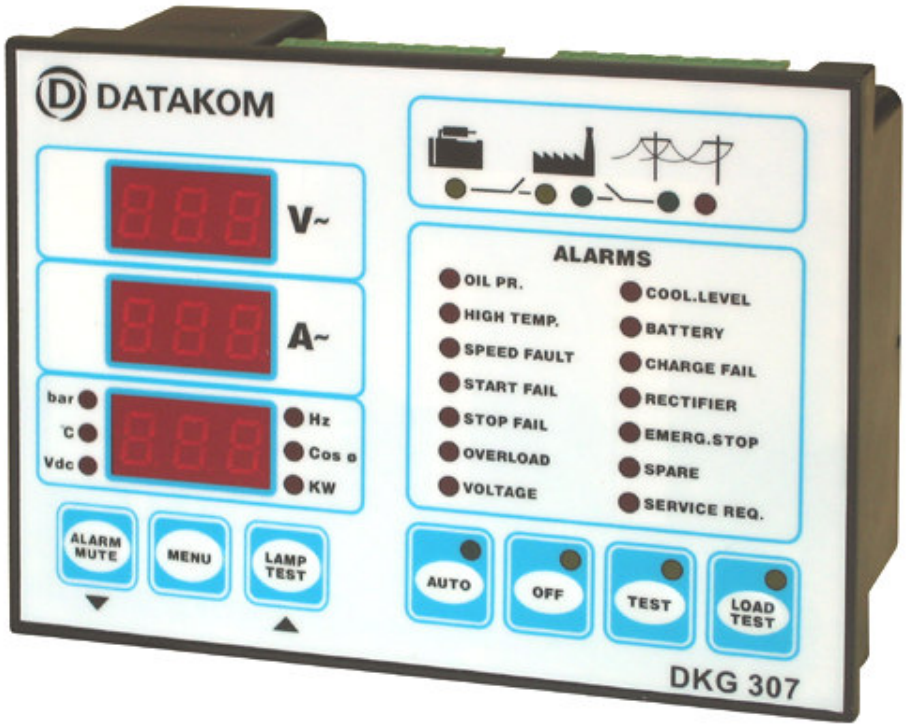
DATAKOM

Genset Automation Control Pte Ltd

DKG-307 AUTOMATIC MAINS FAILURE AND REMOTE START UNIT



FEATURES

Automatic mains failure,
Engine control,
Generator protection,
Built in alarms and warnings,
3 phase mains voltage inputs
3 phase genset voltage inputs
3 phase genset CT inputs
Engine oil pressure measurement
Engine coolant temperature measurement
Genset active power measurement
Genset power factor measurement
Periodic maintenance request indicator
Engine hours counter
Event logging
Statistical counters
Battery backed-up real time clock
Weekly operation schedule programs
Field adjustable parameters
RS-232 serial port
Free MS-Windows Remote monitoring SW:
-local, LAN, IP and modem connection
-monitoring, download of parameters
LED displays
Configurable analogue inputs: 2
Configurable digital inputs: 7
Configurable relay outputs: 2
Total relay outputs: 6
I/O expansion capability
Remote Start operation available
Survives cranking dropouts
Sealed front panel
Plug-in connection system for easy replacement
Small dimensions (155x115x48mm)
Low cost

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1. INSTALLATION

1.1 Introduction to the Control Panel

The unit is a control and protection panel used in gensets. It shows the measured values on its displays. The unit is designed to provide user friendliness for both the installer and the user. Programming is usually unnecessary, as the factory settings have been carefully selected to fit most applications. However programmable parameters allow the complete control over the generating set. Programmed parameters are stored in a Non Volatile Memory and thus all information is retained even in the event of complete loss of power.

The measured parameters are:

Mains voltage phase R to neutral
Mains voltage phase S to neutral
Mains voltage phase T to neutral
Mains voltage phase R-S
Mains voltage phase S-T
Mains voltage phase T-R
Gen voltage phase U to neutral
Gen voltage phase V to neutral
Gen voltage phase W to neutral
Gen voltage phase U-V
Gen voltage phase V-W
Gen voltage phase W-U
Gen frequency
Gen current phase U
Gen current phase V
Gen current phase W
Gen frequency
Gen total KW
Gen total cosΦ
Battery voltage,
Coolant temperature
Oil pressure

1.2 Mounting the Unit

The unit is designed for panel mounting. The user should not be able to access parts of the unit other than the front panel.

Mount the unit on a flat, vertical surface. The unit fits into a standard panel meter opening of 151x111 millimeters. Before mounting, remove the retaining steel spring and connectors from the unit, then pass the unit through the mounting opening. The unit will be maintained in its position by the steel spring.

Engine body must be grounded for correct operation of the unit, otherwise incorrect voltage and frequency measurements may occur.

The output of the current transformers shall be 5 Amperes. The input current rating of the current transformers may be selected as needed (between 10/5 and 9000/5 amps). Current transformer outputs shall be connected by separate cable pairs from each transformer, to related inputs. Never use common terminals or grounding. The power rating of the transformer should be at least 5 VA. It is recommended to use 1% precision transformers.

If analogue senders (e.g. temperature or oil pressure) are connected to the unit, it is not possible to use auxiliary displays, otherwise the unit may be destroyed. If temperature or oil pressure displays are already present on the generator control panel, do not connect the senders to the unit. The unit is factory programmed for VDO type senders. However different types of senders are selectable via programming menu. Please check the programming section.

The programmable digital inputs are compatible with both '**normally open**' and '**normally closed**' contacts, switching either to **BAT-** or **BAT+**.

The charge alternator connection terminal provides also the excitation current, thus it is not necessary to use an external charge lamp.

1.3 Wiring the Unit

WARNING: THE UNIT IS NOT FUSED.
Use external fuses for
Mains phases: R-S-T
Generator phase: U-V-W
Battery positive: BAT(+).
Install the fuses as nearly as possible to the unit in a place easily accessible for the user.
The fuse rating should be 6 Amps.

WARNING: ELECTRICITY CAN KILL
ALWAYS disconnect the power BEFORE connecting the unit.

1) ***ALWAYS remove the plug connectors when inserting wires with a screwdriver.***
2) ***ALWAYS refer to the National Wiring Regulations when conducting installation.***
3) ***An appropriate and readily accessible set of disconnection devices (e.g. automatic fuses) MUST be provided as part of the installation.***
4) ***The disconnection device must NOT be fitted in a flexible cord.***
5) ***The building mains supply MUST incorporate appropriate short-circuit backup protection (e.g. a fuse or circuit breaker) of High Breaking Capacity (HBC, at least 1500A).***
6) ***Use cables of adequate current carrying capacity (at least 0.75mm^2) and temperature range.***

2. INPUTS AND OUTPUTS

RS-232 SERIAL PORT: This connector provides serial data input and output for various purposes like remote monitoring and remote programming.

