COL GIOVANNI PAOLO S.p. A.
COSTRUZIONI ELETTROMECCANICHE

seb DIVISIONE ELETTRONICA E SISTEMI

Project

Directional fault and voltage absence detector (RGDAT-A70)

P515D813

Version Rogowski
User manual

C	March 2016	Revision	M. Ferreri	G. Bonomo
Rev.	**Date**	**Description**	**Draft**	**Checked**

COL GIOVANNI PAOLO S.p. A.
COSTRUZIONI ELETTROMECCANICHE
DIVISIONE ELETTRONICA E SISTEMI

Updates and/or revisions

REV.	CAP.	PAG.	Descrizione	DATA
A			First issue	May 2014
B	Various	Various	Updated according to firmware and software version 1.10	March 2015
C	Various	Various	Updated according to firmware and software version 1.20	March 2016

Index

PURPOSE OF THE DOCUMENT

This document describes how to use and setup the device RGDAT-A70 (directional fault and voltage absence detector) compliant with technical specification DY1059-A70 by ENEL Distribuzione.

REFERENCE DOCUMENTS

- ENEL Distribuzione - DY1059-A70 - rev. 02 - January 20th 2013
- Col - Div. Seb - P515D403 Communication protocol - Rev. D - September 2014

SUMMARY

The fault detector RGDAT-A70 is made according to technical specification DY1059-A70 by ENEL Distribuzione; it is installed in remote controlled Secondary Substations in order to provide local and remote signaling of short circuit faults and ground faults that may occur in medium voltage distribution network, as well as to signal the absence of line voltage. This information can help to locate the section of the network affected by fault.

The voltage measurement is taken using voltage signals supplied by capacitor dividers that normally, when installed on MV protected switchgears, provide signals to voltage presence signaling lamps.

The obtained voltage measurements are used for directional earth fault function and for presence/absence of line voltage detection; values of phase voltage V4, V8 and V12 are processed in order to eliminate measurement errors due to capacitive dividers thanks to voltage self-calibration function.

The current measurement is done using three openable current sensors, included in delivery. The device RGDAT-A70 detects phase faults producing a current greater than a threshold value and ground faults both in isolated neutral networks and in compensated neutral networks.

The device detects definitely failures lasting more than 80 ms and is tolerant to self-extinguishing faults with duration up to 40 ms.

The device RGDAT-A70 implements the following protection / functions:

51	phase overcurrent
51N	earth fault overcurrent
67N	directional earth fault
59	voltage presence function
27Vd	positive sequence undervoltage
59Vi	negative sequence overvoltage
59Vo	residual overvoltage
VSS	voltage sensors supervision function

There are 3 relay outputs, which generally have the following functions:

relay TS51A	signals the intervention of short-circuit function for phase faults (polyphase or double single-phase to ground)

relay TS67AV	signals the intervention of directional earth fault function for line side faults (with reverse direction disabled)
relay TSPresV	managed by voltage presence function

It is also available a different operating mode, called Voltage Monitoring Mode, alternative to the above functions, in which all protective functions are disabled and only the voltage presence function is active, which is managed in different ways (please make reference to document DY1059-A70 by ENEL Distribuzione).

The device RGDAT-A70 has a current converter with output 4÷20 mA for sending the measurement of phase current to remote control unit.

On the front of the device there are the following light signals:

three green leds	signaling the presence of phase voltages V4, V8 and V12
one white led	signaling inversion of surveillance direction for directional earth fault protection
one orange led	signaling trip of phase overcurrent protection (51) or earth fault overcurrent protection (51N), stored
one red led	signaling trip of directional earth fault protection (67N), stored
one red led (blinking)	signaling intervention of self-diagnostic function

Using a specific digital input it is possible to enable the inversion of surveillance direction of directional earth fault protection.

The connection between RGDAT-A70 and remote control unit is made with components and dimensions indicated in ENEL specification DY1059-A70. There is a multicore cable from the cable gland placed on top of the metal container; its wires are connected to terminal block MB, according to connection diagram shown in this manual.

The electronic board of RGDAT-A70 has a 9-pin D-Sub RS232 serial connector, which is used for device configuration and for commissioning procedures.

A specific software, running under Microsoft Windows® (Windows XP and later), allows you to do configuration, monitoring, checking and update the firmware of device. These operations are described in detail later in this document.

Phase current sensors

The two phase current sensors, openable, can be mounted directly on insulated cables of medium voltage line.

For proper positioning of phase current sensors, see chapter "Installation".

Residual current sensor

The homopolar (or residual) current sensor is also openable; it is installed around the insulated cables, making sure that it is also crossed by the ground connection of the shield of cables. Since the circumference of the sensor contains all three phases of the line, the sensor is sensitive to residual current.

For proper positioning of residual current sensor, see chapter "Installation".

Voltage sensors (capacitive dividers)

Connection to voltage sensors is made via a shielded cable; the cable is connected to an hexapolar plug compliant with ENEL specification DY811. The hexapolar plug is plugged into the related fixed part of MV switchgear, normally used for lamps indicator for power.

The current and voltage sensors must be connected to terminal block MA inside the device RGDAT-A70.

FUNCTIONS

Phase overcurrent protection (51)

To ensure protection against polyphase failures, the device RGDAT-A70 has a phase overcurrent protection, in bipolar configuration, with a single threshold. The device acquires the measurement of phase currents by means of suitable sensors and provides a fault signal when the current exceeds the threshold value in at least one phase.

The threshold value of phase overcurrent protection is programmable from 100 A to 900 A, in steps of 50 A.

Signaling protection intervention is provided by relay TS51A, whose contacts are connected to terminal block MB and acquired by remote control system. An orange LED on the front of device turns on when a trip occurs.

Earth fault overcurrent protection (51N)

To ensure protection against double phase to ground failures, the device RGDAT-A70 has an earth fault overcurrent protection, with a single threshold. The device acquires the measure of earth current through an homopolar current sensor and provides a fault signal when the earth current exceeds the threshold value.

The threshold value of earth fault overcurrent protection is programmable from 10 A to 200 A, in steps of 10 A.

Signaling protection intervention is provided by relay TS51A, whose contacts are connected to terminal block MB and acquired by remote control system. An orange LED on the front of the device turns on when a trip occurs.

Directional earth fault protection (67N)

To ensure protection against earth faults, both in isolated neutral networks and in compensated neutral networks, the device has a directional earth fault protection, with two thresholds (67NS1 and 67NS2); each threshold can be enabled independently from the other. The two thresholds have a different set of angular sector of intervention (60÷255° for 67NS1, 60÷120° for 67NS2).

Through the use of an external signal coming from the remote control system, it is possible to control the surveillance direction of the protection when power is supplied from the opposite side of the network (direction of action looking at busbar side of Secondary Substation).

The device acquires the measurement of earth current through an homopolar current sensor, calculates the homopolar voltage using the measurement of the three phase voltages and computes the phase angle between the homopolar voltage and the residual current.

The directional earth fault protection requires the setting of the following parameters:
- residual voltage threshold (Threshold 67 Vo) adjustable range 1÷16% Vn, in step of 1%
- earth fault current threshold (Threshold 67 Io) adjustable range 1÷20 A, in step of 0.5 A

The directional protection detects an earth fault if all the following conditions occur simultaneously:
- residual voltage greater than the threshold 67Vo
- earth fault current greater than the threshold 67Io
- the phase angle between the residual voltage and the earth fault current is inside of angular sector of intervention of the threshold (phase angle Io compared with Vo in lag clockwise and with reverse signal absent)

- all the above conditions are detected for a time longer than 80 ms (this time is programmable).

Signaling intervention of threshold 67NS1 is provided by relay TS67AV; in case of intervention of threshold 67NS2, relays TS67AV and TS51A activate simultaneously. The contacts of relays are connected to terminal block MB and acquired by remote control system. A red LED on the front of the device turns on when a trip occurs.

Voltage presence function (59)

This function uses three phases voltages measurement, and provides the voltage presence signaling when the value of at least one of the phase voltages is higher than 80% of the rated value of phase voltage.

The voltage presence function has two thresholds values:
- voltage presence threshold, set at 80% of rated voltage (with accuracy of 4%)
- voltage absence threshold, set at 20% of rated voltage (with precision of 4%)

These thresholds are used to detect transitions between voltage presence/absence condition as follows:
- starting from the condition of line voltage absence, the logical state Voltage Presence is acknowledged if, for at least 250 ms, it is detected the condition:

(V4 > 80%Vn) OR (V8 > 80%Vn) OR (V12 > 80%Vn)

- starting from the condition of line voltage presence, that logical state is no more acknowledged if it is detected the condition:

(V4 < 20%Vn) AND (V8 < 20%Vn) AND (V12 < 20%Vn) without delay.

Voltage Presence signaling is provided by relay TSPresV, whose contacts are connected to terminal block MB and acquired by remote control system. Three green LEDs on the front of the device, one for each phase voltage, turns on when the voltage presence condition is detected for that phase.

Residual overvoltage protection (59Vo)

This protection function can be enabled or disabled by the user (default is disabled).

The threshold value of residual overvoltage protection can be set from 1% to 40% of rated voltage, in steps of 1%. This threshold has a time delay, whose value can be set from 0 to 60 s, in steps of 0.1 s.

Signaling protection intervention is provided by relay TS67AV, whose contacts are connected to terminal block MB and acquired by remote control system.

Negative sequence overvoltage protection (59Vi)

This protection function can be enabled or disabled by the user (default is disabled).

The threshold value of negative sequence overvoltage protection can be set from 1% to 40% of rated voltage, in steps of 1%. This threshold has a time delay, whose value can be set from 0 to 60 s, in steps of 0.1 s.

Signaling protection intervention is provided by relay TS67AV, whose contacts are connected to terminal block MB and acquired by remote control system.

