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Project

Directional fault and voltage absence detector (RGDAT-A70)

P515D851

Version for Outdoor Installation
User manual

Rev.	Date	Description	Draft	Checked
E	November 2019	Revision	M. Ferreri	G. Bonomo

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Updates and/or revisions

REV.	CHAP.	PAG.	Description	DATE
A			First issue	January 2017
B	Various	Various	Update related to the firmware 2.01 and software 2.03	September 2017
C	Addendum B	43 and 44	Update related to the firmware 2.02 and software 2.04	June 2018
D	Various	Various	Update reference documents Add chapter for coupling between RGDAT and sensors Update related to software 2.05	December 2018
E	Various	Various	Update related to the firmware 2.10 and software 2.10	November 2019

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PURPOSE OF THE DOCUMENT

This document describes how to use and set up the device RGDAT-A70 (directional fault and voltage absence detector) compliant with technical specification GSTP001 by ENEL.
This document is referred to the model installed on pole where are installed driven switch or recloser (RGDAT-A70 /O, ENEL serial number 160004).

REFERENCE DOCUMENTS

- ENEL - GSTP001 - rev. 03 - December 11th 2017
- Col - Div. Seb - P515D404 Communication protocol - Rev. A - September 2016
- Col - 188 MN 0001_EN - Combi-Col-24-O Installation and instruction manual - Rev. 0 - December 2018
- Altea - CVS-P-24-O Technical specifications - Rev. 0 - October 23rd 2015
- Altea - CVS-P-24-O Installation Manual - Rev. 1 - October 23rd 2015

INFORMATION AND PRECAUTIONS

Before using the device RGDAT-A70, please read carefully the following instructions.

Avoid starting the installation, maintenance or setup of the equipment without consulting this manual.

The device RGDAT-A70 has to be used by staff specially trained for the purpose.

For proper operation of the device, you must follow these guidelines:
- The RGDAT-A70 device is intended for use by qualified personnel with knowledge of the physical phenomena and the risks related to electricity. Training and education of the personnel expert in the use of the device is competence of the buying company of the product itself.
- The device should be used only when it appears in good condition, ie there are no signs of damage. Its use must be made in accordance with the security rules of the specific workplace and application.
- The security conditions and criteria are guaranteed under the conditions of use described in this manual. Improper use of the device or the included accessories may cause damage to people, to the device or to the equipment connected to it. The manufacturer and distributors are not liable for any damage caused by improper use of the device. The user assumes all responsibility and risk.
- This user manual must always be available at the place where the device RGDAT-A70 is installed.
- Before using the device RGDAT-A70, the staff assigned to RGDAT-A70 must read this user manual. This also applies to all persons who also occasionally works with the device RGDAT-A70.
- Any breaking or modification to the case, or any part of the equipment, could impair the proper functioning of the device.
- Do not use the device RGDAT-A70 in extremely humid environments and/or if there is risk of condensation inside the device. To avoid the risk of electric shock, do not plunge the equipment or the supplied accessories in the water or other liquids.
- Do not use the device RGDAT-A70 in the presence of open flames.
- Do not use the device RGDAT-A70 in environments where there are flammable gases or vapors.
- Avoid moving the equipment when it is in use, in order to avoid accidental detach of the cables that may create a dangerous situation for the user.
- For your safety, avoid using non-compliant cables, damaged or worn.

• Before powering up the device, make sure that the protective earth is properly connected. The ground connection must be made using the appropriate bolt on the right side of the metal container. The failure to connect the protective earth may cause a safety hazard.

SUMMARY

The fault detector RGDAT-A70 for outdoor installation is made according to technical specification GSTP001 by ENEL; it is installed on pole where are installed driven switch or recloser 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 and current measurements are obtained by 3 combined sensors (one for each phase).

The voltage measurements are used for directional earth fault function and to detect the presence/ absence of line voltage; values of phase voltage V4, V8 and V12 are processed in order to eliminate measurement errors caused by combined sensors using the voltage inputs calibration function.

The device RGDAT-A70 uses current measurement to detect 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 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 indicated functions, in which all protective functions are disabled and only the voltage presence function is active, but it is managed in a different way (please make reference to document GSTP001 by ENEL).

The device RGDAT-A70 has a current converter with output 4÷20 mA for sending the measurement of phase current to a remote control unit. The current converter is galvanically insulated from the other electronic circuits and from the auxiliary power of RGDAT-A70.

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 of the directional earth fault protection
one orange LED	signaling trip of phase overcurrent protection (51) or earth fault overcurrent protection (51N), memorized
one red LED	signaling trip of directional earth fault protection (67N), memorized
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 GSTP001. 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.

On the electronic board of RGDAT-A70 there is 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 the device RGDAT-A70.
These operations are described in detail in the following chapters of this document.

Combined sensors

The combined sensors integrate the following functions into a single device:
• post insulator
• voltage transducer
• current transducer

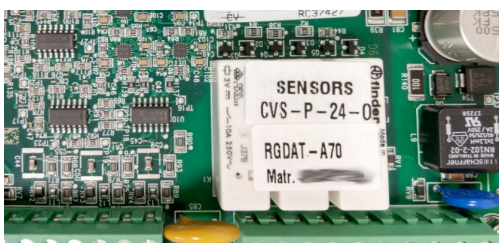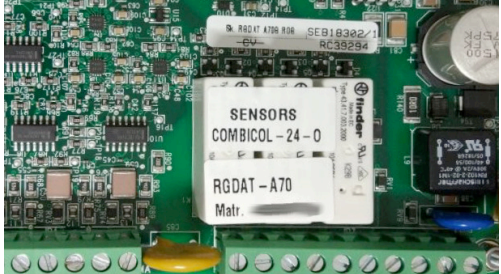It is used one combined sensor for each phase.

For more detailed information on such devices, please refer to the document "CVS-P-24-O Technical specifications" by Altea.

Combine RGDAT-A70 with sensors

To ensure the correct operation between RGDAT-A70 and combined sensors, you must use the type of combined sensors with which the device was originally supplied.

On the front of the RGDAT-A70 and on the electronic board adhesive labels are applied, indicating which type of combined sensors can be used with the specific RGDAT-A70, as shown in the following table.

	RGDAT front panel	RGDAT electronic board
Sensors CVS-P-24-O		
Sensors COMBICOL-24-O		

FUNCTIONS

Phase overcurrent protection (51)

To ensure protection against polyphase failures, the device RGDAT-A70 has a phase overcurrent protection, in tripolar configuration, with a single threshold. The device acquires the measurement of phase currents by combined sensors and provides a fault signal when the current of one or more phases exceeds the threshold value.

The threshold value of phase overcurrent protection is programmable from 20 A to 900 A, in steps of 10 A. The threshold has a trip delay, whose value can be set from 0.05 to 5 s, in steps of 0.01 s.

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 calculates the earth current using the measurements of the phase currents 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 2 A. The threshold has a trip delay, whose value can be set from 0.05 to 5 s, in steps of 0.01 s.

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 (surveillance direction at busbar side of Secondary Substation). In this operation mode, the angular sector of intervention of the thresholds are: 240÷75° for 67NS1, 240÷300° for 67NS2.

The following figure illustrates, for example, the angular sector of intervention of threshold 67NS1 in the two different operating modes.
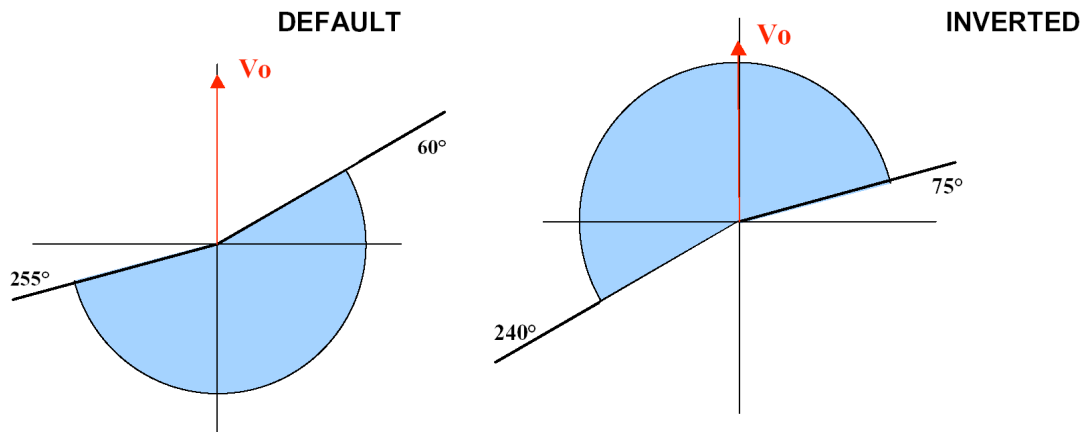
DEFAULT   **INVERTED**

With a proper setting in the setup program you can modify the angular sector of intervention for the threshold 67NS1 to 60÷245° (default direction) and 240÷65° (inverted direction).

The device calculates the earth current using the measurements of the phase currents, calculates the homopolar voltage using the measurement of the phase voltages and computes the phase angle between the homopolar voltage and the earth current.

The directional earth fault protection requires the setting of the following parameters:
• residual voltage threshold (Threshold 67 Vo) adjustable range 1÷40% En, in step of 1%
• earth fault current threshold (Threshold 67 Io) adjustable range 1÷40 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)

This threshold has a trip delay, whose value can be set from 0.11 to 5 s, in steps of 0.01 s.

Signaling intervention of threshold 67NS1 is provided by relay TS67AV; in case of intervention of threshold 67NS2, the 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.

With an appropriate configuration, you can use as reference the negative sequence voltage instead of the zero sequence voltage. In this operation mode, the thresholds 67NS1 and 67NS2 described above are disabled and a directional threshold is activated with the following configuration parameters:
• negative voltage threshold, adjustable range 1÷40% En, in step of 1%
• earth fault current threshold, adjustable range 1÷200 A, in step of 0.5 A

The angular relationship between the negative sequence voltage (Vi) and the residual current that determines the intervention of the threshold is shown in the following figure:

No trip zone

Vi

Trip zone

Ir
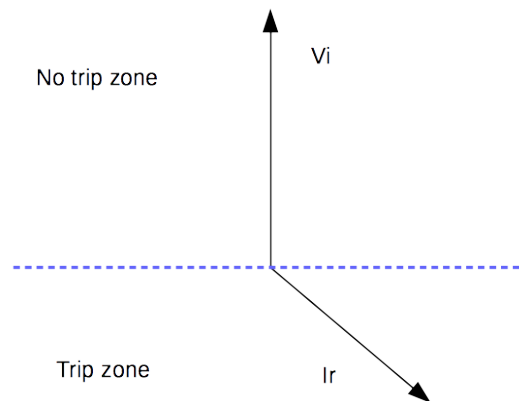
In fault recording event function, a trip of directional earth fault threshold with negative sequence voltage as reference, is labelled as 67N.S1, and in detailed data you will see the angle between that voltage and residual current.