EXTENSION CONNECTOR: This connector is intended for the connection to output extension modules. The optional relay extension module provides 8 programmable 16A relay outputs. The unit allows the use of up to 2 I/O extension modules.

Term	Function	Technical data	Description
1	**GENERATOR CONTACTOR**	Relay output, 16A-AC	This output provides energy to the generator contactor. If the generator phases do not have acceptable voltage or frequency values, the generator contactor will be de-energized. In order to provide extra security, the normally closed contact of the mains contactor should be serially connected to this output.
2	**U**	Generator phase inputs, 0-300V-AC	Connect the generator phases to these inputs. The generator phase voltages upper and lower limits are programmable.
3	**V**		
4	**W**		
5	**GENERATOR NEUTRAL**	Input, 0-300V-AC	Neutral terminal for the generator phases.
6	**MAINS NEUTRAL**	Input, 0-300V-AC	Neutral terminal for the mains phases.
7	**T**	Mains phase inputs, 0-300V-AC	Connect the mains phases to these inputs. The mains voltages upper and lower limits are programmable.
8	**S**		
9	**R**		
10	**MAINS CONTACTOR**	Relay output, 16A-AC	This output provides energy to the mains contactor. If the mains phases do not have acceptable voltages, the mains contactor will be de-energized. In order to provide extra security, the normally closed contact of the generator contactor should be serially connected to this output.
11	**GROUND**	O VDC	Power supply negative connection.
12	**BATTERY POSITIVE**	+12 or 24VDC	The positive terminal of the DC Supply shall be connected to this terminal. The unit operates on both 12V and 24V battery systems.
13	**SPARE SENDER INPUT**	Input, 0-5000 ohms	No connection to this terminal.
14	**OIL PRESSURE SENDER**	Input, 0-5000 ohms	Analogue oil pressure sender connection. Do not connect the sender to other devices. The input has programmable characteristics and connects to any kind of sender.
15	**COOLANT TEMP. SENDER**	Input, 0-5000 ohms	Analogue high temperature sender connection. Do not connect the sender to other devices. The input has programmable characteristics and connects to any kind of sender.
16	**CHARGE**	Input and output	Connect the charge alternator's D+ terminal to this terminal. This terminal will supply the excitation current and measure the voltage of the charge alternator.

Term	Function	Technical data	Description
17	**RELAY-1 (HORN RELAY)**	Output 10A/28VDC	This relay has programmable function, selectable from a list.
18	**RELAY-2 (STOP RELAY)**	Output 10A/28VDC	This relay has programmable function, selectable from a list.
19	**START RELAY**	Output 10A/28VDC	This relay controls the engine cranking.
20	**FUEL RELAY**	Output 10A/28VDC	This relay is used for fuel solenoid control. It is internally connected to terminal **16** for supplying the charge alternator's excitation current.
21	**EMERGENCY STOP**	Digital inputs	These inputs have programmable characteristics selected via the program menu. Each input may be driven by a '**normally closed**' or '**normally open**' contact, switching either **battery+** or **battery-**. The effect of the switch is also selectable from a list. See **PROGRAMMING** section for more details.
22	**SPARE-2**		
23	**PROGRAM LOCK**		
24	**SPARE-1**		
25	**COOLANT LEVEL**		
26	**HIGH TEMP**		
27	**LOW OIL PRESSURE**		
28	**RECTIFIER FAIL**		
29	**CURR_W+**	Current transformer inputs, 5A-AC	Connect the generator current transformer terminals to these inputs. Do not connect the same current transformer to other instruments otherwise a unit fault will occur. Connect each terminal of the transformer to the unit's related terminal. Do not use common terminals. Do not use grounding. Correct polarity of connection is vital. If the measured power is negative, then change the polarity of each 3 current transformers. The rating of the transformers should be the same for each of the 3 phases. The secondary winding rating shall be 5 Amperes. (For ex. 200/5 Amps).
30	**CURR_W-**		
31	**CURR_V+**		
32	**CURR_V-**		
33	**CURR_U+**		
34	**CURR_U-**		

3. DISPLAYS

3.1 Led Displays

The unit has 29 LEDs, divided in 4 groups:
-Group_1: Operating mode: This group indicates the genset function.
-Group_2: Mimic diagram: This group indicates the current status of the mains and genset voltages and contactors.
-Group_3: Warnings and alarms: This group indicates the existence of abnormal conditions encountered during operation.
-Group_4: Unit: This group indicates the unit of the value displayed in the bottom display.

Function	Color	Description
MAINS ON	Green	The LED will turn on when all 3 mains phase voltages are within the limits.
MAINS OFF	Red	The LED will turn on when at least one of the mains phase voltages is outside limits.
GENERATOR	Yellow	The LED will turn on when all 3 generator phase voltages are within the programmed limits.
LOAD GENERATOR	Yellow	It turns on when the generator contactor is activated.
LOAD MAINS	Green	It turns on when the mains contactor is activated.
LOAD TEST	Yellow	It turns on when the related operation mode is selected. One of these LEDs is always on and indicates which operation mode is selected. If the operation of the genset is disabled by the **weekly operation schedule**, then the **AUTO** led will flash.
TEST	Yellow	
OFF	Yellow	
AUTO	Green	
SERVICE REQUEST	Red	Engine periodic maintenance request indicator. It turns on when the preset engine hours or time duration after previous service has elapsed.
ALARM GROUP	Red	If a fault condition resulting to the engine shutdown has occurred, the related alarm led turns on steadily. If a warning condition has occurred, the related led flashes. The alarms work on a first occurring basis. The occurrence of a fault will disable other faults of lower or equal priority.
UNIT GROUP	Red	This group indicates the unit of the value displayed in the bottom display. When the engine is running the unit displays the genset frequency, otherwise it displays the battery voltage. Different values may be scrolled by pressing the **MENU** key.

3.2 Digital Displays

The unit has 3 seven segment displays. They show:
-Measured parameters,
-Service counters,
-Statistical counters,
-Program parameters.

The navigation between different screens in a group is made with the **MENU** button. Holding the **MENU** button pressed for 1 second makes the display to switch to the next group.

VOLTAGE DISPLAY: This display shows:
-phase R voltage if the load is on mains
-Phase U voltage if the load is on the genset

By pressing the MENU key, below values may be displayed:

-(R-S-T) mains phase to neutral voltages
-(U-V-W) generator phase to neutral voltages
-(RS-ST-TR) mains phase to phase voltages
-(UV-VW-WU) generator phase to phase voltages

If the service counters group is displayed, then this display will show the counter name.
In programming mode it displays (**PGM**).