Positive sequence undervoltage protection (27Vd)

This protection function can be enabled or disabled by the user (default is disabled).

The threshold value of positive sequence undervoltage protection can be set from 20% to 110% of rated voltage, in steps of 1%. This threshold has a time delay, whose value can be set from 0 to 60 s, in steps of 0.1 s.

Signaling protection intervention is provided by relay TS67AV, whose contacts are connected to terminal block MB and acquired by remote control system.

Voltage sensors supervisor function (VSS)

This function can be enabled or disabled by the user (default is disabled).

This function uses the residual voltage measurement and has a threshold value that can be set from 1% to 40% of rated voltage, in steps of 1%. This threshold has a time delay, whose value can be set from 1 to 600 s, in steps of 1 s.

Permanence of residual voltage above the programmed threshold for a time longer than the value set for the delay time is used to detect a fault condition of the capacitive dividers used for voltage measurement, therefore the function 67N is disabled and relay TSPresV is placed in quiescent status (the three green LEDs used by voltage presence function will emit a flashing warning). Protection functions 51 and 51N are not affected by this kind of anomaly.

Current converter

The device RGDAT-A70 provides to remote control system a 4÷20 mA current output, proportional to the value of the current measured by current sensor connected to pin 2 of terminal block MA.

Using the configuration software, the user can program the full scale value of current output, from 100 A to 900 A, in steps of 10 A.

Features required by Endesa

With firmware and software version starting from 1.10, some features required by customer Endesa were introduced to fit the operation of RGDAT-A70 with its needs.

In detail:
- the command of relay TS51A is issued only when, after tripping of thresholds 51, 51N, or 67N.S2, the condition of "Voltage Absent" is detected within a certain time (TAtt, programmable, default 0.4 s).
- the command of relay TS67AV is issued only when, after tripping of thresholds 67N.S1 or 67N.S2, the condition of "Voltage Absence" is detected within a certain time (TAtt, programmable, default 0.4 s).
- the return to quiescent status of relays TS51A and TS67AV occurs when "Voltage Presence" condition is detected and that condition holds for a certain time (TDis, programmable, default 10 s).
- if there is no return of power within a certain time (TDurata, programmable, default 4 hours), relays TS51A and TS67AV return to quiescent status anyway.
- LEDs 51 and 67 follow the state of respective relay.
- event logging also records the issuance of commands to relays TS51A and TS67AV, in addiction to tripping of various thresholds.

TECHNICAL CHARACTERISTICS

Auxiliary power supply

Rated value	24 V_{DC}
Range of application	19 ÷ 29 V_{DC}
Typical power consumption (at 24 V_{DC})	80 mA

Phase current sensors (Rogowski coil)

Internal diameter	70 mm
Sensitivity	100 mV/kA (at 50 Hz)
Working frequency	40÷1000 Hz
Connection to RGDAT	shielded cables 2 x 0.15 mm^2, length 3.5 m

Residual current sensor (Rogowski coil)

Internal diameter	180 mm
Sensitivity	100 mV/kA (at 50 Hz)
Working frequency	40÷1000 Hz
Connection to RGDAT	shielded cables 2 x 0.15 mm^2, length 3.5 m

Phase voltage inputs

Hexapolar voltage plug	According to ENEL specification DY811
Connection to RGDAT	shielded cables 0.5 mm^2, length 3.5 m

Digital input

Type of circuit	Optoinsulated
Rated voltage	As auxiliary power supply
Supply power consumption	typical 3 mA

Output relays

Type of contacts	Normally open
Rated voltage	250 V
Rated current	5 A
Breaking capability (24 V_{DC}, L/R = 40 ms)	0.2 A

Current converter

Measurement range	0 ÷ 900 A (programmable)
Output current	4÷20 mA
Precision	10 %
Maximum output load	700 Ω
Response time	< 300 ms

RS232 serial communication

Type of connector	D-sub, 9 pin, female
Settings	9600 baud, 8 data bit, no parity, 1 stop bit
Protocol	Custom (see document P515D403)

Environmental conditions

Operating temperature   -10 ÷ +55 °C
Relative humidity   ≤ 93% (without condensing)
Storage temperature   -20 ÷ +70 °C

Mechanical characteristics

The RGDAT is housed in a metallic case, whose dimensions are shown in the following figure.
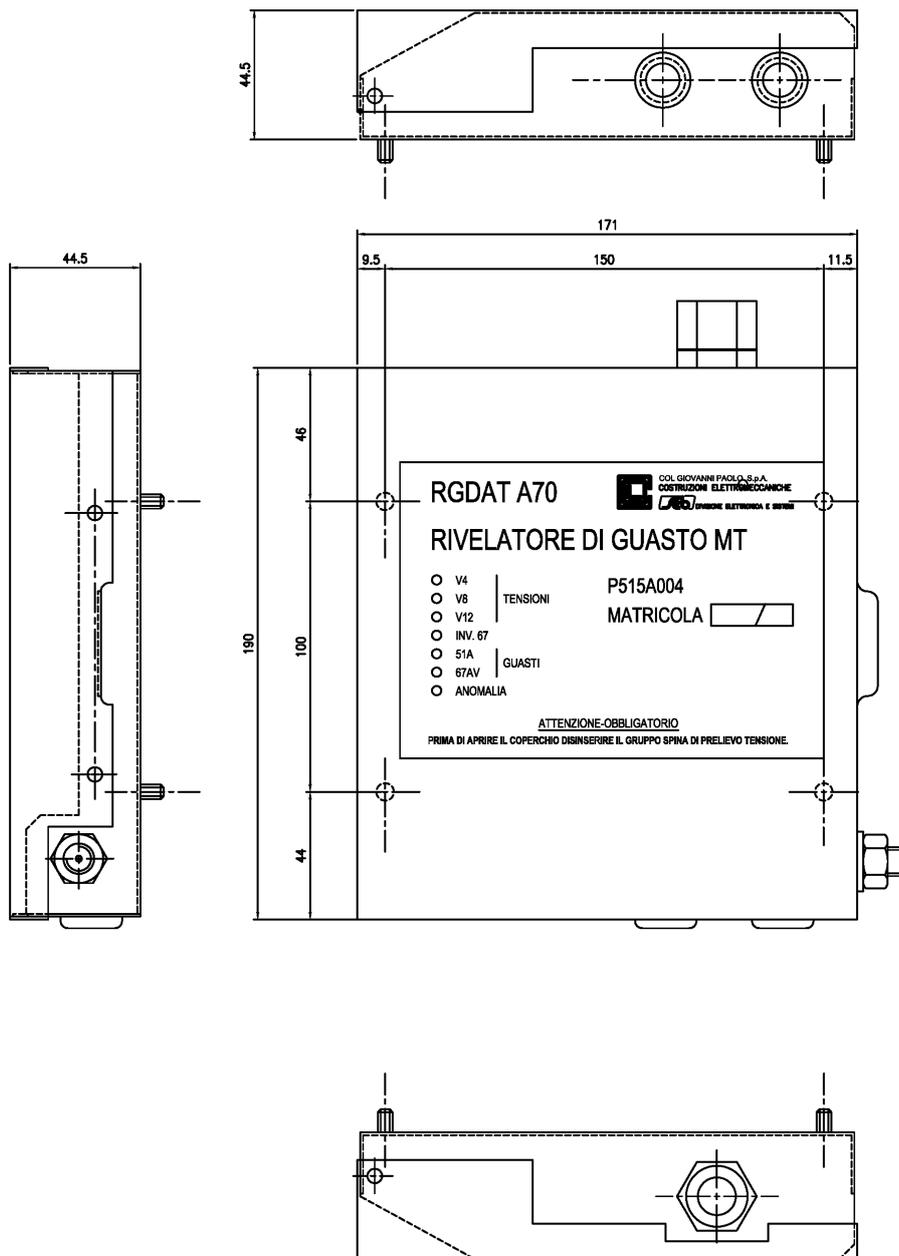
The device is supplied with 4 screws and M5 stainless steel washers for fixing.
On the right side of the box there is a M10 ground terminal.

On the front cover of device, starting from the top, there are:

- three GREEN LEDs, to signal the voltage presence of three phases of MV network
- a WHITE LED, to signal the inversion of surveillance direction of directional earth fault protection
- an ORANGE LED, to locally signal the intervention for polyphase fault or double single-phase ground fault
- a RED LED, to locally signal the intervention for line side single-phase fault
- a RED LED, blinking, to signal a device failure

On the top side of case there is a cable gland for the connection cable with remote control unit.

On the lower side of case there are the outputs (with cable gland) for connections with current transducers and with the hexapolar plug inserted on the capacitive dividers to acquire the voltage measurements.

Terminal blocks

Terminal block MA

It is the terminal block on which you connect the voltage signals (taken by the hexapolar plug) and current signals (using the current sensors).

Pin number	Signal name	Notes
1	COM_I	Current sensors common connection
2	I_4	Current sensor I4
3	I_0	Current sensor Io
4	I_12	Current sensor I12
5	V_4	Input V4
6	V_8	Input V8
7	V_12	Input V12
8	COM_V	Voltage inputs common connection

Terminal block MB

It is the terminal block used by the connection cable to the remote control system. There are the power supply inputs, the outputs relay signals, the 4-20 mA current outputs and the inputs to reverse surveillance direction of directional earth fault protection.

Pin number	Signal name	Notes
1	+VALIM	Power supply input (+24V)
2	TS51A	TS51A relay output
3	TSPRESV	TSPresV relay output

Pin number	Signal name	Notes
4	OUT_4-20+	4÷20 mA current output (+)
5	TS67AV	TS67AV relay output
6		not used (not connected)
7	OUT_4-20-	4÷20 mA current output (-)
8	INV_IN	Reverse signal digital input
9	+VALIM	Reverse signal digital input (common)
10	-VALIM	Power supply input (GND 24V)

The following figure shows the layout of the electronic board, with indication of where terminal blocks MA and MB are placed, and relative pin numbering.