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 accuracy 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 0.05 to 60 s, in steps of 0.05 s.

By means of the programming software, signaling protection intervention of residual overvoltage threshold is user configurable on TS67AV and/or TS51A relay, whose contacts are connected to the terminal block MB and acquired by remote control system (default TS67AV).

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 0.05 to 60 s, in steps of 0.05 s.

By means of the programming software, signaling protection intervention of negative sequence overvoltage threshold is user configurable on TS67AV and/or TS51A relay, whose contacts are connected to the terminal block MB and acquired by remote control system (default TS51A).

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 0.05 to 60 s, in steps of 0.05 s.

By means of the programming software, signaling protection intervention of positive sequence undervoltage threshold is user configurable on TS67AV and/or TS51A relay, whose contacts are connected to the terminal block MB and acquired by remote control system (default TS67AV).

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 0.05 to 600 s, in steps of 0.05 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 voltage transducers of combined sensors, 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.

You can also set up the measurement output as unidirectional or bidirectional. The direction of the measurement is determined by evaluating the angle between the positive sequence voltage and the positive sequence current (direction "positive" for angle between ±90°).

In the case of unidirectional measurement, the entire current range (4÷20 mA) is used to set the full scale.

In the case of bidirectional measurement, there is this division of the scale:
• 4÷12 mA for "negative" measurement
• 12÷20 mA for "positive" measurement

- the full scale parameter is divided equally between "positive" and "negative" (ie if imposed 500 A as full scale parameter, the scale in bidirectional mode will be ± 250 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 timer starts when thresholds drop out).
- 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 timer starts when thresholds drop out).
- 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.

This function is disabled in default configuration.

TECHNICAL CHARACTERISTICS

Auxiliary power supply

Rated value	24 V_{DC}
Range of application	19 ÷ 29 V_{DC}
Typical power consumption (at 24 V_{DC})	110 mA

Combined sensors

Rated transformation ratio (voltage)	25000 V / 1 V
Rated transformation ratio (current)	260 mV/kA (at 50 Hz)
Rated frequency	50 - 60 Hz
Connection to RGDAT	shield cable with connector RJ45, length 8 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

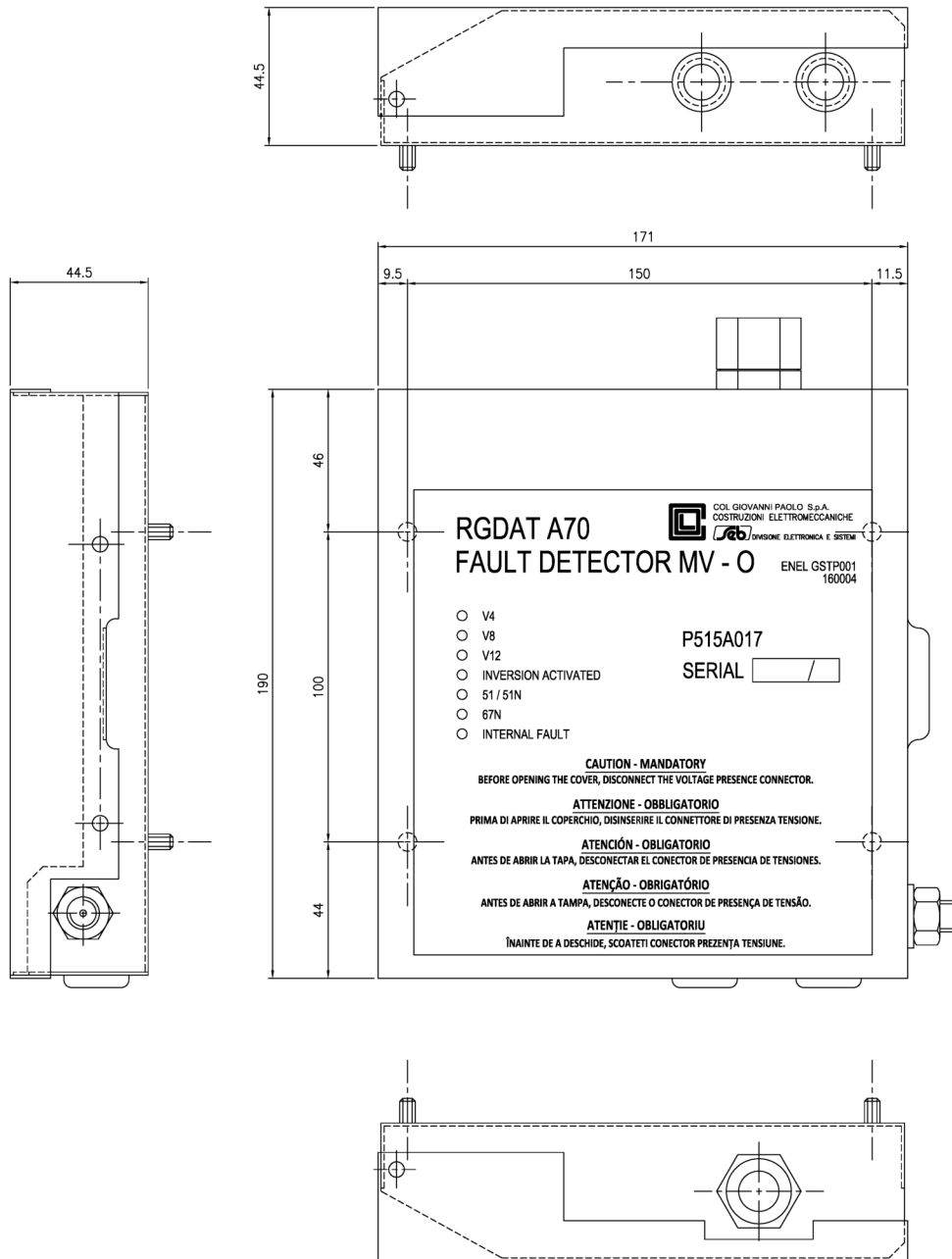|	
Measurement range	0 ÷ 900 A (programmable)
Operating mode	Unidirectional / bidirectional (programmable)
Output current	4÷20 mA
Precision	10 %
Maximum output load	700 Ω
Response time	< 300 ms

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 ÷ +70 °C
Relative humidity	≤ 93% (without condensing)
Storage temperature	-25 ÷ +70 °C

Mechanical characteristics

The RGDAT-A70 is housed in a metallic case, whose dimensions are shown in the following figure.

44.5

171

9.5   150   11.5

46

190

100

RGDAT A70
FAULT DETECTOR MV - O

ENEL GSTP001
160004

44.5

○ V4
○ V8
○ V12
○ INVERSION ACTIVATED
○ 51 / 51N
○ 67N
○ INTERNAL FAULT

P515A017

SERIAL [/   ]

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44

CAUTION - MANDATORY
BEFORE OPENING THE COVER, DISCONNECT THE VOLTAGE PRESENCE CONNECTOR.

ATTENZIONE - OBBLIGATORIO
PRIMA DI APRIRE IL COPERCHIO, DISINSERIRE IL CONNETTORE DI PRESENZA TENSIONE.

ATENCIÓN - OBLIGATORIO
ANTES DE ABRIR LA TAPA, DESCONECTAR EL CONECTOR DE PRESENCIA DE TENSIONES.

ATENÇÃO - OBRIGATÓRIO
ANTES DE ABRIR A TAMPA, DESCONECTE O CONECTOR DE PRESENÇA DE TENSÃO.

ATENŢIE - OBLIGATORIU
ÎNAINTE DE A DESCHIDE, SCOATEŢI CONECTOR PREZENŢA TENSIUNE.

The device is supplied with 4 screws and 4 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 combined sensors.

Terminal blocks

Terminal block MA

It is the terminal block on which you connect the voltage signals and current signals by combined sensors.

Pin number	Signal name	Notes
1	COM_I	Current sensors common connection (connected to ground)
2	I_4	Current signal I4
3	I_8	Current signal I8
4	I_12	Current signal I12
5	V_4	Voltage signal V4
6	V_8	Voltage signal V8
7	V_12	Voltage signal V12
8	COM_V	Voltage sensors common connection (connected to ground)

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
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
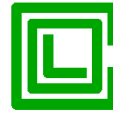
Pin number	Signal name	Notes
9	+VALIM	Reverse signal digital input (common)
10	-VALIM	Power supply input (GND 24V)

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.
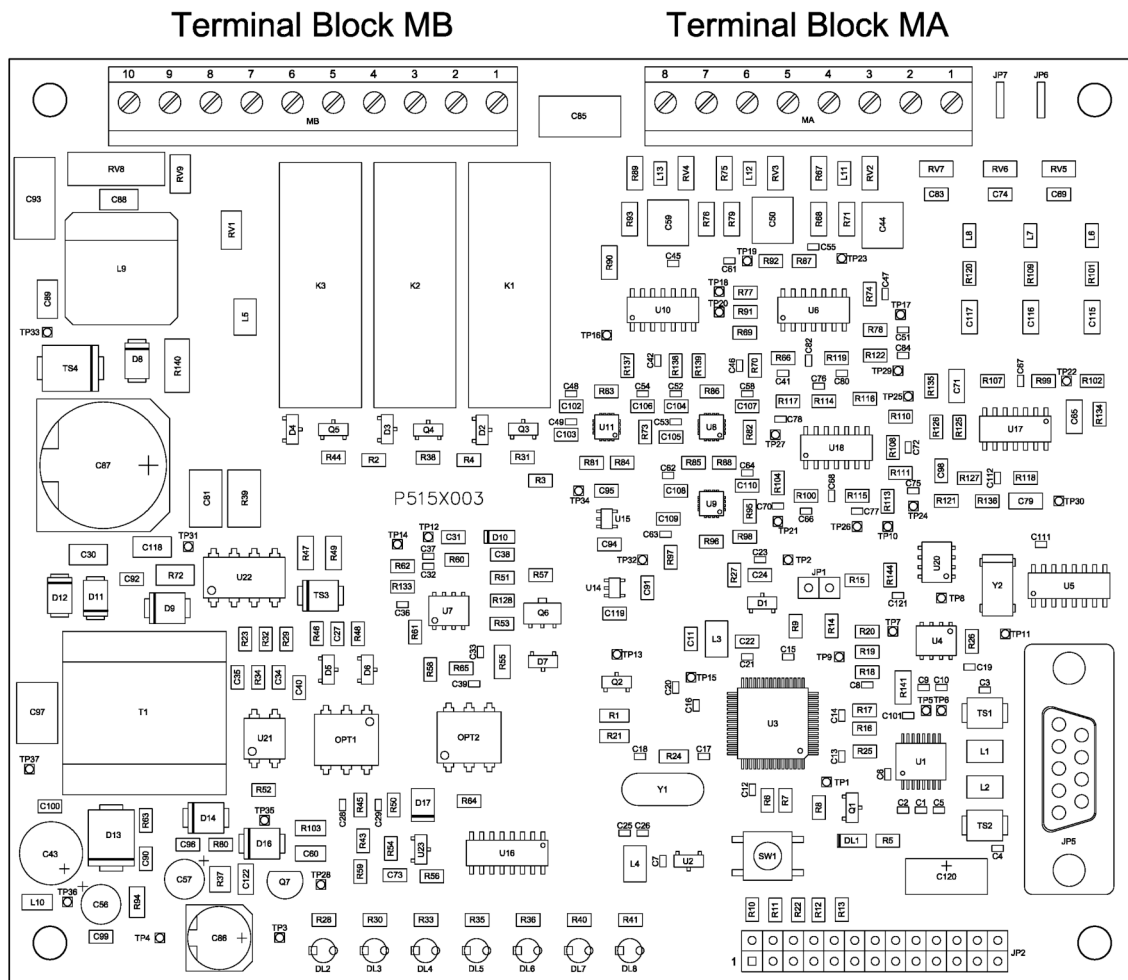
Connector to remote control system

