

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

CONTENTS

1.	DOCUMENT AIMS AND APPLICATION AREA	2
1.1	RELATED DOCUMENTS TO BE IMPLEMENTED AT COUNTRY LEVEL	2
2.	DOCUMENT VERSION MANAGEMENT	2
3.	UNITS IN CHARGE OF THE DOCUMENT	2
4.	REFERENCES	3
5.	ORGANIZATIONAL PROCESS POSITION IN THE PROCESS TAXONOMY.....	3
6.	DEFINITIONS AND ACRONYMS	3
7.	DESCRIPTION	5
7.1	LIST OF COMPONENTS	5
7.2	CONSTRUCTIVE KITS	5
7.2.1.1.	KIT 1.....	5
7.2.1.2.	KIT 2:.....	6
7.2.1.3.	KIT 3.....	7
7.2.1.4.	KIT 4.....	8
7.3	OPERATING CONDITIONS.....	8
7.4	GSCM014/1 - UP CABLE	9
7.5	GSCM014/2 - FSL Adapter for RGDM	12
7.6	GSCM014/3 - RGDM CABLE.....	15
7.7	GSCM014/4 - Y CABLE.....	17
7.8	TESTING AND CERTIFICATIONS	19
7.8.1.	Test documents.....	19
7.8.2.	Type test list.....	19
7.8.3.	Routine and acceptance tests.....	20

THE HEAD OF GLOBAL NETWORK COMPONENTS

Fabrizio GASBARRI

**Application Areas**

Perimeter: Global

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Service Function: -

Business Line: Enel Grids

1. DOCUMENT AIMS AND APPLICATION AREA

The purpose of this document is to provide technical and testing requirements for connection cables used between the protection and control equipment (UP, RGDM, QED) and the switchgears installed within Enel Grids MV/LV substations for remote control and automation.

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

1.1 RELATED DOCUMENTS TO BE IMPLEMENTED AT COUNTRY LEVEL

This document does not require implementation of further documents. Anyway, each Enel Grids Company can issue, under the supervision of Enel Grids Global Network Components detailed documents, according to the provisions of the present document and in case of specific needs.

2. DOCUMENT VERSION MANAGEMENT

Version	Date	Main changes description
1	10/01/2023	First issuing of Enel Grids "GSCM014 MV/LV Substation connection cables"

3. UNITS IN CHARGE OF THE DOCUMENT

Responsible for drawing up the document:

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

Responsible for authorizing the document:

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

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

4. REFERENCES

- Integrated Policy for Quality, Health and Safety, Environment, anti-Bribery and Information security.
- ISO 9001:2015 - Quality Management System – Requirements.
- ISO 14001:2015 - Environmental Management System - Requirements with guidance for use.
- ISO 45001:2018 - Occupational Health and Safety Management System - Requirements with guidance for use.
- ISO 37001:2016 - Anti-bribery Management System - Requirements with guidance for use.
- ISO 27001:2017 - Information Security Management System – Requirements.
- GSTR002: Remote Terminal Unit for MV/LV substation – UP2020 Lite.
- GSCM004: MV RMU with circuit breaker.
- GSM001: MV RMU.
- GSCM005: Modular Medium Voltage Switchgears.

Group Pillar References:

- The Code of Ethics of Enel Group;
- The Enel Group Zero Corruption Tolerance Plan (ZTC);
- Human Rights Policy;
- Organization and Management Model as per Legislative Decree No. 231/2001;
- Enel Global Compliance Program (EGCP).

5. ORGANIZATIONAL PROCESS POSITION IN THE PROCESS TAXONOMY

- Value Chain /Process Area: Engineering and Construction
- Macro process: Devices and Components Development
- Process: Standard Catalog Management

6. DEFINITIONS AND ACRONYMS

Acronym and Key words	Description
Circuit-Breaker (CB)	Mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified duration and breaking currents under specified abnormal circuit conditions such as those of short circuit

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

Logic Selectivity Function (FSL)	Set of operations allowing selective automation for fault detection on the MV network
Medium Voltage (MV)	System with a nominal operative voltage between the phases higher than 1 kV to 35 kV included. NOTE: The boundary value between medium voltage and high voltage depends on local and historical circumstances or on common usage. Nevertheless, for internal standardization purposes, medium voltage is defined as a system with a nominal operative voltage between the phases higher than 1 kV to 35 kV included”
MV Ring Main Unit (RMU)	Compact solution for MV switchboard
MV/LV Substation	Enel Secondary substation
OdM	Manoeuvring organ
Power supply Battery Charger (PSBC)	Power supply unit
RIO - QED	Remote Input/Output module for the Quantum Edge Device
Self Healing Automation (SHA)	System which allows automatic resolution of problems/faults
Smart Fault Selection (SFS)	Automation for automatic fault selection and isolation
Switchgears	A general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended in principle for use in connection with generation, transmission, distribution and conversion of electric energy