CURRENT DISPLAY: This display will show the current values measured using the current transformers. Using the programming menu, current transformers within the range of 10/5A to 9000/5A may be programmed.
In programming mode it displays the program number.

MULTIFUNCTION DISPLAY: By pressing the MENU key below values may read:
-generator frequency (Hz)
-generator cosΦ
-generator active power (KW)
-oil pressure (bar)
-coolant temperature (ºC)
-battery voltage (V-DC),
In programming mode it displays the program value.

4. ALARMS AND WARNINGS

Alarms indicate an abnormal situation in the generating set are divided into 2 priority levels:

1- **ALARMS:** These are the most important fault conditions and cause:
- The related alarm led to be on steadily,
- The genset contactor to be released immediately,
- The engine to be stopped immediately,
- The **Horn**, **Alarm** and **Alarm+Warning** relays output to operate, (if selected via programming menu)

2- **WARNINGS:** These conditions cause:
- The related alarm led to flash,
- The **Horn** and **Alarm+Warning** relay outputs to operate, (if selected via programming menu)

If the **ALARM MUTE** button is pressed, the Horn relay output will be deactivated; however the existing alarms will persist and disable the operation of the genset.

Alarms operate in a first occurring basis:

-If an alarm is present, following alarms and warnings will not be accepted,

-If a warning is present, following warnings will not be accepted.

Alarms may be of LATCHING type following programming. For latching alarms, even if the alarm condition is removed, the alarms will stay on and disable the operation of the genset.

The existing alarms may be canceled by pressing one of the operating mode buttons (**LOAD TEST** / **TEST** / **OFF** / **AUTO**).

Most of the alarms have programmable trip levels. See the programming chapter for settable alarm limits.

LOW OIL PRESSURE: Set if a signal is detected at the Low Oil Pressure Switch input or the oil pressure value measured from the sender is below the programmed limit. **Warning** (**P_016**) and **alarm** (**P-015**) limits are separately programmable for the oil pressure sender input. This fault will be monitored with holdoff timer (**P_023**) delay after the engine is running. Also if the oil pressure switch is open at the beginning of a start attempt, then the engine will not be started and the oil pressure led will flash. When the oil pressure switch closes normal operation will be resumed.

HIGH TEMPERATURE: Set if a signal is detected at the High Temperature Switch input or the coolant temperature value measured from the sender is above the programmed limit. **Warning** (**P_017**) and **alarm** (**P_018**) limits are separately programmable for the temperature sender input.

SPEED: Set if the generator frequency is outside programmed limits (overspeed/Underspeed). This fault will be monitored with holdoff timer (**P_023**) delay after the engine is running. Different low and high limits for warning and alarm are separately programmable. (P_008/P_009/P_010/P_011)

START FAIL: Set if the engine is not running after programmed number of start attempts. (**P_035**)

STOP FAIL: Set if the engine has not stopped before the expiration of the **Stop Timer (P_034)**.

OVERLOAD: Set if at least one of the genset phase currents goes over the **Overcurrent Limit (P_002)** or if the genset power (KW) supplied to the load goes over the **Excess Power (P_003)** limit for **Overcurrent** / **Excess Power Timer (P_511)**. If the currents and power goes below the limits before expiration of the timer then no alarm will be set.

VOLTAGE: Set if any of the generator phase voltages goes outside programmed limits (P_006/P_007). This fault will be monitored with holdoff timer (**P_023**) delay after the engine is running.

COOL: LEVEL: Set when a signal is detected from the coolant level switch input.

BATTERY: Set if the battery voltage goes outside programmed limits. During engine cranking this fault is not monitored. Warning level for low battery voltage (P_012) and both warning (P_013) and alarm (P_014) levels for high battery voltage are programmable.

CHARGE: Set if a charge alternator failure (or broken belt) occurs. This fault condition may result to a **warning** or **alarm** following programming. (P_038)

RECTIFIER FAIL: Set if a signal is detected at the rectifier fail input. This input is only monitored when mains voltages are present.

EMERGENCY STOP: Set if a signal is detected at the emergency stop input.

SPARE: Set if a signal is detected in one of the spare fault inputs.

5. MODES OF OPERATION

The modes of operation are selected by pushing the front panel keys. Changing the operation mode while the genset is running will result to a behavior suitable for the new operating mode. For example, if the LOAD TEST mode is selected when genset is running at TEST mode, then the genset will take the load.

OFF: In this mode, the mains contactor will be energized if mains phase voltages are within the programmed limits. The engine will be stopped.

AUTO: It is used for genset and mains automatic transfer. If at least one of the mains phase voltages is outside limits (P_004/P_005), the mains contactor will be deactivated.
The diesel will be started for programmed times (P_035) after the wait period (P_0026). When the engine runs, the crank relay will be immediately deactivated. The engine will run without load during engine heating period (P_029). After this, if alternator phase voltages and frequency are within limits, then the unit will wait for the generator contactor period (P_032) and the generator contactor will be energized.
When all the mains phase voltages are within the limits, the engine will continue to run for the mains waiting period (P_030). At the end of this period the generator contactor is deactivated and the mains contactor will be energized. If a cooling period is given (P_031), the generator will continue to run during cooling period. At the end of the period, the fuel solenoid will be de-energized and the diesel will stop. The unit will be ready for the next mains failure.
If the operation of the genset is disabled by the **weekly schedule**, then the **AUTO** led will flash, and the operation of the genset will be as in the **OFF** mode.

TEST: It is used to test the generator when the mains are on, or keep the generator running in the emergency backup mode (P_041). The operation of the generator is similar to the AUTO mode, but the mains contactor will not be deactivated if the mains are not off. If the mains are off, mains contactor will be deactivated and the generator contactor will be activated. When the mains are on again, a changeover to the mains will be made, but the engine will be kept running unless another mode is selected. To stop the engine, select **AUTO** or **OFF** mode.

LOAD TEST: It is used to test the genset under load. Once this mode is selected, the engine will run and the load will be transferred to the genset. The genset will feed the load indefinitely unless another mode is selected.

6. OTHER FEATURES

6.1 Remote Start Operation

The unit offers the possibility of **REMOTE START** mode of operation. If the program parameter **P_042** is set to **1** then the unit will enter to the Remote Start operation. The Remote Start signal should be connected to the **SPARE_2** (**22**) input.

The REMOTE START signal may be a NO or NC contact, switching to either battery positive or battery negative. These selections are made using programming menu.

In this mode the mains phases are not monitored. If the REMOTE START signal is present then the mains will be supposed to fail, inversely if the REMOTE START signal is absent, then mains voltages will be supposed to be present. The front panels mimic diagram's mains LEDs will reflect the status of the REMOTE START input.