Terminal block MB   Terminal block MA
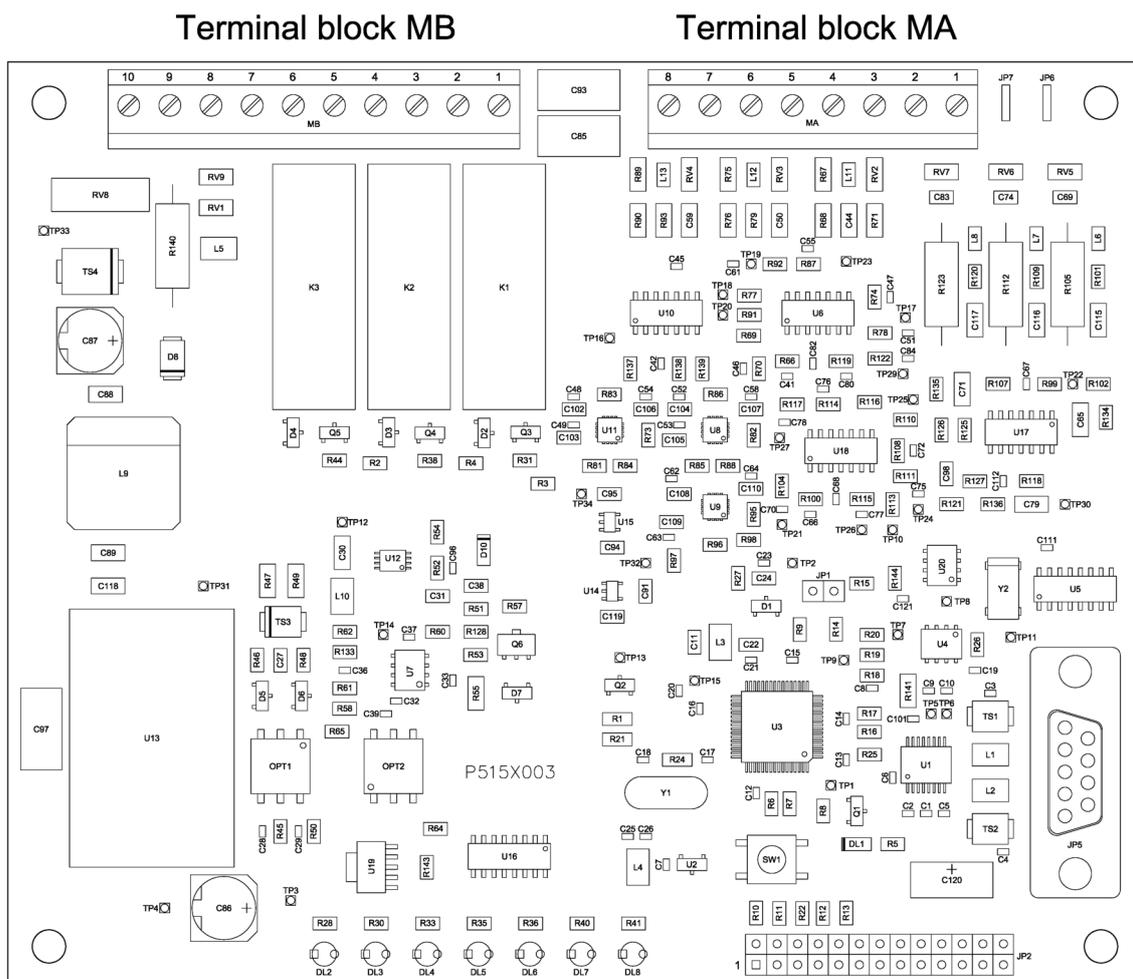
Connector to remote control system

The following figure shows the design of the connector to the remote control system.
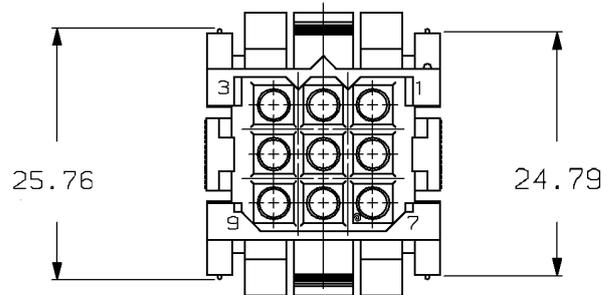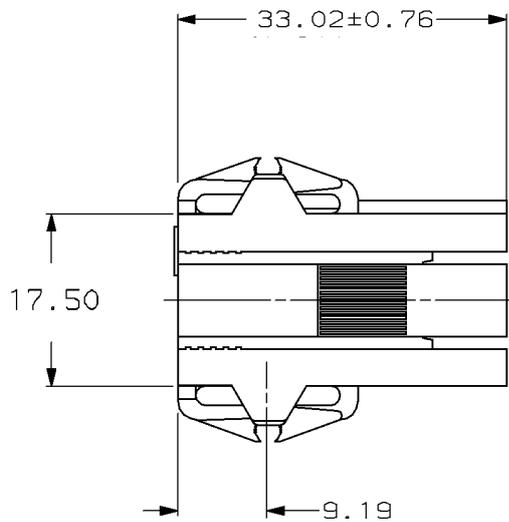
Signals are placed on the connector to the remote control system according to the following table:

Pin number	Signal name	Notes
1	+VALIM	Power supply input (+24V) and remote signals reference
2	TS51A	TS51A relay output
3	TSPRESV	TSPresV relay output
4	OUT_4-20+	4÷20 mA current output (+)
5	TS67AV	TS67AV relay output
6	OUT_4-20-	4÷20 mA current output (-)
7	+VALIM	Reverse signal digital input (common)
8	INV_IN	Reverse signal digital input
9	-VALIM	Power supply input (GND 24V)

PROGRAMMING SOFTWARE (RGDAT_A70)

To do a series of activities with RGDAT-A70 such as parameterization, diagnostics, monitoring, etc. it is available a dedicated software, whose name is RGDAT_A70.

This software runs fine on PC with Microsoft Windows® Xp or newer operating system.

The software is multi-language (at the time of preparation of this document supported languages are: Italian, English, Spanish) and it has a graphical user interface, for easy use.

Communication between PC and RGDAT-A70 is made with an RS232 port, so it is necessary that the PC is equipped with this kind of port (if a physical serial port is not present on the PC, you can use a USB-RS232 converter).

To connect PC and RGDAT-A70 you must use a "straight" serial cable, such as the one shown in the figure.

To gain access to the serial connector of RGDAT-A70 it is necessary to open the cover of the equipment, acting on the prominence in the right side of the cover.

This document refers to the English version of the various parts of user interface.

Software installation

There is a setup wizard, which is activated by running "Setup.exe".
There is an alternate way to start the wizard, running the file "Setup_RgDatA70.msi".

During the setup wizard the user must specify the installation folder of the software.
At the end of installation an icon is created on desktop; that icon can be used to run the software.

Note: If an old version of the software is installed on the PC, you must remove it before installing the new one.

Software removal

You can remove the software using the standard procedures of the operating system.
Please refer to operating system documentation.

Main window

This window allows you to select the various activities you can perform.

There are various menus; each one of them gives access to a specific functionality.
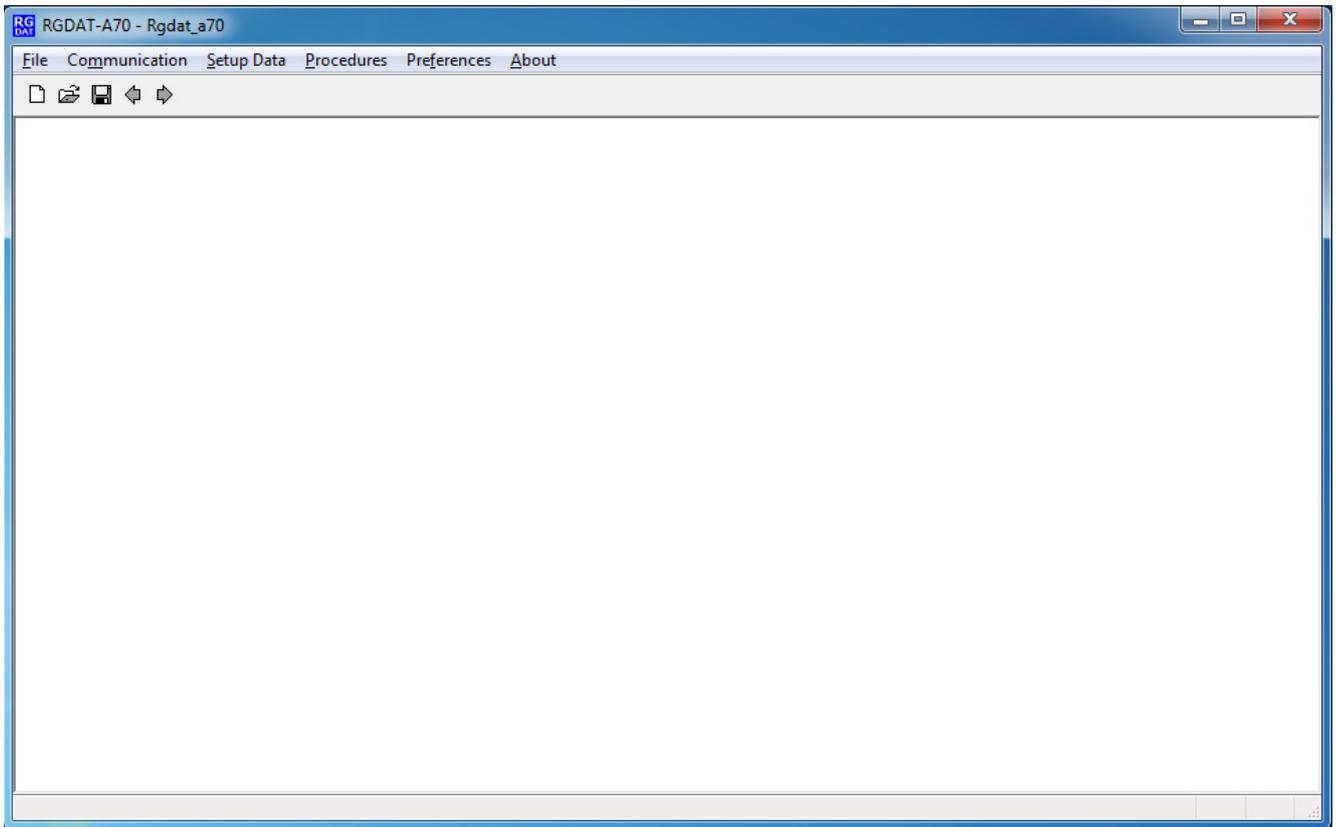
"File" Menu

It has five entries; four of them are used for storing data on file and the last one to quit the program.

