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## OUTDOOR VOLTAGE TRANSFORMERS UP TO U<sub>m</sub> 36 kV

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Revision	Data	List of modifications
02	24/11/2016	4.3 Added particular local seismic requirements - 5 Updated names of local DSOs, weights as indicative values and local specific seismic requirements – 7.2.7 Added the type test for local seismic requirements by analytic demonstration - 7.4.3 Updated reference standard for ageing test
01	22/04/2016	Modification of the main characteristics and updating of the whole document
00	21/01/2016	First emission


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## 1 SCOPE

This document prescribes the technical characteristics, the performance and the testing methods for outdoor Voltage Transformers (VT) to be used in the distribution network up to 36 kV of the Enel Group Distribution Companies located in the countries listed below:

- Argentina
- Brazil
- Chile
- Colombia
- Iberia
- Italy
- Peru
- Romania

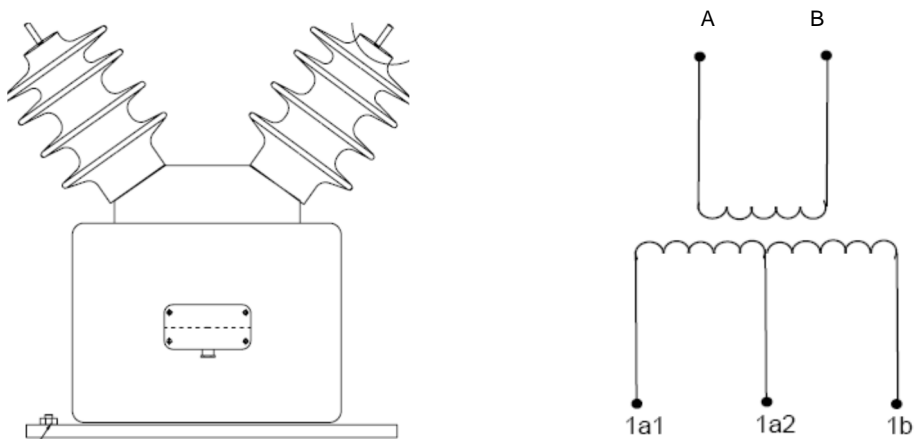
## 2 APPLICATION FIELD

This document applies to Voltage Transformers to be used for power supply of the auxiliary services for the remote control in the Enel Group distribution networks up to 36 kV.


## 3 LIST OF COMPONENTS

The components are identified with the Global Types indicated in the table reported in clause 5 of this document.

The global types are associated with the country codes (identification numbers) for the relevant country of application.



Examples of Voltage Transformer and electrical scheme

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## 4 REFERENCE LAW AND STANDARDS

### 4.1 Laws

#### 4.1.1 Argentina

No specific documents reported.

#### 4.1.2 Brazil

NR-10 - segurança em instalações e serviços em eletricidade.

#### 4.1.3 Chile

NSEG 5. E.n.71 - Reglamento de Instalaciones Eléctricas de Corrientes Fuertes.

#### 4.1.4 Colombia

RETIE - Reglamento Técnico de Instalaciones Eléctricas.

Ley 400 de 1997 - Reglamento Colombiano de Normas sismo-resistentes.

#### 4.1.5 Italy

D.Lgs n. 81 of the 9<sup>th</sup> of April 2008 and subsequent modifications.

#### 4.1.6 Perú

Código Nacional de Electricidad Suministro.

#### 4.1.7 Romania

Legea securității și sănătății în muncă nr.319/2006, cu modificările și completările ulterioare.

#### 4.1.8 Spain

R.D. 614/2001, de 8 de junio, sobre disposiciones mínimas para la protección de la salud y seguridad de los trabajadores frente al riesgo eléctrico.

R.D. 337/2014, de 9 de mayo, por el que se aprueban el Reglamento sobre condiciones técnicas y garantías de seguridad en instalaciones eléctricas de alta tensión y sus Instrucciones Técnicas Complementarias ITC-RAT 01 a 23.

R.D. 223/2008, de 15 de febrero, por el que se aprueban el Reglamento sobre condiciones técnicas y garantías de seguridad en líneas eléctricas de alta tensión y sus instrucciones técnicas complementarias ITC-LAT 01 a 09.


### 4.2 Standards

#### 4.2.1 International standards

The reference documents listed below shall be intended as the edition in force.

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

Standard	Edition
IEC 61869-1	2010-07
IEC 61869-3	2012-07
IEC 60660	1999
IEC 60529 + AMD1 + AMD2	1989 + 1999 + 2013
IEC TS 60815	2008

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### 4.3 Particular local seismic requirements

#### 4.3.1 Chile

- ETGI-1020 - Especificaciones técnicas generales – Requisitos de diseño sísmico para equipo eléctrico
- DMAD-0184 - Poste de hormigón armado 13,5 m.