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

7. DESCRIPTION

7.1 LIST OF COMPONENTS

The MV/LV substation connection cables described in this technical specification can be classified into different products, shown in:

Type Code	Description	Country	Country Code
GSCM014/1	UP Connection Cable	IT	140496
GSCM014/1	UP Connection Cable	RO	140217
GSCM014/2	FSL adapter for RGDM	IT	140497
GSCM014/3	RGDM cable	IT	140498
GSCM014/4	Y cable	IT	140499

Table 1 – List of Components

7.2 CONSTRUCTIVE KITS

Different solutions of connection cables depending on the control and protection devices installed in the MV/LV substation have been identified.

7.2.1.1. KIT 1

KIT 1 shall be used when the following equipment are installed within MV/LV substation:

- UP2020Lite (or old version).
- Switchgears with Switch-disconnector (SD) according to DY8XX series or GSM001 series.
- RGDM/RGDM (no advanced automation).

KIT 1 is composed by:

- GSCM014/1 (UP Connection Cable), to connect the RTU (UP) and the MV switchgear*, according to par. 0.

*For GSM001 series the GSCM014/1 is included in the supply

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

7.2.1.2. KIT 2:

KIT 2 shall be used when the following equipment are installed within MV/LV substation.

- UP2020Lite (or old version).
- Switchgears according to DY800 and DY900 series.
- RGDM (FSL/SFS/SHA).

KIT 2 is composed by:

- GSCM014/1 (UP Connection Cable), to connect the RTU (UP) and the FSL adapter, according to par.0.
- GSCM014/2 (FSL adapter for RGDM) to connect the RGDM with the switchgear, according to par.7.5

In Figure 1 there is the representation of the connections between Switchgear-RGDM-UP

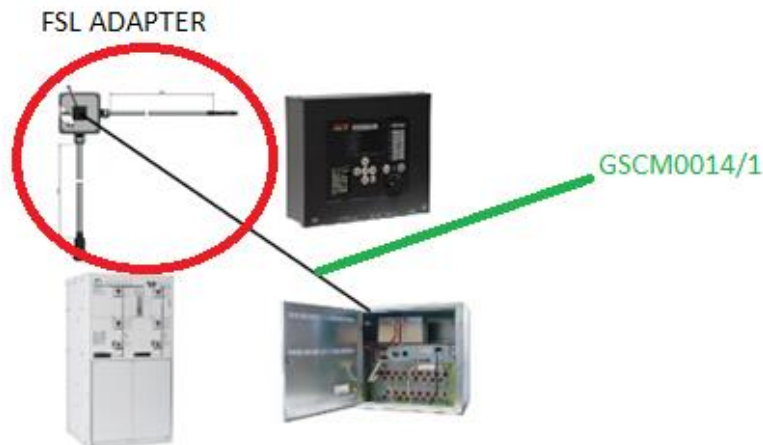


Figure 1 - Kit 2 example, principle diagram of connections between Switchgears-RGDM-UP in according to DY800 and DY900

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

7.2.1.3. KIT 3

KIT 3 shall be used when the following equipment are installed within MV/LV substation.

- UP2020Lite (or old version).
- Switchgears according to GSCM004* and GSCM005.
- RGDM (FSL/SFS/SHA).

KIT3 is composed by:

- GSCM014/1 (UP Connection Cable), to connect the RTU (UP) and the MV switchgear*, according to par.0.
- GSCM014/3 (RGDM cable) to connect the RGDM with the terminal block within the switchgear, according to par.7.6.

*For GSCM004 series GSCM014/1 is included in the supply

In Figure 2 there is the representation of same situation seen above, in according with the new revisions of GSCM004 and GSCM005.



Figure 2 - Principle diagram of connections between Switchgears-RGDM-UP in according to GSCM004, GSCM005

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

7.2.1.4. KIT 4.

KIT 4 shall be used when the following equipment are installed within MV/LV substation.

- UP2020/QED;
- Switchgears with Circuit breaker functional unit.
- RGDM/RIO RGDM (FSL/SFS/SHA);

KIT 4 is composed by:

- GSCM014/4 (Y cable) used to connect UP2020/QED and RGDM/RIO RGDM with the switchgear according to par.7.7.

