

 NTC/SMT/TCI	LVM CONCENTRATOR MANUFACTURING AND ASSEMBLY	DMI A B 000255
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LOW VOLTAGE MANAGER MANUFACTURING AND ASSEMBLY

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1. SCOPE

This document describes the manufacturing and assembly of the LVM concentrator for mass market customers meter reading system.

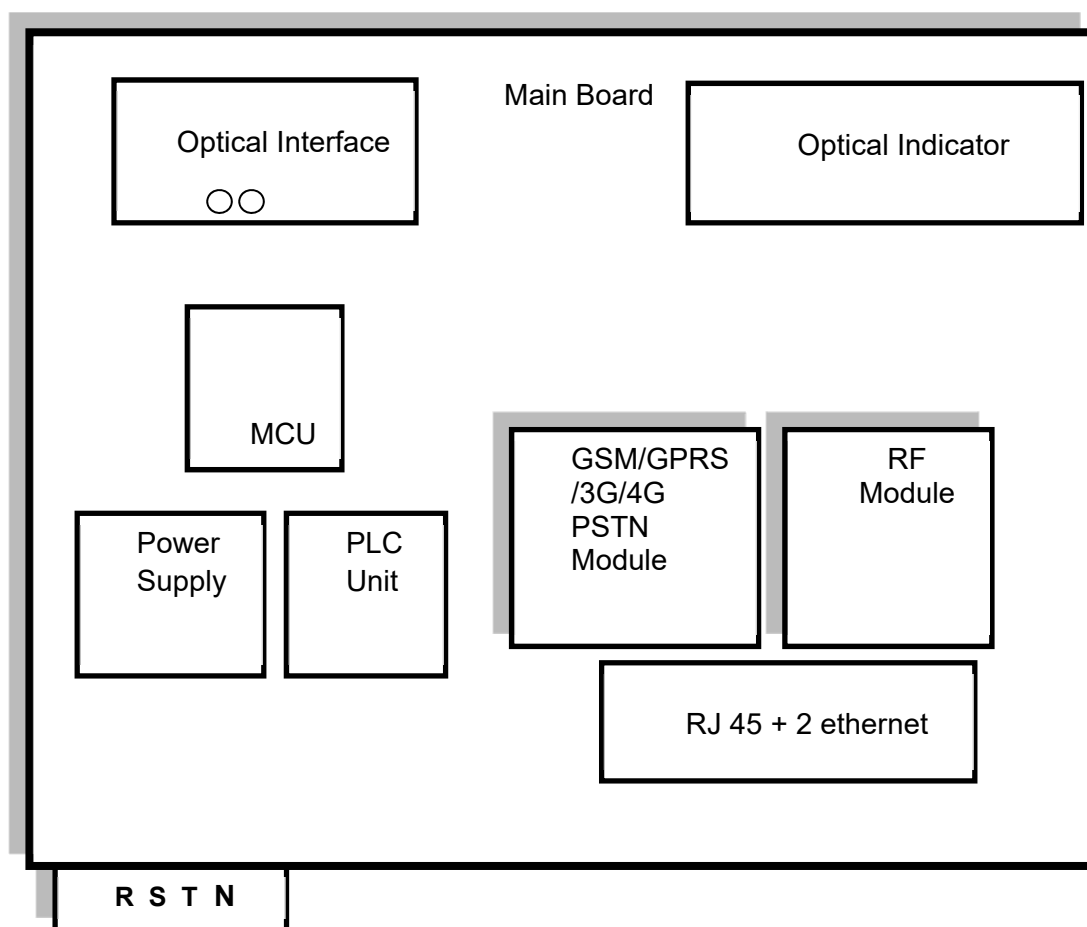
This device must be designed for indoor installation (MV/LV substation). For outdoor or pole installation a suitable enclosure will be adopted. Each LVM concentrator communicates with the control server via public telecommunication networks (GSM, GPRS, 3G, 4G, PSTN, etc.) and with meters by Power line communication, in point to multi-point architecture; and eventually using a RF communication.

