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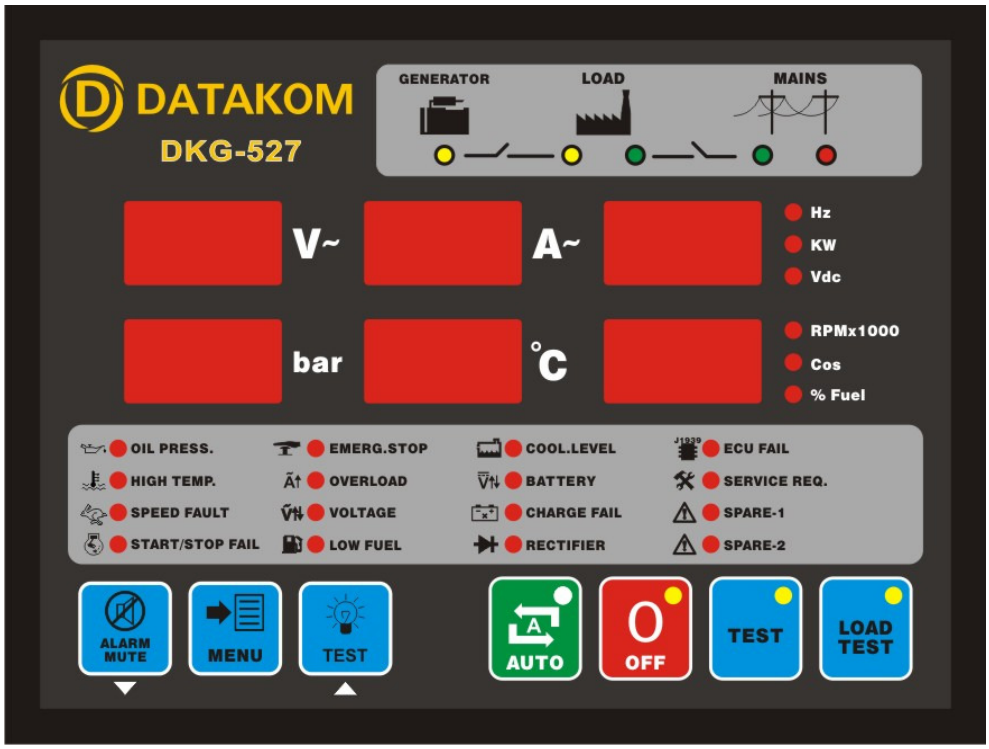
DKG-527 AUTOMATIC MAINS FAILURE UNIT



FEATURES

Automatic mains failure
Engine control
Generator protection
Built in alarms and warning,
J1939 engine monitoring and control port
Gas engine support
3 phase mains voltage inputs
3 phase genset voltage inputs
3 phase genset CT inputs
Engine oil pressure measurement
Engine coolant temperature measurement
Fuel level measurement
Genset active power measurement
Genset power factor measurement
Engine rpm display
Periodic maintenance request indicator
Daily / weekly / monthly exerciser
Engine hours counter
Event logging with date and time stamp
Statistical counters
Battery backed-up real time clock
Weekly operation schedule programs
197 programmable parameters
All parameters field adjustable
RS-232 serial port
Free MS-Windows Remote monitoring SW:
-local, LAN, IP and modem connection
-monitoring, download of parameters
-networking via modems
GSM-SMS sending in case of alarm
Modem call in case of alarm
MODBUS communication
LED displays
Configurable analogue inputs: 3
Configurable digital inputs: 8
Configurable relay outputs: 2
Total relay outputs: 6
Output expansion capability
Remote Start operation available
Mains simulation input
Engine Idle speed control
Survives cranking dropouts
Sealed front panel
Plug-in connection system for easy replacement
Small dimensions (202x148x48mm)
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 current phase U
Gen current phase V
Gen current phase W
Gen frequency
Engine speed (rpm)
Gen total KW
Gen total cosΦ
Battery voltage,
Coolant temperature
Oil pressure
Fuel level
Gen frequency

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. Before mounting, remove the mounting brackets and connectors from the unit, then pass the unit through the mounting opening. The unit will be maintained in its position by the mounting brackets 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, oil pressure or fuel level) are connected to the unit, it is not possible to use auxiliary displays, otherwise the unit may be damaged. If temperature or oil pressure or fuel level 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	**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.
2	**R**	Mains phase inputs, 0-300V-AC	Connect the mains phases to these inputs. The mains voltages upper and lower limits are programmable.
3	**S**		
4	**T**		
5	**MAINS NEUTRAL**	Input, 0-300V-AC	Neutral terminal for the mains phases.
6	**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).
7	**CURR_W+**		
8	**CURR_V-**		
9	**CURR_V+**		
10	**CURR_U-**		
11	**CURR_U+**		
12	**GENERATOR NEUTRAL**	Input, 0-300V-AC	Neutral terminal for the generator phases.
13	**W**	Generator phase inputs, 0-300V-AC	Connect the generator phases to these inputs. The generator phase voltages upper and lower limits are programmable.
14	**V**		
15	**U**		
16	**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.
17	**BATTERY POSITIVE**	+12 or 24VDC	The positive DC Supply terminal for both 12V and 24V battery systems.
18	**FUEL RELAY**	Output 10A/28VDC	This relay is used for fuel solenoid control. It is internally connected to terminal **25** for supplying the charge alternator's excitation current.
19	**START RELAY**	Output 10A/28VDC	This relay controls the engine cranking.
20	**GROUND**	0VDC	Power supply negative connection.

