mecc alte

POWER FROM WITHIN

D-PRO CONTROLLER

SMARTECH

TECHNICAL MANUAL

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Revision	Date	Pages	Notes
00	05/04/2016	41	First revision
01	10/11/2016	45	Valid for the 01.05 revision of the controller. Added alarm 579, 580, 581. Added chapters: 4.5.1 and 4.6.10. Modified chapters: 1.3.1, 3.1, 5, 6.2, 7.7-561, 7.7-579, 7.7-580, 7.7-581.
02	22/10/2019	46	Valid for the 01.09 revision of the controller. Modified chapters: 4.7.7, 4.7.8
03	16/12/2019	54	Valid for the 01.10 revision of the controller. Added technical characteristics paragraph 3 Modified chapters: 8.7-565 and 9.2 Added chapters: 9.2.1 and 9.3
04	30/03/2020	54	Valid since version 01.11 of the controller 5.7.5, 5.7.6, 8.7-581
05	28/07/2020	55	Valid since version 01.13 of the controller 5.7.4, 8.7-566
06	19/04/2022	55	Valid since version 01.15 of the controller 8.7-252, 8,7.254, 8.7-568, 8.7-571

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1. Introduction

1.1 References

[1] MECC ALTE EAAM0495xx - D-PRO parameter tables.

[2] MECC ALTE EAAS0496xx – D-PRO Modbus registers

[3] MECC ALTE EAAS0341xx – Serial Communication.

[4] BOSCH CAN Specification – Version 2.0 – 1991, Robert Bosch Gmbh

[5] CAN open – Cabling and Connector Pin Assignment – CIA Draft Recommendation DR-303-1

[6] MECC ALTE EAAP0457xx – USB driver Installation Guide

[7] MECC ALTE EAAM046200IT – Ethernet TCP/IP – Rapid Installation Guide.

[8] MECC ALTE EAAM00458xx – BoardPrg 3.xx Software Manual

[9] EAAM0410xx – SI.MO.NE User Manual.

1.2 Safety information

Many accidents are caused by poor knowledge and the non-observance of safety regulations, which must be observed when operating and/or servicing the machine.

Before using or servicing the machine, you should read, understand and observe the precautions and warnings in this manual, in order to prevent accidents.

In order to identify the safety messages included in this manual, see the words listed below.

WARNING! This indication is used in the safety messages of the manual when there are possible danger situations that may cause injuries or death if the danger is not avoided.

This safety messages describe the normal precautions needed to avoid danger. Ignoring these instructions may cause serious damages to things and/or people.

WARNING! This indication is used in the safety messages for dangers that, if not avoided, may cause injuries, damages or malfunctioning.

The message can be also used only for few dangers that may cause damages to things and/or people.

INFORMATION! This term indicates that the message provides useful information for performing the current operation, or for explanations or clarifications of procedures.

1.3 General info

D-PRO is a protection relay for the genset. It includes all the necessary functions to acquire the measurements of the plant and to activate one or more outputs in order to keep the plant safe in case of irregular values acknowledged. The system is not equipped by a multifunctional display, but it requires the connection to the DST4602 controller for a complete use with the visualization of the faults and the measurements of frequency, voltage, current and power of the plant. In case of "stand-alone" use (without connection to the DST4602 controller), the D-PRO protection relay carries out the same basic functions, but the information are displayed through LEDs.

1.3.1 Protections (ANSI/IEEE codes)

The following table shows the protections implemented:

	Protection	Description
1	27	Minimum generator's voltage
2	27T	Minimum generator's time-dependent
3	32P	Maximum active power
4	32Q	Maximum reactive power
5	46	Negative sequence
6	47	Wrong phases sequence
7	50	Short circuit
8	50N	Neutral short circuit
9	50V	Short circuit with voltage-restrained
10	51	Maximum current
11	51N	Maximum neutral current
12	51V	Maximum current with voltage-restrained
13	59	Maximum generator's voltage
14	59N - 59V0	Maximum residual voltage (homopolar voltage)
15	81O	Maximum generator's frequency
16	81U	Minimum generator's frequency
17	87G	Genset earthing differential protection
18	32RP	Active power reverse
19	32RQ / 40	Reactive power reverse / Loss of excitation
20	64	Restricted earth fault / Maximum differential current

1.4 Prerequisites

For the appropriate use of this manual it is required knowledge of the use and of the installation of generator groups.

⚠ WARNING!!!

Every operation must be carried out by skilled personnel. There are dangerous voltages on the terminals of the device; before carrying out any operation on them, ensure you have opened the mains and genset circuit breakers or removed the related fuses.
Do not remove or modify any connection during the genset operation.
Do not disconnect the current transformers terminals (C.T.) for any reason.

Wrong interventions on connections can cause the disconnection of the loads from the mains or the genset.

Please read this manual carefully before using the device.

The device uses a large number of configurable parameters; therefore, it is impossible to describe all their possible combinations and effects.

In this document, there isn't a detailed description of all programming parameters: to this purpose, see [1]. These documents have to be considered as part of this manual.

The devices are supplied with a generic "default" configuration; it is the installer's responsibility to adjust the operating parameters to the specific application.

MECC ALTE s.r.l carries out a great effort to improve and update its products; therefore, they are subject to both hardware and software modifications without notice. Some of the features described in this manual may differ from those present in your device.

1.5 Switch SW1

IMPORTANT Both SW1 switches must stay on position OFF.

The SW1 switches allow a reserved access to special functions that usually are not included in the normal operation of the device.

If the device is supplied with one of the two switches in ON position, it does not turn on. In order to bring the device back to the normal operation, you need to disconnect it, position the switches on OFF and connect it again.

If the device does not turn on when supplied, check the position of the switch first.

1.5.1 Notes on the configuration of the device parameters

The parameters and the functions can be configured or adjusted exclusively by the PC program MECC ALTE Board Programmer3 [8] (hereinafter called "BoardPrg3") installed on the CD supplied together with the device and downloadable for free, after registration, on MECC ALTE S.r.l website.

It considerably simplifies the configuration of the device and allows the file saving of the device configuration and its following use on other similar devices too.

The program also allows the configuration, saving or loading of the characteristic curves of non-standard analogue sensors with resistive or live output.

BoardPrg3 [8] can be used on all MECC ALTE devices; the connection to the PC can be direct via serial RS232 or USB, or by remote via modem, serial RS845 or Ethernet. For the use of the program, refer to the proper manual.

1.6 Definitions

1.6.1 Faults

D-PRO is able to report and manage all the faulty conditions occurring during the operation of the system. The faults are classified in two categories, according to their severity and based on the actions D-PRO performs to manage them:

- **Warning.** This term is used to indicate an anomaly that, under the current circumstances, doesn't compromise the operation of the genset: the operator should take note of it anyway, because sooner or later it could worsen in a more serious anomaly.
- **Alarm.** This term is used to indicate an anomaly that requires the stop of genset. There are immediate risks for the genset, therefore it needs to be stopped immediately.

1.6.2 Acronyms

AIF It identifies a function for the configuration of the analogue inputs ("Analogue Input Function"). The number that follows the caption "AIF" is the code to set in the parameter that configures the function of the desired analogue input.

AOF It identifies a function for the configuration of the analogue outputs ("Analogue Output Function"). The number that follows the wording "AOF." is the code to set in the parameter that configures the function of the desired analogue output.

AVF It identifies a function for the configuration of virtual analogue inputs ("Analogue Virtual Function"). The number that follows the wording "AVF." is the code to set in the parameter that configures the function of the desired analogue input.

DIF It identifies a function for the configuration of digital inputs ("Digital Input Function"). The number that follows the caption "DIF" is the code to set in the parameter that configures the function of the desired digital input.

DOF It identifies a function for the configuration with the digital outputs ("Digital Output Function"). The number that follows the caption "DOF" is the code to set in the parameter that configures the function of the desired digital output.

EVT It identifies an event in the history log. The number that follows the caption "EVT" is the numeric code of the event.

ST It identifies a controller status ("Status"). The code the follows the caption "ST." indicates a status of a measurement or a condition of the device or of one of its functions.

AL It identifies an alarm ("Alarm"). The number that follows the caption "AL." indicates the alarm numeric code.

1.7 Conventions

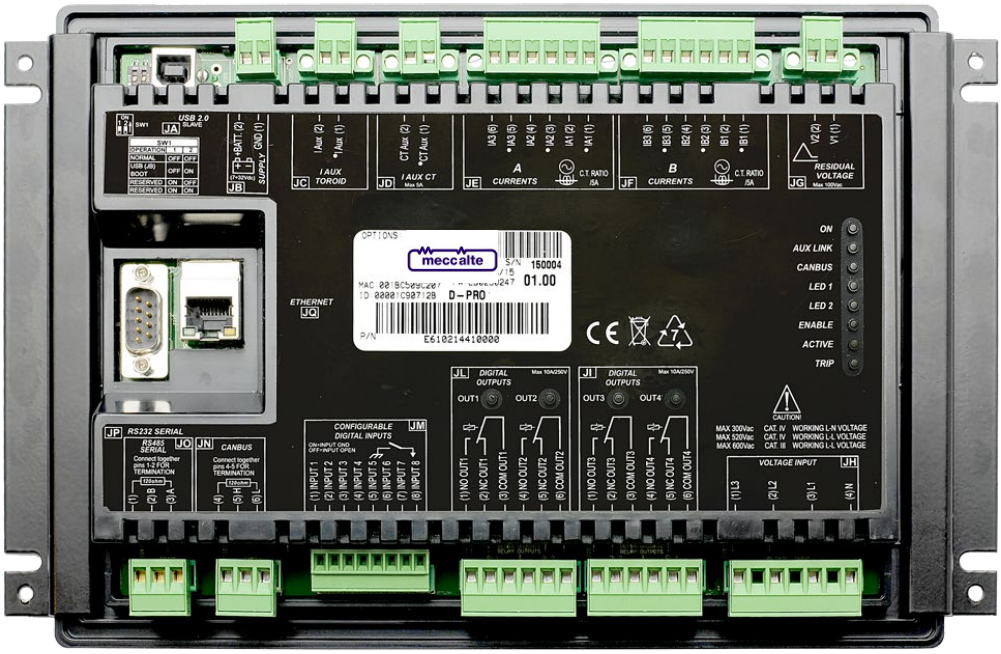
In this manual, the modifications, with respect to the previous version, are signalled by a vertical bar on the right of the paragraphs. The modifications on the fields of a table are highlighted with a grey background.

1.8 Firmware revisions

The software revisions will be described in different part of the manual. These revisions are referred with the MECC ALTE code assigned to it (which is reported on a label on the controller rear side). The code format is: EB0250247XXYY, where “XX” is the major version number and “YY” is the minor version number. Thus, the code EB02502470100 refers to the controller software release "1.00".

INFORMATION! In the codes above, the two letters marked with YY can be replaced by a number indicating the version. The two final letters XX can be replaced by a progressive number indicating the product revision or option.

2. Views of the device



3. Technical characteristics

INFORMATION! GND is referred to the potential of the terminal JB-1

Supply power voltage +VBATT:	
Nominal power supply (Vn)	12Vdc or 24 Vdc
Power supply range (Vn variation)	From 7 to 32Vdc The device identifies the plant operation at 12 or 24V to manage its alarms when powered. Protection against polarity reversal with built-in self-resetting fuse.
Starting minimum voltage	The operation is guaranteed during the engine start up to Vbatt=>5Vdc for undelimited time
Sampling rate	10kHz
Resolution	12 bits
Power consumption in stand-by:	200mA @ 13,5 Vdc 120mA @ 27 Vdc
Maximum power consumption during operation (relays, horn, digital inputs activated)	Max. 580mA @ 7 Vdc 320mA @ 13,5 Vdc 200mA @ 27 Vdc
Generator voltage inputs (JH)	
	Measurement of the L-N and L-L phases voltages. L-N voltage measurements with differential circuit. Measurements of the neutral voltages referred to the negative power supply of the device. Non-isolated measuring circuits. Available option with 100Vac input
Nominal Voltage (Vn)	400Vac L-L (230Vac L-N) 100Vac L-L (58Vac L-N) for D-PRO with 100V option
Sampling rate	10Khz
Type of measurement	True RMS measurements (TRMS).
Input impedance Vn@400V	> 0,8 MΩ L-L > 1,3 MΩ L-N > 3,0 MΩ L-GND > 2,8 MΩ N-GND
Maximum voltages applicable	MAX 300Vac in CAT.III for measurements L-N MAX 520Vac in CAT.III for measurements L-L
Maximum voltages measurable	D-PRO with standard input: Vn@400V Max 450 Vac for measures L-N (with voltage N-GND = 0 Vrms) Max 779 Vac for measures L-L (with voltage N-GND = 0 Vrms) D-PRO with option: Vn@100V Max 130 Vac for measures L-N (with voltage N-GND = 0 Vrms) Max 225 Vac for measures L-L (with voltage N-GND = 0 Vrms)

Max voltage in Common-Mode from GND	Max 100 Vrms
Connection mode	3 phases 4 cables 3 phases 3 cables Single phase 2 cables Aron insertion with 2 voltage transformers
Measurement resolution	12 bits
Measurement accuracy	< 0,5% @ Vn
Homopolar voltage measurement inputs (JG)	
	Measurement of residual voltages directly from open triangle voltmetric (VT) transformers. Voltage measurement with hardware differential circuit. Non-isolated measuring circuit
Nominal Voltage (Vn)	100Vac
Sampling rate	10Khz
Type of measurement	True RMS measurements (TRMS).
Input impedance Vn@400V	> 1,0 MΩ L-L > 1,2 MΩ L-GND
Maximum voltages applicable	Max 300 Vac for measures L-L (with voltage N-GND = 0 Vrms)
Maximum voltages measurable	Max 100 Vrms
Connection mode	open triangle VT
Measurement resolution	12 bits
Measurement accuracy	< 0,5% @ Vn
Current measurement inputs A e B (JE e JF)	
	6 inputs with internal CT It is required the use of current transformers with a secondary current from 1A to 5A. **The external TA must guarantee at least one BASIC isolation for the use of the device in the Overvoltage Cat. III.**
Nominal Current (In)	1Aac o 5Aac
Scale	1Aac nominal 5Aac nominal
Sampling rate	10Khz
Max. measurement range with 5A range	Up to 7,3Aac
Max. measurement range with 1A range	Up to 2,3Aac
Type of measurement	True RMS measurements (TRMS).
Burden per phase (Auto-consumption)	< 1VA
Overload capacity	+40% of the nominal current
Overload peak	Possible sinusoidal transient voltage surges up to 20 Aac with progressive loss of the measurement accuracy depending on the amplitude of the surge.
Measurement resolution	12 bits