The entries have the following behavior:

- the item "New" loads default data in the program database
- the item "Open" opens a standard dialog box to select the file for reading configuration data previously saved
- the item "Save" stores configuration data in a file
- the item "Save as" enables saving configuration data to a different file from the one in use (it shows a standard dialog box to select the name of the new file to store data[1]).

---

[1] The example shows a Windows 7 dialog box; with other operating systems the dialog box could be different.
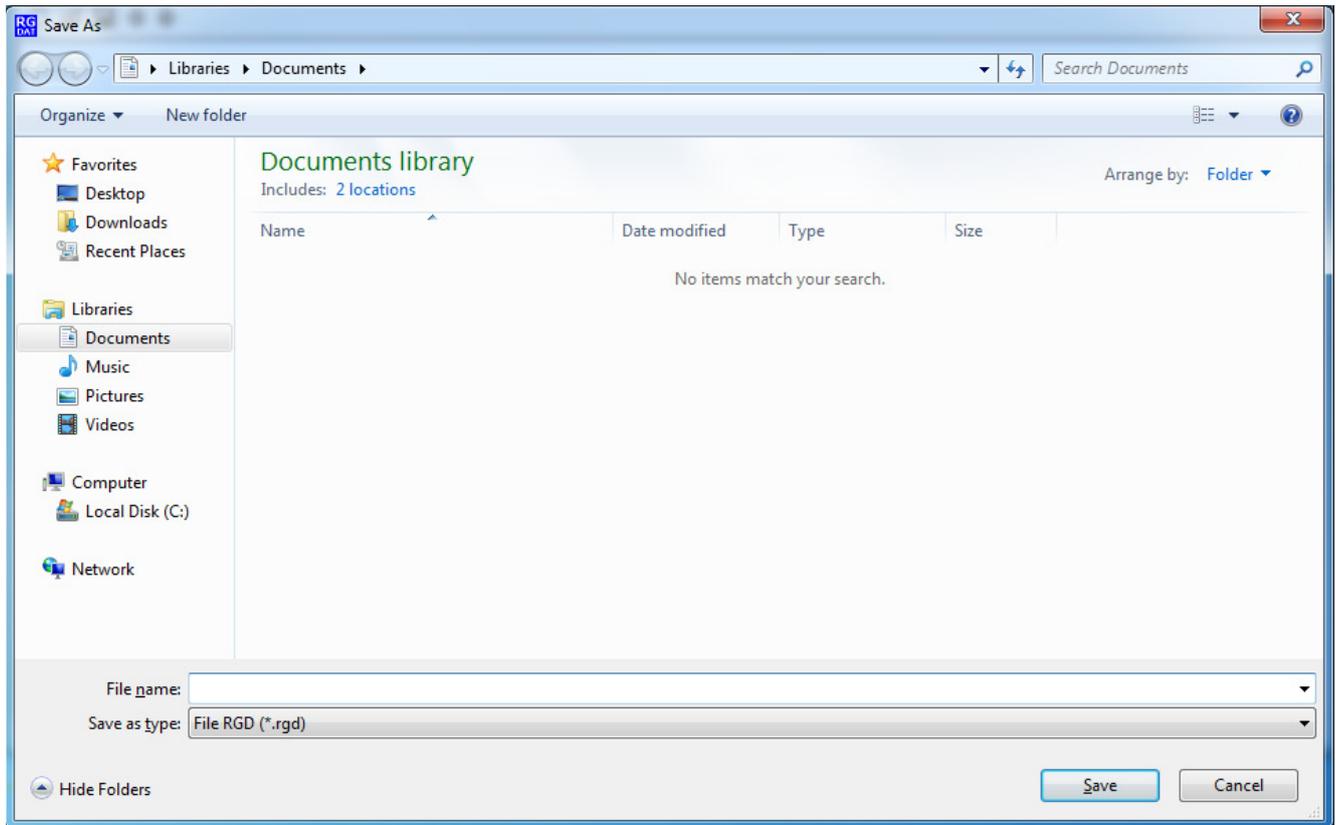
- the item "Exit" ends the program execution

"Communication" Menu

It has two entries, one to select functions for reading data from RGDAT-A70 and the other to select functions for sending data to RGDAT-A70.

"Read data" Submenu

This submenu has a series of items which allow you to read data from the RGDAT-A70 (configuration, measurements, events, diagnostics).

You need to be physically connected with RGDAT-A70 in order to read the required information. If not so, you'll see an error dialog box when you try to access the features of the various items of this submenu.

With the first entry, "Setup data", you can read the configuration data of RGDAT-A70; that data can be viewed and / or edited with the entries of menu "Setup data", which is explained later.
Successfully reading of configuration data is highlighted by a specific dialog box.

The dialog box associated with the item "Measures and status" displays the values of electrical measurements acquired and / or calculated by RGDAT-A70, the output relays status, the LEDs status, etc.

Data are updated about once per second.

Measures and status

Measures

V4 Voltage	1.000 Un
V8 Voltage	1.000 Un
V12 Voltage	1.000 Un
I4 Current	0.0 A
I8 Current	----
I12 Current	0.2 A
Vo Voltage	0.0003 Uon
Io Current	0.01 A
Vd voltage	1.000 Un
Vi voltage	0.000 Un
Frequency	50.00 Hz

Phase V4-V8	240.0°
Phase V4-V12	120.0°
Phase Vo-Io	----

Leds

- ▪ Led V4
- ▪ Led V8
- ▪ Led V12
- ☐ Led Inversion
- ☐ Led 51
- ☐ Led 67
- ☐ Led Fault

I/O

Inversion input	Absent
Relay TS 51A	OFF
Relay TS 67AV	OFF
Relay TS PRES V	ON

VSS function

VSS status	OFF

Cont = 18

Close   Save to file

The execution of this activity has no impact in protection functions of RGDAT.

By pressing the button "Save to File" you save last reading data in a file, whose name is shown in a dialog box.[2]

---

[2] The folder where the file containing the measurements is created is the same that stores configuration data.

Measures and status

Measures

V4 Voltage	1.182 Un		
V8 Voltage	1.220 Un	Phase V4-V8	240.0°
V12 Voltage	1.185 Un	Phase V4-V12	119.9°
I4 Current	0.1 A		
I8 Current	0.3 A		
I12 Current	0.4 A		
Vo Voltage	0.0121 Uon		
Io Current	0.6 A	Phase Vo-Io	----
Vd voltage	1.196 Un		
Vi voltage	0.013 Un		
Frequency	50.00 Hz		

Leds
- ☐ Led V4
- ☐ Led V8
- ☐ Led V12
- ☐ Led Inversion
- ☐ Led 51
- ☐ Led 67
- ☐ Led Fault

I/O

Inversion input	Absent
Relay TS 51A	OFF
Relay TS 67AV	OFF
Relay TS PRES V	OFF

VSS function

VSS status	OFF

Close   Save to file

Cont = 12

If the voltage calibration procedure is not performed, voltage measurements (and related items) are displayed with red color.

The menu item "Events" allows you to get information related to thresholds trips; it displays a dialog box that brings together in summary form such information (tripping threshold, date and time of the intervention).

Events

	Event	Date	Time
Event 1	Trip 51N	26/03/2015	08:54:11
Event 2	Trip 51N	26/03/2015	08:53:51
Event 3	Trip 51N	26/03/2015	08:53:29
Event 4	--	-	-
Event 5	--	-	-
Event 6	--	-	-
Event 7	--	-	-
Event 8	--	-	-
Event 9	--	-	-
Event 10	--	-	-

Close   Save to file

By pressing the button "Save to File" you save events data in a file, whose name is shown in a dialog box.[3]

Clicking on the button of the event you are interested, another window showing more detailed information is displayed, and also allows you to navigate through the various events.
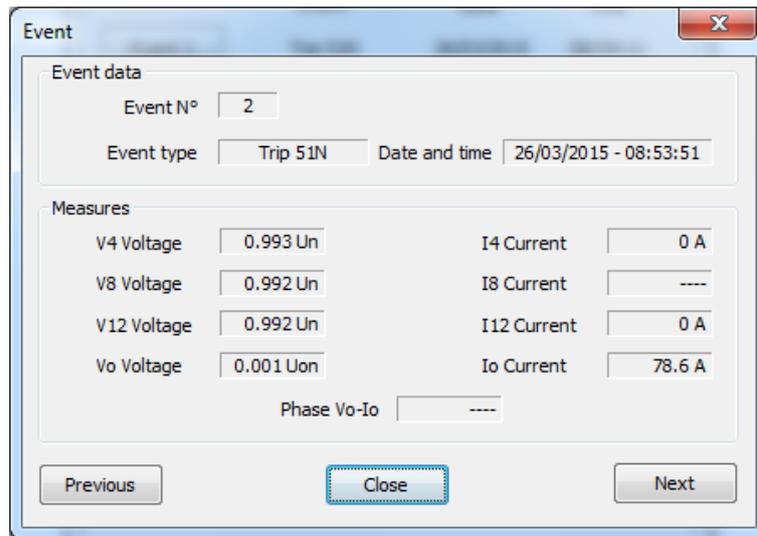
Events are stored by RGDAT-A70 in a non-volatile memory, so they are retained even if you turn off the equipment.