Term	Function	Technical data	Description
21	**FUEL LEVEL SENDER**	Input, 0-5000 ohms	Analogue fuel level sender connection. Do not connect the sender to other devices. The input is programmed for VDO type senders.
22	**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.
23	**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.
24	**SENDER GROUND**	0VDC	Connect this terminal to the engine body, close to the senders. This will allow more precise analog measurements. If this terminal is left open, then the Ground on terminal **20** will be used as sensor ground.
25	**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.
26	**RELAY-2 (HORN RELAY)**	Output 10A/28VDC	This relay has programmable function, selectable from a list.
27	**RELAY-1 (STOP RELAY)**	Output 10A/28VDC	This relay has programmable function, selectable from a list.
28	**PROGRAM LOCK**	Digital input	If this input is left open, then the program mode can be entered and programs may be modified. If it is connected to GROUND, program mode is disabled.
29	**RECTIFIER FAIL**	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.
30	**LOW OIL PRESSURE**		
31	**HIGH TEMP**		
32	**COOLANT LEVEL**		
33	**SPARE-1**		
34	**FUEL LEVEL**		
35	**SPARE-2**		
36	**EMERGENCY STOP**		
37	**J1939 +**	Digital communication port	Connect the J1939 port of an electronic engine to these terminals. The 120 ohm terminating resistors are inside the unit. Please do not connect external resistors. Use a twisted cable pair or coaxial cable for best results.
38	**J1939 -**		

3. DISPLAYS

3.1 Led Displays

The unit has 31 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 flash when all 3 mains phase voltages are within the limits. It will turn on steadily when the mains contactor is energized.
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 flash when the engine is running. It will turn on steadily 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 function displays. Different values may be scrolled by pressing the **MENU** key.

3.2 Digital Displays

The unit has 6 seven segment displays. They show:

-Measured parameters,
-Service counters,
-Statistical counters,
-Software version,
-Event records,
-J1939 engine fault codes,
-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.

OIL PRESSURE DISPLAY: This display will show the oil pressure value measured using the sender.

TEMPERATURE DISPLAY: This display will show the coolant temperature value measured from the sender.

MULTIFUNCTION DISPLAY (LEFT/UPPER): By pressing the MENU key below values may read:

-generator frequency (Hz)
-generator active power (KW)
-battery voltage (V-DC),

In programming mode it displays the program value.

MULTIFUNCTION DISPLAY (RIGHT/LOWER): By pressing the MENU key below values may read:

-engine speed (rpm)
-generator cosΦ
-fuel level (%)

DISPLAY SUMMARY

GROUP	CONTENT
Measured parameters	Voltages: R-S-T-U-V-W-RS-ST-TR-UV-VW-WU Currents: A1-A2-A3 Oil pressure, coolant temperature, fuel level, battery voltage Engine speed, genset frequency, genset active power, genset power factor
Statistics	Engine hours run, Engine hours to service, Time to service, Date-time, Software version.
J1939 engine fault codes	Maximum 8 fault codes can be displayed. Each fault code is represented by an SPN-FMI pair. If the SPN number is 0, it means that there is no failure. The meaning of the fault codes is given in the engine manufacturers user manual. Please review chapter 7 of this manual for a general list of fault codes.
Event records	The records of last 32 events are displayed. Each event record consists of date-time information and the event code. For more details please review chapter 10 of this manual.

4. ALARMS AND WARNINGS

Alarms indicate an abnormal situation in the generating set are divided into 3 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**, **Alarm+Load_dump** and **Alarm+Load_dump+Warning** relays output to operate, (if selected via programming menu)

2- **LOAD_DUMPS:** These fault conditions cause:
- The related alarm led to be on steadily,
- The genset contactor to be released immediately,
- The engine to be stopped after Cooldown period,
- The **Horn**, **Alarm+Load_dump** and **Alarm+Load_dump+Warning** relays output to operate, (if selected via programming menu)

3- **WARNINGS:** These conditions cause:
- The related alarm led to flash,
- The **Horn** and **Alarm+Load_dump+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 or load_dump is present, following alarms, load_dumps 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 adjustable 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_015**) and **alarm** (**P_016**) 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 (alarm): Set if the engine is not running after programmed number of start attempts. (**P_035**)
STOP FAIL (warning): 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_24)**. 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.
LOW FUEL: Set when the fuel level falls below 10%.
COOLANT 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-1 / SPARE-2: Set if a signal is detected from the related spare fault input.
ECU FAIL (warning): Set when an engine fault code is received from the ECU of the electronic engine. This fault will not cause an engine stop. If necessary, the engine will be stopped by the ECU.
ECU FAIL (alarm): Set if no information has been received during 3 seconds from the ECU of the electronic engine. This fault condition is only controlled if fuel is on.

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** (**35**) 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.

It is also necessary to set the program parameter **P_139** to **3** in order to prevent the alarms generated from this input.

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_151 to P_162.
1: VDO 0-7 bars (10-180 ohms)
2: VDO 0-10 bars (10-180 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_163 to P_174.
1: VDO
2: DATCON DAH type
3: DATCON DAL type

Fuel Level Sender Selection:
The fuel level sender input is factory set for VDO 0-100% (10-180 ohms) and not adjustable.

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 Engine Idle Operation

It may be required that the engine runs at the idle speed for a programmed duration for heating. The idle operation duration is adjusted with the parameter **P_055**. The idle speed will be set by the governor control unit of the engine.

Any of the spare relay outputs may be assigned as **IDLE output** using program parameters **P_085**/**P_086**. Also relays on an extension module may be assigned to this function.

6.5 Engine Block Heater

The unit is able to provide a relay output in order to drive the block heater resistor.

The temperature reference is the coolant temperature measured from the the analog sender input.

The block heater relay function may be assigned to spare relays using program parameters **P_085**/**P_086**. Also relays on an extension module may be assigned to this function.

The engine body temperature limit is adjusted using the parameter **P_022**. The same parameter is used for engine heating operation.

The relay will become active if the body temperature falls to 4 degrees below the limit set by **P_022**. It turns off when the body temperature exceeds **P_022**.

6.6 Fuel Pump Control

The unit is able to provide a relay output in order to drive the fuel pump motor. The fuel pump is used in order to transfer fuel from the large capacity main tank (if exists) to the genset daily tank which is generally integrated in the chassis and has a limited capacity.