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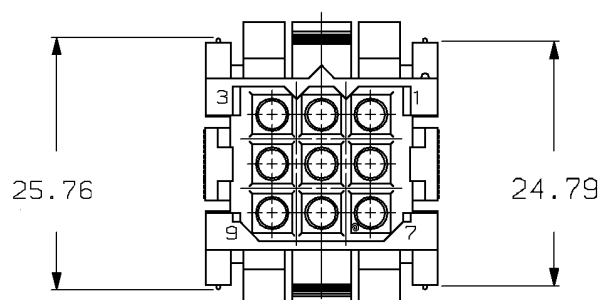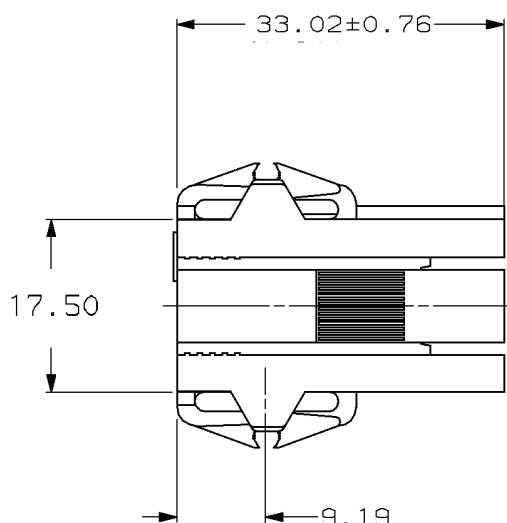
Signals are placed on the connector to the remote control system according to the following table:

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)

Connection with combined sensors

To facilitate the connection between the cables of the combined sensors and the RGDAT-A70, this one is supplied with a proper adapter; one side of the adapter is connected to the terminal block MA and the other side has 3 connectors RJ45 to plug the cables of the combined sensors.

The adapter is factory connected to terminal block MA.

Each RJ45 connector has a label to indicate the related phase.

The following image refers to the above indicated arguments.
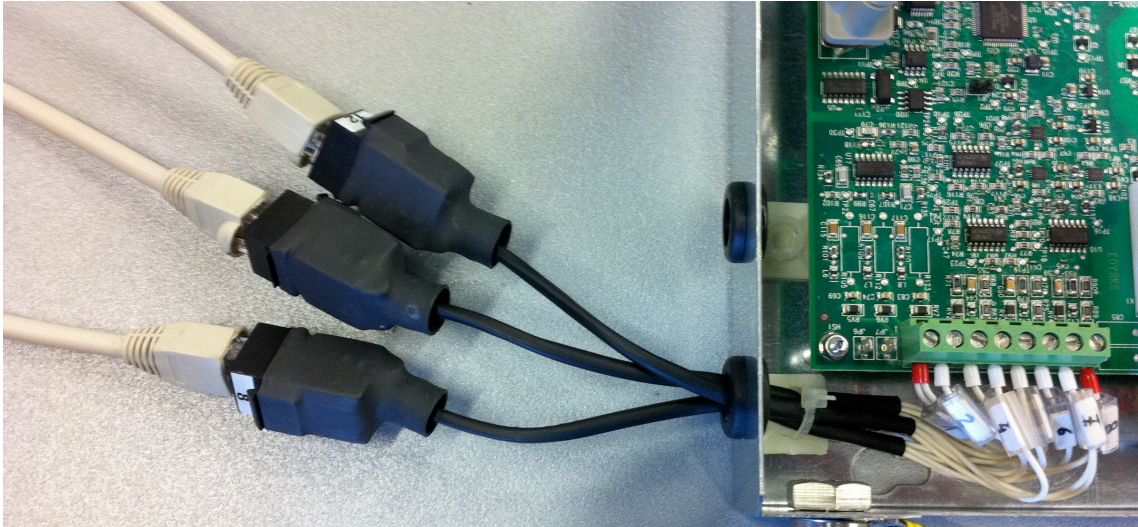
PROGRAMMING SOFTWARE (RGDAT_A70)

To perform a series of activities with RGDAT-A70 such as parameterization, diagnostics, monitoring, etc. it is available a dedicated software, whose name is *RGDAT_A70*; to ensure proper operation with RGDAT-A70 conform to ENEL specification GSTP001, it is required that this software is in version 2.00 (or later). You can use the software also with RGDAT-A70 of the previous generation[1].

This software runs fine on PC with Microsoft Windows® operating system (Windows Xp or newer, updated with the latest Service Pack available).

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 an USB-RS232 converter).

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

If you use an USB-RS232 converter with male connector, you can connect it directly to RGDAT-A70 without interposing any further extension cable.

To gain access to the serial connector placed on the electronic board 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 the "desktop" of the computer; 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, the toolbar, to facilitate some operations, and the status bar, to display specific operating conditions.

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[1] In this document are shown the dialog boxes related to setting parameters for RGDAT-A70 conform to ENEL specification GSTP001. In case of use of the software with RGDAT-A70 of the previous generation (conform to ENEL DY1059-A70) some dialog boxes are different.
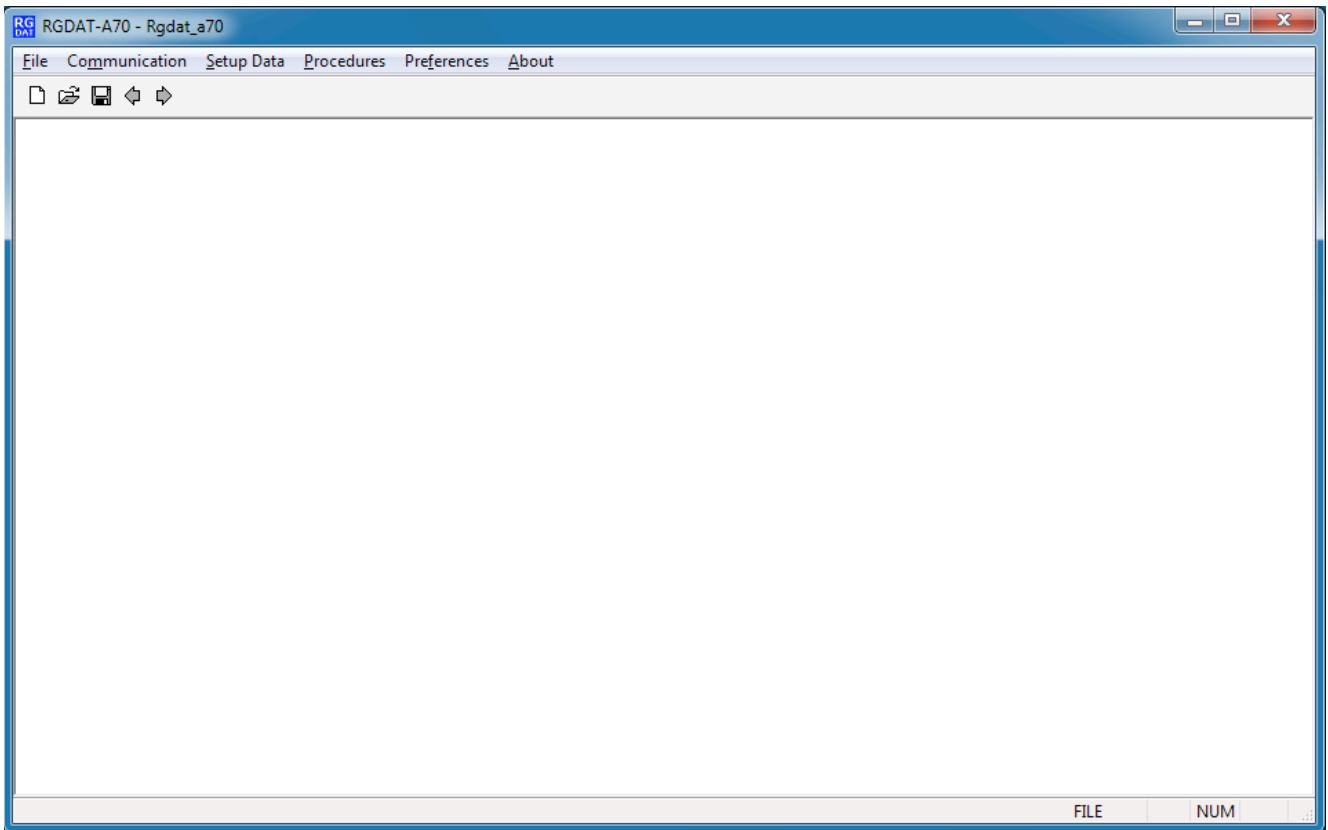
"File" Menu

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[2]).

