), the current and voltage harmonics accuracy is shown in the next table (according to EN 61000-4-7):

Accuracy class	Percentage (ratio) error (+/-) at harmonics shown below		Phase error (+/-) at harmonics shown below (degrees)	
Special quality metering	1st to 2nd harmonic	3rd to 50th harmonic	1st to 2nd harmonic	3rd to 50th harmonic
	1%	5%	1	5

Table 4 - PQ monitoring accuracy.

11. TESTING

a. General

Type tests shall be performed on a fully assembled termination.

The tests on sensors shall be performed considering as secondary terminals the RGDM side of the connecting cable.

If due to the manufacturing process is not possible to perform some routine test on the finished product, or they could be performed only with reduced levels (e.g. for dielectric tests), the manufacturer shall communicate to RETELE ELECTRICE both dates (for routine test performable only on the semi-finished product and for routine test performable on the finished product): if RETELE ELECTRICE will not attend the first date, the manufacturer will provide the relevant test reports in occasion of the second date.

All the routine tests indicated herein shall be carried out by the supplier on all the samples of which the batch is composed. For each piece that belongs to the prepared batch, the supplier shall prepare a test report with the results of the tests performed.

b. Voltage sensor type testing

The voltage sensors shall be compliance with GSCT005. All the test indicated according to table 10 of IEC 61869-11, with the following special considerations:

Description	Test Method	Notes
Test for accuracy	§7.2.6 Standard IEC 61869-11	Including harmonics accuracy verification for the accuracy versus temperature, the verification steady-state conditions are the followings (no cycles are required): lower temperature without current; higher temperature with I_{pr} flowing in the terminal
Temperature - rise test	§7.2.2 Standard IEC 61869-11	For the overheating withstand capability test, the overheating due to the rated primary current shall be considered, therefore the test shall be executed with I_{pr} flowing in the terminal

Table 5 - Voltage sensor type testing, special considerations.

c. Voltage sensor routine test

N°	Description	Test Method
1	Accuracy Test[3]	§7.2.6 Standard IEC 61869-11

Table 6 -Voltage sensor routine test

11.4 Current sensor type testing

The Current sensors shall be compliance with GSCT005. All the test indicated according to table 10 of IEC 61869-10, with the following special consideration:

Description	Test Method	Notes
Accuracy Test[3]	§7.2.6 Standard IEC 61869-10	Including harmonics accuracy verification.

Table 7 - Current sensor type testing, special considerations.

11.5 Current sensor routine test

N°	Description	Test Method
1	Accuracy Test[3]	§7.2.6 Standard IEC 61869-10

Table 8 -Current sensor test

11.6 Termination testing

The Smart Termination for all types shall be tested in accordance with HD 629-1. Lugs shall be tested according to IEC 61238-1 class A.

11.7 Type test and Routine test on the overall component

Description	Type Test	Routine Test
1. Visual check and constructive characteristics check.	**X**	**X[4]**
2. Impulse voltage withstand test for low-voltage components[5].	**X**	
4. Power-frequency withstand test on primary terminals and partial discharge measurement[5]	**X**	**X**
3. Power-frequency voltage withstand test for low-voltage components[5]	**X**	**X**
4. Verification of terminal markings.	**X**	**X**

Table 9 -Test on the overall component

[3] Included the verification of deviation requirement. The following verifications are not required: test for accuracy vs temperature; test for accuracy vs frequency.
[4] Including verification of correspondence to the approved prototype.
[5] In accordance with IEC 61869-11.

11.8 Special test - accuracy versus ageing verification

In order to verify the accuracy stability versus the ageing, after the “Heating Cycles Voltage Test” and the “Humidity Test” requested by HD 629-1 (see 11.4) the current and voltage sensors errors shall not differ from those recorded before the tests by more than half the limits of error in their accuracy classes.

11.9 Integration test

RETELE ELECTRICE will perform integrations tests in its laboratories to verify correct operation of the whole system, i.e. sensors connected to the RGDAT/RGDM protection devices. This shall be considered for both current and voltage sensors.
In the following table integration test are listed.