#### 4.3.2 Colombia

- NSR – 10 - Norma Sismo Resistente Colombiana

#### 4.3.3 Peru

- E-SE-010 - Acción sísmica en equipos eléctricos y mecánicos

#### 4.3.4 Romania

- P100-1 2006 – Code de proiectare seismică




5 MAIN CHARACTERISTICS

Global types associated with country codes, main ratings, requirements and service conditions prescribed are indicated in the following:

MAIN CHARACTERISTICS

GLOBAL TYPE	GSCT004/1	GSCT004/2	GSCT004/3	GSCT004/4	GSCT004/5	GSCT004/6	GSCT004/7	GSCT004/8	GSCT004/9	GSCT004/10	GSCT004/11	GSCT004/12	GSCT004/13	GSCT004/14
COUNTRY CODE	6813065	6813066	6813861	6813862	6813290	6812994	0102-1918	0102-1919	53 45 22	53 45 21	653259	-	-	-
COUNTRY	Brazil	Brazil	Colombia	Colombia	Chile	Peru	Argentina	Argentina	Italy	Italy	Romania	Spain	Spain	Spain
DSO	Enel D. Rio Enel D. Ceará	Enel D. Rio	Codensa	Codensa	Chilecira	Etelhor	Edesur	Edesur	e-distribuzione	e-distribuzione	Erel Distributie	Endesa Distribucion	Endesa Distribucion	Endesa Distribucion
Rated Primary Voltage (kV)	13,8-11,4	34,5	34,5	13,2-11,4	23-12	20-10	13,2	33	20-15	10	20-10	20-15	13,2-10	25
Rated Secondary Voltage (kV)	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Insulation level $U_m$ (AC/LI) (kV)	17,5/38/95	36/70/170	36/70/170(*)	17,5/38/95(*)	24/50/125	24/50/125	17,5/38/95	36/70/170	24/50/125	12/28/75	24/50/125	24/50/125	24/50/125	36/70/170
Rated Frequency (Hz)	60	60	60	60	50	60	50	50	50	50	50	50	50	50
Rated power / Accuracy class	100VA/3 and 250VA/6P - No contemporarily and to be referred to both voltage ratios, if any													
Thermal limiting output (VA)	To be reported in the rating plate (for each rated ratio, if any)													
Rated Voltage Factor	1,5 x 30 sec													
Degree of protection	IP 44 - IEC 60529													
Pollution IEC/TS 60815 - SPC Class	e (very h.)	e (very h.)	c (medium)	c (medium)	c (medium)	e (very h.)	c (medium)	c (medium)	d (heavy)	d (heavy)	d (heavy)	e (very h.)	e (very h.)	e (very h.)
RUSCD (mmikV)	53,7	53,7	34,7	34,7	34,7	53,7	34,7	34,7	43,3	43,3	43,3	53,7	53,7	53,7
Relative humidity	98%	98%	98%	98%	98%	98%	98%	98%	95%	95%	95%	95%	95%	95%
Ambient air temperature (°C)	-10/50	-10/50	-10/50	-10/50	-10/50	-10/50	-10/50	-10/50	-25/40	-25/40	-30/40	-25/40	-25/40	-25/40
Altitude a.s.l. (m)	1000	1000	2700	2700	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Specific seismic requirements			YES	YES	YES	YES					YES			
Overall dimensions	Up to $U_m$ 24: max 320 x 550 h 600 mm - Up to $U_m$ 36: max 320 x 600 h 700 mm													
Fixing dimensions	Slots interaxis: 200 x 270 mm (see relevant clause)													
Weight (indicative values)	Up to $U_m$ 24: 50 kg - up to $U_m$ 36: 70 kg													
Primary terminal connections	Type A	Type A	Type A	Type A	Type A	Type A	Type A	Type A	Type A	Type B	Type B	Type B	Type B	Type B

(\*) These values shall be guaranteed at 2700 m above sea level or at  $U_m$  86,2/209,4 kV for GSCT004/3 and at  $U_m$  46,8/117 kV for GSCT004/4 at 1000 m a.s.l. (IEC 60137 clause 5.2-Altitude correction factor)

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Network neutral system: can be isolated, resonant earthed, solidly earthed or earthed by resistance or impedance

Ferroresonance: to prevent ferroresonance phenomena a Voltage Factor of  $1,5 \times 30$  s is prescribed and moreover the induction value shall be  $\leq 1,3 \text{ Wb/m}^2$  at the rated primary voltage or at the higher one in case of dual voltage

Dual Voltage: to be made by a tap on the secondary winding

Notes: - To take in account the influence of special service conditions prescribed in the above reported table correction factors shall apply in accordance to the international standard.  
- The manufacturer can made the same component to cover more than one global types taking into account an extended range of frequency, service conditions and terminal clamping.