6.2 Sender type Selection

The unit has the ability to adapt to any type of oil pressure and temperature senders. The commonly used standard sender characteristics are recorded in memory and selectable from a list. However non standard senders may also be used by entering their characteristics to the table.

Oil Pressure Sender Type Selection:
The oil pressure sender is selected using parameter P_019. The selectable sender types are:
0: The sender characteristics are defined in table using parameters P_131 to P_142.
1: VDO 0-7 bars (10-180 ohms)
2: VDO 0-10 bars (280-20 ohms)
3: DATCON 0-7 bars (240-33 ohms)
4: DATCON 0-10 bars (240-33 ohms)
5: DATCON 0-7 bars (0-90 ohms)
6: DATCON 0-10 bars (0-90 ohms)
7: DATCON 0-7 bars (75-10 ohms)

Temperature Sender Selection:
The temperature sender is selected using parameter P_020. The selectable sender types are:
0: The sender characteristics are defined in table using parameters P_143 to P_154.
1: VDO
2: DATCON DAH type
3: DATCON DAL type

6.3 Engine Heating Operation

Especially on engine without a body heater, or with a failing one, it may be desired that the genset should not take the load before reaching a suitable temperature. The unit offers 2 different ways of engine heating.

1. Timer controlled heating:
This operation mode is selected when the parameter **P_037** is set to **0**. In this mode, the engine will run during parameter **P_029**, and then the genset will take the load.

2. Timer and temperature controlled heating:
This operation mode is selected when the parameter **P_037** is set to **1**. In this mode, at first the engine will run during parameter **P_029**, then it will continue to run until the measured coolant temperature reaches the limit defined in parameter **P_022**. When the requested temperature is reached, the load will be transferred to the genset. This operation mode may be used as a backup to the engine body heater. If the engine body is warm the heating will be skipped.

6.4 Service Request Display

This led is designed to help the periodic maintenance of the genset to be made consistently.
The periodic maintenance is basically carried out after a given engine hours (for example 200 hours), but even if this amount of engine hours is not fulfilled, it is performed after a given time limit (for example 12 months).

The SERVICE REQUEST led has no effect on the genset operation.

The unit has both programmable engine hours and maintenance time limit. The engine hours is programmable with 50-hour steps (**P_044**), the time limit is programmable between with 1 month steps (**P_045**). If any of the programmed values is zero, this means that the parameter will not be used. For example a maintenance period of 0 months indicates that the unit will request maintenance only based on engine hours, there will be no time limit. If the engine hours is also selected as 0 hours this will mean that the SERVICE REQUEST display will be inoperative.

When the engine hours **OR** the time limit is over, the **SERVICE REQUEST** led (red) will start to flash.
To turn off the led, and reset the service period, press together the ALARM MUTE and LAMP TEST keys for 5 seconds. The upper display will show "**SER**".

The remaining engine hours and the remaining time limit are kept stored in a non-volatile memory and are not modified by power supply failures.

The remaining time and engine hours to service may be checked via the statistics menu selected by pressing the **MENU** key for **1 second**.

For the engine hours, the upper display will show "**HtS**" (hours to service). The mid display will show the first 3 digits of the engine hours to service and the bottom display the last 3 digits.

For the time, the upper display will show "**ttS**" (time to service). The mid display will show the first 3 digits of days to service and the bottom display the last 3 digits.

6.5 Engine Hour Meter

The unit features a non-erasable incremental engine hour meter. The hour meter information is kept in a non-volatile memory and is not modified by power supply failures.

The engine hours may be displayed via the statistics menu selected by pressing the **MENU** key for **1 second**.

For the engine hours, the upper display will show "**EnH**" (engine hours). The mid display will show the first 3 digits of the engine hours and the bottom display the last 3 digits.

6.6 Modem Connection

The unit offers the remote monitoring and programming features over the telephone network via a modem connection. The program used for remote monitoring and programming is the same as the program used for RS-232 connection.

If the modem is connected, the program parameter P_043 should be set to 1, otherwise faulty operation may occur.

6.7 Remote Monitoring and Programming

Thanks to its standard serial RS-232 port, the unit offers the remote monitoring and programming feature.

The remote monitoring and programming PC software may be downloaded from **www.datakom.com.tr** internet site.

The software allows the visualization and recording of all measured parameters. The recorded parameters may then be analyzed graphically and printed. The software also allows the programming of the unit and the storage of the program parameters to PC or the downloading of stored parameters from PC to the unit.

7. WEEKLY OPERATION SCHEDULE

In most applications, the genset is requested to operate only in working hours. Thanks to the weekly program feature unwanted operation of the genset may be prohibited.

The unit has one programmable turn-on/turn-off time pairs for each day of week. These programmable parameters allow the genset to operate automatically only in allowed time limits.

The weekly operation schedule is **only active in AUTO** mode. In other modes it will not affect the genset operation.

In **AUTO** mode, if the operation of the genset is disabled by the weekly schedule, then **the AUTO led will flash** (instead of a steady on state).

Each turn-on/turn-off time is defined in 10 minute steps. These parameters are defined in the parameters P_051 to P_064. On the display, the parameters are shown with 3 digits, the first 2 digit are the hour and the last digit is the first digit of the minutes. For example 19.3 will mean 19:30.

Unused programs should be set to 24.0.

An example setup may be as follows:

P_051: 07.0 (Monday morning 07:00 turn on)
P_052: 18.0 (Monday evening 18:00 turn off)
P_053: 07.0 (Tuesday morning 07:00 turn on)
P_054: 18.0 (Tuesday evening 18:00 turn off)
P_055: 07.0 (Wednesday morning 07:00 turn on)
P_056: 18.0 (Wednesday evening 18:00 turn off)
P_057: 07.0 (Tuesday morning 07:00 turn on)
P_058: 18.0 (Tuesday evening 18:00 turn off)
P_059: 07.0 (Friday morning 07:00 turn on)
P_060: 18.0 (Friday evening 18:00 turn off)
P_061: 07.0 (Saturday morning 07:00 turn on)
P_062: 13.3 (Saturday noon 13:30 turn off)
P_063: 24.0 (Sunday no turn on time, last operation mode continues)
P_064: 24.0 (Sunday no turn off time, last operation mode continues)

If the same time is used for turn on and turn off, then it will be considered as a turn-on time.

The unit has a battery backed-up precision real time clock circuit. The real time clock circuit will continue its operation even in power failures. The real time clock is precisely trimmed using the program parameter **P_046**. For more details check the programming section.

8. EVENT LOGGING

The unit keeps records of the last 12 events in order to supply information for the service personal.

The events are recorded with a date and time stamp. The date and time information comes from the internal battery backed-up real time clock circuit of the unit. The real time clock circuit will continue its operation even in power failures. The real time clock is precisely trimmed using the program parameter **P_046**. For more details check the programming section.