The concentrator design, manufacturing and assembly, must guarantee a suitable flexibility to allow product's evolutions and replacement of internal modules for function enhancements or maintenance purposes. The apparatus has to operate on 400Vac@50Hz (3 x 230Vac) main power system.

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The description covers the main parts of the equipment, as shown in the following block diagram:



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1. main board
 - a. MCU
 - b. Power supply
 - c. PLC unit
 - d. Optical interface
 - e. Optical indicator
 - f. Terminal block for connection
2. GSM/GPRS/3G/4G module (which may be integrated into the same assembly or connected as a separate devices.)
3. RS 232 Port
4. 2 Ethernet Ports
5. Optional RF Module
6. Case and mechanical assembly

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2. Reference document

Reference must be done to the most recent releases of the below listed standards and ENEL internal prescriptions, at the time of this publication.

- CEI EN 62056-21 Data exchange for meter reading, tariff and load control - Direct local data exchange
- CEI EN 60529 Degrees of protection provided by enclosures (IP Code)
- CEI EN 50160 Characteristics of the voltage supplied by the public network power supply distribution
- CENELEC Documents associated with CEI EN 50160: Guide to standards application and Guide for electric quantity measurement.
- CEI EN 60950-1 Safety of Information Technology Equipment
- CEI EN 50065-1 Signaling on low voltage electrical installations in the frequency range 3kHz to 148,5 kHz – Part 1
- CEI EN 55022 Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
- CEI EN 55024 Information technology equipment. Immunity characteristics. Limits and methods of measurement
- CEI EN 62054 – 21 Particular requirements for time switches – Part 21
- CEI EN 50364: Limitation of human exposure to electromagnetic fields from devices operating in the frequency range 0 Hz to 300 GHz, used in Electronic Article Surveillance (EAS), Radio Frequency Identification (RFID) and similar applications

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- ETSI EN 300 330 (v 2.1.1): Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU
- ETSI EN 301 489-3: ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz; Harmonised standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU
- European Directive 2014/30/EU (Electromagnetic Compatibility – EMC)
- European Directive 2014/35/EU (Low Voltage Directive – LVD)
- European Directive 2014/53/EU (Radio Equipment Directive – RED)
- ENEL DMI1 98905 Low Voltage Concentrator (MSC) Data Base
- Enel DMI0 90616 Issue I Test and Test condition of low voltage concentrator
- Enel DMI 1 92604 GPRS modem

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3. Acronyms and abbreviations

- PLC: Power Line Carrier;
- LVM: Low Voltage Manager

4. Concentrator Kit

The equipment and installation elements include the following main parts:

- Plastic socket board/adapter for wall installation
- Protective cabinet for outdoor installation (if requested)
- The GSM/GPRS/3G/4G modem (internal or external)
- Dummy module or cable adapter
- RF modem (Optional)

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5. COMMUNICATION MODEM

The LVM concentrator equipment must incorporate a communication modem able to operate on GPRS/GSM/UMTS (or public switched telephone network PSTN); it is also required to provide the DC power for supplying optional external equipment.

The connector of the GSM/GPRS/3G/4G modem on the LVM is:

- 16 pin pitch 2,54 mm female
- Modem interface includes:
 - Serial interface connected to a serial port in the concentrator;
 - 12 Vdc output 12W.

In case where it is preferable to use an external modem there are the following possibilities:

- Dummy module
- Adapter cable

For more information regarding those adapters see chapter 7

For the requirements and characteristics of GPRS modem, see e-distribuzione DMI 1 92604.

6. RF Module

The RF module must ensure bidirectional communication with other devices that support RF communication. This unit must be designed for operating in 169 Mhz band with the Wireless M-Bus protocol (EN 13757 Mode N) embedded. It has to provide up to 27 dBm ERP level, with an RF sensitivity at least of -105 dBm.