## 6 DESIGN AND CONSTRUCTION REQUIREMENTS

### 6.1 General

Outdoor Voltage Transformers are generally insulated with cycloaliphatic epoxy resin moulded in one single process under vacuum.

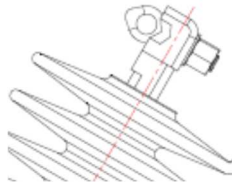
### 6.2 Primary terminals

The primary terminals of the VT shall be made in anticorrosion material and suitable for the connection of naked conductors.

As prescribed in the table with the main characteristic the type of connection for the primary terminals shall be in accordance with type A or type B described in the following:

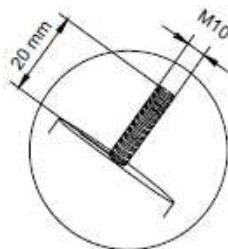
#### Type A - Clamp type

Made in anticorrosion material (tinned) with a clamp adapter of bi-metallic anticorrosion material and suitable for conductor of  $16 \div 70 \text{ mm}^2$ .




#### Type B - Treaded M 10÷12 x 20 mm

Supplied with nuts and washers made of anticorrosion material and included in the supply.





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### 6.3 Secondary terminals

The secondary terminals shall be realized with M 6 screws, suitable for conductor of  $2,5 \div 16 \text{ mm}^2$ .

### 6.4 Mechanical resistance of the terminals

The primary and secondary terminals fixed on the resin shall be designed to withstand the mechanical stresses indicated in the following table:

Thread diameters (M)	Tightening torque (Nm)
6	3,0
10	10,0
12	15,0

### 6.5 Box of the secondary terminals

The terminals box must have a level of protection not lower than IP 44 according to IEC 60529 and it shall be equipped with a cable gland for the passage and the locking of a cable with outer diameter of 16 mm.

### 6.6 External ferrous material

External ferrous material, if any, shall be galvanized in accordance with relevant international standard.

### 6.7 Rating plate

The nameplate shall include all the indications required by the IEC.

### 6.8 Primary terminal markings

According to IEC 61869-3.

### 6.9 Secondary terminal markings

According to IEC 61869-3.

### 6.10 Electrical scheme

According to IEC 61869-3.

### 6.11 Cable for the connection of the secondary terminals

The VT shall be provided with a cable for the connections of the secondary.


This cable shall be included in the supplying and shall have the following characteristics:  $2 \times 2,5 \text{ mm}^2$ , length 15 m, double insulation level 0,6 - 1 kV, suitable for outdoor installation.

### 6.12 Manual and packaging

For each VT the manual for installation and operation, in the language of the Country to be delivered, shall be provided. It shall also include the procedures to be adopted for storage, transportation and dismantling.

Packing for transportation and storage (which does not take part in the homologation process) shall be compliant to the documents referring of each Country.

The primary terminal bushings shall be protected in a suitable way to protect them from impacts that may damage them.

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## 7 LIST OF TESTS

### 7.1 General

The type, routine and special tests shall be performed in accordance to IEC 61869-1 and IEC 61869-3 with the additional special tests prescribed in the following, if not otherwise stated.

### 7.2 Type tests

#### 7.2.1 Verification of the compliance to this technical specification

The characteristics of the components, including ratings and design requirements, shall be in compliance with this technical specification.

The visual inspection shall be performed to verify the absence of imperfections and defects.

#### 7.2.2 Temperature rise test

The test shall be performed in accordance with IEC 61869-3 and the prescribed rated power values.

#### 7.2.3 Impulse voltage withstand test on primary terminals

The test shall be performed in accordance with IEC 61869-3.

#### 7.2.4 Wet test for outdoor type transformers

The test shall be performed in accordance with IEC 61869-3.

#### 7.2.5 Test for accuracy

The test shall be performed in accordance with IEC 61869-3.

Moreover a magnetizing current graph shall be measured to determine the B/H graph in order to verify the requirement on the induction value (by referring to design data).

#### 7.2.6 Short-circuit withstand capability test

The test shall be performed in accordance with IEC 61869-3.

#### 7.2.7 Verification of local seismic requirements

The local seismic requirements indicated in table of clause 5 shall be demonstrated with an appropriate analytic method in accordance with the local requirements specified in 4.3.

### 7.3 Routine tests

#### 7.3.1 Visual inspection

The visual inspection shall verify the compliance with this technical specification and the approved prototype and the absence of imperfections and defects.

#### 7.3.2 Power-frequency voltage withstand tests on primary terminals


The test shall be performed in accordance with IEC 61869-3.