The fuel level reference is measured through the analog fuel level sender. When the measured fuel level falls to 25 % the fuel pump relay output will operate. When the fuel level reaches 75 % the relay will turn off. Thus the chassis fuel tank level will be always kept between ¼ and ¾.

The fuel pump relay function may be assigned to spare relays using program parameters **P_085**/**P_086**. Also relays on an extension module may be assigned to this function.

6.7 Mains Simulation

The unit offers an optional **SIMULATE MAINS** signal input. If the program parameter **P_050** is set to **1** then the **SPARE_2** (**35**) input will be used for mains simulation.

It is also necessary to set the program parameter **P_139** to **3** in order to prevent any alarm generated from this input.

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

If the program parameter **P_050** is set to 1 and the input signal is active, the mains phases are not monitored and supposed to be inside limits. This will prevent the genset from starting even in case of a mains failure. If the genset is running when the signal is applied, then usual Mains Waiting and Cooldown cycles will be performed before engine stop. When the SIMULATE MAINS signal is present, the front panels mimic diagram's mains LEDs will reflect the mains voltages as present.

When the signal is passive, the unit will revert to normal operation and monitor the mains voltage status.

The REMOTE START operation overrides SIMULATE MAINS operation. When both parameters P_042 and P_050 are set then REMOTE START operation mode is performed.

6.8 Delayed Mains Simulation, Battery Charging

The Delayed Mains Simulation feature is used in battery backed up telecom systems where batteries are able to supply the load during a certain period. The genset is requested to run only when battery voltage drops below the critical level. Once the engine runs, the rectifier system starts charging the batteries and the battery voltage goes up immediately. Thus the engine should continue to run a programmed period for effective charging. The critical battery voltage level will be detected by an external unit which provides the digital Simulate Mains signal for the genset control unit.

The unit offers an optional **SIMULATE MAINS** signal input. If the program parameter **P_063** is set to **1** then the **SPARE_2** (**35**) input will be used for delayed mains simulation.

It is also necessary to set the program parameter **P_139** to **3** in order to prevent any alarm generated from this input.

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

If the program parameter **P_063** is set to 1 and the input signal is active when the genset is not feeding the load, the mains phases are not monitored and supposed to be inside limits. This will prevent the genset from starting when the simulate mains signal is present (batteries charged). The genset will start when mains voltage are out of limits and the simulate mains signal not present.

If the genset is running when the signal is applied, then MAINS SIMULATION will be prevented during **Max Engine Run Timer** (**P_047**). After this, usual Mains Waiting and Cooldown cycles will be performed before engine stop. When the SIMULATE MAINS signal is present, the front panels mimic diagram's mains LEDs will reflect the mains voltages as present.

When the signal is passive, the unit will revert to normal operation and monitor the mains voltage status.

The REMOTE START operation overrides DELAYED SIMULATE MAINS operation. When both parameters P_042 and P_063 are set then REMOTE START operation mode is performed.

6.9 Dual Genset Intermittent Operation

Dual genset intermittent operation consists of regular switching of the load between 2 gensets. The use of 2 gensets instead of one is due either to safety porposes in case of a genset failure or to a continuous operation requesting service stops.

The running period for each genset is adjustable between 0 and 144 hours using parameter **P_047**. If the time is adjusted as 0 hours, it will be actually set to 2 minutes for faster testing purpose.

A flashing relay output function is provided, based on the parameter P_047. Each time the period programmed using P_047 elapses, the relay output will change position.

The flashing relay function may be assigned to spare relays using program parameters **P_085**/**P_086**. Also relays on an extension module may be assigned to this function.

The dual genset intermittent operation uses also the **Mains Simulation** feature. Please review chapter **6.7** for a detailed explanation of this feature.

Please contact DATAKOM for a complete application manual.

6.10 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 and the service request relay function will be active.
The service request relay function may be assigned to spare relays using program parameters **P_085**/**P_086**. Also relays on an extension module may be assigned to this function.

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 first display will show "**HtS**" (hours to service). The second display will show the first 3 digits of the engine hours to service and the third display the last 3 digits.

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

6.11 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 first display will show "**EnH**" (engine hours). The second display will show the first 3 digits of the engine hours and the third display the last 3 digits.

6.12 Date & Time Display

The date & time display is provided for verification. The date & time display is selected by pressing the MENU button twic eafter the statistics group is selected by holding the MENU button pressed.

6.13 Software Version Display

Some additional features are installed within consecutive software releases. In order to be sure of the validity of the status of the unit, the software version needs to be known.

The software version display is selected by pressing 3 times the MENU button after the statistics group is selected by holding the MENU button pressed.

The software version consists of 2 numbers. The first number represent the operation software version and the second number represent the J1939 software version.

6.14 Modem Connection

The unit is capable of making modem calls in case of alarm, as well as answering modem calls made from a remote location. **GSM** modems as well as classic cable network (**PSTN**) modems are acceptable.

If the modem is connected to the unit, the program parameter **P_043** should be set to 1, otherwise faulty operation may occur. If the parameters P_043 or P_056 are different from zero, the local PC connection will not work.

A maximum of 2 telephone numbers can be defined for outgoing modem calls. In case of alarm, the unit will attempt to reach control centers associated with each number. In case of modem connection failure, the call will be repeated up to 30 times with 2 minute intervals.

If SMS message sending is enabled, then only the first telephone number will be used for modem calls.

Telephone numbers can only be entered from the PC. They cannot be entered from the front panel.

Advised modems are DATAKOM types which are powered up from the same DC battery voltage than the unit. Most of other desktop modems with standard AT commands are also usable, but it is the user's responsibility to provide an uninterrupted AC supply source to the modem. The necessary modem cable will be supplied by DATAKOM.

Modem calls are always terminated by the central RAINBOW software. However the unit does not allow connection durations exceeding 2 minutes, and hangs up the modem when this period expires.

The PC program used for remote monitoring and programming is the same RAINBOW software used for RS-232 connection.