Measurement accuracy	< 0,2% @ In
Auxiliary current measurement inputs (JD)	
	1 independent auxiliary current with internal CT It is required the use of current transformers with a secondary current from 1A to 5A. **The external TA must guarantee at least one BASIC isolation for the use of the device in the Overvoltage Cat. III**
Nominal Current (In)	1Aac or 5Aac
Scale	1Aac nominal (Low Current range) 5Aac nominal (High Current range) Internal amplifier with automatic change of scale for currents lower than 1,2Aac and higher than 1,5Aac.
Sampling rate	10 KHz
Max. measurement range	Up to 7,3Aac
Type of measurement	True RMS measurements (TRMS).
Burden per phase (Auto-consumption)	< 1VA
Overload capacity	+40% of the nominal current
Overload peak	Possible sinusoidal transient voltage surges up to 20 Aac with progressive loss of the measurement accuracy depending on the amplitude of the surge.
Measurement resolution	12 bits
Measurement accuracy	< 0,2% @ In
Toroidal transformer measuring input (JC)	
	1 independent auxiliary current with internal shunt for connecting external toroid. Toroidal ratio adjustable by parameters.
Nominal Current (In)	150mAac
Sampling rate	10Khz
Max. measurement range	to 150 mAac
Type of measurement	True RMS measurements (TRMS).
Burden per phase (Auto-consumption)	< 0,6VA
Overload capacity	+180% of the nominal current
Overload peak	0,4Aac for 1 second
Input impedance	25,5 ohms
Measurement resolution	12 bits
Measurement accuracy	< 0,2%@ In
Frequency measurements	
	Nominal frequencies 50 or 60Hz detected by the generator's L2-L3 phase voltages.
Nominal Frequency (Fn)	50Hz or 60Hz
Measurement range	5 to 80 Hz
Measurement accuracy	± 50 mHz

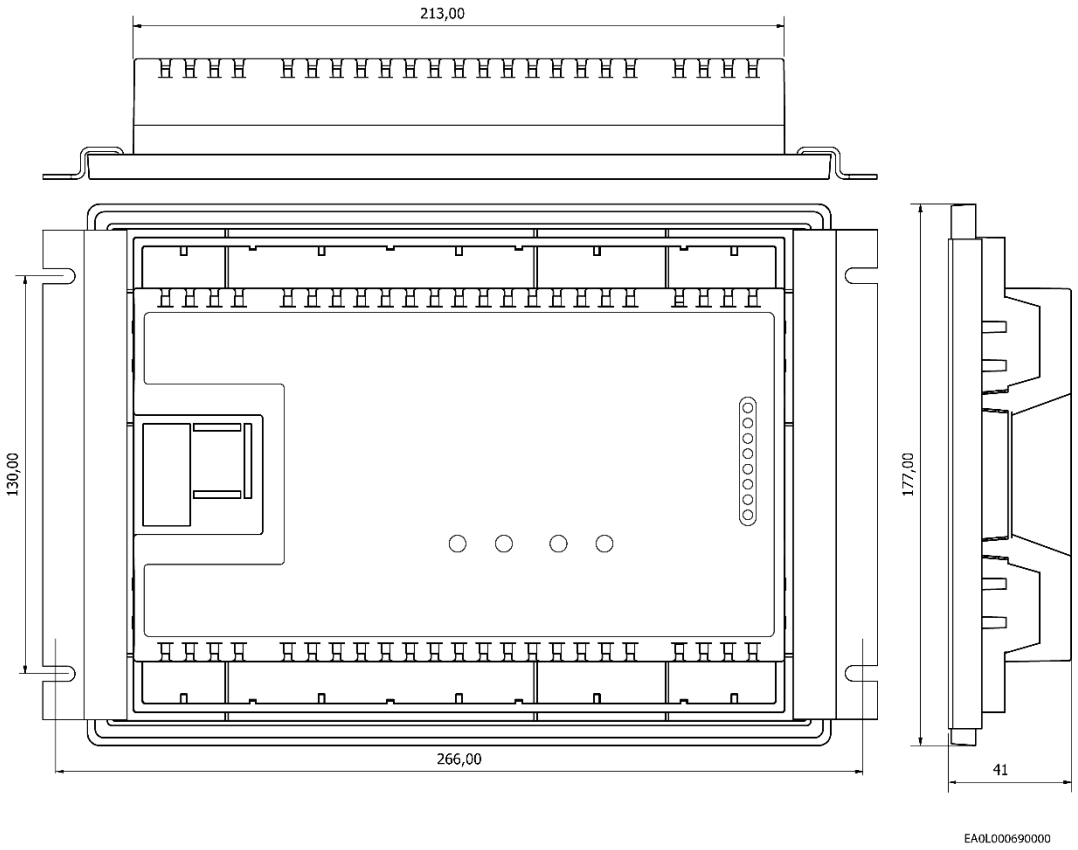
Frequency minimum sensitivity for Genset voltage input	D-PRO with standard input: Vn@400V 24 Vrms L2-L3 D-PRO with option: Vn@100V 7 Vrms L2-L3
Measurement resolution	0,1Hz ± 50ppm, 35ppm/C typical
Digital inputs 01-08	
	8 not insulated with common power supply connected internally to the positive power terminal of the JB (2) +Vbatt device. Active when the input is turned to negative GND power supply. When open, the voltage at the input terminals is equal to +Vbatt.
Activation/deactivation threshold	2,5VDC
Typical current with closed contact	6,5mA @ +Vbatt= 13.5Vdc 12mA @ +Vbatt= 27Vdc
Input signal delay	It can be adjusted by the related parameter for each input
Digital outputs 01-04	
Type of output	4 relays with dry contacts. All relay outputs are adjustable by parameter.
Rated supply	Max. 10A @250Vac.
RS232 Communication interface	
Type of interface	1 RS232 serial port standard TIA/EIA, not insulated on DB connector 9 poles male CANON
Electrical signals	TX. RX, DTR, DSR, RTS, GND
Settings	Baud rate selectable by parameter: 300, 600, 1200, 2400, 4800, **9600***, 19200, 38400, 57600, 115200 bps Parity: **None***, Even, Odd Stop bit: **1***,2 * **Default Setting**
Type of transmission	**Modbus RTU Slave***, Modem AT * **Default Setting**
Maximum distance	Maximum Cable length depends cable capacitance, inductance and screening. 15m (50ft) @ 9600bps 10m (33ft) @ 19200bps 7,5m (25ft) @ 38400bps 5,0m (16ft) @ 57600bps 2.5m (8ft) @ 115200bps
RS485 Communication interface	
Type of interface	1 RS485 serial port standard TIA/EIA, with galvanic insulation. Terminating resistor can be inserted by connecting pins 1 and 2 of the JO connector.
Electrical signals	DATA+ (A), DATA– (B)

Settings	Baud rate selectable by parameter: 300, 600, 1200, 2400, 4800, **9600***, 19200, 38400, 57600, 115200 bps Parity: **None***, Even, Odd Stop bit: **1***,2 * **Default Setting**
Type of transmission	**Modbus RTU Slave**
Insulation voltage	Max operating 560Vdc 1KVdc on transient < 60s.
USB 2.0 Communication interface	
Type of interface	1 USB2.0 serial port not insulated used in Function mode.
Function Mode	Connection to PC by MECC ALTE Driver USB Connector type B. Type of transmission Modbus RTU Slave
Maximum distance	6m (20 feet)
CANBUS Communication interface	
Type of interface	1 CANBUS serial ports with galvanic insulation. Terminating resistor can be inserted by connecting pins 4 and 5 of the JN connector.
CanBus	CanBus connection with protocol MECC ALTE PMCBus for the communication with DST4602.
Rated impedance	120Ω
Insulation voltage	Max operating 560Vdc 1KVdc on transient < 60s.
Ethernet communication interface	
Type of interface	1 Ethernet interface 10/100Mbps full-duplex 10T/100Tx Auto HP Auto-Mdix support Compliant IEE802.3/802.3u (Fast ethernet) Compliant ISO802-3/IEEE802.3 (10BASE-T)
Insulation voltage	1500VRMS
Environmental conditions	
Operating temperature	From -30°C to +70°C
Stock temperature	From -40°C to +80°C
Humidity	IEC 60068-2-30 Db Damp Heat Cyclic 20/55°C @ 95% RH 48 Hours IEC 60068-2-78 Cab Damp Heat steady state 40°C @ 93% RH 48 Hours
Operating altitude	Up to 2000 m (6561 ft.)
Box	
Material	ABS +PC
Size	244(L) x 178(H) x 40(D) mm
Weight	600g
Protection degree	IP20 for the panel interior

4. Installation

4.1 Mounting

The device has to be mounted permanently on a panel. The rear panel of the device must be accessible only by authorized personnel for maintenance operations. Use four screws with metric thread 4 MA and brackets supplied. The drilling wheelbase is 266x130mm.



4.2 Wiring

MECC ALTE cannot be considered responsible for damages to things or persons for the failure to respect the installations and connections indications of the device.

Due to the high voltages connected to the measurement circuits of the controller, all conductive parts of the electrical panel should be connected to the protective earthing through permanent connections.

The installation of an overcurrent protection device is required for each phase of the mains and generator voltage inputs. You can use 1A fuses.

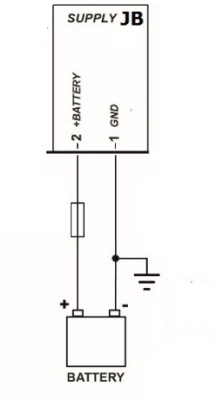
The section of the protective earthing conductor should be at least equal to the section of cables used to wire mains or generator voltage to the control panel. In addition, it must comply with the limit value of the overcurrent protection used.

For CAT.III applications, the maximum phase-to-neutral voltage allowed is 300Vac, while the phase-to-phase voltage is 520Vac. The maximum voltage related to the protective earthing is 300 Vac.

The device can operate in CAT.III only if the supply negative terminal of the device and the neutral terminal of the genset are connected to the protective earthing.

5. Connections

5.1 Device supply (JB)



WARNING! In order to respect the safety rules, you must guarantee an electrical insulation not lower than the one of a safety transformer compliant to the IEC61558-2-6 or equal regulation.

The **JD** connector is the supply connector: connect a continuous power supply (usually the engine starter battery) to the **1-GND** terminal (negative) and to the **2-+BATT** terminal (positive).

The negative terminal **1-GND** is the reference and the common return of the digital inputs, outputs and current and voltage measurements. **It must be connected to the protective earth.** The systems that require insulation between the battery negative and the earthing protection can be used but can generate operating problems and may require particular care, as the use of insulation current transformers for the voltage measurements of Mains and Genset.

Although the device is protected by a built-in self-resetting fuse, it is recommended that you use a fuse for the protection of the positive line **2-+BATT**. The device automatically acknowledges when it is powered if the genset battery nominal voltage is 12 or 24V for managing the related logics and alarms.

NOTE: during the installation, connect the positive voltage only after all fuses available in the panel are all opened.

5.2 LEDs

The controller uses eight LEDs for the user's visualization and four red LEDs associated to the status of the four relay outputs. The LEDs are only on the controller, but they are not associated to any output (static or relay output) and they have the following default function.

Led off	LED steady ON	LED flashing
☐	▣	⧈

LED	Colour	Signalling		Function
ON	Green	Controller status	⧈	Controller working
			▣	Controller in alarm
			☐	Controller in alarm

LED	Colour	Signalling		Function
AUX LINK	Green	Serial communication status	▣	It indicates that a communication on one of the serial interfaces.
			☐	It indicates that no communication on the serial interfaces.
CANBUS	Green	INTERFACE DST4602 Status	▣	It signals that the **CAN-BUS** interface is active and in **ERROR-ACTIVE** mode.
			▣	Flashing at 25% it indicates a communication fault: the port is in **ERROR-PASSIVE** mode.
				Flashing at 75% it indicates a communication fault: the port is in **BUS-OFF** mode.
			☐	It signals that the **CAN-BUS** is disabled.
LED 1	Green	-		Not used.
LED 2	Green	-		Not used.
ENABLE	Green	Protection enabled.	▣	At least one protection is enabled.
			☐	No protection is enabled (that is the protection controller is disabled).
ACTIVE	Yellow	Protection activated.	▣	At least one protection is enabled and exceeded the threshold.
			☐	No protection is activated.
TRIP	Red	Triggered protection	▣	At least one protection has triggered (TRIP). In order to switch off the LED, you need to reset the protection with the reset input or by positioning the key selector on DST4602 on OFF/RESET.
			☐	No protection has triggered.

The status of disabled protection (LED ENABLE off) is acknowledged by OR conditions:

- GCB status input opened (only if configured).
- All the configured inputs of protections disabling are active.

The status of enabled protection (LED ENABLE on) is signalled when at least one protection is enabled (no input or disabling parameter is active) and lower than the protection threshold.

The status of activated protection (LED ACTIVE steady on) is signalled when at least one protection is enabled (no input or disabling parameter is active) and exceeded the protection threshold. The LED refers to the measurements by activating when it exceeds the threshold and by deactivating when it is lower than the threshold (even in case the protection triggers).

5.3 Digital inputs (JM)

The controller is already equipped with 8 digital inputs that activate by connecting them to GND. When it is left floating, the input brings itself to +Vbatt. Avoid situations where intermediate or undefined voltage levels can occur.

In addition to the 8 physical digital inputs, the controller also manages 16 virtual digital inputs. They are managed by the controller exactly as they were physical inputs (without limitations). The virtual inputs status is not acquired by the hardware, but it is determined by software. In fact, every digital input can be associated to an AND/OR logic that determines its status (see par. 5.5.2).

5.3.1 Digital inputs configuration

By default, all digital inputs are “active” only when the related terminal is connected to the negative of the supply voltage of the controller; they are considered “not active” when the related terminal is not connected to anything. **The logic status of the input can be inverted with respect of the physical status by selecting the box “Reverse polarity” in the input configuration page on BoardPrg3.** The box is only visible if the function selected is other than DIF.0000 – “Not used”.

It is also possible to invert the logic status (always individually for each input), by operating directly on the controller by using the parameters P.2000 (for the input 1...8 present on the controller).

Said parameters have a bit for each output:

- A bit set to zero means that the related input is “active” when it is connected to the negative supply of the controller.
- A bit set to one means that the related input is considered “active” when the terminal is not connected to anything (it will become “not active” when the terminal is connected to the supply negative of the controller).

By default, all bits are set to zero.

Each input (both physical and virtual) has three parameters associated:

- One parameter that configures its function (P.2001 for input 1).
- One parameter that configures the delay time (P.2002 for the input 1).
- One parameter that configures a message to show on the display (P.2003 for the input 1).

See documents [1] for the parameters list.

The management of the physical and virtual inputs is the same.

The parameters that configure the delay and the message for an input are used by the controller only for certain features of the inputs. The following table highlights when they are used.

NOTE: in BoardPrg3, the boxes for the delay and for the message are always showed, even if they are not used by the controller.

The identification of the inputs functions that start with 3xxx concern operating statuses, while the ones that start 4xxx activate alarms (warning or alarms).