#### 7.3.3 Partial discharge measurement

The test shall be performed in accordance with IEC 61869-3.

#### 7.3.4 Power-frequency voltage withstand tests between sections

The test shall be performed in accordance with IEC 61869-3.

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### 7.3.5 Power-frequency voltage withstand tests on secondary terminals

The test shall be performed in accordance with IEC 61869-3.

### 7.3.6 Test for accuracy

The test shall be performed in accordance with IEC 61869-3.

The error at  $F_v 1,5$  shall be checked on each voltage transformer.

### 7.3.7 Verification of markings

The test shall be performed in accordance with IEC 61869-3.

### 7.3.8 Mechanical test on terminals

The stresses prescribed in this specification shall be applied without any breaking or deformation on the terminal parts.

### 7.3.9 Verification of the coating of the external ferrous material

The coating of external ferrous material, if any, shall be verified in accordance with relevant international standard.

## 7.4 Special tests

### 7.4.1 Fire test

The test shall be performed in accordance with IEC 60660 or, alternatively, with the following procedure:

- The flame of an oxyacetylene torch shall be applied to the organic material surface with an angle of 45 °. The fuel flow shall be of 100 l/h and the point of the blue region of the flame shall be in contact with the material under the test, avoiding, as much as possible, to address the flame nozzle to the corners or to the edges of the object under test.
- The flame shall be applied for 15 s and shall be removed for other 15 s. This cycle shall be repeated five times in sequence.
- The test may be considered with positive result if the potential burning of the material is extinguished within 60 s from the last removal of the flame, and dripping phenomena are not observed (small breaks or cracks of the specimen are acceptable).

### 7.4.2 Temperature variation test

The test shall be performed in accordance with IEC 60660.

The temperature variation shall be performed with the thermal cycles described in IEC 60660 art. 3.13.


The assessment of the result of the test shall be performed without the application of any mechanical load, by a visual inspection of the absence of cracks and by the industrial frequency withstand test (see Item 7.3 of this regulation) at the 80% of the prescribed voltage value.

### 7.4.3 Accelerated environmental-electric aging test

The voltage transformers shall pass the two tests of IEC 62217 stated in paragraph 9.3.2 and 9.3.3, this last with duration of the test extended to 5000 hours. Different tests performed with the procedures indicated in the previous version of IEC 61109 can be taken into consideration.

The phase-phase VT shall be supplied as in service. The phase voltage value prescribed for the test shall be applied between each terminal and ground (with a three-phase system).

In alternative, the test can be performed with a single-phase system by applying the value of the phase-to-phase voltage to one terminal and connecting the other terminal to ground.

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## 8 DOCUMENTATION

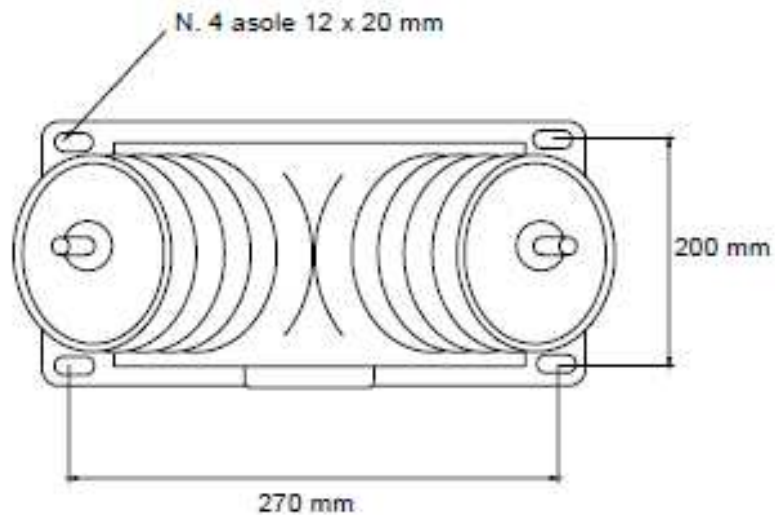
The documentation for the approval of the prototypes shall be arranged in accordance with the specific procedure for the Technical Conformity Assessment.

For the delivering generally the VT shall be supplied with the following documentation:

- Drawings of the VT with overall dimensions, primary and secondary terminals arrangement
- Rating plate
- Tests report
- Declaration of conformity to this technical specification and IEC 61869-1 and IEC 61869-3
- Manual for installation and operation with clear indication for the secondary terminals connections, particularly in case of dual ratio

## 9 OVERALL DIMENSIONS AND WEIGHTS

The overall dimensions are reported in the table with the main characteristics. The fixing dimensions are detailed in the following drawings.



The indicative weights are reported in table of clause 5.