Please note that the modem operation is also compatible with the MODBUS communication. Thus the unit can iniate and receive calls to/from a MODBUS master station. Please review chapter_8 for more details on MODBUS communication.

6.15 SMS Message Sending

The GSM SMS message sending is activated by setting the program parameter **P_056=1**. When the GSM SMS mode is activated, the PC connection will not work. If a local PC connection is necessary, the parameters **P_043** and **P_056** should be set to 0.

When a fault condition occurs, the unit will compose an SMS message and will send it to the second phone number. The telephone number can only be entered from the PC. It cannot be entered from the front panel.

The maximum number of alarms transmitted in a SMS message is 6. This limitation is due to the maximum length of an SMS message which is 160 characters.

A sample GSM SMS message is given below:

DKGxxx <SITE-ID>
STOP :LOW OIL PR.
STOP :HIGH TEMP.
STOP :EMERG.STOP
STOP :COOL.LEVEL
WARNING :ECU WARN.
END OF ALARM LIST

The first line of the message carries information about the unit type and the site identity string. This string can only be entered from the PC. It cannot be entered from the front panel. This line is intended for the correct identification of the genset.

Each following line will give one fault information. The message will always be terminated by the "**END OF ALARM LIST**" string.

When the message is sent, the existing alarms will be masked, causing the audible alarm relay to release and preventing more GSM SMS messages. Any new upcoming alarm will result in a new GSM SMS message. The new message will indicate all existing alarms, even masked ones.

The necessary GSM modem cable will be supplied by DATAKOM. This is the same cable as cable modems.

6.16 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 is called RAINBOW and may be downloaded from **www.datakom.com.tr** internet site with **password login**.

The modem and SMS modes are not compatible with the local PC connection. Program parameters **P_043** and **P_056** should be set to 0 before connection.

The RAINBOW 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.

For PCs without a serial port, below USB to serial adapters are tested and approved :

DIGITUS USB 2.0 TO RS-232 ADAPTER (PRODUCT CODE: DA70146 REV 1.1)
DIGITUS USB 1.1 TO RS-232 ADAPTER (PRODUCT CODE: DA70145 REV 1.1)
FLEXY USB 1.1 TO SERIAL ADAPTER (PRODUCT CODE BF-810)
CASECOM USB TO SERIAL CONVERTER (MODEL: RS-01)

The necessary PC connection cable will be supplied by DATAKOM.

6.17 Exerciser

The unit offers automatic exerciser operation. The exercise operation may be done on a daily, weekly or monthly basis.

The start day and time of the exercise is programmable as well as its duration. The exercise may be done with or without load following programming.

The program parameters related to the exerciser are:

P_175: Exercise start day and hour

P_176: Exercise duration

P_177: Exercise off_load/on_load

P_178: Daily / Weekly / Monthly Exercise

Please refer to the programming section for a more detailed description of the above parameters.

When the start day and hour of exercise has come, the unit will automatically switch to either **TEST** or **LOAD TEST** mode. The engine will run and if the on_load exercise is selected then the load will be transferred to the genset.

If a mains failure occurs during the off-load exercise, the load will not be transferred to the genset unless the **Emergency Backup Operation** is allowed by setting the parameter **P_041** to 1. Thus it is highly recommended that the Emergency Backup mode enabled with off-load exerciser.

At the end of the exercise duration, the unit will switch back to the initial mode of operation.

If any of the mode selection keys are pressed during exercise, then the exercise will be ended.

Using the daily exercise mode, the unit may feed the load from the genset during predefined hours of the day. This operation may be used in high tariff periods of the day.

6.18. Resuming to factory set parameters

In order to resume to the factory set parameter values:
-hold pressed the **OFF** and **ALARM MUTE** buttons for 5 seconds, "**res**" will be displayed
-press and hold pressed the **ALARM MUTE** button for 5 seconds, factory set values will be reprogrammed to the parameter memory. Displays may flash during the operation.

It is not possible to revert back to the user parameters.

6.19. Gas Engine Fuel Solenoid Control

The unit provides a special function for the fuel solenoid control of a gas engine.

The fuel solenoid of a gas engine is different from a diesel engine. It should be opened after the cranking has been started and should be closed between crank cycles. The delay between the crank start and solenoid opening is adjusted using the parameter **P_60**.

The gas engine fuelsolenoid relay function may be assigned to spare relays using program parameters **P_085**/**P_086**. Also relays on an extension module may be assigned to this function.

6.20. Changing the Default Engine Speed in Volvo Engines

Volvo engines equipped with EMS-II engine control unit have the engine speed selectable through the J1939 – CANBUS. The unit offers the possibility to the user to switch between the primary and secondary speed using the programming menu.

The parameter used is P_062. When this parameter is set to 1, the unit will freeze for a few seconds and switch the engine to 1800 rpm, which is generally the secondary speed. When the parameter is set 0, the speed is set to the primary speed, which is generally 1500 rpm.

The unit must be in OFF mode when speed is switched, otherwise the switching will not be performed.

Please note also that a fine adjustment of the engine speed in the ± 8 % range may be done using the program parameter P_058.

7. J1939 ENGINE MONITORING AND CONTROL PORT

The unit offers a special J1939 port in order to communicate with electronic engines controlled by an **ECU** (electronic control unit).

The J1939 port consists of 2 terminals which are **J1939+** and **J1939-**. The connection between the unit and the engine should be made with either a twisted cable pair or a coaxial cable. If a coaxial cable is used, the external conductor should be grounded at one end only.

The **120 ohms** termination resistor is included inside the unit. Please do not connect external resistor.

The J1939 port is activated by setting the parameter **P_051=1**. The engine type should be selected using parameter **P_052**. The list of available engines is given at the programming section. Please contact DATAKOM for the most current list of engines.

If the J1939 port is enabled (P_51=1) then the **oil pressure**, the **coolant temperature** and the **engine speed** information are picked up from the **ECU** unit. Other available measurements of the engine are not displayed by the unit, but they are available for PC and MODBUS communications. Please check the chapter 8 for more details.