The connector for the RF modem on the LVM is:

- 10 pin pitch 2,54 mm male (NOTE: the pin must have the same length)
- Apart from the signals for data exchanging, on connector is present the power supply:
 - 5 Vdc 5 W.

When this module is not assembled in the LVM the following protections will be used, in order to maintain the characteristics of safety and IP protection of the LVM:

- Rubber plug over a connector for RF module (see on pictures below).

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Picture of the LVM Concentrator with focus on the RF module and the Dummy module

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7. Dummy Module / adapter cable

The dummy module/adapter cable is used to allow, an external modem connection. The following signals are supported:

- RS 232 port use for data communication;
- 12 Vdc 12 W for supplying external device.

The dummy box connector, connection to LVM, must have the following characteristics:

- 16 pin pitch 2,54 mm male
- All of 16 pin must have the same length

The dummy box connector, connection to external device, must have the following characteristics:

- RS232 9-pin male connector;
- connector for power supply 4-pin female.

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8. LVM Concentrator

In these paragraphs are illustrated the more important requirements for this device.

Relatively to the functionality of SW some of the most important are mentioned below

- Clock-Calendar function for functional execution, consequently an RTC circuit with accuracy 0.5 s/day in standard condition (see CEI EN 62054-21)
- Battery back-up element must be coupled to the RTC block to keep the RTC working for at least 3 years when LVM is on the shelf
- Battery back-up must maintain the information of anti-tampering.
- The equipment must have some local indicators (LEDs or equivalents) to show some status conditions and working information (the detail shall be defined in cooperation with the designer).
- The GSM/GPRS/3G/4G module must have some local indicators (LEDs or equivalents) to show some status conditions and working information (the detail shall be defined in cooperation with the designer).
- RF Module used to communicate with other nodes RF (eg. Gas meter)
- Local Optical Interface (IEC 62056-21 mode E or IEC 61107)
- 2 Ethernet Ports (10M / 100M)
- Tampering: Detection of separation between terminal cover and case
- Diagnostic: Self-diagnostic of the main functions
- Other functionalities:
 - Automatic management of daylight saving time and leap year
 - Local and remote programming
 - Time zone
- Possibility to communicate on power line with different modulation, FSK and BPSK
- Handling of the nodes subtended to the low voltage network (optionally RF)

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9. Power supply

A.C. INPUT VOLTAGE

LVM is not provided with earth connection terminal

- | | |
|------------------------|--|
| • Nominal value | $V_n = 400 \text{ Vac}@50 \text{ Hz}$ (3 x 230Vac) |
| • Voltage range | $\delta V = \pm 15\% V_n$ |
| • Transitory variation | $(\geq 190\% V_n) \geq 5 \text{ sec.}$ |
| • frequency range | $\delta f = \pm 5\%$ |

The HW must be designed in order to support both connections to:

- 220/127V LV network
- 230/400V LV network

A galvanic insulation between the DC and the AC main sides must be achieved in the Power Supply.

It will provide all the DC supply for internal circuits as well as the specific supply source for GPRS parts.

Particularly for the GSM/GPRS/3G/4G unit a DC isolated power supply (see below the characteristics), must be available at the modem compartment.

- Output voltage: 12 Vdc.
- Output power: 12W (provided the appropriate capability to support inrush currents)
- Output protections: able to support a continuous short-circuit condition without damages.
- Possibility to switch off and on the GSM/GPRS/3G/4G module, by means of a dedicated switch (both electromechanical or solid state)

In order to improve the overall reliability and robustness as well as the safety requirements, the Manufacturer is recommended to set up auxiliary devices or safety components for protection against overloads or other electrical stress.

In any case, the device itself must guarantee the Overvoltage Protection “class IV” also without auxiliary devices.