7.3 OPERATING CONDITIONS

OPERATING VALUES		
Rated supply voltage of SD and CB drives:	[V _{DC}]	24 -15% +20%
Maximum temperature	[°C]	40
Maximum average value of temperature, referring to a period of 24h:	[°C]	35
Minimum temperature for indoor installation:	[°C]	-15
Minimum temperature for outdoor installation:	[°C]	-25
Storage temperature:	[°C]	-25 +70
Relative humidity:	-	95%
Atmospheric pressure:	[kPa]	70 106

Table 2 – Operating conditions

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

7.4 GSCM014/1 - UP CABLE

As indicated above such cable allows interface between the switchgear with the external remote terminal unit (UP).

GSCM014/1 technical characteristic shall be as follows:

- Rated voltage: 300/500 V.
- Flexible annealed, not tinned, copper conductor.
- Cable formation 11x1,5 mm², signal cable type FS18OR18 or equivalent or upper class.
- Cable length 8 mt.
- Circular Plastic Connector male (see Figure 3).
- Square Grid Connector female (see Figure 3).

A belt-type marking device, made in PVC, shall be fitted at each end of the cable, to be used, during installation, to indicate the number and the name of the functional unit it relates to.

The coupling of the parts shall be ensured by means of a quick-release screw ring nut. The detachable part of the rectangular connector provided at the other end of the cable shall be of the type shown in Figure 3. Both the fixed and the detachable parts shall be made of insulating material with dielectric characteristics.

The cable shall have a circular terminal indicated in Figure 3, that is suitable for being inserted into the connector on the MV Switchgear.



Figure 3 - UP Cable

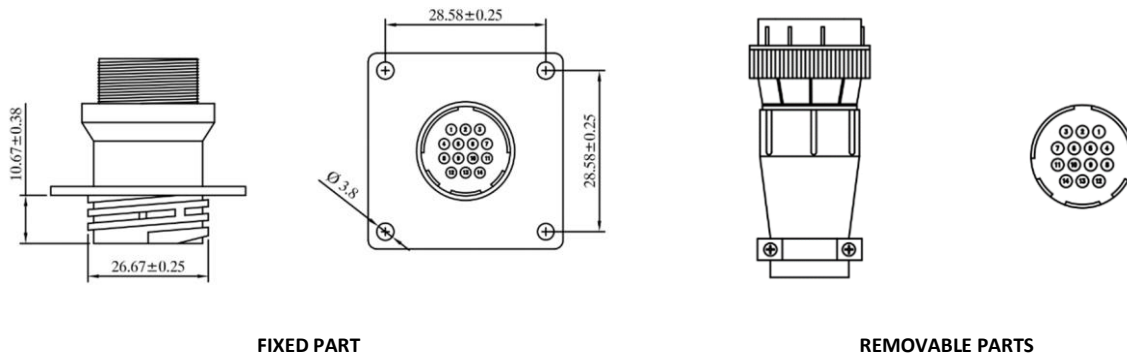
Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids



FIXED PART

REMOVABLE PARTS

Figure 4- Connectors on the Switchgear side (Circular Plastic Connector)

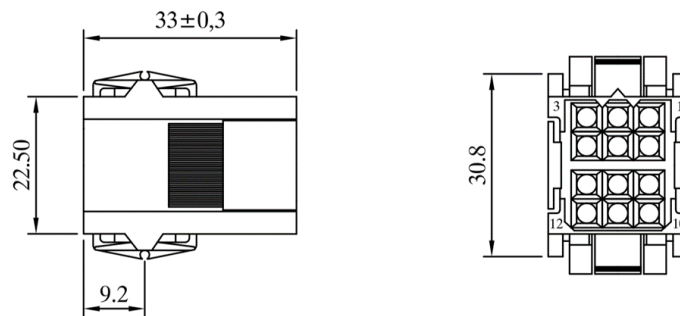


Figure 5- Connector on the Peripheral Unit side of the cable (Square Grid Connector)

The wiring diagram of the cables should be as shown in Figure 6:

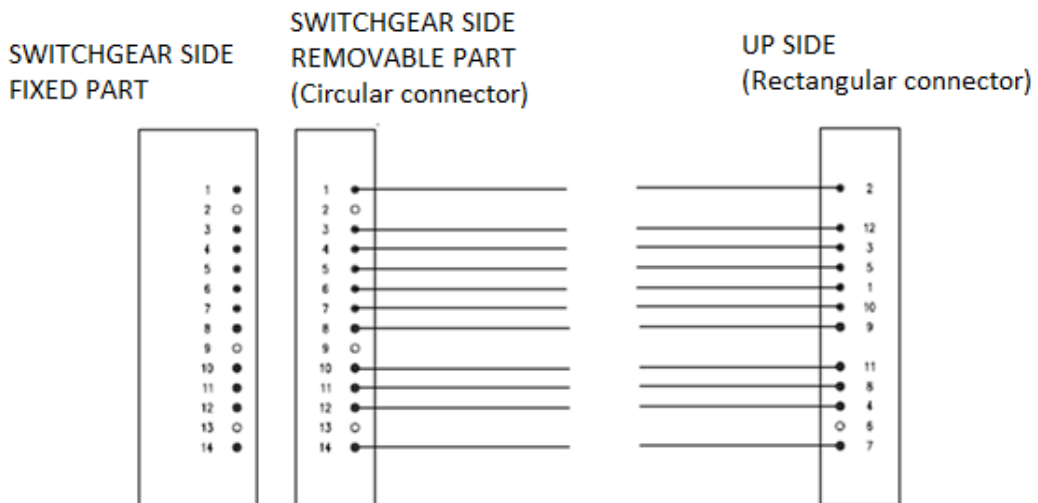


Figure 6 - Wiring diagram between UP and equipment

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

In Table 3 the pin-out of both connectors (Switchgear side and UP side) is showed.

1	+M	Motor supply voltage (+24 Vcc)	8	89cax	Signal opening position switch-disconnector or circuit breaker
2		Not used	9		Not used
3	- A	Common (-24 Vcc) commands	10	- M	Motor supply voltage (-24 Vcc)
4	+ M	Motor supply voltage (+24 Vcc)	11	CH	Closing command
5	Com TS	Common position signals switch-disconnector or circuit breaker	12	89ccx	Signal closing position switch-disconnector or circuit breaker
6	+ L	Local commands supply (+24 Vcc)	13		Not used
7	- M	Power supply (-24 VDC) motor	14	AP	Opening command

Table 3 - Circular connector pin-out (Switchgear side)

1	+ L	Local commands supply (+24 Vcc)	7	AP	Opening command
2	+M	Motor supply voltage (+24 Vcc)	8	CH	Closing command
3	+M	Motor supply voltage (+24 Vcc)	9	89cax	Signal opening position switch-disconnector or circuit breaker
4	89ccx	Signal closing position switch-disconnector or circuit breaker	10	- M	Motor supply voltage (-24 Vcc)
5	Com TS	Common position signals switch-disconnector or circuit breaker	11	- M	Motor supply voltage (-24 Vcc)
6		Not used	12	- A	Common (-24 Vcc) commands

Table 4 - Rectangular connector pin-out (UP Side)

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

7.5 GSCM014/2 - FSL Adapter for RGDM

FSL adapter for RGDM (Figure 8) is used between the GSCM014/1 (UP connection cable) and the circuit breaker functional unit motorisation, to enable advanced automations (FSL/SFS/SHA) with RGDM (Directional Fault Detector and Measurement).

The FSL adapter must be equipped with circular connectors at the ends of the feed-through cables, and the branch cables to the RGDM must be insulated up to the connection with the RGDM terminal blocks (see Figure 7).

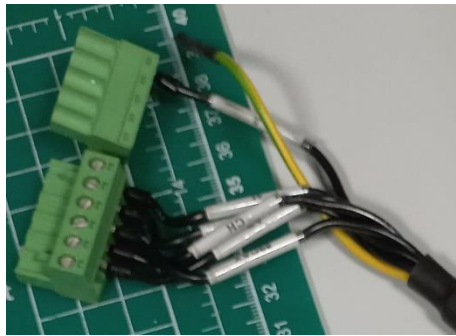


Figure 7 – Insulated cables linked with RGDM terminal blocks

GSCM014/2 shall be made with the following reference material list:

- An external junction box colored in light grey, with IP56 protection degree with dimensions 100x100x50mm. It shall be made in self-extinguishing plastic material with smooth walls (without holes and/or provision for holes) compliant with EN 60670-22.
- 2 grey colored cable glands compliant with standard IEC 62444, for cable formation same as 11x1,5mm² and 7x1,5 mm² to obtain at least a protection degree IP54.
- 1 circular female connector mounted on the cover of the box.
- 1 circular male connector mounted on the cable.
- 1 meter of grey flame-proof cable 11x1,5mm², signal cable type FS18OR18 or equivalent or upper class, on the Circuit breaker functional unit side with circular connector and single female pins.
- 1 meter of grey flame-proof cable 7x1,5mm², signal cable type FS18OR18 or equivalent or upper class on the RGDM side, with insulated ferrules;
- 3 spring terminals to make the RGDM connections inside the box.