When the fuel output is active, if no information is received from the ECU during last 3 seconds, then the unit will give a **ECU FAIL** alarm and stop the engine. This feature prevents uncontrolled engine operation.

The **fault conditions of an electronic engine** are considered by the unit as **warnings** and do not cause engine stop. The engine is supposed protected by the ECU which will stop it when necessary.

The electronic engine **fault codes** are displayed on the unit as **SPN-FMI** pairs. A maximum of 8 fault codes can be displayed.

The fault code group is displayed by holding pressed the MENU button after the statistics screen has been reached. If there is no failure, no number will be displayed. The complete list of fault codes is given in the engine manufacturer's user manual.

Below is a basic list of fault conditions (x denotes any FMI)

SPN	FMI	DESCRIPTION
94	x	Fuel filter restriction Fuel pressure sensor fail
98	x	Low oil level High oil level Oil level sensor fail
100	x	Low oil pressure Oil pressure sensor fail
102	x	High boost pressure Turbo outlet pressure sensor fail
105	x	Intake manifold temp high Intake manifold temp sensor fail
107	x	Air filter restriction Air filter sensor fail
108	x	Athmospheric pressure sensor fail
110	x	High coolant temperature Coolant temperature sensor fail
111	x	Low coolant level Coolant level sensor fail
164	x	High injector activation pressure Injector activation pressure sensor fail
168	x	Battery voltage failure
172	x	High inlet air temperature High inlet manifold air temperature Inlet manifold air temperature sensor fail
174	x	High fuel temperature Fuel temperature sensor fail
175	x	High oil temperature Oil temperature sensor fail
190	x	Overspeed Speed sensor loss of signal Speed sensor mechanical failure
228	x	Timing calibration required
234	x	Incorrect ecm software
620	x	ECU internal +5V fail
629	x	ECU hardware fail
651	x	Injector cylinder #1 fault
652	x	Injector cylinder #2 fault
653	x	Injector cylinder #3 fault
654	x	Injector cylinder #4 fault
655	x	Injector cylinder #5 fault
656	x	Injector cylinder #6 fault
657	x	Injector cylinder #7 fault
657	x	Injector cylinder #8 fault
678	x	ECU internal power supply fail
723	x	Secondary engine speed sensor fail
1108	x	Critical override enabled
1111	x	Check configuration parameters
2000	x	ECU failure

Below is a basic list of FMI codes.

Please be aware that these codes may differ slightly depending on the engine brand and model.

FMI	DESCRIPTION
0	Value too high" Valid data, but above the normal working range
1	"Value too low" Valid data, but below the normal working range
2	"Faulty data" Intermittent or faulty data or Short circuit to battery voltage, injector high voltage side
3	"Electrical fault" Abnormally high voltage or short circuit to battery voltage, injector low voltage side
4	"Electrical fault" Abnormally low voltage or short circuit to battery negative, injector low voltage or high voltage side
5	"Electrical fault" Abnormally low current or open circuit
6	"Electrical fault" Abnormally high current or short circuit to battery negative
7	"Mechanical fault" Faulty response from mechanical system
8	"Mechanical or electrical fault" Abnormal frequency
9	"Communication fault" Abnormal updating rate or Open circuit in injector circuit
10	"Mechanical or electrical fault" Abnormally large variations
11	"Unknown fault" Unidentified fault
12	"Component fault" Faulty unit or component
13	"Faulty calibration" Calibration values outside the limits
14	"Unknown fault" Special instructions
15	Data valid but above normal operating range - least severe level
16	Data valid but above normal operating range - moderately severe level
17	Data valid but below normal operating range - least severe level
18	Data valid but below normal operating range - moderately severe level
19	Received network data in error
20	not used (reserved)
21	not used (reserved)
22	not used (reserved)
23	not used (reserved)
24	not used (reserved)
25	not used (reserved)
26	not used (reserved)
27	not used (reserved)
28	not used (reserved)
29	not used (reserved)
30	not used (reserved)
31	Condition exist

8. MODBUS COMMUNICATION

The unit offers the possibility of MODBUS communication via its RS232 serial port.
The connection to the MODBUS master may be done in 3 ways:

1) RS232 connection using directly the RS232 port provided.
2) RS422/485 connection using external RS422/485 converter.
3) Modem connection using external modem.

The MODBUS mode is activated by assigning a controller address to the unit using parameter **P_057**. The possible address range is 1 to 144. Setting the address 0 will **disable** the MODBUS mode and allow communication under RAINBOW protocol.

The MODBUS properties of the unit are:
-Data transfer mode: RTU
-Serial data: 9600 bps, 8 bit data, no parity, 1 bit stop
-Supported functions:
-Function 3 (Read multiple registers)
-Function 6 (Write single register)

Detailed description about the MODBUS protocol is found in the document "**Modicon Modbus Protocol Reference Guide"**. The web address is: www.modbus.org/docs/PI_MBUS_300.pdf

Below is a limited shortlist of readable registers. For the detailed **Modbus Application Manual** and a complete list of registers please contact DATAKOM.