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10. Functional processing board

- Processing characteristics:
 - Flash Disk: 2 GB (or higher)
 - RAM Memory: 1 GB (or higher)
 - OS: Linux ver. 2.4.21 (or higher)
 - Micro: ARM A7 (or higher)
- Serial Port:
 - 1 x Uart for EN 62056-21 mode E optical communications port;
 - 1 x RJ 45 1 x RS232 ,for connecting the GPRS modem communication equipment (modem interface signal shall be defined in accordance with modem characteristics);
 - 1 x RS232 for connecting the RF module;
 - 2 x Ethernet ports (10M / 100M)
- A metal shield has to be foreseen to fulfill EMC requirements concerning the CPU board; the shield may be employed as processor heat dissipation too.
- The same EMC shield has to be also used as protection against accesses to motherboard components, by sealing/welding it to the same motherboard. This kind of protection shall be also extended on test-points, ports such as JTAG, busses, pull-up/pull-down terminations, by segregating them inside the shield. The protection must have features and performances equivalent to those ones achievable by using BGA components on "PCB multiplayer" technologies. The shield sealing/welding shall be implemented so that its removal may damage the protected components.
- Indicators:

Description	Power	Alarm	R-Phase	S_Phase	T-Phase
Initial Boot (first 60 sec after power on)	On	Off	Off	Off	Off
End of boot phase	Flashing	Flashing	Flashing	Flashing	Flashing
Normal operations	On	Off	Off	Off	Off
R & N swapped	On	Flashing	Flashing	On	On
S & N swapped	On	Flashing	On	Flashing	On
T & N swapped	On	Flashing	On	On	Flashing
N connection missed	Off	Off	Off	Off	Off

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R connection missed	On	Flashing	Flashing	Off	Off
S connection missed	On	Flashing	Off	Flashing	Off
T connection missed	On	Flashing	Off	Off	Flashing
Wrong sequence	On	Off	Rotating flash		
Internal Alarm	On	On	Off	Off	Off

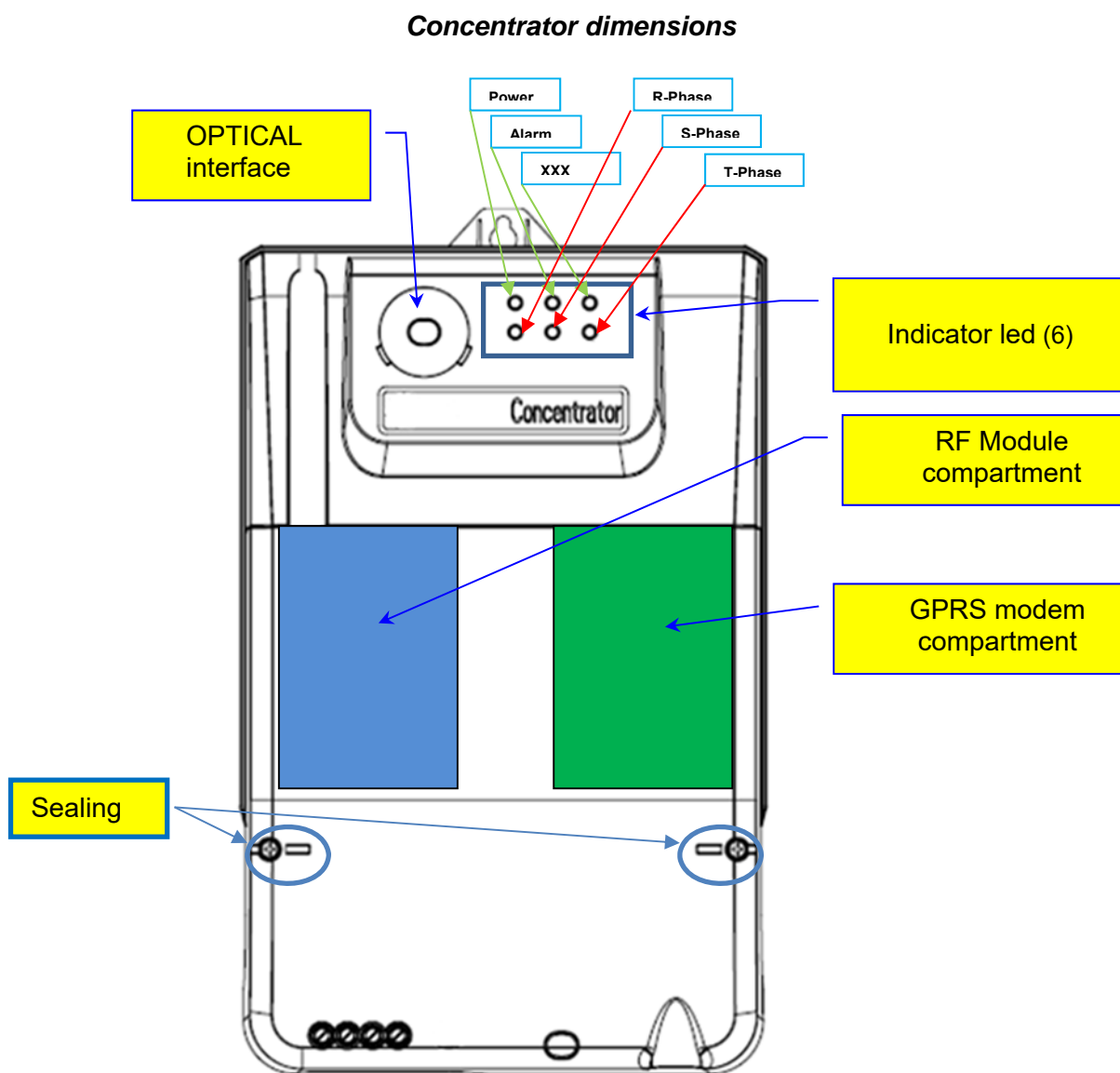
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11. Dimensions