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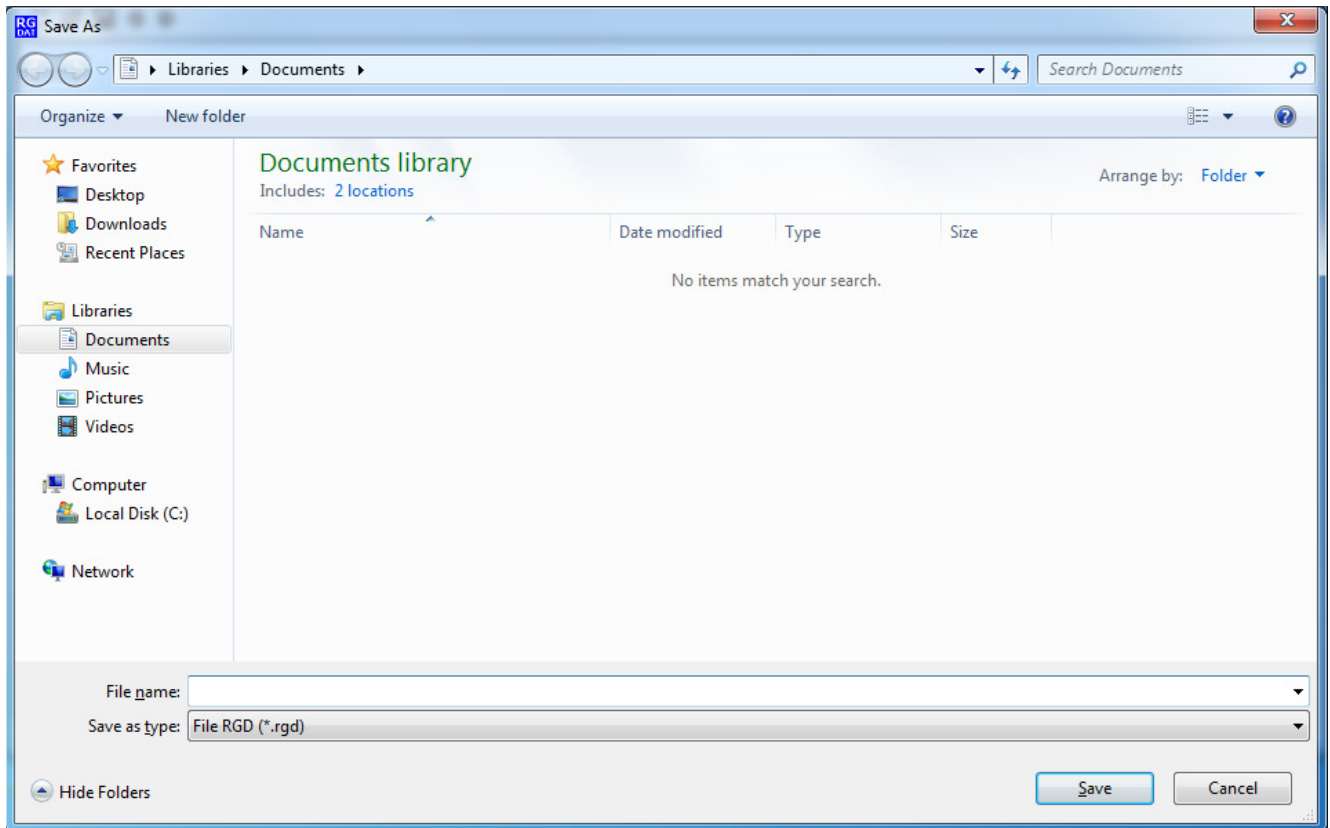
- the item "**Exit**" ends the program execution

File operations (New, Open, Save) are also possible using the appropriate icons on the toolbar.

"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).

It is necessary that the computer is physically connected to RGDAT-A70 by means of a RS232 port (or USB-RS232 converter) in order to read the required 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 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.

The reading of configuration data is also possible using the icon ⬅ in the toolbar.

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.

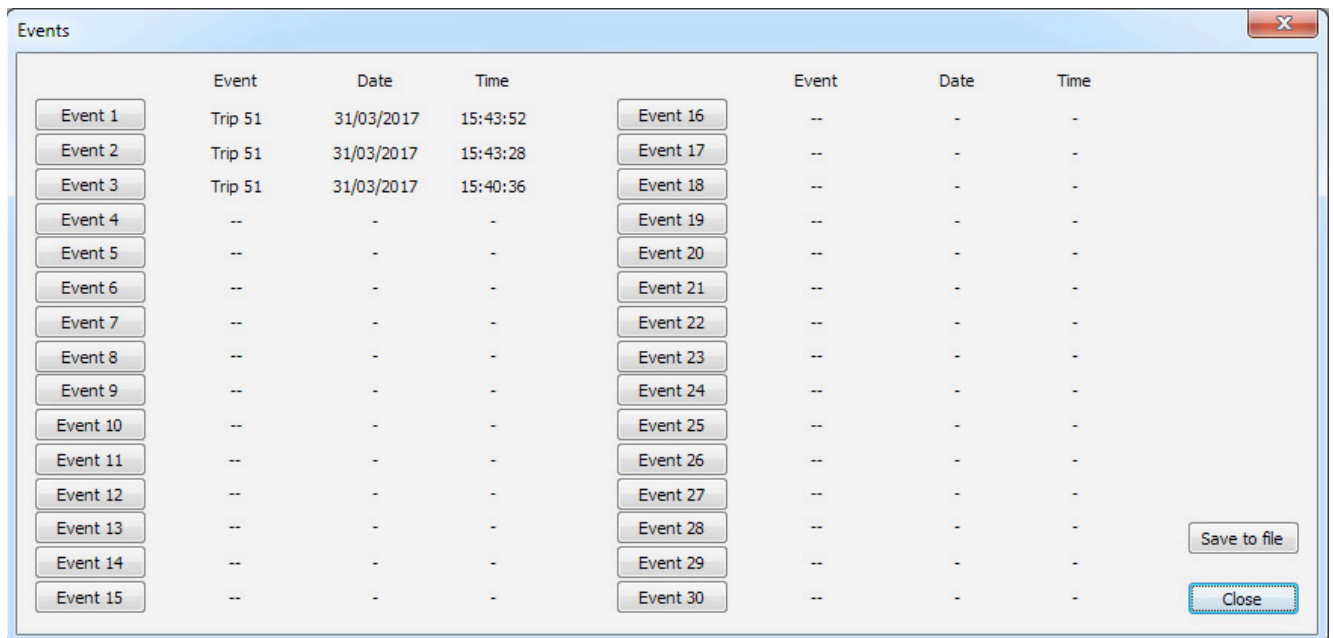The execution of this activity has no impact in protection functions of RGDAT-A70.

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

The "Measures and status" dialog box also allows you to check the correct phase sequence, through the display of angles between the different phase voltages and displaying amplitude of positive and negative voltage sequence. If it is not yet performed the voltages calibration procedure, the measured values for these quantities must be in line with what reported in the example images, which allows to later perform smoothly the voltages calibration procedure.

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

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).


	Event	Date	Time		Event	Date	Time
Event 1	Trip 51	31/03/2017	15:43:52	Event 16	--	-	-
Event 2	Trip 51	31/03/2017	15:43:28	Event 17	--	-	-
Event 3	Trip 51	31/03/2017	15:40:36	Event 18	--	-	-
Event 4	--	-	-	Event 19	--	-	-
Event 5	--	-	-	Event 20	--	-	-
Event 6	--	-	-	Event 21	--	-	-
Event 7	--	-	-	Event 22	--	-	-
Event 8	--	-	-	Event 23	--	-	-
Event 9	--	-	-	Event 24	--	-	-
Event 10	--	-	-	Event 25	--	-	-
Event 11	--	-	-	Event 26	--	-	-
Event 12	--	-	-	Event 27	--	-	-
Event 13	--	-	-	Event 28	--	-	-
Event 14	--	-	-	Event 29	--	-	-
Event 15	--	-	-	Event 30	--	-	-

By pressing the button "Save to File" you save events data in a file, whose name is shown in a dialog box.[4]

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.

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

[4] The folder where the file containing events data is created is the same that stores configuration data
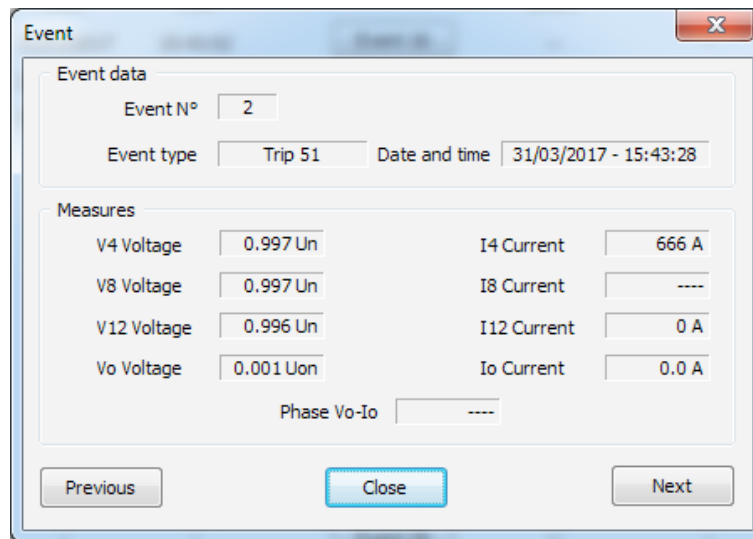
Events are stored by RGDAT-A70 in a non-volatile memory, so they are retained even if you turn off the equipment.

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 (or restart).
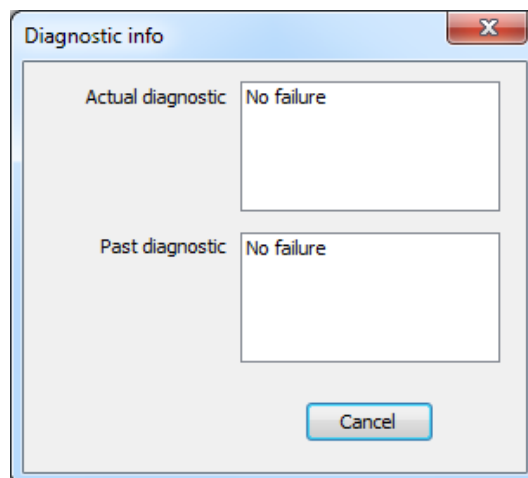
"Send data" Submenu

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

It is necessary that the computer is physically connected to RGDAT-A70 by means of a RS232 port (or USB-RS232 converter) 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.
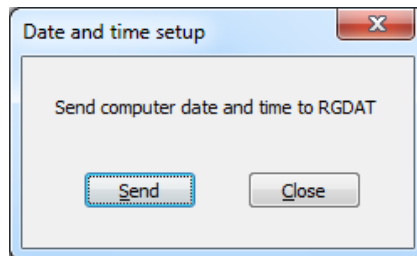
The sending of configuration data is also possible using the icon ➪ in the toolbar.

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 a "Real Time Clock" circuit with an energy storage system (supercapacitor), that allows to properly hold and update the date and time information for at least 8 hours even in the absence of auxiliary power supply[5].

"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"

Please note that in the status bar of the main window there is an indicator ("FILE" or "RGDAT"), which indicates whether the configuration data on which you are working has been read from a file or from a RGDAT.

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.).

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[5] To ensure the indicated retention time for the date and time, it is necessary that the energy storage system is properly charged, ie that the RGDAT has been powered on continuously for at least 24 hours.

If you are working in the "File" mode, there is a combo-box that allows you to select the firmware version of RGDAT with which you will connect later, and this allows you to gain access to specific functionality of that version and prepare offline configuration file with the settings.

If you are connected directly to RGDAT, this box will report the firmware version of RGDAT (and of course you can not change this item).

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 up the full scale value of 4÷20 mA output and the operating mode.

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.