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

- Conductor end sleeves, required for the ends of the RGDM side branch cable
- Indelible numbering of the individual conductors on the RGDM side with transparent sheath protection

For more clarity see also Figure 1, where is visible the configuration where this element is used (reported in Kit 2)

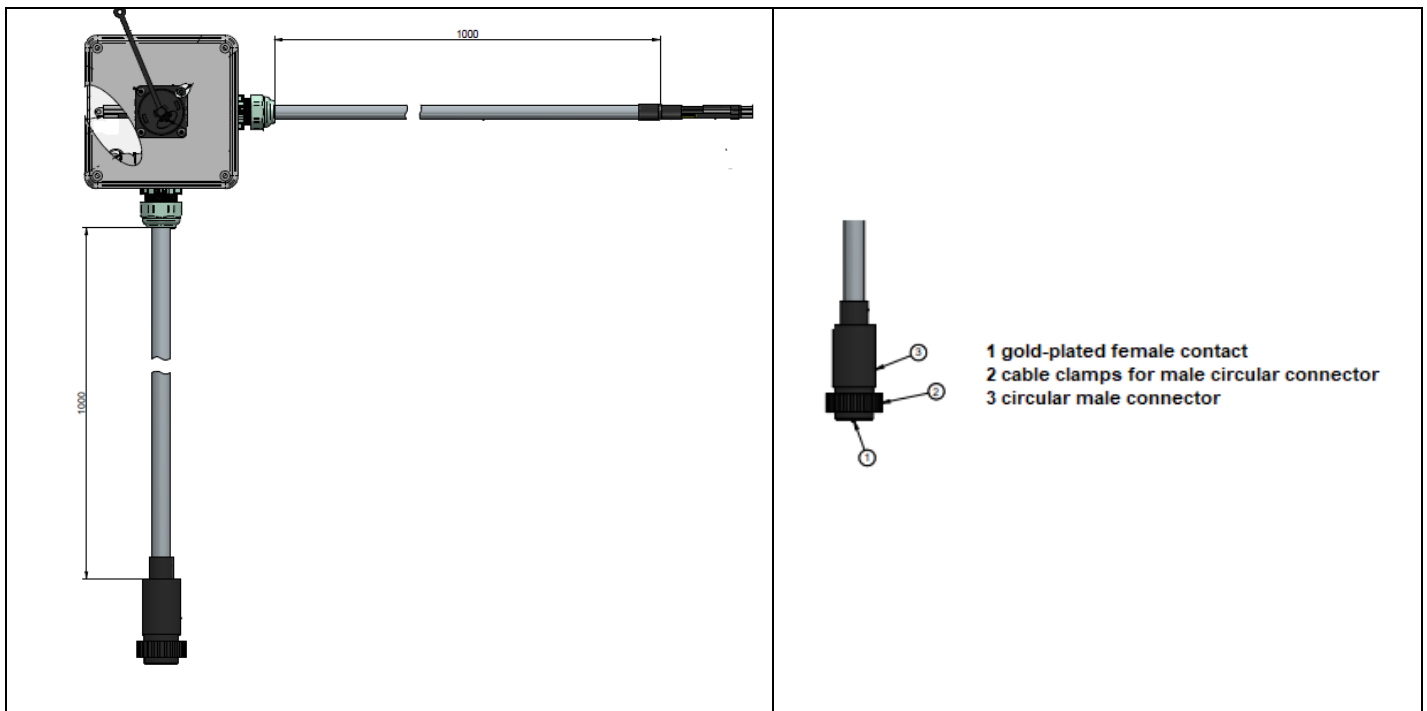


Figure 8 - FSL adapter for RGDM

The wiring diagram of the FSL adapter for RGDM is shown in Figure 9, where there are also the positions and wire numbering of the connectors:

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

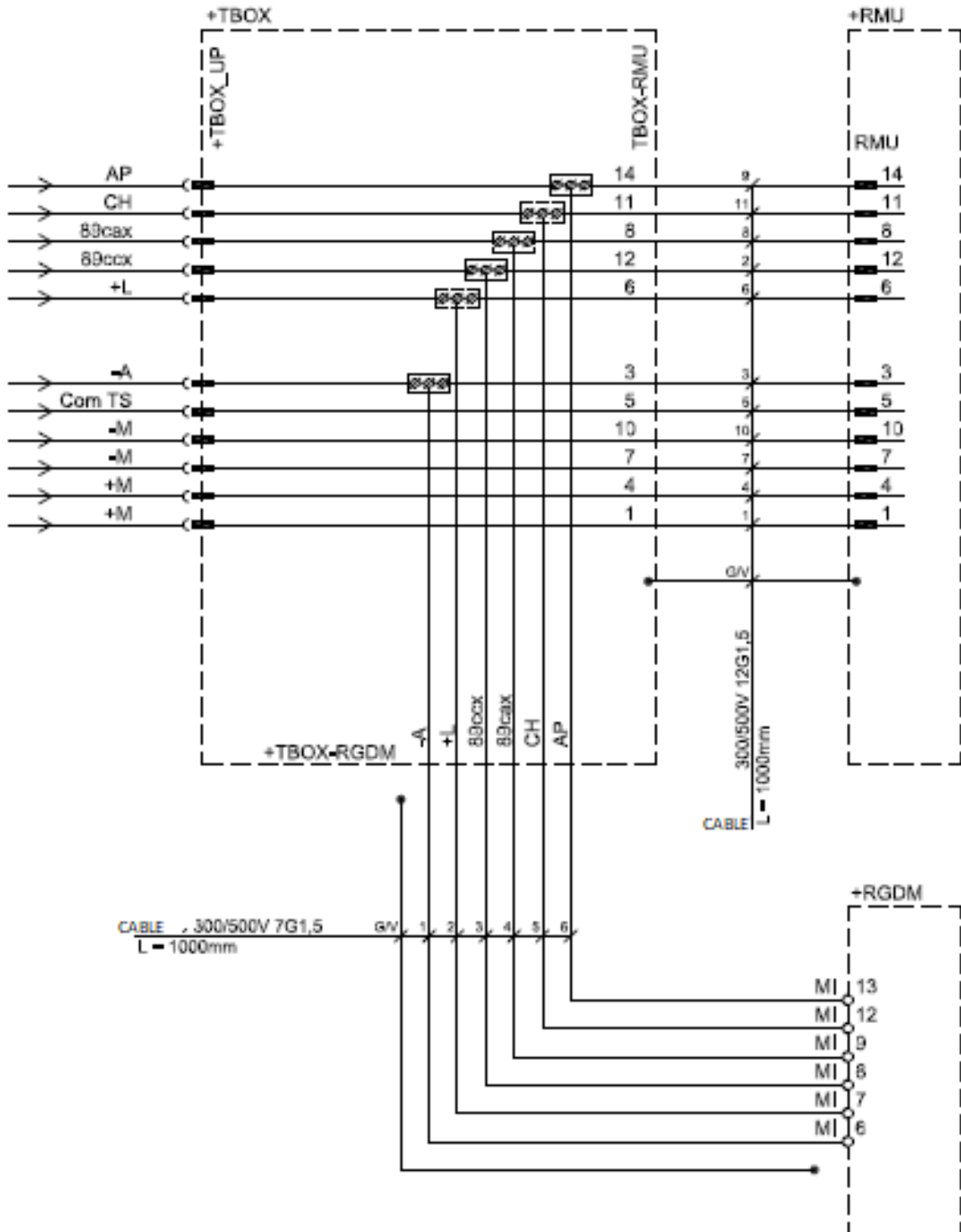


Figure 9 – FSL adapter Electrical scheme

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

7.6 GSCM014/3 - RGDM CABLE

GSCM014/3 - RGDM cable (Figure 10) characteristics shall be as follows:

- Rated voltage: 300/500 V;
- 1 meter of flameproof cable 7x1,5mm², signal cable type FS18OR18 or equivalent or upper class
- Flexible annealed, not tinned, copper conductors.

A belt-type marking device, made in PVC, shall be fitted at each end of the cable, to be used, during installation, to indicate the number and the name of the functional unit it relates to.

Cables must be preassembled by the supplier, with removable terminal boards (Figure 11).

For more clarity see Figure 2 where is visible the configuration where this element is used (reported in Kit 3)

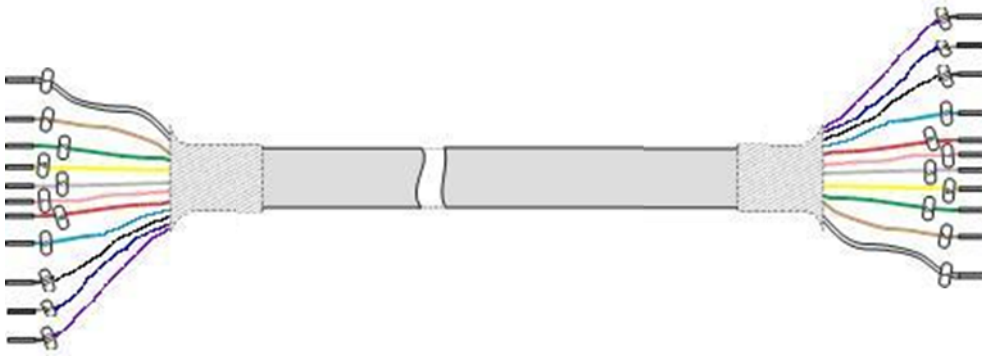


Figure 10 – Example of the connection cable between the MV Switchgear and RGDM

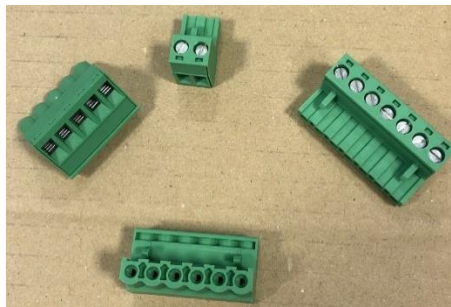


Figure 11 - Example of the removable part of the cable (Switchgear and RGDM side)

The pinout of the cable is shown in Table 5. The correct marking (on each conductor inside the removable part of the terminal board) must be done at each end of the cable according to the following table.