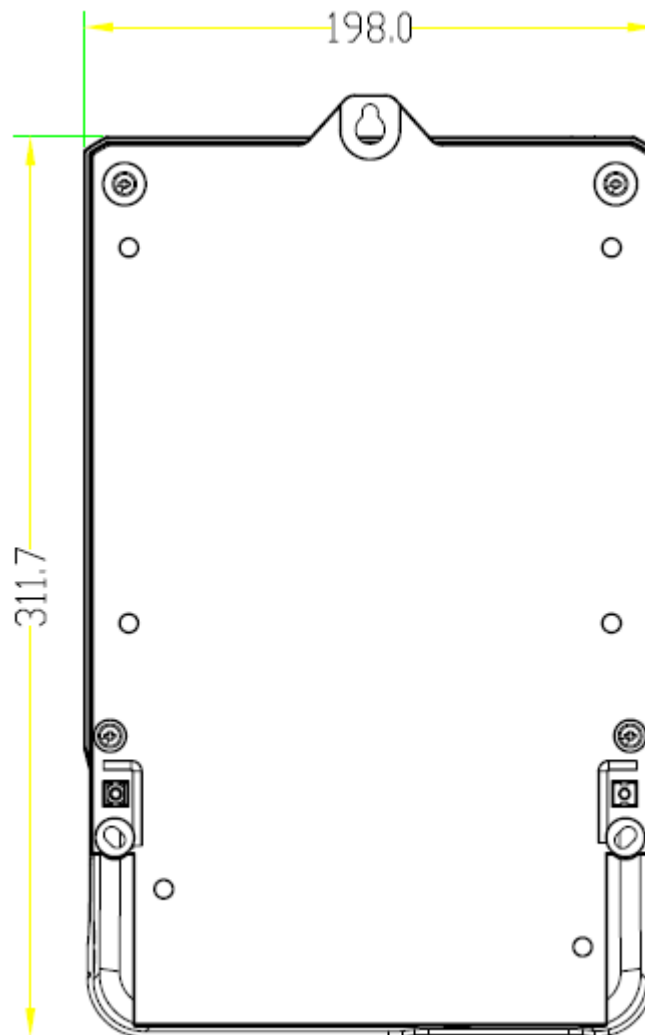
The reference dimensions (including the terminal cover) must comply the mechanical requirements indicated in the DIN standards of polyphase meter to fit into the same installation panels.