Input Function	Name	Delay	Description
DIF.0000	Not used.		Input not used.
DIF.2001	Reset command of the alarms,		When the input becomes "active", the controller carries out a complete reset of all anomalies.
DIF.2063	Protections override		When the input is "active", all the protections, which normally act as alarms, become mere warnings.
DIF.2151	Select configuration 1.		When the input becomes "active", the configuration parameters of the alternative 1 are copied in the working parameters.
DIF.2152	Select configuration 2.		When the input becomes "active", the configuration parameters of the alternative 2 are copied in the working parameters.
DIF.2153	Select configuration 3.		When the input becomes "active", the configuration parameters of the alternative 3 are copied in the working parameters.
DIF.2154	Select configuration 4.		When the input becomes "active", the configuration parameters of the alternative 4 are copied in the working parameters.
DIF.2704	Disable the protections on the 4th current.		When this input is "active", the auxiliary current protection (normally used for the differential protection) is disabled.
DIF.2705	Disable the protections on the analogue measures.		When this input is "active", the thresholds set on analogue measurements with bit 13 ON in the third configuration parameter do not cause the intervention of the related protections.
DIF.2711	Protections disabling - level 1		Disable the protections configured in the parameter P.0201.
DIF.2712	Protections disabling - level 2		Disable the protections configured in the parameter P.0202.
DIF.2713	Protections disabling - level 3		Disable the protections configured in the parameter P.0203.
DIF.2714	Protections disabling - level 4		Disable the protections configured in the parameter P.0204.
DIF.2715	Protections disabling - level 5		Disable the protections configured in the parameter P.0205.
DIF.2716	Protections disabling - level 6		Disable the protections configured in the parameter P.0206.
DIF.2717	Protections disabling - level 7		Disable the protections configured in the parameter P.0207.
DIF.2718	Protections disabling - level 8		Disable the protections configured in the parameter P.0208.
DIF.3001	GCB circuit breaker status.	Yes	An input with such configuration is used to communicate the plant GCB (Genset) circuit breaker status to the protection relay.
DIF.3201	Generic status (page 1).		If this input is "active", the controller shows the text configured by the parameters associated to the input.
DIF.3202	Important generic status (page 1).		If this input is "active", the controller shows the text configured by the parameters associated to the input.
DIF.3203	Generic status (page 2).		If this input is "active", the controller shows the text configured by the parameters associated to the input.
DIF.3204	Important generic status (page 2).		If this input is "active", the controller shows the text configured by the parameters associated to the input.
DIF.3205	Generic status (page 3).		If this input is "active", the controller shows the text configured by the parameters associated to the input.
DIF.3206	Important generic status (page 3).		If this input is "active", the controller shows the text configured by the parameters associated to the input.
DIF.4001	Generic warning.	Yes	If the input is "active", a warning is activated: the message shown is the one set in the parameters associated to the input.
DIF.4004	Generic shut-down.	Yes	When the input is "active", a shut-down is activated: the text displayed is the one set in the parameters associated to the input.

5.4 Virtual digital inputs

In addition to the 8 digital physical inputs, the controller also operates 16 virtual digital inputs. The same are operated by the controller just as if they were physical inputs (with no limitation), but the status of the virtual inputs is not acquired from the hardware, but it is determined through the software. In fact, every digital input can have an AND/OR logic associated, which determines its status (see par.5.5.2).

Each virtual digital input has three parameters associated; see below for example the ones related to virtual digital input 1; for the parameters of the other inputs see document [8] or the I/O configuration page of the BoardPrg3.

We have:

- One parameter which configures its function (P.2151 for the virtual digital input 1).
- One parameter which configures any message (P.2152 for the virtual digital input 1).
- One parameter which configures the (P.2153 for the virtual digital input 1).

5.5 Digital outputs (JL/JI)

The D-PRO protection relay is equipped with four relay outputs with dry contact in exchange, max. **10A/250Vac** all fully adjustable.

Terminal	Type	Function	Output	Function configured
JL - 1	Relay, 10A 250Vac	N.O.	Output 01	DOF.0000 - Not used.
JL - 2		N.C.		
JL - 3		COM.		
JL - 4	Relay, 10A 250Vac	N.O.	Output 02	DOF.0000 - Not used.
JL - 5		N.C.		
JL - 6		COM.		

Terminal	Type	Function	Output	Function configured
JI - 1	Relay, 10A 250Vac	N.O.	Output 03	DOF.0000 - Not used.
JI - 2		N.C.		
JI - 3		COM.		
JI - 4	Relay, 10A 250Vac	N.O.	Output 04	DOF.0000 - Not used.
JI - 5		N.C.		
JI - 6		COM.		

5.5.1 Digital outputs configuration

All controller digital outputs (JL and JI) are fully adjustable individually. Each output is associated to the following parameters:

- A parameter that configures the function (P.3001 for the input 1):
- A parameter that configures the output activation mode (P.3002 for the input 1):

- 0-Normal: the output manages the command guaranteeing a minimum activation time (if the time set is different from zero).
- 1-Maintained: the output stays active up to the reset command.
- 2-Impulsive: the output activates for the time set and stays deactivated until a new command change.

- A parameter that configures the impulse activation or duration minimum time (P.3003 for the input 1). By setting it to zero, the output command stays stable on ON/OFF.

Parameter	Output	Description
P.3001	Output 1 (JL-1)	Output 01 function.
P.3002		Output 01 type (activation mode).
P.3003		Output 01 delay.
P.3004	Output 2 (JL_3)	Output 02 function.
P.3005		Output 02 type (activation mode).
P.3006		Output 02 delay.
P.3007	Output 3 (JI_4)	Output 03 function.
P.3008		Output 03 type (activation mode).
P.3009		Output 03 delay.
P.3010	Output 4 (JI_1)	Output 04 function.
P.3011		Output 04 type (activation mode).
P.3012		Output 04 delay.

By default, all the outputs activate when required by the related function. Using BoardPrg3, it is possible to invert the activation by simply selecting the box “Inverted polarity” on the top of the configuration page of each output.

- A zero-bit means that the output is normally in standby and starts operating when required by the related function.
- A one-bit means that the output is normally operating and goes in standby when required by the related function.

The map of the outputs present on the controller is:

BIT	Value	Output
0	1	Output 1 (JL-1)
1	2	Output 2 (JL_3)
2	4	Output 3 (JI_4)
3	8	Output 4 (JI_1)

By default, all bits are set to zero.

The status of the digital outputs is displayed by the proper LEDs (OUT1, OUT2, OUT3, OUT4) mounted on the controller.

The digital outputs can be used directly as command for controller external devices or as signalization of particular operating conditions. Below the functions adjustable on the digital outputs:

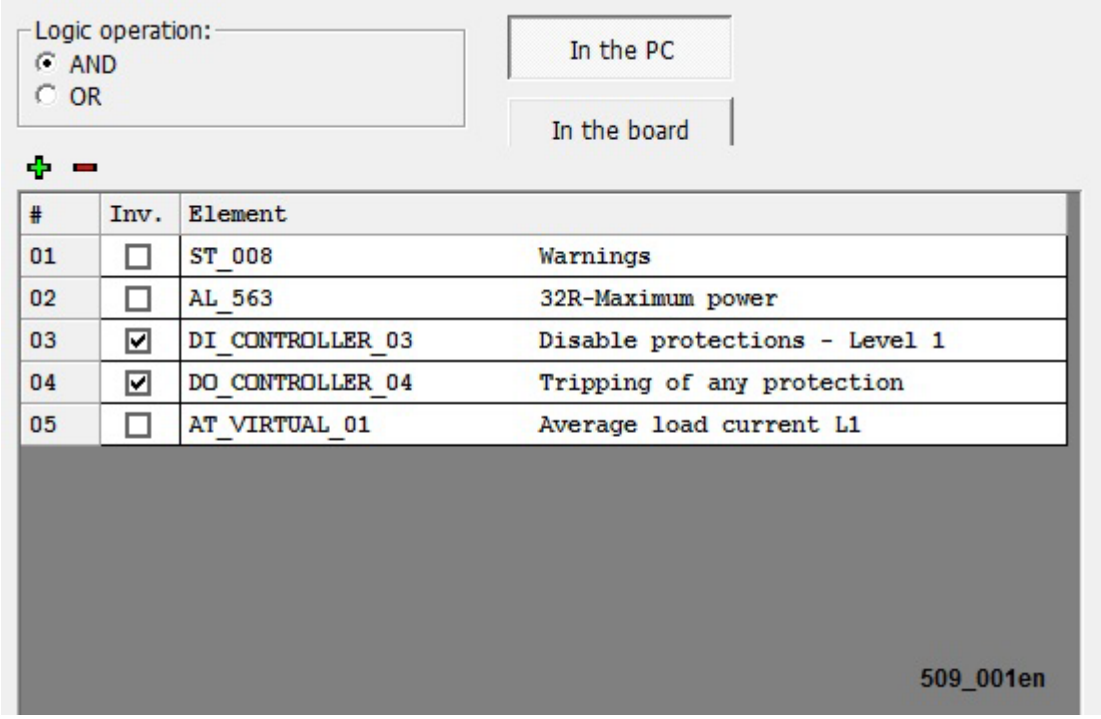
Code	Description	Delay + mode	Note
DOF.0000	Not used		

DOF.0103	AND/OR logics.		The output status results from the combination of the AND/OR logics.
DOF.1001	Protection enabling (ENABLE)	YES	It activates the output when at least one protection is enabled (the parameters are configured correctly and no protections disabling input is active)
DOF.1002	Protection activation (ACTIVE)	YES	It activates the output when at least one protection is started (the threshold has been exceeded but the time configured has not passed)
DOF.1003	Protection intervention (TRIP)	YES	It activates the output when at least one protection has triggered (the threshold has been exceeded for the time configured) The reset depends on the activation of the alarms reset input.
DOF.2001	Protections configuration - level 1	YES	It activates the output if one of the protections configured in the parameter P.0221triggered.
DOF.2002	Protections configuration - level 2	YES	It activates the output if one of the protections configured in the parameter P.0222triggered.
DOF.2003	Protections configuration - level 3	YES	It activates the output if one of the protections configured in the parameter P.0223triggered.
DOF.2004	Protections configuration - level 4	YES	It activates the output if one of the protections configured in the parameter P.0224triggered.
DOF. 3031	Frequency within tolerance	YES	It activates when the frequency parameters are within normal operation. It activates if there is at least one frequency within tolerance
DOF.3151	Faults reset	YES	It activates when the controller goes to RESET mode
DOF.3152	External horn	YES	It activates together with an internal horn.
DOF.4001	Warnings	YES	It activates in case of warnings
DOF.4005	Alarms (deactivations and unloads)	YES	It activates in case of alarms (deactivations and shut-downs)

5.5.2 AND/OR logics.

AND/OR logics are simply a list of boolean values (true/false, on/off, 1/0), which can be configured by the operator (programming), which the controller evaluates and whose result can be assigned to a digital output or to a virtual digital input (see par. 5.5.1). For using the AND/OR logics with a digital output, use the DOF.0103function.

NOTE: the configuration of the AND/OR logics must be carried out by means of a PC with the software BoardPrg3.



First, the operator must decide if the list of conditions have to be evaluated as AND (all must be verified) or OR (at least one condition must be verified). **It's not possible to have mixed AND/OR logics (you can do it using virtual digital inputs, see below).**

You can add up to 30 conditions. Each condition can be denied individually: for example, in the figure above the controller will verify that the digital input 3 and the digital output 8 are both **not active**. The following conditions can be added:

- DI_XXX: logic statuses of all digital inputs (physical and virtual).
- DO_XXX: logic statuses of all digital outputs.
- AL_XXX: presence of warning/alarms.
- ST_XXX: internal statuses of the controller.
- AT_XXX: statuses concerning the thresholds on analogue measures.

The following table shows the list of the internal statuses available for the AND/OR logics.

Status	Description
ST_008	Warnings cumulative
ST_011	Locks cumulative
ST_012	Unacknowledged warnings cumulative
ST_015	Unacknowledged locks cumulative

Using the virtual digital inputs, it is possible to create mixed AND/OR logics (that is composed by AND and OR together). Let's suppose we would like to activate the digital output #1 when the digital inputs #1 and #2 are both active, or if the digital input #3 is active.

First of all, we need to associate to the virtual digital input #1 (for example) an AND/OR logic configured as AND, which verifies that the first two digital inputs are both active. Then we need to

associate to the digital output #1 an AND/OR logic configured as OR, which verifies that the virtual digital input #1 or the digital input #3 is active. Basically, we use the virtual digital input #1 as "support" for the AND condition. In this case, it is not necessary to associate any function to the virtual digital input.

5.6 Virtual analogue inputs

The controller manages 8 virtual analogue inputs. They are managed by the controller exactly as they were physical inputs (without limitations). The virtual inputs status is not acquired by the hardware, but it is determined by software. By means of the parameter "function" of each virtual analogue input, indeed, it is possible to "copy" one of the internal measurement available on the controller in the analogue input:

- AVF.4001 - Frequency
- AVF.4002 - L1-N Generator voltage
- AVF.4003 - L2-N Generator voltage
- AVF.4004 - L3-N Generator voltage
- AVF.4005 - L-N Average Generator voltage
- AVF.4006 - L1-L2 Generator voltage
- AVF.4007 - L2-L3 Generator voltage
- AVF.4008 - L3-L1 Generator voltage
- AVF.4009 - L-L Average Generator voltage
- AVF.4010 - Homopolar voltage (59N)
- AVF.4017 - L1 Phase voltage - Upper part (A)
- AVF.4018 - L2 Phase voltage - Upper part (A)
- AVF.4019 - L3 Phase voltage - Upper part (A)
- AVF.4023 - L1 Phase voltage - Lower part (B)
- AVF.4024 - L2 Phase voltage - Lower part (B)
- AVF.4025 - L3 Phase voltage - Lower part (B)
- AVF.4029 - Auxiliary current
- AVF.4030 - Toroid current
- AVF.4033 - L1 Differential current
- AVF.4034 - L2 Differential current
- AVF.4035 - L3 Differential current
- AVF.4036 - L1 Average Load current
- AVF.4037 - L2 Average Load current

- AVF.4038 - L3 Average Load current
- AVF.4041 - Total Apparent power
- AVF.4047 - Total Reactive power
- AVF.4051 - L1 Active power
- AVF.4052 - L2 Active power
- AVF.4053 - L3 Active power
- AVF.4054 - Total Active power
- AVF.4058 - Total Power factor
- AVF.4059 - Total Cosϕ
- AVF.4105 – Battery voltage measured by the controller

The objective of the virtual analogue inputs is double:

- Allowing to activate warnings/alarms connected to the internal measurements available.
- Activating digital outputs according to the value of the internal measurements available.

5.6.1 Configuration of virtual analogue inputs

Each virtual analogue input has eight parameters associated; see below for example the ones related to virtual analogue input 1; for the parameters of the other inputs see document [8] or the I/O configuration page of the BoardPrg3.

We have:

- One parameter which configures its function (P.4051 for the virtual analogue input 1).
- One parameter which configures any message (P.4052 for the virtual analogue input 1).
- Two thresholds consisting of three parameters each:
    - One parameter which configures the threshold value (P.4053 and P.4056 for the virtual analogue input 1).
    - One parameter which configures the delay for managing the “out of threshold” (P.4054 and P.4057 for the virtual analogue input 1).
    - One parameter which configures the checking options and the actions in case of “out of threshold” (P.4055 and P.4058 for the virtual analogue input 1).

The two thresholds are completely independent on each other. The third parameter of each threshold is a “bit” parameter that allows you to associate to each threshold the following options:

- Bit 0. If this bit is “OFF”, the controller checks if the measure is higher than the threshold. If this bit is “ON”, the controller checks if the measure is lower than the threshold.
- Bit 1. If this bit is “OFF”, the controller sets to OFF the internal status related to this ANALOGUE measure if the measure is “out of threshold”. If this bit is “ON”, the controller sets to ON the internal status related to this ANALOGUE measure if the measure is “out of threshold”.

- Bit 4. If this bit is “ON”, the controller issues a warning if the measure is “out of threshold”.
- Bit 7. If this bit is “ON”, the controller issues a deactivation command if the measure is “out of threshold”.
- Bit 13. If this bit is “ON”, to activate any warning/lock configured with the preceding bits, the controller checks the status of any digital input configured with the function “2705 - Disable the protections on the ANALOGUE measures”. The warnings/locks will be activated if no digital input is configured as such, or if they are all OFF.
- Bit 15. If this bit is “ON”, the fault is subject to engine protections override (see par.8.5)

You can set any combination of these bit.