N°	TEST	Test Method
1	Accuracy level, with particular reference to the measured zero-sequence (residual) current and voltage	Standard GSCT005.
2	Sensor impedance measurement	Standard GSCT005.
3	Transient response	Standard GSCT005.
4	Noise measurement	Standard GSCT005.
5	Harmonic response and accuracy level with harmonics	Standard GSCT005.
6	Common-mode voltage and effect on the differential voltage test, in any condition, also with a connected RGDAT/RGDM	Standard GSCT005.
7	Other tests that Enel considers necessary	Standard GSCT005.

Table 10 -Integration test

11.10 Acceptance test

The acceptance tests when performed in RETELE ELECTRICEl's presence shall be carried out on a sample chosen randomly among those ones of the batch that has already been successfully tested by the supplier during the routine tests. The sampling plan for the routine tests repetition (acceptance tests) shall be in accordance to the ISO 2859-1, single sampling, normal inspection, LQA 1, general inspection level I.
The acceptance tests of the sensors that are performed through an automatic testing system (ATS) shall include a report with the outcome of the automatic tests for each device.
The power-frequency withstand tests on the overall component shall be carried out on 1 sample of each component type. The network frequency at which the tests shall be carried out are indicated on Table 2. For each material code, acceptance tests shall be carried out using the smallest cable section for each rated voltage of the cable.

11.11 RETIE

The Smart Termination shall be provided with 2 labels containing the following information (see chapter 13 for details about their location):

- Country , RETELE ELECTRICE type code (See Table 1) and Country code (see chapter 14 as reference)

- Manufacturer name
- Manufacturer product designation
- Manufacturer serial number
- Frequency (50 Hz or 60 Hz)
- Highest voltage for equipment (U_m)
- Rated primary current (I_{pr})
- Rated voltage transformation ratio (Vkra)
- Actual voltage transformation ratio (Vka) (if applicable)
- “Coefficiente di calibrazione tensione” (=Vkra/Vka, 5 digits)
- Voltage phase shift (V^0N) (if applicable) (resolution 0,025°)
- Rated current transformation ratio (Ikra) (if applicable)
- Actual current transformation ratio (Ika) (if applicable)
- “Coefficiente di calibrazione corrente” (=Ikra/Ika, 5 digits)
- Current phase shift (I^0N) (if applicable) (resolution 0,025°)
- Rated auxiliary power supply voltage (U_{ar}) (if applicable)
- The bar code, in accordance with PVR006.

Each single Smart Termination shall be provided with 2 rating plates (one on the termination body and one on the RJ45 connector) containing at least the following information:

- Country , RETELE ELECTRICE type code (See Table 1) and Country code (see chapter 14 as reference)
- Manufacturer name
- Manufacturer product designation
- Manufacturer serial number
- The bar code, in accordance with PVR006.

12. SUPPLY REQUIREMENTS

A detailed installation instruction manual and a video demo shall be provided.
Each Smart Termination packing shall contain a termination, all the materials necessary for its assembly, the installation instruction manual and 2 rating plate labels (one inside the packing, attached to the installation instruction manual, and one outside, attached on the packing).
The guarantee and barcode data requested by PVR001 and PVR006, for each supplied Smart Termination the supplier shall provide an electronic file with the following information:

Country , RETELE ELECTRICE type code (See Table 1) and Country code (see chapter 14 as reference)

Manufacturer name

Manufacturer product designation

Manufacturer serial number

Frequency (50 Hz or 60 Hz)

Actual voltage transformation ratio (Vka) (if applicable)

“Coefficiente di calibrazione tensione” (=Vkra/Vka, 5 digits)

Voltage phase shift (V^0N) (if applicable) (resolution 0,025°)

Actual current transformation ratio (Ika) (if applicable)

“Coefficiente di calibrazione corrente” (=Ikra/Ika, 5 digits)

Current phase shift (I^0N) (if applicable) (resolution 0,025°).