The last item on this submenu, "Diagnostics", allows you to get the information processed by internal self-diagnostic module of RGDAT-A70. It displays two items: the current diagnostics, instantaneous, and the historical one, showing the conditions recorded since the last power-on.
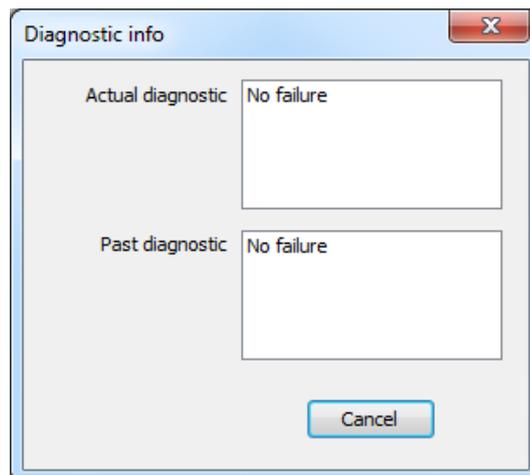
"Send data" Submenu

This submenu has a series of items which allow you to send data to the RGDAT-A70 (configuration, date & time, etc.).

---

[3] The folder where the file containing events data is created is the same that stores configuration data

You need to be physically connected with RGDAT-A70 in order to send data. If not so, you'll see an error dialog box when you try to access the features of the various items of this submenu.

With the first entry, "Setup data", you can send the configuration data to RGDAT-A70; that data can be set with the entries of menu "Setup data", which is explained later.
Successfully sending of configuration data is highlighted by a specific dialog box.

The second entry, "Clock setup", allows you to set the time reference of RGDAT-A70, using date and time of PC.
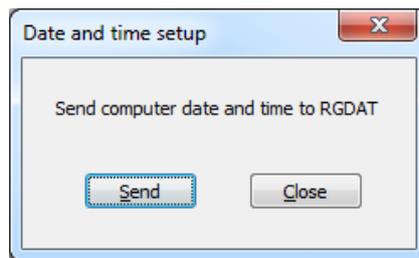
Note: RGDAT-A70 is equipped with an energy storage system, which allows it to hold the date and time information for at least 4 hours even in the absence of auxiliary power supply.

"Setup data" Menu

This menu has a series of items which allow you to set the operating parameters of RGDAT-A70 (functions, threshold values, etc.).

The information displayed in the dialog boxes related to the various items of this menu can be obtained by one of the following options:

• being default data, loaded at program startup or via the menu item "File→New"

• reading a data file, via the menu item "File→Open"

• reading data from RGDAT-A70, via the menu item "Communication→Reading→Configuration data"

The item "Rated values" allows you to read and configure the operating mode of RGDAT-A70, the line voltage rated value and allows you to read various information about the RGDAT-A70 (serial number, firmware release, etc.).

The item "Thresholds 51 51N 67N" allows you to read and configure phase overcurrent, earth fault overcurrent and directional earth fault thresholds. It is also possible to set the full scale value of 4÷20 mA output; the starting value is always 0 A.

As standard behavior when the dialog box is displayed, the delays associated with the various thresholds are not modifiable; to edit them you must select the check-box located at the bottom of dialog box.

Thresholds 51 51N 67N

Threshold 51

☑ Enable threshold 51

Threshold 51 `500` A (100 - 900 step 50)

Threshold 51 delay `0.050` s (0 - 1 step 0.005)

Threshold 51N

☑ Enable threshold 51N

Threshold 51N `150` A (10 - 200 step 10)

Threshold 51N delay `0.085` s (0 - 1 step 0.005)

Threshold 67N

☑ Enable threshold 67NS1

☐ Enable threshold 67NS2

Threshold 67N (I) `1.0` A (1.0 - 20.0 step 0.5)

Threshold 67N (V) `4` % (1 - 20 step 1)

Threshold 67NS1 delay `0.110` s (0 - 1 step 0.005)

Threshold 67NS2 delay `0.110` s (0 - 1 step 0.005)

Analog output

Full scale value `500` A (100 - 900 step 10)

☐ Enable thresholds delays editing
☐ Reset allarms at voltage return

[OK]   [Cancel]

The item "Thresholds Annex A70" allows you to read and configure positive sequence undervoltage, negative sequence overvoltage and residual overvoltage thresholds. These thresholds can be enabled independently.

It also possible to set the quiescent status of the various relay used as remote signals as normally de-energized (selection "OFF"), or normally energized (selection "ON").
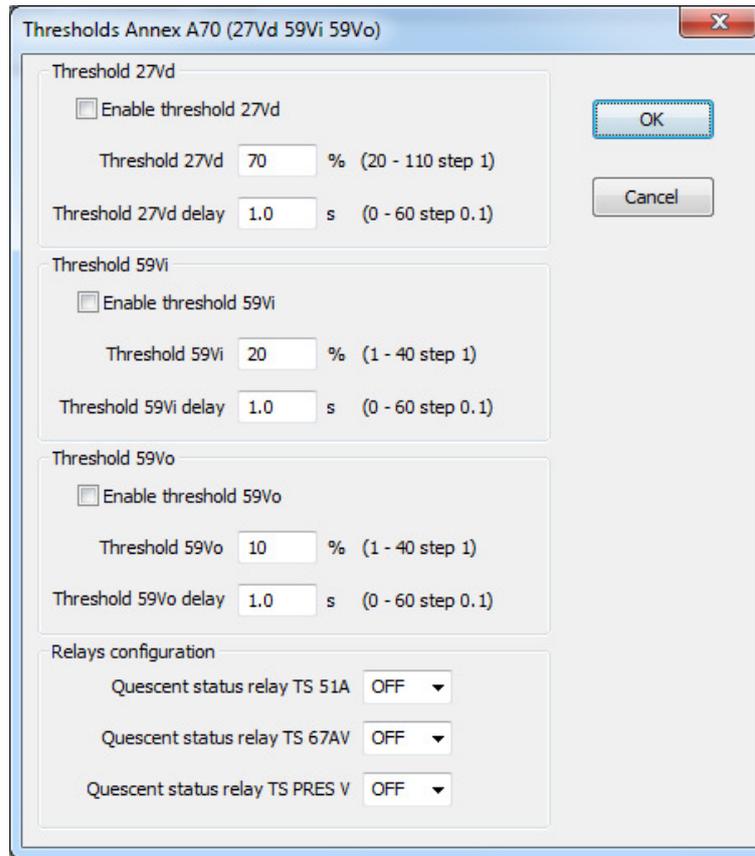
The item "VSS Function" allows you to read and configure the parameters for this function.
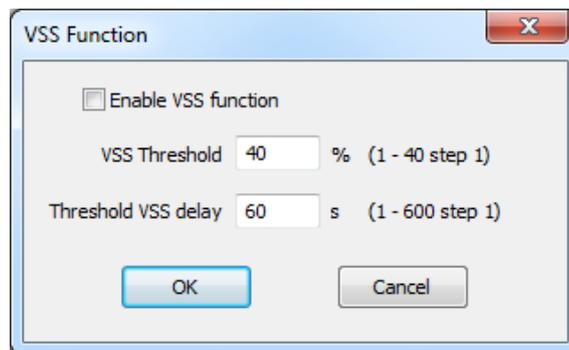
The item "Voltage monitoring" allows you to read and configure the parameters for this function. These parameters are used if you select such function in "General Data" dialog box.
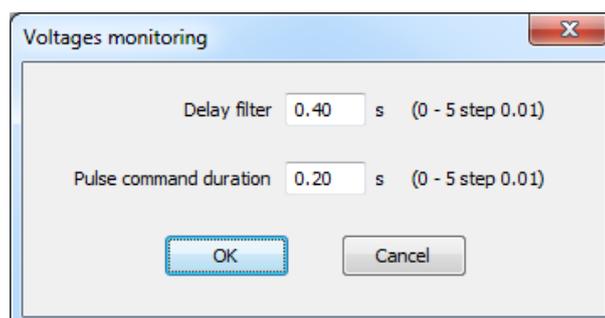
The item "Features for Endesa" is available only if the detected RGDAT-A70 firmware version implements these functions; otherwise the item is disabled.
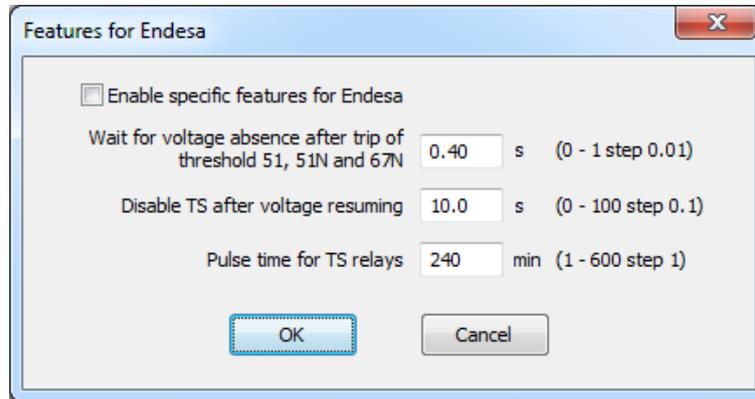
The item "Features for RGDAT-A70 /O" is available only if the detected RGDAT-A70 firmware version implements these functions; otherwise the item is disabled.
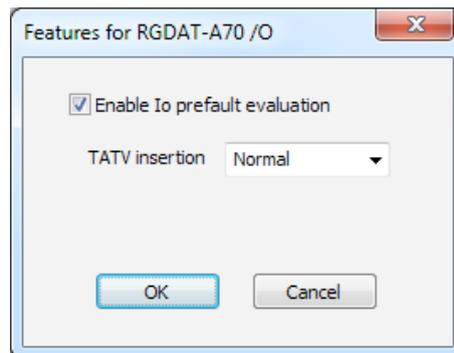
This dialog-box allows you to enable Io (homopolar current) calculation in healthy network conditions (prefault), and then subtract that value to Io when a fault occurs. The use can also specify the insertion mode for combined sensors (Normal or Reverse).