Using the two thresholds and the AND/OR logics together, you can activate a digital output regarding the value of an ANALOGUE measure, with hysteresis. Suppose you want to activate a digital output if the generator frequency exceeds 50.5 Hz. First of all, you have to maintain a minimum hysteresis on the threshold, otherwise, when the generator frequency is close to the threshold, the output will continue to switch on and off, due to minimum variations of the frequency itself. So, suppose you want to activate the output if the frequency exceeds 50.5 Hz and deactivate the output if the frequency is lower than 50.3 Hz. To do that, we can use, for example, the virtual ANALOGUE input #1 which has been configured to contain the generator frequency.

Let us set the parameters as follows:

- P.4051 (function #1): 4001 (AIF.4001).
- P.4052 (message #1): “”.
- P.4053 (threshold #1): 50.5 Hz
- P.4054 (delay #1): 0.5 sec
- P.4055 (configuration #1): 0002 (bit 0 OFF, bit 1 ON)
- P.4056 (threshold #2): 50.3 Hz
- P.4057 (delay #2): 0.5 sec
- P.4058 (configuration #2): 0001 (bit 0 ON, bit 1 OFF)

The first threshold is used to activate the internal status related to the virtual analogue input. Looking at the configuration parameter you can see that:

- Bit 0 OFF (checks that the measure is higher than the threshold).
- Bit 1 ON (activates the internal status in “out of threshold” condition).

The second threshold is used to deactivate the internal status related to the virtual analogue input. Looking at the configuration parameter you can see that:

- Bit 0 ON (check that the measure is lower than the threshold).
- Bit 1 OFF (deactivates the internal status in “out of threshold” condition).

So, with the previous programming, the controller activates the internal status related to the virtual analogue input when the measure is greater than 50.5 Hz for 0,5 seconds; it deactivates the internal status when the measure is less than 50.3 Hz for 0,5 seconds.

Using the AND/OR logics (see par.5.5.2), you can “copy” the internal status on a physical output.

5.7 Measurement inputs

5.7.1 Measuring of the genset voltages

The connection to the genset is made through the connector JH of the controller.

Three-phase connection:

- Connect phase L1 (or R) to terminal 3 of JH connector.
- Connect phase L2 (or S) to terminal 2 of JH connector.
- Connect phase L3 (or T) to terminal 1 of JH connector.
- Connect neutral (N) to terminal 4 of JH connector.

Single-phase connection:

- Connect phase (L) to terminal 3 and 1 of JH connector.
- Connect neutral (N) to terminal 4 and 2 of JH connector.

The parameter P.0101allows to select the three-phase/single-phase mode.

If working voltages are greater than these values, step-down transformer must be used in order to respect the specified limits. The nominal voltages on the primary and secondary side of the voltage transformer are adjustable by means of the related parameters. Voltage transformers having a nominal voltage of 400V on the secondary side are the solution that preserves the best available measurement precision of the board.

In option, it is possible to order a version of the device with max 100Vac (phase-phase) voltage inputs to be used with VT with 100V secondary ones. In this case, the P.0151 parameter should be configured for 100V operation.

Warning! Do not connect devices provided with optional 100V inputs directly to mains or to 400V bus bar, in order not to damage the device.

5.7.2 Measuring of the Genset neutral

The device, in case of three-phase connection, can work both with and without neutral connection; the selection is carried out by means of the parameter P.0129. If the system is configured with the neutral connection, the neutral voltage is measured with respect to GND.

5.7.3 Measuring of the homopolar voltage

The JG terminal allows the acquisition of the homopolar voltage (Residual voltage). It represents the voltage of the real star point voltage of the plant with respect to the ideal one, which coincides with the triangle barycentre of the phase-to-phase voltages.

5.7.4 Measuring of the currents

The currents measure must be carried out exclusively by means of current transformers (CTs). **Do not connect the mains voltage conductors to JE or JF.**

Some external current transformers can be connected to a 5A or 1A secondary: the controller internally manages an adjustable scale change for each of the two currents (P.0112 and P.0117), which guarantees the same measurement accuracy with both types of transformers.

The maximum current that the device can directly measure is 6Aac, beyond which the measurement circuit gets saturated. The controller is still able to measure, but with gradually decreasing precision, down to about 25 A **only for transient situations**, such as measuring overcurrent or short circuit currents on the plant, by using an algorithm to compensate for the saturation of the measurement circuits.

The measuring is carried out through the controller CTs.

Starting from version 01.13, parameter P.0109 "Enable filter on current measurement" has been added. It allows to select the currents on which the filter must be applied. The filter is necessary if T.A. very large are used, because they amplify the value of small disturbances.

P.0109 is a parameter configurable at bit:

Bit	Hexadecimal value	Firmware version	Description
1	01	01.13	Enable filter on the currents side A.
2	02	01.13	Enable filter on the currents side B.
3	04	01.13	Enable filter on the differential currents.
4	08	01.13	-
5	16	01.13	Enable the filter on the auxiliary current.
6	32	01.13	Enable the filter on the toroid current.

5.7.5 Measuring of the current A

The current A measure (upper part) usually is the one towards the loads and has to be carried out by current transformers (CTs) only.

With the parameters P.0110 and P.0111, you set the current values of the CTs primary and secondary (by setting one of the two values to zero, the current will not be measured).

Terminal	Function
JE - 1	CT1 Input (S1) hot pole.
JE - 2	CT1 Input (S2) cold pole.
JE - 3	CT2 Input (S1) hot pole.
JE - 4	CT2 Input (S2) cold pole.
JE - 5	CT3 Input (S1) hot pole.
JE - 6	CT3 Input (S2) cold pole.

5.7.6 Measuring of the current B

The current B measure (lower part) usually is the one on towards the star centre of the genset and has to be carried out by current transformers (CTs) only.

With the parameters P.0115 and P.0116, you set the current values of the CTs primary and secondary (by setting one of the two values to zero, the current will not be measured).

Terminal	Function
JF - 1	CT1 Input (S1) hot pole.
JF - 2	CT1 Input (S2) cold pole.
JF - 3	CT2 Input (S1) hot pole.
JF - 4	CT2 Input (S2) cold pole.
JF - 5	CT3 Input (S1) hot pole.

Terminal	Function
JF - 6	CT3 Input (S2) cold pole.

The D-PRO protection relay measures the power on the current B.

5.7.7 Measuring of the differential current

The differential current measure is an absolute value that corresponds to the difference between the measurements of each phase of the currents A and B. It is used in protections 87T and 87G.

INFORMATION! The measurement is valid only if the CTs of both A and B parts use the same transformer ratio and the same measurement range (up to 01.08 version). Starting from version 01.09 the measurement is valid even if TA with a different transformation ratio and / or measurement range are used.

5.7.8 Measuring of the load average current

The load average current measure corresponds to the average between the measurements of each phase of the currents A and B. It is used in protections 87T and 87G.

INFORMATION! The measurement is valid only if the CTs of both A and B parts use the same transformer ratio and the same measurement range (up to 01.08 version). Starting from version 01.09 the measurement is valid even if TA with a different transformation ratio and / or measurement range are used.

5.7.9 Measuring of the auxiliary current

The device allows to acquire a fourth current measurement, which can be used for example for a protection on the genset neutral (protection 50N and 51N). By default, the fourth measure is not used.

It is possible to configure a digital input with the DIF.2704 function - “Disable the protection on the 4th current”: If the input is active, the thresholds are ignored and no faults are created in case they are exceeded, even if they have been configured.

The controller provides the connection of a current transformer (CT) with the 1A/5A secondary for the measurement of the current through the JD connector or the use of a toroid (instead of the CT) by means of the JC connector. Regardless of the type of external transformer used, then you need to configure the controller once again through the parameter P.0119 (Type of transformer for the auxiliary current), which can have the following values:

0 – C.T.

1 – Toroid.

- **Current transformer**

Terminal	Function
JD - 1	CTAux Input (S1) hot pole.
JD - 2	CTAux Input (S2) cold pole.

The JD terminals can be connected to an external current transformer with a 5A or 1A secondary: the controller internally manages an automatic scale change that guarantees the same measurement accuracy with both types of transformer.

The parameters P.0119 and P.0120 allow to configure the transformation ratio of the external current transformer. For example, if you use a 60/5 current transformer, set P.0120=60 and P.0121=5.

The parameter P.0122 allows to select if and how the auxiliary current is used:

0 - Not used.

1 - General use.

2 - Neutral on genset.

- **Toroid**

Terminal	Function
JC - 1	Input IAux (IN) hot pole.
JC - 2	Input IAux (RTN) cold pole.

The toroid transformation ratio must be configured on the controller through parameters P.0125 and P.0126. For example, if you use a toroid with a transformation ratio equal to 700, set P.0125=500 and P.0126=1.

The parameter P.0127 allows to select if and how the toroid current is used:

0 - Not used.

1 - General use.

2 - Neutral on genset.

5.7.10 Measuring of the differential current used for restricted earth fault

The auxiliary current can be used as a protection of restricted earth fault (or maximum differential current). In order to calculate the differential current (A∑), the CT of the auxiliary current should measure the current on the neutral of the generator and the P.0122 parameter should be set as "2 – Neutral on the generator".

That way, the device calculates the vector sum of all the four currents measured and therefore detects and calculates any imbalance, allowing you to implement, by means of the parameters P.0368 and P.0369 a threshold for the restricted earth fault or maximum differential current protection (64).

The triggering of the protection generates a block.

The P.0123 parameter determines where the auxiliary current is measured:

0- Not used.
1- On currents side A.
2- On currents side B.

5.7.11 Measuring of the sequence current (0 / + / -)

The sequence current zero "I0" is calculated as the vector sum of the three phases current divided by three.

The positive sequence current "1+" or "I1" is calculated as 1/3 module of the vector sum of the three phase currents, aligned in the same direction (120° rotation of L2 phase and 240° rotation of L3 phase, depending on the rotation sense).

The negative sequence current "I2" is calculated as 1/3 module of the vector sum of three phase currents, with a 120° rotation of L2 phase in one direction and a 120° rotation of L3 phase in another

direction (depending on the rotation sense). If the load and the cos(ϕ) on the three phases is balanced, the “I2” current is 0. Basically, it is an unbalance index

5.8 Communication

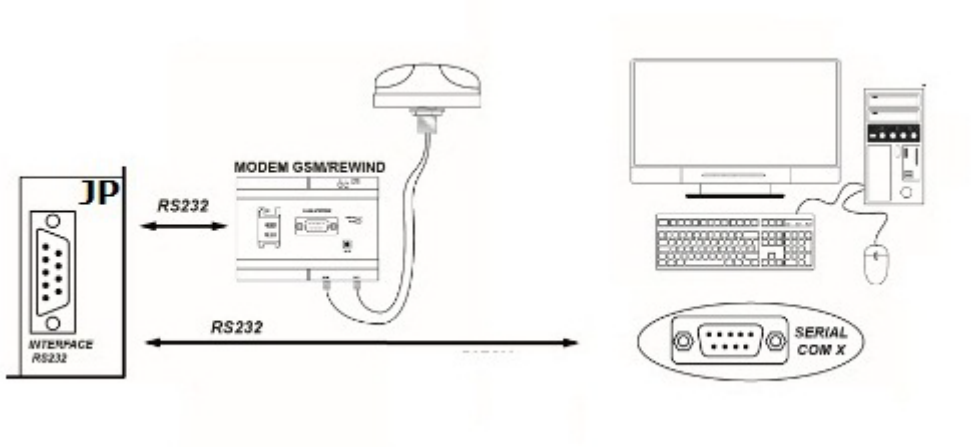
The device is equipped with several communication ports for the connection to PC, modem, networks, etc. The D-PRO protection relay is equipped with:

- A B type USB connection to the PC for the FW update and the configuration of the device parameters. See par. 5.8.3
- A RS232 serial connection (max. 12M), see par. 5.8.1
- A RS485 serial connection with galvanic insulation; the max. connection length in optimal conditions is 1200m. The 120ohm terminal resistor is embedded; you can insert it by connecting the JO pin 1 and 2. It requires the use of a shielded cable with 120ohm impedance (for example, BELDEN 3105A Multi-conductor-EIA Industrial RS-485PLT/CM) See par. 5.8.2
- A CAN-BUS connection to the DST4602 controller with galvanic insulation. The 120ohm terminal resistor is embedded; you can insert it by connecting the JQ pin 4 and 5. It requires the use of a specific shielded cable (e.g. HELUKABEL 800571). See par. 5.9
- A RJ45 connector for the Ethernet connection 10/100Mbps. See par. 5.8.4

For further details on the communication features, see the related parameters and the document [3].

For the CAN-BUS connections, see documents [4] and [5].

5.8.1 RS232 Serial Port 1 (JP)



The JP RS232 connector (serial port 1) can be used for the communication to an external device equipped with RS232 interface, as a modem or a PC. The max. distance of the connection is 12m.

The connection can be used for the configuration of the device parameters by means of the BoardPrg3 program, or for the connection to a monitoring program as MECC ALTESupervisor.

Below the specification of the connector:

- JP_01: not connected
- JP_02: RXD

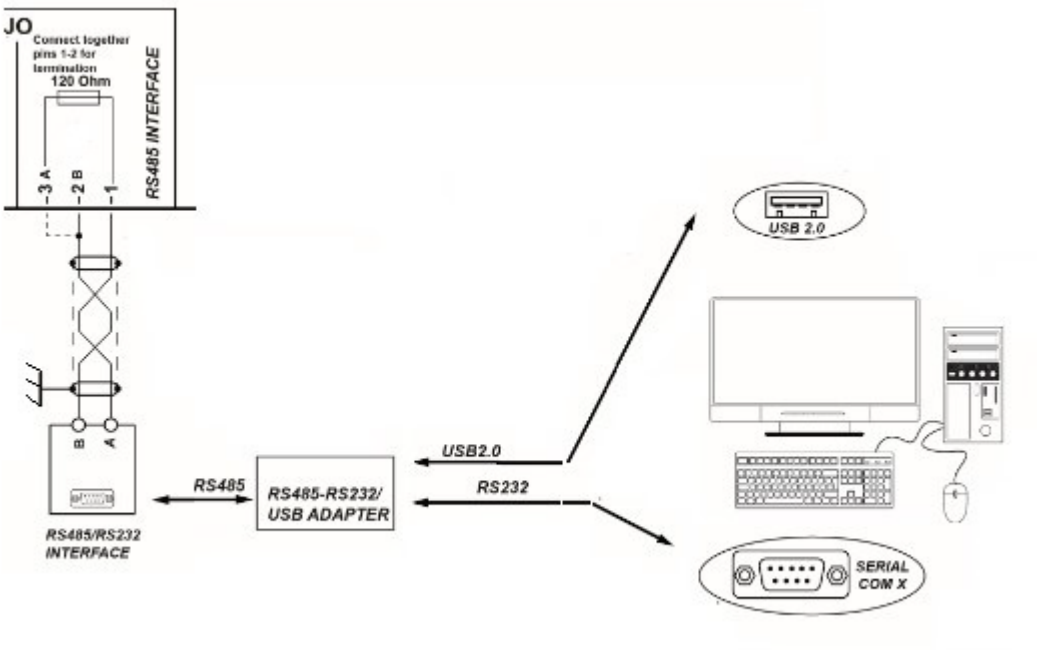
- JP_03: TXD
- JP_04: DTR
- JP_05: GND
- JP_06: DSR
- JP_07: RTS
- JP_08: not connected
- JA_09: not connected

In order to configure the serial port 1, you need to set the parameters:

- P.0452: serial port 1 Modbus address
- P.0453: serial port 1 baud rate
- P.0454: serial port 1 settings
- P.0470: serial port 1 Modbus registers order

The description of these parameters is in document [1].