With an appropriate check-box it is possible to select an option for which the light signals of the LEDs associated with the intervention of the protection thresholds are reset when the line voltage resumes (and therefore the fault that caused the intervention of the protections should be resolved).
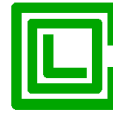
Thresholds 51 51N 67N

Threshold 51
☑ Enable threshold 51

Threshold 51 `500` A (20 - 900 step 10)

Threshold 51 delay `0.05` s (0.05 - 5.00 step 0.01)

Threshold 51N
☑ Enable threshold 51N

Threshold 51N `150` A (10 - 200 step 2)

Threshold 51N delay `0.05` s (0.05 - 5.00 step 0.01)

Voltage reference for directional earth fault
◉ Homopolar voltage (Vo)   ○ Negative sequence voltage (Vi)

Threshold 67N
☑ Enable threshold 67NS1   ☐ Reduced Trip Sector (Dir. 245°/Rev. 65°)
☐ Enable threshold 67NS2

Threshold 67N (I) `1.0` A (1.0 - 40.0 step 0.5)

Threshold 67N (V) `4` %En (1 - 40 step 1)

Threshold 67NS1 delay `0.11` s (0.11 - 5.00 step 0.01)

Threshold 67NS2 delay `0.11` s (0.11 - 5.00 step 0.01)

Threshold 67N (Vi)
☑ Enable threshold 67N (Vi)

Threshold 67N (Vi) (I) `1.0` A (1.0 - 200.0 step 0.5)

Threshold 67N (Vi) (V) `4` %En (1 - 40 step 1)

Threshold 67N (Vi) delay `0.11` s (0.11 - 5.00 step 0.01)

Analog output
Output mode `Unidirectional` ▼

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

☐ Reset allarms at voltage resuming
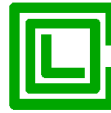☐ Testing mode with Comtrade files
☐ Enable thresholds delays editing

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"), and also the trip matrix related to relay TS51A and TS67AV for the voltage thresholds perviously indicated.
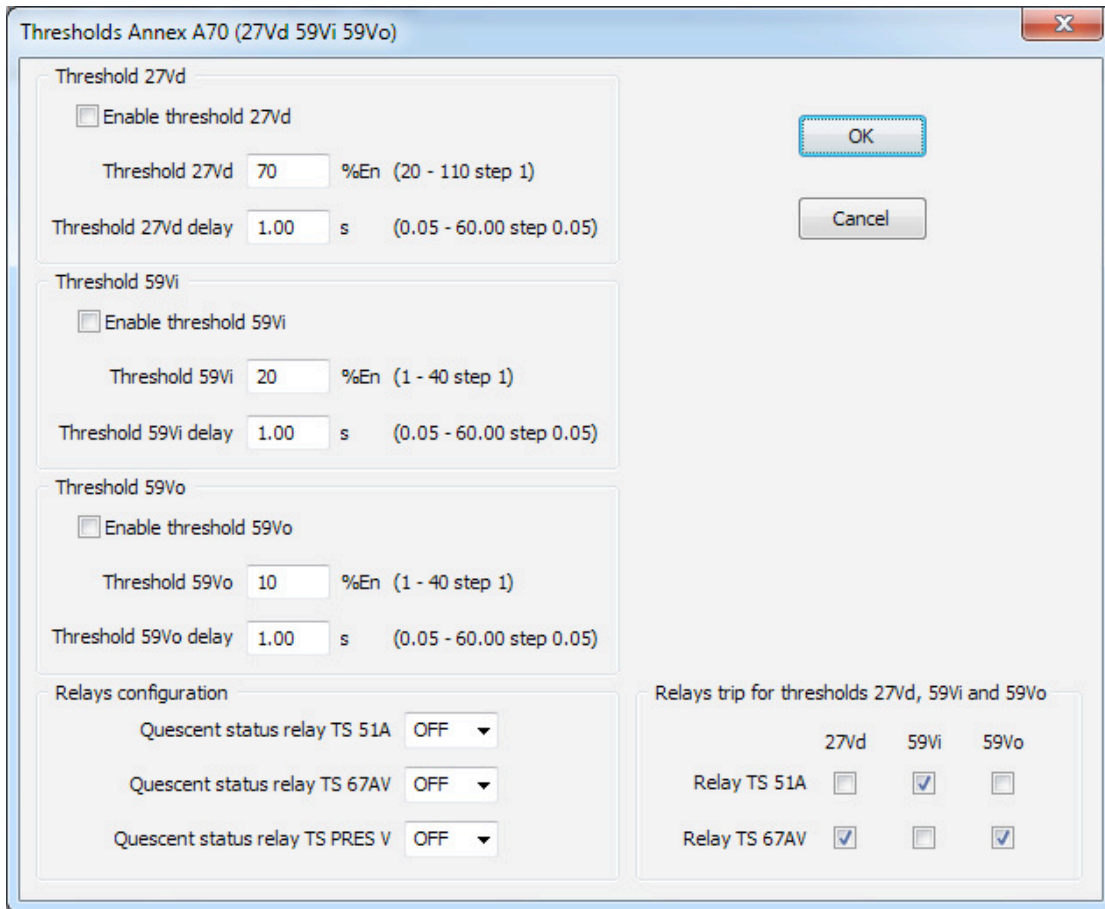
The item "**VSS Function**" allows you to read and configure the parameters for this function.
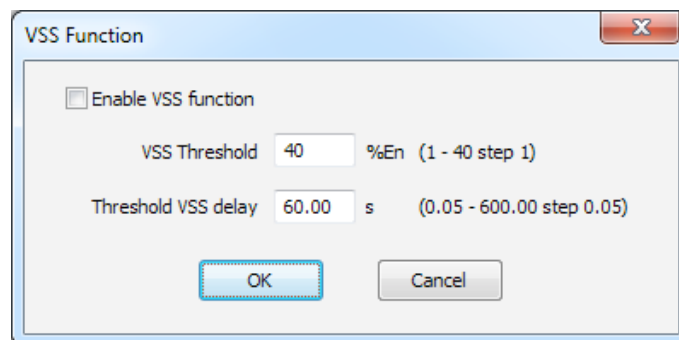

The item "**Voltage monitoring**" allows you to read and configure the parameters for this function. These parameters are used if you select such function in "General Data" dialog box.
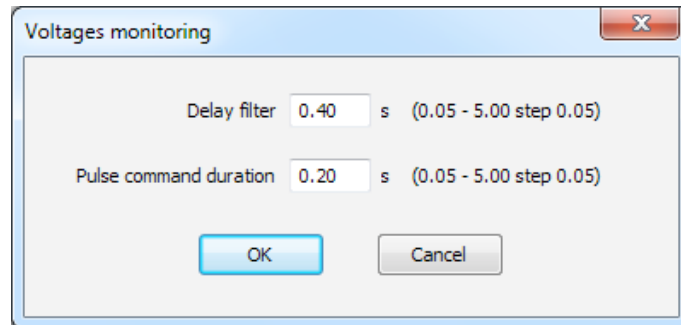
The item "**Features for Endesa**" is available only if the detected RGDAT-A70 firmware version implements these functions; otherwise the item is disabled.
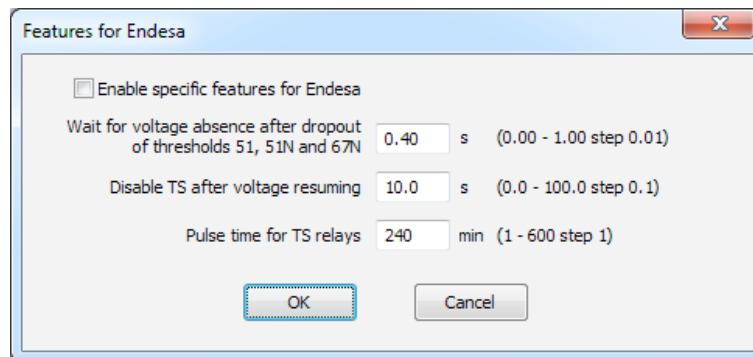
The item "**Features for configuration with 3 phase sensors**" is available only if the detected RGDAT-A70 firmware version implements these functions and the configuration of the current sensors is with 3 phase sensors, and a dedicated sensor for Io measurement is not present (for example in case of combined sensors for outdoor use, aka TATV); otherwise the item is disabled.
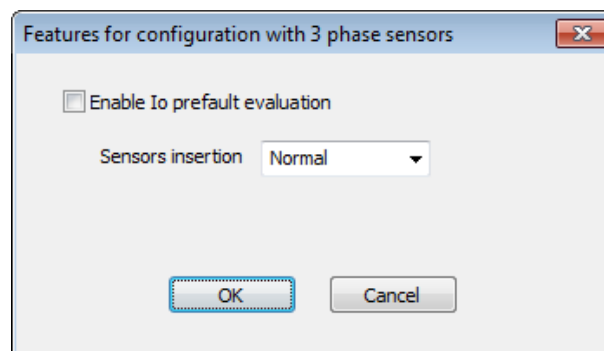
This dialog-box allows you to enable Io (earth current) calculation in healthy network conditions (prefault), and then subtract that value to Io when a fault occurs. The use can also specify the insertion mode for combined sensors (Normal or Reverse).

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 combined sensors is replaced.

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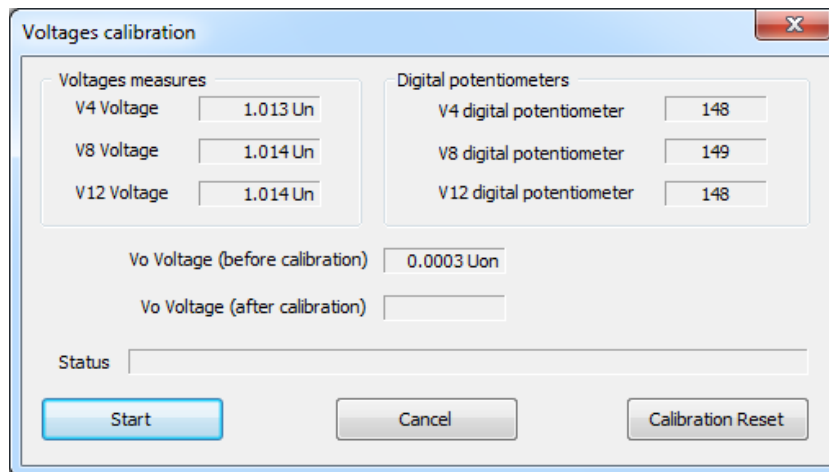
During the execution of voltages calibration procedure, the LEDs V4, V8 and V12 are blinking and the relay TSPresV is de-energized.

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 and test**" 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.