ADDRESS (hex)	R / W	DATA SIZE	COEFFICIENT	DESCRIPTION
0000	R	16bit	x1	Phase R voltage
0001	R	16bit	x1	Phase S voltage
0002	R	16bit	x1	Phase T voltage
0003	R	16bit	x1	Phase U voltage
0004	R	16bit	x1	Phase V voltage
0005	R	16bit	x1	Phase W voltage
0006	R	16bit	x1	Phase U current
0007	R	16bit	x1	Phase V current
0008	R	16bit	x1	Phase W current
000C	R	16bit	x1	Phase RS voltage
000D	R	16bit	x1	Phase ST voltage
000E	R	16bit	x1	Phase TR voltage
000F	R	16bit	x1	Phase UV voltage
0010	R	16bit	x1	Phase VW voltage
0011	R	16bit	x1	Phase WU voltage
0012	R	16bit	x10	Mains frequency
0013	R	16bit	x10	Genset frequency
0016-0017	R	32bit	x256	Genset active power: this 24 bit signed register holds the genset active power multiplied by 256. Least significant 16 bits are in the register 0016h. Most significant 8 bits are in the LSB of the register 0017h.
0018	R	8bit	x100	Power factor multiplied by 100 (signed byte). Negative values indicate a capacitive power factor.
002A	R	16bit	x0.1	Engine speed (rpm)
002B	R	16bit	x10	Oil pressure multiplied in bars.
002C	R	16bit	x1	Coolant temperature in degrees C.
002D	R	16bit	x1	Fuel level as %
002F	R	16bit	x10	Battery voltage
003D	R	8bit	-	Operating mode bit_4: auto mode bit_5: off mode bit_6: test mode bit_7: load test mode

9. 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_071 to P_084. 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_071: 07.0 (Monday morning 07:00 turn on)
P_072: 18.0 (Monday evening 18:00 turn off)
P_073: 07.0 (Tuesday morning 07:00 turn on)
P_074: 18.0 (Tuesday evening 18:00 turn off)
P_075: 07.0 (Wednesday morning 07:00 turn on)
P_076: 18.0 (Wednesday evening 18:00 turn off)
P_077: 07.0 (Tuesday morning 07:00 turn on)
P_078: 18.0 (Tuesday evening 18:00 turn off)
P_079: 07.0 (Friday morning 07:00 turn on)
P_080: 18.0 (Friday evening 18:00 turn off)
P_081: 07.0 (Saturday morning 07:00 turn on)
P_082: 13.3 (Saturday noon 13:30 turn off)
P_083: 24.0 (Sunday no turn on time, last operation mode continues)
P_084: 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.

10. EVENT LOGGING

The unit keeps records of the last 32 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.

In order to view the event records please hold pressed the MENU button when the J1939 alarms are visualized. The latest event record will be displayed. Each depression of the MENU button will cause the previous record to come to the display. After the oldest record, the last record will be displayed again.

The event sources are:

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

A sample event record is as follows:

```
19 06  07
14 37 128
```

The first line: The date as date-month-year (19 June 2007)
The second line: hour-minute-event_code (14:37 Genset on load)

EVENT LIST

00: STOP- low oil pressure
01: STOP- high temp
02: STOP- low coolant level
03: STOP- rectifier fail
04: STOP- emergency stop
05: STOP- spare_1
06: STOP- spare_2
07: STOP- fuel level
08: STOP- low oil press measured
09: STOP- high temp measured
10: STOP- over/under speed
11: STOP- fail to start
12: STOP- charge fail
13: LOAD DUMP- overload
14: STOP- genset voltage fail
15: STOP- high battery voltage
16: WARNING-low oil pressure
17: WARNING-high temp
18: WARNING-low coolant level
19: WARNING-rectifier fail
20: WARNING-emergency stop
21: WARNING-spare_1
22: WARNING-spare_2
23: WARNING-low fuel level
24: WARNING-low oil pressure measured
25: WARNING-high temp measured
26: WARNING-under/over speed
27: WARNING-fail to stop
28: WARNING- charge fail
29: WARNING-low battery voltage
30: WARNING-(not used)
31: WARNING-high battery voltage
32:STOP: J1939 Ecu alarm
48:WARNING: J1939 Ecu engine failure
128: Genset on load
129: Genset off load

11. 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.

12. 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

13. 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 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 parameters are organized in two groups as **SERVICE** and **FACTORY** parameters. Entering the program mode normally, will allow access only to the **SERVICE** group of parameters. In **FACTORY** mode, all parameters may be accessed.

In order to enter the **FACTORY** mode, please press and hold pressed the **OFF** button, then press and hold the **MENU** button for 5 seconds. When the PGM mode is opened, all parameters are available.

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/right 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. If this parameter is set to 0, then the overcurrent checking will be disabled.
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. If this parameter is set to 0, then the excepp power checking will be disabled.
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.
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	35	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	55	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.

Pgm	Definition	Unit	Std Val	Description
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	95	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 (10-180 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
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	12	This parameter defines delay after the engine runs and before the fault monitoring is enabled.

Pgm	Definition	Unit	Std Val	Description
24	Overcurrent / Excess Power / Frequency /Voltage Timer	sec	3	This is the period between the current or active power goes out of 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. This is also the period between the genset voltage goes out of the limits (**P_006/P_007)** and **VOLTAGE** alarm occurs.
25	Wait before Fuel	sec	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	10	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	1.0	This is the time between the mains voltages entered within the limits and the generator contactor is deactivated.
31	Cooling Timer	min	1.5	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	15	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.
36	Horn Timer	sec	60	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)**.

Pgm	Definition	Unit	Std Val	Description
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	-	1	**0:** Display genset Line to Neutral voltages, **1:** Display genset Line to Line voltages.
40	Mains L-L Voltages	-	1	**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	50	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	Flashing relay timer (Max engine run)	hours	0-144	This parameter defines the max genset running time used in dual genset systems. After the engine runs during this period, the relay will change position. This parameter is also used in Delayed Simulate Mains operation.
48	Password	-	0-999	This is the password used in the manual start version of the unit. It has no effect on AMF models.
49	Low Fuel Warning	-	0	**0**: Low Fuel causes engine shutdown. **1**: Low Fuel causes warning.
50	Simulate mains	-	0	**0:** The spare_2 input has normal function **1:** The spare_2 input simulates mains.