As you may have noticed, all these dialogs contains "OK" and "Cancel" buttons; their purpose is to accept the changes made in the dialog box ("OK"), or to exit the dialog box, ignoring any changes ("Cancel" button).

To make sure that the data modified in these dialog boxes are transferred to RGDAT-A70, please use the menu items "Communication→Send data→Setup data".

"Procedures" Menu

This menu has a number of sub-menu items used to perform useful tasks during the commissioning of RGDAT-A70.

The "Voltage calibration" item allows you to make the automatic calibration of inputs that acquire voltage measurements; this task must be executed during the RGDAT-A70 commissioning, if RGDAT-A70 is moved to another plant, or if one of the capacitive dividers used to acquire voltage measurement is replaced.

Using this dialog box you can also set status of RGDAT in condition "Voltages not calibrated".
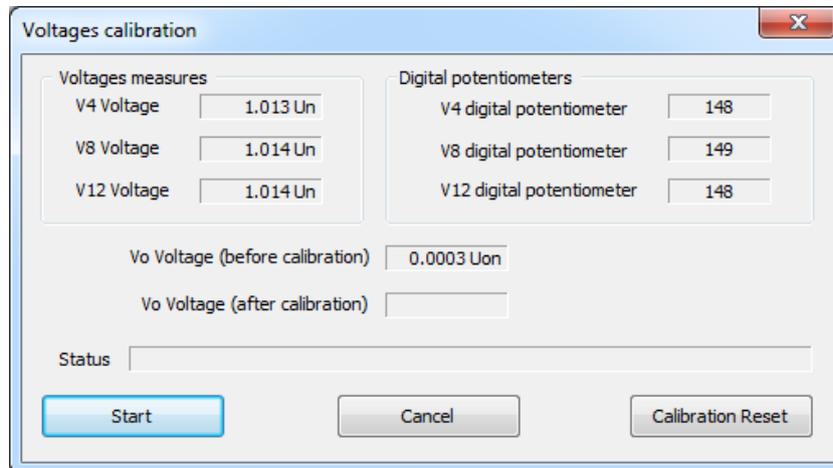
During the execution of voltages calibration procedure, the LEDs V4, V8 and V12 blink and relay TSPresV is de-energized.

Note: The voltages calibration process must be performed in absence of faults in MV network and must be repeated if a fault occurs during the execution of the procedure.

When voltages calibration procedure is in progress the device RGDAT-A70 is unable to perform its protection functions.

For more information on this, please see the chapter "Commissioning".

The menu item "Diagnostic" displays a dialog box that allows you to perform diagnostics tasks on RGDAT-A70, such as energizing or de-energizing the output relays, performing a diagnostic routine, forcing the output of current converter to a value proportional to a specified data.
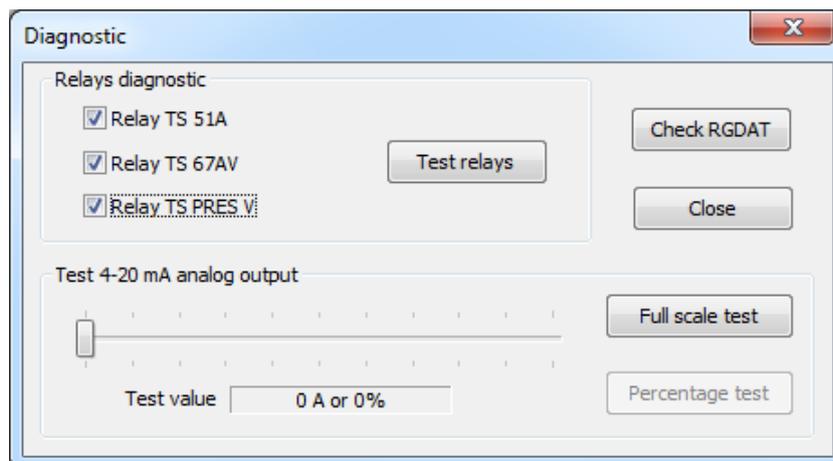
To control output relays, select (or deselect) the related check-box and press the "Test relays" button.

To perform a verification routine of RGDAT-A70, press the "Check RGDAT" button. The execution of the verification routine has an immediate visual feedback on RGDAT-A70 itself and ends automatically after a few seconds.

To control the 4÷20 mA output current, use the proper cursor and one of two buttons on the side: the "Full scale test" allows you to correlate the current value displayed below the cursor as if it were the current measured by the current sensor connected to terminal block MA2 (I4); the output current value is also a function of the full scale value set in the dialog box "Thresholds 51 51N 67N". The button "Percentage test" is used to set the output current to a value related to the effective dynamic range of the converter (can be useful when debugging).

During the execution of diagnostic procedures, the device RGDAT-A70 does not perform protection functions.

When the diagnostic activity ends (that is when the dialog box is closed), the equipment RGDAT-A70 resumes its normal protection functions.

Note that RGDAT-A70 quits diagnostic mode if at least 5 minutes have elapsed without performing any activity.

The item "Alarms reset" switches off the trip signaling LEDs of thresholds 51, 51N and 67N (if thresholds are no longer in trip conditions).
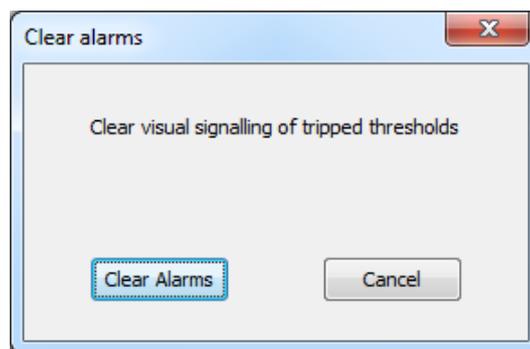
The item "Reset events" clears the event data recorded by RGDAT-A70.
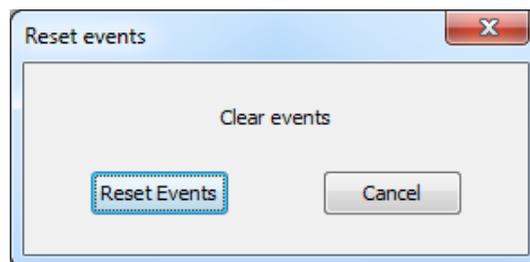
The item "Firmware Update" starts the procedure for updating the firmware of the device. It is a fully automatic procedure and takes several minutes to complete.

At the end of the procedure you need to restart (i.e. shut off and then on again) the device RGDAT-A70 (or press the appropriate pushbutton on electronic board).

For the duration of this procedure the device is not able to perform its protection functions.
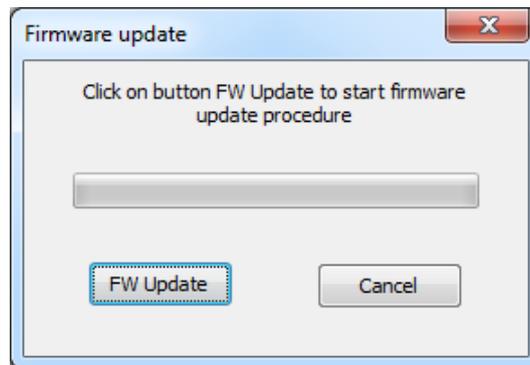
If you perform a firmware update of RGDAT-A70, it is suggested to set the device with default data with the proper command and then resume the setup data.

The item "Default data" restores the RGDAT-A70 configuration values to defaults one.

With a proper checkbox you can set voltages calibration status in condition "Voltages not calibrated". This can be useful if you want to move the device RGDAT-A70 to another plant and you want to be sure that voltages calibration procedure will be executed.

Note: other items in this menu are reserved for exclusive use by the manufacturer and are normally disabled in the version of the software that is distributed for use by end users.

"Preferences" Menu

Provides access to the settings of user interface language of the program and to the selection of the serial port used for communication with RGDAT-A70.

Preferences are stored in the registry.

The item "User interface language" allows you to change the language used in menus and dialog boxes.

If you change the user interface language, you must restart the program to make the changes effective. An appropriate dialog-box reminds this.

The item "Select serial port" is used to select the serial port used for communication with the equipment RGDAT-A70. Note that the selection list displays only the serial ports actually available in your computer.
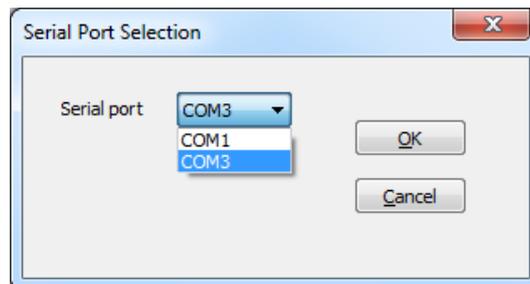
"About" Menu

This item displays a dialog box that contains information about the software itself.
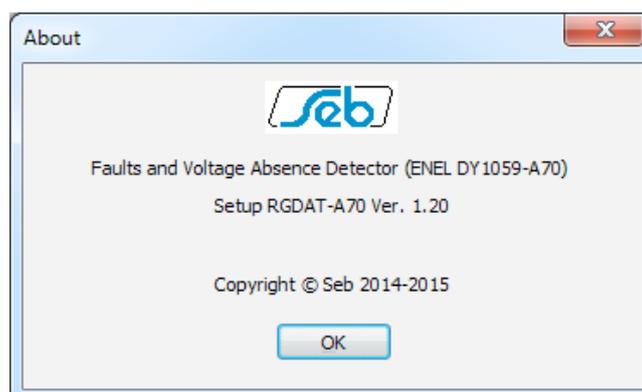
INSTALLATION

Mechanical assembly

The assembly procedure has some common operations, regardless of the type of current sensors used, while there are differences related specifically to current sensors.