The test function of the 4÷20 mA current output takes into account the operating mode set on the RGDAT-A70; in this mode, if the "bidirectional" mode had been selected, you can also simulate the negative direction of the current.
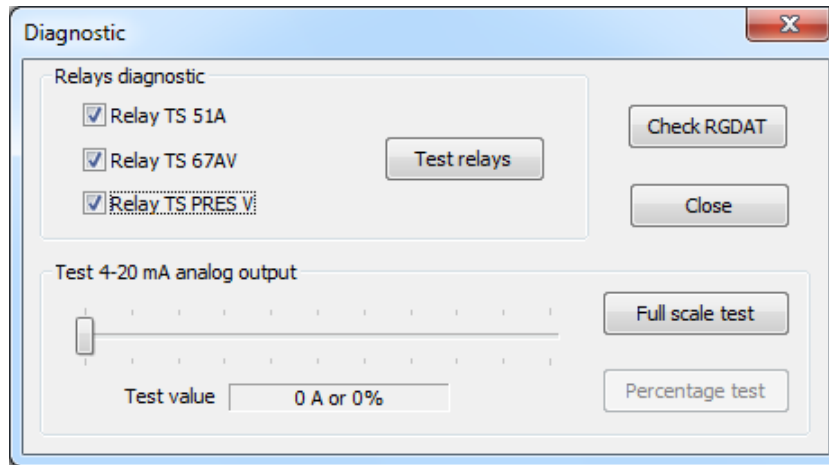
To control output relays, select (or deselect) the related check-box and press the "Test relays" button.

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 diagnostic 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).
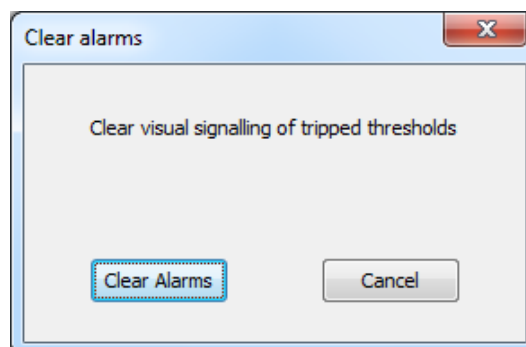

The item "**Reset events**" clears the event data recorded by RGDAT-A70.
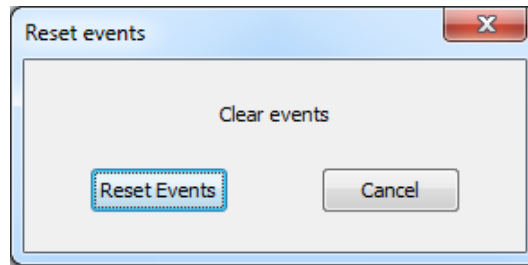
The item "**Firmware Update**" starts the procedure for updating the firmware of the device.

The program read the current firmware release from RGDA-A70 and then shows a dialog-box to the user, to select which firmware version to use for the firmware upgrade, selecting from the available ones, as shown in the following figure.
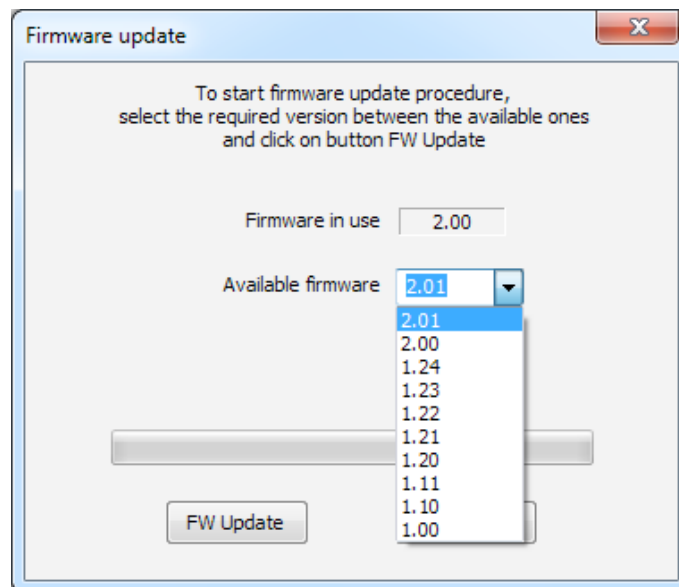
Clicking on button "FW Update", if it was possible to detect the firmware in use on the RGDAT-A70, a dialog-box asks to the user a further confirmation before to start the firmware update procedure.
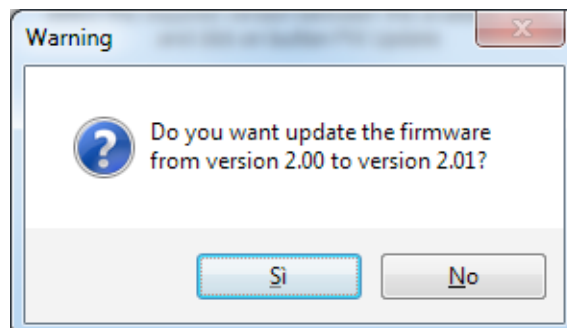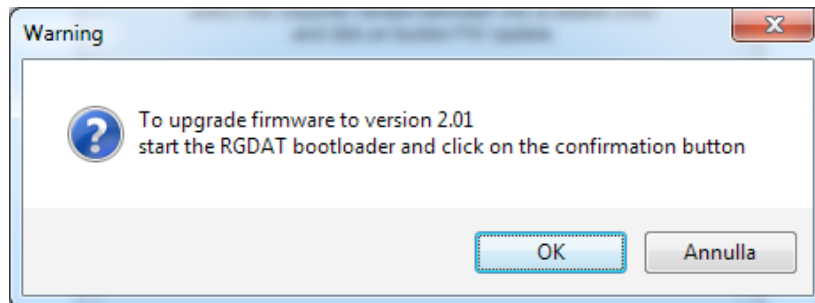

Clicking on button "Yes", the RGDAT-A70 runs the boot-loader and the firmware update procedure starts automatically.

If it was not possible to read the firmware version in use on the RGDAT-A70, for example because the application program was corrupted, you have to run manually the boot-loader of the RGDAT. A proper dialog-box remind this.

There are two modes to run manually the boot-loader:

1. push the reset button on the electronic board of the RGDAT-A70. The reset button is highlighted in yellow in the following figure.
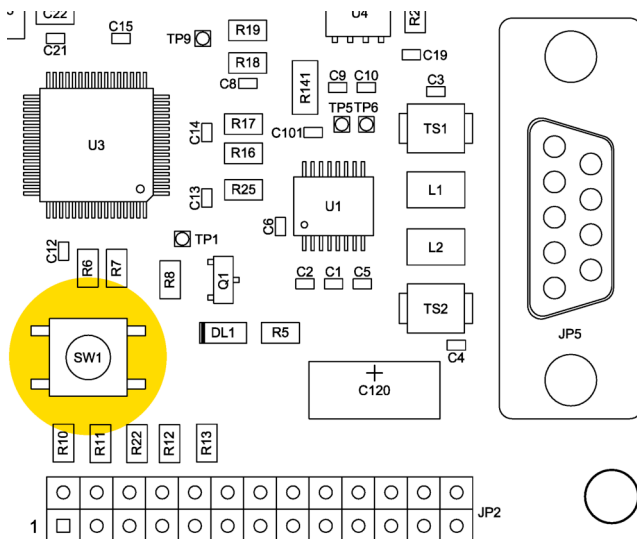
2. turn off and then turn on the RGDAT-A70

When the boot-loader is running the leds in the front panel of the RGDAT-A70 are flashing sequentially. The boot-loader stays in "command waiting" mode for about 10 seconds; you must start the firmware update procedure in this time, after that the boot-loader runs the application program.

For the duration of firmware update procedure, the RGDAT-A70 is not able to perform its protection functions.

The firmware upgrade process takes about one minute; meanwhile, a dialog box shows the progress of operations through a progress bar.

Firmware update

Updating firmware, please wait ...

Firmware in use	2.00
Available firmware	2.01 ▼

[FW Update]   [Cancel]
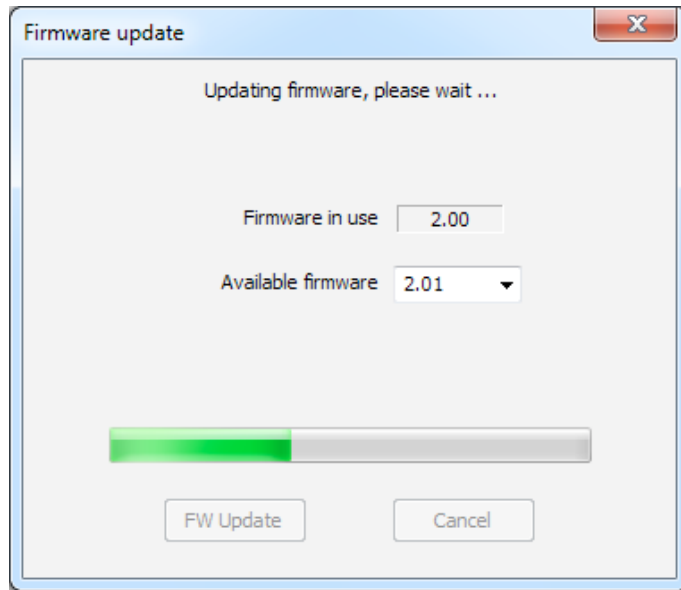
At the end of firmware update, a proper dialog box is shown.

Info

Firmware update successfully done

[OK]
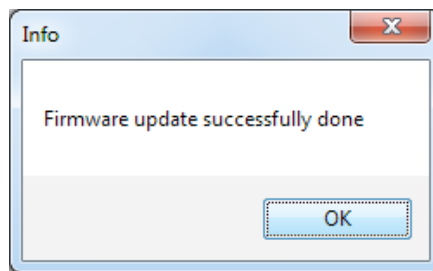
At the end of the procedure you need to restart (i.e. shut off and then on again) the device RGDAT-A70 (or press the appropriate pushbutton on electronic board, highlighted in yellow in the figure below).
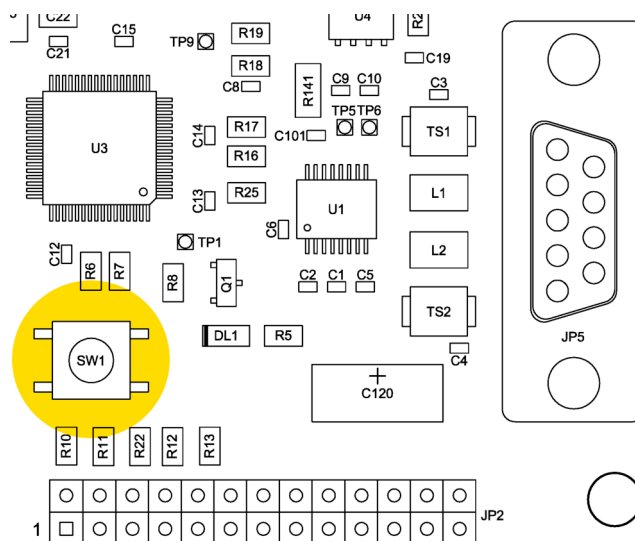
Note: If the new firmware introduces significant changes compared to the one on RGDAT[6], it is recommended to reset the default data on the RGDAT also before updating the firmware.