Pgm	Definition	Unit	Std Val	Description
51	J1939 enable	-	0	**0:** The J1939 port is ignored. **1:** The analog measurements (oil, temp, rpm) are picked_up from the ECU. If the ECU communication is lost, then the engine will be stopped.
52	J1939 engine brand/type	-	0	**00:** CATERPILLAR **16:** CUMMINS **32:** DETROIT DIESEL **48:** DEUTZ **64:** JOHN DEERE **80:** PERKINS **96:** VOLVO (with CIU unit) **97:** VOLVO (without CIU unit) **Other values:** undefined engine. Do not use.
53	Intermittent alarm output	-	0	**0:** continuous **1:** intermittent
54	Alternator number of poles	-	1	**0:** single pole **1:** double pole
55	Idle timer	sec	0	When the engine runs, the Idle output relay function will be active during this timer.
56	SMS enable	-	0	**0:** SMS not enabled **1:** SMS enabled The telephone number used for SMS sending is programmed using the RAINBOW program.
57	MODBUS controller address	-	0	**0:** RAINBOW communication protocol. **1-144:** MODBUS communication. This parameter is also the MODBUS controller address of the unit.
58	Engine speed adjust	%	50	This parameter adjusts the speed of an ECU controlled engine by +/- 8%.
59	GPRS Modem Calls	-	0	**0:** standard modem calls **1:** GPRS modem calls
60	Gas engine solenoid delay	sec	5	The gas solenoid of the gas engine will be opened after this delay during cranking
61	Low Fuel Limit	%	10	If the fuel level measured from the analog input falls below this limit, this will generate a **LOW FUEL** warning or alarm following the value of the parameter **P_049**.
62	Primary / Secondary Speed Select	-	-	This program parameter is not stored, but only used in order to activate the primary or secondary speed selection operation of a Volvo EMS-II engine control unit. **0:** Initiate the primary speed select operation **1:** Initiate the secondary speed select operation
63	Delayed Simulate Mains	-	0	**0:** The spare_2 input has normal function **1:** The spare_2 input has delayed simulate mains function. See chapter 6.8 for more info.
64	Crank Stop with Charge			**0:** no crank stop with charge input **1:** cranking is stopped when the charge alternator voltage is established.
65	Crank Stop with Oil Pressure			**0:** no crank stop with oil pressure **1:** cranking is stopped when oil presure switch is open or the oil pressure measured is above shutdown limit.
66	Not used			
67	Not used			
68	Not used			
69	Not used			
70	Not used			

The parameters from P_071 to P_0847 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
71	Monday turn_on	-	24.0	
72	Monday turn_off	-	24.0	
73	Tuesday turn_on	-	24.0	
74	Tuesday turn_off	-	24.0	
75	Wednesday turn_on	-	24.0	
76	Wednesday turn_off	-	24.0	
77	Thursday turn_on	-	24.0	
78	Thursday turn_off	-	24.0	
79	Friday turn_on	-	24.0	
80	Friday turn_off	-	24.0	
81	Saturday turn_on	-	24.0	
82	Saturday turn_off	-	24.0	
83	Sunday turn_on	-	24.0	
84	Sunday turn_off	-	24.0	

The parameters from P_085 to P_102 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
85	RELAY-1 function	03
86	RELAY-2 function	01
87	RELAY-3 function	16
88	RELAY-4 function	17
89	RELAY-5 function	18
90	RELAY-6 function	19
91	RELAY-7 function	20
92	RELAY-8 function	21
93	RELAY-9 function	22
94	RELAY-10 function	23
95	RELAY-11 function	24
96	RELAY-12 function	25
97	RELAY-13 function	26
98	RELAY-14 function	27
99	RELAY-15 function	28
100	RELAY-16 function	29
101	RELAY-17 function	30
102	RELAY-18 function	31

RELAY FUNCTİON LIST

00	Fuel
01	Horn
02	Start
03	Stop
04	Gen. Contactor
05	mains Contactor
06	Choke
07	Preheat
08	Shutdown alarm
09	Shutdown or load_dump alarm
10	Shutdown or load_dump or warning
11	Automatic ready
12	Week. on time
13	Exerciser on
14	Load_dump alarm
15	-
16	Oil switch alarm
17	Temp switch alarm
18	Coolant Level switch alarm
19	Rectifier alarm
20	Emerg.Stop alarm
21	Spare-1 Alarm
22	Spare-2 Alarm
23	Fuel Level sender alarm
24	Oil sender alarm
25	Temp sender alarm
26	Speed alarm
27	Start fail alarm
28	Charge alarm
29	Overload alarm
30	Voltage alarm
31	Battery High Voltage alarm

32	Oil switch warning
33	Temp switch warn.
34	Coolant Level switch warning
35	Rectifier warning
36	Emerg Stop warn.
37	Spare-1 warning
38	Spare-2 warning
39	Fuel Level sender Warning
40	Oil sender warning
41	Temp sender warn.
42	Speed warning
43	Stop Fail warning
44	Charge warning
45	Battery low voltage warning
46	-
47	Battery high voltage warning
48	Mains fail
49	Block heater
50	Service request
51	J1939 ECU warning
52	J1939 ECU shutdown
53	Flashing relay
54	Gas engine gas solenoid relay
55	Fuel pump
56	Mains phase order fail
57	Genset phase order fail
58	Idle speed
59	-
60	-
61	-
62	-
63	-

Parameters from P_103 to P_150 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	
103	Operation	0	**0:** Alarm (the engine stops and horn relay operates)) **2:** Warning (the horn relay operates) **3:** No operation
104	Fault monitoring	1	**0:** Always **1:** After holdoff timer **2:** When mains present
105	Latching	1	**0:** Non latching **1:** Latching
106	Contact type	0	**0:** Normally open **1:** Normally closed
107	Switching	0	**0:** Battery negative **1:** Battery positive
108	Response delay	0	**0:** No delay **1:** Delayed (4sec)

HIGH TEMPERATURE SWITCH INPUT

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

COOLANT LEVEL SWITCH INPUT

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

RECTIFIER FAIL INPUT

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

EMERGENCY STOP INPUT

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

SPARE-1 FAULT INPUT

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

SPARE-2 FAULT INPUT

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

LOW FUEL LEVEL INPUT

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

Parameters from P_151 to P_162 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.....10 ohm
2.0 bar.....52 ohm
4.0 bar.....90 ohm
7.0 bar.....140 ohm
8.0 bar.....156 ohm
10.0 bar.....184 ohm