5.8.2 RS485 Serial Port 2 (JO)



The device can be equipped with a RS485 serial port (serial port 2), which is galvanically insulated and independent from serial port 1 (RS232), that can be used for the connection by Modbus to PC or other devices.

For further details on the RS485 connection, its use and the parameters configuration, refer to document [1].

Connection:

- JO-3: RS485 connection A
- JO-2: RS485 connection B

The RS485 connection needs a 120Ohm terminal resistor on both ends of the cable. The resistor is included in the device; in order to insert it, you just need to jumper JO-1 and JO-2.

You cannot connect a modem to the serial port 2; despite that, you can use it for the same connections carried out by the RS232 serial port using RS485/RS232 or RS485/USB adapters when it is required.

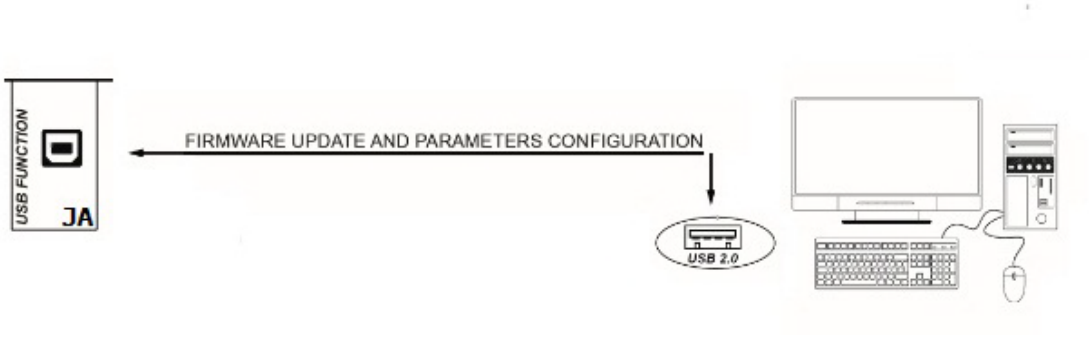
The galvanic insulation guarantees the operating safety of the connection, even among devices at different distances and with different earth potentials with respect to the controller.
The maximum connection length is 1200m; this also depends on the transmission baud rate set. It requires the use of a proper shielded cable (see 4.2) with shield connected to earth.

In order to configure the serial port 2, you need to set the parameters:

- P.0472: serial port 2 Modbus address
- P.0473: serial port 2 baud rate
- P.0474: serial port 2 settings
- P.0475: serial port 2 Modbus registers order

The description of these parameters is in document [1].

5.8.3 USB Port (JA)



The specifications of the USB protocol do not allow its permanent use in the industrial field because of the limited cable length and of the quite high sensitivity to electric disturbances on the PC too. For this reason, **the USB connection cable has to be inserted only when you need to work on the device and it has to be removed by the JA connector when the operation is done.**

The USB connection with PC is used for two purposes:

- Insertion of the firmware in the device
- Parameters configuration

The insertion/replacement of the firmware in the device is a MECC ALTE S.r.l specific operation; besides the operating FW, it requires a particular procedure and proper programs. Usually it cannot be carried out by the installer, except for particular cases previously agreed with MECC ALTE.

The USB port can be used for the configuration of the parameters with the BoardPrg3 program, as alternative to the RS232/RS485 or Ethernet connection.
You need to install the **CDC_MECC ALTE_Win.inf** driver supplied by MECC ALTE on the PC to connect: for the driver installation, refer to document [6].
Once the driver is installed, the PC will detect the controller as a new serial port to be used exactly as a RS232 serial port.

The configuration parameters are:

- P.0478: USB serial port Modbus address
- P.0479: USB serial port Modbus registers order

5.8.4 Ethernet (JQ)

On some versions of the controller, there is a RJ45 port for the data connection via Ethernet. For further details on the Ethernet connection and on the related protocol, refer to document [7].

It's possible to connect the device to a LAN or directly to a PC (point-to-point connection). The connection allows the use of SW MECC ALTESupervisor for the supervision and BoardPrg3 for the configuration, as well as all the features available through the Modbus TCP/IP protocol.

The connection of the device to a LAN network also allows to keep the internal calendar up-to-date, thanks to the UTC time and to the data and event sending towards the SMARTCLOUD server, besides having the possibility to assign a public IP address (static or dynamic) directly to the device.

Parameters for the configuration:

Parameter	Name	Default
P.0500	IP Address	192.168.0.1
P.0501	Subnet mask	255.255.255.0
P.0502	Network Gateway	0.0.0.0
P.0503	Modbus Port. Select the port to use for the Modbus TCP communication.	502
P.0504	Web Server Port **(Currently not supported).** Select the port to use for the management of the TCP/IP data for the Web Server service.	80
P.0505	MODBUS registers order When 32bit information are required, it decides whether to send first the most or the less important 16bit.	0-LSWF
P.0508	NTP Server Port	123
P.0509	NTP Server IP address	0.0.0.0
P.0510	DNS primary server IP address	0.0.0.0
P.0511	DNS secondary server IP address	0.0.0.0
P.0513	DHCP Server Port	67
P.0514	DHCP Server IP address	0.0.0.0

In order to the device to a LAN network, it is necessary to configure at least the parameters P.0500, P.0501 and P.0502. It is possible to proceed in two ways:

- It is possible to configure the three parameters above manually, with values suitable to the network connected (the sub-net mask and the router/gateway address are characteristic of each network, the IP address must be univocal). In order to go ahead, it is necessary to set the parameter P.0514 to 0.0.0.0 or the parameter P.0513 to zero.

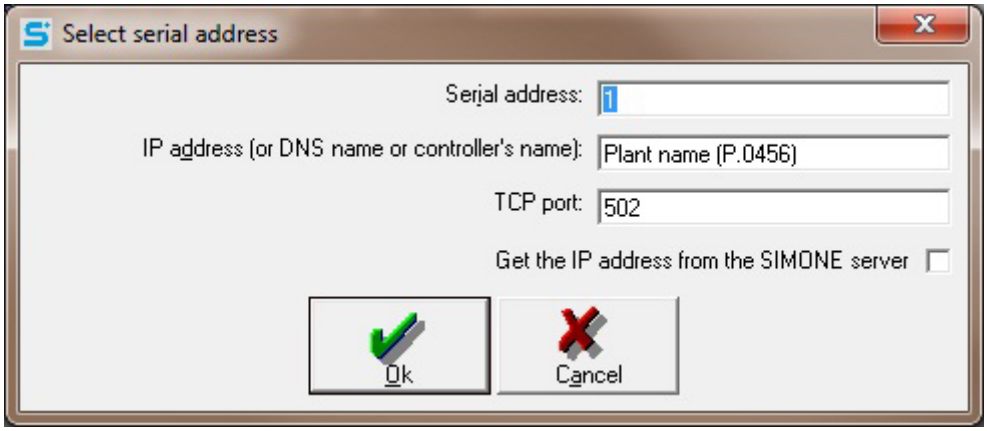
- It is possible to acquire the values for the three parameters above dynamically by the network. To do so, the controller needs to be connected to a DHCP server (Dynamic Host Configuration Protocol). In order to go ahead, it is necessary to set the parameter P.0514 to 255.255.255.255 or the parameter P.0513 to 67 (67 is the standard TCP port for the DHCP server; if your server uses a different port, set it in P.0513).

Once the controller has values valid for the parameters P.0500, P.0501 and P.0502, it can be connected by Modbus-TCP protocol on the IP address configured and on the port configured with P.0503, for example with the supervision software (MECC ALTESupervisor) and with the configuration software (BoardPrg3).

The controller also supports the DNS protocol (Domain Name System). The DNS system is used for the conversion of the names of the network nodes in IP addresses and vice versa. The controller uses this function to convert the name of the SMARTCLOUD server in an IP address, but also to register in the network with a name. The name must be configured by P.0456 and it must be univocal in the network. In order to use the DNS system, it is required:

- If you don't use a DHCP server (see above), you need to set the IP address of the DNS server in P.0510 (it is possible to set the address of a secondary DNS server in P.0511).
- If you use a DHCP server (see above), the IP address of the DNS server is acquired by the controller directly by the DHCP server.

If the DNS server can be reached on the network, the controller registers its name (P.0456) on the network and from that moment on it will be reached through Modbus-TCP protocol on both the IP address and the name configured on the port P.0503.



The parameters P.0508 and P.0509 allow to set the IP address of the NTP server port (Network Time Protocol) to be used to connect to a NTP server in order to maintain the internal calendar synchronized and updated with the date and the time of the related time zone (that is the UTC). By setting one or both parameters to zero, the function will be disabled.

5.9 CAN-BUS Connection

For the connections described below, use a type of cable suitable for the CAN-BUS

5.9.1 CAN-BUS Connection (JN)

The CAN-BUS interface is used exclusively to connect to the DST4602 controller by means of the JO connector and to send it the measurements and the status of the protections.

The CAN-BUS interface is not galvanically insulated.

For further details on the characteristics, the use and the configuration of the parameters related to the CAN-BUS communication, refer to document [4].

Connections:

- Connect the terminal JN-5 to the terminal CAN_H.
- Connect the terminal JN-6 to the terminal CAN_L.
- Connect the shield of the shielded cable to the protective earth or signal on both sides (make sure that interior, panel and the engine frame are kept at the same potential).

The CAN-BUS connection needs a 120Ohm termination resistor on both ends of the cable. Normally, the control units of the engine have the termination resistor built-in (if not, connect the resistor directly on the CAN_H and CAN_L terminals of the control unit).

The terminal resistor is included in our controller; you can insert it by jumper JN-4 with JN-5.

NOTE: the termination must be always enabled, unless the connection proceeds to other devices and the controller is not one of the two ends.

Use the parameters of the menu 7 (in particular the parameters P.0700) to set the proper address of the controller (NOTE: DST4602 supports up to two D-PRO protection relays simultaneously).

6. “SMARTCLOUD” System

SMARTCLOUD is a centralized system for the collection of data: these data can be checked through a WEB interface. The D-PRO protection relays can communicate with the SMARTCLOUD system by the Ethernet port. You must carry out the following configuration

Parameter	Name	Default
P.0530	Enabling connection and sending data to SMARTCLOUD	0-No
P.0531	SMARTCLOUD primary server - IP address or name	
P.0532	SMARTCLOUD primary server port	0
P.0533	SMARTCLOUD secondary server - IP Address or name	
P.0534	SMARTCLOUD secondary server port	0
P.0535	Data sending time with engine running	900
P.0536	Data sending time with engine stopped	3600
P.0537	“Keep Alive Network” data sending time	0
P.0539	Communication events	00
P.0542	Type of generator voltages	0
P.0581	Permanent Coordinates - Latitude (+=North, -=South).	
P.0582	Permanent Coordinates - Longitude (+=East, -=West).	

These parameters can be modified by the BoardPrg3xx program and by the web service in the proper configuration page of the device. In detail:

If the parameter P.0530 is set to “1-Yes”, you enable the data sending to the “SMARTCLOUD” server.

- The parameter P.0531 configures the IP address or the name of the “SMARTCLOUD” primary server, while the parameter P.0533 configures the secondary one. It is possible to set the IP address in text format or the server name in full (e.g. “smartcloud.meccalte.com”), which will be converted by the controller in IP address, using the DNS server (properly configured or automatic on GPRS). It is possible to disable the connection to the primary/secondary server by setting the empty string.
- The parameter P.0532 configures the port of the “SMARTCLOUD” primary server, while the parameter P.0534 configures the secondary one. By setting the port address to zero, the connection to the primary/secondary server is disabled. The standard port is 53052 (verify with Mecc Alte).

- The parameter P.0535 configures the time interval to send periodic data to the server when the genset is running.
- The parameter P.0536 configures the time interval to send periodic data to the server when the genset is stopped.
- The parameter P.0537 configures the time interval in minutes to send the special data “Keep Alive Network”, used to signal a minimum activity to the server.
- The parameter P.0539 configures in which cases the device must carry out the spontaneous sending of the communication events to the server:

Bit	Value P.0539	Description
0	1	For alarms.
1	2	For warnings.
2	4	
3	8	
4	16	
5	32	
6	64	

- The parameter P.0542 allows to choose whether to send the phase-to-phase voltages measurements or the phase-to-neutral ones to the server.

- The parameters P.0581 and P.0582 allows to set the fixed coordinates of device location (latitude and longitude) in Google Maps format to be sent to the server. (e.g. the Mecc Alte UK’s coordinates are: Latitude 52.67822 and Longitude 0.73758).

For further details on the communication to the “SMARTCLOUD” server, see the document [9].

7. Operating sequence

7.1 Operating mode

The correct operation of the controller is guarantee by the flashing of the led “ON”.

The D-PRO protection relay, once the initial check has been carried out, starts to work acquiring the measurements of the plant and checking the status of the protections configured.

In the standard configuration, the protections are always enabled (status ENABLE). It is possible to disable them individually, during the configuration procedure, by setting the related “Protection delay” parameter to zero.

Usually, when the measurement exceeds the threshold configured, the protection is enabled (ACTIVE); if the condition remains stable for the time configured, the protection triggers (TRIP); otherwise, the protection is restored.

7.2 Inhibition to the protection intervention

The intervention of the single protection can be dynamically inhibited according to the status of the plant conditions (by configuring the digital inputs properly). For example, this procedure allows to

enable the protection intervention only with genset running and circuit breaker closed. If no disabling input is combined, the protection is considered always enabled.

The D-PRO protection relay can combine eight functions to the digital inputs:

- DIF.2711 (“Protections disabling - Level 1”). The controller inhibits the intervention of the protections configured in the parameter P.0201.
- DIF.2712 (“Protections disabling - Level 2”). The controller inhibits the intervention of the protections configured in the parameter P.0202.
- DIF.2713 (“Protections disabling - Level 3”). The controller inhibits the intervention of the protections configured in the parameter P.0203.
- DIF.2714 (“Protections disabling - Level 4”). The controller inhibits the intervention of the protections configured in the parameter P.0204.
- DIF.2715 (“Protections disabling - Level 5”). The controller inhibits the intervention of the protections configured in the parameter P.0205.
- DIF.2716 (“Protections disabling - Level 6”). The controller inhibits the intervention of the protections configured in the parameter P.0206.
- DIF.2717 (“Protections disabling - Level 7”). The controller inhibits the intervention of the protections configured in the parameter P.0207.
- DIF.2718 (“Protections disabling - Level 8”). The controller inhibits the intervention of the protections configured in the parameter P.0208.

The bit parameters P.0201, P.0202, P.0203, P.0204, P.0205, P.0206, P.0207 and P.0208 are defined as follows:

Bit	Value	Description
0	1	Disable protection 27
1	2	Disable protection 27T
2	4	Disable protection 32P
3	8	Disable protection 32Q
4	16	Disable protection 46
5	32	Disable protection 47
6	64	Disable protection 50
7	128	Disable protection 50N
8	256	Disable protection 50V
9	512	Disable protection 51
10	1024	Disable protection 51N
11	2048	Disable protection 51V
12	4096	Disable protection 59
13	8192	Disable protection 59N
14	16384	Disable protection 81U
15	32768	Disable protection 81O
16	65536	Disable protection 87G
17	131072	Disable protection 87T

18	262144	Disable protection 32RP
19	524288	Disable protection 32RQ / 40
20	1048576	Disable protection 64

8. Faults

This chapter describes all the faults managed by the protection relay. All the faults connected to the protections are considered as alarms while the other are signals of particular events in the management of the plant, which are usually considered as warnings.