Device RGDAT-A70

Open the cover of the device and, using the four screws and washers, place the device in the specified location.

Current sensors (Rogowski coil)

No special care is required with regard to the outputs of these sensors (the signal levels are very low).

If you want to replace the device RGDAT-A70 or to make tests on current circuits, it is necessary that the associated circuit breaker is open (use caution because line voltage may still be present).

Due to the fact that ground faults detecting function is directional, it is essential to respect the assembly direction of residual current sensor, otherwise improper operation of RGDAT-A70 will occur; it is therefore important that current sensors are assembled with the labeled side (marked "P1") in the correct direction (to facilitate the identification there is also a red stamp that identifies P1).

Phase current sensors
To perform a correct assembly proceed as follows:
- Assembly the sensor around the phase conductor being careful **not to include** the ground connection of shielding braids.
- Close the coil using the proper locking system.
- Connect the wires to RGDAT-A70.

Residual current sensor
To perform a correct assembly proceed as follows:
- Assembly the sensor around the phase conductors.
- Close the coil using the proper locking system.
- Place the core around the phase conductors using the insulating clamps supplied.
- Connect the wires to RGDAT-A70.

In order not to cancel the fault current measurement, it is required that the sensor includes the ground connection of shielding braids.

It is important that the fitting direction of sensors is such that **"P1" reference is positioned toward the top of MV cubicle**. If on the sensor there is an arrow indicating the direction of the current, it should be oriented toward the bottom of MV cubicle.

Note: In order to ensure a linear response of the sensor, the conductors must be placed in the center. In this way the magnetic effect of the three cables is fully compensated in the absence of residual current.
The same considerations apply if sensor is close to the cable bend.
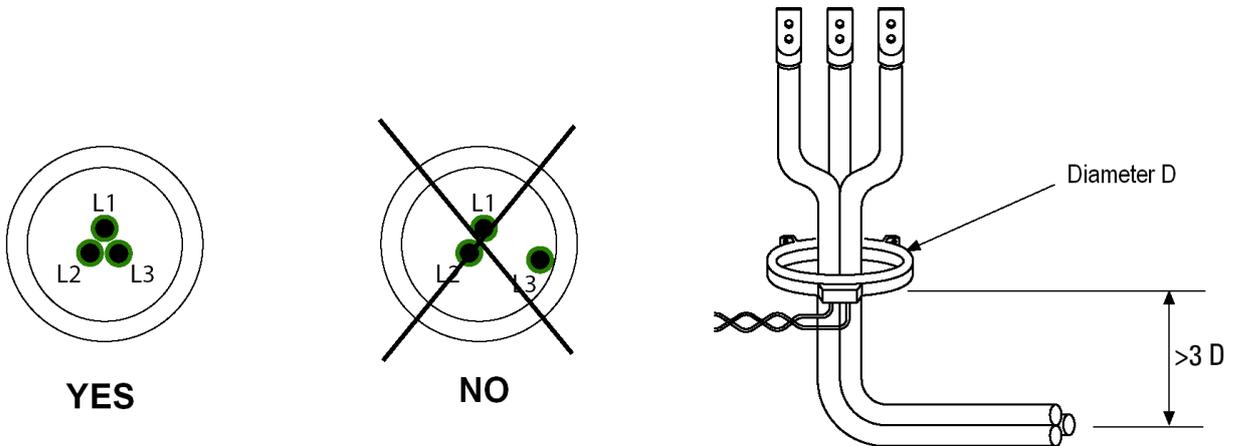
Voltage transducers

- The hexapolar plug used to get voltage measurements is supplied already connected to the terminal block MA, so the only action required is to insert the plug into the hexapolar socket of MV switchgear (usually used for voltage presence lamps).

Electrical connections of current sensors (Rogowski coil)

- Pass the 3 shielded cables from the current sensors through the cable gland.
- Connect the conductors to the proper terminal blocks (MA1-MA2-MA3-MA4), according to wiremarker labels that are superimposed the conductors.
- Connect the fastons (female) of the phase current sensors to the male faston located near the terminal block MA

The figure below shows how the inside of RGDAT-A70 should be once you have done the operations described above.
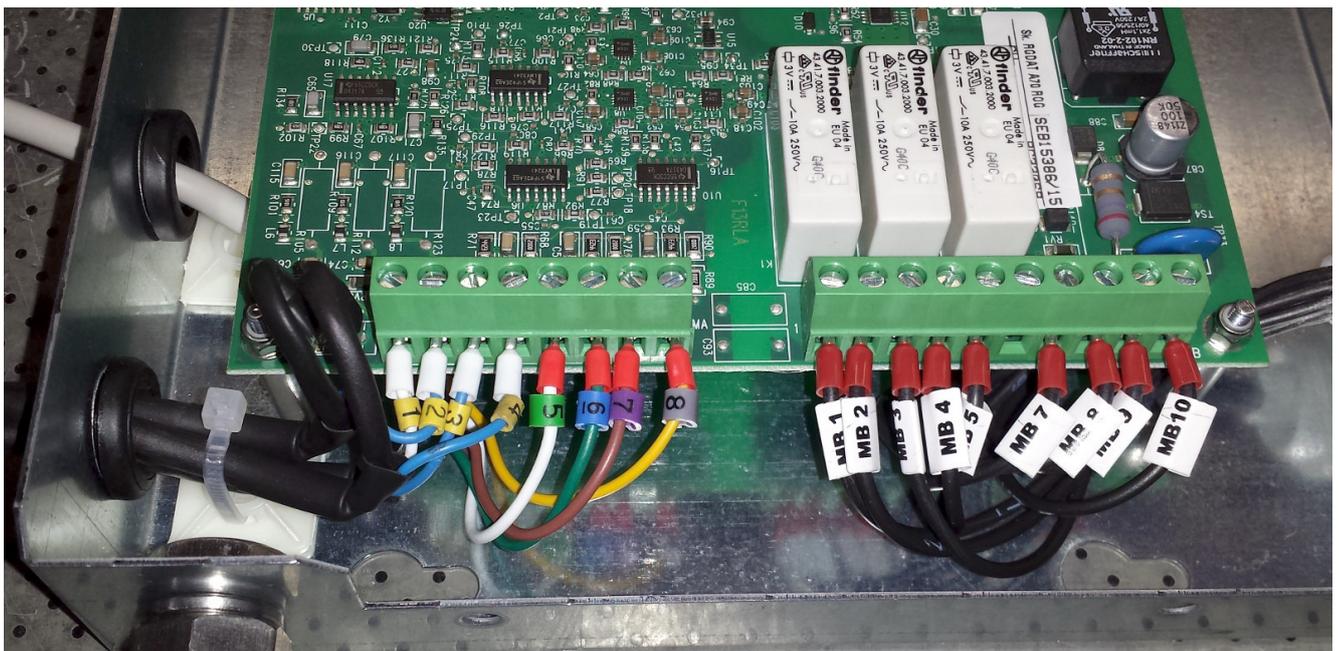
Setting

You can set operating values of the various protection functions using the appropriate configuration software (RGDAT_A70). For more information, please refer to chapter "Programming Software".

COMMISSIONING

For the commissioning you have to apply the auxiliary power supply by inserting the connector into the corresponding socket of remote control unit.

When RGDAT-A70 switches on, LEDs turn on in sequence (indicating the execution of boot-loader), after that all LEDs turn on simultaneously for about 1 s, indicating start of application firmware; then all the LEDs are turned off except for LED V4, V8, V12 (these LEDs stay on only if corresponding phase voltages are present and voltage calibration procedure was previously done).

To verify the right operation of the device, you can measure the power supply current, which, in quiescent status and with a supply voltage equal to nominal value (24 V_{DC}), should be in the range 50 to 100 mA.

Voltage inputs calibration procedure

At the first installation of RGDAT-A70 in the field, or when you move it to another plant, or even in case of replacement of one of the capacitive transducers used for phase voltages measurement, you must execute the procedure described below.

The purpose of voltage inputs calibration procedure is to adjust RGDAT-A70 voltage inputs to the capacitive transducers used in Secondary Substation MV switchgear.
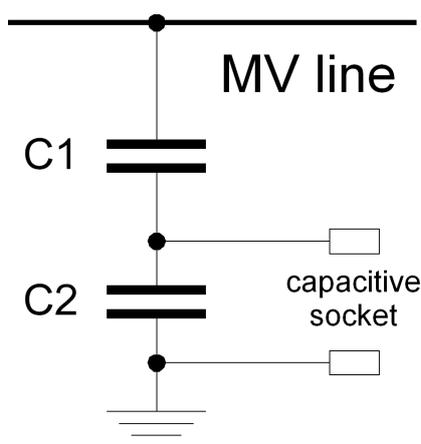
The characteristics of the transducers, with reference to the previous figure, must be the following:

Transformation ratio (between MV voltage and the voltage present on the capacitive socket)	200 ÷ 2000
Capacitive reactance XC1 (at 50 Hz)	100 ÷ 700 MΩ
Voltage induced by capacitive coupling between sockets	30%

The procedure must be performed in absence of faults on MV network and must be repeated in case a fault occurs during execution of the procedure.