After a firmware upgrade may be necessary to reconfigure the RGDAT-A70 operating parameters, especially if the flashing red LED "Fault" indicates a situation of internal fault. In such case, you must apply the default data, update the clock, and then restart the RGDAT-A70; after doing this, the specific configuration data can be set up.
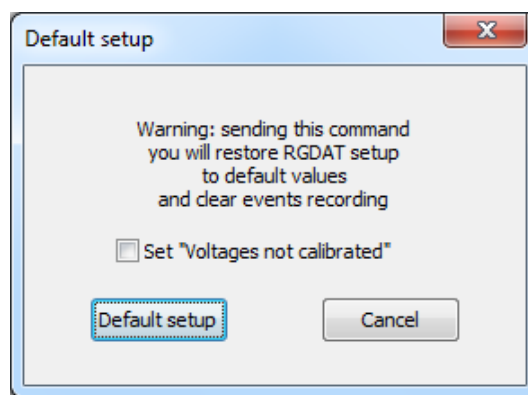
The item "**Default data**" restores the RGDAT-A70 configuration values to defaults one.

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 they are normally disabled in the version of the software that is released to 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.
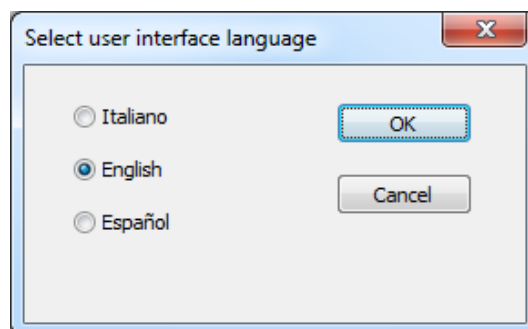
If you change the user interface language, you must restart the program to make the changes effective. An appropriate dialog-box reminds this.

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[6] Please refer to Addendum B for further information

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[7].
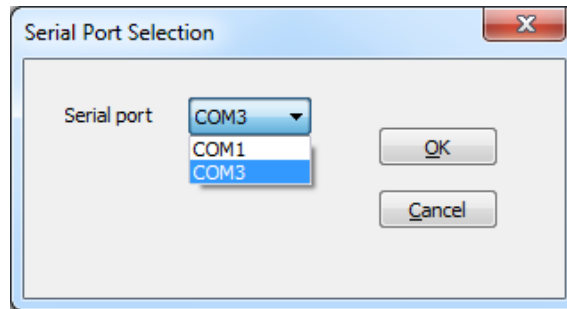
"About" Menu

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

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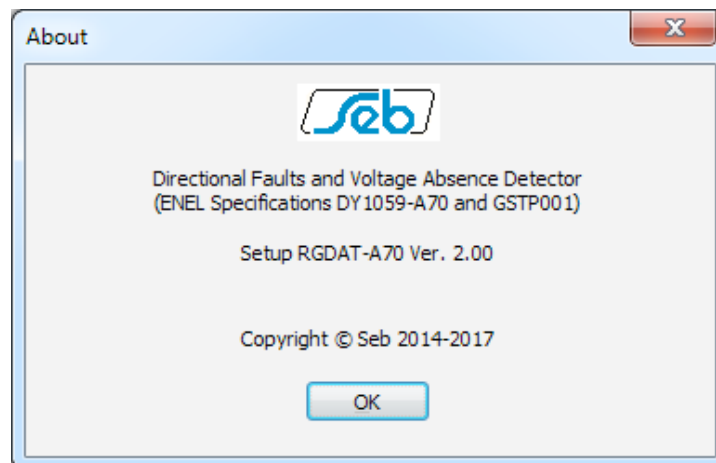
[7] The software scans serial ports starting from COM1 to COM32 and this can take some time before you see this dialog box.

INSTALLATION

Mechanical assembly

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

Device RGDAT-A70

Open the cover of the device and, using the four screws and washers, place the device in the specified location inside the box containing the UP for pole installation.

Combined sensors

Fix the combined sensors to the supplied support bracket.

For further information related to mechanical assembly and the connection of combined sensors to MV line, please refer to document "CVS-P-24-O Installation Manual" by Altea.

To connect the cables of combined sensors to RGDAT-A70, please refer to paragraph "Connection with combined sensors", being careful to match the phases with those reported on the RJ45 connectors connected to RGDAT-A70.

Setting

You can set up the 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.

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 90 to 130 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 combined sensors, you must execute the procedure described below.

The purpose of voltage inputs calibration procedure is to adjust RGDAT-A70 voltage inputs to the voltage transducers of the combined sensors.

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 only the thresholds 51 and 51N are active.

TROUBLESHOOTING

This chapter provides guidance on how to resolve common problems that may occur while using the RGDAT-A70, its accessories and the configuration program.

Issue	Suggested action
RGDAT-A70 does not turn on	Check the correct insertion of the connecting cable with UP
Different kind of errors prevent the successful completion of the voltage inputs calibration procedure	Make sure that the line is live and there are no faults in progress. Check connections between combined sensors and RGDAT-A70. Make sure that there are no problems on voltage measure circuit of combined sensors. Verify correct voltage sequence
No communication between PC and RGDAT-A70	Make sure that you are using the right serial cable. Verify that you have selected the correct serial port, using the configuration software. If you are using an USB-RS232 converter, verify that its drivers are properly installed and configured
The date and time of RGDAT-A70 is incorrect	Set the date and time using the configuration software
Led "Fault" turned on	See chapter "Self diagnostic function"
Incorrect trip of the protection 67N	Verify proper installation and connections of combined sensors
In "Bidirectional" mode, the output of current converter has wrong direction	Verify proper installation and connections of combined sensors
The voltage presence LEDs are off with line voltage present	Perform the calibration procedure of the voltage inputs
The device performs the boot-loader (LEDs that flash in sequence), but then remains as blocked	Perform the firmware update procedure while the boot loader is running

If the action taken against the reported issue has not solved the problem, contact Col - Seb technical support.

Self diagnostic function

The RGDAT-A70 has a self-diagnostic function, to check the proper operating of the equipment. If a problem is detected, a dedicated red LED ("Internal Fault") flashes.

The following table illustrates the type of problems detectable by the self-diagnosis function; they can be acquired using the configuration software (Communication→Read data→Diagnostics); see *"Read data" Submenu* chapter for more information.
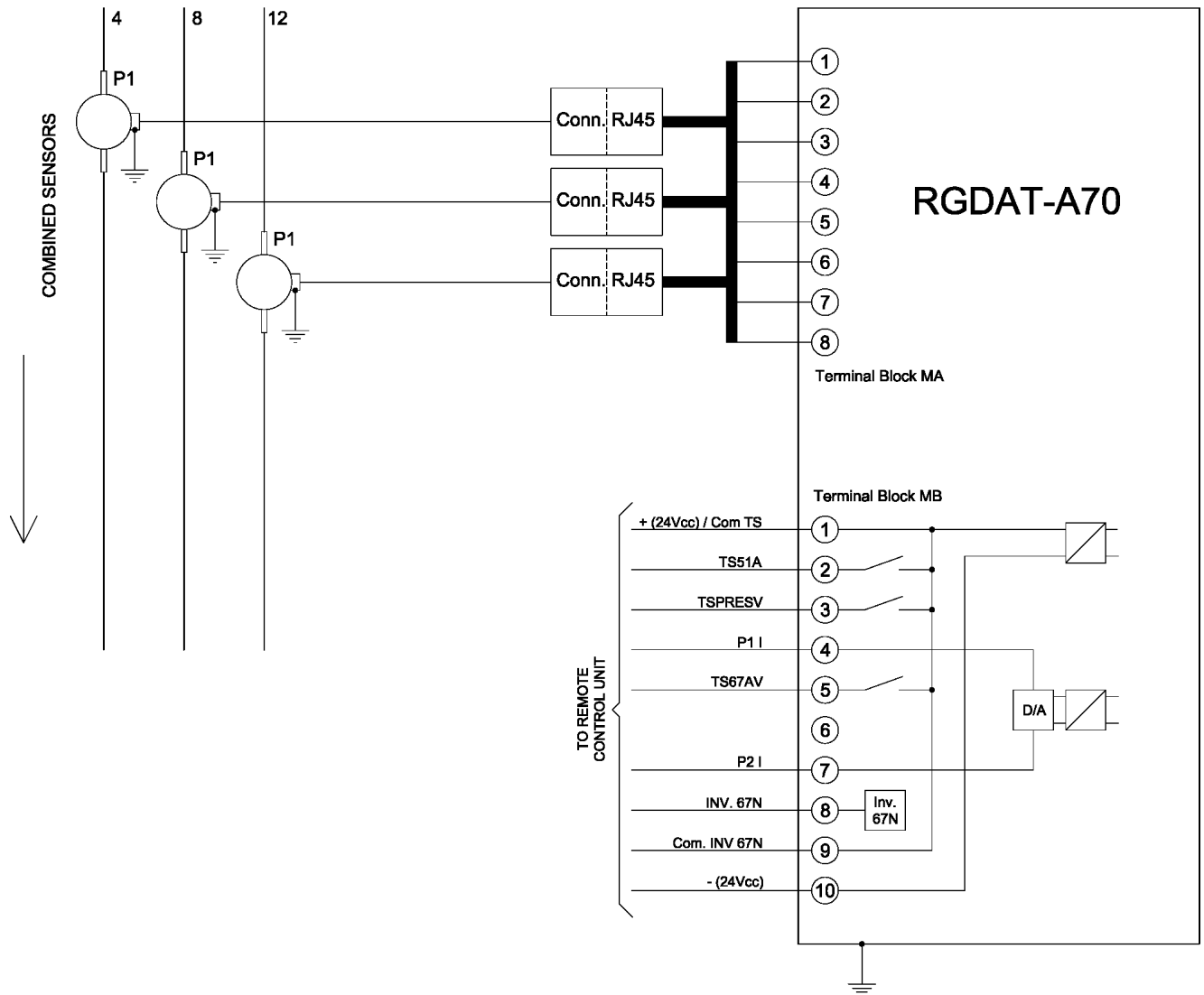
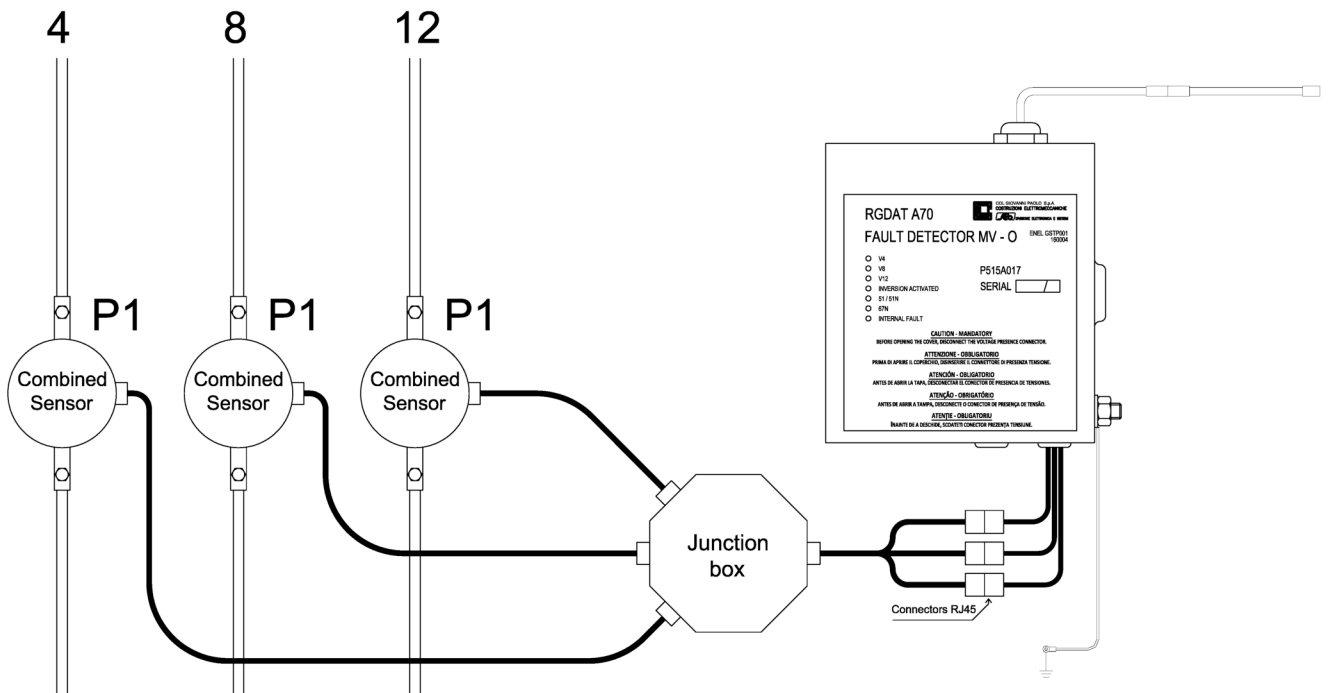| Error code	Suggested action
CPU failure	Send the equipment to Col - Seb technical service
Stack error	Call Col - Seb technical support, describing the circumstances that caused the problem
ADC failure	Send the equipment to Col - Seb technical service
Protected Memory error	Set the default data and restart the equipment. If the problem persists, contact Col - Seb technical support
EEPROM failure	Send the equipment to Col - Seb technical service
Checksum error	Set the default data and restart the equipment. If the problem persists, contact Col - Seb technical support
RTC error	Set date and time and restart the equipment
CT configuration error	Call Col - Seb technical support, describing the circumstances that caused the problem