We define three typologies of anomaly:

- **Warnings**: these faults indicate situations that are not dangerous at the moment, but if ignored they could degenerate in one of the following categories.
- **Alarms**: these faults are considered dangerous for the loads and/or for the engine/genset. It is not possible to restart the engine until the anomaly is acknowledged.

When an anomaly activates, the controller performs the following:

- It activates the acoustic horn (if configured).
- It forces the visualization of the message on the multifunctional display of the DST4602 controller connected to it. This page shows the fault numeric code and the current language text related to the anomaly. The numeric code flashes to indicate that the anomaly hasn't been recognized by the operator yet.

The following operations can be carried out on an anomaly:

- **Silence** the horn.
- **Acknowledge it**: this informs the controller that the operator has acknowledged the event.
- Reset: it tells to the board that the anomaly is not more active.

The multifunction display of the DST4602 controller shows the anomaly until the operator acknowledges it, even if the related cause is no longer present (ISA2C sequence). The controller automatically resets all the acknowledged warnings when their cause is not still active.

8.1 Silence the horn

It is possible to silence the horn in two ways:

- By pressing the ACK/TEST key on the DST4602 controller. This operation does not detect the anomaly, which continues to flash on the display.

The management of the acoustic horn is anyway connected to the value of the parameter P.0491 (“duration of horn control”):

- If set to zero, the horn will be never activated.
- If the horn is set to 999, it will be activated when a new anomaly arises and deactivated with the procedure described above.
- If the horn is set to a value between 1 and 998, it will be activated when a new anomaly arises and deactivated with the procedure described above, or when the configured time has elapsed.

8.2 Identify the anomaly

By pressing the ACK/TEST key on the DST4602 controller, you can identify the anomaly. **If you push this key when the horn is on, it stops the acoustic signal:** if you press it twice, it “acknowledges” the anomaly.

The previous operations “acknowledge” all active anomalies. The relevant numeric codes on the display stop flashing.

8.3 Cancel the anomaly

An anomaly can be cancelled only when the cause that activated it is no more present.

The controller automatically resets all the acknowledged warnings when their cause is no longer active.

In order to reset alarms, it is necessary to follow one of the below procedures:

- Put the key selector on OFF/RESET.
- Using a digital input configured with the feature DIF.2001 - “Alarm reset command”. Anomalies are cancelled when the input from "inactive" turns into "active".

8.4 Signals

The following functions for the configuration of digital outputs are linked to anomalies:

- DOF.3151 (“reset of anomalies”). The controller activates this output for **one** second when the internal sequence for the reset of anomalies is carried out. With this procedure, it is also possible to reset externally managed anomalies.
- DOF.3152 (“external horn”). This output is activated and deactivated along with the internal hooter. It can be used to control a more powerful hooter and/or a lamp.
- DOF.4001: the output will be activated if at least an early warning is active.
- DOF.4004: the output will be activated if at least a shut-down is active.
- DOF.0103 (Logics AND/OR)
    - ST.008: the output will be activated if at least an early warning is active.
    - ST.011: the output will be activated if at least a shut-down is active.
    - ST.012: the output will be activated if at least a non-identified early warning is active.
    - ST.015: the output will be activated if at least a non-identified shut-down is active.

8.5 Protections Override

WARNING: the use of this function may seriously damage the engine. In any case, MECC ALTE cannot be held responsible for malfunctioning and damages to things and/or persons resulting from the use of the OVERRIDE function.

This term defines capacity of D-PRO of temporarily disabling (in particular conditions and on specific request) a series of protections. The OVERRIDE function, when it is activated, turns a set of alarms into simple "warnings": in this way, the controller indicates the presence of problems anyway, but it doesn't reduce the supplying capacity of the genset.

D-PRO manages one only OVERRIDE request of the protections; all of them can be activated through digital inputs. Use the following function to configure the digital inputs:

- DIF.2063 ("Protections Override").

8.6 Faults connected to digital inputs

D-PRO manages a maximum of eight digital inputs. Every input can be used to activate anomalies. These faults can be configured with the functions from DIF.4001 to DIF.4004. For these faults, the operator must configure the message (useful during the programming through BoardPrg3) and the time.

The faults will be described in the following paragraphs: in the description, we will always refer to the parameters related to the digital input #1 of D-PRO (P.2001, P.2002 and P.2003). The document [1] contains a table that shows the parameters to use for each D-PRO digital input.

D-PRO assigns numeric codes from 701 to 742 to generic faults related to analogue inputs (the document [1] contains a table that shows the code of each input). By using the parameter that configures the function (P.2001), it is possible to select the type of fault (warning or alarm) and also to define how to manage the fault. Warning: by setting the delay to "0", the anomaly is disabled.

8.7 Faults list

From this point on, the words **enabling** and **activation** will be used as follows:

- Enabling a fault refers to the minimum conditions required for the controller to detect the related cause.
- Activation of an anomaly refers to the cause after enabling.

37 – Low battery voltage threshold (from measuring)

Type: **Warning**
Related parameters: **P.0391** Second threshold for low battery voltage (%)
P.0392 Delay for low battery voltage second threshold
To disable: **P.0392=0**

The protection is always enabled.

It activates if the battery voltage is continuously lower than the threshold P.0391 for time P.0392. The threshold is expressed as a percentage of the rated battery voltage, which cannot be configured but it

is automatically selected by the controller between 12 e 24 Vdc. The selection is carried out when the controller is powered. If the controller previously measured a value lower than, or equal to, 17 Vdc, it considers to be powered by a 12 Vdc battery; otherwise, it will consider a 24 Vdc rated voltage.

38 – High battery voltage threshold (from measuring)

Type: **Warning**
Related parameters: **P.0393** Second threshold for high battery voltage (%)
P.0394 Delay for high battery voltage second threshold
To disable: **P.0394=0**

The protection is always enabled.

It activates if the battery voltage is continuously above threshold P.0393 for time P.0394. The threshold is expressed as a percentage of the rated battery voltage, which cannot be configured but it is automatically selected by the controller between 12 e 24 Vdc. The selection is carried out when the controller is powered. If the controller previously measured a value lower than, or equal to, 17 Vdc, it considers to be powered by a 12 Vdc battery; otherwise, it will consider a 24 Vdc rated voltage.

561 – Minimum voltage (27)

Type: **Alarm**
Measuring: **V1-V2-V3** Phase voltages
Related parameters: **P.0101** Genset phases number
P.0102 Genset rated voltage
P.0321 Minimum voltage threshold
P.0322 Minimum voltage delay
P.0130 Thresholds on VLN
To disable: **P.0322=0**

The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

It is enabled if at least one of the genset voltages is decreases below the threshold set in P.0321 (percentage of P.0102) for the time configured in P.0322.

This protection can be used individually or in together with 27T.

562 – Minimum voltage (27T)

Type: **Alarm**
Measuring: **V1-V2-V3** Phase voltages
Related parameters: **P.0101** Genset phases number
P.0102 Genset rated voltage
P.0325 Select if the threshold is time-dependent
P.0326 Time-dependent minimum voltage threshold
P.0327 Time-dependent minimum voltage delay
To disable: **P.0327=0**

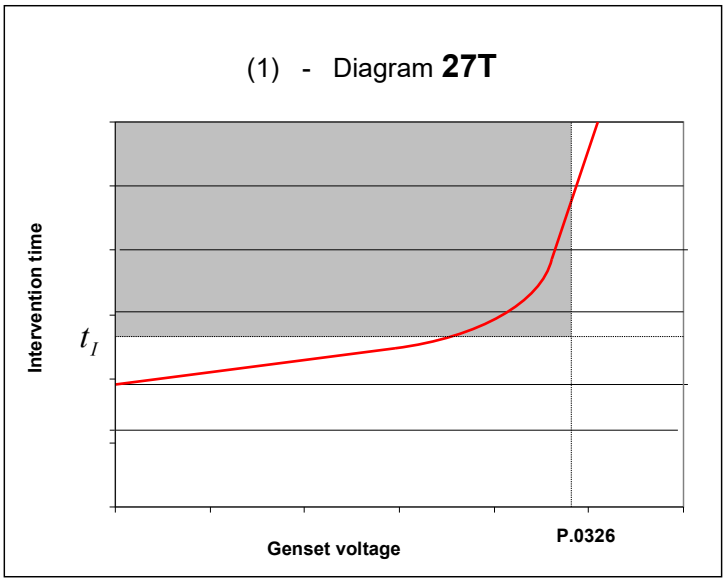
The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

Using the parameter P.0325, the threshold can be configured as time-independent (fixed delay that can be adjusted with the parameter P.0327) or as time-dependent; in this case, the intervention time is calculated according to the following formula:

$$t_{I(\mathrm{sec})} = \frac{0{,}75 \cdot P.0327}{1 - \left(\frac{V}{P.0326} \right)}$$

V represents the genset voltage.

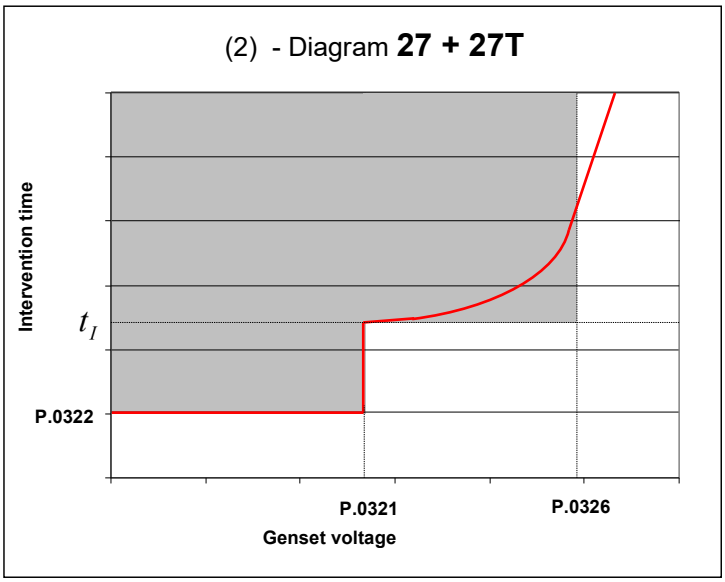
The protection activates if at least one of the genset voltages decreases below the threshold set in P.0326 (percentage of P.0102) for the time configured in P.0327 (if time-independent) or for the time calculated Ti (time-dependent).



(1) See diagram 27T - Time-dependent minimum voltage.

This protection can be used individually or together with 27, having another intervention threshold when at least one of the genset voltages decreases below the threshold set in P.0321 (percentage of P.0102) for the time configured in P.0322.

(2) See diagram 27 + 27T - Time-dependent minimum voltage combined with minimum voltage.



563 – Maximum reactive power (32P)

Type: **Alarm**

Related parameters: **P.0380** Maximum active power threshold (% compared with P.0106)
P.0381 Maximum active power delay

To disable: **P.0381 =0**

The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

The controller measures the power supplied by the genset on the three currents on side B.

The protection activates if the total active power is positive and higher than the threshold set in P.0380 (percentage of P.0106) for the time configured in P.0381.

564 – Maximum reactive power (32Q)

Type: **Alarm**

Related parameters: **P.0382** Maximum reactive power threshold (% compared with P.0106)
P.0383 Maximum reactive power delay

To disable: **P.0383 =0**

The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

The controller measures the reactive power (exported) by the genset on the three currents on side B.

The protection activates if the reactive power is positive and it is higher than the threshold set in P.0382, consecutively for the time configured in P.0383.

565 – Negative sequence (46)

Type: **Alarm**

Related parameters: **P.0101** Genset phase number

P.0102 Genset rated voltage
P.0106 Genset rated power
P.0107 Genset rated current

P.0366 I2 current threshold for negative sequence (%)
P.0367 Delay for negative sequence

To disable: **P.0367=0**

The protection is enabled only for three-phase systems (P.0101=3) and if the current measurement is connected to the genset (current transformers on the genset). It is enabled only in case of absence of the disabling digital input.

The negative sequence current "I2" is calculated as 1/3 module of the vector sum of three phase currents, with a 120° rotation of L2 phase in one direction and a 120° rotation of L3 phase in another direction (depending on the rotation sense). If the load and the cos(ϕ) on the three phases is balanced, the "I2" current is 0. Basically, it is an index of load unbalance, which considers also the current vectors angles, not only the modules.

It activates when the current "I2" is higher than threshold set in P.0366, consecutively for the time configured in P.0367. The threshold P.0366 is expressed in percentage compared to the rated current: see P.0107 to define the rated current from parameters P.0101, P.0102 and P.0106.

566 – Wrong phases sequence (47)

Type: **Alarm**
Related parameters: **P.0101** Genset phases number
P.0328 Genset phases sequence (required)
P.0329 Delay for genset phases sequence

To disable: **P.0329=0**

It is enabled only in case of absence of the disabling digital input and only in the presence of voltage.

It activates when the rotation sense of the genset phases does not comply with the one configured in the parameter P.0328 (0=none, 1=clockwise, 2=counter-clockwise), with a filter time configured with the parameter P.0329.

567 – Short circuit (50)

568 – Short circuit on neutral (50N)

569 – Short circuit with restrained overcurrent (50V)

Type: **Alarm**
Measuring: **IB0-IB1-IB2** Phase current low part
Iaux or **Itor** Auxiliary current or toroid current (50N)
Related parameters: **P.0101** Genset phases number
P.0102 Genset rated voltage
P.0107 Genset rated current

P.0360 Current short circuit threshold (50)
P.0361 Current short circuit delay (50)

P.0362 Neutral current short circuit threshold (50N)
P.0363 Neutral current short circuit delay (50N)

P.0122 Usage of auxiliary current
P.0127 Usage of toroidal current

P.0364 Short circuit threshold 50V (% restrained overcurrent)
P.0365 Short circuit delay (% restrained overcurrent)

To disable: **P.0361=0; P.0363=0; P.0365=0**

This protection intervenes as quickly as possible and it doesn't depend on timings of the curve represented for maximum current protection. The protection is configured by setting a threshold in P.0360, P.0362 and P.0364 expressed as percentage of the system rated current (P.0107).

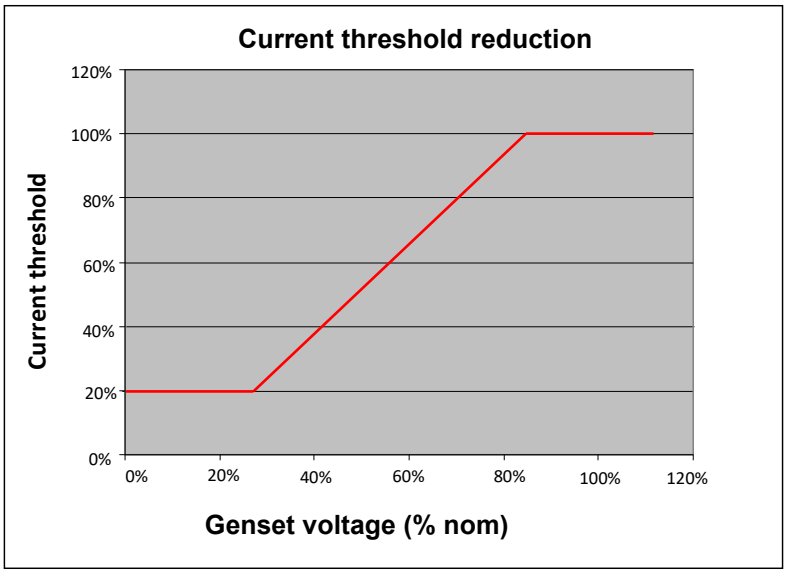
The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

The **50N** protection is enabled by also setting parameters P.0122 or P.0127 to "2-Neutral of the generator".