The calibration procedure can be performed at any time later but you must check the conditions described in the previous paragraph.

To perform the voltage inputs calibration procedure, you must use the software RGDAT_A70 as described in the chapter related to the programming software.

Please note that until you do not perform the voltage inputs calibration procedure, the protection functions of RGDAT-A70 are disabled, unless you select the operating mode "Limited", in which case the thresholds 51 and 51N are active.

ADDENDUM A

In Addendum A there are diagrams and explanatory drawings.
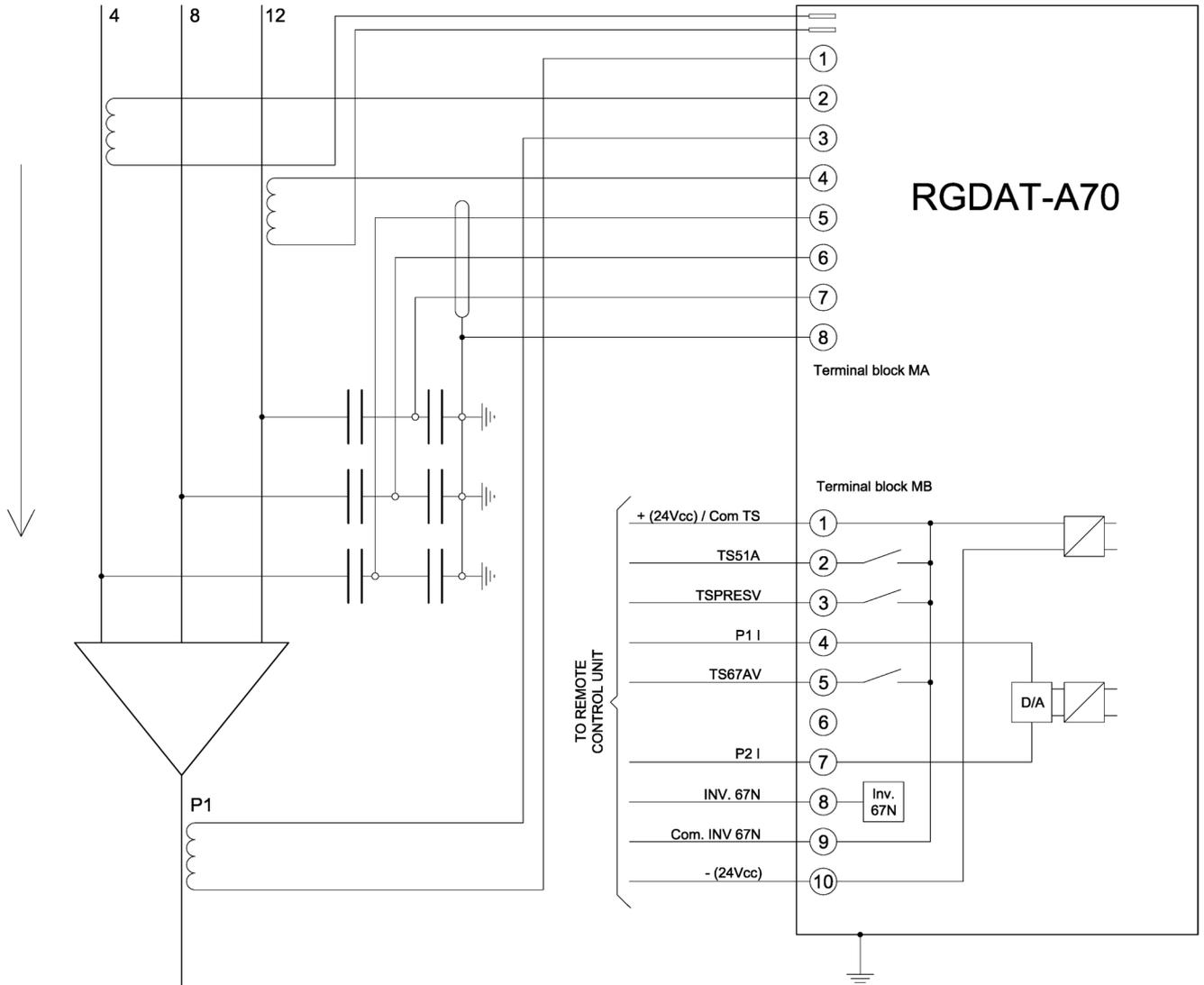
Wiring diagram of RGDAT-A70 (version with Rogowski coil sensors)

Hexapolar plug

RGDAT A70

COL GIOVANNI PAOLO S.p.A.
COSTRUZIONI ELETTROMECCANICHE

RIVELATORE DI GUASTO MT

○ V4
○ V8   TENSIONI   P515A004
○ V12
○ INV. 67   MATRICOLA
○ 51A
○ 67NV   GUASTI
○ ANOMALIA

ATTENZIONE-OBBLIGATORIO
PRIMA DI APRIRE IL COPERCHIO DISINSERIRE IL GRUPPO SPINA DI PRELIEVO TENSIONE.

MV terminations

Earthing
braids of
MV cables

Rogowski coil
phase current
sensors

P1

Rogowski coil
residual current
sensor

MV cables

Schematic representation of connections to RGDAT-A70 (version with Rogowski coil sensors)
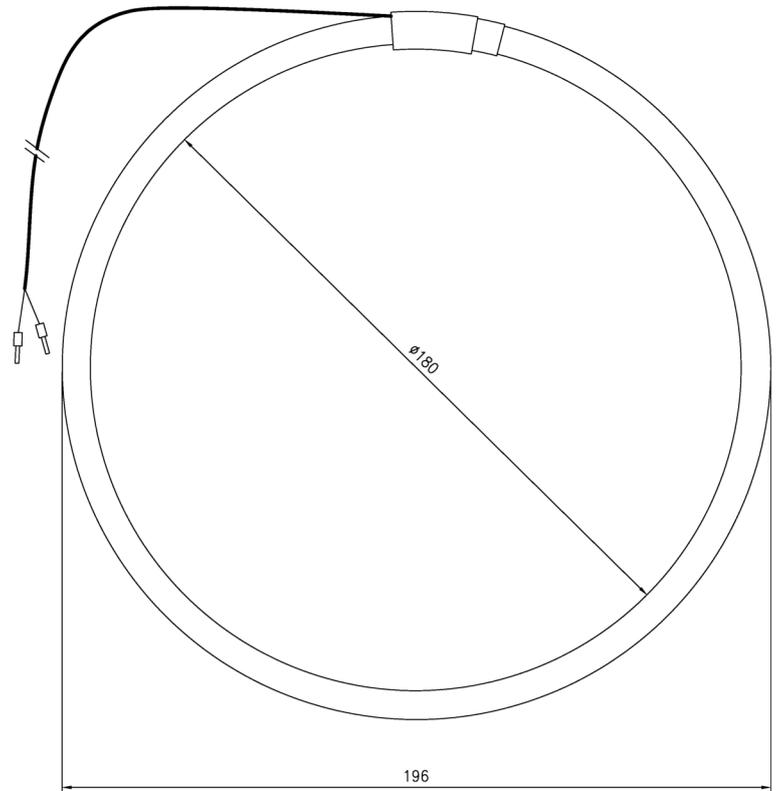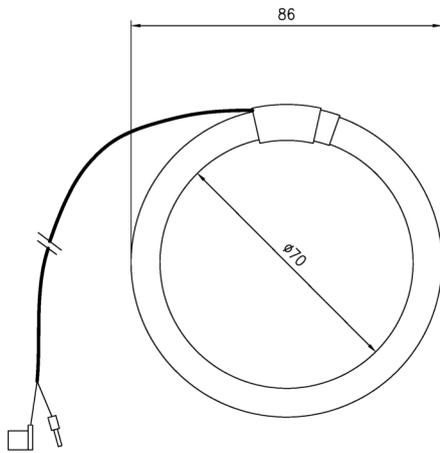
Overall dimensions of current sensors (Rogowski coil)
(phase current sensor on the left, residual current sensor on the right)

ADDENDUM B

Addendum B shows the change log of firmware and software releases of RGDAT-A70.

Changes to firmware RGDAT-A70

Release 1.20

- Added support for RGDAT-A70 Outdoor version (please note that related functions are available only if RGDAT-A70 is used with combined sensors)

Release 1.11

- Added VSS function trip in event recording (request by ENEL)

Release 1.10

- Added support for "3 CT" configuration, with calculation of homopolar current (Io) as vector sum of phase currents
- When you activate the "Test relay" function, LEDs related to energized relays turn on
- Added features required by Endesa

Release 1.00

First official release (ENEL approval)

Changes to software RGDAT-A70

Release 1.20

- Added support for RGDAT-A70 Outdoor version

Release 1.12

- Added VSS function trip in event recording (request by ENEL)
- Updated firmware release of RGDAT-A70 into software distribution package (1.11)
- Minor changes

Release 1.11

- Display voltage measurements (and related items) also if voltage calibration procedure is not performed, with appropriate highlighting of this condition (request by ENEL)

Release 1.10

- Migration of development environment from Visual Studio 2005 to Visual Studio 2013 (now the minimum software platform to run the software is Windows XP)
- Added support for multilingual user interface (now available in Italian, English and Spanish)
- Added features required by Endesa
- Added support for Unicode characters
- The preferences are now stored in the registry instead of in an .ini file
- The dialog box for selecting the serial communication port shows only actual ports on your computer. Serial ports COM1 to COM32 are managed
- Fixed a bug that allowed to insert incorrect data if the step of the variable to be edited was ≥ 1.0

- Fixed a bug that allowed the sending of erroneous coefficients for CT correction curves
- Updated RGDAT- A70 firmware release inserted in distribution package
- Other small fixes and minor changes

Release 1.00

First official release (ENEL approval)