The events are stored in a circular memory. This means that a new coming event will erase the oldest recorded event.

The events are only displayed on the PC screen using the remote monitoring and programming software. They can not be displayed on the unit.

The event sources are:

-Genset on load,
-Genset off load,
-Alarms,
-Warnings.

9. STATISTICAL COUNTERS

The unit provides a set of non resettable incremental counters for statistical purposes.

The counters consist on:

-total engine cranks,
-total genset runs,
-total genset on load.

These counters are kept in a non-volatile memory and are not affected from power failures.

The statistical counters are only displayed on the PC screen using the remote monitoring and programming software. They can not be displayed on the unit.

10. MAINTENANCE

DO NOT OPEN THE UNIT

There are NO serviceable parts inside the unit.

Wipe the unit, if necessary with a soft damp cloth. Do not use chemical agents

10. PROGRAMMING

The program mode is used to program the timers, operational limits and the configuration of the unit.

To **enter the program mode**, press the **MENU** button for 5 seconds. The program mode is only allowed if the **PROGRAM LOCK** input (terminal_23) is left open. If this input is tied to **GROUND**, the program value modification will be disabled to prevent unauthorized intervention. It is advised to keep the **PROGRAM LOCK** input tied to **GROUND**.

The program mode will not affect the operation of the unit. Thus programs may be modified anytime, even while the genset is running.

When the program mode is entered, the upper display will show "**PGM**". The central display will show the program parameter number and the lower display the program parameter value. The first program number is "**000**"

Each depression of the **MENU** key will cause the display to switch to the next program parameter. If the **MENU** key is hold pressed the program numbers will increase by steps of 10. After the last parameter, the display switches back to the first parameter. The displayed parameter value may be increased or decreased using "▲" and "▼" keys. If these keys are hold pressed, the program value will be increased/decreased by steps of 10.

Program parameters are kept in a non-volatile memory and are not affected from power failures.

To **exit the program mode** press one of the mode selection keys. If no button is pressed during 1 minute the program mode will be cancelled automatically.

Pgm	Definition	Unit	Std Val	Description
0	Current Transformer Primary	A	500	This is the rated value of current transformers. All transformers must have the same rating. The secondary of the transformer will be 5 Amps. For values over 990A use 10% of the value. These values will be displayed as K-Amperes. (for ex. 1.85KA) Values under 100A may be used by multiplying with 10 in order to enable the current display with 0.1A precision. (for ex: 35.7A)
1	Current Transformer Decimal Point		0	This parameter determines the display range of current and active power: 0: 000-999 1: 0.00-9.99 2: 00.0-99.9
2	Overcurrent Limit	A	500	If the current goes above this limit, during the period defined in P_024 an OVERLOAD alarm will be generated. Enter this information with the same format as parameter P_000.
3	Excess Power Limit	KW	350	If the active power goes above this limit, during the period defined in P_024 an OVERLOAD alarm will be generated. Enter this information with the same format as parameter P_000.
4	Mains Voltage Low Limit	V	170	If one of the mains phases goes under this limit, it means that the mains are off and it starts the transfer to the genset in **AUTO** and **TEST** modes.
5	Mains Voltage High Limit	V	270	If one of the mains phases goes over this limit, it means that the mains are off and it starts the transfer to the genset in **AUTO** and **TEST** modes.
6	Gen. Voltage Low Limit	V	180	If one of the generator phase voltages goes under this limit when feeding the load, this will generate a **VOLTAGE** alarm and the engine will stop.
7	Gen. Voltage High Limit	V	270	If one of the generator phase voltages goes over this limit when feeding the load, this will generate a **VOLTAGE** alarm and the engine will stop.

Pgm	Definition	Unit	Std Val	Description
8	Low Freq. Alarm	Hz	30	If the genset frequency goes under this limit, a **SPEED** alarm will be generated and the engine will stop. This alarm will be monitored after delay defined in **P_023** when the engine runs.
9	Low Freq. Warning	Hz	40	If the genset frequency goes under this limit, a **SPEED** warning will be generated. This warning will be monitored after delay defined in **P_023** when the engine runs.
10	High Freq. Warning	Hz	54	If the genset frequency goes over this limit, a **SPEED** warning will be generated. This warning will be monitored after delay defined in **P_023** when the engine runs.
11	High Freq. Alarm	Hz	57	If the genset frequency goes over this limit, a **SPEED** alarm will be generated and the engine will stop. This alarm will be monitored after delay defined in **P_023** when the engine runs.
12	Low Battery Voltage Warning	V	9.0	If the battery voltage falls below this limit, this will generate a **BATTERY** warning.
13	High Battery Voltage Warning	V	31.0	If the battery voltage goes over this limit, this will generate a **BATTERY** warning.
14	High Battery Voltage Alarm	V	33.0	If the battery voltage goes over this limit, this will generate a **BATTERY** alarm and the engine will stop.
15	Low Oil Pressure Warning	Bar	1.5	If the oil pressure measured from the analog input falls below this limit, this will generate an **OIL PRESSURE** warning. This input will be monitored after delay defined in **P_023** when the engine runs.
16	Low Oil Pressure Alarm	Bar	1.0	If the oil pressure measured from the analog input falls below this limit, this will generate an **OIL PRESSURE** alarm. This input will be monitored after delay defined in **P_023** when the engine runs.
17	High Temperature Warning	ºC	90	If the coolant temperature measured from the analog input goes over this limit, this will generate a **HIGH TEMP.** warning.
18	High Temperature Alarm	ºC	98	If the coolant temperature measured from the analog input goes over this limit, this will generate a **HIGH TEMP.** alarm and the engine will stop.
19	Oil pressure sender type	-	1	This parameter selects the oil pressure sender type. **0:** Non standard sender. The sender characteristics are defined in table using parameters P_131 to P_142. **1:** VDO 0-7 bars (10-180 ohms) **2:** VDO 0-10 bars (280-20 ohms) **3:** DATCON 0-7 bars (240-33 ohms) **4:** DATCON 0-10 bars (240-33 ohms) **5:** DATCON 0-7 bars (0-90 ohms) **6:** DATCON 0-10 bars (0-90 ohms) **7:** DATCON 0-7 bars (75-10 ohms)
20	Temperature sender type	-	1	This parameter selects the temperature sender type: **0:** The sender characteristics are defined in table using parameters P_143 to P_154. **1:** VDO **2:** DATCON DAH type **3:** DATCON DAL type