For details see the pictures below:



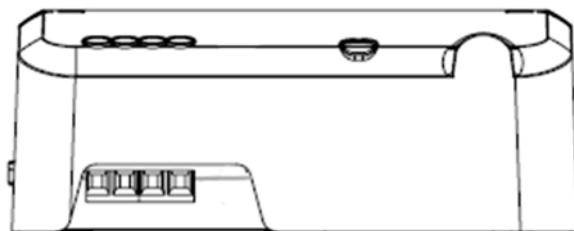
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Features of case:

- **IP 20** wiring compartment
- **IP 41** circuitry compartment

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12. Environmental characteristic and reliability

- Product Life: More than 10 years
- Failure rate: ≤ 0.3 % (percent) per year or better
- Operating Temperature: -25 to +70°C
- Storage and transportation Temperature: -40 to +85°C
- Operating Relative Humidity (non-condensing): 25-90% RH @ 50°C (without condensation)
- Storage Relative Humidity (non-condensing): 95% RH @ 50° C (without condensation)
- Self Consumption: 3W (LVM Concentrator without GSM/GPRS/3G/4G modem, steady state)

13. PLASTIC CASE MATERIAL

The concentrator plastic case must have the following characteristics:

- made of plastic material (Polycarbonate and 10% glass fibre) suitable for recycling (related symbol must be moulded on bigger parts);
- color: LVM's base and case, white (RAL 9016); the characteristics of this color should not be altered due to solar radiation according with EN 60068-2-5.
LVM's terminal cover, transparent;
- heat and flame resistant (class V0 in accordance with UL94);
- low emission of corrosive and toxic gases and smokes;
- the case shall show no deformations, brittleness process or surface hardness reduction, in the temperature range from -25 to +100 °C, and must be able to withstand up to - 40°C temperature.

Taking into account the case plastic material, suitable measures have to be foreseen to prevent light interference on the optical port communication.

All the materials shall comply with the European Directive 2014/35/EU dealing with the restriction of the use of certain hazardous substances in electrical and electronic equipments.

A suitable area for nameplate data printing (done by laser) should be foreseen on the front side of the case in addition to the optional logo hard printed on the front panel.

The external front case surface, not covered by the terminal cover, must be provided with geometrical (rhombus shaped) "bas relieves"; the external lateral case surface, not covered by the terminal cover, must be provided with "bas relieves" as well (vertical lines). the internal surface has to be plain.

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In order to increase the case security, the following further measures have to be added:

- Hot blade welding of the concentrator case.
- Additional appendixes to both the LVM's base and cover at the top right part of the concentrator to add a seal (see picture below)



- The concentrator case must be secured by an RFID device.
RFID has the following characteristics:
 - RFID shall be implement for allowing concentrator secure identification
 - RFID has to be located for resulting clearly readable from the outside of the case

14. CABLING AND CONNECTIONS

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Connection to AC Mains

Each terminal must allow to screw wires in the range of 1.5 to 6 square mm.

The insulation level is:

- 5, 7 kVrms for 60 s.
- 10 kVp (impulse $t_{rise}=1.2\ \mu s$ - $t_{fall} = 50\ \mu s$) Category of isolation IV.

These values arise from the fact that this device is:

- Reinforced insulation
- Class IV overvoltage category

All connections with the LVM concentrator is less than 3m.

A clear identification of all the connections must be made visible for installation and maintenance operations.

15. GENERAL TEST CONDITIONS

All the tests have to be performed on the fully equipped apparatus.

The test plan will comply with Enel DMI0 90616 Test and Test condition of low voltage concentrator Issue I.

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