It activates if at least one current is higher than the threshold P.0360, P.0362 and P.0364 consecutively for the time configured in P.0361, P.0363 and P.0365.

Using the parameters P.0364 and P.0365, it is possible to configure the protection **50V**. This protection differs from the "normal" 50 because the threshold set in P.0324 is automatically restrained when the genset voltage decreases. In detail:

- If the generator voltage is higher than 80% the rated, the current threshold remains the one set.
- If the generator voltage is less or equal to 20% of the rated, the current threshold becomes 20% of the one set.
- If the generator voltage is between 20% and 80% of the rated, the current threshold is reduced in percentage.



570 – Maximum current (51)

571 – Maximum current on neutral (51N)

572 – Maximum current with restrained overcurrent (51V)

Type: **Alarm**

Measuring: **IB0-IB1-IB2** Phase current low part
Iaux or **Itor** Auxiliary current or toroid current (51N)

Related parameters: **P.0101** Genset phases number
P.0102 Genset nominal voltage

P.0351 Curve selection (51 Protection)
P.0352 Maximum current threshold
P.0353 Maximum current delay

P.0354 Curve selection (51N Protection)
P.0355 Neutral maximum current threshold
P.0356 Neutral maximum current delay

P.0122 Usage of auxiliary current
P.0127 Usage of toroidal current

P.0357 Curve selection (51V Protection)
P.0358 Maximum current threshold (% restrained overcurrent)
P.0359 Maximum current delay (% restrained overcurrent)

To disable: **P.0353=0; P.0356=0; P.0359=0**

The **51N** protection is enabled by also setting parameters P.0122 or P.0127 to "2-Neutral of the generator".

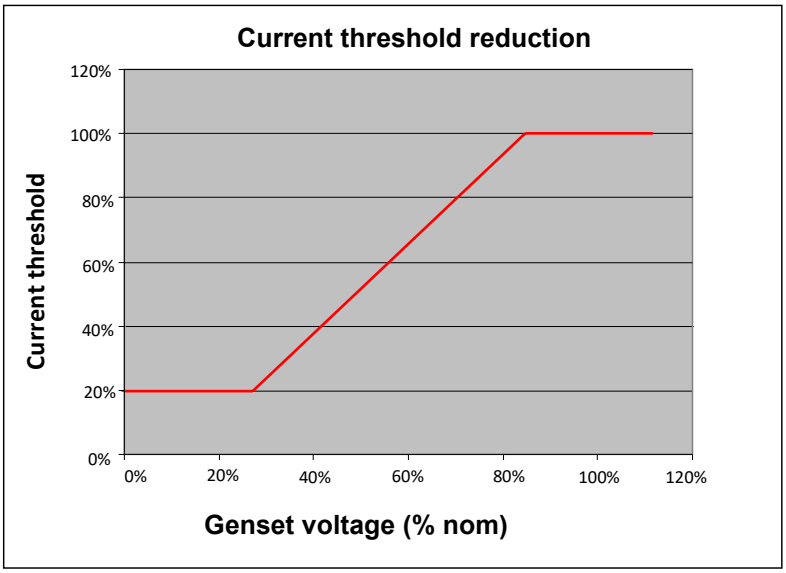
The parameters P.0351 – P.0354 – P.0357 allow to choose the curve to use for the protection among the following:

- 0 = MECC ALTE – Extremely inverse
- 1 = IEC – Extremely inverse
- 2 = IEC – Very inverse
- 3 = ANSI – Extremely inverse (not implemented yet)
- 4 = ANSI – Very inverse (not implemented yet)

The 51V protection uses the parameters P.0357, P.0358 and P.0359 and it differs from the "normal" 51 because the threshold set in P.0358 is automatically restrained when the genset voltage decreases. In detail:

- If the generator voltage is higher than 80% the rated, the current threshold remains the one set.

- If the generator voltage is less or equal to 20% of the rated, the current threshold becomes 20% of the one set.
- If the generator voltage is between 20% and 80% of the rated, the current threshold is reduced in percentage.



MECC ALTE Curve – Extremely inverse

Time-dependant current protection (it activates as much quickly as higher the current overload is). The curve used is called **EXTREMELY INVERSE** with function **I^2t**. It is a generator protection as it limits the thermal accumulation of the generator during the supply phase. As engine protection, you must use the maximum power one, which is independent from the load type.

You have to define a maximum current value and a maximum time that the genset can manage for this current. If the current is lower than the defined threshold, the protection does not activate. If the current rises above the threshold, the protection activates with a time that is inversely proportional to the overcurrent. In order to correctly set the thresholds, you need to perform the following steps:

- Define the system rated current
- Set the maximum current threshold with the parameter P.0352 (or P.0355 or P.0358), as a percentage of the rated current.
- Set the intervention time in the parameter P.0353 (or P.0356 or P.0359): the protection will trigger within time set if the current is constantly equal to the threshold set in P.0352 (or P.0355 or P.0358) multiplied by $\sqrt{2}$. It will trigger more quickly when the current is higher, more slowly when the current is lower.

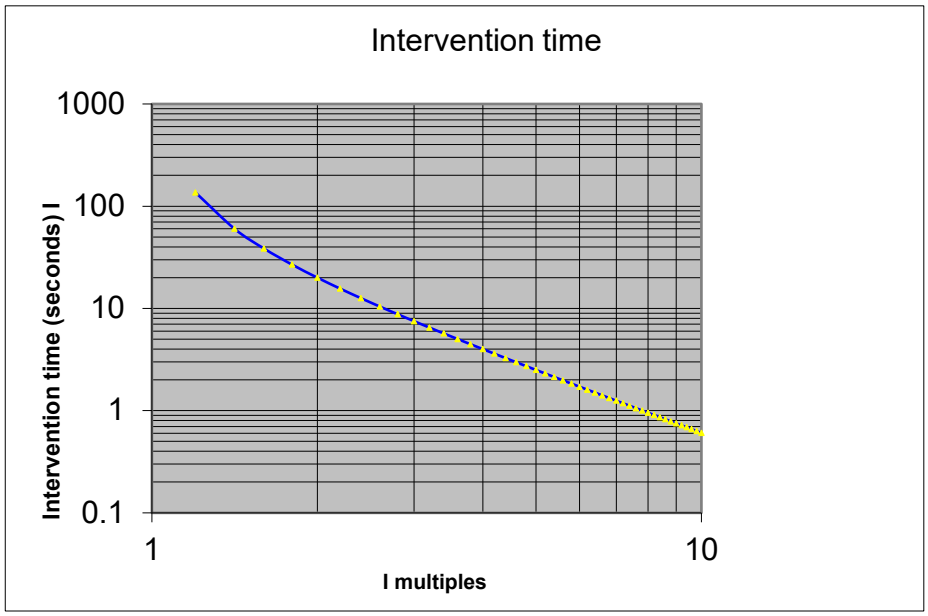
In order to calculate the intervention time for a preferred current, please use the following formula:

$$t_I = \frac{P.0353}{\left(\frac{I}{P.0352}\right)^2 - 1}$$

Where *I* is the current in the circuit.

Please remember that the protection is carried out by performing the integral of the current value during time; therefore, all current values over the rated threshold contribute to define the intervention time, with their instant weight resulting from the above formula. Thus, the only way to experimentally verify this formula is to switch instantaneously from a normal load situation to an overload situation.

The following graph shows the used curve, with P.0353 set to 60 seconds (I is the maximum current): Parameters P.3902



The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

IEC Curve – Extremely inverse and Very Inverse

Time-dependant current protection (it activates as much quickly as higher the current overload is). The curves that can be used are called **EXTREMELY INVERSE** and **VERY INVERSE**. They are configured as genset protections as they set a limit to the thermal accumulation of the genset when supplying. As engine protection, you must use the maximum power one, which is independent from the load type. For further details refer to the document EAAN005602.pdf.

The equation for the IEC curves is the following:

$$T = \frac{K}{\left(\frac{I}{P.0352}\right)^{P} - 1} \cdot P.0353$$

Where:

- I represents the current in the circuit.
- P.0353 is the **time dial** (TMS) set and it must have a value between 0,1 and 1.
- *(I / P.0352) = S* is the ratio between the current and the maximum current.

K and P values are given by the following table:

IEC Curve	K	P
Extremely Inverse	80.0	2.0
Very Inverse	13.5	1.0

ANSI Curve – Extremely inverse and Very Inverse

Time-dependant current protection (it activates as much quickly as higher the current overload is). The curves that can be used are called **EXTREMELY INVERSE** and **VERY INVERSE**. They are configured as genset protections as they set a limit to the thermal accumulation of the genset when supplying. As engine protection, you must use the maximum power one, which is independent from the load type. For further details, refer to EAAN005602.pdf.

The equation for the ANSI curves is the following:

$$T = \left(\frac{K}{\left(\frac{I}{P.0352} \right)^{P} - 1} + B \right) \cdot \left(\frac{(14 \cdot P.0353) - 5}{9} \right)$$

Where:

- I represents the current in the circuit.
- P.0353 is the **time dial** (TMS) set and it must have a value between 1 and 10.
- *(I / P.0352) = S* is the ratio between the current and the maximum current.

K, P and B values are given by the following table:

ANSI Curve	K	D	B
Extremely Inverse	6.407	2.0	0,025
Very Inverse	2,855	2.0	0.0712

573 – Maximum voltage (59)

Type: **Alarm**
Measuring: **V1-V2-V3** Phase voltages
Related parameters: **P.0101** Genset phases number
P.0102 Genset nominal voltage
P.0323 Maximum voltage threshold
P.0324 Maximum voltage delay
To disable: **P.0324=0**

The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

It activates if at least one of the genset voltages exceeds the threshold set in P.0323 (percentage of P.0102) for the time configured in P.0324.

574 – Maximum homopolar voltage (59N)

Usually it is used in genset with insulated neutral and in medium voltage. The control is carried out through the reading of a voltage that results from the “open triangle” of three VT with the star primary and the secondary basically connected in series. Therefore, it requires a dedicate input for the reading of the voltage (two cables).

Some protection relays on the market manage to recreate the signal of the open triangle internally by using the measure of the star voltage.

Type:	**Alarm**
Measuring:	**V59N** - Homopolar voltages (100Vac)
Related parameters:	**P.0330** Maximum homopolar voltage threshold
	P.0331 Maximum homopolar voltage delay
To disable:	**P.0331=0**

The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

The controller measures the homopolar voltage, which results from the “open triangle” of the three VT with the star primary and secondary basically connected in series. The reference value measured is fixed to the hardware circuit at 100Vac.

It activates if the genset homopolar voltage exceeds the threshold set in P.0330 continuously for time configured in P.0331.

575 – Minimum frequency (81U)

Type:	**Alarm**
Measuring:	Generator frequency
Related parameters:	**P.0105** Rated frequency
	P.0305 Minimum frequency threshold
	P.0306 Minimum frequency delay
To disable:	**P.0306=0**

The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

It activates if the genset frequency decreases below the threshold set in P.0305 (percentage of P.0105) for the time configured in P.0306.

576 – Maximum frequency (81O)

Type:	**Alarm**
Measuring:	Generator frequency
Related parameters:	**P.0105** Rated frequency
	P.0307 Maximum frequency threshold
	P.0308 Maximum frequency delay
To disable:	**P.0308=0**

The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

It activates if the genset frequency exceeds the threshold set in P.0307 (percentage of P.0105) for the time configured in P.0308.

577 – Maximum genset differential current (87G)

Type: **Alarm (Maximum differential current)**

Related parameters:
P.0370 Selection 87G or 87T
P.0371 Minimum differential current threshold (Aac)
P.0372 Maximum differential current threshold (Aac)
P.0373 Threshold for load current slope change (Aac)
P.0374 Slope K1 (%)
P.0375 Slope K2 (%)
P.0376 Maximum differential current delay

To disable: **P.0376 =0**

The protection is enabled only in case of absence of the disabling digital input and only if the controller is configured to measure the differential current and selected as 87G (parameter P.0370). It's not possible to activate in the same controller both protection 87G and 87T; therefore, in case of plants that require both 87G+87T, you will need to use two protection controllers (to define).

The differential protection 87G is acquired from the comparison of the readings of one set of three CT on the genset star point and one on the output. It activates on each of the three phases and it can trigger on each single phase.

578 – Maximum transformer differential current (87T)

Type: **Alarm**

Related parameters:
P.0370 Selection 87G or 87T
P.0371 Minimum differential current threshold (Aac)
P.0372 Maximum differential current threshold (Aac)
P.0373 Threshold for load current slope change (Aac)
P.0374 Slope K1 (%)
P.0375 Slope K2 (%)
P.0376 Maximum differential current delay

To disable: **P.0376 =0**

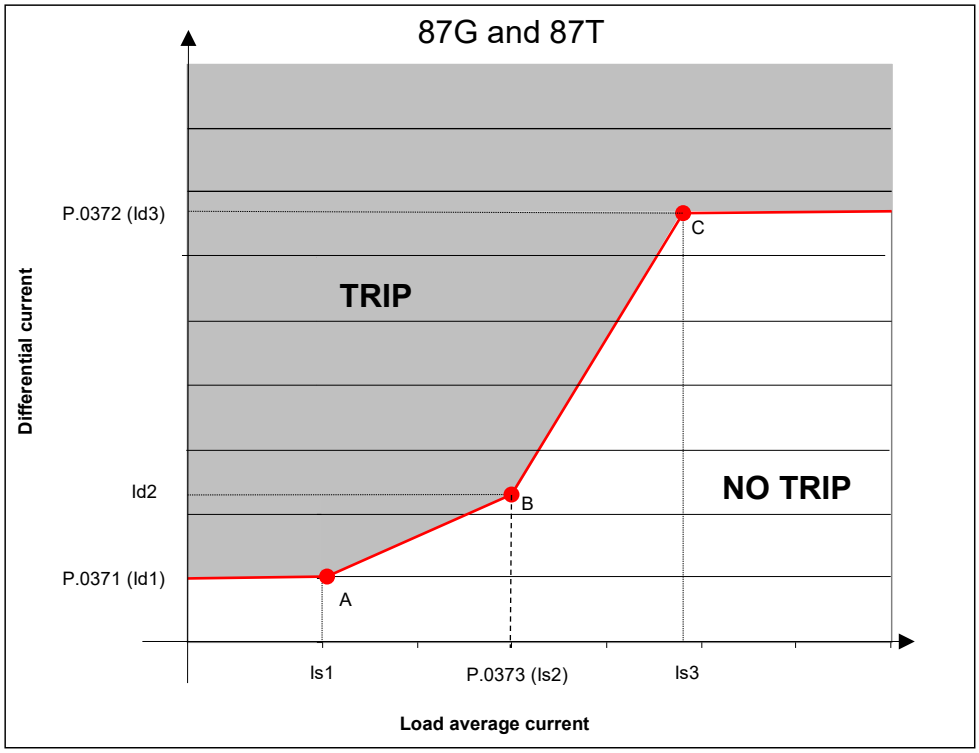
The protection is enabled only in case of absence of the disabling digital input and only if the controller is configured to measure the differential current and selected as 87T (parameter P.0370). It's not possible to activate both protection 87G and 87T in the same controller; therefore, in case of plants that require both 87G+87T, you will need to use two protection controllers (to define).