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

Switchgear terminal board side	RGDM terminal board side (called MI)	Signal	Description
1	6	-A	Common (- 24Vdc) commands
2	7	+L	Local commands (+24Vdc)
3	8	89ccx	Signal closing position switch-disconnector or circuit breaker
4	9	89cax	Signal opening position switch-disconnector or circuit breaker
5	12	CH	Closing command
6	13	AP	Opening command

Table 5 - Connection Cable pinout

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

7.7 GSCM014/4 - Y CABLE

It must be provided the connection cable between the PSBC, the RIO RGDM/RGDM device and the Switchgear (Figure 12). See also 7.2.1.4

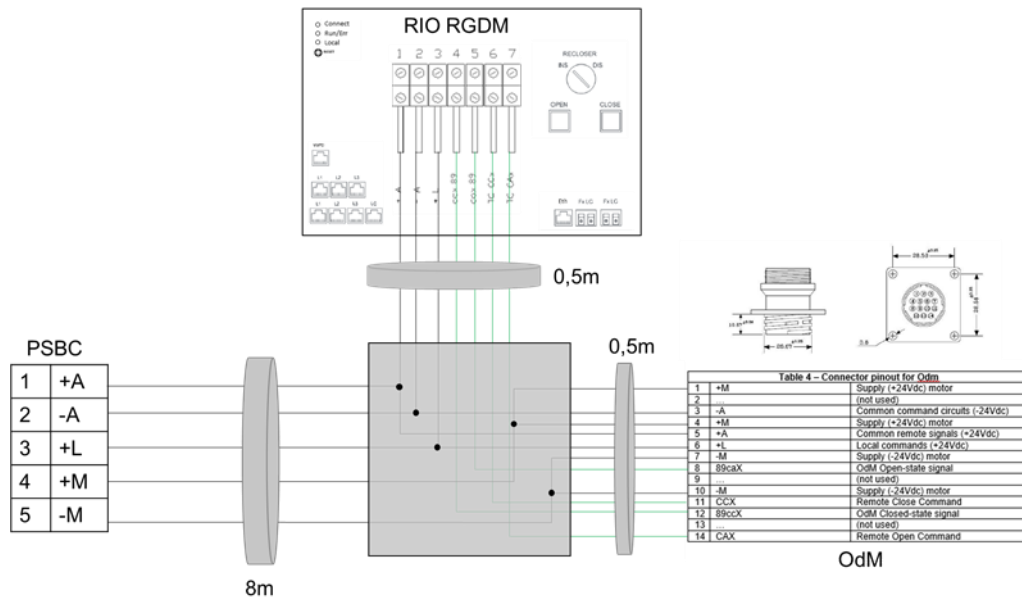


Figure 12 – Example of the technical solution for the "Y" cable

As indicated in the figure, the cable must have at least, a length of 8 meters to the PSBC side and 0,5 meters each to the MI (installed on the RIO RGDM/RGDM) and switchgear side.

The connection cable must be realized with the following characteristics:

- 8 meters of flameproof cable; 5 conductors with section (2,5 mm² for ±M signal and 1,5 mm² for ±A, +L signal), on PSBC side;
- 0,5 meter of flameproof cable; 7 conductor with 1,5 mm² section on RIO-RGDM/RGDM side;
- 0,5 meter of flameproof cable; 11 conductor with 1,5 mm² section on switchgear side with circular connector and single female pins
- All the cables must be signal cables, type FS18OR18 or equivalent or upper class

The not fixed part of the cable, both on the PSBC side and MI side, must be preassembled by the supplier, with removable terminal boards (Figure 13).

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

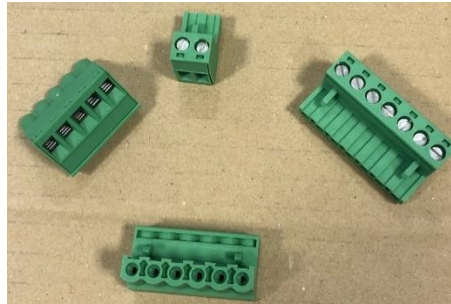


Figure 13 - Example of the removable part of the cable (PSBC and MI side)

The cable, on the switchgear side, must have the following electrical characteristics:

- Rated isolation voltage: 300/500 V
- Flexible annealed, not tinned, copper conductors
- R2 quality PVC insulation
- Outside diameter (of the insulation) of the cores: \varnothing 3 mm
- Distinction of the cores by marked numbers (according to CENELEC HD 186 S2), connecting the marked numbers with the identifying numbers on the conductor's pins
- Rz quality PVC sheath

A belt-type marking device, made in PVC, shall be fitted at each end of the cable, to be used, during installation, to indicate the number and the name of the functional unit it relates to.