Pgm	Definition	Unit	Std Val	Description
21	Hysteresis Voltage	V	8	This parameter provides the mains and genset voltage limits with a hysteresis feature in order to prevent faulty decisions. For example, when the mains are present, the mains voltage low limit will be used as the programmed low limit **P_004**. When the mains fail, the low limit will be used as **P_004+P_021**. It is advised to set this value to 8 volts.
22	Engine Heating Temperature	ºC	50	If it is requested that the engine runs without load until reaching a certain temperature, this parameter defines the temperature.
23	Holdoff timer	sec	8	This parameter defines delay after the engine runs and before the fault monitoring is enabled.
24	Overcurrent / Excess Power / Frequency Timer	sec	3	This is the period between the current or active power goes over the limits **(P_002/P_003)** and **OVERLOAD** alarms occurs. This is also the period between the frequency goes out of the limits (**P_008/P_011)** and **SPEED FAULT** alarm occurs.
25	Wait before Fuel	min	0	This is the time between the mains fails and the fuel solenoid turns on before starting the genset. It prevents unwanted genset operation in battery backed-up loads.
26	Preheat timer	sec	1	This is the time after the fuel solenoid is energized and before the genset is started. During this period the **PREHEAT** relay output is energized (if defined by programming)
27	Start Timer	sec	6	This is the maximum start period. Starting will be automatically cancelled if the genset fires before the timer.
28	Wait between Starts	sec	10	This is the waiting period between two start attempts.
29	Engine Heating Timer	sec	3	This is the period used for engine heating following the program parameter **P_037**.
30	Mains Waiting Timer	min	0.5	This is the time between the mains voltages entered within the limits and the generator contactor is deactivated.
31	Cooling Timer	min	1.0	This is the period that the generator runs for cooling purpose after the load is transferred to mains.
32	Generator Contactor Timer	sec	1	This is the period after the mains contactor has been deactivated and before the generator contactor has been activated.
33	Mains Contactor Timer	sec	1	This is the period after the generator contactor has been deactivated and before the mains contactor has been activated.
34	Stop Timer	sec	10	This is the maximum time duration for the engine to stop. During this period the STOP relay output is energized (if defined by programming). If the genset has not stopped after this period, a **STOP FAIL** alarm will occur.
35	Start Attempts	-	3	This is the maximum number of start attempts.

Pgm	Definition	Unit	Std Val	Description
36	Horn Timer	sec	10	This is the period during which the **HORN** relay is active. If the period is set to 0, this will mean that the period is unlimited.
37	Engine Heating Type	-	0	This parameter defines the engine heating method. The genset will not take the load before engine heating is completed. **0:** engine is heated during the period defined by the **Engine Heating Timer (P_029)**. **1:** engine is heated until the coolant temperature reaches the temperature defined by **Engine Heating Temperature (P_022)** and at least during the period defined by the **Engine Heating Timer (P_029)**.
38	Charge input alarm	-	0	**0:** The charge input generates **CHARGE** warning, and does not stop the engine. **1:** The charge input generates **CHARGE** alarm, and stops the engine.
39	Genset L-L Voltages	-	0	**0:** Display genset Line to Neutral voltages, **1:** Display genset Line to Line voltages.
40	Mains L-L Voltages	-	0	**0:** Display mains Line to Neutral voltages, **1:** Display mains Line to Line voltages.
41	Emergency Backup Operation	-	0	**0:** In TEST mode, the load will not be transferred to the genset even if the mains fail. **1:** In TEST mode, the load will be transferred to the genset if the mains fail.
42	Remote Start Operation	-	0	**0: Not REMOTE START** mode, the engine runs when the mains fail. **1: REMOTE START** mode, the unit does not monitor mains voltages, the engine runs when a signal from the REMOTE START (22) comes.
43	Modem Connection	-	0	**0:** No modem connection, the serial port is connected to PC **1:** Modem connected.
44	Maintenance Period (Engine Hours)	hours	200	The **SERVICE REQUEST** led indicator will turn on after this quantity of engine hours from the last service. If the period is set to '0' no **SERVICE REQUEST** will be generated depending on engine hours.
45	Maintenance Period (Months)	month	6	The **SERVICE REQUEST** led indicator will turn on after this amount of time from the last service. If the period is set to '0' no **SERVICE REQUEST** will be indicated depending on time
46	Real Time Clock trimming	-	0	This parameter is intended to trim precisely the real time clock speed. Values from 0 to 63 speed up the clock with 0.25sec/day steps. Values from 127 to 64 slow down the clock with 0.25sec/day steps.
47	Not used			
48	Not used			
49	Not used			
50	Not used			

The parameters from P_051 to P_064 program the weekly operation schedule feature. For each day of week, one turn_on time and one turn_off time are provided. Times are defined with 10 minute steps and are shown in the 3 digit display as the hours and the first digit of the minutes. If no operation is needed for a certain day of week, then the related time will be defined as 24.0; thus the last definition will continue to be valid. For example if the turn_on and turn_off times for Sunday are given as 24.0 then the unit will not

operate automatically from Saturday turn_off time to Monday turn_on time. If the AUTO mode is disabled by the weekly operation schedule, then the AUTO led will flash, otherwise it is steadily on.

Pgm	Definition	Unit	Std	Description
51	Monday turn_on	-	24.0	
52	Monday turn_off	-	24.0	
53	Tuesday turn_on	-	24.0	
54	Tuesday turn_off	-	24.0	
55	Wednesday turn_on	-	24.0	
56	Wednesday turn_off	-	24.0	
57	Thursday turn_on	-	24.0	
58	Thursday turn_off	-	24.0	
59	Friday turn_on	-	24.0	
60	Friday turn_off	-	24.0	
61	Saturday turn_on	-	24.0	
62	Saturday turn_off	-	24.0	
63	Sunday turn_on	-	24.0	
64	Sunday turn_off	-	24.0	

The parameters from P_065 to P_082 define the functions of relay outputs. The unit has 6 relay outputs and 2 of them have programmable functions. The fixed function relays are Fuel, Start, Mains Contactor and Generator Contactor.

The relays may be extended up to 22 using **Relay Extension Modules**. RELAY-1 and RELAY-2 with programmable functions are inside the unit. Other relays are in the optional Extension Modules.

The function of a programmable relay output may be selected from the below list.