ADDENDUM A

In Addendum A there are diagrams and explanatory drawings.

Wiring diagram of RGDAT-A70 /O (Outdoor)

4 **8** **12**

P1 P1 P1

Combined Sensor Combined Sensor Combined Sensor

Junction box

RGDAT A70
FAULT DETECTOR MV - O

ENEL GSTP001
150004

○ V4
○ V8
○ V12
○ INVERSION ACTIVATED
○ 51 / 51N
○ 67N
○ INTERNAL FAULT

P515A017

SERIAL

CAUTION - MANDATORY
BEFORE OPENING THE COVER, DISCONNECT THE VOLTAGE PRESENCE CONNECTOR.

ATTENZIONE - OBBLIGATORIO
PRIMA DI APRIRE IL COPERCHIO, DISINSERIRE IL CONNETTORE DI PRESENZA TENSIONE.

ATENCIÓN - OBLIGATORIO
ANTES DE ABRIR LA TAPA, DESCONECTAR EL CONECTOR DE PRESENCIA DE TENSIONES.

ATENÇÃO - OBRIGATÓRIO
ANTES DE ABRIR A TAMPA, DESCONECTE O CONECTOR DE PRESENÇA DE TENSÃO.

ATENȚIE - OBLIGATORIU
ÎNAINTE DE A DESCHIDE, SCOATEȚI CONECTOR PREZENȚA TENSIUNE.

Connectors RJ45

Schematic representation of connections to RGDAT-A70 /O
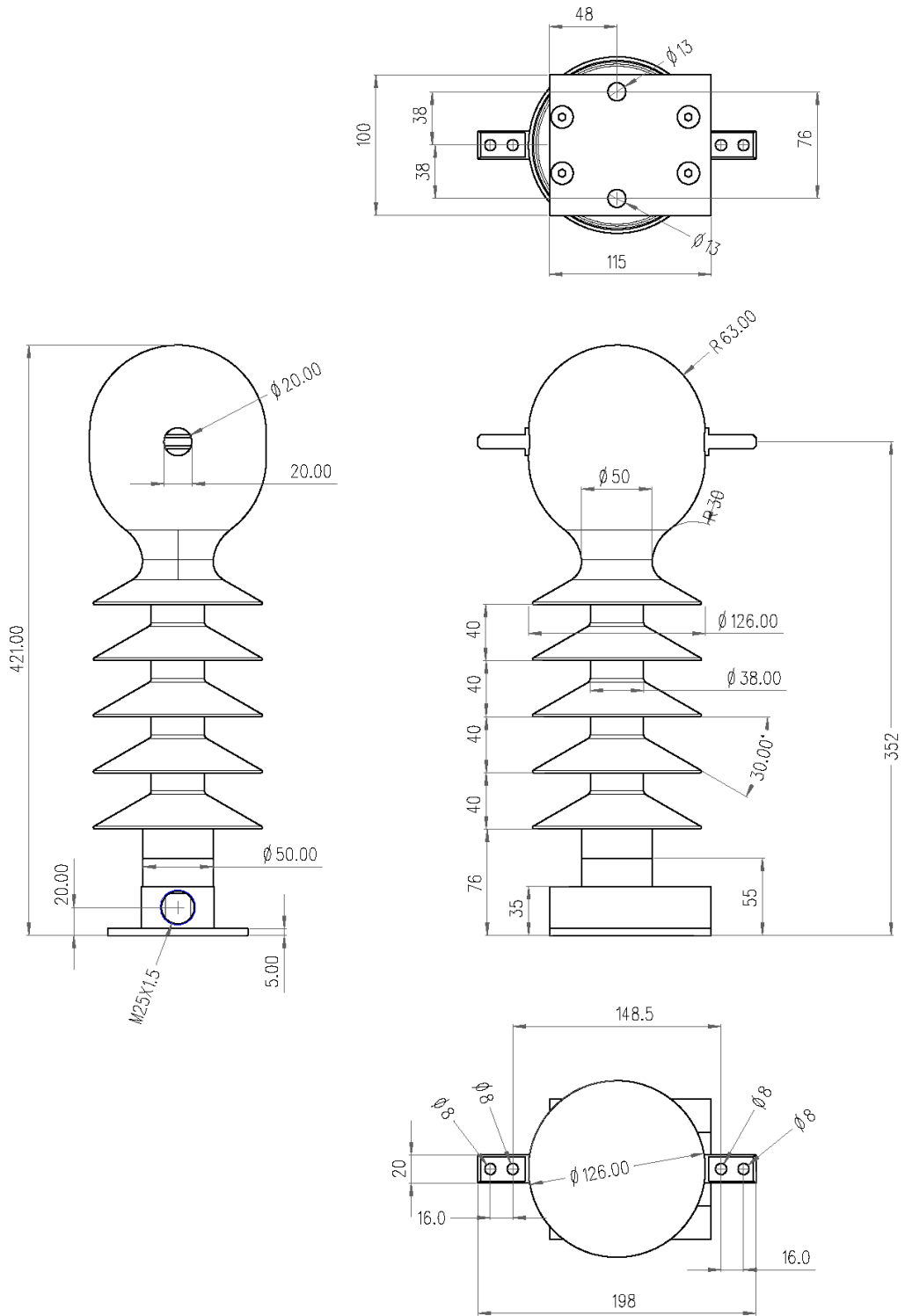
Overall dimensions of combined sensors CVS-P-24-O

ADDENDUM B

Appendix B shows the change log of firmware and software releases for RGDAT-A70 compliant with technical specification GSTP001 by ENEL.

Changes to firmware RGDAT-A70

Release 2.00

First official release (ENEL approval according to technical specification GSTP001)

Release 2.01

Changes in functionalities for Endesa (Request by ENEL)
Other minor changes

Release 2.02

Increase the maximum value of the threshold 51N to 600 A (Request by ENEL)[8]
Improvements in Io pre-fault compensation current calculation (for Outdoor version, with TATVs)

Release 2.10[9]

Io prefault compensation is now used for all configurations with 3 phase current sensors
Io prefault current is calculated using data 100 ms earlier than the actual ones
Add support to fix issues with some lots of Altea combined sensors

Changes to software RGDAT-A70

Release 2.00[10]

First official release (ENEL approval according to technical specification GSTP001)

Release 2.01[11]

In the dialog box of "Firmware Update" procedure, it was added the option of choosing the firmware version to use, selecting it from the ones released so far (Request by ENEL)
All the firmware version released so far (from 1.00 until 2.01) are added to the installation program (Request by ENEL)

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[8] In case of firmware update of RGDAT-A70 with release firmware 1.xx, the function is available only if the RGDAT-A70 is equipped with Rogowski coil current sensors or TATVs

[9] If the RGDAT-A70 firmware is updated to the version indicated, at the end of the update it is necessary to give also the "Default data" command and then reconfigure the device with the data related to the plant in which it is installed

[10] The release 2.00 of the software is compatible also with previous model of RGDAT-A70, with firmware release 1.xx

[11] With the changes introduced with this release, the software RGDAT-A70 with release 1.xx will not be updated and will be discontinued. Any actions that may be relevant to the old firmware and software versions will be implemented directly in the software 2.xx, which will have to ensure compatibility with RGDAT-A70 with firmware 1.xx also in the future

Removal from the source code of the possibility of generating a specific version for use by the Constructor; the "Constructor" mode is now activated by a special parameter to be indicated on the command line when running the program

Other minor changes

Release 2.02

Fix a bug that causes the program to stop unexpectedly during the firmware update procedure (only if the Spanish language is selected). This bug has no effects on firmware of the RGDAT-A70.

Release 2.03

Fix a bug that causes the firmware update process to be blocked if the application program of the RGDAT-A70 is corrupted

Release 2.04

Increase the maximum value of the threshold 51N to 600 A (Request by ENEL)[12]

The firmware release 2.02 is added to the installation program

Release 2.05

Add a setting to select a reduced angular sector of intervention for the threshold 67NS1 (Request by ENEL)

Release 2.10

Add of a file with serial numbers to fix issues with some lots of Altea combined sensors

Renamed dialog box "Features for RGDAT A70 /O" to "Features for configuration with 3 phase sensors"

The firmware release 2.10 is added to the installation program

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[12] The function is available only for RGDAT-A70 with firmware 2.02 or newer, equipped with Rogowski coil current sensors or TATVs