Typically, the differential protection 87T is used if the genset is connected to a step-up transformer by a rigid support. It's similar to the 87G protection, but the reading is acquired between the CT on the star point and a set of three CT on the transformer (usually in medium voltage). Therefore, the protection has to consider the current ratios between the two set of three CT, as well as the characteristics of the step-up transformer. In particular, the transformation ratio. It activates on each of the three phases and it can trigger on each single phase.

This protection is expected but not implemented yet.

Genset (87G) and Transformer (87T) differential protections

Once the type of differential protection (genset or transformer) is selected, the controller activates a similar trigger for 87G and 87T, after analysing the different points of the curve.



First of all, the protection analyses the instantaneous value of the differential current for each of the three phases as instantaneous difference between the currents of the upper part (A) and the ones of the lower part (B); then it analyses the true RMS of each phase:

IdL1 = IL1(A) – IL1(B)

IdL2 = IL2(A) – IL2(B)

IdL3 = IL3(A) – IL3(B)

It also analyses the load average current for each of the three phases as average between the currents of the upper part (A) and the ones of the lower part (B); then it analyses the true RMS of each phase:

IsL1 = (IL1(A) + IL1(B)) / 2

IsL2 = (IL2(A) + IL2(B)) / 2

IsL3 = (IL3(A) + IL3(B)) / 2

The protection doesn't trigger if the value of the differential current is lower than the parameter P.0371 "Minimum differential current threshold", while it always triggers if higher than the value set in the parameter P.0372 "Maximum differential current threshold".

In the central part, the protection triggers according to the slope of the curve. In particular, the constant K1 indicates the slope of the segment A-B, while the constant K2 indicates the B-C one. They are expressed in percentage values. Usually, K2 has to be higher than K1 (in case of wrong configuration, the controller forces the value of K2 to equal to K1).

In the slope segment A-B, where "Is" is lower than the value set in the parameter P.0373 (Is2) and Id is higher than P.0371 (Id1), the protection triggers if:

$$Is_{(misurata)} < \frac{Id}{K1}$$ if Is < Is2 and Id > Id1 (K1 = P.0374)

In the slope segment B-C, where Id is lower than the value set in the parameter P.0372 (Id3) and "Is" is higher than P.0373 (Is2), the protection triggers if:

$$Is_{(misurata)} < \frac{Id - OF}{K2}$$ if Id < Id3 and Is > Is2 (K2 = P.0375)

OF is the extension of BC referred to the axis y and it is calculated as follows:

$$OF = Is2 * (K1 - K2)$$

Anyhow, the protection is fixed according to the time configured in the parameter P.0376 (0 to 200msec maximum). Once the trigger threshold is exceeded, the controller waits for the time configured before activating the alarm. If it is set to zero, the protection is disabled.

Notes

Is1 results from Id1:	Is1 = Id1 / K1
Id2 results from Is2:	Id2 = Is2 * K1
Is3 results from Id3:	Is3 = (Id3 – OF) / K2

579 – Power reverse (32RP)

Type: **Alarm**

Related parameters: **P.0384** Power reverse threshold (% compared with P.0106)
P.0385 Power reverse delay

To disable: **P.0385 =0**

The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

The controller measures the total active power on the three currents on side B.

The protection activates if the total active power of the system has a negative sign and is higher (in absolute value) than P.0384 threshold (percentage of P.0106), uninterruptedly for the P.0385 time span.

580 – Reactive power reverse / Loss of excitation (32RQ/40)

Type: **Alarm**

Related parameters: **P.0386** Loss of excitement threshold (kvar)
P.0387 Loss of excitement delay

To disable: **P.0387 =0**

The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status).

The controller measures the total reactive power on the three currents on side B.

The protection activates if the total reactive power of the system has a negative sign and is higher, as to the module, than P.0386 threshold, uninterruptedly for P.0387 time span.

581 – Restricted earth fault / Maximum differential current (64)

Type: **Alarm**

Related parameters: **P.0110** A- Primary of transformer
P.0111 A- Secondary of transformer
P.0115 B- Primary of transformer
P.0116 B- Secondary of transformer
P.0119 Transformer type for the auxiliary current
P.0120 Primary of transformer for the auxiliary current
P.0121 Secondary of transformer for the auxiliary current
P.0122 Usage of auxiliary current
P.0123 Connection for auxiliary current

P.0368 Restricted earth fault threshold / Max. differential current (Aac)
P.0369 Restricted earth fault delay / Maximum differential current (s)

To disable: **P.0369 =0 or P.0123=0**

The protection is enabled only in case of absence of the disabling digital input (usually combined to the circuit breaker status). The protection will be enabled if a valid current measure is configured. In particular, P.0119 must be set to zero (0-C.T.) and P.0122 must be set to two (2-Neutral of generator). By parameter P.0123 is possible to configure the set of currents (A or B) used to calculate the differential current.

The controller calculates the differential current (A∑) as the instant sum of the three phase currents and of the neutral current. Only in this case, the protection acts on the differential current, not on the fourth current.

The protection will be activated if, according to the previous conditions, the measure of current stays above P.0368 threshold uninterruptedly for P.0369 time span.

252 – CAN-BUS 2 Expansion modules missing (EXBUS)

Type: **Warning**
Related parameters: **P.0701** EXBUS Address.
To disable: **P.0701 =0**

The protection is always enabled.

It activates if the D-PRO Protection relay doesn't manage to communicate with the DST4602 controller.

254 – Input doubled on CAN-BUS 2 (EXBUS)

Type: **Warning**
Related parameters: **P.0701** EXBUS Address.
To disable: **P.0701 =0**

The protection is always enabled.

It activates in the same communication bus if there is another D-PRO protection relay configured with the same address.

701...742 - Generic faults related to the digital inputs

See [1].

301...328 - Generic faults related to the analogue inputs

See [1].

9. Other functions

9.1 Parameters alternative configurations

You can use certain properly configured digital inputs to change the configuration of the system without changing the programming parameters. In fact, the controller manages internally four groups of alternative parameters that can be “copied” in the operating parameters on request (through a dedicated digital input).

Alternative configurations can be programmed only using the BoardPrg3xx.

You cannot program or modify the configurations from the controller.

The parameters present in each alternative group are the following:

- P.0101: Number of phases of the genset.
- P.0102: Rated voltage of the genset.
- P.0103: Generator rated frequency.
- P.0104: Rated power of the genset.

It is possible to change the configuration by means the following input digital functions:

- DIF.2151 – “Select configuration 1”. When the input becomes "active", parameters of alternative configuration set 1 are copied in the working configuration.
- DIF.2152 – “Select configuration 2”. When the input becomes "active", parameters of alternative configuration set 2 are copied in the working configuration.
- DIF.2153 – “Select configuration 3”. When the input becomes "active", parameters of alternative configuration set 3 are copied in the working configuration.
- DIF.2154 – “Select configuration 4”. When the input becomes "active", parameters of alternative configuration set 4 are copied in the working configuration.

Remark: copying an alternative set in working configuration causes the loss of the previous loaded parameters. The only way to restore them is to have them stored in another alternative configuration and recall it.

Usually, this function is used with multiple-voltage and/or multiple-frequency panels: wiring the cams of a selector to the panel on the inputs of the controller, you can manually switch voltages and frequency without having to use the parameters of the controller.

9.2 Clock

The controller is equipped with a hardware clock and it is used for History logs recordings.

The clock is equipped with a rechargeable battery and can be updated for some months, even if the controller is not supplied. After a long time in which the controller is not used (no supply), even if the clock reactivates immediately when the supply comes back, a few hours are necessary to guarantee to full recharge of the internal battery.

9.2.1 Clock automatic update

In case the controller has an Ethernet connection, the clock can be automatically updated through the connection towards the server “SMARTCLOUD” or towards a NTP server. The controller registers the “EVT.1076 event - Date and hour modified” in the history log, only if the difference between the new time received and the current one is higher than one minute.

Server “SMARTCLOUD”

Every time that the controller sends a data package to the server “SMARTCLOUD” receives a synchronization package as a response containing date and time of jet lag (that is UCT Universal Coordinated Time”) including jet lag and summertime; with the value received, the calendar is updated (parameters P.0409 and P.0410 are not used).

Server NTP

The server TNP (questioned by the controller every 5 minutes) gives the date and hour of the jet lag (that is UCT Universal Coordinated Time”) from which the controller can calculate and update the internal calendar considering its own jet lag and eventual summertime. To this purpose, the follow parameters are available:

- P.0409: Legal time.
  - “0-No” jet lag not in use
  - “1-Yes” jet lag in use (it adds an hour to the one received).
  - “2-Automatic (only Europe)”: It is only valid for Europe, as since 2002 has been unified (it activates ate 01.00 of the last Sunday of March and deactivates at 01.00 of the last Sunday of October).
- P.0410: Jet lag (1=15 min.; 4=1 hour). The setting limits are from -47 to + 48 and allow to manage all time bands of the Earth by hour quarts.

9.3 History logs (H.XX)

During the operation, apart from the OFF/RESET mode, the controller makes periodic registration or on event, partially configured with the programming parameters.

The controller manages five types of archive:

1. Events
2. Analogue
3. Pre-Trigger
4. Maximum peaks

The data logged in each archive is viewed using MECC ALTE HisView application.

9.3.1 Logs for events

In the moment in which some events happen (previously configured), the controller adds a registration in this archive. The registration always contains date/hour, numeric code which identifies the event and the controller status. Through BoardPrg3 program, it is possible to select which other information must be registered at every event. It is possible to add 44 information maximum. The capacity of the

archive depends on how many information are memorized at every event: with default configuration, by the way, the total capacity is 832 registrations. If the archive is full and a new event occurs, the less recent is overwritten.

Parameter P.0441 allows to select which events must be registered. It is a parameter configurable at bit:

Bit	Hexadecimal value	Firmware version	Description
1	01	01.10	Events to log
2	02	01.10	Logging interval

A chart follows with the codes for all possible events.

Code	Version	Registration cause.
EVT.1074	01.10	Reset
EVT.1075	01.10	Not valid clock (but used by some functions).
EVT.1076	01.10	Update clock/calendar
EVT.1077	01.10	New starting of controller
EVT.1078	01.10	Default values of parameters reloaded.
EVT.1082	01.10	Engine protection override activated
EVT.1083	01.10	Engine protection override deactivated
EVT.1101	01.10	Trip of protection 27
EVT.1102	01.10	Reset of protection 27
EVT.1103	01.10	Trip of protection 27T
EVT.1104	01.10	Reset of protection 27T
EVT.1105	01.10	Trip of protection 32P
EVT.1106	01.10	Reset of protection 32P
EVT.1107	01.10	Trip of protection 32Q
EVT.1108	01.10	Reset of protection 32Q
EVT.1109	01.10	Trip of protection 46
EVT.1110	01.10	Reset of protection 46
EVT.1111	01.10	Trip of protection 47
EVT.1112	01.10	Reset of protection 47
EVT.1113	01.10	Trip of protection 50
EVT.1114	01.10	Reset of protection 50
EVT.1115	01.10	Trip of protection 50N
EVT.1116	01.10	Reset of protection 50N
EVT.1117	01.10	Trip of protection 50V
EVT.1118	01.10	Reset of protection 50V
EVT.1119	01.10	Trip of protection 51
EVT.1120	01.10	Reset of protection 51
EVT.1121	01.10	Trip of protection 51N
EVT.1122	01.10	Reset of protection 51N
EVT.1123	01.10	Trip of protection 51V
EVT.1124	01.10	Reset of protection 51V
EVT.1125	01.10	Trip of protection 59
EVT.1126	01.10	Reset of protection 59
EVT.1127	01.10	Trip of protection 59N
EVT.1128	01.10	Reset of protection 59N
EVT.1129	01.10	Trip of protection 81O
EVT.1130	01.10	Reset of protection 81O
EVT.1131	01.10	Trip of protection 81U
EVT.1132	01.10	Reset of protection 81U
EVT.1133	01.10	Trip of protection 87G
EVT.1134	01.10	Reset of protection 87G

EVT.1135	01.10	Trip of protection 87T
EVT.1136	01.10	Reset of protection 87T
EVT.1137	01.10	Trip of protection 32RP
EVT.1138	01.10	Reset of protection 32RP
EVT.1139	01.10	Trip of protection 32RQ
EVT.1140	01.10	Reset of protection 32RQ
EVT.1141	01.10	Trip of protection 64
EVT.1142	01.10	Reset of protection 64

All the anomalies are recorded in the records of events. They are recorded with their own numerical code, added to:

- 2000: if the anomaly is a warning.
- 3000: if the anomaly is an unload.
- 4000: if the anomaly is a deactivation.
- 5000: if the anomaly is an alarm.

For example, anomaly 273 will be recorded as "2273" when it is activated as a warning, as "5273" if it is activated as an alarm. By viewing the events from the board panel, the event code "2273" is automatically displayed as "W273", the code 5273 is displayed as "A273".

With the default configuration, each time that an event is recorded, the board also records the following info (this list can be modified by means of the BoardPrg3 program):

- Date/Time
- Phase-to-phase voltages and frequency.
- The three phase currents – side A.
- The three phase currents – side B.
- The three differential currents.
- The total active and reactive powers.
- The battery voltage.

9.3.2 Logs for analogues

The controller records a series of analogue measurements and statuses at regular intervals. The recording interval is configurable using the parameter P.0442 : interval (in seconds) for the recording into the archive of analogue measurements.

Each record always contains the date/time and the status of the controller. By means of the BoardPrg3 program, it is possible to select which information must be recorded. It is possible to add 44 information max. The capacity of the archive depends on the information recorded on event: however, with the default configuration the full capacity is 832 records. If the archive is full and a new event occurs, the oldest is overwritten.

With default configuration, the values recorded are:

- Date/Time
- Phase-to-phase voltages and frequency.
- The three phase currents – side A.

- The three phase currents – side B.
- The three differential currents.
- The total active and reactive powers.
- The battery voltage.

9.3.3 Logs for pre-trigger

The controller records a series of analogue measurements and statuses at regular intervals related to the tripping of a protection. These protections can be enabled through parameter P.0446 (“Enable protections for pre-trigger"), while the recording interval can be configured in hundredths of a second using parameter P.0444 (“Pre-trigger logging interval"). Finally, the parameter P.0445 (“Event position in the pre-trigger archive") allows to define the number of recordings before and / or after the trip of a protection.

For example, if parameter P.0445 is set to 100% the recording ends when a protection is activated; if set to 0% the recording starts at the moment of the intervention of a protection while if it is set at 50% the recordings are divided equally between before and after the trip of the protection.

Each record always contains the date/time and the status of the controller. By means of the BoardPrg3 program, it is possible to select which information must be recorded. It is possible to add 44 information max. The capacity of the archive depends on the information recorded on event: however, with the default configuration the full capacity is 112 records. If the archive is full and a new event occurs, the oldest is overwritten.

With default configuration, the values recorded are:

- Date/Time
- Phase-to-phase voltages and frequency.
- The three phase currents – side A.
- The three phase currents – side B.
- The three differential currents.
- The total active and reactive powers.
- The battery voltage.

In order to erase the archive and restart the recording again, the key selector on the DST4602 must be returned to OFF/RESET or when the digital input configured with the DIF.2001 function (“Alarm reset command”) turns from “inactive" into "active".

9.3.4 Logs for peaks

The controller makes a series of maximum and minimum peaks for some significant values.

- Total active power: the maximum peak is recorded, having the date/time and the measure of the power factor associated.
- Currents: the maximum peaks of individual phases of the currents A and B are recorded, having the date/time associated.

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