The cable, on the switchgear side, must have a terminal that is suitable for being inserted into the connector on the MV Switchgear. Both the fixed part installed on the MV Switchgear and the not fixed part of the cable, are shown below (respectively in Figure 14 and in Figure 15):

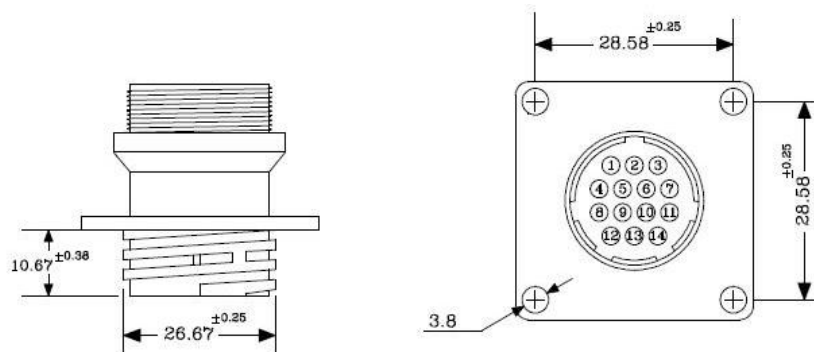


Figure 14 – Fixed part installed on the MV Switchgear

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

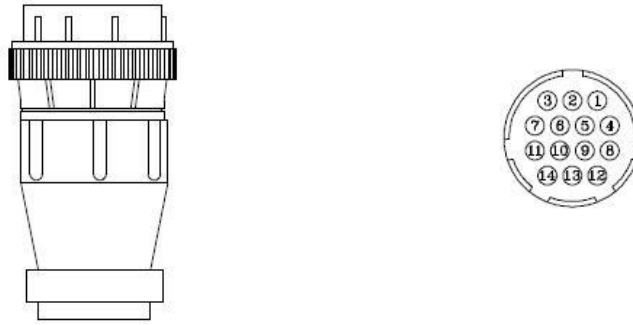


Figure 15 – Not fixed part installed on the cable

The connector's pinout is shown in Table 6.

1	+M	Supply (+24Vdc) motor
2	...	(not used)
3	-A	Common command circuits (-24Vdc)
4	+M	Supply (+24Vdc) motor
5	+A	Common remote signals (+24Vdc)
6	+L	Local commands (+24Vdc)
7	-M	Supply (-24Vdc) motor
8	89caX	Switchgear: Open-state signal
9	...	(not used)
10	-M	Supply (-24Vdc) motor
11	CCX	Remote Close Command
12	89ccX	Switchgear: Closed-state signal
13	...	(not used)
14	CAX	Remote Open Command

Table 6 - Connector pinout for switchgear

7.8 TESTING AND CERTIFICATIONS

All the requirements from this chapter must be respected. These tests must be performed in the provider factory or third part's laboratories.

7.8.1. Test documents

Test documents must contain all drawings and tests for the manufacture and operation of the product from which the conformity of the product with all requirements of the technical specification can be verified, directly or indirectly.

7.8.2.Type test list

Application Areas

Perimeter: Global

Staff Function: -

Service Function: -

Business Line: Enel Grids

-
- Verification of insulation tightness at industrial frequency
 - Verification of the connections and compliance with the wiring diagram
 - Functionality check with UP command simulator
 - Verification of IP protection degree
 - Verification of compliance of the individual components with the product standards

The supplier must retain all the documentation proving the successful results of the type tests and all data must be made available to the technical unit in real time.

At technical unit's discretion these tests may be completely or partially repeated during the lifetime of the contract as continuing evidence of type conformity.

7.8.3. Routine and acceptance tests

The routine tests are here reported:

- Verification of insulation tightness at industrial frequency
- Verification of compliance with the approved;
- Verification of connections and electrical diagram compliance;
- Verification of functionality with a command simulator;
- Verification of IP degree of protection;
- Functional test of the UP/QED connection cable with reference;
- Verification of compliance of individual components with product standards.

The acceptance tests shall be repeated by the supplier, under the Distribution Companies surveillance, on a sample chosen randomly among those ones of the batch that has already been successfully tested by the supplier. The tests shall be carried out on samples defined by the sampling plan below:

Single sampling plan for normal inspection - AQL = 2,5% - Level II (in case of negative result, in the new commissioning the sampling plan shall be ordinary).