Pgm	Description	Std
65	RELAY-1 function	01
66	RELAY-2 function	03
67	RELAY-3 function	16
68	RELAY-4 function	17
69	RELAY-5 function	18
70	RELAY-6 function	19
71	RELAY-7 function	20
72	RELAY-8 function	21
73	RELAY-9 function	22
74	RELAY-10 function	23
75	RELAY-11 function	24
76	RELAY-12 function	25
77	RELAY-13 function	26
78	RELAY-14 function	27
79	RELAY-15 function	28
80	RELAY-16 function	29
81	RELAY-17 function	30
82	RELAY-18 function	31

RELAY FUNCTİON LIST

00	Fuel	24	Oil sender alarm
01	Horn	25	Temp sender alarm
02	Start	26	Speed alarm
03	Stop	27	Start fail alarm
04	Gen. Contactor	28	Charge alarm
05	mains Contactor	29	Overload alarm
06	Choke	30	Voltage alarm
07	Preheat	31	Battery High alarm
08	Alarm	32	Oil switch warning
09	Warning	33	Temp switch warn.
10	Alarm+Warning	34	Level switch warn.
11	Automatic ready	35	Rectifier warning
12	Week. on time	36	Emerg Stop warn.
13	-	37	Spare-1 warning
14	-	38	Spare-2 warning
15	-	39	-
16	Oil switch alarm	40	Oil sender warning
17	Temp switch alarm	41	Temp sender warn.
18	Level switch alarm	42	Speed warning
19	Rectifier alarm	43	Stop Fail warning
20	Emerg.Stop alarm	44	Charge warning
21	Spare-1 Alarm	45	Battery low warning
22	Spare-2 Alarm	46	-
23	-	47	Battery high warn.

Parameters from P_083 to P_130 program the functions of the digital inputs. The programmable properties of digital inputs are:

-action to be taken upon arrival of the fault signal (alarm, warning,etc...),
-when the fault monitoring will be enabled,
-latching of the fault signal,
-contact type (NO/NC)
-switching (bat+, bat-)
-response delay

LOW OIL PRESSURE SWITCH INPUT

Pgm	Description	Std	
83	Operation	0	**0:** Alarm (the engine stops and horn relay operates)) **2:** Warning (the horn relay operates) **3:** No operation
84	Fault monitoring	1	**0:** Always **1:** After holdoff timer **2:** When mains present
85	Latching	1	**0:** Non latching **1:** Latching
86	Contact type	0	**0:** Normally open **1:** Normally closed
87	Switching	0	**0:** Battery negative **1:** Battery positive
88	Response delay	0	**0:** No delay **1:** Delayed (4sec)

HIGH TEMPERATURE SWITCH INPUT

Pgm	Description	Std	
89	Operation	0	**0:** Alarm (the engine stops and horn relay operates)) **2** Warning (the horn relay operates) **3** No operation
90	Fault monitoring	0	**0:** Always **1:** After holdoff timer **2:** When mains present
91	Latching	1	**0:** Non latching **1:** Latching
92	Contact type	0	**0:** Normally open **1:** Normally closed
93	Switching	0	**0:** Battery negative **1:** Battery positive
94	Response delay	0	**0:** No delay **1:** Delayed (4sec)

COOLANT LEVEL SWITCH INPUT

Pgm	Description	Std	
95	Operation	0	**0:** Alarm (the engine stops and horn relay operates)) **2:** Warning (the horn relay operates) **3:** No operation
96	Fault monitoring	0	**0:** Always **1:** After holdoff timer **2:** When mains present
97	Latching	0	**0:** Non latching **1:** Latching
98	Contact type	0	**0:** Normally open **1:** Normally closed
99	Switching	0	**0:** Battery negative **1:** Battery positive
100	Response delay	1	**0:** No delay **1:** Delayed (4sec)

RECTIFIER FAIL INPUT

Pgm	Description	Std	
101	Operation	2	**0:** Alarm (the engine stops and horn relay operates)) **2:** Warning (the horn relay operates) **3:** No operation
102	Fault monitoring	2	**0:** Always **1:** After holdoff timer **2:** When mains present
103	Latching	1	**0:** Non latching **1:** Latching
104	Contact type	0	**0:** Normally open **1:** Normally closed
105	Switching	0	**0:** Battery negative **1:** Battery positive
106	Response delay	1	**0:** No delay **1:** Delayed (4sec)

EMERGENCY STOP INPUT

Pgm	Description	Std	
107	Operation	0	**0:** Alarm (the engine stops and horn relay operates)) **2:** Warning (the horn relay operates) **3:** No operation
108	Fault monitoring	0	**0:** Always **1:** After holdoff timer **2:** When mains present
109	Latching	0	**0:** Non latching **1:** Latching
110	Contact type	0	**0:** Normally open **1:** Normally closed
111	Switching	0	**0:** Battery negative **1:** Battery positive
112	Response delay	0	**0:** No delay **1:** Delayed (4sec)

SPARE-1 FAULT INPUT

Pgm	Description	Std	
113	Operation	0	**0:** Alarm (the engine stops and horn relay operates)) **2:** Warning (the horn relay operates) **3:** No operation
114	Fault monitoring	0	**0:** Always **1:** After holdoff timer **2:** When mains present
115	Latching	0	**0:** Non latching **1:** Latching
116	Contact type	0	**0:** Normally open **1:** Normally closed
117	Switching	0	**0:** Battery negative **1:** Battery positive
118	Response delay	0	**0:** No delay **1:** Delayed (4sec)

SPARE-2 FAULT INPUT

Pgm	Description	Std	
119	Operation	2	**0:** Alarm (the engine stops and horn relay operates)) **2:** Warning (the horn relay operates) **3:** No operation
120	Fault monitoring	0	**0:** Always **1:** After holdoff timer **2:** When mains present
121	Latching	0	**0:** Non latching **1:** Latching
122	Contact type	0	**0:** Normally open **1:** Normally closed
123	Switching	0	**0:** Battery negative **1:** Battery positive
124	Response delay	0	**0:** No delay **1:** Delayed (4sec)

PROGRAM LOCK INPUT

Pgm	Description	Std	
125	Operation	3	**0:** Alarm (the engine stops and horn relay operates)) **2:** Warning (the horn relay operates) **3:** No operation
126	Fault monitoring	0	**0:** Always **1:** After holdoff timer **2:** When mains present
127	Latching	0	**0:** Non latching **1:** Latching
128	Contact type	0	**0:** Normally open **1:** Normally closed
129	Switching	0	**0:** Battery negative **1:** Battery positive
130	Response delay	0	**0:** No delay **1:** Delayed (4sec)

Parameters from P_131 to P_142 define the ohm-bar characteristics of the oil pressure sender. The sender characteristics will be defined using maximum 6 points. The values should be entered in the increasing order of ohm values. For unused points, ohm values should be entered as 0. An example table is given below. The sensor characteristics used in this table are:

0.0 bar.....240 ohms
1.0 bar.....218 ohms
5.0 bar.....153 ohms
10.0 bar.....103 ohms