Pgm	Description	Unit	Value
151	Point_1 resistor	ohm	10
152	Point_1 pressure	bar	0.0
153	Point_2 resistor	ohm	52
154	Point_2 pressure	Bar	2.0
155	Point_3 resistor	Ohm	90
156	Point_3 pressure	Bar	4.0
157	Point_4 resistor	Ohm	140
158	Point_4 pressure	Bar	8.0
159	Point_5 resistor	Ohm	156
160	Point_5 pressure	Bar	8.0
161	Point_6 resistor	Ohm	184
162	Point_6 pressure	bar	10.0

Parameters from P_163 to P_174 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
163	Point_1 resistor	ohm	30
164	Point_1 temperature	ºC	121
165	Point_2 resistor	ohm	40
166	Point_2 temperature	ºC	104
167	Point_3 resistor	ohm	71
168	Point_3 temperature	ºC	82
169	Point_4 resistor	ohm	342
170	Point_4 temperature	ºC	38
171	Point_5 resistor	ohm	0
172	Point_5 temperature	ºC	0
173	Point_6 resistor	ohm	0
174	Point_6 temperature	ºC	0

The parameters from P_175 to P_178 define the **exerciser operation**.

Pgm	Definition	Unit	Std Val	Description
175	Exercise start day and hour	-	168	This parameter defines the start day and hour of the exerciser. Values higher or equal to 168 mean that the exerciser is off. The exercise may be selected to start at the beginning of the any hour of the week. The parameter value is the hour count of the start time. **Examples:** 0 = exercise starts at Monday 00:00 1 = exercise starts at Monday 01:00 8 = exercise starts at Monday 08:00 24 = exercise starts at Tuesday 00:00 167 = exercise starts at Sunday 23:00 168 = exerciser off If a daily exercise is selected with parameter P_158=0, then the day information is **don't care** and the exercise will be performed every day regardless of the day selection. If the monthly exercise is selected with parameter P_158=2 then the exercise will be performed during the first 7 days of each month at the programmed day and hour.
176	Exercise duration	min.	10	This parameter defines the exercise duration and programmed in 10 minute steps up to 24 hours.
177	Exercise off_load/on_load	-	0	If this parameter is set to 0 the genset will not feed the load during exercise. If it is set to 1, then the load will be transferred to the genset during the exercise.
178	Daily / Weekly / Monthly Exercise	-	1	**0:** exercise every day (the exercise will be performed every day regardless of the day selection with parameter P_155). **1:** exercise once per week **2:** exercise once per month (the exercise will be performed during the first 7 days of each month at the programmed day and hour).

The parameters from P_179 to P_184 adjust the date and time.

Pgm	Definition	Unit	Std Val	Description
179	Year	-	00-99	Last two digits of the current year.
180	Month	-	01-12	Current month.
181	Date	-	01-31	Current day of the month.
182	Day	-	0-6	Current day of the week.(0=Monday, 1=Tuesday, 2=Wednesday, 3=Thursday 4=Friday, 5=Saturday, 6=Sunday)
183	Hour	-	00-23	Current hour of the day.
184	Minute	-	00-59	Current minute of the hour.

The parameters from P_185 to P_196 adjust calibration parameters. During calibration, measurements to be calibrated are also visualized.

Pgm	Definition	Unit	Std Val	Description
185	Phase R calibration	-	760	Phase R measurement calibration.
186	Phase S calibration	-	760	Phase S measurement calibration.
187	Phase T calibration	-	760	Phase T measurement calibration.
188	Phase U calibration	-	760	Phase U measurement calibration.
189	Phase V calibration	-	760	Phase V measurement calibration.
190	Phase W calibration	-	760	Phase W measurement calibration.
191	Current A1 calibration	-	6360	Phase A1 current measurement calibration.
192	Current A1 calibration	-	6360	Phase A2 current measurement calibration.
193	Current A1 calibration	-	6360	Phase A3 current measurement calibration.
194	Active power calibration	-	14800	Total active power measurement calibration.
195	Power factor calibration	-	172	Power factor measurement calibration.
196	Battery voltage calibration	-	139	Battery voltage measurement calibration.

14. 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.

Phase-to-Phase AC voltages are not correct although Phase to Neutral voltages are correct:

-Incorrect phase order. Please connect phase voltages in the correct order.

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.

Some program parameters are skipped:

These parameters are reserved for factory setting and cannot be modified.

AUTO led flashes and the genset does not run when mains fail:

The unit is in Weekly Schedule **OFF** time. Please check date and time setting of the unit. Please check also Weekly Schedule programs (parameters P_071 to P_084).

15. DECLARATION OF CONFORMITY

The unit conforms to the EU directives
-2006/95/EC (low voltage)
-2004/108/EC (electro-magnetic compatibility)
Norms of reference:
EN 61010 (safety requirements)
EN 61326 (EMC requirements)

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

16. 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)
0 to 520 V-AC (Ph-Ph)
Mains frequency: 0-100 Hz.
DC Supply range: 9.0 VDC to 30.0 VDC
Cranking dropouts: survives 0 V for 100ms
Typical stand-by current consumption: 150 mADC.
Maximum current consumption: 600 mADC.
Generator/mains contactor outputs: 16 A @ 250 VAC.
DC relay outputs: 10A @ 28 VDC.
Max. current for each terminal: 10 ARMS.
Charge alternator excitation current: min 150 mADC @ 10 to 30 VDC.
Current inputs: from current transformers, .../5A. Max load 0.7VA per phase.
Digital inputs: input voltage 0 - 30 VDC. 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
Communication port: RS-232. 9600 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: 202x148x48mm (WxHxD)
Mounting opening dimensions: 183 x 134mm minimum.
Weight: 460 g (approx.)
Case material: High temperature, self extinguishing ABS (UL94-V0, 100 °C)

15. CONNECTION DIAGRAM