13. LIST OF COMPONENTS

The list of components included in this standard is reported in the following tables for 12/20(24) kV and 18/30(36) kV rated voltages:

Distribution Company (Country)	**Type**	
	GSCC012/1	
REȚELE ELECTRICE ROMÂNIA	270025	-
Cable section (mm^2)	95 - 240	400
Rated voltage *Uo/U (Um)* (kV)	See Table 2	
Min/max diameter over insulation (mm)	20.6/32.2	31/37.5

Table 11 - Material codes for smart termination 12/20(24) kV

Distribution Company (Country)	**Type**	
	GSCC012/3	
REȚELE ELECTRICE ROMÂNIA	270026	-
Characteristics of the cable		
Cable section (mm^2)	95-240	400
Rated voltage *Uo/U (Um)* (kV)	See Table 2	
Min/max diameter over insulation (mm)	20.6/32.2	31/37.5

Table 13 - Material codes for 12/20(24) kV separable connectors (Plug-in Smart Termination)

Distribution Company (Country)	**Type**	
	GSCC012/4	
REȚELE ELECTRICE ROMÂNIA		-
Characteristics of the cable		
Cable section (mm^2)	95-240	400
Rated voltage U_o/U (U_m) (kV)	See Table 2	
Min/max diameter over insulation (mm)	24.8/37.2	34.9/42.5

Table 14 - Material codes for 18/30(36) kV separable connectors (Plug-in Smart Termination)

14. PRE-ASSEMBLED SMART TERMINATION.

The preassembled smart termination shall be made by a piece of cable (connection cable) preassembled with a certain type of smart termination (See Figure 1).

The free end of the cable shall be properly protected through insulation caps.

The connection cable shall be prepared in the factory by the supplier according to smart termination instructions and in compliance with all requirements herein and GSCT005.

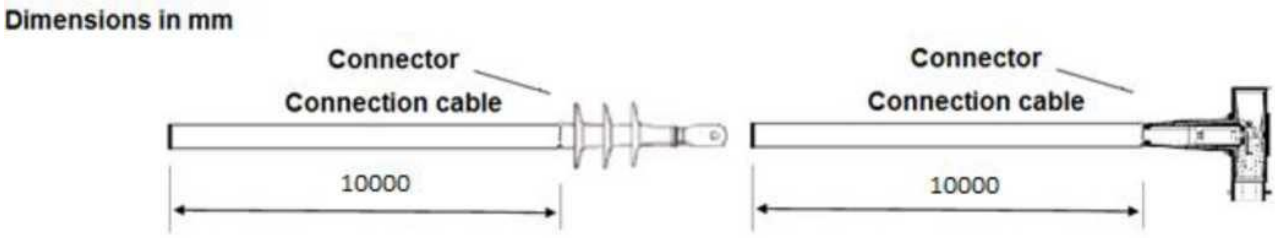


Fig 1. Preassembled smart termination types (Not bidding) measure in mm.

15.1 Connection Cable

Design and manufacturing of the cables shall be according with IEC-60502-1, with the characteristics of the table below:

	12/20 (24) kV
Conductor Material	Copper
Conductor cross-section	150 (mm^2)
Conductor screen	Black semi-conductive cross-linkable compound
Insulation	HEPR
Insulation thickness	4,85 mm min. - 5,5 mm avg.
Insulation screen	Easy strippable Black semi-conductive cross-linkable compound
Earth screen	Continuous crown annealed copper wires
Earth screen cross-section	25 mm^2
Outer sheath	PVC

Table 15 - Connection Cable characteristics

15.2 Types

The following types of reparation joints are defined:

15.3 Tests

The connection cable shall be tested in compliance with IEC-60502-1. The Smart termination shall complete successfully a TCA process in compliance with GSCG002 and according to the requirements specified in GSCC012.

Acceptance tests shall be performed on the preassembled smart termination i.e. with the connection cable and smart termination according to the requirements specified in GSCC012.

15. COMMON LIST

GS Type Code	Distribution Company and Country	Country Code	TAM Description
GSCC012/1	REȚELE ELECTRICE ROMÂNIA	270025	TERMINAL SMART 95-240 24KV GSCC012/1
GSCC012/3	REȚELE ELECTRICE ROMÂNIA	270026	TERMINAL SMART 24 kV GSCC012/3

Table 17 - Common List