Pgm	Description	Unit	Value
131	Point_1 resistor	ohm	103
132	Point_1 pressure	bar	10.0
133	Point_2 resistor	ohm	153
134	Point_2 pressure	Bar	5.0
135	Point_3 resistor	Ohm	218
136	Point_3 pressure	Bar	1.0
137	Point_4 resistor	Ohm	240
138	Point_4 pressure	Bar	0.0
139	Point_5 resistor	Ohm	0
140	Point_5 pressure	Bar	0.0
141	Point_6 resistor	Ohm	0
142	Point_6 pressure	bar	0.0

Parameters from P_143 to P_154 define the ohm-degrees characteristics of the temperature sender. The sender characteristics will be defined using maximum 6 points. The values should be entered in the increasing order of ohm values. For unused points, ohm values should be entered as 0. An example table is given below. The sensor characteristics used in this table are:

38 ºC.....342 ohms
82 ºC.....71 ohms
104 ºC.....40 ohms
121 ºC.....30 ohms

Pgm	Description	Unit	Value
143	Point_1 resistor	ohm	30
144	Point_1 temperature	ºC	121
145	Point_2 resistor	ohm	40
146	Point_2 temperature	ºC	104
147	Point_3 resistor	ohm	71
148	Point_3 temperature	ºC	82
149	Point_4 resistor	ohm	342
150	Point_4 temperature	ºC	38
151	Point_5 resistor	ohm	0
152	Point_5 temperature	ºC	0
153	Point_6 resistor	ohm	0
154	Point_6 temperature	ºC	0

12. TROUBLESHOOTING

The genset operates while AC mains are OK or continues to operate after AC mains are OK:

-Check engine body grounding.
-AC mains voltages may be outside programmed limits, measure the phase voltages.
-Check the AC voltage readings by pressing the MENU button.
-Upper and lower limits of the mains voltages may be too tight. Check the parameters P_004 and P_005. Standard values are 170/270 volts.
-The hysteresis voltage may be given to excessive. Check the parameter P_021, the standard value is 8 volts.

AC voltages or frequency displayed on the unit are not correct:

-Check engine body grounding, it is necessary.
-The error margin of the unit is +/- 3 volts.
-If there are faulty measurements only when the engine is running, there may be a faulty charging alternator or voltage regulator on the engine. Disconnect the charging alternator connection of the engine and check if the error is removed.
-If there are faulty measurements only when mains are present, then the battery charger may be failed. Turn off the rectifier fuse and check.

KW and cosΦ readings are faulty although the Amp readings are correct:

-Current transformers are not connected to the correct inputs or some of the CTs are connected with reverse polarity. Determine the correct connections of each individual CT in order to obtain correct KW and cosΦ for the related phase, and then connect all CTs.

Short circuit the outputs of unused Current Transformers.

When the AC mains fails the unit energizes the fuel solenoid, but does not start and OIL PRESSURE led flashes:

The unit is not supplied with battery (-) voltage at the oil pressure input.
-Oil pressure switch not connected.
-Oil pressure switch connection wire cut.
-Oil pressure switch faulty.
-Oil pressure switch closes too lately. If oil pressure switch closes, the unit will start. Optionally oil pressure switch may be replaced.

The engine does not run after the first start attempt, then the unit does not start again and OIL PRESSURE led flashes:

-The oil pressure switch closes very lately. As the unit senses an oil pressure, it does not start. When oil pressure switch closes the unit will start. Optionally the oil pressure switch may be replaced.

When the AC mains fails, the engine starts to run but the unit gives START FAIL alarm and then the engine stops:

-The generator phase voltages are not connected to the unit. Measure the AC voltage between terminals **U-V-W** and **Generator Neutral** at the rear of the unit while the engine is running. A fuse protecting the generator phases may be failed. A misconnection may be occurred. If everything is OK, turn all the fuses off, and then turn all the fuses on, starting from the DC supply fuse. Then test the unit again.

The unit is late to remove engine cranking:

-The generator voltage rises lately. Also the generator remnant voltage is below 20 volts. The unit removes starting with the generator frequency, and needs at least 20 volts to measure the frequency. If this situation is to be avoided, the only solution is to add an auxiliary relay. The coil of the relay will be between BATTERY (-) and charging alternator D+ terminal. The normally closed contact of the relay will be connected serially to the unit's START output. So the starting will also be removed when the D+ pulls to battery positive.

The unit is inoperative:

Measure the DC-supply voltage between terminals 11 and 12 at the rear of the unit. If OK, turn all the fuses off, then turn all the fuses on, starting from the DC supply fuse. Then test the unit again.

Programming mode can not be entered:

The program lock input disables programming mode entry. Disconnect the program lock input from battery negative before modification. Do not forget to make this connection again to prevent unauthorized program modifications.

13. DECLARATION OF CONFORMITY

The unit conforms to the EU directives
-73/23/EEC and 93/68/EEC (low voltage)
-89/336/EEC, 92/31/EEC and 93/68/EEC (electro-magnetic compatibility)
Norms of reference:
EN 61010 (safety requirements)
EN 50081-2 (EMC requirements)
EN 50082-2 (EMC requirements)

The CE mark indicates that this product complies with the European requirements for safety, health environmental and customer protection.

14. TECHNICAL SPECIFICATIONS

Alternator voltage: 0 to 300 V-AC (Ph-N)
Alternator frequency: 0-100 Hz.
Mains voltage: 0 to 300 V-AC (Ph-N)
Current inputs: from current transformers, .../5A. Max load 0.7VA per phase.
Digital inputs: input voltage 0 - 30 V-DC. Internally connected to battery positive via 4700 ohm resistor.
Analog inputs: Resistor input 0 to 5000 ohms connected to the battery negative. Sources 10 mA when closed to battery negative.
Measurement category: CAT II
Air category: Pollution degree II
DC Supply range: 9.0 V-DC to 30.0 V-DC
Cranking dropouts: survives 0 V for 100ms
Typical current consumption: 100 mA-DC.
Maximum current consumption: 350 mA-DC (Relay outputs open)
Generator/mains contactor outputs: 16 A / 250 V.
DC relay outputs: 10A / 28 V.
Max. current for each terminal: 10A-RMS.
Charge alternator excitation current: 54 mA-DC @ 12 V-DC.
Communication port: RS-232. 2400 bauds, no parity, 1 stop bit.
Operating temperature range: -20°C to +70°C (-4 ºF to +158 ºF)
Storage temperature range: -40°C to +80°C (-40 ºF to +176 ºF)
Maximum humidity: 95%, non-condensing
IP protection: IP65 from front panel, IP30 from the rear
Dimensions: 155 x 115 x 48mm (WxHxD)
Mounting opening dimensions: 151 x 111mm minimum.
Mounting: Front panel mounted, retaining steel spring at the rear
Weight: 360 g (approx.)
Case material: High temperature, self extinguishing ABS (UL94-V0, 110 °C)

15. CONNECTION DIAGRAM